

P425/2

APPLIED MATHEMATICS

PAPER 2

JULY/AUGUST 2022

3 HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

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INSTRUCTIONS TO CANDIDATES

- Attempt **all** the eight questions in **Section A** and **only five** from **Section B**
- Any additional question(s) answered will not be marked.
- All necessary working must be clearly shown.
- Begin each new solution on a fresh page.
- Silent non programmable scientific calculators and mathematical tables with a list of formulae may be used.
- Graph papers will be provided where necessary.
- In numerical work take acceleration due to gravity (g) to be 9.8 ms^{-2}

SECTION A (40 Marks)

Attempt **all** questions in this section

1. A particle A of mass 9kg slides from rest down a smooth inclined plane at $\sin\alpha = \frac{1}{3}$ above the horizontal. After 3 seconds, it collides with particle B of mass 4kg which is sliding down the plane at 2ms^{-1} . If the two collide and coalesce, determine the velocity of A before collision and the common velocity after collision.

(05 marks)

2. A student travels to school by route A or route B. The probability of using route A is 0.3, The probabilities of being late for school are $\frac{2}{3}$ and $\frac{1}{3}$ for A and B respectively. Determine the probability of:

(a) Being late.

(b) Using route B, given will be early.

(05 marks)

3. A continuous function $f(x)$ had experimental values from x values that were as follows.

x	1	1.5	2	2.5	3
$f(x)$	8.01	6.02	4.69	3.80	3.27

Use either linear interpolation or extrapolation to estimate;

(a) x when $f(x) = 5$

(b) $f(x)$ when $x = 3.5$

(05 marks)

4. A uniform rod AB of length 10m and mass 5kg has masses of 4kg and 3kg suspended at ends A and B respectively so as to keep the rod in a horizontal position. Determine the:

(a) Reaction

(b) Distance from B the reaction is acting so as to keep the rod resting horizontally.

(05 marks)

5. X is B (n, p) with mean of 10 and standard deviation of 3. Find the values of:

(a) Probabilities p and q .

(b) Number, n .

(05 marks)

6. Use the trapezium rule to estimate $\int_1^6 x \ln x \, dx$ with six strips correct to 3 decimal places.

(05 marks)

7. The table below shows the items consumed by a certain family in year 2020 and 2021

Item	2020		2021	
	Price	Quantity	Price	Quantity
Rice	3,500	20	4,000	30
Millet	3,800	10	4,200	10
Beans	2,000	5	2,800	7

Using 2020 as the base year:

(a) Calculate the weighted aggregate price index.

(b) Estimate the price of miscellaneous commodities in 2021 if their price in 2020 was shs. 4,500.

(05 marks)

8. A particle of mass 5kg lies on a smooth plane of inclination 1 in 5 and is attached to one end of a light inextensible string passing over a smooth pulley at the vertex of the plane to a mass of 4kg hanging vertically downwards. Determine the common acceleration. **(05 marks)**

SECTION B (60 Marks)

Attempt **only five** questions in this section

All questions carry equal marks

9. The random variable X has probability density function that is as follows.

$$P(X = x) = \begin{cases} kx & ; x = 1, 2, 3 \\ k(8 - x) & ; x = 4, 5, 6 \\ 0 & ; \text{Otherwise} \end{cases}$$

Determine the:

(a) value of the constant k

(b) Mean $E(X)$ and Variance ($\text{Var}(X)$)

(c) $P(X \geq 2/X < 5)$

(12 marks)

10. A particle A is projected upward from a cliff 60m above the ground with velocity of 20ms^{-1} at 30° to the horizontal. At the same time a particle B is projected from the ground upwards towards A at 30° to the horizontal. A and B collide at 60m above the ground level. Find the:

- (a) Time taken for collision to occur and initial speed of B.
(b) Horizontal distance between the points of projection of the two objects.

(12 marks)

11. (a) Given that $x = 5$, $y = 14$ and $z = 8$, all measured to the nearest integers in the expression $\frac{xyz}{(x+y)}$, find the maximum value and the minimum value hence state the interval within which it lies.

- (b) The volume (V) of a cylinder of radius (r) and height (h) is $V = \pi r^2 h$, where $r = 28.5 \pm 0.05$, $h = 12.3 \pm 0.05$ and π is a constant. Find the percentage error in the volume.

(12 marks)

12. The data below represents the marks and their respective number of students obtained in principal mathematics class of a certain school.

Marks	Number of students
0 - < 15	6
15 - < 30	8
30 - < 35	15
35 - < 40	20
40 - < 55	10
55 - < 65	7
65 - < 75	4

- (a) Calculate the mean and variance.
(b) Construct an Ogive and use it to estimate the:
(i) Median
(ii) Interquartile range

(12 mark)

13. At noon particles P and Q have the following position and velocity vectors are as indicated below.

Particles	Position vectors	Velocity vectors
P	$(10\mathbf{i} + 5\mathbf{j} + 8\mathbf{k})\text{m}$	$(-2\mathbf{i} + 4\mathbf{j} - \mathbf{k})\text{ms}^{-1}$
Q	$(2\mathbf{i} - \mathbf{j} + 6\mathbf{k})\text{m}$	$(2\mathbf{i} + 7\mathbf{j})\text{ms}^{-1}$

- (a) Determine the displacement of Q relative to P at any time (t) seconds.
 (b) If P and Q collide, find the time and position of collision.
14. (a) Draw the curves $y = e^x$ and $y = 4 - x^2$ on the same axes and show that there is a root between $x = 0.5$ and $x = 2$, correct the initial approximation (x_0) to 1 decimal place.

(b) Using the initial approximation (x_0) from the above graph and the Newton Raphson method, find the root correct it to 3 decimal places.

(12 marks)

15. Given that X is a continuous random variable which is normally distributed with mean μ and standard deviation σ such that $P(X < 30) = 0.4$ and $P(30 < X < 50) = 0.3$. Find the:
- (a) Values of mean μ and standard deviation σ
 (b) Percentage of P ($X > 40$)

(12 marks)

16. A block of weight 20N rests on a rough plane of inclination 30° to the horizontal. If the coefficient of friction is 0.25, find the;
- (a) Horizontal force required to prevent the block from slipping down the plane.
 (b) Force at an angle of 20° to the line for greatest slope required to make it is just about to slide up the plane.

(12 marks)

END