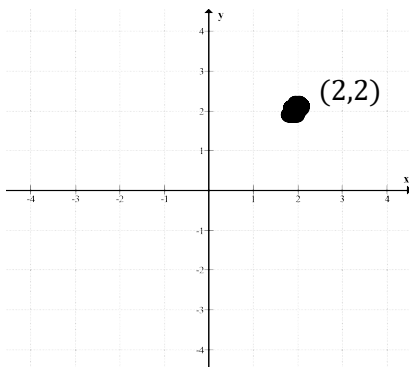


C12 - 1.2 - VHCE Point Notes

Find new point

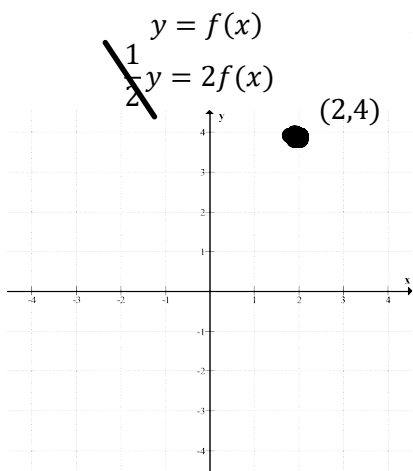
$$y = f(x)$$



Point

$(2,2)$ is on $f(x)$

Function Notation



Operation

$(2,2)$

$VE = 2$ $(2,4)$

$y \text{ times } 2$

$2y$

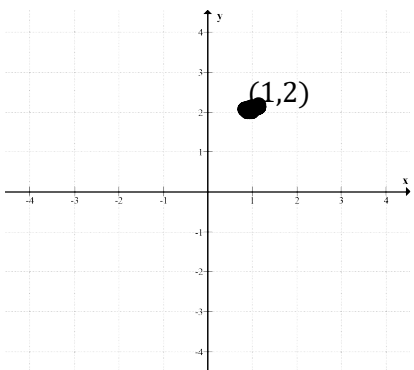
Mapping Notation

$(x, 2y)$

Multiply y-value by 2

A Vertical Expansion by a Factor of 2

$$g(x) = f(2x)$$



$HC = \frac{1}{2}$ $(2,2)$
 $(1,2)$

$x \text{ times } \frac{1}{2}$

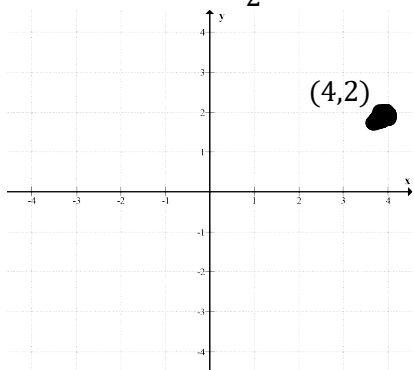
$\frac{1}{2}x$

Multiply x-value by $\frac{1}{2}$

$(\frac{1}{2}x, y)$

A Horizontal Compression by a Half

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



$HE = 2$ $(2,2)$
 $(4,2)$

$x \text{ times } 2$

$2x$

Multiply x-value by 2

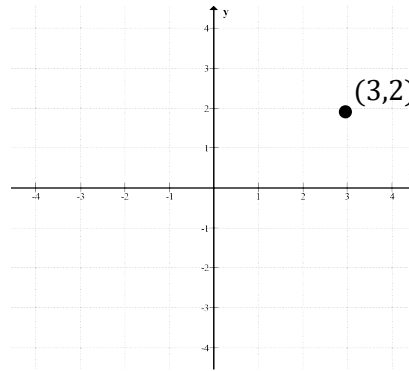
$(2x, y)$

A Horizontal Expansion by 2

Do exactly what you see outside of the brackets on the right-hand side to the **y-value**
 Do the **Opposite** of what you see inside the brackets to the **x-value**. Attached to the variable.
 Do the **Opposite** of what you see on the left hand side to the **y-value**. Attached to the variable.

C12 - 1.2 - VHR Point Notes

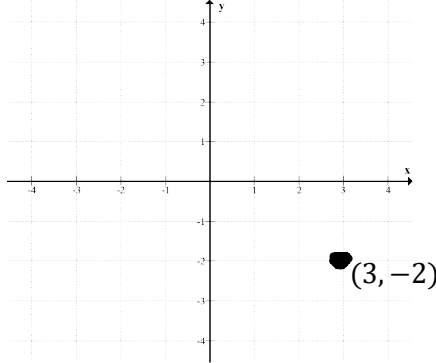
Find $g(x)$



Point
 $(3, 2)$ is on $f(x)$

Function Notation

$$g(x) = -f(x)$$



Operation

$(3, 2)$

VR $(3, -2)$

y times -1

$-y$

Mapping Notation

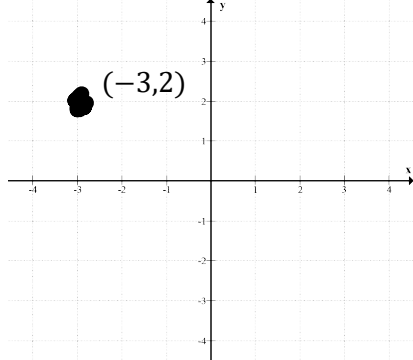
$(x, -y)$

Multiply y-value by -1

A Vertical Reflection

Reflection

$$g(x) = f(-x)$$



$(3, 2)$

HR $(-3, 2)$

x times -1

$-x$

$(-x, y)$

Multiply x-value by -1

A Horizontal Reflection

Reflection

Remember: beDMAS. Function Operations 1st. Inside Out.

C12 - 1.2 - VHCER Function Notation $f(x)$ Notes

$$y = f(x)$$

$$f(x) = x^2$$

Given

$$f(3) = ? \quad (3, y)$$

What is y when x is 3.

$$f(x) = x^2$$

$$f(x) = (x)^2$$

$$f(3) = (3)^2$$

Put 3 in for x .

$$y = x$$

$$y = (3)^2$$

$$y = 9$$

x	y
3	9

$$f(3) = 9$$

(3,9)

Put whatever is inside the brackets in for x .
Substitute with Brackets

$$f(2x) = ?$$

$$f(x) = x^2$$

$$f(2x) = (2x)^2$$

Let's call it y

Put $2x$ in for x

Function Notation

$$y = ?$$

$$y = f(2x)$$

$$y = (2x)^2$$

$$HC = \frac{1}{2}$$

$$2f(x) = ?$$

$$f(x) = x^2$$

$$2f(x) = 2x^2$$

Let's call it $k(x)$

$2 \times f(x)$

$$k(x) = ?$$

$$k(x) = 2f(x)$$

$$k(x) = 2x^2$$

$$VE = 2$$

$$-f(x) = ?$$

$$f(x) = x^2$$

$$-f(x) = -x^2$$

Let's call it $n(x)$

-ve $f(x)$

$$n(x) = ?$$

$$n(x) = -f(x)$$

$$n(x) = -x^2$$

VR

Vertical Reflection

C12 - 1.2 - VHCE Graph $y =$ Notes

Vertical Expansion
by a factor of 2

$$VE = 2$$

$$y = x^2$$

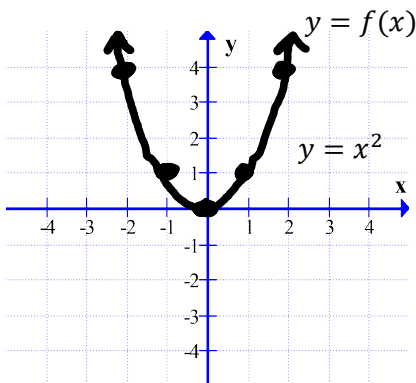
$$\frac{1}{2}y = x^2$$

$$y = 2x^2$$

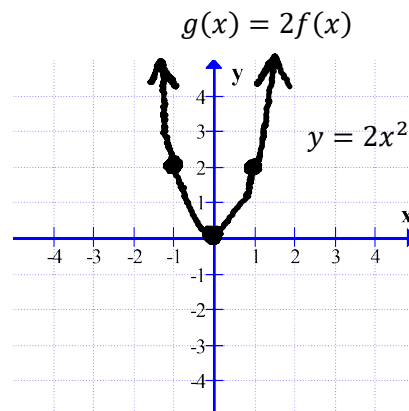
$$y \rightarrow \frac{1}{2}y$$

Put $\frac{1}{2}y$ in for y

**Substitute the Opposite
Operation for the Variable**



x	y
-2	4
-1	1
0	0
1	1
2	4



x	y
-2	8
-1	2
0	0
1	2
2	8

Multiply y values by 2

Horizontal Compression

by a factor of $\frac{1}{2}$

$$HC = \frac{1}{2}$$

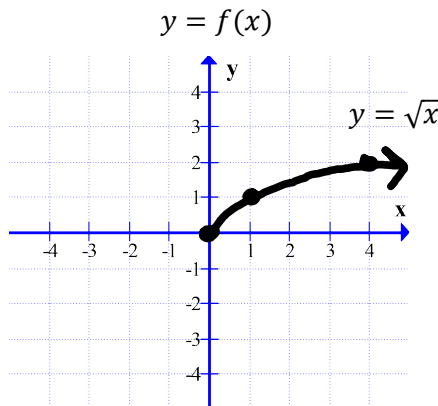
$$y = \sqrt{x}$$

$$y = \sqrt{2x}$$

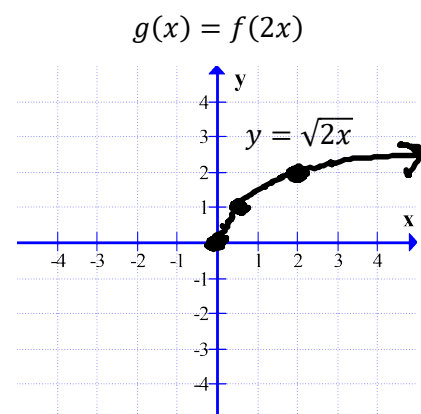
$$x \rightarrow 2x$$

Put $2x$ in for x

**Substitute the Opposite
Operation for the Variable**



x	y
-1	und
0	0
1	1
4	2



x	y
-1	und
0	0
$\frac{1}{2}$	1
2	2

Multiply x values by $\frac{1}{2}$

C12 - 1.2 - VHR Graph $y =$ Notes

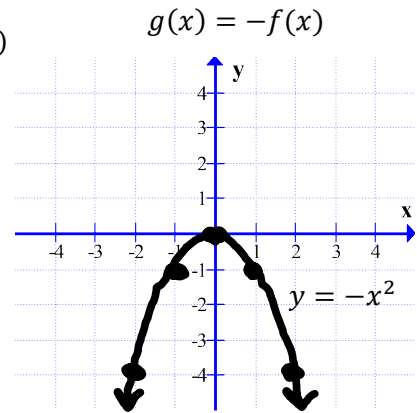
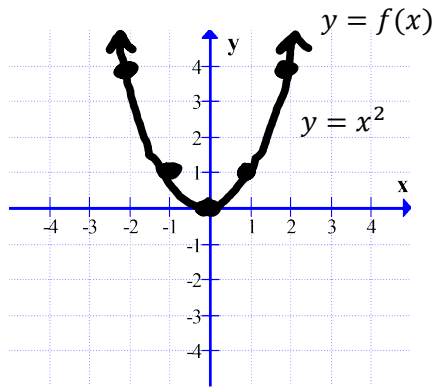
Vertical Reflection VR

$$y = x^2$$

$$-y = x^2 \quad y \rightarrow -y$$

$$y = -x^2$$

Put $-y$ in for y



Substitute the Opposite Operation for the Variable

x	y
-2	4
-1	1
0	0
1	1
2	4

x	y
-2	-4
-1	-1
0	0
1	-1
2	-4

Over the x-axis

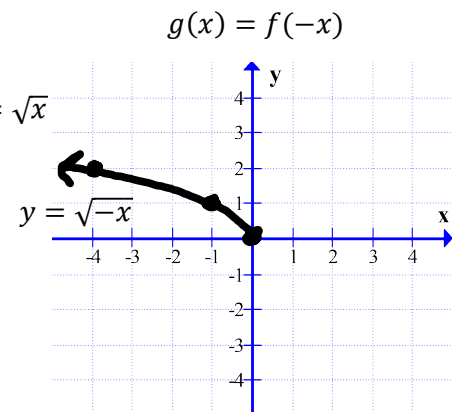
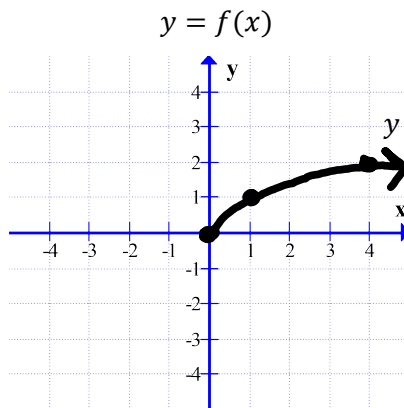
Multiplying y by negative 1

Horizontal Reflection

$$y = \sqrt{x}$$

$$y = \sqrt{-x} \quad HR \quad x \rightarrow -x$$

Put $-x$ in for x



Substitute the Opposite Operation for the Variable

x	y
-1	und
0	0
1	1
4	2

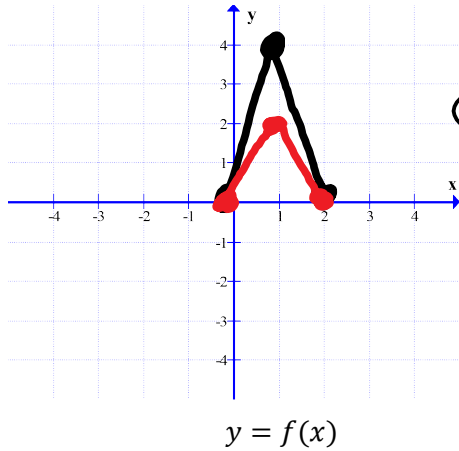
x	y
1	und
0	0
-1	1
-4	2

Over the y-axis

Multiplying x by negative 1

C12 - 1.2 - VHCER Graphs $f(x)$ Notes

Find the transformed equation of $f(x)$ in all forms.



$$y = af(x)$$

$$y = 2f(x)$$

$$ay = f(x)$$

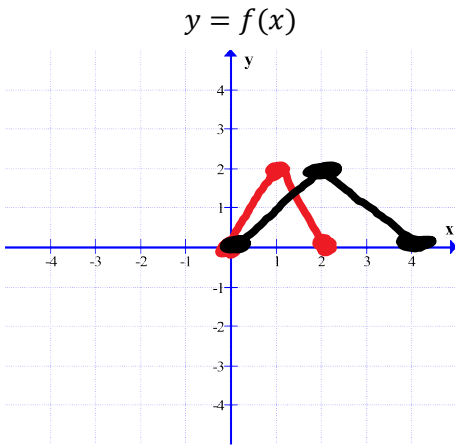
$$\frac{1}{2}y = f(x)$$

$$y = f(x)$$

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

$$VE = 2 \quad y \rightarrow \frac{1}{2}y$$

$$y = 2f(x)$$

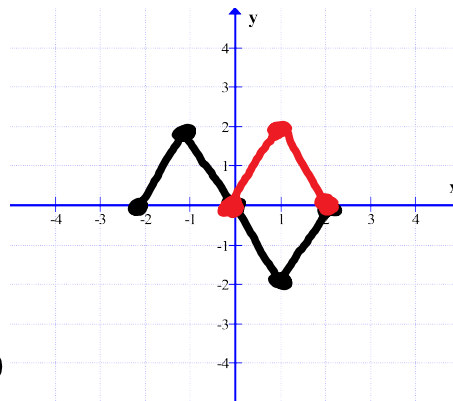


$$y = f(bx)$$

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

$$HE = 2 \quad x \rightarrow \frac{1}{2}x$$

$$y = f(x)$$



$$y = f(bx)$$

$$y = f(x)$$

$$y = f(-x)$$

$$HR \quad x \rightarrow -x$$

$$y = af(x)$$

$$y = f(x)$$

$$-y = f(x)$$

$$VR \quad y \rightarrow -y$$

$$y = -f(x)$$