



47092417



EXAMINATIONS COUNCIL OF ZAMBIA



Examination for School Certificate Ordinary Level

Additional Mathematics

4030/2

Paper 2

Monday

20 NOVEMBER 2023

Additional Materials:

Answer Booklet,
Silent electronic calculator (non programmable),
Graph 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 There are **twelve** questions in this paper. Answer **all** questions.
- 3 Write your answers in the separate Answer Booklet provided.
- 4 If you use more than one Answer Booklet, fasten the Answer Booklets together.
- 5 Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Information for Candidates

- 1 The number of marks is shown in brackets [] at the end of each question or part question.
- 2 **The use of a non programmable electronic calculator is expected, where appropriate.**
- 3 You are reminded of the need for clear presentation in your answers.
- 4 Cell phones are **not allowed** in the examination room.
- 5 Check the formulae overleaf.

Mathematical Formulae

1 ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2 SERIES

Arithmetic $S_n = \frac{1}{2} n [2a + (n-1)d]$

Geometric $S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$

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

3 TRIGONOMETRY

Identities

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

4 STATISTICS

Mean and standard deviation

Ungrouped data

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

Grouped data

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

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1 Solve the following systems of equations:

$$x + 2y - z = 3,$$

$$3x + y - 2z = 6,$$

$$2x + 5y + z = 13.$$

[6]

2 (a) Find the range of values of x for which $3x^2 - 14x + 8 > 0$.

[3]

(b) Express $9 - 4x - 3x^2$ in the form $a - b(x + c)^2$, where a , b and c are constants. Hence, find the coordinates of the turning point.

[4]

3 Solve the equations

(a) $6^x = 3^{x+2}$,

[3]

(b) $\log_6(18x + 6) = 2 + \log_6(2x - 5)$.

[4]

4 (a) Find the value of a , given that the expression $x^3 - 6x^2 + ax - 3$ is divisible by $x - 3$.

[3]

(b) Factorise the expression $2x^3 + 3x^2 - 17x + 12$.

[4]

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5 (a) In how many ways can 6 red flags and 7 green flags be placed in a straight line if

(i) there are no restrictions,

[2]

(ii) flags of the same colour should be next to each other.

[3]

(b) A committee of 10 people has to be chosen from 6 men and 7 women. Find the number of ways of choosing 4 men and 6 women.

[3]

6 (a) Solve the equation $\sqrt{2} \sin(x + 45^\circ) = 4 \cos x$ for values of x in the range $0^\circ \leq x \leq 360^\circ$.

[4]

(b) (i) Express $5 \sin \theta + 12 \cos \theta$ in the form $R \sin(\theta + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$.

[3]

(ii) Hence, find the maximum value of $10 \sin \theta + 24 \cos \theta$.

[1]

- 7 (a) The 12th term of an arithmetic progression is 30 and the 20th term is 78.

Find the

(i) first term and the common difference, [3]

(ii) number of terms whose sum is 90. [3]

- (b) The sum of the first two terms of a geometric progression is $\frac{35}{2}$ and the third term

is $\frac{14}{3}$, where $r > 0$. Find the value of the common ratio. [3]

- 8 The table shows the distribution of examination marks of 115 learners.

Marks	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
Frequency	5	14	22	29	27	14	4

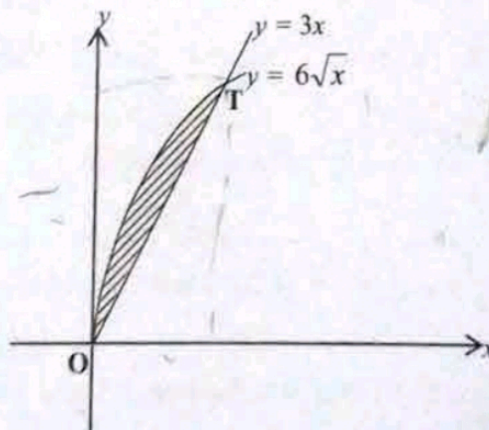
(a) Find the median class. [1]

(b) Calculate

(i) an estimate of the mean, [2]

(ii) the standard deviation. [6]

- 9 The diagram shows part of the curve $y = 6\sqrt{x}$ and part of the straight line $y = 3x$ intersecting at the points O and T.



Find the

(a) coordinates of T, [4]

(b) volume generated when the shaded region is rotated through 360° about the x-axis. [5]

- 10 A particle moves in a straight line so that its velocity, V m/s, at time t seconds from the start is given by $V = 6t^2 - 30t + 24$ ($t \geq 0$). If it started 20 metres from a fixed point O , find
- (a) the value of t when it is at instantaneous rest, [3]
- (b) its positive acceleration at that time, [3]
- (c) its distance from O , when the acceleration is positive. [4]
-
- 11 (a) A curve has the equation $y = x^3 + 6x^2 - 36x + 25$.
- (i) Find the coordinates of the stationary points. [4]
- (ii) Determine the nature of the stationary points. [3]
- (b) A curve has an equation $y = 2x + 3 \cos x$. Find the smallest positive value of x for which the curve has gradient $\frac{1}{2}$. [3]
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- 12 (a) The curves $y = e^{4-3x}$ and $y = e^{x-8}$ intersect at a point P . Find the coordinates of the point P . [3]
- (b) Sketch the curve $y = \ln(x+3)$ for $-2 \leq x \leq 4$, taking values of x at unit intervals. [3]
- (c) Find the equation of the straight line which must be drawn on the graph of $y = 3 - e^{2x}$ to obtain the solution of the equation $x = \ln \sqrt{2-x}$. [4]

$$\frac{a(r^n - 1)}{r - 1}$$

$$\frac{a(r^n - 1)}{r - 1}$$