EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

Mathematics

4024/2

Paper 2

Thursday **27 JULY 2017**

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

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

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

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

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

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

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

Grouped data

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

Section A (52 Marks)

Answer all questions in this section.

1 **(a)** Given that matrix $K = \begin{pmatrix} 10 & -2 \\ 11 & -2 \end{pmatrix}$, find

(i) the determinant of K, [2]

(ii) the inverse of K. [2]

(b) Solve the equation $3z^2 = 7z - 1$, giving your answers correct to 2 decimal places. [5]

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2 **(a)** Simplify $\dfrac{m^2 - 1}{m^2 - m}$. [2]

(b) The first three terms of a geometric progression are $6 + n$, $10 + n$ and $15 + n$. Find

(i) the value of n, [2]

(ii) the common ratio, [2]

(iii) the sum of the first 6 terms of this sequence. [3]

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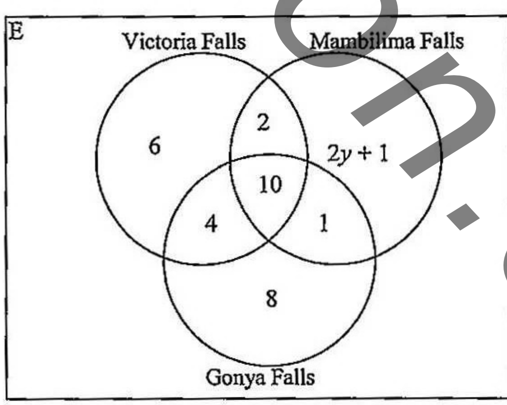
3 **(a)** In a box of 10 bulbs, 3 are faulty. If two bulbs are drawn at random one after the other, find the probability that

(i) both are good, [2]

(ii) one is faulty and the other is good. [3]

(b) The Venn diagram below shows tourist attractions visited by students in a certain week.



(i) Find the value of y, if 7 students visited Mambilima Falls only. [2]

(ii) How many students visited

(a) Victoria Falls but not Gonya Falls, [1]

(b) two tourist attractions only, [1]

(c) one tourist attraction only? [1]

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

(b) Evaluate $\int_2^5 \left(3x^2+2\right)dx$. [3]

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5 (a) (i) Construct triangle PQR in which PQ is 9cm, angle PQR = 60° and QR = 10cm. [1]

(ii) Measure and write the length of PR. [1]

(b) On your diagram, draw the locus of points within triangle PQR which are

(i) 3cm from PQ, [1]

(ii) 7cm from R, [1]

(iii) equidistant from P and R. [2]

(c) A point M, within triangle PQR, is such that it is nearer to R than P, less than or equal to 7cm from R and less than or equal to 3cm from PQ. Shade the region in which M must lie. [2]

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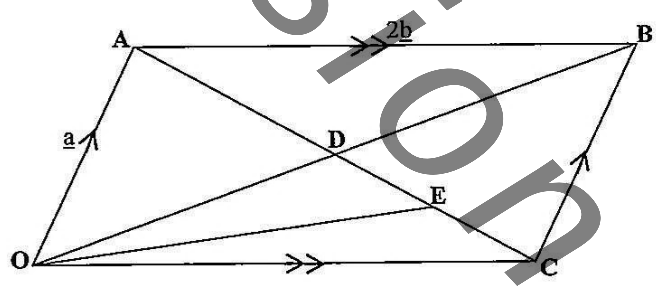
6 (a) In the diagram below, OABC is a parallelogram in which $\overrightarrow{OA} = \underline{a}$ and $\overrightarrow{AB} = 2\underline{b}$. OB and AC intersect at D. E is the midpoint of CD.



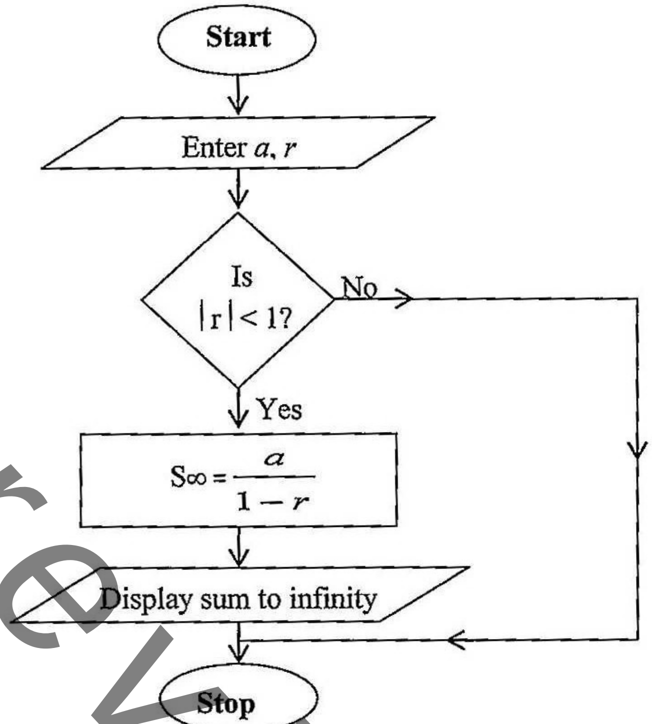
Express in terms of $\underline{a}$ and/or $\underline{b}$.

(i) $\overrightarrow{OB}$, [1]

(ii) $\overrightarrow{OE}$, [2]

(iii) $\overrightarrow{CD}$. [2]

(b) The program below is given in the form of a flow chart.



Write a pseudo code corresponding to the flow chart program above. [5]

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.**

Using a scale of 1cm to represent 1 unit on each axis, draw x and y axes for $-6 \leq x \leq 10$ and $-6 \leq y \leq 12$.

(a) Quadrilateral ABCD has vertices A(1, 2), B(2, 1), C(3, 2) and D(2, 3). Quadrilateral $A_1B_1C_1D_1$ has vertices $A_1(3, 2)$, $B_1(6, 1)$, $C_1(9, 2)$ and $D_1(6, 3)$

(i) Draw and label quadrilaterals ABCD and $A_1B_1C_1D_1$. [2]

(ii) Describe fully a single transformation which maps quadrilateral ABCD onto quadrilateral $A_1B_1C_1D_1$. [3]

(b) The matrix $\begin{pmatrix} 1 & 0 \\ 3 & 1 \end{pmatrix}$, maps quadrilateral ABCD onto quadrilateral $A_2B_2C_2D_2$.

(i) Find the coordinates of quadrilateral $A_2B_2C_2D_2$. [3]

(ii) Draw and label quadrilateral $A_2B_2C_2D_2$. [1]

(c) Quadrilateral $A_3B_3C_3D_3$ has vertices $A_3(-2, -4)$, $B_3(-4, -2)$, $C_3(-6, -4)$ and D_3 $(-4, -6)$. Describe fully the transformation which maps quadrilateral ABCD onto quadrilateral $A_3B_3C_3D_3$. [3]

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8 The frequency table below shows the number of copies of newspapers allocated to 48 newspaper vendors.

Copies of newspapers	$25 < x \leq 30$	$30 < x \leq 35$	$35 < x \leq 40$	$40 < x \leq 45$	$45 < x \leq 50$	$50 < x \leq 55$	$55 < x \leq 60$
Number of vendors	5	4	7	11	12	8	1

(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 cumulative frequency table below.

Copies of newspapers	≤ 25	≤ 30	≤ 35	≤ 40	≤ 45	≤ 50	≤ 55	≤ 60
Number of vendors	0	5	9	16	27			

[1]

(ii) Using a horizontal scale of 2cm to represent 10 newspapers on the x-axis for $0 \leq x \leq 60$ and a vertical scale of 4cm to represent 10 vendors on the y-axis for $0 \leq y \leq 50$, draw a smooth cumulative frequency curve. [3]

(iii) Showing your method clearly, use your graph to estimate the 50^{th} percentile. [2]

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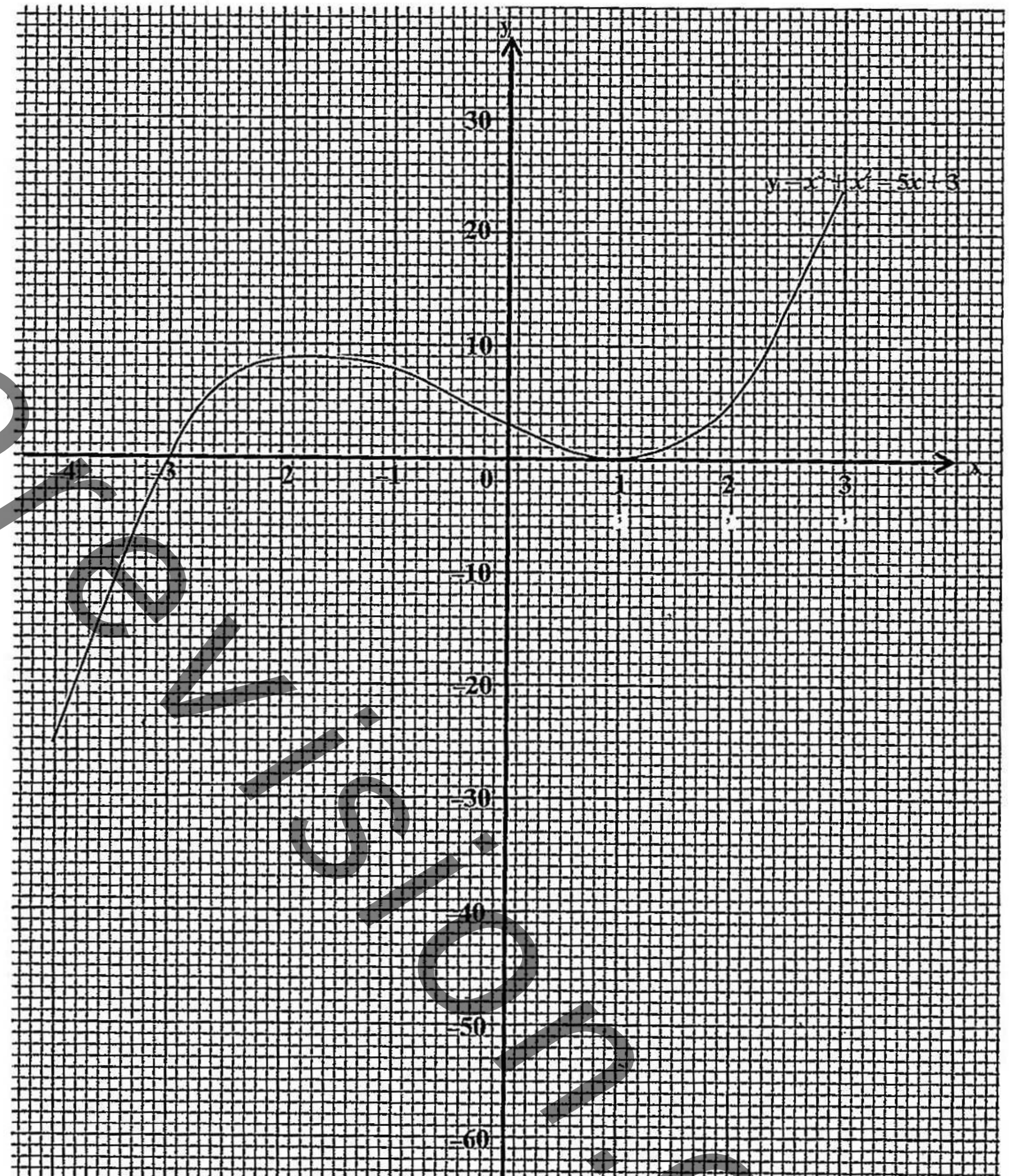
9 (a) The diagram below shows the graph of $y = x^3 + x^2 - 5x + 3$.



Use the graph

(i) to calculate an estimate of the gradient of the curve at the point (2, 5). [2]

(ii) to solve the equations

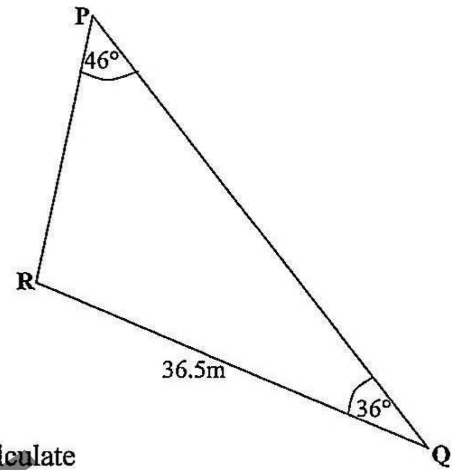
(a) $x^3 + x^2 - 5x + 3 = 0$, [2]

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

(iii) to calculate an estimate of the area bounded by the curve, $x = 0$, $y = 0$ and $x = -2$. [2]

(b) Find the equation of the tangent to the curve $y = x^2 - 3x - 4$ at the point where $x = 2$. [3]

10 **(a)** In triangle PQR below, QR = 36.5m, angle PQR = 36° and angle QPR = 46°.



Calculate

(i) PQ, [4]

(ii) the area of triangle PQR, [2]

(iii) the shortest distance from R to PQ. [2]

(b) Solve the equation $\sin\theta = 0.6792$ for $0° \leq \theta \leq 360°$. [2]

(c) Simplify $\frac{p^2q^3}{4} \times \frac{8}{pq} \div 2p^2q$. [2]

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11 **Answer this question on a sheet of graph paper.**

Makwebo prepares two types of sausages, hungarian and beef, daily for sale. She prepares at least 40 hungarian and at least 10 beef sausages. She prepares not more than 160 sausages altogether. The number of beef sausages prepared are not more than the number of hungarian sausages.

(a) Given that x represents the number of hungarian sausages and y the number of beef sausages, write four inequalities which represent these conditions. [4]

(b) Using a scale of 2cm to represent 20 sausages on both axes, draw the x and y axes for $0 \leq x \leq 160$ and $0 \leq y \leq 160$ 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 hungarian sausage is K3.00 and on each beef sausage is K2.00. How many of each type of sausages are required to be prepared to make maximum profit? [2]

(d) Calculate this maximum profit. [2]

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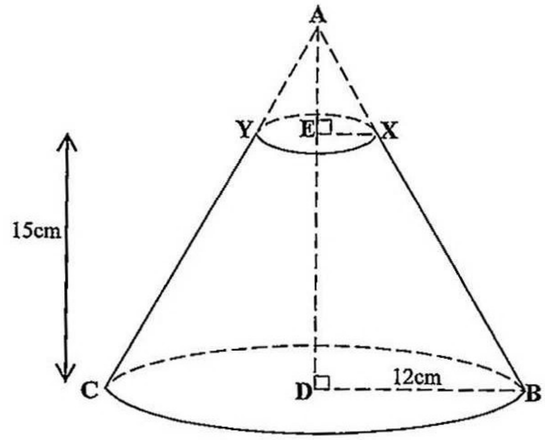
12 (a) The figure below is a cone ABC from which BCXY remained after the small cone AXY was cut off. [Take π as 3.142]



Given that EX = 4cm, DB = 12cm and DE = 15cm, calculate

(i) the height AE, of the smaller cone AXY. [2]

(ii) the volume of XBCY, the shape that remained. [4]

(b) P(80°N, 10°E), Q(80°N, 70°E), R(85°S, 70°E) and S(85°S, 10°E) are four points on the surface of the earth.

(i) Show these points on a clearly labelled sketch of the surface of the earth. [2]

(ii) Find in nautical miles

(a) the distance QR along the longitude, [2]

(b) the circumference of the circle of latitude 85°S. [2]

[Take π as 3.142 and R = 3437nm]