Kafrelsheikh University
Faculty of Engineering
Dept. of Mechanical Eng.
4th Year, Mech. Power Eng.

Pipelines and Networks (MEP4120)

Date: 14 Jan. 2017
Time allowed: 3 hrs.
Full mark: 60
Final Exam: 3 Pages

Name : Academic Number:

Remarks: (Answer ALL the following questions... Assume any missing data... Answers should be supported with sketches... The weight of each problem is indicated, there are 5 Marks bonus

1- a) Show that f = 64/Re for laminar flow in a circular pipe. **(4 Marks)**

b) The figure (Fig Q1-b) shows a network of pipes transporting water at a flow rate Q from the inlet node to the outlet node. The individual pipes in the network are numbered as shown and the friction head loss in the pipes is given by for $h_{fi} = k_i Q_i^2$, i=1,2,3,...,6

Derive an expression for the head loss k_{eq} factor of an equivalent single pipe connected between the same inlet and outlet nodes and transporting the same total flow Q.

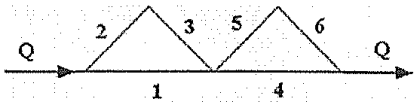


Fig. Q. 1-b

(4 Marks)

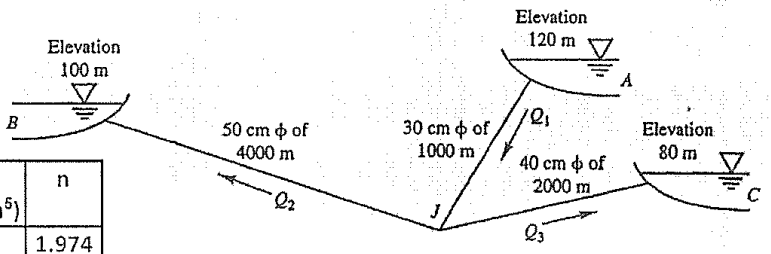
2- a) What are the different methods of analyzing a given distribution system? What are the advantages of Hardy-Cross method of pipe network analysis? **(2 Marks)**

b) Reservoirs A, B and C (Fig. Q2-b) have constant water levels of 120, 100, and, 80 m respectively above datum and are connected by pipes to a single junction J. Work the following:

i. Calculate the flow in each pipe and the pressure head at junction J.

ii. Draw the TEL for all network branches.

(10 Marks)



Pipe No.	K (s^2/m^5)	n
1	816	1.974
2	222	1.927
3	355	1.971

Fig. Q. 2-b

3- In the following figure (Fig. Q3-b), the network consists of 8 pipes and 5 nodes. A source pump and a boosting are mounted. Some local losses exist as shown in figure. Do the following tasks:

i - Write the system of **Q-equations.** ii - Write the system of **H-equations.**

(Use subscripts on K, n and Q corresponding to the pipe number, and substitute the total dynamic head produced by both pumps hp_1 and hp_2 in terms of Q.)

iii- If the discharge in pipe 5 is $Q_7 = 0.055$ m^3/sec. from the reservoir. What is the **elevation of the HGL at node [1]?** **(10 Marks)**

P.T.O

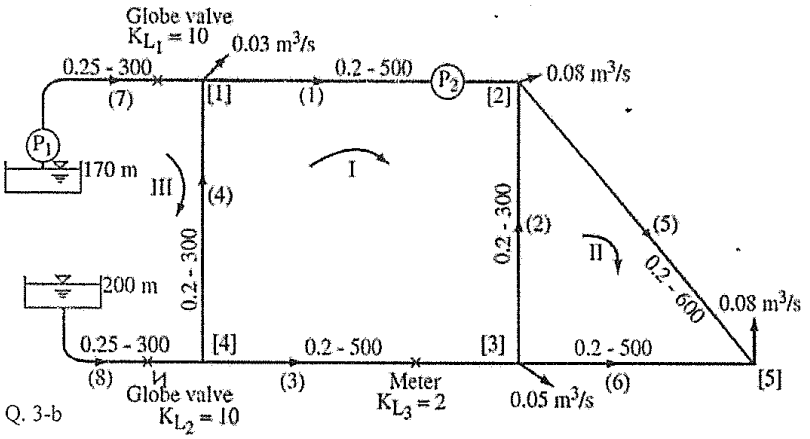


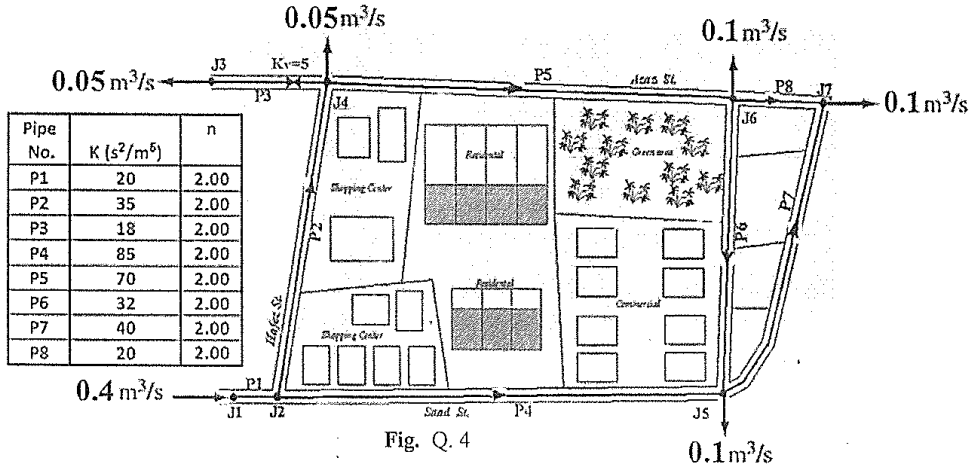
Fig. Q. 3-b

Pump Characteristics (Q in m³/s and h_p in meters)

Pump No.	Point 1		Point 2		Point 3	
	Q	h_p	Q	h_p	Q	h_p
1	0.025	12.0	0.040	10.5	0.055	8.0
2	0.060	4.0	0.090	3.8	0.120	3.5

4- A water distribution network for a town zone is shown in Figure Q. 4. All network elements are at the same elevation. **Analyze the network for pipe discharges** using **Hardy-Cross methods** for just two iterations. If the piezometric head at junction J1 is 30 m, determine the **piezometric head at junction J6** (neglecting velocity heads).

Hint: use the initial guess for discharge tabulated below. **(15 Marks)**



Pipe No.	K (s²/m⁶)	n
P1	20	2.00
P2	35	2.00
P3	18	2.00
P4	85	2.00
P5	70	2.00
P6	32	2.00
P7	40	2.00
P8	20	2.00

Fig. Q. 4

Initial Guess for discharge in pipes								
Pipe	P1	P2	P3	P4	P5	P6	P7	P8
Flow rate, Q (m³/s)	0.4	0.3	0.05	0.1	0.2	0.05	0.05	0.05

P.T.O

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5- **a)** Define the **NPSH** and **Specific speed** (Ns) for pumps, and **discuss its importance** in pump selection. **(4 Marks)**

b) The shown network (Fig. Q. 4-b) consists of 4 pipes and 3 nodes. A source pump and one reservoir supply the network. The pump characteristics and pipes data are tabulated below. Neglecting local losses, determine the following:

i. Determine the discharge Q_i (m^3/s) in each pipe using **Linear Theory Method** for just **two** iterations (**Use the initial guess given below**).

ii. The total **head at nodes [3].**

iii. The head of the pump.

(12 Marks)

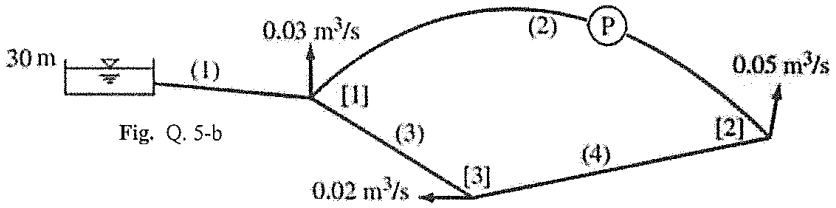

Fig. Q. 5-b

Pipe	Dia. m	Length m	K	n
1	0.30	1000	543	1.886
2	0.20	2500	13700	1.946
3	0.20	1000	3270	1.839
4	0.30	1500	1077	1.965

$$Hp = 36 - 551 \cdot Q^2$$

Intial Guess: $Q1 = 0.1\ m^3/s$
$Q2 = 0.04\ m\ /s$, $Q3 = 0.03\ m^3/s$
$Q4 = 0.01\ m^3/s$

(8 Marks)

End of Questions

=== (With my best wishes) ===

Dr. M. Osama El-samadony