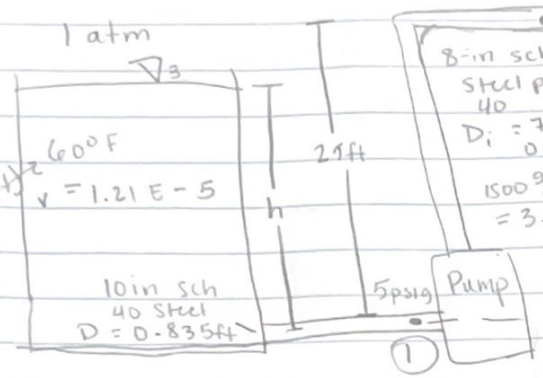
HW 2.2 Chp 8 - 33, 38, 44, 46, 49, 62

33)



$V_1 = \frac{3.34 \frac{ft^3}{s}}{\frac{\pi}{4}(0.835ft)^2}$

$V_1 = 6.1 \frac{ft}{s}$

$Q = V \cdot A$

$V_2 = \frac{Q}{A} = \frac{3.34 \frac{ft^3}{s}}{\frac{\pi}{4}(0.6651ft)^2}$

$V_2 = 9.6135 \frac{ft}{s}$

$Q = 1500 \frac{gal}{min} = 3.34 \frac{ft^3}{s}$

$(9.6135 \frac{ft}{s})$

1 atm $V = 9.6135 \frac{ft}{s}$ 25ft

5psig

$\cancel{h_A}^{0} + \frac{P}{\gamma} + \cancel{\frac{V^2}{2g}} + \cancel{z_1}^{0_{Ref}} = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_R + h_L$

a) $\cancel{h_s} + \frac{P_1}{\gamma} + z_1 = \cancel{h_1} + \frac{P_2}{\gamma} + z_2$ $\quad P = \rho g h \Rightarrow (62.4 \frac{lb}{ft^3})(32.2 \frac{ft}{s^2})$

1 atm ↔ 14.7 psig

$P_s + \frac{V_s^2}{2g} + h_s ft = P_1 + \frac{V_2^2}{2g} + 0ft_{ref}$

$14.7 psig + h_3 ft = 5 psig + \frac{(9.6135 \frac{ft}{s})^2}{2(32 \frac{ft}{s^2})}$

$= 158.816$

$h_3 = 144.12 ft$

b) $R_e = \frac{\rho V D}{\mu} = \frac{V D}{\nu}$

$\frac{(9.6135 \frac{ft}{s})(0.6651 ft)}{1.21 \times 10^{-5} \frac{ft^2}{s}} = 5.284 E5$

Hol 8.2

$\frac{\varepsilon}{D} \quad \frac{(15 \times 10^{-6})}{0.6651} = 2.256 \times 10^{-5}$

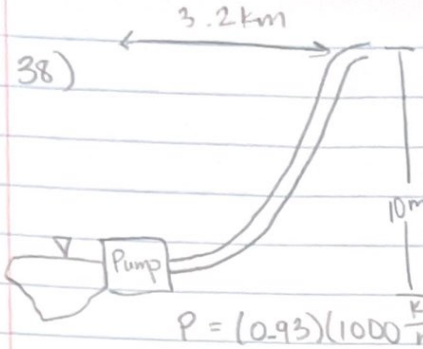
excel sheet: $f = 0.015$

$h = f(\frac{L}{D})(\frac{V^2}{2g})$ $\quad h_L = (0.015)\left(\frac{144.12ft}{0.6651ft}\right)\left(\frac{9.6135 \frac{ft}{s}}{2(32.2) \frac{ft}{s^2}}\right)^2 = 4,836.35 ft$

$P = \gamma h$

$P = (62.4)(144.12ft) = 4669.5 psi$

38)



$Q = 1200 \frac{L}{min} = 0.02 \frac{m^3}{s}$ $T = 100^{oC}$

$\gamma = 0.93$

$P = (0.93)(1000 \frac{kg}{m^3})$

$P = 930 \frac{kg}{m^3}$

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

$V = \frac{0.02 \frac{m^3}{s}}{\frac{\pi}{4}(0.1683)^2} = 0.9 \frac{m}{s}$

$Re = \frac{VD}{\nu} \Rightarrow \frac{(0.9)(0.1683)}{4.9 \times 10^{-5}} = 3091.2$ turb.

excel $f = 0.02$

$h_L = f(\frac{L}{D})(\frac{V^2}{2g}) \Rightarrow (0.02)(\frac{3200m}{0.1683m})(\frac{0.9^2 \frac{m}{s}}{2(9.81 \frac{m}{s^2})}) = 1510.8\ m$

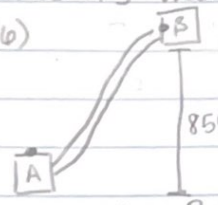
$\Delta P = \rho g h_L$

$\Delta P = (930 \frac{kg}{m^3})(9.81 \frac{m}{s^2})(1510.8m) = 13,783\ MPa$

$P_w = Q \Delta P = 0.02\ (13783) = 275.7\ kW$

If temp increased, it takes less power to move oil since it's more viscous.

46)



50^{oF} gasoline $P_B = 40 psig$ $Q = 4.25 \frac{ft^3}{s}$

$V = \frac{Q}{A} = \frac{4.25}{\frac{\pi}{4}(0.835ft)^2} = 7.76 \frac{ft}{s}$

$\cancel{h_A}^{0} + \frac{P_A}{\gamma} + \cancel{\frac{V_A^2}{2g}}^{0} + \cancel{z_A}^{0} = \frac{P_B}{\gamma} + \cancel{\frac{V_B^2}{2g}}^{0} + z_B + \cancel{h_p}^{0} + h_L$ excel: $f = 0.02$

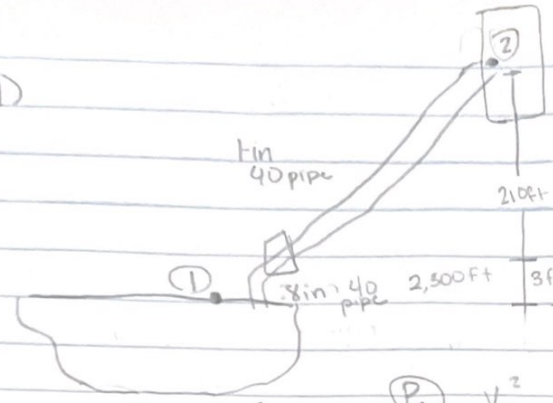
3166.1245

$\frac{P_A}{\gamma} = \frac{P_B}{\gamma} + z_B + h_L \Rightarrow \frac{5760 psi}{27.5} + 85 + 71.67\ ft$

$h_f = f(\frac{L}{D})(\frac{V^2}{2g}) \Rightarrow (0.02)(\frac{3200}{0.835})(\frac{7.76^2 ft}{2(32.2) \frac{ft}{s^2}}) = 71.67\ ft$

$P_A = \frac{10068.4 psi ft}{64} = 157.3 psi$

44)



$Q = 4 \frac{ft^3}{s}$ $T = 60^{\circ}F$

$h = 210$

$V_2 = \frac{Q}{A} = \frac{4 \frac{ft^3}{s}}{\frac{\pi}{4}(0.822)^2}$ $V_2 = 7.53 \frac{ft}{s}$

$\frac{P_1}{\gamma_0} + \frac{V_1^2}{2g} + 39.7ft = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_f$

$\frac{P_2}{\gamma} = z_2 + h_f - \frac{V_2^2}{2g}$

$\frac{\varepsilon}{D} = \frac{0.00015ft}{0.822ft} = 0.000182$

$\frac{P_2}{62.4 \frac{lb}{ft^3}} = 210ft + 39.7ft - \frac{(7.53 \frac{ft}{s})^2}{2(32.2 \frac{ft}{s^2})}$ $P_2 = 15526.34 \frac{lb}{ft^2}$

$\frac{15526.34}{144}$ | 107.8psi |

$h_f = f(\frac{L}{D})(\frac{V_1^2}{2g})$ $Re = \frac{VD}{\nu}$

$h_f = (0.0148)(\frac{2500ft}{0.822ft})(\frac{(7.53 \frac{ft}{s})}{2(32.2 \frac{ft}{s^2})}) = \frac{(11.46 \frac{ft}{s})(0.822ft)}{1.22 \times 10^{-5} \frac{ft^2}{s}} = 772,141$

excel sheet - $f = 0.048$

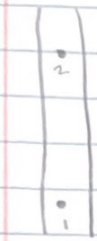
$h_f = 39.7ft$

49) $Q = 180 \frac{L}{min}$ $L = 25.8\,m$

25°C Glycerin $Q = 0.003 \frac{m^3}{s}$

Copper $D_o = 80mm$ $D_i = D_o - 2T \Rightarrow 80mm - 2(2.8mm) = 74.4mm$

$T = 2.8\,mm$ $0.0744\,m$



$A = \frac{\pi}{4}(0.0744\,m)^2 = 0.00435\,m^2$

$V = \frac{Q}{A} = \frac{0.003 \frac{m^3}{s}}{0.0043\,m^2} = 0.69 \frac{m}{s}$

$Re = \frac{V \cdot D}{\nu} \Rightarrow \frac{(0.69 \frac{m}{s})(0.0744\,m)}{4.78 \times 10^{-4} \frac{m^2}{s}} = 107.4$ laminar

table $\nu = 4.78 \times 10^{-4} \frac{m^2}{s}$

$f = \frac{64}{107.4} = 0.59$

$h_L = (0.59)\left(\frac{25.8}{0.0744}\right) \cdot \frac{1}{2}\left(1260 \frac{kg}{m^3}\right)\left(0.69 \frac{m}{s}\right)$

$h_L = 61494.97\,Pa = 61.5\,kPa$

$\Delta P = \rho g \Delta z$

$= (1260)(9.81)(-0.68) = -8405.2\,Pa \approx -8.41\,kPa$

$P_2 - P_1 = \Delta h_L + \Delta P$

$= 61.5 - 8.41 = 53.1\,kPa$

(62) copper

A • ——— • B

$Q = 1000 \frac{L}{min} = 0.017 \frac{m^3}{s}$

$A = \frac{\pi}{4}(D)^2 = \frac{\pi}{4}(0.113m)^2 = 0.01 m^2$

$V = \frac{Q}{A} \Rightarrow \frac{0.017}{0.01} = 1.7 \frac{m}{s}$

excel: $f = 0.02$

$h_L = f(\frac{L}{D})(\frac{V^2}{2g}) \Rightarrow (0.02)(\frac{45m}{0.113m})(\frac{1.7^2}{2(9.81)}) = 2.22 m$

$\Delta P = \rho g h_L \Rightarrow (1000 \frac{kg}{m^3})(9.81 \frac{m^2}{s})(2.22m) = 21778.2 Pa$

$21.78 kPa$