

P425/2

APPLIED MATHEMATICS

PAPER 2

JULY/AUGUST 2024

3 HOURS



UNNASE MOCK EXAMINATIONS 2024

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

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INSTRUCTIONS TO CANDIDATES

*Answer **all** the **eight** questions in Section A and any **Five** from Section B.*

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

*In numerical work, take **g** to be **9.8ms^{-2}** .*

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

6. Given that $X \sim N(\mu, \sigma^2)$, $P(X > 30) = 0.877$ and $P(X < 70) = 0.67$, find the values of μ and σ (05 marks)

7. An elastic string of natural length 0.6m is stretched 8cm by a hanging particle of mass 2kg . Find the energy stored in the string when its length is 0.7m (05 marks)

8. Find the possible values of $P(A)$, if A and B are independent events such that $P(A \cap B) = 0.3$ and $P(A \cup B) = 0.875$ (05 marks)

SECTION B (60 Marks)

Answer any **five** questions in this section. All questions carry equal marks

9. A continuous r.v X has the following distribution function:

$$F(x) = \begin{cases} 0 & , \quad x < 2 \\ k(ax^2 + bx - x^3) & , \quad 2 \leq x \leq 3 \\ 1 & , \quad x > 3 \end{cases}$$

Given that the mode of X is $\frac{8}{3}$, find:

(i) the values of a , b and k

(ii) the equations of the p.d.f

(iii) $P(X < 2.7)$

(12 marks)

SECTION A: (40 MARKS)

Answer *all* the questions in this section.

1. Coplanar forces $(\mathbf{i} + 5\mathbf{j})\text{N}$ and $(-5\mathbf{i} - 2\mathbf{j})\text{N}$ act at points with position vectors $(2\mathbf{i} + 2\mathbf{j})\text{m}$ and $(7\mathbf{i} + 6\mathbf{j})\text{m}$ respectively. Find the resultant force and show that the equation of its line of action is $3x + 4y = 24$ (05 marks)
2. A certain measurement was recorded as $x = \frac{\pi}{3} \pm \frac{\pi}{360}$. State the error in x and find the limits within which the exact value of $y = x \cos x$ lies (05 marks)
3. The price index of an item in 2022 based on 2023 was 88. Its price index in 2024 based on 2023 was 132. Find its price in 2024 if its price in 2022 was Shs 6,000 (05 marks)
4. A stone is thrown straight upward and returns to the thrower's hand after 3s in the air. A ball is thrown at an angle of 30° with the horizontal. At what speed must the ball be thrown so that it reaches the same height as the stone? (05 marks)
5. The commission of a salesman is calculated as follows:

Sales worth, A (£)	Commission, C ,
01–400	$C = 0.2A$
Above 400	$C = 80 + 0.3(A - 400)$

Draw a flowchart that computes and prints the commission for sales worth £A

(05 marks)

10. The length l , width w and height h of a cuboid were measured with errors Δl , Δw and Δh respectively. Show that the maximum relative error in its volume is $\left| \frac{\Delta l}{l} \right| + \left| \frac{\Delta w}{w} \right| + \left| \frac{\Delta h}{h} \right|$. Hence if $l = 8 \pm 0.6$, $w = 2.8 \pm 0.7$ and

$h = 7 \pm 0.35$, find the percentage error in its volume (12 marks)

11. At 10:00 am, ship P leaves a point with position vector $(-4\mathbf{i} + 8\mathbf{j})\text{km}$ sailing North-East with a speed of $10\sqrt{2}\text{kmh}^{-1}$. At 12:00 noon, ship Q leaves a point with position vector $(19\mathbf{i} + 34\mathbf{j})\text{km}$ sailing with a velocity of $(8\mathbf{i} + 6\mathbf{j})\text{kmh}^{-1}$. If the ships maintain these velocities,

(i) find the position vector of ship P at 12:00 noon

(ii) show that the ships will collide and find when and where the collision occurs (12 marks)

12. (i) By drawing graphs of $y = e^x$ and $y = 4\sin x$ on the same axes, find each of the two roots of the equation $e^x - 4\sin x = 0$ for $0 \leq x \leq 1.5$ using intervals of 0.3

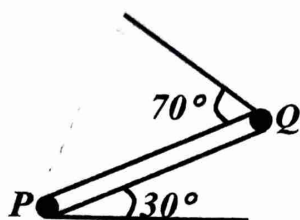
(ii) Use Newton Raphson method to find the largest root of the equation in (i) above correct to 3 decimal places (12 marks)

13. Three pens are drawn at random without replacement from a box containing 4 blue and 5 red pens. If X is the number of red pens drawn, find the:

(i) probability distribution of X

(ii) median, mean and variance of X (12 marks)

14. A uniform rod PQ of length 4m and mass 6kg is kept inclined at 30° to the rough horizontal ground in limiting equilibrium by a string attached to end Q making an angle of 70° with QP as shown below



Find the:

- (i) tension in the string
- (ii) coefficient of friction between the rod and the ground
- (iii) magnitude and direction of the resultant reaction at P (12 marks)

15. The table below shows the weights in kg of 80 boys:

Weights	50–59	60–74	75–79	80–89	90–94
Frequency Density	2.2	1.8	3	1.2	0.8

Calculate the:

- (i) mode, mean and median weight
- (ii) number of students heavier than 76.5kg (12 marks)

16. A car of mass 2000kg develops a constant power of 20kW as it ascends a slope of 1 in 49 with a maximum speed of 10ms^{-1} . The non gravitational resistance to motion of the car is directly proportional to the car's speed. Find the:

- (i) non gravitational resistance at maximum speed
- (ii) maximum speed the car attains, if the car descends the same slope while developing the same power of 20kW (12 marks)