UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

B.Sc. Degree in Environmental Management and Water Resources

MAIN EXAMINATION PAPER MAY 2015

TITLE OF PAPER	:	Water Distribution and Sewerage Systems
COURSE CODE	:	EHM320
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	THERE ARE FIVE QUESTIONS IN THIS EXAM
	:	ANSWER ANY FOUR OUT OF THE FIVE QUESTIONS
	:	EACH QUESTION CARRIES A MAXIMUM MARK OF 25

Question One (25 Marks)

A land lord rents the five houses in his compound to 5 families. Each family renting the house has 5 family members. The land lord wants to charge for water a monthly flat rate per each person living in the compound. By setting this monthly charge he hopes to cover the total monthly bill of water coming from the water company plus a 10% deposit for future maintenance costs of the water facilities. The average per capita consumption of the families in the compound is 30 lppd. The water company sets an increasing block tariff for water consumption in accordance with the rates given below:

Monthly consumption range	Tariff
0 – 3 m^3 / month	E 6 /m^3
3 – 10 m^3 / month	E 8 /m^3
10 – 20 m^3 / month	E 10 / m^3
20 – 30 m^3 / month	E 12 / m^3
> 30 m^3/month	E 14 / m^3

Determine the monthly flat rate charge the land lord must set per each person living in his compound.

Question Two (25 Marks)

A layout of gravity water supply scheme extending from the spring source to a service reservoir is shown in Figure Q2-1 below. The pipe is galvanized iron and its diameter is 19 mm (3/4") throughout. The maximum flow rate is 0.25 lit/sec. Break pressure tanks BP1 and BP2 are provided along the pipeline as shown in the figure. The head loss in m/km for GI pipe is provided in the table given below.

i. Determine the maximum pressures at points 2, 3 and 4 .....[10 marks]

ii. Determine the minimum pressures at points 2, 3 and 4 .....[15 marks]

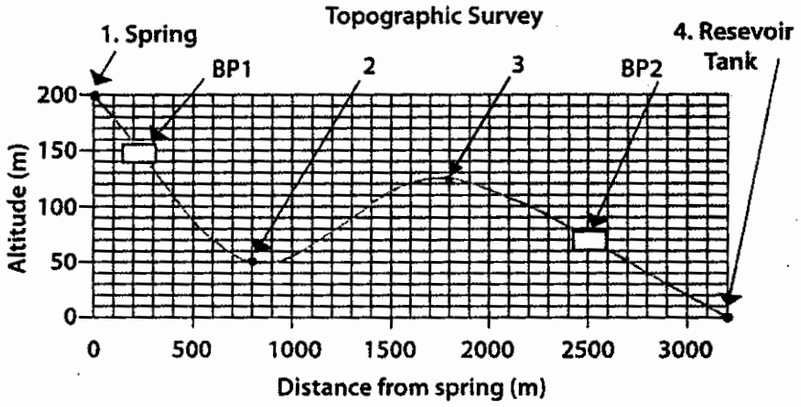


Figure Q2-1

Table 11.2: Friction Head Loss in meters per 100 meters Galvanized Iron (GI) Pipes

Q	Pipe Sizes (mm)									
Lps	13	19	25	31	38	50	63	75	100	150
.06	6.00	0.82	0.20							
.07	8.00	1.00	0.26							
.08	10.00	1.30	0.34							
.09	12.60	1.64	0.44	0.15						
.10	15.20	2.12	0.52	0.18						
.11	18.20	2.36	0.62	0.22						
.12	21.40	3.00	0.72	0.26						
.14		4.00	0.96	0.34	0.13					
.15		4.20	1.10	0.36	0.15					
.16		5.00	1.24	0.44	0.16					
.18		6.20	1.54	0.54	0.202					
.20		7.60	1.88	0.64	0.262	0.70				
.25		11.60	2.84	0.96	0.400	0.10				
.30			4.00	1.34	0.46	0.14				
.40			6.80	2.30	0.94	0.24				
.50			10.20	3.45	1.42	0.36	0.12			
.60			14.40	4.80	2.00	0.50	0.17	0.70		
.70				6.40	2.66	0.66	0.22	0.91		
.80				8.20	3.40	0.84	0.28	0.117		
1.00				12.60	5.20	1.28	0.42	0.177		
1.20				17.60	7.20	1.78	0.60	0.248		
1.40					8.80	2.40	0.80	0.330		
1.50					9.80	2.70	0.88	0.374		
1.60					11.00	3.04	1.02	0.422	0.104	
1.80					14.70	3.76	1.28	0.524	0.129	
2.00					16.80	4.60	1.54	0.640	0.157	
2.50						7.00	2.40	0.96	0.238	
3.00						9.90	3.30	1.36	0.332	
3.50						13.90	4.38	1.80	0.442	
4.00						18.40	6.00	2.30	0.368	

Question Three (25 Marks)

3A. State the advantages and disadvantages of installing a two tank storage system at household level compared to a single elevated storage tank.

.....[5 Marks]

3B. What is the importance/purpose of creating pressure zones in distribution systems?

..... [5 marks]

3C. Discuss a suitable design provision of service reservoir with respect to each of the following service requirements:

i. Excluding surface contamination
ii. Cleaning
iii. Overflow control
iv. Monitoring
v. Water quality

..... [5 Marks]

3D. Match items in B against items from A. Note that items from A can have more than one matches from B and vice versa. .....[10 Marks]

A	B	
Hydrants	i.	Stronger, more flexible and thinner walls,
Concrete pipes	ii.	Oldest pipe material but declined with time
Gate valves	iii.	Used to prevent reservoir overflows
Ductile iron pipe	iv.	Can also be used for pipe cleaning, leakage control, flushing streets, etc.
Float valves	v.	Not suitable for flow regulation
Steel pipes	vi.	Rigid, mainly used for sewerage
Cast iron pipes	vii.	Cement lining to prevent corrosion
	viii.	Alloy of carbon, silicon and iron
	ix.	Not suitable where frequent valve operation is required

Question Four (25 Marks) (Note: each question below carries 5 marks)

4A. Define the following terms in connection with pipe laying (1 marks each)

i) Shoring

ii) Shielding

iii) Surround

iv) Infill

v) Cut and cover

4B. Discuss the provisions that are required during pipe laying for each of the following conditions:

i. Avoiding of point loads at joints (2 marks)

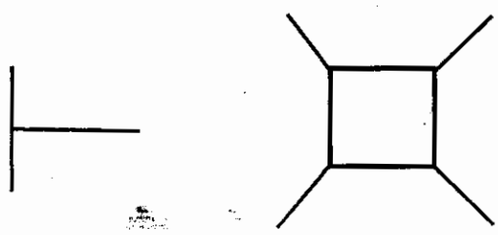
ii. Cover depth requirements (2 marks)

iii. Pipe laying in water logged soils (1 mark)

4C. Describe with the help of a diagram the determination of the operating point of a pump used for pump selection.

4D. List the long term measure that can be used to eliminate growth of animals in distribution systems.

4E. For each of the network junctions shown below, suggest (with the help of a diagram) ways of improving the reliability.



(i) (ii)

Question Five (25 marks)

A sanitary sewer with a design flow of 0.284 m^3/sec enters manhole A. The distance downstream to the next manhole B is 122 meters. The finished street surface elevation at manhole A is 50.72 m and that at manhole B is 50.11 m. For manning's n = 0.013 and using the partial flow diagram shown in Figure Q5-1 over page find;

i) The nominal diameter of the pipe to carry the flow under full flow conditions.....[10 Marks]

ii) The depth of flow and velocity at minimum flow which is equal to 25% of the design flow. .....[10 Marks]

iii) In both cases check if the range of velocities fall in the desirable range between 1m/sec and 1.5m/sec.....[5 Marks]

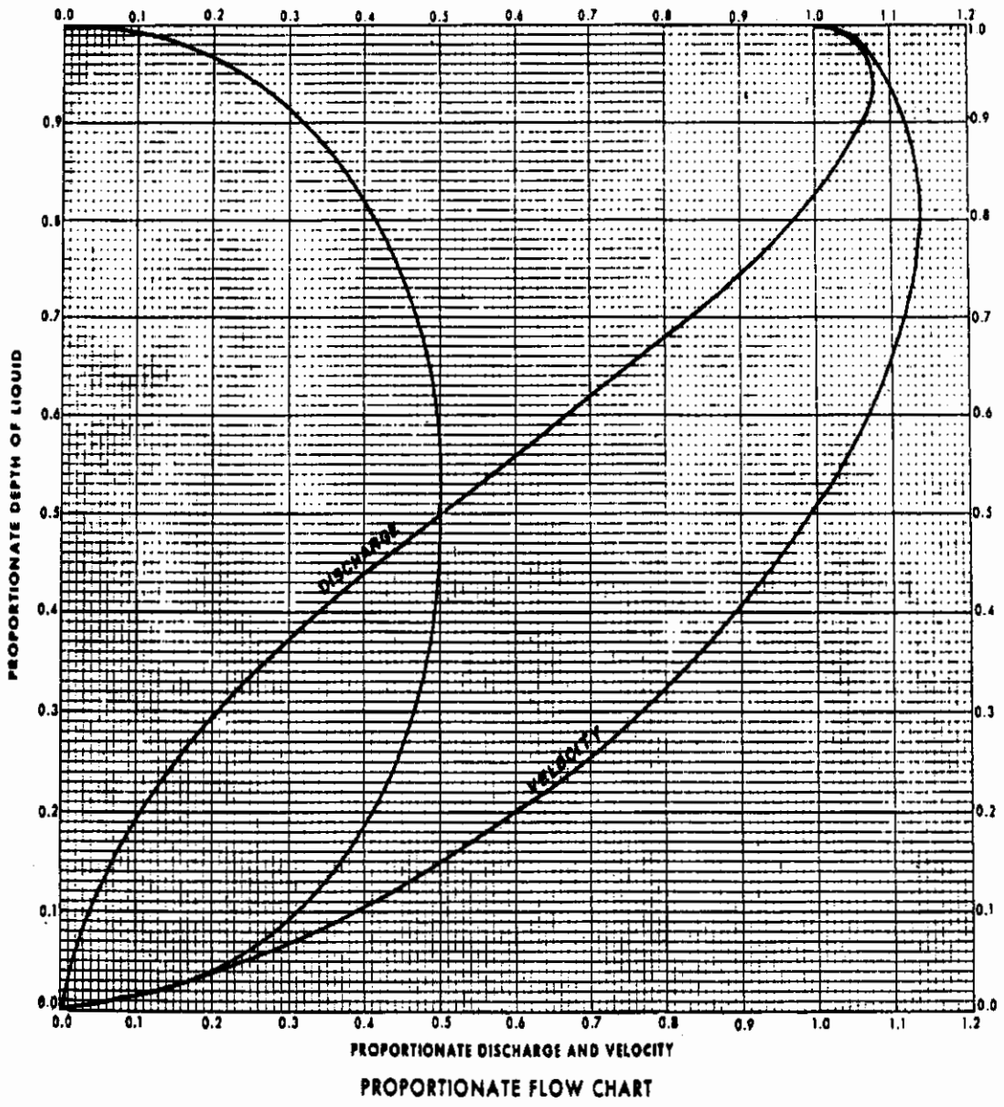


Figure Q5-1: Partial flow graph for Sewer flow calculation

UNIVERSITY OF SWAZILAND
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DEGREE IN WATER RESOURCES AND ENVIRONMENTAL HEALTH MANAGEMENT

FINAL EXAMINATION PAPER 2015

TITLE OF PAPER	:	WATER RESOURCES MANAGEMENT II
COURSE CODE	:	EHM 321
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 OR 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.

102

QUESTION ONE

a) There is a growing perception that there is water resources scarcity in the SADC countries. Explain five reasons that may be the cause for water scarcity in Swaziland. **[Marks 20]**

b) In a paragraph, explain the purpose of water resources management. **[Marks 5]**

QUESTION TWO

a) In water resources management; explain two main components of a robust plan and mention three advantages of cyclic planning method over linear planning? **[Marks 11]**

b) Give an estimate of the amount of "virtual" water that is equivalent with the production of 70kg of maize. If a ton of maize was exported to Mozambique how much virtual water is exported? **[Marks 10]**

c) Mention two consumptive uses and two non-consumptive water uses. **[Marks 4]**

QUESTION THREE

a. What are the five dimensions of water resources that are considered in Integrated Water Resources Management? **[Marks 5]**

b. Explain the purpose of considering the five dimensions you have mentioned in (a) above in Integrated Water Resources Management. **[Marks 20]**

QUESTION FOUR

a) What make water an important resource above all other natural resources? (Give four reasons). **[Marks 20]**

b) What do you understand by the term 'catchment area for a water course in relation to water resources management? **[Marks 5]**

QUESTION FIVE

a) Describe five factors that contribute to global water shortage. **[Marks 10]**

b) Describe the three guiding principles of the statement on water and sustainable development from the Dublin UNCEF Conference in 1992 with regards to water allocation disputing water as a free good? **[Marks 5]**

c) List five factors that contribute to unsustainable water resources in development. **[Marks 10]**