

## Toetsmatrijs PPL Aircraft general knowledge + Operational procedures

In deze toetsmatrijs staat wat u moet kunnen en kennen. De toetsmatrijs vormt daarom de basis van de opleiding en het examen.

<b>Opgesteld door:</b>	<b>CBR divisie CCV</b>
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Categoriecode:	LVPAAGK (PPLA, LAPLA) en LVPHAGK (PPLH, LAPLH)
Toetsvorm:	Digitaal
Totaal aantal vragen:	16 meerkeuzevragen
Cesuur:	75% (12 van de 16 vragen goed)
Bijzonderheden:	Geen

Nr	Eindtermen
<b>020 00 00 00</b>	<b>AIRCRAFT GENERAL KNOWLEDGE</b>
<b>021 00 00 00</b>	<b>Aircraft general knowledge – airframe, systems and power plant</b>
021 01 00 00	System design, loads, stresses, maintenance
021 02 00 00	Airframe
021 03 00 00	Hydraulics
021 04 00 00	Landing gear, wheels, tyres, brakes
021 05 00 00	Flight controls
021 07 00 00	Anti-icing and de-icing systems
021 08 00 00	Fuel system
021 09 00 00	Electrics
021 10 00 00	Piston engines
021 11 00 00	Turbine engines
021 15 00 00	Helicopter: rotor heads
021 16 00 00	Helicopter: transmission
021 17 00 00	Helicopter: blades

<b>022 00 00 00</b>	<b>Aircraft general knowledge – instrumentation</b>
022 01 00 00	Sensors and instruments
022 02 00 00	Measurement of air data parameters
022 03 00 00	Magnetism – direct reading compass and flux valve
022 04 00 00	Gyroscopic instruments
022 12 00 00	Alerting systems, proximity systems
022 13 00 00	Integrated instruments – electronic displays
<b>070 00 00 00</b>	<b>OPERATIONAL PROCEDURES</b>
071 02 00 00	Special operational procedures and hazards (general aspects) → <b>alleen 071 02 05 00 Fire and smoke</b>

<b>Vastgesteld door:</b>	Technische Commissie Aircraft general knowledge + Operational procedures
<b>Beoordeeld door:</b>	Logistiek, Transport en Personenvervoer raad; kamer 3: Luchtvaart <14 september 2018>
<b>Goedgekeurd door:</b>	Divisiemanager CCV <17 september 2018>
<b>Ingangsdatum:</b>	<1 april 2019>

#### **Toelichting**

**Eindtermen:** Dit zijn de hoofdonderwerpen die in het examen voorkomen. Hierin staat 'ruim' omschreven wat er in het examen terug kan komen.

**Toetstermen:** Dit zijn onderdelen van een eindterm. Hierin staat meer uitgebreid omschreven wat er in het examen terug kan komen.

**Tax:** Dit is de taxonomiecode van Romiszowski. Deze code geeft aan op welk niveau de vragen over een toetsterm gesteld worden.

F = Feitelijke kennis. De kandidaat kan feiten reproduceren (herkennen of herinneren).

B = Begripsmatige kennis. De kandidaat kan begrippen of principes omschrijven.

R = Reproductieve vaardigheden. De kandidaat kan acties uitvoeren die volgens een vastgelegde procedure verlopen.

P = Productieve vaardigheden. De kandidaat kan acties uitvoeren waarbij hij zijn eigen creativiteit en inzicht nodig heeft.

Eind- en toetstermen		Tax	PPLA	PPLH
<b>020 00 00 00</b>	<b>AIRCRAFT GENERAL KNOWLEDGE</b>			
<b>021 00 00 00</b>	<b>Aircraft general knowledge – airframe, systems and power plant</b>			
<b>021 01 00 00</b>	<b>System design, loads, stresses, maintenance</b>			
<b>021 01 02 00</b>	<b>Loads and stresses</b>			
<b>021 01 02 01</b>	<b><i>Stress, strain and loads</i></b>			
(02)A	Describe the following types of loads that an aircraft may be subject to, and when they occur: – static loads; – dynamic loads.	B	X	
(02)H	Describe the following types of loads that an aircraft may be subjected to, when they occur, and how a pilot may affect their magnitude: – static loads; – dynamic loads; – cyclic loads.	B		X
(03)	Describe the areas typically prone to stress that should be given particular attention during a pre-flight inspection, and highlight the limited visual cues of any deformation that may be evident.	B	X	X
<b>021 01 03 00</b>	<b>Fatigue and corrosion</b>			
<b>021 01 03 01</b>	<b><i>Describe and explain fatigue and corrosion</i></b>			
(04)	Explain fatigue, how it affects the useful life of an aircraft, and the effect of the following factors on the development of fatigue: – corrosion; – number of cycles; – type of flight manoeuvres; – stress level; – level and quality of maintenance.	B		X
<b>021 02 00 00</b>	<b>Airframe</b>			
<b>021 02 03 00</b>	<b>Aeroplane: wings, tail surfaces and control surfaces</b>			
<b>021 02 03 01</b>	<b><i>Design</i></b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Describe the following types of design and explain their advantages and disadvantages: - high-mounted wing; - low-mounted wing; - low- or mid-set tailplane; - T-tail.	B	X	
<b>021 02 03 02</b>	<b>Structural components</b>			
(01)	Describe the function of the following structural components: - spar and its components (web and girder or cap); - rib.	B	X	
<b>021 02 03 03</b>	<b>Loads, stresses and aero-elastic vibrations (flutter)</b>			
(01)	Describe the vertical and horizontal loads on the ground.	B	X	
(03)	Explain the principle of flutter for the wing and the control surfaces.	B	X	
<b>021 02 04 00</b>	<b>Fuselage, landing gear, doors, floor, windscreen and windows</b>			
<b>021 02 04 01</b>	<b>Construction, functions, loads</b>			
(01)	Describe the following types of fuselage construction: – monocoque, – semi-monocoque.	B		X
(04)	Describe the following loads on a main landing gear: - touch-down loads (vertical and horizontal)	B	X	
(06)	Describe the structural danger of a tail strike with respect to the fuselage.	B	X	
<b>021 02 05 00</b>	<b>Helicopter : Structural aspects of flight controls</b>			
<b>021 02 05 01</b>	<b>Design and construction</b>			
(01)	List the functions of flight controls.	F		X
(02)	Explain why vertical and horizontal stabilisers may have different shapes and alignments.	B		X
<b>021 02 05 03</b>	<b>Loads, stresses and aeroelastic vibrations</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Describe the dangers and stresses regarding safety and serviceability in flight when the manufacturer's design envelope is exceeded.	B		X
(03)	Describe the early indications and vibrations which are likely to be experienced when the main-rotor blades and tail rotor are out of balance or tracking, including the possible early indications due to possible fatigue and overload.	B		X
<b>021 02 06 00</b>	<b>Structural limitations</b>			
<b>021 02 06 01</b>	<b>Maximum structural masses</b>			
(01)	Define and explain the following maximum structural masses: - Maximum ramp mass; - Maximum take-off mass; - Maximum zero fuel mass; - Maximum landing mass. <i>Remark: These limitations may also be found in the relevant part of subjects 031, 032 and 034.</i>	F	X	
(03)	Explain the maximum structural masses: – maximum take-off mass.	B		X
(04)	Explain that airframe life is limited by fatigue, created by load cycles.	B		X
<b>021 03 00 00</b>	<b>Hydraulics</b>			
<b>021 03 01 00</b>	<b>Hydromechanics: basic principles</b>			
<b>021 03 01 01</b>	<b>Concepts and basic principles</b>			
(01)	Explain the concept and basic principles of hydromechanics including: – hydrostatic pressure; – Pascal's law; – the relationship between pressure, force and area; – transmission of power: multiplication of force, decrease of displacement.	B		X
<b>021 03 02 00</b>	<b>Hydraulic systems</b>			
<b>021 03 02 01</b>	<b>Hydraulic fluids: types, characteristics, limitations</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	List and explain the desirable properties of a hydraulic fluid with regard to: – thermal stability; – corrosiveness; – viscosity.	F		X
(02)	State that hydraulic fluids are irritating for skin and eyes.	F	X	X
(04)	State that different types of hydraulic fluids cannot be mixed.	F		X
(05)	State that at the pressures being considered, hydraulic fluid is considered incompressible.	F		X
<b>021 03 02 02</b>	<b>System components: design, operation, degraded modes of operation, indications and warnings</b>			
(01)	Explain the working principle of a hydraulic system.	B	X	X
(05)	List the main uses of hydraulic systems.	F	X	X
(13)	Describe the working principle and functions of the following hydraulic system components: - reservoir (unpressurised); - piston actuators (single and double acting).	B	X	X
(19)A	State the indications and explain the implications of the following malfunctions: - system leak or low level; - low pressure.	F	X	
(19)H	State the indications and explain the implications of the following malfunctions: - system leak or low level; - low pressure. - high temperature.	F		X
<b>021 04 00 00</b>	<b>Landing gear, wheels, tyres, brakes</b>			
<b>021 04 01 00</b>	<b>Landing gear</b>			
<b>021 04 01 01</b>	<b>Types</b>			
(01)	Name, for an aeroplane, the following different landing gear configurations: - nose-wheel; - tail-wheel	F	X	

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	Name, for a helicopter, the following different landing-gear configurations: – nose wheel; – tail wheel; – skids.	F		X
<b>021 04 01 02</b>	<b>System components, design, operation, indications and warnings, on ground/in flight protections, emergency extension systems</b>			
(01)	Explain the function of the following components of a landing gear: – oleo leg/shock strut; – torsion links.	B	X	
(02)	Explain the function of the following components of a landing gear: – oleo leg/shock strut; – axles; – drag struts; – side stays/struts; – torsion links; – locks (over centre); – gear doors.	B		X
<b>021 04 02 00</b>	<b>Nose wheel steering</b>			
<b>021 04 02 01</b>	<b>Design, operation</b>			
(01)	Explain the operating principle of nose-wheel steering.	B	X	
(03)	Describe, for an aeroplane, the functioning of the following systems: – differential braking with free-castoring nose wheel; – rudder pedal nose-wheel steering.	B	X	
(05)	Define the term 'shimmy' and the possible consequences for the nose wheel system and explain the purpose of a shimmy damper to reduce the severity of shimmy.	B	X	
<b>021 04 03 00</b>	<b>Brakes</b>			
<b>021 04 03 01</b>	<b>Types and materials</b>			
(01)	Describe the basic operating principle of a disc brake.	B	X	
(02)	State the different materials used in a disc brake (steel, carbon).	F	X	

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
<b>021 04 03 02</b>	<b>System components, design, operation, indications and warnings</b>			
(02)	Explain how brakes are actuated.	B	X	
<b>021 04 04 00</b>	<b>Wheels, rims and tyres</b>			
<b>021 04 04 01</b>	<b>Types, structural components and materials, operational limitations, thermal plugs</b>			
(01)	Describe the different types of tyres: - tubeless and tube-type and list their limitations and advantages/disadvantages.	B	X	
<b>021 04 05 00</b>	<b>Helicopter equipment</b>			
<b>021 04 05 01</b>	<b>Flotation devices</b>			
(01)	Explain flotation devices, how they are operated, and their limitations.	B		X
(02)	Explain why indicated airspeed (IAS) limitations before, during and after flotation-device deployment must be observed.	B		X
<b>021 05 00 00</b>	<b>Flight controls</b>			
<b>021 05 01 00</b>	<b>Aeroplane: Primary Flight Controls</b>			
<b>021 05 01 01</b>	<b>Definition and control surfaces</b>			
(02)	List the following primary flight control surfaces: - elevator; - aileron; - rudder.	F	X	
<b>021 05 01 02</b>	<b>Manual controls</b>			
(01)	Explain the basic principle of a fully manual control system.	B	X	
<b>021 05 01 05</b>	<b>System components, design, operation, indications and warnings, degraded modes of operation, jamming</b>			
(04)	Explain the methods of locking the controls on the ground and describe "gust or control lock" warnings.	B	X	
<b>021 05 02 00</b>	<b>Aeroplane: Secondary Flight Controls</b>			
<b>021 05 02 01</b>	<b>System components, design, operation, degraded modes of operation, indications and warnings</b>			



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	List the following secondary flight control surfaces: - lift augmentation devices (flaps and slats); - trimming devices such as trim tabs, trimmable horizontal stabiliser.	F	X	
(03)	Describe secondary flight control actuation methods.	B	X	
(05)	Describe the requirement for limiting speeds for the various secondary flight control surfaces.	B	X	
<b>021 05 03 00</b>	<b>Helicopter: flight controls</b>			
<b>021 05 03 01</b>	<b><i>Droop stops, control systems, trim systems, control stops</i></b>			
(01)	Explain the methods of locking the controls on the ground.	B		X
(02)	Describe main rotor droop stops and how rotor flapping is restricted.	B		X
(03)	Explain the principle of phase lag and advance angle.	B		X
(04)	Describe the following four axis of control operation, their operating principle and their associated cockpit controls: - collective control; - cyclic fore and aft (pitch axis); - cyclic lateral (roll axis); - yaw.	B		X
(05)	Describe the swashplate or azimuth star control system including the following: - swashplate inputs - the function of the non-rotating swashplate - the function of the rotating swashplate - how swashplate tilt is achieved - swashplate pitch axis - swashplate roll axis - balancing of pitch/roll/collective inputs to the swashplate to equalise torsional loads on the blades.	B		X
(07)	State the need for artificial feel in a hydraulically actuated flight control system.	F		X
(08)	Describe and explain the purpose of a trim system using the following terms: – force-trim switch; – force gradient.	B		X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>021 07 00 00</b>	<b>Anti-icing and de-icing systems</b>			
<b>021 07 01 00</b>	<b>Types, operation, indications</b>			
<b>021 07 01 01</b>	<b>Types, design, operation, indications and warnings, operational limitations</b>			
(01)	Explain the concepts of anti-icing and de-icing.	B	X	X
(04)A	State the different types of anti-icing/de-icing systems and describe their operating principle: – electrical; – fluid.	F	X	
(04)H	State the different types of anti-icing/de-icing systems and describe their operating principle: – hot air; – electrical; – fluid.	F		X
<b>021 08 00 00</b>	<b>Fuel system</b>			
<b>021 08 01 00</b>	<b>Piston engine</b>			
<b>021 08 01 01</b>	<b>Fuel: types, characteristics, limitations</b>			
(01)	State the types of fuel used by a piston engine and their associated limitations: – diesel; – JET-A1 (for high-compression engines); – AVGAS; – MOGAS.	F	X	X
(02)	State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	F	X	X
<b>021 08 01 02</b>	<b>Design, operation, system components, indications</b>			
(01)	State the tasks of the fuel system.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	Name the following main components of a fuel system, state their location and state their function. - lines; - boost pump; - filter, strainer; - tanks (wing, tip, fuselage); - vent system; - drain; - fuel quantity sensor (LOW LEVEL WARNING).	F	X	X
(03)	Describe a gravity fuel feed system and a pressure feed fuel system.	B	X	X
(05)	Explain the function of cross-feed.	B		X
(06)	Define the term 'unusable fuel'.	F	X	X
(07)	List the following parameters that are monitored for the fuel system: – fuel quantity (low-level warning); – fuel temperature.	F		X
<b>021 08 02 00</b>	<b>Turbine engine</b>			
<b>021 08 02 01</b>	<b>Fuel: types, characteristics, limitations</b>			
(01)	State the types of fuel used by a gas turbine engine: – JET-A; – JET-A1; – JET-B.	F		X
<b>021 08 02 02</b>	<b>Design, operation, system components, indications</b>			
(02)	Name the main components of the fuel system and state their location and their function: – trim fuel tanks; – bafflers; – refuelling/defueling system; – fuel dump/jettison system. <i>Remark: For completion of list, please see 021 08 01 02 (02).</i>	F		X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>021 09 00 00</b>	<b>Electrics</b>			
<b>021 09 01 00</b>	<b>General, definitions, basic applications: circuit-breakers</b>			
<b>021 09 01 01</b>	<b>Static electricity</b>			
(01)	Explain static electricity and describe the flying conditions where aircraft are most susceptible to build-up of static electricity.	B	X	X
(02)	Describe a static discharger and explain its purpose and typical locations.	B	X	X
(03)	Explain why an aircraft must first be grounded before refuelling/defueling.	B	X	X
(04)	Explain the reason for electrical bonding.	B		X
<b>021 09 01 02</b>	<b>Direct Current (DC)</b>			
(01)	Explain the term 'direct current' (DC) and state that current can only flow in a closed circuit.	B	X	X
(04)	Define voltage and current and state their unit of measurement.	F	X	X
<b>021 09 01 03</b>	<b>Alternating current (AC)</b>			
(01)	Explain the term 'alternating current' (AC), and compare its use to DC with regard to complexity.	B		X
(04)	Define frequency and state the unit of measurement.	F		X
<b>021 09 01 06</b>	<b>Electromagnetism</b>			
(01)	State that an electrical current produces a magnetic field.	F		X
(04)	Explain the purpose and the working principle of a relay.	B	X	X
<b>021 09 01 07</b>	<b>Circuit protection</b>			
(01)	Explain the working principle of a fuse and a circuit breaker.	B	X	X
(02)	Explain how a fuse is rated.	B	X	X
<b>021 09 02 00</b>	<b>Batteries</b>			
<b>021 09 02 01</b>	<b>Types, characteristics and limitations</b>			
(01)	State the function of an aircraft battery.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)A	Name the types of rechargeable batteries used in aircraft: – lead-acid; – nickel-cadmium.	F	X	
(02)H	Name the types of rechargeable batteries used in aircraft: – lead-acid; – nickel-cadmium; – lithium-ion; – lithium-polymer	F		X
(03)A	Compare lead-acid and nickel-cadmium (Ni-Cd) batteries with respect to risk of thermal runaway.	B	X	
(03)H	Compare the different battery types with respect to: – load behaviour; – charging characteristics; – risk of thermal runaway.	B		X
(05)	Explain the difference between battery voltage and charging voltage.	B	X	X
(06)	Define the term “capacity of batteries” and state the unit of measurement used.	F	X	X
(07)	State the effect of temperature on battery capacity and performance.	F	X	X
(08)	State that in the case of loss of all generated power (Battery power only) the remaining electrical power is time limited.	F	X	X
<b>021 09 03 00</b>	<b>Generation</b>			
	<i>Remark: For standardisation purposes, the following standard expressions are used:</i> – DC generator: produces DC output; – DC alternator: produces AC, rectified by integrated rectifying unit, the output is DC; – DC alternator: producing a DC output by using a rectifier; – AC generator: produces AC output; – starter generator: integrated combination of a generator and a starter motor; – permanent magnet alternator/ generator: self-exciting AC generator.		X	X
<b>021 09 03 01</b>	<b>DC Generation</b>			
(01)	Describe the basic working principle of a simple DC generator or DC alternator	B	X	X
(02)	Explain the principle of voltage control and why it is required.	B	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(04)	Describe the basic operating principle of a starter generator and state its purpose.	B		X
<b>021 09 04 00</b>	<b>Distribution</b>			
<b>021 09 04 01</b>	<b>General</b>			
(01)	Explain the function of a busbar.	B	X	X
(02)	Describe the function of the following buses: - main bus; - emergency bus; - battery bus.	B	X	
(03)	State that the aircraft structure can be used as a part of the electrical circuit (common earth) and explain the implications for electrical bonding.	F	X	X
(04)	Explain the function of external power.	B	X	X
<b>021 09 04 02</b>	<b>DC distribution</b>			
(01)	Describe a simple DC electrical system of a single engine aircraft.	B	X	X
(04)	Give examples of DC consumers.	F	X	X
<b>021 09 04 04</b>	<b>Electrical load management and monitoring systems: Automatic generators and bus switching during normal and failure operation, indications and warnings</b>			
(04)	Explain the importance of monitoring the battery temperature of nickel-cadmium and lithium-type batteries.	B	X	X
(05)	Interpret ammeter indications of different types of ammeter which monitors the charge current of the battery.	R	X	X
<b>021 10 00 00</b>	<b>Piston engines</b>			
	<i>Remark: This topic includes diesel engines and petrol engines.</i>		X	X
<b>021 10 01 00</b>	<b>General</b>			
<b>021 10 01 01</b>	<b>Types of internal combustion engine: basic principles, definitions</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)A	Define the following terms and expressions: - rpm; - manifold absolute pressure (MAP); - power output.	F	X	
(01)H	Define the following terms and expressions: - rpm; - torque; - manifold absolute pressure (MAP); - power output;	F		X
<b>021 10 01 02</b>	<b>Engine: design, operation, components</b>			
(01)A	Describe the following main engine components and state their function. - crankshaft; - piston; - piston rings; - cylinder; - cylinder head; - valves; - camshaft; - bearings.	B	X	

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)H	Describe the basic operating principle of a piston engine: <ul style="list-style-type: none"> <li>– crankcase;</li> <li>– crankshaft;</li> <li>– connecting rod;</li> <li>– piston;</li> <li>– piston pin;</li> <li>– piston rings;</li> <li>– cylinder;</li> <li>– cylinder head;</li> <li>– valves;</li> <li>– valve springs;</li> <li>– push rod;</li> <li>– camshaft;</li> <li>– rocker arm;</li> <li>– camshaft gear;</li> <li>– bearings.</li> </ul>	B		X
(02)A	Name and identify the various types of engine design with regard to cylinder arrangement and their advantages/disadvantages: <ul style="list-style-type: none"> <li>- horizontally opposed;</li> <li>- in line;</li> <li>- and working cycle (four stroke: petrol and diesel).</li> </ul>	F	X	
(02)H	Name and identify the various types of engine design with regard to cylinder arrangement and their advantages/disadvantages: <ul style="list-style-type: none"> <li>- horizontally opposed;</li> <li>- in line;</li> <li>- radial;</li> <li>- and working cycle (four stroke: petrol and diesel).</li> </ul>	F		X
(03)A	Describe the differences between petrol engines and diesel engines with respect to: <ul style="list-style-type: none"> <li>- means of ignition;</li> <li>- regulating air or mixture supply to the cylinder.</li> </ul>	B	X	



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(03)H	Describe the differences between petrol and diesel engines with respect to: – means of ignition; – maximum compression ratio; – regulating air or mixture supply to the cylinder; – pollution from the exhaust.	B		X
<b>021 10 02 00</b>	<b>Fuel</b>			
<b>021 10 02 01</b>	<b><i>Types, grades, characteristics, limitations</i></b>			
(01)	Name the type of fuel used for petrol engines including its colour (AVGAS).	F	X	X
(02)	Name the type of fuel normally used for aviation diesel engines (Jet A1).	F	X	X
(03)	Define the term 'octane rating'.	F	X	X
(04)	Define the term "detonation" and describe the causes and effects of detonation for both petrol and diesel engines.	F	X	X
(05)	Define the term "pre-ignition" and describe the causes and effects of pre-ignition for both petrol and diesel engines.	F	X	X
(06)	Identify the conditions and power settings that promote detonation for petrol engines.	R	X	X
(07)	Describe how detonation in petrol engines is recognised.	B	X	X
(08)	Describe the method and occasions for checking the fuel for water content.	B	X	X
(09)	State the typical value of fuel density for aviation gasoline and diesel fuel.	F	X	X
(10)	Explain volatility, and vapour locking for petrol and diesel fuels.	B	X	X
<b>021 10 03 00</b>	<b>Engine fuel pumps</b>			
<b>021 10 03 01</b>	<b><i>Engine-driven fuel pump</i></b>			
(01)	Explain the need for a separate engine driven fuel pump.	B	X	X
<b>021 10 04 00</b>	<b>Carburettor/injection system</b>			
<b>021 10 04 01</b>	<b><i>Carburettor: design, operation, degraded modes of operation, indications and warnings</i></b>			
(01)	State the purpose of a carburettor.	F	X	X
(02)	Describe the operating principle of the simple float chamber carburettor.	B	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(04)	Describe the methods of obtaining mixture control over the whole operating altitude range.	B	X	X
(05)	Explain the purpose and the operating principle of an accelerator pump.	B	X	X
(06)	Explain the purpose of power enrichment	B	X	X
(07)	Describe the function of the carburettor heat system.	B	X	X
(08)	Explain the effect of carburettor heat on mixture ratio and power output.	B	X	X
(09)	Explain the purpose and the operating principle of a primer pump.	B	X	X
(11)	Explain the danger of carburettor fire, including corrective measures.	B	X	X
<b>021 10 04 02</b>	<b><i>Injection: design, operation, degraded modes of operation, indications and warnings</i></b>			
(01)	Explain the advantages and difference in operation of an injection system compared with a carburettor system.	B	X	X
<b>021 10 04 03</b>	<b><i>Icing</i></b>			
(01)	Describe the causes and effects of carburettor icing and the action to be taken if carburettor icing is suspected.	B	X	X
(02)	Name the meteorological conditions within which carburettor icing may occur.	F	X	X
(03)	Describe the indications of the presence of carburettor icing for both a fixed pitch and a constant speed propeller.	B	X	
(04)	Describe the indications of the presence of carburettor icing for a helicopter.	B		X
(05)	Describe the indications that will occur upon selection of carburettor heat depending on whether ice is present or not.	B	X	X
(06)	Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle.	B	X	X
(07)	State the meteorological conditions under which induction system icing may occur.	F	X	X
<b>021 10 05 00</b>	<b><i>Cooling systems</i></b>			
<b>021 10 05 01</b>	<b><i>Design, operation, indications and warnings</i></b>			
(01)	Specify the reasons for cooling a piston engine.	B	X	X
(02)	Describe the design features to enhance cylinder air cooling for aeroplanes.	B	X	

		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>Eind- en toetstermen</b>				
(03)	Describe the design features to enhance cylinder air cooling for helicopters (e.g. engine driven impeller and scroll assembly, baffles).	B		X
(04)	Compare the differences between liquid- and air-cooling systems.	R	X	X
(05)	Identify the cylinder head temperature indication to monitor engine cooling.	R	X	X
(06)	Describe the function and the operation of cowl flaps.	B	X	
<b>021 10 06 00</b>	<b>Lubrication systems</b>			
<b>021 10 06 01</b>	<b>Lubricants: characteristics, limitations</b>			
(01)	Describe the term 'viscosity' including the effect of temperature.	B	X	X
(02)	Describe the viscosity grade numbering system used in aviation.	B	X	X
<b>021 10 06 02</b>	<b>Design, operation, indications and warnings</b>			
(01)	State the functions of a piston-engine lubrication system.	F	X	X
(02)	Describe the working principle of a dry sump lubrication system and describe the functions of the following components: - oil tank (reservoir); - check valve (non return valve); - pressure pump and pressure relief valve; - scavenge pump; - filters (suction, pressure and scavenge); - oil cooler; - oil cooler by-pass valve; - pressure and temperature sensors; - lines.	B	X	X
(03)	Describe a wet sump lubrication system.	B	X	X
(04)	State the differences between a wet- and a dry-sump lubrication system and their advantages and disadvantages.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(05)	List the following factors that influence oil consumption: - oil grade; - cylinder and piston wear; - condition of piston rings.	F	X	X
(06)	Describe the interaction between oil pressure, oil temperature and oil quantity.	B	X	X
<b>021 10 07 00</b>	<b>Ignition circuits</b>			
<b>021 10 07 01</b>	<b>Design, operation</b>			
(01)	Describe the working principle of a magneto ignition system and the functions of the following components: - magneto; - coils or windings; - ignition switches; - spark plug.	B	X	X
(02)	State why piston engines are equipped with two electrically independent ignition systems.	F	X	X
(03)	State the function and operating principle of the following methods of spark augmentation: – starter vibrator (booster coil); – impulse start coupling.	F	X	
(04)	State the function and operating principle of the following methods of spark augmentation: – starter vibrator (booster coil); – both magnetos live.	F		X
(05)	Explain the function of the magneto check.	B	X	X
(06)	Explain how combustion is initiated in diesel engines.	B	X	X
<b>021 10 08 00</b>	<b>Mixture</b>			
<b>021 10 08 01</b>	<b>Definition, characteristic mixtures, control instruments, associated control levers, indications</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Define the following terms: - mixture; - chemically correct ratio (stoichiometric); - best power ratio; - lean (weak) mixture (lean or rich side of the EGT top); - rich mixture.	F	X	X
(02)	State the typical fuel to air ratio values of a stoichiometric mixture.	F	X	X
(03)	Describe the advantages and disadvantages of weak and rich mixtures.	B	X	X
(05)	Describe the use of the exhaust gas temperature as an aid to mixture-setting.	B	X	X
(06)	Explain the relation between mixture ratio, cylinder head temperature, detonation and pre-ignition.	B	X	X
(07)	Explain the absence of mixture control in diesel engines.	B	X	X
<b>021 10 09 00</b>	<b>Aeroplane: Propellers</b>			
<b>021 10 09 01</b>	<b>Definitions, general</b>			
	<i>Remark: Definitions and aerodynamic concepts are detailed in subject 081, topic 07 (Propellers) but need to be appreciated for this subject also.</i>		X	
<b>021 10 09 02</b>	<b>Constant speed propeller: design, operation, system components</b>			
(01)	Describe the operating principle of a constant speed propeller system under normal flight operations.	B	X	
(02)	Explain the need for a manifold absolute pressure (MAP) indicator to control the power setting with a constant speed propeller.	B	X	
(04)	State the purpose and describe the operation of a low pitch stop (centrifugal latch).	F	X	
(05)	Describe the operating principle of a single acting and a double acting variable pitch propeller for single engine aeroplanes.	B	X	
<b>021 10 09 04</b>	<b>Propeller handling: associated control levers, degraded modes of operation, indications and warnings</b>			
(01)	Describe the checks to be carried out on a constant speed propeller system after engine start.	B	X	
(02)	Describe the operation of a constant speed propeller system during flight at different true air speeds and RPM including an overspeeding propeller.	B	X	

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(05)	Describe the operation of the propeller levers during different phases of flight.	B	X	
<b>021 10 10 00</b>	<b>Performance and engine handling</b>			
<b>021 10 10 01</b>	<b>Performance</b>			
(01)	Describe the effect on power output of a petrol and diesel engine taking into consideration the following parameters: - ambient pressure, exhaust back pressure; - temperature; - humidity.	B	X	X
(02)	Explain the term 'normally aspirated engine'.	B	X	X
(03)	Power-augmentation devices: explain the requirement for power augmentation (turbocharging) of a piston engine.	B	X	X
(04)A	Describe the function and the principle of operation of the following main components of a turbocharger: - turbine; - compressor; - waste gate.	B	X	
(04)H	Describe the function and the principle of operation of the following main components of a turbocharger: - turbine; - compressor; - waste gate. - waste-gate actuator	B		X
(05)	Explain the difference between an altitude-boosted turbocharger and a ground-boosted turbocharger.	B	X	X
(06)	Explain turbo lag.	B	X	X
(07)	Define the term 'critical altitude'.	F	X	X
(08)	Explain the function of an intercooler.	B	X	X
(09)	Define the terms 'full throttle height' and 'rated altitude'.	F	X	X
<b>021 10 10 02</b>	<b>Engine handling</b>			
(01)	State the correct procedures for setting the engine controls when increasing or decreasing power.	F	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(02)	Define the following terms: - take-off power; - maximum continuous power.	F	X	X
<b>021 11 00 00</b>	<b>Turbine engines</b>			
<b>021 11 01 00</b>	<b>Basic principles</b>			
<b>021 11 01 02</b>	<b><i>Design, types of turbine engines, components</i></b>			
(01)	List the main components of a basic gas turbine engine: - inlet; - compressor; - combustion chamber; - turbine; - outlet.	F		X
(02)	Describe the variation of static pressure, temperature and axial velocity in a gas turbine engine under normal operating conditions and with the aid of a working cycle diagram.	B		X
(04)	List the different types of gas turbine engines. - straight jet; - turbo fan; - turbo prop.	F		X
(08)	Describe the term 'equivalent horsepower' (= thrust horsepower + shaft horsepower).	B		X
(09)	Explain the principle of a free turbine or free-power turbine.	B		X
<b>021 11 01 04</b>	<b><i>Free turbine engine: design, components and materials</i></b>			
(01)	Describe the design methods to keep engine size small for installation in helicopters.	B		X
(02)	List the main components of a free turbine engine.	F		X
(03)	Describe how the power is developed by a turboshaft/free turbine engine.	B		X
(04)	Explain how the exhaust gas temperature is used to monitor turbine stress.	B		X
<b>021 11 02 00</b>	<b>Main engine components</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>021 11 02 02</b>	<b>Compressor and diffuser</b>			
(01)	State the purpose of the compressor	F		X
(16)	Explain the following terms: - compressor stall; - engine surge.	B		X
(17)	State the conditions that are possible causes of stall and surge.	F		X
(18)	Describe the indications of stall and surge.	B		X
<b>021 11 02 03</b>	<b>Combustion chamber</b>			
(01)	Define the purpose of the combustion chamber.	F		X
(02)	List the requirements for combustion.	F		X
(03)	Describe the working principle of a combustion chamber.	B		X
<b>021 11 02 04</b>	<b>Turbine</b>			
(04)	Describe the working principle of a turbine.	B		X
(08)	Explain why the available engine thrust is limited by the turbine inlet temperature.	B		X
<b>021 11 02 06</b>	<b>Helicopter: air intake</b>			
(01)	Name and explain the main task of the engine air intake.	F		X
(05)	Describe and explain the principles of air intake filter systems that can be fitted to some helicopters for operations in icing and sand conditions.	B		X
<b>021 11 02 07</b>	<b>Helicopter: exhaust</b>			
(01)	Describe the working principle of the exhaust unit.	B		X
<b>021 11 03 00</b>	<b>Additional components and systems</b>			
<b>021 11 03 01</b>	<b>Engine fuel system</b>			



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(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;	F		X
<b>021 11 03 08</b>	<b><i>Helicopter specifics on design, operation and components for additional components and systems such as lubrication system, ignition circuit, starter, accessory gearbox</i></b>			
(07)	Explain and describe the ignition circuit for engine start and engine relight facility when the selection is set for both automatic and manual functions.	B		X
<b>021 11 05 00</b>	<b>Performance aspects</b>			
<b>021 11 05 02</b>	<b><i>Helicopter engine ratings, engine performance and limitations, engine handling: torque, performance aspects and limitations</i></b>			
(01)	Describe engine rating torque limits for take-off, transient and maximum continuous.	B		X
(02)	Describe turbine outlet temperature (TOT) limits for take-off.	B		X
(03)	Explain why TOT is a limiting factor for helicopter performance.	B		X
(04)	Describe and explain the relationship between maximum torque available and density altitude, which leads to decreasing torque available with the increase of density altitude.	B		X
(05)	Explain that hovering down wind on some helicopters will noticeably increase the engine TOT.	B		X
(06)	Explain the reason why the engine performance is less when aircraft accessories (i.e. anti-ice, heating, hoist, filters) are switched on.	B		X
(07)	Describe the effects of use of bleed air on engine parameters.	B		X
<b>021 15 00 00</b>	<b>Helicopter: rotor heads</b>			
<b>021 15 01 00</b>	<b>Main rotor</b>			
<b>021 15 01 01</b>	<b>Types</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Describe the following rotor head systems: - teetering (semi-articulated); - articulated; - hingeless (rigid); - bearingless (semi-articulated).	B		X
(02)	Describe in basic terms the following configuration of rotor systems and their advantages and disadvantages: - tandem; - coaxial; - side by side.	B		X
(03)	Explain how flapping, dragging and feathering is achieved in each rotor-head systems.	B		X
<b>021 15 01 02</b>	<b><i>Structural components and materials, stresses, structural limitations</i></b>			
(01)	Identify from a diagram the main structural components of the main types of rotor-head system.	R		X
(02)	List and describe the methods used to detect damage and cracks.	F		X
(03)	Explain and describe the structural limitations to respective rotor systems, including the dangers of negative G inputs to certain rotor head systems.	B		X
(04)	Describe the various rotor-head lubrication methods.	B		X
<b>021 15 01 03</b>	<b><i>Design and construction</i></b>			
(01)	Describe the material technology used in rotor head design, including construction using the following materials or mixture of materials: - composites; - fibreglass; - alloys; - elastomers.	B		X
<b>021 15 02 00</b>	<b>Tail rotor</b>			
<b>021 15 02 01</b>	<b><i>Types</i></b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Describe the following tail-rotor systems: – delta-3 hinge effect; – multi-bladed delta-3 effect; – Fenestron or ducted fan tail rotor; – no tail rotor (NOTAR) low-velocity air jet flows from tangential slots (the Coandă effect); – NOTAR high-velocity air jet flows from adjustable nozzles (the Coandă effect).	B		X
(02)	Identify from a diagram the main structural components of the four main types of tail rotor system.	R		X
(03)	Explain and describe the methods to detect damage and cracks on the tail rotor and assembly.	B		X
(04)	Explain and describe the structural limitations to the respective tail-rotor systems and possible limitations regarding the turning rate of the helicopter.	B		X
(05)	Explain and describe the following methods that helicopter designers use to minimise tail rotor drift and roll. - reducing the couple arm (tail rotor on a pylon); - off setting the rotor mast; - use of "bias" in cyclic control mechanism.	B		X
(06)	Explain pitch input mechanisms.	B		X
(07)	Explain the relationship between tail rotor thrust and engine power.	B		X
(08)	Describe how the vertical fin on some types reduces the power demand of the tail rotor.	B		X
<b>021 15 02 02</b>	<b>Design and construction</b>			
(01)	List and describe the various tail rotor designs and construction methods used on current helicopters in service.	F		X
<b>021 16 00 00</b>	<b>Helicopter: transmission</b>			
<b>021 16 01 00</b>	<b>Main gear box</b>			
<b>021 16 01 01</b>	<b>Different types, design, operation, limitations</b>			
(01)	Describe the following main principles of helicopter transmission systems for single- and twin-engine helicopters: - drive for the main and tail rotor; - accessory drive for the generator/s alternator/s, hydraulic and oil pumps, oil cooler/s and tachometers.	B		X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>021 16 02 00</b>	<b>Rotor brake</b>			
<b>021 16 02 01</b>	<b>Types, operational considerations</b>			
(01)	Describe the main function of the disc type of rotor brake.	B		X
(04)	List the following operational considerations for the use of rotor brakes: - rotor speed at engagement of rotor brake; - risk of blade sailing in windy conditions; - risk of rotor brake overheating and possible fire when brake is applied above the maximum limit, particularly when spilled hydraulic fluid is present; - avoid stopping blades over jet pipe exhaust with engine running; - cockpit annunciation of rotor brake operation.	F		X
<b>021 16 04 00</b>	<b>Drive shaft and associated installation</b>			
<b>021 16 04 01</b>	<b>Power, construction, materials, speed and torque</b>			
(01)	Describe how power is transmitted from the engine to the main-rotor gearbox.	B		X
(02)	Describe the material and construction of the drive shaft.	B		X
<b>021 16 06 00</b>	<b>Clutches</b>			
<b>021 16 06 01</b>	<b>Purpose, operation, components, serviceability</b>			
(01)	Explain the purpose of a clutch.	B		X
<b>021 16 07 00</b>	<b>Freewheels</b>			
<b>021 16 07 01</b>	<b>Purpose, operation, components, location</b>			
(01)	Explain the purpose of a freewheel.	B		X
<b>021 17 00 00</b>	<b>Helicopter: blades</b>			
<b>021 17 01 00</b>	<b>Main-rotor design and blade design</b>			
<b>021 17 01 01</b>	<b>Design, construction</b>			
(01)	Describe the different type of blade construction and the need for torsional stiffness.	B		X

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
<b>021 17 01 02</b>	<b>Structural components and materials</b>			
(01)	List the materials used in the construction of main rotor blades.	F		X
(02)	List the main structural components of a main-rotor blade and their function.	F		X
<b>021 17 01 03</b>	<b>Forces and stresses</b>			
(01)	Describe main rotor blade loading on the ground and in flight.	B		X
(02)	Describe where the most common stress areas are on rotor blades.	B		X
<b>021 17 01 04</b>	<b>Structural limitations</b>			
(01)	Explain the structural limitations in terms of bending and rotor rpm.	B		X
<b>021 17 01 05</b>	<b>Adjustment</b>			
(01)	Explain the use of trim tabs.	B		X
<b>021 17 01 06</b>	<b>Tip shape</b>			
(01)	Describe the various blade tip shapes used by different manufacturers and compare their advantages and disadvantages.	B		X
<b>021 17 02 00</b>	<b>Tail-rotor design and blade design</b>			
<b>021 17 02 01</b>	<b>Design, construction</b>			
(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.	B		X
(05)	Describe the dangers to ground personnel and to the rotor blades, and how to minimise these dangers.	B		X
<b>021 17 02 03</b>	<b>Stresses, vibrations and balancing</b>			
(01)	Describe the tail rotor blade loading on the ground and in flight.	B		X
<b>021 17 02 05</b>	<b>Adjustment</b>			
(01)	Describe the adjustment of yaw pedals in the cockpit, to obtain full control authority of the tail rotor.	B		X
<b>021 17 02 06</b>	<b>The Fenestron</b>			

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(01)	Describe the technical layout of a Fenestron tail rotor.	B		X
(02)	Explain the advantages and disadvantages of a Fenestron tail rotor.	B		X
<b>021 17 02 07</b>	<b>No tail rotor (NOTAR)</b>			
(01)	Describe the technical layout of a NOTAR design.	B		X
(02)	Explain the control concepts of a NOTAR.	B		X
(03)	Explain the advantages and disadvantages of a NOTAR design.	B		X
<b>022 00 00 00</b>	<b>Aircraft general knowledge – instrumentation</b>			
<b>022 01 00 00</b>	<b>Sensors and instruments</b>			
<b>022 01 01 00</b>	<b>Pressure gauge</b>			
<b>022 01 01 01</b>	<b>Units for pressure, sensor types, measurements</b>			
(02)	List the following units used for pressure: - Pascal; - bar; - inches of mercury (in Hg); - pounds per square inch (PSI).	F	X	X
(03)	State the relationship between the different units.	F		X
(04)	List and describe the following different types of sensors used according to the pressure to be measured: - aneroid capsules; - diaphragms; - bourdon tube.	F	X	X
(05)	Identify pressure measurements that are applicable on an aircraft: - liquid pressure measurement (fuel, oil, hydraulic); - manifold absolute pressure (MAP) gauge.	R	X	X
<b>022 01 02 00</b>	<b>Temperature sensing</b>			
<b>022 01 02 01</b>	<b>Units for temperature, measurements</b>			

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(01)	Explain temperature.	B		X
(02)	List the following units that can be used for temperature measurement: – Kelvin; – Celsius; – Fahrenheit.	F		X
(03)	State the relationship between these units and convert between them.	F		X
(04)	Identify temperature measurements that are applicable to an aircraft: - gas temperature measurement (ambient air, exhaust gas); - liquid temperature measurement (oil).	R	X	
<b>022 01 03 00</b>	<b>Fuel gauge</b>			
<b>022 01 03 01</b>	<b>Units for fuel, measurements, fuel gauges</b>			
(01)A	State that the quantity of fuel is usually measured by volume.	F	X	
(01)H	State that the quantity of fuel can be measured by volume or mass.	F		X
(02)A	List the following units used for fuel quantity: - litres; - gallons (US and imperial).	F	X	
(02)H	List the following units used for fuel quantity: – kilogramme; – pound; – litres; – gallons (US and imperial).	F		X
(03)	Convert between the various units.	B	X	X
(04)	Explain the parameters than can affect the measurement of the volume of the fuel in a fuel tank: - temperature; - aircraft accelerations and attitudes. and explain how the fuel gauge system design compensates for these changes.	B	X	X
(05)A	Describe and explain the operating principles and reliability of a float system fuel gauge.	B	X	

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(05)H	Describe and explain the operating principles of the following types of fuel gauges: – float system; – capacitance-type of fuel-gauge system. – ultrasound-type of fuel-gauge system: to be introduced at a later date.	B		X
<b>022 01 04 00</b>	<b>Fuel flowmeters</b>			
<b>022 01 04 01</b>	<b><i>Fuel flow, units for fuel flow, total fuel consumption</i></b>			
(01)	Define 'fuel flow' and where it is measured.	F	X	X
(02)	State that fuel flow may be measured by volume or mass per unit of time.	F	X	X
(04)	List the following units used for fuel flow when measured by volume per hour: - litres/hour; - imperial gallons/hour; - US gallons/hour.	F	X	X
<b>022 01 05 00</b>	<b>Tachometer</b>			
<b>022 01 05 01</b>	<b><i>Types, operating principles, units for engine speed</i></b>			
(01)	Describe the operating principle of a mechanical (rotating magnet) tachometer.	B	X	X
(02)	Explain the typical units for engine speed: - rpm for piston-engine aircraft; - percentage for turbine-engine aircraft (PPL-H only).	B	X	X
<b>022 01 07 00</b>	<b>Engine torque</b>			
<b>022 01 07 01</b>	<b><i>Torque, torque</i></b>			
(01)	Define 'torque'.			X
(02)	Explain the relationship between power, torque and rpm.	B		X
(03)	List the following units used for torque: – Newton meters; – inch or foot pounds.	F		X



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(04)	State that engine torque can be displayed as a percentage.	F		X
<b>022 02 00 00</b>	<b>Measurement of air data parameters</b>			
<b>022 02 01 00</b>	<b>Pressure measurement</b>			
<b>022 02 01 01</b>	<b>Definitions</b>			
(01)	Define the following pressure measurements and state the relationship between them: - static pressure; - dynamic pressure; - total pressure.	F	X	X
<b>022 02 01 02</b>	<b>Pitot/static system: design and errors</b>			
(01)	Describe the design and the operating principle of a: - static port/source; - pitot tube; - combined pitot/static probe.	B	X	X
(02)	For each of these indicate the various locations, describe the following associated errors and how to correct, minimise the effect of or compensate for them: - position errors; - instrument errors; - errors due to a non-longitudinal axial flow (including manoeuvre-induced errors).	B	X	X
(03)	Describe a typical pitot/static system and list the possible outputs.	B	X	X
(05)	Explain the purpose of pitot/static heating.	B	X	X
(06)	Describe alternate static sources and their effects when used, particularly in unpressurised aircraft.	B	X	X
<b>022 02 02 00</b>	<b>Temperature measurement</b>			
<b>022 02 02 01</b>	<b>Definitions</b>			
(01)	Define outside air temperature (OAT).	F	X	X
<b>022 02 04 00</b>	<b>Altimeter</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>022 02 04 01</b>	<b>Units, terms, types, operating principles, displays, errors, corrections</b>			
(01)	List the following two units used for altimeters and state the relationship between them: - feet; - metres.	F	X	X
(02)	Define the following terms: - height, altitude; - indicated altitude, true altitude; - pressure altitude, density altitude.	F	X	X
(03)	Define the following barometric references: 'QNH', 'QFE', '1013,25'.	F	X	X
(05)	Describe a simple altimeter (single capsule).	B	X	X
(07)	Describe the following errors: - static system errors; - instrument error; - barometric error; - temperature error (air column not at ISA conditions) - lag (altimeter response to change of height).	B	X	X
(09)	Describe the effects on an altimeter of a blockage or a leakage on the static pressure line .	B	X	X
<b>022 02 05 00</b>	<b>Vertical Speed Indicator (VSI)</b>			
<b>022 02 05 01</b>	<b>VSI and instantaneous vertical speed indicator (IVSI)</b>			
(01)	List the two units used for VSI: - meters per second; - feet per minute.	F	X	X
(02)A	Explain the operating principles of a VSI (barometric).	B	X	
(02)H	Explain the operating principles of a VSI and an IVSI.	B		X

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(04)	Describe the following VSI errors: - static system errors; - Instrument error; - time lag.	B	X	X
(05)	Describe the effects on a VSI of a blockage or a leakage on the static pressure line.	B	X	X
(06)	Give examples of a VSI display.	F	X	X
<b>022 02 06 00</b>	<b>Airspeed Indicator (ASI)</b>			
<b>022 02 06 01</b>	<b>Units, errors, operating principles, displays, position errors, unreliable airspeed indications</b>			
(01)	List the following three units used for airspeed and state the relationship between them: - nautical miles/hour (knots); - statute miles/hour; - kilometres/hour.	F	X	X
(p01)	Define IAS, CAS, TAS and explain the relationship between these speeds.	F	X	
(02)	Describe the following ASI errors and state when they must be considered: - pitot/static system errors; - instrument errors; - position errors; - density errors.	B	X	X
(03)	Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).	B	X	X
(04)A	Give examples of an ASI display: pointer, vertical straight scale.	R	X	
(04)H	Give examples of an ASI display: pointer, vertical straight scale, and digital (HUD display).	R		X
(05)	Demonstrate the use of an ASI correction table for position error.	P	X	X

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(06)	Define and explain the following colour codes that can be used on an ASI: - white arc (flap operating speed range); - green arc (normal operating speed range) - yellow arc (caution speed range); - red line (VNE)	F	X	
(07)	Define and explain the following colour codes that can be used on an ASI: – green arc (normal operating speed range); – red line (VNE); – blue line (maximum airspeed during autorotation).	F		X
(08)	Describe the effects on an ASI of a blockage or a leak in the static or total pressure line(s).	B	X	X
<b>022 03 00 00</b>	<b>Magnetism – direct reading compass and flux valve</b>			
<b>022 03 01 00</b>	<b>Earth’s magnetic field</b>			
<b>022 03 01 01</b>	<b>Magnetic field, variation, dip</b>			
(01)	Describe the magnetic field of the Earth.	B	X	X
(02)	Explain the properties of a magnet.	B		X
(03)	Define the following terms: – magnetic variation; – magnetic dip (inclination).	F	X	X
(04)	Describe that a magnetic compass will align itself to both the horizontal and vertical components of the Earth’s magnetic field, thus will not function in the vicinity of the magnetic poles.	B	X	X
(05)	Demonstrate the use of variation values (given as East/West (E/W) or +/-) to calculate: – true heading to magnetic heading; – magnetic heading to true heading.	P		X
<b>022 03 02 00</b>	<b>Aircraft magnetic field</b>			
<b>022 03 02 01</b>	<b>Permanent magnetism, electromagnetism, deviation</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Explain the following differences between permanent magnetism and electromagnetism: – when they are present; – what affects their magnitude.	B		X
(02)	Explain the principles of and the reasons for: – compass swinging (determination of initial deviations); – compass compensation (correction of deviations found); – compass calibration (determination of residual deviations).	B		X
(03)	Explain how permanent magnetism within the aircraft structure and electromagnetism from the aircraft systems affect the accuracy of a compass.	B	X	X
(04)	Describe the purpose and the use of a deviation correction card.	B	X	X
(05)	Demonstrate the use of deviation values (either given as E/W or +/-) from a compass deviation card to calculate: – compass heading to magnetic heading; – magnetic heading to compass heading.	P		X
<b>022 03 03 00</b>	<b>Direct Reading Magnetic Compass</b>			
<b>022 03 03 01</b>	<b>Purpose, errors, timed turns, serviceability</b>			
(01)	Explain the purpose of a direct reading magnetic compass.	B	X	X
(02)A	Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): – acceleration and deceleration; – turning.	B	X	
(02)H	Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): – acceleration and deceleration; – turning; – during pitch-up or pitch-down manoeuvres.	B		X
<b>022 04 00 00</b>	<b>Gyroscopic instruments</b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
<b>022 04 01 00</b>	<b>Gyroscope: basic principles</b>			
<b>022 04 01 01</b>	<b><i>Gyroscopic forces, degrees of freedom, gyro wander, driving gyroscopes</i></b>			
(01)	Define a 'gyro'.	F	X	X
(04)A	Explain the following terms: - rigidity; - wander (drift/topple).	B	X	
(04)H	Explain the following terms: - rigidity; - precession; - wander (drift/topple).	B		X
(05)	Explain the three types of gyro wander: - real wander; - apparent wander; - transport wander.	B	X	X
(06)	Describe the two ways of driving gyroscopes and any associated indications: - air/vacuum; - electrically.	B	X	X
<b>022 04 02 00</b>	<b>Rate-of-turn indicator – Turn coordinator – Balance (slip) indicator</b>			
<b>022 04 02 01</b>	<b><i>Indications, relation between bank angle, rate of turn and TAS</i></b>			
(01)	Explain the purpose of a rate-of-turn and balance (slip) indicator.	B	X	X
(02)	Define a 'rate-1 turn'.	F	X	X
(03)	Describe the indications given by a rate-of-turn indicator.	B	X	X
(04)	Explain the relation between bank angle, rate of turn and TAS (no calculations).	B	X	X
(05)	Explain the purpose of a balance (slip) indicator and its principle of operation.	B	X	X
(06)	Describe the indications of a rate-of-turn and balance (slip) indicator during a balanced, slip/ or skid turn.	B	X	X

		Tax	PPLA	PPLH
<b>Eind- en toetstermen</b>				
(07)	Describe the indications given by a turn coordinator (or turn-and-bank indicator).	B	X	X
(08)	Compare the indications of a rate-of-turn indicator and the turn coordinator.	R	X	X
<b>022 04 03 00</b>	<b>Attitude indicator (artificial horizon)</b>			
<b>022 04 03 01</b>	<b><i>Purpose, types, effect of aircraft acceleration, display</i></b>			
(01)	Explain the purpose of the attitude indicator.	B	X	X
(02)	Identify the two types of attitude indicators: – attitude indicator; – attitude and director indicator (ADI).	R		X
(04)	Describe the effects of aircraft acceleration and turns on the instrument indications.	B	X	X
(05)	Describe a typical attitude display and instrument markings.	B	X	X
<b>022 04 04 00</b>	<b>Directional gyroscope</b>			
<b>022 04 04 01</b>	<b><i>Purpose, types, drift, alignment to compass heading</i></b>			
(01)	Explain the purpose of the directional gyroscope.	B	X	X
(02)	Identify the two types of gyro-driven direction indicators: – direction indicator; – horizontal situation indicator (HSI).	R	X	X
(03)	Explain how the directional gyroscope will drift over time due to the following: – rotation of the Earth; – aircraft manoeuvring; – aircraft movement over the Earth's surface/direction of travel.	B	X	X
(04)	Describe the procedure for the pilot to align the directional gyroscope to the correct compass heading.	B	X	X
<b>022 12 00 00</b>	<b>Alerting systems, proximity systems</b>			
<b>022 12 11 00</b>	<b>Rotor/engine overspeed alert system</b>			
<b>022 12 11 01</b>	<b><i>Design, operation, displays, alarms</i></b>			

<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(01)	Describe the basic design principles, operation, displays and warning/alarm systems fitted to different helicopters.	B		X
<b>022 13 00 00</b>	<b>Integrated instruments – electronic displays</b>			
<b>022 13 03 00</b>	<b>Electronic flight instrument systems (EFISs)</b>			
<b>022 13 03 02</b>	<b>Primary flight display (PFD), electronic attitude indicator (EADI)</b>			
(01)A	Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle: <ul style="list-style-type: none"> <li>– attitude information in the centre;</li> <li>– airspeed information on the left;</li> <li>– altitude information on the right;</li> <li>– heading/track indication lower centre.</li> </ul>	B	X	
(01)H	Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle: <ul style="list-style-type: none"> <li>– attitude information in the centre;</li> <li>– airspeed information on the left;</li> <li>– altitude information on the right;</li> <li>– heading/track indication lower centre;</li> <li>– flight mode annunciation;</li> <li>– basic T;</li> <li>– take-off and landing reference speeds;</li> <li>– minimum airspeed;</li> <li>– lower selectable airspeed;</li> <li>– Mach number.</li> </ul>	B		X
(02)	Describe the typical design of the attitude information: <ul style="list-style-type: none"> <li>– artificial horizon with aircraft symbol;</li> <li>– superimposed flight director command bars.</li> </ul>	B		X
(03)A	Describe the typical design of the speed tape: B <ul style="list-style-type: none"> <li>– rolling speed scale with numerical read-out of current speed;</li> <li>– limiting airspeeds according to configuration;</li> <li>– speed trend vector.</li> </ul>	B	X	



<b>Eind- en toetstermen</b>		<b>Tax</b>	<b>PPLA</b>	<b>PPLH</b>
(03)H	Describe the typical design of the speed tape: <ul style="list-style-type: none"> <li>– rolling speed scale with numerical read-out of current speed;</li> <li>– limiting airspeeds according to configuration;</li> <li>– speed trend vector;</li> <li>– bug/indication for selected airspeed.</li> </ul>	B		X
(05)	Describe the typical design of the altitude information: <ul style="list-style-type: none"> <li>– rolling altitude scale with numerical read-out of current altitude;</li> <li>– altimeter pressure setting;</li> <li>– bug/indication for selected altitude.</li> </ul>	B	X	

Eind- en toetstermen		Tax	PPLA	PPLH
<b>070 00 00 00</b>	<b>OPERATIONAL PROCEDURES</b>			
<b>071 02 00 00</b>	<b>Special operational procedures and hazards – general aspects</b>			
<b>071 02 05 00</b>	<b>Fire and smoke</b>			
<b>071 02 05 01</b>	<b><i>Carburettor fire</i></b>			
(p01)	List the actions to be taken in the event of a carburetor fire.	F	X	
(01)	Explain that the actions to be taken in the event of a carburettor fire may be type-specific and should be known by the pilot.	B		X
<b>071 02 05 02</b>	<b><i>Engine fire</i></b>			
(p01)	List the actions to be taken in the event of an engine fire.	F	X	
(01)	Explain that the actions to be taken in the event of an engine fire may be type-specific and should be known by the pilot.	B		X
<b>071 02 05 03</b>	<b><i>Fire in the cabin, cockpit, cargo compartment</i></b>			
(01)	Identify the different types of extinguishants used in handheld fire extinguishers and the type of fire on which each one may be used.	R	X	X
<b>071 02 05 04</b>	<b><i>Smoke in the cockpit and cabin</i></b>			
(p01)	Explain the actions to be taken in the event of smoke in the cockpit or in the cabin.	B	X	
(01)	Explain which actions should be taken in the event of smoke in the flight crew compartment or in the cabin, why these actions may be type-specific, and why they should be known by the pilot.	B		X

*Alleen de onderwerpen die als meest relevant voor privévliegers worden beschouwd zijn uitgewerkt in de leerdoelen. De onderwerpen die niet in de leerdoelen zijn uitgewerkt, maar wel terugkomen in de AMC-syllabus zijn in onderstaand tekstvak onder benoemd:*

De volgende onderwerpen uit de AMC-syllabus zijn niet uitgewerkt in bovenstaande leerdoelen:

- **Electrics:** Alternating current: voltage, current, amplitude, phase, frequency and resistance.
- **Generation:** AC generation: type, design, operation, degraded modes of operation, indications and warnings.
- **Distribution:**(b) AC and DC comparison.
- **Instrumentation:** Position transmitter.
- Communication systems
- Alerting systems and proximity systems

## **Wijzigingen toetsmatrijs LVPAAGK**

Wijzigingen leerdoelen 26-02-2019 (t.o.v. versie 09-03-2015)

### **Algemene wijzigingen**

- De leerdoelen van de vakken die in één examen worden afgenomen, zijn in één document gevoegd.
- De leerdoelen zijn genummerd.
- De kolom met 'opmerkingen' is verwijderd. Alle informatie die (niet) geldt voor PPL staat (niet) in de LO's.
- Voor PPLA en PPLH verschilt hetzelfde leerdoel soms. Als dat het geval is, heeft het leerdoel hetzelfde nummer en staat er een A (bij PPLA) of H (bij PPLH) achter.

### **Grote wijzigingen AGK**

- 021 01 02 00: leerdoel verwijderd. Leerdoel (02) en (03) zijn toegevoegd.
- 021 01 03 01: leerdoel verwijderd. Leerdoel (04) is toegevoegd. Dit leerdoel is alleen voor PPLH.
- 021 01 05 00: dit onderdeel is verwijderd.
- 021 02 03 01: leerdoel verwijderd. Leerdoel (01) is toegevoegd.
- 021 02 03 03: derde leerdoel is verwijderd (verplaatst naar 021 02 03 01).
- 021 02 04 01 (01): alleen voor PPLH.
- 021 02 04 01 (04) en (06): alleen voor PPLA.
- 021 02 05 01: tweede en derde LO zijn verwijderd.
- 021 02 05 02: onderdeel verwijderd.
- 021 02 05 03: eerste en vierde LO zijn verwijderd.
- 021 02 06 00: eerste LO alleen voor PPLA. Leerdoel (03) is toegevoegd, alleen voor PPLH. Leerdoel (04) is ook alleen voor PPLH.
- 021 03 01 00 (01): alleen voor PPLH.
- 021 03 02 01 (01), (04) en (05): alleen voor PPLH.
- 021 04 02 00: tweede LO is verwijderd. Leerdoel (03) is toegevoegd. De drie LO's zijn alleen voor PPLA.
- 021 04 03 01: LO's alleen voor PPLA.
- 021 04 03 02: tweede LO is verwijderd. Leerdoel (02) alleen voor PPLA.

- 021 04 04 01 (01): alleen voor PPLA.
- 021 05 01 01: eerste en derde LO verwijderd.
- 021 05 01 05 (was 021 05 01 04): eerste LO is verwijderd.
- 021 05 02 01: eerste LO is verwijderd.
- 021 05 03 01 (was 021 05 03 00): derde, zevende, achtste, elfde en twaalfde LO zijn verwijderd.
- 021 07 01 01 (was 021 07 01 00): leerdoel verwijderd en leerdoel (01) en (04) toegevoegd.
- 021 08 01 02 (05) en (07): alleen voor PPLH.
- 021 08 02 01: onderdeel toegevoegd (alleen voor PPLH).
- 021 08 02 02: eerste, derde, vierde en vijfde LO zijn verwijderd.
- 021 09 01 01 (04): alleen voor PPLH.
- 021 09 01 02: eerste, derde, vierde en vijfde LO zijn verwijderd. Leerdoel (01) is toegevoegd.
- 021 09 01 03: tweede leerdoel is verwijderd. Leerdoel (01) en (04) alleen voor PPLH.
- 021 09 01 04: onderdeel verwijderd.
- 021 09 01 06: derde LO is verwijderd. Leerdoel (01) alleen voor PPLH.
- 021 09 03 01 (04): alleen voor PPLH.
- 021 09 03 02: onderdeel verwijderd.
- 021 09 04 01 (02): alleen voor PPLA.
- 021 09 04 04: eerste LO is verwijderd.
- 021 10 01 01: tweede LO is verwijderd.
- 021 10 01 02: derde LO is verwijderd.
- 021 10 02 01: vierde, vijfde en tiende LO zijn verwijderd.
- 021 10 02 02: onderdeel verwijderd.
- 021 10 04 01: derde LO is verwijderd. Leerdoel (09) en (11) zijn toegevoegd.
- 021 10 04 02: eerste, derde, vierde, vijfde en zesde LO zijn verwijderd.
- 021 10 04 03 (03): alleen voor PPLA.
- 021 10 05 01 (02): alleen voor PPLA.
- 021 10 06 02: vijfde LO is verwijderd.
- 021 10 07 01 (03): alleen voor PPLA
- 021 10 07 01: leerdoel (04) is toegevoegd, alleen voor PPLH.
- 021 10 07 01: vijfde en zesde leerdoel zijn verwijderd.
- 021 10 10 01: eerste LO is verwijderd.
- 021 10 10 02: derde LO is verwijderd.
- 021 11 01 02: tweede LO is verwijderd. Leerdoel (09) is toegevoegd.
- 021 11 02 02: vijfde LO is verwijderd.
- 021 11 02 04: Leerdoel (04) is toegevoegd.
- 021 11 02 06: Leerdoel (05) is toegevoegd.
- 021 11 02 07: LO is verwijderd en leerdoel (01) is toegevoegd.
- 021 11 03 08: eerste, tweede, derde en vierde LO zijn verwijderd.
- 021 11 05 02: achtste LO is verwijderd.
- 021 15 01 04: onderdeel is verwijderd.
- 021 15 02 03: onderdeel is verwijderd.

- 021 16 04 01 (was 021 06 04 00): derde, vierde en vijfde LO zijn verwijderd.
- 021 16 05 00: onderdeel is verwijderd.
- 021 16 06 00: onderdeel is toegevoegd.
- 021 16 07 00: onderdeel is toegevoegd.
- 021 17 01 01: tweede LO is verwijderd.
- 021 17 02 01: leerdoel (05) is toegevoegd.
- 021 17 02 02: onderdeel is verwijderd.
- 021 17 02 04: onderdeel is verwijderd.
- 021 17 02 06: onderdeel is toegevoegd.
- 021 17 02 07: onderdeel is toegevoegd.
- 022 01 01 01 (was 022 01 01 00): eerste, zesde en zevende LO zijn verwijderd. Leerdoel (03) alleen voor PPLH.
- 022 01 02 01 (was 022 01 02 00): vierde en vijfde LO zijn verwijderd. Leerdoel (01), (02) en (03) alleen voor PPLH.
- 022 01 04 01 (was 022 01 04 00): vierde LO is verwijderd.
- 022 01 05 01 (was 022 01 05 00): tweede LO is verwijderd.
- 022 01 07 00: onderdeel is toegevoegd (alleen voor PPLH).
- 022 01 10 00: onderdeel is verwijderd.
- 022 02 01 02: vierde en zesde LO zijn verwijderd.
- 022 02 02 02: onderdeel is verwijderd.
- 022 02 04 01 (was 022 02 04 00): vijfde LO is verwijderd.
- 022 02 05 01 (was 022 02 05 00): tweede LO is verwijderd en leerdoel (02) is toegevoegd.
- 022 02 06 01 (was 022 02 06 00): (p01) alleen voor PPLA.
- 022 03 01 01 (was 022 03 01 00): leerdoel (02) alleen voor PPLH en leerdoel (04) en (05) zijn toegevoegd.
- 022 03 02 01 (was 022 03 02 00): leerdoel (05) is toegevoegd.
- 022 03 03 01 (was 022 03 03 00): tweede, derde en vijfde LO zijn verwijderd.
- 022 04 01 01 (was 022 04 01 00): tweede, derde, zesde en achtste LO zijn verwijderd.
- 022 04 02 01 (was 022 04 02 00): vierde en zesde LO zijn verwijderd en leerdoel (05) is toegevoegd.
- 022 04 03 01 (was 022 04 03 00): derde, vierde en vijfde LO zijn verwijderd.
- 022 04 04 01 (was 022 04 04 00): derde, vierde, vijfde en zesde LO zijn verwijderd. Leerdoel (03) en (04) zijn toegevoegd.
- 022 06 00 00: onderdeel is verwijderd.
- 022 12 03 00: onderdeel is verwijderd.
- 022 13 01 01: onderdeel is verwijderd.
- 022 13 03 02: tweede LO is verwijderd en leerdoel (02), (03) en (05) zijn toegevoegd.
- 022 13 03 03: onderdeel is verwijderd.

### **Kleine wijzigingen AGK**

- 021 01 03 00: 'corrosion' toegevoegd.
- 021 02 03 03 (03): 'describe' is aangepast in 'explain'.
- 021 02 05 01 (02): aanpassing van 'Describe the construction methods and alignment of vertical and horizontal stabilisers' naar 'Explain why vertical and horizontal stabilisers may have different shapes and alignments'.
- 021 02 06 00 (04): 'alternating stress' is verwijderd.
- 021 04 01 02 (01): 'drag struts' is verwijderd.

- 021 04 02 01 (05): aanpassing van 'Define the term 'shimmy' and the possible consequences for the nose and the main wheel system' naar 'Define the term 'shimmy' and the possible consequences for the nose wheel system and explain the purpose of a shimmy damper to reduce the severity of shimmy.
- 021 04 04 01: 'tube-type' toegevoegd en 'diagonal' en 'radial' verwijderd.
- 021 04 05 01 (01): 'and their limitations' is toegevoegd.
- 021 04 05 01 (02): aanpassing van 'Explain the IAS limitations, before, during and after floatation device deployment' naar 'Explain why indicated airspeed (IAS) limitations before, during and after flotation-device deployment must be observed'.
- 021 05 02 01 (02): 'speed brakes' is verwijderd.
- 021 05 03 01 (07): aanpassing van 'State the need for 'feel systems' in the hydraulic actuated flight control system' naar 'State the need for artificial feel in a hydraulically actuated flight control system'.
- 021 05 03 01 (08): aanpassing van 'Describe the purpose of a trim system' naar 'Describe and explain the purpose of a trim system using the following terms: force-trim switch and force gradient'.
- 021 08 02 02: alleen 'trim fuel tanks, bafflers, refuelling/defueling system en fuel dump/jettison system' van toepassing.
- 021 09 01 01 (01): aanpassing van 'Explain static electricity' naar 'Explain static electricity and describe the flying conditions where aircraft are most susceptible to build-up of static electricity'.
- 021 09 01 01 (04): aanpassing van 'Define voltage, current and resistance and state their unit of measurement' in 'Define voltage and current and state their unit of measurement'.
- 021 09 01 03 (01): 'and compare its use to DC with regard to complexity' is toegevoegd.
- 021 09 01 07: 'circuit breakers' is aangepast naar 'circuit protection'. Bij leerdoel (01) is 'operating principle' aangepast naar 'working principle'.
- 021 09 03 01 (01): 'DC generator' toegevoegd en 'and name its main components' is verwijderd.
- 021 09 03 01 (02) 'and why it is required' is toegevoegd.
- 021 09 04 04 (04): aanpassing van 'State that Ni-Cd batteries are monitored to avoid damage resulting from excessive temperature increase (thermal runaway) naar 'Explain the importance of monitoring the battery temperature of nickel-cadmium and lithium-type batteries'.
- 021 10 01 01 (01): 'torque' (bij PPLA) en 'compression ratio' zijn verwijderd.
- 021 10 01 02 (01): 'crankcase', 'connecting rod', 'piston pin', 'valve springs', 'push rod', 'rocker arm' en 'cam shaft gear' bij PPLA verwijderd.
- 021 10 01 02 (02): 'radial' bij PPLA verwijderd.
- 021 10 01 02 (03): 'maximum compression ratio' bij PPLA verwijderd. 'pollution from the exhaust' bij PPLH toegevoegd.
- 021 10 03 01 (01): 'describe' aangepast in 'explain'.
- 021 10 04 01 (04): aanpassing van 'Describe the methods of obtaining mixture control over the whole engine speed and sltitude range including provision of a method of stopping the engine' naar 'Describe the methods of obtaining mixture control over the whole operating altitude range'.
- 021 10 04 02: 'and difference in operation' toegevoegd.
- 021 10 04 03 (04): aanpassing van 'advantages' naar 'differences'.
- 021 10 06 02 (04): 'and their advantages and disadvantages' is toegevoegd.
- 021 10 08 01 (02): aanpassing van 'State the typical fuel to air ratio values or range of values for the above mixtures' naar 'State the typical fuel to air ratio values of a stoichiometric mixture'.
- 021 10 09 02 (01): 'with the aid of a schematic diagram' is verwijderd.
- 021 10 10 01 (01) 'density altitude' is verwijderd.
- 021 10 10 01 (04): 'waste gate actuator (alleen voor PPLA)', 'absolute pressure controller', 'density controller' en 'differential pressure controller' zijn verwijderd.
- 021 15 01 01 (02): 'in basic terms' toegevoegd.
- 021 15 02 01 (08): aanpassing van 'Describe how the vertical fin on some helicopters reduces the power demand of the fenestron' naar 'Describe how the vertical fin on some types reduces the power demand of the tail rotor'.

- 022 01 01 01 (05): aanpassing van 'For each type of sensor identify applications such as:' naar 'Identify pressure measurements that are applicable on an aircraft:' Alleen 'liquid pressure measurement' en 'Manifold Absolute Pressure (MAP) gauge' zijn van toepassing ('air pressure measurement' en pressure probes for Engine Pressure Ratio' zijn verwijderd).
- 022 01 02 01 (04): aanpassing van 'For each type, identify applications such as:' naar 'Identify temperature measurements that are applicable to an aircraft:'
- 022 01 03 01 (03): aanpassing van 'State the relationship between these different units' naar 'Convert between the various units.'
- 022 01 03 01 (04): 'list' is verwijderd.
- 022 01 04 01 (04): 'kilogrammas/hour' en 'pounds/hour' zijn aangepast in 'Litres/hour', 'imperial gallons/hour' en 'US gallons/hour'.
- 022 01 05 01 (01): 'list the following types of tachometers' aangepast naar 'Describe the operating principle of a mechanical (rotating magnet) tachometer'.
- 022 01 05 01 (02): aanpassing van 'State that engine speed is most commonly displayed as a percentage of a maximum engine speed, as RPM value' naar 'Explain the typical units for engine speed: rpm for piston-engine aircraft and percentage for turbine-engine aircraft (PPL-H only).'
- 022 02 01 02 (02): 'and how to correct, minimise the effect of or compensate for them:' toegevoegd, 'manoeuvre-induced errors' aangepast naar 'errors due to a non-longitudinal axial flow (including manoeuvre-induced errors)' en 'and the means of correction and/or compensation' is verwijderd.
- 022 02 01 02 (05): 'and interpret the effect of heating on sensed pressure' is verwijderd.
- 022 02 01 02 (06): 'particularly in unpressurised aircraft' is toegevoegd.
- 022 02 02 01 (01): 'and its use in calculations' is verwijderd.
- 022 02 04 01 (05): 'compare' is verwijderd.
- 022 02 04 01 (07): 'instrument error' en 'barometric error' zijn toegevoegd.
- 022 02 05 01 (01): 'and state the relationship between them' is verwijderd.
- 022 02 05 01 (04): 'instrument error' is toegevoegd en 'and the means of correction' is verwijderd.
- 022 02 06 01 (01): 'and state the relationship between them' is verwijderd.
- 022 02 06 01 (02): 'instrument error' en 'position error' zijn toegevoegd.
- 022 02 06 01 (05): aanpassing van 'Interpret ASI corrections tables as used in an Aircraft Operations Manual (AOM): naar 'Demonstrate the use of an ASI correction table for position error'.
- 022 03 02 01 (01): aanpassing van 'Define and explain the following terms: magnetic and non-magnetic material, hard and soft iron and permanent magnetism and electro-magnetism' naar 'Explain the following differences between permanent magnetism and electromagnetism: when they are present and what affects their magnitude'.
- 022 03 02 01 (02): 'and the reasons for' toegevoegd.
- 022 03 02 01 (03): aanpassing van 'List the causes of the aircraft's magnetic field and explain how it affects the accuracy of the compass indications' naar 'Explain how permanent magnetism within the aircraft structure and electromagnetism from the aircraft systems affect the accuracy of a compass'.
- 022 03 03 01 (01): 'define the role' aangepast naar 'explain the purpose'.
- 022 03 03 01 (02): aanpassing van 'Describe and interpret the effects of the following errors: acceleration, turning, deviation' naar 'Describe how the direct-reading magnetic compass will only show correct indications during straight, level and unaccelerated flight, and that an error will occur during the following flight manoeuvres (no numerical examples): acceleration and deceleration, turning and during pitch-up or pitch-down manoeuvres (alleen voor PPLH).
- 022 04 01 01 (05): aanpassing van 'Distinguish between: real wander and apparent wander and apparent wander due to the rotation of the Earth and transport wander' naar 'Explain the three types of gyro wander: real wander, apparent wander and transport wander'.
- 022 04 01 01 (06): aanpassing van 'Describe and compare electrically and pneumatically driven gyroscopes' naar 'Describe the two ways of driving gyroscopes and any associated indications: air/vacuum and electrically.
- 022 04 02 01 (03): aanpassing van 'Describe the construction and principles of operation of a rate of turn and balance (slip) indicator' naar 'Describe the indications given by a rate-of-turn indicator'.
- 022 04 03 01 (02): aanpassing van 'Describe the different designs and principles of operation of attitude indicators' naar 'Identify the two types of attitude indicators: attitude indicator and attitude and director indicator (ADI)'.

- 022 04 04 01 (02): aanpassing van 'Describe the following two types of directional gyroscopes: air driven directional gyro and electric directional gyro' naar 'Identify the two types of gyro-driven direction indicators: direction indicator and horizontal situation indicator (HSI)'.
- 022 13 03 02 (01): aanpassing van 'State that a PFD (or an EADI) presents a dynamic color display of all the parameters necessary to control the aircraft' naar Describe that a PFD (or an EADI) presents a dynamic colour display of all the parameters necessary to control the aircraft, and that the main layout conforms with the 'basic T' principle: attitude information in the centre, airspeed information on the left, altitude information on the right, heading/track indication lower centre, flight mode annunciation (alleen PPLH), basic T (alleen PPLH), take-off and landing reference speeds (alleen PPLH), minimum airspeed (alleen PPLH), lower selectable airspeed (alleen PPLH) and Mach number (alleen PPLH).

**Kleine wijzigingen OPS:**

- 071 02 05 01 (01): voor PPLH is het leerdoel gewijzigd naar 'Explain that the actions to be taken in the event of a carburettor fire may be type-specific and should be known by the pilot'.
- 071 02 05 02 (01): voor PPLH is het leerdoel gewijzigd naar 'Explain that the actions to be taken in the event of an engine fire may be type-specific and should be known by the pilot'.
- 071 02 05 04 (p01): 'list' is aangepast naar 'explain'.
- 071 02 05 04 (01): voor PPLH is het leerdoel gewijzigd naar 'Explain which actions should be taken in the event of smoke in the flight crew compartment or in the cabin, why these actions may be type-specific, and why they should be known by the pilot.'