TEACHER: ENGR. ABDUL WAHEED

STUDENT: ALAMGIR KHAN.

I.D: 7282

SUBJECT: FLUID MECHANICS - I

DEPARTMENT: CIVIL ENGINEERING BATCH 2013.

UNIVERSITY: IQRA NATIONAL UNIVERSITY

I.D # 7282 1

Fluid Mechanics 1. Assignment

Student : Alamgir Khan

I.D : 7282

Batch : 2013

Teacher : Engr. Abdul Wahid

Q.No 1. Part a).

Define Viscosity? Derive newton equation of viscosity.

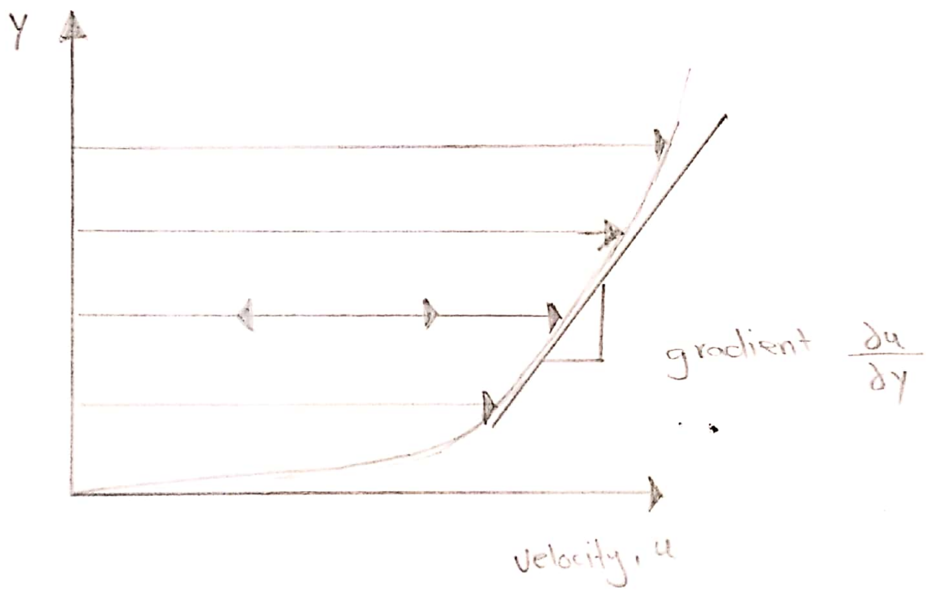
⇒ The viscosity of a fluid is a measure of its resistence to deformation at a given rate. For liquids, it corresponds to the informal concept of "thickness". For example syrup has a higher viscosity than water.

Common symbols η, μ

Viscosity can be conceptualized as quantifying the internal friction force that arises between adjacent layers of fluid that are in relative motion. For instance when a fluid is forced through a tube, it flows more quickly near the tube's axis than near it's walls. In such a case, experiments show that some stress is needed to sustain the flow through tube

Derivation of Newton equation of viscosity.

- Consider a flow in which fluid particles move in a particular direction maintaing straigh parallel lines.



When a flow is adjacent to surface stick to it & have zero velocity relative to the boundry which is called No slip condition.

Mathematically, $\tau \propto \frac{du}{dy}$ OR $\tau = \mu \frac{du}{dy}$

where μ is called coefficient of viscosity.

It can be considered as Modulous of Rigidity of fluid.

Q.No. 1 Part b)

⇒ **Density:** Density is a measurement that compares the amount of matter an object has to its volume. An object with much matter in a certain volume has high density An object with little matter in the same amount of volume has a low density.
Density is found by dividing the mass of an object by its volume.

⇒ **Specific weight:** Specific weight is also known as the unit weight. It is the weight per unit volume of a material. A commonly used value is the specific weight of water on earth at 4°C which is 9.807 KN/m^3 or 62.43 Lbf/ft^3

⇒ **Specific Volume:** The specific volume of a substance is a ratio of the substance's volume to it's mass. It is the reciprocal of density & an intrinsic property of matter as well. Specific volume is defined as the number of cubic meters occupied by one Kilogram of a particular substance

⇒ Relation between Density & Specific Weight.

→ Quite often the specific weight of a substance is found when its density is known & vice versa

→ The conversion is made by the equation

$$\gamma = \rho \times g \qquad \therefore \text{ specific weight} = \gamma = \frac{w}{V}$$

By multiplying 'g' on numerator & denominator we reduced to

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

Q No. 1 Part c.

If the specific volume of a gas is 0.72 m^3/Kg what is its specific weight in N/m^3 ?

Solution:

Given that

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

We have to find

Specific weight, $\gamma_s = ?$

As,

$$V = 1/\rho$$

$$\rho = 1/V$$

$$\rho = 1/0.72$$

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

As

$$\gamma = \rho g$$

$$\gamma = 1.38 \times 9.81$$

$$\gamma = 13.54\ N/m^3$$

Q No. 2 Part a.

=> Pressure

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 $P = F/A$. Unit of pressure is Pascal (Pa).

Types of Pressure are Absolute Pressure, Atmospheric Pressure, Differential & Gauge Pressure.

=> Absolute Pressure:

Absolute pressure is a pressure that is relative to the zero pressure in the empty, air-free space of the universe. This references pressure is the ideal or absolute vaccum. Denoted as "P_{abs}"

=> Gauge Pressure:

Gauge Pressure is defined as the difference between a absolute pressure & prevailing atmospheric pressure. It is denoted as P_e & Given by

$$P_e = P_{abs} - P_{amb}$$

Q2. Part b Numerical Problem

Given Data.

Dimension of tank = 1500 mm x 1500 mm

Depth of tank = H = 7282 mm

H = 7.282 m

Required ① a) Net pressure force on the wall of tank = P_1 = ?

b) location of the Resultant force = H_1' = ?

② If the water level becomes half,

a) Pressure force = P_2 = ?

b) location of force = H_2' = ?

Solution:

First for all the units, we will converts all to M.K.S

(1) When water tank is full

Since, we know that,

(a) hydrostatic pressure

$= P = \gamma H \rightarrow (1)$

where H = 7.282 m

γ = specific weight of water

$= 9.8\ KN/m^3$

Now, Water pressure at the Top of tank

Put $H = 0$ in eq (1)

$\Rightarrow P_1 = 9.80 \times 0 = 0 \Rightarrow \boxed{0\ KN/m^2}$ Fig - I

At the bottom of tank

Put $H = 7.282m$ in eq (1)

$\Rightarrow P_2 = 9.80 \times 7.282 \Rightarrow \boxed{71.36\ KN/m^2}$ - Fig I

(b) Location of the resultant force

As we know Resultant force

$$\Rightarrow F_1 = \frac{1}{2}(71.36 \times 7.282)$$

$$\boxed{F_1 = 259.83\ KN}$$ - Fig I

This force will act at a distance of $H/3$ from the base

$$H_1' = H/3 = \frac{7.282}{3} = 2.43m$$

$$\boxed{H_1' = 2.43m}$$ - Fig I

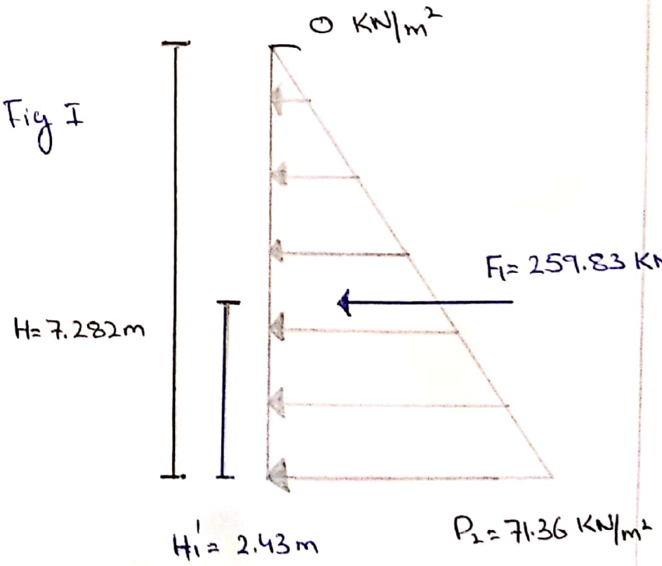


Fig - I.

(2) When ~~ta~~ the tank is Half filled

(a) For that height of water

$$H = \frac{7.282}{2} = 3.641\ m$$

Water pressure at top,

$P_1 = 9.80 \times 0 \Rightarrow 0$

$\boxed{P_1 = 0\ KN/m^2}$ - Fig II

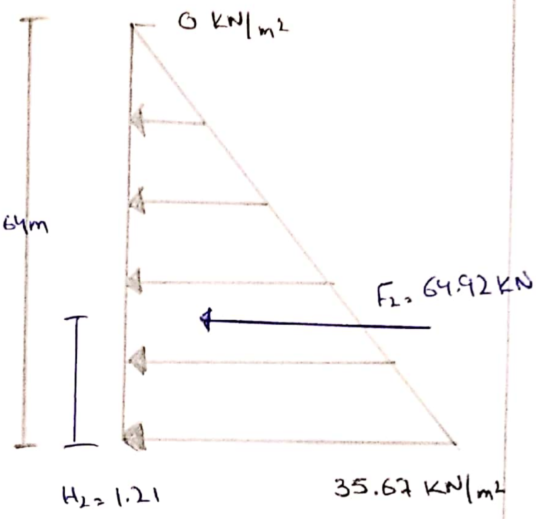


Fig - II

At the bottom of tank

$P_2 = 9.80 \times 3.64$

$\boxed{P_2 = 35.67\ KN/m^2}$ - Fig II

(b) Resultant force & it's location

$F_2 = \frac{1}{2}(35.67 \times 3.64)$

$\boxed{F_2 = 64.92}$ - Fig II

Now, This will act at $H/3$ from the base

$H_2' = H/3 = 3.64/3 = 1.21\ m$

$\boxed{H_2' = 1.21\ m}$ - Fig II