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SECTION: B

SEMESTER: 4th (Spring)

EXAM : Mid

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"FLUID MECHANICS"

Question No 1
Part - a

Define viscocity and Newton equation of viscocity.

Answer:

Viscocity:

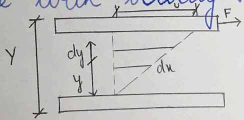
Definition: "Viscocity is the physical property that characterizes the flow of simple fluid."

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

Newton equation of Viscocity:

consider two parallel plates placed at a distance Y and space between them is filled with fluid. The lower surfa-ce is assumed to be stationary while the upper move with velocity 'V' Then;

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



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

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

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

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

For dy the velocity will be du so then

$$\tau = \mu \frac{du}{dy} \quad \text{— a}$$

Where μ is proportionality factor and called viscosity of fluid, and $\frac{du}{dy}$ is velocity gradient.

The above equation a is called "newton equation of viscosity."

PART – b

Define density, specific weight and specific volume. Show relation between density and specific weight.

Answer:

→ Density:

Definition:

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

Denoted: 'ρ' Formula: $\rho = \frac{m}{V}$

Unit: Kg/m^3

→ Specific weight:

Definition:

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

Denoted: 'γ'

Unit: N/m^3

Formula: $\gamma = \frac{W}{V}$

→ Specific volume:

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

Denoted: v

Unit: m^3/Kg

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

→ 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

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

So there is direction relation between specific weight and 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

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

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

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

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

now

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

$$\gamma = \rho \times g$$

$$\gamma = 1.38 \times 9.8$$

$$\boxed{\gamma = 13.54\, N/m^3}$$

RESULT:

Specific weight, $\gamma = 13.54\, N/m^3$

Question no 2

Part - a

Define pressure. what is absolute and guage pressure.

ANSWER:

→ **PRESSURE:**

Definition:

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

$$P = \frac{F}{A} \quad \text{or}$$

$$F = P \times A$$

→ **Absolute pressure:**

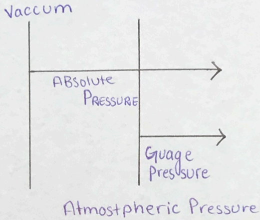
Definition:

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

→ **GUAGE PRESSURE:**

Definition:

" Guage pressure is zero referenced against ambient air pressure, so it is equal to Absolute pressure mins atmost-pheric pressure.



PART - b

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

GIVEN DATA:

PART - b

A water tank having dimension
------- of force?

GIVEN DATA:

Length, l = 1500mm = 1.5m
Breadth, b = 1500mm = 1.5m
depth, h = 7935 = 7.935
gravity, g = 9.81 m/s²
Density of water, ρ = 1000 Kg/m³

REQUIRED:

→ Net Pressure, P = ?
→ Location of force
→ If water level drop half of depth find P and location of force.

SOLUTION:

NET PRESSURE:

As $P = \rho g h$

$$P = 1000 \frac{kg}{m^3} \times 9.81 \frac{m}{s^2} \times 7.957m$$

$$P = 78.05 \times 10^3 \text{ Pa}$$

or

$$\boxed{P = 78.05 \text{ KPa}}$$

PRESSURE PER UNIT WIDTH:

$$P_1 = \frac{P}{width}$$

$$P_1 = \frac{78.05}{1.5}$$

$$\boxed{P_1 = 52.03 \text{ kN/m}}$$

LOCATION OF FORCE:

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

$$\bar{y} = \frac{7.935}{3}$$

$$\boxed{\bar{y} = 2.645 \text{ m}}$$

RESULTANT FORCE:

Always act at $\frac{1}{3}h$ from base

$$\text{Resultant force} = \frac{1}{2} bh$$

$$= \frac{1}{2}(52.03)(7.935)$$

$$\boxed{F = 206.4 \text{ kN}}$$

WATER LEVEL HALF OF DEPTH

$$h = \frac{7.935m}{2} = 3.967m$$

NET ~~FORCE~~ PRESSURE:

$$P = \rho g h$$

$$P = 1000 \frac{kg}{m^3} \times 9.81 \frac{m}{s^2} \times 3.967$$

$$P = 38.9 \times 10^3 \, Pa$$

$$\boxed{P = 38.9 \, kPa}$$

PRESSURE PER UNIT WIDTH:

$$P_2 = \frac{P}{width}$$

$$P_2 = \frac{38.9}{1.5}$$

$$\boxed{P_2 = 25.9 \, kN/m}$$

RESULTANT FORCE:

$$= \frac{1}{2} bh$$

$$= \frac{1}{2} (38.9)(3.967)$$

$$F = 77.1 \, kN$$

LOCATION OF FORCES:

$$\bar{y} = \frac{h}{2}$$

$$\bar{y} = \frac{3.967}{2}$$

$$\boxed{\bar{y} = 1.98m}$$