

P425/2
APPLIED
MATHEMATICS
Paper 2
July/August, 2023
3 HOURS



MATIGO MOCK EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 HOURS

INSTRUCTIONS TO CANDIDATES:

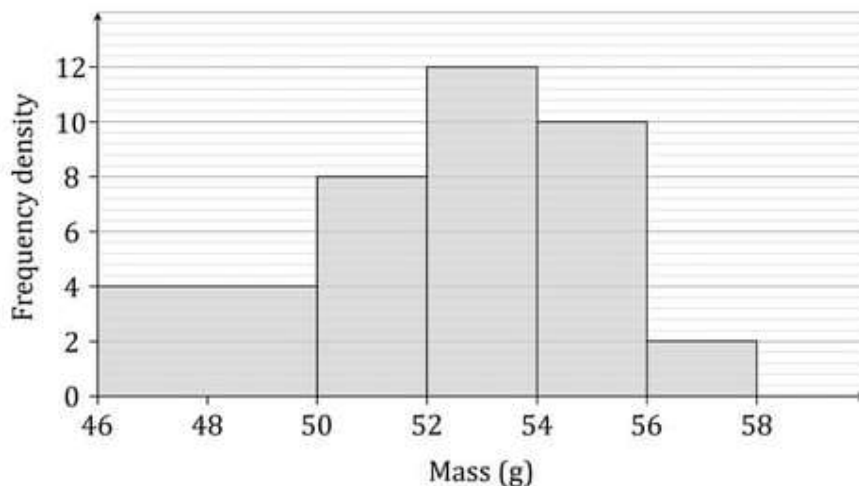
- Answer **all** the **eight** questions in section **A** and any **five** from section **B**.
- Any additional question (s) answered will not be marked
- All necessary working **must** be shown clearly
- Begin each answer on a fresh sheet of paper
- Graph paper is provided
- Silent non-programmable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

Turn Over

SECTION A: (40 MARKS)

Answer all questions in this section

1. The histogram below shows the distribution masses, in grams of 80 newly hatched ducklings.



- (a) Find the probability that a duckling chosen at random has a mass less than **54g** (2 marks)
- (b) Estimate the probability that a duckling chosen has a mass greater than **53g** (3 marks)
2. Car A travelling at **35ms^{-1}** along a straight horizontal road accelerates uniformly at **0.4ms^{-2}** . At the same time, another car B moving at **44ms^{-1}** and accelerating uniformly at **0.5ms^{-2}** , B is **200m** behind A. Find the time taken before car B overtakes car A. (5 marks)
3. The temperature ($^{\circ}\text{C}$) of a room measured at an interval of **2 minutes** were recorded as **55** and **52**. If the initial temperature is **60**. Use linear interpolation or extrapolation to find the
- (a) Temperature after 5 minutes (3 marks)
- (b) Time taken if the temperature is **53.5 $^{\circ}\text{C}$** (2 marks)
4. In an experiment to find the value of π , a student measures the circumference and the diameter of a circle, he measures the circumference, C as **170mm** to the nearest millimeter, he measures the diameter d as **54mm** to the nearest millimeter, he uses $\pi = \frac{C}{d}$ to find the value of π calculate the upper bound and the lower bound for the student's value of π (5 marks)

5. A body of mass **4kg** is moving with an initial velocity of **5ms⁻¹** on a plane. The kinetic energy of the body is reduced by **16 Joules** in a distance of **40m**, find the deceleration of the body (5 marks)
6. A random variable X has probability distribution defined as follows

$$P(X = x) = \begin{cases} kx, & x = 1, 2, 3, 4, 5 \\ 0, & \text{otherwise} \end{cases}$$
 Where k is a constant
 (a) Show that $P(X = 3) = 0.2$ (3 marks)
 (b) Show in a table the values of x and their probabilities (2 marks)
7. The table below shows the scores of eight students for a Math test and an English test
- | | | | | | | | | |
|-------------|---|----|----|----|----|----|----|----|
| Math (x) | 7 | 18 | 37 | 52 | 61 | 68 | 75 | 82 |
| English (y) | 5 | 3 | 9 | 12 | 17 | 41 | 49 | 97 |
- (a) Find the value of spearman's rank correlation for the data and comment on your result at 5% level of significance. (5 marks)
8. Two forces have magnitudes **5N** and **4N** are such that the angle between the two forces is **30°**. Find the resultant force and its direction. (5 marks)

SECTION B: (60 MARKS)

Answer any five questions from this section

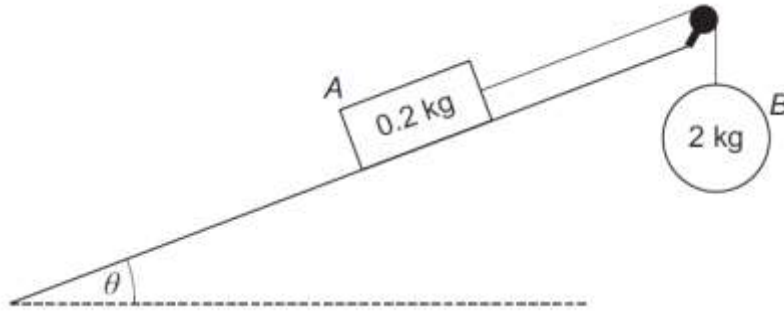
9. The following table shows the time to nearest second recorded for the telephonist to answer the calls received on a certain day.

Time (s)	10-19	20-24	25-29	30	31-34	35-39	40-59
No. of calls	20	20	15	14	16	10	10

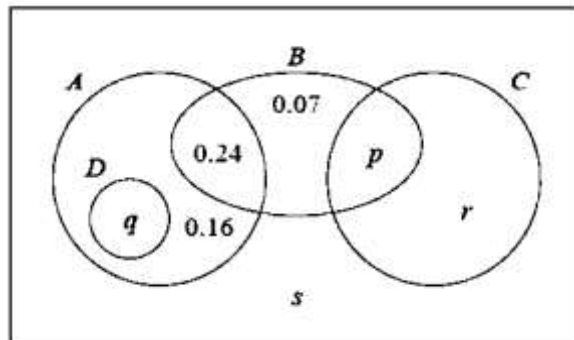
- (a) Draw a histogram to represent this data and use it to estimate the modal time. (6 marks)
- (b) Calculate the
- Mean time (3 marks)
 - Standard deviation (3 marks)

10. Block A, of mass 0.2 kg, lies at rest on a rough plane. The plane is inclined at an angle θ to the horizontal, such that $\tan \theta = \frac{7}{24}$.

A light inextensible string is attached to A and runs parallel to the line of greatest slope until it passes over a smooth fixed pulley at the top of the slope. The other end of this string is attached to particle B, of mass 2 kg, which is held at rest so that the string is taut, as shown in the diagram below.



- (a) B is released from rest so that it begins to move vertically downwards with an acceleration of $\frac{543}{625} \text{ gms}^{-2}$. Show that the coefficient of friction between A and the surface of the inclined plane is **0.17g**. (8 marks)
- (b) When A reaches a speed of 0.5 ms^{-1} the string breaks. Find the distance travelled by A after the string breaks until first coming to rest. (4 marks)
11. (a) The Venn diagram shows the probabilities associated with four events A, B, C and D such that $P(B) = 0.4$, A and B are independent and $P(B^I/C) = 0.64$



Find the values of p, q, r and s (6 marks)

(b) The life time of Techno smartphone batteries, X hours is normally distributed with mean 8 hours and standard deviation 1.5 hours

(i) Find $P(6 < X < 10)$

(ii) Determine the life time exceeded by 90% of Techno smartphone batteries (6 marks)

12. Two yachts P and Q are observed from a coast guard station at 12:00 hours and 13:00 hours respectively. They have the following displacement(S) and velocity (V) $S_1 = (\hat{i} + 3\hat{j})\text{km}$ and $V_1 = (\hat{i} + 2\hat{j})\text{kmhr}^{-1}$ at 12:00 hours.

$S_2 = (\hat{i} + 2\hat{j})\text{km}$ and $V_2 = (5\hat{i} + 6\hat{j})\text{kmhr}^{-1}$ at 13:00 hours, If they continue with the same velocities find the;

- (a) Time taken for the yachts to be closest together (6 marks)
 (b) Smallest distance between the two yachts in the subsequent motion (6 marks)

13. The continuous random variable X has probability density function

$$f(x) = \begin{cases} kx; & 0 \leq x \leq 8 \\ 8k; & 8 \leq x \leq 9 \\ 0; & \text{otherwise} \end{cases}$$

- (a) Find the exact value of k (3marks)
 (b) Sketch the probability density function $f(x)$ (4 marks)
 (c) Find $E(X)$ (5 marks)

14. (a) Show that $x\left(\frac{1}{2} - \sin x\right) = 0$ has a root between $\frac{1}{2}$ and $\frac{3}{5}$ (3 marks)
 (b) Use linear interpolation to find the first approximation x_0 to the correct root of equation in (a) above. Give your answer correct to 3 decimal places (3 marks)
 (c) Using the Newton Raphson iterative method, Find the root of the equation in (a) to 3 decimal places using the first approximation in (b) (6 marks)

15. (a) Use the trapezium rule with six ordinates to estimate

$$\int_1^2 \left(\frac{x}{7x^2 - 3}\right) dx$$

Give your answer correct to 3 significant figures

- (b) (i) Find the exact value of

$$\int_1^2 \left(\frac{x}{7x^2 - 3}\right) dx$$

Correct to 3 significant figures

- (ii) Calculate the percentage error in your calculation in (a) above
 (iii) Suggest how percentage error may be reduced. (12 marks)

16. A light inextensible string has one end attached to a ceiling. The string passes under a smooth movable pulley of mass **2kg** and then over a smooth fixed pulley. Particle of mass **5kg** is attached at the free end of the string, the sections of the strings not in contact with the pulleys are vertical, if the system is released from rest and moves in a vertical plane find the;
- (i) Acceleration of the system
 - (ii) Tension in the string
 - (iii) Distance moved by the movable pulley in 1.5 seconds (12 marks)

END
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