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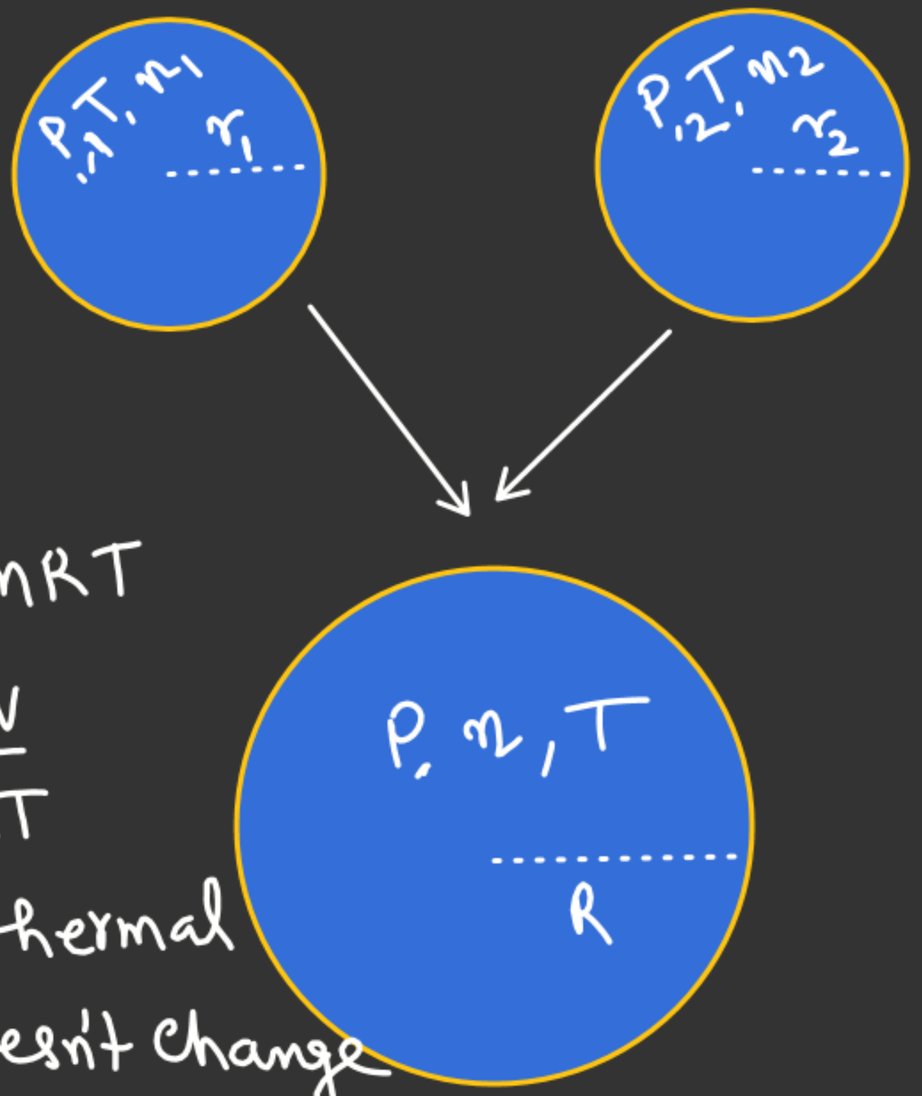

Soap bubble coalsec isothermally.
Isothermally → Temp. constant.
Initially both the bubble have same temp. Find expression for Surface tension 'S' = ??

$PV = nRT$

$n = \frac{PV}{RT}$

For isothermal
Temp doesn't change

No of moles conserved.

$n_1 + n_2 = n$

$\Downarrow$

$P_1 \frac{4}{3}\pi r_1^3 + P_2 \frac{4}{3}\pi r_2^3 = P \frac{4}{3}\pi R^3$

$P_1 - P_{atm} = \frac{4S}{r_1}$

$P_2 - P_{atm} = \frac{4S}{r_2}$

$P - P_{atm} = \frac{4S}{R}$

$\frac{4}{3}\pi(r_1^3 + r_2^3) = \frac{4}{3}\pi R^3$

$R^3 = r_1^3 + r_2^3$

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$$P_1 - P_{atm} = \frac{4S}{r_1}$$

$$P_2 - P_{atm} = \frac{4S}{r_2}$$

$$P - P_{atm} = \frac{4S}{R}$$

$$P_1 \frac{4}{3}\pi r_1^3 + P_2 \frac{4}{3}\pi r_2^3 = \underline{P \frac{4}{3}\pi R^3}$$

$$\left(P_{atm} + \frac{4S}{r_1}\right) r_1^3 + \left(\frac{4S}{r_2} + P_{atm}\right) r_2^3 = \left(P_{atm} + \frac{4S}{R}\right) R^3$$

$$P_{atm}\left(r_1^3 + r_2^3 - R^3\right) = 4S\left(R^2 - \left(r_1^2 + r_2^2\right)\right)$$

$$S = \frac{P_{atm}}{4}\left[\frac{\left(r_1^3 + r_2^3\right) - R^3}{R^2 - \left(r_1^2 + r_2^2\right)}\right]$$

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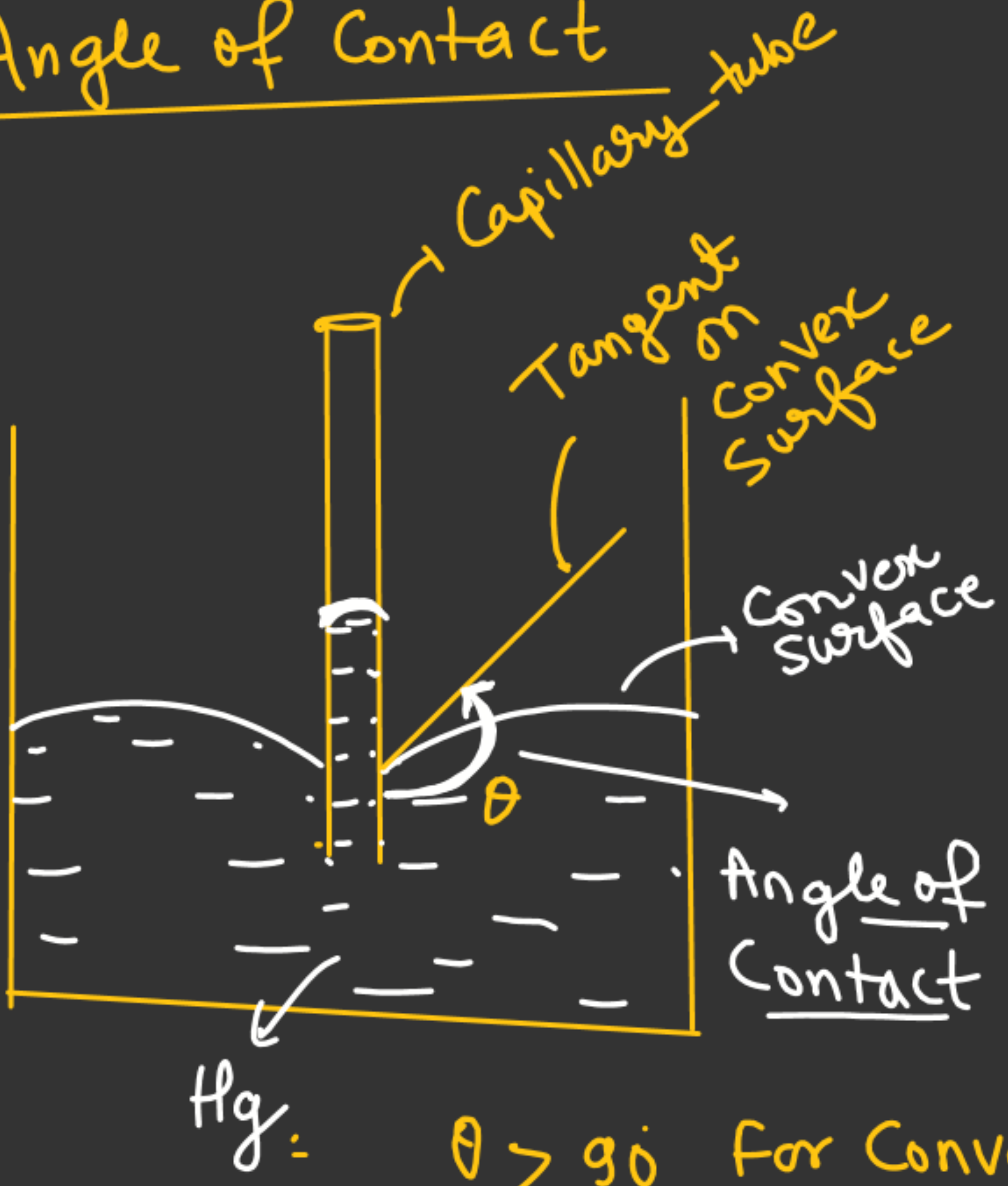
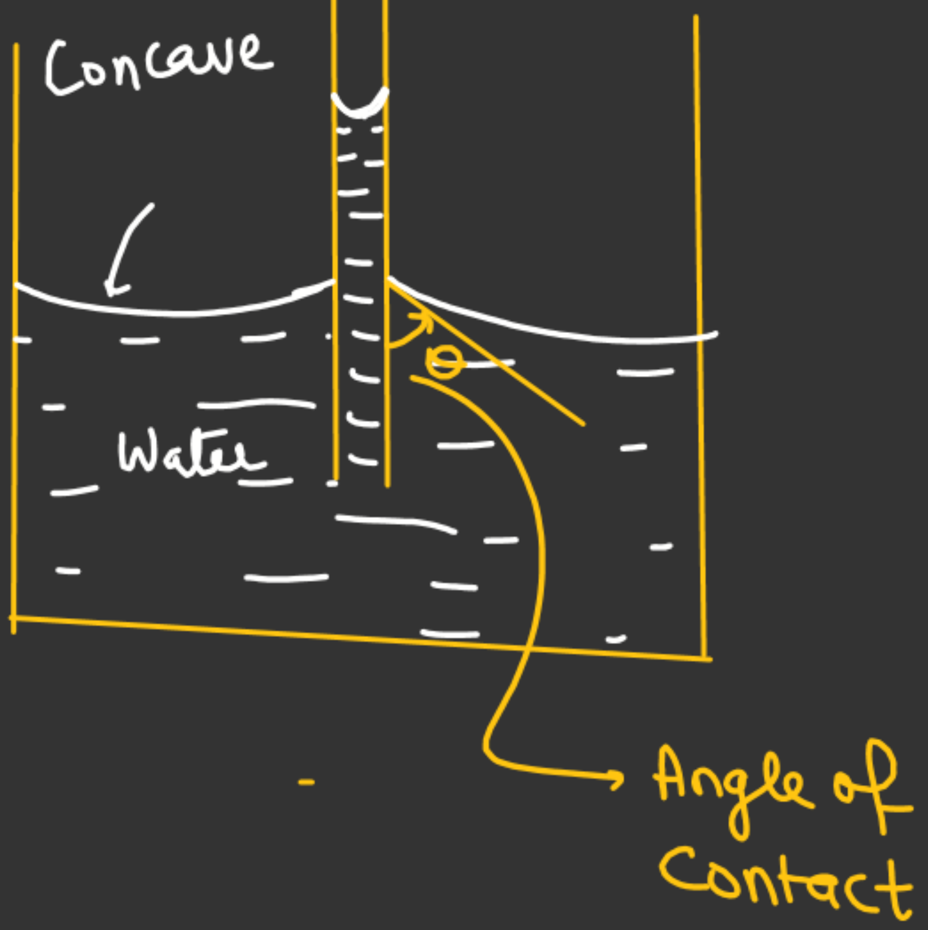
Angle of Contact



$\theta > 90^\circ$ For Convex Meniscus



$\theta < 90^\circ$ For Concave Meniscus.

(*) For pure water and clean glass angle of contact is zero.

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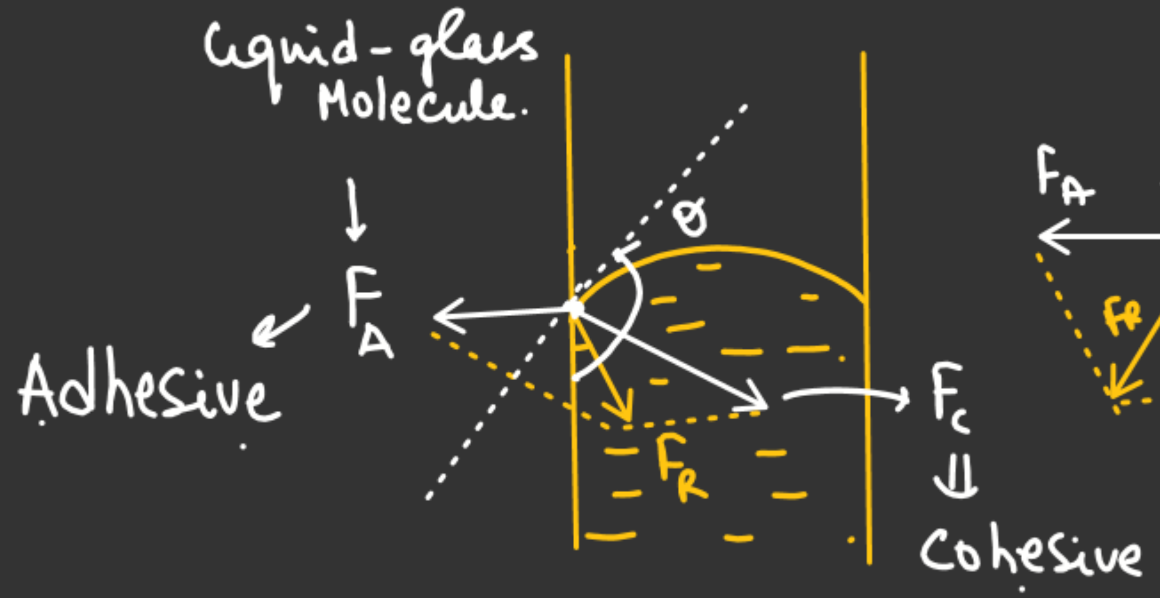
Shape of liquid Meniscus → (Shape of liquid Surface)

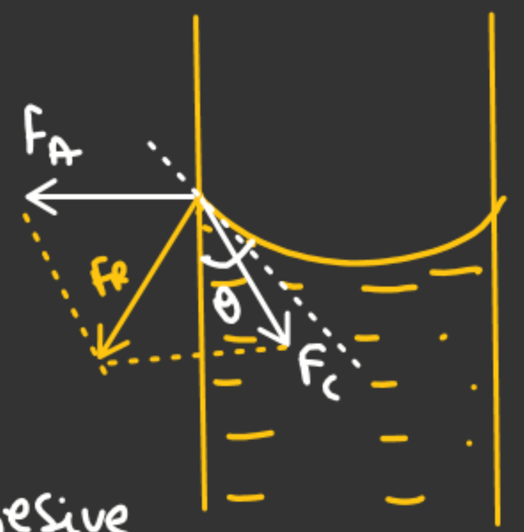


$F_c > F_A \Rightarrow$ Convex Meniscus

⇓

Such liquid is called (Non-Wetting)

Ex:- Hg

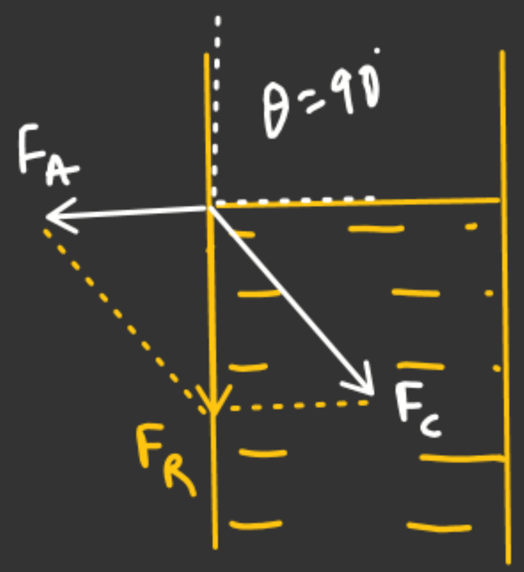


$F_A > F_c$

Concave Meniscus

↳ Wetting liquid

↳ Ex:- Water



$(F_A = F_c)$

$\theta = 0°$

Ex:- Pure water & clean glass

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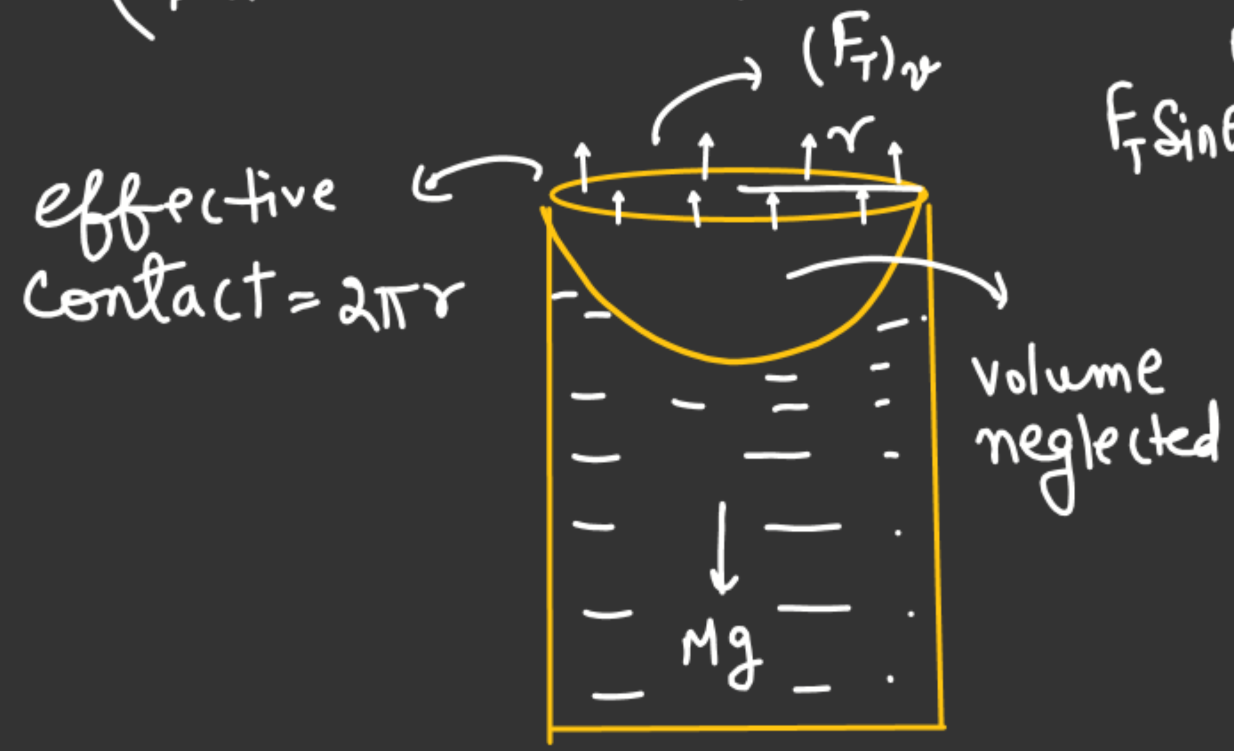
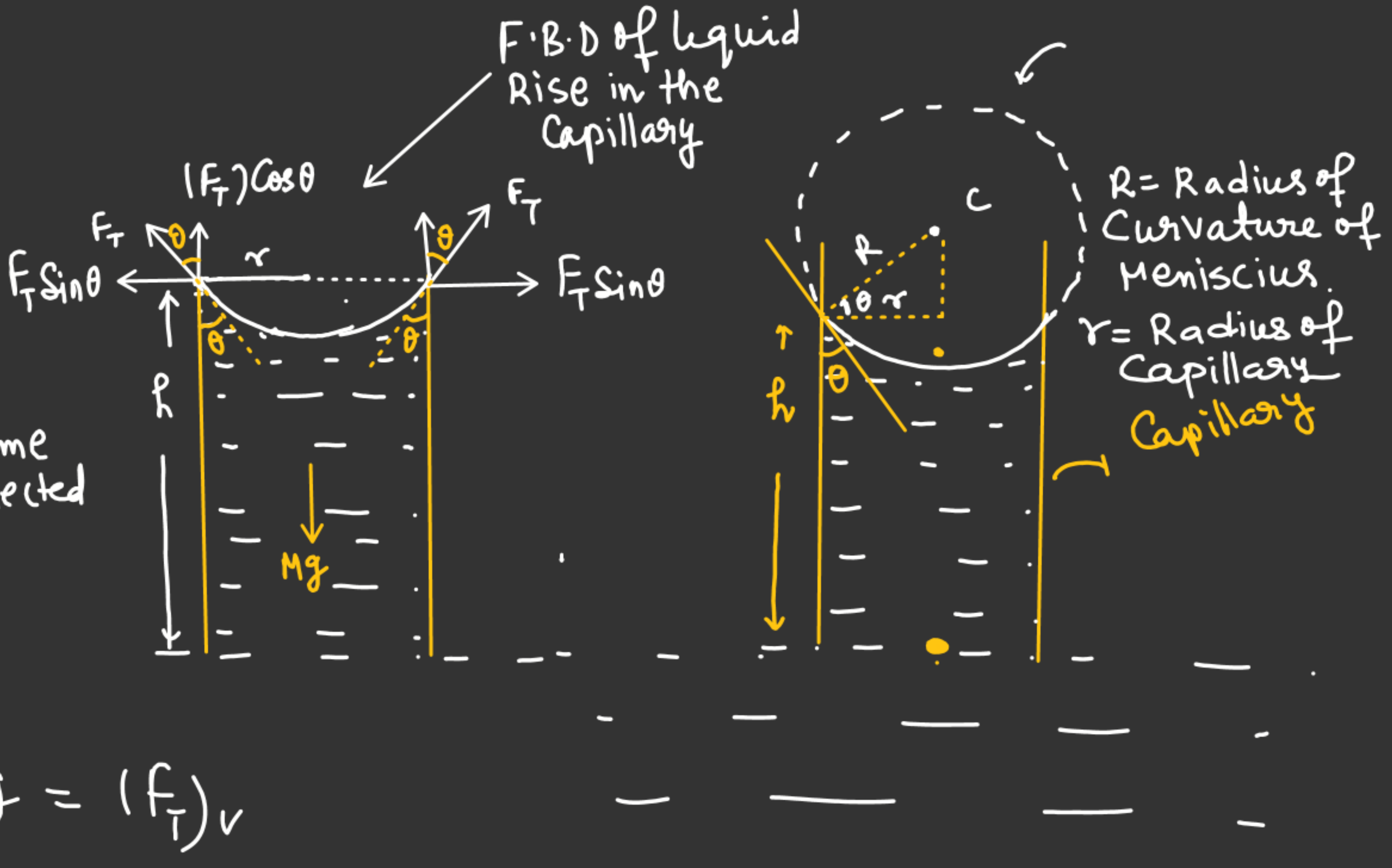
Capillary Rise.

(Due to excess pressure)





$$\underbrace{\rho(\pi r^2 h)g}_{M} = (F_T)_v$$

$$= F_T\cos\theta$$

$$\rho\cancel{\pi}\cancel{r}^{2} h g = T\cdot 2\cancel{\pi}\cancel{r}\cdot\cos\theta \Rightarrow \boxed{h = \frac{2T\cos\theta}{\rho g r}}$$

θ = Angle of Contact
r = Radius of capillary.
T = Surface tension

If height of Capillary is insufficient

$$\cos\theta = \frac{r}{R} \Rightarrow \frac{r}{\cos\theta} = R.$$

$$h = \frac{2T\cos\theta}{\rho g\, r}, \quad \frac{\cos\theta}{r} \Rightarrow \frac{1}{R}$$

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

$$hR = \left(\frac{2T}{\rho g}\right)$$

$$\Downarrow$$

(Constant)

R = Radius of Curvature of liquid meniscus

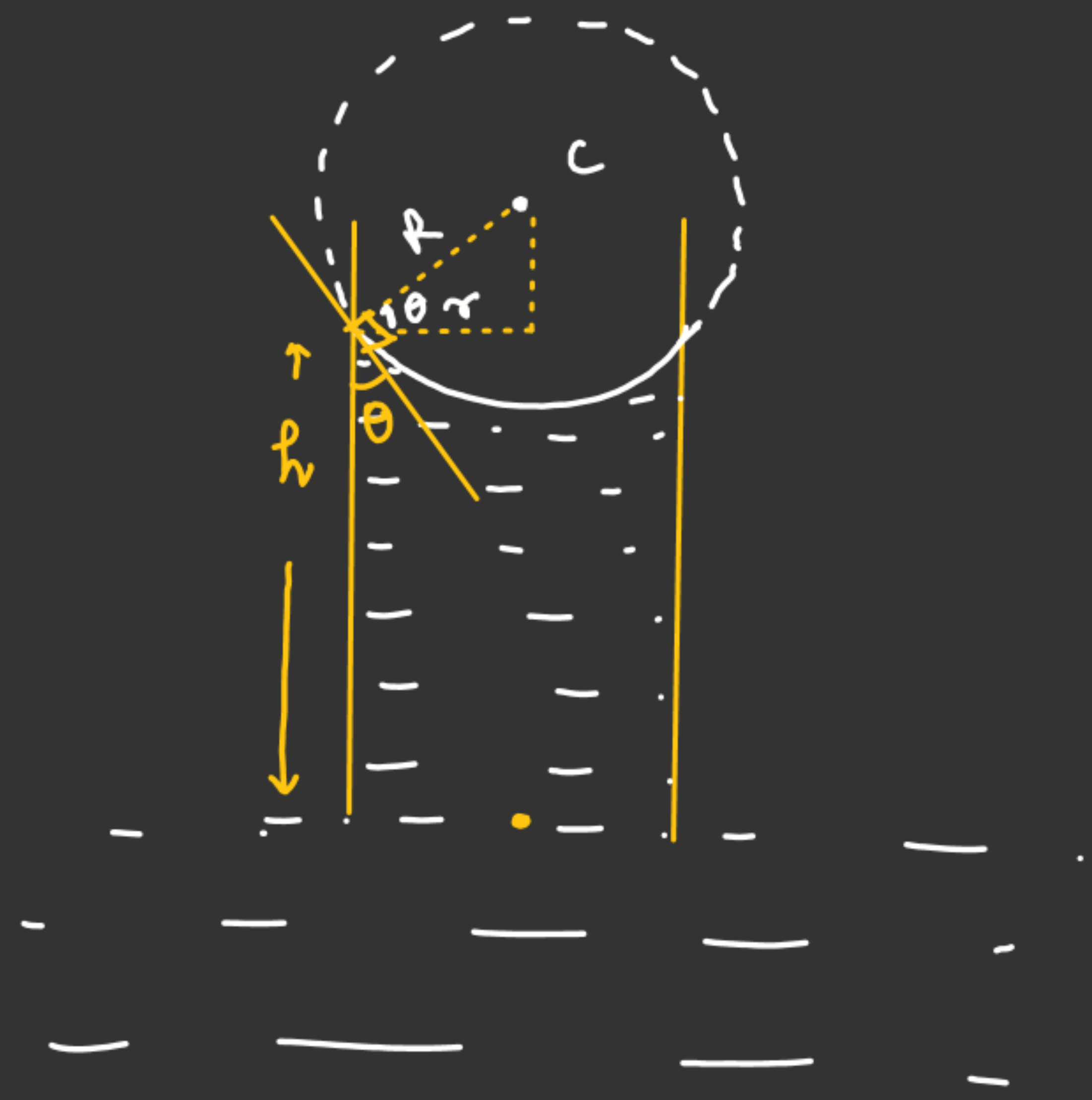
$$h_1 R_1 = h_2 R_2$$

$$R_2 = \left(\frac{h_1 R_1}{h_2}\right)$$

if $h_1 > h_2$

$\Rightarrow R_2 > R_1$

$$\frac{R_2}{R_1} = \frac{h_1}{h_2} \Rightarrow$$



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Another Method !

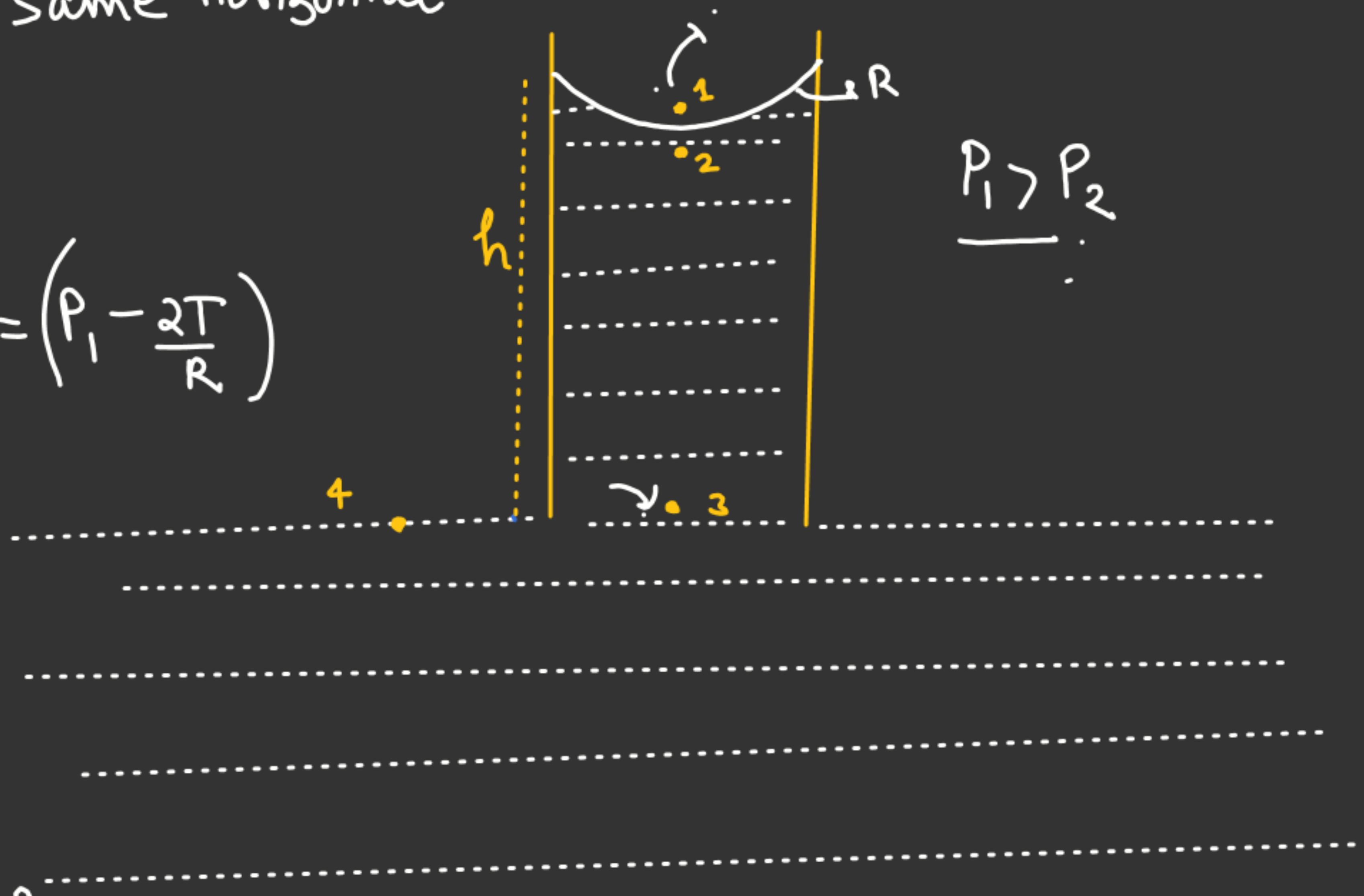
Capillary Rise

$P_1 = P_4 = P_{atm}$ (open to atmosphere)

$P_4 = P_3$ (Points on the same horizontal leve)

$P_4 = P_3 = P_{atm}$

$P_1 > P_2$



$$P_1 - P_2 = \frac{2T}{R} \Rightarrow P_2 = \left(P_1 - \frac{2T}{R}\right)$$

$$P_3 = \underline{\underline{P_2}} + \rho g h$$

$$P_3 = \left(P_1 - \frac{2T}{R}\right) + \rho g h$$

$P_1 = P_3$

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

$$h = \left(\frac{2T}{\rho g R}\right) \Rightarrow \left(h = \frac{2T\cos\theta}{\rho g r}\right)$$