

3.98

**3.98** A conical plug is used to regulate the air flow from the pipe shown in Fig. P3.98. The air leaves the edge of the cone with a uniform thickness of 0.02 m. If viscous effects are negligible and the flowrate is  $0.50 \text{ m}^3/\text{s}$ , determine the pressure within the pipe.

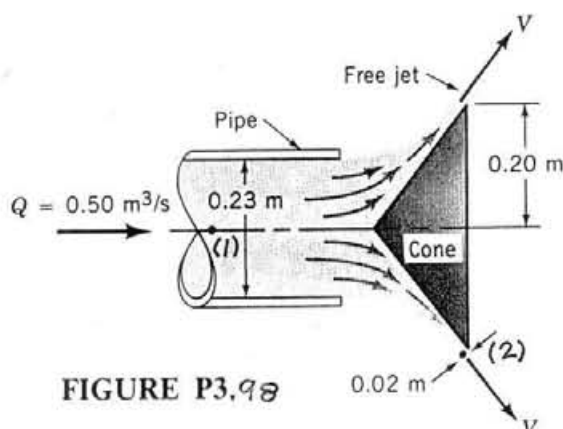


FIGURE P3.98

$$\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \quad \text{where } z_1 = z_2 \text{ and } p_2 = 0$$

Also,

$$V_1 = \frac{Q}{A_1} = \frac{0.5 \frac{\text{m}^3}{\text{s}}}{\frac{\pi}{4} (0.23 \text{ m})^2} = 12.0 \frac{\text{m}}{\text{s}}$$

and

$$V_2 = \frac{Q}{A_2} = \frac{Q}{2\pi R h} = \frac{0.5 \frac{\text{m}^3}{\text{s}}}{2\pi (0.2 \text{ m})(0.02 \text{ m})} = 19.9 \frac{\text{m}}{\text{s}}$$

Thus,

$$p_1 = \frac{1}{2} \rho (V_2^2 - V_1^2) = \frac{1}{2} (1.23 \frac{\text{kg}}{\text{m}^3}) (19.9^2 - 12.0^2) \frac{\text{m}^2}{\text{s}^2} = \underline{\underline{155 \frac{\text{N}}{\text{m}^2}}}$$