



DRONESVIP | CIVIL AERONAUTICAL
TRAINING CENTER

AERODYNAMICS AND PERFORMANCES OF THE UAVs

AGENDA

- Definitions
- Reference Axes
- Newton's Laws
- Bernoulli's principle
- Physical Definitions
- Wing Profile / Lift
- Flow over the Wing
- Main Control Surface
- Control Equipment (Mode 2)
- Maneuvering, Stability and Control
- Equipment of UAV
- Barometer, Variometer
- Barometric Altitude
- Propulsion Engine Group

DEFINITIONS

STRENGTH $F = m \cdot a$

MOMENT (COUPLING) $M = F \cdot d$ (Force x Lever Arm)

ACCELERATION Change of speed over time.

VELOCITY Distance/Time.

ALL VECTOR entities (they have magnitude, direction and sense)

DEFINITIONS

- FLUIDS
- GASES (characteristics)
- PRESSURE Strength/Area

The diagram illustrates the concept of pressure by comparing two blocks of equal weight but different contact areas. On the left, a wide, low block has a weight of 100 N and a contact area of 0.1 m², resulting in a pressure of 1000 Pascals. On the right, a narrow, tall block has the same weight of 100 N but a much smaller contact area of 0.01 m², resulting in a higher pressure of 10,000 Pascals. The text 'Same force, different area, different pressure' is written in red at the bottom right. To the left of the blocks, the formula for pressure is given as $Pressure = \frac{Force}{Area} = \frac{F}{A}$.

$Pressure = \frac{Force}{Area} = \frac{F}{A}$

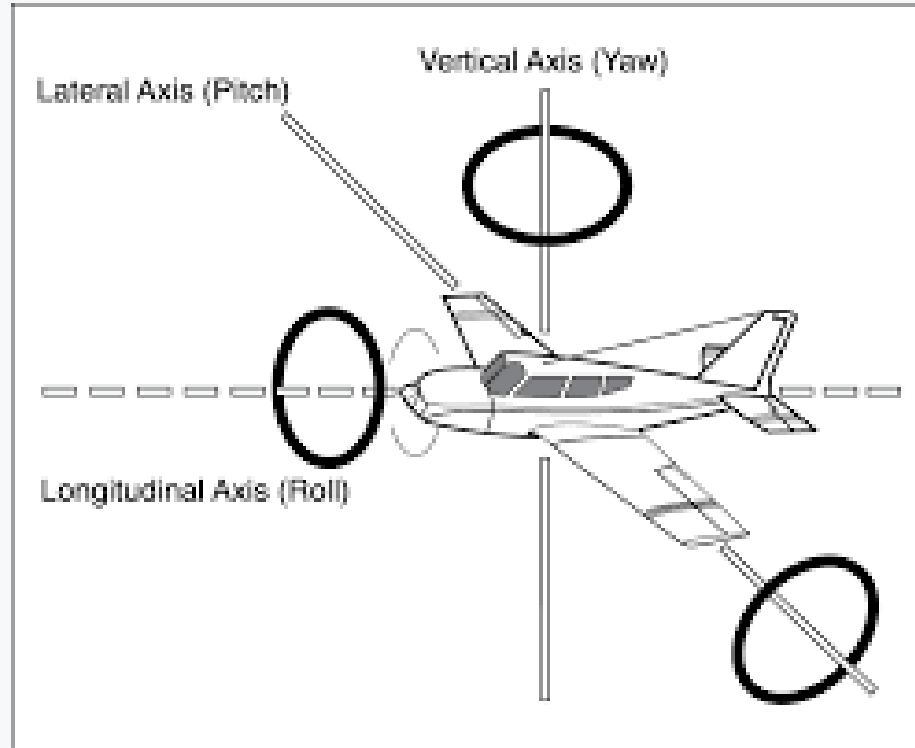
Weight
100 N

A = 0.1 m²
P = 1000 Pascals

A = 0.01 m²
P = 10,000 Pascals

Same force,
different area,
different pressure

REFERENCE AXES



NEWTON'S LAWS



Every body at rest or in uniform rectilinear motion will remain in that state unless an acting force produces a change.

01

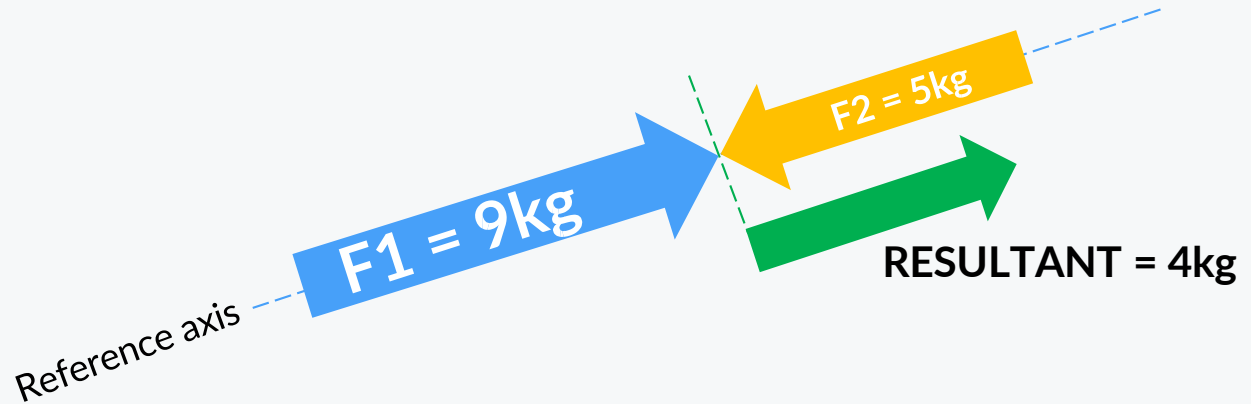
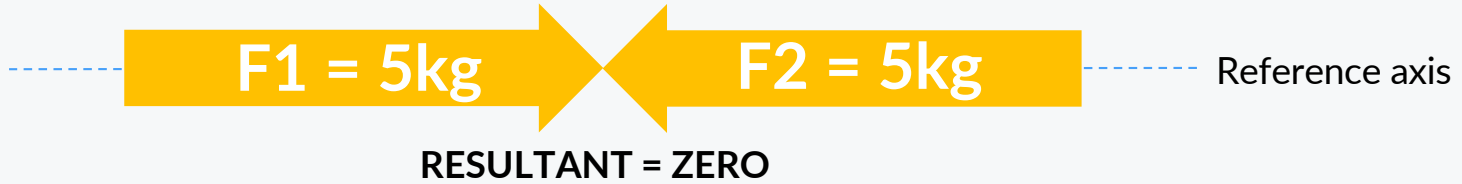
Each action corresponds to an equal and opposite reaction.

03

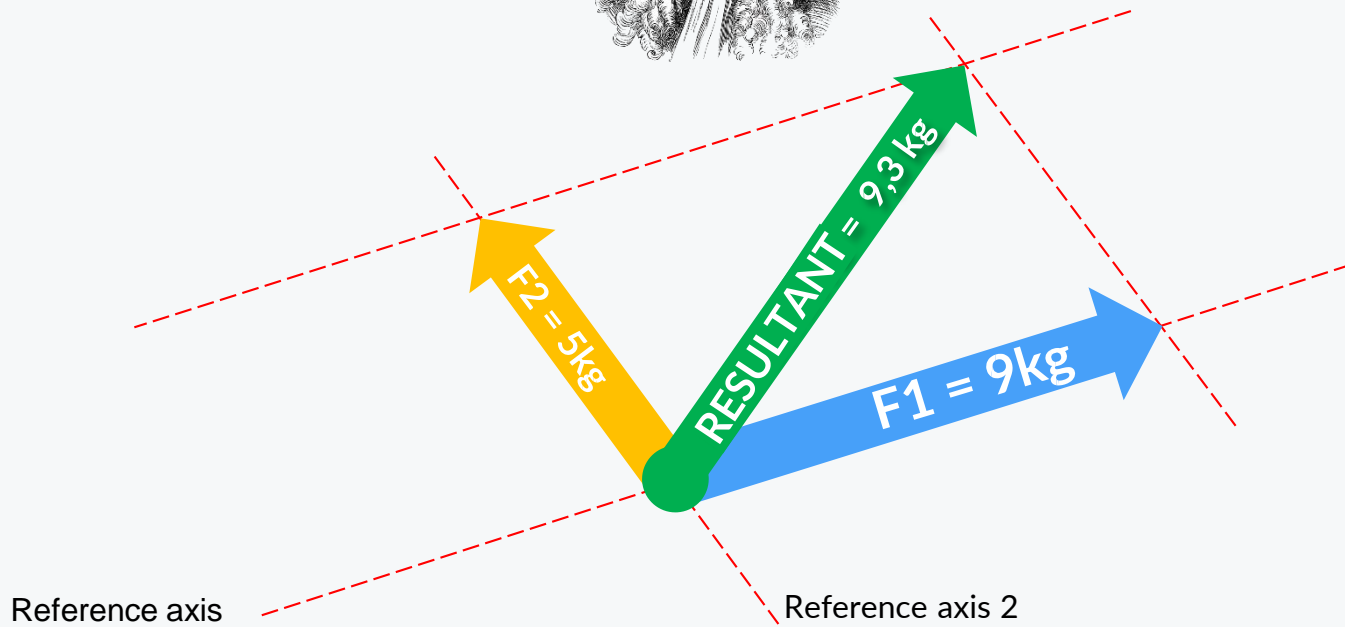
02

The change of motion is proportional to the imprinted force and occurs according to the straight line along which that force is imprinted.

NEWTON'S LAWS



NEWTON'S LAWS



BERNOULLI'S PRINCIPLE

Energy per unit volume before = Energy per unit volume after

$$P_1 + \frac{1}{2} \rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g h_2$$

Pressure Energy Kinetic Energy per unit volume Potential Energy per unit volume

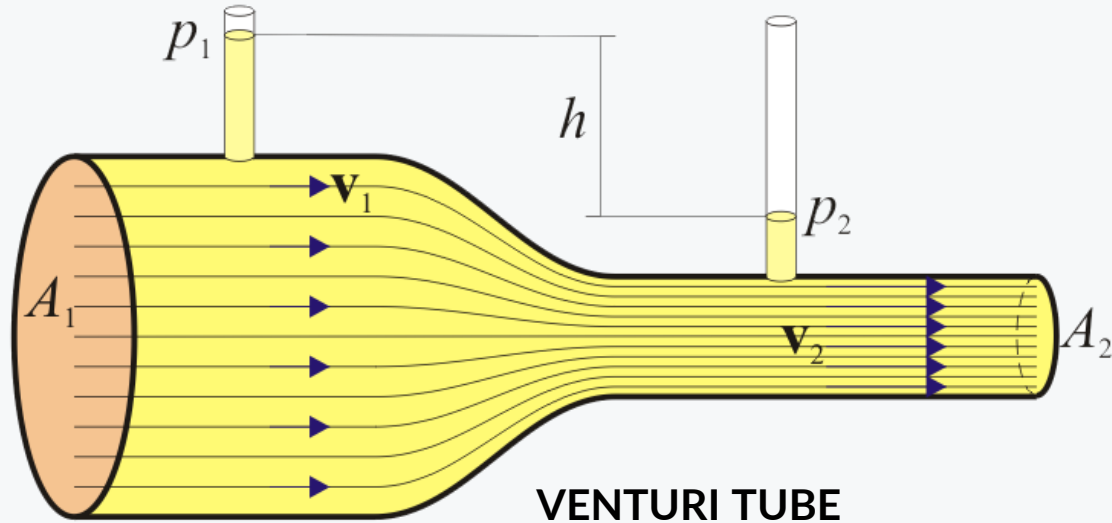
Flow velocity v_1 Flow velocity v_2

The often cited example of the Bernoulli Equation or "Bernoulli Effect" is the reduction in pressure which occurs when the fluid speed increases.

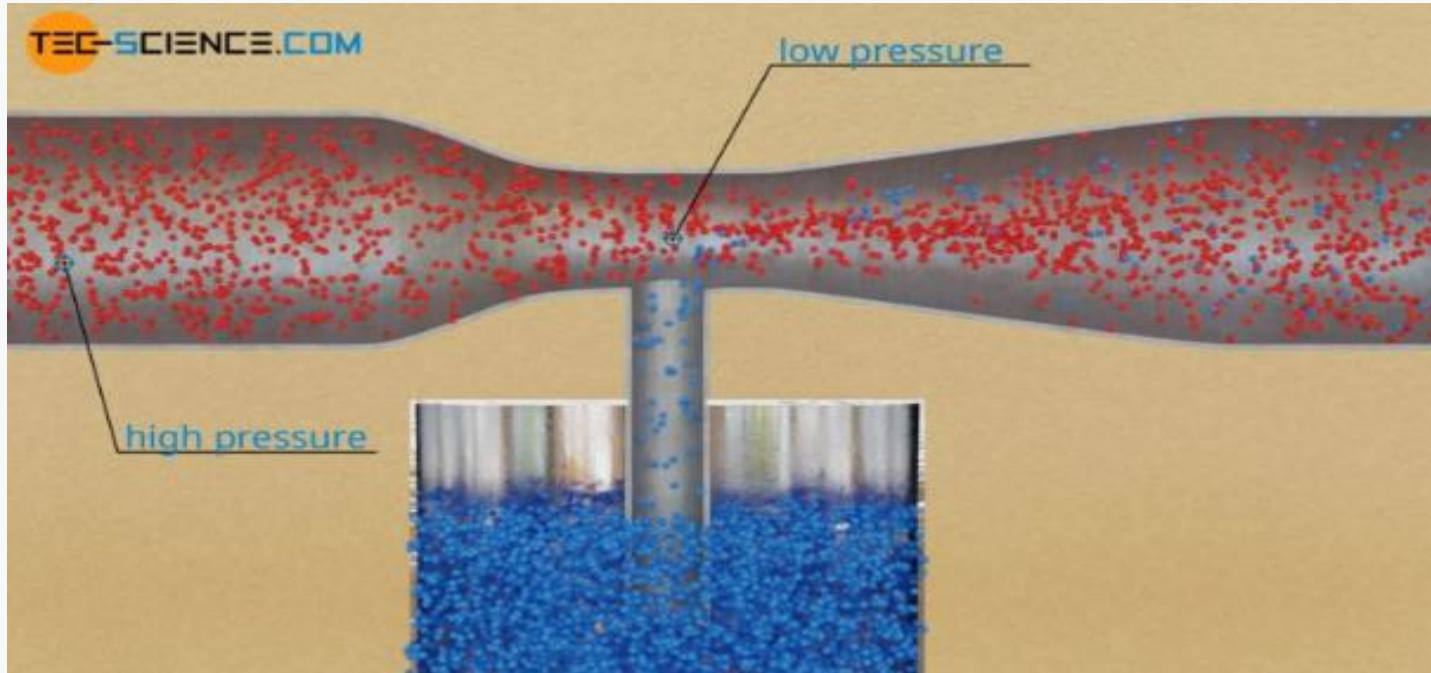
$A_2 < A_1$
 $v_2 > v_1$
 $P_2 < P_1$!

Increased fluid speed, decreased internal pressure.

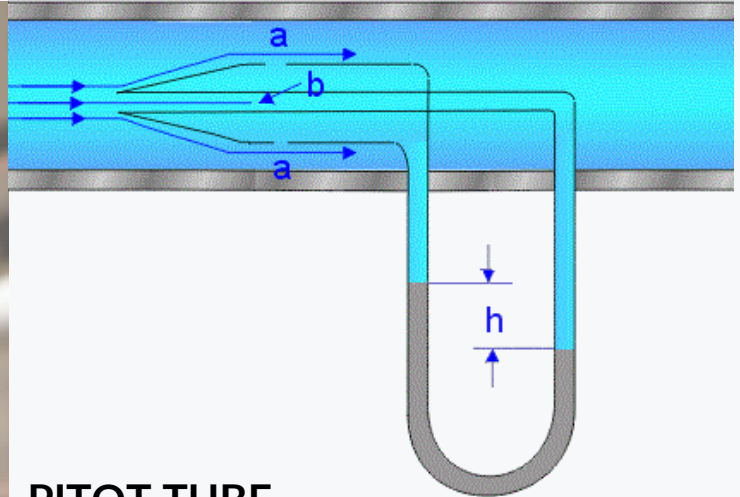
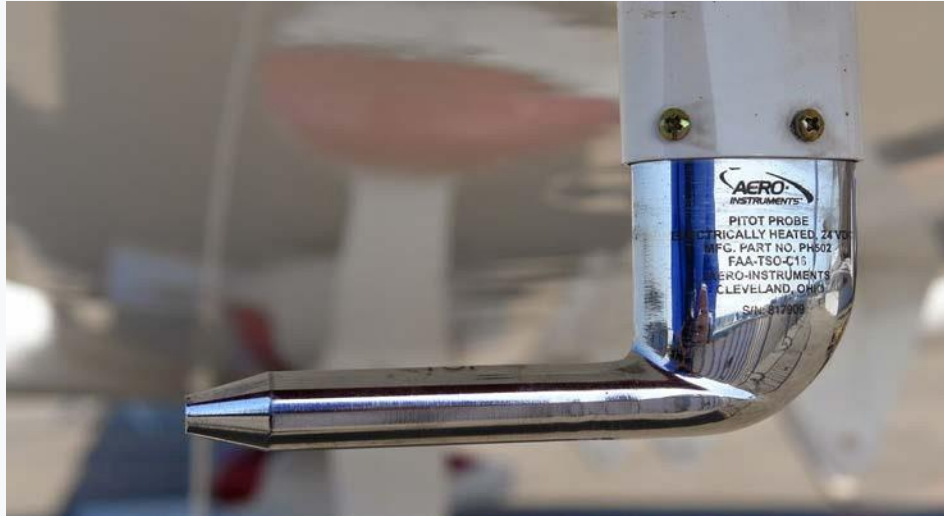
BERNOULLI'S PRINCIPLE - APPLICATIONS



BERNOULLI'S PRINCIPLE - APPLICATIONS

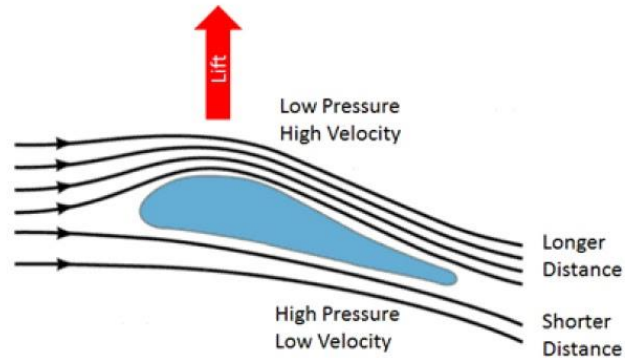


BERNOULLI'S PRINCIPLE - APPLICATIONS

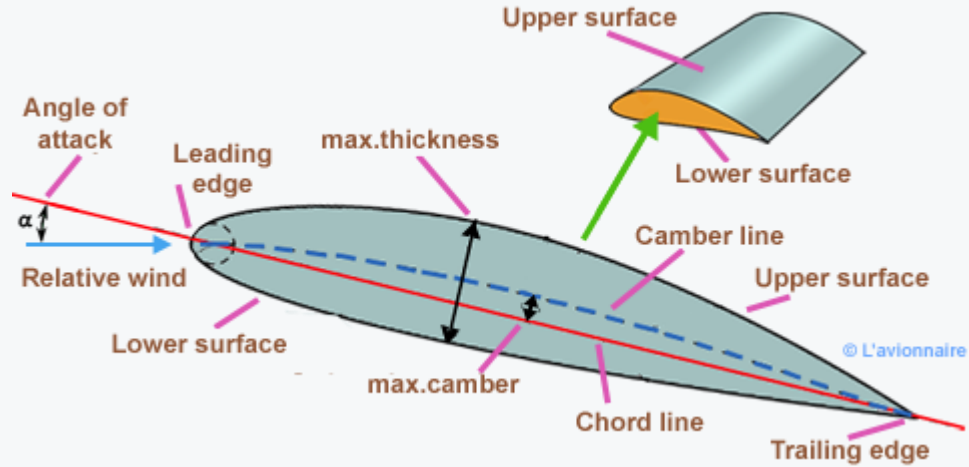


PITOT TUBE

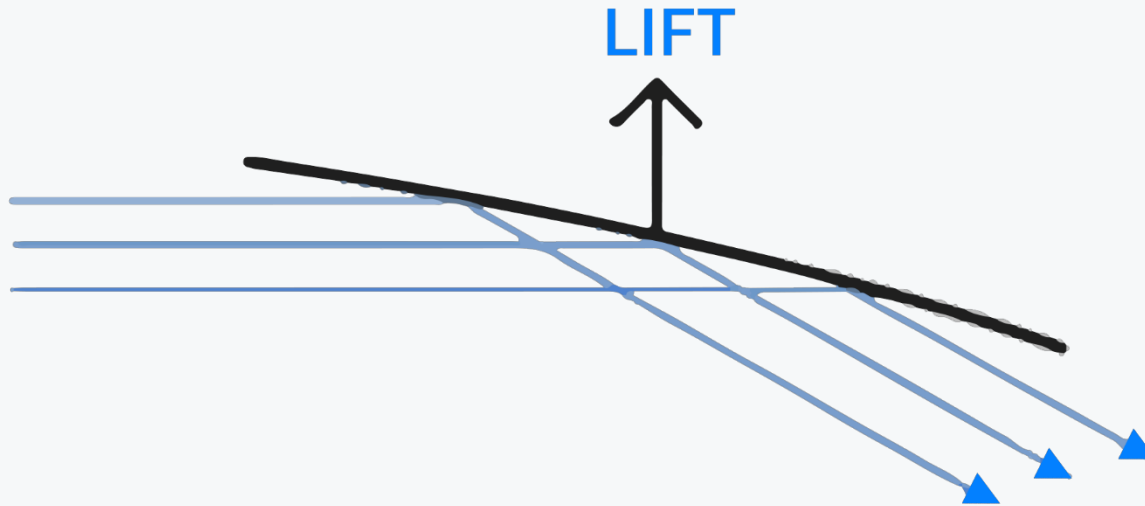
BERNOULLI'S PRINCIPLE - APPLICATIONS



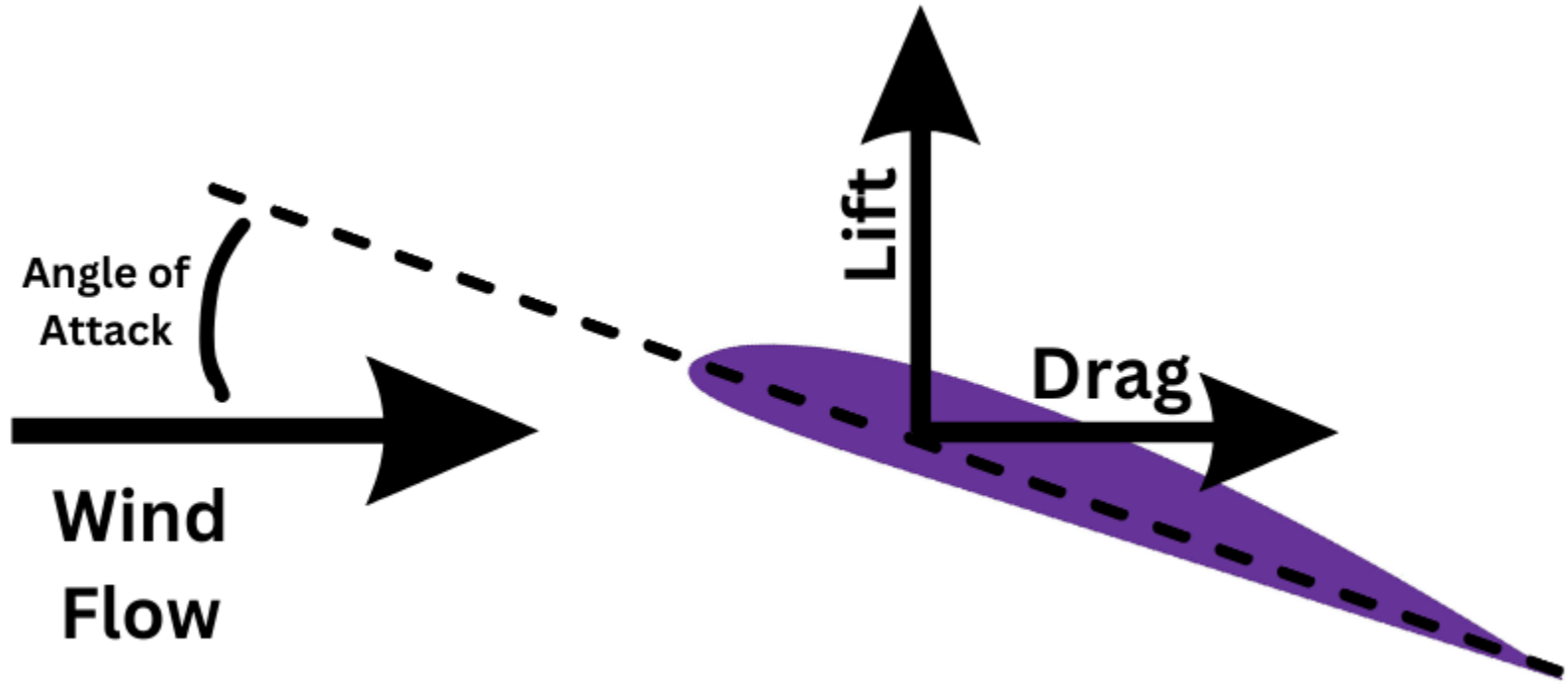
PHYSICAL DEFINITIONS – WING PROFILE



PERFIL ALAR



PHYSICAL DEFINITIONS



QUESTION TIME!