Mansoura University Faculty of Engineering Dept. of Mechanical Power Eng. Course Title: Pipe Lines Course Code: MPE 4325		3rd year Mech. Power Eng. Exam Type: Final Date: June 2013 Time: 3 Hours Full Mark: 60

Answer all the following questions.

Question (1) [15 Marks]

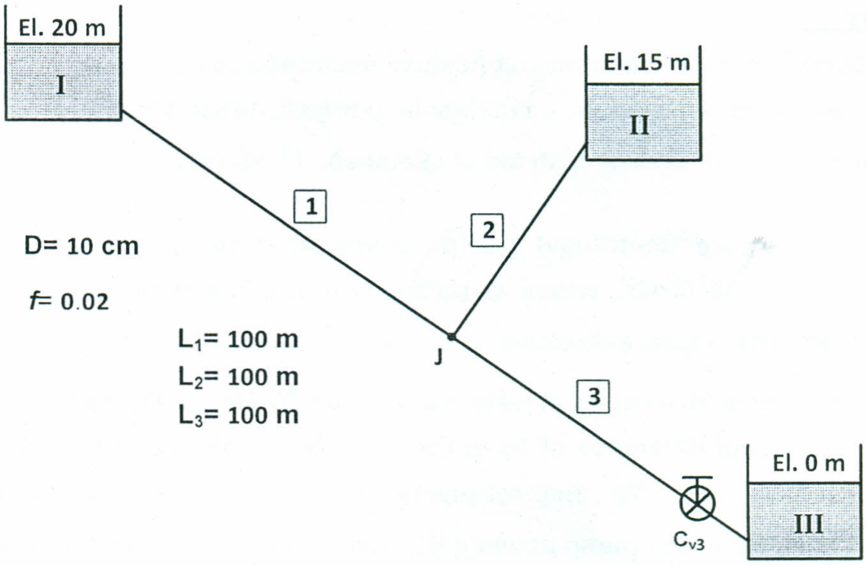
For the water piping system shown in Figure:

d- Find the system flow rates when the valve in line 3 is fully closed. [5 Marks]

e- Determine the head loss coefficient of valve 3 (C_{V3}) so that there is no flow in line 2. [5 Marks]

f- When the valve in line 3 is fully opened (neglect its loss), find the system flow rates. [5 Marks]

Assume the friction coefficient $f = 0.02$ for all pipes.



Question (2) [20 Marks]

Using the Hardy-Cross method, determine the water flow rate in each pipe for the pipe network sketched below. Find the pump head to give the required flow rate demands. Assume the Darcy-Weisbach equation for the head loss.

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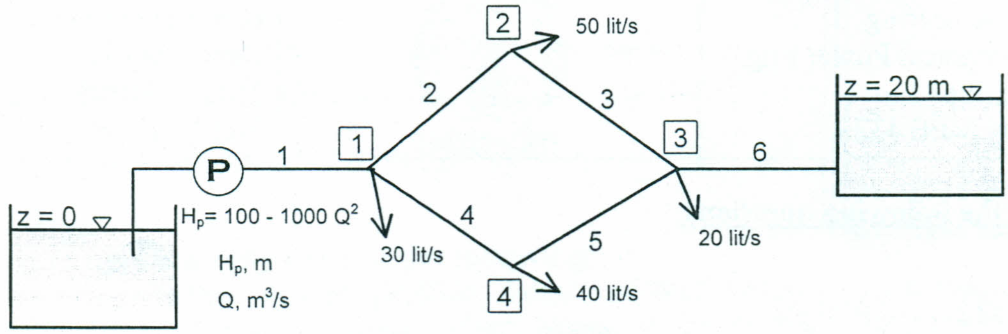

Pipe	L *m*	D *cm*	*f*
1	300	30	0.014
2	200	25	0.015
3	180	20	0.016
4	250	25	0.0155
5	250	20	0.0165
6	300	15	0.016

Node	Demand m^3/s
1	0.030
2	0.050
3	0.020
4	0.040

Question (3) [15 Marks]

(a) Define cavitation, and the net positive suction head for pump.

How could we prevent cavitaion in pumps?. What are the possible ways to achieve this?. Illustrate your answer with aid of sketches. [5 Marks]

(b) A backward centrifugal pump rotates at 1750 rpm and its characteristic is given by: $H = 33 - 35000\ Q^2$, where Q (m^3/s), H (m). If the pump actual shut-off head is 60% of the theoretical value, estimate the impeller diameter. [2 Marks]

This pump is used to elevate water at 35 °C (P_v= 0.056 bar) between two open tanks with a static head difference of 15 m through 1000 m length pipeline of diameter 15 cm and friction coefficient of 0.025 . Neglect pipeline minor losses; find the maximum water flow rate though the pipeline, and pump power if the pump efficiency at the operating point is 80%. [5 Marks]

If the suction pipe head loss (m) is equal $4000\ Q^2$, where Q (m^3/s), and the $NPSH_R = 1.5 + 3200\ Q^2$, where Q (m^3/s) and $NPSH_R$ (m), find the maximum allowable elevation of the pump above the lower tank water level. [3 Marks]

Question (4) [10 Marks]

A horizontal pipe is used to discharge water from a reservoir at a head of H= 50 m. The pipe is commercial steel (ε= 45 μm) of diameter D= 25 cm, and length L= 10 km. The pipe has a fully open gate valve at downstream end. Find the minimum time for the valve to be fully closed if the maximum allowable pressure in the pipe system must not to exceed 30 bar (use rigid theory).

$\nu_{water} = 10^{-6}\ m^2/s$

$$f = \frac{0.3086}{\left\{ Log\left[\frac{6.9}{Re} + \left(\frac{\varepsilon / D}{3.7} \right)^{1.11} \right] \right\}^2}$$

Good luck