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# EXAMINATIONS COUNCIL OF ZAMBIA



## Examination for School Certificate Ordinary Level

### Additional Mathematics

4030/2

Paper 2

Wednesday

24 NOVEMBER 2021

#### Additional Materials:

- Answer Booklet
- Silent electronic calculator (non programmable)

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 and other electronic devices 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

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

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

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

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

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

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

## 4 STATISTICS

Mean and standard deviation

Ungrouped data

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

Grouped data

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

1 Solve the following systems of equations

$$-x + 4y + 2z = 8,$$

$$3x - y + 4z = -1,$$

$$2x + 3y - z = 14.$$

[6]

2 (a) Find the range of values of  $x$  for which  $x(11 - x) \leq 18$ .

[3]

(b) Express  $4x^2 - 3x - 1$  in the form  $a(x + b)^2 + c$ , where  $a$ ,  $b$  and  $c$  are constants. Hence, find the coordinates of the turning point.

[4]

3 Solve the equations

(a)  $6^{2x-1} = 13,$

[3]

(b)  $\log_4(2x + 3) - 3 = \log_4 x.$

[4]

4 The expression  $x^3 - px^2 - qx + 40$  is exactly divisible by  $(x + 4)$  and leaves a remainder of 56 when it is divided by  $(x + 2)$ .

(a) Find the value of  $p$  and of  $q$ .

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(b) Hence, factorise the expression  $x^3 - px^2 - qx + 40$ .

[3]

5 (a) In how many ways can the letters of the word CUSTOMIZED be arranged in a straight line if

(i) there are no restrictions,

[2]

(ii) the letters T, O and M should not be next to each other.

[3]

(b) A committee of 5 learners is to be chosen from 7 girls and 4 boys. Find the number of ways of choosing at least 3 boys.

[3]

6 Find all the angles between  $0^\circ$  and  $360^\circ$  for which

(a)  $\operatorname{cosec} x = -1.43,$

[2]

(b)  $\sqrt{3}\cos(x - 60^\circ) = 4\sin x,$

[3]

(c)  $\sin 2x - \cos x = 0.$

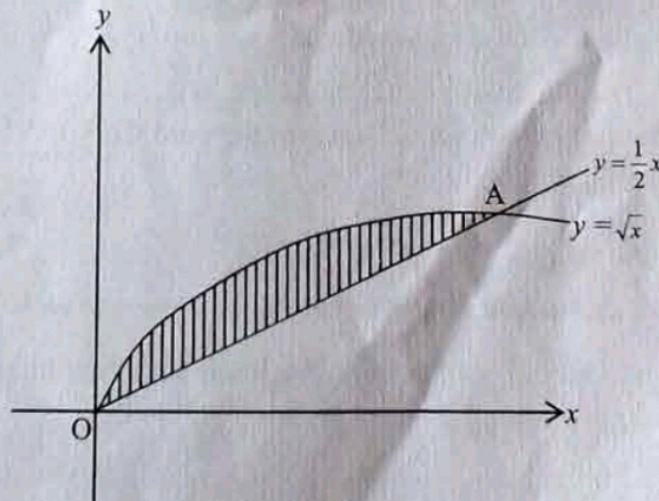
[3]

- 7 (a) If the 4<sup>th</sup> and 8<sup>th</sup> terms of an arithmetic progression are  $\frac{5}{14}$  and  $\frac{1}{14}$  respectively, find the sum of the first 20 terms. [4]
- (b) In a geometric progression, the product of the 1<sup>st</sup> and 7<sup>th</sup> terms is equal to the 4<sup>th</sup> term while the sum of the 1<sup>st</sup> and 4<sup>th</sup> terms is equal to 28. Find the sum of the first 5 terms. [5]

8 The number of farmers who have dairy animals in a certain district is as follows:

Number of dairy animals	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50
Number of farmers	4	3	5	14	18	10	5	7	1	3

- (a) State the median class. [1]
- (b) Calculate an estimate of the
- (i) mean, [2]
- (ii) standard deviation. [6]
- 9 The following diagram shows part of the curve  $y = \sqrt{x}$  and the straight line  $y = \frac{1}{2}x$  meeting at the point A.



Find

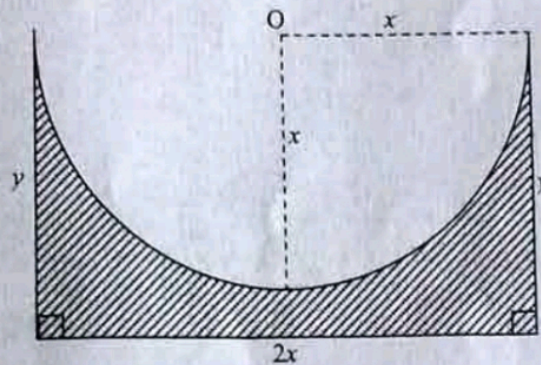
- (a) the coordinates of A, [3]
- (b) the volume obtained by rotating the shaded region through  $360^\circ$  about the x-axis. [6]

- 10 The velocity,  $V \text{ ms}^{-1}$ , of a particle moving in a straight line,  $t$  seconds after passing through a fixed point O, is given by  $V = 3t - t^2$ . The particle comes to instantaneous rest at P.

Find

- (a) the time taken to reach P, [3]  
 (b) the acceleration at P, [3]  
 (c) the distance OP. [4]

- 11 (a) A curve has equation  $y = 3x + 3\cos x$ . Find the smallest positive value of  $x$  for which the curve has a gradient of  $\frac{1}{4}$ . [4]
- (b) A piece of wire 80cm long is bent to form the shape shown in the following diagram. The curved part is a semi-circle with centre O, and the two corners are right-angled.



- (i) Given that  $\pi = \frac{22}{7}$ , show that the area,  $A \text{ cm}^2$ , of the shape is given by  

$$A = 80x - \frac{47}{7}x^2$$
 [4]
- (ii) Given that  $x$  can vary, find the value of  $x$  for which  $A$  is stationary. [2]

- 12 (a) The curve  $y = e^x - 3e^{-x}$  meets the  $x$ -axis at A. Find the coordinates of A. [3]
- (b) Sketch the graph of  $y = e^x - 3e^{-x}$  for the values of  $x$  at intervals of 0.5 from  $x = 0$  to  $x = 2$ . [4]
- (c) Hence, determine the equation of a straight line which can be drawn to find the solution of the equation  $e^{2x} - 2e^x - 3 = 0$ . [3]