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Section "B"

Fourth Semester

Sub: Fluid Mechanics

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Q No# 01 part (a) Ans

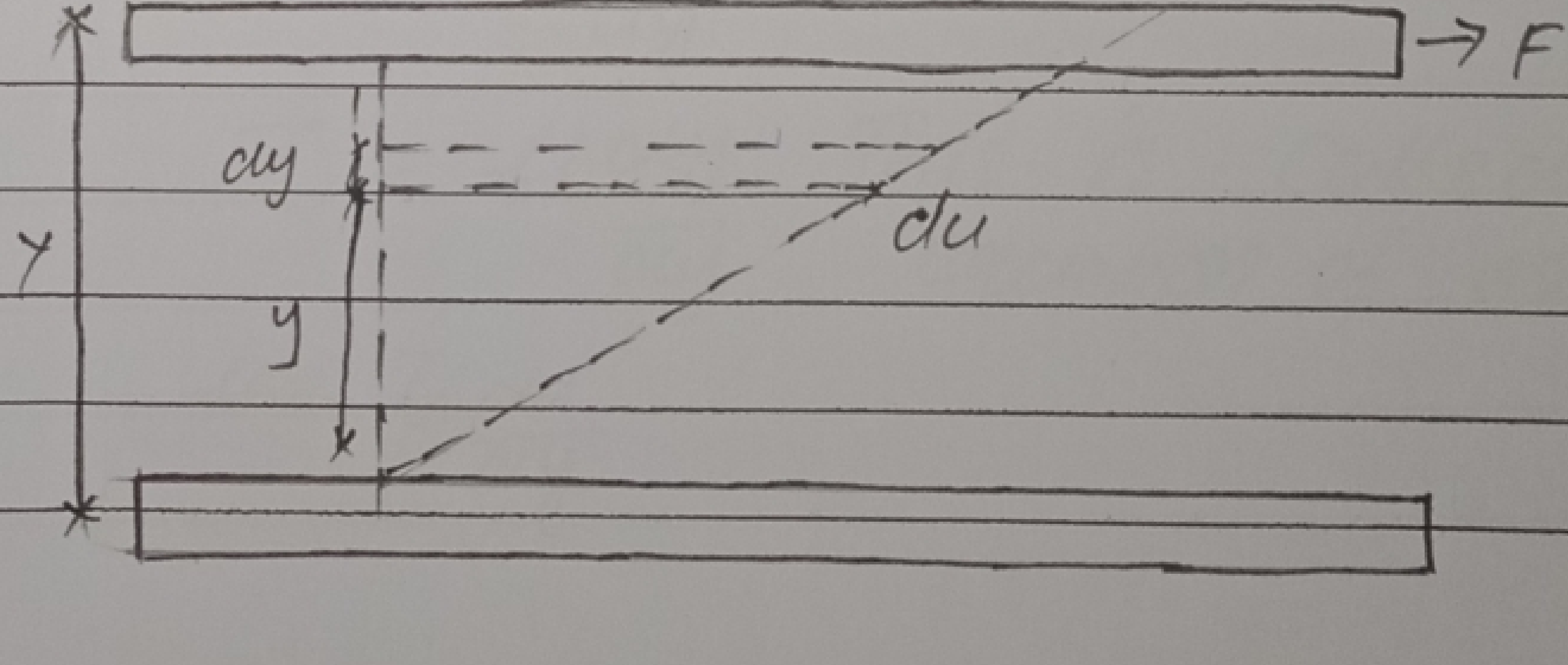
viscosity :→ It is the property of fluid by which it imports resistance to fluid motion by offering resistance to movement of one layer over another.

The viscosity of fluid is measured of its Resistance of Shear OR Anguler deformation.

The friction forces from Cohesion and momentum interchange between molecule in fluid. As temparetuve increase, the viscosity of liquid decrease. In gass viscosity increase with increase in temparetuve because of moleculer 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

$$F = \frac{\mu AU}{Y}$$ ∴ U = velocity, A = Area.

OR $$F/A = \frac{\mu u}{Y}$$

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

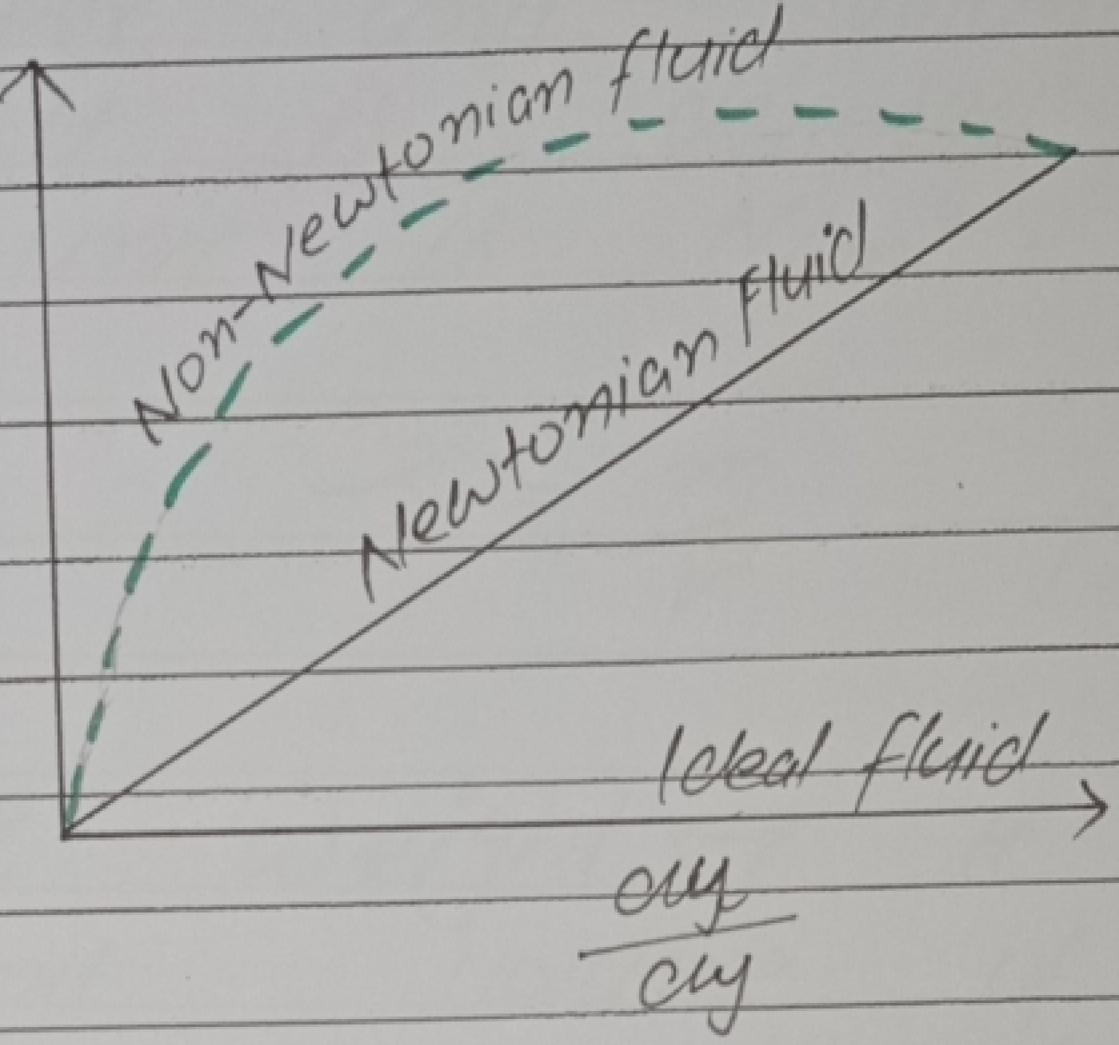
dy, The velocity will be Thus

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

$$\tau = \mu \frac{du}{dy}$$ 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 doesn't change with rate of deformation is said to be newtonian fluid. Ideal fluid with no viscosity is represented by horizontal 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 ν = Kinamitic viscosity
μ = Dynamic viscosity
ρ = 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.

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

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

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

Specific Volume :- it is the volume occopied by unit mass of fluid its unit is m^3/kg

$$\upsilon = V/m = 1/\rho$$

Specific volume also have the inversly Relation to the density.

Relation Between Density and specific weight:

We have formula of the specific weight:

$$\gamma = \frac{W}{V} \rightarrow (A)$$

where $W = mg$

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

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

Put in eq (B)

So
$$\gamma = \rho g$$

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

(6)

Part (C) Solution

Given data:

Specific volume of ges = $0.72\ m^3/kg$

Required: Specific weight?

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

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

Now $\gamma = \rho g$

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

Specific weight $= 13.54\ N/m^3$

Q No # 02 Part (a) Ans:

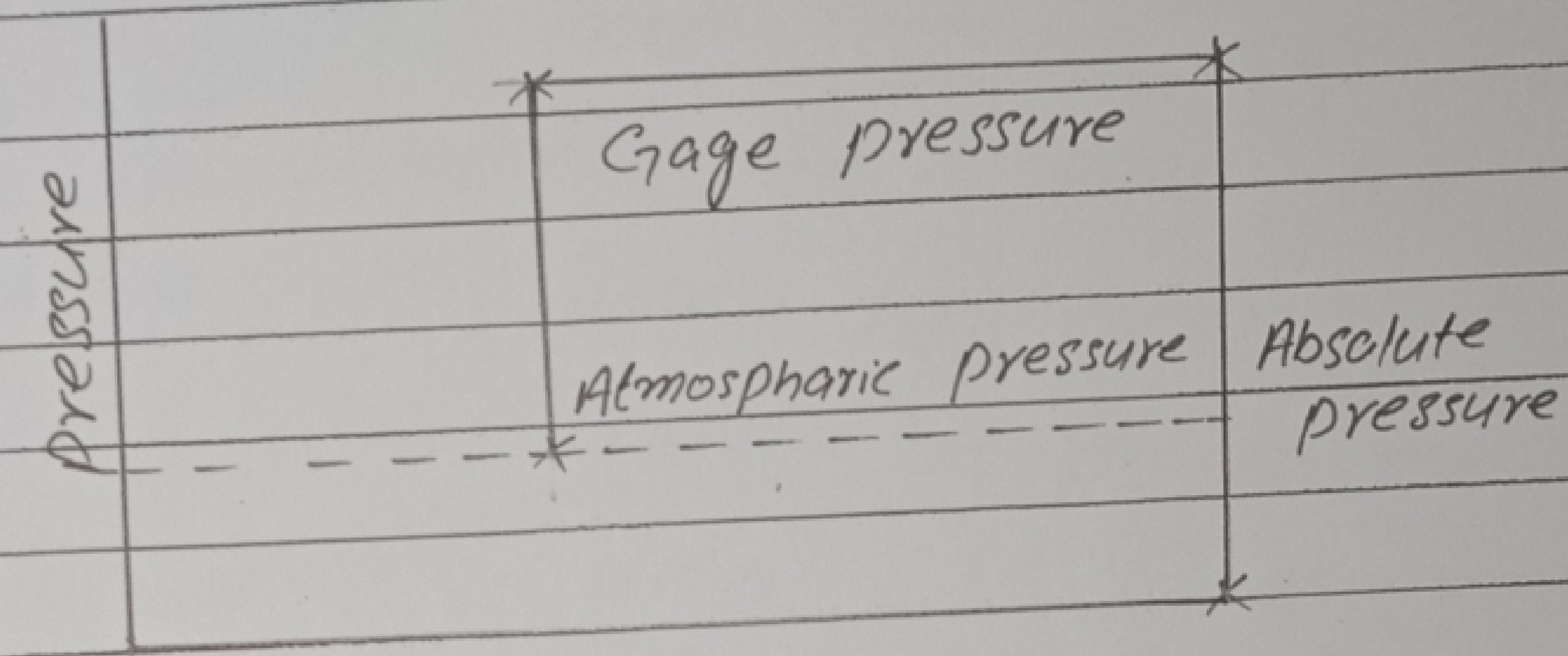
Pressure :→ Fluid in a container Press with an outward force against the walls of that container. The Pressure is defined as the ratio of the force to the area on which the force is exerted.
The SI units of Pressure are N/m^2 as also defined as the pascal where 1 pascal is equal to $1\ N/m^2$.
& 1 atm = 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

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



Q NO # 02 Part (b) A water tank having dimension of 1500mm × 1500mm. Depth of the water tank is equal to your Student ID Numbe. 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.

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

Depth = ID in mm = 7945 ~~mm~~ = 7.945m

So $F_C = \gamma A h_c$

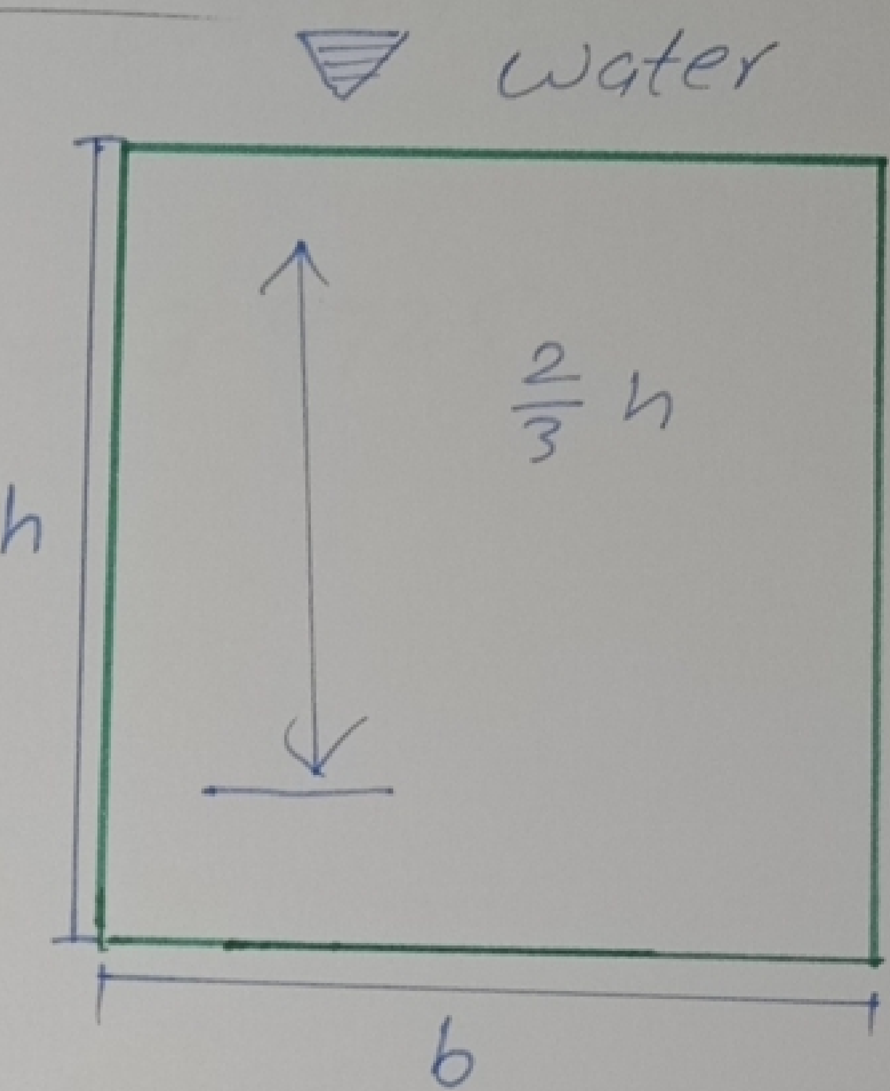
where A = is: Area

γ = specific weight

$h_c = \frac{h}{2} = \frac{7.945}{2}$

$F_C = (9810)(2.25)(3.972)$

$$F_c = 87671.97\,N$$



For $h_r = ?$

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

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

$$h_r = \frac{h}{2} + \frac{bh^3}{6\not{12} * \frac{h}{\not{2}} * bh}$$

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

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

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

Also we can say that

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

$$h_r = \frac{2}{3}\,7.945$$

$$\boxed{h_r = 5.296}$$

For The condition two.
half Depth of the water.

$$d = \frac{7.945}{2} = 3.9725$$

$$\boxed{d = 3.9725}$$

$$h_c = \frac{3.9725}{2}$$

$$\boxed{h_c = 1.986}$$

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

So $F_c = \gamma A h_c$

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

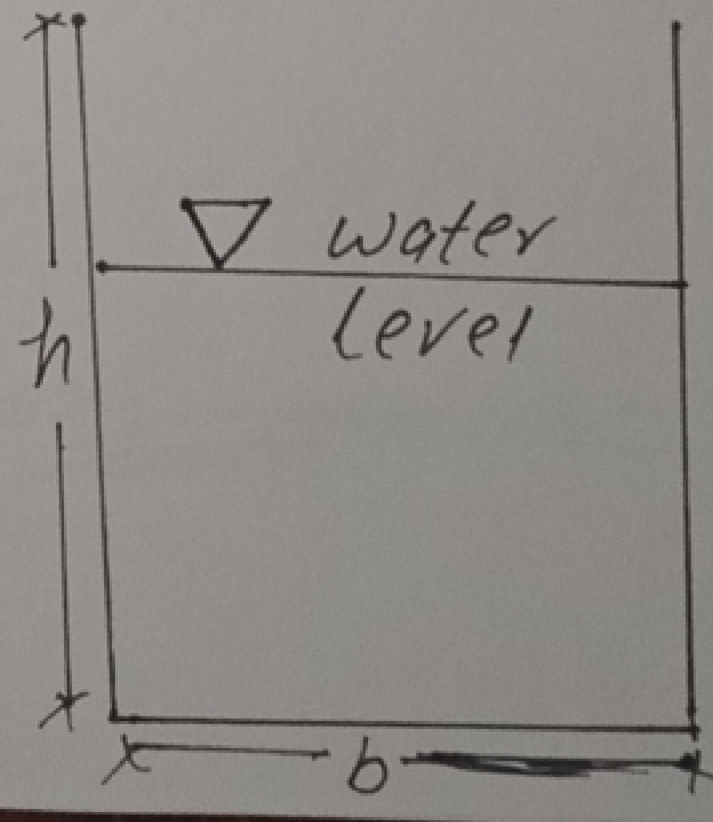
$$\boxed{F_c = 43835.985\ N}$$

If depth is half then $h_r = ?$

$h' = h/2$

Center of pressure from water level.

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



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

In this case

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

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

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

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

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

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

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

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

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

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

$$h_r = \frac{7.945}{3} = 2.648\,m$$

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