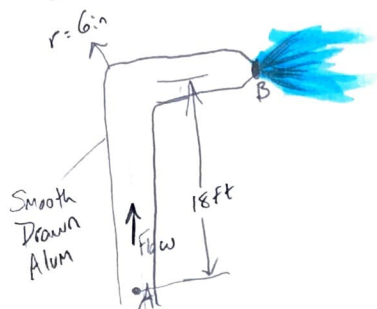


11.13)



$$D/\epsilon = \frac{0.0417 \text{ ft}}{5.0 \times 10^{-6} \text{ ft}} = 8,340$$

$$a) \frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + z_B + h_L$$

$$\therefore h_L = \frac{P_A - P_B}{\gamma} + \left(\frac{V_A^2 - V_B^2}{2g} \right) + \Delta z$$

$$h_L = \frac{2880 \text{ psf}}{62.0 \text{ lb/ft}^3} + \left(\frac{0^2 - 0^2}{2g} \right) - 18$$

$$h_L = 28.45 \text{ ft}$$

$$Q = -2.22 D^2 \sqrt{\frac{g D h_L}{L}} \log \left(\frac{1}{3.7 D/\epsilon} + \frac{1.784 V}{D \sqrt{g D h_L / L}} \right)$$

$$= -2.22 (0.0417)^2 \sqrt{\frac{32.2 (0.0417) (28.45)}{20}} \log \left(\frac{1}{3.7 (8340)} + \frac{1.784 (7.37 \times 10^{-6})}{0.0417 \sqrt{32.2 (0.0417) (28.45) / 20}} \right)$$

$$\therefore Q = 0.0033 \text{ ft}^3/\text{s}$$

$$V = \frac{Q}{A} = \frac{0.0033}{0.0014} = 2.36 \text{ ft/s}$$

$$b) h_L = \frac{11520}{62} - 18 \text{ ft} = 167.80 \text{ ft}$$

$$Q = -2.22 (0.0417)^2 \sqrt{\frac{32.2 (0.0417) (167.80)}{20}} \log \left(\frac{1}{3.7 (8340)} + \frac{1.784 (7.37 \times 10^{-6})}{0.0417 \sqrt{32.2 (0.0417) (167.80) / 20}} \right)$$

$$\therefore Q = 0.013 \text{ ft}^3/\text{s}$$

$$V = \frac{Q}{A} = \frac{0.013}{0.0014} = 9.29 \text{ ft/s}$$

Given

$$P_A = 20 \text{ psig} \text{ \& } 80 \text{ psig}$$

$$2880 \text{ psfg} \text{ \& } 11520 \text{ psfg}$$

$$K = 0.15$$

$$ID = 0.50 \text{ in} = 0.0417 \text{ ft}$$

$$r = 6.0 \text{ in}$$

$$L = 20 \text{ ft}$$

$$T = 100^\circ \text{F}$$

$$A_{\text{Tube}} = 0.0014 \text{ ft}^2$$

$$\gamma_{\text{H}_2\text{O}} @ 100 = 62.0 \text{ lb/ft}^3$$

$$\rho = 1.93 \text{ slug/ft}^3$$

$$\eta = 1.42 \times 10^{-5} \text{ lb-s/ft}^2$$

$$\epsilon = 5.0 \times 10^{-6} \text{ ft}$$

$$V = 7.37 \times 10^{-6} \text{ ft}^2/\text{s}$$

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MET 330
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HW 3.1