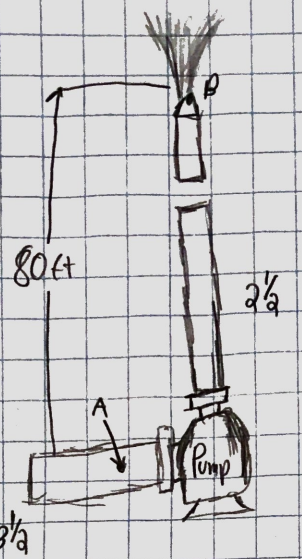
8.44



$$V_A = \frac{Q}{A_A}$$

$$V_A = \frac{0.50\ ft^3/s}{0.06868\ ft^2} = 7.28\ ft/s$$

$$V_B = \frac{Q}{A_B}$$

$$V_B = \frac{0.50\ ft^3/s}{0.03326\ ft^2} = 15.03\ ft/s$$

$$\rho_f = sg(\rho_w)$$

$$\rho_f = 1.026(1.94\ slugs/ft^3) = 1.9904\ slugs/ft^3$$

$$N_R = \frac{V_B D_B \rho_f}{\mu}$$

$$N_R = \frac{(15.03\ ft/s)(0.2058\ ft)(1.9904\ slugs)}{4.0\times10^{-5}\ lbs/ft^2}$$

$$\frac{6.15666}{4.0\times10^{-5}}$$

$= 1.54\times10^5$ the flow is turbulent

$$\text{Roughness} = \frac{D_B}{\varepsilon}$$

$$\left(\frac{D_B}{\varepsilon}\right) = \frac{0.2058\ ft}{1.5\times10^{-4}\ ft} = 1372$$

$$f = \frac{0.25}{\left[\log\left(\frac{1}{3.7(1372)} + \frac{5.47}{(1.54\times10^5)^{0.9}}\right)\right]^2} = 0.020$$

Friction Factor

Heat Loss $h = \frac{f L v^2}{2g D_B}$

$$h_L = \frac{(0.020)(80)(15.03)^2}{2(32.2)(0.2058)} = 27.27\ ft$$

$$\gamma_f = 1.026(62.4\ lb/ft^3) = 64.0224\ lb/ft^3$$

Cont...