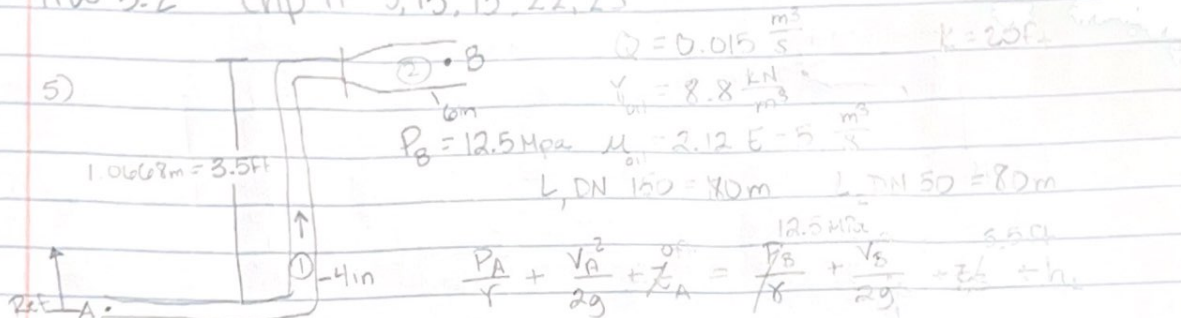


HW 3-2 Chp 11-5, 13, 15, 22, 23



$$Q = V \cdot A$$

$$V = \frac{Q}{A}$$

$$V_B = \frac{0.015 \frac{m^3}{s}}{\frac{\pi}{4} (0.1541m)^2} = 2.8 E-4 \frac{m}{s}$$

$$V_A = \frac{0.015 \frac{m^3}{s}}{\frac{\pi}{4} (0.0525m)^2} = 3.25 E-5 \frac{m}{s}$$

$$h_{L, pipe_1} = f \left(\frac{L}{D} \right) \left(\frac{V_A^2}{2g} \right) \Rightarrow$$

$$h_{L, pipe_2} = f \left(\frac{L}{D} \right) \left(\frac{V_B^2}{2g} \right)$$

$$h_{L, elbow} = k \left(\frac{V_A^2}{2g} \right)$$

$$h_{L, pipe_1} = (1.76 E-2) \left(\frac{181m}{0.0525m} \right) \left(\frac{3.25 E-5 \frac{m}{s}}{2 \cdot 9.81 \frac{m}{s^2}} \right)^2 = 3.27 E-9m$$

$$h_{L, pipe_2} = (1.76 E-2) \left(\frac{80m}{0.1541m} \right) \left(\frac{2.8 E-4 \frac{m}{s}}{2 \cdot 9.81 \frac{m}{s^2}} \right)^2 = 3.65 E-8m$$

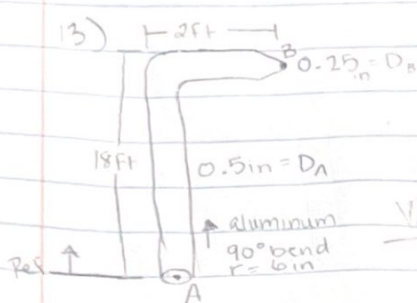
$$h_{L, elbow} = (0.36) \left(\frac{3.25 E-5 \frac{m}{s}}{2 \cdot 9.81} \right)^2 = 1.94 E-11m$$

$$P_A = \left[\frac{(2.8 E-4 - 3.25 E-5)^2}{2 \cdot 9.81 \frac{m}{s^2}} \right] + 12.5 MPa + 1.01m + 3.27 E-9m + 3.65 E-8m + 1.94 E-11m$$

$$P_A = 118.9 MPa$$

$$Q = A \cdot V$$

$$3 \frac{m}{s} \cdot \frac{\pi}{4} (0.0127 m)^2 = Q = 3.8 E - 4 m^3/s$$



V = assume 3 m/s

$P_A = 20 \text{ psig}$ $K = 0.15$ $L = 20 \text{ ft}$ $H_2O @ 100^\circ F$

$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_{f, \text{pipe}} + h_{f, \text{valve}}$$

$$\frac{V_A^2 - V_B^2}{2g} = \frac{P_B - P_A}{\gamma} + h_{f, \text{pipe}} + h_{f, \text{valve}}$$

$$h_{f, \text{pipe}} = f \left(\frac{L}{D} \right) \left(\frac{V^2}{2g} \right) = (2.08 E - 2) \left(\frac{20 \text{ ft}}{0.04167 \text{ ft}} \right) \left(\frac{9.84 \text{ ft/s}}{2 \cdot 9.81 \text{ m/s}^2} \right) = 1.93 \frac{m}{ft} (9.84 \frac{ft}{s}) (0.04167 \text{ ft}) = 1.42 E - 5 \frac{10^{-3}}{ft \cdot s}$$

$$h_{f, \text{elbow}} = K \frac{V^2}{2g} = (0.36) \left(\frac{3 \frac{m}{s}}{2 \cdot 9.81 \frac{m}{s^2}} \right) = 5.5729 \cdot 8$$

$K = 30 \text{ ft}$

$$K = 30 \text{ ft} \quad h_{f, \text{elbow}} = K \frac{V^2}{2g} = (0.15) \left(\frac{3 \frac{m}{s}}{2 \cdot 9.81 \frac{m}{s^2}} \right)$$

$$\frac{L}{E} = \frac{0.04167 \text{ ft}}{5 E - 6 \text{ ft}} = 8534$$

$$\text{excl} \quad f = 2.08 E - 2 \quad f_T = 0.012$$

$$h_{f, \text{pipe}} = 0.79 \text{ ft} = 0.241 \text{ m}$$

$$\frac{V_A^2 - V_B^2}{2 \cdot 9.81} = 0 - 20 \text{ psig} + 0.241 \text{ m} + 0.165 \text{ m} + 0.0688 \text{ m}$$

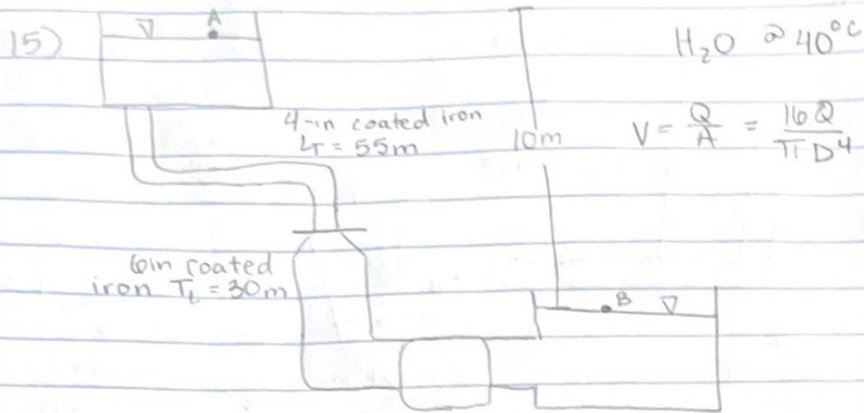
$$h_{f, \text{elbow}} = 0.165 \text{ m}$$

$$h_{f, \text{nozzle}} = 0.0688 \text{ m}$$

$$\Delta V = 1.73 \frac{m}{s}$$

$$\frac{V_A^2 - V_B^2}{2 \cdot 9.81} = 0 - 80 \text{ psig} + 0.241 \text{ m} + 0.165 \text{ m} + 0.0688 \text{ m}$$

$$\Delta V = 15.8 \frac{m}{s}$$



$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + z_B + h_{L_{A-B}}$$

$$h_{L_{\text{Pipe A}}} = f \left(\frac{L}{D} \right) \left(\frac{V^2}{2g} \right) =$$

$$\frac{V_A^2 - V_B^2}{\gamma} - z_{B-A} = h_{L_{A-B}}$$

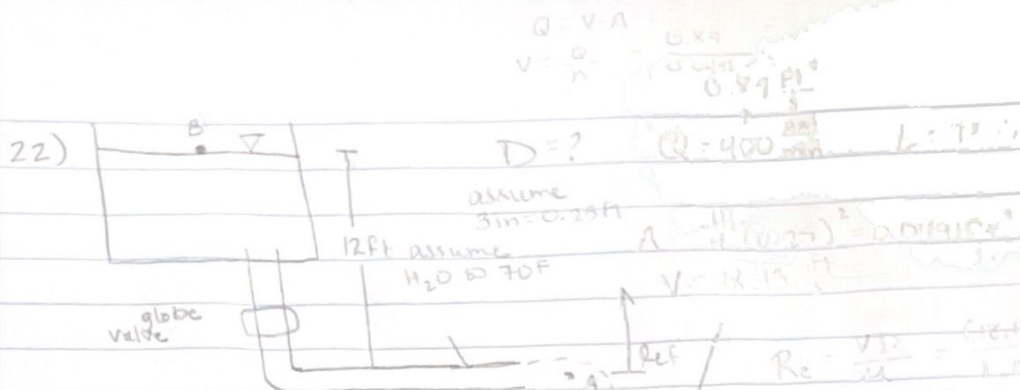
$$h_{L_{\text{Pipe B}}} = f \left(\frac{L}{D} \right) \left(\frac{V^2}{2g} \right) = \frac{V_A^2 - V_B^2}{\gamma} - z_B = f + 3(30\text{ft}) + K_B + K_{\text{fr}} \left(\frac{V^2}{2g} \right)$$

$$= f + 3(30\text{ft} + 45\text{ft}) + \frac{P_B}{D^4} \left(\frac{V^2}{2g} \right)$$

$$h_{L_{\text{elbow}}} = K \left(\frac{V^2}{2g} \right) =$$

calculations on excel

$$Q = 0.017 \frac{\text{m}^3}{\text{s}}$$



$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_L$$

$$\frac{V_A^2 - V_B^2}{2g} = Z_B + h_{L, \text{pipe}} + h_{L, \text{valve}} + h_{L, \text{elbow}}$$

$$h_{L, \text{pipe}} = f \left(\frac{L}{D} \right) \left(\frac{V^2}{2g} \right) = (1.85 \times 10^{-2}) \left(\frac{75 \text{ ft}}{0.25 \text{ ft}} \right) \left(\frac{18.15^2 \text{ ft}^2/\text{s}^2}{2 \cdot 32.2} \right) = 29.33 \text{ ft}$$

$$h_{L, \text{valve}} = K \left(\frac{V^2}{2g} \right) = (5.78) \left(\frac{18.15^2 \text{ ft}^2/\text{s}^2}{2 \cdot 32.2} \right) = 29.5 \text{ ft}$$

$$h_{L, \text{elbow}} = K \left(\frac{V^2}{2g} \right) = (0.51) \left(\frac{18.15^2 \text{ ft}^2/\text{s}^2}{2 \cdot 32.2} \right) = 2.6 \text{ ft}$$

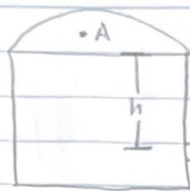
excel iterations

$\approx 0.535 \text{ ft}$ best Diameter

6.42 in

6 in shed 40 steel pipe

23)



gasoline @ 25°C $\gamma = 0.68 \frac{\text{kg}}{\text{m}^3}$ $\rho = 680 \frac{\text{kg}}{\text{m}^3}$
 $\eta = 2.87 \text{ E-4}$ $Q = 1500 \frac{\text{L}}{\text{min}}$

* (neglect $h_{L \text{ pipe}}$)

DN 90 Sch 40 Steel

$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + z_B + h_{L \text{ A-B}}$$

$$-z_B = (8\text{ft} + 30\text{ft}) \frac{1}{2g} \left(\frac{16Q^2}{\pi^2 D^4} \right) \quad -z_B = h_{L \text{ valve}} + h_{L \text{ elbow}}$$

$$f_T = 0.002$$

Calculation on excel

$$h = 7.8\text{m}$$