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Section # B

paper # Fluid Mechanics (Theory)

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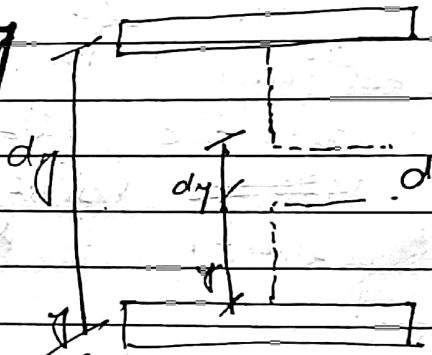
Q#01 ⇒ Define Viscosity? Derive newton equation of Viscosity -

Ans Viscosity :- The property of fluid by virtue of which it offers resistance to shear is known as Viscosity -

Newton equation of Viscosity



⇒ According law

⇒ Now Consider two parallel plates placed at distance "y" and space b/w is filled with fluid - lower surface is assumed to be stationary while upper moved with velocity V - (fluid)

$$f \propto \frac{AV}{y}$$

or

$$F = \frac{\mu AV}{y} \quad \text{or} \quad \frac{F}{A} = \frac{\mu v}{y}$$

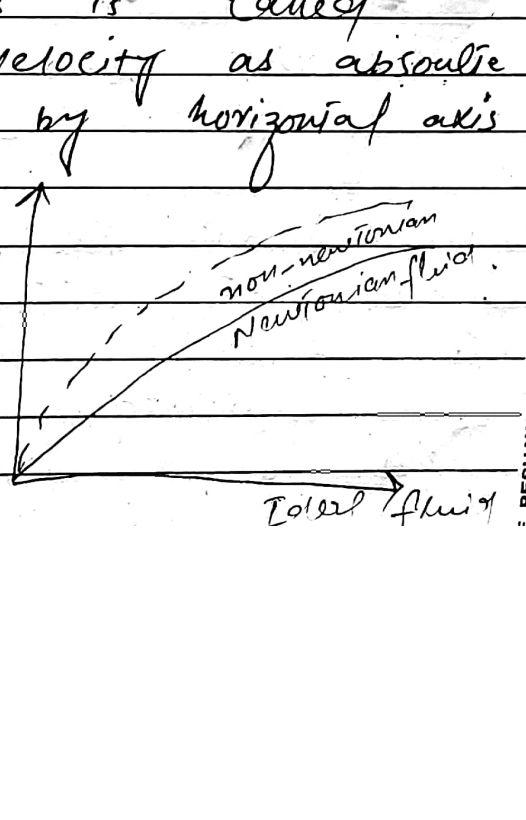
$$\text{Thus} \quad \tau = \frac{\mu V}{y}$$

~~Viscosity~~ ~~velocity~~

for dy the ~~velocity~~ with be dv

thus $\tau = \mu \frac{dv}{dy}$. This is called dynamic co-efficent of velocity as absolute ~~velocity~~ viscosity is represented by horizontal axis

Unit "$\frac{N \cdot s}{m^2}$"



(B) Density

⇒ Mass per unit volume of fluid.
⇒ It is denoted by "ρ" & its unit is kg/m^2 -

Specific weight :- It is weight per unit volume of fluid - It is represented by gamma γ $\gamma = \frac{w}{v}$ - It unit is n/m^3 -

Specific volume :- It is a volume occupied by unit mass of fluid -
Its unit is m^3/kg

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

(4)

Relation b/w Specific weight & Density

As $w = \frac{W}{V}$ where $W = mg$

Thus $w = \frac{mg}{V}$ As we have

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

Thus $w = \rho \times g$ or $\rho = x$.

Q#01(c)

⇒ if specific volume of gas is $0.72\ m^3/kg$ - what is specific weight in N/m^3?

Solution :- Given that

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

We have to find :

specific weight, $V_s = ?$

As

$$V = 1/\rho$$

$$\rho = 1/V$$

$$\rho = 1/0.72$$

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

As

$$r = \rho g$$

$$r = 1.38 \times 9.81$$

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

Q #02

(a) ⇒ Define pressure? What is an absolute & guage pressure?

Ans ⇒ Pressure :- The force applied perpendicular to the surface of an object per unit area over which that force is distributed.
S.I base Unit $1 N/m^2$, $1 kg/(m \cdot s^2)$
⇒ S.I Unit pascal
formula :- $P = F/A$

Absolute pressure :- Absolute pressure that is relative to the zero pressure in the empty air-free space to the Universe.
This reference pressure is the Ideal or absolute vaccum it is denoted with the subscript "abs" Pabs.

Gauge pressure :- The gauge pressure is defined as the difference b/w an absolute pressure & the prevailing atmospheric pressure. It is denoted with subscript "e"; p_e & is calculated as follows;

$$p_e = p_{abs} - p_{amb}$$

(8)

Q#02 (B)

Given data

Length, l = 1500 mm = 1.5m
Breadth, b = 1500mm = 1.5m
Depth, h = 7976mm = 7.976m
Unit weight of water = 9.81 KN/m³

Required Data

⇒ a_0 = net pressure, p = ?
→ b_0 = location of force
→ c_0 = If water level drops half of depth find p & location of force.

Solution

(a) Net pressure

$$p = \gamma h$$

$$p = 9.81 \times 7.976$$

$$\boxed{p = 78.24456\ kN/m^2}$$

(b) Force application (centroid)

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

$$\bar{y} = \frac{7.976}{3}$$

$$\boxed{\bar{y} = 2.6586\ m}$$

(1D)

(c) Half Depth

pressure at half depth, $p' = \gamma h/2$

$$p' = 9.81 \times 7.976/2$$

$$p' = 39.12\ KN/m^2$$

Centroid

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

$$\bar{y} = 1.323\ m$$