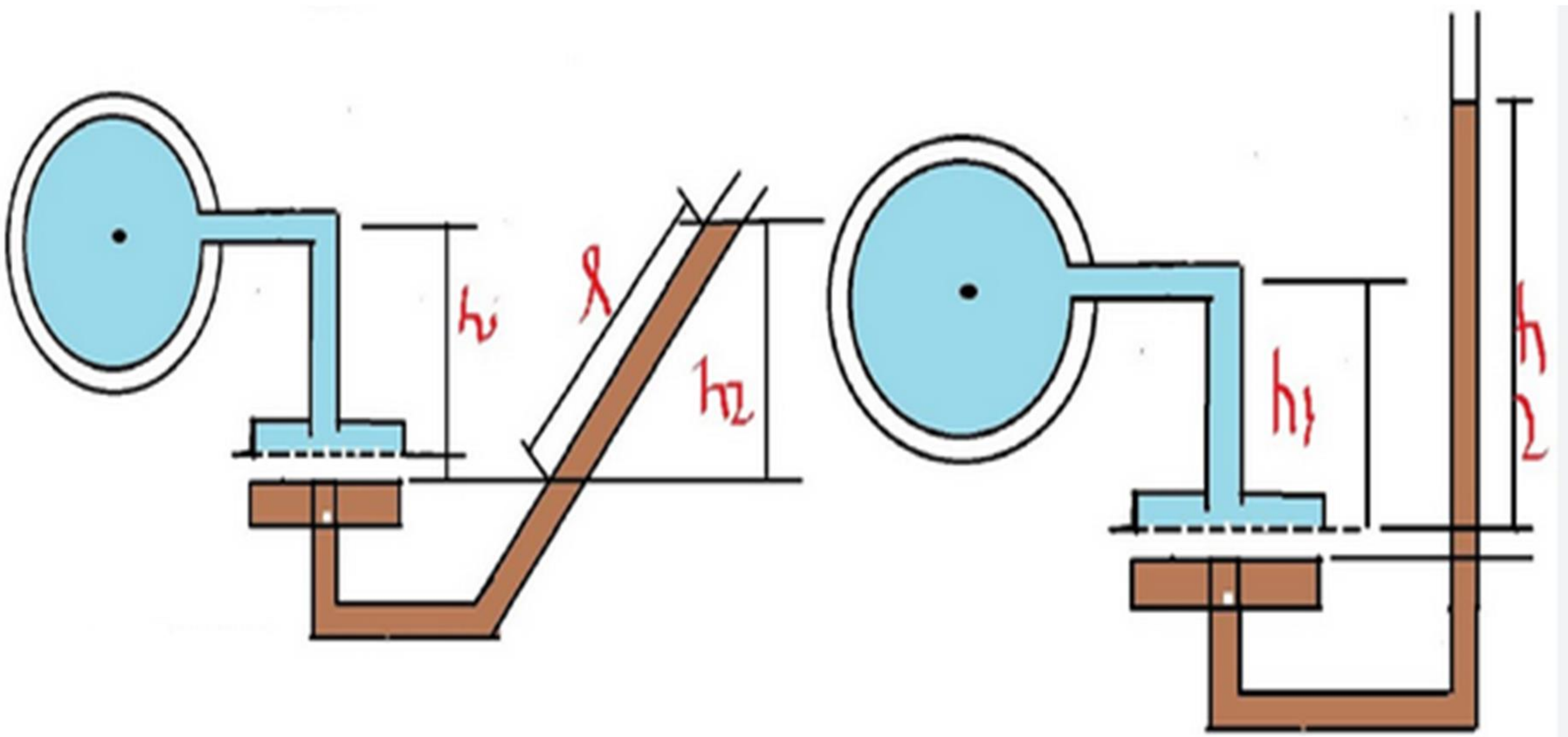
SINGLE COLUMN MANOMETER

- Single column manometer is a modified form of a U- tube manometer in which a reservoir, having a large cross sectional area as compared to the area of tube is connected to one of the limbs (say left limb) of the manometer.
- 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 the liquid in the other limb.
- The other limb may be vertical or inclined.

There are two types of single column manometer

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



VERTICAL SINGLE COLUMN MANOMETER

- Let X – X be the datum line in the reservoir and in the right limb of the manometer, when it is connected to the pipe, when the Manometer is connected to the pipe, due to high pressure at A The heavy in the reservoir will be pushed downwards and will rise in the right limb.
- Let, Δ h= fall of heavy liquid in the reservoir h2= rise of heavy liquid in the right limb
- h1= height of the centre of the pipe above X – X pA= Pressure at A, which is to be measured.
- A = Cross- sectional area of the reservoir a = cross sectional area of the right limb S1= Specific. Gravity of liquid in pipe
- S2= sp. Gravity of heavy liquid in the reservoir and right limb
- ρ1 = density of liquid in pipe
- ρ2= density of liquid in reservoir

Fall of heavy liquid reservoir will cause a rise of heavy liquid level in the right limb

$A \times \Delta h = a \times h_2$

$\Delta h = a \times h_2 / A$ ....(1)

Now consider the datum line Y –Y

The pressure in the right limb above Y – Y

$= \rho_2 \times g \times (\Delta h + h_2)$

Pressure in the left limb above Y—Y

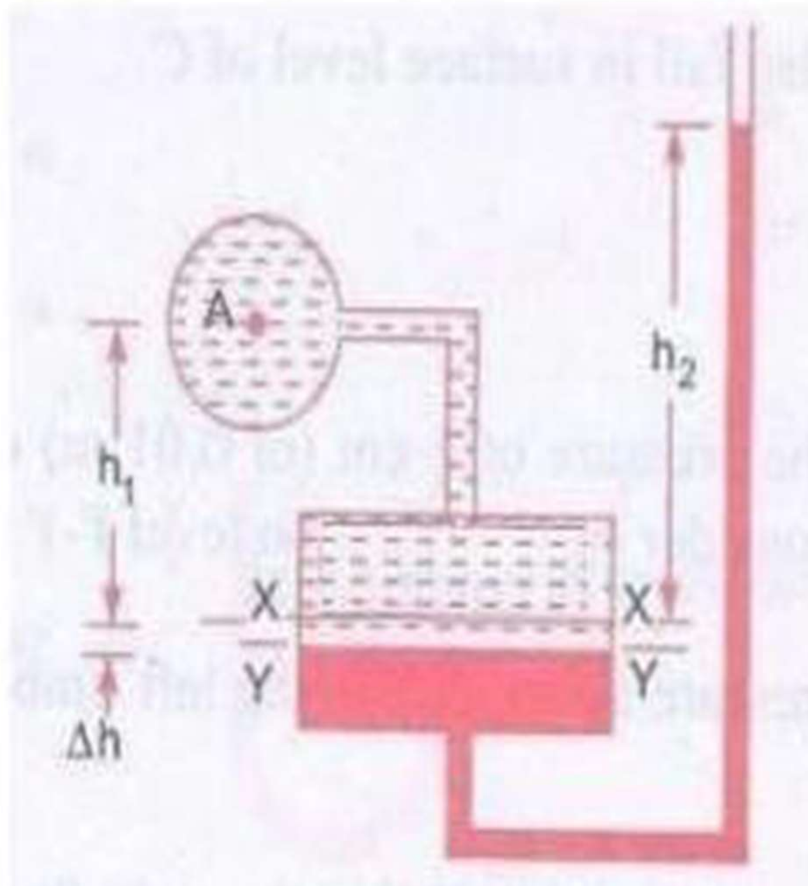
$= \rho_1 \times g \times (\Delta h + h_1) + P_A$

Equating the pressures, we have

$\rho_2 \, g \times (\Delta h + h_2) = \rho_1 \times g \times (\Delta h + h_1) + P_A$

$P_A = \rho_2 \times g \times (\Delta h + h_2) - \rho_1 \times g \times (\Delta h + h_1)$

$= \Delta h \, (\rho_2 g \; \rho_1 g) + h_2 \rho_2 g - h_1 \rho_1 g$



But, from eq (1)

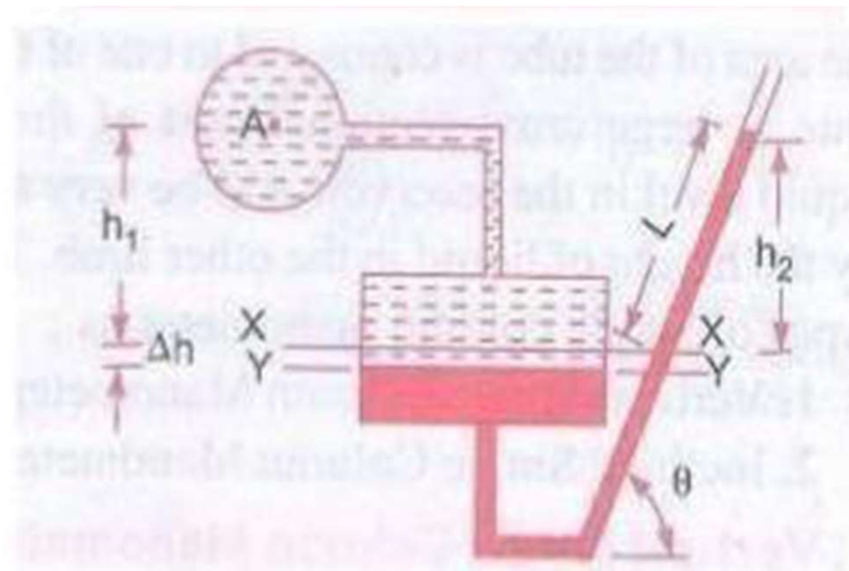
$P_A = (a \times h2 \, /A) \, (\rho 2g \; \rho 1g) + h2\rho 2g - h1\rho 1g$

- As the area A is very large as compared to a/A, hence the ratio a becomes very small and can be neglected Then,

$$\mathbf{pA = h2\rho 2g - h1\rho 1g \;........(2)}$$

INCLINED SINGLE COLUMN MANOMETER

The manometer is more sensitive. Due to inclination the distance moved by heavy liquid in the right limb will be more.



Let L= length of heavy liquid moved in the rite limb

Θ = inclination of right. Limb with horizontal.

H2 = vertical rise of heavy liquid in the right limb above X – X

$$= L \sin\Theta$$

From above eq (2), the pressure at A is $p_A = h_2\rho_2 g - h_1\rho_1 g$

Substituting the value of h2

$$p_A = L \sin\Theta\, \rho_2 g - h_1\rho_1 g$$