Subject :-

Fluid Mechanics I

Submitted :-
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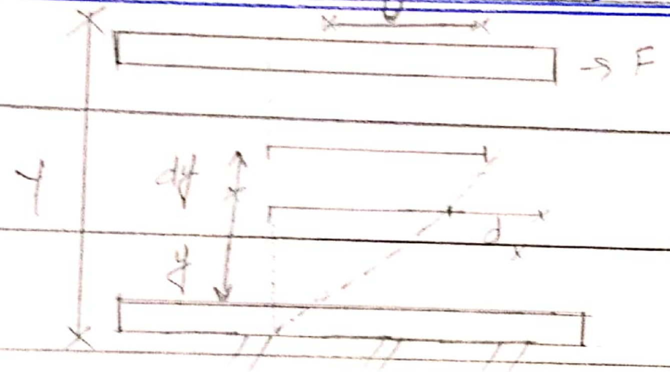
Q No => (1)

Part => (a) Define Viscosity? Derive Newton equation of Viscosity.

Ans:- **VISCOSITY :-** Resistance of a fluid (liquid or gas) to a change in shape, or movement of neighbouring portions relative to one another. Viscosity denotes opposition to flow. The reciprocal of the viscosity is called the fluidity, a measure of the ease of flow. Molasses, for example, has a greater viscosity than water. Because part of a fluid that is forced to moved carries along to some extent adjacent parts, viscosity may be thought of as internal friction between the molecules; such friction opposes the development of velocity difference within a fluid. Viscosity is a major factor in determining the force that must be overcome when fluids are used in lubrication & transported in pipe lines. It controls the liquid flow in such processes a spraying, injection molding, & surface coating.

⇒ NEWTON EQUATION OF VISCOSITY:-



Now consider two parallel plates placed ~~of~~ at distance Y & Y space in b/w is filled with fluid. lower surface is assumed to be stationary while upper moved with velocity "U".

Thus

$$F \propto \frac{AU}{Y} \quad \text{or} \quad F = \frac{\mu AU}{Y} \quad \text{or} \quad \frac{F}{A} = \frac{\mu U}{Y}$$

$$\tau = \frac{\mu u}{y}$$

For dy, the velocity will be du

Thus :- $\tau = \mu \frac{du}{dy}$ → This is called newton equation of vescosity.

Thus $\mu = \tau / du/dy$ → This is called dynamic coefficient of velocity or absolute velocity.

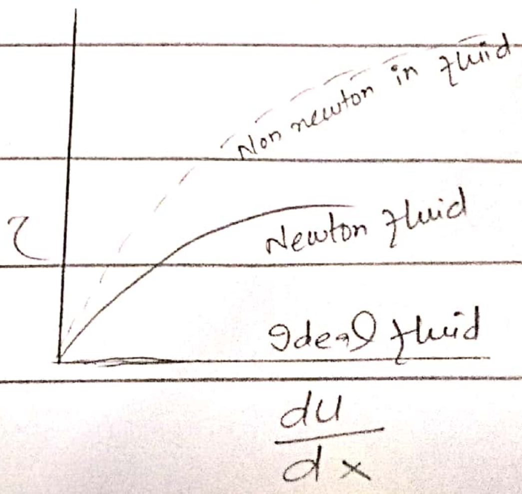
shear stress

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

→ The fluid for which constant of propotionality does not change with rate of deformation is said to be newton fluid.

Ideal fluid with no viscosity is represented by horizontal axis.

Unit of absolute vescosity is $\frac{N.S}{m_2}$



Part ⇒ (b) Define density, Specific weight & Specific volume. Show relation b/w Density & specific weight?

Ans ⇒ **DENSITY :-**

→ Property of fluid.

"Density can be define as "mass per unit Volume of a fluid".

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\rho = \frac{m}{V} = Kg/m^3$$

→ **Specific Weight :-**

"Specific weight is the weight possessed by unit volume of a fluid".

Denoted by "w"

$$w = \frac{\text{Weight}}{\text{Volume}} = N/m^3$$

→ **Relation b/w Density & Specific Weight :-**

as $w = \frac{W}{V}$

we know that $W = mg$

Pg # (5)

$$W = \frac{mg}{V}$$

$$\boxed{W = \rho g} \qquad \because \rho = \frac{m}{V}$$

$\rho \rightarrow$ density.

→ **Part (c)** ⇒ If Specific Volume of gas is $0.72 m^3/kg$. What is Specific weight in N/m^3?

Ans:-

SOLUTION:

Given data,

Specific volume, $V = 0.72 \ m^3/kg$.

We know that or we have to find.

Specific weight, $\gamma_s = ?$

As

$$V = \frac{1}{\rho}$$

$$\rho = \frac{1}{V}$$

$$\rho = \frac{1}{0.72} \rightarrow \rho = 1.38 \ kg/m^3$$

As

$$\gamma = \rho g$$

$$\gamma = 1.38 \times 9.81$$

$$\gamma = 13.54 \ N/m^3.$$

QNO :(2)

(A) Define Pressure ? What is an absolute & guage pressure ?

ANS :- **PRESSURE :-**

" The forced applied perpendicular to the Surface of an a object per unit area over which that force is distributed "

→ UNIT :-

→ The SI unit of Pressure is Pascal (Pa)

→ **GUAGE PRESSURE :-**

→ Def :- Guage pressure is the pressure relative to atmospheric pressure. Guage pressure is positive for pressures above atmospheric pressure & negative for pressures below it.

Mathematically :-

→ Total pressure or absolute pressure is thus the sum of guage pressure & atmospheric pressure.

$$P_{abs} = P_g + P_{atm}.$$

Where,

P_{abs} = Absolute pressure.

P_g = Guage Pressure.

P_{atm} = Atmospheric pressure.

ABSOLUTE PRESSURE :-

Def :- It is the total pressure at a point in a fluid equalling the sum of guage pressure & the atmospheric pressure.

Mathematically :-

$$P_{abs} = P_g + P_{atm}$$

P_{abs} → absolute Pressure

P_g → Guage pressure

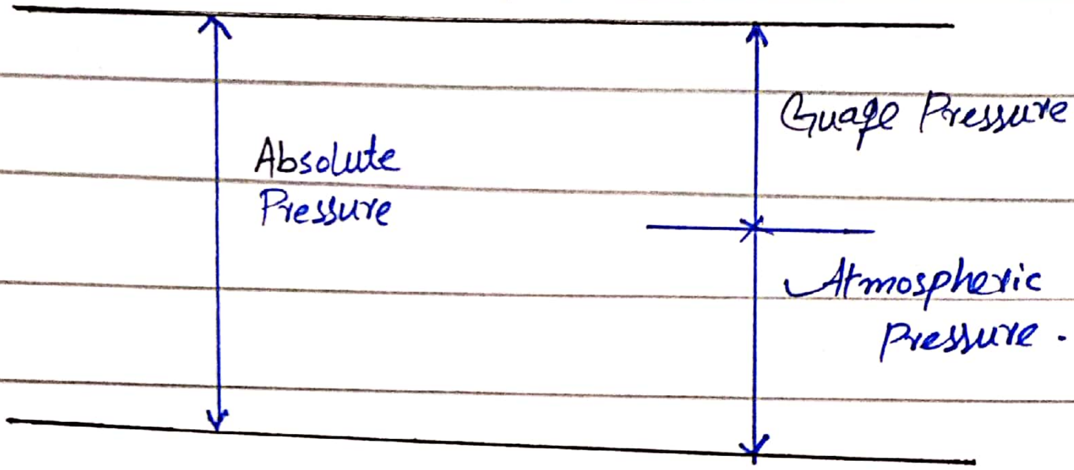
P_{atm} → atmospheric Pressure.

→ **EXAMPLE :-**

If your tire guage reads 39 psi (Pounds Per Square inch) then the absolute pressure is

39 psi plus 14.7 psi (Patm in psi) or 53.7 psi (equivalent to 337 Kpa)

⇒ DIAGRAM



(B) A water tank having dimesions of 1500 mm × 1500 mm. Depth of the water tank is equal to your student ID number in mm. What is the net pressure force on wall of water tank? Find the location of force application?

If the water level drops to the half of the depth, what will be the force & points of application of force?

ANS ⇒

-: SOLUTION :-

Given data :-

Length, l = 1500 mm = 1.5 m

Breadth, b = 1500 mm = 1.5 m

Depth h = 7919 = 7.919

Unit weight of water = 9.81 KN/m³

→ Required data

→ a = Net pressure, P = ?

→ b = location of force

→ c = if water level drops half of depth to find p & location of force.

Sol:- a. Net pressure ⇒ $P = \gamma h$

$P = 9.81 \times 7.919$

$P = 77.68539\ KN/m^2$

(b) Force application (centriod).

$\bar{y} = h/3$

$\bar{y} = \frac{7.918}{3}$

$\bar{y} = 2.639\,m.$

(c) Half depth:-

Pressure at half, $P' = \gamma\ h/2$

$$P' = 9.81 \times \frac{7.919}{2}$$

$$\boxed{P' = 38.84\ KN/m^2}$$

Centroid

$$\bar{y}' = \frac{h}{2} \times \frac{1}{3}$$

$$\bar{y}' = \frac{7.919}{2} \times \frac{1}{3}$$

$$\boxed{\bar{y}' = 1.319m.}$$