

NAME:.....COMB:.....

P425/2

Paper 1

3 hours

**UACE MID TERM 2 2025**  
**S5 PRINCIPAL MATHEMATICS Paper 1**

3 hours

**INSTRUCTIONS:**

- ≈ Answer **all** the items in both section A and B.
- ≈ All necessary working **must** be shown clearly.

**Item one:**

In pilot navigating school, a student is set to drive a plane using a virtual program, the virtual system is set to describe the following path  $y = x^3 - 5x^2 + 3x + 9$ . Where  $(x, y)$  is the grid reference of the planes sky.

As part of a test, the student needs to go to zone with coordinates  $(x, y)$  codified by solving the equations below;  $x - 2y + 3 = 0$  and  $x^2 - 3xy + y^2 = 11$ .

**Task:**

- a) Using differentiation, sketch the path traced by the virtual plane. **(9 scores)**
- b) Find the zonal coordinates of the areas the plane has to go to. **(6 scores)**

**Item two:**

In an insect study focused on movement of a spider has been identified to be moving following patterns with the equations;  $x = \sin\theta + 1$  and  $y = 1 - \cos 2\theta$ .

The model for the whole study program to be a success is based on notation of verifying the following

$$\tan\left(\frac{\pi}{4} + \theta\right) - \tan\left(\frac{\pi}{4} - \theta\right) = 2\tan 2\theta$$

**Task:**

- a) Show that the Cartesian equation of motion of the insect is  $y = 2x^2 - 4x + 2$ .
- b) Verify that the study program is a success. **(9 scores)**

**Item three:**

In certain foreign exchange market model, there two possibilities, either a profit or a loss at any given time, one of the analysts has been tasked to work out the parameter for positive return on investment by solving  $\frac{1}{x+1} < \frac{2}{x-3}$ . With  $x$  representing risks.

Looking at the future investments in A.I a model for the industry was develop as a whole fraction. As shown  $\frac{3x^2+2}{(x)(x-1)^2}$ . With its possible parts representing market share for USA and China.

**Task:** Help the analyst to:

- (i) Find the regions of pure risk
- (ii) Identify the partials that represent market share. **(10 scores)**

**Item four:**

As part of preparation for African Olympiad mathematicians' program one student has come to an S5 principal mathematics student to help solve the following questions for his showing him all relevant steps

Question 1: differentiate with respect to  $x$ :  $4x^2(x + 2)^5$

Question 2: Use trapezium rule to approximate  $\int_1^3 2(\ln x)^2 dx$  to 3 decimal places using 5 strips

**Task:** Help the show how this can be solved **(08 scores)**

**Item five:**

The functional model for working A.I system in accuracy learning from its given data is given by the equation  $A = 7(3 \cos t - 4 \sin t) + 37$ . The lead scientist has asked you to express  $\text{in } R \cos(t + \beta)$  for  $3 \cos t - 4 \sin t$ , hence use it to determine the maximum and minimum accuracy level

A kite, flying with  $x$  in  $\text{km/hr}$  representing wind effect on it, if it flies describing a motion following an equation  $2 \sin 2x = 3 \cos x$ , with  $0 \leq x \leq \pi$ .

**Task:**

- a) Determine the maximum accuracy levels that can be achieved by this A.I model.
- b) **Help** find the posit input wind speed in  $\text{km/hr}$ . ( HINT:  $1^\circ = \frac{\pi}{180}$  ) **(10 scores)**

**Item six:**

A university planning committee is surveying a quadrilateral-shaped recreational area on campus. The four main locations marking the boundary of the recreation space are; South gate: A(2, 3) , student lounge: B(6, 8) , viewpoint tower C(11, 7) and campus café D(8, 2). To allocate university funds for landscaping and maintenance, the committee needs to calculate the total area of the recreation space. The university has approved a budget of UGX.650,000 per 4 square units of land.

An information kiosk is to be installed at the midpoint between the south gate and campus café. As part of annual tech expo, the student-built robots; Volt-R and Hexa-Dare programmed to navigate designated path with in the recreation area as stated below.

**Volt-R** moves along a straight path from P(3, 6) to point Q(7, 10).

**Hexa-D** moves along a straight path from R(5, 2) to point H(9, 5)

Faculty adviser want to compute the angle between the line lines of path taken by theses robots as part of an analysis of motion control algorithms.

**Task:** Help the university planning committee to determine;

- i) Area of the recreation park and how much is to be need for maintenance
- ii) The coordinates of the information kiosk and calculate its distance from student lounge
- iii) The equations of the paths of the Volt-R and Hexa-D, and hence compute the angle between them. **(19 scores)**

**Item seven:**

A forest fire spread in such a way that the burnt area  $H$  (hectares) after  $t$  hours is given by the relation  $H = 20e^{bt}$ . Assume that the fire burns unchecked.

**Task:**

- a) Interpret the meaning value of 20 used in the model and find  $b$  if  $e^b = 1.8$ .
- b) Find the area burnt after 3 hours
- c) How long would it take to burn an area of 500 hectares? **(7 scores)**

**Item eight:**

A cuboid jewelry box with a lid has dimensions  $3x$  cm by  $x$  cm by  $y$  cm. It is made using a total of  $450$  cm<sup>2</sup> of wood.

**Task:** Show that the volume of the box can be expressed as  $V = \frac{1}{4}(675x - 9x^3)$  and use calculus to show the maximum volume is **562.5 cm<sup>3</sup>**. **(7 scores)**

**END**