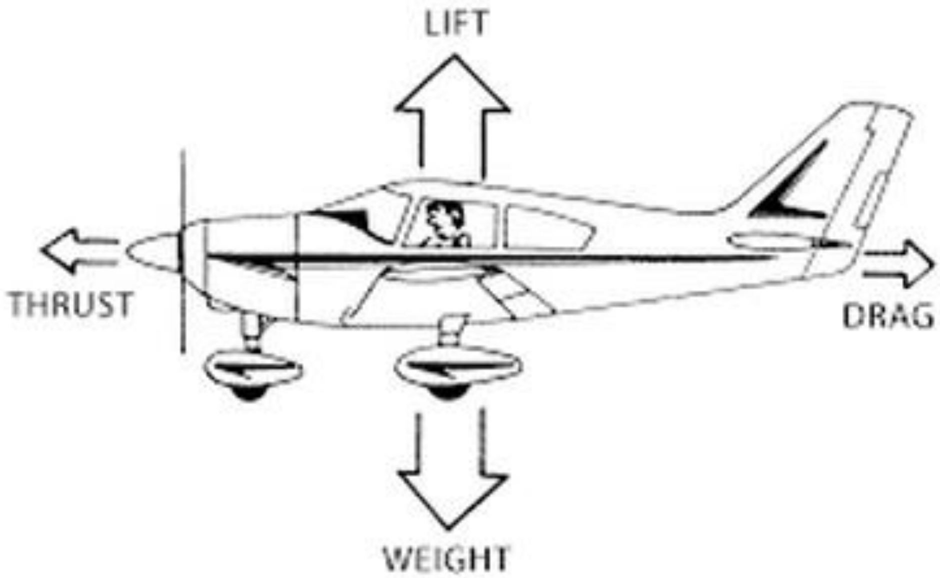
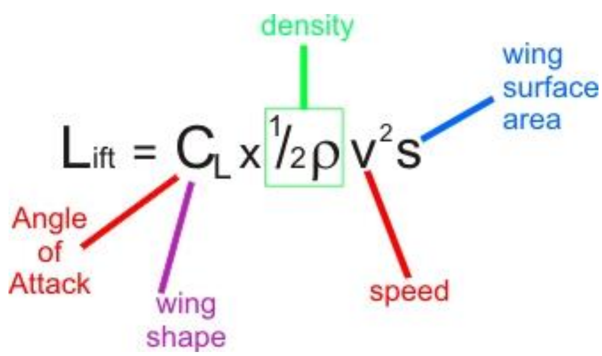
The Four Forces that act on an airplane:





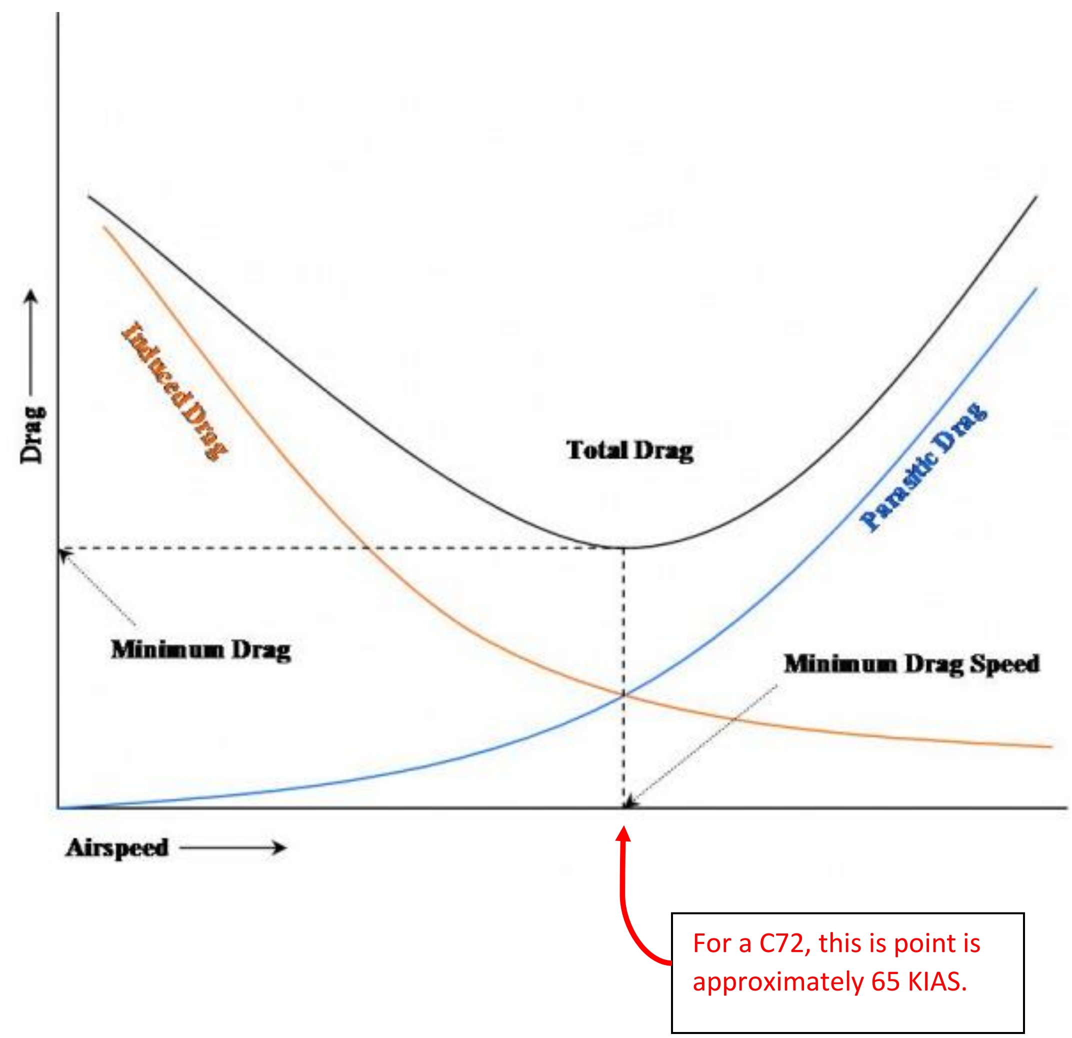
Lift. The equation above is only intended to shows what we (pilots) can control and what we can't. You can control airspeed, and you can control angle of attack. You can't control wing shape, air density, or surface area.

The graph below shows that as angle of attack goes up, the coefficient of lift (Cl) goes up… until a point where is starts going down again. The angle of attack that marks the peak Cl is the critical angle of attack. In level, unaccelerated flight this angle of attack occurs at the airplane's stall speed.

Drag

There are many different types of drag. The most commonly encountered are:

- <u>Parasitic Drag</u>, composed of
  - Form Drag, which is the result of the aerodynamic resistance to motion due to the shape of the aircraft,
  - Skin Friction Drag, which is due to the smoothness or roughness of the surfaces of the aircraft, and
  - Interference Drag, which may occur where surfaces with different characteristics meet (e.g. wing and fuselage)
- <u>Induced Drag</u>, which is a secondary effect of the production of lift



Behind the Power Curve

Imagine an aircraft in cruise flight and the pilot makes a small power reduction:

- Assuming the pilot pitches and trims to maintain altitude, the aircraft will slow down and stabilize at some slower airspeed. This is logical and straight forward… until you get to the point of lowest total drag.

- If the airplane gets slower than this airspeed and the pilot makes an additional power reduction, the airplane will continue to get slower without any additional power reductions because as the airplane gets slower (and you continue to pitch for altitude), drag goes up and the airplane continues to slow down.

- As the pilot raises pitch to maintain altitude while the airplane is slowing, the angle of attack is rising, raising the coefficient of lift until the critical angle of attack is reached, at which point the airplane stalls. The stall is usually preceded by a slight buffeting, "mushing" of the controls, and the stall warning horn.

What happens after the stall

Largely, that depends on the airplane and where the airplane is when the stall occurs. Most training aircraft are very stable and seek to regain airspeed when operated inside their weight and balance limits. In a C172, the nose tends to pitch forward causing airspeed to rise. All the pilot needs to do in this case is relax any backpressure on the yoke, and the airspeed will rise and the stall is over. Now, its just a matter of regaining a climb attitude to minimize the altitude lost.

For the Cessna 172, the following procedure is used to recover from the stall:

Relax backpressure on the yoke

Apply FULL power
Carb Heat Cold
Flaps to 20 (omit this step if flaps are at 20 or less)

Climb at Vx
Retract flaps incrementally above 60 KIAS
When altitude is recovered, execute the cruise checklist

In a training environment, stall recoveries are practiced to recognize the indications of a stall, and also to practice the correct stall recovery technique while minimizing the altitude lost. If a stall were to occur on short final or shortly after takeoff, immediate recognition and a correct response would be critical to a safe recovery.

Some aircraft (especially high performance aircraft) have less stable or more abrupt stall entries and more complicated recoveries. This is one reason why stall entries and recoveries are typically part of learning any new aircraft.