

## Answers for 10.3

For use with pages 647–649

### 10.3 Skill Practice

1.  $2x^2 - 9x + 11 = 0$
2. Yes;  $3x^2 - 2 = 0$  is a quadratic equation in the standard form  $ax^2 + bx + c = 0$ , where  $a = 3$ ,  $b = 0$ , and  $c = -2$ ;  $3x^2 + 0x + (-2) = 0$  or  $3x^2 - 2 = 0$ .
3. 4, 1      4. -3, -2      5. -4, -2
6. 5, -1      7. 8, -2      8. 7, 5
9. 3      10. -4      11. -5
12. 9      13. -7      14. 8
15. no solution      16. no solution
17. no solution      18.  $\pm 5$
19. -6, 2      20. no solution
21. Any solution of a quadratic equation is an  $x$ -intercept of the graph of the related quadratic function. The  $x$ -intercept of the function shown in the graph is 2, not 4; the only solution of the equation is 2.
22. -5, 1      23. -3, 4      24. -1, 6
25. -5, 2      26. -1, 9      27. -5, 4
28. -8, 1      29. 1, 11      30. -2, 6
31.  $-1\frac{1}{2}$ , 1      32.  $-\frac{1}{2}$ ,  $2\frac{1}{2}$
33.  $\frac{1}{2}$       34.  $-\frac{1}{2}$
35. no solution      36. no solution
37. -3.4, -0.6      38. 0.7, 4.3
39. -1.4, 3.4      40. -3.8, 0.8
41. 0.8, 6.2      42. -4.6, -0.4
43. -1.3, 0.8      44. 0.3, 2.4
45. -4.7, -1.3      46. C
47. 3.7 ft      48. 4.2 m
49. 5.8 cm

### 10.3 Problem Solving

50. 30 ft      51. 24.1 ft
52. a.  $h = -16t^2 + 8t + 70$   
b. about 2.4 sec
53. 16 ft; the distance from the nozzle to the circle is the distance between the  $x$ -intercepts of  $y = -0.75x^2 + 6x$ . Substitute 0 for  $y$  and solve for  $x$ :  
 $0 = -0.75x^2 + 6x$  has solutions 0 and 8. The radius of the display circle is 8 feet, so the diameter is 16 feet.

**Answers for 10.3** *continued*  
For use with pages 647–649

**54. a.**  $h = -16t^2 + 40t + 5.5$

**b.** about 2.6 sec

**c.** 2.5 sec; the two points on the graph of  $h = -16t^2 + 40t + 5.5$  that correspond to a height of 5.5 feet are the two points with  $h$ -coordinate 5.5. These points are reflections of each other in the parabola's axis of symmetry,  $t = 1.25$ . Because one point with  $h$ -coordinate 5.5 is  $(0, 5.5)$ , the  $t$ -coordinate of the other point with  $h$ -coordinate 5.5 is  $2(1.25) = 2.5$ . So, after 2.5 seconds, the ball is again at a height of 5.5 feet.

**55.** No; the height of the water at the point 137 feet from the firefighter is  $-0.003(137)^2 + 0.58(137) + 3 \approx 26.2$  feet. The water will hit the building just above the window.

**10.3 Mixed Review**

**56.**  $-5$     **57.**  $20$     **58.**  $\pm 25$

**59.**  $-512$     **60.**  $6561$     **61.**  $-\frac{1}{8}$

**62.**  $0.0000044$

**63.**  $170,000$

**64.**  $680,400,000$

## Answers for 10.4

For use with pages 655–661

### 10.4 Skill Practice

- square root
- (1) Graph the parabola  $y = ax^2 + c$  and find its  $x$ -intercepts.  
(2) Write the equation in the form  $x^2 = -\frac{c}{a}$  and take the square roots of each side.
- $\pm 1$
- $\pm 4$
- $\pm 10$
- $\pm 5$
- 0
- no solution
- $\pm \frac{1}{2}$
- no solution
- $\pm \frac{7}{3}$
- $\pm \frac{2}{5}$
- 0
- no solution
- A
- C
- $\pm 2.65$
- $\pm 3.61$
- no solution
- $\pm 3.16$
- 0
- $\pm 3.32$
- $\pm 2.24$
- $\pm 4.24$
- $\pm 3.78$
- $\pm 0.89$
- $\pm 1.32$
- $\pm 1.11$
- D
- 36 has two square roots, 6 and  $-6$ , so both numbers should be given as solutions of the equation;  $x = \pm \sqrt{36}$ ,  $x = \pm 6$ ; the solutions are  $-6$  and  $6$ .
- Negative numbers do not have real number square roots, so  $\pm \sqrt{-\frac{11}{7}}$  are not real numbers; there is no solution.
- 4.55, 9.45
- 0.76, 5.24
- $-5.73$ ,  $-2.27$
- $-8.16$ ,  $-1.84$
- $-1.74$ ,  $5.74$
- $-16.65$ ,  $-11.35$
- 5.55, 10.45
- $-5.69$ ,  $3.69$
- 2.13, 9.87
- $\pm 4$
- $\pm 3$
- $\pm 1.41$
- $-16$ ,  $26$
- 0.37, 13.63
- $\pm 1.94$
- 12 in.
- 4.58 m
- 11.66 ft
- $-2$ ,  $6$

## Answers for 10.4 *continued*

For use with pages 655–661

51.  $\pm\frac{6}{5}$ , or  $\pm 1.2$ ; *Sample answer:*

Rewrite the decimal as a fraction and then take square roots of each side of the equation:  $x^2 = \frac{100}{144}$ ,

$$\text{so } x = \pm\sqrt{\frac{144}{100}} = \pm\frac{12}{10} = \pm\frac{6}{5},$$

or  $\pm 1.2$ .

52. *Sample answers are given.*

(a) 5, -1; (b) 3, 0; (c) 2, 4

53. -2, 14      54. -11, -3

55. -4, -14

### 10.4 Problem Solving

56. 1.54 sec      57. C

58. 1996 and 1997

59. a. 6.8 mm

b. 5.9 mm

c. 5.6 mm

60. a. 3.06 m/sec,  
3.95 m/sec,  
6.25 m/sec

b. increase; as the wavelength in part (a) increased, respective speeds increased.

61. a.  $D = 4 \pm \sqrt{\frac{16V}{L}}$

b. 11.1 ft, 10.7 ft, 10.3 ft, 10.0 ft

62. a.  $h = -16t^2 + 250$

b.

Time of free fall, $t$ (sec)	Height, $h$ (ft)
0	250
1	234
2	186
3	106
4	-6

about 3 sec

c. 3.0 sec

## Answers for 10.4 *continued*

For use with pages 655–661

- 63.** Earth; on Earth the fraction  $-\frac{g}{2}$  is  $-\frac{32}{2} = -16$ , and on Mars the fraction  $-\frac{g}{2}$  is  $-\frac{12}{2} = -6$ ; so, on Earth the height of the object is modeled by  $h = -16t^2 + s$  and on Mars the height of the object is modeled by  $h = -6t^2 + s$ . To compare how long it takes the same object dropped from the same height  $s$  to hit the ground on each planet, substitute 0 for  $h$  in each equation and solve for  $t$  in terms of  $s$  (disregard any negative solutions).

Earth's equation:

$$0 = -16t^2 + s; 16t^2 = s;$$

$$t^2 = \frac{s}{16};$$

$$t = \sqrt{\frac{s}{16}} = \frac{\sqrt{s}}{\sqrt{16}}, \text{ or } t = \frac{\sqrt{s}}{4}.$$

Mars's equation:

$$0 = -6t^2 + s; 6t^2 = s; t^2 = \frac{s}{6};$$

$$t = \sqrt{\frac{s}{6}} = \frac{\sqrt{s}}{\sqrt{6}}, \text{ or } t \approx \frac{\sqrt{s}}{2.45}.$$

Because  $4 > 2.45$ ,  $\frac{1}{4} < \frac{1}{2.45}$ , and

$$\frac{\sqrt{s}}{4} < \frac{\sqrt{s}}{2.45};$$

thus, it takes less time for the object to hit the ground on Earth than on Mars.

### 10.4 Mixed Review

**64.**  $\frac{25}{4}$

**65.**  $\frac{81}{25}$

**66.**  $\frac{9}{16}$

**67.**  $\frac{49}{4}$

**68.**  $y = -9x + 11$

**69.**  $y = 7x - 7$

**70.**  $y = 3x - 2$

**71.**  $y = -\frac{1}{2}x - \frac{1}{2}$

**72.**  $y = -\frac{1}{4}x + 8$

**73.**  $y = \frac{1}{3}x - 1$

### 10.1–10.4 Mixed Review of Problem Solving

**1. a.** 2000

**b.** \$64,000

**2. a.** 7

**b.** 98 ft<sup>2</sup>

**Answers for 10.4** *continued*  
For use with pages 655–661

3. a.  $h = -16t^2 + 35t + 8$   
 b.  $h = -16t^2 + 45t + 7$   
 c. The second throw; when the ball lands back on the ground,  $h = 0$ . To find the time  $t$  when  $h = 0$  for the first throw, solve  $0 = -16t^2 + 35t + 8$ ;  $t \approx 2.40$  seconds (disregard the negative solution). To find the time  $t$  when  $h = 0$  for the second throw, solve  $0 = -16t^2 + 45t + 7$ ;  $t \approx 2.96$  seconds (disregard the negative solution). The second throw is in the air longer.
4. *Sample answer:* A pine cone hanging on a branch 20 feet above the ground drops off the branch;  $h = -16t^2 + 20$ ;  $t =$  about 1.1 seconds.
5. Yes; to find the height of the football 45 yards from where it was kicked, find the value of  $y$  when  $x = 45$ ;  $y = -0.03(45^2) + 1.8(45) = 20.25$  feet. The ball will be above the 10-foot high goal post.

6. 44 m/sec;

		4	4
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4		
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

7. a. about 15 feet  
 b. Yes; since the trailer is 7.5 feet wide, the height of the tunnel must be at least 10.5 feet high 3.75 units to the left and right of the axis of symmetry,  $x = 12\frac{2}{9}$ . Find the height of the tunnel at these points to be about 12.4 feet, which is higher than the height of the truck, so the truck will fit.

## Answers for 10.5

For use with pages 666–668

### 10.5 Skill Practice

- completing the square
- $x^2 + 14x + 49$ ; 49 is half of 14 squared, which makes it a perfect square trinomial.
- 9;  $(x + 3)^2$
- 36;  $(x + 6)^2$
- 4;  $(x - 2)^2$
- 16;  $(x - 4)^2$
- $\frac{9}{4}$ ;  $(x - \frac{3}{2})^2$
- $\frac{25}{4}$ ;  $(x + \frac{5}{2})^2$
- 1.44;  $(x + 1.2)^2$
- $\frac{1}{16}$ ;  $(x - \frac{1}{4})^2$
- $\frac{4}{9}$ ;  $(x - \frac{2}{3})^2$
- 3, 1
- 12, 2
- 1, 15
- 6, 12
- 3, 5
- 7, 3
- 0.5, 5.5
- 10.5, -0.5
- 2.33, 3
- 0.80, 8.80
- 0.15, 6.85
- 2.5, -0.5
- C
- B
- When completing the square, you must add the same number to each side of the equation, not just to the side of the equation for which you complete the square;  $x^2 - 14x + 49 = 11 + 49$ ,  
 $(x - 7)^2 = 60$ ,  $x - 7 = \pm\sqrt{60}$ ,  
 $x = 7 \pm \sqrt{60}$ .
- The perfect square trinomial  $x^2 - 2x + 1$  factors as  $(x - 1)^2$  not  $(x + 1)^2$ ;  $(x - 1)^2 = 5$ ,  
 $x - 1 = \pm\sqrt{5}$ ,  $x = 1 \pm \sqrt{5}$ .
- 1.32, 5.32
- 11.57, -0.43
- 0.86, 15.14
- 1.91, 0.91
- 3.67, -0.33
- 0.96, 6.96
- 0.30, 12.30
- 0.79, 2.21
- 0.65, 4.65
- 3.68, -0.32
- 9.58, -0.42
- 0.25, 0.75
- 12
- 4.87
- Zero;  $(\frac{b}{2})^2$  is always positive, so if  $c < -(\frac{b}{2})^2$ ,  $c$  must be a negative number whose absolute value is greater than  $(\frac{b}{2})^2$ . Then  $c + (\frac{b}{2})^2$  will simplify to a negative number, implying that  $(x + \frac{b}{2})^2 = c + (\frac{b}{2})^2$  has no solution.

## Answers for 10.5 *continued*

For use with pages 686–688

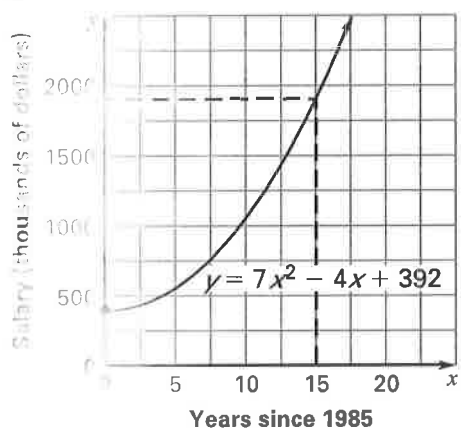
43.  $-15, -14$     44. 16, 18

### 10.5 Problem Solving

45. 3 ft                      46. 30 mi/h

47. a.  $1904 = 7x^2 - 4x + 392$ ; 2000

b.



When  $y \approx 1904$ , the value of  $x$  is about 15. So, the year 2000 ( $1985 + 15$ ) found in part (a) is correct.

48. a.  $l + 2w = 80 + l, lw = 750$

b. length: 50 ft, width: 15 ft;  
length: 30 ft, width: 25 ft

49. Yes; to find the number of days  $x$  after which the stock price was \$23.50 per share, substitute 23.5 for  $y$  and solve for  $x$  by completing the square to find that the solutions are 10 and 30. You could have sold the stock for \$23.50 per share 10 days after you purchased it.

50. a.  $h = -16t^2 + 24t + 16.4$

b. about 1.6 sec

51. length: 80 in., width: 6 in.

### 10.5 Mixed Review

52. 5                      53. 25                      54. 8

55. 22                      56. 0.8                      57. 6.7

58. 9                      59.  $\frac{15}{2}$                       60. 4

61.  $-9, 4$                       62. 2, 13

63.  $-2\frac{1}{3}, -1$                       64.  $2\frac{1}{2}$



## Answers for 10.6

For use with pages 674–676

### 10.6 Skill Practice

- quadratic formula
- Sample answer:* Completing the square, the equation can be put in the form  $ax^2 + bx = c$  where  $a = 1$  and  $b$  is an even number; or quadratic formula, the equation does **not** factor easily.
- −13, 3
- −2, 2.25
- −2, 2.33
- −2.62, −0.38
- −3.27, 4.27
- −4.34, 1.84
- −2.5
- −3.21, 1.71
- −0.63, 2.13
- B
- −2, 7
- −0.33, 4
- −1, 1.29
- −4, −0.5
- 3.27, 4.73
- −1.13, 4.13
- −0.54, 2.29
- −0.82, −0.30
- −0.66, 1.09
- −1, −0.25
- −1.77, −0.57
- −0.54, 0.74
- B
- The first term of the numerator of the quadratic formula is  $-b$ , so the first term of the numerator of the answer

should be  $-(-5) = 5$ ;

$$x = \frac{5 \pm \sqrt{(-5)^2 - 4(7)(-1)}}{2(7)},$$

$$x = \frac{5 \pm \sqrt{53}}{14},$$

$x \approx -0.16$  and  $x \approx 0.88$ .

- Before identifying the values of  $a$ ,  $b$ , and  $c$ , the equation must be written in standard form  $ax^2 + bx + c = 0$ ;  
 $-2x^2 + 3x - 1 = 0$ , so  
 $c = -1$ , not 1;  
$$x = \frac{-3 \pm \sqrt{3^2 - 4(-2)(-1)}}{2(-2)},$$
  
$$x = \frac{-3 \pm \sqrt{1}}{-4}, x = \frac{1}{2} \text{ and } x = 1.$$
- 28–33. Sample answers are given.
28. Factoring, the expression  $3x^2 - 27$  factors easily; or using square roots, the equation can be written in the form  $x^2 = d$ .
29. Using square roots, the equation can be written in the form  $x^2 = d$ .
30. Factoring, the expression  $2x^2 - 12x$  factors easily; or using square roots, the equation can be written in the form  $x^2 = d$ ; completing the square, the equation is of the form  $ax^2 + bx = c$  where  $a = 1$  and  $b$  is an even number.

## Answers for 10.6 *continued*

For use with pages 674–676

31. Factoring, the expression  $m^2 + 5m + 6$  factors easily.

32. Completing the square, the equation is in the form  $ax^2 + bx + c = 0$ , where  $a = 1$  and  $b$  is an even number; or quadratic formula, the equation does not factor easily.

33. Quadratic formula, the equation does not factor easily.

34.  $\pm 4$                       35. 4

36.  $-3.65, 1.65$     37. 6

38.  $-5.61, 1.61$     39.  $-1.94, 2.19$

40.  $\pm 0.77$                 41.  $-0.41, 2.41$

42.  $-18, -8$

43. 5; 13 m by 7 m

44. 4; 19 ft by 11 ft

45.  $-\frac{b}{2a}$  is the equation of the axis of symmetry of the parabola  $y = ax^2 + bx + c$ , and  $-\frac{b}{2a}$  is the  $x$ -coordinate of the vertex of the parabola; the axis of symmetry of  $y = ax^2 + bx + c$  is located half-way between the  $x$ -intercepts, and the  $x$ -intercepts are the solutions of  $ax^2 + bx + c = 0$ , so the mean of the solutions is the equation of the axis of

symmetry; the equation of the axis of symmetry gives the  $x$ -coordinate of the vertex of the parabola.

### 10.3 Problem Solving

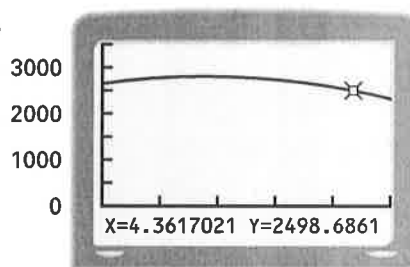
46. 1995                      47. 1993

48. a.  $h = -16t^2 + 45t = 2.5$

b. about 2.7 sec

49. a. 2001

b.



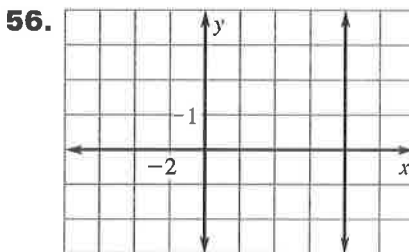
50. about 22 sec

51. about 156.0 mm

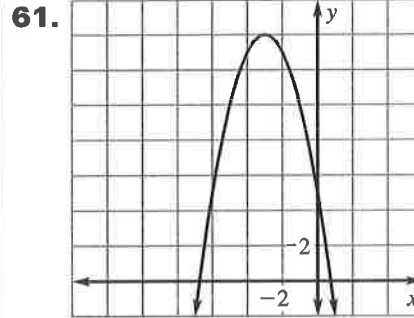
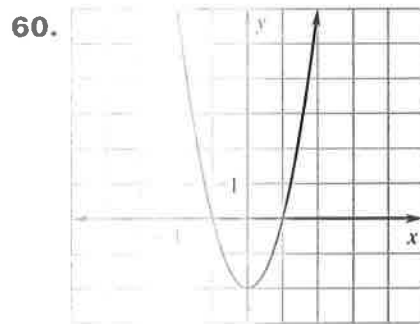
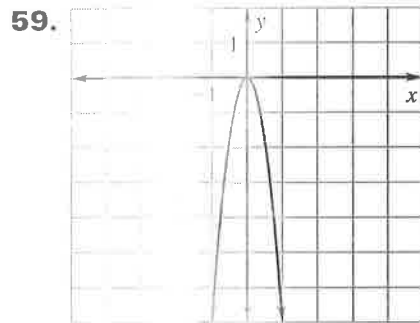
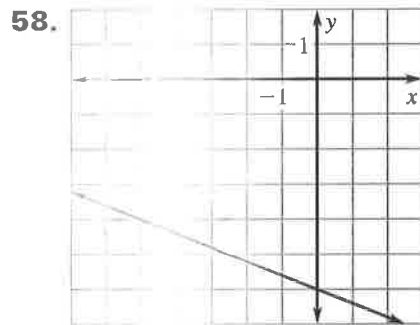
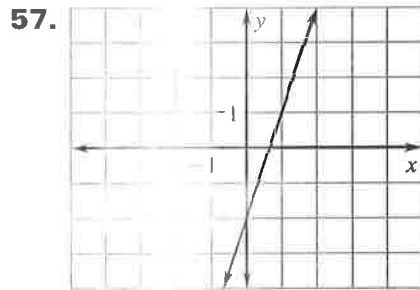
### 10.6 Mixed Review

52. 36                      53.  $-2\frac{1}{5}$

54. 13                      55. 1



**Answers for 10.6** *continued*  
 For use with pages 674-676



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