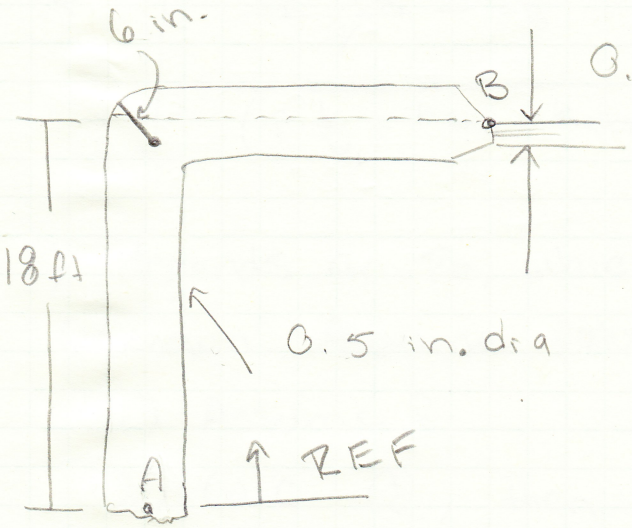
11.13

$P_B = 0$ psig




To find:

Velocity of flow given pressure at A is:

a) 20 psig

b) 80 psig

Constants / given

$h = 0.15$ ft  100°F

Inside Dia. = 0.5 in  Smooth drawn aluminum

90° bend, 6.0 radius  (NO D/ε)

Total Length = 20 ft

$D_1/D_2 = 0.042/0.021 = 2$

$$\frac{P_A - P_B}{\gamma} - z_B = h_{L\,AB}$$

$$h_L = f\frac{L}{D}\frac{V^2}{2g} + K_{contraction}\frac{V^2}{2g} + K_{elbow}\frac{V^2}{2g}$$

Rewriting eqn:

$$\frac{P_a - P_B}{\gamma} - z_B = \left(f\frac{L}{D_1} + \overset{0.15}{K_{cont}} + \overset{30}{K_{elbow}}\right)\frac{8Q^2}{g\pi^2 D_1^4}$$

$V = \frac{4Q}{\pi D^2}$, but Q is unknown. To find V, we will solve for Q

11.13

$$Q = \sqrt{\frac{\frac{P_A - P_B}{\gamma} - z_B}{\left(f\frac{L}{D_1} + K_{cont} + K_{elbow}\right)\frac{8}{g\pi^2 D^4}}}$$

f depends on Re, which needs V, which is unknown. Assume value for f.

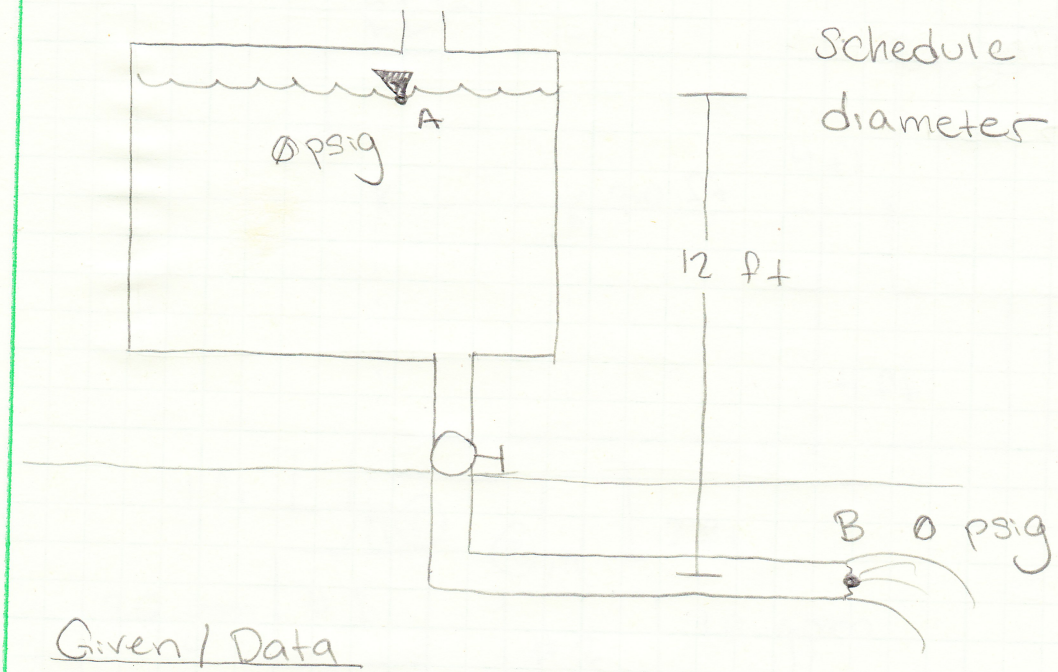
1) Assume f
2) Calc. Q, then Re
3) Compute f from Re in step 2
4) Compare assumed f to new f value

From Excel calculations

a) V = 2.1 ft/s
b) V = 5.2 ft/s

MET 330 | 3.1, 3.2

11.20




TO Find

Schedule 40 pipe diameter

REF

Given / Data

- $H_2O$ @ 80 °F
- $Q = 400$ gal/min $= 0.89$ ft$^3$/s
- $\gamma = 62.2$ @ 80°F
- $\nu = 9.15 \times 10^{-6}$ ft$^2$/s
- $\Delta P = 0$
- $\varepsilon = 1.5 \times 10^{-4}$ ft
- $K_{valve} = 340$
- $L = 75$ ft

$$\frac{P_A - P_B}{\gamma}^{\,0} - z_B = f \frac{8LQ^2}{g\pi^2 D^5} + K_{valve} \frac{8Q^2}{g\pi^2 D^4}$$

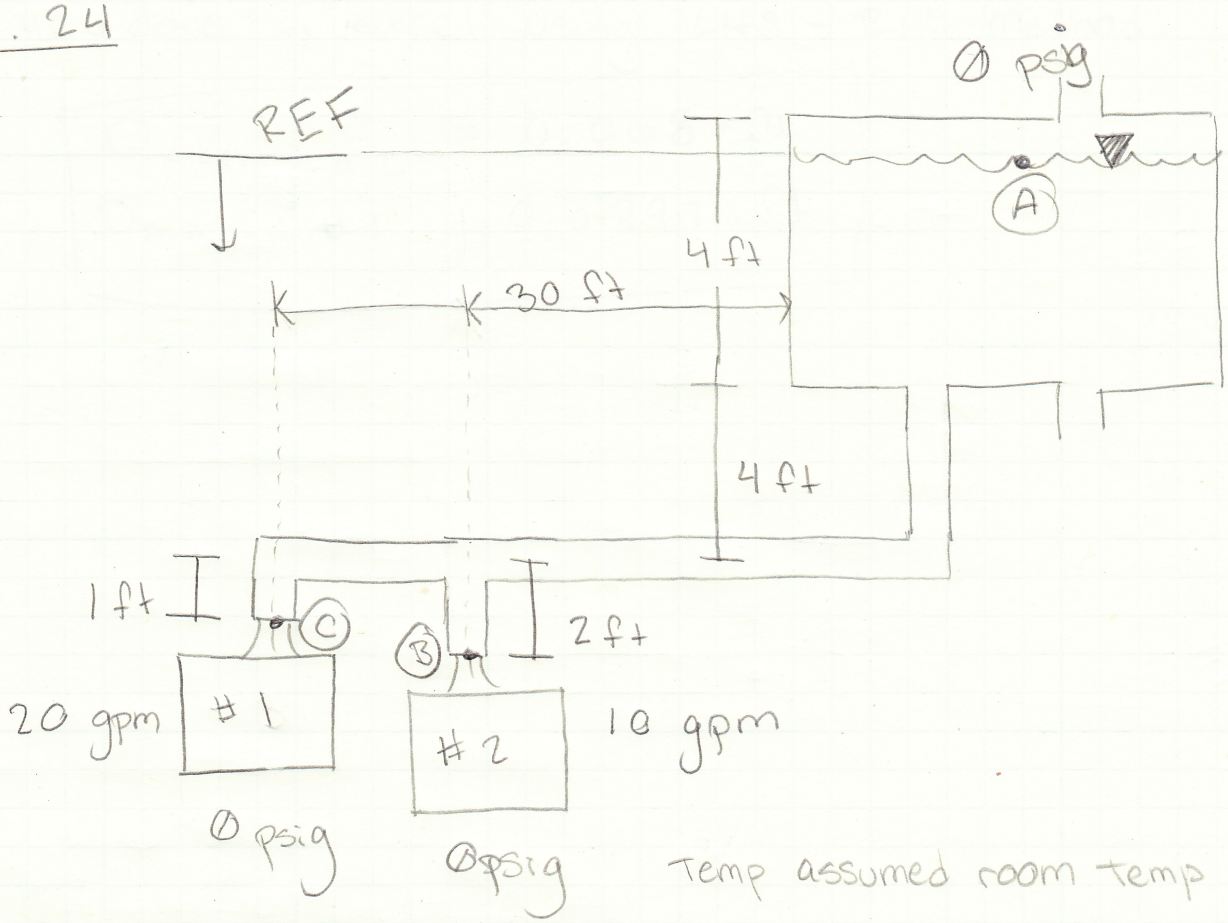
Use excel for the fallowing:

1) Guess D
2) Compute Re & f
3) Compute $f_T$
4) compute RHS + compare to LHS

Min diameter = **0.356 ft**

MET 330 | 3.1, 3.2

11.24




Data

- Schedule 40 → $\varepsilon = 1.5 \times 10^{-4}$ ft
- $Q_1 = 20$ gpm $= 0.0445$ ft$^3$/s
  $Q_2 = 10$ gpm $= 0.0223$ ft$^3$/s
- $K_{elbow} = 30 f_T$
- $z_B = 10$ ft
- $L_B = 34$ ft
- $z_C = 9$ ft
- $L_C = 38$ ft

$$\frac{P_A - P_B}{\gamma} - z_{B,C} = f\frac{L}{D}\frac{V^2}{2g} + K_{elbow}\frac{V^2}{2g}$$

($P_A - P_B = 0$)

$$z_{B,C} = f\frac{8LQ^2}{g\pi^2 D^5} + K_{valve}\frac{8Q^2}{g\pi^2 D^4}$$

Find Pipe dia.

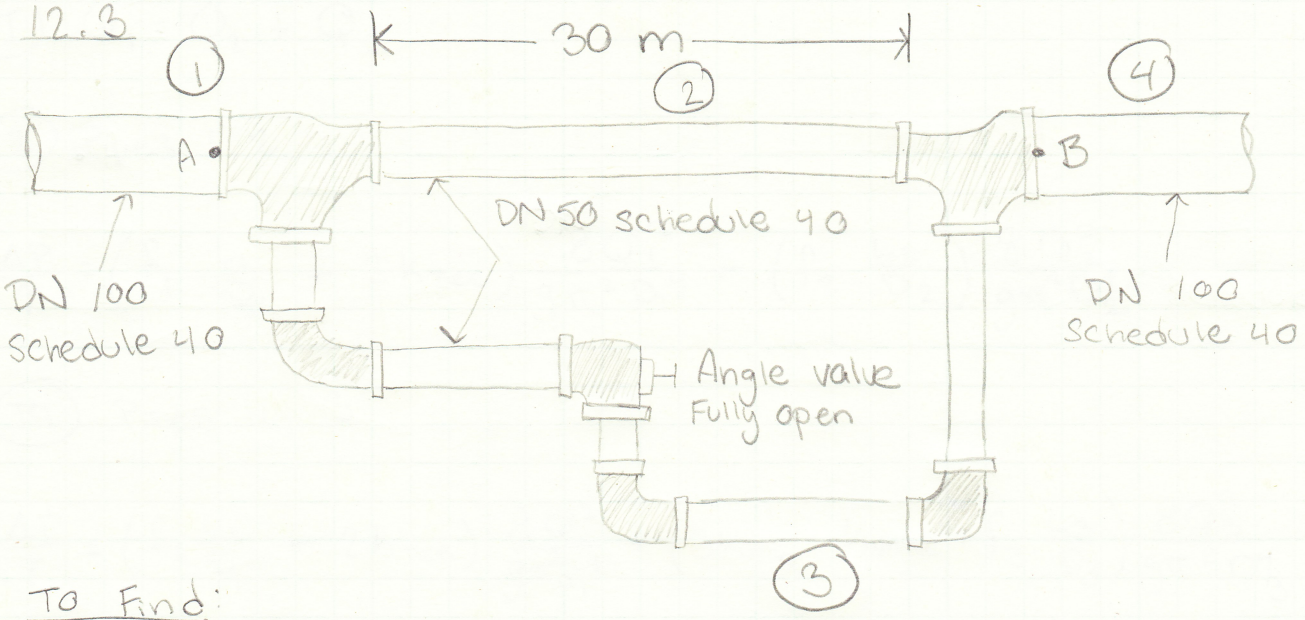
11.24

Calc done in excel using LHS - RHS method

$D_{machine\ \#2} = 0.068$ ft

$D_{machine\ \#1} = 0.0897$ ft

12.3




To Find:

a) Q in each branch

b) $\Delta P$ ($P_A - P_B$)

Constants/Given:

- $Q_1 = 850\ L/min = 0.014\ m^3/s$
- $L_2 = 30\ m$, $L_3 = 60\ m$
- $D_1 = D_4 = 0.1023\ m$ $A_1 = A_4 = 8.213 \times 10^{-3}\ m^2$
- $D_2 = D_3 = 0.0525\ m$ $A_2 = A_3 = 2.168 \times 10^{-3}\ m^2$
- $f_{T,1} = f_{T,4} = 0.016$
- $f_{T,2} = f_{T,3} = 0.019$
- $K_{valve} = 150 f_T$, $h_L = K \frac{V^2}{2g}$
- $K_{elbow} = 30 f_T$
- $K_{Tee} = 20 f_T$ (flow thru run), $60 f_T$ (flow thru branch)
- $\varepsilon = 4.6 \times 10^{-5}\ m$
- $\gamma_{H2O} = 9.81\ KN/m^3$, $\nu_{H2O} = 1.3 \times 10^{-6}$ @ 10°C
  - $Re = \frac{VD}{\nu}$

12.3

(I) $Q_1 = Q_2 + Q_3$

(II) Pipes 1, 2

$$\frac{\Delta P}{\gamma} = \left(f_1 \frac{L_1}{D_1} + 2K_{Tee}\right) \frac{8Q_1^2}{g\pi^2 D_1^4} + \left(f_2 \frac{L_2}{D_2}\right) \frac{8Q_2^2}{g\pi^2 D_2^4}$$

(III) Pipes 1, 3

$$\frac{\Delta P}{\gamma} = \left(f_1 \frac{L_1}{D_1} + 2K_{Tee}\right) \frac{8Q_1^2}{g\pi^2 D_1^4} + \left(3K_{elb} + K_{valve} + f_3 \frac{L_3}{D_3}\right) \frac{8Q_3^2}{g\pi^2 D_3^4}$$

1) $Q_1$ is known. we can calculate $Re_1$, $D/\varepsilon_1$, $f_1$

2) Solve for $Q_2$:

$$Q_2 = \sqrt{\frac{\frac{\Delta P}{\gamma} - \left(f_1 \frac{L_1}{D_1} + 2K_{Tee}\right) \frac{8Q_1^2}{g\pi^2 D_1^4}}{\left(f_2 \frac{L_2}{D_2}\right) \frac{8}{g\pi^2 D_2^4}}}$$

2.1) Assume $\Delta P$, $L_1$, $f_2$

2.2) Solve for $Q_2$ (in excel)

2.3) Compute $Re_2$

2.4) use $Re_2$ to calc new $f_2$

→ $f_2$ found to be 0.0207 in spreadsheed

$\approx 0.021$

3) Solve for $Q_3$

$$Q_3 = \sqrt{\frac{\frac{\Delta P}{\gamma} - \left(f_1 \frac{L_1}{D_1} + 2K_{Tee}\right) \frac{8Q_1^2}{g\pi^2 D_1^4}}{\left(3K_{elb} + K_{valve} + f_3 \frac{L_3}{D_3}\right) \frac{8}{g\pi^2 D_3^4}}}$$

12.3

From Excel Iterations:

$Q_1 = 0.014 \ m^3/s$ (given)

$Q_2 = 0.011 \ m^3/s$

$Q_3 = 0.002 \ m^3/s$