How to describe transformations:

Horizontal and Vertical Translations can be described with a translation vector $\begin{pmatrix} x \\ y \end{pmatrix}$ which describes how far to move in the x and y direction

All others, write out the description of what is happening using correct vocabulary:

"horizontal/vertical stretch by a factor of"

"reflect across the x/y-axis"

If $f(x) = x^2$, find in simplest form:

a $f(2x)$ b $f\left(\frac{x}{3}\right)$ c $2f(x)+1$ d $f(x+3)-4$

$4x^2$ $\frac{x^2}{9}$ $2x^2+1$ x^2+6x+5

horiz stretch by factor of $\frac{1}{2}$

vertical stretch by factor of 4

shift L 3

shift D 4

$(3, -4)$

1 If $f(x) = x$, find in simplest form:

a $f(2x)$ **b** $f(x) + 2$ **c** $\frac{1}{2}f(x)$ **d** $2f(x) + 3$

2 If $f(x) = x^2$, find in simplest form:

a $f(3x)$ **b** $f\left(\frac{x}{2}\right)$ **c** $3f(x)$ **d** $2f(x-1) + 5$

3 If $f(x) = x^3$, find in simplest form: *don't expand

a $f(4x)$ **b** $\frac{1}{2}f(2x)$ **c** $f(x+1)$ **d** $2f(x+1) - 3$

4 If $f(x) = 2^x$, find in simplest form:

a $f(2x)$ **b** $f(-x) + 1$ **c** $f(x-2) + 3$ **d** $2f(x) + 3$

5 If $f(x) = \frac{1}{x}$, find in simplest form:

a $f(-x)$ **b** $f(\frac{1}{2}x)$ **c** $2f(x) + 3$ **d** $3f(x-1) + 2$

2 For each of the following functions f, sketch on the same set of axes $y = f(x)$, $y = f(x) + 1$ and $y = f(x) - 2$.

a $f(x) = 2^x$ **b** $f(x) = x^3$ **c** $f(x) = \frac{1}{x}$ **d** $f(x) = (x-1)^2$

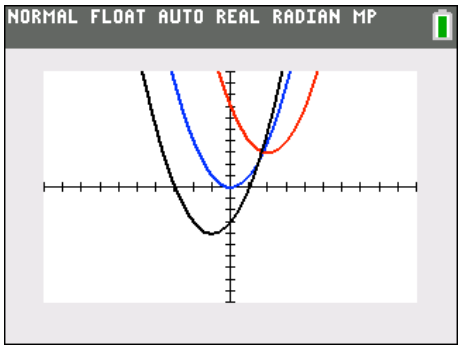
4 For each of the following functions f, sketch on the same set of axes the graphs of $y = f(x)$, $y = f(x-1)$ and $y = f(x+2)$.

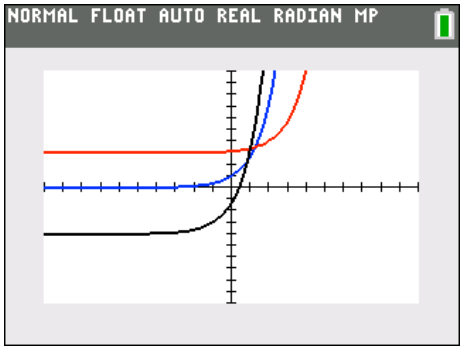
a $f(x) = x^3$ **b** $f(x) = \ln x$ **c** $f(x) = \frac{1}{x}$ **d** $f(x) = (x+1)^2 + 2$

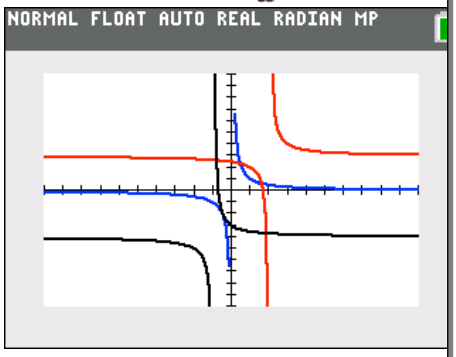
use your calc to help

5 For each of the following functions sketch, on the same set of axes:
$y = f(x)$, $y = f(x-2)+3$ and $y = f(x+1)-4$.

a $f(x) = x^2$ **b** $f(x) = e^x$ **c** $f(x) = \dfrac{1}{x}$

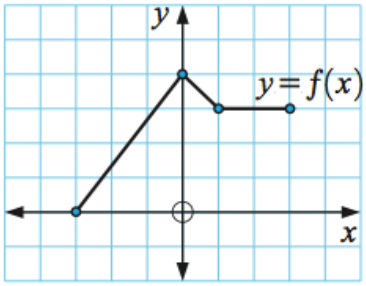




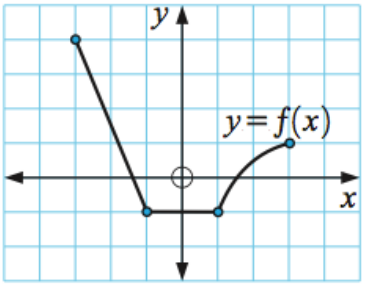


6 Copy these functions and then draw the graph of $y = f(x - 2) - 3$.

a



b



7 Suppose $f(x) = x^2$ is transformed to $g(x) = (x-3)^2 + 2$.

a Find the images of the following points on $f(x)$:

i $(0, 0)$ **ii** $(-3, 9)$ **iii** where $x = 2$

(2,4)

b Find the points on $f(x)$ which correspond to the following points on $g(x)$:

i $(1, 6)$ **ii** $(-2, 27)$

a) i) (3,2) ii) (0,11) iii) (5,6)

b) i) (-2,4) ii) (-5,25)

1 Sketch, on the same set of axes, the graphs of $y = f(x)$, $y = 2f(x)$ and $y = 3f(x)$ for each of:

a $f(x) = x^2$ **b** $f(x) = x^3$ **c** $f(x) = e^x$

d $f(x) = \ln x$ **e** $f(x) = \dfrac{1}{x}$

2 Sketch, on the same set of axes, the graphs of $y = f(x)$, $y = \frac{1}{2}f(x)$ and $y = \frac{1}{4}f(x)$ for each of:

a $f(x) = x^2$ **b** $f(x) = x^3$ **c** $f(x) = e^x$

4 Sketch, on the same set of axes, the graphs of $y = f(x)$ and $y = f\left(\frac{x}{2}\right)$ for each of:

a $y = x^2$ **b** $y = 2x$ **c** $y = (x+2)^2$

5 Sketch, on the same set of axes, the graphs of $y = f(x)$ and $y = f(2x)$ for each of:

a $y = x^2$ **b** $y = (x - 1)^2$ **c** $y = (x + 3)^2$

8 Consider the function $f : x \mapsto x^2$.
On the same set of axes sketch the graphs of:

a $y = f(x)$, $y = 3f(x-2)+1$ and $y = 2f(x+1)-3$

b $y = f(x)$, $y = f(x-3)$, $y = f(\frac{x}{2}-3)$, $y = 2f(\frac{x}{2}-3)$ and $y = 2f(\frac{x}{2}-3)+4$

c $y = f(x)$ and $y = \frac{1}{4}f(2x+5)+1$.

9 **a** Given that the following points lie on $y = f(x)$, find the corresponding points on the image function $y = 3f(2x)$:

i $(3, -5)$ **ii** $(1, 2)$ **iii** $(-2, 1)$

b Find the points on $y = f(x)$ which are moved to the following points under the transformation $y = 3f(2x)$:

i $(2, 1)$ **ii** $(-3, 2)$ **iii** $(-7, 3)$

a) i) $\left(\frac{3}{2}, -15\right)$ ii) $\left(\frac{1}{2}, 6\right)$ iii) $(-1, 3)$

b) i) $\left(4, \frac{1}{3}\right)$ ii) $\left(-6, \frac{2}{3}\right)$ iii) $\left(-4, 1\right)$

horiz stretch by factor $\frac{1}{2}$

vert stretch by factor 3

1 On the same set of axes, sketch the graphs of:

a $y = 3x$ and $y = -3x$

b $y = e^x$ and $y = -e^x$

c $y = x^2$ and $y = -x^2$

d $y = \ln x$ and $y = -\ln x$

e $y = x^3 - 2$ and $y = -x^3 + 2$

f $y = 2(x+1)^2$ and $y = -2(x+1)^2$.

3 **a** Find $f(-x)$ for:

i $f(x) = 2x + 1$ **ii** $f(x) = x^2 + 2x + 1$ **iii** $f(x) = x^3$

b Graph $y = f(x)$ and $y = f(-x)$ for:

i $f(x) = 2x + 1$ **ii** $f(x) = x^2 + 2x + 1$ **iii** $f(x) = x^3$

5 The function $y = f(x)$ is transformed to $g(x) = -f(x)$.

a Find the points on $g(x)$ corresponding to the following points on $f(x)$:

i $(3, 0)$ **ii** $(2, -1)$ **iii** $(-3, 2)$

b Find the points on $f(x)$ that have been transformed to the following points on $g(x)$:

i $(7, -1)$ **ii** $(-5, 0)$ **iii** $(-3, -2)$

6 The function $y = f(x)$ is transformed to $h(x) = f(-x)$.

a Find the image points on $h(x)$ for the following points on $f(x)$:

i $(2, -1)$ **ii** $(0, 3)$ **iii** $(-1, 2)$

b Find the points on $f(x)$ corresponding to the following points on $h(x)$:

i $(5, -4)$ **ii** $(0, 3)$ **iii** $(2, 3)$

7 A function $y = f(x)$ is transformed to the function $y = -f(-x) = g(x)$.

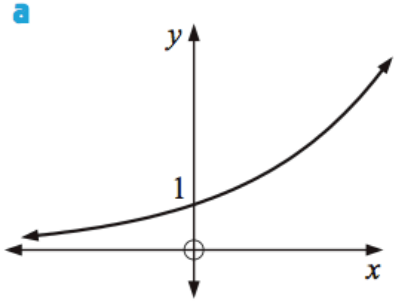
a Describe the nature of the transformation.

b If $(3, -7)$ lies on $y = f(x)$, find the transformed point on $g(x)$.

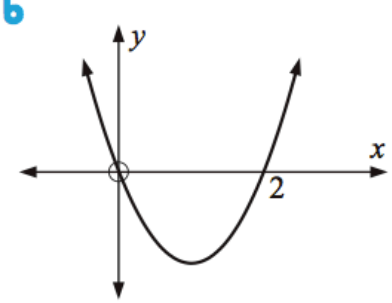
c Find the point on $f(x)$ that transforms to the point $(-5, -1)$.

1 Copy the following graphs for $y = f(x)$ and sketch the graphs of $y = -f(x)$ on the same axes.

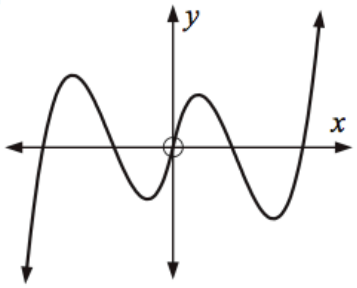
a



b

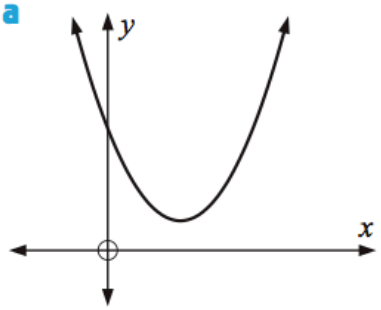


c

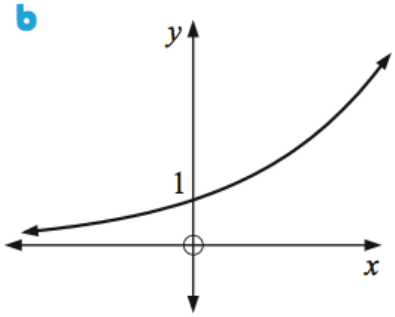


2 Given the following graphs of $y = f(x)$, sketch graphs of $y = f(-x)$:

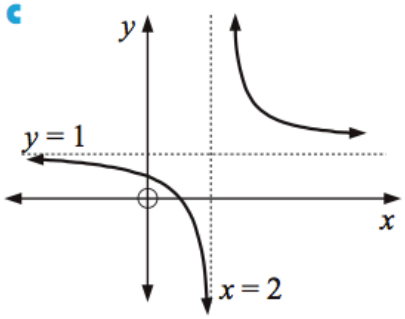
a



b



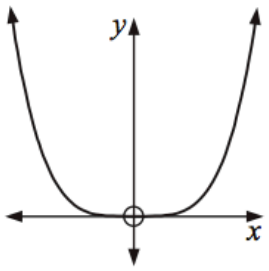
c



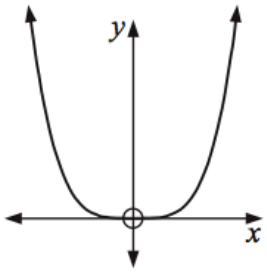
3 The scales on the graphs below are the same. Match each equation to its graph.

A $y = x^4$ **B** $y = 2x^4$ **C** $y = \frac{1}{2}x^4$ **D** $y = 6x^4$

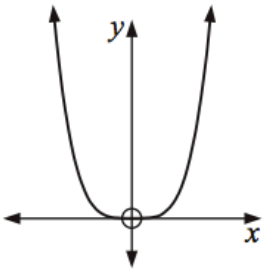
a



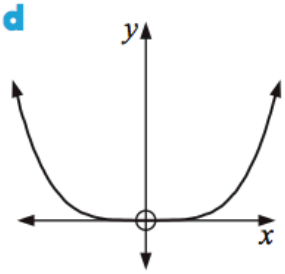
b



c



d

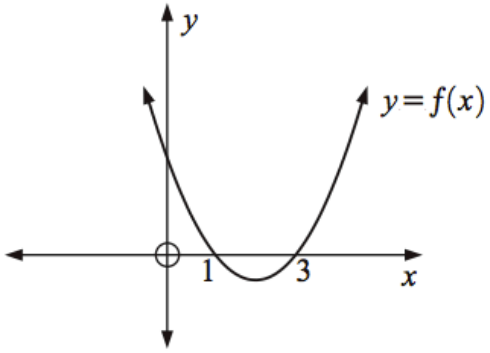


4 For the graph of $y = f(x)$ given, sketch the graph of:

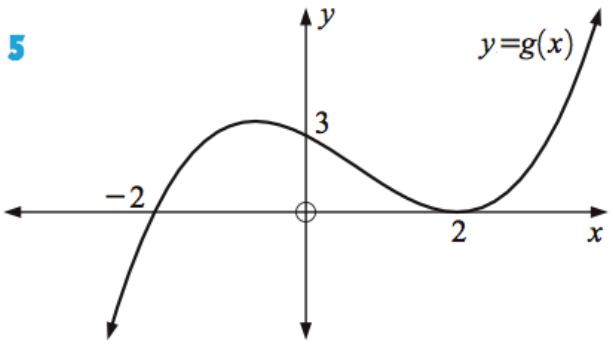
a $y = 2f(x)$ **b** $y = \frac{1}{2}f(x)$

c $y = f(x + 2)$ **d** $y = f(2x)$

e $y = f(\frac{1}{2}x)$



5



For the graph of $y = g(x)$ given, sketch the graph of:

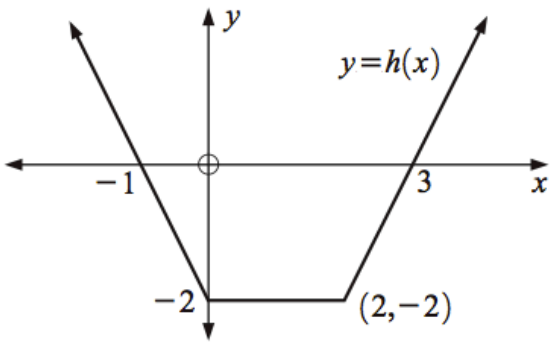
a $y = g(x) + 2$ **b** $y = -g(x)$

c $y = g(-x)$ **d** $y = g(x + 1)$

6 For the graph of $y = h(x)$ given, sketch the graph of:

a $y = h(x) + 1$ **b** $y = \frac{1}{2}h(x)$

c $y = h(-x)$ **d** $y = h\left(\frac{x}{2}\right)$



Additional Practice

Haese and Harris

Chapter 5

Review Set A: 1, 2, 6, 7, 8

Review Set B: 1, 3, 5, 8

Review Set C: 1 - 5