Algebra 2 Notes on Sections 2-1 Using Transformations to Graph Quadratic Functions

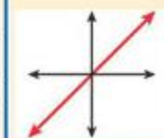
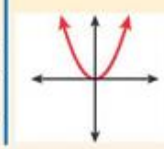
This chapter is about the Quadratic function. The graph of a quadratic function is a parabola.

If you can watch the following video about parabolas in the real world.
https://www.youtube.com/watch?v=lbMir1UAO4I

The vertex form of a quadratic function is $f(x) = a\,(x - h)^2 + k$

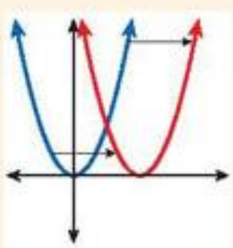
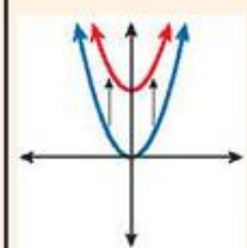
If your function is written in this format, it is easy to graph if you know your transformations.
First remember the Parent functions we covered in chapter 1.

Linear and Quadratic Parent Functions

ALGEBRA	NUMBERS	GRAPH
Linear Parent Function $f(x) = x$	x: −2, −1, 0, 1, 2 $f(x) = x$: −2, −1, 0, 1, 2	
Quadratic Parent Function $f(x) = x^2$	x: −2, −1, 0, 1, 2 $f(x) = x^2$: 4, 1, 0, 1, 4	

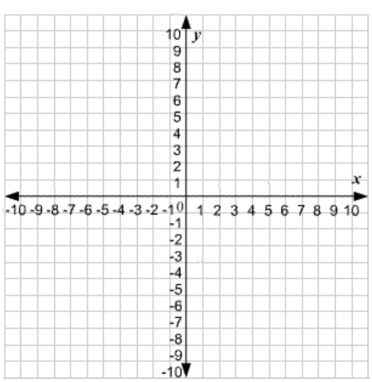
Remembering our first type of transformations, they were called translations. This moved the graph left/right and up/down.

Translations of Quadratic Functions

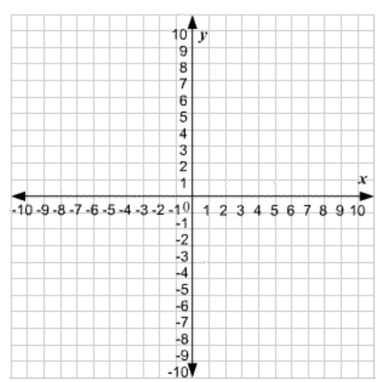
Horizontal Translations		Vertical Translations	
Horizontal Shift of $\lvert h \rvert$ Units		Vertical Shift of $\lvert k \rvert$ Units	
	$f(x) = x^2$ $f(x - h) = (x - h)^2$ Moves left for $h < 0$ Moves right for $h > 0$		$f(x) = x^2$ $f(x) + k = x^2 + k$ Moves down for $k < 0$ Moves up for $k > 0$

Try graphing the following, then turn page over to see if you got them right.

$f(x) = x^2 + 4$

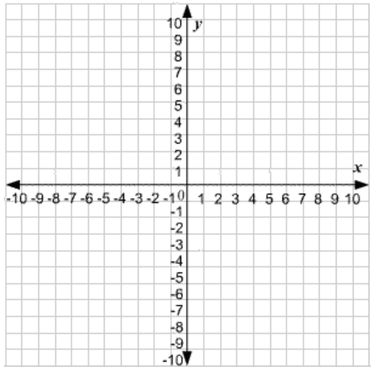


$f(x) = (x + 3)^2$



Answers to the problems on the front.

$f(x) = x^2 + 4$



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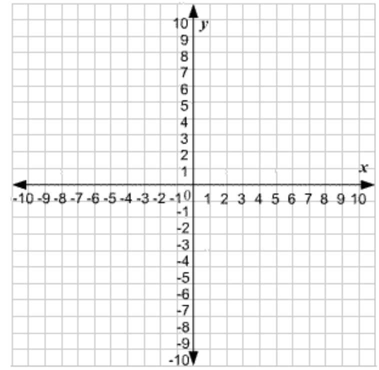
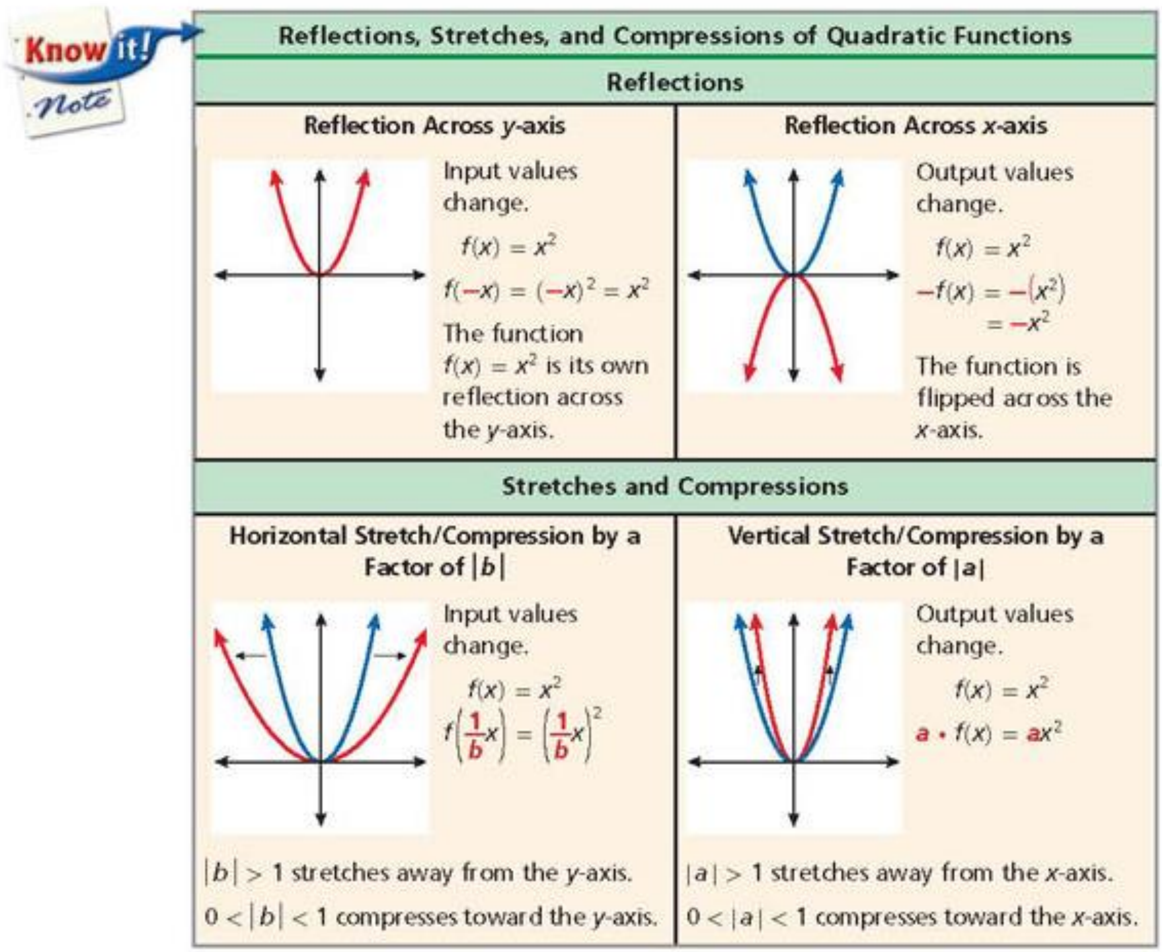


Our next set of transformations are reflections and then the stretch/compressions.



Reflections, Stretches, and Compressions of Quadratic Functions

Reflections

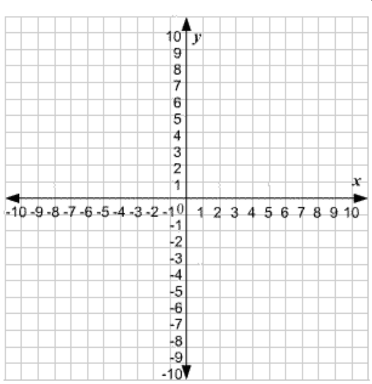
Reflection Across y-axis	Reflection Across x-axis
Input values change. $f(x) = x^2$ $f(-x) = (-x)^2 = x^2$ The function $f(x) = x^2$ is its own reflection across the y-axis.	Output values change. $f(x) = x^2$ $-f(x) = -(x^2) = -x^2$ The function is flipped across the x-axis.

Stretches and Compressions

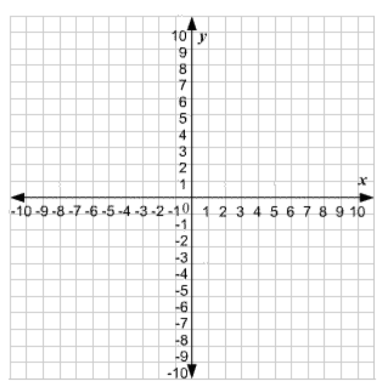
Horizontal Stretch/Compression by a Factor of $\lvert b \rvert$	Vertical Stretch/Compression by a Factor of $\lvert a \rvert$
Input values change. $f(x) = x^2$ $f\left(\frac{1}{b}x\right) = \left(\frac{1}{b}x\right)^2$	Output values change. $f(x) = x^2$ $a \cdot f(x) = ax^2$
$\lvert b \rvert > 1$ stretches away from the y-axis. $0 < \lvert b \rvert < 1$ compresses toward the y-axis.	$\lvert a \rvert > 1$ stretches away from the x-axis. $0 < \lvert a \rvert < 1$ compresses toward the x-axis.

Now try graphing these two functions. See next page for answers.

$G(x) = (2x)^2$

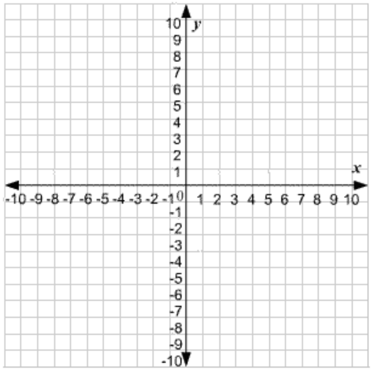


$g(x) = -\frac{1}{2}x$

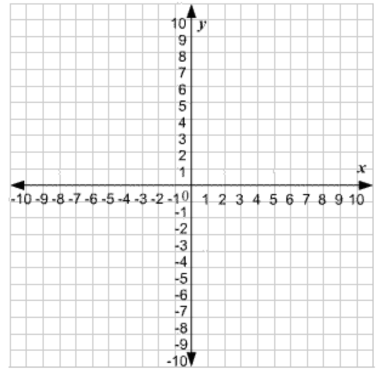


Answers:

$G(x) = (2x)^2$



$g(x) = -\frac{1}{2}x$



Know it! Note

Vertex Form of a Quadratic Function

$$f(x) = a(x-h)^2 + k$$

a indicates a reflection across the *x*-axis and/or a vertical stretch or compression.

h indicates a horizontal translation.

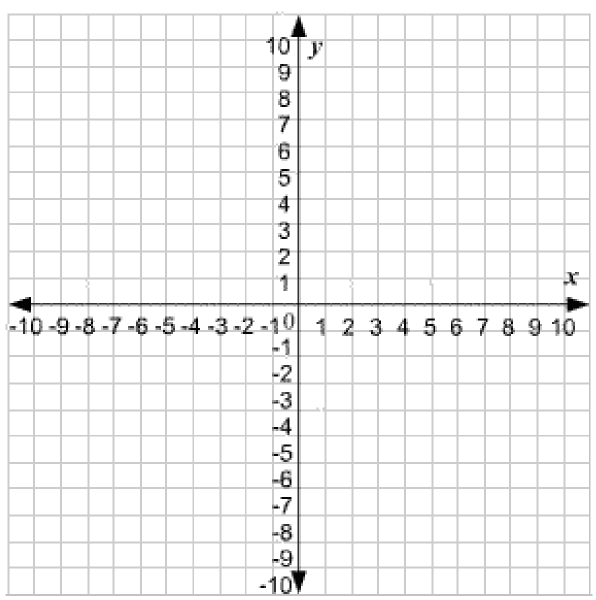
k indicates a vertical translation.

Now lets put it all together:

Graph the following equation: $f(x) = -2(x-3)^2 + 4$

First find some information from the function:

The “-“ means the graph is flipped down over x-axis
the “2” means that the graph is stretched
the “ – 3” inside the parenthesis means the graph is moved 3 units to the right
the “ +4” means that the graph will be moved up 4 units.



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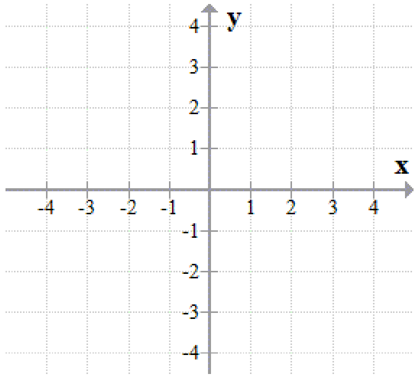
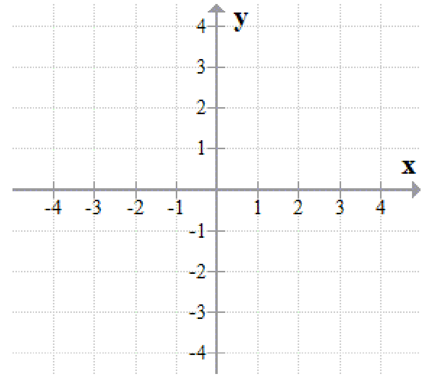
Now try graphing the following quadratic functions.

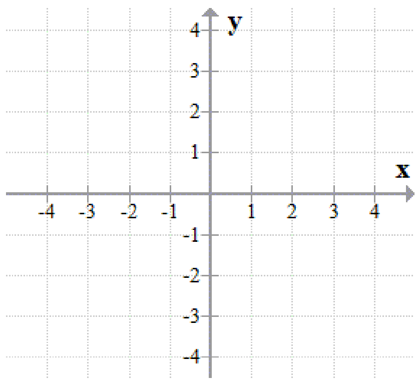
1. $F(x) = x^2 + 3$



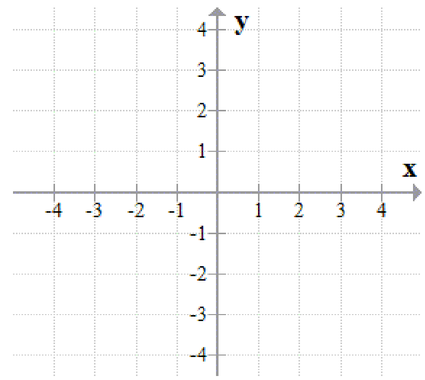
2. $F(x) = -x^2 - 2$



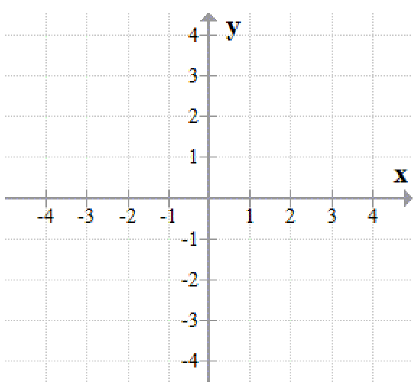
3. $F(x) = (x - 4)^2$



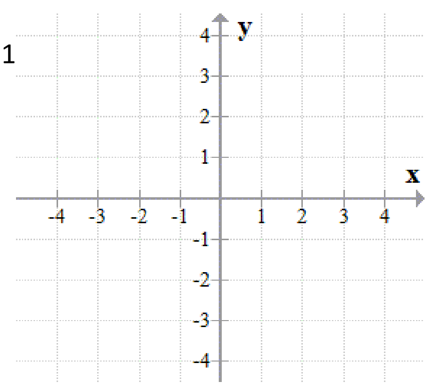
4. $F(x) = -(x + 3)^2$



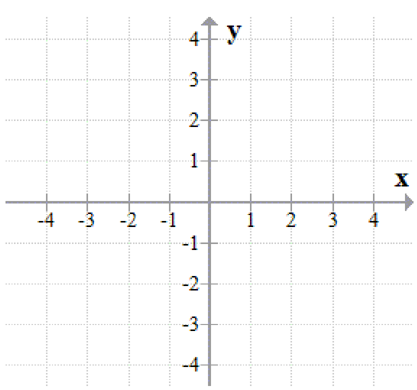
5. $f(x) = -(x + 2)^2 - 3$



6. $F(x) = 3(x + 2)^2 + 1$



7. $f(x) = \frac{1}{2}(x + 4)^2 + 3$



8. $F(x) = -2(x - 3)^2 - 2$