

Single Column Manometers

Single column manometer is a modified form of a U-tube manometer in which a reservoir, having a large cross-sectional area (about 100 times) as compared to area of the tube is connected to one of its limb (say left limb) of the manometer as shown in fig



Due to large cross sectional area of the reservoir, for any variation in pressure, the change in the liquid level in the reservoir will be very small which may be neglected and hence the pressure is given by the height of liquid in the other limb.

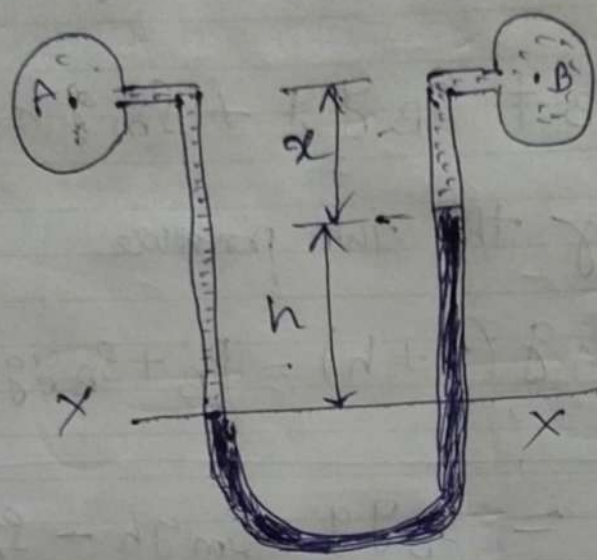
Differential manometers

Differential manometers are the devices used for measuring the difference of pressures between two points in a pipe or in two different pipes.

A differential manometer consists of a U-tube containing a heavy liquid whose two ends are connected to the points, whose difference of pressure is to be measured.

Case 2

A and B are at the same level and contains the same liquid of density ρ_1



pressure at A = P_A

pressure at B = P_B

h = Difference in mercury level in the U tube

x = The Distance of the centre of B from mercury level in the right limb

ρ_1 = Density of liquid

ρ_m = Manometric liquid density

$$\left. \begin{array}{l} \text{pressure above } x-x \\ \text{in right limb} \end{array} \right\} = P_B + \rho_1 x g + \rho_m g h$$
$$= P_B + \rho_1 x g + \rho_m g h$$

$$\left. \begin{array}{l} \text{pressure above } x-x \\ \text{in left limb} \end{array} \right\} = P_A + \rho_1 g (x + h)$$

Equating the two pressure...

$$P_A + \rho_1 g (x + h) = P_B + \rho_1 x g + \rho_m g h$$

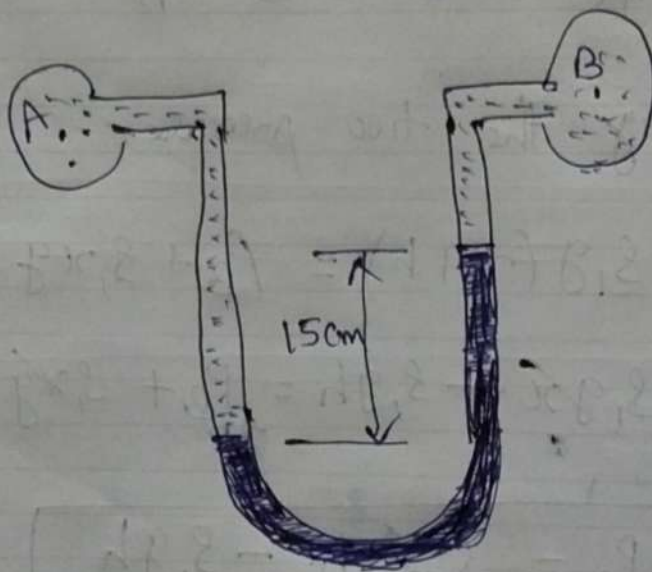
$$P_A + \cancel{\rho_1 g x} + \rho_1 g h = P_B + \cancel{\rho_1 x g} + \rho_m g h$$

$$P_A - P_B = \rho_m g h - \rho_1 g h$$

$$P_A - P_B = g h (\rho_m - \rho_1)$$

→ Equation used to find pressure difference

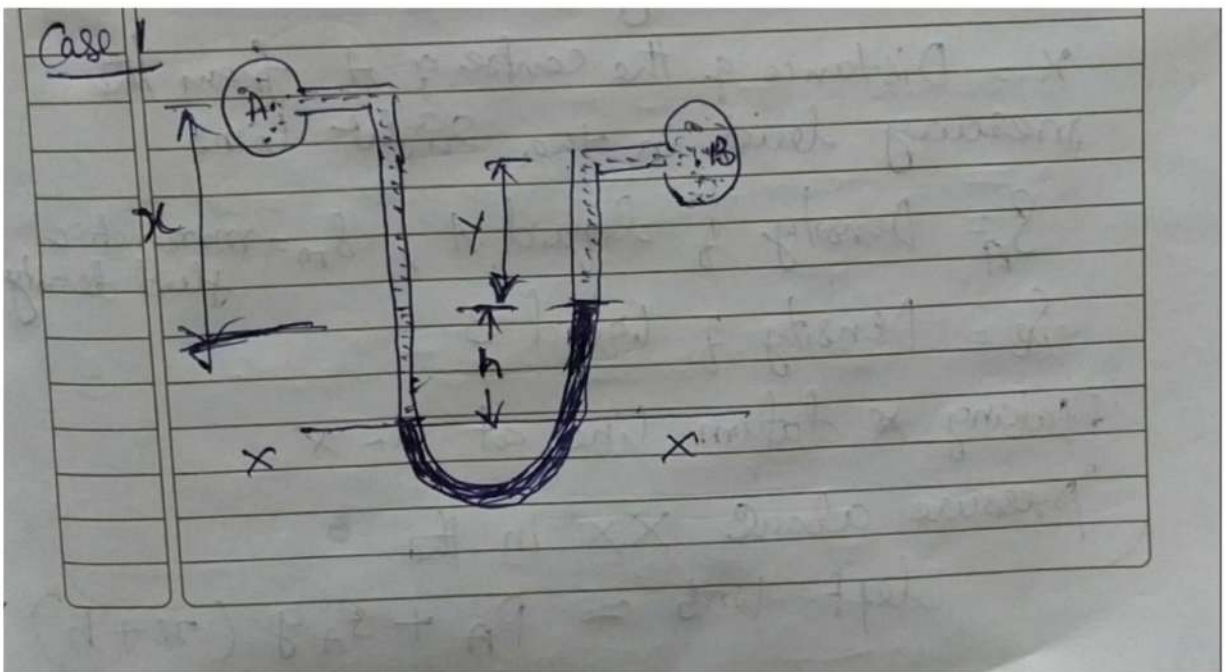
A pipe contains an oil of sp gravity 0.9. A differential manometer connects at the two points A and B shows a difference in mercury level as 15 cm. Find the difference of pressure at the two points.



$$P_A - P_B = gh(s_m - s_1)$$

$$P_A - P_B = 9.81 \times 0.15 (13600 - 900)$$

$$P_A - P_B = 18688 \text{ N/m}^2$$



Let the two points A and B are at different level and also contains liquid of different sp gravity. These points are connected to the U-tube differential manometer.

Let the pressure at A is P_A

pressure at B is P_B

h = Difference of mercury level in the U tube

y = Distance of the centre of B from the mercury level in the right limb

x = Distance of the centre of A from the mercury level in the right limb

ρ_A = Density of liquid A, ρ_m = manometric fluid density

ρ_B = Density of liquid B

Taking datum line at X-X

pressure above XX in the

$$\text{left limb} = P_A + \rho_A g (x + h)$$

pressure above X-X in the right limb

$$= P_B + \rho_B \gamma g + \rho_m g h$$

$$= P_B + \rho_B \gamma g + \rho_m g h$$

Equating the two pressure

$$P_A + \rho_A g (x+h) = P_B + \rho_B \gamma g + \rho_m g h$$

$$P_A - P_B = \rho_B \gamma g + \rho_m g h - \rho_A g (x+h)$$