Name_____ Date_____

2.1 Reteach (continued)

EXAMPLE Transformations of Quadratic Functions

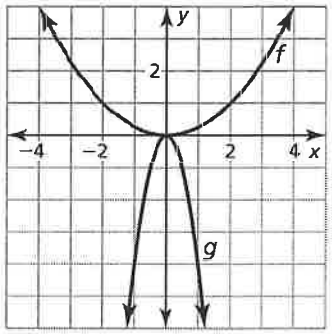
Describe the transformation of $f(x) = x^2$ represented by g. Then graph each function.

a. $g(x) = -(4x)^2$ **b.** $g(x) = 3x^2 - 2$

SOLUTION

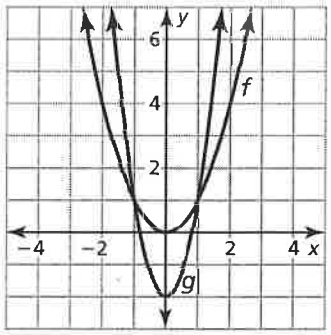
a. Notice that the function is of the form $g(x) = -(ax)^2$, where $a = 4$.

▶ So, the graph of g is a reflection in the x-axis and a horizontal shrink by a factor of $\frac{1}{4}$ of the graph of f.



b. Notice that the function is of the form $g(x) = ax^2 + k$, where $a = 3$ and $k = -2$.

▶ So, the graph of g is a vertical stretch by a factor of 3, followed by a translation 2 units down of the graph of f.



The lowest point on a parabola that opens up or the highest point on a parabola that opens down is the **vertex**. The **vertex form** of a quadratic function is $f(x) = a(x - h)^2 + k$, where $a \neq 0$ and the vertex is (h, k).

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

- a indicates a reflection in the x-axis and/or a vertical stretch or shrink.
- h indicates a horizontal translation.
- k indicates a vertical translation.

Name _____ Date _____

2.1 Reteach (continued)

EXAMPLE Writing a Transformed Quadratic Function

Let the graph of g be a vertical stretch by a factor of 3 and a reflection in the x-axis, followed by a translation 4 units up of the graph of $f(x) = x^2$. Write a rule for g and identify the vertex.

SOLUTION

Identify how the transformations affect the constants in the vertex form.

reflection in the x-axis, vertical stretch by 3 $\}$ $a = -3$

translation 4 units up $\}$ $k = 4$

Write the transformed function.

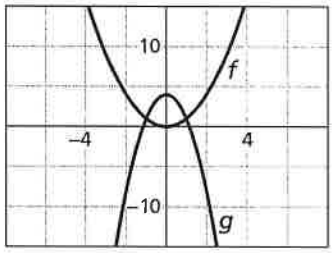
$g(x) = a(x - h)^2 + k$ Vertex form of a quadratic function

$= -3(x - 0)^2 + 4$ Substitute -3 for a, 0 for h, and 4 for k.

$= -3x^2 + 4$ Simplify.

▶ The transformed function is $g(x) = -3x^2 + 4$.
The vertex is $(0, 4)$.

Check



In Exercises 1–9, describe the transformation of $f(x) = x^2$ represented by g. Then graph each function.

1. $g(x) = x^2 - 2$
2. $g(x) = x^2 + 4$
3. $g(x) = (x + 1)^2$
4. $g(x) = (x - 2)^2$
5. $g(x) = (x - 5)^2 + 2$
6. $g(x) = (x + 2)^2 - 1$
7. $g(x) = -2x^2$
8. $g(x) = (-2x)^2$
9. $g(x) = \frac{1}{4}x^2$

In Exercises 10 and 11, write a rule for g described by the transformations of the graph of f. Then identify the vertex.

10. $f(x) = x^2$; vertical stretch by a factor of 3 and a reflection in the x-axis, followed by a translation 3 units down

11. $f(x) = x^2$; vertical shrink by a factor of $\frac{1}{2}$ and a reflection in the x-axis, followed by a translation 6 units left