ACTIVITY 11 PRACTICE

Write your answers on notebook paper. Show your work.

Lesson 11-1

For each function, identify all transformations of the function $f(x) = x^2$. Then graph the function.

1. $g(x) = x^2 + 1$

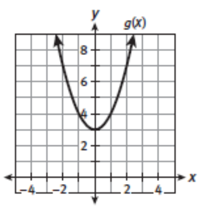
2. $g(x) = (x - 4)^2$

3. $g(x) = (x + 2)^2 + 3$

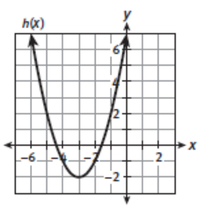
4. $g(x) = (x - 3)^2 - 4$

Each function graphed below is a translation of $f(x) = x^2$. Describe the transformation. Then write the equation of the transformed function.

5.



6.



Use transformations of the parent quadratic function to determine the vertex and axis of symmetry of the graph of each function.

7. $g(x) = (x - 8)^2$

8. $g(x) = (x + 6)^2 - 4$

Write a quadratic function $g(x)$ that represents each transformation of the function $f(x) = x^2$.

9. translate 6 units right

10. translate 10 units down

11. translate 9 units right and 6 units up

12. translate 4 units left and 8 units down

13. The function $g(x)$ is a translation of $f(x) = x^2$. The vertex of the graph of $g(x)$ is $(-4, 7)$. What is the equation of $g(x)$? Explain your answer.

Lesson 11-2

For each function, identify all transformations of the function $f(x) = x^2$. Then graph the function.

14. $g(x) = -\frac{1}{3}x^2$

15. $g(x) = \frac{1}{5}x^2$

16. $g(x) = \frac{1}{2}(x - 3)^2$

17. $g(x) = -2(x + 3)^2 + 1$

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

Write a quadratic function $g(x)$ that represents each transformation of the function $f(x) = x^2$.

19. shrink horizontally by a factor of $\frac{1}{4}$

20. stretch vertically by a factor of 8

21. shrink vertically by a factor of $\frac{1}{3}$, translate 6 units up

22. translate 1 unit right, stretch vertically by a factor of $\frac{3}{2}$, reflect over the x-axis, translate 7 units up

ACTIVITY 11 Continued

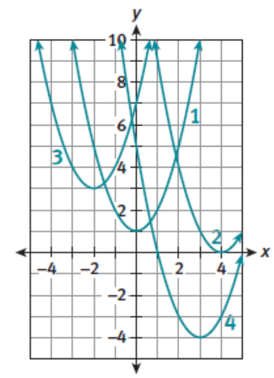
ACTIVITY PRACTICE

1. Translate 1 unit up.

2. Translate 4 units right.

3. Translate 2 units left and 3 units up.

4. Translate 3 units right and 4 units down.



5. Translate 3 units up; $g(x) = x^2 + 3$.

6. Translate 3 units left and 2 units down; $h(x) = (x + 3)^2 - 2$.

7. vertex: $(8, 0)$; axis of symmetry: $x = 8$

8. vertex: $(-6, -4)$; axis of symmetry: $x = -6$

9. $g(x) = (x - 6)^2$

10. $g(x) = x^2 - 10$

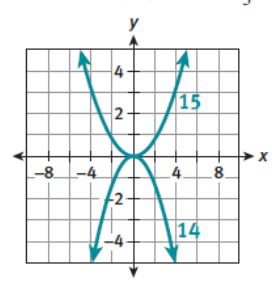
11. $g(x) = (x - 9)^2 + 6$

12. $g(x) = (x + 4)^2 - 8$

13. $g(x) = (x + 4)^2 + 7$. Sample explanation: The coordinates of the vertex show that $g(x)$ is a translation of $f(x)$ 4 units to the left and 7 units up.

14. Shrink vertically by a factor of $\frac{1}{3}$. and reflect over the x-axis

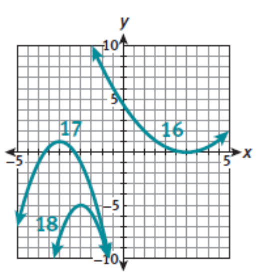
15. Shrink vertically by a factor of $\frac{1}{5}$.



16. Translate 3 units to the right, shrink vertically by a factor of $\frac{1}{2}$.

17. Translate 3 units left, reflect over the x-axis, stretch vertically by a factor of 2, translate 1 unit up.

18. Translate 2 units left, reflect over the x-axis, stretch vertically by a factor of 3, translate 5 units down.



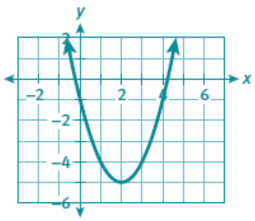
19. $g(x) = (4x)^2$

20. $g(x) = 8x^2$

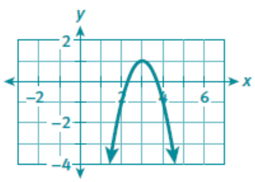
21. $g(x) = \frac{1}{3}x^2 + 6$

22. $g(x) = -\frac{3}{2}(x - 1)^2 + 7$

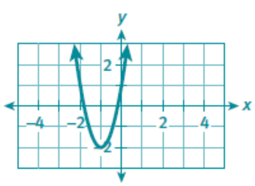
23. vertical stretch by a factor of 3 and reflect over the x-axis; $g(x) = -3x^2$
24. horizontal stretch by a factor of 3; $h(x) = \left(\frac{1}{3}x^2\right)$ (or vertical shrink by factor of 9; $h(x) = \frac{1}{9}x^2$)
25. D
26. $g(x) = (x - 2)^2 - 5$; Translate 2 units right and 5 units down.



27. $g(x) = -2(x - 3)^2 + 1$; Translate 3 units right, reflect over the x-axis, vertically stretch by a factor of 2 and translate 1 unit up.



28. $g(x) = 3(x + 1)^2 - 2$; Translate 1 unit left, vertically stretch by a factor of 3 and translate 2 units down.



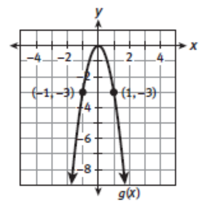
29. $f(x) = (x - 8)^2 + 7$; vertex: (8, 7); axis of symmetry: $x = 8$; opens upward
30. $f(x) = 2(x + 9)^2 - 20$; vertex: (−9, −20); axis of symmetry: $x = -9$; opens upward
31. $f(x) = -3(x - 1)^2 + 12$; vertex: (1, 12); axis of symmetry: $x = 1$; opens downward
32. $f(x) = (x - 1)^2 + 4$; vertex: (1, 4); axis of symmetry: $x = 1$; opens upward

ADDITIONAL PRACTICE

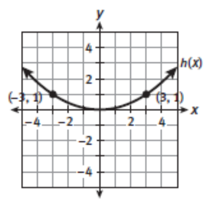
If students need more practice on the concepts in this activity, see the Teacher Resources at SpringBoard Digital for additional practice problems.

Each function graphed below is a transformation of $f(x) = x^2$. Describe the transformation. Then write the equation of the transformed function.

23.



24.



25. Which of these functions has the widest graph when they are graphed on the same coordinate plane?

A. $f(x) = -2x^2$ **B.** $f(x) = 5x^2$
C. $f(x) = \frac{1}{2}x^2$ **D.** $f(x) = -\frac{1}{5}x^2$

Lesson 11-3

Write each function in vertex form. Then describe the transformation(s) from the parent function and use the transformations to graph the function.

26. $g(x) = x^2 - 4x - 1$
27. $g(x) = -2x^2 + 12x - 17$
28. $g(x) = 3x^2 + 6x + 1$

Write each function in vertex form. Then identify the vertex and axis of symmetry of the function's graph, and tell which direction the graph opens.

29. $f(x) = x^2 - 16x + 71$
30. $f(x) = 2x^2 + 36x + 142$
31. $f(x) = -3x^2 + 6x + 9$
32. $f(x) = x^2 - 2x + 5$
33. The function $h(t) = -16t^2 + 22t + 4$ models the height h in feet of a football t seconds after it is thrown.
   a. Write the function in vertex form.
   b. To the nearest foot, what is the greatest height that the football reaches? Explain your answer.
   c. To the nearest tenth of a second, how long after the football is thrown does it reach its greatest height? Explain your answer.
34. Which function has a vertex to the right of the y-axis?
   A. $f(x) = -x^2 - 10x - 29$
   B. $f(x) = x^2 - 12x + 40$
   C. $f(x) = x^2 + 2x - 5$
   D. $f(x) = x^2 + 6x + 2$

MATHEMATICAL PRACTICES
Construct Viable Arguments and Critique the Reasoning of Others

35. A student claims that the function $g(x) = -x^2 - 5$ has no real zeros. As evidence, she claims that the graph of $g(x)$ opens downward and its vertex is $(0, -5)$, which means that the graph never crosses the x-axis. Is the student's argument valid? Support your answer.

33. **a.** $h(t) = -16\left(t - \frac{11}{16}\right)^2 + \frac{185}{16}$
   b. 12 ft. Sample explanation: The vertex form shows that the graph of the function opens downward and its vertex is $\left(\frac{11}{16}, \frac{185}{16}\right)$. The maximum value of the function is $\frac{185}{16} = 11\frac{9}{16}$, or about 12 ft.
   c. 0.7 s. Sample explanation: The maximum value of the function is $\left(\frac{11}{16}, \frac{185}{16}\right)$. The maximum height of $\frac{185}{16}$ ft occurs when $t = \frac{11}{16}$ s, or about 0.7 s.

34. B
35. Yes, the argument is valid. The graph of $g(x)$ is a reflection of $f(x) = x^2$ over the x-axis followed by a translation 5 units down. The reflection over the x-axis results in the graph of $g(x)$ opening downward, which means that $g(x)$ has a maximum value at its vertex. The vertex form of the equation is $g(x) = -(x - 0)^2 + (-5)$, confirming that the vertex is $(0, -5)$. The greatest value of $g(x)$ is -5, which means that there is no real value of x for which $g(x) = 0$.