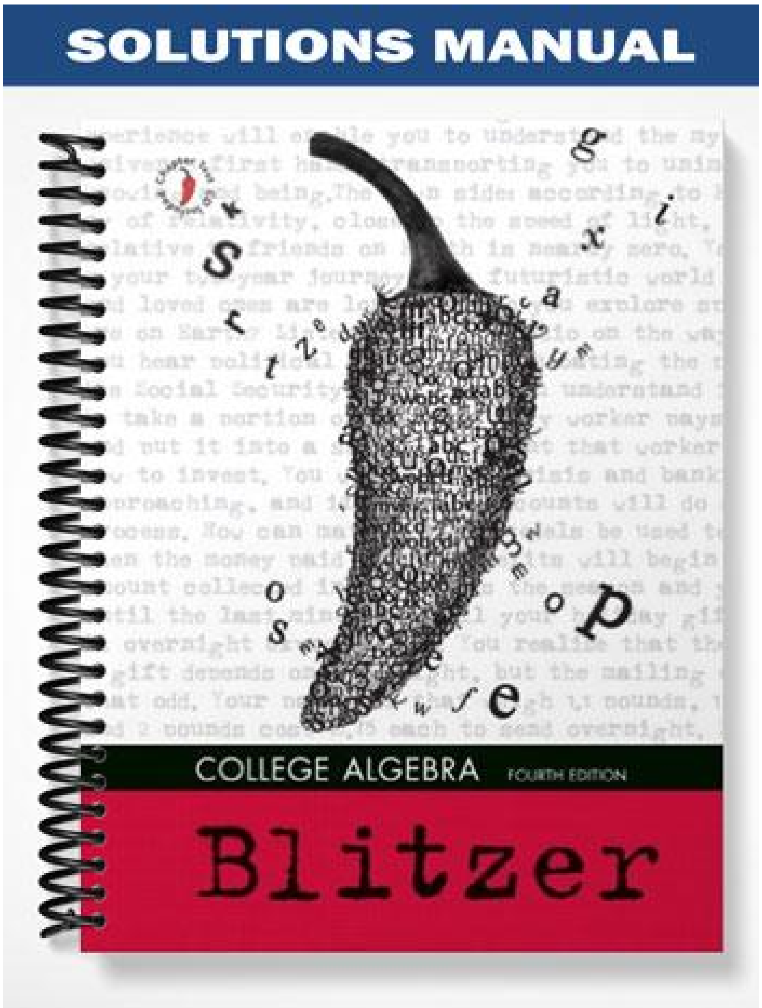
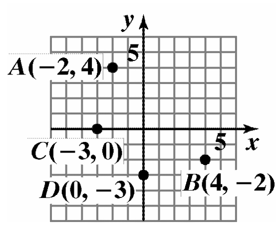

SOLUTIONS MANUAL
COLLEGE ALGEBRA
FOURTH EDITION
Blitzer

Chapter 1

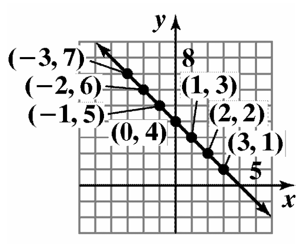
Section 1.1

Check Point Exercises

1.



2.



$y = 4 - x$

$x = -3,\ y = 7$

$x = -2,\ y = 6$

$x = -1,\ y = 5$

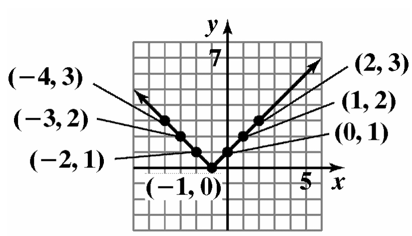
$x = 0,\ y = 4$

$x = 1,\ y = 3$

$x = 2,\ y = 2$

$x = 3,\ y = 1$

3.



$y = |x + 1|$

$x = -4,\ y = 3$

$x = -3,\ y = 2$

$x = -2,\ y = 1$

$x = -1,\ y = 0$

$x = 0,\ y = 1$

$x = 1,\ y = 2$

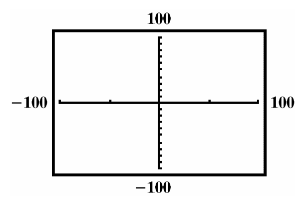
$x = 2,\ y = 3$

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

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

by

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



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.

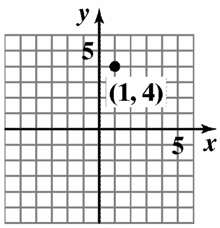
c. The graph crosses the *x*- and *y*-axes at the origin (0, 0). Thus, the *x*-intercept is 0 and the *y*-intercept is 0.

6. The number of federal prisoners sentenced for drug offenses in 2003 is about 57% of 159,275. This can be estimated by finding 60% of 160,000.

$$N \approx 60\% \text{ of } 160{,}000$$
$$= 0.60 \times 160{,}000$$
$$= 96{,}000$$

Exercise Set 1.1

1.



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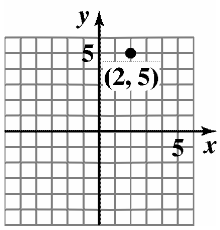
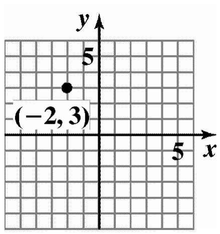
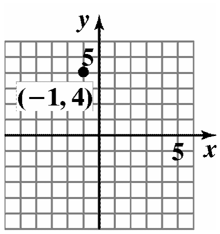


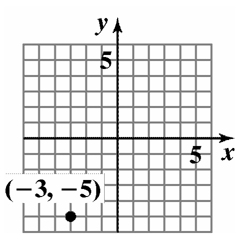
3.



4.



5.



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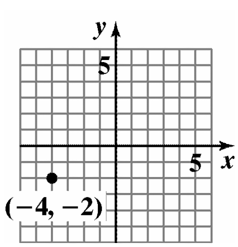

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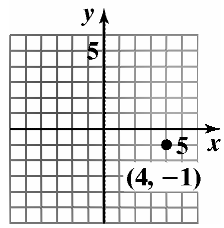
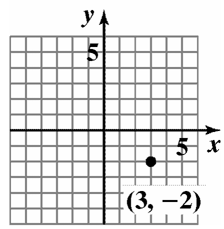
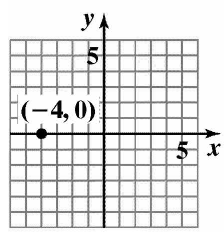


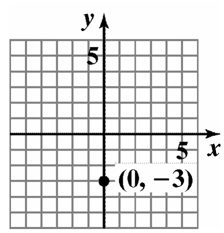
8.



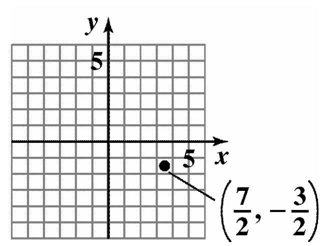
9.



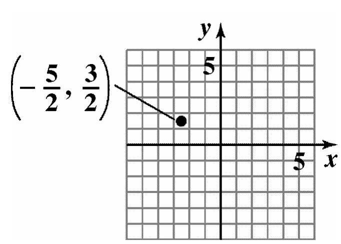
10.



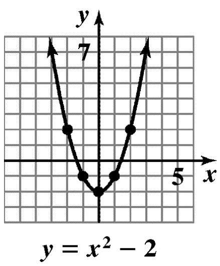
11.



12.



13.



$x = -3, y = 7$

$x = -2, y = 2$

$x = -1, y = -1$

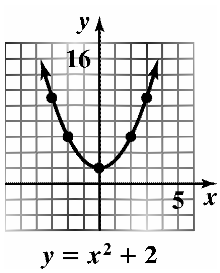
$x = 0, y = -2$

$x = 1, y = -1$

$x = 2, y = 2$

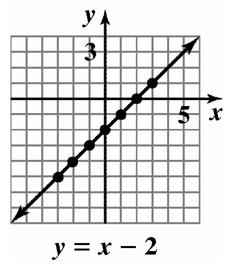
$x = 3, y = 7$

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.



$x = -3, y = -5$

$x = -2, y = -4$

$x = -1, y = -3$

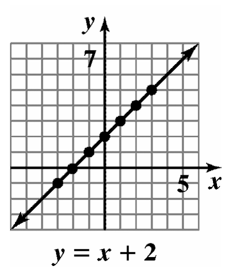
$x = 0, y = -2$

$x = 1, y = -1$

$x = 2, y = 0$

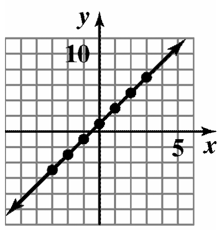
$x = 3, y = 1$

16.



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

17.



$y = 2x + 1$

$x = -3, y = -5$

$x = -2, y = -3$

$x = -1, y = -1$

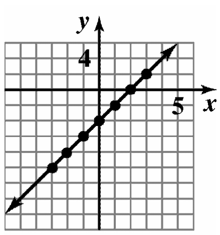
$x = 0, y = 1$

$x = 1, y = 3$

$x = 2, y = 5$

$x = 3, y = 7$

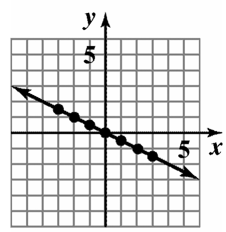
18.



$y = 2x - 4$

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

19.



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

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

$x = -2, y = 1$

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

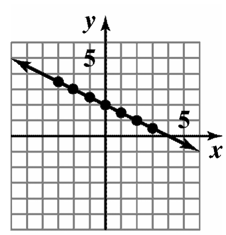
$x = 0, y = 0$

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

$x = 2, y = -1$

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

20.



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

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

$x = -2, y = 3$

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

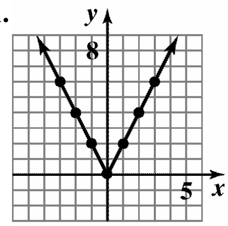
$x = 0, y = 2$

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

$x = 2, y = 1$

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

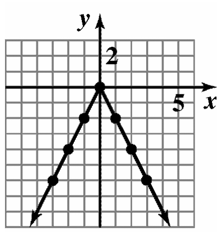
21.



$y = 2|x|$

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

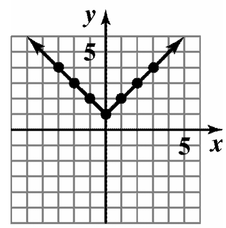
22.



$y = -2|x|$

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

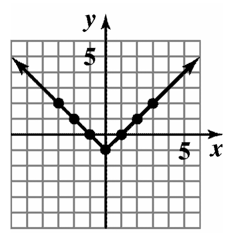
23.



$y = |x| + 1$

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

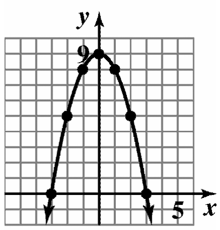
24.



$y = |x| - 1$

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

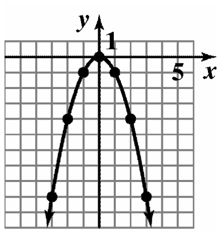
25.



$y = 9 - x^2$

$x = -3, y = 0$
$x = -2, y = 5$
$x = -1, y = 8$
$x = 0, y = 9$
$x = 1, y = 8$
$x = 2, y = 5$
$x = 3, y = 0$

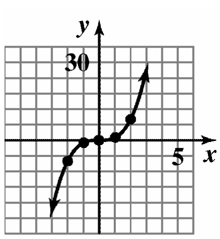
26.



$y = -x^2$

$x = -3, y = -9$
$x = -2, y = -4$
$x = -1, y = -1$
$x = 0, y = 0$
$x = 1, y = -1$
$x = 2, y = -4$
$x = 3, y = -9$

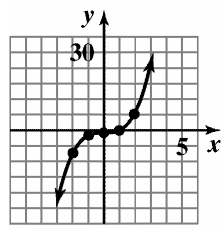
27.



$y = x^3$

$x = -3, y = -27$
$x = -2, y = -8$
$x = -1, y = 1$
$x = 0, y = 0$
$x = 1, y = 1$
$x = 2, y = 8$
$x = 3, y = 27$

28.



$y = x^3 - 1$

$x = -3, y = -28$
$x = -2, y = -9$
$x = -1, y = -2$
$x = 0, y = -1$
$x = 1, y = 0$
$x = 2, y = 7$
$x = 3, y = 26$

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).

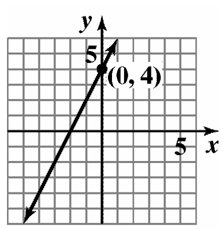
45. **a.** –1; The graph intersects the x-axis at (–1, 0).

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

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

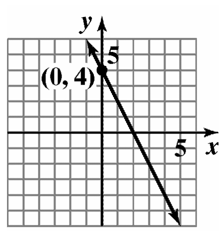
b. 2; The graph intersects the y-axis at (0, 2).

47.



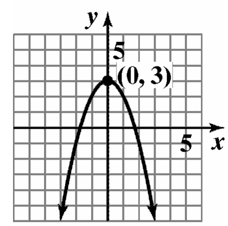
$y = 2x + 4$

48.



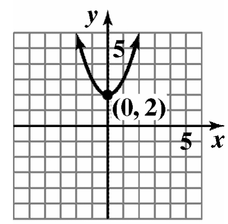
$y = 4 - 2x$

49.



$y = 3 - x^2$

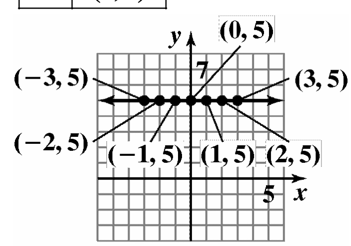
50.



$y = x^2 + 2$

51.

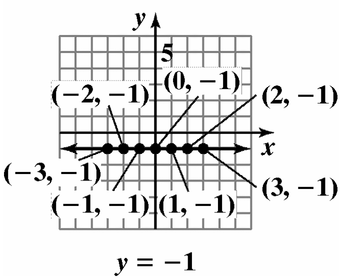
x	(x, y)
–3	$(-3, 5)$
–2	$(-2, 5)$
–1	$(-1, 5)$
0	$(0, 5)$
1	$(1, 5)$
2	$(2, 5)$
3	$(3, 5)$



$y = 5$

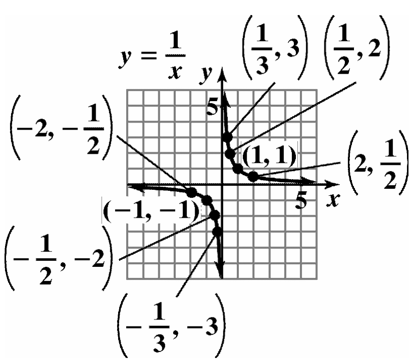
52.

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



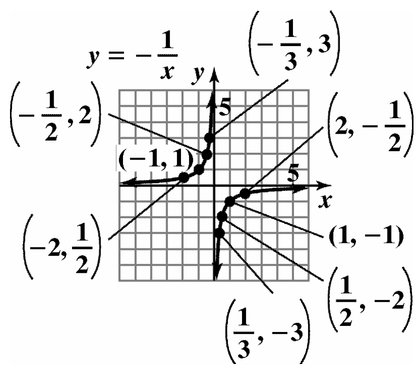
53.

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. There were approximately 65 democracies in 1989.

56. There were 120 – 40 = 80 more democracies in 2002 than in 1973.

57. The number of democracies increased at the greatest rate between 1989 and 1993.

58. The number of democracies increased at the slowest rate between 1981 and 1985.

59. There were 49 democracies in 1977.

60. There were 110 democracies in 1997.

61. $R = 165 - 0.75A; \quad A = 40$

$R - 165 - 0.75A = 165 - 0.75(40)$

$= 165 - 30 = 135$

The desirable heart rate during exercise for a 40-year old man is 135 beats per minute. This corresponds to the point (40, 135) on the blue graph.

62. $R = 143 - 0.65A; \quad A = 40$

$R - 143 - 0.65A = 143 - 0.65(40)$

$= 143 - 26 = 117$

The desirable heart rate during exercise for a 40-year old woman is 117 beats per minute. This corresponds to the point (40, 117) on the red graph.

63. **a.** At birth we have $x = 0$.

$y = 2.9\sqrt{x} + 36$

$= 2.9\sqrt{0} + 36$

$= 2.9(0) + 36$

$= 36$

According to the model, the head circumference at birth is 36 cm.

b. At 9 months we have $x = 9$.

$y = 2.9\sqrt{x} + 36$

$= 2.9\sqrt{9} + 36$

$= 2.9(3) + 36$

$= 44.7$

According to the model, the head circumference at 9 months is 44.7 cm.

c. At 14 months we have $x = 14$.

$y = 2.9\sqrt{x} + 36$

$= 2.9\sqrt{14} + 36$

≈ 46.9

According to the model, the head circumference at 14 months is roughly 46.9 cm.

d. The model describes healthy children.

64. **a.** At birth we have $x = 0$.

$y = 4\sqrt{x} + 35$

$= 4\sqrt{0} + 35$

$= 4(0) + 35$

$= 35$

According to the model, the head circumference at birth is 35 cm.

b. At 9 months we have $x = 9$.

$y = 4\sqrt{x} + 35$

$= 4\sqrt{9} + 35$

$= 4(3) + 35$

$= 47$

According to the model, the head circumference at 9 months is 47 cm.

c. At 14 months we have $x = 14$.

$y = 4\sqrt{x} + 35$

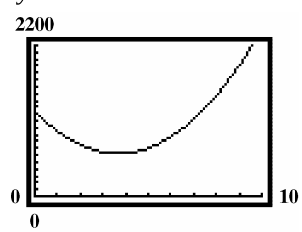
$= 4\sqrt{14} + 35$

≈ 50

According to the model, the head circumference at 14 months is roughly 50 cm.

d. The model describes severe autistic children.

71. $y = 45.48x^2 - 334.35x + 1237.9$



The discharges decreased from 1990 to 1994, but started to increase after 1994. The policy was not a success.

72. **a.** False; (x, y) can be in quadrant III.

b. False; when $x = 2$ and $y = 5$, $3y - 2x = 3(5) - 2(2) = 11$.

c. False; if a point is on the x-axis, $y = 0$.

d. True; all of the above are false. (d) is true.

73. (a)

74. (d)

75. (b)

76. (c)

77. (b)

78. (a)

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.
$$
\begin{aligned}
4(2x+1)-29&=3(2x-5)\\
8x+4-29&=6x-15\\
8x-25&=6x-15\\
8x-25-6x&=6x-15-6x\\
2x-25&=-15\\
2x-25+25&=-15+25\\
2x&=10\\
\frac{2x}{2}&=\frac{10}{2}\\
x&=5
\end{aligned}
$$
Check:
$$
\begin{aligned}
4(2x+1)-29&=3(2x-5)\\
4[2(5)+1]-29&=3[2(5)-5]\\
4[10+1]-29&=3[10-5]\\
4[11]-29&=3[5]\\
44-29&=15\\
15&=15 \text{ true}
\end{aligned}
$$
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. $$\frac{x}{x-2}=\frac{2}{x-2}-\frac{2}{3}, \quad x\neq 2$$
$$3(x-2)\cdot\frac{x}{x-2}=3(x-2)\left[\frac{2}{x-2}-\frac{2}{3}\right]$$
$$3(x-2)\cdot\frac{x}{x-2}=(3x-2)\cdot\frac{2}{x-2}-3(x-2)\cdot\frac{2}{3}$$
$$3x=6-(x-2)\cdot 2$$
$$3x=6-2(x-2)$$
$$3x=6-2x+4$$
$$3x=10-2x$$
$$3x+2x=10-2x+2x$$
$$5x=10$$
$$\frac{5x}{5}=\frac{10}{5}$$
$$x=2$$
The solution set is the empty set, $\varnothing$.

6. Set $y_1=y_2$.
$$\frac{1}{x+4}+\frac{1}{x-4}=\frac{22}{x^2-16}$$
$$\frac{1}{x+4}+\frac{1}{x-4}=\frac{22}{(x+4)(x-4)}$$
$$\frac{(x+4)(x-4)}{x+4}+\frac{(x+4)(x-4)}{x-4}=\frac{22(x+4)(x-4)}{(x+4)(x-4)}$$
$$(x-4)+(x+4)=22$$
$$x-4+x+4=22$$
$$2x=22$$
$$x=11$$
Check:
$$\frac{1}{x+4}+\frac{1}{x-4}=\frac{22}{x^2-16}$$
$$\frac{1}{11+4}+\frac{1}{11-4}=\frac{22}{11^2-16}$$
$$\frac{1}{15}+\frac{1}{7}=\frac{22}{105}$$
$$\frac{22}{105}=\frac{22}{105} \quad \text{true}$$

7. $$4x-7=4(x-1)+3$$
$$4x-7=4(x-1)+3$$
$$4x-7=4x-4+3$$
$$4x-7=4x-1$$
$$-7=-1$$
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.

Exercise Set 1.2

1. $$7x-5=72$$
$$7x=77$$
$$x=11$$
Check:
$$7x-5=72$$
$$7(11)-5=72$$
$$77-5=72$$
$$72=72$$
The solution set is $\{11\}$.

2. $$6x-3=63$$
$$6x=66$$
$$x=11$$
The solution set is $\{11\}$.

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

3. $$11x-(6x-5)=40$$
$$11x-6x+5=40$$
$$5x+5=40$$
$$5x=35$$
$$x=7$$
The solution set is $\{7\}$.

Check:
$$11x-(6x-5)=40$$
$$11(7)-[6(7)-5]=40$$
$$77-(42-5)=40$$
$$77-(37)=40$$
$$40=40$$

4. $5x - (2x - 10) = 35$
$5x - 2x + 10 = 35$
$3x + 10 = 35$
$3x = 25$
$x = \frac{25}{3}$
The solution set is $\left\{\frac{25}{3}\right\}$.

Check:
$$5x-(2x-10)=35$$
$$5\left(\frac{25}{3}\right)-\left[2\left(\frac{25}{3}\right)-10\right]=35$$
$$\frac{125}{3}-\left[\frac{50}{3}-10\right]=35$$
$$\frac{125}{3}-\frac{20}{3}=35$$
$$\frac{105}{3}=35$$
$$35=35$$

5. $2x - 7 = 6 + x$
$x - 7 = 6$
$x = 13$
The solution set is $\{13\}$.

Check:
$$2(13)-7=6+13$$
$$26-7=19$$
$$19=19$$

6. $3x + 5 = 2x + 13$
$x + 5 = 13$
$x = 8$
The solution set is $\{8\}$.

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

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

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

8. $13x + 14 = 12x - 5$
$x + 14 = -5$
$x = -19$
The solution set is $\{-19\}$.

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

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

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

10. $2(x - 1) + 3 = x - 3(x + 1)$
$2x - 2 + 3 = x - 3x - 3$
$2x + 1 = -2x - 3$
$4x + 1 = -3$
$4x = -4$
$x = -1$
The solution set is $\{-1\}$.

Check:
$$2(x-1)+3=x-3(x+1)$$
$$2(-1-1)+3=-1-3(-1+1)$$
$$2(-2)+3=-1-3(0)$$
$$-4+3=-1+0$$
$$-1=-1$$

11. $3(x-4)-4(x-3)=x+3-(x-2)$
$3x-12-4x+12=x+3-x+2$
$-x=5$
$x=-5$
The solution set is {–5}.

Check:
$3(-5-4)-4(-5-3)=-5+3-(-5-2)$
$3(-9)-4(-8)=-2-(-7)$
$-27+32=-2+7$
$5=5$

12. $2-(7x+5)=13-3x$
$2-7x-5=13-3x$
$-7x-3=13-3x$
$-4x=16$
$x=-4$
The solution set is {–4}.

Check:
$2-(7x+5)=13-3x$
$2-[7(-4)+5]=13-3(-4)$
$2-[-28+5]=13+12$
$2-[-23]=15$
$2+23=25$
$25=25$

13. $16=3(x-1)-(x-7)$
$16=3x-3-x+7$
$16=2x+4$
$12=2x$
$6=x$
The solution set is {6}.

Check:
$16=3(6-1)-(6-7)$
$16=3(5)-(-1)$
$16=15+1$
$16=16$

14. $5x-(2x+2)=x+(3x-5)$
$5x-2x-2=x+3x-5$
$3x-2=4x-5$
$-x=-3$
$x=3$
The solution set is {3}.

Check:
$5x-(2x+2)=x+(3x-5)$
$5(3)-[2(3)+2]=3+[3(3)-5]$
$15-[6+2]=3+[9-5]$
$15-8=3+4$
$7=7$

15. $25-[2+5y-3(y+2)]=-3(2y-5)-[5(y-1)-3y+3]$
$25-[2+5y-3y-6]=-6y+15-[5y-5-3y+3]$
$25-[2y-4]=-6y+15-[2y-2]$
$25-2y+4=-6y+15-2y+2$
$-2y+29=-8y+17$
$6y=-12$
$y=-2$
The solution set is {–2}.

Check:
$25-[2+5y-3(y+2)=-3(2y-5)-[5(y-1)-3y+3]$
$25-[2+5(-2)-3(-2+2)=-3[2(-2)-5]-[5(-2-1)-3(-2)+3]$
$25-[2-10-3(0)]=-3[-4-5]-[5(-3)+6+3]$
$25-[-8]=-3(-9)-[-15+9]$
$25+8=27-(-6)$
$33=27+6$
$33=33$

16. $45 - [4 - 2y - 4(y + 7)] = -4(1 + 3y) - [4 - 3(y + 2) - 2(2y - 5)]$

$$45 - [4 - 2y - 4y - 28] = -4 - 12y - [4 - 3y - 6 - 4y + 10]$$
$$45 - [-6y - 24] = -4 - 12y - [-7y + 8]$$
$$45 + 6y + 24 = -4 - 12y + 7y - 8$$
$$6y + 69 = -5y - 12$$
$$11y = -81$$
$$y = -\frac{81}{11}$$

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

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

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

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

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

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

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

19. $20 - \frac{x}{3} = \frac{x}{2}$

$$6\left[20 - \frac{x}{3} = \frac{x}{2}\right]$$
$$120 - 2x = 3x$$
$$120 = 3x + 2x$$
$$120 = 5x$$
$$x = \frac{120}{5}$$
$$x = 24$$

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

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

$$30\left[\frac{x}{5} - \frac{1}{2} = \frac{x}{6}\right]$$
$$6x - 15 = 5x$$
$$6x - 5x = 15$$
$$x = 15$$

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

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

$$15\left[\frac{3x}{5} = \frac{2x}{3} + 1\right]$$
$$9x = 10x + 15$$
$$9x - 10x = 15$$
$$-x = 15$$
$$x = -15$$

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

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

$$4\left[\frac{x}{2} = \frac{3x}{4} + 5\right]$$
$$2x = 3x + 20$$
$$2x - 3x = 20$$
$$-x = 20$$
$$x = -20$$

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

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

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

$6x-10x=x-25$

$-4x-x=-25$

$-5x=-25$

$x=5$

The solution set is {5}.

24. $2x-\frac{2x}{7}=\frac{x}{2}+\frac{17}{2}$

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

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

$24x-7x=119$

$17x=119$

$x=7$

The solution set is {7}.

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

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

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

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

$-2x=-33$

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

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

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

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

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

$3x+4x=10-3$

$7x=7$

$x=1$

The solution set is {1}.

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

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

$3x = 24 + 4x - 12$

$3x - 4x = 12$

$-x = 12$

$x = -12$

The solution set is {–12}.

28. $5+\frac{x-2}{3}=\frac{x+3}{8}$

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

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

$8x-3x=9-104$

$5x=-95$

$x=-19$

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

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

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

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

$7x + 3x = 99 - 7$

$10x = 92$

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

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

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

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

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

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

$3x-10x=20-45$

$-7x=-25$

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

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

31. **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 $\left\{\frac{1}{2}\right\}$.

32. **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 $\left\{\frac{5}{12}\right\}$.

33. **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}.

34. **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 $\left\{\frac{1}{4}\right\}$.

35. **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}.

36. **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}.

37. **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}.

38. **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}.

39. **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}.

40. **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 $\{-3\}$.

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

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

$8x=4(x+1)-8$

$8x=4x+4-8$

$4x=-4$

$x=-1\Rightarrow$ no solution

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

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

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

$2=x-2(x-2)$

$2=x-2x+4$

$x=2\Rightarrow$ no solution

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

43. **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 $\{2\}$.

44. **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 $\{-8\}$.

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

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

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

$3(x-2)+2(x+2)=8$

$3x-6+2x+4=8$

$5x=10$

$x=2\Rightarrow$ no solution

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

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

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

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

$5(x-2)+3(x+2)=12$

$5x-10+3x+6=12$

$8x=16$

$x=2\Rightarrow$ no solution

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

47. **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 $\{-3\}$.

48. **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 $\{7\}$.

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

b. $\frac{1}{x-4}-\frac{5}{x+2}=\frac{6}{x^2-2x-8}$

$\frac{1}{x-4}-\frac{5}{x+2}=\frac{6}{(x-4)(x+2)}$

$(x \neq 4, x \neq -2)$

$1(x+2)-5(x-4)=6$

$x+2-5x+20=6$

$-4x=-16$

$x=4 \Rightarrow$ no solution

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

50. **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 $\{7\}$.

51. 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 $\{6\}$.

52. 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 $\{3\}$.

53. 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 $\{-7\}$.

54. 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 $\{59\}$.

55. Set $y_1 + y_2 = y_3$.

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

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

56. Set $y_1 + y_2 = y_3$.

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

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

57.
$$0=4[x-(3-x)]-7(x+1)$$
$$0=4[x-3+x]-7x-7$$
$$0=4[2x-3]-7x-7$$
$$0=8x-12-7x-7$$
$$0=x-19$$
$$-x=-19$$
$$x=19$$

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

58.
$$0=2[3x-(4x-6)]-5(x-6)$$
$$0=2[3x-4x+6]-5x+30$$
$$0=2[-x+6]-5x+30$$
$$0=-2x+12-5x+30$$
$$0=-7x+42$$
$$7x=42$$
$$x=6$$

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

59.
$$0=\frac{x+6}{3x-12}-\frac{5}{x-4}-\frac{2}{3}$$
$$0=\frac{x+6}{3(x-4)}-\frac{5}{x-4}-\frac{2}{3}$$
$$3(x-4)\cdot 0=3(x-4)\left(\frac{x+6}{3(x-4)}-\frac{5}{x-4}-\frac{2}{3}\right)$$
$$0=\frac{3(x-4)(x+6)}{3(x-4)}-\frac{5\cdot 3(x-4)}{x-4}-\frac{2\cdot 3(x-4)}{3}$$
$$0=(x+6)-15-2(x-4)$$
$$0=x+6-15-2x+8$$
$$0=-x-1$$
$$x=-1$$
The solution set is {–1}.

60.
$$0=\frac{1}{5x+5}-\frac{3}{x+1}+\frac{7}{5}$$
$$0=\frac{1}{5(x+1)}-\frac{3}{x+1}+\frac{7}{5}$$
$$5(x+1)\cdot 0=5(x+1)\left(\frac{1}{5(x+1)}-\frac{3}{x+1}+\frac{7}{5}\right)$$
$$0=\frac{1\cdot 5(x+1)}{5(x+1)}-\frac{3\cdot 5(x+1)}{x+1}+\frac{7\cdot 5(x+1)}{5}$$
$$0=1-15+7(x+1)$$
$$0=1-15+7x+7$$
$$0=-7+7x$$
$$-7x=-7$$
$$x=1$$
The solution set is {1}.

61. $4(x-7) = 4x-28$
$4x-28 = 4x-28$
The given equation is an identity.

62. $4(x-7) = 4x+28$
$4x-28 = 4x+28$
The given equation is an inconsistent equation.

63. $2x+3 = 2x-3$
$3 = -3$
The given equation is an inconsistent equation.

64. $\frac{7x}{x}=7$
$7x=7x$
The given equation is an identity.

65. $4x+5x = 8x$
$9x = 8x$
$x = 0$
The given equation is a conditional equation.

66. $8x+2x = 9x$
$10x = 9x$
$x = 0$
The given equation is a conditional equation.

67.
$$\frac{2x}{x-3}=\frac{6}{x-3}+4$$
$$2x=6+4(x-3)$$
$$2x=6+4x-12$$
$$-2x=-6$$
$$x=3\Rightarrow \text{ no solution}$$
The given equation is an inconsistent equation.

68. $\frac{3}{x-3}=\frac{x}{x-3}+3$

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

$3=x+3x-9$

$-4x=-12$

$x=3\Rightarrow$ no solution

The given equation is an inconsistent equation.

69. $\frac{x+5}{2}-4=\frac{2x-1}{3}$

$3(x+5)-24=2(2x-1)$

$3x+15-24=4x-2$

$-x=7$

$x=-7$

The solution set is $\{-7\}$.
The given equation is a conditional equation.

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

$3(x+2)=105-7(x+1)$

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

$10x=92$

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

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

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

The given equation is a conditional equation.

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

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

$2=3x-6+x$

$-4x=-8$

$x=2\Rightarrow$ no solution

The solution set is the empty set, $\varnothing$.
The given equation is an inconsistent equation.

72. $\frac{6}{x+3}+2=\frac{-2x}{x+3}$

$6+2(x+3)=-2x$

$6+2x+6=-2x$

$4x=-12$

$x=-3\Rightarrow$ no solution

This equation is not true for any real numbers.
The given equation is an inconsistent equation.

73. $8x-(3x+2)+10=3x$

$8x-3x-2+10=3x$

$2x=-8$

$x=-4$

The solution set is $\{-4\}$.
The given equation is a conditional equation.

74. $2(x+2)+2x=4(x+1)$

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

$0=0$

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

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

$8+2x=3x$

$-x=-8$

$x=8$

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

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

$18-x=2x$

$-3x=-18$

$x=6$

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

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

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

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

$7x=-7$

$x=-1$

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

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

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

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

$-2x=-6$

$x=3$

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

79. $$\frac{4x}{x+3}-\frac{12}{x-3}=\frac{4x^2+36}{x^2-9};\ x\neq 3,-3$$
$$4x(x-3)-12(x+3)=4x^2+36$$
$$4x^2-12x-12x-36=4x^2+36$$
$$4x^2-24x-36=4x^2+36$$
$$-24x-36=36$$
$$-24x=72$$
$$x=-3\quad \text{No solution}$$
The solution set is { }.
The given equation is an inconsistent equation.

80. $$\frac{4}{x^2+3x-10}-\frac{1}{x^2+x-6}=\frac{3}{x^2-x-12}$$
$$\frac{4}{(x+5)(x-2)}-\frac{1}{(x+3)(x-2)}=\frac{3}{(x+3)(x-4)},\ x\neq -5,2,-3,4$$
$$4(x+3)(x-4)-1(x+5)(x-4)=3(x+5)(x-2)$$
$$4x^2-4x-48-x^2-x+20=3x^2+9x-30$$
$$3x^2-5x-28=3x^2+9x-30$$
$$2=14x$$
$$\frac{1}{7}=x$$
The solution set is $\left\{\frac{1}{7}\right\}$.
The given equation is a conditional equation.

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

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

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

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

85. Solve: $4(x-2)+2=4x-2(2-x)$
$$4x-8+2=4x-4+2x$$
$$4x-6=6x-4$$
$$-2x-6=-4$$
$$-2x=2$$
$$x=-1$$
Now, evaluate x^2-x for $x=-1$:
$$x^2-x=(-1)^2-(-1)$$
$$=1-(-1)=1+1=2$$

86. Solve: $2(x-6)=3x+2(2x-1)$
$$2x-12=3x+4x-2$$
$$2x-12=7x-2$$
$$-5x-12=-2$$
$$-5x=10$$
$$x=-2$$
Now, evaluate x^2-x for $x=-2$:
$$x^2-x=(-2)^2-(-2)$$
$$=4-(-2)=4+2=6$$

87. Solve for x: $\frac{3(x+3)}{5}=2x+6$
$$3(x+3)=5(2x+6)$$
$$3x+9=10x+30$$
$$-7x+9=30$$
$$-7x=21$$
$$x=-3$$

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

$$-7y-10=18$$
$$-7y=28$$
$$y=-4$$

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

$x^2-(xy-y)$

$=(-3)^2-[-3(-4)-(-4)]$

$=(-3)^2-[12-(-4)]$

$=9-(12+4)=9-16=-7$

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

$$13x-6=4(5x+2)$$
$$13x-6=20x+8$$
$$-7x-6=8$$
$$-7x=14$$
$$x=-2$$

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

$$5-y=7y+28+1$$
$$5-y=7y+29$$
$$5-8y=29$$
$$-8y=24$$
$$y=-3$$

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

$x^2-(xy-y)$

$=(-2)^2-[-2(-3)-(-3)]$

$=(-2)^2-[6-(-3)]$

$=4-(6+3)=4-9=-5$

89. $\left[(3+6)^2\div 3\right]\cdot 4=-54x$

$$\left(9^2\div 3\right)\cdot 4=-54x$$
$$(81\div 3)\cdot 4=-54x$$
$$27\cdot 4=-54x$$
$$108=-54x$$
$$-2=x$$

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

90. $2^3-\left[4(5-3)^3\right]=-8x$

$$8-\left[4(2)^3\right]=-8x$$
$$8-4\cdot 8=-8x$$
$$8-32=-8x$$
$$-24=-8x$$
$$3=x$$

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

91. $5-12x=8-7x-\left[6\div 3\left(2+5^3\right)+5x\right]$

$$5-12x=8-7x-\left[6\div 3(2+125)+5x\right]$$
$$5-12x=8-7x-[6\div 3\cdot 127+5x]$$
$$5-12x=8-7x-[2\cdot 127+5x]$$
$$5-12x=8-7x-[254+5x]$$
$$5-12x=8-7x-254-5x$$
$$5-12x=-12x-246$$
$$5=-246$$

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

92. $2(5x+58)=10x+4(21\div 3.5-11)$

$$10x+116=10x+4(6-11)$$
$$10x+116=10x+4(-5)$$
$$10x+116=10x-20$$
$$116=-20$$

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

93. $0.7x+0.4(20)=0.5(x+20)$

$$0.7x+8=0.5x+10$$
$$0.2x+8=10$$
$$0.2x=2$$
$$x=10$$

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

94. $0.5(x+2)=0.1+3(0.1x+0.3)$

$$0.5x+1=0.1+0.3x+0.9$$
$$0.5x+1=0.3x+1$$
$$0.2x+1=1$$
$$0.2x=0$$
$$x=0$$

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

95. $4x+13-\{2x-[4(x-3)-5]\}=2(x-6)$

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

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

96. $-2\{7-[4-2(1-x)+3]\}=10-[4x-2(x-3)]$

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

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

97. Let T = 4421. Then

$$\begin{aligned}4421&=165x+2771\\1650&=165x\\10&=x\end{aligned}$$

Tuition will be $4421 ten years after 1996, which is the school year ending 2006.

98. Let T = 4751. Then

$$\begin{aligned}4751&=165x+2771\\1980&=165x\\12&=x\end{aligned}$$

Tuition will be $4751 twelve years after 1996, which is the school year ending 2008.

99. $D=\frac{1}{9}N+\frac{26}{9};\ D=\frac{7}{2}$

$$\begin{aligned}\frac{7}{2}&=\frac{1}{9}N+\frac{26}{9}\\18\left(\frac{7}{2}\right)&=18\left(\frac{1}{9}N+\frac{26}{9}\right)\\63&=2N+52\\11&=2N\\\frac{11}{2}&=\frac{2N}{2}\\5.5&=N\end{aligned}$$

If the high-humor group averages a level of depression of 3.5 in response to a negative life event, the intensity of that event would be 5.5. The solution is the point along the horizontal axis where the graph for the high-humor group has a value of 3.5 on the vertical axis. This corresponds to the point $(5.5, 3.5)$ on the high-humor graph.

100. Substitute 10 for *D* in the low humor formula. The LCD is 9.

$$\begin{aligned}10&=\frac{10}{9}N+\frac{53}{9}\\9(10)&=9\left(\frac{10}{9}N\right)+9\left(\frac{53}{9}\right)\\90&=10N+53\\90-53&=10N+53-53\\37&=10N\\\frac{37}{10}&=\frac{10N}{10}\\3.7&=N\end{aligned}$$

The intensity of the event was 3.7. This is shown as the point (3.7, 10) on the low-humor graph.

101. $C=\frac{DA}{A+12};C=500,D=1000$

$$\begin{aligned}500&=\frac{1000A}{A+12}\\(A+12)\cdot 500&=(A+12)\left(\frac{1000A}{A+12}\right)\\500A+6000&=1000A\\6000&=500A\\12&=A\end{aligned}$$

The child's age is 12 years old.

102. $C = \dfrac{DA}{A+12}; C = 300, D = 1000$

$$300 = \frac{1000A}{A+12}$$

LCD = $A+12$

$$(A+12)\cdot 300 = (A+12)\left(\frac{1000A}{A+12}\right)$$

$$300A + 3600 = 1000A$$

$$3600 = 700A$$

$$\frac{3600}{700} = A$$

$$A = \frac{36}{7} \approx 5.14$$

To the nearest year, the child is 5 years old.

103. The solution is the point (12, 500) on the blue graph.

104. The solution is the point (5, 300) on the blue graph..

105. No, because the graphs cross, neither formula gives a consistently smaller dosage.

106. Yes, the dosage given by Cowling's Rule becomes greater at about 10 years.

107. 11 learning trials; represented by the point $(11, 0.95)$ on the graph.

108. 1 learning trial; represented by the point $(1, 0.5)$ on the graph.

109. $$C = \frac{x + 0.1(500)}{x + 500}$$

$$0.28 = \frac{x + 0.1(500)}{x + 500}$$

$$0.28(x + 500) = x + 0.1(500)$$

$$0.28x + 140 = x + 50$$

$$-0.72x = -90$$

$$\frac{-0.72x}{-0.72} = \frac{-90}{-0.72}$$

$$x = 125$$

125 liters of pure peroxide must be added.

110. a. $$C = \frac{x + 0.35(200)}{x + 200}$$

b. $$0.74 = \frac{x + 0.35(200)}{x + 200}$$

$$0.74(x + 200) = x + 0.35(200)$$

$$0.74x + 148 = x + 70$$

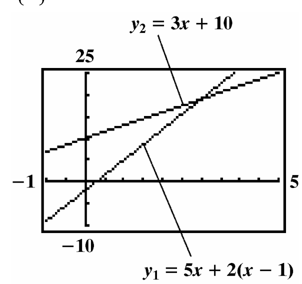
$$-0.26x = -78$$

$$\frac{-0.26x}{-0.26} = \frac{-78}{-0.26}$$

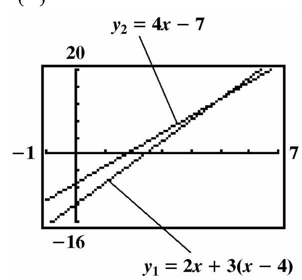
$$x = 300$$

300 liters of pure acid must be added.

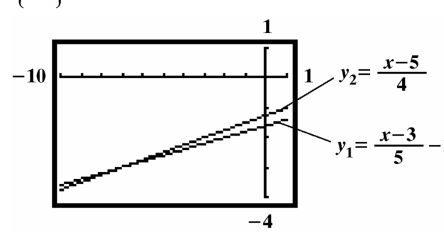
120. $\{3\}$



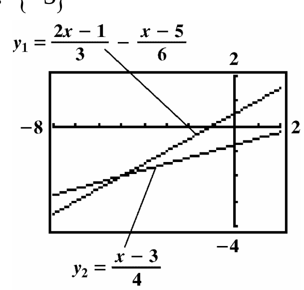
121. $\{5\}$



122. $\{-7\}$



123. $\{-5\}$



124. a. False; $-7x = x$

$$-8x = 0$$
$$x = 0$$

The equation $-7x = x$ has the solution $x = 0$.

b. False; $\frac{x}{x-4} = \frac{4}{x-4}$ $(x \neq 4)$

$$x = 4 \Rightarrow \text{no solution}$$

The equations $\frac{x}{x-4} = \frac{4}{x-4}$ and $x = 4$ are not equivalent.

c. True;

$$3y - 1 = 11 \qquad 3y - 7 = 5$$
$$3y = 12 \qquad 3y = 12$$
$$y = 4 \qquad y = 4$$

The equations $3y - 1 = 11$ and $3y - 7 = 5$ are equivalent since they are both equivalent to the equation $y = 4$.

d. False; if $a = 0$, then $ax + b = 0$ is equivalent to $b = 0$, which either has no solution $(b \neq 0)$ or infinitely many solutions $(b = 0)$.

(c) is true.

125. Answers may vary.

126.

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

127.

$$\frac{4x-b}{x-5} = 3$$
$$4x - b = 3(x-5)$$

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

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

Section 1.3

Check Point Exercises

1. Let x = the number of football injuries
Let $x + 0.6$ = the number of basketball injuries
Let $x + 0.3$ = the number of bicycling injuries

$$x + (x + 0.6) + (x + 0.3) = 3.9$$
$$x + x + 0.6 + x + 0.3 = 3.9$$
$$3x + 0.9 = 3.9$$
$$3x = 3$$
$$x = 1$$

$$x = 1$$
$$x + 0.6 = 1 + 0.6 = 1.6$$
$$x + 0.3 = 1 + 0.3 = 1.3$$

In 2004 there were 1 million football injuries, 1.6 million basketball injuries, and 1.3 million bicycling injuries.

2. Let x = the number of years after 2004 that it will take until Americans will purchase 79.9 million gallons of organic milk.

$$40.7 + 5.6x = 79.9$$
$$5.6x = 79.9 - 40.7$$
$$5.6x = 39.2$$
$$x = \frac{39.2}{5.6}$$
$$x = 7$$

Americans will purchase 79.9 million gallons of organic milk 7 years after 2004, or 2011.

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

$$\overbrace{15 + 0.08x}^{\text{Plan A}} = \overbrace{3 + 0.12x}^{\text{Plan B}}$$
$$15 + 0.08x - 15 = 3 + 0.12x - 15$$
$$0.08x = 0.12x - 12$$
$$0.08x - 0.12x = 0.12x - 12 - 0.12x$$
$$-0.04x = -12$$
$$\frac{-0.04x}{-0.04} = \frac{-12}{-0.04}$$
$$x = 300$$

The two plans are the same at 300 minutes.

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

$$x - 0.30x = 840$$
$$0.70x = 840$$
$$x = \frac{840}{0.70}$$
$$x = 1200$$

Before the reduction the computer's price was $1200.

5. Let x = the amount invested at 9%.
Let 5000 – x = the amount invested at 11%.

$$0.09x + 0.11(5000 - x) = 487$$
$$0.09x + 550 - 0.11x = 487$$
$$-0.02x + 550 = 487$$
$$-0.02x = -63$$
$$x = \frac{-63}{-0.02}$$
$$x = 3150$$
$$5000 - x = 1850$$

$3150 was invested at 9% and $1850 was invested at 11%.

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

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

The dimensions of the court are 50 by 94.

7.

$$2l + 2w = P$$
$$2l + 2w - 2l = P - 2l$$
$$2w = P - 2l$$
$$\frac{2w}{2} = \frac{P - 2l}{2}$$
$$w = \frac{P - 2l}{2}$$

8.

$$P = C + MC$$
$$P = C(1 + M)$$
$$\frac{P}{1 + M} = \frac{C(1 + M)}{1 + M}$$
$$\frac{P}{1 + M} = C$$
$$C = \frac{P}{1 + M}$$

Exercise Set 1.3

1. Let x = the number

$$5x - 4 = 26$$
$$5x = 30$$
$$x = 6$$

The number is 6.

2. Let x = the number

$$2x - 3 = 11$$
$$2x = 14$$
$$x = 7$$

The number is 7.

3. Let x = the number

$$x - 0.20x = 20$$
$$0.80x = 20$$
$$x = 25$$

The number is 25.

4. Let x = the number

$$x - 0.30x = 28$$
$$0.70x = 28$$
$$x = 40$$

The number is 40.

5. Let x = the number

$$0.60x + x = 192$$
$$1.6x = 192$$
$$x = 120$$

The number is 120.

6. Let x = the number

$$0.80x + x = 252$$
$$1.8x = 252$$
$$x = 140$$

The number is 140.

7. Let x = the number

$$0.70x = 224$$
$$x = 320$$

The number is 320.

8. Let x = the number

$$0.70x = 252$$
$$x = 360$$

The number is 360.

9. Let x = the number

$x + 26$ = the other number

$$x + (x + 26) = 64$$
$$x + x + 26 = 64$$
$$2x + 26 = 64$$
$$2x = 38$$
$$x = 19$$

If x = 19, then $x + 26 = 45$.

The numbers are 19 and 45.

10. Let x = the number,

Let x +24 = the other number

$$x + (x + 24) = 58$$
$$x + x + 24 = 58$$
$$2x + 24 = 58$$
$$2x = 34$$
$$x = 17$$

If x = 17, then x +24 = 41.

The numbers are 17 and 41.

11.
$$y_1 - y_2 = 2$$
$$(13x - 4) - (5x + 10) = 2$$
$$13x - 4 - 5x - 10 = 2$$
$$8x - 14 = 2$$
$$8x = 16$$
$$\frac{8x}{8} = \frac{16}{8}$$
$$x = 2$$

12.
$$y_1 - y_2 = 3$$
$$(10x + 6) - (12x - 7) = 3$$
$$10x + 6 - 12x + 7 = 3$$
$$-2x + 13 = 3$$
$$-2x = -10$$
$$\frac{-2x}{-2} = \frac{-10}{-2}$$
$$x = 5$$

13.
$$y_1 = 8y_2 + 14$$
$$10(2x - 1) = 8(2x + 1) + 14$$
$$20x - 10 = 16x + 8 + 14$$
$$20x - 10 = 16x + 22$$
$$4x = 32$$
$$\frac{4x}{4} = \frac{32}{4}$$
$$x = 8$$

14.
$$y_1 = 12y_2 - 51$$
$$9(3x - 5) = 12(3x - 1) - 51$$
$$27x - 45 = 36x - 12 - 51$$
$$27x - 45 = 36x - 63$$
$$-9x = -18$$
$$\frac{-9x}{-9} = \frac{-18}{-9}$$
$$x = 2$$

15.
$$3y_1 - 5y_2 = y_3 - 22$$
$$3(2x + 6) - 5(x + 8) = (x) - 22$$
$$6x + 18 - 5x - 40 = x - 22$$
$$x - 22 = x - 22$$
$$x - x = -22 + 22$$
$$0 = 0$$

The solution set is the set of all real numbers.

16.
$$2y_1 - 3y_2 = 4y_3 - 8$$
$$2(2.5) - 3(2x + 1) = 4(x) - 8$$
$$5 - 6x - 3 = 4x - 8$$
$$-6x + 2 = 4x - 8$$
$$-10x = -10$$
$$\frac{-10x}{-10} = \frac{-10}{-10}$$
$$x = 1$$

17.
$$3y_1 + 4y_2 = 4y_3$$
$$3\left(\frac{1}{x}\right)+4\left(\frac{1}{2x}\right)=4\left(\frac{1}{x-1}\right)$$
$$\frac{3}{x}+\frac{2}{x}=\frac{4}{x-1}$$
$$\frac{5}{x}=\frac{4}{x-1}$$
$$\frac{5x(x-1)}{x}=\frac{4x(x-1)}{x-1}$$
$$5(x-1)=4x$$
$$5x-5=4x$$
$$x=5$$

18.
$$6y_1 - 3y_2 = 7y_3$$
$$6\left(\frac{1}{x}\right)-3\left(\frac{1}{x^2-x}\right)=7\left(\frac{1}{x-1}\right)$$
$$\frac{6}{x}-\frac{3}{x^2-x}=\frac{7}{x-1}$$
$$\frac{6}{x}-\frac{3}{x(x-1)}=\frac{7}{x-1}$$
$$x(x-1)\left(\frac{6}{x}-\frac{3}{x(x-1)}\right)=x(x-1)\frac{7}{x-1}$$
$$\frac{6x(x-1)}{x}-\frac{3x(x-1)}{x(x-1)}=\frac{7x(x-1)}{x-1}$$
$$6(x-1)-3=7x$$
$$6x-6-3=7x$$
$$6x-9=7x$$
$$6x-7x=9$$
$$-x=9$$
$$\frac{-x}{-1}=\frac{9}{-1}$$
$$x=-9$$

19. Let x = the number of births (in thousands)
Let $x-229$ = the number of deaths (in thousands).
$$x+(x-229)=521$$
$$x+x-229=521$$
$$2x-229=521$$
$$2x-229+229=521+229$$
$$2x=750$$
$$\frac{2x}{2}=\frac{750}{2}$$
$$x=375$$
There are 375 thousand births and $375-229=146$ thousand deaths each day.

20. Let x = the number responding yes.
Let $82 - x$ = the number responding no.
$$(82-x)-x=36$$
$$82-x-x=36$$
$$82-2x=36$$
$$-2x=36-82$$
$$-2x=-46$$
$$\frac{-2x}{-2}=\frac{-46}{-2}$$
$$x=23$$
$$82-x=59$$
23% responded yes and 59% responded no.

21. Let x = the number of Internet users in China.
$x+10$ = the number of Internet users in Japan.
$x+123$ = the number of Internet users in the United States.
$$x+(x+10)+(x+123)=271$$
$$3x+133=271$$
$$3x=138$$
$$x=46$$
If $x=46$, then $x+10=56$ and $x+123=169$. Thus, there are 46 million Internet users in China, 56 million Internet users in Japan, and 169 Internet users in the United States.

22. Let x = energy percentage used by Russia.
$x+6$ = energy percentage used by China.
$x+16.4$ = energy percentage used by the United States.
$$x+(x+6)+(x+16.4)=40.4$$
$$x+x+6+x+16.4=40.4$$
$$3x+22.4=40.4$$
$$3x=18$$
$$\frac{3x}{3}=\frac{18}{3}$$
$$x=6$$
$$x+6=12$$
$$x+16.4=22.4$$
Thus, Russia uses 6%, China uses 12%, and the United States uses 22.4% of global energy.

23. Let x = the percentage of Conservatives.
Let $2x + 4.4$ = the percentage of Liberals.

$$x+(2x+4.4)=57.2$$
$$x+2x+4.4=57.2$$
$$3x+4.4=57.2$$
$$3x+4.4-4.4=57.2-4.4$$
$$3x=52.8$$
$$\frac{3x}{3}=\frac{52.8}{3}$$
$$x=17.6$$
$$2x+4.4=39.6$$

The percentage of Conservatives is 17.6% and the percentage of Liberals is 39.6%

24. Let x = the number of hate crimes based on sexual orientation.
$3x+127$ = the number of hate crimes based on race.

$$(3x+127)+1343+x+1026+33=7485$$
$$3x+127+1343+x+1026+33=7485$$
$$4x+2529=7485$$
$$4x=4956$$
$$\frac{4x}{4}=\frac{4956}{4}$$
$$x=1239$$
$$3x+127=3844$$

Thus, there were 3844 hate crimes based on race and 1239 based on sexual orientation.

25. Let L = the life expectancy of an American man.
y = the number of years after 1900.

$$L=55+0.2y$$
$$85=55+0.2y$$
$$30=0.2y$$
$$150=y$$

The life expectancy will be 85 years in the year $1900+150=2050$.

26. Let L = the life expectancy of an American man,
Let y = the number of years after 1900

$$L=55+0.2y$$
$$91=55+0.2y$$
$$36=0.2y$$
$$180=y$$

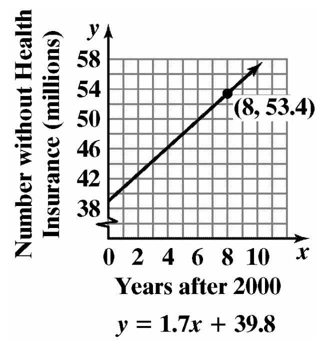
The life expectancy will be 91 years in the year 1900 + 180 = 2080.

27. a. $y=1.7x+39.8$

b.
$$1.7x+39.8=44.9+8.5$$
$$1.7x+39.8=53.4$$
$$1.7x=13.6$$
$$\frac{1.7x}{1.7}=\frac{13.6}{1.7}$$
$$x=8$$

The number of Americans without health insurance will exceed 44.9 million by 8.5 million 8 years after 2000, or 2008.

c.

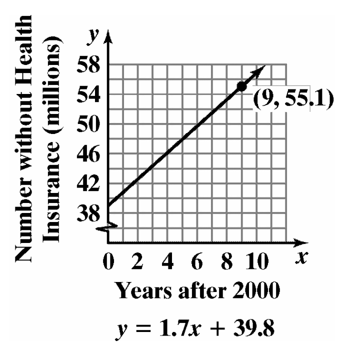


28. a. $y=1.7x+39.8$

b.
$$1.7x+39.8=44.9+10.2$$
$$1.7x+39.8=55.1$$
$$1.7x=15.3$$
$$\frac{1.7x}{1.7}=\frac{15.3}{1.7}$$
$$x=9$$

The number of Americans without health insurance will exceed 44.9 million by 10.2 million 9 years after 2000, or 2009.

c.



29. Let v = the car's value.
y = the number of years (after 2003).

$$v = 80,500 - 8705y$$
$$19,565 = 80,500 - 8705y$$
$$-60,935 = -8705y$$
$$7 = y$$

The car's value will be $19,565 after 7 years.

30. Let v = the car's value.
y = the number of years (after 2003).

$$v = 80,500 - 8705y$$
$$36,975 = 80,500 - 8705y$$
$$-43,525 = -8705y$$
$$5 = y$$

The car's value will be $36,975 after 5 years.

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

$$25x + 40 = 30x + 15$$
$$-5x + 40 = 15$$
$$-5x = -25$$
$$x = 5$$

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

32. Let g = the number of video games rented

$$9g = 4g + 50$$
$$5g = 50$$
$$g = 10$$

The total amount spent at each store will be the same after 10 rentals.
$9g = 9(10) = 90$
The total amount spent will be $90.

33. Let x = the number of uses.
Cost without coupon book: $1.25x$
Cost with coupon book: $15 + 0.75x$

$$1.25x = 15 + 0.75x$$
$$0.50x = 15$$
$$x = 30$$

The bus must be used 30 times in a month for the costs to be equal.

34. Cost per crossing: $\$5x$
Cost with coupon book: $\$30 + \$3.50x$

$$5x = 30 + 3.50x$$
$$1.50x = 30$$
$$x = 20$$

The bridge must be used 20 times in a month for the costs to be equal.

35. **a.** Let x = the number of years (after 2005).
College A's enrollment: $13,300 + 1000x$

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

$$13,300 + 1000x = 26,800 - 500x$$
$$13,300 + 1500x = 26,800$$
$$1500x = 13,500$$
$$x = 9$$

The two colleges will have the same enrollment in the year $2005 + 9 = 2014$.
That year the enrollments 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
$y_2 = 26,800 - 500x$.

36. Let x = the number of years after 2000

$$10,600,000 - 28,000x = 10,200,000 - 12,000x$$
$$-16,000x = -400,000$$
$$x = 25$$

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

$$10,200,000 - 12,000x = 10,200,000 - 12,000(25)$$
$$= 10,200,000 - 300,000$$
$$= 9,900,000$$

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

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

$$x - 0.20x = 336$$
$$0.80x = 336$$
$$x = 420$$

The television set's price is $420.

38. Let x = the cost of the dictionary

$$x - 0.30x = 30.80$$
$$0.70x = 30.80$$
$$x = 44$$

The dictionary's price before the reduction was $44.

39. Let x = the nightly cost

$$x + 0.08x = 162$$
$$1.08x = 162$$
$$x = 150$$

The nightly cost is $150.

40. Let x = the nightly cost

$$x + 0.05x = 252$$
$$1.05x = 252$$
$$x = 240$$

The nightly cost is $240.

41. Let x = the annual salary for men whose highest educational attainment is a high school degree.

$$x + 0.22x = 44,000$$
$$1.22x = 44,000$$
$$x \approx 36,000$$

The annual salary for men whose highest educational attainment is a high school degree is about $36,000.

42. Let x = the annual salary with a high school degree

$$34,000 = x + 0.26x$$
$$34,000 = 1.26x$$
$$26984.13 \doteq x$$

The annual salary for women with a high school degree is approximately $27,000.

43. Let c = the dealer's cost

$$584 = c + 0.25c$$
$$584 = 1.25c$$
$$467.20 = c$$

The dealer's cost is $467.20.

44. Let c = the dealer's cost

$$15 = c + 0.25c$$
$$15 = 1.25c$$
$$12 = c$$

The dealer's cost is $12.

45. Let x = the amount invested at 6%.
Let 7000 – x = the amount invested at 8%.

$$0.06x + 0.08(7000 - x) = 520$$
$$0.06x + 560 - 0.08x = 520$$
$$-0.02x + 560 = 520$$
$$-0.02x = -40$$
$$x = \frac{-40}{-0.02}$$
$$x = 2000$$
$$7000 - x = 5000$$

$2000 was invested at 6% and $5000 was invested at 8%.

46. Let x = the amount invested in stocks.
Let 11,000 – x = the amount invested in bonds.

$$0.05x + 0.08(11,000 - x) = 730$$
$$0.05x + 880 - 0.08x = 730$$
$$-0.03x + 880 = 730$$
$$-0.03x = -150$$
$$x = \frac{-150}{-0.03}$$
$$x = 5000$$
$$11,000 - x = 6000$$

$5000 was invested in stocks and $6000 was invested in bonds.

47. Let x = amount invested at 12%
8000 – x = amount invested at 5% loss

$$.12x - .05(8000 - x) = 620$$
$$.12x - 400 + .05x = 620$$
$$.17x = 1020$$
$$x = 6000$$
$$8000\text{-}x = 2000$$

$6000 at 12%, $2000 at 5% loss

48. Let x = amount at 14%
$12000 - x$ = amount at 6%
$.14x - 0.6(12000 - x) = 680$
$.14x - 720 + .06x = 680$
$.2x = 1400$
$x = 7000$
$12000 - 7000 = 5000$
\$7000 at 14%, \$5000 at 6% loss

49. 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.

50. 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.

51. 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.

52. 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.

53. 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.

54. 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
$2(40 + 2w) + 2(60 + 2w) = 248$
$80 + 4w + 120 + 4w = 248$
$200 + 8w = 248$
$8w = 48$
$w = 6$
The width of the path is 6 feet.

55. Let x = number of hours
$35x$ = labor cost
$35x + 63 = 448$
$35x = 385$
$x = 11$
It took 11 hours.

56. Let x = number of hours
$63x$ = labor cost
$63x + 532 = 1603$
$63x = 1071$
$x = 17$
17 hours were required to repair the yacht.

57. Let x = inches over 5 feet
$100 + 5x = 135$
$5x = 35$
$x = 7$
A height of 5 feet 7 inches corresponds to 135 pounds.

58. Let g = the gross amount of the paycheck
$\text{Yearly Salary} = 2(12)g + 750$
$33150 = 24g + 750$
$32400 = 24g$
$1350 = g$
The gross amount of each paycheck is \$1350.

59. Let x = the weight of unpeeled bananas.

$\frac{7}{8}x =$ weight of peeled bananas

$$x = \frac{7}{8}x + \frac{7}{8}$$
$$\frac{1}{8}x = \frac{7}{8}$$
$$x = 7$$

The banana with peel weighs 7 ounces.

60. Let x = the length of the call.

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

The person talked for 11 minutes.

61. $A = lw$

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

area of rectangle

62. $D = RT$

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

distance, rate, time equation

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

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

area of triangle

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

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

volume of a cone

65. $I = Prt$

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

interest

66. $C = 2\pi r$

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

circumference of a circle

67. $E = mc^2$

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

Einstein's equation

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

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

volume of a cylinder

69. $T = D + pm$

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

total of payment

70. $P = C + MC$

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

markup based on cost

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

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

area of trapezoid

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

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

area of trapezoid

73. $S = P + Prt$

$S - P = Prt$

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

interest

74. $S = P + Prt$

$S - P = Prt$

$\frac{S-P}{Pr} = t;$

interest

75. $B = \frac{F}{S-V}$

$B(S-V) = F$

$S - V = \frac{F}{B}$

$S = \frac{F}{B} + V$

76. $S = \frac{C}{1-r}$

$S(1-r) = C$

$1 - r = \frac{C}{S}$

$-r = \frac{C}{S} - 1$

$r = -\frac{C}{S} + 1$

markup based on selling price

77. $IR + Ir = E$

$I(R+r) = E$

$I = \frac{E}{R+r}$

electric current

78. $A = 2lw + 2lh + 2wh$

$A - 2lw = h(2l + 2w)$

$\frac{A-2lw}{2l+2w} = h$

surface area

79. $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$

$qf + pf = pq$

$f(q+p) = pq$

$f = \frac{pq}{p+q}$

thin lens equation

80. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$R_1R_2 = RR_2 + RR_1$

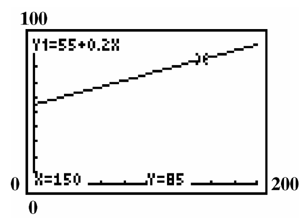
$R_1R_2 - RR_1 = RR_2$

$R_1(R_2 - R) = RR_2$

$R_1 = \frac{RR_2}{R_2 - R}$

resistance

88. Consider Exercise 25.

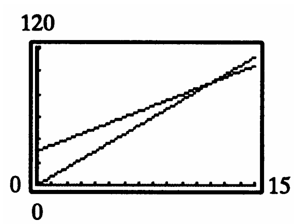


The life expectancy will be 85 years in the year 1900 + 150 = 2050.

89. **a.** $F = 30 + 5x$

$F = 7.5x$

b.



c. Calculator shows the graphs to intersect at (12, 90); the two options both cost $90 when 12 hours court time is used per month.

d. $30 + 5x = 7.5x$

$30 = 2.5x$

$x = 12$

Rent the court 12 hours per month.

90. $.1x + .9(1000 - x) = 420$

$.1 + 900 - .9x = 420$

$-.8x = -480$

$x = 600$

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

91. 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.

92. Let x = woman's age

$3x$ = Coburn's age

$3x + 20 = 2(x + 20)$

$3x + 20 = 2x + 40$

$x + 20 = 40$

$x = 20$

Coburn is 60 years old the woman is 20 years old.

93. 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.

94. 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.

95. 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.

96. $V = C - \frac{C - S}{L}N$

$VL = CL - CN + SN$

$VL - SN = CL - CN$

$VL - SN = C(L - N)$

$\frac{VL - SN}{L - N} = C$

Section 1.4

Check Point Exercises

1. **a.** $(5-2i)+(3+3i)$
$=5-2i+3+3i$
$=(5+3)+(-2+3)i$
$=8+i$

b. $(2+6i)-(12-i)$
$=2+6i-12+i$
$=(2-12)+(6+1)i$
$=-10+7i$

2. **a.** $7i(2-9i)=7i(2)-7i(9i$
$=14i-63i^2$
$=14i-63(-1)$
$=63+14i$

b. $(5+4i)(6-7i)=30-35i+24i-28i^2$
$=30-35i+24i-28(-1)$
$=30+28-35i+24i$
$=58-11i$

3. $\dfrac{5+4i}{4-i}=\dfrac{5+4i}{4-i}\cdot\dfrac{4+i}{4+i}$
$=\dfrac{20+5i+16i+4i^2}{16+4i-4i-i^2}$
$=\dfrac{20+21i-4}{16+1}$
$=\dfrac{16+21i}{17}$
$=\dfrac{16}{17}+\dfrac{21}{17}i$

4. **a.** $\sqrt{-27}+\sqrt{-48}=i\sqrt{27}+i\sqrt{48}$
$=i\sqrt{9\cdot 3}+i\sqrt{16\cdot 3}$
$=3i\sqrt{3}+4i\sqrt{3}$
$=7i\sqrt{3}$

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

c. $\dfrac{-14+\sqrt{-12}}{2}=\dfrac{-14+i\sqrt{12}}{2}$
$=\dfrac{-14+2i\sqrt{3}}{2}$
$=\dfrac{-14}{2}+\dfrac{2i\sqrt{3}}{2}$
$=-7+i\sqrt{3}$

Exercise Set 1.4

1. $(7+2i)+(1-4i)=7+2i+1-4i$
$=7+1+2i-4i$
$=8-2i$

2. $(-2+6i)+(4-i)$
$=-2+6i+4-i$
$=-2+4+6i-i$
$=2+5i$

3. $(3+2i)-(5-7i)=3-5+2i+7i$
$=3+2i-5+7i$
$=-2+9i$

4. $(-7+5i)-(-9-11i)=-7+5i+9+11i$
$=-7+9+5i+11i$
$=2+16i$

5. $6-(-5+4i)-(-13-i)=6+5-4i+13+i$
$=24-3i$

6. $7-(-9+2i)-(-17-i)=7+9-2i+17+i$
$=33-i$

7. $8i-(14-9i)=8i-14+9i$
$=-14+8i+9i$
$=-14+17i$

8. $15i-(12-11i)=15i-12+11i$
$=-12+15i+11i$
$=-12+26i$

9. $-3i(7i-5)=-21i^2+15i$
$=-21(-1)+15i$
$=21+15i$

10. $-8i\,(2i-7)=-16i^2+56i=-16(-1)+56i$
$=9-25i^2=9+25=34=16+56i$

11. $(-5+4i)(3+i) = -15-5i+12i+4i^2$
$= -15+7i-4$
$= -19+7i$

12. $(-4-8i)(3+i) = -12-4i-24i-8i^2$
$= -12-28i+8$
$= -4-28i$

13. $(7-5i)(-2-3i) = -14-21i+10i+15i^2$
$= -14-15-11i$
$= -29-11i$

14. $(8-4i)(-3+9i) = -24+72i+12i-36i^2$
$= -24+36+84i$
$= 12+84i$

15. $(3+5i)(3-5i)$

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

17. $(-5+i)(-5-i) = 25+5i-5i-i^2$
$= 25+1$
$= 26$

18. $(-7+i)(-7-i) = 49+7i-7i-i^2$
$= 49+1$
$= 50$

19. $(2+3i)^2 = 4+12i+9i^2$
$= 4+12i-9$
$= -5+12i$

20. $(5-2i)^2 = 25-20i+4i^2$
$= 25-20i-4$
$= 21-20i$

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

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

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

31. $5\sqrt{-16}+3\sqrt{-81}=5(4i)+3(9i)$
$=20i+27i=47i$

32. $5\sqrt{-8}+3\sqrt{-18}$
$=5i\sqrt{8}+3i\sqrt{18}=5i\sqrt{4\cdot 2}+3i\sqrt{9\cdot 2}$
$=10i\sqrt{2}+9i\sqrt{2}$
$=19i\sqrt{2}$

33. $\left(-2+\sqrt{-4}\right)^2=\left(-2+2i\right)^2$
$=4-8i+4i^2$
$=4-8i-4$
$=-8i$

34. $\left(-5-\sqrt{-9}\right)^2=(-5-i\sqrt{9})^2=\left(-5-3i\right)^2$
$=25+30i+9i^2$
$=25+30i-9$
$=16+30i$

35. $\left(-3-\sqrt{-7}\right)^2=\left(-3-i\sqrt{7}\right)^2$
$=9+6i\sqrt{7}+i^2\left(7\right)$
$=9-7+6i\sqrt{7}$
$=2+6i\sqrt{7}$

36. $\left(-2+\sqrt{-11}\right)^2=\left(-2+i\sqrt{11}\right)^2$
$=4-4i\sqrt{11}+i^2\left(11\right)$
$=4-11-4i\sqrt{11}$
$=-7-4i\sqrt{11}$

37. $\dfrac{-8+\sqrt{-32}}{24}=\dfrac{-8+i\sqrt{32}}{24}$
$=\dfrac{-8+i\sqrt{16\cdot 2}}{24}$
$=\dfrac{-8+4i\sqrt{2}}{24}$
$=-\dfrac{1}{3}+\dfrac{\sqrt{2}}{6}i$

38. $\dfrac{-12+\sqrt{-28}}{32}=\dfrac{-12+i\sqrt{28}}{32}=\dfrac{-12+i\sqrt{4\cdot 7}}{32}$
$=\dfrac{-12+2i\sqrt{7}}{32}=-\dfrac{3}{8}+\dfrac{\sqrt{7}}{16}i$

39. $\dfrac{-6-\sqrt{-12}}{48}=\dfrac{-6-i\sqrt{12}}{48}$
$=\dfrac{-6-i\sqrt{4\cdot 3}}{48}$
$=\dfrac{-6-2i\sqrt{3}}{48}$
$=-\dfrac{1}{8}-\dfrac{\sqrt{3}}{24}i$

40. $\dfrac{-15-\sqrt{-18}}{33}=\dfrac{-15-i\sqrt{18}}{33}=\dfrac{-15-i\sqrt{9\cdot 2}}{33}$
$=\dfrac{-15-3i\sqrt{2}}{33}=-\dfrac{5}{11}-\dfrac{\sqrt{2}}{11}i$

41. $\sqrt{-8}\left(\sqrt{-3}-\sqrt{5}\right)=i\sqrt{8}(i\sqrt{3}-\sqrt{5})$
$=2i\sqrt{2}\left(i\sqrt{3}-\sqrt{5}\right)$
$=-2\sqrt{6}-2i\sqrt{10}$

42. $\sqrt{-12}\left(\sqrt{-4}-\sqrt{2}\right)=i\sqrt{12}(i\sqrt{4}-\sqrt{2})$
$=2i\sqrt{3}\left(2i-\sqrt{2}\right)$
$=4i^2\sqrt{3}-2i\sqrt{6}$
$=-4\sqrt{3}-2i\sqrt{6}$

43. $\left(3\sqrt{-5}\right)\left(-4\sqrt{-12}\right)=\left(3i\sqrt{5}\right)\left(-8i\sqrt{3}\right)$
$=-24i^2\sqrt{15}$
$=24\sqrt{15}$

44. $\left(3\sqrt{-7}\right)\left(2\sqrt{-8}\right)$
$= (3i\sqrt{7})(2i\sqrt{8}) = (3i\sqrt{7})(2i\sqrt{4\cdot 2})$
$= \left(3i\sqrt{7}\right)\left(4i\sqrt{2}\right) = 12i^2\sqrt{14} = -12\sqrt{14}$

45. $(2-3i)(1-i)-(3-i)(3+i)$
$= \left(2-2i-3i+3i^2\right)-\left(3^2-i^2\right)$
$= 2-5i+3i^2-9+i^2$
$= -7-5i+4i^2$
$= -7-5i+4(-1)$
$= -11-5i$

46. $(8+9i)(2-i)-(1-i)(1+i)$
$= \left(16-8i+18i-9i^2\right)-\left(1^2-i^2\right)$
$= 16+10i-9i^2-1+i^2$
$= 15+10i-8i^2$
$= 15+10i-8(-1)$
$= 23+10i$

47. $(2+i)^2-(3-i)^2$
$= \left(4+4i+i^2\right)-\left(9-6i+i^2\right)$
$= 4+4i+i^2-9+6i-i^2$
$= -5+10i$

48. $(4-i)^2-(1+2i)^2$
$= \left(16-8i+i^2\right)-\left(1+4i+4i^2\right)$
$= 16-8i+i^2-1-4i-4i^2$
$= 15-12i-3i^2$
$= 15-12i-3(-1)$
$= 18-12i$

49. $5\sqrt{-16}+3\sqrt{-81}$
$= 5\sqrt{16}\sqrt{-1}+3\sqrt{81}\sqrt{-1}$
$= 5\cdot 4i+3\cdot 9i$
$= 20i+27i$
$= 47i$ or $0+47i$

50. $5\sqrt{-8}+3\sqrt{-18}$
$= 5\sqrt{4}\sqrt{2}\sqrt{-1}+3\sqrt{9}\sqrt{2}\sqrt{-1}$
$= 5\cdot 2\sqrt{2}\,i+3\cdot 3\sqrt{2}\,i$
$= 10i\sqrt{2}+9i\sqrt{2}$
$= (10+9)i\sqrt{2}$
$= 19i\sqrt{2}$ or $0+19i\sqrt{2}$

51. $f(x) = x^2-2x+2$
$f(1+i) = (1+i)^2-2(1+i)+2$
$= 1+2i+i^2-2-2i+2$
$= 1+i^2$
$= 1-1$
$= 0$

52. $f(x) = x^2-2x+5$
$f(1-2i) = (1-2i)^2-2(1-2i)+5$
$= 1-4i+4i^2-2+4i+5$
$= 4+4i^2$
$= 4-4$
$= 0$

53. $f(x) = \dfrac{x^2+19}{2-x}$
$f(3i) = \dfrac{(3i)^2+19}{2-3i}$
$= \dfrac{9i^2+19}{2-3i}$
$= \dfrac{-9+19}{2-3i}$
$= \dfrac{10}{2-3i}$
$= \dfrac{10}{2-3i}\cdot\dfrac{2+3i}{2+3i}$
$= \dfrac{20+30i}{4-9i^2}$
$= \dfrac{20+30i}{4+9}$
$= \dfrac{20+30i}{13}$
$= \dfrac{20}{13}+\dfrac{30}{13}i$

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

$$f(4i)=\frac{(4i)^2+11}{3-4i}=\frac{16i^2+11}{3-4i}$$
$$=\frac{-16+11}{3-4i}$$
$$=\frac{-5}{3-4i}$$
$$=\frac{-5}{3-4i}\cdot\frac{3+4i}{3+4i}$$
$$=\frac{-15-20i}{9-16i^2}$$
$$=\frac{-15-20i}{9+16}$$
$$=\frac{-15-20i}{25}$$
$$=\frac{-15}{25}-\frac{20}{25}i$$
$$=-\frac{3}{5}-\frac{4}{5}i$$

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

$$=12+28i-15i-35i^2$$
$$=12+13i-35(-1)$$
$$=12+35+13i=47+13i$$

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

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

$$=6+10i-9i-15i^2=6+i-15(-1)$$
$$=6+i+15=21+i$$

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

57. Sum:

$$\left(5+i\sqrt{15}\right)+\left(5-i\sqrt{15}\right)$$
$$=5+i\sqrt{15}+5-i\sqrt{15}$$
$$=5+5$$
$$=10$$

Product:

$$\left(5+i\sqrt{15}\right)\left(5-i\sqrt{15}\right)$$
$$=25-5i\sqrt{15}+5i\sqrt{15}-15i^2$$
$$=25+15$$
$$=40$$

67. **a.** False; all irrational numbers are complex numbers.

b. False; (3 + 7*i*)(3 – 7*i*) = 9 + 49 = 58 is a real number.

c. False; $\dfrac{7+3i}{5+3i}=\dfrac{7+3i}{5+3i}\cdot\dfrac{5-3i}{5-3i}$

$$=\frac{44-6i}{34}=\frac{22}{17}-\frac{3}{17}i$$

d. True;

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

(d) is true.

68. $\dfrac{4}{(2+i)(3-i)}=\dfrac{4}{6-2i+3i-i^2}$

$$=\frac{4}{6+i+1}$$
$$=\frac{4}{7+i}$$
$$=\frac{4}{7+i}\cdot\frac{7-i}{7-i}$$
$$=\frac{28-4i}{49-i^2}$$
$$=\frac{28-4i}{49+1}$$
$$=\frac{28-4i}{50}$$
$$=\frac{28}{50}-\frac{4}{50}i$$
$$=\frac{14}{25}-\frac{2}{25}i$$

69. $\dfrac{1+i}{1+2i}+\dfrac{1-i}{1-2i}$

$$=\frac{(1+i)(1-2i)}{(1+2i)(1-2i)}+\frac{(1-i)(1+2i)}{(1+2i)(1-2i)}$$
$$=\frac{(1+i)(1-2i)+(1-i)(1+2i)}{(1+2i)(1-2i)}$$
$$=\frac{1-2i+i-2i^2+1+2i-i-2i^2}{1-4i^2}$$
$$=\frac{1-2i+i+2+1+2i-i+2}{1+4}$$
$$=\frac{6}{5}$$
$$=\frac{6}{5}+0i$$

70. $\dfrac{8}{1+\frac{2}{i}} = \dfrac{8}{\frac{i}{i}+\frac{2}{i}}$

$= \dfrac{8}{\frac{2+i}{i}}$

$= \dfrac{8i}{2+i}$

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

$= \dfrac{16i-8i^2}{4-i^2}$

$= \dfrac{16i+8}{4+1}$

$= \dfrac{8+16i}{5}$

$= \dfrac{8}{5}+\dfrac{16}{5}i$

Section 1.5

Check Point Exercises

1. **a.** $3x^2-9x=0$

$3x(x-3)=0$

$3x=0$ or $x-3=0$

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

The solution set is {0, 3}.

b. $2x^2+x=1$

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

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

$2x-1=0$ or $x+1=0$

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

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

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

2. **a.** $3x^2=21$

$\dfrac{3x^2}{3}=\dfrac{21}{3}$

$x^2=7$

$x=\pm\sqrt{7}$

The solution set is $\left\{-\sqrt{7},\sqrt{7}\right\}$.

b. $5x^2+45=0$

$5x^2=-45$

$x^2=-9$

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

$x=\pm 3i$

c. $(x+5)^2=11$

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

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

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 $-\dfrac{5}{2}$, and $\left(-\dfrac{5}{2}\right)^2$ is $\dfrac{25}{4}$.

$\dfrac{25}{4}$ should be added to the binomial.

$x^2-5x+\dfrac{25}{4}=\left(x-\dfrac{5}{2}\right)^2$

c. The coefficient of the *x*-term is $\dfrac{2}{3}$. Half of $\dfrac{2}{3}$ is $\dfrac{1}{3}$, and $\left(\dfrac{1}{3}\right)^2$ is $\dfrac{1}{9}$.

$\dfrac{1}{9}$ should be added to the binomial.

$x^2+\dfrac{2}{3}x+\dfrac{1}{9}=\left(x+\dfrac{1}{3}\right)^2$

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

$x^2+4x \quad =1$

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

$(x+2)^2=5$

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

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

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

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

$x^2+\frac{3}{2}x \quad =2$

$x^2+\frac{3}{2}x+\frac{9}{16}=2+\frac{9}{16}$

$\left(x+\frac{3}{4}\right)^2=\frac{41}{16}$

$x+\frac{3}{4}=\pm\sqrt{\frac{41}{16}}$

$x+\frac{3}{4}=\pm\frac{\sqrt{41}}{4}$

$x=-\frac{3}{4}\pm\frac{\sqrt{41}}{4}$

$x=\frac{-3\pm\sqrt{41}}{4}$

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

$a=2, b=2, c=-1$

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

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

$=\frac{-2\pm\sqrt{4+8}}{4}$

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

$=\frac{-2\pm2\sqrt{3}}{4}$

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

$=\frac{-1\pm\sqrt{3}}{2}$

The solution set is $\left\{\frac{-1+\sqrt{3}}{2}, \frac{-1-\sqrt{3}}{2}\right\}$.

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

$a=1, b=-2, c=2$

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

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

$x=\frac{2\pm\sqrt{4-8}}{2}$

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

$x=\frac{2\pm2i}{2}$

$x=1\pm i$

The solution set is $\{1+i, 1-i\}$.

8. **a.** $a=1, \quad b=6, \quad c=9$

$b^2-4ac=(6)^2-4(1)(9)$

$=36-36$

$=0$

Since $b^2-4ac=0$, the equation has one real solution.

b. $a=2, \quad b=-7, \quad c=-4$

$b^2-4ac=(-7)^2-4(2)(-4)$

$=49+32$

$=81$

Since $b^2-4ac>0$, the equation has two real solutions. Since 81 is a perfect square, the two solutions are rational.

c. $a=3, \quad b=-2, \quad c=4$

$b^2-4ac=(-2)^2-4(3)(4)$

$=4-48$

$=-44$

Since $b^2-4ac<0$, the equation has two imaginary solutions that are complex conjugates.

9. $P = 0.01A^2 + 0.05A + 107$

$115 = 0.01A^2 + 0.05A + 107$

$0 = 0.01A^2 + 0.05A - 8$

$a = 0.01, \quad b = 0.05, \quad c = -8$

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

$$A = \frac{-(0.05) \pm \sqrt{(0.05)^2 - 4(0.01)(-8)}}{2(0.01)}$$

$$A = \frac{-0.05 \pm \sqrt{0.3225}}{0.02}$$

$$A \approx \frac{-0.05 + \sqrt{0.3225}}{0.02} \qquad A \approx \frac{-0.05 - \sqrt{0.3225}}{0.02}$$

$A \approx 26 \qquad A \approx -31$

Age cannot be negative, reject the negative answer.

Thus, a woman whose normal systolic blood pressure is 115 mm Hg is 26 years old.

10. $w^2 + 9^2 = 15^2$

$w^2 + 81 = 225$

$w^2 = 144$

$w = \pm\sqrt{144}$

$w = \pm 12$

The width of the television is 12 inches.

Exercise Set 1.5

1. $x^2 - 3x - 10 = 0$

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

$x + 2 = 0 \quad \text{or} \quad x - 5 = 0$

$x = -2 \quad \text{or} \quad x = 5$

The solution set is {–2, 5}.

2. $x^2 - 13x + 36 = 0$

$(x - 4)(x - 9) = 0$

$x - 4 = 0 \quad \text{or} \quad x - 9 = 0$

$x = 4 \quad \text{or} \quad x = 9$

The solution set is {4, 9}.

3. $x^2 = 8x - 15$

$x^2 - 8x + 15 = 0$

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

$x - 3 = 0 \quad \text{or} \quad x - 5 = 0$

$x = 3 \quad \text{or} \quad x = 5$

The solution set is {3, 5}.

4. $x^2 = -11x - 10$

$x^2 + 11x + 10 = 0$

$(x + 10)(x + 1) = 0$

$x + 10 = 0 \quad \text{or} \quad x + 1 = 0$

$x = -10 \quad \text{or} \quad x = -1$

The solution set is {–10, –1}.

5. $6x^2 + 11x - 10 = 0$

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

$2x + 5 = 0 \quad \text{or} \quad 3x - 2 = 0$

$2x = -5 \qquad 3x = 2$

$x = -\frac{5}{2} \quad \text{or} \quad x = \frac{2}{3}$

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 $3x + 1 = 0$

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

The solution set is $\left\{-\frac{2}{3}, -\frac{1}{3}\right\}$.

7. $3x^2 - 2x = 8$

$3x^2 - 2x - 8 = 0$

$(3x + 4)(x - 2) = 0$

$3x + 4 = 0 \quad \text{or} \quad x - 2 = 0$

$3x = -4$

$x = -\frac{4}{3} \quad \text{or} \quad x = 2$

The solution set is $\left\{-\frac{4}{3}, 2\right\}$.

8. $4x^2 - 13x = -3$

$4x^2 - 13x + 3 = 0$

$(4x - 1)(x - 3) = 0$

$4x - 1 = 0 \quad \text{or} \quad x - 3 = 0$

$4x = 1$

$x = \frac{1}{4} \quad \text{or} \quad x = 3$

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. $2x(x-3)=5x^2-7x$

$2x^2-6x-5x^2+7x=0$

$-3x^2+x=0$

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

$x=0$ or $-3x+1=0$

$-3x=-1$

$x=\frac{1}{3}$

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. $7-7x=(3x+2)(x-1)$

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

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

$-3x^2-6x+9=0$

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

$x+3=0$ or $x-1=0$

$x=-3$ or $x=1$

The solution set is $\{-3, 1\}$.

14. $10x-1=(2x+1)^2$

$10x-1=4x^2+4x+1$

$10x-1-4x^2-4x-1=0$

$-4x^2+6x-2=0$

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

$2x-1=0$ or $x-1=0$

$2x=1$

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

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. $(x+2)^2 = 25$

$x+2 = \pm\sqrt{25}$

$x+2 = \pm 5$

$x = -2 \pm 5$

$x = -2+5$ or $x = -2-5$

$x = 3$ $x = -7$

The solution set is $\{-7, 3\}$.

22. $(x-3)^2 = 36$

$x-3 = \pm\sqrt{36}$

$x-3 = \pm 6$

$x = 3 \pm 6$

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

$x = 9$ $x = -3$

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 $3x+2 = 3$

$3x = -5$ $3x = 1$

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

$4x = -3$ $4x = 5$

$x = \frac{-3}{4}$ 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. $(8x-3)^2 = 5$

$8x-3 = \pm\sqrt{5}$

$8x = 3 \pm \sqrt{5}$

$x = \dfrac{3 \pm \sqrt{5}}{8}$

The solution set is $\left\{\dfrac{3-\sqrt{5}}{8}, \dfrac{3+\sqrt{5}}{8}\right\}$.

33. $(3x-4)^2 = 8$

$3x-4 = \pm\sqrt{8} = \pm 2\sqrt{2}$

$3x = 4 \pm 2\sqrt{2}$

$x = \dfrac{4 \pm 2\sqrt{2}}{3}$

The solution set is $\left\{\dfrac{4-2\sqrt{2}}{3}, \dfrac{4+2\sqrt{2}}{3}\right\}$.

34. $(2x+8)^2 = 27$

$2x+8 = \pm\sqrt{27} = \pm 3\sqrt{3}$

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

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

The solution set is $\left\{\dfrac{-8-3\sqrt{3}}{2}, \dfrac{-8+3\sqrt{3}}{2}\right\}$.

35. $x^2 + 12x$

$\left(\dfrac{12}{2}\right)^2 = 6^2 = 36$

$x^2 + 12x + 36 = (x+6)^2$

36. $x^2 + 16x$

$\left(\dfrac{16}{2}\right)^2 = 8^2 = 64;$

$x^2 + 16x + 64 = (x+8)^2$

37. $x^2 - 10x$

$\left(\dfrac{10}{2}\right)^2 = 5^2 = 25$

$x^2 - 10x + 25 = (x-5)^2$

38. $x^2 - 14x$

$\left(\dfrac{-14}{2}\right)^2 = (-7)^2 = 49;$

$x^2 - 14x + 49 = (x-7)^2$

39. $x^2 + 3x$

$\left(\dfrac{3}{2}\right)^2 = \dfrac{9}{4}$

$x^2 + 3x + \dfrac{9}{4} = \left(x + \dfrac{3}{2}\right)^2$

40. $x^2 + 5x$

$\left(\dfrac{5}{2}\right)^2 = \dfrac{25}{4};$

$x^2 + 5x + \dfrac{25}{4} = \left(x + \dfrac{5}{2}\right)^2$

41. $x^2 - 7x$

$\left(\dfrac{7}{2}\right)^2 = \dfrac{49}{4}$

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

42. $x^2 - 9x$

$\left(\dfrac{-9}{2}\right)^2 = \dfrac{81}{4};$

$x^2 - 9x + \dfrac{81}{4} = \left(x - \dfrac{9}{2}\right)^2$

43. $x^2 - \dfrac{2}{3}x$

$\left(\dfrac{\frac{2}{3}}{2}\right)^2 = \left(\dfrac{1}{3}\right)^2 = \dfrac{1}{9}$

$x^2 - \dfrac{2}{3}x + \dfrac{1}{9} = \left(x - \dfrac{1}{3}\right)^2$

44. $x^2 + \dfrac{4}{5}x$

$\left(\dfrac{\frac{4}{5}}{2}\right)^2 = \left(\dfrac{2}{5}\right)^2 = \dfrac{4}{25};$

$x^2 + \dfrac{4}{5}x + \dfrac{4}{25} = \left(x + \dfrac{2}{5}\right)^2$

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.
$$x^2 - \frac{1}{4}x$$
$$\left(\frac{\frac{-1}{4}}{2}\right)^2 = \left(\frac{-1}{8}\right)^2 = \frac{1}{64};$$
$$x^2 - \frac{1}{4}x + \frac{1}{64} = \left(x - \frac{1}{8}\right)^2$$

47.
$$x^2 + 6x = 7$$
$$x^2 + 6x + 9 = 7 + 9$$
$$(x+3)^2 = 16$$
$$x + 3 = \pm 4$$
$$x = -3 \pm 4$$
The solution set is {–7, 1}.

48.
$$x^2 + 6x = -8$$
$$x^2 + 6x + 9 = -8 + 9$$
$$(x+3)^2 = 1$$
$$x + 3 = \pm 1$$
$$x = -3 \pm 1$$
The solution set is {–4, –2}.

49.
$$x^2 - 2x = 2$$
$$x^2 - 2x + 1 = 2 + 1$$
$$(x-1)^2 = 3$$
$$x - 1 = \pm\sqrt{3}$$
$$x = 1 \pm \sqrt{3}$$
The solution set is $\left\{1+\sqrt{3}, 1-\sqrt{3}\right\}$.

50.
$$x^2 + 4x = 12$$
$$x^2 + 4x + 4 = 12 + 4$$
$$(x+2)^2 = 16$$
$$x + 2 = \pm 4$$
$$x = -2 \pm 4$$
The solution set is {–6, 2}.

51.
$$x^2 - 6x - 11 = 0$$
$$x^2 - 6x = 11$$
$$x^2 - 6x + 9 = 11 + 9$$
$$(x-3)^2 = 20$$
$$x - 3 = \pm\sqrt{20}$$
$$x = 3 \pm 2\sqrt{5}$$
The solution set is $\left\{3+2\sqrt{5}, 3-2\sqrt{5}\right\}$.

52.
$$x^2 - 2x - 5 = 0$$
$$x^2 - 2x = 5$$
$$x^2 - 2x + 1 = 5 + 1$$
$$(x-1)^2 = 6$$
$$x - 1 = \pm\sqrt{6}$$
$$x = 1 \pm \sqrt{6}$$
The solution set is $\left\{1+\sqrt{6}, 1-\sqrt{6}\right\}$.

53.
$$x^2 + 4x + 1 = 0$$
$$x^2 + 4x = -1$$
$$x^2 + 4x + 4 = -1 + 4$$
$$(x+2)^2 = 3$$
$$x + 2 = \pm\sqrt{3}$$
$$x = -2 \pm \sqrt{3}$$
The solution set is $\left\{-2+\sqrt{3}, -2-\sqrt{3}\right\}$.

54.
$$x^2 + 6x - 5 = 0$$
$$x^2 + 6x = 5$$
$$x^2 + 6x + 9 = 5 + 9$$
$$(x+3)^2 = 14$$
$$x + 3 = \pm\sqrt{14}$$
$$x = -3 \pm \sqrt{14}$$
The solution set is $\left\{-3+\sqrt{14}, -3-\sqrt{14}\right\}$.

55.
$$x^2-5x+6=0$$
$$x^2-5x=-6$$
$$x^2-5x+\frac{25}{4}=-6+\frac{25}{4}$$
$$\left(x-\frac{5}{2}\right)^2=\frac{1}{4}$$
$$x-\frac{5}{2}=\pm\sqrt{\frac{1}{4}}$$
$$x-\frac{5}{2}=\pm\frac{1}{2}$$
$$x=\frac{5}{2}\pm\frac{1}{2}$$
$$x=\frac{5}{2}+\frac{1}{2} \quad \text{or} \quad x=\frac{5}{2}-\frac{1}{2}$$
$$x=3 \qquad\qquad x=2$$
The solution set is {2, 3}.

56.
$$x^2+7x-8=0$$
$$x^2+7x=8$$
$$x^2+7x+\frac{49}{4}=8+\frac{49}{4}$$
$$\left(x+\frac{7}{2}\right)^2=\frac{81}{4}$$
$$x+\frac{7}{2}=\pm\sqrt{\frac{81}{4}}$$
$$x+\frac{7}{2}=\pm\frac{9}{2}$$
$$x=-\frac{7}{2}\pm\frac{9}{2}$$
$$x=-\frac{7}{2}+\frac{9}{2} \quad \text{or} \quad x=-\frac{7}{2}-\frac{9}{2}$$
$$x=1 \qquad\qquad x=-8$$
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 $\left\{-3,\frac{1}{2}\right\}$.

61. $$4x^2-4x-1=0$$
$$4x^2-4x-1=0$$
$$x^2-x-\frac{1}{4}=0$$
$$x^2-x=\frac{1}{4}$$
$$x^2-x+\frac{1}{4}=\frac{1}{4}+\frac{1}{4}$$
$$\left(x-\frac{1}{2}\right)^2=\frac{2}{4}$$
$$x-\frac{1}{2}=\frac{\pm\sqrt{2}}{2}$$
$$x=\frac{1\pm\sqrt{2}}{2}$$
The solution set is $\left\{\frac{1+\sqrt{2}}{2},\frac{1-\sqrt{2}}{2}\right\}$.

62. $$2x^2-4x-1=0$$
$$x^2-2x-\frac{1}{2}=0$$
$$x^2-2x+1=\frac{1}{2}+1$$
$$x^2-2x=\frac{1}{2}$$
$$(x-1)^2=\frac{3}{2}$$
$$x-1=\pm\sqrt{\frac{3}{2}}$$
$$x=1\pm\frac{\sqrt{6}}{2}$$
$$x=\frac{2\pm\sqrt{6}}{2}$$
The solution set is $\left\{\frac{2+\sqrt{6}}{2},\frac{2-\sqrt{6}}{2}\right\}$.

63. $$3x^2-2x-2=0$$
$$x^2-\frac{2}{3}x-\frac{2}{3}=0$$
$$x^2-\frac{2}{3}x=\frac{2}{3}$$
$$x^2-\frac{2}{3}x+\frac{1}{9}=\frac{2}{3}+\frac{1}{9}$$
$$\left(x-\frac{1}{3}\right)^2=\frac{7}{9}$$
$$x-\frac{1}{3}=\frac{\pm\sqrt{7}}{3}$$
$$x=\frac{1\pm\sqrt{7}}{3}$$
The solution set is $\left\{\frac{1+\sqrt{7}}{3},\frac{1-\sqrt{7}}{3}\right\}$.

64. $3x^2 - 5x - 10 = 0$

$$x^2 - \frac{5}{3}x - \frac{10}{3} = 0$$
$$x^2 - \frac{5}{3}x = \frac{10}{3}$$
$$x^2 - \frac{5}{3}x + \frac{25}{36} = \frac{10}{3} + \frac{25}{36}$$
$$\left(x - \frac{5}{6}\right)^2 = \frac{145}{36}$$
$$x - \frac{5}{6} = \frac{\pm\sqrt{145}}{6}$$
$$x = \frac{5 \pm \sqrt{145}}{6}$$

The solution set is $\left\{\frac{5 \pm \sqrt{145}}{6}, \frac{5 - \sqrt{145}}{6}\right\}$.

65. $x^2 + 8x + 15 = 0$

$$x = \frac{-8 \pm \sqrt{8^2 - 4(1)(15)}}{2(1)}$$
$$x = \frac{-8 \pm \sqrt{64 - 60}}{2}$$
$$x = \frac{-8 \pm \sqrt{4}}{2}$$
$$x = \frac{-8 \pm 2}{2}$$

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 $\left\{\frac{3+\sqrt{6}}{3}, \frac{3-\sqrt{6}}{3}\right\}$.

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.

$2x^2 - x = 1$

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

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

$2x+1 = 0$ or $x-1 = 0$

$2x = -1$

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

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

84. $3x^2 - 4x = 4$

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

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

$3x+2$ or $x-2=0$

$3x = -2$

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

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. $3x^2 = 60$

$x^2 = 20$

$x = \pm\sqrt{20}$

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

The solution set is $\left\{-2\sqrt{5}, 2\sqrt{5}\right\}$.

88. $2x^2 = 250$

$x^2 = 125$

$x = \pm\sqrt{125}$

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

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 $\left\{\frac{3+\sqrt{65}}{4},\frac{3-\sqrt{65}}{4}\right\}$.

93.
$$(3x-4)^2=16$$
$$3x-4=\pm\sqrt{16}$$
$$3x-4=\pm4$$
$$3x=4\pm4$$
$$3x=8 \text{ or } 3x=0$$
$$x=\frac{8}{3} \text{ or } x=0$$
The solution set is $\left\{0,\frac{8}{3}\right\}$.

94.
$$(2x+7)^2=25$$
$$2x+7=\pm5$$
$$2x=-7\pm5$$
$$2x=-12 \quad\text{or}\quad 2x=-2$$
$$x=6 \quad\text{or}\quad x=-1$$
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.
$$4x^2-16=0$$
$$4x^2=16$$
$$x^2=4$$
$$x=\pm2$$
The solution set is $\{-2, 2\}$.

98.
$$3x^2-27=0$$
$$3x^2=27$$
$$x^2=9$$
$$x=\pm3$$
The solution set is $\{-3, 3\}$.

99.
$$x^2-6x+13=0$$
$$x^2-6x=-13$$
$$x^2-6x+9=-13+9$$
$$(x-3)^2=-4$$
$$x-3=\pm2i$$
$$x=3\pm2i$$
The solution set is $\{3+2i, 3-2i\}$.

100.
$$x^2-4x+29=0$$
$$x^2-4x=-29$$
$$x^2-4x+4=-29+4$$
$$(x-2)^2=-25$$
$$x-2=\pm5i$$
$$x=2\pm5i$$
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.
$$2x^2 - 7x = 0$$
$$x(2x - 7) = 0$$
$$x = 0 \text{ or } 2x - 7 = 0$$
$$2x = 7$$
$$x = 0 \text{ or } x = \frac{7}{2}$$
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.

$$y_1 y_2 = 14$$
$$(x-1)(x+4) = 14$$
$$x^2 + 3x - 4 = 14$$
$$x^2 + 3x - 18 = 0$$
$$(x+6)(x-3) = 0$$
$$x = -6, \quad x = 3$$

118.

$$y_1 y_2 = -30$$
$$(x-3)(x+8) = -30$$
$$x^2 + 5x - 24 = -30$$
$$x^2 + 5x + 6 = 0$$
$$(x+3)(x+2) = 0$$
$$x = -3, \quad x = -2$$

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.
$$y_1 - y_2 = 0$$
$$\left(2x^2+5x-4\right)-\left(-x^2+15x-10\right)=0$$
$$2x^2+5x-4+x^2-15x+10=0$$
$$3x^2-10x+6=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-10)\pm\sqrt{(-10)^2-4(3)(6)}}{2(3)}$$
$$x=\frac{10\pm\sqrt{28}}{6}$$
$$x=\frac{10\pm2\sqrt{7}}{6}$$
$$x=\frac{5\pm\sqrt{7}}{3}$$
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**.**
$$2x^2+4x-9=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(4)\pm\sqrt{(4)^2-4(2)(-9)}}{2(2)}$$
$$x=\frac{-4\pm\sqrt{88}}{4}$$
$$x=\frac{-4\pm2\sqrt{22}}{4}$$
$$x=\frac{-2\pm\sqrt{22}}{2}$$

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.
$a=1 \quad b=-2 \quad c=-6$
$$x=\frac{-(-2)\pm\sqrt{(-2)^2-4(1)(-6)}}{2(1)}$$
$$=\frac{2\pm\sqrt{4-(-24)}}{2}$$
$$=\frac{2\pm\sqrt{28}}{2}$$
$$=\frac{2\pm\sqrt{4\cdot7}}{2}=\frac{2\pm2\sqrt{7}}{2}=1\pm\sqrt{7}$$
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.

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

Apply the quadratic formula.

$a=2 \quad b=-2 \quad c=-1$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-2)\pm\sqrt{(-2)^2-4(2)(-1)}}{2(2)}$$
$$=\frac{2\pm\sqrt{4-(-8)}}{4}$$
$$=\frac{2\pm\sqrt{12}}{4}=\frac{2\pm\sqrt{4\cdot 3}}{4}=\frac{2\pm 2\sqrt{3}}{4}=\frac{1\pm\sqrt{3}}{2}$$

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:

$a=1 \quad b=1 \quad c=-5$.

$$x=\frac{-1\pm\sqrt{1^2-4(1)(-5)}}{2(1)}=\frac{-1\pm\sqrt{1-(-20)}}{2}$$
$$=\frac{-1\pm\sqrt{21}}{2}$$

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:

$a=\sqrt{2} \quad b=3 \quad c=-2\sqrt{2}$

$$x=\frac{-3\pm\sqrt{3^2-4(\sqrt{2})(-2\sqrt{2})}}{2(\sqrt{2})}$$
$$=\frac{-3\pm\sqrt{9-(-16)}}{2\sqrt{2}}$$
$$=\frac{-3\pm\sqrt{25}}{2\sqrt{2}}=\frac{-3\pm 5}{2\sqrt{2}}$$

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 $\left\{-\sqrt{3} \pm 2i\right\}$.

131. $f(x) = 0.013x^2 - 1.19x + 28.24$

$$3 = 0.013x^2 - 1.19x + 28.24$$

$$0 = 0.013x^2 - 1.19x + 25.24$$

Apply the quadratic formula:

$a = 0.013 \quad b = -1.19 \quad c = 25.24$

$$x = \frac{-(-1.19) \pm \sqrt{(-1.19)^2 - 4(0.013)(25.24)}}{2(0.013)}$$

$$= \frac{1.19 \pm \sqrt{1.4161 - 1.31248}}{0.026}$$

$$= \frac{1.19 \pm \sqrt{0.10362}}{0.026}$$

$$\approx \frac{1.19 \pm 0.32190}{0.026}$$

$$\approx 58.15 \text{ or } 33.39$$

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.

132. $f(x) = 0.013x^2 - 1.19x + 28.24$

$$10 = 0.013x^2 - 1.19x + 28.24$$

$$0 = 0.013x^2 - 1.19x + 18.24$$

$a = 0.013 \quad b = -1.19 \quad c = 18.24$

$$x = \frac{-(-1.19) \pm \sqrt{(-1.19)^2 - 4(0.013)(18.24)}}{2(0.013)}$$

$$= \frac{1.19 \pm \sqrt{1.4161 - 0.94848}}{0.026}$$

$$= \frac{1.19 \pm \sqrt{0.46762}}{0.026} \approx \frac{1.19 \pm 0.68383}{0.026}$$

Evaluate the expression to obtain two solutions.

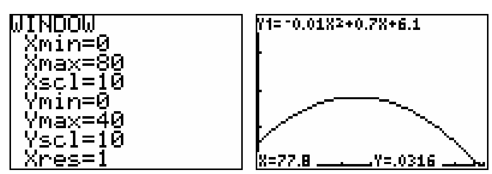
$$x = \frac{1.19 + 0.68383}{0.026} \quad \text{or} \quad x = \frac{1.19 - 0.68383}{0.026}$$

$$x = \frac{1.87383}{0.026} \qquad x = \frac{0.50617}{0.026}$$

$$x \approx 72.1 \qquad x \approx 19$$

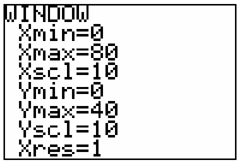
Drivers of approximately age 19 and age 72 are expected to be involved in 10 fatal crashes per 100 million miles driven. The formula does not model the data very well. The formula overestimates the number of fatal accidents.

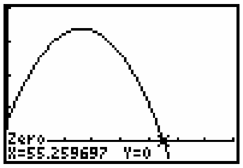
133. Let $y_1 = -0.01x^2 + 0.7x + 6.1$



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.

134. Let $y_1 = -0.04x^2 + 2.1x + 6.1$





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.

135. Ignoring the thickness of the panel, we essentially need to find the diameter of the rectangular opening.

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

$4^2 + 8^2 = c^2$

$16 + 64 = c^2$

$80 = c^2$

$c = \pm\sqrt{80} = \pm 4\sqrt{5}$

Since we are looking for a length, we discard the negative solution. The solution is $4\sqrt{5} \approx 8.9$ and we conclude that a panel that is about 8.9 feet long is the longest that can be taken through the door diagonally.

136.

$90^2 + 90^2 = x^2$

$8100 + 8100 = x^2$

$16200 = x^2$

$x \approx \pm 127.28$

The distance is 127.28 feet.

137. $15^2 + x^2 = 20^2$

$225 + x^2 = 400$

$x^2 = 175$

$x \approx \pm 13.23$

13.23

The ladder reaches 13.23 feet up.

138. $x^2 + 10^2 = 30^2$

$x^2 + 100 = 900$

$x^2 = 800$

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.

139. 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.

140. Let w = the width
Let w + 3 = the width

Area $= lw$

$180 = (w+3)w$

$180 = w^2 + 3w$

$0 = w^2 + 3w - 180$

$0 = (w+15)(w-12)$

$w + 15 = 0 \qquad w - 12 = 0$

~~$w = -15$~~ $\qquad w = 12$

The width is 12 yards and the length is 12 yards + 3 yards = 15 yards.

141. 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.

142. 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.

143. 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.

144. 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.

145. $x(x)(2) = 200$

$$2x^2 = 200$$
$$x^2 = 100$$
$$x = \pm 10$$

The length and width are 10 inches.

146. $x(x)(3) = 75$

$$3x^2 = 75$$
$$x^2 = 25$$
$$x = \pm 5$$

The length and width is 5 inches.

147. $x(20-2x) = 13$

$$20x - 2x^2 = 13$$
$$0 = 2x^2 - 20x + 13$$
$$x = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(2)(13)}}{2(2)}$$
$$x = \frac{20 \pm \sqrt{296}}{4}$$
$$x = \frac{10 \pm 17.2}{4}$$
$$x = 9.3, 0.7$$

9.3 in and 0.7 in

148. $\left(\frac{x}{4}\right)^2 + \left(\frac{8-x}{4}\right)^2 = 2$

$$\frac{x^2}{16} + \frac{64 - 16x + x^2}{16} = 2$$
$$x^2 + 64 - 16x + x^2 = 32$$
$$2x^2 - 16x + 32 = 0$$
$$x^2 - 8x + 16 = 0$$
$$(x-4)(x-4) = 0$$
$$x = 4 \text{ in}$$

Both are 4 inches.

160. **a.** False;

$$(2x-3)^2 = 25$$
$$2x - 3 = \pm 5$$

b. False;
Consider $x^2 = 0$, then $x = 0$ is the only distinct solution.

c. True

d. False;

$$ax^2 + c = 0$$
$$x = \frac{0 \pm \sqrt{0 - 4ac}}{2a} = \frac{2i\sqrt{ac}}{2a} = \frac{i\sqrt{ac}}{a}$$

(c) is true.

161.
$$(x+3)(x-5)=0$$
$$x^2-5x+3x-15=0$$
$$x^2-2x-15=0$$

162.
$$s=-16t^2+v_0t$$
$$0=-16t^2+v_0t-s$$
$$a=-16,\ b=v_0,\ c=-s$$
$$t=\frac{-v_0\pm\sqrt{(v_0)^2-4(-16)(-s)}}{2(-16)}$$
$$t=\frac{-v_0\pm\sqrt{(v_0)^2-64s}}{-32}$$
$$t=\frac{v_0\pm\sqrt{v_0{}^2-64s}}{32}$$

163. 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.
$$(12+2x)(8+2x)-12(8)=120$$
$$\cancel{96}+24x+16x+4x^2-\cancel{96}=120$$
$$4x^2+40x-120=0$$
$$x^2+10x-30=0$$
$$a=1\qquad b=10\qquad c=-30$$
$$x=\frac{-10\pm\sqrt{10^2-4(1)(-30)}}{2(1)}$$
$$=\frac{-10\pm\sqrt{100+120}}{2}$$
$$=\frac{-10\pm\sqrt{220}}{2}\approx\frac{-10\pm14.8}{2}$$
Evaluate the expression to obtain two solutions.
$$x=\frac{-10+14.8}{2}\quad\text{or}\quad x=\frac{-10-14.8}{2}$$
$$x=\frac{4.8}{2}\qquad x=\frac{-24.8}{2}$$
$$x=2.4\qquad x=-12.4$$
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.

Mid-Chapter 1 Check Point

1.
$$-5+3(x+5)=2(3x-4)$$
$$-5+3x+15=6x-8$$
$$3x+10=6x-8$$
$$-3x=-18$$
$$\frac{-3x}{-3}=\frac{-18}{-3}$$
$$x=6$$
The solution set is $\{6\}$.

2.
$$5x^2-2x=7$$
$$5x^2-2x-7=0$$
$$(5x-7)(x+1)=0$$
$$5x-7=0\quad\text{or}\quad x+1=0$$
$$5x=7\qquad x=-1$$
$$x=\frac{7}{5}$$
The solution set is $\left\{-1,\frac{7}{5}\right\}$.

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. $3x^2 - 6x - 2 = 0$

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

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

$$x = \frac{6 \pm \sqrt{60}}{6}$$

$$x = \frac{6 \pm 2\sqrt{15}}{6}$$

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

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 solution set is all real numbers.

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 $\left\{\frac{3+i\sqrt{23}}{4}, \frac{3-i\sqrt{23}}{4}\right\}$.

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 $\left\{-3+2\sqrt{6}, -3-2\sqrt{6}\right\}$.

10. $$\frac{1}{x^2}-\frac{4}{x}+1=0$$

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

$$\frac{x^2}{x^2}-\frac{4x^2}{x}+x^2=0$$

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

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

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

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

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

$$x=\frac{4\pm2\sqrt{3}}{2}$$

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

The solution set is $\left\{2+\sqrt{3},2-\sqrt{3}\right\}$.

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.

15. Let $y = 0$.

$$0 = 2x^2 + 26$$
$$-2x^2 = 26$$
$$x^2 = -13$$
$$x = \pm\sqrt{-13}$$
$$x = \pm i\sqrt{13}$$

There are no x-intercepts.

16. Let $y = 0$.

$$0 = \frac{x^2}{3} + \frac{x}{2} - \frac{2}{3}$$
$$6(0) = 6\left(\frac{x^2}{3} + \frac{x}{2} - \frac{2}{3}\right)$$
$$0 = \frac{6 \cdot x^2}{3} + \frac{6 \cdot x}{2} - \frac{6 \cdot 2}{3}$$
$$0 = 2x^2 + 3x - 4$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(3) \pm \sqrt{(3)^2 - 4(2)(-4)}}{2(2)}$$
$$x = \frac{-3 \pm \sqrt{41}}{4}$$

x-intercepts: $\frac{-3 + \sqrt{41}}{4}$ and $\frac{-3 - \sqrt{41}}{4}$.

17. Let $y = 0$.

$$0 = x^2 - 5x + 8$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(8)}}{2(1)}$$
$$x = \frac{5 \pm \sqrt{-7}}{2}$$
$$x = \frac{5 \pm i\sqrt{7}}{2}$$

There are no x-intercepts.

18.

$$y_1 = y_2$$
$$3(2x - 5) - 2(4x + 1) = -5(x + 3) - 2$$
$$6x - 15 - 8x - 2 = -5x - 15 - 2$$
$$-2x - 17 = -5x - 17$$
$$3x = 0$$
$$x = 0$$

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

19.

$$y_1 y_2 = 10$$
$$(2x+3)(x+2) = 10$$
$$2x^2 + 7x + 6 = 10$$
$$2x^2 + 7x - 4 = 0$$
$$(2x-1)(x+4) = 0$$
$$2x - 1 = 0 \quad \text{or} \quad x + 4 = 0$$
$$x = \frac{1}{2} \qquad x = -4$$

The solution set is $\left\{-4, \frac{1}{2}\right\}$.

20.

$$x^2 + 10x - 3 = 0$$
$$x^2 + 10x = 3$$

Since $b = 10$, we add $\left(\frac{10}{2}\right)^2 = 5^2 = 25$.

$$x^2 + 10x + 25 = 3 + 25$$
$$(x+5)^2 = 28$$

Apply the square root principle:

$$x + 5 = \pm\sqrt{28}$$
$$x + 5 = \pm\sqrt{4 \cdot 7} = \pm 2\sqrt{7}$$
$$x = -5 \pm 2\sqrt{7}$$

The solutions are $-5 \pm 2\sqrt{7}$, and the solution set is $\left\{-5 \pm 2\sqrt{7}\right\}$.

21.

$$2x^2 + 5x + 4 = 0$$
$$a = 2 \quad b = 5 \quad c = 4$$
$$b^2 - 4ac = 5^2 - 4(2)(4)$$
$$= 25 - 32 = -7$$

Since the discriminant is negative, there are no real solutions. There are two imaginary solutions that are complex conjugates.

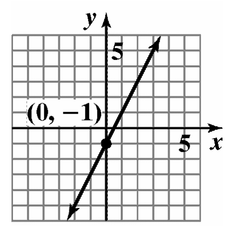
22.

$$10x(x+4) = 15x - 15$$
$$10x^2 + 40x = 15x - 15$$
$$10x^2 - 25x + 15 = 0$$
$$a = 10 \quad b = -25 \quad c = 15$$
$$b^2 - 4ac = (-25)^2 - 4(10)(15)$$
$$= 625 - 600 = 25$$

Since the discriminant is positive and a perfect square, there are two rational solutions.

23.

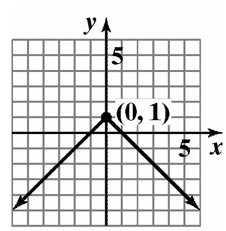
x	(x, y)
–2	–5
–1	–3
0	–1
1	1
2	3



$y = 2x - 1$

24.

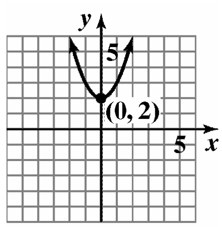
x	(x, y)
–3	–2
–2	–1
–1	0
0	1
1	0
2	–1
3	–2



$y = 1 - |x|$

25.

x	(x, y)
–2	6
–1	3
0	2
1	3
2	6



$y = x^2 + 2$

26.

$$L = a + (n-1)d$$
$$L = a + dn - d$$
$$-dn = a - d - L$$
$$\frac{-dn}{-d} = \frac{a}{-d} - \frac{d}{-d} - \frac{L}{-d}$$
$$n = -\frac{a}{d} + 1 + \frac{L}{d}$$
$$n = \frac{L}{d} - \frac{a}{d} + 1$$
$$n = \frac{L-a}{d} + 1$$

27.

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

28.

$$f = \frac{f_1 f_2}{f_1 + f_2}$$
$$(f_1 + f_2)(f) = (f_1 + f_2)\frac{f_1 f_2}{f_1 + f_2}$$
$$f_1 f + f_2 f = f_1 f_2$$
$$f_1 f - f_1 f_2 = -f_2 f$$
$$f_1(f - f_2) = -f_2 f$$
$$f_1 = \frac{-f_2 f}{f - f_2}$$
$$f_1 = \frac{ff_2}{f - f_2}$$

29. Let x = the defense budget of Japan in billions
Let $x + 4$ = the defense budget of Russia in billions
Let $x + 251$ = the defense budget of U.S. in billions

$$x + (x+4) + (x+251) = 375$$
$$3x + 255 = 375$$
$$3x = 120$$
$$x = 40$$
$$x + 4 = 44$$
$$x + 251 = 291$$

The defense budget of Japan is $40 billion, of Russia $44 billion, and of the U.S. $291 billion.

30. Let x = the number of months it takes for the average female infant to weigh 16 pounds

$$7 + 1.5x = 16$$
$$1.5x = 9$$
$$\frac{1.5x}{1.5} = \frac{9}{1.5}$$
$$x = 6$$

It takes 6 months for the average female infant to weigh 16 pounds.

31. Let x = the amount invested at 8%.
Let $25{,}000 - x$ = the amount invested at 9%.

$$0.08x + 0.09(25{,}000 - x) = 2135$$
$$0.08x + 2250 - 0.09x = 2135$$
$$-0.01x + 2250 = 2135$$
$$-0.01x = -115$$
$$x = \frac{-115}{-0.01}$$
$$x = 11{,}500$$
$$25{,}000 - x = 13{,}500$$

$11,500 was invested at 8% and $13,500 was invested at 9%.

32. Let x = the number of prints.
Photo Shop A: $0.11x+1.60$
Photo Shop B: $0.13x+1.20$

$$0.13x+1.20=0.11x+1.60$$
$$0.02x+1.20=1.60$$
$$0.02x=0.40$$
$$x=20$$

The cost will be the same for 20 prints.
That common price is

$$0.11(20)+1.60=0.13(20)+1.20$$
$$=\$3.80$$

33. Let x = the average weight for an American woman aged 20 through 29 in 1960.

$$x+0.22x=157$$
$$1.22x=157$$
$$\frac{1.22x}{1.22}=\frac{157}{1.22}$$
$$x\approx 129$$

The average weight for an American woman aged 20 through 29 in 1960 was 129 pounds.

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 by 17.

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 by 7.

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 feet up the pole.

38. $N=62.2x^2+7000$

$$62.2x^2+7000=N$$
$$62.2x^2+7000=46,000$$
$$62.2x^2=39,000$$
$$\frac{62.2x^2}{62.2}=\frac{39,000}{62.2}$$
$$x^2\approx 627$$
$$x\approx\pm\sqrt{627}$$
$$x\approx\pm 25$$

–25 must be rejected.
The equation predicts that there were 46,000 multinational corporations 25 years after 1970, or 1995. The model describes the actual data shown in the graph quite well.

39. $P = 0.0049x^2 - 0.359x + 11.78$

$15 = 0.0049x^2 - 0.359x + 11.78$

$0 = 0.0049x^2 - 0.359x - 3.22$

$0 = 0.0049x^2 - 0.359x - 3.22$

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

$$x = \frac{-(-0.359) \pm \sqrt{(-0.359)^2 - 4(0.0049)(-3.22)}}{2(0.0049)}$$

$$x = \frac{0.359 \pm \sqrt{0.191993}}{0.0098}$$

$x \approx 81, \quad x \approx -8$ (rejected)

The percentage of foreign born Americans will be 15% about 81 years after 1930, or 2011.

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. $\left(2-\sqrt{-3}\right)^2 = \left(2-i\sqrt{3}\right)^2$
$= 4-4i\sqrt{3}+3i^2$
$= 4-4i\sqrt{3}-3$
$= 1-4i\sqrt{3}$

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. $x^{\frac{2}{3}}-8=-4$

$x^{2/3}=4$

$\left(x^{2/3}\right)^{3/2}=4^{3/2}$ or

$x=\left(2^2\right)^{3/2}$ $\quad x=(-2)^3$

$x=2^3$ $\quad x=-8$

$x=8$

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 $\left\{-\sqrt{3}, \sqrt{3}, -\sqrt{2}, \sqrt{2}\right\}$.

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. $|2x-1|=5$

$2x-1=5$ or $2x-1=-5$

$2x=6$ $\quad 2x=-4$

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

The solution set is $\{-2, 3\}$.

9. $4|1-2x|-20=0$

$4|1-2x|=20$

$|1-2x|=5$

$1-2x=5$ or $1-2x=-5$

$-2x=4$ $\quad$ $-2x=-6$

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

The solution set is $\{-2, 3\}$.

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 $\left\{-1, -\frac{1}{3}, \frac{1}{3}\right\}$.

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.
$$\sqrt{3x+18}=x$$
$$3x+18=x^2$$
$$x^2-3x-18=0$$
$$(x+3)(x-6)=0$$
$$x+3=0 \quad x-6=0$$
$$x=-3 \qquad x=6$$
$$\sqrt{3(-3)+18}=-3 \quad \sqrt{3(6)+18}=6$$
$$\sqrt{-9+18}=-3 \quad \sqrt{18+18}=6$$
$$\sqrt{9}=-3 \text{ False} \quad \sqrt{36}=6$$
The solution set is $\{6\}$.

12.
$$\sqrt{20-8x}=x$$
$$20-8x=x^2$$
$$x^2+8x-20=0$$
$$(x+10)(x-2)=0$$
$$x+10=0 \quad x-2=0$$
$$x=-10 \qquad x=2$$
$$\sqrt{20-8(-10)}=-10 \qquad \sqrt{20-8(2)}=2$$
$$\sqrt{20+80}=-10 \qquad \sqrt{20-16}=2$$
$$\sqrt{100}=-10 \text{ False} \qquad \sqrt{4}=2$$
The solution set is $\{2\}$.

13.

$$\sqrt{x+3} = x-3$$
$$x+3 = x^2-6x+9$$
$$x^2-7x+6=0$$
$$(x-1)(x-6)=0$$
$$x-1=0 \quad x-6=0$$
$$x=1 \quad x=6$$
$$\sqrt{1+3}=1-3 \quad \sqrt{6+3}=6-3$$
$$\sqrt{4}=-2 \quad \text{False} \quad \sqrt{9}=3$$

The solution set is {6}.

14.

$$\sqrt{x+10} = x-2$$
$$x+10=(x-2)^2$$
$$x+10=x^2-4x+4$$
$$x^2-5x-6=0$$
$$(x+1)(x-6)=0$$
$$x+1=0 \quad x-6=0$$
$$x=-1 \quad x=6$$
$$\sqrt{-1+10}=-1-2 \quad \sqrt{6+10}=6-2$$
$$\sqrt{9}=-3 \quad \text{False} \quad \sqrt{16}=4$$

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.

$$\sqrt{6x+1}=x-1$$
$$6x+1=(x-1)^2$$
$$6x+1=x^2-2x+1$$
$$x^2-8x=0$$
$$x(x-8)=0$$
$$x-8=0 \quad x=0$$
$$x=8$$
$$\sqrt{6(0)+1}=0-1 \quad \sqrt{6(8)+1}=8-1$$
$$\sqrt{0+1}=-1 \quad \sqrt{48+1}=7$$
$$\sqrt{1}=-1 \quad \text{False} \quad \sqrt{49}=7$$

The solution set is {8}.

17.

$$x-\sqrt{2x+5}=5$$
$$x-5=\sqrt{2x+5}$$
$$(x-5)^2=2x+5$$
$$x^2-10x+25=2x+5$$
$$x^2-12x+20=0$$
$$(x-2)(x-10)=0$$
$$x-2=0 \quad x-10=0$$
$$x=2 \quad x=10$$
$$2-\sqrt{2(2)+5}=5 \quad 10-\sqrt{2(10)+5}=5$$
$$2-\sqrt{9}=5 \quad 10-\sqrt{25}=5$$
$$2-3=5 \quad \text{False} \quad 10-5=5$$

The solution set is {10}.

18.

$$x-\sqrt{x+11}=1$$
$$x-1=\sqrt{x+11}$$
$$(x-1)^2=x+11$$
$$x^2-2x+1=x+11$$
$$x^2-3x-10=0$$
$$(x+2)(x-5)=0$$
$$x+2=0 \quad x-5=0$$
$$x=-2 \quad x=5$$
$$-2-\sqrt{-2+11}=1 \quad 5-\sqrt{5+11}=1$$
$$-2-\sqrt{9}=1 \quad 5-\sqrt{16}=1$$
$$-2-3=1 \quad \text{False} \quad 5-4=1$$

The solution set is {5}.

19. $\sqrt{2x+19}-8=x$

$\sqrt{2x+19}=x+8$

$\left(\sqrt{2x+19}\right)^2=(x+8)^2$

$2x+19=x^2+16x+64$

$0=x^2+14x+45$

$0=(x+9)(x+5)$

$x+9=0$ or $x+5=0$

$x=-9$ $x=-5$

–9 does not check and must be rejected.

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

20. $\sqrt{2x+15}-6=x$

$\sqrt{2x+15}=x+6$

$\left(\sqrt{2x+15}\right)^2=(x+6)^2$

$2x+15=x^2+12x+36$

$0=x^2+10x+21$

$0=(x+3)(x+7)$

$x+3=0$ or $x+7=0$

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

–7 does not check and must be rejected.

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

21. $\sqrt{3x}+10=x+4$

$\sqrt{3x}=x-6$

$3x=(x-6)^2$

$3x=x^2-12x+36$

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

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

$x-12=0$ $x-3=0$

$x=12$ $x=3$

$\sqrt{3(12)}+10=12+4$ $\sqrt{3(3)}+10=3+4$

$\sqrt{36}+10=16$ $\sqrt{9}+10=7$

$6+10=16$ $3+10=7$ False

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

22. $\sqrt{x}-3=x-9$

$\sqrt{x}=x-6$

$x=(x-6)^2$

$x=x^2-12x+36$

$x^2-13x+36=0$

$(x-9)(x-4)=0$

$x-9=0$ $x-4=0$

$x=9$ $x=4$

$\sqrt{9}-3=9-9$ $\sqrt{4}-3=4-9$

$3-3=9-9$ $2-3=4-9$ False

The solution set is $\{9\}$.

23. $\sqrt{x+8}-\sqrt{x-4}=2$

$\sqrt{x+8}=\sqrt{x-4}+2$

$x+8=(\sqrt{x-4}+2)^2$

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

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

$8=4\sqrt{x-4}$

$2=\sqrt{x-4}$

$4=x-4$

$x=8$

$\sqrt{8+8}-\sqrt{8-4}=2$

$\sqrt{16}-\sqrt{4}=2$

$4-2=2$

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

24. $\sqrt{x+5}-\sqrt{x-3}=2$

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

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

$x+5=x-3+4\sqrt{x-3}+4$

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

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

$4=4\sqrt{x-3}$

$1=\sqrt{x-3}$

$1=x-3$

$x=4$

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

$\sqrt{9}-\sqrt{1}=2$

$3-1=2$

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

25. $\sqrt{x-5}-\sqrt{x-8}=3$

$$\sqrt{x-5}=\sqrt{x-8}+3$$
$$x-5=(\sqrt{x-8}+3)^2$$
$$x-5=x-8+6\sqrt{x-8}+9$$
$$x-5=x+1+6\sqrt{x-8}$$
$$-6=6\sqrt{x-8}$$
$$-1=\sqrt{x-8}$$
$$1=x-8$$
$$x=9$$
$$\sqrt{9-5}-\sqrt{9-8}=3$$
$$\sqrt{4}-\sqrt{1}=3$$
$$2-1=3 \text{ False}$$

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

26. $\sqrt{2x-3}-\sqrt{x-2}=1$

$$\sqrt{2x-3}=\sqrt{x-2}+1$$
$$2x-3=(\sqrt{x-2}+1)^2$$
$$2x-3=x-2+2\sqrt{x-2}+1$$
$$2x-3=x-1+2\sqrt{x-2}$$
$$x-2=2\sqrt{x-2}$$
$$\frac{x}{2}-1=\sqrt{x-2}$$
$$\left(\frac{x}{2}-1\right)^2=x-2$$
$$\frac{x^2}{4}-x+1=x-2$$
$$x^2-4x+4=4x-8$$
$$x^2-8x+12=0$$
$$(x-6)(x-2)=0$$
$$x-6=0 \quad x-2=0$$
$$x=6 \quad x=2$$
$$\sqrt{2(6)-3}-\sqrt{6-2}=1 \quad \sqrt{2(2)-3}-\sqrt{2-2}=1$$
$$\sqrt{12-3}-\sqrt{4}=1 \quad \sqrt{4-3}-\sqrt{0}=1$$
$$\sqrt{9}-\sqrt{4}=1 \quad \sqrt{1}-0=1$$
$$3-2=1 \quad 1-0=1$$

The solution set is $\{2, 6\}$.

27. $\sqrt{2x+3}+\sqrt{x-2}=2$

$$\sqrt{2x+3}=2-\sqrt{x-2}$$
$$2x+3=(2-\sqrt{x-2})^2$$
$$2x+3=4-4\sqrt{x-2}+x-2$$
$$x+1=-4\sqrt{x-2}$$
$$(x+1)^2=16(x-2)$$
$$x^2+2x+1=16x-32$$
$$x^2-14x+33=0$$
$$(x-11)(x-3)=0$$
$$x-11=0 \quad x-3=0$$
$$x=11 \quad x=3$$
$$\sqrt{2(11)+3}+\sqrt{11-2}=2$$
$$\sqrt{22+3}+\sqrt{9}=2$$
$$5+3=2 \text{ False}$$
$$\sqrt{2(3)+3}+\sqrt{3-2}=2$$
$$\sqrt{6+3}+\sqrt{1}=2$$
$$3+1=2 \text{ False}$$

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

28. $\sqrt{x+2}+\sqrt{3x+7}=1$

$$\sqrt{x+2}=1-\sqrt{3x+7}$$
$$x+2=(1-\sqrt{3x+7})^2$$
$$x+2=1-2\sqrt{3x+7}+3x+7$$
$$-2x-6=-2\sqrt{3x+7}$$
$$x+3=\sqrt{3x+7}$$
$$(x+3)^2=3x+7$$
$$x^2+6x+9=3x+7$$
$$x^2+3x+2=0$$
$$(x+1)(x+2)=0$$
$$x+1=0 \quad x+2=0$$
$$x=-1 \quad x=-2$$
$$\sqrt{-1+2}+\sqrt{3(-1)+7}=1$$
$$\sqrt{1}+\sqrt{4}=1$$
$$1+2=1 \text{ False}$$
$$\sqrt{-2+2}+\sqrt{3(-2)+7}=1$$
$$\sqrt{0}+\sqrt{1}=1$$
$$0+1=1$$

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

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 $\left\{\sqrt[5]{4}\right\}$.

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.
$$(x-4)^{2/3}=16$$
$$\left[(x-4)^{2/3}\right]^{3/2}=(16)^{3/2}$$
$$x-4=\left(2^4\right)^{3/2}$$
$$x-4=4^3 \qquad x-4=(-4)^3$$
$$x-4=64 \qquad x-4=-64$$
$$x=68 \qquad x=-60$$
The solution set is $\{-60, 68\}$.

38.
$$(x+5)^{\frac{2}{3}}=4$$
$$\left[(x+5)\frac{2}{3}\right]^{\frac{3}{2}}=(4)^{\frac{3}{2}}$$
$$x+5=\left(2^2\right)^{\frac{3}{2}}$$
$$x+5=2^3 \quad \text{or} \quad x+5=(-2)^3$$
$$x+5=8 \qquad x+5=-8$$
$$x=3 \qquad x=-13$$
The solution set is $\{-13, 3\}$.

39.
$$(x^2-x-4)^{3/4}-2=6$$
$$(x^2-x-4)^{3/4}=8$$
$$((x^2-x-4)^{3/4})^{4/3}=8^{4/3}$$
$$x^2-x-4=\sqrt[3]{8}^{\,4}$$
$$x^2-x-4=2^4$$
$$x^2-x-4=16$$
$$x^2-x-20=0$$
$$(x-5)(x+4)=0$$
$$x-5=0 \qquad x+4=0$$
$$x=5 \qquad x=-4$$
$$(5^2-5-4)^{3/4}-2=6$$
$$(25-9)^{3/4}-2=6$$
$$16^{3/4}-2=6$$
$$\sqrt[4]{16}^{\,3}-2=6$$
$$2^3-2=6$$
$$8-2=6$$
$$((-4)^2-(-4)-4)^{3/4}-2=6$$
$$(16+4-4)^{3/4}-2=6$$
$$16^{3/4}-2=6$$
$$\sqrt[4]{16}^{\,3}-2=6$$
$$2^3-2=6$$
$$8-2=6$$
The solution set is $\{5, -4\}$.

40.
$$(x^2-3x+3)^{3/2}-1=0$$
$$(x^2-3x+3)^{3/2}=1$$
$$x^2-3x+3=1^{2/3}$$
$$x^2-3x+3=1$$
$$x^2-3x+2=0$$
$$(x-1)(x-2)=0$$
$$x-1=0 \qquad x-2=0$$
$$x=1 \qquad x=2$$
$$(1^2-3(1)+3)^{3/2}-1=0$$
$$(1-3+3)^{3/2}-1=0$$
$$1^{3/2}-1=0$$
$$1-1=0$$
$$(2^2-3(2)+3)^{3/2}-1=0$$
$$(4-6+3)^{3/2}-1=0$$
$$1^{3/2}-1=0$$
$$1-1=0$$
The solution set is $\{1, 2\}$.

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. $9x^4 = 25x^2 - 16$

$9x^4 - 25x^2 + 16 = 0$ 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. $4x^4 = 13x^2 - 9$

$4x^4 - 13x^2 + 9 = 0$ 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.

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}.

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 $t=x^2-x$.

$$t^2-14t+24=0$$
$$(t-2)(t-12)=0$$

$t=2$ 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 $t=x^2-2x$

$$t^2-11t+24=0$$
$$(t-3)(t-8)=0$$

$t=3$ 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 $t=y-\frac{8}{y}$.

$$t^2+5t-14=0$$
$$(t+7)(t-2)=0$$

$t=-7$ 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}.

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 $t=3$

$y-\frac{10}{y}=-9$ or $y-\frac{10}{y}=3$

$y^2+9y-10=0$ $\quad$ $y^2-3y-10=0$

$(y+10)(y-1)=0$ $\quad$ $(y-5)(y+2)=0$

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. $3|2x-1|=21$

$|2x-1|=7$

$2x-1=7$ or $2x-1=-7$

$2x=8 \quad 2x=-6$

$x=4 \quad x=-3$

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. $7|3x|+2=16$

$7|3x|=14$

$|3x|=2$

$3x=2$ or $3x=-2$

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

The solution set is {–2/3, 2/3}

71. $2\left|4-\frac{5}{2}x\right|+6=18$

$2\left|4-\frac{5}{2}x\right|=12$

$\left|4-\frac{5}{2}x\right|=6$

$4-\frac{5}{2}x=6$ or $4-\frac{5}{2}x=-6$

$-\frac{5}{2}x=2$ $\quad$ $-\frac{5}{2}x=-10$

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

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

The solution set is $\left\{-\frac{4}{5}, 4\right\}$.

72. $4\left|1-\frac{3}{4}x\right|+7=10$

$4\left|1-\frac{3}{4}x\right|=3$

$\left|1-\frac{3}{4}x\right|=\frac{3}{4}$

$1-\frac{3}{4}x=\frac{3}{4}$ or $1-\frac{3}{4}x=-\frac{3}{4}$

$-\frac{3}{4}x=-\frac{1}{4}$ $\quad$ $-\frac{3}{4}x=-\frac{7}{4}$

$-\frac{4}{3}\left(-\frac{3}{4}\right)x=-\frac{4}{3}\left(-\frac{1}{4}\right)$ $\quad$ $-\frac{4}{3}\left(-\frac{3}{4}\right)x=-\frac{4}{3}\left(-\frac{7}{4}\right)$

$x=\frac{1}{3}$ $\quad$ $x=\frac{7}{3}$

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. $|x + 1| + 6 = 2$
$|x + 1| = -4$ The solution set is { }.

75. $|2x - 1| + 3 = 3$
$|2x - 1| = 0$
$2x - 1 = 0$
$2x = 1$
$x = 1/2$
The solution set is {1/2}.

76. $|3x-2|+4=4$
$|3x-2|=0$
$3x-2=0$
$3x=2$
$x=\frac{2}{3}$
The solution set is {2/3}.

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. 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).

80. 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).

81. Set $y=0$ to find the x–intercept(s).

$$0=x^{\frac{1}{3}}+2x^{\frac{1}{6}}-3$$

Let $t=x^{\frac{1}{6}}$.

$$x^{\frac{1}{3}}+2x^{\frac{1}{6}}-3=0$$
$$\left(x^{\frac{1}{6}}\right)^2+2x^{\frac{1}{6}}-3=0$$
$$t^2+2t-3=0$$
$$(t+3)(t-1)=0$$

$t+3=0$ or $t-1=0$

$t=-3 \qquad t=1$

Substitute $x^{\frac{1}{6}}$ for t.

$x^{\frac{1}{6}}=-3$ or $x^{\frac{1}{6}}=1$

$\left(x^{\frac{1}{6}}\right)^6=(-3)^6 \qquad \left(x^{\frac{1}{6}}\right)^6=(1)^6$

$x=729 \qquad x=1$

729 does not check and must be rejected.
The x-intercept is 1.
The corresponding graph is graph (e).

82. Set $y = 0$ to find the x–intercept(s).

$0 = x^{-2} - x^{-1} - 6$

Let $t = x^{-1}$.

$x^{-2} - x^{-1} - 6 = 0$

$\left(x^{-1}\right)^2 - x^{-1} - 6 = 0$

$t^2 - t - 6 = 0$

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

$t + 2 = 0$ or $t - 3 = 0$

$t = -2$ $\quad t = 3$

Substitute x^{-1} for t.

$x^{-1} = -2$ or $x^{-1} = 3$

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

The x-intercepts are $-\frac{1}{2}$ and $\frac{1}{3}$.

The corresponding graph is graph (b).

83. Set $y = 0$ to find the x–intercept(s).

$(x+2)^2 - 9(x+2) + 20 = 0$

Let $t = x + 2$.

$(x+2)^2 - 9(x+2) + 20 = 0$

$t^2 - 9t + 20 = 0$

$(t-5)(t-4) = 0$

$t - 5 = 0$ or $t - 4 = 0$

$t = 5$ $\quad t = 4$

Substitute $x + 2$ for t.

$x + 2 = 5$ or $x + 2 = 4$

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

The x-intercepts are 2 and 3.
The corresponding graph is graph (f).

84. Set $y = 0$ to find the x–intercept(s).

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

Let $t = x + 2$.

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

$2t^2 + 5t - 3 = 0$

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

$2t - 1 = 0$ or $t + 3 = 0$

$2t = 1$ $\quad t = -3$

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

Substitute $x + 2$ for t.

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

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

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

The x-intercepts are -5 and $-\frac{3}{2}$.

The corresponding graph is graph (d).

85. $|5 - 4x| = 11$

$5 - 4x = 11$ $\quad 5 - 4x = -11$

$-4x = 6$ or $-4x = -16$

$x = -\frac{3}{2}$ $\quad x = 4$

The solution set is $\left\{-\frac{3}{2}, 4\right\}$.

86. $|2 - 3x| = 13$

$2 - 3x = 13$ $\quad 2 - 3x = -13$

$-3x = 11$ or $-3x = -15$

$x = -\frac{11}{3}$ $\quad x = 5$

The solution set is $\left\{-\frac{11}{3}, 5\right\}$.

87. $x + \sqrt{x+5} = 7$

$\sqrt{x+5} = 7 - x$

$\left(\sqrt{x+5}\right)^2 = (7-x)^2$

$x + 5 = 49 - 14x + x^2$

$0 = x^2 - 15x + 44$

$0 = (x-4)(x-11)$

$x - 4 = 0$ or $x - 11 = 0$

$x = 4$ $\quad x = 11$

11 does not check and must be rejected.
The solution set is $\{4\}$.

88. $x-\sqrt{x-2}=4$

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

$\left(-\sqrt{x-2}\right)^2=(4-x)^2$

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

$0=x^2-9x+18$

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

$x-6=0$ or $x-3=0$

$x=6$ $\quad x=3$

3 does not check and must be rejected.
The solution set is $\{6\}$.

89. $2x^3+x^2-8x+2=6$

$2x^3+x^2-8x-4=0$

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

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

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

$2x+1=0$ or $x+2=0$ or $x-2=0$

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

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

90. $x^3+4x^2-x+6=10$

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

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

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

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

$x+4=0$ or $x+1=0$ or $x-1=0$

$x=-4$ $\quad x=-1$ $\quad x=1$

The solution set is $\{-4,-1,1\}$.

91. $(x+4)^{\frac{3}{2}}=8$

$\left((x+4)^{\frac{3}{2}}\right)^{\frac{2}{3}}=(8)^{\frac{2}{3}}$

$x+4=\left(\sqrt[3]{8}\right)^2$

$x+4=(2)^2$

$x+4=4$

$x=0$

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

92. $(x-5)^{\frac{3}{2}}=125$

$\left((x-5)^{\frac{3}{2}}\right)^{\frac{2}{3}}=(125)^{\frac{2}{3}}$

$x-5=\left(\sqrt[3]{125}\right)^2$

$x-5=(5)^2$

$x-5=25$

$x=30$

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

93. $y_1=y_2+3$

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

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

Let $t=x^2-1$ and substitute.

$t^2-2t-3=0$

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

$t+1=0$ or $t-3=0$

$t=-1$ $\quad t=3$

Substitute x^2-1 for t.

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

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

$x=0$ $\quad x=\pm2$

The solution set is $\{-2,0,2\}$.

94. $$y_1 = y_2 + 6$$
$$6\left(\frac{2x}{x-3}\right)^2 = 5\left(\frac{2x}{x-3}\right) + 6$$
$$6\left(\frac{2x}{x-3}\right)^2 - 5\left(\frac{2x}{x-3}\right) - 6 = 0$$

Let $t = \frac{2x}{x-3}$ and substitute.

$$6t^2 - 5t - 6 = 0$$
$$(3t+2)(2t-3) = 0$$
$$3t+2 = 0 \quad \text{or} \quad 2t-3 = 0$$
$$t = -\frac{2}{3} \qquad t = \frac{3}{2}$$

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 $\left\{-9, \frac{3}{4}\right\}$.

95. $\left|x^2 + 2x - 36\right| = 12$

$$x^2 + 2x - 36 = 12 \qquad x^2 + 2x - 36 = -12$$
$$x^2 + 2x - 48 = 0 \quad \text{or} \quad x^2 + 2x - 24 = 0$$
$$(x+8)(x-6) = 0 \qquad (x+6)(x-4) = 0$$

Setting each of the factors above equal to zero gives $x = -8$, $x = 6$, $x = -6$, and $x = 4$.

The solution set is $\{-8, -6, 4, 6\}$.

96. $\left|x^2 + 6x + 1\right| = 8$

$$x^2 + 6x + 1 = 8 \quad \text{or} \quad x^2 + 6x + 1 = -8$$
$$x^2 + 6x - 7 = 0 \qquad x^2 + 6x + 9 = 0$$
$$(x+7)(x-1) = 0 \qquad (x+3)(x+3) = 0$$

Setting each of the factors above equal to zero gives $x = -7$, $x = -3$, and $x = 1$.

The solution set is $\{-7, -3, 1\}$.

97. $x(x+1)^3 - 42(x+1)^2 = 0$

$$(x+1)^2\left(x(x+1) - 42\right) = 0$$
$$(x+1)^2\left(x^2 + x - 42\right) = 0$$
$$(x+1)^2(x+7)(x-6) = 0$$

Setting each of the factors above equal to zero gives $x = -7$, $x = -1$, and $x = 6$.

The solution set is $\{-7, -1, 6\}$.

98. $x(x-2)^3 - 35(x-2)^2 = 0$

$$x(x-2)^3 - 35(x-2)^2 = 0$$
$$(x-2)^2\left(x(x-2) - 35\right) = 0$$
$$(x-2)^2\left(x^2 - 2x - 35\right) = 0$$
$$(x-2)^2(x+5)(x-7) = 0$$

Setting each of the factors above equal to zero gives $x = -5$, $x = 2$, and $x = 7$.

The solution set is $\{-5, 2, 7\}$.

99. 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.

100. 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.

101.
$$r = \sqrt{\frac{3V}{\pi h}}$$
$$r^2 = \left(\sqrt{\frac{3V}{\pi h}}\right)^2$$
$$r^2 = \frac{3V}{\pi h}$$
$$\pi r^2 h = 3V$$
$$\frac{\pi r^2 h}{3} = V$$
$$V = \frac{\pi r^2 h}{3} \quad \text{or} \quad V = \frac{1}{3}\pi r^2 h$$

102.
$$r = \sqrt{\frac{A}{4\pi}}$$
$$r^2 = \left(\sqrt{\frac{A}{4\pi}}\right)^2$$
$$r^2 = \frac{A}{4\pi}$$
$$4\pi r^2 = A \quad \text{or} \quad A = 4\pi r^2$$

103. 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.

104. 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 $x=-3$, $x=-1$, and $x=1$.

–3, –1, and 1 must be excluded from the domain.

105. Let $P = 192$.

$$P = 28\sqrt{t} + 80$$
$$192 = 28\sqrt{t} + 80$$
$$112 = 28\sqrt{t}$$
$$\frac{112}{28} = \frac{28\sqrt{t}}{28}$$
$$4 = \sqrt{t}$$
$$(4)^2 = \left(\sqrt{t}\right)^2$$
$$16 = t$$

192 million computers will be sold 16 years after 1996, or 2012.

106. Let $P = 143$.

$$P = 28\sqrt{t} + 80$$
$$143 = 28\sqrt{t} + 80$$
$$63 = 28\sqrt{t}$$
$$\frac{63}{28} = \frac{28\sqrt{t}}{28}$$
$$2.25 = \sqrt{t}$$
$$(2.25)^2 = \left(\sqrt{t}\right)^2$$
$$5 \approx t$$

143 million computers were sold 5 years after 1996, or 2001. This matches the data shown in the figure quite well.

107. For the year 2100, we use $x = 98$.

$$H = 0.083(98) + 57.9$$
$$= 66.034$$
$$L = 0.36\sqrt{98} + 57.9$$
$$\approx 61.464$$

In the year 2100, the projected high end temperature is about $66°$ and the projected low end temperature is about $61.5°$.

108. For the year 2080, we use $x = 78$.

$$H = 0.083(78) + 57.9 \approx 64.4$$
$$L = 0.36\sqrt{78} + 57.9 \approx 61.1$$

In the year 2080, the projected high end temperature is about $64.4°$ and the projected low end temperature is about $61.1°$.

109. Using *H*:

$$0.083x + 57.9 = 57.9 + 1$$
$$0.083x = 1$$
$$x = \frac{1}{0.083}$$
$$x \approx 12$$

The projected global temperature will exceed the 2002 average by 1 degree in 2014 (12 years after 2002).

Using *L*:

$$0.36\sqrt{x} + 57.9 = 1 + 57.9$$
$$0.36\sqrt{x} = 1$$
$$\sqrt{x} = \frac{1}{0.36}$$
$$\left(\sqrt{x}\right)^2 = \left(\frac{1}{0.36}\right)^2$$
$$x \approx 8$$

The projected global temperature will exceed the 2002 average by 1 degree in 2010 (8 years after 2002).

110. Using *H*:

$$0.083x + 57.9 = 57.9 + 2$$
$$0.083x = 2$$
$$x = \frac{2}{0.083}$$
$$x \approx 24$$

The projected global temperature will exceed the 2002 average by 2 degrees in 2026 (24 years after 2002).

Using *L*:

$$0.36\sqrt{x} + 57.9 = 57.9 + 2$$
$$0.36\sqrt{x} = 2$$
$$\sqrt{x} = \frac{2}{0.36}$$
$$\left(\sqrt{x}\right)^2 = \left(\frac{2}{0.36}\right)^2$$
$$x \approx 31$$

The projected global temperature will exceed the 2002 average by 2 degrees in 2033 (31 years after 2002).

111.
$$y = 5000\sqrt{100-x}$$
$$40000 = 5000\sqrt{100-x}$$
$$\frac{40000}{5000} = \frac{5000\sqrt{100-x}}{5000}$$
$$8 = \sqrt{100-x}$$
$$8^2 = \left(\sqrt{100-x}\right)^2$$
$$64 = 100-x$$
$$-36 = -x$$
$$36 = x$$
40,000 people in the group will survive to age 36. This is shown on the graph as the point $(36,\ 40000)$.

112.
$$y = 5000\sqrt{100-x}$$
$$35000 = 5000\sqrt{100-x}$$
$$\frac{35000}{5000} = \frac{5000\sqrt{100-x}}{5000}$$
$$7 = \sqrt{100-x}$$
$$7^2 = \left(\sqrt{100-x}\right)^2$$
$$49 = 100-x$$
$$-51 = -x$$
$$51 = x$$
35,000 people will survive to age 51. This corresponds to the point $(51,\ 35000)$ on the graph.

113.
$$365 = 0.2x^{3/2}$$
$$\frac{365}{0.2} = \frac{0.2x^{3/2}}{0.2}$$
$$1825 = x^{3/2}$$
$$1825^2 = \left(x^{3/2}\right)^2$$
$$3,330,625 = x^3$$
$$\sqrt[3]{3,330,625} = \sqrt[3]{x^3}$$
$$149.34 \approx x$$
The average distance of the Earth from the sun is approximately 149 million kilometers.

114.
$$f(x) = 0.2x^{3/2}$$
$$88 = 0.2x^{3/2}$$
$$\frac{88}{0.2} = \frac{0.2x^{3/2}}{0.2}$$
$$440 = x^{3/2}$$
$$440^2 = \left(x^{3/2}\right)^2$$
$$193,600 = x^3$$
$$\sqrt[3]{193,600} = \sqrt[3]{x^3}$$
$$58 \approx x$$
The average distance of Mercury from the sun is approximately 58 million kilometers.

115.
$$\sqrt{6^2+x^2} + \sqrt{8^2+(10-x)^2} = 18$$
$$\sqrt{36+x^2} = 18 - \sqrt{64+100-20x+x^2}$$
$$36+x^2 = 324 - 36\sqrt{x^2-20x+164} + x^2 - 20x + 164$$
$$36\sqrt{x^2-20x+164} = -20x+452$$
$$9\sqrt{x^2-20x+164} = -5x+113$$
$$81(x^2-20x+164) = 25x^2 - 1130x + 12769$$
$$81x^2 - 1620x + 13284 = 25x^2 - 1130x + 12769$$
$$56x^2 - 490x + 515 = 0$$
$$x = \frac{490 \pm \sqrt{(-490)^2 - 4(56)(515)}}{2(56)}$$
$$x = \frac{490 \pm 353.19}{112}$$
$$x \approx 1.2 \qquad x \approx 7.5$$
The point should be located approximately either 1.2 feet or 7.5 feet from the base of the 6-foot pole.

116. 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.

$$\sqrt{6^2+x^2}+\sqrt{3^2+(12-x)^2}=15$$
$$\sqrt{36+x^2}=15-\sqrt{9+144-24x+x^2}$$
$$36+x^2=225-30\sqrt{153-24x+x^2}+x^2-24x+153$$
$$30\sqrt{x^2-24x+153}=-24x+342$$
$$5\sqrt{x^2-24x+153}=-4x+157$$
$$25(x^2-24x+153)=16x^2-456x+3249$$
$$25x^2-600x+3825=16x^2-456x+3249$$
$$9x^2-144x+576=0$$
$$x^2-16x+64=0$$
$$(x-8)(x-8)=0$$
$$x=8$$

The distance is 8 miles.

125. $x^3+3x^2-x-3=0$
The solution set is {–3, –1, 1}.

$$(-3)^3+3(-3)^2-(-3)-3=0$$
$$-27+27+3-3=0$$
$$(-1)^3+3(-1)^2-(-1)-3=0$$
$$-1+3+1-3=0$$
$$1^3+3(1)^2-(1)-3=0$$
$$1+3-1-3=0$$

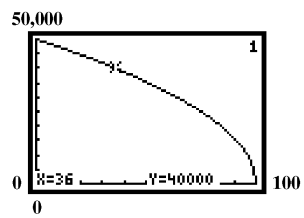
126. $-x^4+4x^3-4x^2=0$
The solution set is {0, 2}.

$$-(0)^4+4(0)^3-4(0)^2=0$$
$$0=0$$
$$-(2)^4+4(2)^3-4(2)^2=0$$
$$-16+32-16=0$$
$$0=0$$

127. $\sqrt{2x+13}-x-5=0$
The solution set is {–2}.

$$\sqrt{2(-2)+13}-(-2)-5=0$$
$$\sqrt{-4+13}+2-5=0$$
$$\sqrt{9}-3=0$$
$$3-3=0$$

128. Tracing along the curve shows the point $(36, 40000)$.



129. a. False; $\left(\sqrt{y+4}+\sqrt{y-1}\right)^2\neq y+4+y-1$

b. False; if $t=(x^2-2x)^3$, the original equation can be written as $t^3-5t+6=0$, not a quadratic form.

c. False; the other value may be a solution.

d. True

(d) is true

130. $\sqrt{6x-2}=\sqrt{2x+3}-\sqrt{4x-1}$

$$6x-2=2x+3-2\sqrt{(2x+3)(4x-1)}+4x-1$$
$$-4=-2\sqrt{(2x+3)(4x-1)}$$
$$2=\sqrt{8x^2+10x-3}$$
$$4=8x^2+10x-3$$
$$8x^2+10x-7=0$$
$$x=\frac{-10\pm\sqrt{10^2-4(8)(-7)}}{2(8)}$$
$$x=\frac{-10\pm\sqrt{100+224}}{16}$$
$$x=\frac{-10\pm\sqrt{324}}{16}$$
$$x=\frac{-10\pm 18}{16}$$
$$x=\frac{-28}{26},\frac{8}{16}$$
$$x=\frac{1}{2}$$

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

131. $5-\frac{2}{x}=\sqrt{5-\frac{2}{x}}$

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 $\left\{\frac{2}{5},\frac{1}{2}\right\}$.

132. $\sqrt[3]{x\sqrt{x}}=9$

$$\sqrt[3]{x\sqrt{x}}=9$$
$$\sqrt[3]{x^1x^{\frac{1}{2}}}=9$$
$$\left(x^1x^{\frac{1}{2}}\right)^{\frac{1}{3}}=9$$
$$\left(x^{\frac{3}{2}}\right)^{\frac{1}{3}}=9$$
$$x^{\frac{1}{2}}=9$$
$$\left(x^{\frac{1}{2}}\right)^2=(9)^2$$
$$x=81$$

The solution set is {81}.

133. $x^{5/6}+x^{2/3}-2x^{1/2}=0$

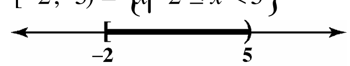
$$x^{1/2}(x^{2/6}+x^{1/6}-2)=0 \text{ let } t=x^{1/6}$$
$$x^{1/2}(t^2+t-2)=0$$
$$x^{1/2}=0 \quad t^2+t-2=0$$
$$(t-1)(t+2)=0$$
$$t-1=0 \qquad t+2=0$$
$$t=1 \qquad t=-2$$
$$x^{1/6}=1 \qquad x^{1/6}=-2$$
$$x=1^6 \qquad x=(-2)^6$$
$$x=0 \quad x=1 \qquad x=64$$

64 does not check and must be rejected.
The solution set is {0, 1}.

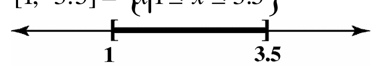
Section 1.7

Check Point Exercises

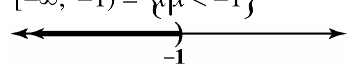
1. **a.** $[-2,\ 5)=\{x \mid -2\le x<5\}$

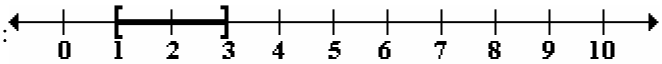


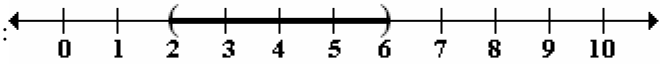
b. $[1,\ 3.5]=\{x \mid 1\le x\le 3.5\}$



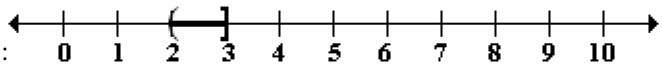
c. $[-\infty,\ -1)=\{x \mid x<-1\}$



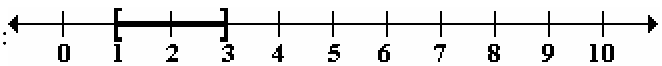
2. a. Graph $[1,3]$:


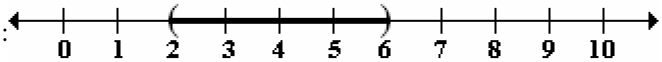
Graph $(2,6)$:


To find the intersection, take the portion of the number line that the two graphs have in common.

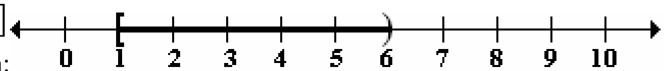
Numbers in both $[1,3]$ and $(2,6)$:


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:


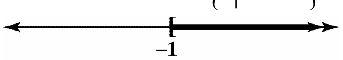
Thus, $[1,3] \cup (2,6) = [1,6)$.

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

b. $x+1 \le x-1$

$1 \le -1$

$1 \le -1$ is false for all values of *x*.

The solution set is $\varnothing$.

6. $1 \le 2x + 3 < 11$

$-2 \le 2x < 8$

$-1 \le x < 4$

The solution set is $\{x | -1 \le x < 4\}$ or $[-1, 4)$.

7. $|x - 2| < 5$

$-5 < x - 2 < 5$

$-3 < x < 7$

The solution set is $\{x | -3 < x < 7\}$ or $(-3, 7)$.

8. $-3|5x - 2| + 20 \ge -19$

$-3|5x - 2| \ge -39$

$\frac{-3|5x-2|}{-3} \le \frac{-39}{-3}$

$|5x - 2| \le 13$

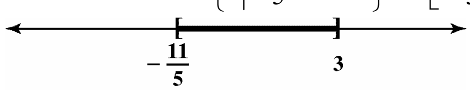
$-13 \le 5x - 2 \le 13$

$-11 \le 5x \le 15$

$\frac{-11}{5} \le \frac{5x}{5} \le \frac{15}{5}$

$-\frac{11}{5} \le x \le 3$

The solution set is $\left\{x \middle| -\frac{11}{5} \le x \le 3\right\}$ or $\left[-\frac{11}{5}, 3\right]$.



9. $18 < |6 - 3x|$

$6 - 3x < -18$ or $6 - 3x > 18$

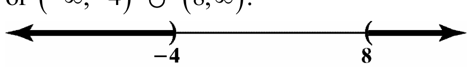
$-3x < -24$ $\quad$ $-3x > 12$

$\frac{-3x}{-3} > \frac{-24}{-3}$ $\quad$ $\frac{-3x}{-3} < \frac{12}{-3}$

$x > 8$ $\quad$ $x < -4$

The solution set is $\{x | x < -4 \text{ or } x > 8\}$

or $(-\infty, -4) \cup (8, \infty)$.



10. Let x = the number of miles driven in a week.

$260 < 80 + 0.25x$

$180 < 0.25x$

$720 < x$

Driving more than 720 miles in a week makes Basic the better deal.

Exercise Set 1.7

1. $1 < x \le 6$

2. $-2 < x \le 4$

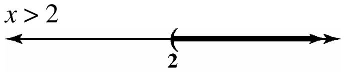
3. $-5 \le x < 2$

4. $-4 \le x < 3$

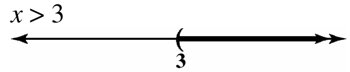
5. $-3 \le x \le 1$

6. $-2 \le x \le 5$

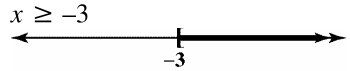
7. $x > 2$



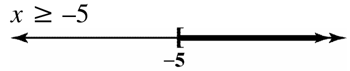
8. $x > 3$



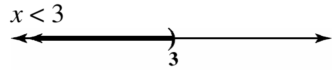
9. $x \ge -3$



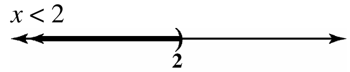
10. $x \ge -5$



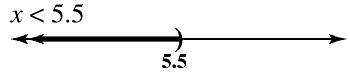
11. $x < 3$



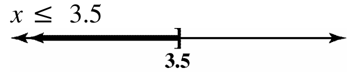
12. $x < 2$



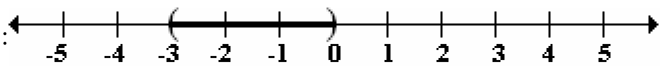
13. $x < 5.5$



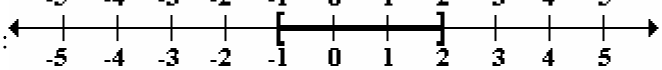
14. $x \le 3.5$



15. Graph $(-3, 0)$:

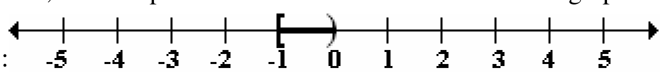


Graph $[-1, 2]$:



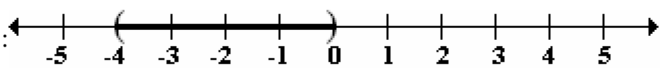
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-3, 0)$ and $[-1, 2]$:

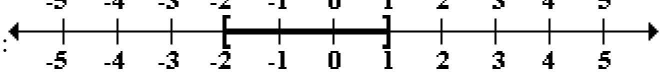


Thus, $(-3, 0) \cap [-1, 2] = [-1, 0)$.

16. Graph $(-4, 0)$:

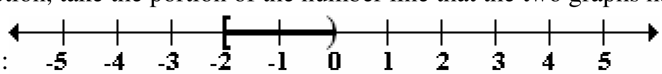


Graph $[-2, 1]$:

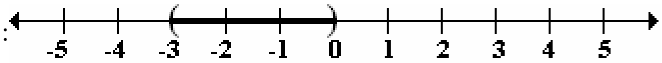


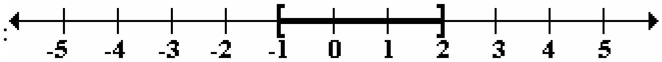
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-4, 0)$ and $[-2, 1]$:

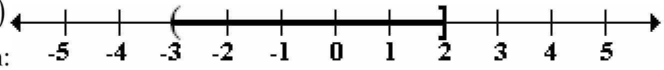


Thus, $(-4, 0) \cap [-2, 1] = [-2, 0)$.

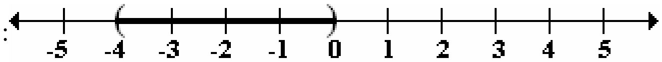
17. Graph $(-3,0)$:


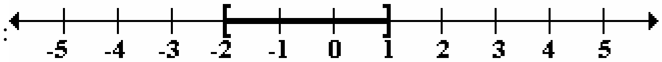
Graph $[-1,2]$:


To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

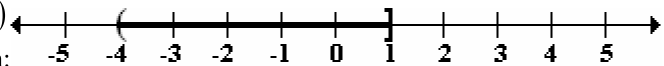
Numbers in either $(-3,0)$ or $[-1,2]$ or both:


Thus, $(-3,0)\cup[-1,2]=(-3,2]$.

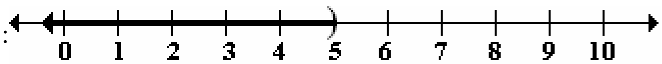
18. Graph $(-4,0)$:


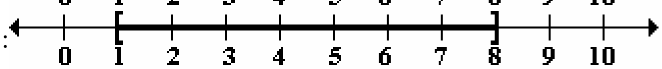
Graph $[-2,1]$:


To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

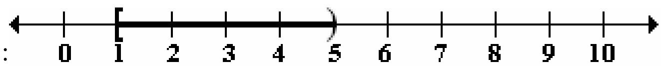
Numbers in either $(-4,0)$ or $[-2,1]$ or both:


Thus, $(-4,0)\cup[-2,1]=(-4,1]$.

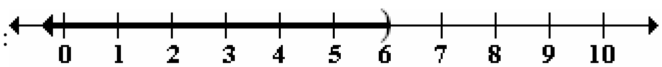
19. Graph $(-\infty,5)$:


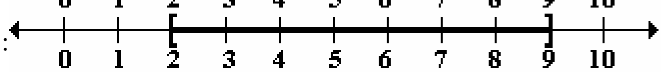
Graph $[1,8]$:


To find the intersection, take the portion of the number line that the two graphs have in common.

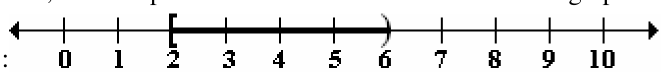
Numbers in both $(-\infty,5)$ and $[1,8]$:


Thus, $(-\infty,5)\cap[1,8]=[1,5)$.

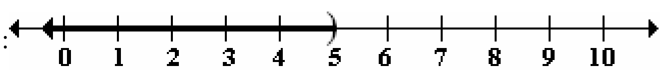
20. Graph $(-\infty,6)$:


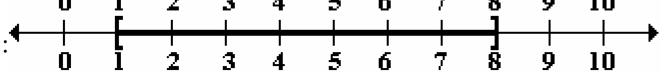
Graph $[2,9]$:


To find the intersection, take the portion of the number line that the two graphs have in common.

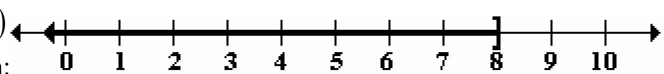
Numbers in both $(-\infty,6)$ and $[2,9]$:


Thus, $(-\infty,6)\cap[2,9]=[2,6)$.

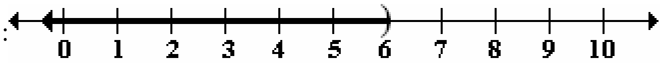
21. Graph $(-\infty,5)$:


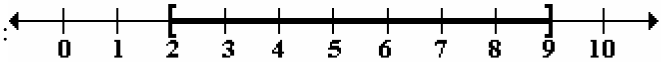
Graph $[1,8]$:


To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

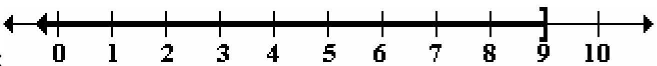
Numbers in either $(-\infty,5)$ or $[1,8]$ or both:


Thus, $(-\infty,5)\cup[1,8]=(-\infty,8]$.

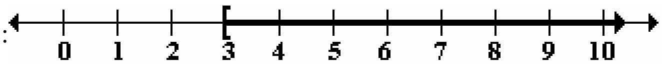
22. Graph $(-\infty, 6)$: 

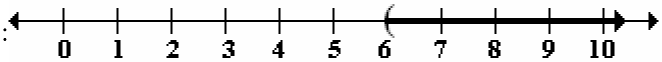
Graph $[2, 9]$: 

To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

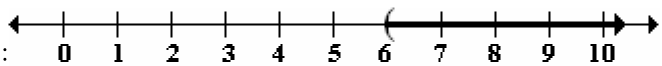
Numbers in either $(-\infty, 6)$ or $[2, 9]$ or both: 

Thus, $(-\infty, 6) \cup [2, 9] = (-\infty, 9]$.

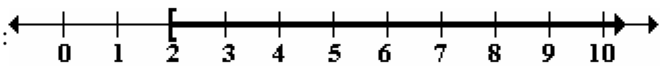
23. Graph $[3, \infty)$: 

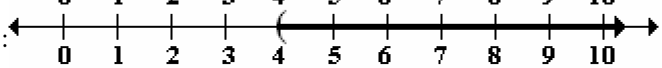
Graph $(6, \infty)$: 

To find the intersection, take the portion of the number line that the two graphs have in common.

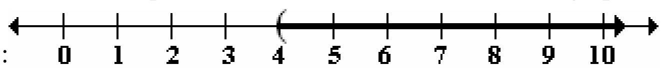
Numbers in both $[3, \infty)$ and $(6, \infty)$: 

Thus, $[3, \infty) \cap (6, \infty) = (6, \infty)$.

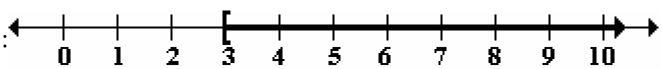
24. Graph $[2, \infty)$: 

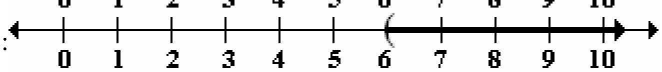
Graph $(4, \infty)$: 

To find the intersection, take the portion of the number line that the two graphs have in common.

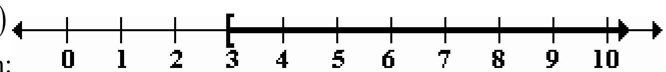
Numbers in both $[2, \infty)$ and $(4, \infty)$: 

Thus, $[2, \infty) \cap (4, \infty) = (4, \infty)$.

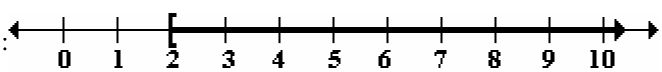
25. Graph $[3, \infty)$: 

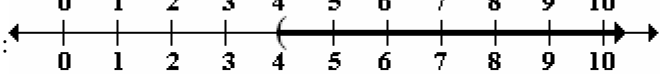
Graph $(6, \infty)$: 

To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

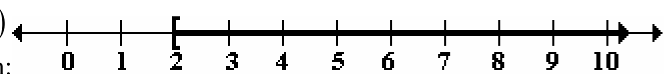
Numbers in either $[3, \infty)$ or $(6, \infty)$ or both: 

Thus, $[3, \infty) \cup (6, \infty) = [3, \infty)$.

26. Graph $[2, \infty)$: 

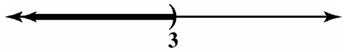
Graph $(4, \infty)$: 

To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

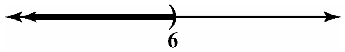
Numbers in either $[2, \infty)$ or $(4, \infty)$ or both: 

Thus, $[2, \infty) \cup (4, \infty) = [2, \infty)$.

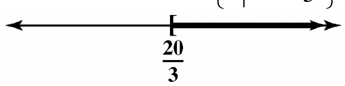
27. $5x + 11 < 26$
$5x < 15$
$x < 3$
The solution set is $\{x \mid x < 3\}$, or $(-\infty, 3)$.



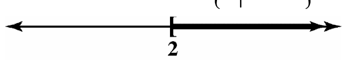
28. $2x + 5 < 17$
$2x < 12$
$x < 6$
The solution set is $\{x \mid x < 6\}$ or $(-\infty, 6)$.



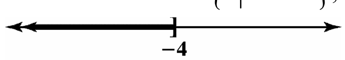
29. $3x - 7 \geq 13$
$3x \geq 20$
$x \geq \frac{20}{3}$
The solution set is $\left\{x \middle| x > \frac{20}{3}\right\}$, or $\left[\frac{20}{3}, \infty\right)$.



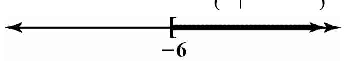
30. $8x - 2 \geq 14$
$8x \geq 16$
$x \geq 2$
The solution set is $\{x \mid x > 2\}$ or $[2, \infty)$.



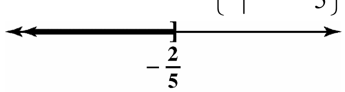
31. $-9x \geq 36$
$x \leq -4$
The solution set is $\{x \mid x \leq -4\}$, or $(-\infty, -4]$.



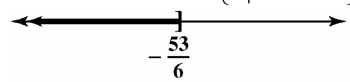
32. $-5x \leq 30$
$x \geq -6$
The solution set is $\{x \mid x \geq -6\}$ or $[-6, \infty)$.



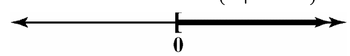
33. $8x - 11 \leq 3x - 13$
$8x - 3x \leq -13 + 11$
$5x \leq -2$
$x \leq -\frac{2}{5}$
The solution set is $\left\{x \middle| x \leq -\frac{2}{5}\right\}$, or $\left(-\infty, -\frac{2}{5}\right]$.



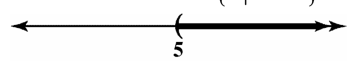
34. $18x + 45 \leq 12x - 8$
$18x - 12x \leq -8 - 45$
$6x \leq -53$
$x \leq -\frac{53}{6}$
The solution set is $\left\{x \middle| x \leq -\frac{53}{6}\right\}$ or $\left(-\infty, -\frac{53}{6}\right]$.



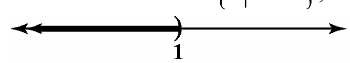
35. $4(x + 1) + 2 \geq 3x + 6$
$4x + 4 + 2 \geq 3x + 6$
$4x + 6 \geq 3x + 6$
$4x - 3x \geq 6 - 6$
$x \geq 0$
The solution set is $\{x \mid x > 0\}$, or $[0, \infty)$.



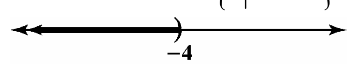
36. $8x + 3 > 3(2x + 1) + x + 5$
$8x + 3 > 6x + 3 + x + 5$
$8x + 3 > 7x + 8$
$8x - 7x > 8 - 3$
$x > 5$
The solution set is $\{x \mid x > 5\}$ or $(5, \infty)$.



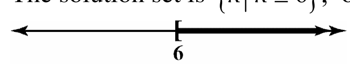
37. $2x - 11 < -3(x + 2)$
$2x - 11 < -3x - 6$
$5x < 5$
$x < 1$
The solution set is $\{x \mid x < 1\}$, or $(-\infty, 1)$.

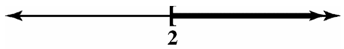


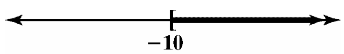
38. $-4(x + 2) > 3x + 20$
$-4x - 8 > 3x + 20$
$-7x > 28$
$x < -4$
The solution set is $\{x \mid x < -4\}$ or $(-\infty, -4)$.

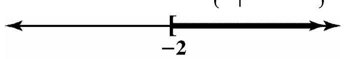


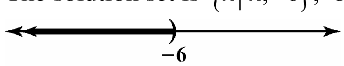
39. $1 - (x + 3) \geq 4 - 2x$
$1 - x - 3 \geq 4 - 2x$
$-x - 2 \geq 4 - 2x$
$x \geq 6$
The solution set is $\{x \mid x \geq 6\}$, or $[6, \infty)$.

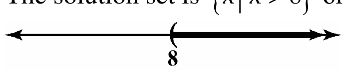


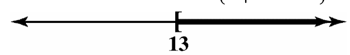
40. $5(3-x) \le 3x-1$
$15-5x \le 3x-1$
$-8x \le -16$
$x \ge 2$
The solution set is $\{x \mid x \ge 2\}$ or $[2, \infty)$.


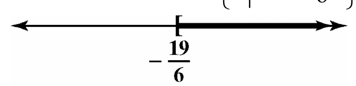
41. $\frac{x}{4}-\frac{3}{2} \le \frac{x}{2}+1$
$\frac{4x}{4}-\frac{4\cdot 3}{2} \le \frac{4\cdot x}{2}+4\cdot 1$
$x-6 \le 2x+4$
$-x \le 10$
$x \ge -10$
The solution set is $\{x \mid x \ge -10\}$, or $[-10, \infty)$.


42. $\frac{3x}{10}+1 \ge \frac{1}{5}-\frac{x}{10}$
$10\left(\frac{3x}{10}+1\right) \ge 10\left(\frac{1}{5}-\frac{x}{10}\right)$
$3x+10 \ge 2-x$
$4x \ge -8$
$x \ge -2$
The solution set is $\{x \mid x \ge -2\}$ or $[-2, \infty)$.


43. $1-\frac{x}{2} > 4$
$-\frac{x}{2} > 3$
$x < -6$
The solution set is $\{x \mid x, -6\}$, 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 $\{x \mid x > 8\}$ 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 $\{x \mid x \ge 13\}$, 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 $\{x \mid x \text{ is any real number}\}$, 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 $\{x \mid 3 < x < 5\}$, or (3, 5).

52. $7 < x+5 < 11$
$7-5 < x+5-5 < 11-5$
$2 < x < 6$
The solution set is $\{x \mid 2 < x < 6\}$ or (2, 6).

53. $-3 \le x-2 < 1$
$-1 \le x < 3$
The solution set is $\{x \mid -1 \le x < 3\}$, or [–1, 3).

54. $-6 < x-4 \le 1$
$-2 < x \le 5$
The solution set is $\{x \mid -2 < x \le 5\}$ or (–2, 5].

55. $-11 < 2x-1 \le -5$
$-10 < 2x \le -4$
$-5 < x \le -2$
The solution set is $\{x \mid -5 < x \le -2\}$, 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 $\{x \mid 3 \le x < 6\}$, 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 $\{x \mid -4 \ge x < 2\}$ or $[-4, 2)$.

59. $|x| < 3$
$-3 < x < 3$
The solution set is $\{x \mid -3 < x < 3\}$, or (–3, 3).

60. $|x| < 5$
$-5 < x < 5$
The solution set is $\{x \mid -5 < x < 5\}$ or (–5, 5).

61. $|x-1| \le 2$
$-2 \le x-1 \le 2$
$-1 \le x \le 3$
The solution set is $\{x \mid -1 \le x \le 3\}$, or [–1, 3].

62. $|x+3| \le 4$
$-4 \le x+3 \le 4$
$-7 \le x \le 1$
The solution set is $\{x \mid -7 \le x \le 1\}$ or [–7, 1].

63. $|2x-6| < 8$
$-8 < 2x-6 < 8$
$-2 < 2x < 14$
$-1 < x < 7$
The solution set is $\{x \mid -1 < x < 7\}$, or (–1, 7).

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 $(5, \infty)$.

71. $|x-1| \ge 2$
$x-1 \ge 2$ or $x-1 \le -2$
$x \ge 3$ $\quad x \le -1$
The solution set is $\{x \mid x \le -1 \text{ or } x \ge 3\}$, that is,
$(-\infty, -1]$ or $[3, \infty)$.

72. $|x+3| \ge 4$
$x+3 \ge 4$ or $x+3 \le -4$
$x \ge 1$ $\quad x \le -7$
The solution set is $\{x \mid x \le -7 \text{ or } x \ge 1\}$, that is,
all x in $(-\infty, -7)$ 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. $\left|\frac{2x+2}{4}\right| \ge 2$
$\frac{2x+2}{4} \ge 2$ or $\frac{2x+2}{4} \le -2$
$2x+2 \ge 8$ $\quad 2x+2 \le -8$
$2x \ge 6$ $\quad 2x \le -10$
$x \ge 3$ $\quad x \le -5$
The solution set is $\{x \mid x \le -5 \text{ or } x \ge 3\}$, that is,
$(-\infty, -5]$ or $[3, \infty)$.

76. $\left|\frac{3x-3}{9}\right| \ge 1$
$\frac{3x-3}{9} \ge 1$ or $\frac{3x-3}{9} \le -1$
$3x-3 \ge 9$ $\quad 3x-3 \le -9$
$3x \ge 12$ $\quad 3x \le -6$
$x \ge 4$ $\quad x \le -2$
The solution set is $\{x \mid x \le -2 \text{ or } x \ge 4\}$,
or $(-\infty, -2]$ or $[4, \infty)$.

77. $\left|3-\frac{2}{3}x\right|>5$

$3-\frac{2}{3}x>5$ or $3-\frac{2}{3}x<-5$

$-\frac{2}{3}x>2$ $\quad -\frac{2}{3}x<-8$

$x<-3$ $\quad x>12$

The solution set is $\{x \mid x<-3 \text{ or } x>12\}$, that is, $(-\infty,-3)$ or $(12,\infty)$.

78. $\left|3-\frac{3}{4}x\right|>9$

$3-\frac{3}{4}x>9$ or $3-\frac{3}{4}x<-9$

$-\frac{3}{4}x>6$ $\quad -\frac{3}{4}x<-12$

$x<-8$ $\quad x>16$

$\{x \mid x<-8 \text{ or } x>16\}$, that is all x in $(-\infty,-8)$ or $(16,\infty)$.

79. $3|x-1|+2 \ge 8$

$3|x-1| \ge 6$

$|x-1| \ge 2$

$x-1\ge 2$ or $x-1\le -2$

$x\ge 3$ $\quad x\le -1$

The solution set is $\{x \mid x\le 1 \text{ or } x\ge 3\}$, that is, $(-\infty,-1]$ or $[3,\infty)$.

80. $5|2x+1|-3\ge 9$

$5|2x+1|\ge 12$

$|2x+1|\ge \frac{12}{5}$

$2x+1\ge \frac{12}{5}$ $\quad 2x+1\le -\frac{12}{5}$

$2x\ge \frac{7}{5}$ or $2x\le -\frac{17}{5}$

$x\ge \frac{7}{10}$ $\quad x\le -\frac{17}{10}$

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 $\{x \mid 2\le x\le 6\}$.

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 $\{x \mid -16\le x\le 2\}$.

83. $-4|1-x|<-16$

$\frac{-4|1-x|}{-4}>\frac{-16}{-4}$

$|1-x|>4$

$1-x>4$ $\quad 1-x<-4$

$-x>3$ or $-x<-5$

$x<-3$ $\quad x>5$

The solution set is $\{x \mid x<-3 \text{ or } x>5\}$.

84. $-2|5-x|<-6$

$-2|5-x|<-6$

$\frac{-2|5-x|}{-2}>\frac{-6}{-2}$

$|5-x|>3$

$5-x>3$ $\quad 5-x<-3$

$-x>-2$ or $-x<-8$

$x<2$ $\quad x>8$

The solution set is $\{x \mid x<2 \text{ or } x>8\}$.

85. $3\le |2x-1|$

$2x-1\ge 3$ $\quad 2x-1\le -3$

$2x\ge 4$ or $2x\le -2$

$x\ge 2$ $\quad x\le -1$

The solution set is $\{x \mid x\le -1 \text{ or } x\ge 2\}$.

86. $9 \le |4x+7|$

$4x+7 \ge 9$ or $4x+7 \le -9$

$4x \ge 2$ $\quad$ $4x \le -16$

$x \ge \frac{2}{4}$ $\quad$ $x \le -4$

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

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 $\{x | 9 < x < 13\}$.

89. $1 < |2-3x|$ is equivalent to $|2-3x| > 1$.

$2-3x > 1$ or $2-3x < -1$

$-3x > -1$ $\quad$ $-3x < -3$

$\frac{-3x}{-3} < \frac{-1}{-3}$ $\quad$ $\frac{-3x}{-3} > \frac{-3}{-3}$

$x < \frac{1}{3}$ $\quad$ $x > 1$

The solution set is $\left\{x \middle| x < \frac{1}{3} \text{ or } x > 1\right\}$.

90. $4 < |2-x|$ is equivalent to $|2-x| > 4$.

$2-x > 4$ or $2-x < -4$

$-x > 2$ $\quad$ $-x < -6$

$\frac{-x}{-1} < \frac{2}{-1}$ $\quad$ $\frac{-x}{-1} > \frac{-6}{-1}$

$x < -2$ $\quad$ $x > 6$

The solution set is $\{x | x < -2 \text{ or } x > 6\}$.

91. $12 < \left|-2x+\frac{6}{7}\right| + \frac{3}{7}$

$\frac{81}{7} < \left|-2x+\frac{6}{7}\right|$

$-2x+\frac{6}{7} > \frac{81}{7}$ or $-2x+\frac{6}{7} < -\frac{81}{7}$

$-2x > \frac{75}{7}$ $\quad$ $-2x < -\frac{87}{7}$

$x < -\frac{75}{14}$ $\quad$ $x > \frac{87}{14}$

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. $4 + \left|3-\frac{x}{3}\right| \ge 9$

$\left|3-\frac{x}{3}\right| \ge 5$

$3-\frac{x}{3} \ge 5$ or $3-\frac{x}{3} \le -5$

$-\frac{x}{3} \ge 2$ $\quad$ $-\frac{x}{3} \le -8$

$x \le -6$ $\quad$ $x \ge 24$

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. $y_1\le y_2$

$\frac{x}{2}+3\le\frac{x}{3}+\frac{5}{2}$

$6\left(\frac{x}{2}+3\right)\le 6\left(\frac{x}{3}+\frac{5}{2}\right)$

$\frac{6x}{2}+6(3)\le\frac{6x}{3}+\frac{6(5)}{2}$

$3x+18\le 2x+15$

$x\le -3$

The solution set is $(-\infty,-3]$.

96. $y_1>y_2$

$\frac{2}{3}(6x-9)+4>5x+1$

$3\left(\frac{2}{3}(6x-9)+4\right)>3(5x+1)$

$2(6x-9)+12>15x+3$

$12x-18+12>15x+3$

$12x-6>15x+3$

$-3x>9$

$\frac{-3x}{-3}<\frac{9}{-3}$

$x<-3$

The solution set is $(-\infty,-3)$.

97. $y\ge 4$

$1-(x+3)+2x\ge 4$

$1-x-3+2x\ge 4$

$x-2\ge 4$

$x\ge 6$

The solution set is $[6,\infty)$.

98. $y\le 0$

$2x-11+3(x+2)\le 0$

$2x-11+3x+6\le 0$

$5x-5\le 0$

$5x\le 5$

$x\le 1$

The solution set is $(-\infty,1]$.

99. $y<8$

$|3x-4|+2<8$

$|3x-4|<6$

$-6<3x-4<6$

$-2<3x<10$

$\frac{-2}{3}<\frac{3x}{3}<\frac{10}{3}$

$\frac{-2}{3}<x<\frac{10}{3}$

The solution set is $\left(\frac{-2}{3},\frac{10}{3}\right)$.

100. $y>9$

$|2x-5|+1>9$

$|2x-5|>8$

$2x-5>8$ or $2x-5<-8$

$2x>13$ $\quad$ $2x<-3$

$x>\frac{13}{2}$ $\quad$ $x<\frac{-3}{2}$

The solution set is $\left(-\infty,-\frac{3}{2}\right)\cup\left(\frac{13}{2},\infty\right)$.

101. $y\le 4$

$7-\left|\frac{x}{2}+2\right|\le 4$

$-\left|\frac{x}{2}+2\right|\le -3$

$\left|\frac{x}{2}+2\right|\ge 3$

$\frac{x}{2}+2\ge 3$ or $\frac{x}{2}+2\le -3$

$x+4\ge 6$ $\quad$ $x+4\le -6$

$x\ge 2$ $\quad$ $x\le -10$

The solution set is $(-\infty,-10]\cup[2,\infty)$.

102.
$$y \ge 6$$
$$8 - |5x+3| \ge 6$$
$$-|5x+3| \ge -2$$
$$-(-|5x+3|) \le -(-2)$$
$$|5x+3| \le 2$$
$$-2 \le 5x+3 \le 2$$
$$-5 \le 5x \le -1$$
$$\frac{-5}{5} \le \frac{5x}{5} \le \frac{-1}{5}$$
$$-1 \le x \le -\frac{1}{5}$$
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 $|3x-4| \ge 5$

$$3x - 4 \ge 5 \qquad 3x-4 \le -5$$
$$3x \ge 9 \quad \text{or} \quad 3x \le -1$$
$$x \ge 3 \qquad x \le -\frac{1}{3}$$
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 $\le$ intimacy or intimacy $\ge$ passion

112. commitment $\ge$ intimacy or intimacy $\le$ 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.
$$3.1x + 25.8 > 63$$
$$3.1x > 37.2$$
$$x > 12$$
Since x is the number of years after 1994, we calculate 1994+12=2006. 63% of voters will use electronic systems after 2006.

118.
$$-2.5x + 63.1 < 38.1$$
$$-2.5x < 25$$
$$x > 10$$
1994 + 10 = 2004
In years after 2004, fewer than 38.1% of U.S. voters will use punch cards or lever machines.

119.
$$28 \le 20 + 0.40(x - 60) \le 40$$
$$28 \le 20 + 0.40x - 24 \le 40$$
$$28 \le 0.40x - 4 \le 40$$
$$32 \le 0.40x \le 44$$
$$80 \le x \le 110$$
Between 80 and 110 ten minutes, inclusive.

120. $15 \le \frac{5}{9}(F-32) \le 35$

$\frac{9}{5}(15) \le \frac{9}{5}\left(\frac{5}{9}(F-32)\right) \le \frac{9}{5}(35)$

$9(3) \le F-32 \le 9(7)$

$27 \le F-32 \le 63$

$59 \le F \le 95$

The range for Fahrenheit temperatures is $59°\text{F}$ to $95°\text{F}$, inclusive or $[59°\text{F}, 95°\text{F}]$.

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. $50 + 0.20x < 20 + 0.50x$

$30 < 0.3x$

$100 < x$

Basic Rental is a better deal when driving more than 100 miles per day.

123. $15 + 0.08x < 3 + .12x$

$12 < 0.04x$

$300 < x$

Plan A is a better deal when driving more than 300 miles a month.

124. $1800 + 0.03x < 200 + 0.08x$

$1600 < 0.05x$

$32000 < x$

A home assessment of greater than $32,000 would make the first bill a better deal.

125. $2 + 0.08x < 8 + 0.05x$

$0.03x < 6$

$x < 200$

The credit union is a better deal when writing less than 200 checks.

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 tapes 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.

131. a. $\frac{86+88+x}{3} \ge 90$

$\frac{174+x}{3} \ge 90$

$174 + x \ge 270$

$x \ge 96$

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.

$226 \le 175 + 34x \le 294$

$51 \le 34x \le 119$

$1.5 \le x \le 3.5$

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.

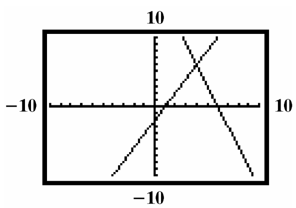
$$2(7.50 + 0.50x) < 30$$
$$15 + x < 30$$
$$x < 15$$

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.

$$3x > 7.50 + 0.50x$$
$$2.50x > 7.50$$
$$x > 3$$

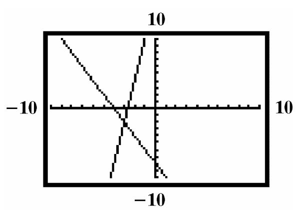
The 3-month pass is the best deal when making more than 3 but less than 15 crossings per 3-month period.

142.



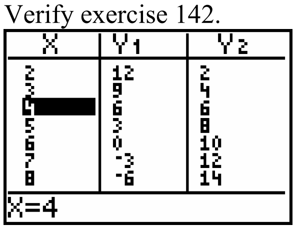
$x < 4$

143.



$x < -3$

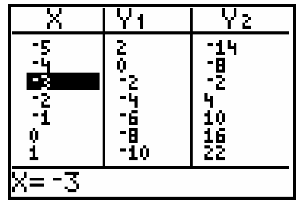
144. Verify exercise 142.



X	Y1	Y2
2	12	2
3	9	4
4	6	6
5	3	8
6	0	10
7	-3	12
8	-6	14

X=4

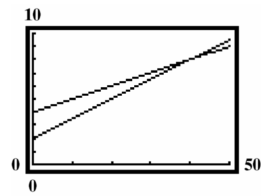
Verify exercise 143.



X	Y1	Y2
-5	2	-14
-4	0	-8
-3	-2	-2
-2	-4	4
-1	-6	10
0	-8	16
1	-10	22

X= -3

145 **a.** The cost of Plan A is 4 + 0.10x;
The cost of Plan B is 2 + 0.15x.



c. 41 or more checks make Plan A better.

d.
$$4 + 0.10x < 2 + 0.15x$$
$$2 < 0.05x$$
$$x > 40$$
The solution set is $\{x \mid x > 40\}$ or $(40, \infty)$.

146. **a.** False; $|2x - 3| > -7$ is true for any x because the absolute value is 0 or positive.

b. False; $2x > 6$, $x > 3$
3.1 is a real number that satisfies the inequality.

c. True; $|x - 4| > 0$ is not satisfied only when $x = 4$. Since 4 is rational, all irrational numbers satisfy the inequality.

d. False

(c) is true.

147. Because $x > y$, $y - x$ represents a negative number. When both sides are multiplied by $(y - x)$ the inequality must be reversed.

148. **a.** $|x - 4| < 3$

b. $|x - 4| \geq 3$

149. Model 1:

$|T-57|<7$

$-7<T-57<7$

$50<T<64$

Model 2:

$|T-50|<22$

$-22<T-50<22$

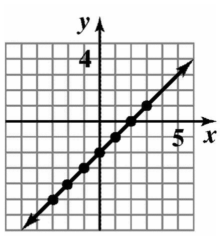
$28<T<72$

Model 1 describes a city with monthly temperature averages ranging from 50 degrees to 64 degrees Fahrenheit. Model 2 describes a city with monthly temperature averages ranging from 28 degrees to 72 degrees Fahrenheit.

Model 1 describes San Francisco and model 2 describes Albany.

Chapter 1 Review Exercises

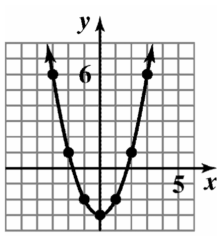
1.



$y = 2x - 2$

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

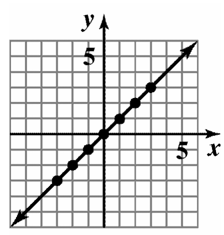
2.



$y = x^2 - 3$

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

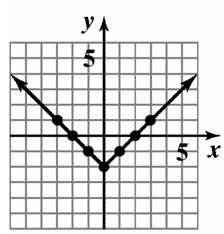
3.



$y = x$

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

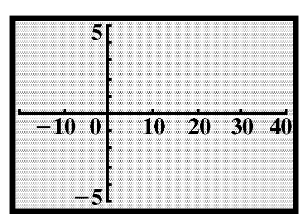
4.



$y = |x| - 2$

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

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. Point A is (91, 125). This means that in 1991, 125,000 acres were used for cultivation

10. Opium cultivation was 150,000 acres in 1997.

11. Opium cultivation was at a minimum in 2001 when approximately 25,000 acres were used.

12. Opium cultivation was at a maximum in 2004 when approximately 300,000 acres were used.

13. Opium cultivation did not change between 1991 and 1992.

14. Opium cultivation increased at the greatest rate between 2001 and 2002. The increase in acres used for opium cultivation in this time period was approximately 180,000 – 25,000 = 155,000 acres.

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.

25. $\frac{2x}{3}=6-\frac{x}{4}$

$4(2x)=12(6)-3x$

$8x=72-3x$

$11x=72$

$x=\frac{72}{11}$

The solution set is $\left\{\frac{72}{11}\right\}$.

This is a conditional equation.

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

$\frac{12\cdot x}{4}=12(2)-\frac{12(x-3)}{3}$

$3x=24-4x+12$

$7x=36$

$x=\frac{36}{7}$

The solution set is $\left\{\frac{36}{7}\right\}$.

This is a conditional equation.

27. $\frac{3x+1}{3}-\frac{13}{2}=\frac{1-x}{4}$

$4(3x+1)-6(13)=3(1-x)$

$12x+4-78=3-3x$

$12x-74=3-3x$

$15x=77$

$x=\frac{77}{15}$

The solution set is $\left\{\frac{77}{15}\right\}$.

This is a conditional equation.

28. $\frac{9}{4}-\frac{1}{2x}=\frac{4}{x}$

$9x-2=16$

$9x=18$

$x=2$

The solution set is $\{2\}$.
This is a conditional equation.

29. $\frac{7}{x-5}+2=\frac{x+2}{x-5}$

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

$7+2x-10=x+2$

$2x-3=x+2$

$x=5$

5 does not check and must be rejected.
The solution set is the empty set, $\varnothing$.
This is an inconsistent equation.

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

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

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

$x+1-x+1=2$

$2=2$

The solution set is all real numbers except –1 and 1. This is a conditional equation.

31. $\frac{5}{x+3}+\frac{1}{x-2}=\frac{8}{x^2+x-6}$

$\frac{5}{x+3}+\frac{1}{x-2}=\frac{8}{(x+3)(x-2)}$

$\frac{5(x+3)(x-2)}{x+3}+\frac{(x+3)(x-2)}{x-2}=\frac{8(x+3)(x-2)}{(x+3)(x-2)}$

$5(x-2)+1(x+3)=8$

$5x-10+x+3=8$

$6x-7=8$

$6x=15$

$x=\frac{15}{6}$

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

The solution set is $\left\{\frac{5}{2}\right\}$.

This is a conditional equation.

32. $$\frac{1}{x+5}=0$$
$$(x+5)\frac{1}{x+5}=(x+5)(0)$$
$$1=0$$
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 of calories in Burger King's Chicken Caesar.
$x+125$ = the number of calories in Taco Bell's Express Taco Salad.
$x+95$ = the number of calories in Wendy's Mandarin Chicken Salad.
$$x+(x+125)+(x+95)=1705$$
$$3x+220=1705$$
$$3x=1485$$
$$x=495$$
$$x+125=495+125=620$$
$$x+95=495+95=590$$

There are 495 calories in the Chicken Caesar, 620 calories in the Express Taco Salad, and 590 calories in the Mandarin Chicken Salad.

37. Let $x =$ the number of years after 1970.
$$P=-0.5x+37.4$$
$$18.4=-0.5x+37.4$$
$$-19=-0.5x$$
$$\frac{-19}{-0.5}=\frac{-0.5x}{-0.5}$$
$$38=x$$
If the trend continues only 18.4% of U.S. adults will smoke cigarettes 38 years after 1970, or 2008.

38. $$15+.05x=5+.07x$$
$$10=.02x$$
$$500=x$$
Both plans cost the same at 500 minutes.

39. Let x = the original price of the phone

$48 = x - 0.20x$

$48 = 0.80x$

$60 = x$

The original price is $60.

40. Let x = the amount sold to earn $800 in one week

$800 = 300 + 0.05x$

$500 = 0.05x$

$10,000 = x$

Sales must be $10,000 in one week to earn $800.

41. Let x = the amount invested at 4%
Let y = the amount invested at 7%

$x + y = 9000$

$0.04x + 0.07y = 555$

Multiply the first equation by –0.04 and add.

$-0.04x - 0.04y = -360$

$0.04x + 0.07y = 555$

$0.03y = 195$

$y = 6500$

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 4% and $6500 invested at 7%.

42. Let $x =$ the amount invested at 2%
Let $8000 - x =$ the amount invested at 5%.

$0.05(8000 - x) = 0.02x + 85$

$400 - 0.05x = 0.02x + 85$

$-0.05x - 0.02x = 85 - 400$

$-0.07x = -315$

$$\frac{-0.07x}{-0.07} = \frac{-315}{-0.07}$$

$x = 4500$

$8000 - x = 3500$

$4500 was invested at 2% and $3500 was invested at 5%.

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 2007).
College A's enrollment: $14,100 + 1500x$
College B's enrollment: $41,700 - 800x$
$14,100 + 1500x = 41,700 - 800x$

b. Check some 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 $2007 + 12 = 2019$. 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. $(7+8i)(7-8i) = 7^2+8^2 = 49+64 = 113$

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. $2x^2+15x = 8$
$2x^2+15x-8 = 0$
$(2x-1)(x+8) = 0$
$2x-1 = 0 \quad x+8 = 0$
$x = \frac{1}{2}$ or $x = -8$
The solution set is $\left\{\frac{1}{2}, -8\right\}$.

59. $5x^2+20x = 0$
$5x(x+4) = 0$
$5x = 0 \quad x+4 = 0$
$x = 0$ 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.
$$x^2 + 20x$$
$$\left(\frac{20}{2}\right)^2 = 10^2 = 100$$
$$x^2 + 20x + 100 = (x+10)^2$$

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 $\left\{1+\sqrt{5}, 1-\sqrt{5}\right\}$.

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 $\left\{1+3i\sqrt{2}, 1-3i\sqrt{2}\right\}$.

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

$3x^2+5x-9x-15=5$

$3x^2-4x-20=0$

$x=\frac{4\pm\sqrt{(-4)^2-4(3)(-20)}}{2(3)}$

$x=\frac{4\pm\sqrt{16+240}}{6}$

$x=\frac{4\pm\sqrt{256}}{6}$

$x=\frac{4\pm16}{6}$

$x=\frac{20}{6},\frac{-12}{6}$

$x=\frac{10}{3},-2$

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. $x^2-9=0$

$x^2=9$

$x=\pm3$

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

77. $(x-3)^2-25=0$

$(x-3)^2=25$

$x-3=\pm5$

$x=3\pm5$

$x=8,-2$

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. $3x^2-10x=8$

$3x^2-10x-8=0$

$(3x+2)(x-4)=0$

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

$3x=-2 \qquad x=4$

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

The solution set is $\left\{-\frac{2}{3},4\right\}$.

80. $(x+2)^2+4=0$

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

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

$x+2=\pm2i$

$x=-2\pm2i$

The solution set is $\{-2+2i,-2-2i\}$.

81.
$$\frac{5}{x+1}+\frac{x-1}{4}=2$$
$$\frac{5\cdot 4(x+1)}{x+1}+\frac{(x-1)\cdot 4(x+1)}{4}=2\cdot 4(x+1)$$
$$20+(x-1)(x+1)=8(x+1)$$
$$20+x^2-1=8x+8$$
$$x^2-8x-11=0$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(-8)\pm\sqrt{(-8)^2-4(1)(11)}}{2(1)}$$
$$x=\frac{8\pm\sqrt{20}}{2}$$
$$x=\frac{8\pm 2\sqrt{5}}{2}$$
$$x=4\pm\sqrt{5}$$
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. $P=-0.035x^2+0.65x+7.6$
$$0=-0.035x^2+0.65x+7.6$$
$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$
$$x=\frac{-(0.65)\pm\sqrt{(0.65)^2-4(-0.035)(7.6)}}{2(-0.035)}$$
$x\approx 27 \quad x\approx -8$ (rejected)

If this trend continues, corporations will pay no taxes 27 years after 1985, or 2012.

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 $\left\{-3, \frac{1}{2}, 3\right\}$.

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. $(x-7)^{\frac{2}{3}}=25$

$\left[(x-7)^{\frac{2}{3}}\right]^{\frac{3}{2}}=25^{\frac{3}{2}}$

$x-7=\left(5^2\right)^{\frac{3}{2}}$

$x-7=5^3$

$x-7=125$

$x=132$

The solution set is {132}.

92. $x^4-5x^2+4=0$

Let $t=x^2$

$t^2-5t+4=0$

$t=4$ or $t=1$

$x^2=4$ $\quad x^2=1$

$x=\pm 2$ $\quad x=\pm 1$

The solution set is {–2, –1, 1, 2}.

93. $x^{1/2}+3x^{1/4}-10=0$

Let $t=x^{1/4}$

$t^2+3t-10=0$

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

$t=-5$ or $t=2$

$x^{\frac{1}{4}}=-5$ $\quad x^{\frac{1}{4}}=2$

$\left(x^{\frac{1}{4}}\right)^4=(-5)^4$ $\quad \left(x^{\frac{1}{4}}\right)^4=(2)^4$

$x=625$ $\quad x=16$

625 does not check and must be rejected.
The solution set is {16}.

94. $|2x+1|=7$

$2x+1=7$ or $2x+1=-7$

$2x=6$ $\quad 2x=-8$

$x=3$ $\quad x=-8$

The solution set is {–4, 3}.

95. $2|x-3|-6=10$

$2|x-3|=16$

$|x-3|=8$

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

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

The solution set is {–5, 11}.

96. $3x^{4/3} - 5x^{2/3} + 2 = 0$

Let $t = x^{\frac{2}{3}}$.

$3t^2 - 5t + 2 = 0$

$(3t-2)(t-1) = 0$

$3t - 2 = 0$ or $t - 1 = 0$

$3t = 2$, $t = \frac{2}{3}$, $x^{\frac{2}{3}} = \frac{2}{3}$, $\left(x^{\frac{2}{3}}\right)^{\frac{3}{2}} = \pm\left(\frac{2}{3}\right)^{\frac{3}{2}}$

$x = \pm\sqrt[2]{\left(\frac{2}{3}\right)^3}$

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

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

$x = \pm\frac{2\sqrt{6}}{9}$

$t = 1$, $x^{\frac{2}{3}} = 1$, $\left(x^{\frac{2}{3}}\right)^{\frac{3}{2}} = \pm(1)^{\frac{3}{2}}$, $x = \pm 1$

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. $|2x-5| - 3 = 0$

$2x - 5 = 3$ or $2x - 5 = -3$

$2x = 8$ $\quad 2x = 2$

$x = 4$ $\quad x = 1$

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. $\sqrt{8-2x} - x = 0$

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

$\left(\sqrt{8-2x}\right)^2 = (x)^2$

$8 - 2x = x^2$

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

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

$x + 4 = 0$ or $x - 2 = 0$

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

–4 does not check.

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

101. $x^3 + 3x^2 - 2x - 6 = 0$

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

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

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

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

$x = \pm\sqrt{2}$

The solution set is $\left\{-3, -\sqrt{2}, \sqrt{2}\right\}$.

102. $-4|x+1| + 12 = 0$

$-4|x+1| = -12$

$|x+1| = 3$

$x + 1 = 3$ or $x + 1 = -3$

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

The solution set is $\{-4, 2\}$.

103. We need to solve $4.3 = 0.3\sqrt{x} + 3.4$ for x.

$4.3 = 0.3\sqrt{x} + 3.4$

$0.9 = 0.3\sqrt{x}$

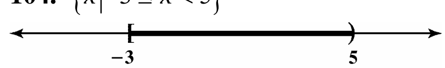
$3 = \sqrt{x}$

$3^2 = \left(\sqrt{x}\right)^2$

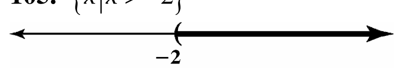
$9 = x$

The model indicates that the number of HIV infections in India will reach 4.3 million in 2007 ($x = 9$ years after 1998).

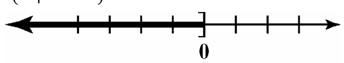
104. $\{x \mid -3 \le x < 5\}$



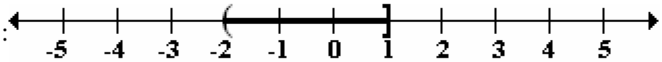
105. $\{x \mid x > -2\}$



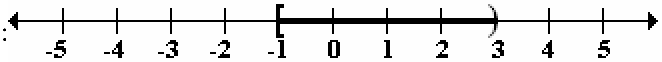
106. $\{x | x \le 0\}$



107. Graph $(-2,1]$:

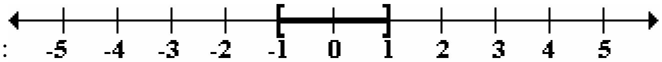


Graph $[-1,3)$:



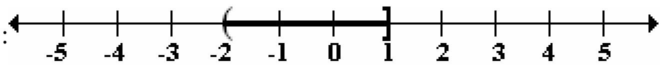
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $(-2,1]$ and $[-1,3)$:

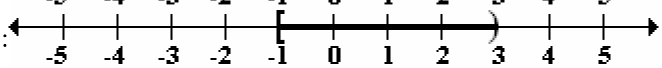


Thus, $(-2,1] \cap [-1,3) = [-1,1]$.

108. Graph $(-2,1]$:

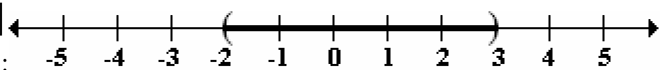


Graph $[-1,3)$:



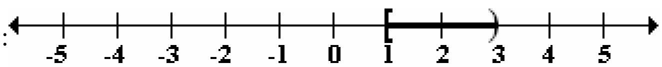
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $(-2,1]$ or $[-1,3)$ or both:

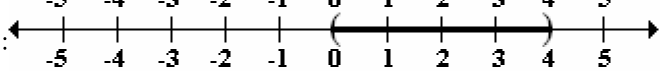


Thus, $(-2,1] \cup [-1,3) = (-2,3)$.

109. Graph $[1,3)$:

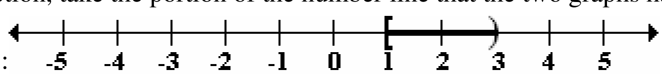


Graph $(0,4)$:



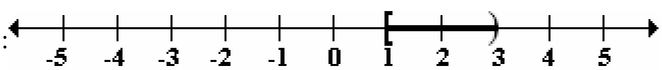
To find the intersection, take the portion of the number line that the two graphs have in common.

Numbers in both $[1,3)$ and $(0,4)$:

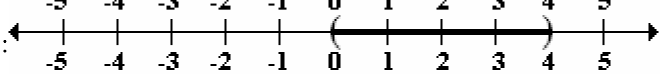


Thus, $[1,3) \cap (0,4) = [1,3)$.

110. Graph $[1,3)$:

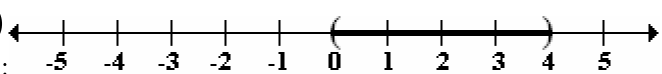


Graph $(0,4)$:



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:

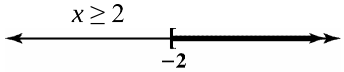


Thus, $[1,3) \cup (0,4) = (0,4)$.

111. $-6x + 3 \le 15$

$-6x \le 12$

$x \ge 2$

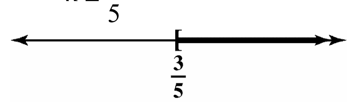


The solution set is $[-2,\infty)$.

112. $6x - 9 \ge -4x - 3$

$10x \ge 6$

$x \ge \frac{3}{5}$



The solution set is $\left[\frac{3}{5},\infty\right)$.

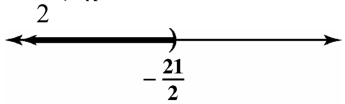
113. $\frac{x}{3}-\frac{3}{4}-1>\frac{x}{2}$

$12\left(\frac{x}{3}-\frac{3}{4}-1\right)>12\left(\frac{x}{2}\right)$

$4x-9-12>6x$

$-21>2x$

$-\frac{21}{2}>x$



The solution set is $\left(-\infty,-\frac{21}{2}\right)$.

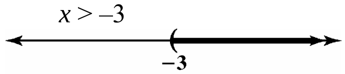
114. $6x+5>-2(x-3)-25$

$6x+5>-2x+6-25$

$8x+5>-19$

$8x>-24$

$x>-3$



The solution set is $(-3,\infty)$.

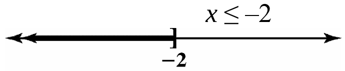
115. $3(2x-1)-2(x-4)\geq 7+2(3+4x)$

$6x-3-2x+8\geq 7+6+8x$

$4x+5\geq 8x+13$

$-4x\geq 8$

$x\leq -2$



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 $[-9,6]$.

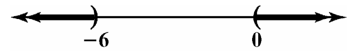
119. $\left|\frac{2x+6}{3}\right|>2$

$\frac{2x+6}{3}>2 \quad \frac{2x+6}{3}<-2$

$2x+6>6 \quad 2x+6<-6$

$2x>0 \quad 2x<-12$

$x>0 \quad x<-6$



The solution set is $(-\infty,-6)$ or $(0,\infty)$.

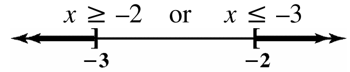
120. $|2x+5|-7\geq -6$

$|2x+5|\geq 1$

$2x+5\geq 1$ 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. $-4|x+2|+5\leq -7$

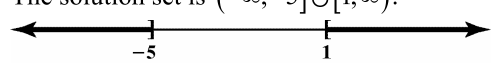
$-4|x+2|\leq -12$

$|x+2|\geq 3$

$x+2\geq 3$ 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. $3-|2x-5| \geq -6$

$-|2x-5| \geq -9$

$\frac{-|2x-5|}{-1} \leq \frac{-9}{-1}$

$|2x-5| \leq 9$

$-9 \leq 2x-5 \leq 9$

$-4 \leq 2x \leq 14$

$-2 \leq x \leq 7$

The solution set is $[-2, 7]$.

124. $0.20x+24 \leq 40$

$0.20x \leq 16$

$\frac{0.20x}{0.20} \leq \frac{16}{0.20}$

$x \leq 80$

A customer can drive no more than 80 miles.

125. $80 \leq \frac{95+79+91+86+x}{5} < 90$

$400 \leq 95+79+91+86+x < 450$

$400 \leq 351+x < 450$

$49 \leq x < 99$

A grade of at least 49% but less than 99% will result in a B.

126. $0.075x \geq 9000$

$\frac{0.075x}{0.075} \geq \frac{9000}{0.075}$

$x \geq 120{,}000$

The investment must be at least $120,000.

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

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

$2x+1 = 0$ or $x-2 = 0$

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

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

6. $(3x-1)^2 = 75$

$3x-1 = \pm\sqrt{75}$

$3x = 1 \pm 5\sqrt{3}$

$x = \frac{1 \pm 5\sqrt{3}}{3}$

The solution set is $\left\{\frac{1-5\sqrt{3}}{3}, \frac{1+5\sqrt{3}}{3}\right\}$.

7. $(x+3)^2 + 25 = 0$

$(x+3)^2 = -25$

$x+3 = \pm\sqrt{-25}$

$x = -3 \pm 5i$

The solution set is $\{-3+5i, -3-5i\}$.

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 $\{5\}$.

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 $t = x^{1/3}$

$t^2 - 9t + 8 = 0$

$(t-1)(t-8) = 0$

$t = 1 \quad t = 8$

$x^{1/3} = 1 \quad x^{1/3} = 8$

$x = 1 \quad x = 512$

The solution set is {1, 512}.

16. $\left|\frac{2}{3}x - 6\right| = 2$

$\frac{2}{3}x - 6 = 2 \quad \frac{2}{3}x - 6 = -2$

$\frac{2}{3}x = 8 \quad \frac{2}{3}x = 4$

$x = 12 \quad x = 6$

The solution set is {6, 12}.

17. $-3|4x-7| + 15 = 0$

$-3|4x-7| = -15$

$|4x-7| = 5$

$4x - 7 = 5$ or $4x - 7 = -5$

$4x = 12 \quad 4x = 2$

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

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. $\frac{2x}{x^2 + 6x + 8} + \frac{2}{x+2} = \frac{x}{x+4}$

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

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

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

$2x + 2x + 8 = x^2 + 2x$

$2x + 8 = x^2$

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

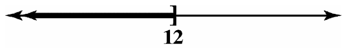
$0 = (x-4)(x+2)$

$x - 4 = 0$ or $x + 2 = 0$

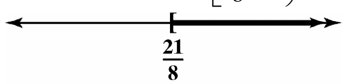
$x = 4 \quad x = -2$ (rejected)

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 $\left[\frac{21}{8}, \infty\right)$.



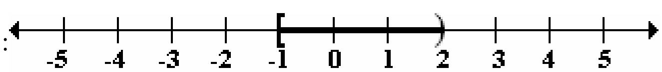
22. $-3 \leq \frac{2x+5}{3} < 6$
$-9 \leq 2x+5 < 18$
$-14 \leq 2x < 13$
$-7 \leq x < \frac{13}{2}$
The solution set is $\left[-7, \frac{13}{2}\right)$.

23. $|3x+2| \geq 3$
$3x+2 \geq 3$ or $3x+2 \leq -3$
$3x \geq 1$ $\quad 3x \leq -5$
$x \geq \frac{1}{3}$ $\quad x \leq -\frac{5}{3}$
The solution set is $\left(-\infty, -\frac{5}{3}\right] \cup \left[\frac{1}{3}, \infty\right)$.

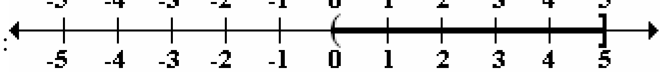
24. $-3 \leq y \leq 7$
$-3 \leq 2x-5 \leq 7$
$2 \leq 2x \leq 12$
$1 \leq x \leq 6$
The solution set is $[1, 6]$.

25. $y \geq 1$
$\left|\frac{2-x}{4}\right| \geq 1$
$\frac{2-x}{4} \geq 1$ or $\frac{2-x}{4} \leq -1$
$2-x \geq 4$ $\quad 2-x \leq -4$
$-x \geq 2$ $\quad -x \leq -6$
$x \leq -2$ $\quad x \geq 6$
The solution set is $(-\infty, -2] \cup [6, \infty)$.

26. Graph $[-1, 2)$:

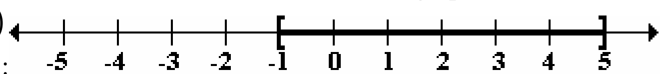


Graph $(0, 5]$:



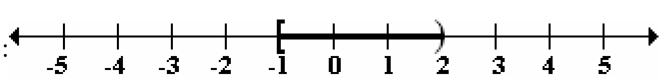
To find the union, take the portion of the number line representing the total collection of numbers in the two graphs.

Numbers in either $[-1, 2)$ or $(0, 5]$ or both:

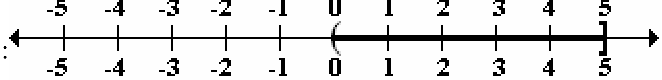


Thus,
$[-1, 2) \cup (0, 5] = [-1, 5]$.

27. Graph $[-1, 2)$:

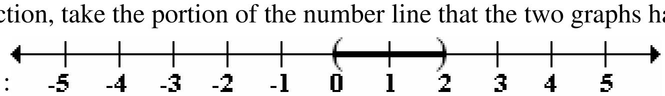


Graph $(0, 5]$:



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. $y - y_1 = m(x - x_1)$

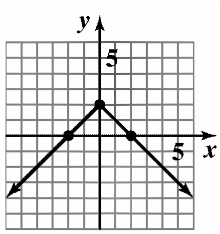
$y - y_1 = mx - mx_1$

$-mx = y_1 - mx_1 - y$

$\frac{-mx}{-m} = \frac{y_1 - mx_1 - y}{-m}$

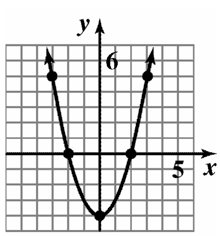
$x = \frac{y - y_1}{m} + x_1$

30.



$y = 2 - |x|$

31.



$y = x^2 - 4$

32. $(6 - 7i)(2 + 5i) = 12 + 30i - 14i - 35i^2$

$= 12 + 16i + 35$

$= 47 + 16i$

33. $\frac{5}{2 - i} = \frac{5}{2 - i} \cdot \frac{2 + i}{2 + i}$

$= \frac{5(2 + i)}{4 + 1}$

$= \frac{5(2 + i)}{5}$

$= 2 + i$

34. $2\sqrt{-49} + 3\sqrt{-64} = 2(7i) + 3(8i)$

$= 14i + 24i$

$= 38i$

35. $43x + 575 = 1177$

$43x = 602$

$x = 14$

The system's income will be \$1177 billion 14 years after 2004, or 2018.

36. $B = 0.07x^2 + 47.4x + 500$

$1177 = 0.07x^2 + 47.4x + 500$

$0 = 0.07x^2 + 47.4x - 677$

$0 = 0.07x^2 + 47.4x - 677$

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

$x = \frac{-(47.4) \pm \sqrt{(47.4)^2 - 4(0.07)(-677)}}{2(0.07)}$

$x \approx 14, \quad x \approx -691$ (rejected)

The system's income will be \$1177 billion 14 years after 2004, or 2018.

37. The formulas model the data quite well.

38. Let x = the number of books in 2002.
Let $x + 62$ = the number of books in 2003.
Let $x + 190$ = the number of books in 2004.

$(x) + (x + 62) + (x + 190) = 2598$

$x + x + 62 + x + 190 = 2598$

$3x + 252 = 2598$

$3x = 2346$

$x = 782$

$x + 62 = 844$

$x + 190 = 972$

The number of books in 2002, 2003, and 2004 were 782, 844, and 972 respectively.

39. $29700 + 150x = 5000 + 1100x$

$24700 = 950x$

$26 = x$

In 26 years, the cost will be \$33,600.

40. Let x = amount invested at 8%
$10000 - x$ = amount invested at 10%

$$.08x + .1(10000 - x) = 940$$
$$.08x + 1000 - .1x = 940$$
$$-.02x = -60$$
$$x = 3000$$
$$10000 - x = 7000$$

$3000 at 8%, $7000 at 10%

41.
$$l = 2w + 4$$
$$A = lw$$
$$48 = (2w + 4)w$$
$$48 = 2w^2 + 4w$$
$$0 = 2w^2 + 4w - 48$$
$$0 = w^2 + 2w - 24$$
$$0 = (w + 6)(w - 4)$$

$$w + 6 = 0 \qquad w - 4 = 0$$
$$w = -6 \qquad w = 4$$
$$2w + 4 = 2(4) + 4 = 12$$

width is 4 feet, length is 12 feet

42.
$$24^2 + x^2 = 26^2$$
$$576 + x^2 = 676$$
$$x^2 = 100$$
$$x = \pm 10$$

The wire should be attached 10 feet up the pole.

43. Let x = the original selling price

$$20 = x - 0.60x$$
$$20 = 0.40x$$
$$50 = x$$

The original price is $50.

44. Let x = the number of local calls
The monthly cost using Plan *A* is $C_A = 25$.
The monthly cost using Plan *B* is $C_B = 13 + 0.06x$.
For Plan *A* to be better deal, it must cost less than Plan *B*.

$$C_A < C_B$$
$$25 < 13 + 0.06x$$
$$12 < 0.06x$$
$$200 < x$$
$$x > 200$$

Plan *A* is a better deal when more than 200 local calls are made per month.