P425/1
PRINCIPAL MATH
Paper 1
July 2026
3 Hours

ACEITEKA JOINT MOCK EXAMINATIONS 2026

Uganda Advanced Certificate of Education

Principal Mathematics

Paper 1

Time: 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

(This section has one compulsory item)

ITEM 1

A certain school is carrying out renovations ahead of re-opening. The school is to mount (install) flood lights at $C(1, -2,8)$ on the administration block to improve on lighting in the school. However, the school security guard patrols at night along the straight path corridor route from $A(2,3,1)$ to $B(5,7,4)$. For proper visibility during the night patrols, these flood lights should be at most 9 m from the patrol corridor, if not the school will find another location. (All coordinates in meters)

The girls' reading shelter is getting a modern, curved arched roof to prevent water logging. When viewed from the front, the cross-section of the roof forms a downward-opening vertical parabola modeled by the equation:

$$y = 4 - \frac{x^2}{8}$$

(where y is the height in meters above the ground, and x is the horizontal distance from the center of the shelter).

Rainwater collects at a central overhead collection node located at $Q(0, 6)$. A straight drainage downpipe must be installed to run from Q, touch the roof curved surface and drain its water directly into a concrete collection trench located at ground level at $T(6, 0)$ to keep the walkway dry.

The school management is also planning to install a CCTV camera to monitor activities in the school, and the camera rotation is modeled such that its distance of coverage in every rotation is:

$$D = 20(3\sin\theta + 4\cos\theta + 6)\,metres$$

The school management wishes to monitor a distance in the range:

$30 < D < 200$ *meters*, but they don't know if this camera will reach their target.

Task: Help the school administration using your mathematical skills to make valid decisions flood lights, drainage pipes, and CCTV camera.

SECTION B

PART I

(Attempt one item in this part)

ITEM 2

A large-scale poultry farmer is conducting a comprehensive audit of his farm records to optimize operational efficiency and cut unnecessary expenses. He needs to evaluate three core areas of his business: feed procurement costs, automated flock hydration safety, and wholesale egg inventory marketability.

The farm's recent inventory ledger shows three bulk purchases of Layers Mash, Maize Bran, and Protein Concentrate as shown below

	Mass of the feeds × 100 Kgs		
Purchase	Layers mash	Maize brand	Protein concentrate
A	3	1	2
B	1	2	1
C	2	1	3

The total amount used in the purchases A, B and C was 2,800,000, 1,800,000 and 2,600,000/= respectively. The farmer will consider these purchases cost friendly if he is to use less than 5,500,000 to purchase 400 kg of layers, 400kg of maize brand and 300kg of protein concentrate.

The farm uses an automated drinking system where a vital vitamin boost is dissolved into the flock's daily water supply. Sensor telemetry records show that the volume of water consumed during the daytime is $\sqrt{3x+700}$ litres, while the volume consumed at night is $\sqrt{x+600}$ litres. The automated system logs show that the total water volume consumed by the birds over a full 24-hour cycle is exactly 70 litres. The vitamin boost will successfully optimize egg production if its mass x doesn't exceed 300g.

The farm currently has an inventory of 33 trays of eggs sitting in storage. Due to market volatility, the farm's management software implements a strict regulatory rule to determine whether a batch of eggs is cleared for immediate sale or held back. A batch can only be sold if 130 times the number of available trays is strictly greater than the square of the number of trays plus 3000. The farmer does not know whether his current stock meets this safety margin to be cleared for the market.

Task: Help the poultry farmer to make decisions on his farm using knowledge of algebra

ITEM 3

A business man set up a large scale baking factory and it is facing some challenges which need to be addressed if the business is to continue.

He uses machines to mixes ingredients at a constant temperature. However, they have discovered that whenever they increase the temperature, the volume of bread obtained decreases and follows the model:

$$V = ax^3 + bx^2 + cx + 30$$

Where a, b and c are the constant amounts of ingredients used.

The table below shows the volume of bread obtained at different temperatures using same amounts of ingredients.

Temperature × 10 (°C)	**Volume of bread, V**
1	28
2	22
3	18

A specialist in baking has advised the business man to always mix the ingredients at a temperature of 45°C which he claims to be the optimal temperature for mixing ingredients.

The bakery has two machines A and B for mixing these ingredients and their workloads relate with operational time,t minutes as:

Machine A: 2^{2t+2} and machine B: $33(2^t) - 8$.

To prevent delays before the heating stage begins, both machines must perfectly balance and operational time t should not exceed 5 minutes.

The factory has a storage facility having 11 rooms represented by the terms of the expansion of

$$N = (x + 2)^{10} \text{ hundreds of boxes}$$

where x is the height of the box used for storage and transportation of the breads

The business man would like to expand his storage space but this will be done if using the first four terms of the expansion with boxes of height 0.25 m the available space cannot store 300,000 boxes

Task:

Help the business man to make the necessary decisions in his factory using your knowledge of Algebra.

ITEM 4

PART II

(Attempt one item in this part)

A farmer practicing large-scale bee-keeping is facing a problem of large amounts of honey produced on his farm. He has decided to further process the honey and add value to it.

He plans to pump filtered honey into cylindrical tins whose height is three times the radius. The tins on the market have a factory error in radius of 0.5%. The farmer will not accept these tins if their corresponding error in volume exceeds 2%.

The pump machine he intends to use records the height (h) and the volume (V) of the honey in the container after time t seconds as:

$$h=\left(\frac{t^2}{5}+3t\right) cm \text{ and } V=\left(\frac{t^2+4t}{t+1}\right) cm^3$$

He will use this machine only if the rate of change of volume with height when time is 3 seconds does not exceed $0.\dot{3}\ cm^2$. This ensures no spilling or wasting of honey

The power cost of this pump machine is modelled by the differential equation:

$$\frac{dp}{dt}=20te^{\frac{-t}{5}}$$

Where p is the cost in thousands of shillings per week.

The farmer should consider other sources of power if the cost for running the machine in 5 weeks exceeds 140,000/=.

Task:

Use your mathematical skills to help the farmer make valid decisions basing on his plans.

ITEM 5

Students in a certain school have for a long time been complaining about unsafe drinking water. The school administration has come up with the following measures to solve this problem.

The administration contracted a welder to make a cuboidal tank whose height h metres relates with the diagonal angle θ as:

$$h = tan\theta \text{ metres}$$

The welder made a tank with diagonal angle 50^o instead of 45^o. The school administration will only accept this tank if the error in the height is less than 0.2 m.

They also plan to buy a machine which can pump water into the tank on daily basis. The available machine is rated:

$$\frac{dv}{dt} = \frac{100t}{(t+1)(t+2)} m^3 per\ hour$$

To save power, the administration needs a machine which can fill the tank with at least 70 m^3 of water in 5 hours.

Once the tank is filled with the required amount of water, they plan to add a water treatment chemical which decomposes in the water at a rate

$$e^t \frac{dm}{dt} + me^t = t^2$$

Where m is the mass in grams of the chemical remaining in the water after t hours.

On a daily basis, initially 100 grams of the chemical is to be added to the water but the water can only remain pure and safe for drinking if after 6 hours the amount of chemical remaining is not less than 0.4 grams.

Task: Using your knowledge in calculus help the school administration to make valid decisions.

END