

P425/2

APPLIED MATHEMATICS

Paper 2

ARUA DIOCESS POST PRIMARY EXAMINATION COUNCIL

SENIOR FIVE EXAMINATION 2023

APPLIED MATHEMATICS

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Paper 2

TIME: 3HOURS

Instructions to candidate

- Answer all the questions in section A and only five from section B
- Any extra question(s) attempted will not be marked
- Begin each answer on a fresh sheet of paper
- Silent, non-programmable scientific calculators and mathematical tables with list formulae may be used.
- Graph work should be done on a graph paper.
- Neat and organized work is needed as dirty work will not be marked.
- Where necessary, assume acceleration due to gravity, $g = 9.81ms^{-2}$.

SECTION A

1. The table below shows the value of the two variables P and Q.

P	14	15	25	20	15	7
Q	30	25	20	18	15	22

Calculate the rank correlation coefficient between the two variables. (05 marks)

2. One end of a light inextensible string of 75cm is fixed to a point on a vertical pole. A particle of weight 12N is attached to the other end of the string. The particle is held 21cm away from the pole by a horizontal force. Find the magnitude of this and the tension in the string. (05marks)

3. In an experiment the following observations were recorded

Time, T(s)	0	12	20	30
Temperature, θ	6.6	2.9	-0.1	-2.9

Using linear interpolation, find

- (i) Temperature corresponding to 16 seconds.
(ii) Time corresponding to 1°C . (05 marks)
4. A discrete random variable X can take values 0, 1, 2 and 3 only. Given $P(X \leq 2) = 0.9$, $P(X \leq 1) = 0.5$ and $E(X) = 1.4$, find
(a) $P(X = 1)$
(b) $P(X = 0)$ (05 marks)
5. The table below shows the length of lectures (to nearest minute) recorded by a student.
- | | | | | |
|---------------------------|---------|---------|---------|---------|
| Length of lecture(minute) | 50 – 53 | 54 – 55 | 56 – 59 | 60 – 67 |
| Frequency density | 5 | 13 | 7.5 | 1.5 |
- Calculate the mean length of time for the lectures attended during the month. (05 marks)
6. A box of mass 4.5kg rests on a rough horizontal plane inclined at an angle of 60° to the horizontal. If the coefficient of friction between the box and the plane is 0.35, determine the force acting parallel to the plane which will move the box up the plane. (05 marks)
7. Event A and B are such that $P(A) = \frac{8}{15}$, $P(B) = \frac{1}{3}$ and $P\left(\frac{A}{B}\right) = \frac{1}{5}$. Calculate the probability that ,
(i) Both events occur
(ii) Only one of the two events occur (05 marks)
8. Locate each of the three roots of the equation $x^3 - 3x + 1 = 0$ (05 marks)

SECTION B (60 MARKS)

9. Show that the iterative formula for finding the 4th root of the number N is given by $x_n = \frac{3}{4}\left(x_n + \frac{N}{3x_n^3}\right)$ $n = 0, 1, 2 \dots$ (03 marks)

(a) draw a flow chart that:

- (i) reads the number N and the initial approximation x_0
(ii) Compute and print N , its 4th root after four (4) iterations and give the root correct to 3 decimal places. (06 marks)
- (b) Perform a dry run for $N = 39$, $x_0 = 2$.

10. A car has a maximum power of 200kW . Its maximum speed on a level road is twice its maximum speed up a hill inclined at $\sin^{-1}\left(\frac{1}{15}\right)$ to the horizontal against resistance to motion of 1600N in each case. Find the

(a). mass of the car

(b) Acceleration of the car at the instance when its speed is 30kmh^{-1} on the level road with the engine working at full power, assuming the resistance to motion is unchanged. (12 marks)

11. The cumulative distribution of the height of employees of a company is given in the table below;

Height (cm)	< 100	< 110	< 120	< 130	< 140	< 150	< 160	< 170
Cum. freq	0	27	85	215	320	370	395	400

(a) Draw accumulative frequency curve and use it to estimate the median.

(b) Determine the interquartile range.

(c) Determine the 10th and 90th percentile range from your curve.

(d) Represent the above information on a histogram and use it to estimate the modal height.

(12 marks)

12. A particles is projected with a speed of 36ms^{-1} at an angle of 40° to the horizontal from a point 0.5m above the level ground. It just clears a wall which is 70metres on the horizontal plane from the point of projection. Find the:

(a) (i) time taken for the particle to reach the wall

(ii) height of the wall.

(08 marks)

(b) maximum height reached by the particle from the point of projection.

(04 marks)

13. A random variable X has a distribution probability function given by

$$f(x) = \begin{cases} k(x^2 + 1) & -1 \leq x \leq 0 \\ k(x + 1) & 0 \leq x \leq 1 \\ 0 & \text{elsewhere} \end{cases}$$

Where k is a positive integer, find

(i) The value of k .

(ii) The median

(iii) Sketch the graph $f(x)$

(12 marks)

14. On a farm, 40% of the goats are infected by a tick disease. If a random sample of 320 goats is selected from the farm, find the probability that:

(a) Less than 40% of the goats are infected

(04 marks)

(b) More than 150 goats are infected (04 marks)

(c) Between 110 and 140 inclusive goats are infected. (04 marks)

15. (i). Use the trapezium rule to estimate the area of $y = 5^{2x}$ between the x - axis, $x = 0$ and $x = 1$, using five sub intervals. Give your answer correct to 3 decimal places.

(ii) Find the exact value of $\int_0^1 5^{2x} dx$

(iii) Determine the percentage error in the two calculations in (i) and (ii) above. (12 marks)

16. (a) the table below shows the percentage sand, y in the soil at different depth x cm.

Depth, x	35	65	55	25	45	75	20	90	51
Sand, y	86	70	84	92	79	68	96	58	86

(a) (i) Plot a scatter diagram for the data. Comment on the relationship between the depth of the soil and the percentage of sand in the soil.

(ii) Draw a line of best fit through the point of the scatter diagram; use your result to estimate the percentage of the sand in the soil at depth of 31cm.

(iii) Depth of the soil with 54% sand.

(b) Calculate a rank correlation coefficient between the percentage of sand in soil and depth of the sand. (12 marks)

THE END

GOOD LUCK

Good luck K272