8.30

8.30 Water flows through a 6-in.-diameter horizontal pipe at a rate of 2.0 cfs and a pressure drop of 4.2 psi per 100 ft of pipe. Determine the friction factor.

For a horizontal pipe, $\Delta p = f \frac{\ell}{D} \frac{1}{2} \rho V^2$,

where $V = \frac{Q}{A} = \frac{2.0 \frac{ft^3}{s}}{\frac{\pi}{4}\left(\frac{6}{12} ft\right)^2} = 10.2 \frac{ft}{s}$

Thus,

$$f = \frac{2 D \Delta p}{\rho \ell V^2} = \frac{2\left(\frac{6}{12} ft\right)\left(4.2 \times 144 \frac{lb}{ft^2}\right)}{\left(1.94 \frac{slugs}{ft^3}\right)(100 ft)\left(10.2 \frac{ft}{s}\right)^2} = \underline{\underline{0.0300}}$$

8.31

8.31 Water flows in a cast-iron pipe of 200-mm diameter at a rate of 0.10 m³/s. Determine the friction factor for this flow.

For a $D = 0.200\,m$ cast iron pipe, $\frac{\varepsilon}{D} = \frac{0.26\,mm}{200\,mm} = 1.3 \times 10^{-3}$ (Table 8.1)

Also,

$$Re = \frac{VD}{\nu}, \text{ where } V = \frac{Q}{A} = \frac{0.10 \frac{m^3}{s}}{\frac{\pi}{4}(0.2 m)^2} = 3.18 \frac{m}{s}$$

Hence,

$$Re = \frac{\left(3.18 \frac{m}{s}\right)(0.2 m)}{1.12 \times 10^{-6} \frac{m^2}{s}} = 5.68 \times 10^5,$$ so from Fig. 8.20 we obtain

$f = \underline{\underline{0.0215}}$