1  a  Solve the simultaneous equations
\[ y = 3x - 4 \]
\[ y = 4x^2 - 9x + 5 \]

b  Hence, describe the geometrical relationship between the straight line \( y = 3x - 4 \) and the curve \( y = 4x^2 - 9x + 5 \).

2  

The diagram shows the graph of \( y = f(x) \) which is defined for \(-2 \leq x \leq 2\).
Labelling the axes in a similar way, sketch on separate diagrams the graphs of

a  \( y = 3f(x) \),  

b  \( y = f(x + 1) \),  

c  \( y = f(-x) \).

3  a  Show that the line \( y = 4x + 1 \) does not intersect the curve \( y = x^2 + 5x + 2 \).

b  Find the values of \( m \) such that the line \( y = mx + 1 \) meets the curve \( y = x^2 + 5x + 2 \) at exactly one point.

4  

The diagram shows the curve with the equation \( y = f(x) \) where
\[ f(x) = \sqrt{x}, \quad x \geq 0. \]
Labelling the axes in a similar way, sketch on the same set of axes the graphs of

a  \( y = 1 + f(x) \) and \( y = f(x + 3) \),

b  Find the coordinates of the point of intersection of the two graphs drawn in part a.

5  The curve \( C \) has the equation \( y = x^2 + kx - 3 \) and the line \( l \) has the equation \( y = k - x \), where \( k \) is a constant.
Prove that for all real values of \( k \), the line \( l \) will intersect the curve \( C \) at exactly two points.

6  

f(x) \equiv 2x^2 - 4x + 5.

a  Express f(x) in the form \( a(x + b)^2 + c \).

b  Showing the coordinates of the turning point in each case, sketch on the same set of axes the curves

i  \( y = f(x) \),

ii  \( y = f(x + 3) \).
7 a Sketch on the same diagram the straight line \( y = 2x - 5 \) and the curve \( y = x^3 - 3x^2 \), showing the coordinates of any points where each graph meets the coordinate axes. (4)

b Hence, state the number of real roots that exist for the equation \( x^3 - 3x^2 - 2x + 5 = 0 \), giving a reason for your answer. (2)

8 The diagram shows the curve with the equation \( y = ax^2 + bx + c \).

Given that the curve crosses the y-axis at the point \((0, -6)\) and touches the x-axis at the point \((2, 0)\), find the values of the constants \(a\), \(b\) and \(c\). (6)

9 a Show that \((1 - x)(2 + x)^2 = 4 - 3x^2 - x^3\). (3)

b Hence, sketch the curve \( y = 4 - 3x^2 - x^3 \), showing the coordinates of any points of intersection with the coordinate axes. (3)

10 The diagram shows the curve with equation \( y = f(x) \) which crosses the coordinate axes at the points \((-5, 0)\), \((1, 0)\) and \((0, -3)\).

Showing the coordinates of any points of intersection with the axes, sketch on separate diagrams the curves

a \( y = -f(x) \), (2)

b \( y = f(x - 5) \), (2)

c \( y = f(2x) \). (2)

11 a Describe fully the transformation that maps the graph of \( y = f(x) \) onto the graph of \( y = f(x + 1) \). (2)

b Sketch the graph of \( y = \frac{1}{x+1} \), showing the coordinates of any points of intersection with the coordinate axes and the equations of any asymptotes. (3)

c By sketching another suitable curve on your diagram in part b, show that the equation \( x^3 - \frac{1}{x+1} = 2 \) has one positive and one negative real root. (4)