



EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

4024/2

Mathematics

Paper 2

Thursday

10 NOVEMBER 2022

- 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 Δ ABC

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

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

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

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

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

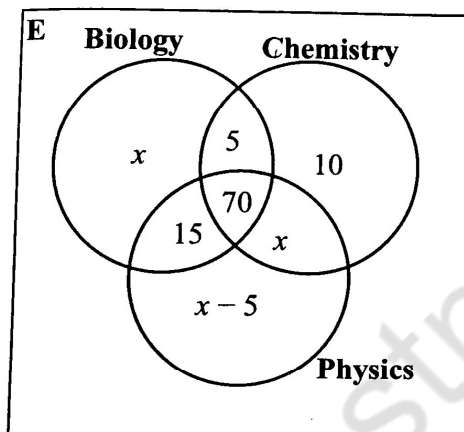
SECTION A: (52 MARKS)

Answer all questions in this section.

- 1 (a) Given that the determinant of matrix $Q = \begin{pmatrix} 2b-1 & 4 \\ -3b & -5 \end{pmatrix}$ is 15,

find the

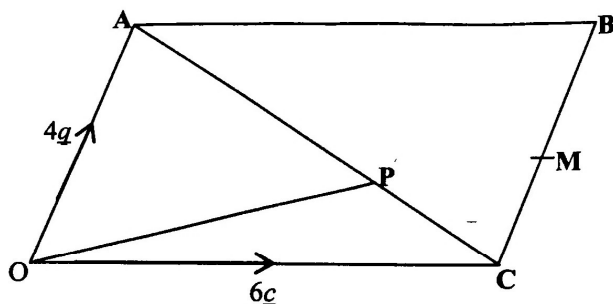
- (i) value of b , [2]
 (ii) inverse of matrix Q . [2]
- (b) The Venn diagram shows the number of learners who took at least one of the three subjects Biology, Chemistry and Physics.



- (i) Given that the total number of learners was 170, calculate the value of x . [2]
 (ii) How many learners took
 (a) Biology and Physics but not Chemistry, [1]
 (b) two subjects only, [1]
 (c) one subject only? [1]

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

- (b) In the parallelogram $OABC$, $\vec{OA} = 4\mathbf{g}$, $\vec{OC} = 6\mathbf{c}$, $\vec{AP} = \frac{2}{3}\vec{AC}$ and M is the midpoint of BC .



- (i) Find in terms of \mathbf{g} and /or \mathbf{c}
- (a) \vec{AC} , [1]
- (b) \vec{OP} , [1]
- (c) \vec{OM} . [1]
- (ii) Hence or otherwise, show that the points O , P and M are collinear. [2]

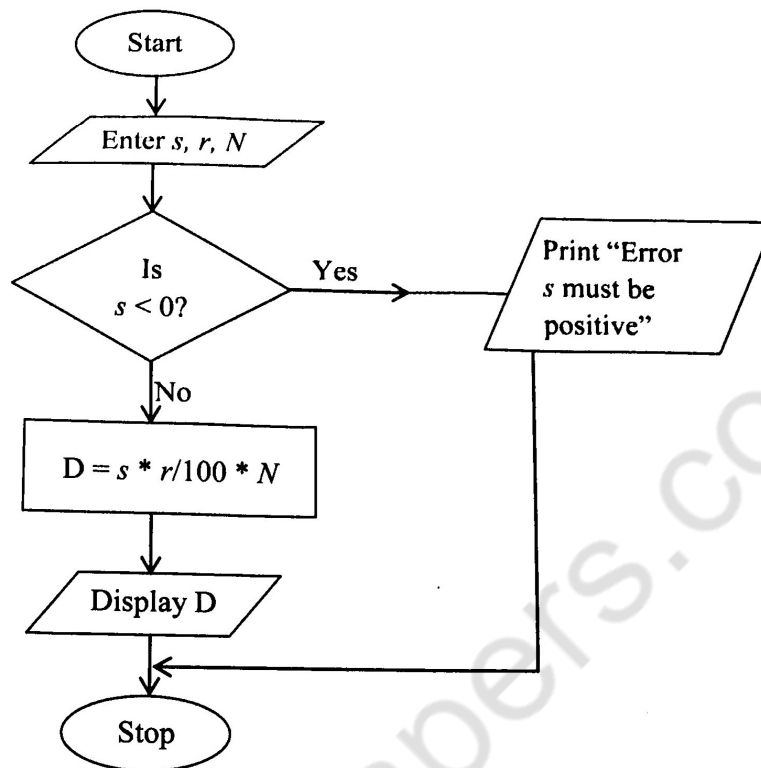
3 (a) Simplify $\frac{2x + 14}{2x^2 - 98}$. [2]

- (b) Given that the third and sixth terms of a geometric progression are $\frac{3}{4}$ and $\frac{3}{32}$

respectively, find the

- (i) first term and the common ratio, [3]
- (ii) n th term, [2]
- (iii) sum to infinity of the progression. [2]

- 4 (a) Study the flowchart below.



Write a pseudocode corresponding to the flowchart above. [5]

- (b) A box contains identical cards and on each card a letter of the English alphabet is printed. A card is selected at random from the box and not replaced, and a second card is then selected. Find the probability that the two cards selected

- (i) have vowels printed, [2]
 (ii) one has a vowel and the other a consonant printed. [3]

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

- (a) Construct a parallelogram ABCD in which $AB = 10\text{cm}$, $AD = BC = 6.5\text{cm}$, angle $BAD = 110^\circ$ and angle $ABC = 70^\circ$. [1]
- (b) Measure and write the length AC. [1]
- (c) Within parallelogram ABCD, construct the locus of points which are
- (i) 3cm from AB, [1]
 (ii) 6cm from C, [1]
 (iii) equidistant from BC and CD. [2]
- (d) A point Z, within parallelogram ABCD, is such that it is less than or equal to 3cm from AB, less than or equal to 6cm from C and nearer to CD than BC. Indicate clearly, by shading, the region in which Z must lie. [2]

- 6 (a) Evaluate $\int_{-1}^4 (2 + 2x + 6x^2) dx$. [3]
- (b) Find the equation of the normal to the curve $y = x^2 - 3x - 4$ at the point $(2, -6)$. [3]

SECTION B: [48 MARKS]

Answer any four questions in this section.

Each question in this section carries 12 marks.

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

A businessman intends to sell two types of markers, permanent and dry erase. He decides that there should be at least 20 permanent markers and at least 10 dry erase markers. In order to make his business stable, he decides to order not more than 70 markers altogether. The order price of a permanent marker is K15.00 and that of a dry erase marker is K20.00. He is prepared to spend not more than K1 200.00 altogether.

- (a) Let x represent the number of permanent markers and y the number of dry erase markers. Write four inequalities which satisfy the above conditions. [5]
- (b) Using a scale of 2cm to represent 10 markers on each axis, draw 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 permanent marker is K25.00 and on each dry erase marker profit is K30.00.
- (i) How many markers of each type should be ordered to make maximum profit? [2]
- (ii) Find the maximum profit. [1]

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

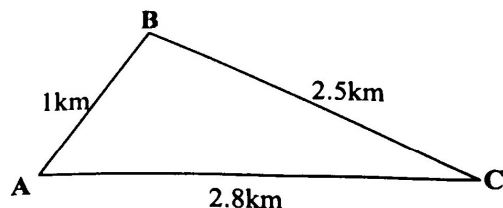
The variables x and y are connected by the equation $y = (x - 3)(x - 5)(x + 2)$. Some corresponding values of x and y are shown in the table below.

x	-2	-1	0	1	2	3	4	5	6
y	0	24	30	24	12	0	-6	0	k

- (i) Calculate the value of k . [1]
- (ii) Using a scale of 2cm to represent 1 unit on the x axis for $-2 \leq x \leq 6$ and a scale of 2cm to represent 10 units on the y axis for $-10 \leq y \leq 40$, draw the graph of $y = (x - 3)(x - 5)(x + 2)$. [3]
- (iii) Use your graph to estimate the
- (a) gradient of the curve at the point $(-1, 24)$, [2]
- (b) area bounded by the curve, $x = -1$, $x = 2$ and $y = 0$. [3]

- (b) Express $\frac{2}{x+5} + \frac{5}{3x-4}$ as a single fraction in its simplest form. [3]

- 9 (a) The diagram shows a triangular piece of land ABC.



Given that $AB = 1\text{km}$, $BC = 2.5\text{km}$ and $AC = 2.8\text{km}$, calculate the

- (i) angle ABC, [5]
 (ii) area of triangle ABC, [2]
 (iii) shortest distance from B to AC. [2]
- (b) Solve the equation $2\cos \theta = -1$ for $180^\circ \leq \theta \leq 360^\circ$. [1]
- (c) Simplify $\frac{42xyz}{56} \times \frac{32xy}{40x^2y}$. [2]

- 10 The table shows the heights of 100 plants measured in centimetres on a particular day.

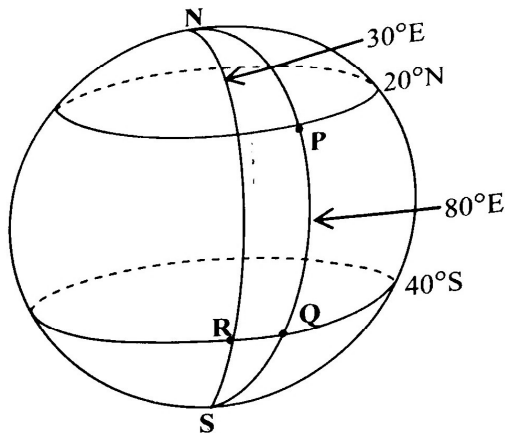
Height (cm)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$	$60 < x \leq 70$
Frequency	3	8	14	22	23	22	8

- (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.

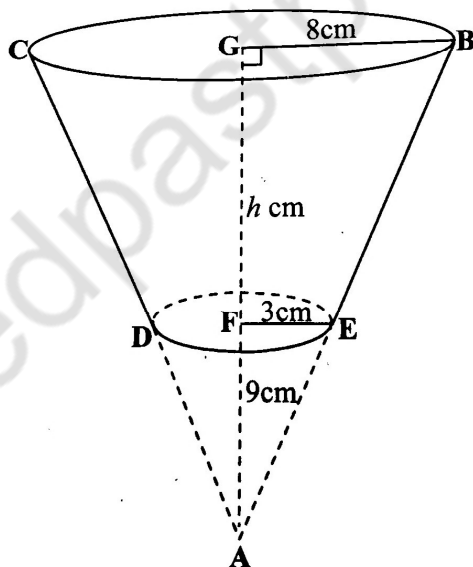
Height (cm)	≤ 0	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	≤ 70
Cumulative frequency	0	3	11	25				100

- (ii) Using a scale of 2cm to represent 10 units on both axes for $0 \leq x \leq 70$ and $0 \leq y \leq 100$, draw a smooth cumulative frequency curve. [1]
 [3]
- (iii) Showing your method clearly, use your graph to estimate the semi-interquartile range. [2]

- 11 (a) The diagram shows the points $P(20^\circ\text{N}, 80^\circ\text{E})$, $Q(40^\circ\text{S}, 80^\circ\text{E})$ and $R(40^\circ\text{S}, 30^\circ\text{E})$ on the surface of the earth. [Take π as 3.142 and $R = 6370$ km]



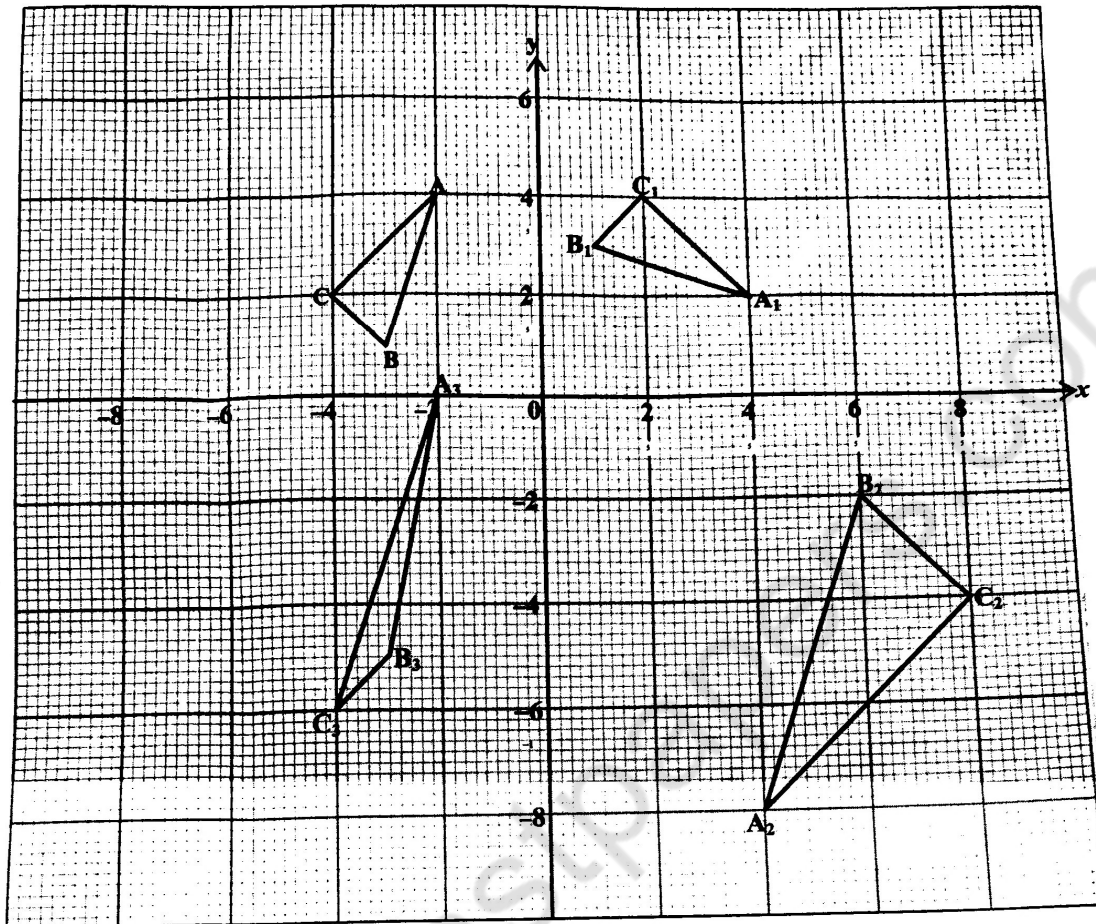
- (i) Find the difference in longitudes between points R and Q. [2]
 (ii) Calculate the distance PQ in kilometres. [2]
 (iii) Find the length of the circle of latitude 40°S in kilometres. [2]
- (b) The diagram shows a bin BCDE which was made by cutting off the smaller cone ADE from the cone ABC. [Take $\pi = 3.142$]



Given that $AF = 9\text{cm}$, $BG = 8\text{cm}$, $EF = 3\text{cm}$ and $GF = h$ cm, calculate the

- (i) value of h , [2]
 (ii) volume of the bin BCDE. [4]

12 Study the following diagram and answer the questions that follow.



- (a) Triangle ABC is mapped onto triangle $A_1B_1C_1$ by a single transformation. Describe fully this transformation. [3]
- (b) An enlargement maps triangle ABC onto triangle $A_2B_2C_2$. Find the
 (i) centre of enlargement, [1]
 (ii) scale factor. [2]
- (c) Triangle ABC is mapped onto triangle $A_3B_3C_3$ by a single transformation. Find the matrix representing this transformation. [3]
- (d) The transformation with matrix $\begin{pmatrix} 1 & 0 \\ 0 & -2 \end{pmatrix}$ maps triangle ABC onto triangle $A_4B_4C_4$ not shown on the diagram. Find the coordinates of A_4 , B_4 and C_4 . [3]