EXAM:

MID TERM

PAPER:

FLUID MECHANICS (I)

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SECTION:

B

SIGN:

No of PAGES:

10

SUMITTED TO:

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QNo1: Define Viscosity? Derive Newton equation of Viscosity.

Ans OF QNo1:

VISCOSITY:

Viscosity is the property of the fluid by which it imparts resistance to fluid motion by offering resistance to movement of one layers over another.

OR

Viscosity is a measure of its resistance to shear or angular deformation.

:- It is due to.

i) intermolecular cohesion

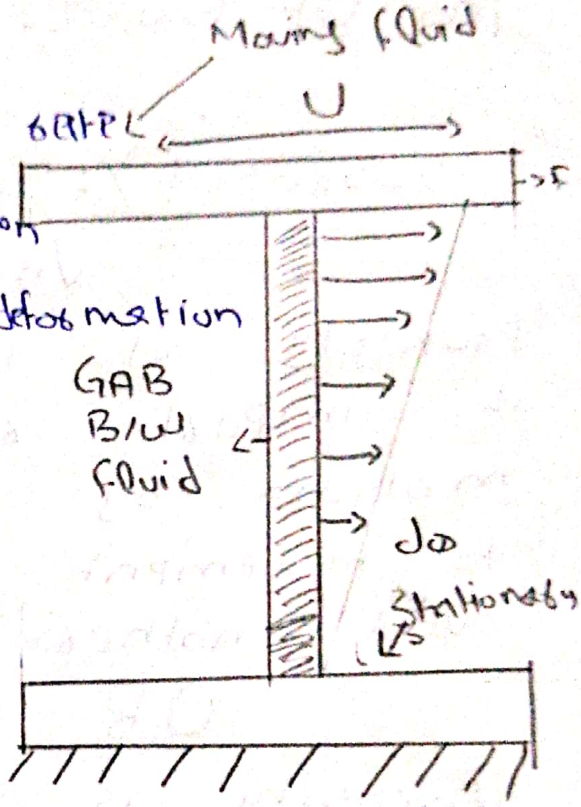
ii) Transfer of molecular momentum.

PART B:

NEWTON EQUATION OF VISCOSITY:

shear stress ∝ time rate of deformation

shear stress ∝ angular deformation



$$\frac{F}{A} \propto \frac{de}{dt}$$

F = Force required

A = Area

$$\frac{F}{A} \propto \frac{U}{Y}$$

DIFFERENTIAL FORM

$$\tau = \mu \left(\frac{du}{dy}\right)$$

where τ = shear stress

$\frac{du}{dy}$ = velocity gradient

μ = dynamic velocity.

According to newton law of viscosity for a giving shear stress (τ) acting on a fluid. The rate of fluid deforms (u/y) is inversly Proportional to viscosity. (μ)

PART B :

1, DENSITY:

- Mass per unit volume

- SI UNIT:

  Kg / m^3

- Absolute quantity does not change with location.
- Density increase with the increase in Pressure.
- It is denoted by "ρ"

2, SPECIFIC WEIGHT:

- weight of the substance per unit volume.
- Also represents force exerted by gravity on unit volume of fluid.
- UNIT:

  N/m^3

3. SPECIFIC VOLUME :

- Volume occupide by unit mass of fluid.
- $v = \frac{1}{\rho}$ (resiprocal of density)

UNIT:

m^3/Kg

- Commonly applied for gases

4. RELATION B/W SPECIFIC WEIGHT AND DENSITY :

As we know.

$$\gamma = \frac{w}{V} \rightarrow (1)$$

$$w = mg$$

Putting values of "w" in eq (1)

$$\gamma = \frac{mg}{V} \rightarrow (2)$$

$\frac{m}{V} = \rho$ putting it in eq (2)

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

PART C:

If specific volume of the gas is 0.72 m^3/Kg. what is specific weight in N/m^3?

SOLUTION:

GIVEN:

specific volume = 0.72 m^3/Kg

To FIND:

specific weight in N/m^3 = ?

SOLUTION:

As $v = \frac{1}{\rho}$

so $\rho = \frac{1}{v}$

Putting value of v

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

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

Now from relation of density and specific weight we have

$\gamma = \rho g$

$\gamma = (1.38) \times 9.81$

$\gamma = 13.54\ N/m^3$

RESULT:

$\gamma = 13.54 \ N/m^3$

or

$\gamma = 13.5378 \ N/m^3$

Q no 2 :-

a, Define Pressure ? what is an absolute and gauge Pressure ?

PRESSURE:

It is the physical force exerted on an object.

- The force applied is perpendicular to the surface of object per unit area.

FORMULA:

The basic formula

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

SI UNIT :

- $1 \ \frac{N}{m^2}$
- $\frac{Kg}{(m.s^2)}$

ATMOSPHERIC PRESSURE

It is a normal pressure exerted by atmospheric ~~pressure~~ air upon surface with which it is in contact.

ABSOLUTE AND GAUGE PRESSURE:

- If pressure is measured relative to absolute zero it is called absolute pressure.

OR

Absolute pressure is the sum of gauge pressure and atmospheric pressure.

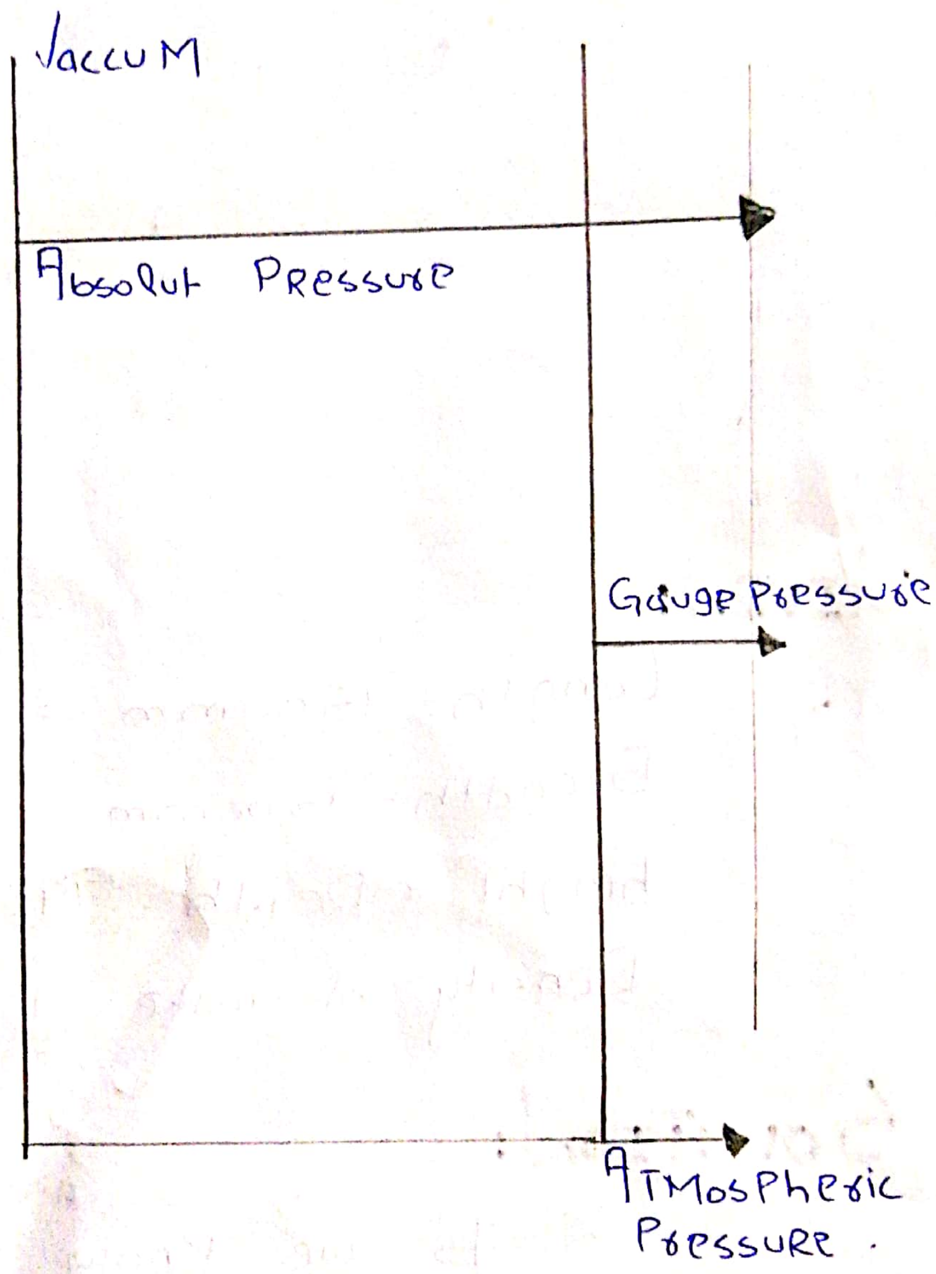
- When pressure is measured relative to atmospheric pressure as base it is called gague pressure.
- Gauge pressure is positive for pressure above atomospheric pressure and negative for pressure below it.

MATHMATICALLY:

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

- While in gage atmospheric pressure is not counted.

DIAGRAM


VaccuM
Absolut Pressure
Gauge Pressure
Atmospheric Pressure.

QNO 2 PART (B)

A water tank having dimensions of 1500mm x 1500mm. Depth of 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 the water drops level to half of the depth. what will be the force and point of application of force?

GIVEN:

Length = 1500mm = 1.500 m

Breadth = 1500mm = 1.500 m

height or Depth = 7968 mm = 7.968 m

Density of water = 1000 kg/m³

SOLUTION:

As we know

$P = \rho g h$

$\rho g = \gamma$

$P = \gamma h$

$P = 9.81 \times 7.968$

$P = 78.166$ KPa

$P = 78.166$ KPa

PER UNIT WIDTH

$P_1 = \frac{P}{width}$

$P_1 = \frac{78.166}{1.5}$

$P_1 = 52.110$ KN/m

LOCATION OF FORCE:

$\bar{y} = h/3$

$\bar{y} = \frac{7.968}{3}$

$\bar{y} = 2.656$ m

RESULTANT FORCE:

Resultant force = $\frac{1}{2}bh$

Resultant force = $\frac{1}{2}(52.110)(7.968)$

Resultant force = 207.606 KN

RESULTANT FORCE = 207.606 KN

WATER LEVEL AT HALF HEIGHT:

$h = \frac{7.968}{2} = 3.984$

$h = 3.984$

JET PRESSURE :

$P = \gamma h_2$

$P = 9.81 \times \frac{7.968}{2}$

$P = 9.81 \times 3.984$

$P = 39.083$ KPa

PRESSURE PER UNIT WIDTH :

$P = \frac{P}{width}$

$P = \frac{39.083}{1.5}$

$P = 26.055$ KN/m

RESULTANT FORCE :

$R.F = \frac{1}{2} bh$

$R.F = \frac{1}{2} (39.083) (3.984)$

$R.F = \frac{1}{2} (39.083) (3.984)$

$R.F = 77.853$ KN

RESULT:

$P_1 = 78.166$ KPa

$P_1' = 52.110$ KN/m

$y' = 2.656$ m

$R.F = 207.606$ KN

$P_2 = 39.083$ KPa

$P_2' = 26.055$ KN/m

$F = 77.853$ KN

$y' = 1.992$ m

LOCATION FORCE.

$y' = \frac{3.984}{2} = 1.992$ m