1. Let $f(x) = x^2$ and $g(x) = 2(x-1)^2$.

(a) The graph of g can be obtained from the graph of f using two transformations. Give a full geometric description of each of the two transformations.

(2)

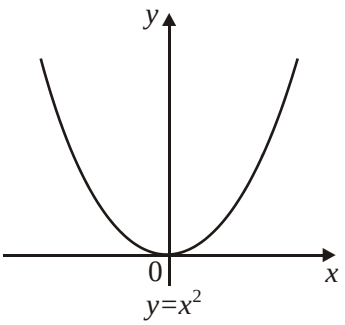
(b) The graph of g is translated by the vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ to give the graph of h.

The point $(-1, 1)$ on the graph of f is translated to the point P on the graph of h. Find the coordinates of P.

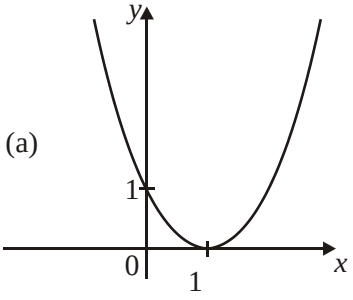
(4)
(Total 6 marks)

2. The diagrams show how the graph of $y = x^2$ is transformed to the graph of $y = f(x)$ in three steps.

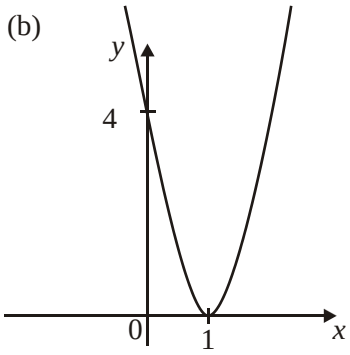
For each diagram give the equation of the curve.



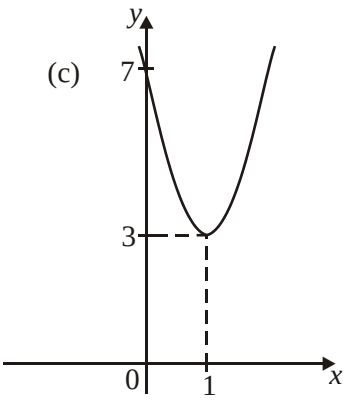
(a)



(b)

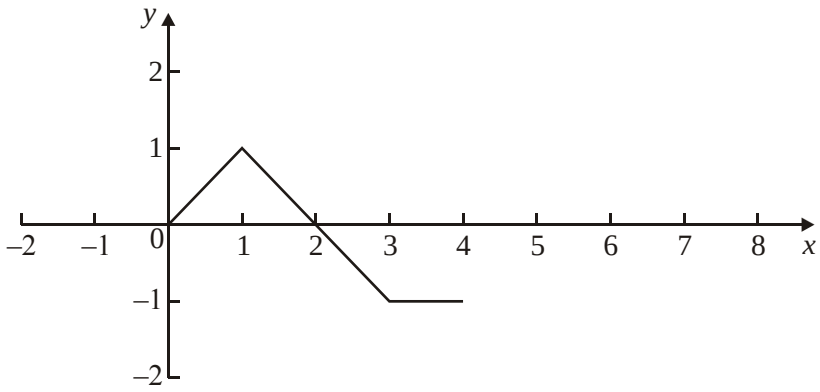


(c)



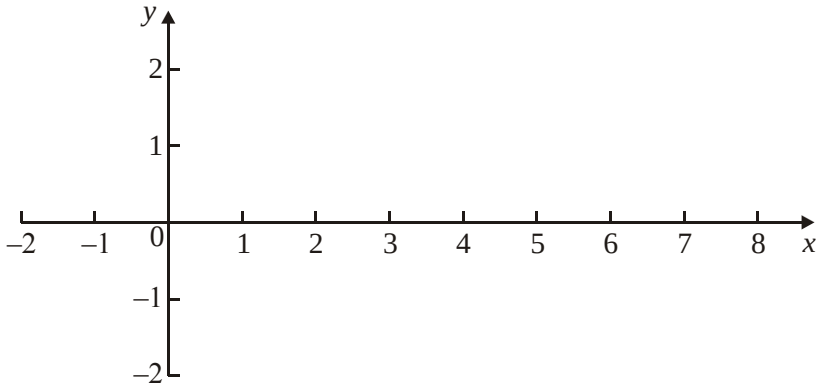
(Total 4 marks)

3. The graph of $y = f(x)$ is shown in the diagram.

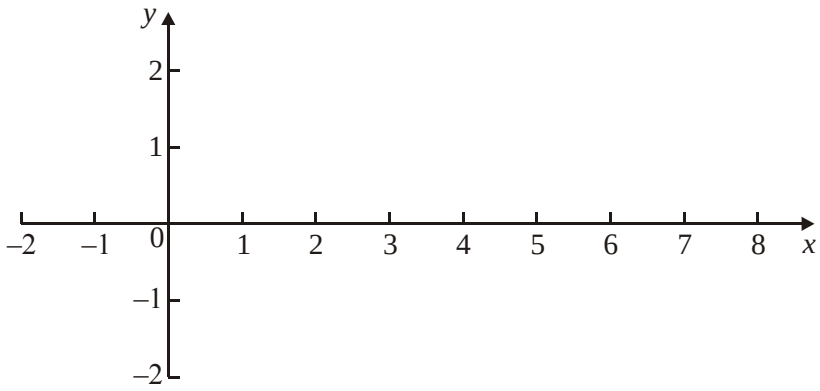


(a) On each of the following diagrams draw the required graph,

(i) $y = 2f(x)$;

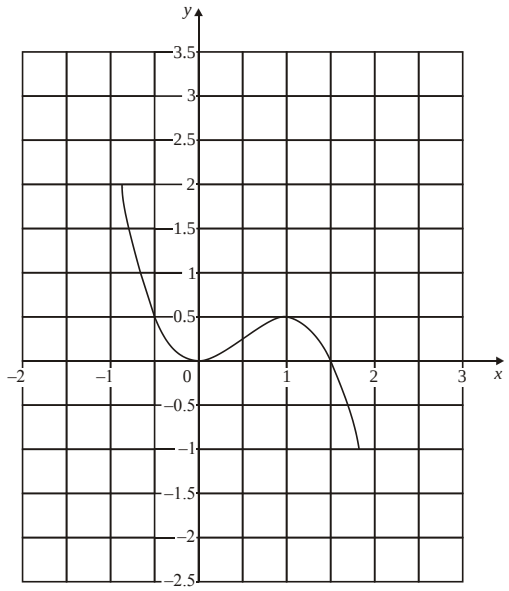


(ii) $y = f(x - 3)$.



(b) The point A (3, –1) is on the graph of f. The point A′ is the corresponding point on the graph of $y = -f(x) + 1$. Find the coordinates of A′. (Total 6 marks)

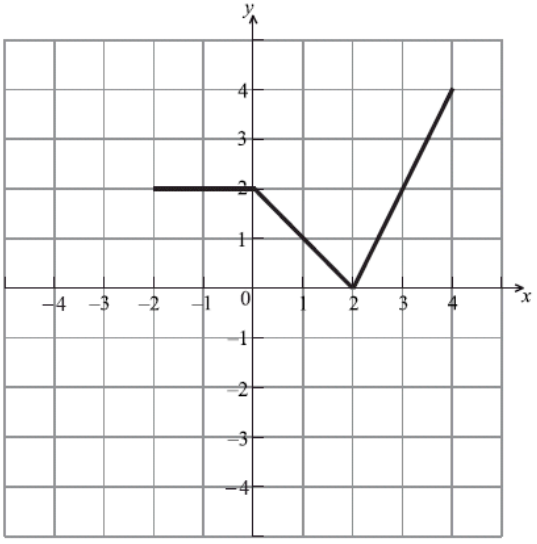
4. The following diagram shows the graph of $y = f(x)$. It has minimum and maximum points at (0, 0) and $(1, \frac{1}{2})$.



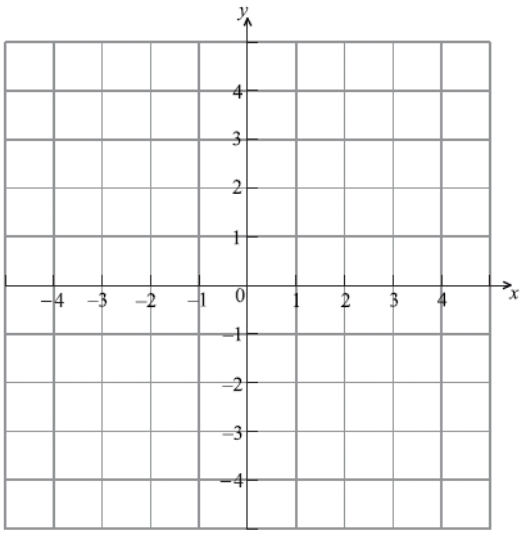
(a) On the same diagram, draw the graph of $y = f(x-1) + \frac{3}{2}$.

(b) What are the coordinates of the minimum and maximum points of $y = f(x-1) + \frac{3}{2}$? (Total 4 marks)

5. The diagram below shows the graph of a function $f(x)$, for $-2 \le x \le 4$.



(a) Let $h(x) = f(-x)$. Sketch the graph of h on the grid below.



(2)

(b) Let $g(x) = \frac{1}{2}f(x-1)$. The point A(3, 2) on the graph of f is transformed to the point P on the graph of g. Find the coordinates of P.

(3)

6. Let $f(x) = 3\ln x$ and $g(x) = \ln 5x^3$.

(a) Express $g(x)$ in the form $f(x) + \ln a$, where $a \in \mathbb{Z}^+$.

(4)

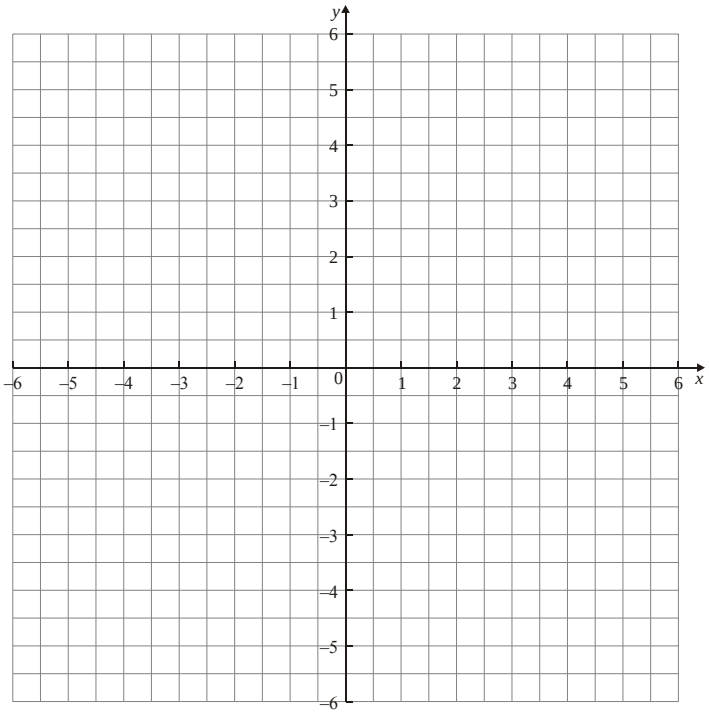
(b) The graph of g is a transformation of the graph of f. Give a full geometric description of this transformation.

(3)

7. Let $f(x) = 2x + 1$.

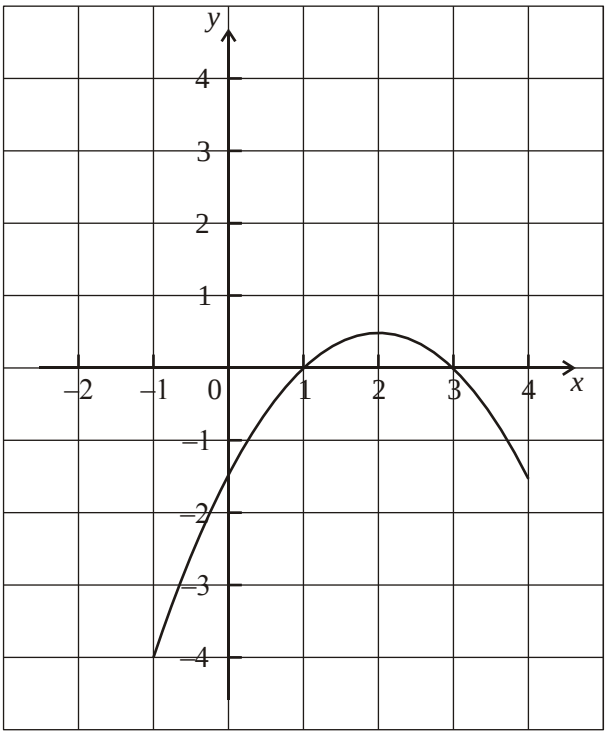
(a) On the grid below draw the graph of $f(x)$ for $0 \le x \le 2$.

(b) Let $g(x) = f(x+3) - 2$. On the grid below draw the graph of $g(x)$ for $-3 \le x \le -1$.



(Total 6 marks)

8. Part of the graph of a function f is shown in the diagram below.



(a) On the same diagram sketch the graph of $y = -f(x)$.

(2)

(b) Let $g(x) = f(x + 3)$.

(i) Find $g(-3)$.

(ii) Describe **fully** the transformation that maps the graph of f to the graph of g.

(4)

(Total 6 marks)