

P425/1
PRINCIPAL
MATHEMATICS
Paper 1
2026
3 hours



UGANDA NATIONAL EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
PRINCIPAL MATHEMATICS

Paper 1

3 hours

INSTRUCTIONS 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 item(s) responded to will **not** be scored.*

Begin each item on a fresh 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 may be used.

SECTION A

The item in this section is compulsory.

Item 1

Joseph is a final year civil engineering student who has been offered an opportunity to do industrial training in a construction company. He has joined at a time when the company has been contracted to design and construct a road connecting three trading centres; A, B and C that are on coordinates (2,3), (-2,1) and (4,7) respectively. The road should include a traffic-lights control tower to be installed at a point such that it is equidistant from all the three trading centres. The contractor has given the company two road design proposals; either to construct a circular road or a triangular road, depending on which one is of shorter length and the company has assigned this work to Joseph who needs assistance.

Task:

- (a) Determine whether it is possible for the company to construct a triangular road through the three trading centres.
- (b) Generate the equation Joseph can use to model the circular road design.
- (c) Recommend, based on calculations, the appropriate road design the company should construct and the point where the traffic lights control tower shall be installed on that design.

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 cooperative society needs to distribute resources to farmers fairly, schedule activities efficiently and plan prize systems transparently using mathematical reasoning.

To balance this, 23 times the number of sacks given to each farmer minus the square of the number of sacks of maize given to each farmer, should be at least 120. The organisers of the festival intend to have 7 helpers whom they also plan to reward with at most 4 prizes.

The prizes for the 4th, 3rd, 2nd, and 1st positions follow the terms of the expansion of $(3+2x)^8$ in ascending powers of x respectively, where x is \$1(**one dollar**).

The organisers need to determine the number of ways to reward the prizes while following fair distribution standards.

The organisers plan to invite 45 guests to the festival with each subsequent guest arriving exactly after a 5-minute interval from the time of arrival of the previous guest and the first guest must arrive at 8:00 A.M.

The chief guest will be the last to arrive and 10 minutes after, the festival will be officially opened. The organisers need to determine the time for the official opening.

Task:

- (a) Compute the range within which the number of sacks given to each farmer should lie.
- (b) Calculate the (i) possible number of ways to reward the prize to the helpers.
(ii) prize for each of the four positions.
- (c) Determine the time for the official opening of the festival.

Item 3

A company that deals in fertilizers has been supplying coffee farmers with a fertilizer mixture to improve on their yields.

When using the mixture, the total quantity of coffee obtained in the four consecutive seasons was modeled as;

Total yield (kg) = $(Ax + By)^3$, where A and B are quantity ratios of the amount of fertilizer (x) and water (y) respectively.

Each container of the mixture contains 6 kg of the fertilizer and 1litre of water.

The terms of the expansion of the Total yield represent the yields per season and the yields were 1728 kg and 216 kg of coffee in the first and last season respectively.

Over the past few years, the company has noticed that farmers are losing interest in the fertilizer mixture because of lack of expiry date information and limited branches of the company to serve farmers.

According to the company, the percentage effectiveness, P , of the fertilizer over a time period, t , in months, is modeled by the equation;

$\log P = \log P_0 - C \log(t - 4)$, where C is the concentration constant in a given batch of fertilizers and P_0 is the initial percentage effectiveness.

The company is planning to manufacture a new batch of fertilizers on the 1st September, 2026 with a 95% effectiveness and a concentration constant of 0.2. According to the company chemist, the fertilizer is considered fit for use when its percentage effectiveness doesn't go below 47.5% and this helps to determine the expiry date.

The company also wishes to set up three different sales outlets for its products whose locations are related by the equation;

$$Z^3 - 5Z^2 - 17Z - 13 = 0$$

where Z is the coordinate of any point on the site map.

However, information about the yields for the 2nd and 3rd seasons, actual expiry date and exact location of the sales outlets is missing, and the company manager needs it.

Task:

- (a) Determine the season that gave the highest yields when the farmer used the mixture.
- (b) Recommend, based on calculations, the actual expiry date to be indicated on the new label of the batch that will be manufactured on the 1st September 2026.
- (c) Generate the coordinates of the sales outlets.

PART II**Item 4**

A land owner is preparing to use a wire mesh to fence a rectangular piece of land that has an area of 39,200 m², with one side of the land along an existing straight wall.

Due to the existing wall, fencing is required on the other three sides only and a space for a 12 m wide gate must be left along the fence, on the side opposite the existing wall.

According to the manager of the company that is going to fence the land, the rate at which the fence is installed after t hours is modeled by;

$$\frac{dL}{dt} = 12 - 0.1t \text{ metres per hour; } 0 \leq t \leq 12, \text{ where } t \text{ is the time in hours and } L$$

is the length fenced in a day.

The land is mostly flat, but has a depression to be filled with 200m³ of soil.

The land also has a small ant-hill in the centre whose, shape is modeled by the equation;

$y = 12 - 3x^2$, where x is the horizontal distance (in metres) from the centre of the ant-hill and y is the height of the ant-hill (in metres) above the flat field.

The ant-hill must be removed to ensure that the land is fully levelled and the soil will be used to fill the depression however, the land owner is not sure whether that soil will completely fill the depression.

The land owner needs to determine the most efficient way to fence the land.

Task:

- a)
 - (i) Calculate the minimum length of wire mesh the land owner must buy to completely fence the land.
 - (ii) Compute the number of days required to install the wire mesh.
- b)
 - (i) Sketch the cross-section of the ant-hill.
 - (ii) Determine whether the depression will completely be filled.

Item 5

Senior six (S6) students are making items to exhibit during their annual competitions. The girls will compete in making moulds using clay while the boys will compete in packing bottles into a box using the shortest time possible.

Jalia had made a conical shaped mould of radius 10 cm and height 100cm but she realised that many other girls had made the same shape. She would like to reshape it into a cylindrical mould with the biggest volume possible and needs assistance to determine that volume.

Margaret designed a spherical mould but she has realised that its radius is 9.8 cm yet she intended to mould one of 10cm.

In the guidelines, only moulds whose error in volume does not exceed 8% will be approved for the competitions and Margaret is not sure whether her mould will be approved.

Moses has been practicing packing 100 bottles in a box similar to that used in the competitions and over time he has realised that he packs at a rate proportional to the square root of the bottles remaining.

In his most recent practice, he packed 19 bottles in 1 minute and according to the records, the winner in this category used 13 minutes last year.

Task:

- (a) Determine the volume of the biggest cylinder Jalia can mould from her piece.
- (b) Establish whether Margaret's mould will be approved for the competition.
- (c) Evaluate whether Moses is likely to win the competition basing on the previous year's record.