EASA PPL(A) · THEORY REVISION

The PPL Cheat Sheet

every memory item, number and trap, all 9 subjects

The facts that actually get tested in the EASA PPL(A) theory exams, stripped to the bone: definitions, key numbers, formulas, mnemonics and the classic traps for each subject. Built for the night before, the commute, and the last scroll before you walk into the exam hall.

9 subjects | **279** memory items | **5** boxes per subject

Definitions, Numbers, Formulas, Mnemonics, Traps

You are reading the static PDF. The interactive web version of this cheat sheet at **skystudyatpl.com/ppl-cheat-sheet** adds a light and dark theme, a quiz mode that covers every key value so you can test your recall, instant search across every memory item, and hover or tap explanations for every aviation abbreviation. Like the rest of SkyStudy, it is free to use in the browser while the beta is open.

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THE 9 SUBJECTS

Air Law
P10
Chicago Convention, PPL(A) licensing, rules of the air, VFR minima, airspace, light signals, altimetry, ATS.

Human Performance
P20
Physiology, hypoxia, vision, hearing, disorientation, health, information processing, decision-making, stress and fatigue.

Meteorology
P30
Atmosphere, pressure and altimetry, wind, cloud and fog, precipitation, air masses and fronts, hazards, observations and forecasts.

Communications
P40
RTF phraseology, phonetic alphabet, numbers, standard words, read-back, call signs, distress and urgency, VHF propagation.

Principles of Flight
P50
Lift and drag, the stall, high-lift devices, stability and control, load and manoeuvre limits, propellers, forces in flight.

Operational Procedures
P60
Part-NCO fuel and oxygen, noise abatement, fire and smoke drills, windshear, wake turbulence, emergency and precautionary landings, contaminated runways.

Flight Performance and Planning
P70
Mass and balance, centre of gravity, performance factors, take-off and landing data, fuel planning, the navigation plan and the ICAO flight plan.

Aircraft General Knowledge
P80
Airframe and systems, piston engine, fuel and ignition, propellers, electrics, pitot-static instruments, compass and gyroscopic instruments.

Navigation
P90
The Earth and charts, time, direction, magnetism, projections, dead reckoning, the triangle of velocities, the 1-in-60 rule, radio navigation aids.

P10 Air Law

Chicago Convention, PPL(A) licensing, rules of the air, VFR minima, airspace, light signals, altimetry, ATS.

VFR WEATHER MINIMA (VMC) AT A GLANCE

At or above 10,000 ft AMSL
Visibility 8 km · 1500 m horizontal and 1000 ft vertical from cloud

Below 10,000 ft down to 3000 ft AMSL
Visibility 5 km · 1500 m horizontal and 1000 ft (300 m) vertical from cloud

At or below 3000 ft AMSL (or 1000 ft above terrain), class F/G
Visibility 5 km · clear of cloud · in sight of the surface
The lower two bands split at 3000 ft AMSL or 1000 ft above terrain, whichever is higher

Speed below 10,000 ft AMSL: 250 kt IAS maximum. In class A you cannot fly VFR at all; class G gives information only.

MUST-KNOW DEFINITIONS AND CONCEPTS

- The **Chicago Convention (1944)** created ICAO and confirms every state has complete and exclusive sovereignty over the airspace above its territory.
- ICAO issues **19 Annexes**. The ones a PPL should know: **1** Personnel Licensing, **2** Rules of the Air, **3** Meteorology, **7** Nationality and Registration Marks, **8** Airworthiness, **11** Air Traffic Services, **13** Accident Investigation, **14** Aerodromes, **17** Security.
- **SERA** (Standardised European Rules of the Air, Reg (EU) 923/2012) is the EU's version of the rules of the air and applies across EASA member states.
- A **PPL(A)** lets you act as PIC or co-pilot on non-commercial aeroplane flights with **no remuneration**; carrying passengers for reward is not permitted.
- The **Pilot-in-Command** has final authority and is responsible for the safety of the aircraft and everyone on board.
- Documents carried on board: **Certificate of Registration**, **Certificate of Airworthiness**, radio licence, insurance, licence and medical, plus (as required) the flight manual and weight and balance data.
- **CAVOK**: visibility 10 km or more, no cloud below 5000 ft (or the highest minimum sector altitude if higher) and none of CB or towering cumulus, and no significant weather.
- **Controlled airspace** (classes A to E) provides an ATC service; **uncontrolled** (F and G) does not. Class A is IFR only.
- **Transition altitude** is set by the state or aerodrome (fly on QNH below it); **transition level** is calculated and varies with pressure (fly on 1013.25 above it).
- **AIP** is the primary source of permanent aeronautical information; a **NOTAM** carries time-critical information not known early enough to publish in the AIP.
- **Annex 13** accident and incident investigation exists only to prevent future accidents, never to apportion blame or liability.

KEY NUMBERS, LIMITS AND VALUES

- SSR transponder codes: **7500** unlawful interference, **7600** radio failure, **7700** general emergency; **7000** is the VFR conspicuity code in Europe.
- Emergency frequency **121.5 MHz**. An ELT alerts the Cospas-Sarsat satellites on **406 MHz**.
- VFR cruising levels above 3000 ft AGL: magnetic track **000 to 179** flies odd thousands plus 500 ft; **180 to 359** flies even thousands plus 500 ft.
- Minimum height rule: **1000 ft** above the highest obstacle within 600 m over congested areas; elsewhere not within **500 ft** of any person, vessel, vehicle or structure.
- Right of way: aircraft in distress first, then balloons, gliders, airships, aircraft towing, then powered aeroplanes.
- Converging at the same level: give way to the aircraft on your **right**. Head-on: **both turn right**. Overtaking: the overtaker alters **right**; the overtaken keeps its heading.
- An aircraft on **final approach** or landing has right of way over aircraft in flight or on the ground; of two landing aircraft the **lower** has priority.
- Runway designators are the magnetic centreline bearing rounded to the nearest 10 degrees, last digit dropped (**274 becomes 27**).
- Light signals **in flight**: steady green = cleared to land; steady red = give way and keep circling; flashing green = return to land; flashing red = aerodrome unsafe, do not land.
- Light signals **on the ground**: steady green = cleared for take-off; flashing green = cleared to taxi; steady red = stop; flashing red = taxi clear of the runway; flashing white = return to the starting point.
- Alcohol: a common minimum is **8 hours** bottle to throttle, and a blood limit around **0.2 g/L** VERIFY.
- PPL(A) minimum age **17**; the medical needed is a **LAPL medical or a Class 2** VERIFY.
- Class 2 medical validity is commonly **60 months** under age 40, **24 months** ages 40 to 50, and **12 months** over 50 VERIFY.
- Time in aviation is always **UTC**.

MNEMONICS AND MEMORY ITEMS

- Right of way pecking order **Big Gliders Are Truly Powerful**: Balloons, Gliders, Airships, Towing, Powered (a powered aeroplane gives way to all of them).
- Squawk ladder by severity: **7500** hijack, **7600** comms lost, **7700** general emergency.
- **MAYDAY = Menace** (grave and imminent danger), **PAN PAN = Precaution** (urgent, not yet grave). Each is said three times.
- VMC vertical clearance below FL100 is **1000 ft**; horizontal is **1500 m**. Above FL100 add up to **8 km** visibility.
- **QNH** reads height above sea level; **QFE** reads zero on the aerodrome (Field).

COMMON EXAM TRAPS

- **Transition altitude is fixed; transition level changes** with QNH. Do not swap them.
- On converging tracks the aircraft that gives way is the one with the other on **its right**, not the faster or first-seen one.
- When overtaking, the **overtaking** aircraft alters right and the overtaken keeps its heading; students often reverse this.
- Powered aeroplanes give way to balloons, gliders and airships regardless of relative position.
- **CAVOK** has strict thresholds; weather just short of them is not CAVOK even if it looks fine.
- Runway numbers round the **magnetic** bearing, not the true bearing; convert first if a true value is given.
- VFR minima change **at** 3000 ft AMSL or 1000 ft above terrain, whichever is higher; do not just read the altitude.
- The **7500** code gives no aural warning at the aircraft that set it; the three emergency codes do not all behave alike.
- **A PPL(A) may not fly for remuneration.** Cost sharing within the rules is not the same as paid work.

P20 Human Performance

Physiology, hypoxia, vision, hearing, disorientation, health, information processing, decision-making, stress and fatigue.

TIME OF USEFUL CONSCIOUSNESS WITH ALTITUDE

20,000 ft	30,000 ft	35,000 ft	40,000 ft
about 30 min	1 to 2 min	30 to 90 s	15 to 20 s

A rapid decompression roughly halves the time above; it also empties the lungs.

Four hypoxia types

Hypoxic (low pressure, altitude) · Anaemic (blood cannot carry oxygen: CO, anaemia)
Stagnant (poor circulation: high g, cold) · Histotoxic (cells cannot use it: alcohol, drugs)
Night vision starts to degrade from about 5000 ft.

Hyperventilation mimics hypoxia (tingling, dizziness); treat it by slowing the breathing. When in doubt at altitude, assume hypoxia and use oxygen.

MUST-KNOW DEFINITIONS AND CONCEPTS

- **Hypoxia** is a lack of oxygen to the tissues. The altitude form (hypoxic hypoxia) comes from the falling partial pressure of oxygen with height.
- **Time of useful consciousness (TUC)** is the time from an oxygen supply cut to the point where you can no longer take corrective action.
- **Hyperventilation** is over-breathing that blows off carbon dioxide, causing tingling, dizziness and anxiety; its symptoms overlap with hypoxia.
- **Carbon monoxide** binds to haemoglobin far more readily than oxygen; a cracked exhaust heater muff is the classic cabin source.
- **Cones** in the fovea give day, colour and detail vision; **rods** off-centre give night vision but no colour; look slightly off-centre at night.
- **Spatial disorientation** is a false sense of attitude, position or motion from misleading sensory cues, mostly from the balance organs of the inner ear.
- The **empty-field myopia** and other visual limitations mean a clear sky can hide traffic; a systematic lookout scan is essential.
- **Situational awareness** is an accurate mental picture of the aircraft, its state and its environment, and a forecast of what happens next.
- The **error chain** is the sequence of small errors and events that, unbroken, leads to an accident; breaking any link prevents it.
- **Stress** is the body's response to demand; short-term arousal can help performance, but too much or chronic stress degrades it (the arousal-performance curve).

KEY NUMBERS, LIMITS AND VALUES

- Air is about **21% oxygen** and **78% nitrogen**, constant with altitude; it is the falling **pressure** with height that starves you, not a change in mix.
- TUC: **20,000 ft about 30 min**, **30,000 ft 1 to 2 min**, **35,000 ft 30 to 90 s**, **40,000 ft 15 to 20 s**. A rapid decompression roughly halves these.
- Dark adaptation takes about **30 minutes** for the rods; a bright light resets it, so protect night vision.
- Alcohol clears at about **one unit per hour** and cannot be sped up; **8 hours** bottle to throttle is a minimum, not a target.
- **Blood donation**: wait about **24 hours** before flying; after scuba diving, at least **12 hours** (no-stop dive) or **24 hours** if decompression stops were needed.
- The three semicircular canals sense **angular (rotational)** acceleration; the otoliths sense **linear** acceleration and gravity.
- The **leans** is the most common disorientation illusion: a slow roll goes unnoticed, so wings-level feels like a bank.
- Trust the instruments, not the seat: in cloud or at night the **instruments override** conflicting bodily sensations.

MNEMONICS AND MEMORY ITEMS

- Hypoxia types **HASH**: Hypoxic, Anaemic, Stagnant, Histotoxic.
- The **IMSAFE** self-check: Illness, Medication, Stress, Alcohol, Fatigue, Emotion (or Eating).
- Hazardous attitudes and antidotes: **Anti-authority** (follow the rules), **Impulsivity** (think first), **Invulnerability** (it can happen to me), **Macho** (taking chances is foolish), **Resignation** (I can make a difference).
- Aviate, Navigate, Communicate: **fly the aircraft first**, then work out where you are, then talk.
- Ear pressure clears easily on the **climb** but needs active clearing on the **descent**; a head cold makes this painful.

COMMON EXAM TRAPS

- **Hypoxia has no reliable warning**; euphoria and good feeling are symptoms, not safety. Use oxygen before judgement fails.
- Do not confuse **hyperventilation** with hypoxia; the fix is opposite (slow the breathing versus add oxygen), but at altitude treat for hypoxia first.
- Carbon monoxide is **colourless and odourless**; a headache with the cabin heater on is a warning, so shut off the heat and ventilate.
- Rods, not cones, do the night work, and the **fovea is night-blind**; staring straight at a faint light at night makes it vanish.
- The inner ear cannot tell a **coordinated turn from level flight**; without visual reference it lies. Believe the instruments.
- Fatigue degrades performance like alcohol; a **microsleep** can occur without you noticing the gap.
- Do not fly soon after **scuba diving**; nitrogen can come out of solution as pressure falls and cause decompression sickness.

P30 Meteorology

Atmosphere, pressure and altimetry, wind, cloud and fog, precipitation, air masses and fronts, hazards, observations and forecasts.

ISA AND KEY MET VALUES

Sea level ISA	Lapse rate	Tropopause
1013.25 hPa · 15 C	about 2 C per 1000 ft	36,090 ft · minus 56.5 C

Pressure
Near sea level about 30 ft per hPa · sea-level density 1.225 kg per cubic metre

Fog needs
Radiation fog: clear sky, light wind (about 2 to 8 kt), moist air, cooling overnight
Advection fog: moist air moving over a colder surface (needs no cooling of its own)

High to low, look out below. Flying into lower pressure or colder-than-ISA air makes the altimeter over-read, so your true height is lower than indicated.

MUST-KNOW DEFINITIONS AND CONCEPTS

- The **ISA (International Standard Atmosphere)** is a reference: 1013.25 hPa and 15 C at sea level, falling about 2 C per 1000 ft to the tropopause.
- **Relative humidity** is how close the air is to saturation; it reaches 100% at the **dew point**, when condensation (cloud, fog, dew) forms.
- **Stability** describes whether a displaced parcel returns (stable, layer cloud, smooth) or keeps rising (unstable, heap cloud, showers, turbulence).
- A **temperature inversion** is warmer air above colder air; it is very stable, traps haze and moisture, and caps convection.
- **Coriolis** deflects moving air to the **right** in the northern hemisphere; with the pressure-gradient force it gives the geostrophic wind flowing along the isobars.
- A **warm front** has a shallow slope, wide layered cloud and steady rain ahead; a **cold front** is steep with convective cloud, showers and a narrow violent band.
- An **occlusion** forms when the faster cold front catches the warm front and lifts the warm air off the surface.
- **Advection fog** forms when moist air moves over a colder surface; **radiation fog** forms overnight under clear skies and light wind.
- A **thunderstorm** needs unstable air, high humidity and a trigger to lift it; its worst stage is the **mature** stage, with updraughts and downdraughts together.
- A **METAR** is an actual weather report for an aerodrome; a **TAF** is a forecast for a period; a **SIGMET** warns of en-route hazards.

KEY NUMBERS, LIMITS AND VALUES

- ISA sea level: **1013.25 hPa**, **15 C**, density **1.225 kg per cubic metre**; lapse rate about **2 C per 1000 ft** (1.98) to the tropopause.
- Tropopause in ISA: **36,090 ft** (about 11 km) at **minus 56.5 C**; above it the temperature is roughly constant.
- Pressure falls about **1 hPa per 30 ft** near sea level (the ratio changes with altitude).
- Dry air cools at about **3 C per 1000 ft** when lifted (DALR); saturated air cools at about **1.5 C per 1000 ft** (SALR).
- Cloud base estimate: **spread (temperature minus dew point) divided by 2.5, times 1000 ft** gives the approximate convective cloud base.
- Cloud by base height: **low** to about 6500 ft, **medium** about 6500 to 20,000 ft, **high** above about 20,000 ft (ice crystal cirrus).
- Radiation fog needs a clear sky, moist air and a light wind of about **2 to 8 kt**; calm air makes dew, strong wind makes low stratus.
- Thunderstorm avoidance: stay at least **10 nm** from a cell; each cell lasts about **20 to 30 minutes**.
- Freezing (airframe icing) risk is greatest in cloud and precipitation between **0 C and about minus 15 C**, worst near 0 to minus 10 C.

FORMULAS AND RELATIONSHIPS

- **Cloud base (ft) is approximately (temperature minus dew point) divided by 2.5, times 1000** for convective cloud.
- **Approximate freezing level: surface temperature divided by 2, times 1000 ft** above the surface (ISA-based rule of thumb).

MNEMONICS AND MEMORY ITEMS

- **Buys Ballot** (northern hemisphere): stand back to the wind and low pressure is on your **left**.
- Wind **backs** with height as you descend into the friction layer and **veers** with height as you climb out of it (northern hemisphere).
- Cold front cloud is **heap** (cumulus, showers); warm front cloud is **layer** (stratus, steady rain).
- **Stable = Smooth and Stratus; Unstable = Upsurging cumulus** with showers and turbulence.
- Halo round the sun or moon (cirrostratus) often means a **warm front and rain within about a day**.

COMMON EXAM TRAPS

- **High to low (pressure or temperature), look out below**: the altimeter over-reads, so your true height is lower than shown.
- Wind is named by where it comes **from**; a wind arrow on a chart points the way the air is **going**.
- Radiation fog needs a **light** wind; calm gives dew and a strong wind gives stratus, not fog.
- A cold front is **steeper and more violent** than a warm front but passes quickly; do not treat the two the same.
- Carburettor icing can form in **positive** temperatures with high humidity; it is not just a sub-zero hazard.
- The mature thunderstorm stage, not the towering build-up, has the **worst** turbulence, hail and windshear.
- QNH set from a distant station can be badly wrong in mountainous or fast-changing pressure; use a local setting when you can.

P40 Communications

RTF phraseology, phonetic alphabet, numbers, standard words, read-back, call signs, distress and urgency, VHF propagation.

TRANSPONDER CODES AND EMERGENCY CALLS

7500	7600	7700	7000
unlawful interference	radio failure	general emergency	VFR conspicuity

MAYDAY (distress)

Grave and imminent danger, immediate assistance needed.

Spoken three times, on 121.5 MHz or the frequency in use.

Absolute priority.

PAN PAN (urgency)

A safety concern that does not need immediate help.

Spoken three times.

Ranks below distress.

PAN PAN MEDICAL adds the condition.

Numbers that trap: three is TREE, five is FIFE, nine is NINER, decimal is DAY-SEE-MAL. Read every read-back back with your call sign.

MUST-KNOW DEFINITIONS AND CONCEPTS

- **Distress (MAYDAY)** means grave and imminent danger requiring immediate assistance; **urgency (PAN PAN)** is a safety concern that does not need immediate help.
- A **read-back** is repeating a clearance so the controller can confirm you heard it correctly; certain items are always read back in full.
- **ROGER** means I have received your last transmission (receipt only, not agreement or compliance); **WILCO** means I have received and will comply.
- **AFFIRM** is yes and **NEGATIVE** is no; **STAND BY** means wait and I will call you; **SAY AGAIN** asks the other station to repeat.
- A **call sign** identifies a station; on first contact with each new unit you use the full call sign, and only ATC may introduce an abbreviation.
- **Simplex** VHF uses one frequency alternately (you cannot transmit and receive at once); it is the normal air-ground mode.
- The **readability scale** runs 1 (unreadable) to 5 (perfectly readable), requested with a radio check.
- **VHF** is line-of-sight: range grows with height and is limited by terrain, not by curvature alone.

KEY NUMBERS, LIMITS AND VALUES

- Emergency frequency **121.5 MHz**, monitored for distress and urgency; use it or the frequency already in use.
- The aviation **VHF band is 118.000 to 136.975 MHz**, with **8.33 kHz** channel spacing now standard.
- The **108.000 to 117.975 MHz** band below it is for navigation aids, not voice (a classic trap).
- Distress and urgency calls are each spoken **three times** (MAYDAY MAYDAY MAYDAY, or PAN PAN PAN PAN PAN PAN).
- Number words: **3 TREE, 4 FOW-er, 5 FIFE, 9 NIN-er**, decimal **DAY-SEE-MAL**, hundred **HUN-dred**, thousand **TOU-SAND**.
- A five-character registration abbreviates to the **first character plus the last two** (G-ABCD becomes Golf Charlie Delta), and only after ATC uses it.
- Speak at about **100 words per minute**, at a steady rate and volume; press the transmit switch, pause, then speak.

FORMULAS AND RELATIONSHIPS

- **Approximate VHF line-of-sight range (nm) is about 1.23 times the square root of the height in feet** (rule of thumb; verify the constant used in your bank).

MNEMONICS AND MEMORY ITEMS

- Distress before urgency: **MAYDAY beats PAN PAN**, whichever was called first.
- **Alfa, Bravo, Charlie ...**: spell names, registrations, abbreviations and anything that could be misheard, never the standard words.
- Read back **runway, altimeter, SSR code, level and heading/speed instructions, and any clearance to enter, cross, land, take off or hold short**.
- **Nature of the distress comes early** in a MAYDAY call, right after the call sign, before intentions.
- End every read-back with your **call sign**; ROGER and WILCO never replace a required read-back.

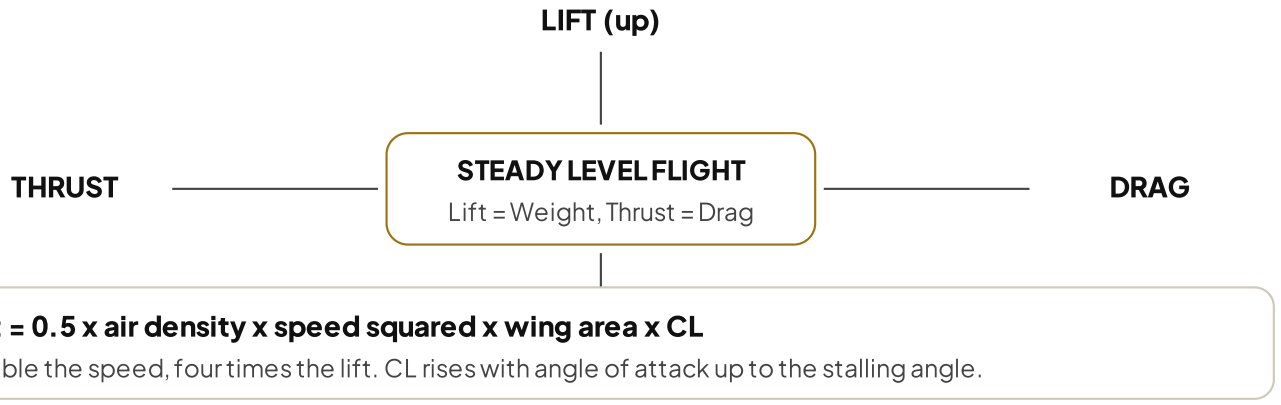
COMMON EXAM TRAPS

- **ROGER is receipt only.** It does not mean yes and it does not mean you will comply; use WILCO for compliance and AFFIRM for yes.
- Numbers are spoken **digit by digit** for headings, levels, squawk and call signs (heading 080 is ZE-RO AIT ZE-RO).
- The registration abbreviation keeps the **first letter and the last two**, but a type-plus-registration call drops the nationality prefix; the two rules differ.
- The **108 to 118 MHz** band is navigation, not voice; do not expect to talk on it.
- **Minimum fuel is advisory only.** A fuel state needing priority is PAN PAN; only fuel too low to reach any suitable aerodrome is MAYDAY.
- 121.5 MHz is not the automatic first choice; call on the **frequency in use first** unless that brings no answer.
- Say **DAY-SEE-MAL**, not the plain word decimal, and keep it consistent.

P50 Principles of Flight

Lift and drag, the stall, high-lift devices, stability and control, load and manoeuvre limits, propellers, forces in flight.

THE FOUR FORCES AND THE LIFT EQUATION



Lift = 0.5 x air density x speed squared x wing area x CL

Double the speed, four times the lift. CL rises with angle of attack up to the stalling angle.

The wing stalls at a fixed angle of attack (about 16 degrees), not a fixed speed. Stall speed rises with weight, bank and load factor.

MUST-KNOW DEFINITIONS AND CONCEPTS

- **Lift** acts perpendicular to the relative airflow; **drag** acts parallel to it; **weight** acts down through the centre of gravity; **thrust** acts forward.
- **Angle of attack** is the angle between the chord line and the relative airflow; lift rises with it up to the **critical (stalling) angle**.
- The **stall** happens when the airflow separates at the critical angle of attack; it is an angle, not a speed, so you can stall at any speed or attitude.
- **Parasite drag** rises with the square of speed; **induced drag** (from lift and wingtip vortices) falls as speed rises; total drag is least at **Vmd**.
- **Load factor** is lift divided by weight, expressed in g; in a level turn it rises with bank angle and increases the stall speed.
- **Static stability** is the initial tendency to return to trimmed flight after a disturbance; **dynamic stability** describes how the following oscillation behaves.
- **Adverse yaw** is the yaw away from a turn caused by the down-going aileron's extra drag; the rudder and design features counter it.
- **Ground effect** is the reduction in induced drag near the surface (within about one wingspan); it can let an overloaded aircraft lift off then sink.
- A **fixed-pitch propeller** is efficient at one speed; a **constant-speed** propeller varies blade pitch to hold a set RPM across the flight envelope.

KEY NUMBERS, LIMITS AND VALUES

- The critical angle of attack is about **16 degrees** for a typical light-aircraft wing; beyond it the wing stalls whatever the speed.
- Stall speed rises with the **square root of the load factor**: at 60 degrees of bank the load factor is 2g and the stall speed is about **1.4 times** the wings-level value.
- Level-turn load factor: **30 degrees of bank about 1.15g, 45 degrees about 1.4g, 60 degrees 2g**.
- Flaps **lower the stall speed** and steepen the descent; the first stage adds mostly lift, later stages add mostly drag.
- A **rate-one turn** is 3 degrees per second (360 degrees in 2 minutes); the bank needed is roughly the TAS in knots divided by 10, plus 7.
- Induced drag dominates at **low speed**, parasite drag at **high speed**; they are equal at Vmd, the minimum-drag speed.
- Washout (less incidence at the tip) makes the **root stall first**, keeping the ailerons effective and giving a gentle nose drop.

FORMULAS AND RELATIONSHIPS

- **Lift = 0.5 x air density x speed squared x wing area x lift coefficient (CL);** the same form gives drag with the drag coefficient (CD).
- **Load factor in a level turn = 1 divided by the cosine of the bank angle** (60 degrees gives 2g).
- **Stall speed in a turn = wings-level stall speed times the square root of the load factor.**

MNEMONICS AND MEMORY ITEMS

- **Lift, Weight, Thrust, Drag**: the four forces; in steady straight flight opposite pairs balance.
- Stall is an **angle**, not a speed: same critical angle of attack every time.
- **Speed squared** in the lift equation: double the speed and you quadruple the lift.
- Induced drag is the price of **lift** and rules at low speed; parasite drag is the price of **shape** and rules at high speed.
- Bank and pull and the stall speed climbs with the **square root of the g**.

COMMON EXAM TRAPS

- You can **stall at any speed and attitude**: it is the critical angle of attack that matters, not the airspeed indicator.
- In a turn the stall speed **rises**; a level 60-degree bank stalls about 40% faster than wings level.
- The **first stage of flap** gives lift for little drag; deploying full flap for take-off is usually wrong.
- **Induced drag rises as speed falls**, so the back of the drag curve is where slow flight bites; more power is needed to go slower.
- Ground effect can let you **lift off below a safe flying speed** then settle back; do not force it off.
- Moving the centre of gravity aft reduces stability and **lowers the stall speed slightly** but makes recovery harder; forward CG is more stable.
- A spin needs **stall plus yaw**; picking up a wing with aileron at the stall can aggravate it, so use rudder to stay coordinated.

P60 Operational Procedures

Part-NCO fuel and oxygen, noise abatement, fire and smoke drills, windshear, wake turbulence, emergency and precautionary landings, contaminated runways.

FUEL AND OXYGEN MINIMUMS (PART-NCO)

Final reserve fuel (VFR)

Day: fuel to fly 30 minutes at holding speed, 1500 ft above the destination

Night or other conditions: 45 minutes

Plus taxi, trip, contingency and alternate fuel on top

Supplemental oxygen (crew)

Above 13,000 ft cabin altitude: continuously

Between 10,000 and 13,000 ft: for any period over 30 minutes

Passengers must be supplied above 13,000 ft (verify current Part-NCO text)

Every in-flight fire drill starves the fuel first. Turn cabin heat off in a fire: it routes air over an exhaust shroud a fire can breach.

MUST-KNOW DEFINITIONS AND CONCEPTS

- **Final reserve fuel** is the untouchable minimum you must plan to land with; for day VFR it is 30 minutes at holding speed, 1500 ft above the destination.
- A **precautionary landing** is a planned landing while you still have control and options (weather, fuel, doubt); an **emergency landing** is forced by a failure now.
- **Wake turbulence** is the pair of counter-rotating tip vortices behind an aircraft; it is strongest when the generator is **heavy, clean and slow**.
- **Windshear** is a sudden change of wind speed or direction; a **microburst** is an intense downdraught that spreads out, giving a headwind then a tailwind.
- A **contaminated runway** has more than 25% of the used area covered by more than 3 mm of water, slush, snow or ice; braking and steering are degraded.
- **Noise abatement** procedures shape the departure and approach to reduce ground noise, but the commander may override them for safety.
- **Ditching** is a forced or precautionary landing on water; brief and prepare the cabin, and unlatch a door before impact so it cannot jam shut.
- **Carburettor icing** can occur in humid air at positive temperatures; apply full carburettor heat early, expecting a brief rough-running rise then recovery.

KEY NUMBERS, LIMITS AND VALUES

- Day VFR final reserve: **30 minutes**; night VFR or other conditions: **45 minutes** (Part-NCO NCO.OP.125, verify current text).
- Oxygen for crew: **above 13,000 ft** continuously; **between 10,000 and 13,000 ft** for any period over 30 minutes (NCO.OP.190, verify).
- Wake turbulence: wait about **2 to 3 minutes** behind a heavier aircraft; take off **before** its rotation point and land **beyond** its touchdown point.
- Stay at least **1000 ft** below and avoid the area behind and below a heavier aircraft, where the vortices sink and drift downwind.
- Fire class letters (as tested in the bank): **A** solids, **B** flammable liquids, **C** electrical, **D** metals.
- A rejected take-off decelerates on the **stopway** (load-bearing); the **clearway** need only be obstacle-free.

MNEMONICS AND MEMORY ITEMS

- In-flight fire drill order **starves the fuel**: fuel and mixture off, then master and ignition, cabin heat off, land as soon as possible.
- Windshear escape: **firewall the power, pitch to the escape attitude, keep the configuration**, respect the stall warning, do not chase the speed.
- Wake turbulence: **rotate before, land beyond**, and stay above the heavy aircraft's flight path.
- Contaminated runway = **more than 3 mm deep on more than a quarter of the surface**; wet is soaked but not that deep.
- Smoke drill: **oxygen and goggles first**, then communicate, isolate the source, remove the smoke, land.

COMMON EXAM TRAPS

- **Final reserve fuel is untouchable**; planning to arrive with exactly the reserve leaves nothing for a hold or diversion.
- Wake turbulence sinks and drifts, so the danger is **behind and below**; take off before, and land beyond, the heavy aircraft's runway point.
- In a microburst you first get a **performance-increasing headwind** that can mask the danger, then a sudden tailwind; do not relax on the early gain.
- Turn cabin heat **off** in an engine or induction fire; it can carry fumes or flame into the cockpit.
- A **wet** runway is not a **contaminated** runway; the contaminated definition needs both the depth (3 mm) and the coverage (25%).
- Carburettor icing bites at **positive** temperatures in humid air; use carb heat before it becomes severe, not after.
- Never descend below your **final reserve** to save time; a precautionary landing beats a fuel emergency.

P70 Flight Performance and Planning

Mass and balance, centre of gravity, performance factors, take-off and landing data, fuel planning, the navigation plan and the ICAO flight plan.

MASS BUILD-UP AND THE CG RULE

Basic empty mass	+ crew, payload	+ usable fuel
aircraft + unusable fuel + oils	= dry operating / zero fuel mass	= take-off mass (below MTOM)

Moment = mass x arm

CG = total moment divided by total mass (the mass-weighted average arm)

Longer take-off and landing when

heavier · higher · hotter · tailwind · upslope · soft or contaminated surface

Density altitude rises with height, temperature and humidity, and cuts performance.

Never average the arms. CG is total moment over total mass; fuel burn walks the CG along the loading line as fuel (ahead of or behind the CG) is used.

MUST-KNOW DEFINITIONS AND CONCEPTS

- **Basic empty mass** is the aircraft with unusable fuel and full operating fluids; add crew and payload for the **dry operating** and **zero fuel** masses, then usable fuel for take-off mass.
- The **centre of gravity (CG)** is the point through which weight acts; it must stay within the forward and aft limits for the whole flight.
- A **moment** is mass times arm (the horizontal distance from the datum); the CG is the total moment divided by the total mass.
- The **forward CG limit** is set by control authority (elevator power to flare and recover); the **aft limit** is set by stability.
- **Density altitude** is pressure altitude corrected for temperature; high, hot and humid conditions raise it and degrade take-off, climb and landing.
- **TODR/LDR** are the required take-off and landing distances from the flight manual for the conditions; apply the required safety factors.
- A **navigation plan** (or log) lists tracks, headings, distances, times and fuel for each leg; the **ICAO flight plan** is the form filed with ATS.
- **Contingency fuel** covers unforeseen factors; **final reserve** is the untouchable minimum you plan to land with.

KEY NUMBERS, LIMITS AND VALUES

- Performance is worse when **heavier, higher, hotter**, with a **tailwind**, on an **upslope**, or on a **soft or contaminated** surface.
- Wind rule of thumb for planning: allow only about **50% of a reported headwind** and at least **150% of a reported tailwind**.
- A rough density-altitude effect: performance falls roughly **1% per 1000 ft** of density altitude for a light piston aircraft VERIFY.
- Take-off and landing distances grow rapidly with mass; a small overload gives a **larger-than-proportional** distance increase.
- Standard passenger and baggage masses may be used where the flight manual and rules allow; otherwise use **actual** weighed masses.
- The **ICAO flight plan** Item 15 carries cruising speed, level and route; **Item 19** is supplementary (endurance, persons on board, emergency equipment).
- AVGAS weighs about **0.72 kg per litre**; multiply litres by the density to convert a fuel volume to a mass for loading.

FORMULAS AND RELATIONSHIPS

- **Moment = mass x arm.** Sum the moments and masses, then **CG = total moment divided by total mass.**
- **CG shift when a load is moved = (mass moved x distance moved) divided by total mass** (the CG moves the same way as the load).
- **Fuel mass = volume x density** (about 0.72 kg per litre for AVGAS).

MNEMONICS AND MEMORY ITEMS

- Performance killers: **Heavy, High, Hot, Humid** and a **tailwind** all lengthen the run.
- **Empty, then payload, then fuel**: basic empty mass to zero fuel mass to take-off mass, each below its limit.
- **Moment = mass x arm; CG = total moment over total mass.** Never average the arms.
- Forward CG = **firm and stable, heavy on the controls**; aft CG = **light and unstable, hard to recover**.
- Item 15 route, **Item 19 the survival details** (endurance, souls on board, equipment).

COMMON EXAM TRAPS

- **Do not average the arms** to find the CG; use total moment over total mass, or a nose-heavy answer will look balanced.
- As fuel burns the CG **moves**; a load legal at take-off can go out of limits later, so check take-off, landing and zero-fuel points.
- **Density altitude, not indicated altitude**, drives performance; a cool sea-level airfield on a hot day can perform like a mountain strip.
- Apply only **half a headwind** and **1.5 times a tailwind** when planning distances; using the full reported wind is optimistic.
- A small overload gives a **disproportionately longer** take-off and a higher stall speed; weight is never a rounding error.
- Standard masses are only allowed where the rules permit; when in doubt use **actual weighed** masses.
- Convert fuel **volume to mass** before adding it to the load sheet; litres are not kilograms.

P80 Aircraft General Knowledge

Airframe and systems, piston engine, fuel and ignition, propellers, electrics, pitot-static instruments, compass and gyroscopic instruments.

THE FOUR-STROKE CYCLE

1. INDUCTION	2. COMPRESSION	3. POWER	4. EXHAUST
inlet open, piston down	valves shut, piston up	spark, gas expands	exhaust open, piston up

Only the power stroke drives the crankshaft; the flywheel carries it through the other three.

Dual magnetos: two spark plugs per cylinder, each fed by an independent, engine-driven magneto.

Compass errors: turning UNOS (Undershoot North, Overshoot South) and acceleration ANDS (Accelerate North, Decelerate South) in the northern hemisphere.

MUST-KNOW DEFINITIONS AND CONCEPTS

- The **four-stroke cycle** is induction, compression, power, exhaust; only the power stroke drives the crankshaft, and the flywheel carries it through the rest.
- **Detonation** is uncontrolled explosive burning (from low-grade fuel, high temperature or over-lean mixture); **pre-ignition** is ignition before the spark. Both damage the engine.
- **Carburettor icing** forms as fuel vaporises and pressure drops in the venturi, cooling the air below freezing even on a warm humid day; carb heat clears it.
- The **mixture control** sets the fuel-to-air ratio; at altitude the air thins, so you **lean** the mixture to keep it correct.
- A **dual magneto** ignition gives two independent sparks per cylinder for redundancy and a more complete burn; magnetos are self-powered, driven by the engine.
- The **pitot-static system** feeds the ASI (pitot and static), the altimeter and the VSI (static only).
- A **gyroscope** has rigidity in space and precession; it drives the attitude indicator, the heading indicator and the turn coordinator.
- The **direct-reading magnetic compass** seeks magnetic north but suffers dip and turning and acceleration errors near the magnetic poles.

KEY NUMBERS, LIMITS AND VALUES

- **AVGAS 100LL** is dyed **blue**; the newer **UL91** is for suitable engines. Always check fuel colour and drain for water and sediment before flight.
- The ASI reads **IAS**; corrected for instrument and position error it is **CAS**, and corrected for density it is **TAS**, which exceeds IAS with altitude.
- Static blockage: the altimeter **freezes**, the VSI reads **zero**, and the ASI under-reads in a climb; use alternate static if fitted.
- Pitot blockage (with the drain blocked): the ASI behaves like an **altimeter**, over-reading in a climb and under-reading in a descent.
- Compass turning error is greatest near **north and south** and zero near east and west; it grows with latitude.
- A typical light-aircraft electrical system is **14 V** (12 V battery) or **28 V** (24 V battery), with an alternator or generator and a battery.
- Magneto check: a small RPM drop on each magneto is normal; **no drop** may mean a live (hot) magneto, and a large drop or rough running means a fault.

FORMULAS AND RELATIONSHIPS

- **Indicated to true airspeed:** IAS to CAS (instrument and position error), CAS to TAS (density); **TAS exceeds IAS with altitude.**
- **Ohm's law: Voltage = Current x Resistance** for the aircraft's DC circuits.

MNEMONICS AND MEMORY ITEMS

- Four-stroke **Suck, Squeeze, Bang, Blow**: induction, compression, power, exhaust.
- Compass turning **UNOS**: Undershoot North, Overshoot South (northern hemisphere).
- Compass acceleration **ANDS**: Accelerate North, Decelerate South (on east/west headings).
- Pitot feeds the ASI only; **static feeds all three** (ASI, altimeter, VSI).
- Magneto check drop is normal; a **zero drop means a hot magneto**, treat the prop as live.

COMMON EXAM TRAPS

- Carburettor icing can form at **positive** temperatures in humid air; the first sign in a fixed-pitch engine is a gradual RPM loss.
- A **static blockage freezes the altimeter and zeroes the VSI**; a pitot blockage makes the ASI act like an altimeter. Know which instrument fails.
- **TAS is greater than IAS at altitude**; do not read the airspeed indicator as your true speed for navigation.
- The compass is only steady in **straight, level, unaccelerated** flight; turn or accelerate and it lies (UNOS and ANDS).
- Treat every propeller as **live**: a magneto can fire even with the master off, so never hand-swing or stand in the arc.
- Over-leaning causes **high temperatures and detonation**; enrich the mixture for high power settings and climbs.
- The heading indicator is **not north-seeking**; realign it to the compass regularly for its apparent wander.

P90 Navigation

The Earth and charts, time, direction, magnetism, projections, dead reckoning, the triangle of velocities, the 1-in-60 rule, radio navigation aids.

DIRECTION LADDER: TRUE TO COMPASS (CDMVT)

TRUE	+	MAGNETIC	+	COMPASS	=	STEER
from the chart		apply variation		apply deviation		this heading

Variation West, Magnetic Best (add West)
Variation East, Magnetic Least (subtract East). Same rule for deviation.

1-in-60: 1 degree off after 60 nm = 1 nm off track. Drift = track minus heading.

1 minute of latitude = 1 nautical mile. A great circle is the shortest path; a rhumb line crosses every meridian at the same angle and is a straight line on a Mercator chart.

MUST-KNOW DEFINITIONS AND CONCEPTS

- A **great circle** is the shortest distance between two points on the Earth; a **rhumb line** crosses every meridian at a constant angle and looks straight on a Mercator chart.
- **Latitude** is measured north or south of the equator, **longitude** east or west of the Greenwich meridian; one minute of latitude is one nautical mile.
- **Variation** is the angle between true and magnetic north; **deviation** is the compass error from the aircraft's own magnetism.
- **UTC** is the world time standard; **local mean time (LMT)** changes with longitude at 4 minutes per degree.
- A **Mercator** chart is a cylindrical projection: rhumb lines are straight, scale grows with latitude; a **Lambert** conic chart keeps great circles nearly straight and scale nearly constant.
- **Dead reckoning** predicts position from heading, airspeed, wind and time; the **triangle of velocities** combines the air vector and the wind to give the ground vector.
- **Drift** is the angle between heading and track caused by wind; the **wind correction angle (WCA)** is applied into wind to hold the desired track.
- The **1-in-60 rule** says a 1-degree error over 60 nm puts you about 1 nm off track; it converts across-track distance into an angle to correct.
- **Isogonals** are lines of equal variation on a chart; variation changes slowly year to year (annual change).

KEY NUMBERS, LIMITS AND VALUES

- **1 minute of latitude = 1 nautical mile**; 1 degree of latitude = 60 nm. **1 nm is about 1.85 km** and about 6076 ft.
- Time and longitude: the Earth turns **15 degrees per hour**, so **1 degree = 4 minutes** of time; the sun moves west, so east is ahead in time.
- The **triangle of velocities**: air vector (heading and TAS) plus wind vector gives the ground vector (track and groundspeed); a headwind makes groundspeed less than TAS.
- **Drift = track minus heading.** A wind from the left gives right (starboard) drift, so the track lies right of the heading.
- **1-in-60 rule**: track error in degrees = 60 times (distance off track divided by distance gone); to regain track add the closing angle.
- **Compass dip** is zero at the magnetic equator and 90 degrees at the magnetic poles; the dip drives the turning and acceleration errors.
- **VHF navigation aids (VOR, DME) are line-of-sight**; range increases with height. DME reads slant range, so it over-reads close and high, and reads height when overhead.
- **GNSS (GPS)** needs at least 4 satellites for a 3D fix; RAIM integrity monitoring needs 5, and needs 6 to detect and exclude a faulty satellite.

FORMULAS AND RELATIONSHIPS

- **Speed, distance, time:** distance = speed x time; time = distance divided by speed; speed = distance divided by time.
- **Track error (degrees) = 60 x (distance off track divided by distance gone); total correction = track error + closing angle.**
- **Drift = track minus heading; wind correction angle is applied the opposite way** to hold the desired track.
- **True to compass (CDMVT): apply variation (True to Magnetic) then deviation (Magnetic to Compass); Variation West, Magnetic Best.**

MNEMONICS AND MEMORY ITEMS

- **Variation West, Magnetic Best; Variation East, Magnetic Least.** The same rule runs for deviation.
- **CDMVT**: Compass, Deviation, Magnetic, Variation, True: the ladder to convert between them.
- **1 minute of latitude is 1 nautical mile**: the built-in scale on every chart's latitude edge.
- Time and longitude: **the sun rises in the east, so places east are ahead** in local time. Add 4 minutes per degree of longitude east of Greenwich, subtract going west.
- Drift is **track minus heading**; the wind blows you off, and you turn into it by the same angle (WCA).

COMMON EXAM TRAPS

- **Measure a distance against the latitude scale**, not the longitude scale; only latitude minutes equal nautical miles.
- **Variation West, Magnetic Best**: add westerly variation going from true to magnetic; reverse it going the other way.
- The wind vector is drawn **downwind** (the way the air is going), while a wind is named by where it comes **from**.
- **DME reads slant range**, not ground distance; overhead a beacon it reads your height in nautical miles, never zero.
- On a Mercator chart the **scale grows with latitude**; measure distance at the latitude of your leg, not at the equator.
- **Drift is track minus heading**; getting the sign wrong sends the correction the wrong way.
- A **great circle is shortest** but changes direction constantly; a rhumb line holds a constant heading but is longer, except along a meridian or the equator.

Exam technique in 60 seconds

1. Answer everything

EASA PPL theory exams have **no negative marking** VERIFY, so never leave a blank. A guess after eliminating two options is a coin flip you paid for.

2. Budget the clock

Divide the minutes by the questions before you start. Anything eating more than about **90 seconds**, flag it and move on; unanswered easy questions at the end cost the most.

3. Read the stem twice

Watch for **NOT** and **except**, for "most correct", and for unit switches: kg vs lb, nm vs km, hPa vs inHg, ft vs m. Half the classic traps are in the wording, not the theory.

4. Eliminate first

Cross out the two clearly wrong options before comparing the last two. Most distractors are built from the **right numbers in the wrong place**.

5. The night before

Sleep beats cramming. Skim only the Traps boxes and your flagged weak areas, then stop. Fatigue loses more marks than any single forgotten number.

6. Check the flags

Leave the last minutes to revisit flagged questions and to confirm you answered **every** question. Change an answer only when you can say why the first one is wrong.

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