



03002560



EXAMINATIONS COUNCIL OF ZAMBIA



Examination for General Certificate of Education Ordinary Level

Mathematics

4024/2

Paper 2

Friday

11 AUGUST 2023

Additional materials:

- Answer Booklet
- Silent Electronic Calculator (non programmable)
- Geometrical instruments
- Graph paper (3 sheets)
- Plain paper (1 sheet)

Time: 2 hours 30 minutes

Marks: 100

Instructions to Candidates

- Write the **centre number** and your **examination number** on **every page** of the separate **Answer Booklet** provided.
- Write your answers and working in the separate **Answer Booklet** provided.
- If you use more than one Answer Booklet, fasten the Answer Booklets together.
- Omission of essential working will result in loss of marks.
- There are **twelve** questions in this paper.
 - Section A**
Answer **all** questions.
 - Section B**
Answer any **four** questions.
- Silent non programmable Calculators** may be used.

Information for Candidates

- The number of marks is given in brackets [] at the end of each question or part question.
- If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
- Cell phones are **not allowed** in the examination room.

Mathematical Formulae

1 ALGEBRA

Quadratic Equation

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2 SERIES

Geometric Progression

$$S_n = \frac{a(1-r^n)}{1-r}, (r < 1)$$

$$S_n = \frac{a(r^n - 1)}{r - 1}, (r > 1)$$

$$S_\infty = \frac{a}{1-r} \text{ for } |r| < 1$$

3 TRIGONOMETRY

Formula for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$\Delta = \frac{1}{2} bc \sin A$$

4 STATISTICS

Mean and standard deviation

Ungrouped data

$$\text{Mean } (\bar{x}) = \frac{\sum x}{n}, \text{SD} = \sqrt{\left\{ \frac{\sum (x - \bar{x})^2}{n} \right\}} = \sqrt{\left\{ \frac{\sum x^2}{n} - (\bar{x})^2 \right\}}$$

Grouped data

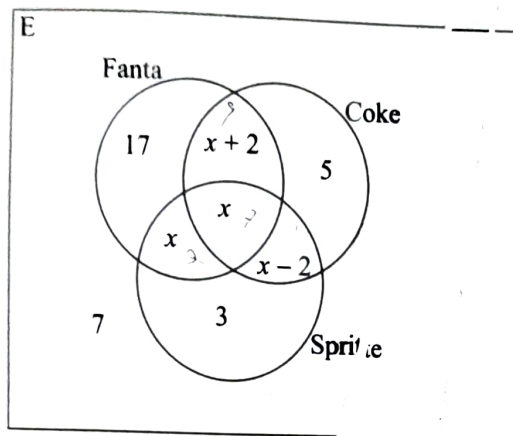
$$\text{Mean } (\bar{x}) = \frac{\sum fx}{\sum f}, \text{SD} = \sqrt{\left\{ \frac{\sum f(x - \bar{x})^2}{\sum f} \right\}} = \sqrt{\left\{ \frac{\sum fx^2}{\sum f} - (\bar{x})^2 \right\}}$$

13
4
5
5

Section A (52 Marks)

Answer all questions in this section

- 1 (a) Simplify $\frac{13a^3}{28a^2b^2} + \frac{65a^4b}{56a^2b^4}$. [2]
- (b) Learners in a Grade 10 class were asked the types of drinks they liked. The Venn diagram shows their responses.



- (i) Given that 40 learners liked 'Fanta, find the value of x . [2]
- (ii) Find the total number of learners in the class. [1]
- (iii) How many learners
- (a) did not like Fanta, [1]
- (b) liked two types of drinks only? [1]
-
- 2 (a) In a geometric progression, the second term is 21 and the fourth term is 189. Calculate the
- (i) first term and the common ratio, [3]
- (ii) sixth term, [2]
- (iii) sum of the first 5 terms of the progression. [2]
- (b) Given that matrix $P = \begin{pmatrix} 7x & -2 \\ -x & 1 \end{pmatrix}$,
- (i) find the value of x for which the determinant of P is -10 , [2]
- (ii) hence, find the inverse of P . [2]
-

- 3 (a) Express $\frac{9}{1-4k} - \frac{8}{1-3k}$ as a single fraction in its simplest form. [3]
- (b) A girl has 7 green apples and 6 red apples in a bag. She picks one apple at random from the bag and eats it. She picks another apple and eats it.
- (i) Draw a tree diagram to illustrate all the possible outcomes. [2]
- (ii) What is the probability that the first apple eaten was green? [3]
-
- 4 (a) (i) Construct a triangle KLM in which $KL = 10\text{cm}$, $LM = 7\text{cm}$ and $\hat{KLM} = 120^\circ$. [1]
- (ii) Measure and write the length KM. [1]
- (b) Within triangle KLM, draw the locus of points which are
- (i) 5.5cm from M, [1]
- (ii) 1cm from LM, [1]
- (iii) equidistant from M and L. [2]
- (c) A point P, within triangle KLM, is such that it is less than or equal to 5.5cm from M, greater than or equal to 1cm from LM and nearer to L than M. Indicate clearly, by shading, the region in which P must lie. [2]
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- 5 (a) The program below is given in the form of a pseudocode.

Begin

Enter n

IF $n < 0$ THEN

Display 'error n must be positive'

ELSE $\text{sum} = n/2 * [2*a + (n - 1) * d]$

ENDIF

Display sum

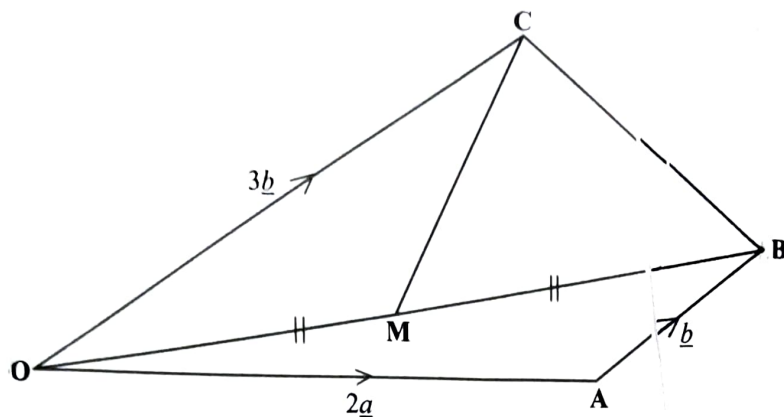
End

Draw a corresponding flowchart for the information given above. [5]

- (b) Solve the equation $8x^2 - 9x + 2 = 0$, giving your answers correct to 2 decimal places. [5]

$$\begin{array}{r} 79 \\ 81 \\ 64 \\ \hline 17 \end{array}$$

- 6 (a) In the diagram, $\vec{OA} = 2\vec{a}$, $\vec{AB} = \vec{b}$, $\vec{OC} = 3\vec{b}$, M is the midpoint of OE and OC is parallel to AB.



Express in terms of \vec{a} and/or \vec{b}

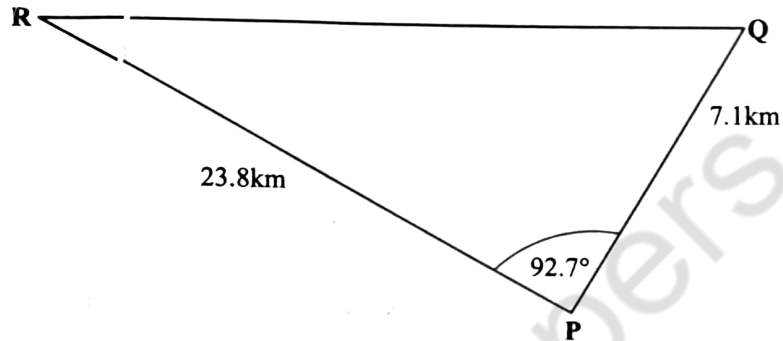
- (i) \vec{OB} , [1]
- (ii) \vec{CB} , [1]
- (iii) \vec{AC} , [1]
- (iv) \vec{CM} . [2]
- (b) The equation of a curve is $y = x^3 - 27x$. Find the coordinates of the turning points of the curve. [3]

Section B [48 marks]

Answer any four questions in this section.

Each question in this section carries 12 marks.

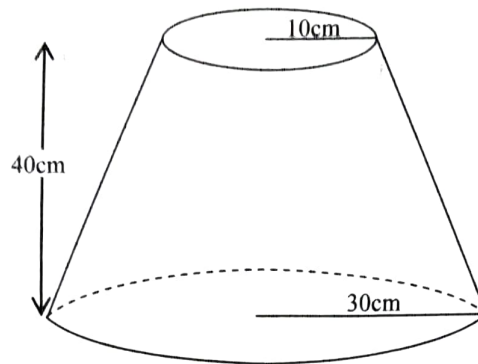
- 7 (a) The diagram shows the positions of three towns P, Q and R. $PQ = 7.1\text{km}$, $PR = 23.8\text{km}$ and angle $RPQ = 92.7^\circ$.



Calculate the

- (i) distance RQ to 2 decimal places, [5]
 (i.i) area of the triangle PQR, [2]
 (iii) shortest distance of P from RQ giving your answer to 2 decimal places. [2]
- (b) Solve the equation $3 \tan \theta = 89$ for $0^\circ \leq \theta \leq 180^\circ$. [1]
- (c) Simplify $\frac{9x^2 - 1}{9x + 3}$. [2]

- 8 (a) The diagram shows the frustum of a cone. The perpendicular height is 40cm. The top and bottom radii are 10cm and 30cm respectively. [Take π as 3.142]



Calculate the volume of the frustum. [6]

- (b) Four towns A(70°N , 65°W), B(70°N , 65°E), C(70°S , 65°E) and D(70°S , 65°W) are on the surface of the earth. Take π as 3.142 and $R = 3\,437\text{nm}$.
- (i) Sketch the surface of the earth showing all the four towns A, B, C and D. [2]
- (ii) Calculate, in nautical miles, the distance
- (a) AB along latitude 70°N , [2]
- (b) BC along longitude 65°E . [2]

9 Answer the whole of this question on a sheet of graph paper.

A lady intends to bake two types of cakes, type A and type B for sale. She intends to bake at least 30 cakes of type A and at least 20 cakes of type B. The number of cakes of type A must be equal to or more than the number of cakes of type B. The total number of cakes must not exceed 90.

- (a) Taking x to represent the number of cakes of type A and y to represent the number of type B cakes, write four inequalities to represent the information above. [4]
- (b) Using a scale of 2cm to represent 10 cakes on each axis, draw x and y axes for $0 \leq x \leq 90$ and $0 \leq y \leq 90$ respectively and shade the unwanted region to indicate clearly the region where the solution of the inequalities lie. [5]
- (c) The profit on the sale of a type A cake is K30.00 and the profit on a type B cake is K50.00. How many cakes of each type can be baked to make maximum profit? [2]
- (d) Calculate the maximum profit. [1]

10 Answer the whole of this question on a sheet of graph paper.

The vertices of triangle ABC are A(0, 4), B(0, 6) and C(-4, 6) while the vertices of triangle $A_1B_1C_1$ are $A_1(4, 0)$, $B_1(6, 0)$, and $C_1(6, 4)$.

- (a) Using a scale of 1cm to represent 1 unit on each axis, draw x and y axes for $-4 \leq x \leq 8$ and $-3 \leq y \leq 12$. Draw and label triangle ABC and triangle $A_1B_1C_1$. [2]
- (b) Describe fully a single transformation that maps triangle ABC onto triangle $A_1B_1C_1$. [3]
- (c) The matrix $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ maps triangle ABC onto triangle $A_2B_2C_2$.
- (i) Find the coordinates of A_2 , B_2 and C_2 . [3]
- (ii) Draw and label triangle $A_2B_2C_2$. [1]
- (d) Triangle $A_1B_1C_1$ is mapped onto triangle $A_3B_3C_3$ with vertices $A_3(4, 0)$, $B_3(6, 0)$ and $C_3(-2, 4)$.
- (i) Draw and label triangle $A_3B_3C_3$. [1]
- (ii) Find the matrix representing this transformation. [2]

11 The ages (in years) of 100 patients treated at a certain health centre on a particular day are given in the table below.

Age (in years)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$
Number of patients	5	10	25	30	20	10

- (a) Calculate the standard deviation. [6]
- (b) Answer this part of the question on a sheet of graph paper.
- (i) Using the table above, copy and complete the cumulative frequency table below. [1]

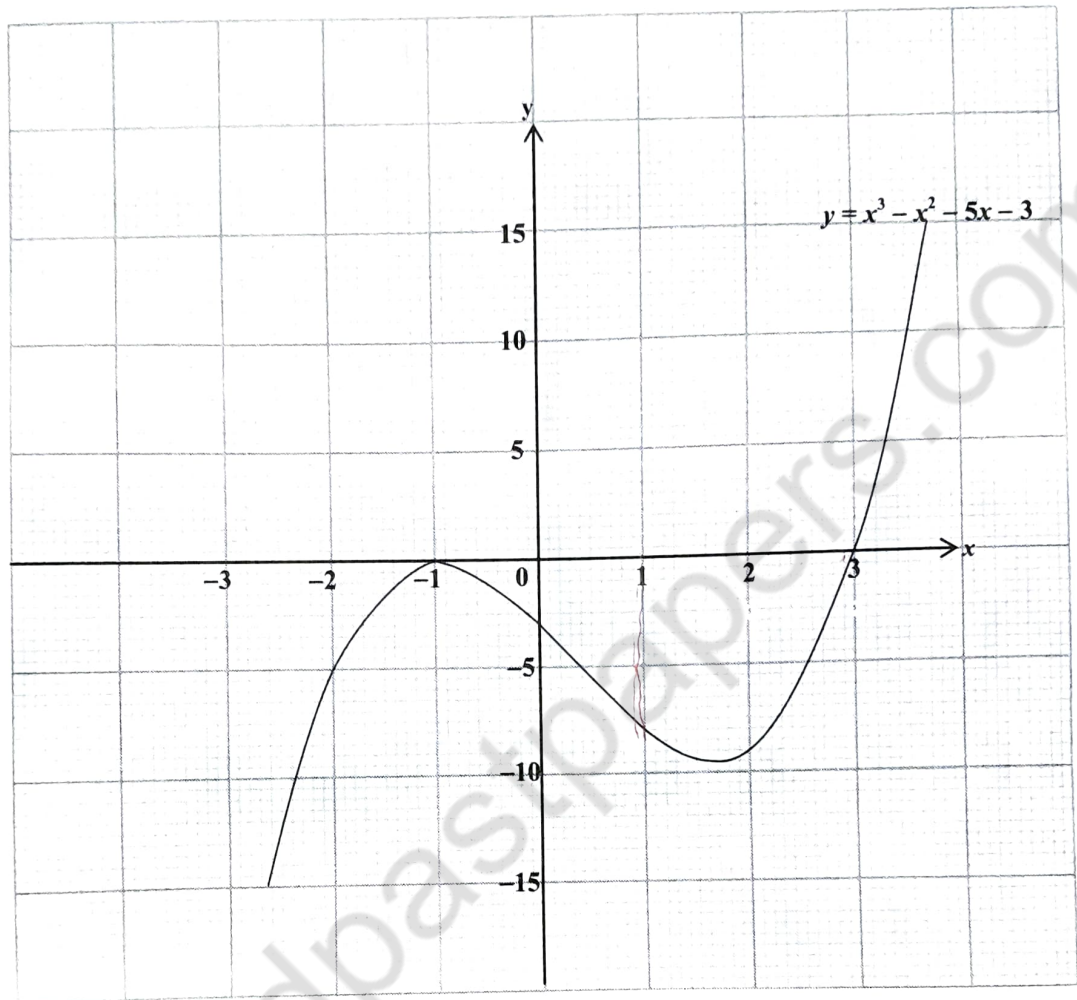
Age (in years)	≤ 0	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60
Number of patients	0	5	15	40	70	90	100

- (ii) Using a scale of 2cm to represent 10 units on each axis for $0 \leq x \leq 60$ and $0 \leq y \leq 100$, draw a smooth cumulative frequency curve. [3]
- (iii) Showing your method clearly, use your graph to estimate the semi-interquartile range. [2]

12 (a) Evaluate $\int_{-1}^1 (-1 - 3x^2) dx$.

[3]

(b) The diagram shows the graph of $y = x^3 - x^2 - 5x - 3$.



(i) Use the graph to find the solution of the equations

(a) $x^3 - x^2 - 5x - 3 = 0$, [2]

(b) $x^3 - x^2 - 5x = x - 3$. [3]

(ii) Find the

(a) gradient of the curve at the point $(-2, -5)$, [2]

(b) area bounded by the curve, $x = 1$, $y = 0$ and $x = 3$. [2]