EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Additional Mathematics 4030/2

PAPER 2

Monday 26 OCTOBER 2015

Additional materials:
Answer Booklet
Mathematical tables/Electronic calculators
Graph paper (1 sheet)

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

$\sin^2 A + \cos^2 A = 1.$

$\sec^2 A = 1 + \tan^2 A.$

$\operatorname{cosec}^2 A = 1 + \cot^2 A.$

Formula for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$\Delta = \frac{1}{2} bc \sin A$$

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

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

1 Solve the simultaneous equations

$4x - y + z = 10$,

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

$2x + y + 2z = 5$. [6]

2 **(a)** Solve the inequality $2x^2 + x < 3 - 4x$. [3]

(b) Given that $h(x) = -2x^2 + 16x - 24$, express $h(x)$ in the form $a(x - b)^2 + k$ where a, b and k are constants. Hence state the maximum value of $h(x)$. [4]

3 Solve the equations

(a) $7^{x-1} = 0.432$, [3]

(b) $\lg (x + 6) - \lg (x - 3) = 1$. [4]

4 **(a)** Given that the expression $2x^3 + px^2 - 8x + q$ is exactly divisible by $2x^2 - 7x + 6$, find the values of p and q. [4]

(b) Given that $3x^3 - 13x^2 + 18x - 10 = (Ax + B)(x - 1)(x - 2) + C$ for all values of x. Find the values of A, B and C. [4]

5 **(a)** In how many ways can seven Additional Mathematics books and two English books be arranged on a shelf if

(i) there are no restrictions, [2]

(ii) one English book is put at one end and the other English book at the other end. [3]

(b) In how many ways can a president, a vice president, a secretary, a treasurer and 2 committee members be appointed from a group of 10 candidates? [3]

6 Find all the angles between 0° and 360° which satisfy the equations

(a) $\cos x = -0.4713$, [2]

(b) $5 \sin \theta - 13 \cos \theta = 0$, [2]

(c) $4 \tan^2 y + 4 \sec y + 1 = 0$. [4]

7 The first term of an arithmetic progression is 8 and the common difference is d, where $d \neq 0$. The first term, the fifth term and the eighth term of this arithmetic progression are the first term, the second term and the third term respectively, of a geometric progression whose common ratio is r.

(a) **(i)** Write two equations connecting d and r. [1]

(ii) Hence find the value of r and the value of d. [3]

(b) Find the sum to infinity of the geometric progression. [2]

(c) Find the sum of the first 8 terms of the arithmetic progression. [3]

8 The masses of 40 packets of tea of a certain brand, measured correct to the nearest gram, are shown in the table below.

Mass (grams)	140 – 144	145 – 149	150 – 154	155 – 159	160 – 164
No of packets	5	10	9	8	8

(a) State the median class. [1]

(b) Find

(i) an estimate of the mean, [3]

(ii) the standard deviation. [5]

9 A particle moves in a straight line so that its velocity V ms^{-1} at time t seconds from the start is given by $V = 4t - \frac{t^2}{2}$.

(a) Find

(i) an expression for acceleration, a, in terms of t, [1]

(ii) the acceleration when $t = 2$. [1]

(iii) the maximum velocity. [3]

(b) If the particle started from a fixed point O on the line, how far is it from O after 8 seconds? [4]

10 **(a)** The equation of a curve is $y = \frac{6}{5-2x}$. Calculate the gradient of the curve at the point where $x = \frac{1}{2}$. [3]

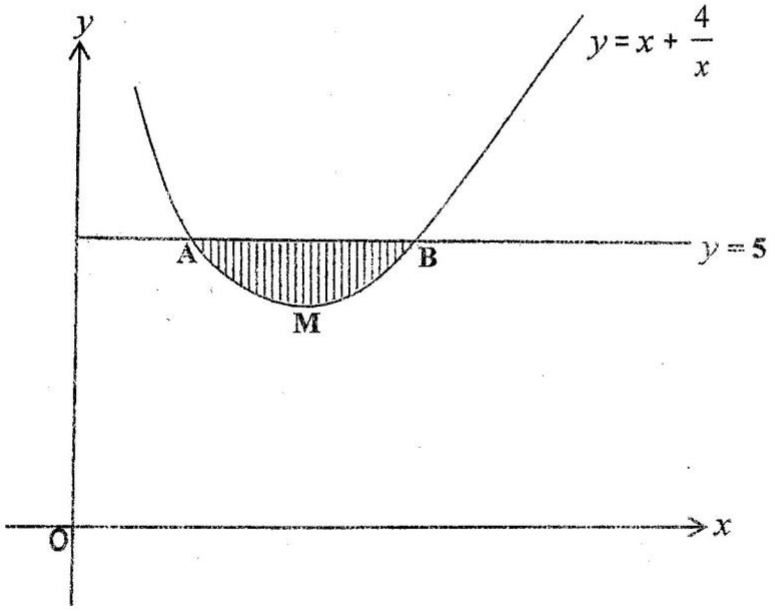
(b) A curve has the equation $p = 2t^3 - 3t^2 - 12t + 18$.

(i) Find the stationary points. [3]

(ii) Determine the nature of the stationary points. [3]

11 The diagram below shows part of the curve $y = x + \frac{4}{x}$ which has a minimum point at **M**.

The line $y = 5$ intersects the curve at the points **A** and B.



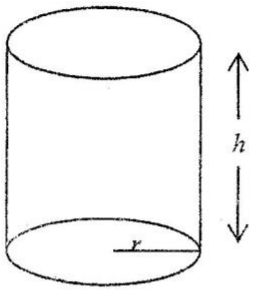
(a) Find the coordinates of **A**, **B** and **M**. [4]

(b) Find the volume obtained when the shaded region is rotated through 360° about the x-axis. [6]

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

EITHER

A closed cylinder shown below is made from thin sheet metal. Its radius is r cm and height h cm. The volume of the cylinder is 600cm^3 and its external surface area is $\mathbf{A}\text{cm}^2$.



(a) Show that $\mathbf{A} = 2\pi r^2 + \frac{1200}{r}$. [3]

(b) Find the value, to two significant figures, of r and h for which **A** has a stationary value. [3]

(c) Calculate the stationary value of **A** and determine whether it is a maximum or a minimum. [4]

OR

(a) The third and sixth terms of a geometric progression are $2\frac{2}{3}$ and $\frac{8}{81}$ respectively. Find the sum to infinity. [4]

(b) An arithmetic progression has third term 90 and fifth term 80.

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

(ii) Find the value of p, given that the sum of the first p terms is equal to the sum of the first $(p + 1)$ terms. [3]