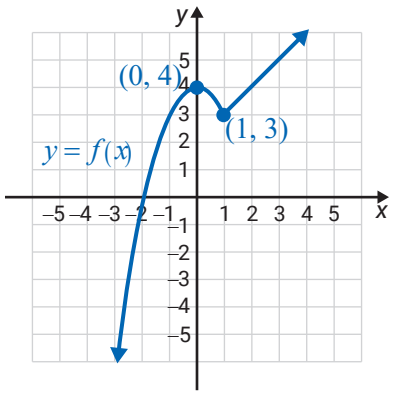
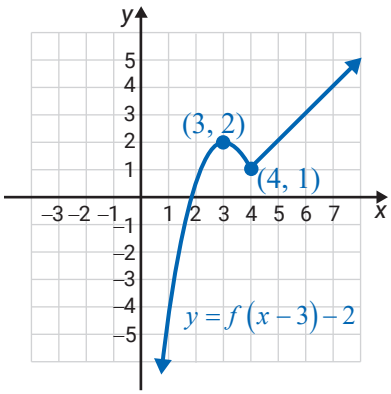
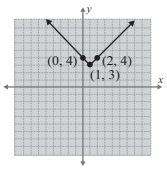




Now work margin exercise 9.

Margin Exercise Answers

1. a. 17 **b.** $3a^2+5$ **c.** $3a^2+12a+17$ **2.** 8 **3.** $2x+h+3$ **4.**



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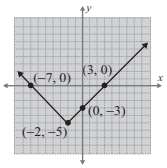

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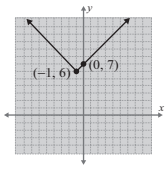

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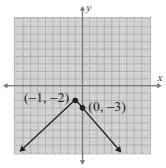

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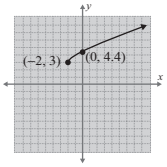

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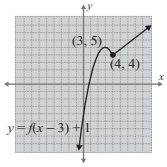


18.1 Exercises

Concept Check

Fill-in-the-Blank. Complete each sentence using information found in this section.

1. The geometric interpretation of the difference quotient is the _____ of a line through _____ points on the graph of a function.
2. The graph of $y = ax^2 + k$ is the _____ translation of $y = ax^2$ by k units.
3. The graph of $y = a(x - h)^2$ is the _____ translation of $y = ax^2$ by h units.
4. In general, the graph of $y = -f(x)$ is the _____ across the _____ of the graph $y = f(x)$.
5. For the function $y = ax^2$, changing the coefficient a can have an effect on the _____ and _____ of the graph of the base function.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

6. Algebraically, the two functions $f(x+h)$ and $f(x)+h$ represent the same thing.

7. Translation changes the shape of the graph of a function.

8. More than one translation cannot be applied to a function at the same time.

Practice

Evaluate the function at the given expressions. See Example 1.

1. For $f(x)=x^2-4$, find:

a. $f(-2)$

b. $f(a-3)$

c. $f(x+h)$

d. $\dfrac{f(x+h)-f(x)}{h}$

2. For $g(x)=2-x^2$, find:

a. $g(\sqrt{2})$

b. $g(a-1)$

c. $g(x+h)$

d. $\dfrac{g(x+h)-g(x)}{h}$

3. For $f(x)=2x^2-3x$, find:

a. $f(0)$

b. $f(a-2)$

c. $f(x+h)$

d. $\dfrac{f(x+h)-f(x)}{h}$

4. For $f(x)=3x^2-x$, find:

a. $f(4)$

b. $f(a+2)$

c. $f(x+h)$

d. $\dfrac{f(x+h)-f(x)}{h}$

Find and simplify the difference quotient, $\dfrac{f(x+h)-f(x)}{h}$, for each function. See Examples 2 and 3.

5. $f(x)=x+7$

6. $f(x)=2x-3$

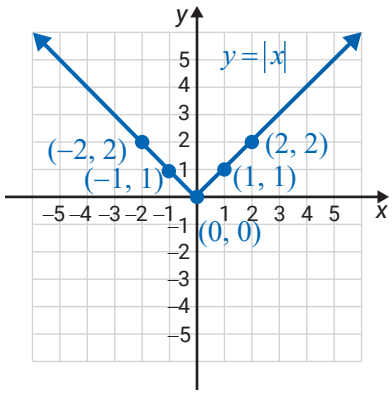
7. $f(x)=5-2x$

8. $f(x)=4x-3$

9. What particular trend, if there is one, do you notice about the results in Exercises 5 through 8?

10. Analyze, in your own words, how the results in Exercise 9 relate to the graphs of the functions in relation to the secant line discussion in the text.

The graph of $y = |x|$ is given along with a few points as aids. Graph the functions using your understanding of reflections and translations with no additional computations. See Examples 4 through 7.



11. $y = |x-1| - 2$

12. $y = |x-2| + 6$

13. $y = -|x+3|$

14. $y = -|x-4|$

15. $y = -|x+5| + 4$

16. $y = -|x+2| + 3$

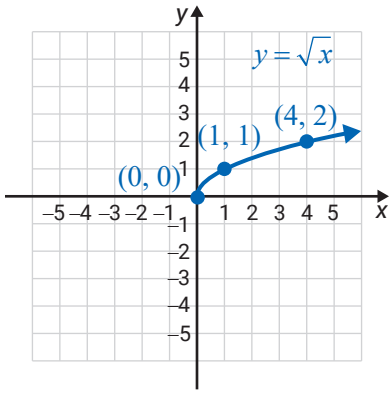
17. $y = \left|x - \frac{5}{4}\right|$

18. $y = \left|x - \frac{2}{3}\right|$

19. $y = \left|x + \frac{3}{4}\right| - 3$

20. $y = \left|x + \frac{1}{2}\right| - \frac{3}{2}$

The graph of $y = \sqrt{x}$ is given along with a few points as aids. Graph the functions using your understanding of reflections and translations with no additional computations. See Example 8.



21. $y = \sqrt{x} - 2$

22. $y = \sqrt{x} + 1$

23. $y = -\sqrt{x+1}$

24. $y = -\sqrt{x-6}$

25. $y = \sqrt{x-4} - 3$

26. $y = \sqrt{x-2} - 4$

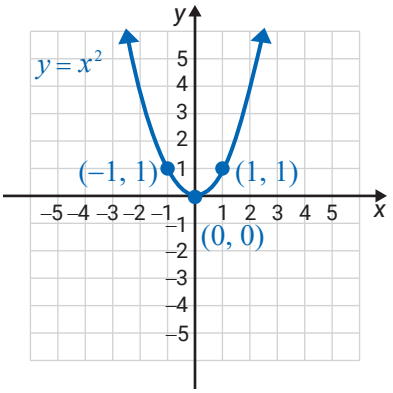
27. $y = \sqrt{x-3} + \frac{1}{2}$

28. $y = \sqrt{x + \frac{3}{2}} + 2$

29. $y = 5 + \sqrt{x+2}$

30. $y = \sqrt{x+4} - 3$

Using the graph of $y = x^2$, graph the functions using your understanding of reflections and translations with no additional computations.



31. $y = x^2 - 3$

32. $y = x^2 + 5$

33. $y = (x-1)^2$

34. $y = (x+2)^2$

35. $y = (x-3)^2 + 1$

36. $y = (x+5)^2 - 2$

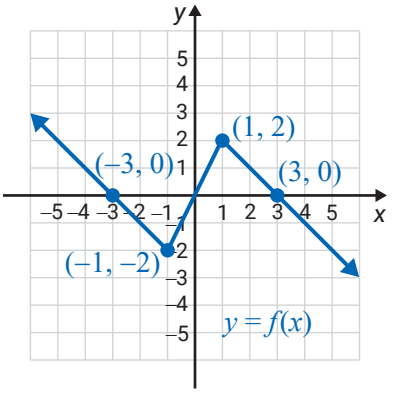
37. $y = (x+1)^2 - 4$

38. $y = (x-2)^2 + 3$

39. $y = -(x+4)^2 - 5$

40. $y = -(x-5)^2 + 2$

The graph of a function $y = f(x)$ is given with the coordinates of four points. Graph the functions using your understanding of reflections and translations ith no additional computations. Label the new points that correspond to the four labeled points. See Example 9.



41. $y = f(x) - 1$

42. $y = f(x) + 2$

43. $y = f(x-3)$

44. $y = f(x+1)$

45. $y = -f(x-3)$

46. $y = -f(x+1)$

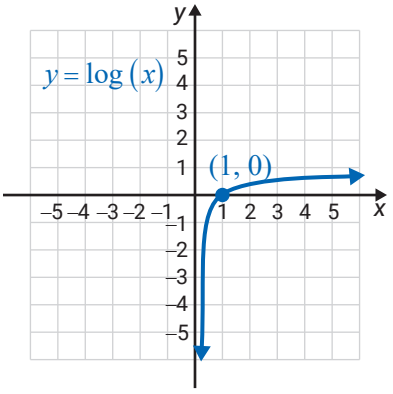
47. $y = f(x+5) + 3$

48. $y = f(x-1) + 5$

49. $y = f(x+2) - 4$

50. $y = f(x+3) + 2$

The graph of $y = \log(x)$ is given. Graph the functions and state the domain and range of each function.



51. $y = \log(x+1)$

52. $y = \log(2-x)$

53. $y = -\log x$

54. $y = \log(-x)$

55. $y = 1 + \log x$

56. $y = -3 - \log x$

Applications

Solve.

57. A landscaper is planning a scenic walkway to go in the large space between the front entrance of a building and the main road that runs in front of the building. He sketches a graph of the area. On it, the edge of the walkway is modeled by $y = x^4 - 5x^2 + 2x$. In order to get a permit, however, the city's building department tells the landscaper that he must move the walkway 10 meters up, farther away from the road. Write the function that represents the new placement of the curve.

58. Joanne wants to put a flowerbed in the front yard of her house. She draws a graph of the land, and the edge of the flowerbed is modeled by $y = x^2 + 2$. Joanne didn't realize that her husband planned to build a walkway from the front door to the driveway. To accommodate the plans for the walkway, Joanne will need to move her flowerbed ten feet to the right. Write the function that represents the new placement of the curve.

Writing & Thinking

59. Explain, in your own words, how the graph of the function $y = f\left(x-h\right)+k$ represents a horizontal and a vertical shift of the graph of the function $y = f\left(x\right)$.

Use a graphing calculator to graph each pair of functions on the same set of axes. Then discuss the differences between the graphs of each pair of functions.

60. $y = 2x^2$ and $y = -3x^2$

61. $y = 4x^2$ and $y = -x^2$

62. $y = x^2 + 5$ and $y = \left(x-1\right)^2$

63. $y = \left(x+1\right)^2$ and $y = x^2 - 4$

64. $y = 2\left(x+3\right)^2 - 4$ and $y = 2x^2 + 3$

65. $y = -3\left(x-2\right)^2 + 1$ and $y = -x^2 + 1$