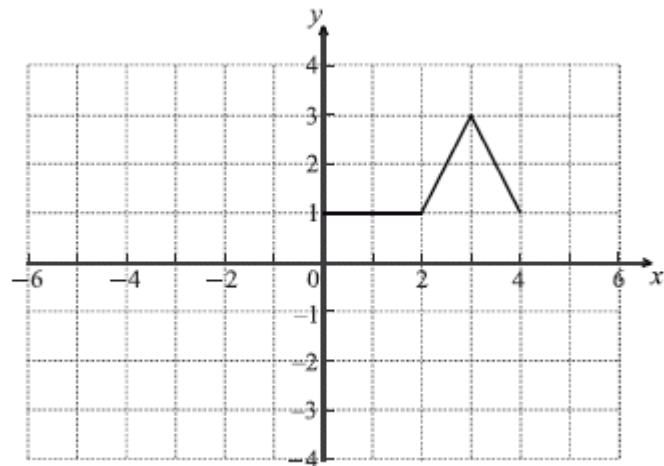**1.** Consider the graph of f shown below.

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

(2)

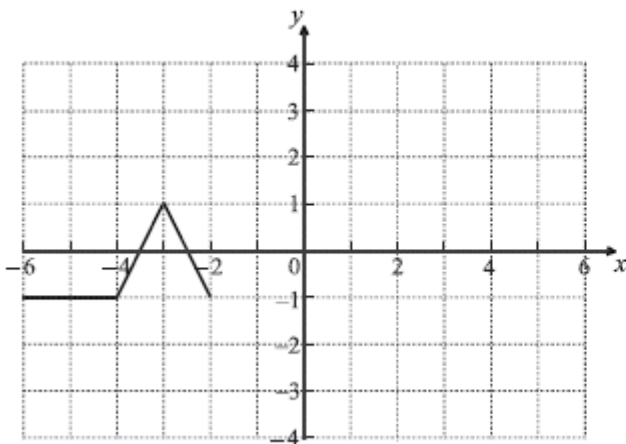The following four diagrams show **images** of f under different transformations.
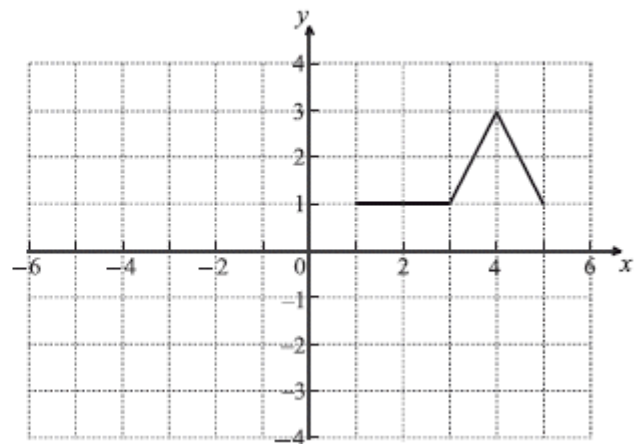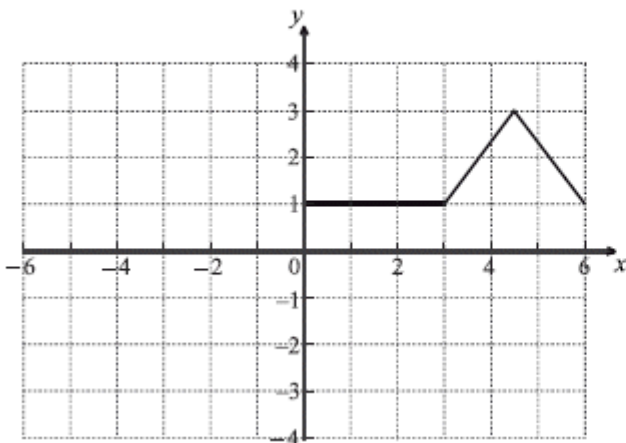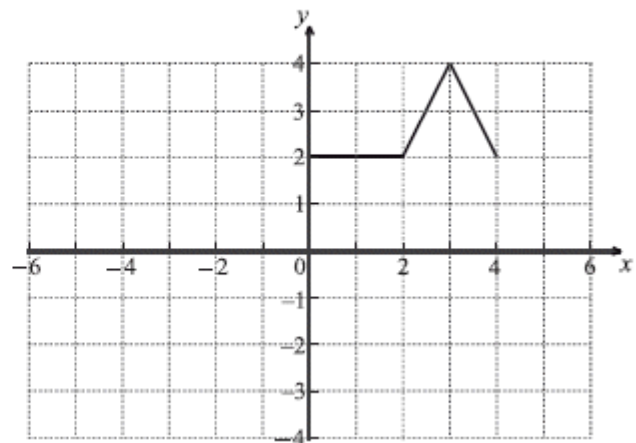
Diagram A

Diagram B

Diagram C

Diagram D

(b) Complete the following table.

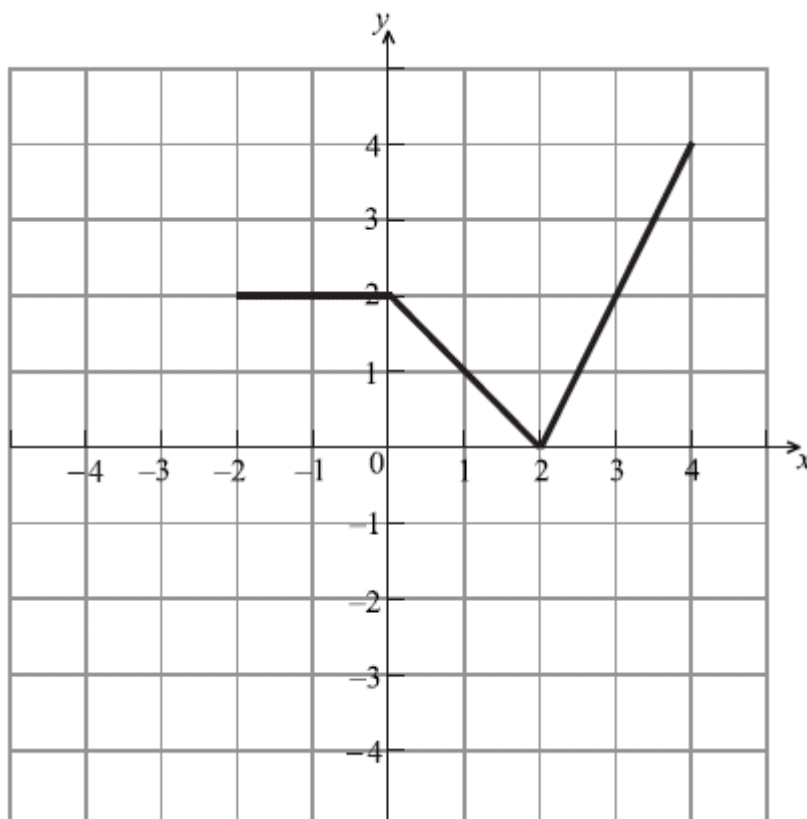| Description of transformation	Diagram letter
Horizontal stretch with scale factor 1.5	
Maps f to $f(x) + 1$	

(2)

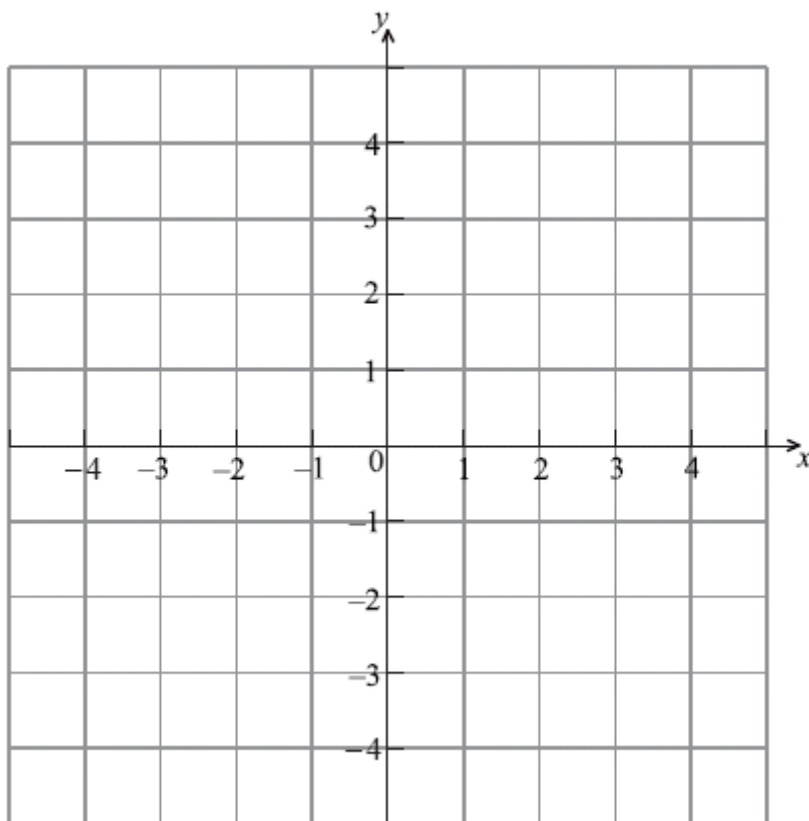(c) Give a full geometric description of the transformation that gives the image in Diagram A.

(2)
(Total 6 marks)

2. 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 $g(x) = \dfrac{1}{2} f(x - 1)$. 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)

3.   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)

4. 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)

5. Let $f(x) = \dfrac{1}{x}$, $x \neq 0$.

(a) Sketch the graph of f.

(2)

The graph of f is transformed to the graph of g by a translation of $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$.

(b) Find an expression for $g(x)$.

(2)

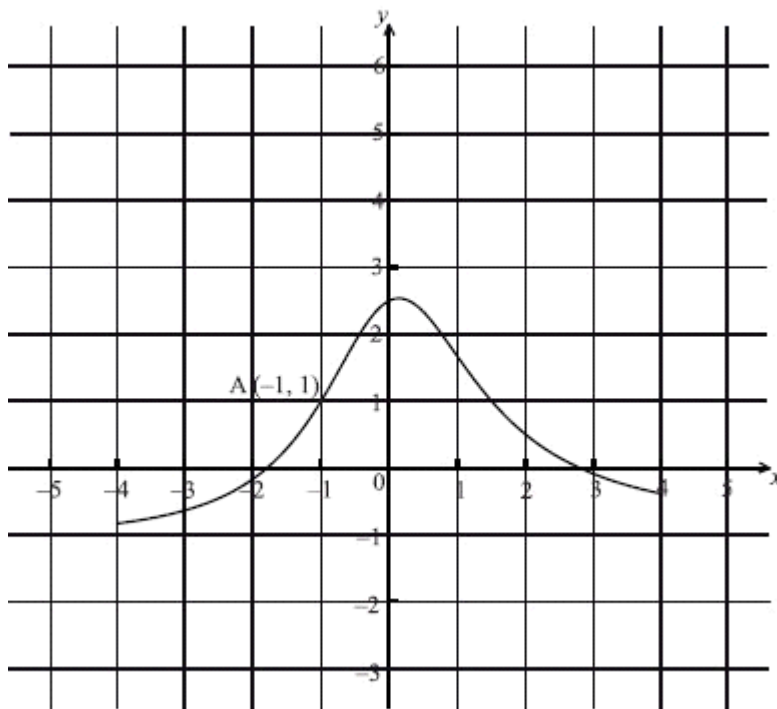(c) (i) Find the intercepts of g.

(ii) Write down the equations of the asymptotes of g.

(iii) Sketch the graph of g.

(10)
(Total 14 marks)

6. 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.
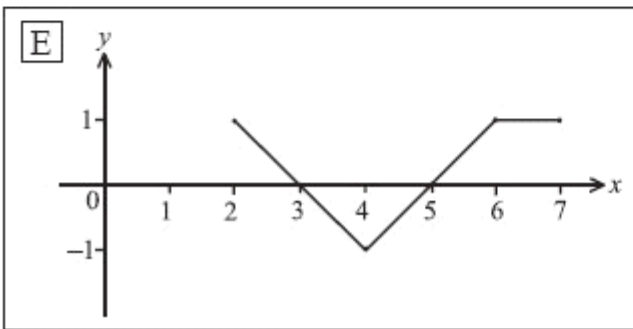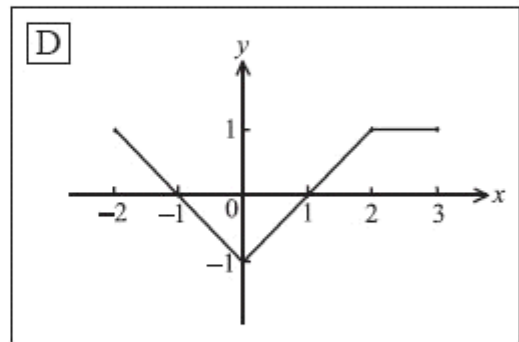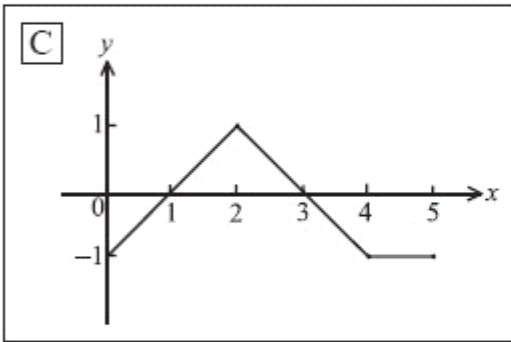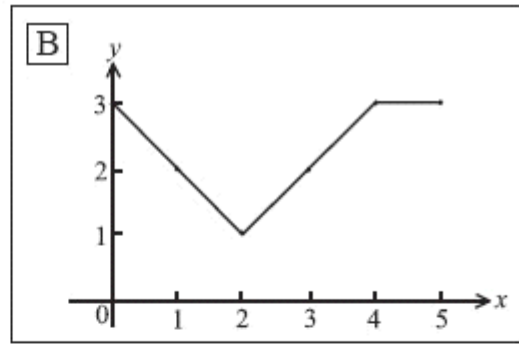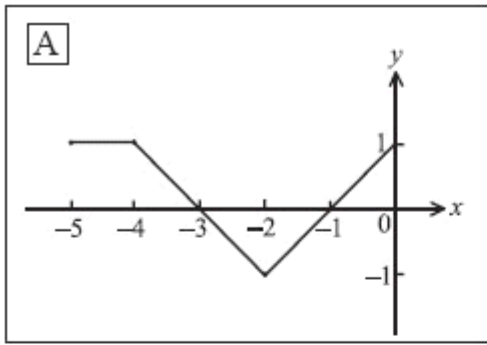

(a) Let $g(x) = f(x - 1) + 2$. On the diagram, sketch the graph of g.

(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)

7. The following diagram shows part of the graph of $f(x)$.
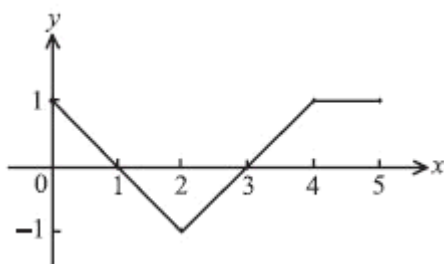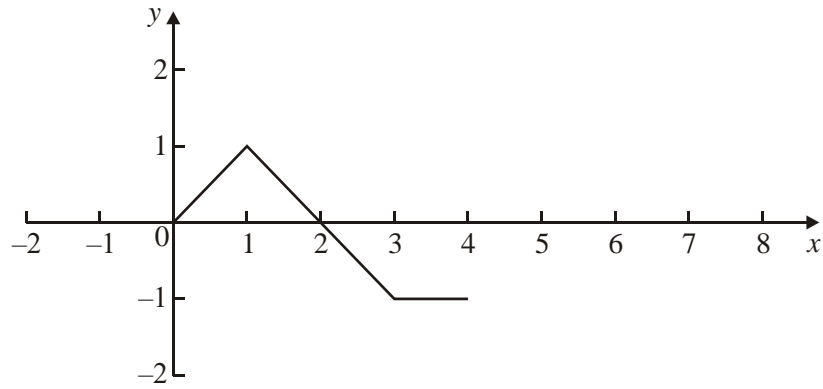

Consider the five graphs in the diagrams labelled A, B, C, D, E below.

A

B

C

D

E

(a)   Which diagram is the graph of $f(x+2)$?

(b)   Which diagram is the graph of $-f(x)$?

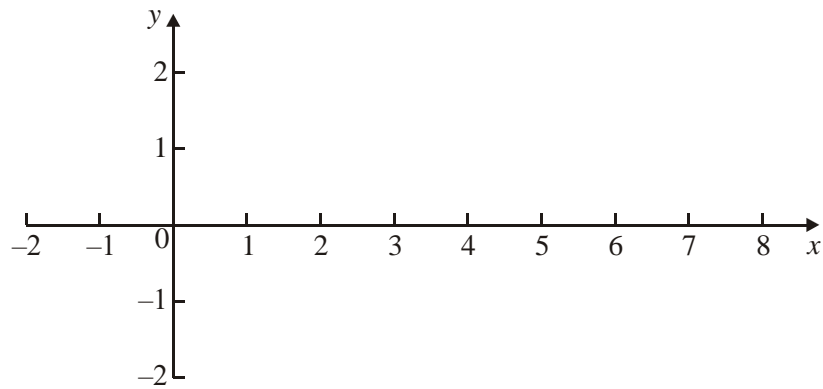(c)   Which diagram is the graph of $f(-x)$

(Total 6 marks)

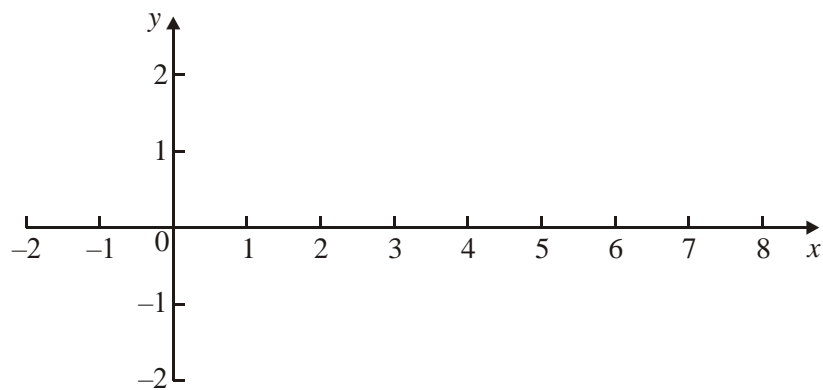**8.** The graph of $y = f(x)$ is shown in the diagram.

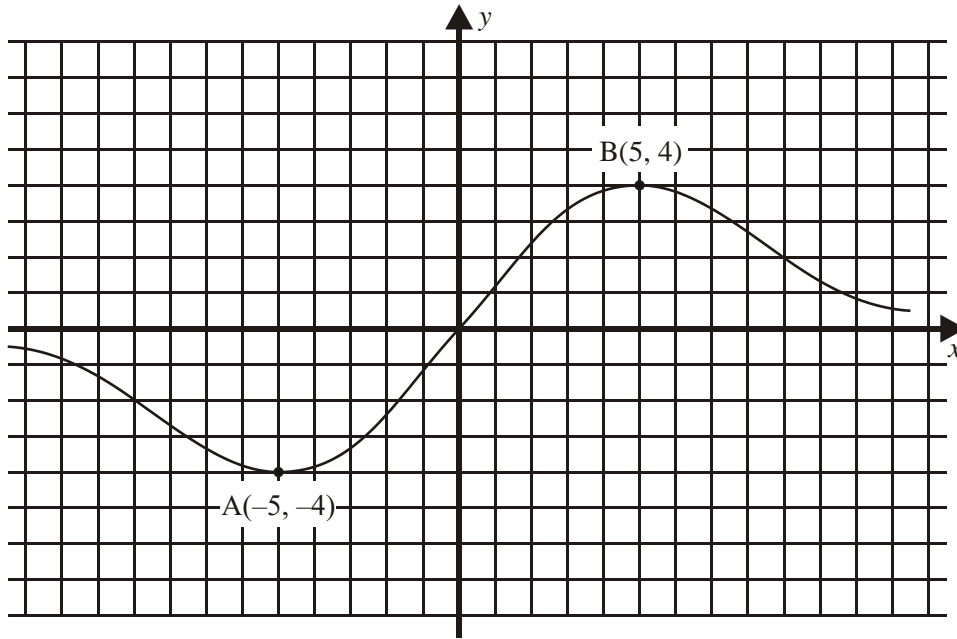(a) On each of the following diagrams draw the required graph,

(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)

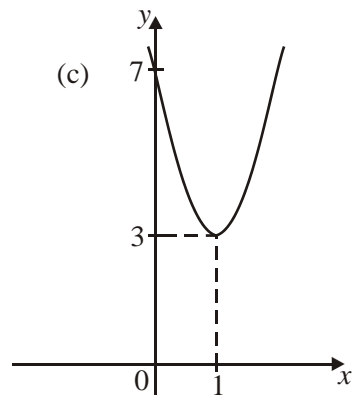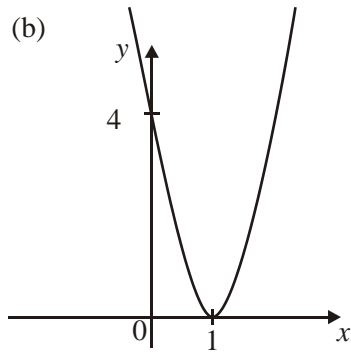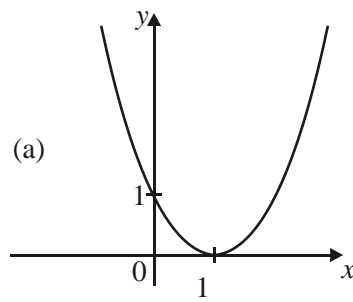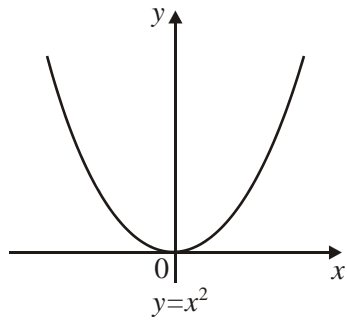**9.** The diagram shows the graph of $y = f(x)$, with the x-axis as an asymptote.

(a) On the same axes, draw the graph of $y = f(x + 2) - 3$, indicating the coordinates of the images of the points A and B.

(b) Write down the equation of the asymptote to the graph of $y = f(x + 2) - 3$.

(Total 4 marks)

10. 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.

(Total 4 marks)