MID TERM EXAM

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SECTION	:	'B'
DEPARTMENT	:	BE (CIVIL)
SEMESTER	:	4th (Spring)
SUBJECT	:	FLUID MECHANICS
INSTRUCTOR	:	Engr. ABDUL WAHEED

QUESTION NO. 1

PART(a):

Define viscocity and newton equation of viscocity.

ANSWER:

VISCOCITY:

DEFINITION:

Viscocity is the physical property that characterizes the flow of simple fluid.

→ Viscocity is the property of fluid by virtue of its offers resistance to the movement of one layer fluid over an adjacent layer.

NEWTON EQUATION OF MOTION:

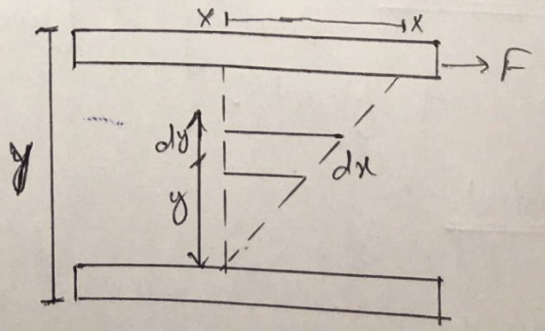
Consider two parallel plates placed at a distance Y and space b/w them is filled with fluid. The lower surface is assumed to be stationary while the upper move with velocity.

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

$$\Rightarrow F = M \frac{AU}{Y}$$

$$\Rightarrow F/A = \frac{MU}{Y}$$

where $F/A = \tau$



$$\Rightarrow \tau = \frac{\mu u}{Y}$$

For dy the velocity will be du so then

$$\tau = \frac{du}{dy} \quad \text{—(a)}$$

where μ is Proportionality factor and called viscosity of fluid and du/dy is velocity gradient.

The above equation "a" is called newton equation of viscocity.

PART- b:

Define density, specific weight and specific volume. Show relation b/w density and specific weight.

ANSWER:

DENSITY:

DEFINITION: "Density of fluid is its mass per unit volume of fluid".

Denoted: ρ

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

UNIT: Kg/m^3

SPECIFIC VOLUME:

DEFINITION: "It is the volume occupied by unit mass of fluid."

DENOTED:

v

UNIT:

m^3/kg

FORMULA:

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

RELATION BETWEEN DENSITY AND SPECIFIC WEIGHT:

Specific weight $= \gamma = \frac{w}{V}$

where $w = mg$ so

$$\gamma = \frac{mg}{V} \quad \text{—(i)}$$

As $\frac{m}{V} = \rho$ put in eq(i)

$$\gamma = \rho g$$

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

So there is the direct relation blw specific weight and density.

PARTC:

If specific volume of gas is $0.72\ m^3/kg$. What is its specific weight?

GIVEN DATA:

Specific volume, $V = 0.72\ m^3/kg$

REQUIRED DATA:

Specific weight, $\gamma = ?$

SOLUTION:

As we know that

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

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

$$\Rightarrow \rho = \frac{1}{0.72\ m^3/kg}$$

$$\Rightarrow \boxed{\rho = 1.38\ kg/m^3}$$

Now

$$\rho = \gamma/g$$

$$\Rightarrow \gamma = \rho g$$

$$\Rightarrow \gamma = 1.38 \times 9.8$$

$$\Rightarrow \boxed{\gamma = 13.54\ N/m^3}$$

RESULT:

Hence specific weight, $\gamma = 13.54\ N/m^3$

QUESTION No. 2

PART- a:

Define Pressure. What is absolute and guage Pressure.

ANSWER:

PRESSURE:

DEFINITION: "Pressure of fluid is define as normal force exerted by fluid on unit area."

$$P = F/A \quad \text{or}$$

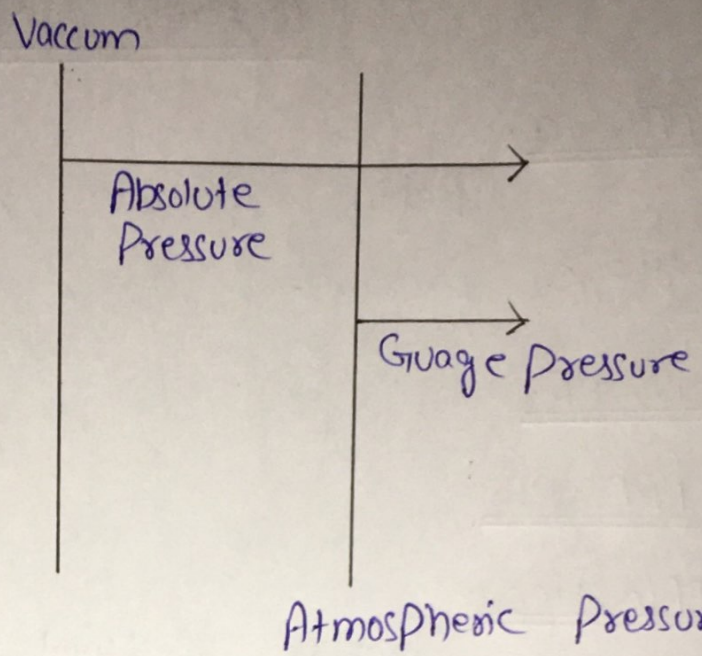
$$F = PA$$

ABSOLUTE PRESSURE:

DEFINITION: "Absolute pressure is zero - refferenced againt a perfect vaccum, so it is equal to guage Pressure Plus atmospheric pressure."

GUAGE PRESSURE:

DEFINITION: "Guage pressure is zero refferenced against ambient air Pressure, so it is equal to Absolute Pressure minus atmospheric Pressure."



PART- b:

A water tank having dimension - - - - - - - - - - of force?

GIVEN DATA:

length, l = 1500mm = 1.5m

Breath, b = 1500mm = 1.5m

Depth, h = 7954 = 7.954

gravity, g = 9.81 m/s^2

Density of water, ρ = 1000 kg/m^3

REQUIRED DATA:

→ Net Pressure, P=?

→ Location of force

→ If water level drop half of depth find P and location of force.

SOLUTION:

NET PRESSURE:

As $P = \rho g h$

$\Rightarrow P = 1000 \frac{kg}{m^3} \times 9.81 \, m/s^2 \times 7.954$

$\Rightarrow P = 78028.74$

$\Rightarrow \boxed{P = 78.028 \, kPa}$

PRESSURE PER UNIT WIDTH:

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

$\Rightarrow P_1 = \frac{78.028}{1.5}$

$\Rightarrow \boxed{P_1 = 52.019 \, kN/m}$

LOCATION OF FORCE:

$\bar{y} = h/3$

$\Rightarrow \bar{y} = \frac{7.954}{3}$

$\Rightarrow \boxed{\bar{y} = 2.651 \, m}$

RESULTANT FORCE:

Always act at $1/3\,h$ from base

Resultant force $= 1/2\,bh$

$= 1/2\,(52.03)(7.954)$

$\boxed{F = 206.92 \, kN}$

WATER LEVEL HALF OF DEPTH:

$$h = \frac{7.954}{2} = 3.997 m$$

NET PRESSURE:

$$P = \rho g h$$

$$\Rightarrow P = 1000\ kg/m^3 \times 9.81 \times 3.997$$

$$\Rightarrow P = 39210.57$$

$$\Rightarrow \boxed{P = 39.210\ kPa}$$

PRESSURE PER UNIT WIDTH:

$$P_2 = \frac{P}{Width}$$

$$\Rightarrow P_2 = \frac{39.210}{1.5}$$

$$\Rightarrow \boxed{P_2 = 26.140\ kN/m}$$

RESULTANT FORCE:

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

$$\Rightarrow F = \frac{1}{2} (839.210)(3.997)$$

$$\Rightarrow \boxed{F = 78.361\ kN}$$

LOCATION OF FORCES:

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

$$\Rightarrow \bar{y} = \frac{3.997}{3}$$

$$\Rightarrow \boxed{\bar{y} = 1.3323\,m}$$

$$\Rightarrow \boxed{\bar{y} = 1.3323\,m}$$