

P425/2
APPLIED
MATHEMATICS
Paper 2
Jul. / Aug. 2022
3 hours



“Together for Mathematics”

SECONDARY MATHEMATICS TEACHERS' ASSOCIATION
SMATA JOINT MOCK EXAMINATIONS 2022
Uganda Advanced Certificate of Education
APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer **all** the **eight** questions in Section **A** and only **four** questions in Section **B**.

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

All working must be shown clearly.

Begin each answer on a **fresh** sheet of paper.

Graph paper is provided.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

Where necessary, take acceleration due to gravity, **$g = 9.8 \text{ ms}^{-2}$**

Answer **all** questions in this Section

1. A body of mass 3kg and velocity $(8\mathbf{i} + 7\mathbf{j})\text{ms}^{-1}$ collides with another body of mass 5kg and velocity $(2\mathbf{i} - 5\mathbf{j})\text{ms}^{-1}$. If the bodies collide after impact. Find the kinetic energy after collision. **(05 marks)**
2. Given that $X \sim N(\mu, 2.5)$ and that $P(X > 3.5) = 0.970$. Find the value of μ . **(05 marks)**
3. In a study of population density **P** and the distance of the suburb from the centre of the town **D** are related as below.

SUBURB	A	B	C	D	E	F	G	H
Population density(P)	55	11	68	38	46	43	21	25
Distance(D)	0.7	3.8	1.7	2.6	1.5	2.6	3.4	1.9

Calculate a coefficient of rank correlation between P and D and comment at the relationship based on **1%** level of significance.

(05 marks)

4. The velocity of a particle of mass 0.4kg at a time t seconds is $V = (3\sin 2t \mathbf{i} + 5e^{4t} \mathbf{j})\text{ms}^{-1}$. Find the power generated after 2 seconds. **(05 marks)**
5. Given that **P** and **Q** are real numbers, write down an expression for the relative error in the product hence find the relative error if **P** = 2.01 and **Q** = - 4.0. **(05 marks)**
6. Events **A** and **B** are such that $P(A) = \frac{2}{5}$, $P(B^I/A) = \frac{3}{4}$ and $P(B/A^I) = \frac{1}{3}$.
Calculate: (i) $P(A \cap B)$
(ii) $P(B)$ **(05 marks)**
7. A particle of mass 4kgs rest on a rough inclined plane at 30° to the horizontal. The particle is supported by a light inextensible string which is at 20° to the plane and the particle is about to slide down the slope. Find the tension in the string. **(05 marks)**

8. The prices of some organic products in these months of March and June 2022 varied as shown in the table below.

Item	Price/litre		Quantity in litres
	March	June	
Diesel	3500	6475	3
Petrol	4000	6960	4
Paraffin	4500	4950	3
Butto	5600	9800	2

Calculate the price relative for each item hence the average weighted index number for June using March as the base year. **(05 marks)**

SECTION B (60 MARKS)

*Attempt any **five** questions from this section.*

9. The continuous random variable X has a p.d.f given by

$$f(x) = \begin{cases} ax & 1 < x < 3 \\ c(4 - x) & 3 \leq x < 4 \\ 0 & \text{otherwise} \end{cases}$$

Where a and c are constants.

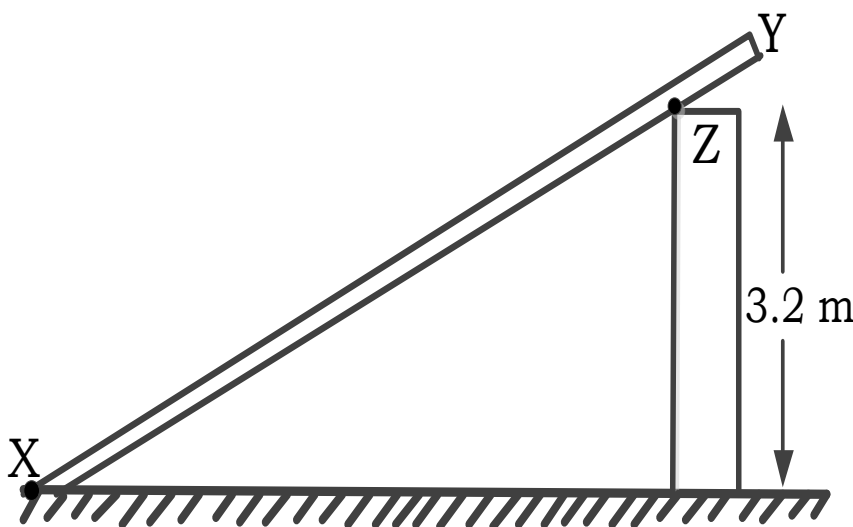
- (a) Determine the; (i) value of a and c . **(05 marks)**
(ii) Median. **(03 marks)**
(b) Work out the cumulative distribution function $F(x)$. **(04 marks)**

10. Particles P and Q start at points with position vectors $(2\mathbf{i} + \mathbf{j})m$ and $(3\mathbf{i} + 4\mathbf{j})m$ respectively. They have constant velocities of $(-\mathbf{i} + 2\mathbf{j})ms^{-1}$ and $(a\mathbf{i} + b\mathbf{j})ms^{-1}$ respectively.

- (a) Show that, if the particles are to collide at the same time after the start; $b - 3a = 5$
(b) If $a = -2$ and $b = 2$, find the time which elapses before the particles are at their point of closest approach. **(12 marks)**

11. (a) Use the trapezium rule to estimate the area of $y = 4^{3x}$ between the x – axis, $x = 0$ and $x = 1$ using 7 ordinates, correct your answer to **3** decimal places.
- (b) Find the exact value of $\int_0^1 4^{3x} dx$
- (c) Determine the absolute error in the two calculations in **(a)** and **(b)** above. **(12 marks)**

12. The diagram below shows a uniform wooden plank XY of mass 80kg and length 5m. The end X rests on a rough horizontal ground. The plank is in contact with the top of a rough pillar at Z. The height of the pillar is 3.2 m, $XZ = 4.5\text{m}$ and $XY = 6.0\text{ m}$.

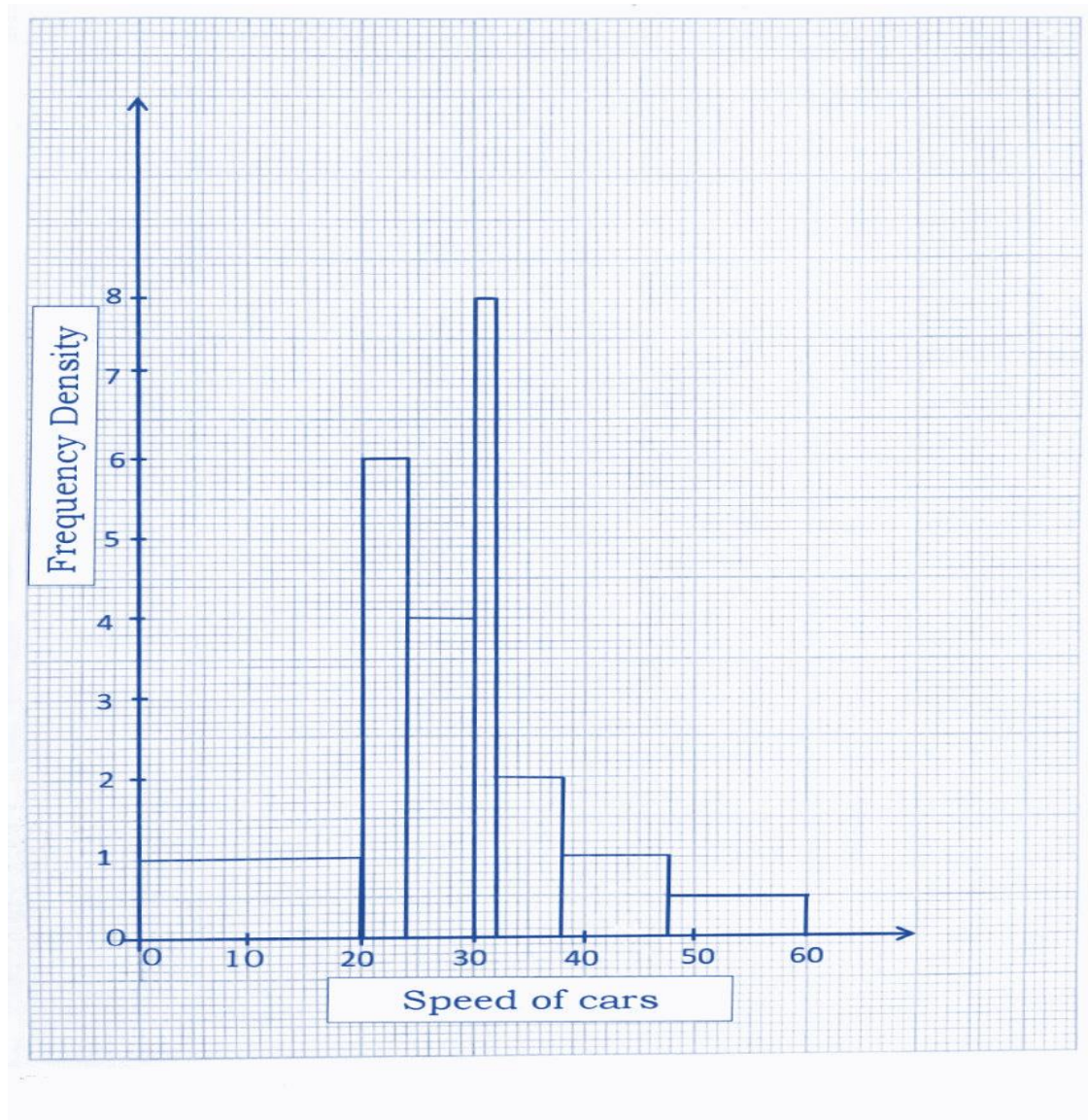


Given that the coefficient of friction of the ground is 0.5 and the plank is just about slip. Find the;

- (a) angle the plank makes with the ground at X.
- (b) normal reaction at X.
- (c) coefficient of friction at Z. **(12 marks)**

13. (a) A factory has 3 machines making large numbers of components. 10% of the components made by machine I are faulty. The corresponding figures for machines II and III are 5% and 1% respectively. The proportion of the total output produced by the machines I, II and III are 50%, 30% and 20% respectively. A randomly selected component is found not to be faulty find the probability that it was made by machine I. **(05 marks)**
- (b) Chelsea football club had three games to play; Carabao Premier and Champions in a week. The probability of winning Carabao is 0.6, and for Premier and Champions are 0.75 and 0.4 respectively. If X is defined as the random variable “the number of games won”, construct a probability distribution table for X hence find $E(x)$. **(07 marks)**
14. Forces of magnitude **3N**, **4N**, **5N**, **3N** and **4N** act along \overrightarrow{OP} , \overrightarrow{PQ} , \overrightarrow{QR} , \overrightarrow{RP} and \overrightarrow{OQ} respectively of a square **OPQR** whose sides have a length 1 units. The directions of the forces are indicated by the order of the letters.
- (a) Find the magnitude and direction of the resultant force.
- (b) If the line of action of the resultant force cuts **OP** produced at **S**, find the length of **OS**. **(12 marks)**
15. (a) (i) Show that the equation $\sin x = \ln x$ has a root in the interval between $x = 2$ and $x = 3$.
- (ii) Use linear interpolation to estimate the initial approximation x_0 to the root.
- (b) Derive the iterative formula based on NRM and use it to work out the root of the equation in (a) using x_0 in a(ii). Correct your answer to 3 decimal places. **(12marks)**

16. The histogram below represents the speeds of cars passing 30 miles per hour sign post.



- (a) Use the graph to estimate the modal speed.
- (b) Form the frequency distribution table and use it to calculate the;
- (i) mean
 - (ii) median
 - (iii) number of cars with speed less than 31 miles per hour.

(12 marks)

END