5.100

5.100 A water siphon having a constant inside diameter of 3 in. is arranged as shown in Fig. P5.100. 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.

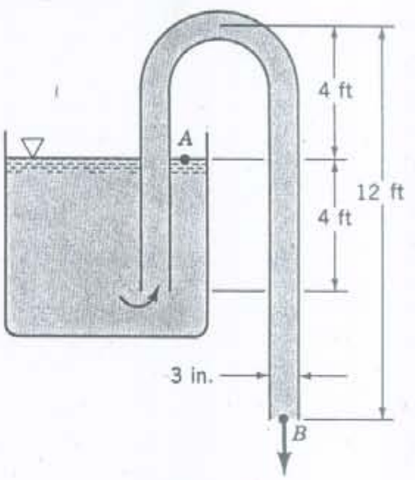

FIGURE P5.100

To determine the flowrate, Q, we use

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

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

$$\cancel{\frac{p_B}{\rho}}^{0} + \frac{V_B^2}{2} + g z_B = \cancel{\frac{p_A}{\rho}}^{0} + \cancel{\frac{V_A^2}{2}}^{0} + g z_A + \underset{\text{net in}}{w_{\text{shaft}}} - \text{loss}$$

or

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

Thus

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

and with Eq. 1

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