Model Question Paper

IV Sem. F.M.

Time: 1 hour
Max marks: 10

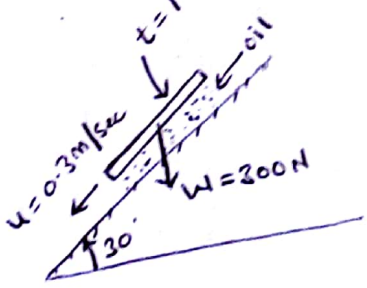
Note:- All questions are compulsory:-

Q.1:- write the specific formulae of — (2)

(i) Density
(ii) Specific weight
(iii) Specific volume
(iv) Specific gravity

Q.2:- Define viscosity & draw the graph of newtons law of viscosity. (4)

Q.3:- Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30° as shown in fig. The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. (4)



Ans. 1 :-

1. Density or mass density = $\frac{\text{Mass}}{\text{Volume}}$

ρ = 1 gm/cm³ or 1000 kg/m³ for water ($\frac{\text{mass}}{\text{vol.}}$)

2. Specific weight (weight density)

$$w = \frac{\text{weight of fluid}}{\text{Vol. of fluid}} = \frac{\text{mass of fluid} \times g}{\text{Vol. of fluid}} = \rho g$$

3 Sp. volume :- Volume per unit mass

$$\text{Sp. vol.} = \frac{\text{volume}}{\text{mass}} = \frac{1}{\rho}$$

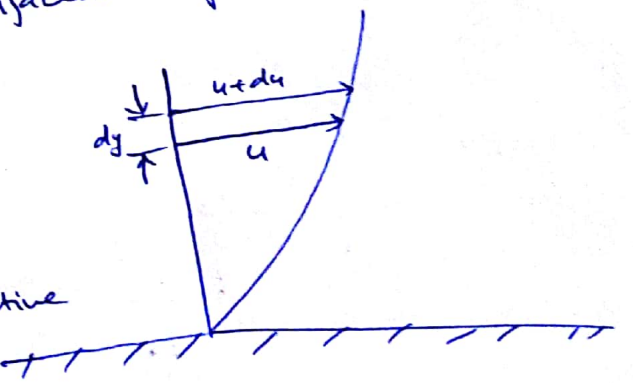
4. Sp. gravity (S) = $\frac{\text{wt. density of liquid}}{\text{wt. density of water}}$
(relative density

=

5. ~~1 litre = 10^{-3} m³~~

Ans. 2 :-

VISCOSITY :- Resistance to the movement of one layer of fluid over another adjacent layer of the fluid



- Two layers of fluid at distance dy apart, move with velocity u & u+du
- The viscosity together with relative velocities causes shear stress acting between the fluid layers
- These shear stress is proportional to the rate of change of velocity with respect to y.

$$\tau \propto \frac{du}{dy} \Rightarrow \tau = \mu \cdot \frac{du}{dy}$$

μ → coeff. of dynamic viscosity or viscosity.

$\left(\frac{du}{dy}\right)$ → known as rate of shear strain or shear deformation.

1 poise (c.g.s) $= \frac{1}{10} \frac{NS}{m^2}$

(CGS = 1 Poise)

Kinematic viscosity:- $\Rightarrow \frac{\mu}{\rho}$

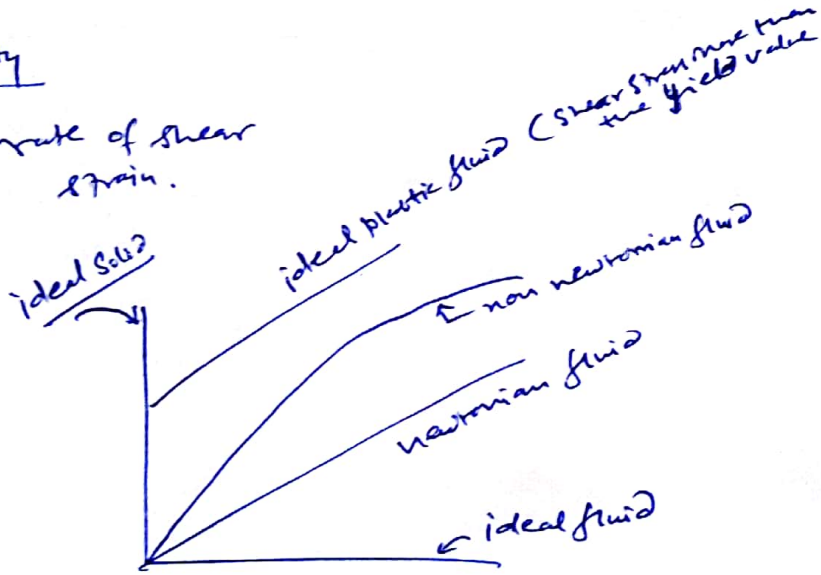
$$\nu = \frac{\mu}{\rho}$$

~~(CGS)~~

(CGS = 1 stroke)

Newtons law of viscosity

$\tau \propto$ rate of shear strain.



Ans. 3:-

Given:-

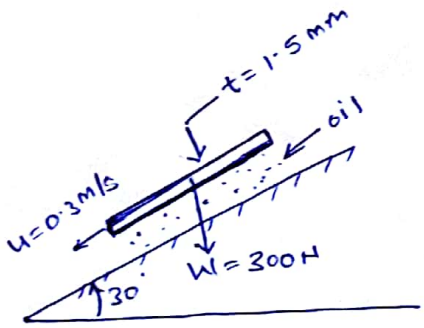
Area of plate = 0.8×0.8
$= 0.64\ m^2$

Angle of plane $\theta = 30^\circ$

Weight of plate $W = 300\ N$

velocity of plate $u = 0.3\ m/sec$

Thickness of film $t = dy = 1.5\ mm = 1.5 \times 10^{-3}\ m$



Let, the viscosity of fluid between plate and inclined plane is μ.

Component of weight W, along the plane = $W \cos 60^\circ$
$= 300 \cos 60^\circ$
$= 150\ N$

Thus the shear force, F, on the bottom surface of the plate = 150 N

and shear stress

$$\tau = \frac{F}{\text{Area}} = \frac{150}{0.64} \text{ N/m}^2$$

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

where, du = change of velocity = $u - 0 = u = 0.3$ m/sec

$dy = t = 1.5 \times 10^{-3}$ m

$$\Rightarrow \quad \frac{150}{0.64} = \mu \frac{0.3}{1.5 \times 10^{-3}}$$

$$\Rightarrow \quad \mu = \frac{150 \times 1.5 \times 10^{-3}}{0.64 \times 0.3}$$

$$= 1.17 \text{ Ns/m}^2$$

$$= 1.17 \times 10 \text{ poise}$$

$$\mu = 11.7 \text{ poise}$$

(Ans. $\mu = 11.7$ poise)

—— x ——