Benzene $Sg = 0.87$

$\gamma = 0.87 \cdot 62.4 \ lb_m/ft^3 = 54.288$

$\nu = 7.41 \times 10^{-6} \ ft^2/s$

$\eta = 8 \times 10^{-6} \ lb\text{-}s/ft^2$

HW 8.2 Chapter 11

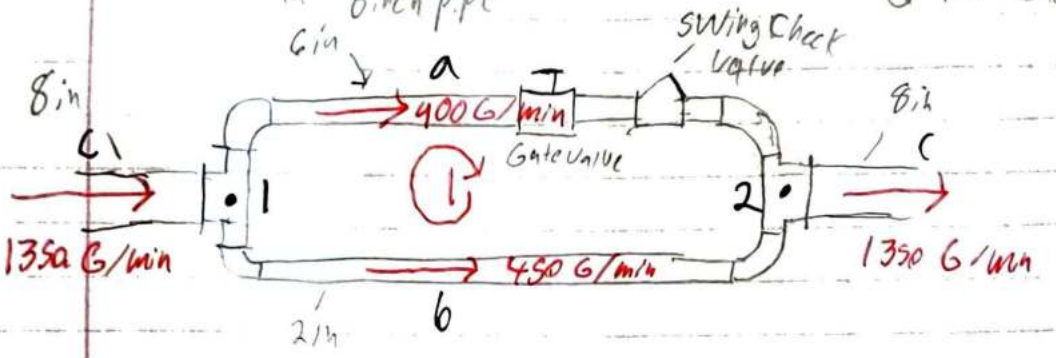
12-7: $Q = 1350$ G/min

1 in 6 inch pipe

Sch 40 Steel

Q in each branch

$L = 500$ ft



$D_a = 0.5054$

$D_b = 0.1723$

$D_C = 0.6651$

$\varepsilon = 4.6 \times 10^{-5}$

- Give flow rate signs based on marching direction

$Q_A = 900$ G/min

$Q_b = -450$ G/min

$\frac{G}{min} \cdot \frac{1 ft^3}{7.48 g} \cdot \frac{1 min}{60 s}$

- Next head to excel and input data

Pipe a losses

- 2 tee, 2 elbow, 1 gate valve, 1 swing check valve

$\frac{L_e}{D} = 2 \cdot 60 + 2 \cdot 30 + 8 + 100 = 288$

Pipe B losses

- 2 tee, 2 elbow

$\frac{L_e}{D} = 2 \cdot 60 + 2 \cdot 30 = 180$

$L_{eA} = \frac{L_e}{D} \cdot D = 288 \cdot 0.5054 ft = 145.555$

$L_{eB} = \frac{L_e}{D} \cdot D = 180 \cdot 0.1723 ft = 31.014$

$$Re_a = \frac{\rho V D}{\eta} = \frac{54.288 \ lb_m/ft^2}{32.2 \ lb_m\text{-}ft/lb_f\text{-}s^2} \cdot \frac{9.9960 \cdot 0.5054}{8 \times 10^{-6} \ \frac{lb_f\text{-}s}{ft^2}}$$

$Re_a = 1060846$

$K = 8 \cdot (H.I) \cdot n / D()^2 / g / f^5$

$KQ^2 = ABS(N \cdot E) \cdot E$

$2 \neq Q = ABS(2 \cdot N \cdot E)$

Sum KQ^2 and $2 \neq Q$

Next find ΔQ

- find % error = ΔQ / Q guess

- Next, correct Q guess with ΔQ

$$Q_{new} = Q_{old} - \Delta Q$$

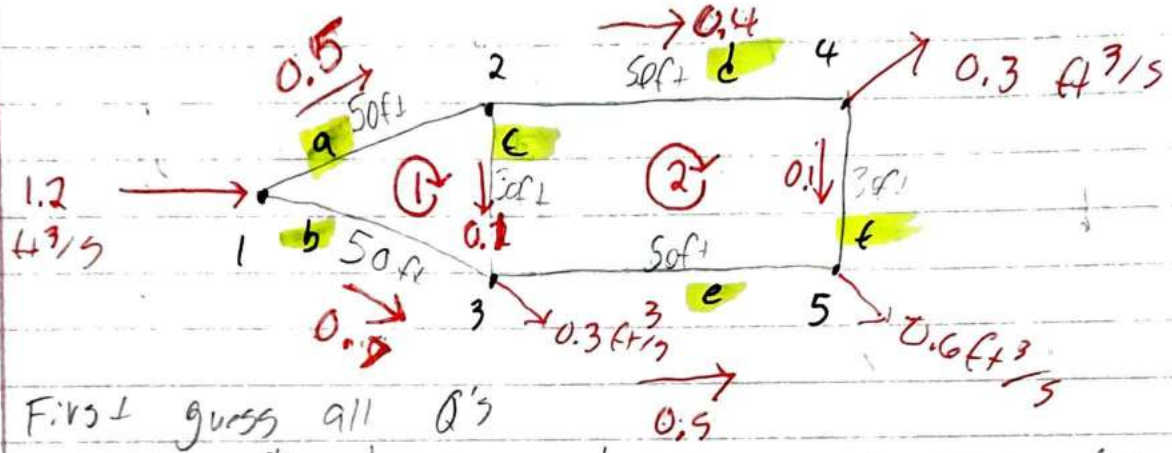
After 7 Iterations

$Q_A = 2.818516$ ft^3/s → 1264,95 Gal/min
$Q_B = 0.18951$ ft^3/s → 85,05 Gal/min

- 2 1/2 in Sch 40 pipe $D = 0.2058 ft$ - $\varepsilon = 1.5 \times 10^{-4} ft$

12.9: - Q in each pipe?

- Neglect minor losses
- water at 60°F $\gamma = 62.4 lb/ft^3$ $\nu = 1.21 \times 10^{-5} ft^2/s$



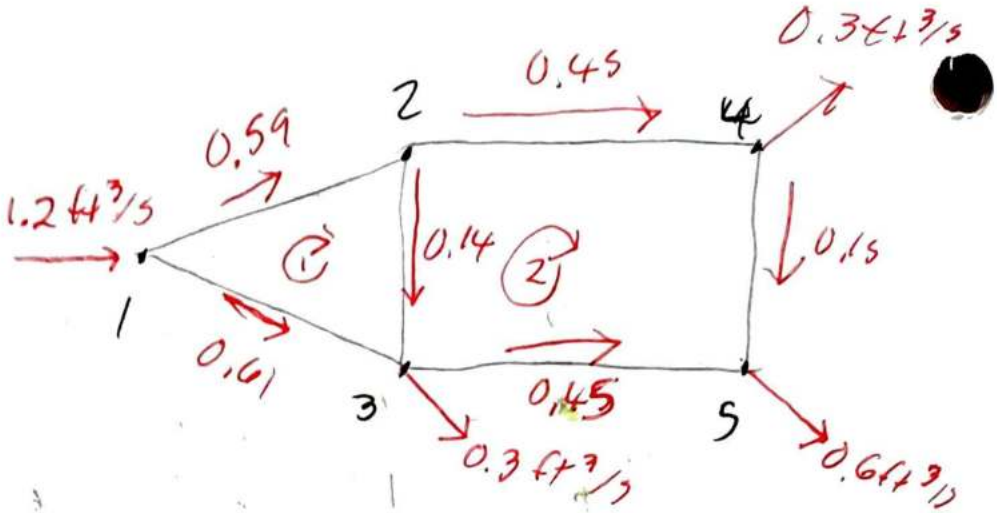
First guess all Q's

- Label Q's + or - based on marching direction

Q_A	+0.6
Q_B	-0.7
Q_C	±0.1
Q_D	+0.4
Q_E	-0.5
Q_F	+0.1

- Input all known data in excel
- Calc D/ε
- Calc V
- Calc Re
- Calc F
- Calc K
- calc $K \cdot Q^2$
- Calc $2KQ$
- Sum $K \cdot Q^2$ and $2KQ$
- Calc ΔQ
- Calc percent error
- Correct Q Guess $Q_{new} = Q_{old} - \Delta Q$

$Q_A = 0.59$
$Q_B = 0.61$
$Q_C = 0.14$
$Q_D = 0.45$
$Q_E = 0.45$
$Q_F = 0.15$



Junction 1

$1.2 = 0.59 + 0.61$ ✓

2

$0.59 = 0.45 + 0.14$ ✓

3

$0.61 + 0.14 = 0.3 + 0.45$ ✓

4

$0.45 = 0.3 + 0.15$ ✓

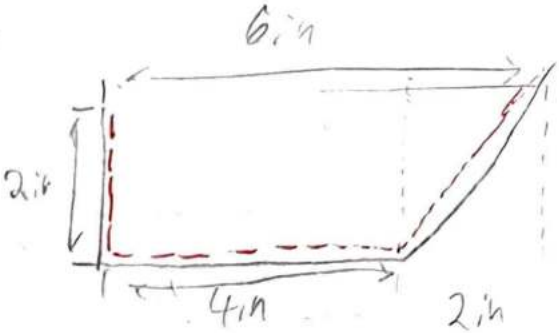
5.

$0.45 + 0.15 = 0.6$ ✓

HW 8.2

Ch 14 6, 15, 21, 36, 42.

6. $R = ?$ $\quad R = \frac{A}{WP}$



$A = 4in \cdot 2in + \frac{1}{2} \cdot 2in^2$

$A = 10in^2$

$WP = 2" + 4" + \sqrt{2"^2 + 2"^2}$

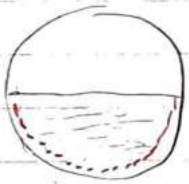
$WP = 8.83 in$

$R = \frac{10in^2}{8.83in}$ $\quad R = 1.13 in$

---

21. $D = ?$ $\quad Q = 500$ Gal/min $\quad S = 0.001$ $\quad n = 0.013$

Round common clay drainage tile



$500 \frac{Gal}{min} = \frac{1 ft^3}{7.48 Gal} \cdot \frac{1 min}{60 s} = 1.114 \frac{ft^3}{s}$

$Q = \frac{1.49}{n} A S^{\frac{1}{2}} R^{\frac{2}{3}} \rightarrow AR^{\frac{2}{3}} = \frac{nQ}{1.49 S^{\frac{1}{2}}}$

$AR^{\frac{2}{3}} = \frac{0.013 \cdot 1.114 ft^3/s}{1.49 \cdot 0.001^{1/2}} = 0.3074$

$A = \frac{1}{2} \cdot \frac{\pi D^2}{4} = \frac{\pi D^2}{8}$ $\quad WP = \frac{\pi D}{2}$ $\quad R = \frac{A}{WP}$

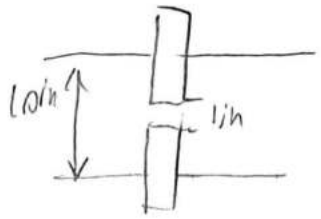
$R = \frac{\frac{\pi D^2}{8}}{\frac{\pi D}{2}} = \frac{\pi D^2 \cdot 2}{8 \cdot \pi D} = \frac{2D}{8}$

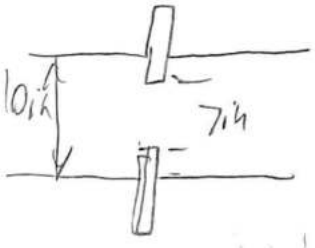
$D = 1.2901 ft$ ✓

$\frac{\pi b^2}{8} \left(\frac{2D}{8}\right)^{\frac{2}{3}} = 0.3074$

- Gate excel to iterate

HW 6.2 Chapter 15





15.4

- Sharp edged orifice - $D = 10\,in = 0.83\,ft$ ammonia
- $Q = 25\ Gal/min$ - h if $d_a = 1in$ $Sg = 0.83$
- h if $d_b = 7in$ $\eta = 2.5 \times 10^{-5}\ lb/ft^2$

$$Q = A_1 \cdot C \sqrt{\frac{2gh\left(\frac{\gamma_m}{\gamma_a} - 1\right)}{\left(\frac{A_1}{A_2}\right)^2 - 1}} \rightarrow \left(\frac{Q}{A_1 \cdot C}\right)^2 = \frac{2gh\left(\frac{\gamma_m}{\gamma_a} - 1\right)}{\left(\frac{A_1}{A_2}\right)^2 - 1}$$

$$\left(\frac{Q}{A_1 \cdot C}\right)^2 \cdot \left(\frac{A_1}{A_2}\right)^2 - 1 = 2gh\left(\frac{\gamma_m}{\gamma_a} - 1\right)$$

$$h = \frac{\left(\frac{Q}{A_1 \cdot C}\right)^2 \cdot \left(\frac{A_1}{A_2}\right)^2 - 1}{2g\left(\frac{\gamma_m}{\gamma_a} - 1\right)}$$

$$Q = 25\frac{Gal}{min} \cdot \frac{1ft^3}{7.48\,gal} \cdot \frac{1min}{60s}$$

$$Q = 0.0557\ ft^3/s$$

$$V = \frac{4Q}{\pi D^2} = \frac{4 \cdot 0.0557\ ft^3/s}{\pi \cdot 0.833ft^2}$$

$$V = 0.102\ ft/s$$

$$A_1 = \frac{\pi}{4} \cdot 0.833ft^2 = 0.545\ ft^2$$

$$A_{2a} = \frac{\pi}{4} \cdot (1/12)^2 = 0.00545\ ft^2$$

$$A_{2b} = \frac{\pi}{4} \cdot (7/12)^2 = 0.267\ ft^2$$

$$Re = \frac{\rho \cdot V \cdot D}{\eta} = \frac{0.83 \cdot 62.4\frac{lbm}{ft^3}}{32.2\,lbm \cdot ft/lbf \cdot s^2} \cdot 0.102\,ft/s \cdot 0.833ft \Big/ 2.5 \times 10^{-5}\frac{lb}{ft^2}$$

$$Re = 54772 \approx 5.4 \times 10^4$$

$\frac{d_a}{D} = \frac{1\,in}{10\,in} = .1$ $\quad \frac{d_b}{D} = 0.7$ $\quad Re = 5.4 \times 10^4$

Read Value of C_a and C_b from Chart

$C_a \cong 0.593$ $\quad C_b = 0.618$

$$h_A = \frac{\left(\frac{0.0557\ ft^3/s}{0.545\ ft^2 \cdot 0.593}\right)^2 \cdot \left[\left(\frac{0.545\ ft^2}{0.00545\ ft^2}\right)^2 - 1\right]}{2 \cdot 32.2 \frac{ft}{s^2}\left(\frac{844.9\ \frac{lb}{ft^3}}{51.792\ \frac{lb}{ft^3}} - 1\right)}$$

$\gamma_{Hg} = 13.54 \cdot 62.4 = 844.9\ lb/ft^3$

$\gamma_a = 0.83 \cdot 62.4$

$$h_A = \frac{0.0297 \cdot 9999}{986.18} = 0.3011\,ft$$

$$h_B = \frac{\left(\frac{0.0557\ ft^3/s}{0.545 ft^2 \cdot 0.618}\right)^2 \cdot \left[\left(\frac{0.545 ft^2}{0.267 ft^2}\right)^2 - 1\right]}{2 \cdot 32.2 \frac{ft}{s^2}\left(\frac{844.9\ \frac{lb}{ft^3}}{51.792\ \frac{lb}{ft^3}} - 1\right)}$$

$$h_h = \frac{0.0273 \cdot 3.166}{986.17} = 8.7685 \times 10^{-5}\ ft$$

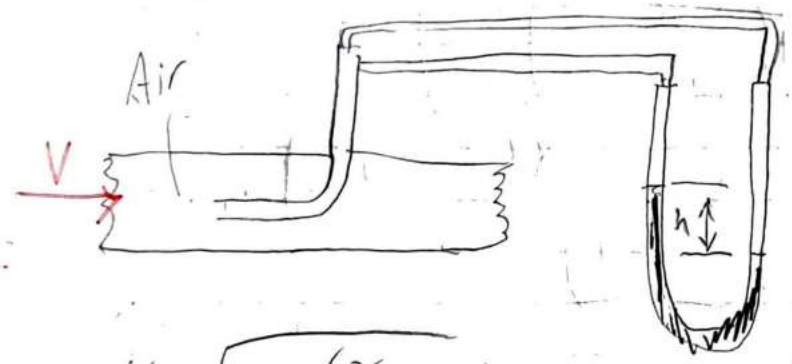
$h_A = 0.3011 ft = 3.6132 in$

$h_b = 8.7685 \times 10^{-5} ft = 0.001 in$

HW8.2

15.15

- Pitot static tube inserted into a duct carrying air at atmospheric pressure and $T = 50°C$.
- Manometer reads 0.24 in of water
- $V = ?$



$T_{air} = 50°C$

$P_{air} = 0$ KPa gage

$$\frac{0.24\ in}{1\ in} \left| \frac{25.4\ mm}{} \right. = 6.096 mm$$

$h = 6.096 mm = 0.00609 cm$

$$V_1 = \sqrt{2gh(\gamma_g - \gamma_{air})/\gamma_{air}}$$

$\gamma_{air} = 10.71\ N/m^3 = 0.01071\ KN/m^3$

$\gamma_g = 9.81\ KN/m^3$

$$V_1 = \sqrt{\frac{2 \cdot 9.81 \frac{m}{s^2} \cdot 0.00609 cm (9.81 KN/m^3 - 0.01071 KN/m^3)}{0.01071\ KN/m^3}}$$

$V_1 = 10.46\ m/s$

$$V_1 = 10.46 \frac{m}{s} \cdot \frac{3.281 ft}{1 m} = 34.32\ ft/s$$

$V_1 = 34.32\ ft/s$