

$$K_p = \frac{8f(L)}{2\pi^2 D^5}$$

Assignment Problem 11.3

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late
10-1
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a) Find the flow in all of the pipes in the network shown below.

b) Find the pressure at junction c.

Assume: $f = 0.025$ and $L = 2000$ ft in all pipes & $K_m = 0$.

All junctions at 0 elevation.

K_p	
1.259	D1 = 12 inches
3.172	D2 = 10 inches
9.558	D3 = 8 inches
40.28	D4 = 6 inches

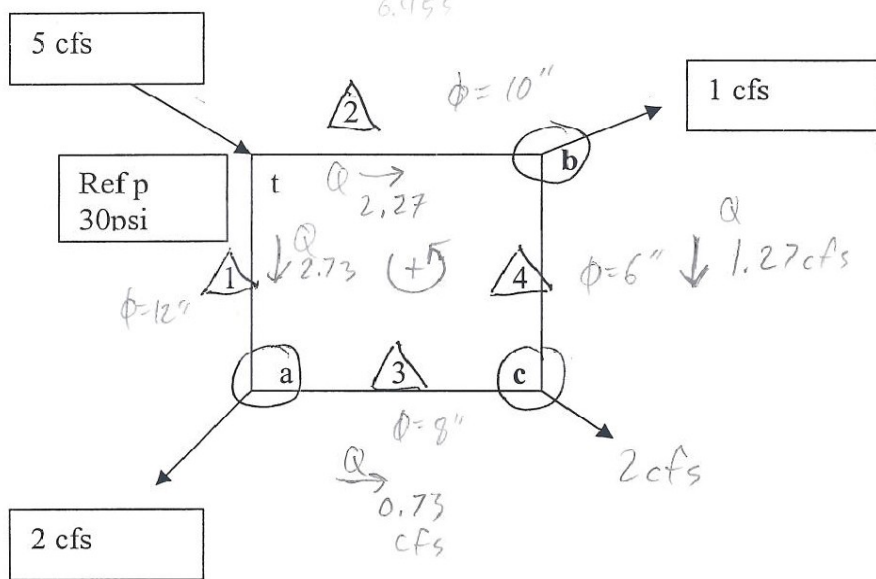
$$K_p = L + e + j$$

$$t = 1, l = 1, e = t - 1 = 0, j = 3, N_p = 4$$

$$4 = 1 + 0 + 3 = 4$$

$$\frac{10}{10+12} = 0.455$$

$$\frac{12}{10+12} = 0.545$$



$$\Delta Q = \frac{-(K_{p1} Q_1 |Q_1| + K_{p3} Q_3 |Q_3| - K_{p4} Q_4 |Q_4| - K_{p2} Q_2 |Q_2|)}{2K_{p1} |Q_1| + 2K_{p3} |Q_3| + 2K_{p4} |Q_4| + 2K_{p2} |Q_2|}$$

ANSWERS:

Q1 = 3.289 cfs

Q2 = 1.711 cfs

Q3 = 1.289 cfs

Q4 = 0.711 cfs

Pressure at c = 17.218 psi

Attach calculation sheet.

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Pipe	kp	8/gpi ²	f	l	d (in)	d (ft)	d ⁵
1	1.259	0.025174	0.025	2000	12	1	1
2	3.132	0.025174	0.025	2000	10	0.833333	0.401878
3	9.558	0.025174	0.025	2000	8	0.666667	0.131687
4	40.279	0.025174	0.025	2000	6	0.5	0.03125

$$k_p = \frac{8 f L}{g \pi^2 D^5}$$

$$\frac{P_t}{\gamma} = 30 \frac{\text{lb}}{\text{in}^2} \left(62.4 \frac{\text{lb}}{\text{ft}^3} \right)^{-1} \left(\frac{144 \text{in}^2}{1 \text{ft}^2} \right) = \underline{69.2 \text{ ft}}$$

All el. = \emptyset

$$H_t = \frac{P_t}{\gamma} + E h_t = 69.2 \text{ ft}$$

$$H_a = \frac{P_a}{\gamma} + E h_a \overset{\emptyset}{=} H_t - \underbrace{k_p (Q_1)^2}_{\text{loss}} = 69.2 \text{ ft} - 1.259 (3.289)^2 = \underline{55.58 \text{ ft}}$$

$$H_c = \frac{P_c}{\gamma} + E h_c \overset{\emptyset}{=} H_a - h_{a-c} = 55.58 \text{ ft} - 9.558 (1.289)^2 = \underline{39.7 \text{ ft}}$$

$$P_c = 39.7 \text{ ft} \left(62.4 \frac{\text{lb}}{\text{ft}^3} \right) \left(\frac{1 \text{ft}^2}{144 \text{in}^2} \right) = \underline{17.2 \text{ lb/in}^2}$$

pipe	Kp	Q	Q
1	1.259	2.73	3.73
2	3.132	-2.27	2.27
3	9.558	0.73	1.73
4	40.28	-1.27	1.27

Delta Q 0.353571

pipe	Kp	Q	Q
1	1.259	3.084	3.084
2	3.132	-1.916	1.916
3	9.558	1.084	1.084
4	40.28	-0.916	0.916

Delta Q 0.1936694

pipe	Kp	Q	Q
1	1.259	3.277	3.277
2	3.132	-1.723	1.723
3	9.558	1.277	1.277
4	40.28	-0.723	0.723

Delta Q 0.0120231

pipe	Kp	Q	Q
1	1.259	3.289	3.289
2	3.132	-1.711	1.711
3	9.558	1.289	1.289
4	40.28	-0.711	0.711

Delta Q 4.67E-05

pipe	Kp	Q	Q
1	1.259	3.289	3.289
2	3.132	-1.711	1.711
3	9.558	1.289	1.289
4	40.28	-0.711	0.711
	Sum:	1 & 2	5.000