Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units

Unit 1 RBAK — Basic aviation knowledge for RPAS

Item	Aeronautical knowledge topics	Priority
1	***Direction of flight and wind*** (a) expressing direction of flight: (i) as a 3-figure group; (ii) in the clock code; (iii) as cardinal and ordinal compass points; (b) difference between aircraft heading and track; (c) wind velocity; (d) the relationship between true and magnetic heading.	**A**
2	***Time*** (a) time as a 4, 6 and 8-figure group; (b) UTC; (c) converting local and standard time to and from UTC.	**B**
3	***Units of measurement for aeronautics*** (a) differences between height, altitude and elevation; (b) units of measurement for: (i) horizontal distance; (ii) vertical distance; (iii) speeds; (iv) visibility; (v) temperature; (vi) atmospheric pressure; (vii) weight; (c) converting between different units of measurement.	**A**
4	***Energy*** Aircraft energy, including: (a) potential energy; (b) kinetic energy; (c) inertia.	**B**
5	***Aerodynamics, weight and balance*** (a) terminology: (i) aerofoil, angle of attack and relative airflow; (ii) centre of pressure and centre of gravity; (iii) lift, weight, thrust and drag;	**A**

Item	Aeronautical knowledge topics	Priority
	(b) "Bernoulli's principal", "Coandra effect" and "Newton's third law"; (c) basic weight and balance principles; (i) empty weight; (ii) operating weight; (iii) maximum gross weight; (iv) arm, moment, datum, station and index unit; (v) centre of gravity limits; (vi) loading limits.	
6	***Lift and drag*** (a) changes to lift and drag resulting from: (i) airspeed changes; (ii) angle of attack changes;	**B**
	(b) types of drag, including: (i) parasite (zero lift), form, interference and skin friction; (ii) induced (lift dependent).	**C**
7	***Propellers and rotors*** (a) terminology; (b) blade angle, helix angle or pitch; (c) propeller/rotor thrust and torque; (d) propeller/rotor principles.	**B**
8	***Principles of operation — flight control*** (a) longitudinal, lateral and vertical axes; (b) pitch, roll and yaw; (c) skid and slip; (d) effect of changes in power on vertical and horizontal speed; (e) relationship between control inputs and aircraft movements; (f) angle of climb and rate of climb; (g) trim controls.	**A**
9	***Principles of operation — remote pilot station*** Features of a remote pilot station: (a) transmitter; (b) command and control link; (c) flight controls; (d) other controls; (e) antennas/aerials; (f) software, including firmware and updates; (g) telemetry; (h) non-payload communications; (i) power supply.	**C**

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 2 RACP — Airspace, charts and aeronautical publications for RPAS

Item	Aeronautical knowledge topics	Priority
1	***Airspace*** (a) classification of airspace; (b) airspace depiction on aeronautical charts, including: (i) flight information area; (ii) Class G airspace; (iii) controlled aerodromes; (iv) control area; (v) control zone; (vi) VFR route and lane of entry; (vii) prohibited areas; (viii) restricted areas; (ix) danger areas; (x) common traffic advisory frequencies and associated airspace; (xi) radio frequency boundaries; (c) airspace in relation to the circumstances in which an aeronautical radio qualification is required: (i) Air Traffic Control (ATC); (ii) in the vicinity of non-controlled aerodromes.	**A**
2	***Obtaining information or approval*** (a) permissions for RPA operations in restricted areas; (b) aeronautical information publications, including: (i) AIP; (ii) ERSA; (iii) NOTAM.	**A**
3	***NOTAMs*** (a) obtaining NOTAMs for operational areas; (b) decoding NOTAMs.	**A**
	NOTAM publication (c) Submitting a NOTAM for publication.	**C**

Item	Aeronautical knowledge topics	Priority
4	***Form of the earth, aeronautical charts and maps*** (a) features on an aeronautical chart (other than airspace); (b) cardinal and ordinal points of the compass; (c) latitude and longitude; (d) depiction of height and elevation on charts; (e) distance on the earth and in charts; (f) magnetic variation; (g) relationship between magnetic heading and magnetic bearing.	**A**
5	***Electronic flight bag*** (a) electronic maps and charts; (b) CASA verified drone safety app.	**C**

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 3 RBMO — Basic meteorology for RPA operations

Item	Aeronautical knowledge topics	Priority
1	***Weather phenomena*** (a) causes and effects of the following weather phenomena in relation to RPA operations: (i) thunderstorms; (ii) low cloud; (iii) poor visibility (fog, mist, dust, haze); (iv) turbulence; (v) extreme heat and cold; (vi) strong winds and windshear; (vii) rain and humidity; (viii) convection; (ix) precipitation static; (b) the meaning of symbols used on weather maps.	**B**
2	***Weather observations*** Indications of the presence of: (a) turbulence, thermals or dust devils; and (b) wind gradient and wind shear.	**B**
3	***Aeronautical forecasts*** (a) obtaining aeronautical forecasts for the area of operations; (b) decoding an aeronautical forecast; (c) using public weather forecasts and reports.	**B**

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 4 REES — Electrical and electronic systems for RPAS

Item	Aeronautical knowledge topics	Priority
1	***Electrical terms*** (a) volts; (b) amps; (c) watts; (d) ohms; (e) hertz.	**B**
2	***Function of electrical components*** (a) electrical components of an RPA: (i) electronic speed controller; (ii) battery eliminator circuit; (iii) receiver and remote receivers; (iv) telemetry module; (v) flight batteries; (vi) receiver battery; (vii) circuit breakers and fuses; (viii) servomechanisms; (ix) aerials/antennas; (x) GPS receivers; (xi) altimeters (radio, radar, laser, acoustic); (xii) collision avoidance sensors; (b) equipment redundancy; (c) malfunctions and system back-ups; (d) consequences of a malfunction; (e) remedial actions in the event of failure.	**A**
3	***Electric motors*** (a) current draw through the motor in relation to rotor or propeller diameter or pitch; (b) current draw through the motor in relation to rotor or propeller loads; (c) determination of appropriate “Kv”.	**A**
4	***Batteries*** (a) types of batteries: (i) nickel metal hydride batteries; (ii) lithium polymer batteries; (iii) alkaline batteries; (iv) nickel cadmium batteries;	**A**

Item	Aeronautical knowledge topics	Priority
	(v) fuel cells; (b) battery specifications and abbreviations (types, voltage; amperage etc); (c) characteristics of batteries used as an energy source for the RPA: (i) cell count; (ii) nominal voltage; (iii) battery configuration: (A) parallel; (B) series; (iv) battery capacity; (v) maximum current draw; (vi) discharge rate; (vii) main power plug; (viii) balance plug; (d) batteries classified as dangerous goods for air transportation.	
5	***Charging/discharging batteries*** (a) charging procedures for batteries; (b) discharging procedures for batteries; (c) cell balancing in multi-cell batteries; (d) state of charge of a battery with reference to capacity and voltage.	**A**
6	***Battery limitations*** (a) "continuous C-rating" and "maximum burst C-rating"; (b) trade-off between battery size and flight endurance of an electrically-powered RPA; (c) battery serviceability; (d) battery checkers.	**B**
7	***Electromagnetic radiation*** (a) radio waves; (b) characteristics of radio waves, wave propagation, transmission including: (i) the radio frequency band ranges (MF, HF, VHF, UHF); (ii) effective range of transmissions; (iii) factors affecting the propagation of radio waves, including: (A) terrain; (B) ionosphere; (C) sun spot activity; (D) interference from electrical equipment; (E) thunderstorms; (c) radio characteristics, optimisation and shielding: (i) digital and analogue signals;	**A**

Item	Aeronautical knowledge topics	Priority
	(ii) command and control link range testing; (iii) radio frequencies for RPA operations.	
8	***Global Positioning System (GPS)*** (a) components of a GPS; (b) how GPS works, including accuracy of different systems; (c) factors that affect the performance of GPS, including the following: (i) number of satellites available; (ii) path interference; (iii) type of software; (iv) signal availability; (v) indications of faulty GPS equipment.	**A**
9	***Electromagnetic signal reliability and hazards*** (a) electromagnetic interference (EMI); (b) powerlines; (c) LTE and Wi-Fi.	**B**

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 5 RHPF — Human performance for RPAS

Item	Aeronautical knowledge topics	Priority
1	***General*** (a) airmanship (including, "aviate", "navigate", "communicate"); (b) differences between the sensory information available to a person operating an RPA compared to the pilot of manned aircraft; (c) situational awareness during RPA operations; (d) information processing and decision making in relation to the following factors: (i) personality traits; (ii) pride, peer pressure or employer pressure; (iii) desire to get the task done; (iv) anxiety, overconfidence, boredom or complacency; (v) long- or short-term memory; (vi) memory limitations; (vii) *aide-memoires* and rules of thumb; (viii) workload and overload; (ix) skill, experience and recency; (e) methods of enhancing decision-making skills; (f) temporal factors relating to system latency.	**C**
2	***Basic health*** Medical and psychological factors that may affect pilot performance in relation to operating RPA: (a) upper respiratory tract infections, including colds, hay fever, congestion of air passages and sinuses; (b) a headache, including a migraine; (c) an injury; (d) ageing; (e) dehydration and heat stroke; (f) fatigue; (g) alcohol use and smoking; (h) drug use, including prescription and over-the-counter medications; (i) emotions, including anger, anxiety, depression and fear.	**C**

Item	Aeronautical knowledge topics	Priority
3	***Vision, spatial disorientation, illusions*** (a) anatomy of the eye and its functioning during the day and at night; (b) limitations of the eye: (i) the ability to discern objects/aircraft at a distance and height; (ii) empty field myopia; (iii) glare; (iv) colour discrimination; (v) myopia, hyperopia, astigmatism, presbyopia and parallax; (c) enhancing vision within the definition of VLOS: (i) prescription spectacles; (ii) suitable sunglasses; (d) disorientation during RPA operations; (e) visual illusions: (i) typical illusions, including relative motion; (ii) conditions under which visual illusions may occur; (iii) how to overcome sensory illusions.	**B**
4	***Stress in relation to operating RPA*** (a) the effects of short- and long-term stress on the performance and health of a person operating an RPA; (b) symptoms of stress in an excessively hot, cold, windy, vibrating or noisy environment; (c) causes and effects of domestic or work-related stress; (d) principles of stress management, including: (i) cognitive or behavioural techniques for managing stress; (ii) relaxation; (iii) time management.	**C**
5	***Threat and error management*** (a) principles of threat and error management in relation to operating RPA; (b) processes to identify and manage threats and errors during RPA operations; (c) the use of checklists and standard operating procedures to prevent errors; (d) crew resource management; (e) risk perception when remote from the location of RPA operation; (f) strategic versus tactical risk management.	**B**
6	***Coordinating crew*** (a) verbal and non-verbal communication, including the following factors: (i) barriers to communication;	**C**

Item	Aeronautical knowledge topics	Priority
	(ii) listening skills; (iii) assertion skills; (b) aspects of individuals that may affect the safe operation of the RPA: (i) personality; (ii) judgement; (iii) leadership style.	

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 6 RKOP RPAS knowledge — operations and procedures

Item	Aeronautical knowledge topics	Priority
1	***General operations*** (a) general considerations relating to: (i) starting and ground running of motors/engines; (ii) bystanders; (iii) crew briefing; (b) responsibilities of the remote pilot: (i) under Part 101 of CASR; (ii) in relation to the operator's documented practices and procedures; (iii) keeping operational, remote pilot and technical logs in accordance with MOS sections 10.05 to 10.06; (c) considerations: (i) after an operation has ended; (ii) in relation to aircraft noise and wildlife.	**A**
2	***Risk assessment and management*** (a) the strategic risk assessment process relevant to RPAS operations, including: (i) hazard identification; (ii) risk identification; (iii) risk mitigation measures; (b) elements of a job safety assessment for the operation of an RPA; (c) completing a job safety assessment for the operation of an RPA.	**A**
3	***Airworthiness — general*** (a) determine RPAS serviceability for a specific operation; (b) use of the RPA technical log; (c) responsibilities of the holder of a remote pilot licence in relation to the continuing airworthiness of the RPA, including: (i) conducting inspections of the RPA; (ii) reporting defects or unserviceability in relation to the RPAS.	**A**
4	***Role equipment or sensors*** Safety and performance implications of various payloads, including cameras and other sensors.	**B**

Item	Aeronautical knowledge topics	Priority
5	***Accident and incident reporting*** (a) definitions of accident and incidents; (b) requirements for accident and incident reporting (however described) mentioned in the *Transport Safety Investigation Regulations 2003* and the *Transport and Safety Investigation (Voluntary and Confidential Reporting Scheme) Regulation 2012*.	**A**
6	***Abnormal operations*** Considerations in the event of the following: (a) if the engine or motors of an RPA fails in the following circumstances: (i) immediately after launch; (ii) on approach to landing; (iii) when operating within controlled airspace under ATC control; (iv) in a built-up area; (v) in the vicinity of bystanders; (b) a control link failure; (c) a remote pilot station failure; (d) if a fire takes hold on the RPA during flight or on the ground; (e) if the RPA is attacked by a bird.	**A**
7	***Fail-safe procedures and emergency actions*** Fail-safe systems and emergency actions, including: (a) the "return to home" system; (b) regain link holding pattern; (c) the RPA flies to a predetermined holding point; (d) emergency parachute deployment; (e) immediate landing; (f) flight termination; (g) carbon fibre containment in the event of a crash.	**A**
8	***Operation of RPA near aerodrome*** (a) considerations in relation to operating an RPA near an aerodrome: (i) the location at an aerodrome of each runway threshold, each runway threshold centrepoint, and the movement areas; (ii) the structure of the approach and departure paths for aerodromes and helicopter landing sites (HLS); (b) the prohibitions in Part 101 of CASR relating to operating an RPA at or near aerodromes and HLS; (c) the process to obtain a permission, approval or exemption (however described) under CASR in relation to operating an RPA at or in the approach and departure paths of a particular aerodrome; (d) determining the runway or runways in use at an aerodrome; (e) traffic patterns at aerodromes;	**A**

Item	Aeronautical knowledge topics	Priority
	(f) limitations on the operation of an RPA near an aerodrome if the aerodrome has more than 1 runway; (g) limitations imposed by the Part 101 MOS with respect to operations in controlled and non-controlled airspace.	
9	***Operations of RPA above 400 ft AGL*** Considerations relating to operations of an RPA above 400 ft AGL: (a) airspace classification; (b) aeronautical radio use and qualifications; (c) identifying the location of non-controlled aerodromes; (d) use of RPA observers; (e) the process to obtain a permission, approval or exemption (however described) under CASR in relation to operating an RPA above 400 ft AGL.	**A**
10	***Tethered operations*** Operational considerations for when the RPA is tethered to the ground.	**B**

Schedule 4 Aeronautical knowledge units

Appendix 1 Any RPA — Common units (contd.)

Unit 7 RORA — Operational rules and air law for RPAS

Item	Aeronautical knowledge topics	Priority
1	***Aviation legislation and information*** (a) documents that contain aviation legislation, aeronautical information and general operating rules that apply to the operation of RPA; (b) obtaining the documents and ensuring that the information is up to date; (c) guidance materials and information sources relating to RPAS operations.	**A**
2	***Remote pilot licence*** (a) conditions that apply to a remote pilot licence under Part 101 of CASR; (b) conditions that may apply to a remote pilot licence under other legislation; (c) conditions that apply to a certified RPA operator under Part 101 of CASR.	**B**

Schedule 4 Aeronautical knowledge units

Appendix 1A Any RPA operated under an automated flight management system

Unit 8 RAFM — Automated flight management systems knowledge

Item	Aeronautical knowledge topics	Priority
1	***General*** (a) use of automated flight management systems for RPA; (b) limitations of an automated flight management system; (c) identifying faults with automated flight management system; (d) automated flight management system in abnormal and emergency situations (for example, loss of control, loss of thrust); (e) precautions when programming an automated flight management system; (f) degraded automated flight management systems (for example, no GPS, IMU failure).	**A**

Schedule 4 Aeronautical knowledge units

Appendix 2 Category specific units — Aeroplane category

Unit 9 RBKA — Aircraft knowledge and operation principles: Aeroplanes

Item	Aeronautical knowledge topics	Priority
1	***RPA components*** (a) typical components found on the fuselage of the RPA: (i) hatches; (ii) vents; (iii) drains; (iv) aerials/antennas; (v) catapult attachment; (vi) airdrop launch attachment; (vii) fail-safe equipment; (b) typical features of the wings of the RPA: (i) leading and trailing edges; (ii) ailerons; (iii) flaps; (iv) elevon/flaperons; (v) servomechanisms; (c) typical components found on the tail of the RPA: (i) vertical stabiliser; (ii) elevator/stabilator; (iii) rudder; (d) undercarriage and recovery fittings of the RPA: (i) wheeled undercarriage; (ii) floats; (iii) brakes; (iv) steering mechanism; (v) hook/skid.	**B**
2	***Aeroplane aerodynamics*** Characteristics of an aerofoil: (a) chord; (b) span; (c) aspect ratio; (d) camber; (e) aerodynamic stall; (f) wing loading.	**B**

Item	Aeronautical knowledge topics	Priority
3	***Launch*** (a) effects of cross-wind on high- and low-wing aeroplanes during launch and control technique; (b) effects of cross-wind on tail-wheel equipped aeroplanes and control techniques; (c) advantages of launching into wind.	**A**
4	***Climbing*** Effect on climb rate and angle resulting from changes in the following: (a) weight; (b) power; (c) airspeed (changed from recommended); (d) flap deflection; (e) headwind/tailwind component, windshear; (f) bank angle; (g) altitude and density altitude.	**A**
5	***Straight and level*** Relationship between attitude, angle of attack and airspeed in level flight.	**A**
6	***Turning*** (a) concept of balanced turns; (b) effect of increasing or decreasing bank angle on: (i) stall airspeed, including the rate of increase of stall speed with increasing bank; (ii) the aircraft's structure (load factor); (c) precautions during steep turns: (i) shortly after launch; and (ii) during a glide, particularly on approach to land; (d) visual illusions during level turns at low level when turning downwind or into wind.	**A**
7	***Stalling, spinning and spiral drives*** (a) the characteristics of a stall; (b) visual signs from the ground when the RPA is approaching a stall; (c) stall recovery: (i) the effect of using ailerons when approaching, and during, the stall; and (ii) why the RPA may stall at different speeds; (d) effects of the following on the stall airspeed: (i) power; (ii) flap; (iii) manoeuvres; (iv) weight;	**A**

Item	Aeronautical knowledge topics	Priority
	(v) airframe frost and ice; (vi) air density; (e) manoeuvres during which the RPA may stall at an angle which appears to be different to the true stalling angle; (f) differences between a spin and a spiral dive; (g) spiral dive recovery.	
8	***Descent*** (a) angle of descent and attitude relating to: (i) power; (ii) flap; (iii) aircraft nose position; (b) effect of headwind/tailwind; (c) rate and angle of descent.	**A**
9	***Landing/recovery*** (a) achieving a smooth landing; (b) effects of a cross-wind on high- and low-wing aeroplanes during landing/recovery; (c) advantages of landing into the wind; (d) differences between a flapless approach and an approach with flap in terms of: (i) approach path angle; and (ii) threshold and touchdown speeds; and (iii) landing distance required; (e) deep stall landings; (f) use of a recovery net.	**A**

Schedule 4 Aeronautical knowledge units

Appendix 3 Category specific units — Helicopter (multirotor class) category

Unit 10 RBKM — Aeronautical knowledge and operation principles: Multirotor

Item	Aeronautical knowledge topics	Priority
1	***RPA components*** (a) typical components of the RPA: (i) the centre body; (ii) the arm attachments; (iii) the battery mounting; (iv) the motors and motor attachments; (v) the landing gear; (vi) other components of the RPA; (b) location and function of electrical components of the RPA: (i) its electronic speed controller(s); (ii) its receiver and antenna; (iii) its gyros/Inertial Management Unit; (iv) its flight controller; (v) its battery; (vi) its battery eliminator circuit; (vii) its GPS sensor/antenna.	**B**
2	***Weight and balance — launch and landing and recovery*** Effects of the following changes to the performance of the RPA: (a) weight; (b) power; (c) ground effect; (d) wind.	**A**
3	***Aerodynamics — multirotor lift and drag*** (a) aerodynamic properties of a rotor blade: (i) aerofoil shape; (ii) blade twist; (iii) blade taper; (b) definitions of the following terms: (i) rotor thrust; (ii) rotor drag; (iii) relative airflow; (iv) rotational airflow; (v) induced airflow; (vi) torque reaction.	**B**

Item	Aeronautical knowledge topics	Priority
4	***Aerodynamics — hovering and forward flight*** (a) definitions of the terms: (i) ground effect; (ii) recirculation; (b) translational lift; (c) drag in forward flight.	**A**
5	***Principles of operation — flight controls*** (a) primary flight controls and how they affect the movement of a multirotor about its longitudinal, lateral and normal vertical axes, including: (i) hover; (ii) yaw control; (iii) forward operation; (iv) ascent and descent; (v) lateral horizontal operation; (b) stabilisation; (c) GPS hold.	**A**
6	***Aerodynamics — abnormal operations*** (a) direction of rotation of a rotor and the implications of incorrect installation; (b) effects on the operation of the RPA if a motor of the RPA fails.	**A**
7	***Launch*** (a) pre-launch checks; (b) post-launch checks.	**B**
8	***Climbing*** Effect on climb rate and angle from changes in the following: (a) weight; (b) power; (c) airspeed; (d) a headwind or tailwind or windshear; (e) bank angle; (f) temperature; (g) altitude.	**A**
9	***Turning*** (a) banked turns; (b) rotations or flat turns; (c) limitations on steep turns.	**B**

Item	Aeronautical knowledge topics	Priority
10	***Descending, landing and recovery*** (a) avoiding vortex ring state when operating the RPA; (b) recovery actions to escape vortex ring state; (c) advantages of landing/recovery into the wind; (d) pre-landing checks.	**A**

Schedule 4 Aeronautical knowledge units

Appendix 4 Category specific units — Helicopter (single rotor) category

Unit 11 RBKH — Aeronautical knowledge and operation principles: Single rotor

Item	Aeronautical knowledge topics	Priority
1	***RPA components*** (a) typical components of the fuselage of the RPA, including: (i) inspection hatches; (ii) vents; (iii) drains; (iv) antennas/aerials; (v) the boom; (vi) the tail rotor; (b) typical components of the landing gear: (i) skids; (ii) floats; (c) other helicopter configurations: (i) contra-rotating main rotors; (ii) horizontal tail rotor; (iii) other solutions to centrifugal reaction.	**B**
2	***Helicopter key lift components*** Typical components of the rotor system: (a) the flybar; (b) the swash plate; (c) the clutch.	**A**
3	***Aircraft performance*** Effects of the following on aircraft performance: (a) the gross weight of the RPA; (b) engine power; (c) ground effect.	**A**
4	***Aerodynamics — lift and drag*** (a) aerodynamic properties of a rotor blade: (i) aerofoil shape; (ii) blade twist; (iii) blade taper; (b) definitions of the following terms: (i) rotor thrust; (ii) rotor drag; (iii) total reaction;	**B**

Item	Aeronautical knowledge topics	Priority
	(iv) relative airflow; (v) centrifugal reaction; (vi) rotor disc; (vii) coning angle; (c) terminology in relation to an operating rotor blade: (i) feathering; (ii) flapping; (iii) flapping to equality; (iv) dragging; (v) advance angle.	
5	***Aerodynamics of hovering*** (a) aerodynamic vectors of a rotor blade during hover; (b) terminology relating to hovering: (i) ground effect; (ii) tail rotor drift; (iii) rotor shaft tilt effect; (iv) recirculation; (c) abnormal operations: (i) vortex ring state (settling with power); (ii) loss of tail-rotor effectiveness; (iii) the appropriate recovery actions to (i) to (ii); (d) effects of the following on hovering: (i) the gross weight of the RPA; (ii) pressure altitude; (iii) temperature.	**A**
6	***Aerodynamics — forward operation*** Terminology in relation to forward flight: (a) dissymmetry of lift; (b) flapback; (c) cyclic limits; (d) airflow reversal; (e) retreating blade stall; (f) compressibility; (g) inflow roll; (h) translational lift; (i) aerodynamic vectors of a rotor blade during forward flight.	**B**

Item	Aeronautical knowledge topics	Priority
7	***Aerodynamics — power requirements*** (a) power available and power required in relation to the following: (i) best speed for range; (ii) best speed for endurance; (iii) best rate of climb; (iv) best angle of climb; (b) "overpitching" — causes and recovery actions.	**A**
8	***Principles of flight — helicopter controls*** (a) flight controls: (i) cyclic and collective; (ii) trim systems; (iii) tail gyroscope; (b) aerodynamic enhancements: (i) a canted tail rotor; (ii) sweep back on tips; (iii) a shrouded tail rotor; (iv) tail surfaces, fins, end plates and stabilators.	**A**
9	***Autorotative flight*** (a) the meaning of the following terms in relation to an RPA that is capable of autorotative flight: (i) autorotative force; (ii) autorotative section; (b) the effect on autorotation of the RPA if the following are varied: (i) all-up weight; (ii) density altitude; (iii) airspeed; (iv) rotor RPM.	**A**
10	***Effects of particular conditions*** (a) undesirable aircraft states: (i) ground resonance; (ii) mast bumping; (iii) dynamic roll-over; (b) avoiding undesirable aircraft states.	**A**

Schedule 4 Aeronautical knowledge units

Appendix 5 Category specific units — powered-lift category

Unit 12 RBKP — Aircraft knowledge and operation principles: Powered-lift

Item	Aeronautical knowledge topics	Priority
1	***RPA components*** (a) typical physical components of the RPA: (i) the fuselage; (ii) the motor attachments, including booms; (iii) hatches; (iv) vents; (v) drains; (vi) aerials; (vii) fail-safe equipment; (viii) the battery compartment/mounting; (ix) the motors/engines(s); (x) the landing gear; (xi) protective components of the RPA; (xii) rotors and propellers; (b) typical features of the wings of the RPA: (i) leading and trailing edges; (ii) ailerons; (iii) flaps; (iv) elevon/flaperon; (v) servomechanisms; (c) typical components found on the tail of the RPA: (i) vertical stabiliser; (ii) elevator/stabiliser/stabilator; (iii) rudder; (d) location and function of electrical components of the RPA: (i) its electronic speed controller(s); (ii) its receiver and antenna; (iii) its gyros/Inertial Management Unit; (iv) its flight controller; (v) its battery or batteries; (vi) its battery eliminator circuit; (vii) its GPS sensor and antenna.	**B**

Item	Aeronautical knowledge topics	Priority
2	***Aeroplane aerodynamics*** Characteristics of an aerofoil: (a) chord; (b) span; (c) aspect ratio; (d) camber; (e) aerodynamic stall; (f) wing loading.	**B**
3	***Aerodynamics — vertical flight*** Definitions of the following terms: (a) rotor thrust; (b) rotor drag; (c) relative airflow; (d) rotational airflow; (e) induced airflow; (f) ground effect; (g) recirculation.	**B**
4	***Principles of operation — flight controls*** Primary flight controls and how they affect the movement of the aircraft about its longitudinal, lateral and vertical axes, including: (a) yaw control; (b) roll control; (c) pitch control; (d) forward flight and turning using vertical motors; (e) vertical ascent and descent; (f) secondary flight controls — trim controls; (g) stabilisation; (h) GPS hold.	**A**
5	***Launch, landing and recovery*** (a) effects of changes to the following on the performance of the RPA: (i) weight; (ii) power; (iii) ground effect; (iv) wind and windshear; (v) translational lift; (vi) pre-launch and pre-landing; (b) avoiding vortex ring state when launching/landing the RPA; (c) recovery actions to escape vortex ring state.	**A**
6	RESERVED	

Item	Aeronautical knowledge topics	Priority
7	***Aerodynamics — transitional flight and forward flight*** (a) aerodynamics of transition from vertical flight to horizontal/climbing flight; (b) aerodynamics of transition from horizontal flight/descent to vertical flight; (c) aircraft configuration changes during transitional flight; (d) relationship between attitude, angle of attack and airspeed in level flight; (e) drag in forward flight; (f) airspeed and ground speed.	**A**
8	***Climbing — aeroplane mode*** Effect on climb rate and angle from changes in the following: (a) weight; (b) power; (c) airspeed; (d) a headwind or tailwind; (e) bank angle; (f) temperature; (g) pressure altitude.	**A**
9	***Turning*** (a) concept of balanced turns; (b) effect of increasing or decreasing bank angle on: (i) stall airspeed, including the rate of increase of stall speed with increasing bank; (ii) the aircraft's structure (load factor); (c) precautions during steep turns: (i) shortly after launch; (ii) during a glide, particularly on approach to land; (d) visual illusions during balanced level turns at low level when turning downwind or into wind; (e) rotations or flat turns in vertical mode.	**A**
10	***Descent*** (a) angle of descent and attitude relating to: (i) power; (ii) flap; (iii) aircraft nose position; (b) effect of headwind/tailwind.	**A**

Item	Aeronautical knowledge topics	Priority
11	***Aerodynamics — abnormal operations vertical flight*** (a) direction of rotation of a rotor and the implication of incorrect installation; (b) effects on the operation of the RPA if a motor of the RPA fails.	**A**
12	***Stalling, spinning and spiral drives — aeroplane mode*** (a) the characteristics of a stall; (b) visual signs from the ground when the RPA is approaching a stall; (c) effects of the following on the stall airspeed: (i) horizontally/vertically-vectored power; (ii) flap; (iii) manoeuvres; (iv) weight; (v) airframe frost and ice; (vi) air density; (d) manoeuvres during which the RPA may stall at an angle which appears to be different to the true stalling angle; (e) differences between a spin and a spiral dive; (f) spin and spiral dive recovery.	**A**

Schedule 4 Aeronautical knowledge units

Appendix 6 RPA with a liquid-fuel system

Unit 13 REFE — Medium or large RPA with a liquid-fuel system knowledge

Item	Aeronautical knowledge topics	Priority
1	***Knowledge requirements*** Characteristics and operation of liquid-fuel systems: (a) the way a liquid-fuel system works; (b) systems associated with a liquid-fuel system; (c) the differences between 2 and 4-stroke engines; (d) the effect of increasing altitude and temperature on engine performance; (e) mixture leaning procedures and effects; (f) the effects and limitations of turbo- and super-charging in relation to the RPA; (g) the kinds of abnormal and emergency situations that may arise; (h) the effect of fuel burn on weight and balance; (i) different types of liquid fuel and engines.	**A**