WAIRAKA MODERN SS, JINJA
S.5 END OF TERM 1 2025
S.5 MATHEMATICS
TIME: 2HRS : 45 MINS

INSTRUCTIONS

*Attempt **All ITEMS** in this paper*
Begin each item on a fresh page

ITEM 1

A biologist is studying the relationship between the population of two bacterial species X and **Y** , in a controlled environment. The population of this bacteria, denoted as **x** and **y** follows the logarithmic relationships

1. The growth rate equation for species X

$$\log_4(6 - x) = \log_2 x$$

2. **The interaction equation between species X and Y:**

$\log_{10} x - \log_{10} y = \log_{10} 2.5$ and

$\log_{10} x + \log_{10} y = 1$

The biologist wants to determine the population values x and y that satisfy these equations

Task:

Help the biologist to get the value of x and y by forming simultaneous equations

ITEM 2

Kiira Motors Corporation, Uganda's vehicle manufacturer, is designing components for their new electric vehicle model. The engineers need to calculate exact dimensions for specific components to ensure proper fitment.

You are an engineering intern at Kiira Motors working on the battery bracket design. The chief engineer has given you measurements for a triangular mounting bracket that involves surds. The diagonal support brace of the bracket needs to be exactly $\sqrt{50}$ cm long. Two sides of the triangular bracket are $(5 + 3\sqrt{2})$ cm and $(7 - 2\sqrt{2})$ cm long.

Tasks:

a) Express the length the bracket diagonal support in the simplified form $\frac{a}{\sqrt{b}}$, where a and b are integers and b is not divisible by a perfect square.

b) Establish the exact length of material needed for both sides combined.

c) If the perimeter of the entire triangular bracket must be exactly 25 cm, calculate the length of the third side.

ITEM 3

The National Water and Sewerage Corporation (NWSC) is designing a water distribution system for three neighboring communities in Kampala. Each community has different water requirements and infrastructure constraints. A consultant engineer working on this project wants to determine the optimal flow rates for each community.

The water distribution system is modeled by the following equations

$X + 2Y + Z = 2400$ (Total available water supply in liters per minute)

$2X + Y + 3Z = 3900$ (Pressure balancing equation)

$3X + 4Y + 2Z = 5100$ (Flow optimization equation)

Where X, Y and Z represent the flow rate in liters per minute in communities A, B and C respectively

The polynomial equation $P(X) = X^3 - 7X^2 + 14X - 8$ models the operational efficiency of the pumping systems

Tasks

a) Help the engineer to determine the optimal flow for each community

b) If the community A's water requirements increase by 200 liters per minute. What adjustments should be made to other communities' supply to maintain the system balance?

c) Determine all the possible value X where the efficiency of the pumping system is zero

ITEM 4

The Ministry of Health is analysing data on malaria cases across different districts in Uganda to allocate resources effectively and plan intervention strategies.

Below is the data on monthly malaria cases reported in 12 Health Centres (HC) in northern Uganda.

Health Centre	**Monthly Cases**
HC1	145
HC2	187
HC3	203
HC4	168
HC5	227
HC6	192
HC7	254
HC8	176
HC9	219

HC10	238
HC11	182
HC12	209

Tasks

a) Organize the data into frequency distribution and represent it on a histogram. b) Determine;

i) The mean number of cases

ii) Median number of cases

iii) The coefficient of variation

c) If resources are allocated proportionally to the number of cases, and the total of UGX 60 million is available, how much will be allocated to each category

THE END