

Section 6.3 The Quadratic Formula

$$1. \quad 2x^2 = 7 - 2x$$

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

$$5. (a) \quad x = \frac{11 \pm \sqrt{11^2 - 4(1)(28)}}{2(1)}$$

$$x = \frac{11 \pm \sqrt{121 - 112}}{2}$$

$$x = \frac{11 \pm \sqrt{9}}{2}$$

$$x = \frac{11 \pm 3}{2}$$

$$x = 7, 4$$

$$(b) \quad (x - 7)(x - 4) = 0$$

$$x - 7 = 0 \quad x - 4 = 0$$

$$x = 7 \quad x = 4$$

$$9. (a) \quad x = \frac{-4 \pm \sqrt{4^2 - 4(4)(1)}}{2(4)}$$

$$x = \frac{-4 \pm \sqrt{16 - 16}}{8}$$

$$x = \frac{-4}{8} = \frac{-1}{2}$$

$$(b) \quad (2x + 1)(2x + 1) = 0$$

$$2x + 1 = 0 \quad 2x + 1 = 0$$

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

$$13. (a) \quad x = \frac{1 \pm \sqrt{(-1)^2 - 4(6)(-2)}}{2(6)}$$

$$x = \frac{1 \pm \sqrt{1 + 48}}{12}$$

$$x = \frac{1 \pm \sqrt{49}}{12}$$

$$x = \frac{1 \pm 7}{12}$$

$$x = \frac{8}{12}, -\frac{6}{12} = \frac{2}{3}, -\frac{1}{2}$$

$$3. \quad x(10 - x) = 5$$

$$10x - x^2 = 5$$

$$-x^2 + 10x - 5 = 0$$

$$x^2 - 10x + 5 = 0$$

$$7. (a) \quad x = \frac{-6 \pm \sqrt{6^2 - 4(1)(8)}}{2(1)}$$

$$x = \frac{6 \pm \sqrt{36 - 32}}{2}$$

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

$$x = \frac{-6 \pm 2}{2} \quad x = -2, -4$$

$$(b) \quad (x + 4)(x + 2) = 0$$

$$x + 4 = 0 \quad x + 2 = 0$$

$$x = -4 \quad x = -2$$

$$11. (a) \quad x = \frac{-12 \pm \sqrt{12^2 - 4(4)(9)}}{2(4)}$$

$$x = \frac{-12 \pm \sqrt{144 - 144}}{8}$$

$$x = \frac{-12 \pm 0}{8}$$

$$x = -\frac{12}{8} = -\frac{3}{2}$$

$$(b) \quad (2x + 3)(2x + 3) = 0$$

$$2x + 3 = 0 \quad 2x + 3 = 0$$

$$x = -\frac{3}{2} \quad x = -\frac{3}{2}$$

$$(b) \quad (3x - 2)(2x + 1) = 0$$

$$3x - 2 = 0 \quad 2x + 1 = 0$$

$$x = \frac{2}{3} \quad x = -\frac{1}{2}$$

$$15. (a) x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-300)}}{2(1)}$$

$$x = \frac{5 \pm \sqrt{25 + 1200}}{2}$$

$$x = \frac{5 \pm \sqrt{1225}}{2}$$

$$x = \frac{5 \pm 35}{2}$$

$$x = 20, -15$$

$$(b) (x - 20)(x + 15) = 0$$

$$x - 20 = 0 \quad x + 15 = 0$$

$$x = 20 \quad x = -15$$

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

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

$$x = \frac{2 \pm \sqrt{20}}{2}$$

$$x = \frac{2 \pm 2\sqrt{5}}{2}$$

$$x = \frac{2(1 \pm \sqrt{5})}{2}$$

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

$$19. t = \frac{-4 \pm \sqrt{4^2 - 4(1)(1)}}{2(1)}$$

$$t = \frac{-4 \pm \sqrt{16 - 4}}{2}$$

$$t = \frac{4 \pm \sqrt{12}}{2}$$

$$t = \frac{-4 \pm 2\sqrt{3}}{2}$$

$$t = \frac{2(-2 \pm \sqrt{3})}{2}$$

$$t = -2 \pm \sqrt{3}$$

$$21. x = \frac{-6 \pm \sqrt{6^2 - 4(1)(-3)}}{2(1)}$$

$$x = \frac{-6 \pm \sqrt{36 + 12}}{2}$$

$$x = \frac{-6 \pm \sqrt{48}}{2}$$

$$x = \frac{-6 \pm 4\sqrt{3}}{2}$$

$$x = \frac{2(-3 \pm 2\sqrt{3})}{2}$$

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

$$23. x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(1)(23)}}{2(1)}$$

$$x = \frac{10 \pm \sqrt{100 - 92}}{2}$$

$$x = \frac{10 \pm \sqrt{8}}{2}$$

$$x = \frac{10 \pm 2\sqrt{2}}{2}$$

$$x = \frac{2(5 \pm \sqrt{2})}{2}$$

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

$$25. x = \frac{-3 \pm \sqrt{3^2 - 4(2)(3)}}{2(2)}$$

$$x = \frac{-3 \pm \sqrt{9 - 24}}{4}$$

$$x = \frac{-3 \pm \sqrt{-15}}{4}$$

$$x = \frac{-3 \pm i\sqrt{15}}{4}$$

$$x = \frac{-3}{4} \pm \frac{\sqrt{15}}{4}i$$

$$27. v = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-1)}}{2(3)}$$

$$v = \frac{2 \pm \sqrt{4 + 12}}{6}$$

$$v = \frac{2 \pm \sqrt{16}}{6}$$

$$v = \frac{2 \pm 4}{6}$$

$$v = \frac{6}{6}, \frac{-2}{6}$$

$$v = 1, -\frac{1}{3}$$

$$29. x = \frac{-4 \pm \sqrt{4^2 - 4(2)(-3)}}{2(2)}$$

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

$$x = \frac{-4 \pm \sqrt{40}}{4}$$

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

$$x = \frac{2(-2 \pm \sqrt{10})}{4}$$

$$x = \frac{-2 \pm \sqrt{10}}{2}$$

$$31. z = \frac{-6 \pm \sqrt{6^2 - 4(9)(-4)}}{2(9)}$$

$$z = \frac{-6 \pm \sqrt{36 + 144}}{18}$$

$$z = \frac{-6 \pm \sqrt{180}}{18}$$

$$z = \frac{-6 \pm 6\sqrt{5}}{18}$$

$$z = \frac{6(-1 \pm \sqrt{5})}{18}$$

$$z = \frac{-1 \pm \sqrt{5}}{3}$$

$$33. x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(-4)(3)}}{2(-4)}$$

$$x = \frac{6 \pm \sqrt{36 + 48}}{-8}$$

$$x = \frac{6 \pm \sqrt{84}}{-8}$$

$$x = \frac{6 \pm 2\sqrt{21}}{-8}$$

$$x = \frac{-3 \pm \sqrt{21}}{4}$$

$$35. 4x^2 - 3x + 1 = 0$$

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

$$x = \frac{3 \pm \sqrt{9 - 16}}{8}$$

$$x = \frac{3 \pm \sqrt{-7}}{8} = \frac{3}{8} \pm \frac{\sqrt{7}}{8}i$$

$$37. 2x^2 - 5x - 6 = 0$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-6)}}{2(2)}$$

$$x = \frac{5 \pm \sqrt{25 + 48}}{4}$$

$$x = \frac{5 \pm \sqrt{73}}{4}$$

$$39. 9x^2 = 1 + 9x$$

$$9x^2 - 9x - 1 = 0$$

$$x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(9)(-1)}}{2(9)}$$

$$x = \frac{9 \pm \sqrt{81 + 36}}{18}$$

$$x = \frac{9 \pm \sqrt{117}}{18}$$

$$x = \frac{9}{18} \pm \frac{3\sqrt{13}}{18}$$

$$x = \frac{1}{2} \pm \frac{\sqrt{13}}{6} \text{ or } \frac{3 \pm \sqrt{13}}{6}$$

$$41. 3x - 2x^2 - 4 + 5x^2 = 0$$

$$3x^2 + 3x - 4 = 0$$

$$x = \frac{-3 \pm \sqrt{3^2 - 4(3)(-4)}}{2(3)}$$

$$x = \frac{-3 \pm \sqrt{9 + 48}}{6}$$

$$x = \frac{-3 \pm \sqrt{57}}{6}$$

$$43. x = \frac{-(-0.4) \pm \sqrt{(-0.4)^2 - 4(1)(-0.16)}}{2(1)}$$

$$x = \frac{0.4 \pm \sqrt{0.16 + 0.64}}{2}$$

$$x = \frac{0.4 \pm \sqrt{0.80}}{2}$$

$$x = \frac{0.4 \pm 2\sqrt{0.2}}{2}$$

$$x = 0.2 \pm \sqrt{0.2} \text{ or } \frac{1 \pm \sqrt{5}}{5}$$

$$45. x = \frac{-1 \pm \sqrt{1^2 - 4(2.5)(-0.9)}}{2(2.5)}$$

$$x = \frac{-1 \pm \sqrt{1 + 9}}{5}$$

$$x = \frac{-1 \pm \sqrt{10}}{5}$$

$$47. \begin{aligned} b^2 - 4ac &= 1^2 - 4(1)(1) \\ &= 1 - 4 \\ &= -3 \end{aligned}$$

2 distinct imaginary solutions

$$49. \begin{aligned} b^2 - 4ac &= (-5)^2 - 4(2)(-4) \\ &= 25 + 32 \\ &= 57 \end{aligned}$$

2 distinct irrational solutions

$$51. \begin{aligned} b^2 - 4ac &= 7^2 - 4(5)(3) \\ &= 49 - 60 \\ &= -11 \end{aligned}$$

2 distinct imaginary solutions

$$53. \begin{aligned} b^2 - 4ac &= (-12)^2 - 4(4)(9) \\ &= 144 - 144 \\ &= 0 \end{aligned}$$

1 rational repeated solution

$$55. \begin{aligned} b^2 - 4ac &= (-1)^2 - 4(3)(2) \\ &= 1 - 24 \\ &= -23 \end{aligned}$$

2 distinct imaginary solutions

$$57. \begin{aligned} z^2 - 169 &= 0 \\ z^2 &= 169 \\ z &= \pm 13 \end{aligned}$$

$$59. \begin{aligned} 5y^2 + 15y &= 0 \\ 5y(y + 3) &= 0 \\ 5y = 0 & \quad y + 3 = 0 \\ y = 0 & \quad y = -3 \end{aligned}$$

$$61. \begin{aligned} 25(x - 3)^2 - 36 &= 0 \\ (x - 3)^2 &= \frac{36}{25} \\ x - 3 &= \pm \sqrt{\frac{36}{25}} \\ x &= 3 \pm \frac{6}{5} \\ x &= \frac{15}{5} \pm \frac{6}{5} \\ x &= \frac{21}{5}, \frac{9}{5} \end{aligned}$$

$$63. \begin{aligned} 2y(y - 18) + 3(y - 18) &= 0 \\ (y - 18)(2y + 3) &= 0 \\ y - 18 = 0 & \quad 2y + 3 = 0 \\ y = 18 & \quad 2y = -3 \\ & \quad y = -\frac{3}{2} \end{aligned}$$

$$65. \begin{aligned} x^2 + 8x + 25 &= 0 \\ x^2 + 8x + 16 &= -25 + 16 \\ (x + 4)^2 &= -9 \\ x + 4 &= \pm \sqrt{-9} \\ x &= -4 \pm 3i \end{aligned}$$

67. $x^2 - 24x + 128 = 0$

$$x^2 - 24x + 144 = -128 + 144$$

$$(x - 12)^2 = 16$$

$$x - 12 = \pm \sqrt{16}$$

$$x = 12 \pm 4$$

$$x = 16, 8$$

71. $x = \frac{-15 \pm \sqrt{15^2 - 4(18)(-50)}}{2(18)}$

$$x = \frac{-15 \pm \sqrt{225 + 3600}}{36}$$

$$x = \frac{-15 \pm \sqrt{3825}}{36}$$

$$x = \frac{-15 \pm 15\sqrt{17}}{36}$$

$$x = \frac{-5 \pm 5\sqrt{17}}{12}$$

75. Keystrokes:

 $\boxed{Y=}$ 3 $\boxed{X,T,\theta}$ $\boxed{x^2}$ $\boxed{-}$ 6 $\boxed{X,T,\theta}$ $\boxed{+}$ 1 $\boxed{\text{GRAPH}}$

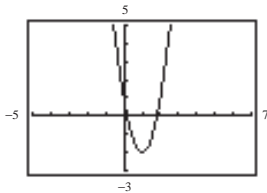
$$0 = 3x^2 - 6x + 1$$

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(3)(1)}}{2(3)}$$

$$x = \frac{6 \pm \sqrt{36 - 12}}{6}$$

$$x = \frac{6 \pm \sqrt{24}}{6}$$

$$x \approx 1.82, 0.18$$



69. $x = \frac{-(-13) \pm \sqrt{(-13)^2 - 4(3)(169)}}{2(3)}$

$$x = \frac{13 \pm \sqrt{169 - 2028}}{6}$$

$$x = \frac{13 \pm \sqrt{-1859}}{6}$$

$$x = \frac{13}{6} \pm \frac{13\sqrt{11}i}{6}$$

73. $1.2x^2 - 0.8x - 5.5 = 0$

$$12x^2 - 8x - 55 = 0$$

$$(6x + 11)(2x - 5) = 0$$

$$6x + 11 = 0 \quad 2x - 5 = 0$$

$$6x = -11 \quad 2x = 5$$

$$x = -\frac{11}{6} \quad x = \frac{5}{2}$$

77. Keystrokes:

 $\boxed{Y=}$ $\boxed{-}$ 4 $\boxed{X,T,\theta}$ $\boxed{x^2}$ $\boxed{-}$ 20 $\boxed{X,T,\theta}$ $\boxed{+}$ 25 $\boxed{\text{GRAPH}}$

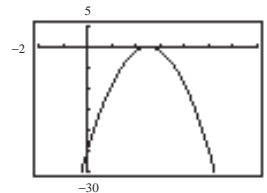
$$0 = -(4x^2 - 20x + 25)$$

$$= 4x^2 - 20x + 25$$

$$x = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(4)(25)}}{2(4)}$$

$$x = \frac{20 \pm \sqrt{400 - 400}}{8}$$

$$x = \frac{20}{8} = \frac{5}{2} = 2.50$$



79. Keystrokes:

$$[Y=] 5 [X,T,\theta] [x^2] [-] 18 [X,T,\theta] [+] 6 [GRAPH]$$

$$x = \frac{-(-18) \pm \sqrt{(-18)^2 - 4(5)(6)}}{2(5)}$$

$$x = \frac{18 \pm \sqrt{324 - 120}}{10}$$

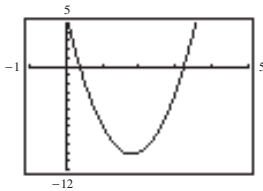
$$x = \frac{18 \pm \sqrt{204}}{10}$$

$$x = \frac{18 \pm 2\sqrt{51}}{10}$$

$$x = \frac{2(9 \pm \sqrt{51})}{10}$$

$$x = \frac{9 \pm \sqrt{51}}{5}$$

$$x \approx 3.23, 0.37$$



83. Keystrokes:

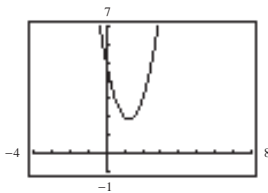
$$[Y=] 2 [X,T,\theta] [x^2] [-] 5 [X,T,\theta] [+] 5 [GRAPH]$$

$$b^2 - 4ac = (-5)^2 - 4(2)(5)$$

$$= 25 - 40$$

$$= -15$$

No real solutions



81. Keystrokes:

$$[Y=] [(-)] .04 [X,T,\theta] [x^2] [+] 4 [X,T,\theta] [-] .8 [GRAPH]$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4(-0.04)(-0.8)}}{2(-0.04)}$$

$$x = \frac{-4 \pm \sqrt{16 - 0.128}}{-0.08}$$

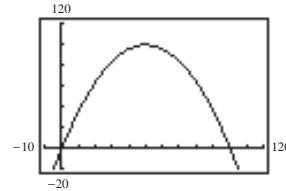
$$x = \frac{-4 \pm \sqrt{15.872}}{-0.08}$$

$$x = \frac{-4 \pm 16\sqrt{0.062}}{-0.08}$$

$$x = \frac{4(-1 \pm 4\sqrt{0.062})}{-0.08}$$

$$x = \frac{-1 \pm 4\sqrt{0.062}}{-0.02}$$

$$x \approx 0.20, 99.80$$



85. Keystrokes:

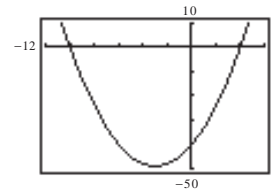
$$[Y=] [X,T,\theta] [x^2] [+] 6 [X,T,\theta] [-] 40 [GRAPH]$$

$$b^2 - 4ac = 6^2 - 4(1)(-40)$$

$$= 36 + 160$$

$$= 196$$

Two real solutions



$$87. \quad \frac{2x^2}{5} - \frac{x}{2} = 1$$

$$10\left(\frac{2x^2}{5} - \frac{x}{2}\right) = (1)10$$

$$4x^2 - 5x = 10$$

$$4x^2 - 5x - 10 = 0$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(4)(-10)}}{2(4)}$$

$$x = \frac{5 \pm \sqrt{25 + 160}}{8}$$

$$x = \frac{5 \pm \sqrt{185}}{8}$$

$$89. \quad \sqrt{x+3} = x-1$$

$$(\sqrt{x+3})^2 = (x-1)^2$$

$$x+3 = x^2 - 2x + 1$$

$$0 = x^2 - 3x - 2$$

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

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

$$x = \frac{3 \pm \sqrt{17}}{2}$$

$$x = \frac{3 + \sqrt{17}}{2}$$

$$x = \frac{3 - \sqrt{17}}{2} \text{ does not check.}$$

$$91. \text{ (a) } b^2 - 4ac > 0$$

$$(-6)^2 - 4(1)c > 0$$

$$36 - 4c > 0$$

$$-4c > -36$$

$$c < 9$$

$$\text{(b) } b^2 - 4ac = 0$$

$$(-6)^2 - 4(1)c = 0$$

$$36 - 4c = 0$$

$$-4c = -36$$

$$c = 9$$

$$\text{(c) } b^2 - 4ac < 0$$

$$(-6)^2 - 4(1)c < 0$$

$$36 - 4c < 0$$

$$-4c < -36$$

$$c > 9$$

$$93. \text{ (a) } b^2 - 4ac > 0$$

$$8^2 - 4(1)c > 0$$

$$64 - 4c > 0$$

$$-4c > -64$$

$$c < 16$$

$$\text{(b) } b^2 - 4ac = 0$$

$$8^2 - 4(1)c = 0$$

$$64 - 4c = 0$$

$$-4c = -64$$

$$c = 16$$

$$\text{(c) } b^2 - 4ac < 0$$

$$8^2 - 4(1)c < 0$$

$$64 - 4c < 0$$

$$-4c < -64$$

$$c > 16$$

$$95. \text{ Verbal model: } \boxed{\text{Area}} = \boxed{\text{Length}} \cdot \boxed{\text{Width}}$$

$$\text{Labels: } \text{Length} = x + 6.3$$

$$\text{Width} = x$$

$$\text{Equation: } 58.14 = (x + 6.3) \cdot x$$

$$58.14 = x^2 + 6.3x$$

$$0 = x^2 + 6.3x - 58.14$$

$$x = \frac{-6.3 \pm \sqrt{6.3^2 - 4(1)(-58.14)}}{2(1)}$$

$$x = \frac{-6.3 \pm \sqrt{39.69 + 232.56}}{2}$$

$$x = \frac{-6.3 \pm \sqrt{272.25}}{2}$$

$$x \approx 5.1 \text{ inches}$$

$$x + 6.3 \approx 11.4 \text{ inches}$$

97. (a) $50 = -16t^2 + 40t + 50$

$$0 = -16t^2 + 40t$$

$$0 = -8(2t^2 - 5t)$$

$$0 = 2t^2 - 5t$$

$$0 = t(2t - 5)$$

$$0 = t \quad 2t - 5 = 0$$

$$t = \frac{5}{2} = 2.5 \text{ seconds}$$

(b) $0 = -16t^2 + 40t + 50$

$$0 = -2(8t^2 - 20t - 25)$$

$$t = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(8)(-25)}}{2(8)}$$

$$t = \frac{20 \pm \sqrt{400 + 800}}{16}$$

$$t = \frac{20 \pm \sqrt{1200}}{16}$$

$$t = \frac{20 \pm 20\sqrt{3}}{16}$$

$$t = \frac{4(5 \pm 5\sqrt{3})}{16}$$

$$t = \frac{5 + 5\sqrt{3}}{4}, \frac{5 - 5\sqrt{3}}{4} \text{ reject}$$

$$t \approx 3.4 \text{ seconds}$$

 99. (a) *Keystrokes:*

$$\boxed{Y=}$$
 831.3 $\boxed{-}$ 85.71 $\boxed{X,T,\theta}$ $\boxed{+}$ 3.452 $\boxed{X,T,\theta}$ $\boxed{x^2}$ $\boxed{\text{GRAPH}}$

(b) $750 = 831.3 - 85.71t + 3.452t^2$

$$0 = 3.452t^2 - 85.71t + 81.3$$

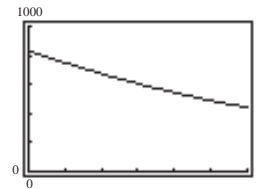
$$t = \frac{-(-85.71) \pm \sqrt{(-85.71)^2 - 4(3.452)(81.3)}}{2(3.452)}$$

$$t = \frac{85.71 \pm \sqrt{6223.6137}}{6.904} = \frac{85.71 \pm 78.89}{6.904}$$

$$t \approx .9879 \text{ year } 1991$$

(c) $y = 831.3 - 85.71(7) + 3.452(7)^2$

$$y = 400,500$$



101. (a) $x^2 - x - 6 = 0$

$$(x - 3)(x + 2) = 0$$

$$x = 3 \quad x = -2$$

(b) $2x^2 + 5x - 3 = 0$

$$(2x - 1)(x + 3) = 0$$

$$x = \frac{1}{2} \quad x = -3$$

(c) $4x^2 - 9 = 0$

$$(2x - 3)(2x + 3)$$

$$x = \frac{3}{2} \quad x = -\frac{3}{2}$$

(d) $x^2 - 10x + 34 = 0$

$$x^2 - 10x + 25 = -34 + 25$$

$$(x - 5)^2 = -9$$

$$x - 5 = \pm\sqrt{-9}$$

$$x = 5 \pm 3i$$

x_1, x_2	$x_1 + x_2$	$x_1 \cdot x_2$
3, -2	1	-6
$\frac{1}{2}, -3$	$-\frac{5}{2}$	$-\frac{3}{2}$
$\frac{3}{2}, -\frac{3}{2}$	0	$-\frac{9}{4}$
$5 + 3i, 5 - 3i$	10	34

103. (c) $h = -16t^2 + v_0t + h_0$ $v_0 = 32$ feet/sec
 $50 = -16t^2 + 32t + 100$ $h = 50$ feet
 $0 = -16t^2 + 32t + 50$
 $0 = 8t^2 - 16t - 25$ (Divide by -2)
 $t = \frac{-(-16) \pm \sqrt{(-16)^2 - 4(8)(-25)}}{2(8)}$
 $t = \frac{16 \pm \sqrt{256 + 800}}{16}$
 $t = \frac{16 \pm \sqrt{1056}}{16} = \frac{16 \pm 4\sqrt{66}}{16} = \frac{4 \pm \sqrt{66}}{4} \approx 3.0$ seconds

Quadratic formula method was used because the numbers were large and equation would not factor.

(d) $0 = -16t^2 + 32t + 100$ $0 = -16t^2 + 32t + 84$
 $0 = 4t^2 - 8t - 25$ $0 = 4t^2 - 8t - 21$
 $t = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(4)(-25)}}{2(4)}$ $t = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(4)(-21)}}{2(4)}$
 $t = \frac{8 \pm \sqrt{64 + 400}}{8}$ $t = \frac{8 \pm \sqrt{64 + 336}}{8}$
 $t = \frac{8 \pm \sqrt{464}}{8}$ $t = \frac{8 \pm \sqrt{400}}{8}$
 $t \approx 3.7$ seconds $t \approx 3.5$ seconds

105. $b^2 - 4ac$. If the discriminant is positive, the quadratic equation has two real solutions; if it is zero, the equation has one (repeated) real solution; and if it is negative, the equation has no real solutions.

107. The four methods are factoring, extracting square roots, completing the square, and the Quadratic Formula.

Mid-Chapter Quiz for Chapter 6

1. $2x^2 - 72 = 0$

$$2(x^2 - 36) = 0$$

$$2(x - 6)(x + 6) = 0$$

$$x - 6 = 0 \quad x + 6 = 0$$

$$x = 6 \quad x = -6$$

2. $2x^2 + 3x - 20 = 0$

$$(2x - 5)(x + 4) = 0$$

$$2x - 5 = 0 \quad x + 4 = 0$$

$$x = \frac{5}{2} \quad x = -4$$

3. $t^2 = 12$

$$t = \pm\sqrt{12}$$

$$t = \pm 2\sqrt{3}$$

4. $(u - 3)^2 - 16 = 0$

$$(u - 3)^2 = 16$$

$$u - 3 = \pm 4$$

$$u = 3 \pm 4 = 7, -1$$

5. $s^2 + 10s + 1 = 0$

$$s^2 + 10s = -1$$

$$s^2 + 10s + 25 = -1 + 25$$

$$(s + 5)^2 = 24$$

$$s + 5 = \pm\sqrt{24}$$

$$s = -5 \pm 2\sqrt{6}$$

6. $2y^2 + 6y - 5 = 0$

$$y^2 + 3y = \frac{5}{2}$$

$$y^2 + 3y + \frac{9}{4} = \frac{5}{2} + \frac{9}{4}$$

$$\left(y + \frac{3}{2}\right)^2 = \frac{10}{4} + \frac{9}{4}$$

$$\left(y + \frac{3}{2}\right)^2 = \frac{19}{4}$$

$$y + \frac{3}{2} = \pm\frac{\sqrt{19}}{2}$$

$$y = -\frac{3}{2} \pm \frac{\sqrt{19}}{2}$$