

IB Functions Transformations

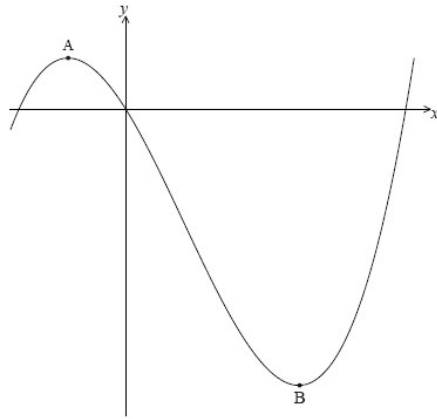
1. Let $f(x) = 3x^2$. The graph of f is translated 1 unit to the right and 2 units down. The graph of g is the image of the graph of f after this translation.

- (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 $f(x) = \frac{1}{3}x^3 - x^2 - 3x$. Part of the graph of f is shown below.



There is a maximum point at A and a minimum point at B(3, -9).

- (a) Find the coordinates of A. (8)
- (b) Write down the coordinates of
- the image of B after reflection in the y -axis;
 - the image of B after a translation of left 2 and up 5;
 - the image of B after reflection in the x -axis followed by a horizontal stretch with scale factor $\frac{1}{2}$.

(6)
(Total 14 marks)

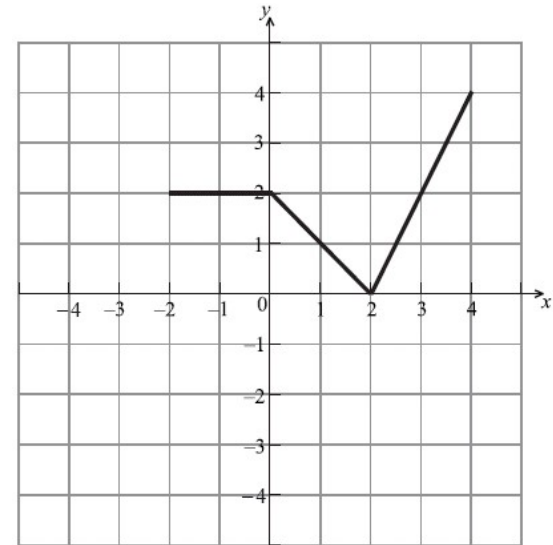
3. Let $f(x) = x^2 + 4$ and $g(x) = x - 1$.

- (a) Find $(f \circ g)(x)$. (2)

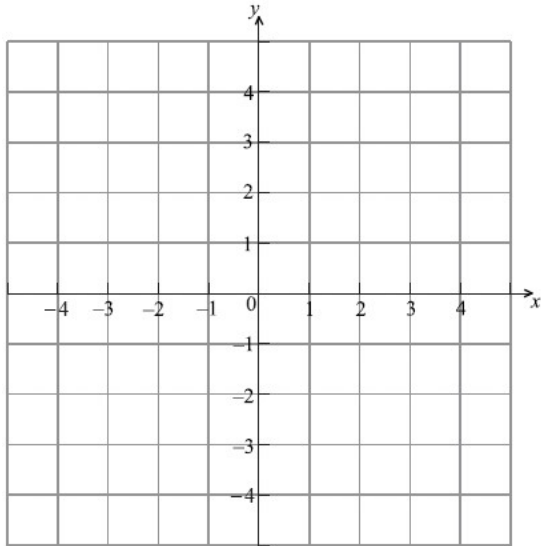
A translation of right 3 and down 1 is applied to the graph of $(f \circ g)$ to the graph of h .

- (b) Find the coordinates of the vertex of the graph of h . (3)
- (c) Show that $h(x) = x^2 - 8x + 19$. (2)
- (d) The line $y = 2x - 6$ is a tangent to the graph of h at the point P. Find the x -coordinate of P. (5)
- (Total 12 marks)

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



- (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)
(Total 5 marks)

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

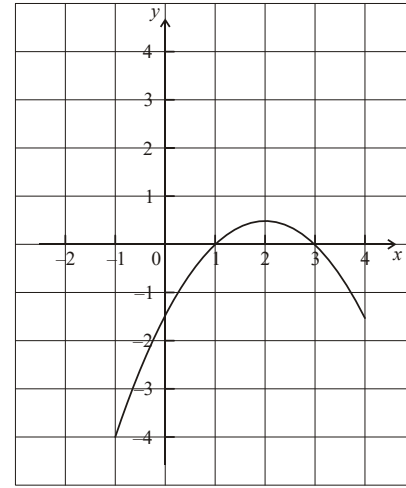
- (a) Write f in the form $f(x) = 3(x-h)^2 - k$.

(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)

6. 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)

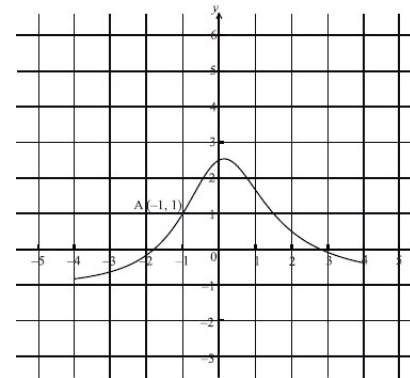
- (b) Let $g(x) = f(x+3)$.

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

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

(4)
(Total 6 marks)

7. The graph of a function f is shown in the diagram below. The point $A(-1, 1)$ is on the graph, and $y = -1$ is a horizontal asymptote.



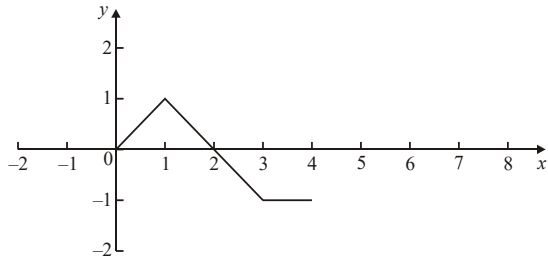
- (a) Let $g(x) = f(x-1) + 2$. On the diagram, sketch the graph of g .

- (b) Write down the equation of the horizontal asymptote of g .

- (c) Let A' be the point on the graph of g corresponding to point A . Write down the coordinates of A' .

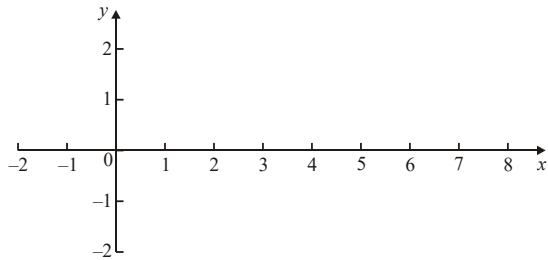
(Total 6 marks)

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

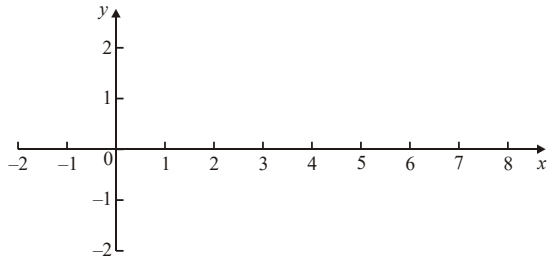


- (a) On each of the following diagrams draw the required graph,

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



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

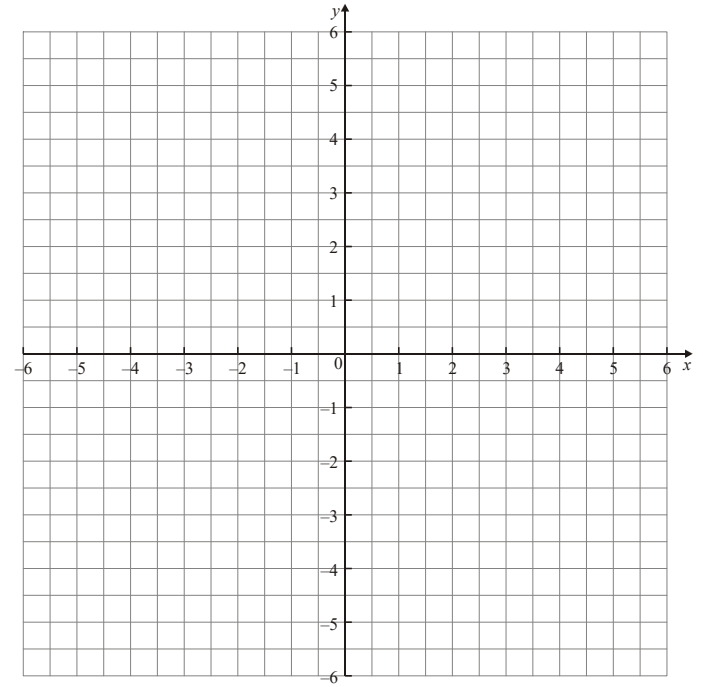


- (b) The point A (3, -1) is on the graph of f . The point A' is the corresponding point on the graph of $y = -f(x) + 1$. Find the coordinates of A'.

(Total 6 marks)

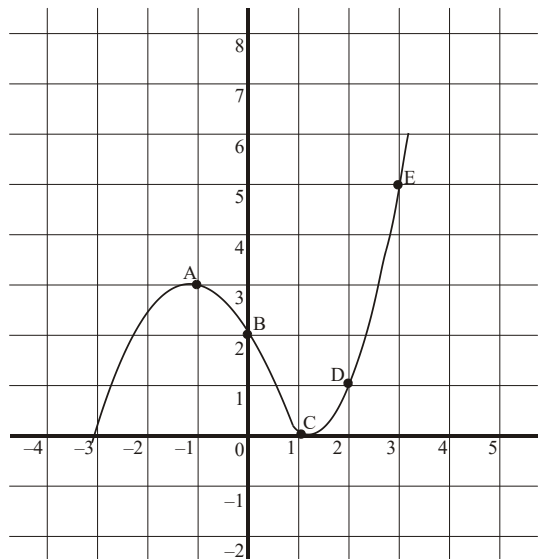
9. Let $f(x) = 2x + 1$.

- (a) On the grid below draw the graph of $f(x)$ for $0 \leq x \leq 2$.
 (b) Let $g(x) = f(x + 3) - 2$. On the grid below draw the graph of $g(x)$ for $-3 \leq x \leq -1$.



(Total 6 marks)

10. The sketch shows part of the graph of $y = f(x)$ which passes through the points A(-1, 3), B(0, 2), C(1, 0), D(2, 1) and E(3, 5).



A second function is defined by $g(x) = 2f(x - 1)$.

- (a) Calculate $g(0)$, $g(1)$, $g(2)$ and $g(3)$.
- (b) On the same axes, sketch the graph of the function $g(x)$.

Working:

Answers:

- (a)
-

(Total 6 marks)