KING SAUD UNIVERSITY
FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPT.
The examination consists of 4 questions in 4 pages.

Hydraulics CE-322

Final Exam
2nd Semester
28/06/1430H
21/06/2009
Time allowed: *3 hours*

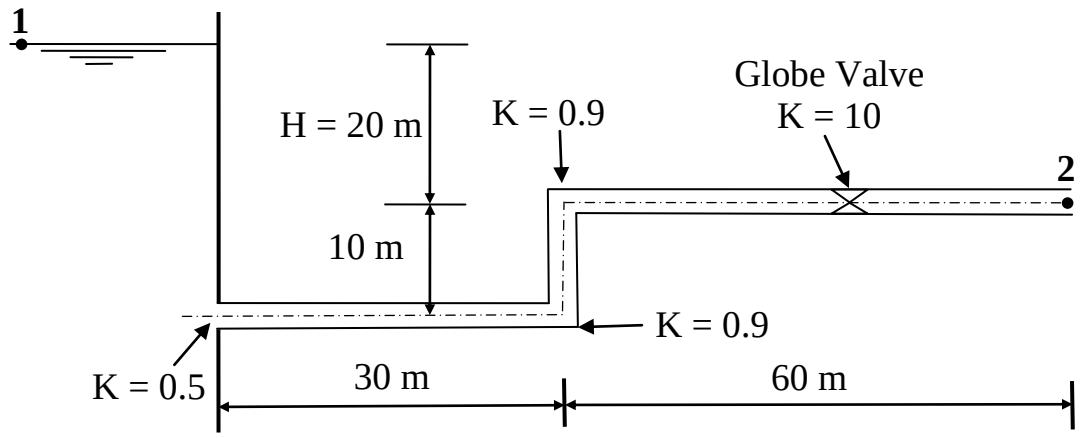
Student Name:

Student ID:

Mark:

Question (1) **(12 marks)**

a) Find the discharge through the pipeline in the shown figure for H = 20 m. Minor loss coefficients for the entrance, elbows, and globe valve are 0.5, 0.9 (each), and 10, respectively. The piping system is of a constant diameter of 150 mm. Consider all losses and use ε = 0.26 mm and ν = 1.02×10^{-6} m^2/s. Assume f = 0.02 as a first trial. Draw the TEL and HGL.



b) Rework the above problem to find H for Q = 0.15 m^3/s.

Question (2) **(12 marks)**

a) A centrifugal pump running at 1500 rpm has the following characteristics.

Q (gpm)	H (ft)	Efficiency (%)
132	115	60
205	113	67.5
284	110	72.0
400	98	73.5
475	88	71
561	75	66
634	61	60

Draw the pump characteristic curves and find the best efficiency point. What is the type specific speed of the pump?

b) The pump with the characteristics given is to be used to pump water from a lower tank to a higher tank having a difference in elevation of 10 m. The piping system comprises of 200 mm diameter pipe of 2000 m length with minor losses = 6 times the velocity head. Determine (i) the pump operating point (ii) operation efficiency, (iii) suitability of the pump, and (iv) input horsepower of the pump (assume f = 0.022).

c) Determine the operating point and the input power if two of this pump are used in series.

Question (3) **(16 marks)**

a) Prove that the condition for the occurrence of critical flow is:

$$\frac{Q}{\sqrt{g}} = A\sqrt{D}$$

and hence show that for a critical flow the Froude number should be equal to one ($F_r = 1$).

b) Plot the specific energy diagram for a discharge Q = 50 m^3/s in a rectangular channel having a bed width of 8 m. Determine the following from the diagram:

1- The critical depth.
2- The minimum specific energy.
3- The specific energy when the depth of flow is 0.5 m.
4- The two depths corresponding to a specific energy of 4 m and classify them.

c) The flow depth for a discharge of 15 m^3/s in a long canal having a trapezoidal cross section (bed width = 10 m; side slopes = 2:1) is 2 m. If the discharge is increased to 20 m^3/s, what will be the uniform flow depth?

Question (4) **(10 marks)**

a) What is meant by a Best Hydraulic Section? Prove that for the best hydraulic rectangular section the bed width is twice the water depth (b = 2y).

b) A rigid-boundary channel of triangular cross section is to be designed to carry 400 ft^3/s. If the longitudinal slope of the channel is 0.0016 and Manning's n is 0.015, determine the appropriate channel dimensions.

c) A long rectangular open channel 3 m wide carries a discharge of 15 m^3/s. The channel slope is 0.004 and Manning's coefficient n is 0.01. Calculate the water depth.

1- Is the flow supercritical or subcritical?
2- If a hydraulic jump takes place at this depth, what is the sequent depth y_2 of the jump?
3- Estimate the energy head loss through the jump.
4- Estimate the hydraulic jump length and height.