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SECTION: A

SEMESTER: 4

SUBJECT: FLUID MECHANICS

SUBMITTED TO: ENGR. ABDUL WAHEED

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QUESTION #1

Part (a)

Define viscosity? Derive newton equation of viscosity.

ANSWER:

VISCOSITY:

Viscosity is a term which shows that how easily a fluid can flow.

DEFINITION:

It is the property of a fluid which resists relative motions of its adjacent layers.
This resistance is due to the cohesion and molecular momentum exchanged between fluid layers.
Its unit is "Paise".

NEWTON EQUATION OF VISCOSITY:

This states that,

"The shear stress in a flowing fluid is directly proportional to the rate of shear strain".

MATHEMATICALLY:

$$\tau \propto \frac{du}{dy}$$

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

where 'μ' is the viscosity
and

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

$\frac{du}{dy}$ = Rate of Shear deformation.

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Part (b)

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

ANSWER:

★ DENSITY:

It is defined as "the mass per unit volume of a fluid." **OR**

"The ratio of mass to the volume of fluid"

MATHEMATICALLY:

$$\rho = \frac{m}{V} = \frac{kg}{m^3}$$

∴ m = mass ∴ V = volume ∴ ρ = density

It's unit is kg/m^3

★ SPECIFIC VOLUME:

"It is defined as "the volume per unit mass of a fluid." **OR**

"The ratio of volume to the mass of fluid"

MATHEMATICALLY:

$$\text{Specific volume} = \frac{V}{m} = \frac{1}{\rho} = \frac{1}{\text{density}}$$

It's unit is m^3/kg.

★ SPECIFIC WEIGHT:

"It is defined as "The weight of a fluid per unit its volume"

"The ratio of weight to volume of fluid"

MATHEMATICALLY:

$$W = \frac{mg}{V} = \rho g \quad \left(\because \frac{m}{V} = \rho\right)$$

Its unit is N/m^3.

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Part (c)

If specific volume of gas is $0.72\ m^3/kg$. What is specific weight in N/m^3?

SOLUTION:-

Specific volume $= 0.72\ m^3/kg$

Specific weight $= ?$

We know that

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

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

$$\rho = \frac{1}{0.72}$$

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

Now As

$$w = \rho g$$

$$w = 1.38 \times 9.81$$

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

★ ★ ★

QUESTION #2

Part (a)

Define Pressure? what is an absolute and guage pressure?

ANSWER:-

PRESSURE:-

The force applied perpindicularly on the surface of an object per unit area.

Its S.I unit is "Pascal"

MATHEMATICALLY:-

$$P = F/A$$

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GUAGE PRESSURE:

It is the pressure taken relative to atmospheric pressure.

It is taken as positive for pressure above atmospheric pressure and negative for pressure below atmospheric pressure.

ABSOLUTE PRESSURE:

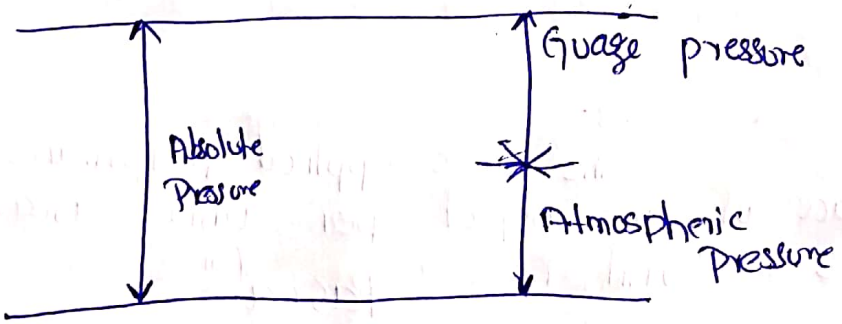
The total Pressure at a point in a fluid. It is the sum of the guage pressure and atmospheic pressure.

MATHEMATICALLY:

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

Part (b)

A water tank having dimensions of 1500mm x 1500mm. Depth of the water tank is equal to your ID in mm. What is the net pressure force on wall of water tank? Find the location of force appilication? If the water level drops to the half of the depth, what will be the force and point of application of force?



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GIVEN:

$l = 1.5m$ (1500mm x 1500mm)
breadth = 1.5m
Depth = 7897mm $\Rightarrow$ 7.897m
Unit weight of water = $9.8\ KN/m^3$

REQUIRED:

Net Pressure = ?
Location of force = ?
If water level drops to half of depth find P and location of force.

SOLUTION:

Net Pressure:

$P = \gamma h$

$P = 9.8 \times 7.897$

$\boxed{P = 77.3906\ KN/m^2}$

Force Application:

$\bar{y} = \frac{h}{3} = \frac{7.897}{3}$

$\boxed{\bar{y} = 2.632m}$

Half depth:

Pressure at half depth = $P' = \frac{\gamma h}{2}$

$P' = \frac{9.8 \times 7.897}{2}$

$\boxed{P' = 38.7347\ KN/m^2}$

Centroid at half depth

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

$\bar{y} = \frac{h}{6}$

$\bar{y} = \frac{7.897}{6}$

$\boxed{\bar{y} = 1.316m}$

★ END ★

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