

P425/2
APPLIED MATHEMATICS
PAPER 2
2024
3 HRS



SISEB JOINT MOCK EXAMINATIONS
UGANDA ADVANCED CERTIFICATE OF EDUCATION
APPLIED MATHEMATICS
PAPER 2
3 HOURS

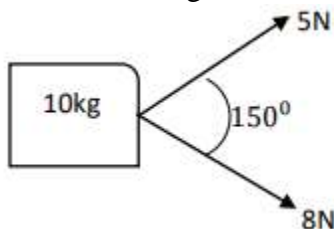
INSTRUCTIONS TO CANDIDATES:

- Answer all the **eight** questions in section **A** and any **5** from section **B**.
- All necessary working must be shown clearly.
- Begin each answer on a fresh sheet of paper
- Mathematical tables with a list of formulae and squared papers are provided.
- Silent, non-programmable scientific calculators may be used.
- In numerical work use $g = 9.81\text{ms}^{-2}$.
- State the degree of accuracy at the end of each answer given, if a calculator or mathematical table is used then indicate **Cal** for calculators or **Tab** for mathematical tables.

SECTION A

1. Use the trapezium rule with six ordinates to estimate $\int_3^5 x^2 \ln x dx$ correct to 3 decimal places. (5marks)

2. Forces of magnitudes 5N and 8N act on a particle of mass 10kg as shown below.



Determine the acceleration of the particle. (5marks)

3. A continuous random variable X is distributed at random between the values $x = 0$ and $x = 2$, and has a probability function of $ax^2 + b$. The mean is 1.25. Find the values of a and b . (5marks)

4. Given that $m = 4.6$ (1d.p) and $n = 3.42$ (2d.p). Find the interval within which the exact value of $m - n$ lies. (5marks)

5. The velocity, v of a particle at a time t is given by $V = 81 - 25t^2$. Determine: a) The value of t when the particle is instantaneously at rest. b) The distance covered by the particle in 3 seconds. (5marks)

6. In a certain factory 10% of chocolates produced are misshaped. A random sample of 1000 chocolates is taken, find the probability that a) Less than 80 are misshaped b) Between 90 and 115 inclusive are misshaped. (5marks)

7. The table below shows the marks scored by eight students in two sets of mocks 1 and 2.

Mock 1	92	60	60	65	45	60	92	65
Mock 2	60	65	80	60	50	68	83	80

Calculate the rank correlation coefficient between the performances in the two sets of mocks. Comment on your result based on 5% level of significance. (5marks)

8. An elastic string of natural length $1m$ is stretched by $0.2m$ by a force of 30N. Find the modulus of elasticity and the extension when a force of 48N is applied. (05marks)

SECTION B (60 MARKS)

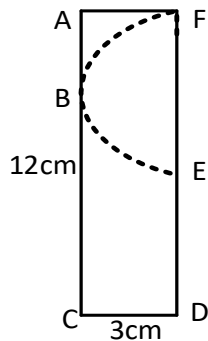
9. The table below shows the marks distribution of a group of students during an examination

Marks	Frequency density
- < 10	1
- < 20	2.5
- < 40	1.5
- < 60	2.2
- < 70	1.6
- < 95	0.6

- a) Calculate
- the mean (03marks)
 - the standard deviation (04marks)
- b) Draw a cumulative frequency curve and use it to estimate the median mark (05marks)

10.a) Particles of masses **1kg, 2kg, 1kg and mkg** are situated at $(6,4)$, $(-1,2)$, $(5,-1)$, and $(1,0)$ respectively. Given that the Centre of gravity of the particles is located at $(2, \bar{y})$, determine m and \bar{y} . (04marks)

b) The figure ABCDEF below shows a lamina in form of a rectangle from which a whole in form of a semi-circle was made. The diameter of the semi-circle is 6cm



- Find the position of the Centre of gravity from AC and CD if the semi-circle EBF is removed.
 - If the remaining lamina is suspended at D, find the angle CD it makes with the vertical (08marks)
11. On the same pair of axes, draw graphs of $y = xe^{-x}$ and $y = 2x - 5$ for the interval $0 \leq x \leq 4$. Use your graphs and locate to 1 decimal place the root of the equation, $xe^{-x} - 2x + 5 = 0$.

Hence use the Newton Raphson method to find the root of the given equation correct to 2 decimal places. (12marks)

12. A continuous random variable X has a probability density function defined by

$$f(x) = \begin{cases} \alpha x & 0 \leq x < 1 \\ \alpha & 1 \leq x < 2 \\ \alpha(3-x) & 2 \leq x < 3 \end{cases}$$

- Sketch $f(x)$ hence find the value of α . (04marks)
- Calculate the expectation of X (03marks)
- Deduce the cumulative distribution function $F(x)$ hence find $P(1.5 < x < 2.5)$ (05marks)

13. (a) Forces of magnitude $4N, \sqrt{5}N, 2N$ and $1N$ act along the sides AB, AC, CD and DA respectively of the rectangle $ABCD$ in which $AB = 4cm$ and $BC = 3cm$. Given that the direction of the forces is indicated by the order of the letters, determine:

- the magnitude of the resultant force
- length AY where Y is the a point where the resultant cuts AB . (06marks)

(b) Anon-uniform ladder PQ of weight $78.4N$ and length $5cm$ if freely suspended horizontally by two light inelastic strings PR and QS that makes angles 30° and 40° respectively with the vertical. Find the distance from P where the weight of the ladder acts. (06marks)

14. a) Given that x and y are values measured with possible errors e_1 and e_2 respectively.

i) Show that the maximum possible relative error in the expression $y\sqrt{x}$ is given by $\frac{1}{2} \left| \frac{e_1}{x} + \frac{e_2}{y} \right|$

ii) Given that $x = 0.38$ and $y = 7.5$ find the percentage error in evaluating $7.4\sqrt{0.38}$ (06 marks)

b) Given that $y = \cos\theta$ and θ is measured with a maximum possible error of 2% . If $\theta = 40^\circ$, determine the; i) Absolute error in y

ii) Interval within which the values of y lie. (06 marks)

15. (a) A projectile is released with speed u at an angle of elevation θ to the horizontal, it just clears two obstacles, both of height hm , whose distances from the projection point are bm and $3bm$ respectively. Show that the range of the projectile is $4bm$. (06marks)

(b) The maximum range of a projectile, fired with speed u is R . A target is placed hm above the landing point. Show that the speed with which it must be projected if it is to hit the target without changing the angle of projection is $\frac{u^2}{\sqrt{u^2 - gh}}$ (06marks)

16.(a) A discrete random variable X can take on values $0, 1, 2, 3$. Given that $p(X \leq 2) = 0.9$, $p(x \leq 1) = 0.5$, and $E(x) = 1.4$. i) Find a) $P(x = 1)$ b) $p(x = 0)$ (06 Marks)

(b) The number of cows owned by residents is assumed to be normally distributed. 15% of the residents have less than 60 cows while 5% of the residents have more than 90 cows. Determine the value of the mean and standard deviation of the cows. (06 mark)

END