Q.No (01)

Part (a) Define Viscosity and derive Newton's equation of Viscosity.

ANSWER.

VISCOSITY:-

It is the property of fluid by which it provides resistances to the fluid motion by offering resistance in between the movement of layers.

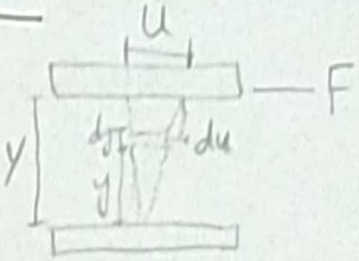
It is the measure of resistance offered to shear or Angular deformation.

Friction forces are due to Cohesion and momentum interchange between molecules in fluid.

Viscosity of liquid decreases as the temperature increases because Cohesion forces decreases.

In gases it increases because of molecular interchange between layers.

Newton's Equation of Viscosity



Now Consider two Parallel plates at a distance "y" and Space in between the plates is filled with a fluid. The lower Surface is assumed to be stationary while the upper plate moves with a velocity of "U".

Hence

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

A is Area of plate

U is the Velocity

Y is the distance between plates.

$$F = \frac{\mu AU}{y}$$

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

$\frac{F}{A} = \tau \Rightarrow$ Shear stress.

Remaining Part of QNO(1) Part(a)

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

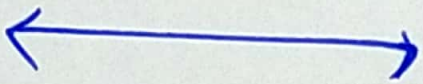
$$\tau = \frac{\mu U}{Y}$$

For dy, the Velocity is du then

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

This is also known as Newton's Equation of Viscosity

$$\mu = \frac{\tau}{du/dy}$$ → This is Co-efficient of Viscosity or dynamic or Absolute Viscosity.



QNO (01)

Part(b) Define Density, Specific weight and Specific Volume. Show relation between Density and Specific weight.

ANSWER.

Density :-

The mass per unit Volume of fluid is called density of fluid. It is denoted by "ρ"

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

its unit is "kg/m^3"

where M is mass and V is Volume.

Specific Weight :-

Weight of the fluid Per unit Volume is called Specific weight of fluid. It is denoted by "γ"

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

Where "W" is weight and "V" is Volume.

Its unit is "N/m^3."

Remaining Part of QNo(01) Part(b)

Specific Volume:

The Volume Occupied by Unit mass of Fluid is called Specific Volume. It is denoted by "v". Its Unit is "m^3/kg"

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

Relation B/w density and Specific weight.

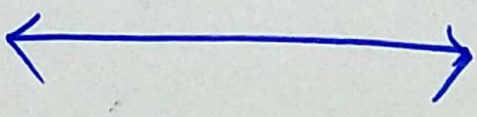
As $\gamma = \frac{W}{V}$ and $W = mg$

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

we know that $\frac{m}{V} = \rho$

$$\gamma = \rho g$$

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



QNO (01)

Part(C) If Specific Volume of gas is $0.72 m^3/kg$ what is Specific weight in N/m^3?

ANSWER.

Given Data:

Specific Volume $= v_2 = 0.72 m^3/kg$.

$g = 9.8 m/sec^2$

Required:

Specific weight $= \gamma_2$?

Solution:

We know that

$$v_2 \frac{1}{\rho}$$

or $$\rho = \frac{1}{v} = \frac{1}{0.72} = 1.389 \ kg/m^3.$$

Now from relation b/w density and Specific weight.

$$\rho_2 \frac{\gamma}{g}$$

or $$\gamma_2 \rho g$$

$$\gamma_2 = 1.389 \times 9.8$$

$$\boxed{\gamma_2 = 13.61 \ N/m^2.}$$ ANSWER..

QNO(02)

Part(a) Define Pressure? What is an absolute and gauge pressure?

ANSWER.

Pressure:.

Pressure is the force Per unit area. Pressure is always Perpendicular to the Surface area Mathematically.

$$P = \frac{F}{A}$$

Its unit is N/m^2.

Absolute Pressure:.

Absolute pressure is the total pressure at a point in a fluid equaling the Sum of gauge and atmospheric pressure. OR Mathematically it is the Pressure measured relative to absolute zero.

$$P_{absolute} = P_{gauge} + P_{atm}.$$

Its unit is Pascal

Part(a) QNO(02) ANSWER.

Gauge Pressure:

The pressure which is relative to atmospheric pressure is called gauge pressure. Gauge pressure is positive for pressures above atmospheric Pressure and Negative when it is below the atmospheric pressure.

Mathematically

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

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

Its unit is Pascal.

ONO(02)

Part(b):- A water tank having dimensions of 1500mm x 1500mm. Depth of water tank is equal to Student ID Number in mm (7894mm). What is the net pressure force on the wall of water tank? Find the location of force application? If the water level drops to the half of depth, what will be the force and the Point of application of force?

Given Data:

Length = 1500mm = 1.5m

Width = 1500mm = 1.5m

depth = 7894mm. = 7.894m.

Specific weight of water = γ_{water} = 9.807 kN/m³

Required:

(i) Net Pressure Force = ?

Location of force = ?

(ii) Net Pressure Force at Half depth = ?

Location of force.

Solution:

(i) We know that

$$P = \gamma h$$

$P = \gamma h$

$P = 9.807 \times 7.894$

$P = 77.41 KN/m^2$

Location of force application

$\bar{y} = h/3 = \frac{7.894}{3}$

$\bar{y} = 2.631 m$.

(ii) Pressure at half depth.

$P = \gamma \frac{h}{2}$

$P = 9.807 \times \frac{7.894}{2}$

$P = 9.807 \times 3.947 = 38.708 KN/m^2$.

Location of force:-

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

$\bar{y} = \frac{3.947}{3}$

$\bar{y} = 1.31567 m$.