

P425/1

PRINCIPAL

MATHEMATICS

PAPER 1

2026

3 HOURS



JINJA JOINT EXAMINATIONS BOARD

Uganda Advance Certificate of Education

PRINCIPAL MATHEMATICS

Paper 1

3 hours

INSTRUCTION TO CANDIDATES

This examination paper consists of two sections; A and B. It has five examination items.

Section A consists of one compulsory item.

Section B has two parts, I and II each with two optional items. Respond to only two items from section B, choosing one item from each of the parts, I and II.

*Respond to **three** items in all.*

*Any additional items(s) responded to will **not** be scored.*

Being each item on afresh page.

*All necessary working **must** be shown clearly.*

Graph paper is provided.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae maybe used.

SECTION A

The item in this section is compulsory

ITEM ONE

An extension worker mapped a village demonstration farm on the cartesian coordinates in three dimensions. He installed a sprinkler at point S (1, 3, 2) inside a green house.

The green house roof is the plane $3x - y + 2z = 7$. A water pipe which runs along the line $r = (2 + \mu)i + (-1 + 2\mu)j + (1 - 2\mu)k$ enters the green house roof at point

P. The extension worker wishes to move the sprinkler closer if the distance between S and P is more than 5 m.

Two boundaries of the sprinkler spray zone on the green house floor have equations $y = 2x - 1$ and $3x + 4y = 8$. The extension worker wishes to change the nozzle if the angle between the two spray boundaries is less than 50° .

During calibration, the sprinkler rotates through angle x which satisfies the equation $2\sin x + 5\cos x - 1 = 0$; $(0^\circ \leq x \leq 180^\circ)$. If the angle is less than 100° , the sprinkler will be adjusted.

A faulty nozzle sprays water such that it hits the floor at a point Q (x, y) whose distance from the point A (2, 1) is twice its distance from the point B (5, 3). The extension worker wishes to relocate a plant at (7, 4) if water can't reach it.

Task;

Based on mathematical computations, advise the extension worker on the decisions to take.

SECTION B

Answer only **two** items from this section, choosing **one** item from each of the parts I and

II.

PART I

ITEM 2

A college administration is planning activities for the Annual Academic Excellence and Innovation week. To ensure fairness in allocating study materials, organizing student's awards, and scheduling the official opening ceremony, the administration applies mathematical reasoning.

To allocate revision booklets fairly, **25** times the number of booklets given to each student minus the square of the number of booklets given to each student should be at least **144**. For fairness each student must get at least 8 booklets.

The administration has selected **8** student leaders, but only **5** of them will receive certificates of excellence. For their plan to continue, the number of possible selections of certificate winners should not exceed 60 and each cash prize should not be more than 120 million.

The certificates for the **5th, 4th, 3rd, 2nd and 1st** positions correspond respectively to the first five terms in ascending powers of x in the expansion of $(4 + 3x)^7$, where x represents shs.5.

The administration wishes to determine the number of possible ways of awarding the certificates while maintaining fairness.

On the day of the ceremony, **50** invited guests are expected. The first guest arrives at **9:10a.m.**, and each subsequent guest arrives at t minutes after the previous one. The Guest of honour is the last person to arrive, and **15** minutes later, the ceremony will officially be declared open. The ceremony is to run for **3 hours 40 minutes** and must end by **5:59pm.**

Tasks

Help the administration whether to carry on the planned format of booklet distribution and certificate awarding and also advise on the arrival time interval (t) for the individual guests in order the function to end on time.

ITEM 3

The security team was tasked to design a stepped security pillar to be constructed in a sugar cane plantation to monitor and fight fire out break. The pillar will provide a high view point for surveillance and quick response.

The heights of the steps above the ground increase by the same vertical distance from one step to the next. The height of the 5th step is three times the 7th step. The total height of the first twelve steps is 21 m. The team wishes to redesign the pillar if the total height of the first five steps is less than 15 m.

The security(safety) team wishes to reduce response time by placing two communication radios a distance of x in tens of meters from the pillar. One radio shows a signal strength of $3\log_8 x$ and the other radio shows a signal strength of $6\log_x 4$.

For the safety team to hear clearly without echo, the sum of the two signal strengths must be 8. The safety team wishes to adjust the radios if their distance from the pillar is less than 40 m.

The team wishes to position at least four solar powered lights. The main light is positioned $-8 + 8\sqrt{3}i$ meters(m) on the plantation grid. The other three lights must be positioned at the cube roots of the main light position. The team wishes to relocate the positions of the lights if the sum of the moduli of the positions of these lights is less than 10 m.

Task.

Based on mathematical evidence, advise the security team on the decisions to make.

PART II

ITEM 4

A farmer in **Buyende District** is establishing a beef cattle project on his land along a river.

He is to construct a rectangular paddock along the river forming one side of the enclosure, only the remaining three sides require fencing. The farmer has 1120 m of fencing available.

Veterinary guidelines recommend that each bull requires 500 m^2 of grazing space. The farmer stocks the farm at a rate proportional to the square of the number of available bulls. Initially, there are 50 bulls on the farm. And after 8 weeks there are 75 bulls. The farmer wishes to start selling bulls when the farm is stocked to full capacity.

To maintain the pasture throughout the year, an irrigation system is installed. The main irrigation pipe follows the path $y = x^2\sqrt{(10 - x)}$,

Where x represents the horizontal distance (in meters) east of the water source and y is the distance (in meters) north of the water source. Engineers are to install inspection gadgets at points where the pipe changes direction which must be 10 meters apart.

Tasks

- Determine the maximum number of bulls that can be grazed according to the veterinary guideline.
- Advise the farmer on when to start the sales.
- Make a recommendation on the engineer's inspection points.

ITEM 5

A community irrigation project is constructing a decorative water feature and a storage system for a farm.

The side profile of the decorative basin is modelled by the; $y = x(4 - x)^2, 0 \leq x \leq 4$.

Units in meters (m).

The region enclosed by the curve and the x - axis is rotated about the x - axis to form a solid basin whose volume must be at least 450m^3 otherwise there is need to redesign that decorative feature.

At the same project, workers use a spherical water pot of radius 2.5 m for processing the water. The pot is filled with water to a depth of 3.6 m. The water is then poured into a cylindrical container of base radius 6 m. For the project to be a success the height of the cylindrical tank must not be greater than 0.5 m.

Tasks

With mathematical justifications, Analyse the project.

THE END