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 ms^{-2}** *unless otherwise.*

SECTION A (40 MARKS)

*Attempt **all** questions in this section.*

1. The system of Forces of (2$\boldsymbol{i}$+b$\boldsymbol{j}$) N and (b$\boldsymbol{i}-a\boldsymbol{j}$) N acting through points with position vectors (-2$\boldsymbol{i}-2\boldsymbol{j}$) m and (3$\boldsymbol{i}-c\boldsymbol{j}$) 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 $P(\text{AUB}^{\text{I}})$.

(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 $\frac{x-y}{z}$. ***(05marks)***

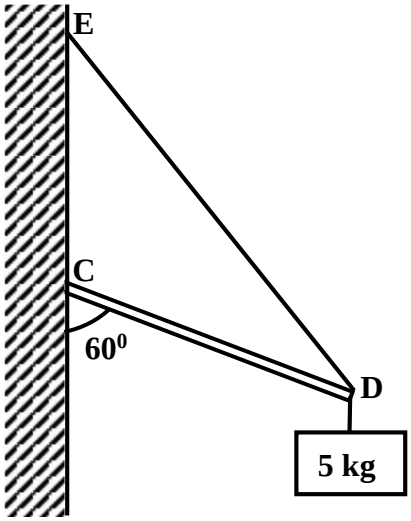
7. Particles P and Q are in space at the same horizontal level and 60 m apart. P was projected vertically upwards with a speed of 40 ms^{-1}. Seven second later, Q was also projected vertically upwards with a speed of 30 ms^{-1}. Find the distance between the particles after 2 seconds of Q's motion. (Take g=10ms^{-2}) ***(05 marks)***

8. IF $X \sim B(20,P)$ and $E(X)=3$, find the;
   (i) 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 60^0 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 30^0 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 $\text{arcsine}\left(\frac{1}{49}\right)$ 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;

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

(b) Draw a flow chart that;

(i) Reads the initial approximation x_o 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**+2**j**) kmh^{-1}	(**i**+3**j**) km	1200 hrs
B	(5**i**+6**j**) kmh^{-1}	(**i**+2**j**) 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;

$$f(x) = \begin{cases} kx(a-x) & ; \quad 0 < x < 2 \\ 0 & ; elsewhere \end{cases}$$ where *a* and k 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	26	33	20	40	35	24	23	26	30
Paper 2	23	25	24	28	23	27	21	33	24	26

(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 $y=tanx - \log_2(e^{0.2x})$ from $x=2$ to $x=4$.

(03 marks)

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

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