EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

4024-2-060-761

Mathematics 4024/2

Paper 2

2021

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.

This question paper consists of 8 printed pages

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

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

Grouped data

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

Section A (52 Marks)

Answer all questions in this section

1 **(a)** Simplify $\frac{a^2x^2 - b^2y^2}{ax + by}$. [2]

(b) Given the geometric progression 4, 2, 1, …, find

(i) the 7^{th} term, [2]

(ii) the sum of the first 9 terms. [3]

(c) Find the geometric mean of 196 and 15 625. [2]

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2 **(a)** Solve the equation $3x + \frac{5}{x} = 12$, giving your answers correct to 2 decimal places. [5]

(b) A boy has a bag containing 5 green balls, 1 red ball and 4 blue balls. A ball is selected at random from the bag and not replaced. A second ball is then selected.

(i) Draw a tree diagram to show all the possible outcomes. [2]

(ii) Find the probability that the two balls are of the same colour. [3]

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

(a) Construct triangle EFG in which EF = 11cm, EG = 6.5cm and GF = 10cm. [1]

(b) Measure and write the size of angle EGF. [1]

(c) Within triangle EFG, construct the locus of points which are;

(i) equidistant from EG and EF, [2]

(ii) 2.5cm from EF, [1]

(iii) equidistant from E and F. [1]

(d) A point P, within triangle EFG is such that it is nearer to EF than to EG, nearer to E than to F and is greater than or equal to 2.5cm away from EF. Indicate clearly by shading, the region in which P must lie. [2]

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4 **(a)** In a group of 60 football fans, 37 support Team A, 28 support Team B and 29 support Team C.
2 support Team A and Team C only,
5 support Team B and Team C only,
7 support Team A and Team B only,
18 support Team A only and
10 support all the three teams.

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

(ii) Find

(a) $n(B)'$, [1]

(b) $n(A \cap B)'$, [1]

(c) $n(A \cup B)'$. [1]

(b) Given that the determinant of the matrix $A = \begin{pmatrix} 2x-1 & 1 \\ 4 & -2 \end{pmatrix}$ is -10, find

(i) the value of x, [2]

(ii) the inverse of matrix A. [2]

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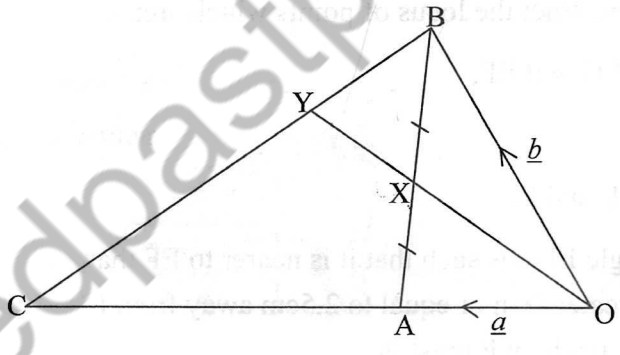
5 **(a)** Find the equation of a tangent to the curve $y = 5x^3 - 7x^2 + 3x + 2$ at the point (1, 3). [3]

(b) In the diagram below $\overrightarrow{OA} = \underline{a}$, $\overrightarrow{OB} = \underline{b}$ and X is the midpoint of AB.



(i) Express in terms of $\underline{a}$ and/or $\underline{b}$

(a) $\overrightarrow{BA}$, [1]

(b) $\overrightarrow{AX}$, [1]

(c) $\overrightarrow{OX}$. [2]

(ii) Given that $\overrightarrow{OC} = 3\underline{a}$, express $\overrightarrow{BC}$ in terms of $\underline{a}$ and $\underline{b}$. [1]

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

(b) The programme below is given in form of a pseudocode.

```
Start
  Enter length
    If length < 0 THEN
      Display error message "length must be positive"
  Else enter height
    If height < 0 THEN
      Display error message "height must be positive"
    Else volume = 1/3 * length ∧ 3* height
    End if
  Display volume
  Stop
```

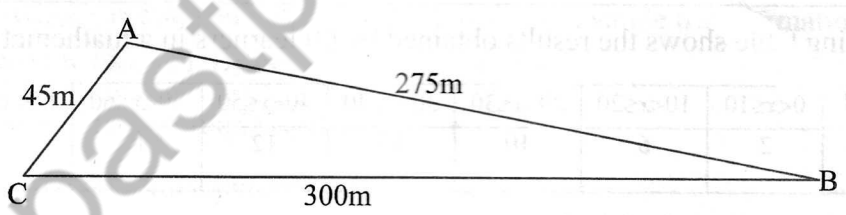
Draw a corresponding flowchart for this pseudocode. [5]

Section B [48 marks]

Answer any four questions in this section.

Each question in this section carries 12 marks.

7 **(a)** In triangle ABC below, AB = 275m, AC = 45m and BC = 300m.



Calculate

(i) angle BAC, [5]

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

(iii) the shortest distance from A to BC. [2]

(b) Solve the equation $\cos\theta = -0.5$ for which $180° \leq \theta \leq 360°$. [1]

(c) Simplify $\frac{18a^2b}{16c^3d^2} \div \frac{24a}{15cb^3} \times \frac{8c^2d^3}{30a^3b}$. [2]

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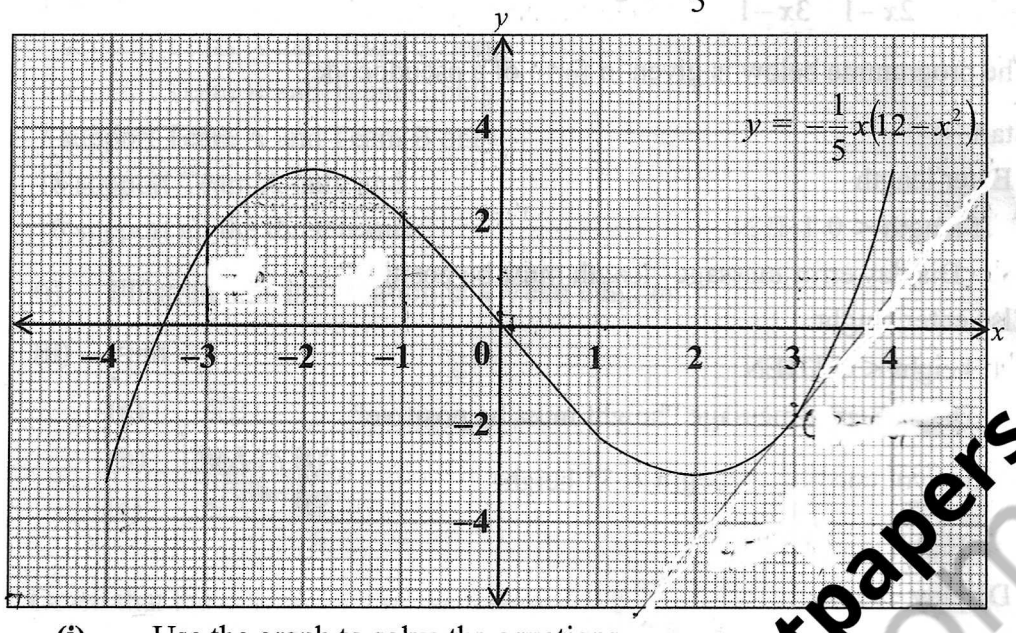
8 **(a)** The following diagram shows the graph of $y = -\frac{1}{5}x(12 - x^2)$.



(i) Use the graph to solve the equations

(a) $-\frac{1}{5}x(12 - x^2) = 1$, [2]

(b) $-\frac{1}{5}x(12 - x^2) = -2$. [2]

(ii) Calculate an estimate of the

(a) area bounded by the curve and the lines $y = 0$, $x = -3$ and $x = -1$, [3]

(b) gradient of the curve at the point (3, −1.8). [2]

(b) Find the equation of the curve for which $\frac{dy}{dx} = 2x - 3$ where $x = y = 3$. [3]

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9 The following table shows the results obtained by 60 learners in a mathematics test.

Marks scored	$0<x\leq10$	$10<x\leq20$	$20<x\leq30$	$30<x\leq40$	$40<x\leq50$	$50<x\leq60$	$60<x\leq70$	$70<x\leq80$
Number of learners	2	6	10	15	12	8	4	3

(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.

Marks scored	≤ 0	≤ 10	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	≤ 70	≤ 80
Number of learners	0	2	8	18	33	45			

[1]

(ii) Using a scale of 2cm to represent 10 units on both axes for $0 \leq x \leq 80$ and $0 \leq y \leq 60$, draw a smooth cumulative frequency curve. [3]

(iii) Showing your method clearly, use your graph to estimate the interquartile range. [2]

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

A businessman orders two types of vehicles namely; sedans and vans for sale. He orders at least 60 sedans and at least 20 vans. He orders not more than 180 vehicles altogether. He makes sure that the number of vans ordered are not more than the number of sedans ordered.

(a) Given that x represents the number of sedans and y represents the number of vans, write four inequalities which satisfy the above conditions. [4]

(b) Using a scale of 2cm to represent 20 vehicles on each axis, draw x and y axes from 0 to 180 and shade the unwanted region to show clearly the region where the solution of the inequalities lie. [4]

(c) If the profit on the sale of a sedan is K10 000.00 and that on each van is K12 000.00, how many of each type should he order to make maximum profit? [2]

(d) Find this maximum profit. [2]

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

The vertices of triangle ABC are A(40, 30), B(40, 70) and C(70, 70) while that of triangle $A_1B_1C_1$ are A_1(20, 15), B_1(20, 35) and C_1(35, 35).

(a) Using a scale of 2cm to represent 10 units on each axis for values of x and y from 0 to 70, draw and label triangles ABC and $A_1B_1C_1$. [2]

(b) Describe fully a single transformation that maps triangle ABC onto triangle $A_1B_1C_1$. [3]

(c) A rotation of 180° about (20, 40) maps triangle $A_1B_1C_1$ onto triangle $A_2B_2C_2$. Determine the coordinates of A_2, B_2 and C_2. [3]

(d) Triangle $A_1B_1C_1$ is mapped onto triangle $A_3B_3C_3$ by a single transformation with vertices A_3(40, 15), B_3(40, 35) and C_3(70, 35).

(i) Draw and label triangle $A_3B_3C_3$. [1]

(ii) Describe fully this transformation. [3]

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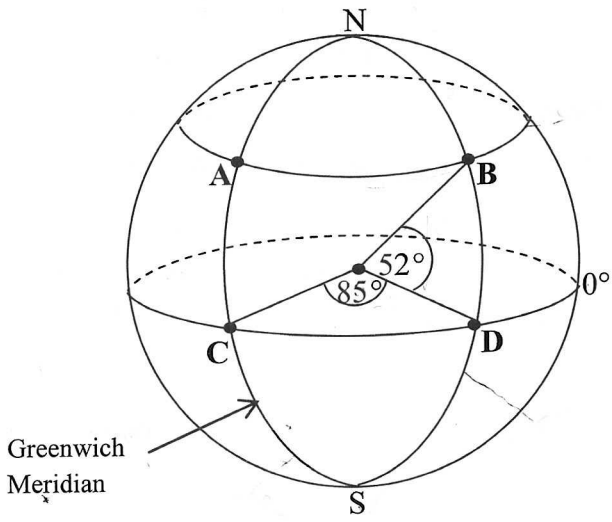
12 **(a)** The points A, B, C and D are on the surface of the earth as shown in the following diagram. (Take π as 3.142, R = 6 370km or 3 437nm)



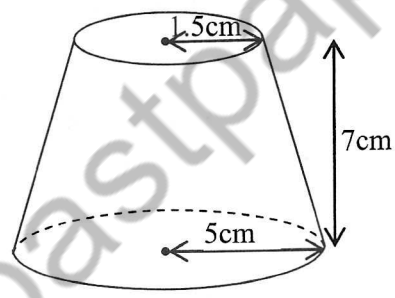
(i) Determine the difference in longitude between points A and B. [1]

(ii) Calculate the distance between points

(a) C and D along the equator in nautical miles, [2]

(b) B and D along longitude NBDS in kilometres. [3]

(b) The following diagram shows a frustum of a cone. The radii of the circles at the top and bottom are 1.5cm and 5cm respectively. Its height is 7cm.



Calculate the volume of the frustum. (Take π as 3.142) [6]