1. Relative to a suitable coordinate system A and B are the points (-2, 1, -1) and (1, 3, 2) respectively. A, B and C are collinear points and C is positioned such that BC=2AB. Find the coordinates of C.

2. A function is defined on the set of real numbers by \( f(x) = x^3 - 3x + 2 \).

(a) Find the coordinates of the stationary points on the curve \( y = f(x) \) and determine their nature.

(b) (i) Show that \( (x-1) \) is a factor of \( x^3 - 3x + 2 \).

(ii) Hence or otherwise factorise \( x^3 - 3x + 2 \) fully.

(c) State the coordinates of the points where the curve with equation \( y = f(x) \) meets both the axis and hence sketch the curve.

3. The diagram shows a sketch of the curve with equation \( y = x^3 - 6x^2 + 8x \).

(a) Find the coordinates of the points on the curve where the gradient of the tangent is -1.

(b) The line \( y = 4 - x \) is a tangent to this curve at a point A. Find the coordinates of A.
4. A sequence is defined by the recurrence relation

\[ U_{n+1} = \frac{1}{4} U_n + 16, U_0 = 0. \]

(a) Calculate the values \(U_1\), \(U_2\) and \(U_3\).

Four terms of this sequence \(U_1\), \(U_2\), \(U_3\) and \(U_4\) are plotted as shown in the graph.

As \(n \to \infty\), the points on the graph approach the line \(U_n = k\), where \(k\) is the limit of the sequence.

(b) (i) Give a reason why this sequence has a limit.

(ii) Find the exact value of \(k\).

5. The large circle has equation

\[ x^2 + y^2 - 14x - 16y + 77 = 0. \]

Three congruent circles with centres A, B and C are drawn inside the large circle with the centres lying on a line parallel to the x-axis. This pattern is continued as shown in the diagram. Find the equation of the circle with centre D.

6. Solve the equation \(\sin 2x = 6 \cos x\) for \(0 \leq x \leq 360\).

7. Given that \(y = \sqrt{3x^2 + 2}\), find \(\frac{dy}{dx}\).
8. The diagram shows a sketch of the graph of \( y = x^3 - 4x^2 + x + 6 \). The graph cuts the x-axis at (3,0).

(a) Find the coordinates of A.

(b) Find the shaded area.

9. Functions, \( f, g \) and \( h \) are defined on suitable domains by

\[ f(x) = x^2 - x + 10, \quad g(x) = 5 - x \quad \text{and} \quad h(x) = \log_2 x. \]

(a) Find expressions for \( h(f(x)) \) and \( h(g(x)) \).

(b) Hence solve \( h(f(x)) - h(g(x)) = 3 \).

[END OF QUESTION PAPER]
1. The vertices of triangle ABC are
A(7,9), B(-3,-1) and C(5,-5) as shown in
the diagram.
The broken line represents the
perpendicular bisector of BC.

(a) Show that the equation of the
perpendicular bisector of BC is  \( y = 2x - 5 \).

(b) Find the equation of the median from
C.

(c) Find the coordinates of the point of
intersection of the perpendicular bisector
of BC and the median from C.

2. The diagram shows two right angled
triangles with angles \( c \) and \( d \) marked as
shown.
Find the exact value of \( \sin(c + d) \).

3. The diagram shows a cuboid OABC,
DEFG. F is the point (8, 4, 6). P divides
AE in the ratio 2:1. Q is the midpoint of
CG.
(a) State the coordinates of P and Q.
(b) Write down the components of PQ and
PA.
(c) Find the size of angle QPA.
4. Find the value of \( \int_{0}^{2} \sin(4x+1) \, dx \).

5. (a) (i) Diagram 1 shows part of the graph of \( y = f(x) \), where \( f(x) = p \cos x \).
Write down the value of \( p \).

(ii) Diagram 2 shows part of the graph \( y = g(x) \), where \( f(x) = q \sin x \).
Write down the value of \( q \).

(b) Write \( f(x) + g(x) \) in the form \( k \cos(x + a) \) where \( k > 0 \), and \( 0 < a < \frac{\pi}{2} \).

(c) Hence find \( f'(x) + g'(x) \) as a single trigonometric expression

6. (a) Write down the centre and the radius of the circle with equation
\( x^2 + y^2 + 8x + 4y - 38 = 0 \).

(b) A second circle has equation \( (x-4)^2 + (y-6)^2 = 26 \).
Find the distance between the centres of these two circles and hence show that the circles intersect.

(c) The line with equation \( y = 4 - x \) is a common chord passing through the intersection of the two circles.
Find the coordinates of the points of intersection of the two circles.
7. The diagram shows the graph of a cubic function \( y = f(x) \) and its derived function \( y = f'(x) \).

Both graphs pass through \((0, 6)\).

The graph of \( y = f'(x) \) also passes through the points \((2, 0)\) and \((4, 0)\).

(a) Given that \( f'(x) \) is of the form \( k(x-a)(x-b) \):

(i) write down the values of \( a \) and \( b \);

(ii) find the value of \( k \).

(b) Find the equation of the graph of the cubic function \( y = f(x) \).

8. In the diagram, Q lies on the line joining \((0, 6)\) and \((3, 0)\).

OPQR is a rectangle, where P and R lie on the axes and OR = t.

(a) Show that QR = \( 6 - 2t \).

(b) Find the coordinates of Q for which the rectangle has a maximum area.

9. The parabola shown in the diagram has equation \( y = 32 - 2x^2 \).

The shaded area lies between the lines \( y = 14 \) and \( y = 24 \).

Calculate the shaded area.