

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Mathematics

4024/2

Paper 2

Thursday

1 NOVEMBER 2018

Additional materials:

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

Time: 2 hours 30 minutes

Instructions to Candidates

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Write your **name, centre number and candidate number** in the spaces provided on the **Answer Booklet**.

Write your answers and working in the **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 (12)** questions in this paper.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Silent non programmable Calculators may be used.

Cell phones are not allowed in the examination room.

Information for Candidates

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

The total marks for this paper is 100.

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.



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

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

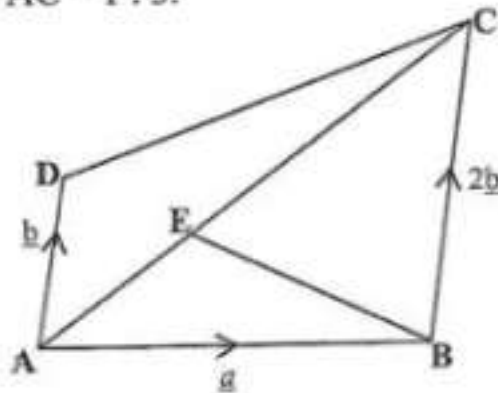
Section A (52 Marks)

Answer all questions in this section

- 1 (a) Given that matrix $A = \begin{pmatrix} 4 & -5 \\ 1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 8 & y \\ 3 & 5 \end{pmatrix}$,
- (i) find the value of y for which the determinants of A and B are equal, [2]
 - (ii) hence find the inverse of B . [2]
- (b) A small bag contains 6 black and 9 green pens of the same type. Two pens are taken at random one after the other from the bag without replacement. Calculate the probability that both pens
- (i) are black, [2]
 - (ii) are of different colours. [3]
-
- 2 (a) Solve the equation $3x^2 - x - 5 = 0$, giving your answers correct to 2 decimal places. [5]
- (b) At Sambilileni College, 20 students study at least one of the three subjects; Mathematics (M), Chemistry (C) and Physics (P). All those who study Chemistry also study Mathematics. 3 students study all the three subjects. 4 students study Mathematics only, 8 students study Chemistry and 14 students study Mathematics.
- (i) Draw a Venn diagram to illustrate this information. [2]
 - (ii) How many students study
 - (a) Physics only, [1]
 - (b) two subjects only, [1]
 - (c) Mathematics and Physics but not Chemistry? [1]
-
- 3 (a) Evaluate $\int_{-1}^2 (2 + x - x^2) dx$. [3]
- (b) Find the equation of the normal to the curve $y = x + \frac{4}{x}$ at the point where $x = 4$. [3]
-
- 4 Answer the whole of this question on a sheet of plain paper.
- (a) (i) Construct a triangle XYZ in which $XY = 9$ cm, $YZ = 7$ cm and angle $XYZ = 38^\circ$. [1]
 - (ii) Measure and write the length of XZ. [1]
 - (b) On your diagram, within triangle XYZ, construct the locus of points which are
 - (i) 6 cm from Y, [1]
 - (ii) equidistant from XZ and XY. [2]
 - (c) Mark clearly with the letter P, within triangle XYZ, a point which is 6 cm from Y and equidistant from XZ and XY. [1]
 - (d) A point T, within triangle XYZ, is such that its distance from Y is less than or equal to 6 cm and it is nearer to XZ than XY. Indicate clearly, by shading, the region in which T must lie. [2]

- 5 (a) Simplify $\frac{b-a}{a^2-b^2}$. [2]
- (b) The first three terms of a geometric progression are $k+4$, k and $2k-15$ where k is a positive constant.
- (i) Find k . [3]
- (ii) List the first three terms of the progression. [2]
- (iii) Calculate the sum to infinity. [2]

- 6 (a) In the quadrilateral ABCD below, $\vec{AB} = \underline{a}$, $\vec{AD} = \underline{b}$, $\vec{BC} = 2\underline{b}$ and $AE : AC = 1 : 3$.



- (i) Find in terms of $\underline{a}$ and/or $\underline{b}$
- (a) $\vec{AE}$, [1]
- (b) $\vec{BE}$, [1]
- (c) $\vec{BD}$. [1]
- (ii) Hence or otherwise, show that the points B, E and D are collinear. [2]
- (b) The program below is given in pseudo code.

Start

Enter x, y

Let $M = \text{square root } (x \text{ squared} + y \text{ squared})$

IF $M < 0$

THEN display error message "M must be positive"

ELSE

END IF

Display M

Stop

Draw the corresponding flow chart for the information given above.

[5]

Section B [48 marks]

Answer any four questions in this section

Each question in this section carries 12 marks.

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

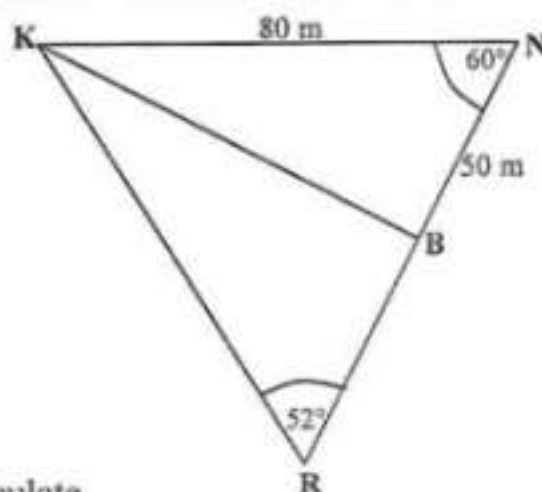
The values of x and y are connected by the equation $y = 2x^3 - 3x^2 + 5$. Some corresponding values of x and y are given in the table below.

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	p	-8.5	0	4	5	4.5	4	5	9

- (i) Calculate the value of p . [1]
- (ii) Using a scale of 4 cm to represent 1 unit on the x -axis for $-2 \leq x \leq 2$ and 2 cm to represent 5 units on the y -axis for $-25 \leq y \leq 10$, draw the graph of $y = 2x^3 - 3x^2 + 5$. [3]
- (iii) Use your graph to solve the equation $2x^3 - 3x^2 + 5 = x$. [3]
- (iv) Calculate an estimate of the gradient of the curve at the point where $x = 1.5$. [2]

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

- 8 (a) In the diagram below, K, N, B and R are places on horizontal surface. $KN = 80$ m, $NB = 50$ m, $\angle KNR = 60^\circ$ and $\angle KRN = 52^\circ$.



- (i) Calculate
- (a) KR , [4]
- (b) the area of triangle KNB . [2]
- (ii) Given that the area of triangle KNR is equal to $3\,260 \text{ m}^2$, calculate the shortest distance from R to KN . [2]
- (b) Sketch the graph of $y = \cos \theta$ for $0^\circ \leq \theta \leq 360^\circ$. [2]
- (c) Simplify $\frac{12dn^3}{15cd^3} \div \frac{9c^3n}{10c^2d^2}$. [2]

- 9 The frequency table below shows the distribution of marks obtained by 90 learners on a test.

Marks (x)	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$	$60 < x \leq 70$
Frequency	2	10	15	23	30	10

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

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

- (i) Copy and complete the relative cumulative frequency table below.

Marks (x)	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	≤ 70
Cumulative Frequency	0	2	12	27	50	80	90
Relative Cumulative frequency	0	0.02	0.13	0.3			

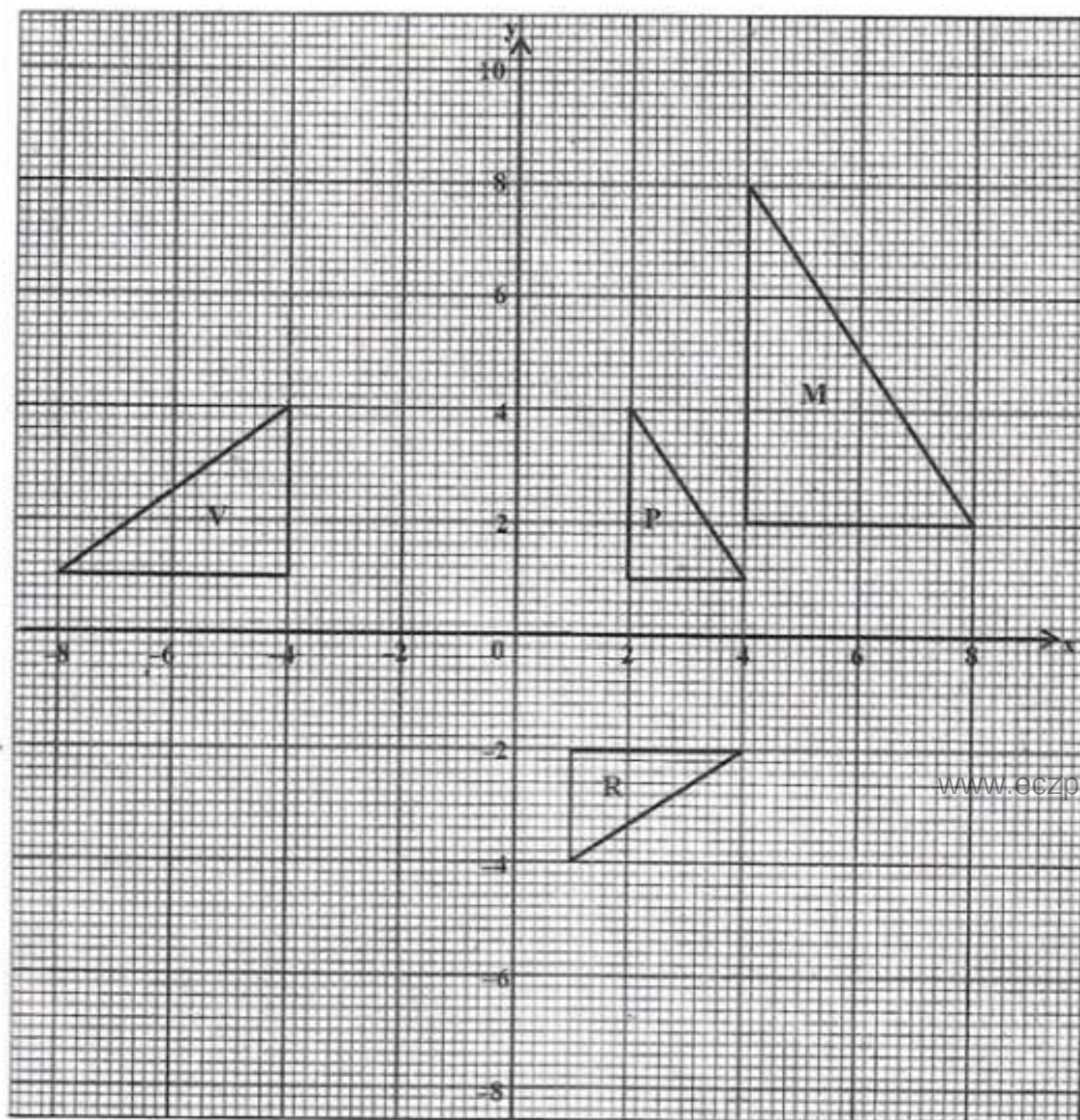
[1]

- (ii) Using a scale of 2 cm to represent 10 units on the x-axis for $0 \leq x \leq 70$ and 2 cm to represent 0.1 units on the y-axis for $0 \leq y \leq 1$, draw a smooth relative cumulative frequency curve. [3]

- (iii) Showing your method clearly, use your graph to estimate the 65th percentile. [2]

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



- (a) Triangle R is the image of triangle P under a rotation. Find the coordinates of the centre, angle and direction of the rotation. [3]
- (b) A single transformation maps triangle P onto triangle M. Describe fully this transformation. [3]
- (c) Triangle P maps onto triangle V by a stretch. Find the matrix of this transformation. [3]
- (d) If triangle P is mapped onto triangle S by a shear represented by the matrix $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$, find the coordinates of the triangle S. [3]

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

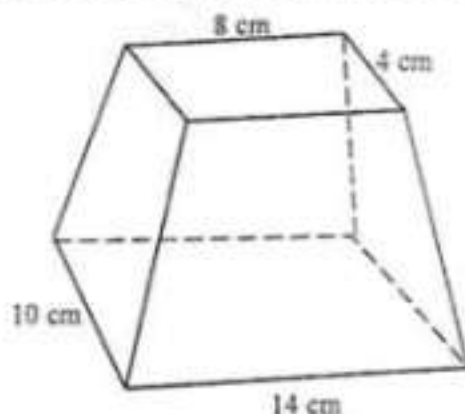
A hired bus is used to take learners and teachers on a trip. The number of learners and teachers must not be more than 60. There must be at least 35 people on the trip. There must be at least 6 teachers on the trip. The number of teachers on the trip should not be more than 14.

Let x be the number of learners and y the number of teachers.

- (a) Write four inequalities which represent the information above. [4]
- (b) Using a scale of 2 cm to represent 10 units on both axes, draw the x and y axes for $0 \leq x \leq 70$ and $0 \leq y \leq 70$ respectively and shade the unwanted region to indicate clearly the region where the solution of the inequalities lie. [4]
- (c)
 - (i) If the group has 25 learners, what is the minimum number of teachers that must accompany them? [1]
 - (ii) If 8 teachers go on this trip, what is the maximum number of learners that can be accommodated on the bus? [1]
- (d) If T is the amount in Kwacha paid by the whole group, what is the cost per learner if $T = 30x + 50y$? [2]

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- 12 (a) The diagram below is a frustum of a rectangular pyramid with a base 14 cm long and 10 cm wide. The top of the frustum is 8 cm long and 4 cm wide.



Given that the height of the frustum is 11.4 cm, calculate its volume. [6]

- (b) The points $A(15^\circ\text{N}, 40^\circ\text{E})$, $B(35^\circ\text{S}, 70^\circ\text{E})$ and $C(35^\circ\text{S}, 40^\circ\text{E})$ are on the surface of the earth. [Use $\pi = 3.142$ and $R = 6370$ km]
 - (i) Calculate the distance AC in kilometres. [2]
 - (ii) An aeroplane takes off from point B and flies due west on the same latitude covering a distance of 900 km to a point Q.
 - (a) Calculate the difference in longitudes between B and Q. [3]
 - (b) Find the position of Q. [1]