

P425/2  
Applied Mathematics  
Paper 2  
July - August, 2023  
3 hours



UGANDA MUSLIM TEACHERS' ASSOCIATION  
UMTA JOINT MOCK EXAMINATIONS 2023  
UGANDA ADVANCED CERTIFICATE OF EDUCATION  
Applied Mathematics  
Paper 2  
3 hours

**INSTRUCTIONS:**

- Answer **all** the eight questions in section A and any five from section B.
- Any additional question(s) answered will **not** be marked.
- All necessary working **must** be shown clearly.
- Begin each number on a fresh sheet of paper.
- Graph paper is provided.
- Silent, non-programmable scientific calculators and mathematical table with a list of formulae may be used.
- In numerical work, take acceleration due to gravity  $g$ , to be  $9.8\text{ms}^{-2}$

Include the allocation table on your answer sheet

Question	Marks
<b>Section A</b>	
9	
10	
11	
12	
13	
14	
15	
16	
<b>Total</b>	



**Section A (40 MARKS)**

1. A body of mass 50kg is acted upon by two forces **P** and **Q**, where **P** acts in the direction  $030^\circ$ , whereas **Q** acts due south. Given that their resultant has magnitude **12N**, acting due East, calculate the magnitudes of **P** and **Q**. (05 marks)
2. During inter-house competitions at a certain primary school, a football tournament of eight houses produced the following data.

House	A	B	C	D	E	F	G	H
Position	1	2	3	4	5	6	7	8
Number of spectators per house	270	290	90	160	240	150	120	220

Calculate the coefficient of rank correlation between position in the tournament and number of spectators. Comment on your result at 5% level of significance. (05marks)

3. An electronic weighing scale is corrupted such that the actual weights of 24g and 54g are recorded as 35g and 60g respectively. Estimate the;
- Weight which is recorded accurately.
  - Weight which the scale records when it is unloaded. (05marks)
4. The table below shows the probability distribution of a discrete random variable **X**

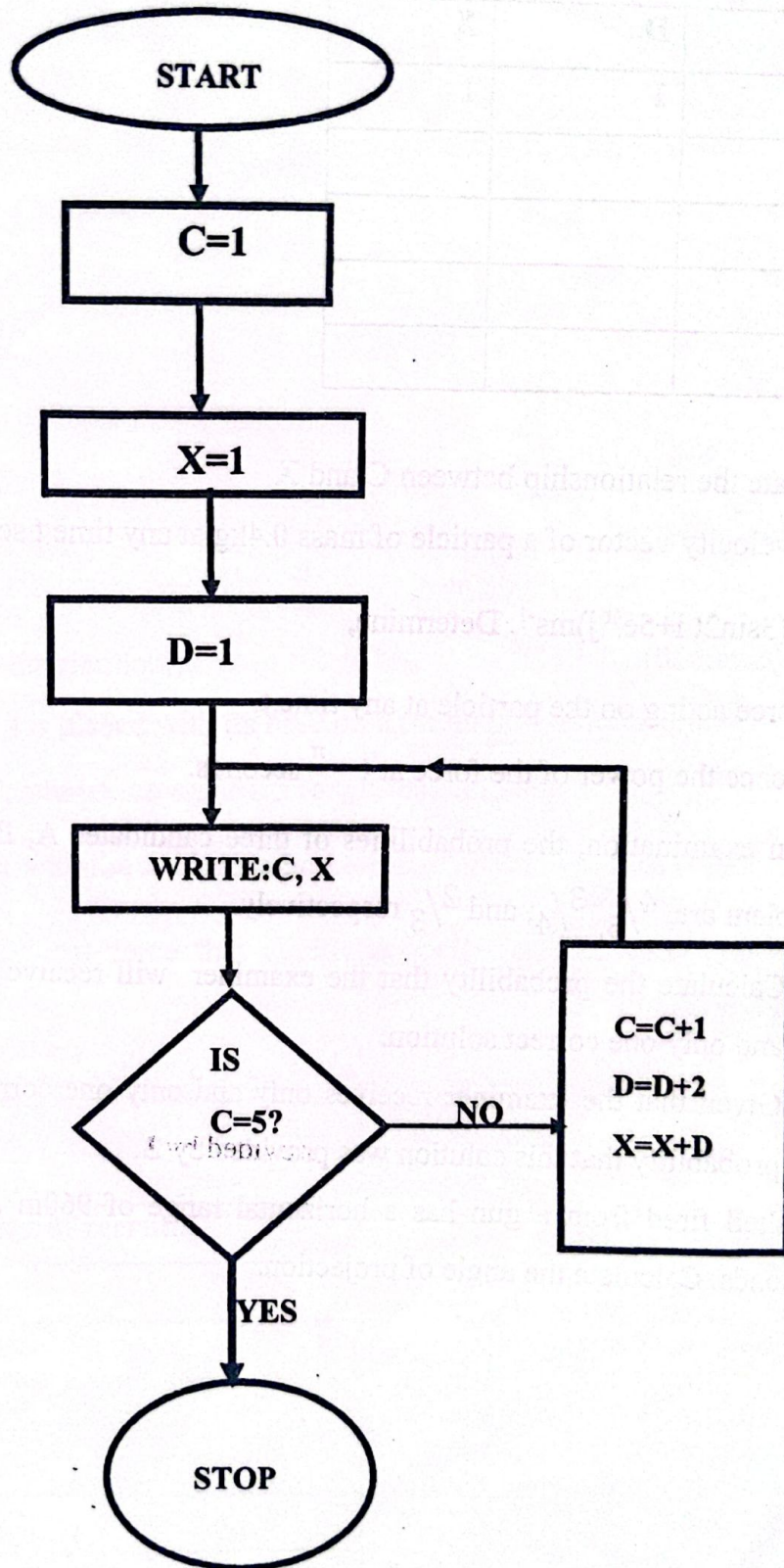
x	0	1	2	3
P(X=x)	c	$c^2$	$c^2+c$	$3c^2+2c$

Calculate,

- Value of the c (02marks)
- $E(5X-2)$  (03marks)



5. Study the flow chart below and answer the questions that follow.





a) Copy and complete the table below.

C	D	X
1	1	1

(04 marks)

b) State the relationship between C and X

(01 marks)

6. The velocity vector of a particle of mass 0.4kg at any time  $t$  seconds is given by,

$$\mathbf{V} = (3\sin 2t \mathbf{i} + 5e^{4t} \mathbf{j}) \text{ms}^{-1}. \text{ Determine,}$$

a) force acting on the particle at any time,  $t$ ,

b) hence the power of the force at  $t = \frac{\pi}{4}$  seconds.

(05marks)

7. In an examination, the probabilities of three candidates A, B and C, solving a certain problem are,  $\frac{4}{5}$ ,  $\frac{3}{4}$ , and  $\frac{2}{3}$  respectively.

a) Calculate the probability that the examiner will receive from these candidates one and only one correct solution.

b) Given that the examiner receives only and only one correct solution, determine the probability that this solution was provided by B.

(05marks)

8. A shell fired from a gun has a horizontal range of 960m and a time of flight of 12 seconds. Calculate the angle of projection.

(05marks)



## SECTION B

- Attempt any **five (5)** questions from this section.
- All questions carry equal marks.

9. The continuous random variable  $X$  has a probability density function,  $f(x)$ , where,

$$f(x) = \frac{x}{3} - \frac{2}{3}, \quad 2 \leq X \leq 3$$

$$a, \quad 3 \leq X \leq 5$$

$$2 - bx, \quad 5 \leq X \leq 6$$

0, else where

a) find the values of the constants  $a$  and  $b$ ;

b) hence sketch the graph of  $f(x)$

(06marks)

c) i)  $P(X > 3.4)$

ii) 60<sup>th</sup> percentile of the distribution.

(06marks)

10. A uniform ladder of mass 25kg is placed with its base on a rough horizontal floor

[angle of friction =  $\tan^{-1}(1/5)$ ], and its top against a rough vertical wall

[angle of friction =  $\tan^{-1}(1/3)$ ], with the ladder making an angle of  $61^\circ$  with the floor.

Calculate the maximum horizontal force that could be applied at the base without slipping occurring.

(12marks)

11. The table below shows the height distribution in centimeters of two hundred and fifty army recruits.

Height(cm)	Number of recruits
165-170	18
170-175	37
175-180	60
180-185	65
185-190	48
190-195	22

a) Calculate the mean height

(04marks)



b) Construct a cumulative frequency curve to the data and use it to estimate the 5<sup>th</sup> decile of the distribution. (05marks)

c) The tallest 40% of the recruits are to be formed into a special squad. Using your Ogive in (b), estimate the upper quartile of the heights of the members of the squad (03marks)

12. a) An aircraft has a maximum speed of  $200\text{kmh}^{-1}$  in still air. The pilot of this aircraft wishes to set a course that he can fly from town A to town B, which is 500km from A on a bearing of  $30^\circ$ . There is a wind blowing from the south east at a speed of  $40\text{kmh}^{-1}$ . Determine the course the pilot should set in order for the journey to be successful. (05marks)

b) To a cyclist travelling east along a straight road at a speed of  $15\text{kmh}^{-1}$ , the wind appears to be coming from the direction  $120^\circ$ . When he increases his speed to  $20\text{kmh}^{-1}$ , without altering his direction, the wind appears to be coming from the direction  $11^\circ$ . Determine the velocity of the wind in vector form. (07marks)

13. 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 and find the root of the given equation, correct to two decimal places. (12 marks)

14. Bags of flour packed by a particular machine have masses which are normally distributed with mean 500g and standard deviation 20g. 2% of the bags are rejected for being underweight and 1% of the bags are rejected for being overweight.

a) Between what range of values should the mass of a bag of flour lie if it is to be accepted? (06 marks)

b) In a consignment of 1000 such bags, estimate how many bags will be accepted by a trader basing on the conditions set in (a). (06 marks)



15. a) Use the trapezium rule with seven ordinates to estimate,

$$\int_0^{\pi} x \sin x dx, \quad \text{correct to 2dps}$$

(06 marks)

b) Determine the percentage error in your estimation. Suggest how this error may be reduced.  
(06 marks)

16. An inelastic pile driver of mass 4000kg falls freely from a height of 5m onto a pile of mass 1000kg driving the pile 20cm into the ground. Find the;

a) Speed with which the pile starts to move into the ground. (07marks)

b) Average resistance to penetration of the ground, assumed uniform. (05marks)

END

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