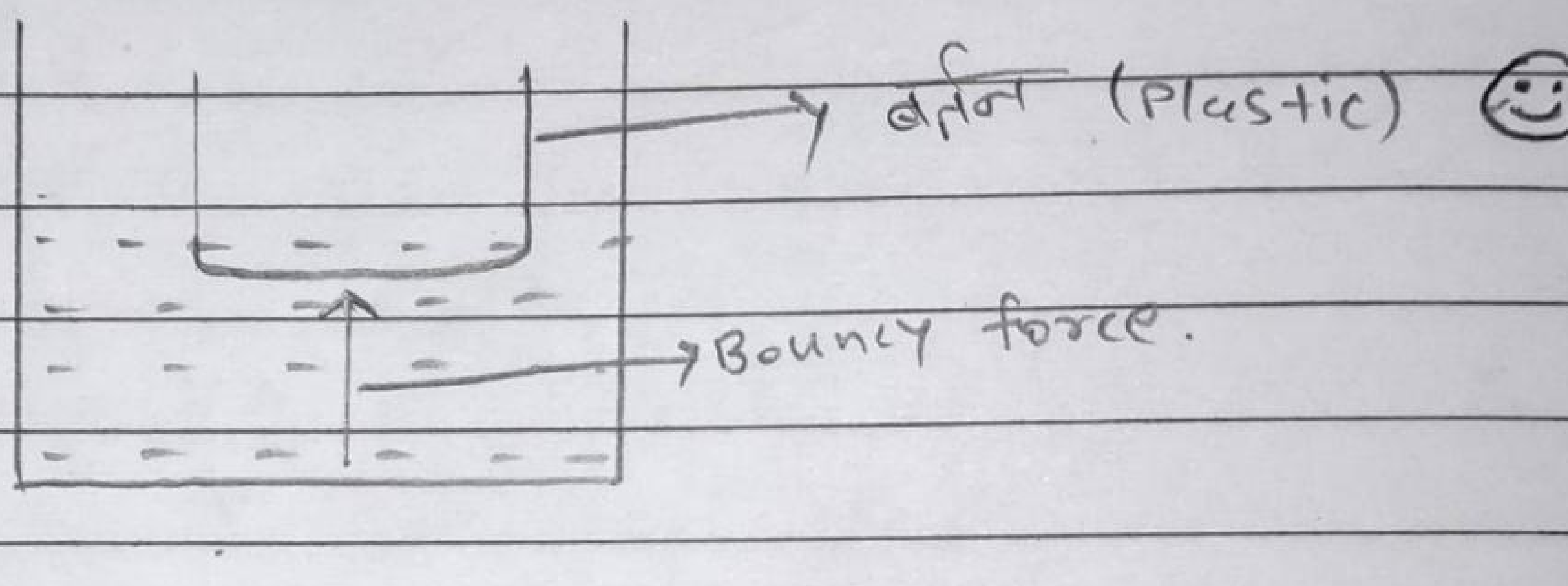
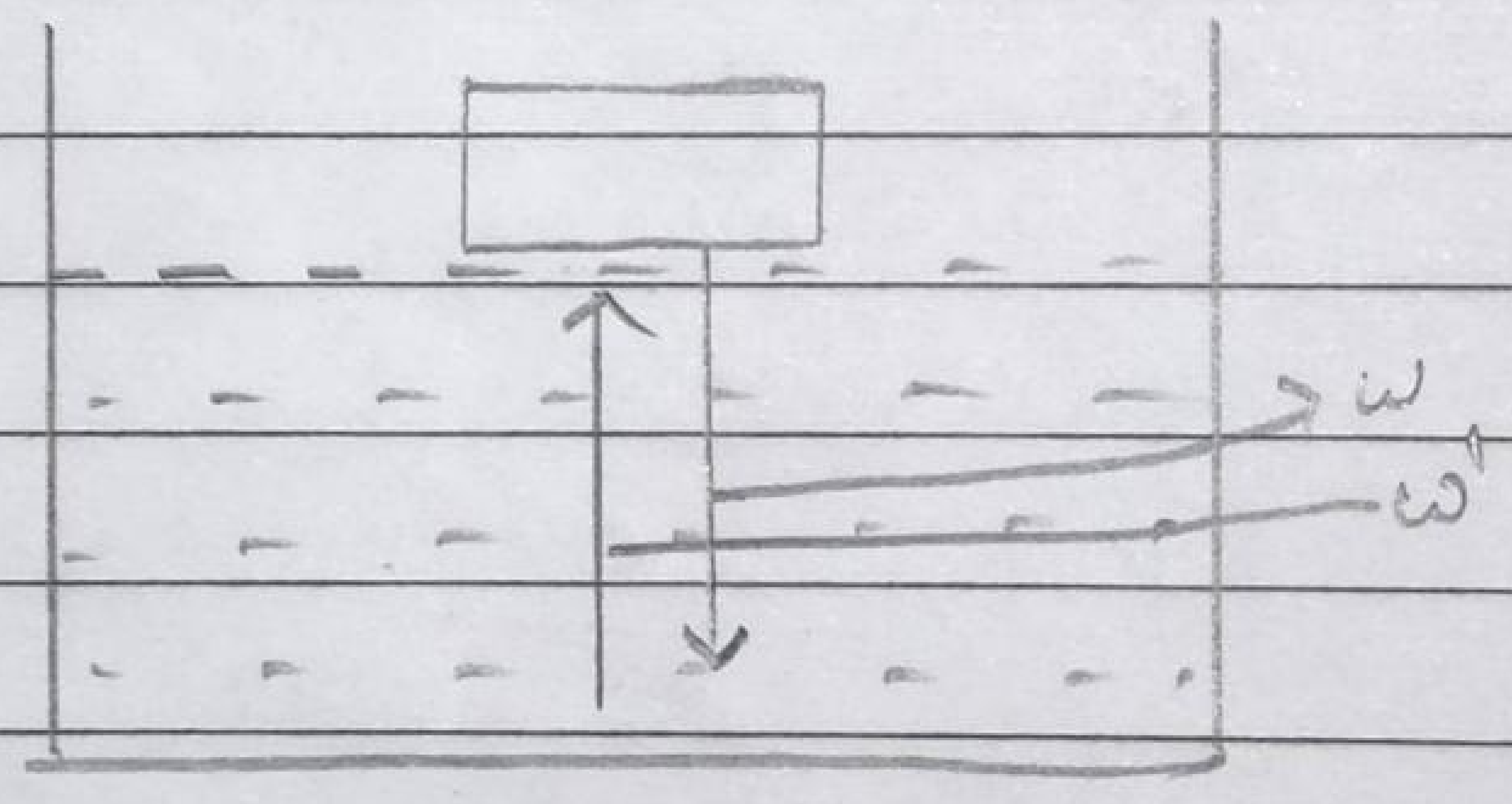
Q. What do you mean by buoyancy?

<u>Ans.</u> The Property of liquid by virtue of which it exert an upward force on the body ~~imaged~~ immensed inside it is called buoyancy.



Principle of flotation :-



<u>when</u>

i) $w = w' \rightarrow$

ii) $w > w' \rightarrow$

iii) $w < w' \rightarrow$

Q. what is cohesive and Adhesive force.

Ans. Cohesive force :- Attractive force b/w molecules of the same type are called cohesive force.

Adhesive force :- Attractive force b/w molecules of the different type are called Adhesive force.

Case I) cohisive force > Adhesive force

then wet the substance.

Case II) Adhesive force > cohesive force

then does not wet the substance

Q. what do you mean by Surface Tension and write SI unit ~~&~~ dimension, and uses of surface Tension.

Ans. Surface Tension :- surface tension is the tendency of fluid surfaces to shrink into the minimum surface area possible. It's SI unit is Newton per meter (N/m)

It's dimension is → MT^{-2}

surface tension is denoted by "T" or "S" or "σ".

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

where,

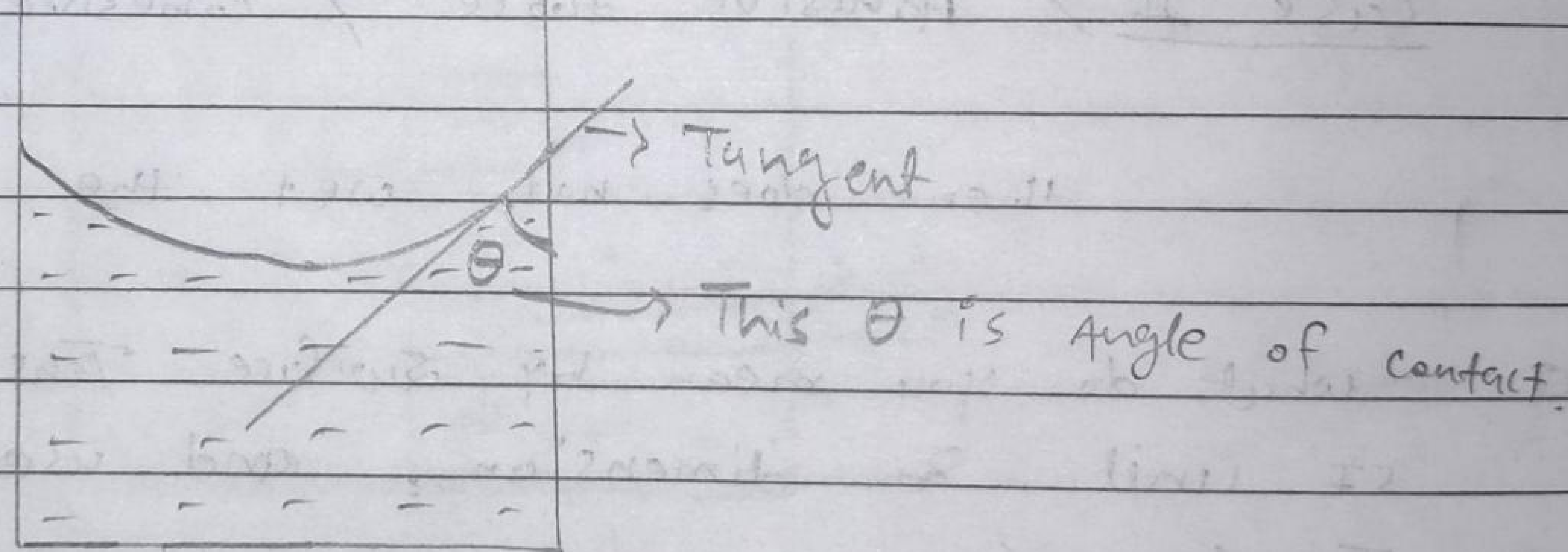
T = surface Tension

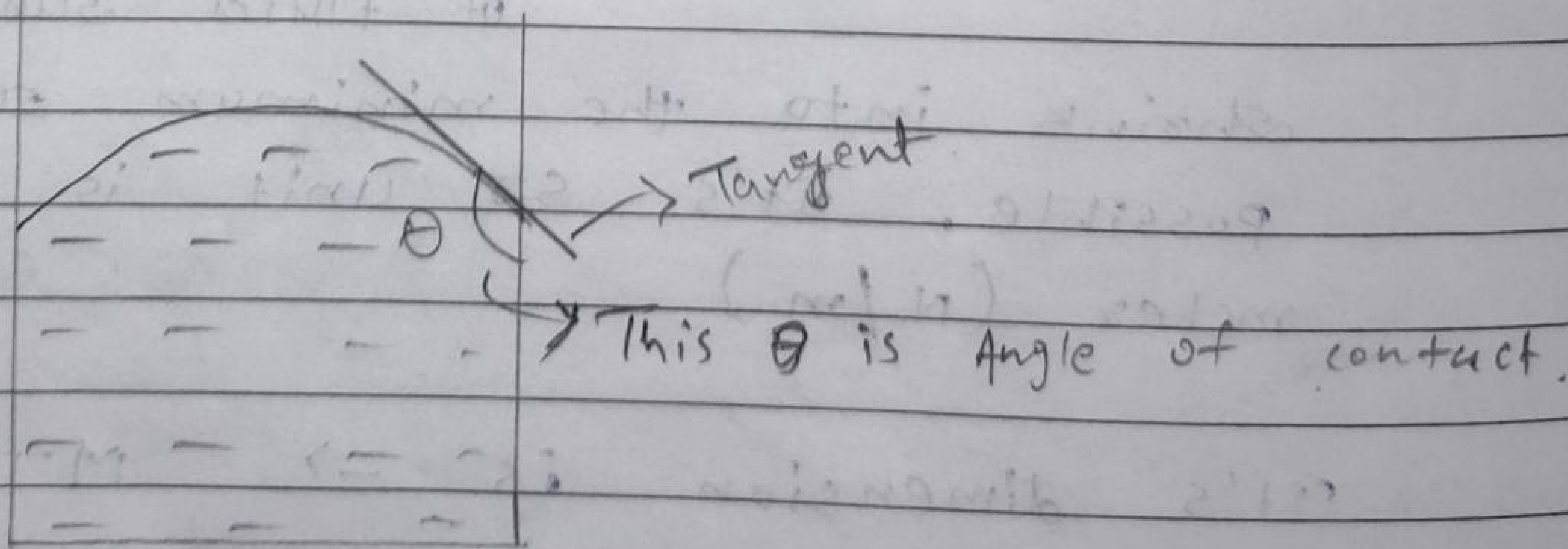
F = force

l = lenghth

Q. What do you mean by surface energy. derive the relation b/w surface energy and surface tension(σ)?

Angle of contact :-





Ans. surface energy :- The energy associated with the intermolecular forces at the interface b/w two media. This energy is also known as "free surface energy."

Unit :- N/m
Dimension :- MT^{-2}

Relation b/w surface energy & surface Tension:-

$\Rightarrow$ surface energy $= \dfrac{\text{Energy}}{\text{Area}}$

$= \dfrac{\text{Newton} \times m}{m^2}$

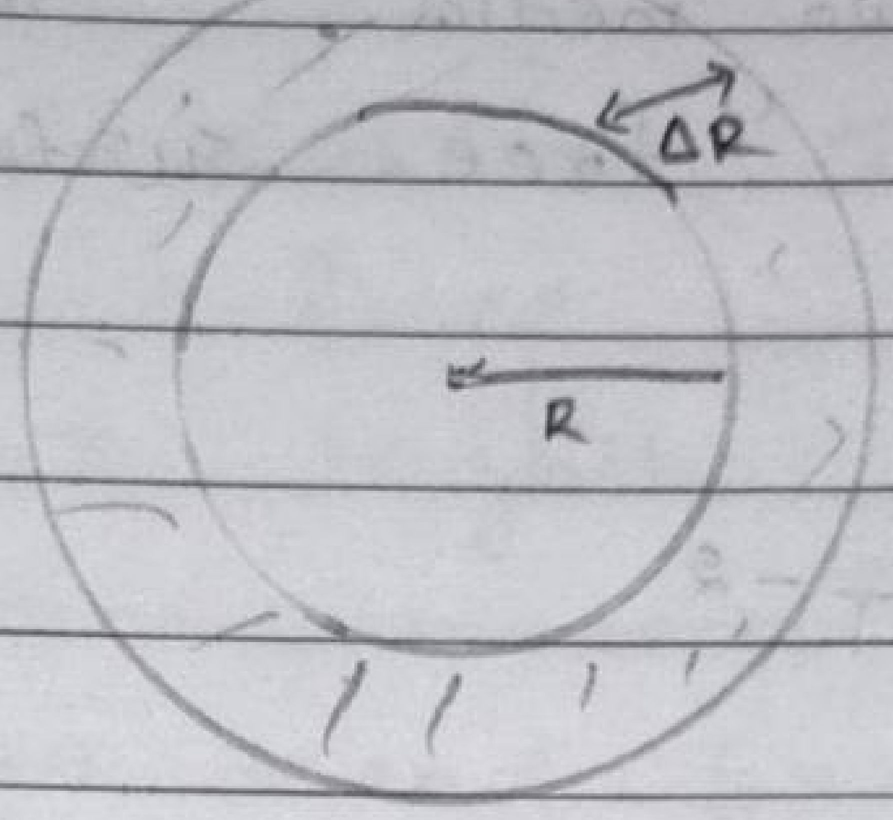
$= \dfrac{\text{Newton}}{m}$

$= \dfrac{\text{Force}}{\text{lenghth}}$

$\Rightarrow$ $\boxed{\text{surface Energy} = \text{surface Tension}}$

* $\boxed{\sigma = \dfrac{W}{A}}$

Excess pressure in the drop :- sphere



$\Rightarrow \quad W = F \cdot \Delta R$

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

$F = PA$

$\Rightarrow \quad W = PA \cdot \Delta R$

$\Rightarrow \quad W = P\, 4\pi R^2 \cdot \Delta R \longrightarrow (1)$

Change in Area,

$\Rightarrow \quad \Delta A = 4\pi (R + \Delta R)^2 - \{4\pi R^2\}$

$\Rightarrow \quad \Delta A = 4\pi \left[R^2 + \Delta R^2 + 2R\Delta R - R^2\right]$

$\Rightarrow \quad \Delta A = 4\pi \Delta R^2 + 8\pi R \cdot \Delta R$

{$\because$ ignoring $4\pi\Delta R^2$ because value of ΔR is very small}

$\Rightarrow \quad \Delta A = 8\pi R \cdot \Delta R$

$\because \quad T = \frac{W}{A}$

$W = TA.$

$\Rightarrow W = T \cdot 8\pi R \cdot \Delta R \longrightarrow (2)$

from (1) & (2)

$\Rightarrow T 8\pi R \cdot \Delta R = 4P\pi R^2 \cdot \Delta R$

$\Rightarrow 2T = PR$

$\Rightarrow \boxed{P = \frac{2T}{R}}$ where, $P \rightarrow$ Excess pressure, $T \rightarrow$ Surface Tension, $R \rightarrow$ Radius

Excess pressure in a bubble :-

bubble has 2 surface.

$\therefore \Delta A = 2 [8\pi R \cdot \Delta R]$ [$\because 8\pi R \cdot \Delta R$ is Area derived in previous derivation.]

$\Delta A = 16 \pi R^2 \Delta R \longrightarrow (1)$

$\Rightarrow W = TA$

$W = T \, 4\pi R^2 \Delta R \longrightarrow (2)$

Eqⁿ (1) & (2),

$\Rightarrow \cancel{16}^{4} \pi \cancel{R^2} \cancel{\Delta R} = \cancel{4} T \cancel{\pi} \cancel{R} \cancel{\Delta R}$

$\Rightarrow 4 = T$

$\Rightarrow W = F \cdot \Delta R$

$\Rightarrow W = PA \cdot \Delta R$

$\Rightarrow W = P \, 4\pi R^2 \cdot \Delta R \longrightarrow (1)$

change in Area,

$\Delta A = 2 [8\pi R \cdot \Delta R]$

$\Delta A = 16 \pi R \Delta R \longrightarrow (2)$

$\because \quad W = TA$

$W = T \cdot 16\pi R \Delta R \quad \longrightarrow (2)$

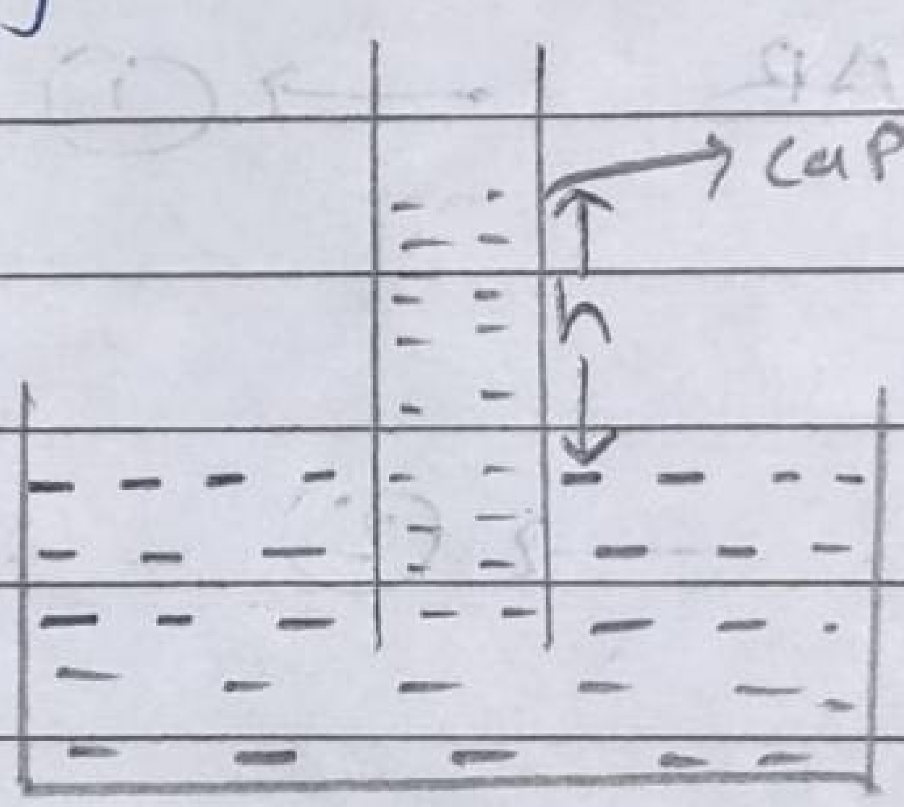
Eqⁿ (1) & (2),

$\Rightarrow \cancel{16}^{4} T \cancel{\pi} \cancel{R} \Delta \cancel{R} = \cancel{4} P \cancel{\pi} R^{\cancel{2}} \Delta \cancel{R}$

$\Rightarrow \quad 4T = PR$

$\Rightarrow \quad \boxed{P = \dfrac{4T}{R}}$

Capillarity:- The raise of liquid or fall of liquid in capilary tube is known as capillarity.

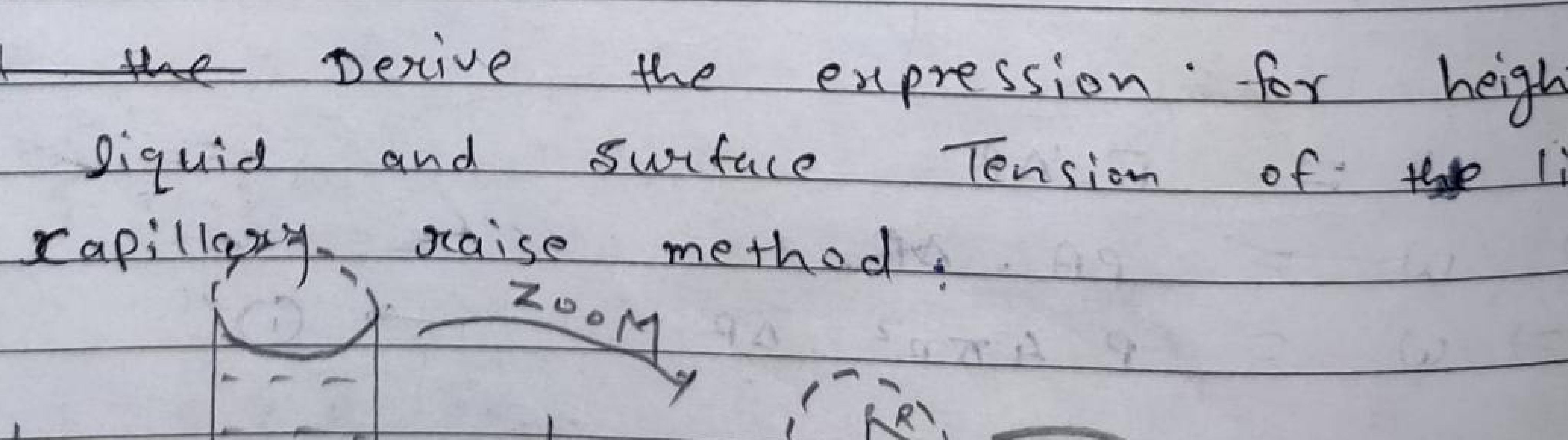


Q: What is capilarity tube?

Ans a Tube of small internal diameter holds liquid by capillary action.

Q. ~~find the~~ Derive the expression for height of the liquid and surface Tension of the liquid by capillary raise method.

Ans.



where, $r \rightarrow$ Radius of tube

$R \rightarrow$ — " — of circle

Taking, Trigonometric relation,

$\Rightarrow \cos\theta = \dfrac{r}{R}$

$\Rightarrow R = \dfrac{r}{\cos\theta}$

$\because P = \dfrac{2T}{R}$

$\Rightarrow P = \dfrac{2T}{\frac{r}{\cos\theta}}$

$\Rightarrow P = \dfrac{2T\cos\theta}{r} \longrightarrow (1)$

$\Rightarrow \because P = \rho g h \longrightarrow (2)$

$\Rightarrow \rho g h = \dfrac{2T\cos\theta}{r}$ [from eq^n (1) & (2)]

$\Rightarrow h = \dfrac{2T\cos\theta}{r g \rho}$ [where, $\rho \rightarrow$ rho $\rightarrow$ density]

$\Rightarrow T = \dfrac{h r g \rho}{2\cos\theta}$

for clean glass and pure water, $\boxed{\theta = 0^\circ}$

Q. 10.5

Sol. $m = 50$ kg

$d = 1$ cm

$r = \frac{1}{2}$ cm , in meter $r = 0.005$ m

=> Area of the heel $= \pi r^2$

$= \pi (0.005)^2$

$= 3.14 \times 0.000025$

$= 0.0000785$

$= 7.85 \times 10^{-5}$ m^2

force $= mg = 50 \times 9.8$

$= 490$ N

$P = \frac{Force}{Area} = \frac{490}{7.85 \times 10^{-5}}$

$= 6.24 \times 10^{6}$ N/m^2 Ans.

Q. 10.6.

Sol. Density of mercury, $\rho_1 = 13.6 \times 10^3$ kg/m^3

, $h_1 = 0.76$ m.

Density of french wine, $\rho_2 = 984$ kg/m^3

height $= h_2$

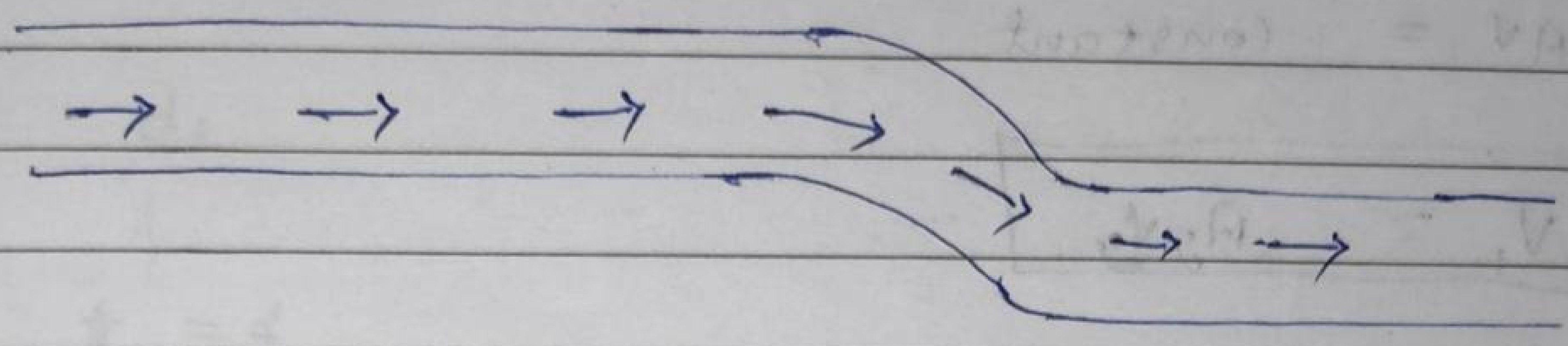
=> pressure in mercury = pressure in french wine.

=> $\rho_1 h_1 g = \rho_2 h_2 g$

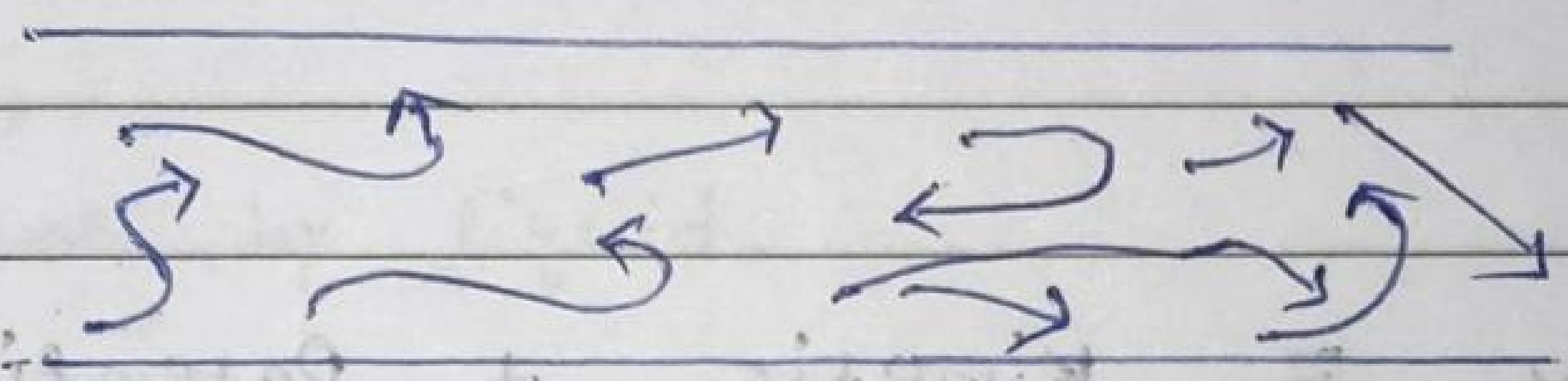
=> $h_2 = \frac{\rho_1 h_1}{\rho_2} = \frac{13.6 \times 10^3 \times 0.76}{984} = 10.5$ m

Ans

Q. What do you mean by streamline or steady flow?
such a flow in which all the Molecules follow the same Path is known as streomline or steady flow.



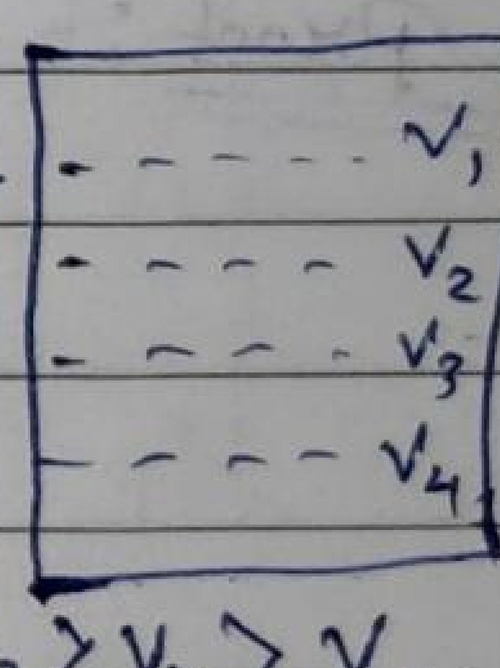
Q. what do you mean by turbulant flow.
such a flow in which random Path is followed by the molecules of liquid is known as turbulant flow.



Viscosity ( ) - Viscocity is the measure of the resistance of the fluid to flow.

1^{st} layer → → → → v_1 , Denoted by μ( ) -
2^{nd} layer → → → → v_2

$\boxed{V_1 > V_2}$



$V_4 > V_3 > V_2 > V_1$

So, there's a friction b/w them, This phenomena is known as viscosity.

Eg. - Honey dropping on floor (high vis cosity).

ideal fluid :- The fluid which is incompressive and non- viscous is known as ideal fluid. Non-viscous means $V_1 = V_2 = V_3 = V_4$

Q. What do you mean by Principle of contiuity ?

Ans. Product of area of crosss section and velocity of fluid will be constant.

$$AV = \text{constant}$$

$$\Rightarrow \boxed{A_1 V_1 = A_2 V_2}$$

IMP.

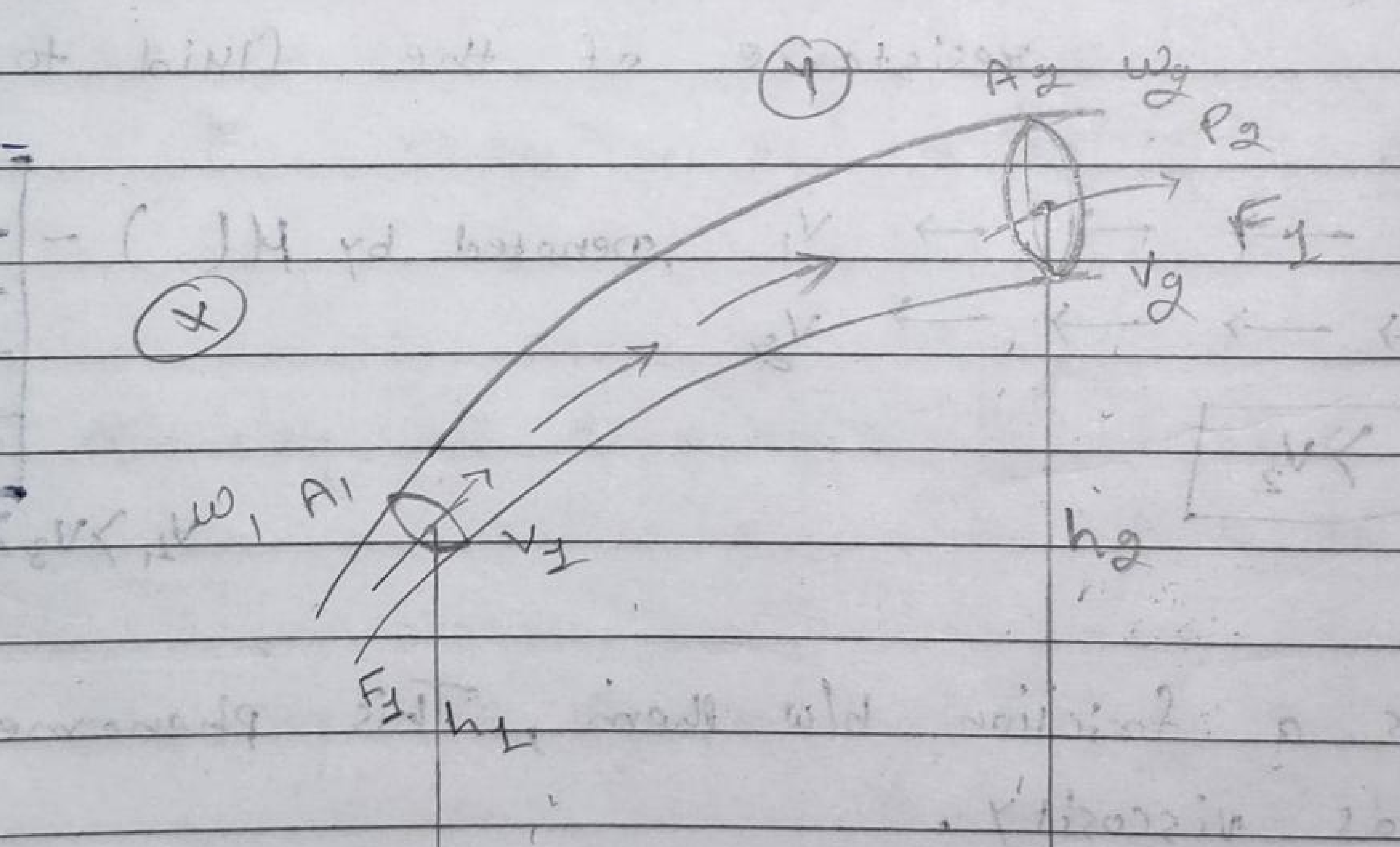
Q. Write the Bernoulli theorem and Prove it?

Ans. → when an ideal fluid flows in a streamlined condition through a tube then the energy of its unit mass or unit volume remains constant, this is bernoullis theorem.

[Total Energy = Kinetic + Potential + pressure energy]

$$\boxed{\text{Total Energy} = \text{Constant}}$$

Proof :-



At X end

Work done on the liquid,

$$W_1 = F_1 \cdot d_1$$

$\because \quad P_1 = \frac{F_1}{A_1}$

$\Rightarrow F_1 = P_1 A_1$

$\Rightarrow W_1 = A_1 d_1 \cancel{P}_1$

$\Rightarrow v_1 = \frac{d_1}{t}$

$\Rightarrow$ if $t = 1$

$v_1 = d_1$

$\Rightarrow W_1 = P_1 A_1 V_1$

Similarly,
work done by liquid,

$\Rightarrow W_2 = P_2 A_2 V_2$.

$\Rightarrow$ Total work done by liquid,

$\Rightarrow W = W_1 - W_2$

$\Rightarrow W = (P_1 A_1 V_1) - (P_2 A_2 V_2) \longrightarrow (1)$

by principle of continuity,

$\because A_1 V_1 = A_2 V_2 =$ volume $\rightarrow$ constant.

$\because \rho = \frac{\text{mass}}{\text{volume}}$.

$\Rightarrow \rho = \frac{m}{\text{volume}}$

$\Rightarrow \text{volume} = \frac{m}{\rho}$

$$A_1 v_1 = A_2 v_2 = \frac{m}{\rho}$$

from (1)

$$\omega = P_1 \frac{m}{\rho} - P_2 \frac{m}{\rho}$$

$$\Rightarrow \omega = (P_1 - P_2)\frac{m}{\rho} \longrightarrow (2)$$

$\Rightarrow$ Increase in P.E $= mgh_2 - mgh_1$

$\Rightarrow$ Increase in P.E $= mg(h_2 - h_1) \longrightarrow (3)$

$\Rightarrow$ Increase in K.E $= \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$

$\Rightarrow$ Increase in K.E $= \frac{1}{2} m (v_2^2 - v_1^2) \longrightarrow (4)$

According to the law of conservation of Energy :-

$\Rightarrow$ Work done on liquid = Increase in P.E + Increase in K.E

$$\Rightarrow (P_1 - P_2)\frac{m}{\rho} = mg(h_2 - h_1) + \frac{1}{2} m (v_2^2 - v_1^2)$$

$$\Rightarrow \frac{P_1 - P_2}{\rho} = gh_2 - gh_1 + \frac{1}{2} v_2^2 - \frac{1}{2} v_1^2$$

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

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

$$\Rightarrow \underset{\text{Pressure Energy}}{P} + \underset{\text{P.E}}{\rho g h} + \underset{\text{K.E}}{\frac{1}{2}\rho v^2} = \text{Constant.}$$