MID TERM EXAM

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SUBJECT : FLUID MECHANICS

SUBMITTED TO : SIR WAHEED

SECTION : "B"

SEMESTER : (4)

DEPARTMENT : BE (CIVIL)

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QUESTION :- 01

(A) Define viscosity and Newton equation of viscosity (Derive).

Answer :-

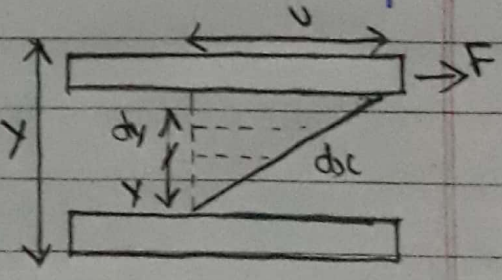
- **Viscosity :**

"Viscosity is the physical property that characterizes the flow of simple fluid."

→ Viscosity is property of fluid by virtue of its offers resistance to the movement of one layer fluid over an adjacent layer.

- **Newton Equation of Viscosity :**

Consider two parallel plates placed at a distance "Y" and Space b/w them is filled with fluid. The lower surface is assumed to be stationary while the upper move with velocity "v". Then,



$$F \propto \frac{AV}{Y}$$

$$F = \frac{\mu A v}{Y}$$

$$\frac{F}{A} = \frac{\mu A}{Y}$$

where $\frac{F}{A} = \tau$

So, $\tau = \frac{\mu A}{Y}$

For dy the velocity will be dv.

Then, $\mu \frac{dv}{dy}$ — ①

where μ is proportionality factor and called viscosity of fluid, and $\frac{dv}{dy}$ is known as velocity gradient.

The above equation -① is known as "Newton Equation of viscosity".

(PART B)

Define Density, Specific weight and Specific volume. Show relation b/w Density and Specific weight.

Answer :-

- **Density:**

"Density of fluid is its mass per unit volume of fluid".

Denoted By :- "ρ"

Formula : $\rho = \frac{m}{v}$

Unit : kg/m^3

- **Specific Weight:**

"It is the weight per unit volume of fluid".

Denoted By : "γ"

Formula : $\gamma = \frac{w}{v}$

Unit : N/m^3

- **Specific Volume :**

"It is the volume occupied by unit mass of the fluid."

Denoted By : "v"

Formula : $v = V/m$ or $v = \frac{1}{\rho}$

Unit : m^3/kg.

⇒ Relation between Density and Specific Weight :-

Specific Weight, $\gamma = \frac{w}{V}$

where $w = mg$

So, $\gamma = \frac{mg}{V}$

As $\frac{m}{V} = \rho$ put in above Equation

$\gamma = \rho g$

or

$\rho = \frac{\gamma}{g}$

⇒ **Specific weight ∝ Density.**

(PART C)

If Specific Volume of gas is $0.72\ m^3/kg$ what is its Specific weight.

- **Given Data:**

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

- **REQUIRED DATA:**

Specific weight, $\gamma = ?$

- **Solution:**

We know that

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

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

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

$$\boxed{\rho = 1.38\ kg/m^3}$$

Now,

$$\rho = \frac{r}{g}$$

$$r = \rho \times g$$

$$r = 1.38 \times 9.8$$

$$= 13.54 \text{ N/m}^2$$

$$\boxed{r = 13.54 \text{ N/m}^2}$$

QUESTION : 03/2

PART (A)

Define pressure what is absolute and gage pressure.

Answer :-

- **Pressure :**

"pressure of fluid is defined as normal force exerted by fluid on unit area".

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

or

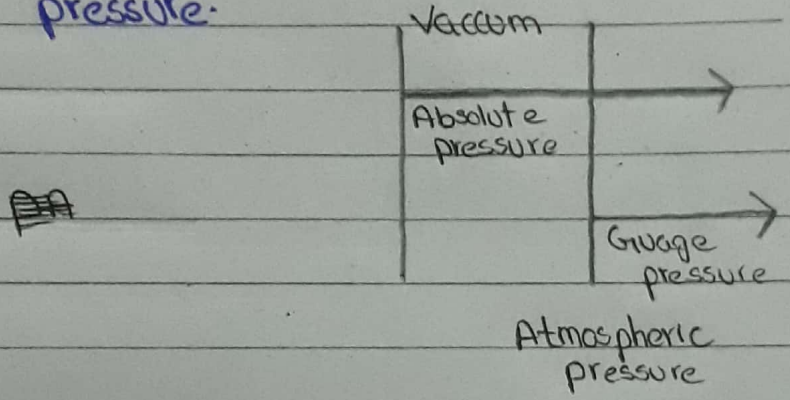
$$F = P \times A$$

- **Absolute pressure :**

"Absolute pressure is zero - refferenced against as perfect vacuum, so it is equal to guage pressure plus atmospheric pressure.

- **Guage pressure:**

" Guage pressure is zero referenced against ambient air pressure, so it is equal to Absolute pressure minus atmospheric pressure.



PART (B)

A water tank - - - - - - - - of force?

- **Given Data:**

Length, L = 1500 mm = 1.5 m
Breadth, b = 1500 mm = 1.5 m
Depth, h = 7965 mm = 7.965 m
Unit weight of water = 9.81 kN/m³

- **Required Data:**

(a) net pressure, p = ?
(b) Location of force
(3) If water level drops half of depth, find p and location of force.

Solution :-

(a) pressure :

$$P = \gamma h$$
$$P = 9.81 \times 7.965$$
$$P = 78.13 \text{ kN/m}^2$$

(b) Force application (centroid)

$$\bar{y} = \frac{h}{3}$$
$$\bar{y} = \frac{7.965}{3}$$
$$\bar{y} = 2.655 \text{ m}$$

(c) Half Depth,

$$\text{pressure} = \gamma \cdot \frac{h}{2}$$
$$= 9.81 \times 7.965/2$$
$$P = 39.06 \text{ kN/m}^2$$

Now Centroid,

$$\bar{y} = \frac{h}{2} \times \frac{1}{3} \quad \therefore h = 7.965$$
$$\bar{y} = 1.3275 \text{ m}$$