

TRANSFORMATIONS

Transformations	Formulas	How Parent Moves	Examples
Vertical Translation	$y = f(x) + k$	Shift up	$y = x^2 + 2$
Vertical Translation	$y = f(x) - k$	Shift down	$y = x^2 - 3$
Horizontal Translation	$y = f(x - h)$	Shift right	$y = (x - 1)^2$
Horizontal Translation	$y = f(x + h)$	Shift left	$y = (x + 2)^2$
Vertical Stretch by factor of a	$y = af(x), a > 1$	Pulled up and down (narrower)	$y = 3x^2$
Vertical Compression by factor of a	$y = af(x), 0 < a < 1$	Pressed flatter (wider)	$y = 1/3x^2$
Horizontal Stretch by factor of 1/b	$y = f(bx), 0 < b < 1$	Pulled out left and right (wider)	$y = (1/3x)^2$
Horizontal Compression by factor of 1/b	$y = f(bx), b > 1$	Pushed in (narrower)	$y = (3x)^2$
Reflection across the x-axis	$y = -f(x)$	Flip over the x	$y = -x^2$
Reflection across the y-axis	$y = f(-x)$	Flip over the y	$y = (-x)^2$

Give the transformations for the following. (From $f(x) = x^2$ to $g(x)$)

- $g(x) = 5x^2 - 3$ v. stretch by 5, v. Trans. down 3
- $g(x) = -2(x+4)^2$ Reflect x-axis, v. stretch by 2, H. Trans. left. 4
- $g(x) = 1/2x^2 - 6$ v. comp. by '1/2, v. Trans down 6
- $g(x) = (-1/3x)^2 + 5$ Reflect y-axis, H. stretch by 3, v. Trans. up 5
- $g(x) = -3(x-8)^2 - 1$ Reflect x-axis, ^{v. stretch by 3} H. Trans right 8, v. Trans. down 1
- $g(x) = 7(x+3)^2 + 4$ v. stretch by 7, H. Trans left 3, v. Trans. up 4
- $g(x) = (-2x)^2 - 3$ Reflect. y-axis, H. Comp. by '1/2, v. Trans down 3
- $g(x) = 1/4 x^2 + 6$ v. comp. by '1/4, v. Trans up 6

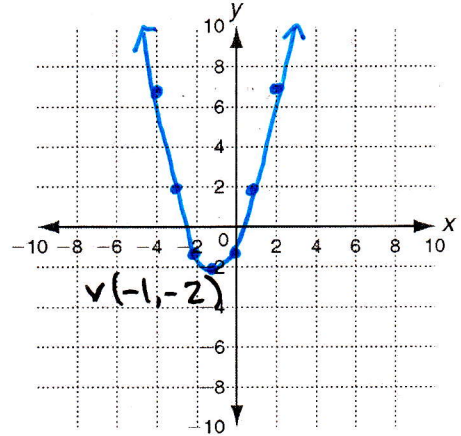
3.1 Practice B

Using Transformations to Graph Quadratic Functions

Graph the function by using a table.

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

X	$f(x) = x^2 + 2x - 1$	$(x, f(x))$
-2	$(-2)^2 + 2(-2) - 1$	$(-2, -1)$
-1	$(-1)^2 + 2(-1) - 1$	$(-1, -2)$
0	$(0)^2 + 2(0) - 1$	$(0, -1)$
1	$(1)^2 + 2(1) - 1$	$(1, 2)$
2	$(2)^2 + 2(2) - 1$	$(2, 7)$



Using the graph of $f(x) = x^2$ as a guide, describe the transformations, and then graph each function. Label each function on the graph.

2. $h(x) = (x - 2)^2 + 2$

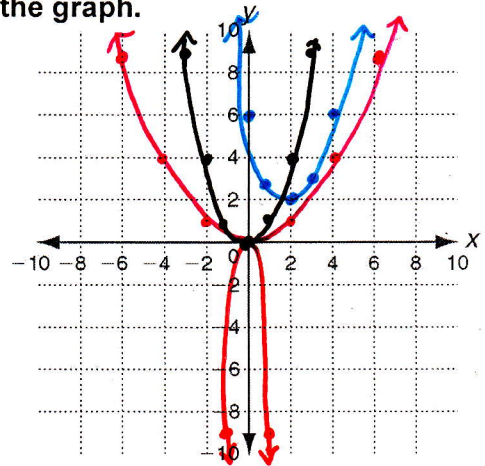
H. Trans. right 2, v. Trans. up 2

3. $h(x) = -(3x)^2$

Reflect x-axis, H. comp. by 1/3

4. $h(x) = \left(\frac{1}{2}x\right)^2$

H. stretch by 2



Use the description to write a quadratic function in vertex form.

5. The parent function $f(x) = x^2$ is reflected across the x-axis, horizontally stretched by a factor of 3 and translated 2 units down to create function g .

$g(x) = -\left(\frac{1}{3}x\right)^2 - 2$

6. A ball dropped from the top of tower A can be modeled by the function $h(t) = -16t^2 + 400$, where t is the time in seconds after it is dropped and $h(t)$ is its height in feet at that time. A ball dropped from the top of tower B can be modeled by the function $h(t) = -16t^2 + 200$. What transformation describes this change? What does this transformation mean?

V. Translation. Tower A is higher than Tower B by 200.