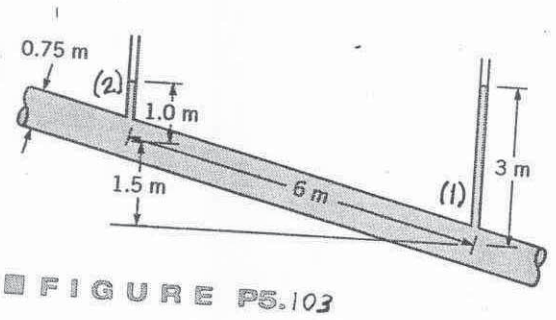
5.103

5.103 An incompressible liquid flows steadily along the pipe shown in Fig. P5.103. Determine the direction of flow and the head loss over the 6-m length of pipe.



■ FIGURE P5.103

Assume flow from (1) to (2) and use the energy equation (Eq. 5.84) to get for the contents of the control volume shown:

$$\frac{P_2}{\gamma} + \cancel{\frac{V_2^2}{2g}} + z_2 = \frac{P_1}{\gamma} + \cancel{\frac{V_1^2}{2g}} + z_1 + \overset{0}{\cancel{h_s}} - h_\ell$$

Thus

$$h_\ell = \frac{P_1}{\gamma} - \frac{P_2}{\gamma} + z_1 - z_2 = 3m - 1.0m - 1.5m = \underline{\underline{0.5m}}$$

and since $h_\ell > 0$, the assumed direction of flow is correct.

The flow is uphill.