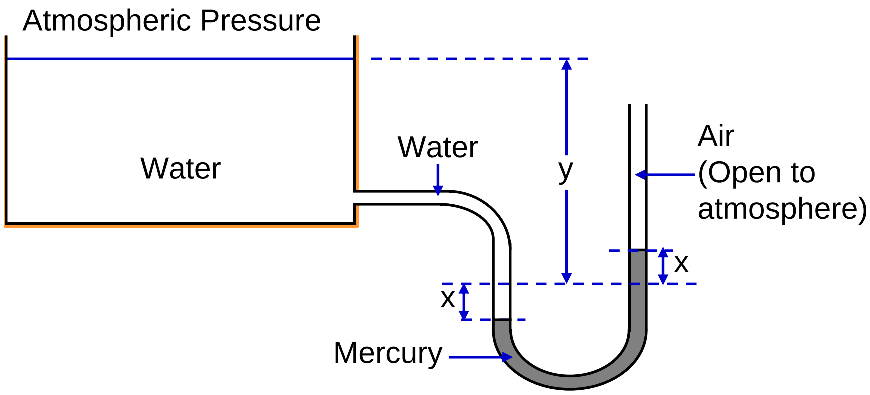
Solution to Problem 102A



As the two fluids (water, mercury) are assumed to be incompressible, the hydrostatic relation can be used:

$$\frac{dP}{dy} = +\rho g$$

Note: y is pointing down. The density of water will be denoted ρ_w, the density of mercury by ρ_m and it is given that:

$$\frac{\rho_m}{\rho_w} = 13.6$$

The pressure of the air is atmospheric pressure P_A. The pressure in the mercury must be the same for both sides of the manometer, thus P_1 can be calculated in two different ways by using the hydrostatic equation:

$$\begin{aligned} P_1 = P_A + \rho_w g\,(x+y) &= P_A + \rho_m g\,(2x) \\ \rho_w\,(x+y) &= \rho_m\,(2x) \\ \frac{x}{y} &= \left[2\frac{\rho_m}{\rho_w} - 1\right]^{-1} \end{aligned}$$

and by using the relation, between the densities of water and mercury it can be solved that:

$$\frac{x}{y} = \frac{1}{26.2} = 3.82 \times 10^{-2}$$