



47121524



EXAMINATIONS COUNCIL OF ZAMBIA



Examination for School Certificate Ordinary Level

Mathematics

4024/2

Paper 2

Thursday

9 NOVEMBER 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

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

Information for Candidates

- 1 The number of marks is given in brackets [] at the end of each question or part question.
- 2 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.
- 3 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

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

Grouped data

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

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Section A (52 Marks)

Answer all questions in this section

1 (a) Express $\frac{2}{3m-2} - \frac{1}{2m-3}$ as a single fraction in its lowest terms. [3]

(b) Solve the equation $3x^2 + 13x - 7 = 0$, giving your answers correct to 2 decimal places. [5]

2 (a) Given that matrix $K = \begin{pmatrix} 8 & 9x \\ 1 & x \end{pmatrix}$, find the

(i) value of x for which the determinant of K is 2, [2]

(ii) inverse of K . [2]

(b) A survey carried out in a certain district showed that out of 215 teachers, 170 taught Mathematics, 100 taught Additional Mathematics, 41 taught Computer Studies, 65 taught Mathematics and Additional Mathematics, 30 taught Additional Mathematics and Computer Studies, 26 taught Computer Studies and Mathematics and 21 taught all the three subjects.

(i) Illustrate this information in a Venn diagram. [2]

(ii) How many teachers taught

(a) none of the subjects carried out in the survey, [1]

(b) Additional Mathematics or Computer Studies but not Mathematics, [1]

(c) two subjects only? [1]

3 (a) Find the equation of the curve for which $\frac{dy}{dx} = 12x^3 - 4x + 5$ at the point $(0, -2)$. [3]

(b) The n th term of a geometric progression is given by $180\left(\frac{1}{2}\right)^n$. Find the

(i) first 3 terms, [2]

(ii) common ratio, [2]

(iii) sum to infinity of the progression. [3]

4 Answer the whole of this question on a sheet of plain paper.

- (a) Construct a trapezium ABCD in which $AB = 10\text{cm}$, $BC = 8\text{cm}$, $AD = 7\text{cm}$, angle $ABC = 60^\circ$ and angle BAD is 90° . [1]
- (b) Measure and write the length of CD. [1]
- (c) Within the trapezium ABCD, draw the locus of points which are
- (i) 2cm from CD, [1]
 - (ii) 9cm from B, [1]
 - (iii) equidistant from AB and AD. [2]
- (d) A point E, within the trapezium ABCD, is such that it is greater than or equal to 2cm from CD, less than or equal to 9cm from B and nearer to AD than AB. Indicate, by shading, the region in which E must lie. [2]

5 (a) Simplify $\frac{10p^3q^4}{8m^4n^2} \div \frac{25p^4q^3}{4m^4n^2}$. [2]

(b) Study the following pseudocode.

Start

Enter E, S

IF $S < E$ THEN

Display 'error message'

ELSE probability = E/S

END IF

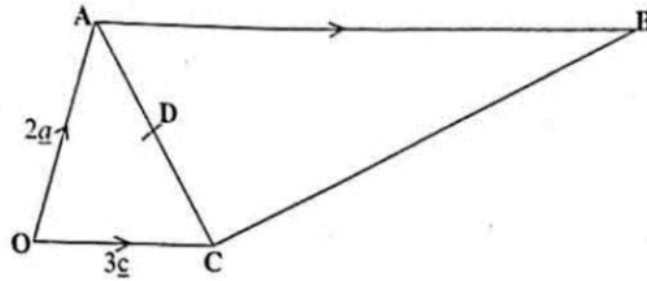
Display probability

Stop

Draw a corresponding flowchart for the pseudocode above. [5]

- 6 (a) A box contains 4 black and 5 blue identical pens. Two pens are picked from the box at random one after the other without replacement. Find the probability that the pens picked are
- (i) both blue, [2]
 - (ii) of the same colour. [3]

- (b) The diagram shows a trapezium OABC in which $\vec{OA} = 2\vec{a}$, $\vec{OC} = 3\vec{c}$, $\vec{AB} = 3\vec{OC}$ and D is the midpoint of AC.



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

- | | | |
|-------|--------------|-----|
| (i) | \vec{AC} , | [1] |
| (ii) | \vec{OD} , | [1] |
| (iii) | \vec{OB} , | [1] |
| (iv) | \vec{BD} . | [2] |

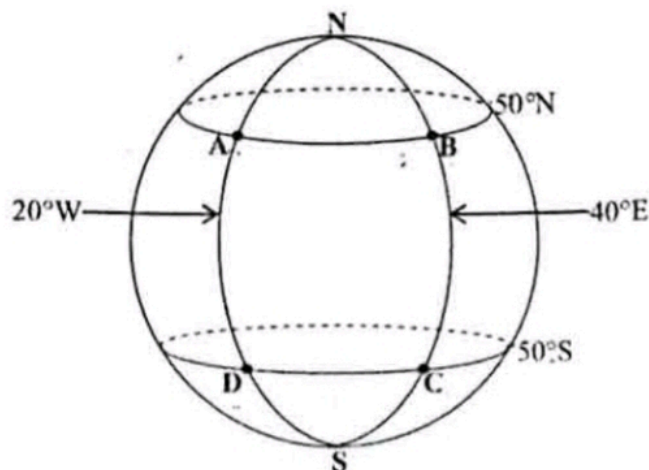
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Section B [48 marks]

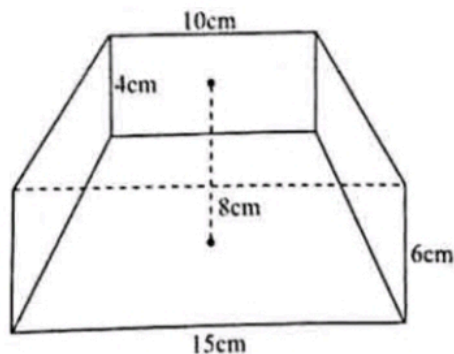
Answer any four questions in this section.

Each question in this section carries 12 marks.

- 7 (a) The points A, B, C and D are on the surface of the earth as shown in the diagram.
(Take $\pi = 3.142$ and $R = 6\,370\text{km}$)

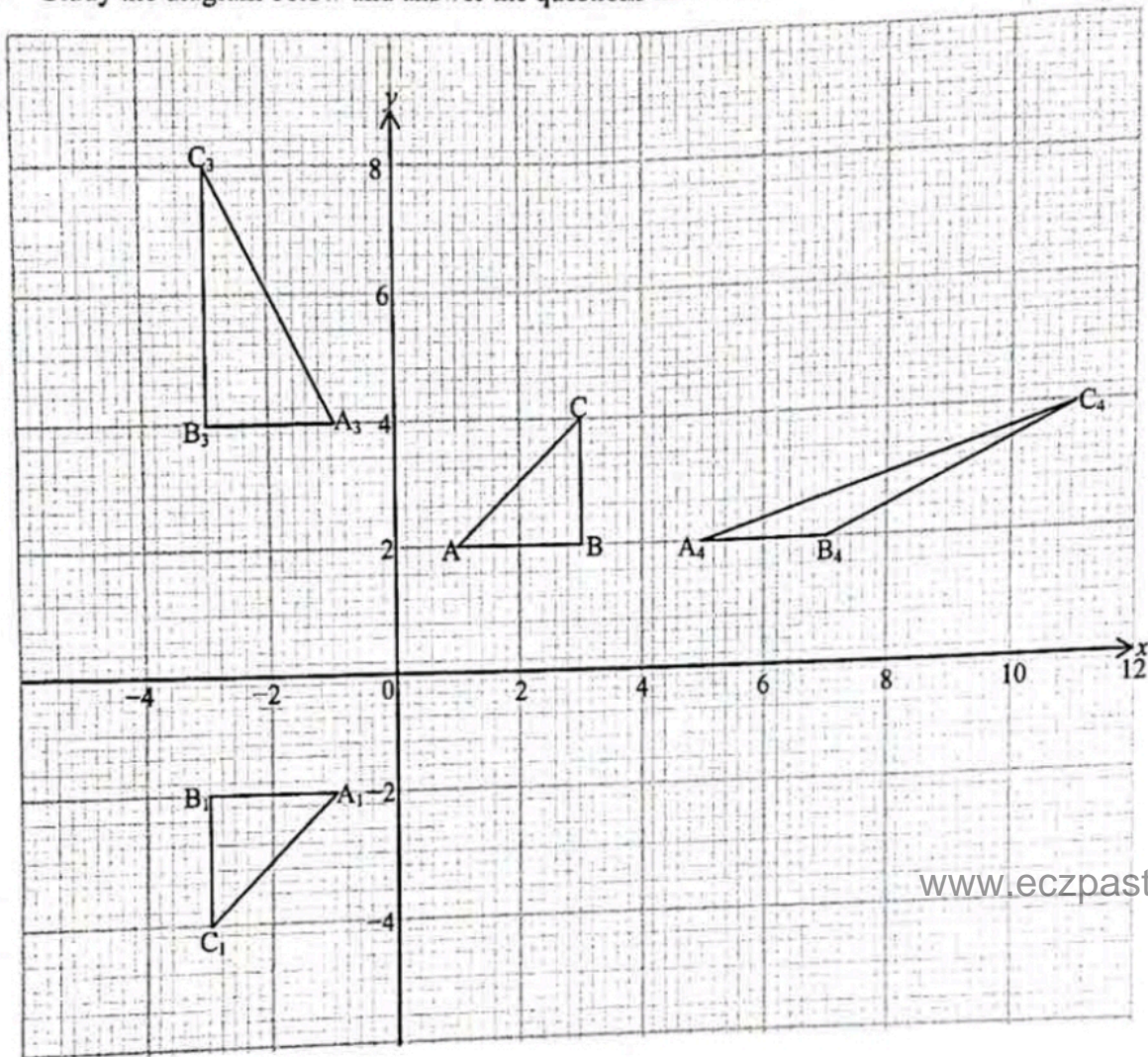


- (i) Find the difference in latitude between points A and D. [2]
 (ii) Calculate in kilometres, the distance between
 (a) A and B along latitude 50°N , [2]
 (b) B and C along longitude 40°E . [2]
- (b) The following diagram is a frustum of a rectangular pyramid with a base 15cm long and 6cm wide. The top of the frustum is 10cm long and 4cm wide. Its perpendicular height is 8cm.



- (i) Find the height of the pyramid. [2]
 (ii) Calculate the volume of the frustum. [4]

8 Study the diagram below and answer the questions that follow.



- (a) Describe fully a single transformation which maps triangle ABC onto triangle $A_1B_1C_1$. [3]
- (b) Triangle ABC is mapped onto triangle $A_2B_2C_2$ (not on the diagram) by an enlargement with centre $(1, 0)$ and scale factor 2. Find the coordinates of A_2 , B_2 and C_2 . [3]
- (c) Given that triangle $A_1B_1C_1$ is mapped onto triangle $A_3B_3C_3$ by a stretch, find the
 (i) invariant line, [1]
 (ii) scale factor. [2]
- (d) Triangle ABC is mapped onto triangle $A_4B_4C_4$ by a shear. Find the matrix of this transformation. [3]

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

A man intends to buy goats and cows for sale. He decides to buy not more than 50 goats and not more than 40 cows. He plans to buy at least 60 animals altogether.

- (a) Given that x represents the number of goats and y the number of cows, write three inequalities which represent these conditions. [4]
- (b) Using a scale of 2cm to represent 10 animals on each axis, draw the x and y axes for $0 \leq x \leq 80$ and $0 \leq y \leq 80$ respectively and shade the unwanted region to show clearly the region where the solution of the inequalities lie. [4]
- (c) The profit on the sale of a goat is K100.00 and on a cow profit is K800.00. How many animals of each type should he buy to make maximum profit? [2]
- (d) What is the maximum profit? [2]

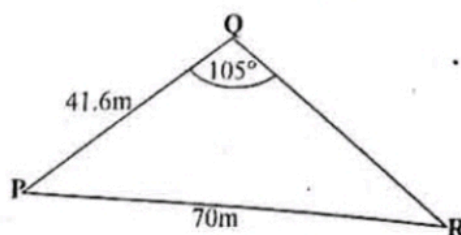
10 (a) Answer this part of the question on a sheet of graph paper.

The values of x and y are connected by the equation $y = x^3 - 9x + 5$. Some of the corresponding values of x and y are given in the table below.

x	-3.5	-3	-2	-1	0	1	2	2.5	3	3.5
y	-6.4	5	q	13	5	-3	-5	-1.9	5	16.4

- (i) Calculate the value of q . [1]
- (ii) Using a scale of 2cm to represent 1 unit on the x -axis and 2cm to represent 5 units on the y -axis for $-4 \leq x \leq 4$ and $-10 \leq y \leq 20$, draw the graph of $y = x^3 - 9x + 5$. [3]
- (iii) Use your graph to find the solutions of the equations
 - (a) $x^3 - 9x + 5 = 0$, [2]
 - (b) $x^3 - 9x + 5 = -3x + 6$. [3]
- (b) Evaluate $\int_{-1}^2 (3x^2 - 2x + 1) dx$. [3]

11 (a) In the following triangle, $PQ = 41.6m$, $PR = 70m$ and angle $PQR = 105^\circ$.



Calculate

- (i) angle QPR, [5]
- (ii) the area of triangle PQR, [2]
- (iii) the shortest distance from Q to PR. [2]

- (b) Solve the equation $\tan \theta = 2.75$ for $180^\circ \leq \theta \leq 270^\circ$. [1]
- (c) Simplify $\frac{3d^2 - 27}{d + 3}$. [2]

12 The following table shows the age distribution of 30 people in a village.

Age (years)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$
Frequency	2	6	9	7	4	2

- (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 relative cumulative frequency table below. [1]

Age (years)	≤ 0	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60
Cumulative frequency	0	2	8	17	24	28	30
Relative cumulative frequency	0.00	0.07	0.27				1.00

- (ii) Using a scale of 2cm to represent 10 units on the horizontal axis and 2cm to represent 0.1 units on the vertical axis for $0 \leq x \leq 60$ and $0.0 \leq y \leq 1.0$, draw a smooth relative cumulative frequency curve. www.eczpastpapers.com
- (iii) Showing your method clearly, use your graph to estimate the 70th percentile. [2]