

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 | <p><i>Direction of flight and wind</i></p> <p>(a) expressing direction of flight:</p> <p> (i) as a 3-figure group;</p> <p> (ii) in the clock code;</p> <p> (iii) as cardinal and ordinal compass points;</p> <p>(b) difference between aircraft heading and track;</p> <p>(c) wind velocity;</p> <p>(d) the relationship between true and magnetic heading.</p> | A |
| 2 | <p><i>Time</i></p> <p>(a) time as a 4, 6 and 8-figure group;</p> <p>(b) UTC;</p> <p>(c) converting local and standard time to and from UTC.</p> | B |
| 3 | <p><i>Units of measurement for aeronautics</i></p> <p>(a) differences between height, altitude and elevation;</p> <p>(b) units of measurement for:</p> <p> (i) horizontal distance;</p> <p> (ii) vertical distance;</p> <p> (iii) speeds;</p> <p> (iv) visibility;</p> <p> (v) temperature;</p> <p> (vi) atmospheric pressure;</p> <p> (vii) weight;</p> <p>(c) converting between different units of measurement.</p> | A |
| 4 | <p><i>Energy</i></p> <p>Aircraft energy, including:</p> <p>(a) potential energy;</p> <p>(b) kinetic energy;</p> <p>(c) inertia.</p> | B |
| 5 | <p><i>Aerodynamics, weight and balance</i></p> <p>(a) terminology:</p> <p> (i) aerofoil, angle of attack and relative airflow;</p> <p> (ii) centre of pressure and centre of gravity;</p> <p> (iii) lift, weight, thrust and drag;</p> | 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 | <i>Lift and drag</i> (a) changes to lift and drag resulting from: (i) airspeed changes; (ii) angle of attack changes; (b) types of drag, including: (i) parasite (zero lift), form, interference and skin friction; (ii) induced (lift dependent). | B C |
| 7 | <i>Propellers and rotors</i> (a) terminology; (b) blade angle, helix angle or pitch; (c) propeller/rotor thrust and torque; (d) propeller/rotor principles. | B |
| 8 | <i>Principles of operation — flight control</i> (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 | <i>Principles of operation — remote pilot station</i> 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 | <p><i>Airspace</i></p> <ul style="list-style-type: none"> (a) classification of airspace; (b) airspace depiction on aeronautical charts, including: <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (i) Air Traffic Control (ATC); (ii) in the vicinity of non-controlled aerodromes. | A |
| 2 | <p><i>Obtaining information or approval</i></p> <ul style="list-style-type: none"> (a) permissions for RPA operations in restricted areas; (b) aeronautical information publications, including: <ul style="list-style-type: none"> (i) AIP; (ii) ERSA; (iii) NOTAM. | A |
| 3 | <p><i>NOTAMs</i></p> <ul style="list-style-type: none"> (a) obtaining NOTAMs for operational areas; (b) decoding NOTAMs. | A |
| | <p><i>NOTAM publication</i></p> <ul style="list-style-type: none"> (c) Submitting a NOTAM for publication. | C |

| Item | Aeronautical knowledge topics | Priority |
|------|---|----------|
| 4 | <p><i>Form of the earth, aeronautical charts and maps</i></p> <ul style="list-style-type: none"> (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 | <p><i>Electronic flight bag</i></p> <ul style="list-style-type: none"> (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 | <p><i>Weather phenomena</i></p> <p>(a) causes and effects of the following weather phenomena in relation to RPA operations:</p> <ul style="list-style-type: none">(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; <p>(b) the meaning of symbols used on weather maps.</p> | B |
| 2 | <p><i>Weather observations</i></p> <p>Indications of the presence of:</p> <ul style="list-style-type: none">(a) turbulence, thermals or dust devils; and(b) wind gradient and wind shear. | B |
| 3 | <p><i>Aeronautical forecasts</i></p> <ul style="list-style-type: none">(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 | <p><i>Electrical terms</i></p> <ul style="list-style-type: none"> (a) volts; (b) amps; (c) watts; (d) ohms; (e) hertz. | B |
| 2 | <p><i>Function of electrical components</i></p> <ul style="list-style-type: none"> (a) electrical components of an RPA: <ul style="list-style-type: none"> (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 | <p><i>Electric motors</i></p> <ul style="list-style-type: none"> (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 | <p><i>Batteries</i></p> <ul style="list-style-type: none"> (a) types of batteries: <ul style="list-style-type: none"> (i) nickel metal hydride batteries; (ii) lithium polymer batteries; (iii) alkaline batteries; (iv) nickel cadmium batteries; | A |

| Item | Aeronautical knowledge topics | Priority |
|------|--|----------|
| | <ul style="list-style-type: none"> (v) fuel cells; (b) battery specifications and abbreviations (types, voltage; amperage etc); (c) characteristics of batteries used as an energy source for the RPA: <ul style="list-style-type: none"> (i) cell count; (ii) nominal voltage; (iii) battery configuration: <ul style="list-style-type: none"> (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 | <p><i>Charging/discharging batteries</i></p> <ul style="list-style-type: none"> (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 | <p><i>Battery limitations</i></p> <ul style="list-style-type: none"> (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 | <p><i>Electromagnetic radiation</i></p> <ul style="list-style-type: none"> (a) radio waves; (b) characteristics of radio waves, wave propagation, transmission including: <ul style="list-style-type: none"> (i) the radio frequency band ranges (MF, HF, VHF, UHF); (ii) effective range of transmissions; (iii) factors affecting the propagation of radio waves, including: <ul style="list-style-type: none"> (A) terrain; (B) ionosphere; (C) sun spot activity; (D) interference from electrical equipment; (E) thunderstorms; (c) radio characteristics, optimisation and shielding: <ul style="list-style-type: none"> (i) digital and analogue signals; | A |

| Item | Aeronautical knowledge topics | Priority |
|------|--|----------|
| | <ul style="list-style-type: none"> (ii) command and control link range testing; (iii) radio frequencies for RPA operations. | |
| 8 | <p><i>Global Positioning System (GPS)</i></p> <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (i) number of satellites available; (ii) path interference; (iii) type of software; (iv) signal availability; (v) indications of faulty GPS equipment. | A |
| 9 | <p><i>Electromagnetic signal reliability and hazards</i></p> <ul style="list-style-type: none"> (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 | <p>General</p> <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (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) <i>aide-memoires</i> 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 | <p>Basic health</p> <p>Medical and psychological factors that may affect pilot performance in relation to operating RPA:</p> <ul style="list-style-type: none"> (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 | <p><i>Vision, spatial disorientation, illusions</i></p> <p>(a) anatomy of the eye and its functioning during the day and at night;</p> <p>(b) limitations of the eye:</p> <ul style="list-style-type: none"> (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; <p>(c) enhancing vision within the definition of VLOS:</p> <ul style="list-style-type: none"> (i) prescription spectacles; (ii) suitable sunglasses; <p>(d) disorientation during RPA operations;</p> <p>(e) visual illusions:</p> <ul style="list-style-type: none"> (i) typical illusions, including relative motion; (ii) conditions under which visual illusions may occur; (iii) how to overcome sensory illusions. | B |
| 4 | <p><i>Stress in relation to operating RPA</i></p> <p>(a) the effects of short- and long-term stress on the performance and health of a person operating an RPA;</p> <p>(b) symptoms of stress in an excessively hot, cold, windy, vibrating or noisy environment;</p> <p>(c) causes and effects of domestic or work-related stress;</p> <p>(d) principles of stress management, including:</p> <ul style="list-style-type: none"> (i) cognitive or behavioural techniques for managing stress; (ii) relaxation; (iii) time management. | C |
| 5 | <p><i>Threat and error management</i></p> <p>(a) principles of threat and error management in relation to operating RPA;</p> <p>(b) processes to identify and manage threats and errors during RPA operations;</p> <p>(c) the use of checklists and standard operating procedures to prevent errors;</p> <p>(d) crew resource management;</p> <p>(e) risk perception when remote from the location of RPA operation;</p> <p>(f) strategic versus tactical risk management.</p> | B |
| 6 | <p><i>Coordinating crew</i></p> <p>(a) verbal and non-verbal communication, including the following factors:</p> <ul style="list-style-type: none"> (i) barriers to communication; | C |

| Item | Aeronautical knowledge topics | Priority |
|------|---|----------|
| | <ul style="list-style-type: none"> <li>(ii) listening skills; <li>(iii) assertion skills; <li>(b) aspects of individuals that may affect the safe operation of the RPA: <ul style="list-style-type: none"> <li>(i) personality; <li>(ii) judgement; <li>(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 | <p><i>General operations</i></p> <p>(a) general considerations relating to:</p> <ul style="list-style-type: none"> (i) starting and ground running of motors/engines; (ii) bystanders; (iii) crew briefing; <p>(b) responsibilities of the remote pilot:</p> <ul style="list-style-type: none"> (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; <p>(c) considerations:</p> <ul style="list-style-type: none"> (i) after an operation has ended; (ii) in relation to aircraft noise and wildlife. | A |
| 2 | <p><i>Risk assessment and management</i></p> <p>(a) the strategic risk assessment process relevant to RPAS operations, including:</p> <ul style="list-style-type: none"> (i) hazard identification; (ii) risk identification; (iii) risk mitigation measures; <p>(b) elements of a job safety assessment for the operation of an RPA;</p> <p>(c) completing a job safety assessment for the operation of an RPA.</p> | A |
| 3 | <p><i>Airworthiness — general</i></p> <p>(a) determine RPAS serviceability for a specific operation;</p> <p>(b) use of the RPA technical log;</p> <p>(c) responsibilities of the holder of a remote pilot licence in relation to the continuing airworthiness of the RPA, including:</p> <ul style="list-style-type: none"> (i) conducting inspections of the RPA; (ii) reporting defects or unserviceability in relation to the RPAS. | A |
| 4 | <p><i>Role equipment or sensors</i></p> <p>Safety and performance implications of various payloads, including cameras and other sensors.</p> | B |

| Item | Aeronautical knowledge topics | Priority |
|------|---|----------|
| 5 | <p><i>Accident and incident reporting</i></p> <p>(a) definitions of accident and incidents;</p> <p>(b) requirements for accident and incident reporting (however described) mentioned in the <i>Transport Safety Investigation Regulations 2003</i> and the <i>Transport and Safety Investigation (Voluntary and Confidential Reporting Scheme) Regulation 2012</i>.</p> | A |
| 6 | <p><i>Abnormal operations</i></p> <p>Considerations in the event of the following:</p> <p>(a) if the engine or motors of an RPA fails in the following circumstances:</p> <ul style="list-style-type: none"> (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; <p>(b) a control link failure;</p> <p>(c) a remote pilot station failure;</p> <p>(d) if a fire takes hold on the RPA during flight or on the ground;</p> <p>(e) if the RPA is attacked by a bird.</p> | A |
| 7 | <p><i>Fail-safe procedures and emergency actions</i></p> <p>Fail-safe systems and emergency actions, including:</p> <p>(a) the “return to home” system;</p> <p>(b) regain link holding pattern;</p> <p>(c) the RPA flies to a predetermined holding point;</p> <p>(d) emergency parachute deployment;</p> <p>(e) immediate landing;</p> <p>(f) flight termination;</p> <p>(g) carbon fibre containment in the event of a crash.</p> | A |
| 8 | <p><i>Operation of RPA near aerodrome</i></p> <p>(a) considerations in relation to operating an RPA near an aerodrome:</p> <ul style="list-style-type: none"> (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); <p>(b) the prohibitions in Part 101 of CASR relating to operating an RPA at or near aerodromes and HLS;</p> <p>(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;</p> <p>(d) determining the runway or runways in use at an aerodrome;</p> <p>(e) traffic patterns at aerodromes;</p> | A |

| Item | Aeronautical knowledge topics | Priority |
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| | (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 | <i>Operations of RPA above 400 ft AGL</i> 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 | <i>Tethered operations</i> 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 | <p><i>Aviation legislation and information</i></p> <p>(a) documents that contain aviation legislation, aeronautical information and general operating rules that apply to the operation of RPA;</p> <p>(b) obtaining the documents and ensuring that the information is up to date;</p> <p>(c) guidance materials and information sources relating to RPAS operations.</p> | A |
| 2 | <p><i>Remote pilot licence</i></p> <p>(a) conditions that apply to a remote pilot licence under Part 101 of CASR;</p> <p>(b) conditions that may apply to a remote pilot licence under other legislation;</p> <p>(c) conditions that apply to a certified RPA operator under Part 101 of CASR.</p> | 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 | <p><i>General</i></p> <ul style="list-style-type: none">(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 | <p><i>RPA components</i></p> <p>(a) typical components found on the fuselage of the RPA:</p> <ul style="list-style-type: none">(i) hatches;(ii) vents;(iii) drains;(iv) aerials/antennas;(v) catapult attachment;(vi) airdrop launch attachment;(vii) fail-safe equipment; <p>(b) typical features of the wings of the RPA:</p> <ul style="list-style-type: none">(i) leading and trailing edges;(ii) ailerons;(iii) flaps;(iv) elevon/flaperons;(v) servomechanisms; <p>(c) typical components found on the tail of the RPA:</p> <ul style="list-style-type: none">(i) vertical stabiliser;(ii) elevator/stabilator;(iii) rudder; <p>(d) undercarriage and recovery fittings of the RPA:</p> <ul style="list-style-type: none">(i) wheeled undercarriage;(ii) floats;(iii) brakes;(iv) steering mechanism;(v) hook/skid. | B |
| 2 | <p><i>Aeroplane aerodynamics</i></p> <p>Characteristics of an aerofoil:</p> <ul style="list-style-type: none">(a) chord;(b) span;(c) aspect ratio;(d) camber;(e) aerodynamic stall;(f) wing loading. | B |

| Item | Aeronautical knowledge topics | Priority |
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| 3 | <p><i>Launch</i></p> <p>(a) effects of cross-wind on high- and low-wing aeroplanes during launch and control technique;</p> <p>(b) effects of cross-wind on tail-wheel equipped aeroplanes and control techniques;</p> <p>(c) advantages of launching into wind.</p> | A |
| 4 | <p><i>Climbing</i></p> <p>Effect on climb rate and angle resulting from changes in the following:</p> <p>(a) weight;</p> <p>(b) power;</p> <p>(c) airspeed (changed from recommended);</p> <p>(d) flap deflection;</p> <p>(e) headwind/tailwind component, windshear;</p> <p>(f) bank angle;</p> <p>(g) altitude and density altitude.</p> | A |
| 5 | <p><i>Straight and level</i></p> <p>Relationship between attitude, angle of attack and airspeed in level flight.</p> | A |
| 6 | <p><i>Turning</i></p> <p>(a) concept of balanced turns;</p> <p>(b) effect of increasing or decreasing bank angle on:</p> <p>(i) stall airspeed, including the rate of increase of stall speed with increasing bank;</p> <p>(ii) the aircraft's structure (load factor);</p> <p>(c) precautions during steep turns:</p> <p>(i) shortly after launch; and</p> <p>(ii) during a glide, particularly on approach to land;</p> <p>(d) visual illusions during level turns at low level when turning downwind or into wind.</p> | A |
| 7 | <p><i>Stalling, spinning and spiral dives</i></p> <p>(a) the characteristics of a stall;</p> <p>(b) visual signs from the ground when the RPA is approaching a stall;</p> <p>(c) stall recovery:</p> <p>(i) the effect of using ailerons when approaching, and during, the stall; and</p> <p>(ii) why the RPA may stall at different speeds;</p> <p>(d) effects of the following on the stall airspeed:</p> <p>(i) power;</p> <p>(ii) flap;</p> <p>(iii) manoeuvres;</p> <p>(iv) weight;</p> | 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 | <i>Descent</i> (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 | <i>Landing/recovery</i> (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 | <p><i>RPA components</i></p> <p>(a) typical components of the RPA:</p> <ul style="list-style-type: none">(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; <p>(b) location and function of electrical components of the RPA:</p> <ul style="list-style-type: none">(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 | <p><i>Weight and balance — launch and landing and recovery</i></p> <p>Effects of the following changes to the performance of the RPA:</p> <ul style="list-style-type: none">(a) weight;(b) power;(c) ground effect;(d) wind. | A |
| 3 | <p><i>Aerodynamics — multirotor lift and drag</i></p> <p>(a) aerodynamic properties of a rotor blade:</p> <ul style="list-style-type: none">(i) aerofoil shape;(ii) blade twist;(iii) blade taper; <p>(b) definitions of the following terms:</p> <ul style="list-style-type: none">(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 | <p><i>Aerodynamics — hovering and forward flight</i></p> <p>(a) definitions of the terms:</p> <p style="padding-left: 20px;">(i) ground effect;</p> <p style="padding-left: 20px;">(ii) recirculation;</p> <p>(b) translational lift;</p> <p>(c) drag in forward flight.</p> | A |
| 5 | <p><i>Principles of operation — flight controls</i></p> <p>(a) primary flight controls and how they affect the movement of a multirotor about its longitudinal, lateral and normal vertical axes, including:</p> <p style="padding-left: 20px;">(i) hover;</p> <p style="padding-left: 20px;">(ii) yaw control;</p> <p style="padding-left: 20px;">(iii) forward operation;</p> <p style="padding-left: 20px;">(iv) ascent and descent;</p> <p style="padding-left: 20px;">(v) lateral horizontal operation;</p> <p>(b) stabilisation;</p> <p>(c) GPS hold.</p> | A |
| 6 | <p><i>Aerodynamics — abnormal operations</i></p> <p>(a) direction of rotation of a rotor and the implications of incorrect installation;</p> <p>(b) effects on the operation of the RPA if a motor of the RPA fails.</p> | A |
| 7 | <p><i>Launch</i></p> <p>(a) pre-launch checks;</p> <p>(b) post-launch checks.</p> | B |
| 8 | <p><i>Climbing</i></p> <p>Effect on climb rate and angle from changes in the following:</p> <p>(a) weight;</p> <p>(b) power;</p> <p>(c) airspeed;</p> <p>(d) a headwind or tailwind or windshear;</p> <p>(e) bank angle;</p> <p>(f) temperature;</p> <p>(g) altitude.</p> | A |
| 9 | <p><i>Turning</i></p> <p>(a) banked turns;</p> <p>(b) rotations or flat turns;</p> <p>(c) limitations on steep turns.</p> | B |

| Item | Aeronautical knowledge topics | Priority |
|------|---|----------|
| 10 | <p><i>Descending, landing and recovery</i></p> <ul style="list-style-type: none"> <li>(a) avoiding vortex ring state when operating the RPA; <li>(b) recovery actions to escape vortex ring state; <li>(c) advantages of landing/recovery into the wind; <li>(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 | <p><i>RPA components</i></p> <p>(a) typical components of the fuselage of the RPA, including:</p> <ul style="list-style-type: none"> (i) inspection hatches; (ii) vents; (iii) drains; (iv) antennas/aerials; (v) the boom; (vi) the tail rotor; <p>(b) typical components of the landing gear:</p> <ul style="list-style-type: none"> (i) skids; (ii) floats; <p>(c) other helicopter configurations:</p> <ul style="list-style-type: none"> (i) contra-rotating main rotors; (ii) horizontal tail rotor; (iii) other solutions to centrifugal reaction. | B |
| 2 | <p><i>Helicopter key lift components</i></p> <p>Typical components of the rotor system:</p> <ul style="list-style-type: none"> (a) the flybar; (b) the swash plate; (c) the clutch. | A |
| 3 | <p><i>Aircraft performance</i></p> <p>Effects of the following on aircraft performance:</p> <ul style="list-style-type: none"> (a) the gross weight of the RPA; (b) engine power; (c) ground effect. | A |
| 4 | <p><i>Aerodynamics — lift and drag</i></p> <p>(a) aerodynamic properties of a rotor blade:</p> <ul style="list-style-type: none"> (i) aerofoil shape; (ii) blade twist; (iii) blade taper; <p>(b) definitions of the following terms:</p> <ul style="list-style-type: none"> (i) rotor thrust; (ii) rotor drag; (iii) total reaction; | B |

| Item | Aeronautical knowledge topics | Priority |
|------|--|----------|
| | <ul style="list-style-type: none"> (iv) relative airflow; (v) centrifugal reaction; (vi) rotor disc; (vii) coning angle; (c) terminology in relation to an operating rotor blade: <ul style="list-style-type: none"> (i) feathering; (ii) flapping; (iii) flapping to equality; (iv) dragging; (v) advance angle. | |
| 5 | <p><i>Aerodynamics of hovering</i></p> <ul style="list-style-type: none"> (a) aerodynamic vectors of a rotor blade during hover; (b) terminology relating to hovering: <ul style="list-style-type: none"> (i) ground effect; (ii) tail rotor drift; (iii) rotor shaft tilt effect; (iv) recirculation; (c) abnormal operations: <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (i) the gross weight of the RPA; (ii) pressure altitude; (iii) temperature. | A |
| 6 | <p><i>Aerodynamics — forward operation</i></p> <p>Terminology in relation to forward flight:</p> <ul style="list-style-type: none"> (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 | <p><i>Aerodynamics — power requirements</i></p> <p>(a) power available and power required in relation to the following:</p> <ul style="list-style-type: none"> (i) best speed for range; (ii) best speed for endurance; (iii) best rate of climb; (iv) best angle of climb; <p>(b) “overpitching” — causes and recovery actions.</p> | A |
| 8 | <p><i>Principles of flight — helicopter controls</i></p> <p>(a) flight controls:</p> <ul style="list-style-type: none"> (i) cyclic and collective; (ii) trim systems; (iii) tail gyroscope; <p>(b) aerodynamic enhancements:</p> <ul style="list-style-type: none"> (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 | <p><i>Autorotative flight</i></p> <p>(a) the meaning of the following terms in relation to an RPA that is capable of autorotative flight:</p> <ul style="list-style-type: none"> (i) autorotative force; (ii) autorotative section; <p>(b) the effect on autorotation of the RPA if the following are varied:</p> <ul style="list-style-type: none"> (i) all-up weight; (ii) density altitude; (iii) airspeed; (iv) rotor RPM. | A |
| 10 | <p><i>Effects of particular conditions</i></p> <p>(a) undesirable aircraft states:</p> <ul style="list-style-type: none"> (i) ground resonance; (ii) mast bumping; (iii) dynamic roll-over; <p>(b) avoiding undesirable aircraft states.</p> | 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 | <p><i>RPA components</i></p> <p>(a) typical physical components of the RPA:</p> <ul style="list-style-type: none">(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; <p>(b) typical features of the wings of the RPA:</p> <ul style="list-style-type: none">(i) leading and trailing edges;(ii) ailerons;(iii) flaps;(iv) elevon/flaperon;(v) servomechanisms; <p>(c) typical components found on the tail of the RPA:</p> <ul style="list-style-type: none">(i) vertical stabiliser;(ii) elevator/stabiliser/stabilator;(iii) rudder; <p>(d) location and function of electrical components of the RPA:</p> <ul style="list-style-type: none">(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 | <p><i>Aeroplane aerodynamics</i> Characteristics of an aerofoil:</p> <ul style="list-style-type: none"> (a) chord; (b) span; (c) aspect ratio; (d) camber; (e) aerodynamic stall; (f) wing loading. | B |
| 3 | <p><i>Aerodynamics — vertical flight</i> Definitions of the following terms:</p> <ul style="list-style-type: none"> (a) rotor thrust; (b) rotor drag; (c) relative airflow; (d) rotational airflow; (e) induced airflow; (f) ground effect; (g) recirculation. | B |
| 4 | <p><i>Principles of operation — flight controls</i> Primary flight controls and how they affect the movement of the aircraft about its longitudinal, lateral and vertical axes, including:</p> <ul style="list-style-type: none"> (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 | <p><i>Launch, landing and recovery</i></p> <ul style="list-style-type: none"> (a) effects of changes to the following on the performance of the RPA: <ul style="list-style-type: none"> (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 | <p><i>Aerodynamics — transitional flight and forward flight</i></p> <ul style="list-style-type: none"> (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 | <p><i>Climbing — aeroplane mode</i></p> <p>Effect on climb rate and angle from changes in the following:</p> <ul style="list-style-type: none"> (a) weight; (b) power; (c) airspeed; (d) a headwind or tailwind; (e) bank angle; (f) temperature; (g) pressure altitude. | A |
| 9 | <p><i>Turning</i></p> <ul style="list-style-type: none"> (a) concept of balanced turns; (b) effect of increasing or decreasing bank angle on: <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (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 | <p><i>Descent</i></p> <ul style="list-style-type: none"> (a) angle of descent and attitude relating to: <ul style="list-style-type: none"> (i) power; (ii) flap; (iii) aircraft nose position; (b) effect of headwind/tailwind. | A |

| Item | Aeronautical knowledge topics | Priority |
|------|---|----------|
| 11 | <p><i>Aerodynamics — abnormal operations vertical flight</i></p> <p>(a) direction of rotation of a rotor and the implication of incorrect installation;</p> <p>(b) effects on the operation of the RPA if a motor of the RPA fails.</p> | A |
| 12 | <p><i>Stalling, spinning and spiral dives — aeroplane mode</i></p> <p>(a) the characteristics of a stall;</p> <p>(b) visual signs from the ground when the RPA is approaching a stall;</p> <p>(c) effects of the following on the stall airspeed:</p> <ul style="list-style-type: none"> <li>(i) horizontally/vertically-vectorred power; <li>(ii) flap; <li>(iii) manoeuvres; <li>(iv) weight; <li>(v) airframe frost and ice; <li>(vi) air density; <p>(d) manoeuvres during which the RPA may stall at an angle which appears to be different to the true stalling angle;</p> <p>(e) differences between a spin and a spiral dive;</p> <p>(f) spin and spiral dive recovery.</p> | 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 | <p><i>Knowledge requirements</i></p> <p>Characteristics and operation of liquid-fuel systems:</p> <ul style="list-style-type: none">(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 |