



Civil Aviation Safety Authority
of Papua New Guinea

Advisory Circular

AC66-2.7

Aircraft Maintenance Engineer Licence -Examination Subject 7 Piston Engines

**Issue1
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GENERAL

Civil Aviation Authority Advisory Circulars (AC) contain information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

PURPOSE

This Advisory Circular provides AMC for the syllabus content in respect of written examinations for Subject 7. (Piston Engines).

This Advisory Circular also provides GM for recommended study material in respect of the examination syllabus in this Advisory Circular.

RELATED CAR

This Advisory Circular relates specifically to Civil Aviation Rule Part 66 Subpart B – Aircraft Maintenance Engineer Licence.

General information on Aircraft Maintenance Engineer Licence (AMEL) examination requirements is contained in Advisory Circular AC66-1.

CHANGE NOTICE

This AC, replaces the Original AC dated 01 June 2015.

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Rule 66.57 Eligibility Requirements

Rule 66.57(a)(2) requires an applicant for an AMEL to have passed written examinations, that are acceptable to the Director, relevant to the duties and responsibilities of an aircraft maintenance engineer in the category of licence sought.

The written examinations acceptable to the Director for Subject 7 (Piston Engines) should comply with the syllabus contained in this Advisory Circular. Each examination will cover all topics and may sample any of the sub-topics.

The new syllabus has been developed after extensive industry consultation and the objectives reflect the knowledge required of current technology and international best work practice.

EXAMINATION OVERVIEW – SUBJECT 7

Subject 7 (Piston Engines) is closed book, written examination. The pass mark is 75 percent.

Application to sit an examination may be made directly online to ASPEQ. Refer to CASA Website <https://casapng.gov.pg/personnel-licensing/Examinations-and-Testing/> for examination information.

An AME sample question booklet with 15 representative questions pertaining to this subject is available for purchase from ASPEQ.

General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Electrical Fundamentals to permit the proper performance, supervision and certification of aircraft maintenance at a level commensurate with the privileges of the various AMEL categories.

Knowledge Levels

LEVEL 1: A familiarisation with the principal elements of the subject. Objectives: The applicant should:

1. be familiar with the basic elements of the subject.
2. be able to give simple descriptions of the whole subject, using common words and examples.
3. be able to use typical terms.

LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject.

An ability to apply the knowledge.

Objectives: The applicant should:

1. be able to understand the theoretical fundamentals of the subject.
2. be able to give a general description of the subject using, as appropriate, typical examples.
3. be able to use mathematical formulae in conjunction with physical laws describing the subject.
4. be able to read and understand sketches, drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using detailed procedures.

LEVEL 3: A detailed knowledge of the theoretical and practical aspects of the subject.

A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

Objectives: The applicant should:

1. know the theory of the subject and the interrelationships with other subjects.
2. be able to give a detailed description of the subject using theoretical fundamentals and

specific examples.

3. understand and be able to use mathematical formulae related to the subject.
4. be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using manufacturer's instructions.

Recommended Study Material

The publication list below provides guidance material for suitable study references for the overall syllabus content. However, applicants may have to conduct further research using other references or sources (including the internet) or attend a formal course in order to gain a comprehensive understanding of all sub-topics in the syllabus.

Where applicable, publication references have been placed below each main topic or sub topic heading in this syllabus.

Publication List

Study Ref	Book Title	Author	ISBN
1	A & P Technician Powerplant Textbook	Jeppesen	0-88487-207-6
2	Aviation Maintenance Technician Series Powerplant	Dale Crane	1-56027-410-7
3	Aircraft Ignition and Electrical Power Systems	Jeppesen	0-89100-063-1
4	Aircraft Propellers and Controls	Frank Delp	0-89100-097-6
5	Aircraft Reciprocating Engines	Jeppesen	0-89100-075-5
6	Aircraft Fuel Metering Systems	Jeppesen	0-89100-057-7
7	Dictionary of Aeronautical Terms	Dale Crane	1-56027-287-2

Syllabus Layout

Topic Numbering – left hand column

The syllabus is set out by topics, each of which is identified by a single-digit number. Each topic is divided into a number of sub-topics, which are identified by two-digit numbers: the first and second digits of which refer to the topic and the sub-topic respectively.

Each sub-topic is further sub-divided into one or more sub-sub-topics, which are identified by three-digit numbers. Where applicable, sub-sub-topics may be further subdivided into paragraphs that are identified by four/five digit alphanumeric sequences.

The three-digit sub-sub-topic numbers shown in the left hand column are used in the 'knowledge deficiency reports' to provide feedback on individual examinations.

Objective description – middle column

The middle column objectively describes each sub-sub-topic by stating, in plain language, its subject matter and the type of performance or activity required. The objectives are intended to be simple, unambiguous, and clearly-focussed, outcomes to aid learning.

Knowledge levels – right hand column

The right hand column specifies the knowledge level for each sub-topic heading. The three levels of knowledge used in this syllabus are described above. Note that the knowledge levels indicate the depth of knowledge required NOT its safety importance.

Syllabus -Subject 7 (Piston Engines)

1. Fundamentals

1 Fundamentals		
1.1	Principles of Piston Engine Operation <i>Study Ref. 1, 2 & 5</i>	
1.1.1	Define the following terms associated with piston engine design and operation: <ol style="list-style-type: none"> Bottom dead centre (BDC) Top dead centre (TDC) Clearance volume Bore Stroke Swept volume Firing order Ignition timing Valve timing 	2
1.1.2	Describe what is meant by the term "heat engine".	1
1.1.3	Compare the difference between internal and external combustion engines.	1
1.1.4	Define the term reciprocating engine.	1
1.1.5	Describe the Otto (four stroke) cycle and explain the events that take place during the induction, compression, power and exhaust strokes.	2
1.1.6	Describe how heat energy is converted into mechanical energy and the relationship between volume, pressure and temperature during the Otto cycle of operation.	2
1.1.7	Reproduce an indicator diagram of the volume and pressure relationship of the Otto cycle of energy release and identify on the diagram the following characteristics: <ol style="list-style-type: none"> Where the intake valve opens and closes Where the exhaust valve opens and closes Pressure rises and falls during each stroke Point of ignition and peak gas pressure Where pressure falls below atmospheric 	2
1.1.8	Using an indicator diagram, show how engine performance is affected by the following factors: <ol style="list-style-type: none"> Incorrect ignition timing Pre-ignition Detonation Induction leaks Burnt exhaust valves Incorrect mixture settings The effects of boosting Overheating Magneto drops and other ignition related defects 	2
1.1.9	State the requirements for effective combustion.	2
1.1.10	Define: <ol style="list-style-type: none"> valve lead lag overlap 	3

1.1.11	Explain why these characteristics have been incorporated into the valve operating cycle.	3
1.1.12	Describe with a diagram the relationship between valve opening and piston position.	2
1.2	Two Stroke Engines <i>Study Ref. 1, 2 & 5</i>	
1.2.1	State the limitations of two stroke piston engines for aeronautical use particularly where the demand is for high power capability.	1
1.2.2	State the advantages that small two stroke engines have over similar sized four stroke engines.	1
1.2.3	Describe the two-stroke cycle and outline the piston displacement and compression ratio.	1
1.2.4	Identify where and why there has been a resurgence of two-stroke engines in small aircraft.	1
1.3	Diesel Aircraft Engines <i>Study Ref 2</i>	
1.3.1	Describe a diesel aircraft engine and state its advantages.	1

2. Engine Performance

2 Engine Performance		
2.1	Engine Operating Parameters <i>Study Ref. 1, 2 & 5</i>	
2.1.1	Define the following terms and perform calculations from given information: a. Mechanical efficiency b. Thermal efficiency c. Volumetric efficiency	2
2.1.2	Describe how each of the above terms relates to the performance of a piston engine.	2
2.1.3	State in percentage terms how heat energy is utilised or lost in a piston engine.	2
2.1.4	Describe how and where heat is dissipated or lost in a piston engine.	2
2.1.5	Specify the effect of compression ratio on thermal efficiency.	2
2.1.6	Specify the effects that the following conditions have on the volumetric efficiency of a piston engine: a. Incorrect valve timing b. Excessive valve clearance c. Part-throttle operation d. Long intake pipes of small diameter e. Sharp bends in the induction system f. Excessive carburettor air temperature g. Excessive cylinder head temperature h. Incomplete exhaust scavenging	2
2.1.7	Describe propulsive efficiency and explain the relationship of engine power output to propeller thrust.	2
2.1.8	Define the following terms and state how they are measured: a. Compression ratio b. Manifold pressure c. Piston displacement	2
2.1.9	Calculate piston displacement and compression ratio from given information.	2
2.2	Engine Power Measurement <i>Study Ref. 1, 2 & 5</i>	
2.2.1	Define the following terms and perform relevant calculations: a. Work b. Force c. Power	2
2.2.2	Show the relationship of each of these terms when applied to piston engine operation.	2
2.2.3	Define the following terms: a. Indicated horsepower (IHP) b. Brake horsepower (BHP) c. Brake mean effective pressure (BMEP) d. Friction Horsepower (FHP) e. Horsepower (HP) and/or kilowatt (KW) f. Indicated mean effective pressure (IMEP)	2

2.2.4	From given information, perform calculations in respect of the above engine performance factors	2
2.2.5	Use appropriate charts and performance graphs found in manufacturer's information to extract engine power and fuel consumption figures.	2
2.2.6	Describe how engine power is measured using a dynamometer.	1
2.2.7	Describe the relationship of engine speed to power output.	2
2.3	Factors Affecting Engine Power <i>Study Ref. 1, 2 & 5</i>	
2.3.1	Detail brake specific fuel consumption (BSFC) and calculate the BSFC of a typical engine from given information.	3
2.3.2	Define the following conditions giving the approximate fuel air ratios for each: <ul style="list-style-type: none"> a. Cruise power mixture b. Lean best power c. Rich best power mixture d. Stoichiometric mixture 	2
2.3.3	Determine the symptoms and causes of the following conditions: <ul style="list-style-type: none"> a. After firing b. Back firing c. Detonation d. Pre-ignition 	3
2.3.4	Explain how rich and lean mixture burn rates affect engine performance.	3
2.3.5	Explain how the following atmospheric or operating conditions affect piston engine performance: <ul style="list-style-type: none"> a. Altitude b. Humidity c. Barometric pressure d. Temperature e. Icing f. Ram air g. Manifold pressure 	3
2.3.6	Describe the following terms relating to engine power output and fuel consumption: <ul style="list-style-type: none"> a. Full throttle power b. Normal rated power c. Propeller load horsepower d. Full throttle specific fuel consumption e. Propeller load specific fuel consumption 	2
2.3.7	Specify how the number of cylinders relates to an engine's smoothness of operation.	1

3.Engine Construction

3 Engine Construction		
ATA 72(R), 75, 78		
3.1	Aero Engine Design and Performance Requirements <i>Study Ref. 1, 2 & 5</i>	
3.1.1	Under the following headings, describe aero engine design and performance requirements that make specific engines uniquely suitable for aircraft propulsion: <ul style="list-style-type: none"> a. Reliability b. Durability c. Maintainability d. Compactness e. Power/weight ratio f. Specific power output g. Fuel economy h. Temperature control i. Free from vibration j. Operating flexibility k. Reasonable cost l. Growth potential m. Manufacturer support 	1
3.2	Engine Design and Layout <i>Study Ref. 1, 2 & 5</i>	
3.2.1	Describe the cylinder and crankcase layout, and the firing order of the following types of piston engine: <ul style="list-style-type: none"> a. Inline b. Opposed c. Vee 	1
3.2.2	Describe derivatives of these engine types such as multi-row, inverted and multi-cylinder arrangements.	1
3.2.3	Show examples of aeroplanes where each of the above piston engine types has been used during the period of aviation.	1
3.2.4	State how the cylinders are numbered for each of the above engines. Specify the different cylinder numbering between Continental and Lycoming engines.	2
3.3	Engine Construction – Top End <i>Study Ref. 1, 2 & 5</i>	
3.3.1	Describe the constructional features, function, classification and material composition of the following engine assemblies: <ul style="list-style-type: none"> a. Connecting rods b. Cylinders c. Inlet and exhaust manifolds d. Piston rings e. Piston pins (fixed and fully floating) f. Pistons 	2
3.3.2	Describe the different types of cylinder bore surfaces and the advantages, disadvantages and precautions when working with each. Specify the type of piston ring that would be assembled with each cylinder bore surface.	2

3.3.3	Specify the reason for piston ring stagger.	2
3.3.4	State why the under surfaces of pistons are often finned.	1
3.3.5	Identify typical defects and their cause/rectification that may be associated with the top-end components.	2
3.3.6	Describe how a compression test is carried out using a compression gauge and differential compression tester.	2
3.3.7	Interpret data obtained from compression tests.	2
3.3.8	Describe the basic practices associated with the removal and replacement of a cylinder assembly.	1
3.3.9	State how ring gaps and side clearances are measured and adjusted, where permitted.	2
3.3.10	State how cylinder heads and bores are normally attached.	2
3.4	Valves and Valve operating Mechanisms <i>Study Ref. 1, 2 & 5</i>	
3.4.1	Describe the constructional features, function and material composition of the following components: <ul style="list-style-type: none"> a. Cam followers b. Inlet and exhaust valves/seats/guides/springs c. Sodium-filled exhaust valves d. Push rods e. Rocker assemblies f. Tappets – especially hydraulic tappets 	2
3.4.2	Specify why aero engines usually have two or more valve springs and how valve spring binding is prevented.	2
3.4.3	Describe typical defects and their cause/rectification that may be associated with valves and valve operating mechanisms.	2
3.4.4	State how valve stems may be checked for bow.	2
3.4.5	Specify the purpose of valve clearance and the procedure for carrying out valve clearance adjustments on engines with camshafts.	2
3.4.6	Describe the effects of excessive valve clearance on valve timing and engine performance.	2
3.5	Engine Construction – Bottom End <i>Study Ref. 1, 2 & 5</i>	

3.5.1	Describe the constructional features, function, classification, material composition and special surface treatment/preparation techniques of the following bottom-end assemblies: <ul style="list-style-type: none"> a. Accessory/reduction gear boxes b. Cam shafts c. Crankshafts d. Counterweights e. Vibration dampers (including torsional/dynamic) f. Engine casings g. Sumps h. Ball bearings including thrust bearings i. Typical plain and roller bearings 	2
3.5.2	Identify typical defects and their cause/rectification that may be associated with bottom end components. Includes defects in the various types of bearings found in piston engines and their components.	2
3.5.3	State how crankshaft run-out is measured and the run-out figure derived.	2
3.5.4	Describe the design and operation of dynamic dampers.	2
3.5.5	Describe the various means of propeller attachment to the crankshaft.	2
3.5.6	State how oil sealing is achieved for the various crankcase components.	2
3.5.7	Specify when seals, gaskets and packings should be replaced during engine maintenance.	2
3.5.8	Describe the special maintenance requirements for magnesium castings.	2
3.5.9	Specify where torque values may be found for the tightening of engine hardware.	2
3.6	Engine Cooling <i>Study Ref. 1, 2 & 5</i>	
3.6.1	Describe how cooling is effected in both a typical air and liquid -cooled engine. Special consideration should be given to the following: <ul style="list-style-type: none"> a. Arrangement and purpose of cylinder fins, baffles and deflectors b. Air seals c. Exhaust augmenters d. Cowls, cowl flaps and gills e. Panels f. Blast tubes g. Cooling properties of lubricating oil. h. Liquid coolants including types, characteristics and hazards i. Water jackets j. Radiators, pipes and connections k. Cooling efficiency l. Heat exchangers 	2
3.6.2	Specify typical maintenance and rectification procedures for broken or damaged cylinder cooling fins.	2
3.7	Exhaust Systems <i>Study Ref. 1, 2 & 5</i>	
3.7.1	State why the length of an exhaust system is important to engine operation.	2
3.7.2	Describe typical exhaust attachment hardware including gaskets and the use of anti-seize compounds.	2

3.7.3	Describe the construction, features, material and operation of typical engine exhaust systems with particular regard to corrosion resistance, expansion and fabrication techniques.	2
3.7.4	Identify typical defects and repair schemes for exhaust systems. Includes special welding and treatment processes.	2
3.7.5	Determine safety issues associated with defective or damaged exhaust systems.	3
3.7.6	Detail the construction, maintenance and pressure testing of exhaust heater shrouds.	3
3.7.7	Explain typical carbon monoxide tests carried out in aircraft cockpits and cabins.	3
3.8	Engine Mounting and Cowls <i>Study Ref. 1, 2 & 5</i>	
3.8.1	Describe the following engine mounting criteria: <ul style="list-style-type: none"> a. Mount design and geometry b. Dynamic suspension c. Tangential suspension d. Dynafocal mounts (Link and pedestal type) e. Lord mounts f. Shock and anti variation mounts g. Mounting pads h. Baskets and frames i. Mounting hardware including engine bearers and bearer mounting points j. Stresses in engine mounts k. Engine mounts condition assessment l. Electrical bonding of mounts m. Corrosion treatment of mounting structure n. Safety precautions associated with the installation and removal of engines o. Lifting points and lifting hardware 	2
3.8.2	Describe the construction, function and maintenance of the following powerplant items: <ul style="list-style-type: none"> a. Firewalls b. Cowls and associated hardware c. Acoustic panels d. Nacelles e. Nacelle plumbing including hoses, pipes, feeders, and connections from systems to the engine f. Drains g. Lifting points h. Feeders i. Connectors j. Wiring Looms k. Exhausts and inlets associated with engine installation 	2
3.9	Maintenance <i>Study Ref. 1, 2 & 5</i>	
3.9.1	Outline the general requirements of a top-end maintenance identifying the components involved, tools and special maintenance practices and procedures used.	1
3.9.2	Explain why lead pencil and other carbon containing products must not be used on engine exhausts.	3

4. Ignition Systems

4 Ignition Systems		
ATA 74		
4.1	Battery Ignition Systems <i>Study Ref. 1, 2 & 3</i>	
4.1.1	Describe the circuit layout and principles of operation of a battery ignition system.	1
4.1.2	Specify the purpose of each of the following components in the system: <ol style="list-style-type: none"> a. Ignition switch b. Capacitor c. Cam d. Points e. Distributor f. Battery g. Spark plugs h. Coil 	1
4.1.3	Explain the limitations of battery powered ignition systems for aircraft use.	1
4.2	Magnetos – General <i>Study Ref. 1, 2 & 3</i>	
4.2.1	Describe the constructional features of the following types of aircraft magneto: <ol style="list-style-type: none"> a. Rotating coil b. Polar inductor c. Rotating magnet 	2
4.3	Magnetic Circuit <i>Study Ref. 1, 2 & 3</i>	
4.3.1	Explain the following terms in relation to the magnetic circuit of a rotating magnet magneto system: <ol style="list-style-type: none"> a. Static flux b. Resultant flux c. Soft iron core d. Full register e. Neutral f. E gap angle g. Flux reversal h. Pole shoes i. Flux flow j. Flux lines k. Flux eddies l. Polarity 	2
4.3.2	Show by graphical representation changes in flux density as the magnet of a magneto rotates through 360 degrees.	2
4.3.3	Specify how an electrical current is produced in the primary circuit as the magneto armature is rotated.	2

4.3.4	Describe the layout of the primary circuit of a rotating magnet magneto and state the purpose of the following components: <ul style="list-style-type: none"> a. Primary and secondary windings b. Capacitor c. Breaker points d. Cam e. Magneto switch 	2
4.3.5	Describe the layout of the secondary circuit and how a high-tension spark is produced at the cylinder spark plugs.	2
4.3.6	Specify how the secondary circuit is grounded.	2
4.3.7	Distinguish between high and low tension ignition systems, the advantages and disadvantages, and where each system is likely to be found.	1
4.3.8	Describe the construction and operation of a low-tension ignition system.	1
4.3.9	State the purpose, construction and operation of a dual magneto incorporating two ignition systems.	1
4.3.10	Explain why most aircraft engines have twin ignition systems.	2
4.3.11	Describe the internal construction of a magneto and the purpose of internal components.	2
4.4	Magneto Operation <i>Study Ref. 1, 2 & 3</i>	
4.4.1	Specify how magneto points-gapping affects timing.	2
4.4.2	Distinguish between advance/retard ignition timing.	2
4.4.3	Describe the operation of magneto switches.	2
4.4.4	Define what is meant by the dwell angle and how it relates to magneto operation.	2
4.4.5	Describe the relationship between distributor and crankshaft speed of a reciprocating engine.	2
4.5	Ignition leads <i>Study Ref. 1, 2 & 3</i>	
4.5.1	Describe the construction and installation of ignition leads and attaching hardware.	2
4.5.2	Specify the reason for crossover ignition wiring.	2
4.5.3	State how ignition leads are tested for insulation and continuity and suggest possible causes for leads to fail either of these tests.	2
4.5.4	Describe the operation of a modern harness tester.	2
4.5.5	State how radio interference occurs, the common sources and how interference is minimised/eliminated from aircraft ignition and electrical systems.	2
4.5.6	Describe how ignition leads are cleaned and protected from deterioration. Particular emphasis should be placed on the prevention of chaffing, fouling, contaminants, burning and moisture ingress.	2

4.5.7	State typical procedures for changing an ignition lead in an ignition harness while in service.	2
4.6	Spark Plugs <i>Study Ref. 1, 2 & 3</i>	
4.6.1	Identify the following types of aero engine spark plug: a. Massive b. Fine wire	2
4.6.2	Describe the construction and functions of the following spark plug components: a. Metal shell b. Ceramic insulator c. Terminal contact d. Electrode assembly including centre and ground electrodes e. Resistor f. Glass seal g. Washer or gasket	2
4.6.3	Specify how the shell /cylinder thread is classified.	2
4.6.4	Describe what is meant by spark plug reach and how it is classified for aero engines.	2
4.6.5	Describe what is meant by heat range and how it is classified.	2
4.6.6	Specify how the polarity of current change affects spark plug operation.	1
4.6.7	Identify cylinder combustion characteristics from the examination of a recently removed spark plug.	2
4.6.8	State how a spark plug is cleaned and tested both by hand and using proprietary cleaning equipment.	2
4.6.9	State why it is normal to exchange plugs top for bottom and next in firing order during refitment.	2
4.6.10	Identify the wear characteristics and limits for a spark plug.	2
4.6.11	Specify the correct gapping procedures for a spark plug using the correct tools and measuring devices.	2
4.6.12	Describe a spark plug that has lead fouling.	2
4.6.13	Explain the correct installation procedures for a spark plug with particular regard to the following: a. Thread serviceability b. Thread lubricants c. Washer serviceability d. Thermocouples e. Seating of the plug f. Torque loading g. Lead (cigarette end) cleaning and installation	3
4.6.14	Describe the procedure for repairing a threaded spark plug insert in a cylinder head.	1

4.6.15	State the effects on engine performance of the following spark plug defects: <ul style="list-style-type: none"> a. Gap too wide or too small b. Electrodes worn beyond limits c. Excessive carbon and lead deposits d. Incorrect heat range e. Incorrect thread length f. Cracked insulator g. Burnt resistor h. Dirty or damaged cigarette end 	2
4.7	Auxiliary Starting devices <i>Study Ref. 1, 2 & 3</i>	
4.7.1	State the purpose, construction and principles of operation of the following devices: <ul style="list-style-type: none"> a. Impulse coupling b. Booster magneto c. Shower of sparks (induction vibrator) system 	2
4.7.2	Describe the procedure for timing a magneto fitted with an impulse coupling.	2
4.8	Ignition System Maintenance Equipment	
4.8.1	State the purpose, operating principles and correct usage of the follow maintenance and test equipment: <ul style="list-style-type: none"> a. Sparkplug cleaner and tester b. Continuity tester c. Megger d. Insulation tester e. Piston position indicator f. Lamp and battery g. Condenser tester 	1
4.9	Ignition System Maintenance <i>Study Ref. 1, 2 & 3</i>	
4.9.1	From given information, interpret ignition and starting system circuit diagrams and determine system operation and system faults.	2
4.9.2	Describe the procedures for magneto internal timing and magneto to engine timing.	2
4.9.3	Describe the following criteria associated with magneto timing: <ul style="list-style-type: none"> a. Where engine-timing marks are normally found b. The use of devices that establish the points opening position c. Devices used to establish piston position 	2
4.9.4	Specify the purpose of magneto synchronisation and how this is achieved.	2

4.9.5	<p>Specify how the following magneto irregularities are caused and how they affect piston engine operation:</p> <ul style="list-style-type: none"> a. Spark too far advanced or retarded (incorrect ignition timing) b. Broken impulse coupling spring c. Loss of magnetism in the armature d. Incorrect internal timing e. Distributor flashover f. Distributor tracking g. Cracked distributor rotor h. Dirty internal surfaces i. Cracks in the insulations j. Unserviceable capacitor k. A “ground” or “open” in the switch circuit l. Burnt or eroded C/B points m. Broken or shorted coil windings n. Blocked vents o. Incorrect C/B gap setting p. Incorrect C/B spring tension q. Twisted magneto or distributor drive r. C/B cam wear s. Armature bearing float t. Loose or perished magneto/engine coupling u. Loss of magneto synchronisation v. Worn cam follower w. Lack of cam lubrication x. Lack of insulation at the primary lead stud 	2
4.9.6	Explain why a retarded spark is required for engine starting.	2
4.9.7	Describe how grease or carbon tracks are cleaned from magnetos, distributors and spark plug insulations.	2
4.9.8	Specify the safety precautions associated with ignition systems.	2

5.Engine Fuel Systems

5 Engine Fuel Systems		
ATA 73		
5.1	Terms and Definitions Relating to Fuel <i>Study Ref. 1, 2 & 3</i>	
5.1.1	Define the following terms in relation to piston engine fuels: <ol style="list-style-type: none"> Anti-knock additive (TEL) Octane rating Performance number including lean and rich mixture ratings Reid vapour pressure test values Calorific value of fuel Specific gravity Volatility Vapour locking 	1
5.1.2	Describe the chemical makeup of aviation fuel with particular regard to the following terms: <ol style="list-style-type: none"> Aromatics Iso-octane Heptane 	1
5.2	Fuel Classification and Identification <i>Study Ref. 1, Ref. 2, Ref. 7</i>	
5.2.1	State how piston engine fuels (aviation gasoline) are classified in terms of grade or performance rating.	2
5.2.2	Describe what is conveyed by fuel designations such as 80/87, 100/130 in regard to lean and rich mixture operation.	1
5.2.3	State the colour code identification for the common grades of fuel.	2
5.2.4	State the purpose of the additive ethylene dibromide in aviation gasoline.	1
5.3	Fuel System Requirements <i>Study Ref. 1, 2 & 3</i>	
5.3.1	Specify the basic fuel system design requirements.	1
5.3.2	Outline a basic fuel system from the tank/s to the engine with particular regard to the following: <ol style="list-style-type: none"> Design, construction, materials, and location of typical fuel tanks and cells Fuel cocks Fuel drains Filters and strainers Vents Cross-feeds Auxiliary and engine driven pumps Differences between gravity feed and pressure-fed systems Plumbing and plumbing hardware Pressure and quantity sensing devices 	2
5.3.3	Specify important requirements for the installation and routing of fuel lines.	2
5.3.4	Describe how vapour locking is caused, detected in service and eliminated.	2

5.3.5	Describe what is meant by the term “cylinder washing” and its cause and effect.	2
5.3.6	Specify the effects of aromatic aviation fuels on rubber components.	2
5.4	Engine Fuel System Components and Plumbing <i>Study Ref. 1, 2 & 3</i>	
5.4.1	Describe the location, construction and operation of the following fuel system components: <ul style="list-style-type: none"> a. Engine driven fuel pump and relief valve/bypass valve assembly b. Auxiliary fuel booster pump (centrifugal and pulsating) c. Main fuel filter/strainer d. Hand operated pump e. Fuel drains f. Fuel vents g. Fuel primers h. Fuel hoses and rigid pipes 	1
5.4.2	Describe the purpose of a diaphragm fitted to vane type fuel pumps.	1
5.4.3	State how fuel vaporisation may be enhanced by the use of oil heater jackets or pipes through the oil sump.	1
5.4.4	Explain the effects of a leaking or unlocked fuel priming pump on engine performance.	3
5.5	Handling and Storage of Fuels <i>Study Ref. 1, 2 & 6</i>	
5.5.1	State the ground handling requirements and the safety precautions to be observed with the use of piston engine fuels including drum storage and refuelling.	2
5.5.2	Describe the various forms of fuel system contamination, including the following: <ul style="list-style-type: none"> a. Foreign particles b. Other grades/types of fuels c. Sediment d. Water 	2
5.5.3	Specify methods of fuel system contamination detection and control including the use of water detection kits and paste.	2
5.5.4	Describe fuel storage limitations and causes of deterioration in fuel quality.	2
5.5.5	Describe the effect of temperature on fuel weight.	2
5.6	Fuel Air Ratios and the Principles of Combustion <i>Study Ref. 1, 2 & 6</i>	
5.6.1	Describe the concepts relating to fuel air mixture and why it is important for combustion.	2
5.6.2	State typical fuel air ratios encountered during engine operation.	2
5.6.3	Describe the effects of altitude on fuel air mixture.	2
5.6.4	Define what is meant by the following terms. Exhaust gas dilution Specific fuel consumption	2
5.6.5	Outline the basic requirements for a fuel metering system.	2

5.6.6	Describe the function and information contained on fuel air mixture and SFC curves.	2
5.6.7	Explain the effects of fuel mixture on cylinder head temperature at power.	3
5.6.8	Explain why piston engines are tuned to run rich at idle RPM.	2
5.6.9	Identify from exhaust colour emission a lean, correct and rich mixture.	1
5.6.10	Describe the effects of exhaust backpressure on engine performance at altitude.	2
5.6.11	Specify the by-products associated with combustion and the effects these products can have on the internal condition of components and aircraft structure.	2
5.6.12	Describe the effects of carburettor heat on mixture and subsequent engine performance.	2
5.7	Float-Type Carburettors <i>Study Ref. 1, 2 & 6</i>	
5.7.1	Describe the principles of operation and constructional features of a typical float type carburettor.	2
5.7.2	Distinguish between down draft and updraft configurations.	1
5.7.3	Outline the basic characteristics of airflow through a carburettor venturi and how these are used in the operation of a carburettor or fuel/air-metering unit.	2
5.7.4	Describe the effects of venturi size on engine performance.	1
5.7.5	Specify how a throttle butterfly modifies venturi airflow characteristics at low and high power settings.	2
5.7.6	Describe the principles of an air-bleed system.	2
5.7.7	Describe the purpose, construction and principles of operation of the following components: <ul style="list-style-type: none"> a. Accelerator pump b. Discharge nozzle c. Float chamber d. Float chamber vents, drains and plugs e. Venturi f. Main/idle jets g. Idle mixture control systems h. Back suction mixture control systems i. Back suction economiser systems j. Power enrichment systems k. Throttle valves l. Idle cut-off systems m. Carburettor air scoops n. Altitude control 	2

5.7.8	State the effects of the following carburettor defects on engine performance and how each would be identified and rectified: <ul style="list-style-type: none"> a. Damaged float valve seat b. Blocked float chamber vent c. Punctured or damaged float d. Incorrect float level setting e. Worn accelerator pump seals f. Leaking throttle lay-shaft seals g. Leaking discharge nozzle or main jet h. Loose main or slow running jet i. Loose carburettor mounting j. Small air leak in the induction system k. Leaking carburettor gaskets l. Incorrectly adjusted fuel pressure m. Blocked strainers or finger screens n. Incorrectly adjusted or leaking mixture control and idle cut-off 	2
5.7.9	Specify why and how engines are shut down using an idle cut-off system.	2
5.8	Carburettor Icing <i>Study Ref. 1</i>	
5.8.1	Describe how the following types of carburettor icing occur and are controlled. Impact Throttle Evaporation icing	2
5.8.2	State the climatic conditions when carburettor icing is most prevalent.	2
5.8.3	Specify the conditions for use and the effects of carburettor heat on engine performance.	2
5.8.4	State the symptoms of carburettor icing during flight.	2
5.9	Engine Induction Systems <i>Study Ref. 1, 2</i>	
5.9.1	Describe the constructional features and operation of typical engine induction/intake and alternate air supply systems.	2
5.9.2	Describe the construction and maintenance of typical induction air filters.	2
5.9.3	State the effects on engine operation of blocked, contaminated or damaged air filter elements.	2
5.9.4	Specify devices for controlling the entry of hot air into the induction system, including heater shrouds and muffs.	2
5.9.5	Describe the use and maintenance of flexible air hose (Scat hose) in induction air systems.	2
5.10	Induction Manifolds <i>Study Ref. 1, 2</i>	
5.10.1	Describe the construction, operation, and sealing of induction manifold assemblies.	2
5.10.2	State how induction leaks are detected and their effects on engine performance at high and low power settings.	2

5.10.3	State typical manifold pressures for boosted and un-boosted engines.	2
5.10.4	Describe why a rich mixture is normally required to start a cold engine.	2
5.10.5	Explain why a manifold leak is likely to have a more pronounced affect on engine operation at low RPM.	2
5.11	Carburettor Maintenance <i>Study Ref. 1, 2 & 6</i>	
5.11.1	Outline the procedures for the installation, removal and servicing of carburettor systems and system components.	1
5.11.2	Describe why carburettors should be soaked in fuel prior to installation.	2
5.11.3	From given information, describe procedures for the inspection, adjustment and functional checks required on the carburettor systems following maintenance.	2
5.11.4	Describe why engine RPM increases when idle cut-off is selected.	2

6. Injection Systems

6 Injection Systems		
ATA 73		
6.1	Pressure Injection Carburettors <i>Study Ref. 1, 2 & 6</i>	
6.1.1	Describe the principles of operation of a typical pressure injection carburettor.	1
6.2	Fuel Injection Systems <i>Study Ref. 1, Ref. 7</i>	
6.2.1	Outline a typical fuel injection system.	1
6.2.2	Describe the function and operation of the following injection system components: <ul style="list-style-type: none"> a. Altitude mixture control b. Fuel control unit c. Fuel injection pump d. Injector nozzles e. Manifold valve f. Venturis g. Flow dividers h. Fuel air metering forces i. Impact tubes j. Throttle valves 	1
6.2.3	Describe the procedure for the installation, removal, inspection and servicing of fuel injection systems and system components.	1
6.2.4	From given information, describe the procedures for the inspection, adjustment and functional checks required of the fuel injection system and components following maintenance.	1
6.2.5	Identify the effects of faults in components on the fuel injection system and determine the rectification requirements of system faults.	1

7. Lubrication Systems

7 Lubrication Systems		
ATA 79		
7.1	Requirements of Lubricating Oil <i>Study Ref. 1, 2 & 5</i>	
7.1.1	Describe the characteristics of piston engine lubrication oil with particular reference to the following requirements: <ol style="list-style-type: none"> Friction reduction Heat absorption Sealing of moving components Cushioning against shock loads Cleaning Corrosion protection 	2
7.2	Properties of Lubricating Oil <i>Study Ref. 1, 2 & 5</i>	
7.2.1	State the properties and specific uses of the following oils and additives: <ol style="list-style-type: none"> Ashless dispersant Detergent Hypoid and extreme pressure lubricants Mineral Multi viscosity Synthetic 	1
7.2.2	Define the following engine oil rating terms and state their affects on piston engine operation: <ol style="list-style-type: none"> Cloud point Flash point Pour point Viscosity and viscosity index Kinematic viscosity rating (centistokes) 	1
7.2.3	Describe the engine design and operating factors that determine the grade of oil to be used in a particular engine.	2
7.3	Engine Oil Grading System <i>Study Ref. 1, 2 & 5</i>	
7.3.1	Describe the SAE grading system and give examples of where the SAE grades may be used throughout the range of climatic temperatures.	1
7.3.2	Specify conditions, limitations and precautions when mixing types and grades of oil.	2
7.4	Grease <i>Study Ref. Manufacturer's Information</i>	
7.4.1	Describe the types, characteristics and uses of common aircraft greases.	1
7.5	Lubrication Systems <i>Study Ref. 1, 2 & 5</i>	
7.5.1	Describe the operating principles, construction and layout of wet and dry sump lubrication systems.	1

7.5.2	State the suitability for each type of engine and how compensation may be made for aerobatic manoeuvres.	1
7.5.3	Describe the following types of lubrication system, their characteristics and the advantages and disadvantages of each: <ul style="list-style-type: none"> a. Pressure lubrication b. Splash lubrication c. Spray lubrication d. Combination system 	1
7.5.4	Describe the constructional features and operation of the following lubrication system components and state where they may be located within the lubrication system: <ul style="list-style-type: none"> a. Check valves b. Oil galleries c. Oil spray jets d. Oil cooler regulators and Vernatherm valves e. Oil coolers f. Oil cooler surge protection devices g. Oil dilution subsystems h. Oil filters i. Filter elements providing depth, semi-depth, surface and edge filtration j. Cono filters k. Filter bypass systems l. Oil tanks/hoppers m. Oil pressure regulation including reliefvalves n. Pressure pumps (gear and gerotor) o. Scavenge pumps p. Oil separators q. Cooler flaps r. Sludge chambers 	1
7.5.5	Specify the lubrication method normally applied to the following parts of an engine: <ul style="list-style-type: none"> a. Valve gear b. Pistons and cylinders c. Crankshaft and camshaft bearings d. Cam followers e. Hydraulic tappets f. Accessory drive gears and bushes/bearings g. Propeller h. Turbocharger or supercharger 	2
7.6	Lubrication System Maintenance <i>Study Ref. 1, 2 & 5</i>	
7.6.1	Describe the procedures for the inspection and servicing of engine oil systems.	2
7.6.2	Specify the procedures for the inspection and servicing of the lubrication oil cooling, temperature control and temperature/pressure measurement systems.	2
7.6.3	Describe the procedures for the inspection and servicing of engine lubrication system filters and screens.	2
7.6.4	Identify the effects of faults in components in lubrication systems and determine rectification requirements.	2

7.6.5	<p>Identify the causes, effects and rectification actions of the following common lubrication system abnormalities:</p> <ol style="list-style-type: none"> a. Low or high oil pressure b. High oil temperature c. Wear debris found in oil filters d. Sludging e. Frothing and foaming f. Water contamination g. Coking h. High oil consumption i. Excessive smoking j. Excessive crankcase breathing or venting k. Oils leakage and seeping l. Glazing of moving components m. Engine oil discolouration n. Oil system surging 	2
7.6.6	State the requirements and procedures for engine oil priming and oil dilution.	1
7.6.7	State why some engines must be run-in on mineral oil.	1
7.6.8	Describe the primary sources of oil system contamination and how contaminants may be used to determine component failures.	2
7.6.9	State why oil changes at predetermined periods are essential to maintaining the good health of an engine.	2
7.6.10	Describe procedures for flushing oil systems.	2
7.6.11	Specify procedures for flushing and pressure testing oil coolers.	2
7.6.12	Describe the construction, installation, bonding and pressure testing of plain hose joints, rigid pipes and pre fabricated hose assemblies.	2
7.6.13	Describe oil system replenishment procedures with particular regard to when replenishment should take place after shut down.	2
7.6.14	State how and when oil pressure relief valves would normally be adjusted.	2
7.6.15	Describe the causes and effects of changes to oil pressure and temperature during all aircraft operating profiles.	2
7.6.16	Specify the design, installation and maintenance requirements of a full-flow oil filter including filter bypass arrangements.	2

8. Super-charging and Turbo-charging Systems

8 Supercharging & Turbocharging Systems		
ATA 72(R)		
8.1	Principles of Supercharging <i>Study Ref. 1 & 2</i>	
8.1.1	State the purpose and principles of supercharging and its effects on the following performance factors: <ol style="list-style-type: none"> a. Brake horsepower (BHP) b. Charge density and temperature c. Detonation d. Fuel consumption e. Manifold absolute pressure (MAP) f. Revolutions per minute (RPM) g. Volumetric efficiency h. Sea level to high altitude operation 	2
8.2	Supercharging Terminology <i>Study Ref. 1 & 2</i>	
8.2.1	Define the following terms: <ol style="list-style-type: none"> a. Boot-strapping b. Critical altitude c. Ambient pressure d. Boost manifold pressure e. Deck/upper deck pressure f. Density altitude g. Over-boost h. Overshoot i. Rated altitude j. Service ceiling k. Rated power 	1
8.3	Construction and Operation <i>Study Ref. 1 & 2</i>	
8.3.1	Describe the construction and operating principles of a geared supercharger.	2
8.3.2	Describe the construction, location and function of the following components: <ol style="list-style-type: none"> a. Diffuser and vanes b. Engine gear drive c. Impellor d. Intercooler e. Turbine 	2
8.3.3	Describe the construction and operation of a turbo charger with particular regard to the following components and systems: <ol style="list-style-type: none"> a. Housings b. Rotating assemblies c. Bearings d. Back plates e. Lubrication system and protective devices 	2
8.4	System Configurations <i>Study Ref. 1 & 2</i>	

8.4.1	Distinguish between the following systems: a. External (turbo supercharger) b. Internal (supercharger) c. Multi-speed d. Multi-stage e. Ground and altitude boosted	1
8.5	Turbocharger Control <i>Study Ref. 1 & 2</i>	
8.5.1	Specify the operation and layout of a system consisting of the following: a. Absolute pressure controller b. Variable absolute pressure controller c. Manifold pressure relief valve d. Ratio controller e. Waste gate assembly	2
8.5.2	Describe the operation and construction of all system components and installation requirements.	2
8.5.3	Specify the operation and layout of a system consisting of the following: a. Density controller b. Differential pressure controller c. Waste gate assembly d. Ground adjusted waste gate valve e. Pressure relief valve	2
8.5.4	Describe the operation construction and adjustment of all system components and describe their installation requirements.	2
8.5.5	Describe the operation of a turbocharger control system over the parameters from engine start to rated altitude.	2
8.5.6	State the effects on engine performance of defects associated with the failure of turbo-charger components.	2
8.5.7	Identify the following supercharger or turbocharger faults and determine how each may be rectified: a. Low power b. Surging c. Low deck pressure d. High deck pressure e. Low critical altitude f. Low oil pressure	2

9.Engine Controls

9	Engine Controls	
	ATA 76	
9.1	Control Systems <i>Study Ref. 1 & 2</i>	

9.1.1	Describe the construction, layout and principles of operation of a typical light aircraft engine control system with particular regard to the following controls: <ul style="list-style-type: none"> a. Throttle b. Pitch c. Mixture d. Carburettor heat e. Cooler flaps f. Turbo-charger g. Alternate air 	2
9.1.2	Describe the following control system components: <ul style="list-style-type: none"> a. Pushrod assemblies b. Control stops c. Cable assemblies d. Flexible cable systems (e.g. Teleflex) e. Quadrants f. Panel attachment devices g. Levers 	2
9.2	Control System Maintenance <i>Study Ref. 1 & 2</i>	
9.2.1	From given information, describe the procedures for the adjustment and rigging of each of the controls that govern engine operation.	2
9.2.2	Specify the effects on engine operation of making adjustments to the various control stops.	2
9.2.3	Describe the importance of spring-back and cushion.	2
9.2.4	State the correct sequence of control stop contact and how this is correctly determined.	2
9.2.5	Identify the effects of faults, control maladjustment and rigging problems on the engine controls and determine the rectification action requirements of these problems or faults.	2
9.2.6	Specify typical procedures for the inspection and lubrication of control rod ball ends.	2
9.2.7	Describe the installation, adjustment and tensioning of control cable runs.	2
9.3	Duplicate Inspection of Engine Controls <i>Study Ref. 1, 2 & AC43</i>	
9.3.1	Detail the requirements for a duplicate inspection of flying controls with particular respect to the following: <ul style="list-style-type: none"> a. By definition, know what constitutes a control system that would require a duplicate inspection b. Selection and training of persons to perform second inspections c. Determining the extent of the inspection d. Determining correct assembly, functioning, sense, freedom of operation and locking of all engine control systems. 	2

9.3.2	Describe the following maintenance activities relating to engine controls and give details of safety inspections you would carry out: <ul style="list-style-type: none">a. Correct assembly of control componentsb. Checking the safety of threaded end fittingsc. The use of jam or lock nutsd. Safety wiring of control system components and stopse. Determining the range of movement of controlsf. Setting spring back or cushiong. Checking assembly and installation of Teleflex or conduit type controlsh. Checking function and sense of controlsi. Checking control clearancesj. Checking adjustment and locking of primary and secondary control stops	2
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10. Fire Protection Systems

10 Fire Protection Systems		
ATA 71		
10.1	Classification of Fires <i>Study Ref. 1 & 2</i>	
10.1.1	State the three elements required to make a fire burn.	1
10.1.2	Describe how a fire extinguisher system puts out a fire.	1
10.1.3	State how fires are classified and give examples of each type.	1
10.1.4	State how engine fire zones are classified and give examples of each.	1
10.1.5	Specify how induction fires are extinguished during engine start or ground operation.	1
10.1.6	Describe decontamination procedures after a fire bottle has been discharged.	2
10.2	Extinguishants <i>Study Ref. 1 & 2</i>	
10.2.1	Describe the chemical composition, uses, advantages and disadvantages of the following piston engine extinguishants: a. Carbon dioxide b. Halogenated hydrocarbons	2
10.3	Fire Extinguishing Systems <i>Study Ref. 1 & 2</i>	
10.3.1	Describe the layout and principles of operation of typical fire detection and extinguishing systems fitted to a piston engine aircraft with particular emphasis on the following: a. Thermocouple systems b. Continuous-loop detector systems such as the Kidde and Fenwal systems c. Spot detector systems	2
10.3.2	Describe the construction, principles of operation, precautions, maintenance and testing requirements of the following fire system components: a. Cylinders and bottles b. Spray and discharge rings c. Detector elements d. Explosive squibs and cartridges (including life limitations and special handling requirements) e. Frangible discs f. Fusible plugs g. Electrical connectors	2
10.3.3	Describe fire extinguisher system operational tests.	2

11. Engine Starting and Ground Operation

11 Engine Starting and Ground Operation		
ATA 80		
11.1	Starters <i>Study Ref. 1 & 2</i>	
11.1.1	Specify the principles of operation of the following types of starter: a. Electric inertia b. Direct-cranking electric	1
11.1.2	Describe the type, and operating characteristics of a common piston engine starter motor.	2
11.1.3	Identify the following starter engagement methods: a. Manual b. Bendix c. Solenoid	1
11.1.4	State the following starting system components: a. Ring gear b. Clutches and torque overload release devices c. Starter gear mechanisms d. Inertia assemblies	2
11.1.5	Describe an engine starting electrical schematic for both a light single and twin-engine aircraft and be able to describe how tests are carried out for circuit and component serviceability.	1
11.1.6	Describe typical starter motor defects and their rectification requirements.	2
11.2	Engine Starting and Ground Running <i>Study Ref. 1 & 2</i>	

11.2.1	<p>Detail typical ground running procedures for a single and light twin-engine aircraft, with particular regard to the following:</p> <ol style="list-style-type: none"> a. Positioning of the aircraft b. Safety of ground personnel c. Chocking d. Hand-swinging e. Ground inspection and fluid checks f. Internal and external security g. Pre-starting checks h. Electrical power i. Instruments and comms equipment j. Fuel management k. Engine priming l. Hydraulicing checks m. Control settings (throttle, mixture, pitch, carb heat, etc) n. Brake operation o. Magneto switches p. Starter operation q. Post start checks r. Post shut-down checks s. Idle cut-off operation t. Switches and power u. Power checks v. Reference (static) RPM checks w. Clearing an over-primed engine (radial and others) x. Ground running precautions 	3
11.2.2	Determine how the ignition system is checked for correct operation with particular regard to identifying a live or faulty magneto or faulty spark plug. State expected performance figures.	3
11.2.3	Explain why an RPM drop naturally occurs when one magneto is isolated.	3
11.3	Engine Operation	
	<i>Study Ref. 1, 2 & 5</i>	
11.3.1	Explain the requirements and procedures for a cold cylinder check.	3
11.3.2	From given information, diagnose faults encountered during engine starting and ground running and determine the rectification actions required.	2
11.3.3	Determine typical engine power output parameters and limitations by interpretation of given power charts or graphs.	3
11.3.4	From given information, diagnose faults and defects encountered during flight operations and determine the necessary rectification actions required.	2
11.3.5	Interpret performance data such as fuel pressure, oil pressure, manifold pressure and RPM. Describe adjustment procedures to correct abnormalities.	2
11.3.6	Describe the sequence of increasing and reducing RPM and manifold pressure on an engine fitted with a variable pitch propeller.	2
11.4	Storage of Piston Engines	

11.4.1	Describe the following criteria for placing engines in long and short-term storage: <ul style="list-style-type: none">a. Corrosion-prevention materialsb. Corrosion-prevention compoundsc. Dehydrating agentsd. Corrosion-prevention treatmentse. Fluid drainingf. Internal preservation of crankcases and cylindersg. Prevention of crankshaft rotation after preservationh. Sealing and blankingi. Inspection of stored enginesj. Ground-running periods for engines in short term or temporary storagek. Storage in containersl. Preservation of accessories and componentsm. Depreservation	1
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12. Piston Engine Propellers

12 Piston Engine Propellers		
ATA 61		
12.1	Propeller Terminology <i>Study Ref. 1, 2 & 4</i>	
12.1.1	Define and explain the following terms relating to propellers: <ol style="list-style-type: none"> a. Leading edge b. Blade face c. Blade back d. Chord line e. Solidity ratio f. Leading edge g. Trailing edge h. Plane of rotation i. Hub assembly j. Hub bore k. Boss (wood Propellers) l. Blade Shank m. Blade n. Tip o. Blade curvature p. Blade cross section q. Blade stations r. Pitch distribution (twist) 	2
12.2	Propeller Theory <i>Study Ref. 1, Ref. 2, Ref. 4</i>	
12.2.1	Define, giving practical explanations, the following terms relating to the operation of a propeller: <ol style="list-style-type: none"> a. Angle of attack b. Relative wind c. High/low blade angle and reverse angle d. Axis of rotation e. Forward velocity f. Propeller pitch g. Geometric pitch h. Effective pitch i. Slip j. Static RPM k. Rotational speed 	2
12.2.2	Describe the primary purpose of a propeller with respect to engine power and thrust.	2
12.2.3	Specify the effects of changes in the direction of the relative airflow on blade angle of attack.	2
12.3	Operational Forces Acting on a Propeller <i>Study Ref. 1, 2 & 4</i>	

12.3.1	Describe the cause and effects of the following forces acting on a propeller: <ul style="list-style-type: none"> a. Centrifugal force b. Thrust bending force c. Torque bending force d. Aerodynamic twisting moment e. Centrifugal twisting moment f. Vibrational force and critical range 	1
12.4	Propeller Classifications <i>Study Ref. 1, 2 & 4</i>	
12.4.1	Describe the following classifications of propellers. Compare advantages and disadvantages and give examples where each may be used on aircraft: <ul style="list-style-type: none"> a. Tractor propellers b. Pusher-type propellers c. Fixed pitch including, standard, climb and cruise propellers d. Ground adjustable e. Controllable pitch f. Constant speed (automatic propellers) g. Reversible pitch h. Featherable 	1
12.5	Design Certification Requirements of Fixed - Pitch Propellers <i>Study Ref. 1, 2 & 4</i>	
12.5.1	Specify the effect a particular propeller type has on engine performance/operation.	1
12.5.2	Describe the general design and matching limitations relevant to the installation of a fixed pitch propeller on a piston engine with particular regard to the following: <ul style="list-style-type: none"> a. Static RPM b. RPM limitations at full power c. best rate of climb conditions d. Over-speed limitation in a dive (VNE) e. Critical RPM range 	2
12.5.3	Explain why static RPM at full power on the ground is less than tacho red line RPM.	2
12.6	Wooden Propellers <i>Study Ref. 1, 2 & 4</i>	
12.6.1	Describe the relative merits of each type of wood used in propeller construction and identify the most commonly used types: <ul style="list-style-type: none"> a. Mahogany b. Cherry c. Black walnut d. Oak e. Birch 	1

12.6.2	Describe the construction of wooden propellers with particular regard to the following: <ul style="list-style-type: none"> a. Fabrication of the blank b. Bonding materials and processes c. Number of wood layers d. Distribution of moisture e. Profiling (the “White”) f. Bore and bolt holes g. Tip fabric h. Metal tipping i. Drain holes j. Varnishing 	1
12.7	Inspection and Maintenance of Wooden Propellers <i>Study Ref. 1, 2 & 4</i>	
12.7.1	Identify the following defects, their cause and rectification: <ul style="list-style-type: none"> a. Separation of laminations/dents b. Bruises c. Scars across the blade surfaces d. Broken sections e. Warping f. Worn or oversize centre or bolt holes g. Small cracks parallel to the grain h. Cracks or bubbles in the tip fabric i. Metal tipping defects such as cracks, slipping, looseness, loose rivets or screws j. Peeling of varnish 	1
12.7.2	Describe how the moisture of wooden propeller blades is equalised.	2
12.8	Balancing Wooden Propellers <i>Study Ref. 1, Ref. 2, Ref. 4</i>	
12.8.1	Describe the following procedures associated with balancing wooden propellers: <ul style="list-style-type: none"> a. Operation of balancing equipment b. Vertical balance check c. Horizontal balance check d. Adjusting tip weight using solder e. Attachment of balance plates to the boss 	1
12.9	Aluminium Fixed-Pitch Propellers <i>Study Ref. 1, 2 & 4</i>	
12.9.1	Describe the basic construction of an aluminium fixed-pitch propeller.	1
12.9.2	Compare the advantages and disadvantages of aluminium over wooden propellers.	1
12.10	Inspection and Maintenance <i>Study Ref. 1, 2 & 4</i>	
12.10.1	Describe using diagrams how the following blade defects may be rectified including surface treatment processes involved: <ul style="list-style-type: none"> a. Pitting b. Nicks c. Dents d. Cracks e. Corrosion f. Erosion g. Delamination 	2

12.10.2	Describe common treatment and repair schemes for metal and wooden propellers including the identification of damage critical areas of a propeller blade.	2
12.10.3	Specify how the blade profile is maintained after leading edge repairs.	2
12.10.4	State how blade bend angle may be measured with a protractor.	2
12.10.5	Describe the general requirements for tracking a propeller including methods of adjustment.	2
12.10.6	State the probable cause of grease streaking on a propeller blade after greasing.	1
12.11	Propeller Mounting <i>Study Ref. 1, 2 & 4</i>	
12.11.1	Describe following propeller mounting arrangements: <ul style="list-style-type: none"> a. Flange with dowel pin holes b. Flange with threaded inserts c. Tapered shafts d. Bolted mounts e. Splined mounts 	2
12.11.2	Describe the construction and function of the following propeller mounting components: <ul style="list-style-type: none"> a. Spacers and extensions b. Faceplates c. Front and rear cones and cone matching d. Snap rings e. Keys and keyways f. Retaining nuts 	1
12.12	Pitch Change Mechanisms <i>Study Ref. 1, 2 & 4</i>	
12.12.1	Describe the operation of the following pitch change mechanisms: <ul style="list-style-type: none"> a. Aerodynamic b. Aerodynamic and hydraulic combination c. Hydraulic d. Mechanical (counterweights) e. Electrical 	1
12.12.2	Specify the blade pitch angles that would optimise propeller performance over the operating envelope of an aircraft.	1
12.13	Propeller Auxiliary Systems <i>Study Ref. 1, 2 & 4</i>	
12.13.1	Specify the configuration and operation of the following typical auxiliary systems: <ul style="list-style-type: none"> a. Auto feather b. Feather (non auto) c. Ice protection/elimination d. Synchronising e. Synchrophasing f. Unfeathering accumulators 	2
12.13.2	Describe the operation of a propeller de-ice system including the fluid used.	1
12.13.3	Outline the features and operating principles of electrical cyclic de-icing systems over other types.	1

12.13.4	State how power is transferred from the engine to the propeller hub.	1
12.14	Ice Protection <i>Study Ref. 1, 2 & 4</i>	
12.14.1	Describe the following types of propeller ice protection systems: a. Fluid b. Electrical	2
12.15	Feathering Systems <i>Study Ref. 1, 2 & 4</i>	
12.15.1	Describe a typical feathering system for a light twin piston engine aeroplane.	2
12.16	Governors – Principles of Operation and Construction <i>Study Ref. 1, 2 & 4</i>	
12.16.1	Describe the operation of a typical governor fitted to a light aeroplane.	2
12.16.2	Specify the effects of variation of speeder spring pressure and engine RPM on governor operation.	2
12.16.3	Distinguish between single and double acting governors.	1
12.16.4	Describe the operation and function of the following: a. Fly weights b. Pilot valve c. Pitch change stops d. Speeder spring e. Oil pump f. Propeller RPM lever in the cockpit	2
12.17	Governor and Propeller Operating Conditions <i>Study Ref. 1, 2 & 4</i>	
12.17.1	Specify the following operational conditions and how they are controlled: a. Feathering b. On speed c. Over speed d. Under speed e. Unfeathering	2
12.18	Propeller Maintenance Practices <i>Study Ref. 1, 2 4 & AC43</i>	
12.18.1	Describe the construction, principles of operation and use of a propeller protractor.	2
12.18.2	State the procedure for replacement of a de-icer boot.	1
12.18.3	Specify how propeller domes are de-sludged.	1
12.18.4	State in-service limitations relating to cold straightening of metal propeller blades.	1
12.18.5	Describe static and dynamic unbalance and how each may be detected and rectified.	1
12.18.6	Specify the effects of propeller out of balance with increase in engine speed.	2
12.18.7	Describe engine and propeller inspections that would normally be carried out on the occurrence of a propeller strike or sudden stoppage.	2

12.18.8	Describe typical removal and installation procedures for propellers including the use of the following: a. Torque multipliers b. Servicing stands c. Slings d. Lubricants e. Paddles	1
12.18.9	State the designation system for Hartzell and McCauley propellers.	1
12.18.10	Describe horsepower/manifold pressure/RPM relationship associated with changes to throttle and propeller control settings.	2
12.18.11	Describe the procedures for long and short-term storage of propellers.	2