UNIVERSITY OF SWAZILAND
Faculty of Health Sciences

DEGREE IN ENVIRONMENTAL HEALTH

FINAL EXAMINATION PAPER 2007/2008

TITLE OF PAPER	:	WATER DISTRIBUTION
COURSE CODE	:	**EHS 586**
DURATION	:	**2 HOURS**
MARKS	:	**100**
INSTRUCTIONS	:	**READ THE QUESTIONS & INSTRUCTIONS CAREFULLY**
	:	**ANSWER ANY FOUR QUESTIONS**
	:	**EACH QUESTION CARRIES 25 MARKS**
	:	**WRITE NEATLY & CLEARLY**
	:	**NO PAPER SHOULD BE BROUGHT INTO NOR OUT OF THE EXAMINATION ROOM**
	:	**BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER**

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION 1

I.

a) For steady condition, total inflow to a junction is equal to total outflow from the junction.

b) In a fluid at rest there cannot be shear forces.

c) In a fluid at rest pressure in all directions at a point is not equal.

d) Absolute pressure is equal to gauge pressure minus atmospheric pressure.

e) Energy losses in sudden transitions are due to the formation of eddies and pressure loss dissipation in the form of heat energy.

f) A fluid moving through a pipeline is not subjected to energy losses from various sources such as continuous resistance exerted by the pipe walls.

g) For the flow of a real fluid through a pipe or other conduit, the velocity will not vary from wall to wall.

h) The hydraulic grade line shows the elevation of the velocity head

i) Except in nuclear processes, matter is neither created nor destroyed.

j) The intensity of pressure measured below or above atmospheric pressure is known as gauge pressure.

(20 marks)

II.

A long 0.25mm diameter glass tube open on both ends is inserted into a bowl containing a fluid. If the tube is held in a vertical position, determine the fluid level in the tube if the fluid in the bowl is:

a) Water with a density of 1000 kg/m^3, surface tension of 73mN/m and the contact angle of 0^0 ; and

b) Mercury with a density of 13 600 kg/m^3, surface tension of 481mN/m and the contact angle of 140^0.

(5 marks)

QUESTION 2

a) A venturi meter is introduced in a 300 mm diameter horizontal pipeline carrying water under pressure of 150kN/m^2. The throat diameter of the meter is 100 mm and the pressure at the throat is 400 mm of mercury below atmosphere. If 3% of the differential pressure is lost between inlet and throat, determine the flow rate in the pipeline.

[16 marks]

b) A pipeline 1500 m long conveys water to a turbine, the difference of the level between the surface of the reservoir and the turbine outlet being 141 m. If the shaft power output of the turbine is 350 kW and the turbine efficiency is 70%, calculate the smallest diameter of pipe which could be used, assuming that f=0.008

[9 marks]

QUESTION 3

a) In the following pipe system, balance the flows:

Loop	Pipe	Q (l/s)	$h_{L\,(m)}$	h_L/Q (m/m^3/s)
1	AB	120	11.48	95.64
	BE	10	3.39	338.77
	EF	-60	-40.42	673.75
	FA	-100	-8.36	83.66

Loop	Pipe	Q (l/s)	$h_{L\,(m)}$	h_L/Q (m/m^3/s)
2	BC	50	28.40	567.98
	CD	10	3.39	338.77
	DE	-20	-4.94	246.78
	EB	-24.23	-18.34	756.77

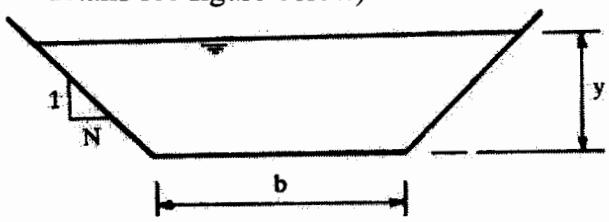
(16 marks)

(b) A pipe line 0.20m diameter and 50m long contains two 90^0 elbows and one gate value. Allowing for sharp pipe entry and exit loss calculate the equivalent pipe length and the total head loss when the flow rate is o.2m^3/s and the value is fully open. Take the function factor; f = 0.005.

(9 marks)

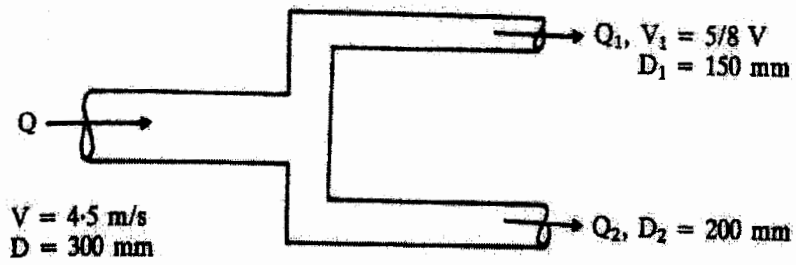
QUESTION 4

(a) A concrete lined trapezoidal channel has a bed width of 3.5 m, side slopes of 45^0 to the horizontal, a bed slope of 1: 1000 and Manning roughness coefficient of 0.015. Calculate the depth of uniform flow when the discharge is 20 m^3/s (For details see figure below)



(14 marks)

(b) A pipeline of 300 mm diameter carrying water at an average velocity of 4.5 m/s branches into two pipes of 150 mm and 200 mm diameters. The average velocity in the 150 mm pipe is 5/8 of the velocity in the main pipeline. Determine the average velocity of flow in the 200 mm pipe and the total flow rate in the system in l/s.



Branching pipeline

(11 marks)

QUESTION 5

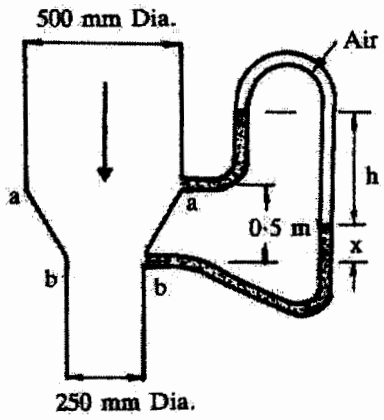
(a) Estimate the energy (head) loss along a short length of pipe suddenly enlarging from a diameter of 350mm to 700mm and conveying 300 liters per second of water. If the pressure at the entrance of the flow is 10^5 N/m^2, find the pressure at the exit of the pipe. What would be the energy loss if the flow were to be reversed with a contraction coefficient of 0.62?

(13 marks)

(b) A 500 mm diameter vertical water pipeline discharges water through a constriction of 250 mm (See figure below). The pressure difference between the normal and constricted sections of the pipe is measured by an inverted U-tube. Determine (i) the difference in pressure between these two sections when

270

discharge through the system is 600 l/s, and (ii) the manometer deflection, h, if the inverted U-tube contains air.



Flow through a vertical constriction

(12 Marks)

271