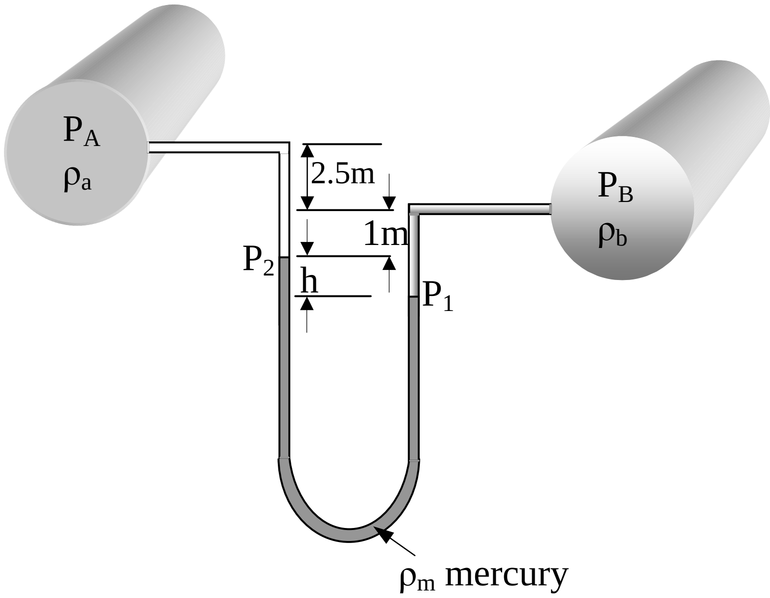
Example -3.8-

A differential manometer is connected to two pipes as shown in Figure. The pipe A is containing carbon tetrachloride sp.gr. = 1.594 and the pipe B is contain an oil of sp.gr. = 0.8. Find the difference of mercury level if the pressure difference in the two pipes be 0.8 kg/cm^2.



Solution:

$P_1 = P_2$

$P_1 = P_B + (1 + h)\,\rho_b\, g$

$P_2 = P_A + 3.5\,\rho_a\, g + h\,\rho_m\, g$

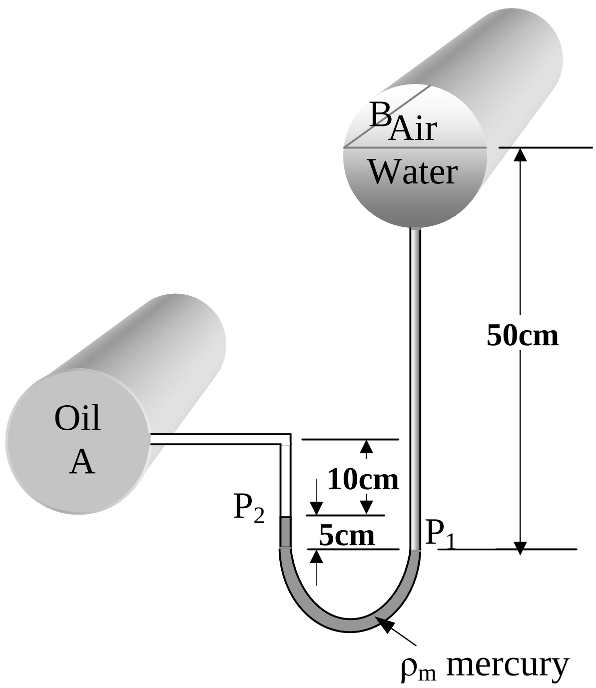
$\Rightarrow\ P_A - P_B = 3.5\,\rho_a\, g + h\,\rho_m\, g - (1 + h)\,\rho_b\, g = (0.8\ kg/cm^2)\,(9.81\ m/s^2)\,(10^4\ cm^2/m^2)$

$\Rightarrow\ 7.848 \times 10^4 = 3.5\,(1594)\,9.81 + h\,(13600)\,9.81 - (1+h)\,800\,(9.81)$

$\Rightarrow h = 25.16$ cm.

Example -3.9-

A differential manometer is connected to two pipes as shown in Figure. At B the air pressure is 1.0 kg/cm^2 (abs), find the absolute pressure at A.



Solution:

$P_1 = P_2$

$P_1 = P_{air} + 0.5\,\rho_w\, g$

$P_2 = P_A + 0.1\,\rho_a\, g + 0.05\,\rho_m\, g$

$\Rightarrow P_A = P_{air} + 0.5\,\rho_w\, g - 0.1\,\rho_a\, g - 0.05\,\rho_m\, g$

$\Rightarrow\ P_{air} = (1.0\ kg/cm^2\ P_B)\,(9.81 m/s^2)\,(10^4\ cm^2/\ m^2)$

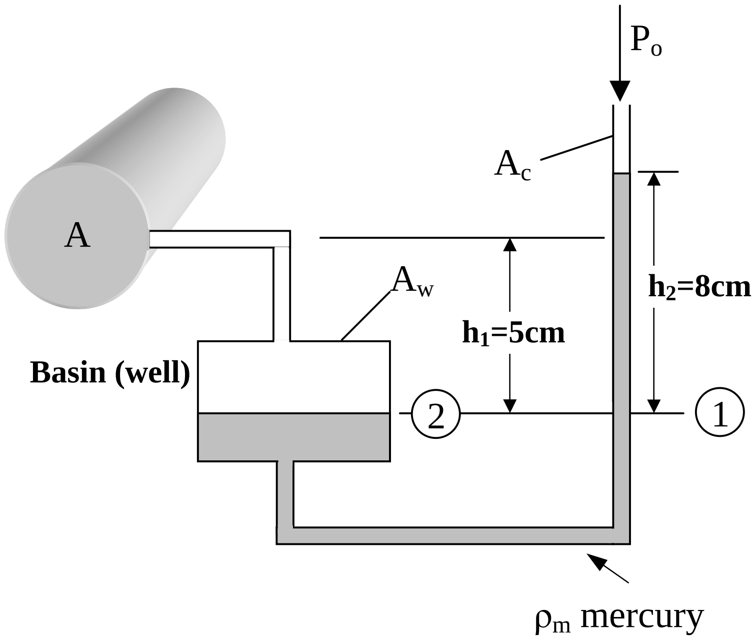
$= 9.81 \times 10^4$ Pa

$\therefore P_A = 9.81 \times 10^4\ Pa + 0.5\,(1000)\,9.81 - 0.1\,(900)\,9.81 - 0.05\,(13600)\,9.81$

$= 9.54513 \times 10^4$ Pa

Example -3.10-

A Micromanometer, having ratio of basin to limb areas as 40, was used to determine the pressure in a pipe containing water. Determine the pressure in the pipe for the manometer reading shown in Figure.



Solution:

$P_1 = P_2$

$P_1 = P_o + h_2\, \rho_m\, g$

$P_2 = P_A + h_1\, \rho_w\, g$

$\Rightarrow\ P_A = P_o + h_2\, \rho_m\, g - h_1\, \rho_w\, g$

$= 1.01325 x 10^5 + 0.08\ (13600)\ 9.81 - 0.05\ (1000)\ 9.81$

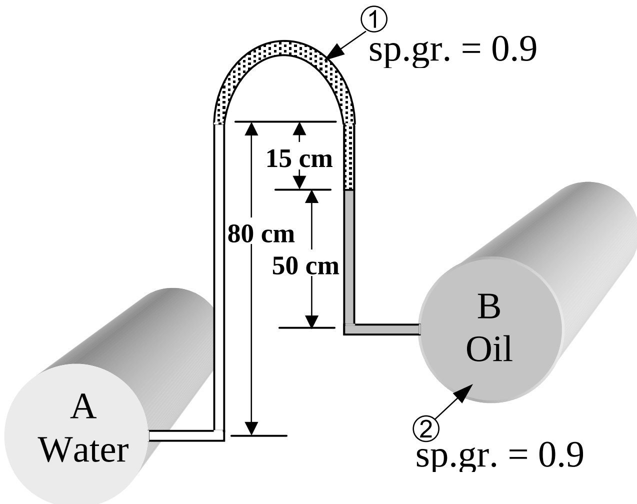
$= 1.11507\ x 10^5$ Pa

Note:

If h_2 and h_1 are the heights from initial level, the ratio (A_w/A_c) will enter in calculation.

Example -3.11-

An inverted manometer, when connected to two pipes A and B, gives the readings as shown in Figure. Determine the pressure in tube B, if the pressure in pipe A 1.0 kg/cm^2.



Solution:

$P_A - 0.8\, \rho_w\, g + 0.15\, \rho_1\, g + 0.5\, \rho_2\, g - P_B = 0$

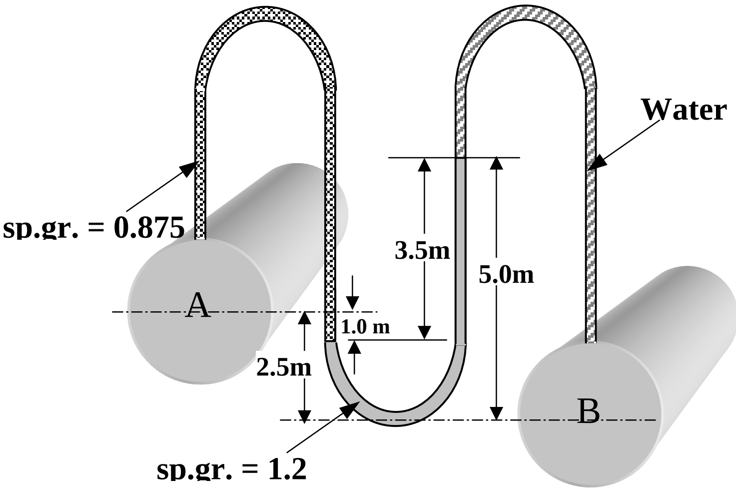
$\Rightarrow\ P_B = P_A - [0.8\ (1000) - 0.15\ (800) - 0.5\ (900)]\ 9.81$

$P_A = 1.0\ kg/cm^2\ x\ 9.81\ x\ 10^4 = 9.81\ x\ 10^4$ Pa

$\therefore P_A = 9.58437\ x 10^4$ Pa

Example -3.12-

Two pipes, one carrying toluene of sp.gr. = 0.875, and the other carrying water are placed at a difference of level of 2.5 m. the pipes are connected by a U-tube manometer carrying liquid of sp.gr. = 1.2. The level of the liquid in the manometer is 3.5 m higher in the right limb than the lower level of toluene in the limb of the manometer. Find the difference of pressure in the two pipes.



Solution:

T ≡ Toluene, W ≡ Water, L ≡ Liquid

$P_A + 3.5\ \rho_T\ g - 3.5\ \rho_L\ g + 5\ \rho_W\ g - P_B = 0$

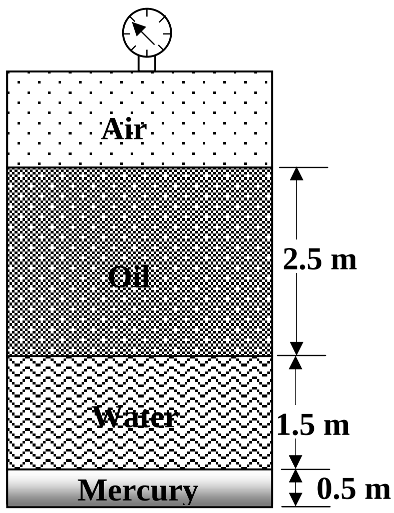
$\Rightarrow\ P_A - P_B = [3.5\ (1200) - 3.5\ (875) - 5\ (1000)]\ 9.81$

$= -3862.5$ Pa

$\Rightarrow\ P_B - P_A = 3862.5$ Pa

Example -3.13-

A closed tank contains 0.5 m of mercury, 1.5 m of water, 2.5 m of oil of sp.gr. = 0.8 and air space above the oil. If the pressure at the bottom of the tank is 2.943 bar gauge, what should be the reading of mechanical gauge at the top of the tank.



Solution:

Pressure due to 0.5 m of mercury

$P_m = 0.5\ (13600)\ 9.81 = 0.66708$ bar

Pressure due to 1.5 m of water

$P_w = 1.5\ (1000)\ 9.81 = 0.14715$ bar

Pressure due to 2.5 m of oil

$P_O = 2.5\ (800)\ 9.81 = 0.19620$ bar

Pressure at the bottom of the tank = $P_m + P_w + P_O + P_{Air}$

$\Rightarrow\ 2.943 = 0.66708$ bar $+ 0.14715$ bar $+ 0.19620$ bar $+ P_{Air}$

$\Rightarrow\ P_{Air} = 1.93257$ bar