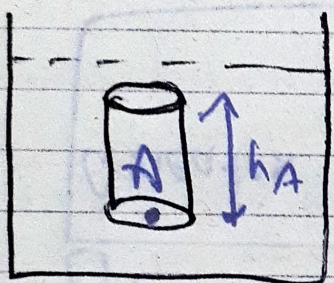
PROPERTIES OF FLUIDS

- **Atm. Pressure :-**

$$\boxed{1\,atm = 1.015 \times 10^5\ N/m^2 \ \text{pascal}}$$



$$\boxed{P_A = P_0 + h_A \rho g}$$

Paradox :-

1.) P doesn't depend on the shape of the container

2.) In one liquid, at one level pressure is same throughout

Barometer

$$\boxed{P_0 = h g \rho_{Hg}}$$

ESTIMATE At sea level,

$$\boxed{h = 760 \text{ mm of } Hg}$$

We use mercury instead of water because density of mercury is 13600 while that of water is 1000

Manometer (Measures Gauge Pressure)

Gauge pressure is pressure over and above at. pressure

$$\boxed{P_{guage} = \Delta h \rho_{Hg} g}$$

Archimedes Principle :-

The object which is fully immersed in the liquid :-

a) Will sink → If $\boxed{W_{object} > F_B}$

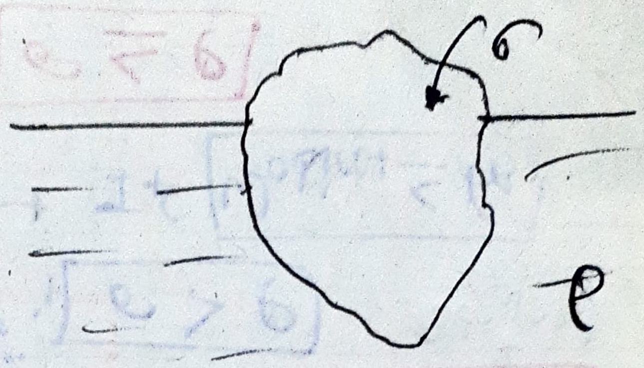
Buoyant Force

i.e, $\boxed{\sigma > \rho}$

b) Will float → If $\boxed{W_{object} \leq F_B}$

i.e, $\boxed{\sigma \leq \rho}$

Iceberg



$$\boxed{\frac{V_{in}}{V} = \frac{\sigma}{\rho}}$$

$$\boxed{\frac{V_{out}}{V} = 1 - \frac{\sigma}{\rho}}$$

Finding the Cavity Inside a Metal

$$W_{air} = \sigma(V - V_c)g \quad \text{— (1)}$$

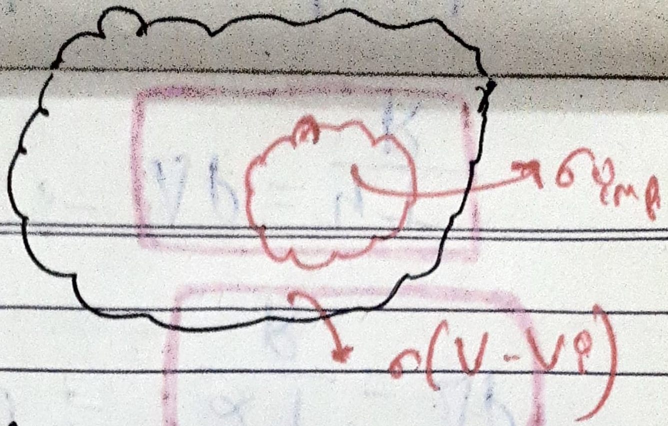
$$W_{air} - W_{liqu.} = F_B = \rho V g \quad \text{— (2)}$$

Finding the Impurity

$$W_{air} = \sigma_i V_i g + \sigma(V - V_i)g$$

$$W_{air} - W_{liqu.} = \rho V g = F_B$$

ESTIMATE



Eqn. of Continuity

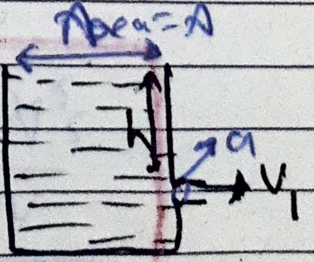
$$\boxed{A_1 V_1 = A_2 V_2} \rightarrow \boxed{AV = \text{const.}}$$

Bernoulli's Eqn.

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

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

Torricelli's Eqn.



$$\boxed{v_1 = \sqrt{2gh}}$$

for $a \ll A$

$$\boxed{v_1 = \sqrt{\frac{2gh}{1 - \left(\frac{a}{A}\right)^2}}}$$

Venturimeter

$$\boxed{Q = \frac{dV}{dt} = AV}$$

$$\boxed{Q = A_1 A_2 \sqrt{\frac{2g\Delta h}{A_1^2 - A_2^2}}}$$

Surface Tension (T)

$$\boxed{T = \frac{F}{l}}$$

Surface Energy (ΔU)

$$\boxed{T = \frac{\Delta U}{\Delta S}}$$

Excess Pressure :

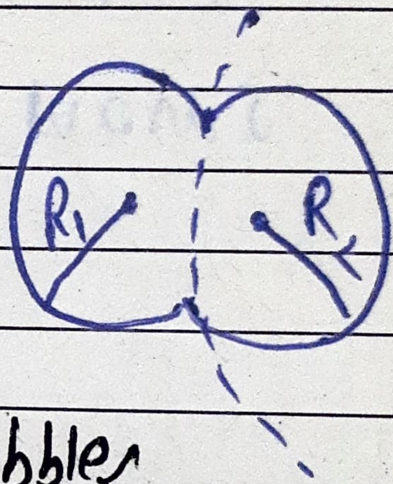
1) For Drop :- $\boxed{\frac{2T}{R} = \Delta P}$

2) For Bubble :- $\boxed{\Delta P = \frac{4T}{R}}$

Sticking of Bubbles

⇒ Radius of common surface is

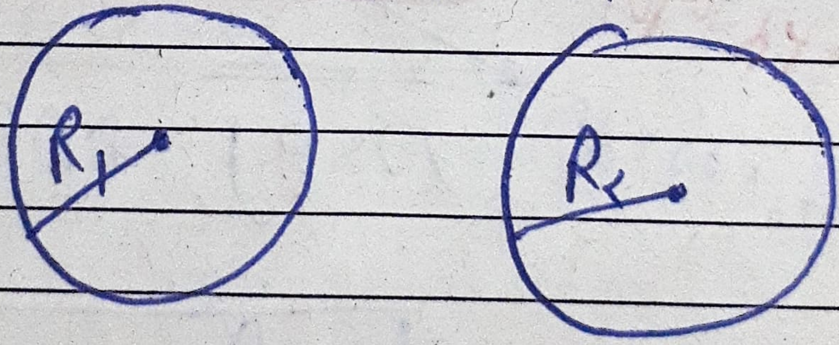
$$\boxed{R = \frac{R_1 R_2}{R_1 - R_2}}$$



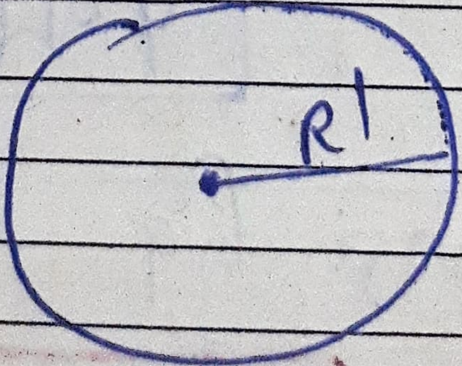
Merging of Soap Bubbles

Vacuum

Before merging →



After Merging →



$$\boxed{R' = \sqrt{R_1^2 + R_2^2}}$$

Capillary Action

Height to which water will rise in the capillary is

$$\boxed{h = \frac{2T\cos\theta}{\rho R g}}$$

Work done by Surface Tension

$$\boxed{W = Mgh}$$

Viscous force

viscosity

velocity

$$\boxed{F = \frac{\eta A v}{d}}$$

Stoke's Law

If round object moves by viscous forces

$$\boxed{F_v = 6\pi\eta r v}$$ *

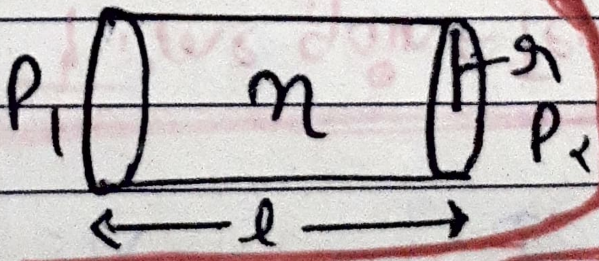
velocity

ESTIMATE Terminal Velocity

$$V = \frac{2}{9\eta}(\sigma - \rho) r^2 g$$

Poiseuille's Eqn.

→ Mathematically flow rate is,



Resistance offered by pipe

$$R = \frac{8\eta l}{\pi r^4}$$

$$R = \frac{\Delta P}{\Phi} = \frac{8\eta l}{\pi R^4}$$

$$\Phi = \frac{\Delta P \pi R^4}{8\eta l}$$

$$\boxed{\text{Reynold's number} = \frac{\text{Inertial force}}{\text{Viscous force}}}$$

$$\boxed{R_e = \frac{\rho V D}{\mu}}$$

, R_e = Reynold no.

ρ = density, μ = viscosity

D = diameter of pipe

V = velocity of flow