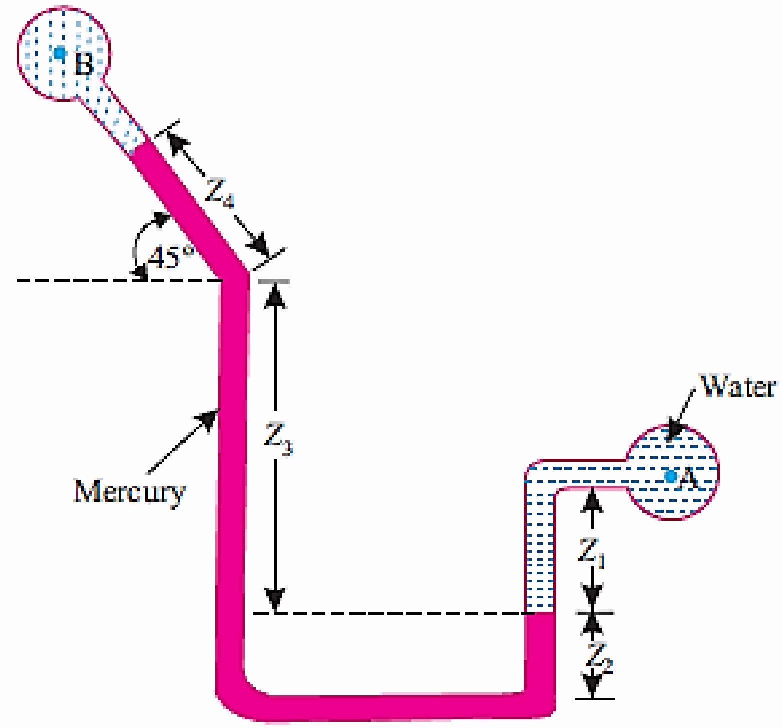
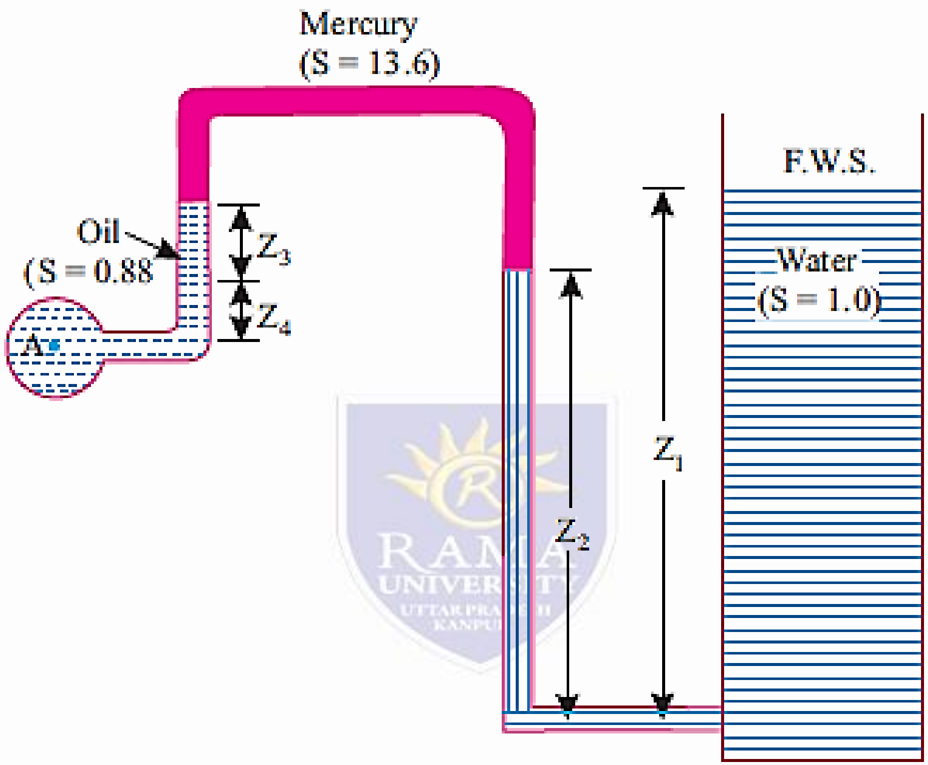
Fluid Properties

- For the Fig. determine the pressure difference between pipes A and B. Take Z1 = 0.45 m, Z2 = 0.225 m, Z3 = 0.675 m and Z4 = 0.3 m.
- Neglect pressure due to pressure of air column in the inclined tube.

- Solution. Starting from point A, the governing manometric equation is:
- $p_A + w_w Z_1 - w_m (Z_3 + Z_4 \sin 45°) = p_B$
- ∴ Pressure difference,
- $p_A - p_B = -w_m Z_1 + w_m (Z_3 + Z_4 \sin 45°)$
- $= -9.81 \times 0.45 + 13.6 \times 9.81 (0.675 + 0.3 \sin 45°)$
- $= -4.414 + 118.357 = 113.943$ kN/m2 (Ans.)



- From the Fig. 2.30 determine the absolute pressure in pipe A that contains oil of specific gravity = 0.88. Take Z1 = 0.66 m, Z2 = 0.33 m, Z3 = 0.165 m and Z4 = 0.11 m. Assume an atmospheric pressure 105 kPa.



- Solution. Starting from F.W.S (free water surface) in tank (at atmospheric pressure), we get
- patm + wwZ1 – wwZ2 – wmZ3 + w0 (Z3 + Z4) = pA
- 105 + 9.81 × 0.66 – 9.81 × 0.33 – 13.6 × 9.81 × 0.165 + 0.88 × 9.81 × (0.165 + 0.11) = pA
- or, pA = 105 + 6.475 – 3.237 – 22.014 + 2.374
- = 88.6 kN/m2 (absolute) (Ans.)

- Find the pressure difference between L and M in Fig.

Solution. $p_L - p_M$:

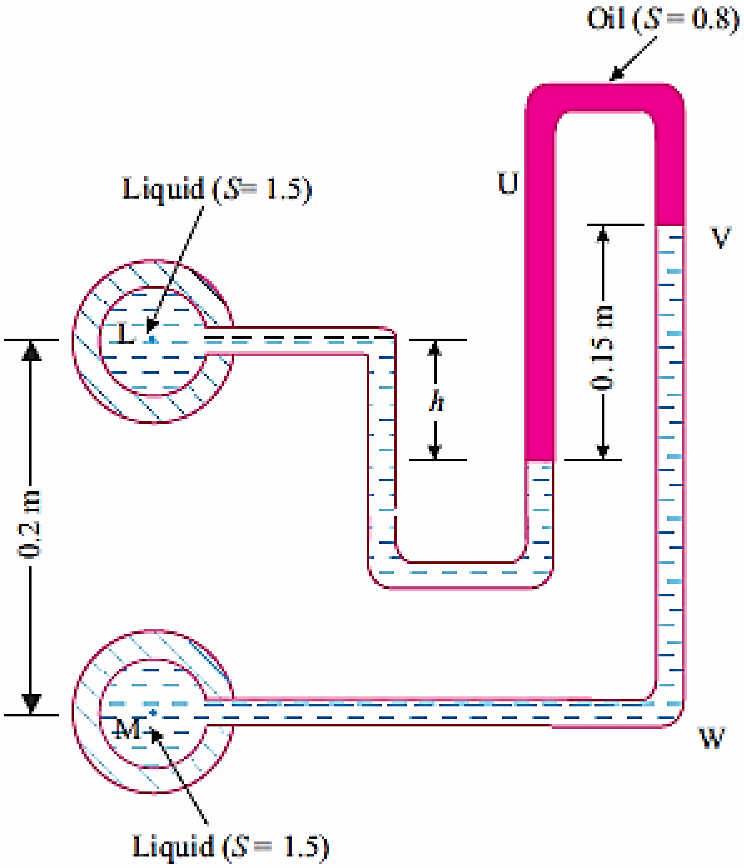
$$\frac{p_L}{w} + h \times 1.5 - 0.15 \times 0.8$$

(at L) (at N) (at $U = V$)

$$+ (0.15 + 0.2 - h) \times 1.5 = \frac{p_M}{w}$$

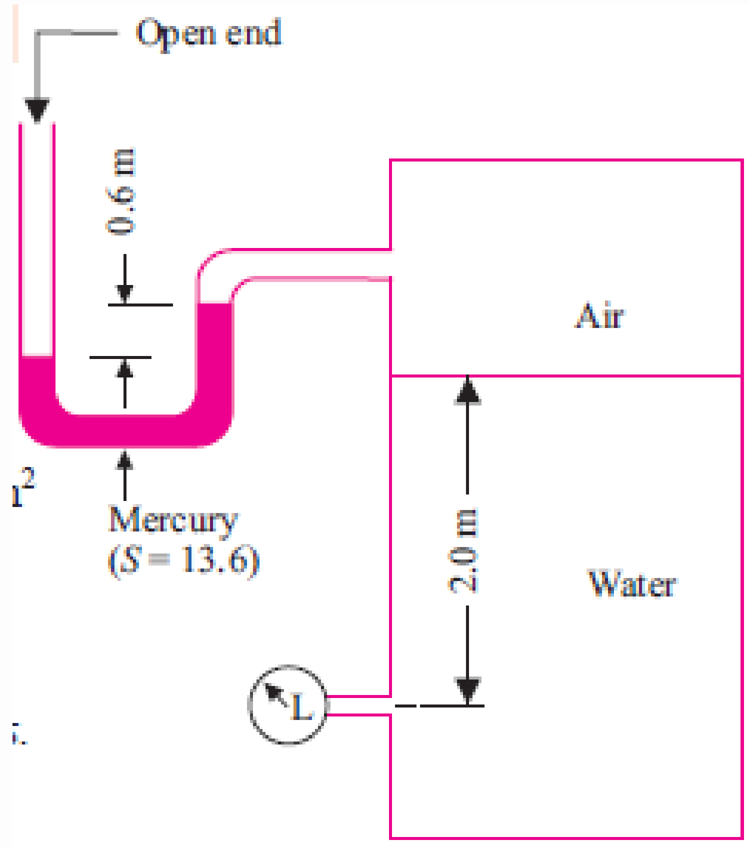
$$\frac{p_L}{w} + 1.5\,h - 0.12 + 0.525 - 1.5\,h = \frac{p_M}{w}$$

or, $$\frac{p_L - p_M}{w} = -0.405 \text{ m}$$



- Negative sign indicates pM > pL
- i.e., pM – pL = 0.405 × 9.81
- = 3.97 kN/m2 (Ans.)

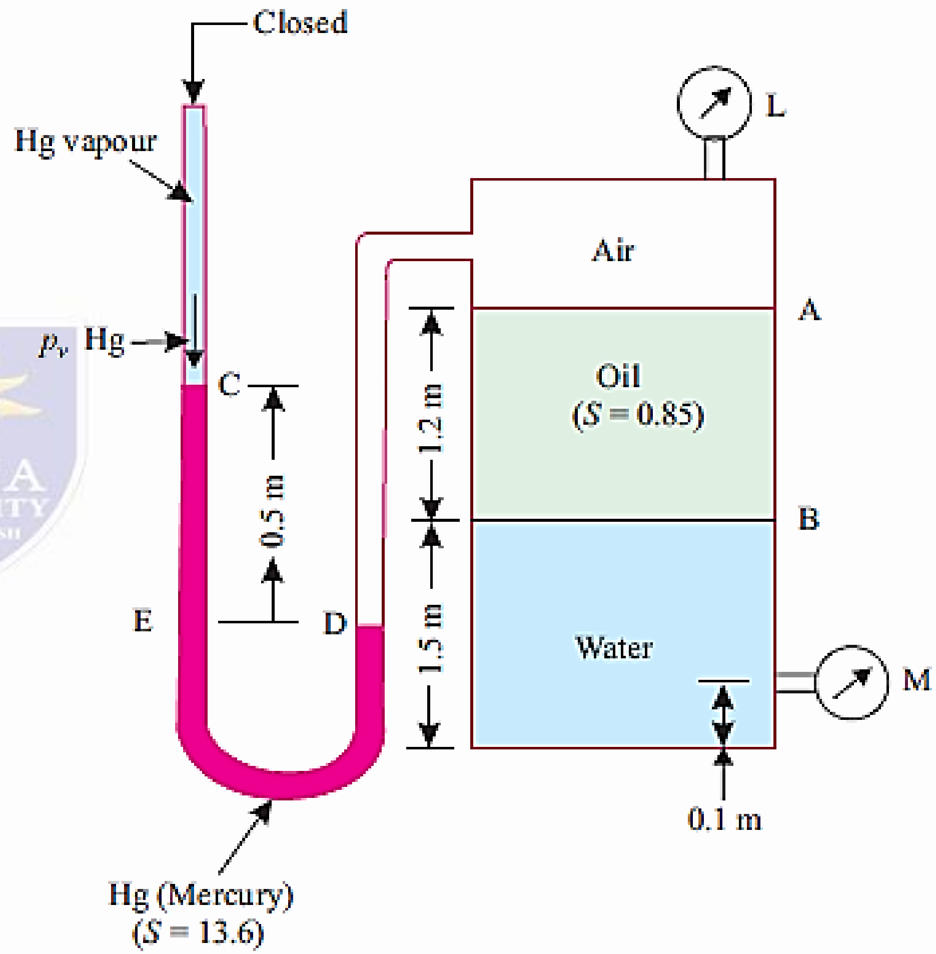
- In the Fig., if the local atmospheric pressure is 755 mm of mercury (sp. gravity = 13.6), calculate: (i) Absolute pressure of air in the tank;
- (ii) Pressure gauge reading at L.



- Solution. (i) Absolute pressure of air, (pabs)air:
- Starting from the open end, we have:
- 0 – (13.6 × w) × 0.6 = pair (pressure of air)
- i.e., pair = – 13.6 × 9.81 × 0.6 = – 80 kN/m2
- patm. = (atmospheric pressure)
- = (755/ 1000)× 13.6 × 9.81 = 100.73 kN/m2
- (pabs.)air = pair + patm. = – 80 + 100.73 = 20.73 kN/m2
- Hence, (pabs.)air= 20.73 kN/m2 (Ans.)
- (ii) Pressure gauge reading at L:
- Pressure at L = pabs. (air) + wh
- pL = 20.73 + 9.81 × 2 = 40.35 kN/m2 abs.
- Now, 40.35 = pgauge + patm.
- pgauge(L) = 40.35 – patm. = 40.35 – 100.73
- = – 60.38 kN/m2
- i.e., Vacuum pressure = 60.38 kN/m2
- Hence, pressure gauge reading at L = 60.38 kN/m2 (vacuum) (Ans.)

Fluid Properties

- Find the gauge readings at L and M in Fig. if the local atmospheric pressure is 755 mm of mercury.
- Solution. Assuming the vapour pressure of mercury (Hg) and pressure due to short column of air (wair is very low) to be negligible, we have:
- (i) (pgauge)L:
- (pv Hg ≈ 0) + 0.5 × 13.6
- (at C) (at D = E = A)
- = 6.8 m of water abs.
- (at A)
- pgauge + patm. = pabs.
- But, patm. =(755/1000) × 13.6 = 10.27 m of water
- ∴ pgauge + 10.27 = 6.8
- or, pgauge = – 3.47 m of water
- = – 3.47 × 9.81
- = – 34 kN/m2
- Hence, gauge reading at L = 34 kN/m2 (vacuum) (Ans.)
- (ii) (pgauge)M :
- 6.8 + 1.2 × 0.85 + (1.5 – 0.1) = 9.22 m of water abs.
- (at A) (at B) (at M)
- pgauge + patm. = pabs.
- pgauge + 10.27 = 9.22
- pgauge = – 1.05 m of water
- = – 1.05 × 9.81 = – 10.3 kN/m2
- Hence, gauge reading at M = 10.3 kN/m2 (vacuum) (Ans.)



Fluid Properties

- For the Fig determine specific gravity of gauge liquid B if the gauge pressure at A is – 18 kN/m2.
- Solution. Sp. gravity of liquid B:
- Pressure at L = pressure at M
- i.e., – 18 + (1.5 × 9.81× 0.6) = pM
- or, pM = – 9.17 kN/m2
- Between points M and U, since there is an air column which can be neglected, therefore,
- pM = pU (= – 9.17 kN/m2)
- Also, pressure at N = pressure at T.
- But point T being at atmospheric pressure,
- pT = 0 = pN
- Thus, pN = pU + S × 9.81 × 0.8 = 0
- or, 0 = – 9.17 + 7.848 S
- S = 1.17 (Ans.)