



### 3.3 Assess Your Understanding

**'Are You Prepared?'** Answers are given at the end of these exercises. If you get a wrong answer, read the pages listed in red.

- List the intercepts of the equation  $y = x^2 - 9$ . (pp. 11–12)
- Find the real solutions of the equation  $2x^2 + 7x - 4 = 0$ . (pp. A47–A51)
- To complete the square of  $x^2 - 5x$ , you add the number \_\_\_\_\_. (pp. A29–A30)
- To graph  $y = (x - 4)^2$ , you shift the graph of  $y = x^2$  to the \_\_\_\_\_ a distance of \_\_\_\_\_ units. (pp. 90–99)

### Concepts and Vocabulary

- The graph of a quadratic function is called a(n) \_\_\_\_\_.
- The vertical line passing through the vertex of a parabola is called the \_\_\_\_\_.
- The  $x$ -coordinate of the vertex of  $f(x) = ax^2 + bx + c$ ,  $a \neq 0$ , is \_\_\_\_\_.
- True or False** The graph of  $f(x) = 2x^2 + 3x - 4$  opens up.
- True or False** The  $y$ -coordinate of the vertex of  $f(x) = -x^2 + 4x + 5$  is  $f(2)$ .
- True or False** If the discriminant  $b^2 - 4ac = 0$ , the graph of  $f(x) = ax^2 + bx + c$ ,  $a \neq 0$ , will touch the  $x$ -axis at its vertex.

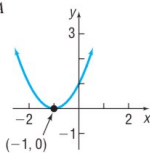
### Skill Building

In Problems 11–18, match each graph to one of the following functions.

11.  $f(x) = x^2 - 1$

15.  $f(x) = x^2 - 2x + 2$

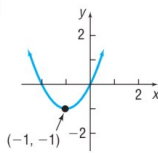
A



12.  $f(x) = -x^2 - 1$

16.  $f(x) = x^2 + 2x$

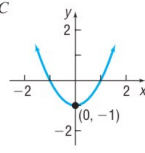
B



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

17.  $f(x) = x^2 - 2x$

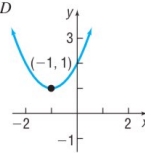
C



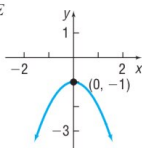
14.  $f(x) = x^2 + 2x + 1$

18.  $f(x) = x^2 + 2x + 2$

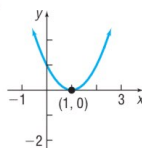
D



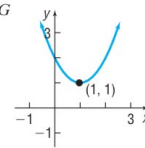
E



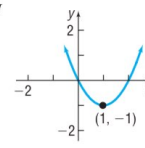
F



G



H



In Problems 19–30, graph the function  $f$  by starting with the graph of  $y = x^2$  and using transformations (shifting, compressing, stretching, and/or reflection).

[Hint: If necessary, write  $f$  in the form  $f(x) = a(x - h)^2 + k$ .]

19.  $f(x) = \frac{1}{4}x^2$

20.  $f(x) = 2x^2 + 4$

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

22.  $f(x) = (x - 3)^2 - 10$

23.  $f(x) = x^2 + 4x + 2$

24.  $f(x) = x^2 - 6x - 1$

25.  $f(x) = 2x^2 - 4x + 1$

26.  $f(x) = 3x^2 + 6x$

27.  $f(x) = -x^2 - 2x$

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

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

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

In Problems 31–46, (a) graph each quadratic function by determining whether its graph opens up or down and by finding its vertex, axis of symmetry,  $y$ -intercept, and  $x$ -intercepts, if any. (b) Determine the domain and the range of the function. (c) Determine where the function is increasing and where it is decreasing.

31.  $f(x) = x^2 + 2x$

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

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

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

35.  $f(x) = x^2 + 2x - 8$

36.  $f(x) = x^2 - 2x - 3$

37.  $f(x) = x^2 + 2x + 1$

38.  $f(x) = x^2 + 6x + 9$

39.  $f(x) = 2x^2 - x + 2$

40.  $f(x) = 4x^2 - 2x + 1$

41.  $f(x) = -2x^2 + 2x - 3$

42.  $f(x) = -3x^2 + 3x - 2$

43.  $f(x) = 3x^2 + 6x + 2$

44.  $f(x) = 2x^2 + 5x + 3$

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

46.  $f(x) = 3x^2 - 8x + 2$

In Problems 47–52, determine the quadratic function whose graph is given.

47.

$y \uparrow$

48.

$y \uparrow$

49.

Vertex:  $(-3, 5)$

$y \uparrow$