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Section " B "

Fourth Semester

Sub: Fluid Mechanics.

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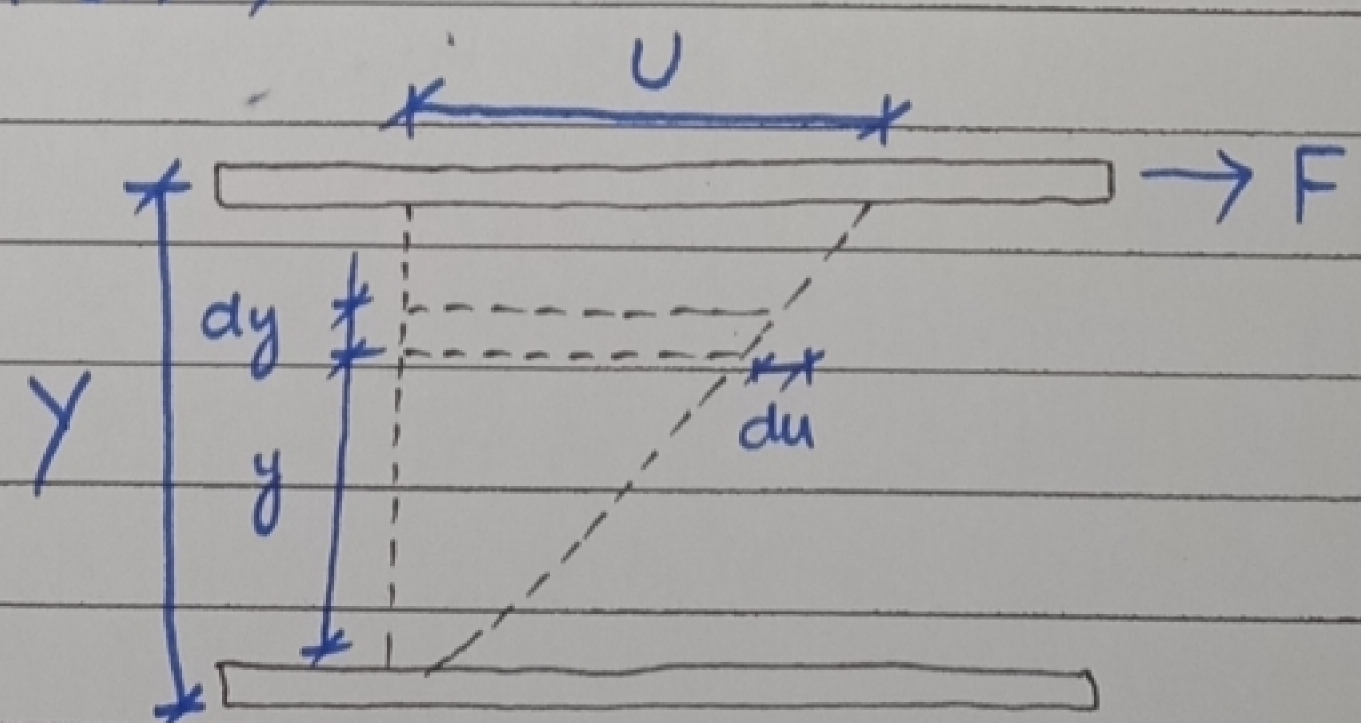
Q NO # 01

part (a) Ans:

Viscosity:→ It is the property of fluid by which it imparts resistance to fluid motion. by Offering resistance to movement of one layer over another.
The viscosity of fluid is measured of its Resistance of shear OR angular deformation.
The friction forces from Cohesion and momentum interchange between molecule in fluid. As temperature increase, the viscosity of Liquid decrease. In gases viscosity increase with increase in temperature because of molecular interchange between layers.

Newton equation of viscosity

Derivation:→



Now Consider two parallel plates placed at distance Y and space between is filled with fluid. Lower surface is assumed to be stationary while upper move with velocity U Thus

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

OR

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

$\therefore$ U = velocity
A = Area.

OR

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

Thus

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

dy, The velocity will be Thus

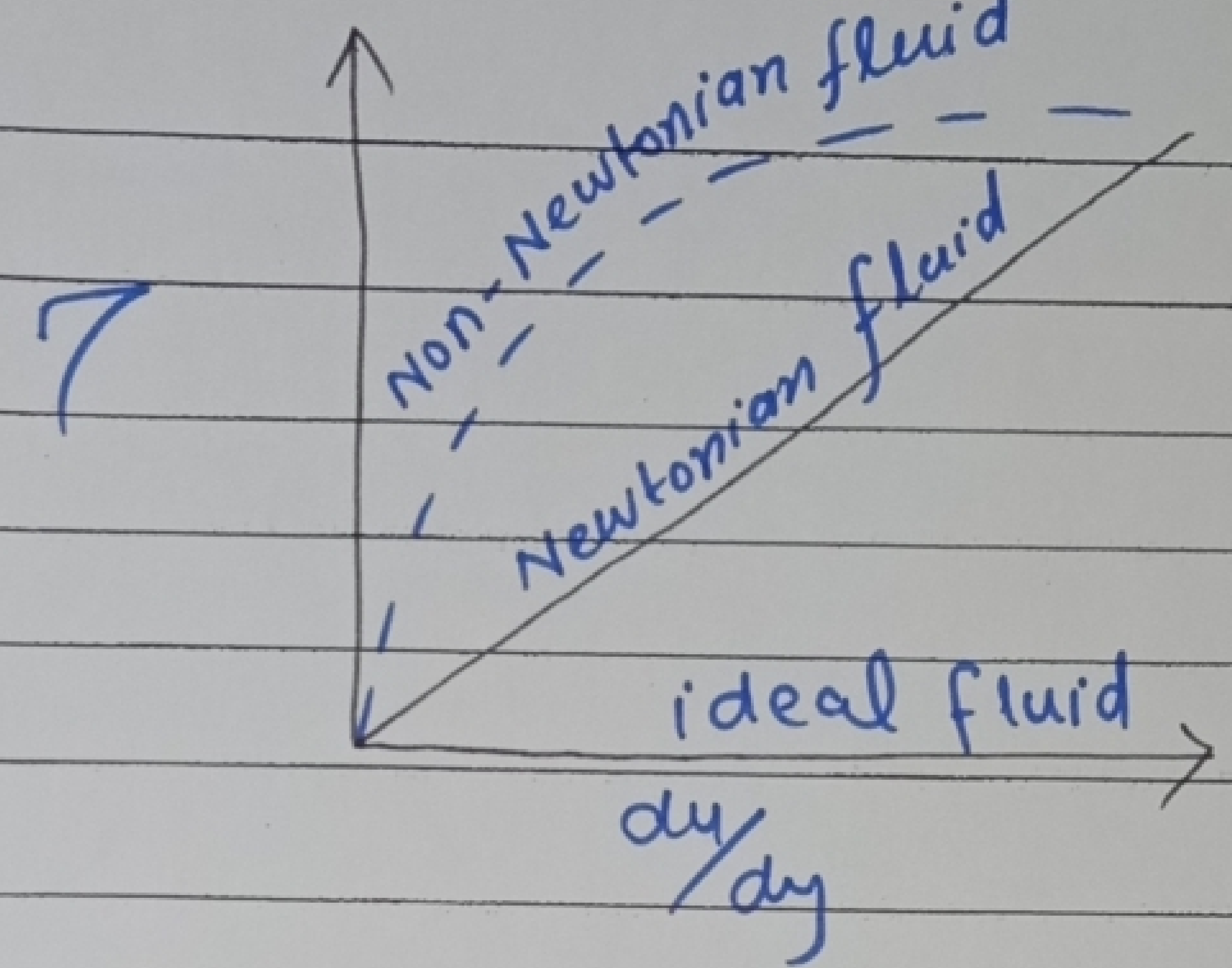
$$\tau = \frac{\mu du}{dy}$$

$$\tau = \frac{\mu du}{dy}$$ This is called equation of viscosity

Thus

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

This is called dynamic co-efficient of viscosity OR Absolute viscosity.



The Fluid which Constant of proportionality does'nt change with rate of deformation is said to be newtonian fluid. Ideal fluid with no viscosity is represented by horizental axis. Unit of absolute viscosity is $N \cdot S/m^2$.

Kinamatic viscosity :→

it is defined is co-efficient of viscosity per Density of fluid.

$$\nu = \frac{\mu}{\rho}$$

where $\nu \rightarrow$ Kinamatic viscosity
$\mu \rightarrow$ Dynamic viscosity
$\rho \rightarrow$ Density.

Part (b) Ans:→

Density :→ Density of fluid is mass per unit volume of fluid. It is denoted by "ρ". its unit is N/m^3.

$$\rho = \frac{m}{V} \longrightarrow N/m^3.$$

Specific weight:→ it is weight per unit volume of fluid. it is represented by "γ", its unit is N/m^3.

$$\gamma = \frac{W}{V} \longrightarrow N/m^3$$

Specific volume :→ it is the volume occopied by unit mass of fluid. it's unit is m^3/kg

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

Specific volume also have the inversly Relation to the density.

Relation Between Density and specific weight:

We have formula of the Specific weight:

$$\gamma = \frac{w}{v} \quad \text{— (A)}$$

where $w = mg$

So

$$\gamma = \frac{mg}{v} \quad \text{— (B)}$$

Thus $\frac{m}{v} = \rho$

put in eq (B)

So

$$\gamma = \rho g$$

OR

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

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Part (c) Solution :→

Given data:

Specific volume of gas = 0.72 m^3/kg

Required ⇒ Specific weight?

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

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

So

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

Now $\gamma = \rho g$

Specific weight = $\frac{1}{0.72} * 9.81$

Specific weight = 13.54 N/m^3

Specific weight = 13.54 N/m^3

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Q NO # 02

part (a) Ans:

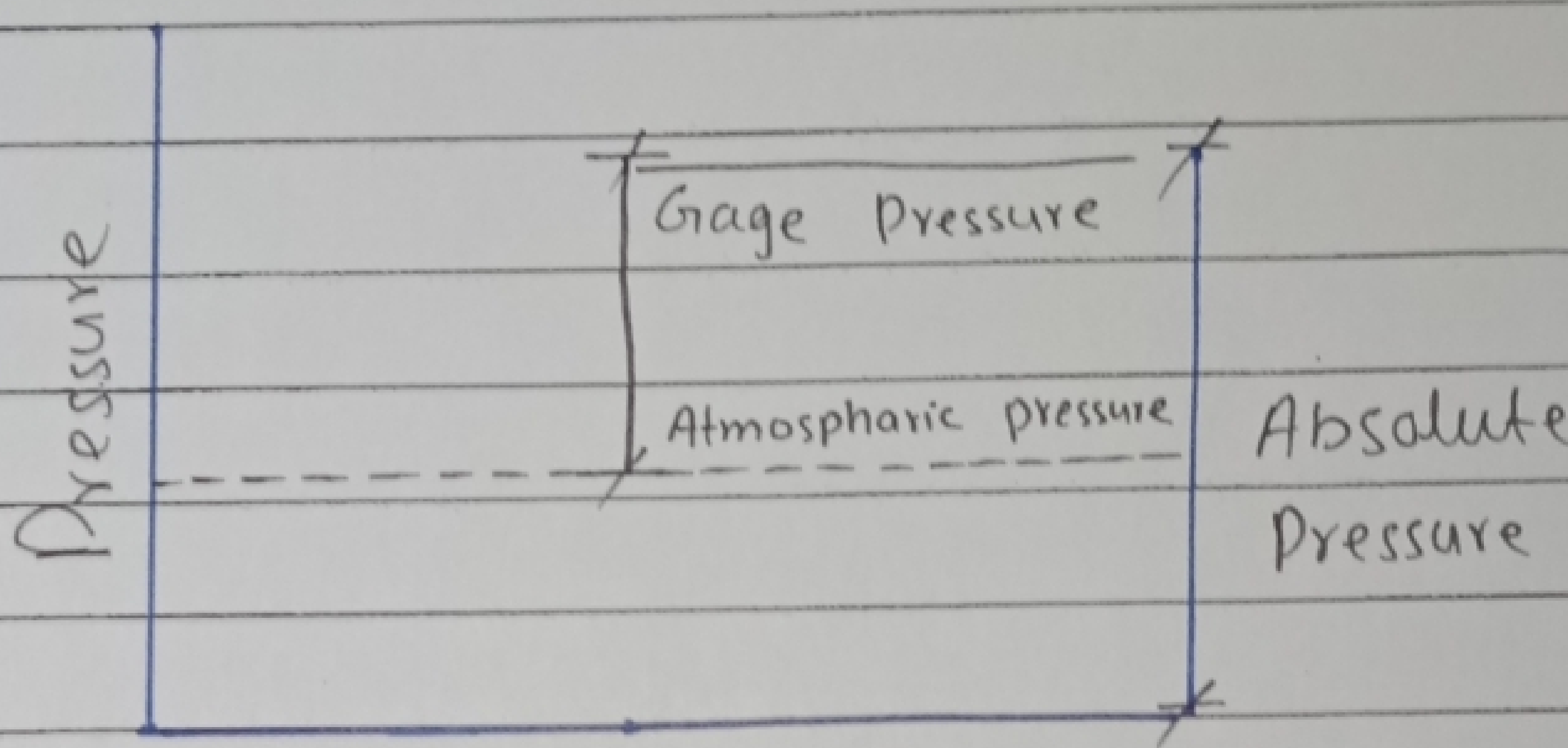
Pressure:→ Fluid in a container press with an outward Force against the walls of that container. The Pressure is defined as the ratio of the Force to the area on which the force is exerted.
The SI units of pressure are N/m^2 as also defined as the pascal where 1 pascal is equal to 1 N/mm^2.
& 1 atm = 760.0 mm Hg = 760.0 torr.
1 atm = 101.3 bar
1 atm = 14.69 psi

Absolute and Gage Pressure:

If the pressure is measured relative to absolute zero. it is called absolute pressure.
When it is measured Relative to atmospharic pressure is Base it is called gage pressure. If the pressure is Below atmospharic it is designated as column. The absolute pressure can only have a positive value. And gage

Pressure by convention measured in the positive direction i-e 8 psig.

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



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Q NO # 02 part (b) A water tank having dimensions of 1500mm X 1500mm. Depth 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 The water level drops to the half of the depth, what will be the force and point of application of Force?

Solution :→ Given data

$$A = 1.5m \times 1.5m = 2.25 m^2$$

$$\text{Depth} = \text{ID in mm} = 7944mm = 7.944m$$

So $$F_c = \gamma A h_c$$

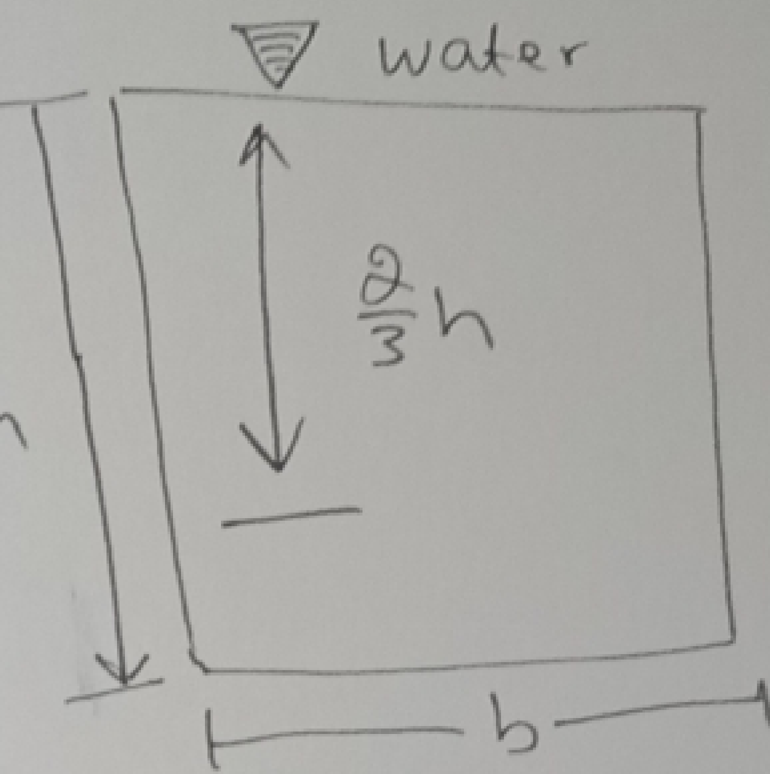
where A = is area.
γ = Specific weight
$$h_c = \frac{h}{2} = \frac{7.944}{2}$$

$$F_c = (9810)(2.25)(3.972)$$

$$F_c = 87671.97\ N$$

For $h_r = ?$

$$h_r = h_c + \frac{I_c}{h_c A}$$



$$h_r = \frac{h}{2} + \frac{bh^3}{12 * \frac{h}{2} * bh}$$

$$h_r = \frac{h}{2} + \frac{bh^3}{6\times\not{2} * \frac{h}{\not{2}} * bh}$$

$$h_r = \frac{h}{2} + \frac{\not{b}h^{\not{3}}}{6\not{b}h^{\not{2}}}$$

$$h_r = \frac{h}{2} + \frac{h}{6}$$

$$h_r = \frac{3h + h}{6} = \frac{4h}{6} = \frac{2h}{3}$$

also we can say that

$$h_r = \frac{2}{3}h \rightarrow (A) \text{ put value in } (A)$$

$$h_r = \frac{2}{3}(7.944)$$

$$\boxed{h_r = 5.926\,m}$$

For The Condition'' two.

half Depth of the water.

$$d = \frac{7.944}{2} = 3.972$$

$$\boxed{d = 3.972}$$

$$h_c = \frac{3.972}{2}$$

$$\boxed{h_c = 1.986m}$$

$$A = 1.5 * 1.5 = 2.25m^2$$

So $F_c = \gamma A h_c$

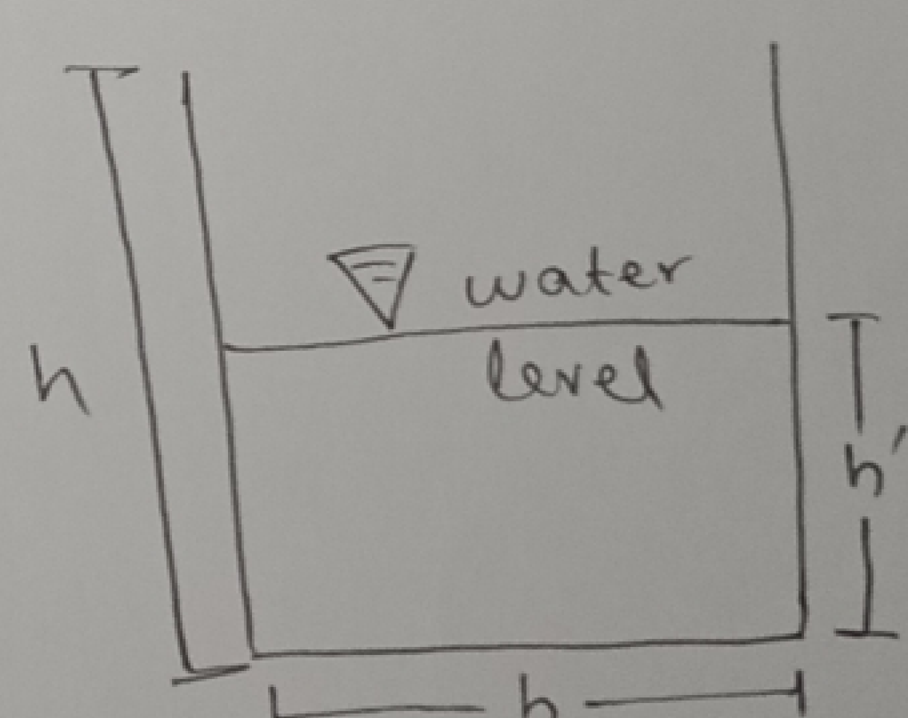
$$F_c = (9810)(2.25)(1.986)$$

$$\boxed{F_c = 43835.985 \ N}$$

If depth is half Then $h_r = ?$

$h' = h/2$

Center of pressure from water Level



$$h_r = h_c + \frac{I_c}{h_c A}$$

$$h_r = h_c + \frac{I_c}{h_c A}$$

$$h_r = \frac{h'}{2} + \frac{b(h')^3}{12 * bh' \cdot \frac{h'}{2}}$$

$$h_r = \frac{h'}{2} + \frac{b(h')^3}{6bh'^2}$$

In this case

$$A = b\frac{h}{2} \text{ or } bh'$$

$$I_c = \frac{bh'^3}{12} \text{ OR } \frac{bh^3}{12 \times 2}$$

$$I_c = \frac{bh^3}{24}$$

$$h_c = \frac{h'}{2}$$

$$h_r = \frac{h'}{2} + \frac{bh'}{6b}$$

$$h_r = \frac{h'}{2} + \frac{h'}{6} \Rightarrow h_r = \frac{3h' + h'}{6} = \frac{4h'}{6} = \frac{2}{3}h'$$

$$h_r = \frac{2}{3}h' = \frac{2}{3} * \frac{h}{2} = \frac{h}{3}$$

$h_r = \frac{h}{3}$ → This is from the top of the wall.

$$h_r = \frac{7.944}{3} = 2.648\,m$$

$h_r = 2.648\,m$ → water level half of the depth The value of h_r is.

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