

EXERCISES

For more practice, see *Extra Practice*.

Practice and Problem Solving

A Practice by Example

Example 1
(page 518)

Find the equation of the axis of symmetry and the coordinates of the vertex of the graph of each function.

1. $y = 2x^2 + 4$

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

3. $y = x^2 - 8x - 9$

4. $y = 3x^2 - 9x + 5$

Match each graph with its function.

A. $y = x^2 - 6x$

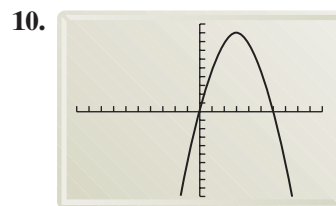
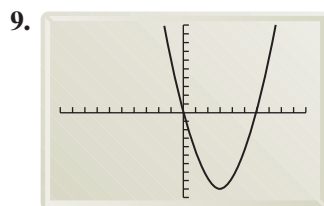
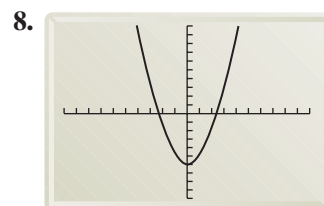
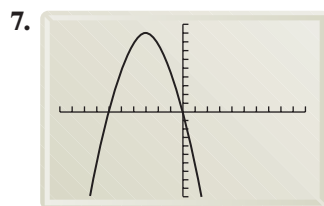
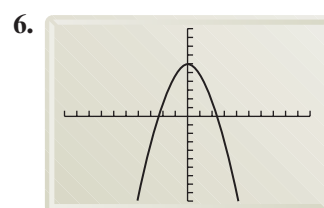
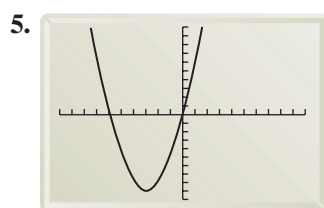
B. $y = x^2 + 6x$

C. $y = -x^2 - 6x$

D. $y = -x^2 + 6x$

E. $y = -x^2 + 6$

F. $y = x^2 - 6$



Graph each function. Label the axis of symmetry and the vertex.

11. $f(x) = x^2 + 4x + 3$

12. $y = 2x^2 - 6x$

13. $y = -x^2 + 4x - 4$

14. $y = 2x^2 + 3x + 1$

Example 2
(page 519)

15. **Gardening** Suppose you have 80 ft of fence to enclose a rectangular garden. The function $A = 40x - x^2$ gives you the area of the garden in square feet where x is the width in feet.

- What width gives you the maximum gardening area?
- What is the maximum area?

16. A ball is thrown into the air with an upward velocity of 40 ft/s. Its height h in feet after t seconds is given by the function $h = -16t^2 + 40t + 6$.

- In how many seconds does the ball reach its maximum height?
- What is the ball's maximum height?

Example 3
(page 519)

Graph each quadratic inequality.

17. $y > x^2$

18. $f(x) < -x^2$

19. $y \leq x^2 + 3$

20. $y < -x^2 + 4$

21. $y \geq -2x^2 + 6$

22. $f(x) > -x^2 + 4x - 4$

B Apply Your Skills

Graph each function. Label the axis of symmetry and the vertex.

23. $y = x^2 - 9x + 3$

24. $f(x) = -x^2 - 4x - 6$

25. $f(x) = x^2 - 2x + 1$

26. $y = 2x^2 + x - 3$

27. $y = x^2 + 3x + 2$

28. $y = -x^2 + 8x - 5$

29. $y = \frac{1}{2}x^2 + 2x + 1$

30. $y = \frac{1}{4}x^2 + 2x + 1$

31. $y = -\frac{1}{4}x^2 + 2x - 3$

Open-Ended For Exercises 32–34, give an example of a quadratic function for each description.

32. Its axis of symmetry is to the right of the y -axis.

33. Its graph opens downward and has its vertex at $(0, 0)$.

34. Its graph lies entirely above the x -axis.

Real-World Connection

After turning a somersault, the diver followed a parabolic path.

35. Diving An athlete dives from the 3-meter springboard. Her altitude y , at horizontal distance x , can be approximated by the function $y = -2.2x^2 + 5.3x + 4$. Both the altitude and distance are in meters.

a. How far has she traveled horizontally when she reaches her maximum altitude? Round to the nearest tenth of a meter.

b. What is her maximum altitude? Round to the nearest tenth of a meter.

36. Road Construction An archway over a road is cut out of rock. Its shape is modeled by the quadratic function $y = -0.1x^2 + 12$ for $y \geq 0$.

a. Write an inequality that describes the opening of the archway.

b. Graph the inequality.

c. **Critical Thinking** Can a camper 6 ft wide and 7 ft high fit under the arch without crossing the median line? Explain.

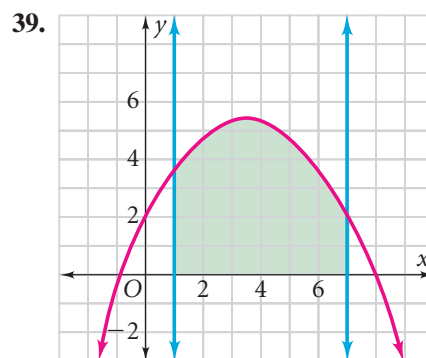
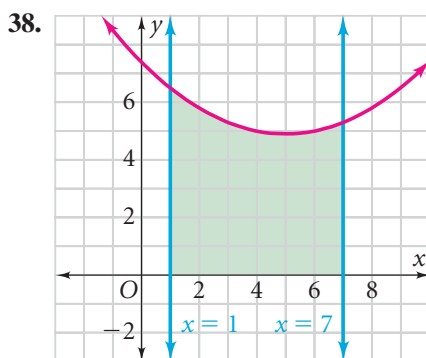
37. Business A small company markets a new toy. The function $S = -64p^2 + 1600p$ predicts, in dollars, the total sales S as a function of the price p of the toy.

a. What price will produce the highest total sales?

b. What is the maximum total sales predicted?

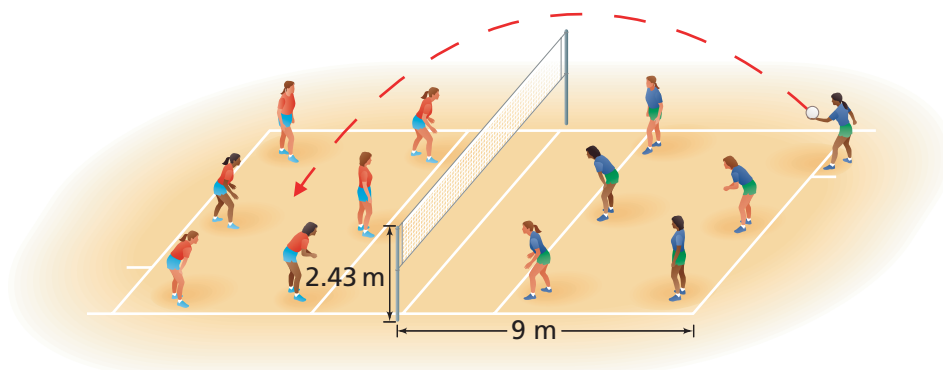
Estimation For each of the graphs below, estimate the area enclosed by the parabola, the x -axis, and the vertical lines $x = 1$ and $x = 7$. Follow the instructions below.

- Count the number of whole grid squares in the region.
- If half a square or more is included in the region, count it as one.
- If less than half a square is included in the region, do *not* count it.
- Add the counted squares to estimate the area.



40. **Critical Thinking** Why is it important to consider the coefficient of the squared term when solving a real-world maximum or minimum problem?

-  **41. Writing** Explain how changing the values of a , b , and c in a quadratic function affects the graph of the function.
-  **42. Pets** Suppose you have 26 ft of fence and want to build a rectangular enclosure for rabbits. You want to make an enclosure with the greatest possible area.
- Write an expression for the width of the rectangle in terms of the length.
 - Write an equation for the area of the rectangle in terms of the length.
 - Find the vertex of the parabola described by the equation in part (b).
 - Which dimensions give the rectangle the greatest area?
-  **Challenge**  **43. Sports** Suppose a volleyball player serves from 1 m behind the back line. If no other player touches the ball, it will land in bounds. The equation $h = -4.9t^2 + 3.82t + 1.7$ gives the ball's height h in meters in terms of time t in seconds.

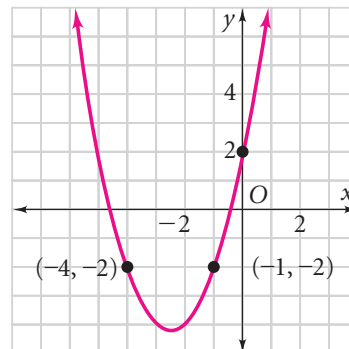


- When will the ball be at its highest point? Round to the nearest tenth of a second.
 - The ball will reach the net at $t = 0.6$ s. Will it clear the net? Explain.
-  **44. Architecture** An architect designs a monument for a new park. The solution of the following system of inequalities describes the shape of the monument. Make a graph of the monument.
- $$y \geq -x^2 + 6 \qquad y \leq -\frac{1}{2}x^2 + 8 \qquad y \geq 0$$

Real-World Connection

A standard tennis court is 78 ft long and 36 ft wide.

-  **45. Sports** Suppose a tennis player hits a ball over the net. The ball leaves his racket 0.5 m above the ground. The equation $h = -4.9t^2 + 3.8t + 0.5$ gives the ball's height h in meters at time t in seconds.
- When will the ball be at the highest point in its path? Round to the nearest tenth of a second.
 - Critical Thinking** If you double the answer from part (a), will you find the amount of time the ball is in the air before it hits the court? Explain.
- 46.** The parabola shown at the right is of the form $y = x^2 + bx + c$.
- Use the graph to find the y -intercept.
 - Find the equation of the axis of symmetry.
 - Use the vertex formula $x = \frac{-b}{2a}$ to find b .
 - Write the equation of the parabola.
 - Test one point using the equation from part (d).
 - Critical Thinking** Would this method work if the value of a were not known? Explain.

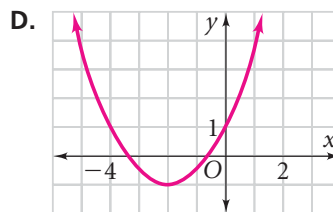
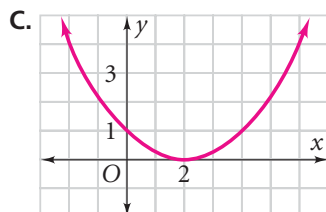
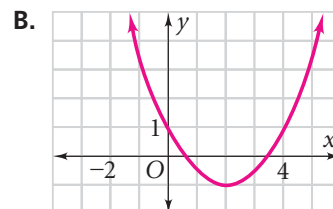
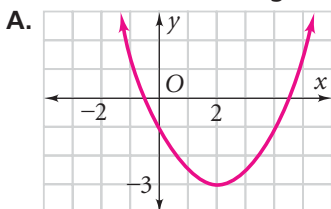




Standardized Test Prep

Multiple Choice

47. Which of the following are the coordinates of the vertex of $y = x^2 - 2x - 1$?
 A. (1, -2) B. (0, 3) C. (1, -4) D. (2, -3)
48. Which of the following parabolas has the greatest b -value?
 F. $y = -x^2 - 2x$ G. $y = -x^2 - 3x$
 H. $y = -x^2 + 2x$ I. $y = -x^2 + 3x$
49. Which of the following is the graph of $y = 0.5x^2 - 2x + 1$?



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Short Response

50. An arrow is shot into the air. It follows a path given by the equation $y = -0.009x^2 + 0.3x + 4.5$, where x and y are in feet. Find its maximum height. Show your work.



Mixed Review

Lesson 10-1

Match each graph with its function.

A. $y = \frac{1}{8}x^2 + 2$

B. $y = \frac{1}{2}x^2 + 2$

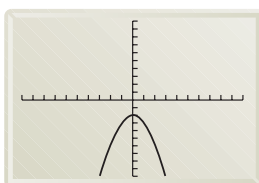
C. $y = -x^2 - 2$

D. $y = x^2 + 2$

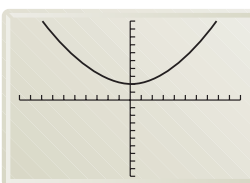
E. $y = -x^2 + 2$

F. $y = -\frac{1}{2}x^2 - 2$

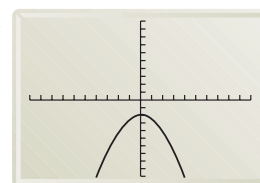
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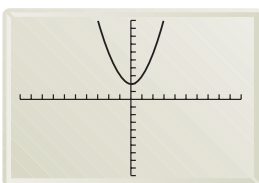
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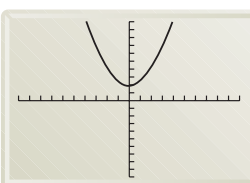
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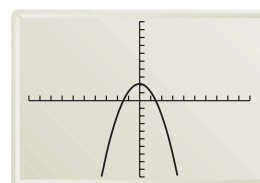
54.



5.



56.



Lesson 9-3

Find each product.

57. $(c + 4)(c - 9)$

58. $(2x - 5)(x + 6)$

59. $(4t + 1)(5t + 3)$

60. $(7n^2 - 2)(3n^2 - 8)$

61. $(a + 5)(2a^2 - a + 4)$

62. $(3r^2 + 6r - 7)(2r - 1)$