

P425/2

PURE MATHEMATICS

PAPER 2

MARCH, 2024

3 HOURS

PRE-REGISTRATION EXAMINATIONS-2024

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

- Attempt **ALL** the **EIGHT** questions in section A and any **FIVE** from section B.
- All working must be clearly shown.
- Mathematical tables with list of formulae and squared paper are provided.
- Silent, non-programmable calculators should be used.
- State the degree of accuracy at the end of each answer using **CAL** for calculator and **TAB** for tables.
- Clearly indicate the questions you have attempted in a grid on your answer scripts.

Question		Mark
Section A		
Section B		
Total		

SECTION A: (40MARKS)*Answer **all** the questions in this Section.*

1. Two events A and B are such that $P(A) = 0.7$ and $P(\bar{A} \cap \bar{B}) = P(\bar{A} \cup \bar{B}) = 0.2$. Determine the;

(i) $P(B)$

(ii) $P(\bar{A}/B)$

(05 marks)

2. A particle of mass 2kg is acted upon by a force of magnitude 21N in the direction $2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$. Find in vector form the;

(i) Force

(ii) acceleration hence its magnitude.

(05 marks)

3. A certain student from S.6 of a certain school recorded the following set of points.

x	-2	-1	0	1	2
y	-5.5	-3.0	1.2	3.4	6.0

Use linear interpolation or extrapolation to estimate;

(i) y when $x = -0.76$

(ii) x when $y = 7.8$

(05 marks)

4. A discrete random variable X has the probability distribution function given by;

x	5	8	9	11	12
$p(X = x)$	a	0.1	a	0.4	0.1

Where a is a constant. Find the;

(i) Value of a

(ii) $E(5x - 7)$

(05 marks)

5. Car A is travelling at 35ms^{-1} along a straight horizontal road and accelerates uniformly at 0.4ms^{-2} . At the same time, another car B moving at 44ms^{-1} and accelerating uniformly at 0.5ms^{-2} , B is 200m behind A, find the time taken before B overtakes Car A.

(05 marks)

6. Use the trapezium rule with five ordinates to estimate $f(x) = x + \tan x$ from $x = 1$ to $x = 1.4$ correct the value to 3 decimal places.

(05 marks)

7. The table below shows the time recorded in minutes when Aeroplanes pass through a point of observation at a certain city.

Time	50–	60–	70–	80–	90–	100–	110–120
Frequency	5	3	8	7	10	8	9

Calculate the;

- (i) median
- (ii) number of Aeroplanes whose time exceed the median value. (05 marks)

8. Forces of magnitude 20N, 12N and 30N act on a particle in the directions due South, east and N40°E respectively. if the fourth force holds the particle in equilibrium;

Determine the;

- (i) magnitude
- (ii) direction of the forth force. (05 marks)

SECTION B (60MARKS)

Answer any *five* questions in this Section.

9. The probability density function of a random variable X is given by;

$$f(x) = \begin{cases} \frac{4}{5}x & ; 0 < x < 1 \\ \frac{2}{3}(3-x) & ; 1 < x < 2 \\ 0 & ; \text{otherwise} \end{cases}$$

- (a) Sketch the function $f(x)$ and show that the area = 1.
- (b) Find the mean of x.
- (c) Determine the cumulative distribution function $F(x)$. (12 marks)

10. (a) Two ships A and B are observed from a coast guard station and have the following displacements velocities and times.

Ship	Displacement	Velocity	Time(t)
A	$(i + 3j)km$	$(i + 2j)kmhr^{-1}$	12:00hours
B	$(i + 2j)km$	$(5i + 6j)kmhr^{-1}$	13:00hours

Find the time when the two are closest to each other.

- (b) If at 13:00hours ship A changed its velocity to $\left(\frac{11}{3}i + 2j\right)kmhr^{-1}$, show that they collide and find the time and position of collision. (12 marks)

11. (a) Show graphically that the equation $f(x) = 1nx - \sin x - 2$ has a root between $x = 3$ and $x = 4$ and estimate the initial approximation (x_0) to 1 decimal place.

- (b) Using the x_0 above and the Newton Raphson method find the root correct it to 3 decimal places. (12 marks)

12. The table below shows the speeds (y) in seconds and the number of errors(x) in the typed scripts of 12 secretaries of a certain institution.

Secretaries	A	B	C	D	E	F	G	H	I	J	K	L
Errors(x)	12	24	20	10	32	30	28	15	18	40	27	35
Speed(y)	130	136	120	120	153	160	155	142	145	172	140	157

- (a) Construct a scatter diagram, draw the line of best fit and comment hence estimate x when $y = 142$.
- (b) Giving rank 1 to the fastest secretary and the secretary with the fewest errors calculate the rank correlation co-efficient and comment at 5% level of significance. (12 marks)
13. A uniform lamina is in form of a square $ABCD$ of side 2cm. E is a point on AD such that $ED = x\text{cm}$, if portion EDC is removed, find the expressions of the location of centre of gravity from AB and from AD, taking AB as the positive y-axis and AD as the positive x-axis. (12 marks)
14. (a) Given that the numbers $x = 4.2$, $y = 16.02$ and $Z = 25$ are rounded off with corresponding percentage errors 0.5 , 0.45 and 0.02 calculate the errors of x , y and Z .
- (b) Hence find the maximum value, the minimum value, absolute error, relative error and percentage error in $\frac{xy}{z}$. (12 marks)
15. The speed of cars passing a certain point on a motorway can be taken to be normally distributed. Observations show that of cars passing the point, 95% are travelling at less than 85kmhr^{-1} and 10% are travelling at less than 55kmh^{-1} . Determine the;
- (a) mean and standard deviation of the distribution.
- (b) proportion of cars that travel at more than 70kmhr^{-1} and the percentage it takes. (12 marks)
16. A light inextensible string has one end attached to a ceiling, the string passes under a smooth moveable pulley of mass 2kg and then over a smooth fixed pulley, the particle of mass 5kg is attached at the free end of the string, the sections of the strings not in contact with the pulleys are vertical, if the system is released from rest and moves in a vertical plane, determine the;
- (i) accelerations of the 2kg and 5kg masses
- (ii) tensions of the 2kg and 5kg masses.
- (iii) distance moved by the system in 1.5 seconds. (12 marks)

END