KING SAUD UNIVERSITY
FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPT.
The examination consists of 2 questions in 2 pages.

Mid Term Exam II
20/05/2009
Time allowed: ***1.5 hours***
Attempt all questions.

Hydraulics CE-322

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NAME:

ID:

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Question (1) **(9 marks)**

(a) A pump having a diameter of 6 inches, rotational speed of 1800 rpm, discharge capacity of 4000 gpm, total head of 157 ft, and power of 190 hp. Find its performance at a rotational speed of 1600 rpm. Also determine the characteristics of a similar pump of 9 inches diameter and rotating at a speed of 1800 rpm.

(b) Two identical pumps are used in parallel to supply water between two tanks with a static lift of 40 ft. The pipeline is 12 inches in diameter and 1200 ft in length. Each pump has the following characteristics:

Q (gpm)	H (ft)	Efficiency (%)
0	132	0
500	121	55
800	111	65
1000	105	68
1300	91	70
1600	71	67

If the friction coefficient f = 0.016 and the minor losses are four times the velocity head, determine (i) the operating head and discharge; (ii) the head and discharge developed by each pump; (iii) the input power.

(c) A pump is to be placed above a large, open water tank and is to pump water at a rate of 0.5 cfs and the suction pipe is 320 ft long and 6 inches in diameter. At this flow rate the required NPSH is 12 ft, as specified by the pump manufacture. Determine the maximum height that the pump can be located above the water surface so that cavitation does not occur. Atmospheric pressure = 14.7 psi and vapour pressure = 0.26 psi. Take f = 0.03 and Σk for minor losses is 3.2.

Question (2) **(6 marks)**

(a) A 1500 m long pipeline (thin-walled with frequent expansion joints) discharges 0.25 m^3/s of a fluid from a tank to the atmosphere through a valve at the downstream end. The pipeline is 250 mm in diameter with a wall thickness of 10 mm. If K = 1.8 GPa, E = 180 GPa, ρ = 1000 Kg/m^3, determine:

i- The maximum transient pressure at the valve and at 500 m upstream of the valve if the valve is closed in 28 seconds.

ii- The maximum transient pressure at the valve if the valve is closed in 2 seconds. How long does it take for a complete cycle to occur?

(b) A *Rigid* steel pipe 350 m long discharges water through a valve under a head (h_0) of 30 m. If bulks modulus and density of water are 1.96 GPa and 1000 kg/m^3, respectively. The pipe has a diameter of 300 mm. The area of the valve opening varies as shown in the table. Determine the variation of head at the valve if it is fully closed in 1.0 seconds. Disregard the friction losses and take C_d = 0.62. Use the following relations:

$Q = C_d A_0 (2gh_0)^{0.5} = A_p V_0$

$N = cV_0/2gh_0$

$\eta_i = A_i/A_0$

$\xi_i = (h_i/h_0)^{0.5}$

$V_i = \eta_i \xi_i V_0$

$\xi^2_i + \xi^2_{i-1} - 2 = 2N (\eta_{i-1} \xi_{i-1} - \eta_i \xi_i)$

Time (s)	0.0	0.5	1.0
Valve area (m^2)	0.04	0.02	0