1. Let $f(x) = 3x^2$. The graph of f is translated 1 unit to the right and 2 units down. The graph of g is the image of the graph of f after this translation.

(a) Write down the coordinates of the vertex of the graph of g.

(2)

(b) Express g in the form $g(x) = 3(x - p)^2 + q$.

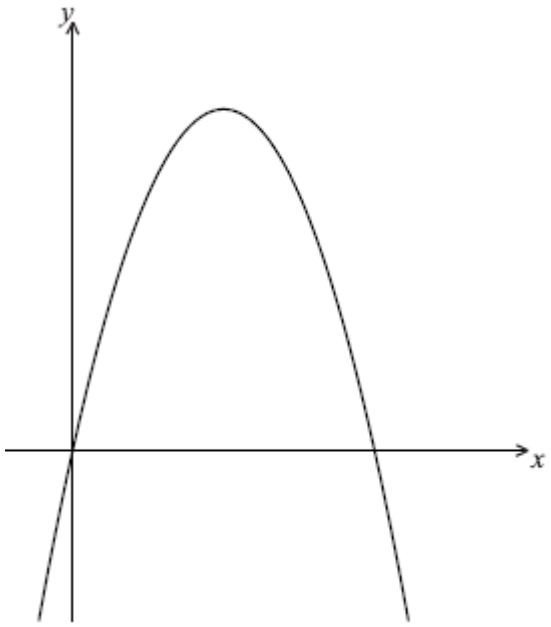
(2)

The graph of h is the reflection of the graph of g in the x-axis.

(c) Write down the coordinates of the vertex of the graph of h.

(2)
(Total 6 marks)

2. Let $f(x) = 8x - 2x^2$. Part of the graph of f is shown below.



(a) Find the x-intercepts of the graph.

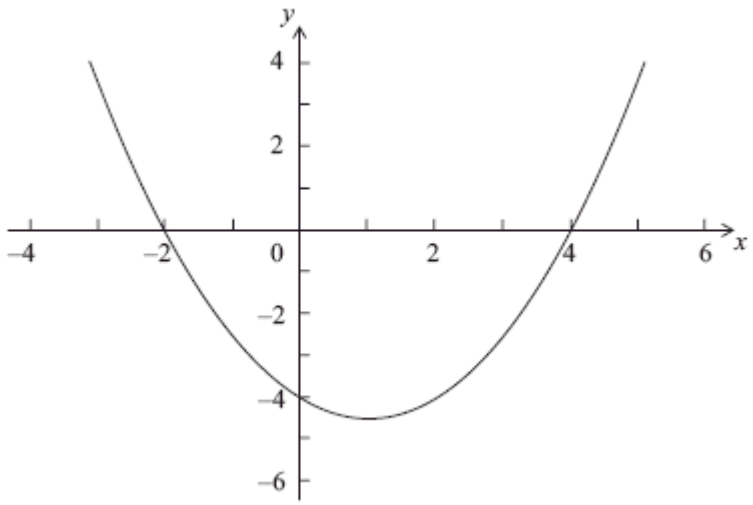
(4)

(b) (i) Write down the equation of the axis of symmetry.

(ii) Find the y-coordinate of the vertex.

(3)
(Total 7 marks)

3. Let $f(x) = p(x - q)(x - r)$. Part of the graph of f is shown below.



The graph passes through the points (–2, 0), (0, –4) and (4, 0).

(a) Write down the value of q and of r.

(2)

(b) Write down the **equation** of the axis of symmetry.

(1)

(c) Find the value of p.

(3)

(Total 6 marks)

4. The quadratic equation $kx^2 + (k - 3)x + 1 = 0$ has two equal real roots.

(a) Find the possible values of k.

(5)

(b) **Write down** the values of k for which $x^2 + (k - 3)x + k = 0$ has two equal real roots.

(2)

(Total 7 marks)

5. Let $f(x) = 3(x + 1)^2 - 12$.

(a) Show that $f(x) = 3x^2 + 6x - 9$.

(2)

(b) For the graph of f

(i) write down the coordinates of the vertex;

(ii) write down the **equation** of the axis of symmetry;

(iii) write down the y-intercept;

(iv) find both x-intercepts.

(8)

(c) **Hence** sketch the graph of f.

(2)

(d) Let $g(x) = x^2$. The graph of f may be obtained from the graph of g by the two transformations:

a stretch of scale factor t in the y-direction

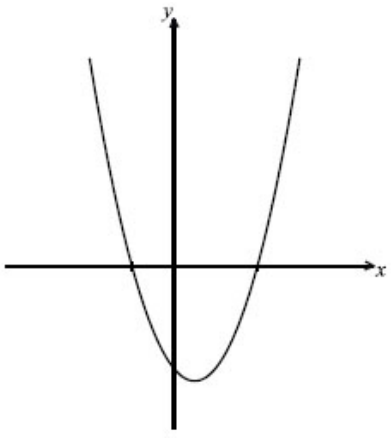
followed by

a translation of $\begin{pmatrix} p \\ q \end{pmatrix}$.

Find $\begin{pmatrix} p \\ q \end{pmatrix}$ and the value of t.

(3)
(Total 15 marks)

6. The following diagram shows part of the graph of f, where $f(x) = x^2 - x - 2$.



(a) Find both x-intercepts.

(4)

(b) Find the x-coordinate of the vertex.

(2)
(Total 6 marks)

7. Let $f(x) = 2x^2 + 4x - 6$.

(a) Express $f(x)$ in the form $f(x) = 2(x - h)^2 + k$.

(3)

(b) Write down the equation of the axis of symmetry of the graph of f.

(1)

(c) Express $f(x)$ in the form $f(x) = 2(x - p)(x - q)$.

(2)

(Total 6 marks)

8. Let $f(x) = a(x - 4)^2 + 8$.

(a) Write down the coordinates of the vertex of the curve of f.

(b) Given that $f(7) = -10$, find the value of a.

(c) Hence find the y-intercept of the curve of f.

(Total 6 marks)

9. (a) Express $y = 2x^2 - 12x + 23$ in the form $y = 2(x - c)^2 + d$.

The graph of $y = x^2$ is transformed into the graph of $y = 2x^2 - 12x + 23$ by the transformations

a vertical stretch with scale factor k **followed by**
a horizontal translation of p units **followed by**
a vertical translation of q units.

(b) Write down the value of

(i) k;

(ii) p;

(iii) q.

(Total 6 marks)

10. The quadratic function f is defined by $f(x) = 3x^2 - 12x + 11$.

(a) Write f in the form $f(x) = 3(x - h)^2 - k$.

(3)

(b) The graph of f is translated 3 units in the positive x-direction and 5 units in the positive y-direction. Find the function g for the translated graph, giving your answer in the form $g(x) = 3(x - p)^2 + q$.

(3)

(Total 6 marks)

11. Consider $f(x) = 2kx^2 - 4kx + 1$, for $k \neq 0$. The equation $f(x) = 0$ has two equal roots.

(a) Find the value of k.

(5)

(b) The line $y = p$ intersects the graph of f. Find all possible values of p.

(2)

(Total 7 marks)

12. The equation $x^2 - 2kx + 1 = 0$ has two distinct real roots. Find the set of all possible values of k.

(Total 6 marks)

13. Let $f(x) = 2x^2 - 12x + 5$.

(a) Express $f(x)$ in the form $f(x) = 2(x - h)^2 - k$.

(3)

(b) Write down the vertex of the graph of f.

(2)

(c) Write down the equation of the axis of symmetry of the graph of f.

(1)

(d) Find the y-intercept of the graph of f.

(2)

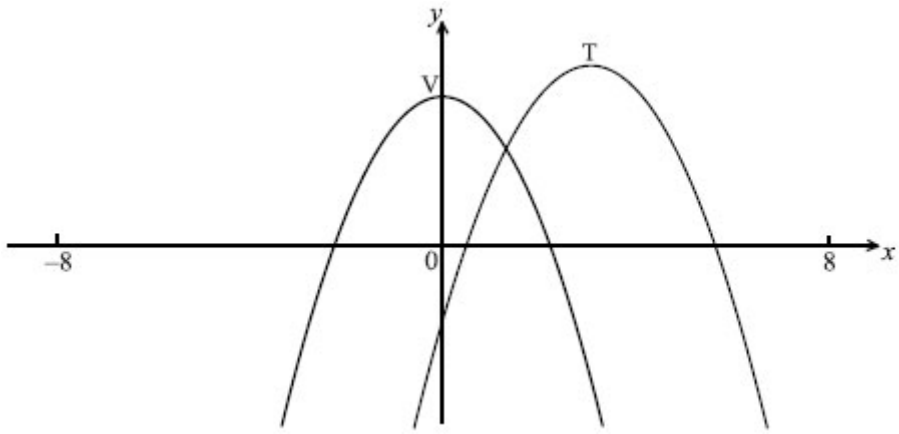
(e) The x-intercepts of f can be written as $\frac{p \pm \sqrt{q}}{r}$, where $p, q, r \in \mathbb{Z}$.
Find the value of p, of q, and of r.

(7)

(Total 15 marks)

14. The following diagram shows part of the graph of $f(x) = 5 - x^2$ with vertex V (0, 5).

Its image $y = g(x)$ after a translation with vector $\begin{pmatrix} h \\ k \end{pmatrix}$ has vertex T (3, 6).



(a) Write down the value of

(i) h;

(ii) k.

(2)

(b) Write down an expression for $g(x)$.

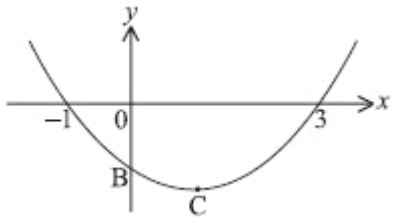
(2)

(c) On the same diagram, sketch the graph of $y = g(-x)$.

(2)

(Total 6 marks)

15. Part of the graph of $f(x) = (x - p)(x - q)$ is shown below.



The vertex is at C. The graph crosses the y-axis at B.

(a) Write down the value of p and of q.

(b) Find the coordinates of C.

(c) Write down the y-coordinate of B.

(Total 6 marks)