PAPER

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- Subject Fluid mechanics
- Section A

4th semester

Paper fluid mechanics

Q(a)

P(a) Define viscosity? Derive newton equation of viscosity.

Viscosity: Viscosity is defined as the measure of the resistance of a fluid to gradual deformation by shear or tensile stress. In other words, viscosity describes a fluids resistance to flow. simply put we can say that honey is thicker than water in term, honey is more viscous than water.

The definition of viscosity can be written as:
The viscosity of a fluid is a measure of its resistance to deformation at a given rate.

Newtonis law of viscosity: Newtonis viscosity lawis states that, the shear stress between adjacent fluid layers is proportional to the vaco velocity gradients between the two layers.

The ratio of shear stress to shear rate is a constant. for a given temperature and pressure and is define as the viscosity or coefficient of viscosity.

Newtonis law of viscosity, $\tau \propto \frac{du}{dy}$

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

where

μ = viscosity

τ = shear stress = F/a

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

P(b) Define density, specific weight and specific volume
Show relation between Density and specific weight.

1) **Density** The mass density or Density of a fluid is defined as the ratio of a mass fluid to its a volume of the fluid.

Density is called a Mass per unit Volume of a fluid. This is denoted by Symbol ρ (rho) and the unit of mass density is (kg/m^3)
(The Density of water is 1000 kg/m^3) or
[we can say 1 g/cm^3]

Mathematically;

ρ (rho) = (Mass of fluid) / (volume of fluid)

2) **weight Density or specific weight:** weight density or specific density of a fluid is defined as the ration of fluid to it is volume of the fluid.

weight density is called weight per unit volume of a fluid. This is denoted by symbol 'w' and the unit of mass density is (N/m^3)

Mathematically

w = (weight of fluid) / (volume of fluid)

$$= \frac{(\text{Mass of fluid}) * (\text{Acceleration due to gravity})}{(\text{volume of fluid})}$$

And we know from previous formula of Density. so this becomes.

$w = \rho * g = N/m^3$

The value of weight density or specific weight for water is 9.81 kN/m^3

Specific volume:

The volume specific volume of a fluid is defined as the ratio of the volume of fluid to the mass of fluid.

Or

The volume of fluid occupied by a unit mass or volume per unit mass of a fluid is called specific volume.

The unit of specific volume is m^3/kg and this is commonly applied to gases.

Mathematically

specific volume = (volume of fluid)/(mass of fluid)

$= (1)/\rho = V/m$

Relation Between Density and specific weight

As we know that

$W = w/v$

and that

$w = mg$

So, $w = mg \Rightarrow w = \rho g \quad \therefore \rho = m/v \Rightarrow \rho$ = density.

P(c) If specific volume of a gas is $0.72 m^3/kg$ which is specific weight in N/m^3?

Given Data: specific volume $v = 0.72 m^3/kg$.

Required: specific weight, $w = ?$

Solution:

As we know

$v = 1/\rho$

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

$\rho = 1/0.72$

$\rho = 1.38 kg/m^3$

As

$W = \rho g$

$g = 9.81 m/s^2$

$W = 1.38 kg/m^3 \times 9.81 m/s^2$

$W = 13.54 N/m^2$.

Q(2)

Q(a) Define pressure? What is absolute and gauge pressure.

Pressure: pressure is the amount of force applied at right angles to the surface of an object per unit area. The symbol for it is P or p.
pressure is a scalar quantity.

Formula

Mathematically:

$p = F/A$

where

p is the pressure F is the magnitude of the normal force.

Absolute pressure: The actual pressure at given position is called the absolute pressure, and it is measured relative to absolute vacuum (i-e absolute zero pressure).

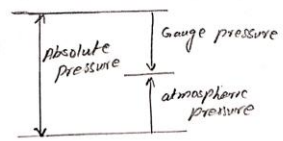
Mathematically

$$P_{abs} = P_{atm} + P_{gage}$$

Guage pressure: Gage pressure is the pressure relative to the atmospheric pressure. In other words how much above or below is the pressure with respect to the atmospheric pressure.

Mathematically

$$P_{gage} = P_{abs} - P_{atm}$$ gage pressure.



b) A water tank having dimensions of 1500mm x 1500mm Dept of the water tank is equal to your student ID number in mm. what is the net pressure force on wall of water tank? Find the location of force application, if water level drops to the half of the depth. what will be the force and point of application of force.

Given Data:

length = l = 1500mm = 1.5m
Breath = b = 1500mm = 1.5m
Depth = d = 7891mm = 7.891m.
unit weight of work = 9.81kN/m³.

Required:

-> a. net pressure = p
-> b. location of force =
-> c. If water level drop half of depth find p and location of force.

Solution:

a) Net pressure.

$p = \gamma h$

$p = 9.81 \times 7.891$

$\boxed{p = 77.41071\ N/m^3}$

b) Force application (centroid)

$\bar{y} = h/3$

$\bar{y} = \frac{7.891}{3}$

$\boxed{\bar{y} = 2.630333\ m}$

c) Half Depth.

Pressure at Half depth, $p' = d/2$

$p' \gamma d/2$

$p = 9.81 \times \frac{7.891}{2}$

$p' = 38.705355 \, N/m^2$

Centriod

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

$\bar{y} = 1.315 m$