For solving the first part of this problem, the control volume shown in the sketch above is used. To determine the loss accompanying flow from section 1 to section 2, Eq. 5.79 can be used as follows.

$$\Delta h_2 = \frac{P_1 - P_2}{g} + \frac{V_1^2 - V_2^2}{2} + g(z_1 - z_2)$$

Since x-y coordinates are specified we assume that the flow is horizontal and $z_1 - z_2 = 0$. Also, $P_2 = P_{a2} = 0$ psi.

From the conservation of mass principle, we conclude that

$$V_2 = V_1 \frac{A_1}{A_2} = V_1 \left(\frac{D_1^2}{D_2^2}\right)$$

Thus

$$\Delta h_2 = \frac{P_1}{g} + \frac{V_1^2}{2} \left(1 - \left(\frac{D_1}{D_2}\right)^4\right) = \frac{P_1}{g} + \frac{V_1^2}{2} \left(1 - \left(\frac{D_1}{D_2}\right)^4\right)$$

or

$$\Delta h_2 = \left(\frac{15.11 \text{ lb}}{1 \text{ in.}^2}\right) \left(\frac{144 \text{ in.}^2}{\text{ft}^2}\right) \left(\frac{5 \text{ ft}}{8}\right)^2 \left[1 - \left(\frac{12 \text{ in.}}{6 \text{ in.}}\right)^4\right] \left(\frac{1 \text{ lb}}{\text{slug. ft}}\right)$$

$$\Delta h_2 = 92.6 \text{ ft. lb perslug}$$

For the second part of this problem, we consider the flow of a fluid particle from section 2 to a state of rest. Eq. 5.79 leads to

$$\Delta h_2 = \frac{V_2^2}{2}$$

Note that we have assumed that $P_2 = P_{a2}$ and $z_2 = z_{a2}$. Thus

$$\Delta h_2 = \frac{V_2^2}{2} = \frac{V_1^2}{2} \left(\frac{D_1^2}{D_2^2}\right)^2 = \frac{V_1^2}{2} \left(\frac{D_1}{D_2}\right)^4 = \left(\frac{5 \text{ ft}}{8}\right)^2 \left(\frac{12 \text{ in.}}{6 \text{ in.}}\right)^4 \left(\frac{1 \text{ lb}}{\text{slug. ft}}\right)$$

$$\Delta h_2 = \frac{200 \text{ ft. lb perslug}}{\text{slug}}$$