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## 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.

DD MM YYYY

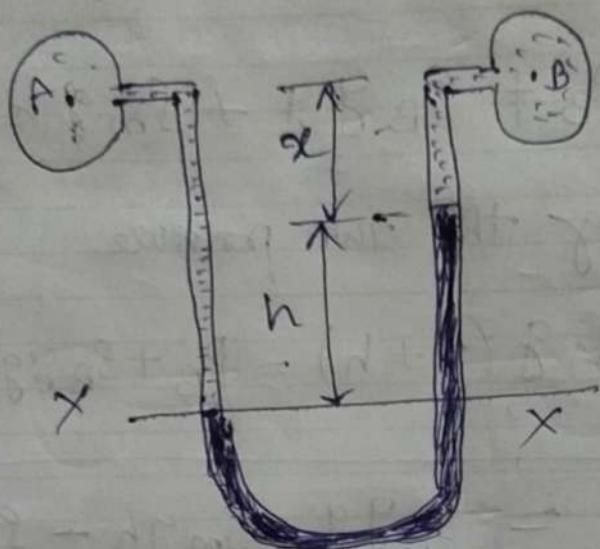
## Differential manometers

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



$$\text{pressure at } A = P_A$$

$$\text{pressure at } B = P_B$$

$h$  = Difference in mercury level in the U tube

$x$  = The Distance of the centre of B

from mercury level in the right limb

$\rho_1$  = Density of liquid

$\rho_m$  = Manometric liquid density

DD MM YYYY

$$\begin{aligned} \text{pressure above } x-x \\ \text{in right limb } \} &= P_B + \gamma_1 x g + \gamma_m g h \\ &= P_B + \gamma_1 x g + \gamma_m g h \end{aligned}$$

$$\begin{aligned} \text{pressure above } x-x \\ \text{in left limb } \} &= P_A + \gamma_1 g (x+h) \end{aligned}$$

Equating the two pressure

$$P_A + \gamma_1 g (x+h) = P_B + \gamma_1 x g + \gamma_m g h$$

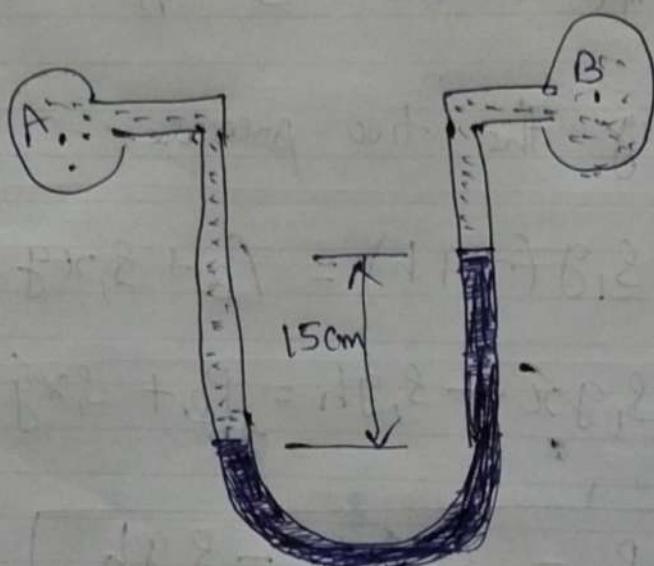
$$P_A + \gamma_1 g x + \gamma_1 g h = P_B + \gamma_1 x g + \gamma_m g h$$

$$P_A - P_B = \gamma_m g h - \gamma_1 g h$$

$$P_A - P_B = g h (\gamma_m - \gamma_1)$$

→ Equation used to find pressure difference

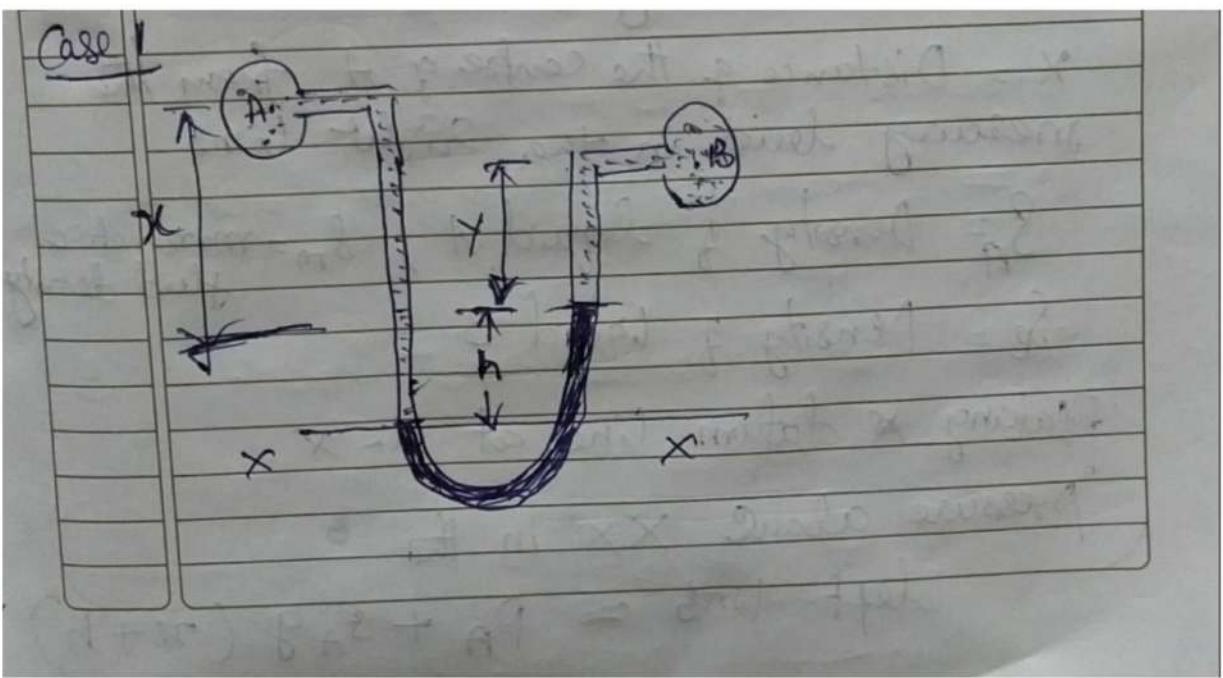
A pipe contains an oil of sp gravity 0.9. A differential manometer connected at the two points A and B shows a difference in mercury level as 15 cm. Find the difference of pressure at the two points.



$$P_A - P_B = \rho g h (\gamma_m - \gamma_1)$$

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

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



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

$s_A$  = Density of liquid A,  $s_m$  = manometric fluid density

$s_B$  = Density of liquid B

Taking  $\times$  datum line at  $XX$

pressure above  $XX$  in the

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

DD MM YYYY

pressure above X-X in the right limb

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

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

Equating the two pressure

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

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