INSTRUCTIONS TO CANDIDATES
Write your name, Centre number and candidate number in the spaces provided on the separate answer paper/answer booklet.

Write your answers and working on the separate answer paper provided. Show all your working on the same page as the rest of the answer. Omission of essential working will result in loss of marks.

Section A
Answer all questions.

Section B
Answer one question.

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

You are expected to use an electronic calculator to evaluate explicit numerical expressions. If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For \( \pi \), use either your calculator value or 3.142, unless the question requires the answer in terms of \( \pi \).
Section A [88 marks]

Answer all questions in this section.

1 (a) Solve the equation \((x + 1)(x - 3) = 12\). [2]

(b) Given that \(p = \sqrt{\frac{2m+5}{m-3}}\), express \(m\) in terms of \(p\). [3]

(c) Express as a single fraction in its simplest form \(\frac{3}{t-4} - \frac{2}{2t+3}\). [3]

2

In the diagram, \(A, B\) and \(C\) are points on the circumference of a circle, whose centre is \(O\). \(BT\) is the tangent to the circle at \(B\) and \(AOCT\) is a straight line. Angle \(\angle TBC = 33^\circ\).

(a) Showing all of the reasons, find

(i) \(\hat{O}CB\), [3]
(ii) \(\hat{CAB}\), [2]
(iii) \(\hat{BTC}\). [2]

(b) A point, \(P\), is to be marked on the diagram, on the same side of \(BC\) as \(O\), so that \(\hat{BPC} = 28^\circ\).

Does the point \(P\) lie on the circumference of the circle, inside the circle or outside the circle?

Give a reason for your answer. [2]
[The volume of a pyramid = \frac{1}{3} \text{ base area} \times \text{height}.]

The diagram shows a pyramid, \(VABCD\), which has a horizontal square base, \(ABCD\), of side 20 cm. The slant edges of the pyramid (\(VA, VB, VC\) and \(VD\)) are each of length 18 cm. The vertical line \(VN\) meets the plane \(ABCD\) at \(N\).

Calculate

(a) \(VAB\),

(b) \(VN\),

(c) \(AVC\),

(d) the volume of the pyramid.
Part of a pattern of numbers is shown in the table below.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row 1</td>
<td>97</td>
<td>2</td>
</tr>
<tr>
<td>Row 2</td>
<td>94</td>
<td>8</td>
</tr>
<tr>
<td>Row 3</td>
<td>91</td>
<td>18</td>
</tr>
<tr>
<td>Row 4</td>
<td>88</td>
<td>32</td>
</tr>
<tr>
<td>Row 5</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>Row n</td>
<td>p</td>
<td>q</td>
</tr>
</tbody>
</table>

(a) Study the pattern and write down the value of $x$, the value of $y$ and the value of $z$. [3]

(b) Express, as simply as possible, in terms of $n$, the value of $p$, the value of $q$ and the value of $r$. [3]

(c) In which row does the first negative term appear in Column 1? [1]

(d) In which row does the first term greater than 50 000 appear in Column 2? [1]

(e) In which row does the first term greater than $2 \times 10^8$ appear in Column 3? [1]
The diagram shows a triangle $ABC$ in which angle $BAC$ is a right angle. The length of $AB$ is $(x + 1)$ cm, the length of $AC$ is $(2x + 1)$ cm and the length of $BC$ is $2(x + 1)$ cm.

(a) Use Pythagoras Theorem to form an equation in $x$, and show that it can be simplified to

$$x^2 - 2x - 2 = 0.$$  

(b) Solve the equation $x^2 - 2x - 2 = 0$, giving the answers correct to two decimal places. 

(c) Calculate the area of triangle $ABC$. 


The diagram shows a concrete block which is part of a water run-way. The end of the block is a rectangle, $ABCD$, from which a semicircle, $EFG$, of radius 18 cm, has been removed. The length of the block is 200 cm. $AB = CD = 25$ cm, $BC = 50$ cm and $DE = AG = 7$ cm.

Calculate

(a) the area of the cross-section, in square centimetres, of the block (shaded in the diagram), [3]  
(b) the volume, in cubic metres, of concrete used to make the block, [3]  
(c) the total surface area, in square metres, of the block. [5]
7 (a) A shop offers a television set for sale for $560. Otherwise a customer may pay a deposit of $160, followed by 12 monthly payments of $35. Calculate the extra cost of this method of payment, expressing your answer as a percentage of $560. [2]

(b) John borrowed $3000 to buy some audio equipment. He agreed to pay 10% compound interest per year on the sum owed.

(i) At the end of the first year he repaid $1000. Show that at the start of the second year he still owed $2300. [2]

(ii) In the same way, he repaid $1000 at the end of the second year. He repaid a further $1000 at the end of the third year. Calculate the sum that he must pay at the end of the fourth year to clear the debt. [4]

(c) Mary invested a sum of money in a savings account. Simple interest at the rate of 6% per year was added to her account. At the end of 5 years, she had $312 in her account. Calculate the sum of money she invested. [3]
The heights, in centimetres, of the 15 girls in a class are represented in the stem and leaf diagram below.

\[
\begin{array}{c|c}
10 & 3 \\
11 & 2, 1 \\
12 & 6, 8, 2, 4, 9, 8 \\
13 & 8, 0, 2, 5 \\
14 & 6 \\
15 & 1 \\
\end{array}
\]

Heights of girls (cm)

The heights, in centimetres, of the 16 boys in the class were also recorded. The results are shown in the table below.

\[
\begin{array}{c}
127 \\
122 \\
139 \\
125 \\
134 \\
114 \\
156 \\
133 \\
121 \\
148 \\
136 \\
131 \\
128 \\
144 \\
115 \\
\end{array}
\]

Heights of boys (cm)

(a) Construct a stem and leaf diagram to represent the heights of the 16 boys in the class. [1]

(b) Construct a single ordered stem and leaf diagram to represent the heights of all 31 children in the class. [2]

(c) For the whole class, find
   (i) the median height, [1]
   (ii) the mean height. [2]

(d) One child is chosen at random from the class.

   Expressing your answer as a fraction in its simplest form, find the probability that the chosen child is
   (i) more than 142 cm tall, [1]
   (ii) a boy of height 128 cm, [1]
   (iii) a girl of height 134 cm. [1]

(e) Two children are chosen at random from the class.

   Expressing your answer as a fraction in its simplest form, find the probability that one has a height of less than 120 cm and the other a height of more than 140 cm. [2]
Diagram I represents a road bridge. The horizontal road, ABC, consists of two equal parts, AB and CB, each of length 12 metres, which can be rotated round A and C respectively, to allow tall boats to pass through the bridge. Vertical towers, AD and CE, each of height 16 metres, stand at the ends of the bridge. Cables, DB and EB, join the tops of the towers to the ends of the road.

Diagram II shows the road when it has been raised. The road has been rotated through 50° and its ends are at M and N.

Calculate

(a) the angle of elevation of D from C,  
(b) the width of the gap, MN, between the ends of road sections,  
(c) the length of DM,  
(d) the reduction in the length of each cable.
Section B [12 marks]

Answer one question in this section.

10 Answer the whole of this question on a sheet of graph paper.

The table below gives some values of \( x \) and the corresponding values of \( y \), correct to two decimal places, where

\[ y = x^3 - 6x^2 + 11x. \]

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>0.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>3.5</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>0</td>
<td>4.13</td>
<td>6</td>
<td>6.38</td>
<td>6</td>
<td>5.63</td>
<td>6</td>
<td>7.88</td>
<td>12</td>
</tr>
</tbody>
</table>

(a) Using a scale of 4 cm to represent 1 unit, draw a horizontal \( x \)-axis for \( 0 \leq x \leq 4 \). Using a scale of 1 cm to represent 1 unit, draw a vertical \( y \)-axis for \( 0 \leq y \leq 16 \). On your axes, plot the points given in the table and join them with a smooth curve. [3]

(b) Describe fully the symmetry of the curve \( y = x^3 - 6x^2 + 11x \). [2]

(c) Use your graph to solve the equation \( x^3 + 11x = 6x^2 + 10 \). [2]

(d) By drawing a tangent, find the gradient of the curve at the point \( (0.5, 4.13) \). [2]

(e) On the same diagram, draw the graph of \( y = 14 - 2x \) for values of \( x \) in \( 0 \leq x \leq 4 \). [2]

(f) The two graphs intersect at the point where the \( x \) coordinate is \( a \). Write down the value of \( a \). [1]
11 (a) Given that \( P \) is the point \((3, 1)\), \( \overrightarrow{PQ} = \left(\frac{-4}{2}\right) \), \( \overrightarrow{PR} = \left(\frac{6}{4}\right) \) and that \( S \) is the midpoint of \( QR \), find

(i) \( Q'R' \), [1]
(ii) \( PS' \), [1]
(iii) the coordinates of the point \( T \), given that \( PQTR \) is a parallelogram. [2]

(b) Answer this part of the question on a sheet of graph paper.

Triangle \( A \) has vertices \((3, 2)\), \((5, 2)\) and \((3, -1)\).

(i) Using a scale of 1 cm to represent 1 unit on each axis, draw axes for values of \( x \) and \( y \) in the ranges \(-8 \leq x \leq 8\) and \(-4 \leq y \leq 12\).
   Draw and label triangle \( A \). [1]

(ii) A rotation through 90° clockwise about the point \((-1, 4)\) maps triangle \( A \) onto triangle \( B \).
   Draw and label triangle \( B \). [2]

(iii) A reflection in the line \( y = 4 \) maps triangle \( B \) onto triangle \( C \).
   Draw and label triangle \( C \). [1]

(iv) Describe fully the single transformation which maps triangle \( C \) onto triangle \( A \). [2]

(v) A shear, of shear factor \(-2\), in which the \( x \)-axis is invariant, maps triangle \( A \) onto triangle \( D \).
   Draw and label triangle \( D \). [2]