



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

BSc DEGREE IN ENVIRONMENTAL MANAGEMENT AND
WATER RESOURCES

MAIN EXAMINATION PAPER DECEMBER 2019

TITLE OF PAPER : WATER DISTRIBUTION AND SEWERAGE
SYSTEMS

COURSE CODE : EHS 451

DURATION : 2 HOURS

MARKS : 100

INSTRUCTIONS :

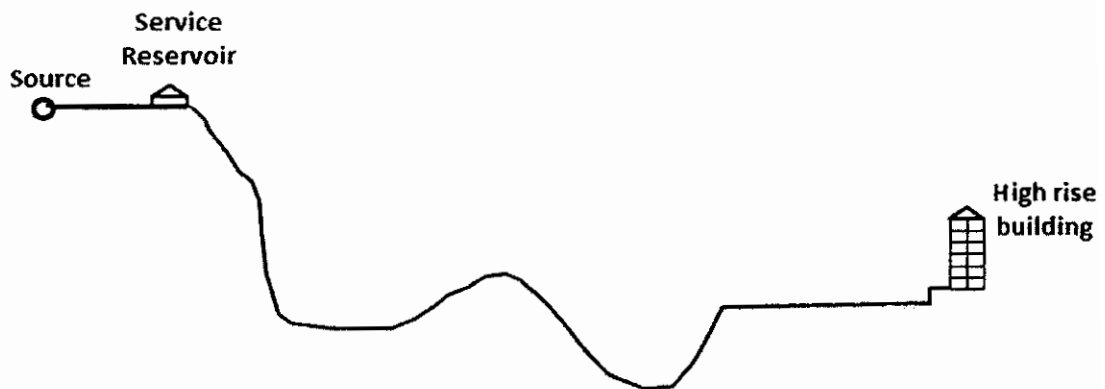
- : READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
- : ANSWER **ANY FOUR** QUESTIONS
- : EACH QUESTION **CARRIES 25** MARKS.
- : WRITE NEATLY & CLEARLY
- : NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
- : BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

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

QUESTION ONE (5 marks each)

1A. Determine the production capacity of a treatment installation for a city with a population of 1,250,000. Assume a specific consumption per capita of 150 l/d, non-domestic water use of 30,000,000 m³/y and UFW of 12%.

1B. For the water supply line shown in the figure below, indicate the locations where valves may be needed. For each location indicate the type of valves required.



1C. Compare i) butterfly valves and ii) gate valves in terms of the following characteristics:

- i. Head loss in full open position
- ii. Structural arrangement
- iii. Suitability for use as flow regulators
- iv. Suitability for cleaning of pipes
- v. Risk of surge pressure during valve operation

1D. For a given well whose diameter is 15 cm and the well is driven to 60 meters while the water table is at 20 meters, determine the amount of chlorine that has to be added into the well to maintain a disinfection concentration of 50 mg/L for 12 hours assuming that the hypochlorite powder has 70% free available chlorine in it.

1E. Describe four methods used for the development of a well.

QUESTION TWO (5 marks each)

- 2A. List and define the four methods of data capture in water distribution systems.
- 2B. It is desired to lay a pipe network connecting the source (reservoir) to the demand areas A, B, C and D shown in the figure below. Draw a pipe network layout with maximum reliability (minimum interruption) and state the overall network reliability for the network you have drawn



A

B

C

D

- 2C. State the advantage and disadvantage of installing a two tank storage system at household level compared to a single elevated storage tank.
- 2D. State the names of the fittings: Type A and Type B shown in the figures below and explain the function and importance of such fittings.



Type A

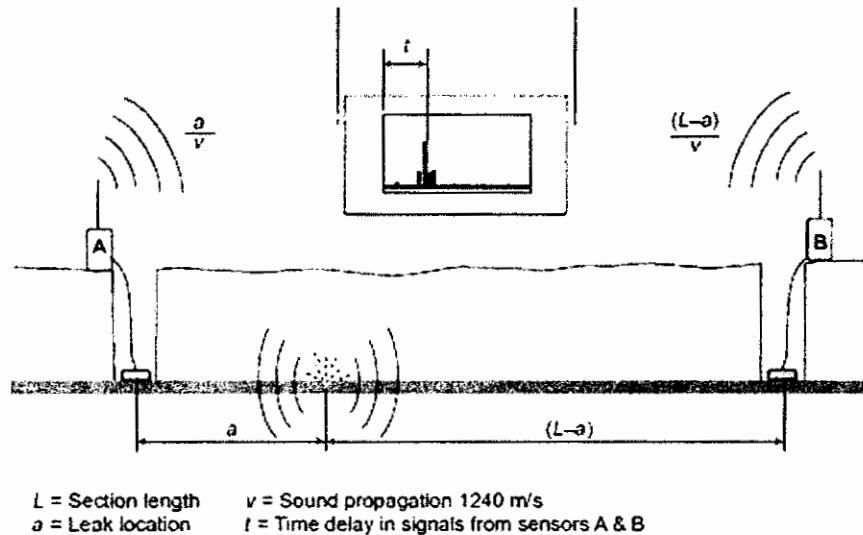


Type B

- 2E. Compare the advantages of direct pumping of water to a distribution system with that of pumping first to an elevated service reservoir from which water will flow to the distribution system by gravity

QUESTION THREE (5 marks each)

3A. A leak noise correlator (shown in the figure below) was used for locating leak along a 200 meter length pipe. If the leak noise signals from the ends of the pipes were received with a time interval difference of 0.1 sec, determine the location of the leak measured from the left end A.



3B. Describe with the help of a diagram the well point method of trench dewatering.

3C. Define the following terms in connection with pipe laying

- i) shoring
- ii) shielding
- iii) surround
- iv) Infill

3D. How is it possible to create a pressure zone (without using pressure reducing valves) in gravity supply systems?

3E. Describe with the help of a diagram the mechanism employed for laying pipe on water logged soil or less stable bottom.

QUESTION FOUR (5 marks each)

4A. Define the following terms:

- i. Infiltration
- ii. Inflow

4B. Describe with the help of a sketch the process of crown corrosion of sewers.

4C. Describe methods that can be employed to remove and control odors in sewer systems.

4D. State the difference between sanitary sewers and storm sewers in setting limit to gravity sewerage because of the maximum economic depth to which sewer excavation can be made. In other words which of these two sewer systems allow gravity sewerage throughout the system even under conditions where the maximum depth of excavation has been reached. Support your answer with the help of a diagram.

4E. Describe briefly what aspects you would look in the preliminary reconnaissance survey for the design of sewer system for a given city.

QUESTION FIVE (5 marks each)

5A. State the advantages and disadvantages of separate sewer systems.

5B. A sewer pipe is serving a community of 100,000 inhabitants. The length of the pipe is 2 km and the average water consumption is 200 Liter per person per day. The waste water produced is 80% of the water consumed. The infiltration rate is 60 m³/day/km. Calculate the design maximum flow and design minimum flows in m³/sec.

$$\begin{aligned}
 \text{Peak factor} &= 1 + \frac{14}{4 + \sqrt{P}} \\
 \text{Minimum flow factor} &= 0.2 * P^{1/6}
 \end{aligned}$$

In both formulas above, the population is to be expressed in thousands.

5C. State methods of reducing combined sewer overflows.

5D. Match the items in B against the items in A.

Item A	Item B
Curved sewers	Consider private ownership of land
Manholes	Maintenance hole provision
Aggressive soil	Economic/practical justification
Design depth of flow	Illegal/inappropriate
Location of pumping stations	Allow for free air ventilation
Width of trench	Cathodic protection
Dead end mains	Provision for venting

5E. Describe possible methods that can be applied for cleaning sewer systems.