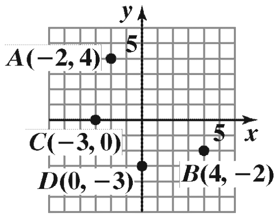
Chapter 1
Equations and Inequalities

Section 1.1

Check Point Exercises

1. Plot points:



2. $x = -3, y = 7$

$x = -2, y = 6$

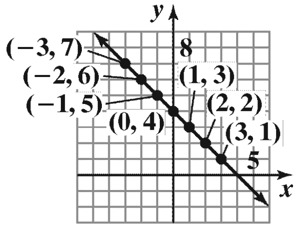
$x = -1, y = 5$

$x = 0, y = 4$

$x = 1, y = 3$

$x = 2, y = 2$

$x = 3, y = 1$



$y = 4 - x$

3. $x = -4, y = 3$

$x = -3, y = 2$

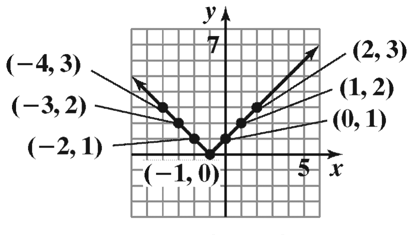
$x = -2, y = 1$

$x = -1, y = 0$

$x = 0, y = 1$

$x = 1, y = 2$

$x = 2, y = 3$



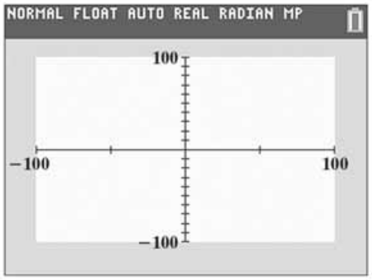
$y = |x + 1|$

4. The meaning of a $[-100,100,50]$ by $[-100,100,10]$ viewing rectangle is as follows:

$$[\overbrace{-100}^{\substack{\text{minimum} \\ x\text{-value}}},\ \overbrace{100}^{\substack{\text{maximum} \\ x\text{-value}}},\ \overbrace{50}^{\substack{\text{distance} \\ \text{between} \\ x\text{-axis} \\ \text{tick} \\ \text{marks}}}]$$

by

$$[\overbrace{-100}^{\substack{\text{minimum} \\ y\text{-value}}},\ \overbrace{100}^{\substack{\text{maximum} \\ y\text{-value}}},\ \overbrace{10}^{\substack{\text{distance} \\ \text{between} \\ y\text{-axis} \\ \text{tick} \\ \text{marks}}}]$$



5. **a.** The graph crosses the x-axis at (–3, 0). Thus, the x-intercept is –3. The graph crosses the y-axis at (0, 5). Thus, the y-intercept is 5.

b. The graph does not cross the x-axis. Thus, there is no x-intercept. The graph crosses the y-axis at (0, 4). Thus, the y-intercept is 4.

c. The graph crosses the x- and y-axes at the origin (0, 0). Thus, the x-intercept is 0 and the y-intercept is 0.

d. The graph crosses the x-axis at (–1, 0) and (1, 0). Thus, the x-intercepts are –1 and 1. The graph crosses the y-axis at (0, 3). Thus, the y-intercept is 3.

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6. **a.** $d = 1.8n + 14$

$d = 1.8(15) + 14 = 41$

41% of marriages end in divorce after 15 years for high school graduates with no college.

b. According to the line graph, 40% of marriages end in divorce after 15 years for high school graduates with no college.

c. The mathematical model overestimates the actual percentage shown in the graph by 1%.

Concept and Vocabulary Check 1.1

C1. x-axis

C2. y-axis

C3. origin

C4. quadrants; four

C5. x-coordinate; y-coordinate

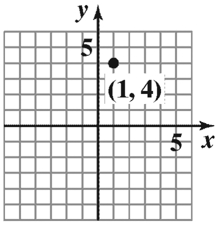
C6. solution; satisfies

C7. x-intercept; zero

C8. y-intercept; zero

Exercise Set 1.1

1.



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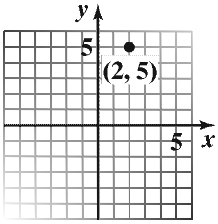

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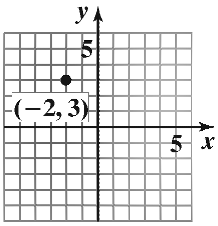

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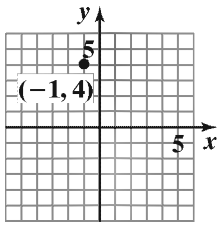

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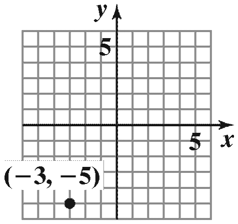
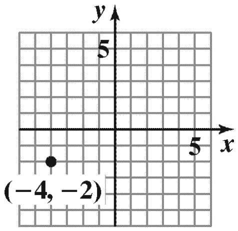


6.



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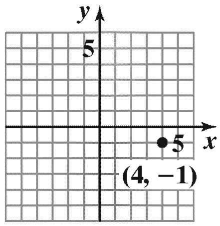

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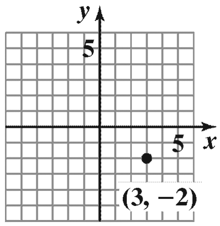

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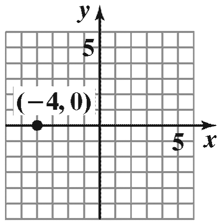

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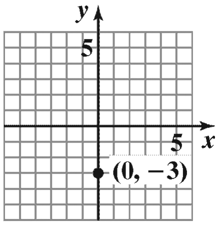
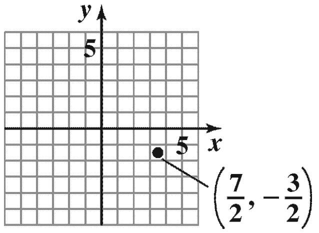
10.



11.



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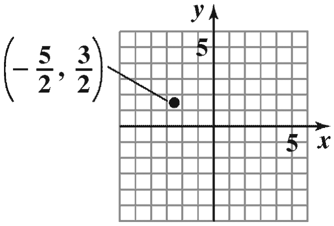
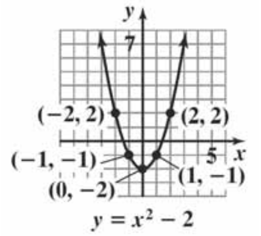


13.



$x = -3, y = 7$

$x = -2, y = 2$

$x = -1, y = -1$

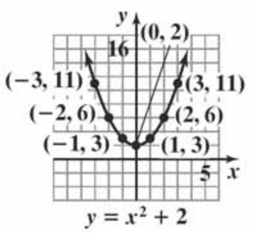
$x = 0, y = -2$

$x = 1, y = -1$

$x = 2, y = 2$

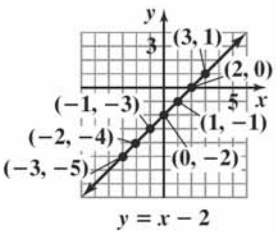
$x = 3, y = 7$

14.



$x = -3, y = 11$
$x = -2, y = 6$
$x = -1, y = 3$
$x = 0, y = 2$
$x = 1, y = 3$
$x = 2, y = 6$
$x = 3, y = 11$

15.



$x = -3, y = -5$

$x = -2, y = -4$

$x = -1, y = -3$

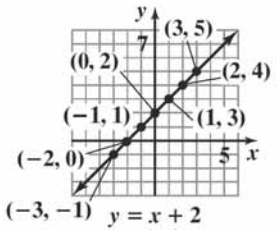
$x = 0, y = -2$

$x = 1, y = -1$

$x = 2, y = 0$

$x = 3, y = 1$

16.



$x = -3, y = -1$
$x = -2, y = 0$
$x = -1, y = 1$
$x = 0, y = 2$
$x = 1, y = 3$
$x = 2, y = 4$
$x = 3, y = 5$

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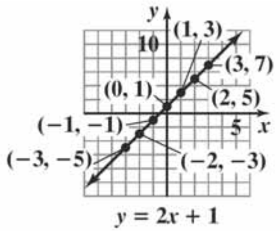
17.



$x=-3, y=-5$

$x=-2, y=-3$

$x=-1, y=-1$

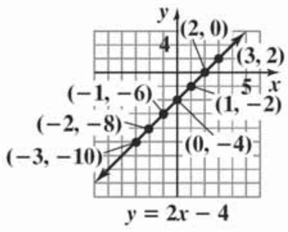
$x=0, y=1$

$x=1, y=3$

$x=2, y=5$

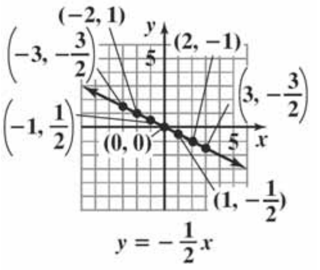
$x=3, y=7$

18.



$x=-3, y=-10$
$x=-2, y=-8$
$x=-1, y=-6$
$x=0, y=-4$
$x=1, y=-2$
$x=2, y=0$
$x=3, y=2$

19.



$x=-3, y=\frac{3}{2}$

$x=-2, y=1$

$x=-1, y=\frac{1}{2}$

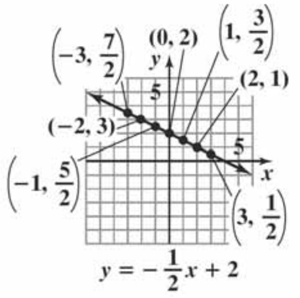
$x=0, y=0$

$x=1, y=-\frac{1}{2}$

$x=2, y=-1$

$x=3, y=-\frac{3}{2}$

20.



$x=-3, y=\frac{7}{2}$

$x=-2, y=3$

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

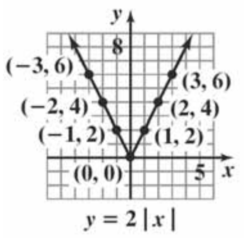
$x=0, y=2$

$x=1, y=\frac{3}{2}$

$x=2, y=1$

$x=3, y=\frac{1}{2}$

21.



$x = -3, y = 6$

$x = -2, y = 4$

$x = -1, y = 2$

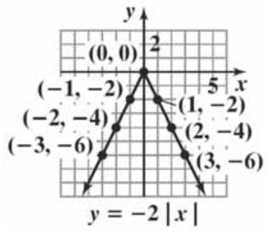
$x = 0, y = 0$

$x = 1, y = 2$

$x = 2, y = 4$

$x = 3, y = 6$

22.



$x = -3, y = -6$

$x = -2, y = -4$

$x = -1, y = -2$

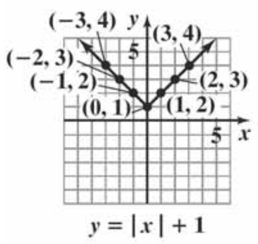
$x = 0, y = 0$

$x = 1, y = -2$

$x = 2, y = -4$

$x = 3, y = -6$

23.



$x = -3, y = 4$

$x = -2, y = 3$

$x = -1, y = 2$

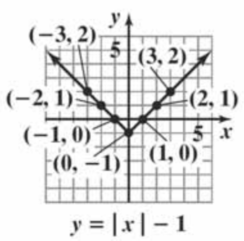
$x = 0, y = 1$

$x = 1, y = 2$

$x = 2, y = 3$

$x = 3, y = 4$

24.



$x = -3, y = 2$

$x = -2, y = 1$

$x = -1, y = 0$

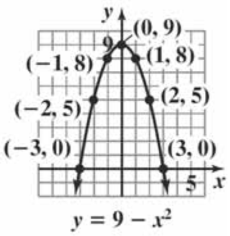
$x = 0, y = -1$

$x = 1, y = 0$

$x = 2, y = 1$

$x = 3, y = 2$

25.



$x = -3, y = 0$

$x = -2, y = 5$

$x = -1, y = 8$

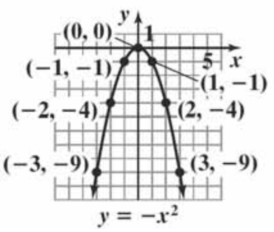
$x = 0, y = 9$

$x = 1, y = 8$

$x = 2, y = 5$

$x = 3, y = 0$

26.



$x = -3, y = -9$

$x = -2, y = -4$

$x = -1, y = -1$

$x = 0, y = 0$

$x = 1, y = -1$

$x = 2, y = -4$

$x = 3, y = -9$

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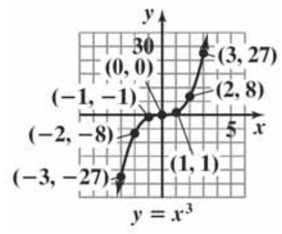
27.



$x = -3, y = -27$

$x = -2, y = -8$

$x = -1, y = 1$

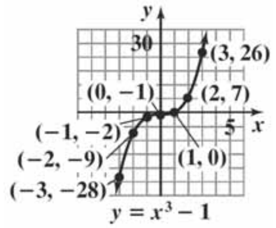
$x = 0, y = 0$

$x = 1, y = 1$

$x = 2, y = 8$

$x = 3, y = 27$

28.



$x = -3, y = -28$

$x = -2, y = -9$

$x = -1, y = -2$

$x = 0, y = -1$

$x = 1, y = 0$

$x = 2, y = 7$

$x = 3, y = 26$

29. (c) *x*-axis tick marks –5, –4, –3, –2, –1, 0, 1, 2, 3, 4, 5; *y*-axis tick marks are the same.

30. (d) *x*-axis tick marks –10, –8, –6, –4, –2, 0, 2, 4, 6, 8, 10; *y*-axis tick marks –4, –2, 0, 2, 4

31. (b); *x*-axis tick marks –20, –10, 0, 10, 20, 30, 40, 50, 60, 70, 80; *y*-axis tick marks –30, –20, –10, 0, 10, 20, 30, 40, 50, 60, 70

32. (a) *x*-axis tick marks –40, –20, 0, 20, 40; *y*-axis tick marks –1000, –900, –800, –700, . . . , 700, 800, 900, 1000

33. The equation that corresponds to Y_2 in the table is (c), $y_2 = 2 - x$. We can tell because all of the points $(-3,5)$, $(-2,4)$, $(-1,3)$, $(0,2)$, $(1,1)$, $(2,0)$, and $(3,-1)$ are on the line $y = 2 - x$, but all are not on any of the others.

34. The equation that corresponds to Y_1 in the table is (b), $y_1 = x^2$. We can tell because all of the points $(-3,9)$, $(-2,4)$, $(-1,1)$, $(0,0)$, $(1,1)$, $(2,4)$, and $(3,9)$ are on the graph $y = x^2$, but all are not on any of the others.

35. No. It passes through the point $(0,2)$.

36. Yes. It passes through the point $(0,0)$.

37. $(2,0)$

38. $(0,2)$

39. The graphs of Y_1 and Y_2 intersect at the points $(-2,4)$ and $(1,1)$.

40. The values of Y_1 and Y_2 are the same when $x = -2$ and $x = 1$.

41. **a.** 2; The graph intersects the *x*-axis at (2, 0).

b. –4; The graph intersects the *y*-axis at (0,–4).

42. **a.** 1; The graph intersects the *x*-axis at (1, 0).

b. 2; The graph intersects the *y*-axis at (0, 2).

43. **a.** 1, –2; The graph intersects the *x*-axis at (1, 0) and (–2, 0).

b. 2; The graph intersects the *y*-axis at (0, 2).

44. **a.** 1, –1; The graph intersects the *x*-axis at (1, 0) and (–1, 0).

b. 1; The graph intersect the *y*-axis at (0, 1).

45. **a.** –1; The graph intersects the *x*-axis at (–1, 0).

b. none; The graph does not intersect the *y*-axis.

46. **a.** none; The graph does not intersect the *x*-axis.

b. 2; The graph intersects the *y*-axis at (0, 2).

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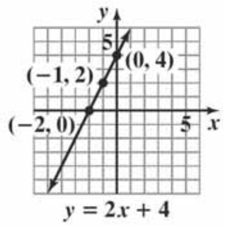
47.



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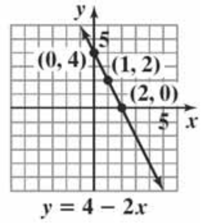

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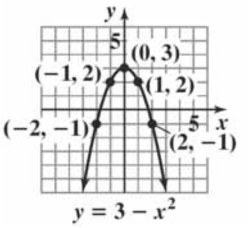

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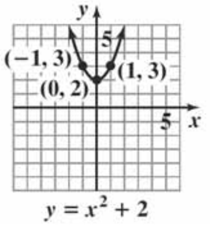
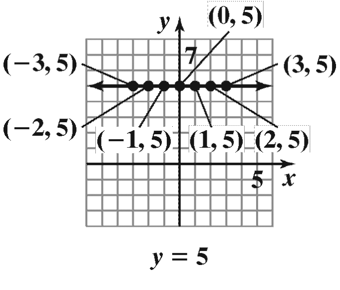


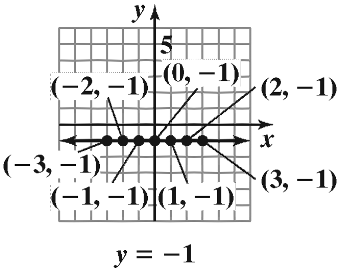
51.

x	(x, y)
–3	(–3, 5)
–2	(–2, 5)
–1	(–1, 5)
0	(0, 5)
1	(1, 5)
2	(2, 5)
3	(3, 5)



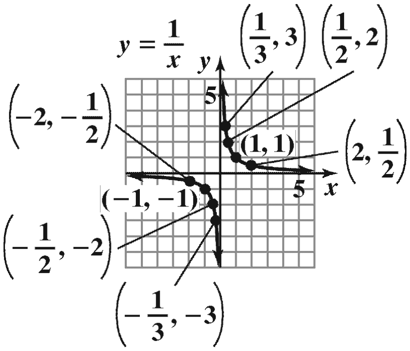
52.

x	(x, y)
–3	(–3, –1)
–2	(–2, –1)
–1	(–1, –1)
0	(0, –1)
1	(1, –1)
2	(2, –1)
3	(3, –1)



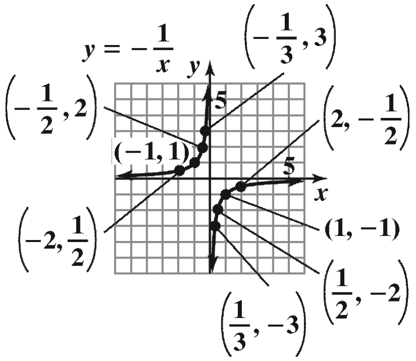
53.

x	(x, y)
–2	$\left(-2, -\frac{1}{2}\right)$
–1	$(-1, -1)$
$-\frac{1}{2}$	$\left(-\frac{1}{2}, -2\right)$
$-\frac{1}{3}$	$\left(-\frac{1}{3}, -3\right)$
$\frac{1}{3}$	$\left(\frac{1}{3}, 3\right)$
$\frac{1}{2}$	$\left(\frac{1}{2}, 2\right)$
1	$(1, 1)$
2	$\left(2, \frac{1}{2}\right)$



54.

x	(x, y)
-2	$\left(-2, \frac{1}{2}\right)$
-1	$(-1, 1)$
$-\frac{1}{2}$	$\left(-\frac{1}{2}, 2\right)$
$-\frac{1}{3}$	$\left(-\frac{1}{3}, 3\right)$
$\frac{1}{3}$	$\left(\frac{1}{3}, -3\right)$
$\frac{1}{2}$	$\left(\frac{1}{2}, -2\right)$
1	$(1, -1)$
2	$\left(2, -\frac{1}{2}\right)$



55. **a.** According to the line graph, about 44% of seniors used marijuana in 2010.

b. 2010 is 20 years after 1990.
$M = 0.1n + 43$
$M = 0.1(20) + 43 = 45$
According to formula, 45% of seniors used marijuana in 2010. It is greater than the estimate, although answers may vary.

c. According to the line graph, about 71% of seniors used alcohol in 2010.

d. 2010 is 20 years after 1990.
$A = -0.9n + 88$
$A = -0.9(20) + 88 = 70$
According to formula, 70% of seniors used alcohol in 2010. It is less than the estimate, although answers may vary.

e. The maximum for marijuana was reached in 2000.
According to the line graph, about 49% of seniors used marijuana in 1990.

56. **a.** According to the line graph, about 65% of seniors used alcohol in 2015.

b. 2015 is 25 years after 1990.
$A = -0.9n + 88$
$A = -0.9(25) + 88 = 65.5$
According to formula, 65.5% of seniors used alcohol in 2015. It is greater than the estimate, although answers may vary.

c. According to the line graph, about 45% of seniors used marijuana in 2015.

d. 2015 is 25 years after 1990.
$M = 0.1n + 43$
$M = 0.1(25) + 43 = 45.5$
According to formula, 45.5% of seniors used marijuana in 2015. It is greater than the estimate, although answers may vary.

e. The maximum for alcohol was reached in 1990. According to the line graph, about 90% of seniors used alcohol in 1990.

57. At age 8, women have the least number of awakenings, averaging about 1 awakening per night.

58. At age 65, men have the greatest number of awakenings, averaging about 8 awakenings per night.

59. The difference between the number of awakenings for 25-year-old men and women is about 1.9.

60. The difference between the number of awakenings for 18-year-old men and women is about 1.1.

61. – 66. Answers will vary.

67. makes sense

68. does not make sense; Explanations will vary. Sample explanation: Most graphing utilities do not display numbers on the axes.

69. does not make sense; Explanations will vary. Sample explanation: These three points are not collinear.

70. does not make sense; Explanations will vary. Sample explanation: As the time of day goes up, the total calories burned will also go up.

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71. false; Changes to make the statement true will vary. A sample change is: The product of the coordinates of a point in quadrant III is also positive.

72. false; Changes to make the statement true will vary. A sample change is: A point on the x-axis will have $y = 0$.

73. true

74. false; Changes to make the statement true will vary. A sample change is: $3(5) - 2(2) \neq -4$.

75. I, III

76. II, IV

77. IV

78. II

79. (a)

80. (d)

81. (b)

82. (c)

83. (b)

84. (a)

85. (c)

86. (b)

87.

$$\begin{aligned}
&d = 1.3n + 6\\
&d = 1.3(5) + 6 = 12.5\\
&d = 1.3(10) + 6 = 19\\
&d = 1.3(15) + 6 = 25.5
\end{aligned}$$

$$\begin{aligned}
&d = 8\sqrt{n} - 6\\
&d = 8\sqrt{5} - 6 = 11.9\\
&d = 8\sqrt{10} - 6 = 19.3\\
&d = 8\sqrt{15} - 6 = 25.0
\end{aligned}$$

Both models give good estimates, but the second model is slightly better.

88. Answers will vary.

89.

$$\begin{aligned}
2(x-3) - 17 &= 13 - 3(x+2)\\
2(6-3) - 17 &= 13 - 3(6+2)\\
2(3) - 17 &= 13 - 3(8)\\
6 - 17 &= 13 - 24\\
-11 &= -11, \text{ true}
\end{aligned}$$

90.

$$\begin{aligned}
12\left(\frac{x+2}{4} - \frac{x-1}{3}\right) &= 12\left(\frac{x+2}{4}\right) - 12\left(\frac{x-1}{3}\right)\\
&= 3(x+2) - 4(x-1)\\
&= 3x + 6 - 4x + 4\\
&= -x + 10
\end{aligned}$$

91.

$$\begin{aligned}
(x-3)\left(\frac{3}{x-3} + 9\right) &= (x-3)\left(\frac{3}{x-3}\right) + (x-3)(9)\\
&= 3 + 9x - 27\\
&= 9x - 24
\end{aligned}$$

Section 1.2

Check Point Exercises

1.

$$\begin{aligned}
4x + 5 &= 29\\
4x + 5 - 5 &= 29 - 5\\
4x &= 24\\
\frac{4x}{4} &= \frac{24}{4}\\
x &= 6
\end{aligned}$$

Check:

$$\begin{aligned}
4x + 5 &= 29\\
4(6) + 5 &= 29\\
24 + 5 &= 29\\
29 &= 29 \text{ true}
\end{aligned}$$

The solution set is $\{6\}$.

2.

$$\begin{aligned}
4(2x+1) &= 29 + 3(2x-5)\\
8x + 4 &= 29 + 6x - 15\\
8x + 4 &= 6x + 14\\
8x + 4 - 6x &= 6x + 14 - 6x\\
2x + 4 &= 14\\
2x + 4 - 4 &= 14 - 4\\
2x &= 10\\
\frac{2x}{2} &= \frac{10}{2}\\
x &= 5
\end{aligned}$$

Check:

$$\begin{aligned}4(2x+1)&=29+3(2x-5)\\4[2(5)+1]&=29+3[2(5)-5]\\4[10+1]&=29+3[10-5]\\4[11]&=29+3[5]\\44&=29+15\\44&=44\ \text{ true}\end{aligned}$$

The solution set is $\{5\}$.

3.

$$\begin{aligned}\frac{x-3}{4}&=\frac{5}{14}-\frac{x+5}{7}\\28\cdot\frac{x-3}{4}&=28\left(\frac{5}{14}-\frac{x+5}{7}\right)\\7(x-3)&=2(5)-4(x+5)\\7x-21&=10-4x-20\\7x-21&=-4x-10\\7x+4x&=-10+21\\11x&=11\\\frac{11x}{11}&=\frac{11}{11}\\x&=1\end{aligned}$$

Check:

$$\begin{aligned}\frac{x-3}{4}&=\frac{5}{14}-\frac{x+5}{7}\\\frac{1-3}{4}&=\frac{5}{14}-\frac{1+5}{7}\\\frac{-2}{4}&=\frac{5}{14}-\frac{6}{7}\\-\frac{1}{2}&=-\frac{1}{2}\end{aligned}$$

The solution set is $\{1\}$.

4.

$$\begin{aligned}\frac{5}{2x}&=\frac{17}{18}-\frac{1}{3x},\ x\neq 0\\18x\cdot\frac{5}{2x}&=18x\left(\frac{17}{18}-\frac{1}{3x}\right)\\18\cdot\frac{5}{2x}&=18x\cdot\frac{17}{18}-18x\cdot\frac{1}{3x}\\45&=17x-6\\45+6&=17x-6+6\\51&=17x\\\frac{51}{17}&=\frac{17x}{17}\\3&=x\end{aligned}$$

The solution set is $\{3\}$.

5.

$$\begin{aligned}\frac{x}{x-2}&=\frac{2}{x-2}-\frac{2}{3},\quad x\neq 2\\3(x-2)\cdot\frac{x}{x-2}&=3(x-2)\left[\frac{2}{x-2}-\frac{2}{3}\right]\\3(x-2)\cdot\frac{x}{x-2}&=3(x-2)\cdot\frac{2}{x-2}-3(x-2)\cdot\frac{2}{3}\\3x&=6-(x-2)\cdot 2\\3x&=6-2(x-2)\\3x&=6-2x+4\\3x&=10-2x\\3x+2x&=10-2x+2x\\5x&=10\\\frac{5x}{5}&=\frac{10}{5}\\x&=2\end{aligned}$$

The solution set is the empty set, $\varnothing$.

6. Set $y_1=y_2$.

$$\begin{aligned}\frac{1}{x+4}+\frac{1}{x-4}&=\frac{22}{x^2-16}\\\frac{1}{x+4}+\frac{1}{x-4}&=\frac{22}{(x+4)(x-4)}\\\frac{(x+4)(x-4)}{x+4}+\frac{(x+4)(x-4)}{x-4}&=\frac{22(x+4)(x-4)}{(x+4)(x-4)}\\(x-4)+(x+4)&=22\\x-4+x+4&=22\\2x&=22\\x&=11\end{aligned}$$

Check:

$$\begin{aligned}\frac{1}{x+4}+\frac{1}{x-4}&=\frac{22}{x^2-16}\\\frac{1}{11+4}+\frac{1}{11-4}&=\frac{22}{11^2-16}\\\frac{1}{15}+\frac{1}{7}&=\frac{22}{105}\\\frac{22}{105}&=\frac{22}{105}\quad\text{true}\end{aligned}$$

7.

$$\begin{aligned}4x-7&=4(x-1)+3\\4x-7&=4(x-1)+3\\4x-7&=4x-4+3\\4x-7&=4x-1\\-7&=-1\end{aligned}$$

The original equation is equivalent to the statement $-7=-1$, which is false for every value of x.
The solution set is the empty set, $\varnothing$.
The equation is an inconsistent equation.

8. $7x+9=9(x+1)-2x$

$$7x+9=9(x+1)-2x$$
$$7x+9=9x+9-2x$$
$$7x+9=7x+9$$
$$9=9$$

The original equation is equivalent to the statement $9=9$, which is true for every value of x.

The equation is an identity, and all real numbers are solutions. The solution set $\{x|x \text{ is a real number}\}$.

9. $D=\frac{10}{9}x+\frac{53}{9}$

$$10=\frac{10}{9}x+\frac{53}{9}$$
$$9\cdot 10=9\left(\frac{10}{9}x+\frac{53}{9}\right)$$
$$90=10x+53$$
$$90-53=10x+53-53$$
$$37=10x$$
$$\frac{37}{10}=\frac{10x}{10}$$
$$3.7=x$$
$$x=3.7$$

The formula indicates that if the low-humor group averages a level of depression of 10 in response to a negative life event, the intensity of that event is 3.7. This is shown as the point whose corresponding value on the vertical axis is 10 and whose value on the horizontal axis is 3.7.

Concept and Vocabulary Check 1.2

C1. linear

C2. equivalent

C3. apply the distributive property

C4. least common denominator**;** 12

C5. 0

C6. $2x$

C7. $(x+5)(x+1)$

C8. $x \neq 2$ **;** $x \neq 4$

C9. $5(x+3)+3(x+4)=12x+9$

C10. identity

C11. inconsistent

Exercise Set 1.2

1. $4x+9=33$

$$4x=24$$
$$x=6$$

Check:

$$4x+9=33$$
$$4(6)+9=33$$
$$24+9=33$$
$$33=33$$

The solution set is $\{6\}$.

2. $3x+11=53$

$$3x=42$$
$$x=14$$

Check:

$$3x+11=53$$
$$3(14)+11=53$$
$$42+11=53$$
$$53=53$$

The solution set is $\{14\}$.

3. $7x-5=72$

$$7x=77$$
$$x=11$$

Check:

$$7x-5=72$$
$$7(11)-5=72$$
$$77-5=72$$
$$72=72$$

The solution set is $\{11\}$.

4. $6x-3=63$

$$6x=66$$
$$x=11$$

The solution set is $\{11\}$.

Check:

$$6x-3=63$$
$$6(11)-3=63$$
$$66-3=63$$
$$63=63$$

5. $3(x-1)=21$

$3x-3=21$

$3x=24$

$x=8$

Check:

$3(x-1)=21$

$3(8-1)=21$

$3(7)=21$

$21=21$

The solution set is $\{8\}$.

6. $4(x+3)=40$

$4x+12=40$

$4x=28$

$x=7$

Check:

$4(x+3)=40$

$4(7+3)=40$

$4(10)=40$

$40=40$

The solution set is $\{11\}$.

7. $11x-(6x-5)=40$

$11x-6x+5=40$

$5x+5=40$

$5x=35$

$x=7$

The solution set is $\{7\}$.

Check:

$11x-(6x-5)=40$

$11(7)-[6(7)-5]=40$

$77-(42-5)=40$

$77-(37)=40$

$40=40$

8. $5x-(2x-10)=35$

$5x-2x+10=35$

$3x+10=35$

$3x=25$

$x=\frac{25}{3}$

The solution set is $\left\{\frac{25}{3}\right\}$.

Check:

$5x-(2x-10)=35$

$5\left(\frac{25}{3}\right)-\left[2\left(\frac{25}{3}\right)-10\right]=35$

$\frac{125}{3}-\left[\frac{50}{3}-10\right]=35$

$\frac{125}{3}-\frac{20}{3}=35$

$\frac{105}{3}=35$

$35=35$

9. $x-5(x+3)=13$

$x-5x-15=13$

$-4x=28$

$x=-7$

Check:

$x-5(x+3)=13$

$-7-5(-7+3)=13$

$-7-5(-4)=13$

$13=13$

The solution set is {-7}.

10. $x-6(x+1)=19$

$x-6x-6=19$

$-5x=25$

$x=-5$

Check:

$x-6(x+1)=19$

$-5-6(-5+1)=19$

$-5-6(-4)=19$

$19=19$

The solution set is {-5}.

11. $2x-7=6+x$

$x-7=6$

$x=13$

The solution set is $\{13\}$.

Check:

$2(13)-7=6+13$

$26-7=19$

$19=19$

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12. $3x + 5 = 2x + 13$
$x + 5 = 13$
$x = 8$
The solution set is $\{8\}$.

Check:
$$3x+5=2x+13$$
$$3(8)+5=2(8)+13$$
$$24+5=16+13$$
$$29=29$$

13. $7x + 4 = x + 16$
$6x + 4 = 16$
$6x = 12$
$x = 2$
The solution set is $\{2\}$.

Check:
$$7(2)+4=2+16$$
$$14+4=18$$
$$18=18$$

14. $13x + 14 = 12x - 5$
$x + 14 = -5$
$x = -19$
The solution set is $\{-19\}$.

Check:
$$13x+14=12x-5$$
$$13(-19)+14=12(-19)-5$$
$$-247+14=-228-5$$
$$-233=-233$$

15. $3(x-8)=x$
$3x-24=x$
$-24=-2x$
$12=x$
Check:
$$3(x-8)=x$$
$$3(12-8)=12$$
$$3(4)=12$$
$$12=12$$
The solution set is $\{12\}$.

16. $4(x+9)=x$
$4x+36=x$
$36=-3x$
$-12=x$
Check:
$$4(x+9)=x$$
$$4(-12+9)=-12$$
$$4(-3)=-12$$
$$-12=-12$$
The solution set is {-12}.

17. $2(x-5)=5(x+4)$
$2x-10=5x+20$
$-3x=30$
$x=-10$
Check:
$$2(x-5)=5(x+4)$$
$$2(-10-5)=5(-10+4)$$
$$2(-15)=5(-6)$$
$$-30=-30$$
The solution set is {-10}.

18. $3(x+7)=7(x-5)$
$3x+21=7x-35$
$-4x=-56$
$x=14$
Check:
$$3(x+7)=7(x-5)$$
$$3(14+7)=7(14-5)$$
$$3(21)=7(9)$$
$$63=63$$
The solution set is $\{14\}$.

19. $3(x - 2) + 7 = 2(x + 5)$
$3x - 6 + 7 = 2x + 10$
$3x + 1 = 2x + 10$
$x + 1 = 10$
$x = 9$
The solution set is $\{9\}$.

Check:
$$3(9-2)+7=2(9+5)$$
$$3(7)+7=2(14)$$
$$21+7=28$$
$$28=28$$

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20. $2(x-1)+3=x-3(x+1)$

$2x-2+3=x-3x-3$

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

$4x+1=-3$

$4x=-4$

$x=-1$

The solution set is $\{-1\}$.

Check:

$$\begin{aligned}2(x-1)+3&=x-3(x+1)\\2(-1-1)+3&=-1-3(-1+1)\\2(-2)+3&=-1-3(0)\\-4+3&=-1+0\\-1&=-1\end{aligned}$$

21. $3(x-4)-4(x-3)=x+3-(x-2)$

$3x-12-4x+12=x+3-x+2$

$-x=5$

$x=-5$

The solution set is $\{-5\}$.

Check:

$$\begin{aligned}3(-5-4)-4(-5-3)&=-5+3-(-5-2)\\3(-9)-4(-8)&=-2-(-7)\\-27+32&=-2+7\\5&=5\end{aligned}$$

22. $2-(7x+5)=13-3x$

$2-7x-5=13-3x$

$-7x-3=13-3x$

$-4x=16$

$x=-4$

The solution set is $\{-4\}$.

Check:

$$\begin{aligned}2-(7x+5)&=13-3x\\2-[7(-4)+5]&=13-3(-4)\\2-[-28+5]&=13+12\\2-[-23]&=15\\2+23&=25\\25&=25\end{aligned}$$

23. $16=3(x-1)-(x-7)$

$16=3x-3-x+7$

$16=2x+4$

$12=2x$

$6=x$

The solution set is $\{6\}$.

Check:

$$\begin{aligned}16&=3(6-1)-(6-7)\\16&=3(5)-(-1)\\16&=15+1\\16&=16\end{aligned}$$

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24.
$$\begin{aligned}5x - (2x + 2) &= x + (3x - 5)\\ 5x - 2x - 2 &= x + 3x - 5\\ 3x - 2 &= 4x - 5\\ -x &= -3\\ x &= 3\end{aligned}$$

The solution set is {3}.

Check:

$$\begin{aligned}5x-\left(2x+2\right) &= x+\left(3x-5\right)\\ 5(3)-[2(3)+2] &= 3+[3(3)-5]\\ 15-[6+2] &= 3+[9-5]\\ 15-8 &= 3+4\\ 7 &= 7\end{aligned}$$

25.
$$\begin{aligned}25-[2+5y-3(y+2) &= -3(2y-5)-[5(y-1)-3y+3]\\ 25-[2+5y-3y-6] &= -6y+15-[5y-5-3y+3]\\ 25-[2y-4] &= -6y+15-[2y-2]\\ 25-2y+4 &= -6y+15-2y+2\\ -2y+29 &= -8y+17\\ 6y &= -12\\ y &= -2\end{aligned}$$

The solution set is {–2}.

Check:

$$\begin{aligned}25-[2+5y-3(y+2) &= -3(2y-5)-[5(y-1)-3y+3]\\ 25-[2+5(-2)-3(-2+2) &= -3[2(-2)-5]-[5(-2-1)-3(-2)+3]\\ 25-[2-10-3(0)] &= -3[-4-5]-[5(-3)+6+3]\\ 25-[-8] &= -3(-9)-[-15+9]\\ 25+8 &= 27-(-6)\\ 33 &= 27+6\\ 33 &= 33\end{aligned}$$

26.
$$\begin{aligned}45 - [4 - 2y - 4(y + 7)] &= -4(1 + 3y) - [4 - 3(y + 2) - 2(2y - 5)]\\ 45 - [4 - 2y - 4y - 28] &= -4 - 12y - [4 - 3y - 6 - 4y + 10]\\ 45 - [-6y - 24] &= -4 - 12y - [-7y + 8]\\ 45 + 6y + 24 &= -4 - 12y + 7y - 8\\ 6y + 69 &= -5y - 12\\ 11y &= -81\\ y &= -\frac{81}{11}\end{aligned}$$

The solution set is $\left\{-\frac{81}{11}\right\}$.

27. $\frac{x}{3}=\frac{x}{2}-2$

$6\left[\frac{x}{3}=\frac{x}{2}-2\right]$

$2x=3x-12$

$12=3x-2x$

$x=12$

The solution set is $\{12\}$.

28. $\frac{x}{5}=\frac{x}{6}+1$

$30\left[\frac{x}{5}=\frac{x}{6}+1\right]$

$6x=5x+30$

$6x-5x=30$

$x=30$

The solution set is $\{30\}$.

29. $20-\frac{x}{3}=\frac{x}{2}$

$6\left[20-\frac{x}{3}=\frac{x}{2}\right]$

$120-2x=3x$

$120=3x+2x$

$120=5x$

$x=\frac{120}{5}$

$x=24$

The solution set is $\{24\}$.

30. $\frac{x}{5}-\frac{1}{2}=\frac{x}{6}$

$30\left[\frac{x}{5}-\frac{1}{2}=\frac{x}{6}\right]$

$6x-15=5x$

$6x-5x=15$

$x=15$

The solution set is $\{15\}$.

31. $\frac{3x}{5}=\frac{2x}{3}+1$

$15\left[\frac{3x}{5}=\frac{2x}{3}+1\right]$

$9x=10x+15$

$9x-10x=15$

$-x=15$

$x=-15$

The solution set is $\{-15\}$.

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

$4\left[\frac{x}{2}=\frac{3x}{4}+5\right]$

$2x=3x+20$

$2x-3x=20$

$-x=20$

$x=-20$

The solution set is $\{-20\}$.

33. $\frac{3x}{5}-x=\frac{x}{10}-\frac{5}{2}$

$10\left[\frac{3x}{5}-x=\frac{x}{10}-\frac{5}{2}\right]$

$6x-10x=x-25$

$-4x-x=-25$

$-5x=-25$

$x=5$

The solution set is $\{5\}$.

34. $2x-\frac{2x}{7}=\frac{x}{2}+\frac{17}{2}$

$14\left[2x-\frac{2x}{7}=\frac{x}{2}+\frac{17}{2}\right]$

$28x-4x=7x+119$

$24x-7x=119$

$17x=119$

$x=7$

The solution set is $\{7\}$.

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35. $$\frac{x+3}{6}=\frac{3}{8}+\frac{x-5}{4}$$

$$24\left[\frac{x+3}{6}=\frac{3}{8}+\frac{x-5}{4}\right]$$

$$4x+12=9+6x-30$$

$$4x-6x=-21-12$$

$$-2x=-33$$

$$x=\frac{33}{2}$$

The solution set is $\left\{\frac{33}{2}\right\}$.

36. $$\frac{x+1}{4}=\frac{1}{6}+\frac{2-x}{3}$$

$$12\left[\frac{x+1}{4}=\frac{1}{6}+\frac{2-x}{3}\right]$$

$$3x+3=2+8-4x$$

$$3x+4x=10-3$$

$$7x=7$$

$$x=1$$

The solution set is $\{1\}$.

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

$$12\left[\frac{x}{4}=2+\frac{x-3}{3}\right]$$

$$3x = 24 + 4x - 12$$

$$3x - 4x = 12$$

$$-x = 12$$

$$x = -12$$

The solution set is $\{-12\}$.

38. $$5+\frac{x-2}{3}=\frac{x+3}{8}$$

$$24\left[5+\frac{x-2}{3}=\frac{x+3}{8}\right]$$

$$120+8x-16=3x+9$$

$$8x-3x=9-104$$

$$5x=-95$$

$$x=-19$$

The solution set is $\{-19\}$.

39. $$\frac{x+1}{3}=5-\frac{x+2}{7}$$

$$21\left[\frac{x+1}{3}=5-\frac{x+2}{7}\right]$$

$$7x + 7 = 105 - 3x - 6$$

$$7x + 3x = 99 - 7$$

$$10x = 92$$

$$x=\frac{92}{10}$$

$$x=\frac{46}{5}$$

The solution set is $\left\{\frac{46}{5}\right\}$.

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

$$30\left[\frac{3x}{5}-\frac{x-3}{2}=\frac{x+2}{3}\right]$$

$$18x-15x+45=10x+20$$

$$3x-10x=20-45$$

$$-7x=-25$$

$$x=\frac{25}{7}$$

The solution set is $\left\{\frac{25}{7}\right\}$.

41. **a.** $$\frac{4}{x}=\frac{5}{2x}+3\ (x\neq 0)$$

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

$$8=5+6x$$

$$3=6x$$

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

The solution set is $\left\{\frac{1}{2}\right\}$.

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42. **a.** $\frac{5}{x}=\frac{10}{3x}+4\ (x\neq 0)$

b. $\frac{5}{x}=\frac{10}{3x}+4$

$15=10+12x$

$5=12x$

$x=\frac{5}{12}$

The solution set is $\left\{\frac{5}{12}\right\}$.

43. **a.** $\frac{2}{x}+3=\frac{5}{2x}+\frac{13}{4}\ (x\neq 0)$

b. $\frac{2}{x}+3=\frac{5}{2x}+\frac{13}{4}$

$8+12x=10+13x$

$-x=2$

$x=-2$

The solution set is $\{-2\}$.

44. **a.** $\frac{7}{2x}-\frac{5}{3x}=\frac{22}{3}\ (x\neq 0)$

b. $\frac{7}{2x}-\frac{5}{3x}=\frac{22}{3}$

$21-10=44x$

$11=44x$

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

The solution set is $\left\{\frac{1}{4}\right\}$.

45. **a.** $\frac{2}{3x}+\frac{1}{4}=\frac{11}{6x}-\frac{1}{3}\ (x\neq 0)$

b. $\frac{2}{3x}+\frac{1}{4}=\frac{11}{6x}-\frac{1}{3}$

$8+3x=22-4x$

$7x=14$

$x=2$

The solution set is $\{2\}$.

46. **a.** $\frac{5}{2x}-\frac{8}{9}=\frac{1}{18}-\frac{1}{3x}\ (x\neq 0)$

b. $\frac{5}{2x}-\frac{8}{9}=\frac{1}{18}-\frac{1}{3x}$

$45-16x=x-6$

$-17x=-51$

$x=3$

The solution set is $\{3\}$.

47. **a.** $\frac{x-2}{2x}+1=\frac{x+1}{x}\quad (x\neq 0)$

b. $\frac{x-2}{2x}+1=\frac{x+1}{x}$

$x-2+2x=2x+2$

$x-2=2$

$x=4$

The solution set is $\{4\}$.

48. **a.** $\frac{4}{x}=\frac{9}{5}-\frac{7x-4}{5x}\quad (x\neq 0)$

b. $\frac{4}{x}=\frac{9}{5}-\frac{7x-4}{5x}$

$20=9x-7x+4$

$16=2x$

$8=x$

The solution set is $\{8\}$.

49. **a.** $\frac{1}{x-1}+5=\frac{11}{x-1}\ (x\neq 1)$

b. $\frac{1}{x-1}+5=\frac{11}{x-1}$

$1+5(x-1)=11$

$1+5x-5=11$

$5x-4=11$

$5x=15$

$x=3$

The solution set is $\{3\}$.

50. **a.** $\frac{3}{x+4}-7=\frac{-4}{x+4}\ (x\neq -4)$

b. $\frac{3}{x+4}-7=\frac{-4}{x+4}$

$3-7(x+4)=-4$

$3-7x-28=-4$

$-7x=21$

$x=-3$

The solution set is $\{-3\}$.

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51. **a.** $\frac{8x}{x+1} = 4 - \frac{8}{x+1}\ (x \neq -1)$

b. $\frac{8x}{x+1} = 4 - \frac{8}{x+1}$

$$8x = 4(x+1) - 8$$
$$8x = 4x + 4 - 8$$
$$4x = -4$$
$$x = -1 \Rightarrow \text{ no solution}$$

The solution set is the empty set, $\varnothing$.

52. **a.** $\frac{2}{x-2} = \frac{x}{x-2} - 2\ (x \neq 2)$

b. $\frac{2}{x-2} = \frac{x}{x-2} - 2$

$$2 = x - 2(x-2)$$
$$2 = x - 2x + 4$$
$$x = 2 \Rightarrow \text{ no solution}$$

The solution set is the empty set, $\varnothing$.

53. **a.** $\frac{3}{2x-2} + \frac{1}{2} = \frac{2}{x-1}\ (x \neq 1)$

b. $\frac{3}{2x-2} + \frac{1}{2} = \frac{2}{x-1}$

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

The solution set is $\{2\}$.

54. **a.** $\frac{3}{x+3} = \frac{5}{2x+6} + \frac{1}{x-2}\ (x \neq -3, x \neq 2)$

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

$$6(x-2) = 5(x-2) + 2(x+3)$$
$$6x - 12 = 5x - 10 + 2x + 6$$
$$-x = 8$$
$$x = -8$$

The solution set is $\{-8\}$.

55. **a.** $\frac{3}{x+2} + \frac{2}{x-2} = \frac{8}{(x+2)(x-2)}; (x \neq -2, 2)$

b. $\frac{3}{x+2} + \frac{2}{x-2} = \frac{8}{(x+2)(x-2)}$

$$(x \neq 2, x \neq -2)$$
$$3(x-2) + 2(x+2) = 8$$
$$3x - 6 + 2x + 4 = 8$$
$$5x = 10$$
$$x = 2 \Rightarrow \text{ no solution}$$

The solution set is the empty set, $\varnothing$.

56. **a.** $\frac{5}{x+2} + \frac{3}{x-2} = \frac{12}{(x+2)(x-2)}$

$$(x \neq 2, x \neq -2)$$

b. $\frac{5}{x+2} + \frac{3}{x-2} = \frac{12}{(x+2)(x-2)}$

$$5(x-2) + 3(x+2) = 12$$
$$5x - 10 + 3x + 6 = 12$$
$$8x = 16$$
$$x = 2 \Rightarrow \text{ no solution}$$

The solution set is the empty set, $\varnothing$.

57. **a.** $\frac{2}{x+1} - \frac{1}{x-1} = \frac{2x}{x^2-1}\ (x \neq 1, x \neq -1)$

b.

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

The solution set is $\{-3\}$.

58. **a.** $\frac{4}{x+5} + \frac{2}{x-5} = \frac{32}{x^2-25};\ x \neq 5, -5$

b. $\frac{4}{x+5} + \frac{2}{x-5} = \frac{32}{(x+5)(x-5)}$

$$(x \neq 5, x \neq -5)$$
$$4(x-5) + 2(x+5) = 32$$
$$4x - 20 + 2x + 10 = 32$$
$$6x = 42$$
$$x = 7$$

The solution set is $\{7\}$.

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59. **a.** $\frac{1}{x-4}-\frac{5}{x+2}=\frac{6}{(x-4)(x+2)};(x \neq -2,4)$

b.
$$\frac{1}{x-4}-\frac{5}{x+2}=\frac{6}{x^2-2x-8}$$
$$\frac{1}{x-4}-\frac{5}{x+2}=\frac{6}{(x-4)(x+2)}$$
$$(x \neq 4, x \neq -2)$$
$$1(x+2)-5(x-4)=6$$
$$x+2-5x+20=6$$
$$-4x=-16$$
$$x=4 \Rightarrow \text{ no solution}$$
The solution set is the empty set, $\varnothing$.

60. **a.** $\frac{6}{x+3}-\frac{5}{x-2}=\frac{-20}{x^2+x-6};\ x \neq -3,2$

b.
$$\frac{6}{x+3}-\frac{5}{x-2}=\frac{-20}{(x-2)(x+3)}$$
$$(x \neq -3, x \neq 2)$$
$$6(x-2)-5(x+3)=-20$$
$$6x-12-5x-15=-20$$
$$x=7$$
The solution set is $\{7\}$.

61. Set $y_1=y_2$.
$$5(2x-8)-2=5(x-3)+3$$
$$10x-40-2=5x-15+3$$
$$10x-42=5x-12$$
$$10x-5x=-12+42$$
$$5x=30$$
$$x=6$$
The solution set is $\{6\}$.

62. Set $y_1=y_2$.
$$7(3x-2)+5=6(2x-1)+24$$
$$21x-14+5=12x-6+24$$
$$21x-9=12x+18$$
$$21x-12x=18+9$$
$$9x=27$$
$$x=3$$
The solution set is $\{3\}$.

63. Set $y_1-y_2=1$.
$$\frac{x-3}{5}-\frac{x-5}{4}=1$$
$$20\cdot\frac{x-3}{5}-20\cdot\frac{x-5}{4}=20\cdot 1$$
$$4(x-3)-5(x-5)=20$$
$$4x-12-5x+25=20$$
$$-x+13=20$$
$$-x=7$$
$$x=-7$$
The solution set is $\{-7\}$.

64. Set $y_1-y_2=-4$.
$$\frac{x+1}{4}-\frac{x-2}{3}=-4$$
$$12\cdot\frac{x+1}{4}-12\cdot\frac{x-2}{3}=12(-4)$$
$$3(x+1)-4(x-2)=-48$$
$$3x+3-4x+8=-48$$
$$-x+11=-48$$
$$-x=-59$$
$$x=59$$
The solution set is $\{59\}$.

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65. Set $y_1 + y_2 = y_3$.

$$\begin{aligned}
\frac{5}{x+4}+\frac{3}{x+3}&=\frac{12x+19}{x^2+7x+12}\\
\frac{5}{x+4}+\frac{3}{x+3}&=\frac{12x+19}{(x+4)(x+3)}\\
(x+4)(x+3)\left(\frac{5}{x+4}+\frac{3}{x+3}\right)&=(x+4)(x+3)\frac{12x+19}{(x+4)(x+3)}\\
5(x+3)+3(x+4)&=12x+19\\
5x+15+3x+12&=12x+19\\
8x+27&=12x+19\\
-4x&=-8\\
x&=2
\end{aligned}$$

The solution set is $\{2\}$.

66. Set $y_1 + y_2 = y_3$.

$$\begin{aligned}
\frac{2x-1}{x^2+2x-8}+\frac{2}{x+4}&=\frac{1}{x-2}\\
\frac{2x-1}{(x+4)(x-2)}+\frac{2}{x+4}&=\frac{1}{x-2}\\
(x+4)(x-2)\left(\frac{2x-1}{(x+4)(x-2)}+\frac{2}{x+4}\right)&=(x+4)(x-2)\frac{1}{x-2}\\
2x-1+2(x-2)&=x+4\\
2x-1+2x-4&=x+4\\
4x-5&=x+4\\
3x&=9\\
x&=3
\end{aligned}$$

The solution set is $\{3\}$.

67.

$$\begin{aligned}
0&=4[x-(3-x)]-7(x+1)\\
0&=4[x-3+x]-7x-7\\
0&=4[2x-3]-7x-7\\
0&=8x-12-7x-7\\
0&=x-19\\
-x&=-19\\
x&=19
\end{aligned}$$

The solution set is $\{19\}$.

68.

$$\begin{aligned}
0&=2[3x-(4x-6)]-5(x-6)\\
0&=2[3x-4x+6]-5x+30\\
0&=2[-x+6]-5x+30\\
0&=-2x+12-5x+30\\
0&=-7x+42\\
7x&=42\\
x&=6
\end{aligned}$$

The solution set is $\{6\}$.

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69.
$$\begin{aligned}
0 &= \frac{x+6}{3x-12}-\frac{5}{x-4}-\frac{2}{3}\\
0 &= \frac{x+6}{3(x-4)}-\frac{5}{x-4}-\frac{2}{3}\\
3(x-4)\cdot 0 &= 3(x-4)\left(\frac{x+6}{3(x-4)}-\frac{5}{x-4}-\frac{2}{3}\right)\\
0 &= \frac{3(x-4)(x+6)}{3(x-4)}-\frac{5\cdot 3(x-4)}{x-4}-\frac{2\cdot 3(x-4)}{3}\\
0 &= (x+6)-15-2(x-4)\\
0 &= x+6-15-2x+8\\
0 &= -x-1\\
x &= -1
\end{aligned}$$

The solution set is $\{-1\}$.

70.
$$\begin{aligned}
0 &= \frac{1}{5x+5}-\frac{3}{x+1}+\frac{7}{5}\\
0 &= \frac{1}{5(x+1)}-\frac{3}{x+1}+\frac{7}{5}\\
5(x+1)\cdot 0 &= 5(x+1)\left(\frac{1}{5(x+1)}-\frac{3}{x+1}+\frac{7}{5}\right)\\
0 &= \frac{1\cdot 5(x+1)}{5(x+1)}-\frac{3\cdot 5(x+1)}{x+1}+\frac{7\cdot 5(x+1)}{5}\\
0 &= 1-15+7(x+1)\\
0 &= 1-15+7x+7\\
0 &= -7+7x\\
-7x &= -7\\
x &= 1
\end{aligned}$$

The solution set is $\{1\}$.

71.
$$\begin{aligned}
5x+9 &= 9(x+1)-4x\\
5x+9 &= 9x+9-4x\\
5x+9 &= 5x+9\\
9 &= 9
\end{aligned}$$

The solution set $\{x|x \text{ is a real number}\}$.

The given equation is an identity.

72.
$$\begin{aligned}
4x+7 &= 7(x+1)-3x\\
4x+7 &= 7x+7-3x\\
4x+7 &= 4x+7\\
7 &= 7
\end{aligned}$$

The solution set $\{x|x \text{ is a real number}\}$.

The given equation is an identity.

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73. $3(x+2)=7+3x$
$3x+6=7+3x$
$6=7$
The solution set $\varnothing$.
The given equation is an inconsistent equation.

74. $4(x+5)=21+4x$
$4x+20=21+4x$
$20=21$
The solution set $\varnothing$.
The given equation is an inconsistent equation.

75. $10x+3=8x+3$
$2x+3=3$
$2x=0$
$x=0$
The solution set $\{0\}$.
The given equation is a conditional equation.

76. $5x+7=2x+7$
$3x+7=7$
$3x=0$
$x=0$
The solution set $\{0\}$.
The given equation is a conditional equation.

77. $\frac{2x}{x-3}=\frac{6}{x-3}+4$
$2x=6+4(x-3)$
$2x=6+4x-12$
$-2x=-6$
$x=3\Rightarrow$ no solution
The given equation is an inconsistent equation.

78. $\frac{3}{x-3}=\frac{x}{x-3}+3$
$3=x+3(x-3)$
$3=x+3x-9$
$-4x=-12$
$x=3\Rightarrow$ no solution
The given equation is an inconsistent equation.

79. $\frac{x+5}{2}-4=\frac{2x-1}{3}$
$3(x+5)-24=2(2x-1)$
$3x+15-24=4x-2$
$-x=7$
$x=-7$
The solution set is $\{-7\}$.
The given equation is a conditional equation.

80. $\frac{x+2}{7}=5-\frac{x+1}{3}$
$3(x+2)=105-7(x+1)$
$3x+6=105-7x-7$
$10x=92$
$x=\frac{92}{10}$
$x=\frac{46}{5}$
The solution set is $\left\{\frac{46}{5}\right\}$.
The given equation is a conditional equation.

81. $\frac{2}{x-2}=3+\frac{x}{x-2}$
$2=3(x-2)+x$
$2=3x-6+x$
$-4x=-8$
$x=2\Rightarrow$ no solution
The solution set is the empty set, $\varnothing$.
The given equation is an inconsistent equation.

82. $\frac{6}{x+3}+2=\frac{-2x}{x+3}$
$6+2(x+3)=-2x$
$6+2x+6=-2x$
$4x=-12$
$x=-3\Rightarrow$ no solution
This equation is not true for any real numbers.
The given equation is an inconsistent equation.

83. $8x-(3x+2)+10=3x$
$8x-3x-2+10=3x$
$2x=-8$
$x=-4$
The solution set is $\{-4\}$.
The given equation is a conditional equation.

84. $2(x + 2) + 2x = 4(x + 1)$

$2x + 4 + 2x = 4x + 4$

$0 = 0$

This equation is true for all real numbers.
The given equation is an identity.

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

$8+2x=3x$

$-x=-8$

$x=8$

The solution set is $\{8\}$.
The given equation is a conditional equation.

86. $\frac{3}{x}-\frac{1}{6}=\frac{1}{3}$

$18-x=2x$

$-3x=-18$

$x=6$

The solution set is $\{6\}$.
The given equation is a conditional equation.

87. $\frac{4}{x-2}+\frac{3}{x+5}=\frac{7}{(x+5)(x-2)}$

$4(x+5)+3(x-2)=7$

$4x+20+3x-6=7$

$7x=-7$

$x=-1$

The solution set is $\{-1\}$.
The given equation is a conditional equation.

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

$1(2x+3)=1+4(x-1)$

$2x+3=1+4x-4$

$-2x=-6$

$x=3$

The solution set is $\{3\}$.
The given equation is a conditional equation.

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89.
$$\begin{aligned}
\frac{4x}{x+3}-\frac{12}{x-3}&=\frac{4x^2+36}{x^2-9};x\neq 3,-3\\
4x(x-3)-12(x+3)&=4x^2+36\\
4x^2-12x-12x-36&=4x^2+36\\
4x^2-24x-36&=4x^2+36\\
-24x-36&=36\\
-24x&=72\\
x&=-3 \quad \text{No solution}
\end{aligned}$$

The solution set is { }.
The given equation is an inconsistent equation.

90.
$$\frac{4}{x^2+3x-10}-\frac{1}{x^2+x-6}=\frac{3}{x^2-x-12}$$
$$\frac{4}{(x+5)(x-2)}-\frac{1}{(x+3)(x-2)}=\frac{3}{(x+3)(x-4)},x\neq -5,2,-3,4$$
$$4(x+3)(x-4)-1(x+5)(x-4)=3(x+5)(x-2)$$
$$4x^2-4x-48-x^2-x+20=3x^2+9x-30$$
$$3x^2-5x-28=3x^2+9x-30$$
$$2=14x$$
$$\frac{1}{7}=x$$

The solution set is $\left\{\frac{1}{7}\right\}$.
The given equation is a conditional equation.

91. The equation is $3(x-4)=3(2-2x)$, and the solution is $x=2$.

92. The equation is $3(2x-5)=5x+2$, and the solution is $x=17$.

93. The equation is $-3(x-3)=5(2-x)$, and the solution is $x=0.5$.

94. The equation is $2x-5=4(3x+1)-2$, and the solution is $x=-0.7$.

95. Solve: $4(x-2)+2=4x-2(2-x)$
$$\begin{aligned}
4x-8+2&=4x-4+2x\\
4x-6&=6x-4\\
-2x-6&=-4\\
-2x&=2\\
x&=-1
\end{aligned}$$
Now, evaluate x^2-x for $x=-1$:
$$\begin{aligned}
x^2-x&=(-1)^2-(-1)\\
&=1-(-1)=1+1=2
\end{aligned}$$

96. Solve: $2(x-6)=3x+2(2x-1)$

$$\begin{aligned}2x-12&=3x+4x-2\\2x-12&=7x-2\\-5x-12&=-2\\-5x&=10\\x&=-2\end{aligned}$$

Now, evaluate x^2-x for $x=-2$:

$$\begin{aligned}x^2-x&=(-2)^2-(-2)\\&=4-(-2)=4+2=6\end{aligned}$$

97. Solve for x: $\dfrac{3(x+3)}{5}=2x+6$

$$\begin{aligned}3(x+3)&=5(2x+6)\\3x+9&=10x+30\\-7x+9&=30\\-7x&=21\\x&=-3\end{aligned}$$

Solve for y: $-2y-10=5y+18$

$$\begin{aligned}-7y-10&=18\\-7y&=28\\y&=-4\end{aligned}$$

Now, evaluate $x^2-(xy-y)$ for $x=-3$ and $y=-4$:

$$\begin{aligned}&x^2-(xy-y)\\&=(-3)^2-[-3(-4)-(-4)]\\&=(-3)^2-[12-(-4)]\\&=9-(12+4)=9-16=-7\end{aligned}$$

98. Solve for x: $\dfrac{13x-6}{4}=5x+2$

$$\begin{aligned}13x-6&=4(5x+2)\\13x-6&=20x+8\\-7x-6&=8\\-7x&=14\\x&=-2\end{aligned}$$

Solve for y: $5-y=7(y+4)+1$

$$\begin{aligned}5-y&=7y+28+1\\5-y&=7y+29\\5-8y&=29\\-8y&=24\\y&=-3\end{aligned}$$

Now, evaluate $x^2-(xy-y)$ for $x=-2$ and $y=-3$:

$$\begin{aligned}&x^2-(xy-y)\\&=(-2)^2-[-2(-3)-(-3)]\\&=(-2)^2-[6-(-3)]\\&=4-(6+3)=4-9=-5\end{aligned}$$

99.

$$\begin{aligned}\left[(3+6)^2\div 3\right]\cdot 4&=-54x\\(9^2\div 3)\cdot 4&=-54x\\(81\div 3)\cdot 4&=-54x\\27\cdot 4&=-54x\\108&=-54x\\-2&=x\end{aligned}$$

The solution set is $\{-2\}$.

100.

$$\begin{aligned}2^3-\left[4(5-3)^3\right]&=-8x\\8-\left[4(2)^3\right]&=-8x\\8-4\cdot 8&=-8x\\8-32&=-8x\\-24&=-8x\\3&=x\end{aligned}$$

The solution set is $\{3\}$.

101.

$$\begin{aligned}5-12x&=8-7x-\left[6\div 3(2+5^3)+5x\right]\\5-12x&=8-7x-\left[6\div 3(2+125)+5x\right]\\5-12x&=8-7x-[6\div 3\cdot 127+5x]\\5-12x&=8-7x-[2\cdot 127+5x]\\5-12x&=8-7x-[254+5x]\\5-12x&=8-7x-254-5x\\5-12x&=-12x-246\\5&=-246\end{aligned}$$

The final statement is a contradiction, so the equation has no solution. The solution set is $\varnothing$.

102.

$$\begin{aligned}2(5x+58)&=10x+4(21\div 3.5-11)\\10x+116&=10x+4(6-11)\\10x+116&=10x+4(-5)\\10x+116&=10x-20\\116&=-20\end{aligned}$$

The final statement is a contradiction, so the equation has no solution. The solution set is $\varnothing$.

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103.

$$\begin{aligned}0.7x+0.4(20)&=0.5(x+20)\\0.7x+8&=0.5x+10\\0.2x+8&=10\\0.2x&=2\\x&=10\end{aligned}$$

The solution set is $\{10\}$.

104.

$$\begin{aligned}0.5(x+2)&=0.1+3(0.1x+0.3)\\0.5x+1&=0.1+0.3x+0.9\\0.5x+1&=0.3x+1\\0.2x+1&=1\\0.2x&=0\\x&=0\end{aligned}$$

The solution set is $\{0\}$.

105.

$$\begin{aligned}4x+13-\{2x-[4(x-3)-5]\}&=2(x-6)\\4x+13-\{2x-[4x-12-5]\}&=2x-12\\4x+13-\{2x-[4x-17]\}&=2x-12\\4x+13-\{2x-4x+17\}&=2x-12\\4x+13-\{-2x+17\}&=2x-12\\4x+13+2x-17&=2x-12\\6x-4&=2x-12\\4x-4&=-12\\4x&=-8\\x&=-2\end{aligned}$$

The solution set is $\{-2\}$.

106.

$$\begin{aligned}-2\{7-[4-2(1-x)+3]\}&=10-[4x-2(x-3)]\\-2\{7-[4-2+2x+3]\}&=10-[4x-2x+6]\\-2\{7-[2x+5]\}&=10-[2x+6]\\-2\{7-2x-5\}&=10-2x-6\\-2\{-2x+2\}&=-2x+4\\4x-4&=-2x+4\\6x-4&=4\\6x&=8\\x&=\frac{8}{6}=\frac{4}{3}\end{aligned}$$

The solution set is $\left\{\frac{4}{3}\right\}$.

107. a.

$$\begin{aligned}p&=\frac{4x}{5}+25\\p&=\frac{4(30)}{5}+25\\p&=24+25\\p&=49\end{aligned}$$

According to the model, 49% of U.S. college freshman had an average grade of A in high school in 2010. This overestimates the value shown in the bar graph by 1%.

b.

$$\begin{aligned}p&=\frac{4x}{5}+25\\57&=\frac{4x}{5}+25\\32&=\frac{4x}{5}\\160&=4x\\40&=x\end{aligned}$$

According to the model, 57% of U.S. college freshman will have an average grade of A in high school 40 years after 1980, or 2020.

108. a.

$$\begin{aligned}p&=\frac{4x}{5}+25\\p&=\frac{4(20)}{5}+25\\p&=16+25\\p&=41\end{aligned}$$

According to the model, 41% of U.S. college freshman had an average grade of A in high school in 2000. This underestimates the value shown in the bar graph by 2%.

b.

$$\begin{aligned}p&=\frac{4x}{5}+25\\65&=\frac{4x}{5}+25\\40&=\frac{4x}{5}\\200&=4x\\50&=x\end{aligned}$$

According to the model, 65% of U.S. college freshman will have an average grade of A in high school 50 years after 1980, or 2030.

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109. **a.** What cost \$100 in 1999 would cost about \$140 in 2018.

b. $C = 1.9x + 125.5$

$= 1.9(8) + 125.5$

$\approx \$141$

It describes the estimate from part (a) reasonably well.

c. $C = 0.02x^2 + 1.7x + 125.7$

$= 0.02(8)^2 + 1.7(8) + 125.7$

$= \$141$

It describes the estimate from part (a) reasonably well.

110. **a.** What cost \$100 in 1999 would cost about \$130 in 2012.

b. $C = 1.9x + 125.5$

$= 1.9(2) + 125.5$

$\approx \$129$

It describes the estimate from part (a) reasonably well.

c. $C = 0.02x^2 + 1.7x + 125.7$

$= 0.02(2)^2 + 1.7(2) + 125.7$

$= \$129$

It describes the estimate from part (a) reasonably well.

111.

$$\begin{aligned} C &= 1.9x + 125.5 \\ 160 &= 1.9x + 125.5 \\ 34.5 &= 1.9x \\ 18 &\approx x \end{aligned}$$

Model 1 predicts the cost will be \$160 18 years after 2010, or 2028.

112.

$$\begin{aligned} C &= 1.9x + 125.5 \\ 175 &= 1.9x + 125.5 \\ 49.5 &= 1.9x \\ 26 &\approx x \end{aligned}$$

Model 1 predicts the cost will be \$175 26 years after 2010, or 2036.

113. 11 learning trials; represented by the point $(11, 0.95)$ on the graph.

114. 1 learning trial; represented by the point $(1, 0.5)$ on the graph.

115.

$$\begin{aligned} C &= \frac{x + 0.1(500)}{x + 500} \\ 0.28 &= \frac{x + 0.1(500)}{x + 500} \\ 0.28(x + 500) &= x + 0.1(500) \\ 0.28x + 140 &= x + 50 \\ -0.72x &= -90 \\ \frac{-0.72x}{-0.72} &= \frac{-90}{-0.72} \\ x &= 125 \end{aligned}$$

125 liters of pure peroxide must be added.

116. **a.** $C = \dfrac{x + 0.35(200)}{x + 200}$

b.

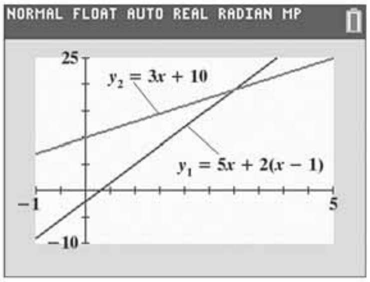
$$\begin{aligned} 0.74 &= \frac{x + 0.35(200)}{x + 200} \\ 0.74(x + 200) &= x + 0.35(200) \\ 0.74x + 148 &= x + 70 \\ -0.26x &= -78 \\ \frac{-0.26x}{-0.26} &= \frac{-78}{-0.26} \\ x &= 300 \end{aligned}$$

300 liters of pure acid must be added.

117. – 125. Answers will vary.

126. $5x + 2(x - 1) = 3x + 10$

Let $y_1 = 5x + 2(x - 1)$ and let $y_2 = 3x + 10$.



The solution set is $\{3\}$.

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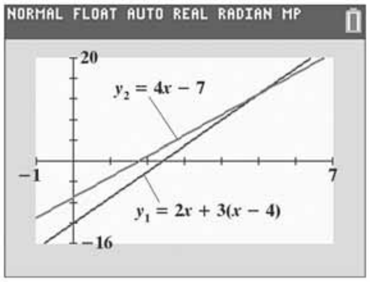
127. $2x+3(x-4)=4x-7$

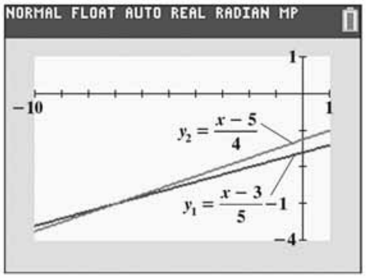
Let $y_1=2x+3(x-4)$ and let $y_2=4x-7$.



The solution set is $\{5\}$.

128. $\frac{x-3}{5}-1=\frac{x-5}{4}$

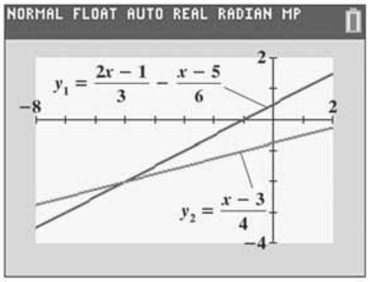
Let $y_1=\frac{x-3}{5}-1$ and let $y_2=\frac{x-5}{4}$.



The solution set is $\{-7\}$.

129. $\frac{2x-1}{3}-\frac{x-5}{6}=\frac{x-3}{4}$

Let $y_1=\frac{2x-1}{3}-\frac{x-5}{6}$ and let $y_2=\frac{x-3}{4}$.



The solution set is $\{-5\}$.

130. does not make sense; Explanations will vary. Sample explanation: Substitute $n=40$ into the equation to find p.

131. makes sense

132. makes sense

133. makes sense

134. false; Changes to make the statement true will vary. A sample change is: $x=0$ is a solution.

135. false; Changes to make the statement true will vary. A sample change is: In the first equation, $x \neq 4$.

136. true

137. false; Changes to make the statement true will vary. A sample change is: If $a = 0$, then $ax + b = 0$ is equivalent to $b = 0$, which either has no solution ($b \neq 0$) or infinitely many solutions ($b = 0$).

138. Answers will vary.

139.
$$\frac{7x+4}{b}+13=x$$
$$\frac{7(-6)+4}{b}+13=-6$$
$$\frac{-42+4}{b}+13=-6$$
$$\frac{-38}{b}+13=-6$$
$$\frac{-38}{b}=-19$$
$$-38=-19b$$
$$b=2$$

140. $\frac{4x-b}{x-5}=3$

$4x-b=3(x-5)$

The solution set will be $\varnothing$ if $x = 5$.

$$4(5)-b=3(5-5)$$
$$20-b=0$$
$$20=b$$
$$b=20$$

141. $x+150$

142. $20+0.99x$

143. $4x+400$

Section 1.3

Check Point Exercises

1. Let x = the average yearly salary, in thousands, of a full-time worker with an associate's degree
Let x + 15 = the average yearly salary, in thousands, of a full-time worker with a bachelor's degree
Let x + 30 = the average yearly salary, in thousands, of a full-time worker with a master's degree

$$\begin{aligned} x+(x+15)+(x+30)&=195\\ x+x+15+x+30&=195\\ 3x+45&=195\\ 3x&=150\\ x&=50 \end{aligned}$$

$$\begin{aligned} x=50,&\text{ associate's degree: \$50,000}\\ x+15=65,&\text{ bachelor's degree: \$65,000}\\ x+30=80,&\text{ master's degree: \$80,000} \end{aligned}$$

2. Let x = the number of years after 1969.

$$\begin{aligned} 85-0.8x&=25\\ -0.8x&=25-85\\ -0.8x&=-60\\ x&=\frac{-60}{-0.8}\\ x&=75 \end{aligned}$$

25% of freshmen will respond this way 75 years after 1969, or 2044.

3. Let x = the number of bridge crossings at which the costs of the two plans are the same.

$$\overbrace{5x}^{\text{No Decal}} \;=\; \overbrace{25+3.75x}^{\text{Bar-Coded Decal}}$$

$$\begin{aligned} 5x-3.75x&=25\\ 1.25x&=25\\ x&=20 \end{aligned}$$

The two plans cost the same for 20 bridge crossings.

4. Let x = the laptop's price before the reduction.

$$\begin{aligned} x-0.30x&=840\\ 0.70x&=840\\ x&=\frac{840}{0.70}\\ x&=1200 \end{aligned}$$

Before the reduction the laptop's price was \$1200.

5. Let x = the amount invested at 0.9%.
Let 50,000 – x = the amount invested at 1.1%.

$$\begin{aligned} 0.009x+0.011(50,000-x)&=515\\ 0.009x+550-0.011x&=515\\ -0.02x+550&=515\\ -0.002x&=-35\\ x&=\frac{-35}{-0.002}\\ x&=17,500\\ 50,000-x&=32,500 \end{aligned}$$

\$17,500 was invested at 0.9% and \$32,500 was invested at 1.1%.

6. Let x = the width of the court.
Let x + 44 = the length of the court.

$$\begin{aligned} 2l+2w&=P\\ 2(x+44)+2x&=288\\ 2x+88+2x&=288\\ 4x+88&=288\\ 4x&=200\\ x&=\frac{200}{4}\\ x&=50\\ x+44&=94 \end{aligned}$$

The dimensions of the court are 50 feet by 94 feet.

7.

$$\begin{aligned} 2l+2w&=P\\ 2l+2w-2l&=P-2l\\ 2w&=P-2l\\ \frac{2w}{2}&=\frac{P-2l}{2}\\ w&=\frac{P-2l}{2} \end{aligned}$$

8.

$$\begin{aligned} P&=C+MC\\ P&=C(1+M)\\ \frac{P}{1+M}&=\frac{C(1+M)}{1+M}\\ \frac{P}{1+M}&=C\\ C&=\frac{P}{1+M} \end{aligned}$$

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Concept and Vocabulary Check 1.3

C1. $x+64$

C2. $31+2.4x$

C3. $19.99+1.07x$

C4. $x-0.15x$ or $0.85x$

C5. $0.012x+0.009(30,000-x)$

C6. isolated on one side

C7. factoring

Exercise Set 1.3

1. Let $x=$ the number of years spent watching TV.
Let $x+19=$ the number of years spent sleeping.

$$\begin{aligned} x+(x+19)&=37\\ x+x+19&=37\\ 2x+19&=37\\ 2x&=18\\ x&=9\\ x+19&=28 \end{aligned}$$

Americans will spend 9 years watching TV and 28 years sleeping.

2. Let $x=$ the number of years spent eating.
Let $x+24=$ the number of years spent sleeping.

$$\begin{aligned} x+(x+24)&=32\\ x+x+24&=32\\ 2x+24&=32\\ 2x&=8\\ x&=4\\ x+24&=28 \end{aligned}$$

Americans will spend 4 years eating and 28 years sleeping.

3. Let $x=$ the median yearly salary for a general manager with just a high school diploma.
Let $2x-31,000=$ the median yearly salary for a general manager with a bachelor's degree or higher.

$$\begin{aligned} x+(2x-31,000)&=149,300\\ x+2x-31,000&=149,300\\ 3x-31,000&=149,300\\ 3x&=180,300\\ x&=60,100\\ 2x-31,000&=89,200 \end{aligned}$$

The median yearly salary for a general manager with just a high school diploma is \$60,100 and for a general manager with a bachelor's degree or higher is \$89,200.

4. Let $x=$ the median yearly salary for a retail salesperson with just a high school diploma.
Let $2x-14,300=$ the median yearly salary for a retail salesperson with a bachelor's degree or higher.

$$\begin{aligned} x+(2x-14,300)&=79,900\\ x+2x-14,300&=79,900\\ 3x-14,300&=79,900\\ 3x&=94,200\\ x&=31,400\\ 2x-14,300&=48,500 \end{aligned}$$

The median yearly salary for a retail salesperson with just a high school diploma is \$31,400 and for a retail salesperson with a bachelor's degree or higher is \$48,500.

5. Let $x=$ the number of years after 2019.

$$\begin{aligned} 38,900+800x&=44,500\\ 800x&=5600\\ \frac{800x}{800}&=\frac{5600}{800}\\ x&=7 \end{aligned}$$

7 years after 2019, or in 2026, the average price of a new car will be \$44,500.

6. Let $x=$ the number of years after 2019.

$$\begin{aligned} 11.8+0.15x&=13\\ 0.15x&=1.2\\ \frac{0.15x}{0.15}&=\frac{1.2}{0.15}\\ x&=8 \end{aligned}$$

8 years after 2019, or in 2027, the average age of vehicles on U.S. roads will be 13 years.

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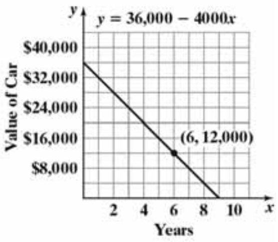
7. **a.** $y = 36,000 - 4000x$

b.
$$\begin{aligned} y &= 36,000 - 4000x \\ 12,000 &= 36,000 - 4000x \\ 12,000 - 36,000 &= -4000x \\ -24,000 &= -4000x \\ x &= \frac{-24,000}{-4000} \\ x &= 6 \end{aligned}$$

The car's value drops to $12,900 after 6 years.

c. Graph:

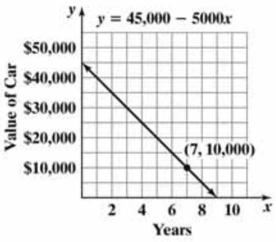


8. **a.** $y = 45,000 - 5000x$

b.
$$\begin{aligned} y &= 45,000 - 5000x \\ 10,000 &= 45,000 - 5000x \\ 10,000 - 45,000 &= -5000x \\ -35,000 &= -5000x \\ x &= \frac{-35,000}{-5000} \\ x &= 7 \end{aligned}$$

The car's value will drop to $10,000 after 7 years.

c. Graph:



9. Let x = the number of months.
The cost for Gym A: $25x + 40$
The cost for Gym B: $30x + 15$

$$\begin{aligned} 25x + 40 &= 30x + 15 \\ -5x + 40 &= 15 \\ -5x &= -25 \\ x &= 5 \end{aligned}$$

The total cost for the clubs will be the same at 5 months. The cost will be
$25(5) + 40 = 30(5) + 15 = \$165$

10. Let x = the number of kilometers.
The cost for a taxi in NYC: $1.56x + 3$
The cost for a taxi in Boston: $1.75x + 2.60$

$$\begin{aligned} 1.56x + 3 &= 1.75x + 2.60 \\ -0.19x + 3 &= 2.60 \\ -0.19x &= -0.40 \\ x &\approx 2 \end{aligned}$$

The total cost for the taxies will be the same at 2 kilometers. The cost will be
$$\begin{aligned} 1.56(2) + 3 &= 6.12 \\ 1.75(2) + 2.60 &= 6.10 \end{aligned}$$
NYC: $612; Boston: $6.10

11. Let x = the number of uses.
Cost without transponder: $(6.25 + 1.25)x$
Cost with transponder: $27.50 + 5x$

$$\begin{aligned} (6.25 + 1.25)x &= 27.50 + 5x \\ 7.5x &= 27.50 + 5x \\ 2.5x &= 27.50 \\ x &= 11 \end{aligned}$$

The bridge must be crossed 11 times for the costs to be equal.

12. Cost per use: $5x$
Cost with electronic pass: 30 + 0.7(5)x

$$\begin{aligned} 5x &= 30 + 3.50x \\ 1.50x &= 30 \\ x &= 20 \end{aligned}$$

The toll road must be used 20 times for the costs to be equal.

13. **a.** Let x = the number of years (after 2010).
College A's enrollment: $13,300 + 1000x$

College B's enrollment: $26,800 - 500x$

$$\begin{aligned} 13,300 + 1000x &= 26,800 - 500x \\ 13,300 + 1500x &= 26,800 \\ 1500x &= 13,500 \\ x &= 9 \end{aligned}$$

The two colleges will have the same enrollment 9 years after 2010, or 2019. That year the enrollment will be
$13,300 + 1000(9)$
$= 26,800 - 500(9)$
$= 22,300$ students

b. Check points to determine that $y_1 = 13,300 + 1000x$ and $y_2 = 26,800 - 500x$.

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14. Let x = the number of years after 2000

$$\begin{aligned}10,600,000-28,000x&=10,200,000-12,000x\\ -16,000x&=-400,000\\ x&=25\end{aligned}$$

The countries will have the same population 25 years after the year 2000, or the year 2025.

$$\begin{aligned}10,200,000-12,000x&=10,200,000-12,000(25)\\ &=10,200,000-300,000\\ &=9,900,000\end{aligned}$$

The population in the year 2025 will be 9,900,000.

15. Let x = the cost of the television set.

$$\begin{aligned}x-0.20x&=336\\ 0.80x&=336\\ x&=420\end{aligned}$$

The television set's price is \$420.

16. Let x = the cost of the earbuds.

$$\begin{aligned}x-0.30x&=90.30\\ 0.70x&=90.30\\ x&=129\end{aligned}$$

The earbuds' price before the reduction was \$129.

17. Let x = the nightly cost

$$\begin{aligned}x+0.105x&=216.58\\ 1.105x&=216.58\\ x&=196\end{aligned}$$

The nightly cost is \$196.

18. Let x = the nightly cost

$$\begin{aligned}x+0.174x&=287.63\\ 1.174x&=287.63\\ x&=245\end{aligned}$$

The nightly cost is \$245.

19. Let c = the dealer's cost

$$\begin{aligned}1198&=c+0.25c\\ 1198&=1.25c\\ 958.40&=c\end{aligned}$$

The dealer's cost is \$958.40.

20. Let c = the dealer's cost

$$\begin{aligned}15&=c+0.25c\\ 15&=1.25c\\ 12&=c\end{aligned}$$

The dealer's cost is \$12.

21. Let x = the amount invested at 1.45%.
Let $20,000-x$ = the amount invested at 1.59%.

$$\begin{aligned}0.0145x+0.0159(20,000-x)&=307.50\\ 0.0145x+318-0.0159x&=307.50\\ -0.0014x+318&=307.50\\ -0.0014x&=-10.50\\ x&=7500\\ 20,000-x&=12,500\end{aligned}$$

\$7500 was invested at 1.45% and \$12,500 was invested at 1.59%.

22. Let x = the amount invested at 2.19%.
Let $30,000-x$ = the amount invested at 2.45%.

$$\begin{aligned}0.0219x+0.0245(30,000-x)&=705.88\\ 0.0219x+735-0.0245x&=705.88\\ -0.0026x+735&=705.88\\ -0.0014x&=-29.12\\ x&=11,200\\ 30,000-x&=18,800\end{aligned}$$

\$11.200 was invested at 2.19% and \$18,800 was invested at 2.45%.

23. Let x = amount invested at 12%
$10,000-x$ = amount invested at 5% loss

$$\begin{aligned}0.12x-0.05(10,000-x)&=520\\ 0\ .12x-500+0.05x&=520\\ 0\ .17x&=1020\\ x&=6000\\ 8000\text{-}x&=2000\end{aligned}$$

\$6000 at 12%, \$4000 at 5% loss

24. Let x = amount at 15%
$15,000-x$ = amount at 7%

$$\begin{aligned}&0.15x-0.07(15,000-x)=1590\\ &0.15x-1050+0.07x=1590\\ &0.22x=2640\\ &x=12,000\\ &15,000-x=3000\end{aligned}$$

\$12,000 at 15%, \$3000 at 7% loss

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25. Let w = the width of the field
Let $2w$ = the length of the field

$P = 2(\text{length}) + 2(\text{width})$

$300 = 2(2w) + 2(w)$

$300 = 4w + 2w$

$300 = 6w$

$50 = w$

If $w = 50$, then $2w = 100$. Thus, the dimensions are 50 yards by 100 yards.

26. Let w = the width of the swimming pool,
Let $3w$ = the length of the swimming pool

$P = 2(\text{length}) + 2(\text{width})$

$320 = 2(3w) + 2(w)$

$320 = 6w + 2w$

$320 = 8w$

$40 = w$

If $w = 40$, $3w = 3(40) = 120$.
The dimensions are 40 feet by 120 feet.

27. Let w = the width of the field
Let $2w + 6$ = the length of the field

$228 = 6w + 12$

$216 = 6w$

$36 = w$

If $w = 36$, then $2w + 6 = 2(36) + 6 = 78$. Thus, the dimensions are 36 feet by 78 feet.

28. Let w = the width of the pool,
Let $2w – 6$ = the length of the pool

$P = 2(\text{length}) + 2(\text{width})$

$126 = 2(2w - 6) + 2(w)$

$126 = 4w - 12 + 2w$

$126 = 6w - 12$

$138 = 6w$

$23 = w$

Find the length.

$2w - 6 = 2(23) - 6 = 46 - 6 = 40$

The dimensions are 23 meters by 40 meters.

29. Let x = the width of the frame.
Total length: $16 + 2x$
Total width: $12 + 2x$

$P = 2(\text{length}) + 2(\text{width})$

$72 = 2(16 + 2x) + 2(12 + 2x)$

$72 = 32 + 4x + 24 + 4x$

$72 = 8x + 56$

$16 = 8x$

$2 = x$

The width of the frame is 2 inches.

30. Let w = the width of the path
Let $40 + 2w$ = the width of the pool and path
Let $60 + 2w$ = the length of the pool and path

$$\begin{aligned} 2(40 + 2w) + 2(60 + 2w) &= 248 \\ 80 + 4w + 120 + 4w &= 248 \\ 200 + 8w &= 248 \\ 8w &= 48 \\ w &= 6 \end{aligned}$$

The width of the path is 6 feet.

31. Let x = number of hours
$75x$ = labor cost

$$\begin{aligned} 75x + 357 &= 1182 \\ 75x &= 825 \\ x &= 11 \end{aligned}$$

It took 11 hours.

32. Let x = number of hours
$90x$ = labor cost

$$\begin{aligned} 90x + 826 &= 2356 \\ 90x &= 1530 \\ x &= 17 \end{aligned}$$

17 hours were required to repair the sailboat.

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33. Let x = minutes talked

$$0.43+0.32(x-1)+2.10=5.73$$
$$0.43+0.32x-0.32+2.10=5.73$$
$$2.21+0.32x=5.73$$
$$0.32x=3.52$$
$$x=11$$

The person talked for 11 minutes.

34. Let x = amount of each paycheck

$$1500+24x=57,900$$
$$24x=56,400$$
$$x=2350$$

Each paycheck will be \$2350.

35. $A=lw$

$$w=\frac{A}{l}$$

area of rectangle

36. $D=RT$

$$R=\frac{D}{T}$$

distance, rate, time equation

37. $A=\frac{1}{2}bh$

$$2A=bh$$
$$b=\frac{2A}{h};$$

area of triangle

38. $V=\frac{1}{3}Bh$

$$3V=Bh$$
$$B=\frac{3V}{h}$$

volume of a cone

39. $I=Prt$

$$P=\frac{I}{rt};$$

interest

40. $C=2\pi r$

$$r=\frac{C}{2\pi};$$

circumference of a circle

41. $E=mc^2$

$$m=\frac{E}{c^2};$$

Einstein’s equation

42. $V=\pi r^2h$

$$h=\frac{V}{\pi r^2};$$

volume of a cylinder

43. $T=D+pm$

$$T-D=pm$$
$$\frac{T-D}{m}=\frac{pm}{m}$$
$$\frac{T-D}{m}=p$$

total of payment

44. $P=C+MC$

$$P-C=MC$$
$$\frac{P-C}{C}=M$$

markup based on cost

45. $A=\frac{1}{2}h(a+b)$

$$2A=h(a+b)$$
$$\frac{2A}{h}=a+b$$
$$\frac{2A}{h}-b=a$$

area of trapezoid

46. $A=\frac{1}{2}h(a+b)$

$$2A=h(a+b)$$
$$\frac{2A}{h}=a+b$$
$$\frac{2A}{h}-a=b$$

area of trapezoid

47. $S=P+Prt$

$$S-P=Prt$$
$$\frac{S-P}{Pt}=r;$$

interest

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48.
$$S = P + Prt$$
$$S - P = Prt$$
$$\frac{S-P}{Pr} = t;$$
interest

49.
$$B = \frac{F}{S-V}$$
$$B(S-V) = F$$
$$S - V = \frac{F}{B}$$
$$S = \frac{F}{B} + V$$

50.
$$S = \frac{C}{1-r}$$
$$S(1-r) = C$$
$$1 - r = \frac{C}{S}$$
$$-r = \frac{C}{S} - 1$$
$$r = -\frac{C}{S} + 1$$
markup based on selling price

51.
$$IR + Ir = E$$
$$I(R+r) = E$$
$$I = \frac{E}{R+r}$$
electric current

52.
$$A = 2lw + 2lh + 2wh$$
$$A - 2lw = h(2l + 2w)$$
$$\frac{A-2lw}{2l+2w} = h$$
surface area

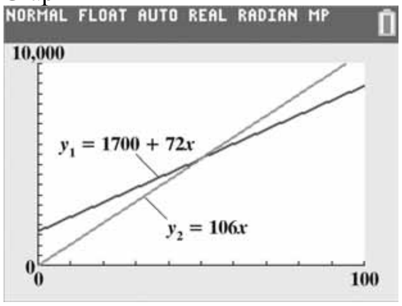
53.
$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$
$$qf + pf = pq$$
$$f(q+p) = pq$$
$$f = \frac{pq}{p+q}$$
thin lens equation

54.
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$R_1R_2 = RR_2 + RR_1$$
$$R_1R_2 - RR_1 = RR_2$$
$$R_1(R_2 - R) = RR_2$$
$$R_1 = \frac{RR_2}{R_2 - R}$$
resistance

55. – 59. Answers will vary.

60. **a.** Let x = number of hours
Model 1 $y = 1700 + 72x$
Model 2 $y = 106x$

b. Graph



c. Calculator shows the graphs intersect at (50, 5300); the two options both cost $5300 when 50 hours court time is used per year.

d.
$$1700 + 72x = 106x$$
$$1700 = 34x$$
$$50 = x$$
Rent the court 50 hours per year.

61. does not make sense; Explanations will vary. Sample explanation: Though mathematical models can often provide excellent estimates about future attitudes, they cannot guaranty perfect precision.

62. makes sense

63. does not make sense; Explanations will vary. Sample explanation: Solving a formula for one of its variables does not produce a numerical value for the variable.

64. does not make sense; Explanations will vary. Sample explanation: The correct equation is $x - 0.35x = 780$.

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65. $0.1x + .9(1000 - x) = 420$

$$0.1 + 900 - 0.9x = 420$$
$$-0.8x = -480$$
$$x = 600$$

600 students at the north campus, 400 students at south campus.

66. Let x = original price
$x - 0.4x = 0.6x$ = price after first reduction
$0.6x - 0.4(0.6x)$ = price after second reduction

$$0.6x - 0.24x = 72$$
$$0.36x = 72$$
$$x = 200$$

The original price was $200.

67. Let x = your age
$3x$ = my age
$3x + 20 = 2(x + 20)$
$3x + 20 = 2x + 40$
$x + 20 = 40$
$x = 20$
I am 60 years old you are
20 years old.

68. Let x = correct answers
$26 - x$ = incorrect answers

$$8x - 5(26 - x) = 0$$
$$8x - 130 + 5x = 0$$
$$13x - 130 = 0$$
$$13x = 130$$
$$x = 10$$

10 problems were solved correctly.

69. Let x = mother's amount
$2x$ = boy's amount
$\frac{x}{2}$ = girl's amount

$$x + 2x + \frac{x}{2} = 14,000$$
$$\frac{7}{2}x = 14,000$$
$$x = \$4,000$$

The mother received $4000, the boy received $8000, and the girl received $2000.

70. Let x = the number of plants originally stolen

After passing the first security guard, the thief has: $x-\left(\frac{1}{2}x+2\right)=x-\frac{1}{2}x-2=\frac{1}{2}x-2$

After passing the second security guard, the thief has: $\frac{1}{2}x-2-\left(\frac{\frac{1}{2}x-2}{2}+2\right)=\frac{1}{4}x-3$

After passing the third security guard, the thief has: $\frac{1}{4}x-3-\left(\frac{\frac{1}{4}x-3}{2}+2\right)=\frac{1}{8}x-\frac{7}{2}$

Thus, $\frac{1}{8}x-\frac{7}{2}=1$

$$x-28=8$$

$$x=36$$

The thief stole 36 plants.

71.
$$\begin{aligned}V&=C-\frac{C-S}{L}N\\ VL&=CL-CN+SN\\ VL-SN&=CL-CN\\ VL-SN&=C(L-N)\\ \frac{VL-SN}{L-N}&=C\\ C&=\frac{VL-SN}{L-N}\end{aligned}$$

72. Answers will vary

73.
$$\begin{aligned}(7-3x)(-2-5x)&=-14-35x+6x+15x^2\\ &=-14-29x+15x^2\\ &\text{or}\\ &=15x^2-29x-14\end{aligned}$$

74.
$$\begin{aligned}\sqrt{18}-\sqrt{8}&=\sqrt{9\cdot 2}-\sqrt{4\cdot 2}\\ &=3\sqrt{2}-2\sqrt{2}\\ &=\sqrt{2}\end{aligned}$$

75.
$$\begin{aligned}\frac{7+4\sqrt{2}}{2-5\sqrt{2}}\cdot\frac{2+5\sqrt{2}}{2+5\sqrt{2}}&=\frac{14+35\sqrt{2}+8\sqrt{2}+40}{4+10\sqrt{2}-10\sqrt{2}-50}\\ &=\frac{54+43\sqrt{2}}{-46}\\ &=-\frac{54+43\sqrt{2}}{46}\end{aligned}$$

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Section 1.4

Check Point Exercises

1. **a.**
$$\begin{aligned}&(5-2i)+(3+3i)\\&=5-2i+3+3i\\&=(5+3)+(-2+3)i\\&=8+i\end{aligned}$$

b.
$$\begin{aligned}&(2+6i)-(12-i)\\&=2+6i-12+i\\&=(2-12)+(6+1)i\\&=-10+7i\end{aligned}$$

2. **a.**
$$\begin{aligned}7i(2-9i)&=7i(2)-7i(9i\\&=14i-63i^2\\&=14i-63(-1)\\&=63+14i\end{aligned}$$

b.
$$\begin{aligned}(5+4i)(6-7i)&=30-35i+24i-28i^2\\&=30-35i+24i-28(-1)\\&=30+28-35i+24i\\&=58-11i\end{aligned}$$

3.
$$\begin{aligned}\frac{5i}{7+i}&=\frac{5i}{7+i}\cdot\frac{7-i}{7-i}\\&=\frac{35i-5i^2}{49+7i-7i-i^2}\\&=\frac{35i+5}{49+1}\\&=\frac{35i+5}{50}\\&=\frac{5}{50}+\frac{35}{50}i\\&=\frac{1}{10}+\frac{7}{10}i\end{aligned}$$

4.
$$\begin{aligned}\frac{5+4i}{4-i}&=\frac{5+4i}{4-i}\cdot\frac{4+i}{4+i}\\&=\frac{20+5i+16i+4i^2}{16+4i-4i-i^2}\\&=\frac{20+21i-4}{16+1}\\&=\frac{16+21i}{17}\\&=\frac{16}{17}+\frac{21}{17}i\end{aligned}$$

5. **a.**
$$\begin{aligned}\sqrt{-121}&=i\sqrt{121}\\&=11i\end{aligned}$$

b.
$$\begin{aligned}\sqrt{-80}&=i\sqrt{80}\\&=4i\sqrt{5}\end{aligned}$$

c.
$$\begin{aligned}\sqrt{7^2-4\cdot5\cdot4}&=\sqrt{-31}\\&=i\sqrt{31}\end{aligned}$$

6. **a.**
$$\begin{aligned}\sqrt{-27}+\sqrt{-48}&=i\sqrt{27}+i\sqrt{48}\\&=i\sqrt{9\cdot3}+i\sqrt{16\cdot3}\\&=3i\sqrt{3}+4i\sqrt{3}\\&=7i\sqrt{3}\end{aligned}$$

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

c.
$$\begin{aligned}\frac{-14+\sqrt{-12}}{2}&=\frac{-14+i\sqrt{12}}{2}\\&=\frac{-14+2i\sqrt{3}}{2}\\&=\frac{-14}{2}+\frac{2i\sqrt{3}}{2}\\&=-7+i\sqrt{3}\end{aligned}$$

7. **a.** Dividing the exponent 65 by 4, the quotient is 16 and the remainder is 1, so $65=4\cdot16+1$.
$$\begin{aligned}i^{65}&=i^{4\cdot16+1}\\&=\left(i^4\right)^{16}i^1\\&=(1)^{16}i\\&=i\end{aligned}$$

b. Dividing the exponent 72 by 4, the quotient is 18 and the remainder is 0, so $72=4\cdot18$
$$\begin{aligned}i^{72}&=i^{4\cdot18}\\&=\left(i^4\right)^{18}\\&=(1)^{18}\\&=1\end{aligned}$$

Concept and Vocabulary Check 1.4

C1. $\sqrt{-1}$; -1

C2. complex; imaginary; real

C3. $-6i$

C4. $14i$

C5. 18 ; $-15i$; $12i$; $-10i^2$; 10

C6. $2+9i$

C7. $2+5i$

C8. i; $2i\sqrt{5}$

C9. $-i$; 1

Exercise Set 1.4

1. $$\begin{aligned}(7+2i)+(1-4i)&=7+2i+1-4i\\&=7+1+2i-4i\\&=8-2i\end{aligned}$$

2. $$\begin{aligned}&(-2+6i)+(4-i)\\&=-2+6i+4-i\\&=-2+4+6i-i\\&=2+5i\end{aligned}$$

3. $$\begin{aligned}(3+2i)-(5-7i)&=3-5+2i+7i\\&=3+2i-5+7i\\&=-2+9i\end{aligned}$$

4. $$\begin{aligned}(-7+5i)-(-9-11i)&=-7+5i+9+11i\\&=-7+9+5i+11i\\&=2+16i\end{aligned}$$

5. $$\begin{aligned}6-(-5+4i)-(-13-i)&=6+5-4i+13+i\\&=24-3i\end{aligned}$$

6. $$\begin{aligned}7-(-9+2i)-(-17-i)&=7+9-2i+17+i\\&=33-i\end{aligned}$$

7. $$\begin{aligned}8i-(14-9i)&=8i-14+9i\\&=-14+8i+9i\\&=-14+17i\end{aligned}$$

8. $$\begin{aligned}15i-(12-11i)&=15i-12+11i\\&=-12+15i+11i\\&=-12+26i\end{aligned}$$

9. $$\begin{aligned}-3i(7i-5)&=-21i^2+15i\\&=-21(-1)+15i\\&=21+15i\end{aligned}$$

10. $$\begin{aligned}-8i\,(2i-7)&=-16i^2+56i=-16(-1)+56i\\&=9-25i^2=9+25=34=16+56i\end{aligned}$$

11. $$\begin{aligned}(-5+4i)(3+i)&=-15-5i+12i+4i^2\\&=-15+7i-4\\&=-19+7i\end{aligned}$$

12. $$\begin{aligned}(-4-8i)(3+i)&=-12-4i-24i-8i^2\\&=-12-28i+8\\&=-4-28i\end{aligned}$$

13. $$\begin{aligned}(7-5i)(-2-3i)&=-14-21i+10i+15i^2\\&=-14-15-11i\\&=-29-11i\end{aligned}$$

14. $$\begin{aligned}(8-4i)(-3+9i)&=-24+72i+12i-36i^2\\&=-24+36+84i\\&=12+84i\end{aligned}$$

15. $$\begin{aligned}(3+5i)(3-5i)&=9-15i+15i-25i^2\\&=9+25\\&=34\end{aligned}$$

16. $$\left(2+7i\right)\left(2-7i\right)=4-49i^2=4+49=53$$

17. $$\begin{aligned}(-5+i)(-5-i)&=25+5i-5i-i^2\\&=25+1\\&=26\end{aligned}$$

18. $$\begin{aligned}(-7+i)(-7-i)&=49+7i-7i-i^2\\&=49+1\\&=50\end{aligned}$$

19. $$\begin{aligned}\left(2+3i\right)^2&=4+12i+9i^2\\&=4+12i-9\\&=-5+12i\end{aligned}$$

20. $$\begin{aligned}\left(5-2i\right)^2&=25-20i+4i^2\\&=25-20i-4\\&=21-20i\end{aligned}$$

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21. $$\frac{2}{3-i}=\frac{2}{3-i}\cdot\frac{3+i}{3+i}=\frac{2(3+i)}{9+1}=\frac{2(3+i)}{10}=\frac{3+i}{5}=\frac{3}{5}+\frac{1}{5}i$$

22. $$\frac{3}{4+i}=\frac{3}{4+i}\cdot\frac{4-i}{4-i}=\frac{3(4-i)}{16-i^2}=\frac{3(4-i)}{17}=\frac{12}{17}-\frac{3}{17}i$$

23. $$\frac{2i}{1+i}=\frac{2i}{1+i}\cdot\frac{1-i}{1-i}=\frac{2i-2i^2}{1+1}=\frac{2+2i}{2}=1+i$$

24. $$\frac{5i}{2-i}=\frac{5i}{2-i}\cdot\frac{2+i}{2+i}=\frac{10i+5i^2}{4+1}=\frac{-5+10i}{5}=-1+2i$$

25. $$\frac{8i}{4-3i}=\frac{8i}{4-3i}\cdot\frac{4+3i}{4+3i}=\frac{32i+24i^2}{16+9}=\frac{-24+32i}{25}=-\frac{24}{25}+\frac{32}{25}i$$

26. $$\frac{-6i}{3+2i}=\frac{-6i}{3+2i}\cdot\frac{3-2i}{3-2i}=\frac{-18i+12i^2}{9+4}=\frac{-12-18i}{13}=-\frac{12}{13}-\frac{18}{13}i$$

27. $$\frac{2+3i}{2+i}=\frac{2+3i}{2+i}\cdot\frac{2-i}{2-i}=\frac{4+4i-3i^2}{4+1}=\frac{7+4i}{5}=\frac{7}{5}+\frac{4}{5}i$$

28. $$\frac{3-4i}{4+3i}=\frac{3-4i}{4+3i}\cdot\frac{4-3i}{4-3i}=\frac{12-25i+12i^2}{16+9}=\frac{-25i}{25}=-i$$

29. $$\sqrt{-49}=i\sqrt{49}=7i$$

30. $$\sqrt{-196}=i\sqrt{196}=14i$$

31. $$\sqrt{-108}=i\sqrt{108}=6i\sqrt{3}$$

32. $$\sqrt{-54}=i\sqrt{54}=3i\sqrt{6}$$

33. $$\sqrt{3^2-4\cdot2\cdot5}=\sqrt{-31}=i\sqrt{31}$$

34. $$\sqrt{5^2-4\cdot6\cdot3}=\sqrt{-47}=i\sqrt{47}$$

35. $$\sqrt{1^2-4\cdot0.5\cdot5}=\sqrt{-9}=3i$$

36. $$\sqrt{3^2-4\cdot0.5\cdot5}=\sqrt{-1}=i$$

37. $$\sqrt{-64}-\sqrt{-25}=i\sqrt{64}-i\sqrt{25}=8i-5i=3i$$

38. $$\sqrt{-81}-\sqrt{-144}=i\sqrt{81}-i\sqrt{144}=9i-12i=-3i$$

39. $5\sqrt{-16}+3\sqrt{-81} = 5(4i) + 3(9i)$

$= 20i + 27i = 47i$

40. $5\sqrt{-8}+3\sqrt{-18}$

$= 5i\sqrt{8}+3i\sqrt{18} = 5i\sqrt{4\cdot 2}+3i\sqrt{9\cdot 2}$

$= 10i\sqrt{2}+9i\sqrt{2}$

$= 19i\sqrt{2}$

41. $\left(-2+\sqrt{-4}\right)^2 = \left(-2+2i\right)^2$

$= 4-8i+4i^2$

$= 4-8i-4$

$= -8i$

42. $\left(-5-\sqrt{-9}\right)^2 = (-5-i\sqrt{9})^2 = \left(-5-3i\right)^2$

$= 25+30i+9i^2$

$= 25+30i-9$

$= 16+30i$

43. $\left(-3-\sqrt{-7}\right)^2 = \left(-3-i\sqrt{7}\right)^2$

$= 9+6i\sqrt{7}+i^2\left(7\right)$

$= 9-7+6i\sqrt{7}$

$= 2+6i\sqrt{7}$

44. $\left(-2+\sqrt{-11}\right)^2 = \left(-2+i\sqrt{11}\right)^2$

$= 4-4i\sqrt{11}+i^2\left(11\right)$

$= 4-11-4i\sqrt{11}$

$= -7-4i\sqrt{11}$

45. $\dfrac{-8+\sqrt{-32}}{24} = \dfrac{-8+i\sqrt{32}}{24}$

$= \dfrac{-8+i\sqrt{16\cdot 2}}{24}$

$= \dfrac{-8+4i\sqrt{2}}{24}$

$= -\dfrac{1}{3}+\dfrac{\sqrt{2}}{6}i$

46. $\dfrac{-12+\sqrt{-28}}{32} = \dfrac{-12+i\sqrt{28}}{32} = \dfrac{-12+i\sqrt{4\cdot 7}}{32}$

$= \dfrac{-12+2i\sqrt{7}}{32} = -\dfrac{3}{8}+\dfrac{\sqrt{7}}{16}i$

47. $\dfrac{-6-\sqrt{-12}}{48} = \dfrac{-6-i\sqrt{12}}{48}$

$= \dfrac{-6-i\sqrt{4\cdot 3}}{48}$

$= \dfrac{-6-2i\sqrt{3}}{48}$

$= -\dfrac{1}{8}-\dfrac{\sqrt{3}}{24}i$

48. $\dfrac{-15-\sqrt{-18}}{33} = \dfrac{-15-i\sqrt{18}}{33} = \dfrac{-15-i\sqrt{9\cdot 2}}{33}$

$= \dfrac{-15-3i\sqrt{2}}{33} = -\dfrac{5}{11}-\dfrac{\sqrt{2}}{11}i$

49. $\sqrt{-8}\left(\sqrt{-3}-\sqrt{5}\right) = i\sqrt{8}(i\sqrt{3}-\sqrt{5})$

$= 2i\sqrt{2}\left(i\sqrt{3}-\sqrt{5}\right)$

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

50. $\sqrt{-12}\left(\sqrt{-4}-\sqrt{2}\right) = i\sqrt{12}(i\sqrt{4}-\sqrt{2})$

$= 2i\sqrt{3}\left(2i-\sqrt{2}\right)$

$= 4i^2\sqrt{3}-2i\sqrt{6}$

$= -4\sqrt{3}-2i\sqrt{6}$

51. $\left(3\sqrt{-5}\right)\left(-4\sqrt{-12}\right) = \left(3i\sqrt{5}\right)\left(-8i\sqrt{3}\right)$

$= -24i^2\sqrt{15}$

$= 24\sqrt{15}$

52. $\left(3\sqrt{-7}\right)\left(2\sqrt{-8}\right)$

$= (3i\sqrt{7})(2i\sqrt{8}) = (3i\sqrt{7})(2i\sqrt{4\cdot 2})$

$= \left(3i\sqrt{7}\right)\left(4i\sqrt{2}\right) = 12i^2\sqrt{14} = -12\sqrt{14}$

53. $i^{31} = i^{4\cdot 7+3}$

$= \left(i^4\right)^7 i^3$

$= \left(1\right)^7\left(-i\right)$

$= -i$

54. $i^{33} = i^{4\cdot 8+1}$

$= \left(i^4\right)^8 i^1$

$= \left(1\right)^8 i$

$= i$

55.
$$\begin{aligned} i^{44} &= i^{4\cdot 11} \\ &= \left(i^4\right)^{11} \\ &= (1)^{11} \\ &= 1 \end{aligned}$$

56.
$$\begin{aligned} i^{46} &= i^{4\cdot 11+2} \\ &= \left(i^4\right)^{11} i^2 \\ &= (1)^{11}(-1) \\ &= -1 \end{aligned}$$

57.
$$\begin{aligned} i^{114} &= i^{4\cdot 28+2} \\ &= \left(i^4\right)^{28} i^2 \\ &= (1)^{28}(-1) \\ &= -1 \end{aligned}$$

58.
$$\begin{aligned} i^{116} &= i^{4\cdot 29} \\ &= \left(i^4\right)^{29} \\ &= (1)^{29} \\ &= 1 \end{aligned}$$

59.
$$\begin{aligned} i^{133} &= i^{4\cdot 33+1} \\ &= \left(i^4\right)^{33} i^1 \\ &= (1)^{33} i \\ &= i \end{aligned}$$

60.
$$\begin{aligned} i^{135} &= i^{4\cdot 33+3} \\ &= \left(i^4\right)^{33} i^3 \\ &= (1)^{33}(-i) \\ &= -i \end{aligned}$$

61.
$$\begin{aligned} (1+i)^3 &= 1^3 + 3\cdot 1^2\cdot i + 3\cdot 1\cdot i^2 + i^3 \\ &= 1 + 3i + 3i^2 + i^3 \\ &= 1 + 3i + 3(-1) - i \\ &= -2 + 2i \end{aligned}$$

62.
$$\begin{aligned} (1-i)^3 &= 1^3 - 3\cdot 1^2\cdot i + 3\cdot 1\cdot i^2 - i^3 \\ &= 1 - 3i + 3i^2 - i^3 \\ &= 1 - 3i + 3(-1) + i \\ &= -2 - 2i \end{aligned}$$

63.
$$\begin{aligned} (2+3i)^3 &= 2^3 + 3\cdot 2^2\cdot 3i + 3\cdot 2\cdot(3i)^2 + (3i)^3 \\ &= 8 + 36i + 54i^2 + 27i^3 \\ &= 8 + 36i + 54(-1) - 27i \\ &= -46 + 9i \end{aligned}$$

64.
$$\begin{aligned} (3+2i)^3 &= 3^3 + 3\cdot 3^2\cdot 2i + 3\cdot 3\cdot(2i)^2 + (2i)^3 \\ &= 27 + 54i + 36i^2 + 8i^3 \\ &= 27 + 54i + 36(-1) - 8i \\ &= -9 + 46i \end{aligned}$$

65.
$$\begin{aligned} &(2-3i)(1-i) - (3-i)(3+i) \\ &= \left(2 - 2i - 3i + 3i^2\right) - \left(3^2 - i^2\right) \\ &= 2 - 5i + 3i^2 - 9 + i^2 \\ &= -7 - 5i + 4i^2 \\ &= -7 - 5i + 4(-1) \\ &= -11 - 5i \end{aligned}$$

66.
$$\begin{aligned} &(8+9i)(2-i) - (1-i)(1+i) \\ &= \left(16 - 8i + 18i - 9i^2\right) - \left(1^2 - i^2\right) \\ &= 16 + 10i - 9i^2 - 1 + i^2 \\ &= 15 + 10i - 8i^2 \\ &= 15 + 10i - 8(-1) \\ &= 23 + 10i \end{aligned}$$

67.
$$\begin{aligned} &(2+i)^2 - (3-i)^2 \\ &= \left(4 + 4i + i^2\right) - \left(9 - 6i + i^2\right) \\ &= 4 + 4i + i^2 - 9 + 6i - i^2 \\ &= -5 + 10i \end{aligned}$$

68.
$$\begin{aligned} &(4-i)^2 - (1+2i)^2 \\ &= \left(16 - 8i + i^2\right) - \left(1 + 4i + 4i^2\right) \\ &= 16 - 8i + i^2 - 1 - 4i - 4i^2 \\ &= 15 - 12i - 3i^2 \\ &= 15 - 12i - 3(-1) \\ &= 18 - 12i \end{aligned}$$

69.
$$\begin{aligned} &5\sqrt{-16} + 3\sqrt{-81} \\ &= 5\sqrt{16}\sqrt{-1} + 3\sqrt{81}\sqrt{-1} \\ &= 5\cdot 4i + 3\cdot 9i \\ &= 20i + 27i \\ &= 47i \quad \text{or} \quad 0 + 47i \end{aligned}$$

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70. $5\sqrt{-8}+3\sqrt{-18}$

$=5\sqrt{4}\sqrt{2}\sqrt{-1}+3\sqrt{9}\sqrt{2}\sqrt{-1}$

$=5\cdot 2\sqrt{2}\,i+3\cdot 3\sqrt{2}\,i$

$=10i\sqrt{2}+9i\sqrt{2}$

$=(10+9)i\sqrt{2}$

$=19i\sqrt{2}$ or $0+19i\sqrt{2}$

71. $f(x)=x^2-2x+2$

$f(1+i)=(1+i)^2-2(1+i)+2$

$=1+2i+i^2-2-2i+2$

$=1+i^2$

$=1-1$

$=0$

72. $f(x)=x^2-2x+5$

$f(1-2i)=(1-2i)^2-2(1-2i)+5$

$=1-4i+4i^2-2+4i+5$

$=4+4i^2$

$=4-4$

$=0$

73. $f(x)=\dfrac{x^2+19}{2-x}$

$f(3i)=\dfrac{(3i)^2+19}{2-3i}$

$=\dfrac{9i^2+19}{2-3i}$

$=\dfrac{-9+19}{2-3i}$

$=\dfrac{10}{2-3i}$

$=\dfrac{10}{2-3i}\cdot\dfrac{2+3i}{2+3i}$

$=\dfrac{20+30i}{4-9i^2}$

$=\dfrac{20+30i}{4+9}$

$=\dfrac{20+30i}{13}$

$=\dfrac{20}{13}+\dfrac{30}{13}i$

74. $f(x)=\dfrac{x^2+11}{3-x}$

$f(4i)=\dfrac{(4i)^2+11}{3-4i}=\dfrac{16i^2+11}{3-4i}$

$=\dfrac{-16+11}{3-4i}$

$=\dfrac{-5}{3-4i}$

$=\dfrac{-5}{3-4i}\cdot\dfrac{3+4i}{3+4i}$

$=\dfrac{-15-20i}{9-16i^2}$

$=\dfrac{-15-20i}{9+16}$

$=\dfrac{-15-20i}{25}$

$=\dfrac{-15}{25}-\dfrac{20}{25}i$

$=-\dfrac{3}{5}-\dfrac{4}{5}i$

75. $E=IR=(4-5i)(3+7i)$

$=12+28i-15i-35i^2$

$=12+13i-35(-1)$

$=12+35+13i=47+13i$

The voltage of the circuit is
(47 + 13*i*) volts.

76. $E=IR=(2-3i)(3+5i)$

$=6+10i-9i-15i^2=6+i-15(-1)$

$=6+i+15=21+i$

The voltage of the circuit is $(21+i)$ volts.

77. Sum:

$(5+i\sqrt{15})+(5-i\sqrt{15})$

$=5+i\sqrt{15}+5-i\sqrt{15}$

$=5+5$

$=10$

Product:

$(5+i\sqrt{15})(5-i\sqrt{15})$

$=25-5i\sqrt{15}+5i\sqrt{15}-15i^2$

$=25+15$

$=40$

78. – 86. Answers will vary.

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87. makes sense

88. does not make sense; Explanations will vary. Sample explanation: Imaginary numbers are not undefined.

89. does not make sense; Explanations will vary. Sample explanation: $i = \sqrt{-1}$; It is not a variable in this context.

90. makes sense

91. false; Changes to make the statement true will vary. A sample change is: All irrational numbers are complex numbers.

92. false; Changes to make the statement true will vary. A sample change is: $(3 + 7i)(3 - 7i) = 9 + 49 = 58$ which is a real number.

93. false; Changes to make the statement true will vary. A sample change is:
$$\frac{7+3i}{5+3i} = \frac{7+3i}{5+3i}\cdot\frac{5-3i}{5-3i} = \frac{44-6i}{34} = \frac{22}{17} - \frac{3}{17}i$$

94. true

95.
$$\begin{aligned}
\frac{4}{(2+i)(3-i)} &= \frac{4}{6-2i+3i-i^2} \\
&= \frac{4}{6+i+1} \\
&= \frac{4}{7+i} \\
&= \frac{4}{7+i}\cdot\frac{7-i}{7-i} \\
&= \frac{28-4i}{49-i^2} \\
&= \frac{28-4i}{49+1} \\
&= \frac{28-4i}{50} \\
&= \frac{28}{50} - \frac{4}{50}i \\
&= \frac{14}{25} - \frac{2}{25}i
\end{aligned}$$

96.
$$\begin{aligned}
&\frac{1+i}{1+2i} + \frac{1-i}{1-2i} \\
&= \frac{(1+i)(1-2i)}{(1+2i)(1-2i)} + \frac{(1-i)(1+2i)}{(1+2i)(1-2i)} \\
&= \frac{(1+i)(1-2i)+(1-i)(1+2i)}{(1+2i)(1-2i)} \\
&= \frac{1-2i+i-2i^2+1+2i-i-2i^2}{1-4i^2} \\
&= \frac{1-2i+i+2+1+2i-i+2}{1+4} \\
&= \frac{6}{5} \\
&= \frac{6}{5} + 0i
\end{aligned}$$

97.
$$\begin{aligned}
\frac{8}{1+\frac{2}{i}} &= \frac{8}{\frac{i}{i}+\frac{2}{i}} \\
&= \frac{8}{\frac{2+i}{i}} \\
&= \frac{8i}{2+i} \\
&= \frac{8i}{2+i}\cdot\frac{2-i}{2-i} \\
&= \frac{16i-8i^2}{4-i^2} \\
&= \frac{16i+8}{4+1} \\
&= \frac{8+16i}{5} \\
&= \frac{8}{5} + \frac{16}{5}i
\end{aligned}$$

98.
$$\begin{aligned}
\frac{i^{85}-i^{83}}{i^{45}} &= \frac{i^{85}}{i^{45}} - \frac{i^{83}}{i^{45}} \\
&= i^{40} - i^{38} \\
&= 1+1 \\
&= 2
\end{aligned}$$

99.
$$\begin{aligned}
\frac{i^{98}-i^{94}}{i^{49}} &= \frac{i^{98}}{i^{49}} - \frac{i^{94}}{i^{49}} \\
&= i^{49} - i^{45} \\
&= i - i \\
&= 0
\end{aligned}$$

100. $2x^2 + 7x - 4 = (2x-1)(x+4)$

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

102.
$$\begin{aligned}\frac{-b-\sqrt{b^2-4ac}}{2a} &= \frac{-(9)-\sqrt{(9)^2-4(2)(-5)}}{2(2)}\\ &= \frac{-9-\sqrt{81+40}}{4}\\ &= \frac{-9-\sqrt{121}}{4}\\ &= \frac{-9-11}{4}\\ &= -5\end{aligned}$$

Section 1.5

Check Point Exercises

1. a.
$$\begin{aligned}3x^2 &= 9x\\ 3x^2 - 9x &= 0\\ 3x(x-3) &= 0\end{aligned}$$
$3x = 0$ or $x - 3 = 0$

$x = 0$ $\quad x = 3$

The solution set is {0, 3}.

b.
$$\begin{aligned}2x^2 &= 1 - x\\ 2x^2 + x - 1 &= 0\\ (2x-1)(x+1) &= 0\end{aligned}$$
$2x - 1 = 0$ or $x + 1 = 0$

$2x = 1$ $\quad x = -1$

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

The solution set is $\left\{-1, \frac{1}{2}\right\}$.

2. a.
$$\begin{aligned}3x^2 - 21 &= 0\\ 3x^2 &= 21\\ \frac{3x^2}{3} &= \frac{21}{3}\\ x^2 &= 7\\ x &= \pm\sqrt{7}\end{aligned}$$
The solution set is $\left\{-\sqrt{7}, \sqrt{7}\right\}$.

b.
$$\begin{aligned}5x^2 + 45 &= 0\\ 5x^2 &= -45\\ x^2 &= -9\\ x &= \pm\sqrt{-9}\\ x &= \pm 3i\end{aligned}$$
The solution set is $\{-3i, 3i\}$.

c.
$$\begin{aligned}(x+5)^2 &= 11\\ x + 5 &= \pm\sqrt{11}\\ x &= -5 \pm \sqrt{11}\end{aligned}$$
The solution set is $\left\{-5+\sqrt{11}, -5-\sqrt{11}\right\}$.

3. a. The coefficient of the x-term is 6. Half of 6 is 3, and 3^2 is 9.
9 should be added to the binomial.
$x^2 + 6x + 9 = (x+3)^2$

b. The coefficient of the x-term is –5.
Half of –5 is $-\frac{5}{2}$, and $\left(-\frac{5}{2}\right)^2$ is $\frac{25}{4}$.
$\frac{25}{4}$ should be added to the binomial.
$x^2 - 5x + \frac{25}{4} = \left(x - \frac{5}{2}\right)^2$

c. The coefficient of the x-term is $\frac{2}{3}$.
Half of $\frac{2}{3}$ is $\frac{1}{3}$, and $\left(\frac{1}{3}\right)^2$ is $\frac{1}{9}$.
$\frac{1}{9}$ should be added to the binomial.
$x^2 + \frac{2}{3}x + \frac{1}{9} = \left(x + \frac{1}{3}\right)^2$

4.
$$\begin{aligned}x^2 + 4x - 1 &= 0\\ x^2 + 4x \quad &= 1\\ x^2 + 4x + 4 &= 1 + 4\\ (x+2)^2 &= 5\\ x + 2 &= \pm\sqrt{5}\\ x &= -2 \pm \sqrt{5}\end{aligned}$$
The solution set is $\left\{-2 \pm \sqrt{5}\right\}$.

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5. $$\begin{aligned} 2x^2+3x-4&=0\\ x^2+\frac{3}{2}x-2&=0\\ x^2+\frac{3}{2}x&=2\\ x^2+\frac{3}{2}x+\frac{9}{16}&=2+\frac{9}{16}\\ \left(x+\frac{3}{4}\right)^2&=\frac{41}{16}\\ x+\frac{3}{4}&=\pm\sqrt{\frac{41}{16}}\\ x+\frac{3}{4}&=\pm\frac{\sqrt{41}}{4}\\ x&=-\frac{3}{4}\pm\frac{\sqrt{41}}{4}\\ x&=\frac{-3\pm\sqrt{41}}{4} \end{aligned}$$

The solution set is $\left\{\frac{-3\pm\sqrt{41}}{4}\right\}$.

6. $$2x^2+9x-5=0$$

$a=2, b=9, c=-5$

$$\begin{aligned} x&=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\\ &=\frac{-9\pm\sqrt{9^2-4(2)(-5)}}{2(2)}\\ &=\frac{-9\pm\sqrt{81+40}}{4}\\ &=\frac{-9\pm\sqrt{121}}{4}\\ &=\frac{-9\pm11}{4} \end{aligned}$$

$$x=\frac{-9+11}{4} \text{ or } x=\frac{-9-11}{4}$$

$$x=\frac{2}{4}=\frac{1}{2} \qquad x=\frac{-20}{4}=-5$$

The solution set is $\left\{-5,\frac{1}{2}\right\}$.

7. $$2x^2+2x-1=0$$

$a=2, b=2, c=-1$

$$\begin{aligned} x&=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\\ &=\frac{-2\pm\sqrt{2^2-4(2)(-1)}}{2(2)}\\ &=\frac{-2\pm\sqrt{4+8}}{4}\\ &=\frac{-2\pm\sqrt{12}}{4}\\ &=\frac{-2\pm2\sqrt{3}}{4}\\ &=\frac{2(-1\pm\sqrt{3})}{4}\\ &=\frac{-1\pm\sqrt{3}}{2} \end{aligned}$$

The solution set is $\left\{\frac{-1\pm\sqrt{3}}{2}\right\}$.

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

$a=1, b=-2, c=2$

$$\begin{aligned} x&=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\\ x&=\frac{-(-2)\pm\sqrt{(-2)^2-4(1)(2)}}{2(1)}\\ x&=\frac{2\pm\sqrt{4-8}}{2}\\ x&=\frac{2\pm\sqrt{-4}}{2}\\ x&=\frac{2\pm2i}{2}\\ x&=1\pm i \end{aligned}$$

The solution set is $\{1+i, 1-i\}$.

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9. **a.** $a=1, \quad b=6, \quad c=9$

$$\begin{aligned} b^2-4ac &= (6)^2-4(1)(9) \\ &= 36-36 \\ &= 0 \end{aligned}$$

Since $b^2-4ac=0$, the equation has one real solution that is rational.

b. $a=2, \quad b=-7, \quad c=-4$

$$\begin{aligned} b^2-4ac &= (-7)^2-4(2)(-4) \\ &= 49+32 \\ &= 81 \end{aligned}$$

Since $b^2-4ac>0$, the equation has two real solutions. Since 81 is a perfect square, the two solutions are rational.

c. $a=3, \quad b=-2, \quad c=4$

$$\begin{aligned} b^2-4ac &= (-2)^2-4(3)(4) \\ &= 4-48 \\ &= -44 \end{aligned}$$

Since $b^2-4ac<0$, the equation has two imaginary solutions that are complex conjugates.

10.
$$\begin{aligned} P &= 0.01A^2+0.05A+107 \\ 115 &= 0.01A^2+0.05A+107 \\ 0 &= 0.01A^2+0.05A-8 \end{aligned}$$

$a=0.01, \quad b=0.05, \quad c=-8$

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

$$A=\frac{-(0.05)\pm\sqrt{(0.05)^2-4(0.01)(-8)}}{2(0.01)}$$

$$A=\frac{-0.05\pm\sqrt{0.3225}}{0.02}$$

$$A\approx\frac{-0.05+\sqrt{0.3225}}{0.02} \qquad A\approx\frac{-0.05-\sqrt{0.3225}}{0.02}$$

$$A\approx 26 \qquad A\approx -31$$

Age cannot be negative, reject the negative answer. Thus, a woman whose normal systolic blood pressure is 115 mm Hg is approximately 26 years old.

11. Let c = the screen's diagonal.

$$\begin{aligned} a^2+b^2 &= c^2 \\ 19.2^2+25.6^2 &= c^2 \\ 368.64+655.36 &= c^2 \\ 1024 &= c^2 \end{aligned}$$

$$c=\sqrt{1024} \quad \text{or} \quad c=-\sqrt{1024}$$

$$c=32 \qquad c=-32$$

The dimension must be positive. Reject –32. The size of the screen is 32 inches.

Concept and Vocabulary Check 1.5

C1. quadratic

C2. $A=0$ or $B=0$

C3. x-intercepts

C4. $\pm\sqrt{d}$

C5. $\pm\sqrt{7}$

C6. $\frac{9}{4}$

C7. $\frac{4}{25}$

C8. 9

C9. $\frac{1}{9}$

C10. $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

C11. 2; 9; –5

C12. 1; –4; –1

C13. $2\pm\sqrt{2}$

C14. $-1\pm i\frac{\sqrt{6}}{2}$

C15. b^2-4ac

C16. no

C17. two

C18. the square root property

C19. the quadratic formula

C20. factoring and the zero-product principle

C21. right; hypotenuse; legs

C22. right; legs; the square of the length of the hypotenuse

Exercise Set 1.5

1. $x^2-3x-10=0$
$(x+2)(x-5)=0$
$x+2=0$ or $x-5=0$
$x=-2$ or $x=5$
The solution set is $\{-2, 5\}$.

2. $x^2-13x+36=0$
$(x-4)(x-9)=0$
$x-4=0$ or $x-9=0$
$x=4$ or $x=9$
The solution set is $\{4, 9\}$.

3. $x^2=8x-15$
$x^2-8x+15=0$
$(x-3)(x-5)=0$
$x-3=0$ or $x-5=0$
$x=3$ or $x=5$
The solution set is $\{3, 5\}$.

4. $x^2=-11x-10$
$x^2+11x+10=0$
$(x+10)(x+1)=0$
$x+10=0$ or $x+1=0$
$x=-10$ or $x=-1$
The solution set is $\{-10, -1\}$.

5. $6x^2+11x-10=0$
$(2x+5)(3x-2)=0$
$2x+5=0$ or $3x-2=0$
$2x=-5$ $\quad 3x=2$
$x=-\frac{5}{2}$ or $x=\frac{2}{3}$
The solution set is $\left\{-\frac{5}{2}, \frac{2}{3}\right\}$.

6. $9x^2+9x+2=0$
$(3x+2)(3x+1)=0$
$3x+2=0$ or $3x+1=0$
$x=-\frac{2}{3}$ or $x=-\frac{1}{3}$
The solution set is $\left\{-\frac{2}{3}, -\frac{1}{3}\right\}$.

7. $3x^2-2x=8$
$3x^2-2x-8=0$
$(3x+4)(x-2)=0$
$3x+4=0$ or $x-2=0$
$3x=-4$
$x=-\frac{4}{3}$ or $x=2$
The solution set is $\left\{-\frac{4}{3}, 2\right\}$.

8. $4x^2-13x=-3$
$4x^2-13x+3=0$
$(4x-1)(x-3)=0$
$4x-1=0$ or $x-3=0$
$4x=1$
$x=\frac{1}{4}$ or $x=3$
The solution set is $\left\{\frac{1}{4}, 3\right\}$.

9. $3x^2+12x=0$
$3x(x+4)=0$
$3x=0$ or $x+4=0$
$x=0$ or $x=-4$
The solution set is $\{-4, 0\}$.

10. $5x^2-20x=0$
$5x(x-4)=0$
$5x=0$ or $x-4=0$
$x=0$ or $x=4$
The solution set is $\{0, 4\}$.

11. $2x(x-3)=5x^2-7x$
$2x^2-6x-5x^2+7x=0$
$-3x^2+x=0$
$x(-3x+1)=0$
$x=0 \quad \text{or} \quad -3x+1=0$
$-3x=-1$
$x=\frac{1}{3}$
The solution set is $\left\{0,\frac{1}{3}\right\}$.

12. $16x(x-2)=8x-25$
$16x^2-32x-8x+25=0$
$16x^2-40x+25=0$
$(4x-5)(4x-5)=0$
$4x-5=0$
$4x=5$
$x=\frac{5}{4}$
The solution set is $\left\{\frac{5}{4}\right\}$.

13. $7-7x=(3x+2)(x-1)$
$7-7x=3x^2-x-2$
$7-7x-3x^2+x+2=0$
$-3x^2-6x+9=0$
$-3(x+3)(x-1)=0$
$x+3=0 \quad \text{or} \quad x-1=0$
$x=-3 \quad \text{or} \quad x=1$
The solution set is $\{-3, 1\}$.

14. $10x-1=(2x+1)^2$
$10x-1=4x^2+4x+1$
$10x-1-4x^2-4x-1=0$
$-4x^2+6x-2=0$
$-2(2x-1)(x-1)=0$
$2x-1=0 \quad \text{or} \quad x-1=0$
$2x=1$
$x=\frac{1}{2} \quad \text{or} \quad x=1$
The solution set is $\left\{\frac{1}{2},1\right\}$.

15. $3x^2=27$
$x^2=9$
$x=\pm\sqrt{9}=\pm 3$
The solution set is $\{-3, 3\}$.

16. $5x^2=45$
$x^2=9$
$x=\pm\sqrt{9}=\pm 3$
The solution set is $\{-3, 3\}$.

17. $5x^2+1=51$
$5x^2=50$
$x^2=10$
$x=\pm\sqrt{10}$
The solution set is $\left\{-\sqrt{10},\sqrt{10}\right\}$.

18. $3x^2-1=47$
$3x^2=48$
$x^2=16$
$x=\pm\sqrt{16}=\pm 4$
The solution set is $\{-4, 4\}$.

19. $2x^2-5=-55$
$2x^2=-50$
$x^2=-25$
$x=\pm\sqrt{-25}=\pm 5i$
The solution set is $\{5i,-5i\}$.

20. $2x^2-7=-15$
$2x^2=-8$
$x^2=-4$
$x=\pm\sqrt{-4}=\pm 2i$
The solution set is $\{2i,-2i\}$.

21. $(x+2)^2=25$
$x+2=\pm\sqrt{25}$
$x+2=\pm 5$
$x=-2\pm 5$
$x=-2+5 \quad \text{or} \quad x=-2-5$
$x=3 \qquad x=-7$
The solution set is $\{-7,3\}$.

22. $(x-3)^2=36$
$x-3=\pm\sqrt{36}$
$x-3=\pm 6$
$x=3\pm 6$
$x=3+6 \quad \text{or} \quad x=3-6$
$x=9 \qquad x=-3$
The solution set is $\{-3,9\}$.

23. $3(x-4)^2 = 15$

$(x-4)^2 = 5$

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

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

The solution set is $\{4+\sqrt{5}, 4-\sqrt{5}\}$.

24. $3(x+4)^2 = 21$

$(x+4)^2 = 7$

$x+4 = \pm\sqrt{7}$

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

The solution set is $\{-4+\sqrt{7}, -4-\sqrt{7}\}$.

25. $(x+3)^2 = -16$

$x+3 = \pm\sqrt{-16}$

$x+3 = \pm 4i$

$x = -3 \pm 4i$

The solution set is $\{-3+4i, -3-4i\}$.

26. $(x-1)^2 = -9$

$x-1 = \pm\sqrt{-9}$

$x-1 = \pm 3i$

$x = 1 \pm 3i$

The solution set is $\{1+3i, 1-3i\}$.

27. $(x-3)^2 = -5$

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

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

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

The solution set is $\{3+i\sqrt{5}, 3-i\sqrt{5}\}$.

28. $(x+2)^2 = -7$

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

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

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

The solution set is $\{-2+i\sqrt{7}, -2-i\sqrt{7}\}$.

29. $(3x+2)^2 = 9$

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

$3x+2 = -3$ or $3x+2 = 3$

$3x = -5$ $\quad$ $3x = 1$

$x = -\frac{5}{3}$ or $x = \frac{1}{3}$

The solution set is $\left\{-\frac{5}{3}, \frac{1}{3}\right\}$.

30. $(4x-1)^2 = 16$

$4x-1 = \pm\sqrt{16} = \pm 4$

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

$4x = -3$ $\quad$ $4x = 5$

$x = \frac{-3}{4}$ or $x = \frac{5}{4}$

The solution set is $\left\{-\frac{3}{4}, \frac{5}{4}\right\}$.

31. $(5x-1)^2 = 7$

$5x-1 = \pm\sqrt{7}$

$5x = 1 \pm \sqrt{7}$

$x = \frac{1 \pm \sqrt{7}}{5}$

The solution set is $\left\{\frac{1-\sqrt{7}}{5}, \frac{1+\sqrt{7}}{5}\right\}$.

32. $(8x-3)^2 = 5$

$8x-3 = \pm\sqrt{5}$

$8x = 3 \pm \sqrt{5}$

$x = \frac{3 \pm \sqrt{5}}{8}$

The solution set is $\left\{\frac{3-\sqrt{5}}{8}, \frac{3+\sqrt{5}}{8}\right\}$.

33. $(3x-4)^2 = 8$

$3x-4 = \pm\sqrt{8} = \pm 2\sqrt{2}$

$3x = 4 \pm 2\sqrt{2}$

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

The solution set is $\left\{\frac{4-2\sqrt{2}}{3}, \frac{4+2\sqrt{2}}{3}\right\}$.

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34. $(2x+8)^2 = 27$

$$2x+8 = \pm\sqrt{27} = \pm 3\sqrt{3}$$

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

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

The solution set is $\left\{\frac{-8-3\sqrt{3}}{2}, \frac{-8+3\sqrt{3}}{2}\right\}$.

35. x^2+12x

$$\left(\frac{12}{2}\right)^2 = 6^2 = 36$$

$$x^2+12x+36 = (x+6)^2$$

36. x^2+16x

$$\left(\frac{16}{2}\right)^2 = 8^2 = 64;$$

$$x^2+16x+64 = (x+8)^2$$

37. x^2-10x

$$\left(\frac{10}{2}\right)^2 = 5^2 = 25$$

$$x^2-10x+25 = (x-5)^2$$

38. x^2-14x

$$\left(\frac{-14}{2}\right)^2 = (-7)^2 = 49;$$

$$x^2-14x+49 = (x-7)^2$$

39. x^2+3x

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

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

40. x^2+5x

$$\left(\frac{5}{2}\right)^2 = \frac{25}{4};$$

$$x^2+5x+\frac{25}{4} = \left(x+\frac{5}{2}\right)^2$$

41. x^2-7x

$$\left(\frac{7}{2}\right)^2 = \frac{49}{4}$$

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

42. x^2-9x

$$\left(\frac{-9}{2}\right)^2 = \frac{81}{4};$$

$$x^2-9x+\frac{81}{4} = \left(x-\frac{9}{2}\right)^2$$

43. $x^2-\frac{2}{3}x$

$$\left(\frac{\frac{2}{3}}{2}\right)^2 = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$$

$$x^2-\frac{2}{3}x+\frac{1}{9} = \left(x-\frac{1}{3}\right)^2$$

44. $x^2+\frac{4}{5}x$

$$\left(\frac{\frac{4}{5}}{2}\right)^2 = \left(\frac{2}{5}\right)^2 = \frac{4}{25};$$

$$x^2+\frac{4}{5}x+\frac{4}{25} = \left(x+\frac{2}{5}\right)^2$$

45. $x^2-\frac{1}{3}x$

$$\left(\frac{\frac{1}{3}}{2}\right)^2 = \left(\frac{1}{6}\right)^2 = \frac{1}{36}$$

$$x^2-\frac{1}{3}x+\frac{1}{36} = \left(x-\frac{1}{6}\right)^2$$

46. $x^2-\frac{1}{4}x$

$$\left(\frac{\frac{-1}{4}}{2}\right)^2 = \left(\frac{-1}{8}\right)^2 = \frac{1}{64};$$

$$x^2-\frac{1}{4}x+\frac{1}{64} = \left(x-\frac{1}{8}\right)^2$$

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47.
$$\begin{aligned} x^2+6x&=7\\ x^2+6x+9&=7+9\\ (x+3)^2&=16\\ x+3&=\pm 4\\ x&=-3\pm 4 \end{aligned}$$
The solution set is $\{-7, 1\}$.

48.
$$\begin{aligned} x^2+6x&=-8\\ x^2+6x+9&=-8+9\\ (x+3)^2&=1\\ x+3&=\pm 1\\ x&=-3\pm 1 \end{aligned}$$
The solution set is $\{-4, -2\}$.

49.
$$\begin{aligned} x^2-2x&=2\\ x^2-2x+1&=2+1\\ (x-1)^2&=3\\ x-1&=\pm\sqrt{3}\\ x&=1\pm\sqrt{3} \end{aligned}$$
The solution set is $\left\{1+\sqrt{3}, 1-\sqrt{3}\right\}$.

50.
$$\begin{aligned} x^2+4x&=12\\ x^2+4x+4&=12+4\\ (x+2)^2&=16\\ x+2&=\pm 4\\ x&=-2\pm 4 \end{aligned}$$
The solution set is $\{-6, 2\}$.

51.
$$\begin{aligned} x^2-6x-11&=0\\ x^2-6x&=11\\ x^2-6x+9&=11+9\\ (x-3)^2&=20\\ x-3&=\pm\sqrt{20}\\ x&=3\pm 2\sqrt{5} \end{aligned}$$
The solution set is $\left\{3+2\sqrt{5}, 3-2\sqrt{5}\right\}$.

52.
$$\begin{aligned} x^2-2x-5&=0\\ x^2-2x&=5\\ x^2-2x+1&=5+1\\ (x-1)^2&=6\\ x-1&=\pm\sqrt{6}\\ x&=1\pm\sqrt{6} \end{aligned}$$
The solution set is $\left\{1+\sqrt{6}, 1-\sqrt{6}\right\}$.

53.
$$\begin{aligned} x^2+4x+1&=0\\ x^2+4x&=-1\\ x^2+4x+4&=-1+4\\ (x+2)^2&=3\\ x+2&=\pm\sqrt{3}\\ x&=-2\pm\sqrt{3} \end{aligned}$$
The solution set is $\left\{-2+\sqrt{3}, -2-\sqrt{3}\right\}$.

54.
$$\begin{aligned} x^2+6x-5&=0\\ x^2+6x&=5\\ x^2+6x+9&=5+9\\ (x+3)^2&=14\\ x+3&=\pm\sqrt{14}\\ x&=-3\pm\sqrt{14} \end{aligned}$$
The solution set is $\left\{-3+\sqrt{14}, -3-\sqrt{14}\right\}$.

55.
$$\begin{aligned} x^2-5x+6&=0\\ x^2-5x\quad&=-6\\ x^2-5x+\frac{25}{4}&=-6+\frac{25}{4}\\ \left(x-\frac{5}{2}\right)^2&=\frac{1}{4}\\ x-\frac{5}{2}&=\pm\sqrt{\frac{1}{4}}\\ x-\frac{5}{2}&=\pm\frac{1}{2}\\ x&=\frac{5}{2}\pm\frac{1}{2} \end{aligned}$$
$$x=\frac{5}{2}+\frac{1}{2} \quad\text{or}\quad x=\frac{5}{2}-\frac{1}{2}$$
$$x=3 \qquad\qquad x=2$$
The solution set is $\{2, 3\}$.

56.

$$x^2+7x-8=0$$
$$x^2+7x\quad=8$$
$$x^2+7x+\frac{49}{4}=8+\frac{49}{4}$$
$$\left(x+\frac{7}{2}\right)^2=\frac{81}{4}$$
$$x+\frac{7}{2}=\pm\sqrt{\frac{81}{4}}$$
$$x+\frac{7}{2}=\pm\frac{9}{2}$$
$$x=-\frac{7}{2}\pm\frac{9}{2}$$
$$x=-\frac{7}{2}+\frac{9}{2}\quad\text{or}\quad x=-\frac{7}{2}-\frac{9}{2}$$
$$x=1\qquad\qquad x=-8$$

The solution set is {–8, 1}.

57.

$$x^2+3x-1=0$$
$$x^2+3x=1$$
$$x^2+3x+\frac{9}{4}=1+\frac{9}{4}$$
$$\left(x+\frac{3}{2}\right)^2=\frac{13}{4}$$
$$x+\frac{3}{2}=\pm\frac{\sqrt{13}}{2}$$
$$x=\frac{-3\pm\sqrt{13}}{2}$$

The solution set is $\left\{\frac{-3+\sqrt{13}}{2},\frac{-3-\sqrt{13}}{2}\right\}$.

58.

$$x^2-3x-5=0$$
$$x^2-3x=5$$
$$x^2-3x+\frac{9}{4}=5+\frac{9}{4}$$
$$\left(x-\frac{3}{2}\right)^2=\frac{29}{4}$$
$$x-\frac{3}{2}=\frac{\pm\sqrt{29}}{2}$$
$$x=\frac{3\pm\sqrt{29}}{2}$$

The solution set is $\left\{\frac{3+\sqrt{29}}{2},\frac{3-\sqrt{29}}{2}\right\}$.

59.

$$2x^2-7x+3=0$$
$$x^2-\frac{7}{2}x+\frac{3}{2}=0$$
$$x^2-\frac{7}{2}x=\frac{-3}{2}$$
$$x^2-\frac{7}{2}x+\frac{49}{16}=-\frac{3}{2}+\frac{49}{16}$$
$$\left(x-\frac{7}{4}\right)^2=\frac{25}{16}$$
$$x-\frac{7}{4}=\pm\frac{5}{4}$$
$$x=\frac{7}{4}\pm\frac{5}{4}$$

The solution set is $\left\{\frac{1}{2},3\right\}$.

60.

$$2x^2+5x-3=0$$
$$x^2+\frac{5}{2}x-\frac{3}{2}=0$$
$$x^2+\frac{5}{2}x=\frac{3}{2}$$
$$x^2+\frac{5}{2}x+\frac{25}{16}=\frac{3}{2}+\frac{25}{16}$$
$$\left(x+\frac{5}{4}\right)^2=\frac{49}{16}$$
$$x+\frac{5}{4}=\pm\frac{7}{4}$$
$$x=-\frac{5}{4}\pm\frac{7}{4}$$
$$x=\frac{1}{2};-3$$

The solution set is $\left\{-3,\frac{1}{2}\right\}$.

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61. $4x^2-4x-1=0$

$$\begin{aligned}4x^2-4x-1&=0\\ x^2-x-\frac{1}{4}&=0\\ x^2-x&=\frac{1}{4}\\ x^2-x+\frac{1}{4}&=\frac{1}{4}+\frac{1}{4}\\ \left(x-\frac{1}{2}\right)^2&=\frac{2}{4}\\ x-\frac{1}{2}&=\frac{\pm\sqrt{2}}{2}\\ x&=\frac{1\pm\sqrt{2}}{2}\end{aligned}$$

The solution set is $\left\{\frac{1+\sqrt{2}}{2},\frac{1-\sqrt{2}}{2}\right\}$.

62. $2x^2-4x-1=0$

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

The solution set is $\left\{\frac{2+\sqrt{6}}{2},\frac{2-\sqrt{6}}{2}\right\}$.

63. $3x^2-2x-2=0$

$$\begin{aligned}x^2-\frac{2}{3}x-\frac{2}{3}&=0\\ x^2-\frac{2}{3}x&=\frac{2}{3}\\ x^2-\frac{2}{3}x+\frac{1}{9}&=\frac{2}{3}+\frac{1}{9}\\ \left(x-\frac{1}{3}\right)^2&=\frac{7}{9}\\ x-\frac{1}{3}&=\frac{\pm\sqrt{7}}{3}\\ x&=\frac{1\pm\sqrt{7}}{3}\end{aligned}$$

The solution set is $\left\{\frac{1+\sqrt{7}}{3},\frac{1-\sqrt{7}}{3}\right\}$.

64. $3x^2-5x-10=0$

$$\begin{aligned}x^2-\frac{5}{3}x-\frac{10}{3}&=0\\ x^2-\frac{5}{3}x&=\frac{10}{3}\\ x^2-\frac{5}{3}x+\frac{25}{36}&=\frac{10}{3}+\frac{25}{36}\\ \left(x-\frac{5}{6}\right)^2&=\frac{145}{36}\\ x-\frac{5}{6}&=\frac{\pm\sqrt{145}}{6}\\ x&=\frac{5\pm\sqrt{145}}{6}\end{aligned}$$

The solution set is $\left\{\frac{5\pm\sqrt{145}}{6},\frac{5-\sqrt{145}}{6}\right\}$.

65. $x^2+8x+15=0$

$$\begin{aligned}x&=\frac{-8\pm\sqrt{8^2-4(1)(15)}}{2(1)}\\ x&=\frac{-8\pm\sqrt{64-60}}{2}\\ x&=\frac{-8\pm\sqrt{4}}{2}\\ x&=\frac{-8\pm2}{2}\end{aligned}$$

The solution set is $\{-5,-3\}$.

66. $x^2+8x+12=0$

$$x=\frac{-8\pm\sqrt{8^2-4(1)(12)}}{2(1)}$$

$$x=\frac{-8\pm\sqrt{64-48}}{2}$$

$$x=\frac{-8\pm\sqrt{16}}{2}$$

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

The solution set is $\{-6,-2\}$.

67. $x^2+5x+3=0$

$$x=\frac{-5\pm\sqrt{5^2-4(1)(3)}}{2(1)}$$

$$x=\frac{-5\pm\sqrt{25-12}}{2}$$

$$x=\frac{-5\pm\sqrt{13}}{2}$$

The solution set is $\left\{\frac{-5+\sqrt{13}}{2},\frac{-5-\sqrt{13}}{2}\right\}$.

68. $x^2+5x+2=0$

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

$$x=\frac{-5\pm\sqrt{25-8}}{2}$$

$$x=\frac{-5\pm\sqrt{17}}{2}$$

The solution set is $\left\{\frac{-5+\sqrt{17}}{2},\frac{-5-\sqrt{17}}{2}\right\}$.

69. $3x^2-3x-4=0$

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

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

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

The solution set is $\left\{\frac{3+\sqrt{57}}{6},\frac{3-\sqrt{57}}{6}\right\}$.

70. $5x^2+x-2=0$

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

$$x=\frac{-1\pm\sqrt{1+40}}{10}$$

$$x=\frac{-1\pm\sqrt{41}}{10}$$

The solution set is $\left\{\frac{-1+\sqrt{41}}{10},\frac{-1-\sqrt{41}}{10}\right\}$.

71. $4x^2=2x+7$

$$4x^2-2x-7=0$$

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

$$x=\frac{2\pm\sqrt{4+112}}{8}$$

$$x=\frac{2\pm\sqrt{116}}{8}$$

$$x=\frac{2\pm 2\sqrt{29}}{8}$$

$$x=\frac{1\pm\sqrt{29}}{4}$$

The solution set is $\left\{\frac{1+\sqrt{29}}{4},\frac{1-\sqrt{29}}{4}\right\}$.

72. $3x^2=6x-1$

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

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

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

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

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

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

The solution set is $\left\{\frac{3+\sqrt{6}}{3},\frac{3-\sqrt{6}}{3}\right\}$.

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73. $x^2-6x+10=0$

$$x=\frac{6\pm\sqrt{(-6)^2-4(1)(10)}}{2(1)}$$

$$x=\frac{6\pm\sqrt{36-40}}{2}$$

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

$$x=\frac{6\pm 2i}{2}$$

$$x=3\pm i$$

The solution set is $\{3+i,3-i\}$.

74. $x^2-2x+17=0$

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

$$x=\frac{2\pm\sqrt{4-68}}{2}$$

$$x=\frac{2\pm\sqrt{-64}}{2}$$

$$x=\frac{2\pm 8i}{2}$$

$$x=1\pm 4i$$

The solution set is $\{1+4i,1-4i\}$.

75. $x^2-4x-5=0$

$(-4)^2-4(1)(-5)$

= 16 + 20

= 36; 2 unequal real solutions

76. $4x^2-2x+3=0$

$(-2)^2-4(4)(3)$

= 4 – 48

= –44; 2 complex imaginary solutions

77. $2x^2-11x+3=0$

$(-11)^2-4(2)(3)$

= 121 – 24

= 97; 2 unequal real solutions

78. $2x^2+11x-6=0$

$11^2-4(2)(-6)$

= 121 + 48

= 169; 2 unequal real solutions

79. $x^2-2x+1=0$

$(-2)^2-4(1)(1)$

= 4 – 4

= 0; 1 real solution

80. $3x^2=2x-1$

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

$(-2)^2-4(3)(1)$

= 4 – 12

= –8; 2 complex imaginary solutions

81. $x^2-3x-7=0$

$(-3)^2-4(1)(-7)$

= 9 + 28

= 37; 2 unequal real solutions

82. $3x^2+4x-2=0$

$4^2-4(3)(-2)$

= 16 + 24

= 40; 2 unequal real solutions

83. $2x^2-x=1$

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

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

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

$$2x=-1$$

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

The solution set is $\left\{-\frac{1}{2},1\right\}$.

84. $3x^2-4x=4$

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

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

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

$$3x=-2$$

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

The solution set is $\left\{-\frac{2}{3},2\right\}$.

85. $5x^2+2=11x$

$5x^2-11x+2=0$

$(5x-1)(x-2)=0$

$5x-1=0$ or $x-2=0$

$5x=1$

$x=\frac{1}{5}$ or $x=2$

The solution set is $\left\{\frac{1}{5},2\right\}$.

86. $5x^2=6-13x$

$5x^2+13x-6=0$

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

$5x-2=0$ or $x+3$

$5x=2$

$x=\frac{2}{5}$ or $x=-3$

The solution set is $\left\{-3,\frac{2}{5}\right\}$.

87. $3x^2=60$

$x^2=20$

$x=\pm\sqrt{20}$

$x=\pm2\sqrt{5}$

The solution set is $\left\{-2\sqrt{5},2\sqrt{5}\right\}$.

88. $2x^2=250$

$x^2=125$

$x=\pm\sqrt{125}$

$x=\pm5\sqrt{5}$

The solution set is $\left\{-5\sqrt{5},5\sqrt{5}\right\}$.

89. $x^2-2x=1$

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

$(x-1)^2=2$

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

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

The solution set is $\left\{1+\sqrt{2},1-\sqrt{2}\right\}$.

90. $2x^2+3x=1$

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

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

$$x=\frac{-3\pm\sqrt{9+8}}{4}$$

$$x=\frac{-3\pm\sqrt{17}}{4}$$

The solution set is $\left\{\frac{-3+\sqrt{17}}{4},\frac{-3-\sqrt{17}}{4}\right\}$.

91. $(2x+3)(x+4)=1$

$2x^2+8x+3x+12=1$

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

$$x=\frac{-11\pm\sqrt{11^2-4(2)(11)}}{2(2)}$$

$$x=\frac{-11\pm\sqrt{121-88}}{4}$$

$$x=\frac{-11\pm\sqrt{33}}{4}$$

The solution set is $\left\{\frac{-11+\sqrt{33}}{4},\frac{-11-\sqrt{33}}{4}\right\}$.

92. $(2x-5)(x+1)=2$

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

$2x^2-3x-7=0$

$$x=\frac{3\pm\sqrt{(-3)^2-4(2)(-7)}}{2(2)}$$

$$x=\frac{3\pm\sqrt{9+56}}{4}$$

$$x=\frac{3\pm\sqrt{65}}{4}$$

The solution set is $\left\{\frac{3+\sqrt{65}}{4},\frac{3-\sqrt{65}}{4}\right\}$.

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93. $(3x-4)^2 = 16$

$$3x-4 = \pm\sqrt{16}$$
$$3x-4 = \pm 4$$
$$3x = 4\pm 4$$
$$3x = 8 \text{ or } 3x = 0$$
$$x = \frac{8}{3} \text{ or } x = 0$$

The solution set is $\left\{0, \frac{8}{3}\right\}$.

94. $(2x+7)^2 = 25$

$$2x+7 = \pm 5$$
$$2x = -7\pm 5$$
$$2x = -12 \quad \text{or} \quad 2x = -2$$
$$x = 6 \qquad \text{or} \qquad x = -1$$

The solution set is $\{-6, -1\}$.

95. $3x^2 - 12x + 12 = 0$

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

The solution set is $\{2\}$.

96. $9 - 6x + x^2 = 0$

$$x^2 - 6x + 9 = 0$$
$$(x-3)(x-3) = 0$$
$$x-3 = 0$$
$$x = 3$$

The solution set is $\{3\}$.

97. $4x^2 - 16 = 0$

$$4x^2 = 16$$
$$x^2 = 4$$
$$x = \pm 2$$

The solution set is $\{-2, 2\}$.

98. $3x^2 - 27 = 0$

$$3x^2 = 27$$
$$x^2 = 9$$
$$x = \pm 3$$

The solution set is $\{-3, 3\}$.

99. $x^2 - 6x + 13 = 0$

$$x^2 - 6x = -13$$
$$x^2 - 6x + 9 = -13 + 9$$
$$(x-3)^2 = -4$$
$$x-3 = \pm 2i$$
$$x = 3\pm 2i$$

The solution set is $\{3+2i, 3-2i\}$.

100. $x^2 - 4x + 29 = 0$

$$x^2 - 4x = -29$$
$$x^2 - 4x + 4 = -29 + 4$$
$$(x-2)^2 = -25$$
$$x-2 = \pm 5i$$
$$x = 2\pm 5i$$

The solution set is $\{2+5i, 2-5i\}$.

101.

$$x^2 = 4x - 7$$
$$x^2 - 4x = -7$$
$$x^2 - 4x + 4 = -7 + 4$$
$$(x-2)^2 = -3$$
$$x-2 = \pm i\sqrt{3}$$
$$x = 2\pm i\sqrt{3}$$

The solution set is $\left\{2+i\sqrt{3}, 2-i\sqrt{3}\right\}$.

102.

$$5x^2 = 2x - 3$$
$$5x^2 - 2x + 3 = 0$$
$$x = \frac{2\pm\sqrt{(-2)^2 - 4(5)(3)}}{2(5)}$$
$$x = \frac{2\pm\sqrt{4-60}}{10}$$
$$x = \frac{2\pm\sqrt{-56}}{10}$$
$$x = \frac{2\pm 2i\sqrt{14}}{10}$$
$$x = \frac{1\pm i\sqrt{14}}{5}$$

The solution set is $\left\{\frac{1+i\sqrt{14}}{5}, \frac{1-i\sqrt{14}}{5}\right\}$.

103. $2x^2 - 7x = 0$

$x(2x-7) = 0$

$x = 0$ or $2x - 7 = 0$

$2x = 7$

$x = 0$ or $x = \frac{7}{2}$

The solution set is $\left\{0, \frac{7}{2}\right\}$.

104. $2x^2 + 5x = 3$

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

$$x = \frac{-5 \pm \sqrt{5^2 - 4(2)(-3)}}{2(2)}$$

$$x = \frac{-5 \pm \sqrt{25+24}}{4}$$

$$x = \frac{-5 \pm \sqrt{49}}{4}$$

$$x = \frac{-5 \pm 7}{4}$$

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

The solution set is $\left\{-3, \frac{1}{2}\right\}$.

105. $\frac{1}{x} + \frac{1}{x+2} = \frac{1}{3}; x \neq 0, -2$

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

$0 = x^2 - 4x - 6$

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

$$x = \frac{4 \pm \sqrt{16+24}}{2}$$

$$x = \frac{4 \pm \sqrt{40}}{2}$$

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

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

The solution set is $\{2 + \sqrt{10},\ 2 - \sqrt{10}\}$.

106. $\frac{1}{x} + \frac{1}{x+3} = \frac{1}{4}; x \neq 0, -3$

$4x + 12 + 4x = x^2 + 3x$

$0 = x^2 - 5x - 12$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-12)}}{2(1)}$$

$$x = \frac{5 \pm \sqrt{25+48}}{2}$$

$$x = \frac{5 \pm \sqrt{73}}{2}$$

The solution set is $\left\{\frac{5+\sqrt{73}}{2}, \frac{5-\sqrt{73}}{2}\right\}$.

107. $\frac{2x}{x-3} + \frac{6}{x+3} = \frac{-28}{x^2-9}; x \neq 3, -3$

$2x(x+3) + 6(x-3) = -28$

$2x^2 + 6x + 6x - 18 = -28$

$2x^2 + 12x + 10 = 0$

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

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

The solution set is $\{-5,\ -1\}$.

108. $\frac{3}{x-3} + \frac{5}{x-4} = \frac{x^2-20}{x^2-7x+12}; x \neq 3, 4$

$3x - 12 + 5x - 15 = x^2 - 20$

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

$0 = (x-7)(x-1)$

$x = 7 \qquad x = 1$

The solution set is $\{1, 7\}$.

109. $x^2 - 4x - 5 = 0$

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

$x + 1 = 0$ or $x - 5 = 0$

$x = -1 \qquad x = 5$

This equation matches graph (d).

110. $x^2-6x+7=0$

$a=1,\quad b=-6,\quad c=7$

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

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

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

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

$x\approx 1.6,\quad x\approx 4.4$

This equation matches graph (a).

111. $0=-(x+1)^2+4$

$(x+1)^2=4$

$x+1=\pm 2$

$x=-1\pm 2$

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

This equation matches graph (f).

112. $0=-(x+3)^2+1$

$(x+3)^2=1$

$x+3=\pm 1$

$x=-3\pm 1$

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

This equation matches graph (e).

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

$a=1,\quad b=-2,\quad c=2$

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

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

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

$$x=\frac{2\pm 2i}{2}$$

$x=1\pm i$

This equation has no real roots. Thus, its equation has no x-intercepts. This equation matches graph (b).

114. $x^2+6x+9=0$

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

$x+3=0$

$x=-3$

This equation matches graph (c).

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

$2=2x^2-3x$

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

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

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

116. $y=5x^2+3x$

$2=5x^2+3x$

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

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

$x=-1,\quad x=\frac{2}{5}$

117. $y_1y_2=14$

$(x-1)(x+4)=14$

$x^2+3x-4=14$

$x^2+3x-18=0$

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

$x=-6,\quad x=3$

118. $y_1y_2=-30$

$(x-3)(x+8)=-30$

$x^2+5x-24=-30$

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

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

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

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119.
$$y_1 + y_2 = 1$$
$$\frac{2x}{x+2} + \frac{3}{x+4} = 1$$
$$(x+2)(x+4)\left(\frac{2x}{x+2} + \frac{3}{x+4}\right) = 1(x+2)(x+4)$$
$$\frac{2x(x+2)(x+4)}{x+2} + \frac{3(x+2)(x+4)}{x+4} = (x+2)(x+4)$$
$$2x(x+4) + 3(x+2) = (x+2)(x+4)$$
$$2x^2 + 8x + 3x + 6 = x^2 + 6x + 8$$
$$x^2 + 5x - 2 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(5) \pm \sqrt{(5)^2 - 4(1)(-2)}}{2(1)}$$
$$x = \frac{-5 \pm \sqrt{33}}{2}$$

The solution set is $\left\{\frac{-5+\sqrt{33}}{2}, \frac{-5-\sqrt{33}}{2}\right\}$.

120.
$$y_1 + y_2 = 3$$
$$\frac{3}{x-1} + \frac{8}{x} = 3$$
$$x(x-1)\left(\frac{3}{x-1} + \frac{8}{x}\right) = 3(x)(x-1)$$
$$\frac{3x(x-1)}{x-1} + \frac{8x(x-1)}{x} = 3x(x-1)$$
$$3x + 8(x-1) = 3x^2 - 3x$$
$$3x + 8x - 8 = 3x^2 - 3x$$
$$11x - 8 = 3x^2 - 3x$$
$$0 = 3x^2 - 14x + 8$$
$$0 = (3x-2)(x-4)$$

$$x = \frac{2}{3}, \quad x = 4$$

The solution set is $\left\{\frac{2}{3}, 4\right\}$.

121.
$$y_1 - y_2 = 0$$
$$\left(2x^2 + 5x - 4\right) - \left(-x^2 + 15x - 10\right) = 0$$
$$2x^2 + 5x - 4 + x^2 - 15x + 10 = 0$$
$$3x^2 - 10x + 6 = 0$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(3)(6)}}{2(3)}$$
$$x = \frac{10 \pm \sqrt{28}}{6}$$
$$x = \frac{10 \pm 2\sqrt{7}}{6}$$
$$x = \frac{5 \pm \sqrt{7}}{3}$$

The solution set is $\left\{\frac{5+\sqrt{7}}{3}, \frac{5-\sqrt{7}}{3}\right\}$.

122.
$$y_1 - y_2 = 0$$
$$\left(-x^2 + 4x - 2\right) - \left(-3x^2 + x - 1\right) = 0$$
$$-x^2 + 4x - 2 + 3x^2 - x + 1 = 0$$
$$2x^2 + 3x - 1 = 0$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(3) \pm \sqrt{(3)^2 - 4(2)(-1)}}{2(2)}$$
$$x = \frac{-3 \pm \sqrt{17}}{4}$$

The solution set is $\left\{\frac{-3+\sqrt{17}}{4}, \frac{-3-\sqrt{17}}{4}\right\}$.

123. Values that make the denominator zero must be excluded**.**
$$2x^2 + 4x - 9 = 0$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(4) \pm \sqrt{(4)^2 - 4(2)(-9)}}{2(2)}$$
$$x = \frac{-4 \pm \sqrt{88}}{4}$$
$$x = \frac{-4 \pm 2\sqrt{22}}{4}$$
$$x = \frac{-2 \pm \sqrt{22}}{2}$$

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124. Values that make the denominator zero must be excluded**.**

$$2x^2-8x+5=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-8)\pm\sqrt{(-8)^2-4(2)(5)}}{2(2)}$$
$$x=\frac{8\pm\sqrt{24}}{4}$$
$$x=\frac{8\pm2\sqrt{6}}{4}$$
$$x=\frac{4\pm\sqrt{6}}{2}$$

125. $x^2-\left(6+2x\right)=0$

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

Apply the quadratic formula.

$a=1\quad b=-2\quad c=-6$

$$x=\frac{-\left(-2\right)\pm\sqrt{\left(-2\right)^2-4\left(1\right)\left(-6\right)}}{2\left(1\right)}$$
$$=\frac{2\pm\sqrt{4-\left(-24\right)}}{2}$$
$$=\frac{2\pm\sqrt{28}}{2}$$
$$=\frac{2\pm\sqrt{4\cdot7}}{2}=\frac{2\pm2\sqrt{7}}{2}=1\pm\sqrt{7}$$

We disregard $1-\sqrt{7}$ because it is negative, and we are looking for a positive number.

Thus, the number is $1+\sqrt{7}$.

126. Let x = the number.

$$2x^2-\left(1+2x\right)=0$$
$$2x^2-2x-1=0$$

Apply the quadratic formula.

$a=2\quad b=-2\quad c=-1$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-\left(-2\right)\pm\sqrt{\left(-2\right)^2-4\left(2\right)\left(-1\right)}}{2\left(2\right)}$$
$$=\frac{2\pm\sqrt{4-\left(-8\right)}}{4}$$
$$=\frac{2\pm\sqrt{12}}{4}=\frac{2\pm\sqrt{4\cdot3}}{4}=\frac{2\pm2\sqrt{3}}{4}=\frac{1\pm\sqrt{3}}{2}$$

We disregard $\frac{1+\sqrt{3}}{2}$ because it is positive, and we are looking for a negative number. The number is $\frac{1-\sqrt{3}}{2}$.

127.

$$\frac{1}{x^2-3x+2}=\frac{1}{x+2}+\frac{5}{x^2-4}$$
$$\frac{1}{(x-1)(x-2)}=\frac{1}{x+2}+\frac{5}{(x+2)(x-2)}$$

Multiply both sides of the equation by the least common denominator, $(x-1)(x-2)(x+2)$. This results in the following:

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

Apply the quadratic formula:

$a=1\quad b=1\quad c=-5$.

$$x=\frac{-1\pm\sqrt{1^2-4\left(1\right)\left(-5\right)}}{2\left(1\right)}=\frac{-1\pm\sqrt{1-\left(-20\right)}}{2}$$
$$=\frac{-1\pm\sqrt{21}}{2}$$

The solutions are $\frac{-1\pm\sqrt{21}}{2}$, and the solution set is $\left\{\frac{-1\pm\sqrt{21}}{2}\right\}$.

128. $$\frac{x-1}{x-2}+\frac{x}{x-3}=\frac{1}{x^2-5x+6}$$
$$\frac{x-1}{x-2}+\frac{x}{x-3}=\frac{1}{(x-2)(x-3)}$$

Multiply both sides of the equation by the least common denominator, $(x-2)(x-3)$. This results in the following:

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

Apply the quadratic formula:
$a=2 \quad b=-6 \quad c=2.$

$$x=\frac{-(-6)\pm\sqrt{(-6)^2-4(2)(2)}}{2(2)}$$
$$=\frac{6\pm\sqrt{36-16}}{4}=\frac{6\pm\sqrt{20}}{4}$$
$$=\frac{6\pm\sqrt{4\cdot 5}}{4}=\frac{6\pm 2\sqrt{5}}{4}$$
$$=\frac{3\pm\sqrt{5}}{2}$$

The solutions are $\frac{3\pm\sqrt{5}}{2}$, and the solution set is $\left\{\frac{3\pm\sqrt{5}}{2}\right\}$.

129. $\sqrt{2}x^2+3x-2\sqrt{2}=0$

Apply the quadratic formula:
$a=\sqrt{2} \quad b=3 \quad c=-2\sqrt{2}$

$$x=\frac{-3\pm\sqrt{3^2-4\left(\sqrt{2}\right)\left(-2\sqrt{2}\right)}}{2\left(\sqrt{2}\right)}$$
$$=\frac{-3\pm\sqrt{9-(-16)}}{2\sqrt{2}}$$
$$=\frac{-3\pm\sqrt{25}}{2\sqrt{2}}=\frac{-3\pm 5}{2\sqrt{2}}$$

Evaluate the expression to obtain two solutions.

$$x=\frac{-3-5}{2\sqrt{2}} \quad \text{or} \quad x=\frac{-3+5}{2\sqrt{2}}$$
$$=\frac{-8}{2\sqrt{2}}\cdot\frac{\sqrt{2}}{\sqrt{2}} \qquad =\frac{2}{2\sqrt{2}}\cdot\frac{\sqrt{2}}{\sqrt{2}}$$
$$=\frac{-8\sqrt{2}}{4} \qquad =\frac{2\sqrt{2}}{4}$$
$$=-2\sqrt{2} \qquad =\frac{\sqrt{2}}{2}$$

The solutions are $-2\sqrt{2}$ and $\frac{\sqrt{2}}{2}$, and the solution set is $\left\{-2\sqrt{2}, \frac{\sqrt{2}}{2}\right\}$.

130. $\sqrt{3}x^2+6x+7\sqrt{3}=0$

Apply the quadratic formula:
$a=\sqrt{3} \quad b=6 \quad c=7\sqrt{3}$

$$x=\frac{-6\pm\sqrt{6^2-4\left(\sqrt{3}\right)\left(7\sqrt{3}\right)}}{2\left(\sqrt{3}\right)}$$
$$=\frac{-6\pm\sqrt{36-84}}{2\sqrt{3}}$$
$$=\frac{-6\pm\sqrt{-48}}{2\sqrt{3}}$$
$$=\frac{-6\pm\sqrt{16\cdot 3\cdot(-1)}}{2\sqrt{3}}$$
$$=\frac{-6\pm 4\sqrt{3}i}{2\sqrt{3}}$$
$$=\frac{-6}{2\sqrt{3}}\pm\frac{4\sqrt{3}i}{2\sqrt{3}}=-\sqrt{3}\pm 2i$$

The solutions are $-\sqrt{3}\pm 2i$, and the solution set is $\left\{-\sqrt{3}\pm 2i\right\}$.

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131. $N = \dfrac{x^2 - x}{2}$

$21 = \dfrac{x^2 - x}{2}$

$42 = x^2 - x$

$0 = x^2 - x - 42$

$0 = (x+6)(x-7)$

$x + 6 = 0 \quad \text{or} \quad x - 7 = 0$

$x = -6 \qquad\quad x = 7$

Reject the negative value.
There were 7 players.

132. $N = \dfrac{x^2 - x}{2}$

$36 = \dfrac{x^2 - x}{2}$

$72 = x^2 - x$

$0 = x^2 - x - 72$

$0 = (x+8)(x-9)$

$x + 8 = 0 \quad \text{or} \quad x - 9 = 0$

$x = -8 \qquad\quad x = 9$

Reject the negative value.
There were 9 players.

133. This is represented on the graph as point (7, 21).

134. This is represented on the graph as point (9, 36).

135. $f(x) = 0.013x^2 - 1.19x + 28.24$

$3 = 0.013x^2 - 1.19x + 28.24$

$0 = 0.013x^2 - 1.19x + 25.24$

Apply the quadratic formula.

$a = 0.013 \quad b = -1.19 \quad c = 25.24$

$$x = \frac{-(-1.19) \pm \sqrt{(-1.19)^2 - 4(0.013)(25.24)}}{2(0.013)}$$

$$= \frac{1.19 \pm \sqrt{1.4161 - 1.31248}}{0.026}$$

$$= \frac{1.19 \pm \sqrt{0.10362}}{0.026}$$

$$\approx \frac{1.19 \pm 0.32190}{0.026}$$

≈ 58.15 or 33.39

The solutions are approximately 33.39 and 58.15. Thus, 33 year olds and 58 year olds are expected to be in 3 fatal crashes per 100 million miles driven. The function models the actual data well.

136. $f(x) = 0.013x^2 - 1.19x + 28.24$

$10 = 0.013x^2 - 1.19x + 28.24$

$0 = 0.013x^2 - 1.19x + 18.24$

$a = 0.013 \quad b = -1.19 \quad c = 18.24$

$$x = \frac{-(-1.19) \pm \sqrt{(-1.19)^2 - 4(0.013)(18.24)}}{2(0.013)}$$

$$= \frac{1.19 \pm \sqrt{1.4161 - 0.94848}}{0.026}$$

$$= \frac{1.19 \pm \sqrt{0.46762}}{0.026} \approx \frac{1.19 \pm 0.68383}{0.026}$$

Evaluate the expression to obtain two solutions.

$x = \dfrac{1.19 + 0.68383}{0.026} \quad \text{or} \quad x = \dfrac{1.19 - 0.68383}{0.026}$

$x = \dfrac{1.87383}{0.026} \qquad\quad x = \dfrac{0.50617}{0.026}$

$x \approx 72.1 \qquad\quad x \approx 19$

Drivers of approximately age 19 and age 72 are expected to be involved in 10 fatal crashes per 100 million miles driven. The model doesn't seem to predict the number of accidents very well. The model overestimates the number of fatal accidents.

137. Using the TRACE feature, we find that the height of the shot put is approximately 0 feet when the distance is 77.8 feet. Graph (b) shows the shot' path.

138. Using the ZERO feature, we find that the height of the shot put is approximately 0 feet when the distance is 55.3 feet. Graph (a) shows the shot's path.

139. $x^2 = 4^2 + 2^2$

$x^2 = 16 + 4$

$x^2 = 20$

$x = \pm\sqrt{20}$

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

We disregard $-2\sqrt{5}$ because we can't have a negative measurement. The path is $2\sqrt{5}$ miles, or approximately 4.5 miles.

140. $x^2 = 6^2 + 3^2$

$x^2 = 36 + 9$

$x^2 = 45$

$x = \pm\sqrt{45}$

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

We disregard $-3\sqrt{5}$ because we can't have a negative measurement. The path is $3\sqrt{5}$ miles, or approximately 6.7 miles.

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141. $x^2+10^2=30^2$

$x^2+100=900$

$x^2=800$

Apply the square root property.

$x=\pm\sqrt{800}=\pm\sqrt{400\cdot 2}=\pm 20\sqrt{2}$

We disregard $-20\sqrt{2}$ because we can't have a negative length measurement. The solution is $20\sqrt{2}$. We conclude that the ladder reaches $20\sqrt{2}$ feet, or approximately 28.3 feet, up the house.

142. $90^2+90^2=x^2$

$8100+8100=x^2$

$16200=x^2$

$x\approx\pm 127.28$

The distance is 127.28 feet.

143. **a.** $x^2+120^2=122^2$

$x^2+14400=14884$

$x^2=484$

$x\approx\pm 22$

The ramp's vertical distance is 22 inches.

b. This ramp does not satisfy the requirement.

144. **a.** $h^2=a^2+a^2$

$h^2=2a^2$

$h=\sqrt{2a^2}$

$h=a\sqrt{2}$

b. The length of the hypotenuse of an isosceles right triangle is the length of the leg times $\sqrt{2}$.

145. Let w = the width
Let w +3 = the length

Area = lw

$54=(w+3)w$

$54=w^2+3w$

$0=w^2+3w-54$

$0=(w+9)(w-6)$

Apply the zero product principle.

$w+9=0 \qquad w-6=0$

$w=-9 \qquad w=6$

The solution set is $\{-9,6\}$. Disregard –9 because we can't have a negative length measurement. The width is 6 feet and the length is $6+3=9$ feet.

146. Let w = the width
Let w + 3 = the width

Area = lw

$180=(w+3)w$

$180=w^2+3w$

$0=w^2+3w-180$

$0=(w+15)(w-12)$

$w+15=0 \qquad w-12=0$

$\cancel{w=-15} \qquad w=12$

The width is 12 yards and the length is 12 yards + 3 yards = 15 yards.

147. Let x = the length of the side of the original square
Let x + 3 = the length of the side of the new, larger square

$(x+3)^2=64$

$x^2+6x+9=64$

$x^2+6x-55=0$

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

Apply the zero product principle.

$x+11=0 \qquad x-5=0$

$x=-11 \qquad x=5$

The solution set is $\{-11,5\}$. Disregard –11 because we can't have a negative length measurement. This means that x, the length of the side of the original square, is 5 inches.

148. Let x = the side of the original square,
Let x + 2 = the side of the new, larger square

$(x+2)^2=36$

$x^2+4x+4=36$

$x^2+4x-32=0$

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

$x+8=0 \qquad x-4=0$

$\cancel{x=-8} \qquad x=4$

The length of the side of the original square, is 4 inches.

149. Let x = the width of the path

$$(20+2x)(10+2x)=600$$
$$200+40x+20x+4x^2=600$$
$$200+60x+4x^2=600$$
$$4x^2+60x+200=600$$
$$4x^2+60x-400=0$$
$$4(x^2+15x-100)=0$$
$$4(x+20)(x-5)=0$$

Apply the zero product principle.

$$4(x+20)=0 \qquad x-5=0$$
$$x+20=0 \qquad x=5$$
$$x=-20$$

The solution set is $\{-20,5\}$. Disregard –20 because we can't have a negative width measurement. The width of the path is 5 meters.

150. Let x = the width of the path

$$(12+2x)(15+2x)=378$$
$$180+24x+30x+4x^2=378$$
$$4x^2+54x+180=378$$
$$4x^2+54x-198=0$$
$$2(2x^2+27x-99)=0$$
$$2(2x+33)(x-3)=0$$
$$2(2x+33)=0 \qquad x-3=0$$
$$2x+33=0 \qquad x=3$$
$$2x=-33$$
$$\cancel{x=-\frac{33}{2}}$$

The width of the path is 3 meters.

151. $x(x)(2)=200$

$$2x^2=200$$
$$x^2=100$$
$$x=\pm10$$

The length and width are 10 inches.

152. $x(x)(3)=75$

$$3x^2=75$$
$$x^2=25$$
$$x=\pm5$$

The length and width is 5 inches.

153. $x(20-2x)=13$

$$20x-2x^2=13$$
$$0=2x^2-20x+13$$
$$x=\frac{-(-20)\pm\sqrt{(-20)^2-4(2)(13)}}{2(2)}$$
$$x=\frac{20\pm\sqrt{296}}{4}$$
$$x=\frac{10\pm17.2}{4}$$
$$x=9.3,0.7$$

9.3 in and 0.7 in

154. $\left(\frac{x}{4}\right)^2+\left(\frac{8-x}{4}\right)^2=2$

$$\frac{x^2}{16}+\frac{64-16x+x^2}{16}=2$$
$$x^2+64-16x+x^2=32$$
$$2x^2-16x+32=0$$
$$x^2-8x+16=0$$
$$(x-4)(x-4)=0$$
$$x=4 \text{ in}$$

Both are 4 inches.

155. – 165. Answers will vary.

166. does not make sense; Explanations will vary. Sample explanation: The factoring method would be quicker.

167. does not make sense; Explanations will vary. Sample explanation: Higher degree polynomial equations can have only one x-intercept.

168. does not make sense; Explanations will vary. Sample explanation: The solutions are not irrational.

169. makes sense

170. false; Changes to make the statement true will vary. A sample change is: $(2x-3)^2=25$

$$2x-3=\pm5$$

171. true

172. false; Changes to make the statement true will vary. A sample change is: The quadratic formula is developed by completing the square.

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173. false; Changes to make the statement true will vary. A sample change is: The first step is to collect all the terms on one side and have 0 on the other.

174.
$$\begin{aligned}(x+3)(x-5)&=0\\ x^2-5x+3x-15&=0\\ x^2-2x-15&=0\end{aligned}$$

175.
$$\begin{aligned}&s=-16t^2+v_0t\\ &0=-16t^2+v_0t-s\\ &a=-16,\ b=v_0,\ c=-s\\ &t=\frac{-v_0\pm\sqrt{(v_0)^2-4(-16)(-s)}}{2(-16)}\\ &t=\frac{-v_0\pm\sqrt{(v_0)^2-64s}}{-32}\\ &t=\frac{v_0\pm\sqrt{v_0{}^2-64s}}{32}\end{aligned}$$

176. The dimensions of the pool are 12 meters by 8 meters. With the tile, the dimensions will be 12 + 2*x* meters by 8 + 2*x* meters. If we take the area of the pool with the tile and subtract the area of the pool without the tile, we are left with the area of the tile only.

$$\begin{aligned}(12+2x)(8+2x)-12(8)&=120\\ \cancel{96}+24x+16x+4x^2-\cancel{96}&=120\\ 4x^2+40x-120&=0\\ x^2+10x-30&=0\end{aligned}$$

$$a=1\qquad b=10\qquad c=-30$$

$$\begin{aligned}x&=\frac{-10\pm\sqrt{10^2-4(1)(-30)}}{2(1)}\\ &=\frac{-10\pm\sqrt{100+120}}{2}\\ &=\frac{-10\pm\sqrt{220}}{2}\approx\frac{-10\pm14.8}{2}\end{aligned}$$

Evaluate the expression to obtain two solutions.

$$\begin{aligned}x&=\frac{-10+14.8}{2}&\text{or}\quad x&=\frac{-10-14.8}{2}\\ x&=\frac{4.8}{2}&x&=\frac{-24.8}{2}\\ x&=2.4&x&=-12.4\end{aligned}$$

We disregard –12.4 because we can't have a negative width measurement. The solution is 2.4 and we conclude that the width of the uniform tile border is 2.4 meters. This is more than the 2-meter requirement, so the tile meets the zoning laws.

177.
$$\begin{aligned}x^3+x^2-4x-4&=x^2(x+1)-4(x+1)\\ &=(x+1)(x^2-4)\\ &=(x+1)(x+2)(x-2)\end{aligned}$$

178.
$$\begin{aligned}(\sqrt{x+4}+1)^2&=\sqrt{x+4}^2+2(\sqrt{x+4})(1)+1^2\\ &=x+4+2\sqrt{x+4}+1\\ &=x+5+2\sqrt{x+4}\end{aligned}$$

179.
$$\begin{aligned}5x^{2/3}+11x^{1/3}+2&=0\\ 5(-8)^{2/3}+11(-8)^{1/3}+2&=0\\ 5(-2)^2+11(-2)^1+2&=0\\ 5(4)+11(-2)+2&=0\\ 20-22+2&=0\\ 0&=0,\ \text{true}\end{aligned}$$

The statement is true.

Mid-Chapter 1 Check Point

1.
$$\begin{aligned}-5+3(x+5)&=2(3x-4)\\ -5+3x+15&=6x-8\\ 3x+10&=6x-8\\ -3x&=-18\\ \frac{-3x}{-3}&=\frac{-18}{-3}\\ x&=6\end{aligned}$$

The solution set is $\{6\}$.

2.
$$\begin{aligned}&5x^2-2x=7\\ &5x^2-2x-7=0\\ &(5x-7)(x+1)=0\\ &5x-7=0\quad\text{or}\quad x+1=0\\ &5x=7\qquad\qquad x=-1\\ &x=\frac{7}{5}\end{aligned}$$

The solution set is $\left\{-1,\frac{7}{5}\right\}$.

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3. $$\frac{x-3}{5}-1=\frac{x-5}{4}$$
$$20\left(\frac{x-3}{5}-1\right)=20\left(\frac{x-5}{4}\right)$$
$$\frac{20(x-3)}{5}-20(1)=\frac{20(x-5)}{4}$$
$$4(x-3)-20=5(x-5)$$
$$4x-12-20=5x-25$$
$$4x-32=5x-25$$
$$-x=7$$
$$x=-7$$
The solution set is $\{-7\}$.

4. $$3x^2-6x-2=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-6)\pm\sqrt{(-6)^2-4(3)(-2)}}{2(3)}$$
$$x=\frac{6\pm\sqrt{60}}{6}$$
$$x=\frac{6\pm2\sqrt{15}}{6}$$
$$x=\frac{3\pm\sqrt{15}}{3}$$
The solution set is $\left\{\frac{3+\sqrt{15}}{3},\frac{3-\sqrt{15}}{3}\right\}$.

5. $$4x-2(1-x)=3(2x+1)-5$$
$$4x-2(1-x)=3(2x+1)-5$$
$$4x-2+2x=6x+3-5$$
$$6x-2=6x-2$$
$$0=0$$
The equation is an identity.
The solution set is $\{x|x \text{ is a real number}\}$.

6. $$5x^2+1=37$$
$$5x^2=36$$
$$\frac{5x^2}{5}=\frac{36}{5}$$
$$x^2=\frac{36}{5}$$
$$x=\pm\sqrt{\frac{36}{5}}$$
$$x=\pm\frac{6}{\sqrt{5}}$$
$$x=\pm\frac{6}{\sqrt{5}}\cdot\frac{\sqrt{5}}{\sqrt{5}}$$
$$x=\pm\frac{6\sqrt{5}}{5}$$
The solution set is $\left\{-\frac{6\sqrt{5}}{5},\frac{6\sqrt{5}}{5}\right\}$.

7. $$x(2x-3)=-4$$
$$2x^2-3x=-4$$
$$2x^2-3x+4=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-3)\pm\sqrt{(-3)^2-4(2)(4)}}{2(2)}$$
$$x=\frac{3\pm\sqrt{-23}}{4}$$
$$x=\frac{3\pm i\sqrt{23}}{4}$$
The solution set is $\left\{\frac{3+i\sqrt{23}}{4},\frac{3-i\sqrt{23}}{4}\right\}$.

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8.

$$\frac{3x}{4}-\frac{x}{3}+1=\frac{4x}{5}-\frac{3}{20}$$

$$\frac{3x}{4}-\frac{x}{3}+1=\frac{4x}{5}-\frac{3}{20}$$

$$60\left(\frac{3x}{4}-\frac{x}{3}+1\right)=60\left(\frac{4x}{5}-\frac{3}{20}\right)$$

$$\frac{60(3x)}{4}-\frac{60x}{3}+60(1)=\frac{60(4x)}{5}-\frac{60(3)}{20}$$

$$45x-20x+60=48x-9$$

$$25x+60=48x-9$$

$$-23x=-69$$

$$\frac{-23x}{-23}=\frac{-69}{-23}$$

$$x=3$$

The solution set is $\{3\}$.

9.

$$(x+3)^2=24$$

$$x+3=\pm\sqrt{24}$$

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

The solution set is $\{-3+2\sqrt{6},-3-2\sqrt{6}\}$.

10.

$$\frac{1}{x^2}-\frac{4}{x}+1=0$$

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

$$\frac{x^2}{x^2}-\frac{4x^2}{x}+x^2=0$$

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

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

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

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

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

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

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

The solution set is $\{2+\sqrt{3},2-\sqrt{3}\}$.

11.

$$3x+1-(x-5)=2x-4$$

$$2x+6=2x-4$$

$$6=-4$$

The solution set is $\varnothing$.

12.

$$\frac{2x}{x^2+6x+8}=\frac{x}{x+4}-\frac{2}{x+2},\quad x\neq-2, x\neq-4$$

$$\frac{2x}{(x+4)(x+2)}=\frac{x}{x+4}-\frac{2}{x+2}$$

$$\frac{2x(x+4)(x+2)}{(x+4)(x+2)}=(x+4)(x+2)\left(\frac{x}{x+4}-\frac{2}{x+2}\right)$$

$$2x=\frac{x(x+4)(x+2)}{x+4}-\frac{2(x+4)(x+2)}{x+2}$$

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

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

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

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

$x+2=0$ or $x-4=0$

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

–2 must be rejected.

The solution set is $\{4\}$.

13. Let $y=0$.

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

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

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

$$x=\frac{-6\pm\sqrt{28}}{2}$$

$$x=\frac{-6\pm 2\sqrt{7}}{2}$$

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

x-intercepts: $-3+\sqrt{7}$ and $-3-\sqrt{7}$.

14. Let $y=0$.

$$0=4(x+1)-3x-(6-x)$$

$$0=4x+4-3x-6+x$$

$$0=2x-2$$

$$-2x=-2$$

$$x=1$$

x-intercept: 1.

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15. Let $y = 0.$

$$\begin{aligned} 0 &= 2x^2 + 26 \\ -2x^2 &= 26 \\ x^2 &= -13 \\ x &= \pm\sqrt{-13} \\ x &= \pm i\sqrt{13} \end{aligned}$$

There are no x-intercepts.

16. Let $y = 0.$

$$\begin{aligned} 0 &= \frac{x^2}{3} + \frac{x}{2} - \frac{2}{3} \\ 6(0) &= 6\left(\frac{x^2}{3} + \frac{x}{2} - \frac{2}{3}\right) \\ 0 &= \frac{6 \cdot x^2}{3} + \frac{6 \cdot x}{2} - \frac{6 \cdot 2}{3} \\ 0 &= 2x^2 + 3x - 4 \\ x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ x &= \frac{-(3) \pm \sqrt{(3)^2 - 4(2)(-4)}}{2(2)} \\ x &= \frac{-3 \pm \sqrt{41}}{4} \end{aligned}$$

x-intercepts: $\frac{-3+\sqrt{41}}{4}$ and $\frac{-3-\sqrt{41}}{4}$.

17. Let $y = 0.$

$$\begin{aligned} 0 &= x^2 - 5x + 8 \\ x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\ x &= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(8)}}{2(1)} \\ x &= \frac{5 \pm \sqrt{-7}}{2} \\ x &= \frac{5 \pm i\sqrt{7}}{2} \end{aligned}$$

There are no x-intercepts.

18.

$$\begin{aligned} y_1 &= y_2 \\ 3(2x-5) - 2(4x+1) &= -5(x+3) - 2 \\ 6x - 15 - 8x - 2 &= -5x - 15 - 2 \\ -2x - 17 &= -5x - 17 \\ 3x &= 0 \\ x &= 0 \end{aligned}$$

The solution set is $\{0\}$.

19.

$$\begin{aligned} y_1 y_2 &= 10 \\ (2x+3)(x+2) &= 10 \\ 2x^2 + 7x + 6 &= 10 \\ 2x^2 + 7x - 4 &= 0 \\ (2x-1)(x+4) &= 0 \end{aligned}$$

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

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

The solution set is $\left\{-4, \frac{1}{2}\right\}$.

20.

$$\begin{aligned} x^2 + 10x - 3 &= 0 \\ x^2 + 10x \quad &= 3 \end{aligned}$$

Since $b = 10$, we add $\left(\frac{10}{2}\right)^2 = 5^2 = 25$.

$$\begin{aligned} x^2 + 10x + 25 &= 3 + 25 \\ (x+5)^2 &= 28 \end{aligned}$$

Apply the square root principle:

$$\begin{aligned} x + 5 &= \pm\sqrt{28} \\ x + 5 &= \pm\sqrt{4 \cdot 7} = \pm 2\sqrt{7} \\ x &= -5 \pm 2\sqrt{7} \end{aligned}$$

The solutions are $-5 \pm 2\sqrt{7}$, and the solution set is $\left\{-5 \pm 2\sqrt{7}\right\}$.

21.

$$2x^2 + 5x + 4 = 0$$

$a = 2 \quad b = 5 \quad c = 4$

$$\begin{aligned} b^2 - 4ac &= 5^2 - 4(2)(4) \\ &= 25 - 32 = -7 \end{aligned}$$

Since the discriminant is negative, there are no real solutions. There are two imaginary solutions that are complex conjugates.

22.

$$\begin{aligned} 10x(x+4) &= 15x - 15 \\ 10x^2 + 40x &= 15x - 15 \\ 10x^2 - 25x + 15 &= 0 \end{aligned}$$

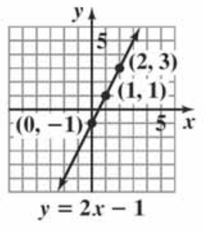
$a = 10 \quad b = -25 \quad c = 15$

$$\begin{aligned} b^2 - 4ac &= (-25)^2 - 4(10)(15) \\ &= 625 - 600 = 25 \end{aligned}$$

Since the discriminant is positive and a perfect square, there are two rational solutions.

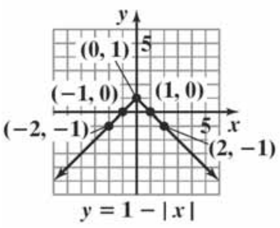
23.

x	(x, y)
−2	−5
−1	−3
0	−1
1	1
2	3



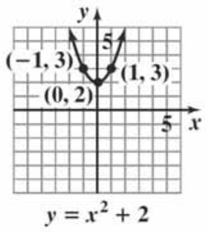
24.

x	(x, y)
−3	−2
−2	−1
−1	0
0	1
1	0
2	−1
3	−2



25.

x	(x, y)
−2	6
−1	3
0	2
1	3
2	6



26.

$$\begin{aligned} L &= a+(n-1)d \\ L &= a+dn-d \\ -dn &= a-d-L \\ \frac{-dn}{-d} &= \frac{a}{-d}-\frac{d}{-d}-\frac{L}{-d} \\ n &= -\frac{a}{d}+1+\frac{L}{d} \\ n &= \frac{L}{d}-\frac{a}{d}+1 \\ n &= \frac{L-a}{d}+1 \end{aligned}$$

27.

$$\begin{aligned} A &= 2lw+2lh+2wh \\ -2lw-2lh &= 2wh-A \\ l(-2w-2h) &= 2wh-A \\ l &= \frac{2wh-A}{-2w-2h} \\ l &= \frac{A-2wh}{2w+2h} \end{aligned}$$

28.

$$\begin{aligned} f &= \frac{f_1 f_2}{f_1+f_2} \\ (f_1+f_2)(f) &= (f_1+f_2)\frac{f_1 f_2}{f_1+f_2} \\ f_1 f + f_2 f &= f_1 f_2 \\ f_1 f - f_1 f_2 &= -f_2 f \\ f_1(f-f_2) &= -f_2 f \\ f_1 &= \frac{-f_2 f}{f-f_2} \\ f_1 &= -\frac{ff_2}{f-f_2} \text{ or } f_1 = \frac{ff_2}{f_2-f} \end{aligned}$$

29. Let $x =$ the average yearly earnings, in thousands, of marketing majors.
Let $x+19 =$ the average yearly earnings, in thousands, of engineering majors.
Let $x+6 =$ the average yearly earnings, in thousands, of accounting majors.

$$x+(x+19)+(x+6)=196$$
$$x+x+19+x+6=196$$
$$3x+25=196$$
$$3x=171$$
$$x=57$$
$$x+19=76$$
$$x+6=63$$

The average yearly earnings for marketing majors, engineering majors, and accounting majors were $57 thousand, $76 thousand, and $63 thousand, respectively.

30. Let x = the number of years since 1960.

$$23-0.28x=0$$
$$-0.28x=-23$$
$$\frac{-0.28x}{-0.28}=\frac{-23}{-0.28}$$
$$x \approx 82$$

If this trend continues, corporations will pay zero taxes 82 years after 1960, or 2042.

31. Let x = the amount invested at 0.99%.
Let 25,000 – x = the amount invested at 1.19%.

$$0.0099x+0.0119(25,000-x)=274.50$$
$$0.0099x+297.50-0.0119x=274.50$$
$$-0.002x+297.50=274.50$$
$$-0.002x=-23$$
$$x=\frac{-23}{-0.002}$$
$$x=11,500$$
$$25,000-x=13,500$$

$11,500 was invested at 0.99% and $13,500 was invested at 1.19%.

32. Let x = the number of bridge crossings.
Without SunPass: $1.50x$
With Sunpass: $19.99+1.07x$

$$1.50x=19.99+1.07x$$
$$0.43x=19.99$$
$$x \approx 46$$

The cost will be the same for about 46 bridge crossings.

33. Let x = the price before the reduction.

$$x-0.40x=479.40$$
$$0.60x=479.40$$
$$\frac{0.60x}{0.60}=\frac{479.40}{0.60}$$
$$x=799$$

The price before the reduction was $799.

34. Let x = the amount invested at 4%.
Let 4000 – x = the amount invested that lost 3%.

$$0.04x-0.03(4000-x)=55$$
$$0.04x-120+0.03x=55$$
$$0.07x-120=55$$
$$0.07x=175$$
$$x=\frac{175}{0.07}$$
$$x=2500$$
$$4000-x=1500$$

$2500 was invested at 4% and $1500 lost 3%.

35. Let x = the width of the rectangle
Let 2x + 5 = the length of the rectangle

$$2l+2w=P$$
$$2(2x+5)+2x=46$$
$$4x+10+2x=46$$
$$6x+10=46$$
$$6x=36$$
$$\frac{6x}{6}=\frac{36}{6}$$
$$x=6$$
$$2x+5=17$$

The dimensions of the rectangle are 6 ft by 17 ft.

36. Let x = the width of the rectangle
Let 2x – 1 = the length of the rectangle

$$lw=A$$
$$(2x-1)x=28$$
$$2x^2-x=28$$
$$2x^2-x-28=0$$
$$(2x+7)(x-4)=0$$
$$2x+7=0 \quad \text{or} \quad x-4=0$$
$$2x=-7 \qquad x=4$$
$$x=-\frac{7}{2}$$

$-\frac{7}{2}$ must be rejected.

If $x=4$, then $2x-1=7$

The dimensions of the rectangle are 4 ft by 7 ft.

37. Let x = the height up the pole at which the wires are attached.

$$x^2+5^2=13^2$$
$$x^2+25=169$$
$$x^2=144$$
$$x=\pm 12$$

–12 must be rejected.
The wires are attached 12 yards up the pole.

38. **a.**
$$P=-10x^2+475x+3500$$
$$5990=-10x^2+475x+3500$$
$$0=-10x^2+475x-2490$$
$$0=2x^2-95x+498$$
$$0=(x-6)(2x-83)$$
$$x-6=0 \quad \text{or} \quad 2x-83=0$$
$$x=6 \qquad\qquad 2x=83$$
$$x=41.5$$

The population reached 5990 after 6 years.

b. This is represented by the point (6, 5990).

39.
$$p=0.004x^2-0.35x+13.9$$
$$19=0.004x^2-0.35x+13.9$$
$$0=0.004x^2-0.35x-5.1$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-0.35)\pm\sqrt{(-0.35)^2-4(0.004)(-5.1)}}{2(0.004)}$$
$$x=\frac{0.35\pm\sqrt{0.1225+0.0816}}{0.008}$$
$$x\approx 100, \quad x\approx -13 \text{ (rejected)}$$

The percentage of foreign born Americans will be 19% about 100 years after 1920, or 2020.

40. $(6-2i)-(7-i)=6-2i-7+i=-1-i$

41. $3i(2+i)=6i+3i^2=-3+6i$

42.
$$(1+i)(4-3i)=4-3i+4i-3i^2$$
$$=4+i+3=7+i$$

43.
$$\frac{1+i}{1-i}=\frac{1+i}{1-i}\cdot\frac{1+i}{1+i}=\frac{1+i+i+i^2}{1-i^2}$$
$$=\frac{1+2i-1}{1+1}$$
$$=\frac{2i}{2}$$
$$=i$$

44. $\sqrt{-75}-\sqrt{-12}=5i\sqrt{3}-2i\sqrt{3}=3i\sqrt{3}$

45.
$$\left(2-\sqrt{-3}\right)^2=\left(2-i\sqrt{3}\right)^2$$
$$=4-4i\sqrt{3}+3i^2$$
$$=4-4i\sqrt{3}-3$$
$$=1-4i\sqrt{3}$$

46.
$$i^{83}=i^{4\cdot 20+3}$$
$$=\left(i^4\right)^{20}i^3$$
$$=(1)^{20}(-i)$$
$$=-i$$

47.
$$i^{94}=i^{4\cdot 23+2}$$
$$=\left(i^4\right)^{23}i^2$$
$$=(1)^{23}(-1)$$
$$=-1$$

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Section 1.6

Check Point Exercises

1. $4x^4 = 12x^2$

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

$4x^2\left(x^2 - 3\right) = 0$

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

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

$x = \pm\sqrt{0}$ $\quad x = \pm\sqrt{3}$

$x = 0$ $\quad x = \pm\sqrt{3}$

The solution set is $\left\{-\sqrt{3}, 0, \sqrt{3}\right\}$.

2. $2x^3 + 3x^2 = 8x + 12$

$x^2(2x+3) - 4(2x+3) = 10$

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

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

$2x = -3$ $\quad x^2 = 4$

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

The solution set is $\left\{-2, -\frac{3}{2}, 2\right\}$.

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

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

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

$x + 3 = x^2 - 6x + 9$

$0 = x^2 - 7x + 6$

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

$x - 6 = 0$ or $x - 1 = 0$

$x = 6$ $\quad x = 1$

1 does not check and must be rejected.
The solution set is $\{6\}$.

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

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

$\left(\sqrt{x+5}\right)^2 = \left(2 + \sqrt{x-3}\right)^2$

$x + 5 = (2)^2 + 2(2)\left(\sqrt{x-3}\right) + \left(\sqrt{x-3}\right)^2$

$x + 5 = 4 + 4\sqrt{x-3} + x - 3$

$4 = 4\sqrt{x-3}$

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

$1 = \sqrt{x-3}$

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

$1 = x - 3$

$4 = x$

The check indicates that 4 is a solution.
The solution set is $\{4\}$.

5. **a.** $5x^{3/2} - 25 = 0$

$5x^{3/2} = 25$

$x^{3/2} = 5$

$\left(x^{3/2}\right)^{2/3} = (5)^{2/3}$

$x = 5^{2/3}$ or $\sqrt[3]{25}$

Check:

$5\left(5^{2/3}\right)^{3/2} - 25 = 0$

$5(5) - 25 = 0$

$25 - 25 = 0$

$0 = 0$

The solution set is $\left\{5^{2/3}\right\}$ or $\left\{\sqrt[3]{25}\right\}$.

b. $x^{\frac{2}{3}} - 8 = -4$

$x^{2/3} = 4$

$\left(x^{2/3}\right)^{3/2} = 4^{3/2}$ $\quad$ or

$x = \left(2^2\right)^{3/2}$

$x = 2^3$ $\quad x = (-2)^3$

$x = 8$ $\quad x = -8$

The solution set is $\{-8, 8\}$.

6. $x^4 - 5x^2 + 6 = 0$

$\left(x^2\right)^2 - 5x^2 + 6 = 0$

Let $t = x^2$.

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

$(t-3)(t-2) = 0$

$t - 3 = 0$ or $t - 2 = 0$

$t = 3$ or $t = 2$

$x^2 = 3$ or $x^2 = 2$

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

The solution set is $\left\{-\sqrt{3}, -\sqrt{2}, \sqrt{2}, \sqrt{3}\right\}$.

7. $3x^{2/3} - 11x^{1/3} - 4 = 0$

Let $t = x^{1/3}$.

$3t^2 - 11t - 4 = 0$

$(3t+1)(t-4) = 0$

$3t + 1 = 0$ or $t - 4 = 0$

$3t = -1$

$t = -\frac{1}{3}$ $\quad t = 4$

$x^{1/3} = -\frac{1}{3}$ $\quad x^{1/3} = 4$

$x = \left(-\frac{1}{3}\right)^3$ $\quad x = 4^3$

$x = -\frac{1}{27}$ $\quad x = 64$

The solution set is $\left\{-\frac{1}{27}, 64\right\}$.

8. $\left(x^2 - 4\right)^2 + \left(x^2 - 4\right) - 6 = 0$

Let $u = x^2 - 4$.

$u^2 + u - 6 = 0$

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

$u + 3 = 0$ or $u - 2 = 0$

$u = -3$ or $u = 2$

$x^2 - 4 = -3$ or $x^2 - 4 = 2$

$x = \pm 1$ or $x = \pm\sqrt{6}$

The solution set is $\left\{-\sqrt{6}, -1, 1, \sqrt{6}\right\}$.

9. $|2x - 1| = 5$

$2x - 1 = 5$ or $2x - 1 = -5$

$2x = 6$ $\quad 2x = -4$

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

The solution set is {–2, 3}.

10. $4|1 - 2x| - 20 = 0$

$4|1 - 2x| = 20$

$|1 - 2x| = 5$

$1 - 2x = 5$ or $1 - 2x = -5$

$-2x = 4$ $\quad -2x = -6$

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

The solution set is {–2, 3}.

11. $H = -2.3\sqrt{I} + 67.6$

$33.1 = -2.3\sqrt{I} + 67.6$

$-34.5 = -2.3\sqrt{I}$

$\frac{-34.5}{-2.3} = \frac{-2.3\sqrt{I}}{-2.3}$

$15 = \sqrt{I}$

$15^2 = \left(\sqrt{I}\right)^2$

$225 = I$

The model indicates that an annual income of 225 thousand dollars, or $225,000, corresponds to 33.1 hours per week watching TV.

Concept and Vocabulary Check 1.6

C1. subtract 8*x* and subtract 12 from both sides

C2. radical

C3. extraneous

C4. $2x + 1$; $x^2 + 14x + 49$

C5. $x + 2$; $x + 8 - 6\sqrt{x-1}$

C6. $5^{\frac{4}{3}}$

C7. $\pm 5^{\frac{3}{2}}$

C8. x^2; $u^2 - 13u + 36 = 0$

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C9. $x^{\frac{1}{3}}$; $u^2 + 2u - 3 = 0$

C10. c; $-c$

C11. $3x - 1 = 7$; $3x - 1 = -7$

Exercise Set 1.6

1.

$$3x^4 - 48x^2 = 0$$
$$3x^2(x^2 - 16) = 0$$
$$3x^2(x+4)(x-4) = 0$$
$$3x^2 = 0 \quad x+4=0 \quad x-4=0$$
$$x^2 = 0 \quad x=-4 \quad x=4$$
$$x = 0$$

The solution set is {–4, 0, 4}.

2.

$$5x^4 - 20x^2 = 0$$
$$5x^2(x^2 - 4) = 0$$
$$5x^2(x+2)(x-2) = 0$$
$$5x^2 = 0 \quad x+2=0 \quad x-2=0$$
$$x^2 = 0$$
$$x = 0 \quad x=-2 \quad x=2$$

The solution set is {–2, 0, 2}.

3.

$$3x^3 + 2x^2 = 12x + 8$$
$$3x^3 + 2x^2 - 12x - 8 = 0$$
$$x^2(3x+2) - 4(3x+2) = 0$$
$$(3x+2)(x^2 - 4) = 0$$
$$3x+2 = 0 \quad x^2 - 4 = 0$$
$$3x = -2 \quad x^2 = 4$$
$$x = -\frac{2}{3} \quad x = \pm 2$$

The solution set is $\left\{-2, -\frac{2}{3}, 2\right\}$.

4.

$$4x^3 - 12x^2 = 9x - 27$$
$$4x^3 - 12x^2 - 9x + 27 = 0$$
$$4x^2(x-3) - 9(x-3) = 0$$
$$(x-3)(4x^2 - 9) = 0$$
$$x-3 = 0 \quad 4x^2 - 9 = 0$$
$$x = 3 \quad 4x^2 = 9$$
$$x^2 = \frac{9}{4}$$
$$x = \pm\frac{3}{2}$$

The solution set is $\left\{-\frac{3}{2}, \frac{3}{2}, 3\right\}$.

5.

$$2x - 3 = 8x^3 - 12x^2$$
$$8x^3 - 12x^2 - 2x + 3 = 0$$
$$4x^2(2x-3) - (2x-3) = 0$$
$$(2x-3)(4x^2 - 1) = 0$$
$$2x-3 = 0 \quad 4x^2 - 1 = 0$$
$$2x = 3 \quad 4x^2 = 1$$
$$x^2 = \frac{1}{4}$$
$$x = \frac{3}{2} \quad x = \pm\frac{1}{2}$$

The solution set is $\left\{\frac{3}{2}, \frac{1}{2}, -\frac{1}{2}\right\}$.

6.

$$x + 1 = 9x^3 + 9x^2$$
$$9x^3 + 9x^2 - x - 1 = 0$$
$$9x^2(x+1) - (x+1) = 0$$
$$(x+1)(9x^2 - 1) = 0$$
$$x+1 = 0 \quad 9x^2 - 1 = 1$$
$$x = -1 \quad 9x^2 = 1$$
$$x^2 = \frac{1}{9}$$
$$x = \pm\frac{1}{3}$$

The solution set is $\left\{-1, -\frac{1}{3}, \frac{1}{3}\right\}$.

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7. $4y^3 - 2 = y - 8y^2$

$4y^3 + 8y^2 - y - 2 = 0$

$4y^2(y+2) - (y+2) = 0$

$(y+2)(4y^2 - 1) = 0$

$y + 2 = 0 \quad 4y^2 - 1 = 0$

$4y^2 = 1$

$y^2 = \frac{1}{4}$

$y = -2 \qquad y = \pm\frac{1}{2}$

The solution set is $\left\{-2, \frac{1}{2}, -\frac{1}{2}\right\}$.

8. $9y^3 + 8 = 4y + 18y^2$

$9y^3 - 18y^2 - 4y + 8 = 0$

$9y^2(y-2) - 4(y-2) = 0$

$(y-2)(9y^2 - 4) = 0$

$y - 2 = 0 \quad 9y^2 - 4 = 0$

$y = 2 \qquad 9y^2 = 4$

$y^2 = \frac{4}{9}$

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

The solution set is $\left\{-\frac{2}{3}, \frac{2}{3}, 2\right\}$.

9. $2x^4 = 16x$

$2x^4 - 16x = 0$

$2x\left(x^3 - 8\right) = 0$

$2x = 0 \qquad x^3 - 8 = 0$

$x = 0 \qquad (x-2)(x^2 + 2x + 2) = 0$

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

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

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

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

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

The solution set is $\left\{0, 2, -1 \pm i\sqrt{3}\right\}$.

10. $3x^4 = 81x$

$3x^4 - 81x = 0$

$3x(x^3 - 27) = 0$

$3x = 0 \qquad x^3 - 27 = 0$

$x = 0;$

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

$x - 3 = 0 \quad x^2 + 3x + 9 = 0$

$x = 3 \qquad x = \frac{-3 \pm \sqrt{3^2 - 4(1)(9)}}{2(1)}$

$x = \frac{-3 \pm \sqrt{9 - 36}}{2}$

$x = \frac{-3 \pm \sqrt{-27}}{2}$

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

The solution set is $\left\{0, 3, \frac{-3 \pm 3i\sqrt{3}}{2}\right\}$.

11. $\sqrt{3x + 18} = x$

$3x + 18 = x^2$

$x^2 - 3x - 18 = 0$

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

$x + 3 = 0 \quad x - 6 = 0$

$x = -3 \qquad x = 6$

$\sqrt{3(-3) + 18} = -3 \quad \sqrt{3(6) + 18} = 6$

$\sqrt{-9 + 18} = -3 \qquad \sqrt{18 + 18} = 6$

$\sqrt{9} = -3$ False $\sqrt{36} = 6$

The solution set is $\{6\}$.

12. $\sqrt{20 - 8x} = x$

$20 - 8x = x^2$

$x^2 + 8x - 20 = 0$

$(x+10)(x-2) = 0$

$x + 10 = 0 \qquad x - 2 = 0$

$x = -10 \qquad x = 2$

$\sqrt{20 - 8(-10)} = -10 \qquad \sqrt{20 - 8(2)} = 2$

$\sqrt{20 + 80} = -10 \qquad \sqrt{20 - 16} = 2$

$\sqrt{100} = -10$ False $\qquad \sqrt{4} = 2$

The solution set is $\{2\}$.

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13. $\sqrt{x+3} = x-3$

$x+3 = x^2 - 6x + 9$

$x^2 - 7x + 6 = 0$

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

$x-1=0 \quad x-6=0$

$x=1 \quad x=6$

$\sqrt{1+3} = 1-3 \qquad \sqrt{6+3} = 6-3$

$\sqrt{4} = -2$ False $\sqrt{9} = 3$

The solution set is {6}.

14. $\sqrt{x+10} = x-2$

$x+10 = (x-2)^2$

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

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

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

$x+1=0 \quad x-6=0$

$x=-1 \quad x=6$

$\sqrt{-1+10} = -1-2 \qquad \sqrt{6+10} = 6-2$

$\sqrt{9} = -3$ False $\sqrt{16} = 4$

The solution set is {6}.

15. $\sqrt{2x+13} = x+7$

$2x+13 = (x+7)^2$

$2x+13 = x^2 + 14x + 49$

$x^2 + 12x + 36 = 0$

$(x+6)^2 = 0$

$x+6 = 0$

$x = -6$

$\sqrt{2(-6)+13} = -6+7$

$\sqrt{-12+13} = 1$

$\sqrt{1} = 1$

The solution set is {–6}.

16. $\sqrt{6x+1} = x-1$

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

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

$x^2 - 8x = 0$

$x(x-8) = 0$

$x-8=0 \quad x=0$

$x=8$

$\sqrt{6(0)+1} = 0-1 \qquad \sqrt{6(8)+1} = 8-1$

$\sqrt{0+1} = -1 \qquad \sqrt{48+1} = 7$

$\sqrt{1} = -1$ False $\sqrt{49} = 7$

The solution set is {8}.

17. $x - \sqrt{2x+5} = 5$

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

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

$x^2 - 10x + 25 = 2x + 5$

$x^2 - 12x + 20 = 0$

$(x-2)(x-10) = 0$

$x-2=0 \quad x-10=0$

$x=2 \quad x=10$

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

$2 - \sqrt{9} = 5 \qquad 10 - \sqrt{25} = 5$

$2-3=5$ False $10-5=5$

The solution set is {10}.

18. $x - \sqrt{x+11} = 1$

$x-1 = \sqrt{x+11}$

$(x-1)^2 = x+11$

$x^2 - 2x + 1 = x + 11$

$x^2 - 3x - 10 = 0$

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

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

$x=-2 \quad x=5$

$-2 - \sqrt{-2+11} = 1 \qquad 5 - \sqrt{5+11} = 1$

$-2 - \sqrt{9} = 1 \qquad 5 - \sqrt{16} = 1$

$-2-3=1$ False $5-4=1$

The solution set is {5}.

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19.
$$\begin{gathered}
\sqrt{2x+19}-8=x\\
\sqrt{2x+19}=x+8\\
\left(\sqrt{2x+19}\right)^2=(x+8)^2\\
2x+19=x^2+16x+64\\
0=x^2+14x+45\\
0=(x+9)(x+5)\\
x+9=0 \quad \text{or} \quad x+5=0\\
x=-9 \qquad x=-5
\end{gathered}$$

–9 does not check and must be rejected.
The solution set is {–5}.

20.
$$\begin{gathered}
\sqrt{2x+15}-6=x\\
\sqrt{2x+15}=x+6\\
\left(\sqrt{2x+15}\right)^2=(x+6)^2\\
2x+15=x^2+12x+36\\
0=x^2+10x+21\\
0=(x+3)(x+7)\\
x+3=0 \quad \text{or} \quad x+7=0\\
x=-3 \qquad x=-7
\end{gathered}$$

–7 does not check and must be rejected.
The solution set is {–3}.

21.
$$\begin{gathered}
\sqrt{3x}+10=x+4\\
\sqrt{3x}=x-6\\
3x=(x-6)^2\\
3x=x^2-12x+36\\
x^2-15x+36=0\\
(x-12)(x-3)=0\\
x-12=0 \qquad x-3=0\\
x=12 \qquad x=3\\
\sqrt{3(12)}+10=12+4 \qquad \sqrt{3(3)}+10=3+4\\
\sqrt{36}+10=16 \qquad \sqrt{9}+10=7\\
6+10=16 \qquad 3+10=7 \text{ False}
\end{gathered}$$

The solution set is {12}.

22.
$$\begin{gathered}
\sqrt{x}-3=x-9\\
\sqrt{x}=x-6\\
x=(x-6)^2\\
x=x^2-12x+36\\
x^2-13x+36=0\\
(x-9)(x-4)=0\\
x-9=0 \qquad x-4=0\\
x=9 \qquad x=4\\
\sqrt{9}-3=9-9 \qquad \sqrt{4}-3=4-9\\
3-3=9-9 \qquad 2-3=4-9 \text{ False}
\end{gathered}$$

The solution set is {9}.

23.
$$\begin{gathered}
\sqrt{x+8}-\sqrt{x-4}=2\\
\sqrt{x+8}=\sqrt{x-4}+2\\
x+8=(\sqrt{x-4}+2)^2\\
x+8=x-4+4\sqrt{x-4}+4\\
x+8=x+4\sqrt{x-4}\\
8=4\sqrt{x-4}\\
2=\sqrt{x-4}\\
4=x-4\\
x=8\\
\sqrt{8+8}-\sqrt{8-4}=2\\
\sqrt{16}-\sqrt{4}=2\\
4-2=2
\end{gathered}$$

The solution set is {8}.

24.
$$\begin{gathered}
\sqrt{x+5}-\sqrt{x-3}=2\\
\sqrt{x+5}=\sqrt{x-3}+2\\
x+5=(\sqrt{x-3}+2)^2\\
x+5=x-3+4\sqrt{x-3}+4\\
x+5=x+1+4\sqrt{x-3}\\
5=1+4\sqrt{x-3}\\
4=4\sqrt{x-3}\\
1=\sqrt{x-3}\\
1=x-3\\
x=4\\
\sqrt{4+5}-\sqrt{4-3}=2\\
\sqrt{9}-\sqrt{1}=2\\
3-1=2
\end{gathered}$$

The solution set is {4}.

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25.
$$\begin{aligned}
\sqrt{x-5}-\sqrt{x-8}&=3\\
\sqrt{x-5}&=\sqrt{x-8}+3\\
x-5&=(\sqrt{x-8}+3)^2\\
x-5&=x-8+6\sqrt{x-8}+9\\
x-5&=x+1+6\sqrt{x-8}\\
-6&=6\sqrt{x-8}\\
-1&=\sqrt{x-8}\\
1&=x-8\\
x&=9\\
\sqrt{9-5}-\sqrt{9-8}&=3\\
\sqrt{4}-\sqrt{1}&=3\\
2-1&=3 \text{ False}
\end{aligned}$$

The solution set is the empty set, $\varnothing$.

26.
$$\begin{aligned}
\sqrt{2x-3}-\sqrt{x-2}&=1\\
\sqrt{2x-3}&=\sqrt{x-2}+1\\
2x-3&=(\sqrt{x-2}+1)^2\\
2x-3&=x-2+2\sqrt{x-2}+1\\
2x-3&=x-1+2\sqrt{x-2}\\
x-2&=2\sqrt{x-2}\\
\frac{x}{2}-1&=\sqrt{x-2}\\
\left(\frac{x}{2}-1\right)^2&=x-2\\
\frac{x^2}{4}-x+1&=x-2\\
x^2-4x+4&=4x-8\\
x^2-8x+12&=0\\
(x-6)(x-2)&=0
\end{aligned}$$

$$x-6=0 \quad x-2=0$$
$$x=6 \qquad x=2$$

$$\begin{aligned}
\sqrt{2(6)-3}-\sqrt{6-2}&=1 & \sqrt{2(2)-3}-\sqrt{2-2}&=1\\
\sqrt{12-3}-\sqrt{4}&=1 & \sqrt{4-3}-\sqrt{0}&=1\\
\sqrt{9}-\sqrt{4}&=1 & \sqrt{1}-0&=1\\
3-2&=1 & 1-0&=1
\end{aligned}$$

The solution set is $\{2, 6\}$.

27.
$$\begin{aligned}
\sqrt{2x+3}+\sqrt{x-2}&=2\\
\sqrt{2x+3}&=2-\sqrt{x-2}\\
2x+3&=(2-\sqrt{x-2})^2\\
2x+3&=4-4\sqrt{x-2}+x-2\\
x+1&=-4\sqrt{x-2}\\
(x+1)^2&=16(x-2)\\
x^2+2x+1&=16x-32\\
x^2-14x+33&=0\\
(x-11)(x-3)&=0
\end{aligned}$$

$$x-11=0 \quad x-3=0$$
$$x=11 \qquad x=3$$

$$\begin{aligned}
\sqrt{2(11)+3}+\sqrt{11-2}&=2\\
\sqrt{22+3}+\sqrt{9}&=2\\
5+3&=2 \text{ False}\\
\sqrt{2(3)+3}+\sqrt{3-2}&=2\\
\sqrt{6+3}+\sqrt{1}&=2\\
3+1&=2 \text{ False}
\end{aligned}$$

The solution set is the empty set, $\varnothing$.

28.
$$\begin{aligned}
\sqrt{x+2}+\sqrt{3x+7}&=1\\
\sqrt{x+2}&=1-\sqrt{3x+7}\\
x+2&=(1-\sqrt{3x+7})^2\\
x+2&=1-2\sqrt{3x+7}+3x+7\\
-2x-6&=-2\sqrt{3x+7}\\
x+3&=\sqrt{3x+7}\\
(x+3)^2&=3x+7\\
x^2+6x+9&=3x+7\\
x^2+3x+2&=0\\
(x+1)(x+2)&=0
\end{aligned}$$

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

$$\begin{aligned}
\sqrt{-1+2}+\sqrt{3(-1)+7}&=1\\
\sqrt{1}+\sqrt{4}&=1\\
1+2&=1 \text{ False}\\
\sqrt{-2+2}+\sqrt{3(-2)+7}&=1\\
\sqrt{0}+\sqrt{1}&=1\\
0+1&=1
\end{aligned}$$

The solution set is $\{-2\}$.

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29. $\sqrt{3\sqrt{x+1}} = \sqrt{3x-5}$

$3\sqrt{x+1} = 3x-5$

$9(x+1) = 9x^2 - 30x + 25$

$9x^2 - 39x + 16 = 0$

$x = \frac{39 \pm \sqrt{945}}{18} = \frac{13 \pm \sqrt{105}}{6}$

Check proposed solutions.

The solution set is $\left\{\frac{13+\sqrt{105}}{6}\right\}$.

30. $\sqrt{1+4\sqrt{x}} = 1+\sqrt{x}$

$1+4\sqrt{x} = 1+2\sqrt{x}+x$

$2\sqrt{x} = x$

$4x = x^2$

$x^2 - 4x = 0$

$x(x-4) = 0$

$x = 0$ or $x = 4$

The solution set is {0, 4}.

31. $x^{3/2} = 8$

$(x^{3/2})^{2/3} = 8^{2/3}$

$x = \sqrt[3]{8}^2$

$x = 2^2$

$x = 4$

$4^{3/2} = 8$

$\sqrt{4}^3 = 8$

$2^3 = 8$

The solution set is {4}.

32. $x^{3/2} = 27$

$(x^{3/2})^{2/3} = 27^{2/3}$

$x = \sqrt[3]{27}^2$

$x = 3^2$

$x = 9$

$9^{3/2} = 27$

$\sqrt{9}^3 = 27$

$3^3 = 27$

The solution set is {9}.

33. $(x-4)^{3/2} = 27$

$((x-4)^{3/2})^{2/3} = 27^{2/3}$

$x-4 = \sqrt[3]{27}^2$

$x-4 = 3^2$

$x-4 = 9$

$x = 13$

$(13-4)^{3/2} = 27$

$9^{3/2} = 27$

$\sqrt{9}^3 = 27$

$3^3 = 27$

The solution set is {13}.

34. $(x+5)^{3/2} = 8$

$((x+5)^{3/2})^{2/3} = 8^{2/3}$

$x+5 = \sqrt[3]{8}^2$

$x+5 = 2^2$

$x+5 = 4$

$x = -1$

$(-1+5)^{3/2} = 8$

$4^{3/2} = 8$

$\sqrt{4}^3 = 8$

$2^3 = 8$

The solution set is {–1}.

35. $6x^{5/2} - 12 = 0$

$6x^{5/2} = 12$

$x^{5/2} = 2$

$(x^{5/2})^{2/5} = 2^{2/5}$

$x = \sqrt[5]{2^2}$

$x = \sqrt[5]{4}$

$6(\sqrt[5]{4})^{5/2} - 12 = 0$

$6(4^{1/5})^{5/2} - 12 = 0$

$6(4^{1/2}) - 12 = 0$

$6(2) - 12 = 0$

The solution set is $\left\{\sqrt[5]{4}\right\}$.

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36.
$$8x^{5/3}-24=0$$
$$8x^{5/3}=24$$
$$x^{5/3}=3$$
$$(x^{5/3})^{3/5}=3^{3/5}$$
$$x=\sqrt[5]{3^3}$$
$$x=\sqrt[5]{27}$$
$$8(\sqrt[5]{27})^{5/3}-24=0$$
$$8(27^{1/5})^{5/3}-24=0$$
$$8(27^{1/3})-24=0$$
$$8(3)-24=0$$

The solution set is $\left\{\sqrt[5]{27}\right\}$.

37.
$$\left(x-4\right)^{2/3}=16$$
$$\left[\left(x-4\right)^{2/3}\right]^{3/2}=\left(16\right)^{3/2}$$
$$x-4=\left(2^4\right)^{3/2}$$
$$x-4=4^3 \qquad x-4=(-4)^3$$
$$x-4=64 \qquad x-4=-64$$
$$x=68 \qquad x=-60$$

The solution set is {– 60, 68}.

38.
$$\left(x+5\right)^{\frac{2}{3}}=4$$
$$\left[\left(x+5\right)^{\frac{2}{3}}\right]^{\frac{3}{2}}=\left(4\right)^{\frac{3}{2}}$$
$$x+5=\left(2^2\right)^{\frac{3}{2}}$$
$$x+5=2^3 \qquad \text{or} \qquad x+5=(-2)^3$$
$$x+5=8 \qquad x+5=-8$$
$$x=3 \qquad x=-13$$

The solution set is {–13, 3}.

39.
$$(x^2-x-4)^{3/4}-2=6$$
$$(x^2-x-4)^{3/4}=8$$
$$((x^2-x-4)^{3/4})^{4/3}=8^{4/3}$$
$$x^2-x-4=\sqrt[3]{8}^4$$
$$x^2-x-4=2^4$$
$$x^2-x-4=16$$
$$x^2-x-20=0$$
$$(x-5)(x+4)=0$$
$$x-5=0 \quad x+4=0$$
$$x=5 \qquad x=-4$$
$$(5^2-5-4)^{3/4}-2=6$$
$$(25-9)^{3/4}-2=6$$
$$16^{3/4}-2=6$$
$$\sqrt[4]{16}^3-2=6$$
$$2^3-2=6$$
$$8-2=6$$
$$((-4)^2-(-4)-4)^{3/4}-2=6$$
$$(16+4-4)^{3/4}-2=6$$
$$16^{3/4}-2=6$$
$$\sqrt[4]{16}^3-2=6$$
$$2^3-2=6$$
$$8-2=6$$

The solution set is {5, –4}.

40.
$$(x^2-3x+3)^{3/2}-1=0$$
$$(x^2-3x+3)^{3/2}=1$$
$$x^2-3x+3=1^{2/3}$$
$$x^2-3x+3=1$$
$$x^2-3x+2=0$$
$$(x-1)(x-2)=0$$
$$x-1=0 \quad x-2=0$$
$$x=1 \qquad x=2$$
$$(1^2-3(1)+3)^{3/2}-1=0$$
$$(1-3+3)^{3/2}-1=0$$
$$1^{3/2}-1=0$$
$$1-1=0$$
$$(2^2-3(2)+3)^{3/2}-1=0$$
$$(4-6+3)^{3/2}-1=0$$
$$1^{3/2}-1=0$$
$$1-1=0$$

The solution set is {1, 2}.

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

$$t^2 - 5t + 4 = 0$$
$$(t-1)(t-4) = 0$$
$$t-1 = 0 \quad t-4 = 0$$
$$t = 1 \quad t = 4$$
$$x^2 = 1 \quad x^2 = 4$$
$$x = \pm 1 \quad x = \pm 2$$

The solution set is {1, –1, 2, –2}.

42. $x^4 - 13x^2 + 36 = 0$ let $t = x^2$

$$t^2 - 13t + 36 = 0$$
$$(t-4)(t-9) = 0$$
$$t-4 = 0 \quad t-9 = 0$$
$$t = 4 \quad t = 9$$
$$x^2 = 4 \quad x^2 = 9$$
$$x = \pm 2 \quad x = \pm 3$$

The solution set is {–3, –2, 2, 3}.

43. $9x^4 = 25x^2 - 16$

$$9x^4 - 25x^2 + 16 = 0 \text{ let } t = x^2$$
$$9t^2 - 25t + 16 = 0$$
$$(9t-16)(t-1) = 0$$
$$9t - 16 = 0 \quad t - 1 = 0$$
$$9t = 16 \quad t = 1$$
$$t = \frac{16}{9} \quad x^2 = 1$$
$$x = \pm 1$$
$$x^2 = \frac{16}{9}$$
$$x = \pm\frac{4}{3}$$

The solution set is $\left\{1, -1, \frac{4}{3}, -\frac{4}{3}\right\}$.

44. $4x^4 = 13x^2 - 9$

$$4x^4 - 13x^2 + 9 = 0 \text{ let } t = x^2$$
$$4t^2 - 13t + 9 = 0$$
$$(4t-9)(t-1) = 0$$
$$4t - 9 = 0 \quad t - 1 = 0$$
$$4t = 9 \quad t = 1$$
$$t = \frac{9}{4} \quad x^2 = 1$$
$$x^2 = \frac{9}{4} \quad x = \pm 1$$
$$x = \pm\frac{3}{2}$$

The solution set is $\left\{-\frac{3}{2}, -1, 1, \frac{3}{2}\right\}$.

45. $x - 13\sqrt{x} + 40 = 0$ Let $t = \sqrt{x}$.

$$t^2 - 13t + 40 = 0$$
$$(t-8)(t-5) = 0$$
$$t - 8 = 0 \quad t - 5 = 0$$
$$t = 8 \quad t = 5$$
$$\sqrt{x} = 8 \quad \sqrt{x} = 5$$
$$x = 64 \quad x = 25$$

The solution set is {25, 64}.

46. $2x - 7\sqrt{x} - 30 = 0$ Let $t = \sqrt{x}$.

$$2t^2 - 7t - 30 = 0$$
$$(2t+5)(t-6) = 0$$
$$2t + 5 = 0$$
$$t = \frac{5}{2} \quad t - 6 = 0$$
$$t = 6$$
$$\sqrt{x} = \frac{5}{2} \quad \sqrt{x} = 6$$
$$x = 36$$
$$x = \frac{25}{4}$$

The solution set is {36} since 25/4 does not check in the original equation.

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47. $x^{-2}-x^{-1}-20=0$ Let $t=x^{-1}$

$t^2-t-20=0$

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

$t-5=0 \quad t+4=0$

$t=5 \quad t=-4$

$x^{-1}=5 \quad x^{-1}=-4$

$\frac{1}{x}=5 \quad \frac{1}{x}=-4$

$1=5x \quad 1=-4x$

$\frac{1}{5}=x \quad -\frac{1}{4}=x$

The solution set is $\left\{-\frac{1}{4},\frac{1}{5}\right\}$.

48. $x^{-2}-x^{-1}-6=0$ Let t = x^{-1}.

$t^2-t-6=0$

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

$t-3=0 \quad t+2=0$

$t=3 \quad t=-2$

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

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

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

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

The solution set is $\left\{-\frac{1}{2},\frac{1}{3}\right\}$.

49. $x^{2/3}-x^{1/3}-6=0$ let $t=x^{1/3}$

$t^2-t-6=0$

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

$t-3=0 \quad t+2=0$

$t=3 \quad t=-2$

$x^{1/3}=3 \quad x^{1/3}=-2$

$x=3^3 \quad x=(-2)^3$

$x=27 \quad x=-8$

The solution set is {27, –8}.

50. $2x^{2/3}+7x^{1/3}-15=0$ let $t=x^{1/3}$

$2t^2+7t-15=0$

$(2t-3)(t+5)=0$

$2t-3=0 \quad t+5=0$

$2t=3 \quad t=-5$

$t=\frac{3}{2} \quad x^{1/3}=-5$

$x^{1/3}=\frac{3}{2} \quad x=(-5)^2$

$x=\left(\frac{3}{2}\right)^3 \quad x=-125$

$x=\frac{27}{8}$

The solution set is $\left\{-125,\frac{27}{8}\right\}$.

51. $x^{3/2}-2x^{3/4}+1=0$ let $t=x^{3/4}$

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

$(t-1)(t-1)=0$

$t-1=0$

$t=1$

$x^{3/4}=1$

$x=1^{4/3}$

$x=1$

The solution set is {1}.

52. $x^{2/5}+x^{1/5}-6=0$ let $t=x^{1/5}$

$t^2+t-6=0$

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

$t+3=0 \quad t-2=0$

$t=-3 \quad t=2$

$x^{1/5}=-3 \quad x^{1/5}=2$

$x=(-3)^5 \quad x=2^5$

$x=-243 \quad x=32$

The solution set is {–243, 32}.

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53. $2x-3x^{1/2}+1=0$ let $t=x^{1/2}$

$$2t^2-3t+1=0$$
$$(2t-1)(t-1)=0$$
$$2t-1=0 \qquad t-1=0$$
$$2t=1$$
$$t=\frac{1}{2} \qquad t=1$$
$$x^{1/2}=\frac{1}{2} \qquad x^{1/2}=1$$
$$x=\left(\frac{1}{2}\right)^2 \qquad x=1^2$$
$$x=\frac{1}{4} \qquad x=1$$

The solution set is $\left\{\frac{1}{4},1\right\}$.

54. $x+3x^{1/2}-4=0$ let $t=x^{1/2}$

$$t^2+3t-4=0$$
$$(t-1)(t+4)=0$$
$$t-1=0 \qquad t+4=0$$
$$t=1 \qquad t=-4$$
$$x^{1/2}=1 \qquad x^{1/2}=-4$$
$$x=1^2 \qquad x=(-4)^2$$
$$x=1 \qquad x=16$$

The solution set is {1}.

55. $(x-5)^2-4(x-5)-21=0$ let $t=x-5$

$$t^2-4t-21=0$$
$$(t+3)(t-7)=0$$
$$t+3=0 \qquad t-7=0$$
$$t=-3 \qquad t=7$$
$$x-5=-3 \qquad x-5=7$$
$$x=2 \qquad x=12$$

The solution set is {2, 12}.

56. $(x+3)^2+7(x+3)-18=0$ let $t=x+3$

$$t^2+7t-18=0$$
$$(t+9)(t-2)=0$$
$$t+9=0 \qquad t-2=0$$
$$t=-9 \qquad t=2$$
$$x+3=-9 \qquad x+3=2$$
$$x=-12 \qquad x=-1$$

The solution set is {–12, –1}.

57. $\left(x^2-x\right)^2-14\left(x^2-x\right)+24=0$

Let $t=x^2-x$.

$$t^2-14t+24=0$$
$$(t-2)(t-12)=0$$
$$t=2 \text{ or } t=12$$
$$x^2-x=2 \quad \text{or} \quad x^2-x=12$$
$$x^2-x-2=0 \qquad x^2-x-12=0$$
$$(x-2)(x+1)=0 \qquad (x-4)(x+3)=0$$

The solution set is {–3, –1, 2, 4}.

58. $\left(x^2-2x\right)^2-11\left(x^2-2x\right)+24=0$

Let $t=x^2-2x$

$$t^2-11t+24=0$$
$$(t-3)(t-8)=0$$
$$t=3 \text{ or } t=8$$
$$x^2-2x=3 \quad \text{or} \quad x^2-2x=8$$
$$x^2-2x-3=0 \qquad x^2-2x-8=0$$
$$(x-3)(x+1)=0 \qquad (x-4)(x+2)=0$$

The solution set is {–2, –1, 3, 4}.

59. $\left(y-\frac{8}{y}\right)^2+5\left(y-\frac{8}{y}\right)-14=0$

Let $t=y-\frac{8}{y}$.

$$t^2+5t-14=0$$
$$(t+7)(t-2)=0$$
$$t=-7 \text{ or } t=2$$
$$y-\frac{8}{y}=-7 \quad \text{or} \quad y-\frac{8}{y}=2$$
$$y^2+7y-8=0 \qquad y^2-2y-8=0$$
$$(y+8)(y-1)=0 \qquad (y-4)(y+2)=0$$

The solution set is {–8, –2, 1, 4}.

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60. $\left(y-\frac{10}{y}\right)^2+6\left(y-\frac{10}{y}\right)-27=0$

Let $t=y-\frac{10}{y}$.

$t^2+6t-27=0$

$(t+9)(t-3)=0$

$t=-9$ or $t=3$

$y-\frac{10}{y}=-9 \quad \text{or} \quad y-\frac{10}{y}=3$

$y^2+9y-10=0 \quad y^2-3y-10=0$

$(y+10)(y-1)=0 \quad (y-5)(y+2)=0$

The solution set is {–10, –2, 1, 5}.

61. $|x|=8$

$x=8, x=-8$

The solution set is {8, –8}.

62. $|x|=6$

$x=6, x=-6$

The solution set is {–6, 6}.

63. $|x-2|=7$

$x-2=7 \quad x-2=-7$

$x=9 \quad x=-5$

The solution set is {9, –5}.

64. $|x+1|=5$

$x+1=5 \quad x+1=-5$

$x=4 \quad x=-6$

The solution set is {–6, 4}.

65. $|2x-1|=5$

$2x-1=5 \quad 2x-1=-5$

$2x=6 \quad 2x=-4$

$x=3 \quad x=-2$

The solution set is {3, –2}.

66. $|2x-3|=11$

$2x-3=11 \quad 2x-3=-11$

$2x=14 \quad 2x=-8$

$x=7 \quad x=-4$

The solution set is {–4, 7}.

67. $2|3x-2|=14$

$|3x-2|=7$

$3x-2=7 \quad 3x-2=-7$

$3x=9 \quad 3x=-5$

$x=3 \quad x=-5/3$

The solution set is {3, –5/3}.

68. $3|2x-1|=21$

$|2x-1|=7$

$2x-1=7 \quad \text{or} \quad 2x-1=-7$

$2x=8 \quad 2x=-6$

$x=4 \quad x=-3$

The solution set is {4, –3}.

69. $7|5x|+2=16$

$7|5x|=14$

$|5x|=2$

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

$x=2/5 \quad x=-2/5$

The solution set is $\left\{\frac{2}{5},-\frac{2}{5}\right\}$.

70. $7|3x|+2=16$

$7|3x|=14$

$|3x|=2$

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

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

The solution set is {–2/3, 2/3}.

71. $2\left|4-\frac{5}{2}x\right|+6=18$

$2\left|4-\frac{5}{2}x\right|=12$

$\left|4-\frac{5}{2}x\right|=6$

$4-\frac{5}{2}x=6 \quad \text{or} \quad 4-\frac{5}{2}x=-6$

$-\frac{5}{2}x=2 \quad -\frac{5}{2}x=-10$

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

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

The solution set is $\left\{-\frac{4}{5},4\right\}$.

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72. $4\left|1-\frac{3}{4}x\right|+7=10$

$$4\left|1-\frac{3}{4}x\right|=3$$

$$\left|1-\frac{3}{4}x\right|=\frac{3}{4}$$

$$1-\frac{3}{4}x=\frac{3}{4} \quad \text{or} \quad 1-\frac{3}{4}x=-\frac{3}{4}$$

$$-\frac{3}{4}x=-\frac{1}{4} \qquad -\frac{3}{4}x=-\frac{7}{4}$$

$$-\frac{4}{3}\left(-\frac{3}{4}\right)x=-\frac{4}{3}\left(-\frac{1}{4}\right) \qquad -\frac{4}{3}\left(-\frac{3}{4}\right)x=-\frac{4}{3}\left(-\frac{7}{4}\right)$$

$$x=\frac{1}{3} \qquad x=\frac{7}{3}$$

The solution set is $\left\{\frac{1}{3},\frac{7}{3}\right\}$.

73. $|x+1|+5=3$

$|x+1|=-2$

No solution

The solution set is { }.

74. $|x+1|+6=2$

$|x+1|=-4$

No solution

The solution set is { }.

75. $|2x-1|+3=3$

$$|2x-1|=0$$

$$2x-1=0$$

$$2x=1$$

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

The solution set is $\left\{\frac{1}{2}\right\}$.

76. $|3x-2|+4=4$

$$|3x-2|=0$$

$$3x-2=0$$

$$3x=2$$

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

The solution set is $\left\{\frac{2}{3}\right\}$.

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77. $|3x-1| = |x+5|$

$3x-1 = x+5 \qquad 3x-1 = -x-5$

$2x-1 = 5 \qquad 4x-1 = -5$

$2x = 6 \qquad 4x = -4$

$x = 3 \qquad x = -1$

The solution set is $\{3, -1\}$.

78. $|2x-7| = |x+3|$

$2x-7 = x+3$ or $2x-7 = -(x+3)$

$x = 10 \qquad 2x-7 = -x-3$

$3x = 4$

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

The solution set is $\left\{10, \frac{4}{3}\right\}$.

79. $|4x-3| = |4x-5|$

$4x-3 = 4x-5$ or $4x-3 = -(4x-5)$

$-3 \neq -5 \qquad 4x-3 = -4x+5$

$8x = 8$

$x = 1$

The solution set is $\{1\}$.

80. $|5x-12| = |5x-8|$

$5x-12 = 5x-8$ or $5x-12 = -(5x-8)$

$-12 \neq -8 \qquad 5x-12 = -5x+8$

$10x = 20$

$x = 2$

The solution set is $\{2\}$.

81. $|x^2-6| = |5x|$

$x^2-6 = 5x \qquad x^2-6 = -(5x)$

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

$(x-6)(x+1) = 0 \qquad (x-1)(x+6) = 0$

$x = 6$ or $x = -1 \qquad x = 1$ or $x = -6$

The solution set is $\{-6, -1, 1, 6\}$.

82. $|x^2-15| = |2x|$

$x^2-15 = 2x \qquad x^2-15 = -(2x)$

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

$(x-5)(x+3) = 0 \qquad (x-3)(x+5) = 0$

$x = 5$ or $x = -3 \qquad x = 3$ or $x = -5$

The solution set is $\{-5, -3, 3, 5\}$.

83. $|2x^2-4| = |2x^2|$

$2x^2-4 = 2x^2$ or $2x^2-4 = -(2x^2)$

$-4 \neq 0 \qquad 4x^2 = 4$

$x^2 = 1$

$x = \pm 1$

The solution set is $\{-1, 1\}$

84. $|x^2-18| = |x^2|$

$x^2-18 = x^2$ or $x^2-18 = -(x^2)$

$-18 \neq 0 \qquad 2x^2 = 18$

$x^2 = 9$

$x = \pm 3$

The solution set is $\{-3, 3\}$

85. Set $y = 0$ to find the x–intercept(s).

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

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

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

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

$$x+2 = x-1-6\sqrt{x-1}+9$$

$$x+2 = x-1-6\sqrt{x-1}+9$$

$$2 = 8-6\sqrt{x-1}$$

$$-6 = -6\sqrt{x-1}$$

$$\frac{-6}{-6} = \frac{-6\sqrt{x-1}}{-6}$$

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

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

$$1 = x-1$$

$$2 = x$$

The x-intercept is 2.

The corresponding graph is graph (c).

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86. Set $y = 0$ to find the x–intercept(s).

$$0 = \sqrt{x-4} + \sqrt{x+4} - 4$$
$$-\sqrt{x-4} = \sqrt{x+4} - 4$$
$$\left(-\sqrt{x-4}\right)^2 = \left(\sqrt{x+4} - 4\right)^2$$
$$x - 4 = \left(\sqrt{x+4}\right)^2 - 2\left(\sqrt{x+4}\right)(4) + (4)^2$$
$$x - 4 = x + 4 - 8\sqrt{x+4} + 16$$
$$-4 = 20 - 8\sqrt{x+4}$$
$$-24 = -8\sqrt{x+4}$$
$$\frac{-24}{-8} = \frac{-8\sqrt{x+4}}{-8}$$
$$3 = \sqrt{x+4}$$
$$(3)^2 = \left(\sqrt{x+4}\right)^2$$
$$9 = x + 4$$
$$5 = x$$

The x-intercept is 5.
The corresponding graph is graph (a).

87. Set $y = 0$ to find the x–intercept(s).

$$0 = x^{\frac{1}{3}} + 2x^{\frac{1}{6}} - 3$$

Let $t = x^{\frac{1}{6}}$.

$$x^{\frac{1}{3}} + 2x^{\frac{1}{6}} - 3 = 0$$
$$\left(x^{\frac{1}{6}}\right)^2 + 2x^{\frac{1}{6}} - 3 = 0$$
$$t^2 + 2t - 3 = 0$$
$$(t+3)(t-1) = 0$$
$$t + 3 = 0 \quad \text{or} \quad t - 1 = 0$$
$$t = -3 \qquad\qquad t = 1$$

Substitute $x^{\frac{1}{6}}$ for t.

$$x^{\frac{1}{6}} = -3 \quad \text{or} \quad x^{\frac{1}{6}} = 1$$
$$\left(x^{\frac{1}{6}}\right)^6 = (-3)^6 \qquad \left(x^{\frac{1}{6}}\right)^6 = (1)^6$$
$$x = 729 \qquad\qquad x = 1$$

729 does not check and must be rejected.
The x-intercept is 1.
The corresponding graph is graph (e).

88. Set $y = 0$ to find the x–intercept(s).

$$0 = x^{-2} - x^{-1} - 6$$

Let $t = x^{-1}$.

$$x^{-2} - x^{-1} - 6 = 0$$
$$\left(x^{-1}\right)^2 - x^{-1} - 6 = 0$$
$$t^2 - t - 6 = 0$$
$$(t+2)(t-3) = 0$$
$$t + 2 = 0 \quad \text{or} \quad t - 3 = 0$$
$$t = -2 \qquad\qquad t = 3$$

Substitute x^{-1} for t.

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

The x-intercepts are $-\frac{1}{2}$ and $\frac{1}{3}$.
The corresponding graph is graph (b).

89. Set $y = 0$ to find the x–intercept(s).

$$(x+2)^2 - 9(x+2) + 20 = 0$$

Let $t = x + 2$.

$$(x+2)^2 - 9(x+2) + 20 = 0$$
$$t^2 - 9t + 20 = 0$$
$$(t-5)(t-4) = 0$$
$$t - 5 = 0 \quad \text{or} \quad t - 4 = 0$$
$$t = 5 \qquad\qquad t = 4$$

Substitute $x + 2$ for t.

$$x + 2 = 5 \quad \text{or} \quad x + 2 = 4$$
$$x = 3 \qquad\qquad x = 2$$

The x-intercepts are 2 and 3.
The corresponding graph is graph (f).

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90. Set $y = 0$ to find the x–intercept(s).

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

Let $t = x+2$.

$$2(x+2)^2 + 5(x+2) - 3 = 0$$
$$2t^2 + 5t - 3 = 0$$
$$(2t-1)(t+3) = 0$$
$$2t - 1 = 0 \quad \text{or} \quad t + 3 = 0$$
$$2t = 1 \qquad t = -3$$
$$t = \frac{1}{2}$$

Substitute $x+2$ for t.

$$x + 2 = \frac{1}{2} \quad \text{or} \quad x + 2 = -3$$
$$x = -5$$
$$x = \frac{1}{2} - 2$$
$$x = -\frac{3}{2}$$

The x-intercepts are -5 and $-\frac{3}{2}$.

The corresponding graph is graph (d).

91. $|5 - 4x| = 11$

$$5 - 4x = 11 \qquad 5 - 4x = -11$$
$$-4x = 6 \quad \text{or} \quad -4x = -16$$
$$x = -\frac{3}{2} \qquad x = 4$$

The solution set is $\left\{-\frac{3}{2}, 4\right\}$.

92. $|2 - 3x| = 13$

$$2 - 3x = 13 \qquad 2 - 3x = -13$$
$$-3x = 11 \quad \text{or} \quad -3x = -15$$
$$x = -\frac{11}{3} \qquad x = 5$$

The solution set is $\left\{-\frac{11}{3}, 5\right\}$.

93. $x + \sqrt{x+5} = 7$

$$\sqrt{x+5} = 7 - x$$
$$\left(\sqrt{x+5}\right)^2 = (7-x)^2$$
$$x + 5 = 49 - 14x + x^2$$
$$0 = x^2 - 15x + 44$$
$$0 = (x-4)(x-11)$$
$$x - 4 = 0 \quad \text{or} \quad x - 11 = 0$$
$$x = 4 \qquad x = 11$$

11 does not check and must be rejected.

The solution set is $\{4\}$.

94. $x - \sqrt{x-2} = 4$

$$-\sqrt{x-2} = 4 - x$$
$$\left(-\sqrt{x-2}\right)^2 = (4-x)^2$$
$$x - 2 = 16 - 8x + x^2$$
$$0 = x^2 - 9x + 18$$
$$0 = (x-6)(x-3)$$
$$x - 6 = 0 \quad \text{or} \quad x - 3 = 0$$
$$x = 6 \qquad x = 3$$

3 does not check and must be rejected.

The solution set is $\{6\}$.

95.

$$2x^3 + x^2 - 8x + 2 = 6$$
$$2x^3 + x^2 - 8x - 4 = 0$$
$$x^2(2x+1) - 4(2x+1) = 0$$
$$(2x+1)(x^2 - 4) = 0$$
$$(2x+1)(x+2)(x-2) = 0$$
$$2x + 1 = 0 \quad \text{or} \quad x + 2 = 0 \quad \text{or} \quad x - 2 = 0$$
$$x = -\frac{1}{2} \qquad x = -2 \qquad x = 2$$

The solution set is $\left\{-\frac{1}{2}, -2, 2\right\}$.

96.

$$x^3 + 4x^2 - x + 6 = 10$$
$$x^3 + 4x^2 - x - 4 = 0$$
$$x^2(x+4) - 1(x+4) = 0$$
$$(x+4)(x^2 - 1) = 0$$
$$(x+4)(x+1)(x-1) = 0$$
$$x + 4 = 0 \quad \text{or} \quad x + 1 = 0 \quad \text{or} \quad x - 1 = 0$$
$$x = -4 \qquad x = -1 \qquad x = 1$$

The solution set is $\{-4, -1, 1\}$.

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97. $(x+4)^{\frac{3}{2}}=8$

$$\left((x+4)^{\frac{3}{2}}\right)^{\frac{2}{3}}=(8)^{\frac{2}{3}}$$
$$x+4=\left(\sqrt[3]{8}\right)^2$$
$$x+4=(2)^2$$
$$x+4=4$$
$$x=0$$

The solution set is $\{0\}$.

98. $(x-5)^{\frac{3}{2}}=125$

$$\left((x-5)^{\frac{3}{2}}\right)^{\frac{2}{3}}=(125)^{\frac{2}{3}}$$
$$x-5=\left(\sqrt[3]{125}\right)^2$$
$$x-5=(5)^2$$
$$x-5=25$$
$$x=30$$

The solution set is $\{30\}$.

99. $y_1=y_2+3$

$$\left(x^2-1\right)^2=2\left(x^2-1\right)+3$$
$$\left(x^2-1\right)^2-2\left(x^2-1\right)-3=0$$

Let $t=x^2-1$ and substitute.

$$t^2-2t-3=0$$
$$(t+1)(t-3)=0$$
$$t+1=0 \quad \text{or} \quad t-3=0$$
$$t=-1 \qquad\qquad t=3$$

Substitute x^2-1 for t.

$$x^2-1=-1 \quad \text{or} \quad x^2-1=3$$
$$x^2=0 \qquad\qquad x^2=4$$
$$x=0 \qquad\qquad x=\pm 2$$

The solution set is $\{-2,0,2\}$.

100. $y_1=y_2+6$

$$6\left(\frac{2x}{x-3}\right)^2=5\left(\frac{2x}{x-3}\right)+6$$
$$6\left(\frac{2x}{x-3}\right)^2-5\left(\frac{2x}{x-3}\right)-6=0$$

Let $t=\frac{2x}{x-3}$ and substitute.

$$6t^2-5t-6=0$$
$$(3t+2)(2t-3)=0$$
$$3t+2=0 \quad \text{or} \quad 2t-3=0$$
$$t=-\frac{2}{3} \qquad\qquad t=\frac{3}{2}$$

Substitute $\frac{2x}{x-3}$ for t.

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

First solve $\frac{2x}{x-3}=-\frac{2}{3}$

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

Next solve $\frac{2x}{x-3}=\frac{3}{2}$

$$\frac{2x(2)(x-3)}{x-3}=\frac{3(2)(x-3)}{2}$$
$$2x(2)=3(x-3)$$
$$4x=3x-9$$
$$x=-9$$

The solution set is $\left\{-9,\frac{3}{4}\right\}$.

101. $\left|\sqrt{x}-5\right|=2$

$$\sqrt{x}-5=2 \quad \text{or} \quad \sqrt{x}-5=-2$$
$$\sqrt{x}=7 \qquad\qquad \sqrt{x}=3$$
$$x=49 \qquad\qquad x=9$$

The solution set is $\{9,49\}$

102. $\left|\sqrt{x}-8\right|=3$

$\sqrt{x}-8=3$ or $\sqrt{x}-8=-3$

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

$x=121$ $x=25$

The solution set is $\{25,121\}$

103. $\left|x^2+2x-36\right|=12$

$x^2+2x-36=12$ $x^2+2x-36=-12$

$x^2+2x-48=0$ or $x^2+2x-24=0$

$(x+8)(x-6)=0$ $(x+6)(x-4)=0$

Setting each of the factors above equal to zero gives $x=-8,$ $x=6,$ $x=-6,$ and $x=4.$

The solution set is $\{-8,-6,4,6\}$.

104. $\left|x^2+6x+1\right|=8$

$x^2+6x+1=8$ or $x^2+6x+1=-8$

$x^2+6x-7=0$ $x^2+6x+9=0$

$(x+7)(x-1)=0$ $(x+3)(x+3)=0$

Setting each of the factors above equal to zero gives $x=-7,$ $x=-3,$ and $x=1.$

The solution set is $\{-7,-3,1\}$.

105. $x(x+1)^3-42(x+1)^2=0$

$(x+1)^2\left(x(x+1)-42\right)=0$

$(x+1)^2\left(x^2+x-42\right)=0$

$(x+1)^2(x+7)(x-6)=0$

Setting each of the factors above equal to zero gives $x=-7,$ $x=-1,$ and $x=6.$

The solution set is $\{-7,-1,6\}$.

106. $x(x-2)^3-35(x-2)^2=0$

$x(x-2)^3-35(x-2)^2=0$

$(x-2)^2\left(x(x-2)-35\right)=0$

$(x-2)^2\left(x^2-2x-35\right)=0$

$(x-2)^2(x+5)(x-7)=0$

Setting each of the factors above equal to zero gives $x=-5,$ $x=2,$ and $x=7.$

The solution set is $\{-5,2,7\}$.

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107. Let x = the number.

$$\sqrt{5x-4} = x-2$$
$$\left(\sqrt{5x-4}\right)^2 = (x-2)^2$$
$$5x-4 = x^2-4x+4$$
$$0 = x^2-9x+8$$
$$0 = (x-8)(x-1)$$
$$x-8=0 \quad \text{or} \quad x-1=0$$
$$x=8 \qquad\qquad x=1$$

Check $x=8$: $\sqrt{5(8)-4} = 8-2$
$$\sqrt{40-4} = 6$$
$$\sqrt{36} = 6$$
$$6 = 6$$

Check $x=1$: $\sqrt{5(1)-4} = 1-2$
$$\sqrt{5-4} = -1$$
$$\sqrt{-1} \neq -1$$

Discard $x=1$. The number is 8.

108. Let x = the number.

$$\sqrt{x-3} = x-5$$
$$\left(\sqrt{x-3}\right)^2 = (x-5)^2$$
$$x-3 = x^2-10x+25$$
$$0 = x^2-11x+28$$
$$0 = (x-7)(x-4)$$
$$x-7=0 \quad \text{or} \quad x-4=0$$
$$x=7 \qquad\qquad x=4$$

Check $x=7$: $\sqrt{7-3} = 7-5$
$$\sqrt{4} = 2$$
$$2 = 2$$

Check $x=4$: $\sqrt{4-3} = 4-5$
$$\sqrt{1} = -1$$
$$1 \neq -1$$

Discard 4. The number is 7.

109.

$$r = \sqrt{\frac{3V}{\pi h}}$$
$$r^2 = \left(\sqrt{\frac{3V}{\pi h}}\right)^2$$
$$r^2 = \frac{3V}{\pi h}$$
$$\pi r^2 h = 3V$$
$$\frac{\pi r^2 h}{3} = V$$
$$V = \frac{\pi r^2 h}{3} \quad \text{or} \quad V = \frac{1}{3}\pi r^2 h$$

110.

$$r = \sqrt{\frac{A}{4\pi}}$$
$$r^2 = \left(\sqrt{\frac{A}{4\pi}}\right)^2$$
$$r^2 = \frac{A}{4\pi}$$
$$4\pi r^2 = A \quad \text{or} \quad A = 4\pi r^2$$

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111. Exclude any value that causes the denominator to equal zero.

$$|x+2|-14=0$$
$$|x+2|=14$$
$$x+2=14 \quad \text{or} \quad x+2=-14$$
$$x=12 \qquad\qquad x=-16$$

–16 and 12 must be excluded from the domain.

112. Exclude any value that causes the denominator to equal zero.

$$x^3+3x^2-x-3=0$$
$$x^2(x+3)-1(x+3)=0$$
$$(x+3)\left(x^2-1\right)=0$$
$$(x+3)(x+1)(x-1)=0$$

Setting each of the factors above equal to zero gives $x=-3, \quad x=-1, \quad \text{and } x=1.$

–3, –1, and 1 must be excluded from the domain.

113.
$$t=\frac{\sqrt{d}}{2}$$
$$1.16=\frac{\sqrt{d}}{2}$$
$$2.32=\sqrt{d}$$
$$2.32^2=\left(\sqrt{d}\right)^2$$
$$d\approx 5.4$$

The vertical distance was about 5.4 feet.

114.
$$t=\frac{\sqrt{d}}{2}$$
$$0.85=\frac{\sqrt{d}}{2}$$
$$1.7=\sqrt{d}$$
$$1.7^2=\left(\sqrt{d}\right)^2$$
$$d\approx 2.9$$

The vertical distance was about 2.9 feet.

115. It is represented by the point $(5.4, 1.16)$.

116. It is represented by the point $(2.9, 0.85)$.

117. **a.** According to the line graph, about 47% $\pm 1\%$ of U.S. women participated in the labor force in 2010.

b. $p=1.6\sqrt{t}+38$

$$p=1.6\sqrt{40}+38\approx 48.1$$

According to the formula, about 48.1% of U.S. women participated in the labor force in 2010.

c. $p=1.6\sqrt{t}+38$

$$51=1.6\sqrt{t}+38$$
$$13=1.6\sqrt{t}$$
$$\frac{13}{1.6}=\frac{1.6\sqrt{t}}{1.6}$$
$$\frac{13}{1.6}=\sqrt{t}$$
$$\left(\frac{13}{1.6}\right)^2=\left(\sqrt{t}\right)^2$$
$$66\approx t$$

According to the formula, 51% of U.S. women will participate in the labor force 66 years after 1970, or 2036.

118. **a.** According to the line graph, about 53% $\pm 1\%$ of U.S. men participated in the labor force in 2010.

b. $p=-1.6\sqrt{t}+62$

$$p=-1.6\sqrt{40}+62\approx 51.9$$

According to the formula, about 51.9% of U.S. men participated in the labor force in 2010.

c. $p=-1.6\sqrt{t}+62$

$$49=-1.6\sqrt{t}+62$$
$$-13=-1.6\sqrt{t}$$
$$\frac{-13}{-1.6}=\frac{-1.6\sqrt{t}}{-1.6}$$
$$\frac{-13}{-1.6}=\sqrt{t}$$
$$\left(\frac{-13}{-1.6}\right)^2=\left(\sqrt{t}\right)^2$$
$$66\approx t$$

According to the formula, 49% of U.S. men will participate in the labor force 66 years after 1970, or 2036.

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119.

$$
\begin{aligned}
365 &= 0.2x^{3/2}\\
\frac{365}{0.2} &= \frac{0.2x^{3/2}}{0.2}\\
1825 &= x^{3/2}\\
1825^2 &= \left(x^{3/2}\right)^2\\
3,330,625 &= x^3\\
\sqrt[3]{3,330,625} &= \sqrt[3]{x^3}\\
149.34 &\approx x
\end{aligned}
$$

The average distance of the Earth from the sun is approximately 149 million kilometers.

120.

$$
\begin{aligned}
f(x) &= 0.2x^{3/2}\\
88 &= 0.2x^{3/2}\\
\frac{88}{0.2} &= \frac{0.2x^{3/2}}{0.2}\\
440 &= x^{3/2}\\
440^2 &= \left(x^{3/2}\right)^2\\
193,600 &= x^3\\
\sqrt[3]{193,600} &= \sqrt[3]{x^3}\\
58 &\approx x
\end{aligned}
$$

The average distance of Mercury from the sun is approximately 58 million kilometers.

121.

$$
\begin{aligned}
&\sqrt{6^2+x^2}+\sqrt{8^2+(10-x)^2}=18\\
&\sqrt{36+x^2}=18-\sqrt{64+100-20x+x^2}\\
&36+x^2=324-36\sqrt{x^2-20x+164}+x^2-20x+164\\
&36\sqrt{x^2-20x+164}=-20x+452\\
&9\sqrt{x^2-20x+164}=-5x+113\\
&81(x^2-20x+164)=25x^2-1130x+12769\\
&81x^2-1620x+13284=25x^2-1130x+12769\\
&56x^2-490x+515=0\\
&x=\frac{490\pm\sqrt{(-490)^2-4(56)(515)}}{2(56)}\\
&x=\frac{490\pm 353.19}{112}\\
&x\approx 1.2 \qquad x\approx 7.5
\end{aligned}
$$

The point should be located approximately either 1.2 feet or 7.5 feet from the base of the 6-foot pole.

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122. a. Distance from point $A=\sqrt{6^2+x^2}+\sqrt{3^2+(12-x)^2}$ or $A=\sqrt{x^2+36}+\sqrt{(12-x)^2+9}$.

b. Let the distance = 15.

$$\begin{aligned}\sqrt{6^2+x^2}+\sqrt{3^2+(12-x)^2}&=15\\ \sqrt{36+x^2}&=15-\sqrt{9+144-24x+x^2}\\ 36+x^2&=225-30\sqrt{153-24x+x^2}+x^2-24x+153\\ 30\sqrt{x^2-24x+153}&=-24x+342\\ 5\sqrt{x^2-24x+153}&=-4x+157\\ 25(x^2-24x+153)&=16x^2-456x+3249\\ 25x^2-600x+3825&=16x^2-456x+3249\\ 9x^2-144x+576&=0\\ x^2-16x+64&=0\\ (x-8)(x-8)&=0\\ x&=8\end{aligned}$$

The distance is 8 miles.

123. – 129. Answers will vary.

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

The solution set is $\{-3,-1,1\}$.

$$\begin{aligned}(-3)^3+3(-3)^2-(-3)-3&=0\\ -27+27+3-3&=0\\ (-1)^3+3(-1)^2-(-1)-3&=0\\ -1+3+1-3&=0\\ 1^3+3(1)^2-(1)-3&=0\\ 1+3-1-3&=0\end{aligned}$$

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

The solution set is $\{0,2\}$.

$$\begin{aligned}-(0)^4+4(0)^3-4(0)^2&=0\\ 0&=0\\ -(2)^4+4(2)^3-4(2)^2&=0\\ -16+32-16&=0\\ 0&=0\end{aligned}$$

132. $\sqrt{2x+13}-x-5=0$

The solution set is $\{-2\}$.

$$\begin{aligned}\sqrt{2(-2)+13}-(-2)-5&=0\\ \sqrt{-4+13}+2-5&=0\\ \sqrt{9}-3&=0\\ 3-3&=0\end{aligned}$$

133. does not make sense; Explanations will vary. Sample explanation: You should substitute into the original equation.

134. makes sense

135. does not make sense; Explanations will vary. Sample explanation: Changing the order of the terms does not change the fact that this equation is quadratic in form.

136. makes sense

137. false; Changes to make the statement true will vary. A sample change is: Squaring $x+2$ results in x^2+4x+4.

138. false; Changes to make the statement true will vary. A sample change is: 21 satisfies the linear equation but not the radical equation.

139. false; Changes to make the statement true will vary. A sample change is: To solve the equation, let $u^2 = x$.

140. false; Changes to make the statement true will vary. A sample change is: Neither 6 nor –6 satisfies the absolute value equation.

141.
$$\sqrt{6x-2} = \sqrt{2x+3} - \sqrt{4x-1}$$
$$6x-2 = 2x+3-2\sqrt{(2x+3)(4x-1)}+4x-1$$
$$-4 = -2\sqrt{(2x+3)(4x-1)}$$
$$2 = \sqrt{8x^2+10x-3}$$
$$4 = 8x^2+10x-3$$
$$8x^2+10x-7=0$$
$$x = \frac{-10 \pm \sqrt{10^2-4(8)(-7)}}{2(8)}$$
$$x = \frac{-10 \pm \sqrt{100+224}}{16}$$
$$x = \frac{-10 \pm \sqrt{324}}{16}$$
$$x = \frac{-10 \pm 18}{16}$$
$$x = \frac{-28}{26}, \frac{8}{16}$$
$$x = \frac{1}{2}$$

The solution set is $\left\{\frac{1}{2}\right\}$.

142. $5-\frac{2}{x}=\sqrt{5-\frac{2}{x}}$

or

$$5-\frac{2}{x}=0 \qquad 5-\frac{2}{x}=1$$
$$5=\frac{2}{x} \qquad -\frac{2}{x}=-4$$
$$5x=2 \qquad -4x=-2$$
$$x=\frac{2}{5} \qquad x=\frac{1}{2}$$

The solution set is $\left\{\frac{2}{5},\frac{1}{2}\right\}$.

143. $\sqrt[3]{x\sqrt{x}}=9$

$$\sqrt[3]{x\sqrt{x}}=9$$
$$\sqrt[3]{x^1x^{\frac{1}{2}}}=9$$
$$\left(x^1x^{\frac{1}{2}}\right)^{\frac{1}{3}}=9$$
$$\left(x^{\frac{3}{2}}\right)^{\frac{1}{3}}=9$$
$$x^{\frac{1}{2}}=9$$
$$\left(x^{\frac{1}{2}}\right)^2=(9)^2$$
$$x=81$$

The solution set is $\{81\}$.

144. $x^{5/6}+x^{2/3}-2x^{1/2}=0$

$x^{1/2}(x^{2/6}+x^{1/6}-2)=0$ let $t=x^{1/6}$

$$x^{1/2}(t^2+t-2)=0$$
$$x^{1/2}=0 \quad t^2+t-2=0$$
$$(t-1)(t+2)=0$$
$$t-1=0 \qquad t+2=0$$
$$t=1 \qquad t=-2$$
$$x^{1/6}=1 \qquad x^{1/6}=-2$$
$$x=1^6 \qquad x=(-2)^6$$
$$x=0 \qquad x=1 \qquad x=64$$

64 does not check and must be rejected.
The solution set is $\{0, 1\}$.

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145.
$$\begin{aligned} 3-2x &\le 11 \\ 3-2(-1) &\le 11 \\ 3+2 &\le 11 \\ 5 &\le 11, \text{ true} \end{aligned}$$
Yes, –1 is a solution.

146.
$$\begin{aligned} -2x-4 &= x+5 \\ -2x-x &= 5+4 \\ -3x &= 9 \\ x &= \frac{9}{-3} \\ x &= -3 \end{aligned}$$
The solution set is $\{-3\}$.

147.
$$\begin{aligned} \frac{x+3}{4} &= \frac{x-2}{3}+\frac{1}{4} \\ 12\left(\frac{x+3}{4}\right) &= 12\left(\frac{x-2}{3}+\frac{1}{4}\right) \\ 3(x+3) &= 4(x-2)+3 \\ 3x+9 &= 4x-8+3 \\ 3x+9 &= 4x-5 \\ 3x-4x &= -5-9 \\ -x &= -14 \\ x &= 14 \end{aligned}$$
The solution set is $\{14\}$.

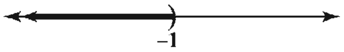
Section 1.7

Check Point Exercises

1. **a.** $[-2,5)=\left\{x \middle| -2 \le x < 5\right\}$

b. $[1,3.5]=\left\{x \middle| 1 \le x \le 3.5\right\}$

c. $(-\infty,-1)=\left\{x \middle| x < -1\right\}$



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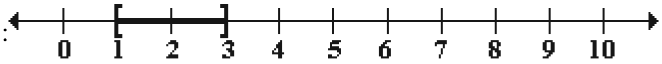
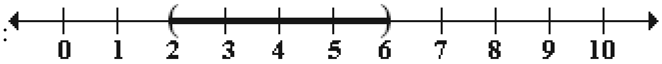
2. **a.** Graph $[1,3]$:

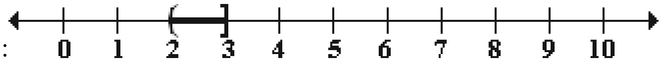


Graph $(2,6)$:



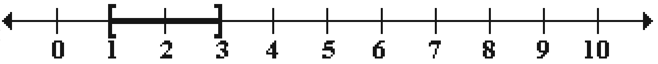
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[1,3]$ and $(2,6)$:

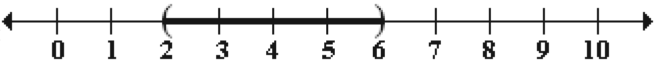


Thus, $[1,3] \cap (2,6) = (2,3]$.

b. Graph $[1,3]$:

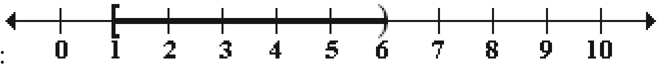


Graph $(2,6)$:



To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

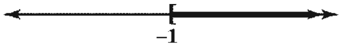
Numbers in either $[1,3]$ or $(2,6)$ or both:



Thus, $[1,3] \cup (2,6) = [1,6)$.

3.
$$2 - 3x \le 5$$
$$-3x \le 3$$
$$x \ge -1$$

The solution set is $\{x | x \ge -1\}$ or $[-1, \infty)$.

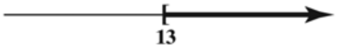


4.
$$3x + 1 > 7x - 15$$
$$-4x > -16$$
$$\frac{-4x}{-4} < \frac{-16}{-4}$$
$$x < 4$$

The solution set is $\{x | x < 4\}$ or $(-\infty, 4)$.

5.
$$\frac{x-4}{2} \ge \frac{x-2}{3} + \frac{5}{6}$$
$$6\left(\frac{x-4}{2}\right) \ge 6\left(\frac{x-2}{3} + \frac{5}{6}\right)$$
$$3(x-4) \ge 2(x-2) + 5$$
$$3x - 12 \ge 2x - 4 + 5$$
$$3x - 12 \ge 2x + 1$$
$$3x - 2x \ge 1 + 12$$
$$x \ge 13$$

The solution set is $\{x | x \ge 13\}$ or $[13, \infty)$.



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6. **a.** $3(x+1) > 3x+2$

$3x+3 > 3x+2$

$3 > 2$

$3 > 2$ is true for all values of x.

The solution set is $\{x \mid x \text{ is a real number}\}$ or $\Re$ or $(-\infty.\infty)$.

b. $x+1 \le x-1$

$1 \le -1$

$1 \le -1$ is false for all values of x.

The solution set is $\varnothing$.

7. $1 \le 2x+3 < 11$

$-2 \le 2x < 8$

$-1 \le x < 4$

The solution set is $\{x \mid -1 \le x < 4\}$ or $[-1, 4)$.

8. $|x-2| < 5$

$-5 < x-2 < 5$

$-3 < x < 7$

The solution set is $\{x \mid -3 < x < 7\}$ or $(-3, 7)$.

9. $-3|5x-2|+20 \ge -19$

$-3|5x-2| \ge -39$

$$\frac{-3|5x-2|}{-3} \le \frac{-39}{-3}$$

$|5x-2| \le 13$

$-13 \le 5x-2 \le 13$

$-11 \le 5x \le 15$

$$\frac{-11}{5} \le \frac{5x}{5} \le \frac{15}{5}$$

$$-\frac{11}{5} \le x \le 3$$

The solution set is $\left\{x \,\middle|\, -\frac{11}{5} \le x \le 3\right\}$ or $\left[-\frac{11}{5}, 3\right]$.

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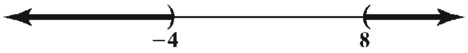
10. $18 < |6 - 3x|$

$$\begin{aligned} 6 - 3x &< -18 & \quad \text{or} \quad && 6 - 3x &> 18 \\ -3x &< -24 & && -3x &> 12 \\ \frac{-3x}{-3} &> \frac{-24}{-3} & && \frac{-3x}{-3} &< \frac{12}{-3} \\ x &> 8 & && x &< -4 \end{aligned}$$

The solution set is $\{x | x < -4 \text{ or } x > 8\}$ or $(-\infty, -4) \cup (8, \infty)$.



11. Let x = the number of bridge crossings.
cost without decal = $5x$
cost with decal = $25 + 0.75(5)x$

$$\begin{aligned} 5x &> 25 + 3.75x \\ 1.25x &> 25 \\ x &> 20 \end{aligned}$$

Crossing more than 20 times will make the decal option the better deal.

Concept and Vocabulary Check 1.7

C1. 2; 5; 2; 5

C2. greater than

C3. less than or equal to

C4. $(-\infty, 9)$; intersection

C5. $(-\infty, 12)$; union

C6. adding 4; dividing; -3; direction; $>$; $<$

C7. $\varnothing$

C8. $(-\infty, \infty)$

C9. middle

C10. $-c$; c

C11. $-c$; c

C12. $-2 < x - 7 < 2$

C13. $x - 7 < -2$ or $-7 > 2$

Exercise Set 1.7

1. $\{x|1 < x \le 6\}$

2. $\{x|-2 < x \le 4\}$

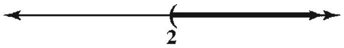
3. $\{x|-5 \le x < 2\}$

4. $\{x|-4 \le x < 3\}$

5. $\{x|-3 \le x \le 1\}$

6. $\{x|-2 \le x \le 5\}$

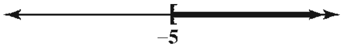
7. $\{x|x > 2\}$



8. $\{x|x > 3\}$

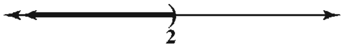
9. $\{x|x \ge -3\}$

10. $\{x|x \ge -5\}$

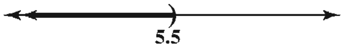


11. $\{x|x < 3\}$

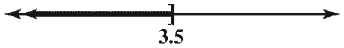
12. $\{x|x < 2\}$



13. $\{x|x < 5.5\}$



14. $\{x|x \le 3.5\}$



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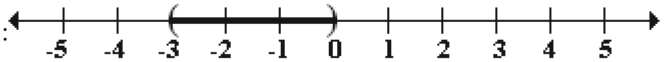
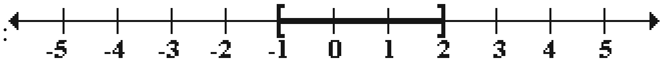
15. Graph $(-3,0)$:

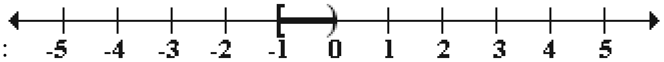


Graph $[-1,2]$:



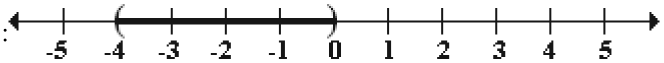
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-3,0)$ and $[-1,2]$:

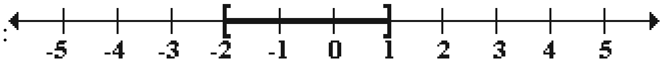


Thus, $(-3,0) \cap [-1,2] = [-1,0)$.

16. Graph $(-4,0)$:

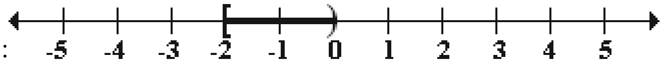


Graph $[-2,1]$:



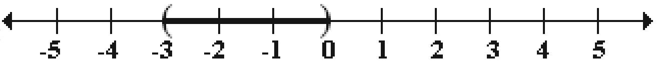
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-4,0)$ and $[-2,1]$:

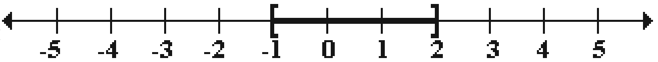


Thus, $(-4,0) \cap [-2,1] = [-2,0)$.

17. Graph $(-3,0)$:

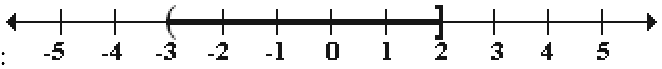


Graph $[-1,2]$:



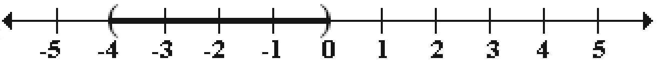
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-3,0)$ or $[-1,2]$ or both:

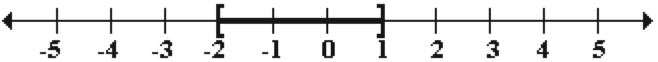


Thus, $(-3,0) \cup [-1,2] = (-3,2]$.

18. Graph $(-4,0)$:

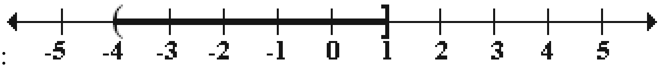


Graph $[-2,1]$:



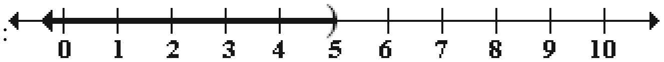
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-4,0)$ or $[-2,1]$ or both:

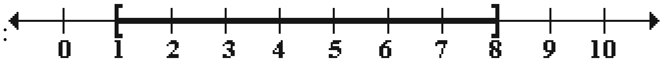


Thus, $(-4,0) \cup [-2,1] = (-4,1]$.

19. Graph $(-\infty,5)$:

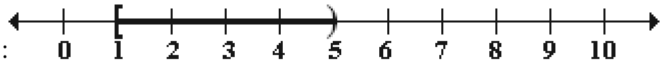


Graph $[1,8]$:



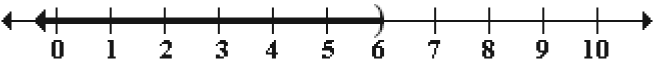
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-\infty,5)$ and $[1,8]$:

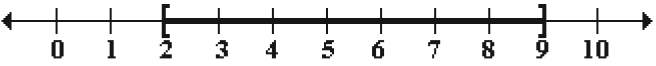


Thus, $(-\infty,5) \cap [1,8] = [1,5)$.

20. Graph $(-\infty,6)$:

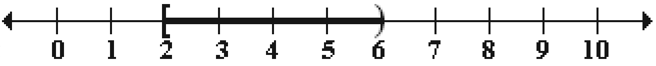


Graph $[2,9]$:



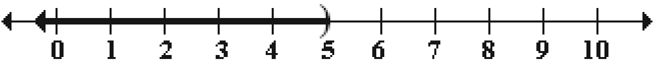
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-\infty,6)$ and $[2,9]$:

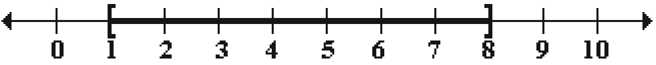


Thus, $(-\infty,6) \cap [2,9] = [2,6)$.

21. Graph $(-\infty,5)$:

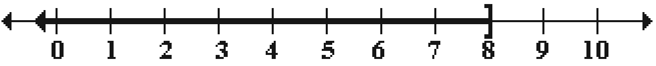


Graph $[1,8]$:



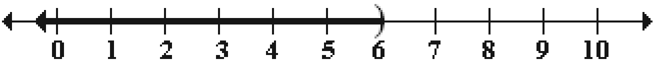
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-\infty,5)$ or $[1,8]$ or both:

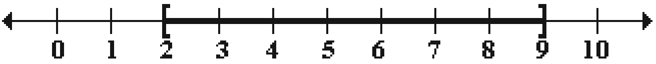


Thus, $(-\infty,5) \cup [1,8] = (-\infty,8]$.

22. Graph $(-\infty,6)$:

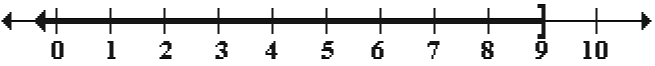


Graph $[2,9]$:



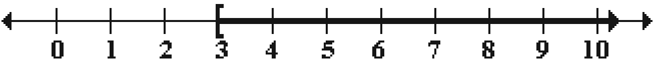
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-\infty,6)$ or $[2,9]$ or both:

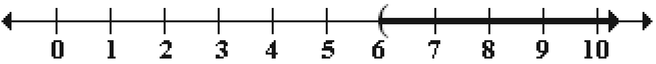


Thus, $(-\infty,6) \cup [2,9] = (-\infty,9]$.

23. Graph $[3,\infty)$:

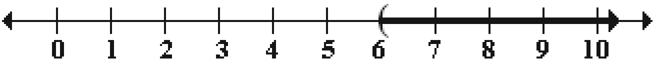


Graph $(6,\infty)$:



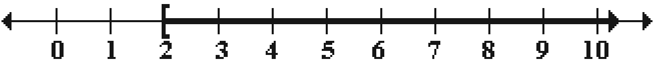
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[3,\infty)$ and $(6,\infty)$:

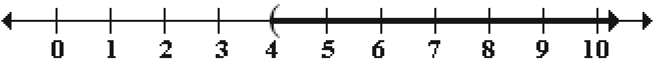


Thus, $[3,\infty) \cap (6,\infty) = (6,\infty)$.

24. Graph $[2,\infty)$:

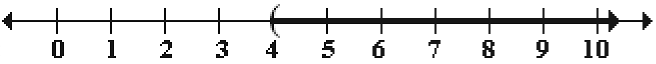


Graph $(4,\infty)$:



To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[2,\infty)$ and $(4,\infty)$:



Thus, $[2,\infty) \cap (4,\infty) = (4,\infty)$.

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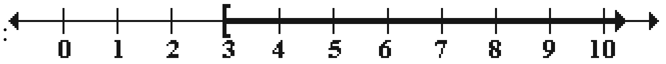
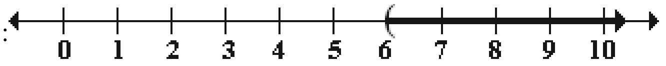
25. Graph $[3, \infty)$:

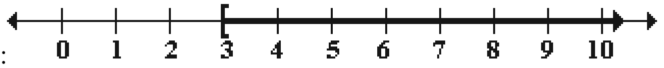


Graph $(6, \infty)$:



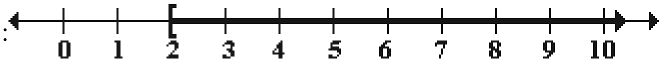
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $[3, \infty)$ or $(6, \infty)$ or both:

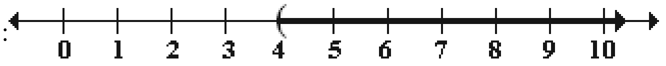


Thus, $[3, \infty) \cup (6, \infty) = [3, \infty)$.

26. Graph $[2, \infty)$:

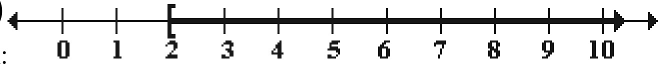


Graph $(4, \infty)$:



To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

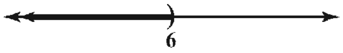
Numbers in either $[2, \infty)$ or $(4, \infty)$ or both:



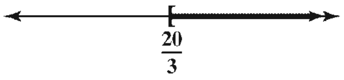
Thus, $[2, \infty) \cup (4, \infty) = [2, \infty)$.

27. $5x + 11 < 26$
$5x < 15$
$x < 3$
The solution set is $\{x \mid x < 3\}$, or $(-\infty, 3)$.

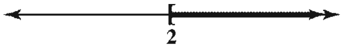
28. $2x + 5 < 17$
$2x < 12$
$x < 6$
The solution set is $\{x \mid x < 6\}$ or $(-\infty, 6)$.



29. $3x - 7 \geq 13$
$3x \geq 20$
$x \geq \frac{20}{3}$
The solution set is $\left\{x \,\middle|\, x > \frac{20}{3}\right\}$, or $\left[\frac{20}{3}, \infty\right)$.



30. $8x - 2 \geq 14$
$8x \geq 16$
$x \geq 2$
The solution set is $\{x \mid x > 2\}$ or $[2, \infty)$.



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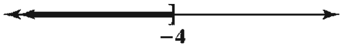
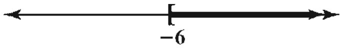
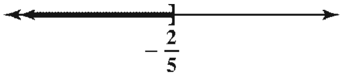
31. $-9x \geq 36$
$x \leq -4$
The solution set is $\{x \mid x \leq -4\}$, or $(-\infty, -4]$.



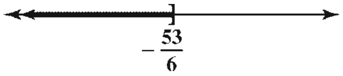
32. $-5x \leq 30$
$x \geq -6$
The solution set is $\{x \mid x \geq -6\}$ or $[-6, \infty)$.



33. $8x - 11 \leq 3x - 13$
$8x - 3x \leq -13 + 11$
$5x \leq -2$
$x \leq -\frac{2}{5}$
The solution set is $\left\{x \,\middle|\, x \leq -\frac{2}{5}\right\}$, or $\left(-\infty, -\frac{2}{5}\right]$.



34. $18x + 45 \leq 12x - 8$
$18x - 12x \leq -8 - 45$
$6x \leq -53$
$x \leq -\frac{53}{6}$
The solution set is $\left\{x \,\middle|\, x \leq -\frac{53}{6}\right\}$ or $\left(-\infty, -\frac{53}{6}\right]$.

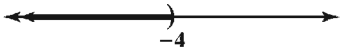


35. $4(x + 1) + 2 \geq 3x + 6$
$4x + 4 + 2 \geq 3x + 6$
$4x + 6 \geq 3x + 6$
$4x - 3x \geq 6 - 6$
$x \geq 0$
The solution set is $\{x \mid x > 0\}$, or $[0, \infty)$.

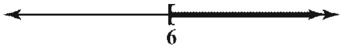
36. $8x + 3 > 3(2x + 1) + x + 5$
$8x + 3 > 6x + 3 + x + 5$
$8x + 3 > 7x + 8$
$8x - 7x > 8 - 3$
$x > 5$
The solution set is $\{x \mid x > 5\}$ or $(5, \infty)$.

37. $2x - 11 < -3(x + 2)$
$2x - 11 < -3x - 6$
$5x < 5$
$x < 1$
The solution set is $\{x \mid x < 1\}$, or $(-\infty, 1)$.

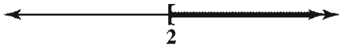
38. $-4(x + 2) > 3x + 20$
$-4x - 8 > 3x + 20$
$-7x > 28$
$x < -4$
The solution set is $\{x \mid x < -4\}$ or $(-\infty, -4)$.



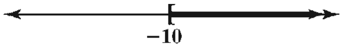
39. $1 - (x + 3) \geq 4 - 2x$
$1 - x - 3 \geq 4 - 2x$
$-x - 2 \geq 4 - 2x$
$x \geq 6$
The solution set is $\{x \mid x \geq 6\}$, or $[6, \infty)$.



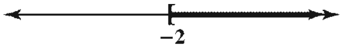
40. $5(3 - x) \leq 3x - 1$
$15 - 5x \leq 3x - 1$
$-8x \leq -16$
$x \geq 2$
The solution set is $\{x \mid x \geq 2\}$ or $[2, \infty)$.



41.
$$\frac{x}{4} - \frac{3}{2} \leq \frac{x}{2} + 1$$
$$\frac{4x}{4} - \frac{4 \cdot 3}{2} \leq \frac{4 \cdot x}{2} + 4 \cdot 1$$
$$x - 6 \leq 2x + 4$$
$$-x \leq 10$$
$$x \geq -10$$
The solution set is $\{x \mid x \geq -10\}$, or $[-10, \infty)$.



42.
$$\frac{3x}{10} + 1 \geq \frac{1}{5} - \frac{x}{10}$$
$$10\left(\frac{3x}{10} + 1\right) \geq 10\left(\frac{1}{5} - \frac{x}{10}\right)$$
$$3x + 10 \geq 2 - x$$
$$4x \geq -8$$
$$x \geq -2$$
The solution set is $\{x \mid x \geq -2\}$ or $[-2, \infty)$.



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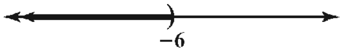
43. $1-\frac{x}{2}>4$

$-\frac{x}{2}>3$

$x<-6$

The solution set is $\{x\,|\,x,-6\}$, or $(-\infty,-6)$.

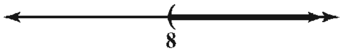


44. $7-\frac{4}{5}x<\frac{3}{5}$

$-\frac{4}{5}x<-\frac{32}{5}$

$x>8$

The solution set is $\{x\,|\,x>8\}$ or $(8, \infty)$.



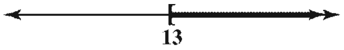
45. $\frac{x-4}{6}\ge\frac{x-2}{9}+\frac{5}{18}$

$3(x-4)\ge 2(x-2)+5$

$3x-12\ge 2x-4+5$

$x\ge 13$

The solution set is $\{x\,|\,x\ge 13\}$, or $[13,\infty)$.



46.

$\frac{4x-3}{6}+2\ge\frac{2x-1}{12}$

$2(4x-3)+24\ge 2x-1$

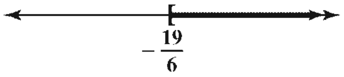
$8x-6+24\ge 2x-1$

$6x+18\ge -1$

$6x\ge -19$

$x\ge -\frac{19}{6}$

The solution set is $\left\{x\,\middle|\,x\ge\frac{-19}{6}\right\}$ or $\left[\frac{-19}{6},\infty\right)$.



47. $4(3x-2)-3x<3(1+3x)-7$

$12x-8-3x<3+9x-7$

$9x-8<-4+9x$

$-8<-4$

True for all x

The solution set is $\{x\,|\,x \text{ is any real number}\}$, or $(-\infty,\infty)$.

48. $3(x-8)-2(10-x)>5(x-1)$

$3x-24-20+2x>5x-5$

$5x-44>5x-5$

$-44>-5$

Not true for any x.

The solution set is the empty set, $\varnothing$.

49. $5(x-2)-3(x+4)\ge 2x-20$

$5x-10-3x-12\ge 2x-20$

$2x-22\ge 2x-20$

$-22\ge -20$

Not true for any x.

The solution set is the empty set, $\varnothing$.

50. $6(x-1)-(4-x)\ge 7x-8$

$6x-6-4+x\ge 7x-8$

$7x-10\ge 7x-8$

$-10\ge -8$

Not true for any x.

The solution set is the empty set, $\varnothing$.

51. $6<x+3<8$

$6-3<x+3-3<8-3$

$3<x<5$

The solution set is $\{x\,|\,3<x<5\}$, or $(3, 5)$.

52. $7<x+5<11$

$7-5<x+5-5<11-5$

$2<x<6$

The solution set is $\{x\,|\,2<x<6\}$ or $(2, 6)$.

53. $-3\le x-2<1$

$-1\le x<3$

The solution set is $\{x\,|\,-1\le x<3\}$, or $[-1, 3)$.

54. $-6<x-4\le 1$

$-2<x\le 5$

The solution set is $\{x\,|\,-2<x\le 5\}$ or $(-2, 5]$.

55. $-11<2x-1\le -5$

$-10<2x\le -4$

$-5<x\le -2$

The solution set is $\{x\,|\,-5<x\le -2\}$, or $(-5, -2]$.

56. $3 \le 4x - 3 < 19$
$6 \le 4x < 22$
$\frac{6}{4} \le x < \frac{22}{4}$
$\frac{3}{2} \le x < \frac{11}{2}$
The solution set is $\left\{x \middle| \frac{3}{2} \le x < \frac{11}{2}\right\}$ or $\left[\frac{3}{2}, \frac{11}{2}\right)$.

57. $-3 \le \frac{2}{3}x - 5 < -1$
$2 \le \frac{2}{3}x < 4$
$3 \le x < 6$
The solution set is $\{x | 3 \le x < 6\}$, or [3, 6).

58. $-6 \le \frac{1}{2}x - 4 < -3$
$-2 \le \frac{1}{2}x < 1$
$-4 \le x < 2$
The solution set is $\{x | -4 \ge x < 2\}$ or $[-4, 2)$.

59. $|x| < 3$
$-3 < x < 3$
The solution set is $\{x | -3 < x < 3\}$, or (–3, 3).

60. $|x| < 5$
$-5 < x < 5$
The solution set is $\{x | -5 < x < 5\}$ or (–5, 5).

61. $|x - 1| \le 2$
$-2 \le x - 1 \le 2$
$-1 \le x \le 3$
The solution set is $\{x | -1 \le x \le 3\}$, or [–1, 3].

62. $|x + 3| \le 4$
$-4 \le x + 3 \le 4$
$-7 \le x \le 1$
The solution set is $\{x | -7 \le x \le 1\}$ or [–7, 1].

63. $|2x - 6| < 8$
$-8 < 2x - 6 < 8$
$-2 < 2x < 14$
$-1 < x < 7$
The solution set is $\{x | -1 < x < 7\}$, or (–1, 7).

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64. $|3x+5|<17$
$-17 < 3x + 5 < 17$
$-22 < 3x < 12$
The solution set is $\left\{x \,\middle|\, -\frac{22}{3} < x < 4\right\}$ or $\left(-\frac{22}{3}, 4\right)$.

65. $|2(x-1)+4| \le 8$
$-8 \le 2(x-1)+4 \le 8$
$-8 \le 2x-2+4 \le 8$
$-8 \le 2x+2 \le 8$
$-10 \le 2x \le 6$
$-5 \le x \le 3$
The solution set is $\{x \mid -5 \le x \le 3\}$, or $[-5, 3]$.

66. $|3(x-1)+2| \le 20$
$-20 \le 3(x-1)+2 \le 20$
$-20 \le 3x-1 \le 20$
$-19 \le 3x \le 21$
$-\frac{19}{3} \le x \le 7$
The solution set is $\left\{x \,\middle|\, -\frac{19}{3} \le x \le 7\right\}$ or $\left[-\frac{19}{3}, 7\right]$.

67. $\left|\frac{2y+6}{3}\right| < 2$
$-2 < \frac{2y+6}{3} < 2$
$-6 < 2y + 6 < 6$
$-12 < 2y < 0$
$-6 < y < 0$
The solution set is $\{x \mid -6 < y < 0\}$, or $(-6, 0)$.

68. $\left|\frac{3(x-1)}{4}\right| < 6$
$-6 < \frac{3(x-1)}{4} < 6$
$-24 < 3x - 3 < 24$
$-21 < 3x < 27$
$-7 < x < 9$
The solution set is $\{x \mid -7 < x < 9\}$ or $(-7, 9)$.

69. $|x| > 3$
$x > 3$ or $x < -3$
The solution set is $\{x \mid x > 3 \text{ or } x < -3\}$, that is, $(-\infty, -3)$ or $(3, \infty)$.

70. $|x| > 5$
$x > 5$ or $x < -5$
The solution set is $\{x \mid x < -5 \text{ or } x > 5\}$, that is,
all x in $(-\infty, -5)$ or $(5, \infty)$.

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71. $|x - 1| \geq 2$

$x-1 \geq 2$ or $x-1 \leq -2$

$x \geq 3$ $\quad x \leq -1$

The solution set is $\{x \mid x \leq -1 \text{ or } x \geq 3\}$, that is, $(-\infty, -1]$ or $[3, \infty)$.

72. $|x + 3| \geq 4$

$x+3 \geq 4$ or $x+3 \leq -4$

$x \geq 1$ $\quad x \leq -7$

The solution set is $\{x \mid x \leq -7 \text{ or } x \geq 1\}$ that is, $(-\infty, -7)$ or $(1, \infty)$.

73. $|3x - 8| > 7$

$3x-8 > 7$ or $3x-8 < -7$

$3x > 15$ $\quad 3x < 1$

$x > 5$ $\quad x < \frac{1}{3}$

The solution set is $\left\{x \middle| x < \frac{1}{3} \text{ or } x > 5\right\}$, that is, $\left(-\infty, \frac{1}{3}\right)$ or $(5, \infty)$.

74. $|5x - 2| > 13$

$5x-2 > 13$ or $5x-2 < -13$

$5x > 15$ $\quad 5x < -11$

$x > 3$ $\quad x < -\frac{11}{5}$

The solution set is $\left\{x \middle| x < \frac{-11}{5} \text{ or } x > 3\right\}$,

that is, all x in $\left(-\infty, \frac{-11}{5}\right)$ or $(3, \infty)$

75. $\left|\frac{2x+2}{4}\right| \geq 2$

$\frac{2x+2}{4} \geq 2$ or $\frac{2x+2}{4} \leq -2$

$2x+2 \geq 8$ $\quad 2x+2 \leq -8$

$2x \geq 6$ $\quad 2x \leq -10$

$x \geq 3$ $\quad x \leq -5$

The solution set is $\{x \mid x \leq -5 \text{ or } x \geq 3\}$, that is, $(-\infty, -5]$ or $[3, \infty)$.

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76. $\left|\dfrac{3x-3}{9}\right| \geq 1$

$\dfrac{3x-3}{9} \geq 1$ or $\dfrac{3x-3}{9} \leq -1$

$3x-3 \geq 9$ $\quad 3x-3 \leq -9$

$3x \geq 12$ $\quad 3x \leq -6$

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

The solution set is $\{x \mid x \leq -2 \text{ or } x \geq 4\}$,

or $(-\infty, -2]$ or $[4, \infty)$.

77. $\left|3 - \dfrac{2}{3}x\right| > 5$

$3 - \dfrac{2}{3}x > 5$ or $3 - \dfrac{2}{3}x < -5$

$-\dfrac{2}{3}x > 2$ $\quad -\dfrac{2}{3}x < -8$

$x < -3$ $\quad x > 12$

The solution set is $\{x \mid x < -3 \text{ or } x > 12\}$, that is, $(-\infty, -3)$ or $(12, \infty)$.

78. $\left|3 - \dfrac{3}{4}x\right| > 9$

$3 - \dfrac{3}{4}x > 9$ or $3 - \dfrac{3}{4}x < -9$

$-\dfrac{3}{4}x > 6$ $\quad -\dfrac{3}{4}x < -12$

$x < -8$ $\quad x > 16$

$\{x \mid x < -8 \text{ or } x > 16\}$, that is all x in

$(-\infty, -8)$ or $(16, \infty)$.

79. $3|x-1| + 2 \geq 8$

$3|x-1| \geq 6$

$|x-1| \geq 2$

$x-1 \geq 2$ or $x-1 \leq -2$

$x \geq 3$ $\quad x \leq -1$

The solution set is $\{x \mid x \leq 1 \text{ or } x \geq 3\}$, that is, $(-\infty, -1]$ or $[3, \infty)$.

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80. $5|2x+1|-3 \ge 9$

$$5|2x+1| \ge 12$$
$$|2x+1| \ge \frac{12}{5}$$
$$2x+1 \ge \frac{12}{5} \qquad 2x+1 \le -\frac{12}{5}$$
$$2x \ge \frac{7}{5} \quad \text{or} \quad 2x \le -\frac{17}{5}$$
$$x \ge \frac{7}{10} \qquad x \le -\frac{17}{10}$$

The solution set is $\left\{x \,\middle|\, x \le -\frac{17}{10} \text{ or } x \ge \frac{7}{10}\right\}$.

81. $-2|x-4| \ge -4$

$$\frac{-2|x-4|}{-2} \le \frac{-4}{-2}$$
$$|x-4| \le 2$$
$$-2 \le x-4 \le 2$$
$$2 \le x \le 6$$

The solution set is $\{x|2 \le x \le 6\}$.

82. $-3|x+7| \ge -27$

$$\frac{-3|x+7|}{-3} \le \frac{-27}{-3}$$
$$|x+7| \le 9$$
$$-9 \le x+7 \le 9$$
$$-16 \le x \le 2$$

The solution set is $\{x|-16 \le x \le 2\}$.

83. $-4|1-x| < -16$

$$\frac{-4|1-x|}{-4} > \frac{-16}{-4}$$
$$|1-x| > 4$$
$$1-x > 4 \qquad 1-x < -4$$
$$-x > 3 \quad \text{or} \quad -x < -5$$
$$x < -3 \qquad x > 5$$

The solution set is $\{x\,|\,x < -3 \text{ or } x > 5\}$.

84. $-2|5-x| < -6$

$$-2|5-x| < -6$$
$$\frac{-2|5-x|}{-2} > \frac{-6}{-2}$$
$$|5-x| > 3$$
$$5-x > 3 \qquad 5-x < -3$$
$$-x > -2 \quad \text{or} \quad -x < -8$$
$$x < 2 \qquad x > 8$$

The solution set is $\{x\,|\,x < 2 \text{ or } x > 8\}$.

85. $3 \le |2x-1|$

$$2x-1 \ge 3 \qquad 2x-1 \le -3$$
$$2x \ge 4 \quad \text{or} \quad 2x \le -2$$
$$x \ge 2 \qquad x \le -1$$

The solution set is $\{x\,|\,x \le -1 \text{ or } x \ge 2\}$.

86. $9 \le |4x+7|$

$$4x+7 \ge 9 \quad \text{or} \quad 4x+7 \le -9$$
$$4x \ge 2 \qquad 4x \le -16$$
$$x \ge \frac{2}{4} \qquad x \le -4$$
$$x \ge \frac{1}{2}$$

The solution set is $\left\{x \,\middle|\, x \le -4 \text{ or } x \ge \frac{1}{2}\right\}$.

87. $5 > |4-x|$ is equivalent to $|4-x| < 5$.

$$-5 < 4-x < 5$$
$$-9 < -x < 1$$
$$\frac{-9}{-1} > \frac{-x}{-1} > \frac{1}{-1}$$
$$9 > x > -1$$
$$-1 < x < 9$$

The solution set is $\{x|-1 < x < 9\}$.

88. $2 > |11-x|$ is equivalent to $|11-x| < 2$.

$$-2 < 11-x < 2$$
$$-13 < -x < -9$$
$$\frac{-13}{-1} > \frac{-x}{-1} > \frac{-9}{-1}$$
$$13 > x > 9$$
$$9 < x < 13$$

The solution set is $\{x\,|\,9 < x < 13\}$.

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89. $1<|2-3x|$ is equivalent to $|2-3x|>1$.

$$\begin{array}{lcl} 2-3x>1 & & 2-3x<-1 \\ -3x>-1 & \text{or} & -3x<-3 \\ \dfrac{-3x}{-3}<\dfrac{-1}{-3} & & \dfrac{-3x}{-3}>\dfrac{-3}{-3} \\ x<\dfrac{1}{3} & & x>1 \end{array}$$

The solution set is $\left\{x\,\middle|\, x<\frac{1}{3} \text{ or } x>1\right\}$.

90. $4<|2-x|$ is equivalent to $|2-x|>4$.

$$\begin{array}{lcl} 2-x>4 & \text{or} & 2-x<-4 \\ -x>2 & & -x<-6 \\ \dfrac{-x}{-1}<\dfrac{2}{-1} & & \dfrac{-x}{-1}>\dfrac{-6}{-1} \\ x<-2 & & x>6 \end{array}$$

The solution set is $\{x\,|\, x<-2 \text{ or } x>6\}$.

91. $12<\left|-2x+\frac{6}{7}\right|+\frac{3}{7}$

$\frac{81}{7}<\left|-2x+\frac{6}{7}\right|$

$$\begin{array}{lcl} -2x+\dfrac{6}{7}>\dfrac{81}{7} & \text{or} & -2x+\dfrac{6}{7}<-\dfrac{81}{7} \\ -2x>\dfrac{75}{7} & & -2x<-\dfrac{87}{7} \\ x<-\dfrac{75}{14} & & x>\dfrac{87}{14} \end{array}$$

The solution set is $\left\{x\,\middle|\, x<-\frac{75}{14} \text{ or } x>\frac{87}{14}\right\}$, that is,

$\left(-\infty,-\frac{75}{14}\right)$ or $\left(\frac{87}{14},\infty\right)$.

92. $1<\left|x-\frac{11}{3}\right|+\frac{7}{3}$

$-\frac{4}{3}<\left|x-\frac{11}{3}\right|$

Since $\left|x-\frac{11}{3}\right|>-\frac{4}{3}$ is true for all x,

the solution set is $\{x\,|\, x \text{ is any real number}\}$

or $(-\infty, \infty)$.

93. $4+\left|3-\frac{x}{3}\right|\ge 9$

$\left|3-\frac{x}{3}\right|\ge 5$

$$\begin{array}{lcl} 3-\dfrac{x}{3}\ge 5 & \text{or} & 3-\dfrac{x}{3}\le -5 \\ -\dfrac{x}{3}\ge 2 & & -\dfrac{x}{3}\le -8 \\ x\le -6 & & x\ge 24 \end{array}$$

The solution set is $\{x\,|\, x\le -6 \text{ or } x\ge 24\}$, that is,

$(-\infty,-6]$ or $[24,\infty)$.

94. $\left|2-\frac{x}{2}\right|-1\le 1$

$\left|2-\frac{x}{2}\right|\le 2$

$-2\le 2-\frac{x}{2}\le 2$

$-4\le -\frac{x}{2}\le 0$

$8\ge x\ge 0$

The solution set is $\{x\,|\, 0\le x\le 8\}$ or $[0,8]$.

95.

$$\begin{aligned} y_1 &\le y_2 \\ \frac{x}{2}+3 &\le \frac{x}{3}+\frac{5}{2} \\ 6\left(\frac{x}{2}+3\right) &\le 6\left(\frac{x}{3}+\frac{5}{2}\right) \\ \frac{6x}{2}+6(3) &\le \frac{6x}{3}+\frac{6(5)}{2} \\ 3x+18 &\le 2x+15 \\ x &\le -3 \end{aligned}$$

The solution set is $(-\infty,-3]$.

96.
$$\begin{aligned}
y_1 &> y_2\\
\frac{2}{3}(6x-9)+4 &> 5x+1\\
3\left(\frac{2}{3}(6x-9)+4\right) &> 3(5x+1)\\
2(6x-9)+12 &> 15x+3\\
12x-18+12 &> 15x+3\\
12x-6 &> 15x+3\\
-3x &> 9\\
\frac{-3x}{-3} &< \frac{9}{-3}\\
x &< -3
\end{aligned}$$
The solution set is $(-\infty,-3)$.

97.
$$\begin{aligned}
y &\ge 4\\
1-(x+3)+2x &\ge 4\\
1-x-3+2x &\ge 4\\
x-2 &\ge 4\\
x &\ge 6
\end{aligned}$$
The solution set is $[6,\infty)$.

98.
$$\begin{aligned}
y &\le 0\\
2x-11+3(x+2) &\le 0\\
2x-11+3x+6 &\le 0\\
5x-5 &\le 0\\
5x &\le 5\\
x &\le 1
\end{aligned}$$
The solution set is $(-\infty,1]$.

99.
$$\begin{aligned}
y &< 8\\
|3x-4|+2 &< 8\\
|3x-4| &< 6\\
-6 < 3x-4 &< 6\\
-2 < 3x &< 10\\
\frac{-2}{3} < \frac{3x}{3} &< \frac{10}{3}\\
\frac{-2}{3} < x &< \frac{10}{3}
\end{aligned}$$
The solution set is $\left(\frac{-2}{3},\frac{10}{3}\right)$.

100.
$$\begin{aligned}
y &> 9\\
|2x-5|+1 &> 9\\
|2x-5| &> 8
\end{aligned}$$
$$\begin{aligned}
2x-5 &< -8 &\quad\text{or}\quad&& 2x-5 &> 8\\
2x &< -3 &&& 2x &> 13\\
x &< -\frac{3}{2} &&& x &> \frac{13}{2}
\end{aligned}$$
The solution set is $\left(-\infty,-\frac{3}{2}\right)\cup\left(\frac{13}{2},\infty\right)$.

101.
$$\begin{aligned}
y &\le 4\\
7-\left|\frac{x}{2}+2\right| &\le 4\\
-\left|\frac{x}{2}+2\right| &\le -3\\
\left|\frac{x}{2}+2\right| &\ge 3
\end{aligned}$$
$$\begin{aligned}
\frac{x}{2}+2 &\ge 3 &\quad\text{or}\quad&& \frac{x}{2}+2 &\le -3\\
x+4 &\ge 6 &&& x+4 &\le -6\\
x &\ge 2 &&& x &\le -10
\end{aligned}$$
The solution set is $(-\infty,-10]\cup[2,\infty)$.

102.
$$\begin{aligned}
y &\ge 6\\
8-|5x+3| &\ge 6\\
-|5x+3| &\ge -2\\
-(-|5x+3|) &\le -(-2)\\
|5x+3| &\le 2\\
-2 \le 5x+3 &\le 2\\
-5 \le 5x &\le -1\\
\frac{-5}{5} \le \frac{5x}{5} &\le \frac{-1}{5}\\
-1 \le x &\le -\frac{1}{5}
\end{aligned}$$
The solution set is $\left[-1,-\frac{1}{5}\right]$.

103. The graph's height is below 5 on the interval $(-1,9)$.

104. The graph's height is at or above 5 on the interval $(-\infty,-1]\cup[9,\infty)$.

105. The solution set is $\{x \mid -1 \le x < 2\}$ or $[-1,2)$.

106. The solution set is $\{x \mid 1 < x \le 4\}$ or $(1,4]$.

107. Let x be the number.

$|4-3x| \ge 5$ or $|3x-4| \ge 5$

$3x-4 \ge 5 \qquad 3x-4 \le -5$

$3x \ge 9$ or $3x \le -1$

$x \ge 3 \qquad x \le -\frac{1}{3}$

The solution set is $\left\{x \mid x \le -\frac{1}{3} \text{ or } x \ge 3\right\}$ or $\left(-\infty,-\frac{1}{3}\right] \cup [3,\infty)$.

108. Let x be the number.

$|5-4x| \le 13$ or $|4x-5| \le 13$

$-13 \le 4x-5 \le 13$

$-8 \le 4x \le 18$

$-2 \le x \le \frac{9}{2}$

The solution set is $\left\{x \mid -2 \le x \le \frac{9}{2}\right\}$ or $\left[-2,-\frac{2}{9}\right]$.

109. $(0,4)$

110. $[0,5]$

111. passion ≤ intimacy or intimacy ≥ passion

112. commitment ≥ intimacy or
intimacy ≤ commitment

113. passion<commitment or
commitment > passion

114. commitment > passion or
passion < commitment

115. 9, after 3 years

116. after approximately $5\frac{1}{2}$ years

117. a. $I = \frac{1}{4}x + 26$

$\frac{1}{4}x + 26 > 33$

$\frac{1}{4}x > 7$

$x > 28$

More than 33% of U.S. households will have an interfaith marriage in years after 2016 (i.e. $1988+28$).

b. $N = \frac{1}{4}x + 6$

$\frac{1}{4}x + 6 > 14$

$\frac{1}{4}x > 8$

$x > 32$

More than 14% of U.S. households will have a person of faith married to someone with no religion in years after 2020 (i.e. $1988+32$).

c. More than 33% of U.S. households will have an interfaith marriage *and* more than 14% of U.S. households will have a person of faith married to someone with no religion in years after 2020.

d. More than 33% of U.S. households will have an interfaith marriage *or* more than 14% of U.S. households will have a person of faith married to someone with no religion in years after 2016.

118. a. $I = \frac{1}{4}x + 26$

$\frac{1}{4}x + 26 > 34$

$\frac{1}{4}x > 8$

$x > 32$

More than 34% of U.S. households will have an interfaith marriage in years after 2020 (i.e. $1988+32$).

b. $N = \frac{1}{4}x + 6$

$\frac{1}{4}x + 6 > 15$

$\frac{1}{4}x > 9$

$x > 36$

More than 15% of U.S. households will have a person of faith married to someone with no religion in years after 2024 (i.e. $1988+36$).

c. More than 34% of U.S. households will have an interfaith marriage *and* more than 15% of U.S. households will have a person of faith married to someone with no religion in years after 2024.

d. More than 34% of U.S. households will have an interfaith marriage *or* more than 15% of U.S. households will have a person of faith married to someone with no religion in years after 2020.

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119. $15 \le \frac{5}{9}(F-32) \le 35$

$\frac{9}{5}(15) \le \frac{9}{5}\left(\frac{5}{9}(F-32)\right) \le \frac{9}{5}(35)$

$9(3) \le F-32 \le 9(7)$

$27 \le F-32 \le 63$

$59 \le F \le 95$

The range for Fahrenheit temperatures is 59°F to 95°F , inclusive or $[59°\text{F}, 95°\text{F}]$.

120. $41 \le \frac{9}{5}C + 32 \le 50$

$41 - 32 \le \frac{9}{5}C + 32 - 32 \le 50 - 32$

$9 \le \frac{9}{5}C \le 18$

$\frac{5}{9}(9) \le \frac{5}{9}\left(\frac{9}{5}C\right) \le \frac{5}{9}(18)$

$5 \le C \le 10$

The range for Celsius temperatures is 5°C to 10°C , inclusive or $[5°\text{C}, 10°\text{C}]$.

121. $\left|\frac{h-50}{5}\right| \ge 1.645$

$\frac{h-50}{5} \ge 1.645$ or $\frac{h-50}{5} \le -1.645$

$h - 50 \ge 8.225$ $\quad$ $h - 50 \le -8.225$

$h \ge 58.225$ $\quad$ $h \le 41.775$

The number of outcomes would be 59 or more, or 41 or less.

122. $20 + 0.80x > 60$

$0.8x > 40$

$x > 50$

The unlimited mileage option is a better deal when driving more than 50 miles per day.

123. $27.50 + 5x > 6.25x + 1.25x$

$27.50 > 2.5x$

$11 > x$

The toll-by-plate option is a better deal with fewer than 11 crossings.

124. $30 + 0.70(5)x < 5x$

$30 + 3.5x < 5x$

$30 < 1.5x$

$20 < x$

The road must be crossed more than 20 times so that the electronic pass option is the better deal.

125. $1200 + 0.005x < 300 + 0.009x$

$900 < 0.004x$

$225,000 < x$

When the home assessment is greater than $225,000 the first bill is a better deal.

126. $2x > 10,000 + 0.40x$

$1.6x > 10,000$

$\frac{1.6x}{1.6} > \frac{10,000}{1.6}$

$x > 6250$

More than 6250 need to be sold a week to make a profit.

127. $3000 + 3x < 5.5x$

$3000 < 2.5x$

$1200 < x$

More then 1200 packets of stationary need to be sold each week to make a profit.

128. $265 + 65x \le 2800$

$65x \le 2535$

$x \le 39$

39 bags or fewer can be lifted safely.

129. $245 + 95x \le 3000$

$95x \le 2755$

$x \le 29$

29 bags or less can be lifted safely.

130. Let $x =$ the grade on the final exam.

$\frac{86+88+92+84+x+x}{6} \ge 90$

$86+88+92+84+x+x \ge 540$

$2x + 350 \ge 540$

$2x \ge 190$

$x \ge 95$

You must receive at least a 95% to earn an A.

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131. **a.**

$$\frac{86+88+x}{3} \geq 90$$
$$\frac{174+x}{3} \geq 90$$
$$174+x \geq 270$$
$$x \geq 96$$

You must get at least a 96.

b.

$$\frac{86+88+x}{3} < 80$$
$$\frac{174+x}{3} < 80$$
$$174+x < 240$$
$$x < 66$$

This will happen if you get a grade less than 66.

132. Let x = the number of hours the mechanic works on the car.

$$351.50 \leq 254+65x \leq 481.50$$
$$97.50 \leq 65x \leq 227.50$$
$$1.5 \leq x \leq 3.5$$

The man will be working on the job at least 1.5 and at most 3.5 hours.

133. Let x = the number of times the bridge is crossed per three month period

The cost with the 3-month pass is $C_3 = 7.50+0.50x$.

The cost with the 6-month pass is $C_6 = 30$.

Because we need to buy two 3-month passes per 6-month pass, we multiply the cost with the 3-month pass by 2.

$$2(7.50+0.50x) < 30$$
$$15+x < 30$$
$$x < 15$$

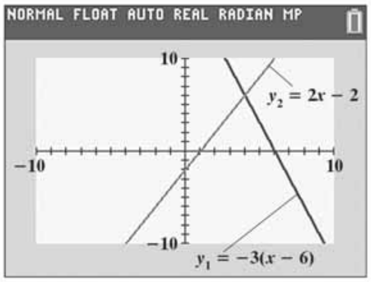
We also must consider the cost without purchasing a pass. We need this cost to be less than the cost with a 3-month pass.

$$3x > 7.50+0.50x$$
$$2.50x > 7.50$$
$$x > 3$$

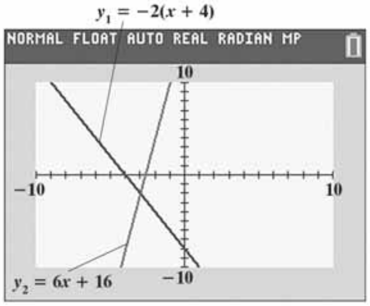
The 3-month pass is the best deal when making more than 3 but less than 15 crossings per 3-month period.

134. – 141. Answers will vary.

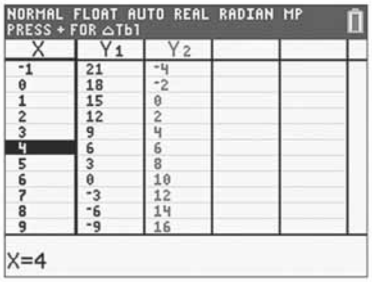
142. $x < 4$



143. $x < -3$



144. Verify exercise 142.

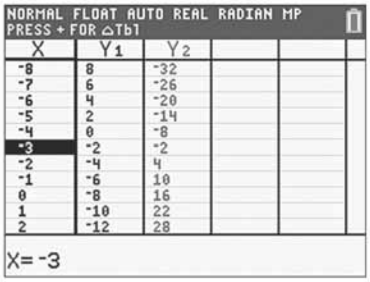


NORMAL FLOAT AUTO REAL RADIAN MP
PRESS + FOR △Tbl

X	Y1	Y2
-1	21	-4
0	18	-2
1	15	0
2	12	2
3	9	4
4	6	6
5	3	8
6	0	10
7	-3	12
8	-6	14
9	-9	16

X=4

Verify exercise 143.



NORMAL FLOAT AUTO REAL RADIAN MP
PRESS + FOR △Tbl

X	Y1	Y2
-8	8	-32
-7	6	-26
-6	4	-20
-5	2	-14
-4	0	-8
-3	-2	-2
-2	-4	4
-1	-6	10
0	-8	16
1	-10	22
2	-12	28

X= -3

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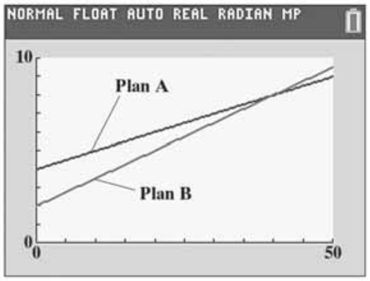
145. **a.** The cost of Plan A is $4 + 0.10x$;
The cost of Plan B is $2 + 0.15x$.

b. Graph:



c. 41 or more checks make Plan A better.

d.

$$\begin{aligned} 4+0.10x &< 2+0.15x \\ 2 &< 0.05x \\ x &> 40 \end{aligned}$$

The solution set is $\{x \mid x > 40\}$ or $(40, \infty)$.

146. makes sense

147. makes sense

148. makes sense

149. makes sense

150. true

151. false; Changes to make the statement true will vary. A sample change is: $(-\infty,3)\cup(-\infty,-2)=(-\infty,3)$

152. false; Changes to make the statement true will vary. A sample change is: $3x > 6$ is equivalent to $x > 2$.

153. true

154. Because $x > y$, $y - x$ represents a negative number. When both sides are multiplied by $(y - x)$ the inequality must be reversed.

155. **a.** $|x-4|< 3$

b. $|x-4|\geq 3$

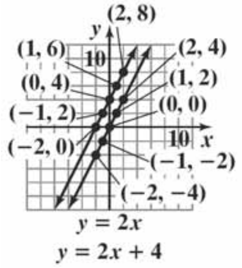
156. Answers will vary.

157. Set 1 has each x-coordinate paired with only one y-coordinate.

158.

x	$y = 2x$	(x, y)
–2	$y = 2(-2) = -4$	$(-2,-4)$
–1	$y = 2(-1)+4 = 2$	$(-1,-2)$
0	$y = 2(0) = 0$	$(0,0)$
1	$y = 2(1) = 2$	$(1,2)$
2	$y = 2(2) = 4$	$(2,4)$

x	$y = 2x+4$	(x, y)
–2	$y = 2(-2)+4 = 0$	$(-2,0)$
–1	$y = 2(-1)+4 = 2$	$(-1,2)$
0	$y = 2(0)+4 = 4$	$(0,4)$
1	$y = 2(1)+4 = 6$	$(1,6)$
2	$y = 2(2)+4 = 8$	$(2,8)$



159. **a.** When the x-coordinate is 2, the y-coordinate is 3.

b. When the y-coordinate is 4, the x-coordinates are –3 and 3.

c. The x-coordinates are all real numbers.

d. The y-coordinates are all real numbers greater than or equal to 1.

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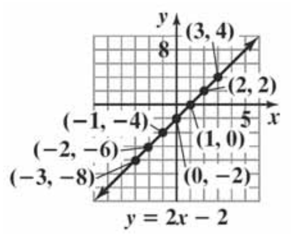
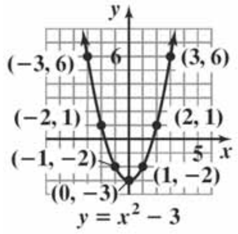
Chapter 1 Review Exercises

1.



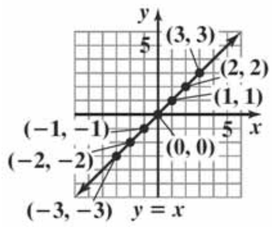
$x = –3, y = –8$
$x = –2, y = –6$
$x = –1, y = –4$
$x = 0, y = –2$
$x = 1, y = 0$
$x = 2, y = 2$
$x = 3, y = 4$

2.



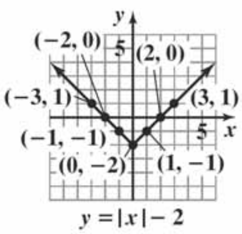
$x = –3, y = 6$
$x = –2, y = 1$
$x = –1, y = –2$
$x = 0, y = –3$
$x = 1, y = –2$
$x = 2, y = 1$
$x = 3, y = 6$

3.



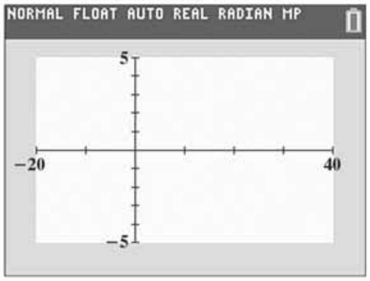
$x = –3, y = –3$
$x = –2, y = –2$
$x = –1, y = –1$
$x = 0, y = 0$
$x = 1, y = 1$
$x = 2, y = 2$
$x = 3, y = 3$

4.



$x = -3, y = 1$
$x = -2, y = 0$
$x = -1, y = -1$
$x = 0, y = -2$
$x = 1, y = -1$
$x = 2, y = 0$
$x = 3, y = 1$

5. A portion of Cartesian coordinate plane with minimum x-value equal to –20, maximum x-value equal to 40, x-scale equal to 10 and with minimum y-value equal to –5, maximum y-value equal to 5, and y-scale equal to 1.



6. x-intercept: –2; The graph intersects the x-axis at $(–2,\ 0)$.

y-intercept: 2; The graph intersects the y-axis at $(0,\ 2)$.

7. x-intercepts: 2, –2; The graph intersects the x-axis at $(–2,\ 0)$ and $(2,\ 0)$.

y-intercept: –4; The graph intercepts the y-axis at $(0,\ -4)$.

8. x-intercept: 5; The graph intersects the x-axis at $(5,\ 0)$.

y-intercept: None; The graph does not intersect the y-axis.

9. The coordinates are (20, 8). This means that 8% of college students anticipated a starting salary of $20 thousand.

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10. The starting salary that was anticipated by the greatest percentage of college students was \$30 thousand. 22% of students anticipated this salary.

11. The starting salary that was anticipated by the least percentage of college students was \$70 thousand. 2% of students anticipated this salary.

12. Starting salaries of \$25 thousand and \$30 thousand were anticipated by more than 20% of college students.

13. 14% of students anticipated a starting salary of \$40 thousand.

14. $p = -0.01s^2 + 0.8s + 3.7$

$p = -0.01(40)^2 + 0.8(40) + 3.7$

$p = 19.7$

This is greater than the estimate of the previous question.

15. $2x - 5 = 7$
$2x = 12$
$x = 6$
The solution set is $\{6\}$.
This is a conditional equation.

16. $5x + 20 = 3x$
$2x = -20$
$x = -10$
The solution set is $\{-10\}$.
This is a conditional equation.

17. $7(x - 4) = x + 2$
$7x - 28 = x + 2$
$6x = 30$
$x = 5$
The solution set is $\{5\}$.
This is a conditional equation.

18. $1 - 2(6 - x) = 3x + 2$
$1 - 12 + 2x = 3x + 2$
$-11 - x = 2$
$-x = 13$
$x = -13$
The solution set is $\{-13\}$.
This is a conditional equation.

19. $2(x - 4) + 3(x + 5) = 2x - 2$
$2x - 8 + 3x + 15 = 2x - 2$
$5x + 7 = 2x - 2$
$3x = -9$
$x = -3$
The solution set is $\{-3\}$.
This is a conditional equation.

20. $2x - 4(5x + 1) = 3x + 17$
$2x - 20x - 4 = 3x + 17$
$-18x - 4 = 3x + 17$
$-21x = 21$
$x = -1$
The solution set is $\{-1\}$.
This is a conditional equation.

21. $7x + 5 = 5(x + 3) + 2x$
$7x + 5 = 5x + 15 + 2x$
$7x + 5 = 7x + 15$
$5 = 15$
The solution set is $\varnothing$.
This is an inconsistent equation.

22. $7x + 13 = 2(2x - 5) + 3x + 23$
$7x + 13 = 2(2x - 5) + 3x + 23$
$7x + 13 = 4x - 10 + 3x + 23$
$7x + 13 = 7x + 13$
$13 = 13$
The solution set is all real numbers.
This is an identity.

23. $\frac{2x}{3} = \frac{x}{6} + 1$
$2(2x) = x + 6$
$4x = x + 6$
$3x = 6$
$x = 2$
The solution set is $\{2\}$.
This is a conditional equation.

24. $\frac{x}{2} - \frac{1}{10} = \frac{x}{5} + \frac{1}{2}$
$5x - 1 = 2x + 5$
$3x = 6$
$x = 2$
The solution set is $\{2\}$.
This is a conditional equation.

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25.
$$\begin{aligned}\frac{2x}{3} &= 6-\frac{x}{4}\\ 4(2x) &= 12(6)-3x\\ 8x &= 72-3x\\ 11x &= 72\\ x &= \frac{72}{11}\end{aligned}$$

The solution set is $\left\{\frac{72}{11}\right\}$.

This is a conditional equation.

26.
$$\begin{aligned}\frac{x}{4} &= 2-\frac{x-3}{3}\\ \frac{12\cdot x}{4} &= 12(2)-\frac{12(x-3)}{3}\\ 3x &= 24-4x+12\\ 7x &= 36\\ x &= \frac{36}{7}\end{aligned}$$

The solution set is $\left\{\frac{36}{7}\right\}$.

This is a conditional equation.

27.
$$\begin{aligned}\frac{3x+1}{3}-\frac{13}{2} &= \frac{1-x}{4}\\ 4(3x+1)-6(13) &= 3(1-x)\\ 12x+4-78 &= 3-3x\\ 12x-74 &= 3-3x\\ 15x &= 77\\ x &= \frac{77}{15}\end{aligned}$$

The solution set is $\left\{\frac{77}{15}\right\}$.

This is a conditional equation.

28.
$$\begin{aligned}\frac{9}{4}-\frac{1}{2x} &= \frac{4}{x}\\ 9x-2 &= 16\\ 9x &= 18\\ x &= 2\end{aligned}$$

The solution set is $\{2\}$.
This is a conditional equation.

29.
$$\begin{aligned}\frac{7}{x-5}+2 &= \frac{x+2}{x-5}\\ 7+2(x-5) &= x+2\\ 7+2x-10 &= x+2\\ 2x-3 &= x+2\\ x &= 5\end{aligned}$$

5 does not check and must be rejected.
The solution set is the empty set, $\varnothing$.
This is an inconsistent equation.

30.
$$\begin{aligned}\frac{1}{x-1}-\frac{1}{x+1} &= \frac{2}{x^2-1}\\ \frac{1}{x-1}-\frac{1}{x+1} &= \frac{2}{(x+1)(x-1)}\\ x+1-(x-1) &= 2\\ x+1-x+1 &= 2\\ 2 &= 2\end{aligned}$$

The solution set is all real numbers except –1 and 1.
This is a conditional equation.

31.
$$\begin{aligned}\frac{5}{x+3}+\frac{1}{x-2} &= \frac{8}{x^2+x-6}\\ \frac{5}{x+3}+\frac{1}{x-2} &= \frac{8}{(x+3)(x-2)}\\ \frac{5(x+3)(x-2)}{x+3}+\frac{(x+3)(x-2)}{x-2} &= \frac{8(x+3)(x-2)}{(x+3)(x-2)}\\ 5(x-2)+1(x+3) &= 8\\ 5x-10+x+3 &= 8\\ 6x-7 &= 8\\ 6x &= 15\\ x &= \frac{15}{6}\\ x &= \frac{5}{2}\end{aligned}$$

The solution set is $\left\{\frac{5}{2}\right\}$.

This is a conditional equation.

32.
$$\begin{aligned}\frac{1}{x+5} &= 0\\ (x+5)\frac{1}{x+5} &= (x+5)(0)\\ 1 &= 0\end{aligned}$$

The solution set is the empty set, $\varnothing$.
This is an inconsistent equation.

33.

$$\frac{4}{x+2}+\frac{3}{x}=\frac{10}{x^2+2x}$$

$$\frac{4}{x+2}+\frac{3}{x}=\frac{10}{x(x+2)}$$

$$\frac{4\cdot x(x+2)}{x+2}+\frac{3\cdot x(x+2)}{x}=\frac{10\cdot x(x+2)}{x(x+2)}$$

$$4x+3(x+2)=10$$

$$4x+3x+6=10$$

$$7x+6=10$$

$$7x=4$$

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

The solution set is $\left\{\frac{4}{7}\right\}$.

This is a conditional equation.

34. $3-5(2x+1)-2(x-4)=0$

$$3-5(2x+1)-2(x-4)=0$$

$$3-10x-5-2x+8=0$$

$$-12x+6=0$$

$$-12x=-6$$

$$x=\frac{-6}{-12}$$

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

The solution set is $\left\{\frac{1}{2}\right\}$.

This is a conditional equation.

35.

$$\frac{x+2}{x+3}+\frac{1}{x^2+2x-3}-1=0$$

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

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

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

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

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

$$x-1=2x-3$$

$$-x=-2$$

$$x=2$$

The solution set is $\{2\}$.

This is a conditional equation.

36. Let $x =$ the number involving oversleeping.
Let $x+10 =$ the number involving computer problems.
Let $x+80 =$ the number involving illness.

$$x+(x+10)+(x+80)=270$$

$$x+x+10+x+80=270$$

$$3x+90=270$$

$$3x=180$$

$$x=60$$

$$x+10=70$$

$$x+80=140$$

The number involving oversleeping, computer problems, and illness, respectively, is 60, 70, and 140.

37. Let x = the number of years after 1980.

$$2.69+0.17x=10$$

$$0.17x=7.31$$

$$x=43$$

The average price of a movie ticket will be $10 43 years after 1980, or 2023.

38. Let x = the number of months.
Provider A: $C=150+60x$
Provider B: $C=30+75x$
Set the costs equal to each other.

$$150+60x=30+75x$$

$$120=15x$$

$$8=x$$

The cost will be the same at 8 months.

39. Let x = the full price

$$945=x-0.30x$$

$$945=0.70x$$

$$1350=x$$

The full price rent is $1350.

40. Let x = the amount sold to earn $9125

$$9125=0.03x-2125$$

$$11{,}250=0.03x$$

$$375{,}000=x$$

Sales must be $375,000 to earn $9125.

41. Let x = the amount invested at 1.7%
Let y = the amount invested at 1.9%

$$x+y=9000$$

$$0.017x+0.019y=166$$

Multiply the first equation by –0.017 and add.

$$\begin{array}{r} -0.017x-0.017y=-153 \\ \underline{0.017x+0.019y=166} \\ 0.002y=13 \\ y=6500 \end{array}$$

Back-substitute 6500 for y in one of the original equations to find x.

$$x+y=9000$$
$$x+6500=9000$$
$$x=2500$$

There was $2500 invested at 1.7% and $6500 invested at 1.9%.

42. Let $x =$ the balance at 1.75%
Let $5000-x$ = the balance at 2.25%.

$$0.0225(5000-x)+0.0175x=94.75$$
$$112.50-0.0225x+0.0175x=94.75$$
$$-0.005x=-17.75$$
$$x=3550$$

$3550 was the balance at 1.75% and $1450 was the balance at 2.25%.

43. Let w = the width of the playing field,
Let $3w – 6$ = the length of the playing field

$$P=2(\text{length})+2(\text{width})$$
$$340=2(3w-6)+2w$$
$$340=6w-12+2w$$
$$340=8w-12$$
$$352=8w$$
$$44=w$$

The dimensions are 44 yards by 126 yards.

44. **a.** Let x = the number of years (after 2015).
College A's enrollment: $14{,}100+1500x$
College B's enrollment: $41{,}700-800x$
$14{,}100+1500x=41{,}700-800x$

b. Check points to determine that $y_1=14{,}100+1500x$ and $y_2=41{,}700-800x$. Since $y_1=y_2=32{,}100$ when $x=12$, the two colleges will have the same enrollment in the year $2015+12=2027$. That year the enrollments will be 32,100 students.

45. $vt+gt^2=s$

$$gt^2=s-vt$$
$$\frac{gt^2}{t^2}=\frac{s-vt}{t^2}$$
$$g=\frac{s-vt}{t^2}$$

46. $T=gr+gvt$

$$T=g(r+vt)$$
$$\frac{T}{r+vt}=\frac{g(r+vt)}{r+vt}$$
$$\frac{T}{r+vt}=g$$
$$g=\frac{T}{r+vt}$$

47. $T=\frac{A-P}{\text{Pr}}$

$$Pr(T)=Pr\frac{A-P}{\text{Pr}}$$
$$PrT=A-P$$
$$PrT+P=A$$
$$P(rT+1)=A$$
$$P=\frac{A}{1+rT}$$

48. $(8-3i)-(17-7i)=8-3i-17+7i$
$=-9+4i$

49. $4i(3i-2)=(4i)(3i)+(4i)(-2)$
$=12i^2-8i$
$=-12-8i$

50. $(7-i)(2+3i)$
$=7\cdot 2+7(3i)+(-i)(2)+(-i)(3i)$
$=14+21i-2i+3$
$=17+19i$

51. $(3-4i)^2=3^2+2\cdot 3(-4i)+(-4i)^2$
$=9-24i-16$
$=-7-24i$

52. $(7+8i)(7-8i)=7^2+8^2=49+64=113$

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53. $$\frac{6}{5+i}=\frac{6}{5+i}\cdot\frac{5-i}{5-i}$$
$$=\frac{30-6i}{25+1}$$
$$=\frac{30-6i}{26}$$
$$=\frac{15-3i}{13}$$
$$=\frac{15}{13}-\frac{3}{13}i$$

54. $$\frac{3+4i}{4-2i}=\frac{3+4i}{4-2i}\cdot\frac{4+2i}{4+2i}$$
$$=\frac{12+6i+16i+8i^2}{16-4i^2}$$
$$=\frac{12+22i-8}{16+4}$$
$$=\frac{4+22i}{20}$$
$$=\frac{1}{5}+\frac{11}{10}i$$

55. $$\sqrt{-32}-\sqrt{-18}=i\sqrt{32}-i\sqrt{18}$$
$$=i\sqrt{16\cdot 2}-i\sqrt{9\cdot 2}$$
$$=4i\sqrt{2}-3i\sqrt{2}$$
$$=(4i-3i)\sqrt{2}$$
$$=i\sqrt{2}$$

56. $$(-2+\sqrt{-100})^2=(-2+i\sqrt{100})^2$$
$$=(-2+10i)^2$$
$$=4-40i+(10i)^2$$
$$=4-40i-100$$
$$=-96-40i$$

57. $$\frac{4+\sqrt{-8}}{2}=\frac{4+i\sqrt{8}}{2}=\frac{4+2i\sqrt{2}}{2}=2+i\sqrt{2}$$

58. $$2x^2+15x=8$$
$$2x^2+15x-8=0$$
$$(2x-1)(x+8)=0$$
$$2x-1=0 \quad x+8=0$$
$$x=\frac{1}{2} \text{ or } x=-8$$

The solution set is $\left\{\frac{1}{2},-8\right\}$.

59. $$5x^2+20x=0$$
$$5x(x+4)=0$$
$$5x=0 \quad x+4=0$$
$$x=0 \text{ or } x=-4$$

The solution set is $\{0, -4\}$.

60. $$2x^2-3=125$$
$$2x^2=128$$
$$x^2=64$$
$$x=\pm 8$$

The solution set is $\{8, -8\}$.

61. $$\frac{x^2}{2}+5=-3$$
$$\frac{x^2}{2}=-8$$
$$x^2=-16$$
$$\sqrt{x^2}=\pm\sqrt{-16}$$
$$x=\pm 4i$$

62. $$(x+3)^2=-10$$
$$\sqrt{(x+3)^2}=\pm\sqrt{-10}$$
$$x+3=\pm i\sqrt{10}$$
$$x=-3\pm i\sqrt{10}$$

63. $$(3x-4)^2=18$$
$$\sqrt{(3x-4)^2}=\pm\sqrt{18}$$
$$3x-4=\pm 3\sqrt{2}$$
$$3x=4\pm 3\sqrt{2}$$
$$\frac{3x}{3}=\frac{4\pm 3\sqrt{2}}{3}$$
$$x=\frac{4\pm 3\sqrt{2}}{3}$$

64. $$x^2+20x$$
$$\left(\frac{20}{2}\right)^2=10^2=100$$
$$x^2+20x+100=(x+10)^2$$

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65. $x^2 - 3x$

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

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

66.
$$x^2 - 12x = -27$$
$$x^2 - 12x + 36 = -27 + 36$$
$$(x-6)^2 = 9$$
$$x - 6 = \pm 3$$
$$x = 6 \pm 3$$
$$x = 9, 3$$

The solution set is $\{9, 3\}$.

67.
$$3x^2 - 12x + 11 = 0$$
$$x^2 - 4x = -\frac{11}{3}$$
$$x^2 - 4x + 4 = -\frac{11}{3} + 4$$
$$(x-2)^2 = \frac{1}{3}$$
$$x - 2 = \pm\sqrt{\frac{1}{3}}$$
$$x = 2 \pm \frac{\sqrt{3}}{3}$$

The solution set is $\left\{2 + \frac{\sqrt{3}}{3}, 2 - \frac{\sqrt{3}}{3}\right\}$.

68.
$$x^2 = 2x + 4$$
$$x^2 - 2x - 4 = 0$$
$$x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2(1)}$$
$$x = \frac{2 \pm \sqrt{4 + 16}}{2}$$
$$x = \frac{2 \pm \sqrt{20}}{2}$$
$$x = \frac{2 \pm 2\sqrt{5}}{2}$$
$$x = 1 \pm \sqrt{5}$$

The solution set is $\{1 + \sqrt{5}, 1 - \sqrt{5}\}$.

69.
$$x^2 - 2x + 19 = 0$$
$$x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(19)}}{2(1)}$$
$$x = \frac{2 \pm \sqrt{4 - 76}}{2}$$
$$x = \frac{2 \pm \sqrt{-72}}{2}$$
$$x = \frac{2 \pm 6i\sqrt{2}}{2}$$
$$x = 1 \pm 3i\sqrt{2}$$

The solution set is $\{1 + 3i\sqrt{2}, 1 - 3i\sqrt{2}\}$.

70.
$$2x^2 = 3 - 4x$$
$$2x^2 + 4x - 3 = 0$$
$$x = \frac{-4 \pm \sqrt{4^2 - 4(2)(-3)}}{2(2)}$$
$$x = \frac{-4 \pm \sqrt{16 + 24}}{4}$$
$$x = \frac{-4 \pm \sqrt{40}}{4}$$
$$x = \frac{-4 \pm 2\sqrt{10}}{4}$$
$$x = \frac{-2 \pm \sqrt{10}}{2}$$

The solution set is $\left\{\frac{-2 + \sqrt{10}}{2}, \frac{-2 - \sqrt{10}}{2}\right\}$.

71. $x^2 - 4x + 13 = 0$

$(-4)^2 - 4(1)(13)$
$= 16 - 52$
$= -36$; 2 complex imaginary solutions

72. $9x^2 = 2 - 3x$

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

$3^2 - 4(9)(-2)$
$= 9 + 72$
$= 81$; 2 unequal real solutions

73. $2x^2 - 11x + 5 = 0$

$(2x - 1)(x - 5) = 0$

$2x - 1 = 0 \quad x - 5 = 0$

$x = \frac{1}{2}$ or $x = 5$

The solution set is $\left\{5, \frac{1}{2}\right\}$.

74. $$\begin{aligned} (3x+5)(x-3) &= 5 \\ 3x^2 + 5x - 9x - 15 &= 5 \\ 3x^2 - 4x - 20 &= 0 \end{aligned}$$

$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(3)(-20)}}{2(3)}$$

$$x = \frac{4 \pm \sqrt{16+240}}{6}$$

$$x = \frac{4 \pm \sqrt{256}}{6}$$

$$x = \frac{4 \pm 16}{6}$$

$$x = \frac{20}{6}, \frac{-12}{6}$$

$$x = \frac{10}{3}, -2$$

The solution set is $\left\{-2, \frac{10}{3}\right\}$.

75. $3x^2 - 7x + 1 = 0$

$$x = \frac{7 \pm \sqrt{(-7)^2 - 4(3)(1)}}{2(3)}$$

$$x = \frac{7 \pm \sqrt{49-12}}{6}$$

$$x = \frac{7 \pm \sqrt{37}}{6}$$

The solution set is $\left\{\frac{7+\sqrt{37}}{6}, \frac{7-\sqrt{37}}{6}\right\}$.

76. $$\begin{aligned} x^2 - 9 &= 0 \\ x^2 &= 9 \\ x &= \pm 3 \end{aligned}$$

The solution set is {–3, 3}.

77. $$\begin{aligned} (x-3)^2 - 25 &= 0 \\ (x-3)^2 &= 25 \\ x - 3 &= \pm 5 \\ x &= 3 \pm 5 \\ x &= 8, -2 \end{aligned}$$

The solution set is {8, –2}.

78. $3x^2 - x + 2 = 0$

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

$$x = \frac{1 \pm \sqrt{1-24}}{6}$$

$$x = \frac{1 \pm \sqrt{-23}}{6}$$

$$x = \frac{1 \pm i\sqrt{23}}{6}$$

The solution set is $\left\{\frac{1+i\sqrt{23}}{6}, \frac{1-i\sqrt{23}}{6}\right\}$.

79. $$\begin{aligned} 3x^2 - 10x &= 8 \\ 3x^2 - 10x - 8 &= 0 \\ (3x+2)(x-4) &= 0 \end{aligned}$$

$$\begin{aligned} 3x + 2 &= 0 \quad \text{or} \quad x - 4 = 0 \\ 3x &= -2 \qquad\quad x = 4 \\ x &= -\frac{2}{3} \end{aligned}$$

The solution set is $\left\{-\frac{2}{3}, 4\right\}$.

80. $$\begin{aligned} (x+2)^2 + 4 &= 0 \\ (x+2)^2 &= -4 \\ \sqrt{(x+2)^2} &= \pm\sqrt{-4} \\ x + 2 &= \pm 2i \\ x &= -2 \pm 2i \end{aligned}$$

The solution set is $\{-2+2i, -2-2i\}$.

81. $$\frac{5}{x+1} + \frac{x-1}{4} = 2$$

$$\frac{5 \cdot 4(x+1)}{x+1} + \frac{(x-1) \cdot 4(x+1)}{4} = 2 \cdot 4(x+1)$$

$$\begin{aligned} 20 + (x-1)(x+1) &= 8(x+1) \\ 20 + x^2 - 1 &= 8x + 8 \\ x^2 - 8x - 11 &= 0 \end{aligned}$$

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

$$x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(1)(11)}}{2(1)}$$

$$x = \frac{8 \pm \sqrt{20}}{2}$$

$$x = \frac{8 \pm 2\sqrt{5}}{2}$$

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

The solution set is $\left\{4+\sqrt{5}, 4-\sqrt{5}\right\}$.

82. $W(t) = 3t^2$

$588 = 3t^2$

$196 = t^2$

Apply the square root property.

$t^2 = 196$

$t = \pm\sqrt{196}$

$t = \pm 14$

The solutions are –14 and 14. We disregard –14, because we cannot have a negative time measurement. The fetus will weigh 588 grams after 14 weeks.

83. **a.** $G = -82x^2 + 410x + 7079$

$G = -82(6)^2 + 410(6) + 7079$

$= 6587$

The model estimates the aid per student in 2011 was $6587. This underestimates the actual number shown in the bar graph by $13.

b.

$$G = -82x^2 + 410x + 7079$$

$$4127 = -82x^2 + 410x + 7079$$

$$82x^2 - 410x - 2952 = 0$$

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

$$x = \frac{-(-410) \pm \sqrt{(-410)^2 - 4(82)(-2952)}}{2(82)}$$

$$x = \frac{410 \pm \sqrt{1136356}}{164}$$

$$x = \frac{410 \pm 1066}{164}$$

$x = 9$ or -4

The model projects government aid per student will be $4127 9 years after 2005, or 2014.

84. $A = lw$

$15 = l(2l - 7)$

$15 = 2l^2 - 7l$

$0 = 2l^2 - 7l - 15$

$0 = (2l + 3)(l - 5)$

$l = 5$

$2l - 7 = 3$

The length is 5 yards, the width is 3 yards.

85. Let x = height of building

$2x$ = shadow height

$x^2 + (2x)^2 = 300^2$

$x^2 + 4x^2 = 90{,}000$

$5x^2 = 90{,}000$

$x^2 = 18{,}000$

$x \approx \pm 134.164$

Discard negative height.

The building is approximately 134 meters high.

86. $2x^4 = 50x^2$

$2x^4 - 50x^2 = 0$

$2x^2\left(x^2 - 25\right) = 0$

$x = 0$

$x = \pm 5$

The solution set is {–5, 0, 5}.

87. $2x^3 - x^2 - 18x + 9 = 0$

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

$\left(x^2 - 9\right)(2x - 1) = 0$

$x = \pm 3, \ x = \frac{1}{2}$

The solution set is $\left\{-3, \frac{1}{2}, 3\right\}$.

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88. $\sqrt{2x-3}+x=3$

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

$$2x-3=9-6x+x^2$$

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

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

$$x^2-8x+16=-12+16$$

$$(x-4)^2=4$$

$$x-4=\pm 2$$

$$x=4+2$$

$$x=6,2$$

The solution set is {2}.

89. $\sqrt{x-4}+\sqrt{x+1}=5$

$$\sqrt{x-4}=5-\sqrt{x+1}$$

$$x-4=25-10\sqrt{x+1}+(x+1)$$

$$x-4=26+x-10\sqrt{x+1}$$

$$-30=-10\sqrt{x+1}$$

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

$$9=x+1$$

$$x=8$$

The solution set is {8}.

90. $3x^{\frac{3}{4}}-24=0$

$$3x^{\frac{3}{4}}=24$$

$$x^{\frac{3}{4}}=8$$

$$\left(x^{\frac{3}{4}}\right)^{\frac{4}{3}}=(8)^{\frac{4}{3}}$$

$$x=16$$

The solution set is {16}.

91. $(x-7)^{\frac{2}{3}}=25$

$$\left[(x-7)^{\frac{2}{3}}\right]^{\frac{3}{2}}=\pm(25)^{\frac{3}{2}}$$

$$x-7=\pm\left(5^2\right)^{\frac{3}{2}}$$

$$x-7=\pm 5^3$$

$$x-7=\pm 125$$

$$x=-118 \text{ or } 132$$

The solution set is {-118, 132}.

92. $x^4-5x^2+4=0$

Let $t=x^2$

$$t^2-5t+4=0$$

$$t=4 \quad \text{or} \quad t=1$$

$$x^2=4 \qquad x^2=1$$

$$x=\pm 2 \qquad x=\pm 1$$

The solution set is {–2, –1, 1, 2}.

93. $x^{1/2}+3x^{1/4}-10=0$

Let $t=x^{1/4}$

$$t^2+3t-10=0$$

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

$$t=-5 \quad \text{or} \quad t=2$$

$$x^{\frac{1}{4}}=-5 \qquad x^{\frac{1}{4}}=2$$

$$\left(x^{\frac{1}{4}}\right)^4=(-5)^4 \qquad \left(x^{\frac{1}{4}}\right)^4=(2)^4$$

$$x=625 \qquad x=16$$

625 does not check and must be rejected.
The solution set is {16}.

94. $|2x+1|=7$

$$2x+1=7 \quad \text{or} \quad 2x+1=-7$$

$$2x=6 \qquad 2x=-8$$

$$x=3 \qquad x=-8$$

The solution set is {–4, 3}.

95. $2|x-3|-6=10$

$$2|x-3|=16$$

$$|x-3|=8$$

$$x-3=8 \quad \text{or} \quad x-3=-8$$

$$x=11 \qquad x=-5$$

The solution set is {–5, 11}.

96. $3x^{4/3}-5x^{2/3}+2=0$

Let $t=x^{\frac{2}{3}}$.

$$3t^2-5t+2=0$$

$$(3t-2)(t-1)=0$$

$$3t-2=0 \quad \text{or} \quad t-1=0$$
$$3t=2 \qquad t=1$$
$$t=\frac{2}{3} \qquad x^{\frac{2}{3}}=1$$
$$x^{\frac{2}{3}}=\frac{2}{3} \qquad \left(x^{\frac{2}{3}}\right)^{\frac{3}{2}}=\pm(1)^{\frac{3}{2}}$$
$$\left(x^{\frac{2}{3}}\right)^{\frac{3}{2}}=\pm\left(\frac{2}{3}\right)^{\frac{3}{2}} \qquad x=\pm 1$$
$$x=\pm\sqrt[2]{\left(\frac{2}{3}\right)^3}$$
$$x=\pm\frac{2}{3}\sqrt{\frac{2}{3}}$$
$$x=\pm\frac{2}{3}\cdot\frac{\sqrt{2}}{\sqrt{3}}\cdot\frac{\sqrt{3}}{\sqrt{3}}$$
$$x=\pm\frac{2\sqrt{6}}{9}$$

The solution set is $\left\{-\frac{2\sqrt{6}}{9},\frac{2\sqrt{6}}{9},-1,1\right\}$.

97. $2\sqrt{x-1}=x$
$$4(x-1)=x^2$$
$$4x-4=x^2$$
$$x^2-4x+4=0$$
$$(x-2)^2=0$$
$$x=2$$
The solution set is {2}.

98. $|2x-5|-3=0$
$$2x-5=3 \quad \text{or} \quad 2x-5=-3$$
$$2x=8 \qquad 2x=2$$
$$x=4 \qquad x=1$$
The solution set is {4, 1}.

99. $x^3+2x^2-9x-18=0$
$$x^2(x+2)-9(x+2)=0$$
$$(x+2)(x^2-9)=0$$
$$(x+2)(x+3)(x-3)=0$$
The solution set is {–3, –2, 3}.

100. $\sqrt{2x+3}-x=0$
$$\sqrt{2x+3}=x$$
$$\left(\sqrt{2x+3}\right)^2=(x)^2$$
$$2x+3=x^2$$
$$0=x^2-2x-3$$
$$0=(x-3)(x+1)$$
$$x-3=0 \quad \text{or} \quad x+1=0$$
$$x=3 \qquad x=-1$$
–1 does not check.
The solution set is $\{3\}$.

101. $x^3+3x^2-2x-6=0$
$$x^2(x+3)-2(x+3)=0$$
$$(x+3)(x^2-2)=0$$
$$x+3=0 \quad \text{or} \quad x^2-2=0$$
$$x=-3 \qquad x^2=2$$
$$x=\pm\sqrt{2}$$
The solution set is $\{-3,-\sqrt{2},\sqrt{2}\}$.

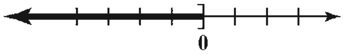
102. $-4|x+1|+12=0$
$$-4|x+1|=-12$$
$$|x+1|=3$$
$$x+1=3 \quad \text{or} \quad x+1=-3$$
$$x=2 \qquad x=-4$$
The solution set is $\{-4, 2\}$.

103. $p=-2.5\sqrt{t}+17$
$$7=-2.5\sqrt{t}+17$$
$$-10=-2.5\sqrt{t}$$
$$4=\sqrt{t}$$
$$16=t$$
The percentage dropped to 7% 16 years after 1993, or 2009.

104. $\{x|-3\le x<5\}$

105. $\{x|x>-2\}$

106. $\{x|x\le 0\}$



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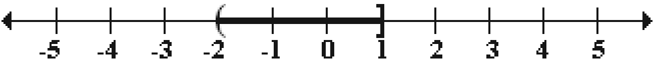
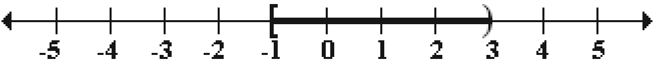
107. Graph $(-2,1]$:

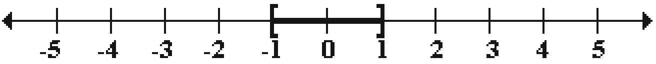


Graph $[-1,3)$:



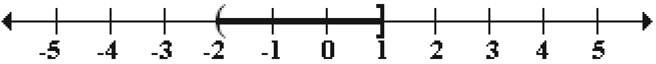
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-2,1]$ and $[-1,3)$:

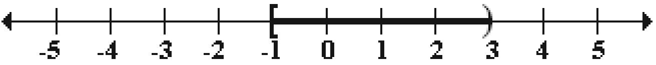


Thus, $(-2,1] \cap [-1,3) = [-1,1]$.

108. Graph $(-2,1]$:

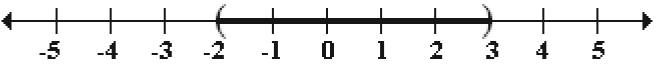


Graph $[-1,3)$:



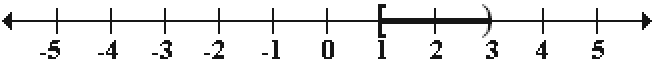
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-2,1]$ or $[-1,3)$ or both:

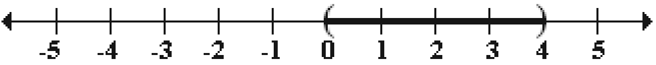


Thus, $(-2,1] \cup [-1,3) = (-2,3)$.

109. Graph $[1,3)$:

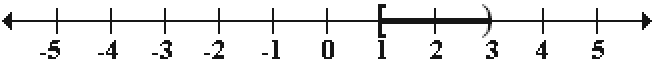


Graph $(0,4)$:



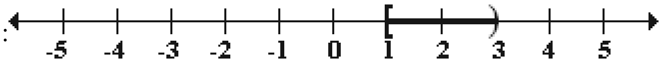
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[1,3)$ and $(0,4)$:

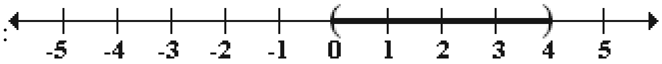


Thus, $[1,3) \cap (0,4) = [1,3)$.

110. Graph $[1,3)$:

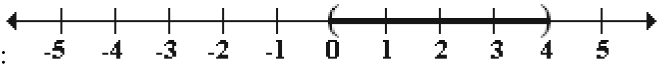


Graph $(0,4)$:



To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $[1,3)$ or $(0,4)$ or both:

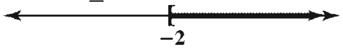


Thus, $[1,3) \cup (0,4) = (0,4)$.

111. $-6x + 3 \le 15$

$-6x \le 12$

$x \ge 2$



The solution set is $[-2,\infty)$.

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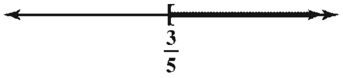
112. $6x - 9 \geq -4x - 3$

$10x \geq 6$

$x \geq \frac{3}{5}$



The solution set is $\left[\frac{3}{5}, \infty\right)$.

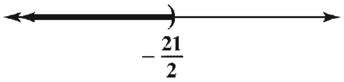
113. $\frac{x}{3} - \frac{3}{4} - 1 > \frac{x}{2}$

$12\left(\frac{x}{3} - \frac{3}{4} - 1\right) > 12\left(\frac{x}{2}\right)$

$4x - 9 - 12 > 6x$

$-21 > 2x$

$-\frac{21}{2} > x$



The solution set is $\left(-\infty, -\frac{21}{2}\right)$.

114. $6x + 5 > -2(x - 3) - 25$

$6x + 5 > -2x + 6 - 25$

$8x + 5 > -19$

$8x > -24$

$x > -3$

The solution set is $(-3, \infty)$.

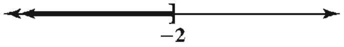
115. $3(2x - 1) - 2(x - 4) \geq 7 + 2(3 + 4x)$

$6x - 3 - 2x + 8 \geq 7 + 6 + 8x$

$4x + 5 \geq 8x + 13$

$-4x \geq 8$

$x \leq -2$



The solution set is $(-\infty, -2]$.

116. $5(x - 2) - 3(x + 4) \geq 2x - 20$

$5x - 10 - 3x - 12 \geq 2x - 20$

$2x - 22 \geq 2x - 20$

$-22 \geq -20$

The solution set is $\varnothing$.

117. $7 < 2x + 3 \leq 9$

$4 < 2x \leq 6$

$2 < x \leq 3$

$(2, 3]$

The solution set is $(2, 3]$.

118. $|2x + 3| \leq 15$

$-15 \leq 2x + 3 \leq 15$

$-18 \leq 2x \leq 12$

$-9 \leq x \leq 6$

The solution set is $[-9, 6]$.

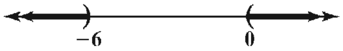
119. $\left|\frac{2x + 6}{3}\right| > 2$

$\frac{2x + 6}{3} > 2 \quad \frac{2x + 6}{3} < -2$

$2x + 6 > 6 \quad 2x + 6 < -6$

$2x > 0 \quad 2x < -12$

$x > 0 \quad x < -6$



The solution set is $(-\infty, -6)$ or $(0, \infty)$.

120. $|2x + 5| - 7 \geq -6$

$|2x + 5| \geq 1$

$2x + 5 \geq 1$ or $2x + 5 \leq -1$

$2x \geq -4 \quad 2x \leq -6$

$x \geq -2$ or $x \leq -3$

The solution set is $(-\infty, -3]$ or $[-2, \infty)$.

121. $-4|x + 2| + 5 \leq -7$

$-4|x + 2| \leq -12$

$|x + 2| \geq 3$

$x + 2 \geq 3$ or $x + 2 \leq -3$

$x \geq 1 \quad x \leq -5$

The solution set is $(-\infty, -5] \cup [1, \infty)$.

122. $y_1 > y_2$

$-10 - 3(2x + 1) > 8x + 1$

$-10 - 6x - 3 > 8x + 1$

$-6x - 13 > 8x + 1$

$-14x > 14$

$\frac{-14x}{-14} < \frac{14}{-14}$

$x < -1$

The solution set is $(-\infty, -1)$.

123. $3-|2x-5|\ge -6$

$$-|2x-5|\ge -9$$

$$\frac{-|2x-5|}{-1}\le\frac{-9}{-1}$$

$$|2x-5|\le 9$$

$$-9\le 2x-5\le 9$$

$$-4\le 2x\le 14$$

$$-2\le x\le 7$$

The solution set is $[-2,7]$.

124. $0.20x+24\le 40$

$$0.20x\le 16$$

$$\frac{0.20x}{0.20}\le\frac{16}{0.20}$$

$$x\le 80$$

A customer can drive no more than 80 miles.

125. $80\le\frac{95+79+91+86+x}{5}<90$

$$400\le 95+79+91+86+x<450$$

$$400\le 351+x<450$$

$$49\le x<99$$

A grade of at least 49% but less than 99% will result in a B.

126. $0.075x\ge 9000$

$$\frac{0.024x}{0.024}\ge\frac{9000}{0.024}$$

$$x\ge 375{,}000$$

The investment must be at least $375,000.

Chapter 1 Test

1. $7(x-2)=4(x+1)-21$

$$7x-14=4x+4-21$$

$$7x-14=4x-17$$

$$3x=-3$$

$$x=-1$$

The solution set is $\{-1\}$.

2. $-10-3(2x+1)-8x-1=0$

$$-10-6x-3-8x-1=0$$

$$-14x-14=0$$

$$-14x=14$$

$$x=-1$$

The solution set is $\{-1\}$.

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

$$2x-3=2(x-4)-(x+1)$$

$$2x-3=2x-8-x-1$$

$$2x-3=x-9$$

$$x=-6$$

The solution set is $\{-6\}$.

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

$$2(x+3)-4(x-3)=8$$

$$2x+6-4x+12=8$$

$$-2x+18=8$$

$$-2x=-10$$

$$x=5$$

The solution set is $\{5\}$.

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

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

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

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

The solution set is $\left\{-\frac{1}{2},2\right\}$.

6. $(3x-1)^2=75$

$$3x-1=\pm\sqrt{75}$$

$$3x=1\pm5\sqrt{3}$$

$$x=\frac{1\pm5\sqrt{3}}{3}$$

The solution set is $\left\{\frac{1-5\sqrt{3}}{3},\frac{1+5\sqrt{3}}{3}\right\}$.

7. $(x+3)^2+25=0$

$$(x+3)^2=-25$$

$$x+3=\pm\sqrt{-25}$$

$$x=-3\pm5i$$

The solution set is $\{-3+5i,-3-5i\}$.

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8. $x(x-2)=4$

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

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

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

$$x=\frac{2\pm2\sqrt{5}}{2}$$

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

The solution set is $\left\{1-\sqrt{5}, 1+\sqrt{5}\right\}$.

9. $4x^2=8x-5$

$$4x^2-8x+5=0$$

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

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

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

$$x=\frac{8\pm4i}{8}$$

$$x=1\pm\frac{1}{2}i$$

The solution set is $\left\{1+\frac{1}{2}i, 1-\frac{1}{2}i\right\}$.

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

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

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

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

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

The solution set is $\{-1, 1, 4\}$.

11. $\sqrt{x-3}+5=x$

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

$$x-3=x^2-10x+25$$

$$x^2-11x+28=0$$

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

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

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

$$x=\frac{11\pm3}{2}$$

$x=7$ or $x=4$

4 does not check and must be rejected.
The solution set is $\{7\}$.

12. $\sqrt{8-2x}-x=0$

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

$$\left(\sqrt{8-2x}\right)^2=(x)^2$$

$$8-2x=x^2$$

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

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

$x+4=0$ or $x-2=0$

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

–4 does not check and must be rejected.
The solution set is $\{2\}$.

13. $\sqrt{x+4}+\sqrt{x-1}=5$

$$\sqrt{x+4}=5-\sqrt{x-1}$$

$$x+4=25-10\sqrt{x-1}+(x-1)$$

$$x+4=25-10\sqrt{x-1}+x-1$$

$$-20=-10\sqrt{x-1}$$

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

$$4=x-1$$

$$x=5$$

The solution set is $\{5\}$.

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14. $5x^{3/2} - 10 = 0$

$5x^{3/2} = 10$

$x^{3/2} = 2$

$x = 2^{2/3}$

$x = \sqrt[3]{4}$

The solution set is $\left\{\sqrt[3]{4}\right\}$.

15. $x^{2/3} - 9x^{1/3} + 8 = 0$ let $t = x^{1/3}$

$t^2 - 9t + 8 = 0$

$(t-1)(t-8) = 0$

$t = 1 \qquad t = 8$

$x^{1/3} = 1 \quad x^{1/3} = 8$

$x = 1 \qquad x = 512$

The solution set is {1, 512}.

16. $\left|\frac{2}{3}x - 6\right| = 2$

$\frac{2}{3}x - 6 = 2 \quad \frac{2}{3}x - 6 = -2$

$\frac{2}{3}x = 8 \qquad \frac{2}{3}x = 4$

$x = 12 \qquad x = 6$

The solution set is {6, 12}.

17. $-3|4x-7| + 15 = 0$

$-3|4x-7| = -15$

$|4x-7| = 5$

$4x - 7 = 5$ or $4x - 7 = -5$

$4x = 12 \qquad 4x = 2$

$x = 3 \qquad x = \frac{1}{2}$

The solution set is $\left\{\frac{1}{2}, 3\right\}$

18. $\frac{1}{x^2} - \frac{4}{x} + 1 = 0$

$\frac{x^2}{x^2} - \frac{4x^2}{x} + x^2 = 0$

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

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

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

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

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

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

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

The solution set is $\left\{2+\sqrt{3}, 2-\sqrt{3}\right\}$.

19. $\frac{2x}{x^2+6x+8} + \frac{2}{x+2} = \frac{x}{x+4}$

$\frac{2x}{(x+4)(x+2)} + \frac{2}{x+2} = \frac{x}{x+4}$

$\frac{2x(x+4)(x+2)}{(x+4)(x+2)} + \frac{2(x+4)(x+2)}{x+2} = \frac{x(x+4)(x+2)}{x+4}$

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

$2x + 2x + 8 = x^2 + 2x$

$2x + 8 = x^2$

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

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

$x - 4 = 0$ or $x + 2 = 0$

$x = 4 \qquad x = -2$ (rejected)

The solution set is $\{4\}$.

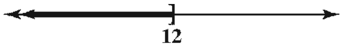
20. $3(x + 4) \geq 5x - 12$

$3x + 12 \geq 5x - 12$

$-2x \geq -24$

$x \leq 12$

The solution set is $(-\infty, 12]$.



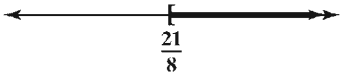
21. $\frac{x}{6} + \frac{1}{8} \leq \frac{x}{2} - \frac{3}{4}$

$4x + 3 \leq 12x - 18$

$-8x \leq -21$

$x \geq \frac{21}{8}$

The solution set is $\left[\frac{21}{8}, \infty\right)$.



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22. $-3 \le \frac{2x+5}{3} < 6$

$-9 \le 2x + 5 < 18$

$-14 \le 2x < 13$

$-7 \le x < \frac{13}{2}$

The solution set is $\left[-7, \frac{13}{2}\right)$.

23. $|3x+2| \ge 3$

$3x+2 \ge 3$ or $3x+2 \le -3$

$3x \ge 1$ $\quad$ $3x \le -5$

$x \ge \frac{1}{3}$ $\quad$ $x \le -\frac{5}{3}$

The solution set is $\left(-\infty, -\frac{5}{3}\right] \cup \left[\frac{1}{3}, \infty\right)$.

24. $-3 \le y \le 7$

$-3 \le 2x - 5 \le 7$

$2 \le 2x \le 12$

$1 \le x \le 6$

The solution set is $[1,6]$.

25. $y \ge 1$

$\left|\frac{2-x}{4}\right| \ge 1$

$\frac{2-x}{4} \ge 1$ or $\frac{2-x}{4} \le -1$

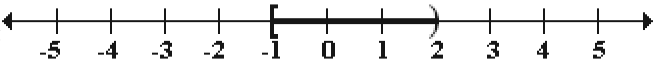
$2 - x \ge 4$ $\quad$ $2 - x \le -4$

$-x \ge 2$ $\quad$ $-x \le -6$

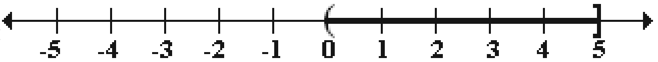
$x \le -2$ $\quad$ $x \ge 6$

The solution set is $(-\infty,-2] \cup [6,\infty)$.

26. Graph $[-1,2)$:



Graph $(0,5]$:

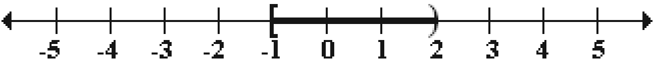


To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

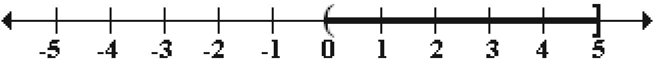
Numbers in either $[-1,2)$ or $(0,5]$ or both:

Thus,
$[-1,2) \cup (0,5] = [-1,5]$.

27. Graph $[-1,2)$:

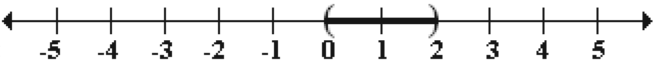


Graph $(0,5]$:



To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[-1,2)$ and $(0,5]$:

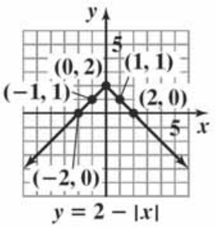


Thus, $[-1,2) \cap (0,5] = (0,2)$.

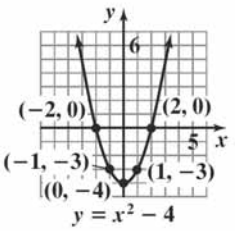
28.
$$V = \frac{1}{3}lwh$$
$$3V = lwh$$
$$\frac{3V}{lw} = \frac{lwh}{lw}$$
$$\frac{3V}{lw} = h$$
$$h = \frac{3V}{lw}$$

29.
$$y - y_1 = m(x - x_1)$$
$$y - y_1 = mx - mx_1$$
$$-mx = y_1 - mx_1 - y$$
$$\frac{-mx}{-m} = \frac{y_1 - mx_1 - y}{-m}$$
$$x = \frac{y - y_1}{m} + x_1$$

30.



31.



32.
$$\begin{aligned}(6-7i)(2+5i) &= 12+30i-14i-35i^2\\ &= 12+16i+35\\ &= 47+16i\end{aligned}$$

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33.
$$\begin{aligned}\frac{5}{2-i} &= \frac{5}{2-i}\cdot\frac{2+i}{2+i}\\ &= \frac{5(2+i)}{4+1}\\ &= \frac{5(2+i)}{5}\\ &= 2+i\end{aligned}$$

34.
$$\begin{aligned}2\sqrt{-49}+3\sqrt{-64} &= 2(7i)+3(8i)\\ &= 14i+24i\\ &= 38i\end{aligned}$$

35.
$$\begin{aligned}43x+575 &= 1177\\ 43x &= 602\\ x &= 14\end{aligned}$$

The system's income was $1177 billion 14 years after 2004, or 2018.

36.
$$\begin{aligned}B &= 0.07x^2+47.4x+500\\ 1177 &= 0.07x^2+47.4x+500\\ 0 &= 0.07x^2+47.4x-677\end{aligned}$$

$$0 = 0.07x^2+47.4x-677$$

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

$$x = \frac{-(47.4)\pm\sqrt{(47.4)^2-4(0.07)(-677)}}{2(0.07)}$$

$x \approx 14,\quad x \approx -691$ (rejected)

The system's income was $1177 billion 14 years after 2004, or 2018.

37. The formulas model the data quite well.

38. Let $x =$ the percentage of strikingly-attractive men.
Let $x+57 =$ the percentage of average-looking men.
Let $x+25 =$ the percentage of good-looking men.

$$\begin{aligned}(x)+(x+57)+(x+25) &= 88\\ x+x+57+x+25 &= 88\\ 3x+82 &= 88\\ 3x &= 6\\ x &= 2\\ x+57 &= 59\\ x+25 &= 27\end{aligned}$$

2% of men are strikingly-attractive.
59% of men are average-looking.
27% of men are good-looking.

39.
$$\begin{aligned}29700+150x &= 5000+1100x\\ 24700 &= 950x\\ 26 &= x\end{aligned}$$

In 26 years, the cost will be $33,600.

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40. Let x = amount invested at 1.3%
10,000 – x = amount invested at 1.7%

$$\begin{aligned} 0.013x+0.017(10,000-x)&=158\\ 0.013x+170-0.017x&=158\\ -0.004x&=-12\\ x&=3000\\ 10000-x&=7000 \end{aligned}$$

\$3000 at 1.3%, \$7000 at 1.7%

41.
$$\begin{aligned} l&=2w+4\\ A&=lw\\ 48&=(2w+4)w\\ 48&=2w^2+4w\\ 0&=2w^2+4w-48\\ 0&=w^2+2w-24\\ 0&=(w+6)(w-4) \end{aligned}$$

$$w+6=0 \qquad w-4=0$$
$$w=-6 \qquad w=4$$
$$2w+4=2(4)+4=12$$
width is 4 feet, length is 12 feet

42.
$$\begin{aligned} 24^2+x^2&=26^2\\ 576+x^2&=676\\ x^2&=100\\ x&=\pm 10 \end{aligned}$$
The wire should be attached 10 feet up the pole.

43. Let x = the original selling price
$$\begin{aligned} 52&=x-0.60x\\ 52&=0.40x\\ 130&=x \end{aligned}$$
The original price is \$130.

44. Let x = the number of months.
Gym A: $C=30+10x$.
Gym B: $C=10+15x$.

$$\begin{aligned} 30+10x&>10+15x\\ 20&>5x\\ 4&>x \end{aligned}$$
Gym B is a better deal with less than 4 months.