EXAMINATIONS COUNCIL OF ZAMBIA
Examination for General Certificate of Education Ordinary Level

Additional Mathematics 4030/2
Paper 2

Wednesday 27 JULY 2016

Additional materials:
- Answer Booklet
- Mathematical tables/Electronic calculators (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 in 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.
MATHMATICS 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 \( S_n = \frac{a(1-r^n)}{1-r} \) (\( r \neq 1 \))
\[
S_\infty = \frac{a}{1-r} \text{ for } |r| < 1
\]

3 TRIGONOMETRY
Identities
\( \sin^2 A + \cos^2 A = 1 \).
\( \sec^2 A = 1 + \tan^2 A \).
\( \csc^2 A = 1 + \cot^2 A \).
Formula for \( \Delta ABC \)
\[
\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}
\]
\( a^2 = b^2 + c^2 - 2bc \cos A \).
\( \Delta = \frac{1}{2} bc \sin A \)

4 STATISTICS
Mean and standard deviation
Ungrouped data
\[
\text{Mean (} \bar{x} \text{)} = \frac{\sum x}{n}, \text{ SD } = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} = \sqrt{\frac{\sum x^2}{n} - (\bar{x})^2}
\]
Grouped data
\[
\text{Mean (} \bar{x} \text{)} = \frac{\sum fx}{\sum f}, \text{ SD } = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2}
\]
1 Solve the simultaneous equations

\[ x + 4y + 3z = 10, \]
\[ 2x + y - z = -1, \]
\[ 3x - y + z = 11. \]  

2 (a) Solve the inequality \(3x^2 < 10x - 3.\)  
(b) Given that \(y = 7 - 5x - 3x^2,\) express \(y\) in the form \(a - b(x + c)^2,\) where \(a, b\) and \(c\) are constants. Hence or otherwise, write the coordinates of the turning point of \(y.\)  

3 Solve the equations

(a) \(8^{x-1} = 3,\)  
(b) \(\log_2 (2x + 1) = 2 + \log_2 (3x - 1).\)  

4 The expression \(x^3 + ax^2 + bx + 12\) is divisible by \((x - 1)\) and \((x + 3).\)

(a) Find the values of \(a\) and \(b.\)  
(b) Find the remaining factor of the expression.  
(c) Hence or otherwise, solve the equation \(x^3 + ax^2 + bx + 12 = 0.\)  

5 (a) Calculate the number of arrangements of the letters in the word LOGARITHMS.  
(b) 12 different books are to be arranged on a shelf. If the shelf has a space for 8 books, how many ways are there of arranging 8 of the books on the shelf?  
(c) A committee of 6 members is to be chosen from 5 students and 4 teachers. Find the number of ways of choosing 4 students and 2 teachers.  

6 (a) The volume \(V\) cm\(^3\) of a liquid in a container when the depth of the liquid is \(x\) cm is given by \(V = 2x^3 - 4x^2 + 5.\)

Given that the depth is increasing at the rate of 1.5 cm/s, find the rate of increase in the volume of the liquid when \(x = 4.\)  

(b) The velocity, \(V\) m/s, of a particle moving in a straight line is given by \(V = 4 + 3t - t^2.\) Find

(i) the value of \(t\) when the particle is at instantaneous rest,  
(ii) the maximum velocity,  
(iii) the displacement of the particle from \(O\) when \(t = 4.\)
7 (a) The 9th term of an arithmetic progression is 22 and the sum of the first 4 terms is 49. Find the first term and the common difference. [4]

(b) The 4th term and the 10th term of a geometric progression are 256 and 4 respectively. Find

(i) the first term and the common ratio, [2]

(ii) the sum to infinity of the progression. [2]

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

(a) \[ \sin \theta = -0.5921, \] [2]

(b) \[ 6 \sin x \cos x = \sin x, \] [3]

(c) \[ 2 \sec^2 y = 3 - \tan^2 y. \] [4]

9 The table below shows the marks obtained by 35 candidates in an examination.

<table>
<thead>
<tr>
<th>Marks</th>
<th>35</th>
<th>45</th>
<th>55</th>
<th>65</th>
<th>75</th>
<th>85</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) State the median mark. [1]

(b) Find the mean mark. [4]

(c) Calculate the standard deviation. [4]

10 A closed cylinder has radius \( r \) cm and height \( h \) cm. The volume of the cylinder is 1500 cm³.

(a) Find an expression of \( h \) in terms of \( r \). [2]

(b) Show that the total surface area, \( A \) cm², of the cylinder is given by

\[ A = 2\pi r^2 + \frac{3000}{r}. \] [2]

(c) Given that \( r \) varies, find correct to 2 decimal places, the value of \( r \) when \( A \) has a stationary value. [4]

(d) Find the stationary value of \( A \) and determine its nature. [2]
11 (a) Evaluate \( \int_1^2 \frac{x^2+1}{x^3} \, dx \). \hspace{1cm} [3]

(b) The diagram below shows part of the curve \( y = x^2 + 3 \) and the line \( y = 4x \) intersecting at A and B.

(i) Find the coordinates of A and B. \hspace{1cm} [3]

(ii) Calculate the volume generated when the shaded region is rotated through 360° about the x-axis. \hspace{1cm} [4]

12 Answer only one of the following alternatives:

EITHER

A curve \( y = x + \frac{4}{x} \) passes through a point P, where \( x = 4 \).

(a) Find the equation of the tangent to the curve at the point P. \hspace{1cm} [3]

(b) Find the equation of the normal at the point P. \hspace{1cm} [3]

(c) Find the co-ordinates of the point Q, where the normal meets the curve again. \hspace{1cm} [4]
OR

(a) The first term of an arithmetic progression is 6. Given that the sum of the first 8 terms is 160 and the sum of all the terms is 240, calculate

(i) the common difference, [2]
(ii) the number of terms. [3]

(b) The numbers $x + 3$, $5x + 3$ and $11x + 3$ ($x \neq 0$) are three consecutive terms of a geometric progression. Find

(i) the value of $x$, [3]
(ii) the sum to infinity of the progression. [2]
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