

P425/2

APPLIED MATHEMATICS

Paper 2.

JULY/AUG.,2024

3hours

**ACHOLI SECONDARY SCHOOLS EXAMINATIONS
COMMITTEE(ASSEC)**

JOINT MOCK EXAMINATIONS,2024

APPLIED MATHEMATICS

3hours

INSTRUCTIONS

- *Answer all the eight questions in section A and **five (5)** from section B.*
- *All necessary working must be shown clearly*
- *Silent non-programmable scientific calculators and mathematical tables with a list of formulae may be used.*
- *Where necessary, take $g = 9.8ms^{-2}$.*

SECTION A(40marks)

Attempt all the questions in this section.

1. A certain frequency distribution with standard deviation 2.5 has the following results:
 $\sum f = n$, $\sum fx = 177$ and $\sum fx^2 = 5259$. Find the value of n .
(05 marks)
2. A, B, C and D are the points $(0, 0)$, $(10, 0)$, $(7, 4)$ and $(3, 4)$ respectively. If AB, BC, CD and DA are made of a thin wire of uniform mass, find the coordinates of the centre of gravity.
(05 marks)
3. During grading, re-scaling was done such that a candidate who had originally scored 42% now gets 58% and the one who scored 51% was given 70%. What was the new mark of a candidate who scored 45% as original mark?
(05 marks)
4. A particle initially is at a point $P_0 = (3\mathbf{i} + 5\mathbf{j} - 8\mathbf{k})m$ with a constant speed of $25ms^{-1}$ in direction of $u = 3\mathbf{j} + 5\mathbf{k}$ Find the constant velocity of the particle and its final position after 10 seconds..
(05 marks)
5. Use the trapezium rule with 6 ordinates to approximate

$$\int_1^2 \tan^{-1} x dx$$

correct to 4 decimal places. (05 marks)

6. A motorcycle decelerated uniformly from $20kmh^{-1}$ to $8kmh^{-1}$ in travelling 896m. Find the rate of deceleration in ms^{-2}
(05 marks)
7. It was observed that 10% of boiled eggs supplied in given restaurant in Gulu City have cracks on them. In a random sample of 300 eggs, find the probability that more than 80 eggs have cracks on them.
(05 marks)
8. A discrete random variable X has a cumulative distribution function ($c.d.f$) as shown below.

x	1	2	3
$F(x)$	c	$4c$	$9c$

Find:

- (i) the value of c
- (ii) mean of X
- (iii) $P(X \geq 2)$

(05 marks)

SECTION B

Answer any five (5) questions from this section

9. The lengths in cm of 40 metal rods were as follows:

Lengths	Frequency
≥ 30	8
≥ 35	5
≥ 40	12
≥ 55	9
≥ 60	6
≥ 65	0

- (a) Calculate the:

(i) mean length (03 marks)

(ii) upper quartile (03 marks)

- (b) Display the data on a histogram and use it to estimate the mode. (06 marks).

10. (a) A point O is vertically above a fixed point A of a horizontal plane. A particle P is projected from O with speed $5V$ at an angle $\cos^{-1}\left(\frac{3}{5}\right)$ above the horizontal and hits the plane at a point B at a distance $\frac{48V^2}{g}$ from A .

Show that the height of O above A is $\frac{64V^2}{g}$. (06 marks)

- (b) A gun fires a shell from a cliff, $100m$ above the sea. The shell is projected at $200ms^{-1}$ at an angle of 45° above the horizontal. Taking $g = 10ms^{-1}$, find:

(i) the time taken for the shell to land in the sea.

(ii) the horizontal distance the shell travels. (06 marks)

11. (a) Show graphically that the equation $2\sin x = \ln x$ has a root between 2 and 3. (06 marks)

(ii) Use Newton Raphsons method to find the root of the equation in (a) above correct to 4 significant figures. (06 marks)

12. Given that $P(A) = \frac{3}{5}$, $P(A/B) = \frac{5}{7}$ and $P(B/A) = \frac{2}{3}$,

- (a) State with reasons whether A and B are:

(i) independent events (02 marks)

(ii) mutually exclusive events (02 marks)

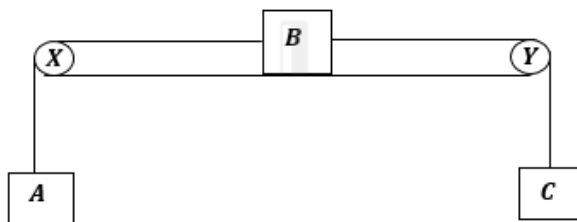
(b) Find:

(i) $P(AnB)$ (02 marks)

(ii) $P(B)$ (02 marks)

(iii) $P(A/\overline{B})$ (04 marks)

13. The diagram below shows particles A , B and C of masses $3kg$, $4kg$ and $6kg$ respectively connected by light inextensible strings which pass over smooth pulleys X and Y .



Mass B rests on a horizontal rough table, the coefficient of friction between the table and mass B being $\frac{1}{2}$. The system is released from rest. Determine;

(i) the acceleration of the masses

(ii) the tensions in the strings.

(c) after mass C has dropped through a distance of $2m$, the string connecting it to mass B snaps, determine the velocity and the time at which it occurs.

(12 marks)

14. (a) The quantities a b were measured with errors Δa and Δb respectively. Show that the maximum relative error in calculating $z = a\sqrt{b}$ is

$$\left| \frac{\Delta a}{a} \right| + \frac{1}{2} \left| \frac{\Delta b}{b} \right|$$

(08 marks)

- (b) Given that $a = 2.5$ and $b = 0.16$ were estimated with percentage errors of 4 and 5 respectively. Calculate the absolute error in evaluating $a\sqrt{b}$. (04 marks)

15. The distribution function of a continuous *r.v* X is as follows:

$$F(x) = \begin{cases} 0; & x \leq 1 \\ \frac{1}{12} (x-1)^2; & 1 < x \leq 3 \\ \frac{1}{24} (\beta x + \alpha - x^2); & 3 < x \leq 7 \\ 1; & x \geq 7 \end{cases}$$

Find the:

- (i) values of β and α . (05 marks)
 - (ii) *p.d.f* of X . (03 marks)
 - (iii) mean, μ of the distribution. (04 marks)
16. (a) $ABCD$ is a square of side $4m$. Forces of magnitude $7N, 3N, 5\sqrt{2}N$ and $2\sqrt{2}N$ act along, $\overrightarrow{AB}, \overrightarrow{BC}, \overrightarrow{CA}$ and \overrightarrow{BD} respectively. Show that the system of these forces reduce to a couple. (04 marks)
- (b) A non uniform ladder AB of length $6m$ and mass $10kg$ has its centre of gravity at G , where $AG = 4m$. The ladder is inclined at 45° to the horizontal with its end B resting against a rough vertical wall and end A on a rough horizontal ground with which the coefficients of friction at each point of contact is μ . If a boy of mass $40kg$ can safely ascend $2m$ up this ladder before it slips, find the value of μ . (08 marks)

END