Chapter 1

Section 1.1

Are You Ready for This Section?

R1. The additive inverse of 5 is -5 because $5 + (-5) = 0$.

R2. The multiplicative inverse of -3 is $-\frac{1}{3}$ because $(-3)\cdot\left(-\frac{1}{3}\right)=1.$

R3. $\frac{1}{5}\cdot 5x=\frac{5\cdot x}{5}=\frac{\cancel{5}\cdot x}{\cancel{5}}=x$

R4. $8=2\cdot 2\cdot 2$
$12=2\cdot 2\cdot 3$
The common factors are 2 and 2. The remaining factors are 2 and 3.
$\text{LCD}=2\cdot 2\cdot 2\cdot 3=24$

R5. $6(z-2)=6\cdot z-6\cdot 2=6z-12$

R6. The coefficient of $-4x$ is -4.

R7. $$\begin{aligned}4(y-2)-y+5&=4y-8-y+5\\&=4y-y-8+5\\&=3y-3\end{aligned}$$

R8. $-5(x+3)-8$
$$\begin{aligned}-5((-2)+3)-8&=-5(1)-8\\&=-5-8\\&=-13\end{aligned}$$

R9. Since division by 0 is undefined, we need to determine if the value for the variable makes $x + 3 = 0$.
When $x=3$, we have $x + 3 = (3) + 3 = 6$, so 3 is in the domain of the variable.
When $x = -3$, we have $x + 3 = (-3) + 3 = 0$, so -3 is **not** in the domain of the variable.

Section 1.1 Quick Checks

1. The equation $3x + 5 = 2x - 3$ is a <u>linear</u> equation in one variable. The expressions $3x + 5$ and $2x - 3$ are called <u>sides</u> of the equation.

2. The <u>solution</u> of a linear equation is the value or values of the variable that satisfy the equation.

3. $-5x+3=-2$
Let $x=-2$ in the equation.
$$\begin{aligned}-5(-2)+3&\stackrel{?}{=}-2\\10+3&\stackrel{?}{=}-2\\13&\neq-2\end{aligned}$$
$x=-2$ is not a solution to the equation.

Let $x=1$ in the equation.
$$\begin{aligned}-5(1)+3&\stackrel{?}{=}-2\\-5+3&\stackrel{?}{=}-2\\-2&=-2 \text{ T}\end{aligned}$$
$x=1$ is a solution to the equation.

Let $x=3$ in the equation.
$$\begin{aligned}-5(3)+3&\stackrel{?}{=}-2\\-15+3&\stackrel{?}{=}-2\\-12&\neq-2\end{aligned}$$
$x=3$ is not a solution to the equation.

4. $3x+2=2x-5$
Let $x=0$ in the equation.
$$\begin{aligned}3(0)+2&\stackrel{?}{=}2(0)-5\\0+2&\stackrel{?}{=}0-5\\2&\neq-5\end{aligned}$$
$x=0$ is not a solution to the equation.

Let $x=6$ in the equation.
$$\begin{aligned}3(6)+2&\stackrel{?}{=}2(6)-5\\18+2&\stackrel{?}{=}12-5\\20&\neq7\end{aligned}$$
$x=6$ is not a solution to the equation.

Let $x=-7$ in the equation.
$$\begin{aligned}3(-7)+2&\stackrel{?}{=}2(-7)-5\\-21+2&\stackrel{?}{=}-14-5\\-19&=-19 \text{ T}\end{aligned}$$
$x=-7$ is a solution to the equation.

5. $-3(z+2)=4z+1$
Let $z=-3$ in the equation.
$$\begin{aligned}-3((-3)+2)&\stackrel{?}{=}4(-3)+1\\-3(-1)&\stackrel{?}{=}-12+1\\3&\neq-11\end{aligned}$$
$z=-3$ is not a solution to the equation.

Let $z=-1$ in the equation.

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

$z=-1$ is a solution to the equation.

Let $z=2$ in the equation.

$$\begin{aligned}-3((2)+2) &\stackrel{?}{=} 4(2)+1\\ -3(4) &\stackrel{?}{=} 8+1\\ -12 &\neq 9\end{aligned}$$

$z=2$ is not a solution to the equation.

6. True

7. To isolate the variable means to get the variable by itself with a coefficient of 1.

8.
$$\begin{aligned}3x+8&=17\\ 3x+8-8&=17-8\\ 3x&=9\\ \frac{3x}{3}&=\frac{9}{3}\\ x&=3\end{aligned}$$

Check:
$$\begin{aligned}3(3)+8 &\stackrel{?}{=} 17\\ 9+8 &\stackrel{?}{=} 17\\ 17 &= 17 \text{ T}\end{aligned}$$

Solution set: $\{3\}$

9.
$$\begin{aligned}-4a-7&=1\\ -4a-7+7&=1+7\\ -4a&=8\\ \frac{-4a}{-4}&=\frac{8}{-4}\\ a&=-2\end{aligned}$$

Check:
$$\begin{aligned}-4(-2)-7 &\stackrel{?}{=} 1\\ 8-7 &\stackrel{?}{=} 1\\ 1 &= 1 \text{ T}\end{aligned}$$

Solution set: $\{-2\}$

10.
$$\begin{aligned}5y+1&=2\\ 5y+1-1&=2-1\\ 5y&=1\\ \frac{5y}{5}&=\frac{1}{5}\\ y&=\frac{1}{5}\end{aligned}$$

Check:
$$\begin{aligned}5\left(\frac{1}{5}\right)+1 &\stackrel{?}{=} 2\\ 1+1 &\stackrel{?}{=} 2\\ 2 &= 2 \text{ T}\end{aligned}$$

Solution set: $\left\{\frac{1}{5}\right\}$

11.
$$\begin{aligned}2x+3+5x+1&=4x+10\\ 7x+4&=4x+10\\ 7x+4-4x&=4x+10-4x\\ 3x+4&=10\\ 3x+4-4&=10-4\\ 3x&=6\\ \frac{3x}{3}&=\frac{6}{3}\\ x&=2\end{aligned}$$

Check:
$$\begin{aligned}2(2)+3+5(2)+1 &\stackrel{?}{=} 4(2)+10\\ 4+3+10+1 &\stackrel{?}{=} 8+10\\ 18 &= 18 \text{ T}\end{aligned}$$

Solution set: $\{2\}$

12.
$$\begin{aligned}4b+3-b-8-5b&=2b-1-b-1\\ -2b-5&=b-2\\ -2b-5-b&=b-2-b\\ -3b-5&=-2\\ -3b-5+5&=-2+5\\ -3b&=3\\ \frac{-3b}{-3}&=\frac{3}{-3}\\ b&=-1\end{aligned}$$

Check:
$$\begin{aligned}4(-1)+3-(-1)-8-5(-1) &\stackrel{?}{=} 2(-1)-1-(-1)-1\\ -4+3+1-8+5 &\stackrel{?}{=} -2-1+1-1\\ -3 &= -3 \text{ T}\end{aligned}$$

Solution set: $\{-1\}$

13.
$$\begin{aligned}2w+8-7w+1&=3w-1+2w-5\\ -5w+9&=5w-6\\ -5w+9-5w&=5w-6-5w\\ -10w+9&=-6\\ -10w+9-9&=-6-9\\ -10w&=-15\\ \frac{-10w}{-10}&=\frac{-15}{-10}\\ w&=\frac{3}{2}\end{aligned}$$

Check:

$$2\left(\frac{3}{2}\right)+8-7\left(\frac{3}{2}\right)+1 \stackrel{?}{=} 3\left(\frac{3}{2}\right)-1+2\left(\frac{3}{2}\right)-5$$
$$3+8-\frac{21}{2}+1 \stackrel{?}{=} \frac{9}{2}-1+3-5$$
$$\frac{3}{2}=\frac{3}{2} \text{ T}$$

Solution set: $\left\{\frac{3}{2}\right\}$

14.
$$4(x-1)=12$$
$$4x-4=12$$
$$4x-4+4=12+4$$
$$4x=16$$
$$\frac{4x}{4}=\frac{16}{4}$$
$$x=4$$

Check:
$$4(4-1) \stackrel{?}{=} 12$$
$$4(3) \stackrel{?}{=} 12$$
$$12=12 \text{ T}$$

Solution set: $\{4\}$

15.
$$-2(x-4)-6=3(x+6)+4$$
$$-2x+8-6=3x+18+4$$
$$-2x+2=3x+22$$
$$-2x+2-3x=3x+22-3x$$
$$-5x+2=22$$
$$-5x+2-2=22-2$$
$$-5x=20$$
$$\frac{-5x}{-5}=\frac{20}{-5}$$
$$x=-4$$

Check:
$$-2(-4-4)-6 \stackrel{?}{=} 3(-4+6)+4$$
$$-2(-8)-6 \stackrel{?}{=} 3(2)+4$$
$$16-6 \stackrel{?}{=} 6+4$$
$$10=10 \text{ T}$$

Solution set: $\{-4\}$

16.
$$4(x+3)-8x=3(x+2)+x$$
$$4x+12-8x=3x+6+x$$
$$-4x+12=4x+6$$
$$-4x+12-4x=4x+6-4x$$
$$-8x+12=6$$
$$-8x+12-12=6-12$$
$$-8x=-6$$
$$\frac{-8x}{-8}=\frac{-6}{-8}$$
$$x=\frac{3}{4}$$

Check:
$$4\left(\frac{3}{4}+3\right)-8\left(\frac{3}{4}\right) \stackrel{?}{=} 3\left(\frac{3}{4}+2\right)+\frac{3}{4}$$
$$4\left(\frac{15}{4}\right)-6 \stackrel{?}{=} 3\left(\frac{11}{4}\right)+\frac{3}{4}$$
$$15-6 \stackrel{?}{=} \frac{33}{4}+\frac{3}{4}$$
$$9=9 \text{ T}$$

Solution set: $\left\{\frac{3}{4}\right\}$

17.
$$5(x-3)+3(x+3)=2x-3$$
$$5x-15+3x+9=2x-3$$
$$8x-6=2x-3$$
$$8x-6-2x=2x-3-2x$$
$$6x-6=-3$$
$$6x-6+6=-3+6$$
$$6x=3$$
$$\frac{6x}{6}=\frac{3}{6}$$
$$x=\frac{1}{2}$$

Check:
$$5\left(\frac{1}{2}-3\right)+3\left(\frac{1}{2}+3\right) \stackrel{?}{=} 2\left(\frac{1}{2}\right)-3$$
$$5\left(-\frac{5}{2}\right)+3\left(\frac{7}{2}\right) \stackrel{?}{=} 1-3$$
$$-\frac{25}{2}+\frac{21}{2} \stackrel{?}{=} -2$$
$$-2=-2 \text{ T}$$

Solution set: $\left\{\frac{1}{2}\right\}$

18. To solve a linear equation containing fractions, we can multiply each side of the equation by the <u>least common denominator</u> to clear the fractions.

19.
$$\frac{3y}{2}+\frac{y}{6}=\frac{10}{3}$$
$$6\left(\frac{3y}{2}+\frac{y}{6}\right)=6\left(\frac{10}{3}\right)$$
$$6\cdot\frac{3y}{2}+6\cdot\frac{y}{6}=6\cdot\frac{10}{3}$$
$$9y+y=20$$
$$10y=20$$
$$\frac{10y}{10}=\frac{20}{10}$$
$$y=2$$

Check:
$$\frac{3(2)}{2}+\frac{2}{6}\stackrel{?}{=}\frac{10}{3}$$
$$3+\frac{1}{3}\stackrel{?}{=}\frac{10}{3}$$
$$\frac{10}{3}=\frac{10}{3}\ \text{T}$$
Solution set: $\{2\}$

20.
$$\frac{3x}{4}-\frac{5}{12}=\frac{5x}{6}$$
$$12\left(\frac{3x}{4}-\frac{5}{12}\right)=12\left(\frac{5x}{6}\right)$$
$$12\cdot\frac{3x}{4}-12\cdot\frac{5}{12}=12\cdot\frac{5x}{6}$$
$$9x-5=10x$$
$$9x-5-9x=10x-9x$$
$$-5=x$$

Check:
$$\frac{3(-5)}{4}-\frac{5}{12}\stackrel{?}{=}\frac{5(-5)}{6}$$
$$\frac{-15}{4}-\frac{5}{12}\stackrel{?}{=}-\frac{25}{6}$$
$$\frac{-45}{12}-\frac{5}{12}\stackrel{?}{=}-\frac{25}{6}$$
$$-\frac{50}{12}\stackrel{?}{=}-\frac{25}{6}$$
$$-\frac{25}{6}=-\frac{25}{6}\ \text{T}$$
Solution set: $\{-5\}$

21.
$$\frac{x+2}{6}+2=\frac{5}{3}$$
$$6\left(\frac{x+2}{6}+2\right)=6\left(\frac{5}{3}\right)$$
$$6\cdot\frac{(x+2)}{6}+6\cdot 2=6\cdot\frac{5}{3}$$
$$x+2+12=10$$
$$x+14=10$$
$$x+14-14=10-14$$
$$x=-4$$

Check:
$$\frac{-4+2}{6}+2\stackrel{?}{=}\frac{5}{3}$$
$$\frac{-2}{6}+2\stackrel{?}{=}\frac{5}{3}$$
$$-\frac{1}{3}+\frac{6}{3}\stackrel{?}{=}\frac{5}{3}$$
$$\frac{5}{3}=\frac{5}{3}\ \text{T}$$
Solution set: $\{-4\}$

22.
$$\frac{4x+3}{9}-\frac{2x+1}{2}=\frac{1}{6}$$
$$18\left(\frac{4x+3}{9}-\frac{2x+1}{2}\right)=18\left(\frac{1}{6}\right)$$
$$18\cdot\frac{(4x+3)}{9}-18\cdot\frac{(2x+1)}{2}=18\cdot\frac{1}{6}$$
$$2(4x+3)-9(2x+1)=3$$
$$8x+6-18x-9=3$$
$$-10x-3=3$$
$$-10x-3+3=3+3$$
$$-10x=6$$
$$\frac{-10x}{-10}=\frac{6}{-10}$$
$$x=-\frac{3}{5}$$

Check:

$$\frac{4\left(-\frac{3}{5}\right)+3}{9}-\frac{2\left(-\frac{3}{5}\right)+1}{2}\stackrel{?}{=}\frac{1}{6}$$
$$\frac{\frac{-12}{5}+\frac{15}{5}}{9}-\frac{\frac{-6}{5}+\frac{5}{5}}{2}\stackrel{?}{=}\frac{1}{6}$$
$$\frac{\frac{3}{5}}{9}-\frac{\frac{-1}{5}}{2}\stackrel{?}{=}\frac{1}{6}$$
$$\frac{3}{5}\cdot\frac{1}{9}+\frac{1}{5}\cdot\frac{1}{2}\stackrel{?}{=}\frac{1}{6}$$
$$\frac{1}{15}+\frac{1}{10}\stackrel{?}{=}\frac{1}{6}$$
$$\frac{2}{30}+\frac{3}{30}\stackrel{?}{=}\frac{5}{30}$$
$$\frac{5}{30}=\frac{5}{30}\text{ T}$$

Solution set: $\left\{-\frac{3}{5}\right\}$

23. Our first step is to multiply both sides of the equation by 100 to eliminate the decimals.

$$100(0.07x-1.3)=100(0.05x-1.1)$$
$$7x-130=5x-110$$
$$7x-130-5x=5x-110-5x$$
$$2x-130=-110$$
$$2x-130+130=-110+130$$
$$2x=20$$
$$\frac{2x}{2}=\frac{20}{2}$$
$$x=10$$

Check:

$$0.07(10)-1.3\stackrel{?}{=}0.05(10)-1.1$$
$$0.7-1.3\stackrel{?}{=}0.5-1.1$$
$$-0.6=-0.6\text{ T}$$

Solution set: $\{10\}$

24. Our first step is to multiply both sides of the equation by 10 to eliminate the decimals.

$$10\left[0.4(y+3)\right]=10\left[0.5(y-4)\right]$$
$$4(y+3)=5(y-4)$$
$$4y+12=5y-20$$
$$4y+12-5y=5y-20-5y$$
$$-y+12=-20$$
$$-y+12-12=-20-12$$
$$-y=-32$$
$$\frac{-y}{-1}=\frac{-32}{-1}$$
$$y=32$$

Check:

$$0.4(32+3)\stackrel{?}{=}0.5(32-4)$$
$$0.4(35)\stackrel{?}{=}0.5(28)$$
$$14=14\text{ T}$$

Solution set: $\{32\}$

25. A <u>conditional equation</u> is an equation that is true for some values of the variable and false for others.

26. A <u>contradiction</u> is an equation that is false for every value of the variable. An <u>identity</u> is an equation that is satisfied by every allowed choice of the variable.

27.

$$4(x+2)=4x+2$$
$$4x+8=4x+2$$
$$4x+8-4x=4x+2-4x$$
$$8=2$$

The last statement is a contradiction. The equation has no solution.
Solution set: $\{\ \}$ or $\varnothing$

28.

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

The last statement is an identity. All real numbers are solutions.
Solution set: $\mathbb{R}$

29.

$$-4x+2+x+1=-4(x+2)+11$$
$$-3x+3=-4x-8+11$$
$$-3x+3=-4x+3$$
$$-3x+3+4x=-4x+3+4x$$
$$x+3=3$$
$$x+3-3=3-3$$
$$x=0$$

This is a conditional equation.
Solution set: $\{0\}$

30.

$$-3(z+1)+2(z-3)=z+6-2z-15$$
$$-3z-3+2z-6=-z-9$$
$$-z-9=-z-9$$
$$-z-9+z=-z-9+z$$
$$-9=-9$$

The last statement is an identity. All real numbers are solutions.
Solution set: $\mathbb{R}$

1.1 Exercises

32. $-4x-3=-15$

Let $x=-2$ in the equation.

$-4(-2)-3 \stackrel{?}{=} -15$
$8-3 \stackrel{?}{=} -15$
$5 \neq -15$

$x=-2$ is **not** a solution to the equation.

Let $x=1$ in the equation.

$-4(1)-3 \stackrel{?}{=} -15$
$-4-3 \stackrel{?}{=} -15$
$-7 \neq -15$

$x=1$ is **not** a solution to the equation.

Let $x=3$ in the equation.

$-4(3)-3 \stackrel{?}{=} -15$
$-12-3 \stackrel{?}{=} -15$
$-15=-15\text{T}$

$x=3$ is a solution to the equation.

34. $6x+1=-2x+9$

Let $x=-2$ in the equation.

$6(-2)+1 \stackrel{?}{=} -2(-2)+9$
$-12+1 \stackrel{?}{=} 4+9$
$-11 \neq 13$

$x=-2$ is **not** a solution to the equation.

Let $x=1$ in the equation.

$6(1)+1 \stackrel{?}{=} -2(1)+9$
$6+1 \stackrel{?}{=} -2+9$
$7=7\text{ T}$

$x=1$ is a solution to the equation.

Let $x=4$ in the equation.

$6(4)+1 \stackrel{?}{=} -2(4)+9$
$24+1 \stackrel{?}{=} -8+9$
$25 \neq 1$

$x=4$ is **not** a solution to the equation.

36. $3(t+1)-t=4t+9$

Let $t=-3$ in the equation.

$3((-3)+1)-(-3) \stackrel{?}{=} 4(-3)+9$
$3(-2)+3 \stackrel{?}{=} -12+9$
$-6+3 \stackrel{?}{=} -3$
$-3=-3\text{ T}$

$t=-3$ is a solution to the equation.

Let $t=-1$ in the equation.

$3((-1)+1)-(-1) \stackrel{?}{=} 4(-1)+9$
$3(0)+1 \stackrel{?}{=} -4+9$
$1 \neq 5$

$t=-1$ is **not** a solution to the equation.

Let $t=2$ in the equation.

$3((2)+1)-(2) \stackrel{?}{=} 4(2)+9$
$3(3)-2 \stackrel{?}{=} 8+9$
$9-2 \stackrel{?}{=} 17$
$7 \neq 17$

$t=2$ is **not** a solution to the equation.

38.

$8x-6=18$
$8x-6+6=18+6$
$8x=24$
$\frac{8x}{8}=\frac{24}{8}$
$x=3$

Check:

$8(3)-6 \stackrel{?}{=} 18$
$24-6 \stackrel{?}{=} 18$
$18=18\text{T}$

Solution set: $\{3\}$

40.

$-6x-5=13$
$-6x-5+5=13+5$
$-6x=18$
$\frac{-6x}{-6}=\frac{18}{-6}$
$x=-3$

Check:

$-6(-3)-5 \stackrel{?}{=} 13$
$18-5 \stackrel{?}{=} 13$
$13=13\text{T}$

Solution set: $\{-3\}$

42.

$-7t-3+5t=11$
$-2t-3=11$
$-2t-3+3=11+3$
$-2t=14$
$\frac{-2t}{-2}=\frac{14}{-2}$
$t=-7$

Check:

$-7(-7)-3+5(-7) \stackrel{?}{=} 11$
$49-3-35 \stackrel{?}{=} 11$
$11=11\text{T}$

Solution set: $\{-7\}$

44.
$$
\begin{aligned}
-6x+2+2x+9+x &= 5x+10-6x+11 \\
-3x+11 &= -x+21 \\
-3x+11-11 &= -x+21-11 \\
-3x &= -x+10 \\
-3x+x &= -x+10+x \\
-2x &= 10 \\
\frac{-2x}{-2} &= \frac{10}{-2} \\
x &= -5
\end{aligned}
$$

Check:
$$
\begin{aligned}
-6(-5)+2+2(-5)+9+(-5) &\stackrel{?}{=} 5(-5)+10-6(-5)+11 \\
30+2-10+9-5 &\stackrel{?}{=} -25+10+30+11 \\
41-15 &\stackrel{?}{=} 51-25 \\
26 &= 26 \text{ T}
\end{aligned}
$$

Solution set: $\{-5\}$

46.
$$
\begin{aligned}
4(z-2) &= 12 \\
\frac{4(z-2)}{4} &= \frac{12}{4} \\
z-2 &= 3 \\
z-2+2 &= 3+2 \\
z &= 5
\end{aligned}
$$

Check:
$$
\begin{aligned}
4((5)-2) &\stackrel{?}{=} 12 \\
4(3) &\stackrel{?}{=} 12 \\
12 &= 12 \text{ T}
\end{aligned}
$$

Solution set: $\{5\}$

48.
$$
\begin{aligned}
\frac{3x}{2}+\frac{x}{6} &= -\frac{5}{3} \\
6\left(\frac{3x}{2}+\frac{x}{6}\right) &= 6\left(-\frac{5}{3}\right) \\
6\cdot\frac{3x}{2}+6\cdot\frac{x}{6} &= 6\left(-\frac{5}{3}\right) \\
9x+x &= -10 \\
10x &= -10 \\
\frac{10x}{10} &= \frac{-10}{10} \\
x &= -1
\end{aligned}
$$

Check:
$$
\begin{aligned}
\frac{3(-1)}{2}+\frac{(-1)}{6} &\stackrel{?}{=} -\frac{5}{3} \\
-\frac{3}{2}-\frac{1}{6} &\stackrel{?}{=} -\frac{5}{3} \\
-\frac{5}{3} &= -\frac{5}{3} \text{ T}
\end{aligned}
$$

Solution set: $\{-1\}$

50. $\frac{2x+1}{3}-\frac{6x-1}{4}=-\frac{5}{12}$

$$12\left(\frac{2x+1}{3}-\frac{6x-1}{4}\right)=12\left(-\frac{5}{12}\right)$$
$$4(2x+1)-3(6x-1)=-5$$
$$8x+4-18x+3=-5$$
$$-10x+7=-5$$
$$-10x+7-7=-5-7$$
$$-10x=-12$$
$$\frac{-10x}{-10}=\frac{-12}{-10}$$
$$x=\frac{6}{5}$$

Check:
$$\frac{2\left(\frac{6}{5}\right)+1}{3}-\frac{6\left(\frac{6}{5}\right)-1}{4}\stackrel{?}{=}-\frac{5}{12}$$
$$\frac{\frac{12}{5}+\frac{5}{5}}{3}-\frac{\frac{36}{5}-\frac{5}{5}}{4}\stackrel{?}{=}-\frac{5}{12}$$
$$\frac{\frac{17}{5}}{3}-\frac{\frac{31}{5}}{4}\stackrel{?}{=}-\frac{5}{12}$$
$$\frac{17}{15}-\frac{31}{20}\stackrel{?}{=}-\frac{5}{12}$$
$$\frac{68}{60}-\frac{93}{60}\stackrel{?}{=}-\frac{5}{12}$$
$$-\frac{25}{60}\stackrel{?}{=}-\frac{5}{12}$$
$$-\frac{5}{12}\stackrel{?}{=}-\frac{5}{12}\text{T}$$

Solution set: $\left\{\frac{6}{5}\right\}$

52. $\frac{n}{5}+3=\frac{n}{2}+6$

$$10\left(\frac{n}{5}+3\right)=10\left(\frac{n}{2}+6\right)$$
$$10\cdot\frac{n}{5}+10(3)=10\cdot\frac{n}{2}+10(6)$$
$$2n+30=5n+60$$
$$2n+30-2n=5n+60-2n$$
$$30=3n+60$$
$$30-60=3n+60-60$$
$$-30=3n$$
$$\frac{-30}{3}=\frac{3n}{3}$$
$$-10=n$$

Check: $\frac{-10}{5}+3\stackrel{?}{=}\frac{-10}{2}+6$
$$-2+3\stackrel{?}{=}-5+6$$
$$1=1\ \text{True}$$

Solution set: $\{-10\}$

54. $0.3z+0.8=-0.1$

$$10(0.3z+0.8)=10(-0.1)$$
$$3z+8=-1$$
$$3z+8-8=-1-8$$
$$3z=-9$$
$$\frac{3z}{3}=\frac{-9}{3}$$
$$z=-3$$

Check:
$$0.3(-3)+0.8\stackrel{?}{=}-0.1$$
$$-0.9+0.8\stackrel{?}{=}-0.1$$
$$-0.1=-0.1\text{T}$$

Solution set: $\{-3\}$

56. $0.12y-5.26=0.05y+1.25$

$$100(0.12y-5.26)=100(0.05y+1.25)$$
$$12y-526=5y+125$$
$$12y-526+526=5y+125+526$$
$$12y=5y+651$$
$$12y-5y=5y+651-5y$$
$$7y=651$$
$$\frac{7y}{7}=\frac{651}{7}$$
$$y=93$$

Check: $0.12(93)-5.26\stackrel{?}{=}0.05(93)+1.25$
$$11.16-5.26\stackrel{?}{=}4.65+1.25$$
$$5.9=5.9\text{T}$$

Solution set: $\{93\}$

58. $5(s+3)=3s+2s$

$$5s+15=5s$$
$$5s+15-5s=5s-5s$$
$$15=0$$

This statement is a contradiction. The equation has no solution.
Solution set: $\{\ \}$ or $\varnothing$

60.
$$\begin{aligned}10(x-1)-4x&=2x-1+4(x+1)\\10x-10-4x&=2x-1+4x+4\\6x-10&=6x+3\\6x-10-6x&=6x+3-6x\\-10&=3\end{aligned}$$
This statement is a contradiction. The equation has no solution.
Solution set: $\{\ \}$ or $\varnothing$

62.
$$\begin{aligned}8(w+2)-3w&=7(w+2)+2(1-w)\\8w+16-3w&=7w+14+2-2w\\5w+16&=5w+16\\5w+16-5w&=5w+16-5w\\16&=16\end{aligned}$$
This statement is an identity. All real numbers are solutions.
Solution set: $\{w \mid w \text{ is a real number}\}$ or $\mathbb{R}$

64.
$$\begin{aligned}\frac{z-2}{4}+\frac{2z-3}{6}&=7\\12\left(\frac{z-2}{4}+\frac{2z-3}{6}\right)&=12(7)\\3(z-2)+2(2z-3)&=84\\3z-6+4z-6&=84\\7z-12&=84\\7z-12+12&=84+12\\7z&=96\\\frac{7z}{7}&=\frac{96}{7}\\z&=\frac{96}{7}\end{aligned}$$
Check:
$$\begin{aligned}\frac{\frac{96}{7}-2}{4}+\frac{2\left(\frac{96}{7}\right)-3}{6}&\stackrel{?}{=}7\\\frac{\frac{96}{7}-\frac{14}{7}}{4}+\frac{\frac{192}{7}-\frac{21}{7}}{6}&\stackrel{?}{=}7\\\frac{\frac{82}{7}}{4}+\frac{\frac{171}{7}}{6}&\stackrel{?}{=}7\\\frac{82}{28}+\frac{171}{42}&\stackrel{?}{=}7\\\frac{41}{14}+\frac{57}{14}&\stackrel{?}{=}7\\7&=7\text{ T}\end{aligned}$$
This is a conditional equation.
Solution set: $\left\{\frac{96}{7}\right\}$

66.
$$\begin{aligned}\frac{r}{2}+2(r-1)&=\frac{5r}{2}+4\\2\left(\frac{r}{2}+2(r-1)\right)&=2\left(\frac{5r}{2}+4\right)\\r+4(r-1)&=5r+8\\r+4r-4&=5r+8\\5r-4&=5r+8\\5r-4-5r&=5r+8-5r\\-4&=8\end{aligned}$$
This statement is a contradiction. The equation has no solution.
Solution set: $\{\ \}$ or $\varnothing$

68.
$$\begin{aligned}\frac{3x+1}{4}-\frac{7x-4}{2}&=\frac{26}{3}\\12\left(\frac{3x+1}{4}-\frac{7x-4}{2}\right)&=12\left(\frac{26}{3}\right)\\3(3x+1)-6(7x-4)&=4(26)\\9x+3-42x+24&=104\\-33x+27&=104\\-33x+27-27&=104-27\\-33x&=77\\\frac{-33x}{-33}&=\frac{77}{-33}\\x&=-\frac{7}{3}\end{aligned}$$
Check:
$$\begin{aligned}\frac{3\left(-\frac{7}{3}\right)+1}{4}-\frac{7\left(-\frac{7}{3}\right)-4}{2}&\stackrel{?}{=}\frac{26}{3}\\\frac{-7+1}{4}-\frac{-\frac{49}{3}-4}{2}&\stackrel{?}{=}\frac{26}{3}\\-\frac{3}{2}+\frac{\frac{61}{3}}{2}&\stackrel{?}{=}\frac{26}{3}\\-\frac{9}{6}+\frac{61}{6}&\stackrel{?}{=}\frac{26}{3}\\\frac{52}{6}&\stackrel{?}{=}\frac{26}{3}\\\frac{26}{3}&=\frac{26}{3}\text{ T}\end{aligned}$$
This is a conditional equation.
Solution set: $\left\{-\frac{7}{3}\right\}$

70.
$$\begin{aligned} 0.9(z-3)-0.2(z-5) &= 0.4(z+1)+0.3z-2.1 \\ 0.9z-2.7-0.2z+1.0 &= 0.4z+0.4+0.3z-2.1 \\ 0.7z-1.7 &= 0.7z-1.7 \\ 0.7z-1.7-0.7z &= 0.7z-1.7-0.7z \\ -1.7 &= -1.7 \end{aligned}$$

This statement is an identity. The solution set is all real numbers.

Solution set: $\{z \mid z \text{ is any real number}\}$ or $\mathbb{R}$

72.
$$\begin{aligned} \frac{4}{5}(y-4)+3 &= \frac{2}{3}(y+1)+\frac{4}{15} \\ 15\left[\frac{4}{5}(y-4)+3\right] &= 15\left[\frac{2}{3}(y+1)+\frac{4}{15}\right] \\ 12(y-4)+45 &= 10(y+1)+4 \\ 12y-48+45 &= 10y+10+4 \\ 12y-3 &= 10y+14 \\ 12y-3+3 &= 10y+14+3 \\ 12y &= 10y+17 \\ 12y-10y &= 10y+17-10y \\ 2y &= 17 \\ y &= \frac{17}{2} \end{aligned}$$

Check:
$$\begin{aligned} \frac{4}{5}\left(\frac{17}{2}-4\right)+3 &\stackrel{?}{=} \frac{2}{3}\left(\frac{17}{2}+1\right)+\frac{4}{15} \\ \frac{4}{5}\left(\frac{9}{2}\right)+3 &\stackrel{?}{=} \frac{2}{3}\left(\frac{19}{2}\right)+\frac{4}{15} \\ \frac{18}{5}+\frac{15}{5} &\stackrel{?}{=} \frac{19}{3}+\frac{4}{15} \\ \frac{33}{5} &\stackrel{?}{=} \frac{95}{15}+\frac{4}{15} \\ \frac{33}{5} &\stackrel{?}{=} \frac{99}{15} \\ \frac{33}{5} &= \frac{33}{5}\text{ T} \end{aligned}$$

This is a conditional equation.

Solution set: $\left\{\frac{17}{2}\right\}$

74.
$$\begin{aligned} 4y+5 &= 7 \\ 4y+5-5 &= 7-5 \\ 4y &= 2 \\ \frac{4y}{4} &= \frac{2}{4} \\ y &= \frac{1}{2} \end{aligned}$$

Check:
$$\begin{aligned} 4\left(\frac{1}{2}\right)+5 &\stackrel{?}{=} 7 \\ 2+5 &\stackrel{?}{=} 7 \\ 7 &= 7\text{ T} \end{aligned}$$

This is a conditional equation.

Solution set: $\left\{\frac{1}{2}\right\}$

76.
$$\begin{aligned} -5x+5+3x+7 &= 5x-6+x+12 \\ -2x+12 &= 6x+6 \\ -2x+12-12 &= 6x+6-12 \\ -2x &= 6x-6 \\ -2x-6x &= 6x-6-6x \\ -8x &= -6 \\ \frac{-8x}{-8} &= \frac{-6}{-8} \\ x &= \frac{3}{4} \end{aligned}$$

Check:
$$\begin{aligned} -5\left(\frac{3}{4}\right)+5+3\left(\frac{3}{4}\right)+7 &\stackrel{?}{=} 5\left(\frac{3}{4}\right)-6+\frac{3}{4}+12 \\ -\frac{15}{4}+12+\frac{9}{4} &\stackrel{?}{=} \frac{15}{4}+6+\frac{3}{4} \\ -\frac{15}{4}+\frac{48}{4}+\frac{9}{4} &\stackrel{?}{=} \frac{15}{4}+\frac{24}{4}+\frac{3}{4} \\ \frac{42}{4} &= \frac{42}{4}\text{ T} \end{aligned}$$

This is a conditional equation.

Solution set: $\left\{\frac{3}{4}\right\}$

78.
$$\begin{aligned} 7(x+2) &= 5(x-2)+2(x+12) \\ 7x+14 &= 5x-10+2x+24 \\ 7x+14 &= 7x+14 \\ 7x+14-7x &= 7x+14-7x \\ 14 &= 14 \end{aligned}$$

This statement is an identity. The solution set is all real numbers.

Solution set: $\{x \mid x \text{ is any real number}\}$ or $\mathbb{R}$

80.
$$\begin{aligned} 13z-8(z+1) &= 2(z-3)+3z \\ 13z-8z-8 &= 2z-6+3z \\ 5z-8 &= 5z-6 \\ 5z-8-5z &= 5z-6-5z \\ -8 &= -6 \end{aligned}$$

This statement is a contradiction. The equation has no solution.

Solution set: $\{\ \}$ or $\varnothing$

82.
$$\begin{aligned}5(2x+3)&=9-(x+5)\\10x+15&=9-x-5\\10x+15&=4-x\\10x+15+x&=4-x+x\\11x+15&=4\\11x+15-15&=4-15\\11x&=-11\\\frac{11x}{11}&=\frac{-11}{11}\\x&=-1\end{aligned}$$

Check:
$$\begin{aligned}5[2(-1)+3]&\stackrel{?}{=}9-(-1+5)\\5(-2+3)&\stackrel{?}{=}9-4\\5(1)&\stackrel{?}{=}5\\5&=5\ \text{True}\end{aligned}$$

This is a conditional equation.
Solution set: $\{-1\}$

84.
$$\begin{aligned}\frac{z-4}{6}-\frac{2z+1}{9}&=\frac{1}{3}\\18\left(\frac{z-4}{6}-\frac{2z+1}{9}\right)&=18\left(\frac{1}{3}\right)\\3(z-4)-2(2z+1)&=6\\3z-12-4z-2&=6\\-z-14&=6\\-z-14+14&=6+14\\-z&=20\\\frac{-z}{-1}&=\frac{20}{-1}\\z&=-20\end{aligned}$$

Check:
$$\begin{aligned}\frac{-20-4}{6}-\frac{2(-20)+1}{9}&\stackrel{?}{=}\frac{1}{3}\\\frac{-24}{6}-\frac{-39}{9}&\stackrel{?}{=}\frac{1}{3}\\-\frac{12}{3}+\frac{13}{3}&\stackrel{?}{=}\frac{1}{3}\\\frac{1}{3}&=\frac{1}{3}\text{T}\end{aligned}$$

This is a conditional equation.
Solution set: $\{-20\}$

86.
$$\begin{aligned}-0.8y+0.3&=0.2y-3.7\\-0.8y+0.3-0.3&=0.2y-3.7-0.3\\-0.8y&=0.2y-4.0\\-0.8y-0.2y&=0.2y-4.0-0.2y\\-1.0y&=-4.0\\\frac{-1.0y}{-1.0}&=\frac{-4.0}{-1.0}\\y&=4\end{aligned}$$

Check:
$$\begin{aligned}-0.8(4)+0.3&\stackrel{?}{=}0.2(4)-3.7\\-3.2+0.3&\stackrel{?}{=}0.8-3.7\\-2.9&=-2.9\text{T}\end{aligned}$$

This is a conditional equation.
Solution set: $\{4\}$

(Note: Alternatively, we could have started by multiplying both sides of the equation by 10 to clear the decimals.)

88.
$$\begin{aligned}0.5(x+3)&=0.2(x-6)\\0.5x+1.5&=0.2x-1.2\\0.5x+1.5-1.5&=0.2x-1.2-1.5\\0.5x&=0.2x-2.7\\0.5x-0.2x&=0.2x-2.7-0.2x\\0.3x&=-2.7\\\frac{0.3x}{0.3}&=\frac{-2.7}{0.3}\\x&=-9\end{aligned}$$

Check:
$$\begin{aligned}0.5(-9+3)&\stackrel{?}{=}0.2(-9-6)\\0.5(-6)&\stackrel{?}{=}0.2(-15)\\-3&=-3\text{T}\end{aligned}$$

This is a conditional equation.
Solution set: $\{-9\}$

(Note: Alternatively, we could have started by multiplying both sides of the equation by 10 to clear the decimals.)

90.
$$\begin{aligned}\frac{1}{5}(2a-5)-4&=\frac{1}{2}(a+4)-\frac{7}{10}\\10\left[\frac{1}{5}(2a-5)-4\right]&=10\left[\frac{1}{2}(a+4)-\frac{7}{10}\right]\\2(2a-5)-40&=5(a+4)-7\\4a-10-40&=5a+20-7\\4a-50&=5a+13\\4a-50+50&=5a+13+50\\4a&=5a+63\\4a-5a&=5a+63-5a\\-a&=63\\a&=-63\end{aligned}$$

Check:

$$\frac{1}{5}(2(-63)-5)-4 \stackrel{?}{=} \frac{1}{2}(-63+4)-\frac{7}{10}$$
$$\frac{1}{5}(-131)-4 \stackrel{?}{=} \frac{1}{2}(-59)-\frac{7}{10}$$
$$-\frac{131}{5}-\frac{20}{5} \stackrel{?}{=} \frac{5}{10}(-59)-\frac{7}{10}$$
$$-\frac{151}{5} \stackrel{?}{=} -\frac{295}{10}-\frac{7}{10}$$
$$-\frac{151}{5} \stackrel{?}{=} -\frac{302}{10}$$
$$-\frac{151}{5} = -\frac{151}{5}\text{T}$$

This is a conditional equation.
Solution set: $\{-63\}$

92. $ax+6=20$
Let $x=7$.

$$a(7)+6=20$$
$$7a+6-6=20-6$$
$$7a=14$$
$$\frac{7a}{7}=\frac{14}{7}$$
$$a=2$$

Check:

$$2x+6=20$$
$$2x+6-6=20-6$$
$$2x=14$$
$$\frac{2x}{2}=\frac{14}{2}$$
$$x=7$$

94. $ax+3=2x+3(x+1)$

$$ax+3=2x+3x+3$$
$$ax+3=5x+3$$

To have the solution set be all real numbers, we need both sides of the linear equation to be identical. This can be achieved by letting $a=5$.

96. We need to set the denominator equal to 0 and solve the resulting equation.

$$5x+8=0$$
$$5x+8-8=0-8$$
$$5x=-8$$
$$\frac{5x}{5}=\frac{-8}{5}$$
$$x=-\frac{8}{5}$$

Check:

$$5\left(-\frac{8}{5}\right)+8 \stackrel{?}{=} 0$$
$$-8+8 \stackrel{?}{=} 0$$
$$0=0\text{T}$$

We must exclude $-\frac{8}{5}$ from the domain.

98. We need to set the denominator equal to 0 and solve the resulting equation.

$$3x+1=0$$
$$3x+1-1=0-1$$
$$3x=-1$$
$$\frac{3x}{3}=\frac{-1}{3}$$
$$x=-\frac{1}{3}$$

Check:

$$3\left(-\frac{1}{3}\right)+1 \stackrel{?}{=} 0$$
$$-1+1 \stackrel{?}{=} 0$$
$$0=0\text{T}$$

We must exclude $x=-\frac{1}{3}$ from the domain.

100. We need to set the denominator equal to 0 and solve the resulting equation.

$$4(x-3)+2=0$$
$$4x-12+2=0$$
$$4x-10=0$$
$$4x-10+10=0+10$$
$$4x=10$$
$$\frac{4x}{4}=\frac{10}{4}$$
$$x=\frac{5}{2}$$

Check:

$$4\left(\frac{5}{2}-3\right)+2 \stackrel{?}{=} 0$$
$$4\left(-\frac{1}{2}\right)+2 \stackrel{?}{=} 0$$
$$-2+2 \stackrel{?}{=} 0$$
$$0=0\text{T}$$

We must exclude $x=\frac{5}{2}$ from the domain.

102. $26x+9x=539$
$35x=539$
$\frac{35x}{35}=\frac{539}{35}$
$x=15.4$
Your regular hourly rate is $15.40 per hour.

104.
$$11,037.5=0.25(I-69,000)+9500$$
$$11,037.5=0.25I-17,250+9500$$
$$11,037.5=0.25I-7750$$
$$11,037.5+7750=0.25I-7750+7750$$
$$18,787.5=0.25I$$
$$\frac{18,787.5}{0.25}=\frac{0.25I}{0.25}$$
$$75,150=I$$
Your adjusted gross income for 2011 was $75,150.

106. The direction "solve" is used with equations and means to find all solutions to an equation. That is, find the values that make the statement true. The direction "simplify" is used with expressions and means to write the expression in a simpler form.

Section 1.2

Are You Ready for This Section?

R1. $12+z$
The keyword 'sum' indicates addition.

R2. $4x$
The keyword 'product' indicates multiplication.

R3. $y-87$
The keywords 'decreased by' indicate subtraction. Since order matters here, we subtract the quantity after the keywords.

R4. $\frac{z}{12}$
The keyword 'quotient' indicates division. The first quantity is the numerator and the second quantity is the denominator.

R5. $4(x+7)$
The keyword 'times' indicates multiplication and the keyword 'sum' indicates addition. Because the statement says 'times the sum' we multiply 4 by the entire sum, not just the *x*.

R6. $4x+7$
The keyword 'times' indicates multiplication and the keyword 'sum' indicates addition. After the keywords 'sum of', we look for the two quantities to add. These are separated by the keyword 'and'. Thus, the first addend is 'four times a number *x*' while the second addend is the number '7'.

Section 1.2 Quick Checks

1. Mathematical statements are represented symbolically as <u>equations</u>.

2. $x + 7 = 12$
[The sum of *x* and 7] [results in] [12].
↓ ↓ ↓
$x + 7$ $=$ 12

3. $3y = 21$
[The product of 3 and *y*] [is equal to] [21].
↓ ↓ ↓
$3y$ $=$ 21

4. $2(n + 3) = 5$
[Two times] [the sum of *n* and 3] [is] [5]
↓ ↓ ↓ ↓
2($n + 3$) $=$ 5

5. $x-10=\frac{x}{2}$
[The difference of *x* and 10] [equals] [the quotient of *x* and 2].
↓ ↓ ↓
$x - 10$ $=$ $\frac{x}{2}$

6. $2n + 3 = 5$
[The sum of two times *n* and 3] [is] [5]
↓ ↓ ↓
$2n + 3$ $=$ 5

7. False; if *n* represents the first of two consecutive odd integers, $n + 2$ represents the next consecutive odd integer.

8. Let x = the first of the consecutive even integers.
Second: $x+2$
Third: $x+4$

$$\begin{aligned} x+(x+2)+(x+4)&=60\\ x+x+2+x+4&=60\\ 3x+6&=60\\ 3x+6-6&=60-6\\ 3x&=54\\ \frac{3x}{3}&=\frac{54}{3}\\ x&=18 \end{aligned}$$

The three consecutive even integers are 18, 20, and 22.
Check:
$18+(18+2)+(18+4)=18+20+22=60$

9. Let x = the first of the consecutive integers.
Second: $x+1$
Third: $x+2$

$$\begin{aligned} x+(x+1)+(x+2)&=78\\ x+x+1+x+2&=78\\ 3x+3&=78\\ 3x+3-3&=78-3\\ 3x&=75\\ \frac{3x}{3}&=\frac{75}{3}\\ x&=25 \end{aligned}$$

The three consecutive integers are 25, 26, and 27.
Check:
$25+(25+1)+(25+2)=25+26+27=78$

10. Let w = Melody's hourly wage.
Overtime rate: $1.5w$

$$\begin{aligned} 40w+6(1.5w)&=735\\ 40w+9w&=735\\ 49w&=735\\ \frac{49w}{49}&=\frac{735}{49}\\ w&=15 \end{aligned}$$

Melody makes $15 per hour.
Check:

$$\begin{aligned} 40(15)+6[1.5(15)]&=600+6(22.5)\\ &=600+135\\ &=735 \end{aligned}$$

11. Let w = Jim's regular hourly rate.
Saturday rate: $1.5w$
Sunday rate: $2w$

$$\begin{aligned} 30w+6(1.5w)+4(2w)&=564\\ 30w+9w+8w&=564\\ 47w&=564\\ \frac{47w}{47}&=\frac{564}{47}\\ w&=12 \end{aligned}$$

Jim's regular hourly rate is $12 per hour.
Check:

$$\begin{aligned} &30(12)+6[1.5(12)]+4[2(12)]\\ &=360+6(18)+4(24)\\ &=360+108+96\\ &=564 \end{aligned}$$

12. Let m = the number of miles.
EZ-Rental cost = Do It Yourself cost

$$\begin{aligned} 35+0.15m&=20+0.25m\\ 0.15m&=-15+0.25m\\ -0.1m&=-15\\ \frac{-0.1m}{-0.1}&=\frac{-15}{-0.1}\\ m&=150 \end{aligned}$$

The rental costs will be the same for 150 miles.
Check:
$35+0.15(150)=35+22.5=\$57.50$
$20+0.25(150)=20+37.5=\$57.50$

13. Let m = the number of minutes used.
Company A cost = Company B cost

$$\begin{aligned} 12+0.1m&=0.15m\\ 12&=0.05m\\ \frac{12}{0.05}&=\frac{0.05m}{0.05}\\ 240&=m \end{aligned}$$

The monthly costs will be the same for 240 minutes.
Check:
$12+0.1(240)=12+24=36$
$0.15(240)=36$

14. Percent means "divided by <u>100</u>."

15. Let x = the desired result.
$x=0.4(100)=40$
40% of 100 is 40.

16. Let x = the desired value.

$$8 = 0.05(x)$$
$$\frac{8}{0.05} = \frac{0.05x}{0.05}$$
$$160 = x$$

8 is 5% of 160.

17. Let p = the desired percent (as a decimal).

$$15 = p \cdot 20$$
$$15 = 20p$$
$$\frac{15}{20} = \frac{20p}{20}$$
$$0.75 = p$$

15 is 75% of 20.

18. Let p = the original price.
Discount: $0.3p$

$$p - 0.3p = 21$$
$$0.7p = 21$$
$$\frac{0.7p}{0.7} = \frac{21}{0.7}$$
$$p = 30$$

The original price of the shirt was $30.

19. Let c = Milex's cost for a spark plug.
Mark up: $0.35c$

$$c + 0.35c = 1.62$$
$$1.35c = 1.62$$
$$\frac{1.35c}{1.35} = \frac{1.62}{1.35}$$
$$c = 1.2$$

Milex's cost for each spark plug is $1.20.

20. Interest is money paid for the use of money. The total amount borrowed is called the principal.

21. Note that 1 month is $\frac{1}{12}$ year.

$$I = Prt$$
$$I = (6500)(0.06)\left(\frac{1}{12}\right) = 32.5$$

The interest charge on Dave's car loan after 1 month is $32.50.

22. Note that 6 months is $\frac{1}{2}$ year.

$$I = Prt$$
$$I = (1400)(0.015)\left(\frac{1}{2}\right) = 10.50$$

The interest paid after 6 months would be $10.50.
The balance is the original amount in the account plus the accrued interest.
$1400 + 10.50 = 1410.50$
The account will have a balance of $1410.50.

23. Let x = the amount invested in Aaa-rated bonds.
B-rated bonds: $90,000 - x$

Int. from Aaa-rated + Int. from B-rated = 5400

$$0.05x + 0.09(90,000 - x) = 5400$$
$$0.05x + 8100 - 0.09x = 5400$$
$$8100 - 0.04x = 5400$$
$$-0.04x = -2700$$
$$\frac{-0.04x}{-0.04} = \frac{-2700}{-0.04}$$
$$x = 67,500$$

Sophia should place $67,500 in Aaa-rated bonds and $\$90,000 - \$67,500 = \$22,500$ in B-rated bonds.

24. Let x = the amount invested in a 5-yr CD.
Corporate bonds: $25,000 - x$

CD interest + bond interest = total interest

$$0.04x + 0.09(25,000 - x) = 0.08(25,000)$$
$$0.04x + 2250 - 0.09x = 2000$$
$$2250 - 0.05x = 2000$$
$$-0.05x = -250$$
$$\frac{-0.05x}{-0.05} = \frac{-250}{-0.05}$$
$$x = 5000$$

Steve should invest $5000 in the CD and $\$25,000 - \$5000 = \$20,000$ in corporate bonds.

25. Let x = pounds of Tea A.
Tea B pounds: $10 - x$

	Tea A	Tea B	Mix
price per pound	4	2.75	3.50
pounds	x	$10 - x$	10
revenue	$4x$	$2.75(10 - x)$	$3.5(10)$

We want the individual revenues to be the same as the revenue from the mix. Therefore, we get

$$4x + 2.75(10 - x) = 3.5(10)$$
$$4x + 27.5 - 2.75x = 35$$
$$1.25x + 27.5 = 35$$
$$1.25x = 7.5$$
$$\frac{1.25x}{1.25} = \frac{7.5}{1.25}$$
$$x = 6$$

You should blend 6 pounds of Tea A and $10 - 6 = 4$ pounds of Tea B.

26. Let x = pounds of cashews.
Peanuts: $30-x$

	Cashews	Peanuts	Mix
price per pound	6	1.5	3
pounds	x	$30-x$	30
revenue	$6x$	$1.5(30-x)$	$3(30)$

We want the individual revenues to be the same as the revenue from the mix. Therefore, we get

$$6x+1.5(30-x)=3(30)$$
$$6x+45-1.5x=90$$
$$4.5x+45=90$$
$$4.5x=45$$
$$\frac{4.5x}{4.5}=\frac{45}{4.5}$$
$$x=10$$

You should blend 10 pounds of cashews and $30-10=20$ pounds of peanuts.

27. Objects that move at a constant velocity are said to be in uniform motion.

28. Another term for speed is rate.

29. We want to know when the distance traveled by both cars will be the same.
Let t = the time of travel by the Cruze.
Then the time of travel for the Dodge will be $t-2$ since it left two hours later.

Cruze distance = Dodge distance

$$(\text{rate})(\text{time})_{\text{Cruze}}=(\text{rate})(\text{time})_{\text{Dodge}}$$
$$40t=60(t-2)$$
$$40t=60t-120$$
$$-20t=-120$$
$$t=6$$

The Dodge will catch the Cruze after the Cruze has been traveling for 6 hours (4 hours for the Dodge). When the Dodge catches the Cruze, both cars will have traveled $40(6)=240$ miles.

30. We want to know when the distance traveled by both the train and the helicopter will be the same.
Let t = the time of travel by the train.
Then the time of travel for the helicopter will be $t-4$ since it left four hours later.

train distance = helicopter distance

$$(\text{rate})(\text{time})_{\text{train}}=(\text{rate})(\text{time})_{\text{helicopter}}$$
$$50t=90(t-4)$$
$$50t=90t-360$$
$$-40t=-360$$
$$t=9$$

The helicopter will catch the train after the train has been traveling for 9 hours (5 hours for the helicopter). When the helicopter catches the train, both the helicopter and the train will have traveled $50(9)=450$ miles.

1.2 Exercises

32. Let x = desired result.
$$x=1.5(70)=105$$
150% of 70 is 105.

34. Let x = original number.
$$0.9x=50$$
$$\frac{0.9x}{0.9}=\frac{50}{0.9}$$
$$x=\frac{500}{9}$$
50 is 90% of $\frac{500}{9}$.

36. Let x = percent as a decimal.
$$120x=90$$
$$\frac{120x}{120}=\frac{90}{120}$$
$$x=\frac{9}{12}=0.75$$
90 is 75% of 120.

38.
$$10-z=6$$
$$10-z-10=6-10$$
$$-z=-4$$
$$\frac{-z}{-1}=\frac{-4}{-1}$$
$$z=4$$

40.
$$2y+3=16$$
$$2y+3-3=16-3$$
$$2y=13$$
$$\frac{2y}{2}=\frac{13}{2}$$
$$y=\frac{13}{2}$$

42.
$$x+4=2x$$
$$x+4-x=2x-x$$
$$4=x \quad \text{or} \quad x=4$$

44.
$$\begin{aligned} 5x &= 3x - 10 \\ 5x - 3x &= 3x - 10 - 3x \\ 2x &= -10 \\ \frac{2x}{2} &= \frac{-10}{2} \\ x &= -5 \end{aligned}$$

46.
$$\begin{aligned} 0.4x &= x - 10 \\ 0.4x - x &= x - 10 - x \\ -0.6x &= -10 \\ \frac{-0.6x}{-0.6} &= \frac{-10}{-0.6} \\ x &= \frac{50}{3} \end{aligned}$$

48. First number: x
Second number: $x+8$
$$\begin{aligned} x + (x+8) &= 56 \\ 2x + 8 &= 56 \\ 2x + 8 - 8 &= 56 - 8 \\ 2x &= 48 \\ \frac{2x}{2} &= \frac{48}{2} \\ x &= 24 \end{aligned}$$
Check:
$$24 + (24+8) = 24 + 32 = 56$$
The two numbers are 24 and 32.

50. First of the consecutive odd integers: x
Second consecutive odd integer: $x+2$
Third consecutive odd integer: $x+4$
Fourth consecutive odd integer: $x+6$
$$\begin{aligned} x + (x+2) + (x+4) + (x+6) &= 104 \\ 4x + 12 &= 104 \\ 4x + 12 - 12 &= 104 - 12 \\ 4x &= 92 \\ \frac{4x}{4} &= \frac{92}{4} \\ x &= 23 \end{aligned}$$
Check:
$$\begin{aligned} &23 + (23+2) + (23+4) + (23+6) \\ &= 23 + 25 + 27 + 29 \\ &= 104 \end{aligned}$$
The integers are 23, 25, 27, and 29.

52. Let x = score on Mark's final exam.
$$\begin{aligned} \frac{3x + 65 + 79 + 83 + 68}{7} &= 70 \\ \frac{3x + 295}{7} &= 70 \\ 7 \cdot \frac{3x + 295}{7} &= 7 \cdot 70 \\ 3x + 295 &= 490 \\ 3x + 295 - 295 &= 490 - 295 \\ 3x &= 195 \\ \frac{3x}{3} &= \frac{195}{3} \\ x &= 65 \end{aligned}$$
Check:
$$\frac{3(65) + 65 + 79 + 83 + 68}{7} = \frac{195 + 295}{7} = \frac{490}{7} = 70$$
Mark needs a 65 on his final exam to have an average of 70.

54. Let x = Maria's monthly sales.
First offer: $2500 + 0.03x$
Second offer: $1500 + 0.035x$
$$\begin{aligned} 2500 + 0.03x &= 1500 + 0.035x \\ 2500 + 0.03x - 2500 &= 1500 + 0.035x - 2500 \\ 0.03x &= 0.035x - 1000 \\ 0.03x - 0.035x &= 0.035x - 1000 - 0.035x \\ -0.005x &= -1000 \\ \frac{-0.005x}{-0.005} &= \frac{-1000}{-0.005} \\ x &= 200{,}000 \end{aligned}$$
Check:
$$\begin{aligned} 2500 + 0.03(200{,}000) &\stackrel{?}{=} 1500 + 0.035(200{,}000) \\ 2500 + 6000 &\stackrel{?}{=} 1500 + 7000 \\ 8500 &= 8500 \text{ T} \end{aligned}$$
Maria would need $200,000 in monthly sales for the two salaries to be equivalent.

56. Let x = amount Linda should pay.
Amount Judy should pay: $\frac{3}{4}x$
$$\begin{aligned} x + \frac{3}{4}x &= 21 \\ \frac{4}{4}x + \frac{3}{4}x &= 21 \\ \frac{7}{4}x &= 21 \\ \frac{4}{7} \cdot \frac{7}{4}x &= \frac{4}{7} \cdot 21 \\ x &= 12 \end{aligned}$$

Check:

$$12+\frac{3}{4}(12)\stackrel{?}{=}21$$
$$12+9\stackrel{?}{=}21$$
$$21=21\text{T}$$

Linda should pay \$12 and Judy should pay \$9.

58. Let c = total cost including tax.

$$c=450+0.0825(450)$$
$$=450+37.125$$
$$=487.125$$

The final bill, including tax, would be \$487.13.

60. Let c = cost of text to bookstore.

$$c+0.3c=95$$
$$1.3c=95$$
$$\frac{1.3c}{1.3}=\frac{95}{1.3}$$
$$c=73.08$$

Check:

$$73.08+0.3(73.08)=73.08+21.92=95$$

The cost of the textbook to the bookstore is \$73.08.

62. Let x = original price of shirt.

Discount price: $x-0.3x=0.7x$

$$0.7x=28$$
$$\frac{0.7x}{0.7}=\frac{28}{0.7}$$
$$x=40$$

Check:

$$0.7(40)\stackrel{?}{=}28$$
$$28=28\text{ T}$$

The shirts originally cost \$40.

64. Let x = cargo space of Mazda 6s

x – 1.9 = cargo space of Honda Accord EX

$$x+(x-1.9)=31.3$$
$$x+x-1.9=31.3$$
$$2x-1.9=31.3$$
$$2x-1.9+1.9=31.3+1.9$$
$$2x=33.2$$
$$\frac{2x}{2}=\frac{33.2}{2}$$
$$x=16.6$$

x – 1.9 = 14.7

The Mazda 6s has 16.6 cubic feet of cargo space and the Honda Accord EX has 14.7 cubic feet of cargo space.

Check: 16.6 + 14.7 = 31.3

66. Let b = amount invested in bonds.

Stocks: $b+6,000$

$$b+(b+6000)=40,000$$
$$2b+6000=40,000$$
$$2b+6000-6000=40,000-6000$$
$$2b=34,000$$
$$\frac{2b}{2}=\frac{34,000}{2}$$
$$b=17,000$$

Check:

$$17,000+(17,000+6000)$$
$$=17,000+23,000$$
$$=40,000$$

\$17,000 should be invested in bonds and \$23,000 should be invested in stocks.

68. Let x = amount invested in stocks.

Bonds: $\frac{2}{3}x$

$$x+\frac{2}{3}x=60,000$$
$$\frac{5}{3}x=60,000$$
$$\frac{3}{5}\cdot\frac{5}{3}x=\frac{3}{5}\cdot 60,000$$
$$x=36,000$$

Check:

$$36,000+\frac{2}{3}(36,000)=36,000+24,000=60,000$$

\$36,000 should be invested in stocks and \$24,000 should be invested in bonds.

70. Let I = interest charge.

$$1\text{ month}=\frac{1}{12}\text{ year}$$
$$I=P\cdot r\cdot t$$
$$=(70,000)(0.06)\left(\frac{1}{12}\right)$$
$$=350$$

The interest charge on Faye's loan after 1 month is \$350.

72. Let x = amount loaned at 6%.
Unsecured loan: $2{,}000{,}000-x$

$$\begin{aligned}0.06x+0.14(2{,}000{,}000-x)&=0.12(2{,}000{,}000)\\ 0.06x+280{,}000-0.14x&=240{,}000\\ -0.08x+280{,}000&=240{,}000\\ -0.08x&=-40{,}000\\ \frac{-0.08x}{-0.08}&=\frac{-40{,}000}{-0.08}\\ x&=500{,}000\end{aligned}$$

Patrick should lend out \$500,000 at 6% and \$1,500,000 at 14%.

74. Let x = amount invested in savings account.
Amount in stocks: $10{,}000-x$
Here we need the simple interest formula $I=P\cdot r\cdot t$. We want the sum of the interest earned from the two sources to equal the interest that would be obtained by investing all the money in a single source at 7%.

$$\begin{aligned}0.02x+0.10(10{,}000-x)&=0.07(10{,}000)\\ 0.02x+1000-0.10x&=700\\ 1000-0.08x&=700\\ 1000-0.08x-1000&=700-1000\\ -0.08x&=-300\\ \frac{-0.08x}{-0.08}&=\frac{-300}{-0.08}\\ x&=3750\end{aligned}$$

Johnny should invest \$3750 in the savings account and $10{,}000-3{,}750=\$6{,}250$ in the stock fund.
Check:

$$\begin{aligned}0.02(3750)+0.1(6250)&\stackrel{?}{=}0.07(10{,}000)\\ 75+625&\stackrel{?}{=}700\\ 700&=700\text{T}\end{aligned}$$

76. Let x = pounds of almonds.
Peanuts: $50-x$

$$\begin{aligned}6.50x+4.00(50-x)&=5.00(50)\\ 6.5x+200-4x&=250\\ 2.5x+200&=250\\ 2.5x&=50\\ \frac{2.5x}{2.5}&=\frac{50}{2.5}\\ x&=20\end{aligned}$$

Check:

$$\begin{aligned}6.5(20)+4(50-20)&=130+4(30)\\ &=130+120\\ &=250\\ &=5(50)\end{aligned}$$

The store should mix 20 pounds of almonds with 30 pounds of peanuts to form the mixture.

78. Let n = number of nickels.
Dimes: $48-n$

$$\begin{aligned}0.05n+0.10(48-n)&=4.50\\ 0.05n+4.8-0.10n&=4.50\\ -0.05n+4.8&=4.50\\ -0.05n&=-0.30\\ \frac{-0.05n}{-0.05}&=\frac{-0.30}{-0.05}\\ n&=6\end{aligned}$$

Check:

$$\begin{aligned}0.05(6)+0.10(48-6)&=0.30+0.10(42)\\ &=0.30+4.20\\ &=4.50\end{aligned}$$

Diana has 6 nickels and 42 dimes in her bank.

80. Let x = number of liters drained and replaced.
Liters left after draining: $15-x$

$$\text{antifreeze}_{\text{after drain}}+\text{antifreeze}_{\text{add}}=\text{antifreeze}_{\text{final}}$$

$$\begin{aligned}0.4(15-x)+1.0(x)&=0.5(15)\\ 6-0.4x+x&=7.5\\ 0.6x+6&=7.5\\ 0.6x&=1.5\\ \frac{0.6x}{0.6}&=\frac{1.5}{0.6}\\ x&=2.5\end{aligned}$$

Check:

$$\begin{aligned}0.4(15-2.5)+1(2.5)&=0.4(12.5)+2.5\\ &=5+2.5\\ &=7.5\\ &=0.5(15)\end{aligned}$$

2.5 liters of the mixture should be drained and replaced with pure antifreeze.

82. Let x = time spent running (hours).
Time swimming: $2.5-x$
For this problem, we will need the distance traveled formula: $d=r\cdot t$

tot. dist. = dist. run + dist. swam

$$\text{tot. dist.}=(\text{run rate})(\text{time})+(\text{swim rate})(\text{time})$$

$$\begin{aligned}15&=7(x)+2(2.5-x)\\ 15&=7x+5-2x\\ 15&=5x+5\\ 10&=5x\\ \frac{10}{5}&=\frac{5x}{5}\\ 2&=x\end{aligned}$$

Check:

$$7(2)+2(2.5-2)=14+2(0.5)=14+1=15$$

We now know that the time spent running is 2 hours and the time spent swimming is 0.5 hour.

However, the question asked for distances. We can use the distance traveled formula here.

Run: $\text{distance} = 7(2) = 14$ miles

Swim: $\text{distance} = 2(0.5) = 1$ mile

The race consists of running for 14 miles and swimming for 1 mile.

84. Let v = speed of slow plane.
Speed of fast plane: $v + 40$

$$\text{distance}_{\text{total}} = \text{distance}_{\text{slow plane}} + \text{distance}_{\text{fast plane}}$$

$$720 = 0.75v + 0.75(v + 40)$$
$$720 = 0.75v + 0.75v + 30$$
$$720 = 1.5v + 30$$
$$690 = 1.5v$$
$$\frac{690}{1.5} = \frac{1.5v}{1.5}$$
$$460 = v$$

Check:

$$0.75(460) + 0.75(460 + 40)$$
$$= 345 + 0.75(500)$$
$$= 345 + 375 = 720$$

The slow plane is traveling at a rate of 460 miles per hour and the fast plane is traveling at a rate of 500 miles per hour.

86. Let v = speed of slow cyclist.
Speed of fast cyclist: $v + 3$

$$\text{distance}_{\text{total}} = \text{distance}_{\text{slow bike}} + \text{distance}_{\text{fast bike}}$$

$$162 = 6v + 6(v + 3)$$
$$162 = 6v + 6v + 18$$
$$162 = 12v + 18$$
$$144 = 12v$$
$$\frac{144}{12} = \frac{12v}{12}$$
$$12 = v$$

Check:

$$6(12) + 6(12 + 3) = 72 + 6(15) = 72 + 90 = 162$$

The slow cyclist is traveling at a rate of 12 miles per hour and the fast cyclist is traveling at a rate of 15 miles per hour.

88. Let v = speed of slow train.
Speed of fast train: $v + 10$

$$\text{distance}_{\text{total}} = \text{distance}_{\text{slow train}} + \text{distance}_{\text{fast train}}$$

$$715 = 5.5v + 5.5(v + 10)$$
$$715 = 5.5v + 5.5v + 55$$
$$715 = 11v + 55$$
$$660 = 11v$$
$$\frac{660}{11} = \frac{11v}{11}$$
$$60 = v$$

Check:

$$5.5(60) + 5.5(60 + 10) = 330 + 5.5(70)$$
$$= 330 + 385$$
$$= 715$$

The slow train is traveling at a rate of 60 miles per hour and the fast train is traveling at a rate of 70 miles per hour.

90. Let p = original price.
Sale price: $0.7p$ (which is 30% off of the original price)

$$\text{profit}_{\text{per shirt}} = \text{revenue}_{\text{per shirt}} - \text{cost}_{\text{per shirt}}$$

$$6 = 0.7p - 15$$
$$21 = 0.7p$$
$$\frac{21}{0.7} = \frac{0.7p}{0.7}$$
$$30 = p$$

The shirts should originally be priced at \$30.

92. Answers will vary. One possibility:
"Kiersten has a calling card plan that charges a flat monthly rate of \$10, plus \$0.14 per minute used. If her bill for one month was \$50, how many minutes did she use that month?"

94. Answers will vary. This means that the sum of the revenue from each item, if sold separately, would equal the revenue of the blend.

96. Answers will vary. Assumptions are typically made to simplify a problem or make it more manageable.

98. Answers will vary.

Section 1.3

Are You Ready for This Section?

R1. a. To round to three decimal places, we first examine the digit in the fourth decimal place and then truncate. Since the fourth decimal place contains a 4, we do not change the digit in the third decimal place. Thus, 3.00343 rounded to three decimal places is 3.003.

b. To truncate, we remove all digits after the third decimal place. So, 3.00343 truncated to three decimal places is 3.003.

R2. a. To round to two decimal places, we first examine the digit in the third decimal place and then truncate. Since the third decimal place contains a 7, we increase the digit in the second decimal place by 1. Thus, 14.957 rounded to two decimal places is 14.96.

b. To truncate, we remove all digits after the second decimal place. So, 14.957 truncated to two decimal places is 14.95.

Section 1.3 Quick Checks

1. A <u>formula</u> is an equation that describes how two or more variables are related.

2. $A = \pi r^2$

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

4. $C = 175x + 7000$

5. $s = \frac{1}{2}gt^2$

6. The <u>area</u> is the amount of space enclosed by a two-dimensional figure and is measured in square units, whereas <u>volume</u> is the amount of space occupied by a three-dimensional figure and is measured in cubic units.

7. False; the units are feet, not square feet.

8. **a.**
$$\begin{aligned} A &= \frac{1}{2}bh \\ 2\cdot A &= 2\cdot\frac{1}{2}bh \\ 2A &= bh \\ \frac{2A}{b} &= \frac{bh}{b} \\ \frac{2A}{b} &= h \quad \text{or} \quad h = \frac{2A}{b} \end{aligned}$$

b. $h = \frac{2A}{b} = \frac{2(10)}{4} = 5$

A triangle whose area is 10 square inches and whose base is 4 inches has a height of 5 inches.

9. **a.**
$$\begin{aligned} P &= 2a + 2b \\ P - 2a &= 2a + 2b - 2a \\ P - 2a &= 2b \\ \frac{P-2a}{2} &= \frac{2b}{2} \\ \frac{P-2a}{2} &= b \quad \text{or} \quad b = \frac{P-2a}{2} \end{aligned}$$

b. $b = \frac{P-2a}{2}$

$b = \frac{60-2(20)}{2} = \frac{60-40}{2} = \frac{20}{2} = 10$

A parallelogram whose perimeter is 60 cm and whose adjacent length is 20 cm has a length of 10 cm.

10.
$$\begin{aligned} I &= P\cdot r\cdot t \\ \frac{I}{r\cdot t} &= \frac{P\cdot r\cdot t}{r\cdot t} \\ \frac{I}{rt} &= P \quad \text{or} \quad P = \frac{I}{rt} \end{aligned}$$

11.
$$\begin{aligned} Ax + By &= C \\ Ax + By - Ax &= C - Ax \\ By &= C - Ax \\ \frac{By}{B} &= \frac{C-Ax}{B} \\ y &= \frac{C-Ax}{B} \end{aligned}$$

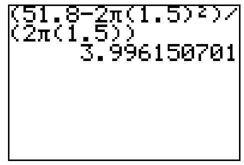
12.
$$
\begin{aligned}
2xh-4x&=3h-3\\
2xh-4x-3h&=3h-3-3h\\
2xh-4x-3h&=-3\\
2xh-4x-3h+4x&=-3+4x\\
2xh-3h&=4x-3\\
h(2x-3)&=4x-3\\
\frac{h(2x-3)}{2x-3}&=\frac{4x-3}{2x-3}\\
h&=\frac{4x-3}{2x-3}
\end{aligned}
$$

13.
$$
\begin{aligned}
S&=na+(n-1)d\\
S&=na+nd-d\\
S+d&=na+nd-d+d\\
S+d&=na+nd\\
S+d&=n(a+d)\\
\frac{S+d}{a+d}&=\frac{n(a+d)}{a+d}\\
\frac{S+d}{a+d}&=n \quad \text{or} \quad n=\frac{S+d}{a+d}
\end{aligned}
$$

14. Let w = the width of the pool in feet. Then the length is $l = w + 10$.
$$
\begin{aligned}
P&=2l+2w\\
180&=2(w+10)+2w\\
180&=2w+20+2w\\
180&=4w+20\\
160&=4w\\
40&=w
\end{aligned}
$$
The pool is 40 feet wide and $40+10=50$ feet long.

15. Since the bookcase is rectangular, we can consider the height as the length in our formula. Let w = the width of the bookcase in inches. Then the height is $h = w + 32$.
$$
\begin{aligned}
P&=2(\text{length})+2(\text{width})\\
224&=2(w+32)+2(w)\\
224&=2w+64+2w\\
224&=4w+64\\
160&=4w\\
40&=w
\end{aligned}
$$
The opening of the bookcase has a width of 40 inches and a height of $40+32=72$ inches.

16.
$$
\begin{aligned}
A&=2\pi r^2+2\pi rh\\
51.8&=2\pi(1.5)^2+2\pi(1.5)h\\
51.8-2\pi(1.5)^2&=2\pi(1.5)h\\
\frac{51.8-2\pi(1.5)^2}{2\pi(1.5)}&=h
\end{aligned}
$$



The height of the can is roughly 4.00 inches.

1.3 Exercises

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

20. $R=\$800x$

22.
$$
\begin{aligned}
y&=kx\\
\frac{y}{x}&=\frac{kx}{x}\\
\frac{y}{x}&=k
\end{aligned}
$$

24.
$$
\begin{aligned}
y&=mx+b\\
y-b&=mx+b-b\\
y-b&=mx\\
\frac{y-b}{x}&=\frac{mx}{x}\\
\frac{y-b}{x}&=m
\end{aligned}
$$

26.
$$
\begin{aligned}
E&=\frac{Z\cdot\sigma}{\sqrt{n}}\\
\sqrt{n}\cdot E&=\sqrt{n}\cdot\frac{Z\cdot\sigma}{\sqrt{n}}\\
\sqrt{n}\cdot E&=Z\cdot\sigma\\
\frac{\sqrt{n}\cdot E}{E}&=\frac{Z\cdot\sigma}{E}\\
\sqrt{n}&=\frac{Z\cdot\sigma}{E}
\end{aligned}
$$

28.

$$S - rS = a - ar^5$$
$$S(1-r) = a - ar^5$$
$$\frac{S(1-r)}{(1-r)} = \frac{a-ar^5}{1-r}$$
$$S = \frac{a-ar^5}{1-r}$$
$$S = \frac{a(1-r^5)}{1-r}$$

30.

$$p + \frac{1}{2}\rho v^2 + \rho g y = a$$
$$p + \frac{1}{2}\rho v^2 + \rho g y - p = a - p$$
$$\frac{1}{2}\rho v^2 + \rho g y = a - p$$
$$\rho\left(\frac{1}{2}v^2 + gy\right) = a - p$$
$$\frac{\rho\left(\frac{1}{2}v^2 + gy\right)}{\left(\frac{1}{2}v^2 + gy\right)} = \frac{a-p}{\left(\frac{1}{2}v^2 + gy\right)}$$
$$\rho = \frac{a-p}{\frac{1}{2}v^2 + gy}$$

32.

$$A = \frac{1}{2}h(B+b)$$
$$2 \cdot A = 2 \cdot \frac{1}{2}h(B+b)$$
$$2A = h(B+b)$$
$$\frac{2A}{h} = \frac{h(B+b)}{h}$$
$$\frac{2A}{h} = B + b$$
$$\frac{2A}{h} - B = B + b - B$$
$$\frac{2A}{h} - B = b \quad \text{or} \quad b = \frac{2A - Bh}{h}$$

34.

$$-4x + y = 12$$
$$-4x + y + 4x = 12 + 4x$$
$$y = 12 + 4x \quad \text{or} \quad y = 4x + 12$$

36.

$$4x + 2y = 20$$
$$4x + 2y - 4x = 20 - 4x$$
$$2y = 20 - 4x$$
$$\frac{2y}{2} = \frac{20-4x}{2}$$
$$y = 10 - 2x \quad \text{or} \quad y = -2x + 10$$

38.

$$5x - 6y = 18$$
$$5x - 6y - 5x = 18 - 5x$$
$$-6y = 18 - 5x$$
$$\frac{-6y}{-6} = \frac{18-5x}{-6}$$
$$y = \frac{18}{-6} - \frac{5x}{-6}$$
$$y = -3 + \frac{5x}{6} \quad \text{or} \quad y = \frac{5}{6}x - 3$$

40.

$$\frac{2}{3}x - \frac{5}{2}y = 5$$
$$\frac{2}{3}x - \frac{5}{2}y - \frac{2}{3}x = 5 - \frac{2}{3}x$$
$$-\frac{5}{2}y = 5 - \frac{2}{3}x$$
$$-\frac{2}{5}\cdot\left(-\frac{5}{2}y\right) = -\frac{2}{5}\cdot\left(5 - \frac{2}{3}x\right)$$
$$y = -2 + \frac{4}{15}x \quad \text{or} \quad y = \frac{4}{15}x - 2$$

42. **a.**

$$A = 2\pi rh + 2\pi r^2$$
$$A - 2\pi r^2 = 2\pi rh + 2\pi r^2 - 2\pi r^2$$
$$A - 2\pi r^2 = 2\pi rh$$
$$\frac{A - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$$
$$\frac{A - 2\pi r^2}{2\pi r} = h$$

b.

$$h = \frac{A - 2\pi r^2}{2\pi r} = \frac{72\pi - 2\pi(4)^2}{2\pi(4)}$$
$$= \frac{72\pi - 32\pi}{8\pi} = 5$$

The height of the cylinder is 5 centimeters.

44. **a.**

$$M = -0.85A + 217$$
$$M - 217 = -0.85A + 217 - 217$$
$$M - 217 = -0.85A$$
$$\frac{M - 217}{-0.85} = \frac{-0.85A}{-0.85}$$
$$\frac{217 - M}{0.85} = A$$

b. $A = \dfrac{217 - M}{0.85} = \dfrac{217 - 160}{0.85} \approx 67.06$

Someone with a maximum heart rate of 160 should be about 67 years old.

46. **a.**

$$\begin{aligned}
T &= 0.25(I - 35{,}350) + 4867.5 \\
T - 4867.5 &= 0.25(I - 35{,}350) + 4867.5 - 4867.5 \\
T - 4867.5 &= 0.25(I - 35{,}350) \\
\frac{T - 4867.5}{0.25} &= \frac{0.25(I - 35{,}350)}{0.25} \\
\frac{T - 4867.5}{0.25} &= I - 35{,}350 \\
\frac{T - 4867.5}{0.25} + 35{,}350 &= I - 35{,}350 + 35{,}350 \\
\frac{T - 4867.5}{0.25} + 35{,}350 &= I
\end{aligned}$$

or $I = 4(T - 4867.5) + 35{,}350$

b. Let $T = 14{,}780$.

$I = 4(14{,}780 - 4867.5) + 35{,}350$

$I = 4(9912.5) + 35{,}350$

$I = 39{,}650 + 35{,}350$

$I = 75{,}000$

The adjusted gross income is \$75,000.

48. Let x = measure of smaller angle (in degrees).

Larger angle: $2x$

$$\begin{aligned}
x + 2x &= 180 \\
3x &= 180 \\
\frac{3x}{3} &= \frac{180}{3} \\
x &= 60
\end{aligned}$$

The smaller angle measures $60°$ and its supplement measures 120°.

50. Let x = measure of one angle (in degrees).

Complementary angle: $2x - 30$

$$\begin{aligned}
x + (2x - 30) &= 90 \\
x + 2x - 30 &= 90 \\
3x - 30 &= 90 \\
3x - 30 + 30 &= 90 + 30 \\
3x &= 120 \\
\frac{3x}{3} &= \frac{120}{3} \\
x &= \frac{120}{3} = 40
\end{aligned}$$

The smaller angle measures $40°$ and its complement measures 50°.

52. Let w = width of the window (in inches).
Length: $2w$

$$P = 2l + 2w$$
$$120 = 2(2w) + 2w$$
$$120 = 4w + 2w$$
$$120 = 6w$$
$$\frac{120}{6} = \frac{6w}{6}$$
$$20 = w$$

The width of the window is 20 inches and the length is 40 inches.

54. Let w = width of rectangle. Length: $2w$

Radius of circles: $\frac{w}{2}$

$$P = 2l + 2w$$
$$36 = 2(2w) + 2w$$
$$36 = 4w + 2w$$
$$36 = 6w$$
$$\frac{36}{6} = \frac{6w}{6}$$
$$6 = w$$

The width of the rectangle is 6 centimeters, so the radius of each circle is 3 centimeters.

$$A = \pi r^2 = \pi(3)^2$$
$$= 9\pi \approx 28.27 \text{ sq. cm.}$$

Each circular window has an area of about 28.27 square centimeters.

56. Let a = measure of first angle.
Second angle: $3a$
Third angle: $a + 20$

$$a + (3a) + (a + 20) = 180$$
$$5a + 20 = 180$$
$$5a + 20 - 20 = 180 - 20$$
$$5a = 160$$
$$\frac{5a}{5} = \frac{160}{5}$$
$$a = 32$$

The interior angles measure 32°, 96°, and 52°.

58. **a.** The diameter of the base is 12 feet so the radius is 6 feet (half the diameter).

$$A = \pi r^2 = \pi(6)^2 = 36\pi \approx 113.1 \text{ ft}^2$$

The area of the base is about 113.1 square feet.

b. Since 4 inches is $\frac{1}{3}$ foot, we get

$$V = A \cdot h = 36\pi \cdot \frac{1}{3} = 12\pi \approx 37.7 \text{ ft}^3$$

You would need to purchase about 37.7 cubic feet of cement.

60. **a.** Since the width of the window is 3 feet, the radius of the semicircle is 1.5 feet.

$$A_{\text{total}} = A_{\text{rectangle}} + A_{\text{semicircle}}$$
$$A = 8 \cdot 3 + \frac{1}{2} \cdot \pi(1.5)^2 \approx 27.53 \text{ ft}^2$$

The window has an area of about 27.53 square feet.

b. The perimeter is half the circumference of a circle with radius $r = 1.5$ plus the width and twice the length of the rectangle.

$$P = \frac{1}{2} \cdot 2\pi r + 2l + w$$
$$= \frac{1}{2} \cdot 2\pi(1.5) + 2(8) + 3 = 1.5\pi + 19 \approx 23.71$$

The perimeter of the window is about 23.71 feet.

c. $\text{Cost} = (\text{price per unit area})(\text{area})$

$$C = (8.25)(27.53)$$
$$= 227.12$$

Glass for the window would cost $227.12.

Section 1.4

Are You Ready for This Section?

R1. $3 < 6$ because 6 is further to the right on a real number line.

R2. $-3 > -6$ because -3 is further to the right on a real number line.

R3. $\frac{1}{2} = 0.5$ because both numbers are at the same point on a real number line.

R4. $\frac{2}{3} = \frac{10}{15} > \frac{9}{15} = \frac{3}{5}$ because $\frac{2}{3}$ is further to the right on a real number line.

R5. False; strict inequalities are either < or >.

R6. $\{x \mid x \text{ is a digit that is divisible by } 3\}$

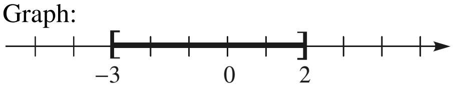
Section 1.4 Quick Checks

1. A <u>closed interval</u>, denoted $[a, b]$ consists of all real numbers x for which $a \le x \le b$.

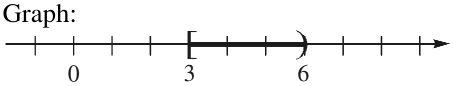
2. In the interval (a, b), a is called the <u>left endpoint</u> and b is called the <u>right endpoint</u> of the interval.

3. False; the interval notation is $(-\infty, -11]$.

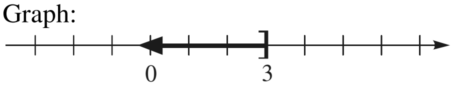
4. $-3 \le x \le 2$
Interval: $[-3, 2]$
Graph:



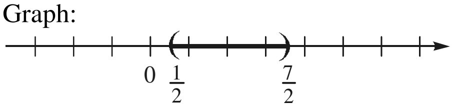
5. $3 \le x < 6$
Interval: $[3, 6)$
Graph:



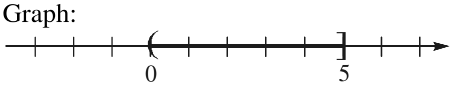
6. $x \le 3$
Interval: $(-\infty, 3]$
Graph:



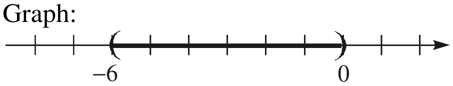
7. $\frac{1}{2} < x < \frac{7}{2}$
Interval: $\left(\frac{1}{2}, \frac{7}{2}\right)$
Graph:



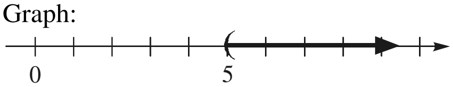
8. $(0, 5]$
Inequality: $0 < x \le 5$
Graph:



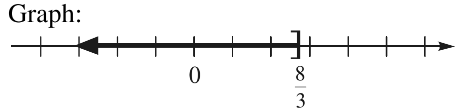
9. $(-6, 0)$
Inequality: $-6 < x < 0$
Graph:



10. $(5, \infty)$
Inequality: $x > 5$
Graph:



11. $\left(-\infty, \frac{8}{3}\right]$
Inequality: $x \le \frac{8}{3}$
Graph:



12.
$$\begin{aligned} 4 &< 7 \\ 4+5 &< 7+5 \\ 9 &< 12 \end{aligned}$$
Addition Property of Inequalities

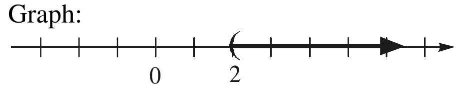
13.
$$\begin{aligned} x+3 &> -6 \\ x+3-3 &> -6-3 \\ x &> -9 \end{aligned}$$
Addition Property of Inequalities

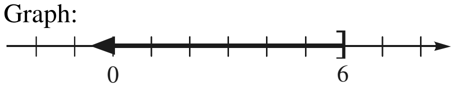
14.
$$\begin{aligned} 2 &> 8 \\ \tfrac{1}{2}\cdot 2 &> \tfrac{1}{2}\cdot 8 \\ 1 &> 4 \end{aligned}$$
Multiplication Property of Inequalities

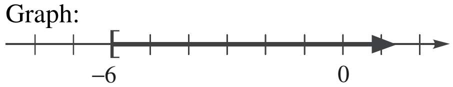
15.
$$\begin{aligned} -6 &< 9 \\ \frac{-6}{-3} &> \frac{9}{-3} \\ 2 &> -3 \end{aligned}$$
Multiplication Property of Inequalities

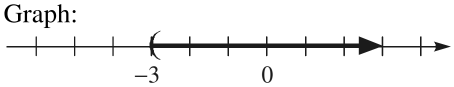
16.
$$\begin{aligned} 5x &< 30 \\ \frac{5x}{5} &< \frac{30}{5} \\ x &< 6 \end{aligned}$$
Multiplication Property of Inequalities

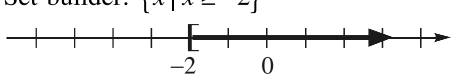
17.
$$\begin{aligned} x+3 &> 5 \\ x+3-3 &> 5-3 \\ x &> 2 \end{aligned}$$
Interval: $(2, \infty)$
Set-builder: $\{x \mid x > 2\}$
Graph:

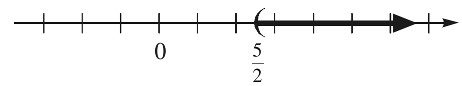


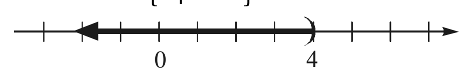
18.
$$\frac{1}{3}x \le 2$$
$$3 \cdot \frac{1}{3}x \le 3 \cdot 2$$
$$x \le 6$$
Interval: $(-\infty, 6]$
Set-builder: $\{x \mid x \le 6\}$
Graph:


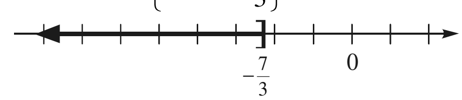
19.
$$-2x+1 \le 13$$
$$-2x+1-1 \le 13-1$$
$$-2x \le 12$$
$$\frac{-2x}{-2} \ge \frac{12}{-2}$$
$$x \ge -6$$
Interval: $[-6, \infty)$
Set-builder: $\{x \mid x \ge -6\}$
Graph:


20.
$$3x+1 > x-5$$
$$3x+1-1 > x-5-1$$
$$3x > x-6$$
$$3x-x > x-6-x$$
$$2x > -6$$
$$\frac{2x}{2} > \frac{-6}{2}$$
$$x > -3$$
Interval: $(-3, \infty)$
Set-builder: $\{x \mid x > -3\}$
Graph:


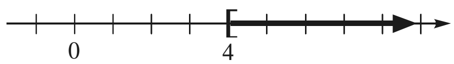
21.
$$-2x+1 \le 3x+11$$
$$-2x+1-1 \le 3x+11-1$$
$$-2x \le 3x+10$$
$$-2x-3x \le 3x+10-3x$$
$$-5x \le 10$$
$$\frac{-5x}{-5} \ge \frac{10}{-5}$$
$$x \ge -2$$
Interval: $[-2, \infty)$
Set-builder: $\{x \mid x \ge -2\}$


22.
$$-5x+12 < x-3$$
$$-5x+12-12 < x-3-12$$
$$-5x < x-15$$
$$-5x-x < x-15-x$$
$$-6x < -15$$
$$\frac{-6x}{-6} > \frac{-15}{-6}$$
$$x > \frac{5}{2}$$
Interval: $\left(\frac{5}{2}, \infty\right)$
Set-builder: $\left\{x \mid x > \frac{5}{2}\right\}$


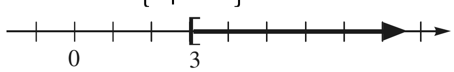
23.
$$4(x-2) < 3x-4$$
$$4x-8 < 3x-4$$
$$4x-8+8 < 3x-4+8$$
$$4x < 3x+4$$
$$4x-3x < 3x+4-3x$$
$$x < 4$$
Interval: $(-\infty, 4)$
Set-builder: $\{x \mid x < 4\}$


24.
$$-2(x+1) \ge 4(x+3)$$
$$-2x-2 \ge 4x+12$$
$$-2x-2+2 \ge 4x+12+2$$
$$-2x \ge 4x+14$$
$$-2x-4x \ge 4x+14-4x$$
$$-6x \ge 14$$
$$\frac{-6x}{-6} \le \frac{14}{-6}$$
$$x \le -\frac{7}{3}$$
Interval: $\left(-\infty, -\frac{7}{3}\right]$
Set-builder: $\left\{x \mid x \le -\frac{7}{3}\right\}$


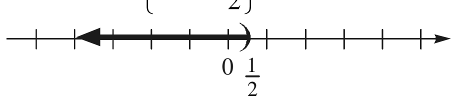
25. $7-2(x+1)\le 3(x-5)$
$$7-2x-2\le 3x-15$$
$$-2x+5\le 3x-15$$
$$-2x+5-5\le 3x-15-5$$
$$-2x\le 3x-20$$
$$-2x-3x\le 3x-20-3x$$
$$-5x\le -20$$
$$\frac{-5x}{-5}\ge\frac{-20}{-5}$$
$$x\ge 4$$
Interval: [4, ∞)
Set-builder: $\{x\,|\,x\ge 4\}$



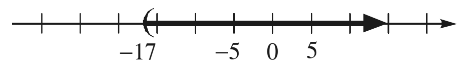
26. $\frac{3x+1}{5}\ge 2$
$$5\cdot\frac{3x+1}{5}\ge 5\cdot 2$$
$$3x+1\ge 10$$
$$3x+1-1\ge 10-1$$
$$3x\ge 9$$
$$\frac{3x}{3}\ge\frac{9}{3}$$
$$x\ge 3$$
Interval: [3, ∞)
Set-builder: $\{x\,|\,x\ge 3\}$



27. $\frac{2}{5}x+\frac{3}{10}<\frac{1}{2}$
$$10\left(\frac{2}{5}x+\frac{3}{10}\right)<10\cdot\frac{1}{2}$$
$$4x+3<5$$
$$4x+3-3<5-3$$
$$4x<2$$
$$\frac{4x}{4}<\frac{2}{4}$$
$$x<\frac{1}{2}$$
Interval: $\left(-\infty, \frac{1}{2}\right)$
Set-builder: $\left\{x\,|\,x<\frac{1}{2}\right\}$



28. $\frac{1}{2}(x+3)>\frac{1}{3}(x-4)$
$$6\cdot\frac{1}{2}(x+3)>6\cdot\frac{1}{3}(x-4)$$
$$3(x+3)>2(x-4)$$
$$3x+9>2x-8$$
$$3x+9-9>2x-8-9$$
$$3x>2x-17$$
$$3x-2x>2x-17-2x$$
$$x>-17$$
Interval: (–17, ∞)
Set-builder: $\{x\,|\,x>-17\}$

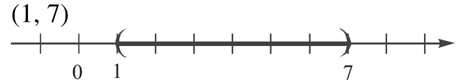


29. Let b = annual balance in dollars.
The annual cost is the sum of the annual fee and the interest charge. To find the interest charge, we use the simple interest formula $I = Prt$ and let $t=1$ year.
$$\text{Bank A cost} < \text{Bank B cost}$$
$$\text{fee}_A+\text{interest}_A<\text{fee}_B+\text{interest}_B$$
$$24+0.0995b<0+0.1495b$$
$$24+0.0995b<0.1495b$$
$$24+0.0995b-0.0995b<0.1495b-0.0995b$$
$$24<0.05b$$
$$\frac{24}{0.05}<\frac{0.05b}{0.05}$$
$$480<b \quad\text{or}\quad b>480$$
The card from Bank A will cost less if the annual balance is more than $480.

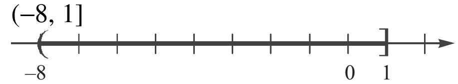
30. Let x = the number of boxes of candy.
$$R>C$$
$$12x>8x+96$$
$$12x-8x>8x+96-8x$$
$$4x>96$$
$$\frac{4x}{4}>\frac{96}{4}$$
$$x>24$$
Revenue will exceed costs when more than 24 boxes of candy are sold.

1.4 Exercises

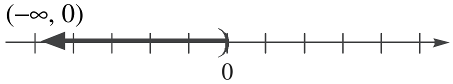
32. (1, 7)



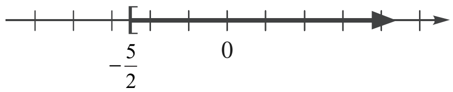
34. (–8, 1]



36. $(-\infty, 0)$

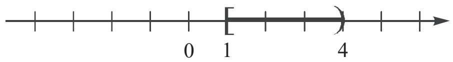


38. $\left[-\frac{5}{2}, \infty\right)$

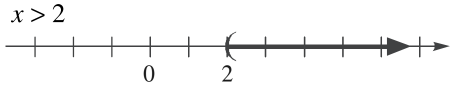


40. $-2 \le x \le 3$

42. $1 \le x < 4$



44. $x > 2$



46. $x \le 8$

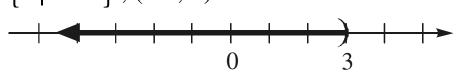
48. >; Addition Property of Inequalities

50. >; Multiplication Property of Inequalities

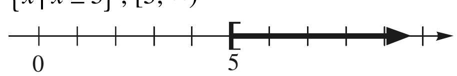
52. ≤; Addition Property of Inequalities

54. >; Multiplication Property of Inequalities

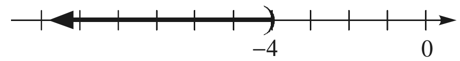
56.
$$x+6<9$$
$$x+6-6<9-6$$
$$x<3$$
$\{x \mid x<3\}$; $(-\infty, 3)$



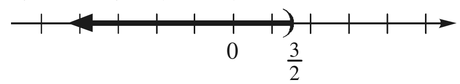
58.
$$4x \ge 20$$
$$\frac{4x}{4} \ge \frac{20}{4}$$
$$x \ge 5$$
$\{x \mid x \ge 5\}$; $[5, \infty)$



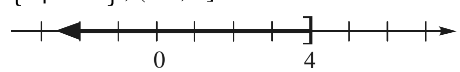
60.
$$-8x > 32$$
$$\frac{-8x}{-8} < \frac{32}{-8}$$
$$x < -4$$
$\{x \mid x < -4\}$; $(-\infty, -4)$



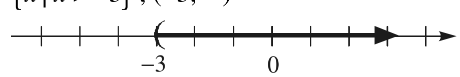
62.
$$\frac{3}{8}x < \frac{9}{16}$$
$$\frac{8}{3}\cdot\frac{3}{8}x < \frac{8}{3}\cdot\frac{9}{16}$$
$$x < \frac{3}{2}$$
$\left\{x \mid x < \frac{3}{2}\right\}$; $\left(-\infty, \frac{3}{2}\right)$



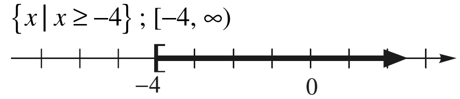
64.
$$5x-4 \le 16$$
$$5x-4+4 \le 16+4$$
$$5x \le 20$$
$$\frac{5x}{5} \le \frac{20}{5}$$
$$x \le 4$$
$\{x \mid x \le 4\}$; $(-\infty, 4]$



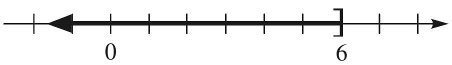
66.
$$-6x-5<13$$
$$-6x-5+5<13+5$$
$$-6x<18$$
$$\frac{-6x}{-6} > \frac{18}{-6}$$
$$x > -3$$
$\{x \mid x > -3\}$; $(-3, \infty)$



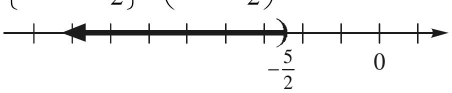
68.
$$8x+3 \ge 5x-9$$
$$8x+3-3 \ge 5x-9-3$$
$$8x \ge 5x-12$$
$$8x-5x \ge 5x-12-5x$$
$$3x \ge -12$$
$$\frac{3x}{3} \ge \frac{-12}{3}$$
$$x \ge -4$$
$\{x \mid x \ge -4\}$; $[-4, \infty)$



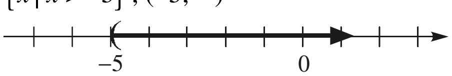
70.
$$\begin{aligned} 3x+4 &\ge 5x-8 \\ 3x+4-4 &\ge 5x-8-4 \\ 3x &\ge 5x-12 \\ 3x-5x &\ge 5x-12-5x \\ -2x &\ge -12 \\ \frac{-2x}{-2} &\le \frac{-12}{-2} \\ x &\le 6 \end{aligned}$$
$\{x \mid x \le 6\}$; $(-\infty, 6]$



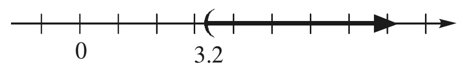
72.
$$\begin{aligned} 3(x-2)+5 &> 4(x+1)+x \\ 3x-6+5 &> 4x+4+x \\ 3x-1 &> 5x+4 \\ 3x-1+1 &> 5x+4+1 \\ 3x &> 5x+5 \\ 3x-5x &> 5x+5-5x \\ -2x &> 5 \\ \frac{-2x}{-2} &< \frac{5}{-2} \\ x &< -\frac{5}{2} \end{aligned}$$
$\left\{x \mid x < -\frac{5}{2}\right\}$; $\left(-\infty, -\frac{5}{2}\right)$



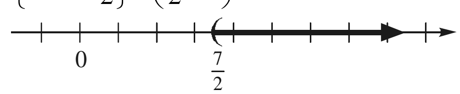
74.
$$\begin{aligned} -3(x+4)+5x &< 4(x+3)-14 \\ -3x-12+5x &< 4x+12-14 \\ 2x-12 &< 4x-2 \\ 2x-12+12 &< 4x-2+12 \\ 2x &< 4x+10 \\ 2x-4x &< 4x+10-4x \\ -2x &< 10 \\ \frac{-2x}{-2} &> \frac{10}{-2} \\ x &> -5 \end{aligned}$$
$\{x \mid x > -5\}$; $(-5, \infty)$



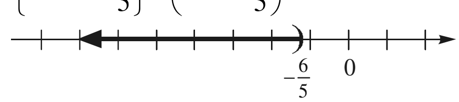
76.
$$\begin{aligned} 2.3x-1.2 &> 1.8x+0.4 \\ 2.3x-1.2+1.2 &> 1.8x+0.4+1.2 \\ 2.3x &> 1.8x+1.6 \\ 2.3x-1.8x &> 1.8x+1.6-1.8x \\ 0.5x &> 1.6 \\ \frac{0.5x}{0.5} &> \frac{1.6}{0.5} \\ x &> 3.2 \end{aligned}$$
$\{x \mid x > 3.2\}$; $(3.2, \infty)$



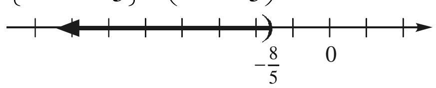
78.
$$\begin{aligned} \frac{2x-3}{3} &> \frac{4}{3} \\ 3\cdot\frac{2x-3}{3} &> 3\cdot\frac{4}{3} \\ 2x-3 &> 4 \\ 2x-3+3 &> 4+3 \\ 2x &> 7 \\ \frac{2x}{2} &> \frac{7}{2} \\ x &> \frac{7}{2} \end{aligned}$$
$\left\{x \mid x > \frac{7}{2}\right\}$; $\left(\frac{7}{2}, \infty\right)$



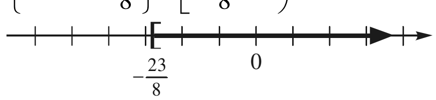
80.
$$\begin{aligned} \frac{1}{3}(3x+5) &< \frac{1}{6}(x+4) \\ 6\cdot\frac{1}{3}(3x+5) &< 6\cdot\frac{1}{6}(x+4) \\ 2(3x+5) &< x+4 \\ 6x+10 &< x+4 \\ 6x+10-10 &< x+4-10 \\ 6x &< x-6 \\ 6x-x &< x-6-x \\ 5x &< -6 \\ \frac{5x}{5} &< \frac{-6}{5} \\ x &< -\frac{6}{5} \end{aligned}$$
$\left\{x \mid x < -\frac{6}{5}\right\}$; $\left(-\infty, -\frac{6}{5}\right)$



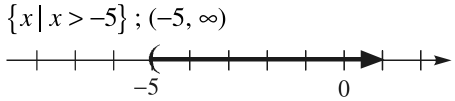
82.
$$\frac{2}{3}-\frac{5}{6}x>2$$
$$\frac{2}{3}-\frac{5}{6}x-\frac{2}{3}>2-\frac{2}{3}$$
$$-\frac{5}{6}x>\frac{6}{3}-\frac{2}{3}$$
$$-\frac{5}{6}x>\frac{4}{3}$$
$$\left(-\frac{6}{5}\right)\cdot\left(-\frac{5}{6}x\right)<-\frac{6}{5}\cdot\frac{4}{3}$$
$$x<-\frac{8}{5}$$
$$\left\{x \mid x<-\frac{8}{5}\right\};\ \left(-\infty,-\frac{8}{5}\right)$$



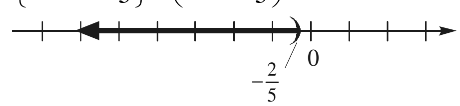
84.
$$-3(2x+1)\le 2[3x-2(x-5)]$$
$$-6x-3\le 2[3x-2x+10]$$
$$-6x-3\le 2(x+10)$$
$$-6x-3\le 2x+20$$
$$-6x-3+3\le 2x+20+3$$
$$-6x\le 2x+23$$
$$-6x-2x\le 2x+23-2x$$
$$-8x\le 23$$
$$x\ge -\frac{23}{8}$$
$$\left\{x \mid x\ge -\frac{23}{8}\right\};\ \left[-\frac{23}{8},\infty\right)$$



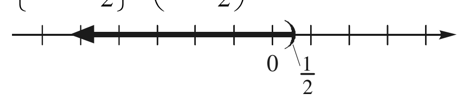
86.
$$7(x+2)-4(2x+3)<-2[5x-2(x+3)]+7x$$
$$7x+14-8x-12<-2[5x-2x-6]+7x$$
$$-x+2<-2(3x-6)+7x$$
$$-x+2<-6x+12+7x$$
$$-x+2<x+12$$
$$-x+2-2<x+12-2$$
$$-x<x+10$$
$$-x-x<x+10-x$$
$$-2x<10$$
$$\frac{-2x}{-2}>\frac{10}{-2}$$
$$x>-5$$
$$\{x \mid x>-5\};\ (-5,\infty)$$



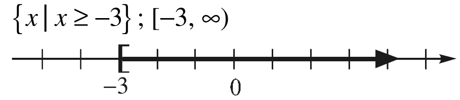
88.
$$\frac{5}{6}(3x-2)-\frac{2}{3}(4x-1)<-\frac{2}{9}(2x+5)$$
$$18\cdot\frac{5}{6}(3x-2)-18\cdot\frac{2}{3}(4x-1)<-18\cdot\frac{2}{9}(2x+5)$$
$$15(3x-2)-12(4x-1)<-4(2x+5)$$
$$45x-30-48x+12<-8x-20$$
$$-3x-18<-8x-20$$
$$-3x-18+18<-8x-20+18$$
$$-3x<-8x-2$$
$$-3x+8x<-8x-2+8x$$
$$5x<-2$$
$$\frac{5x}{5}<\frac{-2}{5}$$
$$x<-\frac{2}{5}$$
$$\left\{x \mid x<-\frac{2}{5}\right\};\ \left(-\infty,-\frac{2}{5}\right)$$



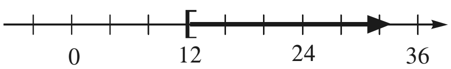
90.
$$\frac{2}{5}x+\frac{3}{10}<\frac{1}{2}$$
$$10\cdot\frac{2}{5}x+10\cdot\frac{3}{10}<10\cdot\frac{1}{2}$$
$$4x+3<5$$
$$4x+3-3<5-3$$
$$4x<2$$
$$\frac{4x}{4}<\frac{2}{4}$$
$$x<\frac{1}{2}$$
$$\left\{x \mid x<\frac{1}{2}\right\};\ \left(-\infty,\frac{1}{2}\right)$$



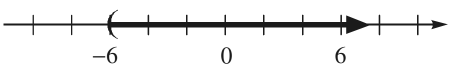
92.
$$\frac{x}{12}\ge\frac{x}{2}-\frac{2x+1}{4}$$
$$12\cdot\frac{x}{12}\ge 12\cdot\frac{x}{2}-12\cdot\frac{2x+1}{4}$$
$$x\ge 6x-3(2x+1)$$
$$x\ge 6x-6x-3$$
$$x\ge -3$$
$$\{x \mid x\ge -3\};\ [-3,\infty)$$



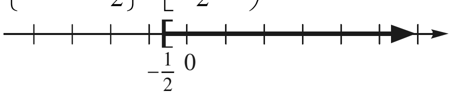
94.
$$\begin{aligned} y-5 &\geq 7 \\ y-5+5 &\geq 7+5 \\ y &\geq 12 \end{aligned}$$
$\{y \mid y \geq 12\}$; $[12, \infty)$



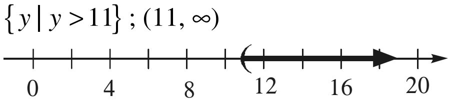
96.
$$\begin{aligned} -5x &< 30 \\ \frac{-5x}{-5} &> \frac{30}{-5} \\ x &> -6 \end{aligned}$$
$\{x \mid x > -6\}$; $(-6, \infty)$



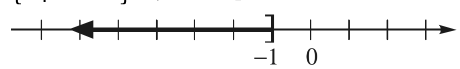
98.
$$\begin{aligned} 4x+3 &\geq -6x-2 \\ 4x+3-3 &\geq -6x-2-3 \\ 4x &\geq -6x-5 \\ 4x+6x &\geq -6x-5+6x \\ 10x &\geq -5 \\ \frac{10x}{10} &\geq \frac{-5}{10} \\ x &\geq -\frac{1}{2} \end{aligned}$$
$\left\{x \,\middle|\, x \geq -\frac{1}{2}\right\}$; $\left[-\frac{1}{2}, \infty\right)$



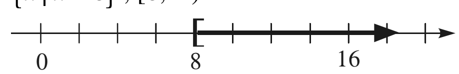
100.
$$\begin{aligned} 5(y+7) &< 6(y+4) \\ 5y+35 &< 6y+24 \\ 5y+35-35 &< 6y+24-35 \\ 5y &< 6y-11 \\ 5y-6y &< 6y-11-6y \\ -y &< -11 \\ \frac{-y}{-1} &> \frac{-11}{-1} \\ y &> 11 \end{aligned}$$
$\{y \mid y > 11\}$; $(11, \infty)$



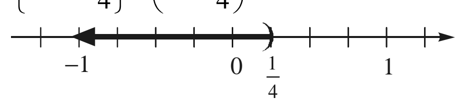
102.
$$\begin{aligned} 2(5-x)-3 &\leq 4-5x \\ 10-2x-3 &\leq 4-5x \\ -2x+7 &\leq 4-5x \\ -2x+7-7 &\leq 4-5x-7 \\ -2x &\leq -5x-3 \\ -2x+5x &\leq -5x-3+5x \\ 3x &\leq -3 \\ \frac{3x}{3} &\leq \frac{-3}{3} \\ x &\leq -1 \end{aligned}$$
$\{x \mid x \leq -1\}$; $(-\infty, -1]$



104.
$$\begin{aligned} 3[1+2(x-4)] &\geq 3x+3 \\ 3[1+2x-8] &\geq 3x+3 \\ 3(2x-7) &\geq 3x+3 \\ 6x-21 &\geq 3x+3 \\ 6x-21+21 &\geq 3x+3+21 \\ 6x &\geq 3x+24 \\ 6x-3x &\geq 3x+24-3x \\ 3x &\geq 24 \\ \frac{3x}{3} &\geq \frac{24}{3} \\ x &\geq 8 \end{aligned}$$
$\{x \mid x \geq 8\}$; $[8, \infty)$



106.
$$\begin{aligned} \frac{b}{3}+\frac{5}{6} &< \frac{11}{12} \\ \frac{b}{3}+\frac{5}{6}-\frac{5}{6} &< \frac{11}{12}-\frac{5}{6} \\ \frac{b}{3} &< \frac{11}{12}-\frac{10}{12} \\ \frac{b}{3} &< \frac{1}{12} \\ 3\cdot\frac{b}{3} &< 3\cdot\frac{1}{12} \\ b &< \frac{1}{4} \end{aligned}$$
$\left\{b \,\middle|\, b < \frac{1}{4}\right\}$; $\left(-\infty, \frac{1}{4}\right)$



108.
$$\begin{aligned} 3x-2&<7\\ 3x-2+2&<7+2\\ 3x&<9\\ \frac{3x}{3}&<\frac{9}{3}\\ x&<3 \end{aligned}$$
$\{x \mid x<3\}$; $(-\infty, 3)$

110.
$$\begin{aligned} 2y+3&>13\\ 2y+3-3&>13-3\\ 2y&>10\\ \frac{2y}{2}&>\frac{10}{2}\\ y&>5 \end{aligned}$$
$\{y \mid y>5\}$; $(5, \infty)$

112. Let x = score on final exam.
$$\begin{aligned} \frac{94+83+88+92+2x}{6}&\geq 90\\ \frac{357+2x}{6}&\geq 90\\ 6\cdot\frac{357+2x}{6}&\geq 6\cdot 90\\ 357+2x&\geq 540\\ 357+2x-357&\geq 540-357\\ 2x&\geq 183\\ \frac{2x}{2}&\geq\frac{183}{2}\\ x&\geq 91.5 \end{aligned}$$
Mark's final exam score must be at least 91.5 in order for him to earn an A.

114. Let x = number of cheeseburgers.
$$\begin{aligned} 13x+21+21&\leq 81\\ 13x+42&\leq 81\\ 13x+42-42&\leq 81-42\\ 13x&\leq 39\\ \frac{13x}{13}&\leq\frac{39}{13}\\ x&\leq 3 \end{aligned}$$
You can order up to three cheeseburgers to keep the total fat content to no more than 81 grams.

116. Let x = number of miles.
$$\begin{aligned} 39.95+0.65x&\leq 125.75\\ 39.95+0.65x-39.95&\leq 125.75-39.95\\ 0.65x&\leq 85.8\\ \frac{0.65x}{0.65}&\leq\frac{85.8}{0.65}\\ x&\leq 132 \end{aligned}$$
You can drive up to 132 miles and be within budget.

118. Let t = number of years since 1990.
$$\begin{aligned} 26t+411&>1000\\ 26t+411-411&>1000-411\\ 26t&>589\\ \frac{26t}{26}&>\frac{589}{26}\\ t&>\frac{589}{26}\approx 22.65 \end{aligned}$$
Total private health expenditures will exceed \$1 trillion in 2013.

120. Let x = annual sales.
$$\begin{aligned} 24,300+0.03x&>60,000\\ 24,300+0.03x-24,300&>60,000-24,300\\ 0.03x&>35,700\\ \frac{0.03x}{0.03}&>\frac{35,700}{0.03}\\ x&>1,190,000 \end{aligned}$$
Al must have annual sales of more than \$1,190,000 to meet his salary goal.
$$\frac{1,190,000}{15,000}\approx 79.33$$
Al would need to sell at least 80 cars to meet his salary goal.

122.
$$\begin{aligned} D&>S\\ 1800-12p&>-2800+13p\\ 1800-12p-1800&>-2800+13p-1800\\ -12p&>13p-4600\\ -12p-13p&>13p-4600-13p\\ -25p&>-4600\\ \frac{-25p}{-25}&<\frac{-4600}{-25}\\ p&<184 \end{aligned}$$
If the price of the digital camera is less than \$184, demand will exceed supply.

124.
$$\begin{aligned} -3(x-2)+7x&>2(2x+5)\\ -3x+6+7x&>4x+10\\ 4x+6&>4x+10\\ 4x+6-4x&>4x+10-4x\\ 6&>10 \end{aligned}$$
This statement is a contradiction. There are no solutions to the inequality.

126. This inequality states that x is greater than 5 *and* that x is less than 1. There are no numbers that are simultaneously greater than 5 and less than 1.

Putting the Concepts Together (Sections 1.1–1.4)

1. a. Let $x=-3$ in the equation.

$$5(2(-3)-3)+1 \stackrel{?}{=} 2(-3)-6$$
$$5(-6-3)+1 \stackrel{?}{=} -6-6$$
$$5(-9)+1 \stackrel{?}{=} -12$$
$$-45+1 \stackrel{?}{=} -12$$
$$-44 \neq -12$$

$x=-3$ is **not** a solution to the equation.

b. Let $x=1$ in the equation.

$$5(2(1)-3)+1 \stackrel{?}{=} 2(1)-6$$
$$5(2-3)+1 \stackrel{?}{=} 2-6$$
$$5(-1)+1 \stackrel{?}{=} -4$$
$$-5+1 \stackrel{?}{=} -4$$
$$-4=-4$$

$x=1$ is a solution to the equation.

2.
$$3(2x-1)+6=5x-2$$
$$6x-3+6=5x-2$$
$$6x+3=5x-2$$
$$6x+3-5x=5x-2-5x$$
$$x+3=-2$$
$$x+3-3=-2-3$$
$$x=-5$$

Solution set: $\{-5\}$

3.
$$\frac{7}{3}x+\frac{4}{5}=\frac{5x+12}{15}$$
$$15\left(\frac{7}{3}x+\frac{4}{5}\right)=15\left(\frac{5x+12}{15}\right)$$
$$35x+12=5x+12$$
$$35x+12-12=5x+12-12$$
$$35x=5x$$
$$35x-5x=5x-5x$$
$$30x=0$$
$$\frac{30x}{30}=\frac{0}{30}$$
$$x=0$$

Solution set: $\{0\}$

4.
$$5-2(x+1)+4x=6(x+1)-(3+4x)$$
$$5-2x-2+4x=6x+6-3-4x$$
$$3+2x=2x+3$$

These expressions are equivalent, so the statement is an identity.

5. Let x represent the number. $x-3=\frac{1}{2}x+2$

6. Let x represent the number.

$$\frac{x}{2}<x+5$$

7. Let x = liters of 20% solution.
Amount of 40% solution: $16-x$ liters

tot. acid = acid from 20% + acid from 40%

$$(\%)(\text{liters})=(\%)(\text{liters})+(\%)(\text{liters})$$
$$0.35(16)=0.2(x)+0.4(16-x)$$
$$5.6=0.2x+6.4-0.4x$$
$$5.6=6.4-0.2x$$
$$5.6-6.4=6.4-0.2x-6.4$$
$$-0.8=-0.2x$$
$$\frac{-0.8}{-0.2}=\frac{-0.2x}{-0.2}$$
$$4=x$$

The chemist needs to mix 4 liters of the 20% solution with 12 liters of the 40% solution.

8. Let t = time of travel in hours.
$d=rt$

total distance = dist. for car 1 + dist. for car 2

$$255=30(t)+45(t)$$
$$255=75t$$
$$\frac{255}{75}=\frac{75t}{75}$$
$$3.4=t$$

After 3.4 hours, the two cars will be 255 miles apart.

9.
$$3x-2y=4$$
$$3x-2y-3x=4-3x$$
$$-2y=-3x+4$$
$$\frac{-2y}{-2}=\frac{-3x+4}{-2}$$
$$y=\frac{-3x}{-2}+\frac{4}{-2}$$
$$y=\frac{3}{2}x-2$$

10.
$$A=P+Prt$$
$$A-P=P+Prt-P$$
$$A-P=Prt$$
$$\frac{A-P}{Pt}=\frac{Prt}{Pt}$$
$$\frac{A-P}{Pt}=r \quad \text{or} \quad r=\frac{A-P}{Pt}$$

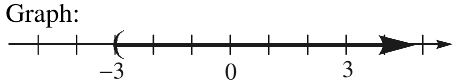
11. a. $V = \pi r^2 h$

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

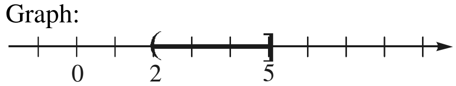
$\frac{V}{\pi r^2} = h$ or $h = \frac{V}{\pi r^2}$

b. $h = \frac{V}{\pi r^2} = \frac{294\pi}{\pi(7)^2} = \frac{294}{49} = 6$ inches

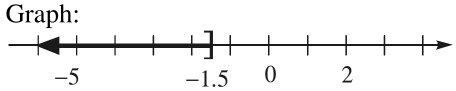
12. a. Interval: $(-3, \infty)$
Graph:



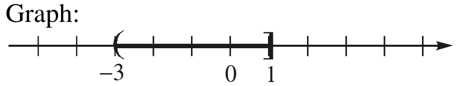
b. Interval: $(2, 5]$
Graph:



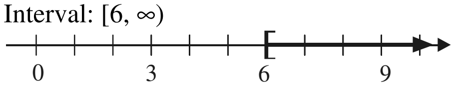
13. a. Inequality: $x \le -1.5$
Graph:



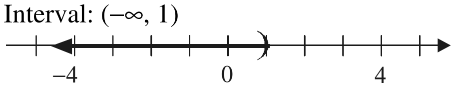
b. Inequality: $-3 < x \le 1$
Graph:



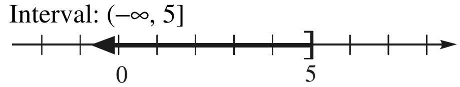
14.
$$2x + 3 \le 4x - 9$$
$$2x + 3 - 3 \le 4x - 9 - 3$$
$$2x \le 4x - 12$$
$$2x - 4x \le 4x - 12 - 4x$$
$$-2x \le -12$$
$$\frac{-2x}{-2} \ge \frac{-12}{-2}$$
$$x \ge 6$$
Interval: $[6, \infty)$



15.
$$-3 > 3x - (x + 5)$$
$$-3 > 3x - x - 5$$
$$-3 > 2x - 5$$
$$-3 + 5 > 2x - 5 + 5$$
$$2 > 2x$$
$$\frac{2}{2} > \frac{2x}{2}$$
$$1 > x \quad \text{or} \quad x < 1$$
Interval: $(-\infty, 1)$



16.
$$x - 9 \le x + 3(2 - x)$$
$$x - 9 \le x + 6 - 3x$$
$$x - 9 \le -2x + 6$$
$$x - 9 + 2x \le -2x + 6 + 2x$$
$$3x - 9 \le 6$$
$$3x - 9 + 9 \le 6 + 9$$
$$3x \le 15$$
$$\frac{3x}{3} \le \frac{15}{3}$$
$$x \le 5$$
Interval: $(-\infty, 5]$

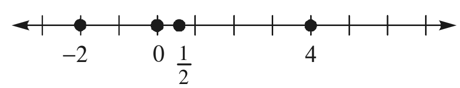


17. Let x = number of children at the party.
$$75 + 5x \le 125$$
$$75 + 5x - 75 \le 125 - 75$$
$$5x \le 50$$
$$\frac{5x}{5} \le \frac{50}{5}$$
$$x \le 10$$
Including Logan, there can be at most 10 children at the party. Therefore, Logan can invite at most 9 children to the party.

Section 1.5

Are You Ready for This Section?

R1.



R2. $3x - 5(x + 2) = 4$

a. Let $x = 0$ in the equation.
$$3(0) - 5(0 + 2) \stackrel{?}{=} 4$$
$$0 - 5(2) \stackrel{?}{=} 4$$
$$-10 = 4 \text{ False}$$
$x = 0$ is not a solution to the equation.

b. Let $x = -3$ in the equation.
$$3(-3) - 5(-3 + 2) \stackrel{?}{=} 4$$
$$-9 - 5(-1) \stackrel{?}{=} 4$$
$$-9 + 5 \stackrel{?}{=} 4$$
$$-4 = 4 \text{ False}$$
$x = -3$ is not a solution to the equation.

c. Let $x=-7$ in the equation.

$$\begin{aligned} 3(-7)-5(-7+2) &\stackrel{?}{=} 4 \\ -21-5(-5) &\stackrel{?}{=} 4 \\ -21+25 &\stackrel{?}{=} 4 \\ 4 &= 4 \text{ True} \end{aligned}$$

$x=-7$ is a solution to the equation.

R3. a. Let $x = 0$:

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

b. Let $x = 2$:

$$\begin{aligned} 2x^2-3x+1 &= 2(2)^2-3(2)+1 \\ &= 2(4)-6+1 \\ &= 8-6+1 \\ &= 3 \end{aligned}$$

c. Let $x = -3$:

$$\begin{aligned} 2x^2-3x+1 &= 2(-3)^2-3(-3)+1 \\ &= 2(9)+9+1 \\ &= 18+9+1 \\ &= 28 \end{aligned}$$

R4.

$$\begin{aligned} 3x+2y &= 8 \\ 3x+2y-3x &= 8-3x \\ 2y &= 8-3x \\ \frac{2y}{2} &= \frac{8-3x}{2} \\ y &= \frac{8}{2}-\frac{3x}{2} \\ y &= 4-\frac{3}{2}x \quad \text{or} \quad y=-\frac{3}{2}x+4 \end{aligned}$$

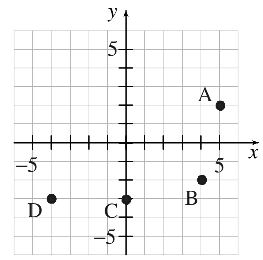
R5. $|-4|=4$ because -4 is 4 units away from 0 on a real number line.

Section 1.5 Quick Checks

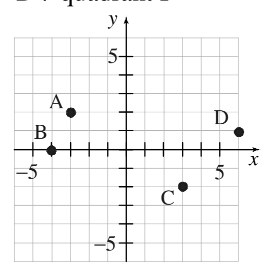
1. The point where the *x*-axis and the *y*-axis intersect in the Cartesian coordinate system is called the <u>origin</u>.

2. True

3. A: quadrant I
B: quadrant IV
C: *y*-axis
D: quadrant III



4. A: quadrant II
B: *x*-axis
C: quadrant IV
D: quadrant I



5. True

6. **a.** Let $x=2$ and $y=-3$.

$$\begin{aligned} 2(2)-4(-3) &\stackrel{?}{=} 12 \\ 4+12 &\stackrel{?}{=} 12 \\ 16 &= 12 \text{ False} \end{aligned}$$

The point (2, –3) is not on the graph.

b. Let $x=2$ and $y=-2$.

$$\begin{aligned} 2(2)-4(-2) &\stackrel{?}{=} 12 \\ 4+8 &\stackrel{?}{=} 12 \\ 12 &= 12 \text{ T} \end{aligned}$$

The point (2, –2) is on the graph.

c. Let $x=\frac{3}{2}$ and $y=-\frac{9}{4}$.

$$\begin{aligned} 2\left(\frac{3}{2}\right)-4\left(-\frac{9}{4}\right) &\stackrel{?}{=} 12 \\ 3+9 &\stackrel{?}{=} 12 \\ 12 &= 12 \text{ T} \end{aligned}$$

The point $\left(\frac{3}{2}, -\frac{9}{4}\right)$ is on the graph.

7. **a.** Let $x=1$ and $y=4$.

$$\begin{aligned} (4) &\stackrel{?}{=} (1)^2+3 \\ 4 &\stackrel{?}{=} 1+3 \\ 4 &= 4 \text{ T} \end{aligned}$$

The point (1, 4) is on the graph.

b. Let $x = -2$ and $y = -1$.

$$(-1) \stackrel{?}{=} (-2)^2 + 3$$
$$-1 \stackrel{?}{=} 4 + 3$$
$$-1 = 7 \text{ False}$$

The point (–2, –1) is not on the graph.

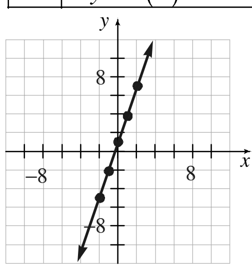
c. Let $x = -3$ and $y = 12$.

$$(12) \stackrel{?}{=} (-3)^2 + 3$$
$$12 \stackrel{?}{=} 9 + 3$$
$$12 = 12 \text{ T}$$

The point (–3, 12) is on the graph.

8. $y = 3x + 1$

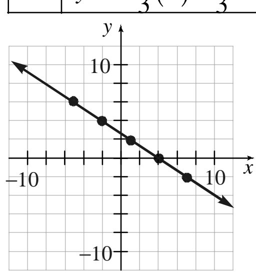
x	$y = 3x + 1$	(x, y)
-2	$y = 3(-2) + 1 = -5$	$(-2, -5)$
-1	$y = 3(-1) + 1 = -2$	$(-1, -2)$
0	$y = 3(0) + 1 = 1$	$(0, 1)$
1	$y = 3(1) + 1 = 4$	$(1, 4)$
2	$y = 3(2) + 1 = 7$	$(2, 7)$



9. $2x + 3y = 8$

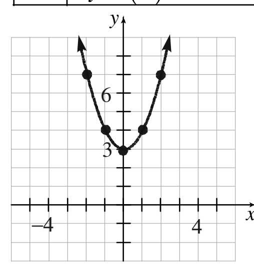
$$3y = -2x + 8$$
$$y = -\frac{2}{3}x + \frac{8}{3}$$

x	$y = -\frac{2}{3}x + \frac{8}{3}$	(x, y)
-5	$y = -\frac{2}{3}(-5) + \frac{8}{3} = 6$	$(-5, 6)$
-2	$y = -\frac{2}{3}(-2) + \frac{8}{3} = 4$	$(-2, 4)$
1	$y = -\frac{2}{3}(1) + \frac{8}{3} = 2$	$(1, 2)$
4	$y = -\frac{2}{3}(4) + \frac{8}{3} = 0$	$(4, 0)$
7	$y = -\frac{2}{3}(7) + \frac{8}{3} = -2$	$(7, -2)$



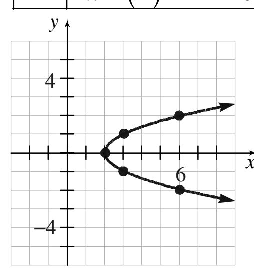
10. $y = x^2 + 3$

x	$y = x^2 + 3$	(x, y)
-2	$y = (-2)^2 + 3 = 7$	$(-2, 7)$
-1	$y = (-1)^2 + 3 = 4$	$(-1, 4)$
0	$y = (0)^2 + 3 = 3$	$(0, 3)$
1	$y = (1)^2 + 3 = 4$	$(1, 4)$
2	$y = (2)^2 + 3 = 7$	$(2, 7)$



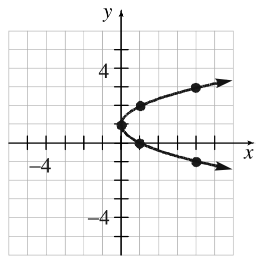
11. $x = y^2 + 2$

y	$x = y^2 + 2$	(x, y)
-2	$x = (-2)^2 + 2 = 6$	$(6, -2)$
-1	$x = (-1)^2 + 2 = 3$	$(3, -1)$
0	$x = (0)^2 + 2 = 2$	$(2, 0)$
1	$x = (1)^2 + 2 = 3$	$(3, 1)$
2	$x = (2)^2 + 2 = 6$	$(6, 2)$



12. $x = (y - 1)^2$

y	$x = (y - 1)^2$	(x, y)
-1	$x = (-1 - 1)^2 = 4$	$(4, -1)$
0	$x = (0 - 1)^2 = 1$	$(1, 0)$
1	$x = (1 - 1)^2 = 0$	$(0, 1)$
2	$x = (2 - 1)^2 = 1$	$(1, 2)$
3	$x = (3 - 1)^2 = 4$	$(4, 3)$



13. The points, if any, at which a graph crosses or touches a coordinate axis are called intercepts.

14. False

15. To find the intercepts, we look for the points where the graph crosses or touches either coordinate axis. From the graph, we see that the intercepts are (–5, 0), (0, –0.9), (1, 0), and (6.7, 0).

    The *x*-intercepts are the points where the graph crosses or touches the *x*-axis. From the graph we see that the *x*-intercepts are (–5, 0), (1, 0), and (6.7, 0).

    The *y*-intercept is the point where the graph crosses the *y*-axis. From the graph we see that the *y*-intercept is (0, –0.9).

16. **a.** Locate the value 250 along the *x*-axis, go up to the graph, and then read the corresponding value on the *y*-axis. According to the graph, the cost of refining 250 thousand gallons of gasoline per hour is \$200 thousand.

    b. Locate the value 400 along the *x*-axis, go up to the graph, and then read the corresponding value on the *y*-axis. According to the graph, the cost of refining 400 thousand gallons of gasoline per hour is \$350 thousand.

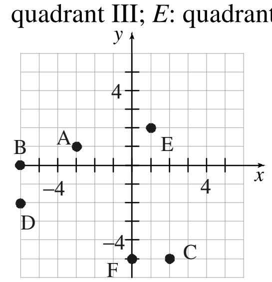
    c. Since the horizontal axis represents the number of gallons per hour that can be refined, the graph ending at 700 thousand gallons per hour represents the capacity of the refinery per hour.

    d. The intercept is (0, 100). This represents the fixed costs of operating the refinery. That is, refining 0 gallons per hour costs \$100 thousand.

1.5 Exercises

18. $A:(1,\ 4);$ in quadrant I
    $B:(-5,\ 6);$ in quadrant II
    $C:(-5,\ 0);$ on the *x*-axis
    $D:(-3,\ -4);$ in quadrant III
    $E:(0,\ -3);$ on the *y*-axis
    $F:(4,\ -2);$ in quadrant IV

20. *A*: quadrant II; *B*: *x*-axis; *C*: quadrant IV; *D:* quadrant III; *E*: quadrant I; *F*: *y*-axis



22. **a.** Let $x=1$ and $y=7$.
    $$-4(1)+3(7) \stackrel{?}{=} 18$$
    $$-4+21 \stackrel{?}{=} 18$$
    $$17=18 \text{ False}$$
    The point (1, 7) is not on the graph.

    b. Let $x=0$ and $y=6$.
    $$-4(0)+3(6) \stackrel{?}{=} 18$$
    $$0+18 \stackrel{?}{=} 18$$
    $$18=18 \text{ True}$$
    The point (0, 6) is on the graph.

    c. Let $x=-3$ and $y=10$.
    $$-4(-3)+3(10) \stackrel{?}{=} 18$$
    $$12+30 \stackrel{?}{=} 18$$
    $$42=18 \text{ False}$$
    The point (–3, 10) is not on the graph.

    d. Let $x=\frac{3}{2}$ and $y=4$.
    $$-4\left(\frac{3}{2}\right)+3(4) \stackrel{?}{=} 18$$
    $$-6+12 \stackrel{?}{=} 18$$
    $$6=18 \text{ False}$$
    The point $\left(\frac{3}{2},\ 4\right)$ is not on the graph.

24. a. Let $x = 2$ and $y = 2$.

$2 \stackrel{?}{=} (2)^3 - 3(2)$
$2 \stackrel{?}{=} 8 - 6$
$2 = 2$ True
The point (2, 2) is on the graph.

b. Let $x = 3$ and $y = 8$.

$8 \stackrel{?}{=} (3)^3 - 3(3)$
$8 \stackrel{?}{=} 27 - 9$
$8 = 18$ False
The point (3, 8) is not on the graph.

c. Let $x = -3$ and $y = -18$.

$-18 \stackrel{?}{=} (-3)^3 - 3(-3)$
$-18 \stackrel{?}{=} -27 + 9$
$-18 = -18$ True
The point (−3, −18) is on the graph.

d. Let $x = 0$ and $y = 0$.

$0 \stackrel{?}{=} (0)^3 - 3(0)$
$0 = 0$ True
The point (0, 0) is on the graph.

26. a. Let $x = 0$ and $y = 1$.

$(0)^2 + (1)^2 \stackrel{?}{=} 1$
$0 + 1 \stackrel{?}{=} 1$
$1 = 1$ True
The point (0, 1) is on the graph.

b. Let $x = 1$ and $y = 1$.

$(1)^2 + (1)^2 \stackrel{?}{=} 1$
$1 + 1 \stackrel{?}{=} 1$
$2 = 1$ False
The point (1, 1) is not on the graph.

c. Let $x = \frac{1}{2}$ and $y = \frac{1}{2}$.

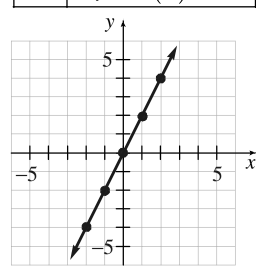
$\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2 \stackrel{?}{=} 1$
$\frac{1}{4} + \frac{1}{4} \stackrel{?}{=} 1$
$\frac{1}{2} = 1$ False
The point $\left(\frac{1}{2}, \frac{1}{2}\right)$ is not on the graph.

d. Let $x = \frac{\sqrt{3}}{2}$ and $y = \frac{1}{2}$.

$\left(\frac{\sqrt{3}}{2}\right)^2 + \left(\frac{1}{2}\right)^2 \stackrel{?}{=} 1$
$\frac{3}{4} + \frac{1}{4} \stackrel{?}{=} 1$
$1 = 1$ True
The point $\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$ is on the graph.

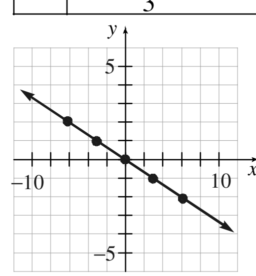
28. $y = 2x$

x	$y = 2x$	(x, y)
−2	$y = 2(-2) = -4$	$(-2, -4)$
−1	$y = 2(-1) = -2$	$(-1, -2)$
0	$y = 2(0) = 0$	$(0, 0)$
1	$y = 2(1) = 2$	$(1, 2)$
2	$y = 2(2) = 4$	$(2, 4)$



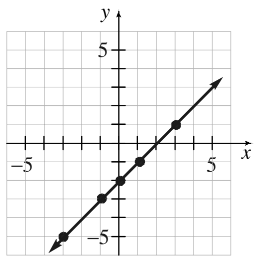
30. $y = -\frac{1}{3}x$

x	$y = -\frac{1}{3}x$	(x, y)
−6	$y = -\frac{1}{3}(-6) = 2$	$(-6, 2)$
−3	$y = -\frac{1}{3}(-3) = 1$	$(-3, 1)$
0	$y = -\frac{1}{3}(0) = 0$	$(0, 0)$
3	$y = -\frac{1}{3}(3) = -1$	$(3, -1)$
6	$y = -\frac{1}{3}(6) = -2$	$(6, -2)$



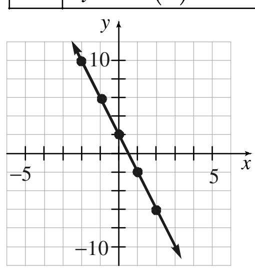
32. $y = x - 2$

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



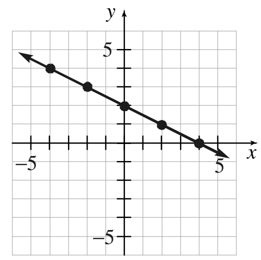
34. $y = -4x + 2$

x	$y = -4x + 2$	(x, y)
-2	$y = -4(-2) + 2 = 10$	$(-2, 10)$
-1	$y = -4(-1) + 2 = 6$	$(-1, 6)$
0	$y = -4(0) + 2 = 2$	$(0, 2)$
1	$y = -4(1) + 2 = -2$	$(1, -2)$
2	$y = -4(2) + 2 = -6$	$(2, -6)$



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

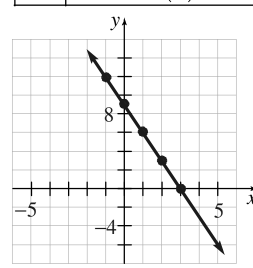
x	$y = -\frac{1}{2}x + 2$	(x, y)
-4	$y = -\frac{1}{2}(-4) + 2 = 4$	$(-4, 4)$
-2	$y = -\frac{1}{2}(-2) + 2 = 3$	$(-2, 3)$
0	$y = -\frac{1}{2}(0) + 2 = 2$	$(0, 2)$
2	$y = -\frac{1}{2}(2) + 2 = 1$	$(2, 1)$
4	$y = -\frac{1}{2}(4) + 2 = 0$	$(4, 0)$



38. $3x + y = 9$

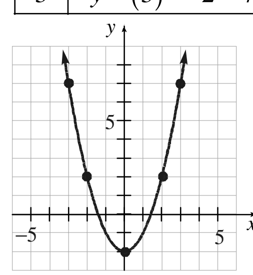
$y = -3x + 9$

x	$y = -3x + 9$	(x, y)
-1	$y = -3(-1) + 9 = 12$	$(-1, 12)$
0	$y = -3(0) + 9 = 9$	$(0, 9)$
1	$y = -3(1) + 9 = 6$	$(1, 6)$
2	$y = -3(2) + 9 = 3$	$(2, 3)$
3	$y = -3(3) + 9 = 0$	$(3, 0)$



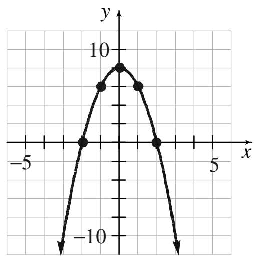
40. $y = x^2 - 2$

x	$y = x^2 - 2$	(x, y)
-3	$y = (-3)^2 - 2 = 7$	$(-3, 7)$
-2	$y = (-2)^2 - 2 = 2$	$(-2, 2)$
0	$y = (0)^2 - 2 = -2$	$(0, -2)$
2	$y = (2)^2 - 2 = 2$	$(2, 2)$
3	$y = (3)^2 - 2 = 7$	$(3, 7)$



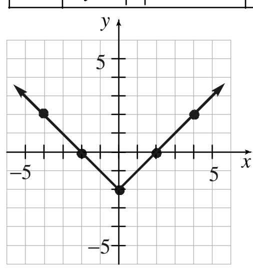
42. $y = -2x^2 + 8$

x	$y = -2x^2 + 8$	(x, y)
-2	$y = -2(-2)^2 + 8 = 0$	$(-2, 0)$
-1	$y = -2(-1)^2 + 8 = 6$	$(-1, 6)$
0	$y = -2(0)^2 + 8 = 8$	$(0, 8)$
1	$y = -2(1)^2 + 8 = 6$	$(1, 6)$
2	$y = -2(2)^2 + 8 = 0$	$(2, 0)$



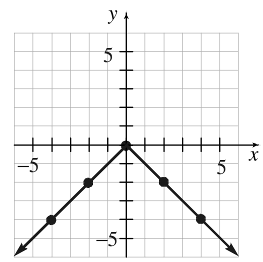
44. $y = |x| - 2$

x	$y = \|x\| - 2$	(x, y)
-4	$y = \|-4\| - 2 = 2$	$(-4, 2)$
-2	$y = \|-2\| - 2 = 0$	$(-2, 0)$
0	$y = \|0\| - 2 = -2$	$(0, -2)$
2	$y = \|2\| - 2 = 0$	$(2, 0)$
4	$y = \|4\| - 2 = 2$	$(4, 2)$



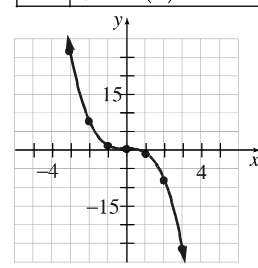
46. $y = -|x|$

x	$y = -\|x\|$	(x, y)
-4	$y = -\|-4\| = -4$	$(-4, -4)$
-2	$y = -\|-2\| = -2$	$(-2, -2)$
0	$y = -\|0\| = 0$	$(0, 0)$
2	$y = -\|2\| = -2$	$(2, -2)$
4	$y = -\|4\| = -4$	$(4, -4)$



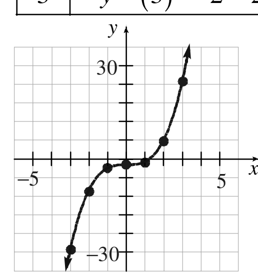
48. $y = -x^3$

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



50. $y = x^3 - 2$

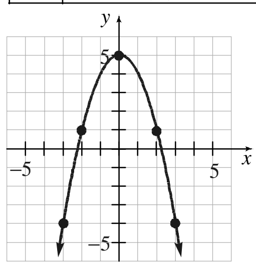
x	$y = x^3 - 2$	(x, y)
-3	$y = (-3)^3 - 2 = -29$	$(-3, -29)$
-2	$y = (-2)^3 - 2 = -10$	$(-2, -10)$
-1	$y = (-1)^3 - 2 = -3$	$(-1, -3)$
0	$y = (0)^3 - 2 = -2$	$(0, -2)$
1	$y = (1)^3 - 2 = -1$	$(1, -1)$
2	$y = (2)^3 - 2 = 6$	$(2, 6)$
3	$y = (3)^3 - 2 = 25$	$(3, 25)$



52. $x^2 + y = 5$

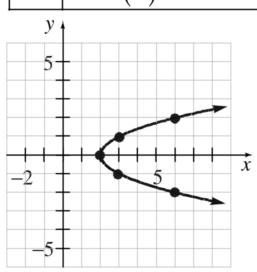
$y = -x^2 + 5$

x	$y = -x^2 + 5$	(x, y)
-3	$y = -(-3)^2 + 5 = -4$	$(-3, -4)$
-2	$y = -(-2)^2 + 5 = 1$	$(-2, 1)$
0	$y = -(0)^2 + 5 = 5$	$(0, 5)$
2	$y = -(2)^2 + 5 = 1$	$(2, 1)$
3	$y = -(3)^2 + 5 = -4$	$(3, -4)$



54. $x = y^2 + 2$

y	$x = y^2 + 2$	(x, y)
-2	$x = (-2)^2 + 2 = 6$	$(6, -2)$
-1	$x = (-1)^2 + 2 = 3$	$(3, -1)$
0	$x = (0)^2 + 2 = 2$	$(2, 0)$
1	$x = (1)^2 + 2 = 3$	$(3, 1)$
2	$x = (2)^2 + 2 = 6$	$(6, 2)$



56. The intercepts are (3, 0) and (0, 2).

58. The intercepts are (–2, 0), (3, 0), and (0, 9).

60. If (a, –2) is a point on the graph, then we have

$-2 = -3(a) + 5$

$-2 = -3a + 5$

$-7 = -3a$

$\frac{7}{3} = a$

We need $a = \frac{7}{3}$.

62. If (–2, b) is a point on the graph, then we have

$b = -2(-2)^2 + 3(-2) + 1$

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

$b = -8 - 6 + 1$

$b = -13$

We need $b = -13$.

64. a. According to the graph, the object had a height of about 175 feet after 1.5 seconds.

b. According to the graph, the object reached a maximum height of 196 feet after 2.5 seconds.

c. The t-intercept is (6, 0). The t-coordinate represents the time needed for the ball to hit the ground.

The H-intercept is (0, 96). The H-coordinate represents the initial height of the ball when it was thrown.

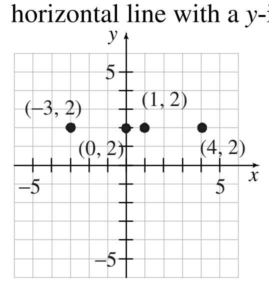
66. a. According to the graph, a temperature of 10°C will have a wind chill of 6°C when the wind is blowing 4 meters per second.

b. According to the graph, a temperature of 10°C will have a wind chill of −3.7°C when the wind is blowing 20 meters per second.

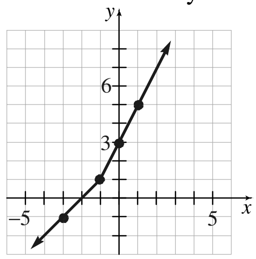
c. The intercept on the horizontal axis is (10, 0). This represents the wind speed (in meters per second) required for the wind chill to be 0°C (the freezing point of water).

The intercept on the vertical axis is (0, 10). This represents the apparent temperature (in °C) when there is no wind blowing.

68. The set of all points of the form (x, 2) form a horizontal line with a y-intercept of (0, 2).



70. Answers will vary. One possible graph is below.



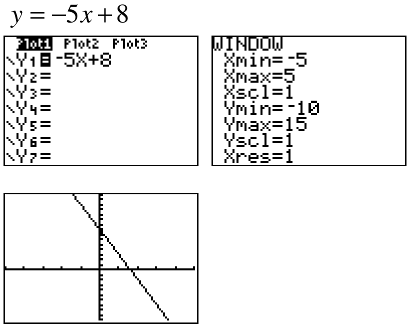
72. Answers will vary. One possibility:
All three points have a y-coordinate of 3. Therefore, they all lie on the horizontal line with equation $y = 3$.

74. The graph of an equation is a visual representation of the solution set for the equation.

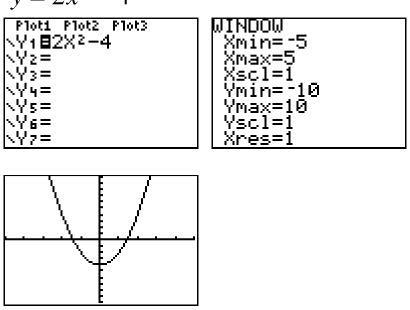
76. The y-coordinate of an x-intercept is always 0 since x-intercepts lie on the x-axis and all points on the x-axis have a y-coordinate of 0.

The x-coordinate of a y-intercept is always 0 since y-intercepts lie on the y-axis and all points on the y-axis have an x-coordinate of 0.

78. $y = -5x + 8$

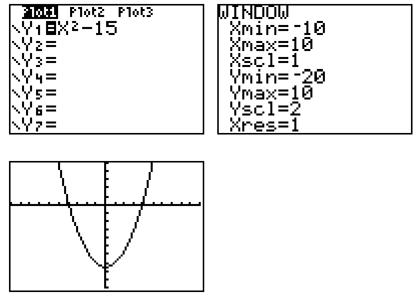


80. $y = 2x^2 - 4$

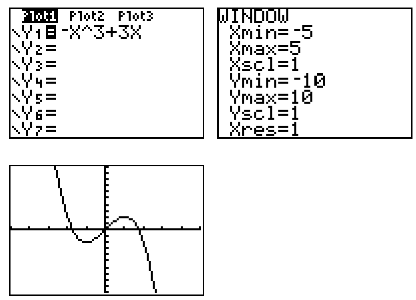


82. $y - x^2 = -15$

$y = x^2 - 15$



84. $y = -x^3 + 3x$



Section 1.6

Are You Ready for This Section?

R1.
$$
\begin{aligned}
3x + 12 &= 0 \\
3x + 12 - 12 &= 0 - 12 \\
3x &= -12 \\
\frac{3x}{3} &= \frac{-12}{3} \\
x &= -4
\end{aligned}
$$
The solution set is $\{-4\}$.

R2.
$$
\begin{aligned}
2x + 5 &= 13 \\
2x + 5 - 5 &= 13 - 5 \\
2x &= 8 \\
\frac{2x}{2} &= \frac{8}{2} \\
x &= 4
\end{aligned}
$$
The solution set is $\{4\}$.

R3.
$$
\begin{aligned}
3x - 2y &= 10 \\
3x - 2y - 3x &= 10 - 3x \\
-2y &= 10 - 3x \\
\frac{-2y}{-2} &= \frac{10 - 3x}{-2} \\
y &= \frac{3x - 10}{2} \text{ or } y = \frac{3}{2}x - 5
\end{aligned}
$$

R4. $\dfrac{5-2}{-2-4}=\dfrac{3}{-6}=-\dfrac{1}{2}$

R5. $\dfrac{-7-2}{-5-(-2)}=\dfrac{-9}{-5+2}=\dfrac{-9}{-3}=3$

R6. $-2(x+3)=(-2)\cdot x+(-2)\cdot 3$
$=-2x-6$

Section 1.6 Quick Checks

1. A linear equation is an equation of the form $Ax + By = C$, where A, B, and C are real numbers, A and B cannot both be 0.

2. The graph of a linear equation is a line.

3. $y=2x-3$
Let $x = -1$, 0, 1, and 2.

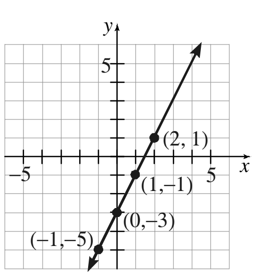
$x=-1:\quad y=2(-1)-3$
$y=-2-3$
$y=-5$

$x=0:\quad y=2(0)-3$
$y=0-3$
$y=-3$

$x=1:\quad y=2(1)-3$
$y=2-3$
$y=-1$

$x=2:\quad y=2(2)-3$
$y=4-3$
$y=1$

Thus, the points (–1, –5), (0, –3), (1, –1), and (2, 1) are on the graph.



4. $\dfrac{1}{2}x+y=2$
Let $x = -2$, 0, 2, and 4.

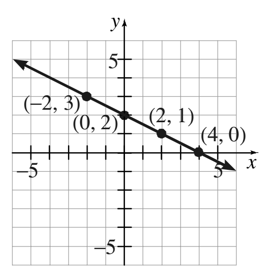
$x=-2:\quad \dfrac{1}{2}(-2)+y=2$
$-1+y=2$
$y=3$

$x=0:\quad \dfrac{1}{2}(0)+y=2$
$0+y=2$
$y=2$

$x=2:\quad \dfrac{1}{2}(2)+y=2$
$1+y=2$
$y=1$

$x=4:\quad \dfrac{1}{2}(4)+y=2$
$2+y=2$
$y=0$

Thus, the points (–2, 3), (0, 2), (2, 1), and (4, 0) are on the graph.



5. $-6x+3y=12$
Let $x = -2$, –1, 0, and 1.

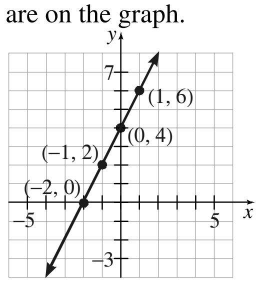
$x=-2:\quad -6(-2)+3y=12$
$12+3y=12$
$3y=0$
$y=0$

$x=-1:\quad -6(-1)+3y=12$
$6+3y=12$
$3y=6$
$y=2$

$$\begin{aligned} x=0: \quad -6(0)+3y&=12\\ 0+3y&=12\\ 3y&=12\\ y&=4 \end{aligned}$$

$$\begin{aligned} x=1: \quad -6(1)+3y&=12\\ -6+3y&=12\\ 3y&=18\\ y&=6 \end{aligned}$$

Thus, the points (–2, 0), (–1, 2), (0, 4), and (1, 6) are on the graph.



6. True

7. $x+y=4$

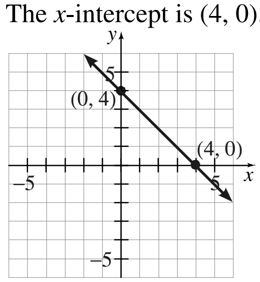
To find the *y*-intercept, let $x=0$ and solve for *y*.

$$\begin{aligned} x=0: \quad 0+y&=4\\ y&=4 \end{aligned}$$

The *y*-intercept is (0, 4). To find the *x*-intercept, let $y=0$ and solve for *x*.

$$\begin{aligned} y=0: \quad x+0&=4\\ x&=4 \end{aligned}$$

The *x*-intercept is (4, 0).



8. $4x-5y=20$

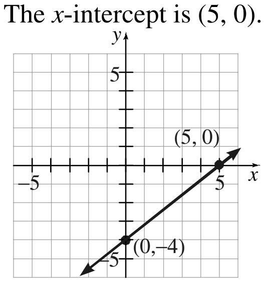
To find the *y*-intercept, let $x=0$ and solve for *y*.

$$\begin{aligned} x=0: \quad 4(0)-5y&=20\\ -5y&=20\\ y&=-4 \end{aligned}$$

The *y*-intercept is (0, –4). To find the *x*-intercept, let $y=0$ and solve for *x*.

$$\begin{aligned} y=0: \quad 4x-5(0)&=20\\ 4x&=20\\ x&=5 \end{aligned}$$

The *x*-intercept is (5, 0).



9. $3x-2y=0$

To find the *y*-intercept, let $x=0$ and solve for *y*.

$$\begin{aligned} x=0: \quad 3(0)-2y&=0\\ -2y&=0\\ y&=0 \end{aligned}$$

The *y*-intercept is (0, 0). To find the *x*-intercept, let *y* = 0 and solve for *x*.

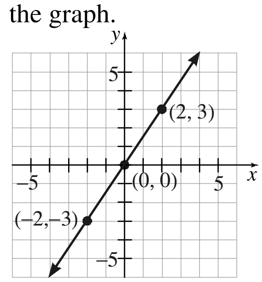
$$\begin{aligned} y=0: \quad 3x-2(0)&=0\\ 3x&=0\\ x&=0 \end{aligned}$$

The *x*-intercept is (0, 0). Since the *x*- and *y*-intercepts both result in the origin, we must find other points on the graph. Let $x=-2$ and 2, and solve for *y*.

$$\begin{aligned} x=-2: \quad 3(-2)-2y&=0\\ -6-2y&=0\\ -2y&=6\\ y&=-3 \end{aligned}$$

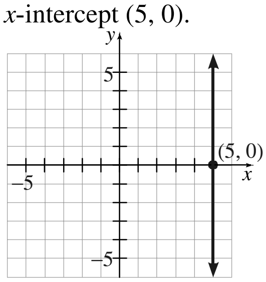
$$\begin{aligned} x=2: \quad 3(2)-2y&=0\\ 6-2y&=0\\ -2y&=-6\\ y&=3 \end{aligned}$$

Thus, the points (–2, –3) and $(2,\ 3)$ are also on the graph.

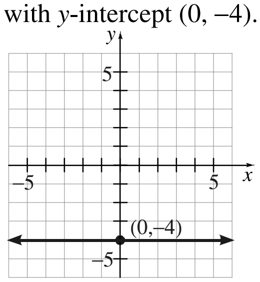


10. The equation of a vertical line is of the form *x* = *a*. The equation of a horizontal line is of the form *y* = *b*.

11. The equation $x = 5$ will be a vertical line with x-intercept (5, 0).

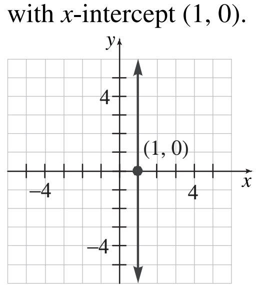


12. The equation $y = -4$ will be a horizontal line with y-intercept (0, −4).



13.
$$-3x + 4 = 1$$
$$-3x + 4 - 4 = 1 - 4$$
$$-3x = -3$$
$$\frac{-3x}{-3} = \frac{-3}{-3}$$
$$x = 1$$

The equation $-3x + 4 = 1$ will be a vertical line with x-intercept (1, 0).



14. If a line is vertical, then its slope is <u>undefined</u>.

15. $\frac{\text{Rise}}{\text{Run}} = \frac{4}{10} = \frac{2}{5}$

16. False; the slope is $m = \frac{y_2 - y_1}{x_2 - x_1}$, $x_1 \neq x_2$

17. True

18. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - 3}{3 - 0} = \frac{9}{3} = 3$

For every 1 unit of increase in x, y will increase by 3 units.

19. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 3}{3 - (-1)} = \frac{-7}{4} = -\frac{7}{4}$

For every 4 units of increase in x, y will decrease by 7 units. For every 4 units of decrease in x, y will increase by 7 units.

20. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 2}{-3 - 3} = \frac{0}{-6} = 0$

The line is horizontal.

21. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 4}{-2 - (-2)} = \frac{-5}{0} = \text{undefined}$

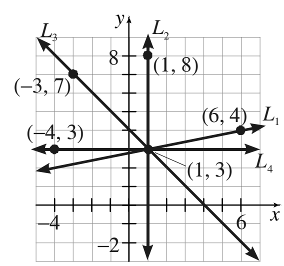
The line is vertical.

22. True

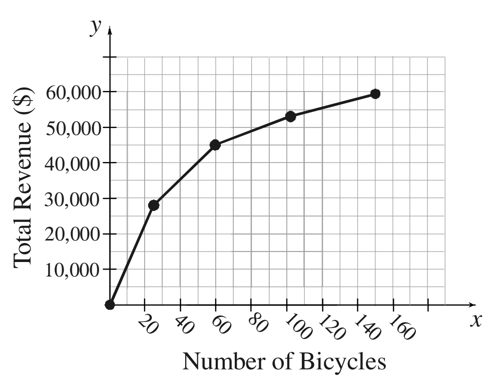
23. A horizontal line has slope = <u>0</u>.

24. $m_1 = \frac{4 - 3}{6 - 1} = \frac{1}{5}$; $m_2 = \frac{8 - 3}{1 - 1} = \frac{5}{0} = \text{undefined}$;

$m_3 = \frac{7 - 3}{-3 - 1} = \frac{4}{-4} = -1$; $m_4 = \frac{3 - 3}{-4 - 1} = \frac{0}{-5} = 0$



25. a.



b. $\text{Average rate of change} = \dfrac{28{,}000 - 0}{25 - 0}$
$= \$1120 \text{ per bicycle}$

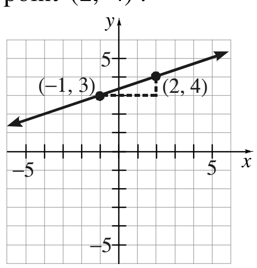
For each bicycle sold, total revenue increased by \$1120 when between 0 and 25 bicycles were sold.

c. $\text{Average rate of change} = \dfrac{59{,}160 - 53{,}400}{150 - 102}$
$= \$120 \text{ per bicycle}$

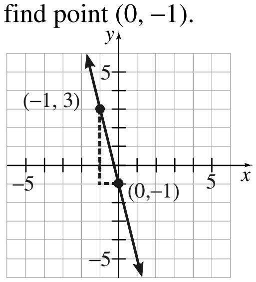
For each bicycle sold, total revenue increased by \$120 when between 102 and 150 bicycles were sold.

d. No, the revenue does not grow linearly. The average rate of change (slope) is not constant.

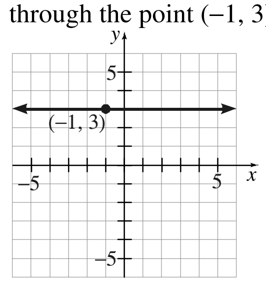
26. a. Start at $(-1,\ 3)$. Because $m = \dfrac{1}{3}$, move 3 units to the right and 1 unit up to find point $(2,\ 4)$.



b. Start at $(-1,\ 3)$. Because $m = -4 = -\dfrac{4}{1}$, move 1 unit to the right and 4 units down to find point (0, −1).



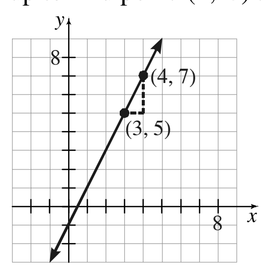
c. Because $m = 0$, the line is horizontal passing through the point (−1, 3).



27. An equation in the form $y - y_1 = m(x - x_1)$ is said to be in <u>point-slope</u> form.

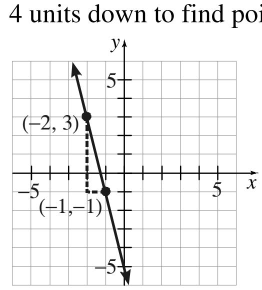
28. $y - y_1 = m(x - x_1)$
$y - 5 = 2(x - 3)$

To graph the line, start at $(3,\ 5)$. Because $m = 2 = \dfrac{2}{1}$, move 1 unit to the right and 2 units up to find point $(4,\ 7)$.



29. $y - y_1 = m(x - x_1)$
$y - 3 = -4(x - (-2))$
$y - 3 = -4(x + 2)$

To graph the line, start at $(-2,\ 3)$. Because $m = -4 = -\dfrac{4}{1}$, move 1 unit to the right and 4 units down to find point $(-1, -1)$.

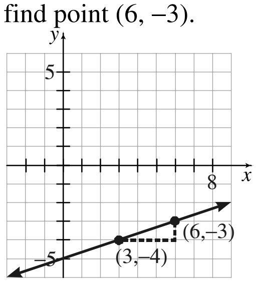


30. $y - y_1 = m(x - x_1)$

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

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

To graph the line, start at $(3, -4)$. Because $m = \frac{1}{3}$, move 3 units to the right and 1 unit up to find point (6, −3).



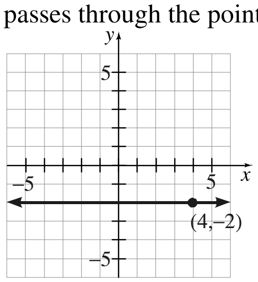
31. $y - y_1 = m(x - x_1)$

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

$y + 2 = 0$

$y = -2$

To graph the line, we draw a horizontal line that passes through the point (4, −2).



32. An equation in the form *y* = *mx* + *b* is said to be in slope-intercept form.

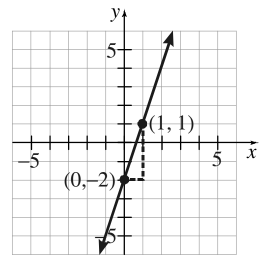
33. $3x - y = 2$

$-y = -3x + 2$

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

$y = 3x - 2$

The slope is 3 and the *y*-intercept is (0, −2). To graph the line, begin at (0, −2) and move to the right 1 unit and up 3 units to find the point (1, 1).



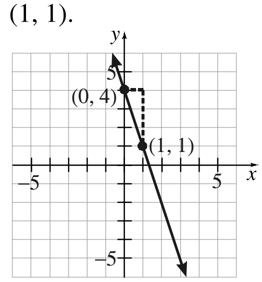
34. $6x + 2y = 8$

$2y = -6x + 8$

$y = \frac{-6x + 8}{2}$

$y = -3x + 4$

The slope is -3 and the *y*-intercept is (0, 4). To graph the line, begin at (0, 4) and move to the right 1 unit and down 3 units to find the point (1, 1).



35. $3x - 2y = 7$

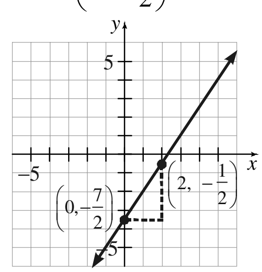
$-2y = -3x + 7$

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

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

The slope is $\frac{3}{2}$ and the *y*-intercept is $\left(0, -\frac{7}{2}\right)$.

To graph the line, begin at $\left(0, -\frac{7}{2}\right)$ and move to the right 2 units and up 3 units to find the point $\left(2, -\frac{1}{2}\right)$.

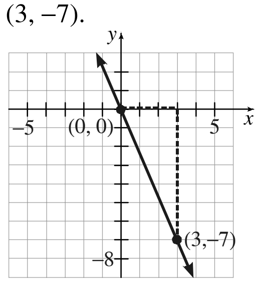


36. $7x+3y=0$

$$3y=-7x$$

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

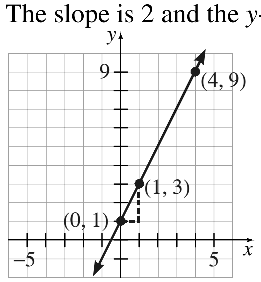
The slope is $-\frac{7}{3}$ and the y-intercept is (0, 0). To graph the line, begin at (0, 0) and move to the right 3 units and down 7 units to find point (3, −7).



37. $m=\frac{y_2-y_1}{x_2-x_1}=\frac{9-3}{4-1}=\frac{6}{3}=2$

$$y-y_1=m(x-x_1)$$
$$y-3=2(x-1)$$
$$y-3=2x-2$$
$$y=2x+1$$

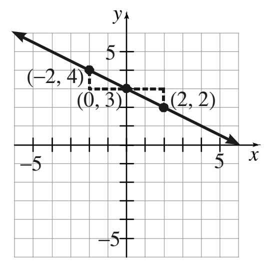
The slope is 2 and the y-intercept is (0, 1).



38. $m=\frac{y_2-y_1}{x_2-x_1}=\frac{2-4}{2-(-2)}=\frac{-2}{4}=-\frac{1}{2}$

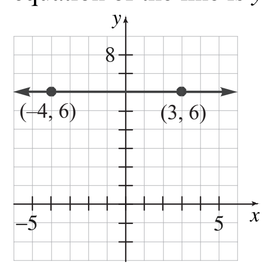
$$y-y_1=m(x-x_1)$$
$$y-4=-\frac{1}{2}(x-(-2))$$
$$y-4=-\frac{1}{2}x-1$$
$$y=-\frac{1}{2}x+3$$

The slope is $-\frac{1}{2}$ and the y-intercept is (0, 3).



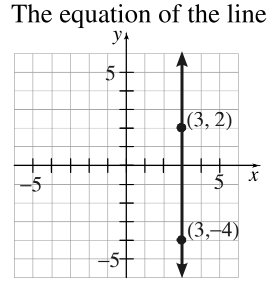
39. $m=\frac{y_2-y_1}{x_2-x_1}=\frac{6-6}{3-(-4)}=\frac{0}{7}=0$

The slope is 0, so the line is horizontal. The equation of the line is $y = 6$.



40. $m=\frac{y_2-y_1}{x_2-x_1}=\frac{-4-2}{3-3}=\frac{-6}{0}=\text{undefined}$

The slope is undefined, so the line is vertical. The equation of the line is $x = 3$.



1.6 Exercises

42. $2x-y=-8$

Let $x=-2,-1,\ 0,\ \text{and}\ 1.$

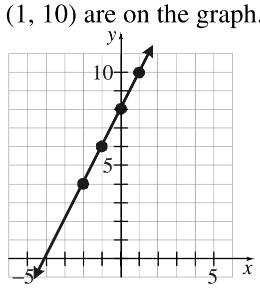
$x=-2$: $2(-2)-y=-8$
$$-4-y=-8$$
$$-y=-4$$
$$y=4$$

$x=-1$: $2(-1)-y=-8$
$$-2-y=-8$$
$$-y=-6$$
$$y=6$$

$x=0$: $2(0)-y=-8$
$-y=-8$
$y=8$

$x=1$: $2(1)-y=-8$
$2-y=-8$
$-y=-10$
$y=10$

Thus, the points (–2, 4), (–1, 6), (0, 8), and (1, 10) are on the graph.



44. $-5x+y=10$

Let $x=-3, -2, -1$, and 0.

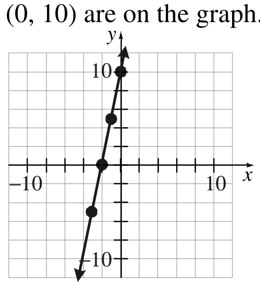
$x=-3$: $-5(-3)+y=10$
$15+y=10$
$y=-5$

$x=-2$: $-5(-2)+y=10$
$10+y=10$
$y=0$

$x=-1$: $-5(-1)+y=10$
$5+y=10$
$y=5$

$x=0$: $-5(0)+y=10$
$y=10$

Thus, the points (–3, –5), (–2, 0), (–1, 5), and (0, 10) are on the graph.



46. $2x-\frac{3}{2}y=10$

Let $x=-1,\ 2,\ 5,$ and 8.

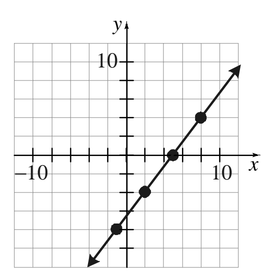
$x=-1$: $2(-1)-\frac{3}{2}y=10$
$-2-\frac{3}{2}y=10$
$-\frac{3}{2}y=12$
$y=-8$

$x=2$: $2(2)-\frac{3}{2}y=10$
$4-\frac{3}{2}y=10$
$-\frac{3}{2}y=6$
$y=-4$

$x=5$: $2(5)-\frac{3}{2}y=10$
$10-\frac{3}{2}y=10$
$-\frac{3}{2}y=0$
$y=0$

$x=8$: $2(8)-\frac{3}{2}y=10$
$16-\frac{3}{2}y=10$
$-\frac{3}{2}y=-6$
$y=4$

Thus, the points (–1, –8), (2, –4), (5, 0), and (8, 4) are on the graph.



48. $-7x+3y=9$

Let $x=-3$, 0, 3, and 6.

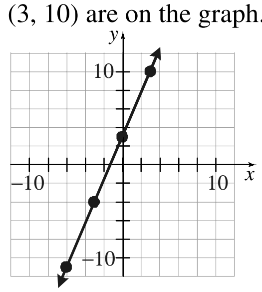
$x=-6$: $-7(-6)+3y=9$
$42+3y=9$
$3y=-33$
$y=-11$

$x=-3$: $-7(-3)+3y=9$
$21+3y=9$
$3y=-12$
$y=-4$

$x=0$: $-7(0)+3y=9$
$3y=9$
$y=3$

$x=3$: $-7(3)+3y=9$
$-21+3y=9$
$3y=30$
$y=10$

Thus, the points (–6, –11), (–3, –4), (0, 3), and (3, 10) are on the graph.



50. $-2x+y=4$

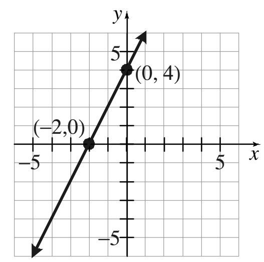
To find the *y*-intercept, let $x=0$ and solve for *y*.

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

The *y*-intercept is (0, 4). To find the *x*-intercept, let $y=0$ and solve for *x*.

$y=0$: $-2x+0=4$
$-2x=4$
$x=-2$

The *x*-intercept is (–2, 0).



52. $-4x+3y=24$

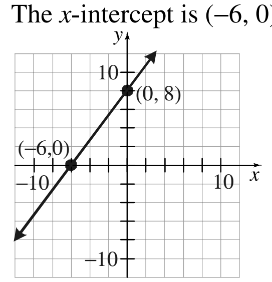
To find the *y*-intercept, let $x=0$ and solve for *y*.

$x=0$: $-4(0)+3y=24$
$3y=24$
$y=8$

The *y*-intercept is (0, 8). To find the *x*-intercept, let $y=0$ and solve for *x*.

$y=0$: $-4x+3(0)=24$
$-4x=24$
$x=-6$

The *x*-intercept is (–6, 0).



54. $\frac{1}{4}x+\frac{1}{5}y=2$

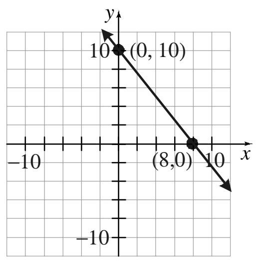
To find the *y*-intercept, let $x=0$ and solve for *y*.

$x=0$: $\frac{1}{4}(0)+\frac{1}{5}y=2$
$\frac{1}{5}y=2$
$y=10$

The *y*-intercept is (0, 10). To find the *x*-intercept, let $y=0$ and solve for *x*.

$y=0$: $\frac{1}{4}x+\frac{1}{5}(0)=2$
$\frac{1}{4}x=2$
$x=8$

The *x*-intercept is (8, 0).



56. $4x+3y=0$

To find the *y*-intercept, let $x=0$ and solve for *y*.

$$x=0:\quad 4(0)+3y=0$$
$$3y=0$$
$$y=0$$

The *y*-intercept is (0, 0) To find the *x*-intercept, let $y=0$ and solve for *x*.

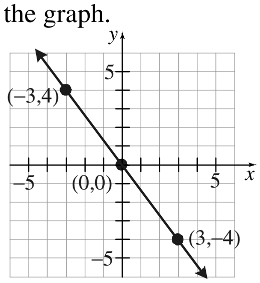
$$y=0:\quad 4x+3(0)=0$$
$$4x=0$$
$$x=0$$

The *x*-intercept is (0, 0). Since the *x*- and *y*-intercepts both result in the origin, we must find other points on the graph. Let $x=-3$ and 3, and solve for *y*.

$$x=-3:\quad 4(-3)+3y=0$$
$$-12+3y=0$$
$$3y=12$$
$$y=4$$

$$x=3:\quad 4(3)+3y=0$$
$$12+3y=0$$
$$3y=-12$$
$$y=-4$$

Thus, the points (–3, 4) and (3, –4) are also on the graph.



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

To find the *y*-intercept, let $x=0$ and solve for *y*.

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

The *y*-intercept is (0, 0). To find the *x*-intercept, let $y=0$ and solve for *x*.

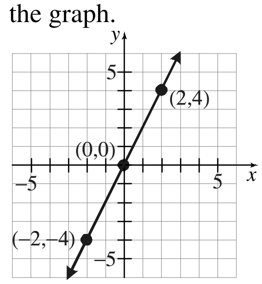
$$y=0:\quad -\frac{3}{2}x+\frac{3}{4}(0)=0$$
$$-\frac{3}{2}x=0$$
$$x=0$$

The *x*-intercept is (0, 0). Since the *x*- and *y*-intercepts both result in the origin, we must find other points on the graph. Let $x=-2$ and 2, and solve for *y*.

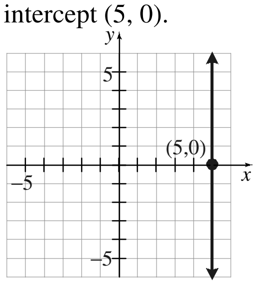
$$x=-2:\quad -\frac{3}{2}(-2)+\frac{3}{4}y=0$$
$$3+\frac{3}{4}y=0$$
$$\frac{3}{4}y=-3$$
$$y=-4$$

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

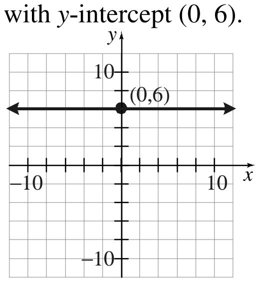
Thus, the points (–2, –4) and (2, 4) are also on the graph.



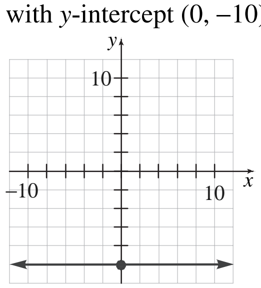
60. The equation $x = 5$ will be a vertical line with x-intercept (5, 0).



62. The equation $y = 6$ will be a horizontal line with y-intercept (0, 6).



64.
$$3y + 20 = -10$$
$$3y = -30$$
$$y = -10$$
The equation $y = -10$ will be a horizontal line with y-intercept (0, –10).



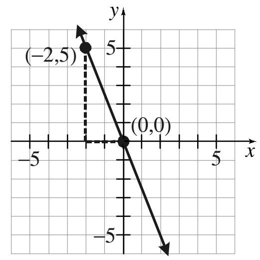
66. **a.** $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-0}{3-0} = \frac{-2}{3} = -\frac{2}{3}$

b. For every 3 units of increase in x, y will decrease by 2 units. For every 3 units of decrease in x, y will increase by 2 units.

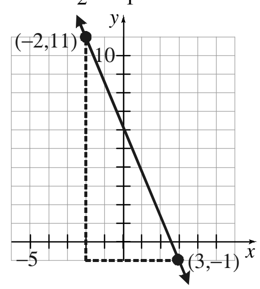
68. **a.** $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2-(-3)}{4-(-2)} = \frac{5}{6}$

b. For every 6 units of increase in x, y will increase by 5 units.

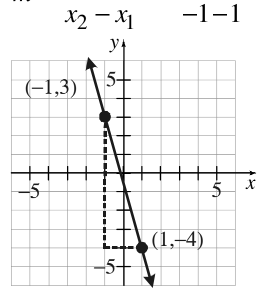
70. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-0}{-2-0} = \frac{5}{-2} = -\frac{5}{2}$



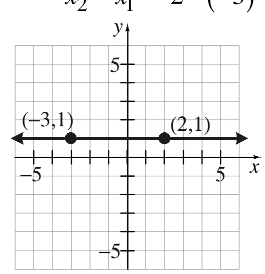
72. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-(-1)}{-2-3} = \frac{12}{-5} = -\frac{12}{5}$



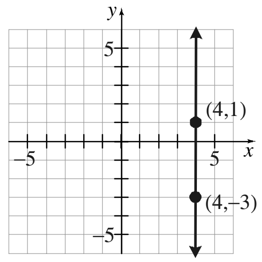
74. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-(-4)}{-1-1} = \frac{7}{-2} = -\frac{7}{2}$



76. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-1}{2-(-3)} = \frac{0}{5} = 0$



78. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-3-1}{4-4} = \dfrac{-4}{0} = \text{undefined}$



80. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

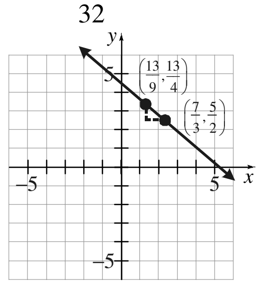
$= \dfrac{\frac{13}{4} - \frac{5}{2}}{\frac{13}{9} - \frac{7}{3}}$

$= \dfrac{\frac{13}{4} - \frac{10}{4}}{\frac{13}{9} - \frac{21}{9}}$

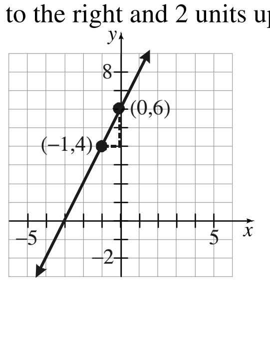
$= \dfrac{\frac{3}{4}}{-\frac{8}{9}}$

$= \dfrac{3}{4}\left(-\dfrac{9}{8}\right)$

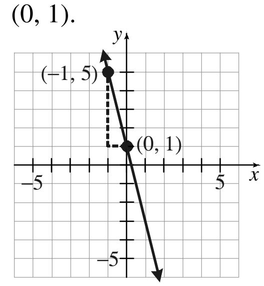
$= -\dfrac{27}{32}$



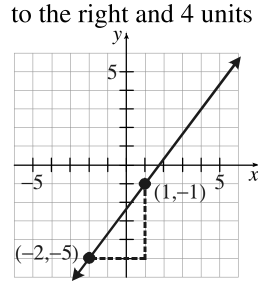
82. Start at (–1, 4). Because $m = 2 = \dfrac{2}{1}$, move 1 unit to the right and 2 units up to find point (0, 6).



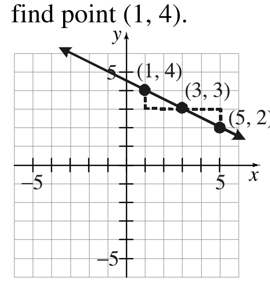
84. Start at (–1, 5). Because $m = -4 = -\dfrac{4}{1}$, move 1 unit to the right and 4 units down to find point (0, 1).



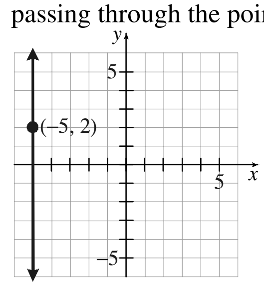
86. Start at (–2, –5). Because $m = \dfrac{4}{3}$, move 3 units to the right and 4 units up to find point (1, –1).



88. Start at (3, 3). Because $m = -\dfrac{1}{2}$, move 2 units to the right and 1 unit down to find point (5, 2). We can also move 2 units to the left and 1 unit up to find point (1, 4).



90. Because m is undefined, the line is vertical passing through the point (–5, 2).



92. Answers will vary. One possible answer follows. We know $m = -\frac{2}{3}$. Beginning at the point (1, −3), and using a change in x of -3 and a change of y of 2, $1+(-3) = -2$ and $-3 + 2 = -1$, so (−2, −1) is on the line. Next, beginning at (−2, −1), $-2+(-3) = -5$ and $-1 + 2 = 1$, so (−5, 1) is on the line. Now, beginning at (−5, 1), $-5+(-3) = -8$ and $1 + 2 = 3$, so (−8, 3) is on the line. In summary, the points (−2, −1), (−5, 1), and (−8, 3) will all be on the line.

94. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4-0}{4-(-2)} = \frac{4}{6} = \frac{2}{3}$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 0 &= \frac{2}{3}(x-(-2)) \\ y &= \frac{2}{3}(x+2) \\ y &= \frac{2}{3}x + \frac{4}{3} \end{aligned}$$

96. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4-(-2)}{2-2} = \frac{6}{0} = \text{undefined}$

So, the line is vertical. The equation of the line is $x = 2$.

98.

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 0 &= -1(x-0) \\ y &= -x \end{aligned}$$

100.

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-(-1) &= 4(x-2) \\ y+1 &= 4x-8 \\ y &= 4x-9 \end{aligned}$$

102.

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-1 &= \frac{1}{2}(x-2) \\ y-1 &= \frac{1}{2}x-1 \\ y &= \frac{1}{2}x \end{aligned}$$

104.

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-(-3) &= -\frac{4}{3}(x-1) \\ y+3 &= -\frac{4}{3}x+\frac{4}{3} \\ y &= -\frac{4}{3}x-\frac{5}{3} \end{aligned}$$

106.

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-(-2) &= 0(x-3) \\ y+2 &= 0 \\ y &= -2 \end{aligned}$$

108. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3-0}{4-0} = -\frac{3}{4}$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 0 &= -\frac{3}{4}(x-0) \\ y &= -\frac{3}{4}x \end{aligned}$$

110. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-3}{3-1} = \frac{4}{2} = 2$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-3 &= 2(x-1) \\ y-3 &= 2x-2 \\ y &= 2x+1 \end{aligned}$$

112. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-1}{1-(-3)} = \frac{5}{4}$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-1 &= \frac{5}{4}(x-(-3)) \\ y-1 &= \frac{5}{4}x+\frac{15}{4} \\ y &= \frac{5}{4}x+\frac{19}{4} \end{aligned}$$

114. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4-(-4)}{1-(-3)} = \frac{0}{4} = 0$

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y-(-4) &= 0(x-(-3)) \\ y+4 &= 0 \\ y &= -4 \end{aligned}$$

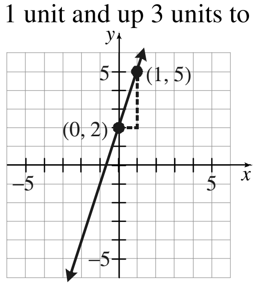
116. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-1-1}{1-(-5)} = \dfrac{-2}{6} = -\dfrac{1}{3}$

$$y - y_1 = m(x - x_1)$$
$$y - 1 = -\frac{1}{3}(x - (-5))$$
$$y - 1 = -\frac{1}{3}(x + 5)$$
$$y - 1 = -\frac{1}{3}x - \frac{5}{3}$$
$$y = -\frac{1}{3}x - \frac{2}{3}$$

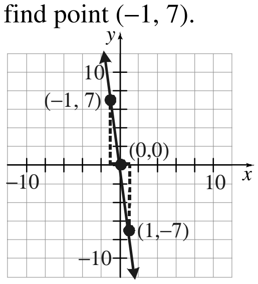
118. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-4-1}{3-3} = \dfrac{-5}{0} =$ undefined

So, the line is vertical. The equation of the line is $x = 3$.

120. For $y = 3x + 2$, the slope is 3 and the y-intercept is (0, 2). Begin at (0, 2) and move to the right 1 unit and up 3 units to find point (1, 5).



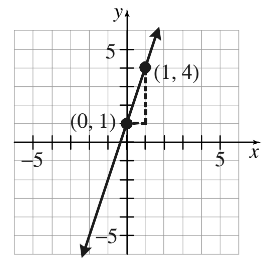
122. For $y = -7x$, the slope is -7 and the y-intercept is (0, 0). Begin at (0, 0) and move to the right 1 unit and down 7 units to find point (1, –7). We can also move 1 unit to the left and 7 units up to find point (–1, 7).



124. $-3x + y = 1$

$$y = 3x + 1$$

The slope is 3 and the y-intercept is (0, 1). Begin at (0, 1) and move to the right 1 unit and up 3 units to find the point (1, 4).

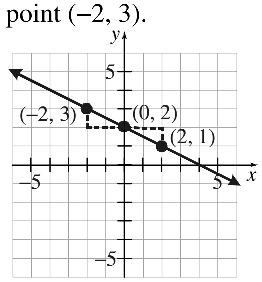


126. $3x + 6y = 12$

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

The slope is $-\dfrac{1}{2}$ and the y-intercept is (0, 2).

Begin at (0, 2) and move to the right 2 units and down 1 unit to find the point (2, 1). We can also move 2 units to the left and 1 unit up to find the point (–2, 3).

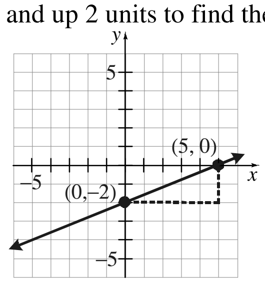


128. $2x - 5y - 10 = 0$

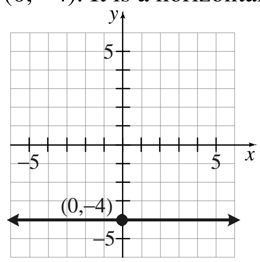
$$-5y = -2x + 10$$
$$y = \frac{-2x + 10}{-5}$$
$$y = \frac{2}{5}x - 2$$

The slope is $\dfrac{2}{5}$ and the y-intercept is (0, –2).

Begin at (0, –2) and move to the right 5 units and up 2 units to find the point (5, 0).

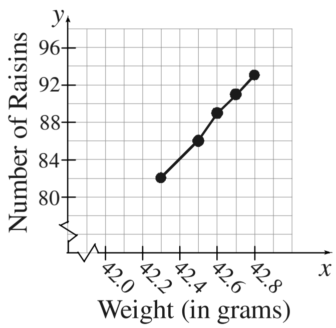


130. For $y = -4$, the slope is 0 and the y-intercept is (0, −4). It is a horizontal line.



132. The y-axis is a vertical line passing through the origin. Thus, the slope is undefined and the x-intercept is 0. So, the equation of the y-axis is $x = 0$.

134. a.



b. Average rate of change

$$= \frac{86-82}{42.5-42.3}$$
= 20 raisins per gram

Between weights of 42.3 and 42.5 grams, the number of raisins is increasing at a rate of 20 raisins per gram.

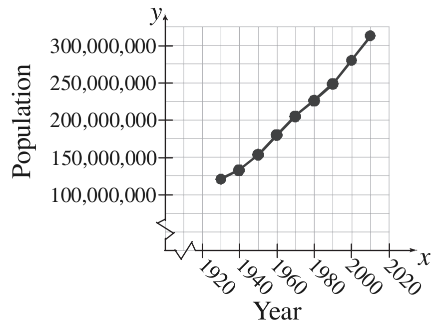
c. Average rate of change

$$= \frac{93-91}{42.8-42.7}$$
= 20 raisins per gram

Between weights of 42.7 and 42.8 grams, the number of raisins is increasing at a rate of 20 raisins per gram.

d. No, the number of raisins is not *perfectly* linearly related to weight. The average rate of change (slope) is not constant. However, it is close.

136. a.



b. Average rate of change

$$= \frac{132{,}164{,}569 - 123{,}202{,}624}{1940-1930}$$
= 896,194.5 people per year

Between 1930 and 1940, the population increased at a rate of 896,194.5 people per year.

c. Average rate of change

$$= \frac{313{,}131{,}065 - 281{,}421{,}906}{2010-2000}$$
= 3,170,915.9 people per year

Between 2000 and 2010, the population increased at a rate of 3,170,915.9 people per year.

d. No. The population is not linearly related to year. The average rate of change (slope) is not constant.

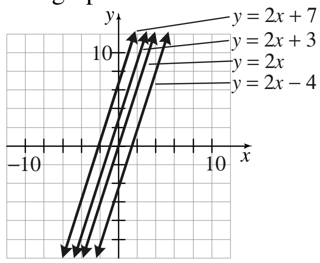
138. According to the ADA codes, for every twelve units of horizontal change in the access ramp, the vertical change must be one unit or less.

140. The graph shown has both a negative slope and a negative y-intercept. Two of the given equations meet both of these conditions: those in parts (c) and (d), $y = -\frac{2}{3}x - 3$ and $4x + 3y = -5$.

142. A vertical line of the form $x = a$ where $a \neq 0$ has one x-intercept, but no y-intercept.

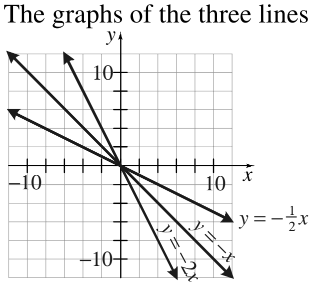
144. Any line that is neither vertical nor horizontal.

146. The graphs of the four lines are shown below.



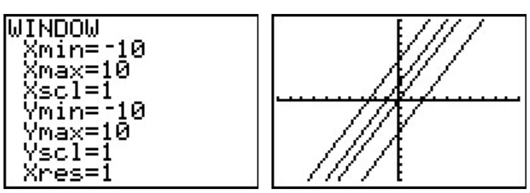
Answers will vary. The lines are all parallel. They all have the same slope, 2. The *y*-intercept of each graph is equal to the constant term in the function being graphed.
The graph of $y = 2x + b$ will be parallel to the lines above. It will have the same slope as the lines above. The *y*-intercept will be *b*.

148. The graphs of the three lines are shown below.



Answers will vary. All three lines pass through the origin and slant downward from left to right. The graph of $y = -x$ slants more steeply than the graph of $y = -\frac{1}{2}x$. The graph of $y = -2x$ slants even more steeply than that of $y = -x$.
The graph of $y = ax$, with $a < 0$, will be a line that passes through the origin and slants downward from left to right.

150.



Answers may vary. For different values of *b*, the graphs of $y = 2x + b$ are parallel lines with different *y*-intercepts.

Section 1.7

Are You Ready for This Section?

R1. The reciprocal of 3 is $\frac{1}{3}$ because $3 \cdot \frac{1}{3} = 1$.

R2. The reciprocal of $-\frac{3}{5}$ is $-\frac{5}{3}$ because $\left(-\frac{3}{5}\right)\left(-\frac{5}{3}\right) = 1$.

Section 1.7 Quick Checks

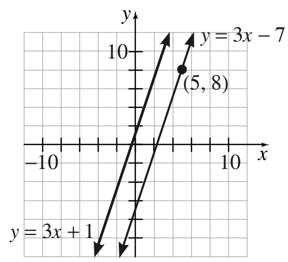
1. Two lines are parallel if and only if they have the same <u>slope</u> and different <u>*y*-intercepts</u>.

2. The slope of $L_1 : y = 3x + 1$ is $m_1 = 3$. The slope of $L_2 : y = -3x - 3$ is $m_2 = -3$. Since the two slopes are not equal, the lines are not parallel.

3. $L_1 : 6x + 3y = 3$
$$3y = -6x + 3$$
$$y = \frac{-6x + 3}{3}$$
$$y = -2x + 1$$
$L_2 : -8x - 4y = 12$
$$-4y = 8x + 12$$
$$y = \frac{8x + 12}{-4}$$
$$y = -2x - 3$$
Since the slopes $m_1 = -2$ and $m_2 = -2$ are equal but the *y*-intercepts are different, the two lines are parallel.

4. $L_1 : -3x + 5y = 10$
$$5y = 3x + 10$$
$$y = \frac{3x + 10}{5}$$
$$y = \frac{3}{5}x + 2$$
$L_2 : 6x + 10y = 10$
$$10y = -6x + 10$$
$$y = \frac{-6x + 10}{10}$$
$$y = -\frac{3}{5}x + 1$$
Since the slopes $m_1 = \frac{3}{5}$ and $m_2 = -\frac{3}{5}$ are not equal, the two lines are not parallel.

5. The slope of the line we seek is $m = 3$, the same as the slope of $y = 3x + 1$. The equation of the line is
$$y - y_1 = m(x - x_1)$$
$$y - 8 = 3(x - 5)$$
$$y - 8 = 3x - 15$$
$$y = 3x - 7$$

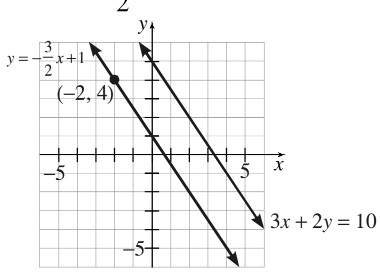


6. The slope of the line we seek is $m=-\frac{3}{2}$, the same as the slope of the line

$$\begin{aligned}3x+2y&=10\\2y&=-3x+10\\y&=\frac{-3x+10}{2}\\y&=-\frac{3}{2}x+5\end{aligned}$$

Thus, the equation of the line we seek is

$$\begin{aligned}y-y_1&=m(x-x_1)\\y-4&=-\frac{3}{2}(x-(-2))\\y-4&=-\frac{3}{2}(x+2)\\y-4&=-\frac{3}{2}x-3\\y&=-\frac{3}{2}x+1\end{aligned}$$



7. Two lines are perpendicular if and only if the product of their slopes is −1.

8. The negative reciprocal of -3 is $-\frac{1}{-3}=\frac{1}{3}$. Any line whose slope is $\frac{1}{3}$ will be perpendicular to a line whose slope is −3.

9. The slope of $L_1: y=5x-3$ is $m_1=5$. The slope of $L_2: y=-\frac{1}{5}x-4$ is $m_2=-\frac{1}{5}$. Since the two slopes are negative reciprocals (i.e., since $5\left(-\frac{1}{5}\right)=-1$), the lines are perpendicular.

10. $L_1: 4x-y=3$ $\quad L_2: x-4y=2$

$$\begin{aligned}-y&=-4x+3 & -4y&=-x+2\\y&=\frac{-4x+3}{-1} & y&=\frac{-x+2}{-4}\\y&=4x-3 & y&=\frac{1}{4}x-\frac{1}{2}\end{aligned}$$

Since the slopes $m_1=4$ and $m_2=\frac{1}{4}$ are not negative reciprocals (i.e., since $4\cdot\frac{1}{4}=1\neq-1$), the two lines are not perpendicular.

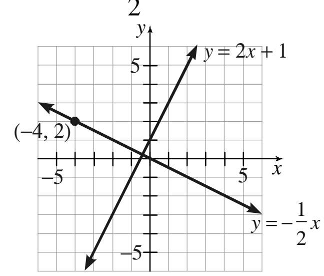
11. $L_1: 2y+4=0$ $\quad L_2: 3x-6=0$

$$\begin{aligned}2y&=-4 & 3x&=6\\\frac{2y}{2}&=\frac{-4}{2} & \frac{3x}{3}&=\frac{6}{3}\\y&=-2 & x&=2\end{aligned}$$

Since L_1 is horizontal with slope 0 and L_2 is vertical with an undefined slope, the two lines are perpendicular.

12. The slope of the line we seek is $m=-\frac{1}{2}$, the negative reciprocal of the slope of the line $y = 2x + 1$. Thus, the equation of the line we seek is

$$\begin{aligned}y-y_1&=m(x-x_1)\\y-2&=-\frac{1}{2}(x-(-4))\\y-2&=-\frac{1}{2}(x+4)\\y-2&=-\frac{1}{2}x-2\\y&=-\frac{1}{2}x\end{aligned}$$

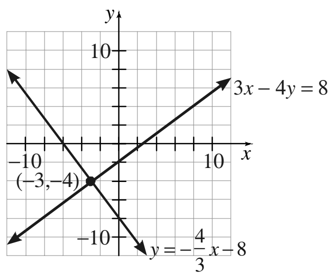


13. The slope of the line we seek is $m=-\frac{4}{3}$, the negative reciprocal of the slope of the line

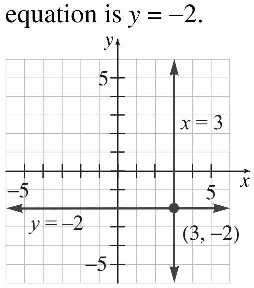
$$3x-4y=8$$
$$-4y=-3x+8$$
$$y=\frac{-3x+8}{-4}$$
$$y=\frac{3}{4}x-2$$

Thus, the equation of the line we seek is

$$y-y_1=m(x-x_1)$$
$$y-(-4)=-\frac{4}{3}(x-(-3))$$
$$y+4=-\frac{4}{3}x-4$$
$$y=-\frac{4}{3}x-8$$



14. The line we seek is a horizontal line, because the line we are given is a vertical line. Since the line we seek must pass through the point (3, –2), its equation is $y=-2$.



1.7 Exercises

16. a. Slope of parallel line: $m=-8/5$.

b. Slope of perpendicular line: $m=5/8$.

18. a. Slope of parallel line: $m=0$.

b. Slope of perpendicular line: m is undefined.

20. Perpendicular. The two slopes, $m_1=3$ and $m_2=-1/3$, are negative reciprocals.

22.

$$-3x-y=3 \qquad 6x+2y=9$$
$$-y=3x+3 \qquad 2y=-6x+9$$
$$y=\frac{3x+3}{-1} \qquad y=\frac{-6x+9}{2}$$
$$y=-3x-3 \qquad y=-3x+\frac{9}{2}$$

Parallel. The two lines have equal slopes, $m=-3$, but different y-intercepts.

24.

$$10x-3y=5 \qquad 5x+6y=3$$
$$-3y=-10x+5 \qquad 6y=-5x+3$$
$$y=\frac{-10x+5}{-3} \qquad y=\frac{-5x+3}{6}$$
$$y=\frac{10}{3}x-\frac{5}{3} \qquad y=-\frac{5}{6}x+\frac{1}{2}$$

Neither. The two slopes, $m_1=10/3$ and $m_2=-5/6$, are not equal and are not negative reciprocals.

26.

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

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

Perpendicular. The two slopes, $m_1=1/3$ and $m_2=-3$, are negative reciprocals.

28. Since line L is parallel to $y=-\frac{1}{2}x+1$, the slope of L is $m=-1/2$. From the graph, the y-intercept of L is (0, –1). Thus, the equation of line L is $y=-\frac{1}{2}x-1$.

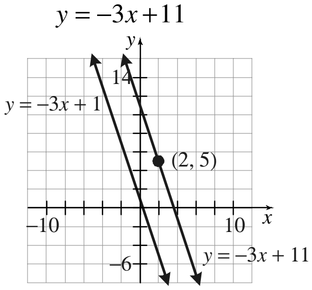
30. Since line L is perpendicular to $y = \frac{2}{3}x + 1$, the slope of L is $m = -3/2$, the negative reciprocal of $2/3$. From the graph the y-intercept is $(0, -2)$. Thus, the equation of line L is

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

32. Since line L is perpendicular to $y = 3$ and since $y = 3$ is a horizontal line, then L must be a vertical line. From the graph, the x-intercept of L is $(1, 0)$. Thus, the equation of line L is $x = 1$.

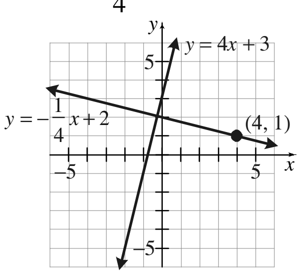
34. The slope of the line we seek is $m = -3$, the same as the slope of $y = -3x + 1$. The equation of the line is

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 5 &= -3(x - 2) \\ y - 5 &= -3x + 6 \\ y &= -3x + 11 \end{aligned}$$

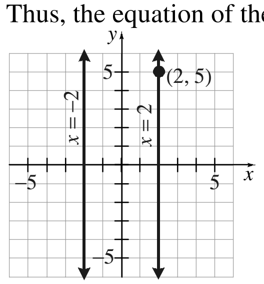


36. The slope of the line we seek is $m = -1/4$, the negative reciprocal of the slope of $y = 4x + 3$. The equation of the line is

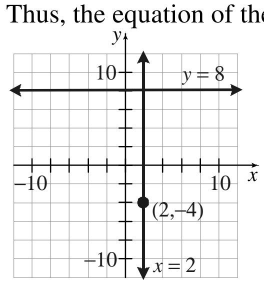
$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 1 &= -\frac{1}{4}(x - 4) \\ y - 1 &= -\frac{1}{4}x + 1 \\ y &= -\frac{1}{4}x + 2 \end{aligned}$$



38. The line we seek is vertical, parallel to the vertical line $x = -2$. Now a vertical line passing through the point $(2, 5)$ must also pass through the point $(2, 0)$. That is, the x-intercept is $(2, 0)$. Thus, the equation of the line is $x = 2$.



40. The line we seek is vertical, perpendicular to the horizontal line $y = 8$. Now a vertical line passing through the point $(2, -4)$ must also pass through the point $(2, 0)$. That is, the x-intercept is $(2, 0)$. Thus, the equation of the line is $x = 2$.

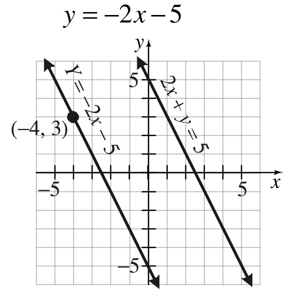


42. The slope of the line we seek is $m = -2$, the same as the slope of the line

$$\begin{aligned} 2x + y &= 5 \\ y &= -2x + 5 \end{aligned}$$

Thus, the equation of the line we seek is

$$\begin{aligned} y - y_1 &= m(x - x_1) \\ y - 3 &= -2(x - (-4)) \\ y - 3 &= -2(x + 4) \\ y - 3 &= -2x - 8 \\ y &= -2x - 5 \end{aligned}$$

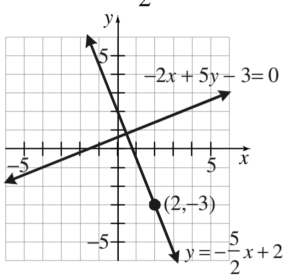


44. The slope of the line we seek is $m = -5/2$, the negative reciprocal of the slope of the line

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

Thus, the equation of the line we seek is

$$y - y_1 = m(x - x_1)$$
$$y - (-3) = -\frac{5}{2}(x - 2)$$
$$y + 3 = -\frac{5}{2}x + 5$$
$$y = -\frac{5}{2}x + 2$$

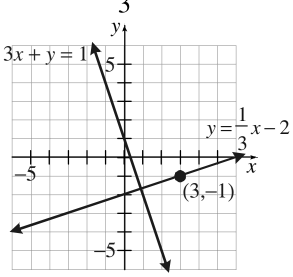


46. The slope of the line we seek is $m = 1/3$, the negative reciprocal of the slope of the line

$$3x + y = 1$$
$$y = -3x + 1$$

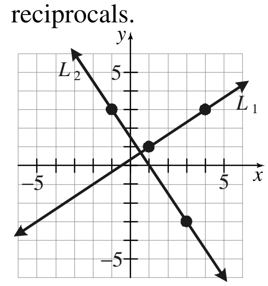
Thus, the equation of the line we seek is

$$y - y_1 = m(x - x_1)$$
$$y - (-1) = \frac{1}{3}(x - 3)$$
$$y + 1 = \frac{1}{3}x - 1$$
$$y = \frac{1}{3}x - 2$$



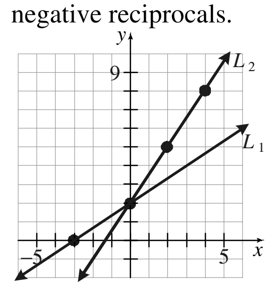
48. $m_1 = \frac{3-1}{4-1} = \frac{2}{3}$; $m_2 = \frac{-3-3}{3-(-1)} = \frac{-6}{4} = -\frac{3}{2}$

Perpendicular. The two slopes are negative reciprocals.



50. $m_1 = \frac{2-0}{0-(-3)} = \frac{2}{3}$; $m_2 = \frac{5-8}{2-4} = \frac{-3}{-2} = \frac{3}{2}$

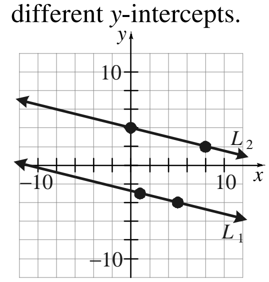
Neither. The two slopes are not equal and are not negative reciprocals.



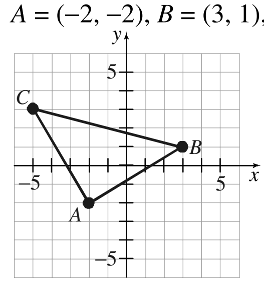
52. $m_1 = \frac{-4-(-3)}{5-1} = \frac{-1}{4} = -\frac{1}{4}$;

$m_2 = \frac{2-4}{8-0} = \frac{-2}{8} = -\frac{1}{4}$

Parallel. The two lines have equal slopes, but different y-intercepts.



54. a. $A = (-2, -2)$, $B = (3, 1)$, $C = (-5, 3)$

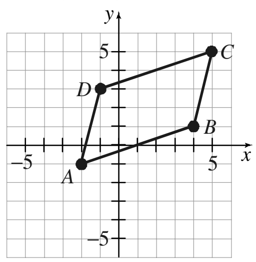


b. Slope of $\overline{AB} = \frac{1-(-2)}{3-(-2)} = \frac{3}{5}$

Slope of $\overline{AC} = \frac{3-(-2)}{-5-(-2)} = \frac{5}{-3} = -\frac{5}{3}$

Because the slopes are negative reciprocals, segments $\overline{AB}$ and $\overline{AC}$ are perpendicular. Thus, triangle *ABC* is a right triangle.

56. a. $A = (-2,-1)$, $B = (4,1)$, $C = (5,5)$, $D = (-1,3)$



b. Slope of $\overline{AB} = \frac{1-(-1)}{4-(-2)} = \frac{2}{6} = \frac{1}{3}$

Slope of $\overline{BC} = \frac{5-1}{5-4} = \frac{4}{1} = 4$

Slope of $\overline{CD} = \frac{3-5}{-1-5} = \frac{-2}{-6} = \frac{1}{3}$

Slope of $\overline{DA} = \frac{-1-3}{-2-(-1)} = \frac{-4}{-1} = 4$

Because the slopes of $\overline{AB}$ and $\overline{CD}$ are equal, $\overline{AB}$ and $\overline{CD}$ are parallel. Because the slopes of $\overline{BC}$ and $\overline{DA}$ are equal, $\overline{BC}$ and $\overline{DA}$ are parallel. Thus, quadrilateral *ABCD* is a parallelogram.

58. The line

$$2x - 3y = 8$$
$$-3y = -2x + 8$$
$$y = \frac{2}{3}x - \frac{8}{3}$$

has a slope of 2/3. The line

$$-6x + By = 3$$
$$By = 6x + 3$$
$$y = \frac{6x+3}{B}$$
$$y = \frac{6}{B}x + \frac{3}{B}$$

has a slope of 6/*B*. For the two lines to be perpendicular, the product of their slopes must be -1. Use this fact to determine the value of *B*:

$$\frac{2}{3} \cdot \left(\frac{6}{B}\right) = -1$$
$$\frac{4}{B} = -1$$
$$4 = -B$$
$$B = -4$$

60. In the graph, the line with the positive slope has a positive *y*-intercept, and the line with the negative slope has a negative *y*-intercept. The only pair of equations that meets these criteria is the pair in part (a). (Note: For the equations in part (b), the equation with the negative slope has a positive *y*-intercept. For the equations in part (c), the equation with the positive slope has a negative *y*-intercept. For the equations in parts (d) and (e), the equations with the negative slopes have positive *y*-intercepts, and the equations with the positive slopes have negative *y*-intercepts.)

62. The slope of a horizontal line is 0, which has no reciprocal. Likewise, the slope of a vertical line is undefined, so it has no reciprocal.

Section 1.8

Are You Ready for This Section?

R1.
$$3(4) + 1 \overset{?}{\geq} 7$$
$$12 + 1 \overset{?}{\geq} 7$$
$$13 \geq 7 \leftarrow \text{True}$$

Yes, $x = 4$ does satisfy the inequality $3x + 1 \geq 7$.

R2.
$$-4x - 3 > 9$$
$$-4x - 3 + 3 > 9 + 3$$
$$-4x > 12$$
$$\frac{-4x}{-4} < \frac{12}{-4}$$
$$x < -3$$

The solution set is $\{x \mid x < -3\}$ or, using interval notation, $(-\infty, -3)$.

R3. True

Section 1.8 Quick Checks

1. If we replace the inequality symbol in $Ax + By > C$ with an equal sign, we obtain the equation of a line, $Ax + By = C$. The line separates the *xy*-plane into two regions called <u>half-planes</u>.

2. **a.** $x=4,\ y=1$ $\quad -2(4)+3(1)\overset{?}{\geq}3$

$$-8+3\overset{?}{\geq}3$$

$$-5\overset{?}{\geq}3 \text{ False}$$

So, $(4,\ 1)$ is not a solution to $-2x + 3y \geq 3$.

b. $x=-1,\ y=2$ $\quad -2(-1)+3(2)\overset{?}{\geq}3$

$$2+6\overset{?}{\geq}3$$

$$8\overset{?}{\geq}3 \text{ True}$$

So, $(-1,\ 2)$ is a solution to $-2x + 3y \geq 3$.

c. $x=2,\ y=3$ $\quad -2(2)+3(3)\overset{?}{\geq}3$

$$-4+9\overset{?}{\geq}3$$

$$5\overset{?}{\geq}3 \text{ True}$$

So, $(2,\ 3)$ is a solution to $-2x + 3y \geq 3$.

d. $x=0,\ y=1$ $\quad -2(0)+3(1)\overset{?}{\geq}3$

$$0+3\overset{?}{\geq}3$$

$$3\overset{?}{\geq}3 \text{ True}$$

So, $(0,\ 1)$ is a solution to $-2x + 3y \geq 3$.

3. False; it also consists of a half-plane.

4. True

5. Replace the inequality symbol with an equal sign to obtain $y = -2x + 3$. Because the inequality is strict, graph $y=-2x+3$ using a dashed line.

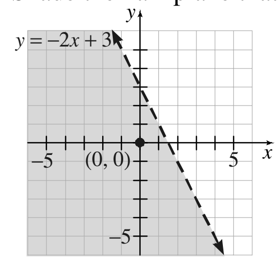
Test Point: $(0,0)$: $\quad 0\overset{?}{<}-2(0)+3$

$$0\overset{?}{<}0+3$$

$$0\overset{?}{<}3 \quad \text{True}$$

Therefore, (0, 0) is a solution to $y < -2x + 3$.

Shade the half-plane that contains (0, 0).

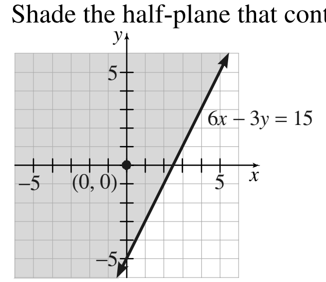


6. Replace the inequality symbol with an equal sign to obtain $6x - 3y = 15$. Because the inequality is non-strict, graph $6x-3y=15$ $(y=2x-5)$ using a solid line.

Test Point: $(0,0)$: $\quad 6(0)-3(0)\overset{?}{\leq}15$

$$0\overset{?}{\leq}15 \quad \text{True}$$

Therefore, (0, 0) is solution to $6x - 3y \leq 15$.
Shade the half-plane that contains (0, 0).



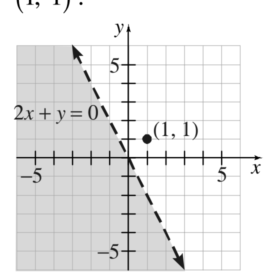
7. Replace the inequality symbol with an equal sign to obtain $2x + y = 0$. Because the inequality is strict, graph $2x+y=0$ $(y=-2x)$ using a dashed line.

Test Point: $(1,\ 1)$: $\quad 2(1)+1\overset{?}{<}0$

$$2+1\overset{?}{<}0$$

$$3\overset{?}{<}0 \quad \text{False}$$

Therefore, $(1,\ 1)$ is not a solution to $2x + y < 0$.
Shade the half-plane that does not contain $(1,\ 1)$.



8. a. Let x = the number of Homestyle Chicken filets.
Let y = the number of Frosties.
$560x + 300y \le 900$

b. $x=1,\ y=1:\quad 560(1)+300(1)\overset{?}{\le}900$

$560+300\overset{?}{\le}900$

$860\overset{?}{\le}900$ True

Yes, Avery can stay within his allotment of calories by eating one Homestyle Chicken filet and one Frosty.

c. $x=2,\ y=1:\quad 560(2)+300(1)\overset{?}{\le}900$

$1120+300\overset{?}{\le}900$

$1420\overset{?}{\le}900$ False

No, Avery cannot stay within his allotment of calories by eating two Homestyle Chicken filets and one Frosty.

1.8 Exercises

10. a. $x=2,\ y=-1\quad 2(2)+(-1)\overset{?}{>}-3$

$4+(-1)\overset{?}{>}-3$

$3\overset{?}{>}-3$ True

So, (2, −1) is a solution to $2x + y > -3$.

b. $x=1,\ y=-3\quad 2(1)+(-3)\overset{?}{>}-3$

$2+(-3)\overset{?}{>}-3$

$-1\overset{?}{>}-3$ True

So, (1, −3) is a solution to $2x + y > -3$.

c. $x=-5,\ y=4\quad 2(-5)+4\overset{?}{>}-3$

$-6\overset{?}{>}-3$ False

So, (−5, 4) is not a solution to $2x + y > -3$.

12. a. $x=1, y=0\quad 2(1)-5(0)\overset{?}{\le}2$

$2-0\overset{?}{\le}2$

$2\overset{?}{\le}2$ True

So, (1, 0) is a solution to $2x - 5y \le 2$.

b. $x=3, y=0\quad 2(3)-5(0)\overset{?}{\le}2$

$6-0\overset{?}{\le}2$

$6\overset{?}{\le}2$ False

So, (3, 0) is not a solution to $2x - 5y \le 2$.

c. $x=1, y=2\quad 2(1)-5(2)\overset{?}{\le}2$

$2-10\overset{?}{\le}2$

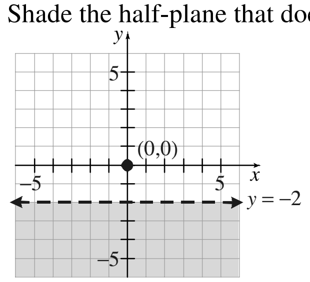
$-8\overset{?}{\le}2$ True

So, (1, 2) is a solution to $2x - 5y \le 2$.

14. Replace the inequality symbol with an equal sign to obtain $y = -2$. Because the inequality is strict, graph $y=-2$ using a dashed line.

Test Point: $(0, 0)$: $0\overset{?}{<}-2$ False

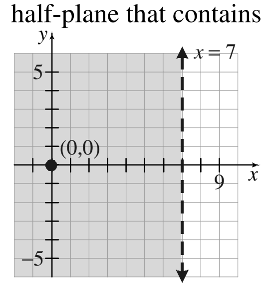
Therefore, (0, 0) is not a solution to $y<-2$.
Shade the half-plane that does not contain (0, 0).



16. Replace the inequality symbol with an equal sign to obtain $x = 7$. Because the inequality is strict, graph $x=7$ using a dashed line.

Test Point: $(0, 0)$: $0\overset{?}{<}7$ True

Therefore, (0, 0) is a solution to $x < 7$. Shade the half-plane that contains (0, 0).

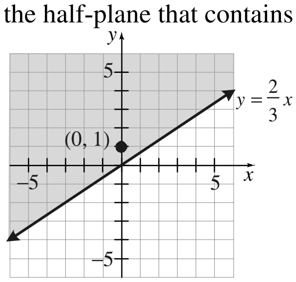


18. Replace the inequality symbol with an equal sign to obtain $y = \frac{2}{3}x$. Because the inequality is non-strict, graph $y = \frac{2}{3}x$ using a solid line.

Test Point: $(0,\ 1)$: $1 \overset{?}{\geq} \frac{2}{3}(0)$

$1 \overset{?}{\geq} 0$ True

Therefore, (0, 1) is a solution to $y \geq \frac{2}{3}x$. Shade the half-plane that contains (0, 1).

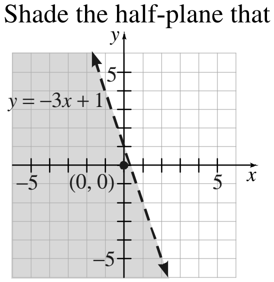


20. Replace the inequality symbol with an equal sign to obtain $y = -3x + 1$. Because the inequality is strict, graph $y = -3x + 1$ using a dashed line.

Test Point: $(0,\ 0)$: $0 \overset{?}{<} -3(0) + 1$

$0 \overset{?}{<} 1$ True

Therefore, (0, 0) is a solution to $y < -3x + 1$. Shade the half-plane that contains (0, 0).

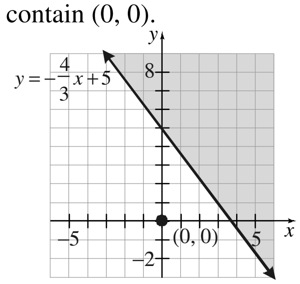


22. Replace the inequality symbol with an equal sign to obtain $y = -\frac{4}{3}x + 5$. Because the inequality is non-strict, graph $y = -\frac{4}{3}x + 5$ using a solid line.

Test Point: $(0,0)$: $0 \overset{?}{\geq} -\frac{4}{3}(0) + 5$

$0 \overset{?}{\geq} 5$ False

Therefore, (0, 0) is not a solution to $y \geq -\frac{4}{3}x + 5$. Shade the half-plane that does not contain (0, 0).

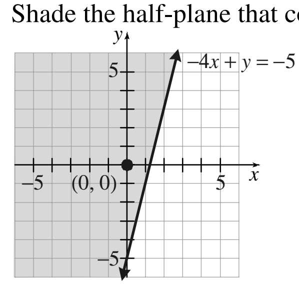


24. Replace the inequality symbol with an equal sign to obtain $-4x + y = -5$. Because the inequality is non-strict, graph $-4x + y = -5$ $(y = 4x - 5)$ using a solid line.

Test Point: $(0,\ 0)$: $-4(0) + 0 \overset{?}{\geq} -5$

$0 \overset{?}{\geq} -5$ True

Therefore, (0, 0) is solution to $-4x + y \geq -5$. Shade the half-plane that contains (0, 0).

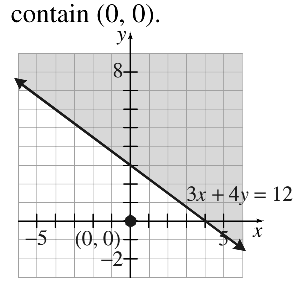


26. Replace the inequality symbol with an equal sign to obtain $3x + 4y = 12$. Because the inequality is non-strict, graph $3x + 4y = 12$ $\left(y = -\frac{3}{4}x + 3\right)$ using a solid line.

Test Point: $(0,\ 0)$: $3(0) + 4(0) \overset{?}{\geq} 12$

$0 \overset{?}{\geq} 12$ False

Therefore, (0, 0) is not a solution to $3x + 4y \geq 12$. Shade the half-plane that does not contain (0, 0).

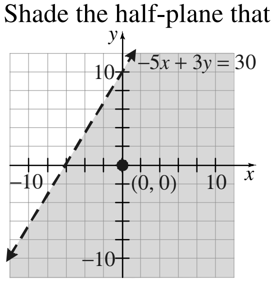


28. Replace the inequality symbol with an equal sign to obtain $-5x + 3y = 30$. Because the inequality is strict, graph $-5x+3y=30$ $\left(y=\frac{5}{3}x+10\right)$ using a dashed line.

Test Point: $(0, 0)$: $-5(0)+3(0)\overset{?}{<}30$

$0\overset{?}{<}30$ True

Therefore, (0, 0) is a solution to $-5x + 3y < 30$. Shade the half-plane that contains (0, 0).



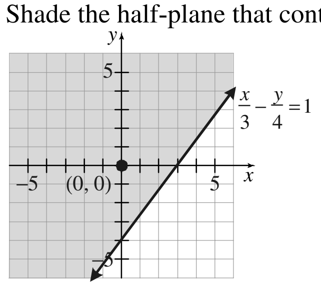
30. Replace the inequality symbol with an equal sign to obtain $\frac{x}{3}-\frac{y}{4}=1.$ Because the inequality is non-strict, graph $\frac{x}{3}-\frac{y}{4}=1$ $\left(y=\frac{4}{3}x-4\right)$ using a solid line.

Test Point: $(0, 0)$: $\frac{0}{3}-\frac{0}{4}\overset{?}{\le}1$

$0\overset{?}{\le}1$ True

Therefore, (0, 0) is a solution to $\frac{x}{3}-\frac{y}{4}\le 1.$

Shade the half-plane that contains (0, 0).



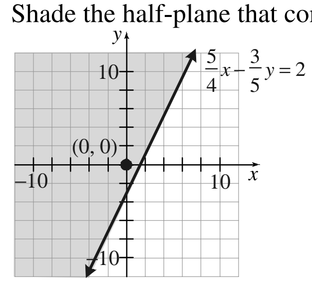
32. Replace the inequality symbol with an equal sign to obtain $\frac{5}{4}x-\frac{3}{5}y=2.$ Because the inequality is non-strict, graph $\frac{5}{4}x-\frac{3}{5}y=2$ $\left(y=\frac{25}{12}x-\frac{10}{3}\right)$ using a solid line.

Test Point: $(0, 0)$: $\frac{5}{4}(0)-\frac{3}{5}(0)\overset{?}{\le}2$

$0\overset{?}{\le}2$ True

Therefore, (0, 0) is a solution to $\frac{5}{4}x-\frac{3}{5}y\le 2.$

Shade the half-plane that contains (0, 0).



34. a. Let x = the number of Model A computers. Let y = the number of Model B computers.
$45x+65y\ge 4000$

b. $x=50,\ y=28$:

$45(50)+65(28)\overset{?}{\ge}4000$

$4070\overset{?}{\ge}4000$ True

Juanita will make her sales goal by selling 50 Model A and 28 Model B computers.

c. $x=41,\ y=33$:

$45(41)+65(33)\overset{?}{\ge}4000$

$3990\overset{?}{\ge}4000$ False

Juanita will not make her sales goal by selling 44 Model A and 33 Model B computers.

36. a. Let x = the number gummy bears. Let y = the number suckers.
$0.10x+0.25y\le 3.00$

b. $x=18,\ y=5$:

$0.10(18)+0.25(5)\overset{?}{\le}3.00$

$3.05\overset{?}{\le}3.00$ False

Johnny cannot buy 18 gummy bears and 5 suckers.

c. $x = 19,\ y = 4$:

$$0.10(19) + 0.25(4) \overset{?}{\leq} 3.00$$

$$2.90 \overset{?}{\leq} 3.00 \quad \text{True}$$

Johnny can buy 19 gummy bears and 4 suckers.

38. The graph contains a line passing through the points (0, 1) and (2, −3). The slope of the line is $m = \frac{-3-1}{2-0} = \frac{-4}{2} = -2$. The *y*-intercept is (0, 1). Thus, the equation of the line is $y = -2x + 1$. Because the half-plane that is shaded is below the line, our inequality will contain a "less than." Because the line is solid, this means that the inequality is non-strict. That is, our inequality will consist of "less than or equal to." Thus, the linear inequality is $y \leq -2x + 1$.

40. The graph contains a line passing through the points (−1, −3) and (2, 1). The slope of the line is $m = \frac{1-(-3)}{2-(-1)} = \frac{4}{3}$.

The equation of the line is

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

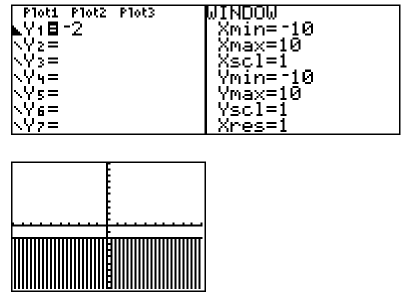
$$y + 3 = \frac{4}{3}x + \frac{4}{3}$$

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

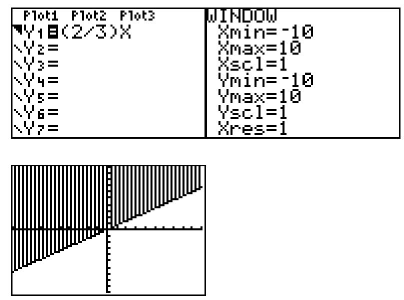
Because the half-plane that is shaded is above the line, our inequality will contain a "greater than." Because the line is dashed, this means that the inequality is strict. That is, our inequality will consist only of "greater than." Thus, the linear inequality is $y > \frac{4}{3}x - \frac{5}{3}$.

42. Answers may vary. If we use a test point that lies on the line separating the two half-planes, then we would not be able to tell which half-plane to shade. We must use a test point not on the line separating the two half-planes, so that we can tell which half-plane to shade.

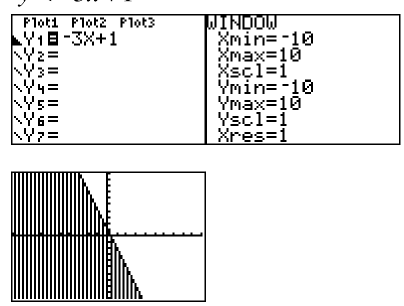
44. $y < -2$



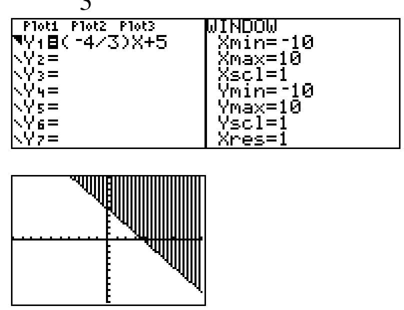
46. $y \geq \frac{2}{3}x$



48. $y < -3x + 1$

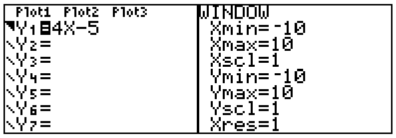


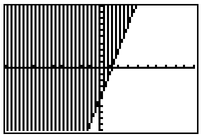
50. $y \geq -\frac{4}{3}x + 5$



52. $-4x + y \ge -5$

$y \ge 4x - 5$



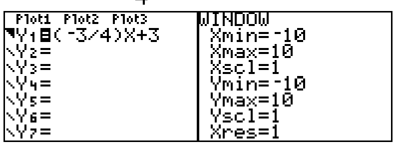


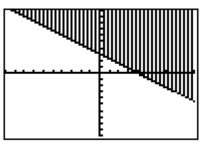
54. $3x + 4y \ge 12$

$4y \ge -3x + 12$

$y \ge \frac{-3x+12}{4}$

$y \ge -\frac{3}{4}x + 3$





Chapter 1 Review

1. $3x - 4 = 6 + x$

Let $x = 5$ in the equation.

$$\begin{aligned} 3(5) - 4 &\stackrel{?}{=} 6 + (5) \\ 15 - 4 &\stackrel{?}{=} 11 \\ 11 &= 11 \text{ T} \end{aligned}$$

$x = 5$ is a solution to the equation.

Let $x = 6$ in the equation.

$$\begin{aligned} 3(6) - 4 &\stackrel{?}{=} 6 + (6) \\ 18 - 4 &\stackrel{?}{=} 12 \\ 14 &\ne 12 \end{aligned}$$

$x = 6$ is **not** a solution to the equation.

2. $-1 - 4x = 2(3 - 2x) - 7$

Let $x = -2$ in the equation.

$$\begin{aligned} -1 - 4(-2) &\stackrel{?}{=} 2(3 - 2(-2)) - 7 \\ -1 + 8 &\stackrel{?}{=} 2(3 + 4) - 7 \\ 7 &\stackrel{?}{=} 2(7) - 7 \\ 7 &\stackrel{?}{=} 14 - 7 \\ 7 &= 7 \text{ T} \end{aligned}$$

$x = -2$ is a solution to the equation.

Let $x = -1$ in the equation.

$$\begin{aligned} -1 - 4(-1) &\stackrel{?}{=} 2(3 - 2(-1)) - 7 \\ -1 + 4 &\stackrel{?}{=} 2(3 + 2) - 7 \\ 3 &\stackrel{?}{=} 2(5) - 7 \\ 3 &\stackrel{?}{=} 10 - 7 \\ 3 &= 3 \text{ T} \end{aligned}$$

$x = -1$ is a solution to the equation.

3. $4y - (1 - y) + 5 = -6 - 2(3y - 5) - 2y$

Let $y = -2$ in the equation.

$$\begin{aligned} 4(-2) - (1 - (-2)) + 5 &\stackrel{?}{=} -6 - 2(3(-2) - 5) - 2(-2) \\ -8 - (3) + 5 &\stackrel{?}{=} -6 - 2(-6 - 5) + 4 \\ -11 + 5 &\stackrel{?}{=} -2 - 2(-11) \\ -6 &\ne 20 \end{aligned}$$

$y = -2$ is **not** a solution to the equation.

Let $y = 0$ in the equation.

$$\begin{aligned} 4(0) - (1 - 0) + 5 &\stackrel{?}{=} -6 - 2(3(0) - 5) - 2(0) \\ 0 - 1 + 5 &\stackrel{?}{=} -6 - 2(-5) - 0 \\ 4 &\stackrel{?}{=} -6 + 10 \\ 4 &= 4 \text{ T} \end{aligned}$$

$y = 0$ is a solution to the equation.

4. $\frac{w-7}{3} - \frac{w}{4} = -\frac{7}{6}$

Let $w = -14$ in the equation.

$$\begin{aligned} \frac{-14-7}{3} - \frac{-14}{4} &\stackrel{?}{=} -\frac{7}{6} \\ \frac{-21}{3} + \frac{14}{4} &\stackrel{?}{=} -\frac{7}{6} \\ -7 + \frac{7}{2} &\stackrel{?}{=} -\frac{7}{6} \\ -\frac{7}{2} &\ne -\frac{7}{6} \end{aligned}$$

$w = -14$ is **not** a solution to the equation.

Let $w = 7$ in the equation.

$$\begin{aligned} \frac{7-7}{3} - \frac{7}{4} &\stackrel{?}{=} -\frac{7}{6} \\ 0 - \frac{7}{4} &\stackrel{?}{=} -\frac{7}{6} \\ -\frac{7}{4} &\ne -\frac{7}{6} \end{aligned}$$

$w = 7$ is **not** a solution to the equation.

5. $2w+9=15$
$2w+9-9=15-9$
$2w=6$
$\frac{2w}{2}=\frac{6}{2}$
$w=3$
Check: $2(3)+9 \overset{?}{=} 15$
$6+9 \overset{?}{=} 15$
$15=15$ T
This is a conditional equation. Solution set: $\{3\}$

6. $-4=8-3y$
$-4-8=8-3y-8$
$-12=-3y$
$\frac{-12}{-3}=\frac{-3y}{-3}$
$4=y$
Check: $-4 \overset{?}{=} 8-3(4)$
$-4 \overset{?}{=} 8-12$
$-4=-4$ T
This is a conditional equation. Solution set: $\{4\}$

7. $2x+5x-1=20$
$7x-1=20$
$7x-1+1=20+1$
$7x=21$
$x=3$
Check: $2(3)+5(3)-1 \overset{?}{=} 20$
$6+15-1 \overset{?}{=} 20$
$20=20$ T
This is a conditional equation. Solution set: $\{3\}$

8. $7x+5-8x=13$
$-x+5=13$
$-x+5-5=13-5$
$-x=8$
$x=-8$
Check: $7(-8)+5-8(-8) \overset{?}{=} 13$
$-56+5+64 \overset{?}{=} 13$
$13=13$ T
This is a conditional equation.
Solution set: $\{-8\}$

9. $-2(x-4)=8-2x$
$-2x+8=8-2x$
$-2x+8-8=8-2x-8$
$-2x=-2x$
$-2x+2x=-2x+2x$
$0=0$
This statement is an identity. The equation is true for all real numbers. Solution set: $\{x \mid x \text{ is a real number}\}$, or $\mathbb{R}$

10. $3(2r+1)-5=9(r-1)-3r$
$6r+3-5=9r-9-3r$
$6r-2=6r-9$
$6r-2+2=6r-9+2$
$6r=6r-7$
$6r-6r=6r-7-6r$
$0=-7$
This statement is a contradiction. The equation has no solution. Solution set: $\{\ \}$ or $\varnothing$

11. $\frac{2y+3}{4}-\frac{y}{2}=5$
$4\left(\frac{2y+3}{4}\right)-4\left(\frac{y}{2}\right)=4(5)$
$2y+3-2y=20$
$3=20$
This statement is a contradiction. The equation has no solution. Solution set: $\{\ \}$ or $\varnothing$

12. $\frac{x}{3}+\frac{2x}{5}=\frac{x-20}{15}$
$15\left(\frac{x}{3}\right)+15\left(\frac{2x}{5}\right)=15\left(\frac{x-20}{15}\right)$
$5x+6x=x-20$
$11x=x-20$
$11x-x=x-20-x$
$10x=-20$
$\frac{10x}{10}=\frac{-20}{10}$
$x=-2$

Check:

$$\frac{-2}{3}+\frac{2(-2)}{5}\stackrel{?}{=}\frac{(-2)-20}{15}$$
$$-\frac{2}{3}-\frac{4}{5}\stackrel{?}{=}-\frac{22}{15}$$
$$-\frac{10}{15}-\frac{12}{15}\stackrel{?}{=}-\frac{22}{15}$$
$$-\frac{22}{15}=-\frac{22}{15}\quad \text{T}$$

This is a conditional equation.
Solution set: $\{-2\}$

13.
$$0.2(x-6)+1.75=4.25+0.1(3x+10)$$
$$0.2x-1.2+1.75=4.25+0.3x+1$$
$$0.2x+0.55=5.25+0.3x$$
$$0.2x-0.3x+0.55=5.25+0.3x-0.3x$$
$$-0.1x+0.55=5.25$$
$$-0.1x+0.55-0.55=5.25-0.55$$
$$-0.1x=4.7$$
$$\frac{-0.1x}{-0.1}=\frac{4.7}{-0.1}$$
$$x=-47$$

Check:

$$0.2(-47-6)+1.75\stackrel{?}{=}4.25+0.1(3(-47)+10)$$
$$0.2(-53)+1.75\stackrel{?}{=}4.25+0.1(-141+10)$$
$$-10.6+1.75\stackrel{?}{=}4.25+0.1(-131)$$
$$-8.85\stackrel{?}{=}4.25-13.1$$
$$-8.85=-8.85\quad \text{T}$$

This is a conditional equation.
Solution set: $\{-47\}$

(Note: Alternatively, we could have started by multiplying both sides of the equation by 100 to clear the decimals.)

14.
$$2.1w-3(2.4-0.2w)=0.9(3w-5)-2.7$$
$$2.1w-7.2+0.6w=2.7w-4.5-2.7$$
$$2.7w-7.2=2.7w-7.2$$
$$0=0$$

This statement is an identity. The equation is true for all real numbers. Solution set: $\{w \mid w \text{ is a real number}\}$, or $\mathbb{R}$

(Note: Alternatively, we could have started by multiplying both sides of the equation by 10 to clear the decimals.)

15. We need to set the denominator equal to 0 and solve the resulting equation.

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

Thus, $x=-\frac{3}{2}$ must be excluded from the domain.

16. We need to set the denominator equal to 0 and solve the resulting equation.

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

Thus, $x=\frac{1}{2}$ must be excluded from the domain.

17.
$$2370=0.06(x-9000)+315$$
$$2370=0.06x-540+315$$
$$2370=0.06x-225$$
$$2370+225=0.06x-225+225$$
$$2595=0.06x$$
$$\frac{2595}{0.06}=\frac{0.06x}{0.06}$$
$$43,250=x$$

Her Missouri taxable income was $43,250.

18.
$$x+4(x-10)=69.75$$
$$x+4x-40=69.75$$
$$5x-40=69.75$$
$$5x-40+40=69.75+40$$
$$5x=109.75$$
$$\frac{5x}{5}=\frac{109.75}{5}$$
$$x=21.95$$

The regular club price for a DVD is $21.95.

19. Let x = the number.
$3x+7=22$

20. Let x = the number.
$x-3=\frac{x}{2}$

21. Let x = the number.
$0.2x=x-12$

22. Let x = the number.
$6x=2x-4$

23. Let x = Payton's age.
Shawn's age: $x+8$

$$\begin{aligned} x+(x+8)&=18\\ 2x+8&=18\\ 2x+8-8&=18-8\\ 2x&=10\\ \frac{2x}{2}&=\frac{10}{2}\\ x&=5 \end{aligned}$$

Payton is 5 years old and Shawn is 13 years old.

24. Let x = the first odd integer.
Second odd integer: $x+2$
Third odd integer: $x+4$
Fourth odd integer: $x+6$
Fifth odd integer: $x+8$

$$\begin{aligned} x+(x+2)+(x+4)+(x+6)+(x+8)&=125\\ 5x+20&=125\\ 5x+20-20&=125-20\\ 5x&=105\\ \frac{5x}{5}&=\frac{105}{5}\\ x&=21 \end{aligned}$$

The five odd integers are 21, 23, 25, 27, and 29.

25. Let x = the final exam score.

$$\begin{aligned} \frac{85+81+84+77+2x}{6}&=80\\ \frac{327+2x}{6}&=80\\ 6\cdot\frac{327+2x}{6}&=6\cdot 80\\ 327+2x&=480\\ 327+2x-327&=480-327\\ 2x&=153\\ \frac{2x}{2}&=\frac{153}{2}\\ x&=76.5 \end{aligned}$$

Logan needs to get a score of 76.5 on the final exam to have an average of 80.

26. Here we can use the simple interest formula $I = Prt$. Remember that t is in years and that the interest rate should be written as a decimal.

$$\begin{aligned} I&=15,000(0.0549)\left(\frac{1}{12}\right)\\ &=68.625 \end{aligned}$$

After 1 month, Cherie will accrue \$68.63 in interest.

27. Let x = the original price.
Discount: $0.3x$
sale price = original price − discount

$$\begin{aligned} 94.50&=x-0.3x\\ 94.50&=0.7x\\ \frac{94.50}{0.7}&=\frac{0.7x}{0.7}\\ 135&=x \end{aligned}$$

The original price of the sleeping bag was \$135.00.

28. Let x = the federal minimum wage.
Increase: $0.107x$

$$\begin{aligned} 7.25&=x+0.107x\\ 7.25&=1.107x\\ \frac{7.25}{1.107}&=\frac{1.107x}{1.107}\\ 6.55&\approx x \end{aligned}$$

The federal minimum wage was \$6.55 (per hour).

29. Let x = pounds of blueberries.
Strawberries: $12-x$

tot. rev. = rev. from b.b. + rev. from s.b.

$$\begin{aligned} (\text{price})(\text{lbs})&=(\text{price})(\text{lbs})+(\text{price})(\text{lbs})\\ (12.95)(12)&=(10.95)(x)+(13.95)(12-x)\\ 155.4&=10.95x+167.4-13.95x\\ 155.4&=167.4-3x\\ 155.4-167.4&=167.4-3x-167.4\\ -12&=-3x\\ \frac{-12}{-3}&=\frac{-3x}{-3}\\ 4&=x \end{aligned}$$

The store should mix 4 pounds of chocolate covered blueberries with 8 pounds of chocolate covered strawberries.

30. Let x = pounds of baseball gum.
Soccer gum: $10-x$

$$\text{tot. rev.} = \text{rev. from b.b.} + \text{rev. from s.b.}$$
$$(\text{price})(\text{lbs}) = (\text{price})(\text{lbs}) + (\text{price})(\text{lbs})$$
$$(3.75)(10) = (3.50)(x) + (4.50)(10-x)$$
$$37.5 = 3.5x + 45 - 4.5x$$
$$37.5 = 45 - x$$
$$37.5 - 45 = 45 - x - 45$$
$$-7.5 = -x$$
$$7.5 = x$$

The store should mix 7.5 pounds of baseball gumballs with 2.5 pounds of soccer gumballs.

31. Let x = amount invested at 8%.
Amount at 18%: $8000-x$

$$\text{tot. return} = \text{ret. from 8\%} + \text{ret. from 18\%}$$
$$(\%)(\$) = (\%)(\$) + (\%)(\$)$$
$$(0.12)(8000) = (0.08)(x) + (0.18)(8000-x)$$
$$960 = 0.08x + 1440 - 0.18x$$
$$960 = 1440 - 0.1x$$
$$960 - 1440 = 1440 - 0.1x - 1440$$
$$-480 = -0.1x$$
$$\frac{-480}{-0.1} = \frac{-0.1x}{-0.1}$$
$$4800 = x$$

Angie should invest \$4800 at 8% and \$3200 at 18% to achieve a 12% return.

32. Let x = quarts drained = quarts added.
We can write the following equation for the amount of antifreeze:

$$\text{final amt} = \text{amt now - amt drain + amt add}$$
$$(\%)(\text{L}) = (\%)(\text{L}) - (\%)(\text{L}) + (\%)(\text{L})$$
$$(0.5)(7.5) = (0.3)(7.5) - (0.3)(x) + (1.0)(x)$$
$$3.75 = 2.25 - 0.3x + x$$
$$3.75 = 2.25 + 0.7x$$
$$3.75 - 2.25 = 2.25 + 0.7x - 2.25$$
$$1.5 = 0.7x$$
$$\frac{1.5}{0.7} = \frac{0.7x}{0.7}$$
$$2.14 \approx x$$

About 2.14 quarts would need to be drained and replaced with pure antifreeze.

33. For this problem, we will need the distance traveled formula: $d = rt$.
Let x = miles driven at 60 mph.
Miles at 70 mph: $300-x$

$$\text{tot. time} = \text{time at 60 mph} + \text{time at 70 mph}$$
$$4.5 = \frac{x}{60} + \frac{300-x}{70}$$
$$420(4.5) = 420\left(\frac{x}{60} + \frac{300-x}{70}\right)$$
$$1890 = 7x + 1800 - 6x$$
$$1890 = x + 1800$$
$$1890 - 1800 = x + 1800 - 1800$$
$$90 = x$$

Josh drove 90 miles at 60 miles per hour and 210 miles at 70 miles per hour.

34. For this problem, we will need the distance traveled formula: $d = rt$

We also need to note that 50 minutes is $\frac{5}{6}$ of an hour.
Let x = speed of the F14.
Speed of F15: $x + 200$.

$$\text{tot. dist.} = \text{dist. of F14} + \text{dist. of F15}$$
$$2200 = \frac{5}{6}x + \frac{5}{6}(x+200)$$
$$2200 = \frac{5}{6}x + \frac{5}{6}x + \frac{500}{3}$$
$$2200 = \frac{5}{3}x + \frac{500}{3}$$
$$3(2200) = 3\left(\frac{5}{3}x + \frac{500}{3}\right)$$
$$6600 = 5x + 500$$
$$6600 - 500 = 5x + 500 - 500$$
$$6100 = 5x$$
$$\frac{6100}{5} = \frac{5x}{5}$$
$$1220 = x$$

The F14 is traveling at a speed of 1220 miles per hour and the F15 is traveling at a speed of 1420 miles per hour.

35.
$$y = \frac{k}{x}$$
$$y \cdot x = \frac{k}{x} \cdot x$$
$$xy = k$$
$$\frac{xy}{y} = \frac{k}{y}$$
$$x = \frac{k}{y}$$

36.
$$F = \frac{9}{5}C + 32$$
$$F - 32 = \frac{9}{5}C + 32 - 32$$
$$F - 32 = \frac{9}{5}C$$
$$\frac{5}{9}(F - 32) = \frac{5}{9}\left(\frac{9}{5}C\right)$$
$$\frac{5}{9}(F - 32) = C$$

37.
$$P = 2L + 2W$$
$$P - 2L = 2L + 2W - 2L$$
$$P - 2L = 2W$$
$$\frac{P - 2L}{2} = \frac{2W}{2}$$
$$\frac{P - 2L}{2} = W$$

38.
$$\rho = m_1v_1 + m_2v_2$$
$$\rho - m_1v_1 = m_1v_1 + m_2v_2 - m_1v_1$$
$$\rho - m_1v_1 = m_2v_2$$
$$\frac{\rho - m_1v_1}{v_2} = \frac{m_2v_2}{v_2}$$
$$\frac{\rho - m_1v_1}{v_2} = m_2$$

39.
$$PV = nRT$$
$$\frac{PV}{nR} = \frac{nRT}{nR}$$
$$\frac{PV}{nR} = T$$

40.
$$S = 2LW + 2LH + 2WH$$
$$S - 2LH = 2LW + 2LH + 2WH - 2LH$$
$$S - 2LH = 2LW + 2WH$$
$$S - 2LH = W(2L + 2H)$$
$$\frac{S - 2LH}{2L + 2H} = \frac{W(2L + 2H)}{2L + 2H}$$
$$\frac{S - 2LH}{2L + 2H} = W$$

41.
$$3x + 4y = 2$$
$$3x + 4y - 3x = 2 - 3x$$
$$4y = -3x + 2$$
$$\frac{4y}{4} = \frac{-3x + 2}{4}$$
$$y = -\frac{3}{4}x + \frac{1}{2}$$

42.
$$-5x + 4y = 10$$
$$-5x + 4y + 5x = 10 + 5x$$
$$4y = 5x + 10$$
$$\frac{4y}{4} = \frac{5x + 10}{4}$$
$$y = \frac{5}{4}x + \frac{5}{2}$$

43.
$$48x - 12y = 60$$
$$48x - 12y - 48x = 60 - 48x$$
$$-12y = -48x + 60$$
$$\frac{-12y}{-12} = \frac{-48x + 60}{-12}$$
$$y = 4x - 5$$

44.
$$\frac{2}{5}x + \frac{1}{3}y = 8$$
$$\frac{2}{5}x + \frac{1}{3}y - \frac{2}{5}x = 8 - \frac{2}{5}x$$
$$\frac{1}{3}y = -\frac{2}{5}x + 8$$
$$3\left(\frac{1}{3}y\right) = 3\left(-\frac{2}{5}x + 8\right)$$
$$y = -\frac{6}{5}x + 24$$

45.
$$C = \frac{5}{9}(3221.6 - 32)$$
$$C = \frac{5}{9}(3189.6)$$
$$C = 1772$$

The melting point of platinum is $1772°\text{C}$.

46. Let x = the measure of the congruent angles.
Third angle: $x - 30$
$$x + x + (x - 30) = 180$$
$$3x - 30 = 180$$
$$3x - 30 + 30 = 180 + 30$$
$$3x = 210$$
$$\frac{3x}{3} = \frac{210}{3}$$
$$x = 70$$

The angles measure 70°, 70°, and 40°.

47. Let w = width of the window in feet.
Length: $l = w + 8$

$$2l + 2w = P$$
$$2(w+8) + 2w = 76$$
$$2w + 16 + 2w = 76$$
$$4w + 16 = 76$$
$$4w + 16 - 16 = 76 - 16$$
$$4w = 60$$
$$\frac{4w}{4} = \frac{60}{4}$$
$$w = 15$$
$$l = w + 8 = 15 + 8 = 23$$

The window measures 15 feet by 23 feet.

48. a.

$$C = 2.95 + 0.04x$$
$$C - 2.95 = 2.95 + 0.04x - 2.95$$
$$C - 2.95 = 0.04x$$
$$\frac{C - 2.95}{0.04} = \frac{0.04x}{0.04}$$
$$25C - 73.75 = x \quad \text{or} \quad x = 25C - 73.75$$

b.

$$x = 25(20) - 73.75$$
$$x = 500 - 73.75$$
$$x = 426.25$$

Debbie can talk for 426 minutes in one month and not spend more than $20 on long distance.

49. Let x = thickness in feet.

$$V = lwh$$
$$80 = 12 \cdot 18 \cdot x$$
$$80 = 216x$$
$$\frac{80}{216} = \frac{216x}{216}$$
$$\frac{10}{27} = x \text{ or } x \approx 0.37$$

The patio will be $\frac{10}{27}$ of a foot thick (i.e. about 4.44 inches).

50. a.

$$A = \pi s(R + r)$$
$$\frac{A}{\pi s} = \frac{\pi s(R+r)}{\pi s}$$
$$\frac{A}{\pi s} = R + r$$
$$\frac{A}{\pi s} - R = r \quad \text{or} \quad r = \frac{A - \pi R s}{\pi s}$$

b.

$$r = \frac{10\pi - \pi(3)(2)}{\pi(2)}$$
$$r = \frac{10 - 6}{2}$$
$$r = \frac{4}{2} = 2$$

The radius of the top of the frustum is 2 feet.

51. a.

$$C = 7.48 + 0.08674x$$
$$C - 7.48 = 7.48 + 0.08674x - 7.48$$
$$C - 7.48 = 0.08674x$$
$$\frac{C - 7.48}{0.08674} = \frac{0.08674x}{0.08674}$$
$$x = \frac{C - 7.48}{0.08674}$$

b.

$$x = \frac{206.03 - 7.48}{0.08674}$$
$$= \frac{198.55}{0.08674}$$
$$\approx 2289$$

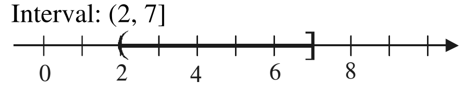
Approximately 2289 kwh were used.

52. Let x = the measure of the angle.
Complement: $90 - x$
Supplement: $180 - x$

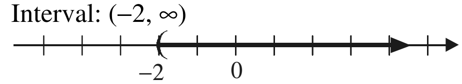
$$(90 - x) + (180 - x) = 150$$
$$90 - x + 180 - x = 150$$
$$270 - 2x = 150$$
$$270 - 2x - 270 = 150 - 270$$
$$-2x = -120$$
$$\frac{-2x}{-2} = \frac{-120}{-2}$$
$$x = 60$$

The angle measures 60°.

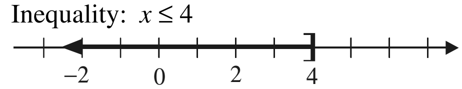
53. $2 < x \le 7$
Interval: (2, 7]



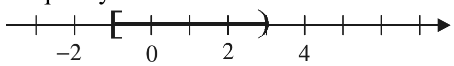
54. $x > -2$
Interval: $(-2, \infty)$



55. $(-\infty, 4]$
Inequality: $x \le 4$



56. [−1, 3)
Inequality: $-1 \le x < 3$

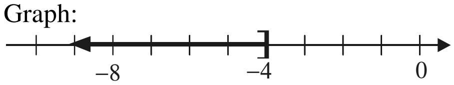


57.
$$5 \le x \le 9$$
$$2 \cdot 5 \le 2 \cdot x \le 2 \cdot 9$$
$$10 \le 2x \le 18$$
$$10 - 3 \le 2x - 3 \le 18 - 3$$
$$7 \le 2x - 3 \le 15$$
Therefore, $a = 7$ and $b = 15$.

58.
$$-2 < x < 0$$
$$3(-2) < 3(x) < 3(0)$$
$$-6 < 3x < 0$$
$$-6 + 5 < 3x + 5 < 0 + 5$$
$$-1 < 3x + 5 < 5$$
Therefore, $a = -1$ and $b = 5$.

59.
$$3x + 12 \le 0$$
$$3x + 12 - 12 \le 0 - 12$$
$$3x \le -12$$
$$\frac{3x}{3} \le \frac{-12}{3}$$
$$x \le -4$$
Solution set: $\{x \mid x \le -4\}$

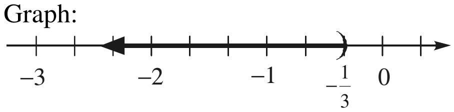
Interval: $(-\infty, -4]$
Graph:



60.
$$2 < 1 - 3x$$
$$2 - 1 < 1 - 3x - 1$$
$$1 < -3x$$
$$\frac{1}{-3} > \frac{-3x}{-3}$$
$$-\frac{1}{3} > x \text{ or } x < -\frac{1}{3}$$
Solution set: $\left\{x \mid x < -\frac{1}{3}\right\}$

Interval: $\left(-\infty, -\frac{1}{3}\right)$

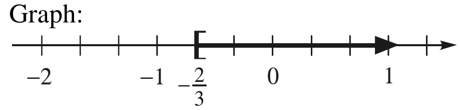
Graph:



61.
$$-7 \le 3(h + 1) - 8$$
$$-7 \le 3h + 3 - 8$$
$$-7 \le 3h - 5$$
$$-7 + 5 \le 3h - 5 + 5$$
$$-2 \le 3h$$
$$\frac{-2}{3} \le \frac{3h}{3}$$
$$-\frac{2}{3} \le h \text{ or } h \ge -\frac{2}{3}$$
Solution set: $\left\{h \mid h \ge -\frac{2}{3}\right\}$

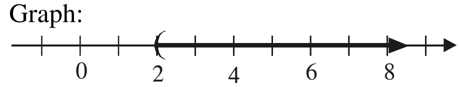
Interval: $\left[-\frac{2}{3}, \infty\right)$

Graph:



62.
$$-7x - 8 < -22$$
$$-7x - 8 + 8 < -22 + 8$$
$$-7x < -14$$
$$\frac{-7x}{-7} > \frac{-14}{-7}$$
$$x > 2$$
Solution set: $\{x \mid x > 2\}$

Interval: $(2, \infty)$
Graph:

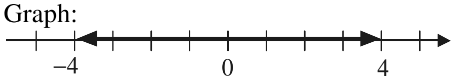


63.
$$3(p - 2) + (5 - p) > 2 - (p - 3)$$
$$3p - 6 + 5 - p > 2 - p + 3$$
$$2p - 1 > 5 - p$$
$$2p + p - 1 > 5 - p + p$$
$$3p - 1 > 5$$
$$3p - 1 + 1 > 5 + 1$$
$$3p > 6$$
$$\frac{3p}{3} > \frac{6}{3}$$
$$p > 2$$
Solution set: $\{p \mid p > 2\}$

Interval: $(2, \infty)$
Graph:

64.
$$\begin{aligned} 2(x+1)+1 &> 2(x-2) \\ 2x+2+1 &> 2x-4 \\ 2x+3 &> 2x-4 \\ 2x+3-2x &> 2x-4-2x \\ 3 &> -4 \end{aligned}$$
This statement is true for all real numbers.
Solution set: $\{x \mid x \text{ is any real number}\}$

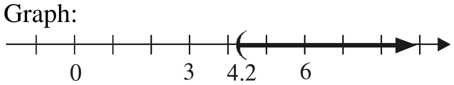
Interval: $(-\infty, \infty)$
Graph:



65.
$$\begin{aligned} 5(x-1)-7x &> 2(2-x) \\ 5x-5-7x &> 4-2x \\ -2x-5 &> 4-2x \\ -2x-5+2x &> 4-2x+2x \\ -5 &> 4 \quad \text{false} \end{aligned}$$
This statement is false for all real numbers. The inequality has no solutions.
Solution set: $\{\ \}$ or $\varnothing$

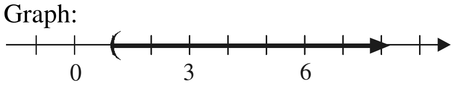
66.
$$\begin{aligned} 0.03x+0.10 &> 0.52-0.07x \\ 0.03x+0.10-0.10 &> 0.52-0.07x-0.10 \\ 0.03x &> 0.42-0.07x \\ 0.03x+0.07x &> 0.42-0.07x+0.07x \\ 0.1x &> 0.42 \\ \frac{0.1x}{0.1} &> \frac{0.42}{0.1} \\ x &> 4.2 \end{aligned}$$
Solution set: $\{x \mid x > 4.2\}$

Interval: $(4.2, \infty)$
Graph:



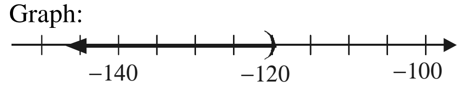
67.
$$\begin{aligned} -\frac{4}{9}w+\frac{7}{12} &< \frac{5}{36} \\ 36\left(-\frac{4}{9}w+\frac{7}{12}\right) &< 36\left(\frac{5}{36}\right) \\ -16w+21 &< 5 \\ -16w+21-21 &< 5-21 \\ -16w &< -16 \\ \frac{-16w}{-16} &> \frac{-16}{-16} \\ w &> 1 \end{aligned}$$
Solution set: $\{w \mid w > 1\}$

Interval: $(1, \infty)$
Graph:



68.
$$\begin{aligned} \frac{2}{5}y-20 &> \frac{2}{3}y+12 \\ 15\left(\frac{2}{5}y-20\right) &> 15\left(\frac{2}{3}y+12\right) \\ 6y-300 &> 10y+180 \\ 6y-300-10y &> 10y+180-10y \\ -4y-300 &> 180 \\ -4y-300+300 &> 180+300 \\ -4y &> 480 \\ \frac{-4y}{-4} &< \frac{480}{-4} \\ y &< -120 \end{aligned}$$
Solution set: $\{y \mid y < -120\}$

Interval: $(-\infty, -120)$
Graph:



69. Let x = number of people attending.
$$\begin{aligned} 7.5x+150 &\le 600 \\ 7.5x+150-150 &\le 600-150 \\ 7.5x &\le 450 \\ \frac{7.5x}{7.5} &\le \frac{450}{7.5} \\ x &\le 60 \end{aligned}$$
To stay within budget, no more than 60 people can attend the banquet.

70. Let x = number of miles driven daily (average)
Miles charged: $x-150$
$$\begin{aligned} 43.46+0.25(x-150) &\le 60 \\ 43.46+0.25x-37.5 &\le 60 \\ 0.25x+5.96 &\le 60 \\ 0.25x+5.96-5.96 &\le 60-5.96 \\ 0.25x &\le 54.04 \\ \frac{0.25x}{0.25} &\le \frac{54.04}{0.25} \\ x &\le 216.16 \end{aligned}$$
To stay within budget, you can drive an average of 216 miles per day.

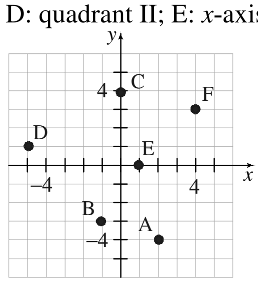
71. Let x = number of candy bars sold.
$$\begin{aligned} 1.0x &> 50+0.6x \\ 1.0x-0.6x &> 50+0.6x-0.6x \\ 0.4x &> 50 \\ \frac{0.4x}{0.4} &> \frac{50}{0.4} \\ x &> 125 \end{aligned}$$
The band must sell more than 125 candy bars to make a profit.

72. Let x = number of DVDs purchased.

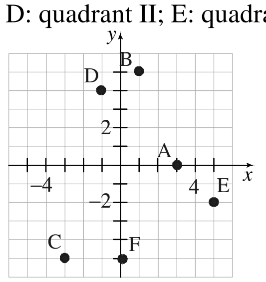
$$\begin{aligned} 24.95+9.95(x-1) &\le 72 \\ 24.95+9.95x-9.95 &\le 72 \\ 15+9.95x &\le 72 \\ 15+9.95x-15 &\le 72-15 \\ 9.95x &\le 57 \\ \frac{9.95x}{9.95} &\le \frac{57}{9.95} \\ x &\le \frac{57}{9.95} \approx 5.73 \end{aligned}$$

You can purchase up to 5 DVDs and still be within budget.

73. A: quadrant IV; B: quadrant III; C: y-axis; D: quadrant II; E: x-axis; F: quadrant I



74. A: x-axis; B: quadrant I; C: quadrant III; D: quadrant II; E: quadrant IV; F: y-axis



75. a. Let $x=3$ and $y=1$.

$$\begin{aligned} 3(3)-2(1) &\stackrel{?}{=} 7 \\ 9-2 &\stackrel{?}{=} 7 \\ 7 &= 7 \text{ True} \end{aligned}$$

The point (3, 1) is on the graph.

b. Let $x=2$ and $y=-1$.

$$\begin{aligned} 3(2)-2(-1) &\stackrel{?}{=} 7 \\ 6+2 &\stackrel{?}{=} 7 \\ 8 &= 7 \text{ False} \end{aligned}$$

The point (2, –1) is not on the graph.

c. Let $x=4$ and $y=0$.

$$\begin{aligned} 3(4)-2(0) &\stackrel{?}{=} 7 \\ 12-0 &\stackrel{?}{=} 7 \\ 12 &= 7 \text{ False} \end{aligned}$$

The point (4, 0) is not on the graph.

d. Let $x=\frac{1}{3}$ and $y=-3$.

$$\begin{aligned} 3\left(\frac{1}{3}\right)-2(-3) &\stackrel{?}{=} 7 \\ 1+6 &\stackrel{?}{=} 7 \\ 7 &= 7 \text{ True} \end{aligned}$$

The point $\left(\frac{1}{3},-3\right)$ is on the graph.

76. a. Let $x=-1$ and $y=3$.

$$\begin{aligned} 3 &\stackrel{?}{=} 2(-1)^2-3(-1)+2 \\ 3 &\stackrel{?}{=} 2(1)+3+2 \\ 3 &\stackrel{?}{=} 2+3+2 \\ 3 &= 7 \text{ False} \end{aligned}$$

The point (–1, 3) is not on the graph.

b. Let $x=1$ and $y=1$.

$$\begin{aligned} 1 &\stackrel{?}{=} 2(1)^2-3(1)+2 \\ 1 &\stackrel{?}{=} 2(1)-3+2 \\ 1 &\stackrel{?}{=} 2-3+2 \\ 1 &= 1 \text{ True} \end{aligned}$$

The point (1, 1) is on the graph.

c. Let $x=-2$ and $y=16$.

$$\begin{aligned} 16 &\stackrel{?}{=} 2(-2)^2-3(-2)+2 \\ 16 &\stackrel{?}{=} 2(4)+6+2 \\ 16 &\stackrel{?}{=} 8+6+2 \\ 16 &= 16 \text{ True} \end{aligned}$$

The point (–2, 16) is on the graph.

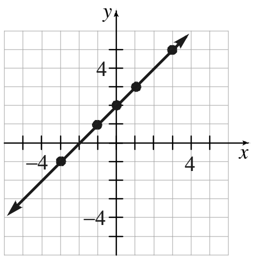
d. Let $x=\frac{1}{2}$ and $y=\frac{3}{2}$.

$$\begin{aligned} \frac{3}{2} &\stackrel{?}{=} 2\left(\frac{1}{2}\right)^2-3\left(\frac{1}{2}\right)+2 \\ \frac{3}{2} &\stackrel{?}{=} 2\left(\frac{1}{4}\right)-\frac{3}{2}+2 \\ \frac{3}{2} &\stackrel{?}{=} \frac{1}{2}-\frac{3}{2}+2 \\ \frac{3}{2} &= 1 \text{ False} \end{aligned}$$

The point $\left(\frac{1}{2},\frac{3}{2}\right)$ is not on the graph.

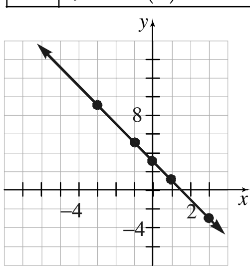
77. $y = x + 2$

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



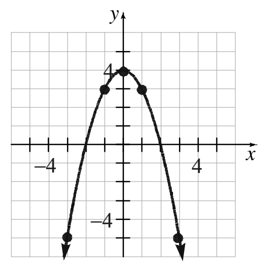
78. $2x + y = 3$
$y = -2x + 3$

x	$y = -2x + 3$	(x, y)
-3	$y = -2(-3) + 3 = 9$	$(-3, 9)$
-1	$y = -2(-1) + 3 = 5$	$(-1, 5)$
0	$y = -2(0) + 3 = 3$	$(0, 3)$
1	$y = -2(1) + 3 = 1$	$(1, 1)$
3	$y = -2(3) + 3 = -3$	$(3, -3)$



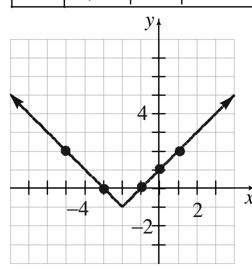
79. $y = -x^2 + 4$

x	$y = -x^2 + 4$	(x, y)
-3	$y = -(-3)^2 + 4 = -5$	$(-3, -5)$
-1	$y = -(-1)^2 + 4 = 3$	$(-1, 3)$
0	$y = -(0)^2 + 4 = 4$	$(0, 4)$
1	$y = -(1)^2 + 4 = 3$	$(1, 3)$
3	$y = -(3)^2 + 4 = -5$	$(3, -5)$



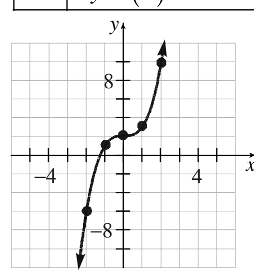
80. $y = |x + 2| - 1$

x	$y = \lvert x + 2\rvert - 1$	(x, y)
-5	$y = \lvert -5 + 2\rvert - 1 = 2$	$(-5, 2)$
-3	$y = \lvert -3 + 2\rvert - 1 = 0$	$(-3, 0)$
-1	$y = \lvert -1 + 2\rvert - 1 = 0$	$(-1, 0)$
0	$y = \lvert 0 + 2\rvert - 1 = 1$	$(0, 1)$
1	$y = \lvert 1 + 2\rvert - 1 = 2$	$(1, 2)$



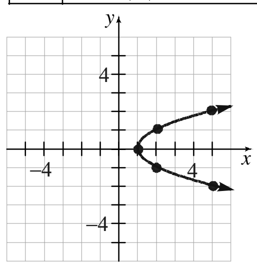
81. $y = x^3 + 2$

x	$y = x^3 + 2$	(x, y)
-2	$y = (-2)^3 + 2 = -6$	$(-2, -6)$
-1	$y = (-1)^3 + 2 = 1$	$(-1, 1)$
0	$y = (0)^3 + 2 = 2$	$(0, 2)$
1	$y = (1)^3 + 2 = 3$	$(1, 3)$
2	$y = (2)^3 + 2 = 10$	$(2, 10)$



82. $x = y^2 + 1$

y	$x = y^2 + 1$	(x, y)
-2	$x = (-2)^2 + 1 = 5$	$(5, -2)$
-1	$x = (-1)^2 + 1 = 2$	$(2, -1)$
0	$x = (0)^2 + 1 = 1$	$(1, 0)$
1	$x = (1)^2 + 1 = 2$	$(2, 1)$
2	$x = (2)^2 + 1 = 5$	$(5, 2)$



83. The intercepts are (–3, 0), (0, –1), and (0, 3).

84. a. Since 2250 is less than 3000, the monthly bill will still be \$40. Using the graph, we find that when $x = 2.25$ (2250 minutes) the y-value is 40, or \$40.

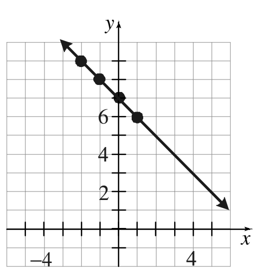
b. For 12,000 minutes, we have $x = 12$. According to the graph, the monthly bill for 12,000 minutes will be about \$500.

85. Let $x = -2, -1, 0,$ and 1.

$x = -2$: $-2 + y = 7$, $y = 9$ $\quad$ $x = -1$: $-1 + y = 7$, $y = 8$

$x = 0$: $0 + y = 7$, $y = 7$ $\quad$ $x = 1$: $1 + y = 7$, $y = 6$

Thus, the points (–2, 9), (–1, 8), (0, 7), and (1, 6) are on the graph.

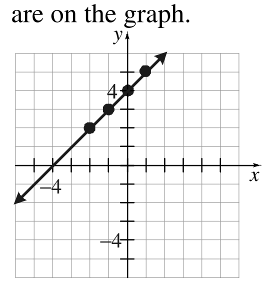


86. Let $x = -2, -1, 0,$ and 1.

$x = -2$: $-2 - y = -4$, $-y = -2$, $y = 2$ $\quad$ $x = -1$: $-1 - y = -4$, $-y = -3$, $y = 3$

$x = 0$: $0 - y = -4$, $-y = -4$, $y = 4$ $\quad$ $x = 1$: $1 - y = -4$, $-y = -5$, $y = 5$

Thus, the points (–2, 2), (–1, 3), (0, 4), and (1, 5) are on the graph.



87. Let $x = -2, 0, 2,$ and 4.

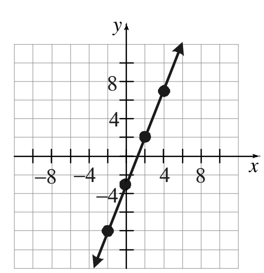
$x = -2$: $5(-2) - 2y = 6$
$-10 - 2y = 6$
$-2y = 16$
$y = -8$

$x = 0$: $5(0) - 2y = 6$
$-2y = 6$
$y = -3$

$x = 2$: $5(2) - 2y = 6$
$10 - 2y = 6$
$-2y = -4$
$y = 2$

$x = 4$: $5(4) - 2y = 6$
$20 - 2y = 6$
$-2y = -14$
$y = 7$

Thus, the points (–2, –8), (0, –3), (2, 2), and (4, 7) are on the graph.



88. Let $x = -4, -2, 0,$ and 2.

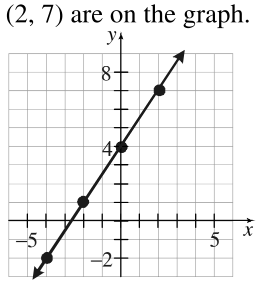
$x=-4$: $-3(-4)+2y=8$
$12+2y=8$
$2y=-4$
$y=-2$

$x=-2$: $-3(-2)+2y=8$
$6+2y=8$
$2y=2$
$y=1$

$x=0$: $-3(0)+2y=8$
$2y=8$
$y=4$

$x=2$: $-3(2)+2y=8$
$-6+2y=8$
$2y=14$
$y=7$

Thus, the points (–4, –2), (–2, 1), (0, 4), and (2, 7) are on the graph.



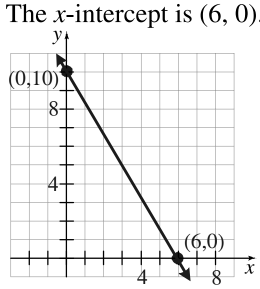
89. To find the y-intercept, let $x = 0$ and solve for y.

$x=0$: $5(0)+3y=30$
$3y=30$
$y=10$

The y-intercept is (0, 10). To find the x-intercept, let $y = 0$ and solve for x.

$y=0$: $5x+3(0)=30$
$5x=30$
$x=6$

The x-intercept is (6, 0).



90. To find the y-intercept, let $x = 0$ and solve for y.

$x=0$: $4(0)+3y=0$
$4y=0$
$y=0$

The y-intercept is (0, 0). To find the x-intercept, let $y = 0$ and solve for x.

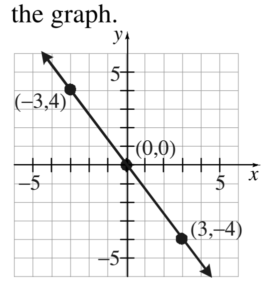
$y=0$: $4x+3(0)=0$
$4x=0$
$x=0$

The x-intercept is (0, 0). Since the x- and y-intercepts both result in the origin, we must find other points on the graph. Let $x = -3$ and 3 and solve for y.

$x=-3$: $4(-3)+3y=0$
$-12+3y=0$
$3y=12$
$y=4$

$x=3$: $4(3)+3y=0$
$12+3y=0$
$3y=-12$
$y=-4$

Thus, the points (–3, 4) and (3, –4) are also on the graph.



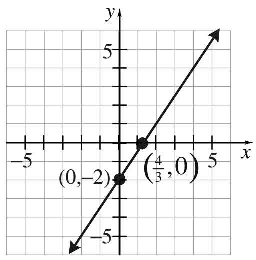
91. To find the y-intercept, let $x = 0$ and solve for y.

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

The y-intercept is (0, –2). To find the x-intercept, let $y = 0$ and solve for x.

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

The x-intercept is $\left(\frac{4}{3}, 0\right)$.



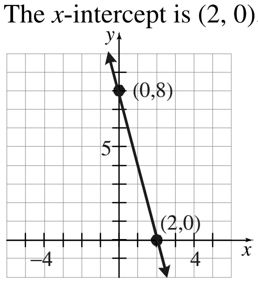
92. To find the y-intercept, let $x = 0$ and solve for y.

$$x = 0: \quad 4(0) + y = 8$$
$$y = 8$$

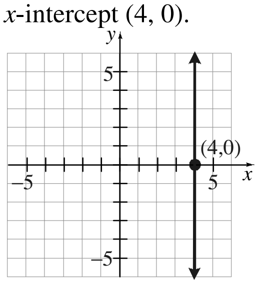
The y-intercept is (0, 8). To find the x-intercept, let $y = 0$ and solve for x.

$$y = 0: \quad 4x + 0 = 8$$
$$4x = 8$$
$$x = 2$$

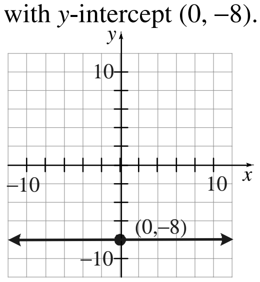
The x-intercept is (2, 0).



93. The equation $x = 4$ will be a vertical line with x-intercept (4, 0).



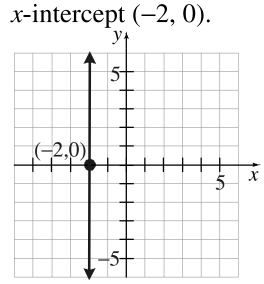
94. The equation $y = -8$ will be a horizontal line with y-intercept (0, −8).



95. $3x + 5 = -1$

$$3x = -6$$
$$x = -2$$

The equation $x = -2$ will be a vertical line with x-intercept (−2, 0).



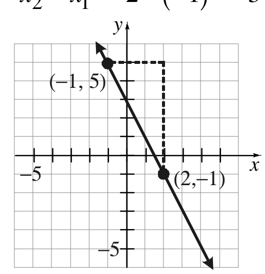
96. a. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{4 - (-1)}{2 - (-2)} = \dfrac{5}{4}$

b. For every 4 units of increase in x, y will increase by 5 units.

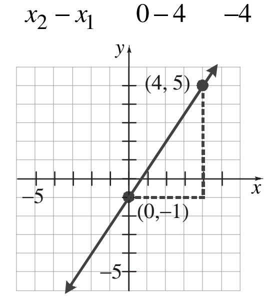
97. a. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-1 - 1}{5 - (-3)} = \dfrac{-2}{8} = -\dfrac{1}{4}$

b. For every 4 units of increase in x, y will decrease by 1 unit. For every 4 units of decrease in x, y will increase by 1 unit.

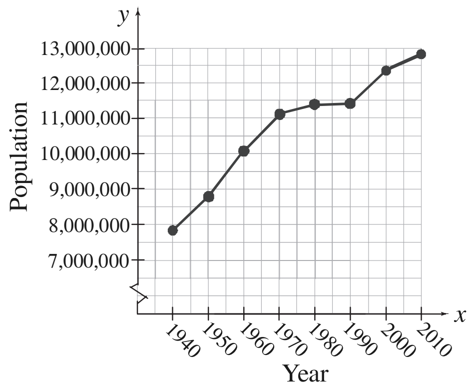
98. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-1 - 5}{2 - (-1)} = \dfrac{-6}{3} = -2$



99. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-1 - 5}{0 - 4} = \dfrac{-6}{-4} = \dfrac{3}{2}$



100. a.



b. Average rate of change

$= \dfrac{8,712,176 - 7,897,241}{1950 - 1940}$

$= 81,493.5$ people per year

Between 1940 and 1950, the population of Illinois increased at a rate of 81,493.5 people per year.

c. Average rate of change

$= \dfrac{11,430,602 - 11,427,409}{1990 - 1980}$

$= 319.3$ people per year

Between 1980 and 1990, the population of Illinois increased at a rate of 319.3 people per year.

d. Average rate of change

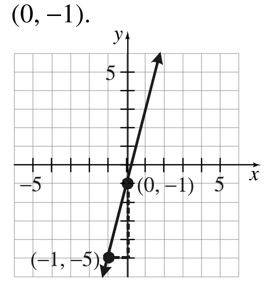
$= \dfrac{12,830,632 - 12,419,293}{2010 - 2000}$

$= 41,133.9$ people per year

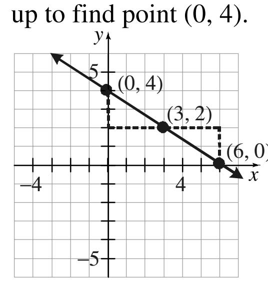
Between 2000 and 2010, the population of Illinois increased at a rate of 41,133.9 people per year.

e. No. The population of Illinois is not linearly related to the year. The average rate of change (slope) is not constant.

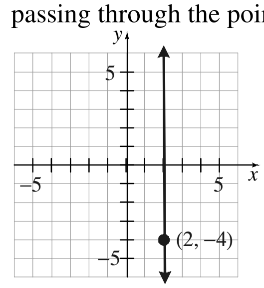
101. Start at (–1, –5). Because $m = 4 = \dfrac{4}{1}$, move 1 unit to the right and 4 units up to find point (0, –1).



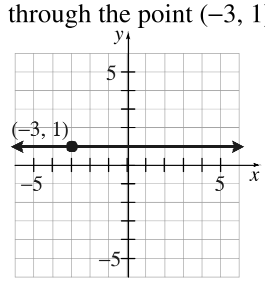
102. Start at (3, 2). Because $m = -\dfrac{2}{3}$, move 3 units to the right and 2 units down to find point (6, 0). We can also move 3 units to the left and 2 units up to find point (0, 4).



103. Because *m* is undefined, the line is vertical passing through the point (2, –4).



104. Because *m* = 0, the line is horizontal passing through the point (–3, 1).



105. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-3}{6-(-2)} = \frac{-4}{8} = -\frac{1}{2}$

$y - y_1 = m(x - x_1)$
$y - (-1) = -\frac{1}{2}(x - 6)$
$y + 1 = -\frac{1}{2}x + 3$
$y = -\frac{1}{2}x + 2$ or $x + 2y = 4$

106. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6-(-3)}{2-(-1)} = \frac{9}{3} = 3$

$y - y_1 = m(x - x_1)$
$y - 6 = 3(x - 2)$
$y - 6 = 3x - 6$
$y = 3x$ or $3x - y = 0$

107. $y - y_1 = m(x - x_1)$
$y - 2 = -1(x - 3)$
$y - 2 = -x + 3$
$y = -x + 5$ or $x + y = 5$

108. $y - y_1 = m(x - x_1)$
$y - (-4) = \frac{3}{5}(x - (-10))$
$y + 4 = \frac{3}{5}(x + 10)$
$y + 4 = \frac{3}{5}x + 6$
$y = \frac{3}{5}x + 2$ or $3x - 5y = -10$

109. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-2}{-3-6} = \frac{3}{-9} = -\frac{1}{3}$

$y - y_1 = m(x - x_1)$
$y - 2 = -\frac{1}{3}(x - 6)$
$y - 2 = -\frac{1}{3}x + 2$
$y = -\frac{1}{3}x + 4$ or $x + 3y = 12$

110. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3-3}{4-(-2)} = \frac{0}{6} = 0$

$y - y_1 = m(x - x_1)$
$y - 3 = 0(x - 4)$
$y - 3 = 0$
$y = 3$

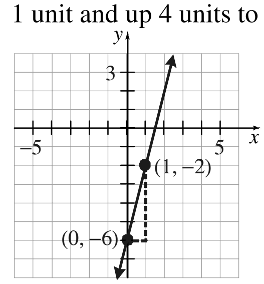
111. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7-(-1)}{1-4} = \frac{-6}{-3} = 2$

$y - y_1 = m(x - x_1)$
$y - (-7) = 2(x - 1)$
$y + 7 = 2x - 2$
$y = 2x - 9$ or $2x - y = 9$

112. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-2}{8-(-1)} = \frac{-3}{9} = -\frac{1}{3}$

$y - y_1 = m(x - x_1)$
$y - (-1) = -\frac{1}{3}(x - 8)$
$y + 1 = -\frac{1}{3}x + \frac{8}{3}$
$y = -\frac{1}{3}x + \frac{5}{3}$ or $x + 3y = 5$

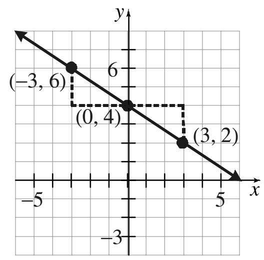
113. For $y = 4x - 6$, the slope is 4 and the y-intercept is (0, –6). Begin at (0, –6) and move to the right 1 unit and up 4 units to find point (1, –2).



114. $2x + 3y = 12$
$3y = -2x + 12$
$y = \frac{-2x + 12}{3}$
$y = -\frac{2}{3}x + 4$

The slope is $-\frac{2}{3}$ and the y-intercept is (0, 4).

Begin at (0, 4) and move to the right 3 units and down 2 units to find the point (3, 2). We can also move 3 units to the left and 2 units up to find the point (–3, 6).



115. A line parallel to L will have a slope equal to the slope of L. Thus, the slope of the line parallel to L is $-\frac{3}{8}$.

116. A line perpendicular to L will have a slope that is the negative reciprocal to the slope of L. Thus, the slope of the line perpendicular to L is

$$\frac{-1}{-\frac{3}{8}} = -1 \cdot -\frac{8}{3} = \frac{8}{3}.$$

117.

$$\begin{aligned} x - 3y &= 9 \\ -3y &= -x + 9 \\ y &= \frac{-x+9}{-3} \\ y &= \frac{1}{3}x - 3 \end{aligned} \qquad \begin{aligned} 9x + 3y &= -3 \\ 3y &= -9x - 3 \\ y &= \frac{-9x-3}{3} \\ y &= -3x - 1 \end{aligned}$$

Perpendicular. The two slopes, $m_1 = \frac{1}{3}$ and $m_2 = -3$, are negative reciprocals.

118.

$$\begin{aligned} 6x - 8y &= 16 \\ -8y &= -6x + 16 \\ y &= \frac{-6x+16}{-8} \\ y &= \frac{3}{4}x - 2 \end{aligned} \qquad \begin{aligned} 3x + 4y &= 28 \\ 4y &= -3x + 28 \\ y &= \frac{-3x+28}{4} \\ y &= -\frac{3}{4}x + 7 \end{aligned}$$

Neither. The two slopes are $m_1 = \frac{3}{4}$ and $m_2 = -\frac{3}{4}$. The two slopes are not equal and are not negative reciprocals.

119.

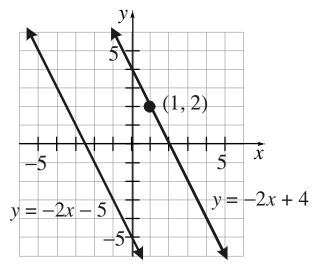
$$\begin{aligned} 2x - y &= 3 \\ -y &= -2x + 3 \\ y &= \frac{-2x+3}{-1} \\ y &= 2x - 3 \end{aligned} \qquad \begin{aligned} -6x + 3y &= 0 \\ 3y &= 6x \\ y &= \frac{6x}{3} \\ y &= 2x \end{aligned}$$

Parallel. The two lines have equal slopes, $m = 2$, but different y-intercepts.

120. Perpendicular. The line $x = 2$ is vertical, and the line $y = 2$ is horizontal. Vertical lines are perpendicular to horizontal lines.

121. The slope of the line we seek is $m = -2$, the same as the slope of $y = -2x - 5$. The equation of the line is:

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

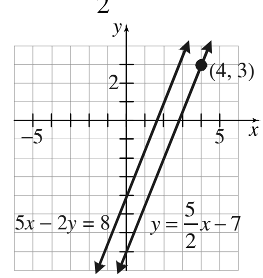


122. The slope of the line we seek is $m = \frac{5}{2}$, the same as the slope of the line

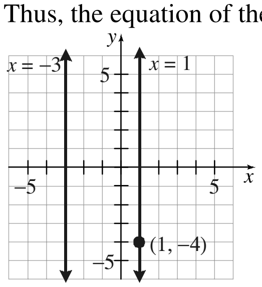
$$\begin{aligned} 5x - 2y &= 8 \\ -2y &= -5x + 8 \\ y &= \frac{-5x+8}{-2} \\ y &= \frac{5}{2}x - 4 \end{aligned}$$

Thus, the equation of the line we seek is:

$$\begin{aligned} y - 3 &= \frac{5}{2}(x - 4) \\ y - 3 &= \frac{5}{2}x - 10 \\ y &= \frac{5}{2}x - 7 \end{aligned}$$

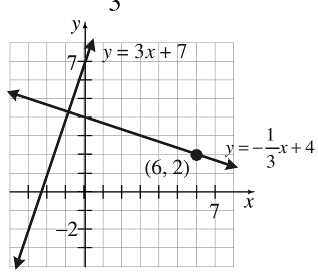


123. The line we seek is vertical, parallel to the vertical line $x = -3$. Now a vertical line passing through the point (1, –4) must also pass through the point (1, 0). That is, the x-intercept is (1, 0). Thus, the equation of the line is $x = 1$.



124. The slope of the line we seek is $m = -\frac{1}{3}$, the negative reciprocal of the slope of $y = 3x + 7$. The equation of the line is:

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

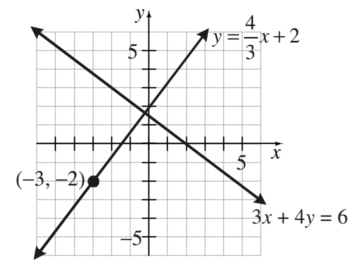


125. The slope of the line we seek is $m = \frac{4}{3}$, the negative reciprocal of the line

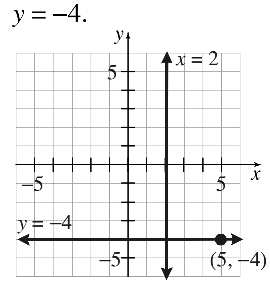
$$3x + 4y = 6$$
$$4y = -3x + 6$$
$$y = \frac{-3x + 6}{4}$$
$$y = -\frac{3}{4}x + \frac{3}{2}$$

Thus, the equation of the line we seek is:

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



126. The line we seek is horizontal, perpendicular to the vertical line $x = 2$. Now a horizontal line passing through the point (5, –4) must also pass through the point (0, –4). That is, the y-intercept is (0, –4). Thus, the equation of the line is $y = -4$.



127. a. $x = 4,\ y = -2$ $\quad 5(4) + 3(-2) \overset{?}{\le} 15$

$$20 - 6 \overset{?}{\le} 15$$
$$14 \overset{?}{\le} 15 \quad \text{True}$$

So, (4, –2) is a solution to $5x + 3y \le 15$.

b. $x = -6,\ y = 15$ $\quad 5(-6) + 3(15) \overset{?}{\le} 15$

$$-30 + 45 \overset{?}{\le} 15$$
$$15 \overset{?}{\le} 15 \quad \text{True}$$

So, (–6, 15) is a solution to $5x + 3y \le 15$.

c. $x = 5,\ y = -1$ $\quad 5(5) + 3(-1) \overset{?}{\le} 15$

$$25 - 3 \overset{?}{\le} 15$$
$$22 \overset{?}{\le} 15 \quad \text{False}$$

So, (5, –1) is not a solution to $5x + 3y \le 15$.

128. a. $x = 2,\ y = 3$ $\quad 2 - 2(3) \overset{?}{>} -4$

$$2 - 6 \overset{?}{>} -4$$
$$-4 \overset{?}{>} -4 \quad \text{False}$$

So, (2, 3) is not a solution to $x - 2y > -4$.

b. $x = 5,\ y = -2$ $\quad 5 - 2(-2) \stackrel{?}{>} -4$

$5 + 4 \stackrel{?}{>} -4$

$9 \stackrel{?}{>} -4$ True

So, (5, −2) is a solution to $x - 2y > -4$.

c. $x = -1,\ y = 3$ $\quad (-1) - 2(3) \stackrel{?}{>} -4$

$-1 - 6 \stackrel{?}{>} -4$

$-7 \stackrel{?}{>} -4$ False

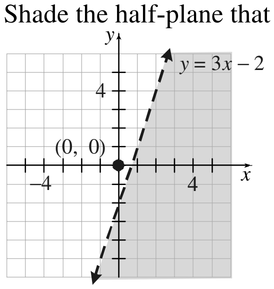
So, (−1, 3) is not a solution to $x - 2y > -4$.

129. Replace the inequality symbol with an equal sign to obtain $y = 3x - 2$. Because the inequality is strict, graph $y = 3x - 2$ using a dashed line.

Test Point: $(0,0)$: $0 \stackrel{?}{<} 3(0) - 2$

$0 \stackrel{?}{<} -2$ False

Therefore, (0, 0) is not a solution to $y < 3x - 2$. Shade the half-plane that does not contain (0, 0).

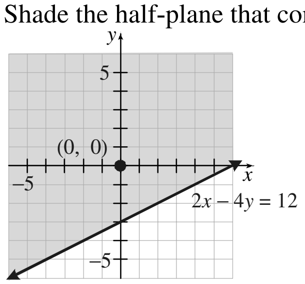


130. Replace the inequality symbol with an equal sign to obtain $2x - 4y = 12$. Because the inequality is non-strict, graph $2x - 4y = 12$ $\left(y = \frac{1}{2}x - 3\right)$ using a solid line.

Test Point: $(0,0)$: $2(0) - 4(0) \stackrel{?}{\le} 12$

$0 \stackrel{?}{\le} 12$ True

Therefore, (0, 0) is a solution to $2x - 4y \le 12$. Shade the half-plane that contains (0, 0).

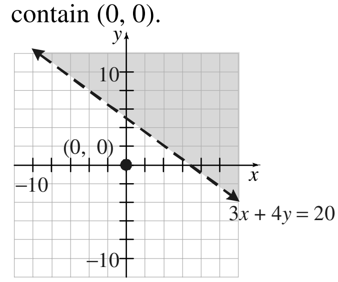


131. Replace the inequality symbol with an equal sign to obtain $3x + 4y = 20$. Because the inequality is strict, graph $3x + 4y = 20$ $\left(y = -\frac{3}{4}x + 5\right)$ using a dashed line.

Test Point: $(0, 0)$: $3(0) + 4(0) \stackrel{?}{>} 20$

$0 \stackrel{?}{>} 20$ False

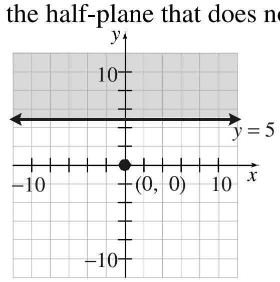
Therefore, (0, 0) is not a solution to $3x + 4y > 20$. Shade the half-plane that does not contain (0, 0).



132. Replace the inequality symbol with an equal sign to obtain $y = 5$. Because the inequality is non-strict, graph $y = 5$ using a solid line.

Test Point: $(0, 0)$: $0 \stackrel{?}{>} 5$ False

Therefore, (0, 0) is not a solution to $y > 5$. Shade the half-plane that does not contain (0, 0).



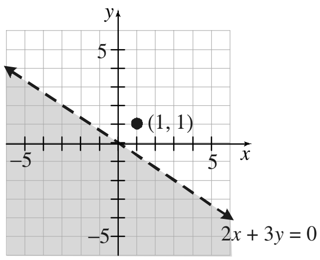
133. Replace the inequality symbol with an equal sign to obtain $2x + 3y = 0$. Because the inequality is strict, graph $2x + 3y = 0$ $\left(y = -\frac{2}{3}x\right)$ using a dashed line.

Test Point: $(1, 1)$: $2(1) + 3(1) \stackrel{?}{<} 0$

$2 + 3 \stackrel{?}{<} 0$

$5 \stackrel{?}{<} 0$ False

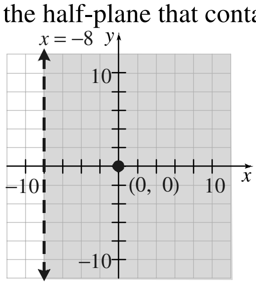
Therefore, (1, 1) is not a solution to $2x + 3x < 0$. Shade the half-plane that does not contain (1, 1).



134. Replace the inequality symbol with an equal sign to obtain $x = -8$. Because the inequality is strict, graph $x = -8$ using a dashed line.

Test Point: $(0, 0)$: $0 \overset{?}{>} -8$ True

Therefore, (0, 0) is a solution to $x > -8$. Shade the half-plane that contains (0, 0).



135. **a.** Let x = the number of movie tickets.
Let y = the number of music downloads.
$7.50x + 2y \le 60$

b. $x = 5$, $y = 15$:

$$7.50(5) + 2(15) \overset{?}{\le} 60$$
$$37.50 + 30 \overset{?}{\le} 60$$
$$67.50 \overset{?}{\le} 60 \quad \text{False}$$

No, Ethan cannot buy 5 movie tickets and 15 music downloads on his $60 budget.

c. $x = 6$, $y = 5$: $7.50(6) + 2(5) \overset{?}{\le} 60$

$$45 + 10 \overset{?}{\le} 60$$
$$55 \overset{?}{\le} 60$$

Yes, Ethan can buy 6 movie tickets and 5 music downloads on his $60 budget.

136. **a.** Let x = the number of candy bars.
Let y = the number of candles.
$0.50x + 2y \ge 1000$

b. $x = 500$, $y = 350$:

$$0.50(500) + 2(350) \overset{?}{\ge} 1000$$
$$250 + 700 \overset{?}{\ge} 1000$$
$$950 \overset{?}{\ge} 1000 \quad \text{False}$$

No, the math club will not earn enough money for the field trip by selling 500 candy bars and 350 candles.

c. $x = 600$, $y = 400$:

$$0.50(600) + 2(400) \overset{?}{\ge} 1000$$
$$300 + 800 \overset{?}{\ge} 1000$$
$$1100 \overset{?}{\ge} 1000 \quad \text{True}$$

Yes, the math club will earn enough money for the field trip by selling 600 candy bars and 400 candles.

Chapter 1 Test

1. **a.** Let $x = 6$ in the equation.

$$3(6-7) + 5 \overset{?}{=} 6 - 4$$
$$3(-1) + 5 \overset{?}{=} 2$$
$$-3 + 5 \overset{?}{=} 2$$
$$2 = 2 \quad \text{True}$$

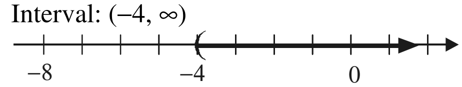
$x = 6$ is a solution to the equation.

b. Let $x = -2$ in the equation.

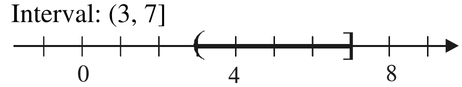
$$3(-2-7) + 5 \overset{?}{=} -2 - 4$$
$$3(-9) + 5 \overset{?}{=} -6$$
$$-27 + 5 \overset{?}{=} -6$$
$$-22 \ne -6$$

$x = -2$ is **not** a solution to the equation.

2. **a.** Interval: $(-4, \infty)$



b. Interval: $(3, 7]$



3. Let x represent the number.
$3x - 8 = x + 4$

4. Let x represent the number.
$\frac{2}{3}x + 2(x-5) > 7$

5. $5x-(x-2)=6+2x$

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

Solution set: $\{2\}$

This is a conditional equation.

6. $7+x-3=3(x+1)-2x$

$$\begin{aligned}7+x-3&=3x+3-2x\\4+x&=x+3\\4+x-x&=x+3-x\\4&=3 \quad \text{False}\end{aligned}$$

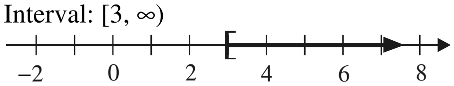
This statement is a contradiction. The equation has no solution. Solution set: $\{\ \}$ or $\varnothing$

7. $x+2\le 3x-4$

$$\begin{aligned}x+2-3x&\le 3x-4-3x\\-2x+2&\le -4\\-2x+2-2&\le -4-2\\-2x&\le -6\\\frac{-2x}{-2}&\ge\frac{-6}{-2}\\x&\ge 3\end{aligned}$$

Solution set: $\{x\mid x\ge 3\}$

Interval: $[3,\infty)$

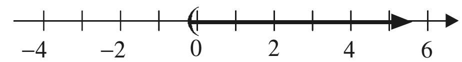


8. $4x+7>2x-3(x-2)$

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

Solution set: $\left\{x\,\middle|\,x>-\frac{1}{5}\right\}$

Interval: $\left(-\frac{1}{5},\infty\right)$

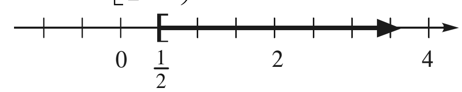


9. $-x+4\le x+3$

$$\begin{aligned}-x+4-x&\le x+3-x\\-2x+4&\le 3\\-2x+4-4&\le 3-4\\-2x&\le -1\\\frac{-2x}{-2}&\ge\frac{-1}{-2}\\x&\ge\frac{1}{2}\end{aligned}$$

Solution set: $\left\{x\,\middle|\,x\ge\frac{1}{2}\right\}$

Interval: $\left[\frac{1}{2},\infty\right)$



10. $7x+4y=3$

$$\begin{aligned}7x+4y-7x&=3-7x\\4y&=-7x+3\\\frac{4y}{4}&=\frac{-7x+3}{4}\\y&=-\frac{7}{4}x+\frac{3}{4}\end{aligned}$$

11. Let x = Glen's weekly sales.

$$\begin{aligned}400+0.08x&\ge 750\\400+0.08x-400&\ge 750-400\\0.08x&\ge 350\\\frac{0.08x}{0.08}&\ge\frac{350}{0.08}\\x&\ge 4375\end{aligned}$$

Glen's weekly sales must be at least \$4375 for him to earn at least \$750.

12. Let x = number of children at the party.

$$\begin{aligned}75+5x&=145\\75+5x-75&=145-75\\5x&=70\\\frac{5x}{5}&=\frac{70}{5}\\x&=14\end{aligned}$$

There were 14 children at Payton's party.

13. Let x = the width of the sandbox.
length: $x+2$

$$P = 2L + 2W$$
$$20 = 2(x+2)+2(x)$$
$$20 = 2x+4+2x$$
$$20 = 4x+4$$
$$20-4 = 4x+4-4$$
$$16 = 4x$$
$$\frac{16}{4} = \frac{4x}{4}$$
$$4 = x$$

The sandbox has a width of 4 feet and a length of 6 feet.

14. Let x = liters of 10% solution.
Amount of 40% solution: $12-x$ liters

tot. acid = acid from 10% + acid from 40%

$$(\%)(\text{liters}) = (\%)(\text{liters}) + (\%)(\text{liters})$$
$$0.2(12) = 0.1(x)+0.4(12-x)$$
$$2.4 = 0.1x+4.8-0.4x$$
$$2.4 = 4.8-0.3x$$
$$2.4-4.8 = 4.8-0.3x-4.8$$
$$-2.4 = -0.3x$$
$$\frac{-2.4}{-0.3} = \frac{-0.3x}{-0.3}$$
$$8 = x$$

The chemist needs to mix 8 liters of the 10% solution with 4 liters of the 40% solution.

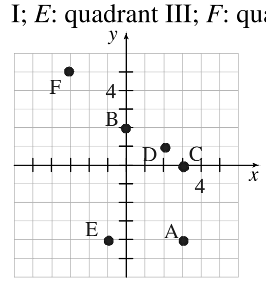
15. Let t = time to catch up in hours.
Running time for A: $t+0.5$
Running time for B: t
The total distance traveled by both runners will be the same when they meet. Therefore, we have

distance A = distance B

$$(\text{rate})(\text{time}) = (\text{rate})(\text{time})$$
$$8(t+0.5) = 10(t)$$
$$8t+4 = 10t$$
$$8t+4-8t = 10t-8t$$
$$4 = 2t$$
$$\frac{4}{2} = \frac{2t}{2}$$
$$2 = t$$

It will take contestant B two hours to catch up to contestant A.

16. A: quadrant IV; B: y-axis; C: x-axis; D: quadrant I; E: quadrant III; F: quadrant II



17. a. Let $x=-2$ and $y=4$.

$$4 \stackrel{?}{=} 3(-2)^2+(-2)-5$$
$$4 \stackrel{?}{=} 3(4)-7$$
$$4 \stackrel{?}{=} 12-7$$
$$4 = 5 \text{ False}$$

The point (–2, 4) is not on the graph.

b. Let $x=-1$ and $y=-3$.

$$-3 \stackrel{?}{=} 3(-1)^2+(-1)-5$$
$$-3 \stackrel{?}{=} 3(1)-6$$
$$-3 \stackrel{?}{=} 3-6$$
$$-3 = -3 \text{ True}$$

The point $(-1,-3)$ is on the graph.

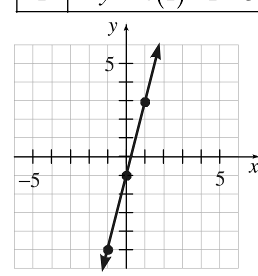
c. Let $x=2$ and $y=9$.

$$9 \stackrel{?}{=} 3(2)^2+(2)-5$$
$$9 \stackrel{?}{=} 3(4)-3$$
$$9 \stackrel{?}{=} 12-3$$
$$9 = 9 \text{ True}$$

The point (2, 9) is on the graph.

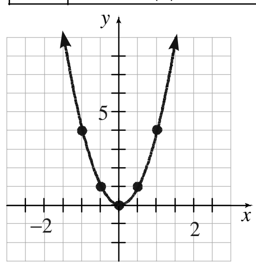
18. $y = 4x-1$

x	$y=4x-1$	$(x,\ y)$
-1	$y=4(-1)-1=-5$	$(-1,\ -5)$
0	$y=4(0)-1=-1$	$(0,\ -1)$
1	$y=4(1)-1=3$	$(1,\ 3)$



19. $y = 4x^2$

x	$y = 4x^2$	(x, y)
-1	$y = 4(-1)^2 = 4$	$(-1, 4)$
$-\frac{1}{2}$	$y = 4\left(-\frac{1}{2}\right)^2 = 1$	$\left(-\frac{1}{2}, 1\right)$
0	$y = 4(0)^2 = 0$	$(0, 0)$
$\frac{1}{2}$	$y = 4\left(\frac{1}{2}\right)^2 = 1$	$\left(\frac{1}{2}, 1\right)$
1	$y = 4(1)^2 = 4$	$(1, 4)$



20. The intercepts are (–3, 0), (0, 1), and (0, 3). The *x*-intercept is (–3, 0) and the *y*-intercepts are (0, 1) and (0, 3).

21. a. 30 miles per hour

b. The graph passes through the origin and the point (32, 0). This means the car was stopped (its speed was 0 mph) at 0 seconds and at 32 seconds.

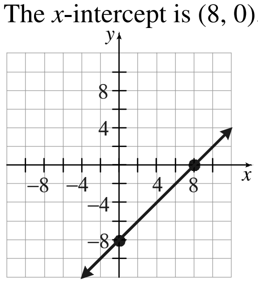
22. Find the *y*-intercept by letting $x = 0$ and solving for *y*.

$$x = 0: \quad 0 - y = 8$$
$$-y = 8$$
$$y = -8$$

The *y*-intercept is (0, –8). Find the *x*-intercept by letting $y = 0$ and solving for *x*.

$$y = 0: \quad x - 0 = 8$$
$$x = 8$$

The *x*-intercept is (8, 0).



23. Let $x = -5,\ 0,\ 5,$ and 10.

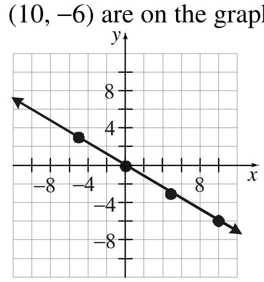
$$x = -5: \quad 3(-5) + 5y = 0$$
$$-15 + 5y = 0$$
$$5y = 15$$
$$y = 3$$

$$x = 0: \quad 3(0) + 5y = 0$$
$$0 + 5y = 0$$
$$y = 0$$

$$x = 5: \quad 3(5) + 5y = 0$$
$$15 + 5y = 0$$
$$5y = -15$$
$$y = -3$$

$$x = 10: \quad 3(10) + 5y = 0$$
$$30 + 5y = 0$$
$$5y = -30$$
$$y = -6$$

Thus, the points (–5, 3), (0, 0), (5, –3), and (10, –6) are on the graph.



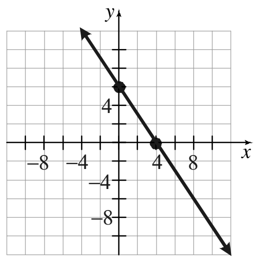
24. Find the *y*-intercept by letting $x = 0$ and solving for *y*.

$$x = 0: \quad 3(0) + 2y = 12$$
$$2y = 12$$
$$y = 6$$

The *y*-intercept is (0, 6). Find the *x*-intercept by letting $y = 0$ and solving for *x*.

$$y = 0: \quad 3x + 2(0) = 12$$
$$3x = 12$$
$$x = 4$$

The *x*-intercept is (4, 0).



25. Let $x = -1,\ 0,\ 1,$ and 2.

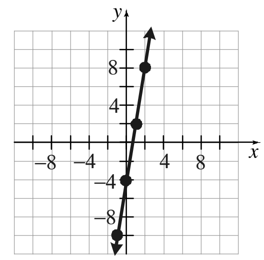
$x = -1$:
$$\frac{3}{2}(-1) - \frac{1}{4}y = 1$$
$$-\frac{3}{2} - \frac{1}{4}y = 1$$
$$-4\left(-\frac{3}{2} - \frac{1}{4}y\right) = -4(1)$$
$$6 + y = -4$$
$$y = -10$$

$x = 0$:
$$\frac{3}{2}(0) - \frac{1}{4}y = 1$$
$$-\frac{1}{4}y = 1$$
$$-4\left(-\frac{1}{4}y\right) = -4(1)$$
$$y = -4$$

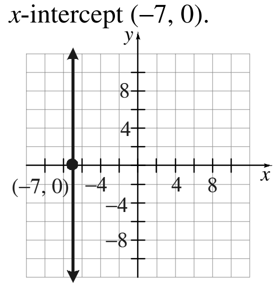
$x = 1$:
$$\frac{3}{2}(1) - \frac{1}{4}y = 1$$
$$\frac{3}{2} - \frac{1}{4}y = 1$$
$$-4\left(\frac{3}{2} - \frac{1}{4}y\right) = -4(1)$$
$$-6 + y = -4$$
$$y = 2$$

$x = 2$:
$$\frac{3}{2}(2) - \frac{1}{4}y = 1$$
$$3 - \frac{1}{4}y = 1$$
$$-\frac{1}{4}y = -2$$
$$-4\left(-\frac{1}{4}y\right) = -4(-2)$$
$$y = 8$$

Thus, the points (−1, −10), (0, −4), (1, 2), and (2, 8) are on the graph.



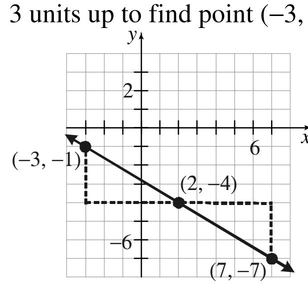
26. The equation $x = -7$ will be a vertical line with x-intercept (−7, 0).



27. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{6-(-2)}{-1-5} = \dfrac{8}{-6} = -\dfrac{4}{3}$;

For every 3 units of increase in x, y will decrease by 4 units. For every 3 units of decrease in x, y will increase by 4 units.

28. Start at (2, −4). Because $m = -\dfrac{3}{5}$, move 5 units to the right and 3 units down to find point (7, −7). We can also move 5 units to the left and 3 units up to find point (−3, −1).



29.

$$8x - 2y = 1 \qquad x + 4y = -2$$
$$-2y = -8x + 1 \qquad 4y = -x - 2$$
$$y = \frac{-8x+1}{-2} \qquad y = \frac{-x-2}{4}$$
$$y = 4x - \frac{1}{2} \qquad y = -\frac{1}{4}x - \frac{1}{2}$$

Perpendicular. The two lines have slopes that are negative reciprocals.

30. $y - y_1 = m(x - x_1)$
$y - 1 = 4(x - (-3))$
$y - 1 = 4(x + 3)$
$y - 1 = 4x + 12$
$y = 4x + 13$ or $4x - y = -13$

31. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{7-1}{-3-6} = \dfrac{6}{-9} = -\dfrac{2}{3}$
$y - y_1 = m(x - x_1)$
$y - 1 = -\dfrac{2}{3}(x - 6)$
$y - 1 = -\dfrac{2}{3}x + 4$
$y = -\dfrac{2}{3}x + 5$ or $2x + 3y = 15$

32. The slope of the line we seek is $m = \dfrac{1}{5}$, the same as the slope of the line
$x - 5y = 15$
$-5y = -x + 15$
$y = \dfrac{-x+15}{-5}$
$y = \dfrac{1}{5}x - 3$
Thus, the equation of the line we seek is:
$y - (-1) = \dfrac{1}{5}(x - 10)$
$y + 1 = \dfrac{1}{5}x - 2$
$y = \dfrac{1}{5}x - 3$ or $x - 5y = 15$

33. The slope of the line we seek is $m = -\dfrac{1}{3}$, the negative reciprocal of the slope of the line
$3x - y = 4$
$-y = -3x + 4$
$y = 3x - 4$
Thus, the equation of the line we seek is:
$y - 2 = -\dfrac{1}{3}(x - 6)$
$y - 2 = -\dfrac{1}{3}x + 2$
$y = -\dfrac{1}{3}x + 4$ or $x + 3y = 12$

34. a. $x = 3,\ y = -1$ $\quad 3(3) - (-1) \stackrel{?}{>} 10$
$9 + 1 \stackrel{?}{>} 10$
$10 \stackrel{?}{>} 10$ False
So, (3, −1) is not a solution to $3x - y > 10$.

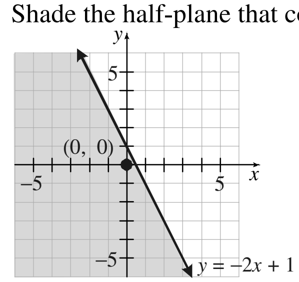
b. $x = 4,\ y = 5$ $\quad 3(4) - 5 \stackrel{?}{>} 10$
$12 - 5 \stackrel{?}{>} 10$
$7 \stackrel{?}{>} 10$ False
So, (4, 5) is not a solution to $3x - y > 10$.

c. $x = 5,\ y = 3$ $\quad 3(5) - 3 \stackrel{?}{>} 10$
$15 - 3 \stackrel{?}{>} 10$
$12 \stackrel{?}{>} 10$ True
So, (5, 3) is a solution to $3x - y > 10$.

35. Replace the inequality symbol with an equal sign to obtain $y = -2x + 1$. Because the inequality is non-strict, graph $y = -2x + 1$ using a solid line.

Test Point: $(0, 0)$: $\quad 0 \stackrel{?}{\le} -2(0) + 1$
$0 \stackrel{?}{\le} 1$ True

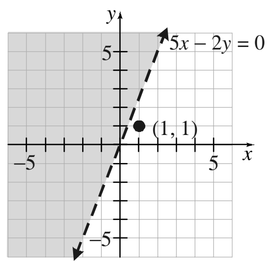
Therefore, (0, 0) is a solution to $y \le -2x + 1$. Shade the half-plane that contains (0, 0).



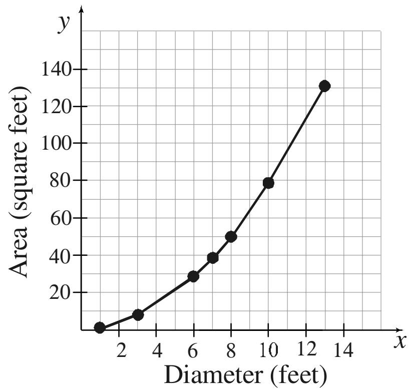
36. Replace the inequality symbol with an equal sign to obtain $5x - 2y = 0$. Because the inequality is strict, graph $5x - 2y = 0$ $\left(y = \dfrac{5}{2}x\right)$ using a dashed line.

Test Point: $(1, 1)$: $\quad 5(1) - 2(1) \stackrel{?}{<} 0$
$5 - 2 \stackrel{?}{<} 0$
$3 \stackrel{?}{<} 0$ False

Therefore, (1, 1) is not a solution to $5x - 2y < 0$. Shade the half-plane that does not contain (1, 1).



37. a.



b. Average rate of change

$$= \frac{7.07 - 0.79}{3 - 1}$$

$= 3.14$ square feet per foot

Between diameters of 1 foot and 3 feet, the area of the circle increases at a rate of 3.14 square feet per foot.

c. Average rate of change

$$= \frac{132.73 - 78.54}{13 - 10}$$

≈ 18.06 square feet per foot

Between diameters of 10 feet and 13 feet, the area of the circle increases at a rate of approximately 18.06 square feet per foot.

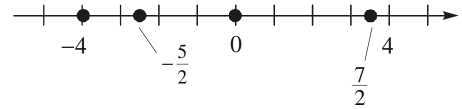
d. No. The area of circles is not linearly related to the diameter. The average rate of change (slope) is not constant.

Cumulative Review Chapters R–1

1. a. (i) 27.235
(ii) 27.236

b. (i) 1.0
(ii) 1.1

2.



3. $-|-14| = -(14) = -14$

4. $-3 + 4 - 7 = 1 - 7 = -6$

5. $\dfrac{-3(12)}{-6} = \dfrac{-36}{-6} = 6$

6. $(-3)^4 = (-3)(-3)(-3)(-3) = 81$

7.
$$\begin{aligned} 5 - 2(1-4)^3 + 5 \cdot 3 &= 5 - 2(-3)^3 + 5 \cdot 3 \\ &= 5 + 54 + 15 = 74 \end{aligned}$$

8. $\dfrac{2}{3} + \dfrac{1}{2} - \dfrac{1}{4} = \dfrac{8}{12} + \dfrac{6}{12} - \dfrac{3}{12} = \dfrac{8 + 6 - 3}{12} = \dfrac{11}{12}$

9. $3(2)^2 + 2(2) - 7 = 3(4) + 4 - 7 = 12 - 3 = 9$

10.
$$\begin{aligned} &4a^2 - 6a + a^2 - 12 + 2a - 1 \\ &= 4a^2 + a^2 - 6a + 2a - 12 - 1 \\ &= 5a^2 - 4a - 13 \end{aligned}$$

11. a. Evaluate the denominator when $x = -2$.

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

Since $x = -2$ makes the denominator 0, it is not in the domain.

b. Evaluate the denominator when $x = 0$.

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

Since $x = 0$ does not make the denominator equal 0, it is in the domain.

12.
$$\begin{aligned} 3(x+2) - 4(2x-1) + 8 &= 3x + 6 - 8x + 4 + 8 \\ &= 3x - 8x + 6 + 4 + 8 \\ &= -5x + 18 \end{aligned}$$

13. Let $x = 3$ in the equation.

$$\begin{aligned} 3 - (2(3) + 3) &\stackrel{?}{=} 5(3) - 1 \\ 3 - (6 + 3) &\stackrel{?}{=} 15 - 1 \\ 3 - 9 &\stackrel{?}{=} 14 \\ -6 &\neq 14 \end{aligned}$$

$x = 3$ is **not** a solution to the equation.

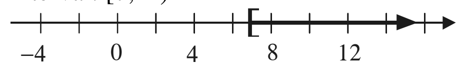
14.
$$
\begin{aligned}
4x-3&=2(3x-2)-7\\
4x-3&=6x-4-7\\
4x-3&=6x-11\\
4x-3-6x&=6x-11-6x\\
-2x-3&=-11\\
-2x-3+3&=-11+3\\
-2x&=-8\\
\frac{-2x}{-2}&=\frac{-8}{-2}\\
x&=4
\end{aligned}
$$
Solution set: $\{4\}$

15.
$$
\begin{aligned}
\frac{x+1}{3}&=x-4\\
3\left(\frac{x+1}{3}\right)&=3(x-4)\\
x+1&=3x-12\\
x+1-3x&=3x-12-3x\\
-2x+1&=-12\\
-2x+1-1&=-12-1\\
-2x&=-13\\
\frac{-2x}{-2}&=\frac{-13}{-2}\\
x&=\frac{13}{2}
\end{aligned}
$$
Solution set: $\left\{\frac{13}{2}\right\}$

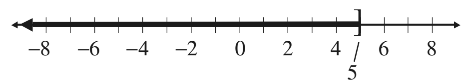
16.
$$
\begin{aligned}
2x-5y&=6\\
2x-5y-2x&=6-2x\\
-5y&=-2x+6\\
\frac{-5y}{-5}&=\frac{-2x+6}{-5}\\
y&=\frac{2}{5}x-\frac{6}{5}
\end{aligned}
$$

17.
$$
\begin{aligned}
\frac{x+3}{2}&\le\frac{3x-1}{4}\\
4\left(\frac{x+3}{2}\right)&\le4\left(\frac{3x-1}{4}\right)\\
2x+6&\le3x-1\\
2x+6-3x&\le3x-1-3x\\
-x+6&\le-1\\
-x+6-6&\le-1-6\\
-x&\le-7\\
x&\ge7
\end{aligned}
$$
Solution set: $\{x \mid x\ge7\}$

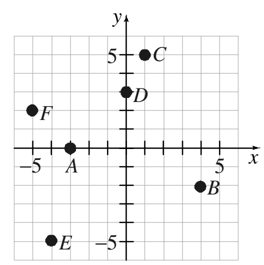
Interval: $[7, \infty)$



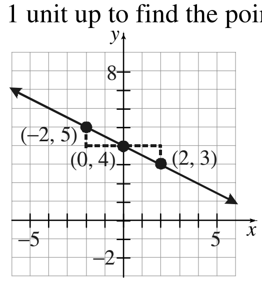
18.
$$
\begin{aligned}
5(x-3)&\ge7(x-4)+3\\
5x-15&\ge7x-28+3\\
5x-15&\ge7x-25\\
5x&\ge7x-10\\
-2x&\ge-10\\
x&\le5
\end{aligned}
$$
$\{x \mid x\le5\}$ or $(-\infty, 5]$



19.

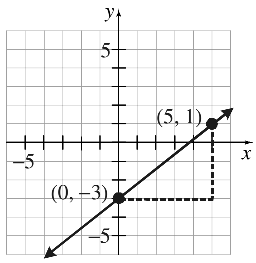


20. For $y=-\frac{1}{2}x+4$, the slope is $-\frac{1}{2}$ and the y-intercept is (0, 4). Begin at (0, 4) and move to the right 2 units and down 1 unit to find the point (2, 3). We can also move 2 unit to the left and 1 unit up to find the point (–2, 5).



21.
$$
\begin{aligned}
4x-5y&=15\\
-5y&=-4x+15\\
y&=\frac{-4x+15}{-5}\\
y&=\frac{4}{5}x-3
\end{aligned}
$$
The slope is $\frac{4}{5}$ and the y-intercept is (0, –3).

Begin at the point (0, –3) and move to the right 5 units and up 4 units to find the point (5, 1).



22. $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{10-(-2)}{-6-3} = \dfrac{12}{-9} = -\dfrac{4}{3}$

$$y - y_1 = m(x - x_1)$$
$$y - 10 = -\frac{4}{3}(x-(-6))$$
$$y - 10 = -\frac{4}{3}(x+6)$$
$$y - 10 = -\frac{4}{3}x - 8$$
$$y = -\frac{4}{3}x + 2 \quad \text{or} \quad 4x + 3y = 6$$

23. The slope of the line we seek is $m = -3$, the same as the slope of the line $y = -3x + 10$

Thus, the equation of the line we seek is:

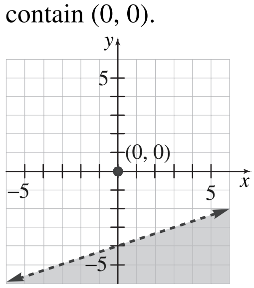
$$y - 7 = -3(x-(-5))$$
$$y - 7 = -3(x+5)$$
$$y - 7 = -3x - 15$$
$$y = -3x - 8 \quad \text{or} \quad 3x + y = -8$$

24. Replace the inequality symbol with an equal sign to obtain $x - 3y = 12$. Because the inequality is strict, graph $x - 3y = 12$ $\left(y = \frac{1}{3}x - 4\right)$ using a dashed line.

Test Point: $(0, 0)$: $0 - 3(0) \overset{?}{>} 12$

$0 \overset{?}{>} 12$ False

Therefore, (0, 0) is a not a solution to $x - 3y > 12$. Shade the half-plane that does not contain (0, 0).



25. Let x = score on final exam.

$$93 \le \frac{94+95+90+97+2x}{6} \le 100$$
$$93 \le \frac{376+2x}{6} \le 100$$
$$6(93) \le 6\left(\frac{376+2x}{6}\right) \le 6(100)$$
$$558 \le 376 + 2x \le 600$$
$$558 - 376 \le 376 + 2x - 376 \le 600 - 376$$
$$182 \le 2x \le 224$$
$$\frac{182}{2} \le \frac{2x}{2} \le \frac{224}{2}$$
$$91 \le x \le 112$$

Shawn needs to score at least 91 on the final exam to earn an A (assuming the maximum score on the exam is 100).

26. Let x = weight in pounds.

$$0.2x - 2 \ge 30$$
$$0.2x - 2 + 2 \ge 30 + 2$$
$$0.2x \ge 32$$
$$\frac{0.2x}{0.2} \ge \frac{32}{0.2}$$
$$x \ge 160$$

A person 62 inches tall would be considered obese if they weighed 160 pounds or more.

27. Let x = measure of the smaller angle.

Larger angle: $15 + 2x$

$$x + (15 + 2x) = 180$$
$$3x + 15 = 180$$
$$3x + 15 - 15 = 180 - 15$$
$$3x = 165$$
$$\frac{3x}{3} = \frac{165}{3}$$
$$x = 55$$

The angles measure $55°$ and $125°$.

28. Let h = height of cylinder in inches.

$$S = 2\pi r^2 + 2\pi rh$$
$$100 = 2\pi(2)^2 + 2\pi(2)h$$
$$100 = 8\pi + 4\pi h$$
$$100 - 8\pi = 4\pi h$$
$$h = \frac{100 - 8\pi}{4\pi} \approx 5.96$$

The cylinder should be about 5.96 inches tall.

29. Let x = first even integer.
Second even integer: $x+2$
Third even integer: $x+4$

$$x+(x+2)=22+(x+4)$$
$$2x+2=x+26$$
$$2x+2-x=x+26-x$$
$$x+2=26$$
$$x+2-2=26-2$$
$$x=24$$

The three consecutive even integers are 24, 26, and 28.