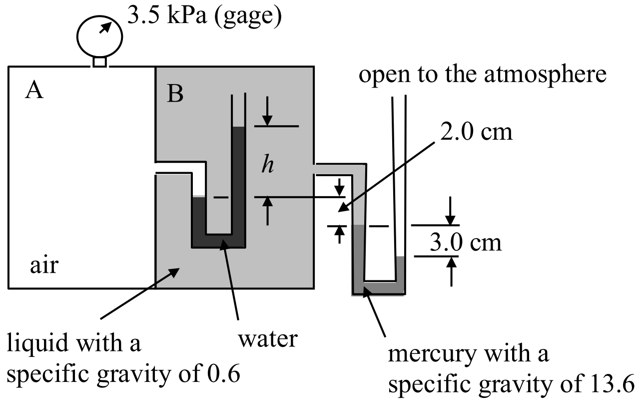
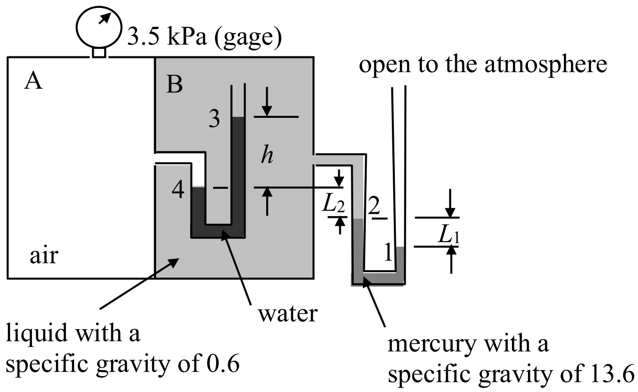
Compartments A and B of the tank shown in the figure below are closed and filled with air and a liquid with a specific gravity equal to 0.6. If atmospheric pressure is 101 kPa (abs) and the pressure gage reads 3.5 kPa (gage), determine the manometer reading, *h*.



SOLUTION:




First determine the pressure at 2 in terms of the pressure at 1.

$$p_2 = p_1 - \rho_{\text{Hg}} g L_1 \tag{1}$$

Now determine the pressure at 3 in terms of the pressure at 2.

$$p_3 = p_2 - \rho_{\text{liquid}} g \left(h + L_2\right) \tag{2}$$

Now determine the pressure at 4 in terms of the pressure at 3.

$$p_4 = p_3 + \rho_{\text{H20}} g h \tag{3}$$

Combine Eqns. (1)-(3).

$$p_4 = p_1 - \rho_{\text{Hg}} g L_1 - \rho_{\text{liquid}} g \left(h + L_2\right) + \rho_{\text{H20}} g h$$

$$p_4 = p_1 - \rho_{\text{H20}} SG_{\text{Hg}} g L_1 - \rho_{\text{H20}} SG_{\text{liquid}} g \left(h + L_2\right) + \rho_{\text{H20}} g h$$

$$p_4 - p_1 = -\rho_{\text{H20}} g \left[ SG_{\text{Hg}} L_1 + SG_{\text{liquid}} h + SG_{\text{liquid}} L_2 - h \right]$$

$$\frac{p_1 - p_4}{\rho_{\text{H20}} g} - SG_{\text{Hg}} L_1 - SG_{\text{liquid}} L_2 = h\left(SG_{\text{liquid}} - 1\right)$$

$$\boxed{h = \frac{1}{\left(1 - SG_{\text{liquid}}\right)} \left[ SG_{\text{Hg}} L_1 + SG_{\text{liquid}} L_2 + \frac{p_4 - p_1}{\rho_{\text{H20}} g} \right]} \tag{4}$$

Using the given data:

| | | |
|---|---|---|
| $p_1$ | = | 101 kPa (abs) = 0 Pa (gage) |
| $p_4$ | = | 3.5 kPa (gage) = 3500 Pa (gage) |
| $SG_{\text{Hg}}$ | = | 13.6 |
| $SG_{\text{liquid}}$ | = | 0.6 |
| $g$ | = | 9.81 m/s$^2$ |
| $\rho_{\text{H20}}$ | = | 1000 kg/m$^3$ |
| $L_1$ | = | 3.0 cm = 3.0*10$^{-2}$ m |
| $L_2$ | = | 2.0 cm = 2.0*10$^{-2}$ m |

Solving Eqn. (4) for $h$ gives:

$$\boxed{h = 1.9 \text{ m}}$$