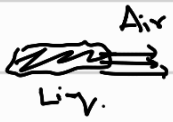
CH6 FLUID DYNAMICS.

→ flow of fluids.
→ Interaction of fluids.



Fluid:

→ Anything that flows.
→ liquids, gases.

Hydrostatics → fluids at rest.

Density (ρ)

$$\rho = \frac{\text{mass}(M)}{\text{volume}(V)}$$

Pressure (P) → (Scalar).

→ Normal force exerted by the fluid on unit area which contains the point.

$$P = \frac{F}{A}$$

→ Compressive in nature.

$$[P] = \boxed{\frac{N}{m^2}} \rightarrow \text{Pascal (Pa)}.$$

$$\left\{ \begin{array}{l} 1\,atm = 1.013 \times 10^5\,Pa \\ 1\,bar = 10^5\,Pa \end{array} \right\} \quad \{1\,atm = 1.013\,bar.\}$$

Thrust:

→ Normal force on surface in contact.

$$\text{Thrust} = P \times A.$$

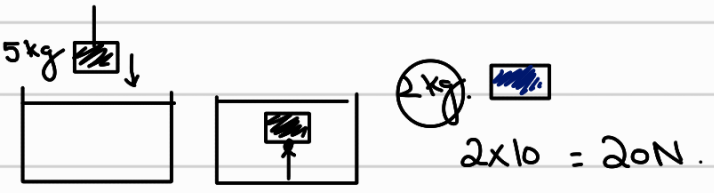
Pascal's law.

→ Pressure exerted at a point is invariant in all directions.

$$\frac{F_1}{F_2} = \frac{A_1}{A_2}$$

Archimedes Principle.

→ A body submerged in a fluid feels upward force equal in magnitude to weight of displaced fluid.



Buoyancy. (B).

→ Upward thrust fluid exerts on submerged fluid.

→ It acts on a point on a body known as centre of buoyancy / floatation.

$$B = V\rho g.$$

Laws of floatation.

1) $W > W'$. → Sink
2) $W = W'$ → floats. immersed
3) $W < W'$ → floats on surface. / partly immersed.

Viscous Drag & Stokes law.

Viscosity: Measure of force req. to slide layers of liquid over.

$$[\eta] = kgm^{-1}s^{-1} = [ML^{-1}T^{-1}]$$

→ Resistance ⟹ Drag force.
↳ • Velocity
• Geometric profile.

from Stokes law:

$$F_D = 6\pi\eta r v$$

Terminal Velocity.

$$F_D = mg$$

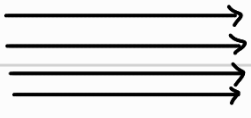
$$\Rightarrow v_t = \text{const}$$

Terminal velocity.

$$v_t = \left(\frac{g}{6\pi\eta r}\right)m = \left(\frac{2\rho g}{9\eta}\right)r^2.$$

Fluid flow.

LAMINAR (Streamline) : TURBULENT.



Ideal fluid.

→ $\eta = 0$

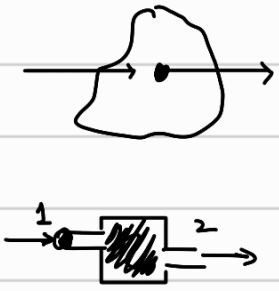
→ ρ = Const

→ Steady motion.

Equation of Continuity.

$\rho A V$ = Const. = $\frac{\text{mass}}{\text{time}}$.

↳ $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$.



Bernoulli's Eq.

$$P + \frac{1}{2}\rho v^2 + \rho g h = \text{Const.}$$

Pressure energy: PV

Kinetic energy: $\frac{1}{2}mv^2 \Rightarrow \frac{1}{2}\rho v^2$ per vol.

Potential energy: $mgh \Rightarrow \rho g h$ per vol.