9.1 Exercises

Identify the vertex of each parabola. See Examples 1–3 and 7 and 8.

1. $y = x^2 - 5$ **2.** $y = x^2 + 7$ **3.** $y = x^2 + 8x + 16$

4. $y = x^2 + 4x + 4$ **5.** $y = x^2 - 18x + 93$ **6.** $y = x^2 + 14x + 46$

7. $y = -4x^2 + 24x - 31$ **8.** $y = -5x^2 - 10x - 7$ **9.** $x = y^2 - 3$

10. $x = y^2 + 2$ **11.** $x = (y + 3)^2 - 2$ **12.** $x = (y - 5)^2 + 1$

13. $x = 4(y - 3)^2 + 1$ **14.** $x = -(y + 2)^2 - 5$ **15.** $x = 2 - (y + 3)^2$

For each parabola, decide whether the graph opens upward or downward and give the number of x-intercepts of the graph. See Examples 3 and 4.

16. $y = \frac{2}{5}x^2$ **17.** $y = -5x^2$ **18.** $y = .8x^2 + 3$

19. $y = \frac{1}{3}x^2 - 1$ **20.** $y = -2x^2 + 4$ **21.** $y = x^2 + 2x + 1$

22. $y = (x - 3)^2$ **23.** $y = -3(x - 1)^2 + 2$ **24.** $y = .2(x + 3)^2 - 1$

Sketch the graph of each parabola. See Examples 1–3, 5, 7, and 8.

25. $y = 3x^2$ **26.** $y = -\frac{1}{4}x^2$ **27.** $y = -x^2 + 2$

28. $y = x^2 + 3$ **29.** $y = 2x^2 - 2$ **30.** $y = -3x^2 + 1$

31. $y = -2x^2 - 4x - 2$ **32.** $y = x^2 - 6x + 9$ **33.** $y = x^2 + 2x - 1$

34. $y = x^2 - 4x + 7$ **35.** $y = -3(x + 2)^2 + 2$ **36.** $y = -3(x + 4)^2 + 5$

37. $x = 2 - y^2$ **38.** $x = y^2 + 1$ **39.** $x = -(y + 2)^2 + 3$

40. $x = (y - 4)^2 - 1$ **41.** $x = 3(y - 1)^2 + 2$ **42.** $x = -2(y + 3)^2 + 1$

Graph each parabola by first completing the square. See Examples 5 and 8.

43. $y = x^2 + 8x + 14$ **44.** $y = x^2 + 10x + 23$ **45.** $y = x^2 + 4x - 3$

46. $y = x^2 + 2x - 4$ **47.** $y = 3x^2 - 9x + 8$ **48.** $y = 2x^2 + 6x - 1$

49. $y = -2x^2 + 4x + 5$ **50.** $y = -5x^2 - 10x + 2$ **51.** $x = y^2 - 6y + 4$

52. $x = 2y^2 + 4y - 5$ **53.** $x = 4y^2 + 8y + 2$ **54.** $x = -3y^2 + 12y - 9$

Solve the following word problems. See Example 6.

55. Bob owns a taco stand. He has found that the profits of his stand are approximately given by

$$P = -x^2 + 16x + 34,$$

where P represents profit and x is the number of units of tacos sold daily. Find the number of units of tacos that Bob should sell daily to produce the maximum profit.

56. Carrie runs a sandwich shop. By studying past results, she has found that the cost of operating her shop is given by

$$c = 2x^2 - 28x + 160,$$

where x is the number of units of sandwiches sold daily. Find the number of units of sandwiches Carrie must sell to produce the lowest cost.

57. Suppose the price p of a product is related to the demand x for the product by the equation

$$p = 980 - 5x^2,$$

where x is measured in hundreds. Find p for each of the following values of x.

(a) 5 (b) 10 (c) 14

(d) Graph the equation.

58. A projectile is fired upward so that its distance (in feet) above the ground t seconds after firing is

$$s = -16t^2 + 400t.$$

Find the maximum height it reaches and the number of seconds it takes to reach that height.

59. If an object is thrown upward with an initial velocity of 32 feet per second, then its height after t seconds is given by

$$h = 32t - 16t^2.$$

Find the maximum height attained by the object. Find the number of seconds it takes the object to hit the ground.

60. Of all pairs of numbers whose sum is 80, find the pair with the maximum product. (*Hint:* Let x and $80 - x$ represent the two numbers. Write a quadratic equation for the product.)

61. The length and width of a rectangle have a sum of 52. What width will lead to the maximum area? (*Hint:* Let x represent the width and $52 - x$ the length. Write a quadratic equation for the area.)

62. For a trip to a resort, a charter bus company charges a fare of \$48 per person, plus \$2 per person for each unsold seat on the bus. If the bus has 42 seats and x represents the number of unsold seats, find the following:

(a) an expression for the total revenue from the trip (*Hint:* Multiply the total number riding, $42 - x$, by the price per ticket, $48 + 2x$);

(b) the graph for the expression from part (a);

(c) the number of unsold seats that produces the maximum revenue;

(d) the maximum revenue.

63. y is proportional to four plus the square of x. Find y when x is 1 if y is 60 when x is 4.

64. y varies directly as the square of the difference of x and three. If y is 16 when x is 5, find y when x is 7.

Review Exercises *Find the distance between each pair of points. See Section 7.1.*

65. (2, −1) and (4, 3) **66.** (5, 6) and (−2, −3) **67.** (−4, 7) and (−1, −8)

68. (x, y) and (2, −1) **69.** (x, y) and (−4, −3) **70.** (x, y) and (h, k)

CHAPTER 9

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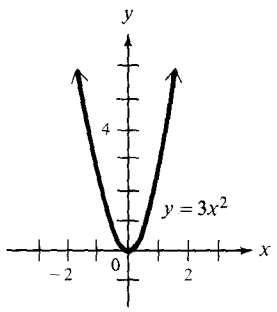
1. (0, −5) **3.** (−4, 0) **5.** (9, 12) **7.** (3, 5) **9.** (−3, 0) **11.** (−2, −3)

13. (1, 3) **15.** (2, −3) **17.** Downward, one **19.** Upward, two **21.** Upward, one

23. Downward, two

25.



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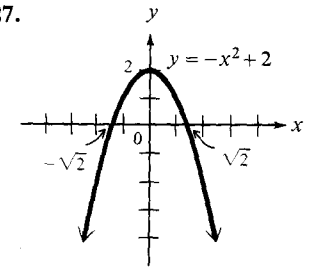

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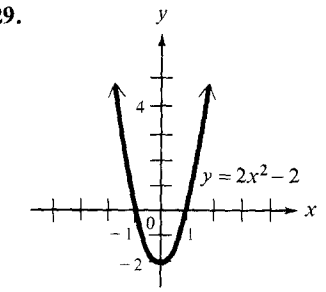

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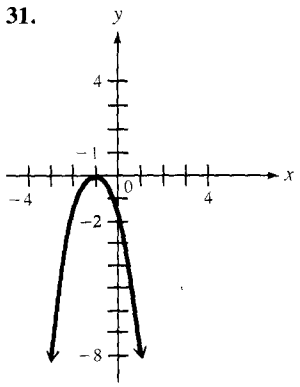

$y = -2x^2 - 4x - 2$

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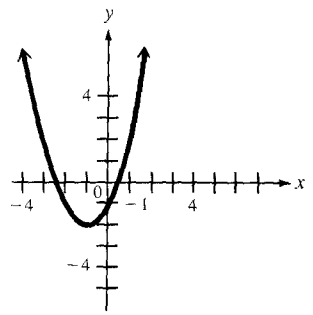

$y = x^2 + 2x - 1$

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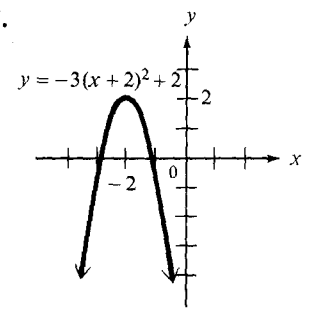

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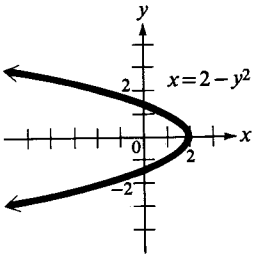

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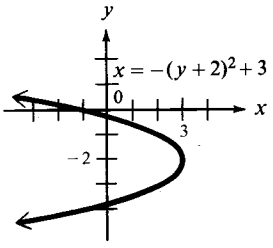

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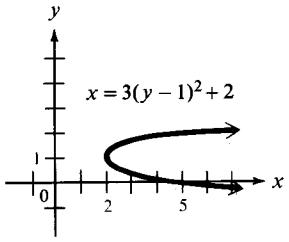

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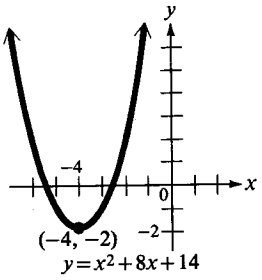

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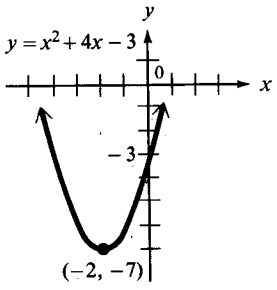

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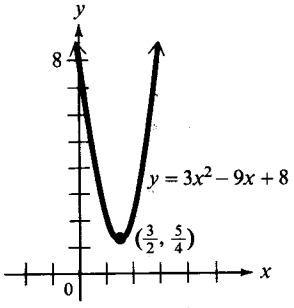

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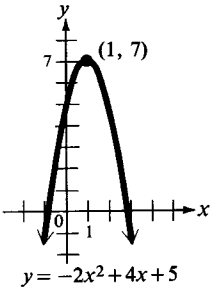

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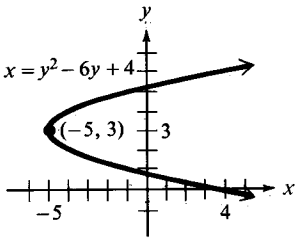

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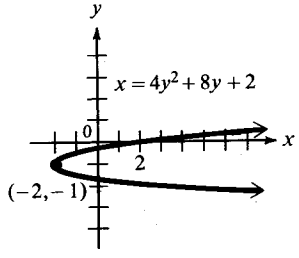
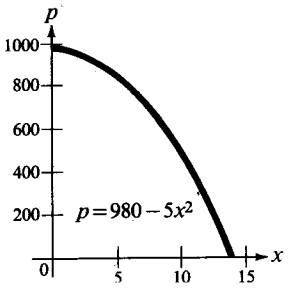


55. 8 units of tacos for a maximum profit of 98 **57.** (a) 855 (b) 480 (c) 0 (d)



59. 16 feet; 2 seconds **61.** 26 units **63.** $y = 15$

65. $2\sqrt{5}$ **67.** $3\sqrt{26}$ **69.** $\sqrt{(x + 4)^2 + (y + 3)^2}$