

Section 3.1 Practice Exercises

1. a. equation

b. solution

c. linear

d. first

e. solution; set

f. solution

g. conditional

h. contradiction

i. empty set; $\{ \}$ or \emptyset

j. identity

3. $8x - 3y + 2xy - 5x + 12xy$
 $= 3x - 3y + 14xy$

5. $2(3z - 4) - (z + 12) = 6z - 8 - z - 12$
 $= 5z - 20$

7. $2x + 1 = 5$
 $2x - 4 = 0$ Linear

9. $x^2 + 7 = 9$ Nonlinear

11. $-3 = x$
 $-x - 3 = 0$ Linear

13. a. $2x - 1 = 5$
 $2(2) - 1 = 5$
 $4 - 1 = 5$
 $3 \neq 5$
 2 is not a solution

c. $2(0) - 1 = 5$
 $0 - 1 = 5$
 $-1 \neq 5$
 0 is not a solution.

b. $2(3) - 1 = 5$
 $6 - 1 = 5$
 $5 = 5$
 3 is a solution.

d. $2(-1) - 1 = 5$
 $-2 - 1 = 5$
 $-3 \neq 5$
 -1 is not a solution.

15. $x + 7 = 19$
 $x + 7 - 7 = 19 - 7$
 $x = 12$ $\{12\}$
 Check: $12 + 7 = 19$
 $19 = 19$

17. $-x = 2$
 $x = -2$ $\{-2\}$
 Check: $-(-2) = 2$
 $2 = 2$

$$19. \quad -\frac{7}{8} = -\frac{5}{6}z$$

$$24\left(-\frac{7}{8}\right) = 24\left(-\frac{5}{6}z\right)$$

$$-21 = -20z$$

$$\frac{-21}{-20} = \frac{-20z}{-20}$$

$$z = \frac{21}{20} \quad \left\{ \frac{21}{20} \right\}$$

$$\text{Check: } -\frac{7}{8} = -\frac{5}{6}\left(\frac{21}{20}\right)$$

$$= -\frac{105}{120}$$

$$= -\frac{7}{8}$$

$$23. \quad 2.53 = -2.3t$$

$$\frac{2.53}{-2.3} = \frac{-2.3t}{-2.3}$$

$$-1.1 = t \quad \{-1.1\}$$

$$\text{Check: } 2.53 = -2.3(-1.1)$$

$$= 2.53$$

$$27. \quad 6q - 4 = 62$$

$$6q - 4 + 4 = 62 + 4$$

$$6q = 66$$

$$\frac{6q}{6} = \frac{66}{6}$$

$$q = 11 \quad \{11\}$$

$$\text{Check:}$$

$$6(11) - 4 = 62$$

$$66 - 4 = 62$$

$$62 = 62$$

$$31. \quad -b - 5 = 2$$

$$-b - 5 + 5 = 2 + 5$$

$$-b = 7$$

$$21. \quad \frac{a}{5} = -8$$

$$5\left(\frac{a}{5}\right) = 5(-8)$$

$$a = -40 \quad \{-40\}$$

$$\text{Check: } \frac{-40}{5} = -8$$

$$-8 = -8$$

$$25. \quad p - 2.9 = 3.8$$

$$p - 2.9 + 2.9 = 3.8 + 2.9$$

$$p = 6.7 \quad \{6.7\}$$

$$\text{Check: } 6.7 - 2.9 = 3.8$$

$$3.8 = 3.8$$

$$29. \quad 4y - 17 = 35$$

$$4y - 17 + 17 = 35 + 17$$

$$4y = 52$$

$$\frac{4y}{4} = \frac{52}{4}$$

$$y = 13 \quad \{13\}$$

$$\text{Check: } 4(13) - 17 = 35$$

$$52 - 17 = 35$$

$$35 = 35$$

$$33. \quad 3(x - 6) = 2x - 5$$

$$3x - 18 = 2x - 5$$

$$3x - 18 + 18 = 2x - 5 + 18$$

$$-1(-b) = -1(7)$$

$$b = -7 \quad \{-7\}$$

$$\text{Check: } -(-7) - 5 = 2$$

$$7 - 5 = 2$$

$$2 = 2$$

$$3x = 2x + 13$$

$$3x - 2x = 2x - 2x + 13$$

$$x = 13 \quad \{13\}$$

$$\text{Check: } 3(13 - 6) = 2(13) - 5$$

$$3(7) = 26 - 5$$

$$21 = 21$$

$$35. \quad 6 - (t + 2) = 5(3t - 4)$$

$$6 - t - 2 = 15t - 20$$

$$-t + 4 = 15t - 20$$

$$-t - 15t + 4 = 15t - 15t - 20$$

$$-16t + 4 = -20$$

$$-16t + 4 - 4 = -20 - 4$$

$$-16t = -24$$

$$\frac{-16t}{-16} = \frac{-24}{-16}$$

$$t = \frac{3}{2} \quad \left\{ \frac{3}{2} \right\}$$

$$\text{Check: } 6 - \left(\frac{3}{2} + 2 \right) = 5 \left(3 \cdot \frac{3}{2} - 4 \right)$$

$$6 - \frac{7}{2} = 5 \left(\frac{9}{2} - 4 \right)$$

$$\frac{5}{2} = 5 \left(\frac{1}{2} \right)$$

$$\frac{5}{2} = \frac{5}{2}$$

$$37. \quad 6(a + 3) - 10 = -2(a - 4)$$

$$6a + 18 - 10 = -2a + 8$$

$$6a + 8 = -2a + 8$$

$$6a + 2a + 8 = -2a + 2a + 8$$

$$8a + 8 = 8$$

$$8a + 8 - 8 = 8 - 8$$

$$8a = 0$$

$$\frac{8a}{8} = \frac{0}{8}$$

$$a = 0 \quad \{0\}$$

$$\text{Check: } 6(0 + 3) - 10 = -2(0 - 4)$$

$$6(3) - 10 = -2(-4)$$

$$18 - 10 = 8$$

$$8 = 8$$

$$39. \quad -2[5 - (2z + 1)] - 4 = 2(3 - z)$$

$$-2[5 - 2z - 1] - 4 = 6 - 2z$$

$$-10 + 4z + 2 - 4 = 6 - 2z$$

$$4z - 12 = 6 - 2z$$

$$4z + 2z - 12 = 6 - 2z + 2z$$

$$6z - 12 = 6$$

$$41. \quad 6(-y + 4) - 3(2y - 3) = -y + 5 + 5y$$

$$-6y + 24 - 6y + 9 = 4y + 5$$

$$-12y + 33 = 4y + 5$$

$$-12y + 12y + 33 = 4y + 12y + 5$$

$$33 = 16y + 5$$

$$33 - 5 = 16y + 5 - 5$$

$$6z - 12 + 12 = 6 + 12$$

$$6z = 18$$

$$\frac{6z}{6} = \frac{18}{6}$$

$$z = 3 \quad \{3\}$$

$$\text{Check: } -2[5 - (2 \cdot 3 + 1)] - 4 = 2(3 - 3)$$

$$-2[5 - (6 + 1)] - 4 = 2(0)$$

$$-2[5 - 7] - 4 = 0$$

$$-2[-2] - 4 = 0$$

$$4 - 4 = 0$$

$$0 = 0$$

$$28 = 16y$$

$$\frac{28}{16} = \frac{16y}{16}$$

$$\frac{7}{4} = y \quad \left\{ \frac{7}{4} \right\}$$

Check:

$$6\left(-\frac{7}{4} + 4\right) - 3\left(2 \cdot \frac{7}{4} - 3\right) = -\frac{7}{4} + 5 + 5 \cdot \frac{7}{4}$$

$$6\left(\frac{9}{4}\right) - 3\left(\frac{14}{4} - \frac{12}{4}\right) = -\frac{7}{4} + \frac{20}{4} + \frac{35}{4}$$

$$\frac{54}{4} - 3\left(\frac{2}{4}\right) = \frac{48}{4}$$

$$\frac{54}{4} - \frac{6}{4} = \frac{48}{4}$$

$$\frac{48}{4} = \frac{48}{4}$$

$$43. \quad 14 - 2x + 5x = -4(-2x - 5) - 6$$

$$14 + 3x = 8x + 20 - 6 = 8x + 14$$

$$14 + 3x - 8x = 8x - 8x + 14$$

$$14 - 5x = 14$$

$$14 - 14 - 5x = 14 - 14$$

$$-5x = 0$$

$$\frac{-5x}{-5} = \frac{0}{-5}$$

$$x = 0 \quad \{0\}$$

Check:

$$14 - 2 \cdot 0 + 5 \cdot 0 = -4(-2 \cdot 0 - 5) - 6$$

$$14 - 0 + 0 = -4(0 - 5) - 6$$

$$14 = -4(-5) - 6$$

$$14 = 20 - 6$$

$$14 = 14$$

45.

$$\frac{2}{3}x - \frac{1}{6} = -\frac{5}{12}x + \frac{3}{2} - \frac{1}{6}x$$

$$12\left(\frac{2}{3}x - \frac{1}{6}\right) = 12\left(-\frac{5}{12}x + \frac{3}{2} - \frac{1}{6}x\right)$$

$$8x - 2 = -5x + 18 - 2x$$

$$8x - 2 = -7x + 18$$

$$8x + 7x - 2 = -7x + 7x + 18$$

$$15x - 2 = 18$$

$$15x - 2 + 2 = 18 + 2$$

$$15x = 20$$

$$\frac{15x}{15} = \frac{20}{15}$$

$$x = \frac{4}{3} \quad \left\{ \frac{4}{3} \right\}$$

$$47. \quad \frac{1}{5}(p - 5) = \frac{3}{5}p + \frac{1}{10}p + 1$$

$$\frac{1}{5}p - 1 = \frac{3}{5}p + \frac{1}{10}p + 1$$

49.

$$\frac{3x - 7}{2} + \frac{3 - 5x}{3} = \frac{3 - 6x}{5}$$

$$30\left(\frac{3x - 7}{2} + \frac{3 - 5x}{3}\right) = 30\left(\frac{3 - 6x}{5}\right)$$

$$\begin{aligned}
10\left(\frac{1}{5}p-1\right) &= 10\left(\frac{3}{5}p+\frac{1}{10}p+1\right) \\
2p-10 &= 6p+p+10 \\
2p-10 &= 7p+10 \\
2p-7p-10 &= 7p-7p+10 \\
-5p-10 &= 10 \\
-5p-10+10 &= 10+10 \\
-5p &= 20 \\
\frac{-5p}{-5} &= \frac{20}{-5} \\
p &= -4 \quad \{-4\}
\end{aligned}$$

$$\begin{aligned}
15(3x-7)+10(3-5x) &= 6(3-6x) \\
45x-105+30-50x &= 18-36x \\
-5x-75 &= 18-36x \\
-5x+36x-75 &= 18-36x+36x \\
31x-75 &= 18 \\
31x-75+75 &= 18+75 \\
31x &= 93 \\
\frac{31x}{31} &= \frac{93}{31} \\
x &= 3 \quad \{3\}
\end{aligned}$$

$$\begin{aligned}
51. \quad \frac{4}{3}(2q+6)-\frac{5q-6}{6}-\frac{q}{3} &= 0 \\
6\left[\frac{4}{3}(2q+6)-\frac{5q-6}{6}-\frac{q}{3}\right] &= 6(0) \\
8(2q+6)-(5q-6)-2q &= 0 \\
16q+48-5q+6-2q &= 0 \\
9q+54 &= 0 \\
9q+54-54 &= 0-54 \\
9q &= -54 \\
\frac{9q}{9} &= \frac{-54}{9} \\
q &= -6 \quad \{-6\}
\end{aligned}$$

$$\begin{aligned}
53. \quad 6.3w-1.5 &= 4.8 \\
10(6.3w-1.5) &= 10(4.8) \\
63w-15 &= 48 \\
63w-15+15 &= 48+15 \\
63w &= 63 \\
\frac{63w}{63} &= \frac{63}{63} \\
w &= 1 \quad \{1\}
\end{aligned}$$

$$\begin{aligned}
55. \quad 0.75(m-2)+0.25m &= 0.5 \\
100[0.75(m-2)+0.25m] &= 100[0.5] \\
75(m-2)+25m &= 50 \\
100m-150 &= 50 \\
100m-150+150 &= 50+150 \\
100m &= 200 \\
\frac{100m}{100} &= \frac{200}{100} \\
m &= 2 \quad \{2\}
\end{aligned}$$

57. A conditional equation is an equation that is true for some values of the variable but false for other values of the variable.

59. $4x+1=2(2x+1)-1$

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

$$4x+1=4x+1$$

$$0=0$$

This is an identity.

$$\{x \mid x \text{ is a real number}\}$$

61. $-11x+4(x-3)=-2x-12$

$$-11x+4x-12=-2x-12$$

$$-7x-12=-2x-12$$

$$-7x+2x-12=-2x+2x-12$$

$$-5x-12=-12$$

$$-5x-12+12=-12+12$$

$$-5x=0$$

$$\frac{-5x}{-5} = \frac{0}{-5}$$

$$x=0$$

This is a conditional equation. $\{0\}$

63. $2x-4+8x=7x-8+3x$

$$10x-4=10x-8$$

$$10x-10x-4=10x-10x-8$$

$$-4=-8$$

This is a contradiction. $\{ \}$

65. $-5b+9=-71$

$$-5b+9-9=-71-9$$

$$-5b=-80$$

$$\frac{-5b}{-5} = \frac{-80}{-5}$$

$$b=16 \quad \{16\}$$

67. $16=-10+13x$

$$16+10=-10+10+13x$$

$$26=13x$$

$$\frac{26}{13} = \frac{13x}{13}$$

$$2=x \quad \{2\}$$

69. $10c+3=-3+12c$

$$10c-12c+3=-3+12c-12c$$

$$-2c+3=-3$$

$$-2c+3-3=-3-3$$

$$-2c=-6$$

$$\frac{-2c}{-2} = \frac{-6}{-2} \Rightarrow c=3 \quad \{3\}$$

71. $12b-8b-8+13=4b+6-1$

$$4b+5=4b+5$$

$$0=0$$

The equation is an identity. The solution set is $\{b \mid b \text{ is a real number}\}$.

73. $5(x-2)-2x=3x+7$

$$5x-10-2x=3x+7$$

$$3x-10=3x+7$$

$$3x-3x-10=3x-3x+7$$

$$-10=7$$

$\{ \}$

$$\begin{aligned}
 75. \quad & \frac{c}{2} - \frac{c}{4} + \frac{3c}{8} = 1 \\
 & 8\left(\frac{c}{2} - \frac{c}{4} + \frac{3c}{8}\right) = 8(1) \\
 & 4c - 2c + 3c = 8 \\
 & 5c = 8 \\
 & \frac{5c}{5} = \frac{8}{5} \\
 & c = \frac{8}{5} \quad \left\{ \frac{8}{5} \right\}
 \end{aligned}$$

$$\begin{aligned}
 77. \quad & 0.75(8x - 4) = \frac{2}{3}(6x - 9) \\
 & 6x - 3 = 4x - 6 \\
 & 6x - 4x - 3 = 4x - 4x - 6 \\
 & 2x - 3 = -6 \\
 & 2x - 3 + 3 = -6 + 3 \\
 & 2x = -3 \\
 & \frac{2x}{2} = \frac{-3}{2} \\
 & x = -\frac{3}{2} \quad \left\{ -\frac{3}{2} \right\}
 \end{aligned}$$

$$\begin{aligned}
 79. \quad & 7(p + 2) - 4p = 3p + 14 \\
 & 7p + 14 - 4p = 3p + 14 \\
 & 3p + 14 = 3p + 14 \\
 & 3p - 3p + 14 = 3p - 3p + 14 \\
 & 14 = 14 \\
 & \left\{ p \mid p \text{ is a real number} \right\}
 \end{aligned}$$

$$\begin{aligned}
 81. \quad & 4[3 + 5(3 - b) + 2b] = 6 - 2b \\
 & 4[3 + 15 - 5b + 2b] = 6 - 2b \\
 & 4[-3b + 18] = 6 - 2b \\
 & -12b + 72 = 6 - 2b \\
 & -12b + 2b + 72 = 6 - 2b + 2b \\
 & -10b + 72 = 6 \\
 & -10b + 72 - 72 = 6 - 72 \\
 & -10b = -66 \\
 & \frac{-10b}{-10} = \frac{-66}{-10} \\
 & b = \frac{33}{5} = 6.6 \quad \left\{ \frac{33}{5} \right\}
 \end{aligned}$$

$$\begin{aligned}
 83. \quad & 3 - \frac{3}{4}x = 3\left(3 - \frac{1}{4}x\right) \\
 & 3 - \frac{3}{4}x = 9 - \frac{3}{4}x \\
 & 3 = 9
 \end{aligned}$$

The equation is a contradiction.

The solution set is $\{ \}$.

$$\begin{aligned}
 85. \quad & \frac{5}{4} + \frac{y-3}{8} = \frac{2y+1}{2} \\
 & 8\left(\frac{5}{4} + \frac{y-3}{8}\right) = 8\left(\frac{2y+1}{2}\right) \\
 & 10 + y - 3 = 4(2y + 1) \\
 & y + 7 = 8y + 4 \\
 & y - 8y + 7 = 8y - 8y + 4 \\
 & -7y + 7 = 4 \\
 & -7y + 7 - 7 = 4 - 7 \\
 & -7y = -3 \\
 & \frac{-7y}{-7} = \frac{-3}{-7} \Rightarrow y = \frac{3}{7} \quad \left\{ \frac{3}{7} \right\}
 \end{aligned}$$

$$\begin{aligned}
87. \quad & \frac{2y-9}{10} + \frac{3}{2} = y \\
& 10\left(\frac{2y-9}{10} + \frac{3}{2}\right) = 10y \\
& 2y - 9 + 15 = 10y \\
& 2y + 6 = 10y \\
& 2y - 2y + 6 = 10y - 2y \\
& 6 = 8y \\
& \frac{6}{8} = \frac{8y}{8} \Rightarrow \frac{3}{4} = y \quad \left\{ \frac{3}{4} \right\}
\end{aligned}$$

$$\begin{aligned}
91. \quad & 0.5x + 0.25 = \frac{1}{3}x + \frac{5}{4} \\
& \frac{1}{2}x + \frac{1}{4} = \frac{1}{3}x + \frac{5}{4} \\
& 12\left(\frac{1}{2}x + \frac{1}{4}\right) = 12\left(\frac{1}{3}x + \frac{5}{4}\right) \\
& 6x + 3 = 4x + 15 \\
& 6x - 4x + 3 = 4x - 4x + 15 \\
& 2x + 3 = 15 \\
& 2x + 3 - 3 = 15 - 3 \Rightarrow 2x = 12 \\
& \frac{2x}{2} = \frac{12}{2} \Rightarrow x = 6 \quad \{6\}
\end{aligned}$$

$$\begin{aligned}
95. \quad & -\frac{7}{8}y + \frac{1}{4} = \frac{1}{2}\left(5 - \frac{3}{4}y\right) = \frac{5}{2} - \frac{3}{8}y \\
& 8\left(-\frac{7}{8}y + \frac{1}{4}\right) = 8\left(\frac{5}{2} - \frac{3}{8}y\right) \\
& -7y + 2 = 20 - 3y \\
& -7y + 3y + 2 = 20 - 3y + 3y \\
& -4y + 2 = 20 \\
& -4y + 2 - 2 = 20 - 2 \Rightarrow -4y = 18 \\
& \frac{-4y}{-4} = \frac{18}{-4} \Rightarrow y = -\frac{9}{2} \quad \left\{ -\frac{9}{2} \right\}
\end{aligned}$$

$$\begin{aligned}
89. \quad & 0.48x - 0.08x = 0.12(260 - x) \\
& 100(0.48x - 0.08x) = 100[0.12(260 - x)] \\
& 48x - 8x = 12(260 - x) \\
& 40x = 3120 - 12x \\
& 40x + 12x = 3120 - 12x + 12x \\
& 52x = 3120 \\
& \frac{52x}{52} = \frac{3120}{52} \\
& x = 60 \quad \{60\}
\end{aligned}$$

$$\begin{aligned}
93. \quad & 0.3b - 1.5 = 0.25(b + 2) + 0.05b \\
& 0.3b - 1.5 = 0.25b + 0.5 + 0.05b \\
& 0.3b - 1.5 = 0.3b + 0.5 \\
& 1.5 = 0.5
\end{aligned}$$

The equation is a contradiction.
The solution set is { }.

$$\begin{aligned}
97. \quad & 0.12h + 14.89 = 137.77 \\
& 0.12h = 137.77 - 14.89 \\
& 0.12h = 122.88 \\
& h = \frac{122.88}{0.12} \\
& h = 1024
\end{aligned}$$

The family used 1024 kWh.

99. a. $-2(y-1)+3(y+2)=-2y+2+3y+6$
 $=y+8$

b. $2(y-1)+3(y+2)=0$
 $y+8=0$
 $y+8-8=0-8$
 $y=-8 \quad \{-8\}$

c. To simplify an expression, clear parentheses and combine like terms.

To solve an equation, isolate the variable to find a solution.

Problem Recognition Exercises

1. Expression

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

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

$$= -4x + 4$$

3. Equation

$$7b - 1 = 2b + 4$$

$$7b - 2b - 1 = 2b - 2b + 4$$

$$5b - 1 = 4$$

$$5b - 1 + 1 = 4 + 1 \Rightarrow 5b = 5$$

$$\frac{5b}{5} = \frac{5}{5} \Rightarrow b = 1 \quad \{1\}$$

5. Expression

$$4(a-8) - 7(2a+1)$$

$$= 4a - 32 - 14a - 7$$

$$= -10a - 39$$

7. Equation

$$7(2-w) = 5w + 8$$

$$14 - 7w = 5w + 8$$

$$14 - 7w - 5w = 5w - 5w + 8$$

$$14 - 12w = 8$$

$$14 - 14 - 12w = 8 - 14$$

$$-12w = -6$$

$$\frac{-12w}{-12} = \frac{-6}{-12} \Rightarrow w = \frac{1}{2} \quad \left\{ \frac{1}{2} \right\}$$

9. Equation

$$2(3x-4) - 4(5x+1) = -8x + 7$$

$$6x - 8 - 20x - 4 = -8x + 7$$

$$-14x - 12 = -8x + 7$$

$$-14x + 8x - 12 = -8x + 8x + 7$$

$$-6x - 12 = 7$$

$$-6x - 12 + 12 = 7 + 12$$

$$-6x = 19$$

$$\frac{-6x}{-6} = \frac{19}{-6}$$

$$x = -\frac{19}{6} \quad \left\{ -\frac{19}{6} \right\}$$

11. Expression

$$\begin{aligned} & \frac{1}{2}v + \frac{3}{5} - \frac{2}{3}v - \frac{7}{10} \\ &= \frac{15}{30}v + \frac{18}{30} - \frac{20}{30}v - \frac{21}{30} \\ &= -\frac{5}{30}v - \frac{3}{30} = -\frac{1}{6}v - \frac{1}{10} \end{aligned}$$

15. Equation

$$\begin{aligned} & \frac{5}{6}y - \frac{7}{8} = \frac{1}{2}y + \frac{3}{4} \\ & 24\left(\frac{5}{6}y - \frac{7}{8}\right) = 24\left(\frac{1}{2}y + \frac{3}{4}\right) \\ & \left(\frac{120}{6}y - \frac{168}{8}\right) = \left(\frac{24}{2}y + \frac{72}{4}\right) \\ & 20y - 21 = 12y + 18 \\ & 20y - 12y - 21 = 12y - 12y + 18 \end{aligned}$$

17. Expression

$$\begin{aligned} & 0.29c + 4.495 - 0.12c \\ &= 0.17c + 4.495 \end{aligned}$$

13. Equation

$$\begin{aligned} 20x - 8 + 7x + 28 &= 27x - 9 \\ 27x + 20 &= 27x - 9 \\ 27x - 27x + 20 &= 27x - 27x - 9 \\ 20 &= -9 \\ \{ & \} \end{aligned}$$

$$\begin{aligned} 8y - 21 &= 18 \\ 8y - 21 + 21 &= 18 + 21 \\ 8y &= 39 \\ \frac{8y}{8} &= \frac{39}{8} \\ y &= \frac{39}{8} \quad \left\{ \frac{39}{8} \right\} \end{aligned}$$

19. Equation

$$\begin{aligned} 0.125(2p - 8) &= 0.25(p - 4) \\ 0.25p - 1 &= 0.25p - 1 \\ 0.25p - 0.25p - 1 &= 0.25p - 0.25p - 1 \\ -1 &= -1 \\ \{p \mid p \text{ is a real number}\} \end{aligned}$$

Section 3.2 Practice Exercises

- 1.**
- a.** consecutive
 - b.** even; odd
 - c.** 1; 2; 2
 - d.** $x+1$
 - e.** $x+2$
 - f.** $x+2$; $x+4$
 - g.** Prt ; interest
 - h.** \$1300
 - i.** $0.48L$;
 $0.12(x+8)$
 - j.** $\frac{d}{t}$; $\frac{d}{r}$

$$\begin{aligned}
3. \quad & 7a - 2 = 11 \\
& 7a - 2 + 2 = 11 + 2 \\
& 7a = 13 \\
& \frac{7a}{7} = \frac{13}{7} \\
& a = \frac{13}{7} \quad \left\{ \frac{13}{7} \right\}
\end{aligned}$$

$$\begin{aligned}
5. \quad & 4(x - 3) + 7 = 19 \\
& 4x - 12 + 7 = 19 \\
& 4x - 5 = 19 \\
& 4x = 24 \\
& \frac{4x}{4} = \frac{24}{4} \\
& x = 6 \quad \{6\}
\end{aligned}$$

$$\begin{aligned}
7. \quad & \frac{3}{8}p + \frac{3}{4} = p - \frac{3}{2} \\
& 8\left(\frac{3}{8}p + \frac{3}{4}\right) = 8\left(p - \frac{3}{2}\right) \\
& 3p + 6 = 8p - 12 \\
& 3p - 8p + 6 = 8p - 8p - 12 \\
& -5p + 6 = -12
\end{aligned}$$

$$\begin{aligned}
& -5p + 6 - 6 = -12 - 6 \\
& -5p = -18 \\
& \frac{-5p}{-5} = \frac{-18}{-5} \\
& p = \frac{18}{5} \quad \left\{ \frac{18}{5} \right\}
\end{aligned}$$

$$9. \quad x + 5$$

$$11. \quad 2t - 7$$

$$\begin{aligned}
13. \quad & \text{Let } x = \text{the smaller number} \\
& 2x + 3 = \text{the larger number} \\
& (\text{larger number}) - (\text{smaller number}) = 8 \\
& (2x + 3) - x = 8 \\
& 2x + 3 - x = 8 \\
& x + 3 = 8 \\
& x + 3 - 3 = 8 - 3 \\
& x = 5 \\
& 2x + 3 = 2(5) + 3 \\
& = 10 + 3 = 13 \\
& \text{The smaller number is 5 and the larger is} \\
& 13.
\end{aligned}$$

$$\begin{aligned}
15. \quad & \text{Let } x = \text{the number} \\
& 3x + 2 = \text{the sum} \\
& x - 4 = \text{the difference} \\
& (\text{sum}) = (\text{difference}) \\
& 3x + 2 = x - 4 \\
& 3x - x + 2 = x - x - 4 \\
& 2x + 2 = -4 \\
& 2x + 2 - 2 = -4 - 2 \\
& 2x = -6 \\
& \frac{2x}{2} = \frac{-6}{2} \\
& x = -3 \\
& \text{The number is } -3.
\end{aligned}$$

$$\begin{aligned}
17. \quad & \text{Let } x = \text{the first page number} \\
& x + 1 = \text{the consecutive page number} \\
& (\text{first}) + (\text{second}) = 223
\end{aligned}$$

$$\begin{aligned}
19. \quad & \text{Let } x = \text{the first odd integer} \\
& x + 2 = \text{the consecutive odd integer} \\
& (\text{first}) + (\text{second}) = -148
\end{aligned}$$

$$x + (x+1) = 223$$

$$2x + 1 = 223$$

$$2x + 1 - 1 = 223 - 1$$

$$2x = 222$$

$$\frac{2x}{2} = \frac{222}{2}$$

$$x = 111$$

$$x + 1 = 111 + 1 = 112$$

The consecutive page numbers are 111 and 112.

$$x + (x+2) = -148$$

$$2x + 2 = -148$$

$$2x + 2 - 2 = -148 - 2$$

$$2x = -150$$

$$\frac{2x}{2} = \frac{-150}{2}$$

$$x = -75$$

$$x + 2 = -75 + 2 = -73$$

The two consecutive odd integers are -75 and -73 .

21. Let x = the smaller even integer

$x + 2$ = larger consecutive even integer

(3 times small) = (-146 minus 4 times larger)

$$3x = -146 - 4(x + 2)$$

$$3x = -146 - 4x - 8$$

$$3x = -154 - 4x$$

$$3x + 4x = -154 - 4x + 4x$$

$$7x = -154$$

$$\frac{7x}{7} = \frac{-154}{7}$$

$$x = -22$$

$$x + 2 = -22 + 2 = -20$$

The two consecutive even integers are -22 and -20 .

23. Let x = first odd integer

$x + 2$ = second consecutive odd integer

$x + 4$ = third consecutive odd integer

(2 times sum) = (23 more than 5 times third)

$$2(x + x + 2 + x + 4) = 5(x + 4) + 23$$

$$2(3x + 6) = 5x + 20 + 23$$

$$6x + 12 = 5x + 43$$

$$6x - 5x + 12 = 5x - 5x + 43$$

$$x + 12 = 43$$

$$x + 12 - 12 = 43 - 12$$

$$x = 31$$

$$x + 2 = 31 + 2 = 33$$

$$x + 4 = 31 + 4 = 35$$

The three consecutive odd integers are 31, 33, and 35.

25. Option 1:

Principal amount borrowed:

$$P = 15,000$$

Interest rate: $r = 0.085$

Duration of loan: $t = 4$

$$x = Prt$$

$$x = 15,000(0.085)(4)$$

$$x = 5100$$

Option 2:

Principal amount borrowed:

$$P = 15,000$$

Interest rate: $r = 0.0775$

Duration of loan: $t = 5$

$$x = Prt$$

$$x = 15,000(0.0775)(5)$$

$$x = 5812.50$$

She would pay \$5100 for 4 yr at 8.5% and \$5812.50 for 5 yr at 7.75%; the 8.5% option for 4 yr requires less interest.

27. Let x = the amount of sales
 (earnings) = 600 + (sales amt)(comm. rate)

$$2400 = 600 + x(0.03)$$

$$2400 - 600 = 600 - 600 + 0.03x$$

$$1800 = 0.03x$$

$$\frac{1800}{0.03} = \frac{0.03x}{0.03}$$

$$60,000 = x$$

She needs to sell \$60,000 to earn \$2400.

29. Let c = the sales before tax
 (total cash) = (sales) + (sales tax)
 (sales tax) = (tax rate)(sales)

$$1293.38 = c + 0.0805c$$

$$1293.38 = 1.0805c$$

$$\frac{1293.38}{1.0805} = \frac{1.0805c}{1.0805}$$

$$1197.02 = c$$

$$t = 0.0805(1197.02) = 96.36$$

The total merchandise was \$1197.02 and the sales tax was \$96.36.

31. Let c = the cost before markup
 (price) = (cost) + (markup)
 (markup) = (markup rate)(cost)

$$43.08 = c + 0.20c$$

$$43.08 = 1.20c$$

$$\frac{43.08}{1.20} = \frac{1.20c}{1.20}$$

$$35.90 = c$$

The price before markup was \$35.90.

33.

	2%	5%		Total
Amount				
Invested	x	$12,500 - x$		12500
Interest				
Earned	$0.02x$	$0.05(12,500 - x)$		370

(int at 2%) + (int at 5%) = (total int)

$$0.02x + 0.05(12,500 - x) = 370$$

$$0.02x + 625 - 0.05x = 370$$

$$-0.03x + 625 = 370$$

$$-0.03x + 625 - 625 = 370 - 625$$

$$-0.03x = -340$$

$$\frac{-0.03x}{-0.03} = \frac{-255}{-0.03}$$

$$x = \frac{-255}{-0.03}$$

$$x = 8500$$

$$12,500 - x = 12,500 - 8500$$

$$= 4000$$

\$8500 was invested at 2% and \$4000 was invested at 5%.

35.

	11%	6%	
	Loan	Loan	Total
Amount			
Borrowed	x	$18,000 - x$	18,000
Interest			
Paid	$0.11x$	$0.06(18,000 - x)$	1380

(int at 11%) + (int at 6%) = (total int)

$$0.11x + 0.06(18,000 - x) = 1380$$

$$0.11x + 1080 - 0.06x = 1380$$

$$0.05x + 1080 = 1380$$

$$0.05x + 1080 - 1080 = 1380 - 1080$$

$$0.05x = 300$$

$$\frac{0.05x}{0.05} = \frac{300}{0.05}$$

$$x = 6000$$

$$18,000 - x = 18,000 - 6000$$

$$= 12,000$$

\$6000 was borrowed at 11% and \$12,000 was borrowed at 6%.

37.

	4%	3%		
	<u>Account</u>	<u>Account</u>		<u>Total</u>

Amount

<u>Invested</u>	<u>x</u>	<u>$x - 4000$</u>		
-----------------	-----------------------	------------------------------	--	--

Interest

<u>Earned</u>	<u>$0.04x$</u>	<u>$0.03(x - 4000)$</u>		<u>720</u>
---------------	---------------------------	------------------------------------	--	------------

(int at 4%) + (int at 3%) = (total int)

$$0.04x + 0.03(x - 4000) = 720$$

$$0.04x + 0.03x - 120 = 720$$

$$0.07x - 120 = 720$$

$$0.07x - 120 + 120 = 720 + 120$$

$$0.07x = 840$$

$$\frac{0.07x}{0.07} = \frac{840}{0.07}$$

$$x = 12,000$$

$$x - 4000 = 12,000 - 4000$$

$$= 8000$$

\$12,000 was invested at 4% and \$8000 was invested at 3%.

39.

	15%	10%		14%
	<u>nitrogen</u>	<u>nitrogen</u>		<u>nitrogen</u>

Amount of

<u>fertilizer</u>	<u>x</u>	<u>2</u>		<u>$x + 2$</u>
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Amount of

<u>nitrogen</u>	<u>$0.15(x)$</u>	<u>$0.10(2)$</u>		<u>$0.14(x + 2)$</u>
-----------------	-----------------------------	-----------------------------	--	---------------------------------

(amt of 15%) + (amt of 10%) = (amt of 14%)

$$0.15x + 0.10(2) = 0.14(x + 2)$$

$$0.15x + 0.20 = 0.14x + 0.28$$

$$0.15x - 0.14x + 0.20 = 0.14x - 0.14x + 0.28$$

$$0.01x + 0.20 = 0.28$$

$$0.01x + 0.20 - 0.20 = 0.28 - 0.20$$

$$0.01x = 0.08$$

$$\frac{0.01x}{0.01} = \frac{0.08}{0.01}$$

$$x = 8$$

8 oz of 15% nitrogen fertilizer should be used.

41.

	50%	75%	60%
	antifreeze	antifreeze	antifreeze

Amount of

fertilizer	3	x	$x + 3$
------------	---	-----	---------

Amount of

nitrogen	$0.50(3)$	$0.75(x)$	$0.60(x + 3)$
----------	-----------	-----------	---------------

(amt of 50%) + (amt of 75%) = (amt of 60%)

$$0.50(3) + 0.75x = 0.60(x + 3)$$

$$1.5 + 0.75x = 0.60x + 1.8$$

$$0.75x - 0.60x + 1.5 = 0.60x - 0.60x + 1.8$$

$$0.15x + 1.5 = 1.8$$

$$0.15x + 1.5 - 1.5 = 1.8 - 1.5$$

$$0.15x = 0.3$$

$$\frac{0.15x}{0.15} = \frac{0.3}{0.15}$$

$$x = 2$$

2 L of the 75% antifreeze solution should be used.

43.

	18%	10%	15%
	Solution	Solution	Solution

Amount of

Solution	x	$20 - x$	20
----------	-----	----------	----

Amount of

Alcohol	$0.18x$	$0.10(20 - x)$	$0.15(20)$
---------	---------	----------------	------------

(amt of 18%) + (amt of 10%) = (amt of 15%)

$$0.18x + 0.10(20 - x) = 0.15(20)$$

$$0.18x + 2 - 0.10x = 3$$

$$0.08x + 2 = 3$$

$$0.08x + 2 - 2 = 3 - 2$$

$$0.08x = 1$$

$$\frac{0.08x}{0.08} = \frac{1}{0.08}$$

$$x = 12.5$$

$$20 - x = 20 - 12.5$$

$$= 7.5$$

12.5 L of 18% solution and 7.5 L of 10% solution must be mixed.

45.

12%	Pure	17.5%
Super Grow	Super Grow	Super Grow

Amount of
 Solution $32-x$ x 32

Amount of
 Super Grow $0.12(32-x)$ $1.00x$ $0.175(32)$

(amt of 12%)+(amt of pure) = (amt of 17.5%)

$$0.12(32-x) + 1.00x = 0.175(32)$$

$$3.84 - 0.12x + x = 5.6$$

$$0.88x + 3.84 = 5.6$$

$$0.88x + 3.84 - 3.84 = 5.6 - 3.84$$

$$0.88x = 1.76$$

$$\frac{0.88x}{0.88} = \frac{1.76}{0.88}$$

$$x = 2$$

2 oz of pure Super Grow must be added.

47.

	Distance	Rate	Time
To FL	$2(x + 60)$	$x + 60$	2
Return	$2.5x$	x	2.5

(dist to FL) = (dist back to Atlanta)

$$2(x + 60) = 2.5x$$

$$2x + 120 = 2.5x$$

$$2x + 120 - 2x = 2.5x - 2x$$

$$120 = 0.5x$$

$$\frac{120}{0.5} = \frac{0.5x}{0.5}$$

$$240 = x$$

$$x + 60 = 240 + 60$$

$$= 300$$

The plane flies 300 mph from Atlanta to Fort Lauderdale and 240 mph on the return trip.

49.

	Distance	Rate	Time
Car A	$2x$	x	2
Car B	$2(x + 4)$	$x + 4$	2

(dist car A) + (dist car B) = (total dist)

$$2x + 2(x + 4) = 192$$

$$2x + 2x + 8 = 192$$

$$4x + 8 = 192$$

$$4x + 8 - 8 = 192 - 8$$

$$4x = 184$$

$$\frac{4x}{4} = \frac{184}{4}$$

$$x = 46$$

$$x + 4 = 46 + 4 = 50$$

The cars are traveling at 46 mph and 50 mph.

51. Let x = the first integer

$30 - x$ = the second integer

(ten times first) = (five times second)

$$10x = 5(30 - x) = 150 - 5x$$

$$10x + 5x = 150 - 5x + 5x$$

$$15x = 150$$

$$\frac{15x}{15} = \frac{150}{15}$$

$$x = 10$$

$$30 - x = 30 - 10 = 20$$

The integers are 10 and 20.

55.

	Distance	Rate	Time
Boat A	$3x$	x	3
Boat B	$3(2x)$	$2x$	3

(dist boat B) - (dist boat A) = (dist between)

$$3(2x) - 3x = 60$$

$$6x - 3x = 60$$

$$3x = 60$$

$$\frac{3x}{3} = \frac{60}{3}$$

$$x = 20$$

$$x = 20$$

$$2x = 2(20)$$

$$= 40$$

The boat's rates are 20 mph and 40 mph.

57.

	5%	6%		
	Account	Account		Total
Amount				
Invested	x	$2x$		
Interest				
Earned	$0.05x$	$0.06(2x)$		765

(int at 5%) + (int at 6%) = (total int)

$$0.05x + 0.06(2x) = 765$$

$$0.05x + 0.12x = 765$$

$$0.17x = 765$$

$$\frac{0.17x}{0.17} = \frac{765}{0.17}$$

$$x = 4500$$

$$2x = 2(4500)$$

$$= 9000$$

\$4500 was invested at 5% and \$9000 was invested at 6%.

59.

	Black	Orange		
	Tea	Pekoe Tea		Total
Pounds of				
Tea	x	$4-x$		4
Cost of Tea	$2.20x$	$3.00(4-x)$		$2.50(4)$

(cost black) + (cost orange) = (cost blend)

$$2.20x + 3.00(4-x) = 2.50(4)$$

$$2.20x + 12 - 3x = 10$$

$$-0.80x + 12 = 10$$

$$-0.80x + 12 - 12 = 10 - 12$$

$$-0.80x = -2$$

$$\frac{-0.80x}{-0.80} = \frac{-2}{-0.80}$$

$$x = 2.5$$

$$4 - x = 4 - 2.5 = 1.5$$

2.5 lb of black tea and 1.5 lb of orange pekoe tea are used in the blend.

61. New Price = Original Price – Price Drop

$$202,100 = x - 0.06x$$

$$202,100 = 0.94x$$



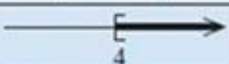
$$\frac{202,100}{0.94} = x$$

$$x = 215,000$$


The median price the previous year was \$215,000.

Section 3.3 Practice Exercises


- 1.**
 - a.** linear; inequality
 - b.** negative
 - c.** Both statements are correct.

	Set-Builder Notation	Interval Notation	Graph
3.	$\{x x > 5\}$	$(5, \infty)$	
5.	$\{x -3 < x \leq 6\}$	$(-3, 6]$	
7.	$\{x x \geq 4\}$	$[4, \infty)$	


9. a. $-2x + 4 = 10$
 $-2x = 10 - 4$
 $-2x = 6$
 $x = -3 \quad \{-3\} \quad \text{n/a}$



b. $-2x + 4 < 10$
 $-2x < 10 - 4$
 $-2x < 6$
 $x < -3$
 $\{x|x < -3\} \quad (-3, \infty)$



c. $-2x + 4 > 10$
 $-2x > 10 - 4$
 $-2x > 6$
 $x > -3$
 $\{x|x < -3\} \quad (-\infty, -3)$



13. $-2x - 5 \leq -25$
 $-2x - 5 + 5 \leq -25 + 5$
 $-2x \leq -20$
 $\frac{-2x}{-2} \geq \frac{-20}{-2}$
 $x \geq \frac{-20}{-2}$
 $x \geq 10$
a. $\{x|x \geq 10\}$

11. $2y + 6 \leq 4$
 $2y + 6 - 6 \leq 4 - 6$
 $2y \leq -2$
 $\frac{2y}{2} \leq \frac{-2}{2}$
 $y \leq -1$

a. $\{y|y \leq -1\}$

b. $(-\infty, -1]$



15. $6z + 3 > 16$
 $6z + 3 - 3 > 16 - 3$
 $6z > 13$
 $\frac{6z}{6} > \frac{13}{6}$
 $z > \frac{13}{6}$

a. $\left\{z \left| z > \frac{13}{6} \right. \right\}$

b. $[10, \infty)$

b. $(\frac{13}{6}, \infty)$

17.

$$-8 > \frac{2}{3}t$$

$$\frac{3}{2}(-8) > \frac{3}{2} \cdot \frac{2}{3}t$$

$$-12 > t$$

$$t < -12$$

a. $\{t \mid t < -12\}$

b. $(-\infty, -12)$

19.

$$\frac{3}{4}(8y-9) < 3$$

$$\frac{4}{3} \left[\frac{3}{4}(8y-9) \right] < \frac{4}{3}[3]$$

$$8y-9 < 4$$

$$8y-9+9 < 4+9$$

$$8y < 13$$

$$\frac{8y}{8} < \frac{13}{8}$$

$$y < \frac{13}{8}$$

a. $\left\{ y \mid y < \frac{13}{8} \right\}$

b. $(-\infty, \frac{13}{8})$

21.

$$0.8a - 0.5 \leq 0.3a - 11$$

$$10(0.8a - 0.5) \leq 10(0.3a - 11)$$

$$8a - 5 \leq 3a - 110$$

$$8a - 3a - 5 \leq 3a - 3a - 110$$

$$5a - 5 \leq -110$$

$$5a - 5 + 5 \leq -110 + 5$$

$$5a \leq -105$$

$$\frac{5a}{5} \leq \frac{-105}{5}$$

$$a \leq -21$$

a. $\{a \mid a \leq -21\}$

b. $(-\infty, -21]$

23.

$$-5x + 7 < 22$$

$$-5x + 7 - 7 < 22 - 7$$

$$-5x < 15$$

$$\frac{-5x}{-5} > \frac{15}{-5}$$

$$x > \frac{15}{-5}$$

$$x > -3$$

25.

$$-\frac{5}{6}x \leq -\frac{3}{4}$$

$$-\frac{6}{5} \left(-\frac{5}{6}x \right) \geq -\frac{6}{5} \left(-\frac{3}{4} \right)$$

$$x \geq \frac{18}{20}$$

$$x \geq \frac{9}{10}$$

a. $\{x \mid x > -3\}$

b. $(-3, \infty)$



27.

$$\begin{aligned} \frac{3p-1}{-2} &> 5 \\ -2\left(\frac{3p-1}{-2}\right) &< -2(5) \\ 3p-1 &< -10 \\ 3p-1+1 &< -10+1 \\ 3p &< -9 \\ \frac{3p}{3} &< \frac{-9}{3} \\ p &< -3 \end{aligned}$$

a. $\{p \mid p < -3\}$

b. $(-\infty, -3)$



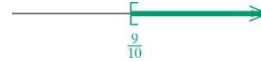
31.

$$\begin{aligned} 3-4(y+2) &\leq 6+4(2y+1) \\ 3-4y-8 &\leq 6+8y+4 \\ -4y-5 &\leq 8y+10 \\ -4y-8y-5 &\leq 8y-8y+10 \\ -12y-5 &\leq 10 \\ -12y-5+5 &\leq 10+5 \\ -12y &\leq 15 \\ \frac{-12y}{-12} &\geq \frac{15}{-12} \\ y &\geq -\frac{5}{4} \end{aligned}$$

a. $\left\{y \mid y \geq -\frac{5}{4}\right\}$

a. $\left\{x \mid x \geq \frac{9}{10}\right\}$

b. $\left[\frac{9}{10}, \infty\right)$



29.

$$\begin{aligned} 0.2t+1 &> 2.4t-10 \\ 10(0.2t+1) &> 10(2.4t-10) \\ 2t+10 &> 24t-100 \\ 2t-24t+10 &> 24t-24t-100 \\ -22t+10 &> -100 \\ -22t+10-10 &> -100-10 \\ -22t &> -110 \\ \frac{-22t}{-22} &< \frac{-110}{-22} \\ t &< 5 \end{aligned}$$

a. $\{t \mid t < 5\}$

b. $(-\infty, 5)$



33.

$$\begin{aligned} 7.2k-5.1 &\geq 5.7 \\ 10(7.2k-5.1) &\geq 10(5.7) \\ 72k-51 &\geq 57 \\ 72k-51+51 &\geq 57+51 \\ 72k &\geq 108 \\ \frac{72k}{72} &\geq \frac{108}{72} \\ k &\geq \frac{3}{2} \quad \text{or } k \geq 1.5 \end{aligned}$$

a. $\{k \mid k \geq 1.5\}$

b. $\left[-\frac{5}{4}, \infty\right)$

b. $[1.5, \infty)$

35. $\frac{3}{4}x - 8 \leq 1 \Rightarrow \frac{3}{4}x - 8 + 8 \leq 1 + 8$

$$\frac{3}{4}x \leq 9$$

$$\frac{4}{3}\left(\frac{3}{4}x\right) \leq \frac{4}{3}(9)$$

$$x \leq \frac{4}{3}(9) \Rightarrow x \leq 12$$

a. $\{x \mid x \leq 12\}$

b. $(-\infty, 12]$

37.

$$-1.2b - 0.4 \geq -0.4b$$

$$-1.2b + 1.2b - 0.4 \geq -0.4b + 1.2b$$

$$-0.4 \geq 0.8b$$

$$\frac{-0.4}{0.8} \geq \frac{0.8b}{0.8}$$

$$-0.5 \geq b$$

$$b \leq -0.5$$

a. $\{b \mid b \leq -0.5\}$

b. $(-\infty, -0.5]$

39.

$$-\frac{3}{4}c - \frac{5}{4} \geq 2c$$

$$4\left(-\frac{3}{4}c - \frac{5}{4}\right) \geq 4(2c)$$

$$-3c - 5 \geq 8c$$

$$-3c + 3c - 5 \geq 8c + 3c$$

$$-5 \geq 11c$$

$$\frac{-5}{11} \geq \frac{11c}{11}$$

$$-\frac{5}{11} \geq c \text{ or } c \leq -\frac{5}{11}$$

a. $\left\{c \mid c \leq -\frac{5}{11}\right\}$

b. $\left(-\infty, -\frac{5}{11}\right]$

41.

$$4 - 4(y - 2) < -5y + 6$$

$$4 - 4y + 8 < -5y + 6$$

$$-4y + 12 < -5y + 6$$

$$-4y + 5y + 12 < -5y + 5y + 6$$

$$y + 12 < 6$$

$$y + 12 - 12 < 6 - 12$$

$$y < -6$$

a. $\{y \mid y < -6\}$

b. $(-\infty, -6)$

$$\begin{aligned}
43. \quad & -6(2x+1) < 5 - (x-4) - 6x \\
& -12x - 6 < 5 - x + 4 - 6x \\
& -12x - 6 < -7x + 9 \\
& -12x + 7x - 6 < -7x + 7x + 9 \\
& -5x - 6 < 9 \\
& -5x - 6 + 6 < 9 + 6 \\
& -5x < 15 \\
& \frac{-5x}{-5} > \frac{15}{-5} \\
& x > -3
\end{aligned}$$

a. $\{x \mid x > -3\}$

b. $(-3, \infty)$



$$\begin{aligned}
45. \quad & 6a - (9a+1) - 3(a-1) \geq 2 \\
& 6a - 9a - 1 - 3a + 3 \geq 2 \\
& -6a + 2 \geq 2 \\
& -6a + 2 - 2 \geq 2 - 2 \\
& -6a \geq 0 \\
& \frac{-6a}{-6} \leq \frac{0}{-6} \\
& a \leq 0
\end{aligned}$$

a. $\{a \mid a \leq 0\}$

b. $(-\infty, 0]$



$$\begin{aligned}
47. \quad \text{a.} \quad & 80 \leq \frac{80+86+73+91+x}{5} < 90 \\
& 5 \cdot 80 \leq 5 \cdot \frac{80+86+73+91+x}{5} < 5 \cdot 90 \\
& 400 \leq 330 + x < 450 \\
& 400 - 330 \leq 330 - 330 + x < 450 - 330 \\
& 70 \leq x < 120
\end{aligned}$$

Nadia needs to score at least a 70% but less than 120% to get a B average.

$$\begin{aligned}
\text{b.} \quad & \frac{80+86+73+91+x}{5} \geq 90 \\
& 5 \cdot \frac{80+86+73+91+x}{5} \geq 5 \cdot 90 \\
& 330 + x \geq 450 \\
& 330 - 330 + x \geq 450 - 330 \\
& x \geq 120
\end{aligned}$$

It would be impossible for Nadia to get an A because she would have to earn 120% on her last quiz and it is impossible to earn more than 100%.

$$\begin{aligned}
49. \quad & 2.5a + 31 \geq 51 \\
& 2.5a + 31 - 31 \geq 51 - 31 \\
& 2.5a \geq 20 \\
& \frac{2.5a}{2.5} \geq \frac{20}{2.5} \\
& a \geq 8
\end{aligned}$$

Boys 8 years old or older will be on average at least 51 in. tall.

$$\begin{aligned}
51. \quad & 2.5a + 31 \leq 46 \\
& 2.5a + 31 - 31 \leq 46 - 31 \\
& 2.5a \leq 15 \\
& \frac{2.5a}{2.5} \leq \frac{15}{2.5} \\
& a \leq 6
\end{aligned}$$

Boys 6 years old or younger will be on average no more than 46 in. tall.

- 53. a.** $25,000 + 0.04x > 40,000$
 $25,000 - 25,000 + 0.04x > 40,000 - 25,000$
 $0.04x > 15,000$ Her sales must exceed \$375,000.
 $\frac{0.04x}{0.04} > \frac{15,000}{0.04}$
 $x > 375,000$
- b.** $25,000 + 0.04x > 80,000$
 $25,000 - 25,000 + 0.04x > 80,000 - 25,000$
 $0.04x > 55,000$ Her sales must exceed \$1,375,000.
 $\frac{0.04x}{0.04} > \frac{55,000}{0.04}$
 $x > 1,375,000$
- c.** The base salary is still the same; the increase comes solely from commission.

55. $R > C$
 $49.95x > 2300 + 18.50x$
 $49.95x - 18.50x > 2300 + 18.50x - 18.50x$
 $31.45x > 2300$
 $\frac{31.45x}{31.45} > \frac{2300}{31.45}$
 $x > 73.13$

There will be a profit if more than 73 jackets are sold.

57. $a > b$
 $a + c > b + c$

59. $a > b$
 $ac < bc$ for $c < 0$

Section 3.4 Practice Exercises

1.
 - a. union; $A \cup B$
 - b. intersection; $A \cap B$
 - c. intersection
 - d. $a < x < b$
 - e. union

3.
$$\begin{aligned} -6u + 8 &> 2 \\ -6u &> -6 \\ \frac{-6u}{-6} &< \frac{-6}{-6} \\ u &< 1 \quad (-\infty, 1) \end{aligned}$$

$$\begin{aligned}
 5. \quad & -12 \leq \frac{3}{4}p \\
 & \frac{4}{3}(-12) \leq \frac{4}{3}\left(\frac{3}{4}p\right) \\
 & -16 \leq p \\
 & p \geq -16 \quad [-16, \infty)
 \end{aligned}$$

$$7. \quad \text{a.} \quad M \cap N = \{-3, -1\}$$

$$\text{b.} \quad M \cup N = \{-4, -3, -2, -1, 0, 1, 3, 5\}$$

$$9. \quad A \cap C = [-7, -4)$$

$$11. \quad A \cup B = (-\infty, -4) \cup (2, \infty)$$

$$13. \quad A \cap B = \{ \}$$

$$15. \quad B \cup C = [-7, \infty)$$

$$17. \quad C \cap D = [0, 5)$$

$$19. \quad C \cup D = [-7, \infty)$$

$$21. \quad \text{a.} \quad (-2, 5) \cap [-1, \infty) \\ = [-1, 5)$$

$$23. \quad \text{a.} \quad \left(-\frac{5}{2}, 3\right) \cap \left(-1, \frac{9}{2}\right) \\ = (-1, 3)$$

$$\text{b.} \quad (-2, 5) \cup [-1, \infty) \\ = (-2, \infty)$$

$$\text{b.} \quad \left(-\frac{5}{2}, 3\right) \cup \left(-1, \frac{9}{2}\right) = \left(-\frac{5}{2}, \frac{9}{2}\right)$$

$$25. \quad \text{a.} \quad (-4, 5] \cap (0, 2] = (0, 2]$$

$$27. \quad y - 7 \geq -9 \quad \text{and} \quad y + 2 \leq 5$$

$$y \geq -2 \quad \cap \quad y \leq 3$$

$$[-2, \infty) \cap (-\infty, 3] = [-2, 3]$$



$$29. \quad 2t + 7 < 19 \quad \text{and} \quad 5t + 13 > 28$$


$$2t < 12 \quad \cap \quad 5t > 15$$

$$t < 6 \quad \cap \quad t > 3$$


$$(-\infty, 6) \cap (3, \infty) = (3, 6)$$



31. $2.1k - 1.1 \leq 0.6k + 1.9$ and $0.3k - 1.1 < -0.1k + 0.9$
 $10(2.1k - 1.1) \leq 10(0.6k + 1.9)$ and $10(0.3k - 1.1) < 10(-0.1k + 0.9)$
 $21k - 11 \leq 6k + 19$ and $3k - 11 < -k + 9$
 $15k - 11 \leq 19$ \cap $4k - 11 < 9$
 $15k \leq 30$ \cap $4k < 20$
 $k \leq 2$ \cap $k < 5$
 $(-\infty, 2] \cap (-\infty, 5) = (-\infty, 2]$



33. $\frac{2}{3}(2p - 1) \geq 10$ and $\frac{4}{5}(3p + 4) \geq 20$
 $\frac{3}{2} \cdot \frac{2}{3}(2p - 1) \geq \frac{3}{2} \cdot 10$ \cap $\frac{5}{4} \cdot \frac{4}{5}(3p + 4) \geq \frac{5}{4} \cdot 20$
 $2p - 1 \geq 15$ \cap $3p + 4 \geq 25$
 $2p \geq 16$ \cap $3p \geq 21$
 $p \geq 8$ \cap $p \geq 7$
 $[8, \infty) \cap [7, \infty) = [8, \infty)$




35. $-2 < -x - 12$ and $-14 < 5(x - 3) + 6x$
 $10 < -x$ \cap $-14 < 5x - 15 + 6x$
 $-10 > x$ \cap $-14 < 11x - 15$
 $x < -10$ \cap $1 < 11x$
 $x < -10$ \cap $x > \frac{1}{11}$
 $(-\infty, -10) \cap \left(\frac{1}{11}, \infty\right) = \{ \}$

37. $-4 \leq t$ and $t < \frac{3}{4}$


39. The statement $6 < x < 2$ is equivalent to $6 < x$ and $x < 2$. However, no real number is greater than 6 and also less than 2.

41. The statement $-5 > y > -2$ is equivalent to $-5 > y$ and $y > -2$. However, no real number is less than -5 and also greater than -2 .

43. $0 \leq 2b - 5 < 9$
 $5 \leq 2b < 14$
 $\frac{5}{2} \leq b < 7$ $\left[\frac{5}{2}, 7 \right)$




45. $-1 < \frac{a}{6} \leq 1$
 $-6 < a \leq 6$ $(-6, 6]$




47. $-\frac{2}{3} < \frac{y - 4}{-6} < \frac{1}{3}$

49. $5 \leq -3x - 2 \leq 8$
 $7 \leq -3x \leq 10$


$$4 > y - 4 > -2$$

$$8 > y > 2 \quad (2, 8)$$



$$-\frac{7}{3} \geq x \geq -\frac{10}{3}$$

$$\left[-\frac{10}{3}, -\frac{7}{3}\right]$$


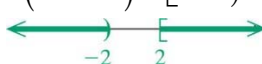
51. $12 > 6x + 3 \geq 0$
 $9 > 6x \geq -3$
 $\frac{3}{2} > x \geq -\frac{1}{2} \quad \left[-\frac{1}{2}, \frac{3}{2}\right)$




53. $-0.2 < 2.6 + 7t < 4$
 $-2.8 < 7t < 1.4$
 $-0.4 < t < 0.2$
 $(-0.4, 0.2)$




55. $2y - 1 \geq 3$ or $y < -2$
 $2y \geq 4 \cup y < -2$
 $y \geq 2 \cup y < -2$
 $(-\infty, -2) \cup [2, \infty)$




57. $1 > 6z - 8$ or $8z - 6 \leq 10$
 $9 > 6z \cup 8z \leq 16$
 $\frac{3}{2} > z \cup z \leq 2$
 $\left(-\infty, \frac{3}{2}\right) \cup (-\infty, 2] = (-\infty, 2]$



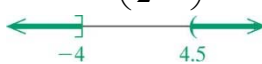
59. $5(x - 1) \geq -5$ or $5 - x \leq 11$
 $5x - 5 \geq -5 \cup -x \leq 6$
 $5x \geq 0 \cup x \geq -6$
 $x \geq 0 \cup x \geq -6$
 $[0, \infty) \cup [-6, \infty) = [-6, \infty)$



61. $\frac{5}{3}v \leq 5$ or $-v - 6 < 1$
 $\frac{3}{5} \cdot \frac{5}{3}v \leq \frac{3}{5} \cdot 5 \cup -v < 7$
 $v \leq 3 \cup v > -7$
 $(-\infty, 3] \cup (-7, \infty) = (-\infty, \infty)$



63. $0.5w + 5 < 2.5w - 4$ or $0.3w \leq -0.1w - 1.6$
 $-2w + 5 < -4 \cup 0.4w \leq -1.6$
 $-2w < -9 \cup w \leq -4$
 $w > \frac{9}{2} \cup w \leq -4$
 $\left(\frac{9}{2}, \infty\right) \cup (-\infty, -4]$



65. a. $3x - 5 < 19$ and $-2x + 3 < 23$
 $3x < 24 \cap -2x < 20$
 $x < 8 \cap x > -10$
 $(-\infty, 8) \cap (-10, \infty) = (-10, 8)$

b. $3x - 5 < 19$ or $-2x + 3 < 23$
 $3x < 24 \cup -2x < 20$
 $x < 8 \cup x > -10$
 $(-\infty, 8) \cup (-10, \infty) = (-\infty, \infty)$

$$67. \text{ a. } 8x - 4 \geq 6.4 \text{ or } 0.3(x + 6) \leq -0.6$$

$$8x \geq 10.4 \quad \cup \quad x + 6 \leq -2$$

$$x \geq 1.3 \quad \cup \quad x \leq -8$$

$$[1.3, \infty) \cup (-\infty, -8]$$

$$67. \text{ b. } 8x - 4 \geq 6.4 \text{ and } 0.3(x + 6) \leq -0.6$$

$$8x \geq 10.4 \quad \cap \quad x + 6 \leq -2$$

$$x \geq 1.3 \quad \cap \quad x \leq -8$$

$$[1.3, \infty) \cap (-\infty, -8] = \text{No Solution}$$

$$71. \quad 5 \geq -4(t - 3) + 3t \text{ or } 6 < 12t + 8(4 - t)$$

$$5 \geq -4t + 12 + 3t \quad \cup \quad 6 < 12t + 32 - 8t$$

$$5 \geq -t + 12 \quad \cup \quad 6 < 4t + 32$$

$$-7 \geq -t \quad \cup \quad -26 < 4t$$

$$7 \leq t \quad \cup \quad -\frac{13}{2} < t$$

$$[7, \infty) \cup \left(-\frac{13}{2}, \infty\right) = \left(-\frac{13}{2}, \infty\right)$$

$$75. \text{ a. } 4800 \leq x \leq 10,800$$

$$75. \text{ b. } x < 4800 \text{ or } x > 10,800$$

$$79. \quad -3 < 2x < 12$$

$$-\frac{3}{2} < x < 6$$

All real numbers between

$$-\frac{3}{2} \text{ and } 6$$

$$69. \quad -4 \leq \frac{2 - 4x}{3} < 8$$

$$-12 \leq 2 - 4x < 24$$

$$-14 \leq -4x < 22$$

$$\frac{7}{2} \geq x > -\frac{11}{2}$$

$$\left(-\frac{11}{2}, \frac{7}{2}\right]$$

$$73. \quad \frac{-x + 3}{2} > \frac{4 + x}{5} \text{ or } \frac{1 - x}{4} > \frac{2 - x}{3}$$

$$5(-x + 3) > 2(4 + x) \quad \cup \quad 3(1 - x) > 4(2 - x)$$

$$-5x + 15 > 8 + 2x \quad \cup \quad 3 - 3x > 8 - 4x$$

$$-7x + 15 > 8 \quad \cup \quad 3 + x > 8$$

$$-7x > -7 \quad \cup \quad x > 5$$

$$x < 1 \quad \cup \quad x > 5$$

$$(-\infty, 1) \cup (5, \infty)$$

$$77. \text{ a. } 44\% < x < 48\%$$

$$77. \text{ b. } x \leq 44\% \text{ or } x \geq 48\%$$

$$81. \quad 2x + 1 > 5 \text{ or } 2x + 1 < -1$$

$$2x > 4 \text{ or } 2x < -2$$

$$x > 2 \text{ or } x < -1$$

All real numbers greater than 2 or
less than -1

83. a. $0.8(92) + 0.2x \geq 90$
 $73.6 + 0.2x \geq 90$
 $0.2x \geq 16.4$
 $x \geq 82$

Amy would need 82% or better on her final exam.

b. $80 \leq 0.8(92) + 0.2x < 90$
 $80 \leq 73.6 + 0.2x < 90$
 $6.4 \leq 0.2x < 16.4$
 $32 \leq x < 82$

If Amy scores at least 32% and less than 82% on her final exam, she will receive a “B” in the class.

85. $0.0 \leq \frac{5}{9}(F - 32) \leq 5.6$

$$9(0.0) \leq 9 \cdot \frac{5}{9}(F - 32) \leq 9(5.6)$$

$$0 \leq 5(F - 32) \leq 50.4$$

$$0 \leq 5F - 160 \leq 50.4$$

$$0 + 160 \leq 5F - 160 + 160 \leq 50.4 + 160$$

$$160 \leq 5F \leq 210.4$$

$$\frac{160}{5} \leq \frac{5F}{5} \leq \frac{210.4}{5}$$

$$32 \leq F \leq 42.08$$

Section 3.5 Absolute Value Equations

Section 3.5 Practice Exercises

1. a. absolute; $\{a, -a\}$
b. Subtract 5 from both sides.
c. y ; $-y$
d. $\{ \}$; $\{-4\}$
3. $3x - 5 \geq 7x + 3$ or $2x - 1 \leq 4x - 5$
 $-4x - 5 \geq 3$ \cup $-2x - 1 \leq -5$
 $-4x \geq 8$ \cup $-2x \leq -4$
 $x \leq -2$ \cup $x \geq 2$
 $(-\infty, -2] \cup [2, \infty)$
5. $5 \geq \frac{x-4}{-2} > -3$
 $-2(5) \leq -2\left(\frac{x-4}{-2}\right) < -2(-3)$
 $-10 \leq x - 4 < 6$
 $-6 \leq x < 10$ $[-6, 10)$
7. $|p| = 7$
 $p = 7$ or $p = -7$ $\{7, -7\}$
9. $|x| + 5 = 11$
 $|x| = 6$
 $x = 6$
or $x = -6$ $\{6, -6\}$
11. $|y| + 8 = 5$
 $|y| = -3$
 $\{ \}$

$$\begin{aligned}
 13. \quad & |w| - 3 = -1 \\
 & |w| = 2 \\
 & w = -2 \quad \text{or} \quad w = 2 \quad \{-2, 2\}
 \end{aligned}$$

$$\begin{aligned}
 15. \quad & |y| = \sqrt{2} \\
 & y = \sqrt{2} \quad \text{or} \quad y = -\sqrt{2} \quad \{\sqrt{2}, -\sqrt{2}\}
 \end{aligned}$$

$$\begin{aligned}
 17. \quad & |w| - 3 = -5 \\
 & |w| = -2 \quad \{ \}
 \end{aligned}$$

$$\begin{aligned}
 19. \quad & |3q| = 0 \\
 & 3q = 0 \quad \text{or} \quad 3q = -0 \\
 & q = 0 \quad \{0\}
 \end{aligned}$$

$$\begin{aligned}
 21. \quad & |3x - 4| = 8 \\
 & 3x - 4 = 8 \quad \text{or} \quad 3x - 4 = -8 \\
 & 3x = 12 \quad \text{or} \quad 3x = -4 \\
 & x = 4 \quad \text{or} \quad x = -\frac{4}{3} \quad \left\{4, -\frac{4}{3}\right\}
 \end{aligned}$$

$$\begin{aligned}
 23. \quad & 5 = |2x - 4| \\
 & 2x - 4 = 5 \quad \text{or} \quad 2x - 4 = -5 \\
 & 2x = 9 \quad \text{or} \quad 2x = -1 \\
 & x = \frac{9}{2} \quad \text{or} \quad x = -\frac{1}{2} \quad \left\{\frac{9}{2}, -\frac{1}{2}\right\}
 \end{aligned}$$

$$\begin{aligned}
 25. \quad & \left|\frac{7z}{3} - \frac{1}{3}\right| + 3 = 6 \Rightarrow \left|\frac{7z}{3} - \frac{1}{3}\right| = 3 \\
 & \frac{7z}{3} - \frac{1}{3} = 3 \quad \text{or} \quad \frac{7z}{3} - \frac{1}{3} = -3 \\
 & 7z - 1 = 9 \quad \text{or} \quad 7z - 1 = -9 \\
 & 7z = 10 \quad \text{or} \quad 7z = -8 \\
 & z = \frac{10}{7} \quad \text{or} \quad z = -\frac{8}{7} \quad \left\{\frac{10}{7}, -\frac{8}{7}\right\}
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & |0.2x - 3.5| = -5.6 \\
 & \{ \}
 \end{aligned}$$

$$\begin{aligned}
 29. \quad & 1 = -4 + \left|2 - \frac{1}{4}w\right| \\
 & \left|2 - \frac{1}{4}w\right| = 5 \\
 & 2 - \frac{1}{4}w = 5 \quad \text{or} \quad 2 - \frac{1}{4}w = -5 \\
 & 8 - w = 20 \quad \text{or} \quad 8 - w = -20 \\
 & -w = 12 \quad \text{or} \quad -w = -28 \\
 & w = -12 \quad \text{or} \quad w = 28 \quad \{-12, 28\}
 \end{aligned}$$

$$\begin{aligned}
 31. \quad & 10 = 4 + |2y + 1| \\
 & |2y + 1| = 6 \\
 & 2y + 1 = 6 \quad \text{or} \quad 2y + 1 = -6 \\
 & 2y = 5 \quad \text{or} \quad 2y = -7 \\
 & y = \frac{5}{2} \quad \text{or} \quad y = -\frac{7}{2} \quad \left\{\frac{5}{2}, -\frac{7}{2}\right\}
 \end{aligned}$$

$$\begin{aligned}
 33. \quad & -2|3b - 7| - 9 = -9 \\
 & -2|3b - 7| = 0
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & -2|x + 3| = 5 \\
 & |x + 3| = -\frac{5}{2} \quad \{ \}
 \end{aligned}$$

$$\begin{aligned}
 |3b-7| &= 0 \\
 3b-7 &= 0 \text{ or } 3b-7 = -0 \\
 3b &= 7 \\
 b &= \frac{7}{3} \quad \left\{ \frac{7}{3} \right\}
 \end{aligned}$$

$$\begin{aligned}
 37. \quad 0 &= |6x-9| \\
 6x-9 &= 0 \text{ or } 6x-9 = -0 \\
 6x &= 9 \\
 x &= \frac{3}{2} \quad \left\{ \frac{3}{2} \right\}
 \end{aligned}$$

$$\begin{aligned}
 39. \quad \left| -\frac{1}{5} - \frac{1}{2}k \right| &= \frac{9}{5} \\
 -\frac{1}{5} - \frac{1}{2}k &= \frac{9}{5} \text{ or } -\frac{1}{5} - \frac{1}{2}k = -\frac{9}{5} \\
 -2-5k &= 18 \text{ or } -2-5k = -18 \\
 -5k &= 20 \text{ or } -5k = -16 \\
 k &= -4 \text{ or } k = \frac{16}{5} \left\{ -4, \frac{16}{5} \right\}
 \end{aligned}$$

$$\begin{aligned}
 41. \quad -3|2-6x|+5 &= -10 \\
 -3|2-6x| &= -15 \\
 |2-6x| &= 5 \\
 2-6x &= 5 \text{ or } 2-6x = -5 \\
 -6x &= 3 \text{ or } -6x = -7 \\
 x &= -\frac{1}{2} \text{ or } x = \frac{7}{6} \left\{ -\frac{1}{2}, \frac{7}{6} \right\}
 \end{aligned}$$

$$\begin{aligned}
 43. \quad |4x-2| &= |-8| \\
 |4x-2| &= 8 \\
 4x-2 &= 8 \text{ or } 4x-2 = -8 \\
 4x &= 10 \text{ or } 4x = -6 \\
 x &= \frac{5}{2} \text{ or } x = -\frac{3}{2} \left\{ \frac{5}{2}, -\frac{3}{2} \right\}
 \end{aligned}$$

$$\begin{aligned}
 45. \quad |4w+3| &= |2w-5| \\
 4w+3 &= 2w-5 \text{ or } 4w+3 = -(2w-5) \\
 4w+3 &= 2w-5 \text{ or } 4w+3 = -2w+5 \\
 2w+3 &= -5 \text{ or } 6w+3 = 5 \\
 2w &= -8 \text{ or } 6w = 2 \\
 w &= -4 \text{ or } w = \frac{1}{3} \\
 &\left\{ -4, \frac{1}{3} \right\}
 \end{aligned}$$

$$\begin{aligned}
 47. \quad |2y+5| &= |7-2y| \\
 2y+5 &= 7-2y \text{ or } 2y+5 = -(7-2y) \\
 2y+5 &= 7-2y \text{ or } 2y+5 = -7+2y \\
 4y+5 &= 7 \text{ or } 5 = -7 \\
 4y &= 2 \text{ or } \text{contradiction} \\
 y &= \frac{1}{2} \\
 &\left\{ \frac{1}{2} \right\}
 \end{aligned}$$

$$\begin{aligned}
 49. \quad & \left| \frac{4w-1}{6} \right| = \left| \frac{2w}{3} + \frac{1}{4} \right| \\
 & \frac{4w-1}{6} = \frac{2w}{3} + \frac{1}{4} \quad \text{or} \quad \frac{4w-1}{6} = -\left(\frac{2w}{3} + \frac{1}{4} \right) \\
 & \frac{4w-1}{6} = \frac{2w}{3} + \frac{1}{4} \quad \text{or} \quad \frac{4w-1}{6} = -\frac{2w}{3} - \frac{1}{4} \\
 & 2(4w-1) = 8w+3 \quad \text{or} \quad 2(4w-1) = -8w-3 \\
 & 8w-2 = 8w+3 \quad \text{or} \quad 8w-2 = -8w-3 \\
 & -2 = 3 \quad \text{or} \quad 16w-2 = -3 \\
 & \text{contradiction} \quad \text{or} \quad 16w = -1 \\
 & w = -\frac{1}{16} \left\{ -\frac{1}{16} \right\}
 \end{aligned}$$

$$\begin{aligned}
 53. \quad & |3.5m-1.2| = |8.5m+6| \\
 & 3.5m-1.2 = 8.5m+6 \quad \text{or} \\
 & \quad 3.5m-1.2 = -(8.5m+6) \\
 & 3.5m-1.2 = 8.5m+6 \quad \text{or} \\
 & \quad 3.5m-1.2 = -8.5m-6 \\
 & -5m-1.2 = 6 \quad \text{or} \quad 12m-1.2 = -6 \\
 & -5m = 7.2 \quad \text{or} \quad 12m = -4.8 \\
 & m = -1.44 \quad \text{or} \quad m = -0.4 \\
 & \{-1.44, -0.4\}
 \end{aligned}$$

$$\begin{aligned}
 57. \quad & |8-7w| = |7w-8| \\
 & 8-7w = 7w-8 \quad \text{or} \quad 8-7w = -(7w-8) \\
 & -14w = -16 \quad \text{or} \quad 8-7w = -7w+8 \\
 & w = \frac{8}{7} \quad \text{or} \quad w = w \\
 & \left\{ w \mid w \text{ is a real number} \right\}
 \end{aligned}$$

$$61. \quad |x| = 6$$

$$\begin{aligned}
 51. \quad & |x+2| = |-x-2| \\
 & x+2 = -x-2 \quad \text{or} \quad x+2 = -(-x-2) \\
 & 2x = -4 \quad \text{or} \quad x+2 = x+2 \\
 & x = -2 \quad \text{or} \quad x = x \\
 & \left\{ x \mid x \text{ is a real number} \right\}
 \end{aligned}$$

$$\begin{aligned}
 55. \quad & |4x-3| = -|2x-1| \\
 & \{ \} - \text{A positive number cannot equal a} \\
 & \text{negative number.}
 \end{aligned}$$

$$\begin{aligned}
 59. \quad & |x+2| + |x-4| = 0 \\
 & |x+2| = -|x-4| \\
 & \{ \} - \text{A positive number cannot equal a} \\
 & \text{negative number.}
 \end{aligned}$$

$$63. \quad |x| = \frac{4}{3}$$

Section 3.6 Practice Exercises

1. a. $-a; a$

b. $-a; >$

c. $\{ \}; (-\infty, \infty)$

d. includes; excludes

3. $2 = |5 - 7x| + 1$

$1 = |5 - 7x|$

$5 - 7x = 1$ or $5 - 7x = -1$

$-7x = -4$ or $-7x = -6$

$x = \frac{4}{7}$ or $x = \frac{6}{7}$ $\left\{ \frac{4}{7}, \frac{6}{7} \right\}$

5. $-15 < 3w - 6 \leq -9$

$-9 < 3w \leq -3$

$-3 < w \leq -1$ $(-3, -1]$



7. $m - 7 \leq -5$ or $m - 7 \geq -10$

$m \leq 2$ \cup $m \geq -3$

$(-\infty, 2] \cup [-3, \infty) = (-\infty, \infty)$



9. a. $|x| = 5$

$x = -5$ or $x = 5$ $\{-5, 5\}$

11. a. $|x - 3| = 7$

$x - 3 = -7$ or $x - 3 = 7$

$x = -4$ or $x = 10$ $\{-4, 10\}$

b. $|x| > 5$

$x < -5$ or $x > 5$ $(-\infty, -5) \cup (5, \infty)$

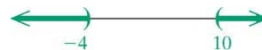


b. $|x - 3| > 7$

$x - 3 < -7$ or $x - 3 > 7$

$x < -4$ or $x > 10$

$(-\infty, -4) \cup (10, \infty)$



c. $|x| < 5$

$-5 < x < 5$ $(-5, 5)$



c. $|x - 3| < 7$

$-7 < x - 3 < 7$

$-4 < x < 10$ $(-4, 10)$

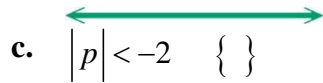


13. a. $|p| = -2$ $\{ \}$

15. a. $|y + 1| = -6$ $\{ \}$

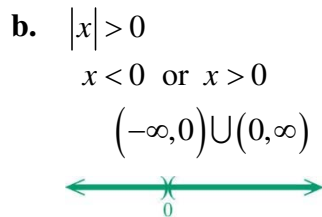
b. $|p| > -2$
All real numbers $(-\infty, \infty)$

c. $|p| < -2$ $\{ \}$



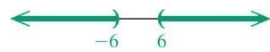
17. a. $|x| = 0$
 $x = 0$ $\{0\}$

b. $|x| > 0$
 $x < 0$ or $x > 0$
 $(-\infty, 0) \cup (0, \infty)$



c. $|x| < 0$ $\{ \}$

21. $|x| > 6$
 $x < -6$ or $x > 6$
 $(-\infty, -6) \cup (6, \infty)$



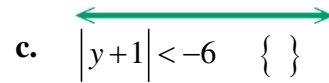
25. $|y+2| \geq 0$
All real numbers $(-\infty, \infty)$



29. $|k-7| < -3$ $\{ \}$

b. $|y+1| > -6$
All real numbers $(-\infty, \infty)$

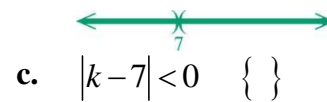
c. $|y+1| < -6$ $\{ \}$



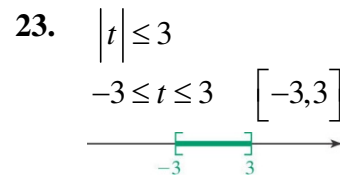
19. a. $|k-7| = 0$
 $k-7 = 0$
 $k = 7$ $\{7\}$

b. $|k-7| > 0$
 $k-7 < 0$ or $k-7 > 0$
 $k < 7$ or $k > 7$
 $(-\infty, 7) \cup (7, \infty)$

c. $|k-7| < 0$ $\{ \}$



23. $|t| \leq 3$
 $-3 \leq t \leq 3$ $[-3, 3]$



27. $5 \leq |2x-1|$
 $|2x-1| \geq 5$
 $2x-1 \leq -5$ or $2x-1 \geq 5$
 $2x \leq -4$ or $2x \geq 6$
 $x \leq -2$ or $x \geq 3$
 $(-\infty, -2] \cup [3, \infty)$



$$\begin{aligned}
 31. \quad & \left| \frac{w-2}{3} \right| - 3 \leq 1 \Rightarrow \left| \frac{w-2}{3} \right| \leq 4 \\
 & -4 \leq \frac{w-2}{3} \leq 4 \\
 & -12 \leq w-2 \leq 12 \\
 & -10 \leq w \leq 14 \quad [-10, 14] \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ -10 \qquad \qquad \qquad 14 \\ \text{---} \end{array} \right]
 \end{aligned}$$

$$\begin{aligned}
 33. \quad & 12 \leq |9-4y| - 2 \Rightarrow |9-4y| \geq 14 \\
 & 9-4y \leq -14 \quad \text{or} \quad 9-4y \geq 14 \\
 & -4y \leq -23 \quad \text{or} \quad -4y \geq 5 \\
 & y \geq \frac{23}{4} \quad \text{or} \quad y \leq -\frac{5}{4} \\
 & \left(-\infty, -\frac{5}{4} \right] \cup \left[\frac{23}{4}, \infty \right) \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ -\frac{5}{4} \qquad \qquad \qquad \frac{23}{4} \\ \text{---} \end{array} \right]
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & 4 > -1 + \left| \frac{2x+1}{4} \right| \\
 & 5 > \left| \frac{2x+1}{4} \right| \\
 & -5 < \frac{2x+1}{4} < 5 \\
 & -20 < 2x+1 < 20 \\
 & -21 < 2x < 19 \\
 & -\frac{21}{2} < x < \frac{19}{2} \quad \left(-\frac{21}{2}, \frac{19}{2} \right) \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ -\frac{21}{2} \qquad \qquad \qquad \frac{19}{2} \\ \text{---} \end{array} \right]
 \end{aligned}$$


$$\begin{aligned}
 37. \quad & 8 < |4-3x| + 12 \\
 & -4 < |4-3x| \\
 & |4-3x| > -4 \\
 & \text{All real numbers} \quad (-\infty, \infty) \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ \text{---} \\ \text{---} \end{array} \right]
 \end{aligned}$$


$$\begin{aligned}
 39. \quad & 5 - |2m+1| > 5 \\
 & -|2m+1| > 0 \\
 & |2m+1| < 0 \quad \{ \}
 \end{aligned}$$

$$\begin{aligned}
 41. \quad & |p+5| \leq 0 \\
 & -0 \leq p+5 \leq 0 \\
 & -5 \leq p \leq -5 \\
 & \{-5\} \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ \bullet \\ -5 \\ \text{---} \end{array} \right]
 \end{aligned}$$

$$\begin{aligned}
 43. \quad & |z-6| + 5 > 5 \\
 & |z-6| > 0 \\
 & z-6 < -0 \quad \text{or} \quad z-6 > 0 \\
 & z < 6 \quad \text{or} \quad z > 6 \\
 & (-\infty, 6) \cup (6, \infty) \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ \times \\ 6 \\ \text{---} \end{array} \right]
 \end{aligned}$$

$$\begin{aligned}
 45. \quad & 5|2y-6| + 3 \geq 13 \\
 & 5|2y-6| \geq 10 \Rightarrow |2y-6| \geq 2 \\
 & 2y-6 \leq -2 \quad \text{or} \quad 2y-6 \geq 2 \\
 & 2y \leq 4 \quad \text{or} \quad 2y \geq 8 \\
 & y \leq 2 \quad \text{or} \quad y \geq 4 \\
 & (-\infty, 2] \cup [4, \infty) \\
 & \text{Number line: } \left[\begin{array}{c} \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \end{array} \right]
 \end{aligned}$$

$$\begin{aligned}
47. \quad & -3|6-t|+1 > -5 \\
& -3|6-t| > -6 \\
& |6-t| < 2 \\
& -2 < 6-t < 2 \\
& -8 < -t < -4 \\
& 8 > t > 4 \quad (4,8)
\end{aligned}$$


$$\begin{aligned}
49. \quad & |0.02x+0.06|-0.1 < 0.05 \\
& |0.02x+0.06| < 0.15 \\
& -0.15 < 0.02x+0.06 < 0.15 \\
& -0.21 < 0.02x < 0.09 \\
& -10.5 < x < 4.5 \quad (-10.5, 4.5)
\end{aligned}$$


$$51. \quad |x| > 7$$

$$53. \quad |x-2| \leq 13$$

$$55. \quad |x-32| \leq 0.05$$

$$57. \quad \left| x - 6\frac{3}{4} \right| \leq \frac{1}{8}$$

$$\begin{aligned}
59. \quad & |w-2| \leq 0.01 \Rightarrow -0.01 \leq w-2 \leq 0.01 \\
& 1.99 \leq w \leq 2.01 \quad [1.99, 2.01]
\end{aligned}$$

The solution set is $\{w \mid 1.99 \leq w \leq 2.01\}$ or equivalently in interval notation, $[1.99, 2.01]$.

This means that the actual width of the bolt could be between 1.99 cm and 2.01 cm, inclusive.

$$61. \quad b$$

$$63. \quad a$$

Problem Recognition Exercises

$$\begin{aligned}
1. \quad \text{a.} \quad & 3x-9=18 \Rightarrow 3x=27 \\
& x=9 \quad \{9\}
\end{aligned}$$

$$\begin{aligned}
\text{b.} \quad & |3x-9|=18 \\
& 3x-9=18 \text{ or } 3x-9=-18 \\
& 3x=27 \text{ or } 3x=-9 \\
& x=9 \text{ or } x=-3 \quad \{9, -3\}
\end{aligned}$$

$$\begin{aligned}
\text{c.} \quad & |3x-9| < 18 \Rightarrow -18 < 3x-9 < 18 \\
& -9 < 3x < 27 \\
& -3 < x < 9 \quad (-3, 9)
\end{aligned}$$

$$\begin{aligned}
3. \quad \text{a.} \quad & -2t-14=0 \Rightarrow -2t=14 \\
& t=-7 \quad \{-7\}
\end{aligned}$$

$$\begin{aligned}
\text{b.} \quad & -2t-14 > 0 \\
& -2t > 14 \\
& t < -7 \quad (-\infty, -7)
\end{aligned}$$

$$\begin{aligned}
\text{c.} \quad & -2t-14 \leq 0 \\
& -2t \leq 14 \\
& t \geq -7 \quad [-7, \infty)
\end{aligned}$$

d. $|3x-9| \geq 18$
 $3x-9 \geq 18$ or $3x-9 \leq -18$
 $3x \geq 27$ or $3x \leq -9$
 $x \geq 9$ or $x \leq -3$
 $(-\infty, -3] \cup [9, \infty)$

5. a. $|8t-2| = |-2t+3|$
 $8t-2 = -2t+3$ or $8t-2 = -(-2t+3)$
 $10t-2 = 3$ or $8t-2 = 2t-3$
 $10t = 5$ or $6t-2 = -3$
 $t = \frac{5}{10}$ or $6t = -1$
 $t = \frac{1}{2}$ or $t = -\frac{1}{6} \left\{ \frac{1}{2}, -\frac{1}{6} \right\}$

b. $8t-2 = -2t+3$
 $10t = 5$
 $t = \frac{1}{2} \left\{ \frac{1}{2} \right\}$

9. a. linear equation
b. $-0.5y + 0.7 = 3.7$
 $-0.5y = 3$
 $y = -6 \quad \{-6\}$

13. a. compound inequality
b. $-11 < 2t+1 < 19$
 $-12 < 2t < 18$
 $-6 < t < 9 \quad (-6, 9)$

17. a. linear inequality

7. a. $-4x-9 < 11$ or $2 \leq x+1$
 $-4x < 20$ or $1 \leq x$
 $x > -5$ or $x \geq 1$
 $(-5, \infty)$

b. $-4x-9 < 11$ and $2 \leq x+1$
 $-4x < 20$ and $1 \leq x$
 $x > -5$ and $x \geq 1$
 $[1, \infty)$

11. a. absolute value inequality
b. $|2t+8| \leq 4 \Rightarrow -4 \leq 2t+8 \leq 4$
 $-12 \leq 2t \leq -4$
 $-6 \leq t \leq -2 \quad [-6, -2]$

15. a. absolute value equation
b. $\left| \frac{1}{2}y+3 \right| = 5$
 $\frac{1}{2}y+3 = 5$ or $\frac{1}{2}y+3 = -5$
 $\frac{1}{2}y = 2$ or $\frac{1}{2}y = -8$
 $y = 4$ or $y = -16 \quad \{4, -16\}$

19. a. absolute value inequality

b.

$$-\frac{3}{4}p \geq -9$$

$$-\frac{4}{3}\left(-\frac{3}{4}p\right) \leq -\frac{4}{3}(-9)$$

$$p \leq 12$$

$$(-\infty, 12]$$

b.

$$\left|\frac{2x-9}{3}\right| \geq 5$$

$$\frac{2x-9}{3} \geq 5 \text{ or } \frac{2x-9}{3} \leq -5$$

$$2x-9 \geq 15 \text{ or } 2x-9 \leq -15$$

$$2x \geq 24 \text{ or } 2x \leq -6$$

$$x \geq 12 \text{ or } x \leq -3$$

$$(-\infty, -3] \cup [12, \infty)$$

21. a. absolute value equation

b.

$$|2-c|+5=3$$

$$|2-c|=-2$$

$$\{ \}$$

23. a. linear equation

b.

$$\frac{w-4}{5} - \frac{w+1}{3} = 1$$

$$15\left(\frac{w-4}{5} - \frac{w+1}{3}\right) = 15(1)$$

$$3(w-4) - 5(w+1) = 15$$

$$3w-12-5w-5=15$$

$$-2w-17=15$$

$$-2w=32 \Rightarrow w=-16 \quad \{-16\}$$

25. a. compound inequality

b.

$$2x-7 > 9 \text{ and } 3x \leq 36$$

$$2x > 16 \text{ and } x \leq 12$$

$$x > 8 \text{ and } x \leq 12$$

$$(8, 12]$$

27. a. linear equation

b.

$$5(x-2)+7=2x+3(x-1)$$

$$5x-10+7=2x+3x-3$$

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

$$-3=-3$$

$$(-\infty, \infty)$$