

P425/2

APPLIED MATHEMATICS

Paper 2

July/Aug, 2023

3 hours



PROVINCIAL - NAMIREMBE DIOCESE
COUHEIA SECONDARY
MOCK EXAMINATIONS 2023



Uganda Advanced Certificate of education
APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES

- Answer all the **eight(8)** questions in Section A and any **five(5)** questions from Section B.
- Any additional question(s) answered will **not** be marked.
- All working **must** be shown clearly.
- Mathematical table with a list of formulae and squared paper are provided.
- Silent, non – programmable scientific calculators and mathematical tables with a list of formulae may be used.
- For numerical work, take acceleration due to gravity
 $g = 9.8 \text{ ms}^{-2}$ unless otherwise.

SECTION A (40 MARKS)

Attempt all questions in this section.

1. The system of Forces of $(2i+bj)$ N and $(bi-aj)$ N acting through points with position vectors $(-2i-2j)$ m and $(3i-cj)$ m respectively is in equilibrium. Find the values of constants a , b and c . (05 marks)

2. The table below shows prices of items B, C, and D in 2018 and 2020 and the price indices for 2020 with 2018=100.

Item	Price in 2018	Price in 2020	Price index
B	150	285	190
C	y	330	200
D	170	z	250

Find the (i) values of y and z . (03 marks)

(ii) simple price index. (02 marks)

3. The table below shows how force, F , in newtons varies with extension, e , in metres for an elastic string.

F (N)	2	3	4
e (m)	38	68	108

Use linear interpolation or extrapolation to estimate,

(i) extension when the force applied is 5 N. (02 marks)

(ii) force when extension is 47.5m. (03 marks)

4. Three particles of masses 2 kg, 6 kg and 10 kg are placed at points with coordinates (2,4), (-5,1) and (3,-4) respectively. Determine the: (i) coordinates of the centre of mass of the system of particles

(ii) distance of the centre of mass from the origin (05 marks)

5. Independent events A and B are such that $P(A \cap B) = 0.15$, $P(A) = m$ and $P(B) = m + 0.2$. Determine the value of m and hence $P(A \cup B)$.

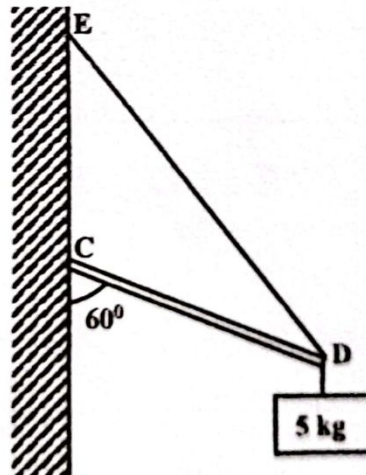
(05 marks)

6. The numbers $x = 2.5$ and $y = 20$ are rounded off with a relative error of 0.004 and a percentage error of 1 respectively. Given that $z = 2.0$ with an absolute error of 0.02; find the maximum value of $\frac{x-y}{z}$. (05 marks)
7. Particles P and Q are in space at the same horizontal level and 60 m apart. P was projected vertically upwards with a speed of 40 ms^{-1} . Seven seconds later, Q was also projected vertically upwards with a speed of 30 ms^{-1} . Find the distance between the particles after 2 seconds of Q's motion. (Take $g = 10 \text{ ms}^{-2}$) (05 marks)
8. IF $X \sim B(20, P)$ and $E(X) = 3$, find the;
 (i) $\text{Var}(X)$. (04 marks)
 (ii) $P(X=9)$. (01 mark)

SECTION B (60 MARKS)

Attempt any five questions from this section.

9. A uniform beam CD of weight 100 N and length 12 m is freely hinged to a vertical wall at point C. A load of mass 5 kg is hang from the beam at end D. The beam rests in equilibrium inclined at 60° to the downward vertical by means of a light inelastic string attached to end D and point E, which is 12 m vertically above C as shown below.



- (a) Find the tension in the string. (04 marks)
 (b) Determine the reaction at the hinge C. (08 marks)

- ✓ 10. The table shows the marks on a scale of 80; obtained by students of a certain school in a certain class.

marks	40-	45-	50-	55-	60-	70-	80-
Number of students	4	13	17	44	59	7	0

- (a) Construct a histogram and use it to estimate the modal mark.
- (b) Calculate the
- (i) standard deviation.
 - (ii) highest percentage mark exceeded by the best 15 students.

(12 marks)

- ✓ 11. (a) A wooden block of mass 112 kg is dragged across a rough horizontal floor by a force F N inclined at 30° above the floor at a uniform speed. If the coefficient of friction between block and floor is $\frac{2}{7}$,

Find the;

- (i) value of F . **(03 marks)**
- (ii) work done by the dragging force in moving the block through 5.5 m under the above conditions. **(02 marks)**

- (b) A vehicle of mass 1200 kg tows a trailer of mass 250 kg up along an incline of inclination $\arcsin\left(\frac{1}{49}\right)$ above the horizontal. If the engine of the car is working at a constant rate of 4.2 kw and that the resistance to motion of the car is four times that of the trailer, find the;

- (i) resistance to motion of the car when it is moving with a steady speed of 12 ms^{-1} . **(05 marks)**
- (ii) tension in the tow bar. **(02 marks)**

12. (a) Show that the Newton-Raphson's iterative formula for finding the fourth root of the reciprocal of a number N is given by;

$$x_{r+1} = \frac{1}{4}(5x_r - Nx_r^5); r = 0, 1, 2, 3, \dots$$

- (b) Draw a flow chart that;

- (i) Reads the initial approximation x_0 and N .
- (ii) Computes and prints N and the fourth root of its reciprocal correct to 2 decimal places.
- (iii) Perform a dry run for $N = 10.0$ and $x_0 = 0.6$ **(12 marks)**

13. Two ships A and B had the following displacements and velocities at given times as shown in the table below.

Ship	Velocity(v)	displacement (r)	Time
A	$(i+2j) \text{ kmh}^{-1}$	$(i+3j) \text{ km}$	1200 hrs
B	$(5i+6j) \text{ kmh}^{-1}$	$(i+2j) \text{ km}$	1300 hrs

Assuming that ships maintained their velocities,

- (a) At what time were the ships closest to each other?
- (b) (i) Calculate the minimum distance separation of the ships during their ensuing motion.
- (ii) If the passengers in the ships could see each other at a ships' separation not exceeding 2.5 km, find the length of time for which the passengers of ships A and B were within the sight of each other.

(12 marks)

- ✓14. The probability density function of a continuous random variable X is given by;

$$f(x) = \begin{cases} kx(a-x) & ; 0 < x < 2 \\ 0 & ; elsewhere \end{cases} \quad \text{where } a \text{ and } k \text{ are constants.}$$

- (a) Show that $k = \frac{3}{2(3a-4)}$
- (b) Given that $E(X) = 1$, find the values of a and k
- (c) Find the mode **(12 marks)**

15. The table below shows the marks scored by 10 A-level students in Mathematics paper 1 and Paper 2 in an examination.

Students	A	B	C	D	E	F	G	H	I	J
Paper 1	35 2.5	26 6.5 ✓	33 4	20 10	40 1	35 2.5	24 8	23 9	26 6.5 ✓	30 5
Paper 2	23 8.5	25 5	24 6.5	28 2	23 8.5	27 3	21 10	33 1	24 6.5	26 4

- (a) (i) Draw a scatter diagram to represent the above information.

(03 marks)

- (ii) Draw a line of best fit and use it to estimate the marks scored by a student in paper 2 if he scored 21 in paper 1. (03 marks)

- (b) Calculate the rank correlation coefficient between paper 1 and 2 and hence comment on your answer at 1% level of significance.

(06 marks)

16. (a) Draw a graph of $y = \tan x - \log_2(e^{0.2x})$ from $x=2$ to $x=4$.

(03 marks)

- (b) Using trapezium rule with 5 ordinates estimate the area enclosed between the curve $y = \tan x - \log_2(e^{0.2x})$, x-axis and the lines $x=2$ and $x=4$, correct to 1 decimal places. (05 marks)

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- (c) (i) Find the exact value of $\int [\tan x - \log_2(e^{0.2x})] dx$, and

2 hence calculate the percentage error in your estimation in (b) above correct to 1 decimal place.

(04 marks)

- (ii) Suggest how the error in your estimation in (b) above can be minimized. (01 mark)

END