Fluid Mechanics

1) **Surface Tension** - defined as the tensile force acting on the surface of a liquid in contact with air such that the surface behaves like a membrane. The property of liquid surface film to exert a tension is called surface tension. (Explain) ③

Fig- ① Unit - N/m or kgf/cm or kgf/(m) ①

Viscosity - property of a fluid by virtue of which it offers resistance to movement of one layer of fluid over adjacent layer. (Explain) - ② ⑤

Fig - ①

Equations - $\tau = \frac{F}{A} \cdot \mu \frac{dv}{dy}$ ②

μ = viscosity Ns/m^2 or $kg/m \cdot s$ or poise.

2) **Hydrostatic law** - rate of increase of pressure in a vertical direction is equal to weight density of fluid at that point. $p = \rho \cdot g \cdot z$ ③ ⑩

or $p = w \cdot z$

z = pressure head.

Derivation - ⑤

Fig - ②

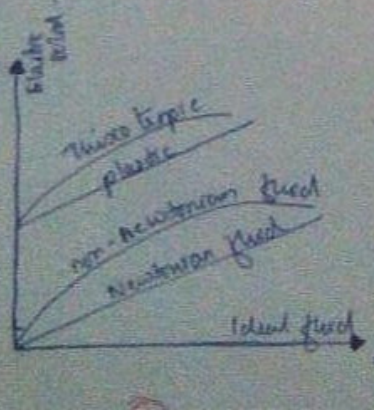
3) **Manometers** - To measure pressure at a point in a fluid by balancing the column of fluid by the same or another column of fluid. ⑩

(a) Simple manometer
- → Piezometer
- → U tube manometer
- → Single column manometer (with figure).

(b) Differential manometer
- → U tube diff manom.
- → Inverted u tube diff.

② marks each.

4) ⑩



$\sigma = 0.0075$ kgf/m.

$d = 4mm = 0.004m$

$P = \frac{\sigma}{r} = \frac{0.0075}{.002}$

$= 3.75$ kgf/m^2

$= 37.5$ Pascal ⑤

5) $d = 4mm = 0.004m$

$r = 0.002m$

$h = \frac{2\sigma\cos\theta}{s.w.r} = \frac{2\sigma\cos\theta}{w_{liq} \cdot r} = \frac{2\sigma\cos\theta}{\rho.g.r}$

(i) Capillary effect of water -

$\sigma = 0.51\ N/m$

$\theta = 0$

$\rho = 1000\ kg/m^3$.

$h = \frac{2\sigma\cos\theta}{\rho_{liq} \cdot g \cdot r}$

(5) $h = \left(\frac{2 \times 0.51 \times \cos 0}{1000 \times 9.81 \times 0.002}\right) = 0.05198\ m$

$= 5.19\ cm$

(ii) Mercury

$h = \frac{0.073575 \times 2 \times \cos 130^\circ)}{(1000 \times 13.6) \times 9.81 \times 0.002}$ (5)

$(\rho_{mercury} = Sp.\ gravity_{mercury} \times \rho_{water})$

$= -0.0003544\ m$

$= -3.544 \times 10^{-4}\ m$

$= -.3544\ mm$

6)

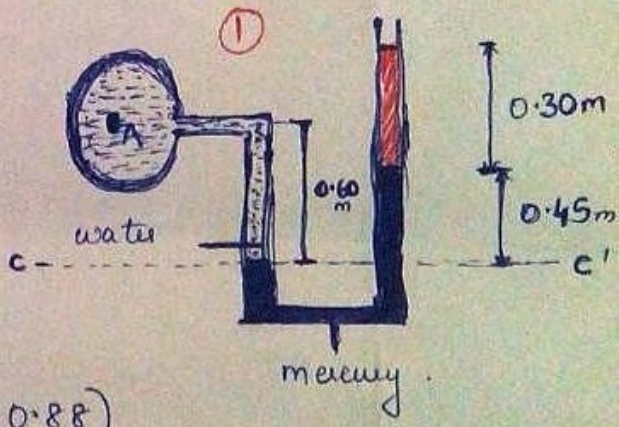
Pressure at c & c' are same (1)

P_c : $P_A + 0.6 w_{water}$ (1)

$P_{c'}$: $0.45 \times (w_{water} \times 13.6) + (1)$

$0.30 \times (w_{water} \times 0.88)$

(10)



(2) $\therefore \frac{P_A}{w} + 0.6 = \underset{6.12}{(0.45 \times 13.6)} + \underset{0.264}{(0.3 \times 0.88)}$

(2) $\frac{P_A}{w} = 5.784m$ of water

$\therefore P_A = 5.784 \times 1000$

$= 5.784 \times 10^3\ kgf/m^2$ (2)

$= 0.5784\ kgf/cm^2$

$P_A = 5.784 \times 9810$

$= 5.674 \times 10^4\ N/m^2$