Single Column Manometer

Single column manometer is a modified form of a U-tube manometer in which a reservoir, having a large C/S area (100 times) as compared to the area of the tube is connected to one of the limbs of the manometer.

Types

1. Vertical single column manometer
2. Inclined single column manometer

1. Vertical single column manometer

Δh - Fall of heavy liquid in reservoir

h_2 - rise of heavy liquid in right limb

h_1 - height of centre of pipe above x-x

P_A - pressure at A

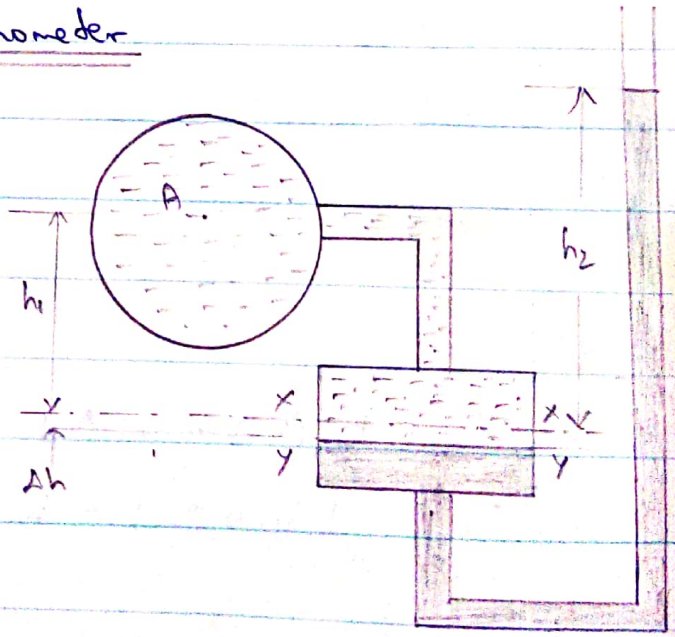
A - C/S area of reservoir

a - C/S area of right limb

S_1 - Specific gravity of light liquid

S_2 - Specific gravity of heavy liquid

ρ_1 - density of liquid in pipe

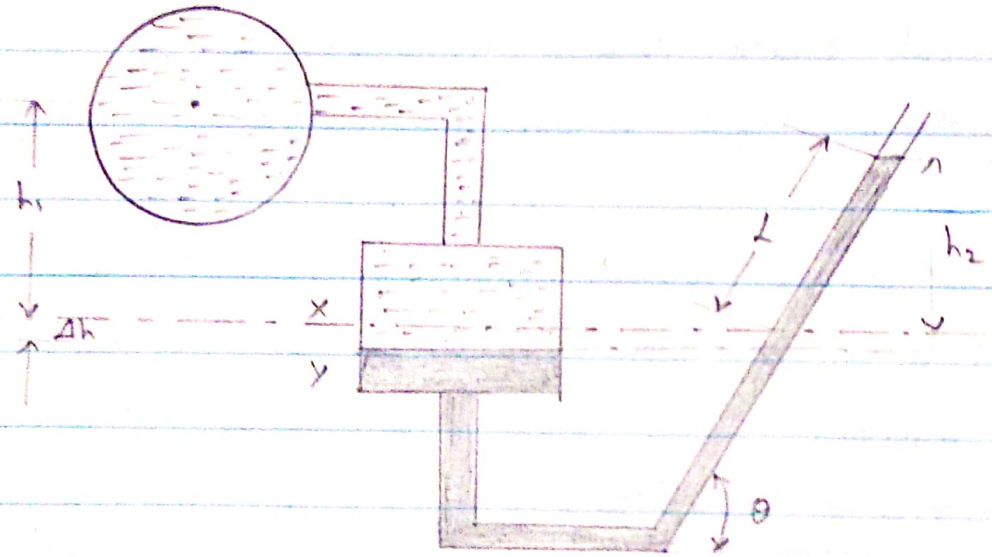


Scanned by CamScanner

ρ_2 - density of heavy liquid

$$P_A = \frac{a \cdot h_2}{A} [\rho_2 g - \rho_1 g] + h_2 \rho_2 g - h_1 \rho_1 g$$

2. Inclined single column manometer



$$P_A = h_2 \rho_2 g - h_1 \rho_1 g$$

$$P_A = l \sin\theta \rho_2 g - h_1 \rho_1 g$$

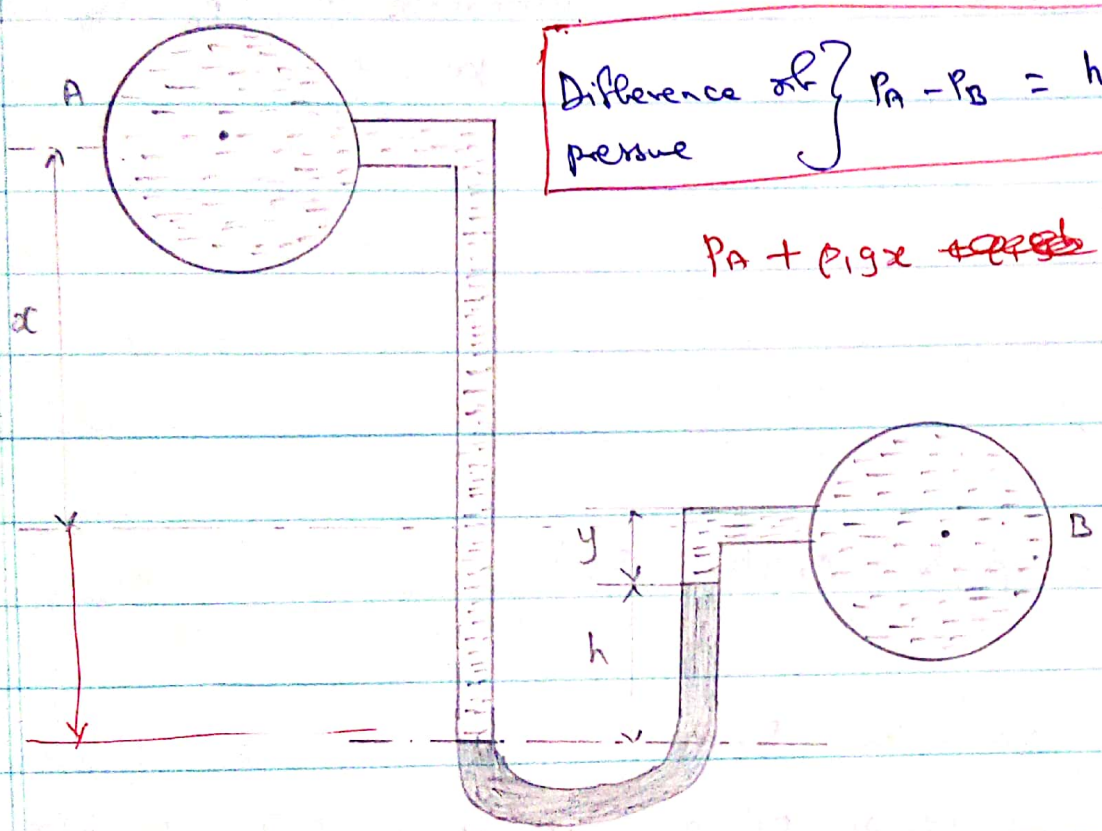
Differential Manometer

It is the device used for measuring the difference of pressure between two points in the same pipe or in two different pipes.

Scanned by CamScanner

1. U-tube Differential manometer

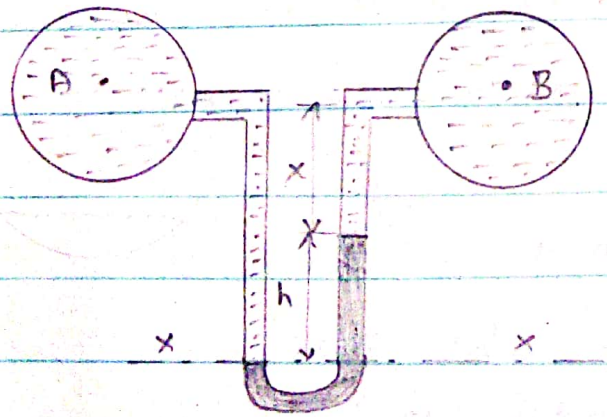
a. two pipes are at different levels



Difference of pressure $\} P_A - P_B = hg(\rho_g - \rho_1) + \rho_2 g y - \rho_1 g x$

$P_A + \rho_1 g x = P_B + \rho_2 g y + \rho_g g h$

b. Pipes are at same level

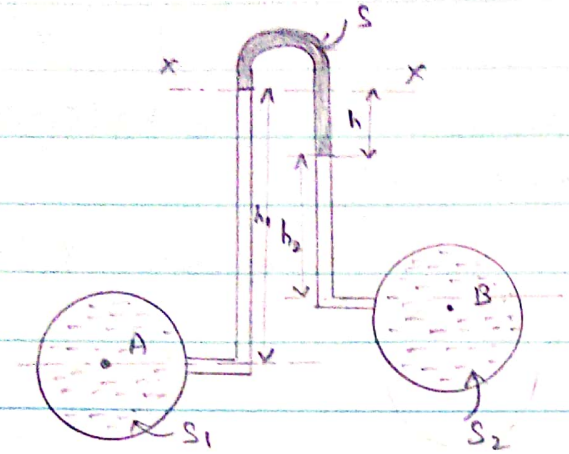


Difference of pressure $\} P_A - P_B = gh(\rho_g - \rho_1)$

$P_A + \rho_1 g h = P_B + \rho_g g h$

Scanned by CamScanner

2. Inverted U-tube differential Manometer



Difference in pressure $= P_A - P_B$

$P_A - \rho_1 g h_1 = P_B - \rho_2 g h_2 - \rho_s g h$

$$P_A - P_B = \rho_1 g h_1 - \rho_2 g h_2 - \rho_s g h$$

Differential Manometer Problems

1. A pipe contains an oil of Sp. gravity 0.9. A differential manometer connected at the two points A and B shows a difference in mercury level as 15cm. Find the difference of pressure at the two points.

14. (b)

G.D

Sp. gr. of oil $S_1 = 0.9$

difference in mercury level $h = 15cm$

Sp. gr. of mercury $S_g = 13.6$

Scanned by CamScanner

Sol

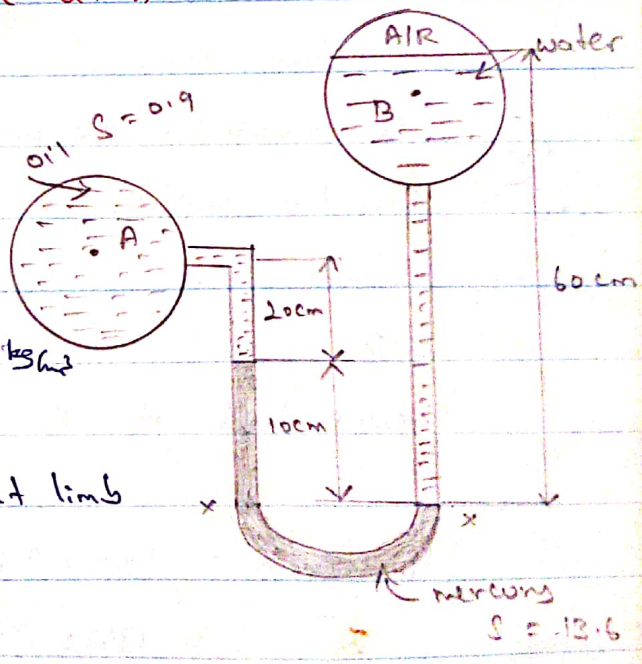
Difference of pressure $P_A - P_B = g \times h \left(S_g \times 1000 - S_1 \times 1000 \right)$

$= 9.81 \times 0.15 \left(13600 - 900 \right)$

$= 18688 \ N/m^2$

2. (15) A differential manometer is connected at the two points A and B as shown in fig. ~~xxx~~ At B air pressure is 9.81 N/cm² (abs). find the absolute pressure at A.

15. (a)



R.D

air pressure at (B) $= 9.81 \ N/cm^2$

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

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

Density of mercury $= 13.6 \times 1000 = 13600 \ kg/m^3$

Pressure above x–x in the right limb

$= 1000 * 9.81 \times 0.6 + P_B$

$= 5886 + 98100$

$= 103986$

Pressure above x–x in the left limb

$= 13.6 \times 1000 \times 9.81 * 0.1 + 900 \times 9.81 \times 0.2 + P_A$

$= 13341.6 + 1765.8 + P_A$

Scanned by CamScanner

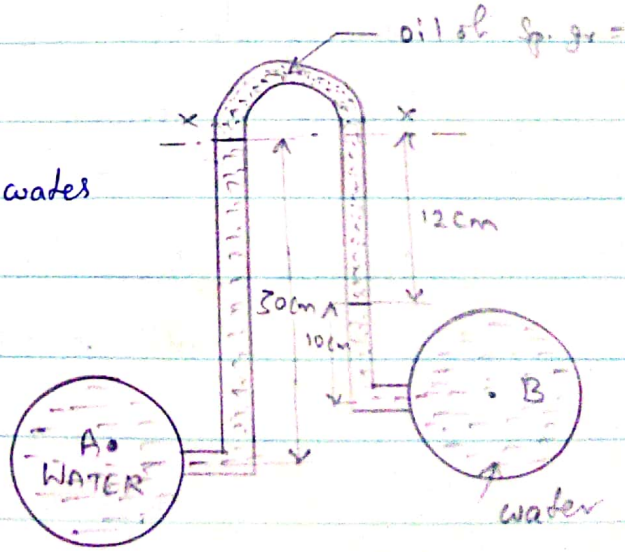
Equating the two pressure head

$$10398.6 = 13341.6 + 1765.8 + P_A$$

$$P_A = 88876.8 \ N/m^2 = \frac{88876.8}{10000} \ N/cm^2$$

absolute pressure at A $= 8.887 \ N/cm^2$

3. Water is flowing through two different pipes to which an inverted differential manometer having an oil of Sp. gr. 0.8 is connected. The pressure head in the pipe A is 2m of water, find the pressure in the pipe B for the manometer readings as shown in fig. (15.6)



A.D

Pressure head at $A = \frac{P_A}{\rho g} = 2m$ of water

$$P_A = \rho g h = 1000 \times 9.81 \times 2$$

$$= 19620 \ N/m^2$$

Pressure below x-x in the left limb $= P_A - \rho_1 g h_1$

$$= 19620 - 1000 \times 9.81 \times 0.3$$

$$= 16677 \ N/m^2$$

Scanned by CamScanner

Pressure below x-x in the right limb

$$= P_B - 1000 \times 9.81 \times 0.1 - 800 \times 9.81 \times 0.12$$
$$= P_B - 981 - 941.76$$
$$= P_B - 1922.76$$

Equating the two pressure we get,

$$16677 = P_B - 1922.76$$
$$P_B = 18599.76 \ N/m^2$$
$$P_B = \frac{18599}{10000} = 1.8599 \ N/cm^2$$

Result → Pressure in the pipe B $(P_B) = 1.8599 \ N/cm^2$

Scanned by CamScanner