

$$15. \frac{\sqrt{7}}{1 + \sqrt{3}} \cdot \frac{1 - \sqrt{3}}{1 - \sqrt{3}} = \frac{\sqrt{7}(1 - \sqrt{3})}{1 - (\sqrt{3})^2} = \frac{\sqrt{7}(1 - \sqrt{3})}{1 - 3} = \frac{\sqrt{7}(1 - \sqrt{3})}{-2}$$

$$= \frac{\sqrt{7} - \sqrt{21}}{-2} = \frac{\sqrt{21} - \sqrt{7}}{2}$$

$$16. \frac{6\sqrt{2}}{2\sqrt{2} - 4} \cdot \frac{2\sqrt{2} + 4}{2\sqrt{2} + 4} = \frac{6\sqrt{2}(2\sqrt{2} + 4)}{(2\sqrt{2})^2 - 4^2} = \frac{12(\sqrt{2})^2 + 24\sqrt{2}}{8 - 16}$$

$$= \frac{24 + 24\sqrt{2}}{-8} = \frac{24(1 + \sqrt{2})}{-8} = -3(1 + \sqrt{2})$$

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

$$17. 4 \div (\sqrt{6} + 3) = \frac{4}{\sqrt{6} + 3} \cdot \frac{\sqrt{6} - 3}{\sqrt{6} - 3} = \frac{4(\sqrt{6} - 3)}{(\sqrt{6})^2 - 3^2} = \frac{4(\sqrt{6} - 3)}{6 - 9}$$

$$= \frac{4(\sqrt{6} - 3)}{-3}$$

$$= \frac{4}{3}(3 - \sqrt{6})$$

$$18. (4\sqrt{2} - 2\sqrt{3}) \div (\sqrt{2} + \sqrt{6}) = \frac{4\sqrt{2} - 2\sqrt{3}}{\sqrt{2} + \sqrt{6}} \cdot \frac{\sqrt{2} - \sqrt{6}}{\sqrt{2} - \sqrt{6}} = \frac{4\sqrt{2} \cdot \sqrt{2} - 4\sqrt{2} \cdot \sqrt{6} - 2\sqrt{3} \cdot \sqrt{2} + 2\sqrt{3} \cdot \sqrt{6}}{(\sqrt{2})^2 - (\sqrt{6})^2}$$

$$= \frac{4(2) - 4\sqrt{12} - 2\sqrt{6} + 2\sqrt{18}}{2 - 6} = \frac{8 - 4\sqrt{4 \cdot 3} - 2\sqrt{6} + 2\sqrt{9 \cdot 2}}{-4} = \frac{8 - 8\sqrt{3} - 2\sqrt{6} + 6\sqrt{2}}{-4}$$

$$= \frac{2(4 - 4\sqrt{3} - \sqrt{6} + 3\sqrt{2})}{-4} = \frac{4 - 4\sqrt{3} - \sqrt{6} + 3\sqrt{2}}{-2} = \frac{1}{2}(4\sqrt{3} + \sqrt{6} - 3\sqrt{2} - 4)$$

19.  $1 + \sqrt{4}$ , conjugate =  $1 - \sqrt{4}$

$$\text{product} = (1 + \sqrt{4})(1 - \sqrt{4})$$

$$= 1^2 - (\sqrt{4})^2$$

$$= 1 - 4$$

$$= -3$$

20.  $\sqrt{10} - 5$ , conjugate =  $\sqrt{10} + 5$

$$\text{product} = (\sqrt{10} - 5)(\sqrt{10} + 5)$$

$$= (\sqrt{10})^2 - 5^2$$

$$= 10 - 25$$

$$= -15$$

21.  $\sqrt{5^2 + 12^2} = \sqrt{25 + 144}$

$$= \sqrt{169}$$

$$= 13$$

$$13 \neq 17$$

$$\sqrt{5^2 + 12^2} \neq 17$$

22.  $C = \sqrt{2^2 + 2^2}$

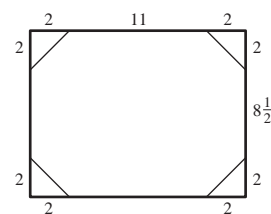
$$= \sqrt{4 + 4} = \sqrt{8}$$

Equation:

$$P = 2(7) + 2(4\frac{1}{2}) + 4(\sqrt{8})$$

$$= 14 + 9 + 8\sqrt{2}$$

$$= 23 + 8\sqrt{2} \text{ inches}$$



## Section 5.4 Solving Radical Equations

- |                     |                                |                |                  |                            |                |
|---------------------|--------------------------------|----------------|------------------|----------------------------|----------------|
| 1. (a) $x = -4$     | $\sqrt{-4} - 10 \neq 0$        | Not a solution | 3. (a) $x = -60$ | $\sqrt[3]{-60 - 4} \neq 4$ | Not a solution |
| (b) $x = -100$      | $\sqrt{-100} - 10 \neq 0$      | Not a solution | (b) $x = 68$     | $\sqrt[3]{68 - 4} = 4$     | A solution     |
| (c) $x = \sqrt{10}$ | $\sqrt{\sqrt{10}} - 10 \neq 0$ | Not a solution | (c) $x = 20$     | $\sqrt[3]{20 - 4} \neq 4$  | Not a solution |
| (d) $x = 100$       | $\sqrt{100} - 10 = 0$          | A solution     | (d) $x = 0$      | $\sqrt[3]{0 - 4} \neq 4$   | Not a solution |

5.  $\sqrt{x} = 20$       **Check:**  $\sqrt{400} \stackrel{?}{=} 20$   
 $(\sqrt{x})^2 = 20^2$        $20 = 20$   
 $x = 400$
7.  $\sqrt{x} = 3$       **Check:**  $\sqrt{9} \stackrel{?}{=} 3$   
 $(\sqrt{x})^2 = 3^2$        $3 = 3$   
 $x = 9$
9.  $\sqrt[3]{z} = 3$       **Check:**  $\sqrt[3]{27} \stackrel{?}{=} 3$   
 $(\sqrt[3]{z})^3 = 3^3$        $3 = 3$   
 $z = 27$
11.  $\sqrt{y} - 7 = 0$       **Check:**  $\sqrt{49} - 7 \stackrel{?}{=} 0$   
 $\sqrt{y} = 7$        $7 - 7 \stackrel{?}{=} 0$   
 $(\sqrt{y})^2 = 7^2$        $0 = 0$   
 $y = 49$
13.  $\sqrt{u} + 13 = 0$       **Check:**  $\sqrt{169} + 13 \stackrel{?}{=} 0$   
 $\sqrt{u} = -13$        $13 + 13 \neq 0$   
 $(\sqrt{u})^2 = (-13)^2$       No solution  
 $u = 169$
15.  $\sqrt{x} - 8 = 0$       **Check:**  $\sqrt{64} - 8 \stackrel{?}{=} 0$   
 $\sqrt{x} = 8$        $8 - 8 \stackrel{?}{=} 0$   
 $(\sqrt{x})^2 = 8^2$        $0 = 0$   
 $x = 64$
17.  $\sqrt{10x} = 30$       **Check:**  $\sqrt{10 \cdot 90} \stackrel{?}{=} 30$   
 $(\sqrt{10x})^2 = 30^2$        $\sqrt{900} \stackrel{?}{=} 30$   
 $10x = 900$        $30 = 30$   
 $x = 90$
19.  $\sqrt{-3x} = 9$       **Check:**  $\sqrt{-3(-27)} \stackrel{?}{=} 9$   
 $(\sqrt{-3x})^2 = 9^2$        $\sqrt{81} \stackrel{?}{=} 9$   
 $-3x = 81$        $9 = 9$   
 $x = -27$
21.  $\sqrt{5t} - 2 = 0$       **Check:**  $\sqrt{5(\frac{4}{5})} - 2 \stackrel{?}{=} 0$   
 $\sqrt{5t} = 2$        $\sqrt{4} - 2 \stackrel{?}{=} 0$   
 $(\sqrt{5t})^2 = 2^2$        $2 - 2 \stackrel{?}{=} 0$   
 $5t = 4$        $0 = 0$   
 $t = \frac{4}{5}$
23.  $\sqrt{3y + 1} = 4$       **Check:**  $\sqrt{3(5) + 1} \stackrel{?}{=} 4$   
 $(\sqrt{3y + 1})^2 = 4^2$        $\sqrt{16} \stackrel{?}{=} 4$   
 $3y + 1 = 16$        $4 = 4$   
 $3y = 15$   
 $y = 5$
25.  $\sqrt{4 - 5x} = -3$       **Check:**  $\sqrt{4 - 5(-1)} \stackrel{?}{=} -3$   
 $(\sqrt{4 - 5x})^2 = (-3)^2$        $\sqrt{9} \stackrel{?}{=} -3$   
 $4 - 5x = 9$        $3 \neq -3$   
 $-5x = 5$       No solution  
 $x = -1$
27.  $\sqrt{3y + 5} - 3 = 4$       **Check:**  $\sqrt{3(\frac{44}{3}) + 5} - 3 \stackrel{?}{=} 4$   
 $\sqrt{3y + 5} = 7$        $\sqrt{49} - 3 \stackrel{?}{=} 4$   
 $(\sqrt{3y + 5})^2 = 7^2$        $7 - 3 \stackrel{?}{=} 4$   
 $3y + 5 = 49$        $4 = 4$   
 $3y = 44$   
 $y = \frac{44}{3}$
29.  $5\sqrt{x + 2} = 8$       **Check:**  $5\sqrt{\frac{14}{25} + 2} \stackrel{?}{=} 8$   
 $(5\sqrt{x + 2})^2 = 8^2$        $5\sqrt{\frac{64}{25}} \stackrel{?}{=} 8$   
 $25(x + 2) = 64$        $5 \cdot \frac{8}{5} \stackrel{?}{=} 8$   
 $25x + 50 = 64$        $8 = 8$   
 $25x = 14$   
 $x = \frac{14}{25}$
31.  $\sqrt{3x + 2} + 5 = 0$       **Check:**  $\sqrt{3(\frac{23}{3}) + 2} + 5 \stackrel{?}{=} 0$   
 $\sqrt{3x + 2} = -5$        $\sqrt{23 + 2} + 5 \stackrel{?}{=} 0$   
 $(\sqrt{3x + 2})^2 = (-5)^2$        $\sqrt{25} + 5 \stackrel{?}{=} 0$   
 $3x + 2 = 25$        $5 + 5 \stackrel{?}{=} 0$   
 $3x = 23$        $10 \neq 0$   
 $x = \frac{23}{3}$       No solution

$$\begin{aligned}
 33. \quad \sqrt{x+3} &= \sqrt{2x-1} \\
 (\sqrt{x+3})^2 &= (\sqrt{2x-1})^2 \\
 x+3 &= 2x-1 \\
 4 &= x
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt{4+3} &\stackrel{?}{=} \sqrt{2(4)-1} \\
 \sqrt{7} &= \sqrt{7}
 \end{aligned}$$

$$\begin{aligned}
 35. \quad \sqrt{3y-5} - 3\sqrt{y} &= 0 \\
 \sqrt{3y-5} &= 3\sqrt{y} \\
 (\sqrt{3y-5})^2 &= (3\sqrt{y})^2 \\
 3y-5 &= 9y \\
 -5 &= 6y \\
 -\frac{5}{6} &= y
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt{3(-\frac{5}{6})-5} - 3\sqrt{-\frac{5}{6}} &\stackrel{?}{=} 0 \\
 \text{No solution}
 \end{aligned}$$

$$\begin{aligned}
 37. \quad \sqrt[3]{3x-4} &= \sqrt[3]{x+10} \\
 (\sqrt[3]{3x-4})^3 &= (\sqrt[3]{x+10})^3 \\
 3x-4 &= x+10 \\
 2x &= 14 \\
 x &= 7
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt[3]{3(7)-4} &\stackrel{?}{=} \sqrt[3]{7+10} \\
 \sqrt[3]{17} &= \sqrt[3]{17}
 \end{aligned}$$

$$\begin{aligned}
 39. \quad \sqrt[3]{2x+15} - \sqrt[3]{x} &= 0 \\
 \sqrt[3]{2x+15} &= \sqrt[3]{x} \\
 (\sqrt[3]{2x+15})^3 &= (\sqrt[3]{x})^3 \\
 2x+15 &= x \\
 x &= -15
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt[3]{2(-15)+15} - \sqrt[3]{-15} &\stackrel{?}{=} 0 \\
 \sqrt[3]{-15} - \sqrt[3]{-15} &\stackrel{?}{=} 0 \\
 0 &= 0
 \end{aligned}$$

$$\begin{aligned}
 41. \quad \sqrt{x^2+5} &= x+3 \\
 (\sqrt{x^2+5})^2 &= (x+3)^2 \\
 x^2+5 &= x^2+6x+9 \\
 -4 &= 6x \\
 -\frac{4}{6} &= x \\
 -\frac{2}{3} &= x
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt{(-\frac{2}{3})^2+5} &\stackrel{?}{=} -\frac{2}{3}+3 \\
 \sqrt{\frac{4}{9}+\frac{45}{9}} &\stackrel{?}{=} -\frac{2}{3}+\frac{9}{3} \\
 \sqrt{\frac{49}{9}} &\stackrel{?}{=} \frac{7}{3} \\
 \frac{7}{3} &= \frac{7}{3}
 \end{aligned}$$

$$\begin{aligned}
 43. \quad \sqrt{2x} &= x-4 \\
 (\sqrt{2x})^2 &= (x-4)^2 \\
 2x &= x^2-8x+16 \\
 0 &= x^2-10x+16 \\
 0 &= (x-8)(x-2) \\
 8 = x, x = 2
 \end{aligned}$$

$$\begin{aligned}
 \text{Check: } \sqrt{2(8)} &\stackrel{?}{=} 8-4 \\
 \sqrt{16} &\stackrel{?}{=} 4 \\
 4 &= 4 \\
 \sqrt{2(2)} &\stackrel{?}{=} 2-4 \\
 \sqrt{4} &\stackrel{?}{=} -2 \\
 2 &\neq -2
 \end{aligned}$$

Not a solution

45.  $\sqrt{8x+1} = x+2$

$$(\sqrt{8x+1})^2 = (x+2)^2$$

$$8x+1 = x^2+4x+4$$

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

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

$$3 = x, \quad x = 1$$

**Check:**  $\sqrt{8(3)+1} \stackrel{?}{=} 3+2$

$$\sqrt{25} \stackrel{?}{=} 5$$

$$5 = 5$$

$$\sqrt{8(1)+1} \stackrel{?}{=} 1+2$$

$$\sqrt{9} \stackrel{?}{=} 3$$

$$3 = 3$$

47.  $\sqrt{z+2} = 1 + \sqrt{z}$

$$(\sqrt{z+2})^2 = (1 + \sqrt{z})^2$$

$$z+2 = 1 + 2\sqrt{z} + z$$

$$1 = 2\sqrt{z}$$

$$1^2 = (2\sqrt{z})^2$$

$$1 = 4z$$

$$\frac{1}{4} = z$$

**Check:**  $\sqrt{\frac{1}{4}+2} \stackrel{?}{=} 1 + \sqrt{\frac{1}{4}}$

$$\sqrt{\frac{9}{4}} \stackrel{?}{=} 1 + \frac{1}{2}$$

$$\frac{3}{2} = \frac{3}{2}$$

49.  $\sqrt{2t+3} = 3 - \sqrt{2t}$

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

$$2t+3 = 9 - 6\sqrt{2t} + 2t$$

$$-6 = -6\sqrt{2t}$$

$$1 = \sqrt{2t}$$

$$1^2 = (\sqrt{2t})^2$$

$$1 = 2t$$

$$\frac{1}{2} = t$$

**Check:**  $\sqrt{2(\frac{1}{2})+3} \stackrel{?}{=} 3 - \sqrt{2(\frac{1}{2})}$

$$\sqrt{1+3} \stackrel{?}{=} 3 - \sqrt{1}$$

$$\sqrt{4} \stackrel{?}{=} 3 - 1$$

$$2 = 2$$

51.  $\sqrt{x+5} - \sqrt{x} = 1$

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

$$(\sqrt{x+5})^2 = (1 + \sqrt{x})^2$$

$$x+5 = 1 + 2\sqrt{x} + x$$

$$4 = 2\sqrt{x}$$

$$2 = \sqrt{x}$$

$$2^2 = (\sqrt{x})^2$$

$$4 = x$$

**Check:**  $\sqrt{4+5} - \sqrt{4} \stackrel{?}{=} 1$

$$\sqrt{9} - \sqrt{4} \stackrel{?}{=} 1$$

$$3 - 2 \stackrel{?}{=} 1$$

$$1 = 1$$

53.  $t^{3/2} = 8$

$$\sqrt{t^3} = 8$$

$$(\sqrt{t^3})^2 = 8^2$$

$$t^3 = 64$$

$$t = 4$$

**Check:**  $4^{3/2} \stackrel{?}{=} 8$

$$(\sqrt{4})^3 \stackrel{?}{=} 8$$

$$2^3 \stackrel{?}{=} 8$$

$$8 = 8$$

55.  $3y^{1/3} = 18$

$y^{1/3} = 6$

$\sqrt[3]{y} = 6$

$(\sqrt[3]{y})^3 = 6^3$

$y = 216$

**Check:**  $3(216)^{1/3} \stackrel{?}{=} 18$

$3\sqrt[3]{216} \stackrel{?}{=} 18$

$3 \cdot 6 \stackrel{?}{=} 18$

$18 = 18$

57.  $(x + 4)^{2/3} = 4$

$\sqrt[3]{(x + 4)^2} = 4$

$(\sqrt[3]{(x + 4)^2})^3 = (4)^3$

$(x + 4)^2 = 64$

$x + 4 = \pm\sqrt{64}$

$x = -4 \pm 8$

$= 4, -12$

**Check:**  $(4 + 4)^{2/3} \stackrel{?}{=} 4$

$8^{2/3} \stackrel{?}{=} 4$

$2^2 = 4$

$(-12 + 4)^{2/3} \stackrel{?}{=} 4$

$(-8)^{2/3} \stackrel{?}{=} 4$

$(-2)^2 = 4$

59.  $(2x + 5)^{1/3} + 3 = 0$

$\sqrt[3]{2x + 5} = -3$

$(\sqrt[3]{2x + 5})^3 = (-3)^3$

$2x + 5 = -27$

$2x = -32$

$x = -16$

**Check:**  $(2(-16) + 5)^{1/3} + 3 \stackrel{?}{=} 0$

$(-32 + 5)^{1/3} + 3 \stackrel{?}{=} 0$

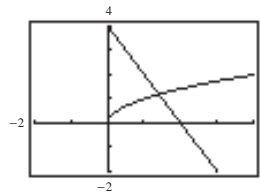
$(-27)^{1/3} + 3 \stackrel{?}{=} 0$

$-3 + 3 \stackrel{?}{=} 0$

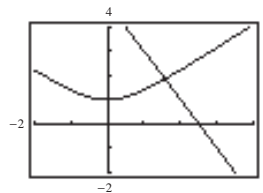
$0 = 0$

61. *Keystrokes:* $y_1$   $\boxed{Y=}$   $\boxed{\sqrt{\quad}}$   $\boxed{(}$   $\boxed{X,T,\theta}$   $\boxed{)}$   $\boxed{ENTER}$  $y_2$   $\boxed{2}$   $\boxed{(}$   $\boxed{2}$   $\boxed{-}$   $\boxed{X,T,\theta}$   $\boxed{)}$   $\boxed{GRAPH}$ Approximate solution:  $x \approx 1.407$ Check algebraically:  $\sqrt{1.407} \stackrel{?}{=} 2(2 - 1.407)$ 

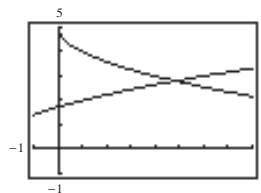
$1.186 = 1.186$

63. *Keystrokes:* $y_1$   $\boxed{Y=}$   $\boxed{\sqrt{\quad}}$   $\boxed{(}$   $\boxed{X,T,\theta}$   $\boxed{+}$   $\boxed{x^2}$   $\boxed{+}$   $\boxed{1}$   $\boxed{)}$   $\boxed{ENTER}$  $y_2$   $\boxed{5}$   $\boxed{-}$   $\boxed{2}$   $\boxed{X,T,\theta}$   $\boxed{GRAPH}$ Approximate solution:  $x \approx 1.569$ Check algebraically:  $\sqrt{1.569^2 + 1} \stackrel{?}{=} 5 - 2(1.569)$ 

$1.86 = 1.86$

65. *Keystrokes:* $y_1$   $\boxed{Y=}$   $\boxed{\sqrt{\quad}}$   $\boxed{(}$   $\boxed{X,T,\theta}$   $\boxed{+}$   $\boxed{3}$   $\boxed{)}$   $\boxed{ENTER}$  $y_2$   $\boxed{5}$   $\boxed{-}$   $\boxed{\sqrt{\quad}}$   $\boxed{X,T,\theta}$   $\boxed{GRAPH}$ Approximate solution:  $x \approx 4.840$ Check algebraically:  $\sqrt{4.840 + 3} \stackrel{?}{=} 5 - \sqrt{4.840}$ 

$2.8 = 2.8$



67. Keystrokes:

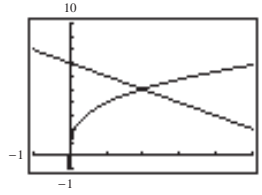
$$y_1 \text{ [Y=] } 4 \text{ [MATH] } 4 \text{ [X,T,}\theta \text{] [ENTER]}$$

$$y_2 \text{ [7] [X,T,}\theta \text{] [GRAPH]}$$

Approximate solution:  $x \approx 1.978$

$$\text{Check algebraically: } 4\sqrt[3]{1.978} \stackrel{?}{=} 7 - 1.978$$

$$5.02 = 5.02$$



69. Keystrokes:

$$y_1 \text{ [Y=] [✓] [15] [X,T,}\theta \text{] [ENTER]}$$

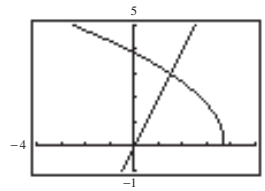
$$y_2 \text{ [2] [X,T,}\theta \text{] [GRAPH]}$$

Solution:  $x = 1.5$

$$\text{Check algebraically: } \sqrt{15 - 4(1.5)} \stackrel{?}{=} 2(1.5)$$

$$\sqrt{9} \stackrel{?}{=} 3$$

$$3 = 3$$



71. (c) graph is shifted down 1 unit

73. (d) graph is shifted left 3 units and upward 1 unit

75. (f) graph is shifted down 1 unit

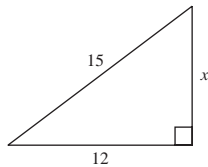
77.  $15^2 = x^2 + 12^2$

$$225 = x^2 + 144$$

$$81 = x^2$$

$$\sqrt{81} = x$$

$$9 = x$$



79.  $c^2 = a^2 + b^2$

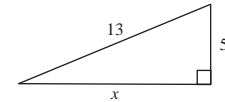
$$13^2 = x^2 + 5^2$$

$$169 = x^2 + 25$$

$$144 = x^2$$

$$\sqrt{144} = x$$

$$12 = x$$

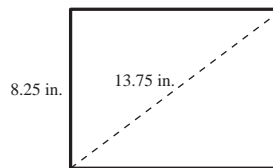


81.  $13.75^2 = 8.25^2 + x^2$

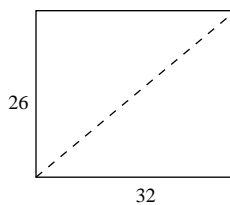
$$x^2 = 13.75^2 - 8.25^2$$

$$x = \sqrt{121}$$

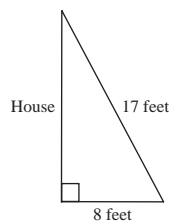
$$x = 11 \text{ inches}$$



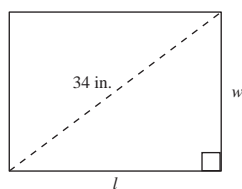
$$\begin{aligned}
 83. \quad c &= \sqrt{32^2 + 26^2} \\
 &= \sqrt{1024 + 676} \\
 &= \sqrt{1700} \\
 &= 10\sqrt{17} \\
 &\approx 41.23 \text{ feet}
 \end{aligned}$$



$$\begin{aligned}
 85. \quad 17^2 &= x^2 + 8^2 \\
 x^2 &= 17^2 - 8^2 \\
 x &= \sqrt{289 - 64} \\
 x &= \sqrt{225} \\
 x &= 15 \text{ feet}
 \end{aligned}$$



$$\begin{aligned}
 87. \quad P &= 2l + 2w \\
 92 &= 2l + 2w \\
 46 &= l + w \\
 46 - w &= l
 \end{aligned}$$



$$\begin{aligned}
 34^2 &= w^2 + (46 - w)^2 \\
 1156 &= w^2 + 2116 - 92w + w^2 \\
 0 &= 2w^2 - 92w + 960 \\
 0 &= w^2 - 46w + 480 \\
 0 &= (w - 30)(w - 16) \\
 w &= 30 \quad w = 16 \\
 l &= 16 \quad l = 30 \\
 30 \text{ inches} &\times 16 \text{ inches}
 \end{aligned}$$

$$\begin{aligned}
 89. \quad S &= \pi r \sqrt{r^2 + h^2} \\
 \frac{S}{\pi r} &= \sqrt{r^2 + h^2} \\
 \left(\frac{S}{\pi r}\right)^2 &= (r^2 + h^2) \\
 \frac{S^2}{\pi^2 r^2} &= r^2 + h^2
 \end{aligned}$$

$$\begin{aligned}
 \frac{S^2}{\pi^2 r^2} - r^2 &= h^2 \\
 \frac{S^2 - \pi^2 r^4}{\pi^2 r^2} &= h^2 \\
 \sqrt{\frac{S^2 - \pi^2 r^4}{\pi^2 r^2}} &= h \\
 \frac{\sqrt{S^2 - \pi^2 r^4}}{\pi r} &= h
 \end{aligned}$$

$$\begin{aligned}
 93. \quad v &= \sqrt{2(32)50} \\
 v &= \sqrt{3200} \\
 v &= 40\sqrt{2} \\
 v &\approx 56.57 \text{ feet per second}
 \end{aligned}$$

$$\begin{aligned}
 91. \quad 2 &= \sqrt{\frac{d}{16}} \\
 2^2 &= \left(\sqrt{\frac{d}{16}}\right)^2 \\
 4 &= \frac{d}{16} \\
 64 \text{ feet} &= d
 \end{aligned}$$

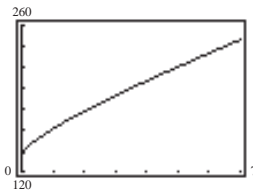
$$\begin{aligned}
 95. \quad 60 &= \sqrt{2(32)h} \\
 60^2 &= (\sqrt{64h})^2 \\
 3600 &= 64h \\
 \frac{3600}{64} &= h \\
 56.25 \text{ feet} &= h
 \end{aligned}$$

$$\begin{aligned}
 97. \quad 1.5 &= 2\pi\sqrt{\frac{L}{32}} \\
 \left(\frac{1.5}{2\pi}\right)^2 &= \left(\sqrt{\frac{L}{32}}\right)^2 \\
 \frac{2.25}{4\pi^2} &= \frac{L}{32} \\
 \frac{2.25}{4\pi^2}(32) &= L \\
 1.82 \text{ feet} &\approx L
 \end{aligned}$$

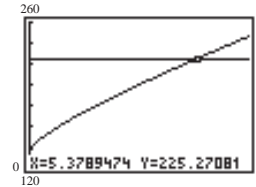
$$\begin{aligned}
 99. \quad 30.02 &= 50 - \sqrt{0.8(x-1)} \\
 \sqrt{0.8(x-1)} &= 19.98 \\
 (\sqrt{0.8(x-1)})^2 &= (19.98)^2 \\
 0.8(x-1) &= 399.2004 \\
 0.8x - 0.8 &= 399.2004 \\
 0.8x &= 400.0004 \\
 x &= 500.0005 \\
 &\approx 500 \text{ units}
 \end{aligned}$$

101. (a) Keystrokes:

$y_1$   $\boxed{Y=}$  133.5  $\boxed{+}$  9.3  $\boxed{X,T,\theta}$   $\boxed{+}$  18  $\boxed{\sqrt{\phantom{x}}}$   $\boxed{X,T,\theta}$   $\boxed{\text{GRAPH}}$



(b)



$\approx 5$  years from 1990  $\approx 1995$

$$\begin{aligned}
 103. \quad R &= \left(\frac{A}{P}\right)^{1/n} - 1 \\
 0.07 &= \left(\frac{25,000}{P}\right)^{1/10} - 1 \\
 1.07 &= \left(\frac{25,000}{P}\right)^{1/10} \\
 1.07 &= \sqrt[10]{\frac{25,000}{P}} \\
 1.07^{10} &= \left(\sqrt[10]{\frac{25,000}{P}}\right)^{10} \\
 1.07^{10} &= \frac{25,000}{P} \\
 P &= \frac{25,000}{1.07^{10}} \\
 P &\approx \$12,708.73
 \end{aligned}$$

105. No. It is not an operation that necessarily yields an equivalent equation. There may be extraneous solutions.

$$\begin{aligned}
 107. \quad (\sqrt{x} + \sqrt{6})^2 &\neq (\sqrt{x})^2 + (\sqrt{6})^2 \\
 (\sqrt{x} + \sqrt{6})^2 &\text{ must be multiplied by FOIL.}
 \end{aligned}$$

## Section 5.5 Complex Numbers

$$\begin{aligned}
 1. \quad \sqrt{-4} &= \sqrt{-1 \cdot 4} \\
 &= \sqrt{-1} \cdot \sqrt{4} \\
 &= 2i
 \end{aligned}$$

$$\begin{aligned}
 3. \quad -\sqrt{-144} &= -\sqrt{144 \cdot -1} \\
 &= -\sqrt{144} \cdot \sqrt{-1} \\
 &= -12i
 \end{aligned}$$

$$\begin{aligned}
 5. \quad \sqrt{\frac{-4}{25}} &= \sqrt{\frac{4}{25} \cdot -1} \\
 &= \sqrt{\frac{4}{25}} \cdot \sqrt{-1} \\
 &= \frac{2}{5}i
 \end{aligned}$$