EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Additional Mathematics 4030/2

Paper 2

Monday **20 NOVEMBER 2017**

Additional Materials:

Answer Booklet
Silent electronic calculator (non programmable)

Time: 2 hours 30 Minutes

Instructions to Candidates

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

There are **twelve (12)** questions in this paper. Answer **all** questions.

Write your answers on the **Answer Booklet** provided.

If you use more than one Answer Booklet, **fasten** the Answer Booklets together.

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

The number of marks is shown in brackets [ ] at the end of each question or part question. The total number of marks for this paper is 100.

The use of a non programmable electronic calculator is expected, where appropriate.

Cell phones are not allowed in the examination room.

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 $\quad Sn = \frac{1}{2} n \{2a + (n-1)d\}$

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

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

3 TRIGONOMETRY

Identities

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

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

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

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

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

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

4 STATISTICS

Mean and standard deviation

Ungrouped data

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

Grouped data

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

1 Solve the following systems of equations

$2a + b - c = -1$,

$a + 3b - 2c = -6$,

$5a + 2b + c = 5$. [6]

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2 **(a)** Find the range of values of x for which $2x^2 < 3x + 14$. [3]

(b) Express $6 + 4x - x^2$ in the form $a(x + b)^2 + c$, where a, b and c are constants. Hence, find the coordinates of the turning point. [4]

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3 Solve the equations

(a) $3^{x+1} = 5$, [3]

(b) $\log_7 (2x - 3) + 2 = \log_7 (17x + 15)$. [4]

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4 **(a)** Find the value of k, given that the expression $x^3 + kx^2 + 2x + 12$ is divisible by $(x - 3)$. [3]

(b) Factorise the expression $2x^3 + x^2 - 13x + 6$. [4]

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5 **(a)** In how many ways can 5 girls and 4 boys be put in a straight line if

(i) the girls are together, [2]

(ii) no two boys are together. [3]

(b) A group of 5 students is to be chosen from 5 girls and 4 boys. Find the number of ways of choosing 3 girls and 2 boys. [3]

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6 **(a)** Solve the equation $\sqrt{2} \cos (x - 45°) = 4 \sin x$ for values of x in the range $0° \leq x \leq 360°$. [4]

(b) **(i)** Express $5 \sin \theta - 12 \cos \theta$ in the form $R \sin (\theta - \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. [3]

(ii) Hence find the maximum value of $R \sin (\theta - \alpha)$. [1]

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7 **(a)** The sum of the first 6 terms of an arithmetic progression is 57 and the sum of the next 7 terms is 203. Find the

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

(ii) sum of the first 12 terms of the progression. [2]

(b) The third term of a geometric progression is 32 and the ninth term is $\frac{1}{2}$.

Find the

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

(ii) sum to infinity. [1]

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8 The table below shows the points scored by 110 students in an examination.

Points scored	6 – 8	8 – 10	10 – 12	12 – 14	14 – 16	16 – 18	18 – 20
Frequency	13	16	9	15	22	15	20

(a) Find the median class. [1]

(b) Calculate

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

(ii) the standard deviation. [6]

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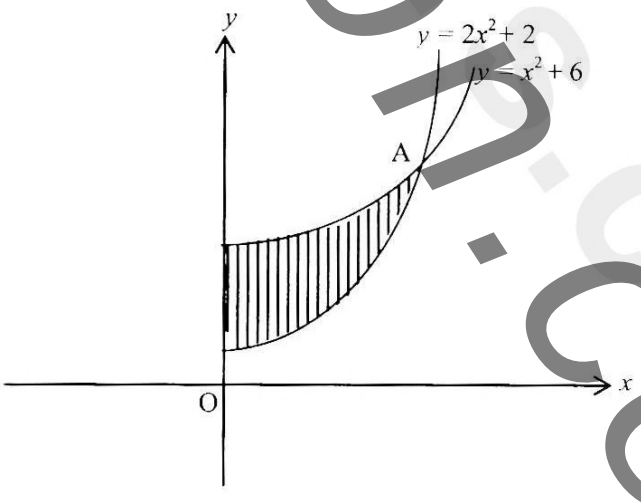
9 The diagram below shows part of the curves $y = x^2 + 6$ and $y = 2x^2 + 2$ meeting at the point A.



Find

(a) the coordinates of A, [3]

(b) the volume obtained by rotating the shaded region through 360° about the x-axis. [6]

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10 The velocity, Vm/s, of a particle travelling in a straight line, at time t seconds after leaving a fixed point O, is given by $V = qt - 3t^2 + 10$, where $t \geq 0$ and q is a constant. When $t = 0$, the particle is at O and its acceleration is $1 m/s^2$. Find

(a) the value of q, [3]

(b) the value of t when the particle is at instantaneous rest, [3]

(c) the distance the particle has travelled when it is at instantaneous rest. [4]

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11 **(a)** A curve has the equation $y = -2x^3 + 3x^2 + 12x + 27$.

(i) Find the stationary points. [4]

(ii) Determine the nature of the stationary points. [2]

(b) A curve has an equation $y = \ln x$. Determine the equation of the straight line which can be drawn to find the solution of the equation $x^2 e^{x-2} = 1$. [4]

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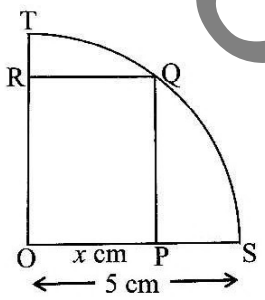
12 **Answer only one of the following alternatives:**

EITHER

(a) A curve has gradient function $\frac{dy}{dx} = 6x^2 + 4x - 5$ and passes through the point (2, 10). Find the equation of the curve. [4]

(b) The diagram below shows a quarter circle with radius 5cm. OPQR are vertices of a rectangle on the quarter circle and OP = x cm.



(i) Given that the area of the rectangle OPQR is $A cm^2$, show that the square of the rectangular area, A^2, is given by $A^2 = (25 - x^2)x^2$. [3]

(ii) Find the values of x for which A^2 is stationary. [3]

OR

(a) In an arithmetic progression, the 5^{th} term is three times the second term. The sum of the first ten terms is 50. Find the first term and the sum of the first 30 terms. [6]

(b) The fifth term of a geometric progression is 8, the third term is 4 and the common ratio is positive. Find the first term, the common ratio and the sum of the first twelve terms. [4]