

5.105

5.105 A water siphon having a constant inside diameter of 3 in. is arranged as shown in Fig. P5.105. If the friction loss between A and B is $0.8V^2/2$, where V is the velocity of flow in the siphon, determine the flowrate involved.

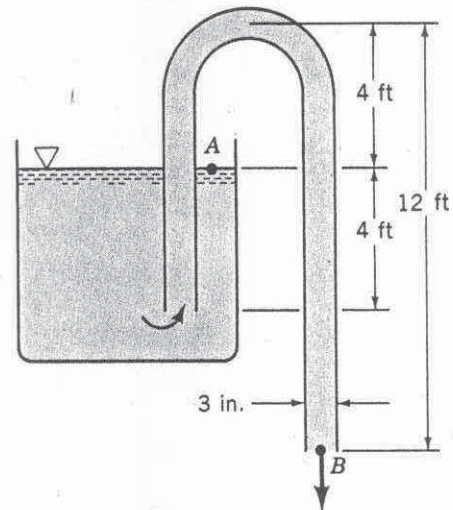


FIGURE P5.105

To determine the flowrate, Q , we use

$$Q = AV = \frac{\pi D^2}{4} V \quad (1)$$

To obtain V we apply the energy equation (Eq. 5.82) between points A and B in the sketch above. Thus,

$$\frac{P_B}{\rho} + \frac{V_B^2}{2} + g z_B = \frac{P_A}{\rho} + \frac{V_A^2}{2} + g z_A + w_{\text{shaft net in}} - \text{loss}$$

or

$$\frac{V^2}{2} + g z_B = g z_A - 0.8 \frac{V^2}{2}$$

Thus

$$V = \sqrt{\frac{g(z_A - z_B)}{0.9}} = \sqrt{\frac{(32.2 \frac{\text{ft}}{\text{s}^2})(8 \text{ ft})}{0.9}} = 16.9 \frac{\text{ft}}{\text{s}}$$

and with Eq. 1

$$Q = \frac{\pi (3 \text{ in.})^2}{4 (144 \frac{\text{in.}^2}{\text{ft}^2})} (16.9 \frac{\text{ft}}{\text{s}}) = \underline{\underline{0.830 \frac{\text{ft}^3}{\text{s}}}}$$