

# The PPL Cheat Sheet

## P50 Principles of Flight

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.

P50 Principles of Flight

31 memory items

One of 9 subjects; the full set is free at [skystudyatpl.com/ppi-cheat-sheet](https://skystudyatpl.com/ppi-cheat-sheet)

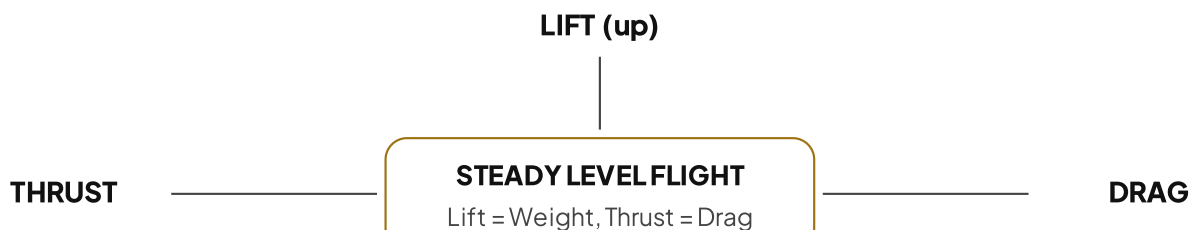
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# Principles of Flight

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 **V<sub>md</sub>**.
- **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 V<sub>md</sub>, 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.

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