1.1 Parent Functions & Transformations
HW #1 (due Tues. 9/22): #1, 3-6, 10-18 even, 36, 39, 40, 47
HW #2 (due Mon. 9/28): #20-34 even, 35, 41, 44, 45, 49

Vocabulary and Core Concept Check

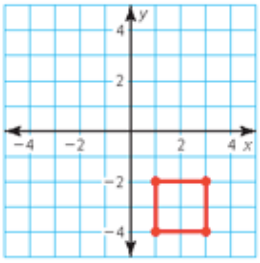
1. **COMPLETE THE SENTENCE** The function $f(x) = x^2$ is the _____ of $f(x) = 2x^2 - 3$.
2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

What are the vertices of the figure after a reflection in the x-axis, followed by a translation 2 units right?

What are the vertices of the figure after a translation 6 units up and 2 units right?

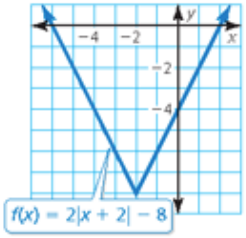
What are the vertices of the figure after a translation 2 units right, followed by a reflection in the x-axis?

What are the vertices of the figure after a translation 6 units up, followed by a reflection in the x-axis?



Monitoring Progress and Modeling with Mathematics

In Exercises 3–6, identify the function family to which f belongs. Compare the graph of f to the graph of its parent function. *(See Example 1.)*

3.


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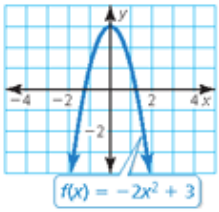

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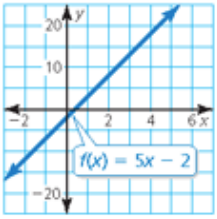

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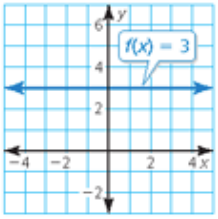


7. **MODELING WITH MATHEMATICS** At 8:00 A.M., the temperature is 43°F. The temperature increases 2°F each hour for the next 7 hours. Graph the temperatures over time t ($t = 0$ represents 8:00 A.M.). What type of function can you use to model the data? Explain.

8. **MODELING WITH MATHEMATICS** You purchase a car from a dealership for $10,000. The trade-in value of the car each year after the purchase is given by the function $f(x) = 10{,}000 - 250x^2$. What type of function models the trade-in value?

In Exercises 9–18, graph the function and its parent function. Then describe the transformation. *(See Examples 2 and 3.)*

9. $g(x) = x + 4$
10. $f(x) = x - 6$
11. $f(x) = x^2 - 1$
12. $h(x) = (x + 4)^2$
13. $g(x) = |x - 5|$
14. $f(x) = 4 + |x|$
15. $h(x) = -x^2$
16. $g(x) = -x$
17. $f(x) = 3$
18. $f(x) = -2$

In Exercises 19–26, graph the function and its parent function. Then describe the transformation. *(See Example 4.)*

19. $f(x) = \frac{1}{3}x$

20. $g(x) = 4x$

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

22. $h(x) = \frac{1}{3}x^2$

23. $h(x) = \frac{3}{4}x$

24. $g(x) = \frac{4}{3}x$

25. $h(x) = 3|x|$

26. $f(x) = \frac{1}{2}|x|$

In Exercises 27–34, use a graphing calculator to graph the function and its parent function. Then describe the transformations. *(See Example 5.)*

27. $f(x) = 3x + 2$

28. $h(x) = -x + 5$

29. $h(x) = -3|x| - 1$

30. $f(x) = \frac{3}{4}|x| + 1$

31. $g(x) = \frac{1}{2}x^2 - 6$

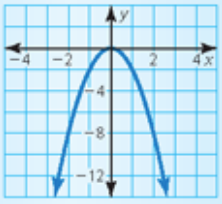
32. $f(x) = 4x^2 - 3$

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

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

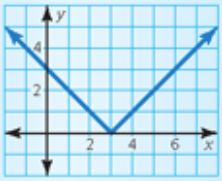
ERROR ANALYSIS **In Exercises 35 and 36, identify and correct the error in describing the transformation of the parent function.**

35.



The graph is a reflection in the x-axis and a vertical shrink of the parent quadratic function.

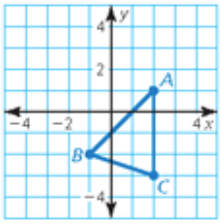
36.



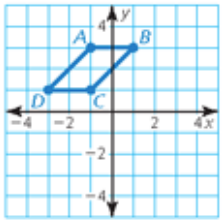
The graph is a translation 3 units right of the parent absolute value function, so the function is $f(x) = |x + 3|$.

MATHEMATICAL CONNECTIONS **In Exercises 37 and 38, find the coordinates of the figure after the transformation.**

37. Translate 2 units down.



38. Reflect in the x-axis.



USING TOOLS **In Exercises 39–44, identify the function family and describe the domain and range. Use a graphing calculator to verify your answer.**

39. $g(x) = |x + 2| - 1$

40. $h(x) = |x - 3| + 2$

41. $g(x) = 3x + 4$

42. $f(x) = -4x + 11$

43. $f(x) = 5x^2 - 2$

44. $f(x) = -2x^2 + 6$

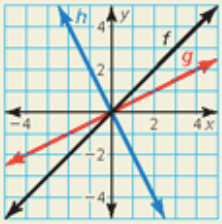
45. **MODELING WITH MATHEMATICS** The table shows the speeds of a car as it travels through an intersection with a stop sign. What type of function can you use to model the data? Estimate the speed of the car when it is 20 yards past the intersection. *(See Example 6.)*

Displacement from sign (yards), x	Speed (miles per hour), y
−100	40
−50	20
−10	4
0	0
10	4
50	20
100	40

46. **THOUGHT PROVOKING** In the same coordinate plane, sketch the graph of the parent quadratic function and the graph of a quadratic function that has no x-intercepts. Describe the transformation(s) of the parent function.

47. **USING STRUCTURE** Graph the functions $f(x) = |x - 4|$ and $g(x) = |x| - 4$. Are they equivalent? Explain.

48. HOW DO YOU SEE IT? Consider the graphs of f, g, and h.



a. Does the graph of g represent a vertical stretch or a vertical shrink of the graph of f? Explain your reasoning.

b. Describe how to transform the graph of f to obtain the graph of h.

49. MAKING AN ARGUMENT Your friend says two different translations of the graph of the parent linear function can result in the graph of $f(x) = x - 2$. Is your friend correct? Explain.

50. DRAWING CONCLUSIONS A person swims at a constant speed of 1 meter per second. What type of function can be used to model the distance the swimmer travels? If the person has a 10-meter head start, what type of transformation does this represent? Explain.

51. PROBLEM SOLVING You are playing basketball with your friends. The height (in feet) of the ball above the ground t seconds after a shot is released from your hand is modeled by the function $f(t) = -16t^2 + 32t + 5.2$.

a. Without graphing, identify the type of function that models the height of the basketball.

b. What is the value of t when the ball is released from your hand? Explain your reasoning.

c. How many feet above the ground is the ball when it is released from your hand? Explain.

52. MODELING WITH MATHEMATICS The table shows the battery lives of a computer over time. What type of function can you use to model the data? Interpret the meaning of the x-intercept in this situation.

Time (hours), x	Battery life remaining, y
1	80%
3	40%
5	0%
6	20%
8	60%

53. REASONING Compare each function with its parent function. State whether it contains a *horizontal translation*, *vertical translation*, *both*, or *neither*. Explain your reasoning.

a. $f(x) = 2|x| - 3$ **b.** $f(x) = (x - 8)^2$

c. $f(x) = |x + 2| + 4$ **d.** $f(x) = 4x^2$

54. CRITICAL THINKING Use the values -1, 0, 1, and 2 in the correct box so the graph of each function intersects the x-axis. Explain your reasoning.

a. $f(x) = 3x$ $\square$ $+ 1$ **b.** $f(x) = |2x - 6| -$ $\square$

c. $f(x) =$ $\square$ $x^2 + 1$ **d.** $f(x) =$ $\square$