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ID - 7978

Sec - B

Subject - FLUID MECHANICS

To - ENGR ABDUL WAHEED

Q. No(01)

a) Define Viscosity. Derive Newton equation of viscosity.

- Viscosity:

Viscosity is a measure of fluid's resistance to flow. It describes the internal fraction of a moving fluid. A fluid with large viscosity resists motion because its molecular makeup gives it a lot of internal fraction.

A fluid with low viscosity flows easily Because its molecular makeup results in very little friction when it is in motion.

Example:

Syrup has a high viscosity than water.

• Newton's equation of Viscosity:

$$F \propto \frac{Au}{y}$$

Where, μ is viscosity constant

$$F = \frac{\mu A u}{y}$$

$$\frac{F}{A} = \frac{\mu u}{y}$$

here, $\frac{F}{A}$ = Shear stress = τ

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

For Dry, $\frac{du}{dy}$ = Rate of shore deformation

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

This is known as Newton equation of viscosity.

(b) Define density, Specific weight & Specific volume. Show relation b/w specific weight and density.

Density:

The density is the mass per unit volume. The symbol must often used for density is ρ.

Mathematically, density is defined as mass divided by volume,

Where ρ is the density, m is the mass and V is the volume.

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

Specific Weight:

The specific weight, known as the unit weight, is the weight per unit volume of material (fluid).

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

It's unit is N/m^2.

- Relationship b/w Density & Specific weight:

As we know that

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

Where,

$$W = mg$$

So,

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

Then,

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

Where ρ is density so,

$$\gamma = \rho g \quad \text{or} \quad \rho = \frac{\gamma}{g}$$

γ = Specific weight.

ρ = Density.

Specific Volume:

Specific volume is define as the number of cubic meters occupied by one kilogram of mater. It is the ratio of a material's volume to its mass, which is resiprocal of it's density. Simply inversly proportional to density.

Formula:

$$V = 1/\rho$$

ρ = density.

Unit:

m^3/Kg.

c) If specific volume of gas is 0.72 m^3/Kg. What is specific weight in N/m^3?

Solution:

Given:

$V = 0.72\ m^3/Kg$

$Y = ?$

As,

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

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

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

$$\rho = 1.38\ Kg/m^3$$

Now,

$$\gamma = \rho g$$

$$\gamma = 1.38 \times 9.81$$

$$\boxed{\gamma = 13.54 \text{ N/m}^3}$$ is the specific weight.

Q.No (02)

a) Define pressure? What is an absolute and guage pressure?

Pressure:

The amount of force exerted (thrust) on a surface per unit area is known 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)

$1pa = 1/Nm^2$.

Dimension:

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

Types:

1) Atomspheric pressure.
2) Absolute pressure.
3) Differential pressure.
4) Guage pressure.

Absolute Pressure:

Absolute pressure is a pressure that is related or relative to zero pressure in the empty, air free space of the universe. The refevance pressure is the ideal or absolute vaccume. It is noted with subscripts "abs" Pabs.

Guage Pressure:

The guage pressure is define as the difference between an absolute pressure (Pabs) and the prevailing atmospheric (Pamb). It is denoted with subscript "e". Pe and is calculated.

$$P_e = P_{abs} - P_{amb}.$$

(b) A water tank having dimensions of 1500mm x 1500mm. Depth of the water tank is equal to your ID (7978) 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 and point of application of force?

Solution:

Given data:

length, $l = 1500\ mm = 1.5\ m$.

Bredth, $b = 1500\ mm = 1.5\ m$.

Depth, $h = 7978 = 7.978\ m$

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

Required data:

a) Net pressure = ?

b) location of force = ?

c) If water level drops half of depth, find P and location of force

a) Net pressure:-

$$P = \gamma \times h$$

$$P = 9.8 \times 7.978$$

$$\boxed{P = 78.1844\ KN/m^2}$$

b) location of force:-

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

$$y = \frac{7.978}{3}$$

$$\boxed{y = 2.65\ m}$$

c) Pressure at half depth,

$$P' = v\frac{h}{2}$$

$$P' = 9.81 \times \frac{7.978}{2}$$

$$\boxed{P' = 39.132\ KN/m^2}$$

Centroid,

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

$$\bar{y} = \frac{1}{3} \times \frac{7.978}{2}$$

$$\boxed{\bar{y} = 1.3296\ m}$$