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Section : B

Department : Be(C)

Subject : Fluid Mechanics I

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Question No : 1

a :- Define viscosity ? Derive Newtom equation of viscosity.

Viscosity :-

Viscosity is the property of fluid which apposses the relative motion between the two surfaces of the fluid. Different fluid have different viscosity depends upon the intermolecular force in fluid.

Example :- Honey has greater viscosity than water.

Newtom Equation of Viscosity :-

It State that

"The Shear Stress in a flowing fluid is directly proportional to the rate of Shear Strain.

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Mathematically :-

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

$\tau \rightarrow$ Shear Stress

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

change the sign of Proportionality

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

μ = viscosity (Dynamic viscos

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

→ The fluid which follows "Newtons law of viscosity" are called "Newton fluid"

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Part B

b:- Define density, specific weight and specific volume. Show relation between density and specific weight.

Density:-

→ Property of fluid

Density can be define as "Mass per unit volume of a fluid".

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

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

Specific weight:-

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

Denoted by "w"

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$$w = \frac{\text{weight}}{\text{volume}}$$

$$\boxed{w = \frac{N}{m^3}}$$

Relation between density and Specific weight:-

As

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

As we know that $W = mg$

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

$\rho \rightarrow$ density $\quad \because \rho = \frac{m}{V}$

$$\boxed{w = \rho g}$$

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Specific Volume:-

→ Property of fluid

Specific volume is the volume of a fluid (V) occupied per unit mass (m).

→ it is the reciprocal of Density.

$$\text{Specific volume } V = \frac{V}{m}$$

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

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

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Part C

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

Given Data:-

Specific volume of gas $V = 0.72 m^3/kg$

Required Data:-

Specific weight in $N/m^3 = ?$

Sol:- As we know that

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

So Density "ρ" $= \frac{1}{V}$

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

$$\boxed{\rho = 1.389 \, kg/m^3}$$

Specific weight "w" $= \rho g$

$$w = 1.389 \times 9.8$$

$$\boxed{w = 13.62 \, N/m^3} \quad \text{Ans}$$

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Q2:- Define pressure? what is an absolute and guage pressure?

Pressure:-

The amount of force exerted (thrust) on a surface per unit area is defined as "pressure". It can also be define as the ratio of the force to the area (over which the force is acting).

Formula:-

$$\text{Pressure } (P) = \frac{\text{Thrust}}{\text{Area}}$$

SI unit:-

→ Pascal (Pa)

$$1Pa = 1/Nm^2$$

Dimensions:-

$$ML^{-1}T^{-2}$$

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Absolute pressure:-

The absolute pressure is a pressure that is related or relative to the zero pressure in the empty, air free space of the universe. This reference pressure is the ideal or absolute vaccum. It is noted with subscript "abs", . p_{abs}.

Gauge pressure:-

The gauge pressure is defined as the difference between an absolute pressure and the prevailing atmospheric. It is denoted with sub-sript "e", P_e and is calculated.

$$P_e = P_{abs} - P_{atm}$$

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Q2: b :-

Given Data

Length = 1500mm = 1.5m

Breadth = 1500mm = 1.5

depth, h = 7946mm = 7.946 (Student ID)

Unit weight of water = $9.81\ KN/m^3$

Required :-

→ Net pressure, P = ?

→ Location of force

→ If water level drop half of depth Find P & location of force.

Sol :-

(a) Pressure :

Formula

$P = \gamma h$

$P = 9.81 \times 7.946$

$P = 77.950 \Rightarrow P = 77.950\ KN/m^2$

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(b) Force application (centroid)

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

$$\bar{y} = \frac{7.946}{3}$$

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

$$\boxed{\bar{y} = 2.649m}$$

(c) half depth :-

pressure

$$P = \gamma . h/2$$

$$P = 9.81 \times \frac{7.946}{2}$$

$$P = 38.98\ KN/m^2$$

centroid

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

$$\boxed{\bar{y} = 1.322m}$$ Ans

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