Got It? **2.** In Problem 2, suppose a T-shirt is launched with an initial upward velocity of 64 ft/s and is caught 35 ft above the court. How long will it take the T-shirt to reach its maximum height? How far above court level will it be? What is the range of the function that models the height of the T-shirt over time?

Lesson Check

Do you know HOW?

Graph each function.

1. $y = x^2 - 4x + 1$
2. $y = -2x^2 - 8x - 3$
3. $y = 3x^2 + 6x + 2$
4. $f(x) = -x^2 + 2x - 5$

Do you UNDERSTAND? MATHEMATICAL PRACTICES

5. **Reasoning** How does each of the numbers a, b, and c affect the graph of a quadratic function $y = ax^2 + bx + c$?
6. **Writing** Explain how you can use the y-intercept, vertex, and axis of symmetry to graph a quadratic function. Assume the vertex is not on the y-axis.

Practice and Problem-Solving Exercises MATHEMATICAL PRACTICES

A Practice

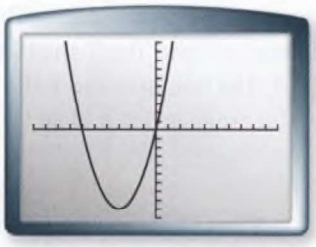
Find the equation of the axis of symmetry and the coordinates of the vertex of the graph of each function. See Problem 1.

7. $y = 2x^2 + 3$
8. $y = -3x^2 + 12x + 1$
9. $f(x) = 2x^2 + 4x - 1$
10. $y = x^2 - 8x - 7$
11. $f(x) = 3x^2 - 9x + 2$
12. $y = -4x^2 + 11$
13. $f(x) = -5x^2 + 3x + 2$
14. $y = -4x^2 - 16x - 3$
15. $f(x) = 6x^2 + 6x - 5$

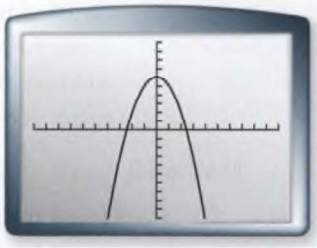
Match each function with its graph.

16. $y = -x^2 - 6x$
17. $y = -x^2 + 6$
18. $y = x^2 - 6$
19. $y = x^2 + 6x$

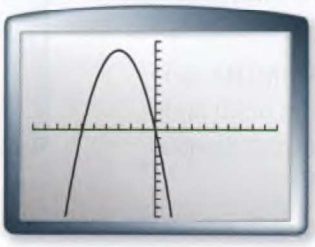
A.



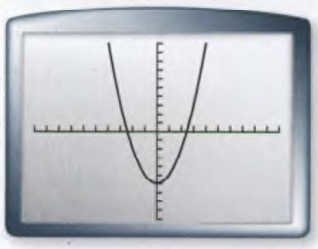
B.



C.



D.



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

20. $f(x) = x^2 + 4x - 5$ **21.** $y = 3x^2 - 20x$ **22.** $y = -2x^2 + 8x + 9$

23. $f(x) = -x^2 + 4x + 3$ **24.** $y = -2x^2 - 10x$ **25.** $y = 2x^2 - 6x + 1$

26. Sports A baseball is thrown into the air with an upward velocity of 30 ft/s. Its height h, in feet, after t seconds is given by the function $h = -16t^2 + 30t + 6$. How long will it take the ball to reach its maximum height? What is the ball's maximum height? What is the range of the function?

See Problem 2.

27. School Fair Suppose you have 100 ft of string to rope off a rectangular section for a bake sale at a school fair. The function $A = -x^2 + 50x$ gives the area of the section in square feet, where x is the width in feet. What width gives you the maximum area you can rope off? What is the maximum area? What is the range of the function?

B Apply

28. a. What is the vertex of the function $y = x^2 + 4$?

b. What is the vertex of the function given in the table?

x	−2	−1	0	1	2
y	−14	−8	−6	−8	−14

29. a. What is the vertex of the function $y = 5x^2 + 10x + 24$?

b. What is the vertex of the function given in the table?

x	−4	−3	−2	−1	0
y	3	−3	−5	−3	3

30. Think About a Plan The Riverside Geyser in Yellowstone National Park erupts about every 6.25 h. When the geyser erupts, the water has an initial upward velocity of 69 ft/s. What is the maximum height of the geyser? Round your answer to the nearest foot.

- What is the initial height of the geyser?
- What function gives the geyser's height h (in feet) t seconds after it starts erupting?

31. Business A cell phone company sells about 500 phones each week when it charges \$75 per phone. It sells about 20 more phones per week for each \$1 decrease in price. The company's revenue is the product of the number of phones sold and the price of each phone. What price should the company charge to maximize its revenue?

32. Graph the function $f(x) = x^2 + 2x - 3$. Then graph the following transformations of the function. Describe how the parent function changes with each transformation.

a. $f(x) + 3$ **b.** $2[f(x)]$

c. $f(4x)$ **d.** $f(x + 5)$

33. Error Analysis Describe and correct the error made in finding the axis of symmetry for the graph of $y = -x^2 - 6x + 2$.

$$x = \frac{-b}{2a} = \frac{-6}{2(-1)} = 3$$

34. Reasoning What do you know about the value of b in the function $y = ax^2 + bx + c$ when the x-coordinate of the vertex is an integer?