P425/2

APPLIED MATHEMATICS

PAPER 2

JULY/AUGUST 2024

3 HOURS

UNNASE MOCK EXAMINATIONS 2024

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

PAPER 2

3 HOURS

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 $9 \cdot 8ms^{-2}$.*

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

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6. *Given that* $X \sim N(\mu, \sigma^2)$, $P(X > 30) = 0{\cdot}877$ *and* $P(X < 70) = 0{\cdot}67$, *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*

$P(A \cap B) = 0 \cdot 3$ *and* $P(A \cup B) = 0 \cdot 875$ **(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:*

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

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) $P(X < 2 \cdot 7)$

(12 marks)

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SECTION A: (40 MARKS)

*Answer **all** the questions in this section.*

1. *Coplanar forces* $(i + 5j)N$ *and* $(-5i - 2j)N$ *act at points with position vectors* $(2i + 2j)m$ *and* $(7i + 6j)m$ *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	$\acute{C} = 0 \cdot 2A$
Above 400	$C = 80 + 0 \cdot 3\,(A - 400)$

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

(05 marks)

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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* $l = 8 \pm 0{\cdot}6$, $w = 2{\cdot}8 \pm 0{\cdot}7$ *and* $h = 7 \pm 0{\cdot}35$, *find the percentage error in its volume* **(12 marks)**

11. *At* **10:00 am,** *ship* **P** *leaves a point with position vector* $(-4\mathbf{i} + 8\mathbf{j})\mathbf{km}$ *sailing North–East with a speed of* $10\sqrt{2}\,\mathbf{kmh}^{-1}$. *At* **12:00 noon,** *ship* **Q** *leaves a point with position vector* $(19\mathbf{i} + 34\mathbf{j})\mathbf{km}$ *sailing with a velocity of* $(8\mathbf{i} + 6\mathbf{j})\mathbf{kmh}^{-1}$. *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* $0 \leq x \leq 1{\cdot}5$ *using intervals of* $0{\cdot}3$

(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)**

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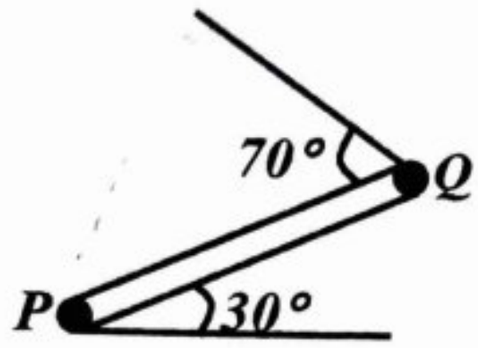
14. *A uniform rod* **PQ** *of length* **4m** *and mass* **6kg** *is kept inclined at* **30°** *to the rough horizontal ground in limiting equilibrium by a string attached to end* **Q** *making an angle of* **70°** *with* **QP** *as shown below*



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* $\mathbf{10ms^{-1}}$. *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)**

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