NAME: M. Humais

ID: 7963

SECTION: "B"

DEPARTMENT: BE Civil Engineering.

SUBJECT: Fluid Mechanics.

DATE: 16th April - 2020.

QUESTION: 1 (a):-

=> Define viscosity? Drive newton equation of viscosity.

Ans=> VISCOSITY:-

=> Definition:

"It is the property of fluid which imparts resistance to fluid motion by offering resistance to movement of one layer over another."

OR

Another definition of viscosity is "the property of fluid by virtue of which it offer resistance to shear is known as viscosity".

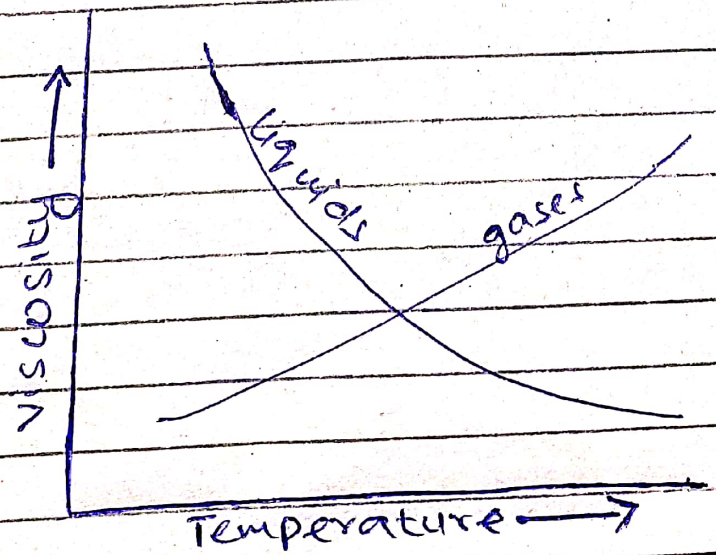
=> Example:

=> Motor oil has high viscosity and resistance to shear, is cohesive and feel "sticky", whereas gasoline has low viscosity.

=> Explaination:

=> The friction forces in flowing fluid result from the cohesion and momentum interchange between molecules. As temperature increases, the velocities of liquids decreases while the velocities of all gases increase. This is because the force of cohesion, which demolishes with temperature, predominates with liquids while the gases, the predominating with factor, is the interchange of molecules between the layer of different velocities.

=> Diagramitically:-

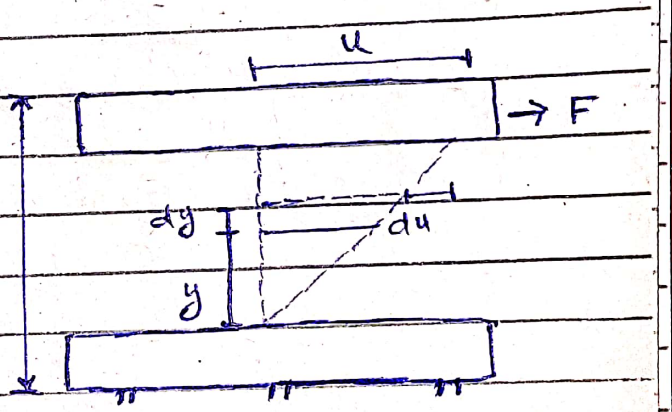


⇒ UNIT:-

Its unit is kg/m.sec or Pascal-second.

⇒ Newton equation of viscosity:

Now, consider two parallel plates placed at distance y as spaced in between with fluid. lower ~~the~~ surface is assumed to be stationary while upper moved v Thus,



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

putting constant so that proportionality sign be removed.

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

OR.

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

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

stated that:-

"The shear stress in

a flowing fluid is directly proportional to the rate of "strain".

⇒ **Mathematically:** ∴ (For dry, the velocity will be du)

Thus,

$$\tau \propto \frac{du}{dy}$$

Here τ is shear stress.

So,

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

and "μ" is proportionality constant.

$\tau = \frac{\mu du}{dy}$ ⇒ **(Newton eq of viscosity).**

μ = viscosity (Dynamic viscosity).

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

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

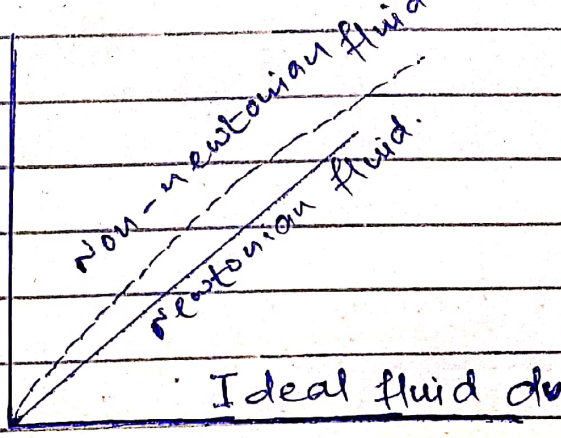


fig (1)

The fluid for which constant of proportionality does not change with rate of deformation as shown in (fig - 1) is ~~called~~ said to be newtonian fluid.

⇒ Ideal fluid with no viscosity is represented by horizontal line as shown in (fig- 1).

Unit of absolute viscosity is $\frac{N.s}{m^2}$.

⇒ QUESTION: 1 ⇒ (b) :-

⇒ Define Density specific weight and specific volume. show relation b/w density and specific weight.

Ans :- Density :-

Def :-

"Density can be defined as mass per unit volume of a fluid."

Mathematically :-

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

Here;

ρ = density

m = mass

V = Volume.

Unit:- kg/m^3

=> Specific weight :-

"Specific weight is the weight possessed by unit volume of a fluid".

=> Mathematically :-

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

Here;

γ = specific weight

w = weight.

V = Volume.

Unit:-

N/m.

=> Specific Volume:-

=> It is the fluid property.

=> "Specific volume is the volume of a fluid which occupied per unit mass. OR :- It is the reciprocal

of density.

Mathematically:-

$$v = V/m$$

Here :-

v = specific volume.
V = volume.
m = mass.

Unit:- m^3/kg

⇒ Relation b/w Specific weight and Density :-

As we know that

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

Thus putting $w = mg$ in above equation. $\therefore w = mg$

$$\gamma = \frac{mg}{V} \quad \text{——— (1)}$$

and :- $$\frac{m}{V} = \rho \quad \text{——— (2)}$$

putting eq (2) value of "ρ" in eq (1)

$$\boxed{\gamma = \rho g} \quad \text{OR} \quad \boxed{\rho = \gamma/g}$$

Question # 1 (c):-
If specific volume of gas is $0.72\ m^3/kg$. what is the specific weight in N/m^3?

=> Given DATA:-
Specific volume of gas = $0.72\ m^3/kg$

=> Required:-
Specific weight in $N/m^3 = \gamma = ?$

=> Solution:-
we know that:-

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

$$\rho = 1/V$$

$$\rho = 1/0.72$$

$$\boxed{\rho = 1.389\ kg/m^3}$$

required => specific weight:

$$\gamma = \rho \times g$$

$$\gamma = 1.389 \times 9.8$$

$$\boxed{\gamma = 13.62\ N/m^3}$$

Question # 02 (a):-

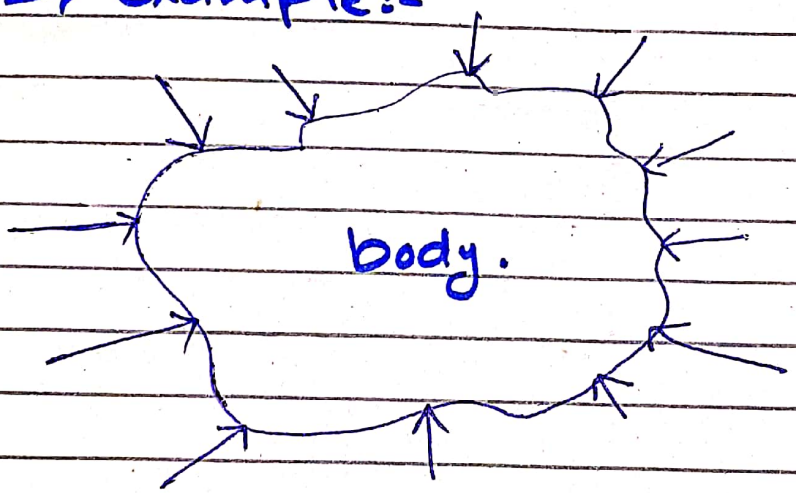
Define Pressure? what is an absolute and guage pressure?

Ans ⇒

PRESSURE:-

"Pressure is a normal stress, and has dimension of force per unit area."

⇒ **Example:-**



Pressure always act inwards normal to any surface (even imaginary surfaces as in a control volume).

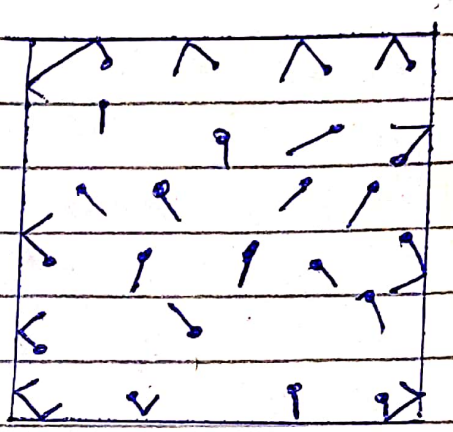
OR:

Pressure is defined as the physical force exerted on an object. The force applied is perpendicular to the surface of objects per unit area. The basic formula for

pressure is F/A (force per unit Area)

=> Example:-

Pressure on wall of the container.



Formula:-

The formula of pressure is

Pressure (P) = Thrust / Area = Force / Area.

$$P = F/A.$$

=> Unit:-

=> In english system of unit, Pressure is expressed as "Psi" or lbf/in^2.

=> In the Matric system of unit, pressure is expressed as "Pascals" or N/m^2.

⇒ Absolute Pressure:-

If we measures pressure relative to absolute zero we call it absolute pressure.

⇒ Gauge Pressure:-

If we measures relative to atmospheric pressure as a base we call it guage pressure.

⇒ Explanation of Absolute & Guage pressure:-

⇒ This is because practically all pressure guages register zero when open to the atmosphere, and so they measure the difference between the pressure of the fluid they are connected to and that of the surrounding air.

⇒ If the pressure is below that of the atmosphere, we call it a vaccum and if guage value is the amount by

which it is below that of atmosphere, i-e we call a "**high vaccum**" is really a low absolute pressure; a perfect vaccum would correspond to absolute zero pressure.

⇒ All the value of absolute pressure are positive since a negative value would Tension, which are normally consider in any fluid. Gauge pressure are positive if they are above that of the atmosphere and negative if they are vaccum.

we can calculate from the preceding discussion that the following relation hold mathematically

⇒ Mathematically:-

$$P_{Abs} = P_{Atm} + P_{guage}.$$

where,

Pguage may be positive or negative (vaccum).

Question # 02 (b):-

=> A water tank having dimensions of 1500 mm x 1500 mm. 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 & point of application of force.

=> Given data:-

Length of water Tank = "l" = 1500 mm
= 1.5m

Width of water tank = w = 1500 mm
= 1.5m.

Depth of water tank = h = 7963 mm
= 7.963m

Unit weight of water = $9.81\ KN/m^3$

=> Required:-

1 => Net pressure =?

2 => location of pressure =?

3 => If water level drop half of depth what will be net

pressure and location of force application = ?

SOLUTION:-

1=> NET Pressure:-

we know that:-

$$P = \gamma h.$$

$$P = 9.81 \times 7.963$$

$$\boxed{P = 78.11 \text{ kN/m}^2}$$

2 => Force Application (centroid):

$$\bar{y} = h/3 \Rightarrow \bar{y} = \frac{7.963}{3}$$

$$\boxed{\bar{y} = 2.65 \text{m}}$$

3 => half Depth (pressure) & (centroid):

$$P = \gamma \times h/2.$$

$$P = 9.81 \times \frac{7.963}{2}$$

$$\boxed{P = 39.05 \text{ kN/m}^3}$$

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

$$\bar{y} = \frac{7.963}{2} \times \frac{1}{3} \Rightarrow \boxed{\bar{y} = 1.325 \text{ m}}$$