

**EXAMPLE 3**

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for Exs. 28–36

**MAXIMUM AND MINIMUM VALUES** Tell whether the function has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.

28.  $f(x) = x^2 - 6$

29.  $f(x) = -5x^2 + 7$

30.  $f(x) = 4x^2 + 32x$

31.  $f(x) = -3x^2 + 12x - 20$

32.  $f(x) = x^2 + 7x + 8$

33.  $f(x) = -2x^2 - x + 10$

34.  $f(x) = \frac{1}{2}x^2 - 2x + 5$

35.  $f(x) = -\frac{3}{8}x^2 + 9x$

36.  $f(x) = \frac{1}{4}x^2 + 7x + 11$

37. **WRITING** Compare the graph of  $y = x^2 + 4x + 1$  with the graph of  $y = x^2 - 4x + 1$ .

38. **REASONING** Follow the steps below to justify the equation for the axis of symmetry for the graph of  $y = ax^2 + bx + c$ . Because the graph of  $y = ax^2 + bx + c$  is a vertical translation of the graph of  $y = ax^2 + bx$ , the two graphs have the same axis of symmetry. Use the function  $y = ax^2 + bx$  in place of  $y = ax^2 + bx + c$ .

- Find the  $x$ -intercepts of the graph of  $y = ax^2 + bx$ . (You can do this by finding the zeros of the function  $y = ax^2 + bx$  using factoring.)
- Because a parabola is symmetric about its axis of symmetry, the axis of symmetry passes through a point halfway between the  $x$ -intercepts of the parabola. Find the  $x$ -coordinate of this point. What is an equation of the vertical line through this point?

39. **CHALLENGE** Write a function of the form  $y = ax^2 + bx$  whose graph contains the points (1, 6) and (3, 6).

## PROBLEM SOLVING



**GRAPHING CALCULATOR** You may wish to use a graphing calculator to complete the following Problem Solving exercises.

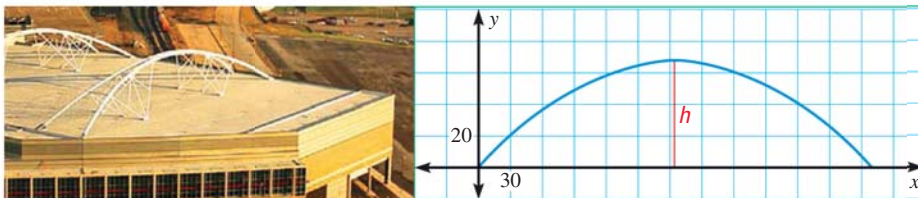
**EXAMPLE 4**

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for Exs. 40–42

40. **SPIDERS** Fishing spiders can propel themselves across water and leap vertically from the surface of the water. During a vertical jump, the height of the body of the spider can be modeled by the function  $y = -4500x^2 + 820x + 43$  where  $x$  is the duration (in seconds) of the jump and  $y$  is the height (in millimeters) of the spider above the surface of the water. After how many seconds does the spider's body reach its maximum height? What is the maximum height?

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41. **ARCHITECTURE** The parabolic arches that support the roof of the Dallas Convention Center can be modeled by the graph of the equation  $y = -0.0019x^2 + 0.71x$  where  $x$  and  $y$  are measured in feet. What is the height  $h$  at the highest point of the arch as shown in the diagram?



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