# Chapter 3 Systems of Linear Equations

## Section 3.1 Practice Exercises

**1.** **a.** system
**b.** solution
**c.** intersect
**d.** consistent
**e.** the empty set, $\{\ \}$
**f.** dependent
**g.** independent

**3.** $y = 8x - 5$
$y = 4x + 3$
Substitute $(-1, 13)$:
$13 = 8(-1) - 5$
$= -8 - 5 = -13$
Not a solution.
Substitute $(-1, 1)$:
$1 = 8(-1) - 5$
$= -8 - 5 = -13$
Not a solution.
Substitute $(2, 11)$:
$11 = 8(2) - 5$
$= 16 - 5 = 11$
$11 = 4(2) + 3$
$= 8 + 3 = 11$
$(2, 11)$ is a solution.

**5.** $2x - 7y = -30$
$y = 3x + 7$
Substitute $(0, -30)$:
$2(0) - 7(-30) = 0 + 210 = 210 \neq -30$
Not a solution.
Substitute $\left(\frac{3}{2}, 5\right)$:
$2\left(\frac{3}{2}\right) - 7(5) = 3 - 35 = -32 \neq -30$
Not a solution.
Substitute $(-1, 4)$:
$2(-1) - 7(4) = -2 - 28 = -30 = -30$
$4 = 3(-1) + 7$
$= -3 + 7$
$= 4$
$(-1, 4)$ is a solution.

**7.** $x - y = 6$
$4x + 3y = -4$
Substitute $(4, -2)$:
$4 - (-2) = 4 + 2 = 6 = 6$
$4(4) + 3(-2) = 16 - 6 = 10 \neq -4$
Not a solution.
Substitute $(6, 0)$:
$6 - 0 = 6 = 6$
$4(6) + 3(0) = 24 + 0 = 24 \neq -4$
Not a solution.
Substitute $(2, 4)$:
$2 - 4 = -2 \neq 6$
Not a solution.

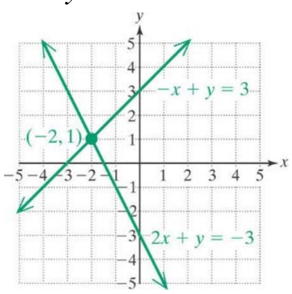
**9.** **a.** Consistent
**b.** Independent
**c.** One solution

**11.** **a.** Inconsistent
**b.** Independent
**c.** Zero solutions

**13.** **a.** Consistent
**b.** Dependent
**c.** Infinitely many solutions

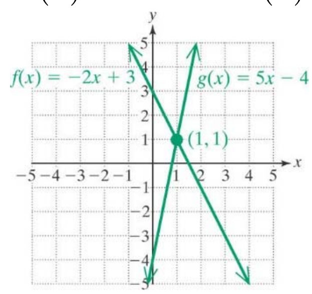
**15.** $2x + y = -3$ $\quad\quad$ $-x + y = 3$

$y = -2x - 3$ $\quad\quad$ $y = x + 3$



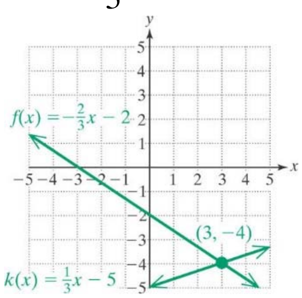

The solution is $\{(-2,1)\}$.

**17.** $f(x) = -2x + 3$ $\quad$ $g(x) = 5x - 4$



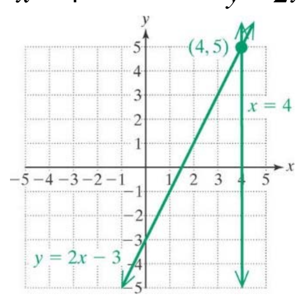

The solution is $\{(1,1)\}$.

**19.** $k(x) = \frac{1}{3}x - 5$ $\quad$ $f(x) = -\frac{2}{3}x - 2$




The solution is $\{(3,-4)\}$.

**21.** $x = 4$ $\quad\quad$ $y = 2x - 3$




The solution is $\{(4,5)\}$.

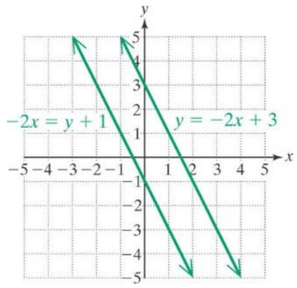
**23.** $y = -2x + 3$ $\quad\quad$ $-2x = y + 1$

$y = -2x - 1$

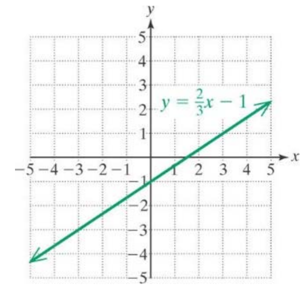
**25.** $y = \frac{2}{3}x - 1$ $\quad\quad$ $2x = 3y + 3$

$3y = 2x - 3$

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



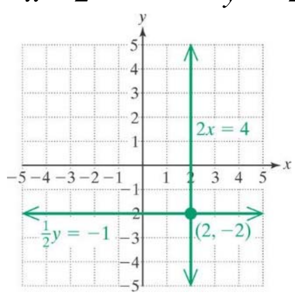

There is no solution; $\{\ \}$.
Inconsistent system.




Infinitely many solutions of the form $\left\{(x,y)\middle|\, y=\frac{2}{3}x-1\right\}$. Dependent equations.

**27.**

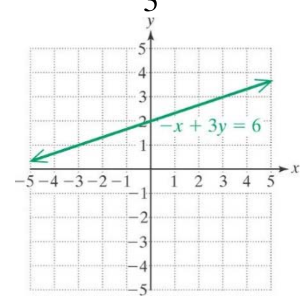
$$2x = 4 \qquad \frac{1}{2}y = -1$$
$$x = 2 \qquad y = -2$$




The solution is $\{(2,-2)\}$.

**29.**

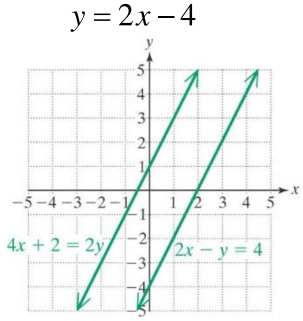
$$-x+3y=6 \qquad 6y=2x+12$$
$$3y=x+6 \qquad y=\frac{1}{3}x+2$$
$$y=\frac{1}{3}x+2$$




Infinitely many solutions of the form $\{(x,y)\,|\,-x+3y=6\}$. Dependent equations.

**31.**

$$2x-y=4 \qquad 4x+2=2y$$
$$-y=-2x+4 \qquad 2y=4x+2$$
$$y=2x-4 \qquad y=2x+1$$




There is no solution; $\{\ \}$. Inconsistent system.

**33.** False

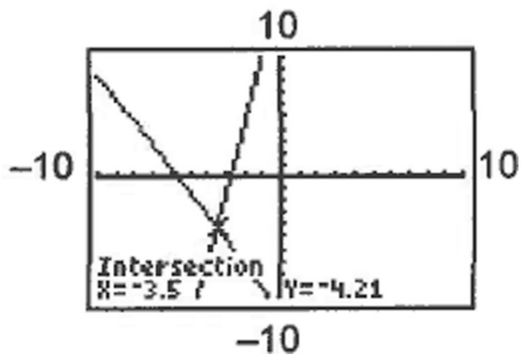
**35.** True

**37.** For example: The system $\begin{aligned} x+y&=9 \\ 2x+y&=13 \end{aligned}$ has solution $\{(4,5)\}$.

**39.**
$$\begin{aligned} Cx+2y&=11 \\ C(1)+2(3)&=11 \\ C+6&=11 \\ C&=5 \end{aligned}$$

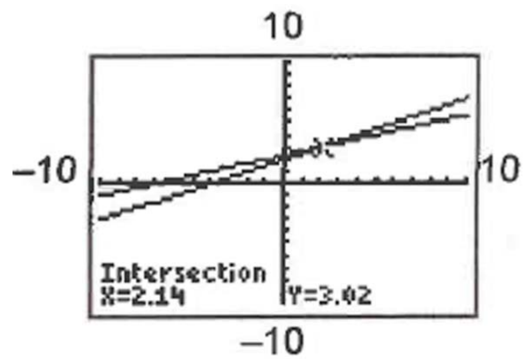
$$\begin{aligned} -3x+Dy&=9 \\ 3(1)+D(3)&=9 \\ -3+3D&=9 \\ 3D&=12 \\ D&=4 \end{aligned}$$

**41.**
$$\begin{aligned} y&=5.62x+15.46 \\ y&=-1.96x-11.07 \end{aligned}$$




$\{(-3.5,-4.21)\}$

**43.**
$$\begin{aligned} 2.4x-4.8y&=-9.36 \\ -4.8y&=-2.4x-9.36 \\ y&=0.5x+1.95 \\ -1.8x+5.4y&=12.456 \\ 5.4y&=1.8x+12.456 \\ y&=\frac{1}{3}x+\frac{173}{75} \end{aligned}$$




$\{(2.14,3.02)\}$

## Section 3.2 Practice Exercises

**1.** $y=8x-1$

$$\begin{aligned} 2x-16y&=3 \\ -16y&=-2x+3 \\ y&=\frac{1}{8}x-\frac{3}{16} \end{aligned}$$

One solution

**3.**
$$\begin{aligned} 2x-4y&=0 \\ -4y&=-2x \\ y&=\frac{1}{2}x \end{aligned}$$

$$\begin{aligned} x-2y&=9 \\ -2y&=-x+9 \\ y&=\frac{1}{2}x-\frac{9}{2} \end{aligned}$$

No solution

**5.** $-x+2y=10$ $\quad$ $2x-y=11$

$-(-4)+2(3)=10$ $\quad$ $2(-4)-3=11$

$4+6=10$ $\quad$ $-8-3=11$

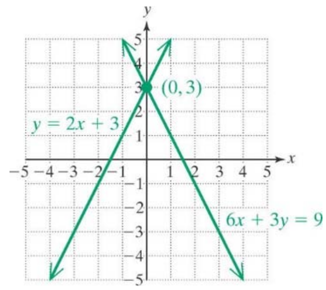
$10=10$ $\quad$ $-11=11$

$(-4,3)$ is not a solution.

**7.** $y=2x+3$ $\quad$ $6x+3y=9$

$3y=-6x+9$

$y=-2x+3$




The solution is $\{(0,3)\}$.

**9.** $y=-3x-1$

$2x-3y=-8$

$2x-3(-3x-1)=-8$

$2x+9x+3=-8$

$11x=-11$

$x=-1$

$y=-3x-1=-3(-1)-1=3-1=2$

The solution is $\{(-1,2)\}$.

**11.** $-3x+8y=-1$

$4x-11=y$

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

$-3x+32x-88=-1$

$29x=87$

$x=3$

$y=4x-11=4(3)-11=12-11=1$

The solution is $\{(3,1)\}$.

**13.** $3x+12y=36$

$x-5y=12 \rightarrow x=5y+12$

$3(5y+12)+12y=36$

$15y+36+12y=36$

$27y=0$

$y=0$

$x=5y+12=5(0)+12=0+12=12$

The solution is $\{(12,0)\}$.

**15.** $x-y=8 \rightarrow x=y+8$

$3x+2y=9$

$3(y+8)+2y=9$

$3y+24+2y=9$

$5y=-15$

$y=-3$

$x=y+8=-3+8=5$

The solution is $\{(5,-3)\}$.

**17.** $2x-y=-1$

$y=-2x$

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

$4x=-1$

**19.** $2x+3=7 \rightarrow 2x=4 \rightarrow x=2$

$3x-4y=6$

$3(2)-4y=6$

$6-4y=6$

$4y=0$

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

$y = -2x = -2\left(-\frac{1}{4}\right) = \frac{1}{2}$

The solution is $\left\{\left(-\frac{1}{4}, \frac{1}{2}\right)\right\}$.

$y = 0$

The solution is $\{(2,0)\}$.

**21.** $4x - 5y = 14$

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

$4x - 5\left(\frac{x-7}{3}\right) = 14$

$3(4x) - 5(x-7) = 3(14)$

$12x - 5x + 35 = 42$

$7x + 35 = 42$

$7x = 7$

$x = 1$

$y = \frac{1-7}{3} = \frac{-6}{3} = -2$

The solution is $\{(1,-2)\}$.

**23.** $2x - 6y = -2$

$x = 3y - 1$

$2(3y-1) - 6y = -2$

$6y - 2 - 6y = -2$

$-2 = -2$

Infinitely many solutions of the form $\{(x,y) \mid x = 3y - 1\}$; dependent equations.

**25.** $y = \frac{1}{7}x + 3$

$x - 7y = -4$

$x - 7\left(\frac{1}{7}x + 3\right) = -4$

$x - x - 21 = -4$

$-21 \neq -4$

There is no solution; $\{\ \}$. This is an inconsistent system.

**27.** $5x - y = 10 \rightarrow y = 5x - 10$

$2y = 10x - 5$

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

$10x - 20 = 10x - 5$

$-20 \neq -5$

There is no solution; $\{\ \}$. This is an inconsistent system.

**29.** $3x - y = 7 \rightarrow y = 3x - 7$

$-14 + 6x = 2y$

$-14 + 6x = 2(3x - 7)$

$-14 + 6x = 6x - 14$

$-14 = -14$

**31.** If you get an identity, such as 0 = 0 or 5 = 5 when solving a system of equations, then the equations are dependent.

Infinitely many solutions of the form $\{(x,y) | 3x - y = 7\}$; dependent equations.

**33.** $x = 1.3y + 1.5$

$y = 1.2x - 4.6$

$$x = 1.3(1.2x - 4.6) + 1.5$$
$$x = 1.56x - 5.98 + 1.5$$
$$-0.56x = -4.48$$
$$x = 8$$
$$y = 1.2x - 4.6$$
$$= 1.2(8) - 4.6$$
$$= 9.6 - 4.6$$
$$= 5$$

The solution is $\{(8,5)\}$.

**35.** $y = \frac{2}{3}x - \frac{1}{3}$

$x = \frac{1}{4}y + \frac{17}{4}$

$$x = \frac{1}{4}\left(\frac{2}{3}x - \frac{1}{3}\right) + \frac{17}{4}$$
$$x = \frac{1}{6}x - \frac{1}{12} + \frac{17}{4}$$
$$\frac{5}{6}x = -\frac{1}{12} + \frac{51}{12}$$
$$\frac{5}{6}x = \frac{50}{12}$$
$$x = \frac{50}{12} \cdot \frac{6}{5} = \frac{300}{60} = 5$$
$$y = \frac{2}{3}x - \frac{1}{3} = \frac{2}{3}(5) - \frac{1}{3} = \frac{10}{3} - \frac{1}{3} = \frac{9}{3}$$
$$= 3$$

The solution is $\{(5,3)\}$.

**37.** $-2x + y = 4 \rightarrow y = 2x + 4$

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

$$-\frac{1}{4}x + \frac{1}{8}(2x + 4) = \frac{1}{4}$$
$$-\frac{1}{4}x + \frac{1}{4}x + \frac{1}{2} = \frac{1}{4}$$
$$\frac{1}{2} \neq \frac{1}{4}$$

There is no solution; $\{\ \}$. This is an inconsistent system.

**39.** $3x + 2y = 6$

$y = x + 3$

$$3x + 2(x + 3) = 6$$
$$3x + 2x + 6 = 6$$
$$5x + 6 = 6$$
$$5x = 0$$
$$x = 0$$
$$y = 0 + 3 = 3$$

The solution is $\{(0,3)\}$.

**41.** $-300x - 125y = 1350$

$y + 2 = 8 \rightarrow y = 6$

**43.** $2x - y = 6 \rightarrow y = 2x - 6$

$\frac{1}{6}x - \frac{1}{12}y = \frac{1}{2}$

$$-300x-125(6)=1350$$
$$-300x-750=1350$$
$$-300x=2100$$
$$x=-7$$
The solution is $\{(-7,6)\}$.

$$\frac{1}{6}x-\frac{1}{12}(2x-6)=\frac{1}{2}$$
$$\frac{1}{6}x-\frac{1}{6}x+\frac{1}{2}=\frac{1}{2}$$
$$\frac{1}{2}=\frac{1}{2}$$
Infinitely many solutions of the form $\{(x,y)|2x-y=6\}$; dependent equations.

**45.** $y=-2.7x-5.1$
$$y=3.1x-63.1$$
$$3.1x-63.1=-2.7x-5.1$$
$$5.8x=58$$
$$x=10$$
$$y=3.1x-63.1=3.1(10)-63.1$$
$$=31-63.1=-32.1$$
The solution is $\{(10,-32.1)\}$.

**47.** $4x+4y=5$
$$x-4y=-\frac{5}{2}\rightarrow x=4y-\frac{5}{2}$$
$$4\left(4y-\frac{5}{2}\right)+4y=5$$
$$16y-10+4y=5$$
$$20y=15$$
$$y=\frac{15}{20}=\frac{3}{4}$$
$$x=4y-\frac{5}{2}=4\left(\frac{3}{4}\right)-\frac{5}{2}=3-\frac{5}{2}=\frac{1}{2}$$
The solution is $\left\{\left(\frac{1}{2},\frac{3}{4}\right)\right\}$.

**49.** $2(x+2y)=12\rightarrow x+2y=6$
$$x=-2y+6$$
$$-6x=5y-8$$
$$-6(-2y+6)=5y-8$$
$$12y-36=5y-8$$
$$7y=28$$
$$y=\frac{28}{7}=4$$
$$x=-2(4)+6$$
$$=-8+6$$
$$=-2$$
The solution is $\{(-2,4)\}$.

**51.** $5(3y-2)=x+4\rightarrow 15y-10=x+4$
$$\rightarrow 15y-14=x$$
$$4y=7x-3$$
$$4y=7(15y-14)-3$$
$$4y=105y-98-3$$
$$4y=105y-101$$
$$-101y=-101$$
$$y=1$$
$$x=15(1)-14$$
$$=15-14$$
$$=1$$
The solution is $\{(1,1)\}$.

**53.** $2x-5=7$

$2x=12$

$x=6$

$4=3y+1$

$3=3y$

$y=1$

The solution is $\{(6,1)\}$.

**55.** $0.01y=0.02x-0.11 \rightarrow y=2x-11$

$0.3x-0.5y=2 \rightarrow 3x-5y=20$

$3x-5(2x-11)=20$

$3x-10x+55=20$

$-7x+55=20$

$-7x=-35$

$x=5$

$y=2(5)-11$

$=10-11$

$=-1$

The solution is $\{(5,-1)\}$.

**57.** **a.** points $(-4,1)$ and $(5,5)$

$m=\frac{5-1}{5-(-4)}=\frac{4}{5+4}=\frac{4}{9}$

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

$(x_1,y_1)=(-4,1)$

$y-1=\frac{4}{9}[x-(-4)]$

$y-1=\frac{4}{9}x+\frac{16}{9}$

$y=\frac{4}{9}x+\frac{25}{9}$

**b.** points $(-3,5)$ and $(4,1)$

$m=\frac{1-5}{4-(-3)}=\frac{-4}{7}=-\frac{4}{7}$

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

$(x_1,y_1)=(-3,5)$

$y-5=-\frac{4}{7}[x-(-3)]$

$y-5=-\frac{4}{7}x-\frac{12}{7}$

$y=-\frac{4}{7}x+\frac{23}{7}$

**c.** $\frac{4}{9}x+\frac{25}{9}=-\frac{4}{7}x+\frac{23}{7}$

$63\left[\frac{4}{9}x+\frac{25}{9}\right]=63\left[-\frac{4}{7}x+\frac{23}{7}\right]$

$28x+175=-36x+207$

$64x=32$

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

$y=\frac{4}{9}x+\frac{25}{9}$

$y=\frac{4}{9}\left(\frac{1}{2}\right)+\frac{25}{9}=\frac{2}{9}+\frac{25}{9}=\frac{27}{9}=3$

The centroid is $\left(\frac{1}{2},3\right)$.

**59.** **a.** At Glendale Lakes:

$y = 800x + 250$

At the Breakers: $y = 750x + 500$

**b.** $800x + 250 = 750x + 500$

$50x = 250$

$x = 5$

The amount spent is the same for 5 months.

## Section 3.3 Practice Exercises

**1.** **a.** $-3$

**b.** $5$

**3.** One solution – different slopes

**5.** Add the two equations and solve for *y*:

$$\begin{aligned} 3x - y &= -1 \\ -3x + 4y &= -14 \\ \hline 3y &= -15 \\ y &= -5 \end{aligned}$$

Substitute into the first equation and solve for *x*:

$$\begin{aligned} 3x - (-5) &= -1 \\ 3x + 5 &= -1 \\ 3x &= -6 \\ x &= -2 \end{aligned}$$

The solution is $\{(-2, -5)\}$.

**7.** $2x + 3y = 3$

$-10x + 2y = -32$

Multiply the first equation by 5, add to the second equation and solve for *y*:

$$\begin{aligned} 2x + 3y = 3 &\xrightarrow{\times 5} 10x + 15y = 15 \\ -10x + 2y = -32 &\longrightarrow -10x + 2y = -32 \\ & \hline 17y = -17 \\ & y = -1 \end{aligned}$$

Substitute into the first equation and solve for *x*:

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

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

**9.** $3x + 7y = -20$

$-5x + 3y = -84$

Multiply the first equation by 5 and the second equation by 3, add the results and solve for *y*:

**11.** Write in standard form:

$3x = 10y + 13 \rightarrow 3x - 10y = 13$

$7y = 4x - 11 \rightarrow -4x + 7y = -11$

Multiply the first equation by 4 and the second equation by 3, add the results and solve for *y*:

$$\begin{aligned} 3x+7y=-20 &\xrightarrow{\times 5} 15x+35y=-100 \\ -5x+3y=-84 &\xrightarrow{\times 3} \underline{-15x+9y=-252} \\ &\qquad 44y=-352 \\ &\qquad y=-8 \end{aligned}$$

Substitute into the first equation and solve for $x$:

$$\begin{aligned} 3x+7(-8)&=-20 \\ 3x-56&=-20 \\ 3x&=36 \\ x&=12 \end{aligned}$$

The solution is $\{(12,-8)\}$.

$$\begin{aligned} 3x-10y=13 &\xrightarrow{\times 4} 12x-40y=52 \\ -4x+7y=-11 &\xrightarrow{\times 3} \underline{-12x+21y=-33} \\ &\qquad -19y=19 \\ &\qquad y=-1 \end{aligned}$$

Substitute into the first equation and solve for $x$:

$$\begin{aligned} 3x&=10(-1)+13 \\ 3x&=-10+13 \\ 3x&=3 \\ x&=1 \end{aligned}$$

The solution is $\{(1,-1)\}$.

**13.** Multiply each equation by 10:

$$\begin{aligned} 1.2x-0.6y=3 &\rightarrow 12x-6y=30 \\ 0.8x-1.4y=3 &\rightarrow 8x-14y=30 \end{aligned}$$

Multiply the first equation by 2 and the second equation by –3, add the results and solve for $y$:

$$\begin{aligned} 12x-6y=30 &\xrightarrow{\times 2} 24x-12y=60 \\ 8x-14y=30 &\xrightarrow{\times -3} \underline{-24x+42y=-90} \\ &\qquad 30y=-30 \\ &\qquad y=-1 \end{aligned}$$

Substitute into the first equation and solve for $x$:

$$\begin{aligned} 12x-6(-1)&=30 \\ 12x+6&=30 \\ 12x&=24 \\ x&=2 \end{aligned}$$

The solution is $\{(2,-1)\}$.

**15.** Write in standard form:

$$\begin{aligned} 3x+2=4y+2 &\rightarrow 3x-4y=0 \\ 7x=3y &\rightarrow 7x-3y=0 \end{aligned}$$

Multiply the first equation by 3 and the second equation by –4, add the results and solve for $x$:

$$\begin{aligned} 3x-4y=0 &\xrightarrow{\times 3} 9x-12y=0 \\ 7x-3y=0 &\xrightarrow{\times -4} \underline{-28x+12y=0} \\ &\qquad -19x=0 \\ &\qquad x=0 \end{aligned}$$

Substitute into the first equation and solve for $y$:

$$\begin{aligned} 3(0)-4y&=0 \\ 0-4y&=0 \\ -4y&=0 \\ y&=0 \end{aligned}$$

The solution is $\{(0.0)\}$.

**17.**

$$\begin{aligned} 3x-2y&=1 \\ -6x+4y&=-2 \end{aligned}$$

Multiply the first equation by 2, add to the second equation and solve for $y$:

**19.** Write in standard form:

$$\begin{aligned} 6y=14-4x &\rightarrow 4x+6y=14 \\ 2x=-3y-7 &\rightarrow 2x+3y=-7 \end{aligned}$$

Multiply the second equation by –2, add to the first equation and solve for $y$:

$$\begin{array}{rl} 3x-2y=1 \xrightarrow{\times 2} & 6x-4y=2 \\ -6x+4y=-2 \longrightarrow & -6x+4y=-2 \\ \hline & 0=0 \end{array}$$

Infinitely many solutions of the form $\{(x,y) | 3x-2y=1\}$; dependent equations.

$$\begin{array}{rl} 4x+6y=14 \longrightarrow & 4x+6y=14 \\ 2x+3y=-7 \xrightarrow{\times -2} & -4x-6y=14 \\ \hline & 0 \neq 28 \end{array}$$

There is no solution; $\{ \}$. This is an inconsistent system.

**21.** Write in standard form:

$$\begin{array}{rl} 12x-4y=2 & \rightarrow 12x-4y=2 \\ 6x=1+2y & \rightarrow 6x-2y=1 \end{array}$$

Multiply the second equation by –2, add to the first equation and solve for $y$:

$$\begin{array}{rl} 12x-4y=2 \longrightarrow & 12x-4y=2 \\ 6x-2y=1 \xrightarrow{\times -2} & -12x+4y=-2 \\ \hline & 0=0 \end{array}$$

Infinitely many solutions of the form $\{(x,y) | 12x-4y=2\}$; dependent equations.

**23.** $\frac{1}{2}x+y=\frac{7}{6}$

$x+2y=4.5$

Multiply the first equation by –2, add to the second equation and solve for $y$:

$$\begin{array}{rl} \frac{1}{2}x+y=\frac{7}{6} \xrightarrow{\times -2} & -x-2y=-\frac{7}{3} \\ x+2y=4.5 \longrightarrow & x+2y=4.5 \\ \hline & 0 \neq \frac{13}{6} \end{array}$$

There is no solution; $\{ \}$. This is an inconsistent system.

**25.** Use the substitution method if one equation has $x$ or $y$ already isolated.

**27.** False

**29.** True

**31.** True

**33.** $2x-4y=8$

$y=2x+1$

$2x-4(2x+1)=8$

$2x-8x-4=8$

$-6x=12$

$x=-2$

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

The solution is $\{(-2,-3)\}$.

**35.** $2x+5y=9$

$4x-7y=-16$

Multiply the first equation by –2, add to the second equation and solve for $y$:

$$\begin{array}{rl} 2x+5y=9 \xrightarrow{\times -2} & -4x-10y=-18 \\ 4x-7y=-16 \longrightarrow & 4x-7y=-16 \\ \hline & -17y=-34 \\ & y=2 \end{array}$$

Substitute into the first equation and solve for $x$:

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

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

**37.** $0.2x-0.1y=0.8$
$0.1x-0.1y=0.4 \rightarrow 0.1x=0.1y+0.4$
$\rightarrow x=y+4$
$0.2(y+4)-0.1y=0.8$
$0.2y+0.8-0.1y=0.8$
$0.1y+0.8=0.8$
$0.1y=0$
$y=0$
$x=0+4$
$=4$

The solution is $\{(4,0)\}$.

**39.** $4x-6y=5$
$2x-3y=7$

Multiply the second equation by –2, add to the first equation and solve for *y*:

$4x-6y=5 \longrightarrow 4x-6y=5$
$2x-3y=7 \xrightarrow{\times -2} -4x+6y=-14$
$0\neq -9$

There is no solution; $\{\ \}$. This is an inconsistent system.

**41.** Multiply each equation by the LCD:

$\frac{1}{4}x-\frac{1}{6}y=-2 \xrightarrow{\times 12} 3x-2y=-24$
$-\frac{1}{6}x+\frac{1}{5}y=4 \xrightarrow{\times 30} -5x+6y=120$

Multiply the first equation by 3, add to the second equation and solve for *x*:

$3x-2y=-24 \xrightarrow{\times 3} 9x-6y=-72$
$-5x+6y=120 \longrightarrow -5x+6y=120$
$4x=48$
$x=12$

Substitute into the first equation and solve for *y*:

**43.** $\frac{1}{3}x-\frac{1}{2}y=0$
$x=\frac{3}{2}y$
$\frac{1}{3}\left(\frac{3}{2}y\right)-\frac{1}{2}y=0$
$\frac{1}{2}y-\frac{1}{2}y=0$
$0=0$

Infinitely many solutions of the form $\left\{(x,y)\,\middle|\,x=\frac{3}{2}y\right\}$. The equations are dependent.

$$3(12)-2y=-24$$
$$36-2y=-24$$
$$-2y=-60$$
$$y=30$$

The solution is $\{(12,30)\}$.

**45.** Write in standard form:

$$2(x+2y)=20-y \rightarrow 2x+4y=20-y$$
$$\rightarrow 2x+5y=20$$
$$-7(x-y)=16+3y \rightarrow -7x+7y=16+3y$$
$$\rightarrow -7x+4y=16$$

Multiply the first equation by 4 and the second equation by –5, add the results and solve for *x*:

$$2x+5y=20 \xrightarrow{\times 4} 8x+20y=80$$
$$-7x+4y=16 \xrightarrow{\times -5} 35x-20y=-80$$
$$43x=0$$
$$x=0$$

Substitute into the first equation and solve for *y*:

$$2(0)+5y=20$$
$$0+5y=20$$
$$5y=20$$
$$y=4$$

The solution is $\{(0,4)\}$.

**47.** Solve each equation:

$$-4y=10$$
$$y=-\frac{10}{4}=-\frac{5}{2}$$

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

The solution is $\left\{\left(-\frac{1}{2},-\frac{5}{2}\right)\right\}$.

**49.**

$$0.04x=-0.05y+1.7 \rightarrow 4x=-5y+170$$
$$\rightarrow 4x+5y=170$$
$$-0.03y=-2.4+0.07x \rightarrow -3y=-240+7x$$
$$\rightarrow 7x+3y=240$$

Multiply the first equation by 3 and the second equation by –5, add the results and solve for *x*:

**51.** Write in standard form:

$$3x-2=\frac{1}{3}(11+5y) \rightarrow 3x-2=\frac{11}{3}+\frac{5}{3}y$$
$$\rightarrow 3x-\frac{5}{3}y=\frac{17}{3} \rightarrow 9x-5y=17$$
$$x+\frac{2}{3}(2y-3)=-2 \rightarrow x+\frac{4}{3}y-2=-2$$
$$\rightarrow x+\frac{4}{3}y=0 \rightarrow 3x+4y=0$$

$$\begin{aligned} 4x+5y=170 &\xrightarrow{\times 3} & 12x+15y &= 510 \\ 7x+3y=240 &\xrightarrow{\times -5} & -35x-15y &= -1200 \\ \hline & & -23x &= -690 \\ & & x &= 30 \end{aligned}$$

Substitute into the first equation and solve for $y$:

$$\begin{aligned} 4(30)+5y &= 170 \\ 120+5y &= 170 \\ 5y &= 50 \\ y &= 10 \end{aligned}$$

The solution is $\{(30,10)\}$.

Multiply the second equation by –3, add to the first equation and solve for $y$:

$$\begin{aligned} 9x-5y=17 &\longrightarrow & 9x-5y &= 17 \\ 3x+4y=0 &\xrightarrow{\times -3} & -9x-12y &= 0 \\ \hline & & -17y &= 17 \\ & & y &= -1 \end{aligned}$$

Substitute into the first equation and solve:

$$\begin{aligned} 9x-5(-1) &= 17 \\ 9x+5 &= 17 \\ 9x &= 12 \\ x &= \frac{12}{9} = \frac{4}{3} \end{aligned}$$

The solution is $\left\{\left(\frac{4}{3},-1\right)\right\}$.

**53.**

$$\begin{aligned} \frac{1}{4}x+\frac{1}{2}y &= \frac{11}{4} \\ \frac{2}{3}x+\frac{1}{3}y &= \frac{7}{3} \end{aligned}$$

Multiply the first equation by 4 and the second equation by –6, add the results and solve for $x$:

$$\begin{aligned} \frac{1}{4}x+\frac{1}{2}y=\frac{11}{4} &\xrightarrow{\times 4} & x+2y &= 11 \\ \frac{2}{3}x+\frac{1}{3}y=\frac{7}{3} &\xrightarrow{\times -6} & -4x-2y &= -14 \\ \hline & & -3x &= -3 \\ & & x &= 1 \end{aligned}$$

Substitute into the first equation above and solve for $y$:

$$\begin{aligned} 1+2y &= 11 \\ 2y &= 10 \\ y &= 5 \end{aligned}$$

The solution is $\{(1,5)\}$.

**55.**

$$4x=3y \rightarrow x=\frac{3}{4}y$$

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

Substitute for $x$ and solve for $y$:

$$\begin{aligned} y &= \frac{4}{3}\left(\frac{3}{4}y\right)+2 \\ y &= y+2 \\ 0 &= 2 \end{aligned}$$

There is no solution; $\{\ \}$. This is an inconsistent system.

**57.** Multiply each equation by the LCD:

$$\frac{1}{16}c+\frac{1}{24}h=12\xrightarrow{\times 48}3c+2h=576$$
$$\frac{1}{14}c+\frac{1}{20}h=14\xrightarrow{\times 140}10c+7h=1960$$

Multiply the first equation by $-\frac{10}{3}$, add to the second equation and solve for $h$:

$$\begin{aligned} 3c+2h=576 &\xrightarrow{\times -\frac{10}{3}} -10c-\frac{20}{3}h=-1920 \\ 10c+7h=1960 &\xrightarrow{\phantom{\times}} \underline{\;10c + 7h=1960\;} \\ &\qquad\qquad \frac{1}{3}h=40 \\ &\qquad\qquad h=120 \end{aligned}$$

Substitute into the first equation and solve for $c$:

$$\begin{aligned} 3c+2h&=576 \\ 3c+2(120)&=576 \\ 3c+240&=576 \\ 3c&=336 \\ c&=112 \end{aligned}$$

112 mi in the city and 120 mi on the highway.

**59.**
$$9x+11y=47$$
$$-5x+3y=23$$

Multiply the first equation by –3 and the second equation by 11, add the results and solve for $x$:

$$\begin{aligned} 9x+11y=47 &\xrightarrow{\times -3} -27x-33y=-141 \\ -5x+3y=23 &\xrightarrow{\times 11} \underline{-55x+33y=\;253} \\ &\qquad -82x \qquad\;\; =112 \\ &\qquad x=-\frac{112}{82}=-\frac{56}{41} \end{aligned}$$

Multiply the first equation by 5 and the second equation by 9, add the results and solve for $y$:

$$\begin{aligned} 9x+11y=47 &\xrightarrow{\times 5} 45x+55y=235 \\ -5x+3y=23 &\xrightarrow{\times 9} \underline{-45x+27y=207} \\ &\qquad 82y=442 \\ &\qquad y=\frac{442}{82}=\frac{221}{41} \end{aligned}$$

The solution is $\left\{\left(-\frac{56}{41},\frac{221}{41}\right)\right\}$.

**61.**
$$4x-10y=\;19$$
$$5x+12y=-41$$

Multiply the first equation by 6 and the second equation by 5, add the results and solve for $x$:

$$\begin{aligned} 4x-10y=19 &\xrightarrow{\times 6} 24x-60y=\;114 \\ 5x+12y=-41 &\xrightarrow{\times 5} \underline{25x+60y=-205} \\ &\qquad 49x=-91 \\ &\qquad x=-\frac{91}{49} \\ &\qquad\;\; =-\frac{13}{7} \end{aligned}$$

Multiply the first equation by –5 and the second equation by 4, add the results and solve for $y$:

$$\begin{aligned} 4x-10y=19 &\xrightarrow{\times -5} -20x+50y=-95 \\ 5x+12y=-41 &\xrightarrow{\times 4} \underline{20x+48y=-164} \\ &\qquad 98y=-259 \\ &\qquad y=-\frac{259}{98}=-\frac{37}{14} \end{aligned}$$

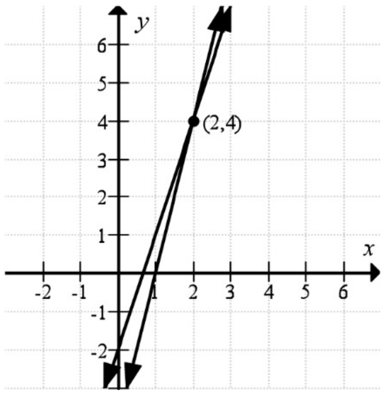
The solution is $\left\{\left(-\frac{13}{7},-\frac{37}{14}\right)\right\}$.

**Problem Recognition Exercises: Solving Systems of Linear Equations**

**1.** **a.** $-3x + y = -2$ $\quad$ $4x - y = 4$

$y = 3x - 2$ $\quad$ $-y = -4x + 4$

$y = 4x - 4$




The solution is $\{(2,4)\}$.

**b.** $-3x + y = -2 \rightarrow y = 3x - 2$

$4x - y = 4$

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

$4x - 3x + 2 = 4$

$x + 2 = 4$

$x = 2$

$y = 3(2) - 2$

$= 6 - 2$

$= 4$

The solution is $\{(2,4)\}$.

**c.** $-3x + y = -2$

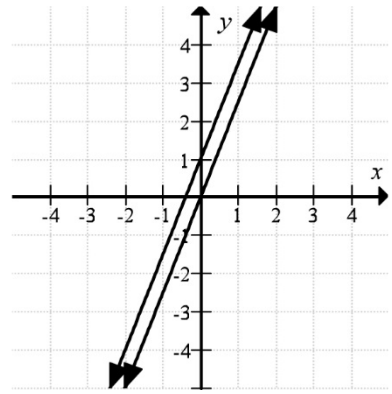
$4x - y = 4$

Add the equations and solve for *x*:

$$\begin{array}{r} -3x + y = -2 \\ 4x - y = 4 \\ \hline x \quad = 2 \end{array}$$

**3.** **a.** $5x = 2y \rightarrow y = \frac{5}{2}x$

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




No solution; $\{ \}$; inconsistent system

**b.** $\frac{5}{2}x = \frac{5}{2}x + 1$

$0 = 1$

No solution; $\{ \}$; inconsistent system

**c.** Write in standard form:

$5x = 2y$ $\quad$ $y = \frac{5}{2}x + 1$

$5x - 2y = 0$ $\quad$ $2y = 5x + 2$

$-5x + 2y = 2$

Substitute into the first equation and solve for *y*:

$$-3(2)+y=-2$$
$$-6+y=-2$$
$$y=4$$

The solution is $\{(2,4)\}$.

Add the equations to solve for *x*:

$$\begin{array}{r} 5x-2y=0 \\ \underline{-5x+2y=2} \\ 0=2 \end{array}$$

No solution; $\{\ \}$; inconsistent system

**5.** $y=-4x-9$
$8x+3y=-29$

Substitute the first equation into the second and solve for *x*:

$$8x+3(-4x-9)=-29$$
$$8x-12x-27=-29$$
$$-4x-27=-29$$
$$-4x=-2$$
$$x=\frac{1}{2}$$
$$y=-4x-9=-4\left(\frac{1}{2}\right)-9=-2-9$$
$$=-11$$

The solution is $\left\{\left(\frac{1}{2},-11\right)\right\}$.

**7.** $5x-3y=\ \ 2$
$7x+4y=-30$

Multiply the first equation by 4 and the second equation by 3, add the results and solve for *x*:

$$5x-3y=\ \ 2\xrightarrow{\times 4}20x-12y=\ \ 8$$
$$7x+4y=-30\xrightarrow{\times 3}\underline{21x+12y=-90}$$
$$41x=-82$$
$$x=-2$$

Substitute into the first equation and solve for *y*:

$$5(-2)-3y=2$$
$$-10-3y=2$$
$$-3y=12$$
$$y=-4$$

The solution is $\{(-2,-4)\}$.

## Section 3.4 Practice Exercises

**1.** **a.** $5\cdot\$12=\$60$
$x\cdot 12=12x$

**b.** $0.10\cdot 20=2\text{L}$
$0.10\cdot x=0.10x$

**c.** $0.04\cdot\$5000=\$200$
$0.04\cdot y=0.04y$

**d.** $b-c$ ; $b+c$

**e.** $180°$

**f.** $180°$

**g.** $90°$

**h.** $90°$

**3.** Substitution:

$$\begin{aligned} y &= 9-2x \\ 3x-y &= 16 \\ 3x-(9-2x) &= 16 \\ 3x-9+2x &= 16 \\ 5x &= 25 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} y &= 9-2x \\ &= 9-2(5) \\ &= 9-10 \\ &= -1 \end{aligned}$$

The solution is $\{(5,-1)\}$.

**5.** Let $x$ = the number of premium tickets sold

$y$ = the number of regular tickets sold

$30x$ = receipts from premium tickets

$20y$ = receipts from regular tickets

$$x+\ y=\ 1190 \rightarrow y=1190-x$$

$$\begin{aligned} 30x+20y &= 30{,}180 \\ 30x+20(1190-x) &= 30{,}180 \\ 30x+23{,}800-20x &= 30{,}180 \\ 10x &= 6380 \\ x &= 638 \\ y &= 1190-638=552 \end{aligned}$$

There were 638 tickets sold at \$30 each and 552 tickets sold at \$20 each.

**7.** Let $x$ = the cost of 1 hamburger

$y$ = the cost of 1 fish sandwich

$$3x+2y=24.20$$

$$4x+\ y=23.60 \rightarrow y=23.60-4x$$

$$\begin{aligned} 3x+2(23.60-4x) &= 24.20 \\ 3x+47.20-8x &= 24.20 \\ -5x &= -23 \\ x &= 4.60 \\ y &= 23.60-4(4.60) \\ &= 23.60-18.40 \\ &= 5.20 \end{aligned}$$

Hamburgers cost \$4.60 and fish sandwiches cost \$5.20.

**9.** Let $x$ = fat in 1 scoop of vanilla

$y$ = fat in 1 scoop of mud pie

$$2x+\ y=40 \rightarrow y=40-2x$$

$$x+2y=44$$

$$\begin{aligned} x+2(40-2x) &= 44 \\ x+80-4x &= 44 \\ -3x &= -36 \\ x &= 12 \\ y &= 40-2(12) \\ &= 40-24 \\ &= 16 \end{aligned}$$

Vanilla has 12 g of fat per scoop and mud pie has 16 g of fat per scoop.

**11.** Let $x$ = the amount of 18% moisturizer cream

$y$ = the amount of 24% moisturizer cream

**13.** Let $x$ = the amount of 8% nitrogen fertilizer

$y$ = the amount of 12% nitrogen fertilizer

| | 18% Cr | 24% Cr | 22% Cr |
|---|---|---|---|
| oz cream | $x$ | $y$ | 12 |
| oz moist | $0.18x$ | $0.24y$ | 0.22(12) |

$$\begin{aligned} x + \quad y &= 12 \\ 0.18x + 0.24y &= 0.22(12) \end{aligned}$$

Multiply the first equation by –0.18, add to the second equation and solve for $y$:

$$\begin{aligned} x + \quad y = 12 &\to -0.18x - 0.18y = -2.16 \\ 0.18x + 0.24y = 2.64 &\to \underline{0.18x + 0.24y = 2.64} \\ &\qquad\qquad 0.06y = 0.48 \\ &\qquad\qquad\quad y = 8 \end{aligned}$$

Substitute into the first equation and solve for $x$:

$$\begin{aligned} x + 8 &= 12 \\ x &= 4 \end{aligned}$$

The mixture contains 4 oz of 18% moisturizer and 8 oz of 24% moisturizer.

| | 8% nit | 12% nit | 11% nit |
|---|---|---|---|
| oz cream | $x$ | $y$ | 8 |
| oz moist | $0.08x$ | $0.12y$ | 0.11(8) |

$$\begin{aligned} x + \quad y &= 8 \\ 0.08x + 0.12y &= 0.11(8) \end{aligned}$$

Multiply the first equation by –0.08, add to the second equation and solve for $y$:

$$\begin{aligned} x + \quad y = 8 &\to -0.08x - 0.08y = -0.64 \\ 0.08x + 0.12y = 0.88 &\to \underline{0.08x + 0.12y = 0.88} \\ &\qquad\qquad 0.04y = 0.24 \\ &\qquad\qquad\quad y = 6 \end{aligned}$$

Substitute into the first equation and solve for $x$:

$$\begin{aligned} x + 6 &= 8 \\ x &= 2 \end{aligned}$$

The mixture contains 2 L of 8% nitrogen fertilizer and 6 L of 12% nitrogen fertilizer.

**15.** Let $x$ = amount of pure (100%) bleach sol

$y$ = the amount of 4% bleach solution

| | 100% bl | 4% bl | 12% bl |
|---|---|---|---|
| oz solution | $x$ | $y$ | 12 |
| oz bleach | $1.00x$ | $0.04y$ | 0.12(12) |

$$\begin{aligned} x + \quad y &= 12 \\ 1.00x + 0.04y &= 0.12(12) \end{aligned}$$

Multiply the first equation by –0.04, add to the second equation and solve for $x$:

$$\begin{aligned} x + \quad y = 12 &\to -0.04x - 0.04y = -0.48 \\ 1x + 0.04y = 1.44 &\to \underline{1.00x + 0.04y = \ 1.44} \\ &\qquad 0.96x \qquad\quad = 0.96 \\ &\qquad\qquad\qquad x = 1 \end{aligned}$$

**17.** Let $x$ = the amount invested in 5% bonds

$3x$ = the amount invested in 8% stocks

| | 5% Acct | 8% Acct | Total |
|---|---|---|---|
| Principal | $x$ | $3x$ | |
| Interest | $0.05x$ | $0.08(3x)$ | 435 |

$$\begin{aligned} 0.05x + 0.08(3x) &= 435 \\ 0.05x + 0.24x &= 435 \\ 0.29x &= 435 \\ x &= 1500 \\ 3x &= 3(1500) \\ &= 4500 \end{aligned}$$

He invested \$1500 in the bond fund and \$4500 in the stock fund.

Substitute into the first equation and solve for $y$:

$$1 + y = 12$$
$$y = 11$$

The mixture contains 1 oz of pure bleach and 11 oz of 4% bleach solution.

**19.** Let $x$ = the amount borrowed at 5.5%
$y$ = the amount borrowed at 3.5%

| | 5.5% Acct | 3.5% Acct | Total |
|---|---|---|---|
| Principal | $x$ | $y$ | |
| Interest | $0.055x$ | $0.035y$ | 245 |

$$x = y + 200$$
$$0.055x + 0.035y = 245$$

Substitute and solve for $y$:

$$0.055(y + 200) + 0.035y = 245$$
$$0.055y + 11 + 0.035y = 245$$
$$0.09y = 234$$
$$y = 2600$$

Substitute into the first equation and solve for $x$:

$$x = 2600 + 200$$
$$x = 2800$$

He borrowed \$2800 at 5.5% and \$2600 at 3.5%.

**21.** Let $x$ = the amount borrowed at 6%
$y$ = the amount borrowed at 7%

| | 6% Acct | 7% Acct | Total |
|---|---|---|---|
| Principal | $x$ | $y$ | 15,000 |
| Interest | $0.06x$ | $0.07y$ | 4750/5 |

$$x + \quad y = 15,000$$
$$0.06x + 0.07y = \frac{4750}{5} = 950$$

Multiply the first equation by –0.06, add to the second equation and solve for $y$:

$$x + y = 15,000 \rightarrow -0.06x - 0.06y = -900$$
$$0.06x + 0.07y = 950 \rightarrow \underline{0.06x + 0.07y = 950}$$
$$0.01y = 50$$
$$y = 5000$$

Substitute into the first equation and solve for $x$:

$$x + 5000 = 15,000$$
$$x = 10,000$$

Alina borrowed \$10,000 from the bank charging 6% interest and \$5000 from the bank charging 7% interest.

**23.** Let $b$ = the speed of the boat in still water
$c$ = the speed of the current
$b + c$ = speed of boat with the current
$b - c$ = speed of boat against the current

**25.** Let $p$ = the speed of the plane in still air
Let $w$ = the speed of the wind
$p + w$ = speed of the plane with the wind
$p - w$ = speed of plane against the wind

| | Distance | Rate | Time |
|---|---|---|---|
| With current | 16 | $b+c$ | 2 |
| Against current | 16 | $b-c$ | 4 |

(rate)(time) = (distance)

$(b+c)(2)=16$

$(b-c)(4)=16$

Divide the first equation by 2, the second equation by 4, add the results, and solve:

$$(b+c)(2)=16 \xrightarrow{div\ 2} b+c=8$$
$$(b-c)(4)=16 \xrightarrow{div\ 4} \underline{b-c=4}$$
$$2b \quad =12$$
$$b=6$$

Substitute and solve for $c$:

$6+c=8$

$c=2$

The speed of the boat is 6 mph and the speed of the current is 2 mph.

| | Distance | Rate | Time |
|---|---|---|---|
| Tailwind | 3200 | $p+w$ | 4 |
| Headwind | 3200 | $p-w$ | 5 |

(rate)(time) = (distance)

$(p+w)(4)=3200$

$(p-w)(5)=3200$

Divide the first equation by 4, the second equation by 5, add the results, and solve:

$$(p+w)(4)=3200 \xrightarrow{div\ 4} p+w=800$$
$$(p-w)(5)=3200 \xrightarrow{div\ 5} \underline{p-w=640}$$
$$2p \quad =1440$$
$$p=720$$

Substitute and solve for $w$:

$720+w=800$

$w=80$

The speed of the plane is 720 km/hr in still air and the speed of the wind is 80 km/hr.

**27.** Let $x$ = the walking speed

Let $y$ = the speed of the moving sidewalk

$x + y$ = speed of walking with sidewalk

$x–y$ = speed of walking against sidewalk

| | Distance | Rate | Time |
|---|---|---|---|
| With walk | 100 | $x+y$ | 20 |
| Against walk | 60 | $x-y$ | 30 |

(rate)(time) = (distance)

$(x+y)(20)=100$

$(x-y)(30)=60$

Divide the first equation by 20, the second equation by 30, add the results, and solve:

$$(x+y)(20)=100 \xrightarrow{div\ 20} x+y=5$$
$$(x-y)(30)=60 \xrightarrow{div\ 30} \underline{x-y=2}$$
$$2x \quad =7$$
$$x=3.5$$

Substitute and solve for $y$:

$3.5+y=5$

$y=1.5$

Stephen's speed on nonmoving ground is 3.5 ft/sec. The sidewalk moves at 1.5 ft/sec.

**29.** Let $x$ = one acute angle

Let $y$ = the other acute angle

$x = 3y + 6$

$x + y = 90$

Substitute and solve:

$3y + 6 + y = 90$

$4y = 84$

$y = 21$

$x = 3(21) + 6 = 63 + 6 = 69$

The two acute angles measure 69º and 21º.

**31.** Let $x$ = one angle

Let $y$ = the other angle

$y = 3x - 2$

$x + y = 180$

Substitute and solve:

$x + 3x - 2 = 180$

$4x = 182$

$x = 45.5$

$y = 3(45.5) - 2$

$= 136.5 - 2 = 134.5$

The two angles measure 45.5º and 134.5º.

**33.** Let $x$ = one angle

Let $y$ = the other angle

$y = 2x + 6$

$x + y = 90$

Substitute and solve:

$x + 2x + 6 = 90$

$3x = 84$

$x = 28$

$y = 2(28) + 6$

$= 56 + 6$

$= 62$

The two angles measure 28º and 62º.

**35.** Let $x$ = the amount of pure (100%) gold

$y$ = the amount of 60% gold

| | 100% gold | 60% gold | 75% gold |
|---|---|---|---|
| g mix | $x$ | $y$ | 20 |
| g gold | $1.00x$ | $0.60y$ | $0.75(20)$ |

$x + \quad y = 20$

$1.00x + 0.60y = 0.75(20)$

Multiply the first equation by –0.60, add to the second equation and solve for $x$:

$x + \quad y = 15{,}500 \rightarrow -0.06x - 0.06y = -930$

$0.05x + 0.06y = 875 \rightarrow 0.05x + 0.06y = 875$

$-0.01x \qquad = -55$

$x = 5500$

7.5 g of pure gold must be used.

**37.** Let $b$ = the speed of the boat in still water

Let $c$ = the speed of the current

$b + c$ = speed of boat with the current

$b - c$ = speed of boat against the current

**39.** Let $x$ = the cost of a grandstand ticket

y = the cost of a general admission ticket

$6x + 2y = 2330$

$4x + 4y = 2020$

Multiply the first equation by –2, add to the second equation and solve for $x$:

| | Distance | Rate | Time |
|---|---|---|---|
| With current | 16 | $b+c$ | 2.5 |
| Against current | 10 | $b-c$ | 2.5 |

(rate)(time) = (distance)

$(b+c)(2.5)=16 \rightarrow 2.5b+2.5c=16$
$(b-c)(2.5)=10 \rightarrow 2.5b-2.5c=10$

Add the two equations, and solve:

$$\begin{aligned} 2.5b+2.5c&=16\\ 2.5b-2.5c&=10\\ \hline 5b\quad\quad&=26\\ b&=5.2 \end{aligned}$$

Substitute and solve for $c$:

$$\begin{aligned} 2.5(5.2)+2.5c&=16\\ 13+2.5c&=16\\ 2.5c&=3\\ c&=1.2 \end{aligned}$$

The speed of the boat in still water is 5.2 mph and the speed of the current is 1.2 mph.

$$\begin{aligned} 6x+2y=2330 &\xrightarrow{\times -2} -12x-4y=-4660\\ 4x+4y=2020 &\longrightarrow \underline{\quad 4x+4y=\ 2020}\\ &\qquad -8x\qquad=-2640\\ &\qquad\qquad x=330 \end{aligned}$$

Substitute and solve for $y$:

$$\begin{aligned} 6(330)+2y&=2330\\ 1980+2y&=2330\\ 2y&=350\\ y&=175 \end{aligned}$$

Grandstand tickets cost \$330 and general admission tickets cost \$175.

**41.** Let $x$ = the amount invested at 2%

$y$ = the amount invested at 1.3%

| | 2% Acct | 1.3% Acct | Total |
|---|---|---|---|
| Principal | $x$ | $y$ | 3,000 |
| Interest | $0.02x$ | $0.013y$ | 51.25 |

$$\begin{aligned} x+\quad y&=3,000\\ 0.02x+0.013y&=51.25 \end{aligned}$$

Multiply the first equation by –0.02, add to the second equation and solve for $y$:

$$\begin{aligned} x+\quad y=3{,}000 &\rightarrow -.02x-.02y=-60\\ .02x+.013y=51.25 &\rightarrow \underline{.02x+.013y=51.25}\\ &\qquad -0.007y=-8.75\\ &\qquad\qquad y=1250 \end{aligned}$$

Substitute into the first equation and solve for $x$:

**43.** Let $w$ = the width of the rectangle

Let $l$ = the length of the rectangle

$$l=w+1$$
$$2l+2w=42$$

Substitute and solve:

$$\begin{aligned} 2(w+1)+2w&=42\\ 2w+2+2w&=42\\ 4w+2&=42\\ 4w&=40\\ w&=10\\ l&=10+1\\ &=11 \end{aligned}$$

The width is 10 m and the length is 11 m.

$$x + 1250 = 3000$$
$$y = 1750$$

Svetlana invested \$1750 at 2% and \$1250 at 1.3%.

**45.** Let $d$ = the number of \$1 coins
$f$ = the number of 50 cent pieces

$$d + f = 21 \rightarrow f = 21 - d$$
$$1d + 0.50f = 15.50$$
$$d + 0.50(21 - d) = 15.50$$
$$d + 10.50 - 0.50d = 15.50$$
$$0.50d = 5.00$$
$$d = 10$$
$$f = 21 - 10$$
$$= 11$$

The collection contains 10 - \$1 coins and 11 – 50 cent pieces.

**47.** **a.** $f(x) = 60x$

**b.** $g(x) = 50x + 100$

**c.** Substitute and solve:

$$60x = 50x + 100$$
$$10x = 100$$
$$x = 10$$

10 months