Fm(202) CE202

① निम्न को UNIT सहित परिभाषित करें।
(a) Density (b) specific gravity (c) viscosity

Ans.

(a) Density:-

Density or mass density of a fluid is defined as the ratio of the mass of a fluid to its volume. The unit of mass density in SI unit is kg per cubic metre, i.e., kg/m^3.

$$\rho = \frac{\text{mass of fluid}}{\text{volume of fluid}}$$

(b) Specific gravity:- Specific gravity is defined as the ratio of the weight density of a fluid to the weight density of a standard fluid.

$$S = \frac{\text{weight density of liquid}}{\text{weight density of water}}$$

(c) Viscosity:- Viscosity is defined as the property of a fluid which offer resistance to the movement of one layer of fluid over another adjacent layer of the fluid. Unit of viscosity is ~~meter Square/Second~~ $\frac{N\text{-}s}{m^2}$ in MKS.

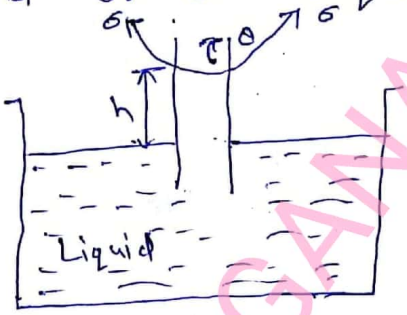
② What is Capalarity find the expretion for Capalary rise?

Ans. Capillarity:- Capillarity is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known a Capillary rise while the fall of the liquid surface is known as Capillary depression.

Expression for Capillary Rise:-

Consider a glass tube of small diameter 'd' opened a both ends and is inserted in a liquid.

Let h = height of the liquid in the tube



Let σ = Surface tension of liquid

θ = Angle of Contact between liquid and glass tube.

weight of liquid height h in tube = Volume × ρ × g

$$= \frac{\pi}{4} d^2 \times h \times \rho \times g \quad - (1)$$

Vertical Component tensile force

$$= (\sigma \times \text{Circumference}) \times \cos\theta$$

$$= \sigma \times \pi d \times \cos\theta \quad - (2)$$

From (1) & (2)

$$\frac{\pi}{4} d^2 \times h \times \rho \times g = \sigma \times \pi d \times \cos\theta$$

$$h = \frac{\sigma \times \pi d \times \cos\theta}{\frac{\pi}{4} d^2 \times \rho \times g} = \frac{4\sigma\cos\theta}{\rho \times g \times d}$$

(3) find the kinematic viscosity of an oil having density 981 kg/m³ the shear stress at a point in oil is .1256 N/m² and velocity gradiant .1 per second.?

Soln Given data

$$\rho = 981 \text{ kg/m}^3$$

$$\tau = .1256 \text{ N/m}^2$$

$$\frac{du}{dy} = .1 \text{ /sec}$$

we know

$$\tau = \mu \frac{du}{dy}$$

$$\frac{\partial P}{\partial z}\Delta z \Delta A = \rho \times g \times \Delta A \Delta z \quad \text{or} \quad \frac{\partial P}{\partial z} = \rho \times g$$ [Cancelling $\Delta A \Delta z$ on both sides]

$$\frac{\partial P}{\partial z} = \rho \times g = \omega$$

(5) What is absolute pressure, gauge pressure, vacuume pressure?

Ans. Absolute pressure:- Absolute Pressure is defined as the pressure which is measured with reference to absolute vaccume pressure.

$$P_{ab} = P_{atm} + P_{gauge}$$

Gauge pressure:- Gauge pressure is defined as the pressure which is measured with the help of a pressure measuring instrument, in which the atmospheric pressure in taken as datum.

Vacuume pressure:- vacuume pressure is defined as the pressure below the atmospheric pressure.

Vacuume pressure = Atmospheric pressure - absolute pressure.

$$.1256 = \mu \times .1$$

$$\mu = 1.256 \ \frac{N-s}{m^2}$$

Kinematic Viscosity

$$\nu = \frac{\mu}{\rho} = \frac{1.256}{981} = .00128 \ m^2/sec \quad \text{Ans.}$$

(4) What is hydrostatic law prove it?

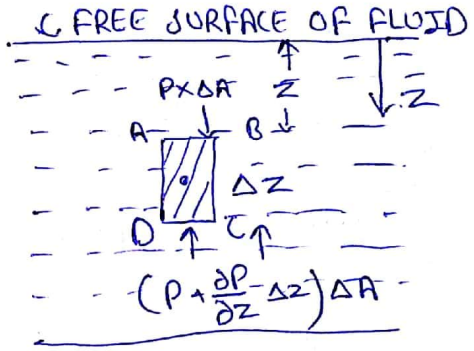
Ans. The pressure at any point in a fluid at rest is obtained by the Hydrostatic Law which states that the rate of increase of pressure in a vertically downward direction must be equal to the specific weight of the fluid at that point.

Let ΔA = Cross-sectional area of element

Δz = Height of fluid element

P = Pressure on face AB

z = Distance of fluid element from free surface.



The forces acting on the fluid element are:

1. Pressure force on AB = $P \times \Delta A$ in the downward direction.
2. Pressure force on CD = $\left(P + \frac{\partial P}{\partial z}\Delta z\right) \times \Delta A$, vertically upward direction
3. weight of fluid element = Density $\times g \times$ Volume = $\rho \times g \times (\Delta A \times \Delta z)$
4. Pressure force on surface BC and AD are equal and opposite. for equilibrium of fluid element, we have

$$P\Delta A - \left(P + \frac{\partial P}{\partial z}\Delta z\right)\Delta A + \rho \times g \times (\Delta A \times \Delta z) = 0$$

$$P\Delta A - P\Delta A - \frac{\partial P}{\partial z}\Delta z \Delta A + \rho \times g \times \Delta A \times z = 0$$

$$-\frac{\partial P}{\partial z}\Delta z \Delta A + \rho \times g \times \Delta A \Delta z = 0$$