MECHANICAL PROPERTIES OF FLUIDS

Pressure :→

→ Fluid : that can flow, like - Gases, liquids

- Pressure : $P_{avg} = \frac{F}{A}$
- Pascal's Law: Pressure is same at all points at the same horizontal level for a fluid at rest.

$1\,Pa = 1\,N/m^2$
$1\,Bar = 10^5\,Pa$
$1\,torr = 1\,mm\,of\,Hg$
$1\,atm = 1.013 \times 10^5\,Pa$

→ At depth h, absolute pressure = $P_0 + \rho gh$ (P_0 : Atmospheric pressure.)

→ Gauge pressure = Absolute pressure − Atmospheric pressure

→ Pressure applied at any point is transmitted equally in all directions.

Archimedes' Principle :→

Upthrust = Weight of liquid displaced by the body

Upthrust = $V\rho g$

ρ = density of liquid.

g = Volume of immersed part of the body.

Equation of Continuity and Bernoulli's Theorem :→

→ In stream line flow, velocity of particles passing at any point is same at that point.

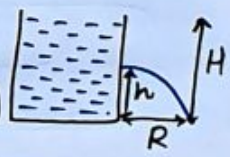
→ Equation of Continuity : $A_1V_1 = A_2V_2$ for incompressible fluid. (using conservation of mass)

→ Bernoulli's Principle : For an incompressible and non-viscous fluid.

$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$ using conservation of energy.

→ Toricelli's Law : $V_{efflux} = \sqrt{2gh}$ (when the tank is open).

→ Range of fluid : $R = 2\sqrt{h(H-h)}$, when $h = \frac{H}{2} \Rightarrow R = max$



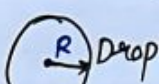
→ Venturimeter : $V_1 = \sqrt{\frac{2h\rho_m g}{\rho\left[\frac{A^2}{a^2} - 1\right]}}$

Surface Tension and Capillary Rise :→

* Surface Tension = Force per unit length $T = \frac{F}{l}$.

→ Surface Energy : amt. of work to be done to form a surface. $E = S \times A$

$\Delta p = \frac{4T}{R}$



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* Angle Of Contact - angle b/w tangent to liquid surface at point of contact and solid surface inside the liquid.

angle of Contact
- Obtuse: liq. will fall in capillary tube.
- acute: liq. will rise in capillary tube.

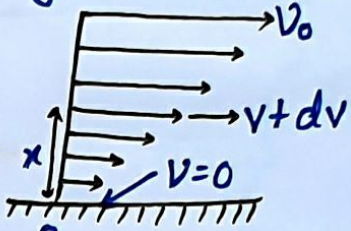
* Capillary Rise : $h = \frac{2 \cdot T\cos\theta}{r\rho g}$

Viscosity and Stoke's Law :→

→ Viscosity : a resistance to fluid motion.

→ Coeff. of Viscosity : $\eta = \frac{\text{Shearing stress}}{\text{Shearing strain}} = \frac{Fl}{vA}$.

→ Viscous Force (b/w layers) : $F = -\eta A \frac{dv}{dx}$.



* Stoke's Law : Viscous force on a body moving in the fluid is given by—

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

* Terminal Velocity : $V_T = \frac{2r^2(\sigma-\rho)g}{9\eta}$

* Renyold's Number :

$$R_N = \frac{\rho v D}{\eta}$$

→ $R_N < 1000$ → streamline flow

$1000 < R_N < 2000$ → transition flow

$R_N > 2000$ → turbulent.