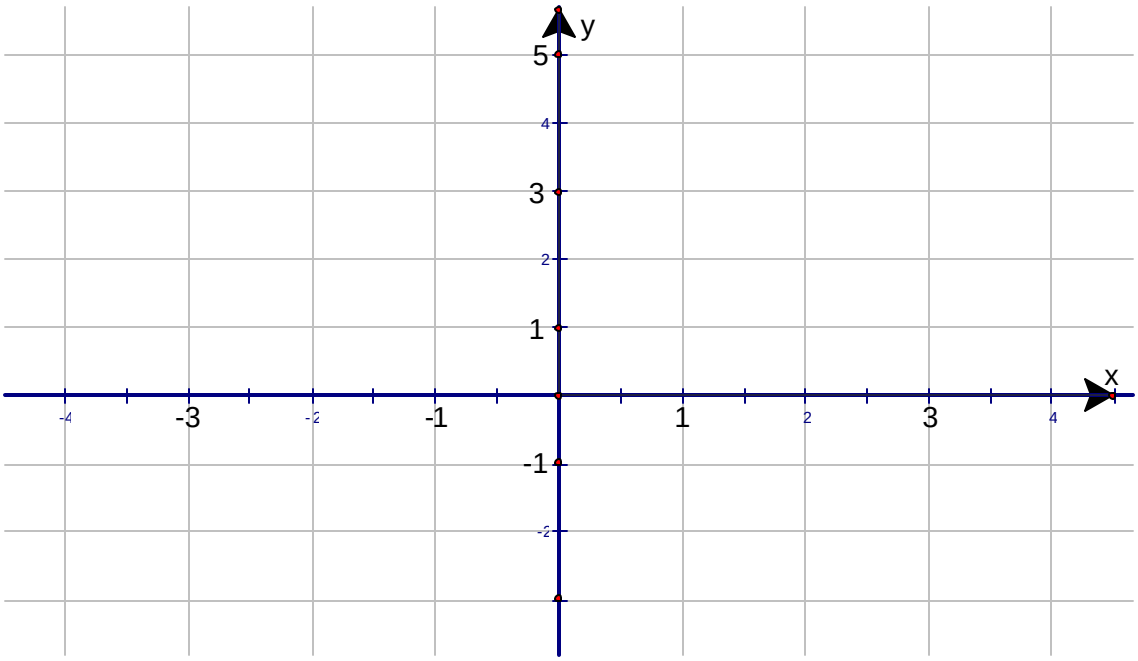
VERTICAL SHIFTING

Exercise #1 .

Use the graph of
$f(x)=x^2$
to obtain the graphs of
$g(x)=x^2+1$
and
$h(x)=x^2-2$.



Equation	How to obtain the graph	Example
$y=f(x)+k$ $k>0$	Shift graph of $y=f(x)$ upward k units.	$g(x)=x^2+1$
$y=f(x)-k$ $k>0$	Shift graph of $y=f(x)$ downward k units.	$h(x)=x^2-2$

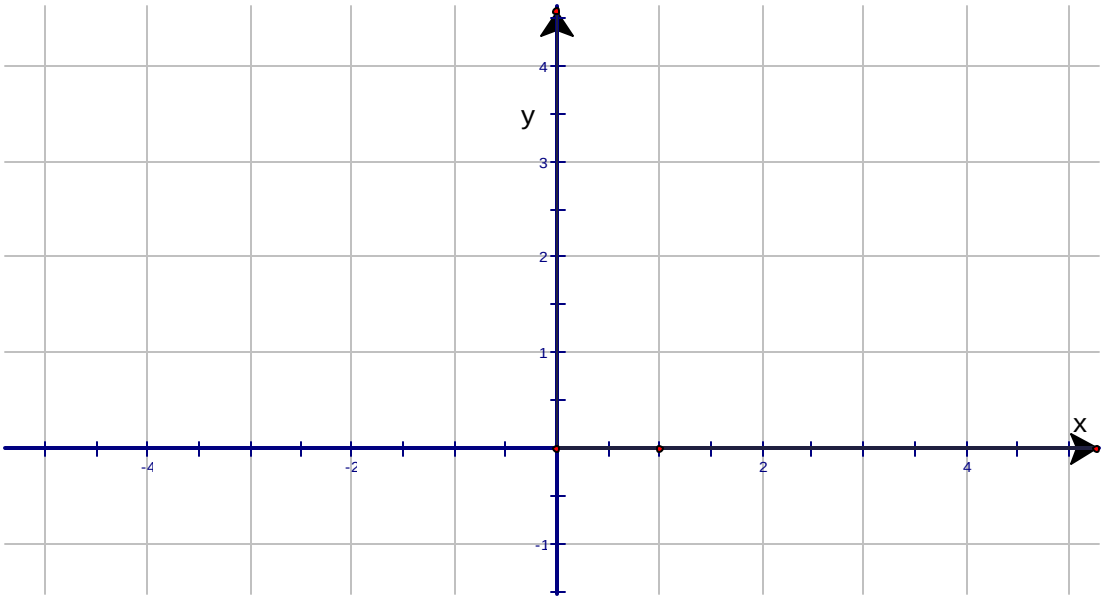
Exercise #2 .

Use the graph of
$f(x)=|x|$
to obtain the graph of
$g(x)=|x|+2$.

HORIZONTAL SHIFTING

Exercise #3 .

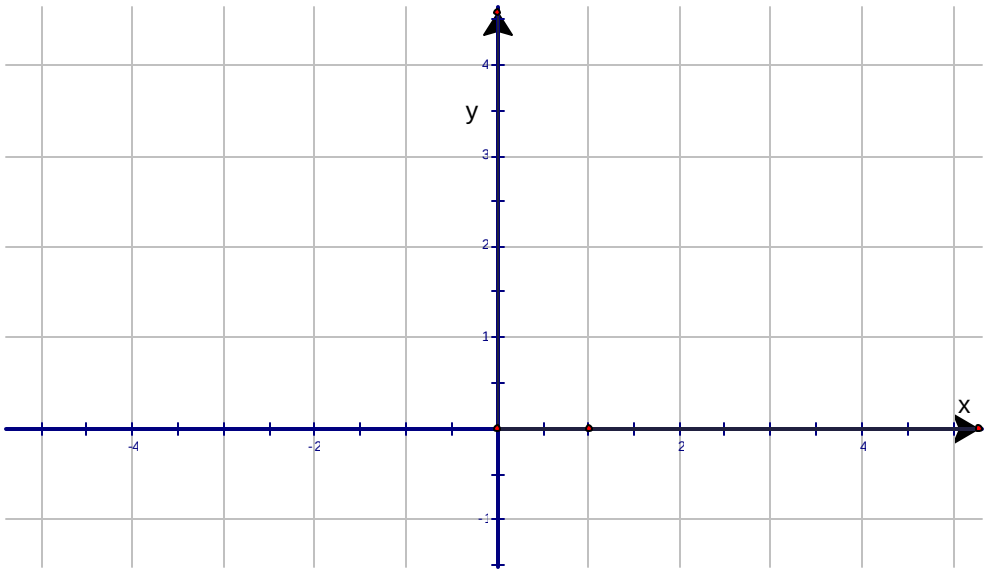
Use the graph of
$f(x)=x^2$
to obtain the graphs of
$g(x)=(x-1)^2$
and
$h(x)=(x+1)^2$.



Equation	How to obtain the graph	Example
$y=f(x-h)$ $h>0$	Shift graph of $y=f(x)$ to the right h units.	$g(x)=(x-1)^2$
$y=f(x+h)$ $h>0$	Shift graph of $y=f(x)$ to the left h units.	$h(x)=(x+1)^2$

Exercise #4 .

Use the graph of
$f(x)=\sqrt{x}$
to obtain the graph of
$g(x)=\sqrt{x-3}$.



VERTICAL STRETCH AND COMPRESSION

Exercise #5 .

Use the graph of

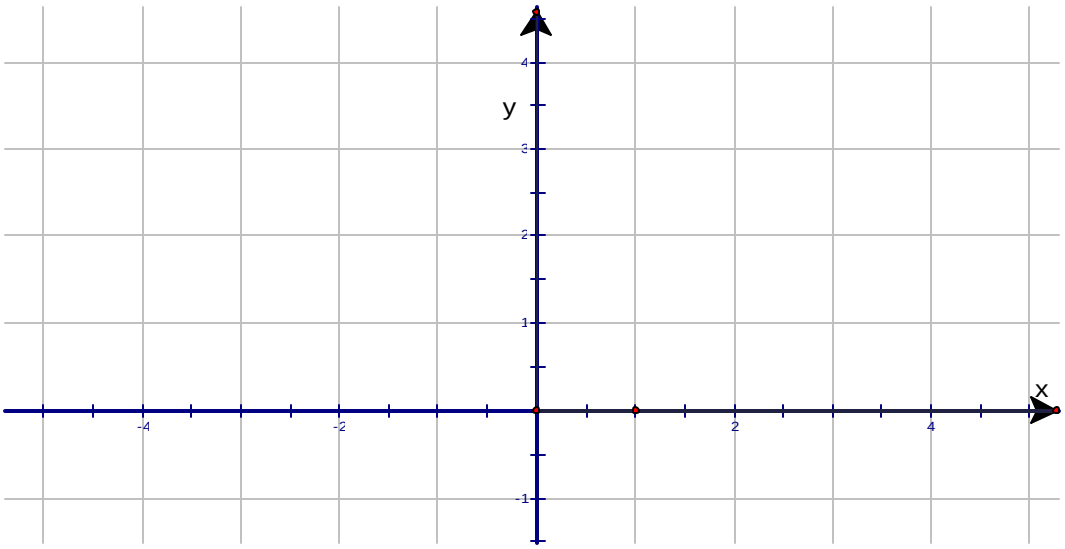
$f(x)=|x|$

to obtain the graphs of

$g(x)=2|x|$

and

$h(x)=\frac{1}{2}|x|$



Equation	How to obtain the graph	Example
$y=af(x)$ $a>1$	Stretch the graph of $y=f(x)$ vertically by a factor of a.	$g(x)=2\|x\|$
$y=af(x)$ $0<a<1$	Compress the graph of $y=f(x)$ vertically by a factor of $\frac{1}{a}$.	$h(x)=\frac{1}{2}\|x\|$

HORIZONTAL COMPRESSION AND STRETCH

Exercise #6 .

Use the graph of

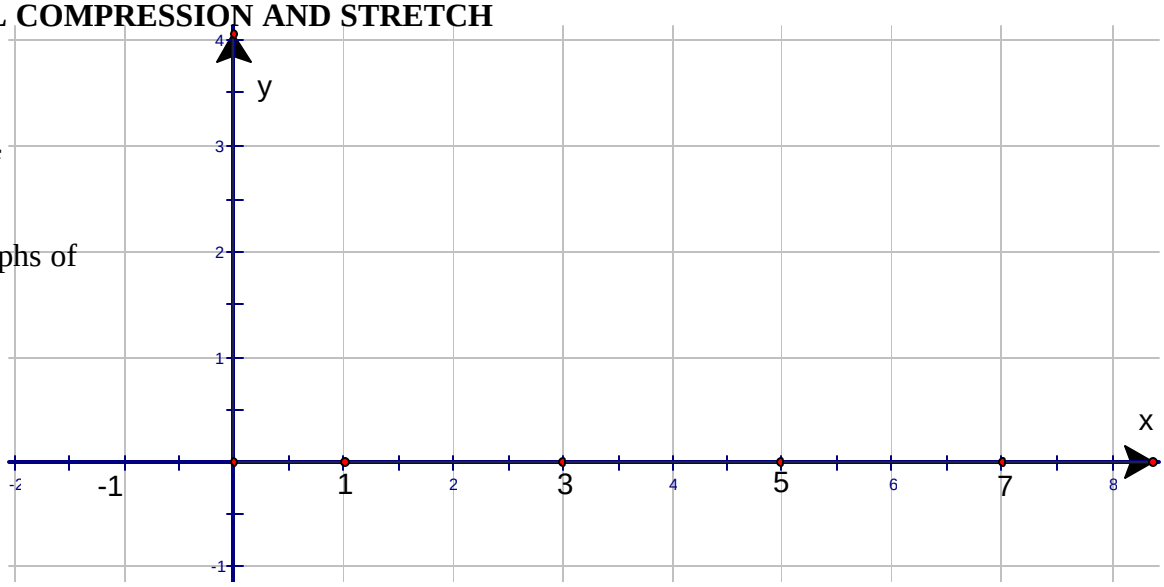
$f(x)=\sqrt{x}$

to obtain the graphs of

$g(x)=\sqrt{2x}$

and

$h(x)=\sqrt{\frac{1}{2}x}$.



Equation	How to obtain the graph	Example
$y=f(ax)$ $a>1$	Compress the graph of $y=f(x)$ horizontally by a factor of a.	$g(x)=\sqrt{2x}$
$y=f(ax)$ $0<a<1$	Stretch the graph of $y=f(x)$ horizontally by a factor of $\frac{1}{a}$.	$h(x)=\sqrt{\frac{1}{2}x}$

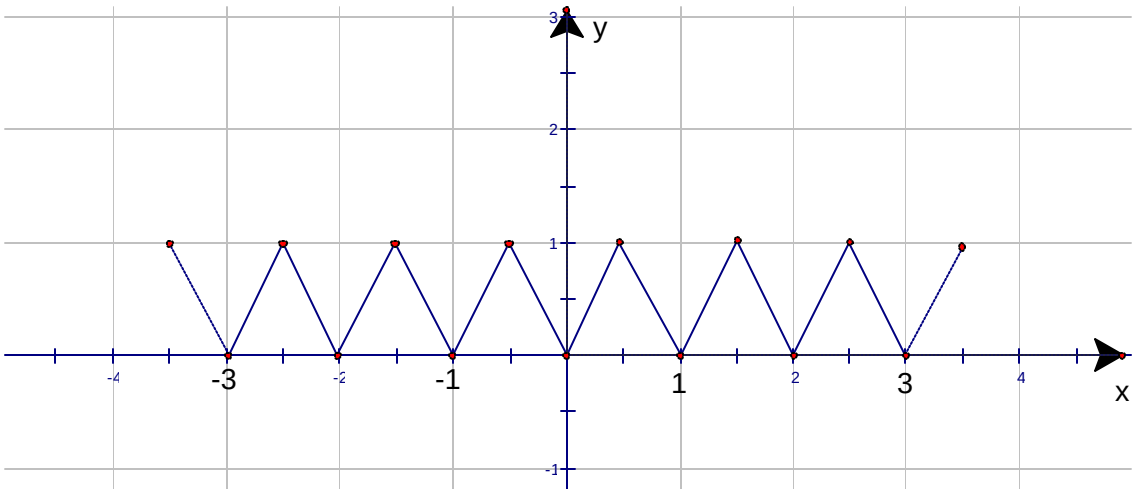
Exercise #7 Find the function that is finally graphed after the following transformations are applied to the graph of a) $f(x)=\sqrt{x}$; b) $g(x)=x^3$.

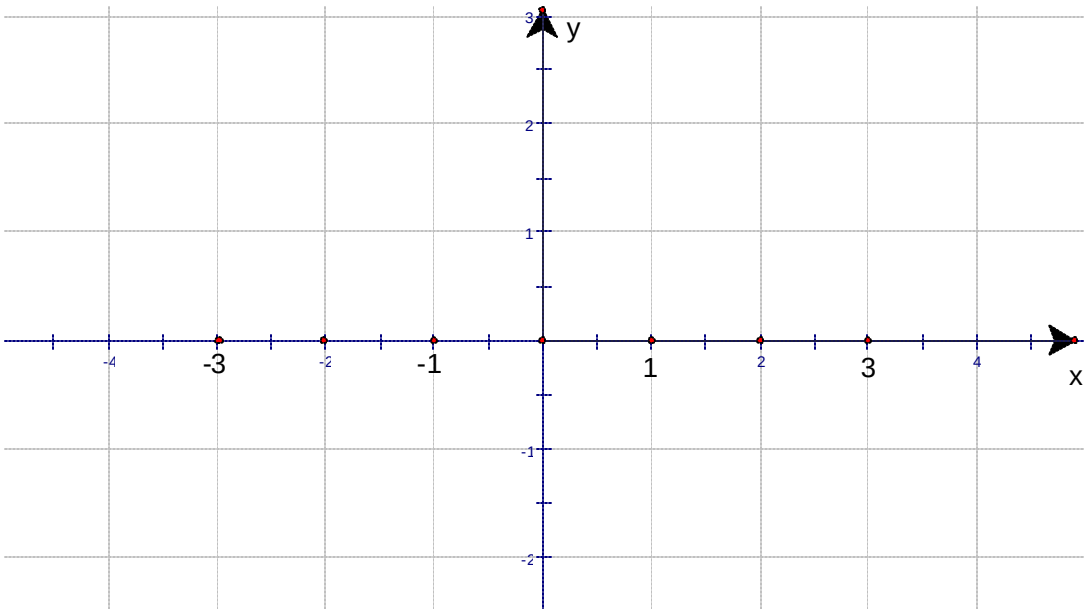
1) Shift left 3 units

2) Shift up 1 unit.

Exercise #8 The graph of $y=f(x)$ is shown. Sketch the graph of each function:

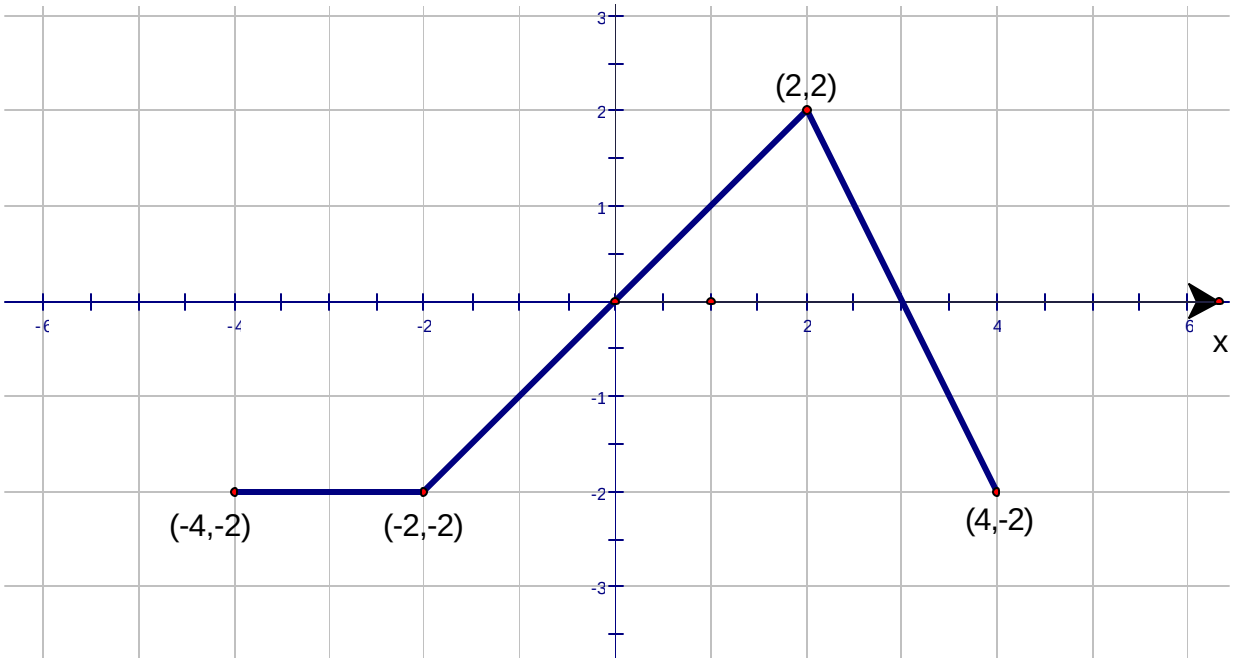
a) $y=f(2x)$ b) $y=f\left(\frac{1}{2}x\right)$.





Exercise #9 The graph of $y = f(x)$ is shown. Sketch the graph of each function:

a) $H(x) = f(x+1) - 2$ b) $Q(x) = \frac{1}{2} f(x)$.



Exercise #10 If $(0,3)$ is a point on the graph of $y = f(x)$, which of the following points must be on the graph of $y = 2f(x)$?

a) $(0,3)$

b) $(0,2)$

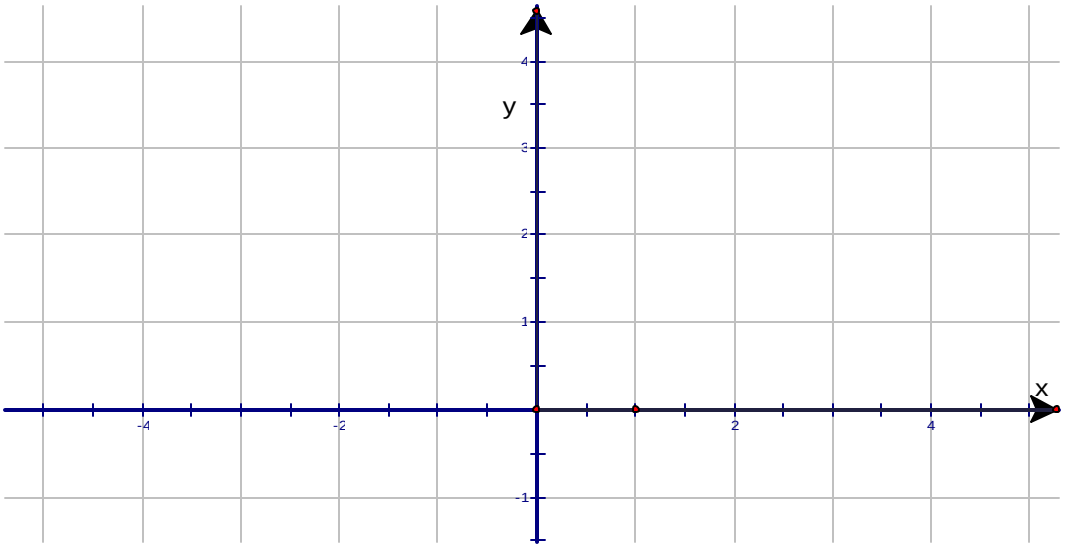
c) $(0,6)$

d) $(6,0)$.

REFLECTION ABOUT THE AXES

Exercise #11

Use the graph of
$f(x)=\sqrt{x}$
to obtain the graphs of
$g(x)=-\sqrt{x}$
and
$h(x)=\sqrt{-x}$



Equation	How to obtain the graph	Example
$y=-f(x)$	Reflect the graph of $y=f(x)$ about the x-axis.	$g(x)=-\sqrt{x}$
$y=f(-x)$	Reflect the graph of $y=f(x)$ about the y-axis.	$h(x)=\sqrt{-x}$

Exercise #12 Graph each function using the techniques of shifting, compressing, stretching, and/or reflecting. Start with the graph of the basic function and show all stages.

a) $f(x)=\dfrac{1}{-x}+2$ b) $g(x)=-(x+1)^3-1$