

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

Mathematics

4024/2

Paper 2

2020

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 **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 (12)** 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

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

Grouped data

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

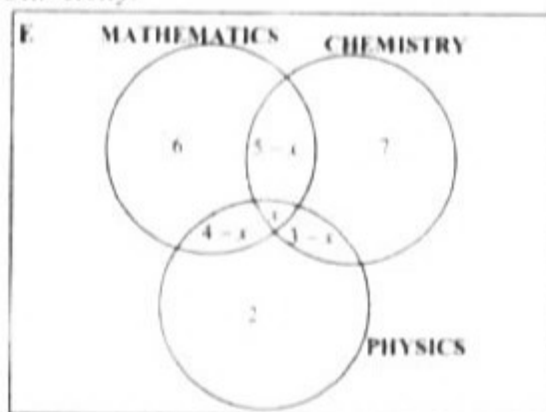
Section A (52 Marks)

Answer all questions in this section

- 1 (a) Given that matrix $A = \begin{pmatrix} 7 & 4p \\ 9 & 5p \end{pmatrix}$,
- (i) find the value of p for which the determinant of A is -2 , [2]
- (ii) hence, find the inverse of A . [2]
- (b) Mutola and Mwambi were to be selected as members of a netball team. The probability of selecting Mutola is $\frac{7}{8}$ and that of selecting Mwambi is $\frac{9}{10}$. Find the probability that
- (i) only one of them is selected. [3]
- (ii) none of them is selected. [2]

- 2 (a) Simplify $\frac{y+1}{y^2-1}$. [2]
- (b) The sum of n terms of a geometric progression (G.P) is given by $10 - \frac{10}{2^n}$. Find
- (i) the sum of the first 4 terms of this G.P. [2]
- (ii) the first term. [2]
- (iii) the first 4 terms. [3]

- 3 (a) Solve the equation $2x^2 + 3x - 7 = 0$, giving your answers correct to 2 decimal places. [5]
- (b) The Venn diagram below shows the number of students in each of the three courses at a University.



- (i) Given that there were 25 students altogether, find the value of x . [2]
- (ii) How many students studied
- (a) Mathematics and Chemistry only. [1]
- (b) one course only. [1]
- (c) Chemistry and Physics but not Mathematics? [1]

- 4 (a) The programme below is given in the form of a pseudocode.

Start

Enter radius

If radius < 0

Then display "error message" and re-enter positive radius

Else enter slant height

If slant height < 0

Then display "error message" and re-enter positive slant height

Else Area = $\pi * r * (r + \text{slant height})$

End if

Display Area

Stop

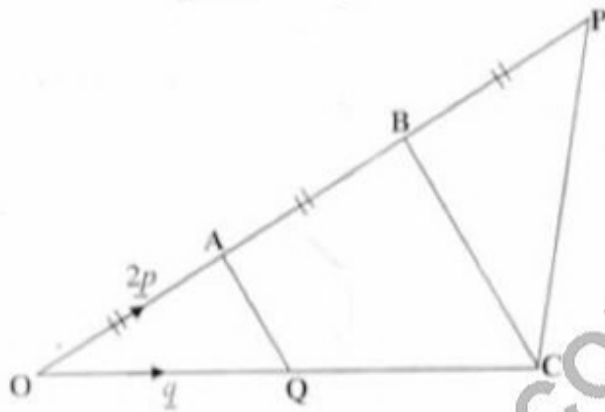
Draw the corresponding flow chart for the information given above. [5]

- (b) Express $\frac{2}{x-1} - \frac{3}{1-x}$ as a single fraction in its simplest form. [3]

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

- (a) (i) Construct a quadrilateral PQRS in which QR = 6cm, angle PQR = 90°, angle QRS = 120°, RS = 7cm and PQ = 10cm. [1]
- (ii) Measure and write the size of angle QPS. [1]
- (b) On your diagram, draw the locus of points within quadrilateral PQRS which are
- (i) 8cm from R, [1]
- (ii) equidistant from R and S, [1]
- (iii) equidistant from PS and RS. [2]
- (c) A point X, within quadrilateral PQRS, is such that it is less than or equal to 8cm from R, nearer to S than R and nearer to PS than RS. Shade the region in which X must lie. [2]
-

- 6 (a) In the diagram below, Q is the midpoint of OC and OABP is a straight line with $OA = AB = BP$, $\vec{OA} = 2p$ and $\vec{OQ} = q$.



Express in terms of p and/or q

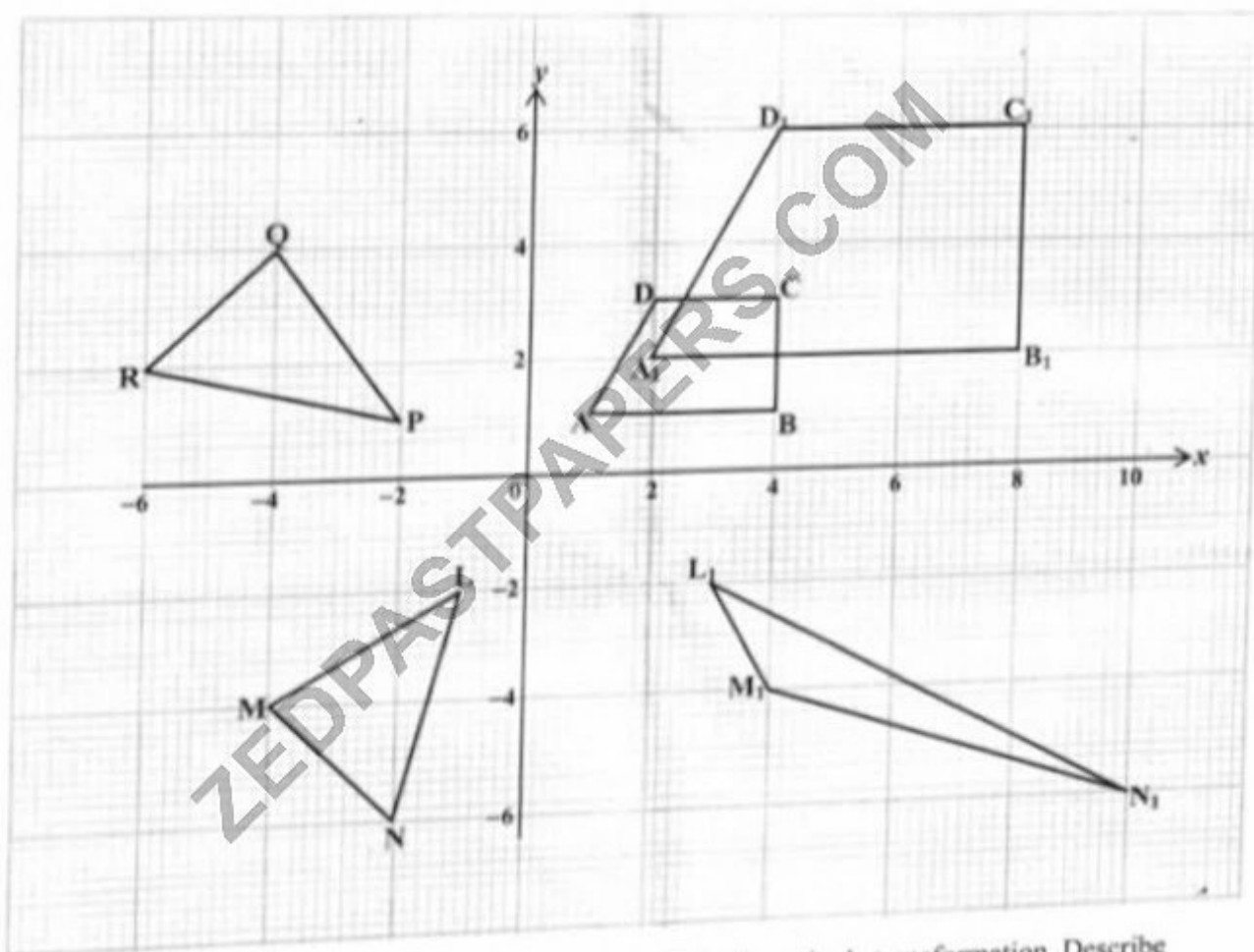
- (i) \vec{OB} , [1]
 (ii) \vec{BC} , [1]
 (iii) \vec{AQ} , [1]
 (iv) \vec{CP} . [2]
- (b) The gradient function of a curve is $3x + 2$. Find the equation of the curve if it passes through the point $(2, 3)$. [3]

Section B [48 marks]

Answer any four questions in this section.

Each question in this section carries 12 marks.

- 7 Study the diagram below and answer the questions that follow.



- (a) Triangle PQR is mapped onto triangle LMN by a single transformation. Describe this transformation fully. [3]
- (b) An enlargement maps trapezium ABCD onto trapezium $A_1B_1C_1D_1$. Find the centre of enlargement and the scale factor. [3]
- (c) A transformation with the matrix $\begin{pmatrix} 1 & 0 \\ 0 & -3 \end{pmatrix}$ maps triangle PQR onto triangle XYZ, not drawn on the diagram. Find the coordinates of X, Y and Z. [3]
- (d) Triangle LMN is mapped onto triangle $L_1M_1N_1$ by a shear. Find [2]
 (i) the matrix of shear, [1]
 (ii) the shear factor.

- 8 The frequency table below shows the mark distribution for 30 learners in a Mathematics test.

Marks	$10 < x \leq 15$	$15 < x \leq 20$	$20 < x \leq 25$	$25 < x \leq 30$	$30 < x \leq 35$	$35 < x \leq 40$	$40 < x \leq 45$	$45 < x \leq 50$
Number. of Learners	2	3	3	5	6	6	3	2

- (a) Calculate the standard deviation. [6]

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

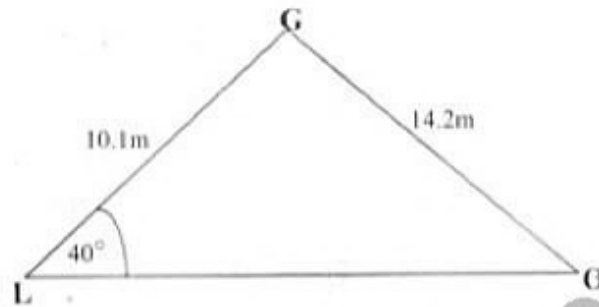
- (i) Using the information in the table above, copy and complete the relative cumulative frequency table below.

Marks	≤ 15	≤ 20	≤ 25	≤ 30	≤ 35	≤ 40	≤ 45	≤ 50
Number of Learners	2	5	8	13	19	25	28	30
Relative cumulative frequency	0.07	0.17	0.27	0.43				1

[1]

- (ii) Using a scale of 2 cm to represent 5 marks on the axis for $15 \leq x \leq 50$ and a scale of 2 cm to represent 0.1 units on the y-axis for $0.0 \leq y \leq 1.0$, draw a smooth relative cumulative frequency curve. [3]
- (iii) Showing your method clearly, use your graph to estimate the semi-interquartile range. [2]

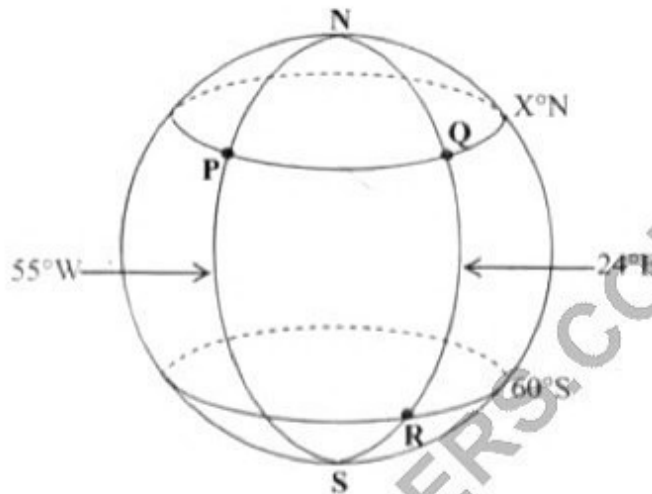
- 9 (a) The diagram below shows the positions of a Guava (G) tree, Orange (O) tree and Lemon (L) tree on a farm.



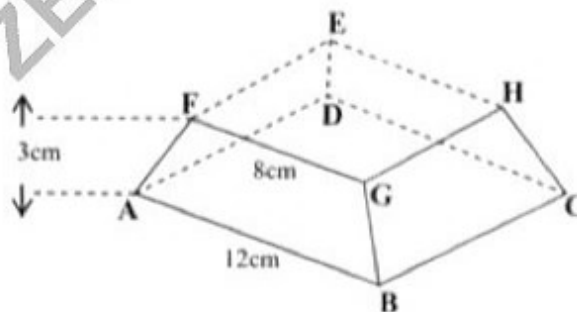
Given that $LG = 10.1\text{m}$, $OG = 14.2\text{m}$ and angle $OLG = 40^\circ$; calculate

- (i) angle OGL, [5]
(ii) the area of triangle OGL, [2]
(iii) the shortest distance from L to OG. [2]
- (b) Solve the equation $5\cos \theta = 3$ for $0^\circ \leq \theta \leq 180^\circ$. [1]
- (c) Simplify $\frac{99m^3n^2}{20p^2q^3} + \frac{33m^4n}{40p^2q^3}$. [2]
-

- 10 (a) The diagram below shows three points P, Q and R on the surface of the earth.
 [Take π as 3.142 and $R = 6370\text{km}$].



- (i) Calculate the difference in longitude between P and R. [2]
 (ii) Given that the distance between P and Q on latitude $X^\circ\text{N}$ is 4392.079611km , calculate X. [2]
 (iii) Calculate the distance QR on longitude 24°E . [2]
- (b) The figure ABCDEFGH below is a frustum of a pyramid. EFGH and ABCD are squares of sides 8cm and 12cm respectively.



- Given that the height of the frustum is 3cm , calculate its volume. [6]

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

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

x	-3	-2	-1	0	1	2	3
y	0	9	r	3	0	5	24

- (i) Calculate value of r . [1]
- (ii) Taking 2cm to represent 1 unit on the x -axis for $-3 \leq x \leq 3$, and 2cm to represent 10 units on the y -axis for $0 \leq y \leq 30$, draw the graph of $y = 3 - 5x + x^2 + x^3$. [3]
- (iii) Use your graph to calculate an estimate of the
- (a) gradient of the curve at the point where $x = 2$. [2]
- (b) area bounded by the curve, $x = -3$ and $x = 2$. [3]
- (b) Find the coordinates of the stationary points on the curve $y = 2x^3 - 3x^2 - 12x + 4$. [3]

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

Menda intends to run a business of selling mineral water. He needs to order at least 10 small bottles and at most 60 large bottles of water. He decides to order at most 80 bottles of water altogether and the number of large bottles he orders should be at least twice that of small bottles.

- (a) Given that x is the number of small bottles and y is the number of large bottles, write four inequalities which represent these conditions. [4]
- (a) Using a scale of 2cm to represent 10 bottles 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 each small bottle of mineral water is K1.50 while on each large bottle of mineral water profit is K2.50. How many bottles of each type can be bought to make maximum profit? [2]
- (d) Hence, find this maximum profit. [2]