19/6/17

Fluid Mechanics

unit:-1

fluid mechanics:- fluid Mechanics is a branch of the Science which deals with behaviour of the fluids (fluid is not only liquids gaseous also)

fluid:- fluid is a Substance which deforms Continously when External shear forces are excerted on it types

1) Real fluid
2) Ideal fluid

fluid Mechanics are classiefied in ~~two~~ three types they are

1) fluid static's
2) fluid kynamatics
3) fluid dynamic-atics

→ (Rest position)

fluid statics:- It is defined as the study of the fluid at the position
Ex: Rest position

fluid kynamatics:- It is define as the study of the fluid at Motion the ~~external~~ pressure forces are Neglect

fluid Dynamatics:- It is defined as the study of the fluid at Motion with Considered pressure force

Physical quantity

	length	Mass	time
CGS	Centimeter	Gram	sec
MKS	Meter	kg	sec
FPS	fout	pound	sec

Physical quantites :- the quantites means of which we described the law of physics is called a physical quantity

the physical quantity are derived into two types

1) fundamental quantities

2) derived quantities

UNITS AND DEMENSIONS :-

fundamental quantities

the quantities are independent of each other and cant further resolved into any other physical quantities

S.NO	fundamental quantity	units	Symbols
1	length	Meters	M
2	Mass	kg	kg
3	time	sec	S
4	electric Current	Ampere	A

5	Thermodynamic temperature	kalven	k
6.	luminous intensity	Candila	cd
7.	Amount of Substance	Mole	Mol

Derived quantities:- The physical quantites which depends up on the fundamental quantities As these types of quantity is Called fundamental quantities

or

Which Can be derived from fundamental Quantities are known as derived Quantity units

Which quantities are Measured is known as unit

The units are divided into three classification

1) fundamental units

2) derived units

3) Supplementary units

Dimensions:-

Dimensions of physical quantities are the power to which the fundamental quantity much be rising to represent the physical Quantity

F = mass x Acceleration

$M \times \frac{velocity}{time}$

$Velocity = \frac{displacement}{time}$

$V = \frac{L}{t}$

$\frac{M \times L/t}{T}$

$M \times \frac{L}{T^2}$

$M \times L \times T^{-2}$

Dimension less formula

$f = MLT^{-2}$

Quantity	Symbol	formula	S.I unit	Dimensions less formula
Displacement	S	No (formula)	Meter	$M^0 L T^0$
Area	A	$l \times b$	M^2	$M L^2 T^0$
Volume	V	$l \times b \times h$	M^3	$M^0 L^3 T^0$
Velocity	v	$\frac{\text{displacement}}{\text{time}}$	M/s	$M^0 L^1 T^{-1}$
Momentum	P	Mass x velocity	kg m/s	$M^1 L^1 T^{-1}$
Acceleration	a	V/T	m/s^2	$M^0 L^1 T^{-2}$
force	F	ma	$kg\,m^2/s^2$	M
Work	ω	F x d	N/s^2	$M^1 L^1 T^{-2}$
Impulse	-	F x t	N x sec	$M^1 L^1 T^1$
Energy	E	KE PE	-	-
kinetic energy	KE	$\frac{1}{2} M V^2$	Joules	-
potential energy	PE	mgh	Joules	-
power	P	ω / T	V/s^3	$M^1 L^1 T^{-3}$

Properties of fluids :- (density)

property
↓
Physical | Mechinal

Physical property

It's study way (Means chemical) of proceeding

Mechinal property

It's study the strengths

Properties of fluids :-

These are types of fluids. of properties

1. density or Mass density → Mass - kg, V - m³

density ↓ It's the ratio of $\frac{\text{the mass of the fluid}}{\text{volume of the fluid}}$

2. Weight density :-

It's the ratio of $\frac{\text{weight (~~mass~~) of fluid}}{\text{volume (~~weight~~) of the fluid.}}$

3. Specific Gravity

properties of fluids:-

1. **density:-** It is defined as the ratio of the mass of fluid to the volume of fluid

Mathematically density (ρ) row = $\frac{\text{Mass of the fluid}}{\text{volume of the fluid}}$

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

$$\rho = \frac{9810}{0.1}$$

∴ units = kg/m^3

The density for standard liquid (water) = $1000\ kg/m^3$

2. **Weight density:-** It is defined as the ratio of the weight of the fluid to volume of the fluid

Mathematically (w) = $\frac{\text{weight of the fluid}}{\text{volume of the fluid}}$

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

units are = N/m^3 (or) KN/m^3.

(or)

We can find also

w = mean × acceleration due to gravity

= m × g

$$w = \frac{m}{v} \times g$$

$$\boxed{w = \rho g}$$

∴ Weight density of ~~wa~~ standard light

$$w = \rho g$$

$$= 1000 \times 9.81$$

$$= 9810\ N/v$$

3. Specific volume :-

It is defined as the ratio of the volume of the fluid to mass of the fluid

Mathematically (v) = $\frac{\text{volume of the fluid}}{\text{Mass of the fluid}}$

$$v = \frac{V}{M}$$

Specific volume is reciprocal of density

∴ units = m^3/kg

$$\boxed{v = 1/\rho} \rightarrow \text{density}$$

4. Specific Gravity :-

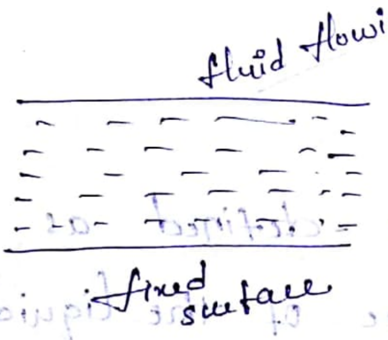
It is defined as the ratio of the weight density of liquid to weight density of water

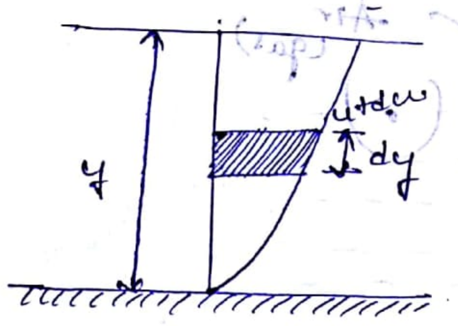
Mathematically $S = \frac{\text{Weight density of liquid}}{\text{Weight density of Water}}$

It's is a dimensional formula.

Viscocity:-

It is defined as the resistance offer to a layer of fluid when it moves over a another layer of the fluid.





The rate of Shear Stress is directly proportional to velocity ~~radiant~~ gradient

$$\tau \propto \frac{dv}{dt}$$

$\tau \propto \frac{dv}{dt}$

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

Where μ = co-efficient of $\frac{du}{dy}$

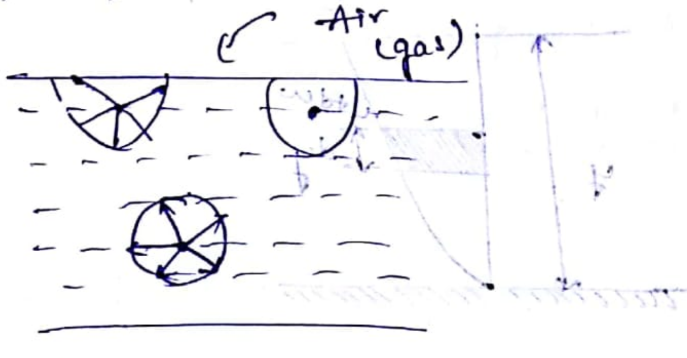
$$\tau = \mu \frac{du}{dy}$$ or μ dynamic

units of viscosity Ns/m^2

1 poise = $\frac{1}{10}$ Ns/m^2

Surface tension :-

It is defined as a tensile force acting on Surface of the liquid in contanct with air (or) b/w two im-brcsible liquids



units are N/m

It is denoted by σ

where ϕ

It's is the ratio find out the tensile force

$$p = \frac{4\sigma}{d}$$

Where P = Pressure force

σ = Surface tension

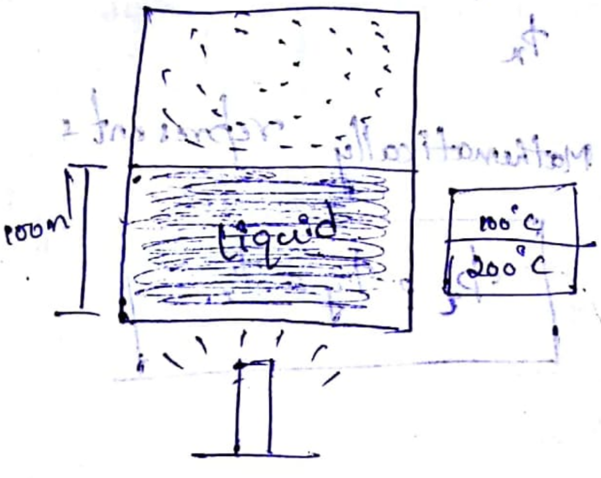
d = diameter of the Water bubble

The surface tencion of the soap bubble =

$$p = \frac{8\sigma}{d}$$

Vapour pressure:-

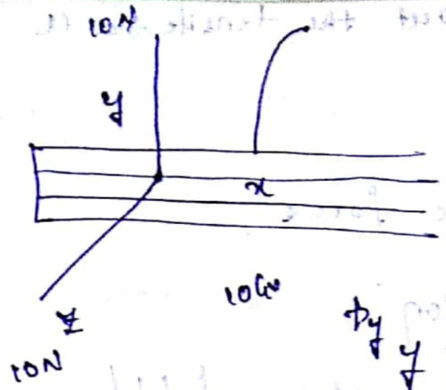
Vapour pressure is a pressure Exacated by the vapour of the liquid

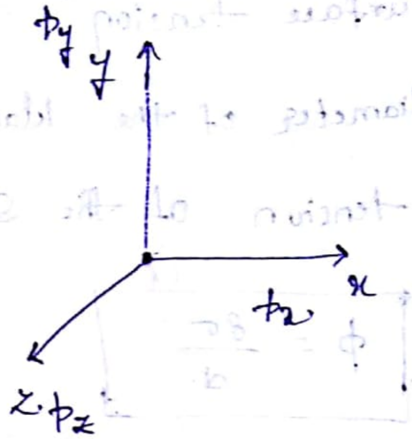


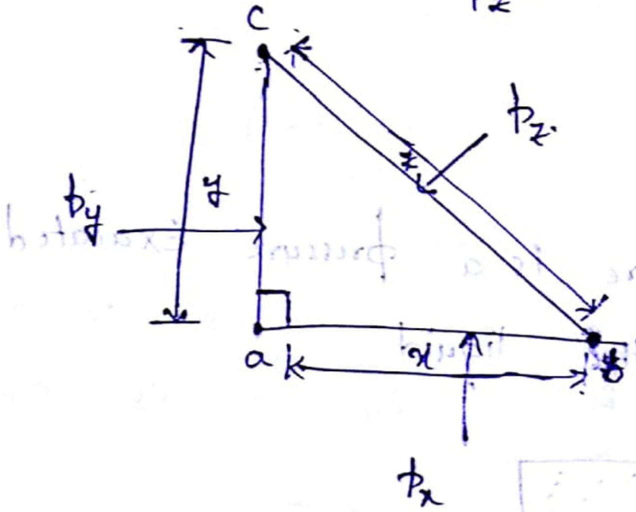
Pascal's law:-

It states that the pressure or instensity of pressure at a point in a static fluid in same in all directions

static
(rest position.)







It's Mathematically represents

$$p_x = p_y = p_z.$$

Hydro static law :-

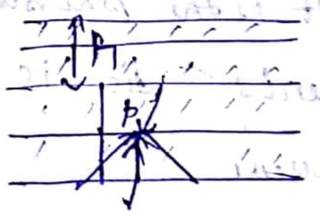
It's states that the rate of increasing pressure in ~~parti~~ vertical direction is Equal to weight density (or) Specific weight the rate of increasing pressure in vertical direction.

$$\frac{dp}{dh} = w$$

$$w = \rho g$$

$$\frac{dp}{dh} = \rho g$$

$$dp = \rho g\, dh$$



$$\int dp = \rho g \int dh$$

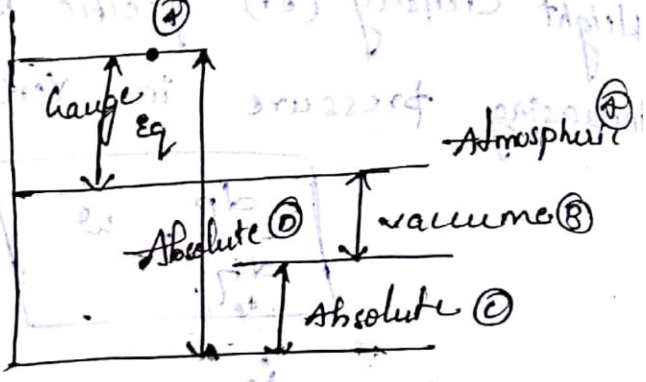
$$p = \rho g h \qquad \because \rho g = \text{constant}$$

Were p = hydro static pressure above atmospheric pressure {Those pressure are in atmosphere is called atmospheric pressure}

~~Atmospheric~~

absolute pressure:-

It is the pressure measured form absolute of the vaccume



Gauge pressure:-

It is the pressure measured with measuring instruments dis. is pressure is above the atmospheric pressure.

vaccume pressure:-

This pressure is Negative pressure below the atmospheric ~~press~~ pressure

Atmospheric pressure:-

It is the pressure sourrounded by the atmosphere

Measurement of pressure:-

i) piezometers → inverted U-tube Manometre

ii) U-tube Manometer → single column manometre

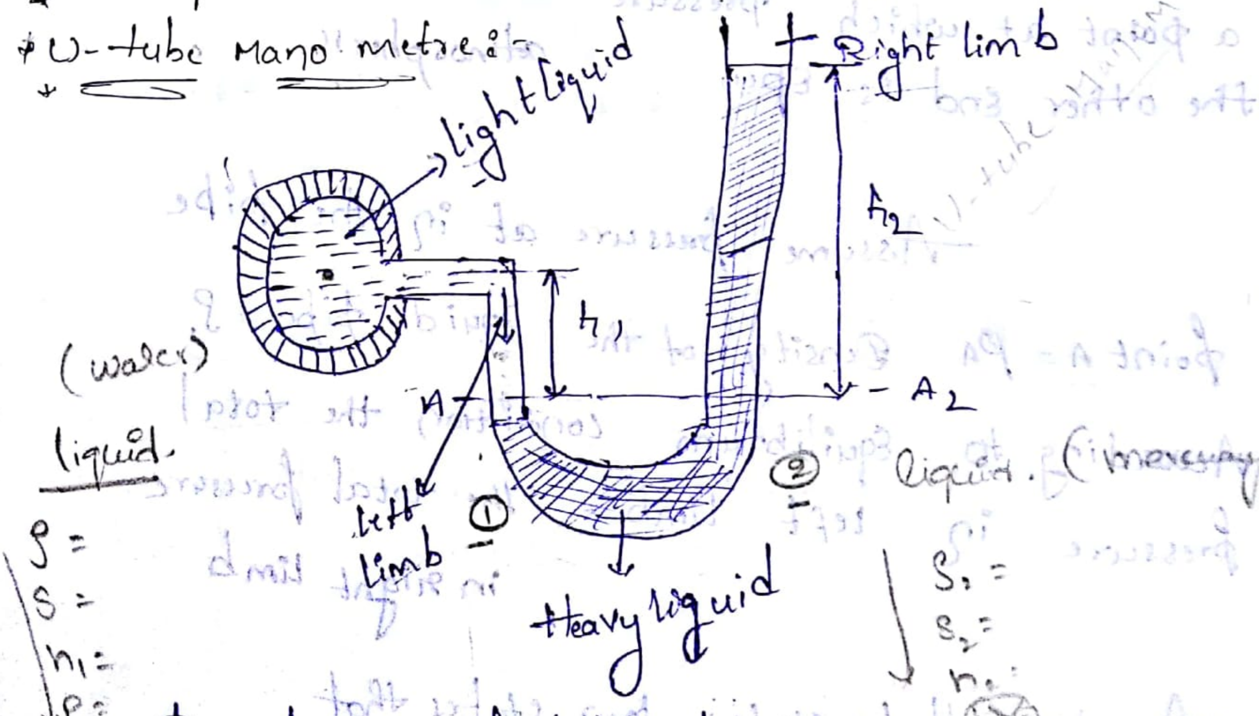
iii) Differential U-tube Manometre → inclined Manometre

→ conical Manometre

ii) The Gauges :- Mechinal guage are divided into further '3' classification

1. Bellow tube
2. Dead weight pressure guage
3. Bourdn tube pressure guage

* v.v.Imp
* U-tube Manometre :-



P_A = pressure of pipe point A

h_1 = The height of the liquid in left limb

h_2 = The height of the liquid in Right limb

ρ_2 = The density of heavy liquid pipe ②

g_1 = Acceleration due to gravity at light liquid ①

S_1 = Specific gravity at light liquid

g_2 = Acceleration due to gravity at heavy liquid

→ piezometre can not be Employed when the large pressure because a gay from enxo fue atmospheric Surface

→ These Limitation can be over come by the U-tube Manometre

U-tube Manometre consist of blast bend in U-shape one End of which is connected to a point at which pressure is to measured and the other End is open atmospheric

Assume pressure at in the pipe point $A = P_A$ Density of the liquid pipe = ρ_1

According to Equilibrium condition the total pressure in left limb = The total pressure in right limb

According Hydro static law states that

$$p = \rho g h$$

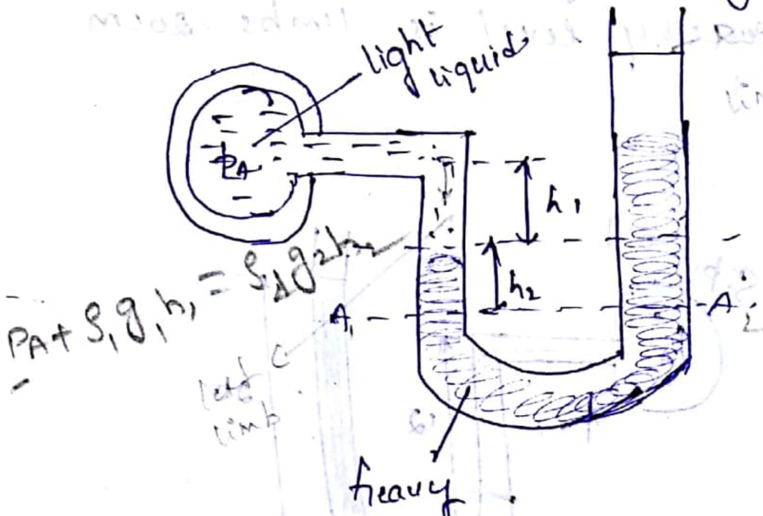
The total pressure in left limb $= p_A + \rho_1 g_1 h_1$

The total pressure in right limb $= \rho_2 g_2 h_2$

The Equilibrium condition $p_A + \rho_1 g_1 h_1 = \rho_2 g_2 h_2$

$$\boxed{p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1}$$

Here P_A = Absolute pressure (or) guage pressure



According to Equilibrum condition

$$p_A + \rho_1 g_1 h_1 + \rho_2 g_2 h_2 = 0$$

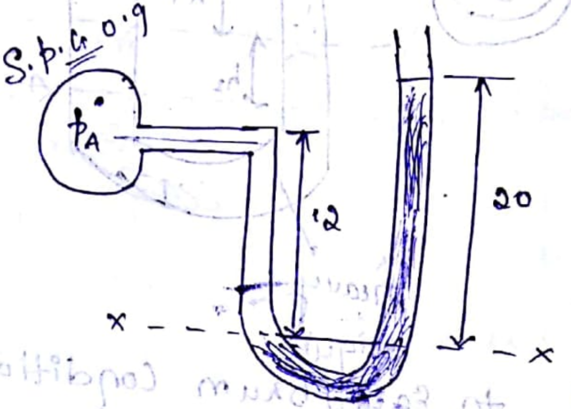
$$p_A = -(\rho_1 g_1 h_1 + \rho_2 g_2 h_2)$$

Here p_A = vacuum pressure

problems * weight of water = 9.81.

The right limb of simple U-tube manometer contains mercury.
① is open to the atmosphere why the left limb connected to a pipe in which fluid of specific gravity 0.9 is flowing the central of the pipe is 12cm below the level of mercury in right limb find the pressure of the fluid in the pipe the diff of mercury level is limbs 20cm

Sol:- given:-



S.p gravity left limb (s_1) = 0.9

$S = \frac{\text{weight liquid}}{\text{weight of water}}$

5 × 9.81 = S_{liquid}

5 × 9810 = S_{liquid}

81820 = S_{liquid},

$\delta = \delta t_i$.

Specific mercury density → 13.6

Height of left limb (h_1) = 12cm.

Height of right limb (h_2) = 20cm.

$\rho_1 = \frac{m}{v}$ $\frac{M}{V}$

$P_A = \rho g h$

$\rho_1 g_1 h_1 = \rho_2 g_2 h_2$

$P_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1$

$S = \frac{\rho_{liquid}}{\rho_{water}}$ $\frac{\rho_{liquid}}{\rho_{water}}$

$0.9 = \frac{\rho_{liquid}}{1000}$ $\frac{\rho_{liquid}}{1000}$

$0.9 \rho_{liquid} = 1000 \times 0.9$
$= 900\ kg/m^3$

$\rho_1 = 0.9 \times 1000$

$\rho_1 = 900\ kg/m^3$.

specific gravity = 13.6

$13.6 = \frac{\rho_{liquid}}{1000}$

Specific Gravity = 13.6.

$\rho_{liquid} = 13600\ kg/m^3$

$13.6 = \frac{\rho_{liquid}}{\rho_{water}}$

$13.6 \times 1000 = \rho_{m2}$

$\rho_2 = 13600\ kg/m^3$

$p_A = S_2 g_2 h_2 - S_1 g_1 h_1$

$= 13600 \times 9.81 \times 20 - 900 \times 98.1 \times 12$

$p_A = 26683200 - 1059480$

$p_A = 25623720 \ N/cm^2$

H.W

Q. A ~~You~~ U-tube Manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. The left end is connected to a pipe and right limb opened to atmospheric pressure. The centre of the pipe is 100mm below the level of mercury in right limb. If the difference of the mercury level in two limbs 160 m determine the pressure which type of pressure is develop in pipe 'A' in U-tube Manometre

$p_A = S_2 g_2 h_2 - S_1 g_1 h_1$

$S = \frac{S_{liquid}}{S_{water}}$

$0.85 = \frac{S}{1000}$

13600

$= 900\ 850$

Scanned by CamScanner

3. A U-tube Manometre containing mecury was used to find negative pressure in the pipe contained water the right limb was opened to atmosphere find the vaccum pressure in the pipe of the difference of mecury level in two limbs was 100 mm and height of water in the left limb from the centre of pipe is 40mm below

previous paper problem (4)

(4) Calculate the Specific weight, density and Specific gravity of a one litre of liquid which the weight of the liquid is 7N

$1/10^3$

1m = 1000m

1m = 10^{-3}

m = 10^{-3}.

Sol:- given:-

liquid = one litre

(v) = 10^{-3} m

Weight of the liquid (w) = 7N

Sp. weight (ω) = ?

Sp. density = ?

S.P Gravity (s) = ?

$\frac{w}{v}$

$= \frac{7}{10^{-3}}$

7000 N/m³

S.p Weight (ω) = $\frac{W}{V}$

$= \frac{7}{10^{-3}}$

(ω) = 7000 N/m³

Sp. density = $\frac{M}{V}$

$= \frac{7000}{10^{-3}}$

$= 7L \; N/m^3$

Sp. gravity (s) = $\frac{Wt\ liquid}{Wt.\ water}$

$= \frac{7000}{9.810}$

$s = 0.7135$

$w = \rho g$

$\frac{7000}{9.81} = \rho \times 9.81$

$\frac{7000}{9.81} = \rho$

$\rho = 713.5 \; N/m^3$

$\frac{7000}{10^{-3}}$

$= 7L \; N/m^3$

$\frac{w_{liquid}}{w_{water}}$

$\frac{7000}{9.810}$

$= 0.7135$

7135

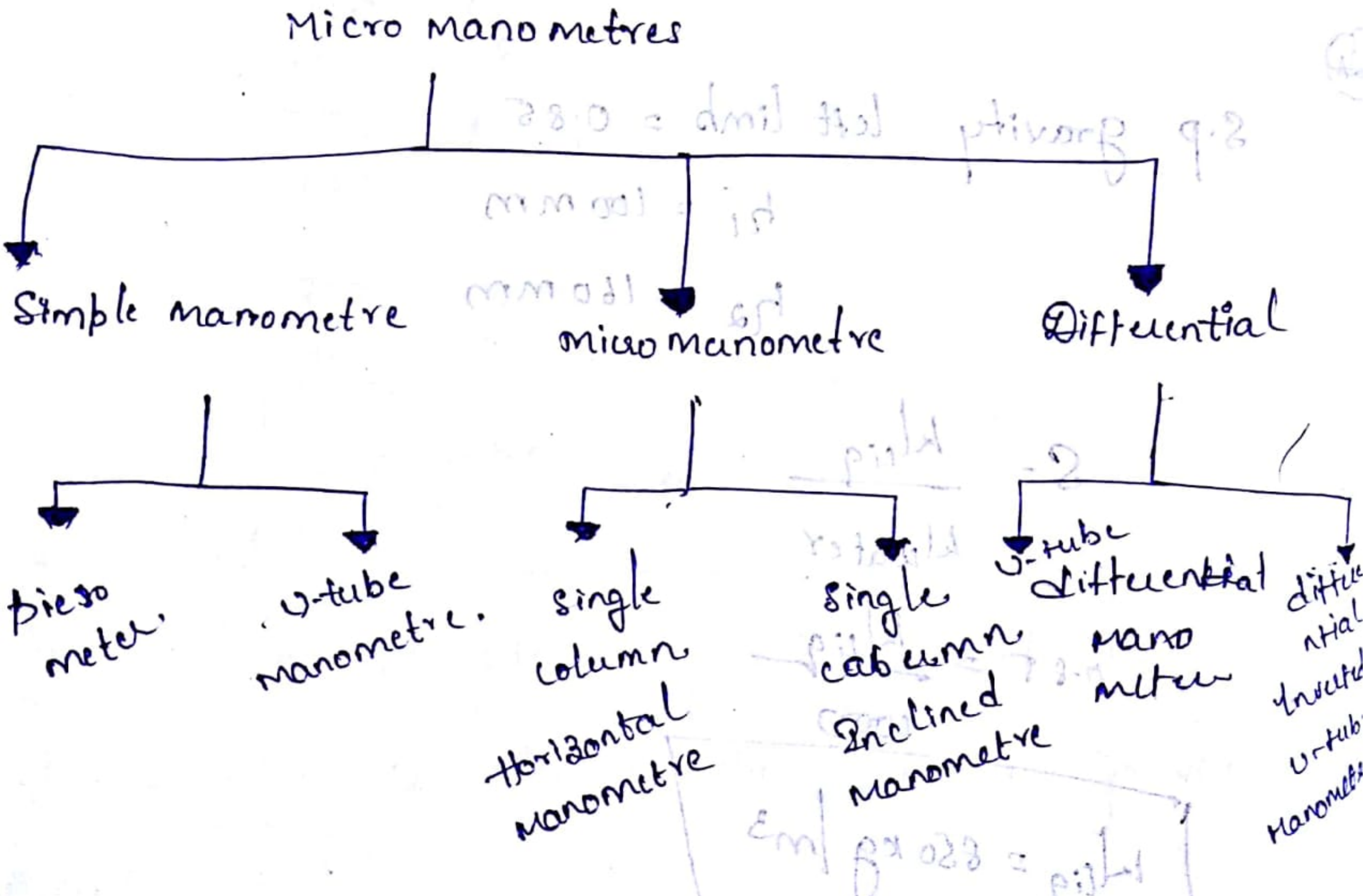
$w = \rho g$

$7000 = \rho \times 9.81$

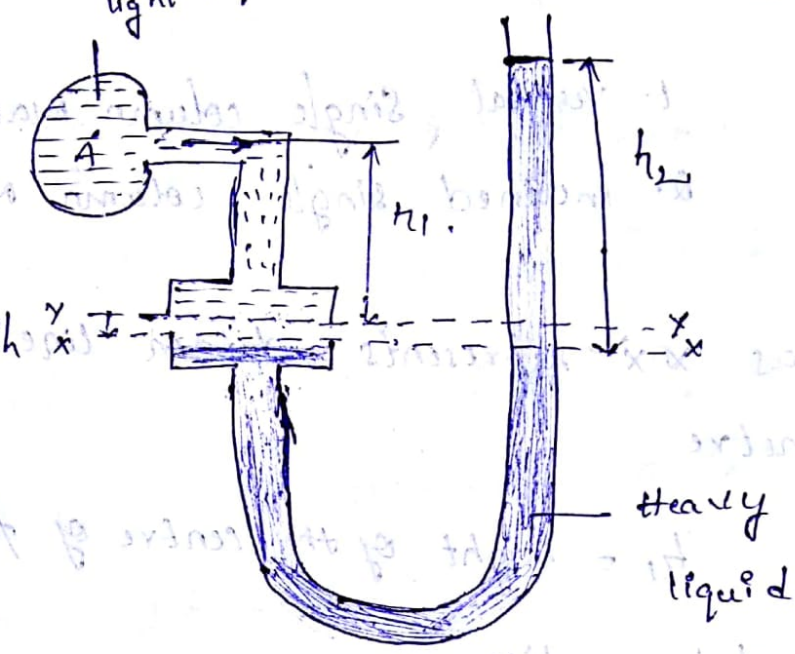
$\frac{7000}{9.81}$

Scanned by CamScanner

Micro Manometres :-



Single column U-tube Manometre → It is Example for micromanometre



A single Manometre is a modified form U-tube Manometre in which a reservior having a larger cross sectional area as compare to area of the tube is connected to one limb of manometre to the reservior. for any vari

For any variation in pressure the chaino change in liquid level in the reservio will be the so small that may be neglected and the pressure is indicated by the height of the liquid in other limb

The single column manometres are divided in two classifications.

1. vertical single column manometre
2. inclined single column manometre

Let us x x represents datum line of the manometre

h_1 = height of the centre of pipe above the datum line

h_2 = height Rise of heavy liquid in right limb above the datum line

δh = fall of heavy liquid level in reservoir

h = pressure in the pipe head

A = cross sectional area of the reservoir

a = cross sectional area of the tube

S_1 = Specific Gravity of light liquid in pipe

S_2 = Specific gravity of heavy liquid in right limb.

The Equilibrium condition the total pressure in left limb ~~the~~ = ~~total~~ pressure in right limb

$$P_A + \rho_1 g_1 (h_1 + \delta h) = \rho_2 g_2 (h_2 + \delta h)$$

$$p_A + \rho_1 g_1 h_1 + \rho_1 g_1 \delta h = \rho_2 g_2 h_2 + \rho_2 g_2 \delta h$$

$$p_A = \rho_2 g_2 h_2 + \rho_2 g_2 \delta h - \rho_1 g_1 h_1 - \rho_1 g_1 \delta h$$

$$p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \rho_2 g_2 \delta h - \rho_1 g_1 \delta h$$

$$p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \delta h (\rho_2 g_2 - \rho_1 g_1)$$

$$\rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \frac{a \times h}{A} (\rho_2 g_2 - \rho_1 g_1)$$

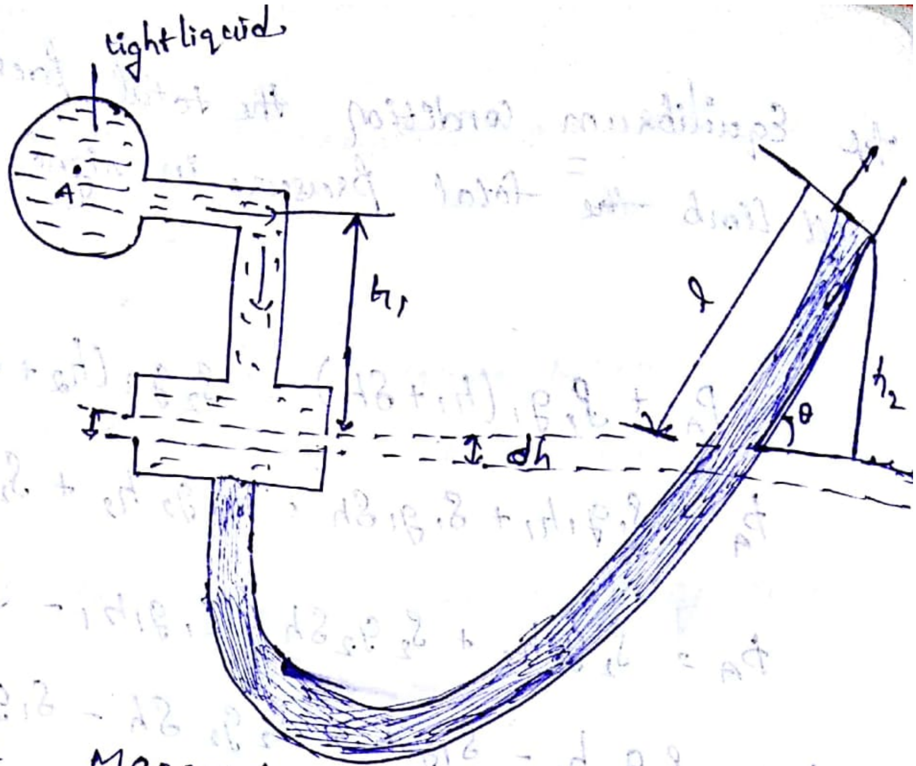
$$p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h.$$

$$A \times \delta h = a \times h$$

$$\delta h = \frac{a \times h}{A} \quad \text{-①}$$

$$H = \rho_2 h_2 - \rho_1 h_1 + \frac{a \times h}{A} (\rho_2 - \rho_1)$$

tube



The Single Manometre is a modified form U-tube Manometre in which reservior having a large cross Sectional area as compare to area of the tube connected to one limb of Manometre of the reservior

For any variation in pressure the change in liquid level in the reservior will be the so small that may be Neglected and the pressure indicated by the height of the liquid

The Single column Manometers are divided two classifications

1. vertical Single column Manometre
2. inclined single column manometre

Let us XX represents datum line of the manometre

h_1 = height of the centre of the pipe above the datum

$$p = \rho g h$$

Pr. of left limb = Pr. of Right limb

$$p_A + \rho_1 g_1 (h_1 + \delta h) = \rho_2 g_2 (h_2 + \delta h)$$

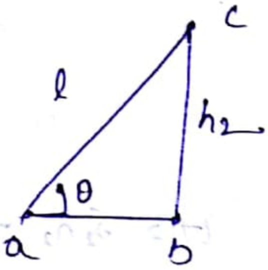
$$p_A + \rho_1 g_1 h_1 + \rho_1 g_1 \delta h = \rho_2 g_2 h_2 + \rho_2 g_2 \delta h$$

$$p_A = \rho_2 g_2 h_2 + \rho_2 g_2 \delta h - \rho_1 g_1 h_1 - \rho_1 g_1 \delta h$$

$$p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \rho_2 g_2 \delta h - \rho_1 g_1 \delta h$$

$$p_A = \rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \delta h (\rho_2 g_2 - \rho_1 g_1)$$

$$= \rho_2 g_2 h_2 - \rho_1 g_1 h_1 + \left(\frac{a \times h}{A}\right) (\rho_2 g_2 - \rho_1 g_1)$$



$$p = \rho_2 g_2 h_2 - \rho_1 g_1 h_1$$

$$p = \rho_2 g_2 (l \sin\theta) - \rho_1 g_1 h_1$$

$h_2 = l \sin\theta$

Problems :-

(1) A Single column U-tube manometre connected to a pipe contain a liquid with specific gravity of 0.8 the ratio of area of the reservior is that of limb is 100 find the pressure should be developed inside the pipe

$A \times \delta h = a \times h$

$\frac{A}{a} = 100$

$\delta h = \frac{a \times h}{A}$

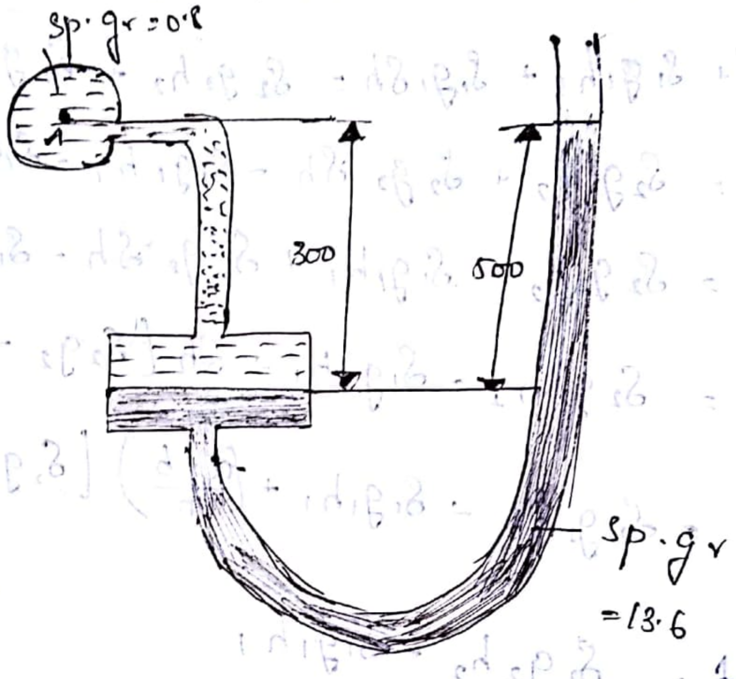
Note:- Take the specific gravity of heavy liquid. (Mercury) 13.6

Sol. given:-

Specific gravity of light liquid (water) $(S_1) = 0.8$

Specific gravity of heavy liquid (Mercury) $(S_2) = 13.6$

Area ratio $\left(\frac{A}{a}\right) = 100$



$H = S_2 h_2 - S_1 h_1 + \frac{a \times h}{A} (S_2 - S_1)$

$= S_2 h_2 - S_1 h_1 + \frac{a}{A} (S_2 - S_1)$

$= (13.6 \times 500) - (0.8 \times 300) + \frac{1}{100} (13.6 - 0.8)$

$= 6800 - 240 + 0.128$

$= 6560.128 \; N/m^2$

$p = wh$

$= 9.81 \times 6560.128$

$p = 64{,}354.85 \; N/mm$

$p = 64.35\ kN/m^2$

Differential Manometre :-

1. It is used to measure the differences of the pressures between two points in two different pipes

2. It is a simple form of differential manometre consist of a U-tube It contain heavy liquid then two Ends are connected two En points whose difference of pressure to be find out.

The differential manometre divided in to two classification based up on the construction details

1. differential U-tube Manometre
2. differential Inverted U-tube Manometre

1. Differential U-tube Manometre :-

The differential U-tube Manometre base on the poistons of two pipes they are mainly two types.

1. Two pipes are in the same level
2. The Two pipes are in the different level

case (i)

(B) U-tube Differential manometres in same line

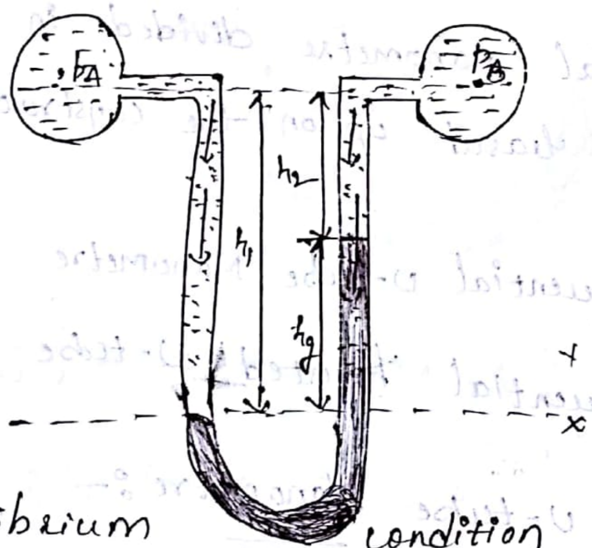
The differential manometres the two ends are connected in two point A & B are in the same level. Let assume h = difference of cent. of A form mercury level in right limb the points

S = Specific gravity of heavy liquid

A & B pipes

p_A = Pressure at point 'A'

p_B = pressure at point 'B'



For Equilibrium condition the total pressure in left limb = The total pressure in right limb

$$p_A + S_1 g_1 h_1 = p_B + S_2 g_2 h_2 + S_g \cdot g\, h_g$$

$p_A + S_1 g_1 h_1 = p_B + S_2 g_2 h_2 + S_g g h_g$

$$p_A - p_B = S_2 g_2 h_2 - S_1 g_1 h_1 + S_g g\, h_g$$

$$p_A - p_B = S_2 h_2 - S_1 h_1 + S_g h_g$$

$$p_A - p_B = S_2 h_2 - S_1 h_1 + S_g (h_1 - h_2)$$

$a \times S h = a \times h$

$S h = \frac{a \times b}{A}$

problems

A bike contain An oil with a Specific gravity of 0.9 A differential manometre is connected two points A and B its Shows a differential mercury level in 15 in 2 points Find the difference of pressure

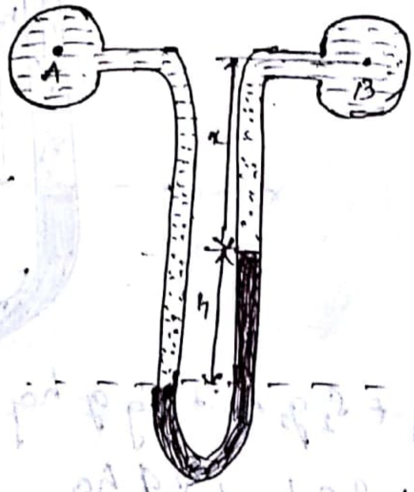
Sol:- given :-

Sp. gravity oil $(S_1) = (S_2) = 0.9$

$= 0.9 \times 1000 = 900\ kg/m^3$

difference of mercury level $(h) = 15cm$

$= 0.15m.$



$p_A + S_1 g_1 (x+h) =$

$p_B + S_2 g_2 x + S_m g_m h$

$p_A + S_1 g_1 h = p_B + S_m g_m$

Total pressure in left limb = Total pressure in right limb

$p_A + S_1 g_1 (x+h) = p_B + S_2 g_2 x + S_m g_m h_m$

$p_A + S_1 g_1 x + S_1 g_1 h = p_B + S_2 g_2 x + S_m g_m h_m$

$p_A + S_1 g_1 h = p_B + S_m g_m h_m$

$p_A + p_B = S_m g_m h_m - S_1 g_1 h$ 0.9

$p_A - p_B = (13600 \times 9.81 \times 0.15) - (900 \times 9.81 \times 0.15)$

$= 20{,}012.4 - 1324.35$

$= 18{,}688.05 \text{ N/m}^2$

$p_A\ p_B = S_m g_m h_m \pm S_1 g_1 h$

$p_A - p_B = (13600 \times 9.81 \times 0.15) - (900 \times 9.81 \times 0.15)$

4*** **problem:-**

A differential manometre is connected at two points A and B as show in figure at B point the air pressure is 9.81 N/cm^2 find the absolute pressure at point A

Sol:- given:-

Sp.gr (s) = 0.9

$s_1 = 0.9 \times 100$

$s_1 = 900 \text{ kg/m}^3$

$p_A = 9.81 \times 10^4 \text{ N/m}^2$

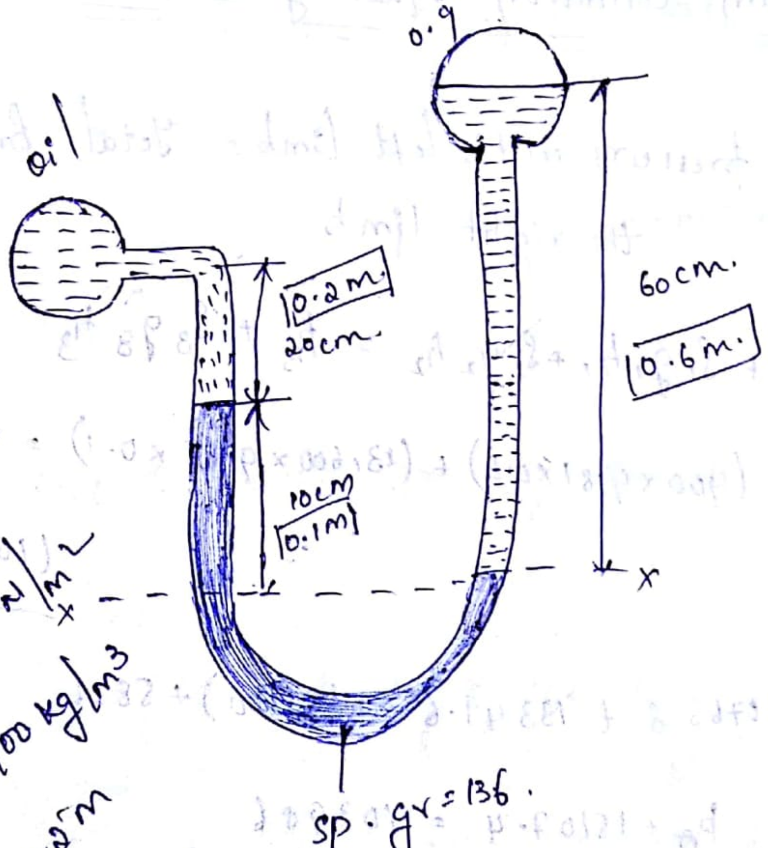
sp.gr = 900 kg/m³

$h_1 = 0.2 \text{ m}$

$h_2 = 0.1 \text{ m}$

$h_3 = 0.6 \text{ m}$

$S_m = 13{,}600$



Sol: Given :-

$p_B = 9.81\ N/cm^2$

$p_B = 9.81 \times 10^4\ N/m^2$

1,7658

13,3416

11886

$p_A = ?$

$S_l = 0.9$

$S_l = 900 kg/m^3$

$h_l = 0.2 m$

$h_2 = 0.1 m$

$h_3 = 0.6 m$

$S_m = 13,600$

Equilibrium Condition Equating the both sides :-

Total pressure in the left limb = Total pressure in the right limb

$$p_A + S_1 g_1 h_1 + S_2 g_2 h_2 = p_B + S_3 g_3 h_3$$

$$p_A + (900 \times 9.81 \times 0.2) + (13,600 \times 9.81 \times 0.1) = 9.81 \times 10^4 + (1000 \times 9.81 \times 0.6)$$

$$p_A + 1765.8 + 13341.6 = (98100) + 5886$$

$$\therefore\ p_A + 15107.4 = 103986$$

$$p_A = 88878.6$$

$$p_A = 88.87\ kN/m^2$$

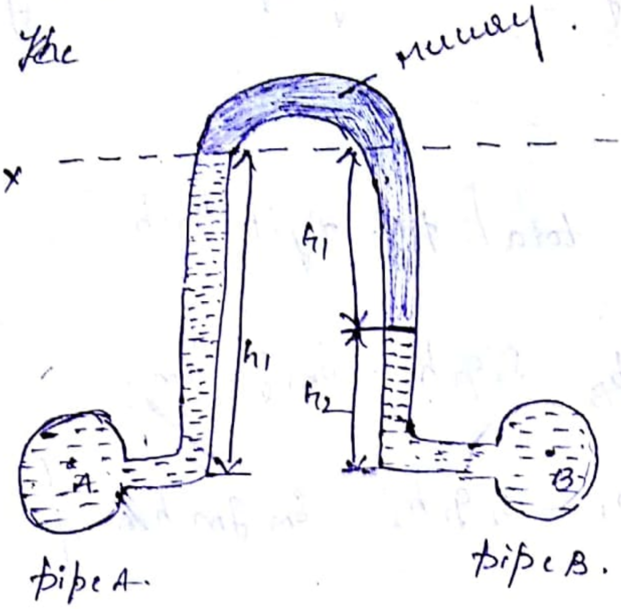
absolute pressure

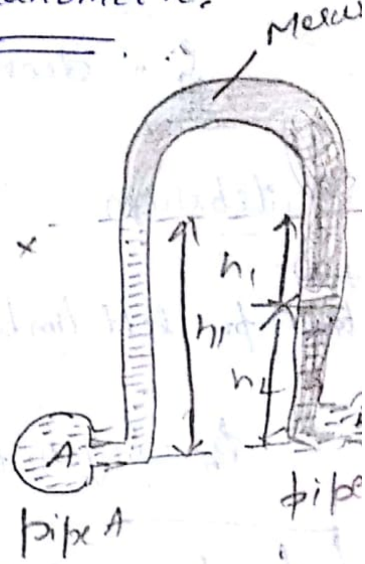
(The pressure should be developed at pipe

~~Differential Inverted~~

** Inverted Differential U-tube Manometre:-

The





→ The Inverted U-tube Manometre used for measuring vacuum pressure.

→ It having U-shaped glass tube at Inverse position or Reverse position

→ These type of U-shape glass tube consist two pipes at two Ends

→ Assume that S_1 = Specific gravity of an light liquid in left limb

ρ_1 = density of the light liquid in left limb

h_1 = height of the liquid from centre of the pipe up to mercury level.

at point A)

S_2 = Specific gravity on heavy liquid of right limb
ρ_2 = density of heavy liquid in right limb

Equilibrium

total pr. left limb = total pre. right limb

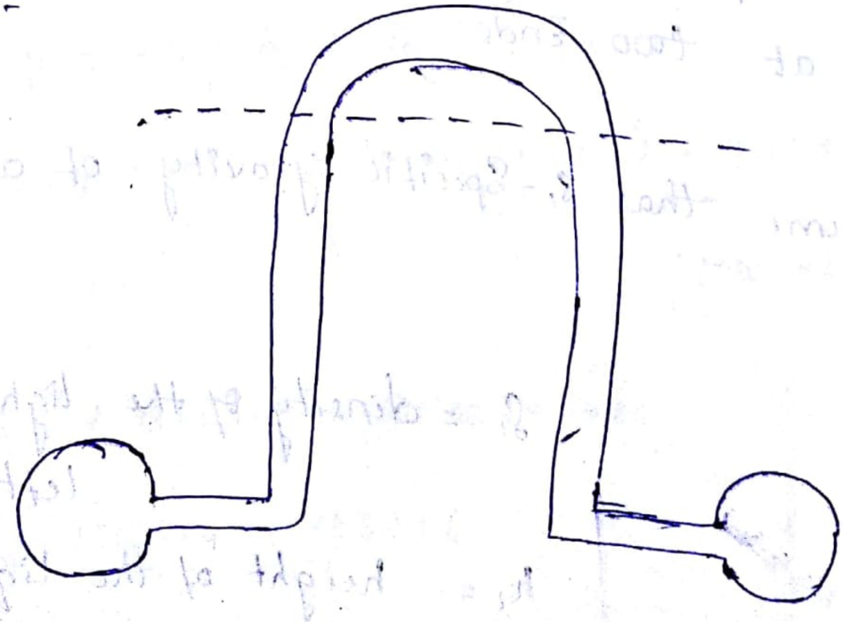
$$p_A - S_1 g_1 h_1 = p_B - S_2 g_2 h_2 - S_m g_m h_m.$$

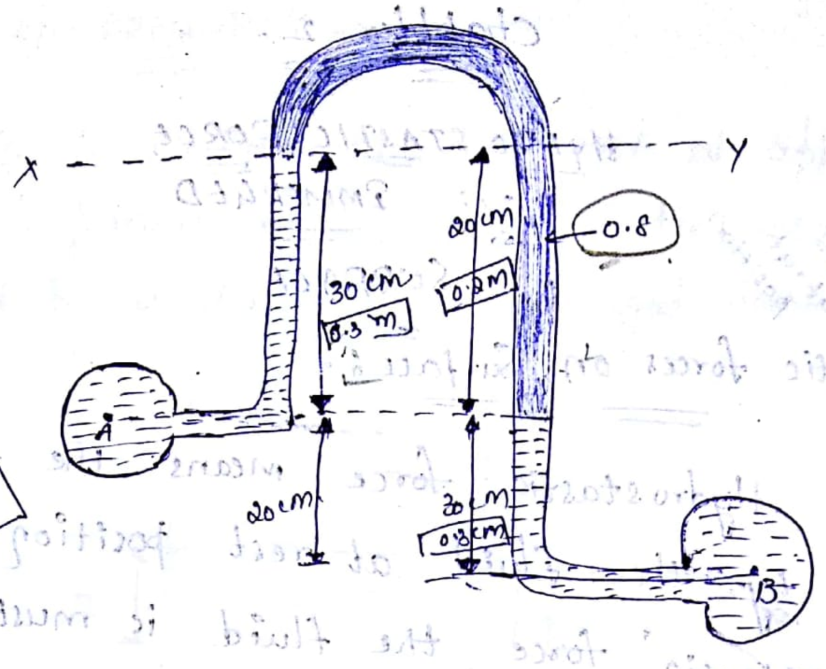
$$p_A - p_B = S_1 g_1 h_1 - S_2 g_2 h_2 - S_m g_m h_m.$$

Problem:-

As show in figure An inverted differential U-tube manometre is connected to two pipes A & B which convey the water the final pressure difference of A and B should be find out

Sol:- given:-





Total pr. left limb = Total pr. right limb

$p_A - \rho_1 g_1 h_1 = p_B - \rho_2 g_2 h_2 - \rho_m g_m h_m$

$p_A - (1000 \times 9.81 \times 0.3) = p_B - (1000 \times 9.81 \times 0.3) - (800 \times 9.81 \times 0.2)$

$p_A - (2943) = p_B - (2943) - (1569.6)$

$$p_A - p_B = -(1569.6)\ N/m^2$$

The pressure should be developed at pipe A at point is vacuum pressure