95. (a) $y = 92.84t + 487.82$ (answers will vary)

(b) For 2000, $t = 12$ and $y = 1{,}601$ corresponding to \$1,601,000.

(c) The slope is the average increase per year.

97. False.

The equation of the line joining $(10, -3)$ and $(2, -9)$ is

$$y + 3 = \frac{-9 + 3}{2 - 10}(x - 10)$$

$$y + 3 = \frac{3}{4}(x - 10)$$

$$y = \frac{3}{4}x - \frac{21}{2}$$

For $x = -12$, $y = \frac{3}{4}(-12) - \frac{21}{2}$

$$= -19.5$$

$$\neq \frac{-37}{2}$$

$$= -18.5$$

99. The line with slope -4 is steeper.

101. No, the slopes of perpendicular lines are negativ reciprocals of each other.

Section P.4 Solving Equations Algebraically and Graphically

Solutions to Odd-Numbered Exercises

- You should know how to solve linear equations. $ax + b = 0$
- An identity is an equation whose solution consists of every real number in its domain.
- To solve an equation you can:
  (a) Add or subtract the same quantity from both sides.
  (b) Multiply or divide both sides by the same nonzero quantity.
- To solve an equation that can be simplified to a linear equation:
  (a) Remove all symbols of grouping and all fractions.
  (b) Combine like terms.
  (c) Solve by algebra.
  (d) Check the answer.
- A "solution" that does not satisfy the original equation is called an extraneous solution.
- You should be able to solve equations graphically.
- You should be able to solve a quadratic equation by factoring, if possible.
- You should be able to solve a quadratic equation of the form $u^2 = d$ by extracting square roots.
- You should be able to solve a quadratic equation by completing the square.
- You should know and be able to use the Quadratic Formula: For $ax^2 + bx + c = 0$, $a \neq 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

- You should be able to solve polynomials of higher degree by factoring.
- For equations involving radicals or fractional powers, raise both sides to the same power.
- For equations with fractions, multiply both sides by the least common denominator to clear the fractions.
- For equations involving absolute value, remember that the expression inside the absolute value can be positive or negative.
- Always check for extraneous solutions.

1. $\dfrac{5}{2x} - \dfrac{4}{x} = 3$

(a) $\dfrac{5}{2(-1/2)} - \dfrac{4}{(-1/2)} \stackrel{?}{=} 3$

$3 = 3$

$x = -\frac{1}{2}$ *is* a solution.

(b) $\dfrac{5}{2(4)} - \dfrac{4}{4} \stackrel{?}{=} 3$

$-\dfrac{3}{8} \neq 3$

$x = 4$ *is not* a solution.

(c) $\dfrac{5}{2(0)} - \dfrac{4}{0}$ is undefined.

$x = 0$ *is not* a solution.

(d) $\dfrac{5}{2(1/4)} - \dfrac{4}{1/4} \stackrel{?}{=} 3$

$-6 \neq 3$

$x = \frac{1}{4}$ *is not* a solution.

3. $3 + \dfrac{1}{x+2} = 4$

(a) $3 + \dfrac{1}{(-1)+2} \stackrel{?}{=} 4$

$4 = 4$

$x = -1$ is a solution

(b) $3 + \dfrac{1}{(-2)+2} = 3 + \dfrac{1}{0}$ is undefined

$x = -2$ is not a solution

(c) $3 + \dfrac{1}{0+2} \stackrel{?}{=} 4$

$\dfrac{7}{2} \neq 4$

$x = 0$ is not a solution

(d) $3 + \dfrac{1}{5+2} \stackrel{?}{=} 4$

$\dfrac{22}{7} = 4$

$x = 5$ is not a solution

5. $\dfrac{\sqrt{x+4}}{6} + 3 = 4$

(a) $\dfrac{\sqrt{-3+4}}{6} + 3 \stackrel{?}{=} 4$

$\dfrac{19}{6} \neq 4$

$x = -3$ is not a solution

(b) $\dfrac{\sqrt{0+4}}{6} + 3 \stackrel{?}{=} 4$

$\dfrac{10}{3} \neq 4$

$x = 0$ is not a solution

(c) $\dfrac{\sqrt{21+4}}{6} + 3 \stackrel{?}{=} 4$

$\dfrac{23}{6} \neq 4$

$x = 21$ is not a solution

(d) $\dfrac{\sqrt{32+4}}{6} + 3 \stackrel{?}{=} 4$

$4 = 4$

$x = 32$ is a solution

7. $2(x-1) = 2x - 2$ is an *identity* by the Distributive Property. It is true for all real values of x.

9. $x^2 - 8x + 5 = (x-4)^2 - 11$ is an *identity* since $(x-4)^2 - 11 = x^2 - 8x + 16 - 11 = x^2 - 8x + 5$.

11. $3 + \dfrac{1}{x+1} = \dfrac{4x}{x+1}$ is *conditional.* There are real values of x for which the equation is not true.

13. Method 1:
$$\frac{3x}{8} - \frac{4x}{3} = 4$$
$$\frac{9x - 32x}{24} = 4$$
$$-23x = 96$$
$$x = -\frac{96}{23}$$

Method 2: Graph $y_1 = \frac{3x}{8} - \frac{4x}{3}$ and $y_2 = 4$ in the same viewing window. These lines intersect at $x \approx -4.1739 \approx -\frac{96}{23}$

15.
$$\frac{5x}{4} + \frac{1}{2} = x - \frac{1}{2}$$
$$4\left(\frac{5x}{4}\right) + 4\left(\frac{1}{2}\right) = 4(x) - 4\left(\frac{1}{2}\right)$$
$$5x + 2 = 4x - 2$$
$$x = -4$$

17.
$$\tfrac{3}{2}(z + 5) - \tfrac{1}{4}(z + 24) = 0$$
$$4\left(\tfrac{3}{2}\right)(z + 5) - 4\left(\tfrac{1}{4}\right)(z + 24) = 4(0)$$
$$6(z + 5) - (z + 24) = 0$$
$$6z + 30 - z - 24 = 0$$
$$5z = -6$$
$$z = -\tfrac{6}{5}$$

19.
$$\frac{100 - 4u}{3} = \frac{5u + 6}{4} + 6$$
$$12\left(\frac{100 - 4u}{3}\right) = 12\left(\frac{5u + 6}{4}\right) + 12(6)$$
$$4(100 - 4u) = 3(5u + 6) + 72$$
$$400 - 16u = 15u + 18 + 72$$
$$-31u = -310$$
$$u = 10$$

21.
$$\frac{5x - 4}{5x + 4} = \frac{2}{3}$$
$$3(5x - 4) = 2(5x + 4)$$
$$15x - 12 = 10x + 8$$
$$5x = 20$$
$$x = 4$$

23.
$$\frac{1}{x - 3} + \frac{1}{x + 3} = \frac{10}{x^2 - 9}$$
$$\frac{(x + 3) + (x - 3)}{x^2 - 9} = \frac{10}{x^2 - 9}$$
$$2x = 10$$
$$x = 5$$

25.
$$\frac{7}{2x + 1} - \frac{8x}{2x - 1} = -4$$
$$7(2x - 1) - 8x(2x + 1) = -4(2x + 1)(2x - 1)$$
$$14x - 7 - 16x^2 - 8x = -16x^2 + 4$$
$$6x = 11$$
$$x = \frac{11}{6}$$

27.
$$\frac{1}{x} + \frac{2}{x - 5} = 0$$
$$1(x - 5) + 2x = 0$$
$$3x - 5 = 0$$
$$3x = 5$$
$$x = \frac{5}{3}$$

29.
$$\frac{3}{x(x - 3)} + \frac{4}{x} = \frac{1}{x - 3}$$
$$3 + 4(x - 3) = x$$
$$3 + 4x - 12 = x$$
$$3x = 9$$
$$x = 3$$

A check reveals that $x = 3$ is an extraneous solution, so there is no solution.

31. $y = x - 5$

Let $y = 0$: $0 = x - 5 \implies x = 5 \implies (5, 0)$ x-intercept

Let $x = 0$: $y = 0 - 5 \implies y = -5 \implies (0, -5)$ y-intercept

33. $y = x^2 + x - 2$

Let $y = 0$: $(x^2 + x - 2) = (x + 2)(x - 1) = 0 \implies x = -2, 1 \implies (-2, 0), (1, 0)$ x-intercepts

Let $x = 0$: $y = 0^2 + 0 - 2 = -2 \implies (0, -2)$ y-intercept

35. $y = x\sqrt{x + 2}$

Let $y = 0$: $0 = x\sqrt{x + 2} \implies x = 0, -2 \implies (0, 0), (-2, 0)$ x-intercepts

Let $x = 0$: $y = 0\sqrt{0 + 2} = 0 \implies (0, 0)$ y-intercept

37. $y = |x - 2| - 4$

Let $y = 0$: $|x - 2| - 4 = 0 \implies |x - 2| = 4 \implies x = -2, 6 \implies (-2, 0), (6, 0)$ x-intercepts

Let $x = 0$: $|0 - 2| - 4 = |-2| - 4 = 2 - 4 = -2 = y \implies (0, -2)$ y-intercept

39. $xy - 2y - x + 1 = 0$

Let $y = 0$: $-x + 1 = 0 \implies x = 1 \implies (1, 0)$ x-intercept

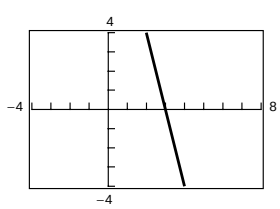
Let $x = 0$: $-2y + 1 = 0 \implies y = \frac{1}{2} \implies \left(0, \frac{1}{2}\right)$ y-intercept

41. $y = 12 - 4x$

$12 - 4x = 0$

$12 = 4x$

$3 = x$

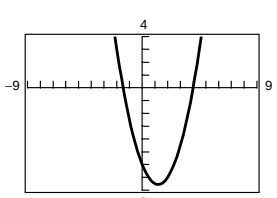


43. $y = x^2 - 2.5x - 6$

$x^2 - 2.5x - 6 = 0$

$(x - 4)(x + 1.5) = 0$

$x = 4, -1.5$



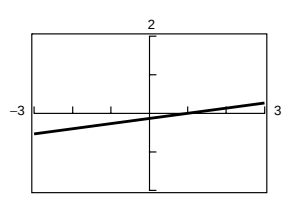
45. $y = \dfrac{x + 2}{3} - \dfrac{x - 1}{5} - 1$

$\dfrac{x + 2}{3} - \dfrac{x - 1}{5} - 1 = 0$

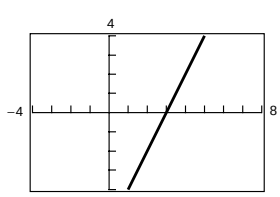
$5(x + 2) - 3(x - 1) - 15 = 0$

$2x = 2$

$x = 1$



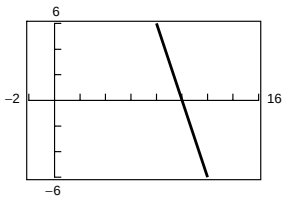
47.



(3, 0)

$y = 0 = 2(x - 1) - 4 = 2x - 2 - 4 = 2x - 6 \implies 2x = 6 \implies x = 3$

49.



(10, 0)

$y = 0 = 20 - (3x - 10) = 20 - 3x + 10 = 30 - 3x \implies 3x = 30 \implies x = 10$

51. $27 - 4x = 12$

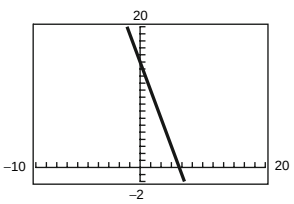
$-4x = -15$

$x = \frac{15}{4}$

$27 - 4x - 12 = 0$

$y = 15 - 4x = 0$

$x = 3.75 = \frac{15}{4}$



53. $25(x - 3) = 12(x + 2) - 10$

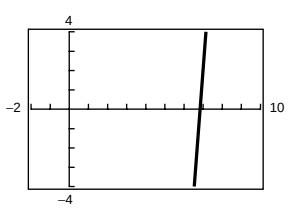
$25x - 75 = 12x + 24 - 10$

$13x - 89 = 0$

$x = \frac{89}{13}$

$y = 25(x - 3) - 12(x + 2) + 10 = 0$

$x = 6.846$



55. $\frac{3x}{2} + \frac{1}{4}(x - 2) = 10$

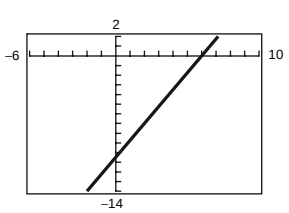
$\frac{6x}{4} + \frac{x}{4} = 10 + \frac{1}{2}$

$\frac{7x}{4} = \frac{21}{2}$

$x = 6$

$y = \frac{3x}{2} + \frac{1}{4}(x - 2) - 10 = 0$

$x = 6.0$



57. $\frac{2x}{3} = 10 - \frac{24}{x}$

$\frac{2x}{3}(3x) = 10(3x) - \frac{24}{x}(3x)$

$2x^2 = 30x - 72$

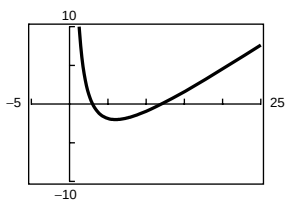
$2x^2 - 30x + 72 = 0$

$x^2 - 15x + 36 = 0$

$(x - 3)(x - 12) = 0$

$x = 3, 12$

$y = \frac{2x}{3} - 10 + \frac{24}{x}$



$x = 3, 12$

59. $\frac{3}{x + 2} - \frac{4}{x - 2} = 5$

$3(x - 2) - 4(x + 2) = 5(x + 2)(x - 2)$

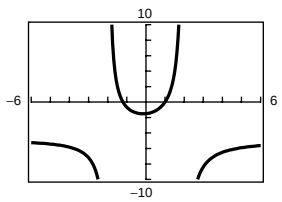
$3x - 6 - 4x - 8 = 5(x^2 - 4)$

$0 = 5x^2 + x - 6$

$0 = (x - 1)(5x + 6)$

$x = 1, -\frac{6}{5}$

$y = \frac{3}{x + 2} - \frac{4}{x - 2} - 5 = 0$



$x = 1.0, -1.2$

61. $3(x + 3) = 5(1 - x) - 1$

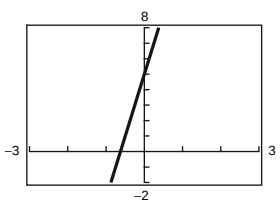
$3x + 9 = 5 - 5x - 1$

$8x = -5$

$x = -\frac{5}{8}$

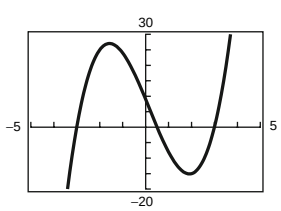
$y = 3(x + 3) - 5(1 - x) + 1 = 0$

$x = -0.625$



63. $2x^3 - x^2 - 18x + 9 = 0$

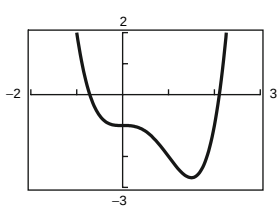
$x = -3.0,\ 0.5,\ 3.0$



65. $x^4 = 2x^3 + 1$

$x^4 - 2x^3 - 1 = 0$

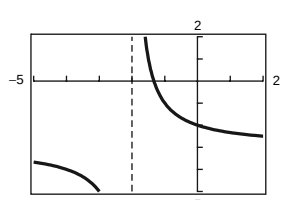
$x = -0.717,\ 2.107$



67. $\frac{2}{x + 2} = 3$

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

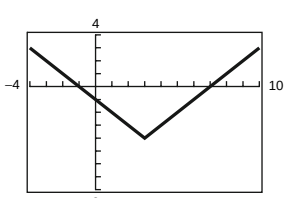
$x = -1.333$



69. $|x - 3| = 4$

$|x - 3| - 4 = 0$

$x = -1, 7$



71. $y = 2 - x$

$y = 2x - 1$

$2 - x = 2x - 1$

$3 = 3x$

$x = 1, y = 2 - 1 = 1$

$(x, y) = (1, 1)$

73. $x - y = -4 \Rightarrow y = x + 4$

$x^2 - y = -2 \Rightarrow y = x^2 + 2$

$x^2 + 2 = x + 4$

$x^2 - x - 2 = 0$

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

$x = 2, y = 6$

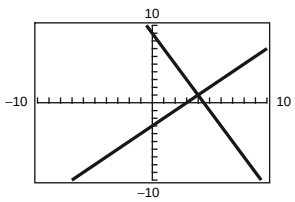
$x = -1, y = 3$

$(2, 6), (-1, 3)$

75. $y = 9 - 2x$

$y = x - 3$

$(4, 1)$

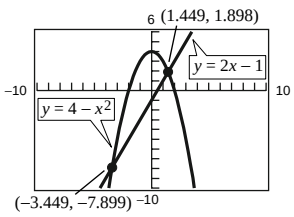


77. $y = 4 - x^2$

$y = 2x - 1$

$(x, y) = (1.449, 1.898),$

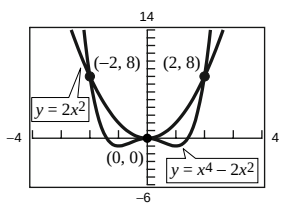
$(-3.449, -7.899)$



79. $y = 2x^2$

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

$(x, y) = (0, 0),\ (2, 8),\ (-2, 8)$



81. $6x^2 + 3x = 0$

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

$3x = 0 \quad \text{or} \quad 2x + 1 = 0$

$x = 0 \quad \text{or} \quad x = -\frac{1}{2}$

83. $x^2 - 2x - 8 = 0$

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

$x - 4 = 0 \quad \text{or} \quad x + 2 = 0$

$x = 4 \quad \text{or} \quad x = -2$

85. $3 + 5x - 2x^2 = 0$

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

$3 - x = 0 \quad \text{or} \quad 1 + 2x = 0$

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

87. $x^2 + 4x = 12$

$x^2 + 4x - 12 = 0$

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

$x + 6 = 0 \quad \text{or} \quad x - 2 = 0$

$x = -6 \quad \text{or} \quad x = 2$

89. $x^2 = 7$

$x = \pm\sqrt{7}$

$\approx \pm 2.65$

91. $(x - 12)^2 = 18$

$x - 12 = \pm 3\sqrt{2}$

$x = 12 \pm 3\sqrt{2}$

$x \approx 16.24 \quad \text{or} \quad \approx 7.76$

93. $(2x - 1)^2 = 18$

$2x - 1 = \pm\sqrt{18} = \pm 3\sqrt{2}$

$2x = \pm 3\sqrt{2} + 1$

$x = \pm\frac{3}{2}\sqrt{2} + \frac{1}{2}$

$x \approx 2.62 \text{ or } \approx -1.62$

95. $(x - 7)^2 = (x + 3)^2$

$x - 7 = \pm(x + 3)$

$x - 7 = x + 3$ impossible

$x - 7 = -(x + 3) \Rightarrow 2x = 4$

$\Rightarrow x = 2$

97. $x^2 + 4x = 32$

$x^2 + 4x + 4 = 32 + 4$

$(x + 2)^2 = 36$

$x + 2 = \pm 6$

$x = -2 \pm 6$

$x = -8, 4$

99. $x^2 + 6x + 2 = 0$

$x^2 + 6x = -2$

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

$(x + 3)^2 = 7$

$x + 3 = \pm\sqrt{7}$

$x = -3 \pm \sqrt{7}$

101. $9x^2 - 18x + 3 = 0$

$$x^2 - 2x + \frac{1}{3} = 0$$
$$x^2 - 2x = -\frac{1}{3}$$
$$x^2 - 2x + 1^2 = -\frac{1}{3} + 1^2$$
$$(x-1)^2 = \frac{2}{3}$$
$$x - 1 = \pm\sqrt{\frac{2}{3}}$$
$$x = 1 \pm \sqrt{\frac{2}{3}}$$
$$x = 1 \pm \frac{\sqrt{6}}{3}$$

103. $-x^2 + 2x + 2 = 0$

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

105. $x^2 + 8x - 4 = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-8 \pm \sqrt{8^2 - 4(1)(-4}}{2(1)}$$
$$= \frac{-8 \pm 4\sqrt{5}}{2}$$
$$= -4 \pm 2\sqrt{5}$$

107. $4x^2 + 16x + 15 = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-16 \pm \sqrt{16^2 - 4(4)(15)}}{2(4)}$$
$$= \frac{-16 + \sqrt{16}}{8}$$
$$= -2 \pm \frac{1}{2} = -\frac{3}{2}, \; -\frac{5}{2}.$$

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

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

111. $(x+3)^3 = 81$

$$x + 3 = \pm 9$$
$$x + 3 = 9 \quad \text{or} \quad x + 3 = -$$
$$x = 6 \quad \text{or} \quad x = -$$

113.

$$x^2 - x - \frac{11}{4} = 0$$
$$x^2 - x + \frac{1}{4} = \frac{11}{4} + \frac{1}{4}$$
$$\left(x - \frac{1}{2}\right)^2 = 3$$
$$x - \frac{1}{2} = \pm\sqrt{3}$$
$$x = \frac{1}{2} \pm \sqrt{3}$$

$$x = \frac{1}{2} + \sqrt{3}, \frac{1}{2} - \sqrt{3}$$

115. $4x^4 - 18x^2 = 0$

$$2x^2(2x^2 - 9) = 0$$
$$2x^2 = 0 \implies x = 0$$
$$2x^2 - 9 = 0 \implies x = \pm\frac{3\sqrt{2}}{2}$$

117. $x^4 - 81 = 0$

$(x^2 + 9)(x + 3)(x - 3) = 0$

$x^2 + 9 = 0$ No real solution.

$x + 3 = 0 \implies x = -3$

$x - 3 = 0 \implies x = 3$

119. $5x^3 + 30x^2 + 45x = 0$

$5x(x^2 + 6x + 9) = 0$

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

$5x = 0 \implies x = 0$

$x + 3 = 0 \implies x = -3$

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

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

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

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

$x - 3 = 0 \implies x = 3$

$x + 1 = 0 \implies x = -1$

$x - 1 = 0 \implies x = 1$

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

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

$\left(x + \sqrt{3}\right)\left(x - \sqrt{3}\right)(x + 1)(x - 1) = 0$

$x + \sqrt{3} = 0 \implies x = -\sqrt{3}$

$x - \sqrt{3} = 0 \implies x = \sqrt{3}$

$x + 1 = 0 \implies x = -1$

$x - 1 = 0 \implies x = 1$

125. $4x^4 - 65x^2 + 16 = 0$

$(4x^2 - 1)(x^2 - 16) = 0$

$(2x + 1)(2x - 1)(x + 4)(x - 4) = 0$

$2x + 1 = 0 \implies x = -\frac{1}{2}$

$2x - 1 = 0 \implies x = \frac{1}{2}$

$x + 4 = 0 \implies x = -4$

$x - 4 = 0 \implies x = 4$

127. $\dfrac{1}{t^2} + \dfrac{8}{t} + 15 = 0$

$1 + 8t + 15t^2 = 0$

$(1 + 3t)(1 + 5t) = 0$

$1 + 3t = 0 \implies t = -\dfrac{1}{3}$

$1 + 5t = 0 \implies t = -\dfrac{1}{5}$

129. $2x + 9\sqrt{x} - 5 = 0$

$\left(2\sqrt{x} - 1\right)\left(\sqrt{x} + 5\right) = 0$

$\sqrt{x} = \frac{1}{2} \implies x = \frac{1}{4}$

($\sqrt{x} = -5$ is not possible.)

Note: You can see graphically that there is only one solution.

131. $\sqrt{x - 10} - 4 = 0$

$\sqrt{x - 10} = 4$

$x - 10 = 16$

$x = 26$

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

$\sqrt{x + 1} = 3x + 1$

$x + 1 = 9x^2 + 6x + 1$

$0 = 9x^2 + 5x$

$0 = x(9x + 5)$

$x = 0$

$9x + 5 = 0 \implies x = -\frac{5}{9}$, extraneous

135. $\sqrt{x} - \sqrt{x - 5} = 1$

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

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

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

$4 = 2\sqrt{x - 5}$

$2 = \sqrt{x - 5}$

$4 = x - 5$

$9 = x$

137. $(x - 5)^{2/3} = 16$

$x - 5 = \pm 16^{3/2}$

$x - 5 = \pm 64$

$x = 69, \ -59$

139. $3x(x-1)^{1/2} + 2(x-1)^{3/2} = 0$

$(x-1)^{1/2}[3x + 2(x-1)] = 0$

$(x-1)^{1/2}(5x-2) = 0$

$(x-1)^{1/2} = 0 \implies x - 1 = 0 \implies x = 1$

$5x - 2 = 0 \implies x = \frac{2}{5}$ which is extraneous.

141. $\dfrac{20-x}{x} = x$

$20 - x = x^2$

$0 = x^2 + x - 20$

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

$x + 5 = 0 \implies x = -5$

$x - 4 = 0 \implies x = 4$

143. $\dfrac{1}{x} - \dfrac{1}{x+1} = 3$

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

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

$1 = 3x^2 + 3x$

$0 = 3x^2 + 3x - 1;\ a = 3,\ b = 3,\ c = -1$

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

145. $x = \dfrac{3}{x} + \dfrac{1}{2}$

$(2x)(x) = (2x)\left(\dfrac{3}{x}\right) + (2x)\left(\dfrac{1}{2}\right)$

$2x^2 = 6 + x$

$2x^2 - x - 6 = 0$

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

$2x + 3 = 0 \implies x = -\dfrac{3}{2}$

$x - 2 = 0 \implies x = 2$

147. $|2x-1| = 5$

$2x - 1 = 5 \implies x = 3$

$-(2x-1) = 5 \implies x = -2$

149. $|x| = x^2 + x - 3$

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

$x^2 - 3 = 0$ $\qquad$ $x^2 + 2x - 3 = 0$

$x = \pm\sqrt{3}$ $\qquad$ $(x-1)(x+3) = 0$

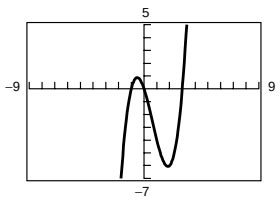
$x - 1 = 0 \implies x = 1$

$x + 3 = 0 \implies x = -3$

Only $x = \sqrt{3}$, and $x = -3$ are solutions to the original equation. $x = -\sqrt{3}$ and $x = 1$ are extraneous. Note that the graph of $y = x^2 + x - 3 - |x|$ has two x-intercepts.

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

(a)



(b) x-intercepts: $(-1, 0)$, $(0, 0)$, $(3, 0)$

(c) $0 = x^3 - 2x^2 - 3x$

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

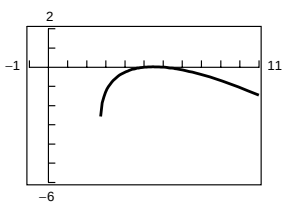
$x = 0$

$x + 1 = 0 \implies x = -1$

$x - 3 = 0 \implies x = 3$

153. $y = \sqrt{11x - 30} - x$

(a)



(b) x-intercepts: $(5, 0)$, $(6, 0)$

(c) $0 = \sqrt{11x - 30} - x$

$x = \sqrt{11x - 30}$

$x^2 = 11x - 30$

$x^2 - 11x + 30 = 0$

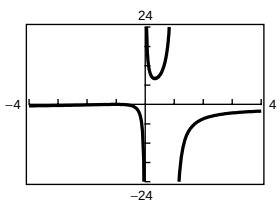
$(x - 5)(x - 6) = 0$

$x - 5 = 0 \implies x = 5$

$x - 6 = 0 \implies x = 6$

155. $y = \dfrac{1}{x} - \dfrac{4}{x - 1} - 1$

(a)



(b) x-intercept: $(-1, 0)$

(c) $0 = \dfrac{1}{x} - \dfrac{4}{x - 1} - 1$

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

$0 = x - 1 - 4x - x^2 + x$

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

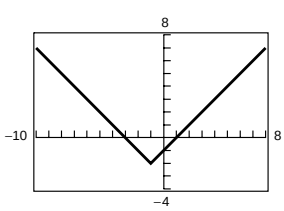
$0 = x^2 + 2x + 1$

$0 = (x + 1)^2$

$x + 1 = 0 \implies x = -1$

157. $y = |x + 1| - 2$

(a)



(b) x-intercept: $(1, 0)$, $(-3, 0)$

(c) $0 = |x + 1| - 2$

$2 = |x + 1|$

$x + 1 = 2$ or $-(x + 1) = 2$

$x = 1$ or $-x - 1 = 2$

$-x = 3$

$x = -3$