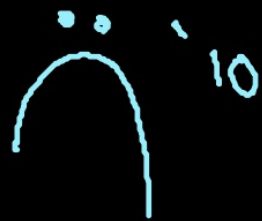


There are 6 transformations.

How many can you remember?

Of those, for how many could you write the appropriate formula?

John Paulson ☺ '07



x-axis reflection  $f(x) \rightarrow -f(x)$

y-axis reflection  $f(x) \rightarrow f(-x)$

horiz trans  $f(x) \rightarrow f(x-h)$

vert trans  $f(x) \rightarrow f(x) + k$

horiz stretch  $f(x) \rightarrow f\left(\frac{x}{b}\right)$

vert stretch  $f(x) \rightarrow a \cdot f(x)$

Today's learning objective:

By the end of class, I will be able to solve problems with all 6 transformations.

Today's language objective:

Vertical translation

Horizontal translation

X-axis reflection

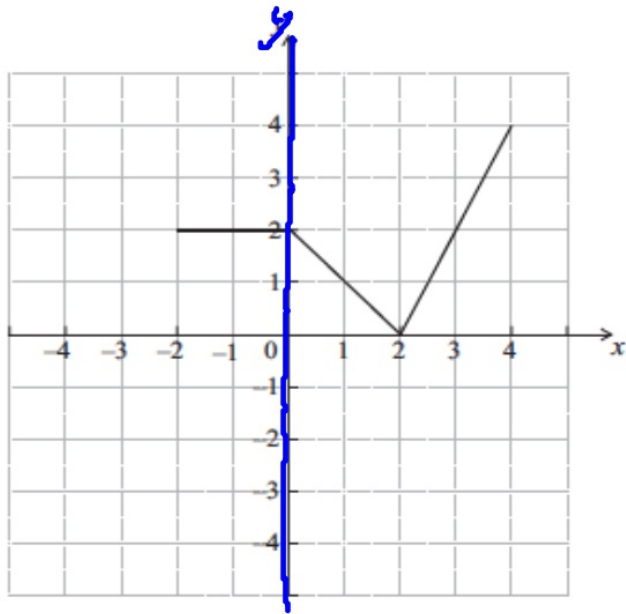
Y-axis reflection

Vertical stretch

Horizontal stretch

num mark: 5]

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



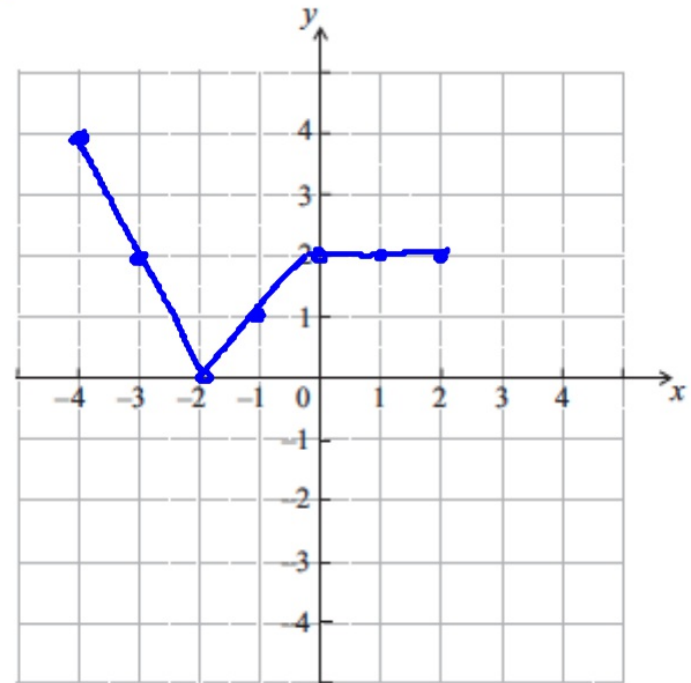
$$y = (x-h)^2 + k \quad (\text{This question cont.})$$

$$(x-3)^2 + 2$$

$$39.) (3, 2)$$

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

y-axis ref



(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.

(2, 1)

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

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

$$(x-1)^2 + 4 \quad x^2 - 2x + 5$$

The vector  $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$  translates the graph of  $(f \circ g)$  to the graph of  $h$ .

$$(x-3)^2 - 2(x-3) + 4$$

(2)

(b) Find the coordinates of the vertex of the graph of  $h$ .

$$x = 4 \quad y = 3$$

$$(x-4)^2 + 3$$

$$x^2 - 6x + 9 - 2x + 6 + 4$$

$$x^2 - 8x + 19$$

(3)

(c) Show that  $h(x) = x^2 - 8x + 19$ .

$$(x-4)^2 + 3$$

(2)

$$h'(x) = 2x - 8$$

$$2 = 2x - 8$$

(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)

2 is the gradient

(Total 12 marks)

6.) 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  $g$ .

$$(1, -2)$$

(2)

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

$$3(x-1)^2 - 2$$

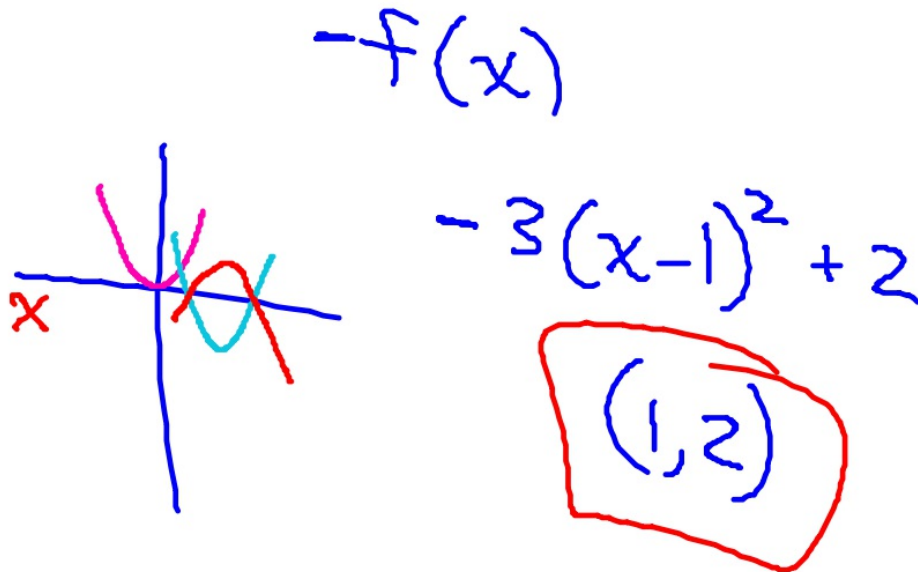
(2)

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)





28.) 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.

horiz. translation 1 unit to the right  
vertical stretch by a factor of 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  $P$ .

~~$f(x) = 2(x-4)^2 - 2$~~        $h(3) = 0$

(Total



thanks

Ash

44.) 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

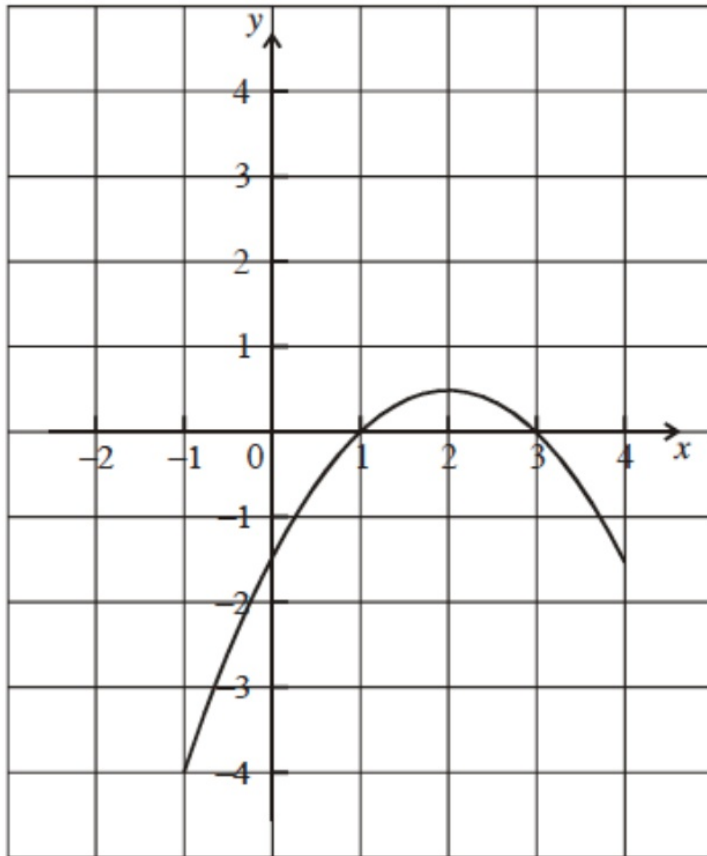
followed by

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

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

(3)

46.) 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)



55.) 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)

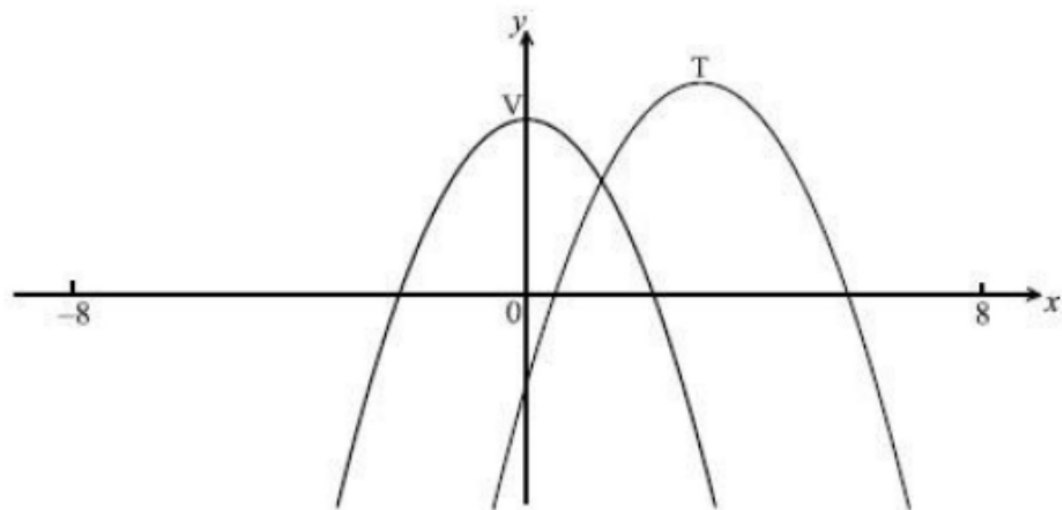
(b) The graph of  $f$  is translated 3 units in the positive  $x$ -direction and 5 units in the positive  $y$ -direction. Find the function  $g$  for the translated graph, giving your answer in the form  $g(x) = 3(x - p)^2 + q$ .

(3)

(Total 6 marks)

75.) 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  $y = g(-x)$ .

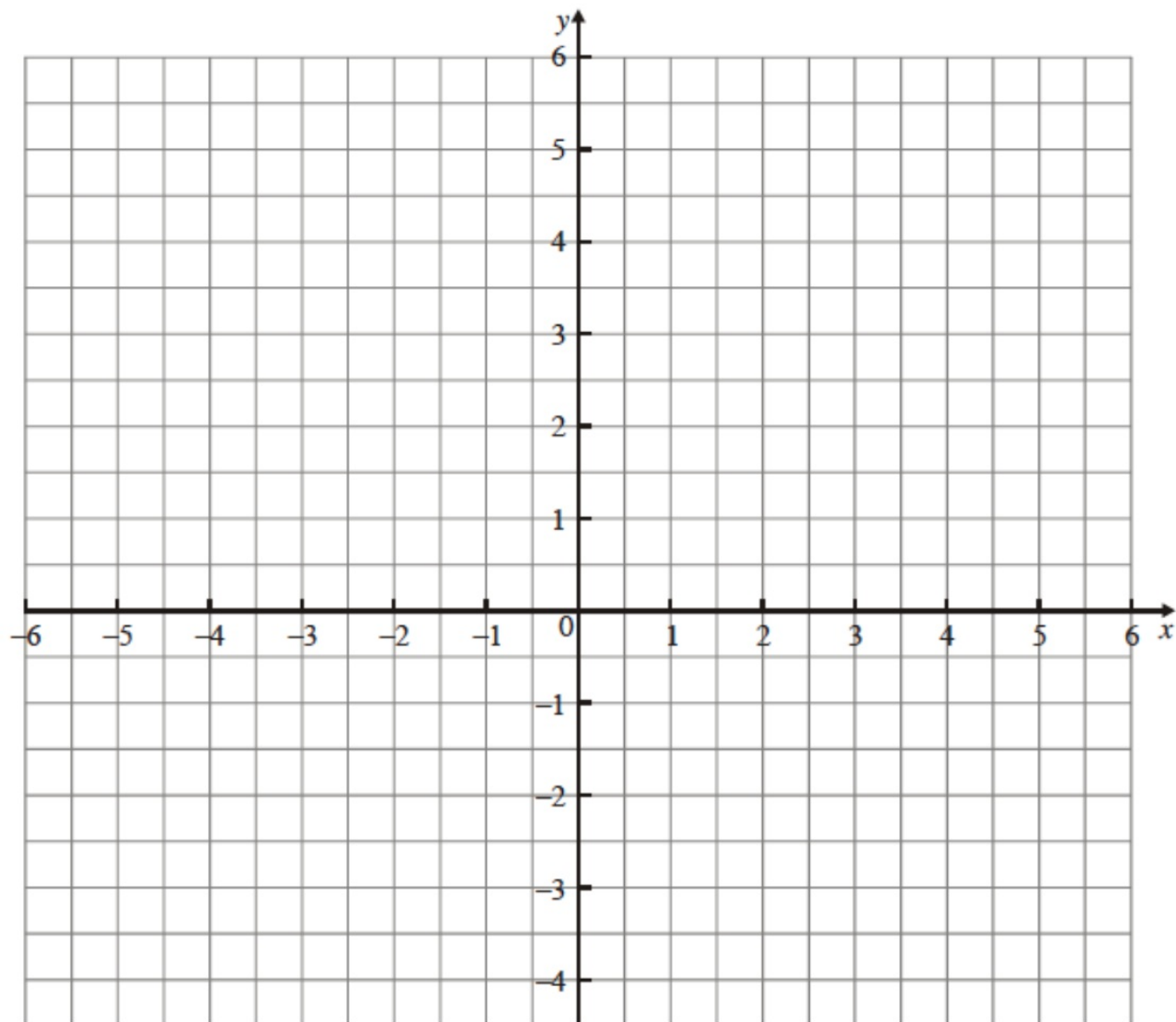
(2)

(Total 6 marks)

107.) 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  $-3 \leq x \leq -1$ .



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  $P$ .

*[Maximum mark: 14]*

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

(a) Sketch the graph of  $f$ .

*[2 marks]*

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 marks]*

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

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

(iii) Sketch the graph of  $g$ .

*[10 marks]*