1. ALGEBRA

Quadratic Equation

For the equation \( ax^2 + bx + c = 0 \),

\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.
\]

Binomial Theorem

\[
(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,
\]

where \( n \) is a positive integer and \( \binom{n}{r} = \frac{n!}{(n-r)!r!} \).

2. TRIGONOMETRY

Identities

\[
\sin^2 A + \cos^2 A = 1.
\]
\[
\sec^2 A = 1 + \tan^2 A.
\]
\[
\cosec^2 A = 1 + \cot^2 A.
\]

Formulae for \( \triangle ABC \)

\[
\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.
\]
\[
a^2 = b^2 + c^2 - 2bc \cos A.
\]
\[
\Delta = \frac{1}{2} bc \sin A.
\]
1  Given that \( A = \begin{pmatrix} 13 & 6 \\ 7 & 4 \end{pmatrix} \), find the inverse matrix \( A^{-1} \) and hence solve the simultaneous equations

\[
13x + 6y = 41, \\
7x + 4y = 24.
\]

[4]

2  Variables \( x \) and \( y \) are connected by the equation \( y = (2x - 9)^3 \). Given that \( x \) is increasing at the rate of 4 units per second, find the rate of increase of \( y \) when \( x = 7 \).  

[4]
3 Find the set of values of \( m \) for which the line \( y = mx + 2 \) does not meet the curve \( y = x^2 - 5x + 18 \). [5]

4 (a) A sports team of 3 attackers, 2 centres and 4 defenders is to be chosen from a squad of 5 attackers, 3 centres and 6 defenders. Calculate the number of different ways in which this can be done. [3]
(b) How many different 4-digit numbers greater than 3000 can be formed using the six digits 1, 2, 3, 4, 5 and 6 if no digit can be used more than once? [3]

5 (i) Differentiate $x \ln x$ with respect to $x$. [2]

(ii) Hence find $\int \ln x \, dx$. [3]
Solve the following equations.

(i) \[ \frac{4^x}{2^{2-x}} = \frac{2^{4x}}{8^{x-3}} \] [3]

(ii) \[ \lg (2y + 10) + \lg y = 2 \] [3]
The diagram shows a river with parallel banks. The river is 48 m wide and is flowing with a speed of 1.4 ms$^{-1}$. A boat travels in a straight line from a point $P$ on one bank to a point $Q$ which is on the other bank directly opposite $P$. It is given that the boat takes 10 seconds to cross the river.

(i) Find the speed of the boat in still water. [4]

(ii) Find the angle to the bank at which the boat should be steered. [2]
8 The function $f$ is defined, for $0 \leq x \leq 2\pi$, by

$$f(x) = 3 + 5 \sin 2x.$$ 

State

(i) the amplitude of $f$, [1]

(ii) the period of $f$, [1]

(iii) the maximum and minimum values of $f$. [2]

Sketch the graph of $y = f(x)$. [3]
The line \( y = 2x - 9 \) intersects the curve \( x^2 + y^2 + xy + 3x = 46 \) at the points A and B. Find the equation of the perpendicular bisector of AB.
The diagram shows part of the curve \( y = x^3 - 8x^2 + 16x \).

(i) Show that the curve has a minimum point at (4, 0) and find the coordinates of the maximum point. [4]
(ii) Find the area of the shaded region enclosed by the x-axis and the curve. [4]
The table shows experimental values of two variables \( x \) and \( y \).

<table>
<thead>
<tr>
<th>( x )</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>2.25</td>
<td>0.81</td>
<td>0.47</td>
<td>0.33</td>
</tr>
</tbody>
</table>

(i) On the graph paper below, plot \( xy \) against \( \frac{1}{x} \) and draw a straight line graph. [3]
(ii) Use your graph to express $y$ in terms of $x$. [5]

(iii) Estimate the value of $x$ and of $y$ for which $xy = 4$. [3]
The diagram shows a sector \( AOB \) of a circle with centre \( O \) and radius 6 cm. Angle \( AOB = 0.6 \) radians. The point \( D \) lies on \( OB \) such that the length of \( OD \) is 2 cm. The point \( C \) lies on \( OA \) such that \( OCD \) is a right angle.

(i) Show that the length of \( OC \) is approximately 1.65 cm and find the length of \( CD \). [4]
(ii) Find the perimeter of the shaded region. [3]

(iii) Find the area of the shaded region. [3]