—Suggested Assignment: Exercises 1–77, every other odd

Exercise Set 1.3

In Exercises 1 to 10, solve each quadratic equation by factoring and applying the zero product principle.

1. $x^2 - 2x - 15 = 0$ $-3, 5$
2. $x^2 + 3x - 10 = 0$ $-5, 2$
3. $2x^2 - x = 1$ $-\frac{1}{2}, 1$
4. $2x^2 + 5x = 3$ $-3, \frac{1}{2}$
5. $8x^2 + 189x - 72 = 0$ $-24, \frac{3}{8}$
6. $12x^2 - 41x + 24 = 0$ $\frac{8}{3}, \frac{3}{4}$
7. $3x^2 - 7x = 0$ $0, \frac{7}{3}$
8. $5x^2 = -8x$ $0, -\frac{8}{5}$
9. $(x - 5)^2 - 9 = 0$ $2, 8$
10. $(3x + 4)^2 - 16 = 0$ $-\frac{8}{3}, 0$

In Exercises 11 to 20, use the square root procedure to solve each quadratic equation.

11. $x^2 = 81$ ± 9
12. $x^2 = 225$ ± 15
13. $2x^2 = 48$ $\pm 2\sqrt{6}$
14. $3x^2 = 144$ $\pm 4\sqrt{3}$
15. $3x^2 + 12 = 0$ $\pm 2i$
16. $4x^2 + 20 = 0$ $\pm i\sqrt{5}$
17. $(x - 5)^2 = 36$ $-1, 11$
18. $(x + 4)^2 = 121$ $-15, 7$
19. $(x - 3)^2 + 16 = 0$ $3 \pm 4i$
20. $(x + 2)^2 + 28 = 0$ $-2 \pm 2i\sqrt{7}$

In Exercises 21 to 32, solve each quadratic equation by completing the square.

21. $x^2 + 6x + 1 = 0$ $-3 \pm 2\sqrt{2}$
22. $x^2 + 8x - 10 = 0$ $-4 \pm \sqrt{26}$
23. $x^2 - 2x - 15 = 0$ $-3, 5$
24. $x^2 + 2x - 8 = 0$ $-4, 2$
25. $x^2 + 4x + 5 = 0$ $-2 \pm i$
26. $x^2 - 6x + 10 = 0$ $3 \pm i$
27. $x^2 + 3x - 1 = 0$ $\frac{-3 \pm \sqrt{13}}{2}$
28. $x^2 + 7x - 2 = 0$ $\frac{-7 \pm \sqrt{57}}{2}$
29. $2x^2 + 4x - 1 = 0$ $\frac{-2 \pm \sqrt{6}}{2}$
30. $2x^2 + 10x - 3 = 0$ $\frac{-5 \pm \sqrt{31}}{2}$
31. $3x^2 - 8x = -1$ $\frac{4 \pm \sqrt{13}}{3}$
32. $4x^2 - 4x = -15$ $\frac{1}{2} \pm \frac{\sqrt{14}}{2}i$

In Exercises 33 to 46, solve each quadratic equation by using the quadratic formula.

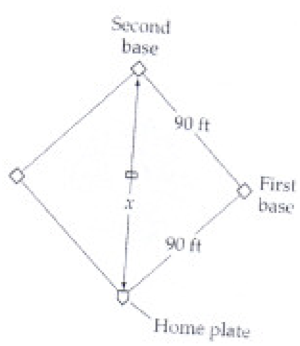
33. $x^2 - 2x = 15$ $-3, 5$
34. $x^2 - 5x = 24$ $-3, 8$
35. $x^2 = -x + 1$ $\frac{-1 \pm \sqrt{5}}{2}$
36. $x^2 = -x - 1$ $-\frac{1}{2} \pm \frac{\sqrt{3}}{2}i$
37. $2x^2 + 4x = -1$ $\frac{-2 \pm \sqrt{2}}{2}$
38. $2x^2 + 4x = 1$ $\frac{-2 \pm \sqrt{6}}{2}$
39. $3x^2 - 5x + 3 = 0$ $\frac{5}{6} \pm \frac{\sqrt{11}}{6}i$
40. $3x^2 - 5x + 4 = 0$ $\frac{5}{6} \pm \frac{\sqrt{23}}{6}i$
41. $\frac{1}{2}x^2 + \frac{3}{4}x - 1 = 0$ $\frac{-3 \pm \sqrt{41}}{4}$
42. $\frac{2}{3}x^2 - 5x + \frac{1}{2} = 0$ $\frac{\ldots \pm \sqrt{213}}{4}$
43. $24x^2 = 22x + 35$ $-\frac{5}{6}, \frac{7}{4}$
44. $72x^2 + 13x = 15$ $-\frac{5}{9}, \frac{3}{8}$
45. $0.5x^2 + 0.6x = 0.8$ $-2, \frac{4}{5}$
46. $1.2x^2 + 0.4x - 0.5 = 0$ $-\frac{5}{6}, \frac{1}{2}$

In Exercises 47 to 56, determine the discriminant of the quadratic equation, and then state the number of real solutions of the equation. Do not solve the equation.

47. $2x^2 - 5x - 7 = 0$ 81; two real solutions
48. $x^2 + 3x - 11 = 0$ 53; two real solutions
49. $3x^2 - 2x + 10 = 0$ −116; no real solutions
50. $x^2 + 3x + 3 = 0$ −3; no real solutions
51. $x^2 - 20x + 100 = 0$ 0; one real solution
52. $4x^2 + 12x + 9 = 0$ 0; one real solution
53. $24x^2 = -10x + 21$ 2116; two real solutions
54. $32x^2 - 44x = -15$ 16; two real solutions
55. $12x^2 + 15x = -7$ −111; no real solutions
56. $8x^2 = 5x - 3$ −71; no real solutions

57. GEOMETRY The length of each side of an equilateral triangle is 31 centimeters. Find the altitude of the triangle. Round to the nearest tenth of a centimeter. 26.8 cm

58. DIMENSIONS OF A BASEBALL DIAMOND How far, to the nearest tenth of a foot, is it from home plate to second base on a baseball diamond? (*Hint:* The bases in a baseball diamond form a square that measures 90 feet on each side.) 127.3 ft



59. DIMENSIONS OF A TELEVISION SCREEN A television screen measures 54 inches diagonally, and its aspect ratio is 4 to 3. Find the width and the height of the screen. Width 43.2 in.; height 32.4 in.

60. PUBLISHING COSTS The cost, in dollars, of publishing x books is $C(x) = 40{,}000 + 20x + 0.0001x^2$. How many books can be published for \$250,000? 10,000 books

61. Cost of a Wedding The average cost of a wedding, in dollars, is modeled by

$$C(t) = 38t^2 + 291t + 15{,}208$$

where $t = 0$ represents the year 1990 and $0 \le t \le 14$. Use the model to determine the year during which the average cost of a wedding first reached \$19,000. 1996

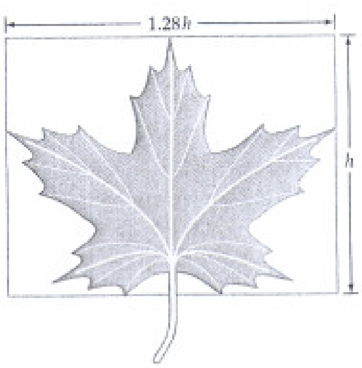
62. Revenue The demand for a certain product is given by $p = 26 - 0.01x$, where x is the number of units sold per month and p is the price, in dollars, at which each item is sold. The monthly revenue is given by $R = xp$. What number of items sold produces a monthly revenue of \$16,500?
1100 or 1500 items

63. Profit A company has determined that the profit, in dollars, it can expect from the manufacture and sale of x tennis racquets is given by

$$P = -0.01x^2 + 168x - 120{,}000$$

How many racquets should the company manufacture and sell to earn a profit of \$518,000?
5800 or 11,000 racquets

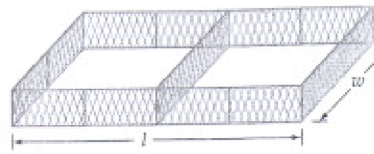
64. Quadratic Growth A plant's ability to create food through the process of photosynthesis depends on the surface area of its leaves. A biologist has determined that the surface area A of a maple leaf can be closely approximated by the formula $A = 0.72(1.28)h^2$, where h is the height of the leaf in inches.



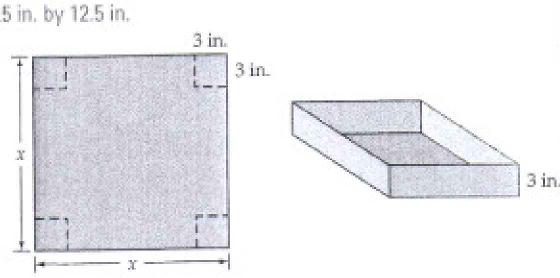
a. Find the surface area of a maple leaf with a height of 7 inches. Round to the nearest tenth of a square inch.
45.2 in^2

b. Find the height of a maple leaf with an area of 92 square inches. Round to the nearest tenth of an inch.
10.0 in.

65. Dimensions of an Animal Enclosure A veterinarian wishes to use 132 feet of chain-link fencing to enclose a rectangular region and subdivide the region into two smaller rectangular regions, as shown in the following figure. If the total enclosed area is 576 square feet, find the dimensions of the enclosed region.
12 ft by 48 ft or 32 ft by 18 ft



66. Construction of a Box A square piece of cardboard is formed into a box by cutting out 3-inch squares from each of the corners and folding up the sides, as shown in the following figure. If the volume of the box needs to be 126.75 cubic inches, what size square piece of cardboard is needed?
12.5 in. by 12.5 in.



67. Population Density of a City The population density D (in people per square mile) of a city is related to the horizontal distance x, in miles, from the center of the city by $D = -45x^2 + 190x + 200$, $0 < x < 5$. At what distances from the center of the city does the population density equal 250 people per square mile? Round each result to the nearest tenth of a mile.
0.3 mi and 3.9 mi

68. Traffic Control Traffic engineers install "flow lights" at the entrances of freeways to control the number of cars entering the freeway during times of heavy traffic. For a particular freeway entrance, the number of cars N waiting to enter the freeway during the morning hours can be approximated by $N = -5t^2 + 80t - 280$, where t is the time of the day and $6 \le t \le 10.5$. According to this model, when will there be 35 cars waiting to enter the freeway?
7 A.M. and 9 A.M.

69. Daredevil Motorcycle Jump In March of 2000, Doug Danger made a successful motorcycle jump over an L-1011 jumbo jet. The horizontal distance of his jump was 160 feet, and his height, in feet, during the jump was approximated by $h = -16t^2 + 25.3t + 20$, $t \ge 0$. He left the takeoff ramp at a height of 20 feet, and he landed on the landing ramp at a height of about 17 feet. How long, to the nearest tenth of a second, was he in the air?
1.7 s

70. Dimensions of a Candy Bar At the present time a company makes rectangular solid candy bars that measure 5 inches by 2 inches by 0.5 inch. Due to difficult financial times, the company has decided to keep the price of the candy bar fixed and reduce the volume of the bar by 20%. What should be the dimensions, to the nearest tenth of an

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—Answer graphs to Exercises 1–16 are on page AA1

Exercise Set 1.5

In Exercises 1 to 8, use the properties of inequalities to solve each inequality. Write the solution set using set-builder notation, and graph the solution set.

1. $2x + 3 < 11$
$\{x \mid x < 4\}$

2. $3x - 5 > 16$
$\{x \mid x > 7\}$

3. $x + 4 > 3x + 16$
$\{x \mid x < -6\}$

4. $5x + 6 < 2x + 1$
$\left\{x \mid x < -\frac{5}{3}\right\}$

5. $-3(x + 2) \le 5x + 7$
5. $\left\{x \mid x \ge -\frac{13}{8}\right\}$

6. $-4(x - 5) \ge 2x + 15$
$\left\{x \mid x \le \frac{5}{6}\right\}$

7. $-4(3x - 5) > 2(x - 4)$
$\{x \mid x < 2\}$

8. $3(x + 7) \le 5(2x - 8)$
$\left\{x \mid x \ge \frac{61}{7}\right\}$

In Exercises 9 to 16, solve each compound inequality. Write the solution set using set-builder notation, and graph the solution set.

9. $4x + 1 > -2$ and $4x + 1 \le 17$ $\left\{x \mid -\frac{3}{4} < x \le 4\right\}$

10. $2x + 5 > -16$ and $2x + 5 < 9$ $\left\{x \mid -\frac{21}{2} < x < 2\right\}$

11. $10 \ge 3x - 1 \ge 0$ $\left\{x \mid \frac{1}{3} \le x \le \frac{11}{3}\right\}$

12. $0 \le 2x + 6 \le 54$
$\{x \mid -3 \le x \le 24\}$

13. $x + 2 < -1$ or $x + 3 \ge 2$
$\{x \mid x < -3 \text{ or } x \ge -1\}$

14. $x + 1 > 4$ or $x + 2 \le 3$
$\{x \mid x \le 1 \text{ or } x > 3\}$

15. $-4x + 5 > 9$ or $4x + 1 < 5$
$\{x \mid x < 1\}$

16. $2x - 7 \le 15$ or $3x - 1 \le 5$
$\{x \mid x \le 11\}$

In Exercises 17 to 28, use interval notation to express the solution set of each inequality.

17. $|2x - 1| > 4$
17. $\left(-\infty, -\frac{3}{2}\right) \cup \left(\frac{5}{2}, \infty\right)$

18. $|2x - 9| < 7$
$(1, 8)$

19. $|x + 3| \ge 5$
$(-\infty, -8] \cup [2, \infty)$

20. $|x - 10| \ge 2$
$(-\infty, 8] \cup [12, \infty)$

21. $|3x - 10| \le 14$ $\left[-\frac{4}{3}, 8\right]$

22. $|2x - 5| \ge 1$
$(-\infty, 2] \cup [3, \infty)$

23. $|4 - 5x| \ge 24$
$(-\infty, -4] \cup \left[\frac{28}{5}, \infty\right)$

24. $|3 - 2x| \le 5$
$[-1, 4]$

25. $|x - 5| \ge 0$
$(-\infty, \infty)$

26. $|x - 7| \ge 0$
$(-\infty, \infty)$

27. $|x - 4| \le 0$
$\{4\}$

28. $|2x + 7| \le 0$ $\left\{-\frac{7}{2}\right\}$

In Exercises 29 to 36, use the critical value method to solve each polynomial inequality. Use interval notation to write each solution set.

29. $x^2 + 7x > 0$
$(-\infty, -7) \cup (0, \infty)$

30. $x^2 - 5x \le 0$
$[0, 5]$

31. $x^2 - 16 \le 0$
$[-4, 4]$

32. $x^2 - 49 > 0$
$(-\infty, -7) \cup (7, \infty)$

33. $x^2 + 7x + 10 < 0$
$(-5, -2)$

34. $x^2 + 5x + 6 < 0$
$(-3, -2)$

35. $x^2 - 3x \ge 28$
$(-\infty, -4] \cup [7, \infty)$

36. $x^2 < -x + 30$
$(-6, 5)$

In Exercises 37 to 50, use the critical value method to solve each rational inequality. Write each solution set in interval notation.

37. $\dfrac{x + 4}{x - 1} < 0$
$(-4, 1)$

38. $\dfrac{x - 2}{x + 3} > 0$
$(-\infty, -3) \cup (2, \infty)$

39. $\dfrac{x - 5}{x + 8} \ge 3$ $\left[-\frac{29}{2}, -8\right)$

40. $\dfrac{x - 4}{x + 6} \le 1$
$(-6, \infty)$

41. $\dfrac{x}{2x + 7} \ge 4$ $\left[-4, -\frac{7}{2}\right)$

42. $\dfrac{x}{3x - 5} \le -5$ $\left[\frac{25}{16}, \frac{5}{3}\right)$

43. $\dfrac{(x + 1)(x - 4)}{x - 2} < 0$
$(-\infty, -1) \cup (2, 4)$

44. $\dfrac{x(x - 4)}{x + 5} > 0$
$(-5, 0) \cup (4, \infty)$

45. $\dfrac{x + 2}{x - 5} \le 2$
$(-\infty, 5) \cup [12, \infty)$

46. $\dfrac{3x + 1}{x - 2} \ge 4$
$(2, 9]$

47. $\dfrac{6x^2 - 11x - 10}{x} > 0$
$\left(-\frac{2}{3}, 0\right) \cup \left(\frac{5}{2}, \infty\right)$

48. $\dfrac{3x^2 - 2x - 8}{x - 1} \ge 0$
$\left[-\frac{4}{3}, 1\right) \cup [2, \infty)$

49. $\dfrac{x^2 - 6x + 9}{x - 5} \le 0$
$(-\infty, 5)$

50. $\dfrac{x^2 + 10x + 25}{x + 1} \ge 0$
$\{-5\} \cup (-1, \infty)$

51. Personal Finance A bank offers two checking account plans. The monthly fee and charge per check for each plan are shown below. Under what conditions is it less expensive to use the LowCharge plan?
If you write more than 57 checks a month

Account Plan	Monthly Fee	Charge per Check
LowCharge	\$5.00	\$.01
FeeSaver	\$1.00	\$.08

52. Personal Finance You can rent a car for the day from Company A for \$29.00 plus \$0.12 a mile. Company B charges \$22.00 plus \$0.21 a mile. Find the number of miles m (to the nearest mile) per day for which it is cheaper to rent from Company A.
At least 78 mi