P425/2
APPLIED
MATHEMATICS
Paper 2
July/August 2023
3 hours

MASAKA DIOCESAN EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
Joint Mock Examinations 2023
APPLIED MATHEMATICS
Paper 2
3 hours

INSTRUCTIONSTO CANDIDATES;

Answer **all** *the* **eight** *questions in section***A** *and* **five** *questions from section* **B.**

Any additional question(s) answered will **not** *be marked.*

All *necessary working* **must** *be shown clearly.*

Begin each answer on a fresh sheet of paper.

Squared paper is provided.

Silent, non-programmable scientific calculators and mathematical tables with a list

Of formulae may be used.

In numerical work, take acceleration due to gravity g to be 9.8 ms^{-2} .

SECTION A: *(40 marks)*

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

1. The probability that John speaks the truth is $\frac{3}{5}$ and that of Peter is $\frac{5}{8}$. Find the probability that they are likely to contradict each other on an identical point.
(05 marks)

2. Locate each of the roots of the equation $x^3 + 2x^2 = 4x + 4$. (05 marks)

3. A car of mass 2 tonnes moves from rest down a road of inclination $30°$ to the horizontal. Given that the engine develops a maximum power of 64.8 Kw and the resistance to motion is 500 N, find the acceleration of the car at the speed of 54 kmh^{-1}.
(05 marks)

4. The table below gives the grades of eight candidates in mock and UNEB 2018 in a certain subject.

MOCK	E	C	B	F	D	A	B	O
UNEB	O	B	C	O	C	C	B	F

   Calculate the rank correlation coefficient for the data and test for significance at 1% level.
(05 marks)

5. A particle travelling in a straight line with a constant acceleration covers distances d_1 and d_2 in the third and fourth seconds of its motion respectively.

   Show that its initial speed is $\frac{1}{2}(7d_1 - 5d_2)$. (05 marks)

6. Okello has worked for 4 years and earns Shs 400,000 while Mukasa has worked for 10 years in the same company and earns Shs 800,000. Estimate the;

   (a) salary of Kakeeto who has worked for 7 years in the same company.
(03 marks)

   (b) number of years Kalekezi who earns one million has worked for in the company.
(02 marks)

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7. At a certain supermarket, the customers only pay cash or use credit cards. The ratio of customers who pay by cash to those who pay by credit cards is $3:2$. If a random sample of 10 customers is selected, calculate the probability that ;
   (a)   exactly three, customers pay by credit cards.
   (b)   between five to nine pay by cash.   (05 *marks*)

8. A particle of mass 2 kg resting on a rough horizontal plane is pulled by a force of magnitude

   $\frac{20\sqrt{3}}{3} N$ inclined at $60°$ to the horizontal . If the particle does not move, find the minimum value of the coefficient of friction between the particle and the plane.   (05 *marks*)

SECTION B: *(60 marks)*

Answer any **five** *questions from this section.* **All** *questions carry equal marks.*

9. The table below shows the time taken by a telephonist to answer calls.

Time (seconds)	Number of calls
$10 - 19$	20
$20 - 24$	20
$25 - 29$	15
30	14
$31 - 34$	16
$35 - 39$	10
$40 - 59$	10

   (a) Calculate the;
      (i) Mean time
      (ii) 80th percentile of the time   (07 *marks*)
   (b) Draw a histogram for the data.   (05 *marks*)

10. A particle with a 2 kg mass moves on a space curve such that its velocity at any time t is given by $V(t) = (2 - 3t^2)i - 2\sin 2t\, j \ ms^{-1}$. Determine the;
   (a) impulse after one second   (06 *marks*)
   (b) work done between $t = 1$ and $t = 2\ seconds$.   (06 marks)

11. (a) Use the trapezium rule with **five** strips to estimate $\int_0^1 \frac{dx}{\sqrt{3-2x}}$ correct to **three** decimal places. (06 marks)

   (b) Find the exact value of $\int_0^1 \frac{dx}{\sqrt{3-2x}}$ correct to **three** decimal places. Hence find the relative error in your estimation in (a) above. (06 marks)

12. A continuous random variable X has a probability density function given by the graph below.
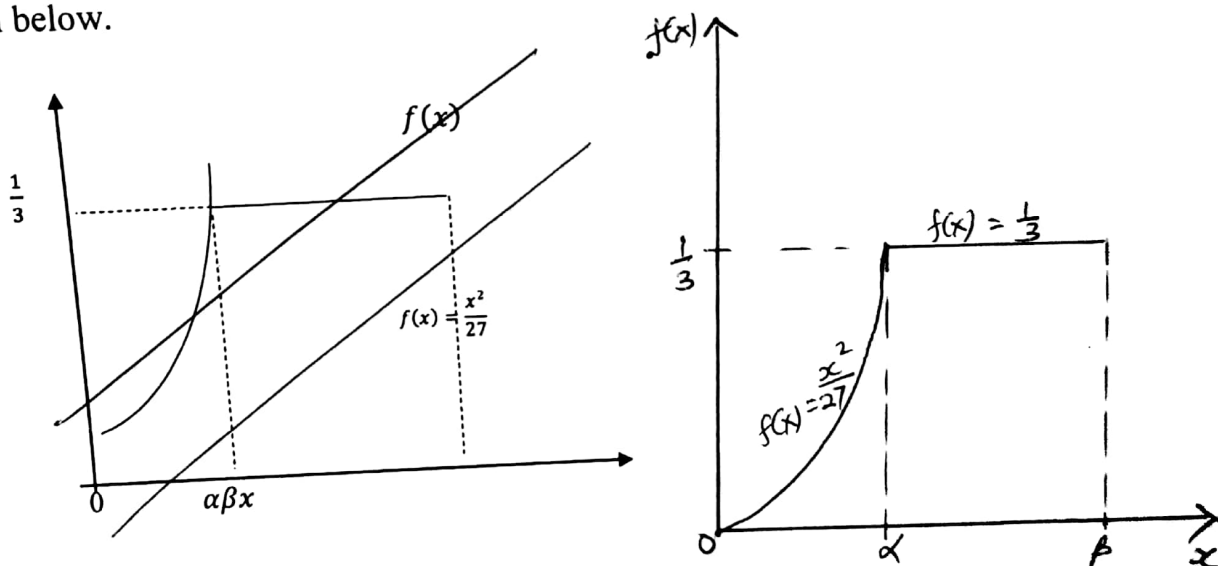
   Determine the ;

   (a) values of α and β, hence the $p.d.f$ of X

   (b) cumulative distribution function of X. Hence find the 90th percentile. (07 marks)

13. A car of mass $300 \, kg$ moving at $144 \, kmh^{-1}$ collides with a stationary trailer of mass $900 \, kg$ there by losing its momentum by 15%. If the car decelerates at $6 \, ms^{-2}$ after collision, calculate the;

   (a)   trailer's velocity after (06 marks)

   (b)   distance the car would have to move before (04 marks)

   (c)   deceleration (02 marks)

14.(a) Real numbers X and Y are approximated by x and y with errors Δx and Δy respectively.

Show that the percentage error made in approximating $X\sqrt{Y}$ by $x\sqrt{y}$ is given by

$\left(\left|\frac{\Delta x}{x}\right| + \frac{1}{2}\left|\frac{\Delta y}{y}\right|\right) \times 100$. State any assumptions made. (06 marks)

(b) The height H and radius R of a cylinder are measured as $H = 5.18\ cm$ and $R = 2.6cm$ respectively. Determine the interval with in which the volume of the cylinder is expected to lie. (06 marks)

15.(a) Point O is the origin and points A, B and C have position vectors $3i$, $3i + 2j$ and $2j$ respectively. A force of $(i + 4j)N$ acts at A, $5i\ N$ at B and $(-2i + 2j)N$ at C. Find the position vector of the point where the line of action of the resultant force cuts OA. (06 marks)

(b) Forces of magnitudes $4P$, $6P$, P, $2P$ and $3P$ act along lines $\overrightarrow{BA}, \overrightarrow{BC}, \overrightarrow{DC}, \overrightarrow{EF}$ and $\overrightarrow{FA}$ of a regular hexagon of side a. Show that the forces reduce to a couple. (06 marks)

16.(a) Given that $Y \sim N(-8, 12)$, find $P(Y > -8.2)$ (04 marks)

(b) The marks of candidates in an examination are normally distributed with a mean of 45 marks and standard deviation 20 marks.

(i) Find the probability that a candidate selected at random scored between 31 and 58 marks. (04 marks)

(ii) If 500 candidates sat for the examination and the pass mark was fixed at 41, estimate the number of candidates who passed the examination. (04 marks)

END