Part I : Applicant's Information

Organisation:		ATO certificate no.: *FTO-XXXX or ATCO-XXXX or MTO-XXXX*	
Title of proposed Training Program: *Course title issues XX revision XX*		Date of Submitted: *DD – MMM - YYYY* Date of Expected: *DD – MMM - YYYY*	Application No.: *(For CAAT)*

Prior Approval	Type of Submission	Type of Program	How the training is to be delivered
	☐ Initial ☐ Amendment **No. of Attempt** ☐ 1st attempt ☐ 2nd attempt ☐ 3rd attempt	☐ Initial Training ☐ Rating Training ☐ Refresher ☐ Recurrent ☐ Other (specify).......... ☐ Additional ☐ Requalification	☐ Classroom Delivery ☐ Virtual Classroom ☐ Flight Training ☐ Simulator Training ☐ Other (specify).......... **Training device will be used for this course (Type and number)** ☐ Simulator (FSTD/STD).......... ☐ Actual aircraft..........

Coordinator Name/ contact: *1. Mr. XXX YYYY/ email*
2. Mr. XXX YYYY/ email

The following documents are submitted with this application by applicant:

☐ 1. Intention letter on the applicant's company letterhead specifying the title of the training programme
☐ 2. Checklist No..
☐ 3. Draft Manual
☐ 4. Reference of training material/Other relevant documents or required by competent official..........

Please ensure that

- There is a list of effective pages. Every page is identified with a page number, a date and a revision number.
- Training materials and Examination Tests, in any format, shall be made accessible for CAAT inspector
- Reference in the applicable Training Program should be detail appropriate with training materials
- Organisation declaration and signature in the first page must be signed

Declaration and Signature

the information provided in this form is complete and correct and that the documents provided are genuine.

Signature: Applicant's Name/: Date:

Part II	Competent Official Use Only		
Check Submitted document			
1st checked ☐ Complete date........................ ☐ Incomplete date........................ Signature/Name:	2nd checked ☐ Complete date........................ ☐ Incomplete date........................ Signature/Name:	3rd checked ☐ Complete date........................ ☐ Incomplete date........................ Signature/Name:	Financial (If applicable) ☐ Invoice No......................... Date:........................ ☐ Receipt No......................... Date:........................
Verification result: ☐ Accept ☐ Reject			
This compliance check form has been verified by: **Signature:** **Inspector's Name:** **Date:** **(If applicable) Under supervision of:** **Signature:** **Inspector's Name:** **Date:**			

Instructions:

1) ATO is to conduct a self-assessment as part of its compliance check by providing manual references into the 'Compliance checked by ATO'.
2) Failure to complete this form may result in a delay in approval processing. After 3rd rejected, applicant shall start the new process from the beginning with the new intention letter.
3) Each check list item shall be assessed and given a result either Satisfactory or Unsatisfactory
   - **(a) Satisfactory** shall be given if the ATO is able to provide valid contents and details that comply with the requirements .
   - **(b) Unsatisfactory** shall be given if the ATO is provide insufficient contents/details that comply with the requirement as well as impractical/non-realistic process or procedures that do not reflect an actual context and operations of the ATO.
   - **(c)** Not applicable shall be filled out as **N/A**
4) Provide detail in each subtopic/content of every subjects.
5) Checklist does not address Training Manual requirements as per TCAR PEL Part ORA. Applicant shall provide separate Training Manual checklist for review and approval along with this checklist.
6) In case of amendment, Non-applicable items in the checklist may be greyed out by the applicant.

Syllabus reference	BK	Syllabus details and associated Learning Objectives	ATPL(A)	CPL(A)	ATPL/IR(H)	ATPL(H)	CPL(H)	IR	CB-IR(A)	Compliance checked by ATO			CAAT Officials Use Only		
										Yes	No	References	S	U	Remark
010 00 00 00		AIR LAW													
010 01 00 00		INTERNATIONAL LAW: CONVENTIONS, AGREEMENTS AND ORGANISATIONS													
010 01 01 00		The Convention on International Civil Aviation (Chicago) — ICAO Doc 7300/9 Convention on the High Seas (Geneva, 29 April 1958)													
010 01 01 01		The establishment of the Convention on International Civil Aviation, Chicago, 7 December 1944													
(01)	X	Explain the circumstances that led to the establishment of the Convention on International Civil Aviation, Chicago, 7 December 1944. Source: ICAO Doc 7300/9 Preamble	X	X	X	X	X								
010 01 01 02		Part I — Air navigation													

(01)	X	Recall the general contents of relevant parts of the following chapters: — general principles and application of the Convention; — flight over territory of Contracting States; — nationality of aircraft; — international standards and recommended practices (SARPs), especially notification of differences and validity of endorsed certificates and licences. Source: ICAO Doc 7300/9 Part 1, Articles 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 16, 17, 18, 19, 20, 37, 38, 39, 40	X	X	X	X	X								
(02)	X	General principles Describe the application of the following terms in civil aviation: — sovereignty; — territory and high seas according to the UN Convention on the High Seas. Source: Convention on the High Seas (Geneva, 29 April 1958) Articles 1, 2; ICAO Doc 7300/9 Part 1, Articles 1, 2	X	X	X	X	X								

(03)		Explain the following terms and how they apply to international air traffic: — right of non-scheduled flight (including the two technical freedoms of the air); — scheduled air services; — cabotage; — landing at customs airports; — Rules of the Air; — search of aircraft. Source: ICAO Doc 7300/9, Articles 5, 6, 7, 10, 12, 16	X	X	X	X	X								
(04)	X	Explain the duties of Contracting States in relation to: — documents carried on board the aircraft: — certificate of registration; — certificates of airworthiness; — licences of personnel; — recognition of certificates and licences; — cargo restrictions; — photographic apparatus. Source: ICAO Doc 7300/9, Articles 29, 31, 32, 33, 35, 36	X	X	X	X	X								
010 01 01 03		Part II — The International Civil Aviation Organization (ICAO)													

(01)	X	Describe the objectives of ICAO. Source: ICAO Doc 7300/9, Article 44	X	X	X	X	X								
(02)	X	Recognise the organisation and duties of the ICAO Assembly, Council and Air Navigation Commission (ANC). Source: ICAO Doc 7300/9, Articles 48, 49, 50, 54, 56, 57	X	X	X	X	X								
(03)	X	Describe the annexes to the Convention. Source: ICAO Doc 7300/9, Articles 54, 90, 94, 95	X	X	X	X	X								
010 01 02 00		Other conventions and agreements													
010 01 02 01		The International Air Services Transit Agreement (ICAO Doc 7500)													
(01)		Explain the two technical freedoms of the air. Source: ICAO Doc 7500	X	X	X	X	X								
010 01 02 02		The International Air Transport Agreement (ICAO Doc 9626)													
(01)		Explain the three commercial freedoms of the air. Source: ICAO Doc 9626	X	X	X	X	X								
010 01 02 03		Suppression of Unlawful Acts Against the Safety of Civil Aviation — The Tokyo Convention of 1963													

(01)		Describe the measures and actions to be taken by the pilot-in- command (PIC) of an aircraft in order to suppress unlawful acts against the safety of the aircraft. Source: ICAO Doc 8364 — Convention on Offences and Certain Other Acts Committed on Board Aircraft, signed in Tokyo on 14 September 1963	X	X	X	X	X								
010 01 02 04		Intentionally left blank													
010 01 02 05		Private international law													
(01)		Explain the legal significance of the issue of a passenger ticket or of baggage/cargo documents (that the issue is a form of contract). Source: ICAO Doc 9740 Convention for the Unification of Certain Rules for International Carriage — The Montreal Convention of 1999	X	X	X	X	X								
(02)		Describe the consequences for an airline or the PIC when a document of carriage is not issued (that the contract is unaffected). Source: ICAO Doc 9740 Convention for the Unification of Certain Rules for International Carriage — The Montreal Convention of 1999	X	X	X	X	X								

(03)	X	Explain the consequences for an airline operator of Ministry of Transport Announcement on Protection of Passenger Rights related to Charter Flight Services B.E. 2556 for the protection of passenger rights in the event of delay, cancellation or denial of boarding. Source: Ministry of Transport Announcement on Protection of Passenger Rights related to Charter Flight Services B.E. 2556	X	X	X	X	X								
(04)		Explain the liability limit in relation to destruction, loss, damage or delay of baggage. Source: ICAO Doc 9740 Convention for the Unification of Certain Rules for International Carriage — The Montreal Convention of 1999	X	X	X	X	X								
010 01 03 00		World organisations													
010 01 03 01		The International Air Transport Association (IATA)													
(01)		Describe the objectives of IATA. Source: http://www.iata.org/about/pages/mission.aspx	X		X	X									
010 01 04 00		Civil Aviation system in Thailand													
010 01 04 01		CAAT													
(01)	X	Describe the objectives of the CAAT.	X	X	X	X	X								
(02)		Describe the role of the CAAT in Thailand civil aviation.	X	X	X	X	X								

(03)		State that the structure of the regulatory material related to CAAT involves: — hard law (regulations, delegated acts, implementing acts, and implementing rules); — soft law (certification specifications, acceptable means of compliance, and guidance material).	X	X	X	X	X								
(04)		State the meaning of the terminology associated with the structure of the Thai regulatory material, specifically: announcements, ministerial regulations, CAAT regulations, etc., acceptable means of compliance, and guidance material.	X	X	X	X	X								
010 02 00 00		AIRWORTHINESS OF AIRCRAFT, AIRCRAFT NATIONALITY AND REGISTRATION MARKS													
010 02 01 00		Intentionally left blank													
010 02 02 00		Certificate of Airworthiness (CofA)													
010 02 02 01		Certificate of Airworthiness (CofA) — Details													
(01)		State the issuing authority of a CofA. Source: ICAO Annex 8, Chapter 3.2 Issuance and continued validity of a Certificate of Airworthiness	X	X	X	X	X								
(02)		State the necessity to hold a CofA. Source: ICAO Doc 7300, Article 31	X	X	X	X	X								

(03)	X	Explain the prerequisites for the issue of a CofA according to Airworthiness regulation Source: initial airworthiness regulations applicable in Thailand related to airworthiness certificates	X	X	X	X	X								
(04)		State who shall determine an aircraft's continuing airworthiness. Source: ICAO Annex 8, Chapter 3.2 Issuance and continued validity of a Certificate of Airworthiness	X	X	X	X	X								
(05)		Describe how a CofA can be renewed or may remain valid. Source: ICAO Annex 8 Chapter 3.2 Issuance and continued validity of a Certificate of Airworthiness; Chapter 3.5 Temporary loss of airworthiness; Chapter 3.6 Damage to aircraft	X	X	X	X	X								
010 02 03 00		ICAO Annex 7 — Aircraft Nationality and Registration Marks													
010 02 03 01		ICAO Annex 7 — Definitions													
(01)	X	Recall the definition of the following terms: aircraft; heavier-than-air aircraft; State of Registry. Source: ICAO Annex 7, Chapter 1 Definitions	X	X	X	X	X								
010 02 04 00		Nationality marks, common marks and registration marks													

010 02 04 01		Nationality marks, common marks and registration marks — assignment and location Source: ICAO Annex 7													
(01)		State the location of nationality marks, common marks and registration marks. Source: ICAO Annex 7, Chapter 4.3 Heavier-than-air aircraft; ICAO Annex 7, Chapter 9 Identification plate	X		X										
(02)		Explain who is responsible for assigning nationality marks, common marks and registration marks. Source: ICAO Annex 7, Chapter 3 Nationality, common and registration marks to be used	X	X	X	X	X								
010 03 00 00		Intentionally left blank													
010 04 00 00		PERSONNEL LICENSING													
010 04 01 00		ICAO Annex 1													
010 04 01 01		Differences between ICAO Annex 1 & Regulation TCAR PEL													
(01)	X	Describe the relationship and differences between ICAO Annex 1 and the Aircrew Regulation.	X	X	X	X	X	X							
010 04 02 00		Aircrew Regulation — TCAR PEL Part-FCL Source: TCAR PEL Part FCL													

010 04 02 01		Definitions													
(01)		Define the following: Category, class and type of aircraft, cross-country, dual instruction time, flight time, student pilot-in-command (SPIC), instrument time, instrument flight time, instrument ground time, night, private pilot, proficiency check, renewal, revalidation, skill test, solo flight time. Source: TCAR PEL Part FCL, point FCL.010 Definitions	X	X	X	X	X	X	X						
(02)		Define the following: multi-crew cooperation (MCC), multi-pilot aircraft, rating. Source: TCAR PEL Part FCL, point FCL.010 Definitions; Note: 'rating' is defined in point 1.1 Definitions of ICAO Annex 1	X	X	X	X	X								
010 04 02 02		Content and structure													
(01)	X	Explain the structure of Part-FCL. Source: TCAR PEL Part FCL Regulation, and TCAR PEL FCL/TO Subject matter	X	X	X	X	X	X	X						

(02)		Explain the requirements to act as a flight crew member of a civil aircraft registered in a Member State, and know the general principles of the licensing system (light aircraft pilot licence (LAPL), private pilot licence (PPL), commercial pilot licence (CPL), multi-crew pilot licence (MPL), airline transport pilot licence (ATPL)). Source: TCAR PEL FCL/TO 'Essential requirements for aircrew'; TCAR PEL Part FCL Regulation, point FCL.015 Application and issue, revalidation and renewal of licences, ratings and certificates	X	X	X	X	X	X							
(03)	X	List the two factors that are relevant to the exercise of the privileges of a licence. Source: TCAR PELPart FCL Regulation, point FCL.040 Exercise of the privileges of licences	X	X	X	X	X	X							
(04)	X	State the circumstances in which a language proficiency endorsement is required. Source: TCAR PEL Part FCL Regulation, point FCL.055 Language proficiency	X	X	X	X	X	X							
(05)	X	List the restrictions for licence holders with an age of 60 years or more. Source: TCAR PEL Part FCL Regulation, point FCL.065	X	X	X	X	X								

		Curtailment of privileges of licence holders aged 60 years or more in commercial air transport													
(06)	X	Explain the term 'competent authority'. Source: TCAR PEL Part FCL Regulation, point FCL.001	X	X	X	X	X	X							
(07)		Describe the obligation to carry and present documents (e.g. a flight crew licence) under Part-FCL. Source: TCAR PEL Part FCL Regulation, point FCL.045 Obligation to carry and present documents	X	X	X	X	X	X							
010 04 02 03		Commercial pilot licence (CPL)													
(01)	X	State the requirements for the issue of a CPL. Source: TCAR PEL Part FCL Regulation point FCL.300 CPL — Minimum age; Appendix 3, D. CPL integrated course — Aeroplanes, Flying Training (8, a–f); Appendix 3, E. CPL modular course — Aeroplanes, Experience (12, a–d)	X	X	X	X	X								
(02)		State the privileges of a CPL. Source: TCAR PEL Part FCL Regulation, point FCL.305 CPL — Privileges and conditions	X	X	X	X	X								
010 04 02 04		Airline transport pilot licence (ATPL) and multi-crew pilot licence (MPL)													

(01)	X	State the requirements for the issue of an ATPL. Source: TCAR PEL Part FCL Regulation, point FCL.500 ATPL — Minimum age; TCAR PEL Part FCL Regulation, point FCL.510.A ATPL(A) — Prerequisites, experience and crediting ((a) and (b)); TCAR PEL Part FCL Regulation, point FCL.510.H ATPL(H) — Prerequisites, experience and crediting	X		X	X									
(02)		State the privileges of an ATPL. Source: TCAR PEL Part FCL Regulation, point FCL.505 ATPL — Privileges	X		X	X									
(03)	X	State the requirements for the issue of an MPL. Source: TCAR PEL Part FCL Regulation, point FCL.400.A MPL — Minimum age; TCAR PEL Part FCL Regulation, point FCL.410.A MPL — Training course and theoretical knowledge examinations and Appendix 5 (items 1 to 8)	X												
(04)		State the privileges of an MPL. Source: TCAR PEL Part FCL Regulation, point FCL.405.A MPL — Privileges	X												
010 04 02 05		Ratings													

(01)		State the requirements for class ratings, their validity and privileges. Source: TCAR PEL Part FCL Regulation, point FCL.740 Validity and renewal of class and type ratings; TCAR PEL Part FCL Regulation, point FCL.705 Privileges of the holder of a class or type rating; TCAR PEL Part FCL Regulation, point FCL.720.A Experience requirements and prerequisites for the issue of class or type ratings — aeroplanes	X	X											
(02)		State the requirements for type ratings, their validity and privileges. Source: TCAR PEL Part FCL Regulation, point FCL.705 Privileges of the holder of a class or type rating; TCAR PEL Part FCL Regulation, point FCL.720.A Experience requirements and prerequisites for the issue of class or type ratings — aeroplanes; TCAR PEL Part FCL Regulation, point FCL.740 Validity and renewal of class and type ratings	X	X	X	X	X								

(03)		State the requirements for instrument ratings, their validity and privileges (instrument rating (IR), competency-based instrument rating (CB-IR) and en-route instrument rating (EIR)). Source: TCAR PEL Part FCL Regulation, FCL.610 IR — Prerequisites and crediting; TCAR PEL Part FCL Regulation, point FCL.605 IR — Privileges; TCAR PEL Part FCL Regulation, point FCL.625 IR — Validity, revalidation and renewal	X		X			X	X						
(04)		State the requirements for other ratings, their validity and privileges according to Part-FCL. Source: TCAR PEL Part FCL Regulation, point FCL.800 Aerobatic rating; TCAR PEL Part FCL Regulation, point FCL.805 Sailplane towing and banner towing ratings; TCAR PEL Part FCL Regulation, point FCL.810 Night rating;	X	X	X	X	X								
010 04 03 00		Medical regulation													
010 04 03 01		Medical regulations - Details													
(01)	X	Describe the relevant content of Thai Medical Regulation — Medical requirements (administrative parts and requirements related to licensing only). Source: TCAR PEL Medical regulations, Aircrew	X	X	X	X	X	X							

		Regulation, Scope; Validity, revalidation and renewal of medical certificates													
(02)		State the requirements for the issue of a medical certificate. Source: TCAR PEL Medical regulations regulation, issue, revalidation and renewal of medical certificates	X	X	X	X	X	X							
(03)		Name the class of medical certificate required when exercising the privileges of a CPL, MPL or ATPL. Source: TCAR PEL Medical regulations, Medical certificates	X	X	X	X	X								
(04)		State the actions to be taken in case of a decrease in medical fitness. Source: TCAR PEL Medical regulations, Decrease in medical fitness	X	X	X	X	X	X							
010 05 00 00		RULES OF THE AIR ACCORDING TO ICAO ANNEX 2 AND RCAB N° 94													
010 05 01 00		Overview of ICAO Annex 2 and Rules of the air													
010 05 01 01		ICAO Annex 2 and RCAB N° 94 regulations — Relationship and content													
(01)		Explain the scope and purpose of ICAO Annex 2. Source: ICAO Annex 2, Foreword, Applicability	X	X	X	X	X	X							

(02)		Explain the scope and main content of RCAB N° 94. Source: RCAB N° 94	X	X	X	X	X	X							
010 05 02 00		Rules of the Air													
010 05 02 01		Applicability of the Rules of the Air													
(01)		Explain the principle of territorial application of the various Rules of the Air, e.g. ICAO Annex 2, RCAB N° 94. Source: ICAO Annex 2, Chapter 2, 2.1 Territorial application of the rules of the air; RCAB N° 94	X	X	X	X	X								
(02)		Explain the necessity to comply with the RCAB 94.	X	X	X	X	X								
(03)		State the responsibilities of the PIC. Source: RCAB N° 94	X	X	X	X	X								
(04)		Identify under what circumstances departure from RCAB N° 94 may be allowed. Source: RCAB N° 94	X	X	X	X	X								
(05)		Explain the duties of the PIC concerning pre-flight actions in case of an instrument flight rule (IFR) flight. Source: RCAB N° 94	X		X			X	X						

(06)		State that the PIC of an aircraft has final authority as to the disposition of the aircraft while in command. Source: RCAB N° 94	X	X	X	X	X								
(07)		Explain when the use of psychoactive substances, taking into consideration their effects, by flight crew members is prohibited. Source: RCAB N° 94	X	X	X	X	X	X							
010 05 03 00		General rules													
010 05 03 01		General rules — Collision avoidance — RCAB N° 94													
(01)		Describe the rules for the avoidance of collisions. Source: RCAB N° 94	X	X	X	X	X								
(02)		Describe the lights, including their angles, to be displayed by aircraft. Source: RCAB N° 94, lights to be displayed by aircraft; ICAO Annex 2, Chapter 3, 3.2.3; ICAO Annex 6, Part I, Chapter 6, 6.10 and Appendix 1; and ICAO Annex 6, Part III, Chapter 4, 4.42.	X	X	X	X	X								
(03)		Interpret marshalling signals. Source: RCAB N° 94, Marshalling signals	X	X	X	X	X								

(04)		State the basic requirements for minimum height (HGT) for the flight over congested areas of cities, towns or settlements, or over an open-air assembly of persons. Source: RCAB N° 94, minimum heights	X	X	X	X	X								
(05)		Define when the cruising levels shall be expressed in terms of flight levels (FLs). Source: RCAB N° 94, cruising levels	X	X	X	X	X								
(06)		Define under what circumstances cruising levels shall be expressed in terms of altitude (ALT). Source: RCAB N° 94, cruising levels	X	X	X	X	X								
(07)		Explain the limitation for proximity to other aircraft and the right-of-way rules, including holding at runway (RWY) holding positions and lighted stop bars. Source: RCAB N° 94, proximity; right-of-way	X	X	X	X	X								
(08)		Describe the meaning of light signals displayed to aircraft and by aircraft. Source: RCAB N° 94, lights to be displayed by aircraft; signals for aerodrome traffic	X	X	X	X	X								

(09)		Describe the requirements when carrying out simulated instrument flights. Source: RCAB N° 94, simulated instrument flights	X		X			X	X						
(10)		Explain the basic rules for an aircraft operating on and in the vicinity of an aerodrome (AD). Source: RCAB N° 94, Operation on and in the vicinity of an aerodrome	X	X	X	X	X								
(11)		Explain the requirements for the submission of an air traffic service (ATS) flight plan. Source: RCAB N° 94, Submission of a flight plan	X	X	X	X	X								
(12)		Explain the actions to be taken in case of flight plan change or delay. Source: RCAB N° 94, Changes to a flight plan; Adherence to flight plan	X	X	X	X	X	X							
(13)		State the actions to be taken in case of inadvertent changes to track, true airspeed (TAS) and time estimate affecting the current flight plan. Source: RCAB N° 94, Adherence to flight plan	X	X	X	X	X	X							
(14)		Explain the procedures for closing a flight plan. Source: RCAB N° 94, Closing a flight plan	X	X	X	X	X								

(15)		State for which flights an air traffic control (ATC) clearance shall be obtained. Source: RCAB N° 94, Air traffic control clearances	X	X	X	X	X								
(16)		State how a pilot may request ATC clearance. Source: RCAB N° 94, Air traffic control clearances	X	X	X	X	X								
(17)		State the action to be taken if an ATC clearance is not satisfactory to a PIC. Source: RCAB N° 94, Air traffic control clearances	X	X	X	X	X								
(18)		Describe the required actions to be carried out if the continuation of a controlled visual flight rule (VFR) flight in visual meteorological conditions (VMC) is not practicable any more. Source: RCAB N° 94, Adherence to flight plan	X		X	X		X	X						
(19)		Describe the provisions for transmitting a position report to the appropriate ATS unit including time of transmission and normal content of the message. Source: RCAB N° 94, Position reports	X	X	X	X	X	X	X						

(20)		Describe the necessary action when an aircraft experiences a communication (COM) failure. Source: RCAB N° 94, Communications	X	X	X	X	X	X	X						
(21)		State what information an aircraft being subjected to unlawful interference shall give to the appropriate ATS unit. Source: RCAB N° 94, Unlawful interference	X	X	X	X	X	X							
010 05 04 00		Visual flight rules (VFR)													
010 05 04 01		Visual flight rules (VFR) — RCAB N° 94													
(01)		Describe the VFR as contained in RCAB N° 94 Source: RCAB N° 94, VMC visibility and distance from cloud minima; Visual flight rules; Special VFR in control zones	X	X	X	X	X								
010 05 05 00		Instrument flight rules (IFR)													
010 05 05 01		Instrument flight rules (IFR) — RCAB N° 94													
(01)		Describe the IFR as contained in RCAB N° 94. Source: RCAB N° 94, Instrument flight rules (IFR) — Rules applicable to all IFR flights; Rules applicable to IFR flights within controlled airspace; Rules applicable to IFR flights outside controlled airspace	X		X			X	X						
010 05 06 00		Interception of civil aircraft													
010 05 06 01		Interception of civil aircraft — RCAB N° 94													

(01)		List the circumstances in which interception of a civil aircraft may occur. Source: RCAB N° 94, Interception; ICAO Doc 9433, 1.2 Circumstances in which interception may occur	X	X	X	X	X								
(02)		State what primary action should be carried out by an intercepted aircraft. Source: RCAB N° 94, Interception	X	X	X	X	X								
(03)		State which frequency should primarily be tried in order to contact an intercepting aircraft. Source: RCAB N° 94, Interception	X	X	X	X	X								
(04)		State on which mode and code a transponder on board the intercepted aircraft should be operated. Source: RCAB N° 94, Interception	X	X	X	X	X								
(05)		Recall the interception signals and phrases. Source: RCAB N° 94, Interception	X	X	X	X	X								
010 06 00 00		AIRCRAFT OPERATIONS													
010 06 01 00		Intentionally left blank													
010 06 02 00		Definitions and abbreviations (PANS-OPS Flight Procedures, ICAO Doc 8168, Volume I)													

010 06 02 01		Definitions and abbreviations — ICAO Doc 8168, Volume I													
(01)	X	Recall all definitions included in ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 1. Source: ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 1	X		X			X							
(02)	X	Interpret all abbreviations and acronyms as shown in ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 2. Source: ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 2	X		X			X							
010 06 03 00		Departure procedures — (ICAO Doc 8168, Volume I)													
010 06 03 01		General criteria (assuming all engines operating)													
(01)	X	State the factors dictating the design of instrument departure procedures. Source: ICAO Doc 8168, Volume I, Part II, Section 1, Chapter 1, 1.1 General	X		X			X	X						
(02)		Explain in which situations the criteria for omnidirectional departures are applied. Source: ICAO Doc 8168, Volume I, Part II, Section 2, Chapter 3, Omnidirectional departures, 3.1.1; 3.1.2; 3.1.3	X		X			X	X						
010 06 03 02		Standard instrument departures (SIDs)													

(01)		Explain the terms ‘straight departure’ and ‘turning departure’. Source: ICAO Doc 8168, Volume I, Part II, Section 2, Chapter 2, 2.1 General; 2.3 Straight Departures; 2.4 Turning (excluding maximum speeds)	X		X			X	X						
010 06 03 03		Omnidirectional departures													
(01)		Explain the meaning of an ‘omnidirectional departure’. Source: ICAO Doc 8168, Volume I, Attachment B, paragraph 2.5	X		X			X	X						
010 06 03 04		Intentionally left blank													
010 06 03 05		Intentionally left blank													
010 06 04 00		Approach procedures — ICAO Doc 8168, Volume I													
010 06 04 01		General criteria													
(01)		State the general criteria (except ‘Speeds for procedure calculations’) of the approach procedure design: — instrument approach areas; — accuracy of fixes; — fixes formed by intersections; — intersection fix-tolerance factors; — other fix-tolerance factors; — descent gradient. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1	X		X			X							

(02)		Name the five possible segments of an instrument approach procedure. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.2.3 Segments of the approach procedure	X		X			X	X						
(03)		State the reasons for establishing aircraft categories for the approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.4 Categories of aircraft	X		X			X	X						
(04)		State the maximum angle between the final approach track and the extended RWY centre line to still consider a non- precision approach as being a ‘straight-in approach’. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.2.4 Types of approach	X		X			X	X						
(05)		State the minimum obstacle clearance (MOC) provided by the minimum sector altitudes (MSAs) established for an aerodrome. Source: ICAO Doc 8168, Volume I, Part II, Section 4, Chapter 1, 1.3 Minimum sector altitudes (MSA)/terminal arrival altitudes (TAA)	X		X			X	X						
(06)	X	State that a pilot shall apply wind corrections when carrying out an instrument approach procedure.	X		X			X	X						

(07)		State the most significant factor influencing the conduct of instrument approach procedures. Source: ICAO Doc 8168, Volume II, Part I, Section 2, Chapter 1	X		X			X	X						
(08)		Explain why a pilot should not descend below obstacle clearance altitude/height (OCA/H), which are established for: — precision approach procedures; — non-precision approach procedures; — visual (circling) procedures; — APV approach procedures. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.6 Obstacle clearance altitude/height (OCA/H)	X		X			X	X						
(09)		Describe in general terms the relevant factors for the calculation of operational minima. Source: ICAO Doc 8168, Volume I, Part II Section 5, Chapter 1, 1.7 Factors affecting operational minima	X		X			X	X						
(10)		State the following acronyms in plain language: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H. Source: ICAO Doc 8168, Volume I, Part I, Section 1, Chapters 1 and 2	X		X			X	X						

(11)		Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, and MDA/H. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1 General requirements	X		X			X	X						
010 06 04 02		Approach procedure design													
(01)		Describe how the vertical cross section for each of the five approach segments is broken down into the various areas. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1 General requirements	X		X			X	X						
(02)		State within which area of the cross section the minimum obstacle clearance (MOC) is provided for the whole width of the area. Source: ICAO Doc 8168, Volume I, Part II, Section 1, Chapter 1, 1.3 Areas, 1.3.1	X		X			X	X						
(03)		Define the terms 'IAF', 'IF', 'FAF', 'FAP', 'MAPt' and 'TP'. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X		X			X	X						

(04)	X	State the accuracy of facilities providing track (VHF omnidirectional radio range (VOR), instrument landing system (ILS), non-directional beacon (NDB)). Source: ICAO Doc 8168, Volume I, Attachment A, Section 2, Table A-2-1. System use accuracy (2 SD) of facility providing track guidance and facility not providing track guidance	X		X			X	X						
(05)		State the optimum descent gradient (preferred for a precision approach) in degrees and per cent. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.10 Descent gradient	X		X			X	X						
010 06 04 03		Arrival and approach segments													
(01)		Name the five standard segments of an instrument approach procedure, and state the beginning and end for each of them. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1, 1.2 Instrument approach procedure	X		X			X	X						
(02)		Describe where an arrival route normally ends. Source: ICAO Doc 8168, Volume I, Part II, Section 4 Arrival procedures, Chapter 1 General requirements	X		X			X	X						

(03)		State the main task of the initial approach segment. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 3 Initial approach	X		X			X	X						
(04)		Describe the maximum angle of interception between the initial approach segment and the intermediate approach segment (provided at the intermediate fix) for a precision approach and a non-precision approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 3 Initial approach	X		X			X	X						
(05)		Describe the main task of the intermediate approach segment. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 4 Intermediate approach	X		X			X	X						
(06)		State the main task of the final approach segment. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 5 Final approach	X		X			X	X						
(07)		Name the two possible aims of a final approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 1 General requirements and Chapter 5 Final approach	X		X			X	X						

(08)		Explain the term ‘final approach point’ in case of an ILS approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 5 Final approach	X		X			X	X						
(09)		State what happens if an ILS glide path (GP) becomes inoperative during the approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 5 Final approach	X		X			X	X						
010 06 04 04		Missed approach													
(01)		Name the three phases of a missed approach procedure and describe their geometric limits. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach	X		X			X	X						
(02)		State the main task of a missed approach procedure. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach segment	X		X			X	X						
(03)		Define the term ‘missed approach point (MAPt)’. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X		X			X	X						

(04)		Describe how a MAPt may be established in an approach procedure. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach	X		X			X	X						
(05)		State the pilot’s action if, upon reaching the MAPt, the required visual reference is not established. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach	X		X			X	X						
(06)		Describe what a pilot is expected to do in the event a missed approach is initiated prior to arriving at the MAPt. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach	X		X			X	X						
(07)		State whether the pilot is obliged to cross the MAPt at the height (HGT)/altitude (ALT) required by the procedure or whether they are allowed to cross the MAPt at a HGT/ALT greater than that required by the procedure. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 7 Missed approach	X		X			X	X						
010 06 04 05		Visual manoeuvring (circling) in the vicinity of the aerodrome (AD)													

(01)		Describe what is meant by 'visual manoeuvring (circling)'. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(02)		Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final approach and missed approach area has to be considered for the visual circling. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(03)		State for which category of aircraft the obstacle clearance altitude/height (OCA/H) within an established visual manoeuvring (circling) area is determined. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(04)		Describe how the minimum descent altitude/height (MDA/H) is specified for visual manoeuvring (circling) if the OCA/H is known. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						

(05)		State the conditions to be fulfilled before descending below MDA/H in a visual manoeuvring (circling) approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(06)		Explain why there can be no single procedure designed that will cater for conducting a circling approach in every situation. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(07)		State how the pilot is expected to act after initial visual contact during a visual manoeuvring (circling). Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling)	X		X			X	X						
(08)		Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach. Source: ICAO Doc 8168, Volume I, Part II, Section 5, Chapter 6 Visual manoeuvring (circling) area	X		X			X	X						
010 06 04 06		Intentionally left blank Note: VOR and VOR/DME are covered under 062 02 03 00 and 062 02 04 00.													
010 06 05 00		Holding procedures — ICAO Doc 8168, Volume I													
010 06 05 01		Entry and holding													

(01)		Explain why deviations from the in-flight procedures of a holding established in accordance with ICAO Doc 8168 are dangerous. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(02)		State that if for any reason a pilot is unable to conform to the procedures for normal conditions laid down for any particular holding pattern, this pilot should advise ATC as early as possible. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(03)		Describe the shape and terminology associated with the holding pattern. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(04)		State the bank angle and rate of turn to be used whilst flying in a holding pattern. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(05)		Explain why a pilot in a holding pattern should attempt to maintain tracks and how this can be achieved. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(06)		Describe where outbound timing begins in a holding pattern.	X		X			X	X						

		Source: ICAO Doc 8168, Volume I, Part II, Section 6													
(07)		State where the outbound leg in a holding terminates if the outbound leg is based on DME. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(08)		Describe the three heading entry sectors for entries into a holding pattern. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(09)		Describe the terms ‘parallel entry’, ‘offset entry’ and ‘direct entry’. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(10)		Determine the correct entry procedure for a given holding pattern. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(11)		State the still-air time for flying the outbound entry heading with or without DME. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						

(12)		Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
010 06 05 02		Obstacle clearance													
(01)	X	Describe the layout of the basic holding area, entry area and buffer area of a holding pattern. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
(02)	X	State which obstacle clearance is provided by a minimum permissible holding level referring to the holding area, the buffer area (general only) and over high terrain or in mountainous areas. Source: ICAO Doc 8168, Volume I, Part II, Section 6	X		X			X	X						
010 06 06 00		Altimeter-setting procedures — ICAO Doc 8168													
010 06 06 01		Basic requirements and procedures													
(01)		Describe the two main objectives of altimeter settings. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 1	X	X	X	X	X	X	X						
(02)		Define the terms 'QNH' and 'QFE'. Source: ICAO Doc 8168, Volume I, Part I, Section 1, Chapter 2; ICAO Doc 8168, Volume III, Section 2, Chapter 1	X	X	X	X	X	X	X						

(03)		Describe the different terms for ALT or flight levels (FLs) respectively, which are the references during climb or descent to change the altimeter settings from QNH to 1013.2 hPa and vice versa. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 1	X	X	X	X	X	X	X						
(04)		Define the term ‘flight level (FL)’. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X	X	X	X	X	X	X						
(05)		State where FL zero shall be located. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(06)		State the interval by which consecutive FLs shall be separated. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(07)		Describe how FLs are defined. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(08)		Define the term ‘transition altitude (TA)’. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X	X	X	X	X	X	X						

(09)		State how TAs shall normally be specified. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(10)		Explain how the HGT of the TA is calculated and expressed in practice. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(11)		State where TAs shall be published. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(12)		Define the term 'transition level (TRL)'. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X	X	X	X	X	X	X						
(13)		State when the TRL is normally passed on to the aircraft. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(14)		State how the vertical position of the aircraft shall be expressed at or below the TA and TRL. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						

(15)		Define the term 'transition layer'. Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement	X	X	X	X	X	X	X						
(16)		Describe when the vertical position of an aircraft passing through the transition layer shall be expressed in terms of FLs and when in terms of ALT. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(17)		State when the QNH altimeter setting shall be made available to departing aircraft. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(18)		Explain when the vertical separation of an aircraft during en- route flight shall be assessed in terms of ALT and when in terms of FLs. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						
(19)		Explain when, in air–ground communications during an en- route flight, the vertical position of an aircraft shall be expressed in terms of ALT and when in terms of FLs. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						

(20)		Describe why QNH altimeter-setting reports should be provided from sufficient locations. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(21)		State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome (AD) for landing. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
(22)		State under which circumstances the vertical position of an aircraft above the TRL may be referenced in ALT. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2	X	X	X	X	X	X	X						
010 06 06 02		Procedures for operators and pilots													
(01)		State on which setting at least one altimeter shall be set prior to take-off. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						
(02)		State where during the climb the altimeter setting shall be changed from QNH to 1013.2 hPa. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						

(03)		Describe when a pilot of an aircraft intending to land at an AD shall obtain the TRL. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						
(04)		Describe when a pilot of an aircraft intending to land at an AD shall obtain the actual QNH altimeter setting. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						
(05)		State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing. Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3	X	X	X	X	X	X	X						
010 06 07 00		Parallel or near-parallel instrument RWYs — ICAO Doc 8168, Volume I													
010 06 07 01		Simultaneous operation on parallel or near-parallel instrument RWYs													
(01)	X	Describe the difference between independent and dependent parallel approaches. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X	X						

(02)		Describe the following different operations: — simultaneous instrument departures; — segregated parallel approaches/departures; — Semi-mixed and mixed operations. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X	X						
(03)		Describe the terms 'normal operating zone (NOZ)' and 'no transgression zone (NTZ)'. Source: ICAO Doc 8168, Volume III, Section 1, Chapter 1; ICAO Doc 4444, Chapter 6 (Note: For the dimensions of the NTZ)	X	X	X	X	X	X							
(04)		State the aircraft avionics requirements for conducting parallel instrument approaches. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X							
(05)		State where guidance material may be located for simultaneous operations on parallel or near-parallel instrument runways. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X							

(06)		State the radar requirements for simultaneous, independent, and parallel instrument approaches, and how weather conditions effect these. Source: ICAO Doc 8168 Volume III, Section 3, Chapter 1; ICAO Doc 4444, Chapter 6	X	X	X	X	X	X							
(07)		State the maximum angle of interception for an ILS localiser course (CRS) or microwave landing system (MLS) final approach track in case of simultaneous, independent, and parallel instrument approaches. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X							
(08)		Describe the special conditions for tracks on missed approach procedures and departures in case of simultaneous or parallel operations. Source: ICAO Doc 8168, Volume III, Section 3, Chapter 1	X	X	X	X	X	X							
010 06 08 00		Secondary surveillance radar (transponder) operating procedures —— ICAO Doc 8168													
010 06 08 01		Operation of transponders													
(01)		State when and where the pilot shall operate the transponder. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						

(02)		State the modes and codes that the pilot shall operate in the absence of any ATC directions or regional air navigation agreements. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						
(03)		State when the pilot shall operate Mode C. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X							
(04)		State when the pilot shall 'SQUAWK IDENT'. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						
(05)		State the transponder code to indicate: — a state of emergency; — a COM failure; — unlawful interference. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						
(06)		Describe the consequences of a transponder failure in flight. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						
(07)		State the primary action of the pilot in the case of an unserviceable transponder before departure when no repair or replacement at the given AD is possible. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1	X	X	X	X	X	X	X						

(08)		State when the pilot shall operate Mode S. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1							X						
010 06 08 02		Operation of airborne collision avoidance system (ACAS) equipment													
(01)		Describe the main reason for using ACAS. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.1 ACAS overview	X	X	X	X	X	X	X						
(02)		State whether the 'use of ACAS indications' described in ICAO Doc 8168 is absolutely mandatory. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(03)		Explain the pilots' reaction required to allow ACAS to fulfil its role of assisting pilots in the avoidance of potential collisions. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(04)		Explain why pilots shall not manoeuvre their aircraft in response to traffic advisories (TAs) only. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							

(05)		Explain the significance of TAs in view of possible resolution advisories (RAs). Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(06)		State why a pilot should follow RAs immediately. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(07)		List the reasons which may force a pilot to disregard an RA. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(08)		Explain the importance of instructing ATC immediately that an RA has been followed. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
(09)		Explain the duties of a pilot with regard to ATC when an RA situation is resolved. Source: ICAO Doc 8168, Volume III, Section 4, Chapter 3, 3.2 Use of ACAS indications	X	X	X	X	X	X							
010 06 09 00		TCAR OPS regulations on AIR OPERATIONS													

010 06 09 01		Regulation structure													
(01)		Describe the subject matter and scope of that Regulation. Source: TCAR OPS regulation, subject matter and scope	X	X	X	X	X	X	X						
(02)	X	State that TCAR OPS Regulation covers all types of commercial and non-commercial operations.	X	X	X	X	X	X	X						
010 06 09 02		Definitions													
(01)		Recall the definitions in the Regulation not already given in ICAO PAN-OPS. Source: TCAR OPS Regulation, Definitions	X	X	X	X	X	X	X						
010 06 09 03		Part-SPA, Part-NCC and Part-NCO													
(01)		Describe the scope of these Parts.	X	X	X	X	X								
(02)	X	Explain the main content of these Parts, except the operational procedures.	X	X	X	X	X								
010 07 00 00		AIR TRAFFIC SERVICES (ATS) AND AIR TRAFFIC MANAGEMENT (ATM)													
010 07 01 00		ICAO Annex 11 — Air Traffic Services													
010 07 01 01		Definitions													
(01)	X	Recall the definitions given in ICAO Annex 11. Source: ICAO Annex 11, Chapter 1 Definitions	X	X	X	X	X	X							
010 07 01 02		General													

(01)	X	State the objectives of ATS. Source: ICAO Annex 11, Chapter 2, 2.2 Objectives of ATS	X	X	X	X	X	X							
(02)	X	Describe the three basic types of ATS. Source: ICAO Annex 11, Chapter 2, 2.3 Divisions of the air traffic services	X	X	X	X	X	X							
(03)	X	Describe the three basic types of ATC services. Source: ICAO Annex 11, Chapter 2, 2.3 Divisions of the air traffic services	X	X	X	X	X	X							
(04)		State on which frequencies a pilot can expect ATC to contact them in case of an emergency. Source: ICAO Annex 11, Chapter 2, 2.24 Service to aircraft in the event of an emergency, 2.25 In-flight contingencies, Chapter 5, 5.3 Use of communication facilities, and Chapter 6, 6.1.1.1 (referring to Annex 10, Volumes II and V), Chapter 4, 4.1.3.1	X	X	X	X	X	X							
(05)		Describe the procedure for the transfer of an aircraft from one ATC unit to another. Source: ICAO Annex 11, Chapter 3, 3.6.1 Transfer of responsibility for control	X	X	X	X	X								
010 07 01 03		Airspace													

(01)		Describe the purpose for establishing flight information regions (FIRs) including upper flight information regions (UIRs). Source: ICAO Annex 11, Chapter 2: 2.10; 2.11	X	X	X	X	X	X							
(02)		Describe the various rules and services that apply to the various classes of airspace. Source: ICAO Annex 11, Chapter 2, 2.6 Classification of airspaces and Annex 11, Appendix 4	X	X	X	X	X	X	X						
(03)		Explain which airspace shall be included in an FIR or UIR.	X	X	X	X	X	X							
(04)		State the designation for those portions of the airspace where flight information service (FIS) and alerting service shall be provided. Source: ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided	X	X	X	X	X	X							
(05)		State the designations for those portions of the airspace where ATC services shall be provided. Source: ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided	X	X	X	X	X	X							

(06)		Identify whether or not control areas (CTAs) and control zones (CTRs) designated within an FIR shall form part of that FIR. Source: ICAO Annex 11, Chapter 2, 2.5 Designation of the portions of the airspace and controlled aerodromes where air traffic services will be provided	X	X	X	X	X	X							
(07)		State the lower limit of a CTA as far as ICAO Standards are concerned. Source: ICAO Annex 11, Chapter 2, 2.11.3 Control areas	X	X	X	X	X	X							
(08)		State whether or not the lower limit of a CTA has to be established uniformly. Source: ICAO Annex 11, Chapter 2, 2.11.3 Control areas	X	X	X	X	X	X							
(09)		Explain why a UIR or upper CTA should be delineated to include the upper airspace within the lateral limits of a number of lower FIRs or CTAs. Source: ICAO Annex 11, Chapter 2, 2.11 Specifications for flight information regions, control areas and control zones	X	X	X	X	X	X							
(10)		Describe in general the lateral limits of CTRs. Source: ICAO Annex 11, Chapter 2, 2.11.5 Control zones	X	X	X	X	X	X							

(11)		State the minimum extension (in NM) of the lateral limits of a CTR. Source: ICAO Annex 11, Chapter 2, 2.11.5 Control zones	X	X	X	X	X	X							
(12)		State the upper limits of a CTR located within the lateral limits of a CTA. Source: ICAO Annex 11, Chapter 2, 2.11.5 Control zones	X	X	X	X	X	X							
010 07 01 04		Air traffic control (ATC) services													
(01)		Name all classes of airspace in which ATC services shall be provided. Source: ICAO Annex 11, Chapter 3, 3.1 Application	X	X	X	X	X	X							
(02)		Name the ATS units providing ATC services (area control service, approach control service, aerodrome control service). Source: ICAO Annex 11, Chapter 3, 3.2 Provision of air traffic control service	X	X	X	X	X	X	X						
(03)		Describe which unit(s) may be assigned with the task to provide specified services on the apron. Source: ICAO Annex 11, Chapter 3, 3.2 Provision of air traffic control service	X	X	X	X	X	X	X						
(04)		State the purpose of clearances issued by an ATC unit. Source:	X	X	X	X	X	X	X						

		ICAO Annex 11, Chapter 3, 3.3 Operation of air traffic control service													
(05)		List the various (five possible) parts of an ATC clearance. Source: ICAO Annex 11, Chapter 3, 3.7.1 Contents of clearances	X	X	X	X	X	X	X						
(06)		Explain why the movement of persons, vehicles and towed aircraft on the manoeuvring area of an AD shall be controlled by the aerodrome control tower (TWR) (as necessary). Source: ICAO Annex 11, Chapter 3, 3.8 Control of persons and vehicles at aerodromes, 3.8.1	X	X	X	X	X	X							
010 07 01 05		Flight information service (FIS)													
(01)	X	State for which aircraft FIS shall be provided. Source: ICAO Annex 11, Chapter 4, 4.1 Application	X	X	X	X	X	X							
(02)	X	State whether or not FIS shall include the provision of pertinent significant meteorological information (SIGMET) and air meteorological information report (AIRMET) information. Source: ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service	X	X	X	X	X	X							

(03)	X	State which information FIS shall include in addition to SIGMET and AIRMET information. Source: ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service	X	X	X	X	X	X								
(04)	X	Indicate which other information the FIS shall include in addition to the special information given in Annex 11. Source: ICAO Annex 11, Chapter 4, 4.2 Scope of flight information service, 4.2.2 Note 2 and Attachment B	X	X	X	X	X	X								
(05)	X	State the meaning of the acronym 'ATIS' in plain language. Source: ICAO Annex 11, Chapter 4, 4.3.4 Voice-automatic terminal information service (Voice-ATIS) broadcasts	X	X	X	X	X	X								
(06)		List the basic information concerning automatic terminal information service (ATIS) broadcasts (e.g. frequencies used, number of ADs included, updating, identification, acknowledgment of receipt, language and channels, ALT- setting). Source: ICAO Annex 11, Chapter 4, 4.3.4 Voice-automatic terminal information service (Voice-ATIS) broadcasts	X	X	X	X	X	X								

(07)		State the content of an ATIS message. Source: ICAO Annex 11, Chapter 4, 4.3.7 ATIS for arriving and departing aircraft	X	X	X	X	X								
(08)		State the reasons and circumstances when an ATIS message shall be updated. Source: ICAO Annex 11, Chapter 4, 4.3.6 Automatic terminal information service (voice and/or data link)	X	X	X	X	X	X							
010 07 01 06		Alerting service													
(01)		State who provides the alerting service. Source: ICAO Annex 11, Chapter 2, 2.10 Establishment and designation of the units providing air traffic services	X	X	X	X	X								
(02)		State who is responsible for initiating the appropriate emergency phase. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								
(03)		State the aircraft to which alerting service shall be provided. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								

(04)		State which unit shall be notified by the responsible ATS unit immediately when an aircraft is considered to be in a state of emergency. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								
(05)		Name the three stages of emergency and describe the basic conditions for each kind of emergency. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								
(06)	X	State the meaning of the expressions ‘INCERFA’, ‘ALERFA’ and ‘DETRESFA’. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								
(07)	X	State the information to be provided to those aircraft that operate in the vicinity of an aircraft that is either in a state of emergency or unlawful interference. Source: ICAO Annex 11, Chapter 5 Alerting service	X	X	X	X	X								
010 07 01 07		Principles governing required navigation performance (RNP) and air traffic service (ATS) route designators													
(01)		State the meaning of the acronym ‘RNP’. Source: ICAO Annex 11, Chapter 1 Definitions	X	X	X	X	X								

(02)		State the factors that RNP is based on. Source: ICAO Annex 11, Chapter 1 Definitions (Navigation specification)	X	X	X	X	X								
(03)	X	Describe the reason for establishing a system of route designators and navigation specifications. Source: ICAO Annex 11, App 1, 1. Designators for ATS routes and navigation specifications	X	X	X	X	X								
(04)		State whether or not a prescribed RNP type is considered an integral part of the ATS route designator. Source: ICAO Annex 11, App 1, 1. Designators for ATS routes and navigation specifications	X	X	X	X	X								
(05)		Explain the composition of an ATS route designator. Source: ICAO Annex 11, Appendix 1, 2. Composition of designator (not to the extent of memorising the codes in 2.2.1)	X	X	X	X	X								
010 07 02 00		ICAO Doc 4444 — Air Traffic Management													
010 07 02 01		Foreword (Scope and purpose)													
(01)		State which ATS units provide clearances that do, and do not, include the prevention of collision with terrain. Source:	X	X	X	X	X	X	X						

		ICAO Doc 4444, Foreword, 2 Scope and purpose, 2.1													
010 07 02 02		Definitions													
(01)	X	Recall all definitions given in ICAO Doc 4444 except the following: accepting unit/controller, AD taxi circuit, aeronautical fixed service (AFS), aeronautical fixed station, air-taxiing, allocation, approach funnel, assignment, data convention, data processing, discrete code, D-value, flight status, ground effect, receiving unit/controller, sending unit/controller, transfer of control point, transferring unit/controller, unmanned free balloon. Source: ICAO Doc 4444, Chapter 1 Definitions	X	X	X	X	X	X							
010 07 02 03		ATS system capacity and air traffic flow management (ATFM)													
(01)	X	Explain when and where ATFM services shall be implemented. Source: ICAO Doc 4444, Chapter 3, 3.2 Air traffic flow management, 3.2.1 General	X	X	X	X	X	X	X						
010 07 02 04		General provisions for air traffic services (ATS)													

(01)	X	Describe who is responsible for the provision of flight information and alerting services within an FIR, within controlled airspace and at controlled ADs. Source: ICAO Doc 4444, Chapter 4, 4.2 Responsibility for the provision of flight information service and alerting service	X	X	X	X	X	X							
010 07 02 05		ATC clearances													
(01)		State which information the issue of an ATC clearance is based on. Source: ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose	X	X	X	X	X	X	X						
(02)		Describe what a PIC should do if an ATC clearance is not suitable. Source: ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose	X	X	X	X	X	X	X						
(03)		State who bears the responsibility for adhering to the applicable rules and regulations whilst flying under the control of an ATC unit. Source: ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose	X	X	X	X	X	X	X						

(04)	X	State the two primary purposes of clearances issued by ATC units. Source: ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose	X	X	X	X	X	X							
(05)		State why clearances must be issued 'early enough' to aircraft. Source: ICAO Doc 4444, Chapter 4, 4.5 Air traffic control clearances, 4.5.1 Scope and purpose	X	X	X	X	X	X							
(06)		Explain what is meant by the expression 'clearance limit'. Source: ICAO Doc 4444, Chapter 4, 4.5.7 Description of air traffic control clearances, 4.5.7.1 Clearance limit	X	X	X	X	X	X	X						
(07)		Explain the meaning of the phrases 'cleared via flight planned route', 'cleared via (designation) departure' and 'cleared via (designation) arrival' in an ATC clearance. Source: ICAO Doc 4444, Chapter 4, 4.5.7 Description of air traffic control clearances, 4.5.7.2 Route of flight	X	X	X	X	X	X	X						
(08)		List which items of an ATC clearance shall always be read back by the flight crew. Source: ICAO Doc 4444, Chapter 4, 4.5.7.5 Readback of clearances	X	X	X	X	X	X	X						
010 07 02 06		Horizontal speed control instructions													

(01)		Explain the reason for speed control by ATC. Source: ICAO Doc 4444, Chapter 4, 4.6 Horizontal speed control instructions, 4.6.1 General	X	X	X	X	X	X	X						
(02)	X	Define the maximum speed changes that ATC may impose. Source: ICAO Doc 4444, Chapter 4, 4.6.3 Descending and arriving aircraft	X	X	X	X	X	X	X						
(03)		State within what distance from the THR the PIC should not expect any kind of speed control. Source: ICAO Doc 4444, Chapter 4, 4.6.3 Descending and arriving aircraft	X	X	X	X	X	X	X						
010 07 02 07		Change from IFR to VFR flight													
(01)		Explain how the change from IFR to VFR can be initiated by the PIC. Source: ICAO Doc 4444, Chapter 4, 4.8 Change from IFR to VFR flight	X		X			X	X						
(02)		Describe the expected reaction of the appropriate ATC unit upon a request to change from IFR to VFR. Source: ICAO Doc 4444, Chapter 4, 4.8 Change from IFR to VFR flight	X		X			X	X						
010 07 02 08		Wake turbulence													

(01)		State the wake-turbulence categories of aircraft. Source: ICAO Doc 4444, Chapter 4, 4.9.1 Wake turbulence categories of aircraft	X	X	X	X	X	X							
(02)		State the wake-turbulence separation minima. Source: ICAO Doc 4444, Chapter 5, 5.8 Time-based wake turbulence longitudinal separation minima; ICAO Doc 4444, Chapter 8, 8.7.3.4 (table of distance-based wake turbulence separation minima) and 8.7.3.4.1 (appropriate conditions for application)	X	X	X	X	X	X							
(03)		Describe how a 'heavy' aircraft shall indicate this in the initial radiotelephony contact with ATS. Source: ICAO Doc 4444, Chapter 4, 4.9.2 Indication of heavy wake turbulence category	X	X	X	X	X	X							
010 07 02 09		Altimeter-setting procedures													
(01)		Define the following terms: — TRL; — transition layer; and — TA. Source: ICAO Doc 4444, Chapter 1 Definitions	X	X	X	X	X	X	X						

(02)		Describe how the vertical position of an aircraft in the vicinity of an AD shall be expressed at or below the TA, at or above the TRL, and while climbing or descending through the transition layer. Source: ICAO Doc 4444, Chapter 4, 4.10.1 Expression of vertical position of aircraft	X	X	X	X	X	X	X						
(03)		Describe when the HGT of an aircraft using QFE during an NDB approach is referred to the landing THR instead of the AD elevation. Source: ICAO Doc 4444, Chapter 4, 4.10.1 Expression of vertical position of aircraft	X	X	X	X	X	X	X						
(04)		State in which margin altimeter settings provided to aircraft shall be rounded up or down. Source: ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information	X	X	X	X	X	X	X						
(05)		Describe the expression ‘lowest usable FL’. Source: ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information	X	X	X	X	X	X	X						

(06)		Determine how the vertical position of an aircraft on an en- route flight is expressed at or above the lowest usable FL and below the lowest usable FL. Source: ICAO Doc 4444, Chapter 4, 4.10.1 Expression of vertical position of aircraft	X	X	X	X	X	X	X						
(07)		State who establishes the TRL to be used in the vicinity of an AD. Source: ICAO Doc 4444, Chapter 4, 4.10.2 Determination of the transition level	X	X	X	X	X	X	X						
(08)		Decide how and when a flight crew member shall be informed about the TRL. Source: ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information	X	X	X	X	X	X	X						
(09)		State whether or not the pilot can request TRL to be included in the approach clearance. Source: ICAO Doc 4444, Chapter 4, 4.10.4 Provision of altimeter setting information	X	X	X	X	X	X	X						
010 07 02 10		Position reporting													

(01)		Describe when position reports shall be made by an aircraft flying on routes defined by designated significant points. Source: ICAO Doc 4444, Chapter 4, 4.11.1 Transmission of position reports, 4.11.1.1	X	X	X	X	X	X	X						
(02)		List the six items that are normally included in a voice position report. Source: ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X	X						
(03)	X	State the requirements for using a simplified position report with FL, next position (and time-over) and ensuing significant points omitted. Source: ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X	X						
(04)		State the item of a position report which must be forwarded on to ATC with the initial call after changing to a new frequency. Source: ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X	X						
(05)		Indicate the item of a position report which may be omitted if secondary surveillance radar (SSR) Mode C is used. Source: ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X	X						

(06)		Explain in which circumstances the airspeed should be included in a position report. Source: ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X							
(07)		Explain the meaning of the acronym 'ADS'.	X	X	X	X	X	X							
(08)		Describe which expression shall precede the level figures in a position report if the level is reported in relation to 1013.2 hPa (standard pressure). Source: ICAO Doc 4444, Chapter 4, 4.5.7.5 Readback of clearances; ICAO Doc 4444, Chapter 4, 4.11.2 Contents of voice position reports	X	X	X	X	X	X							
010 07 02 11		Reporting of operational and meteorological information													
(01)		List the occasions when special air-reports shall be made. Source: ICAO Doc 4444, Chapter 4, 4.12.3 Contents of special air-reports 4.12.3.1 (a to k inclusive)	X	X	X	X	X	X							
010 07 02 12		Separation methods and minima													
(01)		Explain the general provisions for the separation of controlled air traffic. Source: ICAO Doc 4444, Chapter 5, 5.2.1 General and 5.2.2 Degraded aircraft performance	X		X			X	X						

(02)	X	Name the different kinds of separation used in aviation. Source: ICAO Doc 4444, Chapter 5; ICAO Annex 11, Chapter 3, 3.5.2	X		X			X	X						
(03)		State the difference between the type of separation provided within the various classes of airspace and the various types of flight. Source: ICAO Doc 4444, Chapter 5, 5.2 Provisions for the separation of controlled traffic	X		X			X	X						
(04)		State who is responsible for the avoidance of collision with other aircraft when operating in VMC. Source: ICAO Doc 4444, Chapter 5, 5.9 Clearances to fly maintaining own separation while in VMC	X		X			X	X						
(05)		Describe how vertical separation is obtained. Source: ICAO Doc 4444, Chapter 5, 5.3.1 Vertical separation application	X		X			X	X						
(06)		State the required vertical separation minimum. Source: ICAO Doc 4444, Chapter 5, 5.3.2 Vertical separation minimum	X		X			X	X						

(07)		Describe how the cruising levels of aircraft flying to the same destination and in the expected approach sequence are correlated with each other. Source: ICAO Doc 4444, Chapter 5, 5.3.3 Assignment of cruising levels for controlled flights	X		X			X	X						
(08)		Name the conditions that must be adhered to when two aircraft are cleared to maintain a specified vertical separation between them during climb or descent. Source: ICAO Doc 4444, Chapter 5, 5.3.4 Vertical separation during climb or descent	X		X			X	X						
(09)		State the two main methods for horizontal separation. Source: ICAO Doc 4444, Chapter 5	X		X			X	X						
(10)		Describe how lateral separation of aircraft at the same level may be obtained. Source: ICAO Doc 4444, Chapter 5, 5.4.1 Lateral separation, 5.4.1.1.2	X		X			X	X						
(11)		Explain the term 'geographical separation'. Source: ICAO Doc 4444, Chapter 5, 5.4.1 Lateral separation	X		X			X	X						

(12)		Describe track separation between aircraft using the same navigation aid or method. Source: ICAO Doc 4444, Chapter 5, 5.4.1.2 Lateral separation criteria and minima, 5.4.1.2.1.2	X		X			X	X						
(13)		Describe the three basic means for the establishment of longitudinal separation. Source: ICAO Doc 4444, Chapter 5, 5.4.2	X		X			X	X						
(14)		State the minimum standard horizontal radar separation in NM. Source: ICAO Doc 4444, Chapter 5	X		X			X	X						
(15)		Describe the method of the Mach number technique. Source: ICAO Doc 4444, Chapter 5, 5.4.2.4 Longitudinal separation minima with Mach number technique based on time	X	X											
010 07 02 13		Separation in the vicinity of aerodromes (ADs)													
(01)		Describe the expression ‘essential local traffic’. Source: ICAO Doc 4444, Chapter 6, 6.2 Essential local traffic	X	X	X	X	X	X							

(02)		State which possible decision the PIC may choose to take if they are asked to accept take-off in a direction which is not 'into the wind'. Source: ICAO Doc 4444, Chapter 6, 6.3.3 Departure sequence	X	X	X	X	X	X							
(03)		State the condition to enable ATC to initiate a visual approach for an IFR flight. Source: ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach, 6.5.3.1	X	X	X	X	X	X	X						
(04)		State whether or not separation shall be provided by ATC between an aircraft executing a visual approach and other arriving or departing aircraft. Source: ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach,6.5.3.4	X	X	X	X	X	X	X						
(05)		State in which case, when the flight crew are not familiar with the instrument approach procedure being carried out, only the final approach track has to be given to them by ATC. Source: ICAO Doc 4444, Chapter 6, 6.5.4 Instrument approach	X	X	X	X	X	X	X						
(06)		Describe which FL should be assigned to an aircraft first arriving over a holding fix for landing. Source: ICAO Doc 4444, Chapter 6, 6.5.5 Holding	X	X	X	X	X	X	X						

(07)		State which kinds of priority can be applied to aircraft for a landing. Source: ICAO Doc 4444, Chapter 6, 6.5.6 Approach sequence, 6.5.6.1 General	X	X	X	X	X	X	X						
(08)		Describe the situation when a pilot of an aircraft in an approach sequence indicates their intention to hold for weather improvements. Source: ICAO Doc 4444, Chapter 6, 6.5.6 Approach sequence,6.5.6.1 General	X	X	X	X	X	X	X						
(09)		Explain the term 'expected approach time' and the procedures for its use. Source: ICAO Doc 4444, Chapter 6, 6.5.7 Expected approach time	X	X	X	X	X	X	X						
(10)		State the reasons which could probably lead to the decision to use another take-off or landing direction than the one into the wind. Source: ICAO Doc 4444, Chapter 7, 7.2 Selection of runway-in-use	X	X	X	X	X	X	X						
(11)		State the possible consequences for a PIC if the 'RWY-in-use' is not considered suitable for the operation involved. Source: ICAO Doc 4444, Chapter 7	X	X	X	X	X	X	X						
010 07 02 14		Miscellaneous separation procedures													

(01)		State the minimum separation between departing and arriving aircraft. Source: ICAO Doc 4444, Chapter 5, 5.7 Separation of departing aircraft from arriving aircraft	X	X	X	X	X	X	X						
(02)		State the non-radar wake-turbulence longitudinal separation minima. Source: ICAO Doc 4444, Chapter 5 and 6	X	X	X	X	X	X	X						
(03)		Describe the consequences of a clearance to ‘maintain own separation’ while in VMC. Source: ICAO Doc 4444, Chapter 5, 5.8 Time-based wake turbulence longitudinal separation minima, 5.8.1; ICAO Doc 4444, Chapter 6, 6.5.3 Visual approach	X	X	X	X	X	X	X						
(04)		Give a brief description of ‘essential traffic’ and ‘essential traffic information’. Source: ICAO Doc 4444, Chapter 5, 5.10 Essential traffic information	X	X	X	X	X	X	X						
(05)		Describe the circumstances under which a reduction in separation minima may be allowed. Source: ICAO Doc 4444, Chapter 6, 6.1 Reduction in separation minima in the vicinity of aerodromes	X	X	X	X	X	X	X						
010 07 02 15		Arriving and departing aircraft													

(01)		List the elements of information which shall be transmitted to an aircraft as early as practicable if an approach for landing is intended. Source: ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft	X	X	X	X	X	X	X						
(02)		List the elements of information to be transmitted to an aircraft at the commencement of final approach. Source: ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft	X	X	X	X	X	X	X						
(03)		List the elements of information to be transmitted to an aircraft during final approach. Source: ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft	X	X	X	X	X	X	X						
(04)		State the prerequisites for operating on parallel or near- parallel RWYs including the different combinations of parallel arrivals or departures. Source: ICAO Doc 4444, Chapter 6, 6.7 Operations on parallel or near-parallel runways	X	X	X	X	X	X							
(05)		State the sequence of priority between aircraft landing (or in the final stage of an approach to land) and aircraft intending to depart. Source: ICAO Doc 4444, Chapter 7, 7.8 Order of priority for arriving and departing aircraft	X	X	X	X	X	X	X						

(06)		State the significant changes in the meteorological conditions in the take-off or climb-out area that shall be transmitted without delay to a departing aircraft. Source: ICAO Doc 4444, Chapter 6, 6.4.1 Meteorological conditions	X	X	X	X	X	X	X						
(07)		State the significant changes that shall be transmitted as early as practicably possible to an arriving aircraft, particularly changes in the meteorological conditions. Source: ICAO Doc 4444, Chapter 6, 6.6 Information for arriving aircraft	X	X	X	X	X	X	X						
010 07 02 16		Procedures for aerodrome (AD) control service													
(01)		Name the operational failure or irregularity of AD equipment which shall be reported by the TWR immediately. Source: ICAO Doc 4444, Chapter 7, 7.1.3 Failure or irregularity of aids and equipment	X	X	X	X	X	X	X						
(02)		Explain that, after a given period of time, the TWR shall report to the area control centre (ACC) or flight information centre (FIC) if an aircraft does not land as expected. Source: ICAO Doc 4444, Chapter 7, 7.1.2 Alerting service provided by aerodrome control towers	X	X	X	X	X	X	X						

(03)		Describe the procedures to be observed by the TWR whenever VFR operations are suspended. Source: ICAO Doc 4444, Chapter 7, 7.13 Suspension of visual flight rules operations	X	X	X	X	X	X	X						
(04)		Explain the term ‘RWY-in-use’ and its selection. Source: ICAO Doc 4444, Chapter 7, 7.2 Selection of runway-in- use	X	X	X	X	X	X							
(05)		List the information the TWR should give to an aircraft prior to: — taxiing for take-off; — take-off; — entering the traffic circuit. Source: ICAO Doc 4444, Chapter 7, 7.4.1.2 Aerodrome and meteorological information	X	X	X	X	X	X							
(06)		Explain that a report of surface wind direction given to a pilot by the TWR is magnetic. Source: ICAO Doc 4444, Chapter 11, 11.4.3.2 Messages containing meteorological information	X	X	X	X	X	X							
(07)		Explain the exact meaning of the expression ‘RWY vacated’. Source: ICAO Doc 4444, Chapter 7, 7.10.3.4	X	X	X	X	X	X							

010 07 02 17		Radar services													
(01)		State the basic identification procedures used with radar. Source: ICAO Doc 4444, Chapter 8, 8.6.2.3 SSR and/or MLAT identification procedures and Chapter 8, 8.6.2.4 PSR identification procedures	X	X	X	X	X	X	X						
(02)		Define the term 'PSR'. Source: ICAO Doc 4444, Chapter 1 Definitions	X	X	X	X	X	X	X						
(03)		Describe the circumstances under which an aircraft provided with radar service should be informed of its position. Source: ICAO Doc 4444, Chapter 8, 8.6.4 Position information	X	X	X	X	X	X	X						
(04)		List the possible forms of position information passed on to the aircraft by radar services. Source: ICAO Doc 4444, Chapter 8, 8.6.4 Position information	X	X	X	X	X	X	X						
(05)		Describe the term 'radar vectoring'. Source: ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring	X	X	X	X	X	X	X						
(06)		State the aims of radar vectoring as shown in ICAO Doc 4444.	X	X	X	X	X	X	X						

		Source: ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring													
(07)		Describe how radar vectoring shall be achieved. Source: ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring	X	X	X	X	X	X	X						
(08)		Describe the information which shall be given to an aircraft when radar vectoring is terminated and the pilot is instructed to resume own navigation. Source: ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring	X	X	X	X	X	X	X						
(09)		Explain the procedures for the conduct of surveillance radar approaches (SRAs). Source: ICAO Doc 4444, Chapter 8, 8.9.7.1 Surveillance radar approach	X	X	X	X	X	X	X						
(10)		Describe what kind of action (concerning the transponder) the pilot is expected to perform in case of emergency if they have previously been directed by ATC to operate the transponder on a specific code. Source: ICAO Doc 4444, Chapter 8, 8.8.1 Emergencies	X	X	X	X	X	X	X						
010 07 02 18		Air traffic advisory service													

(01)		Describe the objective and basic principles of the air traffic advisory service. Source: ICAO Doc 4444, Chapter 9, 9.1.4.1 Objective and basic principles	X	X	X	X	X	X							
(02)		State to which aircraft air traffic advisory service may be provided. Source: ICAO Doc 4444, Chapter 9, 9.1.4.1 Objective and basic principles	X	X	X	X	X	X							
(03)		Explain the difference between advisory information and clearances, stating which ATS units are responsible for their issue. Source: ICAO Doc 4444, Chapter 9, 9.1.4.1.3	X	X	X	X	X	X							
010 07 02 19		Procedures related to emergencies, communication (COM) failure and contingencies													
(01)		State the mode and code of SSR equipment a pilot might operate in a (general) state of emergency or (specifically) in case the aircraft is subject to unlawful interference. Source: ICAO Doc 4444, Chapter 15, 15.1 Emergency procedures	X	X	X	X	X	X	X						

(02)		State the special rights an aircraft in a state of emergency can expect from ATC. Source: ICAO Doc 4444, Chapter 15, 15.1.1 General; 15.1.2 Priority; 15.1.3 Unlawful interference and aircraft bomb threat	X	X	X	X	X	X	X						
(03)		Describe the expected action of aircraft after receiving a broadcast from ATS concerning the emergency descent of an aircraft. Source: ICAO Doc 4444, Chapter 15, 15.1.4 Emergency descent	X	X	X	X	X	X	X						
(04)		State how it can be ascertained, in case of a failure of two-way COM, whether the aircraft is able to receive transmissions from the ATS unit. Source: ICAO Doc 4444, Chapter 15, 15.3 Air-ground communications failure	X	X	X	X	X	X	X						
(05)		State on which frequencies appropriate information, for an aircraft encountering two-way COM failure, shall be sent by ATS. Source: ICAO Doc 4444, Chapter 15, 15.3.5	X	X	X	X	X	X	X						
(06)		State what is meant by the expressions 'strayed aircraft' and 'unidentified aircraft'. Source: ICAO Doc 4444, Chapter 15, 15.5.1 Strayed or unidentified aircraft	X	X	X	X	X	X	X						

(07)		Explain the reasons for fuel-dumping and state the minimum level. Source: ICAO Doc 4444, Chapter 15, 15.5.3 Fuel dumping	X	X	X	X	X	X							
(08)		Explain the possible request of ATC to an aircraft to change its radio-telephone (RTF) call sign.	X	X	X	X	X	X							
010 07 02 20		Miscellaneous procedures													
(01)		Explain the meaning of ‘AIRPROX’. Source: ICAO Doc 4444, Chapter 1 Definitions; ICAO Doc 4444, Chapter 16, 16.3 Air traffic incident report	X	X	X	X	X	X							
(02)		Describe the task of an air traffic incident report. Source: ICAO Doc 4444, Chapter 16, 16.3 Air traffic incident report	X	X	X	X	X	X							
010 08 00 00		AERONAUTICAL INFORMATION SERVICE (AIS)													
010 08 01 00		Introduction													
010 08 01 01		Introduction to ICAO Annex 15 — Aeronautical Information Service (AIS)													
(01)		State, in general terms, the objective of an AIS. Source: ICAO Annex 15, Chapter 1, Note 1	X	X	X	X	X	X							
010 08 02 00		Definitions of ICAO Annex 15													
010 08 02 01		Definitions of ICAO Annex 15													

(01)		Recall the following definitions: aeronautical information circular (AIC), aeronautical information publication (AIP), AIP amendment, AIP supplement, aeronautical information regulation and control (AIRAC), danger area, aeronautical information management, international airport, international NOTAM office (NOF), manoeuvring area, movement area, NOTAM, pre-flight information bulletin (PIB), prohibited area, restricted area, SNOWTAM, ASHTAM. Source: ICAO Annex 15, Chapter 1, 1.1 Definitions	X	X	X	X	X	X	X						
010 08 03 00		General													
010 08 03 01		General — AIS responsibilities and functions													
(01)		State during which period of time an AIS shall be available with reference to an aircraft flying in the area of responsibility of an AIS, provided a 24-hour service is not available. Source: ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions	X	X	X	X	X	X							
(02)		List, in general, the kind of aeronautical information/data which an AIS service shall make available in a suitable form to flight crew. Source: ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions	X	X	X	X	X	X							

(03)		Summarise the duties of an AIS concerning aeronautical information data for the territory of a particular State. Source: ICAO Annex 15, Chapter 2, 2.2 AIS responsibilities and functions; ICAO Annex 15, Chapter 2, 2.3 Exchange of aeronautical data and aeronautical information	X	X	X	X	X	X							
010 08 04 00		Aeronautical information products and services													
010 08 04 01		Aeronautical information publication (AIP)													
(01)		State the primary purpose of the AIP. Source: ICAO Annex 15, Chapter 5, 5.2.2, Notes 1 and 2	X	X	X	X	X	X							
(02)		Name the different parts of the AIP. Source: ICAO Annex 15, Chapter 5, 5.2.1, Note 1; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.1.2.5	X	X	X	X	X	X							

(03)		State the main parts of the AIP where the following information can be found: — differences from the ICAO Standards, Recommended Practices and Procedures; — location indicators, AIS, minimum flight ALT, meteorological information for aircraft in flight (VOLMET) service, SIGMET service; — general rules and procedures (especially general rules, VFR, IFR, ALT-setting procedure, interception of civil aircraft, unlawful interference, air traffic incidents); — ATS airspace (especially FIR, UIR, TMA); — ATS routes (especially lower ATS routes, upper ATS routes, area navigation routes); — AD data including aprons, taxiways (TWYs) and check locations/positions data; — navigation warnings (especially prohibited, restricted and danger areas); — aircraft instruments, equipment and flight documents; — AD surface movement guidance and control system and markings; — RWY physical characteristics, declared distances, approach (APP) and RWY lighting; — AD radio navigation and landing aids; — charts related to an AD; — entry, transit and departure of aircraft, passengers, crew and cargo, and the significance	X	X	X	X	X	X	X						

		of this information to flight crew. Source: ICAO Annex 15, Chapter 5, 5.2.1, Note 1; PANS-AIM (ICAO Doc 10066), Appendix 2													

(04)		State how permanent changes to the AIP shall be published. Source: ICAO Annex 15, Chapter 5, 5.4 Distribution services and Chapter 6, 6.3.1 AIP updates, 6.3.1.2; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.1 Aeronautical Information Publication (AIP), 5.2.1.3, 5.4 Distribution services, Chapter 6, 6.1.2 Specifications for AIP amendments	X	X	X	X	X	X							
(05)		Explain what kind of information shall be published in the form of AIP Supplements. Source: ICAO Annex 15, Chapter 6, 6.3.1 AIP updates, 6.3.1.3; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.1.4 Specifications for AIP Supplements	X	X	X	X	X	X							
010 08 04 02		Notices to airmen (NOTAMs)													
(01)		Describe how information shall be published which in principle would belong to NOTAMs but includes extensive text or graphics. Source: ICAO Annex 15, Chapter 6, 6.3.1.3, 6.3.2.1 and 6.3.2.2	X	X	X	X	X	X	X						
(02)		Summarise the essential information which leads to the issue of a NOTAM. Source: ICAO Annex 15, Chapter 6, 6.3.2.3	X	X	X	X	X	X	X						

(03)		State how NOTAMs shall be distributed. Source: ICAO Annex 15, Chapter 5.4.2	X	X	X	X	X	X							
(04)		Explain how information regarding snow, ice and standing water on AD pavements shall be reported. Source: ICAO Annex 15, Chapter 5, 5.2.6 Note; PANS-AIM (ICAO Doc 10066), Appendix 4 Instructions for the completion of the SNOWTAM format	X	X	X	X	X	X	X						
(05)		Describe the means by which NOTAMs shall be distributed. Source: ICAO Annex 15, Chapter 5, 5.4 Distribution services; PANS- AIM (ICAO Doc 10066), 5.2.5 NOTAM, 5.2.5.1.3, and Appendix 7	X	X	X	X	X	X							
(06)		Define and state which information an ASHTAM may contain. Source: ICAO Annex 15, Chapter 5, 5.2.6 Note; PANS-AIM (ICAO Doc 10066), Appendix 5 ASHTAM format	X	X	X	X	X	X							
010 08 04 03		Aeronautical information regulation and control (AIRAC)													
(01)	X	List the circumstances under which the information concerned shall or should be distributed as an AIRAC. Source: ICAO Annex 15, Chapter 6, 6.2	X	X	X	X	X	X	X						

010 08 04 04		Aeronautical information circulars (AICs)													
(01)	X	Describe the type of information that may be published in AICs. Source: ICAO Annex 15, Chapter 5, 5.2.4 Aeronautical Information Circulars; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.2 Aeronautical Information Circulars (AIC)	X	X	X	X	X	X							
(02)		Explain the organisation of AICs. Source: ICAO Annex 15, Chapter 5, 5.2.4, Note; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.2 Aeronautical Information Circulars (AIC), 5.2.2.3 to 5.2.2.9	X	X	X	X	X	X							
010 08 04 05		Pre-flight and post-flight information/data													
(01)		Summarise, in addition to the elements of the integrated AIP and maps/charts, the additional current information relating to the AD of departure that shall be provided as pre-flight information. Source: ICAO Annex 15, Chapter 5, 5.5 Pre-flight information service; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.5 Pre-flight information services	X	X	X	X	X	X							
(02)		Describe how a recapitulation of current NOTAM and other information of urgent character shall be made available to flight crew. Source:	X	X	X	X	X	X	X						

		ICAO Annex 15, Chapter 5, 5.5 Pre-flight information service, Note 2													
(03)		State which post-flight information from flight crew shall be submitted to AIS for distribution as required by the circumstances. Source: ICAO Annex 15, Chapter 5, 5.6 Post-flight information service	X	X	X	X	X	X							
010 08 05 00		ATM service providers													
010 08 05 01		ATM													
(01)		State that Thai regulation on ATM/ANS provides: — general requirements for the provision of air navigation services; — specific requirements for the provision of air traffic services; — specific requirements for the provision of meteorological services; — specific requirements for the provision of aeronautical information services; — specific requirements for the provision of communication, navigation or surveillance services.	X		X	X									
010 09 00 00		AERODROMES (ICAO Annex 14, Volume I — Aerodrome Design and Operations, Aerodrome regulation)													

010 09 01 00		General													
010 09 01 01		General — AD reference code													
(01)		Describe the intent of the AD reference code and state the functions of the two code elements. Source: ICAO Annex 14, Volume 1, Chapter 1, 1.6 Reference Code	X	X											
010 09 02 00		Aerodrome (AD) data													
010 09 02 01		Aerodrome (AD) reference point													
(01)		Describe where the AD reference point shall be located and where it shall normally remain. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.2 Aerodrome reference point	X	X	X	X	X	X	X						
010 09 02 02		Pavement strengths													
(01)		Explain the terms: 'pavement classification number (PCN)' and 'aircraft classification number (ACN)', and describe their mutual dependence. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.6 Strength of pavements	X	X	X	X	X	X							
(02)		Describe how the bearing strength for an aircraft with an apron mass equal to or less than 5 700 kg shall be reported. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.6 Strength of pavements	X	X	X	X	X	X							

010 09 02 03		Declared distances													
(01)		State that ICAO Annex 14 provides guidance on the calculation of declared distances (TORA, TODA, ASDA, LDA).	X	X	X	X	X	X							
(02)		Recall the definitions for the four main declared distances. Source: ICAO Annex 14, Volume 1, Chapter 1, 1.1 Definitions	X	X	X	X	X	X							
010 09 02 04		Condition of the movement area and related facilities													
(01)		State the purpose of informing AIS and ATS units about the condition of the movement area and related facilities. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities	X	X	X	X	X	X							
(02)		List the matters of operational significance or affecting aircraft performance which should be reported to AIS and ATS units to be transmitted to aircraft involved. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities	X	X	X	X	X	X							

(03)		Describe the three different types of water deposit on RWYs. Source: ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities	X	X	X	X	X	X							
(04)		Explain the different types of frozen water on the RWY and their impact on aircraft braking performance. Source: ICAO Annex 14, Volume 1, Chapter 1, 1.1 Definitions and Chapter 2, 2.9 Condition of the movement area and related facilities	X	X	X	X	X	X							
(05)		Describe the five levels of braking action including the associated coefficients and codes. Source: ICAO Annex 14, Volume 1, Attachment A, 6. Assessing the surface friction characteristics of snow-, slush-, ice- and frost-covered paved surfaces	X	X	X	X	X									
010 09 03 00		Physical characteristics													
010 09 03 01		Runways (RWYs)													
(01)		Describe where a THR should normally be located. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.1.5 and 3.1.6 Location of threshold	X	X	X	X	X	X							

(02)		Describe the general considerations concerning RWYs associated with a stopway (SWY) or clearway (CWY). Source: ICAO Annex 14, Volume 1, Chapter 3, 3.1.9 Runways with stopways or clearways	X	X	X	X	X	X	X						
010 09 03 02		Runway (RWY) strips													
(01)		Explain the term 'runway strip'. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.4 General, 3.4.1	X	X	X	X	X	X	X						
010 09 03 03		Runway-end safety area													
(01)		Explain the term 'runway-end safety area'. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.5 Runway end safety area 3.5.1 and 3.5.2	X	X	X	X	X	X	X						
010 09 03 04		Clearway (CWY)													
(01)		Explain the term 'clearway'. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.6 Clearways	X	X	X	X	X	X	X						
010 09 03 05		Stopway (SWY)													
(01)		Explain the term 'stopway'. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.7 Stopways	X	X	X	X	X	X	X						
010 09 03 06		Intentionally left blank													

010 09 03 07		Taxiways (TWYs)													
(01)		Describe the reasons and the requirements for rapid-exit TWYs. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.9 Taxiways — Rapid-exit taxiways	X	X	X	X	X	X							
(02)		Explain TWY widening in curves. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.9.5 Taxiways curves	X	X	X	X	X	X							
(03)		Explain when and where holding bays should be provided. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.12	X	X	X	X	X	X							
(04)		Describe where RWY holding positions shall be established. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.12	X	X	X	X	X	X	X						
(05)		Describe the term 'road holding position'. Source: ICAO Annex 14, Volume 1, Chapter 1, 1.1 and Chapter 3, 3.12	X	X	X	X	X	X							
(06)		Describe where intermediate TWY holding positions should be established. Source: ICAO Annex 14, Volume 1, Chapter 3, 3.12	X	X	X	X	X	X							
010 09 04 00		Visual aids for navigation													

010 09 04 01		Indicators and signalling devices													
(01)		Describe the wind-direction indicators with which ADs shall be equipped. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.1.1 Wind direction indicator (Application, Location and Characteristics)	X	X	X	X	X	X	X						
(02)		Describe a landing-direction indicator. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.1.2 Landing direction indicator	X	X	X	X	X	X							
(03)		Explain the capabilities of a signalling lamp.	X	X	X	X	X	X	X						
(04)	X	State which characteristics a signal area should have. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.1.4 Signal panels and signal area, 5.1.4.1 to 5.1.4.3	X	X	X	X	X	X	X						
(05)	X	Interpret all indications and signals that may be used in a signal area. Source: RCAB N° 94, Signals, Visual ground signals	X	X	X	X	X	X	X						
010 09 04 02		Markings													
(01)		Name the colours used for the various markings (RWY, TWY, aircraft stands, apron safety lines). Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings	X	X	X	X	X	X	X						

(02)		State where a RWY designation marking shall be provided and describe the different layouts (excluding dimensions). Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings	X	X	X	X	X	X	X						
(03)		Describe the application and general characteristics (excluding dimensions) of: — RWY-centre-line markings; — THR markings; — touchdown-zone (TDZ) markings; — RWY-side-stripe markings; — TWY-centre-line markings; — RWY holding position markings; — intermediate holding position markings; — aircraft-stand markings; — apron safety lines; — road holding position markings; — mandatory instruction markings; — information markings. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings	X	X	X	X	X	X	X						
010 09 04 03		Lights													

(01)		Describe the mechanical safety considerations regarding elevated approach lights and elevated RWY, SWY and TWY lights. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.1.4 to 5.3.1.8 (Elevated approach lights, elevated lights and surface lights)	X	X	X	X	X	X	X						
(02)		List the conditions for the installation of an aerodrome beacon (ABN) and describe its general characteristics. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.3 Aeronautical beacons	X	X	X	X	X	X	X						
(03)		Describe the different kinds of operations for which a simple approach lighting system shall be used. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.4 Approach lighting systems	X	X	X	X	X	X	X						
(04)		Describe the basic installations of a simple approach lighting system including the dimensions and distances normally used. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.2	X	X	X	X	X	X	X						

(05)		Describe the principle of a precision approach category I lighting system including information such as location and characteristics. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.10; ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.14	X	X	X	X	X	X	X						
(06)		Describe the principle of a precision approach category II and III lighting system including information such as location and characteristics, especially the inner 300 m of the system. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.22; ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.30; ICAO Annex 14, Volume 1, Chapter 5, 5.3.4.31	X					X	X						
(07)		Describe the wing bars of the precision approach path indicator (PAPI) and the abbreviated precision approach path indicator (APAPI). Interpret what the pilot will see during the approach using PAPI. Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.5.24 to 5.3.5.27 PAPI and APAPI	X	X	X	X	X	X	X						
(08)		Interpret what the pilot will see during an approach using a helicopter approach path indicator (HAPI). Source: ICAO Annex 14, Volume II, Chapter 5, 5.3.6 Visual approach slope indicator			X	X	X								

(09)		Explain the application and characteristics (as applicable, but limited to colour, intensity, direction and whether fixed or flashing) of: — RWY-edge lights; — RWY-THR and wing-bar lights; — RWY-end lights; — RWY-centre-line lights; — RWY-lead-in lights; — RWY-TDZ lights; — SWY lights; — TWY-centre-line lights; — TWY-edge lights; — stop bars; — intermediate holding position lights; — RWY guard lights; — road holding position lights. Source: ICAO Annex 14, Volume 1, Chapter 5	X	X	X	X	X	X	X						
(10)		State the timescale within which aeronautical ground lights shall be made available to arriving aircraft. Source: ICAO Doc 4444, Section 7.15 Aeronautical ground lights	X	X	X	X	X	X	X						
010 09 04 04		Signs													

(01)		Explain which signs are the only ones on the movement area utilising red. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(02)		List the provisions for illuminating signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(03)		Name the kinds of signs which shall be included in mandatory instruction signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(04)		Name the colours used for mandatory instruction signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(05)		Describe by which sign a pattern 'A' RWY holding position (i.e. at an intersection of a TWY and a non-instrument, non- precision approach or take-off RWY) marking shall be supplemented. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(06)		Describe by which sign a pattern 'B' RWY holding position (i.e. at an intersection of a TWY and a precision approach RWY) marking shall be supplemented. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						

(07)		Describe the location of: — a RWY designation sign at a TWY/RWY intersection; — a 'NO ENTRY' sign; — a RWY holding position sign. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(08)		State which sign indicates that a taxiing aircraft is about to infringe an obstacle limitation surface or interfere with the operation of radio navigation aids (e.g. ILS/MLS critical/sensitive area). Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(09)		Describe the various possible inscriptions on RWY designation signs and on holding position signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(10)		Describe the colours used in connection with information signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(11)		Describe the possible inscriptions on information signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						

(12)		Explain the application, location and characteristics of aircraft stand identification signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
(13)		Explain the application, location and characteristics of road holding position signs. Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs	X	X	X	X	X	X	X						
010 09 04 05		Markers													
(01)		Explain why markers located near a RWY or TWY shall be HGT limited. Source: ICAO Annex 14, Volume 1, Chapter 5.5 Markers	X	X	X	X	X	X	X						
(02)		Explain the application and characteristics (excluding dimensions) of: — unpaved RWY-edge markers; — TWY-edge markers; — TWY-centre-line markers; — unpaved TWY-edge markers; — boundary markers; — SWY-edge markers. Source: ICAO Annex 14, Volume 1, Chapter 5.5 Markers	X	X	X	X	X	X	X						
010 09 05 00		Visual aids for denoting obstacles													
010 09 05 01		Marking of objects													

(01)		State how fixed or mobile objects shall be marked if colouring is not practicable. Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.3.1 Marking	X	X	X	X	X	X							
(02)		Describe marking by colours (fixed or mobile objects). Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.2 Mobile objects: 6.2.2.1, 6.2.2.2; 6.2.2.3; 6.2.2.4; ICAO Annex 14, Volume 1, Chapter 6, 6.2.3 Fixed objects: 6.2.3.1; 6.2.3.2; 6.2.3.3	X	X	X	X	X	X							
(03)		Explain the use of markers for the marking of objects, overhead wires, cables, etc. Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.5 Overhead wires, cables, etc., and supporting towers	X	X	X	X	X	X							
(04)		Explain the use of flags for the marking of objects. Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.3 Fixed objects: 6.2.3.5; 6.2.3.6; 6.2.3.7	X	X	X	X	X	X							
010 09 05 02		Lighting of objects													

(01)		Name the different types of lights to indicate the presence of objects which must be lighted. Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2 Marking and/or lighting of objects: 6.2.1.1	X	X	X	X	X	X							
(02)		Describe (in general terms) the location of obstacle lights. Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2 Marking and/or lighting of objects: 6.2.1.3	X	X	X	X	X	X							
(03)		Describe (in general and for normal circumstances) the colour and sequence of low-intensity obstacle lights, medium- intensity obstacle lights and high-intensity obstacle lights. Source: ICAO Annex 14, Volume 1, Chapter 6: Table 6-1. Characteristics of obstacle lights	X	X	X	X	X	X							
(04)		State that information about lights to be displayed by aircraft is provided in both ICAO Annex 2 (Rules of the Air) and RCAB N° 94.	X	X	X	X	X	X							
010 09 06 00		Visual aids for denoting restricted use of areas													
010 09 06 01		Visual aids for denoting restricted use of areas on RWYs and TWYs													

(01)		Describe the colours and meaning of 'closed markings' on RWYs and TWYs. Source: ICAO Annex 14, Volume 1, Chapter 7, 7.1 Closed runways and taxiways, or parts thereof	X	X	X	X	X	X							
(02)		State how the pilot of an aircraft moving on the surface of a TWY, holding bay or apron shall be warned that the shoulders of these surfaces are 'non-load-bearing'. Source: ICAO Annex 14, Volume 1, Chapter 7, 7.2 Non-load- bearing surfaces	X	X	X	X	X	X							
(03)		Describe the pre-THR marking (including colours) when the surface before the THR is not suitable for normal use by aircraft. Source: ICAO Annex 14, Volume 1, Chapter 7, 7.3 Pre-threshold area	X	X	X	X	X	X							
010 09 07 00		Aerodrome (AD) operational services, equipment and installations													
010 09 07 01		Rescue and firefighting (RFF)													
(01)		State the principal objective of RFF services. Source: ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting	X	X	X	X	X	X							

(02)		Explain the basic information the AD category (for RFF) depends upon. Source: ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting	X	X	X	X	X	X							
(03)		Describe what is meant by the term ‘response time’, and state its normal and maximum limits. Source: ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting	X	X	X	X	X	X							
010 09 07 02		Apron management service													
(01)		State who has a right-of-way against vehicles operating on an apron. Source: ICAO Annex 14, Volume 1, Chapter 9, 9.5 Apron management service	X	X	X	X	X	X							
010 09 07 03		Ground-servicing of aircraft													
(01)		Describe the necessary actions during the ground-servicing of an aircraft with regard to the possible event of a fuel fire. Source: ICAO Annex 14, Volume 1, Chapter 9, 9.6 Ground servicing of aircraft	X	X	X	X	X	X							
010 09 08 00		Attachment A to ICAO Annex 14, Volume 1 — Supplementary Guidance Material													
010 09 08 01		Declared distances													

(01)		List the four types of ‘declared distances’ on a RWY and also the appropriate abbreviations. Source: ICAO Annex 14, Volume 1, Attachment A, 3.Calculation of declared distances: 3.1	X	X	X	X	X	X							
(02)		Explain the circumstances which lead to the situation that the four declared distances on a RWY are equal to the length of the RWY. Source: ICAO Annex 14, Volume 1, Attachment A, 3.Calculation of declared distances: 3.2	X	X	X	X	X	X							
(03)		Describe the influence of a CWY, SWY or displaced THR upon the four ‘declared distances’. Source: ICAO Annex 14, Volume 1, Attachment A, 3. Calculation of declared distances: 3.3; 3.4; 3.5	X	X	X	X	X	X							
010 09 08 02		Intentionally left blank													
010 09 08 03		Approach lighting systems													
(01)		Name the two main groups of approach lighting systems. Source: ICAO Annex 14, Volume 1, Attachment A, 12.1 Types and characteristics	X	X	X	X	X	X	X						
(02)		Describe the two different versions of a simple approach lighting system.	X	X	X	X	X	X	X						

(03)		Describe the two different basic versions of precision approach lighting systems for CAT I.	X	X	X	X	X	X	X						
(04)		Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III.	X												
(05)		Describe how the arrangement of an approach lighting system and the location of the appropriate THR are interrelated.	X	X	X	X	X	X	X						
010 10 00 00		FACILITATION (ICAO Annex 9)													
010 10 01 00		Intentionally left blank													
010 10 02 00		Entry and departure of aircraft													
010 10 02 01		General declaration													
(01)		Describe the purpose and use of aircraft documents as regards a 'general declaration'. Source: ICAO Annex 9, Chapter 2 Entry and departure of aircraft, Section B Documents — requirements and use and Section D Disinsection of aircraft	X	X	X	X	X								
010 10 02 02		Entry and departure of crew													
(01)		Explain entry requirements for crew. Source: ICAO Annex 9, Chapter 3, K. Entry procedures and responsibilities; N. Identification and entry of crew and other aircraft operators' personnel	X	X	X	X	X								

(02)		Explain the reasons for the use of crew member certificates (CMC) for crew members engaged in international air transport. Source: ICAO Annex 9, Chapter 3, N. Identification and entry of crew and other aircraft operators' personnel	X	X	X	X	X								
(03)		Explain in which cases Contracting States should accept the CMC as an identity document instead of a passport or visa. Source: ICAO Annex 9, Chapter 3, N. Identification and entry of crew and other aircraft operators' personnel	X	X	X	X	X								
010 10 02 03		Entry and departure of passengers and baggage													
(01)		Explain the entry requirements for passengers and their baggage. Source: ICAO Annex 9, Chapter 3 Entry and departure of persons and their baggage: General; Documents required for travel; F. Entry/re-entry visas; P. Emergency assistance/entry visas in cases of force majeure	X	X	X	X	X								

(02)		Explain the requirements and documentation for unaccompanied baggage. Source: ICAO Annex 9, Chapter 3, M. Disposition of baggage separated from its owner; ICAO Annex 9, Chapter 4, C. Release and clearance of export and import cargo	X	X	X	X	X								
(03)		Identify the documentation required for the departure and entry of passengers and their baggage. Source: ICAO Annex 9, Chapter 3. Entry and departure of persons and their baggage	X	X	X	X	X								
(04)		Explain the arrangements in the event of a passenger being declared an inadmissible person. Source: ICAO Annex 9, Chapter 5, INADMISSIBLE PERSONS AND DEPORTEES: A. General; B. Inadmissible persons	X	X	X	X	X								
(05)		Describe the pilot's authority towards unruly passengers. Source: ICAO Annex 9, Chapter 6, E. Unruly passengers	X	X	X	X	X								
010 10 02 04		Entry and departure of cargo													
(01)		Explain the entry requirements for cargo.	X	X	X	X	X								
010 11 00 00		SEARCH AND RESCUE (SAR)													
010 11 01 00		Essential SAR definitions													

010 11 01 01		Essential SAR definitions —— ICAO Annex 12												
(01)		Recall the definitions of the following terms: Alert phase, distress phase, emergency phase, operator, PIC, rescue coordination centre, State of Registry, uncertainty phase. Source: ICAO Annex 12, Chapter 1 Definitions	X	X	X	X	X								
010 11 02 00		SAR —— Organisation													
010 11 02 01		SAR —— Organisation —— Establishment and provision													
(01)		Describe how ICAO Contracting States shall arrange for the establishment and prompt provision of SAR services. Source: ICAO Annex 12, Chapter 2	X	X	X	X	X								
(02)		Explain the establishment of SAR by Contracting States. Source: ICAO Annex 12, Chapter 2	X	X	X	X	X								
(03)		Describe the areas within which SAR services shall be established by Contracting States. Source: ICAO Annex 12, Chapter 2	X	X	X	X	X								
(04)		State the period of time per day within which SAR services shall be available. Source: ICAO Annex 12, Chapter 2	X	X	X	X	X								

(05)		Describe for which areas rescue coordination centres shall be established. Source: ICAO Annex 12, Chapter 2	X	X	X	X	X								
010 11 03 00		Operating procedures for non-SAR crews													
010 11 03 01		Operating procedures for non-SAR crews — PIC													
(01)		Explain the SAR operating procedures for the PIC who arrives first at the scene of an accident. Source: ICAO Annex 12, Chapter 5, 5.6 Procedures at the scene of an accident	X	X	X	X	X								
(02)		Explain the SAR operating procedures for the PIC intercepting a distress transmission. Source: ICAO Annex 12, Chapter 5, 5.7 Procedures for a pilot-in-command intercepting a distress transmission	X	X	X	X	X								
010 11 04 00		Search and rescue signals													
010 11 04 01		Search and rescue signals — Survivors													
(01)		Explain the 'ground—air visual signal code' for use by survivors. Source: ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix	X	X	X	X	X								
(02)		Recognise the SAR 'air-to-ground signals' for use by survivors. Source:	X	X	X	X	X								

		ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix													
010 12 00 00		SECURITY — Safeguarding International Civil Aviation against Acts of Unlawful Interference (ICAO Annex 17)													
010 12 01 00		Essential definitions of ICAO Annex 17													
010 12 01 01		Essential definitions of ICAO Annex 17													
(01)		Recall the definitions of the following terms: Airside, aircraft security check, screening, security, security control, security-restricted area, unidentified baggage. Source: ICAO Annex 17, Chapter 1 Definitions	X	X	X	X	X								
010 12 02 00		General principles													
010 12 02 01		General principles — Objectives of security													
(01)		State the objectives of security. Source: ICAO Annex 17, Chapter 2, 2.1 Objectives	X	X	X	X	X								
010 12 03 00		Intentionally left blank													
010 12 04 00		Preventive security measures													
010 12 04 01		Preventive security measures													

(01)		Describe the objects not allowed (for reasons of aviation security) on board an aircraft that is engaged in international civil aviation. Source: ICAO Annex 17, Chapter 4, 4.1 Objective	X	X	X	X	X								
(02)		State what each Contracting State is supposed to do if passengers subjected to security control have mixed after a security screening point. Source: ICAO Annex 17, Chapter 4, 4.4 Measures relating to passengers and their cabin baggage	X	X	X	X	X								
(03)		Explain what has to be done when passengers who are obliged to travel because of judicial or administrative proceedings are supposed to board an aircraft. Source: ICAO Annex 17, Chapter 4, 4.7 Measures relating to special categories of passengers	X	X	X	X	X								
(04)		Explain what has to be considered if law enforcement officers carry weapons on board. Source: ICAO Annex 17, Chapter 4, 4.7 Measures relating to special categories of passengers	X	X	X	X	X								
010 12 05 00		Management of response to acts of unlawful interference													
010 12 05 01		Management of response to acts of unlawful interference													

(01)		Describe the assistance each Contracting State shall provide to an aircraft subjected to an act of unlawful seizure. Source: ICAO Annex 17, Chapter 5, 5.2 Response	X	X	X	X	X								
(02)		State the circumstances which could prevent a Contracting State from detaining an aircraft on the ground after being subjected to an act of unlawful seizure. Source: ICAO Annex 17, Chapter 5, 5.2 Response	X	X	X	X	X								
010 12 06 00		Operators’ security programme													
010 12 06 01		Operators’ security programme — Principles													
(01)		Describe the principles of the written operator’s security programme each Contracting State requires from operators. Source: ICAO Annex 17, Chapter 3, 3.3 Aircraft operators	X	X	X	X	X								
010 12 07 00		Security procedures in other documents, i.e. ICAO Annexes 2, 6 and 14, ICAO Doc 4444, TCAR OPS regulation and certification specification for design of aerodromes													
010 12 07 01		ICAO Annex 2 — Rules of the Air, including Attachment B — Unlawful interference													

(01)		Describe what the PIC should do, in a situation of unlawful interference, unless considerations aboard the aircraft dictate otherwise. Source: ICAO Annex 2, Chapter 3, 3.7 Unlawful interference	X	X	X	X	X								
(02)		Describe what the PIC, of an aircraft subjected to unlawful interference, should do if: The aircraft must depart from its assigned track; the aircraft must depart from its assigned cruising level; the aircraft is unable to notify an ATS unit of the unlawful interference. Source: ICAO Annex 2, Attachment B 'Unlawful interference'	X	X	X	X	X								
(03)		Describe what the PIC should attempt to do with regard to broadcast warnings and the level at which to proceed, in a situation of unlawful interference, if no applicable regional procedures for in-flight contingencies have been established. Source: ICAO Annex 2, Attachment B 'Unlawful interference'	X	X	X	X	X								
010 12 07 02		ICAO Annex 6 — Operation of Aircraft Chapter 13 — Security													

(01)		Describe the special considerations referring to flight crew compartment doors with regard to aviation security. Source: ICAO Annex 6, Part I — International Commercial Air Transport — Aeroplanes, Chapter 13, 13.2 Security of the flight crew compartment	X	X	X	X	X								
010 12 07 03		ICAO Annex 14 Volume I — Aerodromes Chapter 3 — Physical characteristics													
(01)		Describe what minimum distance an isolated aircraft parking position (after the aircraft has been subjected to unlawful interference) should have from other parking positions, buildings or public areas. Source: ICAO Annex 14 Volume I, Chapter 3, 3.14 Isolated aircraft parking position	X	X	X	X	X								
010 12 07 04		ICAO Doc 4444 — Air Traffic Management													
(01)		Describe the considerations that must take place with regard to a taxi clearance in case an aircraft is known or believed to have been subjected to unlawful interference. Source: ICAO Doc 4444, Chapter 15, 15.1.3 Unlawful interference and aircraft bomb threat	X	X	X	X	X								
010 13 00 00		AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION													
010 13 01 00		Essential definitions of ICAO Annex 13													

010 13 01 01		Definitions and descriptions													
(01)		Recall the definitions of the following terms: Accident, aircraft, flight recorder, incident, investigation, maximum mass, operator, serious incident, serious injury, State of Design, State of Manufacture, State of Occurrence, State of the Operator, State of Registry. Source: ICAO Annex 13, Chapter 1 Definitions	X	X	X	X	X								
(02)		Explain the difference between ‘serious incident’ and ‘accident’. Source: ICAO Annex 13, Chapter 1 Definitions and Attachment C ‘List of examples of serious incidents’	X	X	X	X	X								
(03)		Determine whether a certain occurrence has to be defined as a serious incident or as an accident. Source: ICAO Annex 13, Chapter 1 Definitions and Attachment C ‘List of examples of serious incidents’	X	X	X	X	X								
(04)		Recognise the description of an accident or incident. Source: ICAO Annex 13, Chapter 1 Definitions	X	X	X	X	X								
010 13 02 00		Accident and incident investigation in ICAO Annex 13													
010 13 02 01		Objectives and procedures													

(01)		State the objective(s) of the investigation of an accident or incident according to ICAO Annex 13. Source: ICAO Annex 13, Chapter 3, 3.1 Objective of the investigation	X	X	X	X	X								
(02)		Describe the general procedures for the investigation of an accident or incident according to ICAO Annex 13. Source: ICAO Annex 13, Chapter 4, 4.1; ICAO Annex 13, Chapter 5, 5.1 to 5.4.1	X	X	X	X	X								
010 13 03 00		Accident and incident investigation in Thai regulations													
010 13 03 01		Occurrences													
(01)		Identify an occurrence as being either an accident, incident or serious incident in RCAB 22 on the investigation and prevention of accidents and incidents in civil aviation. Source: RCAB 22 — list of examples of serious incidents & accidents	X	X	X	X	X								
(02)		Describe the relationship between RCAB 22 on the reporting, analysis and follow-up of occurrences in civil aviation and Thai Air Navigation Act § 7 or regulation about aircraft accident incident and accident investigation . Source: RCAB 22 and Thai Air Navigation Act § 7	X	X	X	X	X								

(03)		State the subject matter and scope of RCAB 22. Source: RCAB 22, Scope	X	X	X	X	X								
(04)		Identify occurrences that must be reported (RCAB 22). Source: RCAB 22, Appendix A	X	X	X	X	X								
(05)		Identify occurrences that should be voluntarily reported (RCAB 22). Source: RCAB 22, chapter 2	X	X	X	X	X								
(06)		Describe how information from occurrences is collected, stored and analysed (RCAB 22). Source: RCAB 22, chapter 4 & 5	X	X	X	X	X								
020 00 00 00		AIRCRAFT GENERAL KNOWLEDGE													
021 00 00 00		AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME, SYSTEMS AND POWER PLANT													
021 01 00 00		SYSTEM DESIGN, LOADS, STRESSES, MAINTENANCE													
021 01 01 00		System design													
021 01 01 01		Design concepts													
(01)	X	Describe the following structural design philosophy: — safe life; — fail-safe (multiple load paths); — damage-tolerant.	X	X	X	X	X								

(02)		Explain the purpose of redundancy in aircraft design.	X	X	X	X	X								
021 01 01 02		Level of certification													
(01)	X	Explain why some systems are duplicated or triplicated	X	X	X	X	X								
(02)	X	Explain that all aircraft are certified according to specifications determined by the CAAT, and that these certification specifications cover aspects such as design, material quality and build quality.	X	X	X	X	X								
(03)	X	State that the certification specifications for aeroplanes issued by EASA are: — CS-23 for Normal, Utility, Aerobatic and Commuter Aeroplanes; — CS-25 for Large Aeroplanes	X	X											
(04)	X	State that the certification specifications for rotorcraft issued by EASA are: — CS-27 for Small Rotorcraft; — CS-29 for Large Rotorcraft.			X	X	X								
021 01 02 00		Loads and stresses													
021 01 02 01		Stress, strain and loads													
(01)		Explain how stress and strain are always present in an aircraft structure both when parked and during manoeuvring. Remark: Stress is the internal force per unit area inside a structural part as a result of external loads. Strain is the deformation caused by the action of stress on a material.	X	X	X	X	X								

(02)		Describe the following types of loads that an aircraft may be subjected to, when they occur, and how a pilot may affect their magnitude: — static loads; — dynamic loads; — cyclic loads.	X	X	X	X	X								
(03)		Describe the areas typically prone to stress that should be given particular attention during a pre-flight inspection, and highlight the limited visual cues of any deformation that may be evident.	X	X	X	X	X								
021 01 03 00		Fatigue and corrosion													
021 01 03 01		Describe and explain fatigue and corrosion													
(01)		Describe the effects of corrosion and how it can be visually identified by a pilot during the pre-flight inspection.	X	X	X	X	X								
(02)		Describe the operating environments where the risk of corrosion is increased and how to minimise the effects of the environmental factors.	X	X	X	X	X								
(03)		Explain that aircraft have highly corrosive fluids on board as part of their systems and equipment.	X	X	X	X	X								

(04)		Explain fatigue, how it affects the useful life of an aircraft, and the effect of the following factors on the development of fatigue: — corrosion; — number of cycles; — type of flight manoeuvres; — stress level; — level and quality of maintenance.	X	X	X	X	X								
021 01 04 00		Intentionally left blank													
021 01 05 00		Maintenance													
021 01 05 01		Maintenance methods: hard-time and on-condition monitoring													
(01)		Explain the following terms: — hard-time or fixed-time maintenance; — on-condition maintenance; — condition monitoring.	X	X	X	X	X								
021 02 00 00		AIRFRAME													
021 02 01 00		Attachment methods													
021 02 01 01		Attachment methods and detecting the development of faulty attachments													

(01)		Describe the following attachment methods used for aircraft parts and components: — riveting; — welding; — bolting; — pinning; — adhesives (bonding); — screwing.	X	X	X	X	X								
(02)		Explain how the development of a faulty attachment between aircraft parts or components can be detected by a pilot during the pre-flight inspection.	X	X	X	X	X								
021 02 02 00		Materials													
021 02 02 01		Composite and other materials													
(01)	X	Explain the principle of a composite material, and give examples of typical non-metallic materials used on aircraft: — carbon; — glass; — Kevlar aramid; — resin or filler.	X	X	X	X	X								

(02)	X	State the advantages and disadvantages of composite materials compared with metal alloys by considering the following: — strength-to-weight ratio; — capability to tailor the strength to the direction of the load; — stiffness; — electrical conductivity (lightning); — resistance to fatigue and corrosion; — resistance to cost; — discovering damage during a pre-flight inspection.	X	X	X	X	X								
(03)		State that several types of materials are used on aircraft and that they are chosen based on type of structure or component and the required/desired material properties.	X	X	X	X	X								
021 02 03 00		Aeroplane: wings, tail surfaces and control surfaces													
021 02 03 01		Design													
(01)		Describe the following types of design and explain their advantages and disadvantages: — high-mounted wing; — low-mounted wing; — low- or mid-set tailplane; — T-tail.	X	X											
021 02 03 02		Structural components													

(01)		Describe the function of the following structural components: — spar and its components (web and girder or cap); — rib; — stringer; — skin; — torsion box.	X	X											
021 02 03 03		Loads, stresses and aeroelastic vibrations (flutter)													
(01)		Describe the vertical and horizontal loads on the ground and during normal flight.	X	X											
(02)		Describe the vertical and horizontal loads during asymmetric flight following an engine failure for a multi-engine aeroplane, and how a pilot may potentially overstress the structure during the failure scenario.	X	X											
(03)		Explain the principle of flutter and resonance for the wing and control surfaces.	X	X											
(04)		Explain the following countermeasures used to achieve stress relief and reduce resonance: — chord-wise and span-wise position of masses (e.g. engines, fuel, balance masses for wing and control balance masses); — torsional stiffness; — bending flexibility; — fuel-balancing procedures during flight (automatic or applied by the pilot).	X	X											

021 02 04 00		Fuselage, landing gear, doors, floor, windscreen and windows													
021 02 04 01		Construction, functions, loads													
(01)	X	Describe the following types of fuselage construction: — monocoque, Semi-monocoque.	X	X	X	X	X								
(01)		Describe the construction and the function of the following structural components of a fuselage: — frames; — bulkhead; — pressure bulkhead; — stiffeners, stringers, longerons; — skin, doublers; — floor suspension (crossbeams); — floor panels; — firewall.	X	X	X	X	X								
(03)		Describe the loads on the fuselage due to pressurisation.	X	X											
(04)		Describe the following loads on a main landing gear: — touch-down loads (vertical and horizontal); — taxi loads on bogie gear (turns).	X	X											
(05)		Describe the structural danger of a nose-wheel landing with respect to:	X	X											

		— fuselage loads; — nose-wheel strut loads.													
(06)		Describe the structural danger of a tail strike with respect to: — fuselage and aft bulkhead damage (pressurisation).	X	X											
(07)		Describe the door and hatch construction for pressurised and unpressurised aeroplanes including: — door and frame (plug type); — hinge location; — locking mechanism.	X	X											
(08)	X	Explain the advantages and disadvantages of the following fuselage cross sections: — circular; — double bubble; — oval; — rectangular.	X	X											
(09)		Explain why flight-deck windows are constructed with different layers.	X	X											
(10)		Explain the function of window heating for structural purposes.	X	X											
(11)		Explain the implication of a direct-vision window (see CS 25.773(b)(3)).	X	X											
(12)		Explain the need for an eye-reference position.	X	X											

(13)		Explain the function of floor venting (blow-out panels).	X	X											
(14)		Describe the construction and fitting of sliding doors.			X	X	X								
021 02 05 00		Helicopter: structural aspects of flight controls													
021 02 05 01		Design and construction													
(01)		List the functions of flight controls.			X	X	X								
(02)		Explain why vertical and horizontal stabilisers may have different shapes and alignments.			X	X	X								
021 02 05 02		Structural components and materials													
(01)		Describe the fatigue life and methods of checking for serviceability of the components and materials of flight and control surfaces.			X	X	X								
021 02 05 03		Loads, stresses and aeroelastic vibrations													
(01)		Describe the dangers and stresses regarding safety and serviceability in flight when the manufacturer's design envelope is exceeded.			X	X	X								
(02)		Explain that blade tracking is important both to minimise vibration and to help ensure uniformity of flow through the disc.			X	X	X								
(03)		Describe the early indications and vibrations which are likely to be experienced when the main-rotor blades and tail rotor are out of balance or tracking, including the possible early indications due to possible fatigue and overload.			X	X	X								

(04)		Explain how a vibration harmonic can be set up in other components which can lead to their early failure.			X	X	X								
(05)		State the three planes of vibration measurement, i.e. vertical, lateral, fore and aft.			X	X	X								
021 02 06 00		Structural limitations													
021 02 06 01		Maximum structural masses													
(01)		Define and explain the following maximum structural masses: — maximum ramp mass; — maximum take-off mass; — maximum zero fuel mass; — maximum landing mass. Remark: These limitations may also be found in the relevant part of Subjects 031 'Mass and balance', 032 'Performance (aeroplane)' and 034 'Performance (helicopter)'.	X	X											
(02)		Explain that airframe life is limited by fatigue, created by alternating stress and the number of load cycles.	X	X											
(03)		Explain the maximum structural masses: — maximum take-off mass.			X	X	X								
(04)		Explain that airframe life is limited by fatigue, created by load cycles.			X	X	X								
021 03 00 00		HYDRAULICS													
021 03 01 00		Hydromechanics: basic principles													
021 03 01 01		Concepts and basic principles													

(01)	X	Explain the concept and basic principles of hydromechanics including: — hydrostatic pressure; — Pascal's law; — the relationship between pressure, force and area; — transmission of power: multiplication of force, decrease of displacement.	X	X	X	X	X								
021 03 02 00		Hydraulic systems													
021 03 02 01		Hydraulic fluids: types, characteristics, limitations													
(01)	X	List and explain the desirable properties of a hydraulic fluid with regard to: — thermal stability; — corrosiveness; — flashpoint and flammability; — volatility; — viscosity.	X	X	X	X	X								
(02)	X	State that hydraulic fluids are irritating to skin and eyes.	X	X	X	X	X								
(03)		List the two different types of hydraulic fluids: — synthetic; — mineral.	X	X	X	X	X								
(04)		State that different types of hydraulic fluids cannot be mixed.	X	X	X	X	X								
(05)	X	State that at the pressures being considered, hydraulic fluid is considered incompressible.	X	X	X	X	X								

021 03 02 02		System components: design, operation, degraded modes of operation, indications and warnings													
(01)		Explain the working principle of a hydraulic system.	X	X	X	X	X								
(02)		Describe the difference in the principle of operation between a constant pressure system and a system pressurised only on specific demand.	X	X	X	X	X								
(03)		State the differences in the principle of operation between a passive hydraulic system (without a pressure pump) and an active hydraulic system (with a pressure pump).	X	X	X	X	X								
(04)	X	List the main advantages and disadvantages of system actuation by hydraulic or purely mechanical means with respect to: — weight; — size; — force.	X	X	X	X	X								
(05)		List the main uses of hydraulic systems.	X	X	X	X	X								
(06)		State that hydraulic systems can be classified as either high pressure (typically 3000 psi or higher) or low pressure (typically up to 2000 psi).	X	X	X	X	X								
(07)		State that a high-pressure hydraulic system is typically operating at 3000 psi but on some aircraft a hydraulic pressure of 4000 to 5000 psi may also be used.	X	X	X	X	X								
(08)		Explain the working principle of a low-pressure (0—2000 psi) system.	X	X	X	X	X								

(09)		Explain the advantages and disadvantages of a high-pressure system over a low-pressure system.	X	X	X	X	X								
(10)		Describe the working principle and functions of pressure pumps including: — constant pressure pump (swash plate or cam plate); — pressure pump whose output is dependent on pump revolutions per minute (rpm) (gear type).	X	X	X	X	X								
(11)		Explain the following different sources of hydraulic pressure, their typical application and potential operational limitations: — manual; — engine gearbox; — electrical; — air (pneumatic and ram-air turbine); — hydraulic (power transfer unit) or reversible motor pumps; — accessory.	X	X											
(12)		Explain the following different sources of hydraulic pressure, their typical application and potential operational limitations: — manual; — engine; — gearbox; — electrical.			X	X	X								

(13)		Describe the working principle and functions of the following hydraulic system components: — reservoir (pressurised and unpressurised); — accumulators; — case drain lines and fluid cooler return lines; — piston actuators (single- and double-acting); — hydraulic motors; — filters; — non-return (check) valves; — relief valves; — restrictor valves; — elector valves (linear and basic rotary selectors, two and four ports); — bypass valves; — shuttle valves; — fire shut-off valves — priority valves; — fuse valves; — pressure and return pipes.;	X	X	X	X	X								
(14)		Explain the function of the demand pump installed on many transport aeroplanes.	X	X											
(15)		Explain how redundancy is obtained by giving examples.	X	X	X	X	X								
(16)		Interpret a typical hydraulic system schematic to the level of detail as found in an aircraft flight crew operating manual (FCOM).	X	X	X	X	X								

(17)		Explain the implication of a high system demand.	X	X	X	X	X								
(18)		List and describe the instruments and alerts for monitoring a hydraulic system.	X	X	X	X	X								
(19)		State the indications and explain the implications of the following malfunctions: — system leak or low level; — low pressure; — high temperature.	X	X	X	X	X								
021 04 00 00		LANDING GEAR, WHEELS, TYRES, BRAKES													
021 04 01 00		Landing gear													
021 04 01 01		Types													
(01)	X	Name, for an aeroplane, the following different landing-gear configurations: — nose wheel; — tail wheel.	X	X											
(02)	X	Name, for a helicopter, the following different landing-gear configurations: — nose wheel; — tail wheel; — skids.			X	X	X								
021 04 01 02		System components, design, operation, indications and warnings, on-ground/in-flight protections, emergency extension systems													

(01)		Explain the function of the following components of a landing gear: — oleo leg/shock strut; — axles; — bogies and bogie beam; — drag struts; — side stays/struts; — torsion links; — locks (over centre); — gear doors.	X	X											
(02)		Explain the function of the following components of a landing gear: — oleo leg/shock strut; — axles; — drag struts; — side stays/struts; — torsion links; — locks (over centre); — gear doors.			X	X	X								
(03)		Name the different components of a landing gear, using the diagram appended to these LOs (021).	X	X	X	X	X								
(04)		Describe the sequence of events during normal operation of the landing gear.	X	X	X	X	X								
(05)		State how landing-gear position indication and alerting is implemented.	X	X	X	X	X								

(06)		Describe the various protection devices to avoid inadvertent gear retraction on the ground and explain the implications of taking off with one or more protection devices in place: — ground lock (pins); — protection devices in the gear retraction mechanism.	X	X	X	X	X								
(07)		Explain the speed limitations for gear operation (VLO (maximum landing gear operating speed) and VLE (maximum landing gear extended speed)).	X	X	X	X	X								
(08)		Describe the sequence for emergency gear extension: — unlocking; — operating; — down-locking.	X	X	X	X	X								
(09)		Describe some methods for emergency gear extension including: — gravity/free fall; — air or nitrogen pressure; — manually/mechanically.	X	X	X	X	X								
021 04 02 00		Nose-wheel steering													
021 04 02 01		Design, operation													
(01)		Explain the operating principle of nose-wheel steering.	X	X	X	X	X								
(02)		Explain, for a helicopter, the functioning of differential braking with free-castoring nose wheel.			X	X	X								

(03)		Describe, for an aeroplane, the functioning of the following systems: — differential braking with free-castoring nose wheel; — tiller or hand wheel steering; — rudder pedal nose-wheel steering.	X	X											
(04)		Explain the centring mechanism of the nose wheel.	X	X	X	X	X								
(05)		Define the term 'shimmy' and the possible consequences of shimmy for the nose- and the main-wheel system and explain the purpose of a shimmy damper to reduce the severity of shimmy.	X	X											
(06)		Explain the purpose of main-wheel (body) steering.	X	X											
021 04 03 00		Brakes													
021 04 03 01		Types and materials													
(01)		Describe the basic operating principle of a disc brake.	X	X	X	X	X								
(02)		State the different materials used in a disc brake (steel, carbon).	X	X	X	X	X								
(03)		Describe the characteristics, advantages and disadvantages of steel and carbon brake discs with regard to: — weight; — temperature limits; — internal-friction coefficient; — wear.	X	X	X	X	X								

021 04 03 02		System components, design, operation, indications and warnings													
(01)		Explain the limitation of brake energy and describe the operational consequences.	X	X											
(02)		Explain how brakes are actuated: hydraulically, electrically.	X	X	X	X	X								
(03)		Explain the purpose of an in-flight wheel brake system.	X	X											
(04)		Describe the function of a brake accumulator.	X	X	X	X	X								
(05)		Describe the function of the parking brake.	X	X	X	X	X								
(06)		Explain the function of brake-wear indicators.	X	X											
(07)		Explain the reason for the brake-temperature indicator.	X	X											
021 04 03 03		Anti-skid													
(01)		Describe the operating principle of anti-skid where excessive brake pressure applied is automatically reduced for optimum breaking performance.	X	X											
(02)		Explain that the anti-skid computer compares wheel speed to aeroplane reference speed to provide the following: — slip ratio for maximum braking performance; — locked-wheel prevention (protection against deep skid on one wheel); — touchdown protection (protection against brake-pressure application during touchdown); — hydroplane protection.	X	X											

(03)		Give examples of the impact of an anti-skid system on performance, and explain the implications of anti-skid system failure.	X	X											
021 04 03 04		Autobrake													
(01)		Describe the operating principle of an autobrake system.	X	X											
(02)		Explain why the anti-skid system must be available when using autobrakes.	X	X											
(03)		Explain the difference between the three modes of operation of an autobrake system: — OFF (system off or reset); — Armed (the system is ready to operate under certain conditions); — Activated/Deactivated (application of pressure on brakes).	X	X											
(04)		Describe how an autobrake system setting will either apply maximum braking (RTO or MAX) or result in a given rate of deceleration, where the amount of braking applied may be affected by: — the use of reverse thrust; — slippery runway.	X	X											
021 04 04 00		Wheels, rims and tyres													
021 04 04 01		Types, structural components and materials, operational limitations, thermal plugs													

(01)	X	Describe the different types of tyres such as: — tubeless; — diagonal (cross ply); — radial (circumferential bias).	X	X	X	X	X								
(02)	X	Define the following terms: — ply rating; — tyre tread; — tyre creep; — retread (cover).	X	X	X	X	X								
(03)		Explain the function of thermal/fusible plugs.	X	X											
(04)		Explain the implications of and how to identify tread separation and wear or damage with associated increased risk of tyre burst.	X	X											
(05)		Explain why the ground speed of tyres is limited.	X	X											
(06)		Describe the following tyre checks a pilot will perform during the pre-flight inspection and identify probable causes: — cuts and damages; — flat spots.	X	X											
021 04 05 00		Helicopter equipment													
021 04 05 01		Flotation devices													
(01)		Explain flotation devices, how they are operated, and their limitations.			X	X	X								
(02)		Explain why indicated airspeed (IAS) limitations before, during and after flotation-device deployment must be observed.			X	X	X								

021 05 00 00		FLIGHT CONTROLS													
021 05 01 00		Aeroplane: primary flight controls													
021 05 01 01		Definition and control surfaces													
(01)		Define a 'primary flight control'.	X	X											
(02)		List the following primary flight control surfaces: — elevator; — aileron, roll spoilers, flaperon; — rudder.	X	X											
(03)		List the various means of control surface actuation including: — manual; — fully powered (irreversible); — partially powered (reversible).	X	X											
021 05 01 02		Manual controls													
(01)		Explain the basic principle of a fully manual control system.	X	X											
021 05 01 03		Fully powered controls (irreversible)													
(01)		Explain the basic principle of a fully powered control system.	X	X											
(02)		Explain the concept of irreversibility in a flight control system.	X	X											
(03)		Explain the need for a 'feel system' in a fully powered control system.	X	X											
(04)		Explain the operating principle of a stabiliser trim system in a fully powered control system.	X	X											

(05)		Explain the operating principle of rudder and aileron trim in a fully powered control system.	X	X												
021 05 01 04		Partially powered controls (reversible)														
(01)		Explain the basic principle of a partially powered control system.	X	X												
(02)		Explain why a ‘feel system’ is not necessary in a partially powered control system.	X	X												
021 05 01 05		System components, design, operation, indications and warnings, degraded modes of operation, jamming														
(01)		List and describe the function of the following components of a flight control system: — actuators; — control valves; — cables; — electrical wiring; — control surface position sensors.	X	X												
(02)		Explain how redundancy is obtained in primary flight control systems of large transport aeroplanes.	X	X												
(03)		Explain the danger of control jamming and the means of retaining sufficient control capability.	X	X												
(04)		Explain the methods of locking the controls on the ground and describe ‘gust or control lock’ warnings.	X	X												

(05)		Explain the concept of a rudder deflection limitation (rudder limiter) system and the various means of implementation (rudder ratio changer, variable stops, blow-back).	X	X											
021 05 02 00		Aeroplane: secondary flight controls													
021 05 02 01		System components, design, operation, degraded modes of operation, indications and warnings													
(01)		Define a ‘secondary flight control’.	X	X											
(02)		List the following secondary flight control surfaces: — lift-augmentation devices (flaps and slats); — speed brakes; — flight and ground spoilers; — trimming devices such as trim tabs, trimmable horizontal stabiliser.	X	X											
(03)		Describe secondary flight control actuation methods and sources of actuating power.	X	X											
(04)		Explain the function of a mechanical lock when using hydraulic motors driving a screw jack.	X	X											
(05)		Describe the requirement for limiting flight speeds for the various secondary flight control surfaces.	X	X											
(06)		For lift-augmentation devices, explain the load-limiting (relief) protection devices and the functioning of an auto-retraction system.	X	X											

(07)		Explain how a flap/slat asymmetry protection device functions, and describe the implications of a flap/slat asymmetry situation.	X	X											
(08)		Describe the function of an auto-slat system.	X	X											
(09)		Explain the concept of control surface blow-back (aerodynamic forces overruling hydraulic forces).	X	X											
021 05 03 00		Helicopter: flight controls													
021 05 03 01		Droop stops, control systems, trim systems, control stops													
(01)		Explain the methods of locking the controls on the ground.			X	X	X								
(02)		Describe main-rotor droop stops and how rotor flapping is restricted.			X	X	X								
(03)		Explain the principle of phase lag and advance angle.			X	X	X								
(04)		Describe the following four axes of control operation, their operating principle and their associated cockpit controls: — collective control; — cyclic fore and aft (pitch axis); — cyclic lateral (roll axis); — yaw.			X	X	X								

(05)		Describe the swash plate or azimuth star control system including the following: — swash plate inputs; — the function of the non-rotating swash plate; — the function of the rotating swash plate; — how swash plate tilt is achieved; — swash plate pitch axis; — swash plate roll axis; — balancing of pitch/roll/collective inputs to the swash plate to equalise torsional loads on the blades.			X	X	X								
(06)		Describe the operation of the spider control system.			X	X	X								
(07)		State the need for artificial feel in a hydraulically actuated flight control system.			X	X	X								
(08)		Describe and explain the purpose of a trim system using the following terms: — force-trim switch; — force gradient; — parallel trim actuator; — cyclic 4-way trim switch; — interaction of trim system with an SAS/SCAS/ASS stability system; — trim-motor indicators.			X	X	X								
(09)		Describe the different types of control runs.			X	X	X								
(10)		Explain the use of control stops.			X	X	X								

021 05 04 00		Aeroplane: fly-by-wire (FBW) control systems													
021 05 04 01		Composition, explanation of operation, modes of operation													
(01)		Explain that an FBW flight control system is composed of the following: — pilot's input command (control column/sidestick/rudder — pedals); — electrical signalling paths, including: — pilot input to computer; — computer to flight control surfaces; — feedback from aircraft response to computer; — flight control computers; — actuators; — flight control surfaces.													
(02)		State the advantages of an FBW system in comparison with a conventional flight control system including: — weight; — pilot workload; — flight-envelope protection.													
(03)		Explain why an FBW system is always irreversible.													
(04)		Explain the different modes of operation: — normal operation (e.g. normal law or normal mode); — downgraded operation (e.g. alternate law or secondary mode); — direct law.													

(05)		Describe the implications of mode degradation in relation to pilot workload and flight-envelope protection.													
(06)		Intentionally left blank													
(07)		For aircraft using sidestick for manual control, describe the implications of: — dual control input made by the pilot; — the control takeover facility available to the pilot.													
(08)		Intentionally left blank													
(09)		Explain why several types of computers are needed and why they should be dissimilar.	X	X											
(10)		Explain why several control surfaces on every axis are needed on FBW aircraft.	X	X											
(11)		Explain why several sensors are needed on critical parameters.													
021 05 05 00		Helicopter: fly-by-wire (FBW) control systems													
		To be introduced at a later date.			X	X	X								
021 06 00 00		PNEUMATICS — PRESSURISATION AND AIR-CONDITIONING SYSTEMS													
021 06 01 00		Pneumatic/bleed-air supply													
021 06 01 01		Piston-engine air supply													

(01)		Describe the following means of supplying air for the pneumatic systems for piston-engine aircraft: — compressor; — vacuum pump.	X	X	X	X	X								
(02)		State that an air supply is required for the following systems: — instrumentation; — heating; — de-icing.	X	X	X	X	X								
021 06 01 02		Gas turbine engine: bleed-air supply													
(01)		State that the possible bleed-air sources for gas turbine engine aircraft are the following: — engine; — auxiliary power unit (APU); — ground supply.	X	X	X	X	X								
(02)		State that for an aeroplane a bleed-air supply can be used for the following systems or components: — ice protection; — engine air starter; — pressurisation of a hydraulic reservoir; — air-driven hydraulic pumps; — pressurisation and air conditioning.	X	X											

(03)		State that for a helicopter a bleed-air supply can be used for the following systems or components: — anti-icing; — engine air starter; — pressurisation of a hydraulic reservoir.			X	X	X								
(04)		State that the bleed-air supply system can comprise the following: — pneumatic ducts; — isolation valve; — pressure-regulating valve; — engine bleed valve (HP/IP valves); — fan-air pre-cooler; — Temperature and pressure sensors.	X	X	X	X	X								
(05)		Interpret a basic pneumatic system schematic to the level of detail as found in an FCOM.	X	X	X	X	X								
(06)		Describe the cockpit indications for bleed-air systems.	X	X	X	X	X								
(07)		Explain how the bleed-air supply system is controlled and monitored.	X	X	X	X	X								
(08)		State the following bleed-air malfunctions: — over-temperature; — over-pressure; — low pressure; — overheat/duct leak; and describe the potential consequences.	X	X	X	X	X								
021 06 02 00		Helicopter: air-conditioning systems													

021 06 02 01		Types, system components, design, operation, degraded modes of operation, indications and warnings													
(01)		Describe the purpose of an air-conditioning system.			X	X	X								
(02)		Explain how an air-conditioning system is controlled.			X	X	X								
(03)		Describe the vapour cycle air-conditioning system including system components, design, operation, degraded modes of operation and system malfunction indications.			X	X	X								
(04)		Identify the following components from a diagram of an air- conditioning system and describe the operating principle and function: — air-cycle machine (pack, bootstrap system); — pack-cooling fan; — water separator; — mixing valves; — flow-control valves; — isolation valves; — recirculation fans; — filters for recirculation; — temperature sensors.			X	X	X								
(05)		List and describe the controls, indications and warnings related to an air-conditioning system.			X	X	X								
021 06 03 00		Aeroplane: pressurisation and air-conditioning system													

021 06 03 01		System components, design, operation, degraded modes of operation, indications and warnings													
(01)		Explain that a pressurisation and an air-conditioning system of an aeroplane controls: — ventilation; — temperature; — pressure.	X	X											
(02)		Explain how humidity is controlled.	X	X											
(03)		Explain that the following components constitute a pressurisation system: — pneumatic system as the power source; — outflow valve; — outflow valve actuator; — pressure controller; — excessive differential pressure-relief valve; — negative differential pressure-relief valve.	X	X											

(04)		Explain that the following components constitute an air-conditioning system and describe their operating principles and function: — air-cycle machine (pack, bootstrap system); — pack-cooling fan; — water separator; — mixing valves; — flow-control valves (outflow valve); — isolation valves; — ram-air valve; — recirculation fans; — filters for recirculated air; — temperature sensors. Remark: The bootstrap system is the only air-conditioning system considered for Part-FCL aeroplane examinations.	X	X												
(05)		Describe the use of hot trim air.	X	X												
(06)		Define the following terms: — cabin altitude; — cabin vertical speed; — differential pressure; — ground pressurisation.	X	X												
(07)		Describe the operating principle of a pressurisation system.	X	X												
(08)		Describe the emergency operation by manual setting of the outflow valve position.	X	X												

(09)		Describe the working principle of an electronic cabin-pressure controller.	X	X											
(10)		State how the maximum operating altitude is determined.	X	X											
(11)		Explain: — why the maximum allowed value of cabin altitude is limited; — a typical value of maximum differential pressure for large transport aeroplanes; — the relation between cabin altitude, the maximum differential pressure and maximum aeroplane operating altitude.	X	X											
(12)		Explain the typical warning on a transport category aircraft when cabin altitude exceeds 10 000 ft.	X	X											
(13)		List and interpret typical indications of the pressurisation system.	X	X											
(14)		Describe the main operational differences between a bleed-air- driven air-conditioning system and an electrically driven air- conditioning system as found on aircraft without engine bleed-air system.	X	X											
021 07 00 00		ANTI-ICING AND DE-ICING SYSTEMS													
021 07 01 00		Types, operation, indications													
021 07 01 01		Types, design, operation, indications and warnings, operational limitations													
(01)		Explain the concepts of anti-icing and de-icing.	X	X	X	X	X								

(02)		Name the components of an aircraft which can be protected from ice accretion.	X	X	X	X	X								
(03)		State that on some aeroplanes the tail does not have an ice-protection system.	X	X											
(04)		State the different types of anti-icing/de-icing systems and describe their operating principle: — hot air; — electrical; — fluid.	X	X	X	X	X								
(05)		Describe the operating principle of the inflatable boot de-icing system.	X	X											
021 07 02 00		Ice warning systems													
021 07 02 01		Types, operation, and indications													
(01)		Describe the different operating principles of the following ice detectors: — mechanical systems using air pressure; — electromechanical systems using resonance frequencies.	X	X											
(02)		Describe the principle of operation of ice warning systems.	X	X											
021 07 03 00		Helicopter blade heating systems													
021 07 03 01		Limitations													
(01)		Explain the limitations on blade heating and the fact that on some helicopters the heating does not heat all the main-rotor blades at the same time.			X	X	X								

021 08 00 00		FUEL SYSTEM												
021 08 01 00		Piston engine												
021 08 01 01		Fuel: types, characteristics, limitations												
(01)		State the types of fuel used by a piston engine and their associated limitations: — diesel; — JET-A1 (for high-compression engines); — AVGAS; — MOGAS.	X	X	X	X	X							
(02)		State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	X	X	X	X	X							
021 08 01 02		Design, operation, system components, indications												
(01)		State the tasks of the fuel system.	X	X	X	X	X							

(02)		Name the following main components of a fuel system, and state their location and their function: — lines; — boost pump; — pressure valves; — filter, strainer; — tanks (wing, tip, fuselage); — vent system; — sump; — drain; — fuel-quantity sensor; — fuel-temperature sensor.	X	X	X	X	X								
(03)		Describe a gravity fuel feed system and a pressure feed fuel system.	X	X	X	X	X								
(04)		Describe the construction of the different types of fuel tanks and state their advantages and disadvantages: — drum tank; — bladder tank; — integral tank.	X	X	X	X	X								
(05)		Explain the function of cross-feed.	X	X	X	X	X								
(06)		Define the term ‘unusable fuel’.	X	X	X	X	X								
(07)		List the following parameters that are monitored for the fuel system: — fuel quantity (low-level warning); — fuel temperature.	X	X	X	X	X								

021 08 02 00		Turbine engine													
021 08 02 01		Fuel: types, characteristics, limitations													
(01)		State the types of fuel used by a gas turbine engine: — JET-A; — JET-A1; — JET-B.	X	X	X	X	X								
(02)		State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	X	X	X	X	X								
(03)		State the existence of additives for freezing.	X	X	X	X	X								
021 08 02 02		Design, operation, system components, indications													

(01)		Explain the function of the fuel system: — lines; — centrifugal boost pump; — pressure valves; — fuel shut-off valve; — filter, strainer; — tanks (wing, tip, fuselage, tail); — bafflers/baffles; — sump; — vent system; — drain; — fuel-quantity sensor; — fuel-temperature sensor; — refuelling/defueling system; — fuel dump/jettison system.	X	X	X	X	X								
(02)		Name the main components of the fuel system and state their location and their function: — trim fuel tanks; — bafflers; — refuelling/defueling system; — fuel dump/jettison system. Remark: For completion of list, please see 021 08 01 02 (02).	X	X	X	X	X								
(03)		Interpret a typical fuel system schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X								

(04)		Explain the limitations in the event of loss of booster pump fuel pressure.	X	X	X	X	X								
(05)		Describe the use and purpose of drip sticks (manual magnetic indicators) (may also be known as dip stick or drop stick).	X	X											
(06)		Explain the considerations for fitting a fuel dump/jettison system and, if fitted, its function.	X	X	X	X	X								
021 09 00 00		ELECTRICS													
		Remark: For any reference to the direction of current flow, the conventional current flow shall be used, i.e. from positive to negative.													
021 09 01 00		General, definitions, basic applications: circuit breakers, logic circuits													
021 09 01 01		Static electricity													
(01)		Explain static electricity and describe the flying conditions where aircraft are most susceptible to build-up of static electricity.	X	X	X	X	X								
(02)		Describe a static discharger and explain the following: — its purpose; — typical locations; — pilot's role of observing it during pre-flight inspection.	X	X	X	X	X								
(03)		Explain why an aircraft must first be grounded before refuelling/defueling.	X	X	X	X	X								
(04)		Explain the reason for electrical bonding.	X	X	X	X	X								
021 09 01 02		Direct current (DC)													

(01)		Explain the term 'direct current' (DC), and state that current can only flow in a closed circuit.	X	X	X	X	X								
(02)	X	Explain the basic principles of conductivity and give examples of conductors, semiconductors and insulators.	X	X	X	X	X								
(03)		Describe the difference in use of the following mechanical switches and explain the difference in observing their state (e.g. ON/OFF), and why some switches are guarded: — toggle switch; — rocker switch; — pushbutton switch; — rotary switch. Explain the difference in observing their state (e.g. ON/OFF) and why some switches are guarded.	X	X	X	X	X								
(04)		Define voltage and current, and state their unit of measurement.	X	X	X	X	X								
(05)	X	Explain Ohm's law in qualitative terms.	X	X	X	X	X								
(06)	X	Explain the effect on total resistance when resistors are connected in series or in parallel.	X	X	X	X	X								
(07)	X	State that resistances can have a positive or a negative temperature coefficient (PTC/NTC) and state their use.	X	X	X	X	X								
(08)		Define electrical power and state the unit of measurement.	X	X	X	X	X								
021 09 01 03		Alternating current (AC)													

(01)	X	Explain the term 'alternating current' (AC), and compare its use to DC with regard to complexity.	X	X	X	X	X								
(02)		Define the term 'phase', and explain the basic principle of single- phase and three-phase AC.	X	X	X	X	X								
(03)		State that aircraft can use single-phase or three-phase AC.	X	X	X	X	X								
(04)		Define frequency and state the unit of measurement.	X	X	X	X	X								
(05)	X	Define 'phase shift' in qualitative terms.	X	X	X	X	X								
021 09 01 04		Intentionally left blank													
021 09 01 05		Intentionally left blank													
021 09 01 06		Electromagnetism													
(01)		State that an electrical current produces a magnetic field.	X	X	X	X	X								
(02)		Describe how the strength of the magnetic field changes with the magnitude of the current.	X	X	X	X	X								
(03)		Explain the purpose and the working principle of a solenoid.	X	X	X	X	X								
(04)		Explain the purpose and the working principle of a relay.	X	X	X	X	X								
(05)		Explain the principle of electromagnetic induction and how two electrical components or systems may affect each other through this principle.	X	X	X	X	X								
021 09 01 07		Circuit protection													
(01)		Explain the working principle of a fuse and a circuit breaker.	X	X	X	X	X								

(02)		Explain how a fuse is rated.	X	X	X	X	X								
(03)		Describe the principal difference between the following types of circuit breakers: — thermal circuit breaker sensing magnitude of current; — magnetic circuit breaker sensing direction of current.	X	X	X	X	X								
(04)		Describe how circuit breakers may be used to reset aircraft systems/computers in the event of system failure (when part of a described procedure).	X	X	X	X	X								
(05)		Explain a short circuit in practical terms using Ohm's Law, power and energy expressions highlighting the risk of fire due to power transfer and extreme energy dissipation.	X	X	X	X	X								
(06)		Explain the risk of fire resulting from excessive heat in a circuit subjected to overcurrent.	X	X	X	X	X								
(07)		Explain that overcurrent situations may be transient.	X	X	X	X	X								
(08)		Explain the hazards of multiple resets of a circuit breaker or the use of incorrect fuse rating when replacing blown fuses.	X	X	X	X	X								
021 09 01 08		Semiconductors and logic circuits													
(01)		Describe the effect of temperature on semiconductors with regard to function and longevity of the component.	X	X	X	X	X								

(02)		Describe the following five basic logic functions, as used in aircraft FCOM documentation, and recognise their schematic symbols according to the ANSI/MIL standard: — AND; — OR; — NOT; — NOR; — NAND.	X	X	X	X	X								
(03)		Interpret a typical logic circuit schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X								
021 09 02 00		Batteries													
021 09 02 01		Types, characteristics and limitations													
(01)		State the function of an aircraft battery.	X	X	X	X	X								
(02)		Name the types of rechargeable batteries used in aircraft: — lead-acid; — nickel-cadmium; — lithium-ion; — lithium-polymer.	X	X	X	X	X								
(03)		Compare the different battery types with respect to: — load behaviour; — charging characteristics; — risk of thermal runaway.	X	X	X	X	X								

(04)		Explain the term 'cell voltage' and describe how a battery may consist of several cells that combined provide the desirable voltage and capacity.	X	X	X	X	X								
(05)		Explain the difference between battery voltage and charging voltage.	X	X	X	X	X								
(06)		Define the term 'capacity of batteries' and state the unit of measurement used.	X	X	X	X	X								
(07)		State the effect of temperature on battery capacity and performance.	X	X	X	X	X								
(08)		State that in the case of loss of all generated power (battery power only) the remaining electrical power is time-limited. — numbers of batteries on board an aircraft including those brought on board by passengers; — temperature, of both battery and environment; — physical condition of the battery; — battery charging.	X	X	X	X	X								
(10)		Describe how to contain a battery thermal runaway highlighting the following: — how one cell can affect the neighbouring cells; — challenges if it happens in an aircraft during flight.	X	X	X	X	X								
021 09 03 00		Generation													

		Remark: For standardisation purposes, the following standard expressions are used: — DC generator: produces DC output; — DC alternator: produces AC, rectified by integrated rectifying unit, the output is DC; — DC alternator: producing a DC output by using a rectifier; — AC generator: produces AC output; — starter generator: integrated combination of a generator and a starter motor; — permanent magnet alternator/ generator: self-exciting AC generator.	X	X	X	X	X								
021 09 03 01		DC generation													
(01)		Describe the basic working principle of a simple DC generator or DC alternator.	X	X	X	X	X								
(02)		Explain the principle of voltage control and why it is required.	X	X	X	X	X								
(03)		Explain the purpose of reverse current protection from the battery/busbar to the alternator.	X	X	X	X	X								
(04)		Describe the basic operating principle of a starter generator and state its purpose.	X	X	X	X	X								
021 09 03 02		AC generation													
(01)		Describe the working principle of a brushless three-phase AC generator.	X	X	X	X	X								
(02)		State that the generator field current is used to control voltage.	X	X	X	X	X								

(03)		State the relationship between output frequency and the rpm of a three-phase AC generator.	X	X	X	X	X								
(04)		Explain the term 'frequency wild generator'.	X	X	X	X	X								
(05)		List the following different power sources that can be used for an aeroplane to drive an AC generator: — engine; — APU; — RAT; — hydraulic.	X	X											
(06)		List the following different power sources that can be used for a helicopter to drive an AC generator: — engine; — APU; — gearbox.			X	X	X								
021 09 03 03		Constant speed drive (CSD) and integrated drive generator (IDG) systems													
(01)		Describe the function of a CSD.	X	X											
(02)		Explain the parameters of a CSD that are monitored.	X	X											
(03)		Describe the function of an IDG.	X	X											
(04)		Explain the consequences of a mechanical disconnection during flight for a CSD and an IDG.	X	X											
(05)		Explain that a CSD/IDG has its own, independent oil system and how a leak from this may appear as an engine oil leak.	X	X											

021 09 03 04		Transformers, transformer rectifier units (TRUs), static inverters													
(01)		State the function of a transformer.	X	X	X	X	X								
(02)		State the function of a TRU and its purpose, including type of output.	X	X	X	X	X								
(03)		State the function of a static inverter and its purpose, including type of output.	X	X	X	X	X								
021 09 04 00		Distribution													
021 09 04 01		General													
(01)		Explain the function of a busbar.	X	X	X	X	X								
(02)		Describe the function of the following buses: — AC bus; — DC bus; — emergency AC or DC bus; — essential AC or DC bus; — battery bus; — hot bus, ground servicing or maintenance bus.	X	X	X	X	X								
(03)		State that the aircraft structure can be used as a part of the electrical circuit (common earth) and explain the implications for electrical bonding.	X	X	X	X	X								
(04)		Explain the function of external power.	X	X	X	X	X								
(05)		State that a priority sequence exists between the different sources of electrical power on ground and in flight.	X	X	X	X	X								
(06)		Explain the term 'load sharing'.	X	X	X	X	X								

(07)		Explain the term 'load shedding'.	X	X	X	X	X								
(08)		Describe typical systems that can be shed in the event of a supply failure, such as passenger entertainment system and galley power.	X	X	X	X	X								
(09)		Interpret a typical electrical system schematic to the level of detail as found in an aircraft FCOM.	X	X	X	X	X								
(10)		Explain the difference between a supply (e.g. generator) failure and a bus failure, and the operating consequences of either.	X	X	X	X	X								
021 09 04 02		DC distribution													
(01)		Describe a simple DC electrical system of a single-engine aircraft.	X	X	X	X	X								
(02)		Describe a DC electrical system of a multi-engine aircraft (CS-23/CS-27) including the distribution consequences of loss of generator(s) or bus failure.	X	X	X	X	X								
(03)		Describe the DC part of an electrical system of a transport aircraft (CS-25/CS-29) including the distribution consequences of loss of DC supply or bus failure.	X	X	X	X	X								
(04)		Give examples of DC consumers.	X	X	X	X	X								
021 09 04 03		AC distribution													
(01)		Explain the difference in the principle of operation for a split AC electrical system and a parallel AC electrical system.	X	X	X	X	X								

(02)		Describe the following distribution consequences: — power transfer between different power supplies; — power transfer in the event of a supply failure; — loss of all normal AC supplies.	X	X	X	X	X									
(03)		Give examples of AC consumers.	X	X	X	X	X									
(04)		Explain the conditions to be met for paralleling AC generators.	X	X	X	X	X									
(05)		State that volt-ampere (VA) is the unit for total power consumed in an AC system.	X	X	X	X	X									
021 09 04 04		Electrical load management and monitoring systems: automatic generators and bus switching during normal and failure operation, indications and warnings														

(01)		Give examples of system control, monitoring and annunciators using the following terms: — generator control unit (GCU) for monitoring generator output and providing network protection; — exciter contactor/breaker/relay for control of generator exciter field; — generator contactor/breaker/relay for connecting the generator to the network; — bus-tie contactor/breaker/relay for connecting busbars together; — generator switch on the flight deck for manual control of exciter contactor; — IDG/CSD disconnect switch on the flight deck for mechanical disconnection of the generator; — bus-tie switch on the flight deck with AUTO and OFF positions only.	X	X	X	X	X								
(02)		Describe, for normal and degraded modes of operation, the following functions of an electrical load management system on ground and in flight using the terms in 021 09 04 04 (01): — distribution; — monitoring; — protection in the event of incorrect voltage; — protection in the event of incorrect frequency; — protection in the event of a differential fault.	X	X	X	X	X								

(03)		Describe the requirement for monitoring the aircraft batteries.	X	X	X	X	X								
(04)		Explain the importance of monitoring the temperature of nickel- cadmium and lithium-type batteries.	X	X	X	X	X								
(05)		Interpret various different ammeter indications of an ammeter which monitors the charge current of the battery.	X	X	X	X	X								
021 09 05 00		Electrical motors													
021 09 05 01		General													
(01)	X	State that the purpose of an electrical motor is to convert electrical energy into mechanical energy.	X	X	X	X	X								
(02)		State that because of the similarity in design, a generator and an electrical motor may be combined into a starter generator.	X	X	X	X	X								
(03)		Explain that the size of the engine determines how much energy is required for starting, and state the following: — small turbine engines may be able to use the battery for a very limited number of start attempts; — large turbine engines require one or more power sources, either external or on-board.	X	X	X	X	X								
021 09 05 02		Operating principle													
(01)		Describe how the torque of an electrical motor is determined by the supplied voltage and current, and the resulting magnetic fields within the motor.	X	X	X	X	X								

(02)	X	State that electrical motors can be either AC or DC.	X	X	X	X	X								
(03)		Explain the consequences of the following: rotor seizure; rotor runaway.	X	X	X	X	X								
021 09 05 03		Components													
(01)	X	Name the following components of an electrical motor: rotor (rotating part of an electrical motor); stator (stationary part of an electrical motor).	X	X	X	X	X								
021 10 00 00		PISTON ENGINES													
		Remark: This topic includes diesel and petrol engines.													
021 10 01 00		General													
021 10 01 01		Types of internal-combustion engines: basic principles, definitions													
(01)		Define the following terms and expressions: — rpm; — torque; — manifold absolute pressure (MAP); — power output; — specific fuel consumption; — compression ratio, clearance volume, swept (displaced) volume, total volume.	X	X	X	X	X								
021 10 01 02		Engine: design, operation, components													

(01)		Describe the basic operating principle of a piston engine: — crankcase; — crankshaft; — connecting rod; — piston; — piston pin; — piston rings; — cylinder; — cylinder head; — valves; — valve springs; — push rod; — camshaft; — rocker arm; — camshaft gear; — bearings.	X	X	X	X	X								
(02)		Name and identify the various types of engine design with regard to cylinder arrangement and their advantages/disadvantages: — horizontally opposed; — in line; — radial; — and working cycle (four stroke: petrol and diesel).	X	X	X	X	X								

(03)		Describe the differences between petrol and diesel engines with respect to: — means of ignition; — maximum compression ratio; — regulating air or mixture supply to the cylinder; — pollution from the exhaust.	X	X	X	X	X								
021 10 02 00		Fuel													
021 10 02 01		Types, grades, characteristics, limitations													
(01)		Name the type of fuel used for petrol engines including its colour (AVGAS); — 100 (green); — 100LL (blue).	X	X	X	X	X								
(02)		Name the type of fuel normally used for aviation diesel engines (JET-A1).	X	X	X	X	X								
(03)	X	Define the term ‘octane rating’.	X	X	X	X	X								
(04)		Define the term ‘detonation’ and describe the causes and effects of detonation for both petrol and diesel engines.	X	X	X	X	X								
(05)		Define the term ‘pre-ignition’ and describe the causes and effects of pre-ignition for both petrol and diesel engines.	X	X	X	X	X								
(06)		Identify the conditions and power settings that promote detonation for petrol engines.	X	X	X	X	X								
(07)		Describe how detonation in petrol engines is recognised.	X	X	X	X	X								

(08)		Describe the method and occasions for checking the fuel for water content.	X	X	X	X	X								
(09)		State the typical value of fuel density for aviation gasoline and diesel fuel.	X	X	X	X	X								
(10)		Explain volatility, viscosity and vapour locking for petrol and diesel fuels.	X	X	X	X	X								
021 10 03 00		Engine fuel pumps													
021 10 03 01		Engine-driven fuel pump													
(01)		Explain the need for a separate engine-driven fuel pump.	X	X	X	X	X								
021 10 04 00		Carburettor/injection system													
021 10 04 01		Carburettor: design, operation, degraded modes of operation, indications and warnings													
(01)		State the purpose of a carburettor.	X	X	X	X	X								
(02)		Describe the operating principle of the simple float chamber carburettor.	X	X	X	X	X								
(03)		Describe the methods of obtaining mixture control over the whole operating engine power setting range (compensation jet, diffuser).	X	X	X	X	X								
(04)		Describe the methods of obtaining mixture control over the whole operating altitude range.	X	X	X	X	X								
(05)		Explain the purpose and the operating principle of an accelerator pump.	X	X	X	X	X								
(06)		Explain the purpose of power enrichment.	X	X	X	X	X								

(07)		Describe the function of the carburettor heat system.	X	X	X	X	X								
(08)		Explain the effect of carburettor heat on mixture ratio and power output.	X	X	X	X	X								
(09)		Explain the purpose and the operating principle of a primer pump.	X	X	X	X	X								
(10)		Discuss other methods for priming an engine (acceleration pumps).	X	X	X	X	X								
(11)		Explain the danger of carburettor fire, including corrective measures.	X	X	X	X	X								
021 10 04 02		Injection: design, operation, degraded modes of operation, indications and warnings													
(01)		Explain the advantages and difference in operation of an injection system compared with a carburettor system.	X	X	X	X	X								
021 10 04 03		Icing													
(01)		Describe the causes and effects of carburettor icing and the action to be taken if carburettor icing is suspected.	X	X	X	X	X								
(02)		Name the meteorological conditions under which carburettor icing may occur.	X	X	X	X	X								
(03)		Describe the indications of the presence of carburettor icing for both a fixed pitch and a constant speed propeller.	X	X											
(04)		Describe the indications of the presence of carburettor icing for a helicopter.			X	X	X								

(05)		Describe the indications that will occur upon selection of carburettor heat depending on whether ice is present or not.	X	X	X	X	X								
(06)		Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle.	X	X	X	X	X								
(07)		State the meteorological conditions under which induction system icing may occur.	X	X	X	X	X								
021 10 05 00		Cooling systems													
021 10 05 01		Design, operation, indications and warnings													
(01)		Specify the reasons for cooling a piston engine.	X	X	X	X	X								
(02)		Describe the design features to enhance cylinder air cooling for aeroplanes.	X	X											
(03)		Describe the design features to enhance cylinder air cooling for helicopters (e.g. engine-driven impeller and scroll assembly, baffles).			X	X	X								
(04)		Compare the differences between liquid- and air-cooling systems.	X	X	X	X	X								
(05)		Identify the cylinder head temperature indication to monitor engine cooling.	X	X	X	X	X								
(06)		Describe the function and the operation of cowl flaps.	X	X											
021 10 06 00		Lubrication systems													
021 10 06 01		Lubricants: characteristics, limitations													
(01)		Describe the term 'viscosity' including the effect of temperature.	X	X	X	X	X								

(02)		Describe the viscosity grade numbering system used in aviation.	X	X	X	X	X								
021 10 06 02		Design, operation, indications and warnings													
(01)		State the functions of a piston-engine lubrication system.	X	X	X	X	X								
(02)		Describe the working principle of a dry-sump lubrication system and describe the functions of the following components: — oil tank (reservoir) and its internal components: hot well, de- aerator, vent, expansion space; — check valve (non-return valve); — pressure pump and pressure-relief valve; — scavenge pump; — filters (suction, pressure and scavenge); — oil cooler; — oil cooler bypass valve (anti-surge and thermostatic); — pressure and temperature sensors; — lines.	X	X	X	X	X								
(03)		Describe a wet-sump lubrication system.	X	X	X	X	X								
(04)		State the differences between a wet- and a dry-sump lubrication system and their advantages and disadvantages.	X	X	X	X	X								

(05)		List the following factors that influence oil consumption: — oil grade; — cylinder and piston wear; — condition of piston rings.	X	X	X	X	X								
(06)		Describe the interaction between oil pressure, oil temperature and oil quantity.	X	X	X	X	X								
021 10 07 00		Ignition circuits													
021 10 07 01		Design, operation													
(01)		Describe the working principle of a magneto-ignition system and the functions of the following components: — magneto; — contact-breaker points; — capacitor (condenser); — coils or windings; — ignition switches; — distributor; — spark plug; — high-tension (HT) cable.	X	X	X	X	X								
(02)		State why piston engines are equipped with two electrically independent ignition systems.	X	X	X	X	X								
(03)		State the function and operating principle of the following methods of spark augmentation: — starter vibrator (booster coil); — impulse-start coupling.	X	X											

(04)		State the function and operating principle of the following methods of spark augmentation: — starter vibrator (booster coil); — both magnetos live.			X	X	X								
(05)		Explain the function of the magneto check.	X	X	X	X	X								
(06)		Explain how combustion is initiated in diesel engines.	X	X	X	X	X								
021 10 08 00		Mixture													
021 10 08 01		Definition, characteristic mixtures, control instruments, associated control levers, indications													
(01)		Define the following terms: — mixture; — chemically correct ratio (stoichiometric); — best power ratio; — lean (weak) mixture (lean or rich side of the exhaust gas temperature (EGT) top); — rich mixture.	X	X	X	X	X								
(02)		State the typical fuel-to-air ratio values or range of values for the above mixtures.	X	X	X	X	X								
(03)		Describe the advantages and disadvantages of weak and rich mixtures.	X	X	X	X	X								
(04)		Describe the relation between engine-specific fuel consumption and mixture ratio.	X	X	X	X	X								

(05)		Describe the use of the exhaust gas temperature as an aid to mixture-setting.	X	X	X	X	X								
(06)		Explain the relation between mixture ratio, cylinder head temperature, detonation and pre-ignition.	X	X	X	X	X								
(07)		Explain the absence of mixture control in diesel engines.	X	X	X	X	X								
021 10 09 00		Aeroplane: propellers													
021 10 09 01		Definitions, general													
		Remark: Definitions and aerodynamic concepts are detailed in Subject 081 'Principles of flight (aeroplane)', Topic 07 (Propellers), but need to be appreciated for this Subject as well.	X	X											
021 10 09 02		Constant-speed propeller: design, operation, system components													
(01)		Describe the operating principle of a constant-speed propeller system under normal flight operations with the aid of a schematic.	X	X											
(02)		Explain the need for a MAP indicator to control the power setting with a constant-speed propeller.	X	X											
(03)		State the purpose of a torque-meter.	X	X											
(04)		State the purpose and describe the operation of a low-pitch stop (centrifugal latch).	X	X											
(05)		Describe the operating principle of a single-acting and a double- acting variable pitch propeller for single- and multi-engine aeroplanes.	X	X											

(06)		Describe the function and the basic operating principle of synchronising and synchro-phasing systems.	X	X											
(07)		Explain the purpose and the basic operating principle of an auto-feathering system and unfeathering.	X	X											
021 10 09 03		Reduction gearing: design													
(01)		State the purpose of reduction gearing.	X	X											
021 10 09 04		Propeller handling: associated control levers, degraded modes of operation, indications and warnings													
(01)		Describe the checks to be carried out on a constant-speed propeller system after engine start.	X	X											
(02)		Describe the operation of a constant-speed propeller system during flight at different true airspeeds (TAS) and rpm including an overspeeding propeller.	X	X											
(03)		Describe the operating principle of a variable pitch propeller when feathering and unfeathering, including the operation of cockpit controls.	X	X											
(04)		Describe the operating principle of a variable pitch propeller when reverse pitch is selected, including the operation of cockpit controls.	X	X											
(05)		Describe the operation of the propeller levers during different phases of flight.	X	X											
021 10 10 00		Performance and engine handling													

021 10 10 01		Performance													
(01)		Describe the effect on power output of a petrol and diesel engine taking into consideration the following parameters: — ambient pressure, exhaust back pressure; — temperature; — density altitude; — humidity.	X	X	X	X	X								
(02)		Explain the term 'normally aspirated engine'.	X	X	X	X	X								
(03)		Power-augmentation devices: explain the requirement for power augmentation (turbocharging) of a piston engine.	X	X	X	X	X								
(04)		Describe the function and the principle of operation of the following main components of a turbocharger: — turbine; — compressor; — waste gate; — waste-gate actuator.	X	X	X	X	X								
(05)		Explain the difference between an altitude-boosted turbocharger and a ground-boosted turbocharger.	X	X	X	X	X								
(06)		Explain turbo lag.	X	X	X	X	X								
(07)		Define the term 'critical altitude'.	X	X	X	X	X								
(08)		Explain the function of an intercooler.	X	X	X	X	X								
(09)		Define the terms 'full-throttle height' and 'rated altitude'.	X	X	X	X	X								

(10)		Explain the purpose of a supercharger and the basic differences from a turbocharger.	X	X	X	X	X								
021 10 10 02		Engine handling													
(01)		State the correct procedures for setting the engine controls when increasing or decreasing power.	X	X	X	X	X								
(02)		Define the following terms: — take-off power; — maximum continuous power.	X	X	X	X	X								
(03)		Describe the start problems associated with extreme cold weather.	X	X	X	X	X								
(04)		Describe the principal difference between a full-authority digital engine control (FADEC) system-controlled engine and traditional manual engine controls.	X	X	X	X	X								
(05)		Describe the engine controls available on the flight deck for a FADEC-controlled engine.	X	X	X	X	X								
(06)		Explain that the FADEC has full authority of the control of all engine parameters ensuring efficient and correct running of the engine, including protection in the event of failure.	X	X	X	X	X								
(07)		Explain the need for FADEC redundancy with regard to power supply and data input and output.	X	X	X	X	X								
021 11 00 00		TURBINE ENGINES													
021 11 01 00		Basic principles													
021 11 01 01		Basic generation of thrust and the thrust formula													

(01)		Describe how thrust is produced by a basic gas turbine engine.	X	X											
(02)		Describe the simple form of the thrust formula for a basic, straight jet engine and perform simple calculations (including pressure thrust).	X	X											
(03)		State that thrust can be considered to remain approximately constant over the whole aeroplane subsonic speed range.	X	X											
021 11 01 02		Design, types and components of turbine engines													
(01)		List the main components of a basic gas turbine engine: — inlet; — compressor; — combustion chamber; — turbine; — outlet.	X	X	X	X	X								
(02)		Describe the variation of static pressure, temperature and axial velocity in a gas turbine engine under normal operating conditions and with the aid of a working cycle diagram.	X	X	X	X	X								
(03)		Describe the differences between absolute, circumferential (tangential) and axial velocity.	X	X	X	X	X								
(04)		List the different types of gas turbine engines: — straight jet; — turbofan; — turboprop.	X	X											

(05)		State that a gas turbine engine can have one or more spools.	X	X	X	X	X								
(06)		Describe how thrust is produced by turbojet and turbofan engines.	X	X											
(07)		Describe how power is produced by turboprop engines.	X	X											
(08)		Describe the term 'equivalent horsepower' (= thrust horsepower + shaft horsepower).	X	X											
(09)		Explain the principle of a free turbine or free-power turbine.	X	X	X	X	X								
(10)		Define the term 'bypass ratio' and perform simple calculations to determine it.	X	X											
(11)		Define the terms 'propulsive power', 'propulsive efficiency', 'thermal efficiency' and 'total efficiency'.	X	X											
(12)		Describe the influence of compressor-pressure ratio on thermal efficiency.	X	X	X	X	X								
(13)		Explain the variations of propulsive efficiency with forward speed for turbojet, turbofan and turboprop engines.	X	X											
(14)		Define the term 'specific fuel consumption' for turbojets and turboprops.	X	X											
021 11 01 03		Coupled turbine engine: design, operation, components and materials													
(01)		Name the main assembly parts of a coupled turbine engine and explain its operation.			X	X	X								

(02)		Explain the limitations of the materials used with regard to maximum turbine temperature, engine and drive train torque limits.			X	X	X								
(03)		Describe the possible effects on engine components when limits are exceeded.			X	X	X								
(04)		Explain that when engine limits are exceeded, this event must be reported.			X	X	X								
021 11 01 04		Free-turbine engine: design, components and materials													
(01)		Describe the design methods to keep the engine’s size small for installation in helicopters.			X	X	X								
(02)		List the main components of a free-turbine engine.			X	X	X								
(03)		Describe how the power is developed by a turboshaft/free-turbine engine.			X	X	X								
(04)		Explain how the exhaust gas temperature is used to monitor turbine stress.			X	X	X								
021 11 02 00		Main-engine components													
021 11 02 01		Aeroplane: air intake													
(01)		State the functions of the engine air inlet/air intake.	X	X											
(02)		Describe the geometry of a subsonic (pitot-type) air inlet.	X	X											
(03)		Explain the gas-parameter changes in a subsonic air inlet at different flight speeds.	X	X											

(04)		Describe the reasons for, and the dangers of, the following operational problems concerning the engine air inlet: — airflow separation; — inlet icing; — inlet damage; — foreign object damage (FOD); — heavy in-flight turbulence.	X	X											
021 11 02 02		Compressor and diffuser													
(01)		State the purpose of the compressor.	X	X	X	X	X								
(02)		Describe the working principle of a centrifugal and an axial flow compressor.	X	X	X	X	X								
(03)		Name the following main components of a single stage and describe their function for a centrifugal compressor: — impeller; — diffuser.	X	X	X	X	X								
(04)		Name the following main components of a single stage and describe their function for an axial compressor: — rotor vanes; — stator vanes.	X	X	X	X	X								
(05)		Describe the gas-parameter changes in a compressor stage.	X	X	X	X	X								
(06)		Define the term ‘pressure ratio’ and state a typical value for one stage of a centrifugal and an	X	X	X	X	X								

		axial flow compressor and for the complete compressor.													
(07)		State the advantages and disadvantages of increasing the number of stages in a centrifugal compressor.	X	X	X	X	X								
(08)		Explain the difference in sensitivity for FOD of a centrifugal compressor compared with an axial flow type.	X	X	X	X	X								
(09)		Explain the convergent air annulus through an axial flow compressor.	X	X	X	X	X								
(10)		Describe the reason for twisting the compressor blades.	X	X	X	X	X								
(11)		State the tasks of inlet guide vanes (IGVs).	X	X	X	X	X								
(12)		State the reason for the clicking noise whilst the compressor slowly rotates on the ground.	X	X	X	X	X								
(13)		State the advantages of increasing the number of spools.	X	X	X	X	X								
(14)		Explain the implications of tip losses and describe the design features to minimise the problem.	X	X	X	X	X								
(15)		Explain the problems of blade bending and flapping and describe the design features to minimise the problem.	X	X	X	X	X								
(16)		Explain the following terms: — compressor stall; — engine surge.	X	X	X	X	X								

(17)		State the conditions that are possible causes of stall and surge.	X	X	X	X	X									
(18)		Describe the indications of stall and surge.	X	X	X	X	X									
(19)		Describe the design features used to minimise the occurrence of stall and surge.	X	X	X	X	X									
(20)		Describe a compressor map (surge envelope) with rpm lines, stall limit, steady state line and acceleration line.	X	X	X	X	X									
(21)		Describe the function of the diffuser.	X	X	X	X	X									
021 11 02 03		Combustion chamber														
(01)		Define the purpose of the combustion chamber.	X	X	X	X	X									
(02)		List the requirements for combustion.	X	X	X	X	X									
(03)		Describe the working principle of a combustion chamber.	X	X	X	X	X									
(04)		Explain the reason for reducing the airflow axial velocity at the combustion chamber inlet (snout).	X	X	X	X	X									
(05)		State the function of the swirl vanes (swirler).	X	X	X	X	X									
(06)		State the function of the drain valves.	X	X	X	X	X									
(07)		Define the terms ‘primary airflow’ and ‘secondary airflow’, and explain their purpose.	X	X	X	X	X									
(08)		Explain the following two mixture ratios: — primary airflow to fuel; — total airflow (within the combustion chamber) to fuel.	X	X	X	X	X									
(09)		Describe the gas-parameter changes in the combustion chamber.	X	X	X	X	X									

(10)		State a typical maximum value of the outlet temperature of the combustion chamber.	X	X	X	X	X								
(11)		Describe the following types of combustion chambers and state the differences between them: — can type; — can-annular, cannular or turbo-annular; — annular; — reverse-flow annular.	X	X	X	X	X								
021 11 02 04		Turbine													
(01)		Explain the purpose of a turbine in different types of gas turbine engines.	X	X	X	X	X								
(02)		Describe the principles of operation of impulse, reaction and impulse-reaction axial flow turbines.	X	X	X	X	X								
(03)		Name the main components of a turbine stage and their function.	X	X	X	X	X								
(04)		Describe the working principle of a turbine.	X	X	X	X	X								
(05)		Describe the gas-parameter changes in a turbine stage.	X	X	X	X	X								
(06)		Describe the function and the working principle of active clearance control.	X	X											
(07)		Describe the implications of tip losses and the means to minimize them.	X	X	X	X	X								
(08)		Explain why the available engine thrust is limited by the turbine inlet temperature.	X	X											

(09)		Explain the divergent gas-flow annulus through an axial-flow turbine.	X	X	X	X	X								
(10)		Explain the high mechanical thermal stress in the turbine blades and wheels/discs.	X	X	X	X	X								
021 11 02 05		Aeroplane: exhaust													
(01)		Name the following main components of the exhaust unit and their function: — jet pipe; — propelling nozzle; — exhaust cone.	X	X											
(02)		Describe the working principle of the exhaust unit.	X	X											
(03)		Describe the gas-parameter changes in the exhaust unit.	X	X											
(04)		Define the term 'choked exhaust nozzle' (not applicable to turboprops).	X												
(05)		Explain how jet exhaust noise can be reduced.	X	X											
021 11 02 06		Helicopter: air intake													
(01)		Name and explain the main task of the engine air intake.			X	X	X								
(02)		Describe the use of a convergent air-intake ducting on helicopters.			X	X	X								

(03)		Describe the reasons for and the dangers of the following operational problems concerning engine air intake: — airflow separations; — intake icing; — intake damage; — FOD; — heavy in-flight turbulence.			X	X	X								
(04)		Describe the conditions and circumstances during ground operations when FOD is most likely to occur.			X	X	X								
(05)		Describe and explain the principles of air intake filter systems that can be fitted to some helicopters for operations in icing and sand conditions.			X	X	X								
(06)		Describe the function of the heated pads on some helicopter air intakes.			X	X	X								
021 11 02 07		Helicopter: exhaust													
(01)		Describe the working principle of the exhaust unit.			X	X	X								
(02)		Describe the gas-parameter changes in the exhaust unit.			X	X	X								
021 11 03 00		Additional components and systems													
021 11 03 01		Engine fuel system													

(01)		Name the main components of the engine fuel system and state their function: — filters; — low-pressure (LP) pump; — high-pressure (HP) pump; — fuel manifold; — fuel nozzles; — HP fuel cock; — fuel control; or — hydromechanical unit.	X	X	X	X	X								
(02)		Name the two types of engine-driven high-pressure pumps, such as: — gear-type; — swash plate-type.	X	X	X	X	X								
(03)		State the tasks of the fuel control unit.	X	X	X	X	X								
(04)		List the possible input parameters to a fuel control unit to achieve a given thrust/power setting.	X	X	X	X	X								
021 11 03 02		Engine control system													
(01)		State the tasks of the engine control system.	X	X	X	X	X								
(02)		List the following different types of engine control systems: — hydromechanical; — hydromechanical with a limited authority electronic supervisor; — single-channel FADEC with hydromechanical	X	X	X	X	X								

		backup; — dual-channel FADEC with no backup or any other combination.													
(03)		Describe a FADEC as a full-authority dual-channel system including functions such as an electronic engine control unit, wiring, sensors, variable vanes, active clearance control, bleed configuration, electrical signalling of thrust lever angle (TLA) (see also AMC to CS-E-50), and an EGT protection function and engine overspeed.	X		X	X									
(04)		Explain how redundancy is achieved by using more than one channel in a FADEC system.	X		X	X									
(05)		State the consequences of a FADEC single input data failure.	X		X	X									
(06)		State that all input and output data is checked by both channels in a FADEC system.	X		X	X									
(07)		State that a FADEC system uses its own sensors and that, in some cases, also data from aircraft systems is used.	X		X	X									
(08)		State that a FADEC must have its own source of electrical power.	X		X	X									
021 11 03 03		Engine lubrication													
(01)		State the tasks of an engine lubrication system.	X	X											

(02)		Name the following main components of a lubrication system and state their function: — oil tank and centrifugal breather; — oil pumps (pressure and scavenge pumps); — oil filters (including the bypass); — oil sumps; — chip detectors; — coolers.	X	X											
(03)		Explain that each spool is fitted with at least one ball bearing and two or more roller bearings.	X	X											
(04)		Explain the use of compressor air in oil-sealing systems (e.g. labyrinth seals).	X	X											
021 11 03 04		Engine auxiliary gearbox													
(01)		State the tasks of the auxiliary gearbox.	X	X											
(02)		Describe how the gearbox is driven and lubricated.	X	X											
021 11 03 05		Engine ignition													
(01)		State the task of the ignition system.	X	X											
(02)		Name the following main components of the ignition system and state their function: — power sources; — igniters.	X	X											
(03)		State why jet turbine engines are equipped with two electrically independent ignition systems.	X	X											

(04)		Explain the different modes of operation of the ignition system.	X	X											
021 11 03 06		Engine starter													
(01)		Name the main components of the starting system and state their function.	X	X											
(02)		Explain the principle of a turbine engine start.	X	X											
(03)		Describe the following two types of starters: — electric; — pneumatic.	X	X											
(04)		Describe a typical start sequence (on ground/in flight) for a turbofan.	X	X											
(05)		Define 'self-sustaining rpm'.	X	X											
021 11 03 07		Reverse thrust													
(01)		Name the following main components of a reverse-thrust system and state their function: — reverse-thrust select lever; — power source (pneumatic or hydraulic); — actuators; — doors; — annunciations.	X	X											
(02)		Explain the principle of a reverse-thrust system.	X	X											
(03)		Identify the advantages and disadvantages of using reverse thrust.	X	X											

(04)		Describe and explain the following different types of thrust- reverser systems: — hot-stream reverser; — clamshell or bucket-door system; — cold-stream reverser (only turbofan engines); blocker doors; — cascade vanes.	X	X											
(05)		Explain the implications of reversing the cold stream (fan reverser) only on a high bypass ratio engine.	X	X											
(06)		Describe the protection features against inadvertent thrust- reverse deployment in flight as present on most transport aeroplanes.	X	X											
(07)		Describe the controls and indications provided for the thrust- reverser system.	X	X											
021 11 03 08		Helicopter specifics on design, operation and components for additional components and systems such as lubrication system, ignition circuit, starter, accessory gearbox													
(01)		State the task of the lubrication system.			X	X	X								
(02)		List and describe the common helicopter lubrication systems.			X	X	X								

(03)		Name the following main components of a helicopter lubrication system: — reservoir; — pump assembly; — external oil filter; — magnetic chip detectors, electronic chip detectors; — thermostatic oil coolers; — breather.			X	X	X								
(04)		Identify and name the components of a helicopter lubrication system from a diagram.			X	X	X								
(05)		Identify the indications used to monitor a lubrication system including warning systems.			X	X	X								
(06)		Explain the differences and appropriate use of straight oil and compound oil, and describe the oil numbering system for aviation use.			X	X	X								
(07)		Explain and describe the ignition circuit for engine start and engine relight facility when the selection is set for both automatic and manual functions.			X	X	X								
(08)		Explain and describe the starter motor and the sequence of events when starting, and that for most helicopters the starter becomes the generator after the starting sequence is over.			X	X	X								
(09)		Explain and describe why the engine drives the accessory gearbox.			X	X	X								
021 11 04 00		Engine operation and monitoring													

021 11 04 01		General													
(01)		Explain the following aeroplane engine ratings: — take-off; — go-around; — maximum continuous thrust/power; — maximum climb thrust/power.	X	X											
(02)		Explain spool-up time.	X	X	X	X	X								
(03)		Explain the reason for the difference between ground and approach flight idle values (rpm).	X	X											
(04)		State the parameters that can be used for setting and monitoring the thrust/power.	X	X	X	X	X								
(05)		Describe the terms 'alpha range', 'beta range' and 'reverse thrust' as applied to a turboprop power lever.	X	X											
(06)		Explain the dangers of inadvertent beta-range selection in flight for a turboprop.	X	X											
(07)		Explain the purpose of engine trending.	X	X											
(08)		Explain how the exhaust gas temperature is used to monitor turbine stress.	X	X	X	X	X								
(09)		Describe the effect of engine acceleration and deceleration on the EGT.	X	X	X	X									
(10)		Describe the possible effects on engine components when EGT limits are exceeded.	X	X	X	X	X								
(11)		Explain why engine-limit exceedances must be reported.	X	X	X	X	X								

(12)		Explain the limitations on the use of the thrust-reverser system at low forward speed.	X	X			X								
(13)		Explain the term ‘engine seizure’.	X	X	X	X	X								
(14)		State the possible causes of engine seizure and explain their preventative measures.	X	X	X	X	X								
(15)		Describe the potential consequences of a leak in the following two designs of fuel and oil heat exchanger: — oil pressure higher than fuel pressure with oil leaking into the fuel system, potentially affecting the combustion and running of the engine; — fuel pressure higher than oil pressure with fuel leaking into the oil system, potentially increasing the risk of a fire due to fuel entering warm parts of the engine that should be free from fuel.	X	X	X	X	X								
(16)		Explain oil-filter clogging (blockage) and the implications for the lubrication system.	X	X	X	X	X								
(17)		Give examples of monitoring instruments of an engine.	X	X	X	X	X								
(18)		Describe how to identify and assess engine damage based on instrument indications.	X	X	X	X	X								
021 11 04 02		Starting malfunctions													

(01)		Describe the indications and the possible causes of the following aeroplane starting malfunctions: — false (dry or wet) start; — tailpipe fire (torching); — hot start; — abortive (hung) start; — no N1 rotation; — no FADEC indications.	X	X											
(02)		Describe the indications and the possible causes of the following helicopter starting malfunctions: — false (dry or wet) start; — tailpipe fire (torching); — hot start; — abortive (hung) start; — no N1 rotation; — freewheel failure; — no FADEC indications.			X	X	X								
021 11 04 03		Relight envelope													
(01)		Explain the relight envelope.	X	X											
021 11 05 00		Performance aspects													
021 11 05 01		Thrust, performance aspects, and limitations													
(01)		Describe the variation of thrust and specific fuel consumption with altitude at constant TAS.	X	X											

(02)		Describe the variation of thrust and specific fuel consumption with TAS at constant altitude.	X	X											
(03)		Explain the term 'flat-rated engine' by describing the change of take-off thrust, turbine inlet temperature and engine rpm with outside air temperature (OAT).	X	X											
(04)		Define the term 'engine pressure ratio' (EPR).	X	X											
(05)		Explain the use of reduced (flexible) and derated thrust for take- off, and explain the advantages and disadvantages when compared with a full-rated take-off.	X	X											
(06)		Describe the effects of use of bleed air on rpm, EGT, thrust, and specific fuel consumption.	X	X											
021 11 05 02		Helicopter engine ratings, engine performance and limitations, engine handling: torque, performance aspects and limitations													
(01)		Describe engine rating torque limits for take-off, transient and maximum continuous.			X	X	X								
(02)		Describe turbine outlet temperature (TOT) limits for take-off.			X	X	X								
(03)		Explain why TOT is a limiting factor for helicopter performance.			X	X	X								
(04)		Describe and explain the relationship between maximum torque available and density altitude, which leads to decreasing torque available with the increase of density altitude.			X	X	X								

(05)		Explain that hovering downwind, on some helicopters, will noticeably increase the engine TOT.			X	X	X								
(06)		Explain the reason why the engine performance is less when aircraft accessories (i.e. anti-ice, heating, hoist, filters) are switched on.			X	X	X								
(07)		Describe the effects of use of bleed air on engine parameters.			X	X	X								
(08)		Explain that, on some helicopters, exceeding the TOT limit may cause the main rotor to droop (slow down).			X	X	X								
(09)		Describe overtorquing and explain the consequences.			X	X	X								
021 11 06 00		Auxiliary power unit (APU)													
021 11 06 01		Design, operation, functions, operational limitations													
(01)		State that an APU is a gas turbine engine and list its tasks.	X		X	X									
(02)		State the difference between the two types of APU inlets.	X		X	X									
(03)		Define 'maximum operating and maximum starting altitude'.	X		X	X									
(04)		Name the typical APU control and monitoring instruments.	X		X	X									
(05)		Describe the APU's automatic shutdown protection.	X		X	X									
021 12 00 00		PROTECTION AND DETECTION SYSTEMS													
021 12 01 00		Smoke detection													

021 12 01 01		Types, design, operation, indications and warnings													
(01)		Explain the operating principle of the following types of smoke detection sensors: — optical; — ionising.	X	X	X	X	X								
(02)		Give an example of warnings, indications and function tests.	X	X	X	X	X								
021 12 02 00		Fire-protection systems													
021 12 02 01		Fire extinguishing (engine and cargo compartments)													
(01)		Explain the operating principle of a built-in fire-extinguishing system and describe its components.	X	X	X	X	X								
(02)		State that two discharges must be provided for each engine (see CS 25.1195(c) Fire-extinguisher systems).	X	X											
021 12 02 02		Fire detection													
(01)		Explain the following principles of fire detection: resistance and capacitance; gas pressure.	X	X	X	X	X								
(02)		Explain fire-detection applications such as: bimetallic; continuous loop; gaseous loop (gas-filled detectors).	X	X	X	X	X								
(03)		Explain why generally double-loop systems are used.	X	X	X	X	X								
(04)		Give an example of warnings, indications and function tests of a fire-protection system.	X	X	X	X	X								

021 12 03 00		Rain-protection system													
021 12 03 01		Principle and method of operation													
(01)		Explain the principle and method of operation of the following windshield rain-protection systems for an aeroplane: — wipers; — liquids (rain-repellent); — coating.	X	X											
(02)		Explain the principle and method of operation of wipers for a helicopter.			X	X	X								
021 13 00 00		OXYGEN SYSTEMS													
021 13 01 00		Cockpit, portable and chemical oxygen systems													
021 13 01 01		Operating principles, actuation methods, comparison													
(01)		Describe the basic operating principle of a cockpit oxygen system and describe the following different modes of operation: — normal (diluter demand); — 100 %; — emergency.	X	X											
(02)		Describe the operating principle and the purposes of the following two portable oxygen systems: — smoke hood; — portable bottle.	X	X											

(03)		Describe the following two oxygen systems that can be used to supply oxygen to passengers: — fixed system (chemical oxygen generator or gaseous system); — portable.	X	X											
(04)		Describe the actuation methods (automatic and manual) and the functioning of a passenger oxygen mask.	X	X											
(05)		Compare chemical oxygen generators to gaseous systems with respect to: — capacity; — flow regulation.	X	X											
(06)		State the dangers of grease or oil related to the use of oxygen systems.	X	X											
021 14 00 00		HELICOPTER: MISCELLANEOUS SYSTEMS													
021 14 01 00		Variable rotor speed, active vibration suppression, night-vision goggles (NVG)													
021 14 01 01		Variable rotor speed													
(01)		Explain the system for ‘beeping’ the NR to its upper limit.			X	X	X								
021 14 01 02		Active vibration suppression													
(01)		Explain and describe how the active vibration suppression system works through high-speed actuators and accelerometer inputs.			X	X	X								
021 14 01 03		NVG													
		To be introduced at a later date.			X	X	X								

021 15 00 00		HELICOPTER: ROTOR HEADS													
021 15 01 00		Main rotor													
021 15 01 01		Types													
(01)		Describe the following rotor-head systems: — teetering (semi-articulated); — articulated; — hingeless (rigid); — bearingless (semi-articulated).			X	X	X								
(02)		Describe in basic terms the following configuration of rotor systems and their advantages and disadvantages: — tandem; — coaxial; — side by side.			X	X	X								
(03)		Explain how flapping, dragging and feathering is achieved in each rotor-head system.			X	X	X								
021 15 01 02		Structural components and materials, stresses, structural limitations													
(01)		Identify from a diagram the main structural components of the main types of rotor-head systems.			X	X	X								
(02)		List and describe the methods used to detect damage and cracks.			X	X	X								

(03)		Explain and describe the structural limitations to respective rotor systems, including the dangers of negative G inputs to certain rotor-head systems.			X	X	X								
(04)		Describe the various rotor-head lubrication methods.			X	X	X								
021 15 01 03		Design and construction													
(01)		Describe the material technology used in rotor-head design, including construction, using the following materials or mixture of materials: — composites; — fibreglass; — alloys; — elastomers.			X	X	X								
021 15 01 04		Adjustment													
(01)		Describe and explain the methods of adjustment which are possible on various helicopter rotor-head assemblies.			X	X	X								
021 15 02 00		Tail rotor													
021 15 02 01		Types													

(01)		Describe the following tail-rotor systems: — delta-3 hinge effect; — multi-bladed delta-3 effect; — Fenestron or ducted fan tail rotor; — no tail rotor (NOTAR) low-velocity air jet flows from tangential slots (the Coandă effect); — NOTAR high-velocity air jet flows from adjustable nozzles (the Coandă effect).			X	X	X								
(02)		Identify from a diagram the main structural components of the four main types of tail-rotor systems.			X	X	X								
(03)		Explain and describe the methods to detect damage and cracks on the tail rotor and assembly.			X	X	X								
(04)		Explain and describe the structural limitations to the respective tail-rotor systems and possible limitations regarding the turning rate of the helicopter.			X	X	X								
(05)		Explain and describe the following methods that helicopter designers use to minimise tail-rotor drift and roll: — reducing the couple arm (tail rotor on a pylon); — offsetting the rotor mast; — use of 'bias' in cyclic control mechanism.			X	X	X								
(06)		Explain pitch-input mechanisms.			X	X	X								

(07)		Explain the relationship between tail-rotor thrust and engine power.			X	X	X								
(08)		Describe how the vertical fin on some types reduces the power demand of the tail rotor.			X	X	X								
021 15 02 02		Design and construction													
(01)		List and describe the various tail-rotor designs and construction methods used on helicopters currently in service.			X	X	X								
021 16 00 00		HELICOPTER: TRANSMISSION													
021 16 01 00		Main gearbox													
021 16 01 01		Different types, design, operation, limitations													
(01)		Describe the following main principles of helicopter transmission systems for single- and twin-engine helicopters: — drive for the main and tail rotor; — accessory drive for the generator(s), alternator(s), hydraulic and oil pumps, oil cooler(s) and tachometers.			X	X	X								
(02)		Describe the reason for limitations on multi-engine helicopter transmissions in various engine-out situations.			X	X	X								
(03)		Describe how the passive vibration control works with gearbox mountings.			X	X	X								
021 16 02 00		Rotor brake													
021 16 02 01		Types, operational considerations													
(01)		Describe the main function of the disc type of rotor brake.			X	X	X								

(02)		Describe both hydraulic- and cable-operated rotor-brake systems.			X	X	X								
(03)		Describe the different options for the location of the rotor brake.			X	X	X								
(04)		List the following operational considerations for the use of rotor brakes: — rotor speed at engagement of rotor brake; — risk of blade sailing in windy conditions; — risk of rotor-brake overheating and possible fire when brake is applied above the maximum limit, particularly when spilled hydraulic fluid is present; — avoid stopping blades over jet-pipe exhaust with engine running; — cockpit annunciation of rotor-brake operation.			X	X	X								
021 16 03 00		Auxiliary systems													
021 16 03 01		Powering the air-conditioning system													
(01)		Explain how power for the air-conditioning system is taken from the auxiliary gearbox.			X	X	X								
021 16 04 00		Driveshaft and associated installation													
021 16 04 01		Power, construction, materials, speed and torque													
(01)		Describe how power is transmitted from the engine to the main- rotor gearbox.			X	X	X								
(02)		Describe the material and construction of the driveshaft.			X	X	X								

(03)		Explain the need for alignment between the engine and the main-rotor gearbox.			X	X	X								
(04)		Identify how temporary misalignment occurs between driving and driven components.			X	X	X								
(05)		Explain the relationship between driveshaft speed and torque.			X	X	X								
(06)		Describe the methods with which power is delivered to the tail rotor.			X	X	X								
(07)		Describe and identify the construction and materials of tail-rotor/Fenestron driveshafts.			X	X	X								
021 16 05 00		Intermediate and tail gearbox													
021 16 05 01		Lubrication, gearing													
(01)		Explain and describe the various arrangements when the drive changes direction and the need for an intermediate or tail gearbox.			X	X	X								
(02)		Explain the lubrication requirements for intermediate and tail- rotor gearboxes and methods of checking levels.			X	X	X								
(03)		Explain how on most helicopters the tail-rotor gearbox contains gearing, etc., for the tail-rotor pitch-change mechanism.			X	X	X								
021 16 06 00		Clutches													
021 16 06 01		Purpose, operation, components, serviceability													
(01)		Explain the purpose of a clutch.			X	X	X								

(02)		Describe and explain the operation of a: — centrifugal clutch; — actuated clutch.			X	X	X								
(03)		List the typical components of the various clutches.			X	X	X								
(04)		Identify the following methods by which clutch serviceability can be ascertained: — brake-shoe dust; — vibration; — main-rotor run-down time; — engine speed at time of main-rotor engagement; — belt tensioning; — start protection in a belt-drive clutch system.			X	X	X								
021 16 07 00		Freewheels													
021 16 07 01		Purpose, operation, components, location													
(01)		Explain the purpose of a freewheel.			X	X	X								
(02)		Describe and explain the operation of a: — cam- and roller-type freewheel; — sprag-clutch-type freewheel.			X	X	X								
(03)		List the typical components of the various freewheels.			X	X	X								
(04)		Identify the various locations of freewheels in power plant and transmission systems.			X	X	X								
(05)		Explain the implications regarding the engagement and disengagement of the freewheel.			X	X	X								

021 17 00 00		HELICOPTER: BLADES													
021 17 01 00		Main-rotor design and blade design													
021 17 01 01		Design, construction													
(01)		Describe the different types of blade construction and the need for torsional stiffness.			X	X	X								
(02)		Describe the principles of heating systems/pads on some blades for anti-icing/de-icing.			X	X	X								
(03)		Describe the fully articulated rotor with hinges and feathering hinges.			X	X	X								
021 17 01 02		Structural components and materials													
(01)		List the materials used in the construction of main-rotor blades.			X	X	X								
(02)		List the main structural components of a main-rotor blade and their function.			X	X	X								
(03)		Describe the drag hinge of the fully articulated rotor and the lag flexure in the hingeless rotor.			X	X	X								
(04)		Explain the necessity for drag dampers.			X	X	X								
021 17 01 03		Forces and stresses													
(01)		Describe main-rotor blade-loading on the ground and in flight.			X	X	X								
(02)		Describe where the most common stress areas are on rotor blades.			X	X	X								
(03)		Show how the centrifugal forces depend on rotor rpm and blade mass and how they pull on the blade's attachment to the hub. Justify the upper limit of the rotor rpm.			X	X	X								

(04)		Assume a rigid attachment and show how thrust may cause huge oscillating bending moments which stress the attachment.			X	X	X								
(05)		Explain why flapping hinges do not transfer such moments. Show the small flapping hinge offset on fully articulated rotors and zero offset in the case of teetering rotors.			X	X	X								
(06)		Describe the working principle of the flexible element in the hingeless rotor and describe the equivalent flapping hinge offset compared to that of the articulated rotor.			X	X	X								
021 17 01 04		Structural limitations													
(01)		Explain the structural limitations in terms of bending and rotor rpm.			X	X	X								
021 17 01 05		Adjustment													
(01)	X	Explain the use of trim tabs.			X	X	X								
021 17 01 06		Tip shape													
(01)		Describe the various blade-tip shapes used by different manufacturers and compare their advantages and disadvantages.			X	X	X								
021 17 01 07		Origins of the vertical vibrations													
(01)		Explain the lift (thrust) variations per revolution of a blade and the resulting vertical total rotor thrust (TRT) variation in the case of perfectly identical blades.			X	X	X								
(02)		Show the resulting frequencies and amplitudes as a function of the number of blades.			X	X	X								

(03)		Explain the thrust variation in the case of an out-of-track blade, causes, and frequencies (one-per-revolution).			X	X	X								
021 17 01 08		Lateral vibrations													
(01)		Explain blade imbalances, causes, and effects.			X	X	X								
021 17 02 00		Tail-rotor design and blade design													
021 17 02 01		Design, construction													
(01)		Describe the most common design of tail-rotor blade construction, consisting of stainless steel shell reinforced by a honeycomb filler and stainless steel leading abrasive strip.			X	X	X								
(02)		Explain that ballast weights are located at the inboard trailing edge and tip of blades, and that the weights used are determined when the blades are manufactured.			X	X	X								
(03)		Describe how, for some helicopters, anti-icing/de-icing systems are designed into the blade construction.			X	X	X								
(04)		Describe the two-bladed rotor with a teetering hinge, and rotors with more than two blades.			X	X	X								
(05)		Describe the dangers to ground personnel and to the rotor blades, and how to minimise these dangers.			X	X	X								
021 17 02 02		Intentionally left blank													
021 17 02 03		Stresses, vibrations and balancing													
(01)		Describe the tail-rotor blade-loading on the ground and in flight.			X	X	X								

(02)		Explain the sources of vibration of the tail rotor and the resulting high frequencies.			X	X	X								
(03)		Explain balancing and tracking of the tail rotor.			X	X	X								
021 17 02 04		Structural limitations													
(01)		Describe the structural limitations of the tail-rotor blades.			X	X	X								
(02)		Describe the method of checking the strike indicators placed on the tip of some tail-rotor blades.			X	X	X								
021 17 02 05		Adjustment													
(01)		Describe the adjustment of yaw pedals in the cockpit to obtain full-control authority of the tail rotor.			X	X	X								
021 17 02 06		The Fenestron													
(01)		Describe the technical layout of a Fenestron tail rotor.			X	X	X								
(02)		Explain the advantages and disadvantages of a Fenestron tail rotor.			X	X	X								
021 17 02 07		No tail rotor (NOTAR)													
(01)		Describe the technical layout of a NOTAR design.			X	X	X								
(02)		Explain the control concepts of a NOTAR.			X	X	X								
(03)		Explain the advantages and disadvantages of a NOTAR design.			X	X	X								
022 00 00 00		AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION SENSORS AND INSTRUMENTS													
022 01 00 00		Pressure gauge													

022 01 01 00		Units for pressure, sensor types, measurements													
022 01 01 01		AIRCRAFT GENERAL KNOWLEDGE													
(01)	X	Define ‘pressure’, ‘absolute pressure’ and ‘differential pressure’.	X	X	X	X	X								
(02)	X	List the following units used for pressure measurement: — Pascal; — bar; — inches of mercury (in Hg); — pounds per square inch (psi).	X	X	X	X	X								
(03)	X	State the relationship between the different units.	X	X	X	X	X								
(04)		List and describe the following different types of sensors us according to the pressure to be measured: — aneroid capsules; — bellows; — diaphragms; — Bourdon tube.	X	X	X	X	X								
(05)		Identify pressure measurements that are applicable to an aircraft: — liquid-pressure measurement (fuel, oil, hydraulic); — air-pressure measurement (bleed-air systems, air- conditioning systems); — engine-pressure measurement manifold pressure (MAP), engine pressure ratio (EPR)).	X	X	X	X	X								

(06)		Identify and read pressure measurement indications both for engine indications and other systems	X	X	X	X	X								
(07)		Explain the implications of the following pressure measurement errors both for engine indications and other systems: — loss of pressure sensing; — incorrect pressure indications.	X	X	X	X	X								
022 01 02 00		Temperature sensing													
022 01 02 01		Units for temperature, measurements													
(01)	X	Explain temperature.	X	X	X	X	X								
(02)	X	List the following units that can be used for temperature measurement: — Kelvin; — Celsius; — Fahrenheit.	X	X	X	X	X								
(03)	X	State the relationship between these units and convert between them.	X	X	X	X	X								
(04)		Identify temperature measurements that are applicable to an aircraft: — gas temperature measurement (ambient air, bleed-air systems, air-conditioning systems, air inlet, exhaust gas, gas turbine outlets); — liquid-temperature measurement (fuel, oil, hydraulic); — component-temperature measurement (generator, transformer rectifier unit (TRU), pumps (fuel, hydraulic), power transfer unit (PTU).	X	X	X	X	X								

(05)		Identify and read temperature measurement indications for both engine indications and other systems.	X	X	X	X	X								
022 01 03 00		Fuel gauge													
022 01 03 01		Units for fuel, measurements, fuel gauges													
(01)		State that the quantity of fuel can be measured by volume or mass.	X	X	X	X	X								
(02)		List the following units used for fuel quantity: — kilogramme; — pound; — litres; — gallons (US and imperial).	X	X	X	X	X								
(03)		Convert between the various units.	X	X	X	X	X								
(04)		Explain the parameters that can affect the measurement of the volume or mass of the fuel in a fuel tank: — temperature; — aircraft accelerations and attitudes; — and explain how the fuel-gauge system design compensates for these changes.	X	X	X	X	X								
(05)		Describe and explain the operating principles of the following types of fuel gauges: — float system; — capacitance-type of fuel-gauge system. — ultrasound-type of fuel-gauge system: to be introduced at a later date.	X	X	X	X	X								

(06)		Describe and complete a typical post-refuelling procedure for a pilot: — recording the volume that was filled; — converting to the appropriate unit used by the aircraft fuel gauge(s) to compare the actual indicated fuel content to the calculated fuel content; — assess appropriate action if the numbers does not compare.	X	X	X	X	X								
022 01 04 00		Fuel flowmeters													
022 01 04 01		Fuel flow, units for fuel flow, total fuel consumption													
(01)		Define 'fuel flow' and where it is measured.	X	X	X	X	X								
(02)		State that fuel flow may be measured by volume or mass per unit of time.	X	X	X	X	X								
(03)		List the following units used for fuel flow when measured by mass per hour: — kilogrammes/hour; — pounds/hour.	X	X	X	X	X								
(04)		List the following units used for fuel flow when measured by volume per hour: — litres/hour; — imperial gallons/hour; — US gallons/hour.	X	X	X	X	X								
(05)		Explain how total fuel consumption is obtained.	X	X	X	X	X								
022 01 05 00		Tachometer													

022 01 05 01		Types, operating principles, units for engine speed													
(01)	X	List the following types of tachometers, describe their basic operating principle and give examples of use: — mechanical (rotating magnet); — electrical (three-phase tacho-generator); — electronic (impulse measurement with speed probe and phonic wheel); — and describe the operating principle of each type.	X	X	X	X	X								
(02)		Explain the typical units for engine speed: — rpm for piston-engine aircraft; — percentage for turbine-engine aircraft.	X	X	X	X	X								
(03)		Explain that some types of rpm indicators require electrical power to provide an indication.	X	X	X	X	X								
022 01 06 00		Thrust measurement													
022 01 06 01		Parameters, operating principle													
(01)		List and describe the following two parameters used to represent thrust: — N1; — EPR.	X	X											
(02)		Explain the operating principle of using an engine with EPR indication and explain the consequences of incorrect or missing EPR to the operation of the engine, including reverting to N1 mode.	X	X											
(03)		Give examples of display for N1 and EPR.	X	X											

022 01 07 00		Engine torquemeter													
022 01 07 01		Torque, torquemeters													
(01)		Define ‘torque’.	X	X	X	X	X								
(02)		Explain the relationship between power, torque and rpm.	X	X	X	X	X								
(03)		List the following units used for torque: — Newton meters; — inch or foot pounds.	X	X	X	X	X								
(04)		State that engine torque can be displayed as a percentage.	X	X	X	X	X								
(05)	X	List and describe the following different types of torquemeters, and explain their operating principles: — mechanical; — electronic.	X	X	X	X	X								
(06)	X	Compare the two systems with regard to design and weight.	X	X	X	X	X								
(07)		Give examples of display.	X	X	X	X	X								
022 01 08 00		Synchroscope													
022 01 08 01		Purpose, operating principle, display													
(01)		State the purpose of a synchroscope.	X	X											
(02)	X	Explain the operating principle of a synchroscope.	X	X											
(03)		Give examples of display.	X	X											
022 01 09 00		Engine-vibration monitoring													
022 01 09 01		Purpose, operating principle of a vibration-monitoring system, display													

(01)		State the purpose of a vibration-monitoring system for a jet engine.	X	X											
(02)	X	Describe the operating principle of a vibration-monitoring system using the following two types of sensors: piezoelectric crystal; magnet.	X	X											
(03)		Explain that there is no specific unit for vibration monitoring, i.e. it is determined by specified numeric threshold values.	X	X											
(04)		Give examples of display.	X	X											
022 01 10 00		Time measurement													
022 01 10 01		On-board clock													
(01)		Explain that the on-board aircraft clock provides a time reference for several of the on-board systems including aircraft communications addressing and reporting system (ACARS) and engine and systems maintenance.	X	X	X	X	X								
022 02 00 00		MEASUREMENT OF AIR-DATA PARAMETERS													
022 02 01 00		Pressure measurement													
022 02 01 01		Definitions													
(01)		Define the following pressure measurements and state the relationship between them: — static pressure; — dynamic pressure; — total pressure.	X	X	X	X	X	X							
022 02 01 02		Pitot/static system: design and errors													

(01)		Describe the design and the operating principle of a: — static port/source; — pitot tube; — combined pitot/static probe.	X	X	X	X	X	X	X						
(02)		For each of these indicate the various locations and describe the following associated errors and how to correct, minimise the effect of or compensate for them: — position errors; — instrument errors; — errors due to a non-longitudinal axial flow (including manoeuvre-induced errors).	X	X	X	X	X	X	X						
(03)		Describe a typical pitot/static system and list the possible outputs.	X	X	X	X	X	X							
(04)		Explain the redundancy and the interconnections that typically exist in complex pitot/static systems found in large aircraft.	X	X	X	X	X	X							
(05)		Explain the purpose of pitot/static system heating.	X	X	X	X	X	X	X						
(06)		Describe alternate static sources and their effects when used, particularly in unpressurised aircraft.	X	X	X	X	X	X	X						
(07)		Describe a modern pitot static system using solid-state sensors near the pitot probe or static port converting the air data to numerical data (electrical signals) before being sent to the air-data computer(s).	X	X	X	X	X	X							
022 02 02 00		Temperature measurement													

022 02 02 01		Definitions													
(01)		Define the following and explain the relationship between them: — outside air temperature (OAT); — total air temperature (TAT); — static air temperature (SAT).	X	X	X	X	X	X	X						
(02)		Explain the term 'ram rise' and convert TAT to SAT.	X					X							
(03)		Explain why TAT is often displayed and that TAT is the temperature input to the air-data computer.	X	X	X	X	X	X	X						
022 02 02 02		Design and operation													
(01)		Indicate typical locations for both direct-reading and remote- reading temperature probes, and describe the following errors: — position error; — instrument error.	X	X	X	X	X	X							
(02)		Explain the purpose of temperature probe heating and interpret the effect of heating on sensed temperature unless automatically compensated for.	X	X	X	X	X	X							
022 02 03 00		Angle-of-attack (AoA) measurement													
022 02 03 01		Sensor types, operating principles, ice protection, displays, incorrect indications													
(01)		Describe the following two types of AoA sensors: — null-seeking (slotted) probe; — vane detector.	X	X											

(02)		For each type, explain the operating principles.	X	X											
(03)		Explain how both types are protected against ice.	X	X											
(04)		Give examples of systems that use the AoA as an input, such as: — air-data computer; — stall warning systems; — flight-envelope protection systems.	X	X											
(05)		Give examples of and interpret different types of AoA displays: — simple light arrays of green, amber and red lights; — gauges showing a numerical scale.	X	X											
(06)		Explain the implications for the pilot if the AoA indication becomes incorrect but still provides data, e.g. if the sensor is frozen in a fixed position.	X	X											
(07)		Explain how an incorrect AoA measurement can affect the controllability of an aircraft with flight-envelope protection.	X	X											
022 02 04 00		Altimeter													
022 02 04 01		Units, terms, types, operating principles, displays, errors, corrections													
(01)		List the following two units used for altimeters and state the relationship between them: — feet; — metres.	X	X	X	X	X	X							

(02)	X	Define the following terms: — height, altitude; — indicated altitude, true altitude; — pressure altitude, density altitude.	X	X	X	X	X	X	X						
(03)	X	Define the following barometric references: 'QNH', 'QFE', '1013,25'.	X	X	X	X	X	X	X						
(04)		Explain the operating principles of an altimeter.	X	X	X	X	X	X	X						
(05)	X	Describe and compare the following three types of altimeters and reason(s) why particular designs may be required in certain airspace: — simple altimeter (single capsule); — sensitive altimeter (multi-capsule); — servo-assisted altimeter.	X	X	X	X	X	X	X						
(06)	X	Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale.	X	X	X	X	X	X	X						
(07)		Describe the following errors: — static system error; — instrument error; — barometric error; — temperature error (air column not at ISA conditions); — lag (altimeter response to change of height).	X	X	X	X	X	X	X						

(08)		Demonstrate the use of an altimeter correction table for the following errors: — temperature corrections; — aircraft position errors.	X	X	X	X	X	X	X						
(09)		Describe the effects of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X						
(10)		Describe the use of GPS altitude as an alternative means of checking erroneous altimeter indications, and highlight the limitations of the GPS altitude indication.	X	X	X	X	X	X	X						
022 02 05 00		Vertical speed indicator (VSI)													
022 02 05 01		VSI and instantaneous vertical speed indicator (IVSI)													
(01)		List the two units used for VSIs and state the relationship between them: — metres per second; — feet per minute.	X	X	X	X	X	X							
(02)		Explain the operating principles of a VSI and an IVSI.	X	X	X	X	X	X	X						
(03)		Describe and compare the following types of VSIs: — barometric type (VSI); — instantaneous barometric type (IVSI); — inertial type (inertial information provided by an inertial reference unit).	X	X	X	X	X	X	X						

(04)		Describe the following VSI errors: — static system errors; — instrument errors; — time lag.	X	X	X	X	X	X	X						
(05)		Describe the effects on a VSI of a blockage or a leakage on the static pressure line.	X	X	X	X	X	X	X						
(06)		Give examples of a VSI display.	X	X	X	X	X	X							
(07)		Compare the indications of a VSI and an IVSI during flight in turbulence and appropriate pilot technique during manoeuvring using either type.	X	X	X	X	X	X							
022 02 06 00		Airspeed indicator (ASI)													
022 02 06 01		Units, errors, operating principles, displays, position errors, unreliable airspeed indications													
(01)		List the following three units used for airspeed and state the relationship between them: — nautical miles/hour (kt); — statute miles/hour (mph); — kilometres/hour (km/h).	X	X	X	X	X	X							

(02)		Describe the following ASI errors and state when they must be considered: — pitot/static system errors; — instrument errors; — position errors; — compressibility errors; — density errors.	X	X	X	X	X	X	X						
(03)		Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).	X	X	X	X	X	X	X						
(04)		Give examples of an ASI display: pointer, vertical straight scale, and digital (HUD display).	X	X	X	X	X	X							
(05)		Demonstrate the use of an ASI correction table for position error.	X	X	X	X	X	X							
(06)		Define and explain the following colour codes that can be used on an ASI: — white arc (flap operating speed range); — green arc (normal operating speed range); — yellow arc (caution speed range); — red line (VNE) or barber's pole (VMO); — blue line (best rate of climb speed, one-engine-out for multi-engine piston light aeroplanes).	X	X													

(07)		Define and explain the following colour codes that can be used on an ASI: — green arc (normal operating speed range); — red line (VNE); — blue line (maximum airspeed during autorotation).			X	X	X								
(08)		Describe the effects on an ASI of a blockage or a leakage in the static or total pressure line(s).	X	X	X	X	X	X	X						
(09)		Define the term 'unreliable airspeed' and describe the means by which it can be recognised such as: — different airspeed indications between ASIs; — unexpected aircraft behaviour; — buffeting; — aircraft systems warning; — aircraft attitude.	X	X	X	X	X	X	X						
(10)		Describe the appropriate procedures available to the pilot in the event of unreliable airspeed indications: — combination of a pitch attitude and power setting; — ambient wind noise inside the aircraft; — use of GPS speed indications and the associated limitations.	X	X	X	X	X	X	X						
022 02 07 00		Machmeter													
022 02 07 01		Operating principle, display, CAS, TAS and Mach number													

(01)		Define ‘Mach number’ and ‘local speed sound’ (LSS). Calculate between LSS, TAS and Mach number.	X												
(02)	X	Describe the operating principle of a Machmeter.	X												
(03)	X	Explain why a Machmeter does not suffer from compressibility error.	X												
(04)		Give examples of a Machmeter display: pointer, drum, vertical straight scale, digital.	X												
(05)		Describe the effects on a Machmeter of a blockage or a leakage in the static or total pressure line(s).	X												
(06)		Explain the relationship between CAS, TAS and Mach number. Explain how CAS, TAS and Mach number vary in relation to each other during a climb, a descent, or in level flight in different temperature conditions.	X												
(07)		State the existence of maximum operating limit speed (VMO) and maximum operating Mach number (MMO).	X												
(08)		Describe typical indications of MMO and VMO on analogue and digital instruments.	X												
(09)		Describe the relationship between MMO and VMO with change in altitude and the implications of climbing at constant IAS and descending at constant Mach number with respect to the margin to MMO and VMO.	X												

(10)		Describe the implications of climbing or descending at constant Mach number or constant IAS with respect to the margin to the stall speed or maximum speed.	X												
022 02 08 00		Air-data computer (ADC)													
022 02 08 01		Operating principle, data, errors, air-data inertial reference unit													
(01)		Explain the operating principle of an ADC.	X	X	X	X	X	X							
(02)	X	List the following possible input data: — TAT; — static pressure; — total pressure; — measured temperature; — AoA; — flaps position; — landing gear position; — stored aircraft data.	X	X	X	X	X	X							

(03)	X	List the following possible output data, as applicable to aeroplanes or helicopters: — IAS; — TAS; — SAT; — TAT; — Mach number; — AoA; — altitude; — vertical speed; — VMO/MMO pointer.	X	X	X	X	X	X							
(04)		Explain how position, instrument, compressibility and density errors can be compensated/corrected to achieve a TAS calculation.	X	X	X	X	X	X							
(05)		Give examples of instruments or systems which may use ADC output data.	X	X	X	X	X	X							
(06)		Explain that an air-data inertial reference unit (ADIRU) is an ADC integrated with an inertial reference unit (IRU), that there will be separate controls for the ADC part and inertial reference (IR) part, and that incorrect selection during failure scenarios may lead to unintended and potentially irreversible consequences.	X	X	X	X	X	X							
(07)	X	Explain the ADC architecture for air-data measurement including sensors, processing units	X	X	X	X	X	X							

		and displays, as opposed to stand-alone air-data measurement instruments.													
(08)		Describe the consequences of the loss of an ADC compared to the failure of individual instruments.	X	X	X	X	X	X							
022 03 00 00		MAGNETISM — DIRECT-READING COMPASS AND FLUX VALVE													
022 03 01 00		Earth's magnetic field													
022 03 01 01		Magnetic field, variation, dip													
(01)		Describe the magnetic field of the Earth.	X	X	X	X	X	X							
(02)	X	Explain the properties of a magnet.	X	X	X	X	X	X							
(03)		Define the following terms: — magnetic variation; — magnetic dip (inclination).	X	X	X	X	X	X							
(04)		Describe that a magnetic compass will align itself to both the horizontal (azimuth) and vertical (dip) components of the Earth's magnetic field, thus will not function in the vicinity of the magnetic poles.	X	X	X	X	X	X							
(05)		Demonstrate the use of variation values (given as East/West (E/W) or +/—) to calculate: — true heading to magnetic heading; — magnetic heading to true heading.	X	X	X	X	X	X							
022 03 02 00		Aircraft magnetic field													

022 03 02 01		Permanent magnetism, electromagnetism, deviation													
(01)	X	Explain the following differences between permanent magnetism and electromagnetism: — when they are present; — what affects their magnitude.	X	X	X	X	X	X							
(02)	X	Explain the principles of and the reasons for: — compass swinging (determination of initial deviations); — compass compensation (correction of deviations found); — compass calibration (determination of residual deviations).	X	X	X	X	X	X							
(03)		Explain how permanent magnetism within the aircraft structure and electromagnetism from the aircraft systems affect the accuracy of a compass.	X	X	X	X	X	X							
(04)		Describe the purpose and the use of a deviation correction card.	X	X	X	X	X	X							
(05)		Demonstrate the use of deviation values (either given as E/W or +/—) from a compass deviation card to calculate: — compass heading to magnetic heading; — magnetic heading to compass heading.	X	X	X	X	X	X	X						
022 03 03 00		Direct-reading magnetic compass													
022 03 03 01		Purpose, errors, timed turns, serviceability													
(01)		Explain the purpose of a direct-reading magnetic compass.	X	X	X	X	X	X							

(02)		Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): — acceleration and deceleration; — turning; — during pitch-up or pitch-down manoeuvres.	X	X	X	X	X	X							
(03)		Explain how the use of timed turns eliminates the problem of the turning errors of a direct-reading magnetic compass, and calculate the duration of a rate-1 turn for a given change of heading.	X	X	X	X	X	X							
(04)		Describe the serviceability check for a direct-reading magnetic compass prior to flight, such as: — the physical appearance of the device; — comparing the indication to another known direction such as a different compass or runway direction.	X	X	X	X	X	X	X						
022 03 04 00		Flux valve													
022 03 04 01		Purpose, operating principle, location, errors													
(01)		Explain the purpose of a flux valve.	X	X	X	X	X	X							
(02)	X	Explain its operating principle.	X	X	X	X	X	X							
(03)		Indicate typical locations of the flux valve(s).	X	X	X	X	X	X							
(04)		Give the remote-reading compass system as example of application for a flux valve.	X	X	X	X	X	X							

(05)		Explain that deviation is compensated for and, therefore, eliminates the need for a deviation correction card.	X	X	X	X	X	X							
(06)		Explain that a flux valve does not suffer from the same magnitude of errors as a direct-reading magnetic compass when turning, accelerating or decelerating and during pitch-up or pitch-down manoeuvres.	X	X	X	X	X	X							
022 04 00 00		GYROSCOPIC INSTRUMENTS													
022 04 01 00		Gyroscope: basic principles													
022 04 01 01		Gyroscopic forces, degrees of freedom, gyro wander, driving gyroscopes													
(01)	X	Define a 'gyro'.	X	X	X	X	X	X	X						
(02)	X	Explain the fundamentals of the theory of gyroscopic forces.	X	X	X	X	X	X	X						
(03)	X	Define the 'degrees of freedom' of a gyro. Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).	X	X	X	X	X	X	X						
(04)	X	Explain the following terms: — rigidity; — precession; — wander (drift/topple).	X	X	X	X	X	X							
(05)		Explain the three types of gyro wander: — real wander; — apparent wander; — transport wander.	X	X	X	X	X	X							

(06)		Describe the two ways of driving gyroscopes and any associated indications: — air/vacuum; — electrically.	X	X	X	X	X	X	X						
022 04 02 00		Rate-of-turn indicator — Turn coordinator — Balance (slip) indicator													
022 04 02 01		Indications, relation between bank angle, rate of turn and TAS													
(01)		Explain the purpose of a rate-of-turn and balance (slip) indicator.	X	X	X	X	X	X	X						
(02)		Define a 'rate-1 turn'.	X	X	X	X	X	X	X						
(03)		Describe the indications given by a rate-of-turn indicator.	X	X	X	X	X	X	X						
(04)		Explain the relation between bank angle, rate of turn and TAS, and how bank angle becomes the limiting factor at high speed (no calculations).	X	X	X	X	X	X	X						
(05)		Explain the purpose of a balance (slip) indicator and its principle of operation.	X	X	X	X	X	X	X						
(06)		Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip or skid turn.	X	X	X	X	X	X	X						
(07)		Describe the indications given by a turn coordinator (or turn- and-bank indicator).	X	X	X	X	X	X	X						
(08)		Compare the indications on the rate-of-turn indicator and the turn coordinator.	X	X	X	X	X	X	X						
022 04 03 00		Attitude indicator (artificial horizon)													

022 04 03 01		Purpose, types, effect of aircraft acceleration, display													
(01)		Explain the purpose of the attitude indicator.	X	X	X	X	X	X	X						
(02)		Identify the two types of attitude indicators: — attitude indicator; — attitude and director indicator (ADI).	X	X	X	X	X	X	X						
(03)	X	State the degrees of freedom.	X	X	X	X	X	X							
(04)		Describe the effects of the aircraft's acceleration and turns on instrument indications.	X	X	X	X	X	X							
(05)		Describe a typical attitude display and instrument markings.	X	X	X	X	X	X	X						
022 04 04 00		Directional gyroscope													
022 04 04 01		Purpose, types, drift, alignment to compass heading													
(01)		Explain the purpose of the directional gyroscope.	X	X	X	X	X	X	X						
(02)		Identify the two types of gyro-driven direction indicators: — direction indicator; — horizontal situation indicator (HSI).	X	X	X	X	X	X	X						
(03)		Explain how the directional gyroscope will drift over time due to the following: — rotation of the Earth; — aircraft manoeuvring; — aircraft movement over the Earth's surface/direction of travel.	X	X	X	X	X	X							

(04)		Describe the procedure for the pilot to align the directional gyroscope to the correct compass heading.	X	X	X	X	X	X							
022 04 05 00		Remote-reading compass systems													
022 04 05 01		Operating principles, components, comparison with a direct- reading magnetic compass													
(01)		Describe the principles of operation of a remote-reading compass system.	X	X	X	X	X	X	X						
(02)		Using a block diagram, list and explain the function of the following components of a remote-reading compass system: — flux detection unit; — gyro unit; — transducers, precession amplifiers, annunciator; — display unit (compass card, synchronising and set-heading knob, DG/compass/slave/free switch).	X	X	X	X	X	X	X						

(03)		State the advantages and disadvantages of a remote-reading compass system compared to a direct-reading magnetic compass with regard to: — design (power source, weight and volume); — deviation due to aircraft magnetism; — turning and acceleration errors; — attitude errors; — accuracy and stability of the information displayed; — availability of the information for several systems (compass card, RMI, automatic flight control system (AFCS)).	X	X	X	X	X	X							
022 04 06 00		Solid-state systems — attitude and heading reference system (AHRS)	X	X	X	X	X	X							
022 04 06 01		Components, indications													
(01)		Explain that the AHRS is a replacement for traditional gyros using solid-state technology with no moving parts and is a single unit consisting of: — solid-state accelerometers; — solid-state rate sensor gyroscopes; — solid-state magnetometers (measurement of the Earth's magnetic field).	X	X	X	X	X	X	X						
(02)		Explain that the AHRS senses rotation and acceleration for all three axes and senses the direction of the Earth's magnetic field where the indications are normally provided on electronic	X	X	X	X	X	X	X						

		screens (electronic flight instrument system (EFIS)).													
022 05 00 00		INERTIAL NAVIGATION													
022 05 01 00		Basic principles													
022 05 01 01		Systems													
(01)		State that inertial navigation/reference systems are the main source of attitude and one of the main sources of navigational data in commercial air transport aeroplanes.	X		X	X									
(02)		State that inertial systems require no external input, except TAS, to determine aircraft attitude and navigational data.	X		X	X									
(03)		State that earlier gyro mechanically stabilised platforms are (technically incorrectly but conventionally) referred to as inertial navigation systems (INSs) and more modern fixed (strap down) platforms are conventionally referred to as inertial reference systems (IRSs). INSs can be considered to be stand- alone, whereas IRSs are integrated with the FMS.	X		X	X									
(04)		Explain the basic principles of inertial navigation (including double integration of measured acceleration and the necessity for north—south, east—west and vertical components to be measured/extracted).	X		X	X									

(05)		Explain the necessity of applying correction for transport precession, and Earth rate precession, Coriolis and gravity.	X		X	X									
(06)		State that in modern aircraft fitted with inertial reference system (IRS) and flight management system (FMS), the flight management computer (FMC) position is normally derived from a mathematical analysis of IRS, global positioning system (GPS), and distance measuring equipment (DME) data, VHF omnidirectional radio range (VOR) and LOC.	X		X	X									
(07)		List all navigational data that can be determined by a stand-alone inertial navigation system.	X		X	X									
(08)		State that a strap-down system is fixed to the structure of the aircraft and normally consists of three laser ring gyros and three accelerometers.	X		X	X									
(09)		State the differences between a laser ring gyro and a conventional mechanical gyro.	X		X	X									
022 05 02 00		Alignment and operation													
022 05 02 01		Alignment process, incorrect data entry, and control panels													
(01)		State that during the alignment process, the inertial platform is levelled (INS) or the local vertical is determined (IRS), and true north/aircraft heading is established.	X		X	X									

(02)		Explain that the aircraft must be stationary during alignment, the aircraft position is entered during the alignment phase, and that the alignment process takes around 10 to 20 minutes at mid latitudes (longer at high latitudes).	X		X	X									
(03)		State that in-flight realignment is not possible and loss of alignment leads to loss of navigational data although attitude information may still be available.	X		X	X									
(04)		Explain that the inertial navigation system (INS) platform is maintained level and north-aligned after alignment is complete and the aircraft is in motion.	X		X	X									
(05)		State that an incorrect entry of latitude may lead to a loss of alignment and is more critical than the incorrect entry of longitude.	X		X	X									
(06)		State that the positional error of a stand-alone INS varies (a typical value can be quoted as 1—2 NM/h) and is dependent on the gyro drift rate, accelerometer bias, misalignment of the platform, and computational errors.	X		X	X									
(07)		Explain that, on a modern aircraft, there is likely to be an air- data inertial reference unit (ADIRU), which is an inertial reference unit (IRU) integrated with an air-data computer (ADC).	X		X	X									
(08)		Identify examples of IRS control panels.	X		X	X									

(09)		Explain the following selections on the IRU mode selector: — NAV (normal operation); — ATT (attitude only).	X		X	X									
(10)		State that the majority of the IRS data can be accessed through the FMS control and display unit (CDU)/flight management and guidance system (FMGS) multifunction control and display unit (MCDU).	X		X	X									
(11)		Describe the procedure available to the pilot for assessing the performance of individual IRUs after a flight: — reviewing the residual indicated ground speed when the aircraft has parked; — reviewing the drift given as NM/h.	X		X	X									
022 06 00 00		AEROPLANE: AUTOMATIC FLIGHT CONTROL SYSTEMS													
022 06 01 00		General													
022 06 01 01		Definitions and control loops													
(01)		Describe the following purposes of an automatic flight control system (AFCS): — enhancement of flight controls; — reduction of pilot workload.	X	X				X							
(02)		Define and explain the following two functions of an AFCS: — aircraft control: stabilise the aircraft around its centre of gravity (CG);	X	X				X							

		— aircraft guidance: guidance of the aircraft's flight path.													
(03)		Describe the following two automatic control principles: — closed loop, where a feedback from an action or state is compared to the desired action or state; — open loop, where there is no feedback loop.	X	X											
(04)		List the following elements of a closed-loop control system and explain their basic function: — input signal; — error detector; — signal processor providing a measured output signal according to set criteria or laws; — control element such as an actuator; — feedback signal to error detector for comparison with input signal.	X	X											
(05)		Describe how a closed-loop system may enter a state of self- induced oscillation if the system overcompensates for deviations from the desired state.	X	X											

(06)		Explain how a state of self-induced oscillations may be detected and describe the effects of self-induced oscillations: — aircraft controllability; — aircraft safety; — timely manual intervention as a way of mitigating loss of control; — techniques that may be used to maintain positive control of the aircraft.	X	X											
022 06 02 00		Autopilot system													
022 06 02 01		Design and operation													
(01)		Define the three basic control channels.	X	X											
(02)		Define the three different types of autopilots: — single or 1 axis (roll); — 2 axes (pith and roll); — 3 axes (pitch, roll and yaw);	X	X											
(03)		Describe the purpose of the following components of an autopilot system: — flight control unit (FCU), mode control panel (MCP) or equivalent; — flight mode annunciator (FMA) (see Subject 022 06 04 00); — autopilot computer; — actuator.	X	X											

(04)		Explain the following lateral modes: — heading (HDG)/track (TRK); — VOR (VOR)/localiser (LOC); — lateral navigation/managed navigation (LNAV or NAV).	X	X											
(05)		Describe the purpose of control laws for pitch and roll modes.	X	X											
(06)		Explain the following vertical modes: — vertical speed (V/S); — flight path angle (FPA); — level change (LVL CHG)/open climb (OP CLB) or open descent (OP DES); — speed reference system (SRS); — altitude (ALT) hold; — vertical navigation (VNAV)/managed climb (CLB) or descent (DES); — glideslope (G/S).	X	X											
(07)		Describe how the autopilot uses speed, aircraft configuration or flight phase as a measure for the magnitude of control inputs and how this may affect precision and stability.	X	X											
(08)		Explain the following mixed modes: — take-off; — go-around; — approach (APP).	X	X											

(09)		Describe the two types of autopilot configurations and explain the implications to the pilot for either and when comparing the two principles: — flight-deck controls move with the control surface when the autopilot is engaged; — flight-deck controls remain static when the autopilot is engaged.	X	X											
(10)		Describe the purpose of the following inputs and outputs for an autopilot system: — attitude information; — flight path/trajectory information; — control surface position information; — airspeed information; — aircraft configuration information; — FCU/MCP selections; — FMAs.	X	X											
(11)		Describe the purpose of the synchronisation function when engaging the autopilot and explain why the autopilot should be engaged when the aircraft is in trim.	X	X											
(12)		Define the control wheel steering (CWS) mode as manual manoeuvring of the aircraft through the autopilot computer and autopilot servos/actuators using the control column/control wheel.	X	X											

(13)		Describe the following elements of CWS: — CWS as an autopilot mode; — flight phases where CWS cannot be used; — whether the pilot or the autopilot is controlling the flight path; — the availability of flight path/performance protections; — potential different feel and control response compared to manual flight.	X	X											
(14)		Describe touch control steering (TCS) and highlight the differences when compared to CWS: — autopilot remains engaged but autopilot servos/actuators are disconnected from the control surfaces; — manual control of the aircraft as long as TCS button is depressed; — autopilot servos/actuators reconnect when TCS button is released and the autopilot returns to previously engaged mode(s).	X	X				X							
(15)		Explain that only one autopilot may be engaged at any time except for when APP is armed in order to facilitate a fail- operational autoland.	X	X				X							
(16)		Explain the difference between an armed and an engaged mode: — not all modes have an armed state available; — a mode will only become armed if certain criteria are met; — an armed mode will become engaged	X	X				X							

		(replacing the previously engaged mode, if any) when certain criteria are met.													
(17)		Describe the sequence of events when a mode is engaged and the different phases: — initial phase where attitude is changed to obtain a new trajectory in order to achieve the new parameter; — the trajectory will be based on rate of closure which is again based on the difference between the original parameter and the new parameter; — capture phase where the aircraft will follow a predefined rate of change of trajectory to achieve the new parameter without overshooting/ undershooting; — tracking or hold phase where the aircraft will maintain the set parameter until a new change has been initiated.	X	X				X							

(18)		Explain automatic mode reversion and typical situations where it may occur: — no suitable data for the current mode such as flight plan discontinuity when in LNAV/managed NAV; — change of parameter during capture phase for original parameter such as change of altitude target during ALT ACQ/ALT*; — mismanagement of a mode resulting in engagement of the autopilot envelope protection, e.g. selecting excessive V/S resulting in a loss of speed control.	X	X				X							
(19)		Explain the dangers of mismanagement of the following modes: — use of V/S and lack of speed protection, i.e. excessive V/S or FPA may be selected with subsequent uncontrolled loss or gain of airspeed; — arming VOR/LOC or APP outside the protected area of the localiser or ILS.	X	X				X							
(20)		Describe how failure of other systems may influence the availability of the autopilot and how incorrect data from other systems may result in an undesirable aircraft state, potentially without any failure indications. Explain the importance of prompt and appropriate pilot intervention during such events.	X	X				X							

(21)		Explain an appropriate procedure for disengaging the autopilot and why both aural and visual warnings are used to indicate that the autopilot is being disengaged: — temporary warning for intended disengagement using the design method; — continuous warning for unintended disengagement or using a method other than the design method.	X	X				X							
(22)		Explain the following regarding autopilot and aircraft with manual trim: — the autopilot may not engage unless the aircraft controls are in trim; — the aircraft will normally be in trim when the autopilot is disconnected; — use of manual trim when the autopilot is engaged will normally lead to autopilot disconnection and a risk of an out-of-trim situation.	X	X				X							
022 06 03 00		Flight director: design and operation													
022 06 03 01		Purpose, use, indications, modes, data													
(01)		Explain the purpose of a flight director system.	X	X				X							
(02)		Describe the different types of display: — pitch and roll crossbars; — V-bar.	X	X				X							

(03)		Explain the differences between a flight director and an autopilot and how the flight director provides a means of cross-checking the control/guidance commands sent to the autopilot.	X	X				X							
(04)		Explain why the flight director must be followed when engaged/shown, and describe the appropriate use of the flight director: — flight director only; — autopilot only; — flight director and autopilot; — typical job-share between pilots (pilot flying (PF)/pilot monitoring (PM)) for selecting the parameters when autopilot is engaged versus disengaged; — highlight when the flight director should not be followed or should be disengaged.	X	X				X							
(05)		Give examples of different scenarios and the resulting flight director indications.	X	X				X							
(06)		Explain that the flight director computes and indicates the direction and magnitude of control inputs required in order to achieve an attitude to follow a trajectory.	X	X				X							
(07)		Explain how the modes available for the flight director are the same as those available for the autopilot, and that the same panel (FCU/MCP) is normally used for selection.	X	X				X							

(08)		Explain the importance of checking the FMC data or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed and should be turned off.	X	X				X							
022 06 04 00		Aeroplane: flight mode annunciator (FMA)													
022 06 04 01		Purpose, modes, display scenarios													
(01)		Explain the purpose of FMAs and their importance being the only indication of the state of a system rather than a switch position.	X	X				X							
(02)		Describe where the FMAs are normally shown and how the FMAs will be divided into sections (as applicable to aircraft complexity): — vertical modes; — lateral modes; — autothrust modes; — autopilot and flight director annunciators; — landing capability.	X	X				X							
(03)		Explain why FMAs for engaged or armed modes have different colour or different font size.	X	X				X							
(04)		Describe the following FMA display scenarios: — engagement of a mode; — mode change from armed to becoming engaged; — mode reversion.	X	X				X							

(05)		Explain the importance of monitoring the FMAs and announcing mode changes at all times (including when selecting a new mode) and why only certain mode changes will be accompanied by an aural notification or additional visual cues.	X	X				X							
(06)		Describe the consequences of not understanding what the FMAs imply or missing mode changes, and how it may lead to an undesirable aircraft state.	X	X				X							
022 06 05 00		Autoland													
022 06 05 01		Design and operation													
(01)		Explain the purpose of an autoland system.	X					X							
(02)		Explain the significance of the following components required for an autoland: — autopilot; — autothrust; — radio altimeter; — ILS receivers.	X					X							
(03)		Explain the following terms (reference to CS-AWO 'All Weather Operations'): — fail-passive automatic landing system; — fail-operational automatic landing system; — fail-operational hybrid landing system; — alert height.	X												

(04)		Describe the autoland sequence including the following: — FMAs regarding the landing capability of the aircraft; — the significance of monitoring the FMAs to ensure the automatic arming/engagement of modes triggered by defined radio altitudes or other thresholds; — in the event of a go-around, that the aircraft performs the go-around manoeuvre both by reading the FMAs and supporting those readings by raw data; — during the landing phase, that 'FLARE' mode engages at the appropriate radio altitude, including typical time frame and actions if 'FLARE' does not engage; — after landing, that 'ROLL-OUT' mode engages and the significance of disconnecting the autopilot prior to vacating the runway.	X												
(05)		Explain that there are operational limitations in order to legally perform an autoland beyond the technical capability of the aircraft.	X												
(06)		Explain the purpose and significance of alert height, describe the indications and implications, and consider typical pilot actions for a failure situation: — above the alert height; — below the alert height.	X												

(07)		Describe typical failures that, if occurring below the alert height, will trigger a warning: — all autopilots disengage; — loss of ILS signal or components thereof; — excessive ILS deviations; — radio-altimeter failure.	X												
(08)		Describe how the failure of various systems, including systems not directly involved in the autoland process, can influence the ability to perform an autoland or affect the minima down to which the approach may be conducted.	X												
(09)		Describe the fail-operational hybrid landing system as a primary fail-passive automatic landing system with a secondary independent guidance system such as a head-up display (HUD) to enable the pilot to complete a manual landing if the primary system fails.	X												
022 07 00 00		HELICOPTER: AUTOMATIC FLIGHT CONTROL SYSTEMS													
022 07 01 00		General principles													
022 07 01 01		Stabilisation													
(01)		Explain the similarities and differences between SAS and AFCS (the latter can actually fly the helicopter to perform certain functions selected by the pilot). Some AFCSs just have altitude and heading hold whilst others include a vertical			X	X	X								

		speed or IAS hold mode, where a constant rate of climb/decent or IAS is maintained by the AFCS.													
022 07 01 02		Reduction of pilot workload													
(01)		Appreciate how effective the AFCS is in reducing pilot workload by improving basic aircraft control harmony and decreasing disturbances.			X	X	X								
022 07 01 03		Enhancement of helicopter capability													
(01)		Explain how an AFCS improves helicopter flight safety during: — search and rescue (SAR) because of increased capabilities; — flight by sole reference to instruments; — underslung load operations; — white-out conditions in snow-covered landscapes; — an approach to land with lack of visual cues.			X	X	X								

(02)		Explain that the SAR modes of AFCS include the following functions: — ability to autohover; — facility for mark on target (MOT) approach to hover; — automatically transition from cruise down to a predetermined point or over-flown point; — ability for the rear crew to move the helicopter around in the hover; — the ability to automatically transition from the hover back to cruise flight; — the ability to fly various search patterns.			X	X	X								
(03)		Explain that earlier autohover systems use Doppler velocity sensors and modern systems use inertial sensors plus GPS, and normally include a two-dimensional hover-velocity indicator for the pilots.			X	X	X								
(04)		Explain why some SAR helicopters have both radio-altimeter height hold and barometric altitude hold.			X	X	X								
022 07 01 04		Failures													
(01)		Explain the various redundancies and independent systems that are built into the AFCSs.			X	X	X								
(02)		Appreciate that the pilot can override the system in the event of a failure.			X	X	X								

(03)		Explain a series actuator ‘hard over’ which equals aircraft attitude runaway.			X	X	X							
(04)		Explain the consequences of a saturation of the series actuators.			X	X	X							
022 07 02 00		Components: operation												
022 07 02 01		Basic sensors												
(01)		Explain the basic sensors in the system and their functions.			X	X	X							
(02)		Explain that the number of sensors will be dependent on the number of coupled modes of the system.			X	X	X							
022 07 02 02		Specific sensors												
(01)		Explain the function of the microswitches and strain gauges in the system which sense pilot input to prevent excessive feedback forces from the system.			X	X	X							
022 07 02 03		Actuators												
(01)		Explain the principles of operation of the series and parallel actuators, spring-box clutches and the autotrim system.			X	X	X							
(02)		Explain the principle of operation of the electronic hydraulic actuators in the system.			X	X	X							
022 07 02 04		Pilot—system interface: control panels, system indications, warnings												
(01)		Describe the typical layout of the AFCS control panel.			X	X	X							

(02)		Describe the system indications and warnings.			X	X	X								
022 07 02 05		Operation													
(01)		Explain the functions of the redundant sensors' simplex and duplex channels (single/dual channel).			X	X	X								
022 07 03 00		Stability augmentation system (SAS)													
022 07 03 01		General principles and operation													
(01)		Explain the general principles and operation of an SAS with regard to: — rate damping; — short-term attitude hold; — effect on static stability; — effect on dynamic stability; — aerodynamic cross-coupling; — effect on manoeuvrability; — control response; — engagement/disengagement; — authority.			X	X	X								
(02)		Explain and describe the general working principles and primary use of an SAS by damping pitch, roll and yaw motions.			X	X	X								
(03)		Describe a simple SAS with force trim system which uses magnetic clutch and springs to hold cyclic control in the position where it was last released.			X	X	X								
(04)		Explain the interaction of trim with SAS/stability and control augmentation system (SCAS).			X	X	X								

(05)		Appreciate that the system can be overridden by the pilot and that individual channels can be deselected.			X	X	X								
(06)		Describe the operational limits of the system.			X	X	X								
(07)		Explain why the system should be turned off in severe turbulence or when extreme flight attitudes are reached.			X	X	X								
(08)		Explain the safety design features built into some SASs to limit the authority of the actuators to 10—20 % of the full-control throw in order to allow the pilot to override if actuators demand an unsafe control input.			X	X	X								
(09)		Explain how cross-coupling produces an adverse effect on roll-to-yaw coupling when the helicopter is subjected to gusts.			X	X	X								
(10)		Explain the collective-to-pitch coupling, side-slip-to-pitch coupling and inter-axis coupling.			X	X	X								
022 07 04 00		Autopilot — automatic stability equipment													
022 07 04 01		General principles													
(01)		Explain the general autopilot principles with regard to: — long-term attitude hold; — fly-through; — changing the reference (beep trim, trim release).			X	X	X								
022 07 04 02		Basic modes (3/4 axes)													

(01)		Explain the AFCS operation on cyclic axes (pitch/roll), yaw axis, and on collective (fourth axis).			X	X	X								
022 07 04 03		Automatic guidance (upper modes of AFCS)													
(01)		Explain the function of the attitude-hold system in an AFCS.			X	X	X								
(02)		Explain the function of the heading-hold system in an AFCS.			X	X	X								
(03)		Explain the function of the vertical-speed hold system in an AFCS.			X	X	X								
(04)		Explain the function of the navigation-coupling system in an AFCS.			X	X	X								
(05)		Explain the function of the VOR-/ILS-coupling system in an AFCS.			X	X	X								
(06)		Explain the function of the hover-mode system in an AFCS (including Doppler and radio-altimeter systems).			X	X	X								
(07)		Explain the function of the SAR mode (automatic transition to hover and back to cruise) in an AFCS.			X	X	X								
022 07 04 04		Flight director: design and operation													
(01)		Explain the purpose of a flight director system.			X	X	X								
(02)		Describe the different types of display: — pitch and roll crossbars; — V-bar.			X	X	X								

(03)		State the difference between the flight director system and the autopilot system. Explain how each can be used independently.			X	X	X								
(04)		List and describe the main components of the flight director system.			X	X	X								
(05)		Give examples of different situations with the respective indications of the command bars.			X	X	X								
(06)		Explain the architecture of the different flight directors fitted to helicopters and the importance to monitor other instruments as well as the flight director.			X	X	X								
(07)		Explain how some helicopter types have the collective setting as a flight director command; however, the command does not provide protection against a transmission overtorque.			X	X	X								
(08)		Describe the collective setting and yaw depiction on flight director for some helicopters.			X	X	X								
022 07 04 05		Automatic flight control panel (AFCP)													
(01)		Explain the purpose and the importance of the AFCP.			X	X	X								
(02)		State that the AFCP provides: — AFCS basic and upper modes; — flight director selection, SAS and AP engagement; — failure and alert messages.			X	X	X								
022 08 00 00		TRIMS — YAW DAMPER — FLIGHT-ENVELOPE PROTECTION													

022 08 01 00		Trim systems													
022 08 01 01		Design and operation													
(01)		Explain the purpose of the trim system and describe the layout with one trim system for each control axis, depending on the complexity of the aircraft.	X	X											
(02)		Give examples of trim indicators and their function, and explain the significance of a 'green band/area' for the pitch trim.	X	X											
(03)		Describe and explain an automatic pitch-trim system for a conventional aeroplane.	X	X											
(04)		Describe and explain an automatic pitch-trim system for an FBW aeroplane and that it is also operating during manual flight; however, during certain phases it may be automatically disabled to alter the handling characteristics of the aircraft.	X	X											
(05)		Describe the consequences of manual operation on the trim wheel when the automatic pitch-trim system is engaged.	X	X											
(06)		Describe and explain the engagement and disengagement conditions of the autopilot according to trim controls.	X	X											
(07)		Define 'Mach trim' and state that the Mach-trim system can be independent.	X	X											
(08)		Describe the implications for the pilot in the event of a runaway trim or significant out-of-trim state.	X	X											

022 08 02 00		Yaw damper													
022 08 02 01		Design and operation													
(01)		Explain the purpose of the yaw-damper system.	X	X											
(02)		Explain the purpose of the Dutch-roll filter (filtering of the yaw input signal).	X	X											
(03)		Explain the operation of a yaw-damper system and state the difference between a yaw-damper system and a 3-axis autopilot operation on the rudder channel.	X	X											
022 08 03 00		Flight-envelope protection (FEP)													
022 08 03 01		Purpose, input parameters, functions													
(01)		Explain the purpose of the FEP.	X	X				X							
(02)		Explain typical input parameters to the FEP: — AoA; — aircraft configuration; — airspeed information.	X	X				X							
(03)		Explain the following functions of the FEP: — stall protection; — overspeed protection.	X	X				X							
(04)		Explain how the stall-protection function and the overspeed- protection function apply to both mechanical/conventional and FBW control systems, but other functions (e.g. pitch or bank limitation) can only apply to FBW control systems.	X	X				X							
022 09 00 00		AUTOTHRUST — AUTOMATIC THRUST CONTROL SYSTEM													

022 09 01 00		Autothrust system													
022 09 01 01		Purpose, operation, overcompensation, speed control													
(01)		Describe the purpose of the autothrust system and explain how the FMAs will be the only indication on active autothrust modes.	X												
(02)		Explain the operation of an autothrust system with regard to the following modes: — take-off/go-around (TOGA); — climb or maximum continuous thrust (MCT), N1 or EPR targeted (THR CLB, THR MCT, N1, THR HOLD, EPR); — speed (SPEED, MCP SPD); — idle thrust (THR IDLE, RETARD/ARM); — landing (RETARD, THR IDLE).	X												
(03)		Describe the two main variants of autothrust systems: — mode selections available on the FCU/MCP and thrust levers move with autothrust commands; — mode selections made using the thrust levers which remain static during autothrust operation.	X												

(04)		Explain how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed. Airspeed indications/trend vectors may give an indication of appropriate thrust adjustments but any reaction should not be too aggressive.	X												
(05)		Explain the threats associated with the use of autothrust resulting in the pilot losing the sense of energy awareness (e.g. speed, thrust).	X												
(06)		Explain the relationship between autopilot pitch modes and autothrust modes, and how the autopilot and autothrust will interact upon selecting modes for one of the systems.	X												
(07)		Explain the principles of speed control and how speed can be controlled: — by varying the engine thrust; — by varying the aircraft pitch.	X												
(08)		Explain the potential implications on speed control when the autothrust controls speed and the autopilot pitch channel has a fixed pitch target for the following mode combinations: — MCP SPD/SPEED and ALT HOLD/ALT; — MCP SPD/SPEED and VSP (climb); — MCP SPD/SPEED and VSP (descent).	X												

(09)		Explain the potential implications on speed control when the autothrust has a fixed thrust target and the autopilot pitch channel controls speed for the following mode combinations: — N1/THR CLB and LVL CHG/OP CLB; — ARM/THR IDLE and LVL CHG/OP DES.	X												
022 10 00 00		COMMUNICATION SYSTEMS													
022 10 01 00		Voice communication, data-link transmission													
022 10 01 01		Definitions and transmission modes													
(01)		Describe the purpose of a data-link transmission system.	X		X	X									
(02)		Compare voice communication versus data-link transmission systems.	X		X	X									
(03)		Describe the communication links that are used in aircraft: — high-frequency (HF) communications; — very high-frequency (VHF) communications; — satellite communications (SATCOM).	X		X	X									
(04)		Consider the properties of the communication links with regard to: — signal quality; — range/area coverage; — range; — line-of-sight limitations; — quality of the signal received; — interference due to ionospheric conditions; — data transmission speed.	X		X	X									

(05)		Define and explain the following terms in relation to aircraft data-link communications: — message/data uplink; — message/data downlink.	X		X	X									
022 10 01 02		Systems: architecture, design and operation													
(01)		Describe the purpose of the ACARS network.	X												
(02)		Describe the systems using the ACARS network through the air traffic service unit (ATSU) suite: — aeronautical/airline operational control (AOC); — air traffic control (ATC).	X												
(03)		Explain the purpose of the following parts of the on-board equipment: — ATSU communications computer; — control and display unit (CDU)/multifunction control and display unit (MCDU); — data communication display unit (DCDU); — ATC message visual annunciator; — printer.	X												

(04)		Give examples of airline operations communications (AOC) data-link messages such as: — out of the gate, off the ground, on the ground, into the gate (OOOI); — load sheet; — passenger information (connecting flights); — weather reports (METAR, TAF); — maintenance reports (engine exceedances); — aircraft technical data; — free-text messages.	X												
(05)		Give examples of ATC data-link messages such as: — departure clearance; — oceanic clearance; — digital ATIS (D-ATIS); — controller—pilot data-link communications (CPDLC).	X												
022 10 02 00		Future air navigation systems (FANSs)													
022 10 02 01		Versions, applications, CPDLC messages, ADS contracts													
(01)		Describe the existence of the ICAO communication, navigation, surveillance/air traffic management (CNS/ATM) concept.	X												
(02)		Explain the two versions of FANSs: — FANS A/FANS 1 using the ACARS network; — FANS B/FANS 2 using the ACARS network and the aeronautical telecommunication network (ATN).	X												

(03)		List and explain the following FANS A/FANS 1 applications: — ATS facility notification (AFN); — automatic dependent surveillance (ADS); — CPDLC.	X												
(04)		Compare the ADS application with the secondary surveillance radar function, and the CPDLC application with VHF communication systems.	X												
(05)		State that an ATCU can use the ADS application only, or the CPDLC application only, or both of them (not including AFN).	X												
(06)		Describe the AFN process for logging on with an ATCU and typical data that will be included in the message.	X												
(07)		Describe typical types of CPDLC messages and the typical pilot work practices when requesting or accepting a CPDLC clearance.	X												
(08)		List and describe the different types of ADS contracts that are controlled by the ATCU and beyond the control of the pilot: — periodic: data sent at set time intervals; — on demand: data sent when requested; — on event: data sent when an event occurs (e.g. heading change, climb initiated, etc.); — emergency mode.	X												

(09)		Describe the purpose of the ADS emergency mode contract and highlight the difference to the ATCU controlled contracts.	X												
022 11 00 00		FLIGHT MANAGEMENT SYSTEM (FMS)/ FLIGHT MANAGEMENT AND GUIDANCE SYSTEM (FMGS)													
022 11 01 00		Design													
022 11 01 01		Purpose, architecture, failures, functions													
(01)		Explain the purpose of an FMS.	X		X	X		X							
(02)		Describe a typical dual FMS architecture including the following components: — flight management computer (FMC); — CDU/MCDU; — cross-talk bus.	X		X	X									
(03)		Describe the following failures of a dual FMS architecture and explain the potential implications to the pilots: — failure of one FMC; — failure of one CDU/MCDU; — failure of the cross-talk bus.	X		X	X									
(04)		Describe how the FMS integrates with other systems and gathers data in order to provide outputs depending on its level of complexity.	X		X	X		X							
(05)		Explain how the FMS may provide the following functions: — navigation;	X	X	X	X		X							

		— lateral and vertical flight planning; — performance parameters.													
022 11 02 00		FMC databases													
022 11 02 01		Navigation database													
(01)		Explain the purpose of, and describe typical content of, the navigation database.	X		X	X		X	X						
(02)		Describe the 28-day aeronautical information regulation and control (AIRAC) update cycle of the navigation database and explain the reason for having two navigation databases (one active, one standby) and the implication this has to the pilot.	X		X	X		X	X						
(03)		Explain the purpose of typical user-defined waypoints such as: — latitude/longitude coordinates; — place/bearing/distance (PBD); — place/bearing place/bearing (PBX); — place/distance (PD).	X		X	X		X							
(04)		Explain that the pilot cannot change or overwrite any of the data in the navigation database and that any user-defined waypoints, routes and inputted data will be erased when a different database is activated.	X		X	X		X	X						
(05)		Explain the threats and implications to the pilot of changing the database by error either on the ground or while flying.	X		X	X		X							

022 11 02 02		Aircraft performance database													
(01)		Explain the purpose of, and describe the typical content of, the aircraft performance database.	X		X	X		X							
(02)		Explain the importance of verifying that the aircraft performance database is based on the correct data, such as engine type and aircraft variant.	X		X	X		X							
(03)		Explain that the contents of the aircraft performance database cannot be modified by the pilot.	X		X	X		X							
(04)		Explain the purpose of performance factor and how it influences the calculations.	X		X	X		X							
(05)		Explain the purpose of cost index (CI) and how it influences the calculations.	X												
022 11 03 00		Operations, limitations													
022 11 03 01		Data, calculations, position inputs, raw data													
(01)		Describe typical data that may be provided by the FMS: — lateral and vertical navigation guidance; — present position; — time predictions; — fuel predictions; — altitude/flight level predictions.	X		X	X		X							
(02)		Explain how the FMS will use a combination of inputted/database and measured data in order to calculate projections and provide output data.	X		X	X		X							

(04)		Describe fuel consumption calculations during standard operations and explain typical data that will have an influence on the accuracy of the calculations.	X		X	X									
(05)		Explain the implications on the accuracy of the calculations during flight in abnormal configurations (such as engine out, gear down, flaps extended, spoilers extended, etc.) if the FMS is unable to detect the failure.	X		X	X									
(06)		Describe and explain the purpose of an FMS having dedicated radio-navigation receivers that it will tune automatically.	X		X	X									
(07)		Explain typical position inputs to an FMS: — GPS; — IRS; — DME; — VOR; — LOC; — runway threshold (RWY THR).	X		X	X			X						
(08)		Explain how the FMS will create its own FMS position fix and that the FMS calculations will be based on the FMS position. Depending on the type of system, the FMS position may be calculated from: — a single source of position data where the most accurate data available at a given time will be used;	X		X	X									

		— multiple sources from which a position will be derived using the combined inputs.													
(09)		Explain the implications of a reduction in available position inputs to the FMS, especially GPS in relation to the capability of performing RNP/PBN approaches.	X		X	X									
(10)		Explain the difference between following the FMS data compared to following raw data from radio-navigation receivers and describe how there may be limitations for using FMS data as primary source to follow an instrument approach procedure (IAP) such as LOC, VOR or NDB.	X		X	X		X							
022 11 04 00		Human—machine interface (control and display unit (CDU)/ multifunction control and display unit (MCDU))													
022 11 04 01		Purpose, scratchpad, data input, set-up process													
(01)		Describe the purpose of a CDU/MCDU.	X		X	X		X							

(02)		Describe the typical layout of a CDU/MCDU and the general purpose of the following: — screen; — line select keys; — menu select keys; — alphanumerical keys.	X		X	X		X							
(03)		Explain the function of the ‘scratchpad’ part of the screen.	X		X	X		X							
(04)		Describe how input of some data is compulsory for the function of the FMS and other data is optional, and that different symbology is used to highlight this: — rectangular boxes = compulsory information; — dashed line = optional information.	X		X	X		X							

(05)		Describe a typical FMS pre-flight set-up process through the CDU/MCDU to cover the most basic information (with the aim to create awareness of required information as this is irrespective of aircraft type and FMS/FMGS make): — ident page (who am I = aircraft type/variant, engine type/rating and appropriate navigation database); — position initialisation (where am I = position for aligning the IRS and FMS position); — route initialisation (where am I going to = place of departure/destination and alternate(s)); — route programming (how will I get there = SIDs, STARS, route (company or otherwise)); — performance initialisation (when will I arrive = weights, flap setting, FLEX/assumed temperature/derate, take-off speeds).	X													
022 12 00 00		ALERTING SYSTEMS, PROXIMITY SYSTEMS													
022 12 01 00		General													
022 12 01 01		Alerting systems according to CS-25 and CS-29													
(01)		State definitions, category, criteria and characteristics of alerting systems according to CS-25/AMC 25.1322 for aeroplanes and CS-29 for helicopters as appropriate.	X	X	X	X	X								
022 12 02 00		Flight warning systems (FWSs)													
022 12 02 01		Annunciations, master warning, master caution, advisory													

(01)		State the annunciations given by the FWS and typical location for the annunciator(s): — master warning; — master caution; — advisory.	X	X	X	X	X	X							
(02)		Explain master warning: — colour of annunciator: red; — nature of aural alerts: continuous; — typical failure scenarios triggering the alert.	X	X	X	X	X	X							
(03)		Explain master caution: — colour of the annunciator: amber or yellow; — nature of aural alerts: attention-getter; — typical failure scenarios triggering the alert.	X	X	X	X	X	X							
(04)		Describe a typical procedure following a master warning or master caution alert: — acknowledging the failure; — silencing the aural warning; — initiating the appropriate response/procedure.	X	X	X	X	X	X							
(05)		Explain advisory: — colour of the annunciator: any other than red, amber, yellow or green; — absence of aural alert; — typical scenarios triggering the advisory.	X	X	X	X	X	X							
022 12 03 00		Stall warning systems (SWSs)													

022 12 03 01		Function, types, components													
(01)		Describe the function of an SWS and explain why the warning must be unique.	X	X											
(02)		Describe the different types of SWSs.	X	X											
(03)		List the main components of an SWS.	X	X											
(04)		Explain the difference between the stall warning speed and the actual stalling speed of the aeroplane.	X	X											
022 12 04 00		Stall protection													
022 12 04 01		Function, types													
(01)		Describe the function of a stall protection system.	X												
(02)		Describe the different types of stall protection systems including the difference between mechanical and FBW controls.	X												
(03)		Explain the difference between an SWS and a stall protection system.	X												
022 12 05 00		Overspeed warning													
022 12 05 01		Purpose, aural warning, VMO/MMO pointer													
(01)		Explain the purpose of an overspeed warning system (VMO/MMO pointer).	X	X											
(02)		State that for large aeroplanes, an aural warning must be associated to the overspeed warning if an electronic display is used (see AMC 25.11, paragraph 10.b(2), p. 2-GEN-22).	X	X											

(03)		Describe and give examples of VMO/MMO pointer: barber's/barber pole pointer, barber's/barber pole vertical scale.	X	X											
022 12 06 00		Take-off warning													
022 12 06 01		Purpose													
(01)		Explain the purpose of a take-off warning system and list the typical abnormal situations which generate a warning (see AMC 25.703, paragraphs 4 and 5).	X												
022 12 07 00		Altitude alert system													
022 12 07 01		Function, displays, alerts													
(01)		Describe the function of an altitude alert system.	X	X	X	X	X	X							
(02)		Describe different types of displays and possible alerts.	X	X	X	X	X	X							
022 12 08 00		Radio altimeter													
022 12 08 01		Purpose, range, displays, incorrect indications													
(01)		Explain the purpose of a low-altitude radio altimeter.	X	X	X	X	X	X							
(02)		Describe the principle of the distance (height) measurement.	X	X	X	X	X	X							
(03)		Describe the different types of radio-altimeter displays.	X	X	X	X	X	X							
(04)		Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems.	X	X	X	X	X	X							
(05)		State the range of a radio altimeter.	X	X	X	X	X	X							

(06)		Explain the potential implications of a faulty radio-altimeter and how this in particular may affect the following systems: — autothrust (flare/retard); — ground-proximity warning systems (GPWSs).	X	X				X							
022 12 09 00		Ground-proximity warning systems (GPWSs)													
022 12 09 01		GPWSs: design, operation, indications													
(01)		Explain the purpose of GPWSs.	X		X	X									
(02)		Explain inputs and outputs of a GPWS and describe its operating principle.	X		X	X									
(03)		List and describe the different modes of operation of a GPWS.	X		X	X									
022 12 09 02		Terrain-avoidance warning system (TAWS); other name: enhanced GPWS (EGPWS)													
(01)		Explain the purpose of a TAWS for aeroplanes and of a HTAWS for helicopters, and explain the difference from a GPWS.	X		X	X									
(02)		Explain inputs and outputs of a TAWS/HTAWS and describe its working principle.	X		X	X									
(03)		Give examples of terrain displays and list the different possible alerts.	X		X	X									
(04)		Give examples of time response left to the pilot according to look-ahead distance, speed and aircraft performances.	X		X	X									
(05)		Explain why the TAWS/HTAWS must be coupled to a precise- position sensor.	X		X	X									

(06)		Explain the possibility of triggering spurious TAWS/HTAWS warnings as a result of mismanaging the flight path in the proximity to obstacles: — high rate of descent; — high airspeed; — a combination of high rate of descent and high airspeed.	X		X	X									
022 12 09 03		Intentionally left blank													
022 12 10 00		ACAS/TCAS	X	X	X	X	X	X							
022 12 10 01		Principles and operations													
(01)		State that ACAS II is an ICAO standard for anti-collision purposes.	X	X	X	X	X	X							
(02)		Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.	X	X	X	X	X	X							
(03)		Describe the purpose of an ACAS II system as an anti-collision system.	X	X	X	X	X	X							
(04)		Describe the following outputs from a TCAS: — other intruders; — proximate intruders; — traffic advisory (TA); — resolution advisory (RA).	X	X	X	X	X	X							
(05)		State that ACAS II will issue commands in the vertical plane only (climb, descent or maintain), and that the commands are complied with as a manual manoeuvre.	X	X	X	X	X	X							

(06)		Explain that an RA may or may not require any active control input and the implications of reacting instinctively without awareness of actual control inputs required to comply with the RA.	X	X	X	X	X	X							
(07)		Explain that if two aircraft are fitted with ACAS II, the RA will be coordinated.	X	X	X	X	X	X							
(08)		State that ACAS II equipment can take into account several threats simultaneously.	X	X	X	X	X	X							
(09)		State that a detected aircraft without altitude-reporting can only generate a TA; describe typical type of traffic and how this can create distractions during flight in certain areas of significant air traffic activity.	X	X	X	X	X	X							
(10)		Describe the interaction between the TCAS II system and the transponder, radio altimeter and the air-data computer: — antenna used; — computer and links with radio altimeter, air-data computer and mode-S transponder.	X	X	X	X	X	X							
(11)		Explain the principle of TCAS II interrogations.	X	X	X	X	X	X							
(12)		State the typical standard detection range for TCAS II: — 35—40 NM horizontally; — approximately 2 000 ft above and below (any setting); — extension to approximately 10 000 ft above (ABV selected) or approximately 10 000 ft below (BLW selected).	X	X	X	X	X	X							

(13)		Explain the principle of 'reduced surveillance'.	X	X	X	X	X	X							
(14)		Explain that in high-density traffic areas the range may automatically be decreased in order to enable detection of the threats in the proximity of the aircraft due to a limitation of the maximum number of possible intruders the system is able to process.	X	X	X	X	X	X							
(15)		Identify the equipment which an intruder must be fitted with in order to be detected by TCAS II.	X	X	X	X	X	X							
(16)		Explain in the anti-collision process: — the criteria used to trigger an alarm (TA or RA) are the time to reach the closest point of approach (CPA) (called TAU) and the difference of altitude; — an intruder will be classified as 'proximate' when being less than 6 NM and 1 200 ft from the TCAS-equipped aircraft; — the time limit to CPA is different depending on aircraft altitude, is linked to a sensitivity level (SL), and state that the value to trigger an RA is from 15 to 35 seconds; — in case of an RA, the intended vertical separation varies from 300 to 600 ft (700 ft above FL420), depending on the SL; — below 1 000 ft above ground, no RA can be generated; — below 1 450 ft (radio-altimeter value) 'increase descent' RA is inhibited;	X	X	X	X	X	X							

		— at high altitude, performances of the type of aircraft are taken into account to inhibit 'climb' and 'increase climb' RA.													
(17)		List and interpret the following information available from TCAS: — the different possible statuses of a detected aircraft: 'other', 'proximate', 'intruder'; — the appropriate graphic symbols and their position on the horizontal display; — different aural warnings	X	X	X	X	X	X							
(18)		Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Some variants will also include a green area. To manoeuvre the aircraft to comply with the RA, the pilot should 'avoid the red' or 'fly the green'.	X	X	X	X	X	X							
(19)		Explain that the pilot must not interpret the horizontal track of an intruder upon the display.	X	X	X	X	X	X							
022 12 11 00		Rotor/engine overspeed alert system													
022 12 11 01		Design, operation, displays, alarms													
(01)		Describe the basic design principles, operation, displays and warning/alarm systems fitted to different helicopters.			X	X	X								
022 13 00 00		INTEGRATED INSTRUMENTS — ELECTRONIC DISPLAYS													
022 13 01 00		Electronic display units													

(01)		List the different technologies used, e.g. CRT and LCD, and the associated limitations: — cockpit temperature; — glare; — resolution.	X	X	X	X	X	X	X						
022 13 02 00		Mechanical integrated instruments													
022 13 02 01		Attitude and director indicator (ADI)/ horizontal situation indicator (HSI)													
(01)		Describe an ADI and an HSI.	X	X	X	X	X	X	X						
(02)		List all the information that can be displayed on either instrument.	X	X	X	X	X	X	X						
022 13 03 00		Electronic flight instrument systems (EFISs)													
022 13 03 01		Design, operation													
(01)		List the following parts of an EFIS: — control panel; — display units; — symbol generator; — remote light sensor.	X	X	X	X	X	X							
(02)		Describe the typical layout of the EFIS display units and how there may be a facility to transfer the information from one display unit on to another if a display unit fails.	X	X	X	X	X	X							
(03)		Explain the need for standby instruments to supplement the EFIS in the event of all the display units failing and the challenge of using	X	X	X	X	X	X							

		these standby instruments, namely their size and position on the flight deck.													
(04)		Explain the difference between a symbol generator failing and a display unit failing, and the implications if there are redundant symbol generators available.	X	X	X	X	X	X							
(05)		Describe the purpose of an EFIS control panel and typical selections that may be available: — altimeter pressure setting; — navigation display (ND) mode selector; — ND range selector; — ND data selector (waypoints, facilities, constraints, data, etc.); — radio-navigation aids selector (VOR 1/2 or ADF 1/2); — decision altitude (DA)/decision height (DH) selection.	X	X	X	X	X	X							
022 13 03 02		Primary flight display (PFD), electronic attitude director indicator (EADI)													
		— flight mode annunciation; — basic T; — take-off and landing reference speeds; — minimum airspeed; — lower selectable airspeed; — Mach number.													

(02)		Describe the typical design of the attitude information: artificial horizon with aircraft symbol; superimposed flight director command bars.	X	X	X	X	X	X	X						
(03)		Describe the typical design of the speed tape: — rolling speed scale with numerical read-out of current speed; — limiting airspeeds according to configuration; — speed trend vector; — bug/indication for selected airspeed.	X	X	X	X	X	X	X						
(04)		Explain the Mach number indications and how a selected Mach number is presented with the speed bug on a corresponding IAS on the speed tape with the Mach number shown as a numerical indication outside the speed tape.	X												
(05)		Describe the typical design of the altitude information: — rolling altitude scale with numerical read-out of current altitude; — altimeter pressure setting; — bug/indication for selected altitude; — means of highlighting the altitude if certain criteria are met.	X	X	X	X	X	X	X						
(06)		Describe the typical design of the heading/track information: — rolling compass scale/rose with numerical read-out of current heading/track; — bug/indication for selected heading/track.	X	X	X	X	X	X	X						

(07)		Describe the typical design and location of the following information: — flight mode annunciators (FMAs); — vertical speed indicator including TCAS RA command indications; — radio altitude; — ILS localiser/glideslope and RNP/PBN, GBAS or SBAS horizontal/vertical flight path deviation indicator; — decision altitude/height (DA/H).	X	X	X	X	X	X	X						
022 13 03 03		Navigation display (ND), electronic horizontal situation indicator (EHSI)													
(01)		Describe that an ND (or an EHSI) provides a mode-selectable colour flight ND.	X	X	X	X	X	X	X						
(02)		List the following four modes typically available to be displayed on an ND unit: — MAP (or ARC); — VOR (or ROSE VOR); — APP (or ROSE LS); — PLAN.	X	X	X	X	X	X							

(03)		List and explain the following information that can be displayed with the MAP (or ARC) mode selected on an ND unit: — aircraft symbol, compass scale and range markers; — current heading and track (either one may be 'up' depending on selection), true or magnetic; — selected heading and track; — TAS/GS; — wind direction and speed (W/V); — raw data radio magnetic indicator (RMI) needles/pointers for VOR/automatic direction-finding equipment (ADF), if selected, including the frequency or ident of the selected navigation facility; — route/flight plan data from the FMS; — TO/next waypoint data from the FMS; — data from the navigation database such as airports, waypoints or navigation facilities as selected; — weather radar information; — TCAS traffic information (no TCAS commands); — TAWS (EGPWS) terrain information; — failure flags and messages.	X	X	X	X	X	X							

(04)		List and explain the following information that can be displayed with the VOR or APP (or ROSE VOR or ROSE LS) mode selected on an ND unit: — aircraft symbol and compass scale; — current heading and track (either one may be 'up' depending on selection), true or magnetic; — selected heading and track; — TAS/ground speed (GS); — wind direction and speed (W/V); — VOR or ILS frequency and identification of the selected navigation aid; — VOR selected course, deviation indicator and a TO/FROM indicator in a HSI-type display format when in VOR mode; — localiser selected course, deviation indicator and glideslope indicator in a HSI-type display format when in APP mode. — weather radar information; — TCAS traffic information (no TCAS commands); — TAWS (EGPWS) terrain information; — failure flags and messages.	X	X	X	X	X	X							

(05)		List and explain the following information that can be displayed with the PLAN mode selected on an ND unit: — north-up compass rose and range markers; — aircraft symbol oriented according to aircraft heading; — TAS/GS; — wind direction and speed (W/V); — route/flight plan data from the FMS; — TO/next waypoint data from the FMS; — data from the navigation database such as airports, waypoints or navigation facilities as selected; — failure flags and messages.	X	X	X	X	X	X							
(06)		Explain the purpose of PLAN mode and its characteristics such as: — no compass information; — north is up on the display unit at all times; — the centre waypoint is the selected waypoint on the FMS CDU; — scrolling through the flight plan on the FMS CDU will shift the map view along the flight path; — the aircraft symbol will be positioned in the appropriate place along the flight path; — using PLAN mode as the primary mode during flight may lead to disorientation and loss of situational awareness.	X	X	X	X	X	X							

(07)		Distinguish the difference between the appearance of an EXPANDED or FULL/ROSE mode and how the displayed range differs between them.	X	X	X	X	X	X							
(08)		Explain the combination of mode and range selection including how selecting the appropriate range and displayed data can improve situational awareness for a given phase of flight.	X	X	X	X	X	X							
022 13 04 00		Engine parameters, crew warnings, aircraft systems, procedure and mission display systems													
022 13 04 01		Purposes of systems, display systems, checklists													
(01)		State the purpose of the following systems: — engine instruments centralised display unit; — crew alerting system/aircraft display unit; — facility for appropriate on-screen checklists; — that the aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems; — that the systems/aircraft display unit is able to show pictorial systems diagrams/schematics and associated parameters.	X		X	X									
(02)		Describe the similarities to EFIS with regard to basic system architecture.	X		X	X									

(03)		Give the following different names by which engine parameters, crew warnings, aircraft systems and procedures display systems are known: — multifunction display unit (MFDU); — engine indication and crew alerting systems (EICASs); — engine and warning display (EWD); — electronic centralised aircraft monitor (ECAM); — systems display (S/D).	X												
(04)		Give the names of the following different display systems and describe their main functions: — vehicle engine monitoring display (VEMD); — integrated instruments display system (IIDS).			X	X									
(05)		State the purpose of a mission display unit.			X	X									
(06)		Describe the architecture of each system and give examples of display.			X	X									
(07)		Explain why awareness of the consequences of the actions commanded by the automatic checklist is required.	X		X	X									
(08)		Explain the limited ability of the computer to assess a situation other than using the exceedance of certain thresholds to trigger the main and subsequent events and programmed actions.	X		X	X									

(09)		Describe an appropriate procedure for following an on-screen checklist associated with a failure scenario including the following: — confirm the failure with the other flight crew member prior to performing any of the actions; — seek confirmation prior to manipulating any guarded switches or thrust levers; — follow the checklist slowly and methodically; — assess the possible implications of making certain selections, such as opening the fuel cross-feed if there is a fuel leak even though the electronic checklist may ask for the action.	X		X	X									
022 13 05 00		Engine first limit indicator													
022 13 05 01		Design, operation, information on display													
(01)		Describe the principles of design and operation, and compare the different indications and displays available.			X	X	X								
(02)		Describe what information can be displayed on the screen, when the screen is in the limited composite mode.			X	X	X								
022 13 06 00		Electronic flight bag (EFB)													
022 13 06 01		Purpose, certification, malfunctions													
(01)		Explain the purpose of the EFB and list typical equipment: (a) computer laptop; (b) tablet device; (c) integrated avionics suite in the aircraft.	X	X	X	X	X	X							

(02)		Describe the ‘class’ hardware certification: — portable: portable electronic device (PED) that can be used inside or outside the aircraft, is not part of the certified aircraft configuration and does not require tools to remove it from the flight-deck cradle, if one exists; — installed: an electronic device that is considered an aircraft part covered by the aircraft airworthiness approval, thus is a minimum equipment list (MEL) item in the event of failure.	X		X	X									
(03)		Describe the ‘type’ software certification: — type A: applications whose misuse or malfunctions have no adverse effect on flight safety; — type B: applications for which evaluation of the hazards presented by misuse or malfunctions is required.	X		X	X									
(04)		Explain implications of malfunctions with the EFB installation in a fully electronic flight-deck environment: — mass and balance calculations; — performance calculations; — access to charts; — access to manuals.	X		X	X									
022 13 07 00		Head-up display (HUD), synthetic vision system (SVS) and enhanced visual system (EVS)	X		X	X									

022 13 07 01		Components, benefits, modes of operation													
		State the components of a typical HUD installation: — HUD projector and stowable combiner; — HUD controls such as declutter and dimmer; — HUD computer.	X		X	X									
		Explain the reasons and benefits of having an HUD: — increased situational awareness due to reduced need to look inside to view primary flight information; — lower minima for both departure and landing; — improved accuracy of flying thus reduced susceptibility to enter a state of aircraft upset.	X		X	X									
		Describe how the HUD replicates the information on the primary flight display (PFD) by showing the following data: — altitude; — speed, including speed trend; — heading; — flight path vector (track and vertical flight path); — flight mode annunciator (FMA); — CAS, TAWS and wind shear command annunciations.	X		X	X									

		Describe the following modes of operation of an HUD: — normal display mode that may automatically adapt the information based on the phase of flight; — declutter function.	X		X	X									
		Describe the principle of SVS: — an enhanced database used as reference to provide terrain and ground features to be shown on the PFD; — limitations due to being a synthetic image not based on actual sensory information thus not lowering landing minima; — implications if aircraft position accuracy becomes reduced.	X		X	X									
		Describe the principle of EVS: — includes external sensors such as infrared cameras to generate a real-time image on the PFD or on the HUD; — limitation of the fact that an infrared camera uses temperature and temperature difference in order to produce an image; — enables lower minima because of the real-time image, thus enhancing the visibility as experienced by the pilot.	X		X	X									
022 14 00 00		MAINTENANCE, MONITORING AND RECORDING SYSTEMS													
022 14 01 00		Cockpit voice recorder (CVR)													

022 14 01 01		Purpose, components, parameters													
(01)		Describe the purpose of a CVR, its typical location, and explain the implications of knowingly erasing or tampering with any information or equipment.	X	X	X	X	X								
(02)		List the main components of a CVR: — a shock-resistant tape recorder or digital storage associated with an underwater locating beacon (ULB); — a cockpit area microphone (CAM); — a control unit with the following controls: auto/on, test and erase, and a headset jack; — limited flight-deck controls such as erase and test switches.	X	X	X	X	X								
(023		List the following main parameters recorded on the CVR: — voice communications transmitted from or received on the flight deck; — the aural environment of the flight deck; — voice communication of flight crew members using the aeroplane's interphone system; — voice or audio signals introduced into a headset or speaker; — voice communication of flight crew members using the public address system, if installed.	X	X	X	X	X								
022 14 02 00		Flight data recorder (FDR)													
022 14 02 01		Purpose, components, parameters													

(02)		Describe the purpose of an FDR and its typical location.	X	X											
(02)		List the main components of an FDR: — a shock-resistant data recorder associated with a ULB; — a data interface and acquisition unit; — a recording system (digital flight data recorder); — two control units (start sequence, event mark setting); — limited flight-deck controls, but includes an event switch.	X	X											
(02)		List the following main parameters recorded on the FDR: — time or relative time count; — attitude (pitch and roll); — airspeed; — pressure altitude; — heading; — normal acceleration; — propulsive/thrust power on each engine and flight-deck thrust/power lever position, if applicable; — flaps/slats configuration or flight-deck selection; — ground spoilers or speed brake selection.	X	X											
(02)		State that additional parameters can be recorded according to	X												

		FDR capacity and applicable operational requirements.													
022 14 03 00		Maintenance and monitoring systems													
022 14 03 01		Helicopter operations monitoring programme (HOMP): design, operation, performance													
(01)		Describe the HOMP as a helicopter version of the aeroplane flight data monitoring (FDM) programme.			X	X									
(02)		State that the HOMP software consists of three integrated modules: — flight data events (FDEs); — flight data measurements (FDMs); — flight data traces (FDTs).			X	X									
(03)		Describe and explain the information flow of an HOMP.			X	X									
(04)		Describe HOMP operation and management processes.			X	X									
022 14 03 02		Integrated health and usage monitoring system (IHUMS): design, operation, performance													

(01)		Describe the main features of an IHUMS: — rotor system health; — cockpit voice recorder (CVR)/flight data recorder (FDR); — gearbox system health; — engine health; — exceedance monitoring; — usage monitoring; — transparent operation; — ground station features; — monitoring; — rotor track and balance; — engine performance trending; — quality controlled to level 2.			X	X									
(02)		Describe the ground station features of an IHUMS.			X	X									
(03)		Summarise the benefits of an IHUMS including: — reduced risk of catastrophic failure of rotor or gearbox; — improved rotor track and balance giving lower vibration levels; — accurate recording of flight exceedances; — CVR/FDR allows accurate accident/incident investigation and HOMP; — maintenance cost savings.			X	X									
(04)		State the benefits of an IHUMS and an HOMP.			X	X									

022 14 03 03		Aeroplane condition monitoring system (ACMS): general, design, operation													
(01)		State the purpose of an ACMS.	X												
(02)		Describe the structure of an ACMS including: — inputs: aircraft systems (such as air conditioning, autoflight, flight controls, fuel, landing gear, navigation, pneumatic, APU, engine), MCDU; — data management unit; — recording unit: digital recorder; — outputs: printer, ACARS or ATSU.	X												
(03)		State that maintenance messages sent by an ACMS can be transmitted without crew notification.	X												
(05)		Explain that data from the ACMS can be used as part of an FDM and safety programme.	X												
(05)		Explain that the FDM programme collects data anonymously; however, grave exceedance of parameters may warrant a further investigation of the event by the operator.	X												
(06)		Explain the purpose of FDM as a system for identifying adverse safety trends and tailoring training programmes in order to enhance the overall safety of the operation.	X												
022 15 00 00		DIGITAL CIRCUITS AND COMPUTERS													
022 15 01 00		Digital circuits and computers													

022 15 01 01		General, definitions and design													
(01)		Define a ‘computer’ as a machine for manipulating data according to a list of instructions.	X		X	X		X	X						
(02)		Explain the term ‘bus’ being used as a term for a facility (wiring, optical fibre, etc.) transferring data between different parts of a computer, both internally and externally.	X		X	X		X	X						
(03)		Define the terms ‘hardware’ and ‘software’.	X		X	X		X	X						
(04)	X	With the help of the relevant 022 references, give examples of airborne computers and list the possible peripheral equipment for each system, such as: — ADC with pitot probe(s), static port(s) and indicators; — FMS with GPS, CDU/MCDU and ND; — GPWS with radio altimeter, ADC and ND.	X		X	X		X	X						
030 00 00 00		FLIGHT PERFORMANCE AND PLANNING													
031 00 00 00		MASS AND BALANCE — AEROPLANES/HELICOPTERS													
031 01 00 00		PURPOSE OF MASS-AND-BALANCE CONSIDERATIONS													
031 01 01 00		Mass limitations													
031 01 01 01		Importance with regard to structural limitations													
(01)	X	Describe the relationship between aircraft mass and structural stress. Remark: See also Subject 021 01 01 00.	X	X	X	X	X								

(02)	X	Describe why mass must be limited to ensure adequate margins of strength.	X	X	X	X	X								
031 01 01 02		Importance with regard to performance Remark: See also Subjects 032/034 and 081/082.													
(01)		Describe the relationship between aircraft mass and aircraft performance.	X	X	X	X	X								
(02)	X	Describe why aircraft mass must be limited to ensure adequate aircraft performance.	X	X	X	X	X								
031 01 02 00		Centre-of-gravity (CG) limitations													
031 01 02 01		Importance with regard to stability and controllability Remark: See also Subjects 081/082.													
(01)	X	Describe the relationship between CG position and stability/controllability of the aircraft.	X	X	X	X	X								
(02)		Describe the consequences if CG is in front of the forward limit.	X	X	X	X	X								
(03)		Describe the consequences if CG is behind the aft limit.	X	X	X	X	X								
031 01 02 02		Importance with regard to performance Remark: See also Subjects 032/034 and 081/082.													
(01)	X	Describe the relationship between CG position and aircraft performance.	X	X	X	X	X								
(02)		Describe the effects of CG position on performance parameters (speeds, altitude, endurance and range).	X	X	X	X	X								
031 02 00 00		LOADING													

031 02 01 00		Terminology														
031 02 01 01		Mass terms														
(01)	X	Define the following mass terms: — basic empty mass; — dry operating mass; — operating mass; — take-off mass; — landing mass; — ramp/taxi mass; — in-flight mass (gross mass); — zero fuel mass.	X	X	X	X	X									
031 02 01 02		Load terms (including fuel terms) Remark: See also Subject 033.														
(01)	X	Define the following load terms: — payload/traffic load; — block fuel; — taxi fuel; — take-off fuel; — trip fuel; — reserve fuel (contingency, alternate, final reserve and additional fuel); — extra fuel.	X	X	X	X	X									
(02)		Explain the relationship between the various load-and-mass components listed in 031 02 01 01 and 031 02 01 02.	X	X	X	X	X									

(03)		Calculate the mass of particular components from other given components.	X	X	X	X	X								
(04)		Convert fuel mass, fuel volume and fuel density given in different units used in aviation.	X	X	X	X	X								
031 02 02 00		Mass limits													
031 02 02 01		Structural limitations													
(01)	X	Define the maximum zero fuel mass.	X	X											
(02)	X	Define the maximum ramp/taxi mass.	X												
(03)	X	Define the maximum take-off mass.	X	X	X	X	X								
(04)	X	Define the maximum in-flight (gross) mass with external load.			X	X	X								
(05)	X	Define the maximum landing mass.	X	X	X	X	X								
031 02 02 02		Performance and regulated limitations													
(01)		Describe the following performance and regulated mass limitations: — performance-limited take-off mass; — performance-limited landing mass; — regulated take-off mass; — regulated landing mass.	X	X	X	X	X								
031 02 02 03		Cargo compartment limitations													
(01)	X	Describe the maximum floor load (maximum load per unit of area).	X	X	X	X	X								
(02)	X	Describe the maximum running load (maximum load per unit of fuselage length).	X	X	X	X	X								
031 02 03 00		Mass calculations													

031 02 03 01		Maximum masses for take-off and landing													
(01)		Calculate the maximum mass for take-off (regulated take-off mass) given mass-and-load components and structural/ performance limits.	X	X	X	X	X								
(02)		Calculate the maximum mass for landing (regulated landing mass) given mass-and-load components and structural/ performance limits.	X	X	X	X	X								
(03)		Calculate the allowed mass for take-off.	X	X	X	X	X								
031 02 03 02		Allowed traffic load and fuel load													
(01)		Calculate the maximum allowed traffic load and fuel load in order not to exceed the given allowed take-off mass.	X	X	X	X	X								
(02)		Calculate 'under load'/'over load' given the allowed mass for take-off, operating mass and actual traffic load.	X	X	X	X	X								
031 02 03 03		Use of standard masses for passengers, baggage and crew													
(01)	X	Extract the appropriate standard masses for passengers, baggage and crew from relevant documents or operator requirements.	X	X	X	X	X								
(02)		Calculate the traffic load by using standard masses.	X	X	X	X	X								
031 03 00 00		INTENTIONALLY LEFT BLANK													
031 04 00 00		MASS-AND-BALANCE DETAILS OF AIRCRAFT													
031 04 01 00		Contents of mass-and-balance documentation													
031 04 01 01		Datum, moment arm													

(01)	X	State where the datum and moment arms for aircraft can be found.	X	X	X	X	X								
(02)	X	Extract the appropriate data from given documents.	X	X	X	X	X								
(03)	X	Define 'datum' (reference point), 'moment arm' and 'moment'.	X	X	X	X	X								
031 04 01 02		CG position as distance from datum													
(01)	X	State where the CG position for an aircraft at basic empty mass can be found.	X	X	X	X	X								
(02)	X	State where the CG limits for an aircraft can be found.	X	X	X	X	X								
(03)		Describe the different forms in presenting CG position as distance from datum or other references.	X	X	X	X	X								
(04)		Explain the meaning of centre of gravity (CG).	X	X	X	X	X								
031 04 01 03		CG position as percentage of mean aerodynamic chord (% MAC) Remark: Knowledge of the definition of MAC is covered under Subject 081 01 01 05.													
(01)		Extract MAC information from aircraft documents.	X	X											
(02)		Explain the principle of using % MAC for the description of the CG position.	X	X											
(03)		Calculate the CG position as % MAC.	X	X											
031 04 01 04		Longitudinal CG limits													
(01)		Extract the appropriate data from given sample documents.	X	X	X	X	X								
031 04 01 05		Lateral CG limits													

(01)		Extract the appropriate data from given sample documents.			X	X	X								
031 04 01 06		Details of passenger and cargo compartments													
(01)		Extract the appropriate data (e.g. seating schemes, compartment dimensions and limitations) from given sample documents.	X	X	X	X	X								
031 04 01 07		Details of fuel system relevant to mass-and-balance considerations													
(01)	X	Extract the appropriate data (e.g. fuel-tank capacities and fuel-tank positions) from given sample documents.	X	X	X	X	X								
(02)		Explain aircraft CG movement as flight progresses given location of fuel tank (inner wing, outer wing, central, additional aft central, horizontal stabiliser) and mass of fuel consumed from that tank and aeroplane's previous CG.	X												
(03)		Explain advantages and risks associated with fuel tanks in the aeroplane's fin or horizontal stabiliser.	X												
031 04 02 00		Determination of aircraft empty mass and CG position by weighing													
031 04 02 01		Weighing of aircraft (general aspects)													
(01)		Describe the general procedure and regulations relating to when an aircraft should be weighed, reweighed or data recalculated.	X	X	X	X	X								

		Remark: See the applicable operational requirements.													
(02)	X	Extract and interpret entries from/in ‘mass (weight) report’ of an aircraft.	X	X	X	X	X								
031 04 02 02		Calculation of mass and CG position of an aircraft using weighing data													
(01)		Calculate the mass and CG position of an aircraft from given reaction forces on jacking points.	X	X	X	X	X								
031 04 03 00		Extraction of basic empty mass (BEM) and CG data from aircraft documentation													
031 04 03 01		BEM or dry operating mass (DOM)													
(01)	X	Extract values for BEM or DOM from given documents.	X	X	X	X	X								
031 04 03 02		CG position or moment at BEM/DOM													
(01)		Extract values for CG position and moment at BEM or DOM from given documents.	X	X	X	X	X								
031 04 03 03		Deviations from standard configuration													
(01)		Extract values from given documents for deviation from standard configuration as a result of varying crew, optional equipment, optional fuel tanks, etc.	X	X	X	X	X								
031 05 00 00		DETERMINATION OF CG POSITION													
031 05 01 00		Methods													

031 05 01 01		Arithmetic method													
(01)		Calculate the CG position of an aircraft by using the formula: CG position = sum of moments / total mass.	X	X	X	X	X								
031 05 01 02		Graphic method													
(01)		Determine the CG position of an aircraft by using the loading graphs given in sample documents.	X	X	X	X	X								
031 05 01 03		Index method													
(01)	X	Explain the principle of the index method.	X	X	X	X	X								
(02)		Define the terms 'index' and 'dry operating index' (DOI), and calculate the DOI given the relevant formula and data.	X	X	X	X	X								
(03)		Explain the advantage(s) of the index method.	X	X	X	X	X								
031 05 02 00		Load and trim sheet													
031 05 02 01		General considerations													
(01)	X	Explain the principle and the purpose of load sheets.	X	X											
(02)	X	Explain the principle and the purpose of trim sheets.	X												
031 05 02 02		Load sheet/balance schedule and CG envelope for light aeroplanes and for helicopters													
(01)		Add loading data and calculate masses in a sample load sheet/balance schedule.	X	X	X	X	X								
(02)		Calculate moments and CG positions.	X	X	X	X	X								

(03)		Check CG position at zero fuel mass and take-off mass to be within the CG envelope including last-minute changes, if applicable.	X	X	X	X	X								
031 05 02 03		Load sheet for large aeroplanes													
(01)		Complete a sample load sheet to determine the 'allowed mass for take-off', 'allowed traffic load' and 'under load'.	X												
(02)		Explain the purpose of each load sheet section.	X												
(03)		Explain that the purpose of boxed maximum figures in load sheet sections is to cross-check the actual and limiting mass values.	X												
(04)		Complete and cross-check a sample load sheet.	X												
031 05 02 04		Trim sheet for large aeroplanes													
(01)		Explain the purpose of the trim sheet and the methods to determine the CG position.	X												
(02)		Check if the zero fuel mass CG or index is within the limits.	X												
(03)		Determine the fuel index by using the 'fuel index correction table' and determine the CG position as % MAC.	X												
(04)		Check that the take-off mass CG or index are within the limits.	X												
(05)		Determine 'stabiliser trim units' for take-off.	X												
(06)		Explain the difference between certified and operational CG limits.	X												
(07)		Determine the zero fuel mass CG or index.	X												

(08)		Explain the relationship between pitch control and CG position and the operational significance.	X												
031 05 02 05		Intentionally left blank													
031 05 02 06		Other methods to present load and trim information													
(01)	X	Describe information from other methods of presenting load and balance information, e.g. aircraft communications addressing and reporting system (ACARS), electronic flight bags (EFBs), and the 'less paper in the cockpit' (LPC) software.	X												
031 05 03 00		Repositioning of CG													
031 05 03 01		Repositioning of CG by shifting the load													
(01)		Calculate the mass to be moved over a given distance, or to/from given compartments, to establish a defined CG position.	X	X	X	X	X								
(02)		Calculate the distance to move a given mass to establish a defined CG position.	X	X	X	X	X								
(03)	X	Describe the methods to check that cargo has been loaded in correct position in relation to the loading manifest, including identifying hazard of cargo loaded in reverse order (visual inspection of one or more unit load devices (ULDs).	X	X											
(04)		Determine whether CG remains within limits if cargo has been loaded in incorrect order or at incorrect location.	X	X											
031 05 03 02		Repositioning of CG by additional load or ballast or by load or ballast removal													

(01)		Calculate the amount of additional load or ballast to be loaded at or removed from a given position or compartment to establish a defined CG position.	X	X	X	X	X								
(02)		Calculate the loading position or compartment for a given amount of additional load or ballast to establish a defined CG position.	X	X	X	X	X								
031 06 00 00		CARGO HANDLING													
031 06 01 00		Types of cargo													
031 06 01 01		Types of cargo (general aspects)													
(01)		Describe the typical types of cargo, e.g. containerised cargo, palletised cargo, bulk cargo, and the advantages of containerised and palletised cargo.	X	X	X	X	X								
031 06 02 00		Floor-area load and running-load limitations													
031 06 02 01		Floor-area load and running-load limitations in cargo compartments													
(01)		Calculate the required floor-contact area for a given load to avoid exceeding the maximum permissible floor load of a cargo compartment.	X	X	X	X	X								
(02)		Calculate the maximum mass of a container with given floor- contact area to avoid exceeding the maximum permissible floor load of a cargo compartment.	X	X	X	X	X								
(03)		Calculate the linear load distribution of a container to avoid exceeding the maximum permissible running load.	X	X	X	X	X								
031 06 03 00		Securement of load													

031 06 03 01		Securement of load (reasons and methods)													
(01)		Explain the reasons to restrain or secure cargo and baggage.	X	X	X	X	X								
(02)		Describe the basic methods to restrain or secure loads (unit load devices secured by latches on roller tracks or to tie down points by straps; bulk cargo restrained by restraining nets attached to attachment points and tie-down points).	X	X	X	X	X								
032 00 00 00		PERFORMANCE — AEROPLANES													
032 01 00 00		GENERAL													
032 01 01 00		Performance legislation													
032 01 01 01		Applicability of airworthiness requirements of CS-23 and CS-25													
(01)	X	Describe the application of certification specification (CSs) with regard to the different kinds of aeroplanes.	X	X											
(02)	X	Describe the general differences between aeroplanes certified according to CS-23 (CS 23.1, CS 23.3) and CS-25 (CS 25.1, CS 25.20).	X												
032 01 01 02		Operational regulations and safety													
(01)	X	Describe the basic concept that the applicable operational requirements differ depending on aeroplane performance.	X	X											
(02)		Describe the performance classes for commercial air transport according to the applicable operational requirements.	X	X											

032 01 01 03		Performance and safety													
(01)	X	State that aeroplane performance required for commercial air transport may limit the weight of a dispatched aeroplane in order to achieve a sufficient level of safety.	X	X											
(02)	X	Describe that the minimum level of safety required for commercial air transport is ensured through the combination of airworthiness requirements and operational limitations, i.e. the more stringent airworthiness requirements of CS-25 enable a wider range of operating conditions for these aeroplanes.	X	X											
032 01 01 04		Performance definitions and safety factors													
(01)	X	Describe measured performance and explain how it is determined.	X	X											
(02)		Describe gross performance.	X	X											
(03)		Describe net performance and safety factors.	X	X											
(04)	X	Describe that the size of a safety factor depends on the likelihood of the event and the range of the measured performance data.	X	X											
(05)		Describe the relationship between net and gross take-off and landing distances, and net and gross climb and descent gradients.	X	X											
032 01 02 00		General performance theory													
032 01 02 01		Intentionally left blank													
032 01 02 02		Definitions and terms													

(01)	X	Define the terms 'climb angle' and 'climb gradient'.	X	X											
(02)	X	Define the terms 'flight-path angle' and 'flight-path gradient'.	X	X											
(03)	X	Define the terms 'descent angle' and 'descent gradient'.	X	X											
(04)	X	Explain the difference between climb/descent angle and flight- path angle.	X	X											
(05)	X	Define 'absolute ceiling'.	X	X											
(06)		Describe 'clearway' and 'stopway' according to CS-Definitions.	X	X											
(07)		Describe: — take-off run available (TORA); — take-off distance available (TODA); — accelerate-stop distance available (ASDA); and determine each from given data or appropriate aerodrome charts.	X	X											
(08)		Describe 'screen height' including its various values.	X	X											
(09)	X	Define the terms 'range' and 'endurance'.	X	X											
(10)		Define an aeroplane's 'specific range' (SR) in terms of nautical air miles (NAM) per unit of fuel, and 'specific range over the ground' (SRG) in terms of nautical ground miles (NGM) per unit of fuel.	X	X											
(11)		Define the power available and power required.	X	X											
032 01 02 03		Variables influencing performance													

(01)	X	Name the following factors that affect aeroplane performance: pressure altitude and temperature, wind, aeroplane weight, aeroplane configuration, aeroplane anti-skid status, aeroplane centre of gravity (CG), aerodrome runway surface, and aerodrome runway slope.	X	X											
(02)	X	Describe how, for different density altitudes, the thrust and power available vary with speed for a propeller-driven aeroplane.	X	X											
(03)	X	Describe how, for different density altitudes, the thrust and power available vary with speed for a turbojet aeroplane.	X												
(04)		Describe how, for different density altitudes, the drag and power required vary with indicated airspeeds (IAS) and true airspeeds (TAS).	X	X											
(05)		Describe how, for different aeroplane weights and configurations, the drag and power required vary with IAS and TAS.	X	X											
032 01 03 00		Level flight, range and endurance													
032 01 03 01		Steady level flight													
(01)	X	Explain how drag (thrust) and power required vary with speed in straight and level flight.	X	X											
(02)	X	Explain the effect of excess thrust and power on speed in level flight.	X	X											
(03)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in straight and level flight.	X	X											

(04)		Describe how the maximum achievable straight and level flight IAS and TAS vary with altitude.	X	X											
(05)		Describe situations in which a pilot may elect to fly for 'maximum endurance' or 'maximum range'.	X	X											
032 01 03 02		Range													
(01)		Define a turbojet aeroplane's specific fuel consumption (SFC) and describe how it affects fuel flow and specific range.	X												
(02)		Define a propeller-driven aeroplane's SFC and describe how it affects fuel flow and specific range.	X	X											
(03)		Explain the optimum speed for maximum SR for a turbojet aeroplane in relation to the drag curve.	X												
(04)		Explain the optimum speed to achieve maximum SR for a propeller-driven aeroplane in relation to the power required and drag graphs.	X	X											
(05)		Explain the effect of aeroplane weight and CG position on fuel consumption, range and the optimum speed for maximum SR.	X	X											
(06)		State how a turbojet engine's SFC varies with temperature and thrust setting.	X												
(07)		Explain how SR for a turbojet aeroplane varies with altitude and under different meteorological conditions.	X												

(08)		Explain how SRG for a propeller-driven aeroplane varies with altitude and under different meteorological conditions.	X	X											
(09)		Explain the effect of weight on the optimum altitude for maximum range.	X	X											
(10)		Describe the effect of wind on SRG and the optimum speed for SRG , when compared to SR, and the optimum speed for SR.	X	X											
032 01 03 03		Maximum endurance													
(01)		Explain fuel flow in relation to TAS and thrust for a turbojet aeroplane.	X												
(02)		State the speed for maximum endurance for a turbojet aeroplane.	X												
(03)		Explain fuel flow in relation to TAS and thrust for a propeller- driven aeroplane.	X	X											
(04)		State the speed for maximum endurance for a propeller-driven aeroplane and the disadvantages of holding at this speed (e.g. high angle of attack (AoA) and lack of speed stability).	X	X											
(05)		Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a turbojet aeroplane.	X												
(06)		Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a propeller-driven aeroplane.	X	X											

(07)		Describe the benefits of managing your en-route airspeed to reduce or avoid holding time, and the operational situations when it could be used (commanded by the pilot or air traffic control (ATC), when delays at arrival airport occur).	X	X											
032 01 04 00		Climbing													
032 01 04 01		Climbing (climb performance)													
(01)		Resolve the forces during a steady climb.	X	X											
(02)		Define and explain the following terms: — critical engine; — speed for best angle of climb (VX); — speed for best rate of climb (VY).	X	X											
(03)		Explain climb performance in relation to the thrust available and thrust required (angle of climb), and power available and power required (rate of climb).	X	X											
(04)		Explain the meaning and effect of ‘excess thrust’ and ‘excess power’ in a steady climb.	X	X											
(05)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in a steady climb.	X	X											
(06)		State the difference between climb angle and gradient.	X	X											
(07)		Explain the effect of weight on the climb angle and rate of climb, and the speed for best angle and best rate of climb.	X	X											

(08)		Explain the effects of pressure altitude and temperature, including an inversion on climb performance (angle and rate of climb).	X	X											
(09)		Explain the effect of configuration on climb performance (angle and rate of climb, and VX and VY).	X	X											
(10)		Describe the effect of engine failure on climb performance (angle and rate of climb, and VX and VY).	X	X											
(11)		Calculate the all-engine and one-engine-out climb gradient from given values of engine thrust and aeroplane drag and weight.	X	X											
032 01 05 00		Descending													
032 01 05 01		Descending (descent performance)													
(01)		Resolve the forces during steady descent and in the glide.	X	X											
(02)		Explain descent performance in relation to thrust available and thrust required (drag), and power available and power required.	X	X											
(03)		Explain the meaning of ‘excess thrust required’ (excess drag) and ‘excess power required’ in a steady descent.	X	X											
(04)		Interpret the ‘thrust/power required’ and ‘thrust/power available’ curves in a steady descent.	X	X											
(05)		Explain the effect of mass, altitude, wind, speed and configuration on the glide descent.	X	X											

(06)		Explain the effect of mass, altitude, wind, speed and configuration on the powered descent.	X	X												
032 02 00 00		CS-23/APPLICABLE OPERATIONAL REQUIREMENTS PERFORMANCE CLASS B — THEORY														
032 02 01 00		Airworthiness requirements														
032 02 01 01		Airworthiness requirements and definitions														
(01)	X	Define the following speeds: — stall speeds VS, VS0 and VS1; — rotation speed VR; — speed at 50 ft above the take-off surface level; — reference landing speed VREF.	X	X												
(02)		Describe the limitations on VR, on the speed at 50 ft above the take-off surface and on VREF, and given the appropriate stall speed, estimate the values based on these limitations for a single-engine, class B aeroplane.	X	X												
(03)		Describe the limitations on VR, on the speed at 50 ft above the take-off surface and on VREF, and given the appropriate stall speed, estimate the values based on these limitations for a multi-engine, class B aeroplane.	X	X												
(04)	X	Describe the European Union airworthiness requirements according to CS-23 relating to aeroplane performance (CS-23 SUBPART A — GENERAL, PERFORMANCE, CS 23.45	X	X												

		to CS 23.78 inclusive).														
(05)		Define and identify the critical engine of a multi-engine propeller aeroplane.	X	X												
(06)		Explain the effect of an engine failure on the power required, the total drag (thrust required) and climb performance of a multi-engine aeroplane.	X	X												
(07)		Explain the effect of engine failure on the minimum control speed of a multi-engine aeroplane under given conditions (temperature and pressure altitude).	X	X												
032 02 02 00		Intentionally left blank														
032 02 03 00		Take-off and landing														
032 02 03 01		Take-off and landing (definitions and effects)														
(01)	X	Define the following distances and masses: — take-off distance; — landing distance; — ground-roll distance; — maximum allowed take-off mass; — maximum allowed landing mass.	X	X												
(02)		Explain the effect of flap-setting on the take-off, landing and ground-roll distances.	X	X												

(03)		Explain the effects of the following runway (RWY) variables on take-off distances: — RWY slope; — RWY surface conditions: dry, wet and contaminated; — RWY elevation.	X	X											
(04)		For both fixed-pitch and constant-speed propeller aeroplanes, explain the effect of airspeed on thrust during the take-off run.	X	X											
(05)		Describe the effects of brake release before take-off power is set on the TOD and ASD.	X	X											
(06)		Explain the effect of wind on take-off and landing distances, and determine the actual headwind/tailwind component given the runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb.	X	X											
(07)		Explain why an aeroplane has maximum crosswind limit(s) and determine the crosswind component given the runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb.	X	X											
(08)		Explain the percentage of accountability for headwind and tailwind components during take-off and landing calculations.	X	X											
(09)		Explain the effect of runway conditions on the landing distance.	X	X											

(10)		Explain the effects of pressure altitude and temperature on the take-off distance, take-off climb, landing distance and approach climb.	X	X											
(11)		Describe the landing airborne distance and ground-roll distance and estimate the effect on the landing distance when the aeroplane is too fast or too high at the screen.	X	X											
(12)		Describe the take-off flight path for a multi-engine, class B aeroplane.	X	X											
(13)		Describe the dimensions of the take-off flight path accountability area (domain).	X	X											
032 02 04 00		Climb, cruise and descent													
032 02 04 01		Climb, cruise and descent (requirements and calculations)													
(01)		Describe the climb and en-route requirements according to the applicable operational requirements.	X	X											
(02)		For a single-engine aeroplane, calculate the expected obstacle clearance (in visual meteorological conditions (VMC)) given gross climb performance, obstacle height and distance from reference zero.	X	X											
(03)		For a single-engine aeroplane, calculate the net glide gradient and net glide distance, given aeroplane altitude, terrain elevation, gross gradient or lift/drag ratio (L/D ratio), and headwind or tailwind component.	X	X											

032 03 00 00		CS-23/APPLICABLE OPERATIONAL REQUIREMENTS PERFORMANCE CLASS B — USE OF AEROPLANE PERFORMANCE DATA FOR SINGLE- AND MULTI-ENGINE AEROPLANES													
032 03 01 00		Intentionally left blank													
032 03 02 00		Intentionally left blank													
032 03 03 00		Use of aeroplane performance data													
032 03 03 01		Take-off													
(01)		Determine the field-length-limited take-off mass and take-off speeds given defactored distance, configuration, pressure altitude, temperature and headwind/tailwind component.	X	X											
(02)		Determine the accelerate-go distance and accelerate-stop distance data.	X	X											
(03)		Determine the ground-roll distance and take-off distance from graphs.	X	X											
(04)		Determine the all-engine-out and critical-engine-out take-off climb data.	X	X											
(05)		Determine take off flight path for a MEP aeroplane of given mass and given airfield conditions, and calculate the obstacle clearance based on the take-off flight path.	X	X											
(06)		Determine the minimum headwind or maximum tailwind component required for take-off for a given mass and given airfield conditions.	X	X											

(07)		Given take-off run available (TORA), TODA and ASDA, slope and surface conditions, calculate the defactored distance to be used for commercial air transport using the appropriate take- off graphs.	X	X											
(08)		Calculate the minimum TORA or TODA for commercial air transport given the defactored take-off distance or run, runway surface and slope.	X	X											
032 03 03 02		Climb													
(01)		Determine rate of climb.	X	X											
(02)		Calculate obstacle clearance climb data.	X	X											
(03)		Determine the still-air and flight-path gradients for given IAS, altitude, temperature, aeroplane weight and, if relevant, wind component.	X	X											
032 03 03 03		Intentionally left blank													
032 03 03 04		Landing													
(01)		Determine the field-length-limited landing mass and landing speeds given defactored distance, configuration, pressure altitude, temperature and headwind or tailwind component.	X	X											
(02)		Determine landing climb data in the event of balked landing.	X	X											
(03)		Determine landing distance and ground-roll distance for given flap position, aeroplane weight and airfield data.	X	X											

(04)		Calculate, given the landing distance available (LDA), slope and surface type and condition, the defactored distance to be used for commercial air transport using the appropriate landing graphs.	X	X											
(05)		Calculate the minimum landing distance (LD) that must be available for commercial air transport given the defactored landing distance, runway surface and slope.	X	X											
032 04 00 00		CS-25/APPLICABLE OPERATIONAL REQUIREMENTS PERFORMANCE CLASS A —— THEORY													
032 04 01 00		Take-off													
032 04 01 01		Take-off performance, definitions of and relationships between terms													
(01)	X	Explain the forces affecting the aeroplane during the take-off run.	X												
(02)	X	State the effects of thrust-to-weight ratio and flap-setting on ground roll.	X												
(03)		Describe the European Union airworthiness requirements according to CS-25 relating to large aeroplane performance (General and Take-off) (SUBPART B —— FLIGHT PERFORMANCE: CS 25.101 to CS 25.109 inclusive, and CS 25.113).	X												
(04)		Describe the terms ‘aircraft classification number’ (ACN) and ‘pavement classification number’ (PCN), and the requirements and hazards of operating on aerodrome surfaces with PCNs smaller than the ACNs.	X												

(05)		Define and explain the following speeds in accordance with CS- 25 or CS-Definitions: — reference stall speed (VSR); — reference stall speed in a specific configuration (VSR1); — 1-g stall speed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight (VS1g); — minimum control speed with critical engine inoperative (VMC); — minimum control speed on or near the ground (VMCG); — minimum control speed at take-off climb (VMCA); — engine failure speed (VEF); — take-off decision speed (V1); — rotation speed (VR); — take-off safety speed (V2); — minimum take-off safety speed (V2MIN); — minimum unstick speed (VMU); — lift-off speed (VLOF); — maximum brake energy speed (VMBE); — maximum tyre speed (VMax Tyre).	X												
(08)		Explain how loss of TORA due to alignment is accounted for.	X												
(09)		Explain the effect of the interdependency of relevant speeds in 032 04 01 01 (05) and the	X												

		situations in which these interdependencies can cause speed and performance restrictions.														
032 04 01 02		Take-off distances														
(01)		Explain the effects of the following runway (RWY) variables on take-off distances: — RWY slope; — RWY surface conditions: dry, wet and contaminated; — RWY elevation.	X													
(02)		Explain the effects of the following aeroplane variables on take-off distance: — aeroplane mass; — take-off configuration; — bleed-air configurations.	X													
(03)		Explain the effects of the following meteorological variables on take-off distances: — wind; — temperature; — pressure altitude.	X													
(04)		Explain the consequence of errors in rotation technique on take-off distance: — early and late rotation; — too high and too low rotation angle; — too high and too low rotation rate.	X													

(05)		Compare the take-off distance for specified conditions and configuration for all engines operating and one-engine- inoperative.	X												
(06)		Explain the effect of using clearway on the field-length-limited take-off mass.	X												
(07)		Explain the influence of aeroplane mass, air density and flap settings on V1, V2 and V2MIN and thereby on take-off distance.	X												
(08)		Explain the effect of an error in V1 on the resulting one-engine- out take-off distance.	X												
032 04 01 03		Accelerate-stop distance													
(01)		Explain how the accelerate-stop distance is affected by given conditions and configuration for all engines operating and one- engine-inoperative.	X												
(02)		Explain the effect of using a stopway on the field-length-limited take-off mass.	X												
(03)		Explain the effect of an error in V1 on the resulting accelerate- stop distance.	X												
(04)		Explain the effect of runway slope or wind component on the accelerate-stop distance.	X												
(05)		Explain how the accelerate-stop distance is determined and discuss the deceleration procedure.	X												

(06)		Explain how the accelerate-stop distance is affected by the use of brakes, anti-skid, reverse thrust, ground spoilers (lift dumpers) and by brake energy absorption limits, delayed temperature rise and brake temperature indication.	X												
(07)	X	Explain the hazards of rejecting a take-off from high ground speed or high take-off mass, and how to manage these hazards.	X												
032 04 01 04		Balanced field length concept													
(01)	X	Define the term 'balanced field length'.	X												
(02)		Describe the relationship between take-off distance and accelerate-stop distance, and identify on a diagram the balanced field length and balanced V1.	X												
(03)	X	Describe the applicability of a balanced field length.	X												
032 04 01 05		Unbalanced field length concept													
(01)	X	Describe the applicability of an unbalanced field length.	X												
(02)		Explain the effect of additional stopway on the allowed take-off mass and appropriate V1 when using an unbalanced field.	X												
(03)		Explain the effect of additional clearway on the allowed take- off mass and appropriate V1 when using an unbalanced field.	X												
032 04 01 06		Field-length-limited take-off mass (FLLTOM)													
(01)		Explain the factors that affect the FLLTOM.	X												

(02)		Explain the concept of a 'range of V1' and explain reasons for the placement of the designated V1 towards the faster or slower end of the range.	X												
032 04 01 07		Contaminated runways													
(01)		Define a 'contaminated runway', 'wet runway', and a 'dry runway'.	X	X											
(02)		Describe the different types of contamination: wet or water patches, rime- or frost-covered, dry snow, wet snow, slush, ice, compacted or rolled snow, frozen ruts or ridges. Source: ICAO Annex 15, Appendix 2	X	X											
(03)	X	Identify the difference between friction coefficient and estimated surface friction. Source: ICAO Annex 15, Appendix 2	X	X											
(04)		State that when friction coefficient is 0.40 or higher, the expected braking action is good. Source: ICAO Annex 14, Vol. I, Attachment A	X	X											
(05)		Define the different types of hydroplaning. Source: NASA TM-85652, Tire Friction Performance, pp. 6 to 9	X	X											
(06)		Explain the difference between the two dynamic hydroplaning speeds and state which of them is the most limiting for an aircraft operating on a wet runway. Source: NASA TM-85652, Tire Friction Performance, p. 8	X	X											

(07)		State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in Part B of the Operations Manual — Limitations.	X	X												
(08)		State that the procedures associated with take-off and landing on contaminated runways are to be found in Part B of the Operations Manual — Normal procedures.	X	X												
(09)		State that the performance associated with contaminated runways is to be found in Part B of the Operations Manual — Performance.	X	X												
032 04 01 08		Take-off climb														
(01)		Explain the difference between the flat-rated and non-flat-rated part in performance charts.	X													
(02)		State the differences in climb-gradient requirements for two-, three- and four-engined aeroplanes.	X													
(03)		Explain the effects of aeroplane configuration and meteorological conditions on the take-off climb.	X													
(04)		Determine the climb-limited take-off mass.	X													
032 04 01 09		Obstacle-limited take-off														
(01)		Describe the operational regulations for obstacle clearance in the net take-off flight path (NTOFP).	X													
(02)		Define the actual and NTOFP with one-engine-inoperative in accordance with CS-25.	X													

(03)		Explain the effects of aeroplane configuration and meteorological conditions on the obstacle-limited take-off mass.	X												
(04)		Describe the segments of the actual take-off flight path.	X												
(05)		Describe the changes in the configuration, power, thrust and speed in the NTOFP climb segments.	X												
(06)		State the standard maximum bank angle(s) in the first and second segment, and determine the effect on the stall speed and implication on V2.	X												
(07)		Explain the influence of airspeed selection, acceleration and turns on the climb gradient.	X												
(08)		Describe the European Union airworthiness requirements according to CS-25 relating to aeroplane performance take-off climb and flight path (SUBPART B —— FLIGHT PERFORMANCE: CS 25.111, CS 25.115, CS 25.117 and CS 25.121)	X												
032 04 01 10		Performance-limited take-off mass (PLTOM) and regulated take-off mass (RTOM) tables													
(01)		Define PLTOM and RTOM.	X												
(02)	X	Describe the use of RTOM tables or similar to find PLTOM and how this can also be done using an EFB.	X												
(03)		Interpret what take-off limitation (field length, obstacle, climb, structural, etc.) is restricting a particular RTOM as it is presented in RTOM tables or similar.	X												

(04)		Describe why data from an EFB can differ from data derived from RTOM tables or similar.	X													
032 04 01 11		Take-off performance on wet and contaminated runways														
(01)		Explain the differences between the take-off performance determination on a wet or contaminated runway and on a dry runway.	X													
(02)		Describe a wet V1 and explain the consequences of using a wet V1.	X													
(03)		Describe the hazards, effects and management of operating from a contaminated runway.	X													
(04)		Describe displacement drag, impingement drag, and the methods to monitor acceleration.	X													
(05)		Explain the benefits and implications of using a derated take- off on a contaminated runway.	X													
032 04 01 12		Use of reduced (flexible or flex) and derated thrust														
(01)		Explain the advantages and disadvantages of using reduced (flex) and derated thrust.	X													
(02)		Explain the difference between and principles behind reduced (flex) and derated thrust.	X													
(03)		Explain when reduced (flex) and derated thrust may and may not be used.	X													

(04)		Explain the effect of using reduced (flex) and derated thrust on take-off performance including take-off speeds, take-off distance, climb performance and obstacle clearance.	X												
(05)		Explain the assumed temperature method for determining reduced (flex) thrust performance.	X												
032 04 01 13		Take-off performance using different take-off flap settings													
(01)		Explain the advantages and disadvantages of using different take-off flap settings to optimise the performance-limited take- off mass (PLTOM).	X												
(02)		Determine the optimum flap position and PLTOM from given figures.	X												
032 04 01 14		Take-off performance using increased V2 speeds (‘improved climb performance’)													
(01)		Explain the advantages and disadvantages of the increased V2 procedure.	X												
(02)		Explain under what circumstances this procedure can be used.	X												
(03)		Explain the hazards of the fast V1 and VLOF speeds associated with the increased V2 procedure and how they can be managed.	X												
032 04 01 15		Brake-energy and tyre-speed limit													
(01)		Explain the effects on take-off performance of brake-energy and tyre-speed limits.	X												

(02)		Explain under what conditions they are more likely to become limiting.	X												
032 04 02 00		Climb													
032 04 02 01		Climb techniques													
(01)		Explain the effect of climbing at constant IAS on: —— TAS; —— Mach number; —— climb gradient; —— rate of climb.	X												
(02)		Explain the effect of climbing at constant Mach number on: —— TAS; —— IAS; —— climb gradient; —— rate of climb.	X												
(03)		Explain the correct sequence of climb speeds for turbojet transport aeroplanes.	X												
(04)		Determine the effect on TAS when climbing in and above the troposphere at constant Mach number.	X												
032 04 02 02		Influence of variables on climb performance													
(01)		Explain the effect on the operational speed limit when climbing at constant IAS and at constant Mach number.	X												

(02)		Explain the term 'crossover altitude' which occurs during the climb speed schedule (IAS—Mach number).	X												
032 04 03 00		Cruise													
032 04 03 01		Intentionally left blank													
032 04 03 02		Intentionally left blank													
032 04 03 03		Intentionally left blank													
032 04 03 04		Long-range cruise													
(01)		Define the term 'long-range cruise'.	X												
(02)		Explain the differences between flying at long-range speed and maximum-range speed with regard to fuel-flow and speed stability.	X												
032 04 03 05		Intentionally left blank													
032 04 03 06		Cruise altitudes													
(01)	X	Define the term 'optimum cruise altitude'.	X												
(02)		Explain the factors that affect optimum cruise altitude.	X												
(03)		Explain the factors that can affect or limit the maximum operating cruise altitude.	X												
(04)		Explain the purpose of, and operational reasons for, a step climb and when such a climb would be initiated for optimum range.	X												
(05)		Describe the buffet onset boundary (BOB) and determine the high- and low-speed buffet (speed/Mach number only).	X												

(06)		Analyse the influence of bank angle, mass and the 1.3g buffet margin on a step climb.	X												
(07)		Describe that the high-speed buffet can occur at speeds slower or faster than MMO.	X												
(08)		Explain the reasons why a step climb may not be used (e.g. for short sectors, advantageous winds, avoiding turbulence, and due to air traffic restrictions).	X												
032 04 03 07		Cost index (CI)													
(01)		Describe 'cost index'.	X												
(02)		Describe the reason for economical cruise speed.	X												
(03)		Describe the effect of cost index on climb, cruise and descent speeds.	X												
032 04 04 00		En-route one-engine-inoperative													
032 04 04 01		Drift-down													
(01)		Describe the determination of en-route flight-path data with one-engine-inoperative in accordance with CS 25.123.	X												
(02)		Describe the minimum obstacle-clearance height prescribed in the applicable operational requirements.	X												
(03)		Describe the optimum speed that the pilot should select during drift-down.	X												
(04)		Explain the influence of deceleration on the drift-down profiles.	X												

032 04 04 02		Influence of variables on the en-route one-engine-inoperative performance													
(01)		Describe and explain the factors which affect the en-route net drift-down flight path.	X												
032 04 05 00		Descent													
032 04 05 01		Descent techniques													
(01)		Explain the effect of descending at constant Mach number.	X												
(02)		Explain the effect of descending at constant IAS.	X												
(03)		Explain the correct sequence of descent speeds for turbojet transport aeroplanes.	X												
(04)		Determine the effect on TAS when descending in and above the troposphere at constant Mach number.	X												
(05)		Describe the following limiting speeds for descent: — maximum operating speed (VMO); — maximum Mach number (MMO).	X												
(06)		Explain the effect of a descent at constant Mach number on the margin to low- and high-speed buffet.	X												
032 04 05 02		Energy management in the descent													
(01)		Explain the advantages and principle of a continuous descent.	X												
(02)	X	Describe energy management in terms of chemical, potential and kinetic energy.	X												

(03)		Describe the effect of increasing/decreasing headwind and tailwind on profile management.	X												
(04)		Describe the effect of the Mach number to IAS transition (speed conversion) on profile management.	X												
(05)		Describe situations during the descent and approach in which a pilot could find that an aeroplane flies high or fast, and explain how the pilot can manage descent angle/excess energy.	X												
032 04 06 00		Approach and landing													
032 04 06 01		Approach requirements													
(01)		Describe the CS-25 requirements for the approach climb (CS 25.121).	X												
(02)		Describe the CS-25 requirements for the landing climb.	X												
(03)		Explain the effect of temperature and pressure altitude on approach and landing-climb performance.	X												
032 04 06 02		Landing-field-length and landing-speed requirements													
(01)	X	Describe the landing distance determined according to CS 25.125 (‘demonstrated’ landing distance).	X												
(02)		Describe the landing-field-length requirements for dry, wet and contaminated runways and the applicable operational requirements.	X												
(03)	X	Define the ‘landing distance available’ (LDA).	X												

(04)		Define and explain the following speeds in accordance with CS- 25 or CS-Definitions: — reference stall speed in the landing configuration (VSR0); — reference landing speed (VREF); — minimum control speed, approach and landing (VMCL).	X												
032 04 06 03		Influence of variables on landing performance													
(01)		Explain the effect of runway slope, surface conditions and wind on the maximum landing mass for a given landing distance available in accordance with the applicable operational requirements.	X												
(02)		Explain the effect on landing distance and maximum allowable landing mass of the following devices affecting deceleration: — reverse; — anti-skid; — ground spoilers or lift dumpers; — autobrakes.	X												
(03)		Explain the effect of temperature and pressure altitude on the maximum landing mass for a given landing distance available.	X												
(04)		Explain the effect of hydroplaning on landing distance required and methods of managing landing on contaminated or wet runways.	X												
032 04 06 04		Quick turnaround limit													

(01)		Describe how brake temperature limits the turnaround times.	X												
032 05 00 00		CS-25/APPLICABLE OPERATIONAL REQUIREMENTS PERFORMANCE CLASS A — USE OF AEROPLANE PERFORMANCE DATA	X												
032 05 01 00		Take-off													
032 05 01 01		Take-off (performance data)													
(01)		Determine from given graphs the field-length-limited take-off mass (FLLTOM) and describe situations in which this limitation could be most restrictive for take-off.	X												
(02)		Determine from given graphs the climb-limited take-off mass and describe situations in which this limitation could be most restrictive for take-off.	X												
(03)		Determine from given graphs the obstacle-limited mass and describe situations in which this limitation could be most restrictive for take-off.	X												
(04)		Determine from given graphs the tyre-speed-limited take-off mass.	X												
(05)		Determine from given graphs the maximum brake-energy-limited take-off mass.	X												
(06)		Determine the take-off V speeds for the actual take-off mass.	X												
(07)		Determine the maximum take-off mass using given RTOM tables.	X												

(08)		Using RTOM tables, determine the take-off V speeds for the actual take-off weight using appropriate corrections.	X												
(09)		Determine the assumed/flex temperature and take-off V speeds using the RTOM tables.	X												
(10)		Calculate the break cooling time following a rejected take-off given appropriate data.	X												
032 05 02 00		Drift-down and stabilising altitude													
032 05 02 01		Drift-down and stabilising altitude (performance data)													
(01)		Determine the one-engine-out net stabilising altitude (level-off altitude) from given graphs/tables.	X												
(02)		Determine the maximum mass at which the net stabilizing altitude with one-engine-out clears the highest relevant obstacle by the required clearance margin.	X												
(03)		Determine, using drift-down graphs, fuel used, time and distance travelled in a descent from a cruise flight level to a given altitude.	X												
032 05 03 00		Landing													
032 05 03 01		Landing (performance data)													
(01)		Determine the field length required for landing with a given landing mass from the aeroplane performance data sheets.	X												

(02)		Determine the landing and approach climb-limited landing mass from the aeroplane performance data sheets.	X												
(03)		Calculate the maximum allowable landing mass as the lowest of: — approach-climb- and landing-climb-limited landing mass; — landing-field-length-limited landing mass; — structural-limited landing mass.	X												
(04)		Determine the brake cooling time for different landing masses using the aeroplane performance data sheets.	X												
033 00 00 00		FLIGHT PLANNING AND MONITORING													
033 01 00 00		FLIGHT PLANNING FOR VFR FLIGHTS Remark: Using the GSPRM VFR charts.													
033 01 01 00		VFR navigation plan													
033 01 01 01		Airspace, communication, visual and radio-navigation data from VFR charts													
(01)		Select routes taking the following criteria into account: — classification of airspace; — restricted areas; — VFR semicircular rules; — visually conspicuous points; — radio-navigation aids.	X	X	X	X	X								
(02)		Find the frequencies or identifiers of radio-navigation aids from charts.	X	X	X	X	X								

(03)		Find the communication frequencies and call signs for the following: — control agencies and service facilities; — flight information service (FIS); — weather information stations; — automatic terminal information service (ATIS).	X	X	X	X	X								
033 01 01 02		Planning courses, distances and cruising levels with VFR charts													
(01)		Choose visual waypoints in accordance with specified criteria (large, unique, contrast, vertical extent, etc.).	X	X	X	X	X								
(02)		Measure courses and distances from a VFR chart.	X	X	X	X	X								
(03)		Find the highest obstacle within a given distance on either side of the course.	X	X	X	X	X								
(04)		Find the following data from a VFR chart and transfer them to a navigation plan: — waypoints or turning points; — distances; — true/magnetic courses.	X	X	X	X	X								
(05)		Calculate the minimum pressure altitude with a given obstacle clearance or true altitude from a given altitude or pressure altitude from minimum grid-area altitude using outside air temperature (OAT) and QNH.	X	X	X	X	X								
(06)		Calculate the vertical or horizontal distance and time to climb or descend to/from a given level or altitude with given data.	X	X	X	X	X								

(07)		Explain how to determine the position of a significant VFR point for insertion into a global navigation satellite system (GNSS) flight plan, using the distance and bearing from an existing significant point and using coordinates.	X	X	X	X	X								
033 01 01 03		Aerodrome charts and aerodrome directory													
(01)	X	Explain the reasons for studying the visual departure procedures and the available approach procedures.	X	X	X	X	X								
(02)		Find all visual procedures which can be expected at the departure, destination and alternate aerodromes.	X	X	X	X	X								
(03)		Find all relevant aeronautical and regulatory information required for VFR flight planning from the aerodrome charts or aerodrome directory.	X	X	X	X	X								
033 01 01 04		Intentionally left blank													
033 01 01 05		Completion of navigation plan													
(01)		Calculate the true airspeed (TAS) from given aircraft performance data, altitude and OAT.	X	X	X	X	X								
(02)		Calculate wind correction angles (WCAs), drift and ground speeds (GS).	X	X	X	X	X								
(03)		Calculate individual and accumulated times for each leg to destination and alternate aerodromes.	X	X	X	X	X								
033 02 00 00		FLIGHT PLANNING FOR IFR FLIGHTS Remark: Using the GSPRM IFR charts.													
033 02 01 00		IFR navigation plan													

033 02 01 01		Air traffic service (ATS) routes													
(01)		Identify suitable routings by identifying all relevant aeronautical and regulatory information (including information published in the national aeronautical information publication (AIP)) required for IFR flight planning.	X		X			X	X						
(02)		Identify and describe ATS routes (conventional, area navigation (RNAV), required navigation performance (RNP), conditional routes (CDRs), and direct routes).	X		X			X	X						
033 02 01 02		Courses and distances from en-route charts													
(01)		Determine courses and distances.	X		X			X	X						
(02)		Determine bearings and distances of waypoints from radio-navigation aids.	X		X			X	X						
033 02 01 03		Altitudes													
(01)		Define the following altitudes: — minimum en-route altitude (MEA); — minimum obstacle clearance altitude (MOCA); — minimum sector altitude (MSA); — minimum off-route altitude (MORA); — grid minimum off-route altitude (Grid MORA); — maximum authorised altitude (MAA); — minimum crossing altitude (MCA); — minimum holding altitude (MHA).	X		X			X	X						

(02)		Extract the following altitudes from the chart(s): — MEA; — MOCA; — MSA; — MORA; — Grid MORA; — MAA; — MCA; — MHA.	X		X			X	X						
(03)		State who is responsible for terrain separation during IFR flight inside and outside controlled airspace.	X		X			X	X						
(04)		State the minimum obstacle clearance requirements for en-route IFR flight inside and outside controlled airspace.	X		X			X	X						
(05)		State when a temperature error correction must be applied by either the pilot or ATC.	X		X			X	X						
(06)		Identify and explain the use of minimum radar vectoring altitudes.	X		X			X	X						
(07)		Calculate the minimum pressure altitude required with a given obstacle clearance, magnetic track, OAT, QNH and reduced vertical separation minimum (RVSM)/non-RVSM information.	X		X			X	X						
(08)		Calculate true altitude above a given datum using a given pressure altitude, OAT and QNH.	X		X			X	X						

033 02 01 04		Standard instrument departure (SID) and standard instrument arrival (STAR) routes													
(01)	X	State the reasons for studying SID and STAR charts.	X		X			X	X						
(02)	X	State that SID and STAR charts show procedures only in a pictorial presentation style which may not be true to scale.	X		X			X	X						
(03)		Interpret all data and information represented on SID and STAR charts, particularly: — routings; — distances; — courses; — radials; — altitudes/levels; — frequencies; — restrictions; — RNAV waypoints and non-RNAV intersection; — fly-over and fly-by waypoints.	X		X			X	X						
(04)		Identify SID and STAR charts which might be relevant for a planned flight.	X		X			X	X						
(05)		Define SID and STAR for RNAV only.	X		X			X	X						
(06)		Describe the difference between SID/STAR, RNAV SID/STAR and RNAV SID/STAR overlay.	X		X			X	X						
033 02 01 05		Instrument-approach charts													

(01)	X	State the reasons for being familiar with instrument-approach procedures (IAPs) and appropriate data for departure, destination and alternate aerodromes.	X		X			X	X						
(02)		Select IAPs appropriate for departure, destination and alternate aerodromes.	X		X			X	X						
(03)		Interpret all procedures, data and information represented on instrument-approach charts, particularly: — courses and radials; — distances; — altitudes/levels/heights; — restrictions; — obstructions; — frequencies; — speeds and times; — decision altitudes/heights (DAs/Hs); — (DA/H) and minimum descent altitudes/heights (MDAs/Hs); — visibility and runway visual ranges (RVRs); — approach-light systems.	X		X			X	X						

(04)		Explain the following IAP terms: — type A and B; — 2D and 3D; — CAT I, II and III; — precision approach (conventional and ground-based augmentation system (GBAS)); — non-precision approach (conventional and required navigation performance approach (RNP APCH) (lateral navigation (LNAV), LNAV/vertical navigation (VNAV), localiser performance (LP), localiser performance with vertical guidance (LPV), and required navigation performance authorisation required approach (RNP AR APCH)); — approach procedure with vertical guidance (APV) (APV Baro and APV satellite-based augmentation system (SBAS)).	X		X			X	X						
033 02 01 06		Communications and radio-navigation planning data													
(01)		Find the communication frequencies and call signs for aeronautical services for IFR flights from en-route charts.	X		X			X	X						
(02)		Find the frequency or identifiers of radio-navigation aids for IFR flights from en-route charts.	X		X			X	X						
033 02 01 07		Completion of a manual navigation plan													
(01)		Complete a navigation plan with the courses, distances and frequencies taken from charts.	X		X			X	X						

(02)		Find the SID and STAR routes to be flown or to be expected.	X		X			X	X						
(03)		Determine the position of top of climb (TOC) and top of descent (TOD) from given appropriate data.	X		X			X	X						
(04)		Determine variation and calculate magnetic/true courses.	X		X			X	X						
(05)		Calculate TAS from given aircraft performance data, altitude and OAT.	X		X			X	X						
(06)		Calculate wind correction angles (WCAs)/drift and ground speeds (GSs).	X		X			X	X						
(07)		Calculate individual and accumulated times for each leg to destination and alternate aerodromes.	X		X			X	X						
(08)		Describe the advantages of global navigation satellite system/flight management computer (GNSS/FMC) equipment regarding: — automatic calculation and display of tracks and leg distances; — additional route information in the database (minimum altitudes, approach procedures); — time and fuel estimates over waypoints; — ability to adjust speed to arrive over a waypoint at a defined time; — time and fuel revisions based on predicted and actual wind.	X		X			X	X						

(09)		Describe the limitations of using GNSS/FMC equipment: — pilot-inputted errors (flight levels, wind, temperature, fuel); — the effect of other than predicted wind on fuel and time estimates; — the effect of aircraft's non-standard configuration on flight management system (FMS) predictions.	X		X			X	X						
033 03 00 00		FUEL PLANNING — TCAR OPS CAT.OP.MPA.106 and CAT.OP.MPA.150 plus AMC1, 2 and 3													
033 03 01 00		General													
033 03 01 01		Fuel planning (general)													
(01)		Convert to volume, mass and density given in different units which are commonly used in aviation.	X	X	X	X	X	X	X						
(02)		Determine relevant data, such as fuel capacity, fuel flow/ consumption at different power/thrust settings, altitudes and atmospheric conditions, from the flight manual.	X	X	X	X	X	X	X						
(03)		Calculate the attainable flight time/range from given average fuel flow/consumption and available amount of fuel.	X	X	X	X	X	X	X						
(04)		Calculate the required fuel from given average fuel flow/ consumption and required time/range to be flown.	X	X	X	X	X	X	X						

(05)		Calculate the required fuel for a VFR or IFR flight from given forecast meteorological conditions.	X	X	X	X	X	X	X						
(06)		State the minimum amount of remaining fuel required on arrival at the destination and alternate aerodromes/ heliports.	X	X	X	X	X	X	X						
(07)		Explain and describe how to calculate nautical air miles (NAM) from nautical ground miles (NGM).	X	X	X	X	X	X	X						
033 03 02 00		Pre-flight fuel planning for commercial flights													
033 03 02 01		Taxi fuel													
(01)		Determine the fuel required for engine start and taxiing by consulting the fuel-usage tables or graphs from the flight manual taking into account all the relevant conditions.	X	X	X	X	X								
033 03 02 02		Trip fuel													
(01)		Define trip fuel and name the segments of flight for which the trip fuel is relevant.	X	X	X	X	X								
(02)		Determine the trip fuel for the flight by using data from the fuel tables or graphs from the flight manual.	X	X	X	X	X								
033 03 02 03		Reserve fuel and its components													
		Contingency fuel													
(01)		Explain the reasons for having contingency fuel.	X	X	X	X	X								
(02)		Calculate the contingency fuel according to the applicable operational requirements.	X	X	X	X	X								
		Alternate fuel													

(03)		Explain the reasons and regulations for having alternate fuel and name the segments of flight for which the alternate fuel is relevant.	X	X	X	X	X								
(04)		Calculate the alternate fuel in accordance with the applicable operational requirements and relevant data from the navigation plan and the flight manual.	X	X	X	X	X								
		Final reserve fuel													
(05)		Explain the reasons and regulations for having final reserve fuel.	X	X	X	X	X								
(06)		Calculate the final reserve fuel for an aircraft in accordance with the applicable operational requirements and by using relevant data from the flight manual.	X	X	X	X	X								
		Additional fuel													
(07)		Explain the reasons and regulations for having additional fuel.	X	X	X	X	X								
(08)		Calculate the additional fuel for a flight in accordance with the applicable operational requirements.	X	X	X	X	X								
033 03 02 04		Extra fuel													
(01)		Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.	X	X	X	X	X								
(02)		Calculate the possible extra fuel under given conditions.	X	X	X	X	X								

(03)		Explain the fuel penalty incurred when loading extra fuel (i.e. the additional fuel consumption due to increased mass).	X	X	X	X	X								
033 03 02 05		Calculation of total fuel and completion of the fuel section of the navigation plan (fuel plan)													
(01)		Calculate the total fuel required for a given flight.	X	X	X	X	X								
(02)		Complete the fuel plan.	X	X	X	X	X								
033 03 03 00		Specific fuel-calculation procedures													
033 03 03 01		Reduced contingency fuel procedure													
(01)	X	Explain the reasons and regulations for reduced contingency fuel as stated in the applicable operational requirements.	X												
(02)		Calculate the contingency fuel and trip fuel required in accordance with the reduced contingency fuel procedure.	X												
033 03 03 02		Isolated aerodrome or heliport procedure													
(01)	X	Explain the basic procedures for an isolated aerodrome or heliport as stated in the applicable operational requirements.	X		X	X									
(02)		Calculate the additional fuel for aeroplanes or helicopters according to the isolated aerodrome or heliport procedures.	X		X	X									
033 03 03 03		Predetermined-point procedure													
(01)	X	Explain the basic idea of the predetermined-point procedure as stated in the applicable operational requirements.	X												
033 03 03 04		Fuel-tankering													

(01)		Explain the basic idea of fuel-tankering procedures.	X												
(02)		Calculate how much fuel to tank by using given appropriate graphs, tables or data.	X												
033 03 03 05		Intentionally left blank													
033 04 00 00		PRE-FLIGHT PREPARATION													
033 04 01 00		Notice to airmen (NOTAM) briefing													
033 04 01 01		Ground- and satellite-based facilities and services													
(01)		Check that the ground- and satellite-based facilities and services required for the planned flight are available and adequate.	X	X	X	X	X	X	X						
033 04 01 02		Departure, destination and alternate aerodromes													
(01)		Find and analyse the latest state at the departure, destination and alternate aerodromes, in particular for: — opening hours; — work in progress (WIP); — special procedures due to WIP; — obstructions; — changes of frequencies for communications, navigation aids and facilities.	X	X	X	X	X	X	X						
(02)		Check that satellite-based facilities are available during the expected time of use.	X	X	X	X	X	X	X						
(03)		Check that GBAS/SBAS augmentation is available during the expected time of use.	X	X	X	X	X	X	X						
033 04 01 03		Airway routings and airspace structure													

(01)		Find and analyse the latest en-route state for: — airway(s) or route(s); — restricted, danger and prohibited areas; — changes of frequencies for communications, navigation aids and facilities.	X	X	X	X	X	X	X						
033 04 01 04		Pre-flight preparation of GNSS achievability													
(01)		Define why it is important to check GNSS achievability.	X												
(02)		Define receiver autonomous integrity monitoring (RAIM), NOTAM and notice advisory to NavStar users (NANU) messages.	X												
(03)		Explain the difference in use of augmented and non-augmented GNSS in connection with the achievability check.	X												
(04)		Explain the difference in planned and unplanned outage of GNSS or SBAS.	X												
033 04 02 00		Meteorological briefing													
033 04 02 01		Intentionally left blank													
033 04 02 02		Update of navigation plan using the latest meteorological information													
(01)		Confirm the most fuel-efficient altitude from given wind, temperature and aircraft data.	X	X					X						
(02)		Confirm true altitudes from given atmospheric data to ensure that statutory minimum clearance is attained.	X	X	X	X	X	X							
(03)		Confirm magnetic headings and GSs.	X	X	X	X	X	X	X						

(04)		Confirm the individual leg times and the total time en route.	X	X	X	X	X	X	X						
(05)		Confirm the total time en route for the trip to the destination.	X	X	X	X	X	X	X						
(06)		Confirm the total time from destination to the alternate aerodrome.	X	X	X	X	X	X	X						
033 04 02 03		Intentionally left blank													
033 04 02 04		Intentionally left blank													
033 04 02 05		Update of fuel plan													
(01)		Calculate the revised fuel data in accordance with the changed conditions.	X	X	X	X	X	X							
033 04 03 00		Point of equal time (PET) and point of safe return (PSR)													
033 04 03 01		Point of equal time (PET)													
(01)		Define ‘PET'.	X	X	X	X	X								
(02)		Calculate the position of a PET and the estimated time of arrival (ETA) at the PET from given relevant data.	X	X	X	X	X								
033 04 03 02		Point of safe return (PSR)													
(01)		Define ‘PSR'.	X	X	X	X	X								
(02)		Calculate the position of a PSR and the ETA at the PSR from given relevant data.	X	X	X	X	X								
033 05 00 00		ICAO FLIGHT PLAN (ATS flight plan (FPL))													
033 05 01 00		Individual FPL													
033 05 01 01		Format of FPL													

(01)	X	State the reasons for a fixed format of an ICAO ATS FPL.	X	X	X	X	X	X	X						
(02)		Determine the correct entries to complete an ATS FPL plus decode and interpret the entries in a completed ATS FPL, particularly for the following: — aircraft identification (Item 7); — flight rules and type of flight (Item 8); — number and type of aircraft and wake-turbulence category (Item 9); — equipment (Item 10); — departure aerodrome and time (Item 13); — route (Item 15); — destination aerodrome, total estimated elapsed time and alternate aerodrome (Item 16); — other information (Item 18); — supplementary information (Item 19).	X	X	X	X	X	X	X						
033 05 01 02		Intentionally left blank													
033 05 02 00		Repetitive flight plan (RPL)													
033 05 02 01		Repetitive flight plan (RPL)													
(01)	X	Explain the difference between an individual FPL and an RPL.	X		X	X									
033 06 00 00		FLIGHT MONITORING AND IN-FLIGHT REPLANNING													
033 06 01 00		Flight monitoring													
033 06 01 01		Monitoring of track and time													
(01)		State the reasons for possible deviations from the planned track and planned timings.	X	X	X	X	X	X							

(02)		Calculate GS by using actual in-flight parameters.	X	X	X	X	X	X							
(03)		Calculate the expected leg times by using actual in-flight parameters.	X	X	X	X	X	X							
(04)		Enter, in the progress of flight, at the checkpoint or turning point, the ‘actual time-over’ and the ‘estimated time-over’ for the next checkpoint into the flight plan.	X	X	X	X	X								
(05)		State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to ensure safe ground clearance.	X	X	X	X	X								
(06)		Calculate revised ETA based on changes to the pre-flight plan, including changes of W/V, cruise level, OAT, distances, Mach number and calibrated airspeed (CAS).	X	X	X	X	X								
033 06 01 02		In-flight fuel management													
(01)		Explain why fuel checks must be carried out in flight at regular intervals and why relevant fuel data must be recorded.	X	X	X	X	X	X							
(02)		Assess deviations of actual fuel consumption from planned consumption.	X	X	X	X	X	X							
(03)		Calculate fuel quantity used, fuel consumption, and fuel remaining at navigation checkpoints/waypoints.	X	X	X	X	X	X							
(04)		Compare the actual with the planned fuel consumption by means of calculation.	X	X	X	X	X	X							

(05)		Determine the remaining range and endurance by means of calculation.	X	X	X	X	X	X							
(06)		Calculate the revised fuel consumption based on changes to the pre-flight plan, including changes of W/V, cruise level, OAT, distances, Mach number and CAS.	X	X	X	X	X	X							
033 06 02 00		In-flight replanning													
033 06 02 01		Deviation from planned data													
(01)		State that the commander is responsible for ensuring that, even in case of diversion, the remaining fuel is not less than the fuel required to proceed to an aerodrome where a safe landing can be made, with final reserve fuel remaining.	X	X	X	X	X								
(02)		Explain that, in the case of an in-flight update, the commander has to check the following: —— the suitability of the new destination or alternate aerodrome; —— meteorological conditions on revised routing and at revised destination or alternate aerodrome; —— the aircraft must be able to land with the prescribed final reserve fuel.	X	X	X	X	X								
(03)		Calculate the revised destination/alternate aerodrome landing mass from given latest data.	X	X	X	X	X								
034 00 00 00		PERFORMANCE —— HELICOPTERS													
034 01 00 00		GENERAL													
034 01 01 00		Performance legislation													

034 01 01 01		Airworthiness requirements													
(01)		Interpret the airworthiness requirements of CS-27 and CS-29.			X	X	X								
(02)		Name the general differences between helicopters certified according to CS-27 and CS-29.			X	X	X								
(03)		Interpret the airworthiness requirements of CS-27 and CS-29.			X	X	X								
034 01 01 02		Operational regulations													
(01)		State that the person responsible for complying with operational procedures is the commander.			X	X	X								
(2)		Use and interpret diagrams and tables associated with CAT A and CAT B procedures in order to select and develop Class 1, 2 and 3 performance profiles according to available heliport size and location (surface or elevated).			X	X									
(3)		Interpret the charts showing minimum clearances associated with CAT A and CAT B procedures.			X	X									
034 01 02 00		General performance theory													
034 01 02 01		Phases of flight													
(1)		Explain the following phases of flight: — take-off; — climb; — level flight; — descent; — approach and landing.			X	X	X								

(02)		Describe the necessity for different take-off and landing procedures.			X	X	X								
034 01 02 02		Definitions and terms													
(01)		Define the following terms: — CAT A; — CAT B; — Performance Class 1, 2 and 3; — congested area; — elevated heliport; — helideck; — heliport; — hostile environment; — maximum operational passenger seating configuration (MOPSC); — non-hostile environment; — obstacle; — rotor radius (R); — take-off mass; — touchdown and lift-off area (TLOF); — safe forced landing; — speed for best rate of climb (Vy); — never exceed speed (VNE); — velocity landing gear extended (VLE); — velocity landing gear operation (VLO); — cruising speed and maximum cruising speed.			X	X	X								

(02)		Define the following terms: — reported headwind component; — take-off decision point (TDP); — defined point after take-off (DPATO); — take-off distance required helicopter (TODRH); — take-off distance available helicopter (TODAH); — distance required (DR); — rejected take-off distance required helicopter (RTODRH); — rotation point (RP); — committal point (CP); — defined point before landing (DPBL); — landing decision point (LDP); — landing distance available helicopter (LDAH); — landing distance required helicopter (LDRH); — ditching (see operations).			X	X									
(03)		Understand the meaning and significance of the acronyms AEO and OEI.			X	X									
(04)		Define the terms 'climb angle' and 'climb gradient'.			X	X									
(05)		Define the terms 'flight-path angle' and 'flight-path gradient'.			X	X									
(06)		Define 'VmaxRange' (speed for maximum range) and VmaxEnd (speed for maximum endurance).			X	X	X								
(07)		Define and calculate the gradient by using power, wind, and helicopter mass.			X	X									

(08)		Explain the terms 'operational ceiling' and 'absolute ceiling'.			X	X	X								
(09)		Explain the term 'service ceiling OEI'.			X	X	X								
(10)		Explain the difference between hovering in ground effect (HIGE) and hovering out of ground effect (HOGE).			X	X	X								
034 01 02 03		Power required/power available curves													
(01)		Understand and interpret the power required/power available versus TAS graphs.			X	X	X								
034 01 02 04		Height—velocity graphs													
(01)		Understand and interpret height—velocity graphs.			X	X	X								
034 01 02 05		Influencing variables on performance													
(01)		Explain how the following factors affect helicopter performance: — pressure altitude; — humidity; — temperature; — wind; — helicopter mass; — helicopter configuration; — helicopter centre of gravity (CG).			X	X	X								
034 02 00 00		PERFORMANCE CLASS 3 — SINGLE-ENGINE HELICOPTERS													
034 02 01 00		Effect of variables on single-engine (SE) helicopter performance													
034 02 01 01		Effect of variables on SE helicopter performance													

(01)		Determine the wind component, altitude and temperature for hovering, take-off and landing.			X	X	X								
(02)		Explain that operations are to be conducted only from/to heliports and over such routes, areas and diversions contained in a non-hostile environment where a safe forced landing can be carried out (point TCAR OPS CAT.OP.MPA.137, except when the helicopter is approved to operate in accordance with point TCAR OPS CAT.POL.H.420). (Consider the exception: Operations may be conducted in a hostile environment. Ground level exposure — and exposure for elevated final approach and take-off areas (FATOs) or helidecks in non-hostile environments — is allowed for operations approved under TCAR OPS CAT.POL.H.305, during the take-off and landing phases.)			X	X	X								
(03)		Explain the effect of temperature, wind and altitude on climb, cruise and descent performance.			X	X	X								
034 02 02 00		Take-off and landing													
034 02 02 01		Take-off and landing (including hover)													
(01)		Explain the take-off and landing requirements.			X	X	X								
(02)		Explain the maximum allowed take-off and landing mass.			X	X	X								
(03)		Explain that mass has to be restricted to HIGE.			X	X	X								

(04)		Explain that if HIGE is unlikely to be achieved (for example, blocked by an obstruction), then mass must be restricted to HOGE.			X	X	X								
034 02 03 00		Climb, cruise and descent													
034 02 03 01		Climb, cruise and descent (capabilities)													
(01)		State that the helicopter must be capable of flying its intended track without flying below the appropriate minimum flight altitude and be able to perform a safe forced landing.			X	X	X								
(02)		Explain the effect of altitude on the maximum endurance speed.			X	X	X								
034 02 04 00		Use of helicopter performance data													
034 02 04 01		Take-off (including hover)													
(01)		Find the maximum wind component.			X	X	X								
(02)		Find the maximum allowed take-off mass for certain conditions.			X	X	X								
(03)		Find the height—velocity parameters.			X	X	X								
034 02 04 02		Climb													
(01)		Find the time, distance and fuel required to climb for certain conditions.			X	X	X								
(02)		Find the rate of climb under given conditions and the best rate- of-climb speed VY.			X	X	X								
034 02 04 03		Cruise													
(01)		Find the cruising speed and fuel consumption for certain conditions.			X	X	X								
(02)		Calculate the range and endurance under given conditions.			X	X	X								

034 02 04 04		Landing (including hover)													
(01)		Find the maximum wind component.			X	X	X								
(02)		Find the maximum allowed landing mass for certain conditions.			X	X	X								
(03)		Find the height—velocity parameters.			X	X	X								
034 03 00 00		PERFORMANCE CLASS 2													
		General remark: The Learning Objectives for Performance Class 2 are principally identical with those for Performance Class 1. (See 034 04 00 00)													
		Additional Learning Objectives are shown below.													
034 03 01 00		Operations without an assured safe forced landing capability													
034 03 01 01		Responsibility for operations without an assured safe forced landing capability													
		State the responsibility of the operator for assuring safe forced landings (point TCAR OPS CAT.POL.H.305).			X	X									
034 03 02 00		Take-off													
034 03 02 01		Take-off requirements													
		State the climb and other requirements for take-off.			X	X									
034 03 03 00		Take-off flight path													
034 03 03 01		Take-off flight path requirements													

		State the height above the take-off surface at which at least the requirements for the take-off flight path for Performance Class 1 are to be met.			X	X									
034 03 04 00		Landing													
034 03 04 01		Landing requirements													
(01)		State the requirements for the climb capability when OEI.			X	X									
(02)		State the options for a Performance Class 2 operation in the case of a critical power-unit failure at any point in the approach path.			X	X									
(03)		State the limitations for operations to/from a helideck.			X	X									
034 04 00 00		PERFORMANCE CLASS 1 — HELICOPTERS CERTIFIED ACCORDING TO CS-29 ONLY													
034 04 01 00		Take-off													
034 04 01 01		Take-off distances													
(01)		Explain the effects of the following variables on the flight-path and take-off distances: — take-off with HIGE or HOGE; — take-off procedure; — obstacle clearances both laterally and vertically; — take-off from non-elevated heliports; — take-off from elevated heliports or helidecks; — take-off from a TLOF.			X	X									

(02)		Explain the effects of the following variables on take-off distances: — mass; — take-off configuration; — bleed-air configurations.			X	X									
(03)		Explain the effects of the following meteorological conditions on take-off distances: — wind; — temperature; — pressure altitude.			X	X									
(04)		Explain the take-off distances for specified conditions and configuration for AEO and OEI.			X	X									
(05)		Explain the effect of obstacles on the take-off distance required.			X	X									
(06)		State the assumed reaction time between engine failure and recognition.			X	X									
(07)		Explain that the flight must be carried out visually up to TDP.			X	X									
034 04 01 02		Rejected take-off distance required (helicopter) (RTODR(H))													
(01)		Explain RTODR(H) for specified conditions and configuration for AEO and OEI.			X	X									
(02)		Explain the time-to-decide allowance (decision time) and deceleration procedure.			X	X									
034 04 01 03		Intentionally left blank													
034 04 01 04		Take-off climb													

(01)		Define the segments of the take-off flight path.			X	X									
(02)		Explain the effect of changes in the configuration on power and speed in the segments.			X	X									
(03)		Explain the climb-gradient requirements for OEI.			X	X									
(04)		State the minimum altitude over the take-off path when flying at the take-off safety speed in a Category A helicopter (VTOSS).			X	X									
(05)		Describe the influence of airspeed selection, acceleration and turns on the climb gradient and best rate-of-climb speed.			X	X									
034 04 01 05		Obstacle-limited take-off													
(01)		Describe the operational regulations for obstacle clearance of the take-off flight path in the departure sector with OEI.			X	X									
034 04 01 06		Use of helicopter performance data													
(01)		Determine from helicopter performance data sheets the maximum mass that satisfies the operational regulations for take-off in terms of regulated take-off mass, TODRH and minimum gradients for climb and obstacle clearance.			X	X									
034 04 02 00		Climb													
034 04 02 01		Climb techniques													
(01)		Explain the effect of climbing with best rate-of-climb speed (VY).			X	X									
(02)		Explain the influence of altitude on VY.			X	X									
034 04 02 02		Use of helicopter flight data													

(01)		Find the rate of climb and calculate the time to climb to a given altitude.			X	X									
034 04 03 00		Cruise													
034 04 03 01		Cruise techniques													
(01)		Explain the cruise procedures for ‘maximum endurance’ and ‘maximum range’.			X	X									
034 04 03 02		Maximum endurance													
(01)		Explain fuel flow in relation to true airspeed (TAS).			X	X									
(02)		Explain the speed for maximum endurance.			X	X									
034 04 03 03		Maximum range													
(01)		Explain the speed for maximum range.			X	X									
034 04 03 04		Maximum cruise													
(01)		Explain the speed for maximum cruise.			X	X									
034 04 03 05		Cruise altitudes													
(01)		Explain the factors which might affect or limit the operating altitude.			X	X									
(02)		Understand the relation between power setting, fuel consumption, cruising speed and altitude.			X	X									
034 04 03 06		Use of helicopter performance data													
(01)		Determine the fuel consumption from the helicopter performance data sheets in accordance with altitude and helicopter mass.			X	X									
034 04 04 00		En-route one-engine-inoperative (OEI)													
034 04 04 01		Requirements for en-route flights with OEI													
(01)		State the flight-path clearance requirements.			X	X									

(02)		Explain drift-down techniques.			X	X									
(03)		State the reduction in the flight-path width when navigational accuracy can be achieved.			X	X									
034 04 04 02		Use of helicopter flight data													
(01)		Find the single-engine service ceiling, range and endurance from given engine-inoperative charts.			X	X									
(02)		Find OEI operating data from suitable charts.			X	X									
(03)		Find the amount of fuel to be jettisoned in order to reduce helicopter mass.			X	X									
(04)		Calculate the relevant parameters for drift-down procedures.			X	X									
034 04 05 00		Descent													
034 04 05 01		Use of helicopter flight data													
(01)		Find the rate of descent and calculate the time to descend to a given altitude.			X	X									
034 04 06 00		Landing													
034 04 06 01		Landing requirements													
(01)		State the requirements for landing.			X	X									
034 04 06 02		Landing procedures													
(01)		Explain the procedure for critical power-unit failure before and after the landing decision point.			X	X									
(02)		Explain that the portion of flight after the landing decision point must be carried out visually.			X	X									

(03)		Explain the procedures and required obstacle clearances for landings on different heliports/helidecks.			X	X									
034 04 06 03		Use of helicopter performance data													
(01)		Determine from helicopter performance data sheets the maximum mass that satisfies the operational regulations for landing in terms of regulated landing mass, LDRH and minimum gradients for climb and obstacle clearance.			X	X									
040 00 00 00		HUMAN PERFORMANCE AND LIMITATIONS													
040 01 00 00		HUMAN FACTORS: BASIC CONCEPTS													
040 01 01 00		Human factors in aviation													
040 01 01 01		Becoming a competent pilot													
(01)		State that competence is based on knowledge, skills and attitudes of the individual pilot, and list the ICAO eight core competencies: — application of procedures; — communication; — aircraft flight path management, automation; — aircraft flight path management, manual control; — leadership and teamwork; — problem-solving and decision-making; — situation awareness; — workload management.	X	X	X	X	X	X							
040 01 02 00		Intentionally left blank													
040 01 03 00		Flight safety concepts													

040 01 03 01		Threat and error management (TEM) model and SHELL model													
(01)		Explain the three components of the TEM model.	X	X	X	X	X	X	X						
(02)		Explain and give examples of latent threats.	X	X	X	X	X	X	X						
(03)		Explain and give examples of environmental threats.	X	X	X	X	X	X	X						
(04)		Explain and give examples of organisational threats.	X	X	X	X	X	X	X						
(05)		Explain and give a definition of 'error' according to the TEM model of ICAO Doc 9683 (Part II, Chapter 2).	X	X	X	X	X	X	X						
(06)		Give examples of different countermeasures which may be used in order to manage threats, errors, and undesired aircraft states.	X	X	X	X	X	X	X						
(07)		Explain and give examples of procedural error, communication errors, and aircraft handling errors.	X	X	X	X	X	X	X						
(08)		Explain and give examples of 'undesired aircraft states'.	X	X	X	X	X	X							
(09)		State the components of the SHELL model.	X	X	X	X	X	X							
(10)		State the relevance of the SHELL model to the work in the cockpit.	X	X	X	X	X	X							
040 01 04 00		Safety culture													
040 01 04 01		Safety culture and safety management													
(01)		Distinguish between 'open cultures' and 'closed cultures'.	X	X	X	X	X	X	X						
(02)		Illustrate how safety culture is reflected in national culture.	X	X	X	X	X	X	X						

(03)		Discuss the established expression ‘safety first’ in a commercial entity.	X	X	X	X	X	X							
(04)		Explain James Reason’s ‘Swiss Cheese Model’.	X	X	X	X	X	X	X						
(05)		State the important factors that promote a good safety culture.	X	X	X	X	X	X	X						
(06)		Distinguish between ‘just culture’ and ‘non-punitive culture’.	X	X	X	X	X	X	X						
(07)		Name the five components which form safety culture (according to James Reason: informed culture, reporting culture, learning culture, just culture, flexible culture).	X	X	X	X	X	X	X						
(08)		Name the basic concepts of safety management system (SMS) (including hazard identification and risk management) and its relationship with safety culture in order to: — define how the organisation is set up to manage risks; — identify workplace risk and implement suitable controls; — implement effective communication across all levels of the organisation.	X	X	X	X	X	X	X						
040 02 00 00		Basics of aviation physiology and health maintenance													
040 02 01 00		Basics of flight physiology													
040 02 01 01		The atmosphere													
(01)		State that the volume percentage of the gases in ambient air will remain constant at all altitudes at which conventional aircraft operate.	X	X	X	X	X	X							

040 02 01 02		Respiratory and circulatory system													
(01)		List the main components of the respiratory system and their function.	X	X	X	X	X	X							
(02)		Identify the different volumes of air in the lungs and state the normal respiratory rate.	X	X	X	X	X	X							
(03)		Explain the role of carbon dioxide in the control and regulation of respiration.	X	X	X	X	X	X							
(04)		Describe the basic processes of external respiration and internal respiration.	X	X	X	X	X	X							
(05)		List the factors that determine pulse rate.	X	X	X	X	X	X							
(06)		Name the major components of the circulatory system and describe their function.	X	X	X	X	X	X							
(07)		State the values for a normal pulse rate and the average cardiac output (heart rate × stroke volume) of an adult at rest.	X	X	X	X	X	X							
(08)		Define 'systolic' and 'diastolic' blood pressure.	X	X	X	X	X	X							
(09)		State the normal blood pressure ranges and units of measurement.	X	X	X	X	X	X							
(10)		List the main constituents of blood and describe their functions.	X	X	X	X	X	X							
(11)		Stress the function of haemoglobin in the circulatory system.	X	X	X	X	X	X							
(12)		Define 'anaemia' and state its common causes.	X	X	X	X	X	X							
(13)		Indicate the effect of increasing altitude on haemoglobin oxygen saturation.	X	X	X	X	X	X							
		Hypertension and hypotension													

(14)		Define ‘hypertension’ and ‘hypotension’.	X	X	X	X	X	X							
(15)		List the effects that high and low blood pressure will have on some normal functions of the human body.	X	X	X	X	X	X							
(16)		State that both hypotension and hypertension may disqualify a pilot from obtaining medical clearance to fly.	X	X	X	X	X	X							
(17)		List the factors which can lead to hypertension for an individual.	X	X	X	X	X	X							
(18)		State the corrective actions that may be taken to reduce high blood pressure.	X	X	X	X	X	X							
(19)		Stress that hypertension is the major factor of strokes in the general population.	X	X	X	X	X	X							
		Coronary artery disease													
(20)		Differentiate between ‘angina’ and ‘heart attack’.	X	X	X	X	X	X							
(21)		Explain the major risk factors for coronary disease.	X	X	X	X	X	X							
(22)		State the role physical exercise plays in reducing the chances of developing coronary disease.	X	X	X	X	X	X							
		Hypoxia													
(23)		Define the two major forms of hypoxia (hypoxic and anaemic), and the common causes of both.	X	X	X	X	X	X							
(24)		State the symptoms of hypoxia.	X	X	X	X	X	X							
(25)		State that healthy people are able to compensate for altitudes up to approximately 10 000—12 000 ft.	X	X	X	X	X	X							

(26)		Name the three physiological thresholds and allocate the corresponding altitudes for each of them: — reaction threshold (7 000 ft); — disturbance threshold (10—12 000 ft); and — critical threshold (22 000 ft).	X	X	X	X	X	X							
(27)		State the altitude at which short-term memory begins to be affected by hypoxia.	X	X	X	X	X	X							
(28)		Define the terms 'time of useful consciousness' (TUC) and 'effective performance time' (EPT).	X	X	X	X	X	X							
(29)		State that TUC varies among individuals, but the approximate values for a person seated (at rest) are: 20 000 ft 30 min 30 000 ft 1—2 min 35 000 ft 30—90 s 40 000 ft 15—20 s	X	X	X	X	X	X							
(30)		List the factors that determine the severity of hypoxia.	X	X	X	X	X	X							
(31)		State the equivalent altitudes when breathing ambient air and 100 % oxygen at mean sea level (MSL) and at approximately 10 000, 30 000 and 40 000 ft.	X	X	X	X	X	X							
		Hyperventilation													
(32)		Describe the role of carbon dioxide in hyperventilation.	X	X	X	X	X	X							
(33)		Define the term 'hyperventilation'.	X	X	X	X	X	X							

(34)		List the factors that cause hyperventilation.	X	X	X	X	X	X							
(35)		State that hyperventilation may be caused by psychological or physiological reasons.	X	X	X	X	X	X							
(36)		List the signs and symptoms of hyperventilation.	X	X	X	X	X	X							
(37)		List the measures which may be taken to counteract hyperventilation: breath slowly, close one opening of the nose, speak loudly, place a paper bag over nose and mouth.	X	X	X	X	X	X							
		Decompression sickness/illness													
(38)		State the normal range of cabin pressure altitude in pressurised commercial air transport aircraft and describe its protective function for aircrew and passengers.	X	X	X	X	X	X							
(39)		List the vital actions the crew has to perform when cabin pressurisation is lost (oxygen mask on, emergency descent, land as soon as possible, and no further flight for the next minimum 24 hours). State that decompression sickness symptoms can occur up to 24 hours later.	X	X	X	X	X	X							
(40)		Identify the causes of decompression sickness in flight operation.	X	X	X	X	X	X							
(41)		State how decompression sickness can be prevented.	X	X	X	X	X	X							
(42)		List the symptoms of decompression sickness (bends, creeps, chokes, staggers).	X	X	X	X	X	X							
(43)		Indicate how decompression sickness may be treated.	X	X	X	X	X	X							

(44)		Define the hazards of diving and flying, and give the recommendations associated with these activities.	X	X	X	X	X	X							
		Acceleration													
(45)		Define 'linear acceleration' and 'angular acceleration'.	X	X	X	X	X	X	X						
(46)		Describe the effects of z-acceleration on the circulation and blood volume distribution.	X	X	X	X	X	X							
(47)		List magnitude, duration and onset as factors that determine the effects of acceleration on the human body.	X	X	X	X	X	X	X						
(48)		List the effects of positive acceleration with respect to type, sequence and corresponding G-load.	X	X	X	X	X	X							
		Carbon monoxide													
(49)		State how carbon monoxide is produced.	X	X	X	X	X	X							
(50)		State how the presence of carbon monoxide in the blood affects the distribution of oxygen.	X	X	X	X	X	X							
(51)		List the signs and symptoms of carbon-monoxide poisoning.	X	X	X	X	X	X							
(52)		Explain immediate countermeasures on suspicion of carbon- monoxide poisoning and how poisoning can be treated later on the ground.	X	X	X	X	X	X							
040 02 01 03		High-altitude environment													

(01)		State how an increase in altitude may change the proportion of ozone in the atmosphere and that aircraft can be equipped with special ozone removers.	X												
		Radiation													
(02)		State the sources of radiation at high altitude.	X												
(03)		List the effects of excessive exposure to radiation.	X												
		Humidity													
(04)		List the factors that affect the relative humidity of both the atmosphere and cabin air.	X												
(05)		List the effects of low humidity on human body to be spurious thirst, dry eyes, skin and mucous membranes, and indicate measures that can be taken: drinking water, using eye drops and aqueous creams.	X												
040 02 02 00		People and the environment: the sensory system													
040 02 02 01		The different senses													
(01)		List the different senses.	X	X	X	X	X	X	X						
040 02 02 02		Central, peripheral and autonomic nervous system													
(01)		Define the term 'sensory threshold'.	X	X	X	X	X	X							
(02)		Define the term 'sensitivity', especially in the context of vision.	X	X	X	X	X	X							
(03)		Give examples of sensory adaptation.	X	X	X	X	X	X							
(04)		Define the term 'habituation' and state its implication for flight safety.	X	X	X	X	X	X							

040 02 02 03		Vision													
		Functional anatomy													
(01)		Name the most important parts of the eye and the pathway to the visual cortex.	X	X	X	X	X								
(02)		State the basic functions of the parts of the eye.	X	X	X	X	X	X							
(03)		Define ‘accommodation’.	X	X	X	X	X	X							
(04)		Distinguish between the functions of the rod and cone cells.	X	X	X	X	X	X							
(05)		Describe the distribution of rod and cone cells in the retina and explain their relevance to vision.	X	X	X	X	X	X							
		The fovea (fovea centralis) and peripheral vision													
(06)		Explain the terms ‘visual acuity’, ‘visual field’, ‘central vision’, ‘peripheral vision’ and ‘the fovea’, and explain their function in the process of vision.	X	X	X	X	X	X							
(07)		List the factors that may degrade visual acuity and the importance of ‘lookout’.	X	X	X	X	X	X							
(08)		State the limitations of night vision and the different scanning techniques at both night and day.	X	X	X	X	X	X							
(09)		State the time necessary for the eye to adapt both to bright light and the dark.	X	X	X	X	X	X							
(10)		State the effect of hypoxia, smoking and altitude in excess of 5 000 ft on night vision.	X	X	X	X	X	X							
(11)		Explain the nature of colour blindness.	X	X	X	X	X	X							

		Binocular and monocular vision													
(12)		Distinguish between monocular and binocular vision.	X	X	X	X	X	X							
(13)		Explain the basis of depth perception and its relevance to flight performance.	X	X	X	X	X	X							
(14)		List the possible monocular cues for depth perception.	X	X	X	X	X	X							
(15)		State that for high-energy blue light and UV rays, sunglasses can prevent damage to the retina.	X	X	X	X	X	X							
		Defective vision													
(16)		Explain long-sightedness, short-sightedness and astigmatism.	X	X	X	X	X	X							
(17)		List the causes of and the precautions that may be taken to reduce the probability of vision loss due to: —— presbyopia; —— cataract; —— glaucoma.	X	X	X	X	X	X							
(18)		List the types of sunglasses that could cause perceptional problems in flight.	X	X	X	X	X	X							
(19)		List the measures that may be taken to protect oneself from flash blindness.	X	X	X	X	X	X							
(20)		State the possible problems associated with contact lenses.	X	X	X	X	X	X							
(21)		State the current rules/regulations governing the wearing of corrective spectacles and contact lenses when operating as a pilot.	X	X	X	X	X	X							

(22)		Explain the significance of the ‘blind spot’ on the retina in detecting other traffic in flight.	X	X	X	X	X	X							
040 02 02 04		Hearing													
		Descriptive and functional anatomy													
(01)		State the basic parts and functions of the outer, the middle and the inner ear.	X	X	X	X	X	X							
(02)		Differentiate between the functions of the vestibular apparatus and the cochlea in the inner ear.	X	X	X	X	X	X							
		Hearing loss													
(03)		Define the main causes of the following hearing defects/loss: — ‘conductive deafness’; — ‘noise-induced hearing loss’ (NIHL); — ‘presbycusis’.	X	X	X	X	X	X							
(04)		Summarise the effects of environmental noise on hearing.	X	X	X	X	X	X							
(05)		State the decibel level of received noise that will cause NIHL.	X	X	X	X	X	X							
(06)		Identify the potential occupational risks that may cause hearing loss.	X	X	X	X	X	X							
(07)		List the main sources of hearing loss in the flying environment.	X	X	X	X	X	X							
(08)		List the precautions that may be taken to reduce the probability of onset of hearing loss.	X	X	X	X	X	X							
040 02 02 05		Equilibrium													

		Functional anatomy													
(01)		List the main elements of the vestibular apparatus.	X	X	X	X	X	X							
(02)		State the functions of the vestibular apparatus on the ground and in flight.	X	X	X	X	X	X							
(03)		Distinguish between the component parts of the vestibular apparatus in the detection of linear and angular acceleration as well as on gravity.	X	X	X	X	X	X							
(04)		Explain how the semicircular canals are stimulated.	X	X	X	X	X	X							
		Motion sickness													
(05)		Describe air sickness and its accompanying symptoms.	X	X	X	X	X	X	X						
(06)		List the causes of air sickness.	X	X	X	X	X	X	X						
(08)		Describe the necessary actions to be taken to counteract the symptoms of air sickness.	X	X	X	X	X	X							
040 02 02 06		Integration of sensory inputs													
(01)		State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight.	X	X	X	X	X	X	X						
(02)		Define the term 'illusion'.	X	X	X	X	X	X	X						
(03)		Give examples of visual illusions based on shape constancy, size constancy, aerial perspective, atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons, field myopia, and surface planes.	X	X	X	X	X	X	X						

(04)		Relate these illusions to problems that may be experienced in flight and identify the danger attached to them.	X	X	X	X	X	X	X						
(05)		List approach and landing illusions for slope of the runway, black-hole approach, and terrain around runway, and state the danger involved with recommendations to avoid or counteract the problems with high or low approach or flare at the wrong time.	X	X	X	X	X	X	X						
(06)		State the problems associated with flickering lights (strobe lights, anti-collision lights, propellers and rotors under certain light conditions, etc.).	X	X	X	X	X	X	X						
(07)		Describe vestibular illusions caused by the angular accelerations (the Leans, Coriolis) and linear accelerations (somatogravic, G-effect).	X	X	X	X	X	X	X						
(08)		Relate the above-mentioned vestibular illusions to problems encountered in flight and state the dangers involved.	X	X	X	X	X	X	X						
(09)		State that the 'seat-of-the-pants' sense is completely unreliable when visual contact with the ground is lost or when flying in instrument meteorological conditions (IMC) or with a poor visual horizon.	X	X	X	X	X	X	X						
(10)		Differentiate between vertigo, Coriolis effect, and spatial disorientation.	X	X	X	X	X	X	X						
(11)		List the measures to prevent or overcome spatial disorientation.	X	X	X	X	X	X	X						
040 02 03 00		Health and hygiene													

040 02 03 01		Intentionally left blank													
040 02 03 02		Body rhythm and sleep													
(01)		Name some internal body rhythms and their relevance to sleep. Explain that the most important of which is body temperature.	X	X	X	X									
(02)		Explain the term 'circadian rhythm'.	X	X	X	X	X								
(03)		State the approximate duration of a 'free-running' rhythm.	X	X	X	X	X								
(04)		Explain the significance of the 'internal clock' in regulating the normal circadian rhythm.	X	X	X	X	X								
(05)		State the effect of the circadian rhythm of body temperature on an individual's performance standard and on an individual's sleep patterns.	X	X	X	X	X								
(06)		List and describe the stages of a sleep cycle.	X	X	X	X	X								
(07)		Differentiate between rapid eye movement (REM) and non- REM sleep.	X	X	X	X	X								
(08)		Explain the function of sleep and describe the effects of insufficient sleep on performance.	X	X	X	X	X								
(09)		Explain the simple calculations for the sleep/wake credit/debit situation.	X	X	X	X	X								
(10)		Explain how sleep debit can become cumulative.	X	X	X	X	X								
(11)		State the time formula for the adjustment of body rhythms to the new local time scale after crossing time zones.	X	X	X	X	X								

(12)		State the problems caused by circadian disrhythmia (jet lag) with regard to an individual's performance and sleep.	X	X	X	X	X								
(13)		Differentiate between the effects of westbound and eastbound travel.	X	X	X	X	X								
(14)		Explain the interactive effects of circadian rhythm and vigilance on a pilot's performance during flight as the duty day elapses.	X	X	X	X	X								
(15)		Describe the main effects of lack of sleep on an individual's performance.	X	X	X	X	X								
(16)		List the possible strategies to cope with jet lag.	X	X	X	X	X								
040 02 03 03		Problem areas for pilots													
		Common minor ailments													
(01)		State the role of the Eustachian tube in equalising pressure between the middle ear and the environment.	X	X	X	X	X	X							
(02)		State that the in-flight environment may increase the severity of symptoms which may be minor while on the ground.	X	X	X	X	X	X							
(03)		List the negative effects of suffering from colds or flu on flight operations especially with regard to the middle ear, the sinuses, and the teeth.	X	X	X	X	X	X							
(04)		State when a pilot should seek medical advice from an aeromedical examiner (AME) or aeromedical centre (AeMC).	X	X	X	X	X	X							
(05)		Describe the measures to prevent or clear problems due to pressure changes during flight.	X	X	X	X	X	X							

		Entrapped gases and barotrauma													
(06)		Define ‘barotrauma’.	X	X	X	X	X	X							
(07)		Differentiate between otic, sinus, gastrointestinal and aerodontalgia (of the teeth) barotraumas and explain avoidance strategies.	X	X	X	X	X	X							
(08)		Explain why the effects of otic barotrauma can be worse in the descent.	X	X	X	X	X	X							
		Gastrointestinal upsets													
(09)		State the effects of gastrointestinal upsets that may occur during flight.	X	X	X	X	X	X							
(10)		List the precautions that should be observed to reduce the occurrence of gastrointestinal upsets.	X	X	X	X	X	X							
(11)		Indicate the major sources of gastrointestinal upsets.	X	X	X	X	X	X							
		Obesity													
(12)		Define ‘obesity’.	X	X	X	X	X	X							
(13)		State the following harmful effects obesity can cause: — possibility of developing coronary problems; — increased chances of developing diabetes; — reduced ability to withstand G-forces; — development of problems with the joints of the limbs; — general circulatory problems; — reduced ability to cope with hypoxia or decompression sickness; — sleep apnoea.	X	X	X	X	X	X							

(14)		Describe the problems associated with Type 2 (mostly adult) diabetes: — risk factors; — insulin resistance; — complications (vascular, neurological) and the consequences for the medical licence; — pilots are not protected from Type 2 diabetes more than other people.	X	X	X	X	X	X							
(15)		Describe the typical back problems (unspecific back pain, slipped disc) that pilots have. Explain also the ways of preventing and treating these problems: — good sitting posture; — lumbar support; — good physical condition; — in-flight exercise, if possible; — physiotherapy.	X	X	X	X	X	X							
		Food hygiene													
(16)		Stress the importance of and methods to be adopted by aircrew, especially when travelling abroad, to avoid contaminated food and liquids.	X	X	X	X	X	X							
(17)		List the major contaminating sources in foodstuffs.	X	X	X	X	X	X							
(18)		State the major constituents of a healthy diet.	X	X	X	X	X	X							
(19)		State the measure to avoid hypoglycaemia.	X	X	X	X	X	X							
(20)		State the importance of adequate hydration.	X	X	X	X	X	X							
		Tropical climates													

(21)		List the problems associated with operating in tropical climates.	X	X	X	X	X								
(22)		State the possible causes/sources of incapacitation in tropical countries with reference to: — standards of hygiene; — quality of water supply; — insect borne diseases; — parasitic worms; — rabies or other diseases that may be spread through contact with animals; — sexually transmitted diseases.	X	X	X	X	X								
(23)		State the precautions to be taken to reduce the risks of developing problems in tropical areas.	X	X	X	X	X								
		Infectious diseases													
(24)		State the major infectious diseases that may severely incapacitate or kill individuals.	X	X	X	X	X	X							
(25)		State the precautions that must be taken to ensure that disease-carrying insects are not transported between areas.	X	X	X	X	X	X							
040 02 03 04		Intoxication													
		Tobacco													

(01)		State the harmful effects of tobacco on: — the respiratory system; — the cardiovascular system; — the ability to resist hypoxia; — the ability to withstand G-forces; — night vision.	X	X	X	X	X	X							
		Caffeine													
(02)		Indicate the level of caffeine dosage at which performance is degraded.	X	X	X	X	X	X							
(03)		Besides coffee, indicate other beverages containing caffeine.	X	X	X	X	X	X							
		Alcohol													
(04)		State the maximum acceptable limit of alcohol for flight crew according to the applicable regulations.	X	X	X	X	X	X							
(05)		State the effects of alcohol consumption on: — the ability to reason; — inhibitions and self-control; — vision; — the sense of balance and sensory illusions; — sleep patterns; — hypoxia.	X	X	X	X	X	X							
(06)		State the effects alcohol may have if consumed together with other drugs.	X	X	X	X	X	X							
(07)		List the signs and symptoms of alcoholism.	X	X	X	X	X	X							

(08)		List the factors that may be associated with the development of alcoholism.	X	X	X	X	X	X							
(09)		Define the 'unit' of alcohol and state the approximate elimination rate from the blood.	X	X	X	X	X	X							
(10)		State the maximum daily and weekly intake of units of alcohol which may be consumed without causing damage to the organs and systems of the human body.	X	X	X	X	X	X							
(11)		Discuss the actions that might be taken if a crew member is suspected of being an alcoholic.	X		X	X									
		Prescription and non-prescription drugs and self-medication													
(12)		State the dangers associated with the use of non-prescription drugs.	X	X	X	X	X	X							
(13)		State the side effects of common non-prescription drugs used to treat colds, flu, hay fever and other allergies, especially medicines containing antihistamine preparations.	X	X	X	X	X	X							
(14)		Interpret the rules relevant to using (prescription or non-prescription) drugs that the pilot has not used before.	X	X	X	X	X	X							
(15)		Interpret the general rule that 'if a pilot is so unwell that they require any medication, then they should consider themselves unfit to fly'.	X	X	X	X	X	X							
		Toxic materials													

(16)		List those materials present in an aircraft which may, when uncontained, cause severe health problems.	X	X	X	X	X	X							
(17)		List those aircraft-component parts which if burnt may give off toxic fumes.	X	X	X	X	X	X							
(18)		Describe a fume event and the possible incapacitating effects on those exposed to it.	X	X	X	X	X	X							
040 02 03 05		Incapacitation in flight													
(01)		State that incapacitation is most dangerous when its onset is insidious.	X	X	X	X	X	X							
(02)		List the major causes of in-flight incapacitation.	X	X	X	X	X	X							
(03)		State the importance of crew to be able to recognise and promptly react upon incapacitation of other crew members, should it occur in flight.	X		X	X									
(04)		Explain methods and procedures to cope with incapacitation in flight.	X	X	X	X	X	X							
040 03 00 00		BASIC AVIATION PSYCHOLOGY													
040 03 01 00		Human information processing													
040 03 01 01		Attention and vigilance													
(01)		Differentiate between 'attention' and 'vigilance'.	X	X	X	X	X	X							
(02)		Differentiate between 'selective' and 'divided' attention.	X	X	X	X	X	X							
(03)		Define 'hypovigilance'.	X	X	X	X	X	X							
(04)		Identify the factors that may affect the state of vigilance.	X	X	X	X	X	X							

(05)		List the factors that may forestall hypovigilance during flight.	X	X	X	X	X	X							
(06)		Indicate the signs of reduced vigilance.	X	X	X	X	X	X							
(07)		List the factors that affect a person's level of attention.	X	X	X	X	X	X							
040 03 01 02		Perception													
(01)		Name the basis of the perceptual process.	X	X	X	X	X	X							
(02)		Describe the mechanism of perception ('bottom-up'/'top- down' process).	X	X	X	X	X	X							
(03)		Illustrate why perception is subjective and state the relevant factors that influence interpretation of perceived information.	X	X	X	X	X	X							
(04)		Describe some basic perceptual illusions.	X	X	X	X	X	X							
(05)		Illustrate some basic perceptual concepts.	X	X	X	X	X	X							
(06)		Give examples where perception plays a decisive role in flight safety.	X	X	X	X	X	X							
(07)		Stress how persuasive and believable mistaken perception can manifest itself both for an individual and a group.	X	X	X	X	X	X							
040 03 01 03		Memory													
(01)		Explain the link between the types of memory (to include sensory, working/short-term and long-term memory).	X	X	X	X	X	X							
(02)		Describe the differences between the types of memory in terms of capacity and retention time.	X	X	X	X	X	X							

(03)		Justify the importance of sensory-store memories in processing information.	X	X	X	X	X	X							
(04)		State the average maximum number of separate items that may be held in working memory (5 ± 2).	X	X	X	X	X	X							
(05)		Stress how interruption can affect short-term/working memory.	X	X	X	X	X	X							
(06)		Give examples of items that are important for pilots to hold in working memory during flight.	X	X	X	X	X	X							
(07)		Describe how the capacity of the working-memory store may be increased.	X	X	X	X	X	X							
(08)		State the subdivisions of long-term memory and give examples of their content.	X	X	X	X	X	X							
(09)		Explain that skills are kept primarily in the long-term memory.	X	X	X	X	X	X							
(10)		Describe amnesia and how it affects memory.	X	X	X	X	X	X							
(11)		Name the common problems with both the long- and short- term memories and the best methods to try to counteract them.	X	X	X	X	X	X							
040 03 01 04		Response selection													
		Learning principles and techniques													
(01)		Explain and distinguish between the following basic forms of learning: — classic and operant conditioning (behaviouristic approach);	X	X	X	X	X	X							

		— learning by insight (cognitive approach); — learning by imitating (modelling).													
(02)		Recognise pilot-related examples as behaviouristic, cognitive or modelling forms of learning.	X	X	X	X	X	X							
(03)		State the factors that are necessary for and promote the quality of learning: — intrinsic motivation; — good mental health; — rehearsals for improvement of memory; — consciousness; — vigilance; — application in practical exercises.	X	X	X	X	X	X							
(04)		Explain ways to facilitate the memorisation of information with the following learning techniques: — mnemonics; — mental training.	X	X	X	X	X	X							
(05)		Describe the advantage of planning and anticipation of future actions: — define the term 'skills'; — state the three phases of learning a skill (Anderson: cognitive, associative and autonomous phase).	X	X	X	X	X	X							

(06)		Explain the term 'motor programme' or 'mental schema'.	X	X	X	X	X	X							
(07)		Describe the advantages and disadvantages of mental schemas.	X	X	X	X	X	X							
(08)		Explain the Rasmussen model which describes the guidance of a pilot's behaviour in different situations.	X	X	X	X	X	X							
(09)		State the possible problems or risks associated with skill-, rule- and knowledge-based behaviour.	X	X	X	X	X	X							
		Motivation													
(10)		Define 'motivation'.	X	X	X	X	X	X							
(11)		Explain the relationship between motivation and learning.	X	X	X	X	X	X							
(12)		Explain the problems of over-motivation, especially in the context of the extreme need to achieve.	X	X	X	X	X	X							
040 03 02 00		Human error and reliability													
040 03 02 01		Reliability of human behaviour													
(01)		Name and explain the factors that influence human reliability.	X	X	X	X	X	X							
040 03 02 02		Mental models and situation awareness													
(01)		Define the term 'situation awareness'.	X	X	X	X	X	X	X						
(02)		List the cues that indicate loss of situation awareness and name the steps to regain it.	X	X	X	X	X	X	X						

(03)		List the factors that influence one's situation awareness both positively and negatively, and stress the importance of situation awareness in the context of flight safety.	X	X	X	X	X	X	X						
(04)		Define the term 'mental model' in relation to a surrounding complex situation.	X	X	X	X	X	X	X						
(05)		Describe the advantages/disadvantages of mental models.	X	X	X	X	X	X	X						
(06)		Explain the relationship between personal 'mental models' and the creation of cognitive illusions.	X	X	X	X	X	X	X						
040 03 02 03		Theory and model of human error													
(01)		Explain the concept of the 'error chain'.	X	X	X	X	X	X	X						
(02)		Differentiate between an isolated error and an error chain.	X	X	X	X	X	X	X						
(03)		Distinguish between the main forms/types of errors (i.e. slips, faults, omissions and violations).	X	X	X	X	X	X	X						
(04)		Discuss the above errors and their relevance in flight.	X	X	X	X	X	X	X						
(05)		Distinguish between an active and a latent error, and give examples.	X	X	X	X	X	X	X						
040 03 02 04		Error generation													
(01)		Distinguish between internal and external factors in error generation.	X	X	X	X	X	X	X						
(02)		Identify possible sources of internal error generation.	X	X	X	X	X	X	X						

(03)		Define and discuss the two errors associated with motor programmes (action slip and environmental capture).	X	X	X	X	X	X	X						
(04)		List the three main sources of external error generation in the flight crew compartment.	X	X	X	X	X	X	X						
(05)		Give examples to illustrate the following factors in external error generation in the flight crew compartment: — ergonomics; — economics; — social environment.	X	X	X	X	X	X	X						
(06)		Name the major goals in the design of human-centred human— machine interfaces.	X	X	X	X	X	X	X						
(07)		Define the term 'error tolerance'.	X	X	X	X	X	X	X						
(08)		List and describe the strategies that are used to reduce human error.	X	X	X	X	X	X	X						
(09)		Describe the advantage of planning and the anticipation of future actions.	X	X	X	X	X	X	X						
040 03 03 00		Decision-making													
040 03 03 01		Decision-making concepts													
(01)		Define the terms 'deciding' and 'decision-making'.	X	X	X	X	X	X	X						
(02)		Describe the major factors on which decision-making should be based during the course of a flight.	X	X	X	X	X	X	X						
(03)		Describe the main human attributes with regard to decision- making.	X	X	X	X	X	X	X						

(04)		Discuss the nature of bias and its influence on the decision- making process.	X	X	X	X	X	X	X						
(05)		Describe the main error sources and limits in an individual's decision-making mechanism.	X	X	X	X	X	X	X						
(06)		State the factors upon which an individual's risk assessment is based.	X	X	X	X	X	X	X						
(07)		Explain the relationship between risk assessment, commitment and pressure of time in decision-making strategies.	X	X	X	X	X	X	X						
(08)		Explain the risks associated with dispersion or channelised attention during the application of procedures requiring a high workload within a short time frame (e.g. a go-around).	X	X	X	X	X	X							
(09)		Describe the positive and negative influences exerted by other group members on an individual's decision-making process (risky shift).	X	X	X	X	X	X	X						

(10)		Explain the general idea behind the creation of a model for decision-making based upon: — definition of the aim; — collection of information; — risk assessment; — development of options; — evaluation of options; — decision; — implementation; — consequences; — review and feedback.	X	X	X	X	X	X	X						
040 03 04 00		Avoiding and managing errors: cockpit management													
040 03 04 01		Safety awareness													
(01)		Justify the need for being aware of not only one's own performance but that of others before and during a flight and the possible consequences or risks.	X	X	X	X	X	X	X						
040 03 04 02		Coordination (multi-crew concepts)													
(01)		Name the objectives of the multi-crew concept.	X		X	X									
(02)		State and explain the elements of multi-crew concepts.	X		X	X									
(03)		Describe the concepts of 'standard operating procedures' (SOPs), checklists and crew briefings.	X	X	X	X	X								

(04)		Describe the purpose of and procedure for crew briefings.	X		X	X									
(05)		Describe the purpose of and procedure for checklists.	X	X	X	X	X								
(06)		Describe the function of communication in a coordinated team.	X		X	X									
(07)		Explain the advantages of SOPs.	X	X	X	X	X								
(08)		Explain how SOPs contribute to avoiding, reducing and managing threats and errors.	X	X	X	X	X								
(09)		Explain potential threats of SOPs, for example during company or type conversion (e.g. motor programmes, company culture, hazardous attitudes, developed habits).	X	X	X	X	X								
040 03 04 03		Cooperation													
(01)		Distinguish between cooperation and coaction.	X	X	X	X	X								
(02)		Define the term 'group'.	X	X	X	X	X								
(03)		Illustrate the influence of interdependence in a group.	X	X	X	X	X								
(04)		List the advantages and disadvantages of teamwork.	X	X	X	X	X								
(05)		Explain the term 'synergy'.	X	X	X	X	X								
(06)		Define the term 'cohesion'.	X	X	X	X	X								
(07)		Define the term 'groupthink'.	X	X	X	X	X								
(08)		State the essential conditions for good teamwork.	X	X	X	X	X								
(09)		Explain the function of role and norm in a group.	X	X	X	X	X								

(10)		Name the different role patterns which occur in a group situation.	X	X	X	X	X								
(11)		Explain how behaviour can be affected by the following factors: — persuasion; — conformity; — compliance; — obedience.	X	X	X	X	X								
(12)		Distinguish between status and role.	X	X	X	X	X								
(13)		Stress the inherent dangers of a situation where there is a mix of role and status within the flight crew compartment.	X	X	X	X	X								
(14)		Explain the terms 'leadership' and 'followership'.	X	X	X	X	X								
(15)		Describe the trans-cockpit authority gradient and its affiliated leadership styles (i.e. autocratic, laissez-faire and synergistic).	X	X	X	X	X								
(16)		Name the most important attributes of a positive leadership style.	X	X	X	X	X								
040 03 04 04		Communication													
(01)		Define the term 'communication'.	X	X	X	X	X	X							
(02)		List the most basic components of interpersonal communication.	X	X	X	X	X	X							
(03)		Explain the advantages of in-person two-way communication as opposed to one-way communication.	X	X	X	X	X	X							
(04)		Intentionally left blank													

(05)		Name the importance of non-verbal communication.	X	X	X	X	X	X							
(06)		Describe the general aspects of non-verbal communication.	X	X	X	X	X	X							
(07)		Describe the advantages/disadvantages of implicit and explicit communication.	X	X	X	X	X	X							
(08)		Describe the advantages and possible problems of using 'social' and 'professional' language in high- and low-workload situations.	X	X	X	X	X	X							
(09)		Name and explain the major obstacles to effective communication.	X	X	X	X	X	X							
(10)		Explain the difference between intrapersonal and interpersonal conflict.	X	X	X	X	X	X							
(11)		Describe the escalation process in human conflict.	X	X	X	X	X	X							
(12)		List the typical consequences of conflicts between crew members.	X	X	X	X	X	X							
(13)		Explain the following terms as part of the communication practice with regard to preventing or resolving conflicts: — inquiry; — active listening; — advocacy; — feedback; — metacommunication; — negotiation.	X	X	X	X	X	X							

(14)		Describe the limitations of communication in situations of high workload in the flight crew compartment in view of listening, verbal, non-verbal and visual effects.	X	X	X	X	X	X							
040 03 05 00		Human behaviour													
040 03 05 01		Personality, attitude and behaviour													
(01)		Describe the factors that determine an individual's behaviour.	X	X	X	X	X	X							
(02)		Define and distinguish between 'personality', 'attitude' and 'behaviour'.	X	X	X	X	X	X							
(03)		State the origin of personality and attitude.	X	X	X	X	X	X							
(04)		State that with behaviour good and bad habits can be formed.	X	X	X	X	X	X							
(05)		Explain how behaviour is generally a product of personality, attitude and the environment to which one was exposed at significant moments (childhood, schooling and training).	X	X	X	X	X	X							
(06)		State that personality differences and selfish attitude may have effects on flight crew performance.	X	X	X	X	X	X							
040 03 05 02		Individual differences in personality and motivation													
(01)		Describe the individual differences in personality by means of a common trait model (e.g. Eysenck's personality factors) and use it to describe today's ideal pilot.	X	X	X	X	X	X							
		Self-concept													

(02)		Define the term 'self-concept' and the role it plays in any change of personality.	X	X	X	X	X	X							
(03)		Explain how a self-concept of underconfidence may lead to an outward show of aggression and self- assertiveness.	X	X	X	X	X	X							
		Self-discipline													
(04)		Define 'self-discipline' and justify its importance for flight safety.	X	X	X	X	X	X							
040 03 05 03		Identification of hazardous attitudes (error proneness)													
(01)		Explain dangerous attitudes in aviation: — anti-authority; — macho; — impulsivity; — invulnerability; — complacency; — resignation.	X	X	X	X	X								
(02)		Describe the personality, attitude and behaviour patterns of an ideal crew member.	X	X	X	X	X								
(03)		Summarise how a person's attitude influences their work in the flight crew compartment.	X	X	X	X	X								
040 03 06 00		Human overload and underload													
040 03 06 01		Arousal													
(01)		Explain the term 'arousal'.	X	X	X	X	X	X							

(02)		Describe the relationship between arousal and performance.	X	X	X	X	X	X							
(03)		Explain the circumstances under which underload may occur and its possible dangers.	X	X	X	X	X	X							
040 03 06 02		Stress													
(01)		Explain the term 'stress' and why stress is a natural human reaction.	X	X	X	X	X	X							
(02)		State that the physiological response to stress is generated by the 'fight or flight' response.	X	X	X	X	X	X							
(03)		Describe the function of the autonomic nervous system (ANS) in stress response.	X	X	X	X	X	X							
(04)		Explain the relationship between arousal and stress.	X	X	X	X	X	X							
(05)		State the relationship between stress and performance.	X	X	X	X	X	X	X						
(06)		State the basic categories of stressors.	X	X	X	X	X	X	X						
(07)		List and discuss the major environmental sources of stress in the flight crew compartment.	X	X	X	X	X	X	X						
(08)		Discuss the concept of 'break point' with regard to stress, overload and performance.	X	X	X	X	X	X	X						
(09)		Name the principal causes of domestic stress.	X	X	X	X	X	X							
(10)		State that the stress experienced as a result of particular demands varies among individuals.	X	X	X	X	X	X							
(11)		Explain the factors that lead to differences in the levels of stress experienced by individuals.	X	X	X	X	X	X	X						

(12)		List the factors that influence the tolerance of stressors.	X	X	X	X	X	X						
(13)		State that stress is a result of perceived demands and perceived ability.	X	X	X	X	X	X						
(14)		Explain the relationship between stress and anxiety.	X	X	X	X	X	X	X					
(15)		Describe the effects of anxiety on human performance.	X	X	X	X	X	X	X					
(16)		State the general effect of acute stress on people.	X	X	X	X	X	X	X					
(17)		Describe the relationship between stress, arousal and vigilance.	X	X	X	X	X	X						
(18)		State the general effect of chronic stress and the biological reaction by means of the three stages of the general adaptation syndrome (Selye): alarm, resistance, and exhaustion.	X	X	X	X	X	X						
(19)		Explain the differences between psychological, psychosomatic and somatic stress reactions.	X	X	X	X	X	X						
(20)		Name the typical common physiological and psychological symptoms of human overload.	X	X	X	X	X	X						
(21)		Describe the effects of stress on human behaviour.	X	X	X	X	X	X						
(22)		Explain how stress is cumulative and how stress from one situation can be transferred to a different situation.	X	X	X	X	X	X	X					
(23)		Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future.	X	X	X	X	X	X	X					

(24)		Describe the effect of human underload/overload on effectiveness in the flight crew compartment.	X	X	X	X	X	X	X						
(25)		List sources and symptoms of human underload.	X	X	X	X	X	X	X						
040 03 06 03		Intentionally left blank													
040 03 06 04		Intentionally left blank													
040 03 06 05		Fatigue and stress management													
(01)		Explain the term 'fatigue' and differentiate between the two types of fatigue (short-term and chronic fatigue).	X	X	X	X	X	X							
(02)		Name the causes of short-term and chronic fatigue.	X	X	X	X	X	X							
(03)		Identify the symptoms and describe the effects of fatigue.	X	X	X	X	X	X							
(04)		List the strategies that prevent or delay the onset of fatigue and hypovigilance.	X	X	X	X	X	X							
(05)		List and describe strategies for coping with stress factors and stress reactions.	X	X	X	X	X	X							
(06)		Distinguish between short-term and long-term methods of stress management.	X	X	X	X	X	X							
(07)		Give examples of short-term methods of stress management.	X	X	X	X	X	X							
(08)		Give examples of long-term methods of coping with stress.	X	X	X	X	X	X							

(09)		Describe the fatigue risk management system (FRMS) as follows: a data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience that aims to ensure relevant personnel are performing at adequate levels of alertness.	X	X	X	X	X	X							
040 03 07 00		Advanced cockpit automation													
040 03 07 01		Advantages and disadvantages													
(01)		Compare the two basic concepts of automation: — as per Boeing, where the pilot remains the last operator; — and as per Airbus, where automated systems can correct erroneous pilot action.	X	X	X	X	X	X	X						
(02)		Explain the fundamental restrictions of autoflight systems to be lack of creativity in unknown situations, and lack of personal motivation with regard to safety.	X	X	X	X	X	X	X						
(03)		List the principal strengths and weaknesses of pilot versus autopilot systems to be creativity, decision-making, prioritisation of tasks, safety attitude versus precision, reliability.	X	X	X	X	X	X	X						

(04)		Explain the 'ironies of automation': designers' errors due to wrong interpretation of the data, leaving tasks to the pilot that are too complex to automate, loss of manual and cognitive skills of the pilot. State the necessity for regular training flights as one possible countermeasure.	X	X	X	X	X	X	X					
(05)		Describe methods to overcome the drawbacks of autoflight systems to be loss of manual flying capabilities, additional workload through programming, risk of slips during programming, and hypovigilance during cruise.	X	X	X	X	X	X	X					
040 03 07 02		Automation complacency												
(01)		State the main weaknesses in the monitoring of automatic systems to be hypovigilance during flight, and loss of flying skills.	X	X	X	X	X	X	X					
(02)		Explain some basic flight crew errors and terms that arise with the introduction of automation: — passive monitoring; — blinkered concentration; — confusion; — mode awareness.	X	X	X	X	X	X	X					
(03)		Explain how the method of call-outs counteracts ineffective monitoring of automatic systems.	X	X	X	X	X	X	X					
(04)		Define 'complacency'.	X	X	X	X	X	X	X					
040 03 07 03		Working concepts												

(01)		Explain that the potential disadvantages of automation on crew communication are loss of awareness of input errors, flight modes, failure detection, failure comprehension, status of the aircraft and aircraft position.	X		X	X									
(02)		Explain how the negative effects of automation on pilots may be alleviated by degrading to a lower level of automation to recover comprehension of the flight status from VNAV/LNAV to ALT/HDG or even to manual flying.	X	X	X	X	X	X	X						
(03)		Interpret the role of automation with respect to flight safety regarding the basic principle of the use of manual versus autoflight in normal operations, frequent changes in the flight profile, and in abnormal situations.	X	X	X	X	X	X	X						
050 00 00 00		METEOROLOGY													
050 01 00 00		THE ATMOSPHERE													
050 01 01 00		Composition, extent, vertical division													
050 01 01 01		Structure of the atmosphere													
(01)		Describe the vertical division of the atmosphere up to flight level (FL) 650, based on the temperature variations with height.	X	X	X	X	X	X	X						
(02)		List the different layers and their main qualitative characteristics up to FL 650.	X	X	X	X	X	X	X						
050 01 01 02		Troposphere													
(01)		Describe the troposphere.	X	X	X	X	X	X	X						

(02)		Describe the main characteristics of the tropopause.	X	X	X	X	X	X	X						
(03)		Describe the proportions of the most important gases in the air in the troposphere.	X	X	X	X	X	X	X						
(04)		Describe the variations of the FL and temperature of the tropopause from the poles to the equator.	X	X	X	X	X	X	X						
(05)		Describe the breaks in the tropopause along the boundaries of the main air masses.	X	X	X	X	X	X	X						
(06)		Indicate the variations of the FL of the tropopause with the seasons and the variations of atmospheric pressure.	X		X	X									
050 01 01 03		Stratosphere													
(01)		Describe the stratosphere up to FL 650.	X												
(02)		Describe that ozone can occur at jet cruise altitudes and that it constitutes a hazard.	X		X	X									
050 01 02 00		Air temperature													
050 01 02 01		Definition and units													
(01)		Define ‘air temperature’.	X	X	X	X	X	X	X						
(02)	X	List the units of measurement of air temperature used in aviation meteorology (Celsius, Fahrenheit, Kelvin). (Refer to Subject 050 10 01 01)	X	X	X	X	X	X	X						
050 01 02 02		Vertical distribution of temperature													
(01)		Describe the mean vertical distribution of temperature up to FL 650.	X	X	X	X	X	X	X						

(02)		Mention the general causes of the cooling of the air in the troposphere with increasing altitude.	X	X	X	X	X	X	X						
(03)		Calculate the temperature and temperature deviations (in relation to International Standard Atmosphere (ISA)) at specified levels.	X	X	X	X	X	X	X						
050 01 02 03		Transfer of heat													
(01)		Explain how local cooling or warming processes result in transfer of heat.	X	X	X	X	X	X	X						
(02)		Describe radiation.	X	X	X	X	X	X	X						
(03)		Describe solar radiation reaching the Earth.	X	X	X	X	X	X	X						
(04)		Describe the filtering effect of the atmosphere on solar radiation.	X	X	X	X	X	X	X						
(05)		Describe terrestrial radiation.	X	X	X	X	X	X	X						
(06)		Explain how terrestrial radiation is absorbed by some components of the atmosphere.	X	X	X	X	X	X	X						
(07)		Explain the effect of absorption and radiation in connection with clouds.	X	X	X	X	X	X	X						
(08)		Explain the process of conduction.	X	X	X	X	X	X	X						
(09)		Explain the role of conduction in the cooling and warming of the atmosphere.	X	X	X	X	X	X	X						
(10)		Explain the process of convection.	X	X	X	X	X	X	X						
(11)		Name the situations in which convection occurs.	X	X	X	X	X	X	X						
(12)		Explain the process of advection.	X	X	X	X	X	X	X						
(13)		Name the situations in which advection occurs.	X	X	X	X	X	X	X						
(14)		Describe the transfer of heat by turbulence.	X	X	X	X	X	X	X						

(15)		Describe the transfer of latent heat.	X	X	X	X	X	X	X						
050 01 02 04		Lapse rates													
(01)		Describe qualitatively and quantitatively the temperature lapse rates of the troposphere (mean value 0.65 °C/100 m or 2 °C/1 000 ft and actual values).	X	X	X	X	X	X	X						
050 01 02 05		Development of inversions, types of inversions													
(01)		Describe the development and types of inversions.	X	X	X	X	X	X	X						
(02)		Explain the characteristics of inversions and of an isothermal layer concerning stability and vertical motions.	X	X	X	X	X	X	X						
(03)		Explain the reasons for the formation of the following inversions: — ground inversion (nocturnal radiation/advection), — subsidence inversion, — frontal inversion, — inversion above friction layer, — valley inversion.	X	X	X	X	X	X	X						
050 01 02 06		Temperature near the Earth's surface, insolation, surface effects, effect of clouds, effect of wind													
(01)		Explain the cooling/warming of the surface of the Earth by radiation.	X	X	X	X	X	X	X						
(02)		Explain the cooling/warming of the air by molecular or turbulent heat transfer to/from the earth or sea surfaces.	X	X	X	X	X	X	X						

(03)		Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface.	X	X	X	X	X	X	X						
(04)		Explain the influence of the wind on the cooling and warming of the air near the surfaces.	X	X	X	X	X	X	X						
050 01 03 00		Atmospheric pressure													
050 01 03 01		Barometric pressure, isobars													
(01)		Define 'atmospheric pressure'.	X	X	X	X	X	X	X						
(02)	X	List the units of measurement of the atmospheric pressure used in aviation (hPa, inches of mercury). (Refer to Subject 050 10 01 01)	X	X	X	X	X	X	X						
(03)	X	Describe the principle of the barometers (mercury barometer, aneroid barometer).	X	X	X	X	X	X							
(04)		Define isobars and identify them on surface weather charts.	X	X	X	X	X	X	X						
(05)		Define 'high', 'low', 'trough', 'ridge', 'col'.	X	X	X	X	X	X	X						
050 01 03 02		Pressure variation with height, contours (isohypses)													
(01)		Explain the pressure variation with height.	X	X	X	X	X	X	X						
(02)		Describe quantitatively the variation of the barometric lapse rate. Remark: An approximation of the average value for the barometric lapse rate near mean sea level (MSL) is 30 ft (9 m) per 1 hPa.	X	X	X	X	X	X	X						

(03)		State that (under conditions of ISA) pressure is approximately 50 % of MSL at 18 000 ft and density is approximately 50 % of MSL at 22 000 ft and 25 % of MSL at 40 000 ft.	X	X	X	X	X	X	X						
050 01 03 03		Reduction of pressure to QFF (MSL)													
(01)		Define 'QFF'.	X	X	X	X	X	X	X						
(02)		Explain the reduction of measured pressure (QFE) to QFF (MSL).	X	X	X	X	X	X	X						
(03)		Mention the use of QFF for surface weather charts.	X	X	X	X	X	X	X						
050 01 03 04		Relationship between surface pressure centres and pressure centres aloft													
(01)		Illustrate with a vertical cross section of isobaric surfaces the relationship between surface pressure systems and upper-air pressure systems.	X	X	X	X	X	X	X						
050 01 04 00		Air density													
050 01 04 01		Relationship between pressure, temperature and density													
(01)		Describe the relationship between pressure, temperature and density.	X	X	X	X	X	X	X						
(02)		Describe the vertical variation of the air density in the atmosphere.	X	X	X	X	X	X	X						
050 01 05 00		International Standard Atmosphere (ISA)													
050 01 05 01		International Standard Atmosphere (ISA)													
(01)		Explain the use of standardised values for the atmosphere.	X	X	X	X	X	X	X						

(02)		List the main values of the ISA MSL pressure, MSL temperature, the vertical temperature lapse rate up to FL 650, height and temperature of the tropopause.	X	X	X	X	X	X	X						
050 01 06 00		Altimetry													
050 01 06 01		Terminology and definitions													
(01)		Define the following terms and explain how they are related to each other: height, altitude, pressure altitude, FL, pressure level, true altitude, true height, elevation, QNH, QFE, and standard altimeter setting.	X	X	X	X	X	X	X						
(02)		Describe the terms 'transition altitude', 'transition level', 'transition layer', 'terrain clearance', 'lowest usable flight level'.	X	X	X	X	X	X	X						
050 01 06 02		Altimeter settings													
(01)		Name the altimeter settings associated to height, altitude, pressure altitude and FL.	X	X	X	X	X	X	X						
(02)		Describe the altimeter-setting procedures.	X	X	X	X	X	X	X						
050 01 06 03		Calculations													
(01)		Calculate the different readings on the altimeter when the pilot uses different settings (QNH, 1013.25, QFE).	X	X	X	X	X	X	X						
(02)		Illustrate with a numbered example the changes of altimeter setting and the associated changes in reading when the pilot climbs through the transition altitude or descends through the transition level.	X	X	X	X	X	X	X						

(03)		Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings.	X	X	X	X	X	X	X						
(04)		Explain the influence of the air temperature on the distance between the ground and the level read on the altimeter and between two FLs.	X	X	X	X	X	X	X						
(05)		Explain the influence of pressure areas on true altitude.	X	X	X	X	X	X	X						
(06)		Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation.	X	X	X	X	X	X	X						
(07)		Calculate the terrain clearance and the lowest usable FL for given atmospheric temperature and pressure conditions.	X	X	X	X	X	X	X						
(08)		State that the 4 %-rule can be used to calculate true altitude from indicated altitude, and also indicated altitude from true altitude (not precise but sufficient due to the approximation of the 4%- rule.)	X	X	X	X	X	X	X						

		Remark: The following rules should be considered for altimetry calculations: a) All calculations are based on rounded pressure values to the nearest lower hPa. b) The value for the barometric lapse rate between MSL and 700 hPa to be used is 30 ft/hPa as an acceptable approximation of the barometric lapse rate. c) To determine the true altitude/height, the following rule of thumb, called the '4 %-rule', shall be used: the altitude/height changes by 4 % for each 10 °C temperature deviation from ISA. d) If no further information is given, the deviation of the outside-air temperature from ISA is considered to be constantly the same given value in the whole layer. e) The elevation of the aerodrome has to be taken into account. The temperature correction has to be considered for the layer between the ground and the position of the aircraft.													
050 02 00 00		WIND													
050 02 01 00		Definition and measurement of wind													
050 02 01 01		Definition and measurement													
(01)		Define 'wind' and 'surface wind'.	X	X	X	X	X	X	X						
(02)		State the units of wind directions (degrees true in reports; degrees magnetic from tower) and speed (kt, m/s).	X	X	X	X	X	X	X						

(03)		Describe that the reported wind is an average wind derived from measurements with an anemometer at a height of 10 m over 2 min for local routine and special reports and ATS units, and over 10 min for aerodrome routine meteorological reports (METARs) and aerodrome special meteorological reports (SPECIs).	X	X	X	X	X	X	X						
050 02 02 00		Primary cause of wind													
050 02 02 01		Primary cause of wind, pressure gradient, Coriolis force, gradient wind													
(01)		Define the term 'horizontal pressure gradient'.	X	X	X	X	X	X	X						
(02)		Explain how the pressure gradient force acts in relation to the pressure gradient.	X	X	X	X	X	X	X						
(03)		Explain how the Coriolis force acts in relation to the wind.	X	X	X	X	X	X	X						
(04)		Explain the development of the geostrophic wind.	X	X	X	X	X	X	X						
(05)		Indicate how the geostrophic wind flows in relation to the isobars/isohypses in the northern and in the southern hemisphere.	X	X	X	X	X	X	X						
(06)		Analyse the effect of changing latitude on the geostrophic wind speed.	X		X	X			X						
(07)		Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation.	X	X	X	X	X	X							
050 02 02 02		Variation of wind in the friction layer													

(01)		Describe why and how the wind changes direction and speed with height in the friction layer in the northern and in the southern hemisphere (rule of thumb).	X	X	X	X	X	X	X						
(02)		State the surface and air-mass conditions that influence the wind in the friction layer (diurnal variation).	X	X	X	X	X	X	X						
(03)		Name terrain, wind speed and stability as the main factors that influence the vertical extent of the friction layer.	X	X	X	X	X	X	X						
(04)		Explain the relationship between isobars and wind (direction and speed).	X	X	X	X	X	X	X						
		Remark: Approximate value for variation of wind in the friction layer (values to be used in examinations):													
		Type of landscape // Wind speed in friction layer in % of the geostrophic wind // The wind in the friction layer blows across the isobars towards the low pressure. Angle between wind direction and isobars. over water // ca 70 % // ca 10° over land // ca 50 % // ca 30°													
		WMO - No. 266													
050 02 02 03		Effects of convergence and divergence													
(01)		Describe atmospheric convergence and divergence.	X	X	X	X	X	X	X						

(02)		Explain the relationship between convergence and divergence on the following: pressure systems at the surface and aloft; wind speed; vertical motion and cloud formation (relationship between upper-air conditions and surface pressure systems).	X	X	X	X	X	X	X						
050 02 03 00		General global circulation													
050 02 03 01		General circulation around the globe													
(01)		Describe the general global circulation. (Refer to Subject 050 08 01 01)	X	X	X	X	X	X	X						
(02)		Name and sketch or indicate on a map the global distribution of the surface pressure and the resulting wind pattern for all latitudes at low level in January and July.	X		X	X									
(03)		Sketch or indicate on a map the westerly and easterly tropospheric winds at high level in January and July.	X		X	X									
050 02 04 00		Local winds													
050 02 04 01		Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes													
(01)		Describe and explain anabatic and katabatic winds.	X	X	X	X	X	X	X						
(02)		Describe mountain and valley winds.	X	X	X	X	X	X	X						
(03)		Describe the Venturi effect, convergence in valleys and mountain areas.	X	X	X	X	X	X	X						

(04)		Describe land and sea breezes, and sea-breeze front.	X	X	X	X	X	X	X						
(05)		Describe that local, low-level jet streams can develop in the evening.	X	X	X	X	X	X	X						
050 02 05 00		Mountain waves (standing waves, lee waves)													
050 02 05 01		Origin and characteristics													
(01)		Explain the origin and formation of mountain waves.	X	X	X	X	X	X	X						
(02)		State the conditions necessary for the formation of mountain waves.	X	X	X	X	X	X	X						
(03)		Describe the structure and properties of mountain waves.	X	X	X	X	X	X	X						
(04)		Explain how mountain waves may be identified by their associated meteorological phenomena.	X	X	X	X	X	X	X						
(05)		Describe that mountain wave effects can exceed the performance or structural capability of aircraft.	X	X	X	X	X	X	X						
(06)		Describe that mountain wave effects can propagate from low to high level, e.g. over Greenland and elsewhere.	X	X	X	X	X	X	X						
050 02 06 00		Turbulence													
050 02 06 01		Description and types of turbulence													
(01)		Describe turbulence and gustiness.	X	X	X	X	X	X	X						
(02)		List the common types of turbulence (convective, mechanical, orographic, frontal, clear-air turbulence).	X	X	X	X	X	X	X						
050 02 06 02		Formation and location of turbulence													

(01)		Explain the formation of convective turbulence, mechanical and orographic turbulence, and frontal turbulence.	X	X	X	X	X	X	X						
(02)		State where turbulence will normally be found (rough-ground surfaces, relief, inversion layers, cumulonimbus (CB), thunderstorm (TS) zones, unstable layers).	X	X	X	X	X	X	X						
050 02 06 03		Clear-air turbulence (CAT) — description, cause and location													
(01)		Describe CAT.	X	X				X	X						
(02)		Describe the formation of CAT.	X	X	X	X	X	X	X						
(03)		State where CAT is found in association with jet streams, in high- level troughs and in other disturbed high-level air flows. (Refer to Subject 050 09 02 02)	X												
(04)		State that remote sensing of CAT from satellites is not possible and that forecasting is limited.	X	X				X	X						
(05)		State that pilot reports of turbulence are a very valuable source of information as remote measurements are not available.	X	X	X	X	X	X	X						
050 02 07 00		Jet streams													
050 02 07 01		Description													
(01)		Describe jet streams.	X	X				X	X						
(02)		State the defined minimum speed of a jet stream (60 kt).	X	X				X	X						
(03)		State the typical figures for the dimensions of jet streams.	X	X				X	X						

050 02 07 02		Formation and properties of jet streams													
(01)		Explain the formation and state the heights, the speeds, the seasonal variations of speeds, the geographical positions, the seasonal occurrence and the seasonal movements of the arctic (front) jet stream, the polar (front) jet stream, the subtropical jet stream, and the tropical (easterly/equatorial) jet stream.	X	X											
050 02 07 03		Location of jet streams and associated CAT areas													
(01)		Sketch or describe where polar front and arctic jet streams are found in the troposphere in relation to the tropopause and to fronts.	X	X											
(02)		Describe and indicate the areas of worst wind shear and CAT.	X	X											
050 02 07 04		Intentionally left blank													
050 03 00 00		THERMODYNAMICS													
050 03 01 00		Humidity													
050 03 01 01		Water vapour in the atmosphere													
(01)		State that the density of moist air is less than the density of dry air.	X	X	X	X	X	X	X						
(02)		Describe the significance for meteorology of water vapour in the atmosphere.	X	X	X	X	X	X	X						
(03)		Indicate the sources of atmospheric humidity.	X	X	X	X	X	X	X						
(04)		Define ‘saturation of air by water vapour’.	X	X	X	X	X	X							
050 03 01 02		Intentionally left blank													
050 03 01 03		Temperature/dew point, relative humidity													

(01)		Define ‘dew point’.	X	X	X	X	X	X	X						
(02)		Define ‘relative humidity’.	X	X	X	X	X	X	X						
(03)		Explain the factors that influence the relative humidity at constant pressure.	X	X	X	X	X	X	X						
(04)		Explain the diurnal variation of the relative humidity.	X	X	X	X	X	X	X						
(05)		Describe the relationship between temperature and dew point.	X	X	X	X	X	X	X						
(06)		Estimate the relative humidity of the air from the difference between dew point and temperature.	X	X	X	X	X	X	X						
050 03 02 00		Change of state of water													
050 03 02 01		Condensation, evaporation, sublimation, freezing and melting, latent heat													
(01)		Define ‘condensation’, ‘evaporation’, ‘sublimation’, ‘freezing and melting’ and ‘latent heat’.	X	X	X	X	X	X	X						
(02)		List the conditions for condensation/evaporation.	X	X	X	X	X	X	X						
(03)		Explain the condensation process.	X	X	X	X	X	X	X						
(04)		Explain the nature of and the need for condensation nuclei.	X	X	X	X	X	X	X						
(05)		Explain the effects of condensation on the weather.	X	X	X	X	X	X	X						
(06)		List the conditions for freezing/melting.	X	X	X	X	X	X	X						
(07)		Explain the process of freezing.	X	X	X	X	X	X	X						
(08)		Explain the nature of and the need for freezing nuclei.	X	X	X	X	X	X	X						

(09)		Define 'supercooled water'. (Refer to Subject 050 09 01 01)	X	X	X	X	X	X	X					
(10)		List the conditions for sublimation.	X	X	X	X	X	X	X					
(11)		Explain the sublimation process.	X	X	X	X	X	X	X					
(12)		Explain the nature of and the need for sublimation nuclei.	X	X	X	X	X	X	X					
(13)		Describe the absorption or release of latent heat in each change of state of water.	X	X	X	X	X	X	X					
(14)		Illustrate all the changes of state of water with practical examples.	X	X	X	X	X	X	X					
050 03 03 00		Adiabatic processes												
050 03 03 01		Adiabatic processes, stability of the atmosphere												
(01)		Describe the adiabatic process in an unsaturated rising or descending air particle.	X	X	X	X	X	X	X					
(02)		Explain the variation of temperature of an unsaturated rising or descending air particle.	X	X	X	X	X	X	X					
(03)		Explain the variation of humidity of an unsaturated rising or descending air particle.	X	X	X	X	X	X	X					
(04)		Describe the adiabatic process in a saturated rising or descending air particle.	X	X	X	X	X	X	X					
(05)		Explain the variation of temperature of a saturated air particle with changing altitude.	X	X	X	X	X	X	X					
(06)		Explain the static stability of the atmosphere using the actual temperature curve with reference to the adiabatic lapse rates.	X	X	X	X	X	X	X					

(07)		Define qualitatively and quantitatively the terms ‘stable’, ‘conditionally unstable’, ‘unstable’ and ‘indifferent’.	X	X	X	X	X	X	X						
(08)		Illustrate with a schematic sketch the formation of Foehn.	X	X	X	X	X	X	X						
(06)		List the conditions for freezing/melting.	X	X	X	X	X	X	X						
(07)		Explain the process of freezing.	X	X	X	X	X	X	X						
(08)		Explain the nature of and the need for freezing nuclei.	X	X	X	X	X	X	X						
(09)		Define ‘supercooled water’. (Refer to Subject 050 09 01 01)	X	X	X	X	X	X	X						
(10)		List the conditions for sublimation.	X	X	X	X	X	X	X						
(11)		Explain the sublimation process.	X	X	X	X	X	X	X						
(12)		Explain the nature of and the need for sublimation nuclei.	X	X	X	X	X	X	X						
(13)		Describe the absorption or release of latent heat in each change of state of water.	X	X	X	X	X	X	X						
(14)		Illustrate all the changes of state of water with practical examples.	X	X	X	X	X	X	X						
(15)		Explain the effect of the advection of air (warm or cold) on the stability of the air.	X	X	X	X	X	X	X						
		Remark: Dry adiabatic lapse rate = 1 °C/100 m or 3 °C/1 000 ft; average value at lower levels for saturated adiabatic lapse rate =0.6 °C/100 m or 1.8 °C/1 000 ft (values to be used in examinations).													

050 04 00 00		CLOUDS AND FOG													
050 04 01 00		Cloud formation and description													
050 04 01 01		Cloud formation													
(01)		Explain cloud formation by adiabatic cooling, conduction, advection and radiation.	X	X	X	X	X	X	X						
(02)		Describe cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection.	X	X	X	X	X	X	X						
(03)		List cloud types typical for stable and unstable air conditions.	X	X	X	X	X	X	X						
(04)		Summarise the conditions for the dissipation of clouds.	X	X	X	X	X	X	X						
050 04 01 02		Cloud types and cloud classification													
(01)		Describe the different cloud types and their classification.	X	X	X	X	X	X	X						
(02)		Identify by shape cirriform, cumuliform and stratiform clouds.	X	X	X	X	X	X	X						
(03)		Identify by shape and typical level the 10 cloud types (general).	X	X	X	X	X	X	X						
(04)		Describe and identify by shape the following species and supplementary features: castellanus, lenticularis, congestus, calvus, capillatus and virga.	X	X	X	X	X	X	X						
(05)		Distinguish between low-medium- and high-level clouds according to the World Meteorological Organization's (WMO) 'cloud etage'.	X	X	X	X	X	X	X						

(06)		Distinguish between ice clouds, mixed clouds and pure-water clouds.	X	X	X	X	X	X	X						
050 04 01 03		Influence of inversions on cloud development													
(01)		Explain the influence of inversions on vertical movements in the atmosphere.	X	X	X	X	X	X	X						
(02)		Explain the influence of an inversion on the formation of stratus clouds.	X	X	X	X	X	X	X						
(03)		Explain the influence of ground inversion on the formation of fog.	X	X	X	X	X	X	X						
(04)		Describe the role of the tropopause inversion with regard to the vertical development of clouds.	X	X	X	X	X								
050 04 01 04		Flying conditions in each cloud type													
(01)		Assess the 10 cloud types for icing and turbulence.	X	X	X	X	X	X	X						
050 04 02 00		Fog, mist, haze													
050 04 02 01		General aspects													
(01)		Define ‘fog’, ‘mist’ and ‘haze’ with reference to the WMO standards of visibility range.	X	X	X	X	X	X	X						
(02)		Explain briefly the formation of fog, mist and haze.	X	X	X	X	X	X	X						
(03)		Name the factors that generally contribute to the formation of fog and mist.	X	X	X	X	X	X	X						
(04)		Name the factors that contribute to the formation of haze.	X	X	X	X	X	X	X						
(05)		Describe freezing fog and ice fog.	X	X	X	X	X	X	X						
050 04 02 02		Radiation fog													

(01)		Explain the formation of radiation fog.	X	X	X	X	X	X	X						
(02)		Describe the significant characteristics of radiation fog, and its vertical extent.	X	X	X	X	X	X	X						
(03)		Summarise the conditions for the dissipation of radiation fog.	X	X	X	X	X	X	X						
050 04 02 03		Advection fog													
(01)		Explain the formation of advection fog.	X	X	X	X	X	X	X						
(02)		Describe the different possibilities of advection-fog formation (over land, sea and coastal regions).	X	X	X	X	X	X	X						
(04)		Describe the significant characteristics of advection fog.	X	X	X	X	X	X	X						
(05)		Summarise the conditions for the dissipation of advection fog.	X	X	X	X	X	X	X						
050 04 02 04		Sea smoke													
(01)		Explain the formation of sea smoke.	X	X	X	X	X	X	X						
(02)		Explain the conditions for the development of sea smoke.	X	X	X	X	X	X	X						
(03)		Summarise the conditions for the dissipation of sea smoke.	X	X	X	X	X	X	X						
050 04 02 05		Frontal fog													
(01)		Explain the formation of frontal fog.	X	X	X	X	X	X	X						
(02)		Describe the significant characteristics of frontal fog.	X	X	X	X	X	X	X						
(03)		Summarise the conditions for the dissipation of frontal fog.	X	X	X	X	X	X	X						
050 04 02 06		Orographic fog (hill fog)													

(01)		Summarise the features of orographic fog.	X	X	X	X	X	X	X						
(02)		Describe the significant characteristics of orographic fog.	X	X	X	X	X	X	X						
(03)		Summarise the conditions for the dissipation of orographic fog.	X	X	X	X	X	X	X						
050 05 00 00		PRECIPITATION													
050 05 01 00		Development of precipitation													
050 05 01 01		Process of development of precipitation													
(01)		Describe the two basic processes of forming precipitation (The Wegener─Bergeron─Findeisen process, Coalescence).	X	X	X	X	X	X	X						
(02)		Summarise the outlines of the ice-crystal process (The Wegener─Bergeron─Findeisen process).	X	X	X	X	X	X	X						
(03)		Summarise the outlines of the coalescence process.	X	X	X	X	X	X	X						
(04)		Explain the development of snow, rain, drizzle and hail.	X	X	X	X	X	X	X						
050 05 02 00		Types of precipitation													
050 05 02 01		Types of precipitation, relationship with cloud types													
(01)		List and describe the types of precipitation given in the aerodrome forecast (TAF) and METAR codes (drizzle, rain, snow, snow grains, ice pellets, hail, small hail, snow pellets, ice crystals, freezing drizzle, freezing rain).	X	X	X	X	X	X	X						
(02)		State the ICAO/WMO approximate diameters for cloud, drizzle and rain drops.	X	X	X	X	X	X	X						

(03)		State that, because of their size, hail stones can cause significant damage to aircraft.	X	X	X	X	X	X	X						
(04)	X	Explain the mechanism for the formation of freezing precipitation.	X	X	X	X	X	X	X						
(05)		Describe the weather conditions that give rise to freezing precipitation.	X	X	X	X	X	X	X						
(06)		Distinguish between the types of precipitation generated in convective and stratiform clouds.	X	X	X	X	X	X	X						
(07)		Assign typical precipitation types and intensities to different cloud types.	X	X	X	X	X	X	X						
(08)		Explain the relationship between moisture content and visibility during different types of winter precipitation (e.g. large vs small snowflakes).	X	X	X	X	X	X	X						
050 06 00 00		AIR MASSES AND FRONTS													
050 06 01 00		Air masses													
050 06 01 01		Description, classification and source regions of air masses													
(01)		Define the term ‘air mass’.	X	X	X	X	X	X	X						
(02)		Describe the properties of the source regions.	X	X	X	X	X	X	X						
(03)		Summarise the classification of air masses by source regions.	X	X	X	X	X	X	X						
(04)		State the classifications of air masses by temperature and humidity at source.	X	X	X	X	X	X	X						
(05)		State the characteristic weather in each of the air masses.	X	X	X	X	X	X	X						

(06)		Name the main air masses that affect Asian region.	X	X	X	X	X	X	X						
(07)		Classify air masses on a surface weather chart.	X	X	X	X	X	X	X						
		Remark: Names and abbreviations of air masses used in examinations: — first letter: humidity — continental (c) — maritime (m) — second letter: type of air mass — arctic (A) — polar (P) — tropical (T) — equatorial (E) — third letter: temperature — cold (c) warm (w)													
050 06 01 02		Modifications of air masses													
(01)		List the environmental factors that affect the final properties of an air mass.	X	X	X	X	X	X	X						
(02)		Explain how maritime and continental tracks modify air masses.	X	X	X	X	X	X	X						
(03)		Explain the effect of passage over cold or warm surfaces.	X	X	X	X	X	X	X						
(04)		Explain how air-mass weather is affected by the season, the air-mass track and by orographic and thermal effects over land.	X	X	X	X	X	X	X						

(05)		Assess the tendencies of the stability of an air mass and describe the typical resulting air-mass weather including the hazards for aviation.	X	X	X	X	X	X	X						
050 06 02 00		Fronts													
050 06 02 01		General aspects													
(01)		Describe the boundaries between air masses (fronts).	X	X	X	X	X	X	X						
(02)		Define ‘front’ and ‘frontal zone’.	X	X	X	X	X	X	X						
(03)		Name the global frontal systems (polar front, arctic front).	X	X	X	X	X	X							
(04)		State the approximate seasonal latitudes and geographic positions of the polar front and the arctic front.	X	X	X	X	X	X							
050 06 02 02		Warm front, associated clouds and weather													
(01)		Define a ‘warm front’.	X	X	X	X	X	X	X						
(02)		Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air.	X	X	X	X	X	X	X						
(03)		Explain the seasonal differences in the weather at warm fronts.	X	X	X	X	X	X	X						
(04)		Describe the structure, slope and dimensions of a warm front.	X	X	X	X	X	X	X						
(05)		Sketch a cross section of a warm front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X						
050 06 02 03		Cold front, associated clouds and weather													
(01)		Define a ‘cold front’.	X	X	X	X	X	X	X						

(02)		Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air.	X	X	X	X	X	X	X						
(03)		Explain the seasonal differences in the weather at cold fronts.	X	X	X	X	X	X	X						
(04)		Describe the structure, slope and dimensions of a cold front.	X	X	X	X	X	X	X						
(05)		Sketch a cross section of a cold front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X						
050 06 02 04		Warm sector, associated clouds and weather													
(01)		Describe fronts and air masses associated with the warm sector.	X	X	X	X	X	X	X						
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a warm sector.	X	X	X	X	X	X	X						
(03)		Explain the seasonal differences in the weather in the warm sector.	X	X	X	X	X	X	X						
(04)		Sketch a cross section of a warm sector showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X						
050 06 02 05		Weather behind the cold front													
(01)		Describe the cloud, weather, ground visibility and aviation hazards behind the cold front.	X	X	X	X	X	X	X						
(02)		Explain the seasonal differences in the weather behind the cold front.	X	X	X	X	X	X	X						
050 06 02 06		Occlusions, associated clouds and weather													
(01)	X	Define the term 'occlusion' and 'occluded front'.	X	X	X	X	X	X	X						

(02)		Describe the cloud, weather, ground visibility and aviation hazards in a cold occlusion.	X	X	X	X	X	X	X						
(03)		Describe the cloud, weather, ground visibility and aviation hazards in a warm occlusion.	X	X	X	X	X	X	X						
(04)		Explain the seasonal differences in the weather at occlusions.	X	X	X	X	X	X	X						
(05)		Sketch a cross section of occlusions showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X						
(06)		On a sketch illustrate the development of an occlusion and the movement of the occlusion point.	X	X	X	X	X	X	X						
050 06 02 07		Stationary front, associated clouds and weather													
(01)		Define a 'stationary front'.	X	X	X	X	X	X	X						
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a stationary front.	X	X	X	X	X	X	X						
050 06 02 08		Movement of fronts and pressure systems, life cycle													
(01)		Describe the movements of fronts and pressure systems and the life cycle of a mid-latitude depression.	X	X	X	X	X	X	X						
(02)		State the rules for predicting the direction and the speed of movement of fronts.	X	X	X	X	X	X	X						
(03)		State the difference in the speed of movement between cold and warm fronts.	X	X	X	X	X	X	X						
(04)		State the rules for predicting the direction and the speed of movement of frontal depressions.	X	X	X	X	X	X	X						

(05)		Describe, with a sketch if required, the genesis, development and life cycle of a frontal depression with associated cloud and rain belts.	X	X	X	X	X	X	X						
050 06 02 09		Changes of meteorological elements at a frontal wave													
(01)		Sketch a plan and a cross section of a frontal wave (warm front, warm sector, and cold front) and illustrate the changes of pressure, temperature, surface wind and wind in the vertical axis.	X	X	X	X	X	X	X						
050 07 00 00		PRESSURE SYSTEMS													
050 07 01 00		The principal pressure areas													
050 07 01 01		Location of the principal pressure areas													
(01)		Identify or indicate on a map the principal global high-pressure and low-pressure areas in January and July.	X		X	X									
(02)		Explain how these pressure areas are formed.	X		X	X									
(03)		Explain how the pressure areas move with the seasons.	X		X	X									
050 07 02 00		Anticyclone													
050 07 02 01		Anticyclones, types, general properties, cold and warm anticyclones, ridges and subsidence													
(01)		List the different types of anticyclones.	X	X	X	X	X	X	X						
(02)		Describe the effect of high-level convergence in producing areas of high pressure at ground level.	X	X	X	X	X	X	X						

(03)		Describe air-mass subsidence, its effect on the environmental lapse rate, and the associated weather.	X	X	X	X	X	X	X						
(04)		Describe the formation of warm and cold anticyclones.	X	X	X	X	X	X	X						
(05)		Describe the formation of ridges.	X	X	X	X	X	X	X						
(06)		Describe the properties of and the weather associated with warm and cold anticyclones.	X	X	X	X	X	X	X						
(07)		Describe the properties of and the weather associated with ridges.	X	X	X	X	X	X	X						
(08)		Describe the blocking anticyclone and its effects.	X	X	X	X	X	X	X						
050 07 03 00		Non-frontal depressions													
050 07 03 01		Thermal, orographic, polar and secondary depressions; troughs													
(01)		Describe the effect of high-level divergence in producing areas of low pressure at ground level.	X	X	X	X	X	X	X						
(02)		Describe the formation and properties of thermal, orographic (lee lows), polar and secondary depressions.	X	X	X	X	X	X	X						
(03)		Describe the formation, the properties and the associated weather at troughs.	X	X	X	X	X	X	X						
050 07 04 00		Tropical revolving storms													
050 07 04 01		Characteristics of tropical revolving storms													
(01)		State the conditions necessary for the formation of tropical revolving storms.	X	X	X	X	X								

(02)		State how a tropical revolving storm generally moves in its area of occurrence.	X	X	X	X	X								
(03)		Name the stages of the development of tropical revolving storms (tropical disturbance, tropical depression, tropical storm, severe tropical storm, tropical revolving storm).	X	X	X	X	X								
(04)		Describe the meteorological conditions in and near a tropical revolving storm.	X	X	X	X	X								
(05)		State the approximate dimensions of a tropical revolving storm.	X	X	X	X	X								
(06)		State that the movement of a tropical revolving storm can only rarely be forecast exactly, and that utmost care is necessary near a tropical revolving storm.	X	X	X	X	X								
050 07 04 02		Origin and local names, location and period of occurrence													
(01)		List the areas of origin and occurrence of tropical revolving storms, and their specified names (hurricane, typhoon, tropical cyclone).	X	X	X	X	X								
(02)		State the expected times of occurrence of tropical revolving storms in each of the source areas, and their approximate frequency.	X	X	X	X	X								
050 08 00 00		CLIMATOLOGY													
050 08 01 00		Climatic zones													
050 08 01 01		General circulation in the troposphere and lower stratosphere													

(01)	X	Describe the general tropospheric and low stratospheric circulation. (Refer to Subject 050 02 03 01)	X	X	X	X	X								
050 08 01 02		Climatic classification													
(01)		Describe the characteristics of the tropical rain climate, the dry climate, the mid-latitude climate (warm temperate rain climate), the subarctic climate (cold snow forest climate) and the snow climate (polar climate).	X	X	X	X	X								
(02)		Explain how the seasonal movement of the sun generates the transitional climate zones.	X	X	X	X	X								
(03)		State the typical locations of each major climatic zone.	X		X	X									
050 08 02 00		Tropical climatology													
050 08 02 01		Cause and development of tropical showers and thunderstorms: humidity, temperature, tropopause													
(01)		State the conditions necessary for the formation of tropical showers and thunderstorms (mesoscale convective complex, cloud clusters).	X	X	X	X	X								
(02)		Describe the characteristics of tropical squall lines.	X	X	X	X	X								
(03)		Explain the formation of convective cloud structures caused by convergence at the boundary of the NE and SE trade winds (Intertropical Convergence Zone (ITCZ)).	X	X	X	X	X								
(04)		State the typical figures for tropical surface air temperatures and humidities, and for heights of the zero-degree isotherm.	X	X	X	X	X								

050 08 02 02		Seasonal variations of weather and wind, typical synoptic situations													
(01)		Indicate on a map the trade winds (tropical easterlies) and describe the associated weather.	X	X	X	X	X								
(02)		Indicate on a map the doldrums and describe the associated weather.	X	X	X	X	X								
(03)		Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather.	X	X											
(04)		Indicate on a map the major monsoon winds.	X	X	X	X	X								
050 08 02 03		Intertropical Convergence Zone (ITCZ), weather in the ITCZ, general seasonal movement													
(01)		Identify or indicate on a map the positions of the ITCZ in January and July.	X	X											
(02)		Explain the seasonal movement of the ITCZ.	X	X											
(03)		Describe the weather and winds at the ITCZ.	X	X											
(04)		Explain the flight hazards associated with the ITCZ.	X	X											
050 08 02 04		Monsoon, sandstorms, cold-air outbreaks													
(01)		Define in general the term 'monsoon' and give a general overview of regions of occurrence.	X	X	X	X	X								
(02)		Describe the major monsoon conditions. (Refer to Subject 050 08 02 02)		X			X								
(03)		Explain how trade winds change character after a long track and become monsoon winds.	X	X	X	X	X								

(04)		Explain the weather and the flight hazards associated with a monsoon.	X	X	X	X	X								
(05)		Explain the formation of the SW/NE monsoon over West Africa and describe the weather, stressing the seasonal differences.	X	X	X	X	X								
(06)		Explain the formation of the SW/NE monsoon over India and describe the weather, stressing the seasonal differences.	X	X	X	X	X								
(07)		Explain the formation of the monsoon over the Far East and northern Australia and describe the weather, stressing the seasonal differences.	X	X	X	X	X								
(08)		Describe the formation and properties of sandstorms.	X	X	X	X	X								
(09)		Indicate when and where outbreaks of cold polar air can enter subtropical weather systems.	X	X	X	X	X								
(10)		Name well-known examples of polar-air outbreaks (Blizzard, Pampero).	X	X	X	X	X								
050 08 02 05		Easterly waves													
(01)		Explain the effect of easterly waves on tropical weather systems.	X		X	X									
050 08 03 00		Typical weather situations in the mid-latitudes													
050 08 03 01		Westerly situation (westerlies)													
(01)		Identify on a weather chart the typical westerly situation with travelling polar front waves.	X	X				X	X						
050 08 03 02		High-pressure area													
(01)		Describe the high-pressure zones with the associated weather.	X	X	X	X	X	X	X						

(02)		Identify on a weather chart the high-pressure regions.	X	X	X	X	X	X	X						
050 08 03 03		Intentionally left blank													
050 08 03 04		Cold-air drop													
(01)		Define ‘cold-air drop’.	X	X	X	X	X	X	X						
(02)		Describe the formation of a cold-air drop.	X	X	X	X	X	X	X						
(03)		Identify cold-air drops on weather charts.	X	X	X	X	X	X	X						
(04)		Explain the problems and dangers of cold-air drops for aviation.	X	X	X	X	X	X	X						
050 08 04 00		Local winds and associated weather													
050 08 04 01		Foehn, Mistral, Bora													
(01)		Describe the mechanism for the development of Foehn winds (including Chinook).	X	X	X	X	X	X							
(02)		Describe the weather associated with Foehn winds.	X	X	X	X	X	X							
(03)		Describe the formation of, the characteristics of, and the weather associated with Mistral and Bora.	X	X	X	X	X	X							
050 08 04 02		Harmattan													
(01)		Describe the Harmattan wind and the associated visibility problems as an example of local winds affecting visibility.	X	X	X	X	X								
050 09 00 00		FLIGHT HAZARDS													
050 09 01 00		Icing													
050 09 01 01		Conditions for ice accretion													

(01)		Summarise the general conditions under which ice accretion occurs on aircraft (temperatures of outside air; temperature of the airframe; presence of supercooled water in clouds, fog, rain and drizzle; possibility of sublimation).	X	X	X	X	X	X	X						
(02)		Explain the general weather conditions under which ice accretion occurs in a venturi carburettor.	X	X	X	X	X	X	X						
(03)		Explain the general weather conditions under which ice accretion occurs on airframe.	X	X	X	X	X	X	X						
(04)		Explain the formation of supercooled water in clouds, rain and drizzle. (Refer to Subject 050 03 02 01)	X	X	X	X	X	X	X						
(05)		Explain qualitatively the relationship between the air temperature and the amount of supercooled water.	X	X	X	X	X	X	X						
(06)		Explain qualitatively the relationship between the type of cloud and the size and number of the droplets in cumuliform and stratiform clouds.	X	X	X	X	X	X	X						
(07)		Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation.	X	X	X	X	X	X	X						
(08)		Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, and outside clouds and precipitation.	X	X	X	X	X	X	X						

(09)		Explain the influence of fuel temperature, radiative cooling of the aircraft surface and temperature of the aircraft surface (e.g. from previous flight) on ice formation.													
(10)		Describe the different factors that influence the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, etc.).	X	X	X	X	X	X	X						
(11)		Explain the effects of topography on icing.	X	X	X	X	X	X	X						
(12)		Explain the higher concentration of water drops in stratiform orographic clouds.	X	X	X	X	X	X	X						
050 09 01 02		Types of ice accretion													
(01)	X	Define ‘clear ice’.	X	X	X	X	X	X	X						
(02)		Describe the conditions for the formation of clear ice.	X	X	X	X	X	X	X						
(03)		Explain the formation of the structure of clear ice with the release of latent heat during the freezing process.	X	X	X	X	X	X	X						
(04)		Describe the aspects of clear ice: appearance, weight, solidity.	X	X	X	X	X	X	X						
(05)		Define ‘rime ice’.	X	X	X	X	X	X	X						
(06)		Describe the conditions for the formation of rime ice.	X	X	X	X	X	X	X						
(07)		Describe the aspects of rime ice: appearance, weight, solidity.	X	X	X	X	X	X	X						

(08)		Define ‘mixed ice’.	X	X	X	X	X	X	X						
(09)		Describe the conditions for the formation of mixed ice.	X	X	X	X	X	X	X						
(10)		Describe the aspects of mixed ice: appearance, weight, solidity.	X	X	X	X	X	X	X						
(11)		Describe the possible process of ice formation in snow conditions.	X	X	X	X	X	X	X						
(12)		Define ‘hoar frost’.	X	X	X	X	X	X	X						
(13)		Describe the conditions for the formation of hoar frost.	X	X	X	X	X	X	X						
(14)		Describe the aspects of hoar frost: appearance, solidity.	X	X	X	X	X	X	X						
050 09 01 03		Hazards of ice accretion, avoidance													
(01)		State the ICAO qualifying terms for the intensity of icing. Source: ICAO Doc 4444 ‘Procedures for Air Navigation Services — Air Traffic Management’	X	X	X	X	X	X	X						
(02)		Describe, in general, the hazards of icing.	X	X	X	X	X	X	X						
(03)		Assess the dangers of the different types of ice accretion.	X	X	X	X	X	X	X						
(04)		Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds, and in the different precipitation types.	X	X	X	X	X	X	X						

(05)		Indicate the possibilities of avoiding dangerous zones of icing: — in the flight planning: weather briefing, selection of track and altitude; — during flight: recognition of the dangerous zones, selection of appropriate track and altitude.	X	X	X	X	X	X	X						
050 09 01 04		Ice crystal icing													
(01)		Describe ice crystal icing.	X	X	X	X	X	X	X						
(02)		Describe the atmospheric processes leading to high ice crystal concentration. Define the variable ice water content (IWC).	X	X	X	X	X	X	X						
(03)		Identify weather situations and their relevant areas where high concentrations of ice crystals are likely to occur.	X	X	X	X	X	X	X						
(04)		Name, in general, the flight hazards associated with high concentrations of ice crystals.	X	X	X	X	X	X	X						
(05)		Explain how a pilot may possibly avoid areas with a high concentration of ice crystals.	X	X	X	X	X	X	X						
050 09 02 00		Turbulence													
050 09 02 01		Effects on flight, avoidance													
(01)		State the ICAO qualifying terms for the intensity of turbulence. Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management'	X	X	X	X	X	X	X						

(02)		Describe the effects of turbulence on an aircraft in flight.	X	X	X	X	X	X	X						
(03)		Indicate the possibilities of avoiding turbulence: — in the flight planning: weather briefing, selection of track and altitude; — during flight: selection of appropriate track and altitude.	X	X	X	X	X	X	X						
(04)		Describe atmospheric turbulence and distinguish between turbulence, gustiness and wind shear.	X	X	X	X	X	X	X						
(05)		Describe that forecasts of turbulence are not very reliable and state that pilot reports of turbulence are very valuable as they help others to prepare for or avoid turbulence.	X	X	X	X	X	X	X						
050 09 02 02		Clear-air turbulence (CAT): effects on flight, avoidance													
(01)		Describe the effects of CAT on flight. (Refer to Subject 050 02 06 03)	X	X	X	X	X								
(02)		Indicate the possibilities of avoiding CAT in flight: in the flight planning: weather briefing, selection of track and altitude; during flight: selection of appropriate track and altitude.	X	X	X	X	X								
050 09 03 00		Wind shear													
050 09 03 01		Definition of wind shear													
(01)		Define 'wind shear' (vertical and horizontal).	X	X	X	X	X	X	X						
(02)		Define 'low-level wind shear'.	X	X	X	X	X	X	X						
050 09 03 02		Weather conditions for wind shear													

(01)		Describe the conditions, where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief).	X	X	X	X	X	X	X						
050 09 03 03		Effects on flight, avoidance													
(01)		Describe the effects of wind shear on flight.	X	X	X	X	X	X	X						
(02)		Indicate the possibilities of avoiding wind shear in flight: — in the flight planning; — during flight.	X	X	X	X	X	X	X						
050 09 04 00		Thunderstorms													
050 09 04 01		Conditions for and process of development, forecast, location, type specification													
(01)		Name the cloud types which indicate the development of thunderstorms.	X	X	X	X	X	X	X						
(02)		Describe the different types of thunderstorms, their location, the conditions for and the process of development, and list their properties (air-mass thunderstorms, frontal thunderstorms, squall lines, supercell storms, orographic thunderstorms).	X	X	X	X	X	X	X						
050 09 04 02		Structure of thunderstorms, life cycle													
(01)		Assess the average duration of thunderstorms and their different stages.	X	X	X	X	X	X	X						
(02)		Describe a supercell storm: initial, supercell, tornado and dissipating stage.	X	X	X	X	X	X	X						

(03)		Summarise the flight hazards associated with a fully developed thunderstorm.	X	X	X	X	X	X	X						
(04)		Indicate on a sketch the most dangerous zones in and around a single-cell and a multi-cell thunderstorm.	X	X	X	X	X	X	X						
050 09 04 03		Electrical discharges													
(01)		Describe the basic outline of the electric field in the atmosphere.	X	X	X	X	X	X	X						
(02)		Describe types of lightning, i.e. ground stroke, intra-cloud lightning, cloud-to-cloud lightning, upward lightning.	X	X	X	X	X	X	X						
(03)		Describe and assess the 'St. Elmo's fire' weather phenomenon.	X	X	X	X	X	X	X						
(04)		Describe the development of lightning discharges.	X	X	X	X	X	X	X						
(05)		Describe the effect of lightning strike on aircraft and flight execution.	X	X	X	X	X	X	X						
050 09 04 04		Development and effects of downbursts													
(01)		Define the term 'downburst'.	X	X	X	X	X	X	X						
(02)		Distinguish between macroburst and microburst.	X	X	X	X	X	X	X						
(03)		State the weather situations leading to the formation of downbursts.	X	X	X	X	X	X	X						
(04)		Describe the process of development of a downburst.	X	X	X	X	X	X	X						
(05)		Give the typical duration of a downburst.	X	X	X	X	X	X	X						
(06)		Describe the effects of downbursts.	X	X	X	X	X	X	X						
050 09 04 05		Thunderstorm avoidance													

(01)		Explain how the pilot can anticipate each type of thunderstorm: through pre-flight weather briefing, observation in flight, use of specific meteorological information, use of information given by ground weather radar and by airborne weather radar. (Refer to Subject 050 10 01 04), use of a lightning detector (stormscope). (Refer to Subject 050 10 01 04), use of the stormscope (lightning detector).	X	X	X	X	X	X	X						
(02)		Describe practical examples of flight techniques used to avoid the hazards of thunderstorms.	X	X	X	X	X	X	X						
050 09 05 00		Tornadoes													
050 09 05 01		Properties and occurrence													
(01)		Define ‘tornado’.	X	X	X	X	X	X	X						
(02)		Describe the formation of a tornado.	X	X	X	X	X								
(03)		Describe the typical features of a tornado such as appearance, season, time of day, stage of development, speed of movement, and wind speed.	X	X	X	X	X								
(04)		Compare the occurrence of tornadoes in Asia with the occurrence in other locations, especially in the United States of America.	X	X	X	X	X								
(05)		Compare the dimensions and properties of tornadoes and dust devils.	X	X	X	X	X								
050 09 06 00		Inversions													
050 09 06 01		Influence on aircraft performance													

(01)		Compare the flight hazards during take-off and approach associated with a strong inversion alone and with a strong inversion combined with marked wind shear.	X	X	X	X	X	X	X						
050 09 07 00		Stratospheric conditions													
050 09 07 01		Influence on aircraft performance													
(01)		Summarise the advantages of stratospheric flights.	X	X	X	X	X								
(02)		List the influences of the phenomena associated with the lower stratosphere (wind, temperature, air density, turbulence).	X	X	X	X	X								
050 09 08 00		Hazards in mountainous areas													
050 09 08 01		Influence of terrain on clouds and precipitation, frontal passage													
(01)		Describe the influence of mountainous area on a frontal passage.	X	X	X	X	X	X	X						
050 09 08 02		Vertical movements, mountain waves, wind shear, turbulence, ice accretion													
(01)		Describe the vertical movements, wind shear and turbulence that are typical of mountain areas.	X	X	X	X	X	X	X						
(02)		Indicate on a sketch of a chain of mountains the turbulent zones (mountain waves, rotors).	X	X	X	X	X	X	X						
(03)		Explain the influence of relief on ice accretion.	X	X	X	X	X	X	X						
050 09 08 03		Development and effect of valley inversions													
(01)		Describe the formation of a valley inversion due to katabatic winds.	X	X	X	X	X	X	X						

(02)		Describe the valley inversion formed by warm winds aloft.	X	X	X	X	X	X	X						
(03)		Describe the effects of a valley inversion for an aircraft in flight.	X	X	X	X	X	X	X						
050 09 09 00		Visibility-reducing phenomena													
050 09 09 01		Reduction of visibility caused by precipitation and obscurations													
(01)		Describe the reduction of visibility caused by precipitation: drizzle, rain, snow.	X	X	X	X	X	X	X						
(02)		Describe the reduction of visibility caused by obscurations: — fog, mist, haze, smoke, volcanic ash.	X	X	X	X	X	X	X						
(03)		Describe the reduction of visibility caused by obscurations: — sand (SA), dust (DU).	X		X	X									
(04)		Describe the differences between ground and flight visibility, and slant and vertical visibility when an aircraft is above or within a layer of haze or fog.	X	X	X	X	X	X	X						
050 09 09 02		Reduction of visibility caused by other phenomena													
(01)		Describe the reduction of visibility caused by low drifting and blowing snow.	X	X	X	X	X	X	X						
(02)		Describe the reduction of visibility caused by low drifting and blowing dust and sand.	X	X	X	X	X								

(03)		Describe the reduction of visibility caused by dust storm (DS) and sandstorm (SS).	X	X	X	X	X								
(04)		Describe the reduction of visibility caused by icing (windshield).	X	X	X	X	X	X	X						
(05)		Describe the reduction of visibility caused by the position of the sun relative to the visual direction.	X	X	X	X	X	X	X						
(06)		Describe the reduction of visibility caused by the reflection of the sun's rays from the top of the layers of haze, fog and clouds.	X	X	X	X	X	X	X						
050 10 00 00		METEOROLOGICAL INFORMATION													
050 10 01 00		Observation													
050 10 01 01		Surface observations													
(01)		Define 'gusts', as given in METARs.	X	X	X	X	X	X	X						
(02)		Distinguish wind given in METARs and wind given by the control tower for take-off and landing.	X	X	X	X	X	X	X						
(03)		Define 'visibility'.	X	X	X	X	X	X	X						
(04)		Describe the meteorological measurement of visibility.	X	X	X	X	X	X	X						
(05)		Define 'prevailing visibility'.	X	X	X	X	X	X	X						
(06)		Define 'ground visibility'.	X	X	X	X	X	X	X						
(07)		List the units used for visibility (m, km, statute mile).	X	X	X	X	X	X	X						
(08)		Define 'runway visual range'.	X	X	X	X	X	X	X						
(09)		Describe the meteorological measurement of runway visual range.	X	X	X	X	X	X	X						

(10)		Indicate where the transmissometers/forward-scatter meters are placed on the aerodrome.	X	X	X	X	X	X	X						
(11)		List the units used for runway visual range (m, ft).	X	X	X	X	X	X	X						
(12)		List the different possibilities to transmit information to pilots about runway visual range.	X	X	X	X	X	X	X						
(13)		Compare ground visibility, prevailing visibility, and runway visual range.	X	X	X	X	X	X	X						
(14)		Indicate the means of observation of present weather.	X	X	X	X	X	X							
(15)		Indicate the means of observing clouds for the purpose of recording: type, amount, height of base (ceilometers), and top.	X	X	X	X	X	X							
(16)		State the clouds which are indicated in METAR, TAF and SIGMET.	X	X	X	X	X	X	X						
(17)		Define 'oktas'.	X	X	X	X	X	X	X						
(18)		Define 'cloud base'.	X	X	X	X	X	X	X						
(19)		Define 'ceiling'.	X	X	X	X	X	X	X						
(20)		Name the unit and the reference level used for information about cloud base (ft).	X	X	X	X	X	X	X						
(21)		Define 'vertical visibility'.	X	X	X	X	X	X	X						
(22)		Explain briefly how and when vertical visibility is measured.	X	X	X	X	X	X	X						
(23)		Name the units used for vertical visibility (ft, m).	X	X	X	X	X	X	X						
(24)		Indicate the means of observation of air temperature (thermometer).	X	X	X	X	X	X	X						

(25)		Name the units of relative humidity (%) and dew-point temperature (Celsius, Fahrenheit).	X	X	X	X	X	X							
050 10 01 02		Radiosonde observations													
(01)		Describe the principle of radiosondes.	X	X	X	X	X	X							
(02)	X	Describe and interpret the sounding by radiosonde given on a simplified temperature—pressure (T—P) diagram.	X	X	X	X	X	X							
050 10 01 03		Satellite observations													
(01)		Describe the basic outlines of satellite observations.	X	X	X	X	X	X	X						
(02)		Name the main uses of satellite pictures in aviation meteorology.	X	X	X	X	X	X	X						
(03)		Describe the different types of satellite imagery.	X	X	X	X	X	X	X						
(04)		Interpret qualitatively the satellite pictures in order to get useful information for flights: — location of clouds (distinguish between stratiform and cumuliform clouds).	X	X	X	X	X	X	X						
(05)		Interpret qualitatively the satellite pictures in order to get useful information for flights: — location of fronts.	X	X	X	X	X	X	X						
(06)		Interpret qualitatively the satellite pictures in order to get useful information for flights using atmospheric motion vector images to locate jet streams.	X												
050 10 01 04		Weather radar observations (Refer to Subject 050 09 04 05)													

(01)		Describe the basic principle and the type of information given by a ground weather radar.	X	X	X	X	X	X							
(02)		Interpret ground weather radar images.	X	X	X	X	X	X	X						
(03)		Describe the basic principle and the type of information given by airborne weather radar.	X	X	X	X	X	X	X						
(04)		Describe the limits and the errors of airborne weather radar information.	X	X	X	X	X	X	X						
(05)		Interpret typical airborne weather radar images.	X	X	X	X	X	X	X						
050 10 01 05		Aircraft observations and reporting													
(01)		Describe routine air-report and special air-report (ARS).	X	X	X	X	X	X	X						
(02)		State the obligation of a pilot to prepare air-reports.	X	X	X	X	X	X	X						
(03)		Name the weather phenomena to be stated in an ARS.	X	X	X	X	X	X	X						
050 10 02 00		Weather charts													
050 10 02 01		Significant weather charts													
(01)		Decode and interpret significant weather charts (low, medium and high level).	X	X	X	X	X	X	X						
(02)		Describe from a significant weather chart the flight conditions at designated locations or along a defined flight route at a given FL.	X	X	X	X	X	X	X						
050 10 02 02		Surface charts													

(01)		Recognise the following weather systems on a surface weather chart (analysed and forecast): ridges, cols and troughs; fronts; frontal side, warm sector and rear side of mid-latitude frontal lows; high- and low-pressure areas.	X	X	X	X	X	X	X						
(02)		Determine from surface weather charts the wind direction and speed.	X	X	X	X	X	X	X						
050 10 02 03		Upper-air charts													
(01)		Define ‘constant-pressure chart’.	X	X	X										
(02)		Define ‘isohypse (contour line)’. (Refer to Subject 050 01 03 02)	X	X	X										
(03)		Define ‘isotherm’.	X	X	X										
(04)		Define ‘isotach’.	X	X	X										
(05)		Describe forecast upper-wind and temperature charts.	X	X	X										
(06)		For designated locations or routes determine from forecast upper-wind and temperature charts, if necessary by interpolation, the spot/average values for outside-air temperature, temperature deviation from ISA, wind direction, and wind speed.	X	X	X										
050 10 02 04		Gridded forecast products													
(01)		State that numerical weather prediction uses a 3D grid of weather data, consisting of horizontal data (latitude-longitude) and vertical data (height or pressure).	X	X	X	X	X								

(02)		Explain that world area forecast centres prepare global sets of gridded forecasts for flight planning purposes (upper wind, temperature, humidity).	X	X	X	X	X								
(03)		State that the WAFCs also produce gridded datasets for Flight Level and temperature of the tropopause, direction and speed of maximum wind, cumulonimbus clouds, icing and turbulence.	X	X	X	X	X								
(04)		Explain that the data on CB and turbulence can be used in the visualization of flight hazards.	X	X	X	X	X								
(05)		Explain that the gridded forecasts can be merged in information processing systems with data relayed from aircraft or pilot reports, e.g. of turbulence, to provide improved situation awareness.	X	X	X	X	X								
050 10 03 00		Information for flight planning													
050 10 03 01		Aviation weather messages													
(01)		Describe, decode and interpret the following aviation weather messages (given in written or graphical format): METAR, aerodrome special meteorological report (SPECI), trend forecast (TREND), TAF, information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations (AIRMET), area forecast for low-level	X	X	X	X	X	X	X						

		flights (GAMET), ARS, volcanic ash advisory information.													
(02)		Describe, decode and interpret the tropical cyclone advisory information in written and graphical form.	X	X	X	X	X								
(03)		Describe the general meaning of MET REPORT and SPECIAL REPORT.	X	X	X	X	X	X	X						
(04)		List, in general, the cases when a SIGMET and an AIRMET are issued.	X	X	X	X	X	X	X						
(05)		Describe, decode (by using a code table) and interpret the following messages: runway state message (as written in a METAR).	X	X	X	X	X	X	X						
050 10 03 02		Meteorological broadcasts for aviation													
(01)		Describe the meteorological content of broadcasts for aviation: — meteorological information for aircraft in flight (VOLMET); — automatic terminal information service (ATIS).	X	X	X	X	X	X	X						
(02)		Describe the meteorological content of broadcasts for aviation: — HF-VOLMET.	X	X	X	X	X								
050 10 03 03		Use of meteorological documents													
(01)		Describe meteorological briefing and advice.	X	X	X	X	X	X	X						
(02)		List the information that a flight crew can receive from meteorological services for pre-flight planning and apply the content of this information on a designated flight route.	X	X	X	X	X	X	X						

(03)		List the meteorological information that a flight crew can receive from flight information services during flight and apply the content of this information for the continuation of the flight.	X	X	X	X	X	X	X						
050 10 03 04		Meteorological warnings													
(01)		Describe and interpret aerodrome warnings and wind-shear warnings and alerts.	X	X	X	X	X	X	X						
050 10 04 00		Meteorological services													
050 10 04 01		World area forecast system and meteorological offices													
(01)	X	Name the world area forecast centres (WAFCs) as the provider for upper-air forecasts: WAFCs prepare upper-air gridded forecasts of upper winds; upper-air temperature and humidity; direction, speed and flight level of maximum wind; flight level and temperature of tropopause, areas of cumulonimbus clouds, icing, clear-air and in-cloud turbulence, and geopotential altitude of flight levels.	X	X	X	X	X	X	X						
(02)	X	Name the meteorological (MET) offices as the provider for aerodrome forecasts and briefing documents.	X	X	X	X	X	X	X						
(03)	X	Name the meteorological watch offices (MWOs) as the provider for SIGMET and AIRMET information.	X	X	X	X	X	X							
(04)	X	Name the aeronautical meteorological stations as the provider for METAR and MET reports.	X	X	X	X	X	X							

(05)	X	Name the volcanic ash advisory centres (VAACs) as the provider for forecasts of volcanic ash clouds.	X	X	X	X	X	X							
(06)	X	Name the tropical cyclone advisory centres (TCACs) as the provider for forecasts of tropical cyclones.	X		X	X									
050 10 04 02		International organisations													
(01)	X	Describe briefly the following organisations and their chief activities in relation to weather for aviation: — International Civil Aviation Organization (ICAO) (Refer to Subject 010 'Air Law'); World Meteorological Organization (WMO).	X	X	X	X	X	X							
060 00 00 00		NAVIGATION													
061 00 00 00		GENERAL NAVIGATION													
061 01 00 00		BASICS OF NAVIGATION													
061 01 01 00		The Earth													
061 01 01 01		Form													
(01)	X	State that the geoid is an irregular shape based on the surface of the oceans influenced only by gravity and centrifugal force.	X	X	X	X	X								
(02)	X	State that a number of different ellipsoids are used to describe the shape of the Earth for mapping but that WGS-84 is the reference ellipsoid required for geographical coordinates.	X	X	X	X	X								

(03)		State that the circumference of the Earth is approximately 40 000 km or approximately 21 600 NM.	X	X	X	X	X								
061 01 01 02		Earth rotation													
(01)	X	Describe the rotation of the Earth around its own spin axis and the plane of the ecliptic (including the relationship of the spin axis to the plane of the ecliptic).	X	X	X	X	X								
(02)		Explain the effect that the inclination of the Earth's spin axis has on insolation and duration of daylight.	X	X	X	X	X								
061 01 02 00		Position													
061 01 02 01		Position reference system													
(01)	X	State that geodetic latitude and longitude is used to define a position on the WGS-84 ellipsoid.	X	X	X	X	X								
(02)		Define geographic (geodetic) latitude and parallels of latitude.	X	X	X	X	X								
(03)		Calculate the difference in latitude between any two given positions.	X	X	X	X	X								
(04)		Define geographic (geodetic) longitude and meridians.	X	X	X	X	X								
061 01 03 00		Direction													
061 01 03 01		Datums													
(01)	X	Define 'true north' (TN).	X	X	X	X	X								
(02)		Measure a true direction on any given aeronautical chart.	X	X	X	X	X								
(03)	X	Define 'magnetic north' (MN).	X	X	X	X	X								

(04)		Define and apply variation.	X	X	X	X	X								
(05)		Explain changes of variation with time and position.	X	X	X	X	X								
(06)	X	Define ‘compass north’ (CN).	X	X	X	X	X								
(07)		Apply deviation.	X	X	X	X	X								
061 01 03 02		Track and heading													
(01)		Calculate XWC by: — trigonometry; and — MDR.													
(02)		Explain and apply the concepts of drift and WCA.	X	X	X	X	X								
(03)		Calculate the actual track with appropriate data of heading and drift.	X	X	X	X	X								
(04)		Calculate TKE with appropriate data of WCA and drift.	X	X	X	X	X								
(05)		Calculate the heading change at an off-course fix to directly reach the next waypoint using the 1:60 rule.	X	X	X	X	X								
(06)		Calculate the average drift angle based upon an off-course fix observation.	X	X	X	X	X								
061 01 04 00		Distance													
061 01 04 01		WGS-84 ellipsoid													
(01)	X	State that 1 NM is equal to 1 852 km, which is the average distance of 1' of latitude change on the WGS-84 ellipsoid.	X	X	X	X	X								

(02)		State that 1' of longitude change at the equator on the WGS-84 ellipsoid is approximately equal to 1 NM.	X	X	X	X	X								
061 01 04 02		Units													
(01)		Convert between units of distance (nautical mile (NM), kilometre (km), statute mile (SM), feet (ft), inches (in)).	X	X	X	X	X								
061 01 04 03		Graticule distances													
(01)		Calculate the distance between positions on the same meridian, on opposite (antipodal) meridians, on the same parallel of latitude, and calculate new latitude/longitude when given distances north-south and east-west.	X	X	X	X	X								
061 01 04 04		Air mile													
(01)		Evaluate the effect of wind and altitude on air distance.	X	X	X	X	X								
(02)		Convert between ground distance (NM) and air distance (NAM) using the formula: NAM = NM × TAS/GS.	X	X	X	X	X								
061 01 05 00		Speed													
061 01 05 01		True airspeed (TAS)													
(01)		Calculate TAS from CAS, and CAS from TAS by: — mechanical computer; and — rule of thumb (2 % per 1 000 ft).	X	X	X	X	X								
061 01 05 02		Mach number (M)													
(01)		Calculate TAS from M, and M from TAS.	X	X											

061 01 05 03		CAS/TAS/M relationship													
(01)		Deduce the CAS, TAS and M relationship in climb/descent/cruise (flying at constant CAS or M).	X	X											
(02)		Deduce CAS and TAS in climb/descent/cruise (flying at constant CAS).			X	X	X								
061 01 05 04		Ground speed (GS)													
(01)		Calculate headwind component (HWC) and tailwind component (TWC) by: — trigonometry; and — MDR.	X	X	X	X	X								
(02)		Apply HWC and TWC to determine GS from TAS and vice versa.	X	X	X	X									
(03)	X	Explain the relationship between GS and TAS with increasing WCA.	X	X	X	X	X								
(04)		Calculate GS with: — mechanical computer (TOV solution); and — MDR (given track, TAS and WV).	X	X	X	X	X								
(05)		Perform GS, distance and time calculations.	X	X	X	X	X								
(06)		Calculate revised GS to reach a waypoint at a specific time.	X	X	X	X	X								
(07)		Calculate the average GS based on two observed fixes.	X	X	X	X	X								
061 01 05 05		Flight log													

(01)		Enter revised navigational en-route data, for the legs concerned, into the flight plan (e.g. updated wind and GS and correspondingly losses or gains in time and fuel consumption).	X	X	X	X	X								
061 01 05 06		Gradient versus rate of climb/descent													
(01)		Estimate average climb/descent gradient (%) or glide path degrees according to the following rule of thumb: — Gradient in degrees = (vertical distance (ft) / 100) / ground distance (NM)) — Gradient in % = (vertical distance (ft) / 60) / ground distance (NM)) — Gradient in degrees = arctan (altitude difference (ft) / ground distance (ft)). N.B. These rules of thumb approximate 1 NM to 6 000 ft and are based on the 1:60 rule.	X	X	X	X	X								
(02)		Calculate rate of descent (ROD) on a given glide-path angle or gradient using the following rule of thumb formulae: — ROD (ft/min) = GP° × GS (NM/min) × 100 — ROD (ft/min) = GP% × GS (kt)	X	X	X	X	X								
(03)		Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formula: — Vertical speed (ft/min) = (GS (kt) × gradient (ft/NM)) / 60.	X	X	X	X	X								

(04)	X	State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to ensure safe ground clearance.	X	X	X	X	X								
061 01 06 00		Triangle of velocities (TOV)													
061 01 06 01		Construction													
(01)		Draw and correctly label the TOV.	X	X	X	X	X								
061 01 06 02		Solutions													
(01)		Resolve the TOV for: — heading and GS (with mechanical computer and MDR); — WV (with mechanical computer); and — track and GS (with mechanical computer and MDR.	X	X	X	X	X								
061 01 07 00		Dead reckoning (DR)													
061 01 07 01		Dead reckoning (DR) technique													
(01)		Determine a DR position.	X	X	X	X	X								
(02)		Evaluate the difference between a DR and a fix position.	X	X	X	X	X								
(03)		Define 'speed factor' (SF). Speed divided by 60, used for mental flight-path calculations.	X	X	X	X	X								
(04)		Calculate wind correction angle (WCA) using the formula: — WCA = XWC (crosswind component)/SF	X	X	X	X	X								
061 01 08 00		Navigation in climb and descent													
061 01 08 01		Average airspeed													

(01)		Average TAS used for climb problems is calculated at the altitude 2/3 of the cruising altitude.	X	X	X	X	X								
(02)		Average TAS used for descent problems is calculated at the altitude 1/2 of the descent altitude.	X	X	X	X	X								
061 01 08 02		Average wind velocity (WV)													
(01)		WV used for climb problems is the WV at the altitude 2/3 of the cruising altitude.	X	X	X	X	X								
(02)		WV used for descent problems is the WV at the altitude 1/2 of the descent altitude.	X	X	X	X	X								
(03)		Calculate the average climb/descent GS from given TAS at various altitudes, and WV at various altitudes and true track.	X	X	X	X	X								
061 01 08 03		Ground speed (GS)/distance covered during climb or descent													
(01)	X	State that most aircraft operating handbooks supply graphical material to calculate climb and descent problems.	X	X	X	X	X								
(02)		Calculate the flying time and distance during climb/descent from given average rate of climb/descent and using average GS using the following formulae valid for a 3°-glide path: — rate of descent = (GS × 10) / 2 — rate of descent = speed factor (SF) × glide-path angle × 100	X	X	X	X	X								

(03)		Given distance, speed and present altitude, calculate the rate of climb/descent in order to reach a certain position at a given altitude.	X	X	X	X	X								
(04)		Given speed, rate of climb/descent and altitude, calculate the distance required in order to reach a certain position at a given altitude.	X	X	X	X	X								
(05)		Given speed, distance to go and altitude to climb/descent, calculate the rate of climb/descent.	X	X	X	X	X								
061 02 00 00		Visual flight rule (VFR) NAVIGATION													
061 02 01 00		Ground features													
061 02 01 01		Ground features													
(01)		Recognise which elements would make a ground feature suitable for use for VFR navigation.	X	X	X	X	X								
061 02 01 02		Visual identification													
(01)		Describe the problems of VFR navigation at lower levels and the causes of reduced visibility.	X	X	X	X	X								
(02)		Describe the problems of VFR navigation at night.	X	X	X	X	X								
061 02 02 00		VFR navigation techniques													
061 02 02 01		Use of visual observations and application to in-flight navigation													
(01)	X	Describe what is meant by the term 'map reading'.	X	X	X	X	X								
(02)	X	Define the term 'visual checkpoint'.	X	X	X	X	X								

(03)		Discuss the general features of a visual checkpoint and give examples.	X	X	X	X	X								
(04)		State that the evaluation of the differences between DR positions and actual position can refine flight performance and navigation.	X	X	X	X	X								
(05)	X	Establish fixes on navigational charts by plotting visually derived intersecting lines of position.	X	X	X	X	X								
(06)	X	Describe the use of a single observed position line to check flight progress.	X	X	X	X	X								
(07)	X	Describe how to prepare and align a map/chart for use in visual navigation.	X	X	X	X	X								
(08)		Describe visual-navigation techniques including: — use of DR position to locate identifiable landmarks; — identification of charted features/landmarks; — factors affecting the selection of landmarks; — an understanding of seasonal and meteorological effects on the appearance and visibility of landmarks; — selection of suitable landmarks; — estimation of distance from landmarks from successive bearings; — estimation of the distance from a landmark using an approximation of the sighting angle and the flight altitude.	X	X	X	X	X								

(09)		Describe the action to be taken if there is no visual checkpoint available at a scheduled turning point.	X	X	X	X	X								
(10)		Understand the difficulties and limitations that may be encountered in map reading in some geographical areas due to the nature of terrain, lack of distinctive landmarks, or lack of detailed and accurate charted data.	X	X	X	X	X								
(11)	X	State the function of contour lines on a topographical chart.	X	X	X	X	X								
(12)	X	Indicate the role of 'layer tinting' (colour gradient) in relation to the depiction of topography on a chart.	X	X	X	X	X								
(13)		Using the contours shown on a chart, describe the appearance of a significant feature.	X	X	X	X	X								
(14)		Apply the techniques of DR, map reading, orientation, timing and revision of ETAs and headings.	X	X	X	X	X								
061 02 02 02		Unplanned events													
(01)		Explain what needs to be considered in case of diversion, when unsure of position and when lost.	X	X	X	X	X								
061 03 00 00		GREAT CIRCLES AND RHUMB LINES													
061 03 01 00		Great circles													
061 03 01 01		Properties													
(01)		Describe the geometric properties of a great circle (including the vertex) and a small circle.	X	X											

(02)		Describe the geometric properties of a great circle and a small circle, up to 30° difference of longitude.			X	X	X								
(03)	X	Explain why a great-circle route is the shortest distance between any two positions on the Earth.	X	X	X	X	X								
(04)		Name examples of great circles on the surface of the Earth.	X	X	X	X	X								
061 03 01 02		Convergence													
(01)	X	Explain why the track direction of a great-circle route (other than following a meridian or the equator) changes.	X	X	X	X	X								
(02)		State the formula used to approximate the value of Earth convergence as change of longitude × sine mean latitude.	X	X	X	X	X								
(03)		Calculate the approximate value of Earth convergence between any two positions, up to 30° difference of longitude.	X	X	X	X	X								
061 03 02 00		Rhumb lines													
061 03 02 01		Properties													
(01)	X	Describe the geometric properties of a rhumb line.	X	X	X	X	X								
(02)	X	State that a rhumb-line route is not the shortest distance between any two positions on the Earth (excluding meridians and equator).	X	X	X	X	X								
061 03 03 00		Relationship													
061 03 03 01		Distances													

(01)		Explain that the variation in distance of the great-circle route and rhumb-line route between any two positions increases with increasing latitude or change in longitude.	X	X	X	X	X								
061 03 03 02		Conversion angle													
(01)		Calculate and apply the conversion angle.	X	X											
061 04 00 00		CHARTS													
061 04 01 00		Chart requirements													
061 04 01 01		ICAO Annex 4 'Aeronautical Charts'													
(01)		State the requirement for conformality and for a straight line to approximate a great circle.	X	X	X	X	X								
061 04 01 02		Convergence													
(01)		Explain and calculate the constant of the cone (sine of parallel of origin).	X	X	X	X	X								
(02)		Explain the relationship between Earth and chart convergence with respect to the ICAO requirement for a straight line to approximate a great circle.	X	X	X	X	X								
061 04 01 03		Scale													
(01)		Recognise methods of representing scale on aeronautical charts.	X	X	X	X	X								
(02)		Perform scale calculations based on typical en-route chart scales.	X	X	X	X	X								
061 04 02 00		Projections													
061 04 02 01		Methods of projection													

(01)	X	Identify azimuthal, cylindrical and conical projections.	X	X	X	X	X								
061 04 02 02		Polar stereographic													
(01)		State the properties of a polar stereographic projection.	X	X	X	X	X								
(02)		Calculate straight line track changes on a polar stereographic chart.	X	X	X	X	X								
061 04 02 03		Direct Mercator													
(01)		State the properties of a direct Mercator projection.	X	X	X	X	X								
(02)		Given the scale at one latitude, calculate the scale at different latitudes.	X	X	X	X	X								
(03)		Given a chart length at one latitude, show that it represents a different Earth distance at other latitudes.	X	X	X	X	X								
061 04 02 04		Lambert													
(01)		State the properties of a Lambert projection.	X	X	X	X	X								
(02)		Calculate straight line track changes on a Lambert chart.	X	X	X	X	X								
(03)		Explain the scale variation throughout the charts as follows: — the scale indicated on the chart will be correct at the standard parallels; — the scale will increase away from the parallel of origin; — the scale within the standard parallels differs	X	X	X	X	X								

		by less than 1 % from the scale stated on the chart.													
(04)		Given appropriate data, calculate initial, final or rhumb-line tracks between two positions (lat./long.).	X	X	X	X	X								
(05)		Given two positions (lat./long.) and information to determine convergency between the two positions, calculate the parallel of origin.	X	X	X	X	X								
(06)		Given a Lambert chart, determine the parallel of origin, or constant of cone.	X	X	X	X	X								
(07)		Given constant of cone or parallel of origin, great-circle track at one position and great-circle track at another position, calculate the difference of longitude between the two positions.	X	X	X	X	X								
061 04 03 00		Practical use													
061 04 03 01		Symbology													
(01)		Recognise ICAO Annex 4 symbology.	X	X	X	X	X								
061 04 03 02		Plotting													
(01)		Measure tracks and distances on VFR and IFR en-route charts.	X	X	X	X	X								
(02)		Fix the aircraft position on an en-route chart with information from VOR and DME equipment.	X	X	X	X	X								

(03)		Resolve bearings of an NDB station for plotting on an aeronautical chart.	X	X	X	X	X								
061 05 00 00		Time													
061 05 01 00		Local Mean Time (LMT)													
061 05 01 01		Mean solar day													
(01)	X	Explain the concepts of a mean solar day and LMT.	X	X	X	X	X								
061 05 01 02		Local Mean Time (LMT) and Universal Time Coordinated (UTC)													
(01)		Perform LMT and UTC calculations.	X	X	X	X	X								
061 05 02 00		Standard time													
061 05 02 01		Standard time and daylight saving time													
(01)		Explain and apply the concept of standard time and daylight saving time, and perform standard time and daylight saving time calculations.	X	X	X	X	X								
061 05 02 02		International Date Line													
(01)		State the changes when crossing the International Date Line.	X	X	X	X	X								
061 05 03 00		Sunrise and sunset													
061 05 03 01		Sunrise and sunset times													
(01)		Define sunrise, sunset, and civil twilight, and extract times from a suitable source (e.g. an almanac).	X	X	X	X	X								
(02)		Explain the changes to sunrise, sunset, and civil twilight times with date, latitude and altitude.	X	X	X	X	X								

(03)		Explain at which time of the year the duration of daylight changes at the highest rate.	X	X	X	X	X								
062 00 00 00		RADIO NAVIGATION													
062 01 00 00		BASIC RADIO PROPAGATION THEORY													
062 01 01 00		Basic principles													
062 01 01 01		Electromagnetic waves													
(01)	X	State that radio waves travel at the speed of light, being approximately 300 000 km/s.	X	X	X	X	X	X							
(02)	X	Define a ‘cycle’: a complete series of values of a periodical process.	X	X	X	X	X	X							
062 01 01 02		Frequency, wavelength, amplitude, phase angle													
(01)	X	Define ‘frequency’: the number of cycles occurring in 1 second expressed in Hertz (Hz).	X	X	X	X	X	X							
(02)	X	Define ‘wavelength’: the physical distance travelled by a radio wave during one cycle of transmission.	X	X	X	X	X	X							
(03)	X	Define ‘amplitude’: the maximum deflection in an oscillation or wave.	X	X	X	X	X	X							
(04)	X	State that the relationship between wavelength and frequency is: wavelength (λ) = speed of light (c) / frequency (f).	X	X	X	X	X	X							
(05)	X	Define ‘phase angle’: the fraction of one wavelength expressed in degrees from 000° to 360°.	X	X	X	X	X	X							

(06)	X	Define 'phase angle difference/shift': the angular difference between the corresponding points of two cycles of equal wavelength, which is measurable in degrees (°).	X	X	X	X	X	X							
062 01 01 03		Frequency bands, sidebands, single sideband													
(01)		List the bands of the frequency spectrum for electromagnetic waves: — very low frequency (VLF): 3—30 kHz; — low frequency (LF): 30—300 kHz; — medium frequency (MF): 300—3 000 kHz; — high frequency (HF): 3—30 MHz; — very high frequency (VHF): 30—300 MHz; — ultra-high frequency (UHF): 300—3 000 MHz; — super high frequency (SHF): 3—30 GHz; — extremely high frequency (EHF): 30—300 GHz.	X	X	X	X	X	X							
(02)		State that when a carrier wave is modulated, the resultant radiation consists of the carrier frequency plus additional upper and lower sidebands.	X	X	X	X	X	X							
(03)		State that HF meteorological information for aircraft in flight (VOLMET) and HF two-way communication use a single sideband.	X	X	X	X	X	X							

(04)		State that the following abbreviations (classifications according to International Telecommunication Union (ITU) regulations) are used for aviation applications: — N0N: carrier without modulation as used by non- directional radio beacons (NDBs); — A1A: carrier with keyed Morse code modulation as used by NDBs; — A2A: carrier with amplitude modulated Morse code as used by NDBs; — A3E: carrier with amplitude modulated speech used for communication (VHF-COM).	X	X	X	X	X	X							
062 01 01 04		Pulse characteristics													
(01)		Define the following terms that are associated with a pulse string: — pulse length; — pulse power; — continuous power.	X	X	X	X	X	X							
062 01 01 05		Carrier, modulation													
(01)	X	Define 'carrier wave': the radio wave acting as the carrier or transporter.	X	X	X	X	X	X							
(02)	X	Define 'modulation': the technical term for the process of impressing and transporting information by radio waves.	X	X	X	X	X	X							
062 01 01 06		Kinds of modulation (amplitude, frequency, pulse, phase)													

(01)	X	Define 'amplitude modulation': the information that is impressed onto the carrier wave by altering the amplitude of the carrier.	X	X	X	X	X	X							
(02)	X	Define 'frequency modulation': the information that is impressed onto the carrier wave by altering the frequency of the carrier.	X	X	X	X	X	X							
(03)	X	Describe 'pulse modulation': a modulation form used in radar by transmitting short pulses followed by larger interruptions.	X	X	X	X	X	X							
(04)	X	Describe 'phase modulation': a modulation form used in GPS where the phase of the carrier wave is reversed.	X	X	X	X	X	X							
062 01 02 00		Antennas													
062 01 02 01		Characteristics													
(01)	X	Define 'antenna': an antenna or aerial is an electrical device which converts electric power into radio waves, and vice versa.	X	X	X	X	X	X							
(02)	X	State that the simplest type of antenna is a dipole, which is a wire of length equal to one half of the wavelength.	X	X	X	X	X	X							
(03)	X	State that an electromagnetic wave always consists of an oscillating electric (E) and an oscillating magnetic (H) field which propagates at the speed of light.	X	X	X	X	X	X							
(04)	X	State that the E and H fields are perpendicular to each other. The oscillations are perpendicular to the propagation direction and are in-phase.	X	X	X	X	X	X							

062 01 02 02		Polarisation													
(01)	X	State that the polarisation of an electromagnetic wave describes the orientation of the plane of oscillation of the electrical component of the wave with regard to its direction of propagation.	X	X	X	X	X	X							
062 01 02 03		Types of antennas													
(01)		Name the common different types of directional antennas: — loop antenna used in old automatic direction-finding (ADF) receivers; — parabolic antenna used in weather radars; — slotted planar array used in more modern weather radars.	X	X	X	X	X	X							
(02)		Explain 'antenna shadowing'.	X	X	X	X	X								
(03)		Explain the importance of antenna placement on aircraft.	X	X	X	X	X								
062 01 03 00		Wave propagation													
062 01 03 01		Structure of the ionosphere and its effect on radio waves													
(01)	X	State that the ionosphere is the ionised component of the Earth's upper atmosphere from approximately 60 to 400 km above the surface, which is vertically structured in three regions or layers.	X	X	X	X	X	X							
(02)	X	State that the layers of the ionosphere are named D, E and F layers, and their depth varies with time.	X	X	X	X	X	X							

(03)	X	State that electromagnetic waves refracted from the E and F layers of the ionosphere are called sky waves.	X	X	X	X	X	X							
(04)	X	Explain how the different layers of the ionosphere influence wave propagation.	X	X	X	X	X	X							
062 01 03 02		Ground waves													
(01)	X	Define ‘ground or surface waves’: the electromagnetic waves travelling along the surface of the Earth.	X	X	X	X	X	X							
062 01 03 03		Space waves													
(01)	X	Define ‘space waves’: the electromagnetic waves travelling through the air directly from the transmitter to the receiver.	X	X	X	X	X	X							
062 01 03 04		Propagation with the frequency bands													
(01)		State that radio waves in VHF, UHF, SHF and EHF propagate as space waves.	X	X	X	X	X	X							
(02)		State that radio waves in LF, MF and HF propagate as surface/ground waves and sky waves.	X	X	X	X	X	X							
062 01 03 05		Doppler principle													
(01)	X	State that the Doppler effect is the phenomenon where the frequency of a wave will increase or decrease if there is relative motion between the transmitter and the receiver.	X	X	X	X	X	X							
062 01 03 06		Factors affecting propagation													

(01)	X	Define ‘skip distance’: the distance between the transmitter and the point on the surface of the Earth where the first sky wave return arrives.	X	X	X	X	X	X							
(02)		State that skip zone/dead space is the distance between the limit of the surface wave and the sky wave.	X	X	X	X	X	X							
(03)		Describe ‘fading’: when a receiver picks up two signals with the same frequency, and the signals will interfere with each other causing changes in the resultant signal strength and polarisation.	X	X	X	X	X	X							
(04)		State that radio waves in the VHF band and above are limited in range as they are not reflected by the ionosphere and do not have a surface wave.	X	X	X	X	X	X							
(05)	X	Describe the physical phenomena ‘reflection’, ‘refraction’, ‘diffraction’, ‘absorption’ and ‘interference’.	X	X	X	X	X	X							
(06)		State that multipath is when the signal arrives at the receiver via more than one path (the signal being reflected from surfaces near the receiver).	X	X	X	X	X	X							
062 02 00 00		RADIO AIDS													
062 02 01 00		Ground direction finding (DF)													
062 02 01 01		Principles													
(01)	X	Describe the use of a ground DF.	X	X	X	X	X	X							
(02)		Explain the limitation of range because of the path of the VHF signal.	X	X	X	X	X	X							
062 02 01 02		Presentation and interpretation													

(01)		Define the term 'QDM': the magnetic bearing to the station.	X	X	X	X	X	X	X						
(02)		Define the term 'QDR': the magnetic bearing from the station.	X	X	X	X	X	X	X						
(03)		Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot.	X	X	X	X	X	X							
062 02 01 03		Coverage and range													
(01)		Use the formula: $1.23 \times \sqrt{\text{transmitter height in feet}} + 1.23 \times \sqrt{\text{receiver height in}}$ Feet to calculate the range in NM.	X	X	X	X	X	X	X						
062 02 01 04		Errors and accuracy													
(01)	X	Explain why synchronous transmissions will cause errors.	X	X	X	X	X	X							
(02)	X	Describe the effect of 'multipath signals'.	X	X	X	X	X	X							
(03)		Explain that VDF information is divided into the following classes according to ICAO Annex 10: — Class A: accurate to a range within $\pm$ 2°; — Class B: accurate to a range within $\pm$ 5°; — Class C: accurate to a range within $\pm$ 10°; — Class D: accurate to less than Class C.	X	X	X	X	X	X							
062 02 02 00		Non-directional radio beacon (NDB)/automatic direction finding (ADF)													
062 02 02 01		Principles													

(01)	X	Define the acronym 'NDB': non-directional radio beacon.	X	X	X	X	X	X	X						
(02)	X	Define the acronym 'ADF': automatic direction-finding equipment.	X	X	X	X	X	X	X						
(03)	X	State that the NDB is the ground part of the system.	X	X	X	X	X	X	X						
(04)	X	State that the ADF is the airborne part of the system.	X	X	X	X	X	X	X						
(05)		State that the NDB operates in the LF and MF frequency bands.	X	X	X	X	X	X	X						
(06)		State that the frequency band assigned to aeronautical NDBs according to ICAO Annex 10 is 190—1 750 kHz.	X	X	X	X	X	X	X						
(07)		Define a 'locator beacon': an LF/MF NDB used as an aid to final approach usually with a range of 10—25 NM.	X	X	X	X	X	X	X						
(08)	X	State that certain commercial radio stations transmit within the frequency band of the NDB.	X	X	X	X	X	X	X						
(09)	X	State that according to ICAO Annex 10, an NDB station has an automatic ground monitoring system.	X	X	X	X	X	X	X						
(10)		Describe the use of NDBs for navigation.	X	X	X	X	X	X	X						
(11)		Describe the procedure to identify an NDB station.	X	X	X	X	X	X	X						
(12)	X	Interpret the term 'cone of confusion' in respect of an NDB.	X	X	X	X	X	X	X						
(13)	X	State that an NDB station emits a N0N/A1A or a N0N/A2A signal.	X	X	X	X	X	X	X						

(14)	X	State the function of the beat frequency oscillator (BFO).	X	X	X	X	X	X	X						
(15)	X	State that in order to identify a N0N/A1A NDB, the BFO circuit of the receiver has to be activated.	X	X	X	X	X	X	X						
(16)	X	State that on modern aircraft, the BFO is activated automatically.	X	X	X	X	X	X	X						
062 02 02 02		Presentation and interpretation													
(01)	X	Name the types of indicators commonly in use: — electronic display; — radio magnetic indicator (RMI); — fixed-card ADF (radio compass); — moving-card ADF.	X	X	X	X	X	X	X						
(02)		Interpret the indications given on RMI, fixed-card and moving- card ADF displays.	X	X	X	X	X	X	X						
(03)		Given a display, interpret the relevant ADF information.	X	X	X	X	X	X	X						
(04)		Calculate the true bearing from the compass heading and relative bearing.	X	X	X	X	X	X	X						
(05)		Convert the compass bearing into magnetic bearing and true bearing.	X	X	X	X	X	X	X						
(06)		Describe how to fly the following in-flight ADF procedures: — homing and tracking, and explain the influence of wind; — interception of inbound QDM and outbound QDR;	X	X	X	X	X	X	X						

		— changing from one QDM/QDR to another; — determining station passage and the abeam point.													
062 02 02 03		Coverage and range													
(01)	X	State that the power of the transmitter limits the range of an NDB.	X	X	X	X	X	X	X						
(02)		Explain the relationship between power and range.	X	X	X	X	X	X	X						
(03)	X	Describe the propagation path of NDB radio waves with respect to the ionosphere and the Earth's surface.	X	X	X	X	X	X	X						
(04)		Explain that the interference between sky waves and ground waves leads to 'fading'.	X	X	X	X	X	X	X						
(05)		Define that the accuracy the pilot has to fly the required bearing in order to be considered established during approach, according to ICAO Doc 8168, has to be within $\pm 5°$.	X	X	X	X	X	X	X						
(06)		State that there is no warning indication of NDB failure.	X	X	X	X	X	X	X						
062 02 02 04		Errors and accuracy													
(01)	X	Explain 'coastal refraction': as a radio wave travelling over land crosses the coast, the wave speeds up over water and the wave front bends.	X	X	X	X	X	X	X						
(02)	X	Define 'night/twilight effect': the influence of sky waves and ground waves arriving at the ADF receiver with a difference of phase and polarisation which introduce bearing errors.	X	X	X	X	X	X	X						

(03)		State that interference from other NDB stations on the same frequency may occur at night due to sky-wave contamination.	X	X	X	X	X	X	X						
062 02 02 05		Factors affecting range and accuracy													
(01)		Describe diffraction of radio waves in mountainous terrain (mountain effect).	X	X	X	X	X	X	X						
(02)		State that static radiation energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication.	X	X	X	X	X	X	X						
(03)		Explain that the bank angle of the aircraft causes a dip error.	X	X	X	X	X	X	X						
062 02 03 00		VHF omnidirectional radio range (VOR): conventional VOR (CVOR) and Doppler VOR (DVOR)													
062 02 03 01		Principles													
(01)	X	Explain the working principle of VOR using the following general terms: — reference phase; — variable phase; — phase difference.	X	X	X	X	X	X							
(02)		State that the frequency band allocated to VOR according to ICAO Annex 10 is VHF, and the frequencies used are 108.0— 117.975 MHz.	X	X	X	X	X	X	X						
(03)		State that frequencies within the allocated VOR range 108.0— 111.975 MHz, which have an odd number in the first decimal place, are used by instrument landing system (ILS).	X	X	X	X	X	X	X						

(04)		State that the following types of VOR are in operation: — conventional VOR (CVOR): a first-generation VOR station emitting signals by means of a rotating antenna; — Doppler VOR (DVOR): a second-generation VOR station emitting signals by means of a combination of fixed antennas utilising the Doppler principle; — en-route VOR for use by IFR traffic; — terminal VOR (TVOR): a station with a shorter range used as part of the approach and departure structure at major aerodromes; — test VOR (VOT): a VOR station emitting a signal to test VOR indicators in an aircraft.	X	X	X	X	X	X	X						
(05)		State that automatic terminal information service (ATIS) information is transmitted on VOR frequencies.	X	X	X	X	X	X	X						
(06)	X	List the three main components of VOR airborne equipment: — the antenna; — the receiver; — the indicator.	X	X	X	X	X	X	X						
(07)		Describe the identification of a VOR in terms of Morse-code letters and additional plain text.	X	X	X	X	X	X	X						
(08)	X	State that according to ICAO Annex 10, a VOR station has an automatic ground monitoring system.	X	X	X	X	X	X							

(09)		State that failure of the VOR station to stay within the required limits can cause the removal of identification and navigation components from the carrier or radiation to cease.	X	X	X	X	X	X	X						
062 02 03 02		Presentation and interpretation													
(01)		Read off the radial on an RMI.	X	X	X	X	X	X							
(02)		Read off the angular displacement in relation to a preselected radial on a horizontal situation indicator (HSI) or omnibearing indicator (OBI).	X	X	X	X	X	X							
(03)		Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft.	X	X	X	X	X	X							
(04)		Interpret VOR information as displayed on HSI, CDI and RMI.	X	X	X	X	X	X							
(05)		Describe the following in-flight VOR procedures: — tracking, and explain the influence of wind when tracking; — interception of a radial inbound and outbound to/from a VOR; — changing from one radial inbound/outbound to another; — determining station passage and the abeam point.	X	X	X	X	X	X							
(06)		State that when converting a radial into a true bearing, the variation at the VOR station has to be taken into account.	X	X	X	X	X	X							
062 02 03 03		Intentionally left blank													

062 02 03 04		Errors and accuracy													
(01)		Define that the accuracy the pilot has to fly the required bearing in order to be considered established on a VOR track when flying approach procedures, according to ICAO Doc 8168, has to be within the half-full scale deflection of the required track.	X	X	X	X	X	X	X						
(02)		State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications, which is called 'scalloping'.	X	X	X	X	X	X	X						
062 02 04 00		Distance-measuring equipment (DME)													
062 02 04 01		Principles													
(01)		State that DME operates in the UHF band.	X	X	X	X	X	X	X						
(02)	X	State that the system comprises two basic components: — the aircraft component: the interrogator; — the ground component: the transponder.	X	X	X	X	X	X	X						
(03)		Describe the principle of distance measurement using DME in terms of a timed transmission from the interrogator and reply from the transponder on different frequencies.	X	X	X	X	X	X							
(04)		Explain that the distance measured by DME is slant range.	X	X	X	X	X	X	X						
(05)		Illustrate that a position line using DME is a circle with the station at its centre.	X	X	X	X	X	X	X						

(06)		State that the pairing of VHF and UHF frequencies (VOR/DME) enables the selection of two items of navigation information from one frequency setting.	X	X	X	X	X	X	X						
(07)	X	Describe, in the case of co-location with VOR and ILS, the frequency pairing and identification procedure.	X	X	X	X	X	X	X						
(08)		State that military UHF tactical air navigation aid (TACAN) stations may be used for DME information.	X	X	X	X	X	X	X						
062 02 04 02		Presentation and interpretation													
(01)	X	State that when identifying a DME station co-located with a VOR station, the identification signal with the higher-tone frequency is the DME which identifies itself approximately every 40 seconds.	X	X	X	X	X	X	X						
(02)		Calculate ground distance from given slant range and altitude.	X	X	X	X	X	X	X						
(03)		Describe the use of DME to fly a DME arc in accordance with ICAO Doc 8168 Volume 1.	X	X	X	X	X	X	X						
(04)	X	State that a DME system may have a ground speed (GS) and time to station read-out combined with the DME read-out.	X	X	X	X	X	X	X						
062 02 04 03		Coverage and range													
(01)		Explain why a ground station can generally respond to a maximum of 100 aircraft.	X	X	X	X	X	X	X						

(02)		Explain which aircraft will be denied a DME range first when more than 100 interrogations are being made.	X	X	X	X	X	X	X						
062 02 04 04		Intentionally left blank													
062 02 04 05		Factors affecting range and accuracy													
(01)		Explain why the GS read-out from a DME can be less than the actual GS, and is zero when flying a DME arc.	X	X	X	X	X	X	X						
062 02 05 00		Instrument landing system (ILS)													
062 02 05 01		Principles													
(01)		Name the three main components of an ILS: — the localiser (LOC); — the glide path (GP); — range information (markers or DME).	X		X			X	X						
(02)	X	State the site locations of the ILS components: — the LOC antenna should be located on the extension of the runway centre line at the stop-end; — the GP antenna should be locate beyond the runway threshold, laterally displaced to the side of the runway centre line.	X		X			X	X						
(03)		Explain that marker beacons produce radiation patterns to indicate predetermined distances from the threshold along the ILS GP.	X		X			X	X						

(04)		State that marker beacons are sometimes replaced by a DME paired with the LOC frequency.	X		X			X	X						
(05)		State that in the ILS LOC frequency assigned band 108.0— 111.975 MHz, only frequencies which have an odd number in the first decimal are ILS LOC frequencies.	X		X			X	X						
(06)		State that the GP operates in the UHF band.	X		X			X	X						
(07)	X	Describe the use of the 90-Hz and the 150-Hz signals in the LOC and GP transmitters/receivers, stating how the signals at the receivers vary with angular deviation.	X		X			X	X						
(08)		State that the UHF GP frequency is selected automatically by being paired with the LOC frequency.	X		X			X							
(09)		Explain that both the LOC and the GP antenna radiates side lobes (false beams) which can give rise to false centre-line and false GP indication.	X		X			X	X						
(10)	X	Explain that the back beam from the LOC antenna may be used as a published 'non-precision approach'.	X		X			X	X						
(11)		State that the recommended GP is 3°.	X		X			X	X						

(12)		Name the frequency, modulation and identification assigned to all marker beacons. All marker beacons operate on 75-MHz carrier frequency. The modulation frequencies of the audio are: — outer marker: low; — middle marker: medium; — inner marker: high. The audio frequency modulation (for identification) is the continuous modulation of the audio frequency and is keyed as follows: — outer marker: 2 dashes per second continuously; — middle marker: a continuous series of alternate dots and dashes; — inner marker: 6 dots per second continuously. — the outer-marker cockpit indicator is coloured blue, the middle marker amber, and the inner marker white.	X		X			X	X						
(13)		State that the final-approach area contains a fix or facility that permits verification of the ILS GP—altimeter relationship. The outer marker or DME is usually used for this purpose.	X		X			X	X						
062 02 05 02		Presentation and interpretation													
(01)		Describe the ILS identification regarding frequency and Morse code or plain text.	X		X			X	X						

(02)		State that an ILS installation has an automatic ground monitoring system.	X		X			X							
(03)		State that the LOC and GP monitoring system monitors any shift in the LOC and GP mean course line or reduction in signal strength.	X		X			X							
(04)		State that warning flags will appear for both the LOC and the GP if the received signal strength is below a threshold value.	X		X			X	X						
(05)		Describe the circumstances in which warning flags will appear for both the LOC and the GP: — absence of the carrier frequency; — absence of the modulation simultaneously; — the percentage modulation of the navigation signal reduced to 0.	X		X			X							
(06)		Interpret the indications on a CDI and an HSI: — full-scale deflection of the CDI needle corresponds to approximately 2.5° displacement from the ILS centre line; — full-scale deflection on the GP corresponds to approximately 0.7° from the ILS GP centre line.	X		X			X	X						
(07)		Interpret the aircraft's position in relation to the extended runway centre line on a back-beam approach.	X		X			X							
(08)		Explain the setting of the course pointer of an HSI and the course selector of an omnibearing indicator (OBI) for front-beam and back-beam approaches.	X		X			X							
062 02 05 03		Coverage and range													

(01)		Sketch the standard coverage area of the LOC and GP with angular sector limits in degrees and distance limits from the transmitter: LOC coverage area is 10° on either side of the centre line to a distance of 25 NM from the runway, and 35° on either side of the centre line to a distance of 17 NM from the runway; GP coverage area is 8° on either side of the centre line to a distance of minimum 10 NM from the runway.	X		X			X	X						
062 02 05 04		Errors and accuracy													
(01)		Explain that ILS approaches are divided into facility performance categories defined in ICAO Annex 10.	X		X			X	X						
(02)		Define the following ILS operation categories: — Category I; — Category II; — Category IIIA; — Category IIIB; — Category IIIC.	X		X			X							
(03)		Explain that all Category III ILS operations guidance information is provided from the coverage limits of the facility to, and along, the surface of the runway.	X		X			X							
(04)		Explain why the accuracy requirements are progressively higher for CAT I, CAT II and CAT III ILS.	X		X			X							

(05)		Explain the following in accordance with ICAO Doc 8168: — the accuracy the pilot has to fly the ILS LOC to be considered established on an ILS track is within the half- full scale deflection of the required track; — the aircraft has to be established within the half-scale deflection of the LOC before starting descent on the GP; — the pilot has to fly the ILS GP to a maximum of half-scale fly-up deflection of the GP in order to stay in protected airspace.	X		X			X	X						
(06)		State that if a pilot deviates by more than half-course deflection on the LOC or by more than half-dot deflection on the GP, an immediate go-around should be executed because obstacle clearance may no longer be guaranteed.	X		X			X	X						
(07)		Describe ILS beam bends as deviations from the nominal LOC and GP respectively which can be assessed by flight test.	X		X			X							
(08)		Explain that multipath interference is caused by reflections from objects within the ILS coverage area.	X		X			X							
062 02 05 05		Factors affecting range and accuracy													
(01)		Define the 'ILS-critical area': an area of defined dimensions around the LOC and GP antennas where vehicles, including aircraft, are excluded during all ILS operations.	X		X			X	X						

(02)		Define the 'ILS-sensitive area': an area extending beyond the ILS- critical area where the parking or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.	X		X			X	X						
062 02 06 00		Microwave landing system (MLS)													
062 02 06 01		Principles													
(01)		Explain the principle of operation: — horizontal course guidance during the approach; — vertical guidance during the approach; — horizontal guidance for departure and missed approach; — DME (DME/P) distance; — transmission of special information regarding the system and the approach conditions.	X		X			X							
(02)		State that MLS operates in the SHF band on any one of 200 channels, on assigned frequencies.	X		X			X							
(03)		Explain the reason why MLS can be installed at aerodromes where, as a result of the effects of surrounding buildings or terrain, ILS siting is difficult.	X		X			X							
062 02 06 02		Presentation and interpretation													

(01)		Interpret the display of airborne equipment designed to continuously show the position of the aircraft in relation to a preselected course and glide path, along with distance information, during approach and departure.	X		X			X							
(02)		Explain that segmented approaches can be carried out with a presentation with two cross bars directed by a computer which has been programmed with the approach to be flown.	X		X			X							
(03)		Illustrate that segmented and curved approaches can only be executed with DME/P installed.	X		X			X							
(04)		Explain why aircraft are equipped with a multimode receiver (MMR) in order to be able to receive ILS, MLS and GPS.	X		X			X							
(05)		Explain why MLS without DME/P gives an ILS lookalike straight-line approach.	X		X			X							
062 02 06 03		Coverage and range													
(01)		Describe the coverage area for the approach direction as being within a sector of $\pm$ 40° of the centre line out to a range of 20 NM from the threshold (according to ICAO Annex 10).	X		X			X							
062 03 00 00		RADAR													
062 03 01 00		Pulse techniques													
062 03 01 01		Pulse techniques and associated terms													

(01)		Name the different applications of radar with respect to air traffic control (ATC), weather observations, and airborne weather radar (AWR).	X	X	X	X	X	X	X						
(02)	X	Describe the pulse technique and echo principle on which primary radar systems are based.	X	X	X	X	X	X							
(03)	X	State that the range of a radar depends on pulse repetition frequency (PRF), pulse length, pulse power, height of aircraft, height of antenna and frequency used.	X	X	X	X	X	X							
062 03 02 00		Ground radar													
062 03 02 01		Principles													
(01)		Explain that primary radar provides bearing and distance of targets.	X		X	X		X	X						
(02)	X	Explain that primary ground radar is used to detect aircraft that are not equipped with a secondary radar transponder.	X		X	X		X	X						
062 03 02 02		Presentation and interpretation													
(01)		State that modern ATC systems use inputs from various sensors to generate the display.	X		X	X		X	X						
062 03 03 00		Airborne weather radar													
062 03 03 01		Principles													
(01)		List the two main tasks of the weather radar in respect of weather and navigation.	X		X	X		X	X						
(02)		State that modern weather radars employ frequencies that give wavelengths of about 3 cm that reflect best on wet hailstones.	X		X	X		X	X						

(03)	X	State that the antenna is stabilised in the horizontal plane with signals from the aircraft's attitude reference system.	X		X	X		X	X						
(04)	X	Describe the cone-shaped pencil beam of about 3 to 5° beam width used for weather detection.	X		X	X		X	X						
062 03 03 02		Presentation and interpretation													
(01)		Explain the functions of the following different controls on the radar control panel: — off/on switch; — function switch with WX, WX+T and MAP modes; — gain-control setting (auto/manual); — tilt/autotilt switch.	X		X	X		X	X						
(02)		Name, for areas of differing reflection intensity, the colour gradations (green, yellow, red and magenta) indicating the increasing intensity of precipitation.	X		X	X		X	X						
(03)	X	State the use of azimuth-marker lines and range lines in respect of the relative bearing and the distance to a thunderstorm on the screen.	X		X	X		X	X						
062 03 03 03		Coverage and range													
(01)		Explain how the radar is used for weather detection and for mapping (range, tilt and gain, if available).	X		X	X		X	X						
062 03 03 04		Errors, accuracy, limitations													
(01)		Explain why AWR should be used with extreme caution when on the ground.	X		X	X		X	X						

062 03 03 05		Factors affecting range and accuracy													
(01)		Explain the danger of the area behind heavy rain (shadow area) where no radar waves will penetrate.	X		X	X		X	X						
(02)		Describe appropriate tilt settings in relation to altitude and thunderstorms.	X		X	X		X	X						
(03)		Explain why a thunderstorm may not be detected when the tilt is set too high.	X		X	X		X	X						
062 03 03 06		Application for navigation													
(01)		Describe the navigation function of the radar in the mapping mode.	X		X	X		X	X						
(02)		Describe the use of the weather radar to avoid a thunderstorm (Cb).	X		X	X		X	X						
(03)		Explain how turbulence (not CAT) can be detected by a modern weather radar.	X		X	X		X	X						
(04)		Explain how wind shear can be detected by a modern weather radar.	X		X	X		X	X						
062 03 04 00		Secondary surveillance radar and transponder													
062 03 04 01		Principles													
(01)		State that the ATC system is based on the replies provided by the airborne transponders in response to interrogations from the ATC secondary radar.	X	X	X	X	X	X	X						

(02)	X	State that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by the primary radar.	X	X	X	X	X	X	X						
(03)	X	State that an airborne transponder provides coded-reply signals in response to interrogation signals from the ground secondary radar and from aircraft equipped with traffic alert and collision avoidance system (TCAS).	X	X	X	X	X	X	X						
(04)		State the advantages of secondary surveillance radar (SSR) over a primary radar regarding range and collected information due to transponder principal information and active participation of the aircraft.	X	X	X	X	X	X	X						
062 03 04 02		Modes and codes													
(01)	X	State that the interrogator transmits its interrogations in the form of a series of pulse pairs.	X	X	X	X	X	X	X						
(02)		Name the interrogation modes: — Mode A; — Mode C; — Mode S.	X	X	X	X	X	X	X						
(03)		State that the interrogation frequency and the reply frequency are different.	X	X	X	X	X								

(04)		Explain that the decoding of the time interval between the pulse pairs determines the operating mode of the transponder: — Mode A: transmission of aircraft transponder code; — Mode C: transmission of aircraft pressure altitude; — Mode S: selection of aircraft address and transmission of flight data for the ground surveillance.	X	X	X	X	X								
(05)		State that Mode A designation is a sequence of four digits which can be manually selected from 4 096 available codes.	X	X	X	X	X	X	X						
(06)		State that in Mode C reply, the pressure altitude is reported in 100-ft increments.	X	X	X	X	X	X							
(07)		State that in addition to the information provided, on request from ATC, a special position identification (SPI) pulse can be transmitted but only as a result of a manual selection by the pilot (IDENT button).	X	X	X	X	X	X							
(08)	X	State the need for compatibility of Mode S with Mode A and C.	X	X	X	X	X	X							
(09)		Explain that Mode S transponders receive interrogations from TCAS and SSR ground stations.	X	X	X	X	X	X							
(10)	X	State that Mode S interrogation contains either the aircraft address, selective call or all-call address.	X	X	X	X	X	X							

(11)		State that every aircraft is allocated an ICAO aircraft address, which is hard-coded into the Mode S transponder (Mode S address).	X	X	X	X	X	X	X						
(12)		Explain that a 24-bit address is used in all Mode S transmissions, so that every interrogation can be directed to a specific aircraft.	X	X	X	X	X	X							
(13)		State that Mode S can provide enhanced vertical tracking, using a 25-ft altitude increment.	X	X	X	X	X	X							
(14)		State that SSR can be used for automatic dependent surveillance — broadcast (ADS-B).	X	X	X	X	X	X							
062 03 04 03		Presentation and interpretation													
(01)		State that an aircraft can be identified by a unique code.	X	X	X	X	X	X	X						
(02)		State which information can be presented on the ATC display system: — pressure altitude; — flight level; — flight number or aircraft registration number; — GS.	X	X	X	X	X	X	X						
(03)	X	Explain the use and function of the selector modes: OFF, Standby, ON (Mode A), ALT (Mode A, C and S), TEST, and of the reply lamp.	X	X	X	X	X	X	X						
062 04 00 00		INTENTIONALLY LEFT BLANK													
062 05 00 00		INTENTIONALLY LEFT BLANK													
062 06 00 00		GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSSs)													
062 06 01 00		Global navigation satellite systems (GNSSs)													

062 06 01 01		General													
(01)		State that there are four main GNSSs. These are: — USA NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS); — Russian GLObal NAvigation Satellite System (GLONASS); — European Galileo (under construction); — Chinese BeiDou (under construction).	X	X	X	X	X	X	X						
(02)	X	State that all four systems (will) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position.	X	X	X	X	X	X	X						
062 06 01 02		Operation													
		Global navigation satellite system (GNSS)													
(01)		State that there are currently two modes of operation: standard positioning service (SPS) for civilian users, and precise positioning service (PPS) for authorised users.	X	X	X	X	X	X	X						
(02)		SPS was originally designed to provide civilian users with a less accurate positioning capability than PPS.	X	X	X	X	X	X	X						
(03)	X	Name the three GNSS segments as follows: — space segment; — control segment; — user segment.	X	X	X	X	X	X	X						
		Space segment (example: NAVSTAR GPS)													

(04)		State that each satellite broadcasts ranging signals on two UHF frequencies: L1 and L2.	X	X	X	X	X	X							
(05)		State that SPS is a positioning and timing service provided on frequency L1.	X	X	X	X	X	X							
(06)		State that PPS uses both frequencies L1 and L2.	X	X	X	X	X	X							
(07)	X	State that the satellites transmit a coded signal used for ranging, identification (satellite individual PRN code), timing and navigation.	X	X	X	X	X	X							
(08)	X	State that the navigation message contains: — satellite clock correction parameters; — Universal Time Coordinated (UTC) parameters; — an ionospheric model; — satellite health data.	X	X	X	X	X	X							
(09)	X	State that an ionospheric model is used to calculate the time delay of the signal travelling through the ionosphere.	X	X	X	X	X	X	X						
(10)	X	State that two codes are transmitted on the L1 frequency, namely a coarse acquisition (C/A) code and a precision (P) code. The P code is not used for standard positioning service (SPS).	X	X	X	X	X	X							
(11)	X	State that satellites are equipped with atomic clocks which allow the system to keep very accurate time reference.	X	X	X	X	X	X	X						
		Control segment													

(12)	X	State that the control segment comprises: — a master control station; — a ground antenna; — monitoring stations.	X	X	X	X	X	X	X						
(13)	X	State that the control segment provides: — monitoring of the constellation status; — correction of orbital parameters; — navigation data uploading.	X	X	X	X	X	X	X						
		User segment													
(14)	X	State that GNSS supplies three-dimensional position fixes and speed data, plus a precise time reference.	X	X	X	X	X	X	X						
(15)	X	State that a GNSS receiver is able to determine the distance to a satellite by determining the difference between the time of transmission by the satellite and the time of reception.	X	X	X	X	X	X	X						
(16)	X	State that the initial distance calculated to the satellites is called pseudo-range because the difference between the GNSS receiver and the satellite time references initially creates an erroneous range.	X	X	X	X	X	X							
(17)	X	State that each range defines a sphere with its centre at the satellite.	X	X	X	X	X	X	X						
(18)	X	State that there are four unknown parameters (x, y, z and Δt) (receiver clock error) which require the measurement of ranges to four different satellites in order to get the position.	X	X	X	X	X	X	X						

(19)	X	State that the GNSS receiver is able to synchronise to the correct time reference when receiving four satellites.	X	X	X	X	X	X	X						
(20)	X	State that the receiver is able to calculate aircraft ground speed using the space vehicle (SV) Doppler frequency shift or the change in receiver position over time.	X	X	X	X	X	X							
		NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS) integrity													
(21)		Define ‘receiver autonomous integrity monitoring (RAIM)’ as a technique that ensures the integrity of the provided data by redundant measurements.	X	X	X	X	X	X	X						
(22)		State that RAIM is achieved by consistency checks among range measurements.	X	X	X	X	X	X	X						
(23)		State that basic RAIM requires five satellites. A sixth one is for isolating a faulty satellite from the navigation solution.	X	X	X	X	X	X	X						
(24)		State that agreements have been concluded between the appropriate agencies for the compatibility and interoperability by any approved user of NAVSTAR and GLONASS systems.	X	X	X	X	X	X							
(25)	X	State that the different GNSSs use different data with respect to reference systems, orbital data, and navigation services.	X	X	X	X	X	X							
062 06 01 03		Errors and factors affecting accuracy													

(01)		List the most significant factors that affect accuracy: — ionospheric propagation delay; — dilution of precision; — satellite clock error; — satellite orbital variations; — multipath.	X	X	X	X	X	X	X						
(02)		State that a user equivalent range error (UERE) can be computed from all these factors.	X	X	X	X	X	X							
(03)	X	State that the error from the ionospheric propagation delay (IPD) can be reduced by modelling, using a model of the ionosphere, or can almost be eliminated by using two frequencies.	X	X	X	X	X	X							
(04)	X	State that ionospheric delay is the most significant error.	X	X	X	X	X	X							
(05)		State that dilution of precision arises from the geometry and number of satellites in view. It is called geometric dilution of precision (GDOP).	X	X	X	X	X	X							
(06)		State that the UERE in combination with the geometric dilution of precision (GDOP) allows for an estimation of position accuracy.	X	X	X	X	X	X							
(07)	X	State that errors in the satellite orbits are due to: — solar winds; — gravitation of the Sun and the Moon.	X	X	X	X	X	X							
062 06 02 00		Ground-, satellite- and aircraft-based augmentation systems													

062 06 02 01		Ground-based augmentation systems (GBASs)													
(01)		Explain the principle of a GBAS: to measure on the ground the errors in the signals transmitted by GNSS satellites and relay the measured errors to the user for correction.	X	X	X	X	X	X	X						
(02)	X	State that the ICAO GBAS standard is based on this technique through the use of a data link in the VHF band of ILS—VOR systems (108—118 MHz).	X	X	X	X	X	X	X						
(03)		State that for a GBAS station the coverage is about 20 NM.	X	X	X	X	X	X	X						
(04)		State that GBAS provides information for guidance in the terminal area, and for three-dimensional guidance in the final approach segment (FAS) by transmitting the FAS data block.	X	X	X	X	X	X	X						
(05)		State that one ground station can support all the aircraft subsystems within its coverage providing the aircraft with approach data, corrections and integrity information for GNSS satellites in view via a VHF data broadcast (VDB).	X	X	X	X	X	X							
(06)	X	State that the minimum software designed coverage area is 10° on either side of the final approach path to a distance between 15 and 20 NM, and 35° on either side of the final approach path up to a distance of 15 NM.	X	X	X	X	X	X							
(07)		State that outside this area the FAS data of GBAS is not used.	X	X	X	X	X	X							

(08)	X	State that GBAS based on GPS is sometimes called local area augmentation system (LAAS).	X	X	X	X	X	X							
(09)		State that a GBAS-based approach is called GLS approach (GLS- GNSS landing system).	X	X	X	X	X	X							
062 06 02 02		Satellite-based augmentation systems (SBASs)													
(01)	X	Explain the principle of an SBAS: to measure on the ground the errors in the signals received from the satellites and transmit differential corrections and integrity messages for navigation satellites.	X	X	X	X	X	X	X						
(02)	X	State that the frequency band of the data link is identical to that of the GPS signals.	X	X	X	X	X	X	X						
(03)	X	Explain that the use of geostationary satellites enables messages to be broadcast over very wide areas.	X	X	X	X	X	X	X						
(04)	X	State that pseudo-range measurements to these geostationary satellites can also be made, as if they were GPS satellites.	X	X	X	X	X	X	X						
(05)	X	State that SBAS consists of two elements: — ground infrastructure (monitoring and processing stations); — communication satellites.	X	X	X	X	X	X	X						
(06)		State that SBAS allows the implementation of three-dimensional Type A and Type B approaches.	X	X	X	X	X	X	X						

(07)	X	State the following examples of SBAS: —— European Geostationary Navigation Overlay Service (EGNOS) in western Europe and the Mediterranean; —— wide area augmentation system (WAAS) in the USA; —— multi-functional transport satellite (MTSAT)-based augmentation system (MSAS) in Japan; —— GPS and geostationary earth orbit augmented navigation (GAGAN) in India.	X	X	X	X	X	X	X						
(08)	X	State that SBAS is designed to significantly improve accuracy and integrity.	X	X	X	X	X	X	X						
(09)		Explain that integrity and safety are improved by alerting SBAS users within 6 seconds if a GPS malfunction occurs.	X	X	X	X	X	X	X						
062 06 02 03		Intentionally left blank													
062 06 02 04		Aircraft-based augmentation systems (ABASs)													
(01)		Explain the principle of ABAS: to use redundant elements within the GPS constellation (e.g. multiplicity of distance measurements to various satellites) or the combination of GNSS measurements with those of other navigation sensors (such as inertial systems) in order to develop integrity control.	X	X	X	X	X	X	X						
(02)		State that the type of ABAS using only GNSS information is named receiver autonomous integrity monitoring (RAIM).	X	X	X	X	X	X	X						

(03)		State that a system using information from additional onboard sensors is named aircraft autonomous integrity monitoring (AAIM).	X	X	X	X	X	X	X						
(04)		Explain that the typical sensors used are barometric altimeter and inertial reference system (IRS).	X	X	X	X	X	X	X						
062 07 00 00		PERFORMANCE-BASED NAVIGATION (PBN)													
062 07 01 00		Performance-based navigation (PBN) concept (as described in ICAO Doc 9613)													
062 07 01 01		PBN principles													
(01)		List the factors used to define area navigation (RNAV) or required navigation performance (RNP) system performance requirements (accuracy, integrity and continuity).	X		X			X	X						
(02)	X	State that these RNAV and RNP systems are necessary to optimise the utilisation of available airspace.	X		X			X							
(03)		State that it is necessary for flight crew and air traffic controllers to be aware of the on-board RNAV or RNP system capabilities in order to determine whether the performance of the RNAV or RNP system is appropriate for the specific airspace requirements.	X		X			X							
(04)		Define accuracy as the conformance of the true position and the required position.	X		X			X							

(05)		Define continuity as the capability of the system to perform its function without unscheduled interruptions during the intended operation.	X		X			X	X						
(06)		Define integrity as a measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid alerts to the user.	X		X			X	X						
(07)		State that, unlike conventional navigation, PBN is not sensor- specific.	X		X			X	X						
(08)		Explain the difference between raw data and computed data.	X		X			X	X						
(09)		Define availability as the percentage of time (annually) during which the system is available for use.	X		X			X	X						
062 07 01 02		PBN components													
(01)		List the components of PBN as navigational aid (NAVAID) infrastructure, navigation specification and navigation application.	X		X			X							
062 07 01 03		PBN scope													
(01)		State that in oceanic/remote, en-route and terminal phases of flight, PBN is limited to operations with linear lateral performance requirements and time constraints.	X		X			X							
(02)		State that in the approach phases of flight, PBN accommodates both linear and angular laterally guided operations, and explain the difference between the two.	X		X			X							

062 07 02 00		Navigation specifications													
062 07 02 01		Area navigation (RNAV) and required navigation performance (RNP)													
(01)		State the difference between RNAV and RNP in terms of the requirement for on-board performance monitoring and alerting.	X		X			X	X						
062 07 02 02		Navigation functional requirements													
(01)	X	List the basic functional requirements of the RNAV and RNP specifications (continuous indication of lateral deviation, distance/bearing to active waypoint, GS or time to active waypoint, navigation data storage and failure indication).	X		X			X							
062 07 02 03		Designation of RNP and RNAV specifications													
(01)		Interpret X in RNAV X or RNP X as the lateral navigation (LNAV) accuracy (total system error) in nautical miles, which is expected to be achieved at least 95 % of the flight time by the population of aircraft operating within the given airspace, route or procedure.	X		X			X							
(02)		State that aircraft approved to the more stringent accuracy requirements may not necessarily meet some of the functional requirements of the navigation specification that has a less stringent accuracy requirement.	X		X			X	X						
(03)		State that RNAV 10 and RNP 4 are used in the oceanic/remote phase of flight.	X		X			X							

(04)		State that RNAV 5 is used in the en-route and arrival phases of flight.	X		X			X	X						
(05)		State that RNAV 2 and RNP 2 are also used as navigation specifications.	X		X			X							
(06)		State that RNP 2 is used in the en-route and oceanic/remote phases of flight.	X		X			X							
(07)		State that RNAV 2 might be used in the en-route continental, arrival and departure phases of flight.	X		X			X							
(08)		State that RNAV 1 and RNP 1 are used in the arrival and departure phases of flight.	X		X			X	X						
(09)		State that required navigation performance approach (RNP APCH) is used in the approach phase of flight.	X		X			X	X						
(10)		State that required navigation performance authorisation required approach (RNP AR APCH) is used in the approach phase of flight.	X		X			X	X						
(11)		State that RNP 0.3 navigation specification is used in all phases of flight except for oceanic/remote and final approach, primarily for helicopters.	X		X			X							
(12)		State that RNAV 1, RNP 1 and RNP 0.3 may also be used in en- route phases of low-level instrument flight rule (IFR) helicopter flights.	X		X			X							
062 07 03 00		Use of performance-based navigation (PBN)													
062 07 03 01		Intentionally left blank													
062 07 03 02		Intentionally left blank													
062 07 03 03		Specific RNAV and RNP system functions													

(01)		Recognise the definition of radius to fix (RF) leg.	X		X			X	X						
(02)		Recognise the definition of a fixed radius transition (FRT).	X		X			X	X						
(03)		State the importance of respecting the flight director guidance and the speed constraints associated with an RF procedure.	X		X			X	X						
(04)		Explain the difference between a fly-by-turn and a fly-over.	X		X			X	X						
(05)		State that the Aeronautical Radio, Incorporated (ARINC) 424 path terminators set the standards for coding the SIDs, STARs and instrument approach procedures (IAPs) from the official published government source documentation into the ARINC navigation database format.	X		X			X							
(06)		State that the path terminators define a specific type of termination of the previous flight path.	X		X			X							
(07)		Define the term 'offset flight path'.	X		X			X	X						
062 07 03 04		Intentionally left blank													
062 07 04 00		Performance-based navigation (PBN) operations													
062 07 04 01		Performance-based navigation (PBN) principles													
(01)		Define 'path definition error' (PDE).	X		X			X	X						
(02)		Define 'flight technical error' (FTE) and state that the FTE is the error in following the prescribed path, either by the auto-flight system or by the pilot.	X		X			X	X						

(03)		Define 'navigation system error' (NSE) and state that the accuracy of a navigation system may be referred to as NSE.	X		X			X	X						
(04)		Define 'total system error' (TSE) and state that the geometric sum of the PDE, FTE and NSE equals the TSE.	X		X			X	X						
(05)		State that navigation accuracy depends on the TSE.	X		X			X							
062 07 04 02		On-board performance monitoring and alerting													
(01)		State that on-board performance monitoring and alerting of flight technical errors is managed by on-board systems or flight crew procedures.	X		X			X	X						
(02)		State that on-board performance monitoring and alerting of navigation system errors is a requirement of on-board equipment for RNP.	X		X			X	X						
(03)		State that, dependent on the navigation sensor, the estimated position error (EPE) is compared with the required navigation specification.	X		X			X							
(04)		Explain how a navigation system assesses the EPE.	X		X			X							
(05)		Give an example of how the loss of the ability to operate in RNP airspace may be indicated by the navigation system.	X		X			X							
(06)		State that on-board performance monitoring and alerting of path definition error is managed by gross reasonableness checks of navigation data.	X		X			X	X						
062 07 04 03		Abnormal situations													

(01)		State that abnormal and contingency procedures are to be used in case of loss of the PBN capability.	X		X			X	X						
062 07 04 04		Database management													
(01)		State that, unless otherwise specified in the operations documentation or acceptable means of compliance (AMCs), the navigational database must be valid for the current aeronautical information regulation and control (AIRAC) cycle.	X		X			X	X						
062 07 05 00		Requirements of specific RNAV and RNP specifications													
062 07 05 01		RNAV 10													
(01)		State that RNAV 10 requires that aircraft operating in oceanic and remote areas be equipped with at least two independent and serviceable long-range navigation systems (LRNSs) comprising an INS, an inertial reference system (IRS)/flight management system (FMS) or a GNSS.	X		X			X							
(02)		State that operators may extend their RNAV 10 navigation capability time by updating.	X		X			X							
062 07 05 02		RNAV 5													
(01)		State that manual data entry is acceptable for RNAV 5.	X		X			X	X						
062 07 05 03		RNAV 1/RNAV 2/RNP 1/RNP 2													

(01)		State that pilots must not fly an RNAV 1, RNAV 2, RNP 1 or RNP 2 standard instrument departure (SID) or standard instrument arrival (STAR) unless it is retrievable by route name from the on- board navigation database and conforms to the charted route.	X		X			X	X						
(02)		State that the route may subsequently be modified through the insertion (from the database) or deletion of specific waypoints in response to ATC clearances.	X		X			X	X						
(03)		State that the manual entry, or creation of new waypoints by manual entry, of either latitude and longitude or place/bearing/distance values is not permitted.	X		X			X	X						
062 07 05 04		Intentionally left blank													
062 07 05 05		Required navigation performance approach (RNP APCH)													
(01)		State that pilots must not fly an RNP APCH unless it is retrievable by procedure name from the on-board navigation database and conforms to the charted procedure.	X		X			X	X						
(02)		State that an RNP APCH to LNAV minima is a non-precision IAP designed for two-dimensional approach operations.	X		X			X	X						
(03)		State that an RNP APCH to lateral navigation (LNAV)/vertical navigation (VNAV) minima has lateral guidance based on GNSS and vertical	X		X			X	X						

		guidance based on either SBAS or barometric vertical navigation (Baro-VNAV).													
(04)		State that an RNP APCH to LNAV/VNAV minima may only be conducted with vertical guidance certified for the purpose.	X		X			X	X						
(05)		Explain why an RNP APCH to LNAV/VNAV minima based on Baro-VNAV may only be conducted when the aerodrome temperature is within a promulgated range if the barometric input is not automatically temperature-compensated.	X		X			X	X						
(06)		State that the correct altimeter setting is critical for the safe conduct of an RNP APCH using Baro-VNAV.	X		X			X	X						
(07)		State that an RNP APCH to LNAV/VNAV minima is a three-dimensional operation.	X		X			X	X						
(08)		State that an RNP APCH to localiser performance with vertical guidance (LPV) minima is a three-dimensional operation.	X		X			X	X						
(09)		State that RNP APCH to LPV minima requires a final approach segment (FAS) data block.	X		X			X	X						
(10)		State that RNP approaches to LPV minima require SBAS.	X		X			X	X						
(11)		State that the FAS data block is a standard data format to describe the final approach path.	X		X			X	X						

062 07 05 06		Required navigation performance authorisation required approach (RNP AR APCH)													
(01)		State that RNP AR APCH requires authorisation.	X		X			X	X						
062 07 05 07		Advanced required navigation performance (A-RNP)													
(01)		State that A-RNP incorporates the navigation specifications RNAV 5, RNAV 2, RNAV 1, RNP 2, RNP 1 and RNP APCH.	X		X			X							
062 07 05 08		PBN point-in-space (PinS) departure													
(01)		State that a PinS departure is a departure procedure designed for helicopters only.			X			X							
(02)		State that a PinS departure procedure includes either a 'proceed VFR' or a 'proceed visually' instruction from the landing location to the initial departure fix (IDF).			X			X							
(03)		Recognise the differences in the instructions 'proceed VFR' and 'proceed visually'.			X			X							
062 07 05 09		PBN point-in-space (PinS) approach													
(01)		State that a PinS approach procedure is an instrument RNP APCH procedure designed for helicopters only, and that it may be published with LNAV minima or LPV minima.			X			X							
(02)		State that a PinS approach procedure includes either a 'proceed VFR' or a 'proceed visually' instruction from the			X			X							

		missed approach point (MAPt) to a landing location.													
(03)		Recognise the differences between ‘proceed VFR’ and ‘proceed visually’.			X			X							
070 00 00 00		OPERATIONAL PROCEDURES													
071 01 00 00		GENERAL REQUIREMENTS													
071 01 01 00		ICAO Annex 6													
071 01 01 01		Definitions													
(01)		Define the following: alternate aerodrome: flight time (aeroplanes); take-off alternate; en-route alternate; destination alternate. Source: ICAO Annex 6, Part I, Chapter 1	X	X											
(02)		Define ‘alternate heliport’; ‘flight time (helicopters)’. Source: ICAO Annex 6, Part III, Section 1, Chapter 1			X	X	X								
071 01 01 02		Applicability													
(01)		State that Part I shall be applicable to the operation of aeroplanes by operators authorised to conduct international commercial air transport (CAT) operations. Source: ICAO Annex 6, Part I, Chapter 2	X	X											
(02)		State that Part III shall be applicable to all helicopters engaged in international CAT operations or in international general aviation operations, except helicopters engaged in aerial			X	X	X								

		work. Source: ICAO Annex 6, Part III, Section 1, Chapter 2													
071 01 01 03		General													
(01)		Explain the compliance with laws, regulations and procedures. Source: ICAO Annex 6, Part I, Chapter 3.1; ICAO Annex 6, Part III, Section 2, Chapter 1.1	X	X	X	X	X								
(02)		State the condition(s) required for the establishment of a flight data analysis programme, and state what this programme is part of. Source: ICAO Annex 6, Part I, Chapter 3.3	X	X	X	X	X								
(03)		Explain what is a flight safety documents system. Source: ICAO Annex 6, Part I, Chapter 3.3	X	X	X	X	X								
(04)		Explain what is maintenance release. Source: ICAO Annex 6, Part I, Chapter 8.8; ICAO Annex 6 Part III, Section 2, Chapter 6.7	X	X	X	X	X								
(05)		List and describe the lights to be displayed by aircraft. Source: ICAO Annex 6, Part I, Appendix 1: 2. Navigation lights to be displayed in the air	X	X	X	X	X								
071 01 02 00		Operational requirements													

071 01 02 01		Applicability														
(01)	X	State the operational regulations applicable to CAT and other activities (e.g. specialised operations (SPO)). Source: TCAR OPS; TCAR PEL Part FCL	X	X	X	X	X									
(02)		State the nature of CAT operations and exceptions. Source: TCAR OPS Air Operations (cover regulation); TCAR OPS Part ORO point ORO.GEN.005 'Scope' and Part CAT point CAT.GEN.100	X	X	X	X	X									
071 01 02 02		General														
(01)	X	Explain why CAT flights must meet the applicable operational requirements. Source: TCAR OPS Part ORO, Point ORO.GEN.105 and related AMCs/GM; TCAR OPS Part ORO Point ORO.GEN.110 'Operator responsibilities' and related AMCs/GM	X	X	X	X	X									
(02)		Define 'flight manual limitations — flight through the height velocity (HV) envelope'.			X	X	X									
(03)		Define 'helicopter emergency medical service (HEMS)'.			X	X	X									

(04)		Define ‘operations over a hostile environment — applicability’. Explain that there are certain areas which should not be overflown and state possible sources of that information (e.g. governmental warnings, operator risk assessment).			X	X	X								
(05)		Define ‘local area operations — approval’.			X	X	X								
(06)		Explain the requirements about language used for crew communication and in the operations manual. Source: TCAR OPS Part CAT point CAT.GEN.MPA.120 ‘Common language’	X	X	X	X	X								
(07)		Explain which are the operator requirements regarding the management system. Source: TCAR OPS Part ORO, point ORO.GEN.200 ‘Management system’; AMCs/GM to ORO.GEN.205 ‘Contracted activities’ and to ORO.GEN.220 ‘Record-keeping’	X	X	X	X	X								
(08)		Explain which are the operator requirements regarding accident prevention and the flight safety programme. Source: TCAR Part ORO, point ORO.GEN.200 ‘Management system’; AMCs/GM to ORO.GEN.205 ‘Contracted activities’, to ORO.GEN.220 ‘Record-keeping’, and to ORO.AOC.130 ‘Flight data monitoring — aeroplanes’	X	X	X	X	X								

(09)		Explain which are the regulations concerning the carriage of persons on an aircraft. Source: TCAR OPS Part CAT, point CAT.GEN.MPA.165 'Method of carriage of persons'	X	X	X	X	X								
(10)		Explain the operator's and commander's responsibility concerning portable electronic devices (PEDs). Source: TCAR OPS Part CAT, point CAT.GEN.MPA.140 'Portable electronic devices'	X	X	X	X	X								
(11)		Explain the operator's and commander's responsibility regarding admission in an aircraft of a person under the influence of drug or alcohol. Source: TCAR OPS Part CAT, point CAT.GEN.MPA.170 'Alcohol and drugs'	X	X	X	X	X								
(12)		Explain the regulations concerning the endangerment of safety. Source: TCAR OPS Part CAT, point CAT.GEN.MPA.175 'Endangering safety'	X	X	X	X	X								
(13)		List the documents to be carried on each flight. Source: TCAR OPS Part Cat, point CAT.GEN.MPA.180 'Documents, manuals and information to be carried' and related AMCs/GM	X	X	X	X	X								

(14)		Explain the operator's responsibility regarding manuals to be carried on board an aircraft. Source: TCAR OPS Part CAT, point CAT.GEN.MPA.180 'Documents, manuals and information to be carried' and related AMCs/GM	X	X	X	X	X								
(15)		List the additional information and forms to be carried on board an aircraft. Source: TCAR OPS Part CAT, point CAT.GEN.MPA.180 'Documents, manuals and information to be carried on board an aircraft' and related AMCs/GM	X	X	X	X	X								
(16)		List the copies of items of information to be retained on the ground by the operator. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.185 'Information to be retained on the ground'	X	X	X	X	X								
(17)		Explain what responsibilities the operator and the commander have regarding the production of and access to records and documents. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.190 'Provision of documentation and records'	X	X	X	X	X								
071 01 02 03		Operator certification and supervision													

(01)		Explain what requirement has to be satisfied for the issue of an air operator certificate (AOC). Source: RCAB 85 ‘Air operator certificate’; TCAR OPS Part ORO, Point ORO.GEN.210 ‘Personnel requirements’; TCAR OPS Part ORO, Point ORO.AOC.100 ‘Application for an air operator certificate’	X	X	X	X	X								
(02)		Explain what the rules applicable to air operator certification are. Source: RCAB 85 ‘Air operator certificate’; TCAR OPS Part ORO, Point ORO.GEN.210 ‘Personnel requirements’; TCAR OPS Part ORO, Point ORO.AOC.100 ‘Application for an air operator certificate’ TCAR OPS Part ORO, Point ORO.AOC.105 ‘Operations specifications and privileges of an AOC holder’	X	X	X	X	X								

(03)		Explain the conditions to be met for the issue or revalidation of an AOC. Source: RCAB 85 'Air operator certificate'; TCAR OPS Part ORO, Point ORO.GEN.210 'Personnel requirements'; TCAR OPS Part ORO, Point ORO.AOC.100 'Application for an air operator certificate' TCAR OPS Part ORO, Point ORO.AOC.105 'Operations specifications and privileges of an AOC holder'	X	X	X	X	X								
(04)		Explain the contents and conditions of the AOC. Source: RCAB 85 'Air operator certificate'; TCAR OPS Part ORO, Point ORO.GEN.210 'Personnel requirements'; TCAR OPS Part ORO, Point ORO.AOC.100 'Application for an air operator certificate' TCAR OPS Part ORO, Point ORO.AOC.105 'Operations specifications and privileges of an AOC holder'	X	X	X	X	X								
071 01 02 04		Operational procedures (except preparation for long-range flight)													

(01)		Define the terms used for operational procedures. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.106 ‘Use of isolated aerodromes — aeroplanes’; TCAR OPS Part CAT, Point CAT.OP.MPA.107 ‘Adequate aerodrome’	X	X											
(02)		State the operator’s responsibilities regarding the use of air traffic services (ATS). Source: TCAR OPS Part CAT, Point CAT.OP.MPA.100 ‘Use of air traffic services’	X	X	X	X	X								
(03)		State the operator’s responsibilities regarding authorisation of aerodromes/heliports by the operator. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.105 ‘Use of aerodromes and operating sites’; TCAR OPS Part CAT, Point CAT.OP.MPA.106 ‘Use of isolated aerodromes — aeroplanes’; TCAR OPS Part CAT, Point CAT.OP.MPA.107 ‘Adequate aerodrome’	X	X	X	X	X								

(04)		Explain which elements must be considered by the operator when specifying aerodrome/heliport operating minima. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.110 (a) and (c) ‘Aerodrome operating minima’, TCAR OPS Part CAT, Point CAT.OP.MPA.115 ‘Approach flight technique - aeroplanes’, TCAR OPS Part SPA, Point SPA.LVO.100 ‘Low visibility operations’ and related AMCs/GM; TCAR OPS Part SPA, Point SPA.LVO.110 ‘General operating requirements’	X	X	X	X	X								
(05)		Explain what the operator’s responsibilities are regarding departure and approach procedures. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.125 ‘Instrument departure and approach procedures’	X	X	X	X	X								
(06)		Explain which parameters should be considered in noise- abatement procedures. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.130 ‘Noise abatement procedures — aeroplanes’; AMC1 CAT.OP.MPA.130; GM1 CAT.OP.MPA.130	X	X											

(07)		Explain which elements should be considered regarding routes and areas of operation. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.135 'Routes and areas of operation — general'; TCAR OPS Part CAT, Point CAT.OP.MPA.136 'Routes and areas of operation — single-engined aeroplanes'	X	X	X	X	X								
(08)		Explain the requirements for flights in reduced vertical separation minima (RVSM) airspace. Source: TCAR OPS Part SPA, Point SPA.RVSM.100 'RVSM operations'; TCAR OPS Part SPA, Point SPA.RVSM.105 'RVSM operational approval'; TCAR OPS Part SPA, Point SPA.RVSM.110 'RVSM equipment requirements' and AMC1 SPA.RVSM.110(a); TCAR OPS Part SPA, Point SPA.RVSM.115 'RVSM height-keeping errors'	X	X											
(09)		List the factors to be considered when establishing minimum flight altitude. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.145 'Establishment of minimum flight altitudes' and related AMCs/GM; AMC1 CAT.OP.MPA.145(a); AMC1.1 CAT.OP.MPA.145(a)	X	X	X	X	X								

(10)		Explain the requirements for carrying persons with reduced mobility. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.155 'Carriage of special categories of passengers (SCPs)'	X	X	X	X	X								
(11)		Explain the operator's responsibilities for the carriage of inadmissible passengers, deportees or persons in custody. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.155 'Carriage of special categories of passengers (SCPs)'	X	X	X	X	X								
(12)		Explain the requirements regarding passenger seating and emergency evacuation. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.165 'Passenger seating' and related AMCs/GM	X	X	X	X	X								
(13)		Detail the procedures for passenger briefing in respect of emergency equipment and exits. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.170 'Passenger briefing'; AMC1 CAT.OP.MPA.170; AMC2 CAT.OP.MPA.170	X	X	X	X	X								

(14)		State the flight preparation forms to be completed before flight. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.175 'Flight preparation' and related AMCs/GM; AMC1 CAT.OP.MPA.175(a)	X	X	X	X	X								
(15)		State the commander's responsibilities during flight preparation. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.175 'Flight preparation'	X	X	X	X	X								
(16)		State the rules for aerodrome/heliport selection. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'; TCAR OPS Part CAT, Point CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'	X	X	X	X	X								
(17)		Explain the planning minima for instrument flight rule (IFR) flights. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'	X		X										

(18)		Explain the rules for refuelling/defueling with passengers on board. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.195 ‘Refuelling/defuelling with passengers embarking, on board or disembarking’ and related AMCs; AMC1 CAT.OP.MPA.195; TCAR OPS Part CAT, Point CAT.OP.MPA.200 ‘Refuelling/ defuelling with wide-cut fuel’ and related AMCs; GM1 CAT.OP.MPA.200	X	X	X	X	X								
(19)		Explain the ‘crew members at station’ policy. Source: TCAR OPS Part CAT, CAT.OP.MPA.210 ‘Crew members at stations’ and related AMCs; AMC1 CAT.OP.MPA.210(b); GM1 CAT.OP.MPA.210	X	X	X	X	X								
(20)		Explain the use of seats, safety belts and harnesses. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.225 ‘Seats, safety belts and restraint systems’	X	X	X	X	X								
(21)		Explain the requirements for securing passenger cabin and galley. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.230 ‘Securing of passenger compartment and galley(s)’	X	X	X	X	X								

(22)		Explain the commander's responsibility regarding smoking on board. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.240 'Smoking on board'	X	X	X	X	X								
(23)		State under which conditions a commander can commence or continue a flight regarding meteorological conditions. Source: Point CAT.OP.MPA.245 'Meteorological conditions — all aircraft'; Point CAT.OP.MPA.246 'Meteorological conditions — aeroplanes'; Point CAT.OP.MPA.265 'Take-off conditions'	X	X	X	X	X								
(24)		Explain the commander's responsibility regarding ice and other contaminants. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.250 'Ice and other contaminants — ground procedures' and related AMCs/GM; TCAR OPS Part CAT, Point CAT.OP.MPA.255 'Ice and other contaminants — flight procedures' and related AMCs/GM; GM1 CAT.OP.MPA.250 (a) to (l); GM2 CAT.OP.MPA.250 (a) to (f); GM3 CAT.OP.MPA.250 (a)(1) to (3); AMC1 CAT.OP.MPA.255 (a)	X	X	X	X	X								

(25)		Explain the commander's responsibility regarding fuel to be carried and in-flight fuel management. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.260 'Fuel and oil supply'; TCAR OPS Part CAT, Point CAT.OP.MPA.280 'In-flight fuel management — aeroplanes'; TCAR OPS Part CAT, Point CAT.OP.MPA.281 'In-flight fuel management — helicopters' and AMC1 CAT.OP.MPA.281	X	X	X	X	X								
(26)		Detail the rules regarding carriage and use of supplemental oxygen for passengers and aircrew. Source: TCAR OPS Part CAT Point CAT.OP.MPA.285 'Use of supplemental oxygen'; Point CAT.IDE.A.235 'Supplemental oxygen — pressurized aeroplanes and related AMCs/GM	X	X	X	X	X								
		Flight preparation													
(27)		Explain the commander's responsibility regarding approach and landing. Source: TCAR OPS Part CAT Point CAT.OP.MPA.300 'Approach and landing conditions' and AMC1 CAT.OP.MPA.300; TCAR OPS Part CAT Point CAT.OP.MPA.305 'Commencement and continuation of approach' and related AMCs/GM	X	X	X	X	X								

(28)		Explain the circumstances under which a report shall be submitted. TCAR OPS Part CAT Point ORO.GEN.160 'Occurrence reporting' and related AMCs/GM	X	X	X	X	X								
071 01 02 05		All-weather operations													
(01)		Explain the operator's responsibility regarding aerodrome/heliport operating minima. Source: TCAR OPS Part CAT Point CAT.OP.MPA.110 'Aerodrome operating minima' and related AMCs/GM; TCAR OPS Part CAT, Point CAT.OP.MPA.115 'Approach flight technique — aeroplanes' and related AMCs/GM	X		X										
(02)		Define the following terms: 'circling', 'low-visibility procedures', 'low-visibility take-off', 'visual approach'. Source: TCAR OPS Part DEF	X		X										
(03)		Define the following terms: 'flight control system', 'fail-passive flight control system', 'fail-operational flight control system', 'fail-operational hybrid landing system'. Source: TCAR OPS Part DEF	X												
(04)		Define the following terms: 'final approach and take-off area'. Source: TCAR OPS Part DEF			X										

(05)		Explain the general operating requirements for low-visibility operations. Source: TCAR OPS Part SPA, Point SPA.LVO.100 ‘Low visibility operations’ and related AMCs; TCAR OPS Part SPA, Point SPA.LVO.105 ‘LVO approval’; TCAR OPS Part SPA, Point SPA.LVO.110 ‘General operating requirements’; TCAR OPS Part SPA, Point SPA.LVO.115 ‘Aerodrome related requirements’	X		X										
(06)		Define aerodrome/heliport considerations regarding low- visibility operations. Source: TCAR OPS Part SPO, Point SPA.LVO.115 ‘Aerodrome related requirements’	X		X										
(07)		Explain the training and qualification requirements for flight crew to conduct low-visibility operations. Source: TCAR OPS Part SPA, Point SPA.LVO.120 ‘Flight crew training and qualifications’ and related AMCs	X		X										
(08)		Explain the operating procedures for low-visibility operations. Source: TCAR OPS Part SPA, Point SPA.LVO.125 ‘Operating procedures and AMC1 SPA.LVO.125	X		X										
(09)		Explain the operator’s and commander’s responsibilities regarding minimum equipment for low-visibility operations.	X		X										

		Source: TCAR OPS Part SPA, Point SPA.LVO.130 'Minimum equipment'													
(10)		Explain the VFR operating minima. Source: TCAR OPS Part CAT, AMC12 CAT.OP.MPA.110 'Aerodrome operating minima — VFR OPERATIONS WITH OTHER-THAN-COMPLEX MOTOR-POWERED AIRCRAFT'	X		X										
(11)		Aerodrome operating minima: explain under which conditions the commander can commence take-off. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.110 'Aerodrome operating minima' and related AMCs/GM; TCAR OPS Part SPA, Point SPA.LVO.110 'General operating requirements' and related AMCs/GM	X		X										
(12)		Aerodrome operating minima: explain that take-off minima are expressed as visibility or runway visual range (RVR). Source: TCAR OPS Part CAT, Point CAT.OP.MPA.110 'Aerodrome operating minima'; AMC1 CAT.OP.MPA.110; AMC2 CAT.OP.MPA.110	X		X										

(13)		Aerodrome operating minima: explain the take-off RVR value depending on the aerodrome facilities. Source: TCAR OPS Part CAT, AMC1 CAT.OP.MPA.110 'Aerodrome operating minima', Table 1.A; TCAR OPS Part CAT, AMC2 CAT.OP.MPA.110 'Aerodrome operating minima', Table 1.H	X		X										
(14)		Aerodrome operating minima: explain the system minima for non-precision approach (NPA) (minimum descent altitude/height (MDA/H) and decision altitude/height (DA/H), not RVR). Source: TCAR OPS Part CAT, AMC3 CAT.OP.MPA.110 'Aerodrome operating minima' (Table 3: ILS/MLS/GLS; SRA 1NM; VOR; NDB); TCAR OPS Part CAT, AMC6 CAT.OP.MPA.110 'Aerodrome operating minima'	X		X										
(15)		Aerodrome operating minima: explain under which conditions a pilot can continue the approach below MDA/H or DA/H. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.305 'Commencement and continuation of approach'; TCAR OPS Part CAT, AMC1 CAT.OP.MPA.305(e)	X		X										

(16)		Aerodrome operating minima: explain the lowest minima for precision approach category 1 (including single-pilot operations). Source: TCAR OPS Part SPA, AMC3 SPA.LVO.100 'Low visibility operations'	X		X										
(17)		Aerodrome operating minima: explain the lowest minima for precision approach category 2 operations. Source: TCAR OPS Part SPA, AMC4 SPA.LVO.100 'Low visibility operations'	X		X										
(18)		Aerodrome operating minima: explain the lowest minima for precision approach category 3 operations. Source: TCAR OPS Part SPA, AMC5 SPA.LVO.100 'Low visibility operations'	X												
(19)		Aerodrome operating minima: explain the lowest minima for circling and visual approach. Source: TCAR OPS Part CAT, AMC7 CAT.OP.MPA.110 'Aerodrome operating minima'; AMC9 CAT.OP.MPA.110; TCAR OPS AMC8 CAT.OP.MPA.110	X		X										

(20)		Aerodrome operating minima: explain the RVR value and cloud ceiling depending on the aerodrome. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.110 ‘Aerodrome operating minima’ and related AMCs/GM; TCAR OPS Part SPA, Point SPA.LVO.110 ‘General operating requirements’ and related AMCs			X										

(21)		Aerodrome operating minima: explain under which conditions an airborne radar approach can be performed and state the relevant minima. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.120 ‘Airborne radar approaches (ARAs) for overwater operations — helicopters’; TCAR OPS Part SPA, AMC1 SPA.HOFO.120 ‘Selection of aerodromes and operating sites — COASTAL AERODROME’; TCAR OPS Part SPA, AMC2 SPA.HOFO.120 ‘Selection of aerodromes and operating sites — OFFSHORE DESTINATION ALTERNATE AERODROME’; TCAR OPS Part SPA, AMC1 SPA.HOFO.125 ‘Airborne radar approach (ARA) to offshore locations — GENERAL’; TCAR OPS Part SPA, GM1 SPA.HOFO.125 ‘Airborne radar approach (ARA) to offshore locations — GENERAL’; TCAR OPS Part SPA, GM2 SPA.HOFO.125 ‘Airborne radar approach (ARA) to offshore locations — GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)/AREA NAVIGATION SYSTEM’			X										
071 01 02 06		Instruments and equipment													

(01)		Explain which items do not require an equipment approval. Source: TCAR OPS Part CAT, Point CAT.IDE.A.100 ‘Instruments and equipment — general’ and related GM, and TCAR OPS Part CAT, Point CAT.IDE.H.100 ‘Instruments and equipment — general’; TCAR OPS Part CAT, Points CAT.IDE.A.105/CAT.IDE.H.105 ‘Minimum equipment for flight’	X	X	X	X	X								
(02)		Explain the requirements regarding availability of spare electrical fuses. Source: TCAR OPS Part CAT, Point CAT.IDE.A.110 ‘Spare electrical fuses’ and related GM	X	X	X	X	X								
(03)		Explain the requirements regarding windshield wipers. Source: TCAR OPS Part CAT, Point CAT.IDE.A.120 ‘Equipment to clear windshield’ and related AMCs	X	X											
(04)		List the minimum equipment required for day and night VFR flights. Source: TCAR OPS Part CAT, Point CAT.IDE.A.125 ‘Operations under VFR by day’ and related AMCs/GM	X	X	X	X	X								

(05)		List the minimum equipment required for IFR flights. Source: TCAR OPS Part CAT, Point CAT.IDE.A.130 ‘Operations under IFR or at night — flight and navigational instruments and associated equipment’ and related AMCs/GM; TCAR OPS Part CAT, Point CAT.IDE.H.130 ‘Operations under IFR or at night — flight and navigational instruments and associated equipment’ and related AMCs/GM	X		X										
(06)		Explain the required additional equipment for single-pilot operations under IFR. Source: TCAR OPS Part CAT, Points CAT.IDE.A.135/CAT.IDE.H.135 ‘Additional equipment for single-pilot operation under IFR’	X		X										
(07)		State the requirements for an altitude alerting system. Source: TCAR OPS Part CAT, Point CAT.IDE.A.140 ‘Altitude alerting system’	X	X											
(08)		State the requirements for radio altimeters. Source: TCAR OPS Part CAT, Point CAT.IDE.H.145 ‘Radio altimeters’			X	X	X								
(09)		State the requirements for ground proximity warning system (GPWS)/terrain awareness and warning system (TAWS). Source: TCAR OPS Part CAT, Point CAT.IDE.A.150 ‘Terrain awareness warning system (TAWS)’	X	X											

(10)		State the requirements for airborne collision avoidance system (ACAS). Source: TCAR OPS Part CAT, Point CAT.IDE.A.155 'Airborne collision avoidance system (ACAS)'	X	X											
(11)		State the conditions under which an aircraft must be fitted with a weather radar. Source: TCAR OPS Part CAT, Points CAT.IDE.A.160/CAT.IDE.H.160 'Airborne weather detecting equipment'	X	X	X	X	X								
(12)		State the circumstances under which a cockpit voice recorder (CVR) is compulsory (after 1998). Source: TCAR OPS Part CAT, Points CAT.IDE.A.185/CAT.IDE.H.185 'Cockpit voice recorder'	X	X	X	X	X								
(13)		State the rules regarding the location, construction, installation, and operation of cockpit voice recorders (CVRs) (after 1998). Source: TCAR OPS Part CAT, Points CAT.IDE.A.185/CAT.IDE.H.185 'Cockpit voice recorder'	X	X	X	X	X								
(14)		State the circumstances under which a flight data recorder (FDR) is compulsory (after 1998). Source: TCAR OPS Part CAT, Points CAT.IDE.A.190/CAT.IDE.A.190 'Flight data recorder' and related AMCs/GM	X	X	X	X	X								

(15)		State the rules regarding the location, construction, installation, and operation of flight data recorders (FDRs) (after 1998). Source: TCAR OPS Part CAT, Points CAT.IDE.A.190/CAT.IDE.A.190 'Flight data recorder' and related AMCs/GM	X	X	X	X	X								
(16)		Explain the requirements about seats, seat safety belts, harnesses, and child-restraint devices. Source: TCAR OPS Part CAT, Points CAT.IDE.A.205/CAT.IDE.H.205 'Seats, seat safety belts, restraint systems and child restraint devices' and related AMCs/GM	X	X	X	X	X								
(17)		Explain the requirements about 'Fasten seat belt' and 'No smoking' signs. Source: TCAR OPS Part CAT, Points CAT.IDE.A.210/CAT.IDE.H.210 'Fasten seat belt and no smoking signs'	X	X	X	X	X								
(18)		Explain the requirements regarding internal doors and curtains. Source: TCAR OPS Part CAT, Point CAT.IDE.A.215 'Internal doors and curtains'	X	X											
		First-aid and emergency equipment													

(19)		Explain the requirements regarding first-aid kits. Source: TCAR OPS Part CAT, Points CAT.IDE.A.220/CAT.IDE.H.220 ‘First-aid kit’ and related AMCs/GM	X	X	X	X	X								
(20)		Explain the requirements regarding emergency medical kits and first-aid oxygen. Source: TCAR OPS Part CAT, Point CAT.IDE.A.225 ‘Emergency medical kit’; AMC1 CAT.IDE.A.225; AMC2 CAT.IDE.A.225; AMC3 CAT.IDE.A.225; AMC4 CAT.IDE.A.225; GM1 CAT.IDE.A.225; TCAR OPS Part CAT, Point CAT.IDE.A.230 ‘First-aid oxygen’	X	X											
(21)		Detail the rules regarding crew protective breathing equipment. Source: TCAR OPS Part CAT, Point CAT.IDE.A.245 ‘Crew protective breathing equipment’; AMC1 CAT.IDE.A.245	X	X											
(22)		Describe the type and location of handheld fire extinguishers. Source: TCAR OPS Part CAT, Points CAT.IDE.A.250/CAT.IDE.H.250 ‘Hand fire extinguishers’ and related AMCs/GM	X	X	X	X	X								

(23)		Describe the location of crash axes and crowbars. Source: TCAR OPS Part CAT, Point CAT.IDE.A.255 'Crash axe and crowbar'; AMC1 CAT.IDE.A.255	X	X											
(24)		Specify the colours and markings used to indicate break-in points. Source: TCAR OPS Part CAT, Points CAT.IDE.A.260/CAT.IDE.H.260 'Marking of break-in points' and related AMCs/GM	X	X	X	X	X								
(25)		Explain the requirements for means of emergency evacuation. Source: TCAR OPS Part CAT, Point CAT.IDE.A.265 'Means for emergency evacuation'	X	X											
(26)		Explain the requirements for megaphones. Source: TCAR OPS Part CAT, Points CAT.IDE.A.270/CAT.IDE.H.270 'Megaphones' and related AMCs/GM	X	X	X	X	X								
(27)		Explain the requirements for emergency lighting and marking. Source: TCAR OPS Part CAT, Points CAT.IDE.A.275/CAT.IDE.H.275 'Emergency lighting and marking	X	X	X	X	X								
(28)		Explain the requirements for an emergency locator transmitter (ELT). Source: TCAR OPS Part CAT, Points	X	X	X	X	X								

		CAT.IDE.A.280/CAT.IDE.H.280 ‘Emergency locator transmitter (ELT)’ and related AMCs/GM													
(29)		Explain the requirements for life jackets, life rafts, survival kits, and ELTs. Source: TCAR OPS Part CAT, Points CAT.IDE.A.285 Flight over water’; CAT.IDE.A.305 ‘Survival equipment’; CAT.IDE.H.280 ‘Emergency locator transmitter (ELT)’; CAT.IDE.H.290 ‘Life-jackets’; CAT.IDE.H.295 ‘Crew survival suits’; CAT.IDE.H.300 ‘Life-rafts, survival ELTs and survival equipment on extended overwater flights’	X	X	X	X	X								
(30)		Explain the requirements for crew survival suit. Source: TCAR OPS Part CAT, Point CAT.IDE.H.295 ‘Crew survival suits’; GM1 CAT.IDE.H.295			X	X	X								
(31)		Explain the requirements for survival equipment. Source: TCAR OPS Part CAT, Points CAT.IDE.A.305/CAT.IDE.H.305 ‘Survival equipment’	X	X	X	X	X								
(32)		Explain the additional requirements for helicopters operating to or from helidecks located in hostile sea areas. Source: TCAR OPS Part CAT, Point CAT.IDE.H.310 ‘Additional requirements for			X	X	X								

		helicopters conducting offshore operations in a hostile sea area’													
(33)		Explain the requirements for emergency flotation equipment. Source: TCAR OPS Part CAT, Points CAT.IDE.H.315 ‘Helicopters certified for operating on water — miscellaneous equipment’; CAT.IDE.H.320 ‘All helicopters on flights over water — ditching’			X	X	X								
071 01 02 07		Communication and navigation equipment													
(01)		Explain the general requirements for communication and navigation equipment. Source: TCAR OPS Part CAT, Point CAT.IDE.A.325 ‘Headset’ and related AMCs/GM	X	X	X	X	X								
(02)		Explain why the radio-communication equipment must be able to send and receive on 121.5 MHz. Source: TCAR OPS Part CAT, Points CAT.IDE.A.330/CAT.IDE.H.330 ‘Radio communication equipment’	X	X	X	X	X								

(03)		Explain the requirements regarding the provision of an audio selector panel. Source: TCAR OPS Part CAT, Points CAT.IDE.A.335/CAT.IDE.H.335 'Audio selector panel'	X	X	X	X	X								
(04)		List the requirements for radio equipment when flying under VFR by reference to visual landmarks. Source: TCAR OPS Part CAT, Points CAT.IDE.A.340/CAT.IDE.H.340 'Radio equipment for operations under VFR over routes navigated by reference to visual landmarks'	X	X	X	X	X								
(05)		List the requirements for communication and navigation equipment when operating under IFR or under VFR over routes not navigated by reference to visual landmarks. Source: TCAR OPS Part CAT, Points CAT.IDE.A.345/CAT.IDE.H.345 'Communication and navigation equipment for operations under IFR or under VFR over routes not navigated by reference to visual landmarks'	X	X	X	X	X								
(06)		Explain what equipment is required to operate in airspace with reduced vertical separation minima (RVSM). Source: TCAR OPS Part SPA, Point SPA.RVSM.110 'RVSM equipment requirements'	X	X											

(07)		Explain the conditions under which a crew member interphone system and public address system are mandatory. Source: TCAR OPS Part CAT, Points CAT.IDE.A.170/CAT.IDE.H.170 'Flight crew interphone system'; AMC1 CAT.IDE.A.170/CAT.IDE.H.170; TCAR OPS Part CAT, Points CAT.IDE.A.175/CAT.IDE.H.175 'Crew member interphone system'; AMC1 CAT.IDE.A.175/CAT.IDE.H.175; TCAR OPS Part CAT, Points CAT.IDE.A.180/CAT.IDE.H.180 'Public address system'; AMC1 CAT.IDE.A.180/CAT.IDE.H.180	X	X	X	X	X								
(08)		List the equipment for operations requiring a radio communication. Source: TCAR OPS Part CAT, Points CAT.IDE.H.325 'Headset'; CAT.IDE.H.330 'Radio communication equipment'; CAT.IDE.H.335 'Audio selector panel'; CAT.IDE.H.340 'Radio equipment for operations under VFR over routes navigated by reference to visual landmarks'			X	X	X								

(09)		List the equipment for operations that require a radio navigation system. Source: TCAR OPS Part CAT, Point CAT.IDE.H.325 'Headset'; AMC1 CAT.IDE.H.325; TCAR OPS Part CAT, Point CAT.IDE.H.345 'Communication and navigation equipment for operations under IFR or under VFR over routes not navigated by reference to visual landmarks'			X	X	X								
(10)		Explain the requirements regarding the provision of a transponder. Source: TCAR OPS Part CAT, Points CAT.IDE.A.350/CAT.IDE.H.350 'Transponder'; AMC1 CAT.IDE.A.350/CAT.IDE.H.350	X	X	X	X	X								
(11)		Explain the requirements regarding the management of aeronautical databases. Source: TCAR OPS Part CAT, Point CAT.IDE.A.355 'Management of aeronautical databases'; AMC1 CAT.IDE.A.355 'Management of aeronautical databases — AERONAUTICAL DATABASES'	X	X											
071 01 02 08		Intentionally left blank													
071 01 02 09		Flight crew													

(01)		Explain the requirement regarding flight crew composition and in-flight relief. Source: TCAR OPS Part ORO, Points ORO.FC.100 'Composition of flight crew; AMC1 ORO.FC.100(c); ORO.FC.105 'Designation as pilot-in-command/commander'; AMC1 ORO.FC.105(b)(2);(c); GM1 ORO.FC.105 (b)(2); AMC1 ORO.FC.105(c); TCAR OPS Part ORO, Points ORO.FC.110 'Flight engineer'; ORO.FC.115 'Crew resource management (CRM) training'; ORO.FC.200 'Composition of flight crew'; AMC1 ORO.FC.200(a); TCAR OPS Part ORO, Points ORO.FC.A.201 'In-flight relief of flight crew members'; ORO.FC.202 Single-pilot operations under IFR or at night	X	X	X	X	X									
(02)		Explain the requirement for conversion training and checking. Source: TCAR OPS Part ORO, Points ORO.FC.120 'Operator conversion training'; Point ORO.FC.145 'Provision of training'; ORO.FC.220 'Operator conversion training and checking'; and related AMCs/GM	X	X	X	X	X									

(03)		Explain the requirement for differences training and familiarisation training. Source: TCAR OPS Part ORO, Point ORO.FC.125 'Differences training and familiarisation training'; AMC1 ORO.FC.125	X	X	X	X	X									
(04)		Explain the conditions for upgrade from co-pilot to commander. Source: TCAR OPS Part ORO, Point ORO.FC.205 'Command course'	X	X	X	X	X									
(05)		Explain the minimum qualification requirements to operate as a commander. Source: TCAR OPS Part ORO, Point ORO.FC.A.250 'Commanders holding a CPL(A)'	X	X	X	X	X									
(06)		Explain the requirement for recurrent training and checking. Source: TCAR OPS Part ORO, Point ORO.FC.230 'Recurrent training and checking'	X	X	X	X	X									
(07)		Explain the requirement for a pilot to operate on either pilot's seat. Source: TCAR OPS Part ORO, Point ORO.FC.235 'Pilot qualification to operate in either pilot's seat'; AMC1 ORO.FC.235(d); GM1 ORO.FC.235(f);(g)	X	X	X	X	X									

(08)		Explain the minimum recent experience requirements for the commander and the co-pilot. Source: TCAR PEL Part FCL, Point FCL.060 'Recent experience'; AMC1 FCL.060(b)(1); GM1 FCL.060(b)(1)	X	X	X	X	X								
(09)		Specify the route and aerodrome/heliport knowledge required for a PIC/commander. Source: TCAR OPS Part ORO, Point ORO.FC.105 'Designation as pilot-in-command/ commander'; AMC1 ORO.FC.105(b)(2);(c); GM1 ORO.FC.105(b)(2); AMC1 ORO.FC.105(c)	X	X	X	X	X								
(10)		Explain the requirement to operate on more than one aircraft type or variant. Source: TCAR OPS Part ORO, Points ORO.FC.140 'Operation on more than one type or variant'; ORO.FC.240 'Operation on more than one type or variant'; AMC1 ORO.FC.240(a)(1)	X	X	X	X	X								
(11)		Explain that when a flight crew member operates both helicopters and aeroplanes, the operations are limited to one of each type. Source: TCAR OPS Part ORO, Point ORO.FC.240 'Operation on more than one type or variant'	X	X	X	X	X								

(12)		Explain the requirement(s) for training records. Source: TCAR OPS Part ORO, Point ORO.MLR.115 'Record-keeping'	X	X	X	X	X								
(13)		Explain the crew members' responsibilities in the execution of their duties, and define the commander's authority. Source: TCAR OPS Part CAT, Points CAT.GEN.MPA.100 'Crew responsibilities; CAT.GEN.MPA.105 'Responsibilities of the commander; CAT.GEN.MPA.110 'Authority of the commander'	X	X	X	X	X								
(14)		Explain the operator's and commander's responsibilities regarding persons on board, admission to the flight crew compartment and carriage of unauthorised persons or cargo. Source: TCAR OPS Part CAT, Points CAT.GEN.MPA.135 'Admission to the flight crew compartment; CAT.GEN.MPA.165 'Method of carriage of persons; CAT.GEN.MPA.105 'Responsibilities of the commander'	X	X	X	X	X								
(15)		Explain the requirements for the initial operator's crew resource management (CRM) training. Source: TCAR OPS Part ORO, Point ORO.FC.215 'Initial operator's crew resource management (CRM) training'	X	X	X	X	X								
071 01 02 10		Cabin crew/crew members other than flight crew													

(01)		Explain who is regarded as cabin crew member. Source: TCAR OPS Regulation, Part DEF	X	X	X	X	X							
(02)		Detail the requirements regarding the number and composition of cabin crew. Source: TCAR OPS Part ORO, Point ORO.CC.100 'Number and composition of cabin crew; AMC1 ORO.CC.100; GM1 ORO.CC.100; TCAR OPS Part ORO, Point ORO.CC.205 'Reduction of the number of cabin crew during ground operations and in unforeseen circumstances'	X	X	X	X	X							
(03)		Explain the conditions and the additional conditions for assignment to duties. Source: TCAR OPS Part ORO, Points ORO.CC.110 'Conditions for assignment to duties; ORO.CC.210 'Additional conditions for assignment to duties; GM1 ORO.CC.210(d)	X	X	X	X	X							
(04)		Explain the requirements regarding senior cabin crew members. Source: TCAR OPS Part ORO, Point ORO.CC.200 'Senior cabin crew member; AMC1 ORO.CC.200(c);(d);(e)	X	X	X	X	X							

(05)		Explain the conditions for operating on more than one aircraft type or variant. Source: TCAR OPS Part ORO, Point ORO.CC.250 'Operation on more than one aircraft type or variant; AMC1 ORO.CC.250(b); GM1 ORO.CC.250	X	X	X	X	X								
(06)		Explain what is the operator's responsibility regarding the distinction between cabin crew members and additional crew members. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.115 'Personnel or crew members other than cabin crew in the passenger compartment'	X	X	X	X	X								
071 01 02 11		Intentionally left blank													
071 01 02 12		Flight and duty time limitations and rest requirements													
(01)		Explain the definitions used for the regulation of flight time limitations. Source: TCAR OPS Part ORO, Points ORO.FTL.100 'Scope'; ORO.FTL.105 'Definitions' (values of Table 1 excluded)	X	X											
(02)		Explain the flight and duty time limitations. Source: TCAR OPS Part ORO, Points ORO.FTL.200 'Home base'; ORO.FTL.210 'Flight times and duty periods'	X	X											

(03)		Explain the requirements regarding the maximum daily flight duty period. Source: TCAR OPS Part ORO Point, ORO.FTL.205 'Flight duty period (FDP)'; ORO.FTL.205(b) 'Basic maximum daily FDP' (use of the tables but not memorisation)	X	X											
(04)		Explain the requirements regarding rest periods. Source: TCAR OPS Part ORO Point ORO.FTL.235 'Rest periods'	X	X											
(05)		Explain the possible extension of flight duty period due to in- flight rest. Source: TCAR OPS Part ORO, Points ORO.FTL.205 'Flight duty period (FDP)'; ORO.FTL.205(e) 'Maximum daily FDP with the use of extensions due to in-flight rest'	X	X											
(06)		Explain that it is the captain's discretion to extend flight duty in case of unforeseen circumstances in actual flight operations. Source: TCAR OPS Part ORO, Points ORO.FTL.205 'Flight duty period (FDP)'; ORO.FTL.205(f) 'Unforeseen circumstances in flight operations — commander's discretion'	X	X											

(07)		Explain the requirement regarding standby. Source: TCAR OPS Part ORO, Point ORO.FTL.225 'Standby and duties at the airport'	X	X											
071 01 03 00		Long-range flights													
071 01 03 01		Flight management													
(01)		Minimum time routes: define and interpret minimum time route (route that gives the shortest flight time from departure to destination adhering to all ATC and airspace restrictions). Source: N/A	X													
(02)		State the circumstances in which a take-off alternate must be selected. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes; CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'	X		X											
(03)		State the maximum flight distance of a take-off alternate for: — two-engined aeroplanes; — ETOPS-approved aeroplanes; — three- or four-engined aeroplanes. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'; CAT.OP.MPA.181 'Selection of aerodromes and operating sites — helicopters'	X		X											

(04)		State the factors to be considered in the selection of a take-off alternate. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.185 ‘Planning minima for IFR flights — aeroplanes’ & CAT.OP.MPA.186 ‘Planning minima for IFR flights — helicopters’	X		X										
(05)		State when a destination alternate need not be selected. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.180 ‘Selection of aerodromes-aeroplanes’ & CAT.OP.MPA.181 ‘Selection of aerodromes and operating sites-helicopters’	X		X										
(06)		State when two destination alternates must be selected. Source: TCAR OPS Part CAT Points CAT.OP.MPA.180 ‘Selection of aerodromes-aeroplanes’ & CAT.OP.MPA.181 ‘Selection of aerodromes and operating sites-helicopters’	X		X										
(07)		State the factors to be considered in the selection of a destination alternate aerodrome. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.185 ‘Planning minima for IFR flights — aeroplanes’ & CAT.OP.MPA.186 ‘Planning minima for IFR flights — helicopters’	X		X										

(08)		State the factors to be considered in the selection of an en- route alternate aerodrome. Source: TCAR OPS Part CAT Point CAT.OP.MPA.185 'Planning minima for IFR flights — aeroplanes'	X		X										
071 01 03 02		Transoceanic and polar flights (ICAO Doc 7030 'Regional Supplementary Procedures — North Atlantic Operations and Airspace Manual')													
(01)		According to ICAO Doc 7030, explain that special rules apply to the North Atlantic (NAT) Region, and crews need to be specifically trained before flying in this area. Source: NAT 007, 1.3.8 Crew Training	X												
(02)		Describe the possible indications of navigation system degradation, including any system-generated warning. Source: NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure	X												
(03)		Describe by what emergency means course and inertial navigation system (INS) can be cross-checked in the case of three navigation systems and two navigation systems. Source: NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure	X												

(04)		Describe the general ICAO procedures applicable in NAT airspace if the aircraft is unable to continue the flight in accordance with its air traffic control (ATC) clearance. Source: NAT 007, 13.2 General procedures	X												
(05)		Describe the ICAO procedures applicable in NAT airspace in case of radio-communication failure. Source: NAT 007, 6.6 HF Communications failure	X												
(06)		Describe the recommended initial action if an aircraft is unable to obtain a revised ATC clearance. Source: NAT 007, Chapter 13 Special procedures for in-flight contingencies	X												
(07)		Describe the subsequent action for aircraft able to maintain assigned flight level and for aircraft unable to maintain assigned flight level. Source: NAT 007, Chapter 13 Special procedures for in-flight contingencies	X												
(08)		Describe determination of tracks and courses for random routes in NAT airspace. Source: ICAO Doc 7030, NAT 2.1.9.1 General; NAT 007, 2.1.3; NAT 007, Chapter 4 Flight Planning	X												

(09)		Specify the method by which planned tracks are defined (by latitude and longitude) in the NAT airspace: when operating predominately in an east—west direction south of 70°N, and when operating predominately in an east—west direction north of 70°N. Source: ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Route Segments in a Predominantly East - West Direction)	X												
(10)		State the maximum flight time recommended between significant points on random routes. Source: ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Route Segments in a Predominantly East - West Direction and Predominantly North - South Direction)	X												
(11)		Specify the method by which planned tracks for random routes are defined for flights operating predominantly in a north—south direction. Source: ICAO Doc 7030, NAT 2.1.9 Route; NAT 007, Chapter 4 (Flights Planning on Random Routes in a Predominantly North - South Direction)	X												

(12)		Describe how the desired random route must be specified in the ATC flight plan. Source: NAT 007, 4.2 Flight planning requirements on specific routes	X												
(13)		Describe what precautions can be taken when operating in the area of compass unreliability as a contingency against INS failure. Source: NAT 007, Chapter 12 Procedures in the event of navigation system degradation or failure (not including detailed information on route structures and their coordinates); NAT 007, Chapter 8 (Master document — position plotting)	X												
071 01 03 03		North Atlantic High Level Airspace (NAT HLA)													
		NAT Region North Atlantic Operations and Airspace Manual (NAT Doc 007 Version 2017-1 and NAT Doc 7030)													
(01)		State the lateral dimensions (in general terms) and vertical limits of the NAT HLA. Source: NAT 007, 17.1 GENERAL: 17.1.1 and 17.1.2	X												
(02)		Define the following acronyms: LRNS, MASPS, NAT HLA, OCA, OTS, PRM, RVSM, SLOP, and WATRS. Source: NAT 007, Glossary of Terms	X												

(03)		State the NAT HLA operations. Source: NAT 007, 1.1.2; 1.1.3; 1.1.5; 1.1.6; 1.1.7; 1.2.1; 1.2.2; 1.3.1; 1.3.2; 1.3.6; 1.3.7; 1.3.8	X												
(04)		Describe the routes for aircraft with only one long-range navigation system (LRNS). Source: NAT 007, 1.4.1	X												
(05)		Describe the routes for aircraft with short-range navigation equipment only. Source: NAT 007, 1.4.2; 1.4.3	X												
(06)		Explain why the horizontal (i.e. latitudinal and longitudinal) and vertical navigation performance of operators within NAT HLA is monitored on a continual basis. Source: NAT 007, 1.9.1	X												
(07)		Describe the organised track system (OTS). Source: NAT 007, 2.1 GENERAL; 2.2 Construction of the organised track system (OTS)	X												
(08)		State the OTS changeover periods. Source: NAT 007, 2.4 OTS Changeover periods	X												

(09)		Describe the NAT track message. Source: NAT 007, 2.3 The NAT track message	X												
(10)		Illustrate routes between northern Europe and the Spain/Canaries/Lisbon flight information region (FIR) (T9, T13 and T16) within NAT HLA. Source: NAT 007, 3.2 Other routes within the NAT HLA	X												
(11)		Describe the function of the North American Routes (NARs) and Shannon Oceanic Transition Area (SOTA) and Northern Oceanic Transition Area (NOTA). Source: NAT 007, 3.3 Route structures adjacent to the NAT HLA	X												
(12)		State that all flights should plan to operate on great-circle tracks joining successive significant waypoints. Source: NAT 007, 4.1.3	X												

(13)		State that during the hours of validity of the OTS, operators are encouraged to plan flights: — in accordance with the OTS; — or along a route to join or leave an outer track of the OTS; — or on a random route to remain clear of the OTS, — either laterally or vertically. Source: NAT 007, 4.1.4	X												
(14)		State which flight levels are available on OTS tracks during OTS periods. Source: NAT 007, 4.1.10; 4.1.11 and 4.1.12 (dates not required)	X												
(15)		State which flight levels are to be planned on random tracks or outside OTS periods. Source: NAT 007, 4.1.13	X												
(16)		Selection of cruising altitude. Specify the appropriate cruising levels for normal long-range IFR flights and for those operating on the North Atlantic OTS. Source: NAT 007, Chapter 4 Flight Planning - Flight Levels; Rules of the AIR in Thailand	X												

(17)		Oceanic ATC clearances State that it is recommended that pilots should request their oceanic clearance at least 40 minutes prior to the oceanic entry point estimated time of arrival (ETA). Source: NAT 007, 5.1.2	X												
(18)		State that pilots should notify the oceanic area control centre (OAC) of the maximum acceptable flight level possible at the boundary. Source: NAT 007, 5.1.3	X												
(19)		State that at some aerodromes which are situated close to oceanic boundaries, the oceanic clearance must be obtained before departure. Source: NAT 007, 5.1.5	X												
(20)		State that if an aircraft, which would normally be RVSM- or NAT HLA-approved, encounters, whilst en-route to the NAT Oceanic Airspace, a critical in-flight equipment failure, or at dispatch is unable to meet the MEL requirements for RVSM or NAT HLA approval of the flight, then the pilot must advise ATC at initial contact when requesting oceanic clearance. Source: NAT 007, 5.1.6	X												

(21)		State that after obtaining and reading back the clearance, the pilot should monitor the forward estimate for oceanic entry, and if this changes by 3 minutes or more, unless providing position reports via automatic dependent surveillance — contract (ADS-C), the pilot must pass a revised estimate on to ATC. Source: NAT 007, 5.1.7	X												
(22)		State that pilots should pay particular attention when the issued clearance differs from the flight plan as a significant proportion of navigation errors investigated in the NAT Region involve aircraft which have followed their flight plan rather than the differing clearance. Source: NAT 007, 5.1.8	X												
(23)		State that if the entry point of the oceanic route for which the flight is cleared differs from that originally requested or the oceanic flight level differs from the current flight level, the pilot is responsible for requesting and obtaining the necessary domestic reclearance. Source: NAT 007, 5.1.9	X												

(24)		State that there are three elements to an oceanic clearance: route, Mach number, and flight level, and that these elements serve to provide for the three basic elements of separation: lateral, longitudinal, and vertical. Source: NAT 007, 5.1.1	X												
(25)		Communications and position-reporting procedures State that pilots communicate with OACs via aeradio stations staffed by communicators who have no executive ATC authority. Source: NAT 007, 6.1.1	X												
(26)		State that messages are relayed from the ground station to the air traffic controllers of the relevant OAC for action. Source: NAT 007, 6.1.1	X												
(27)		State that frequencies from the lower HF bands tend to be used for communications during night-time and those from the higher bands during daytime. Generally, in NAT, frequencies of less than 7 MHz are utilised at night and frequencies greater than 8 MHz are utilised during the day. When initiating contact with an aeradio station, the pilot should state the HF frequency in use. Source: NAT 007, 6.1.4 and 6.1.7	X												

(28)		State that since oceanic traffic typically communicates with ATC through aeradio facilities, a satellite communication (SATCOM) call, made due to unforeseen inability to communicate by other means, should be made to such a facility rather than the ATC centre, unless the urgency of the communication dictates otherwise. Source: NAT 007, 6.1.17	X												
(29)		State that an air-to-air VHF frequency has been established for worldwide use when aircraft are out of range of VHF ground stations which utilise the same or adjacent frequencies. This frequency, 123.45 MHz, is intended for pilot-to-pilot exchanges of operationally significant information. Source: NAT 007, 6.2.2	X												
(30)		State that any pilot, who provides position reports via data link and encounters significant meteorological phenomena (such as moderate/severe turbulence or icing, volcanic ash or thunderstorms), should report this information. Source: NAT 007, 6.5.2	X												

(31)		State that all turbine-engined aeroplanes having a maximum certified take-off mass exceeding 5 700 kg or authorised to carry more than 19 passengers are required to carry and operate airborne collision avoidance system (ACAS) II in the NAT Region. Source: NAT 007, 6.9.1	X												
(32)		State that even with the growing use of data-link communications, a significant volume of NAT air—ground communications are conducted using voice on single sideband (SSB) HF frequencies. To support air—ground ATC communications in the North Atlantic Region, 24 HF frequencies have been allocated, in bands ranging from 2.8 to 18 MHz. Source: NAT 007, 6.1.3	X												
(33)		Application of the Mach number technique (NAT HLA) State that practical experience has shown that when two or more turbojet aircraft, operating along the same route at the same flight level, maintain the same Mach number, they are more likely to maintain a constant time interval between each other than when using other methods. Source: NAT 007, 7.2.1	X												

(34)		State that after leaving oceanic airspace, pilots must maintain their assigned Mach number in domestic controlled airspace unless and until the appropriate ATC unit authorises a change. Source: NAT 007, 7.4.1 North Atlantic High Level Airspace (NAT HLA) flight operation and navigation procedures	X												
(35)		NAT HLA flight operation and navigation procedures State that the pre-flight procedures for any NAT HLA flight must include a Universal Time Coordinated (UTC) time check. Source: NAT 007, 8.2.2	X												
(36)		Describe the function and use of the master document. Source: NAT 007, 8.2.5 to 8.2.9	X												
(37)		State the requirements for position plotting. Source: NAT 007, 8.2.10 to 8.2.13	X												

(38)		Describe the pre-flight procedures for: — the alignment of IRS; — the satellite navigation availability prediction programme for flights using global navigation satellite long-range navigation system (GNSS LRNS); — loading of initial waypoints; and — flight plan check. Source: NAT 007, 8.3.2 to 8.3.5; 8.3.6 to 8.3.8; 8.3.13 to 8.3.17	X													
(39)		Describe the strategic lateral offset procedure (SLOP) and state that along a route or track there will be three positions that an aircraft may fly: centre line, or 1 or 2 miles right. Source: NAT 007, 8.5.1 to 8.5.5	X													
(40)		State that RNAV 10 retains the RNP 10 designation, as specified in the Performance-based Navigation Manual (ICAO Doc 9613), 1.2.3.5. (ICAO Doc 7030, NAT Chapter 4). Source: NAT 007, 1.3.4	X													
(41)		State that both aircraft and operators must be RNP 10- or RNP 4-approved by the State of the Operator or the State of Registry, as appropriate. Source: NAT 007, 1.3.4	X													

(42)		State that RNP 10 is the minimum navigation specification for the application of 93 km (50 NM) lateral separation. Source: NAT 007, 1.3.4 and 4.1.18	X												
(43)		Reduced vertical separation minima (RVSM) flight in NAT HLA State the altimeter cross-check to be performed before entering NAT HLA. Source: NAT 007, 9.1.10	X												
(44)		State the altimeter cross-check to be performed when entering and flying in NAT HLA. Source: NAT 007, 9.1.12	X												
(45)		State that pilots not using controller—pilot data-link communications (CPDLC)/ADS-C always report to ATC immediately on leaving the current cruising level and on reaching any new cruising level. Source: NAT 007, 9.1.15	X												
(46)		State that flight crew should report when a 300-ft deviation or more occurs. Source: NAT 007, 11.3.4 and 11.3.6	X												
(47)		Navigation planning procedures List the factors to be considered by the commander before commencing the flight. Source: NAT 007, 8.3 Pre-flight procedures Navigation system degradation (NAT Doc 007, Chapter 12)	X												

(48)		For this part, consider aircraft equipped with only two operational LRNSs and state the requirements for the following situations: — one system fails before take-off; — one system fails before the OCA boundary is reached; — one system fails after the OCA boundary is crossed; and — the remaining system fails after entering NAT HLA. Source: NAT 007, 12.2 Special procedures for in-flight contingencies (NAT Doc 007, Chapter 13)	X												
(49)		State the general procedures and also state that the general concept of these NAT in-flight contingency procedures is, whenever operationally feasible, to offset the assigned route by 15 NM and climb or descend to a level which differs from those normally used by 500 ft if below FL 410 or by 1 000 ft if above FL 410. Source: NAT 007, 13.1 and 13.2	X												

(50)		State all the factors which may affect the direction of turn including: — direction to an alternate aerodrome; — terrain clearance; — levels allocated on adjacent routes or tracks and any known SLOP offsets adopted by other nearby traffic. Source: NAT 007, 13.3.2	X												
(51)		State that if the deviation around severe weather is to be greater than 10 NM, the assigned flight level must be changed by ± 300 ft depending on the followed track and the direction of the deviation. Source: NAT 007, 13.4	X												
071 01 03 04		Extended-range operations with two-engined aeroplanes (ETOPS)													
(01)		State that ETOPS approval is part of an AOC. Source: TCAR OPS Part SPA, Point SPA.ETOPS.100 'ETOPS' & SPA.ETOPS.105 'ETOPS operational approval'	X												

(02)		State that prior to conducting an ETOPS flight, an operator shall ensure that a suitable ETOPS en-route alternate is available, within either the approved diversion time or a diversion time based on the MEL-generated serviceability status of the aeroplane, whichever is shorter. Source: TCAR OPS Part SPA, Point SPA.ETOPS.110 'ETOPS en-route alternate aerodrome'	X												
(03)		State the requirements for take-off alternate. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.180 'Selection of aerodromes-aeroplanes'	X												
(04)		State the planning minima for ETOPS en-route alternate. Source: TCAR OPS Part SPA, Point SPA.ETOPS.115 'ETOPS en-route alternate aerodrome planning minima'	X												
(05)		Navigation-planning procedures. Describe the operator's responsibilities concerning ETOPS routes. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.135 'Routes and areas of operation — general' & CAT.OP.MPA.145 'Establishment of minimum flight altitudes' & CAT.OP.MPA.150 'Fuel policy'	X												

(06)		Selection of a route. Describe the limitations on extended-range operations with two-engined aeroplanes with and without ETOPS approval.	X												
(07)		Selection of alternate aerodrome. State the maximum flight distance of a take-off alternate for: — two-engined aeroplanes; — ETOPS-approved aeroplanes; — three- or four-engined aeroplanes. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.180 'Selection of aerodromes — aeroplanes'	X												
(08)		State the maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS approval. Source: TCAR OPS Part CAT, Point CAT.OP.MPA.140 'Maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS approval'	X												
(09)		State the requirement for alternate aerodrome accessibility check for ETOPS operations.	X												
071 02 00 00		SPECIAL OPERATIONAL PROCEDURES AND HAZARDS — GENERAL ASPECTS													

071 02 01 00		Operations manual (TCAR OPS Part ORO, Points ORO.MLR.100, ORO.MLR.101 and related AMCs/GM)													
071 02 01 01		Operating procedures													
(01)		Explain the general rules for the operations manual. Source: TCAR OPS Part ORO, Point ORO.MLR.100 'Operations manual — general'; AMC1 ORO.MLR.100	X	X	X	X	X								
(02)		Explain the structure and subject headings of the operations manual. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'; GM1 ORO.MLR.100(k) 'Operations manual — general'	X	X	X	X	X								
(03)		Explain the requirements for a journey log or equivalent. Source: TCAR OPS Part ORO, Point ORO.MLR.110 'Journey log'; AMC1 ORO.MLR.110	X	X	X	X	X								
(04)		Describe the requirements regarding the operational flight plan. Source: TCAR OPS Part ORO, Point ORO.MLR.115 'Record-keeping'	X	X	X	X	X								

(05)		Explain the requirements for document-storage periods. Source: TCAR OPS Part ORO, Point ORO.MLR.115 'Record-keeping'; AMC1 ORO.MLR.115; GM1 ORO.MLR.115(c);(d)	X	X	X	X	X								
(06)		Explain that all non-type-related operational policies, instructions and procedures required for a safe operation are included in Part A of the operations manual. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport; AMC3 ORO.MLR.100 'Operations manual — general' (main topics in Part A, e.g. General/Basic, etc.)	X	X	X	X	X								

(07)		State that the following items are included into Part A: — de-icing and anti-icing on the ground; — adverse and potentially hazardous atmospheric conditions; — wake turbulence; — incapacitation of crew members; — use of the minimum equipment list (MEL) and configuration deviation list(s) (CDL); — security; — handling of accidents and occurrences. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'; AMC3 ORO.MLR.100 'Operations manual — general'	X	X	X	X	X								
(08)		State that the following items are included into Part A: — altitude alerting system procedures; — ground proximity warning system procedures; — policy and procedures for the use of traffic alert and collision avoidance system (TCAS)/airborne collision avoidance system (ACAS). Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport';	X	X											

		AMC3 ORO.MLR.100 'Operations manual — general'													
(09)		State that rotor downwash is included into Part A. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'; AMC3 ORO.MLR.100 'Operations manual — general'			X	X	X								
071 02 01 02		Aeroplane/helicopter operating matters — type-related													
(01)		State that all type-related instructions and procedures required for a safe operation are included in Part B of the operations manual. They take account of any differences between types, variants or individual aircraft used by an operator. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'	X	X	X	X	X								

(02)		State that the following items are included into Part B: — abnormal and emergency procedures; — configuration deviation list (CDL); — minimum equipment list (MEL); — emergency evacuation procedures. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'; AMC3 ORO.MLR.100 'Operations manual — general'	X	X										
(03)		State that the following items are included into Part B: — emergency procedures; — configuration deviation list (CDL); — minimum equipment list (MEL); — emergency evacuation procedures. Source: TCAR OPS Part ORO, Point ORO.MLR.101 'Operations manual — structure for commercial air transport'; AMC3 ORO.MLR.100 'Operations manual — general'			X	X	X							
071 02 01 03		Minimum equipment list (MEL) and master minimum equipment list (MMEL)												

(01)		Describe the following terms: 'commencement of flight', 'inoperative', 'MEL', 'MMEL', 'rectification interval'. Source: GM1 ORO.MLR.105(a) 'Minimum equipment list'; CS-MMEL; GM2 ORO.MLR.105(d)(3)	X	X	X	X	X								
(02)		Explain the relation between MMEL and MEL. Source: TCAR OPS Part ORO, Point ORO.MLR.100 'Operations manual — general'; Point ORO.MLR.105 'Minimum equipment list'; AMC1 ORO.MLR.105(j);(g) GM1 ORO.MLR.105(j)	X	X	X	X	X								
(03)		Define the 'extent of the MEL'. Source: AMC2 ORO.MLR.105(d)(3) 'Minimum equipment list'	X	X	X	X	X								
(04)		Explain the responsibilities of the operator and the CAAT with regard to MEL and MMEL. Source: TCAR OPS Part ORO, Point ORO.MLR.100 'Operations manual — general'; Point ORO.MLR.105 'Minimum equipment list'; AMC1 ORO.MLR.105(c); GM1 ORO.MLR.105(d)(3)	X	X	X	X	X								

(05)		Explain the responsibilities of the flight crew members with regard to MEL. Source: TCAR OPS Part CAT, Points CAT.IDE.A.105/CAT.IDE.H.105 'Minimum equipment for flight'	X	X	X	X	X								
(06)		Explain the responsibilities of the commander with regard to MEL. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.175 'Flight preparation' & Point CAT.IDE.A.105/CAT.IDE.H.105 'Minimum equipment for flight'	X	X	X	X	X								
071 02 02 00		Icing conditions													
071 02 02 01		On-ground de-icing/anti-icing procedures, types of de-icing/anti-icing fluids													
(01)		Define the following terms: 'anti-icing', 'de-icing', 'one-step de-icing/anti-icing', 'two-step de-icing/anti-icing', 'holdover time'. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Glossary	X	X											

(02)		Describe 'the clean aircraft concept' as presented in the relevant chapter of ICAO Doc 9640. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 2	X	X											
(03)		List the types of de-icing/anti-icing fluids available. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 4, 4.1	X	X	X	X	X								
(04)		Explain the procedure to be followed when an aeroplane has exceeded the holdover time. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 4, 4.9	X	X											
(05)		Interpret the guidelines for fluid holdover times and list the factors which can reduce the fluid protection time. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 5: 5.1, 5.2 and Attachment (5 tables)	X	X											

(06)		Explain how the pre-take-off check, which is the responsibility of the pilot-in-command, ensures that the critical surfaces of the aircraft are free of ice, snow, slush or frost just prior to take-off. This check shall be accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 6, 6.4	X	X											
(07)		Explain why an aircraft has to be treated symmetrically. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 11	X	X											
(08)		Explain why an operator shall establish procedures to be followed when ground de-icing and anti-icing and related inspections of the aircraft are necessary. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1: Introduction 1.1 to 1.6	X	X	X	X	X								

(09)		Explain why a commander shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect the performance or controllability of the aircraft except as permitted in the flight manual. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations'; TCAR OPS Part CAT, Point CAT.OP.MPA.250 'Ice and other contaminants — ground procedures'	X	X	X	X	X								
(10)		Explain the requirements for operations in icing conditions. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.250 'Ice and other contaminants — ground procedures', CAT.OP.MPA.255 'Ice and other contaminants — flight procedures', CAT.IDE.A.165 'Additional equipment for operations in icing conditions at night' & CAT.IDE.H.165 'Additional equipment for operations in icing conditions at night'	X	X	X	X	X								
(11)		Explain why safety must come before commercial pressures in relation to de-icing and anti-icing of aircraft. (Consider time and financial cost versus direct and indirect effects of an incident/accident). Source: N/A	X	X	X	X	X								

071 02 02 02		Procedure to apply in case of performance deterioration, on ground/in flight													
(01)		Explain that the effects of icing are wide-ranging, unpredictable and dependent upon individual aircraft design. The magnitude of these effects is dependent upon many variables, but the effects can be both significant and dangerous. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1	X	X	X	X	X								
(02)		Explain that in icing conditions, for a given speed and a given angle of attack, wing lift can be reduced by as much as 30 % and drag increased by up to 40 %. State that these changes in lift and drag will significantly increase stall speed, reduce controllability, and alter flight characteristics. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1	X	X	X	X	X								
(03)		Explain that ice on critical surfaces and on the airframe may also break away during take-off and be ingested into engines, possibly damaging fan and compressor blades. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1	X	X	X	X	X								

(04)		Explain that ice forming on pitot tubes and static ports or on angle-of-attack vanes may give false altitude, airspeed, angle-of- attack and engine-power information for air-data systems. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1	X	X	X	X	X								
(05)		Explain that ice, frost and snow formed on the critical surfaces on the ground can have a totally different effect on aircraft flight characteristics than ice, frost and snow formed in flight. Source: ICAO Doc 9640 'Manual of Aircraft Ground De-icing/Anti-icing Operations', Chapter 1	X	X	X	X	X								
(06)		Explain that flight in known icing conditions is subject to limitations that are contained in Part B of the operations manual. Source: AMC4 ORO.MLR.100 'Operations manual — general'	X	X	X	X	X								
(07)		Explain where procedures and performances regarding flight in expected or actual icing conditions can be found. Source: AMC4 ORO.MLR.100 'Operations manual — general'	X	X	X	X	X								
071 02 03 00		Bird-strike risk													
071 02 03 01		Bird-strike risk and avoidance													

(01)		Explain that the presence of birds that constitute a potential hazard to aircraft operations is part of the pre-flight information. Source: ICAO Annex 15, 8.1 Pre-flight information	X	X	X	X	X								
(02)		Explain how information concerning the presence of birds observed by aircrews is made available to the aeronautical information service (AIS) for distribution as the circumstances dictate. Source: ICAO Annex 15, Chapter 8	X	X	X	X	X								
(03)		Explain that the Aeronautical Information Publication (AIP) Section En-route (ENR) 5.6 contains information regarding bird migrations. Source: ICAO Annex 15, Appendix 1	X	X	X	X	X								
(04)		Explain significant data regarding bird strikes contained in ICAO Doc 9137 'Airport Services Manual'. Source: ICAO Doc 9137 'Airport Services Manual', Chapter 1	X	X	X	X	X								

(05)		Explain why birds constitute a hazard to aircraft (damage to probes, sensors, engines, windscreens, airframes, degradation in vision, etc.). Source: N/A, though history in ICAO Doc 9137, Chapter 1. For more information, refer to information such as the EGAST safety promotion leaflet 'Bird strike, a European risk with local specificities', available at: www.easa.europa.eu/system/files/dfu/EGAST_GA6-bird-strikes- final.pdf	X	X	X	X	X								
(06)		Define the commander's responsibilities regarding the reporting of bird hazards and bird strikes. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.105 'Responsibilities of the commander'	X	X	X	X	X								
(07)		State that birds tend to flock to areas where food is plentiful. Such areas include: rubbish (garbage) facilities; open sewage treatment works; recently ploughed land; as well as their natural habitats. Source: N/A	X	X	X	X	X								
071 02 04 00		Noise abatement													
071 02 04 01		Noise-abatement procedures													

(01)		Define the operator's responsibilities regarding the establishment of noise-abatement procedures. Source: TCAR OPS Part CAT, Points CAT.OP.MPA.130 'Noise abatement procedures — aeroplanes' & CAT.OP.MPA.131 'Noise abatement procedures — helicopters'	X	X	X	X	X							
(2)		State the main purpose of noise-abatement departure procedure (NADP) 1 and NADP 2. Source: ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Appendix to Chapter 3, 1.1	X	X	X	X	X							
(03)		State that the PIC/commander has the authority to decide not to execute an NADP if conditions preclude the safe execution of the procedure. Source: ICAO Doc 8168 'Procedures for Air Navigation Services— Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 3, 3.2.1 General	X	X	X	X	X							
071 02 04 02		Influence of the flight procedure (departure, cruise, approach)												

(01)		List the main parameters for NADP 1 and NADP 2 (i.e. speeds, heights and configuration). Source: ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 3, 3.3 and Appendix to Chapter 3	X	X											
(02)		State that a runway lead-in lighting system should be provided where it is desired to provide visual guidance along a specific approach path for noise-abatement purposes. Source: ICAO Annex 14, Volume 1, 5.3.7.1/Volume 2, 5.3.4.1	X	X	X	X	X								
(03)		State that detailed information about noise-abatement procedures is to be found in Part 'Aerodromes' (AD), Sections 2 and 3 of the AIP. Source: ICAO Annex 15, Appendix 1	X	X	X	X	X								
071 02 04 03		Influence by the pilot (power setting, low drag)													
(01)		List the adverse operating conditions under which noise- abatement procedures in the form of reduced-power take-off should not be required Source: ICAO Doc 8168 'Procedures for Air Navigation Services— Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 3, Chapter 1, 1.2.3 Reduced power take-off	X	X											

(02)		List the adverse operating conditions under which noise- abatement procedures during approach should not be required. Source: ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 2, 2.1 Noise preferential runways	X	X											
(03)		State the rule regarding the use of reverse thrust on landing. Source: ICAO Doc 8168 'Procedures for Air Navigation Services — Aircraft Operations' (PANS-OPS), Volume 1, Part I, Section 7, Chapter 3, 3.5 Aeroplane operating procedures — landing	X	X											
071 02 04 04		Influence by the pilot (power setting, track of helicopter)													
(01)		List the adverse operating conditions under which noise- abatement procedures in the form of reduced-power take-off should not be required.			X	X	X								
071 02 05 00		Fire and smoke													
071 02 05 01		Carburettor fire													
(01)		Explain that the actions to be taken in the event of a carburettor fire may be type-specific and should be known by the pilot.	X	X	X	X	X								
071 02 05 02		Engine fire													

(01)		Explain that the actions to be taken in the event of an engine fire may be type-specific and should be known by the pilot.	X	X	X	X	X								
071 02 05 03		Fire in the cabin, in the flight crew compartment and in the cargo compartment													
(01)		Identify the different types of extinguishants used in handheld fire extinguishers and the type of fire for which each one may be used.	X	X	X	X	X								
(02)		Describe the precautions to be considered when applying fire extinguishants.	X	X	X	X	X								
(03)		Identify the appropriate handheld fire extinguishers to be used in the flight crew compartment, the passenger cabin and lavatories, and in the cargo compartments.	X	X	X	X	X								
071 02 05 04		Smoke in the flight crew compartment and in the cabin													
(01)		Explain which actions should be taken in the event of smoke in the flight crew compartment or in the cabin, why these actions may be type-specific, and why they should be known by the pilot.	X	X	X	X	X								
071 02 05 05		Actions in case of overheated brakes													
(01)		Describe the problems and safety precautions in the event that brakes overheat after a heavy-weight landing or a rejected take- off.	X	X											
(02)		Explain the difference in the way steel and carbon brakes react to energy absorption and the operational consequences.	X	X											

071 02 06 00		Decompression of pressurised cabin													
071 02 06 01		Slow decompression													
(01)		Explain what can cause, and how to detect, a slow decompression or an automatic pressurisation system failure.	X	X											
(02)		Describe the actions required following a slow decompression.	X	X											
071 02 06 02		Rapid and explosive decompression													
(01)		Explain what can cause, and how to detect, a rapid or an explosive decompression.	X	X											
071 02 06 03		Dangers and action to be taken													
(01)		Describe the actions required following a rapid or explosive decompression.	X	X											
(02)		Describe the effects on aircraft occupants of a slow decompression and of a rapid or explosive decompression.	X	X											
071 02 07 00		Wind shear and microburst													
071 02 07 01		Effects and recognition during departure and approach													
(01)		Explain how to identify low-level wind shear. Source: ICAO Circular 186 'Wind Shear'	X	X	X	X	X								
071 02 07 02		Actions to avoid and actions to take when encountering wind shear													

(01)		Describe the effects of wind shear and the actions required when wind shear is encountered at take-off and approach. Source: ICAO Circular 186 'Wind Shear'	X	X	X	X	X								
(02)		Describe the precautions to be taken when wind shear is suspected at take-off and approach. Source: ICAO Circular 186 'Wind Shear'	X	X	X	X	X								
(03)		Describe the effects of wind shear and the actions required following entry into a strong downdraft wind shear. Source: ICAO Circular 186 'Wind Shear'	X	X	X	X	X								
(04)		Describe a microburst and its effects. Source: ICAO Circular 186 'Wind Shear'	X	X	X	X	X								
071 02 08 00		Wake turbulence													
071 02 08 01		Cause													
(01)		Describe the term 'wake turbulence'. Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X								
(02)		Describe tip vortex circulation. Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X								

(03)		State when vortex generation begins and ends. Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X							
(04)		Describe vortex circulation on the ground with and without crosswind. Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X							
071 02 08 02		List of relevant parameters												
(01)		List the three main factors which, when combined, give the strongest vortices (heavy, clean, slow). Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X							
(02)		Describe the wind conditions which are worst for wake turbulence near the ground. Source: ICAO Doc 9426 'Air Traffic Services Planning Manual', Part II	X	X	X	X	X							
071 02 08 03		Actions to be taken when crossing traffic, during take-off and landing												

(01)		Describe the actions to be taken to avoid wake turbulence, specifically separations. Source: ICAO Doc 4444 'Procedures for Air Navigation Services—— Air Traffic Management' (PANS-ATM), 5.8 Time-based wake turbulence longitudinal separation minima	X	X	X	X	X								
071 02 09 00		Security (unlawful events)													
071 02 09 01		ICAO Annex 17 and applicable Thai National Aviation Security Programme													
(01)		Define the following terms: 'aircraft security check', 'screening', 'security', 'security- restricted area', 'unidentified baggage'. Source: ICAO Annex 17, Chapter 1 Definitions	X	X	X	X	X								
(02)		State the objectives of security. Source: ICAO Annex 17, 2.1 Objectives	X	X	X	X	X								
071 02 09 02		Use of secondary surveillance radar (SSR)													
(01)		Describe the commander's responsibilities concerning notifying the appropriate ATS unit. Source: ICAO Annex 17, Attachment to Annex 17	X	X	X	X	X								

(02)		Describe the commander's responsibilities concerning operation of SSR. Source: ICAO Annex 17, Attachment to Annex 17	X	X	X	X	X								
(03)		Describe the commander's responsibilities concerning departing from assigned track or cruising level. Source: ICAO Annex 17, Attachment to Annex 17	X	X	X	X	X								
(04)		Describe the commander's responsibilities concerning the action required or being requested by an ATS unit to confirm SSR code and ATS interpretation response. Source: ICAO Annex 17, Attachment to Annex 17	X	X	X	X	X								
071 02 09 03		Security (Thai National Aviation Security Programme and ICAO Annex 17)													
(01)		Describe the relationship between Thai National Aviation Security Programme and ICAO Annex 17. Source: Thai National Aviation Security Programme	X	X	X	X	X								
(02)		Explain the requirements regarding training programmes. Source: Thai National Aviation Security Programme: 'In-flight security measures' and 'Staff recruitment and training'; ICAO Annex 17, 13.4 Training programmes	X	X	X	X	X								

(03)		State the requirements regarding reporting acts of unlawful interference. Source: ICAO Annex 17, 13.5 Reporting acts of unlawful interference	X	X	X	X	X								
(04)		State the requirements regarding aircraft search procedures. Source: ICAO Annex 17: 4.3 Measures relating to aircraft; 5.1 Prevention; 13.3 Aeroplane search procedure checklist	X	X	X	X	X								
071 02 10 00		Emergency and precautionary landing, and ditching													
071 02 10 01		Descriptions													
(01)		Describe the meaning of: ‘ditching’, ‘precautionary landing’, and ‘emergency landing’.	X	X	X	X	X								
(02)		Describe a ditching procedure.	X	X	X	X	X								
(03)		Describe a precautionary landing procedure.	X	X	X	X	X								
(04)		Describe an emergency landing procedure.	X	X	X	X	X								
(05)		Explain the factors to be considered when deciding to conduct a precautionary/emergency landing or ditching.	X	X	X	X	X								
071 02 10 02		Cause													
(01)		List some circumstances that may require a ditching, a precautionary landing or an emergency landing.	X	X	X	X	X								

071 02 10 03		Passenger information													
(01)		Describe the briefing to be given to passengers before conducting a precautionary/emergency landing or ditching (including evacuation). Source: AMC1 CAT.OP.MPA.170 'Passenger briefing'	X	X	X	X	X								
071 02 10 04		Action after a precautionary/emergency landing or ditching													
(01)		Describe the actions and responsibilities of crew members after landing.	X	X	X	X	X								
071 02 10 05		Evacuation													
(01)		Explain why the aircraft must be stopped and the engine(s) shut down before launching an emergency evacuation.	X	X	X	X	X								
(02)		Explain the CS-25 requirements regarding evacuation procedures. Source: CS 25.803 and Appendix J	X	X											
071 02 11 00		Fuel jettisoning													
071 02 11 01		Safety aspects													
(01)		Explain why an aircraft may need to jettison fuel so as to reduce its landing mass in order to make a safe landing. Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), 15.5.3 Fuel dumping	X	X											

(02)		Explain that when an aircraft that operates within controlled airspace needs to jettison fuel, the flight crew shall coordinate with ATC the following: — route to be flown which, if possible, should be clear of cities and towns, preferably over water and away from areas where thunderstorms have been reported or are expected; — the flight level to be used, which should be not less than 1 800 m (6 000 ft); and — the duration of fuel jettisoning. Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), 15.5.3 Fuel dumping	X	X											
(03)		Explain how flaps and slats may adversely affect fuel jettisoning. Source: CS 25.1001 Fuel jettisoning system	X	X											
071 02 11 02		Requirements													
(01)		Explain why a fuel-jettisoning system must be capable of jettisoning enough fuel within 15 minutes. Source: CS 25.1001 Fuel jettisoning system	X	X											
071 02 12 00		Transport of dangerous goods by air													
071 02 12 01		ICAO Annex 18 (4th Edition, July 2011)													

(01)		Define the following terms: 'dangerous goods', 'dangerous goods accident', 'dangerous goods incident', 'exemption', 'incompatible', 'packaging', 'UN number'. Source: ICAO Annex 18, Chapter 1 Definitions	X	X	X	X	X								
(02)		Explain that detailed provisions for the transport of dangerous goods by air are contained in the Technical Instructions for the Safe Transport of Dangerous Goods by Air. Source: ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air'; ICAO Annex 18, Chapter 2, 2.2.1	X	X	X	X	X								
(03)		State that in the event of an in-flight emergency, the pilot-in- command must inform the ATC of the transport of dangerous goods by air. Source: ICAO Annex 18, Chapter 9, 9.5	X	X	X	X	X								
071 02 12 02		Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Doc 9284)													
(01)		Explain the principle of dangerous goods compatibility and segregation. Source: ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air'	X	X	X	X	X								

(02)		Explain the special requirements for the loading of radioactive materials. Source: ICAO Doc 9284 ‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’	X	X	X	X	X								
(03)		Explain the use of the dangerous goods list. Source: ICAO Doc 9284 ‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’	X	X	X	X	X								
(04)		Identify the labels. Source: ICAO Doc 9284 ‘Technical Instructions For The Safe Transport of Dangerous Goods by Air’	X	X	X	X	X								
071 02 12 03		TCAR Regulation Part-CAT and Part-SPA													
(01)		Explain the terminology relevant to dangerous goods. Source: TCAR OPS Part SPA, Points SPA.DG.100 ‘Transport of dangerous goods’, SPA.DG.105 ‘Approval to transport dangerous goods’ & Point SPA.DG.110 ‘Dangerous goods information and documentation’	X	X	X	X	X								

(02)		Explain the scope of that Regulation. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 'Transport of dangerous goods'	X	X	X	X	X								
(03)		Explain why the transport of dangerous goods by air is subject to operator approval. Source: TCAR OPS Part SPA? Point SPA.DG.100 'Transport of dangerous goods'; AMC1 ARO.OPS.200 'Specific approval procedure'													
(04)		Explain the limitations on the transport of dangerous goods by air. Source: TCAR OPS Part SPA, Points SPA.DG.100 'Transport of dangerous goods', SPA.DG.105 'Approval to transport dangerous goods' & SPA.DG.110 'Dangerous goods information and documentation'	X	X	X	X	X								
(05)		Explain the requirements for the acceptance of dangerous goods. Source: TCAR OPS Part SPA, Point SPA.DG.110 'Dangerous goods information and documentation'; AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation'	X	X	X	X	X								

(06)		Explain the requirements regarding inspection for damage, leakage or contamination. Source: TCAR OPS Part SPA, Point SPA.DG.105 'Approval to transport dangerous goods'; AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation': (a)(1)	X	X	X	X	X								
(07)		Explain the requirement for the provision of information to flight crew. Source: TCAR OPS Part SPA, Point SPA.DG.110 'Dangerous goods information and documentation'; AMC1 SPA.DG.110(a);(b) 'Dangerous goods information and documentation'	X	X	X	X	X								
(08)		Explain the requirements for dangerous goods incident and accident reports. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 'Transport of dangerous goods'	X	X	X	X	X								

(09)		State that some articles and substances, which would otherwise be classed as dangerous goods, can be exempted if they are part of the aircraft equipment, or required for use during aeromedical flights. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 'Transport of dangerous goods'; ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', 2.2 Exceptions for dangerous goods of the operator	X	X	X	X	X								
(10)		Explain why some articles and substances may be forbidden for transport by air. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 'Transport of dangerous goods'; ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', 2.1 Dangerous goods forbidden for transport by air under any circumstance	X	X	X	X	X								
(11)		Explain why packing must comply with the specifications of the Technical Instructions. Source: ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', Introductory chapter, 2.4 (for packing purposes, etc.)	X	X	X	X	X								

(12)		Explain the need for an inspection prior to loading dangerous goods on an aircraft. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 'Transport of dangerous goods'; AMC1 SPA.DG.110(b) 'Dangerous goods information and documentation'	X	X	X	X	X								
(13)		Explain why some dangerous goods are designated for carriage only on cargo aircraft. Source: ICAO Annex 18, 8.9 Loading on cargo aircraft; ICAO Doc 9284 'Technical Instructions For The Safe Transport of Dangerous Goods by Air', GENERAL PRINCIPLES	X	X	X	X	X								
(14)		Explain how misdeclared or undeclared dangerous goods found in baggage are to be reported. Source: TCAR OPS Part CAT, Point CAT.GEN.MPA.200 and related AMCs/GM	X	X	X	X	X								
071 02 13 00		Contaminated runways													
071 02 13 01		Intentionally left blank													
071 02 13 02		Estimated surface friction, friction coefficient													
(01)		Identify the difference between friction coefficient and estimated surface friction. Source: ICAO Annex 15, Appendix 2	X	X											

(02)		State that when estimated surface friction is 4 or 5, the expected braking action is good. Source: ICAO Annex 15, Appendix 2	X	X											
071 02 13 03		Hydroplaning principles and effects													
(01)		Define the different types of hydroplaning. Source: NASA TM-85652 — Tire friction performance	X	X											
(02)		Compute the two dynamic hydroplaning speeds using the following formulas: — spin-down speed (rotating tire) (kt) = 9 square root (pressure in PSI) — spin-up speed (non-rotating tire) (kt) = 7.7 square root (pressure in PSI). Source: NASA TM-85652 — Tire friction performance	X	X											
(03)		State that it is the spin-up speed rather than the spin-down speed which represents the actual tire situation for aircraft touchdown on flooded runways. Source: NASA TM-85652 — Tire friction performance	X	X											
071 02 13 04		Intentionally left blank													
071 02 13 05		Snowtam and contamination on the aerodrome													

(01)		Interpret from a snowtam the contamination and braking action on a runway, taxiways and apron. Source: ICAO Annex 15, Appendix 2	X	X											
(02)		Explain which hazards can be identified from the SNOWTAM/METAR and how to mitigate them.	X	X	X	X	X								
071 02 14 00		Rotor downwash													
071 02 14 01		Describe downwash													
(01)		Describe the downwash.			X	X	X								
071 02 14 02		Effects													
(01)		Explain its effects: soil erosion, water dispersal and spray, recirculation, damage to property, loose articles.			X	X	X								
071 02 15 00		Operation influence by meteorological conditions (helicopter)													
071 02 15 01		White-out/sand/dust													
(01)		Give the definition of ‘white-out’.			X	X	X								
(02)		Describe loss of spatial orientation.			X	X	X								
(03)		Describe take-off and landing techniques.			X	X	X								
071 02 15 02		Strong winds													
(01)		Describe blade sailing.			X	X	X								
(02)		Describe wind operating envelopes.			X	X	X								
(03)		Describe vertical speed problems.			X	X	X								
071 02 15 03		Mountain environment													
(01)		Describe constraints associated with mountain environment.			X	X	X								

071 03 00 00		EMERGENCY PROCEDURES (HELICOPTER)													
071 03 01 00		Influence of technical problems													
071 03 01 01		Engine failure													
(01)		Describe recovery techniques in the event of engine failure during hover, climb, cruise, approach.			X	X	X								
071 03 01 02		Fire in the cabin, in the flight crew compartment and in the engine(s)													
(01)		Describe the basic actions when encountering fire in the cabin, flight deck or engine(s).			X	X	X								
071 03 01 03		Tail-rotor directional control failure													
(01)		Describe the basic actions following loss of tail rotor.			X	X	X								
(02)		Describe the basic actions following loss of directional control.			X	X	X								
071 03 01 04		Ground resonance													
(01)		Describe recovery actions.			X	X	X								
071 03 01 05		Blade stall													
(01)		Describe cause of and recovery actions when encountering retreating blade stall.			X	X	X								
071 03 01 06		Settling with power (vortex ring)													
(01)		Describe potential conditions for this event and recovery actions.			X	X	X								
071 03 01 07		Overpitch													
(01)		Describe recovery actions.			X	X	X								
071 03 01 08		Overspeed: rotor/engine													

(01)		Describe overspeed control.			X	X	X								
071 03 01 09		Dynamic rollover													
(01)		Describe potential conditions for this event and recovery action.			X	X	X								
071 03 01 10		Mast bumping													
(01)		Describe potential conditions of the 'conducive to' and 'avoidance of' effect.			X	X	X								
071 04 01 00		SPECIALISED OPERATIONS (Regulation TCAR OPS on air operations, as amended)													
071 04 01 01		Additional requirements for commercial specialised operations and CAT operations (TCAR OPS Part ORO, Subpart FC, Section 3)													
(01)		Explain the requirements related to flight crew recurrent training and checking and operator proficiency check. Source: TCAR OPS Part ORO, Point ORO.FC.330 'Recurrent training and checking — operator proficiency check'	X	X	X	X	X								
071 04 01 02		General requirements (TCAR OPS Part SPO, Subpart A)													
(01)		Explain the task specialist's responsibilities. Source: TCAR OPS Part SPO, Point SPO.GEN.106 'Task specialists responsibilities'	X	X	X	X	X								
071 04 01 03		Helicopter external sling load operations (HESLO) (TCAR OPS Part SPO, Subpart E)			X	X	X								

(01)		Explain the standard operating procedures and equipment requirements. Source: TCAR OPS Part SPO, Point SPO.SPEC.HESLO.100 'Standard operating procedures' and related AMCs/GM; Point SPO.SPEC.HESLO.105 'Specific HESLO equipment' and related AMCs/GM			X	X	X								
071 04 01 04		Human external cargo operations (HEC) (TCAR OPS Part SPO, Subpart E)			X	X	X								
(01)		Explain the standard operating procedures and equipment requirements. Source: TCAR OPS Part SPO, Point SPO.SPEC.HEC.100 'Standard operating procedures' and related AMCs/GM; Point SPO.SPEC.HEC.105 'Specific HEC equipment' and related AMCs/GM			X	X	X								
080 00 00 00		PRINCIPLES OF FLIGHT													
081 00 00 00		PRINCIPLES OF FLIGHT —— AEROPLANES													
081 01 00 00		SUBSONIC AERODYNAMICS													
081 01 01 00		Basics, laws and definitions													
081 01 01 01		Laws and definitions													
(01)		List the international system of units of measurement (SI) for mass, acceleration, weight, velocity, energy, density, temperature, pressure, force, wing loading, and power.	X	X											

(02)	X	Define 'mass', 'force', 'acceleration', and 'weight'.	X	X											
(03)		State and interpret Newton's three laws of motion.	X	X											
(04)	X	Explain air density.	X	X											
(05)	X	List the atmospheric properties that effect air density.	X	X											
(06)		Explain how temperature and pressure changes affect air density.	X	X											
(07)	X	Define 'static pressure'.	X	X											
(08)	X	Define 'dynamic pressure'.	X	X											
(09)	X	State the formula for 'dynamic pressure'.	X	X											
(10)		Describe dynamic pressure in terms of an indication of the energy in the system, and how it is related to indicated airspeed (IAS) and air density for a given altitude and speed.	X	X											
(11)		State Bernoulli's equation for incompressible flow.	X	X											
(12)		Define 'total pressure' and explain that the total pressure differs in different systems.	X	X											
(13)		Apply Bernoulli's equation to flow through a venturi stream tube for incompressible flow.	X	X											
(14)		Describe how IAS is acquired from the pitot static system.	X	X											
(15)		Describe the relationship between density, temperature, and pressure for air.	X	X											

(16)		Explain the equation of continuity and its application to the flow through a stream tube.	X	X											
(17)	X	Define ‘IAS’, ‘CAS’, ‘EAS’, and ‘TAS’.	X	X											
081 01 01 02		Basics of airflow													
(01)	X	Describe steady and unsteady airflow.	X	X											
(02)	X	Explain the concept of a streamline and a stream tube.	X	X											
(03)	X	Describe and explain airflow through a stream tube.	X	X											
(04)	X	Explain the difference between two- and three-dimensional airflow.	X	X											
081 01 01 03		Aerodynamic forces on aerofoils													
(01)		Describe the originating point and direction of the resultant force caused by the pressure distribution around an aerofoil.	X	X											
(02)	X	Resolve the resultant force into the components ‘lift’ and ‘drag’.	X	X											
(03)		Describe the direction of lift and drag.	X	X											
(04)	X	Define the ‘aerodynamic moment’.	X	X											
(05)	X	List the factors that affect the aerodynamic moment.	X	X											
(06)		Describe the aerodynamic moment for a symmetrical aerofoil.	X	X											
(07)		Describe the aerodynamic moment for a positively and negatively cambered aerofoil.	X	X											
(08)	X	Define ‘angle of attack’ (a).	X	X											

081 01 01 04		Shape of an aerofoil section													
(01)	X	Describe the following parameter of an aerofoil section: leading edge.	X	X											
(02)	X	Describe the following parameter of an aerofoil section: trailing edge.	X	X											
(03)		Describe the following parameter of an aerofoil section: chord line.	X	X											
(04)		Describe the following parameter of an aerofoil section: thickness-to-chord ratio or relative thickness.	X	X											
(05)		Describe the following parameter of an aerofoil section: location of maximum thickness.	X	X											
(06)		Describe the following parameter of an aerofoil section: camber line.	X	X											
(07)		Describe the following parameter of an aerofoil section: camber.	X	X											
(08)	X	Describe the following parameter of an aerofoil section: nose radius.	X	X											
(09)	X	Describe a symmetrical and an asymmetrical aerofoil section.	X	X											
081 01 01 05		Wing shape													
(01)	X	Describe the following parameter of a wing: span.	X	X											
(02)	X	Describe the following parameter of a wing: tip and root chord.	X	X											
(03)		Describe the following parameter of a wing: taper ratio.	X	X											
(04)	X	Describe the following parameter of a wing: wing area.	X	X											

(05)		Describe the following parameter of a wing: wing planform.	X	X												
(06)	X	Describe the following parameter of a wing: mean geometric chord.	X	X												
(07)		Describe the following parameter of a wing: mean aerodynamic chord (MAC).	X	X												
(08)		Describe the following parameter of a wing: aspect ratio.	X	X												
(09)	X	Describe the following parameter of a wing: dihedral angle.	X	X												
(10)	X	Describe the following parameter of a wing: sweep angle.	X	X												
(11)	X	Describe the following parameter of a wing: wing twist, geometric and aerodynamic.	X	X												
(12)		Describe the following parameter of a wing: angle of incidence. Remark: In certain textbooks, angle of incidence is used as angle of attack (α). For Part-FCL theoretical knowledge examination purposes, this use is discontinued, and the angle of incidence is defined as the angle between the aeroplane longitudinal axis and the wing-root chord line.	X	X												
081 01 02 00		Two-dimensional airflow around an aerofoil														
081 01 02 01		Streamline pattern														
(01)	X	Describe the streamline pattern around an aerofoil.	X	X												

(02)		Describe converging and diverging streamlines, and their effect on static pressure and velocity.													
(03)	X	Describe upwash and downwash.	X	X											
081 01 02 02		Stagnation point													
(01)		Describe the stagnation point.	X	X											
(02)		Describe the movement of the stagnation point as the α changes.	X	X											
081 01 02 03		Pressure distribution													
(01)		Describe pressure distribution and local speeds around an aerofoil including effects of camber and α.	X	X											
(02)		Intentionally left blank													
081 01 02 04		Centre of pressure (CP) and aerodynamic centre (AC)													
(01)		Explain CP and AC.	X	X											
081 01 02 05		Intentionally left blank													
081 01 02 06		Drag and wake													
(01)	X	List two physical phenomena that cause drag.	X	X											
(02)		Describe skin friction drag.	X	X											
(03)		Describe form (pressure) drag.	X	X											
(04)	X	Explain why drag and wake cause loss of energy (momentum).	X	X											
081 01 02 07		Influence of angle of attack (α)													
(01)		Explain the influence of α on lift.	X	X											
081 01 02 08		Intentionally left blank													

081 01 02 09		The lift coefficient (CL) — angle of attack (α) graph													
(01)		Describe the CL—α graph.	X	X											
(02)		Explain the significant points: — point where the curve crosses the horizontal axis (zero lift); — point where the curve crosses the vertical axis (α = 0); — point where the curve reaches its maximum (CLMAX).	X	X											
081 01 03 00		Coefficients													
081 01 03 01		General use of coefficients													
(01)	X	Explain why coefficients are used in general.	X	X											
081 01 03 02		The lift coefficient (CL)													
(01)		Explain the lift formula, the factors that affect lift, and perform simple calculations.	X	X											
(02)		Describe the effect of camber on the CL—a graph (symmetrical and positively/negatively cambered aerofoils).	X	X											
(03)		Describe the typical difference in the CL—a graph for fast and slow aerofoil design.	X	X											
(04)	X	Define ‘CLMAX’ (maximum lift coefficient) and ‘aCRIT’ (stalling a) on the graph.	X	X											
(05)		Describe CL and explain the variables that affect it in low subsonic flight.	X	X											
081 01 03 03		Drag													

(01)		Describe the two-dimensional drag formula.	X	X											
(02)		Discuss the effect of the shape of a body, cross-sectional area, and surface roughness on the drag coefficient.	X	X											
081 01 04 00		Three-dimensional airflow around an aeroplane													
081 01 04 01		Angle of attack (α)													
(01)	X	Define 'angle of attack' (α). Remark: For theoretical knowledge examination purposes, the angle-of-attack definition requires a reference line. This reference line for 3D has been chosen to be the longitudinal axis and for 2D the chord line.	X	X											
(02)		Explain the difference between the α and the attitude of an aeroplane.	X	X											
081 01 04 02		Streamline pattern													
(01)		Describe the general streamline pattern around the wing, tail section, and fuselage.	X	X											
(02)		Explain and describe the causes of spanwise flow over top and bottom surfaces.	X	X											
(03)		Describe wing tip vortices and their contribution to downwash behind the wing.	X	X											
(04)		Explain why wing tip vortices vary with α.	X	X											
(05)		Describe spanwise lift distribution including the effect of wing planform.	X	X											
(06)		Describe the causes, distribution and duration of the wake-turbulence behind an aeroplane.	X	X											

(07)		Describe the influence of flap deflection on the wing tip vortex.	X	X											
(08)		Describe the parameters that influence wake turbulence.	X	X											
081 01 04 03		Induced drag													
(01)		Explain the factors that cause induced drag.	X	X											
(02)		Describe the approximate formula for the induced drag coefficient (including variables but excluding constants).	X	X											
(03)		Describe the relationship between induced drag and total drag in straight and level flight with variable speed.	X	X											
(04)		Describe the effect of mass on induced drag at a given IAS.	X	X											
(05)		Describe the means to reduce induced drag: — aspect ratio; — winglets; — tip tanks; — wing twist; — camber change.	X	X											
(06)		Describe the influence of lift distribution on induced drag.	X	X											
(07)		Describe the influence of downwash on the effective airflow.	X	X											
(08)		Explain induced and effective local α.	X	X											
(09)		Explain the influence of the induced α on the direction of the lift vector.	X	X											

(10)		Explain the relationship between induced drag and: — speed; — aspect ratio; — wing planform; — bank angle in a horizontal coordinated turn.	X	X											
(11)		Explain the induced drag coefficient and its relationship with the lift coefficient and aspect ratio.	X	X											
(12)		Explain the influence of induced drag on: — the CL—α graph, and show the effect on the graph when comparing high- and low-aspect ratio wings; — the CL—CD (aeroplane polar), and show the effect on the graph when comparing high- and low-aspect ratio wings; — the parabolic aeroplane polar in a graph and as a formula [CD = CPD + kCL2], where CD = coefficient of drag and CPD = coefficient of parasite drag.	X	X											
(13)		Describe the CL—CD graph (polar).	X	X											
(14)		Indicate minimum drag on the graph.	X	X											
(15)		Explain why the CL—CD ratio is important as a measure of performance.	X	X											
(16)		Intentionally left blank													
081 01 05 00		Total drag													
081 01 05 01		Total drag in relation to parasite drag and induced drag													

(01)	X	State that total drag consists of parasite drag and induced drag.	X	X											
081 01 05 02		Parasite drag													
(01)		Describe the types of drag that are included in parasite drag.	X	X											
(02)		Describe form (pressure) drag and the factors which affect its magnitude.	X	X											
(03)		Describe interference drag and the factors which affect its magnitude.	X	X											
(04)		Describe friction drag and the factors which affect its magnitude.	X	X											
081 01 05 03		Parasite drag and speed													
(01)		Describe the relationship between parasite drag and speed.	X	X											
081 01 05 04		Induced drag and speed (Refer to 081 01 04 03)													
081 01 05 05		Total drag													
(01)		Explain the total drag–speed graph and the constituent drag components.	X	X											
(02)		Indicate the speed for minimum drag.	X	X											
081 01 05 06		Intentionally left blank													
081 01 05 07		Variables affecting the total drag–speed graph													
(01)		Describe the effect of aeroplane gross mass on the graph.	X	X											

(02)		Describe the effect of pressure altitude on: — drag—IAS graph; — drag—TAS graph.	X	X											
(03)		Describe speed stability from the graph.	X	X											
(04)		Describe non-stable, neutral, and stable IAS regions.	X	X											
(05)		Explain what happens to the IAS and drag in the non-stable region if speed suddenly decreases and why this could occur.	X	X											
081 01 06 00		Ground effect													
081 01 06 01		Influence of ground effect													
(01)		Explain the influence of ground effect on wing tip vortices, downwash, airflow pattern, lift, and drag.	X	X											
(02)		Describe the influence of ground effect on induced a and the coefficient of induced drag (CDi).	X	X											
(03)		Explain the effects of entering and leaving ground effect.	X	X											
081 01 06 02		Effect on stalling angle of attack (αCRIT)													
(01)		Describe the influence of ground effect on αCRIT.	X	X											
081 01 06 03		Effect on lift coefficient (CL)													
(01)		Describe the influence of ground effect on the effective a and CL.	X	X											
081 01 06 04		Effect on take-off and landing characteristics of an aeroplane													

(01)		Describe the influence of ground effect on take-off and landing characteristics and performance of an aeroplane.	X	X											
(02)		Describe the difference in take-off and landing characteristics of high- and low-wing aeroplanes.	X	X											
081 01 07 00		The relationship between lift coefficient and speed in steady, straight, and level flight													
081 01 07 01		Represented by an equation													
(01)		Explain the effect on CL during speed increase/decrease in steady, straight, and level flight, and perform simple calculations.	X	X											
081 01 07 02		Represented by a graph													
(01)		Explain, by using a graph, the effect on speed of CL changes at a given weight.	X	X											
081 01 08 00		Intentionally left blank													
081 01 09 00		CLMAX augmentation													
081 01 09 01		Trailing-edge flaps and the reasons for their use in take-off and landing													
(01)		From the given relevant diagrams, describe or identify the following types of trailing-edge flaps: — split flaps; — plain flaps; — slotted flaps; — Fowler flaps.	X	X											

(02)		Describe how the wing's effective camber increases the CL and CD, and the reasons why this can be beneficial.	X	X										
(03)		Describe their effect on: — the location of CP; — pitching moments (due to wing CP movement); — stall speed.	X	X										
(04)		Compare their influence on the CL—a graph: — indicate the variation in CL at any given a; — indicate their effect on CLMAX; — indicate their effect on critical a; — indicate their effect on the a at a given CL.	X	X										
(05)		Compare their influence on the CL—CD graph: — indicate how the (CL/CD)MAX differs from that of a clean wing.	X	X										
(06)		Explain the influence of trailing-edge flap deflection on the glide angle.	X	X										
(07)		Describe flap asymmetry: — explain the effect on aeroplane controllability.	X	X										
(08)		Describe trailing-edge flap effect on take-off and landing: — explain the advantages of lower-nose attitudes; — explain why take-off and landing speeds/distances are reduced.	X	X										

(09)		Explain the effects of flap-setting errors, such as mis-selection and premature/late extension or retraction of flaps, on: — take-off and landing distance and speeds; — climb and descent performance; — stall buffet margins.	X	X											
081 01 09 02		Leading-edge devices and the reasons for their use in take-off and landing													
(01)		From the given relevant diagrams, describe or identify the different types of leading-edge high-lift devices: — Krueger flaps; — variable camber flaps; — slats.	X	X											
(02)		Describe the function of the slot.	X	X											
(03)		Describe how the wing's effective camber increases with a leading-edge flap.	X	X											
(04)		Explain the effect of leading-edge flaps on the stall speed, also in comparison with trailing-edge flaps.	X	X											
(05)		Compare their influence on the CL—a graph, compared with trailing-edge flaps and a clean wing: — indicate the effect of leading-edge devices on CLMAX; — explain how the CL curve differs from that of a clean wing;	X	X											

		— indicate the effect of leading-edge devices on αCRIT.														
(06)		Compare their influence on the CL—CD graph.	X	X												
(07)		Describe slat asymmetry: — describe the effect on aeroplane controllability.	X	X												
(08)		Explain the reasons for using leading-edge high-lift devices on take-off and landing: — explain the disadvantage of increased nose-up attitudes; — explain why take-off and landing speeds/distances are reduced.	X	X												
081 01 09 03		Vortex generators														
(01)		Explain the purpose of vortex generators.	X	X												
(02)		Describe the basic operating principle of vortex generators.	X	X												
(03)		State their advantages and disadvantages.	X	X												
081 01 10 00		Means to reduce the CL—CD ratio														
081 01 10 01		Spoilers and the reasons for their use in the different phases of flight														
(01)		Describe the aerodynamic functioning of spoilers: — roll spoilers; — flight spoilers (speed brakes); — ground spoilers (lift dumpers).	X	X												

(02)		Describe the effect of spoilers on the CL—a graph and stall speed.	X	X											
(03)		Describe the influence of spoilers on the CL—CD graph and lift- drag ratio.	X	X											
081 01 10 02		Speed brakes and the reasons for their use in the different phases of flight													
(01)		Describe speed brakes and the reasons for using them in the different phases of flight.	X	X											
(02)		State their influence on the CL—CD graph and lift—drag ratio.	X	X											
(03)		Explain how speed brakes increase parasite drag.	X	X											
(04)		Describe how speed brakes affect the minimum drag speed.	X	X											
(05)		Describe their effect on rate and angle of descent.	X	X											
081 01 11 00		Intentionally left blank													
081 01 12 00		Aerodynamic degradation													
081 01 12 01		Ice and other contaminants													
(01)		Describe the locations on an aeroplane where ice build-up will occur during flight.	X	X											
(02)		Explain the aerodynamic effects of ice and other contaminants on: — lift (maximum CL); — drag; — stall speed; — aCRIT; — stability and controllability.	X	X											

(03)		Explain the aerodynamic effects of icing during take-off.	X	X											
081 01 12 02		Deformation and modification of airframe, ageing aeroplanes													
(01)		Describe the effect of airframe deformation and modification of an ageing aeroplane on aeroplane performance.	X	X											
(02)		Explain the effect on boundary layer condition of an ageing aeroplane.	X	X											
081 02 00 00		HIGH-SPEED AERODYNAMICS													
081 02 01 00		Speeds													
081 02 01 01		Speed of sound													
(01)	X	Define 'speed of sound'.	X												
(02)		Explain the variation of the speed of sound with altitude.	X												
(03)		Explain the influence of temperature on the speed of sound.	X												
081 02 01 02		Mach number													
(01)		Define 'Mach number' as a function of TAS and speed of sound.	X												
081 02 01 03		Influence of temperature and altitude on Mach number													
(01)		Explain the absence of change of Mach number with varying temperature at constant flight level and calibrated airspeed.	X												

(02)		Explain the relationship between Mach number, TAS and IAS during climb and descent at constant Mach number or IAS, and explain variation of lift coefficient, α, pitch and flight-path angle.	X												
(03)		Explain: — risk of exceeding the maximum operation speed (VMO) when descending at constant Mach number; — risk of exceeding the maximum operating Mach number (MMO) when climbing at constant IAS; — risk of a low-speed stall at high altitude when climbing at a too low Mach number.	X												
081 02 01 04		Compressibility													
(01)		State that compressibility means that density can change along a streamline, and that this occurs in the high subsonic (from Mach 0.4), transonic, and supersonic flow.	X												
(02)	X	State that compressibility negatively affects the pressure gradient, leading to an overall reduction of the CL.	X												
(03)	X	State that Mach number is a measure of compressibility.	X												
(04)		Describe that compressibility increases low-speed stall speed and decreases αCRIT.	X												
081 02 01 05		Subdivision of aerodynamic flow													

(01)	X	List the subdivision of aerodynamic flow: — subsonic flow below compressibility; — subsonic flow above compressibility; — transonic flow; — supersonic flow.	X												
(02)		Describe the characteristics of the flow regimes listed above.	X												
(03)		Explain why some transport aeroplanes cruise at Mach numbers above the critical Mach number (MCRIT).	X												
081 02 02 00		Shock waves													
081 02 02 01		Definition of shock wave													
(01)	X	Define a 'shock wave'.	X												
081 02 02 02		Normal shock waves													
(01)		Describe a normal shock wave with respect to changes in: — static temperature; — static and total pressure; — velocity; — local speed of sound; — Mach number; — density.	X												
(02)		Describe a normal shock wave with respect to orientation relative to the wing surface.	X												

(03)		Explain the influence of increasing Mach number on a normal shock wave, at positive lift, with respect to: — strength; — position relative to the wing; — second shock wave at the lower surface.	X														
(04)		Explain the influence of a on shock-wave intensity and shock- wave location at constant Mach number.	X														
081 02 03 00		Effects of exceeding the critical Mach number (MCRIT)															
081 02 03 01		Critical Mach number (MCRIT)															
(01)		Define 'MCRIT'.	X														
(02)		Explain how a change in a, aeroplane weight, manoeuvres, and centre-of-gravity (CG) position influences MCRIT.	X														
081 02 03 02		Effect on lift															
(01)		Describe the behaviour of CL versus Mach number at constant a.	X														
(02)		Explain the consequences of exceeding MCRIT with respect to CL and CLMAX.	X														
(03)		Explain the change in stall indicated airspeed (IAS) with altitude.	X														
(04)		Discuss the effect on αCRIT.	X														

(05)		Explain the advantages of exceeding MCRIT in aeroplanes with supercritical aerofoils with respect to: — speed versus drag ratio; — specific range; — optimum altitude.	X												
081 02 03 03		Effect on drag													
(01)		Describe wave drag.	X												
(02)		Describe the behaviour of CD versus Mach number at constant a.	X												
(03)		Explain the effect of Mach number on the CL—CD graph.	X												
(04)		Describe the effects and hazards of exceeding MDRAG DIVERGENCE, namely: — drag rise; — instability; — Mach tuck; — shock stall.	X												
(05)		State the relation between MCRIT and MDRAG DIVERGENCE.	X												
081 02 03 04		Effect on pitching moment													
(01)		Discuss the effect of Mach number on the CP location.	X												
(02)		Describe the overall change in pitching moment and explain the 'tuck under' or 'Mach tuck' effect.	X												

(03)	X	State the requirement for a Mach trim system to compensate for the effect of the CP movement and 'tuck under' effect.	X												
(04)	X	Discuss the aerodynamic functioning of the Mach trim system.	X												
(05)		Discuss the corrective measures if the Mach trim fails.	X												
		Effect on control effectiveness													
(01)		Discuss the effects on the effectiveness of control surfaces.	X												
081 02 04 00		Intentionally left blank													
081 02 05 00		Means to influence critical Mach number (MCRIT)													
081 02 05 01		Wing sweep													
(01)		Explain the influence of the angle of sweep on: — MCRIT; — effective thickness/chord change or velocity component perpendicular to the quarter chord line.	X												
(02)		Describe the influence of the angle of sweepback at subsonic speed on: — CLMAX; — efficiency of and requirement for high-lift devices; — pitch-up stall behaviour.	X												
(03)		Discuss the effect of wing sweepback on drag.	X												
081 02 05 02		Aerofoil shape													

(01)		Explain the use of thin aerofoils with reduced camber.	X												
(02)		Explain the main purpose of supercritical aerofoils.	X												
(03)		Intentionally left blank													
(04)		Explain the advantages and disadvantages of supercritical aerofoils for wing design.	X												
081 02 05 03		Vortex generators													
(01)		Explain the use of vortex generators as a means to avoid or restrict flow separation caused by the presence of a normal shock wave.	X												
081 03 00 00		Stall, Mach tuck, and upset prevention and recovery													
081 03 01 00		The stall													
081 03 01 01		Flow separation at increasing α													
(01)	X	Define the 'boundary layer'.	X	X											
(02)	X	Describe the thickness of a typical laminar and turbulent boundary layer.	X	X											
(03)		Describe the properties, advantages and disadvantages of the laminar boundary layer.	X	X											
(04)		Describe the properties, advantages and disadvantages of the turbulent boundary layer.	X	X											
(05)		Define the 'transition point'.	X	X											
(06)		Explain why the laminar boundary layer separates easier than the turbulent boundary layer does.	X	X											

(07)		Describe why the airflow over the aft part of a wing slows down as the α increases.	X	X											
(08)		Define the 'separation point' and describe its location as a function of α.	X	X											
(09)	X	Define αCRIT.	X	X											
(10)		Describe in straight and level flight the influence of increasing the α and the phenomenon that may occur regarding: — the forward stagnation point; — the pressure distribution; — the CP location (straight and swept-back wing); — CL; — CD and D (drag); — the pitching moment (straight and swept-back wing); — buffet onset; — deterrent buffet for a clean wing at high Mach number; — lack of pitch authority; — uncommanded pitch down; — uncommanded roll.	X	X											
(11)		Explain what causes the possible natural buffet on the aeroplane in a pre-stall condition.	X	X											
(12)		Describe the effectiveness of the flight controls in a pre-stall condition.	X	X											

(13)		Describe and explain the normal post-stall behaviour of a straight-wing aeroplane.	X	X											
(14)		Describe the effect and dangers of using the controls close to the stall.	X	X											
(15)		Describe the deterrent buffet.	X	X											
(16)		Explain the occurrence of the deterrent buffet and why this phenomenon is considered to be a stall limit.	X	X											
081 03 01 02		The stall speed													
(01)		Explain VS0, VS1, VSR, and VS1G.	X	X											
(02)		Solve VS1G from the lift formula given varying CL.	X	X											
(03)		Describe and explain the influence of the following parameters on stall speed: — CG; — thrust component; — slipstream; — wing loading; — mass; — wing contamination; — angle of sweep; — altitude (for compressibility effects, see 081 02 03 02).	X	X											
(04)	X	Define the ‘load factor n’.	X	X											
(05)		Explain why the load factor increases in a turn.	X	X											
(06)		Explain why the load factor increases in a pull-up and decreases in a push-over manoeuvre.	X	X											

(07)		Describe and explain the influence of the 'load factor n' on stall speed.	X	X											
(08)	X	Explain the expression 'accelerated stall'. Remark: Sometimes, accelerated stall is also erroneously referred to as high-speed stall. This latter expression will not be used for Subject 081.	X	X											
(09)		Calculate the change of stall speed as a function of the load factor.	X	X											
(10)		Calculate the increase of stall speed in a horizontal coordinated turn as a function of bank angle.	X	X											
(11)		Calculate the change of stall speed as a function of the gross mass.	X	X											
081 03 01 03		The initial stall in spanwise direction													
(01)		Explain the initial stall sequence on the following planforms: — elliptical; — rectangular; — moderate and high taper; — sweepback or delta.	X	X											
(02)		Explain the purpose of aerodynamic and geometric twist (washout).	X	X											
(03)		Intentionally left blank													
(04)		Explain the influence of fences, vortilons, saw teeth, vortex generators, and strakes on engine nacelles.	X	X											
081 03 01 04		Stall warning													

(01)	X	Explain why stall warning is necessary.	X	X											
(02)	X	Explain when aerodynamic and artificial stall warnings are used.	X	X											
(03)		Explain why CS-23 and CS-25 require a margin to stall speed for take-off and landing speeds.	X	X											
(04)	X	Describe: — buffet; — stall strip; — flapper switch (leading-edge stall-warning vane); — angle-of-attack vane; — angle-of-attack probe; — stick shaker.	X	X											
(05)		Describe the recovery after: — stall warning; — stall; — stick-pusher actuation.	X	X											
081 03 01 05		Special phenomena of stall													
(01)		Intentionally left blank													
(02)		Explain the difference between power-off and power-on stalls and recovery.	X	X											
(03)		Describe stall and recovery in a climbing and descending turn.	X	X											
(04)		Describe the pitch-up effect on a swept wing aeroplane and also an aeroplane with a T-tail.	X	X											
(05)		Describe super stall or deep stall.	X	X											

(06)		Describe the philosophy behind the stick-pusher system.	X	X											
(07)		Describe the factors that can lead to the absence of stall warning and explain the associated risks.	X	X											
(08)		Describe the indications and explain the consequences of premature stabiliser stall due to ice contamination (negative tail stall).	X	X											
(09)		Describe when to expect in-flight icing.	X	X											
(10)		Explain how the effect is changed when retracting/extending lift-augmentation devices.	X	X											
(11)		Intentionally left blank													
(12)		Explain the effect of a contaminated wing on the stall speed and αCRIT.	X	X											
(13)		Explain the hazards associated with airframe contamination when parked and during ground operations in winter conditions, and the aerodynamic effects when attempting a take-off.	X	X											
(14)		Explain de-icing/anti-icing holdover time and the likely hazards after it has expired.	X	X											
(15)		Describe the aerodynamic effects of heavy tropical rain on stall speed and drag, and the appropriate mitigation in such conditions.	X	X											
081 03 01 06		The spin													
(01)		Explain how to avoid spins.	X	X											
(02)		List the factors that cause a spin to develop.	X	X											

(03)		Describe an 'incipient' and 'developed' spin, recognition and recovery.	X	X											
(04)		Describe the differences in spin attitude with forward and aft CG.	X	X											
081 03 02 00		Buffet onset boundary													
081 03 02 01		Mach buffet													
(01)		Explain shock-induced separation, and describe its relationship with Mach buffet (high speed buffet) and Mach tuck.	X												
(02)		Intentionally left blank													
081 03 02 02		Buffet onset													
(01)		Explain the concept of buffet margin, and describe the influence of the following parameters on the concept of buffet margin: — a; — Mach number; — pressure altitude; — mass; — load factor; — angle of bank; — CG location.	X												
(02)		Explain how the buffet onset boundary chart can be used to determine: — manoeuvrability; — buffet margin.	X												
(03)		Describe the consequences of exceeding MMO: light buffet, buffet onset.	X												

(04)		Explain ‘aerodynamic ceiling’ and ‘coffin corner’.	X												
(05)		Explain the concept of the ‘1.3g’ buffet margin altitude.	X												
(06)		Find (using an example graph): — buffet free range; — aerodynamic ceiling at a given mass; — load factor and bank angle at which buffet occurs at a — given mass, Mach number, and pressure altitude.	X												
(07)		Explain why descent increases the buffet free range.	X												
081 03 03 00		Situations in which buffet or stall could occur													
081 03 03 01		Explain why buffet or stall occurs													
(01)		Explain why buffet or stall could occur in the following pilot- induced situations, and the methods to mitigate them: — inappropriate take-off configuration, detailing the consequences of errors associated with leading-edge devices; — steep turns; — go-around using take-off/go-around (TOGA) setting (underslung engines).	X	X											

(02)		Explain why buffet or stall could occur in the following environmental conditions at low altitude, and how to mitigate them: — thunderstorms; — wind shear and microburst; — turbulence; — wake turbulence; — icing conditions.	X	X											
(03)		Explain why buffet or stall could occur in the following environmental conditions at high altitude, and how to mitigate them: — thunderstorms in the intertropical convergence zone (ITCZ); — jet streams; — clear-air turbulence.	X												
(04)		Explain why buffet or stall could occur in the following situations, and how to mitigate them: — inappropriate autopilot climb mode; — loss of, or unreliable, airspeed indication.	X	X											
081 03 04 00		Recognition of stalled condition													
081 03 04 01		Recognition and explanation of stalled condition													
(01)		Explain why a stalled condition can occur at any airspeed, or attitude or altitude.	X	X											

(02)		Explain that a stall may be recognised by continuous stall- warning activation accompanied by at least one of the following: — buffet, that can be heavy; — lack of pitch authority; — uncommanded pitch down and uncommanded roll; — inability to arrest the descent rate.	X	X											
(03)		Explain that 'stall warning' means a natural or synthetic indication provided when approaching the stall that may include one or more of the following indications: — aerodynamic buffeting; — reduced roll stability and aileron effectiveness; — visual or aural clues and warnings; — reduced elevator (pitch) authority; — inability to maintain altitude or arrest a rate of descent; — stick-shaker activation.	X	X											
081 04 00 00		STABILITY													
081 04 01 00		Static and dynamic stability													
081 04 01 01		Basics and definitions													
(01)		Define 'static stability': — describe/identify a statically stable, neutral, and unstable condition (positive, neutral, and negative	X	X											

		static stability), and — explain why aeroplanes are statically stable.													
(02)		Explain manoeuvrability.	X	X											
(03)		Explain the relationship between static stability and manoeuvrability.	X	X											
(04)		Define 'dynamic stability': — describe/identify a dynamically stable, neutral, and unstable motion (positive, neutral, and negative dynamic stability); — describe/identify periodic and aperiodic motion.	X	X											
(05)		Intentionally left blank													
081 04 01 02		Precondition for static stability													
(01)	X	Explain an equilibrium of forces and moments as the initial condition for static stability.	X	X											
081 04 01 03		Sum of forces													
(01)	X	Identify the forces considered in the equilibrium of forces.	X	X											
081 04 01 04		Sum of moments													
(01)		Identify the moments about all three axes considered in the equilibrium of moments.	X	X											
(02)		Discuss the effect of sum of moments not being zero.	X	X											
081 04 02 00		Intentionally left blank													

081 04 03 00		Static and dynamic longitudinal stability													
081 04 03 01		Methods for achieving balance													
(01)	X	Explain the stabiliser as the means to satisfy the condition of nullifying the total sum of the moments about the lateral axis.	X	X											
(02)		Explain the influence of the location of the wing CP relative to the CG on the magnitude and direction of the balancing force on the stabiliser.	X	X											
(03)		Explain the influence of the indicated airspeed on the magnitude and direction of the balancing force on the stabiliser.	X	X											
(04)		Explain the use of the elevator deflection or stabiliser angle for the generation of the balancing force and its direction.	X	X											
(05)		Explain the elevator deflection required to balance thrust change as a function of engine position.	X	X											
081 04 03 02		Static longitudinal stability													
(01)		Discuss the effect of the CG location on pitch manoeuvrability and longitudinal stability.	X	X											
081 04 03 03		Neutral point													
(01)	X	Define ‘neutral point’.	X	X											
(02)	X	Explain why the location of the neutral point is only dependent on the aerodynamic design of the aeroplane.	X	X											
081 04 03 04		Factors affecting neutral point													

(01)		Describe the location of the neutral point relative to the locations of the aerodynamic centre of the wing and tail.	X	X											
081 04 03 05		Location of centre of gravity (CG)													
(01)		Explain the influence of the CG location on the static longitudinal stability of the aeroplane.	X	X											
(02)		Explain the CG forward and aft limits with respect to: longitudinal control forces; elevator effectiveness; stability.	X	X											
(03)		Define 'static margin'.	X	X											
081 04 03 06		The Cm—a graph													
(01)	X	Describe the Cm—a graph with respect to the relationship between the slope of the graph and static stability.	X	X											
081 04 03 07		Factors affecting the Cm—a graph													
(01)		Explain: — the effect on the Cm—a graph of a shift of CG in the forward and aft direction; — the effect on the Cm—a graph when the elevator is moved up or down; — the effect on the Cm—a graph when the trim is moved; — the effect of the wing contribution; — the tail contribution.	X	X											
081 04 03 08		Intentionally left blank													
081 04 03 09		Intentionally left blank													

081 04 03 10		The stick force versus speed graph (IAS)													
(01)		Explain how a pilot perceives stable static longitudinal stick force stability regarding changes in: — speed; — altitude; — mass distribution (CG location).	X	X											
081 04 03 11		Intentionally left blank													
081 04 03 12		The manoeuvring stability/stick force per g													
(01)	X	Define the 'stick force per g', and describe that the stick force increases linearly with increase in g.	X	X											
(02)		Explain why: — the stick force per g has a prescribed minimum and maximum value; — the stick force per g decreases with pressure altitude.	X	X											
081 04 03 13		Intentionally left blank													
081 04 03 14		Factors affecting the manoeuvring stability/stick force per g													
(01)		Explain the influence on stick force per g of: — CG location; — trim setting.	X	X											
081 04 03 15		Intentionally left blank													
081 04 03 16		Dynamic longitudinal stability													

(01)		Describe the phugoid and short-period motion in terms of period, damping, variations (if applicable) in speed, altitude, and α.	X	X											
(02)		Explain why the short-period motion is more hazardous than the phugoid.	X	X											
(03)		Describe 'pilot-induced oscillations'.	X	X											
(04)		Explain the effect of high altitude on dynamic stability.	X	X											
(05)		Describe the influence of the CG location on the dynamic longitudinal stability of the aeroplane.	X	X											
081 04 04 00		Static directional stability													
081 04 04 01		Definition and effects of static directional stability													
(01)	X	Define 'static directional stability'.	X	X											
(02)		Explain the effects of static directional stability being too weak or too strong.	X	X											
081 04 04 02		Sideslip angle													
(01)		Define 'sideslip angle'.	X	X											
(02)		Identify 13 as the symbol used for the sideslip angle.	X	X											
081 04 04 03		Yaw-moment coefficient Cn													
(01)	X	Define the 'yawing-moment coefficient Cn'.	X	X											
(02)	X	Define the relationship between Cn and 13 for an aeroplane with static directional stability.	X	X											
081 04 04 04		Cn—13 graph													

(01)	X	Explain why: — Cn depends on 13; — Cn equals zero for that 13 that provides static equilibrium about the aeroplane's normal axis; — if no asymmetric engine thrust, flight control or loading condition prevails, the equilibrium 13 equals zero.	X	X											
(02)	X	Identify how the slope of the Cn—13 graph is a measure for static directional stability.	X	X											
(03)	X	Identify how the slope of the Cn—13 graph is affected by altitude.	X	X											
081 04 04 05		Factors affecting static directional stability													
(01)		Describe how the following aeroplane components contribute to static directional stability: — wing; — fin; — dorsal fin; — ventral fin; — angle of sweep of the wing; — angle of sweep of the fin; — fuselage at high α; — strakes.	X	X											
(02)		Explain the reduction in static directional stability when the CG moves aft.	X	X											
081 04 05 00		Static lateral stability													

081 04 05 01		Definition and effects of static lateral stability													
(01)	X	Define 'static lateral stability'.	X	X											
(02)		Explain the effects of static lateral stability being too weak or too strong.	X	X											
081 04 05 02		Bank angle Ø													
(01)	X	Define 'bank angle Ø'.	X	X											
081 04 05 03		The roll-moment coefficient Cl													
(01)	X	Define the 'roll-moment coefficient Cl'.	X	X											
081 04 05 04		Contribution of sideslip angle (8)													
(01)		Explain how without coordination the bank angle (Ø) creates sideslip angle (β).	X	X											
081 04 05 05		The Cl—8 graph													
(01)	X	Describe the Cl—β graph.	X	X											
(02)	X	Identify the slope of the Cl—β graph as a measure for static lateral stability.	X	X											
(03)	X	Identify how the slope of the Cl—β graph is affected by altitude.	X	X											
081 04 05 06		Factors affecting static lateral stability													
(01)		Explain the contribution to the static lateral stability of: — dihedral, anhedral; — high wing, low wing; — sweep angle of the wing; — ventral fin; — vertical tail.	X	X											

081 04 06 00		Dynamic lateral/directional stability													
081 04 06 01		Intentionally left blank													
081 04 06 02		Tendency to spiral dive													
(01)		Explain how lateral and directional stability are coupled.	X	X											
(02)		Explain how high static directional stability and low static lateral stability may cause spiral divergence (unstable spiral dive), and under which conditions the spiral dive mode is neutral or stable.	X	X											
(03)		Describe an unstable spiral dive mode with respect to deviations in speed, bank angle, nose low-pitch attitude, and decreasing altitude.	X	X											
081 04 06 03		Dutch roll													
(01)		Describe Dutch roll.	X	X											
(02)		Explain: — why Dutch roll occurs when the static lateral stability is higher than static directional stability; — the conditions for a stable, neutral or unstable Dutch roll motion; — the function of the yaw damper; — the actions to be taken when the yaw damper is not available.	X	X											
(03)		Describe how the asymmetric nature of shock waves on both wings, at high Mach numbers, can lead to Dutch roll.	X												
081 04 06 04		Effects of altitude on dynamic stability													

(01)		Explain that increased pressure altitude reduces dynamic lateral/directional stability.	X	X											
081 05 00 00		CONTROL													
081 05 01 00		General													
081 05 01 01		Basics — The three planes and three axes													
(01)	X	Define: — lateral axis; — longitudinal axis; — normal axis.	X	X											
(02)	X	Define: — pitch angle; — bank angle (Ø); — yaw angle.	X	X											
(03)		Describe the motion about the three axes.	X	X											
(04)		Name and describe the devices that control these motions.	X	X											
081 05 01 02		Camber change													
(01)		State that camber is changed by movement of a control surface and explain the effect.	X	X											
081 05 01 03		Angle-of-attack (α) change													
(01)	X	Explain the influence of local α change by movement of a control surface.	X	X											
081 05 02 00		Pitch (longitudinal) control													
081 05 02 01		Elevator/all-flying tails													

(01)		Explain the working principle of the elevator/all-flying tail and describe its function.	X	X											
081 05 02 02		Downwash effects													
(01)		Explain the effect of downwash on the tailplane α.	X	X											
(02)		Intentionally left blank													
081 05 02 03		Intentionally left blank													
081 05 02 04		Location of centre of gravity (CG)													
(01)		Explain the relationship between elevator deflection and CG location to produce a given aeroplane response.	X	X											
(02)		Explain the effect of forward CG limit on pitch control.	X	X											
081 05 02 05		Moments due to engine thrust													
(01)		Describe the effect of engine thrust on pitching moments for different engine locations.	X	X											
081 05 03 00		Yaw (directional) control													
081 05 03 01		The rudder													
(01)		Explain the working principle of the rudder and describe its function. State the relationship between rudder deflection and the moment about the normal axis. Describe the effect of sideslip on the moment about the normal axis.	X	X											
081 05 03 02		Rudder limiting													

(01)		Explain why and how rudder deflection is limited on CAT aeroplanes.	X												
081 05 04 00		Roll (lateral) control													
081 05 04 01		Ailerons													
(01)		Explain the functioning of ailerons.	X	X											
(02)		Describe the adverse effects of aileron deflection. (Refer to Subjects 081 05 04 04 and 081 06 01 02)	X	X											
(03)		Explain why some aeroplanes have inboard and outboard ailerons.	X	X											
(04)		State that the outboard ailerons are locked beyond a given speed to prevent: — over-control; — exceeding structural limitations; — aeroelastic phenomena (flutter, divergence and aileron reversal).	X	X											
(05)		Describe the use of aileron deflection in normal flight, flight with sideslip, crosswind landings, horizontal turns, flight with one-engine-inoperative.	X	X											
(06)	X	Define 'roll rate'.	X	X											
(07)	X	List the factors that affect roll rate.	X	X											
(08)		Describe flaperons and aileron droop.	X	X											
081 05 04 02		Intentionally left blank													
081 05 04 03		Spoilers													

(01)		Explain how spoilers can be used to control the rolling movement in combination with or instead of the ailerons.	X	X											
081 05 04 04		Adverse yaw													
(01)		Explain why the use of ailerons induces adverse yaw.	X	X											
081 05 04 05		Means to avoid adverse yaw													
(01)		Explain how the following reduce adverse yaw: — Frise ailerons; — differential aileron deflection; — rudder aileron cross-coupling; — roll spoilers.	X	X											
081 05 05 00		Roll/yaw interaction													
081 05 05 01		Explain roll/yaw interaction													
(01)		Explain the secondary effect of roll.	X	X											
(02)		Explain the secondary effect of yaw.	X	X											
081 05 06 00		Means to reduce control forces													
081 05 06 01		Aerodynamic balance													
(01)		Describe the purpose of aerodynamic balance.	X	X											
(02)		Describe the working principle of the horn balance.	X	X											
(03)		Describe the working principle of the internal balance.	X	X											

(04)		Describe the working principle and application of: — balance tab; — anti-balance tab; — spring tab; — servo tab.	X	X											
081 05 06 02		Artificial means													
(01)		State the differences between fully powered controls and power-assisted controls.	X	X											
(02)		Describe power-assisted controls.	X	X											
(03)		Describe the advantages of artificial feel in fully powered control.	X	X											
081 05 07 00		Fly-by-wire (FBW)													
081 05 07 01		Control laws													
(01)		Explain which parameters may be controlled in level flight with the pitch control law.	X												
(02)		Explain the advantages of using the CG position in the FBW system.	X												
(03)		Explain what type of flight-degraded control laws may be available in case of failure.	X												
(04)		Explain what are hard and soft protections.	X												
081 05 08 00		Trimming													
081 05 08 01		Reasons to trim													
(01)		State the reasons for using trimming devices.	X	X											
(02)		Explain the difference between a trim tab and the various balance tabs.	X	X											

081 05 08 02		Trim tabs													
(01)		Describe the working principle of a trim tab including cockpit indications.	X	X											
081 05 08 03		Stabiliser trim													
(01)		Describe the working principle of stabiliser trim including the flight deck indications.	X	X											
(02)		Explain the advantages and disadvantages of a stabiliser trim compared to a trim tab.	X	X											
(03)		Explain the relationship between CG position, take-off trim setting, and stabiliser trim position.	X	X											
(04)		Explain the effect of errors in the take-off stabiliser trim setting on the rotation characteristics and stick force during take-off rotation.	X	X											
(05)		Discuss the effects of jammed and runaway stabiliser.	X	X											
(06)		Explain the consequences of a jammed stabiliser during take- off, landing, and go-around.	X	X											
081 06 00 00		LIMITATIONS													
081 06 01 00		Operating limitations													
081 06 01 01		Flutter													
(01)		Describe the phenomenon of flutter and how IAS and mass distribution affects the likelihood of flutter occurrence.	X	X											

(02)		Describe the use of mass balance to alleviate the flutter problem by adjusting the mass distribution: — wing-mounted engines on pylons; — control surface mass balance.	X	X											
(03)		Explain what is the flight envelope free of flutter.	X	X											
081 06 01 02		Intentionally left blank													
(01)		Intentionally left blank													
081 06 01 03		Landing gear/flap operating													
(01)		Describe the reason for flap/landing gear limitations. Define 'VLO'. Define 'VLE'.	X	X											
(02)		Explain why there is a difference between VLO and VLE in the case of some aeroplane types.	X	X											
(03)		Define 'VFE' and describe flap limiting speeds.	X	X											
(04)		Describe flap design features, procedures and warnings to prevent overload.	X	X											
081 06 01 04		VMO, VNO, and VNE													
(01)	X	Define 'VMO', 'VNO', and 'VNE'.	X	X											
(02)		Explain the significance of VMO, VNO and VNE, and the differences between these airspeeds.	X	X											
(03)		Explain the hazards of flying at speeds above VNE and VMO.	X	X											
081 06 01 05		MMO													
(01)		Define 'MMO' and state its limiting factors.	X												

081 06 02 00		Manoeuvring envelope													
081 06 02 01		Manoeuvring—load diagram													
(01)		Describe the manoeuvring—load diagram.	X	X											
(02)		Define limit and ultimate load factor, and explain what can happen if these values are exceeded.	X	X											
(03)		Define ‘VA’, ‘VB’, ‘VC’, and ‘VD’.	X	X											
(04)		Identify and explain the varying features on the VN diagram: — load factor ‘n’; — speed scale, equivalent airspeed; — equivalent airspeed envelope; — 1g stall speed; — stall boundary (refer to 081 03 01 02).	X	X											
(05)		Describe the relationship between VMO or VNE and VC.	X	X											
(06)		State all the manoeuvring load-factors limits applicable to CS-23 and CS-25 aeroplanes.	X	X											
(07)		Explain the relationship between VA and VS in a formula, and calculate the values.	X	X											
(08)		Explain the significance of VA and the adverse consequences of applying full, abrupt nose-up elevator deflection when exceeding VA.	X	X											
081 06 02 02		Factors affecting the manoeuvring—load diagram													
(01)		State the relationship of mass to load-factor limits and accelerated stall speed boundary limit.	X	X											

(02)		Calculate the change of VA with changing mass.	X	X											
(03)		Explain why VA loses significance at higher altitude.	X												
(04)	X	Define 'MC' and 'MD'.	X												
081 06 03 00		Gust envelope													
081 06 03 01		Gust—load diagram													
(01)		Recognise a typical gust—load diagram, and state the minimum gust speeds in ft/s, m/s and kt that the aeroplane must be designed to withstand at VB to VC and VD.	X	X											
(02)		Discuss considerations for the selection of VRA.	X	X											
(03)		Explain the adverse effects on the aeroplane when flying in turbulence.	X	X											
081 06 03 02		Factors affecting the gust—load diagram													
(01)		Describe and explain the relationship between the gust—load factor and the following: lift—curve slope, aspect ratio, angle of sweep, altitude, wing loading, weight, wing area, equivalent airspeed (EAS), and speed of vertical gust. (Note: For examination purposes, the ECQB questions will not be calculation based.)	X	X											
081 07 00 00		PROPELLERS													
081 07 01 00		Conversion of engine torque to thrust													
081 07 01 01		Explain conversion of aerodynamic force on a propeller blade													

(01)		Explain the resolution of aerodynamic force on a propeller blade element into lift and drag or into thrust and torque.	X	X											
(02)		Describe how propeller thrust and aerodynamic torque vary with IAS.	X	X											
081 07 01 02		Relevant propeller parameters													
(01)		Describe the geometry of a typical propeller blade element at the reference section: — blade chord line; — propeller rotational velocity vector; — true airspeed vector; — blade angle of attack; — pitch or blade angle; — advance or helix angle. Define ‘geometric pitch’, ‘effective pitch’, and ‘propeller slip’. Remark: For theoretical knowledge examination purposes, the following definition is used for geometric pitch: the theoretical distance a propeller would advance in one revolution at zero blade angle of attack.	X	X											
(02)		Describe how the terms ‘fine pitch’ and ‘coarse pitch’ can be used to express blade angle.	X	X											
081 07 01 03		Blade twist													
(01)	X	Define ‘blade twist’.	X	X											
(02)		Explain why blade twist is necessary.	X	X											
081 07 01 04		Fixed pitch and variable pitch/constant speed													

(01)	X	List the different types of propellers: — fixed pitch; — adjustable pitch or variable pitch (non-governing); — variable pitch (governing)/constant speed.	X	X											
(02)		Discuss the advantages and disadvantages of fixed-pitch and constant-speed propellers.	X	X											
(03)		Discuss climb and cruise propellers.	X	X											
(04)		Explain the relationship between blade angle, blade angle of attack, and airspeed for fixed and variable pitch propellers.	X	X											
(05)		Describe and explain the forces that act on a rotating blade element in normal, feathered, windmilling, and reverse operation.	X	X											
(06)		Explain the effects of changing propeller pitch at constant IAS.	X	X											
081 07 01 05		Propeller efficiency versus speed													
(01)		Define ‘propeller efficiency’.	X	X											
(02)		Explain and describe the relationship between propeller efficiency and speed (TAS) for different types of propellers.	X	X											
(03)		Explain the relationship between blade angle and thrust.	X	X											
081 07 01 06		Effects of ice on propeller													
(01)		Describe the effects and hazards of ice on a propeller.	X	X											
081 07 02 00		Engine failure													

081 07 02 01		Windmilling drag													
(01)		Describe the effects of an inoperative engine on the performance and controllability of an aeroplane: — thrust loss/drag increase; — influence on yaw moment during asymmetric power.	X	X											
081 07 02 02		Feathering													
(01)		Explain the reasons for feathering a propeller, including the effect on the yaw moment, performance and controllability.	X	X											
081 07 03 00		Design features for power absorption													
081 07 03 01		Propeller design characteristics that increase power absorption													
(01)	X	Name the propeller design characteristics that increase power absorption.	X	X											
081 07 03 02		Diameter of propeller													
(01)		Explain the reasons for restricting propeller diameter.	X	X											
081 07 03 03		Number of blades													
(01)	X	Define ‘solidity’.	X	X											
(02)		Describe the advantages and disadvantages of increasing the number of blades.	X	X											
081 07 03 04		Propeller noise													
(01)	X	Describe how propeller noise can be minimised.	X	X											
081 07 04 00		Secondary effects of propellers													

081 07 04 01		Torque reaction													
(01)		Describe the effects of engine/propeller torque.	X	X											
(02)		Describe the following methods for counteracting engine/propeller torque: — counter-rotating propellers; — contra-rotating propellers.	X	X											
081 07 04 02		Gyroscopic precession													
(01)	X	Describe what causes gyroscopic precession.	X	X											
(02)	X	Describe the effect on the aeroplane due to the gyroscopic effect.	X	X											
081 07 04 03		Slipstream effect													
(01)		Describe the possible effects of the rotating propeller slipstream.	X	X											
081 07 04 04		Asymmetric blade effect													
(01)		Explain the asymmetric blade effect (also called P factor).	X	X											
(02)		Explain the influence of direction of rotation on the critical engine on twin-engine aeroplanes.	X	X											
081 07 04 05		Consideration of propeller effects													
(01)		Describe, given direction of propeller rotation, the propeller effects during take-off run, rotation and initial climb, and their consequence on controllability.	X	X											
(02)		Describe, given the direction of propeller rotation, the propeller effects during a go-around and their consequence on controllability.	X	X											

(03)		Explain how the propeller effects during go-around can be affected by: high engine performance conditions and their effect on the VMC speeds; loss of the critical engine; crosswind; high flap setting;	X	X											
081 08 00 00		FLIGHT MECHANICS													
081 08 01 00		Forces acting on an aeroplane													
081 08 01 01		Straight, horizontal, steady flight													
(01)	X	Describe the forces that act on an aeroplane in straight, horizontal, and steady flight.	X	X											
(02)	X	List the four forces and state where they act on.	X	X											
(03)		Explain how the four forces are balanced, including the function of the tailplane.	X	X											
081 08 01 02		Straight, steady climb													
(01)	X	Define ‘flight-path angle’ (g).	X	X											
(02)		Describe the relationship between pitch attitude, g and α for zero-wind and zero-bank conditions.	X	X											
(03)	X	Describe the forces that act on an aeroplane in a straight, steady climb.	X	X											
(04)		Name the forces parallel and perpendicular to the direction of flight. — Apply the formula relating to the parallel forces (T = D + W sin g). — Apply the formula relating to the perpendicular forces (L = W cos g).	X	X											

(05)		Explain why thrust is greater than drag.	X	X											
(06)		Explain why lift is less than weight.	X	X											
(07)		Explain the formula (for small angles) that gives the relationship between g, thrust, weight, and lift–drag ratio, and use this formula for simple calculations.	X	X											
(08)		Explain how IAS, α, and g change in a climb performed with constant vertical speed and constant thrust setting.	X	X											
081 08 01 03		Straight, steady descent													
(01)	X	Describe the forces that act on an aeroplane in a straight, steady descent.	X	X											
(02)		Name the forces parallel and perpendicular to the direction of flight. — Apply the formula for forces parallel to the direction of flight (T = D – W sin g). — Apply the formula relating to the perpendicular forces (L = W cos g).	X	X											
(03)		Explain why lift is less than weight.	X	X											
(04)		Explain why thrust is less than drag.	X	X											
081 08 01 04		Straight, steady glide													
(01)	X	Describe the forces that act on an aeroplane in a straight, steady glide.	X	X											

(02)		Name the forces parallel and perpendicular to the direction of flight. — Apply the formula for forces parallel to the direction of flight (D = W sin g). — Apply the formula for forces perpendicular to the direction of flight (L = W cos g).	X	X											
(03)		Describe the relationship between the glide gradient and the lift–drag ratio, and calculate glide range given: — initial height; — L–D ratio; — glide speed and wind speed.	X	X											
(04)		Define VMD (speed for minimum drag) and explain the relationship between α, VMD and the best lift–drag ratio.	X	X											
(05)		Explain the effect of wind component on glide angle, duration, and distance.	X	X											
(06)		Explain the effect of mass change on glide angle, duration, and distance, given that the aeroplane remains at either the same airspeed or at VMD.	X	X											
(07)		Explain the effect of configuration change on glide angle and duration.	X	X											
(08)		Describe the relation between TAS, gradient of descent, and rate of descent.	X	X											

(09)		Define VMP (speed for minimum power) and describe that the minimum rate of descent in the glide will be at VMP, and explain the relationship of this speed to the optimum speed for minimum glide angle.	X	X											
(10)		Discuss when a pilot could elect to fly for minimum glide rate of descent or minimum glide angle, and why speed stability or headwinds/tailwinds may favour a speed that is faster or slower than the optimum airspeed in still air.	X	X											
081 08 01 05		Steady, coordinated turn													
(01)		Describe the forces that act on an aeroplane in a steady, coordinated turn.	X	X											
(02)		Resolve the forces that act horizontally and vertically during a coordinated turn (tanf = V2/gR).	X	X											
(03)		Describe the difference between a coordinated and an uncoordinated turn, and describe how to correct an uncoordinated turn using turn and slip indicator or turn coordinator.	X	X											
(04)		Explain why the angle of bank is independent of mass, and that it only depends on TAS and radius of turn.	X	X											
(05)		Resolve the forces to show that for a given angle of bank the radius of turn is determined solely by airspeed (tanf = V2/gR).	X	X											
(06)		Calculate the turn radius of a steady turn given TAS and angle of bank.	X	X											

(07)		Explain the effects of bank angle on: — load factor (LF = 1/cosf); — α; — thrust; — drag.	X	X											
(08)	X	Define 'angular velocity'.	X	X											
(09)	X	Define 'rate of turn' and 'rate-1 turn'.	X	X											
(10)		Explain the influence of TAS on rate of turn at a given bank angle.	X	X											
(11)		Calculate the load factor and stall speed in a turn given angle of bank and 1g stall speed.	X	X											
(12)		Explain situations in which turn radius is relevant for safety, such as maximum speed limits on departure or arrival plates, or outbound speed categories on approach plates, and the implications/hazards of exceeding given speeds.	X	X											
(13)		Describe the hazards of excessive use of rudder to increase the rate of turn in a swept-wing aeroplane.	X	X											
081 08 02 00		Asymmetric thrust													
081 08 02 01		Jet-engined and propeller-driven aeroplanes													
(01)		Describe the effects on the aeroplane of asymmetric thrust during flight, for both jet-engined and propeller-driven aeroplanes.	X	X											
(02)		Explain critical engine, and explain, for a propeller-driven aeroplane, the effect of the direction of propeller rotation.	X	X											

(03)	X	Explain the effect of steady, asymmetric flight on a conventional (ball) slip indicator/turn indicator.	X	X											
(04)		Explain the effect of a crosswind on asymmetric flight.	X	X											
081 08 02 02		Balanced moments about the normal axis													
(01)		Explain the yaw moments about the CG.	X	X											
(02)		Explain the change to the yaw moment caused by the effect of air density on thrust.	X	X											
(03)		Describe the changes to the yaw moment caused by engine distance from CG.	X	X											
(04)		Describe the methods to achieve directional balance following engine loss.	X	X											
081 08 02 03		Forces parallel to the lateral axis													
(01)		Explain: — the force on the vertical fin; — the fuselage side force due to sideslip (using wing-level method); — the use of bank angle to tilt the lift vector (in wing-down method).	X	X											
(02)		Explain: — α; — side slip; — loads on the fin; — α on the fin.	X	X											
(03)		Explain the effect on fin α due to sideslip.	X	X											

081 08 02 04		Influence of aeroplane mass													
(01)		Explain why controllability with one-engine-inoperative is a typical problem arising from the low speeds associated with low aeroplane mass.	X	X											
081 08 02 05		Intentionally left blank													
081 08 02 06		Intentionally left blank													
081 08 02 07		Intentionally left blank													
081 08 02 08		Minimum control speed (VMC)													
(01)		Define 'VMC'.	X	X											
(02)		Describe how VMC is determined.	X	X											
(03)		Explain the influence of the CG location.	X	X											
081 08 02 09		Minimum control speed during approach and landing (VMCL)													
(01)		Define 'VMCL'.	X	X											
(02)		Describe how VMCL is determined.	X	X											
(03)		Explain the influence of the CG location.	X	X											
081 08 02 10		Minimum control speed on the ground (VMCG)													
(01)		Define 'VMCG'.	X	X											
(02)		Describe how VMCG is determined.	X	X											
(03)		Explain the influence of the CG location.	X	X											
081 08 02 11		Influence of density													
(01)		Describe the influence of density on thrust during asymmetric flight.	X	X											
(02)		Explain why VMC, VMCL and VMCG reduce with reduction in thrust.	X	X											

081 08 03 00		Significant points on a polar curve													
081 08 03 01		Identify and explain													
(01)		Identify and explain the significant points on a polar curve.	X	X											
082 00 00 00		PRINCIPLES OF FLIGHT —— HELICOPTERS													
082 01 00 00		SUBSONIC AERODYNAMICS													
082 01 01 00		Basic concepts, laws and definitions													
082 01 01 01		International system of units of measurement (SI) and conversion of SI units													
(01)	X	List the fundamental quantities and units in SI, such as mass (kg), length (m), time (s).			X	X	X								
(02)	X	Be able to convert imperial units to SI units and vice versa.			X	X	X								
082 01 01 02		Definitions and basic concepts of air													
(01)	X	Describe air temperature and pressure as functions of height.			X	X	X								
(02)	X	Define the International Standard Atmosphere (ISA).			X	X	X								
(03)	X	Define air density, and explain the relationship between air density, pressure, and temperature.			X	X	X								
(04)	X	Explain the influence of moisture content on air density.			X	X	X								
(05)	X	Define pressure altitude and air density altitude.			X	X	X								
082 01 01 03		Newton's laws													

(01)	X	State and interpret Newton's three laws of motion.			X	X	X								
(02)	X	Distinguish between mass and weight, and their units.			X	X	X								
082 01 01 04		Basic concepts of airflow													
(01)	X	Describe steady and unsteady airflow.			X	X	X								
(02)	X	Define 'streamline' and 'stream tube'.			X	X	X								
(03)	X	Explain the principle of the continuity equation or the conservation of mass.			X	X	X								
(04)	X	Describe the mass flow rate through a stream tube section.			X	X	X								
(05)		State Bernoulli's equation and use it to explain and define the relationship between static, dynamic and total pressure.			X	X	X								
(06)		Define the stagnation point in the flow around an aerofoil, and explain the pressure obtained at the stagnation point.			X	X	X								
(07)		Use the pitot system to explain the measurement of airspeed (no compressibility effects).			X	X	X								
(08)		Define 'TAS', 'IAS', and 'CAS'.			X	X	X								
(09)	X	Define two-dimensional airflow and its relationship to an aerofoil of infinite span (i.e. no blade tip vortices and, therefore, no induced drag). Explain the difference between two- and three-dimensional airflows.			X	X	X								
(10)	X	Explain that viscosity is a feature of any fluid (gas or liquid).			X	X	X								

(11)		Explain the tangential friction between air and the surface of an aerofoil, and the development of a boundary layer.			X	X	X								
(12)		Describe laminar and turbulent boundary layers and the transition from laminar to turbulent. Show the influence of the roughness of the surface on the position of the transition point.			X	X	X								
082 01 02 00		Two-dimensional airflow													
082 01 02 01		Aerofoil section geometry													
(01)	X	Define the terms: 'aerofoil section', 'aerofoil element', 'chord line', 'chord', 'thickness', 'thickness-to-chord ratio, 'camber line', 'camber', and 'leading-edge radius'.			X	X	X								
(02)		Describe symmetrical and asymmetrical aerofoil sections.			X	X	X								
082 01 02 02		Aerodynamic forces on aerofoil elements													
(01)		Define the angle of attack (α).			X	X	X								
(02)		Describe: — the resultant force from the pressure distribution and the friction at the element; — the resultant force from the boundary layers and the velocities in the wake; and — the loss of momentum due to friction forces.			X	X	X								
(03)		Resolve the aerodynamic force into the components of lift (L) and drag (D).			X	X	X								

(04)		Define the lift coefficient (CL) and the drag coefficient (CD).			X	X	X								
(05)		Show that the CL is a function of the α.			X	X	X								
(06)		Explain how drag is caused by pressure forces on the surfaces of an aerofoil and by friction in the boundary layers. Define the term ‘profile drag’.			X	X	X								
(07)		Define the L–D ratio.			X	X	X								
(08)		Use the lift and drag equations to show the influence of speed and density on lift and drag for a given α.			X	X	X								
(09)		Define the action line of the aerodynamic force and the CP.			X	X	X								
(10)		Know that symmetrical aerofoils have a CP that is approximately a quarter chord behind the leading edge.			X	X	X								
082 01 02 03		Stall													
(01)		Explain the boundary layer separation when α increases beyond the onset of stall and the decrease of lift and the increase of drag. Define the ‘separation point’.			X	X	X								
082 01 02 04		Disturbances due to profile contamination													
(01)		Explain ice contamination, the modification of the section profile and surfaces due to ice and snow, the influence on L and D and the L–D ratio, the influence on α (at stall onset), and the effect of the increase in weight.			X	X	X								

(02)		Explain the effect of erosion by heavy rain on the blade and subsequent increase in profile drag.			X	X	X								
082 01 03 00		Three-dimensional airflow around a blade													
082 01 03 01		The blade													
(01)		Describe the various blade planforms.			X	X	X								
(02)		Define aspect ratio and blade twist.			X	X	X								
082 01 03 02		Airflow pattern and influence on lift (L)													
(01)		Explain the spanwise flow around a blade and the appearance of blade tip vortices which are a loss of energy.			X	X	X								
(02)		Show that the strength of the vortices increases as α and L increase.			X	X	X								
(03)		Show that downwash causes vortices.			X	X	X								
(04)		Define the relative airflow as the resultant of the undisturbed air velocity and induced velocity, and define α.			X	X	X								
(05)		Explain the spanwise L distribution and the way in which it can be modified by twist (washout).			X	X	X								
082 01 03 03		Induced drag													
(01)		Explain induced drag and the influence of α and aspect ratio.			X	X	X								
082 01 03 04		The airflow around the fuselage													

(01)		Describe the fuselage and the external components that cause (parasite) drag, the airflow around the fuselage, and the influence of the pitch angle of the fuselage. Describe fuselage shapes that minimise drag.			X	X	X								
(02)		Define profile drag as the sum of pressure (form) drag and skin friction drag.			X	X	X								
(03)		Define 'interference drag'.			X	X	X								
(04)		Know the drag formula.			X	X	X								
082 02 00 00		TRANSONIC AERODYNAMICS and COMPRESSIBILITY EFFECTS													
082 02 01 00		Airflow speeds and velocities													
082 02 01 01		Speeds and Mach number													
(01)		Define the speed of sound in air.			X	X	X								
(02)		State that the speed of sound is proportional to the square root of the absolute temperature (in Kelvins).			X	X	X								
(03)		Explain the variation in the speed of sound with altitude.			X	X	X								
(04)		Define Mach number.			X	X	X								
(05)		Explain the meaning of incompressibility and compressibility of air; relate this to the value of the Mach number.			X	X	X								
(06)		Define high subsonic, transonic and supersonic flows in relation to the value of the Mach number.			X	X	X								
082 02 01 02		Shock waves													

(01)		Describe shock waves in a supersonic flow and the changes in pressure and speed.			X	X	X								
(02)		Describe the appearance of local supersonic flows on the surfaces of a blade.			X	X	X								
082 02 01 03		Influence of aerofoil section and blade planform													
(01)		Explain the different shapes that allow higher Mach numbers without generating a shock wave on the upper surface, such as: — reducing the section thickness-to-chord ratio; — a planform with a sweep angle.			X	X	X								
082 03 00 00		ROTORCRAFT TYPES													
082 03 01 00		Rotorcraft													
082 03 01 01		Rotorcraft types													
(01)		Explain the difference between an autogyro and a helicopter.			X	X	X								
082 03 02 00		Helicopters													
082 03 02 01		Helicopter configurations													
(01)		Describe (briefly) the single-main-rotor helicopter and other configurations: tandem, coaxial, side-by-side, synchrocopter (with intermeshing blades), the compound helicopter and tilt rotor.			X	X	X								
082 03 02 02		The helicopter, characteristics and associated terminology													
(01)		Mention the tail rotor, the Fenestron, and the no tail rotor (NOTAR).			X	X	X								

(02)		Define the rotor disc area and the blade area.			X	X	X								
(03)		Describe the teetering rotor with its hinge axis on the shaft axis, and rotors with more than two blades with offset hinge axes.			X	X	X								
(04)		Define the fuselage centre line and the three axes: roll, pitch, and normal (yaw).			X	X	X								
(05)		Define gross weight and gross mass (and the units involved), disc and blade loading.			X	X	X								
082 04 00 00		MAIN-ROTOR AERODYNAMICS													
082 04 01 00		Hover flight outside ground effect													
082 04 01 01		Airflow through the rotor disc and around the blades													
(01)	X	Based on Newton's second law (momentum), explain that the upward vertical force from the disc, i.e. the rotor thrust, is the result of vertical downward velocities inside the rotor disc.			X	X	X								
(02)		Explain why the production of the induced flow requires power applied to the shaft, i.e. induced power. Induced power is least if the induced velocities have the same value on the whole disc (i.e. there is uniformity of flow over the disc).			X	X	X								
(03)		Explain why vertical rotor thrust must be higher than the weight of the helicopter because of the vertical drag on the fuselage.			X	X	X								
(04)		Define the pitch angle and the α of a blade element.			X	X	X								

(05)		Explain L and D relating to a blade element (including induced and profile drag).			X	X	X								
(06)		Explain the necessity for collective pitch angle changes, the influence on the α and rotor thrust, and the need for blade feathering.			X	X	X								
(07)		Describe the different blade shapes (as viewed from above).			X	X	X								
(08)		Explain how profile drag on the blade elements generates a torque on the main shaft, and define the resulting rotor profile power.			X	X	X								
(09)		Explain the influence of air density on the required powers.			X	X	X								
082 04 01 02		Anti-torque force and tail rotor													
(01)		Using Newton's third law (motion), explain the need for tail- rotor thrust, the required value being proportional to main-rotor torque. Show that tail-rotor power is proportional to tail-rotor thrust.			X	X	X								
(02)		Explain the necessity for feathering of the tail-rotor blades and their control by the yaw pedals, and the maximum and minimum values of the pitch angles of the blades.			X	X	X								
082 04 01 03		Total power required and hover outside ground effect (HOGE)													
(01)		Define ancillary equipment and its power requirement.			X	X	X								
(02)		Define the total power required.			X	X	X								

(03)	X	Describe the influence of ambient pressure, temperature and moisture on the required power.			X	X	X								
082 04 02 00		Vertical climb													
082 04 02 01		Relative airflow and angles of attack (α)													
(01)	X	Describe the dependence of the vertical climb speed on the opposite vertical air velocity relative to the rotor disk.			X	X	X								
(02)		Explain how α is controlled by the collective pitch angle control.			X	X	X								
082 04 02 02		Power and vertical speed													
(01)		Define total main-rotor power as the sum of parasite power, induced power, climb power, and rotor profile power.			X	X	X								
(02)		Explain why the total main-rotor power required increases when the rate of climb increases.			X	X	X								
082 04 03 00		Forward flight													
082 04 03 01		Airflow and forces in uniform inflow distribution													
(01)		Explain the assumption of a uniform inflow distribution on the rotor disc.			X	X	X								
(02)		Show the upstream air velocities relative to the blade elements and the different effects on the advancing and retreating blades. Define the area of reverse flow. Explain the influence of forward speed on the circumferential speed of the blade tip.			X	X	X								

(03)		Assuming constant pitch angles and rigid blade attachments, explain the roll moment from the asymmetric distribution of L.			X	X	X								
(04)		Show that through cyclic feathering this imbalance could be eliminated by a low α (accomplished by a low pitch angle) on the advancing blade, and a high α (accomplished by a high pitch angle) on the retreating blade.			X	X	X								
(05)		Describe the high air velocity at the advancing blade tip and the compressibility effects which limit maximum speed.			X	X	X								
(06)		Describe the low air velocity on the retreating blade tip resulting from the difference between the circumferential speed and forward speed, the need for high α, and the onset of stall.			X	X	X								
(07)		Define the blade tip speed ratio.			X	X	X								
(08)		Explain the total rotor thrust that is perpendicular to the rotor disc and the need for tilting the thrust vector forward.			X	X	X								
(09)		Explain the conditions of equilibrium in steady straight and level flight.			X	X	X								
082 04 03 02		The flare (powered flight)													
(01)		Explain the flare in powered flight, the rearward tilt of the rotor disc and the thrust vector. Show the horizontal thrust component that is in the opposite direction to forward velocity.			X	X	X								

(02)		State the increase in thrust due to the upward inflow, and show the modifications in the α.			X	X	X								
(03)		Explain the increase in rotor rpm for a non-governed rotor.			X	X	X								
082 04 03 03		Non-uniform inflow distribution in relation to inflow roll													
(01)		Describe the inflow distribution which modifies α and L especially on the advancing and retreating blades.			X	X	X								
082 04 03 04		Power and maximum speed													
(01)		Explain that the induced velocities and power values decrease as the speed of the helicopter increases.			X	X	X								
(02)		Define profile drag and profile power, and the increase in their values with the speed of the helicopter.			X	X	X								
(03)		Define parasite drag and parasite power, and the increase in their values with the speed of the helicopter.			X	X	X								
(04)		Define total drag and its increase with the speed of the helicopter.			X	X	X								
(05)		Describe the power required for the tail rotor and the power required by ancillary equipment.			X	X	X								
(06)		Define the total power requirement as a sum of the above partial powers, and explain how it varies with the speed of the helicopter.			X	X	X								

(07)		Explain the influence of helicopter mass, air density, and additional external equipment on the partial powers and the total power required.			X	X	X								
(08)		Describe translational lift and show the decrease in required total power as the helicopter increases its speed from the hover.			X	X	X								
082 04 04 00		Hover and forward flight in ground effect													
082 04 04 01		Airflow in ground effect, downwash													
(01)		Explain how the vicinity of the ground changes the downward flow pattern and the consequences on lift (thrust) at constant rotor power. Show that ground effect depends on the height of the rotor above the ground and the rotor diameter. Show the required rotor power at constant all-up mass (AUM) as a function of height above the ground. Describe the influence of forward speed.			X	X	X								
082 04 05 00		Vertical descent													
082 04 05 01		Vertical descent, power on													
(01)		Describe the airflow around the rotor disc in a trouble-free vertical descent, power on, the airflow opposing the helicopter's velocity, the relative airflow, and α.			X	X	X								
(02)		Explain the vortex-ring state, also known as settling with power. State the approximate vertical descent speeds that allow the formation			X	X	X								

		of vortex ring, related to the values of the induced velocities.													
(03)		Describe the airflow relative to the blades, the root stall, the loss of lift at the blade tip, and the turbulence. Show the effect of raising the lever and describe the effects on the controls.			X	X	X								
082 04 05 02		Autorotation													
(01)		State the need for early recognition and for a quick initiation of recovery. Describe the recovery actions.			X	X	X								
(02)		Explain that the collective lever must be lowered quickly enough to avoid a rapid decay of rotor rpm due to drag on the blades, and explain the influence of rotational inertia of the rotor on the rate of decay.			X	X	X								
(03)		Show the induced flow through the rotor disc, the rotational velocity and relative airflow, the inflow and inflow angles.			X	X	X								
(04)		Show how the aerodynamic forces on the blade elements vary from root to tip and distinguish three zones: the inner stalled region, the middle driving region, and the driven region.			X	X	X								
(05)		Explain the control of the rotor rpm with collective pitch.			X	X	X								
(06)		Show the need for negative tail-rotor thrust with yaw control.			X	X	X								

(07)		Explain the final increase in rotor thrust caused by raising the collective pitch to decrease the vertical descent speed and the decay in rotor rpm.			X	X	X								
082 04 06 00		Forward flight — autorotation													
082 04 06 01		Airflow at the rotor disc													
(01)		Explain the factors that affect inflow angle and α, the autorotative power distribution, and the dissymmetry over the rotor disc in forward flight.			X	X	X								
082 04 06 02		Flight and landing													
(01)		Show the effect of forward speed on the vertical descent speed.			X	X	X								
(02)		Explain the effects of gross weight, rotor rpm, and altitude (density) on endurance and range.			X	X	X								
(03)		Explain the manoeuvres for turning and touchdown.			X	X	X								
(04)		Explain the height—velocity curves.			X	X	X								
082 05 00 00		MAIN-ROTOR MECHANICS													
082 05 01 00		Flapping of the blade in hover													
082 05 01 01		Intentionally left blank													
082 05 01 02		Centrifugal turning moment (CTM)													
(01)		Describe the centrifugal forces on the mass elements of a blade with pitch applied and the components of those forces. Show how the forces generate a moment that tries to reduce the blade pitch angle.			X	X	X								

(02)		Explain the methods of counteracting CTM with hydraulics, bias springs, and balance masses.			X	X	X								
082 05 01 03		Coning angle in the hover													
(01)		Define the tip path plane and the coning angle.			X	X	X								
(02)		Show how the equilibrium of the moments about the flapping hinge of lift (thrust) and of the centrifugal force determine the coning angle of the blade (the blade mass being negligible).			X	X	X								
(03)		Justify the lower limit of rotor rpm.			X	X	X								
(04)		Explain the effect of the mass of a blade on the tip path and the tracking.			X	X	X								
082 05 02 00		Flapping angles of the blade in forward flight													
082 05 02 01		Forces on the blade in forward flight without cyclic feathering													
(01)		Assume rigid attachments of the blade to the hub and show the periodic lift, moment and stresses on the attachment, the ensuing metal fatigue, the roll moment on the helicopter, and justify the necessity for a flapping hinge.			X	X	X								
(02)		Assume no cyclic pitch and describe the lift on the advancing and retreating blades.			X	X	X								
(03)		State the azimuthal phase lag (90° or less) between the input (applied pitch) and the output (flapping angle). Explain flapback (the rearward tilting of the tip path plane and total rotor thrust).			X	X	X								
082 05 02 02		Cyclic pitch (feathering) in forward flight													

(01)		Show that in order to assume and maintain forward flight, the total rotor thrust vector must obtain a forward component by tilting the tip path plane.			X	X	X								
(02)		Show how the applied cyclic pitch modifies the lift on the advancing and retreating blades and produces the required forward tilting of the tip path plane and the total rotor thrust.			X	X	X								
(03)		Show the cone described by the blades and define the virtual axis of rotation. Define the plane of rotation.			X	X	X								
(04)		Define the reference system in which the movements are defined: the shaft axis and the hub plane.			X	X	X								
(05)		Describe the swash plates, the pitch links and horns. Explain how the collective lever moves the non-rotating swash plate up or down the shaft axis.			X	X	X								
(06)		Describe the mechanism by which the desired cyclic blade pitch can be produced by tilting the swash plate with the cyclic stick.			X	X	X								
(07)		Explain the translational lift effect when the speed increases.			X	X	X								
(08)	X	Justify the increase of the tilt angle of the thrust vector and of the disc in order to increase the speed.			X	X	X								
082 05 03 00		Blade-lag motion in forward flight													

082 05 03 01		Forces on the blade in the disc plane (tip path plane) in forward flight													
(01)		Explain the Coriolis force due to flapping, the resulting periodic moments in the hub plane, and the resulting periodic stresses which make lead-lag hinges necessary to avoid material fatigue.			X	X	X								
(02)		Describe the profile drag forces on the blade elements and the periodic variation of these forces.			X	X	X								
082 05 03 02		Intentionally left blank													
082 05 03 03		Ground resonance													
(01)		Explain the movement of the CG of the blades due to lead-lag movements in the multibladed rotor.			X	X	X								
(02)		Show the effect on the fuselage and the danger of resonance between this force and the fuselage and undercarriage when the gear touches the ground.			X	X	X								
082 05 04 00		Rotor systems													
082 05 04 01		See-saw or teetering rotor													
(01)		Explain that a teetering rotor is prone to mast bumping in low-G situations, and that it is difficult to counteract because there is no lift force to provide sideways movement.			X	X	X								
082 05 04 02		Intentionally left blank													
082 05 04 03		Hingeless rotor, bearingless rotor													

(01)		Show the forces on the flapping hinges with a large offset (virtual hinge) and the resulting moments, and compare them with other rotor systems.			X	X	X								
082 05 05 00		Blade sailing													
082 05 05 01		Blade sailing and causes													
(01)		Define blade sailing, the influence of low rotor rpm and of a headwind.			X	X	X								
082 05 05 02		Minimising the danger													
(01)		Describe actions that minimise danger and the demonstrated wind envelope for engaging and disengaging rotors.			X	X	X								
082 05 05 03		Droop stops													
(01)		Explain the purpose of droop stops, and their retraction.			X	X	X								
082 05 06 00		Vibrations due to main rotor													
082 05 06 01		Intentionally left blank													
082 06 01 02		Tail-rotor aerodynamics													
(01)		Explain the airflow around the blades in the hover and in forward flight, and the effects of the tip speeds on noise production and compressibility.			X	X	X								
(02)		Explain the effect of wind on tail-rotor aerodynamics and thrust in the hover, and any problems.			X	X	X								
(03)		Explain tail-rotor thrust and the control through pitch alterations (feathering).			X	X	X								

(04)		Explain tail-rotor flapback, and the effects of Delta 3.			X	X	X								
(05)		Describe the roll moment and drift as side effects of the tail rotor.			X	X	X								
(06)		Explain the effects of tail-rotor failure.			X	X	X								
(07)		Explain the loss of tail-rotor effectiveness (LTE), tail-rotor vortex- ring state, causes, crosswind, and yaw speed.			X	X	X								
082 06 01 03		Strakes on the tail boom													
(01)		Describe the strake and explain its function.			X	X	X								
082 07 00 00		EQUILIBRIUM, STABILITY AND CONTROL													
082 07 01 00		Equilibrium and helicopter attitudes													
082 07 01 01		Hover													
(01)		Explain why the vector sum of forces and moments must be zero in any acceleration-free situation.			X	X	X								
(02)		Indicate the forces and the moments about the lateral axis in a steady hover.			X	X	X								
(03)		Indicate the forces and the moments about the longitudinal axis in a steady hover.			X	X	X								
(04)		Deduce how the roll angle in a steady hover without wind results from the moments about the longitudinal axis.			X	X	X								
(05)		Explain how the cyclic is used to equalise moments about the lateral axis in a steady hover.			X	X	X								

(06)		Explain the consequence of the cyclic stick reaching its forward or aft limit during an attempt to take off to the hover.			X	X	X								
(07)		Explain the influence of density altitude on the equilibrium of forces and moments in a steady hover.			X	X	X								
082 07 01 02		Forward flight													
(01)		Explain why the vector sum of forces and of moments must be zero in unaccelerated flight.			X	X	X								
(02)		Indicate the forces and the moments about the lateral axis in steady straight and level flight.			X	X	X								
(03)		Explain the influence of AUM on the forces and moments about the lateral axis in forward flight.			X	X	X								
(04)		Explain the influence of the CG position on the forces and moments about the lateral axis in forward flight.			X	X	X								
(05)		Explain the role of the cyclic stick position in creating equilibrium of forces and moments about the lateral axis in forward flight.			X	X	X								
(06)		Explain how forward speed influences the fuselage attitude.			X	X	X								
(07)		Describe and explain the inflow roll effect.			X	X	X								
082 07 02 00		Stability													
082 07 02 01		Static longitudinal, roll and directional stability													
(01)		Define static stability; give an example of static stability and of static instability.			X	X	X								

(02)		Explain the contribution of the main rotor to speed stability.			X	X	X								
(03)		Describe the influence of the horizontal stabiliser on static longitudinal stability.			X	X	X								
(04)		Explain the effect of hinge offset on static stability.			X	X	X								
(05)		Describe the influence of the tail rotor on static directional stability.			X	X	X								
(06)		Describe the influence of the vertical stabiliser on static directional stability.			X	X	X								
(07)		Explain the influence of the main rotor on static roll stability.			X	X	X								
(08)		Describe the influence of the longitudinal position of the CG on static longitudinal stability.			X	X	X								
082 07 02 02		Static stability in the hover													
(01)		Describe the initial movements of a hovering helicopter after the occurrence of a horizontal gust.			X	X	X								
082 07 02 03		Dynamic stability													
(01)		Define dynamic stability; give an example of dynamic stability and of dynamic instability.			X	X	X								
(02)		Explain why static stability is a precondition for dynamic stability.			X	X	X								
082 07 02 04		Longitudinal stability													

(01)		Explain the individual contributions of α and speed stability together with the stabiliser and fuselage to dynamic longitudinal stability.			X	X	X								
082 07 02 05		Roll stability and directional stability													
(01)		Know that a large static roll stability together with a small directional stability may lead to a Dutch roll.			X	X	X								
082 07 03 00		Control													
082 07 03 01		Manoeuvre stability													
(01)		Explain how helicopter control can be limited because of available stick travel.			X	X	X								
(02)		Explain how the CG position influences the remaining stick travel.			X	X	X								
082 07 03 02		Control power													
(01)		Explain the meaning of the control moment.			X	X	X								
(02)		Explain the importance of the CG position on the control moment.			X	X	X								
(03)		Explain the influence of hinge offset on controllability.			X	X	X								
082 07 03 03		Static and dynamic rollover													
(01)		Explain the mechanism which causes dynamic rollover.			X	X	X								
(02)		Explain the required pilot action when dynamic rollover is starting to develop.			X	X	X								
082 08 00 00		HELICOPTER FLIGHT MECHANICS													
082 08 01 00		Flight limits													

082 08 01 01		Hover and vertical flight													
(01)		Show the power required for HOGE and HIGE, and the power available.			X	X	X								
(02)		Explain the effects of AUM, ambient temperature and pressure, density altitude, and moisture.			X	X	X								
(03)		Describe the rate of climb in a vertical flight.			X	X	X								
082 08 01 02		Forward flight													
(01)		Compare the power required and the power available as a function of speed in straight and level flight.			X	X	X								
(02)		Define the maximum speed limited by power and the value relative to VNE and VNO.			X	X	X								
(03)		Use the power graph to determine the speeds of maximum rate of climb and the maximum angle of climb.			X	X	X								
(04)		Use the power graph to define true airspeed (TAS) for maximum range and maximum endurance, and consider the case of piston engine and turbine engine. Explain the effects of tailwind or headwind on the speed for maximum range.			X	X	X								
(05)		Explain the effects of AUM, pressure and temperature, density altitude, and humidity.			X	X	X								
082 08 01 03		Manoeuvring													
(01)		Define the load factor, the radius, and the rate of turn.			X	X	X								

(02)		Explain the relationship between the angle of bank, the airspeed and the radius of turn, and between the angle of bank and the load factor.			X	X	X								
(03)		Explain the influence of AUM, pressure and temperature, density altitude, and humidity.			X	X	X								
082 08 02 00		Special conditions													
082 08 02 01		Operating with limited power													
(01)		Explain operations with limited power, use the power graph to show the limitations on vertical and level flight, and describe power checks and procedures for take-off and landing.			X	X	X								
(02)		Describe manoeuvres with limited power.			X	X	X								
082 08 02 02		Overpitch, overtorque													
(01)		Describe overpitching and show the consequences.			X	X	X								
(02)		Describe situations likely to lead to overpitching.			X	X	X								
(03)		Describe overtorquing and show the consequences.			X	X	X								
(04)		Describe situations likely to lead to overtorquing.			X	X	X								
090 00 00 00		COMMUNICATIONS													
090 01 00 00		CONCEPTS													
090 01 01 00		Associated terms													
090 01 01 01		Meanings and significance													
(01)		Define commonly used air traffic services (ATS) terms for stations.	X	X	X	X	X	X	X						

(02)		Define commonly used ATS terms for communication methods.	X	X	X	X	X	X	X						
(03)		Recognise the terms used in conjunction with the approach and holding procedures.	X	X	X	X	X	X	X						
090 01 01 02		Air traffic services (ATS) abbreviations													
(01)		Define commonly used ATS abbreviations: — flight conditions; — airspace; — services; — time; — VFR-related terms; — IFR-related terms; — miscellaneous.	X	X	X	X	X	X	X						
090 01 01 03		Q-code groups commonly used in radiotelephony (RT) air- ground communications													
(01)		Define Q-code groups commonly used in RT air-ground communications: — pressure settings; — directions and bearings.	X	X	X	X	X	X	X						
(02)		State the procedure for obtaining bearing information in flight.	X	X	X	X	X	X	X						
090 01 01 04		Categories of messages													
(01)		Identify to which category of messages a type of message belongs and identify the associated priority indicator.	X	X	X	X	X	X	X						

090 02 00 00		GENERAL OPERATING PROCEDURES													
090 02 01 00		Transmission standards													
090 02 01 01		Transmission of letters													
(01)		Know the phonetic alphabet used in RT.	X	X	X	X	X	X	X						
(02)		Identify the circumstances when words should be spelt out.	X	X	X	X	X	X	X						
090 02 01 02		Transmission of numbers													
(01)		Describe the method of transmission of numbers: — pronunciation; — single digits, whole hundreds and whole thousands; — state how numbers are transmitted in different circumstances.	X	X	X	X	X	X	X						
090 02 01 03		Transmission of time													
(01)		Describe the ways of transmitting time: — the standard time reference is the Coordinated Universal Time (UTC); — using only minutes, or minutes and hours, when required.	X	X	X	X	X	X	X						
(02)		Describe the different ways in which time is to be transmitted.	X	X	X	X	X	X	X						
090 02 01 04		Transmission techniques													
(01)	X	Explain the techniques used for making good RT transmissions.	X	X	X	X	X	X	X						
090 02 01 05		Standard words and phrases													
(01)		Define the meaning of standard words and phrases.	X	X	X	X	X	X	X						

(02)		Recognise, describe and use the correct standard phraseology for each phase of a VFR flight (consider communication with each type of aeronautical station): — before taxi; — taxi; — departure; — en route; — circuit; — final; — landing; — after landing.	X	X	X	X	X	X	X						
(03)		Recognise, describe and use the correct standard phraseology for each phase of an IFR flight, including PBN operations (consider communication with each type of aeronautical station): — before pushback or taxi; — pushback; — taxi; — departure; — en route; — approach; — final approach; — landing; — after landing.	X	X	X	X	X	X	X						

(04)		Explain phraseology for the selective calling system (SELCAL) and aircraft communications addressing and reporting system (ACARS).	X	X	X	X	X	X	X						
(05)		Explain traffic alert and collision avoidance system (TCAS) phraseology.	X	X	X	X	X	X	X						
090 02 01 06		RT call signs for aeronautical stations including use of abbreviated call signs													
(01)		Name the two parts of the call sign of an aeronautical station.	X	X	X	X	X	X	X						
(02)		Identify the call-sign suffixes for aeronautical stations.	X	X	X	X	X	X	X						
(03)		Explain when the call sign may be omitted or abbreviated to the use of suffix only.	X	X	X	X	X	X	X						
090 02 01 07		RT call signs for aircraft including use of abbreviated call signs													
(01)		Describe the three different ways to compose an aircraft call sign.	X	X	X	X	X	X	X						
(02)		Describe the abbreviated forms for aircraft call signs.	X	X	X	X	X	X	X						
(03)		Explain when aircraft call signs may be abbreviated.	X	X	X	X	X	X	X						
(04)		Explain when the suffix ‘HEAVY’ or ‘SUPER’ is used with an aircraft call sign.	X	X	X	X	X	X	X						
(05)		Explain the use of the phrase ‘Change your call sign to...’.	X	X	X	X	X	X	X						

(06)		Explain the use of the phrase 'Revert to flight plan call sign'.	X	X	X	X	X	X	X						
090 02 01 08		Transfer of communication													
(01)		Describe the procedure for transfer of communication: — by ground station; — by aircraft.	X	X	X	X	X	X	X						
090 02 01 09		Test procedures including readability scale													
(01)		Explain how to test radio transmission and reception.	X	X	X	X	X	X	X						
(02)		State the readability scale and explain its meaning.	X	X	X	X	X	X	X						
090 02 01 10		Read-back and acknowledgement requirements													
(01)		Describe the requirement to read back ATC route clearances.	X	X	X	X	X	X	X						
(02)		Describe the requirement to read back clearances related to the runway in use.	X	X	X	X	X	X	X						
(03)		Describe the requirement to read back other clearances including conditional clearances.	X	X	X	X	X	X	X						
(04)		Describe the requirement to read back other data such as runway, secondary surveillance radar (SSR) codes, etc.	X	X	X	X	X	X	X						
090 02 01 11		Radar procedural phraseology													

(01)		Use the correct phraseology for an aircraft receiving a radar service: — radar identification; — radar vectoring; — traffic information and avoidance; — SSR procedures.	X	X	X	X	X	X	X						
090 02 01 12		Level changes and reports													
(01)		Use the correct term to describe vertical position in relation to: — flight level (standard pressure setting); — altitude (metres/feet on QNH); — height (metres/feet on QFE).	X	X	X	X	X	X	X						
090 02 01 13		Data link messages													
(01)		List the different types of messages of the controller–pilot data link communications (CPDLC) function and give examples of data link messages.	X	X	X	X	X	X	X						
(02)		Describe a notification phase (LOG ON) and state its purpose.	X	X	X	X	X	X	X						
(03)		Explain the phrases to be used: — when voice communication is used to correct a CPDLC message; — in case of single CPDLC message failure; — when CPDLC has failed; — when reverting from CPDLC to voice communication.	X	X	X	X	X	X	X						
090 03 00 00		RELEVANT WEATHER INFORMATION													

090 03 01 00		Aerodrome weather													
090 03 01 01		Aerodrome weather terms													
(01)		List the contents of aerodrome weather reports and state units of measurement used for each item: — wind direction and speed; — variation of wind direction and speed; — visibility; — present weather; — cloud amount and type (including the definition of cloud and visibility OK (CAVOK); — air temperature and dew point; — pressure values (QNH, QFE); — supplementary information (aerodrome warnings, landing runway, runway conditions, restrictions, obstructions, wind-shear warnings, etc.).	X	X	X	X	X	X	X						
090 03 01 02		Weather broadcast													
(01)		List the sources (VOLMET and ATIS units) of weather information available for aircraft in flight, and describe situation(s) in which a pilot would normally obtain each.	X	X	X	X	X	X	X						
(02)	X	Explain the meaning of the acronyms 'D-ATIS', 'ATIS', and 'VOLMET'.	X	X	X	X	X	X	X						
(03)		Explain and demonstrate how to decode ATIS messages.	X	X	X	X	X	X	X						

(04)		Explain and demonstrate how to decode D-ATIS messages.	X	X	X	X	X	X	X						
090 04 00 00		VOICE COMMUNICATION FAILURE													
090 04 01 00		Required action													
090 04 01 01		Action required to be taken in case of communication failure													
(01)		State the action to be taken in case of communication failure on a controlled VFR flight.	X	X	X	X	X	X	X						
(02)		Identify the frequencies to be used in an attempt to establish communication.	X	X	X	X	X	X	X						
(03)		State the additional information that should be transmitted in the event of receiver failure.	X	X	X	X	X	X	X						
(04)		Identify the SSR code that may be used to indicate communication failure.	X	X	X	X	X	X	X						
(05)		Explain the action to be taken by a pilot that experiences a communication failure in the aerodrome traffic pattern at controlled aerodromes.	X	X	X	X	X	X	X						
(06)		Describe the action to be taken in case of communication failure on an IFR flight.	X	X	X	X	X	X	X						
(07)		Describe the action to be taken in case of communication failure on an IFR flight when flying in visual meteorological conditions (VMC) and the flight will be terminated in VMC.	X	X	X	X	X	X	X						

(08)		Describe the action to be taken in case of communication failure on an IFR flight when flying in instrument meteorological conditions (IMC).	X	X	X	X	X	X	X						
(09)		Explain the causes and possible safety impacts of a blocked frequency.	X	X	X	X	X	X	X						
090 05 00 00		DISTRESS AND URGENCY PROCEDURES													
090 05 01 00		Signals and procedures													
090 05 01 01		Distress													
(01)		State the DISTRESS signal(s) and DISTRESS procedure(s).	X	X	X	X	X	X	X						
(02)		Define 'DISTRESS'.	X	X	X	X	X	X	X						
(03)		Identify the frequencies that should be used by aircraft in DISTRESS.	X	X	X	X	X	X	X						
(04)		Specify the emergency SSR codes that may be used by aircraft, and the meaning of the codes.	X	X	X	X	X	X	X						
(05)		Describe the action to be taken by the station which receives a DISTRESS message.	X	X	X	X	X	X	X						
(06)		Describe the action to be taken by all other stations when a DISTRESS procedure is in progress.	X	X	X	X	X	X	X						
(07)		List the correctly sequenced elements of a DISTRESS signal/message and describe the message content.	X	X	X	X	X	X	X						
(08)		Describe the use of discrete frequencies (DEF) in case of distress or urgency.	X	X	X	X	X	X	X						
(09)		State that DISTRESS messages take priority over all other messages.	X	X	X	X	X	X	X						

090 05 01 02		Urgency													
(01)		State the URGENCY signal(s) and URGENCY procedure(s).	X	X	X	X	X	X	X						
(02)		Define ‘URGENCY’.	X	X	X	X	X	X	X						
(03)		Identify the frequencies that should be used by aircraft in URGENCY.	X	X	X	X	X	X	X						
(04)		Describe the action to be taken by the station which receives an URGENCY message.	X	X	X	X	X	X	X						
(05)		Describe the action to be taken by all other stations when an URGENCY procedure is in progress.	X	X	X	X	X	X	X						
(06)		List the correctly sequenced elements of an URGENCY signal/message and describe the message content.	X	X	X	X	X	X	X						
(07)		State that URGENCY messages take priority over all other messages except DISTRESS.	X	X	X	X	X	X	X						
090 06 00 00		VHF PROPAGATION AND ALLOCATION OF FREQUENCIES													
090 06 01 00		General principles													
090 06 01 01		Spectrum, bands, range													
(01)		Describe the radio-frequency spectrum with particular reference to VHF.	X	X	X	X	X	X	X						
(02)		Describe the radio-frequency spectrum of the bands into which the radio-frequency spectrum is divided.	X	X	X	X	X	X	X						
(03)		Identify the frequency range of the VHF band.	X	X	X	X	X	X	X						

(04)		State the band normally used for aeronautical mobile service (AMS) voice communication.	X	X	X	X	X	X	X						
(05)		State the frequency separation allocated between consecutive VHF frequencies.	X	X	X	X	X	X	X						
(06)		List the factors which reduce the effective range and quality of VHF radio transmissions.	X	X	X	X	X	X	X						
090 07 00 00		Other communications													
090 07 01 00		Weather observations, Morse code													
090 07 01 01		Meteorological observations													
(01)		Explain when aircraft routine meteorological observations should be made.	X	X	X	X	X	X	X						
(02)		Explain when aircraft special meteorological observations should be made.	X	X	X	X	X	X	X						
090 07 01 02		Use of Morse code													
(01)	X	Describe and list Morse code.	X	X	X	X	X	X	X						
(02)		Find the Morse code identifiers of radio navigation aids (VHF omnidirectional radio range (VOR), distance-measuring equipment (DME), non-directional radio beacon (NDB), instrument landing system (ILS)) using aeronautical charts.	X	X	X	X	X	X	X						
100 00 00 00		KNOWLEDGE, SKILLS AND ATTITUDES (KSA)													
100 01 00 00		ICAO CORE COMPETENCIES													

(01)		Recognise the ICAO Core Competencies listed below and the associated competency descriptions (ICAO Doc 9995 'Manual of Evidence-based Training'): — Application of Procedures; — Communication; — Aircraft Flight Path Management, automation; — Aircraft Flight Path Management, manual control; — Leadership and Teamwork; — Problem Solving and Decision Making; — Situation Awareness; — Workload Management.	X	X	X	X	X								
100 02 00 00		CORE COMPETENCIES LEARNING OBJECTIVES													
100 02 01 00		Communication													
(01)		Show the ability to identify whether the recipient is ready and able to receive the information.	X	X	X	X	X								
(02)		Show the ability to appropriately select what, when, how and with whom to communicate.	X	X	X	X	X								
(03)		Show the ability to communicate clearly, accurately and concisely.	X	X	X	X	X								
(04)		Show the ability to confirm whether the recipient correctly understands important information.	X	X	X	X	X								
(05)		Show the ability to listen actively and show you understand the information you receive.	X	X	X	X	X								

(06)		Show the ability to ask relevant and effective questions.	X	X	X	X	X										
(07)		Show the ability to adhere to standard radio-telephony phraseology.	X	X	X	X	X										
(08)		Show the ability to accurately read, interpret, construct and respond to given documentation in English.	X	X	X	X	X										
(09)		Show the ability to correctly interpret non-verbal communication.	X	X	X	X	X										
(10)		Show the ability to use appropriate eye contact, body movement and gestures that are consistent with and support verbal messages.	X	X	X	X	X										
100 02 02 00		Leadership and teamwork															
(01)		Show the ability to create an atmosphere of open communication that encourages participation.	X	X	X	X	X										
(02)		Show the initiative and the ability to give directions when required.	X	X	X	X	X										
(03)		Show the ability to admit mistakes and take responsibility.	X	X	X	X	X										
(04)		Show the ability to anticipate and respond appropriately to others' needs.	X	X	X	X	X										
(05)		Show the ability to carry out instructions when directed.	X	X	X	X	X										
(06)		Show the ability to communicate relevant concerns and intentions.	X	X	X	X	X										
(07)		Show the ability to give and receive feedback constructively.	X	X	X	X	X										

(08)		Show empathy, respect and tolerance for others.	X	X	X	X	X								
(09)		Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.	X	X	X	X	X								
(10)		Show the ability to address and resolve conflicts and disagreement in a constructive manner.	X	X	X	X	X								
(11)		Show the ability to project self-control.	X	X	X	X	X								
100 02 03 00		Problem-solving and decision-making													
(01)		Show the ability to seek accurate and adequate information from appropriate sources.	X	X	X	X	X								
(02)		Show the ability to identify and verify what and why things have gone wrong.	X	X	X	X	X								
(03)		Show the ability to employ proper problem-solving strategies.	X	X	X	X	X								
(04)		Show the ability to persevere in working through problems.	X	X	X	X	X								
(05)		Show the ability to use appropriate and timely decision-making processes.	X	X	X	X	X								
(06)		Show the ability to set priorities appropriately.	X	X	X	X	X								
(07)		Show the ability to identify and consider options effectively.	X	X	X	X	X								
(08)		Show the ability to monitor, review and adapt decisions as required.	X	X	X	X	X								
(09)		Show the ability to identify and manage risks.	X	X	X	X	X								
100 02 04 00		Situation awareness													

(01)		Demonstrate the ability to identify and assess accurately the general environment as it may affect the operation.	X	X	X	X	X								
(02)		Demonstrate the ability to identify threats, errors and undesirable aircraft states.	X	X	X	X	X								
(03)		Demonstrate the ability to manage threats, errors and undesirable aircraft states.	X	X	X	X	X								
100 02 05 00		Workload management													
(01)		Show the ability to maintain self-control.	X	X	X	X	X								
(02)		Show the ability to plan, prioritise and schedule tasks effectively.	X	X	X	X	X								
(03)		Show the ability to manage time effectively when carrying out tasks.	X	X	X	X	X								
(04)		Show the ability to offer and accept assistance, delegate when necessary and ask for help early.	X	X	X	X	X								
(05)		Show the ability to manage interruptions, distractions, variations and failures effectively.	X	X	X	X	X								
100 03 00 00		ADDITIONAL THREAT AND ERROR MANAGEMENT (TEM) RELATED LEARNING OBJECTIVES													
100 03 01 00		Application of knowledge													
(01)		Demonstrate the ability to complete pre-flight planning in practical exercises.	X	X	X	X	X								
(02)		Demonstrate the KSA and TEM relating to phases of flight in the ground training environment.	X	X	X	X	X								

100 03 02 00		Upset prevention and recovery training (UPRT) and resilience													
		Note: Resilience is defined as 'the ability to recognise, absorb and adapt to disruptions'. It is supported by the pilot's core competencies and improved by experience, which can be gained by training for unexpected events or situations.													
(01)		Recognise potential upset 'threats' and suggest effective 'threat management' in scenario situations.	X	X											
(02)		Recognise potential upset 'errors' and suggest effective 'error management' in scenario situations.	X	X											
(03)		Explain the causes of and contributing factors to upsets.	X	X											
(04)		Demonstrate resilience during scenario and/or other exercises.	X	X	X	X	X								
(05)		Show the ability to identify the signs and discuss the effects of stress, fatigue and aviation lifestyle on situation awareness, and how to cope with them in order to maintain situation awareness.	X	X	X	X	X								
100 04 00 00		MENTAL MATHS													
		Note: Demonstrate, in non-calculator test scenarios or scenario exercises, the ability in a time-efficient manner to make correct mental calculation approximations for the following.													

(01)		Convert between volumes and masses of fuel using range of units.	X	X	X	X	X								
(02)		Estimate time, distance and speed.	X	X	X	X	X								
(03)		Estimate the rate of climb or rate of descent, distance and time.	X	X											
(04)		Add or subtract time, distance, and fuel mass.	X	X	X	X	X								
(05)		Calculate fuel burn given time and fuel flow.	X	X	X	X	X								
(06)		Calculate the time available (for decision-making) given relevant fuel information.	X	X	X	X	X								
(07)		Determine the top of descent using a simple method that is described by the approved training organisation (ATO).	X	X											
(08)		Determine the values that vary by a percentage, e.g. dry-to-wet landing distance and fuel burn.	X	X	X	X	X								
(09)		Estimate heights at distances on a 3-degree glideslope.	X	X	X	X	X								
(10)		Estimate headings using the 1-in-60 rule.	X	X	X	X	X								
(11)		Estimate headwind and crosswind components given wind speed and direction and runway in use.	X	X	X	X	X								