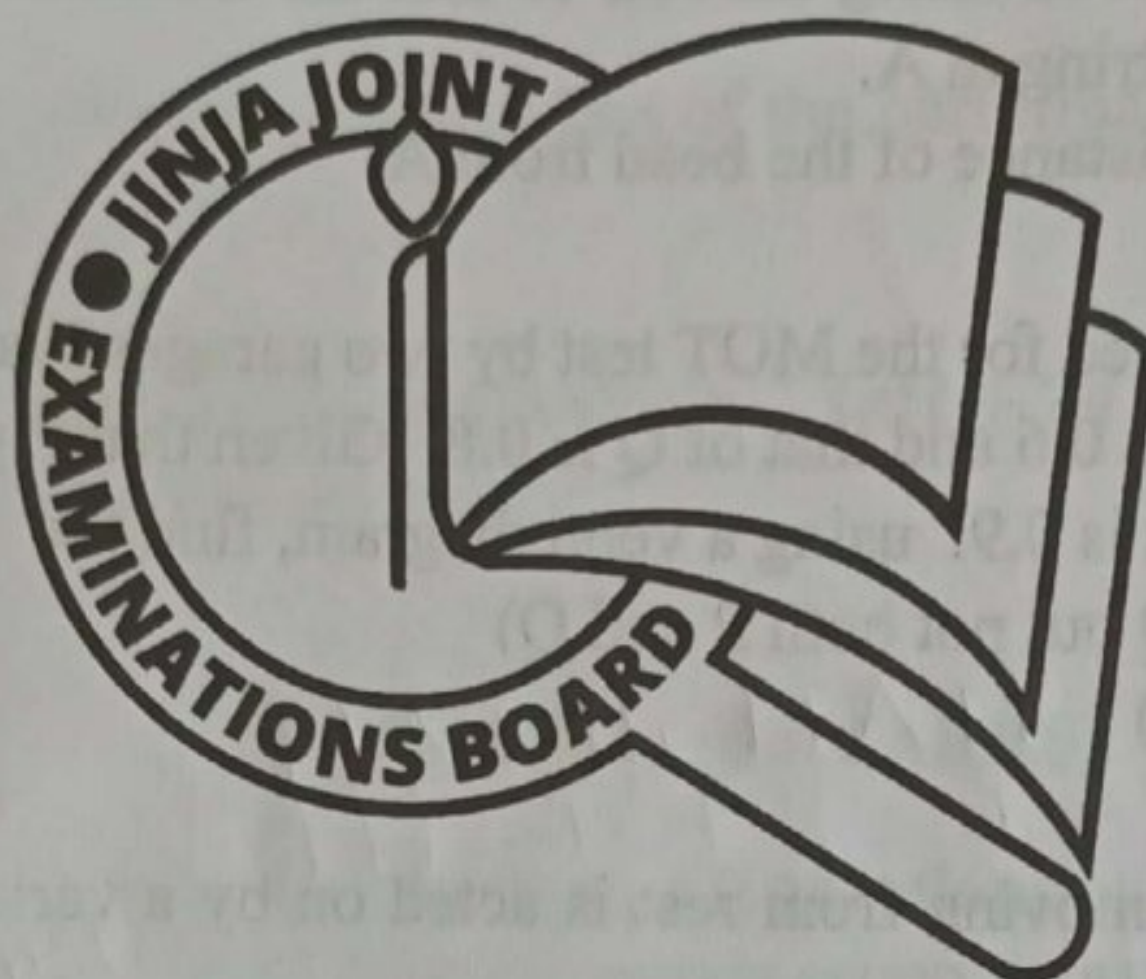


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PURE MATHEMATICS

AUGUST - 2022

3 HOURS



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST, 2022

PURE MATHEMATICS

Paper 1

3 HOURS

INSTRUCTIONS TO CANDIDATES

Answer all questions in section A and any five from section B.

Any additional question(s) will not be marked.

All working must be shown clearly.

Begin each question on a fresh sheet of paper.

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

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SECTION A: (40 MARKS)
ANSWER ALL THE QUESTION IN THIS SECTION

1. A uniform rod AB of length 4m and weight 20N hangs in equilibrium in a horizontal position supported by two vertical inextensible strings at A and B. If a bead of weight 16N is now moved along the rod so that the tension in the string at B is twice the tension in the string at A.
 Calculate the distance of the bead from A. (05 marks)

2. A car is examined for the MOT test by two garages P and Q. The probability that P passes the car is 0.6 and that of Q is 0.8. Given that P passes the car, the probability that Q passes it is 0.9. using a venn diagram, find the
 (i) $P(P \text{ or } Q \text{ but not both } P \text{ and } Q)$ (03 marks)
 (ii) $P(P / Q)$ (02 marks)

3. A body freely moving from rest is acted on by a variable force, F as shown in the table below;

| | | | | | | | |
|--------------|-----|-----|----|----|------|------|-----|
| Distance (m) | 0 | 4 | 10 | 15 | 20 | 25 | 31 |
| Force (N) | 5.0 | 8.0 | 11 | 12 | 13.6 | 10.5 | 5.0 |

Using linear interpolation / extrapolation determine the;

- (a) Distance when a force of 12.8N is acted on the body (03 marks)
 (b) Force when the body has travelled a distance of 34.7m (02 marks)
4. The driver of a train moving Eastwards at a velocity of 100ms^{-1} sights a car moving North – Eastwards at a velocity of 60ms^{-1} . Calculate the;
 (i) relative velocity of the car to the train. (03 marks)
 (ii) direction of the car relative to the train (02 marks)
5. In a certain town, 46% of the population are under 30 years of age. If a random sample of 100 people is taken, find the probability that less than half of the people in the sample are under 30 years. (05 marks)

6. Use the trapezium rule with four sub – intervals to estimate the

$$\int_0^{\frac{\pi}{3}} e^x \cos x \, dx$$

Correct to 3 significant figures

(05 marks)

7. The marks scored by 8 students in chemistry (x) and mathematics (y) are given below;

| | | | | | | | | |
|---------------------|----|----|----|----|----|----|----|----|
| Chemistry (x) | 55 | 42 | 37 | 59 | 38 | 48 | 56 | 48 |
| Mathematics (y) | 60 | 48 | 41 | 63 | 35 | 39 | 51 | 55 |

Calculate the rank correlation coefficient of the performance of the students in the two subjects. (05 marks)

8. A particle of mass 2kg moves with velocity $(e^t \mathbf{i} + 2e^{-2t} \mathbf{j} - \sin k) \text{ ms}^{-1}$. Find the power developed after 4 seconds. (05 marks)

SECTION B: (60 MARKS)

Answer any five questions from this section. All questions carry equal marks.

9. The marks of all the candidates from a certain school in a national examination were normally distributed with a mean of 52% and standard deviation of 16%. The lowest mark for a distinction in the examination was 68%.

- (a) (i) determine the number of candidates in the school given that 20 candidates scored below 40%. (04 marks)
 (ii) calculate the number of candidates who got distinctions (03 marks)
 (b) If sixteen candidates in the examination were picked at random, find the probability that their mean score was between 46% and 58%. (05 marks)

10. (a) Derive the equation of the path of a particle projected from 0 at angle α to the horizontal with initial speed $u \text{ ms}^{-1}$ (06 marks)

- (b) A particle projected from point A with speed 30 ms^{-1} at an angle of elevation θ , hits the ground again at B at the same level as A. If before landing the particle just clears the top of a tree which is at a horizontal distance of 72m from A, the top of the tree being 9m above the level AB.

Calculate the possible angles of projection. (Use $g = 10 \text{ ms}^{-2}$)

(06 marks)

11. (a) (i) On the same axes, draw graphs of $y = x^2$ and $y = \sin x$ for $0 \leq x \leq \frac{\pi}{2}$ at intervals of $\frac{\pi}{8}$.

- (ii) From your graphs, obtain to one decimal place an approximate root of the equation $x^2 - \sin x = 0$ (06 marks)

- (b) Using Newton – Raphson method, find the root of the equation $x^2 - \sin x = 0$, taking the approximate root in (a) (i) as an initial approximation. Given your answer correct to 3 decimal places. (06 marks)

12. A body moving with acceleration $\mathbf{a} = e^{-2t}\mathbf{i} - 2\cos t\mathbf{j} + 4\sin 2t\mathbf{k}$ is initially located at point $(2, -1, 4)$ and has a velocity $\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$. Find the
- (a) velocity of the body at any time t , (04 marks)
 - (b) speed of the body at time $t = \frac{\pi}{2}$ (03 marks)
 - (c) displacement of the body at any time t . (05 marks)

13. The table below shows the heights (in cm) of a senior six science class of a certain school.

| Height (cm) | Frequency |
|-------------|-----------|
| 147 – 156 | 12 |
| 157 – 161 | 8 |
| 162 – 166 | 8 |
| 167 – 171 | 9 |
| 172 – 176 | 7 |
| 177 – 186 | 6 |

- (a) Draw a histogram and use it to estimate the modal height (06 marks)
- (b) Calculate the
 - (i) mean height (03 marks)
 - (ii) standard deviation of the data (03 marks)

14. (a) The dimensions of a rectangular plot are 1.25km and 0.44km. If the length and width have 5% and 4.2% errors respectively, in the estimates. Calculate the limits within which the area of the plot lies correct to two significant figures. (06 marks)
- (b) The number a and b are approximated with possible errors of e_1 and e_2 respectively. Show that the maximum absolute relative error in the quotient $\frac{a^2}{b}$ is given by $2 \left| \frac{e_1}{a} \right| + \left| \frac{e_2}{b} \right|$ (06 marks)

15. A continuous random variable X has a probability density function given by

$$f(x) = \begin{cases} Kx & , \quad 0 \leq x \leq 1 \\ K & , \quad 1 \leq x \leq 4 \\ 0 & , \quad \text{other wise} \end{cases}$$

- (a) Sketch $f(x)$ (03 marks)

(b) Find the

- | | | |
|-------|-------------|------------|
| (i) | value of K | (02 marks) |
| (ii) | mean, | (03 marks) |
| (iii) | median of X | (04 marks) |

16. A particle of mass 2kg moves up a line of greatest slope on a rough plane inclined at 25° to the horizontal. It is attached to a taut inextensible string which makes an angle of 30° with the plane. If the particle moves up the plane with an acceleration of 1.8 ms^{-2} and the tension in the string is 20N,

- (a) calculate the coefficient of friction between the particle and the plane.
(07 marks)
- (b) while the particle is moving up the plane, the string is cut and the particle comes to rest. Show that the particle will remain at rest on the plane.
(05 marks)