



**UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER**

PROGRAMME: BSC ABE III

COURSE CODE: ABE 304

TITLE OF PAPER: RURAL WATER SUPPLY AND HYDROLOGY

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION I: COMPULSARY

QUESTION 1

A) A small rural community of **1000 households (X)** had a water supply project to conduct in order to meet its annual water consumption patterns. The community had **500 livestock**. The per capita water requirements were identified as **40 L/ TLU**, and **20 L / capita/ person (y)** and the average number of people per households (**Y**) was **4**.

i. Briefly describe the information that is required to calculate the water demand for a small rural community supply. **(6 marks)**

ii. Calculate the annual water demand or consumption for this community using equation 1. **(10 marks)**

$$R = (1 + E) D \times X (Yy + Zz) \quad (1)$$

Where:

R - Domestic and livestock water requirement (Litres/ year).

E - Extra allowance for population growth usually taken as 50% increase i.e. 0.5.

D - Number of days for which the stored water supply is needed.

X - Number of households using the water.

Y - Average number of people in a household.

y - Average daily water consumption per person in the area (l/c/d)

Z - Average number of tropical livestock units (TLU) in a household.

z - Average daily water consumption per TLU (L/TLU/d).

B) i. Define **run-off** as used in small rural community water supply. **(1 mark)**

ii. Why is it not advisable to directly use **run-off** from the catchment for rural water supply? **(3 marks)**

iii. Discuss briefly the factors that affect the quantity of run-off that could be harvested from a given catchment. **(10 marks)**

[40 marks]

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION 2

- A) i. State and briefly discuss the other water conveyance method other than pipe flow. In the discussion, highlight the energy that is used to convey the water from intake to storage or point of use. (5 marks)
- ii. Water flows from a tank into a pipe at a rate of 1.0 L/s. Calculate the velocity of entrance into the pipe if the internal diameter of the inlet is 45 mm. (5 marks)
- iv. The pipe does not maintain its size as its outlet has a diameter of 50 mm; calculate the new velocity at that section of the pipe. (5 marks)
- B) Briefly discuss the following concepts as used in rural water supply.
 - i. Water harvesting. (5 marks)
 - ii. Water collected from rivers and streams. (5 marks)
 - iii. Ground water. (5 marks)[30 marks]

QUESTION 3

- A) Name any **three (3) methods** for the determination of reservoir capacity for water storage other than the spot height method. (6 marks)
- B) i. If the excavated reservoir is to have a uniform depth of 8.0 m above datum, **complete and calculate** the mean level using the data in **Table 1**. (8 marks)

Table 1. Volume calculation from spot heights grid.

Station	Reduced Level (R L) (m)	Number of Times RL is used (n)	Product (RL x n) (m)
A	12.16	1	
B	12.48	2	
C	13.01	1	
D	12.56	2	
E	12.82	4	
F	13.53	2	
G	12.94	1	
H	13.27	2	
I	13.84	1	
Total		16	

- ii. Calculate the **depth** of excavation. (8 marks)
- iii. Calculate the **volume** of excavation if the grid had a length of **30 m** and a width of **15 m**. (8 marks)
- [30 marks]

QUESTION 4

- A) Discuss briefly with the aid of a diagram the **water distribution** system. (6 marks)
- B) i. What are the **two water bodies** that could be used for rural water supply **intake** to channel water for domestic applications? (4 marks)
- ii. The recommended velocity (**V**) of flow through an intake is less than **0.1 m/s**. If the channel cross-sectional area (**A**) was **970 m²** with a discharge (**Q**) of **100 m³/s**. Prove that this intake velocity was suitable using **equation 1**.
- $$Q = V \times A \quad (1) \quad (4 \text{ marks})$$
- iii. Why should the **velocity** of water be this low at the water intake? (1 mark)

- C) The Mdlwayiza canal in Malkerns uses the continuity equation principle to convey water by gravity over a distance of more than **40 km** from the Great Usuthu River water intake at Mhlabubovu. Discuss how this hydraulic principle was utilized in the **design and construction** of the canal to convey water over such a long distance. **(15 marks)**
- [30 marks]**