Chapter 5 *continued*

117.   **118.**

Technology Activity 5.5 *(p. 290)*

1. min; -4.25; 2.5
2. max; 5; 4
3. min; 4; -3
4. min; -5; -4
5. max; 8.125; -0.75
6. max; -2.125; -3.75
7. min; 2.375; 3.75
8. min; -4; -1
9. max; 8.65; 2.3
10. max at 80 cars per mile and 1997 cars per hour

Lesson 5.6

5.6 Guided Practice *(p. 295)*

1. the discriminant 2. 2 real; 1 real; 2 imaginary

3. *Sample answer:* when an object is thrown upward

4. $x = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(3)}}{2} = \dfrac{4 \pm \sqrt{16 - 12}}{2}$

   $= \dfrac{4 \pm \sqrt{4}}{2} = \dfrac{4 \pm 2}{2} \qquad x = 3 \text{ or } 1$

5. $x = \dfrac{-1 \pm \sqrt{1 + 4}}{2} = \dfrac{-1 \pm \sqrt{5}}{2}$

6. $x = \dfrac{-3 \pm \sqrt{9 - 40}}{4} = \dfrac{-3 \pm \sqrt{31}}{4}$

7. $x = \dfrac{-6 \pm \sqrt{36 + 36}}{18} = \dfrac{-1 \pm \sqrt{2}}{3}$

8. $x = \dfrac{-8 \pm \sqrt{64 - 4}}{-2} = 4 \pm \sqrt{15}$

9. $x = \dfrac{4 \pm \sqrt{16 - 4(4)37}}{8} = \dfrac{4 \pm \sqrt{-576}}{8}$

   $= \dfrac{4 \pm 24i}{8} = \dfrac{1}{2} \pm 3i$

10. $25 - 4(1)(2) = 25 - 8 = 17$

    2 real

11. $2^2 - 4(1)(5) = 4 - 20 = -16$

    2 imaginary

12. $(-4)^2 - 4(4)(1) = 16 - 16 = 0$

    one real

13. $(3)^2 - 4(-2)(-7) = 9 - 56 = -47$

    2 imaginary

14. $144 - 4(9)(4) = 144 - 144 = 0$

    1 real

15. $(-1)^2 - 4(5)(-13) = 1 + 260 = 261$

    2 real

16. $h = -16t^2 + v_0t + h_0$

    $0 = -16t^2 + 21t - 6$

    $t = \dfrac{-21 \pm \sqrt{(21)^2 - 4(-16)(-6)}}{-32}$

    $t = \dfrac{-21 \pm \sqrt{441 - 384}}{-32}$

    $t = \dfrac{-21 + \sqrt{57}}{-32}$

    $t \approx 0.42$

    0.42 sec

5.6 Practice and Applications *(pp. 295–297)*

17. $x = \dfrac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-14)}}{2(1)}$

    $x = \dfrac{5 \pm \sqrt{25 + 56}}{2}$

    $x = \dfrac{5 \pm 9}{2}$

    $7, -2$

18. $x = \dfrac{-3 \pm \sqrt{3^2 - 4(1)(-2)}}{2}$

    $x = \dfrac{-3 \pm \sqrt{9 + 8}}{2}$

    $x = \dfrac{-3 \pm \sqrt{17}}{2}$

19. $x = \dfrac{2 \pm \sqrt{4 - 4(1)(-4)}}{2}$

    $x = \dfrac{2 \pm \sqrt{4 + 16}}{2}$

    $x = 1 \pm \sqrt{5}$

20. $x = \dfrac{-10 \pm \sqrt{100 - 88}}{2}$

    $x = \dfrac{-10 \pm \sqrt{12}}{2}$

    $x = -5 \pm \sqrt{3}$

21. $x = \dfrac{-6 \pm \sqrt{36 - 232}}{2}$

    $x = \dfrac{-6 \pm 14i}{2}$

    $x = -3 \pm 7i$

22. $x = \dfrac{-7 \pm \sqrt{49 - 76}}{-2}$

    $x = \dfrac{-7 \pm 3i\sqrt{3}}{-2}$

    $x = \dfrac{7 \pm 3i\sqrt{3}}{2}$

23. $x = \dfrac{-3 \pm \sqrt{9 + 20}}{10}$

    $x = \dfrac{-3 \pm \sqrt{29}}{10}$

24. $x = \dfrac{11 \pm \sqrt{121 + 48}}{6}$

    $x = \dfrac{11 \pm 13}{6}$

    $4, -\dfrac{1}{3}$

Chapter 5 *continued*

25. $x = \dfrac{-1 \pm \sqrt{1-8}}{4}$

$x = \dfrac{-1 \pm i\sqrt{7}}{4}$

26. $p = \dfrac{8 \pm \sqrt{64-72}}{12}$

$p = \dfrac{8 \pm 2i\sqrt{2}}{12}$

$p = \dfrac{2}{3} \pm \dfrac{i\sqrt{2}}{6}$

27. $q = \dfrac{-2 \pm \sqrt{4+252}}{-14}$

$q = \dfrac{-2 \pm 16}{-14}$

$-1, \dfrac{9}{7}$

28. $r = \dfrac{-4 \pm \sqrt{16-160}}{16}$

$r = \dfrac{-4 \pm 12i}{16}$

$r = -\dfrac{1}{4} \pm \dfrac{3}{4}i$

29. $t = \dfrac{9 \pm \sqrt{81-48}}{-8}$

$t = \dfrac{-9 \pm \sqrt{33}}{8}$

30. $u = \dfrac{12 \pm \sqrt{144-3060}}{18}$

$u = \dfrac{12 \pm 54i}{18}$

$u = \dfrac{2}{3} \pm 3i$

31. $v = \dfrac{-8 \pm \sqrt{64+40}}{20}$

$v = \dfrac{-8 \pm 2\sqrt{26}}{20}$

$v = -\dfrac{2}{5} \pm \dfrac{\sqrt{26}}{10}$

32. $x^2 + 4x + 20 = 0$

$x = \dfrac{-4 \pm \sqrt{16-80}}{2}$

$x = \dfrac{-4 \pm 8i}{2}$

$x = -2 \pm 4i$

33. $x^2 - 2x - 99 = 0$

$x = \dfrac{2 \pm \sqrt{4+396}}{2}$

$x = \dfrac{2 \pm 20}{2}$

$x = 11 \text{ or } -9$

34. $x^2 - 10x + 14 = 0$

$x = \dfrac{10 \pm \sqrt{100-56}}{2}$

$x = \dfrac{10 \pm 2\sqrt{11}}{2}$

$x = 5 \pm \sqrt{11}$

35. $x^2 - 8x + 35 = 0$

$x = \dfrac{8 \pm \sqrt{64-140}}{2}$

$x = \dfrac{8 \pm 2i\sqrt{19}}{2}$

$x = 4 \pm i\sqrt{19}$

36. $x^2 + 3x - 7 = 0$

$x = \dfrac{-3 \pm \sqrt{9+28}}{2}$

$x = \dfrac{-3 \pm \sqrt{37}}{2}$

37. $x^2 + 16x + 46 = 0$

$x = \dfrac{-16 \pm \sqrt{256-184}}{2}$

$x = \dfrac{-16 \pm 6\sqrt{2}}{2}$

$x = -8 \pm 3\sqrt{2}$

38. $3x^2 + 6x + 2 = 0$

$x = \dfrac{-6 \pm \sqrt{36-24}}{6}$

$x = \dfrac{-6 \pm 2\sqrt{3}}{6}$

$x = -1 \pm \dfrac{\sqrt{3}}{3}$

39. $8x^2 - 8x - 1 = 0$

$x = \dfrac{8 \pm \sqrt{64+32}}{16}$

$x = \dfrac{8 \pm 4\sqrt{6}}{16}$

$x = \dfrac{1}{2} \pm \dfrac{\sqrt{6}}{4}$

40. $6x^2 + 4x - 1 = 0$

$x = \dfrac{-4 \pm \sqrt{16+24}}{12}$

$x = \dfrac{-4 \pm 2\sqrt{10}}{12}$

$x = -\dfrac{1}{3} \pm \dfrac{\sqrt{10}}{6}$

41. $4x^2 - 40x + 101 = 0$

$x = \dfrac{40 \pm \sqrt{1600-1616}}{8}$

$x = \dfrac{40 \pm 4i}{8}$

$x = 5 \pm \dfrac{1}{2}$

42. $36k^2 + 24k + 5 = 0$

$k = \dfrac{-24 \pm \sqrt{576-720}}{72}$

$k = \dfrac{-24 \pm 12i}{72}$

$k = -\dfrac{1}{3} \pm \dfrac{i}{6}$

Chapter 5 *continued*

43. $9n^2 + 12n - 5 = 0$

$$n \approx \frac{-12 \pm \sqrt{144 + 180}}{18}$$

$$n = \frac{-12 \pm 18}{18}$$

$$n = \frac{1}{3} \text{ or } -\frac{5}{3}$$

44. $3d^2 - 10d + 1 = 0$

$$d = \frac{10 \pm \sqrt{100 - 12}}{6}$$

$$d = \frac{10 \pm 2\sqrt{22}}{6}$$

$$d = \frac{5 \pm \sqrt{22}}{3}$$

45. $3.9y^2 + 9.5y - 8.2 = 0$

$$y = \frac{-9.5 \pm \sqrt{90.25 + 127.92}}{7.8}$$

$$y = \frac{-9.5 \pm \sqrt{218.17}}{7.8}$$

46. $6(x^2 - 2) = 0$

$$x = \pm\sqrt{2}$$

47.
$$x = \frac{3 \pm \sqrt{9 + 60}}{2}$$

$$x = \frac{3 \pm \sqrt{69}}{2}$$

48. $x^2 + 4x + 4 = -29 + 4$ **49.** $(x - 16)(x - 2) = 0$

$\quad (x + 2)^2 = -25$ $x = 2, 16$

$\quad x + 2 = \pm 5i$

$\quad\quad x = -2 \pm 5i$

50. $4\left(x^2 + 7x + \frac{49}{4}\right) = -49 + 49$

$\quad 4\left(x + \frac{7}{2}\right)^2 = 0$

$\quad\quad x = -\frac{7}{2}$

51. $(x + 4)^2 = -9$

$\quad x + 4 = \pm 3i$

$\quad\quad x = -4 \pm 3i$

52. $-5u^2 + 10u + 5 = 0$

$\quad u^2 - 2u - 1 = 0$

$\quad u^2 - 2u + 1 = 1 + 1$

$\quad\quad (u - 1)^2 = 2$

$\quad\quad u - 1 = \pm\sqrt{2}$

$\quad\quad\quad u = 1 \pm \sqrt{2}$

53. $4m^2 = 3$

$\quad m^2 = \frac{3}{4}$

$\quad m = \pm\frac{\sqrt{3}}{2}$

54. $-9v^2 + 36v - 31 = 0$

$$v = \frac{-36 \pm \sqrt{1296 - 1116}}{-18}$$

$$v = \frac{-36 \pm \sqrt{180}}{-18}$$

$$v = 2 \pm \frac{\sqrt{5}}{3}$$

55. $14p^2 + 19p - 3 = 0$

$$p = \frac{-19 \pm \sqrt{361 + 168}}{28}$$

$$p = \frac{-19 \pm 23}{28}$$

$$p = \frac{1}{7} \text{ or } p = -\frac{3}{2}$$

56. $16 - 40 = -24$; 2 imaginary

57. $9 + 24 = 33$; 2 real

58. $196 - 196 = 0$; 1 real

59. $100 + 60 = 160$; 2 real

60. $256 - 256 = 0$; 1 real

61. $25 - 32 = -7$; 2 imaginary

62. $0 + 84 = 84$; 2 real

63. $1 - 20 = -19$; 2 imaginary

64. $400 - 400 = 0$ 1; real

65. zero   **66.** negative   **67.** positive

68. $x^2 - 2x + c = 0$ **69.** $x^2 + 4x + c$

  a. $c < 1$ **a.** $c < 4$

  b. $c = 1$ **b.** $c = 4$

  c. $c > 1$ **c.** $c > 4$

70. $x^2 + 10x + c = 0$ **71.** $x^2 - 8x + c = 0$

  a. $c < 25$ **a.** $c < 16$

  b. $c = 25$ **b.** $c = 16$

  c. $c > 25$ **c.** $c > 16$

72. $x^2 + 6x + c = 0$ **73.** $x^2 - 12x + c = 0$

  a. $c < 9$ **a.** $c < 36$

  b. $c = 9$ **b.** $c = 36$

  c. $c > 9$ **c.** $c > 36$

74. *Sample answer:* The initial velocity substituted into the formula can be zero.

75. $0 = -16t^2 + 5t + 92$

$$t = \frac{-5 \pm \sqrt{25 + 5888}}{-32}$$

$$t = \frac{-5 - \sqrt{5913}}{-32}$$

$$t \approx 2.56 \text{ sec}$$

Chapter 5 *continued*

76. $\frac{1}{3}(77) = 7x + (11 - x)x$

$$0 = -x^2 + 18x - \frac{77}{3}$$

$$x = \frac{-18 \pm \sqrt{324 - \frac{308}{3}}}{-2}$$

$$x = 9 \pm \frac{\sqrt{\frac{664}{3}}}{-2}$$

$$x \approx 1.56 \text{ in.}$$

77. $0 = -16t^2 - 55t + 10$

$$x = \frac{55 \pm \sqrt{3025 + 640}}{-32}$$

$$x = \frac{55 \pm \sqrt{3665}}{-32}$$

$$x \approx 0.17 \text{ sec}$$

78. $l = 0.1s^2 - 3s + 22$

$$2000 = 0.1s^2 - 3s + 22$$

$$0 = 0.1s^2 - 3s - 1978$$

$$s = \frac{3 \pm \sqrt{9 + 791.2}}{0.2}$$

$$s = \frac{3 \pm \sqrt{800.2}}{0.2}$$

$$s \approx 156.4 \text{ ft/sec}$$

79. $\$60 = 0.560t^2 + 0.488t + 51$

$$0 = 0.56t^2 + 0.488t - 9$$

$$t = \frac{-0.488 \pm \sqrt{0.24 + 20.16}}{1.12}$$

$$t = \frac{-0.488 \pm \sqrt{20.4}}{1.12}$$

$$t \approx 3.6$$

in the year 1993

80. a. $v_0 = 350 \text{ ft/sec}$

$h_m \approx 1914 \text{ ft}$

b. $0 = -16t^2 + 350t$

$$0 = t(-16t + 350)$$

$$16t = 350$$

$$t = 21.875 \text{ sec}$$

81. $36 + 4 = 40 \qquad 25 + 16 = 41 \qquad$ B

82. $4k^2 - 4 = 4(k^2 - 1) \qquad 9 + 4k^2 \qquad$ B

83. $3.6 \qquad 2.7 \qquad$ A

84. a. maximum height occurs when $t = \frac{v_0}{32}$;

$$0 = -16\frac{v_0^2}{1024} + \frac{v_0^2}{32} - 160$$

$$0 = \frac{v_0^2}{64} - 160$$

$$(160)(64) = v_0^2$$

$$32\sqrt{10} \text{ ft/sec} = v_0$$

b. $t = \sqrt{10} \text{ ft/sec} \approx 3.16 \text{ sec}$

Sample answer: If $t = 2$ sec then v_0 would need to be equal to $v_0 = 32(2)^2 = 112$ ft/sec.

5.6 Mixed Review (p. 298)

85. $3x + 6 > 12$

$3x > 6$

$x > 2$

86. $16 - 7x \geq -5$

$-7x \geq -21$

$x \leq 3$

87. $-2x - 18 \leq 8$

$-2x \leq 26$
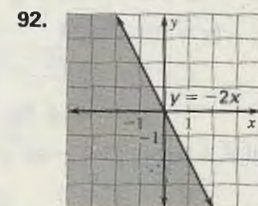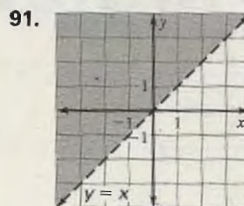
$x \geq -13$

88. $4x + 3 < -1$

$4x < -4$

$x < -1$

89. $4 \leq 5x - 11 \leq 29$

$15 \leq 5x \leq 40$

$3 \leq x \leq 8$

90. $\frac{3}{2}x + 20 \leq 14 \qquad$ or $\qquad 1 > 8 - x$

$\frac{3}{2}x \leq -6 \qquad$ or $\qquad -7 > -x$

$x \leq -4 \qquad$ or $\qquad 7 < x$

91.

92.

93.

94.

95.

96.

Chapter 5 *continued*

97.

$y = |x - 3|$
(3, 0)

98.

(0, 2)
$y = |x| + 2$

99.

(0, −1)
$y = -2|x| - 1$

100.

$y = 3|x + 4|$
(−4, 0)

101.

$y = |x + 2| + 3$
(−2, 3)

102.

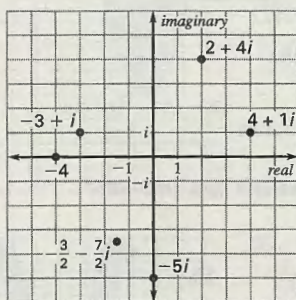$y = \frac{1}{2}|x - 5| - 4$
(5, −4)
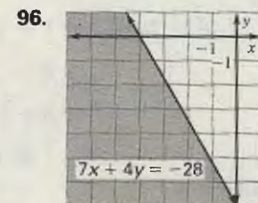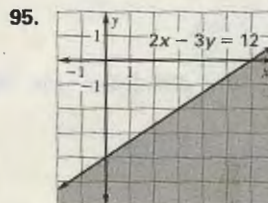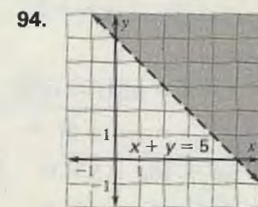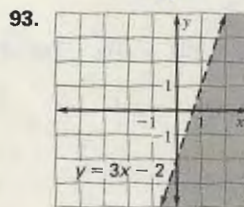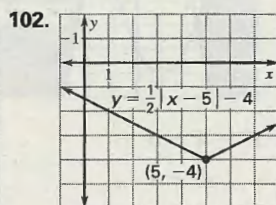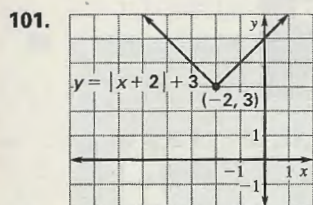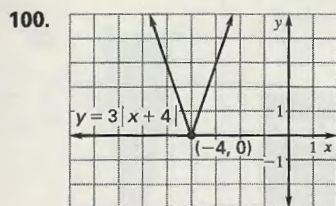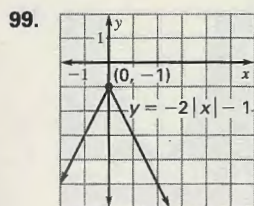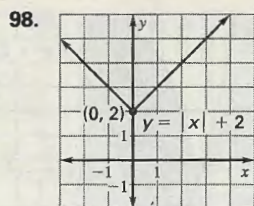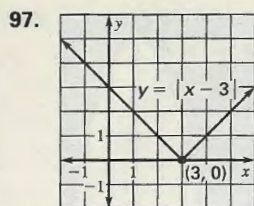
Quiz 2 (p. 298)

1. $5 + 16i$ **2.** $-4 + 10i$

3. $24 + 7 - 6i + 8i = 31 + 22i$

4. $\dfrac{1 - 3i}{5 + i} \times \dfrac{5 - i}{5 - i} = \dfrac{5 - 3 - 15i - i}{25 + 1}$

$\qquad\qquad = \dfrac{1 - 8i}{13}$

5.–10.

imaginary
2 + 4i
−3 + i
i
4 + 1i
−4   −1   1   real
−i
$-\frac{3}{2} - \frac{7}{2}i$
−5i

5. $\sqrt{2^2 + 4^2} = \sqrt{4 + 16} = 2\sqrt{5}$ **6.** $\sqrt{(-5)^2} = 5$

7. $\sqrt{(-3)^2 + 1^2} = \sqrt{9 + 1} = \sqrt{10}$

8. $\sqrt{4^2 + 3^2} = \sqrt{16 + 9} = 5$ **9.** $\sqrt{(-4)^2} = 4$

10. $\sqrt{\left(\dfrac{-3}{2}\right)^2 + \left(\dfrac{-7}{2}\right)^2} = \sqrt{\dfrac{9}{4} + \dfrac{49}{4}} = \dfrac{\sqrt{58}}{2}$

11. $x^2 + 8x + 16 = -14 + 16$

$\qquad (x + 4)^2 = 2$

$\qquad\quad x + 4 = \pm\sqrt{2}$

$\qquad\qquad\quad x = -4 \pm \sqrt{2}$

12. $x^2 - 2x + 1 = -17 + 1$

$\qquad (x - 1)^2 = -16$

$\qquad (x - 1) = \pm 4i$

$\qquad\qquad x = 1 \pm 4i$

13. $p^2 - 10p + 25 = 27$

$\qquad (p - 5)^2 = 27$

$\qquad\quad p - 5 = \pm 3\sqrt{3}$

$\qquad\qquad\quad p = 5 \pm 3\sqrt{3}$

14. $\qquad 5q^2 + 20q = -19$

$\quad 5(q^2 + 4q + 4) = -19 + 20$

$\qquad\quad 5(q + 2)^2 = 1$

$\qquad\qquad (q + 2)^2 = \dfrac{1}{5}$

$\qquad\qquad\quad q + 2 = \pm\dfrac{\sqrt{5}}{5}$

$\qquad\qquad\qquad q = -2 \pm \dfrac{\sqrt{5}}{5}$

15. $\qquad y - 1 = x^2 + 6x$

$\quad y - 1 + 9 = x^2 + 6x + 9$

$\qquad\qquad y = (x + 3)^2 - 8$

16. $\qquad y - 50 = x^2 - 18x$

$\quad y - 50 + 81 = x^2 - 18x + 81$

$\qquad\qquad y = (x - 9)^2 - 31$

17. $\qquad y + 7 = -2(x^2 - 4x)$

$\quad y + 7 - 8 = -2(x^2 - 4x + 4)$

$\qquad\qquad y = -2(x - 2)^2 + 1$

18. $x = \dfrac{-2 \pm \sqrt{4 + 40}}{2}$

$\quad x = \dfrac{-2 \pm 2\sqrt{11}}{2}$

$\quad x = -1 \pm \sqrt{11}$

19. $x = \dfrac{16 \pm \sqrt{256 - 292}}{2}$

$\quad x = \dfrac{16 \pm 6i}{2}$

$\quad x = 8 \pm 3i$

20. $-w^2 + 3w - 4 = 0$

$$w = \frac{-3 \pm \sqrt{9 - 16}}{-2}$$

$$w = \frac{-3 \pm i\sqrt{7}}{-2}$$

$$w = \frac{3 \pm i\sqrt{7}}{2}$$

21. $25y^2 + 40y - 8 = 0$

$$y = \frac{-40 \pm \sqrt{1600 + 800}}{50}$$

$$y = \frac{-40 \pm 20\sqrt{6}}{50}$$

$$y = \frac{-4 \pm 2\sqrt{6}}{5}$$

22. $4 = -16t^2 + 15t + 3$

$0 = -16t^2 + 15t - 1$

$$t = \frac{-15 \pm \sqrt{225 - 64}}{-32}$$
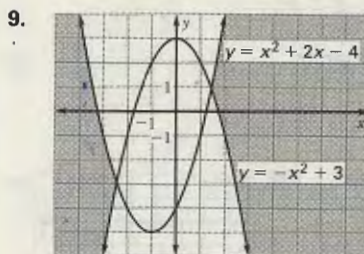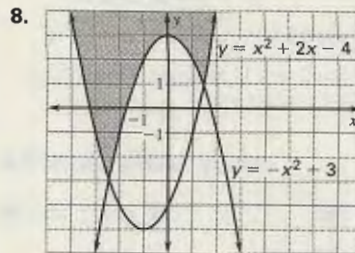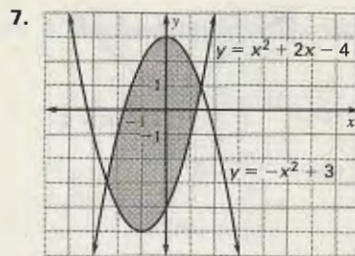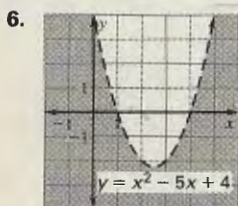
$$t = \frac{-15 \pm \sqrt{161}}{-32}$$

$t \approx 0.86$

about 1 sec

Lesson 5.7

5.7 Guided Practice (p. 303)

1. *Sample answer:* one variable: $-x^2 - 5x + 7 > 0$
two variables: $-y \geq x^2 - 5x + 7$

2. *Sample answer:* $y \geq x^2$ includes points on the graph of $y = x^2$ while $y > x^2$ does not.

3. *Sample answer:* graphical: Graph $y = x^2 - 3x - 4$ using a dotted line; find the x-intercepts and determine where the graph lies above the x-axis; algebraic: factor $x^2 - 3x - 4$ and graph the critical x-values on a number line; determine where the solutions lie on the number line.

4.

$y = x^2 + 2$

5.

$y = -2x^2$

6.

$y = x^2 - 5x + 4$

7.

$y = x^2 + 2x - 4$
$y = -x^2 + 3$

8.

$y = x^2 + 2x - 4$
$y = -x^2 + 3$

9.

$y = x^2 + 2x - 4$
$y = -x^2 + 3$
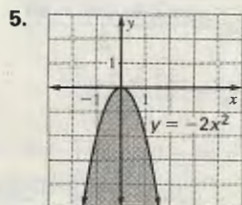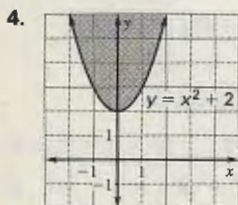
10. $x^2 - 4 < 0$

$x^2 < 4$

$-2 < x < 2$

11. $x^2 - 4 \geq 0$

$x^2 \geq 4$

$x \leq -2$ or $x \geq 2$

12. $x^2 - 4 > 3x$

$x^2 - 3x - 4 > 0$

$(x + 1)(x - 4) > 0$

$x < -1$ or $x > 4$

13. $y = -0.00211x^2 + 1.06x$
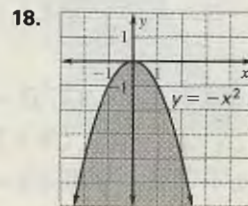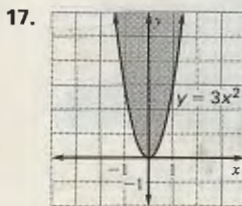
$0 = -0.00211x^2 + 1.06x - 52$

$$x = \frac{-1.06 \pm \sqrt{1.1236 - 0.4389}}{-0.00422}$$
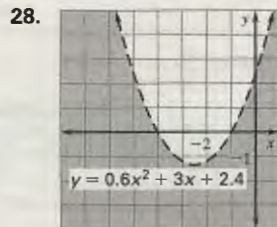
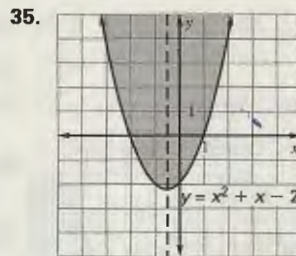$$x = \frac{-1.06 \pm \sqrt{0.6847}}{-0.00422}$$

$x = 55.1$ m and 447.3 m

5.7 Practice and Applications (pp. 303–305)

14. B **15.** C **16.** A

17.

$y = 3x^2$

18.

$y = -x^2$

Chapter 5 *continued*

19.

$y = -x^2 + 5$

20.

$y = x^2 - 3x$

21.

$y = x^2 + 8x + 16$

22.

$y = -x^2 + x + 6$

23.

$y = 2x^2 - 2x - 5$

24.

$y = -2x^2 - x + 3$

25.

$y = -3x^2 + 5x - 4$

26.

$y = -\frac{1}{2}x^2 - 2x + 4$

27.

$y = \frac{4}{3}x^2 - 12x + 29$

28.

$y = 0.6x^2 + 3x + 2.4$

29.

$y = x^2 + 3$

$y = x^2$

30.

$y = -3x^2$

$y = -\frac{1}{2}x^2 - 5$

31.

$y = x^2 - 6x + 9$

$y = -x^2 + 6x - 3$

32.

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

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

33.

$y = 3x^2 + 2x - 5$

$y = -2x^2 + 1$

34.

$y = 2x^2 - 9x + 8$

$y = -x^2 - 6x - 4$

35.

$y = x^2 + x - 2$

$-2 < x < 1$

36.

$y = 2x^2 - 7x + 3$

$x \leq \frac{1}{2}$ or $x \geq 3$

37.

$y = -x^2 - 2x + 8$

$x \leq -4$ or $x \geq 2$

38.

$y = -x^2 + x + 5$
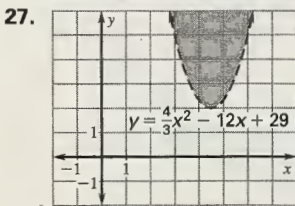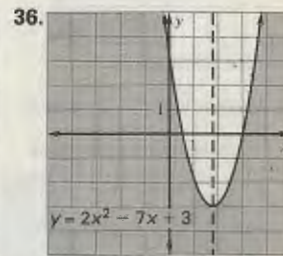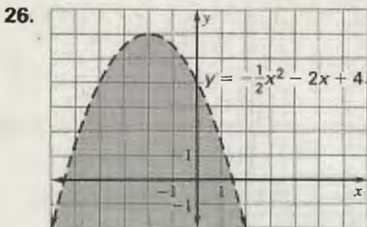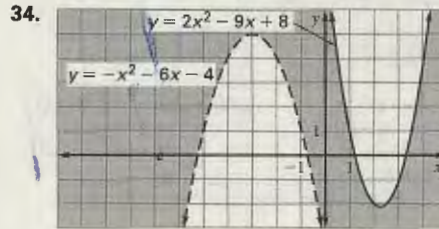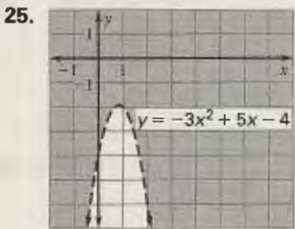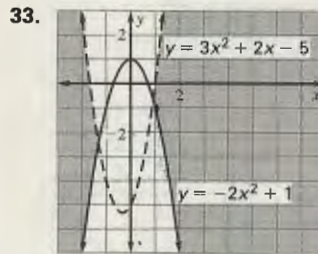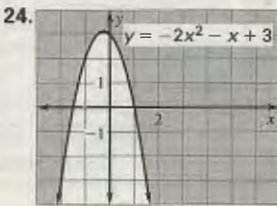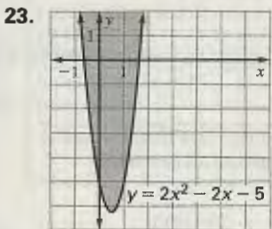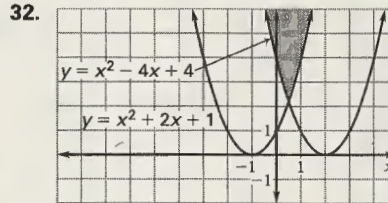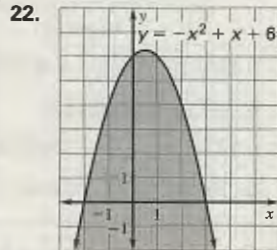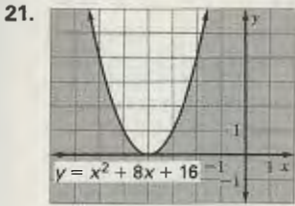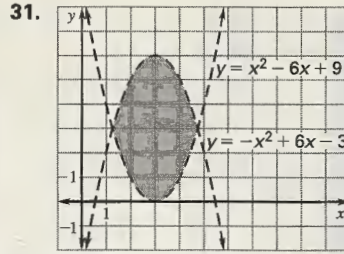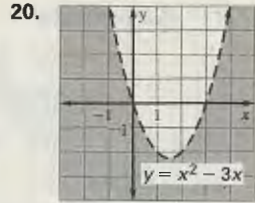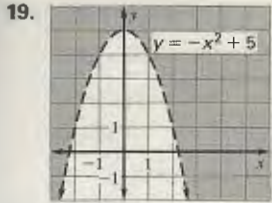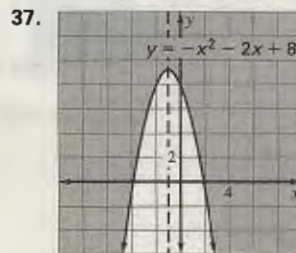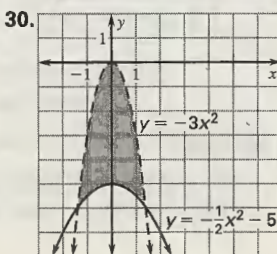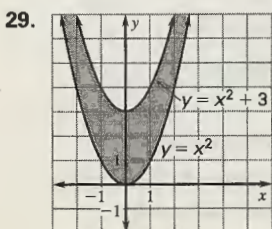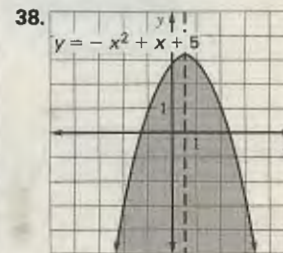
$-1.8 < x < 2.8$

Chapter 5 *continued*

39.

$x \le -5.5$ or $x \ge -2.5$

$y = 3x^2 + 24x + 41$
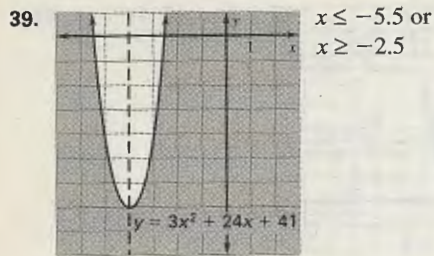
40. no real solutions

41. $x^2 + 3x - 18 \ge 0$

$(x - 3)(x + 6) = 0$

$x = 3$ or $x = -6$

$x \le -6$ or $x \ge 3$

42. $3x^2 - 16x + 5 \le 0$

$(3x - 1)(x - 5) = 0$

$x = 5$ or $x = \dfrac{1}{3}$

$\dfrac{1}{3} \le x \le 5$

43. $4x^2 < 25$

$x^2 = \dfrac{25}{4}$

$x = \pm \dfrac{5}{2}$

$-\dfrac{5}{2} < x < \dfrac{5}{2}$

44. $-x^2 - 12x - 32 < 0$

$-(x + 8)(x + 4) = 0$

$x = -8$ or $x = -4$

$x < -8$ or $x > -4$

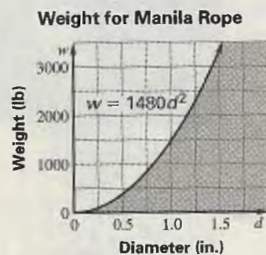**45.** $2x^2 - 4x - 5 > 0$

$x = \dfrac{4 \pm \sqrt{16 + 40}}{4}$

$x \approx -0.9$ or $x \approx 2.9$

$x < -0.9$ or $x > 2.9$

46. $\dfrac{1}{2}x^2 + 3x + 6 \le 0$

$x = \dfrac{-3 \pm \sqrt{9 - 12}}{1}$

no real solutions

47. Manila Rope   Wire Rope

Weight for Manila Rope

$w = 1480d^2$

Weight for Wire Rope

$w = 8000d^2$
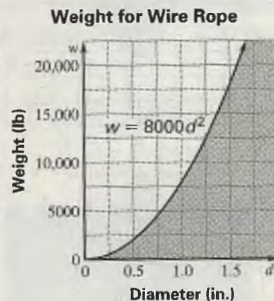
48. no; yes

49.

Healthy Weights   121–160 lb

$w = \dfrac{19h^2}{703}$

$w = \dfrac{25h^2}{703}$
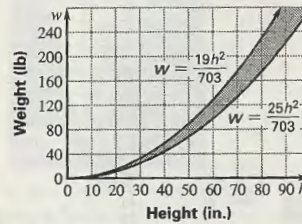
50. $0.125x^2 - 569x + 848{,}000 \ge 400{,}000$

a. $400 \le x \le 1012.6$

$0.125x^2 - 569x + 448{,}000 \ge 0$

b. Decreases; there is an oversupply of timber.
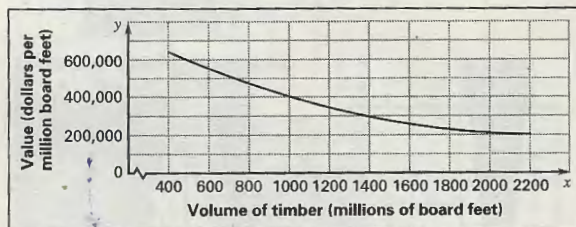
51. $-425x^2 + 42{,}500x - 761{,}000 > 250{,}000$

$-425x^2 + 42{,}500x - 1{,}011{,}000 > 0$

$39 < x < 61$
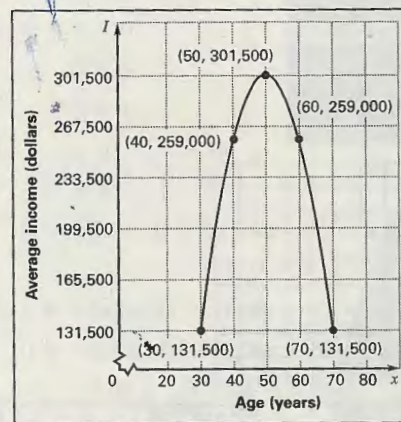
about 39 to 61 years

52. a.   **Reaction Times**

$V(x) = 0.005x^2 - 0.23x + 22$

$A(x) = 0.0051x^2 - 0.319x + 15$
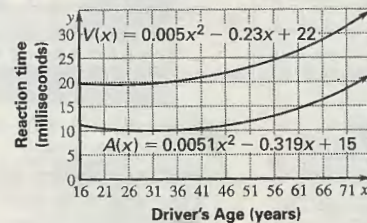
b. *Sample answer: $A(x)$ is always less than $V(x)$.*

c. *Sample answer:* siren; since audio stimuli reaction time is less than visual stimuli reaction time

Chapter 5 *continued*

53. a. $y \le -x(x-4)$
$0 \le x \le 4$
$y = -2(2-4)$
$y = 4$
$A = \frac{2}{3}(4)(4)$
$A = \frac{32}{3}$

b. $y \ge (x-5)(x+1)$
$y \le 3$
$h = 12$
$b = 7$
$A = \frac{2}{3}(12)(7) \approx 56$

5.7 Mixed Review (p. 305)

54. $3x + y = 1$
$y = 1 - 3x$

55. $8x - 2y = 10$
$-2y = 10 - 8x$
$y = -5 + 4x$

56. $-2x + 5y = 9$
$5y = 9 + 2x$
$y = \frac{9}{5} + \frac{2}{5}x$

57. $\frac{1}{3}y = -\frac{11}{12} - \frac{1}{6}x$
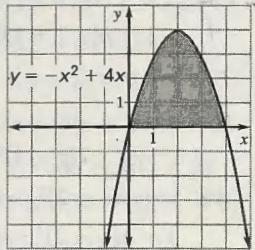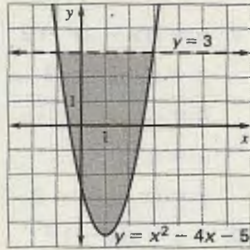$y = -\frac{11}{4} - \frac{1}{2}x$

58. $xy - x = 2$
$xy = 2 + x$
$y = \frac{2}{x} + 1$

59. $x - 3y = 28x$
$-3y = 27x$
$y = -9x$

60. $A = \begin{bmatrix} 5 & -3 & -2 \\ -1 & 7 & -3 \\ 3 & 2 & 4 \end{bmatrix}$

det $A = (140 + 27 + 4) - (-42 - 30 + 12) = 231$

$x = \dfrac{\begin{vmatrix} -17 & -3 & -2 \\ 6 & 7 & -3 \\ 13 & 2 & 4 \end{vmatrix}}{231}$

$= \dfrac{(-476 + 117 - 24) - (-182 + 102 - 72)}{231}$

$= \dfrac{-231}{231} = -1$

$y = \dfrac{\begin{vmatrix} 5 & -17 & -2 \\ -1 & 6 & -3 \\ 3 & 13 & 4 \end{vmatrix}}{231}$

$= \dfrac{(120 + 153 + 26) - (-36 - 195 + 68)}{231} = \dfrac{462}{231} = 2$

$z = \dfrac{\begin{vmatrix} 5 & -3 & -17 \\ -1 & 7 & 6 \\ 3 & 2 & 13 \end{vmatrix}}{231}$

$= \dfrac{(455 - 54 + 34) - (-357 + 60 + 39)}{231} = \dfrac{693}{231} = 3$

$(-1, 2, 3)$

61. $A = \begin{bmatrix} 1 & -4 & 1 \\ 2 & 3 & 7 \\ -3 & 5 & -5 \end{bmatrix}$

det $A = (-15 + 84 + 10) - (-9 + 35 + 40) = 13$

$x = \dfrac{\begin{vmatrix} -14 & -4 & 1 \\ -15 & 3 & 7 \\ 29 & 5 & -5 \end{vmatrix}}{13}$

$= \dfrac{(210 - 812 - 75) - (87 - 490 - 300)}{13} = \dfrac{26}{13} = 2$

$y = \dfrac{\begin{vmatrix} 1 & -14 & 1 \\ 2 & -15 & 7 \\ -3 & 29 & -5 \end{vmatrix}}{13}$

$= \dfrac{(75 + 294 + 58) - (45 + 203 + 140)}{13} = \dfrac{39}{13} = 3$

$z = \dfrac{\begin{vmatrix} 1 & -4 & -14 \\ 2 & 3 & -15 \\ -3 & 5 & 29 \end{vmatrix}}{13}$

$= \dfrac{(87 - 180 - 140) - (126 - 75 - 232)}{13} = \dfrac{-52}{13} = -4$

$(2, 3, -4)$

62. $13 + 3i$ **63.** -6 **64.** $5 + 2i$ **65.** $6 - 5i$

66. $-6 + 48i$

67. $14 + 15 + 6i - 35i = 29 - 29i$

68. $\dfrac{1}{3 - i} \times \dfrac{3 + i}{3 + i} = \dfrac{3 + i}{10}$

69. $\dfrac{4 - 3i}{9 + 2i} \times \dfrac{9 - 2i}{9 - 2i} = \dfrac{36 - 6 - 27i - 8i}{81 + 4} = \dfrac{30 - 35i}{85}$

$= \dfrac{6}{17} - \dfrac{7i}{17}$

Lesson 5.8

Activity (p. 307)

1. $a - b + c = 2$; $9a + 3b + c = 0$

Chapter 5 *continued*

2. $A = \begin{bmatrix} 1 & -1 & 1 \\ 9 & 3 & 1 \\ 4 & -2 & 1 \end{bmatrix}$

$\det A = (3 - 4 - 18) - (12 - 2 - 9) = -20$

$a = \dfrac{\begin{vmatrix} 2 & -1 & 1 \\ 0 & 3 & 1 \\ 0 & -2 & 1 \end{vmatrix}}{-20} = \dfrac{6 + 4}{-20} = -\dfrac{1}{2}$

$b = \dfrac{\begin{vmatrix} 1 & 2 & 1 \\ 9 & 0 & 1 \\ 4 & 0 & 1 \end{vmatrix}}{-20} = \dfrac{8 - 18}{-20} = \dfrac{-10}{-20} = \dfrac{1}{2}$

$c = \dfrac{\begin{vmatrix} 1 & -1 & 2 \\ 9 & 3 & 0 \\ 4 & -2 & 0 \end{vmatrix}}{-20} = \dfrac{-36 - 24}{-20} = \dfrac{-60}{-20} = 3$

$\left(-\dfrac{1}{2}, \dfrac{1}{2}, 3\right); y = -\dfrac{1}{2}x^2 + \dfrac{1}{2}x + 3$

3. $y = -\dfrac{1}{2}(x + 2)(x - 3)$

$y = -\dfrac{1}{2}(x^2 - x - 6)$

$y = -\dfrac{1}{2}x^2 + \dfrac{1}{2}x + 3$

5.8 Guided Practice (p. 309)

1. best-fitting quadratic model   **2.** 2; 3

3. $y = -(x - 1)^2 + 3$ **4.** $-4 = a(0 + 1)(0 - 2)$

$\qquad\qquad\qquad\qquad\qquad\qquad\quad 2 = a$

$\qquad\qquad\qquad\qquad\qquad\quad y = 2(x + 1)(x - 2)$

5. $A = \begin{bmatrix} 16 & -4 & 1 \\ 1 & 1 & 1 \\ 4 & -2 & 1 \end{bmatrix}$

$\det A = (16 - 16 - 2) - (4 - 32 - 4) = 30$

$a = \dfrac{\begin{vmatrix} 2 & -4 & 1 \\ 2 & 1 & 1 \\ -4 & -2 & 1 \end{vmatrix}}{30} = \dfrac{(2 + 16 - 4) - (-4 - 4 - 8)}{30}$

$= \dfrac{30}{30} = 1$

$b = \dfrac{\begin{vmatrix} 16 & 2 & 1 \\ 1 & 2 & 1 \\ 4 & -4 & 1 \end{vmatrix}}{30} = \dfrac{(32 + 8 - 4) - (8 - 64 + 2)}{30}$

$= \dfrac{90}{30} = 3$

$c = \dfrac{\begin{vmatrix} 16 & -4 & 2 \\ 1 & 1 & 2 \\ 4 & -2 & -4 \end{vmatrix}}{30}$

$= \dfrac{(-64 - 32 - 4) - (8 - 64 + 16)}{30} = \dfrac{-60}{30} = -2$

$y = x^2 + 3x - 2$

6. $100a + 10b + c = 165$

$\quad 36a + 6b + c = 115$

$\quad 16a + 4b + c = 154.5$

$\quad p = 1.83t^2 - 19.55t + 172.73$

5.8 Practice and Applications (pp. 309–312)

7. $y = a(x - 2)^2 - 2$ **8.** $y = a(x + 1)^2 + 4$

$\quad 2 = a(-2)^2 - 2$ $2 = a(-2 + 1)^2 + 4$

$\quad 4 = 4a$ $-2 = a$

$\quad 1 = a$

$\quad y = (x - 2)^2 - 2$ $y = -2(x + 1)^2 + 4$

9. $y = a(x - 1)^2$ **10.** $y = a(x - 2)^2 - 1$

$\quad -3 = a(-1 - 1)^2$ $3 = a(4 - 2)^2 - 1$

$\quad -3 = 4a$ $4 = 4a$

$\quad -\dfrac{3}{4} = a$ $1 = a$

$\quad y = -\dfrac{3}{4}(x - 1)^2$ $y = (x - 2)^2 - 1$

11. $y = a(x + 4)^2 + 6$ **12.** $y = a(x - 4)^2 + 5$

$\quad 9 = a(-1 + 4)^2 + 6$ $-3 = a(8 - 4)^2 + 5$

$\quad 3 = 9a$ $-8 = 16a$

$\quad \dfrac{1}{3} = a$ $-\dfrac{1}{2} = a$

$\quad y = \dfrac{1}{3}(x + 4)^2 + 6$ $y = -\dfrac{1}{2}(x - 4)^2 + 5$

13. $y = ax^2$ **14.** $y = a(x - 1)^2 - 10$

$\quad -12 = 4a$ $54 = a(-3 - 1)^2 - 10$

$\quad -3 = a$ $54 = a(16) - 10$

$\quad y = -3x^2$ $64 = 16a$

$\qquad\qquad\qquad\qquad\quad 4 = a$

$\qquad\qquad\qquad\quad y = 4(x - 1)^2 - 10$

15. $y = a(x + 6)^2 - 7$ **16.** $y = a(x - 3)(x + 3)$

$\quad -61 = 36a - 7$ $-4 = a(1 - 3)(1 + 3)$

$\quad -54 = 36a$ $-4 = a(-2)(4)$

$\quad -\dfrac{3}{2} = a$ $\dfrac{1}{2} = a$

$\quad y = -\dfrac{3}{2}(x + 6)^2 - 7$ $y = \dfrac{1}{2}(x - 3)(x + 3)$

17. $y = a(x + 2)(x - 1)$

$\quad -6 = a(-1 + 2)(-1 - 1)$

$\quad -6 = -2a$

$\quad 3 = a$

$\quad y = 3(x + 2)(x - 1)$

18. $y = a(x - 0)(x - 4)$ **19.** $y = a(x - 1)(x - 4)$

$\quad 3 = a(3)(-1)$ $2 = a(3 - 1)(3 - 4)$

$\quad -1 = a$ $2 = a(2)(-1)$

$\quad y = -(x + 0)(x - 4)$ $-1 = a$

$\qquad\qquad\qquad\qquad\quad y = -(x - 1)(x - 4)$

Chapter 5 *continued*

76. $\frac{1}{3}(77) = 7x + (11 - x)x$

$$0 = -x^2 + 18x - \frac{77}{3}$$

$$x = \frac{-18 \pm \sqrt{324 - \frac{308}{3}}}{-2}$$

$$x = 9 \pm \frac{\sqrt{\frac{664}{3}}}{-2}$$

$$x = 1.56 \text{ in.}$$

77. $0 = -16t^2 - 55t + 10$

$$x = \frac{55 \pm \sqrt{3025 + 640}}{-32}$$

$$x = \frac{55 \pm \sqrt{3665}}{-32}$$

$$x = 0.17 \text{ sec}$$

78. $l = 0.1s^2 - 3s + 22$

$$2000 = 0.1s^2 - 3s + 22$$

$$0 = 0.1s^2 - 3s - 1978$$

$$s = \frac{3 \pm \sqrt{9 + 791.2}}{0.2}$$

$$s = \frac{3 \pm \sqrt{800.2}}{0.2}$$

$$s = 156.4 \text{ ft/sec}$$

79. $S(t) = 0.560t^2 + 0.488t + 51$

$$0 = 0.56t^2 + 0.488t - 9$$

$$t = \frac{-0.488 \pm \sqrt{0.24 + 20.16}}{1.12}$$

$$t = \frac{-0.488 \pm \sqrt{20.4}}{1.12}$$

$$t = 3.6$$

in the year 1993

80. a. $v_0 = 350$ ft/sec

$h_m = 1914$ ft

b. $0 = -16t^2 + 350t$

$$0 = t(-16t + 350)$$

$$16t = 350$$

$$t = 21.875 \text{ sec}$$

81. $36 + 4 = 40 \qquad 25 + 16 = 41 \qquad$ B

82. $4k^2 - 4 = 4(k^2 - 1) \qquad 9 + 4k^2 \qquad$ B

83. $3.6 \qquad 2.7 \qquad$ A

84. a. maximum height occurs when $t = \frac{v_0}{32}$.

$$0 = -16\frac{v_0^2}{1024} + \frac{v_0^2}{32} - 160$$

$$0 = \frac{v_0^2}{64} - 160$$

$$(160)(64) = v_0^2$$

$$32\sqrt{10} \text{ ft/sec} = v_0$$

b. $t = \sqrt{10} \text{ ft/sec} = 3.16 \text{ sec}$

Sample answer: If $t = 2$ sec then v_0 would need to equal to $v_0 = 32(2)^2 = 112$ ft/sec.

5.8 Mixed Review (p. 298)

85. $3x + 6 > 12$

$3x > 6$

$x > 2$

86. $16 - 7x \geq -5$

$-7x \geq -21$

$x \leq 3$

87. $-2x - 18 \leq 8$

$-2x \leq 26$

$x \geq -13$

88. $4x + 3 < -1$
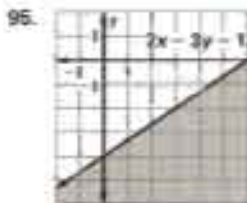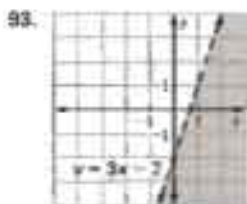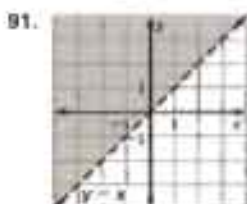
$4x < -4$

$x < -1$

89. $4 \leq 5x - 11 \leq 29$

$15 \leq 5x \leq 40$

$3 \leq x \leq 8$

90. $\frac{1}{2}x + 20 \leq 14$ or $1 > 8 - x$

$\frac{1}{2}x \leq -6$ or $-7 > -x$

$x \leq -4$ or $7 < x$

91.

$y = x$

92.

$y = -b$

93.

$y = 3x - 2$

94.

$x - y = 3$

95.

$2x - 3y = 12$

96.

$7x + 4y = -28$
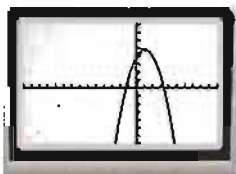
Chapter 5 *continued*

20. $y = a(x + 2)(x - 2)$
$8 = a(-4 + 2)(-4 - 2)$
$8 = a(-2)(-6)$
$\frac{2}{3} = a$
$y = \frac{2}{3}(x + 2)(x - 2)$

21. $y = a(x + 1)(x - 6)$
$-20 = a(1 + 1)(1 - 6)$
$-20 = a(2)(-5)$
$2 = a$
$y = 2(x + 1)(x - 6)$

22. $y = a(x + 10)(x + 8)$
$-15 = a(-7 + 10)(-7 + 8)$
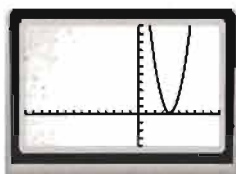$-15 = a(3)(1)$
$-5 = a$
$y = -5(x + 10)(x + 8)$

23. $y = a(x - 3)(x - 9)$
$77 = a(14 - 3)(14 - 9)$
$77 = a(11)(5)$
$\frac{7}{5} = a$
$y = \frac{7}{5}(x - 3)(x - 9)$

24. $y = a(x + 0)(x + 5)$
$18 = a(-3 + 0)(-3 + 5)$
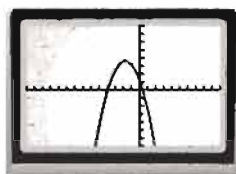$18 = a(-3)(2)$
$-3 = a$
$y = -3(x + 0)(x + 5)$

25. $a - b + c = 2$
$c = 4$
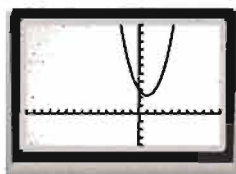$9a + 3b + c = -2$
$y = -x^2 + x + 4$

26. $4a + 2b + c = 7$
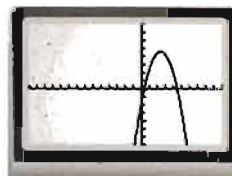$9a + 3b + c = 2$
$25a + 5b + c = 4$
$y = 2x^2 - 15x + 29$

27. $25a - 5b + c = -4$
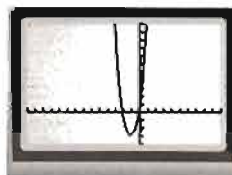$16a - 4b + c = 0$
$c = 1$
$y = -0.75x^2 - 2.75x + 1$

28. $a - b + c = 5$
$c = 3$
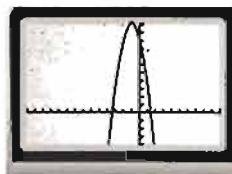$9a + 3b + c = 9$
$y = x^2 - x + 3$

29. $a + b + c = 2$
$9a + 3b + c = 4$
$36a + 6b + c = -8$
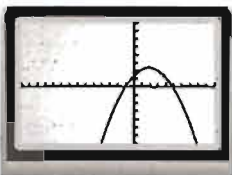$y = -x^2 + 5x - 2$

30. $4a - 2b + c = -1$
$a + b + c = 11$
$4a + 2b + c = 27$
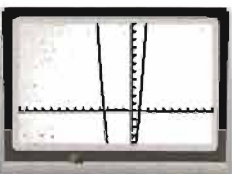$y = 3x^2 + 7x + 1$

31. $16a - 4b + c = -7$
$9a - 3b + c = 3$
$9a + 3b + c = -21$
$y = -2x^2 - 4x + 9$

32. $9a - 3b + c = -4$
$a - b + c = 0$
$81a + 9b + c = -10$
$y = -0.25x^2 + x + 1.25$

33. $36a - 6b + c = 46$
$4a + 2b + c = 14$
$16a + 4b + c = 56$
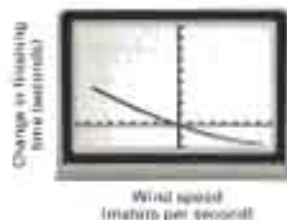$y = 2.5x^2 + 6x - 8$

34. $h = a(s - 27)^2 + 16$
$40 = a(20 - 27)^2 + 16$
$24 = a(49)$
$\frac{24}{49} = a$
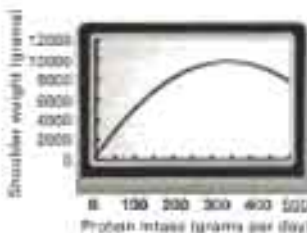$h = \frac{24}{49}(s - 27)^2 + 16$

35. $y = a(x - 0)(x - 24)$
$0.2 = a(17)(17 - 24)$
$0.2 = \quad 119a$
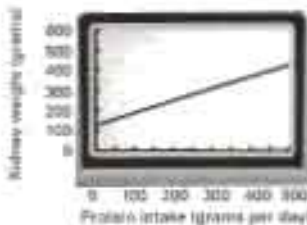$-0.00168 = a$
$y = -0.00168(x - 0)(x - 24)$

Chapter 5 *continued*

36. $16a - 4b + c = 1.42$

$4a + 2b + c = -0.57$

$36a + 6b + c = -1.42$

$t = 0.0119d^2 - 0.3086s - 0.0005$

Wind speed
(meters per second)

37. a. $38,025a + 195b + c = 8130$

$88,209a + 297b + c = 9680$

$160,801a + 401b + c = 9810$

$z = -0.0807p^2 + 55.229p + 330.38$

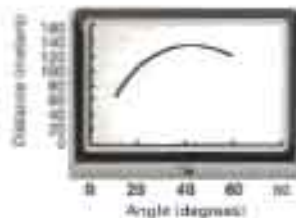Protein intake (grams per day)

b. $38,025a + 195b + c = 239$

$116,281a - 341b + c = 334$

$182,329a + 427b + c = 373$

$k = -0.00006p^2 + 0.6257p + 125.1598$

Protein intake (grams per day)

38. a. $100a + 10b + c = 61.2$

$900a + 30b + c = 130.4$

$2304a + 48b + c = 140.7$

$d = -0.0771A^2 + 6.5803A + 2.4614$

Angle (degrees)
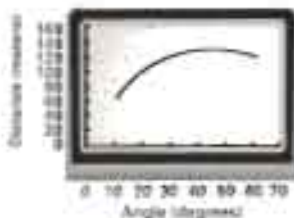
b. $100a + 10b + c = 58.3$

$900a + 30b + c = 126.9$

$2304a + 48b + c = 139.3$

$d = -0.07384^2 + 6.4304A + 0.6928$

Angle (degrees)

c. $100a + 10b + c = 56.1$

$900a + 30b + c = 122.8$

$2304a + 48b + c = 137.8$

$d = -0.07A^2 + 6.2284A - 0.2623$

39. a. 1.35, 1.68, 2.03, 2.37, 2.725, 3.07, 3.4; no, the keep increasing as the diameter increases.

b. 0.0675, 0.0672, 0.0678, 0.0678, 0.0681, 0.0683; the ratios are approximately equal.

c. $t = 0.068d^2$; about 206 min

40.

n	0	1	2	3	4	5	6
R	1	2	4	7	11	16	22

$a + b + c = 2$

$9a + 3b + c = 7$

$25a + 5b + c = 16$

$R = 0.5n^2 + 0.5n + 1$

5.8 Mixed Review (p. 312)

41. $(3)^2 - 4 = 9 - 4 = 5$

42. $(2)^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

43. $3(-4)^3 + 10 = 3(-64) + 10 = -192 + 10 = -182$

44. $-(-1)^4 + 2(-1) + 7 = -1 - 2 + 7 = 4$

45. $x - y = 4$

$\underline{x + y = 2}$

$2x = 6$

$x = 3$

$3 - y = 4$

$-1 = y$

$(3, -1)$

46. $2x - y = 0$

$\underline{5x + 3y = 11}$

$5x + 3(2x) = 11$

$5x + 6x = 11$

$11x = 11$

$x = 1$

$y = 2(1)$

$y = 2$

$(1, 2)$

Chapter 5 *continued*

47. $3x + 2y = -2$

$\underline{4x + 7y = 19}$

$4x + 7\left(-1 - \dfrac{3x}{2}\right) = 19$

$4x - 7 - \dfrac{21x}{2} = 19$
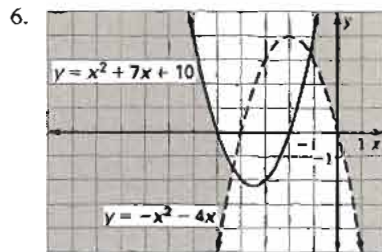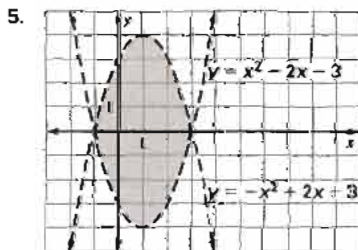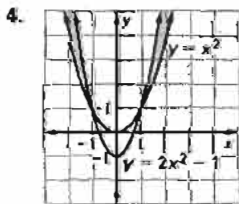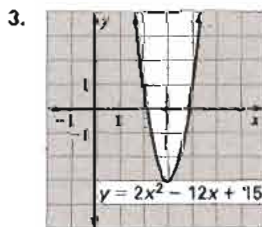
$-\dfrac{13}{2}x = 26$

$x = -4$

$y = -1 - \dfrac{(3 \cdot -4)}{2}$

$y = -1 + 6 = 5$

$(-4, 5)$

48. $C = 1800 + 15v + 10p$

Quiz 3 (p. 312)

1.

$y = x^2 + 2$

2.

$y = -x^2 - x + 3$

3.

$y = 2x^2 - 12x + 15$

4.

$y = x^2$

$y = 2x^2 - 1$

5.

$y = x^2 - 2x - 3$

$y = -x^2 + 2x + 3$

6.

$y = x^2 + 7x + 10$

$y = -x^2 - 4x$
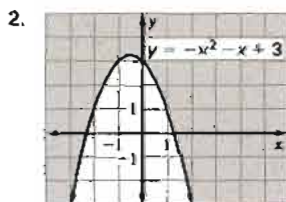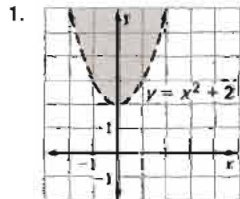
7. $y = a(x - 5)^2 - 2$

$0 = a(-1)^2 - 2$

$2 = a$

$y = 2(x - 5)^2 - 2$

8. $y = a(x + 3)(x - 1)$

$-5 = a(5)(1)$

$-1 = a$

$y = -(x + 3)(x - 1)$

9. $16a - 4b + c = 8$

$4a - 2b + c = 1$

$4a + 2b + c = 5$

$16a - 4b + c = 8$

$\underline{8a + 4b + 2c = 10}$

$24a \qquad + 3c = 18 \quad$ Eq 2

$4a - 2b + c = 1$

$\underline{4a + 2b + c = 5}$

$8a + \qquad 2c = 6 \quad$ Eq 1

$8a + 2c = 6$

$\underline{-8a - c = -6}$

$c = 0$

$8a = 6$

$a = \frac{3}{4}$

$4\left(\frac{3}{4}\right) + 2b + 0 = 5$

$2b = 2$

$b = 1$

$y = \frac{3}{4}x^2 + x$

10. $0.00339N^2 + 0.00143N - 5.95 < 1000$

$0.00339(N^2 + 0.42N + 0.0441) < 1005.95 + 0.0001495$
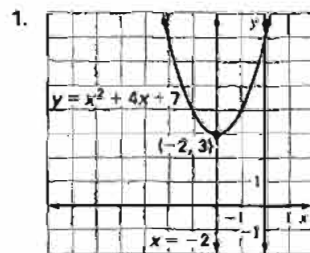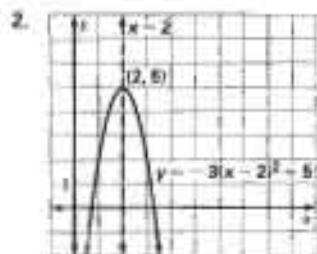
$0.00339(N + 0.21)^2 < 1005.9502$

$(N + 0.21)^2 < 296,740$

$(N + 0.21) < 544.7$

$N < 544$

$0 < N < 544$

Chapter 5 Review (pp. 314–316)

1.

$y = x^2 + 4x + 7$

$(-2, 3)$

$x = -2$

Chapter 5 *continued*

2.

3.
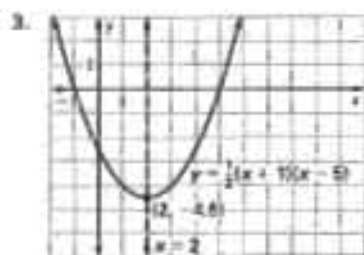
4. $x^2 + 11x + 24 = 0$

$(x + 3)(x + 8) = 0$

$x = -3$ or $x = -8$

5. $x^2 - 8x + 16 = 0$

$(x - 4)^2 = 0$

$x = 4$

6. $2x^2 + 3x + 1 = 0$

$(2x + 1)(x + 1) = 0$

$x = -\frac{1}{2}$ or $x = -1$

7. $3u^2 + 4u - 15 = 0$

$(u + 3)(3u - 5) = 0$

$u = -3$ or $u = \frac{5}{3}$

8. $25v^2 - 30v + 9 = 0$

$(5v - 3)^2 = 0$

$v = \frac{3}{5}$

9. $2x^2 = 200$

$x^2 = 100$

$x = \pm 10$

10. $5x^2 = 15$

$x^2 = 3$

$x = \pm\sqrt{3}$

11. $4(i + 6)^2 = 160$

$(i + 6)^2 = 40$

$(i + 6) = \pm 2\sqrt{10}$

$i = \pm 2\sqrt{10} - 6$

12. $-(k - 1)^2 + 7 = -43$

$-(k - 1)^2 = -50$

$(k - 1)^2 = 50$

$k - 1 = \pm 5\sqrt{2}$

$k = 1 \pm 5\sqrt{2}$

13. $(7 - 2) + (-4i + 5i) = 5 + i$

14. $(2 - 6) + (11i + i) = -4 + 12i$

15. $(12 + 90) + (40i - 27i) = 102 + 13i$

16. $\dfrac{8 + i}{1 - 2i} \times \dfrac{1 + 2i}{1 + 2i} = \dfrac{(8 - 2) + (i + 16i)}{1 + 4} = \dfrac{6 + 17i}{5}$

17. $\sqrt{(6)^2 + (9)^2} = \sqrt{36 + 81} = \sqrt{117} = 3\sqrt{13}$

18. $x^2 + 4x = 3$

$x^2 + 4x + 4 = 7$

$(x + 2)^2 = 7$

$x + 2 = \pm\sqrt{7}$

$x = -2 \pm \sqrt{7}$

19. $x^2 - 10x = -$

$x^2 - 10x + 25 = -$

$(x - 5)^2 = -$

$x - 5 = \pm$

$x =$

20. $2w^2 + w - 7 = 0$

$w^2 + \frac{1}{2}w + \frac{1}{16} = \frac{7}{2} + \frac{1}{16}$

$\left(w + \frac{1}{4}\right)^2 = \frac{57}{16}$

$w + \frac{1}{4} = \pm\frac{\sqrt{57}}{4}$

$w = -\frac{1}{4} \pm \frac{\sqrt{57}}{4}$

21. $y = x^2 - 8x + 17$

$y - 17 + 16 = x^2 - 8x + 16$

$y = (x - 4)^2 + 1;$

$(4, 1)$

22. $y = -x^2 - 2x - 6$

$y + 6 = -(x^2 + 2x)$

$y = -(x^2 + 2x + 1) - 5$

$y = -(x + 1)^2 - 5;$

$(-1, -5)$

23. $y = 4x^2 + 16x + 23$

$y - 23 = 4(x^2 + 4x)$

$y = 4(x^2 + 4x + 4) + 7$

$y = 4(x + 2)^2 + 7;$

$(-2, 7)$

24. $x^2 - 8x + 5 = 0$

$x = \dfrac{8 \pm \sqrt{64 - 20}}{2}$

$x = \dfrac{8 \pm \sqrt{44}}{2}$

$x = 4 \pm \sqrt{11}$

25. $9x^2 + 7x - 1 =$

$x = \dfrac{-7 \pm \sqrt{}}{}$

$x = \dfrac{-7 \pm \sqrt{}}{}$

26. $4v^2 + 10v + 7 = 0$

$v = \dfrac{-10 \pm \sqrt{100 - 112}}{8}$

$v = \dfrac{-10 \pm 2i\sqrt{3}}{8}$

$v = \dfrac{-5 \pm i\sqrt{3}}{4}$

Chapter 5 *continued*
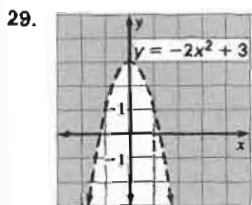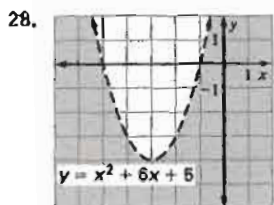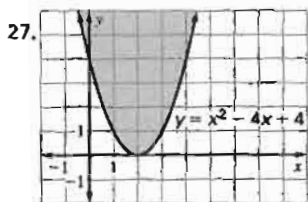
27.

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

28.

$y = x^2 + 6x + 5$

29.

$y = -2x^2 + 3$

30. $x^2 - 3x - 4 \le 0$

$(x - 4)(x + 1) = 0$

$x = 4$ or $x = -1$

$-1 \le x \le 4$

31. $2x^2 + 7x + 2 \ge 0$

$x = \dfrac{-7 \pm \sqrt{49 - 16}}{4}$

$x = \dfrac{-7 \pm \sqrt{33}}{4}$

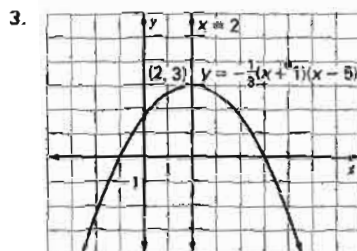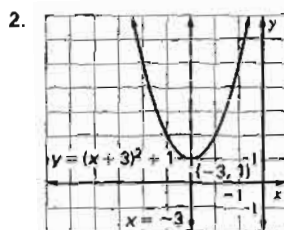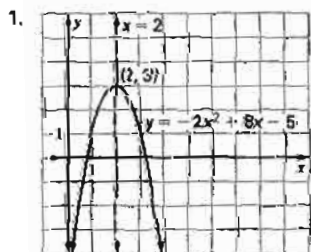$x \le \dfrac{-7 - \sqrt{33}}{4}$ or $x \ge \dfrac{-7 + \sqrt{33}}{4}$

32. $9x^2 > 49$

$x^2 = \frac{49}{9}$

$x = \pm \frac{7}{3}$

$x < -\frac{7}{3}$ or $x > \frac{7}{3}$

33. $y = a(x - 6)^2 + 1$

$5 = a(4 - 6)^2 + 1$

$4 = 4a$

$a = 1$

$y = (x - 6)^2 + 1$

34. $y = a(x + 4)(x - 3)$

$20 = a(1 + 4)(1 - 3)$

$20 = a(-10)$

$-2 = a$

$y = -2(x + 4)(x - 3)$

35. $25a - 5b + c = 1$

$16a - 4b + c = -2$

$9a + 3b + c = 5$

$y = 0.5x^2 + 1.5x - 4$

Chapter 5 Test (p. 317)

1.

$y = -2x^2 + 8x - 5$

2.

$y = (x + 3)^2 + 1$

3.

$y = -\frac{1}{3}(x + 1)(x - 5)$

4. $y = 4(x - 3)^2 - 7$

$y + 7 = 4(x^2 - 6x + 9)$

$y + 7 = 4x^2 - 24x + 36$

$y = 4x^2 - 24x + 29$

5. $x^2 - x - 20 = (x - 5)(x + 4)$

6. $9x^2 + 6x + 1 = (3x + 1)^2$

7. $3u^2 - 108 = 3(u^2 - 36) = 3(u + 6)(u - 6)$

8. $y = x^2 - 10x + 16$

$y = (x - 8)(x - 2)$;

$8, 2$

9. **a.** $\sqrt{5 \cdot 5 \cdot 5 \cdot 2 \cdot 2} = 10\sqrt{5}$

b. $\sqrt{\dfrac{8}{3}} = \dfrac{\sqrt{8}\sqrt{3}}{\sqrt{3}\sqrt{3}} = \dfrac{2\sqrt{6}}{3}$

10.

11. $(3 + 1) + (i - 5i)$

$= 4 - 4i$

12. $(-4 - 7) + (2i + 3i) = -11 + 5i$

13. $(48 - 2) + (6i + 16i) = 46 + 22i$

14. $\dfrac{9 + 2i}{1 - 4i} \times \dfrac{1 + 4i}{1 + 4i} = \dfrac{(9 - 8) + (2i + 36i)}{1 + 16} = \dfrac{1 + 38i}{17}$

Chapter 5 *continued*

15. $f(z) = z^2 - 0.5i$

$z_0 = 0$

$z_1 = f(0) = -0.5i$

$z_2 = f(-0.5i) = -0.25 - 0.5i$

$z_3 = f(-0.25 - 0.5i) = -0.1875 - 0.5i$

$|z_0| = 0$

$|z_1| = 0.5$

$|z_2| = \sqrt{0.0625 + .25} = \sqrt{0.3125} \approx 0.56$

$|z_3| = \sqrt{(-0.1875)^2 + (-0.5)^2} \approx 0.53$

Yes, the absolute values are less than $N = 1$.

16. $c = 4$; $(x - 2)^2$

17. $c = \frac{121}{4}$; $\left(x + \frac{11}{2}\right)^2$

18. $c = 0.09$; $(x - 0.3)^2$

19. $y = x^2 + 18x - 4$
$y + 4 + 81 = x^2 + 18x + 81$
$y = (x + 9)^2 - 85$;
$(-9, -85)$

20. $7x^2 - 3 = 11$
$7x^2 = 14$
$x^2 = 2$
$x = \pm\sqrt{2}$

21. $5x^2 - 60x + 180 = 0$
$x^2 - 12x + 36 = 0$
$(x - 6)(x - 6) = 0$
$x = 6$

22. $4x^2 + 28 - 15 = 0$
$(2x + 15)(2x - 1) = 0$
$x = -\frac{15}{2}$ or $x = \frac{1}{2}$

23. $m^2 + 8m + 3 = 0$
$m = \frac{-8 \pm \sqrt{64 - 12}}{2}$
$m = -4 \pm \frac{\sqrt{52}}{2}$
$m = -4 \pm \sqrt{13}$

24. $3(p - 9)^2 = 81$
$(p - 9)^2 = 27$
$p - 9 = \pm 3\sqrt{3}$
$p = 9 \pm 3\sqrt{3}$

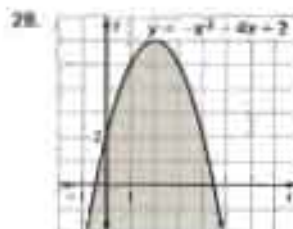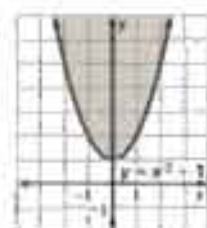**25.** $2x^2 - 3x + 2 = 0$
$x = \frac{3 \pm \sqrt{9 - 16}}{4}$
$x = \frac{3 \pm i\sqrt{7}}{4}$

26. $(-1)^2 - 4(7)(10)$
-279;
2 imaginary

27.

$y = x^2 + 1$

28.

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

29.

$y = 2x^2 + 12x + 15$

30. $-x^2 + x + 6 \geq 0$
$-(x^2 - x - 6) = 0$
$-(x - 3)(x + 2) = 0$
$x = 3$ or $x = -2$
$-2 \leq x \leq 3$

31. $2x^2 - 9 > 23$
$2x^2 = 32$
$x^2 = 16$
$x = \pm 4$
$x < -4$ or $x > 4$

32. $x = \frac{7 \pm \sqrt{49 - 16}}{2}$
$x = \frac{7 \pm \sqrt{33}}{2}$
$\frac{7 - \sqrt{33}}{2} < x < \frac{7 + \sqrt{33}}{2}$

33. $y = a(x + 3)^2 + 2$
$-18 = a(-1 + 3)^2 + 2$
$-20 = 4a$
$-5 = a$
$y = -5(x + 3)^2 + 2$

34. $y = a(x - 1)(x + ?)$
$-2 = a(2 - 1)(2 + ?)$
$-2 = a(-6)$
$\frac{1}{3} = a$
$y = \frac{1}{3}(x - 1)(x + ?)$

35. $a + b + c = 7$
$16a + 4b + c = -2$
$25a + 5b + c = -1$
$y = x^2 - 8x + 14$

36. $0 = -16t^2 + ?$
$167 = 16t^2$
$\frac{167}{16} = t^2$
$t = 3.23$
about 3.23 sec.

37. $p = 1.225a^2 - 88a + 1697.375$

Chapter 5 Standardized Test (pp. 316-318)

1. B

2. $4x^2 + 4x - 35 = (2x - 5)(2x + 7)$ B

3. $y = x^2 - 13x + 40$
$0 = (x - 5)(x - 8)$
5, 8
D

4. $4(x - 1)^2 = 28$
$(x - 1)^2 = 7$
$x - 1 = \pm\sqrt{7}$
$x = 1 \pm \sqrt{7}$
C

5. $(-12 + 8i)(10 - i) = (-120 + 8) + (80i + 12i)$
$= -112 + 92i$
D

6. C

Chapter 5 *continued*

7. $\sqrt{2^2 - 4(3)(-7)} = 88$

  2 real solutions

  A

8. $x^2 + 7x - 8 > 0$

  $x^2 + 7x - 8 = 0$

  $(x + 8)(x - 1) = 0$

  $x = -8$ or $x = 1$

  $x < -8$ or $x > 1$

  B

9. D

10. E

11. $\sqrt{(-3)^2 + (2)^2} = \sqrt{9 + 4} = \sqrt{13} \approx 3.61$ or

  $\sqrt{(1)^2 + (-4)^2} = \sqrt{1 + 17} = \sqrt{18} = 3\sqrt{2} \approx 4.24$ B

12. $49 + 96 = 145$ or $196 - 200 = -4$ A

13. a. $r = 0.334(30)^2$

  $r = 300.6$ ft

  b. $400 = 0.334s^2$

  $1197.6 = s^2$

  $34.6 \approx s$

  about 34.6 mi/h

  c. $A = 24\pi r$ **d.** $A = 8.016\pi s^2$ **e.** linear; quadratic

14. a. $h = -16t^2 + 40t + 3$

  b. $h - 3 = -16t^2 \cdot 40t$

  $h - 3 = -16(t^2 - 2.5t + 1.5625)$

  $h - 3 = -16(t - 1.25)^2$

  $h = -16(t - 1.25)^2 + 3 + 25$

  $h = -16(t - 1.25)^2 + 28$

  about 1.25 sec; 28 ft

  c. $8 = -16(t - 1.25)^2 + 28$

  $\dfrac{-20}{-16} = (t - 1.25)^2$

  $\dfrac{5}{4} = (t - 1.25)^2$

  $\pm\dfrac{\sqrt{5}}{2} = t - 1.25$

  $1.25 - \dfrac{\sqrt{5}}{2} = t$

  about 2.37 sec

  d. $6 \le -16(t - 1.25)^2 + 28 \le 9$

  $\dfrac{-22}{-16} \ge (t - 1.25)^2 \ge \dfrac{-19}{-16}$

  $1.375 \ge (t - 1.25)^2 \ge 1.1875$

  $1.173 \ge t - 1.25 \ge 1.090$

  $2.42 \ge t \ge 2.34$

  from about 2.34 sec to 2.42 sec

  e. $0 = -16(0.1)^2 + (0.1)v_0 + 8$

  $0 = -0.16 + 8 + 0.1v_0$

  $-7.84 = 0.1v_0$

  $-78.4 = v_0$

  78.4 feet per sec