MET330 Homework

11.5 $Q = 0.015 m^3/s$

$h_{L_2} = f \cdot \frac{L}{D} \cdot \frac{V^2}{2g}$

$h_c = k(V_2^2/2g)$

$h_a + \frac{P_a}{\gamma} + \frac{V_a^2}{2g} + Z_a = \frac{P_B}{\gamma} + \frac{V^2}{2g} + Z_B + h_{L_1} + h_c + h_{L_2}$

$\frac{D_1}{D_2} = \frac{146.3\,mm}{49.3\,mm} = 2.96$

↳ $k \approx 0.34$

$Q = V_2 A_2 \rightarrow \quad V_2 = \frac{0.015 m^3/s}{1.905 \cdot 10^{-3} m^2}$

$V_2 = 7.874\ m/s$

$h_c = 0.34(7.874^2/2(9.81))$

$h_c = 1.03.5$

$Q = V_1 A_1 \rightarrow \quad V_1 = \frac{0.015 m^3/s}{1.69 \cdot 10^{-2} m^2}$

$V_1 = 0.8917\ m/s$

$\varepsilon_{steel} = 1.5 \cdot 10^{-6}\ m$

$N_{R_1} = \frac{VD}{\nu} = \frac{0.8917(0.1463)}{2.12 \cdot 10^{-5}}$

$N_{R_1} = 6153.5 > = 6.153 \cdot 10^3$

$D/\varepsilon_1 = \frac{0.1463}{1.5 \cdot 10^{-6}} = 97533$

$N_{R_2} = \frac{VD}{\nu} = \frac{7.874(0.0493)}{2.12 \cdot 10^{-5}}$

$N_{R_2} = 14510.76\ m = 1.45 \cdot 10^4$

$D/\varepsilon_2 = \frac{0.0493}{1.5 \cdot 10^{-6}} = 32866.6$

$h_{L_1} = f \cdot \frac{L}{D} \cdot \frac{V^2}{2g} = 0.039 \cdot \frac{1.80}{0.1463} \cdot \frac{0.8917}{2(9.81)}$

$h_{L_1} = 2.1807$

$h_{L_2} = 0.027 \cdot \frac{8+3}{0.0493} \cdot \frac{7.874^2}{2(9.81)}$

$h_{L_2} = 22.498$

$\frac{P_a}{\gamma} + \frac{V_a^2}{2g} = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_{L_1} + h_c + h_{L_2}$

$\frac{P_a}{\gamma} - \frac{P_B}{\gamma} = \frac{V_B^2}{2g} - \frac{V_a^2}{2g} + Z_B + h_{L_1} + h_c + h_{L_2}$

$= \frac{7.874^2}{2(9.81)} - \frac{0.8917^2}{2(9.81)} + 4.5 + 2.1807 + 103.5 + 22.498$

$P_a - P_B = \frac{135.794}{\gamma} = \frac{135.794}{8.680} = 15.43$ (MPa? kPa?)

~~P_B~~ P_B is 12.5 MPA and I'm so forgot elbows

$P_A = 15.43 + 12.5 = 27.43$ MPA