CIVIL AVIATION DIRECTORATE
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MALTA PART-FCL PPL (A) or PPL(H) THEORETICAL EXAMS

1.0 REQUIREMENTS

1.1 Responsibilities of the applicant

(1) Applicants shall take the entire set of examinations under the responsibility of TM CAD. Students who have completed the entire set of examinations under the responsibility of another EU Member State may also apply for a Malta PPL. They would need to provide any records and verification of their certificate as requested byTM-CAD.

(2) An applicant must have completed a course of theoretical instruction at an Approved Training Organisation (ATO) before s/he can sit for the PPL theoretical examinations. For the purpose of this notice an ATO includes also a Declared Training Organisation.

Applicants shall only take the examinations when recommended by the ATO responsible for their training, once they have completed the appropriate elements of the training course of theoretical knowledge instruction to a satisfactory standard.

(3) The recommendation by the ATO shall be valid for 12 months. If the applicant has failed to attempt at least one theoretical knowledge examination paper within this period of validity, the need for further training shall be determined by the ATO, based on the needs of the applicant.

1.2 Pass standards

(1) A pass in an examination will be awarded to an applicant achieving at least 75% of the marks allocated to that examination. There is no penalty marking.

(2) An applicant has successfully completed the required theoretical knowledge examination for the private pilot licence when s/he has passed all the required examinations within a period of 18 months counted from the end of the calendar month when the applicant first attempted an examination.

(3) With effect from 11th November 2019, if an applicant has failed to pass one of the theoretical knowledge examinations within 4 attempts or has failed to pass all examinations within the period mentioned in paragraph (2), s/he shall re-take the complete set of examinations for all subjects.

Before re-taking the examinations, the applicant shall undertake further training at an ATO. The extent and scope of the training needed shall be determined by the ATO, based on the needs of the applicant.

1.3 Validity period

(1) The successful completion of the theoretical knowledge examinations will be valid for the issue of a private pilot licence, for a period of 24 months counted from the daywhen the pilot successfully completes the theoretical knowledge examination, inaccordance with (b)(2).

1.4 Terminology

The meaning of the following terms used in FCL.210 shall be as follows:

1. 'Entire set of examinations': an examination in all subjects required by the licence level.
2. 'Examination': the demonstration of knowledge in one or more examination papers.
3. 'Examination paper': a set of questions , which covers one subject required by the licence level or rating, to be answered by a candidate for examination.
4. 'Attempt': a try to pass a specific paper.
5. 'Sitting': a period established by the competent authority within which a candidate can take an examination. For all intents and purposes, TM-CAD established a PPL sitting as 3 consecutive working days. Only one attempt at each examination paper is allowed in one sitting.

2.0 EXAMINATION PROCEDURE

2.1 Subjects

An applicant for the PPL(A) or PPL(H) theoretical knowledge examinations shall be examined in the following subjects as per AMC1 FCL.210 and FCL.215:

Subject	Time (minutes)	Number of Questions
110 Air Law	45	16
140 Human Performance	30	12
150 Meteorology	30	12
190 Communications	30	12
160 Navigation	60	16

In addition, an applicant for the PPL(A) theoretical knowledge examinations shall be examined in the following 4 subjects as per AMC1 FCL.210 and FCL.215:

Subject	Time (minutes)	Number of Questions
120(A) Aircraft General Knowledge	45	16
130(A) Flight Performance and Planning	30	12
170(A) Operational Procedures	30	12
180(A) Principles of Flight	30	12

In addition, an applicant for the PPL(H) theoretical knowledge examinations shall be examined in the following 4 subjects as per AMC1 FCL.210 and FCL.215:

Subject	Time (minutes)	Number of Questions
120(H) Aircraft General Knowledge	45	16
130(H) Flight Performance and Planning	30	12
170(H) Operational Procedures	30	12
180(H) Principles of Flight	30	12

2.2 Frequency

TM CAD will conduct the Part-FCL PPL theory exams with a frequency of approximately once every three weeks.

The sitting schedule will be published on the Transport Malta website.

In special circumstances additional sittings may be coordinated with TM-CAD subject to staff and room availability and at an extra charge. This request shall be made in writing to the Director General for Civil Aviation and/or Head of Personnel Licensing.

2.3 Application Forms and Examination Slots

TM CAD will be providing 3 examination slots on the published examination dates;

- From 09:00hrs – 11:00hrs
- From 12:00hrs – 13:00hrs
- From 13:30hrs – 15:30hrs

When applying for an examination, candidates are to select their preferred slot however slots are limited to a first come first served basis and TM-CAD officers will allocate the next available slot to accommodate all applications. Should there not be a slot available, a TM- CAD officer will allocate the next available slot during the same sitting and will advise the candidate accordingly via email. Please make sure that email addresses are listed in the application form and are clearly legible.

Applications for theoretical examinations shall be made on Application Form Number TM/CAD/0173 which can be downloaded from the Transport Malta website www.transport.gov.mt. When applying make sure you are submitting the latest version of TM/CAD/0173.

Application forms must be received at least **8 working** days before the start of the examination session together with the payment.

For the first examination a copy of the ID card or Passport certified as a true copy by the Head of Training must be submitted.

2.4 ATO/DTO recommendation

An applicant shall be recommended for an examination by the Approved Training Organisation or Declared Training Organisation responsible for the applicant's training when the applicant has completed the appropriate elements of the course of theoretical knowledge instruction to a satisfactory standard. The recommendation of the ATO shall be valid for 12 months. If the applicant has failed to attempt at least one theoretical knowledge examination within this period of validity, the need for further training shall be determined by the ATO, based on the needs of the applicant.

2.5 Language

The theoretical examinations will be carried out in the English language.

2.6 Content

The theoretical examination questions are all multiple choice with no penalty marking.

2.7 Oral Examinations

Oral examinations will not be conducted in lieu of written or computer based examinations.

2.8 Examination Material

All charts, maps and data sheets will be provided by TM CAD during the examination. Candidates must bring their own scientific, non-programmable, non-alphanumeric calculator without specific aviation functions, mechanical navigation slide-rule (CRP), protractor, divider, ruler, highlighter pen, and if they wish a translation dictionary.

2.9 Fees

Candidates shall pay the cost of €40.00, per exam paper for each subject covered in this notice.

2.10 Security

Candidates will not be allowed to take the examination unless they present a Malta or State of Nationality ID Card with photo or a passport. The photo ID must be placed on the desk and will be checked by the invigilator.

2.11 Misconduct

If TM CAD considers that the applicant is not complying with examination procedures during the examination, this misconduct will be considered with a view to failing the applicant, either in the examination of a single subject or in the examination set as a whole. In addition, the applicant may be banned from taking theoretical examinations for a period decided by the TM CAD.

2.12 Results

Examination results will be sent to the ATO/DTO or individuals (according to declaration) within 5 working days from end of sitting. In exceptional circumstances and should delays be expected for the issuance of such results, TM CAD will notify the ATO/DTO or individual accordingly.

Any queries from students regarding specific questions or appeals are to be referred to the Head of Personnel Licensing by the CTKI who in return will advise on the appropriate way forward depending on the case. Refer to PEL Notice 57 for further information.

CONDUCT OF EXAMINATIONS

- Candidates must ensure that they are available for the examination 15 minutes before the start time of the slot to follow the invigilator's pre-examination Instructions. **If the candidate arrives after the recording starts, and/or without valid reason, s/he shall be prohibited from taking the examination.**

- Mobile phones and any other communication or recording equipment must be switched off and placed in the locker provided. **Any attempt to communicate with anyone outside the examination room or record an examination question will be very severely dealt with and may lead to immediate disqualification and you may lose any passes already achieved.**

- **Wrist watches of any kind are not permitted** during the examination. Start time and finish time of examinations are regulated by the e-examination system and is visible to the student on the upper right hand side of the screen. In case of a paper based examination, start time and finish time will be taken from the clock in the examination room.

- Clothing during examination shall not include any type of head gear, scarves, ties, bulky jackets and large ornaments/necklaces. Candidates may be requested to remove any items which the invigilator might find unnecessary for the conduct of the written examination. It is the responsibility of the student not to bring any such items into the classroom. TM-CAD will not be held responsible for any loss or damages of such.

- Bags and coats are always to be placed in the area allocated and indicated by the invigilators but away from the candidates sitting or the examination.

- The only items that are to be placed on the desk are the mandatory items i.e. In case of paper based examinations; Exam Question Paper and Answer Sheet and in the case of all other exams conducted electronically and paper based; Annexes to the exam questions, calculator, CRP, ruler and dividers. Pens will be provided by TM-CAD. All other items including pencil cases and CRP cases must be placed at the far end of the candidates' desk and made easily accessible to the Invigilator.

- In the case of a paper based examination, check that the details, including the paper number are correct on the cover sheet. In the case of electronic examinations ensure that the examination released for you to undertake is correct. Ask for the assistance of the Invigilator should this not be the case.

- In the case of a paper based examination, do not make any other marks on the question paper or the answer sheet apart from your answers.

- Starting of the examination before being instructed by the Invigilator to do so will not be tolerated.

- Workings must be done on the rough working paper provided. No other paper can be used except the rough working paper and the answer sheet (in case of paper based examinations). The rough working paper will also be collected at the end of the exam and it shall include your name, ID Card or Passport number, signature and date of exam.

- In the case of paper based examinations, pens must be put down immediately when time is called, otherwise disciplinary action may be taken. In the case of electronic examinations, as soon as time is up for the subject the examination is automatically terminated and no further amendments to the answer selection can be made.

- No extra time will be given for the candidates to write comments. Any comments must be written during the exam time.

- If you wish to speak to the invigilator raise your hand. Silence must always be observed.

- At the end of the examination remain seated until all the paperwork is collected. If you finish the examination early please raise your hand and remain seated until all your paperwork is collected and checked, then if permitted by the invigilator leave the room quietly. Candidates may only leave the room if permitted by the invigilator. All the question papers (in case of paper based examinations), appendixes and other writing paper used during the examination must be handed in to the invigilator. **Write your name, paper number and date and sign all the papers where you have done your working**. All your papers will be placed in an envelope and sealed. Make sure you have returned all the papers and appendixes.

Any attempt to take a question paper (in case of paper based examinations) or an appendix or text written during the examination out of the examination room will be very severely dealt with and may lead to immediate disqualification and you may lose any passes already achieved.

In accordance with ARA.FCL.300(e) and ARA.FCL.300(f) of Commission Regulation (EU) No 1178/2011 of 3 November 2011 as amended, any violation of examination regulations may result in the candidate being disqualified in any subject that has been taken and barred from further participation in future examinations for a period of at least 12 months.

In accordance with the provision of ARA.GEN.355(e) of Commission Regulation (EU) No 1178/2011 of 3 November 2011 as amended, the Civil Aviation Directorate may inform other national authorities that the candidate is banned from the examinations.

The examination room will have 24 hour CCTV monitoring as images will be recorded for the purpose of monitoring of student's conduct during the examination. For further information please refer to PEL Notice 77. The examination room will be locked during the lunch breaks. Personal items left anywhere on the premises including the lockers area remain your own responsibility.

3.0 Learning objectives

3.1 Syllabus

A new detailed syllabus (found below) is being launched and affective as from **1st July 2023**. The present learning objectives as per *Regulation (EU) No 1178/2011 ANNEX I (Part-FCL) SUBPART C – PRIVATE PILOT LICENCE (PPL)* will **not** change but this detailed description of each learning objective will enable ATO's and students to have a better guidance to what is expected.

Reference	Description	PPL(A)	PPL(H)	Remarks
10	**AIR LAW AND ATC PROCEDURES**	**x**	**x**	
10.1	**International law: conventions, agreements and organisations**	**x**	**x**	
10.1.1	**The Convention on international civil aviation (Chicago) Doc. 7300/6**	**x**	**x**	
10.1.1.1	**Part I Air Navigation: Recall the general contents of relevant parts of the following chapters:**	**x**	**x**	
(01)	*(a) general principles and application of the convention*	*x*	*x*	
(02)	*(b) flight over territory of Contracting States*	*x*	*x*	
(03)	*(c) nationality of aircraft*	*x*	*x*	
(04)	*(d) measures to facilitate air navigation*	*x*	*x*	
(05)	*(e) conditions to be fulfilled on aircraft*	*x*	*x*	
(06)	*(f) international standards and recommended practices*	*x*	*x*	
(07)	*(g) validity of endorsed certificates and licences*	*x*	*x*	
(08)	*(h) notification of differences*	*x*	*x*	
10.1.1.2	**Part II The International Civil Aviation Organisation (ICAO): objectives and composition**	**x**	**x**	
(01)	*Describe the objectives of ICAO*	*x*	*x*	
(02)	*Explain the most important effects of the Chicago Convention on General Aviation*	*x*	*x*	
(03)	*Describe the application of international standards and laws (non-binding/ translation into national law)*	*x*	*x*	
10.1.2	**European Organisations**	**x**	**x**	
10.1.2.1	**EASA**	**x**	**x**	
(01)	*Describe the objectices of EASA, and the role of EASA in European civil aviation*	*x*	*x*	
(02)	*State that EU regulations are binding throughout all EU member states without prior national legal translation*	*x*	*x*	
(03)	*Explain the significance of regulations and AMC/GM material initiated/developed by EASA*	*x*	*x*	
(04)	*List the most significant parts of EU aviation legislation for private pilots (FCL, NCO, SERA)*	*x*	*x*	
(05)	*Describe how to find information about EU regulations/ be able to locate the EU regulations online (eur-lex or easa.europa.eu)*	*x*	*x*	
10.1.2.2	**EUROCONOTROL**	**x**	**x**	
(01)	*State the various roles of EUROCONTROL: Network Manager, Centralised Route Charges, ATM strategy, Training, etc.*	*x*	*x*	

10.2	**Annex 8: Airworthiness of aircraft**	**x**	**x**	
10.2.1	**Certificate of airworthiness**			
10.2.1.1	**Terms and definitions**	**x**	**x**	
(01)	*Define 'Certificate of Airworthiness' (CofA) and 'Airworthyness Review Certificate' (ARC)*	*x*	*x*	
10.2.1.2	**Procedures**	**x**	**x**	
(01)	*State the issuing authority of a CofA*	*x*	*x*	
(02)	*State who shall determine an aircraft's continuing airworthiness*	*x*	*x*	
(03)	*Describe how a CofA can be renewed or may remain valid*	*x*	*x*	
(04)	*Identify a certificate of airworthiness, and explain the reasons for issuing such certificates*	*x*	*x*	
(05)	*Identify an airworthiness review certificate (ARC) and assess its validity*	*x*	*x*	
(06)	*State which documents must be carried on board an aircraft during a local - and a X-country flight.*	*x*	*x*	
10.2.2	**Aircraft Radio Station**	**x**	**x**	
10.2.2.1	**General**	**x**	**x**	
(01)	*State that any radio station is bound to a prior approval, and that approval must be carried along*	*x*	*x*	
10.2.3	**Aircraft Logbook**	**x**	**x**	
10.2.3.1	**Purpose**	**x**	**x**	
(01)	*Explain why an aircraft logbook is required for any aircraft*	*x*	*x*	
10.2.3.2	**Tracking defects**	**x**	**x**	
(01)	*State that defects and their rectification have to be entered into the aircraft logbook and can be traced using the aircraft logbook*	*x*	*x*	
(02)	*State that an aircraft may only be taken to flight by the pilot if all relevant defects have been rectified*	*x*	*x*	
10.3	**Annex 7: Aircraft nationality and registration marks**	**x**	**x**	
10.3.1	**Nationality marks, common marks and registration marks**	**x**	**x**	
10.3.1.1	**Foreword and definitions**	**x**	**x**	
(01)	*Recall the definition of the following terms: 'aircraft', 'heavier-than-air aircraft, 'State of Registry'*	*x*	*x*	
10.3.1.2	**Common- and registration marks**	**x**	**x**	
(01)	*State the location of nationality- and registration marks, and when they must be carried*	*x*	*x*	

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(02)	*State that National registration markings must be installed and that they include: registration, possible flag, fireproof registration plate.*	*x*	*x*	
10.3.1.3	**Certificate of registration and aircraft nationality**	**x**	**x**	
(01)	*Explain who is responsible for assigning nationality marks, common marks and registration marks*	*x*	*x*	
(02)	*Identify a certificate of registration as such and should be able to explain the reasons for issuing such certificates*	*x*	*x*	
10.4	**Annex 1: Personnel licensing**	**x**	**x**	
10.4.1	**Aircrew Regulation - Annex I (Part-FCL)**	**x**	**x**	
10.4.1.1	**Definitions and responsibilities**	**x**	**x**	
(01)	*Define the following: Category, class and type of aircraft, cross-country, flight time, night, private pilot, renewal, revalidation, skill test, solo flight time*	*x*	*x*	
(02)	*Define 'block time', and state that this time is to be recorded in a pilot's personal flight logbook*	*x*	*x*	
(03)	*Define the term 'PIC'*	*x*	*x*	
(04)	*State who (in case of General Aviation) designates the PIC with regard to Commission Regulation (EU) No 923/2012 Art. 2 (100)*	*x*	*x*	*Commission Regulation (EU) No 923/2012 Art. 2 (100)*
(05)	*List the duties and responsibilities of the PIC with regard to NCO.GEN.105*	*x*	*x*	*NCO.GEN.105*
(06)	*Explain the difference between a 'commercial' and 'non-commercial' flight*	*x*	*x*	
(07)	*Explain for given examples, which kinds of flights (e.g. introductory flights, cost-sharing flights, aerial work/SPO operation) a private pilot is allowed to perform*	*x*	*x*	
10.4.2	**Relevant parts of Annex 1 connected to Part-FCL and Part-Medical**	**x**	**x**	
10.4.2.1	**Part FCL**	**x**	**x**	
(01)	*Explain the structure of Part-FCL*	*x*	*x*	*Source: Aircrew Regulation, Article 1 Subject matter*
(02)	*Describe the general principles of the licensing system (Light Aircraft Pilot Licence (LAPL) and Private Pilot Licence (PPL)*	*x*	*x*	*Source: Regulation (EU) 2018/1139, Article 21 and point 2 of Annex IV 'Essential requirements for aircrew' to this Regulation, Aircrew Regulation, point FCL.015*
(03)	*List the factors that are relevant to the exercise of the privileges of a licence*	*x*	*x*	*Source: Aircrew Regulation, point FCL.040 Exercise of the privileges of licences*
(04)	*State the circumstances in which a language proficiency endorsement is required*	*x*	*x*	*Source: Aircrew Regulation, point FCL.055 Language proficiency*
(05)	*Explain the term 'competent authority'*	*x*	*x*	*Source: Aircrew Regulation, point FCL.001 Competent authority*

(06)	*Name and identify personal documents required to be carried on board*	*x*	*x*	*Source: Aircrew Regulation, point FCL.045 Obligation to carry and present documents*
(07)	*State which documents may be kept at the airfield during local flights*	*x*	*x*	
10.4.2.2	**Part MED**	**x**	**x**	
(01)	*State the requirements for the issue of a medical certificate*	*x*	*x*	*State the requirements for the issue of a medical certificate*
(02)	*Name the class of medical certificate required when exercising the privileges of a LAPL or PPL*	*x*	*x*	*Source: Aircrew Regulation, point MED.A.030 Medical certificates*
(03)	*State the period of validity of a Medical class 2 for a pilot with given age*	*x*	*x*	
10.4.2.3	**Validity and priviledges of licences and ratings**	**x**	**x**	
	Requirements and privileges			
(01)	*State the requirements for the issue of a PPL*	*x*	*x*	
(02)	*State the privileges of a PPL*	*x*	*x*	
(03)	*State the requirements for class ratings, their validity and privileges*	*x*	*x*	
(04)	*State the requirements for other ratings, their validity and privileges according to Part-FCL, e.g. Aerobatic rating, Sailplane towing and banner towing rating, Night rating*	*x*	*x*	*Source: Aircrew Regulation, point FCL.800 Aerobatic rating; Aircrew Regulation, point FCL.805 Sailplane towing and banner towing ratings; Aircrew Regulation, point FCL.810 Night rating; Aircrew Regulation, point FCL.815 Mountain rating; Aircrew Regulation, point FCL.820 Flight test rating.*
(05)	*Explain with given examples, what aircraft types/variants can be operated with a SEP(land) or TMG class rating*	*x*	-	
	Revalidation and Renewal	**x**	**x**	
(06)	*State the period of validity of a PPL*	*x*	*x*	
(07)	*State the period of validity of a SEP(land) / TMG class rating or or helicopter type rating*	*x*	*x*	
(08)	*State the requirements how revalidate a SEP(land) / TMG class rating or or helicopter type rating*	*x*	*x*	
(09)	*State the requirements how to renew a SEP(land), TMG class rating or or helicopter type rating*	*x*	*x*	
	Differences Training	**x**	**x**	
(10)	*Explain the terms 'differences training' and 'familiarization'*	*x*	*x*	
(11)	*Explain for which variants within the SEP(land) class rating or helicopter type rating a differences training is required*	*x*	*x*	
(12)	*State the period of validity of a differences training*	*x*	*x*	
	Recency	**x**	**x**	
(13)	*State the flight experience required for a pilot to act as a PIC*	*x*	*x*	

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(14)	*State the flight experience required for a pilot to carry passengers*	*x*	*x*	
10.5	**Annex 2: Rules of the air**	**x**	**x**	
10.5.1	**Essential definitions**	**x**	**x**	
10.5.1.1	**Scope and definitions**	**x**	**x**	
(01)	*Explain the scope and purpose of ICAO Annex 2*	*x*	*x*	*Source: ICAO Annex 2, Foreword, Applicability*
(02)	*Define the term 'SERA'*	*x*	*x*	*Source: SERA, Article 1 Subject matter and scope*
(03)	*Explain the scope and main content of SERA*	*x*	*x*	*Source: SERA, Article 1 Subject matter and scope*
(04)	*Explain the terms 'VMC', 'IMC' and 'VFR' / 'IFR' flights*	*x*	*x*	
(05)	*Define the term 'ceiling'*	*x*	*x*	
10.5.2	**Applicability**	**x**	**x**	
10.5.2.1	**Applicability of the Rules of the Air**	**x**	**x**	
(01)	*Explain the principle of territorial application of the various Rules of the Air, e.g. ICAO, SERA, national rules*	*x*	*x*	*Source: ICAO Annex 2, Chapter 2, 2.1 Territorial application of the rules of the air; SERA.1001 and SERA.2001*
(02)	*State the responsibilities of the PIC, and identify under what circumstances departure from the Rules of the Air may be allowed*	*x*	*x*	*Source: SERA.2010 Responsibilities*
(03)	*State that the PIC of an aircraft has final authority as to the disposition of the aircraft while in command*	*x*	*x*	*Source: SERA.2015 Authority of pilot-in-command of an aircraft*
10.5.3	**General rules (except water operations)**	**x**	**x**	
10.5.3.1	**Rules - SERA**	**x**	**x**	
(01)	*Describe the rules for the avoidance of collisions*	*x*	*x*	*Source: SERA Chapter 2 Avoidance of collisions (except water operations)*
(02)	*Describe the lights, including their angles, to be displayed by aircraft*	*x*	*x*	*Source: SERA.3215 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*
(03)	*Explain when the cruising levels shall be expressed in terms of altitude (ALT) or flight levels (FLs)*	*x*	*x*	*Source: SERA.3110 Cruising levels*
(04)	*State the minimum flight altitude with regard to SERA, for flights over populated and unpopulated areas*	*x*	*x*	*Source: SERA.3105 Minimum heights*
(05)	*Explain the difference between 'populated' and 'unpopulated areas'*	*x*	*x*	
(06)	*List example cases in which the minimum flight altitude does not apply*	*x*	*x*	
(07)	*State for which flights an air traffic control (ATC) clearance shall be obtained*	*x*	*x*	*Source: SERA.8015 Air traffic control clearances*
10.5.4	**Visual flight rules**	**x**	**x**	
10.5.4.1	**Visual flight rules (VFR) - SERA**	**x**	**x**	

(01)	*State the flight visibility to be maintained during VFR flight in a given airspace*	*x*	*x*	*SERA.5001 VMC visibility and distance from cloud minima; SERA.5005 Visual flight rules; SERA.5010 Special VFR in control zones*
(02)	*State the horizontal and vertical distance to clouds to be maintained during VFR flight in a given airspace*	*x*	*x*	*SERA.5001 VMC visibility and distance from cloud minima; SERA.5005 Visual flight rules; SERA.5010 Special VFR in control zones*
(03)	*Apply the right-of-way- and collision aviodance rules to given examples*	*x*	*x*	*SERA.3210*
(04)	*Determine the right of way when other categories of aircraft (gliders, hang-gliders, balloons, etc.) are involved*	*x*	*x*	
10.5.4.2	**Special VFR flights (SVFR)**	**x**	**x**	
(01)	*Explain the term 'Special VFR flight'*	*x*	*x*	
(02)	*State the restrictions and minimum weather conditions for Special VFR (SVFR) flights*	*x*	*x*	
(03)	*Explain that the possibility to execute SVFR flights exists only within CTRs, and that this restriction has to be linked to the minimum weather conditions for VFR flights in airspace GOLF*	*x*	*x*	
(04)	*State sthat Special VFR (SVFR) flights are bound to a specific clearance*	*x*	*x*	
10.5.4.3	**VFR Night Flights**	**x**	**x**	
(01)	*State under which conditions a VFR flight may be conducted during night time*	*x*	*x*	
(02)	*State the requirements to acquire a rating for VFR night flights*	*x*	*x*	
10.5.5	**Signals and interception of civil aircraft**	**x**	**x**	
10.5.5.1	**Interception of civil aircraft - SERA**	**x**	**x**	
(01)	*State what primary action should be carried out by an intercepted aircraft*	*x*	*x*	*Source: SERA.11015 Interception*
(02)	*State which frequency should primarily be tried in order to contact an intercepting aircraft*	*x*	*x*	*Source: SERA.11015 Interception*
(03)	*State on which mode and code a transponder on board the intercepted aircraft should be operated*	*x*	*x*	*Source: SERA.11015 Interception*
(04)	*Recall the interception signals and phrases*	*x*	*x*	*Source: SERA.11015 Interception, Tables S11-1, S11-2, S11-3*
10.6	**Procedures for air navigation: aircraft operations doc. 8168- ops/611, volume 1**	**x**	**x**	
10.6.1	**Altimeter setting procedures (including IACO doc. 7030 – regional supplementary procedures)**	**x**	**x**	
10.6.1.1	**Basic requirements and definitions**	**x**	**x**	
(01)	*Describe the two main objectives of altimeter settings*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 2, Chapter 1*

(02)	*Define the terms 'QNH' and 'QFE'*	*x*	*x*	*Source: ICAO Doc 8168, Volume I, Part I, Section 2, Chapter 2; ICAO Doc 8168, Volume III, Section 2, Chapter 1*
(03)	*Define the terms 'flight level (FL)', 'transition altitude (TA)', 'transition level (TRL)' and 'transition layer'*	*x*	*x*	*Source: ICAO Doc 8168, Volume I, Part I, Section 1 Definitions, abbreviations and acronyms and units of measurement*
10.6.1.2	**Procedures applicable (except tables)**	**x**	**x**	
(01)	*State the interval by which consecutive FLs shall be separated*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 2, Chapter 2*
(02)	*Explain when a flight altitude should be selected in terms of ALT and when in terms of FLs, and when to switch between ALT and FL*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 2, Chapter 3*
(03)	*Explain the purpose of 'semi-circular rules'*	*x*	*x*	
(04)	*State the correct flight altitude with regard to semi-circular rules for a given routing*	*x*	*x*	
10.6.2	**Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – regional supplementary procedures)**	**x**	**x**	
10.6.2.1	**Operation of transponders**	**x**	**x**	
(01)	*State when and where the pilot shall operate the transponder*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(02)	*State the standard squawk to be used by VFR flights is 7000 and 2000 and their use*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(03)	*Explain the available modes (Mode A / C / S) and their use, and when the pilot shall operate the transponder*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(04)	*State when the pilot shall 'SQUAWK IDENT'*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(05)	*Explain the use of the codes 7500, 7600, 7700*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(06)	*Describe the consequences of a transponder failure in flight*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
(07)	*State the primary action in case of an unserviceable transponder before departure when no repair or replacement is possible*	*x*	*x*	*Source: ICAO Doc 8168, Volume III, Section 4, Chapter 1*
10.7	**Annex 11: Air Traffic Managent and Services**	**x**	**x**	
10.7.1	**Doc. 4444: Air Traffic Management**	**x**	**x**	
10.7.1.1	**Definitions**	**x**	**x**	
(01)	*Recall the definitions given in ICAO Annex 11*	*x*	*x*	*Source: ICAO Annex 11, Chapter 1 Definitions*
10.7.1.2	**General provisions for air traffic services**	**x**	**x**	
(01)	*State the objectives of ATS*	*x*	*x*	*Source: ICAO Annex 11, Chapter 2, 2.2 Objectives of ATS*
(02)	*Explain the pilot's responsibilities in respect of ATC-communication, especially the obligation to 'read-back', follow ATC instructions, the right to request a changed clearance or rejection of a given clearance*	*x*	*x*	

10.7.1.3	**Airspace structure**	**x**	**x**	
	General			
(01)	*Explain the difference between controlled and uncontrolled airspace*	*x*	*x*	
(02)	*Describe the general structure of the airspace with classes of airspace A-G and their lower/upper horizontal limits*	*x*	*x*	
(03)	*State that VFR flights can only be executed up to FL195, and that an approval is required for higher VFR flights*	*x*	*x*	
(04)	*Describe specialities and associated dangers of airspace ECHO (collision avoidance, transponder mandatory, IFR and VFR traffic)*	*x*	*x*	
(05)	*List the available air traffic services for different types of airspace*	*x*	*x*	
	CTR	**x**	**x**	
(06)	*Describe the dimension and significance of Control Zones (CTR) and the pilot's obigations before/at entering a CTR*	*x*	*x*	
	Restricted Areas	**x**	**x**	
(07)	*Explain the implications of danger-, restricted- and prohibited areas to the planned routing*	*x*	*x*	
(08)	*Extract the associated restrictions of an airspace (if any) from given material (AIP, VFR charts)*	*x*	*x*	
(09)	*Describe how to obtain information about activation status of restricted areas (e.g. NOTAMs and interpretation thereof)*	*x*	*x*	
	TMZ, RMZ and TRA	**x**	**x**	
(10)	*Describe the characteristics of a Transponder Mandatory Zone (TMZ) and the pilot's obigations before/at entering a TMZ*	*x*	*x*	
(11)	*Describe the characteristics of a Radio Mandatory Zone (RMZ) and the pilot's obigations before/at entering a RMZ*	*x*	*x*	
(12)	*Describe the characteristics of a Temporary Reserved Area (TRA), a Temporary Segregated Area (TSA) and the pilot's obigations before/at entering a TRA or TSA*	*x*	*x*	
	FIR	**x**	**x**	
(13)	*Describe the purpose for establishing flight information regions (FIRs)*	*x*	*x*	*Source: ICAO Annex 11, Chapter 2: 2.10; 2.11.*
(14)	*Describe the possibility and advantages of contacting FIS before entering an FIR*	*x*	*x*	
10.7.1.4	**Visual separation in the vicinity of aerodromes**	**x**	**x**	
(01)	*Describe the categories of wake-turbulence 'light', 'medium' and 'heavy'*	*x*	*x*	

(02)	*Describe the consequences of clearance to 'maintain own separation' while in VMC*	*x*	*x*	*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*
10.7.1.5	**Procedures for aerodrome control services**	**x**	**x**	
(01)	*Explain the term 'RWY-in-use' and its selection*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 7, 7.2 Selection of runway-in-use*
(02)	*State that a report of surface wind direction given to a pilot by the TWR is magnetic (MAG)*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 11, 11.4.3.2 Messages containing meteorological information*
10.7.1.6	**Radar services**	**x**	**x**	
(01)	*Describe the circumstances under which an aircraft provided with radar service should be informed of its position*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 8, 8.6.4 Position information*
(02)	*State the definition and aim of the term 'radar vectoring'*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 8, 8.6.5 Vectoring*
(03)	*Describe the actions (concerning the transponder) to be taken by the pilot in case of emergency if previously been directed by ATC to operate the transponder on a specific code*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 8, 8.8.1 Emergencies*
10.7.1.7	**Flight information service and alerting service**	**x**	**x**	
(01)	*State for which aircraft FIS shall be provided*	*x*	*x*	*Source: ICAO Annex 11, Chapter 4, 4.1 Application*
(02)	*State the meaning of the term 'ATIS' in plain language*	*x*	*x*	*Source: ICAO Annex 11, Chapter 4, 4.3.4 Voice-automatic terminal information service (Voice-ATIS) broadcasts*
(03)	*Describe the content of an ATIS message*	*x*	*x*	*Source: ICAO Annex 11, Chapter 4, 4.3.7 ATIS for arriving and departing aircraft*
10.7.1.8	**Procedures related to emergencies, communication failure and contingencies**	**x**	**x**	
(01)	*Explain the procedure for communication failure when indending to join a traffic circuit*	*x*	*x*	
(02)	*State the mode and code of SSR equipment a pilot might operate in case of communiction (COM) failure*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 15, 15.1 Emergency procedures*
(03)	*State the mode and code of SSR equipment a pilot might operate in a state of emergency*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 15, 15.1 Emergency procedures*
(04)	*State the special rights an aircraft in a state of emergency can expect from ATC*	*x*	*x*	*Source: ICAO Doc 4444, Chapter 15, 15.1.1 General; 15.1.2 Priority; 15.1.3 Unlawful interference and aircraft bomb threat*
10.8	**Annex 15: Aeronautical information service**	**x**	**x**	
10.8.1	**Introduction, essential definitions**	**x**	**x**	

10.8.1.1	**Definitions**	**x**	**x**	
(01)	*State, in general terms, the objective of an AIS*	*x*	*x*	*Source: ICAO Annex 15, Chapter 1, Note 1*
(02)	*Recall the following definitions aeronautical information circular (AIC), aeronautical information publication (AIP), aeronautical information regulation and control (AIRAC), NOTAM, pre-flight information bulletin (PIB)*	*x*	*x*	*Source: ICAO Annex 15, Chapter 1, 1.1 Definitions*
10.8.2	**Integrated Aeronautical Information Package**	**x**	**x**	
10.8.2.1	**Aeronautical information publication (AIP)**	**x**	**x**	
(01)	*State the primary purpose of the AIP*	*x*	*x*	*Source: ICAO Annex 15, Chapter 5, 5.2.2, Notes 1 and 2*
(02)	*Name and explain the contents of the different parts of the AIP*	*x*	*x*	*Source: ICAO Annex 15, Chapter 5, 5.2.1, Note 1; PANS-AIM (ICAO Doc 10066), Chapter 5, 5.2.1.2.5*
(03)	*Explain what kind of information shall be published in the form of AIP Supplements*	*x*	*x*	*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*
10.8.2.2	**Notices to airmen (NOTAMs)**	**x**	**x**	
(01)	*Summarise the essential information which leads to the issue of a NOTAM*	*x*	*x*	*Source: ICAO Annex 15, Chapter 6, 6.3.2.3*
(02)	*Describe the means by which NOTAMs shall be distributed*	*x*	*x*	*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*
(03)	*Read and interpret information from NOTAMs goven by example*	*x*	*x*	*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*
10.8.2.3	**Aeronautical information regulation and control (AIRAC)**	**x**	**x**	
(01)	*List the circumstances under which the information concerned shall or should be distributed as an AIRAC*	*x*	*x*	*Source: ICAO Annex 15, Chapter 6, 6.2*
10.8.2.4	**Aeronautical information circulars (AICs)**	**x**	**x**	
(01)	*Describe the type of information that may be published in AICs*	*x*	*x*	*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)*
(02)	*Explain the organisation of AICs*	*x*	*x*	*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*

10.9	**Annex 14, Volume 1 and 2: Aerodromes**	**x**	**x**	
10.9.1	**Introduction, essential definitions**	**x**	**x**	
10.9.1.1	**General**	**x**	**x**	
(01)	*Define the terms 'aerdrome traffic', 'aerodrome elevation', 'runway', 'taxi holding point'*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 2, 2.2 Aerodrome reference point*
(02)	*State the different parts of the 'traffic pattern' (or 'traffic circuit')*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 2, 2.2 Aerodrome reference point*
(03)	*Recall the definitions for the four main declared distances TORA, TODA, ASDA and LDA*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 1, 1.1 Definitions*
(04)	*Define the 'AD reference point' and describe where it shall be located and where it shall normally remain*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 2, 2.2 Aerodrome reference point*
10.9.2	**Aerodrome data**	**x**	**x**	
10.9.2.1	**Conditions of the movement area and related facilities**	**x**	**x**	
(01)	*Describe the different types of water deposit on RWYs (DAMP, WET, STANDING WATER)*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 2, 2.9 Condition of the movement area and related facilities*
(02)	*Explain the different types of frozen water on the RWY (snow, slush, ice or frost) and their impact on aircraft braking performance*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 1, 1.1 Definitions and Chapter 2, 2.9 Condition of the movement area and related facilities*
10.9.3	**Visual aids for navigation**	**x**	**x**	
10.9.3.1	**(a) indicators and signalling devices**	**x**	**x**	
(01)	*Describe the wind-direction indicators with which ADs shall be equipped*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.1.1 Wind dire ction indicator (Application, Location and Characteristics)*
(02)	*Describe a landing-direction indicator*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.1.2 Landing direction indicator*
(03)	*Explain the use and capabilities of a signalling lamp, and state the meaning of various light signals from TWR to aircraft on ground and in flight*	*x*	*x*	*Source: Commission Implementing Regulation (EU) No 923/2012 (SERA) - Appendix 1 Signals, 3.2 Visual ground signals*
(04)	*Describe how lights from a signalling lamp should be confirmed by aircraft on ground and in flight*	*x*	*x*	*Source: Commission Implementing Regulation (EU) No 923/2012 (SERA) - Appendix 1 Signals, 3.2 Visual ground signals*
(05)	*Interpret indications and signals that may be used in a signal area*	*x*	*x*	*Source: Commission Implementing Regulation (EU) No 923/2012 (SERA) - Appendix 1 Signals, 3.2 Visual ground signals*
10.9.3.2	**(b) markings**	**x**	**x**	

(01)	*Name the colours used for the various markings (RWY, TWY, aircraft stands)*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings*
(02)	*State where a RWY designation marking shall be provided and describe the different layouts (excluding dimensions)*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings*
(03)	*Describe the characteristics of: RWY-centre-line markings, THR markings, touchdown-zone (TDZ) markings, RWY-side-stripe markings; TWY-centre-line markings, RWY holding position markings, aircraft-stand markings*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.2 Markings*
10.9.3.3	**(c) lights**	**x**	**x**	
(01)	*Describe the precision approach path indicator (PAPI) and interpret what the pilot will see during the approach using PAPI*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5, 5.3.5.24 to 5.3.5.27 PAPI and APAPI*
(02)	*Interpret what the pilot will see during an approach using a helicopter approach path indicator (HAPI)*	*x*	*x*	*Source: ICAO Annex 14, Volume II, Chapter 5, 5.3.6 Visual approach slope indicator*
(03)	*Describe the characteristics of an 'Aerodrome Beacon'*	*x*	*x*	
(04)	*Explain the characteristics (color and fixed/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, TWY-centre-line lights, TWY-edge lights, stop bars*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5*
10.9.3.4	**(d) signs**	**x**	**x**	
(01)	*Describe and identify a RWY/TWY designation sign at a TWY/RWY intersection, a 'NO ENTRY' sign, a RWY holding position sign*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs*
(02)	*Describe and identify a intersection take-off sign at a TWY/RWY intersection, indicating the remaining runway length available*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs*
(03)	*Describe the colours and inscriptions used in connection with information signs*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5.4 Signs*
(04)	*Describe the meaning of a sign 'C' as a reporting point for air traffic services*	*x*	*x*	
10.9.3.5	**(e) markers**	**x**	**x**	
(01)	*Describe the characteristics of: unpaved RWY-edge markers, TWY-edge markers, TWY-centre-line markers, unpaved TWY-edge markers*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 5.5 Markers*
10.9.4	**Visual aids for denoting obstacles**	**x**	**x**	
10.9.4.1	**(a) marking of objects**	**x**	**x**	
(01)	*State how fixed or mobile objects shall be marked if colouring is not practicable*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.3.1 Marking*
(02)	*Describe marking by colours (fixed or mobile objects)*	*x*	*x*	*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*

(03)	*Explain the use of markers for the marking of objects, overhead wires, cables, etc.*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 6, 6.2.5 Overhead wires, cables, etc., and supporting towers*
10.9.4.2	**(b) lighting of objects**	**x**	**x**	
(01)	*Describe the colour and sequence of low-intensity obstacle lights, medium-intensity obstacle lights and high-intensity obstacle lights*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 6: Table 6-1. Characteristics of obstacle lights*
10.9.5	**Visual aids for denoting restricted use of areas**	**x**	**x**	
10.9.5.1	**Visual aids for denoting restricted use of areas on RWYs and TWYs**	**x**	**x**	
(01)	*Describe the colours and meaning of 'closed markings' on RWYs and TWYs*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 7, 7.1 Closed runways and taxiways, or parts thereof*
(02)	*Describe the pre-THR marking (including colours) when the surface before the THR should not be used*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 7, 7.3 Pre-threshold area*
10.9.6	**Emergency and other services**	**x**	**x**	
10.9.6.1	**(a) rescue and fire fighting**	**x**	**x**	
(01)	*Explain the basic information the AD category (for RFF) depends upon*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 9, 9.2 Rescue and firefighting*
10.9.6.2	**(b) apron management service**	**x**	**x**	
(01)	*State who has a right-of-way against vehicles operating on an apron*	*x*	*x*	*Source: ICAO Annex 14, Volume 1, Chapter 9, 9.5 Apron management service*
10.10	**Annex 12: Search and rescue**	**x**	**x**	
10.10.1	**Essential definitions**	**x**	**x**	
10.10.1.1	**Definitions and responsibilities**	**x**	**x**	
(01)	*State which organisations provide Search And Rescue Services (civil and military)*	*x*	*x*	
(02)	*Recall the definitions of the following terms: INCERFA, ALERFA, DETRESFA*	*x*	*x*	*Source: ICAO Annex 12, Chapter 1 Definitions*
(03)	*Describe the consequences in case of forgetting to close a flight plan, resulting in an unjustified SAR search mission*	*x*	*x*	
10.10.2	**Operating procedures**	**x**	**x**	
10.10.2.1	**(a) procedures for PIC at the scene of an accident**	**x**	**x**	
(01)	*Explain the SAR operating procedures for the PIC who arrives first at the scene of an accident*	*x*	*x*	*Source: ICAO Annex 12, Chapter 5, 5.6 Procedures at thescene of an accident*
10.10.2.2	**(b) procedures for PIC intercepting a distress transmission**	**x**	**x**	
(01)	*Explain the SAR operating procedures for the PIC intercepting a distress transmission*	*x*	*x*	*Source: ICAO Annex 12, Chapter 5, 5.7 Procedures for a pilot-in-command intercepting a distress transmission*

10.10.3	**Search and rescue signals**	**x**	**x**	
10.10.3.1	**Search and rescue signals - Survivors**	**x**	**x**	
(01)	*Explain the 'ground-air visual signal code' for use by survivors*	*x*	*x*	*Source: ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix*
(02)	*Recognise the SAR 'air-to-ground signals' for use by survivors*	*x*	*x*	*Source: ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix*
(03)	*Describe how an aircraft should confirm to have received the information from ground-air signals*	*x*	*x*	*Source: ICAO Annex 12, Chapter 5.8 Search and rescue signals and Appendix*
10.11	**Annex 17: Security**	**x**	**x**	
10.11.1	**General**	**x**	**x**	
10.11.1.1	**Aims and objectives**	**x**	**x**	
(01)	*State the objectives of security*	*x*	*x*	*Source: ICAO Annex 17, Chapter 2, 2.1 Objectives*
(02)	*List the objects not allowed on board an aircraft due to security reasons*	*x*	*x*	*Source: ICAO Annex 17, Chapter 4, 4.1 Objective*
10.12	**Annex 13: Aircraft accident investigation**	**x**	**x**	
10.12.1	**Essential definitions and applicability**	**x**	**x**	
10.12.1.1	**Definitions**	**x**	**x**	
(01)	*Recall the definitions of the following terms: accident, incident, investigation, serious incident, serious injury*	*x*	*x*	*Source: ICAO Annex 13, Chapter 1 Definitions*
(02)	*Explain the difference between 'serious incident' and 'accident'*	*x*	*x*	*Source: ICAO Annex 13, Chapter 1 Definitions and Attachment C 'List of examples of serious incidents'*
10.12.1.2	**Applicability**	**x**	**x**	
(01)	*State the objective(s) of the investigation of an accident or incident*	*x*	*x*	*Source: ICAO Annex 13, Chapter 3, 3.1 Objective of the investigation*
(02)	*Identify an occurrence as being either an accident, incident or serious incident in Regulation (EU) No 996/2010*	*x*	*x*	*Source: Regulation (EU) No 996/2010, Article 2(1), (7) and (16) and Annex 'List of examples of serious incidents'*
10.12.1.3	**Objectives and procedures**	**x**	**x**	
(01)	*State the objective(s) of the investigation of an accident or incident*	*x*	*x*	*Source: ICAO Annex 13, Chapter 4, 4.1; ICAO Annex 13, Chapter 5, 5.1 to 5.4.1*
(02)	*Describe the general procedures for the investigation of an accident or incident*	*x*	*x*	*Source: ICAO Annex 13, Chapter 4, 4.1; ICAO Annex 13, Chapter 5, 5.1 to 5.4.1*
10.13	**National law**	**x**	**x**	
10.13.1	**National law and differences to relevant ICAO Annexes and relevant EU regulations**	**x**	**x**	
10.13.1.1	**National regulations**	**x**	**x**	

(01)	*List the most important national regulations and laws concerning aviation*	*x*	*x*	
(02)	*Explain how to find national laws and regulations*	*x*	*x*	
(03)	*Name and describe the relevance of the national competent authority for his/her pilot licensing*	*x*	*x*	
10.13.1.2	**Differences from ICAO Annexes**	**x**	**x**	
(01)	*Describe situations and list examples in which national legislation may differ from ICAO Annexes*	*x*	*x*	
10.13.1.3	**Differences from EU-Regulations**	**x**	**x**	
(01)	*Describe the primacy of application of EU law*	*x*	*x*	
(02)	*Describe situations and list examples in which national legislation of member states may differ from EU Regulations*	*x*	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
20	**HUMAN PERFORMANCE**	**x**	**x**	
20.1	**Human factors: basic concepts**	**x**	**x**	
20.1.1	**Human factors in aviation**	**x**	**x**	
20.1.1.1	**Becoming a competent pilot**	**x**	**x**	
(01)	*State that competence is based on knowledge, skills and attitudes of the individual pilot*	*x*	*x*	
(02)	*State that the ICAO core competencies include: application of procedures, communication, aircraft flight path management (automation and manual control), leadership and teamwork, problem-solving and decision-making, situation awareness and workload management*	*x*	*x*	
20.2	**Basic aviation physiology and health maintenance**	**x**	**x**	
20.2.1	**Basic aviation physiology**	**x**	**x**	
20.2.1.1	**The atmosphere**	**x**	**x**	
	(a) composition	**x**	**x**	
(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*	
(02)	*State in terms of % the parts of Oxygen, Nitrogen and other gases present in the atmosphere*	*x*	*x*	
(03)	*State the effects of increasing altitude on the overall pressure and partial pressures of the various gases in the atmosphere*	*x*	*x*	
	(b) gas laws	**x**	**x**	
(04)	*State the physiological significance of the following laws: Boyle's Law, Dalton's Law, Henry's Laws, the General Gas Law*	*x*	*x*	
20.2.1.2	**Respiratory and circulatory systems**	**x**	**x**	
	(a) oxygen requirement of tissues	**x**	**x**	
(01)	*List the main components of the respiratory system and their function*	*x*	*x*	
(02)	*Explain the function of haemoglobin in the circulatory system*	*x*	*x*	
(03)	*Explain the role of carbon dioxide in the control and regulation of respiration*	*x*	*x*	
(04)	*State that the body starts to react on decreasing atmospheric pressure at approx. 5000 - 7000 ft*	*x*	*x*	
(05)	*State that healthy people are able to compensate for altitudes up to approximately 10.000-12.000 ft ('disturbence threshold')*	*x*	*x*	

(06)	*Explain which body functions are impaired above the disturbence threshold*	*x*	*x*	
	(b) functional anatomy	**x**	**x**	
(07)	*Name the major components of the circulatory system and describe their function*	*x*	*x*	
	(c) main forms of hypoxia (hypoxic and anaemic)	**x**	**x**	
(08)	*Name the two major forms of hypoxia (hypoxic and anaemic), and the common causes of both*	*x*	*x*	
	(1) sources, effects and countermeasures of carbon monoxide			
(09)	*List possible sources of carbon monoxide in the cockpit*	*x*	*x*	
(10)	*List the sources and symptoms of carbon-monoxide poisoning*	*x*	*x*	
(11)	*Describe immediate countermeasures on suspicion of carbon-monoxide poisoning*	*x*	*x*	
	(2) counter measures and hypoxia			
(12)	*Name factors influencing the body's tolerance to altitude and hypoxia (e.g. smoking, tiredness, sickness, etc.)*	*x*	*x*	
	(3) symptoms of hypoxia			
(13)	*State the symptoms of hypoxia*	*x*	*x*	
	(d) hyperventilation	**x**	**x**	
(14)	*Define the term 'hyperventilation'*	*x*	*x*	
(15)	*List the factors that cause hyperventilation*	*x*	*x*	
(16)	*List the signs and symptoms of hyperventilation*	*x*	*x*	
(17)	*List the measures to counteract hyperventilation: breath slowly, close one opening of the nose, speak loudly, place a paper bag over nose and mouth*	*x*	*x*	
	(e) the effects of accelerations on the circulatory system	**x**	**x**	
(18)	*Explain the terms 'linear acceleration' and 'angular acceleration'*	*x*	*x*	
(19)	*State situations in which linear and angular acceleration can occur*	*x*	*x*	
(20)	*List the effects of positive and negative acceleration (G-load)*	*x*	*x*	
	(f) hypertension and coronary heart disease	**x**	**x**	
(21)	*Explain the term 'hypertension'*	*x*	*x*	
(22)	*List the effects that high blood pressure will have on functions of the human body*	*x*	*x*	
(23)	*Explain the major risk factors for coronary disease*	*x*	*x*	
(24)	*Explain the role of physical exercise in reducing chances for developing coronary disease*	*x*	*x*	
20.2.2	**People and environment**	**x**	**x**	
20.2.2.1	**Central, peripheral and autonomic nervous systems**	**x**	**x**	
(01)	*Describe the role of the autonomic nervous system*	*x*	*x*	
(02)	*Describe the term 'sensitivity', especially in the context of vision*	*x*	*x*	
(03)	*State examples of sensory adaptation*	*x*	*x*	
(04)	*Describe the term 'reflex'*	*x*	*x*	
20.2.2.2	**Vision**	**x**	**x**	
	(a) functional anatomy	**x**	**x**	
(01)	*Name and identify the most important parts of the eye*	*x*	*x*	
(02)	*Explain the functions of the rod and cone cells*	*x*	*x*	
(03)	*Define 'accommodation'*	*x*	*x*	

	(b) visual field, foveal and peripheral vision	**x**	**x**	
(04)	*Explain the terms 'visual acuity', 'central vision', 'peripheral vision' and 'fovea', and explain their function in the process of vision*	*x*	*x*	
	(c) binocular and monocular vision	**x**	**x**	
(05)	*Explain the 'parallax error'*	*x*	*x*	
(06)	*Describe the effect of UV ray protection of the retina by wearing sunglasses*	*x*	*x*	
(07)	*Explain the differences and limitations between seeing with one eye or both eyes*	*x*	*x*	
	(d) monocular vision cues	**x**	**x**	
(08)	*List the possible monocular cues for depth perception*	*x*	*x*	
	(e) night vision	**x**	**x**	
(09)	*State the limitations of night vision and the different scanning techniques at both night and day*	*x*	*x*	
(10)	*State the time necessary for the eye to adapt to bright light and to the dark*	*x*	*x*	
	(f) visual scanning and detection techniques and importance of 'look-out'	**x**	**x**	
(11)	*List the factors that may degrade visual acuity and the importance of 'lookout'*	*x*	*x*	
	(g) defective vision	**x**	**x**	
(12)	*Decribe the nature and effects of colour blindness*	*x*	*x*	
20.2.2.3	**Hearing**	**x**	**x**	
	(a) descriptive and functional anatomy	**x**	**x**	
(01)	*State the basic parts and functions of the outer, the middle and the inner ear*	*x*	*x*	
	(b) flight related hazards to hearing	**x**	**x**	
(02)	*Explain the value of headsets as a means to prevent hearing defects caused by engine noise*	*x*	*x*	
(03)	*Explain the difference between a standard headset and an active noise reduction headset*	*x*	*x*	
	(c) hearing loss	**x**	**x**	
(04)	*Describe possible damages caused by continued exposure to loud noise*	*x*	*x*	
(05)	*List the main sources of hearing loss in the flying environment*	*x*	*x*	
(06)	*Describe the level of noise that will cause 'noise-induced hearing loss' (NIHL)*	*x*	*x*	
20.2.2.4	**Equilibrium**	**x**	**x**	
	(a) functional anatomy	**x**	**x**	
(01)	*List the main elements of the vestibular apparatus*	*x*	*x*	
(02)	*Describe the functions of the vestibular apparatus and possible problems in flight*	*x*	*x*	
	(b) motion and acceleration	**x**	**x**	
(03)	*Describe the causes and symptoms of 'air sickness'*	*x*	*x*	
	(c) motion sickness	*x*	*x*	
(04)	*Describe suitable actions to counteract the symptoms of air sickness*	*x*	*x*	
20.2.2.5	**Integration of sensory inputs**	**x**	**x**	
	(a) spatial disorientation: forms, recognition and avoidance	**x**	**x**	
(01)	*State the interaction between vision, equilibrium and proprioception* ~~and hearing~~ **to obtain spatial orientation in flight**	*x*	*x*	
(02)	*Describe the cause of 'vertigo' as a mismatch between the vestibular organ inputs and optical/visual inputs*	*x*	*x*	

(03)	*State that when entering clouds optical as well as sensory inputs immediately become unreliable*	*x*	*x*	
	(b) illusions: forms, recognition and avoidance: **(1) physical origin;** **(2) physiological origin;** **(3) psychological origin.**	**x**	**x**	
(04)	*Describe the term 'illusion' and give examples*	*x*	*x*	
(05)	*Explain how optical illusions typically occur due to misinterpretation of visual inputs by the brain*	*x*	*x*	
(06)	*Explain that the vestibular organ accommodates to steady loads and accelerations - e.g. during banked turns - and that illusions might arise when ending the turn*	*x*	*x*	
(07)	*List the measures to prevent or overcome spatial disorientation*	*x*	*x*	
	(c) approach and landing problems	**x**	**x**	
(08)	*List approach and landing illusions for slope of the runway, black-hole approach and terrain around runway*	*x*	*x*	
20.2.3	**Health and hygiene**	**x**	**x**	
20.2.3.1	**Personal hygiene: personal fitness**	**x**	**x**	
(01)	*State the pilot's responsibility of assessing his/her own health status before attempting the flight*	*x*	*x*	
20.2.3.2	**Body rhythm and sleep**	**x**	**x**	
	(a) rhythm disturbances	**x**	**x**	
(01)	*Name some internal body rhythms and their relevance to sleep*	*x*	*x*	
	(b) symptoms, effects and management	**x**	**x**	
(02)	*Explain the function of sleep and describe the effects of insufficient sleep on performance*	*x*	*x*	
20.2.3.3	**Problem areas for pilots:**	**x**	**x**	
	(a) common minor ailments including cold, influenza and gastro-intestinal upset	**x**	**x**	
(01)	*Explain the role of the 'Eustachian tube' in equalising pressure between the middle ear and the environment*	*x*	*x*	
(02)	*List the negative effects of suffering from colds or flu on flight operations, with regard to the middle ear, the sinuses and the teeth*	*x*	*x*	
(03)	*Describe the measures to prevent or clear problems due to pressure changes during flight*	*x*	*x*	
(04)	*Describe the sources and effects of gastrointestinal upsets that may occur during flight*	*x*	*x*	
(05)	*List precautions to reduce the occurrence of gastrointestinal upsets*	*x*	*x*	
	(b) entrapped gases and barotrauma, (scuba diving)	**x**	**x**	
(06)	*Describe the term 'barotrauma'*	*x*	*x*	
(07)	*Explain why the effects of otic barotrauma can be worse in the descent*	*x*	*x*	
	(c) obesity	**x**	**x**	
(08)	*Describe the term 'obesity'*	*x*	*x*	
(09)	*State that harmful effects obesity can cause: developing coronary problems, developing diabetes, reduced ability to withstand G-forces, problems with the joints of the limbs, general circulatory problems*	*x*	*x*	
	(d) food hygiene	**x**	**x**	

(10)	*State the importance of adequate hydration*	*x*	*x*	
	(f) nutrition	**x**	**x**	
(11)	*State the major constituents of a healthy diet*	*x*	*x*	
20.2.3.4	**Intoxication**	**x**	**x**	
	(a) prescribed medication	**x**	**x**	
(01)	*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*	
	(b) tobacco	**x**	**x**	
(02)	*State that smoking reduces the body's tolerance to compensate for higher altitudes*	*x*	*x*	
	(c) alcohol and drugs	**x**	**x**	
(03)	*State the 'unit' of alcohol and state the approximate elimination rate from the blood*	*x*	*x*	
(04)	*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*	
	(d) caffeine	**x**	**x**	
(05)	*Indicate other beverages besides coffee containing caffeine*	*x*	*x*	
	(e) self-medication	**x**	**x**	
(06)	*State considerations to be made when using self-medication, e.g. prior contact to an aeromedical examiner*	*x*	*x*	
20.3	**Basic aviation psychology**	**x**	**x**	
20.3.1	**Human information processing**	**x**	**x**	
20.3.1.1	**Attention and vigilance**	**x**	**x**	
	(a) selectivity of attention **(b) divided attention**	**x**	**x**	
(01)	*Differentiate between 'attention' and 'vigilance'*	*x*	*x*	
(02)	*Differentiate between 'selective' and 'divided' attention*	*x*	*x*	
(03)	*List the factors that affect a person's level of attention*	*x*	*x*	
(04)	*Indicate the signs of reduced vigilance*	*x*	*x*	
20.3.1.2	**Perception**	**x**	**x**	
	(A) perceptual illusions	**x**	**x**	
(01)	*Describe some basic perceptual illusions*	*x*	*x*	
	(B) subjectivity of perception	**x**	**x**	
(02)	*Illustrate why perception is subjective and state the relevant factors that influence interpretation of perceived information*	*x*	*x*	
	(C) processes of perception.	**x**	**x**	
(03)	*Describe the mechanism of perception ('bottom-up'/'top-down' process)*	*x*	*x*	
20.3.1.3	**Memory**	**x**	**x**	
	(a) sensory memory	**x**	**x**	
(01)	*Explain the link between the types of memory (sensory, working/short-term and long-term memory)*	*x*	*x*	
	(b) working or short term memory	**x**	**x**	

(02)	*State the average maximum number of separate items that may be held in working memory: 7 plus/minus 2 (Miller's number)*	*x*	*x*	
(03)	*Describe how interruption can affect short-term/working memory*	*x*	*x*	
	(c) long term memory to include motor memory (skills)	**x**	**x**	
(04)	*State the subdivisions of long-term memory and give examples of their content*	*x*	*x*	
(05)	*Explain that skills are kept primarily in the long-term memory*	*x*	*x*	
20.3.2	**Human error and reliability**	**x**	**x**	
20.3.2.1	**Reliability of human behaviour**	**x**	**x**	
(01)	*Name and explain the factors that influence human reliability*	*x*	*x*	
(02)	*Explain the effect of 'confirmation bias'*	*x*	*x*	
20.3.2.2	**Error generation: social environment (group, organisation)**	**x**	**x**	
	Swiss cheese model	**x**	**x**	
(01)	*Explain the concept of the 'error chain' ('swiss cheese' model)*	*x*	*x*	
(02)	*State the meaning and consequences of 'latent errors'*	*x*	*x*	
	Error generation: social environment (group, organisation)	**x**	**x**	
(03)	*Describe social (group) effects on error generation*	*x*	*x*	
20.3.3	**Decision making**	**x**	**x**	
20.3.3.1	**Decision-making concepts** **(a) structure (phases)** **(b) limits** **(d) practical application** **(c) risk assessment**	**x**	**x**	
(01)	*Explain the terms 'deciding' and 'decision-making'*	*x*	*x*	
(02)	*Describe the process of decision-making in the cockpit*	*x*	*x*	
(03)	*Describe the main error sources and limits in an individual's decision-making mechanism*	*x*	*x*	
(04)	*Describe the influences exerted by other group members on an individuals decision-making process ('risky shift')*	*x*	*x*	
20.3.4	**Avoiding and managing errors: cockpit management**	**x**	**x**	
20.3.4.1	**Safety awareness**	**x**	**x**	
	(a) risk area awareness	**x**	**x**	
(01)	*Explain 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*	
	(b) situational awareness	**x**	**x**	
(02)	*Describe the term 'situation awareness'*	*x*	*x*	
(03)	*Identify factors that influence one's situation awareness both positively and negatively*	*x*	*x*	
(04)	*Describe the importance of situation awareness in the context of flight safety*	*x*	*x*	
20.3.4.2	**Communication: verbal and non-verbal communication**	**x**	**x**	
(01)	*Define the terms 'communication' and 'closed-loop'*	*x*	*x*	
(02)	*State the importance and problems of non-verbal communication*	*x*	*x*	
(03)	*Describe the advantages and possible problems of using 'social' and 'professional' language in high- and low-workload situations*	*x*	*x*	

20.3.5	**Human behaviour**	**x**	**x**	
20.3.5.1	**Personality and attitudes**	**x**	**x**	
	(a) development	**x**	**x**	
(01)	*Define and distinguish between 'personality', 'attitude' and 'behaviour'*	*x*	*x*	
	(b) environmental influences	**x**	**x**	
(02)	*Describe the factors that determine an individual's behaviour*	*x*	*x*	
20.3.5.2	**Identification of hazardous attitudes (error proneness)**	**x**	**x**	
(01)	*Explain dangerous attitudes in aviation, e.g. impulsivity, invulnerability, complacency, resignation*	*x*	*x*	
20.3.6	**Human overload and underload**	**x**	**x**	
20.3.6.1	**Stress**	**x**	**x**	
	(a) definition(s)	**x**	**x**	
(01)	*Explain the term 'stress' and why stress is a natural human reaction*	*x*	*x*	
	(b) anxiety and stress	**x**	**x**	
(02)	*Explain the relationship between stress and anxiety*	*x*	*x*	
	(c) effects of stress	**x**	**x**	
(03)	*Describe the relationship between stress and performance*	*x*	*x*	
(04)	*List human properties that are affectd by stress*	*x*	*x*	
(05)	*State that the stress experienced as a result of particular demands varies among individuals*	*x*	*x*	
(06)	*Explain how stress is cumulative and how stress from one situation can be transferred to a different situation*	*x*	*x*	
(07)	*Describe the effect of human underload/overload on cockpit performance*	*x*	*x*	
20.3.6.2	**Fatigue and stress management**	**x**	**x**	
	(a) types, causes and symptoms of fatigue	**x**	**x**	
(01)	*Explain the term 'fatigue' and differentiate between the two types of fatigue (short-term and chronic fatigue)*	*x*	*x*	
(02)	*Name the causes of short-term and chronic fatigue*	*x*	*x*	
	(b) effects of fatigue;	**x**	**x**	
(03)	*Identify the symptoms and describe the effects of fatigue*	*x*	*x*	
	(c) coping strategies	**x**	**x**	
(04)	*List and describe strategies for coping with stress factors and stress reactions*	*x*	*x*	
	(d) management techniques	**x**	**x**	
(05)	*Give examples of short-term methods of stress management*	*x*	*x*	
(06)	*Give examples of long-term methods of coping with stress*	*x*	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
30	**METEOROLOGY**	**x**	**x**	
30.1	**THE ATMOSPHERE (AND PHYSICAL BASICS)**	**x**	**x**	
30.1.1	**Composition, extend and vertical division**	**x**	**x**	
30.1.1.1	**Structure of the atmosphere (Basics)**	**x**	**x**	
(01)	*List the composition of gases in dry air with 78% Nitrogen, 21% Oxygen and 1% CO2 and other gases*	*x*	*x*	

(02)	*List the different layers of the atmosphere and know their approximate extent*	*x*	*x*	
(03)	*Describe the temperature profile within the troposphere and stratosphere*	*x*	*x*	
(04)	*Explain the relationship between air pressure, air density and air temperature*	*x*	*x*	
30.1.1.2	**Troposphere**	**x**	**x**	
(01)	*State that the troposphere contains water vapour responsible for weather phenomena*	*x*	*x*	
(02)	*Describe the Tropopause as the boundary area between Troposphere and Stratosphere*	*x*	*x*	
(03)	*State that temperature remains constant with altitude above the tropopause (up to approx. FL 650)*	*x*	*x*	
30.1.2	**Air temperature**	**x**	**x**	
30.1.2.1	**Definition and units**	**x**	**x**	
(01)	*State the unit for air temperature used in flight meteorology: degrees Celsius*	*x*	*x*	
(02)	*Describe the physical character of air temperature*	*x*	*x*	
30.1.2.2	**Vertical distribution of temperature**	**x**	**x**	
(01)	*Describe the environmental temperature lapse with altitude within in the Tropopshere and Stratosphere*	*x*	*x*	
30.1.2.3	**Transfer of heat**	**x**	**x**	
(01)	*State conduction and latent heat as primary factors for tranfer of heat within the Troposphere*	*x*	*x*	
30.1.2.4	**Lapse rates, stability and instability**	**x**	**x**	
(01)	*State that adiabatic processes in the atmosphere assume no exchange of energy or heat with environmental air*	*x*	*x*	
(02)	*Explain how the rate at which an air mass cools/heats when rising/descending depends on the relative humidity*	*x*	*x*	
(03)	*State the dry adiabatic lapse rate as 3 deg C/1000 ft (or 1 deg C/100 m) and saturated adiabatic lapse rate with an average of 1.8 deg C/1000 ft (or 0.6 deg C/100 m)*	*x*	*x*	
(04)	*Describe the terms 'stable', 'unstable' or 'conditionally unstable' in atmospheric conditions*	*x*	*x*	
30.1.2.5	**Development of inversions and types of inversions**	**x**	**x**	
(01)	*Describe an 'inversion' as a layer with increasing temperature with increasing height*	*x*	*x*	
(02)	*Describe an 'isothermal layer' as a layer with constant temperature with increasing height*	*x*	*x*	
(03)	*State that inversions may occur from ground up as ground inversions, or at any higher altitude*	*x*	*x*	
30.1.2.6	**Temperature near the earth's surface, surface effects, diurnal and seasonal variation, effect of clouds and effect of wind**	**x**	**x**	
(01)	*Explain the effect of solar insolation on ground heating depending on latitude and seasons*	*x*	*x*	
(02)	*Explain the differences in rate of temperature change of ground surfaces depending on the amount of water content*	*x*	*x*	
30.1.3	**Atmospheric pressure**	**x**	**x**	
30.1.3.1	**Barometric pressure and isobars**	**x**	**x**	
(01)	*Define pressure and list units of pressure used in flight meteorology (mbar, hPa, inHg)*	*x*	*x*	

(02)	*Describe the origin of atmospheric pressure from the gravitational force acting on the mass of air*	*x*	*x*	
(03)	*Define isobars as lines connecting positions of equal barometric pressure at MSL, as shown on surface (analytic) charts*	*x*	*x*	
30.1.3.2	**Pressure variation with height**	**x**	**x**	
(01)	*State the decrease in air pressure with increasing altitude as approximately by 1/2 every 5.500 m or 18.000 ft*	*x*	*x*	
30.1.3.3	**Reduction of pressure to mean sea level**	**x**	**x**	
(01)	*Define QFF as air pressure measured on ground or airport elevation, reduced to MSL by assuming actual atmospheric parameters*	*x*	*x*	
(02)	*Define QNH as air pressure measured on ground or airport elevation, reduced to MSL by assuming ISA conditions*	*x*	*x*	
30.1.3.4	**Relationship between surface pressure centres and pressure centres aloft**	**x**	**x**	
(01)	*Describe a high pressure center as an area where air pressure is higher than at any surrounding area, and where pressure levels bulge upwards*	*x*	*x*	
(02)	*Describe a low pressure center as an area where air pressure is lower than at any surrounding area, and where pressure levels bulge downwards*	*x*	*x*	
(03)	*State that the bulge in pressure levels (up- or downwards) may be different at different altitudes*	*x*	*x*	
30.1.4	**Air density**	**x**	**x**	
30.1.4.1	**Relationship between pressure, temperature and density**	**x**	**x**	
(01)	*Define 'air density'*	*x*	*x*	
(02)	*Describe the relationship between air density, temperature and pressure*	*x*	*x*	
30.1.5	**ICAO standard atmosphere**	**x**	**x**	
30.1.5.1	**Standard values**	**x**	**x**	
(01)	*State the rate of decrease in temperature with altitude altitude in the ISA Troposphere as 0.65 deg C/100 m or 2 deg C/1000 ft*	*x*	*x*	
(02)	*List the values of the ICAO standard atmosphere at MSL with +15 deg C, 1013.25 hPa, 1.225 kg/m3 and 0% relative humidity*	*x*	*x*	
(03)	*State the height of the tropopause in ISA with 11 km or 36.000 ft*	*x*	*x*	
30.1.6	**Altimetry**	**x**	**x**	
30.1.6.1	**Terminology and definitions**	**x**	**x**	
(01)	*Define and describe the terms 'pressure altitude', 'QNH altitude' and 'true altitude'*	*x*	*x*	
30.1.6.2	**Altimeter and altimeter settings**	**x**	**x**	
(01)	*Describe the indication of the barometric altimeter as height above selected reference pressure level*	*x*	*x*	
(02)	*Interpret the indication on the barometric altimeter when selecting QNH, QFE or 1013 hPa as reference pressure level*	*x*	*x*	
(03)	*Convert QFE into QNH, using airfield elevation and MSL barometric lapse rate of 30 ft/hPa*	*x*	*x*	
(04)	*Explain the difference between the altimeter settings and describe in which situations they are used*	*x*	*x*	

(05)	*Explain why true altitude, indicated altitude and the height indication on a GNSS system might differ*	*x*	*x*	
(06)	*Explain how temperatures lower than ISA affect the altimeter indication*	*x*	*x*	
(07)	*Assess the hazards when flying from high to low pressure with constant altimeter setting*	*x*	*x*	
30.1.6.3	**Calculations**	**x**	**x**	
(01)	*Determine true altitude from pressure altitude or QNH altitude with QNH and temperature deviation from ISA given, using 30 ft/hPa and 4% per 10 deg deviation from ISA*	*x*	*x*	
(02)	*Determine lowest usable flight level or lowest QNH altitude for given obstacle clearance, QNH and temperature deviation from ISA; using 30 ft/hPa and 4% per 10 deg deviation from ISA*	*x*	*x*	
30.1.6.4	**Effect of accelerated airflow due to topography**	**x**	**x**	
(01)	*Explain how altimeter indication may be affected from accelerated airflow through a valley or narrowed mountain ridge*	*x*	*x*	
30.2	**Wind**	**x**	**x**	
30.2.1	**Definition and measurement of wind**	**x**	**x**	
30.2.1.1	**Definition and measurement**	**x**	**x**	
(01)	*Describe how wind is measured for flight meteorological purposes*	*x*	*x*	
(02)	*List the units used for reporting wind speed in flight meteorology as kt or m/s*	*x*	*x*	
30.2.2	**Primary cause of wind**	**x**	**x**	
30.2.2.1	**Primary cause of wind, pressure gradient, coriolis force and gradient wind**	**x**	**x**	
(01)	*List the forces acting on air in the presence of pressure differences: gradient force and geostrophic (Coriolis) force*	*x*	*x*	
(02)	*Describe the effect of the geostrophic force on airflow as deflecting to the right on the northern hemisphere*	*x*	*x*	
(03)	*Describe the resulting airflow above the friction layer as parallel to the isobars (geostrophic wind)*	*x*	*x*	
30.2.2.2	**Variation of wind in the friction layer**	**x**	**x**	
(01)	*Explain the influence of surface friction on wind direction in the friction layer*	*x*	*x*	
(02)	*Describe the approximate change in wind direction and speed in the ground layer compared to friction-free layers over land: airflow directed approx. 30 degrees into low pressure compared with isobar-parallel direction, wind speed approx. 50% of frictionless speed*	*x*	*x*	
(03)	*State that the effects from friction depend on topographic conditions and are usually less above the sea*	*x*	*x*	
30.2.2.3	**Effects of convergence and divergence**	**x**	**x**	
(01)	*State that along low pressure troughs, deflection from isobar-parallel wind direction due to friction may lead to convergence effects*	*x*	*x*	
30.2.3	**General global circulation**	**x**	**x**	
30.2.3.1	**General circulation around the globe**	**x**	**x**	
(01)	*Define the terms 'convergence' and 'divergence' and describe associated weather conditions*	*x*	*x*	
(02)	*Describe the mid-latitudes (50 - 70N/S) as an area where polar air and subtropical air form the Polar Front as a wave-like boundary line around the globe*	*x*	*x*	

(03)	*List the typical latitudes for High- and Low pressure areas resulting from global circulation*	*x*	*x*	
30.2.4	**Local winds**	**x**	**x**	
30.2.4.1	**Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes**	**x**	**x**	
(01)	*Define the terms 'anabatic' and 'katabatic winds', and 'mountain' and 'valley winds'*	*x*	*x*	
(02)	*Describe possible hazards associated with strong winds perpendicular to a mountain ridge / range*	*x*	*x*	
(03)	*Describe how local topography may effect the prevailling wind direction and speed through valleys*	*x*	*x*	
(04)	*Describe how properties of ground surface may form local wind systems in absence of a prevailling wind direction (flat pressure pattern)*	*x*	*x*	
(05)	*Explain the effect of sea breeze and land breeze with change of daytime*	*x*	*x*	
30.2.5	**Mountain waves (standing waves, lee waves)**	**x**	**x**	
30.2.5.1	**Origin and characteristics**	**x**	**x**	
(01)	*Explain possible hazards associated with strong winds perpendicular to a mountain ridge / range*	*x*	*x*	
(02)	*Describe the formation of rotors and associated hazards*	*x*	*x*	
(03)	*Describe the formation of lenticularis clouds and associated hazards*	*x*	*x*	
(04)	*Describe the possible hazards and correct procedure when approaching a mountain ridge (never perpendicular)*	*x*	*x*	
30.2.6	**Turbulence**	**x**	**x**	
30.2.6.1	**Description and types of turbulence**	**x**	**x**	
(01)	*Define turbulence conditions 'light' / 'medium' / 'severe'*	*x*	*x*	
30.2.6.2	**Formation and location of turbulence**	**x**	**x**	
(01)	*Describe typical zones with turbulence, and how they can be avoided*	*x*	*x*	
(02)	*Describe hazards from turbulence close to the ground (e.g. when approaching, rows of trees, heating of surfaces)*	*x*	*x*	
30.3	**THERMODYNAMICS**	**x**	**x**	
30.3.1	**Humidity**	**x**	**x**	
30.3.1.1	**Water vapour in the atmosphere**	**x**	**x**	
(01)	*Describe air humidity as water molecules in gaseous form mixed with dry air*	*x*	*x*	
30.3.1.2	**Temperature/dew point, relative humidity**	**x**	**x**	
(01)	*Define 'absolute humidity' as mass of water vapour per volume of air, given in kg per cubic m*	*x*	*x*	
(02)	*Define 'saturation humidity' as the maximum mass of water vapour per volume of air, given in kg per cubic m*	*x*	*x*	
(03)	*Define 'relative humidity' as ratio of absolute to saturation humidity, ranging from 0 to 100%*	*x*	*x*	
(04)	*Describe the dependence of saturation humidity on air temperature*	*x*	*x*	
(05)	*Define 'dew point' as the temperature air with given humidity must be cooled air to reach saturation*	*x*	*x*	
(07)	*Describe the relationship between relative humidity, dew point and spread with change in temperature*	*x*	*x*	

30.3.2	**Change of state of aggregation**	**x**	**x**	
30.3.2.1	**Condensation, evaporation, sublimation, freezing and melting, latent heat**	**x**	**x**	
(01)	*Explain the change between aggretation states of water (solid, liquid, gaseous) with respect to heat released or required*	*x*	*x*	
(02)	*Define 'latent heat' as heat or energy released during phase transition from gaseous to liquid (or solid) state of water*	*x*	*x*	
30.3.3	**Adiabatic processes**	**x**	**x**	
20.3.3.1	**Adiabatic processes, stability of the atmosphere**			
(01)	*Explain that ascending or descending air changes its temperature by expansion (or compression) due to changing ambient air pressure.*	*x*	*x*	
(02)	*Describe atmospheric stability with respect to environmental temperature lapse rate compared to dry and saturated adiabatic lapse rate*	*x*	*x*	
30.4	**CLOUDS AND FOG**	**x**	**x**	
30.4.1	**Cloud formation and description**	**x**	**x**	
30.4.1.1	**Cooling by adiabatic expansion and by advection**	**x**	**x**	
(01)	*State that any clound formation requires a lifting process*	*x*	*x*	
(02)	*Describe thermal cloud formation process as sequence of dry adiabatic ascension and saturated adiabatic ascension with condensation and cloud formation*	*x*	*x*	
(03)	*Explain the height of the cloud base with regard to the spread of the ascending air (at ground level)*	*x*	*x*	
(04)	*Describe the effect of an upper level inversion on the height of the cloud tops*	*x*	*x*	
(05)	*State that convection processes usually result in cloud formation*	*x*	*x*	
30.4.1.2	**Cloud types and cloud classification**	**x**	**x**	
(01)	*Describe the two basic cloud types Cumulus (Cu) and Stratus (St) with regard to flight hazards (turbulence and visibility)*	*x*	*x*	
(02)	*Describe cloud types based on type of water content as liquid, supercooled (alto) and ice (cirrus)*	*x*	*x*	
(03)	*Identify cumulus/stratus clouds on a given picture*	*x*	*x*	
(04)	*Identifiy low/alto/cirro clouds on a given picture*	*x*	*x*	
(05)	*Identify clouds forming across multiple layers (nimbo)*	*x*	*x*	
(06)	*List the lettercodes for typical cloud types, e.g. Cu, Ac, St, As, Cb, Ci, Ns*	*x*	*x*	
30.4.1.3	**Influence of inversions on cloud development**	**x**	**x**	
(01)	*Describe the effect of an inversion layer on the lifting process with cloud development and atmospheric stability*	*x*	*x*	
30.4.2	**Fog, mist, haze**	**x**	**x**	
30.4.2.1	**General aspects**	**x**	**x**	
(01)	*Describe the general conditions for fog formation with low spread and descending temperature*	*x*	*x*	
(02)	*Associate 'fog' with visibility lower than 1000 m*	*x*	*x*	
(03)	*Explain the difference between 'haze' (HZ) and 'mist' (BR)*	*x*	*x*	
(04)	*Interpret spread information from ATIS with regard to propability of fog formation*	*x*	*x*	
30.4.2.2	**Radiation fog**	**x**	**x**	

(01)	*Explain the formation of radiation fog*	*x*	*x*	
(02)	*List conditions likely for the formation of radiation fog with regard to wind, cloud cover and spread*	*x*	*x*	
(03)	*State that formation and dissipation of radiation depends on time of day and year*	*x*	*x*	
(04)	*State that formation and dissipation of radiation depends over larger areas can be monitored via satellite pictures (visual channel)*	*x*	*x*	
30.4.2.3	**Advection fog**	**x**	**x**	
(01)	*Explain the formation of advection fog*	*x*	*x*	
(02)	*State example situations in which advection fog may occur*	*x*	*x*	
30.4.2.4	**Steaming fog**	**x**	**x**	
(01)	*Explain the formation of steaming fog (or arctic smoke)*	*x*	*x*	
(02)	*State example situations in which steaming fog may occur*	*x*	*x*	
30.4.2.5	**Frontal fog**	**x**	**x**	
(01)	*Explain the formation of frontal (or mixing) fog*	*x*	*x*	
(02)	*State example situations in which frontal fog may occur*	*x*	*x*	
30.4.2.6	**Orographic fog (hill fog)**	**x**	**x**	
(01)	*Explain the formation of orographic (or hill) fog*	*x*	*x*	
(02)	*State example situations in which hill fog may occur*	*x*	*x*	
30.5	**PRECIPITATION**	**x**	**x**	
30.5.1	**Development of precipitation**	**x**	**x**	
30.5.1.1	**Processes of development of precipitation**	**x**	**x**	
(01)	*Describe the process of precipitation develepment as a combination of coalescence and icing*	*x*	*x*	
30.5.2	**Types of precipitation**	**x**	**x**	
30.5.2.1	**Types of precipitation, relationship with cloud types**	**x**	**x**	
(01)	*Explain the correlation of different types of precipitation (rain or showers of rain) with cloud type (St or Cu)*	*x*	*x*	
(02)	*List and characterize different types of precipitation (e.g. drizzle, rain, showers of rain or snow) with regard to turbulence, visibility, duration and movement, assiciated clouds*	*x*	*x*	
30.6	**AIR MASSES AND FRONTS**	**x**	**x**	
30.6.1	**Air masses**	**x**	**x**	
30.6.1.1	Description, classification and source regions of air masses	x	x	
(01)	*List the air masses usually affecting the weather in mid Europe*	*x*	*x*	
(02)	*Describe and identify air masses with respect to origin (tropical/polar) and track (maritime/continental)*	*x*	*x*	
30.6.1.2	**Modifications of air masses**	**x**	**x**	
(01)	*Describe how properties of air masses (humidity, temperature and stability) may change along their tracks*	*x*	*x*	
30.6.2	**Fronts**	**x**	**x**	
30.6.2.1	**General aspects**	**x**	**x**	
(01)	*Describe a 'front' as a boundary between different air masses with active weather phenomena*	*x*	*x*	
30.6.2.2	**Warm front, associated clouds, and weather**	**x**	**x**	

(01)	*Describe the behavior of warm air approaching cold air (vertical profile)*	*x*	*x*	
(02)	*List typical clouds and precipitation associated with a warm front*	*x*	*x*	
(03)	*Describe typical visual meteorological flight conditions associated with warm fronts*	*x*	*x*	
(04)	*List and explain the possible hazards to aviation, associated with a warm front*	*x*	*x*	
(05)	*State the horizontal extension of the frontal area of a warm front*	*x*	*x*	
(06)	*Name and identify warm fronts on surface weather charts*	*x*	*x*	
30.6.2.3	**Cold front, associated clouds, and weather**	**x**	**x**	
(01)	*Describe the behavior of cold air approaching warm air (vertical profile)*	*x*	*x*	
(02)	*List typical clouds and precipitation associated with a cold front*	*x*	*x*	
(03)	*Describe typical visual meteorological flight conditions associated with cold fronts*	*x*	*x*	
(04)	*List and explain the possible hazards to aviation, associated with a cold front*	*x*	*x*	
(05)	*State the horizontal extension of the frontal area of a cold front*	*x*	*x*	
(06)	*Name and identify cold fronts on surface weather charts*	*x*	*x*	
30.6.2.4	**Warm sector, associated clouds, and weather**	**x**	**x**	
(01)	*Describe the typical weather phenomena and visual meteorological flight conditions after a warm front has passed with regards to clouds, precipitation, turbulence and visibility*	*x*	*x*	
30.6.2.5	**Weather behind the cold front**	**x**	**x**	
(01)	*Describe the typical weather phenomena and visual meteorological flight conditions after a cold front has passed with regards to clouds, precipitation, turbulence and visibility*	*x*	*x*	
30.6.2.6	**Occlusions, associated clouds, and weather**	**x**	**x**	
(01)	*Describe how the polar air mass ahead of the warm front re-combines with polar air behind the cold front*	*x*	*x*	
(02)	*Describe typical visual meteorological flight conditions associated with occlusions*	*x*	*x*	
(03)	*List possible hazards to aviation, associated with occlusions*	*x*	*x*	
(04)	*Name and identify occlusion lines on surface weather charts*	*x*	*x*	
30.6.2.7	**Stationary front, associated clouds, and weather**	**x**	**x**	
(01)	*Describe a 'stationary front' as a front not showing any horizontal displacement*	*x*	*x*	
(02)	*Describe typical visual meteorological flight conditions associated with stationary fronts*	*x*	*x*	
(03)	*Name and identify stationary fronts on surface weather charts*	*x*	*x*	
30.6.2.8	**Movement of fronts and pressure systems, life cycle**	**x**	**x**	
(01)	*Describe the typical path of movement of a polar front low as in direction of the warm sector isobars*	*x*	*x*	
(02)	*State the life cycle of a polar front low as in order of a few days*	*x*	*x*	
30.6.2.9	**Changes of meteorological elements at a frontal wave**	**x**	**x**	
(01)	*Describe the changes in air pressure, temperature and approximate wind direction with the passage of a polar front low*	*x*	*x*	
30.7	**PRESSURE SYSTEMS**	**x**	**x**	
30.7.1	**Anticyclone**	**x**	**x**	

30.7.1.1	**Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence**	**x**	**x**	
(01)	*State that high pressure results from wide-area increase or inflow of air mass*	*x*	*x*	
(02)	*Describe the atmospheric processes that result in subsidence and adiabatic warming (dynamic or warm high)*	*x*	*x*	
(03)	*Describe the atmospheric processes that result in extreme cooling of air and increased air density (cold high)*	*x*	*x*	
30.7.2	**Non-frontal depressions**	**x**	**x**	
30.7.2.1	**Thermal, orographic and polar depressions, troughs**	**x**	**x**	
(01)	*State that low pressure areas on different scale are usually associated with convergence and ascending air with formation of cloud and weather*	*x*	*x*	
(02)	*Describe visual meteorological conditions typically found around depression and throughs (with showers and thunderstorms)*	*x*	*x*	
30.8	**CLIMATOLOGY**	**x**	**x**	
30.8.1	**Climatic zones**	**x**	**x**	
30.8.1.1	**General seasonal circulation in the troposphere**	**x**	**x**	
(01)	*Describe the seasonal variation of the polar front*	*x*	*x*	
(02)	*List the typical locations of high and low pressure areas (e.g. Azores High, Iceland Low)*	*x*	*x*	
30.8.2	**Typical weather situations in the mid-latitudes**	**x**	**x**	
30.8.2.1	**Westerly situation**	**x**	**x**	
(01)	*Describe the prevailing weather situation / phenomenas within the westerlies (prevailing westerly wind, passing of cyclones and frontal systems)*	*x*	*x*	
30.8.2.2	**High-pressure area**	**x**	**x**	
(01)	*Describe the prevailing weather situation with high pressure areas (warm and cold high) in summer and winter*	*x*	*x*	
30.8.2.3	**Flat-pressure pattern**	**x**	**x**	
(01)	*State that high pressure areas in summer are usually associated with flat pressure pattern*	*x*	*x*	
(02)	*Describe the prevailing weather situation with flat pressure pattern*	*x*	*x*	
(03)	*State that with a flat pressure pattern local wind systems may form*	*x*	*x*	
30.8.3	**Local winds and associated weather**	**x**	**x**	
30.8.3.1	**Mountain waves, e.g. Foehn**	**x**	**x**	
(01)	*Explain the typical conditions and development of a mountain wave over the alps ('Foehn')*	*x*	*x*	
(02)	*Identify the different zones with downdrafts, updrafts, rotors and lenticular clouds of a mountain wave (foehn system)*	*x*	*x*	
(03)	*Describe the approximate magnitude of downdrafts associates with foehn (or similar) conditions with regard to maximum climb performance of aircraft*	*x*	*x*	
30.9	**FLIGHT HAZARDS**	**x**	**x**	
30.9.1	**Icing**	**x**	**x**	
30.9.1.1	**Conditions for ice accretion**	**x**	**x**	

(01)	*List meteorological conditions (humidity, temperature, precipitation) that affecting type and intensity of airframe icing*	*x*	*x*	
30.9.1.2	**Types of ice accretion**	**x**	**x**	
(01)	*List and describe different forms of ice build up (clear ice, rime ice and mixed ice)*	*x*	*x*	
(02)	*List the different levels of icing intensity (light, moderate, severe)*			
30.9.1.3	**Hazards of ice accretion, avoidance**	**x**	**x**	
(01)	*Describe how airframe icing affects aircraft performance with regard to: lift, drag, mass, engine power, operational limits*	*x*	*x*	
(02)	*Describe typical situations with possible hazards of airframe icing*	*x*	*x*	
(03)	*Recall strategies / flight paths to leave a zone of icing on the fastest / most effective way*	*x*	*x*	
(04)	*Describe the capabilities of 'ice prevention' or 'de-icing' systems commonly used in general aviation aircraft, also with regard to medium/severe icing*	*x*	*x*	
(05)	*Explain under which conditions flight into known icing is approved / possible*	*x*	*x*	
30.9.2	**Turbulence**	**x**	**x**	
30.9.2.1	**Effects on flight, avoidance**	**x**	**x**	
(01)	*Describe effects of of different types turbulence (light, moderate, severe) on the aircraft*	*x*	*x*	
(02)	*List typical zones with turbulence and how to avoid them, e.g. below Cu clouds, shower downdrafts, mountain waves, inversions*	*x*	*x*	
30.9.3	**Wind shear**	**x**	**x**	
30.9.3.1	**Definition of wind shear**	**x**	**x**	
(01)	*Define the term 'wind shear' as a significant change of wind speed and/or direction over a horizontal or vertical interval*	*x*	*x*	
(02)	*Explain the possible hazards associated with horizontal or vertical wind sheer*	*x*	*x*	
30.9.3.2	**Weather conditions for wind shear**	**x**	**x**	
(01)	*Describe wind sheer associated with rain showers and vertical downdrafts*	*x*	*x*	
(02)	*Describe wind sheer associated with strong inversion layers*	*x*	*x*	
(03)	*Describe wind sheer associated with strong winds blowing cross mountain ridges ('Foehn' conditions)*	*x*	*x*	
30.9.3.3	**Effects on flight, avoidance**	**x**	**x**	
(01)	*Explain the effects of horizontal or vertical wind sheer on airspeed, glide path and climb performance*	*x*	*x*	
(02)	*Explain how to identify and avoid hazards associated with wind shears from rain showers during final approach*	*x*	*x*	
(03)	*Explain how to avoid hazards associated with wind shears with strong inversion layers during climb*	*x*	*x*	
30.9.4	**Thunderstorms**	**x**	**x**	
30.9.4.1	**Conditions for, and process of, development, forecast, location, type specification**	**x**	**x**	
(01)	*List the conditions favourable for thunderstorm formation with regard to temperature, humidity and atmospheric stability*	*x*	*x*	

(02)	*List typical weather situations where thunderstorms are likely to occur as single-cell storm or along frontal and squall lines*	*x*	*x*	
(03)	*Explain the effect of topography on the formation of thunderstorms*	*x*	*x*	
30.9.4.2	**Structure of thunderstorms, life cycle, squall lines, electricity in the atmosphere, static charges**	**x**	**x**	
(01)	*Describe the formation and life-cycle of single-cell thunderstorms*	*x*	*x*	
(02)	*List Ac Castellanis and Cb clouds as early indications for the onset of thunderstorm formation*	*x*	*x*	
(03)	*Describe the possible hazards from thunderstorm with regard to turbulence, wind shear and eletrical discharges*	*x*	*x*	
30.9.4.3	**Electrical discharges**	**x**	**x**	
(01)	*Explain the possible hazards from lightning strikes to aircrafts in flight*	*x*	*x*	
(02)	*Describe crackling noises on the radio as a result of lightning strikes in the immediate vicinity*	*x*	*x*	
30.9.4.4	**Development and effects of downbursts**	**x**	**x**	
(01)	*Describe the vertical outflow of air below thunderstorms resulting in vertical and horizontal wind shear as possible hazard to aircrafts in flight*	*x*	*x*	
30.9.4.5	**Thunderstorm avoidance**	**x**	**x**	
(01)	*Identify the stages of a thunderstorm / Cb cloud (initial stage, mature stage, dissipating stage) and possible hazards to aviation in each phase*	*x*	*x*	
(02)	*Explain how to avoid thunderstorms by delaying take-off or final approach*	*x*	*x*	
(03)	*Explain how to avoid single-cell thunderstorm enroute by small changes of heading*	*x*	*x*	
30.9.5	**Inversions**	**x**	**x**	
30.9.5.1	**Influence on aircraft performance**	**x**	**x**	
(01)	*Explain the possible hazards from strong inversion layers with regard to aircraft performance*	*x*	*x*	
30.9.6	**Hazards in mountainous areas**	**x**	**x**	
30.9.6.1	**Influence of terrain on clouds and precipitation, frontal passage**	**x**	**x**	
(01)	*Describe the effect of topography on frontal activity and formation of clouds*	*x*	*x*	
(02)	*Describe possible hazards from stable air mass lifted due to horizontal movement against a mountain range with regard to visibility and cloud base*	*x*	*x*	
30.9.6.2	**Vertical movements, mountain waves, wind shear, turbulence, ice accretion**	**x**	**x**	
(01)	*Explain the hazards from flying into a valley with no meteorological possibility to get out of it*	*x*	*x*	
(02)	*Describe possible hazards associated with strong winds perpendicular to a mountain ridge / range*	*x*	*x*	
30.9.6.3	**Development and effect of valley inversions**	**x**	**x**	
(01)	*Describe the development of valley inversions*	*x*	*x*	
(02)	*Explain the hazards when departing through a strong valley inversion*	*x*	*x*	
30.9.7	**Visibility-reducing phenomena**	**x**	**x**	
30.9.7.1	**Reduction of visibility caused by precipitation and obscuration**	**x**	**x**	
(01)	*List possible reasons for reduced visibility*	*x*	*x*	
(02)	*Explain possible hazards from a reduction in visibility*	*x*	*x*	

30.9.7.2	**Reduction of visibility caused by other phenomena**	**x**	**x**	
(01)	*Explain why flying below an inversion layer visibility may be reduced*	*x*	*x*	
30.10	**METEOROLOGICAL INFORMATION**	**x**	**x**	
30.10.1	**Observation**	**x**	**x**	
30.10.1.1	**Surface observations**	**x**	**x**	
(01)	*State that 'surface observation' shows various atmospheric parameters taken on a specific time*	*x*	*x*	
(02)	*Identify the VALID TIME from a given synoptic chart or observation message*	*x*	*x*	
30.10.1.2	**Radiosonde observations**	**x**	**x**	
(01)	*Determine the temperature and dew point at a given altitude from a radio sonde plot*	*x*	*x*	
(02)	*Determine cloud or fog layers by interpretation of temperature / dew point plots*	*x*	*x*	
30.10.1.3	**Satellite observations**	**x**	**x**	
(01)	*Explain the purpose of meteorological satellite imagery*	*x*	*x*	
(02)	*Describe different types of satellity image construction (VIS / IR)*	*x*	*x*	
(03)	*Describe and interpret data from meteorological satellite imagery*	*x*	*x*	
30.10.1.4	**Weather radar observations**	**x**	**x**	
(01)	*Explain the purpose of ground-based WX radar*	*x*	*x*	
(02)	*Describe the operating principle of WX radar*	*x*	*x*	
(03)	*Describe and interpret information from WX radar images*	*x*	*x*	
30.10.1.5	**Aircraft observations and reporting**	**x**	**x**	
(01)	*State that pilot reports provide the most detailled and timely accurate information about possible hazardous situations enroute*	*x*	*x*	
30.10.2	**Weather charts**	**x**	**x**	
30.10.2.1	**Significant weather charts**	**x**	**x**	
(01)	*Define the term 'significant weather' as potential hazards relevant for flight planning decisions*	*x*	*x*	
(02)	*Describe the structure of Significant Weather Charts (SWC) with chart and legend part*	*x*	*x*	
(03)	*Interpret chart symbolics for significant weather, weather areas ('bubbles') and lower and upper interval limits of turbulence and icing*	*x*	*x*	
(04)	*Identify areas from a significant weather chart which may impose hazards to a planned flight*	*x*	*x*	
30.10.2.2	**Surface charts**	**x**	**x**	
(01)	*Describe the basic contents shown in surface weather charts (synoptic or analytic charts)*	*x*	*x*	
(02)	*Interpret chart symbolic from surface weather charts with regard to pressure areas and fronts*	*x*	*x*	
(03)	*Identify areas from a weather chart which may impose hazards to a planned flight*	*x*	*x*	
(04)	*Describe the wind direction to be expected on a chart showing high and low pressure areas and isobars*	*x*	*x*	
30.10.3	**Information for flight planning**	**x**	**x**	
30.10.3.1	**Aviation weather messages**	**x**	**x**	
(01)	*Define METAR and describe content with structure, time of issue and validity period*	*x*	*x*	

(02)	*Define TAF and describe content with structure, time of issue and validity period*	*x*	*x*	
(03)	*Define ATIS and describe content with structure, time of issue and validity period*	*x*	*x*	
(04)	*List and interpret the lettergroups for METAR and TAF commonly used in Europe*	*x*	*x*	
(05)	*Extract the validity period of a TAF message from a given TAF message*	*x*	*x*	
(06)	*Decide if indicated weather conditions allow a VFR or SVFR flight*	*x*	*x*	
30.10.3.2	**Meteorological broadcasts for aviation**	**x**	**x**	
(01)	*Describe VOLMET service and possible application on enroute flights*	*x*	*x*	
30.10.3.3	**Use of meteorological documents**	**x**	**x**	
(01)	*List type of weather charts and reports suitable for pre-flight (flight planning) and and enroute phases of flight*	*x*	*x*	
30.10.3.4	**Meteorological warnings**	**x**	**x**	
(01)	*Describe SIGMET and list criteria for issueing*	*x*	*x*	
(02)	*Describe PIREPs and their relevance for providing most accurate information about flight hazards currently observed*	*x*	*x*	
30.10.4	**Meteorological services**	**x**	**x**	
30.10.4.1	**World area forecast system (WAFS) and meteorological offices**	**x**	**x**	
(01)	*State the purpose of WAFS as to provide the worldwide aviation community with operational meteorological forecasts and information about meteorological phenomena required for flight planning and safe, economic, and efficient air navigation*	*x*	*x*	*Refereence: https://www.icao.int/APAC/Documents/edocs/WAFS_Service_Reference_v2.pdf*
(02)	*State that models provided by WAFS mainly provide global gridded forecasts of upper levels (FL 100 and above) including winds, temperature and humidity, and speed and flight level of maximum wind*	*x*	*x*	*Refereence: https://www.icao.int/APAC/Documents/edocs/WAFS_Service_Reference_v2.pdf*
(03)	*Describe how data from numerical weather prediction models can be used during flight*	*x*	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
40	**COMMUNICATION**	**x**	**x**	
40.1	**VFR COMMUNICATIONS**	**x**	**x**	
40.1.1	**Definitions**	**x**	**x**	
40.1.1.1	**Meanings and significance of associated terms**	**x**	**x**	
(01)	*Define commonly used air traffic services (ATS) terms for stations*	*x*	*x*	
40.1.1.2	**ATS abbreviations**	**x**	**x**	
(01)	*Define commonly used ATS abbreviations: flight conditions, airspace, services, time, VFR-related terms*	*x*	*x*	
40.1.1.3	**Q-code groups commonly used in RTF airground communications**	**x**	**x**	
(01)	*Define Q-code groups commonly used in RT air-ground communications: pressure settings (QNH, QFE, Standard)*	*x*	*x*	

(02)	*Define Q-code groups commonly used in RT air-ground communications: directions (Magnetic) and bearings (QDM, QDR)*	*x*	*x*	
(03)	*Give example situations for obtaining bearing information in flight*	*x*	*x*	
40.1.1.4	**Categories of messages**	**x**	**x**	
(01)	*Name different categories of radio messages*	*x*	*x*	
(02)	*Name the correct priority of radio messages*	*x*	*x*	
(03)	*Identify to which category of messages a type of message belongs and identify the associated priority indicator*	*x*	*x*	
40.1.2	**General operating procedures**	**x**	**x**	
40.1.2.1	**Transmission of letters**	**x**	**x**	
(01)	*Know and use the phonetic alphabet used in RT ('ICAO alphabet')*	*x*	*x*	
(02)	*Explain which names are transmitted phonetically (e.g. VOR, NDB, QNH) and which have to be spelled*	*x*	*x*	
40.1.2.2	**Transmission of numbers (including level information)**	**x**	**x**	
(01)	*Describe the method of transmission of numbers: pronunciation, single digits, whole hundreds and whole thousands*	*x*	*x*	
(02)	*Describe the abbreviation numbers using the words 'triple' or 'double'*	*x*	*x*	
(03)	*State how to transmit altitudes, flight levels and heights correctly*	*x*	*x*	
(04)	*State how to transmit headings and bearings correctly*	*x*	*x*	
(05)	*State how to transmit frequencies correctly*	*x*	*x*	
(06)	*State how to transmit QNH correctly*	*x*	*x*	
(07)	*State how to transmit visibility correctly, and which units used*	*x*	*x*	
40.1.2.3	**Transmission of time**	**x**	**x**	
(01)	*State that UTC is used as standard time reference in RT*	*x*	*x*	
(02)	*Describe the ways of transmitting time: using only minutes, or minutes and hours, when required*	*x*	*x*	
40.1.2.4	**Transmission technique**	**x**	**x**	
(01)	*Explain the causes and possible safety impacts of a blocked frequency*	*x*	*x*	
(02)	*Explain why, after switching to a certain frequency, the frequency should be monitored before making an initial call*	*x*	*x*	
40.1.2.5	**Standard words and phrases (relevant RTF phraseology included)**	**x**	**x**	
(01)	*Define the meaning of standard words and phrases*	*x*	*x*	
(02)	*Recognise, describe and use the correct standard phraseology for each phase of a VFR flight: before taxi, taxi, departure, en route, circuit, final, landing, after landing*	*x*	*x*	
(03)	*State how to affirm or negate questions correctly*	*x*	*x*	
(04)	*State how to make use of radio phraseology to correct errors*	*x*	*x*	
(05)	*State how to request the repetition of a certain part of a message*	*x*	*x*	
(06)	*Describe the procedure for 'blind transmissions'*	*x*	*x*	
40.1.2.6	**R/T call signs for aeronautical stations including use of abbreviated call signs**	**x**	**x**	
(01)	*Name the two parts of the call sign of an aeronautical station*	*x*	*x*	
(02)	*Identify the call-sign suffixes for aeronautical stations*	*x*	*x*	
(03)	*Explain when the call sign may be omitted or abbreviated to the use of suffix only*	*x*	*x*	

40.1.2.7	**R/T call signs for aircraft including use of abbreviated call signs**	**x**	**x**	
(01)	*Describe the composition and transmission of an aircraft call sign*	*x*	*x*	
(02)	*Describe the abbreviated forms for aircraft call signs*	*x*	*x*	
(03)	*State that upon initial contact all characters of an aircraft have to be transmitted*	*x*	*x*	
(04)	*State that an abbreviated call sign must only be used if it was already abbreviated by the ground station*	*x*	*x*	
40.1.2.8	**Transfer of communication**	**x**	**x**	
(01)	*Describe the procedure for transfer of communication: by ground station, or by aircraft*	*x*	*x*	
40.1.2.9	**Test procedures including readability scale**	**x**	**x**	
(01)	*Explain how to test radio transmission and reception*	*x*	*x*	
(02)	*State the readability scale and explain its meaning*	*x*	*x*	
40.1.2.10	**Read back and acknowledgement requirements**	**x**	**x**	
(01)	*Describe the requirement to read back ATC clearances*	*x*	*x*	
(02)	*Describe the requirement to read back other data such as runway, secondary surveillance radar (SSR) codes, etc.*	*x*	*x*	
(03)	*Give examples of how to correctly read back ATC instructions*	*x*	*x*	
(04)	*Give examples of data that shall NOT be read back (e.g. wind, traffic information, etc.)*	*x*	*x*	
(05)	*State in which cases leaving frequency has to be approved or reported*	*x*	*x*	
40.1.3	**Relevant weather information terms (VFR)**	**x**	**x**	
40.1.3.1	**Aerodrome weather**	**x**	**x**	
(01)	*List the contents of aerodrome weather reports and state units of measurement used: wind, visibility, cloud, temperture, dew point, pressure, supplementary information*	*x*	*x*	
(02)	*Define meteorological terms used with aviation weather messages (e.g. 'ceiling', 'CAVOK', 'FEW', 'SCT', 'BKN', 'OVC')*	*x*	*x*	
40.1.3.2	**Weather broadcast**	**x**	**x**	
(01)	*List the sources (VOLMET and ATIS units) of weather information available for aircraft in flight*	*x*	*x*	
(02)	*Describe situations in which a pilot can obtain weather broadcasts*	*x*	*x*	
(03)	*Explain the terms 'ATIS' and 'VOLMET' and their relevant content*	*x*	*x*	
(04)	*Explain and demonstrate how to decode ATIS messages*	*x*	*x*	
40.1.4	**Action required to be taken in case of communication failure**	**x**	**x**	
40.1.4.1	**Procedures**	**x**	**x**	
(01)	*Describe procedures in case of communication failure in uncontrolled airspace*	*x*	*x*	
(02)	*Describe procedures in case of communication failure when approaching or in controlled airspace (e.g. CTR)*	*x*	*x*	
(03)	*Identify frequencies to be used in attempt to establish communication*	*x*	*x*	
(04)	*State the SSR code that may be used to indicate communication failure*	*x*	*x*	
40.1.5	**Distress and urgency procedures**	**x**	**x**	
40.1.5.1	**Distress (definition, frequencies, watch of distress frequencies, distress signal and distress message)**	**x**	**x**	
(01)	*Define 'DISTRESS'*	*x*	*x*	

(02)	*State the wording used with distress messages ('MAYDAY')*	*x*	*x*	
(03)	*State the frequencies that should be used by aircraft in DISTRESS*	*x*	*x*	
(04)	*State the SSR codes that may be used by aircraft in emergency*	*x*	*x*	
(05)	*Describe the action to be taken by the station which receives a DISTRESS message*	*x*	*x*	
(06)	*Describe the action to be taken by all other stations when a DISTRESS procedure is in progress*	*x*	*x*	
(07)	*List the correctly sequenced elements of a DISTRESS signal/message and describe the message content*	*x*	*x*	
40.1.5.2	**Urgency (definition, frequencies, urgency signal and urgency message)**	**x**	**x**	
(01)	*Define 'URGENCY'*	*x*	*x*	
(02)	*State the wording used with urgency messages ('PAN PAN')*	*x*	*x*	
(03)	*State the frequencies that should be used by aircraft in URGENCY*	*x*	*x*	
(04)	*State that URGENCY messages take priority over all other messages except DISTRESS*	*x*	*x*	
(05)	*Describe the action to be taken by the station which receives an URGENCY message*	*x*	*x*	
(06)	*Describe the action to be taken by all other stations when an URGENCY procedure is in progress*	*x*	*x*	
(07)	*List the correctly sequenced elements of an URGENCY signal/message and describe the message content*	*x*	*x*	
40.1.6	**General principles of VHF propagation and allocation of x frequencies**	**x**	**x**	
40.1.6.1	**General principles: spectrum, bands, range**	**x**	**x**	
(01)	*State the properties of electromagnetic waves (e.g. frequency, wavelength, speed of propagation)*	*x*	*x*	
(02)	*Describe the radio-frequency spectrum of the bands into which the radio-frequency spectrum is divided*	*x*	*x*	
(03)	*State the frequency range of the VHF band, and identify frequency used for VHF voice communication*	*x*	*x*	
(04)	*State the frequency band and channel spacing for VHF radio communications*	*x*	*x*	
(05)	*List factors which reduce the effective range and quality of VHF radio transmissions (e.g. tranmission power, altitude, thunderstorms etc.)*	*x*	*x*	
(06)	*Describe the difference between a 'channel' and a 'frequency'*	*x*	*x*	
(07)	*Explain the difference between 8,33 kHz and 25 kHz channel spacing*	*x*	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
51	**PRINCIPLES OF FLIGHT: AEROPLANE**	**x**	**-**	
51.1	**Subsonic aerodynamics**	**x**	**-**	
51.1.1	**Basic concepts, laws and definitions**	**x**	**-**	
51.1.1.1	**Laws and definitions**	**x**	**-**	
	(a) conversion of units	**x**	**-**	
	(b) Newton´s laws	**x**	**-**	
	(c) Bernoulli's equation and venturi	**x**	**-**	
	(d) static pressure, dynamic pressure and total pressure	**x**	**-**	

	(e) density	**x**	**-**	
	(f) IAS and TAS	**x**	**-**	
(01)	*Define 'static pressure', 'dynamic pressure' and 'total pressure'*	*x*	-	
(02)	*Describe the relationship of total, static and dynamic pressure with airflow through a narrowed cross section (Bernoulli' law)*	*x*	-	
(03)	*Describe the relationship of IAS and TAS with dynamic pressure*	*x*	-	
51.1.1.2	**Basics about airflow**	**x**	**-**	
	(a) streamline	**x**	**-**	
	(b) two-dimensional airflow	**x**	**-**	
	(c) three-dimensional airflow	**x**	**-**	
(01)	*Explain the concept of 'streamline pattern' with regard to airflow speed, static and dynamic pressure*	*x*	-	
(02)	*Apply Bernoulli's law to the airflow around an aerofoil with regard to speed and change in static and dynamic pressure*	*x*	-	
51.1.1.3	**Aerodynamic forces on surfaces**	**x**	**-**	
	(a) resulting airforce	**x**	**-**	
(01)	*Describe the total aerodynamic force on a wing as a vectorized sum of drag and lift force*	*x*	-	
	(b) lift	**x**	**-**	
(02)	*Describe the 'lift force' resulting from pressure differences on the upper and lower side of the wing*	*x*	-	
(03)	*State that the lift force acts perpendicular to the airflow*	*x*	-	
	(c) drag	**x**	**-**	
(04)	*State that the drag force acts opposite to the direction of the flight path*	*x*	-	
	(d) angle of attack	**x**	**-**	
(05)	*Define the term 'angle of attack (AOA)'*	*x*	-	
(06)	*Describe how lift and drag change with changing AOA or modifications of the airfoil (e.g. when extending high-lift devices)*	*x*	-	
51.1.1.4	**Shape of an aerofoil section**	**x**	**-**	
	(a) thickness to chord ratio	**x**	**-**	
	(b) chord line	**x**	**-**	
	(c) camber line	**x**	**-**	
	(d) camber	**x**	**-**	
	(e) angle of attack	**x**	**-**	
(01)	*Explain the basic reasons for designing an 'airfoil' in the typical way (round leading edge, camber, pointed trailing edge)*	*x*	-	
(02)	*Name and identify geometric properties of an airfoil (nose radius, chord, chamber, location of max. thickness, angle of attack etc.)*	*x*	-	
(03)	*Describe and identify laminar and symmetric airfoils*	*x*	-	
(04)	*State and explain the advantages and disadvantages of a laminar airfoil*	*x*	-	
(05)	*State and explain advantages and disadvantages of a symmetric airfoil and its common usage*	*x*	-	
51.1.1.5	**The wing shape**	**x**	**-**	

	(a) aspect ratio	**x**	**-**	
	(b) root chord	**x**	**-**	
	(c) tip chord	**x**	**-**	
	(d) tapered wings	**x**	**-**	
	(e) wing planform	**x**	**-**	
(01)	*Define 'aspect ratio'*	*x*	-	
(02)	*Identify wings with high and wings with low aspect ratio*	*x*	-	
(03)	*Explain the influence of aspect ratio on flight characteristics*	*x*	-	
(04)	*Name and identify typical wing shapes (e.g. straight, tapered, delta or swept back wings)*	*x*	-	
(05)	*Define 'wing span'*	*x*	-	
(06)	*Name and identify the main geometric parameters of a wing (e.g. angle of incidence, tip and root chord, taper ratio, chord at tip and wing root)*	*x*	-	
51.1.2	**The two-dimensional airflow about an aerofoil**	**x**	**-**	
51.1.2.1	**Streamline pattern**	**x**	**-**	
(01)	*Describe the air flow around a streamline pattern (depiction with stream lines)*	*x*	-	
(02)	*Describe the changes in air flow velocity around an airplane's wing*	*x*	-	
51.1.2.2	**Stagnation point**	**x**	**-**	
(01)	*Define and identify the stagnation point (from depictions)*	*x*	-	
(02)	*Describe the movement of the stagnation point with angle of attack*	*x*	-	
51.1.2.3	**Pressure distribution**	**x**	**-**	
(01)	*Apply Bernoulli's law to the streamline pattern around an airfoil in terms of changes in flow velocity and distribution of pressure (static / dynamic / total)*	*x*	-	
(02)	*Describe lift generation in terms of pressure distribution*	*x*	-	
51.1.2.4	**Centre of pressure**	**x**	**-**	
(01)	*Define and interpret 'center of pressure' as a point the resulting aeordynamic force acts on*	*x*	-	
(02)	*Explain the longitudinal movement of center of pressure with changing angle of attack*	*x*	-	
51.1.2.5	**Influence of angle of attack**	**x**	**-**	
(01)	*Describe the change in lift coefficient (cL) with angle of attack*	*x*	-	
51.1.2.6	**Flow separation at high angles of attack**	**x**	**-**	
(01)	*Explain the reduction in lift (cL) beyond a critical angle of attack by beginning of flow separation*	*x*	-	
(02)	*Describe the change in center of pressure with flow separation*	*x*	-	
51.1.2.7	**The lift – α graph**	**x**	**-**	
(01)	*Describe the relationship of angle of attack (AOA) with lift coefficient (cL) by use of the cL/AOA graph*	*x*	-	
51.1.3	**The coefficients**	**x**	**-**	
51.1.3.1	**The lift coefficient cL: the lift formula**	**x**	**-**	
(01)	*Explain the meaning of the coefficients of lift cL and its usage in the lift formula*	*x*	-	
(02)	*State the formula for lift qualitatively (factors, dependencies, no calculations)*	*x*	-	

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51.1.3.2	**The drag coefficient Cd: the drag formula**	**x**	**-**	
(01)	*Explain the meaning of the coefficients of drag cD and its usage in the drag formula*	*x*	-	
(02)	*State the formula for drag qualitatively (factors, dependencies, no calculations)*	*x*	-	
51.1.3.3	**Correlation of cL with cD**	**x**	**-**	
(01)	*Explain the correlation of cL and cD for various flight phases using the cL-cD diagram*	*x*	-	
51.1.4	**The three-dimensional airflow round a wing and a fuselage**	**x**	**-**	
51.1.4.1	**Streamline pattern**	**x**	**-**	
	(a) span-wise flow and causes	**x**	**-**	
	(b) tip vortices and angle of attack	**x**	**-**	
	(c) upwash and downwash due to tip vortices	**x**	**-**	
	(d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon)	**x**	**-**	
(01)	*Describe the pressure equalization between upper and lower side of the wing*	*x*	-	
(02)	*Describe 'wake turbulence' as resulting from pressure equalization at the wing tips and downwash effects behind an aeroplane*	*x*	-	
(03)	*Explain possible hazards from wake turbulence for succeeding aircraft*	*x*	-	
(04)	*State the factors that affect the magnitude of wake turbulence: weight, speed and configuration of the aircraft*	*x*	-	
(05)	*State the most hazardous conditions for the magnitude of wake turbulence as 'heavy and slow'*	*x*	-	
51.1.4.2	**Induced drag**	**x**	**-**	
	(a) influence of tip vortices on the angle of attack	**x**	**-**	
	(b) the induced local α	**x**	**-**	
	(c) influence of induced angle of attack on the diretion of the lift vector	**x**	**-**	
	(d) induced drag and angle of attack	**x**	**-**	
	(e) development of induced drag and influencing parameters	**x**	**-**	
(01)	*Explain the formation of induced drag and tip vortices*	*x*	-	
(02)	*Describe the change in induced drag in dependence of the aeroplane's angle of attack (air speed)*	*x*	-	
(03)	*Explain how the shape of a wing can affect the formation of induced drag*	*x*	-	
(04)	*Explain how using winglets can reduce induced drag*	*x*	-	
51.1.5	**Drag**	**x**	**-**	
51.1.5.1	**The parasite drag**	**x**	**-**	
	(a) pressure drag	**x**	**-**	
(01)	*Describe the formation of pressure drag (form drag)*	*x*	-	
(02)	*Assess the drag of different shapes (e.g. ball, plate, drop, etc. with the same frontal area)*	*x*	-	
	(b) interference drag	**x**	**-**	
(03)	*Describe the formation of interference drag*	*x*	-	
(04)	*State reasons for aerodynamic fairing of airframe parts, e.g. wheels*	*x*	-	

(05)	*State that the total drag of connected parts is usually greater than the drag of the single parts (negative interference)*	*x*	-	
	(c) friction drag	**x**	**-**	
(06)	*Describe the formation of friction drag*	*x*	-	
(07)	*Explain the influence of ice, dirt and rough surfaces on friction drag and boundary layer*	*x*	-	
51.1.5.2	**The parasite drag and speed**	**x**	**-**	
(01)	*Describe the change in parasite drag with increasing air speed*	*x*	-	
(02)	*State that double airspeed results in four times the parasite drag (square law)*	*x*	-	
51.1.5.3	**The induced drag and speed**	**x**	**-**	
(01)	*Describe the change in induced drag with increasing air speed*	*x*	-	
51.1.5.4	**The total drag**	**x**	**-**	
(01)	*State that total drag is composed from parasite drag and induced drag*	*x*	-	
(02)	*Explain why total drag is lowest at a certain airspeed*	*x*	-	
(03)	*Identify curves for parasite drag, induced drag and total drag in drag vs. airspeed plots*	*x*	-	
51.1.6	**The ground effect**	**x**	**-**	
51.1.6.1	**Effect on take off and landing characteristics of an aeroplane**	**x**	**-**	
(01)	*Explain the effects of entering and leaving ground effect.*	*x*	-	
51.1.7	**The stall**	**x**	**-**	
51.1.7.1	**Flow separation at increasing angles of attack**			
	(a) the boundary layer	**x**	**-**	
(01)	*Explain the term 'boundary layer'*			
	(1) laminar layer			
(02)	*Describe a laminar boundary layer and identify it on a streamline pattern*	*x*	-	
	(2) turbulent layer	**x**	**-**	
(03)	*Describe a turbulent boundary layer and identify it on a streamline pattern*	*x*	-	
(04)	*Explain the different behaviour on flow separation with laminar or turbulent boundary layers*	*x*	-	
	(3) transition	**x**	**-**	
(05)	*Describe the transition point and locate it in streamline pattern*	*x*	-	
	(b) separation point	**x**	**-**	
(06)	*Describe the separation point and locate it in streamline pattern*	*x*	-	
	(c) influence of angle of attack	**x**	**-**	
(07)	*State how the location of the transition- and separation point changes with increasing angle of attack*	*x*	-	
	(d) influence on	**x**	**-**	
	(1) pressure distribution	**x**	**-**	
	(2) location of centre of pressure	**x**	**-**	
	(3) CL	**x**	**-**	
(08)	*Explain the reduction in lift / cL at increasing AOA using the cL-alpha graph*	*x*	-	
(09)	*Describe the 'critical angle of attack' and factors affecting it*	*x*	-	

	(4) CD	**x**	**-**	
	(5) pitch moments	**x**	**-**	
	(e) buffet	**x**	**-**	
(10)	*Describe the effects of flow separation onset ('buffeting')*	*x*	-	
	(f) use of controls	**x**	**-**	
(11)	*Explain why pulling the yoke is not an adequate way to increase altitude when flying at a low air speed*	*x*	-	
51.1.7.2	**The stall speed**	**x**	**-**	
	(a) in the lift formula	**x**	**-**	
(01)	*Explain the stall speed (IAS) from the factors speed and cL in the lift formula*	*x*	-	
	(b) 1g stall speed	**x**	**-**	
(02)	*Describe the change in stall speed with varying mass*	*x*	-	
(03)	*Derive the stall speeds from markings at the air speed indicator*	*x*	-	
(04)	*State for which airplane weight the stall speed marking on the air speed indicator is applicable*	*x*	-	
	(c) influence of	**x**	**-**	
	(1) the centre of gravity	**x**	**-**	
(05)	*State that the load distribution inside the aircraft can have an influence on stall/spin characteristics*	*x*	-	
	(2) power setting	**x**	**-**	
	(3) altitude (IAS)	**x**	**-**	
(06)	*Explain why the stall speed (IAS) is independent of altitude*	*x*	-	
	(4) wing loading	**x**	**-**	
	(5) load factor n: (i) definition, (ii) turns, (iii) forces	**x**	**-**	
(07)	*Define 'load factor (n)'*	*x*	-	
(08)	*Explain the relationship between load factor and stall speed*	*x*	-	
(09)	*List situations during which the load factor increases, e.g. during stall recovery, aerobatics, turns or gusts*	*x*	-	
(10)	*Explain the increase in stall speeds during turns*	*x*	-	
51.1.7.3	**The initial stall in span-wise direction**	**x**	**-**	
	(a) influence of planform	**x**	**-**	
	(b) geometric twist (wash out)	**x**	**-**	
(01)	*Describe the influence of washout on an aircraft's stall characteristics*	*x*	-	
(02)	*Describe the difference between aerodynamic and geometric washout*	*x*	-	
	(c) use of ailerons	**x**	**-**	
(03)	*Explain the effect of washout on the effectiveness of ailerons at low speed*	*x*	-	
51.1.7.4	**Stall warning**	**x**	**-**	
	(a) importance of stall warning	**x**	**-**	
	(b) speed margin	**x**	**-**	
(01)	*State the approximate warning threshold of a stall warning (kt / % of stall speed)*	*x*	-	
	(c) buffet	**x**	**-**	
(02)	*Explain the effect of low speed / stall buffeting*	*x*	-	

	(d) stall strip	**x**	**-**	
	(e) flapper switch	**x**	**-**	
(03)	*Describe typical stall warning systems commonly used on piston engine aeroplanes (e.g. via movement of stagnation point with flapper switch, suction hole)*	*x*	-	
	(f) recovery from stall	**x**	**-**	
(04)	*Describe the general procedures for preventing imminant stall, if not stated other in AFM/POH*	*x*	-	
51.1.7.5	**Special phenomena of stall**	**x**	**-**	
	(a) the power-on stall	**x**	**-**	
	(b) climbing and descending turns	**x**	**-**	
	(c) t-tailed aeroplane	**x**	**-**	
	(d) avoidance of spins	**x**	**-**	
	(1) spin development	**x**	**-**	
(01)	*Describe the 'spin' and 'spiral dive' flight states*	*x*	-	
(02)	*List flight situations that might lead to a spin*	*x*	-	
(03)	*State that spinning usually is a stationary flight situation that does not impose heavy loads on the airframe*	*x*	-	
(04)	*State that intentional spinning is an aerobatic manoeuver and must not be executed without aerobatic rating and/or aeroplane approved for the manoeuver*	*x*	-	
	(2) spin recognition	**x**	**-**	
(05)	*Describe the difference between a fully developed spin and a stall*	*x*	-	
(06)	*Explain the term 'flat spin'*	*x*	-	
(07)	*Explain the dangers imposed by flat spin and describe how to avoid such situations (e.g. by correct loading)*	*x*	-	
	(3) spin recovery	**x**	**-**	
(08)	*State that recovery from a spin usually comes with greater loads on the aircraft structure*	*x*	-	
(09)	*Describe the general procedures for spin recovery, if not stated other in AFM/POH*	*x*	-	
(10)	*Explain the possible negative influences / uselessness of ailerons during spin recovery, and that the rudder is still effective*	*x*	-	
(11)	*Explain how, after the spinning turns have stopped, too sudden back-pressure on the elevator can cause a secondary stall*	*x*	-	
	(e) ice (in stagnation point and on surface)	**x**	**-**	
	(1) absence of stall warning	**x**	**-**	
	(2) abnormal behaviour of the aircraft during stall	**x**	**-**	
(12)	*Explain how icing on the airframe and wings can cause different stall speeds and stall characteristics*	*x*	-	
(13)	*Describe how greater amounts of ice or rain can jam a stall warning*	*x*	-	
51.1.8	**CL augmentation**	**x**	**-**	
51.1.8.1	**Trailing edge flaps and the reasons for use in take-off and landing**	**x**	**-**	
	(a) influence on cL-alpha-graph	**x**	**-**	
(01)	*State that high-lift devices are used to lower approach speed, to increase maximum cL and decrease required take-off/landing distance*	*x*	-	

(02)	*Describe the effect of extending flaps with regard to the cL-alpha-graph*	*x*	-	
	(b) different types of flaps	**x**	**-**	
(03)	*Explain the general working principles of high-lift devices, e.g. increase of chamber, increase of wing area*	*x*	-	
(04)	*Describe how the stall speed changes by deploying / retracting flaps*	*x*	-	
(05)	*Describe and identify common trailing edge high-lift devices as such and explain their function*	*x*	-	
(06)	*Explain the usage of flaps for take-off and landing*	*x*	-	
(07)	*State the procedure to retract flaps after take-off or go-around*	*x*	-	
	(c) flap asymmetry	**x**	**-**	
(08)	*Explain the effect of asymmetric deployment of flaps*	*x*	-	
(09)	*Describe the correct actions in case of asymmetric flaps deployment*	*x*	-	
	(d) influence on pitch movement	**x**	**-**	
(10)	*Explain the 'ballooning' effect when deploying flaps, and describe how to counteract*	*x*	-	
51.1.8.2	**Leading edge devices and the reasons for use in take-off and landing**	**x**	**-**	
(01)	*Explain the general working principles of leading edge high-lift devices, e.g. refreshing the boundary layer*	*x*	-	
(02)	*Describe the differences between leading- and trailing edge high-lift devices with regard to critical angle of attack and drag*	*x*	-	
(03)	*Identify common leading edge high-lift devices as such and be able to explain their function.*	*x*	-	
51.1.9	**The boundary layer**	**x**	**-**	
51.1.9.1	**Different types**	**x**	**-**	
	(a) laminar	**x**	**-**	
(01)	*Describe a laminar boundary layer and identify it on a streamline pattern*	*x*	-	
	(b) turbulent	**x**	**-**	
(02)	*Describe a turbulent layer and identify it on a streamline pattern*	*x*	-	
(03)	*Explain the different behaviour on flow separation with laminar or turbulent boundary layers*	*x*	-	
51.1.10	**Special circumstances**	**x**	**-**	
51.1.10.1	**Ice and other contamination**	**x**	**-**	
	(a) ice in stagnation point	**x**	**-**	
	(b) ice on the surface (frost, snow and clear ice)	**x**	**-**	
	(c) rain	**x**	**-**	
	(d) contamination of the leading edge	**x**	**-**	
	(e) effects on stall	**x**	**-**	
	(f) effects on loss of controllability	**x**	**-**	
	(g) effects on control surface moment	**x**	**-**	
	(h) influence on high lift devices during takeoff, landing and low speeds	**x**	**-**	
(01)	*Describe the effect of ice or other contamination of a wing on lift, drag and stall speed*	*x*	-	
(02)	*State that ice or other contamination on the wing results in undefined operational limits (i.e. unknown stall speed)*	*x*	-	

(03)	*State that ice, when undetected during pre-flight inspection, may result in blockage of control surfaces*	*x*	-	
(04)	*Explain how ice or other contamination may result in sudden stall when extending flaps*	*x*	-	
51.2	**Stability**	**x**	**-**	
51.2.1	**Condition of equilibrium in steady horizontal flight**	**x**	**-**	
51.2.1.1	**Precondition for static stability**	**x**	**-**	
(01)	*Describe the principal behaviour of an aircraft showing static stability when experiencing a disturbence from equilibrium in steady horizontal flight*	*x*	-	
51.2.1.2	**Equilibrium**	**x**	**-**	
	(a) lift and weight	**x**	**-**	
(01)	*Describe the effects of a gust on the equilibrium of forces*	*x*	-	
	(b) drag and thrust	**x**	**-**	
(02)	*Describe the effects of a gust on the equilibrium of forces*	*x*	-	
51.2.2	**Methods of achieving balance**	**x**	**-**	
51.2.2.1	**Wing and empennage (tail and canard)**	**x**	**-**	
(01)	*Explain the balancing of moments between wing lift, weight and forces generated by the elevator/horizontal stabilizer*	*x*	-	
(02)	*Explain why the elevator of an aircraft (except canards) usually produces a force downward*	*x*	-	
51.2.2.2	**Control surfaces**	**x**	**-**	
(01)	*Explain how use of trim tabs helps to adjust the forces generated by the elevator/horizontal stabilizer with varying longitudinal CG position*	*x*	-	
51.2.2.3	**Ballast or weight trim**	**x**	**-**	
(01)	*Explain how ballast or trim weights can be used to establish the balancing of moment from wing and empennage*	*x*	-	
51.2.3	**Static and dynamic longitudinal stability**	**x**	**-**	
51.2.3.1	**Basics and definitions**	**x**	**-**	
	(a) static stability, positive, neutral and negative	**x**	**-**	
	(b) precondition for dynamic stability	**x**	**-**	
	(c) dynamic stability, positive, neutral and negative	**x**	**-**	
(01)	*Explain 'static stability'*	*x*	-	
(02)	*Explain 'dynamic stability'*	*x*	-	
(03)	*Describe the requirement of static stability for dynamic stability*	*x*	-	
51.2.3.2	**Location of centre of gravity**	**x**	**-**	
	(a) aft limit and minimum stability margin	**x**	**-**	
	(b) forward position	**x**	**-**	
	(c) effects on static and dynamic stability	**x**	**-**	
(01)	*State the importance for keeping CG in limits to maintain controllability*	*x*	-	
(02)	*Explain the effect of the CG location on pitch manoeuvrability and longitudinal stability*	*x*	-	
51.2.4	**Dynamic lateral or directional stability**	**x**	**-**	
51.2.4.1	**Spiral dive and corrective actions**	**x**	**-**	
(01)	*Explain the influence of wing dihedral on roll stability*	*x*	-	

(02)	*Explain the influence of the vertical stabilizer on directional stability*	*x*	-	
(03)	*Explain the term 'weather vaning'*	*x*	-	
(04)	*Explain the effect of wing sweep on directional stability*	*x*	-	
51.3	**Control**	**x**	**-**	
51.3.1	**General**	**x**	**-**	
51.3.1.1	**Basics, the three planes and three axis**	**x**	**-**	
(01)	*Name the axis (Lon/Lat/V) and the corresponding movements (roll, yaw, pitch) of an aircraft*	*x*	-	
51.3.1.2	**Angle of attack change**	**x**	**-**	
(01)	*Explain the influence of local AOA change by movement of a control surface*	*x*	-	
51.3.2	**Pitch control**	**x**	**-**	
51.3.2.1	**Elevator**	**x**	**-**	
(01)	*Identify and name the 'horizontal stabilizer' and 'elevator'*	*x*	-	
(02)	*Explain the aerodynamic basics of pitch control*	*x*	-	
(03)	*Define the term 'longitudinal stability'*	*x*	-	
(04)	*Describe how the elevator influences flight attitude / flight path*	*x*	-	
(05)	*Explain the functions of a horizontal stabilizer in terms of longitudinal stability.*	*x*	-	
51.3.2.2	**Downwash effects**	**x**	**-**	
(01)	*Explain the effect of downwash on the tailplane angle of attack*	*x*	-	
51.3.2.3	**Location of centre of gravity**	**x**	**-**	
(01)	*Explain how the longitudinal stability changes with longitudinal CG position*	*x*	-	
(02)	*Explain how the manoeuvrability stability changes with longitudinal CG position*	*x*	-	
51.3.3	**Yaw control**	**x**	**-**	
51.3.3.1	**Pedal or rudder**	**x**	**-**	
(01)	*Identify and name the 'vertical stabilizer' and 'rudder'*	*x*	-	
(02)	*Explain the aerodynamic basics of yaw control*	*x*	-	
(03)	*List reasons for the lower significance of the rudder at higher airspeeds*	*x*	-	
51.3.4	**Roll control**	**x**	**-**	
51.3.4.1	**Ailerons: function in different phases of flight**	**x**	**-**	
(01)	*Identify and name the 'ailerons'*	*x*	-	
(02)	*Explain the aerodynamic basics of aileron / roll control*	*x*	-	
(03)	*Describe the correct method to fly 'coordinated turns'*	*x*	-	
(04)	*Describe the effects of slip / skid during turns.*	*x*	-	
(05)	*Describe the aileron / control reversal at low flight speeds*	*x*	-	
51.3.4.2	**Adverse yaw**	**x**	**-**	
(01)	*Explain the effect of 'adverse yaw'*	*x*	-	
(02)	*Describe the flight path / attitude when initiating turns without using the rudder*	*x*	-	
	Means to avoid adverse yaw	**x**	**-**	
	(a) frise ailerons	**x**	**-**	
(03)	*Describe technical (aerodynamic) means to reduce adverse yaw by frise ailerons*	*x*	-	

	(b) differential ailerons deflection	**x**	**-**	
(04)	*Describe technical (aerodynamic) means to reduce adverse yaw by differential aileron deflection*	*x*	-	
51.3.5	**Means to reduce control forces**	**x**	**-**	
51.3.5.1	**Aerodynamic balance**	**x**	**-**	
	(a) balance tab and anti-balance tab	**x**	**-**	
	(b) servo tab	**x**	**-**	
(01)	*Describe the effect of aerodynamic balance by use of balance tabs / servo tabs*	*x*	-	
(02)	*Explain the anti-balance tab*	*x*	-	
51.3.6	**Mass balance**	**x**	**-**	
51.3.6.1	**Reasons to balance**	**x**	**-**	
(01)	*Describe the effect of aerodynamic balance by use of mass balance*	*x*	-	
51.3.7	**Trimming**	**x**	**-**	
51.3.7.1	**Reasons to trim**	**x**	**-**	
(01)	*Explain why an elevator trim is fitted to the aircraft*	*x*	-	
(02)	*Define the need for a an elevator trim*	*x*	-	
(03)	*Describe the limitations of trim (e.g. with incorrect CG position)*	*x*	-	
(04)	*State that not all general aviation aeroplanes are fitted with an aileron / roll trim*	*x*	-	
(05)	*State that not all general aviation aircraft are fitted with rudder trim*	*x*	-	
(06)	*State that especially higher powered general aviation aircraft are fitted with rudder trim*	*x*	-	
51.3.7.2	**Trim tabs**	**x**	**-**	
(01)	*Name and describe the function of the most common types of trim*	*x*	-	
(02)	*Explain the function of a fixed trim tab*	*x*	-	
(03)	*Identify a trim tab at the rudder as such and explain its function to move the control surface*	*x*	-	
51.4	**Limitations**	**x**	**-**	
51.4.1	**Operating limitations**	**x**	**-**	
51.4.1.1	**Flutter**	**x**	**-**	
(01)	*Describe flutter effects generally*	*x*	-	
(02)	*State in what speed range flutter can happen*	*x*	-	
(03)	*Describe methods to reduce flutter*	*x*	-	
51.4.1.2	**vFE**	**x**	**-**	
(01)	*State limits for operating high-lift devices (vFE) and describe how they are indicated*	*x*	-	
51.4.1.3	**vNO, vNE**	**x**	**-**	
(01)	*Describe the velocities vNO and vNE and how they are indicated*	*x*	-	
(02)	*List possible consequences of exceeding vNE*	*x*	-	
(03)	*Explain the meaning of the 'yellow range' on the airspeed indicator*	*x*	-	
51.4.2	**Manoeuvring envelope**	**x**	**-**	
51.4.2.1	**Manoeuvring load diagram**	**x**	**-**	
(01)	*Identify and describe the manoeuvering envelope*	*x*	-	
	(a) load factor	**x**	**-**	

(02)	*Explain why other operating limits (e.g. load factor) are affected when deploying / retracting high-lift devices.*	*x*	-	
(03)	*Explain the difference between negative and positive load factor.*	*x*	-	
(04)	*Derive the maximum allowed load factor from a given AFM/POH*	*x*	-	
(05)	*Derive the following data from the manoeuvering envelope: max. load factor*	*x*	-	
	(b) accelerated stall speed	**x**	**-**	
(06)	*Explain how a stall is possible also at speeds above the stall speed, e.g. when encountering gusts or after hard control inputs*	*x*	-	
	(c) vA	**x**	**-**	
(07)	*Explain why an aircraft will not exceed maximum allowed load factor after a hard control input below vA*	*x*	-	
(08)	*Explain why an aircraft will probably exceed maximum allowed load factor after a hard control input above vA*	*x*	-	
(09)	*Describe how to find out vA when in the cockpit*	*x*	-	
(10)	*Determine manoeuvering speed vA from AFM/POH*	*x*	-	
	(d) manoeuvring limit load factor or certification category	**x**	**-**	
(11)	*List and describe different aircraft certification categories (aerobatic / normal / utility) with different maximum load factor requirements*	*x*	-	
51.4.2.2	**Contribution of mass**	**x**	**-**	
(01)	*State the relationship of mass to load-factor limits*	*x*	-	
51.4.3	**Gust envelope**	**x**	**-**	
51.4.3.1	**Gust load diagram**	**x**	**-**	
(01)	*Recognise and describe a typical gust-load diagram*	*x*	-	
51.4.3.2	**Factors contributing to gust loads**	**x**	**-**	
(01)	*Explain what speeds are safe when encountering gusts*	*x*	-	
(02)	*List factors additionally influence gust loads, such as: aspect ratio, speed, wing loading*	*x*	-	
51.5	**Propellers**	**x**	**-**	
51.5.1	**Conversion of engine torque to thrust**	**x**	**-**	
51.5.1.1	**Meaning of pitch**	**x**	**-**	
(01)	*Name and describe the geometric properties of a propeller*	*x*	-	
(02)	*Describe the movement (screw pattern) of a propeller, depending on its pitch*	*x*	-	
(03)	*Explain the propeller angle of attack depending on blade angle of incidence and air speed*	*x*	-	
(04)	*Describe the differences between a fixed pitch propeller, constant speed propeller and variable pitch propeller*	*x*	-	
(05)	*List flight phases in which a small or high propeller pitch is favorable*	*x*	-	
(06)	*Explain why the efficiency of a fixed pitch propeller decreases at high air speeds*	*x*	-	
(07)	*Explain the change of RPM of a fixed pitch propeller at constant throttle when varying air speed*	*x*	-	
(08)	*Explain how pitch and drag (sink rate) changes during glide when moving the propeller lever*		-	
51.5.1.2	**Blade twist**	**x**	**-**	

(01)	*Describe the 'blade twist' and explain why it is used*	*x*	-	
51.5.1.3	**Effects of ice on propeller**	**x**	**-**	
(01)	*Explain the effect of ice accretion on the propeller blade*	*x*	-	
(02)	*List and describe systems to prevent ice accretion on the propeller blade (anti-ice)*	*x*	-	
51.5.2	**Engine failure or engine stop**	**x**	**-**	
51.5.2.1	**Windmilling drag**	**x**	**-**	
(01)	*Describe the term 'windmilling' and explain its influence on gliding performance*	*x*	-	
51.5.3	**Moments due to propeller operation**	**x**	**-**	
51.5.3.1	**Torque reaction**	**x**	**-**	
(01)	*Describe the effects caused by the torque of the propeller*	*x*	-	
51.5.3.2	**Asymmetric slipstream effect**	**x**	**-**	
(01)	*Determine the direction of effect, given the propeller's sense of rotation*	*x*	-	
(02)	*Explain the effects caused by the slipstream of the propeller.*	*x*	-	
(03)	*Name phases of flight in which the 'slipstream effect' is most significant.*	*x*	-	
(04)	*Describe actions by the pilot to counteract the 'slipstream effect'*	*x*	-	
(05)	*State phases of flight in which the 'slipstream effect' is most significant*	*x*	-	
51.5.3.3	**Asymmetric blade effect**	**x**	**-**	
(01)	*Describe the 'asymmetric blade effect' (P-factor) and its effect on aircraft movement*	*x*	-	
51.6	**Flight mechanics**	**x**	**-**	
51.6.1	**Forces acting on an aeroplane**	**x**	**-**	
51.6.1.1	**Straight horizontal steady flight**	**x**	**-**	
(01)	*Describe straight and level flight as a flight without change in altitude, airspeed, density, without gust influence and without any control inputs*	*x*	-	
(02)	*Describe the equilibrium of forces (weight, lift, drag, thrust) and depict the forces from a corresponding sketch*	*x*	-	
51.6.1.2	**Straight steady climb**	**x**	**-**	
(01)	*State that forces are different during initiation of climb and steady climb*	*x*	-	
(02)	*Explain the equilibrium of forces (weight, lift, thrust, drag including the influence of weight on thrust and lift) and depict the forces from a corresponding sketch*	*x*	-	
(03)	*Describe the difference in angle of attack in climb when compared to straight and level flight*	*x*	-	
51.6.1.3	**Straight steady descent**	**x**	**-**	
(01)	*State that forces are different during initiation of descend and steady descend*	*x*	-	
(02)	*Explain the equilibrium of forces (weight, lift, thrust, drag including the influence of weight on thrust and lift) and depict the forces from a corresponding sketch*	*x*	-	
51.6.1.4	**Straight steady glide**	**x**	**-**	
(01)	*Explain the equilibrium of forces (weight, lift, drag slope driving force / thrust) and depict the forces from a corresponding sketch*	*x*	-	
(02)	*Describe how a component of the weight force substitutes the missing thrust*	*x*	-	
(03)	*Define and explain the terms 'glide path angle' and 'glide ratio'*	*x*	-	

(04)	*Derive glide path angle or glide ratio from an AFM/POH*	*x*	-	
(05)	*Explain the difference between the speeds for best glide ratio and lowest rate of descent*	*x*	-	
(06)	*Explain the change of speed for best glide with mass*	*x*	-	
51.6.1.5	**Steady coordinated turn**	**x**	**-**	
	(a) bank angle	**x**	**-**	
(01)	*State that the necessary increase in lift mainly depends on bank angle*	*x*	-	
	(b) load factor	**x**	**-**	
(02)	*Explain the increase in load factor during a turn*	*x*	-	
(03)	*Explain the equilibrium of forces (weight, lift, drag including the influence of weight on thrust and lift) and depict the forces from a corresponding sketch*	*x*	-	
(04)	*Explain why during level turns an increase in speed (and throttle) is neccessary*	*x*	-	
(05)	*Determine or state approximately the load factor during turns at 30°, 45° or 60° bank angle*	*x*	-	
	(c) turn radius	**x**	**-**	
(06)	*Describe how the turn radius changes with TAS and bank angle*	*x*	-	
	(d) rate one turn	**x**	**-**	
(07)	*Define 'rate-one-turn'*	*x*	-	
(08)	*Describe how the correct bank for a 'rate-one-turn' changes with TAS*	*x*	-	

Reference	Description	PPL(A)	PPL(H)	Remarks
52	**PRINCIPLES OF FLIGHT: HELICOPTER**	**-**	**x**	
52.1	**Subsonic aerodynamics**	**-**	**x**	
52.1.1	**Basics concepts, laws and definitions**	**-**	**x**	
52.1.1.1	**Conversion of units**	**-**	**x**	
(01)	*List the units used in SI for as mass (kg), length (m), time (s)*	-	*x*	
52.1.1.2	**Definitions and basic concepts about air:**	**-**	**x**	
	(a) density	-	**x**	
	(b) influence of pressure and temperature on density	-	**x**	
(01)	*Define 'air density'*	-	*x*	
(02)	*Define 'pressure altitude' and 'density altitude'*	-	*x*	
(03)	*Explain the relationship between air density, pressure and temperature*	-	*x*	
52.1.1.3	**Newton's laws:**	**-**	**x**	
	(a) Newton's second law: Momentum equation	-	**x**	
	(b) Newton's third law: action and reaction	-	**x**	
(01)	*State and interpret Newton's laws of motion*	-	*x*	
(02)	*Explain the relationship between 'mass' and 'force' (weight)*	-	*x*	
52.1.1.4	**Basic concepts about airflow:**	**-**	**x**	
	(a) steady airflow and unsteady airflow	-	**x**	
	(b) Bernoulli's equation	-	**x**	
	(c) static pressure, dynamic pressure, total pressure and stagnation point	-	**x**	
	(d) TAS, IAS and CAS	-	**x**	
	(e) two-dimensional airflow and three-dimensional airflow	-	**x**	

	(f) viscosity and boundary layer	-	**x**	
(01)	*Describe steady and unsteady airflow*	-	*x*	
(02)	*Explain the principle of Bernoulli's continuity equation with regard to conservation of mass*	-	*x*	
(03)	*Explain the relationship between static, dynamic and total pressure*	-	*x*	
(04)	*Define 'stagnation point' in the flow around an airfoil, and explain the pressure obtained at the stagnation point*	-	*x*	
(05)	*Define and explain the terms 'TAS', 'IAS' and 'CAS'*	-	*x*	
(06)	*Describe the two-dimensional airflow around an airfoil of infinite span*	-	*x*	
(07)	*Explain the difference between two- and three-dimensional airflow (span-wise flow, tip vortices)*	-	*x*	
(08)	*Describe 'laminar' and 'turbulent' boundary layers, and the transition from laminar to turbulent*	-	*x*	
(09)	*State where on a blade laminar or turbulent airflow can be observed*	-	*x*	
52.1.2	**Two-dimensional airflow**	**-**	**x**	
52.1.2.1	**airfoil section geometry:**	**-**	**x**	
	(a) airfoil section	-	**x**	
	(b) chord line, thickness and thickness to chord ratio of a section	-	**x**	
	(c) camber line and camber	-	**x**	
	(d) symmetrical and asymmetrical airfoils sections	-	**x**	
(01)	*Define the following terms: 'airfoil section', 'airfoil element', 'chord line', 'chord', 'thickness', 'thickness-to-chord ratio, 'camber line', 'camber', 'leading-edge radius'*	-	*x*	
(02)	*Describe symmetrical and asymmetrical airfoil sections, and state where they are used*	-	*x*	
52.1.2.2	**Aerodynamic forces on airfoil elements:**	**-**	**x**	
	(a) angle of attack	-	**x**	
	(b) pressure distribution	-	**x**	
	(c) lift and lift coefficient	-	**x**	
	(d) relation lift coefficient: angle of attack	-	**x**	
	(e) profile drag and drag coefficient	-	**x**	
	(f) relation drag coefficient: angle of attack	-	**x**	
	(g) resulting force, centre of pressure and pitching moment	-	**x**	
(01)	*Define 'angle of attack' (AOA, alpha)*	-	*x*	
(02)	*Describe the resultant force from the pressure distribution around and airfoil*	-	*x*	
(03)	*Resolve the aerodynamic force into the components of lift (L) and drag (D)*	-	*x*	
(04)	*Describe the 'center of pressure' (CP) as the point the aerodynamic forces are acting on*	-	*x*	
(05)	*State which factors 'lift coefficient' (CL) and 'drag coefficient' (CD) depend on, e.g. surface condition, profile shape, effective angle of attack*	-	*x*	
(06)	*Describe CL as a function of AOA*	-	*x*	
(07)	*Explain how drag is caused by pressure forces on the surfaces of an airfoil and by friction in the boundary layers*	-	*x*	
(08)	*Define the term 'profile drag'*	-	*x*	

(09)	*Explain the relationship of angle of attack, CL and CD, and airflow speed ('lift/drag formula') in qualitative terms*	-	*x*	
(10)	*Explain the pitching moment resulting from varying locations of center of pressure with angle of attack*	-	*x*	
(11)	*Describe the significance of 'lift-to-drag ratio', and state typical values used with helicopters*	-	*x*	
52.1.2.3	**Stall:**	**-**	**x**	
	(a) boundary layer and reasons for stalling	**-**	**x**	
	(b) variation of lift and drag as a function of angle of attack	**-**	**x**	
	(c) displacement of the centre of pressure and pitching moment	**-**	**x**	
(01)	*Describe the boundary layer separation when AOA increases beyond the onset of stall, and the decrease of lift and the increase of drag*	-	*x*	
(02)	*Describe the effect of effective (vertical) airflow on the lift created with constant pitch and peripheral speed*	-	*x*	
52.1.2.4	**Disturbances due to profile contamination:**	**-**	**x**	
	(a) ice contamination (b) ice on the surface (frost, snow and clear ice)	**-**	**x**	
(01)	*Explain the effects of ice contamination on the section profile and surfaces (AOA at stall onset, effect of the increase in weight)*	-	*x*	
(02)	*Explain the effect of erosion by heavy rain on the blade and subsequent increase in profile drag*	-	*x*	
52.1.3	**The three-dimensional airflow**	**-**	**x**	
52.1.3.1	**The blade:**	**-**	**x**	
(01)	*Describe the various blade planforms and their properties*	-	*x*	
(02)	*Define the terms 'aspect ratio' and 'blade twist'*	-	*x*	
52.1.3.2	**Airflow pattern and influence on lift:**	**-**	**x**	
	(a) span wise flow on upper and lower surface (b) tip vortices (c) span-wise lift distribution	**-**	**x**	
(01)	*Explain the spanwise flow around a blade and the appearance of blade tip vortices causing induced drag*	-	*x*	
(02)	*Describe the relationship between spanwise flow, angle of attack and strength of blade tip vortices*	-	*x*	
(03)	*Describe the spanwise lift distribution, and ways to be modified, e.g. by twist (washout)*	-	*x*	
52.1.3.3	**Induced drag: causes and vortices**	**-**	**x**	
(01)	*Explain 'induced drag' and the influence of AOA and aspect ratio*	-	*x*	
(02)	*Describe the correlation between induced drag and the creation of lift*	-	*x*	
52.1.3.4	**The airflow round a fuselage:**	**-**	**x**	
	(a) components of a fuselage (b) parasite drag (c) variation with speed	**-**	**x**	
(01)	*Describe the fuselage and the external components that cause (parasite) drag*	-	*x*	
(02)	*Describe the airflow around the fuselage, and the effect of the pitch angle of the fuselage*	-	*x*	

(03)	*Describe fuselage shapes that minimise drag*	-	*x*	
(04)	*Describe 'interference drag'*	-	*x*	
52.2	**Transonic aerodynamics and compressibility effects**	**-**	**x**	
52.2.1	**Airflow velocities**	**-**	**x**	
52.2.1.1	**Airflow speeds:**	**-**	**x**	
	(a) speed of sound (b) subsonic, high subsonic and supersonic flows	**-**	**x**	
(01)	*Define 'speed of sound', and describe ist dependency on air temperature*	-	*x*	
(02)	*Explain the variation in the speed of sound with altitude*	-	*x*	
(03)	*Define 'Mach number' as ratio of True Airspeed (TAS) and speed of sound*	-	*x*	
(04)	*Define 'high subsonic', 'transonic' and 'supersonic flows' in relation to the value of the Mach number*	-	*x*	
52.2.1.2	**Shock waves:**	**-**	**x**	
	(a) compressibility and shock waves (b) the reasons for their formation at upstream high subsonic airflow (c) their effect on lift and drag	**-**	**x**	
(01)	*Describe shock waves in a supersonic flow and the changes in pressure and speed*	-	*x*	
(02)	*Describe the appearance of local supersonic flows on the surfaces of a blade*	-	*x*	
52.2.1.3	**Influence of airfoil section and blade planform**	**-**	**x**	
(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, or a planform with a sweep angle*	-	*x*	
52.3	**Rotorcraft types**	**-**	**x**	
52.3.1	**Rotorcraft**	**-**	**x**	
52.3.1.1	**Rotorcraft types:**	**-**	**x**	
	(a) autogyro (b) helicopter	**-**	**x**	
(01)	*Explain the difference between 'autogyro' and 'helicopter'*	-	*x*	
52.3.2	**Helicopters**	**-**	**x**	
52.3.2.1	**Helicopters configurations: the single main rotor helicopter**	**-**	**x**	
(01)	*Describe the single-main-rotor helicopter, and give examples of other configurations (e.g. tandem, coaxial, side-by-side, synchrocopter, compound helicopter and tilt rotor)*	-	*x*	
52.3.2.2	**The helicopter, characteristics and associated terminology:**	**-**	**x**	

	(a) general lay-out, fuselage, engine and gearbox (b) tail rotor, fenestron and NOTAR (c) engines (reciprocating and turbo shaft engines) (e) rotor shaft axis, rotor hub and rotor blades (f) rotor disc and rotor disc area (g) teetering rotor (two blades) and rotors with more than two blades (d) power transmission (h) skids and wheels (i) helicopter axes and fuselage centre line (j) roll axis, pitch axis and normal or yaw axis (k) gross mass, gross weight and disc loading	-	x	
(01)	*Describe the tail rotor, the Fenestron, and the no tail rotor (NOTAR)*	-	x	
(02)	*Define 'rotor disc area' and 'blade area'*	-	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	
(04)	*Define the fuselage centre line and the three axes: roll, pitch, and normal (yaw)*	-	x	
52.4	**Main rotor aerodynamics**	**-**	**x**	
52.4.1	**Hover flight outside ground effect**	**-**	**x**	
52.4.1.1	**Airflow through the rotor discs and round the blades:**	**-**	**x**	
	(a) circumferential velocity of the blade sections (b) induced airflow, through the disc and downstream (c) downward fuselage drag (d) equilibrium of rotor thrust, weight and fuselage drag (e) rotor disc induced power (f) relative airflow to the blade (g) pitch angle and angle of attack of a blade section (h) lift and profile drag on the blade element (i) resulting lift and thrust on the blade and rotor thrust (j) collective pitch angle changes and necessity of blade feathering (k) required total main rotor-torque and rotor-power (l) influence of the air density	-	x	
(01)	*State the relationship between motor RPM and peripheral blade speed, and how it can be controlled*	-	x	
(02)	*Describe the terms 'tip path plane' and 'virtual rotation axis'*	-	x	
(03)	*Based on Newton's second law (momentum), explain that the upward vertical force from the disc (rotor thrust), is the result of vertical downward velocities inside the rotor disc*	-	x	
(04)	*Define the 'pitch angle' and the AOA of a blade element*	-	x	
(05)	*Explain lift and drag relating to a blade element, including induced and profile drag*	-	x	
(06)	*Explain the necessity for collective pitch angle changes, the influence on the AOA and rotor thrust, and the need for blade feathering*	-	x	
(07)	*Explain how profile drag on the blade elements generates a torque on the main shaft*	-	x	
(08)	*Explain the influence of air density on the required power*	-	x	

(09)	*State where the induced airflow is the highest with regard to the main rotor*	-	*x*	
(10)	*Describe the change in pitch angle when the helicopter is hovering to the side*	-	*x*	
52.4.1.2	**Anti-torque force and tail rotor:**	**-**	**x**	
	(a) force of tail rotor as a function of main rotor-torque (b) anti-torque rotor power (c) necessity of blade feathering of tail rotor blades and yaw pedals	**-**	**x**	
(01)	*Using Newton's third law (motion), explain the need for tail-rotor thrust, the required value being proportional to main-rotor torque*	-	*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*	
52.4.1.3	**Total power required and hover outside ground effect (HOGE)**	**-**	**x**	
	(a) total power required and power available (b) maximum hover altitude as a function of pressure altitude and OAT	**-**	**x**	
(01)	*Describe the influence of ambient pressure, temperature and moisture on the required power*	-	*x*	
52.4.2	**Vertical climb**	**-**	**x**	
52.4.2.1	**Relative airflow and angles of attack:**	**-**	**x**	
	(a) climb velocity vC, induced and relative velocity and angle of attack (b) collective pitch angle and blade feathering	**-**	**x**	
(01)	*Describe the dependence of the vertical climb speed on the opposite vertical air velocity relative to the rotor disk*	-	*x*	
(02)	*Explain how AOA is controlled by the collective pitch angle control*	-	*x*	
52.4.2.2	**Power and vertical speed:**	**-**	**x**	
	(a) induced power, climb power and profile power (b) total main rotor power and main rotor torque (c) tail rotor power (d) total power requirement in vertical flight	**-**	**x**	
(01)	*Describe total main-rotor power as the sum of parasite power, induced power, climb power and rotor profile power*	-	*x*	
(02)	*Explain the initial increase and following decrease in vertical speed after increasing the pitch angle*	-	*x*	
(03)	*Explain why the total main-rotor power required increases when the rate of climb increases*	-	*x*	
52.4.3	**Forward flight**	**-**	**x**	
52.4.3.1	**Airflow and forces in uniform inflow distribution:**	**-**	**x**	

	(a) assumption of uniform inflow distribution on rotor disc (b) advancing blade (90 deg) and retreating blade (270 deg) (c) airflow velocity relative to the blade sections, area of reverse flow (d) lift on the advancing and retreating blades at constant pitch angles (e) necessity of cyclic pitch changes (f) compressibility effects on the advancing blade tip and speed limitations (g) high angle of attack on the retreating blade, blade stall and speed limitations (h) thrust on rotor disc and tilt of thrust vector (i) vertical component of the thrust vector and gross weight equilibrium (j) horizontal component of the thrust vector and drag equilibrium	**-**	**x**	
(01)	*Describe the upstream air velocities relative to the blade elements and the different effects on the advancing and retreating blades*	-	*x*	
(02)	*Explain the influence of forward speed on the circumferential airspeed of the blade tip*	-	*x*	
(03)	*Explain the 'lateral lift asymmetry' (roll moment) from the asymmetric distribution of lift due to different effective pitch angles at the advancing blade (90 deg) and retreating blade (270 deg)*	-	*x*	
(04)	*Describe how cyclic feathering can eliminate the asymmetric lift distribution: by low AOA (low pitch angle) on the advancing blade, and high AOA (high pitch angle) on the retreating blade*	-	*x*	
(05)	*Describe the differeces in induced airflow on the front and rear rotor plane*	-	*x*	
(06)	*State that the total rotor thrust that is perpendicular to the rotor disc, and explain the need for tilting the thrust vector forward*	-	*x*	
(07)	*Describe the relationship between motor RPM, thrust and tangential force*	-	*x*	
52.4.3.2	**The flare (power flight):**	**-**	**x**	
	(a) thrust reversal and increase in rotor thrust (b) increase of rotor RPM on non governed rotor	**-**	**x**	
(01)	*Explain the flare in powered flight, the rearward tilt of the rotor disc and the thrust vector*	-	*x*	
(02)	*Explain the increase in thrust due to the upward inflow, and show the modifications in the AOA*	-	*x*	
52.4.3.3	**Power and maximum speed:**	**-**	**x**	
	(a) induced power as a function of helicopter speed (b) rotor profile power as a function of helicopter speed (c) fuselage drag and parasite power as a function of forward speed (d) tail rotor power and power ancillary equipment (e) total power requirement as a function of forward speed (f) influence of helicopter mass, air density and drag of additional external equipment (g) translational lift and influence on power required	**-**	**x**	
(01)	*State that the induced velocities and power values decrease as the speed of the helicopter increases*	-	*x*	
(02)	*Define 'profile drag' and 'profile power', and explain the increase of their values with the speed of the helicopter*	-	*x*	
(03)	*Define 'total drag' and its increase with the speed of the helicopter*	-	*x*	
(04)	*Describe the influence of helicopter mass, air density, airspeed and additional external equipment on the partial powers and the total power required*	-	*x*	

(05)	*Describe the 'translational lift', and explain the decrease in required total power as the helicopter increases its speed from the hover*	-	*x*	
52.4.4	**Hover and forward flight in ground effect**	**-**	**x**	
52.4.4.1	**Airflow in ground effect and downwash:**	**-**	**x**	
	rotor power decrease as a function of rotor height above the ground at constant helicopter mass	**-**	**x**	
(01)	*Explain how the vicinity of the ground changes the downward flow pattern and the consequences on lift (thrust) at constant rotor power*	-	*x*	
(02)	*Describe how ground effect depends on the height of the rotor above the ground and the rotor diameter*	-	*x*	
(03)	*Describe the movement of a helicopter hovering in ground effect with zero-wind conditions*	-	*x*	
(04)	*State factors that may result in an impairment of ground effect (e.g. tree environment, uneven surfaces)*	-	*x*	
52.4.5	**Vertical descent**	**-**	**x**	
52.4.5.1	**Vertical descent, power on:**	**-**	**x**	
	(a) airflow through the rotor, low and moderate descent speeds (b) vortex ring state, settling with power and consequences	**-**	**x**	
(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 AOA*	-	*x*	
(02)	*Explain the vortex-ring state, also known as 'settling with power', and how to counteract*	-	*x*	
(03)	*Describe the airflow relative to the blades, the root stall, the loss of lift at the blade tip and the turbulence*	-	*x*	
(04)	*Describe the effect of raising the lever and the effects on the controls*	-	*x*	
52.4.5.2	**Autorotation:**	**-**	**x**	
	(a) collective lever position after failure (b) up flow through the rotor, auto-rotation and anti-autorotation rings (c) tail rotor thrust and yaw control (d) control of rotor RPM with collective lever (e) landing after increase of rotor thrust by pulling collective and reduction in vertical speed	**-**	**x**	
(01)	*Explain the influence of rotational inertia of the rotor on the rate of decay*	-	*x*	
(02)	*Describe 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*	
(03)	*Explain the control of the rotor RPM with collective pitch*	-	*x*	
(04)	*Explain that the collective lever must be lowered quickly enough to avoid a rapid decay of rotor RPM due to drag on the blades*	-	*x*	
(05)	*Explain the need for negative tail-rotor thrust with yaw control*	-	*x*	
(06)	*Explain the final increase in rotor thrust by raising the collective pitch to decrease the vertical descent speed, and the decay in rotor RPM*	-	*x*	
52.4.6	**Forward flight: Autorotation**	**-**	**x**	
52.4.6.1	**Airflow through the rotor disc:**	**-**	**x**	
	(a) descent speed and up flow through the disc (b) the flare, increase in rotor thrust, reduction of vertical speed and ground speed	**-**	**x**	

(01)	*State the factors that affect inflow angle and AOA, the autorotative power distribution, and the dissymmetry over the rotor disc in forward flight*	-	*x*	
(02)	*State the effects of mass and density altitude on autorotation*	-	*x*	
(03)	*State the relation between airspeed and rotor RPM during autorotation*	-	*x*	
52.4.6.2	**Flight and landing:**	**-**	**x**	
	(a) turning (b) flare (c) autorotative landing (d) height or velocity avoidance graph and dead man's curve	**-**	**x**	
(01)	*Describe the effect of forward speed on the vertical descent speed*	-	*x*	
(02)	*Explain the effects of gross weight, rotor RPM, AOA and altitude (density) on endurance and range*	-	*x*	
(03)	*Describe the manoeuvres for turning and touchdown*	-	*x*	
(04)	*Explain the height-velocity curves*	-	*x*	
(05)	*Describe the required change in collective pitch before initiating a turn during autorotation*	-	*x*	
(06)	*Explain the increase in RPM during flare due to increased vertical airflow*	-	*x*	
52.5	**Main rotor mechanics**	**-**	**x**	
52.5.1	**Flapping of the blade in hover**	**-**	**x**	
52.5.1.1	**Forces and stresses on the blade:**	**-**	**x**	
	(a) centrifugal force on the blade and attachments (b) limits of rotor RPM (c) lift on the blade and bending stresses on a rigid attachment (d) the flapping hinge of the articulated rotor and flapping hinge offset (e) the flapping of the hingeless rotor and flexible element			
(01)	*Define the term 'rotor disc load'*	-	*x*	
(02)	*Describe the centrifugal forces on the mass elements of a blade with pitch applied and the components of those forces*	-	*x*	
(03)	*Explain the lower limit of rotor RPM*	-	*x*	
52.5.1.2	**Coning angle in hover:**	**-**	**x**	
	(a) lift and centrifugal force in hover and blade weight negligible (b) flapping, tip path plane and disc area	**-**	**x**	
(01)	*Describe the equilibrium of moments about the flapping hinge of lift (thrust) and of the centrifugal force determine the coning angle of the blade (assuming blade mass negligible)*	-	*x*	
(02)	*Describe the properties of a semi-rigid flapping hinge*	-	*x*	
52.5.2	**Flapping angles of the blade in forward flight**	**-**	**x**	
52.5.2.1	**Forces on the blade in forward flight without cyclic feathering:**	**-**	**x**	
	(a) aerodynamic forces on the advancing and retreating blades without cyclic feathering (b) periodic forces and stresses, fatigue and flapping hinge (c) phase lag between the force and the flapping angle (about 90 deg) (d) flapping motion of the hinged blades and tilting of the cone and flap back of rotor (e) rotor disc attitude and thrust vector tilt	**-**	**x**	

(01)	*Describe periodic lift, moment and stresses on the attachment with rigid attachments of the blade to the hub*	-	*x*	
(02)	*Explain the necessity for a flapping hinge*	-	*x*	
(03)	*Explain the azimuthal phase lag (90 degrees or less) between the input (applied pitch) and the output (flapping angle)*	-	*x*	
52.5.2.2	**Cyclic pitch (feathering) in helicopter mode, forward flight:**	**-**	**x**	
	(a) necessity of forward rotor disc tilt and thrust vector tilt (b) flapping and tip path plane, virtual rotation axis or no flapping axis and plane of rotation (c) shaft axis and hub plane (d) cyclic pitch change (feathering) and rotor thrust vector tilt (e) collective pitch change, collective lever, swash plate, pitch link and pitch horn (f) cyclic stick, rotating swash plate and pitch link movement and phase angle	**-**	**x**	
(01)	*Explain why 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*	
(02)	*Describe 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*	
(03)	*Describe the mechanism by which the desired cyclic blade pitch can be produced by tilting the swash plate with the cyclic stick*	-	*x*	
52.5.3	**Blade lag motion**	**-**	**x**	
52.5.3.1	**Forces on the blade in the disc plane (tip path plane) in forward flight:**	**-**	**x**	
	(a) forces due to the Coriolis effect because of the flapping (b) alternating stresses and the need of the drag or lag hinge	**-**	**x**	
(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*	-	*x*	
52.5.3.2	**The drag or lag hinge:**	**-**	**x**	
	(a) the drag hinge in the fully articulated rotor (b) the lag flexure in the hinge less rotor (c) drag dampers	**-**	**x**	
(01)	*Describe the drag hinge of the fully articulated rotor and the lag flexure in the hingeless rotor*	-	*x*	
(02)	*Explain the necessity for drag dampers*	-	*x*	
52.5.3.3	**Ground resonance:**	**-**	**x**	
	(a) blade lag motion and movement of the centre of gravity of the blades and the rotor (b) oscillating force on the fuselage (c) fuselage, undercarriage and resonance	**-**	**x**	
(01)	*Explain the movement of the CG of the blades due to lead-lag movements in the multibladed rotor*	-	*x*	
(02)	*Describe the effect of the CG movement on the fuselage, and the danger of resonance when the gear touches the ground*	-	*x*	
52.5.4	**Rotor systems**	**-**	**x**	
52.5.4.1	**See-saw or teetering rotor**	**-**	**x**	
(01)	*Explain that a teetering rotor is prone to mast bumping in low-G situations*	-	*x*	

52.5.4.2	**Fully articulated rotor:**	**-**	**x**	
	(a) three hinges arrangement (b) bearings and elastomeric hinges	**-**	**x**	
(01)	*Describe the fully articulated rotor with hinges and feathering bearings*	-	*x*	
52.5.4.3	**Hinge less rotor and bearing less rotor**	**-**	**x**	
(01)	*Describe the forces on the flapping hinges with a large offset (virtual hinge) and the resulting moments*	-	*x*	
52.5.4.4	**Blade sailing:**	**-**	**x**	
	(a) low rotor RPM and effect of adverse wind (b) minimising the danger (c) droop stops	**-**	**x**	
(01)	*Explain blade sailing, and the influence of low rotor RPM and headwind*	-	*x*	
(02)	*Explain the purpose of droop stops, and their retraction by centrifugal forces*	-	*x*	
52.5.4.5	**Vibrations due to main rotor:**	**-**	**x**	
	(a) origins of the vibrations: in plane and vertical (b) blade tracking and balancing	**-**	**x**	
(01)	*Explain the lift variations per rev of a blade and the resulting vertical rotor thrust variation*	-	*x*	
(02)	*Describe the resulting frequencies and amplitudes as a function of the number of blades*	-	*x*	
52.6	**Tail rotors**	**-**	**x**	
52.6.1	**Conventional tail rotor**	**-**	**x**	
52.6.1.1	**Rotor description:**	**-**	**x**	
	(a) two-blades tail rotors with teetering hinge (b) rotors with more than two blades (c) feathering bearings and flapping hinges (d) dangers to people and to the tail rotor, rotor height and safety	**-**	**x**	
(01)	*Describe the two-bladed rotor with teetering hinge, and rotors with more than two blades*	-	*x*	
(02)	*Describe the dangers to ground personnel to the rotor blades, and possibilities of minimising these dangers*	-	*x*	
52.6.1.2	**Aerodynamics:**	**-**	**x**	
	(a) induced airflow and tail rotor thrust (b) thrust control by feathering, tail rotor drift and roll (c) effect of tail rotor failure and vortex ring	**-**	**x**	
(01)	*Explain the airflow around the blades in hover and in forward flight*	-	*x*	
(02)	*Explain the effect of wind on tail-rotor aerodynamics and thrust in the hover*	-	*x*	
(03)	*Explain tail-rotor thrust and the control through pitch alterations (feathering)*	-	*x*	
(04)	*Describe side effects of the tail rotor: roll moment and drift*	-	*x*	
(05)	*Explain the effects of temporary loss of tail rotor efficiency in a stationary hover*	-	*x*	
52.6.2	**The fenestron: technical lay-out**	**-**	**x**	
52.6.2.1	**Layout and control**	**-**	**x**	
(01)	*Describe the technical layout of a fenestron tail rotor*	-	*x*	

(02)	*State the advantages and disadvantages of a fenestron*	-	*x*	
52.6.3	**The NOTAR: technical lay-out**	**-**	**x**	
52.6.3.1	**Layout and control**	**-**	**x**	
(01)	*Describe the technical layout of a NOTAR (no-tailrotor) design*	-	*x*	
(02)	*State the advantages and disadvantages of a NOTAR*	-	*x*	
52.6.4	**Vibrations**	**-**	**x**	
52.6.4.1	**High frequency vibrations due to the tail rotors**	**-**	**x**	
(01)	*Explain the sources of vibration of the tail rotor and the resulting high frequencies*	-	*x*	
52.7	**Equilibrium, stability and control**	**-**	**x**	
52.7.1	**Equilibrium and helicopter attitudes**	**-**	**x**	
52.7.1.1	**Hover:**	**-**	**x**	
	(a) forces and equilibrium conditions (b) helicopter pitching moment and pitch angle (c) helicopter rolling moment and roll angle	**-**	**x**	
(01)	*Explain the zero-vector sum of forces and moments in any acceleration-free situation*	-	*x*	
(02)	*Explain the effect of density altitude on the equilibrium of forces*	-	*x*	
(03)	*Describe the forces and the moments about the longitudinal and lateral axis in a steady hover*	-	*x*	
(04)	*Explain how the roll angle in a steady hover without wind results from the moments about the longitudinal axis*	-	*x*	
(05)	*Explain how the cyclic is used to equalise moments about the lateral axis in a steady hover*	-	*x*	
52.7.1.2	**Forward flight:**	**-**	**x**	
	(a) forces and equilibrium conditions (b) helicopter moments and angles (c) effect of speed on fuselage attitude	**-**	**x**	
(01)	*Describe the forces and the moments about the lateral axis in steady straight and level flight*	-	*x*	
(02)	*Explain the influence of mass and CG position on the forces and moments about the lateral axis in forward flight*	-	*x*	
(03)	*Explain the role of the cyclic stick position in creating equilibrium of forces and moments about the lateral axis in forward flight*	-	*x*	
(04)	*Explain the 'inflow roll effect'*	-	*x*	
52.7.2	**Stability**	**-**	**x**	
52.7.2.1	**General aspects**	**-**	**x**	
(01)	*Explain the role of stability in overall flight safety*	-	*x*	
(02)	*Describe the relationship between stability and controllability*	-	*x*	
52.7.2.2	**Static longitudinal, roll and directional stability**	**-**	**x**	
(01)	*Define 'static stability' and give examples of static stability and of static instability*	-	*x*	
(02)	*Describe the influence of the longitudinal position of the CG and the horizontal stabilizer on static longitudinal stability*	-	*x*	
(03)	*Describe the influence of the tail rotor and the vertical stabilizer on static directional stability*	-	*x*	

(04)	*Explain the influence of the main rotor on static roll stability*	-	*x*	
52.7.2.3	**Static stability in the hover**	**-**	**x**	
(01)	*Describe the initial movements of a hovering helicopter after the occurrence of a horizontal gust*	-	*x*	
52.7.2.4	**Dynamic stability**	**-**	**x**	
(01)	*Define 'dynamic stability' and give examples of dynamic stability and of dynamic instability*	-	*x*	
(02)	*Explain why static stability is a precondition for dynamic stability*	-	*x*	
52.7.3	**Control**	**-**	**x**	
52.7.3.1	**Control power**	**-**	**x**	
	(a) fully articulated rotor (b) hinge less rotor (c) teetering rotor	**-**	**x**	
(01)	*Explain the meaning of the control moment*	-	*x*	
(02)	*Explain the importance of the CG position on the control moment*	-	*x*	
(03)	*Explain the influence of hinge offset on controllability*	-	*x*	
52.7.3.2	**Dynamic roll over**	**-**	**x**	
(01)	*Explain the mechanism which causes dynamic rollover*	-	*x*	
(02)	*Explain the required pilot action when dynamic rollover is starting to develop*	-	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
60	**OPERATIONAL PROCEDURES**			
61	**OPERATIONAL PROCEDURES - AEROPLANE AND HELICOPTER**			
61.1	**General**	**x**	**x**	
61.1.1	**Operation of aircraft: ICAO Annex 6, General requirements**	**x**	**x**	
61.1.1.1	**Definitions**	**x**	**x**	
(01)	*Define 'flight time (aeroplanes)'*	*x*	-	
(02)	*Define 'flight time (helicopter)'*	-	*x*	
(03)	*Define 'flight time (glider)'*	-	-	
61.1.1.2	**Applicability**	**x**	**x**	
(01)	*Describe the pilot's legal obligation to plan and prepare a flight*	*x*	*x*	
61.2	**Special operational procedures and hazards (general aspects)**	**x**	**x**	
61.2.1	**Ground operations**	**x**	**x**	
61.2.1.1	**Preflight**	**x**	**x**	
(01)	*Explain the use of checklists during pre-flight check*	*x*	*x*	
(02)	*Describe the use of entering amounts of refilled oil and fuel into the aircraft logbook*	*x*	*x*	
(03)	*Describe the procedure to be followed in case of defects discovered during the pre-flight check*	*x*	*x*	
(04)	*Explain the importance of using AFM/POH procedures.*	*x*	*x*	
(05)	*Explain possible hazards from rigging / weights the pilot did NOT untie before flight*	*x*	*x*	
61.2.1.2	**Refuelling**	**x**	**x**	
(01)	*State that the indications on a fuel gauge of an airplane are often erroneous*	*x*	*x*	

(02)	*Describe techniques how to assess the fuel quantity inside the fuel tanks in a precise way (e.g. stick measuring, calculation)*	x	x	
(03)	*Describe common safety precautions during refuelling (e.g. non-smoking, fuel grades, grounding, paved ground etc.)*	x	x	
(04)	*State that refuelling shall not be commenced with passengers on board*	x	x	
(05)	*Determine the allowed grades of fuel when given an AFM/POH*	x	x	
61.2.1.3	**Taxiing**	**x**	**x**	
(01)	*Explain the possible problems with regard to use of the carburator heat during taxi*	x	x	
(02)	*Explain which aircraft instruments (e.g. gyroscopic instruments) can be tested during taxiing*	x	x	
(03)	*Describe the importance of a brake test when starting to taxi, and explain be able to explain what to do in case allowed tolerances are exceeded*	x	x	
61.2.1.4	**Postflight**	**x**	**x**	
(01)	*Explain the reason and the procedure to record every flight in the aircraft logbook*	x	x	
(02)	*Explain the reason and the procedure to report detected malfunctions / defects to the aircraft holder or even the competent authority*	x	x	
61.2.2	**Flight operations**	**x**	**-**	
61.2.2.1	**Takeoff and landing**	**x**	**-**	
(01)	*Describe the effects of crosswind, headwind and tailwind on take off and landing*	x	-	
(02)	*Explain the term 'maximum demonstrated crosswind component' and determine it from a given AFM/POH*	x	-	
(03)	*Define and explain the speeds Vr, Vx and Vy*	x	-	
(04)	*Explain the effect of flaps configuration on ground roll distance and obstacle clearance*	x	-	
61.2.2.2	**Traffic pattern**	**x**	**-**	
(01)	*Explain the term 'traffic pattern' and the standard pattern direction*	x	-	
(02)	*Describe an appropriate way of entering a traffic pattern, and state the usual reporting points / positions within a traffic pattern (e.g. before turning base)*	x	-	
61.2.2.3	**Go around**	**x**	**-**	
(01)	*Describe situations in which a go-around should be executed*	x	-	
(02)	*Explain the procedures for retraction of flaps or other high-lift devices, and describe the hazards of retraction at low altitude*	x	-	
61.2.3	**Noise abatement**	**x**	**x**	
61.2.3.1	**Noise abatement procedures**	**x**	**x**	
(01)	*Explain why flying directly above settlements / town should be avoided*	x	x	
61.2.3.2	**Influence of the flight procedure (departure, cruise and approach)**	**x**	**x**	
(01)	*Describe how noise abatement can be performed during flight at low altitude (e.g. when entering / joining / exiting traffic pattern)*	x	x	
(02)	*Identify zones of 'noise abatement / protection' from an airport chart*	x	x	

61.2.4	**Runway excursion and incursion awareness**	**x**	**x**	
61.2.4.1	**Runway excursion awareness (meaning of surface markings and signals)**	**x**	**-**	
(01)	*Describe how to determine remaining runway distance from light signals and markings (e.g. light colors, half-length marking etc.)*	*x*	-	
(02)	*List factors that might lead to a runway excursion, e.g. higher than normal approach, incorrect braking, contaminated runway, approach speed or incorrectly selected airport*	*x*	-	
61.2.4.2	**Runway incursion awareness (meaning of surface markings and signals)**	**x**	**x**	
(01)	*Describe procedures to prevent runway incursion, e.g. stop bars, clearances when approaching holding points, expedited vacating of runways and look-out*	*x*	*x*	
(02)	*Identify the marking 'runway incursion hotspot' from an airport chart.*	*x*	*x*	
61.2.5	**Fire or smoke**	**x**	**x**	
61.2.5.1	**Carburettor fire**	**x**	**x**	
(01)	*Explain what a 'carburetor fire' is and how to handle such a situation*	*x*	*x*	
61.2.5.2	**Engine fire**	**x**	**x**	
(01)	*Describe actions in case of engine fire during flight with regard to emergency checklist and engine restart*	*x*	*x*	
(02)	*Describe hazards from engine fire during flight with regard to power loss, possible visual obstructions and carbon monoxide in the cabin*	*x*	*x*	
(03)	*Describe how to detect high carbon monoxide concentration inside the cockpit*	*x*	*x*	
(04)	*Name the heating system / exhaust system as a possible cause for high carbon monoxide concentration in the cockpit*	*x*	*x*	
(05)	*Describe actions in case of detecting high carbon monoxide concentration, e.g. turn off heating, ventilate cabin, land as soon as practicable, etc.*	*x*	*x*	
(06)	*Explain why applying full throttle and closing the fuel shutoff valve might help in case of an engine fire on ground*	*x*	*x*	
61.2.5.3	**Fire in the cabin and cockpit, (choice of extinguishing agents according to fire classification and use of the extinguishers)**	**x**	**x**	
(01)	*List different extinguishing agents and suitable fire for use of the extinguishers*	*x*	*x*	
(02)	*Describe the use of fire extinguishers inside the cockpit can explain negative effects*	*x*	*x*	
61.2.5.4	**Smoke in the cockpit and (effects and action to be taken) and smoke in the cockpit and cabin (effects and actions taken)**	**x**	**x**	
(01)	*Describe the procedure to switch off electrical users one by one to find the possible source of an electric fire*	*x*	*x*	
(02)	*List actions in case of smoke in the cockpit, e.g. open windows and turn off heating system*	*x*	*x*	
61.2.6	**Windshear and microburst**	**x**	**x**	
61.2.6.1	**Effects and recognition during departure and approach**	**x**	**x**	
(01)	*Define 'wind shear' (horizontal or vertical)*	*x*	*x*	

(02)	*Describe typical meteorological situations in which 'wind shear' may occur*	*x*	*x*	
(03)	*Describe the effects on aerodynamics and the hazards for an aircraft that a strong wind shear imposes*	*x*	*x*	
(04)	*Describe the variation in airspeed and climb performance when encountering a downburst / microburst close to the ground*	*x*	*x*	
(05)	*Describe the effects of wind shear during final approach with regard to speed and variation from the intended glide path*	*x*	*x*	
61.2.6.2	**Actions to avoid and actions taken during encounter**	**x**	**x**	
(01)	*Describe flight procedures that can be applied when experiencing strong wind shear during approach and landing*	*x*	*x*	
(02)	*Describe procedures to avoid wind shear during approach and landing*	*x*	*x*	
61.2.7	**Wake turbulence**			
61.2.7.1	**Cause**	**x**	**x**	
(01)	*Describe the origin and hazards resulting from 'wake turbulences'*	*x*	*x*	
(02)	*State that significant wake turbulences exist from rotation to nose-wheel touchdown*	*x*	*x*	
(03)	*Describe the movement of wake turbulences as spreading sideways and downwards, and explain the effect of a slight crosswind on the runway*	*x*	*x*	
(04)	*Describe the origin and hazards resulting from helicopter rotor downwash*	*x*	*x*	
61.2.7.2	**List of relevant parameters**	**x**	**x**	
(01)	*List the wake turbulence categories 'light', 'medium' and 'heavy' ('super heavy')*	*x*	*x*	
(02)	*Describe how the intensity of wake turbulence depends on aircraft's size (mass), speed and configuration*	*x*	*x*	
(03)	*State the most critical situation for wake turbulence as 'heavy and slow'*	*x*	*x*	
61.2.7.3	**Actions taken when crossing traffic, during take-off and landing**	**x**	**x**	
(01)	*State that ATC separates traffic also based on the wake turbulence category of the preceding aircraft*	*x*	*x*	
(02)	*State the approximate time that should be waited before taking off behind a preceding medium or heavy aircraft*	*x*	*x*	
(03)	*Describe procedures to handle wake turbulence at takeoff and landing (e.g. higher approach, later touch down)*	*x*	*x*	
(04)	*Describe the pilot's responsibility for establishing an appropriate amount of separation during taxi and on uncontrolled airfields*	*x*	*x*	
61.2.8	**Engine failure at take off**	**x**	**-**	
61.2.8.1	**General**	**x**	**-**	
(01)	*State that in case of engine failure during take-off an immediate reduction of AOA is necessary*	*x*	-	
(02)	*Explain the importance to observe air speed*	*x*	-	
(03)	*Explain why - up to a certain altitude / safe altitude - a straight ahead landing is better than turning back to the airfield*	*x*	-	

(04)	*Explain how a steep turn back leads to an excessive loss of altitude*	*x*	-	
(05)	*Explain that the use of the full runway length (by doing a backtrack) is favorable in any case, to mitigate the effect of a possible engine failure*	*x*	-	
61.2.9	**Emergency and precautionary landings**	**x**	**x**	
61.2.9.1	**Definition**	**x**	**x**	
(01)	*Define and explain the differences between 'precautionary landing' and 'emergency landing'*	*x*	*x*	
(02)	*List examples in which cases to do an emergency landing*	*x*	*x*	
(03)	*State that notes / advices in AFM/POH should be followed correctly, e.g. land as soon as possible / on next airfield / etc.*	*x*	*x*	
(04)	*State in which cases life wests for every passenger have to carried on board*	*x*	*x*	
61.2.9.2	**Cause (of emergency and precautionary landings)**	**x**	**x**	
(01)	*Describe situations in which to prepare for an emergency landing (e.g. loss of oil or fuel, fire, smoke)*	*x*	*x*	
(02)	*Describe situations that might lead to a precautionary landing (e.g. passenger sickness)*	*x*	*x*	
61.2.9.3	**Landing preparation**	**x**	**-**	
(01)	*Describe appropriate actions for conducting a off-field landing (unless stated other by AFM/POH)*	*x*	-	
(02)	*Describe how to select a suitable emergency landing area, e.g. how field should look like, be orientated to the wind, should provide clear approach area, etc.*	*x*	-	
(03)	*Explain why the aircraft should be flared at the upper visible surface of vegetation (e.g. corn, tree tops)*	*x*	-	
(04)	*State why the fuel shut-off valve should be closed before an emergency landing with a non-working engine*	*x*	-	
(05)	*Explain why touch down on an emergency landing area should occur at minimum speed*	*x*	-	
61.2.9.4	**Passenger information**	**x**	**x**	
(01)	*Describe the briefing to be given to passengers before conducting a precautionary/emergency landing or ditching (including evacuation)*	*x*	*x*	
61.2.9.5	**Evacuation**	**x**	**x**	
(01)	*Explain why the aircraft must be stopped and the engine shut down before an emergency evacuation*	*x*	*x*	
(02)	*Explain when to inflate life wests in case of emergency ditching*	*x*	*x*	
61.2.9.6	**Action after landing**	**x**	**x**	
(01)	*Describe and identify ground-air distress signals*	*x*	*x*	
61.2.10	**Contaminated runways**	**x**	**-**	
61.2.10.1	**Kinds of contamination**	**x**	**-**	
(01)	*Explain the term 'contaminated runway'*	*x*	-	
(02)	*List and describe different types of contamination*	*x*	-	
61.2.10.2	**Estimated surface friction and friction coefficient**	**x**	**-**	

(01)	*Describe the term 'friction coefficient'*	*x*	-	
(02)	*Explain the potential effects of contaminations (e.g. longer take-off / landing roll, lower braking coefficient)*	*x*	-	
(03)	*Describe how to get information about the condition of a runway, if such were published (e.g. SNOWTAM)*	*x*	-	
(04)	*Describe precautions and procedures in case of poor friction coefficient, or if information about friction coefficient is not available*	*x*	-	
61.2.11	**Operation influence by meteorological conditions**	**x**	**-**	
61.2.11.1	**Maintaining VMC**	**x**	**-**	
(01)	*Describe the correct procedure when encountering meteorological conditions coming below VMC minima*	*x*	-	
61.2.12	**Ballistic Recovery Systems (BRS)**	**x**	**-**	
61.2.12.1	**General**	**x**	**-**	
(01)	*Describe the purpose and function of a BRS*	*x*	-	
(02)	*Describe situations that may lead to the use of the BRS system*	*x*	-	
61.2.12.2	**Design**	**x**	**-**	
(01)	*List the major components of a BRS system*	*x*	-	
(02)	*Explain the purpose and operation of the slider*	*x*	-	
(03)	*List the safety features of a BRS*	*x*	-	
61.2.12.3	**Operation and Limitations**	**x**	**-**	
(01)	*Describe the actions before and after the flight in an aircraft equipped with a BRS (removing and installing the safety pin)*	*x*	-	
(02)	*Describe how to activate a BRS*	*x*	-	
(03)	*State the actions for using a BRS at an altitude below 500 ft AGL*	*x*	-	
(04)	*State the actions for using a BRS between 500 ft and 2000 ft AGL*	*x*	-	
(05)	*State the actions for using a BRS at an altitude above 2000 ft AGL*	*x*	-	
(06)	*Describe the limitations in function of altitude and speed for using a BRS*	*x*	-	
61.2.12.4	**Precautions**	**x**	**-**	
(01)	*Describe the passenger briefing with regard to the BRS*	*x*	-	
(02)	*Describe the precautions to be taken on the ground during normal handling of an aircraft equipped with BRS, and after an accident*	*x*	-	
61.3	**Special operational procedures and hazards (helicopter)**	**-**	**x**	
61.3.1	**Rotor downwash**	**-**	**x**	
61.3.1.1	**Effects of roter downwash**	**-**	**x**	
(01)	*Describe 'rotor downwash'*	-	*x*	
(02)	*Describe the effects of downwash: soil erosion, water dispersal and spray, recirculation, damage to property, loose articles*	-	*x*	
61.3.2	**Operation influence by meteorological conditions (helicopter)**	**-**	**x**	
61.3.2.1	**White out, sand or dust**	**-**	**x**	
(01)	*Describe the effect of 'white-out' and its hazards (e.g. loss of orientation)*	-	*x*	
(02)	*Describe take-off and landing techniques in 'white-out' situations*	-	*x*	

61.3.2.2	**Strong winds**	-	**x**	
(01)	*Describe the effect of 'blade sailing'*	-	*x*	
(02)	*Describe wind operating envelopes and vertical speed problems*	-	*x*	
(03)	*State the procedures for starting engines in presence of strong winds*	-	*x*	
61.3.2.3	**Mountain environment**	-	**x**	
(01)	*Describe constraints associated with helicopter operation in mountain environment*	-	*x*	
61.3.3	**Emergency procedures (helicopter): Influence of technical problems**	-	**x**	
61.3.3.1	**Engine failure**	-	**x**	
(01)	*Describe recovery techniques in the event of engine failure during hover, climb, cruise, approach*	-	*x*	
61.3.3.2	**Fire in cabin, cockpit or engine**	-	**x**	
(01)	*Describe the basic actions when encountering fire in the cabin, cockpit or engine*	-	*x*	
61.3.3.3	**Tail, rotor or directional control failure**	-	**x**	
(01)	*Describe the basic actions following loss of tail rotor*	-	*x*	
(02)	*Describe the basic actions following loss of directional control*	-	*x*	
61.3.3.4	**Ground resonance**	-	**x**	
(01)	*Describe the effect of 'ground resonance'*	-	*x*	
(02)	*Describe recovery actions in case of ground resonance*	-	*x*	
61.3.3.5	**Blade stall**	-	**x**	
(01)	*Describe situations in which 'blade stall' may occur*	-	*x*	
(02)	*Describe recovery actions when encountering retreating blade stall*	-	*x*	
61.3.3.6	**Settling with power (vortex ring)**	-	**x**	
(01)	*Describe potential conditions for settling with power and recovery actions*	-	*x*	
61.3.3.7	**Overpitch**	-	**x**	
(01)	*Describe situations in which 'overpitch' may occur*	-	*x*	
(02)	*Describe recovery actions in case of overpitch*	-	*x*	
61.3.3.8	**Overspeed: rotor or engine**	-	**x**	
(01)	*Describe situations that might lead to overspeed with rotor or engine*	-	*x*	
(02)	*Describe overspeed control*	-	*x*	
61.3.3.9	**Dynamic rollover**	-	**x**	
(01)	*Describe potential conditions for 'dynamic rollover'*	-	*x*	
(02)	*Describe recovery actions for dynamic rollover*	-	*x*	
61.3.3.10	**Mast bumping**	-	**x**	
(01)	*Describe potential conditions of the 'conducive to' and 'avoidance of' effect*	-	*x*	

Reference	**Description**	**PPL(A)**	**PPL(H)**	**Remarks**
70	**FLIGHT PERFORMANCE AND PLANNING**	**x**	**x**	
71	**MASS AND BALANCE: AEROPLANES OR HELICOPTERS**	**x**	**x**	
71.1	**Purpose of mass and balance considerations**	**x**	**x**	

71.1.1	**Mass limitations**	**x**	**x**	
71.1.1.1	**Importance in regard to structural limitations**	**x**	**x**	
(01)	*Describe the relationship between aircraft mass and structural stress*	*x*	*x*	
(02)	*Describe the possible hazards resulting from a (too) high take off mass with regard to structural stress*	*x*	*x*	
(03)	*Explain why loads exceeding the loading limitations have to be reduced to limits*	*x*	*x*	
71.1.1.2	**Importance in regard to performance limitations**	**x**	**x**	
(01)	*Describe the relationship between aircraft mass and aircraft performance*	*x*	*x*	
(02)	*Describe the possible hazards resulting from a (too) high take-off mass with regard to aeroplane/helicopter performance*	*x*	*x*	
71.1.2	**CG limitations**	**x**	**x**	
71.1.2.1	**Importance in regard to stability and controllability**	**x**	**x**	
(01)	*Describe the relationship between CG position and stability/controllability of the aircraft*	*x*	*x*	
(02)	*Describe possible hazards associated with a CG position out of aft/forward limits*	*x*	*x*	
(03)	*Explain the importance of securing or tying down pieces of baggage*	*x*	*x*	
(04)	*Explain the importance to load or unload masses to achieve an acceptable CG position*	*x*	*x*	
71.1.2.2	**Importance in regard to performance**	**x**	**x**	
(01)	*Describe the effects of CG position on performance parameters (speeds, altitude, endurance and range)*	*x*	*x*	
71.2	**Loading**	**x**	**x**	
71.2.1	**Terminology**	**x**	**x**	
71.2.1.1	**Mass terms**	**x**	**x**	
(01)	*Define the term 'basic empty mass'*	*x*	*x*	
(02)	*Define the terms 'take-off mass', 'landing mass', 'ramp/taxi mass', 'zero fuel mass'*	*x*	*x*	
71.2.1.2	**Load terms (including fuel terms)**	**x**	**x**	
(01)	*Define the terms: '(traffic) load', 'block fuel', 'taxi fuel', 'take-off fuel', 'trip fuel', 'reserve fuel' (contingency, alternate, final reserve), 'extra fuel'*	*x*	*x*	
(02)	*List the common units of measurement for masses and convert them (lbs, kg, kp, etc.)*	*x*	*x*	
(03)	*List the common units of measurement for fuel volume and and mass, and convert them (liters, US/Imp gallons)*	*x*	*x*	
71.2.2	**Mass limits**	**x**	**x**	
71.2.2.1	**Structural limitations**	**x**	**x**	
(01)	*Explain the term 'maximum ramp mass'*	*x*	*x*	
(02)	*Explain the term 'maximum take off mass (MTOM)'*	*x*	*x*	
(03)	*Explain the term 'maximum landing mass (MLM)'*	*x*	*x*	
(04)	*Explain the term 'maximum zero-fuel mass (MZFM)'*	*x*	*x*	
(05)	*Explain why on most aircrafts, the max allowed landing mass is smaller than the max allowed take off mass*	*x*	*x*	

71.2.2.2	**Performance limitations**	**x**	**x**	
(01)	*Describe the terms 'performance-limited take-off mass' and 'performance-limited landing mass'*	*x*	*x*	
71.2.2.3	**Baggage compartment limitations**	**x**	**x**	
(01)	*Describe the maximum load in baggage compartments (maximum load and maximum load per unit area)*	*x*	*x*	
71.2.3	**Mass calculations**	**x**	**x**	
71.2.3.1	**Maximum masses for take-off and landing**	**x**	**x**	
(01)	*Calculate the maximum mass for take-off and landing, given mass-and-load components and structural/ performance limits*	*x*	*x*	
(02)	*Calculate the maximum allowed traffic load and fuel load in order not to exceed the given allowed take-off mass*	*x*	*x*	
71.3	**Fundamentals of CG calculations**	**x**	**x**	
71.3.1	**Definition of centre of gravity**	**x**	**x**	
71.3.1.1	**Definition**	**x**	**x**	
(01)	*Define and explain the meaning of 'center of gravity (CG)'*	*x*	*x*	
71.3.1.2	**Limitations**	**x**	**x**	
(01)	*State where the CG position and forward/aft limits for an aircraft at basic empty mass can be found*	*x*	*x*	
71.3.2	**Conditions of equilibrium (balance of forces and balance of moments**	**x**	**x**	
71.3.2.1	**Definition**	**x**	**x**	
(01)	*Define 'datum' (reference point), 'moment arm' and 'moment'*	*x*	*x*	
71.3.2.2	**Relation between factors for equlilbrium**	**x**	**x**	
(01)	*List the forces acting for the balance of moments*	*x*	*x*	
(02)	*Describe the relationship between center of pressure, CG and elevator downforce*	*x*	*x*	
71.3.3	**Basic calculations of CG**	**x**	**x**	
71.3.3.1	**General considerations**	**x**	**x**	
(01)	*Describe how to calculate 'moment' by multiplying 'mass (force)' x 'moment arm'*	*x*	*x*	
71.3.3.2	**Calculations**	**x**	**x**	
(01)	*Calculate moments / CG position for different loads (pilot, passengers, baggage, fuel)*	*x*	*x*	
(02)	*Determine whether a flight can be performed with a given load or not*	*x*	*x*	
71.4	**Mass and balance details of aircraft**	**x**	**x**	
71.4.1	**Contents of mass and balance documentation**	**x**	**x**	
71.4.1.1	**Datum and moment arm**	**x**	**x**	
(01)	*Describe when an airplane is weighed, either periodically or after bigger repairs, after repainting or when larger pieces of equipment are installed or removed*	*x*	*x*	
(02)	*State where the datum and moment arms for aircraft can be found*	*x*	*x*	
(03)	*List the common units of measurement used for moments and convert them (kgm, lbft, etc.)*	*x*	*x*	
71.4.1.2	**CG position as distance from datum**	**x**	**x**	

(01)	*Describe the different forms in presenting CG position as distance from datum or as percentage of mean aerodynamic chord (% MAC)*	*x*	*x*	
71.4.2	**Extraction of basic mass and balance data from aircraft documentation**	**x**	**x**	
71.4.2.1	**BEM**	**x**	**x**	
(01)	*Extract empty weight and moment from a given weighing report*	*x*	*x*	
(02)	*Determine the loading limits (e.g. pilot/passenger seat, maximum compartment load) from a given AFM/POH*	*x*	*x*	
(03)	*State that actual weight & balance data / weighing report can be found in the aircraft documents or the AFM/POH*	*x*	*x*	
(04)	*Extract the datume plane, and arms for different stations (rows of seats, fuel tanks) from a given AFM/POH*	*x*	*x*	
(05)	*State which pieces of equipment / fuel / oil masses are included in the basic empty weight*	*x*	*x*	
71.4.2.2	**CG position or moment at BEM**	**x**	**x**	
(01)	*Determine CG position at basic empty mass from AFM/POH*	*x*	*x*	
(02)	*Determine the allowed CG range from a given AFM/POH*	*x*	*x*	
71.4.2.3	**Deviations from standard configuration**	**x**	**x**	
(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*	
71.5	**Determination of CG position**	**x**	**x**	
71.5.1	**Methods**	**x**	**x**	
71.5.1.1	**Arithmetic method**	**x**	**x**	
(01)	*Calculate the CG position of an aircraft by using the formula: CG position = sum of moments / total mass*	*x*	*x*	
(02)	*Determine how the CG position will shift during flight*	*x*	*x*	
(03)	*Explain how in some cases, a CG position out of limits can be corrected using trim ballast*	*x*	*x*	
71.5.1.2	**Graphic method**	**x**	**x**	
(01)	*Determine the CG position of an aircraft by using the loading graphs given in sample documents*	*x*	*x*	
71.5.2	**Load and trim sheet**	**x**	**x**	
71.5.2.1	**General considerations**	**x**	**x**	
(01)	*Explain the principle and the purpose of load sheets.*	*x*	*x*	
71.5.2.2	**Load sheet and CG envelope for light aeroplanes and for helicopters**	**x**	**x**	
(01)	*Add loading data and calculate masses in a sample load sheet/balance schedule*	*x*	*x*	
72	**PERFORMANCE: AEROPLANES**	**x**	**-**	
72.1	**Introduction**	**x**	**-**	
72.1.1	**Performance classes**	**x**	**-**	
72.1.1.1	**Definitions and concept**	**x**	**-**	
(01)	*Describe the basic concept that the applicable operational requirements differ depending on aeroplane performance*	*x*	*-*	

(02)	*State that light aeroplanes are operated under Performance Class B (certified CS-23)*	*x*	-	
72.1.2	**Stages of flight**	**x**	**-**	
72.1.2.1	**Definitions**	**x**	**-**	
(01)	*Define and explain the terms 'take off roll' and 'landing roll'*	*x*	-	
(02)	*Define the terms 'Takeoff Distance Available (TODA)' and 'Landing Distance Available (LDA)'*	*x*	-	
(03)	*State that take-off or landing distance is computed from standstill to an altitude of 15m/50ft*	*x*	-	
72.1.2.2	**Factors affecting take-off and landing distances**	**x**	**-**	
(01)	*Explain the effect of flap configuration with regard to takeoff ground roll, takeoff distance and clearance of close-in and distant obstacles*	*x*	-	
(02)	*Explain the influence of a grass runway surface on take-off and landing performance*	*x*	-	
72.1.3	**Effect of aeroplane mass, wind, altitude, runway slope and runway conditions**	**x**	**-**	
72.1.3.1	**General considerations**	**x**	**-**	
(01)	*Describe the influence of aerodrome elevation, temperature and QNH on take-off and landing performance*	*x*	-	
(02)	*Explain the influence of runway conditions on take-off and landing performance*	*x*	-	
72.1.3.2	**Effect on aeroplane performance**	**x**	**-**	
(01)	*Explain the general influence of temperature and air density (chosen flight altitude or elevation) on aircraft performance*	*x*	-	
(02)	*Describe the influence of head- and tail wind on take-off and landing performance*	*x*	-	
(03)	*Describe the influence of aircraft mass on take-off and landing performance*	*x*	-	
(04)	*Explain the influence of runway slope on take-off and landing performance*	*x*	-	
72.1.4	**Gradients**	**x**	**-**	
72.1.4.1	**Definitions**	**x**	**-**	
(01)	*Define the term 'climb/descent gradient' and 'climb/descent angle'*	*x*	-	
(02)	*Describe the mathematical relationship between 'climb/descent gradient' and 'climb/descent angle' of the flight path*	*x*	-	
72.2	**SE Aeroplanes**	**x**	**-**	
72.2.1	**Definitions of terms and speeds**	**x**	**-**	
72.2.1.1	**Terms**	**x**	**-**	
(01)	*Define and explain the following terms: Speed for best angle of climb (vX), Speed for best rate of climb (vY)*	*x*	-	
72.2.1.2	**Speeds**	**x**	**-**	
(01)	*Define the following speeds: stall speeds vS, vS0 and vS1, rotation speed vR*	*x*	-	
72.2.2	**Take-off and landing performance**	**x**	**-**	
72.2.2.1	**Use of aeroplane flight manual data**	**x**	**-**	
(01)	*Determine take-off and landing roll and distances from given AFM/POH tables*	*x*	-	

(02)	*Determine take-off and landing roll and distances from given AFM/POH graphs*	*x*	-	
(03)	*Calculate head- and crosswind components for use with performance graphs/tables from given MET report data*	*x*	-	
(04)	*Explain how in performance graphs/tables air density is considered by combination of air temperature and pressure altitude*	*x*	-	
(05)	*State that performance factors included in an AFM/POH for grass runways are not valid in case of every grass height and that this factor needs to be considered additionally*	*x*	-	
(06)	*Decide, based on relevant calculations, if a certain flight can be performed safely or not*	*x*	-	
72.2.3	**Climb and cruise performance**	**x**	**-**	
72.2.3.1	**Use of aeroplane flight data**	**x**	**-**	
(01)	*Determine the time, distance or fuel needed to reach a certain flight altitude, with given data from AFM/POH*	*x*	-	
(02)	*Determine the climb rate of an aircraft depending on temperature and pressure altitude, with given data from AFM/POH*	*x*	-	
(03)	*Determine the maximum achievable climb rate of an aircraft depending on parameters like temperature, load, engine power, with given data from AFM/POH*	*x*	-	
(04)	*Determine the cruising speed (TAS) and fuel flow at a certain engine power and flight altitude, with given data from AFM/POH*	*x*	-	
(05)	*Determine the engine power required to reach a certain cruise speed (TAS) at given altitude and temperature, with given data from AFM/POH*	*x*	-	
(06)	*Determine fuel flow for given altitude and speed (TAS) / power setting, with given data from AFM/POH*	*x*	-	
72.2.3.2	**Effect of density altitude and aeroplane mass**	**x**	**-**	
(01)	*Explain the term 'density altitude'*	*x*	-	
(02)	*Describe the effect of density altitude on aeroplane performance with regard to speed (TAS), climb rate and fuel flow*	*x*	-	
(03)	*Determine the mass, or mass range, for which aeropolane performance data from AFM/POH is given*	*x*	-	
72.2.3.3	**Endurance and the effects of the different recommended power or thrust settings**	**x**	**-**	
(01)	*Explain the effect of power on fuel flow, range and endurance*	*x*	-	
(02)	*Explain the term 'maximum endurance'*	*x*	-	
(03)	*State which value for 'endurance' should to be entered into the ATS flight plan*	*x*	-	
72.2.3.4	**Still air range with various power or thrust settings**	**x**	**-**	
(01)	*Describe how the achievable range varies with different power settings*	*x*	-	
(02)	*Explain the term 'maximum range'*	*x*	-	
(03)	*Describe the difference between 'maximum endurance' and 'maximum range' with regard to power setting and speed*	*x*	-	
73	**PERFORMANCE: HELICOPTERS**	**-**	**x**	
73.1	**General**	**-**	**x**	

73.1.1	**Introduction**	-	x	
73.1.1.1	**Definitions and terms**	-	x	
(01)	*Define the terms 'climb angle' and 'climb gradient'*	-	x	
(02)	*Define the terms 'flight-path angle' and 'flight-path gradient'*	-	x	
73.1.1.2	**Stages of flight**	-	x	
(01)	*Explain the following phases of flight: take-off, climb, level flight, descent, approach and landing*	-	x	
(02)	*Explain the necessity for different take-off and landing procedures*	-	x	
(03)	*Explain the difference between hovering in ground effect (HIGE) and hovering out of ground effect (HOGE)*	-	x	
73.1.1.3	**Effect on performance of atmospheric, airport or heliport and helicopter conditions**	-	x	
(01)	*Explain how the following factors affect helicopter performance: pressure altitude, humidity, temperature, wind, helicopter mass, helicopter configuration, helicopter centre of gravity (CG)*	-	x	
73.2	**Applicability of airworthiness requirements**	-	x	
73.2.1	**Definitions and terminology**	-	x	
73.2.1.1	**Helicopter performance certification**	-	x	
(01)	*Name the general differences between helicopters certified according to CS-27 and CS-29*	-	x	
73.3	**Performance: SE helicopters**	-	x	
73.3.1	**Definitions of terms**	-	x	
73.3.1.1	**(a) velocities: vx, vy**	-	x	
(01)	*Define and explain the speeds 'vX' and 'vY'*	-	x	
73.3.1.2	**(b) velocity of best range and of maximum endurance**	-	x	
(01)	*Define 'VmaxRange' (speed for maximum range) and 'VmaxEnd' (speed for maximum endurance)*	-	x	
73.3.1.3	**(c) power limitations**	-	x	
(01)	*Understand and interpret the power required/power available versus TAS graphs*	-	x	
73.3.1.4	**(d) altitudes**	-	x	
(01)	*Explain the terms 'operational ceiling' and 'absolute ceiling'*	-	x	
73.3.2	**Take-off, cruise and landing performance: Use and interpretation of diagrams and tables**	-	x	
73.3.2.1	**(a) Take-off**	-	x	
(01)	*(1) take-off run and distance available*	-	x	
(02)	*(2) take-off and initial climb*	-	x	
(03)	*(3) effects of mass, wind and density altitude*	-	x	
(04)	*(4) effects of ground surface and gradient*	-	x	
73.3.2.2	**(b) Landing**	-	x	
(01)	*(1) effects of mass, wind, density altitude and approach speed*	-	x	
(02)	*(2) effects of ground surface and gradient*	-	x	
73.3.2.3	**(c) In-flight**	-	x	
(01)	*(1) relationship between power required and power available*	-	x	
(02)	*(2) performance diagram*	-	x	
(03)	*(3) effects of configuration, mass, temperature and altitude*	-	x	

(04)	*(4) reduction of performance during climbing turns*	-	*x*	
(05)	*(5) autorotation*	-	*x*	
(06)	*(6) adverse effects (icing, rain and condition of the airframe)*	-	*x*	
74	**FLIGHT PLANNING AND FLIGHT MONITORING**	**x**	**x**	
74.1	**Flight planning for VFR flights**	**x**	**x**	
74.1.1	**VFR navigation plan**	**x**	**x**	
74.1.1.1	**Routes, airfields, heights and altitudes from VFR charts**	**x**	**x**	
(01)	*List available charts for different phases of flight (e.g. airport chart, visual flight chart, enroute chart, E-LO)*	*x*	*x*	
(02)	*Extract and interpret information about routings and airspace structure from VFR charts*	*x*	*x*	
(03)	*Extract and interpret information about airfield data from VFR charts*	*x*	*x*	
(04)	*Extract and interpret information about heights and altitudes from VFR charts*	*x*	*x*	
(05)	*Find the highest obstacle within a given distance on either side of the course*	*x*	*x*	
(06)	*Extract and interpret various symbols from VFR charts according to ICAO standard*	*x*	*x*	
74.1.1.2	**Courses and distances from VFR charts**	**x**	**x**	
(01)	*Extract courses (true, magnetic) from VFR charts*	*x*	*x*	
(02)	*Extract distances from VFR charts*	*x*	*x*	
(03)	*Explain the use of distance markings ('ticks') on full degrees of longitude for distance measuring*	*x*	*x*	
74.1.1.3	**Aerodrome charts and aerodrome directory**	**x**	**x**	
(01)	*Explain the reasons for studying the visual departure procedures and the available approach procedures prior to a flight*	*x*	*x*	
(02)	*Extract the available distances for take-off and landing (TODA, TORA, LDA) on a specific runway from a given aerodrome chart*	*x*	*x*	
(03)	*Extract various information of ground structure and annotations from a given aerodrome chart (e.g. taxi ways, displaced thresholds, fuel station etc.)*	*x*	*x*	
74.1.1.4	**Communications and radio navigation planning data**	**x**	**x**	
(01)	*Extract frequencies for radio communication from a given VFR chart (e.g. TWR, INFORMATION, INFO etc.)*	*x*	*x*	
(02)	*Extract frequencies for radio navigation from a given VFR chart (e.g. NDB, VOR etc.)*	*x*	*x*	
74.1.1.5	**Completion of navigation plan**	**x**	**x**	
(01)	*Given an excerpt from a flight log, determine various values, e.g. MH, WCA, GS, leg-wise and accumulated times, distances and fuel required*	*x*	*x*	
(02)	*Calculate the horizontal distance to climb (TOC) or descend (TOD) to/from a given level or altitude with given data*	*x*	*x*	
(03)	*Explain how to determine the position of a significant VFR point for insertion into a GNSS flight plan, using distance and bearing from existing significant points or using coordinates*	*x*	*x*	
74.2	**Fuel planning**	**x**	**x**	
74.2.1	**General knowledge**	**x**	**x**	
74.2.1.1	**Definitions and general considerations**	**x**	**x**	

(01)	*Explain the effect of flight altitude on fuel consumption, and where to find information about consumption*	*x*	*x*	
(02)	*Explain the relations between airspeed, engine power setting and fuel consumption during different phases of flight*	*x*	*x*	
(03)	*Explain the terms 'maximum usable fuel', 'total amount of fuel', 'unusable fuel'*	*x*	*x*	
74.2.1.2	**General calculations**	**x**	**x**	
(01)	*Calculate the available flight time/range from given average fuel flow/consumption and available amount of fuel*	*x*	*x*	
(02)	*Calculate the required fuel from given average fuel flow/ consumption and required time/range to be flown*	*x*	*x*	
74.2.2	**Pre-flight calculation of fuel required**	**x**	**x**	
74.2.2.1	**General**	**x**	**x**	
(01)	*Determine relevant data, such as fuel capacity, fuel flow/ consumption at different power settings, altitudes and atmospheric conditions, using the AFM/POH*	*x*	*x*	
(02)	*State a suitable amount of fuel for engine-start, run-up and taxiing*	*x*	*x*	
(03)	*Determine the fuel consumption during climb, using the AFM/POH*	*x*	*x*	
(04)	*Determine the fuel consumption during cruising flight at a certain engine power setting and at certain environmental conditions (altitude, etc.) using the AFM/POH*	*x*	*x*	
(05)	*Determine the fuel consumption during descent, using the AFM/POH*	*x*	*x*	
(06)	*Determine the fuel required for flight to the alternate aerodrome*	*x*	*x*	
(07)	*Determine the fuel additionals for unplanned deviation from planned fuel consumption ('contingencies')*	*x*	*x*	
(08)	*Describe which minimum reserve fuel is to be carried on board according to NCO.OP.125 (10min/30min)*	*x*	*x*	
(09)	*State that the minimum reserve is to be calculated using cruise performance on cruise altitude*	*x*	*x*	
(10)	*Calculate the fuel required for a flight (block fuel, trip fuel) from fuel amounts required for engine-start, taxiing, climb, en-route flight, descent and reserves (contingency, alternate, final reserve)*	*x*	*x*	
74.2.2.2	**Calculation of extra fuel**	**x**	**x**	
(01)	*Explain the different types of fuel reserves, especially: 'alternate fuel', 'contingency fuel', 'minimum reserve'*	*x*	*x*	
(02)	*Describe situations in which cases additional fuel reserve can be / might be / should be carried*	*x*	*x*	
(03)	*Calculate the possible extra fuel under given conditions.*	*x*	*x*	
74.2.2.3	**Completion of the fuel section of the navigation plan (fuel log) and calculation of total fuel**	**x**	**x**	
(01)	*Calculate the total fuel required for a given flight*	*x*	*x*	
(02)	*Complete the fuel section of the navigational plan (fuel log)*	*x*	*x*	
74.3	**Pre-flight preparation**	**x**	**x**	
74.3.1	**AIP and NOTAM briefing**	**x**	**x**	
74.3.1.1	**General**	**x**	**x**	

(01)	*Describe the content and usage of aeronautical and regulatory information published in the national aeronautical information publication (AIP)*	*x*	*x*	
(02)	*Determine beginning and end of civil twilight (ECET/BCMT) times using the AIP*	*x*	*x*	
(03)	*Define the term 'NOTAM', and describe how NOTAM information can be recieved*	*x*	*x*	
74.3.1.2	**Ground facilities and services**	**x**	**x**	
(01)	*Extract operational information of an aerodrome using the AIP, e.g. fuel grades, operating times (PPR), ground services etc.*	*x*	*x*	
(02)	*Explain the meaning and practical significance of the term 'PPR'*	*x*	*x*	
(03)	*Extract specific information about runways (e.g. TODA, TORA, LDA), taxiways and VFR flight procedures (e.g. traffic pattern, noise abatement) from AIP aerodome charts*	*x*	*x*	
74.3.1.3	**Departure, destination and alternate aerodromes**	**x**	**x**	
(01)	*List criteria how to select suitable aerodromes for take-off and landing and alternate aerodromes*	*x*	*x*	
(02)	*Explain for what types of flights an alternate aerodrome has to be selected*	*x*	*x*	
(03)	*Using AIP and/or NOTAM information given, determine if an aerodrome is suitable as departure, destination or alternate aerodrome*	*x*	*x*	
(04)	*Extract and interpret airport information from NOTAMs given, e.g. opening hours, work in progress (WIP), restrictions, changes of frequencies, navigation aids and facilities*	*x*	*x*	
(05)	*Check if satellite-based services are (RAIM) available during the expected time of use of NOTAMs*	*x*	*x*	
74.3.1.4	**Airway routings and airspace structure**	**x**	**x**	
(01)	*Select an appropriate altitude/FL with respect to semi-circular rules and rules-of-the-air requirements*	*x*	*x*	
(02)	*Determine from airspace classification which equipment has to be carried on a specific routing*	*x*	*x*	
(03)	*Determine from given instrumentation/equipment if a flight can be performed in certain airspaces*	*x*	*x*	
74.3.2	**Meteorological briefing**	**x**	**x**	
74.3.2.1	**Extraction and analysis of relevant data from meteorological documents**	**x**	**x**	
(01)	*State under which conditions an aircaft may be operated into known icing conditions*	*x*	*x*	
(02)	*From given RWY and ATIS/METAR information, calculate head/tail and crosswind components for take-off or landing*	*x*	*x*	
(03)	*With cloud information given by met reports (e.g. GAFOR) and given airspace structure, decide under which conditions a VFR flight can be conducted*	*x*	*x*	
(04)	*From given QNH, determine the lowest (usable) FL above a given transition altitude*	*x*	*x*	
(05)	*For given obstacle clearance and lowest QNH and ISA temperture deviation along the planned track, determine the lowest usable FL providing the required obstacle clearance*	*x*	*x*	
74.4	**ICAO flight plan (ATS flight plan)**	**x**	**x**	
74.4.1	**Individual flight plan**	**x**	**x**	

74.4.1.1	**Format of flight plan**	**x**	**x**	
(01)	*State where to find information about requirements and the format of an ATS flight plan*	*x*	*x*	
(02)	*State the maximum period of validity of an ATS flight plan*	*x*	*x*	
(03)	*Given example equipment, list the correct code for type of equipment on board to be entered into the flight plan*	*x*	*x*	
(04)	*Extract the required information for an ATS flight plan out of an operational flight plan*	*x*	*x*	
74.4.1.2	**Completion of the flight plan**	**x**	**x**	
(01)	*Define and explain the terms 'Estimated off block time (EOBT)' and 'Estimated time of arrival (ETA)'*	*x*	*x*	
(02)	*From example data given, enter or extract the required/possible entries into/from the fields of the ATS flight plan*	*x*	*x*	
(03)	*Enter the crossing of state borders into the ATS flight plan correctly*	*x*	*x*	
(04)	*Enter a suitable routing information into the ATS flight plan*	*x*	*x*	
74.4.1.3	**Submission of the flight plan**	**x**	**x**	
(01)	*Describe ways how to submit an ATS flight plan*	*x*	*x*	
(02)	*State from given examples, in which cases the submission of a flight plan is required (e.g. flight at night, IFR, crossing specific state borders)*	*x*	*x*	
(03)	*Explain why a flight plan should be submitted even in cases in which it isn't mandatory*	*x*	*x*	
(04)	*State in which timeframe before a flight an ATS flight plan needs to be submitted to ATS*	*x*	*x*	
(05)	*State the timeframe in which (after filing an ATS flight plan) ATC should be contacted*	*x*	*x*	
(06)	*Describe the actions to be taken in case an aircraft landed on an aerodrome other than stated in the ATS flight plan*	*x*	*x*	
(07)	*Describe how to postpone the 'EOBT' as submitted in the flight plan*	*x*	*x*	
74.5	**Flight monitoring and in-flight replanning**	**x**	**x**	
74.5.1	**Flight monitoring**	**x**	**x**	
74.5.1.1	**Monitoring of track and time**	**x**	**x**	
(01)	*Explain the relevance of an operational flight plan during flight planning and during flight*	*x*	*x*	
(02)	*State the reasons for possible deviations from the planned track and planned timings*	*x*	*x*	
(03)	*Using excerpts from an operational flight plan (flight log) and actual track information, determine actual wind and WCA for the remaining legs*	*x*	*x*	
(04)	*Using excerpts from an operational flight plan (flight log) and actual times given, calculate the expected times of overflight of the following waypoints*	*x*	*x*	
74.5.1.2	**In-flight fuel management**	**x**	**x**	
(01)	*Explain the relevance of monitoring planned and actual fuel used and fuel on board*	*x*	*x*	
(02)	*Using excerpts from an operational flight plan (flight log) and actual fuel amounts given, calculate the remaining fuel at the following waypoints and fuel required for the remaining track*	*x*	*x*	

(03)	*Describe actions to be taken in case the remaining fuel is not sufficient to reach the destination airport with the prescribed amount of reserve fuel*	*x*	*x*	
(04)	*Explain that remaining fuel below the minimum required amount of reserve fuel and during flight can be an emergency situation which justifies the use of a 'mayday' call*	*x*	*x*	
74.5.1.3	**In-flight re-planning in case of deviation from planned data**	**x**	**x**	
(01)	*Explain that in case of in-flight re-planning (e.g. to a new destination) all requirements concerning minimum required fuel reserves need to be observed*	*x*	*x*	
(02)	*Explain that in the case of an in-flight update, meteorological conditions on revised routing and at revised destination or alternate aerodrome needs to be observed*	*x*	*x*	

Reference	Description	PPL(A)	PPL(H)	Remarks
80	**AIRCRAFT GENERAL KNOWLEDGE**	**x**	**x**	
81	**AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT AND EMERGENCY EQUIPMENT**	**x**	**x**	
81.1	**System design, loads, stresses, maintenance**	**x**	**x**	
81.1.1	**Loads and combination loadings applied to an aircraft's structure**	**x**	**x**	
81.1.1.1	**Design concepts**	**x**	**x**	
(01)	*Explain the purpose of redundancy in aircraft design*	*x*	*x*	
(02)	*Describe the following structural design philosophy: safe life, fail-safe (multiple load paths), damage-tolerant*	*x*	*x*	
81.1.1.2	**Loads and stresses**	**x**	**x**	
(01)	*Describe the following types of loads that an aircraft may be subjected to: static loads, dynamic loads, cyclic loads*	*x*	*x*	
(02)	*Describe areas typically prone to stress that should be given particular attention during a pre-flight inspection*	*x*	*x*	
(03)	*Define the 'load factor (n)'*	*x*	*x*	
(04)	*State that there are different categories of aircraft (utility, normal, aerobatic) with different requirements regarding allowed load factors*	*x*	*x*	
(05)	*State that excessive stress can be exerted on the structure when exceeding the manoeuvring speed in heavy gusts*	*x*	*x*	
81.1.1.3	**Fatigue and corrosion**	**x**	**x**	
(01)	*Describe the effects of corrosion and how it can be detected during pre-flight inspection*	*x*	*x*	
(02)	*Explain fatigue, how it affects the useful life of an aircraft with regard to: corrosion, number of cycles, type of flight manoeuvres, quality of maintenance*	*x*	*x*	
81.1.1.4	**Maintenance**	**x**	**x**	
(01)	*Explain circumstances that required aircraft maintenence (hard-time or fixed-time maintenance, on-condition maintenance, condition monitoring)*	*x*	*x*	

(02)	*Describe dangers associated with overloading the aircraft, and state that any exceedance of maximum limit load needs to be reported*	*x*	*x*	
81.2	**Airframe**	**x**	**x**	
81.2.1	**Wings, tail surfaces and control surfaces**	**x**	**-**	
81.2.1.1	**Design and constructions**	**x**	**-**	
(01)	*Describe the following types of design and their advantages and disadvantages: high-mounted wing, low-mounted wing, low- or mid-set tailplane, T-tail*	*x*	-	
(02)	*Describe different types of constructions: grid, sandwich*	*x*	-	
(03)	*Name and identify typical parts of the wing and tail- and control surfaces*	*x*	-	
81.2.1.2	**Structural components and materials**	**x**	**-**	
(01)	*Eplain the general assembly of a wing: (main) spar, wing nose, spars, ribs, ailerons, flaps, skin or fabric cover*	*x*	-	
(02)	*State that the main spar carries the main loads resulting out of the flight*	*x*	-	
(03)	*State different types of materials for the construction of wings (e.g. sheet metal, wood, or fabric cover)*	*x*	-	
81.2.1.3	**Stresses**	**x**	**-**	
(01)	*Describe the vertical and horizontal loads on the ground and during normal flight*	*x*	-	
(02)	*Explain how to achieve stress relief by fuel-balancing during flight*	*x*	-	
(03)	*Explain the principle of flutter and resonance for the wing and control surfaces*	*x*	-	
(04)	*Describe which parts of the airframe are strained the most, and how they need to be inspected during the pre-flight check*	*x*	-	
81.2.1.4	**Structural limitations**	**x**	**-**	
(01)	*Explain that airframe life is limited by fatigue, created by alternating stress and the number of load cycles*	*x*	-	
(02)	*Describe measures to reduce stress on aircraft parts*	*x*	-	
81.2.2	**Fuselage, doors, floor, wind-screen and windows**	**x**	**x**	
81.2.2.1	**Design and constructions**	**x**	**x**	
(01)	*Describe different types of fuselage constructions: monocoque, semi-monocoque, truss*	*x*	*x*	
81.2.2.2	**Structural components and materials**	**x**	**x**	
(01)	*Describe the construction and the function of the following structural components of a fuselage: frames, bulkhead, stiffeners, stringers, longerons, skin*	*x*	*x*	
(02)	*State out of which materials aircraft windshields are made and how they should be treated*	*x*	*x*	
81.2.2.3	**Stresses**	**x**	**x**	
(01)	*Describe the structural danger of a hard or nose-wheel landing with respect to: fuselage loads, nose-wheel strut loads*	*x*	*x*	

81.2.2.4	**Structural limitations**	**x**	**x**	
(01)	*Explain the floor load limits with regard to maximum load and maximum load per area*	*x*	*x*	
81.3	**Hydraulics**	**x**	**x**	
81.3.1	**Hydromechanics**	**x**	**x**	
81.3.1.1	**Basic principles**	**x**	**x**	
(01)	*Explain the concept and basic principles of hydromechanics*	*x*	*x*	
(02)	*Explain the relationship between pressure, force and area*	*x*	*x*	
81.3.2	**Hydraulic systems**	**x**	**x**	
81.3.2.1	**Hydraulic fluids: types and characteristics, limitations**	**x**	**x**	
(01)	*Describe the desirable properties of a hydraulic fluid*	*x*	*x*	
(02)	*State that hydraulic fluids are irritating to skin and eyes*	*x*	*x*	
(03)	*List the two different types of hydraulic fluids: synthetic and mineral, and state that they must not be mixed*	*x*	*x*	
(04)	*Describe how to check for a possible spill of fluids, such as brake (hydraulic) fluid, during the pre-flight check*	*x*	*x*	
81.3.2.2	**System components: design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Explain the working principle of a hydraulic system*	*x*	*x*	
(02)	*List typical aircraft systems that make use of hydraulic systems*	*x*	*x*	
(03)	*List and describe the instruments and alerts for monitoring a hydraulic system*	*x*	*x*	
81.4	**Landing gear, wheels, tyres and brakes**	**x**	**x**	
81.4.1	**Landing gear**	**x**	**x**	
81.4.1.1	**Types and materials, and operation**	**x**	**x**	
(01)	*Name different landing-gear configurations: nose wheel, tail wheel, skid (helicopter)*	*x*	*x*	
(02)	*Name and identify the components of a landing gear, and describe their functions*	*x*	*x*	
(03)	*State that ground stearing is usually actuated via rudder pedals*	*x*	*x*	
(04)	*Describe how landing-gear position indication and alerting is implemented*	*x*	*x*	
(05)	*Explain the speed limitations for gear operation: VLO (maximum landing gear operating speed) and VLE (maximum landing gear extended speed)*	*x*	*x*	
(06)	*Describe methods for emergency gear extension*	*x*	*x*	
(07)	*State that the main weight is carried by the main landing gear and that nose wheel/tail wheel only carry a small a small portion of the weight*	*x*	*x*	
81.4.2	**Nose wheel steering**	**x**	**-**	
81.4.2.1	**Design and operation**	**x**	**-**	
(01)	*Explain the operating principle of nose wheel steering*	*x*	-	

(02)	*Define the term 'shimmy' and the possible consequences of shimmy for the nose- and the main-wheel system*	*x*	-	
(03)	*Explain the purpose of a shimmy damper to reduce the severity of shimmy*	*x*	-	
(04)	*Describe possible hazards in case of landing on the nose gear*	*x*	-	
(05)	*State which flight errors might lead to a landing on the nose gear*	*x*	-	
81.4.3	**Brakes**	**x**	**x**	
81.4.3.1	**Types and materials**	**x**	**x**	
(01)	*Describe the basic operating principle of a disc brake*	*x*	*x*	
81.4.3.2	**System components: design, operation, indications and warnings**	**x**	**x**	
(01)	*Describe how brake force is transmitted (machanically or hydraulically) from the pedals to the brakes*	*x*	*x*	
(02)	*State that brakes are only applied to the main gear, and that differential braking can be used for stearing*	*x*	*x*	
(03)	*Describe the function of the parking brake*	*x*	*x*	
(04)	*State that on some airports, aircraft should be parked without the brakes set, secured by chocks*	*x*	*x*	
81.4.4	**Wheels and tyres**	**x**	**x**	
81.4.4.1	**Types and operational limitations**	**x**	**x**	
(01)	*State that general aviation aircraft are usually equipped with wheels comprising tyre, wheel rim and a tube*	*x*	*x*	
(02)	*Describe possible damages in which cases a tyre can no longer be used (e.g. larger delamination, heavy wear)*	*x*	*x*	
(03)	*Describe and recognize tyre creep marks and name their function*	*x*	*x*	
81.4.5	**Helicopter equipments**	**-**	**x**	
81.4.5.1	**Flotation devices**	**-**	**x**	
(01)	*Explain flotation devices, how they are operated, and their limitation*	-	*x*	
(02)	*Explain why indicated airspeed (IAS) limitations before, during and after flotation-device deployment must be observed*	-	*x*	
81.4.5.2	**Skid-shoe landing gear**	**-**	**x**	
(01)	*Describe measures to reduce wear on skid-shoe landing gear*	-	*x*	
81.5	**Flight controls**	**x**	**x**	
81.5.1	**Aeroplane: primary flight controls**	**x**	**-**	
81.5.1.1	**Definition and control surfaces**	**x**	**-**	
(01)	*Define a 'primary flight control'*	*x*	-	
(02)	*List the following as primary flight control surfaces: elevator, aileron, rudder*	*x*	-	
81.5.1.2	**Control systems and mechanical**	**x**	**-**	
(01)	*Explain the basic principle of a fully manual control system*	*x*	-	
(02)	*State which control surfaces initiates rotation around which axis, and how these movements are called ('roll' / 'pitch' / 'yaw')*	*x*	-	
81.5.1.3	**System components: design, operation, indications and warnings, degraded modes of operation and jamming**	**x**	**-**	

(01)	*Explain the danger of control jamming*	*x*	-	
(02)	*Explain the methods of locking the controls on the ground and describe 'gust or control lock' warnings*	*x*	-	
81.5.2	**Aeroplane: secondary flight controls**	**x**	**-**	
81.5.2.1	**System components: design, operation, degraded modes of operation, indications and warnings**	**x**	**-**	
(01)	*Define 'secondary flight controls' and describe their purpose*	*x*	-	
(02)	*List the following as secondary flight control surfaces: flaps, trimming devices (trim tabs), leading edge devices, spoilers or speedbrakes*	*x*	-	
(03)	*Describe the movement of trim tabs to achieve a required rudder deflection for trim*	*x*	-	
(04)	*Describe the operation of 'balance tabs'*	*x*	-	
(05)	*Describe the requirement for limiting flight speeds for various secondary flight control surfaces*	*x*	-	
81.5.3	**Helicopter: flight controls**	**-**	**x**	
81.5.3.1	**Droop stops, control systems, trim systems, control stops**	**-**	**x**	
(01)	*Explain the methods of locking the controls on the ground*	-	*x*	
(02)	*Explain the principle of phase lag and advance angle*	-	*x*	
(03)	*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*	
(04)	*Describe and explain the purpose of a trim system*	-	*x*	
(05)	*Explain the use of control stops*	-	*x*	
81.6	**Anti-icing systems**	**x**	**x**	
81.6.1	**Concept, types and operation (pitot and windshield)**	**x**	**x**	
81.6.1.1	**Concept and general considerations**	**x**	**x**	
(01)	*Explain the concept of 'clean aircraft'*	*x*	*x*	
(02)	*Explain the concepts of anti-icing and de-icing*	*x*	*x*	
(03)	*State that any ice accretion on the airframe results in undefined operational limits must be prevented*	*x*	*x*	
(04)	*Explain the effect of ice accretion on drag, wing lift, mass and available power*	*x*	*x*	
(05)	*Name the components of an aircraft that can be protected from ice accretion*	*x*	*x*	
(06)	*State that any aircraft may only be operating in icing conditions if explicitly permitted by the AFM/POH*	*x*	*x*	
81.6.1.2	**Pitot**	**x**	**x**	
(01)	*Describe possible hazards resulting from ice on sensors of the pitot-static system*	*x*	*x*	
(02)	*Explain the operating principle of a pitot-heating system*	*x*	*x*	
(03)	*Name situations when pitot-heat system should be switched on*	*x*	*x*	
81.6.1.3	**Windshield**	**x**	**x**	

(01)	*Describe possible hazards resulting from ice on the wind shield*	*x*	*x*	
(02)	*Explain the operating principle of a windshield de-ice system using fluids*	*x*	*x*	
81.6.1.4	**Propeller**	**x**	**x**	
(01)	*Describe possible hazards resulting from ice accretion on the propeller*	*x*	*x*	
(02)	*Explain the operating principle of an electrical propeller de-ice system and its limitations*	*x*	*x*	
81.7	**Fuel system**	**x**	**x**	
81.7.1	**Piston engine**	**x**	**x**	
81.7.1.1	**System components: design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*State the types of fuel used by a piston engine: AVGAS, MOGAS, Diesel*	*x*	*x*	
(02)	*Describe a gravity fuel feed system and a pressure feed fuel system*	*x*	*x*	
(03)	*Name the main components of a fuel system, and state their function: lines, boost pump, pressure valves, filter, strainer, tanks (wing, tip, fuselage), vent system, sump, drain, fuel-quantity sensor*	*x*	*x*	
(04)	*Explain the function of 'cross-feed'*	*x*	*x*	
(05)	*Explain the term 'unusable fuel'*	*x*	*x*	
(06)	*Explain the reasons and situations for 'draining' the fuel tanks*	*x*	*x*	
81.7.2	**Turbine engine (helicopter)**	**-**	**x**	
81.7.2.1	**System components: design, operation, degraded modes of operation, indications and warnings**	**-**	**x**	
(01)	*State the types of fuel used by a gas turbine engine: JET-A, JET-A1, JET-B*	-	*x*	
(02)	*State the existence of additives for freezing*	-	*x*	
(03)	*Name the main components of the fuel system and state their location and their function: trim fuel tanks, bafflers, refuelling/defueling system*	-	*x*	
(04)	*Explain the limitations in the event of loss of booster pump fuel pressure*	-	*x*	
81.8	**Electrics**	**x**	**x**	
81.8.1	**Electrics: general and definitions**	**x**	**x**	
81.8.1.1	**Direct current: voltage, current, resistance, conductivity, Ohm's law, power and work**	**x**	**x**	
(01)	*Explain the term 'direct current' (DC), and state that current can only flow in a closed circuit*	*x*	*x*	
(02)	*Define 'voltage', 'current' and 'resistance', and state their unit of measurement*	*x*	*x*	
(03)	*Explain Ohm's law in qualitative terms*	*x*	*x*	
(04)	*Define 'electrical power' and state the unit of measurement*	*x*	*x*	
81.8.1.2	**Alternating current: voltage, current, amplitude, phase, frequency and resistance**	**x**	**x**	
(01)	*Explain the term 'alternating current' (AC), and compare its use to DC with regard to complexity*	*x*	*x*	

(02)	*Define 'frequency' and state the unit of measurement*	*x*	*x*	
81.8.1.3	**Circuits: series and parallel**	**x**	**x**	
(01)	*Explain a short circuit in practical terms using Ohm's Law, power and energy, highlighting the risk of fire due to extreme energy dissipation*	*x*	*x*	
81.8.1.4	**Magnetic field: effects in an electrical circuit**	**x**	**x**	
(01)	*State that an electrical current produces a magnetic field*	*x*	*x*	
(02)	*Describe how the strength of the magnetic field changes with the magnitude of the current*	*x*	*x*	
(03)	*Explain the principle of electromagnetic induction and how two electrical components or systems may affect each other*	*x*	*x*	
81.8.2	**Batteries**	**x**	**x**	
81.8.2.1	**Types, characteristics and limitations**	**x**	**x**	
(01)	*Explain the function of an aircraft battery*	*x*	*x*	
(02)	*Describe the effect of temperature on battery capacity and performance*	*x*	*x*	
(03)	*State that in the case of loss of all generated power (battery power only) the remaining electrical power is time-limited*	*x*	*x*	
81.8.2.2	**Battery chargers, characteristics and limitations**	**x**	**x**	
(01)	*Define the term 'capacity of batteries' and state the unit of measurement*	*x*	*x*	
(02)	*Explain the difference between 'battery voltage' and 'charging voltage'*	*x*	*x*	
81.8.3	**Static electricity: general**	**x**	**x**	
81.8.3.1	**Basic principles**	**x**	**x**	
(01)	*Explain static electricity, and describe the flying conditions where aircraft are most susceptible to build-up of static electricity*	*x*	*x*	
(02)	*Explain why an aircraft must first be grounded before refuelling*	*x*	*x*	
81.8.3.2	**Static dischargers**	**x**	**x**	
(01)	*Describe a static discharger and explain its purpose, typical locations and check during pre-flight inspection*	*x*	*x*	
81.8.4	**Generation: production, distribution and use**	**x**	**x**	
	Remark: For standardisation purposes, the following standard expressions are used: - DC generator: produces DC output - DC alternator: produces AC, rectified by integrated rectifying unit, output is DC - AC alternator: producing a DC output by using a rectifier - AC generator: produces AC output	x	x	
81.8.4.1	**DC generation: types, design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Describe the basic working principle of a simple DC generator or DC alternator*	*x*	*x*	
81.8.4.2	**AC generation: types, design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	

(01)	*Describe the working principle of a brushless three-phase AC generator*	*x*	*x*	
(02)	*State the relationship between output frequency and RPM of a three-phase AC generator*	*x*	*x*	
81.8.5	**Electric components**	**x**	**x**	
81.8.5.1	**Basic elements: basic principles of switches, circuit-breakers and relays**	**x**	**x**	
(01)	*Explain the working principle of a fuse and a circuit breaker*	*x*	*x*	
(02)	*Describe under which conditions circuit breakers may be used to reset aircraft systems in the event of system failure*	*x*	*x*	
(03)	*Explain the hazards of multiple resets of a circuit breaker, or the use of incorrect fuse rating when replacing blown fuses*	*x*	*x*	
81.8.6	**Distribution**	**x**	**x**	
81.8.6.1	**General:**	**x**	**x**	
	(a) bus bar, common earth and priority	**x**	**x**	
(01)	*State that the generator is driven by the engine*	*x*	*x*	
(02)	*Explain that at the same time, the generator re-loads the battery and powers the electrical loads of the airplane*	*x*	*x*	
(03)	*Describe a simple DC electrical system of a single-engine aircraft*	*x*	*x*	
(04)	*Give examples of DC consumers*	*x*	*x*	
(05)	*Interpret various different ammeter indications of an ammeter which monitors the charge current of the battery*	*x*	*x*	
(06)	*List instruments that may be affected by loss of electrical power*	*x*	*x*	
81.9	**Piston Engines**	**x**	**x**	
81.9.1	**General**	**x**	**x**	
81.9.1.1	**Types of internal combustion engine: basic principles and definitions**	**x**	**x**	
(01)	*Name and identify the various types of engine design with regard to cylinder arrangement*	*x*	*x*	
81.9.1.2	**Engine: design, operation, components and materials**	**x**	**x**	
(01)	*Explain the general operating principle of a 4-stroke piston engine, and explain the cycles intake, compression, power and exhaust*	*x*	*x*	
(02)	*Name and identify the basic components of a piston engine: crankshaft, piston, cylinder, valves*	*x*	*x*	
(03)	*Describe the differences between petrol engines and diesel engines with regard to means of ignition and regulating air or mixture supply to the cylinder*	*x*	*x*	
81.9.2	**Fuel**	**x**	**x**	
81.9.2.1	**Types, grades, characteristics and limitations**	**x**	**x**	
(01)	*Name the type of fuel used for petrol engines: AVGAS 100 (green), 100LL (blue)*	*x*	*x*	
(02)	*Define the term 'octane rating'*	*x*	*x*	
(03)	*Identify the conditions and power settings leading to 'detonation' for petrol engines*	*x*	*x*	

(04)	*State the typical values of fuel density for aviation gasoline: AVGAS approx. 0.72 kg/liter*	*x*	*x*	
(05)	*Calculate volume (liters) from masses (kg or lbs) and vice versa for AVGAS*	*x*	*x*	
81.9.2.2	**Alternate fuel: characteristics and limitations**	**x**	**x**	
(01)	*Describe the differences of AVGAS and MOGAS with regard to lead and ethanol content*	*x*	*x*	
(02)	*State that any use of alternative fuel must be explicitly permitted by the AFM/POH*	*x*	*x*	
(03)	*Name the type of fuel normally used for aviation diesel engines (JET-A1)*	*x*	*x*	
(04)	*State the typical value of fuel density for diesel fuel*	*x*	*x*	
(05)	*Calculate volume (liters) from masses (kg or lbs) and vice versa for diesel fuel*	*x*	*x*	
81.9.3	**Carburettor or injection system**	**x**	**x**	
81.9.3.1	**Carburettor: design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Describe the purpose and the operating principle of a simple float chamber carburettor*	*x*	*x*	
(02)	*Explain the purpose and the operating principle of a primer pump*	*x*	*x*	
(03)	*Explain the danger of carburettor fire, including corrective measures*	*x*	*x*	
81.9.3.2	**Injection: design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Explain the advantages and difference in operation of an injection system compared with a carburettor system*	*x*	*x*	
81.9.3.3	**Icing**	**x**	**x**	
	Carburettor	**x**	**x**	
(01)	*Name the meteorological conditions under which carburettor icing may occur*	*x*	*x*	
(02)	*Describe the causes and effects of carburettor icing, and actions to be taken if carburettor icing is suspected*	*x*	*x*	
(03)	*Describe the indications for carburettor icing*	*x*	*x*	
(04)	*Describe the changes in RPM/power when switching on/off carburetter heating*	*x*	*x*	
(05)	*Describe measures to compensate for power loss by switching on carburettor heat*	-	*x*	
(06)	*State that with some engines the pre-heated air for the carburettor will not be filtered*	*x*	*x*	
(07)	*Describe situations when carburettor heat must be OFF*	*x*	*x*	
	Injection systems	**x**	**x**	
(08)	*Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle*	*x*	*x*	
(09)	*State the meteorological conditions under which induction system icing may occur*	*x*	*x*	

81.9.4	**Air cooling systems**	**x**	**x**	
81.9.4.1	**Design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Describe the design features to enhance cylinder air cooling for aeroplanes*	*x*	-	
(02)	*Describe the design features to enhance cylinder air cooling for helicopters*	-	*x*	
(03)	*Name the cylinder head temperature indication to monitor engine cooling*	*x*	*x*	
(04)	*Explain possible consequences that a sudden descent with little power can have on an air cooled engine (rapid cooling)*	*x*	*x*	
(05)	*Explain possible consequences of taxiing or standing on the ground with a running engine which is air-cooled*	*x*	*x*	
81.9.4.2	**Differences to liquid-cooling systems**	**x**	**x**	
(01)	*Describe the design and function of liquid cooling for aeroplanes*	*x*	*x*	
(02)	*Describe the differences with liquid cooling system compared to air cooling systems*	*x*	*x*	
81.9.5	**Lubrication systems**	**x**	**x**	
81.9.5.1	**Lubricants: types, characteristics and limitations**	**x**	**x**	
(01)	*Describe the term 'viscosity', and describe how it is affected by temperature*	*x*	*x*	
(02)	*Describe the viscosity grade numbering system used in aviation*	*x*	*x*	
81.9.5.2	**Design, operation, degraded modes of operation, indications and warnings**	**x**	**x**	
(01)	*Describe the purpose and working principle of a lubrication system, and describe the functions of its components: oil tank (reservoir), check valve, pressure pump, filters, bypass*	*x*	*x*	
(02)	*List factors that may affect oil consumption: oil grade, cylinder and piston wear, condition of piston rings*	*x*	*x*	
(03)	*Describe the relationsship between oil pressure, oil temperature and oil quantity*	*x*	*x*	
(04)	*Describe actions to be taken in case of oil pressure drop*	*x*	*x*	
(05)	*Describe the difference in design and operation of a wet- and dry sump-lubrication system*	*x*	*x*	
81.9.6	**Ignition circuits**	**x**	**x**	
81.9.6.1	**Design, operation, degraded modes of operation**	**x**	**x**	
(01)	*Describe the working principle of a magneto-ignition system*	*x*	*x*	
(02)	*Explain why piston engines are equipped with two electrically independent ignition systems*	*x*	*x*	
(03)	*Describe the purpose and function of the 'magneto check'*	*x*	*x*	
(04)	*Explain how combustion is initiated in diesel engines*	*x*	*x*	
(05)	*State that ignition can be made electronically*	*x*	*x*	
(06)	*Explain why dieselengines do not need an ignition system*	*x*	*x*	
81.9.7	**Mixture**	**x**	**x**	
81.9.7.1	**Definition, characteristic mixtures, control instruments, associated control levers and indications**	**x**	**x**	

(01)	*Define the following terms: mixture, chemically correct ratio, best power, lean (weak) mixture, rich mixture*	*x*	*x*	
(02)	*Describe the advantages and disadvantages of weak and rich mixtures*	*x*	*x*	
(03)	*Explain and use the procedure of 'leaning' the mixture in relation to the EGT gauge*	*x*	*x*	
(04)	*Explain how to shut down an petrol engine*	*x*	*x*	
(05)	*Explain the absence of mixture control in diesel engines*	*x*	*x*	
81.9.8	**Propellers**	**x**	**-**	
81.9.8.1	**Constant speed propeller: design, operation and system components**	**x**	**-**	
(01)	*State the advantages, and describe the operating principle of a constant-speed propeller system*	*x*	-	
81.9.8.2	**Propeller handling: associated control levers, degraded modes of operation, indications and warnings**	**x**	**-**	
(01)	*Explain the terms 'RPM', 'torque' and 'manifold absolute pressure (MAP)' and their relationships*	*x*	*x*	
(02)	*Describe the propeller controls: power lever (black) and prop lever (blue)*	*x*	*x*	
(03)	*State the correct procedures for setting the engine controls when increasing or decreasing power (using power lever and prop lever)*	*x*	-	
81.9.9	**Performance and engine handling**	**x**	**x**	
81.9.9.1	**Performance: influence of engine parameters, influence of atmospheric conditions, limitations and power augmentation systems**	**x**	**x**	
(01)	*Describe the effect on power output of an piston engine taking into consideration: ambient pressure, temperature, density altitude*	*x*	*x*	
(02)	*Explain the term 'normally aspirated engine'*	*x*	*x*	
(03)	*Explain the requirement for power augmentation (turbocharging) of a piston engine*	*x*	*x*	
81.9.9.2	**Engine handling: power and mixture settings during various flight phases and operational limitations**	**x**	**x**	
(01)	*Explain reasons for a rough engine run, and state possible corrective actions*	*x*	*x*	
81.9.9.3	**Engine handling: Single Level Power Control (SLPC)**	**x**	**-**	
(01)	*State that SLPC requires a computer management system controlling the engine and propeller parameters*	*x*	-	
(02)	*Describe the procedures with SLPC for engine start and shut-off*	*x*	-	
(03)	*Describe the procedures for engine checks with SLPC prior to take-off*	*x*	-	
(04)	*Describe the procedures with SLPC for different phases of flight (climb, cruise, descent)*	*x*	-	
(05)	*Describe the procedures with SLPC to apply in engine failure situations*	*x*	-	
(06)	*State the requirement for differences training before operating aeroplanes with SLPC*	*x*	-	

81.10	**Turbine engines**	**-**	**x**	
81.10.1	**Definitions**	**-**	**x**	
81.10.1.1	**Coupled turbine engine: design, operation, components and materials**	**-**	**x**	
(01)	*Name the main assembly parts of a coupled turbine engine and explain its operation*	-	*x*	
(02)	*Explain the limitations of the materials used with regard to maximum turbine temperature, engine and drive train torque limits*	-	*x*	
81.10.1.2	**Free turbine engine: design, operation, components and materials**	**-**	**x**	
(01)	*Describe the design methods to keep the engine's size small for installation in helicopters*	-	*x*	
(02)	*List the main components of a free-turbine engine*	-	*x*	
(03)	*Describe how the power is developed by a turboshaft/free-turbine engine*	-	*x*	
81.10.2	**Main engine components**	**-**	**x**	
81.10.2.1	**Compressor:** **(a) types, design, operation, components and materials** **(b) stresses and limitations** **(c) stall, surge and means of prevention**	**-**	**x**	
(01)	*State the purpose of the compressor*	-	*x*	
(02)	*Describe the working principle of a centrifugal and an axial flow compressor*	-	*x*	
(03)	*State the reason for the clicking noise whilst the compressor slowly rotates on the ground*	-	*x*	
(04)	*Explain the following terms: 'compressor stall', 'engine surge'*	-	*x*	
(05)	*Describe the indications of stall and surge*	-	*x*	
81.10.2.2	**Combustion chamber:** **(a) types, design, operation, components and materials** **(b) stresses and limitations** **(c) emission problems**	**-**	**x**	
(01)	*Explain the purpose of the combustion chamber*	-	*x*	
(02)	*Describe the working principle of a combustion chamber*	-	*x*	
(03)	*State a typical maximum value of the outlet temperature of the combustion chamber*	-	*x*	
81.10.2.3	**Turbine:** **(a) types, design, operation, components and materials** **(b) stresses, creep and limitations**	**-**	**x**	
(01)	*Explain the purpose of a turbine in different types of gas turbine engines*	-	*x*	
(02)	*Name the main components of a turbine stage and their function*	-	*x*	
(03)	*Describe the high mechanical thermal stress in the turbine blades and wheels/discs*	-	*x*	

81.10.2.4	**Exhaust:** **(a) design, operation and materials** **(b) noise reduction**	**-**	**x**	
(01)	*Describe the working principle of the exhaust unit*	-	*x*	
81.10.2.5	**Fuel control units: types, operation and sensors**	**-**	**x**	
(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*	-	*x*	
(02)	*State the tasks of the fuel control unit*	-	*x*	
81.10.2.6	**Helicopter air intake: different types, design, operation, materials and optional equipments**	**-**	**x**	
(01)	*Name and explain the main task of the engine air intake*	-	*x*	
(02)	*Describe the use of a convergent air-intake ducting on helicopters*	-	*x*	
(03)	*Describe the function of the heated pads on some helicopter air intakes*	-	*x*	
81.10.3	**Additional components and systems**	**-**	**x**	
81.10.3.1	**Helicopter additional components and systems: lubrication system, ignition circuit, starter, accessory gearbox, free wheel units: design, operation and components**	**-**	**x**	
	Lubrication system	**-**	**x**	
(01)	*State the task of the lubrication system*	-	*x*	
(02)	*Name the main components of a helicopter lubrication system: reservoir, pump assembly, external oil filter, chip detectors, thermostatic oil coolers, breather*	-	*x*	
(03)	*Identify the indications used to monitor a lubrication system including warning systems*	-	*x*	
	Accessory gearbox	**-**	**x**	
(04)	*State the tasks of the auxiliary gearbox*	-	*x*	
	Ignition circuit	**-**	**x**	
(05)	*State the task of the ignition system*	-	*x*	
(06)	*Name the main components of the ignition system and state their function: power sources, igniters*	-	*x*	
(07)	*Explain the different modes of operation of the ignition system*	-	*x*	
	Starter	**-**	**x**	
(08)	*Explain the principle of a turbine engine start*	-	*x*	
(09	*Name the main components of the starting system and state their function*	-	*x*	
(10)	*Explain the term 'self-sustaining RPM'*	-	*x*	
(11)	*Describe the indications and the possible causes of helicopter starting malfunctions: false (dry or wet) start, tailpipe fire (torching), hot start, abortive (hung) start, no N1 rotation, freewheel failure*	-	*x*	
81.10.4	**Performance aspects**	**-**	**x**	

81.10.4.1	**Torque, performance aspects, engine handling and limitations:** **(a) engine ratings** **(b) engine performance and limitations** **(c) engine handling**	**-**	**x**	
(01)	*Describe engine rating torque limits for take-off, transient and maximum continuous*	-	*x*	
(02)	*Explain why TOT is a limiting factor for helicopter performance*	-	*x*	
(03)	*Describe and explain the relationship between maximum torque available and density altitude*	-	*x*	
(04)	*Describe overtorquing and explain the consequences*	-	*x*	
81.11	**Protection and detection systems**	**-**	**x**	
81.11.1	**Fire detection systems**	**-**	**x**	
81.11.1.1	**Operation and indications**	**-**	**x**	
(01)	*Explain the following principles of fire detection: resistance and capacitance, gas pressure*	-	*x*	
(02)	*Give an example of warnings, indications and function tests of a fire-protection system*	-	*x*	
81.12	**Rotor heads**	**-**	**x**	
81.12.1	**Main rotor**	**-**	**x**	
81.12.1.1	**Types**	**-**	**x**	
(01)	*Describe the following rotor-head systems: teetering (semi-articulated), articulated, hingeless (rigid), bearingless (semi-articulated)*	-	*x*	
(02)	*Describe in basic terms the following configuration of rotor systems: tandem, coaxial, side by side*	-	*x*	
(03)	*Explain how flapping, dragging and feathering is achieved in each rotor-head system*	-	*x*	
81.12.1.2	**Structural components and materials, stresses and structural limitations**	**-**	**x**	
(01)	*Identify from a diagram the main structural components of the main types of rotor-head systems*	-	*x*	
(02)	*List and describe the methods used to detect damage and cracks*	-	*x*	
81.12.1.3	**Design and construction**	**-**	**x**	
(01)	*Describe the technology used in rotor-head design: composites, fibreglass, alloys, elastomers*	-	*x*	
81.12.1.4	**Adjustment**	**-**	**x**	
(01)	*Describe and explain the methods of adjustment which are possible on various helicopter rotor-head assemblies*	-	*x*	
81.12.2	**Tail rotor**	**-**	**x**	
81.12.2.1	**Types**	**-**	**x**	
(01)	*Explain the requirement for a tail rotor and its function*	-	*x*	
(02)	*Describe different types of tail-rotor systems and their advantages*	-	*x*	
(03)	*Identify from a diagram the main structural components of tail-rotor systems*	-	*x*	

(04)	*Explain and describe the methods to detect damage and cracks on the tail rotor and assembly*	-	*x*	
81.12.2.2	**Structural components and materials, stresses and structural limitations**	**-**	**x**	
(01)	*Explain pitch-input mechanisms*	-	*x*	
81.12.2.3	**Design and construction**	**-**	**x**	
(01)	*List and describe various tail-rotor designs and construction methods used on helicopters*	-	*x*	
81.13	**Transmission**	**-**	**x**	
81.13.1	**Main gear box**	**-**	**x**	
81.13.1.1	**Different types, design, operation and limitations**	**-**	**x**	
(01)	*Describe the main principles of helicopter transmission systems and ist limitations: 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*	
81.13.2	**Rotor brake**	**-**	**x**	
81.13.2.1	**Different types, design, operation and limitations**	**-**	**x**	
(01)	*Describe the main function and usage of the disc type of rotor brake*	-	*x*	
(02)	*Describe hydraulic- and cable-operated rotor-brake systems*	-	*x*	
81.13.3	**Auxiliary systems**	**-**	**x**	
81.13.3.1	**Design, operation and limitations**	**-**	**x**	
(01)	*Explain how power for the air-conditioning system is taken from the auxiliary gearbox*	-	*x*	
81.13.4	**Drive shaft and associated installation**	**-**	**x**	
81.13.4.1	**Design, operation and limitations**	**-**	**x**	
(01)	*Describe how power is transmitted from the engine to the main-rotor gearbox*	-	*x*	
(02)	*Describe the material and construction of the driveshaft*	-	*x*	
(03)	*Explain the relationship between driveshaft speed and torque*	-	*x*	
(04)	*Describe the methods with which power is delivered to the tail rotor*	-	*x*	
81.13.5	**Intermediate and tail gear box**	**-**	**x**	
81.13.5.1	**Different types, design, operation and limitations**	**-**	**x**	
(01)	*Describe various arrangements when the drive changes direction and the need for an intermediate or tail gearbox*	-	*x*	
(02)	*Explain how on most helicopters the tail-rotor gearbox contains gearing, etc., for the tail-rotor pitch-change mechanism*	-	*x*	
81.14	**Blades**	**-**	**x**	
81.14.1	**Main rotor blade**	**-**	**x**	
81.14.1.1	**Design and construction**	**-**	**x**	
(01)	*Describe the different types of blade construction and the need for torsional stiffness*	-	*x*	
(02)	*State the advantages of a hingeless rotor*	-	*x*	

(03)	*Describe and explain the use of blade twist*	-	*x*	
81.14.1.2	**Structural components and materials**	**-**	**x**	
(01)	*List the materials used in the construction of main-rotor blades*	-	*x*	
(02)	*List the main structural components of a main-rotor blade and their function*	-	*x*	
81.14.1.3	**Stresses**	**-**	**x**	
(01)	*Describe main-rotor blade-loading on the ground and in flight*	-	*x*	
(02)	*Describe where the most common stress areas are on rotor blades*	-	*x*	
(03)	*Explain the upper limit of the rotor RPM by centrifugal forces pulling on the blade's attachment to the hub*	-	*x*	
(04)	*Explain how use of flapping hinges or flexible element in the hingeless rotor can reduce oscillating bending moments*	-	*x*	
81.14.1.4	**Structural limitations**	**-**	**x**	
(01)	*Explain the structural limitations in terms of bending and rotor RPM*	-	*x*	
81.14.1.5	**Adjustment**	**-**	**x**	
(01)	*Explain how the pitch angle of the rotor blades can be adjusted*	-	*x*	
(02)	*Explain the use of trim tabs*	-	*x*	
81.14.1.6	**Tip shape**	**-**	**x**	
(01)	*Describe the different blade-tip shapes, and compare their advantages and disadvantages*	-	*x*	
81.14.2	**Tail rotor blade**	**-**	**x**	
81.14.2.1	**Design and construction**	**-**	**x**	
(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*	
(02)	*Describe the two-bladed rotor with a teetering hinge, and rotors with more than two blades*	-	*x*	
(03)	*Describe the dangers to ground personnel and to the rotor blades, and how to minimise these dangers*	-	*x*	
(04)	*Describe measures to reduce noise produced by the tail rotor*	-	*x*	
81.14.2.2	**Stresses, vibrations and balancing**	**-**	**x**	
(01)	*Describe the tail-rotor blade-loading on the ground and in flight*	-	*x*	
(02)	*Explain the sources of vibration of the tail rotor and the resulting high frequencies*	-	*x*	
81.14.2.3	**Structural limitations**	**-**	**x**	
(01)	*Describe the structural limitations of the tail-rotor blades*	-	*x*	
(02)	*Describe the method of checking the strike indicators on the tip of some tail-rotor blades*	-	*x*	
81.14.2.4	**Adjustment**	**-**	**x**	
(01)	*Describe the adjustment of yaw pedals in the cockpit to obtain full-control authority of the tail rotor*	-	*x*	
82	**INSTRUMENTATION**	**x**	**x**	
82.1	**Instrument and indication systems**	**x**	**x**	

82.1.1	**Pressure gauge**	**x**	**x**	
82.1.1.1	**Different types, design, operation, characteristics and accuracy**	**x**	**x**	
(01)	*List the units used for pressure measurement: Pascal, bar, inches of mercury (in Hg), pounds per square inch (psi)*	*x*	*x*	
(02)	*Identify pressure measurements applicable to general aviation aircrafts: air pressure (pitot-static), liquid-pressure measurement (fuel, oil, hydraulic), engine-pressure measurement manifold pressure (MAP)*	*x*	*x*	
82.1.2	**Temperature sensing**	**x**	**x**	
82.1.2.1	**Different types, design, operation, characteristics and accuracy**	**x**	**x**	
(01)	*List the units used in aviation for temperature measurement: Kelvin, Celsius, Fahrenheit*	*x*	*x*	
(02)	*Identify temperature measurements that are applicable to general aviation aircrafts: gas temperature measurement (ambient air, exhaust gas), liquid-temperature measurement (fuel, oil, hydraulic)*	*x*	*x*	
82.1.3	**Fuel gauge**	**x**	**x**	
82.1.3.1	**Different types, design, operation, characteristics and accuracy**	**x**	**x**	
(01)	*State that the quantity of fuel is usually measured by capacitance (by volume)*	*x*	*x*	
(02)	*List the following units used for fuel quantity: kilogramme; pound, litres, gallons (US and imperial)*	*x*	*x*	
(02)	*Convert between the various units of fuel quantity*	*x*	*x*	
(03)	*Explain the parameters that can affect the measurement of the volume or mass of the fuel in a fuel tank: temperature, aircraft attitudes*	*x*	*x*	
(04)	*State that an fuel indication of 'zero' means the remaining fuel in the tank is equal to the 'unusable fuel'*	*x*	*x*	
(05)	*Describe a typical post-refuelling procedure: 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*	*x*	*x*	
82.1.4	**Flow meter**	**x**	**x**	
82.1.4.1	**Different types, design, operation, characteristics and accuracy**	**x**	**x**	
(01)	*Define 'fuel flow' and how it is measured*	*x*	*x*	
(02)	*List the units used for fuel flow when measured by mass per hour: kilogrammes/hour, pounds/hour*	*x*	*x*	
(03)	*List the units used for fuel flow when measured by volume per hour: litres/hour, imperial gallons/hour, US gallons/hour*	*x*	*x*	
82.1.5	**Torque meter**	**-**	**x**	
82.1.5.1	**Different types, design, operation, characteristics and accuracy**	**-**	**x**	
(01)	*Define 'torque', and state the units used for torque: Newton meters, inch or foot pounds*	-	*x*	
(02)	*Explain the relationship between power, torque and RPM*	-	*x*	
(03)	*Give examples of display*	-	*x*	
82.1.6	**Tachometer**	**x**	**x**	

82.1.6.1	**Different types, design, operation, characteristics and accuracy**	**x**	**x**	
(01)	*State where tachometers are used in general aviation aircraft*	*x*	*x*	
(02)	*Describe the operating principle of tachometers: mechanical, electrical (or electronic), and state that some types require electrical power to provide an indication*	*x*	*x*	
(03)	*State the typical units for engine speed: RPM for piston-engine aircraft*	*x*	*x*	
(04)	*State the typical units for engine speed: percentage for turbine-engine aircraft*	-	*x*	
(05)	*Describe actions to be taken in case rotor RPM indicator fails*	-	*x*	
82.2	**Measurement of aerodynamic parameters**	**x**	**x**	
82.2.1	**Pressure measurement**	**x**	**x**	
82.2.1.1	**Static pressure, dynamic pressure, density and definitions**	**x**	**x**	
(01)	*Define the following pressure measurements and describe their relationship: 'static pressure', 'dynamic pressure', 'total pressure'*	*x*	*x*	
82.2.1.2	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Describe a typical pitot/static system and list the different instruments connected to the sources*	*x*	*x*	
(02)	*State the requirement to check pitot/static sources to be clean of dirt and ice before any flight*	*x*	*x*	
(03)	*Describe alternate static sources and their effects when used*	*x*	*x*	
(04)	*Describe the associated errors and how to compensate for them: position error, instrument error*	*x*	*x*	
82.2.2	**Temperature measurement: aeroplane and helicopter**	**x**	**x**	
82.2.2.1	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Describe the term 'outside air temperature (OAT)' and how it is measured on general aviation aircraft (piston engine)*	*x*	*x*	
82.2.2.2	**Displays**	**x**	**x**	
(01)	*Describe how temperature is displayed on general aviation aircraft (piston enine)*	*x*	*x*	
82.2.3	**Altimeter**	**x**	**x**	
82.2.3.1	**The different barometric references (QNH, QFE and 1013.25)**	**x**	**x**	
(01)	*Define the following barometric references: 'QNH', 'QFE', '1013,25'*	*x*	*x*	
82.2.3.2	**Height, indicated altitude, true altitude, pressure altitude and density altitude**	**x**	**x**	
(01)	*List the following units used for altimeters and state the relationship between them: feet, metres*	*x*	*x*	
(02)	*Define the terms 'height', 'altitude' and 'pressure altitude (flight level)'*	*x*	*x*	
(03)	*Define the terms: 'indicated altitude', 'true altitude', 'pressure altitude', 'density altitude'*	*x*	*x*	
82.2.3.3	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Explain the operating principles of a barometric altimeter*	*x*	*x*	

(02)	*Explain the procedure for setting the correct pressure reference*	*x*	*x*	
(03)	*Describe meteorological conditions that lead to a higher/lower indicated altitude, compared to the true altitude/FL, with regard to QNH and temperature deviation from ISA*	*x*	*x*	
(04)	*Describe the effects of a blockage or leakage on the static pressure line*	*x*	*x*	
(05)	*Describe the use of GNSS altitude as alternative means of checking altimeter indications, and highlight the limitations of the GNSS altitude indication*	*x*	*x*	
82.2.3.4	**Displays**	**x**	**x**	
(01)	*Describe how the altimeter indication changes when setting higher/lower reference pressure*	*x*	*x*	
(02)	*Describe and identify how altitude can be displayed on: analog instruments (pointer), integrated electronic instruments (altitude 'tape')*	*x*	*x*	
(03)	*Interpret example altimeter indications be means of pressure reference setting*	*x*	*x*	
82.2.4	**Vertical speed indicator (VSI)**	**x**	**x**	
82.2.4.1	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*List the units used for VSIs: metres per second, feet per minute*	*x*	*x*	
(02)	*Explain the operating principles of a VSI*	*x*	*x*	
(03)	*Describe the effects on a VSI of a blockage or leakage on the static pressure line*	*x*	*x*	
(04)	*Explain the lag in indication due to the time required for difference in pressure to be established*	*x*	*x*	
(05)	*Describe the lag-free indication of an Instantaneous Vertical Speed Indicator (IVSI) by the use of accelerometers*	*x*	*x*	
82.2.4.2	**Displays**	**x**	**x**	
(01)	*Describe and identify how vertical speed can be displayed on: analog instruments (pointer), integrated electronic instruments (e.g. arrow/pointer)*	*x*	*x*	
(02)	*State that Instantaneous Vertical Speed Indicators (IVSIs) can be identified by the letters "IVSI" on the indicator face*	*x*	*x*	
82.2.5	**Air speed indicator**	**x**	**x**	
82.2.5.1	**The different speeds IAS, CAS, TAS: definition, usage and relationships**	**x**	**x**	
(01)	*Define the terms: 'IAS', 'CAS', 'TAS'*	*x*	*x*	
(02)	*Convert between IAS/CAS and TAS using the rule of thumb ('2% per 1000 ft')*	*x*	*x*	
(03)	*Convert between IAS/CAS and TAS using the mechanical flight calculator*	*x*	*x*	
(04)	*Explain the relevance of IAS with regard to speed limitations (stall speed, VNE), and how they change with environmental factors (e.g. altitude, airfield elevation, temperature)*	*x*	-	
82.2.5.2	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Explain the operating principles of an airspeed indicator (ASI)*	*x*	*x*	

(02)	*Describe the following ASI errors: instrument error, position error, density error*	*x*	*x*	
(03)	*Describe the effects on an ASI of a blockage or leakage in the static or total pressure line*	*x*	*x*	
(04)	*Describe appropriate procedures in the event of unreliable airspeed indications: combination of pitch attitude / power setting, ambient wind noise, use of GPS speed indications and the associated limitations (having GS instead of IAS/CAS)*	*x*	*x*	
82.2.5.3	**Displays**	**x**	**x**	
(01)	*Identify and describe how airspeed can be displayed on analog instruments (pointer), integrated electronic instruments (speed 'tape')*	*x*	*x*	
(02)	*Explain the following colour codes that can be used on an aeroplane ASI: white arc (flap operating speed range), green arc (normal operating speed range), yellow arc (caution speed range), red line (VNE)*	*x*	-	
(03)	*Explain the following colour codes that can be used on an helicopter ASI: green arc (normal operating speed range), red line (VNE), blue line (maximum airspeed during autorotation)*	-	*x*	
82.3	**Magnetism: direct reading compass**	**x**	**x**	
82.3.1	**Earth magnetic field**	**x**	**x**	
82.3.1.1	**Field geometry**	**x**	**x**	
(01)	*Describe the magnetic field of the Earth with regard to: magnetic poles, orientation of the magnetic field lines*	*x*	*x*	
(02)	*Define the following terms: 'magnetic variation (VAR)', 'magnetic dip (inclination)'*	*x*	*x*	
	Define 'magnetic north (MN)'			
82.3.1.2	**Directive force**	**x**	**x**	
(01)	*Explain why online the horizontal component of the Earth's magnetic field can be used for directional reference*	*x*	*x*	
(02)	*Explain why a magnetic compass becomes unusable close to Earth's magnetic poles*	*x*	*x*	
82.3.2	**Direct reading compass**	**x**	**x**	
82.3.2.1	**Design, operation, data processing, accuracy and deviation**	**x**	**x**	
(01)	*Describe how a magnetic compass will align to both the horizontal and vertical components of the Earth's magnetic field*	*x*	*x*	
(02)	*Explain the origin and effect of aircraft's magnetic field on the alignment of the magnetic compass*	*x*	*x*	
(03)	*Define 'deviation (DEV)' and 'compass north (CN)'*	*x*	*x*	
(04)	*Explain the use of deviation tables for correct gyro settings with given examples*	*x*	*x*	
82.3.2.2	**Turning and acceleration errors**	**x**	**x**	
(01)	*State that the indication of a magnetic compass is affected by deviation, turning and acceleration errors*	*x*	*x*	

(02)	*Describe the 'turning error' and determine required indication the roll out on a desired heading*	*x*	*x*	
(03)	*Describe the indications when accelerating/decerating on east or west headings*	*x*	*x*	
82.4	**Gyroscopic instruments**	**x**	**x**	
82.4.1	**Gyroscope: basic principles**	**x**	**x**	
82.4.1.1	**Definitions and design**	**x**	**x**	
(01)	*Define a 'gyro'*	*x*	*x*	
(02)	*Define the 'degrees of freedom' of a gyro*	*x*	*x*	
82.4.1.2	**Fundamental properties**	**x**	**x**	
(01)	*Explain the fundamentals of the theory of gyroscopic forces*	*x*	*x*	
(02)	*Explain the terms 'rigidity', 'precession', 'drift' and 'wander'*	*x*	*x*	
(03)	*Describe the two ways of driving gyroscopes: air/vacuum or electrically*	*x*	*x*	
(04)	*Explain why some instruments are driven electrically while others by air/vacuum*	*x*	*x*	
82.4.2	**Turn and bank indicator**	**x**	**x**	
82.4.2.1	**Design, operation and errors**	**x**	**x**	
(01)	*Explain the purpose of a rate-of-turn and balance (slip) indicator*	*x*	*x*	
(02)	*Define 'rate-1 turn', and describe the relation between bank and TAS for a rate-1-turn*	*x*	*x*	
(03)	*Explain the operating principle of a turn-and-bank indicator and a turn coordinator with regard to: orientation of axis, degrees of freedom, drive*	*x*	*x*	
(04)	*Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip or skid turn*	*x*	*x*	
(05)	*Describe and compare the indications of a 'rate-of-turn indicator' and a 'turn coordinator' (or 'turn-and-bank indicator')*	*x*	*x*	
82.4.3	**Attitude indicator**	**x**	**x**	
82.4.3.1	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Explain the purpose of the attitude indicator*	*x*	*x*	
(02)	*Explain the operating principle of an attitude indicator with regard to: orientation of axis, degrees of freedom, drive*	*x*	*x*	
(03)	*Describe a typical attitude display and instrument markings, and identify flight attitudes from example indications*	*x*	*x*	
(04)	*Describe the limitations of the ADI with regard to extreme flight situations*	*x*	*x*	
82.4.4	**Directional gyroscope**	**x**	**x**	
82.4.4.1	**Design, operation, errors and accuracy**	**x**	**x**	
(01)	*Explain the purpose of the directional gyroscope*	*x*	*x*	
(02)	*Explain the operating principle of a directional gyro with regard to: orientation of axis, degrees of freedom, drive*	*x*	*x*	
(03)	*Describe the Horzintal Situation Indicator (HSI) with regard to: power supply, indication*	*x*	*x*	

(04)	*Describe how the directional gyroscope will drift over time*	*x*	*x*	
(05)	*Describe the procedure to align the directional gyro to the correct compass heading*	*x*	*x*	
82.5	**Communication systems**	**x**	**x**	
82.5.1	**Transmission modes: VHF, HF and SATCOM**	**x**	**x**	
82.5.1.1	**Principles, bandwidth, operational limitations and use**	**x**	**x**	
(01)	*Describe the use of HF and VHF for voice communication*	*x*	*x*	
(02)	*State the frequency range used with HF and VHF communication*	*x*	*x*	
(03)	*Explain which factors affect the range and availability of HF communication*	*x*	*x*	
(04)	*Explain which factors affect the range and availability of VHF communication*	*x*	*x*	
82.6	**Alerting systems and proximity systems**	**x**	**x**	
82.6.1	**Flight warning systems**	**x**	**x**	
82.6.1.1	**Design, operation, indications and alarms**	**x**	**x**	
(01)	*State the colors used for 'warning' and 'caution' indications (red, amber)*	*x*	*x*	
(02)	*State how operational limits are displayed*	*x*	*x*	
82.6.2	**Stall warning**	**x**	**-**	
82.6.2.1	**Design, operation, indications and alarms**	**x**	**-**	
(01)	*Describe the purpose of an Stall Warning System (SWS)*	*x*	*-*	
(02)	*Describe the different types of SWS used in general aviation aircraft*	*x*	*-*	
(03)	*Explain the difference between the stall warning speed and the actual stalling speed of the aeroplane*	*x*	*-*	
82.6.3	**Radio-altimeter**	**-**	**x**	
82.6.3.1	**Design, operation, indications and alarms**	**-**	**x**	
(01)	*Explain the purpose of a low-altitude radio altimeter*	*-*	*x*	
(02)	*Describe the principle of the distance (height) measurement*	*-*	*x*	
(03)	*State the range of a radio altimeter*	*-*	*x*	
82.6.4	**Rotor or engine over speed alert system**	**-**	**x**	
82.6.4.1	**Design, operation, indications and alarms**	**-**	**x**	
(01)	*Describe the basic design principles, operation, displays and warning/alarm systems fitted to helicopters*	*-*	*x*	
82.7	**Integrated instruments: electronic displays**	**x**	**x**	
82.7.1	**Display units**	**x**	**x**	
82.7.1.1	**Design, different technologies and limitations**	**x**	**x**	
	General concept	**x**	**x**	
(01)	*Explain the advantage of using integrated displays compared to single analog instruments*	*x*	*x*	
	Displayed information	**x**	**x**	

(02)	*State the information typically displayed on electronic flight displays: primary flight data and navigational data ('basic-T'), engine parameters*	x	x	
	PFD layout	**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	
(04)	*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*	x	x	
	User interface	**x**	**x**	
(05)	*Describe how data can be selected or inserted into electronic displays (e.g. using 'line select keys', rotational knobs, touch screens)*	x	x	
	Identification and interpretation	**x**	**x**	
(06)	*Identify displayed information from example display pictures*	x	x	
	Failure	**x**	**x**	
(07)	*Explain the requirement of standy-by instruments when using integrated flight displays*	x	x	

Reference	Description	PPL(A)	PPL(H)	Remarks
90	**NAVIGATION**	**x**	**x**	
91	**GENERAL NAVIGATION**	**x**	**x**	
91.1	**Basics of navigation**	**x**	**x**	
91.1.1	**The solar system**	**x**	**x**	
91.1.1.1	**Seasonal and apparent movements of the sun**	**x**	**x**	
(01)	*Describe the rotation of the Earth around its own spin axis and the earth's orbit around the sun*	x	x	
(02)	*State that the earth's spin axis is inclined by 23.5 degrees to the vertical on the orbital plane around the sun*	x	x	
(03)	*Describe the effect that the inclination of the Earth's spin axis has on insolation and duration of daylight on different latutudes throughout the year*	x	x	
(04)	*Explain how the inclination of the earth's spin axis results in seasons on the northern and southern hemisphere*	x	x	
91.1.2	**The earth**	**x**	**x**	
91.1.2.1	**Position**	**x**	**x**	
(01)	*State that a position in latitude and longitude is referred to a WGS-84 ellipsoid*	x	x	
(02)	*State that the circumference of the Earth is approximately 40000 km or approximately 21600 NM*	x	x	
(03)	*Explain the use of degrees, minutes and seconds (DMS) for position reference*	x	x	
91.1.2.2	**Great circle, small circle and rhumb line**	**x**	**x**	
	Great circle	**x**	**x**	

(01)	*Describe the geometric properties of a 'great circle' as a circle with maximium circumfence on the earth's surface and its center in the center of the earth*	*x*	*x*	
(02)	*Explain the significance of a great circle in navigation*	*x*	*x*	
(03)	*Explain the change in great circle course due to the angle between the meridians along the track*	*x*	*x*	
(04)	*Explain that along any great circle, the angular difference of 1 degree corresponds to a distance of 60 NM on the earth's surface*	*x*	*x*	
	Rhumb line, small circle	**x**	**x**	
(05)	*Define the term 'rhumb line' and 'small circle'*	*x*	*x*	
(06)	*List examples from the earth's coordinate grid for great circles, small circles and rhumb lines*	*x*	*x*	
	Relationship between great circle and rhumb line tracks	**x**	**x**	
(07)	*State that the great circle and rhumb line track both lead from a position A to position B, but the rhumb line track in general is a longer distance (detour) when compared to the great circle track*	*x*	*x*	
91.1.2.3	**Latitude and difference of latitude**	**x**	**x**	
(01)	*Define 'latitude' as the angle between the equatorial plane and the local vertical direction at a point on earth's surface*	*x*	*x*	
(02)	*Calculate the difference in latitude between any two given positions*	*x*	*x*	
(03)	*Calculate the distance in NM any two given positions on the same meridian (using 60 NM per degree difference in latutude)*	*x*	*x*	
91.1.2.4	**Longitude and difference of longitude**	**x**	**x**	
(01)	*Define 'longitude' as the angle from the reference (Greewich) meridian to the local meridian*	*x*	*x*	
(02)	*Calculate the difference in longitude between any two given positions*	*x*	*x*	
91.1.2.5	**Use of latitude and longitude co-ordinates to locate any specific position**	**x**	**x**	
(01)	*Describe the format for expressing position coodinates with degrees, minutes and seconds for latitude and longitude*	*x*	*x*	
(02)	*State that meridians and parallels of latitude intersect with 90 degrees all over the globe*	*x*	*x*	
(03)	*Describe the coordinate grid of the earth, and name and identify the Greenwich meridian, dateline, tropics and polar (arctic) circles*	*x*	*x*	
91.1.3	**Time and time conversions**	**x**	**x**	
91.1.3.1	**Apparent time**	**x**	**x**	
(01)	*State that the 'apparent time' is based on the movement of the actual (apparent) sun*	*x*	*x*	
(02)	*State that 'apparent time' is NOT exactly 24 hours every day, and it is different for every degree of longitude*	*x*	*x*	
(03)	*Describe the daily movement of the apparent sun from east to west across the sky with approximately 15 degrees per hour*	*x*	*x*	

91.1.3.2	**LMT**	**x**	**x**	**sequence changed with 1.3.3**
(01)	*State that the 'local mean time (LMT)' is based on a fictious, 'mean' sun moving with constant, averaged speed*	*x*	*x*	
(02)	*State that 'local mean time (LMT)' is 24 hours every day, and it is different for every degree of longitude*	*x*	*x*	
(03)	*State that a difference in longitude of 15 degrees corresponds to the angle the earth is turning around its axis within 1 hour*	*x*	*x*	
(04)	*Explain the relevance of LMT with documentation of astronomical events (sunrise, sunset, begin/end of twilight)*	*x*	*x*	
91.1.3.3	**UTC**	**x**	**x**	**sequence changed with 1.3.2**
(01)	*Explain the requirement for having a universal time in aviation, being the same at a given moment at any place around the globe*	*x*	*x*	
(02)	*Describe 'universal co-ordinated time (UTC)' as global time reference, with the time given corresponding to the LMT at the Greenwich meridian (GMT)*	*x*	*x*	
(03)	*State that in aviation, all times in documentation are UTC*	*x*	*x*	
91.1.3.4	**Standard times**	**x**	**x**	
(01)	*Explain the requirement for having time zones, defined by political and economical constraints*	*x*	*x*	
(02)	*State that 'standard time (ST)' is defined by a given, arbitrary time difference to UTC*	*x*	*x*	
(03)	*Explain the concept of 'daylight saving time (DST)'*	*x*	*x*	
(04)	*Describe the usage of almanacs or tables to find the current time difference to UTC for a time zone, including DST*	*x*	*x*	
(05)	*State that for 2 positions on the same latitude, when expressed in ST, sunrise and sunset is earlier for the position further east*	*x*	*x*	
(06)	*With given time difference to UTC, or almanac reference, convert between ST and UTC*	*x*	*x*	
91.1.3.5	**Dateline**	**x**	**x**	
(01)	*Describe the 'dateline' as a line running approxiamately along the 180E/W meridian, with the 'new' day west of the line (on east hemisphere), and the 'old' day east of the line (on western hemisphere)*	*x*	*x*	
(02)	*State that the local calendar date increases or decreases when flying across the dateline*	*x*	*x*	
91.1.3.6	**Definition of sunrise, sunset and civil twilight**	**x**	**x**	
(01)	*Define 'sunrise' and 'sunset' as the time when the sun's upper edge is at the observer's horizon*	*x*	*x*	
(02)	*Define the beginning / end of 'civil twilight' (BCMT/ECET) as the time before sunrise / after sunset when the centre of the sun is 6 degrees below the horizon*	*x*	*x*	

(03)	*Extract sunrise, sunset and twilight times from a suitable source (e.g. an almanac/table, or AIP)*	*x*	*x*	
(04)	*State that for VFR flights, 'night' begins with end of civil (evening) twilight and ends with beginning of civil (morning) twilight*	*x*	*x*	
91.1.4	**Directions**	**x**	**x**	
91.1.4.1	**True north, magnetic north and compass north**	**x**	**x**	
	True North	**x**	**x**	
(01)	*Define 'true north' (TN) and corresponding directions (TH, TC)*	*x*	*x*	
(02)	*Describe how to termine true directions on an aeronautical charts using meridian lines*	*x*	*x*	
	Magnetic North and Variation	**x**	**x**	
(03)	*Define 'magnetic north' (MN) and corresponding directions (MH, MC)*	*x*	*x*	
(04)	*Define 'variation (VAR)' as the angle between TN and MN*	*x*	*x*	
(05)	*Describe the change of variation with time and position*	*x*	*x*	
(06)	*State that 'westerly variation' (MN west of TN) is negative (- or W), and 'easterly variation' (MN east of TN) is positive (+ or E) for use in calculations*	*x*	*x*	
(07)	*Calculate magnetic values (M) from true values (T) and vice versa using VAR*	*x*	*x*	
	Compass North	**x**	**x**	
(08)	*Define 'compass north' (CN) and corresponding directions (CH)*	*x*	*x*	
(09)	*Define 'deviation (DEV)' as the angle between MN and CN*	*x*	*x*	
(10)	*State that 'westerly deviation' (CN west of MN) is negative (- or W), and 'easterly deviation' (CN east of MN) is positive (+ or E) for use in calculations*	*x*	*x*	
(11)	*Calculate compass values (C) from magnetic values (M) and vice versa using DEV*	*x*	*x*	
(12)	*Explain the usage of deviation tables*	*x*	*x*	
91.1.4.2	**Magnetic poles, isogonals, relationship between true (T) and magnetic (M)**	**x**	**x**	
(01)	*Describe how local variation can be obtained from different charts: using isogonal lines (enroute charts) or MN arrows (e.g. on airport charts)*	*x*	*x*	
91.1.5	**Distance**	**x**	**x**	
91.1.5.1	**Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres and ft**	**x**	**x**	
(01)	*State the typical units and conversion factors for distance: nautical mile (NM), kilometre (km)*	*x*	*x*	
(02)	*State the typical units and conversion factors for height or altitude: feet (ft), metres (m)*	*x*	*x*	
91.1.5.2	**Conversion from one unit to another**	**x**	**x**	
(01)	*Convert between units of distance: nautical mile (NM), kilometre (km)*	*x*	*x*	
(02)	*Convert between units of height or altitude: feet (ft), metres (m)*	*x*	*x*	
91.1.5.3	**Relationship between nautical miles and minutes of latitude and minutes of longitude**	**x**	**x**	

(01)	*State that 1' (minute of arc) along any meridian corresponds to a distance of 1 NM or 1.852 km*	x	x	
(02)	*Calculate distances along any meridian with latitudes given between to positions*	x	x	
(03)	*State that 1' (minute of arc) along the equator corresponds to a distance of 1 NM or 1.852 km*	x	x	
(04)	*State that 1' (minute of arc) along any circle of latitude (except the equator) corresponds to a distance of less than 1 NM or 1.852 km*	x	x	
91.2	**Charts**	**x**	**x**	
91.2.1	**General properties of miscellaneous types of projections**	**x**	**x**	
91.2.1.1	**General properties: scale**	**x**	**x**	
(01)	*Describe the term 'scale' as ratio of chart distance to (real) earth distance*	x	x	
(02)	*With given values, calculate between scale, chart distance and (real) earth distance*	x	x	
(03)	*State the scales that are typically used with aviation enroute charts (e.g. 1:500 000 and 1:1000 000)*	x	x	
91.2.1.2	**Direct Mercator**	**x**	**x**	
(01)	*Describe the cylindrical type of projection, attached to the equator, used as basis for a 'direct Mercator' chart*	x	x	
(02)	*State that the scale on a direct Mercator chart is NOT constant and changes significantly with latitude*	x	x	
(03)	*Describe the quality of the projection of a direct Mercator with regard to shape, size and proportions of projected areas, and assess its usability in aviation*	x	x	
91.2.1.3	**Lambert conformal conic**	**x**	**x**	
(01)	*Describe the conic projection, intersecting the earth at two standard parallels, used as basis for the 'Lambert conformal conic projection'*	x	x	
(02)	*State that the Lambert chart is exactly true to angles, and that for all navigational purposes the scale can be assumed as constant*	x	x	
(03)	*State that Lambert conformal chart are usually used for aviation enroute chart*	x	x	
91.2.2	**The representation of meridians, parallels, great circles and rhumb lines**	**x**	**x**	
91.2.2.1	**Direct Mercator**	**x**	**x**	
(01)	*Describe the shape and alignment of merdians and parallels of latitude on a direct Mercator chart*	x	x	
(02)	*From a given sketch with latitudes and longitudes, identify a direct Mercator chart*	x	x	
(03)	*Describe the appearance of great circles and rhumb lines on a direct Mercator chart*	x	x	
(04)	*State that a straight line on a direct Mercator chart represents the rhumb line*	x	x	
(05)	*Discuss the appearance of a rhumb line track on a direct Mercator chart as a shorter route compared to the great circle track*	x	x	

91.2.2.2	**Lambert conformal conic**	**x**	**x**	
(01)	*Describe the shape and alignment of merdians and parallels of latitude on a Lambert conformal chart*	*x*	*x*	
(02)	*From a given sketch with latitudes and longitudes, identify a Lambert conformal chart*			
(03)	*Describe the appearance of great circles and rhumb lines on a Lambert chart*	*x*	*x*	
(04)	*State that a straight line on a Lambert chart represents the great circle*	*x*	*x*	
(05)	*Describe how to obtain the rhumb line track by taking the average great circle track (measured at a meridian close to half of the track), and starting off with that track at the departure aerodrome*	*x*	*x*	
91.2.3	**The use of current aeronautical charts**	**x**	**x**	
91.2.3.1	**Plotting positions**	**x**	**x**	
	Usage of coordinate grid	**x**	**x**	
(01)	*Describe how to plot positions given with degrees and minutes of latutude and longitude, using the 'tick' markings on the full degrees of latitude/longitude*	*x*	*x*	
(02)	*Describe how to find determine coordinates (degrees and minutes) for a given location on a chart, using using the 'tick' markings on the full degrees of latitude/longitude*	*x*	*x*	
	True bearings	**x**	**x**	
(03)	*State that directions measured at merdian lines are referenced to True North (TN) and can be used with true bearings (QTE, QUJ)*	*x*	*x*	
	Magnetic bearings	**x**	**x**	
(04)	*State that when plotting magnetic bearings (QDM, QDR), local Variation (VAR) has to be taken into account*	*x*	*x*	
	Application	**x**	**x**	
(05)	*Demonstrate how to plot a position line into a chart from a station or airfield, with given MH and relative bearing (RB)*	*x*	*x*	
(06)	*Demonstrate how to plot a position line into a chart from a VOR, with given selected course (OBS), CDI/HSI needle centered and TO/FR flag*	*x*	*x*	
91.2.3.2	**Methods of indicating scale and relief (ICAO topographical chart)**	**x**	**x**	
(01)	*Describe the use of 'contour lines' and 'layer tinting' (colour gradient) for depiction of topography on a chart*	*x*	*x*	
91.2.3.3	**Conventional signs**	**x**	**x**	
(01)	*Name and identify features on an aeronautical chart using ICAO symbology (see ICAO Annex 4), e.g. obstacles, aerodromes, mountains and passes*	*x*	*x*	
91.2.3.4	**Measuring tracks and distances**	**x**	**x**	
(01)	*Explain how to use markings ('ticks') printed along meridians of full degrees on aeronautical charts as a distance scale*	*x*	*x*	
(02)	*Explain why the 'ticks' on full degrees of latitude should NOT be used as a scale for distances*	*x*	*x*	
(03)	*Extract courses magnetic (M) and true (T) from chart samples*	*x*	*x*	

(04)	*Extract distances from chart samples*	*x*	*x*	
91.2.3.5	**Plotting bearings and distances**	**x**	**x**	
(01)	*Explain the terms 'QTE', 'QUJ', 'QDM', 'QDR' and 'relative bearing (RB)' used for plotting positions*	*x*	*x*	
(02)	*With appropriate values given, convert between QTE/QUJ and QDM/QDR*	*x*	*x*	
(03)	*Explain how to obtain position by distance/bearing information, e.g. from an RNAV station (VOR)*	*x*	*x*	
(04)	*Explain how to obtain position by intersection of two position lines from different ground features, e.g. by visual references or RNAV bearings*	*x*	*x*	
91.3	**DR navigation**	**x**	**x**	
91.3.1	**Basis of DR**	**x**	**x**	
91.3.1.1	**Track and Heading (compass, magnetic and true)**	**x**	**x**	**merged with 91.4.1.2**
(01)	*Explain and apply the concepts of drift and WCA*	*x*	*x*	
(02)	*With appropriate values given, calculate between heading and track and different direction references (T), (M), (C)*	*x*	*x*	
(03)	*Calculate TKE with appropriate data of WCA and drift*	*x*	*x*	
91.3.1.2	**Air speed (IAS, CAS and TAS)**	**x**	**x**	
(01)	*Calculate TAS from CAS, and vice versa, using the 'rule of thumb' (2 per cent per 1000 ft)*	*x*	*x*	
(02)	*Explain the relevance of the speeds (IAS/CAS, TAS) for different phases of flight preparation and flight conduction*	*x*	*x*	
91.3.1.3	**Groundspeed and revisions**	**x**	**x**	**91.5.1.3 integrated**
(01)	*Explain the relationship between TAS and GS*	*x*	*x*	
(02)	*Apply HWC and TWC to determine GS from TAS and vice versa*	*x*	*x*	
(03)	*Perform GS, distance and time calculations, e.g. calculate average GS based on observed fixes*	*x*	*x*	
(04)	*With a revised remaining time and distance to a waypoint or destination given, determine revised GS or IAS/CAS*	*x*	*x*	
91.3.1.4	**ETA**	**x**	**x**	
(01)	*With remaining distance and observed ground speed given, calculate the remaining time and expected time of arrival (ETA) to a waypoint or destination*	*x*	*x*	
91.3.1.5	**Climb and Descent**	**x**	**x**	
(01)	*For a vertical interval (ft), GS and rate of climb/descent given, calculate the time required for climb/descent*	*x*	*x*	
(02)	*For a vertical interval (ft), GS and rate of climb/descent given, determine the distance required for the climb/descent*	*x*	*x*	
91.3.1.6	**DR position fix**	**x**	**x**	
(01)	*Explain the concept of 'Dead reckoning (DR)' using the terms 'fix', 'air position' and 'DR position'*	*x*	*x*	
(02)	*Describe situations when DR reckoning may be used*	*x*	*x*	

91.3.2	**Use of the navigational computer**	**x**	**x**	
91.3.2.1	**Speed**	**x**	**x**	
(01)	*Calculate speed from appropriate values given, using an electronic calculator or the mechanical flight calculator*	*x*	*x*	
91.3.2.2	**Time**	**x**	**x**	
(01)	*Calculate time from appropriate values given, using an electronic calculator or the mechanical flight calculator*	*x*	*x*	
91.3.2.3	**Distance**	**x**	**x**	
(01)	*Calculate distance from appropriate values given, using an electronic calculator or the mechanical flight calculator*	*x*	*x*	
91.3.2.4	**Fuel consumption**	**x**	**x**	
(01)	*Calculate fuel consumption from appropriate values given, using an electronic calculator or the mechanical flight calculator*	*x*	*x*	
91.3.2.5	**Conversions**	**x**	**x**	
(01)	*Convert between units used in navigation (km/NM/SM, m/ft, liters/USGAL/IMPGAL), using an electronic calculator or the mechanical flight calculator*	*x*	*x*	
91.3.2.6	**Air speed**	**x**	**x**	
(01)	*With CAS, OAT and Pressure ALT given, determine TAS using the mechanical flight calculator and vice versa*	*x*	*x*	
91.3.2.7	**True altitude**	**x**	**x**	
	For true altitude and obstacle clearance calculation, the following scheme can be used: *Pressure Altitude (FL)* *+ (QNH - 1013) x 30 ft/hPa* *= QNH Altitude* *+/- 4% per 10 degrees deviation from ISA (using + for T>ISA and - for T<ISA)* *= True Altitude* *- obstacle altitude* *= obstacle clearance*	x	x	
(01)	*Eplain the difference in altimeter indication between standard (1013) and QNH setting*	*x*	*x*	
(02)	*Eplain the difference in altimeter indication between QNH setting and true altitude in qualitative terms*	*x*	*x*	
(03)	*Calculate ISA standard temperatures for pressure altitudes using the formula T(ISA) in degrees C = 15 - 2 x FL/10*	*x*	*x*	
(04)	*With Pressure ALT, OAT (or temperature deviation from ISA) and QNH given, calculate the true altitude (TA) using: 30 ft/hPa for QNH correction and 4% per 10 degrees deviation from ISA for temperature correction*	*x*	*x*	
91.3.3	**The triangle of velocities**	**x**	**x**	
91.3.3.1	**Construction**	**x**	**x**	
(01)	*Explain the terms 'air vector', 'wind vector' and 'ground vector'*	*x*	*x*	
(02)	*Explain the construction of the 'triangle of velocities (TOV)'*	*x*	*x*	

(03)	*State what parameters have to be given to construct a complete TOV*	*x*	*x*	
(04)	*Name and identify air vector, wind vector, ground vector, WCA and drift angle from an example sketch of a TOV*	*x*	*x*	
91.3.3.2	**WCA, heading and ground speed**	**x**	**x**	
(01)	*With course or track, TAS and wind/velocity given, resolve the TOV for heading/WCA and GS using a mechanical flight calculator (flight planning situation)*	*x*	*x*	
91.3.3.3	**Wind velocity**	**x**	**x**	
(01)	*With heading/TAS and track/GS given, resolve the TOV for wind/velocity using a mechanical flight calculator*	*x*	*x*	
91.3.3.4	**GS, track and drift angle**	**x**	**x**	
(01)	*With heading/TAS and wind/velocity given, resolve the TOV for track and GS using a mechanical flight calculator*	*x*	*x*	
91.4	**In-flight navigation**	**x**	**x**	
91.4.1	**Use of visual observations and application to in-flight navigation**	**x**	**x**	
91.4.1.1	**Concept of terrestrial navigation**	**x**	**x**	
(01)	*Explain the term 'terrestrial navigation'*	*x*	*x*	
(02)	*Explain the term 'map reading', and describe how to prepare and align a map for use in visual navigation*	*x*	*x*	
(03)	*Describe the term 'visual checkpoint', and give examples*	*x*	*x*	
91.4.1.2	**Use of visual features and limitations**	**x**	**x**	
(01)	*Explain which elements would make a ground feature suitable for use for VFR navigation, and give examples*	*x*	*x*	
(02)	*Describe the problems of VFR navigation at lower levels*	*x*	*x*	
(03)	*List causes of reduced visibility (e.g. below inversion layers), and explain how to proceed with such situations*	*x*	*x*	
(04)	*Describe the special situation and problems of VFR navigation at night*	*x*	*x*	
91.4.2	**Navigation in cruising flight, use of fixes to revise navigation data**	**x**	**x**	
91.4.2.1	**Off-track corrections**	**x**	**x**	
(01)	*Define the terms 'track error' (or 'track error angle') and 'closing angle'*	*x*	*x*	
(02)	*Calculate the track error at an off-course fix using the 1:60 rule*	*x*	*x*	
(03)	*Calculate the heading change at an off-course fix to directly reach the next waypoint using the 1:60 rule*	*x*	*x*	
(04)	*For a given situation, determine headings and time correction for a 30 and 60 degree dog leg, e.g. for bad weather (CB) avoidance*	*x*	*x*	
91.4.2.2	**ETA revisions**	**x**	**x**	
(01)	*With GS observed from visual features enroute, calculate revised time of arrival (ETA) at next waypoint*	*x*	*x*	
91.4.2.3	**Flight log**	**x**	**x**	

(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*	
92	**RADIO NAVIGATION**	**x**	**x**	
92.1	**Basic radio propagation theory**	**x**	**x**	
92.1.1	**Electromagnetic waves and antennas**	**x**	**x**	
92.1.1.1	**Characteristics and definitions**	**x**	**x**	
(01)	*State that radio waves are forms of electromagnetic waves*	*x*	*x*	
(02)	*State that electromagnetic waves travel at the speed of light, being approximately 300 000 km/s*	*x*	*x*	
(03)	*Explain the following terms and their relationship: 'amplitude', 'frequency', 'wavelength', 'phase angle', 'phase angle difference/shift'*	*x*	*x*	
(04)	*Describe the 'Doppler effect' an a phenomenon where the frequency of a wave will increase or decrease if there is relative motion between the transmitter and the receiver*	*x*	*x*	
92.1.1.2	**Frequency bands and modulation**	**x**	**x**	
(01)	*List the most importand bands of the frequency spectrum for electromagnetic waves for ground based systems used in VFR flights: low frequency (LF): 30-300 kHz, medium frequency (MF): 300-3 000 kHz, very high frequency (VHF): 30-300 MHz*	*x*	*x*	
(02)	*Explain how information using lower frequencies (e.g. voice) can be transmitted by high frequency electromagnetic waves using 'modulation'*	*x*	*x*	
(03)	*Describe the terms: 'amplitude modulation', 'frequency modulation', 'pulse modulation'*	*x*	*x*	
92.1.1.3	**Antennas**	**x**	**x**	
(01)	*Describe an 'antenna' as an electrical device which converts electric power into radio waves, and vice versa*	*x*	*x*	
(02)	*Explain the different sizes of an aircraft's antennas by the different wavelengths used by the systems*	*x*	*x*	
(03)	*Explain the different positions antennas are placed around an aircraft*	*x*	*x*	
92.1.2	**Wave propagation**	**x**	**x**	
92.1.2.1	**Propagation with the frequency bands**	**x**	**x**	
(01)	*List and explain the possible paths by which an electromagnetic waves can be received: via 'direct (space) wave', 'ground wave' and 'sky wave'*	*x*	*x*	
(02)	*Explain the role of ionospheric layers with 'sky waves', and how day or night time may affect the reception*	*x*	*x*	
(03)	*Explain 'fading' by the effect of 'interference' when receiving the same signal via different paths (e.g. via ground wave and skywave)*	*x*	*x*	
(04)	*State that LF/MF waves can propagate as 'ground wave' and 'sky wave'*	*x*	*x*	
(05)	*State that VHF waves (and higher frequencies) only propagate as 'direct wave'*	*x*	*x*	

92.2	**Radio aids**	**x**	**x**	
92.2.1	**Ground DF**	**x**	**x**	
92.2.1.1	**Principles**	**x**	**x**	
(01)	*Describe the use of a ground DF*	*x*	*x*	
(02)	*State that, besides a VHF radio, no further airborne equipment is required*	*x*	*x*	
92.2.1.2	**Presentation and interpretation**	**x**	**x**	
(01)	*Define 'QDM': the magnetic bearing TO the station*	*x*	*x*	
(02)	*Define 'QDR': the magnetic bearing FROM the station*	*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*	
(04)	*With example QDM/QDR information given, determine the aprroximate location of the aircraft in relation to the station*	*x*	*x*	
92.2.1.3	**Coverage and range**	**x**	**x**	
(01)	*Explain the limitation of range due to the path of the VHF signal (station elevation and aircraft altitude)*	*x*	*x*	
92.2.1.4	**Errors and accuracy**	**x**	**x**	
(01)	*Explain why synchronous transmissions will cause errors*	*x*	*x*	
92.2.2	**NDB/ADF**	**x**	**x**	
92.2.2.1	**Principles**	**x**	**x**	
(01)	*Explain the term 'NDB' (non-directional radio beacon) as the ground part of the system*	*x*	*x*	
(02)	*Explain the term 'ADF' (automatic direction-finding equipment) as the airborne part of the system*	*x*	*x*	
(03)	*State that the NDB operates in the LF and MF frequency bands (190-1750 kHz)*	*x*	*x*	
(04)	*Describe the use of NDBs for navigation*	*x*	*x*	
(05)	*Describe the procedure to identify a NDB station*	*x*	*x*	
(06)	*Describe the function of the 'BFO' (beat frequency oscillator), and state that on modern aircraft, BFO is activated automatically*	*x*	*x*	
92.2.2.2	**Presentation and interpretation**	**x**	**x**	
(01)	*Name and describes the following types of indicators: fixed-card ADF, moving-card ADF, radio magnetic indicator (RMI)*	*x*	*x*	
(02)	*Interpret the indications given on RMI, fixed-card and moving-card ADF display with regard to relative bearning (RB) and QDM/QDR*	*x*	*x*	
(03)	*Describe how to fly the following in-flight ADF procedures: homing and tracking, interceptions of inbound QDM, determining station passage*			
92.2.2.3	**Coverage and range**	**x**	**x**	
(01)	*State that the power of the transmitter limits the range of a NDB*	*x*	*x*	
(02)	*State that the range of a NDB is the largest during night, due to reception of a sky wave*	*x*	*x*	
(03)	*State that there is no warning indication of NDB failure or loss of signal*	*x*	*x*	
92.2.2.4	**Errors and accuracy**	**x**	**x**	

(01)	*Describe the typical errors with NDB/ADF: 'fading' or 'twilight effect', 'coastal refraction'*	*x*	*x*	
(02)	*State that static electricity from CB clouds and lightning may result in erroneous ADF bearing indication*	*x*	*x*	
92.2.3	**VOR**	**x**	**x**	
92.2.3.1	**Principles**	**x**	**x**	
(01)	*Explain the term 'radial', and describe the working principle of a VOR with regard to shift between reference and variable phase*	*x*	*x*	
(02)	*State that radials are referenced to magnetic north (MN)*	*x*	*x*	
(03)	*State that a VOR operates in the VHF frequency bands (108.0-117.975 MHz)*	*x*	*x*	
(04)	*State that different types of VOR are in operation (e.g. CVOR, DVOR), but use of the signals is the same on airborne side*	*x*	*x*	
(05)	*List the main components of VOR airborne equipment: antenna, receiver, indicating instrument (CDI or HSI, electronic display)*	*x*	*x*	
(06)	*Describe the procedure to identify a VOR*	*x*	*x*	
92.2.3.2	**Presentation and interpretation**	**x**	**x**	
	RMI	**x**	**x**	
(01)	*Read off the radial on an RMI*	*x*	*x*	
	CDI or HSI	**x**	**x**	
(02)	*State that the deviation indication on a CDI or HSI corresponds to the angular displacement from the selected course*	*x*	*x*	
(03)	*State that deviation indication usually is 2 degrees per dot (5-dot display) or 5 degrees per dot (2-dot display) to the left and right*	*x*	*x*	
(04)	*State maximum deflection corresponds to a deviation from selected course of 10 degrees or more*	*x*	*x*	
	TO/FR flags	**x**	**x**	
(05)	*Explain the relation between TO and FROM flag with position of the aircraft*	*x*	*x*	
(06)	*State that TO/FR flags are NOT related to the actual movement of the aircraft 'to' or 'from' the station*	*x*	*x*	
(07)	*Read and interpret VOR information (selected course, deviation, flag) as displayed on CDI, HSI and RMI*	*x*	*x*	
	Procedures	**x**	**x**	
(08)	*Describe how to fly the following in-flight VOR procedures: tracking, interceptions of a radial, determining station passage*	*x*	*x*	
92.2.3.3	**Coverage and range**	**x**	**x**	
(01)	*Explain the limitation of range due to the path of the VHF signal (station elevation and aircraft altitude)*	*x*	*x*	
92.2.3.4	**Errors and accuracy**	**x**	**x**	
(01)	*State that in case no valid signal is reveived, the NAV flag is displayed on the CDI or HSI*	*x*	*x*	
(02)	*Describe the 'cone of silence' overhead a VOR station, and how to proceed when entering it*	*x*	*x*	

92.2.4	**DME**	**x**	**x**	
92.2.4.1	**Principles**	**x**	**x**	
(01)	*Explain the principle of determining distance via run-time measurement*	*x*	*x*	
(02)	*State that the measured distance corresponds to the direct, radial distance from the DME ('slant range')*	*x*	*x*	
(03)	*State the VOR and DME can be co-located to provide bearing and distance at the same time*	*x*	*x*	
92.2.4.2	**Presentation and interpretation**	**x**	**x**	
(01)	*State that with a given distance displayed, the aircraft can be anywhere on a circle around the station*	*x*	*x*	
(02)	*Explain why DME distance ist NOT zero when the aircraft is directly overhead the station*	*x*	*x*	
92.2.4.3	**Coverage and range**	**x**	**x**	
(01)	*State that DME stations usually can respond only up to 100 aircrafts at the same time*	*x*	*x*	
92.2.4.4	**Errors and accuracy**	**x**	**x**	
(01)	*Explain the difference between 'horzontal distance' and 'slant range'*	*x*	*x*	
(02)	*Explain why the GS read-out from a DME can be less than the actual GS*	*x*	*x*	
92.3	**RADAR**	**x**	**x**	
92.3.1	**Ground radar**	**x**	**x**	
92.3.1.1	**Principles**	**x**	**x**	
(01)	*Describe the pulse technique and echo principle used by primary radar systems*	*x*	*x*	
(02)	*State that for providing echos to be detected by primary radar, no airborne equipment is required*	*x*	*x*	
92.3.1.2	**Presentation and interpretation**	**x**	**x**	
(01)	*State that primary radar only provides bearing and distance of targets*	*x*	*x*	
92.3.1.3	**Coverage and range**	**x**	**x**	
(01)	*State that the theoretical range of a radar is limited by technical factors, e.g. pulse length and frequency, transmission power, rotation speed of the antenna*	*x*	*x*	
92.3.1.4	**Errors and accuracy**	**x**	**x**	
(01)	*State that the chance for being detected by primary radar depends on the height of aircraft, height of antenna and frequency used*	*x*	*x*	
92.3.2	**Secondary surveillance radar and transponder**	**x**	**x**	
92.3.2.1	**Principles**	**x**	**x**	
(01)	*State that use of secondary surveillance radar (SSR) requires a transponder as airborne equipment*	*x*	*x*	
(02)	*Describe how pulses from primary radar triggers an active replay by the transponder of an aircraft which is received by a separate antenna*	*x*	*x*	

(03)	*Describe the advantages of SSR over a primary radar regarding the variety of information that can be transmitted*	*x*	*x*	
92.3.2.2	**Presentation and interpretation**	**x**	**x**	
(01)	*State that modern ATC systems use inputs from various sensors and SSR information to generate the display*	*x*	*x*	
(02)	*State that an aircraft can be identified by a unique code*	*x*	*x*	
(03)	*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*	
92.3.2.3	**Modes and codes**	**x**	**x**	
(01)	*State what information is provided by a transponder in modes A, C and S*	*x*	*x*	
(02)	*State there are 4096 different transponder codes, using only numerals 0 - 7*	*x*	*x*	
(03)	*Describe the use of the IDENT button*	*x*	*x*	
92.4	**GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSSs)**	**x**	**x**	
92.4.1	**GPS, GLONASS OR GALILEO**	**x**	**x**	
92.4.1.1	**Principles**	**x**	**x**	
(01)	*State that Global Navigation Satellite Systems (GNSS) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position*	*x*	*x*	
92.4.1.2	**Operation**	**x**	**x**	
(01)	*Explain how the signals of different satellites can be used to determine position in space*	*x*	*x*	
(02)	*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*	
(03)	*State that GNSS supplies three-dimensional position fixes and speed data (using doppler shift), plus a precise time reference*	*x*	*x*	
(04)	*State that the GNSS receiver is able determine position when receiving at least 4 satellites*	*x*	*x*	
(05)	*Describe the requirement to keep the databases used by GNSS current, and state the update cycle*	*x*	*x*	
92.4.1.3	**Presentation and interpretation**	**x**	**x**	
(01)	*State that when using deviation indicators with GNSS, the deviation corresponds to the absolute off-track distance (in NM)*	*x*	*x*	
(02)	*State that the scale of the off-track indication varies with the selected procedure (e.g. enroute or approach)*	*x*	*x*	
(03)	*State that the indicated speed corresponds to the actual ground speed (GS) of the aircraft*	*x*	*x*	
92.4.1.4	**Errors and factors affecting accuracy**	**x**	**x**	
(01)	*Describe 'receiver autonomous integrity monitoring (RAIM)' as a technique that ensures the integrity of the provided data by redundant measurements*	*x*	*x*	
(02)	*State that basic RAIM requires five satellites, a sixth one is for isolating a faulty satellite from the navigation solution*	*x*	*x*	

(03)	*Explain how RAIM information can be obtain before the flight (e.g. via NOTAM)*	*x*	*x*	
(04)	*State that 'geometric dilution of precision (GDOP)' arises from the geometry and number of satellites in view*	*x*	*x*	
(05)	*Explain why an automotive GPS or not aviation-specific GNSS system or mobile phone app is not an adequate primary source of navigation*	*x*	*x*	

Personnel Licensing Section