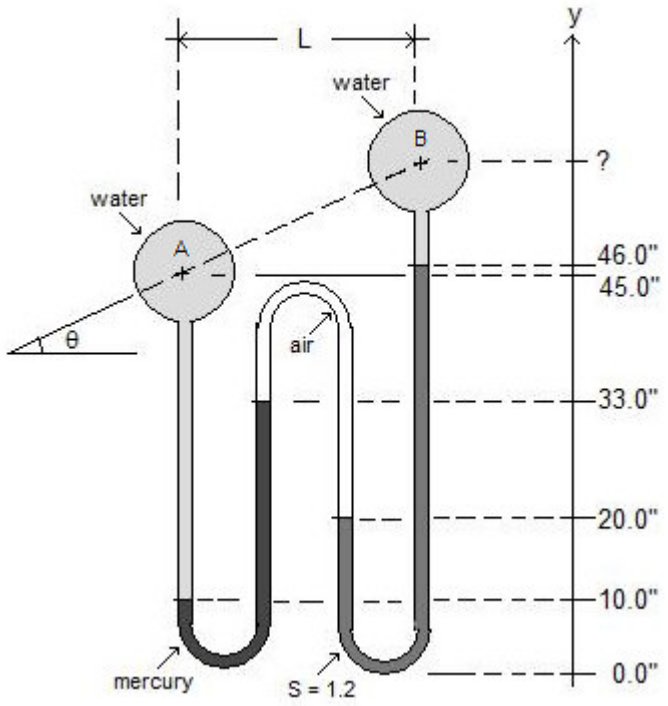
[2]. The manometer shown connects points A and B in parallel runs of a water pipeline. Points A and B are located in the same vertical plane along a line inclined at θ = 30o with a horizontal separation L = 25 in between them. Determine the pressure difference Δp = pB − pA in psi. The y-scale at the right-hand side of the figure shows the location of point A and each of the meniscii in the manometer in inches (in).



$\theta := 30 \cdot \frac{\pi}{180}\ ^{o}$

$\theta = 0.5236\ ^{r}$

$L := 25\ in$

sB: B scale position

$sB := 46 + L \cdot \tan(\theta)$

$sB = 60.4338\ in$

Write manometer equation from A to B. Calculate differences in heights from A on, call them h1, h2, ..., etc.

Differences in height are to be multiplied by 12 to convert to feet. Specific weight of water:

$\gamma w := 62.4\ \frac{lb}{ft^3}$

$h1 := 45 - 10$ i.e., $h1 = 35\ in$ $S1 := 1.0$

$h2 := 33 - 10$ i.e., $h2 = 23\ in$ $S2 := 13.56$

$h3 := 33 - 20$ i.e., $h3 = 13\ in$ $S3 := 0$

$h4 := 46 - 20$ i.e., $h4 = 26\ in$ $S4 := 1.2$

$h5 := sB - 46$ i.e., $h5 = 14.4338\ in$

$S5 := 1.0$

Manometer equation:

$$pA + S1 \cdot \gamma w \cdot h1 - S2 \cdot \gamma w \cdot h2 + S3 \cdot \gamma w \cdot h3 - S4 \cdot \gamma w \cdot h4 - S5 \cdot \gamma w \cdot h5 = pB$$

Thus,

$$\Delta p = pB - pA = 0 + S1 \cdot \gamma w \cdot h1 - S2 \cdot \gamma w \cdot h2 + S3 \cdot \gamma w \cdot h3 - S4 \cdot \gamma w \cdot h4 - S5 \cdot \gamma w \cdot h5$$

$\Delta p := 0 + S1 \cdot \gamma w \cdot h1 - S2 \cdot \gamma w \cdot h2 + S3 \cdot \gamma w \cdot h3 - S4 \cdot \gamma w \cdot h4 - S5 \cdot \gamma w \cdot h5$ i.e.,

$\Delta p = -139.756\ \frac{lb}{ft^2}$ convert to psi: $\Delta p := \frac{\Delta p}{144}$

i.e., $\Delta p = -139.756$ psi