Determine the best method to solve each system of equations. Then solve the system.
1. \(2x + 3y = -11\)
   \(-8x - 5y = 9\)

**SOLUTION:**
No variables can be eliminated through adding or subtracting. Solve the system by elimination using multiplication. Notice that if you multiply the first equation by 4, the coefficients of the \(x\)-terms are additive inverses.

\[
\begin{align*}
2x + 3y &= -11 & \text{Equation 1} \\
4(2x + 3y) &= 4(-11) & \text{Multiply each side by 4.} \\
8x + 12y &= -44 & \text{Simplify.} \\
8x + 12y &= -44 \\
\underline{(+)} -8x - 5y &= 9 & \text{Equation 2} \\
7y &= -35 & \text{\(x\) - term is eliminated.} \\
\frac{7y}{7} &= \frac{-35}{7} & \text{Divide each side by 7.} \\
y &= -5 & \text{Simplify.}
\end{align*}
\]

Now, substitute \(-5\) for \(y\) in either equation to find the value of \(x\).

\[
\begin{align*}
2x + 3(-5) &= -11 & \text{Equation 1} \\
2x - 15 &= -11 \\
2x &= 4 \\
\frac{2x}{2} &= \frac{4}{2} \\
x &= 2
\end{align*}
\]

The solution is \((2, -5)\).
6-5 Applying Systems of Linear Equations

2. \(3x + 4y = 11\) \\
\(2x + y = -1\)

**SOLUTION:** 
The coefficient of \(y\) in one of the equations is 1, so solve the system by substitution. Isolate the \(y\) in equation 2 first.

\[
\begin{align*}
2x + y &= -1 & \text{Equation 2} \\
2x - 2x + y &= -2x - 1 \\
y &= -2x - 1 \tag*{Substitution}
\end{align*}
\]

\[
\begin{align*}
3x + 4y &= 11 & \text{Equation 1} \\
3x + 4(-2x - 1) &= 11 & \text{Substitution} \\
3x - 8x - 4 &= 11 \\
-5x - 4 &= 11 \\
-5x - 4 + 4 &= 11 + 4 \\
-5x &= 15 \\
\frac{-5x}{-5} &= \frac{15}{-5} \\
x &= -3
\end{align*}
\]

Now, substitute \(-3\) for \(x\) in either equation to find the value of \(y\).

\[
\begin{align*}
2x + y &= -1 & \text{Equation 1} \\
2(-3) + y &= -1 \\
-6 + y &= -1 \\
-6 + 6 + y &= -1 + 6 \\
y &= 5
\end{align*}
\]

The solution is \((-3, 5)\).
3. $3x - 4y = -5$
   $-3x + 2y = 3$

**SOLUTION:**

The coefficients for $x$ are additive inverses. Solve the system by elimination using addition.

\[
\begin{align*}
3x - 4y &= -5 \quad \text{Equation 1} \\
(-3x + 2y) &= 3 \quad \text{Equation 2} \\
\hline
-2y &= -2 \quad \text{Add equations} \\
-2y &= -2 \\
\frac{-2y}{-2} &= \frac{-2}{-2} \\
y &= 1
\end{align*}
\]

Now, substitute 1 for $y$ in either equation to find the value of $x$.

\[
\begin{align*}
-3x + 2y &= 3 \quad \text{Equation 2} \\
-3x + 2(1) &= 3 \\
-3x &= 1 \\
\frac{-3x}{-3} &= \frac{1}{-3} \\
x &= -\frac{1}{3}
\end{align*}
\]

The solution is \((-\frac{1}{3}, 1)\).
4. \(3x + 7y = 4\)  
\(5x - 7y = -12\)

**SOLUTION:**

The coefficients for \(y\) are additive inverses. Solve the system by elimination using addition.

\[
\begin{align*}
3x + 7y &= 4 \quad \text{Equation 1} \\
5x - 7y &= -12 \quad \text{Equation 2}
\end{align*}
\]

\[
\begin{align*}
8x &= -8 & \text{Add equations} \\
\frac{8x}{8} &= \frac{-8}{8} \\
x &= -1
\end{align*}
\]

Now, substitute \(-1\) for \(x\) in either equation to find the value of \(y\).

\[
\begin{align*}
3(-1) + 7y &= 4 \quad \text{Equation 1} \\
-3 + 7y &= 4 \\
7y &= 7 \\
\frac{7y}{7} &= \frac{7}{7} \\
y &= 1
\end{align*}
\]

The solution is \((-1, 1)\).
6-5 Applying Systems of Linear Equations

5. **SHOPPING** At a sale, Salazar bought 4 T-shirts and 3 pairs of jeans for $181. At the same store, Jenna bought 1 T-shirt and 2 pairs of jeans for $94. The T-shirts were all the same price, and the jeans were all the same price.

a. Write a system of equations that can be used to represent this situation.

b. Determine the best method to solve the system of equations.

c. Solve the system.

**SOLUTION:**

a. Let $t$ stand for the price of T-shirts and $j$ stand for the price of jeans.

\[4t + 3j = 181; \quad t + 2j = 94\]

b. The coefficient of $t$ in one of the equations is 1, so solve the system by substitution.

c. First solve the second equation for $t$

\[t + 2j = 94 \quad \text{Equation 2}\]

\[t + 2j - 2j = 94 - 2j\]
\[t = 94 - 2j\]

Substitute into equation 1.

\[4t + 3j = 181 \quad \text{Equation 1}\]

\[4(-2j + 94) + 3j = 181 \quad \text{Substitution}\]
\[-8j + 376 + 3j = 181\]
\[-5j = -195\]
\[j = 39\]

Now, substitute 39 for $j$ in either equation to find the value of $t$.

\[t + 2j = 94 \quad \text{Equation 2}\]
\[t + 2(39) = 94\]
\[t + 78 = 94\]
\[t = 16\]

So, each T-shirt cost $16 and each pair of jeans cost $39.
Determine the best method to solve each system of equations. Then solve the system.

6. \(-3x + y = -3\)
   \(4x + 2y = 14\)

**SOLUTION:**
The coefficient of \(y\) in one of the equations is 1, so solve the system by substitution.

First, solve equation 1 for \(y\).

\[-3x + y = -3 \quad \text{Equation 1}\]
\[-3x + 3x + y = 3x - 3\]
\[y = 3x - 3\]

Substitute into equation 2.

\[4x + 2y = 14 \quad \text{Equation 2}\]
\[4x + 2(3x - 3) = 14 \quad \text{Substitution}\]
\[4x + 6x - 6 = 14\]
\[10x - 6 = 14\]
\[10x - 6 + 6 = 14 + 6\]
\[10x = 20\]
\[\frac{10x}{10} = \frac{20}{10}\]
\[x = 2\]

Now, substitute 2 for \(x\) in either equation to find the value of \(y\).

\[-3x + y = -3 \quad \text{Equation 1}\]
\[-3(2) + y = -3\]
\[-6 + y = -3\]
\[y = 3\]

The solution is (2, 3).
6-5 Applying Systems of Linear Equations

7. \(2x + 6y = -8\)
   \(x - 3y = 8\)

**SOLUTION:**
The coefficient of \(x\) in one of the equations is 1, so solve the system by substitution. First, solve for \(x\) in equation 2.

\[
x - 3y = 8 \quad \text{Equation 2}
\]
\[
x - 3y + 3y = 3y + 8
\]
\[
x = 3y + 8
\]

Substitute into equation 1.

\[
2x + 6y = -8 \quad \text{Equation 1}
\]
\[
2(3y + 8) + 6y = -8 \quad \text{Substitution}
\]
\[
6y + 16 + 6y = -8
\]
\[
12y + 16 = -8
\]
\[
12y + 16 - 16 = -8 - 16
\]
\[
12y = -24
\]
\[
\frac{12y}{12} = \frac{-24}{12}
\]
\[
y = -2
\]

Now, substitute \(-2\) for \(y\) in either equation to find the value of \(x\).

\[
x - 3y = 8 \quad \text{Equation 2}
\]
\[
x - 3(-2) = 8
\]
\[
x + 6 = 8
\]
\[
x + 6 - 6 = 8 - 6
\]
\[
x = 2
\]

The solution is \((2, -2)\).
8. \(3x - 4y = -5\)
   \(-3x - 6y = -5\)

**SOLUTION:**
The coefficients for \(x\) are additive inverses. Solve the system by elimination using addition.

\[
\begin{align*}
3x - 4y &= -5 \quad \text{Equation 1} \\
(+) -3x - 6y &= -5 \quad \text{Equation 2} \\
-10y &= -10 \quad \text{Add equations} \\
\frac{-10y}{-10} &= \frac{-10}{-10} \\
y &= 1
\end{align*}
\]

Now, substitute 1 for \(y\) in either equation to find the value of \(x\).

\[
\begin{align*}
3x - 4y &= -5 \quad \text{Equation 1} \\
3x - 4(1) &= -5 \\
3x &= -1 \\
\frac{3x}{3} &= \frac{-1}{3} \\
x &= -\frac{1}{3}
\end{align*}
\]

The solution is \((-\frac{1}{3}, 1)\).
6-5 Applying Systems of Linear Equations

9. \(5x + 8y = 1\)
   \(-2x + 8y = -6\)

**SOLUTION:**
The coefficients for \(y\) are the same. Solve the system by elimination using subtraction.

\[
\begin{align*}
5x + 8y &= 1 \\
(-) - 2x + 8y &= -6
\end{align*}
\]

\[
7x = 7
\]

\[
x = 1
\]

Now, substitute 1 for \(x\) in either equation to find the value of \(y\).

\[
5(1) + 8y = 1
\]

\[
5 + 8y = 1
\]

\[
8y = -4
\]

\[
y = -\frac{1}{2}
\]

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

10. \(y + 4x = 3\)
    \(y = -4x - 1\)

**SOLUTION:**
The coefficient of \(y\) in the equations is 1, so solve the system by substitution.

\[
y + 4x = 3 \quad \text{Equation 1}
\]

\[
(-4x - 1) + 4x = 3 \quad \text{Substitution}
\]

\[
-1 \neq 3
\]

The substitution results in an invalid statement. There is no solution.
6-5 Applying Systems of Linear Equations

11. \(-5x + 4y = 7\)
\(-5x - 3y = -14\)

**SOLUTION:**
The coefficients for \(x\) are the same. Solve the system by elimination using subtraction.

\[
\begin{align*}
-5x + 4y &= 7 \\
(-) \quad -5x - 3y &= -14 \\
\hline
7y &= 21 \\
y &= 3
\end{align*}
\]

Now, substitute 3 for \(y\) in either equation to find the value of \(x\).

\[
\begin{align*}
-5x + 4(3) &= 7 \\
-5x + 12 &= 7 \\
-5x &= -5 \\
x &= 1
\end{align*}
\]

The solution is (1, 3).
### 6-5 Applying Systems of Linear Equations

12. **FINANCIAL LITERACY** For a Future Teachers of America fundraiser, Denzell sold food as shown in the table. He sold 11 more subs than pizzas and earned a total of $233. Write and solve a system of equations to represent this situation. Then describe what the solution means.

<table>
<thead>
<tr>
<th>Item</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>pizza</td>
<td>$5.00</td>
</tr>
<tr>
<td>sub</td>
<td>$3.00</td>
</tr>
</tbody>
</table>

**SOLUTION:**

Let \( s \) represent the number of subs sold and \( p \) represent the number of pizzas sold.

\[ 3s + 5p = 233; s = p + 11 \]

Solve through substitution.

\[ 3s + 5p = 233 \quad \text{Equation 1} \]

\[ 3(s + 11) + 5p = 233 \quad \text{Substitution} \]

\[ 3p + 33 + 5p = 233 \]

\[ 8p + 33 = 233 \]

\[ 8p = 200 \]

\[ \frac{8p}{8} = \frac{200}{8} \]

\[ p = 25 \]

Now, substitute 25 for \( p \) in either equation to find the value of \( s \).

\[ s = p + 11 \quad \text{Equation 2} \]

\[ s = 25 + 11 \]

\[ s = 36 \]

Denzell sold 25 pizzas and 36 subs.


6-5 Applying Systems of Linear Equations

13. **DVDs** Manuela has a total of 40 DVDs of movies and television shows. The number of movies is 4 less than 3 times the number of television shows. Write and solve a system of equations to find the numbers of movies and television shows that she has on DVD.

**SOLUTION:**
Let \( m \) represent the number of movies Manuela has and \( t \) represent the number of television shows Manuela has. \( m + t = 40; m = 3t - 4 \)
Solve through substitution.

\[
\begin{align*}
m + t &= 40 & \text{Equation 1} \\
(3t - 4) + t &= 40 & \text{Substitution} \\
4t - 4 &= 40 \\
4t &= 44 \\
t &= 11
\end{align*}
\]

Now, substitute 11 for \( t \) in either equation to find the value of \( m \).

\[
\begin{align*}
m &= 3s - 4 & \text{Equation 2} \\
&= 3(11) - 4 \\
&= 33 - 4 \\
&= 29
\end{align*}
\]

Manuela has 29 movies, 11 television shows.
6-5 Applying Systems of Linear Equations

14. CAVES The Caverns of Sonora have two different tours: the Crystal Palace tour and the Horseshoe Lake tour. The total length of both tours is 3.25 miles. The Crystal Palace tour is a half-mile less than twice the distance of the Horseshoe Lake tour. Determine the length of each tour.

**SOLUTION:**
Let \( h \) represent the length of the Horseshoe Lake tour and \( c \) represent the length of the Crystal Palace tour.

\[ h + c = 3.25 \]
\[ c = 2h - 0.5 \]

Solve through substitution.

\[ h + (2h - 0.5) = 3.25 \quad \text{Substitution} \]
\[ 3h - 0.5 = 3.25 \]
\[ 3h - 0.5 + 0.5 = 3.25 + 0.5 \]
\[ 3h = 3.75 \]
\[ \frac{3h}{3} = \frac{3.75}{3} \]
\[ h = 1.25 \]

Now, substitute 1.25 for \( h \) in either equation to find the value of \( c \).

\[ c = 2h - 0.5 \quad \text{Equation} 2 \]
\[ = 2(1.25) - 0.5 \]
\[ = 2.5 - 0.5 \]
\[ = 2 \]

The length of the Horseshoe Lake tour is 1.25 miles. The length of the Crystal Palace tour is 2 miles.
15. **CCSS MODELING** The *break-even point* is the point at which income equals expenses. Ridgemont High School is paying $13,200 for the writing and research of their yearbook plus a printing fee of $25 per book. If they sell the books for $40 each, how many will they have to sell to break even? Explain.

**SOLUTION:**
Let \( b \) represent the number of books they have to sell and \( p \) represent the break-even point.
\[
13,200 + 25b = p; 40b = p
\]
Solve through substitution.

\[
13,200 + 25b = p \quad \text{Equation 1}
\]
\[
13,200 + 25b = 40b \quad \text{Substitution}
\]
\[
13,200 = 15b
\]
\[
\frac{13,200}{15} = \frac{15b}{15}
\]
\[
880 = b
\]

Now, substitute 880 for \( b \) in either equation to find the value of \( p \).

\[
40b = p \quad \text{Equation 2}
\]
\[
40(880) = p
\]
\[
35,200 = p
\]

The school needs to sell 880 books to break even. If they sell this number, then their income and expenses both equal $35,200.
16. **PAINTBALL** Clara and her friends are planning a trip to a paintball park. Find the cost of lunch and the cost of each paintball. What would be the cost for 400 paintballs and lunch?

**SOLUTION:**

Let \( l \) represent the cost of lunch and \( p \) represent the cost of each paintball.

\[
500p + l = 25; \quad 200p + l = 16
\]

Solve through elimination by subtraction.

\[
\begin{align*}
500p + l &= 25 & \text{Equation 1} \\
( - ) 200p + l &= 16 & \text{Equation 2} \\
300p &= 9 & \text{Add equations} \\
300p &= \frac{9}{300} & \text{Divide by 300.} \\
p &= 0.03 & \text{Simplify.}
\end{align*}
\]

Now, substitute 0.3 for \( p \) in either equation to find the value of \( l \).

\[
200p + l = 16 \quad \text{Equation 2}
\]

\[
200(0.03) + l = 16 \\
6 + l = 16 \\
l = 10
\]

The cost of 400 paintballs and lunch would be:

\[
\text{Total Cost} = \text{paintballs} + \text{lunch} \\
= 0.03(400) + 10 \quad \text{Substitution} \\
= 12 + 10 \\
= 22
\]

The cost of the lunch is $10 and the cost of each paintball is $0.03. The cost of 400 paintballs and lunch would be $22.
6-5 Applying Systems of Linear Equations

17. RECYCLING  Mara and Ling each recycled aluminum cans and newspaper, as shown in the table. Mara earned $3.77, and Ling earned $4.65.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Pounds Recycled</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mara</td>
<td>Ling</td>
</tr>
<tr>
<td>aluminum cans</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>newspaper</td>
<td>26</td>
<td>114</td>
</tr>
</tbody>
</table>

a. Define variables and write a system of linear equations from this situation.

b. What was the price per pound of aluminum? Determine the reasonableness of your solution.

SOLUTION:

a. Let \( x \) represent the cost per pound of aluminum cans and \( y \) represent the cost per pound of newspaper.

\[
9x + 26y = 3.77 \quad \text{and} \quad 9x + 114y = 4.65
\]

b. The coefficients for \( x \) are the same. Solve the system by elimination using subtraction, so this solution is reasonable.

\[
\begin{align*}
9x + 26y &= 3.77 \\
(-)9x + 114y &= 4.65 \\
-88y &= -0.88 \\
y &= 0.01
\end{align*}
\]

Now, substitute 0.01 for \( y \) in either equation to find the value of \( x \).

\[
\begin{align*}
9x + 26(0.01) &= 3.77 \\
9x + 0.26 &= 3.77 \\
9x &= 3.51 \\
x &= 0.39
\end{align*}
\]

So, the price per pound of aluminum is $0.39. Aluminum recycling is worth more than paper recycling, so the solution is reasonable.
6-5 Applying Systems of Linear Equations

18. **BOOKS** The library is having a book sale. Hardcover books sell for $4 each, and paperback books are $2 each. If Connie spends $26 for 8 books, how many hardcover books did she buy?

**SOLUTION:**

Let \( h \) represent the number of hardcover books and \( p \) represent the number of paperback books Connie bought.

\[
4h + 2p = 26; \quad h + p = 8
\]

Solve through substitution.

First, solve for \( p \) in equation 2.

\[
\begin{align*}
4h + 2p &= 26 \quad \text{Equation 1} \\
4h + 2(-h + 8) &= 26 \\
4h - 2h + 16 &= 26 \\
2h + 16 &= 26 \\
2h + 16 - 16 &= 26 - 16 \\
2h &= 10 \\
\frac{2h}{2} &= \frac{10}{2} \\
h &= 5
\end{align*}
\]

Connie bought 5 hardcover books.
6-5 Applying Systems of Linear Equations

19. **MUSIC** An online music club offers individual songs for one price or entire albums for another. Kendrick pays $14.90 to download 5 individual songs and 1 album. Geoffrey pays $21.75 to download 3 individual songs and 2 albums.

a. How much does the music club charge to download a song?

b. How much does the music club charge to download an entire album?

**SOLUTION:**

a. Let \( s \) represent the cost of a song and \( a \) represent the cost of an album.

\[ 5s + a = 14.90 \]

\[ 3s + 2a = 21.75 \]

Solve through substitution.

First solve for \( a \) in equation 1.

\[ 5s + a = 14.90 \quad \text{Equation 1} \]

\[ 5s - 5s + a = -5s + 14.90 \]

\[ a = -5s + 14.90 \]

Substitute into equation 2.

\[ 3s + 2a = 21.75 \quad \text{Equation 2} \]

\[ 3s + 2(-5s + 14.90) = 21.75 \quad \text{Substitution} \]

\[ 3s - 10s + 29.80 = 21.75 \]

\[ -7s + 29.80 = 21.75 \]

\[ -7s + 29.80 - 29.80 = 21.75 - 29.80 \]

\[ -7s = -8.05 \]

\[ \frac{-7s}{-7} = \frac{-8.05}{-4} \]

\[ s = 1.15 \]

The music club charges $1.15 to download a song.

b. Substitute 1.15 for \( s \) in either equation to find the value of \( a \).

\[ 5s + a = 14.90 \quad \text{Equation 1} \]

\[ 5(1.15) + a = 14.90 \]

\[ 5.75 + a = 14.90 \]

\[ 5.75 - 5.75 + a = 14.90 - 5.75 \]

\[ a = 9.15 \]

The music club charges $9.15 to download an entire album.

20. **CANOEING** Malik traveled against the current for 2 hours and then with the current for 1 hour before resting. Julio traveled against the current for 2.5 hours and then with the current for 1.5 hours before resting. If they traveled a total of 9.5 miles against the current, and 20.5 miles with the current, and the speed of the current is 3 miles per hour.
6-5 Applying Systems of Linear Equations

hour, how fast do Malik and Julio travel in still water?

**SOLUTION:**
Let \( m = \) Malik's speed in still water, and let \( j = \) Julio's speed in still water

The speed of the current is 3 mph, so Malik's speed with the current is \( m + 3 \) and his speed against the current is \( m - 3 \). Likewise for Julio.

Write a system of equations using \( d = rt \).

Against the current:
\[
2.5(m - 3) + 2(j - 3) = 9.5
\]

With the current:
\[
1.5(m + 3) + 1(j + 3) = 20.5
\]

Simplify the equations.
\[
\begin{align*}
2.5(m - 3) + 2(j - 3) & = 9.5 \\
2.5m - 7.5 + 2j - 6 & = 9.5 \\
2.5m + 2j - 13.5 & = 9.5 \\
2.5m + 2j & = 23 \\
1.5(m + 3) + 1(j + 3) & = 20.5 \\
1.5m + 4.5 + j + 3 & = 20.5 \\
1.5m + j + 7.5 & = 20.5 \\
1.5m + j & = 13
\end{align*}
\]

Solve the system with substitution.
\[
1.5m + j = 13
\]
\[
j = 13 - 1.5m
\]

Substitute into the other equation.
\[
2.5m + 2j = 23
\]
\[
2.5m + 2(13 - 1.5m) = 23
\]
\[
2.5m + 26 - 3m = 23
\]
\[
-0.5m + 26 = 23
\]
\[
-0.5m = -3
\]
\[
m = 6
\]

Substitute 6 for \( m \).
\[
\begin{align*}
j & = 13 - 1.5m \\
j & = 13 - 1.5(6) \\
j & = 13 - 9 \\
j & = 4
\end{align*}
\]
6-5 Applying Systems of Linear Equations

Malik: 6 mph; Julio: 4 mph

21. OPEN ENDED  Formulate a system of equations that represents a situation in your school. Describe the method that you would use to solve the system. Then solve the system and explain what the solution means.

SOLUTION:
Sample answer: x + y = 12 and 3x + 2y = 29, where x represents the cost of a student ticket for the basketball game and y represents the cost of an adult ticket; substitution could be used to solve the system; (5, 7) means the cost of a student ticket is $5 and the cost of an adult ticket is $7.

22. CCSS REASONING  In a system of equations, x represents the time spent riding a bike, and y represents the distance traveled. You determine the solution to be (−1, 7). Use this problem to discuss the importance of analyzing solutions in the context of real-world problems.

SOLUTION:
Sample answer: You should always check that the answer makes sense in the context of the original problem. If it does not, you may have made an incorrect calculation. If (−1, 7) was the solution, then it is probably incorrect, since time in this case cannot be a negative number. The solution should be recalculated.

23. CHALLENGE  Solve the following system of equations by using three different methods. Show your work.

\[
\begin{align*}
4x + y &= 13 \\
6x - y &= 7
\end{align*}
\]

SOLUTION:
Graphing:
Rewrite the equations in slope-intercept form.

**Equation 1:**
\[
4x + y = 13 \quad \text{Equation 1}
\]
\[
4x - 4x + y = -4x + 13
\]
\[
y = -4x + 13
\]

**Equation 2:**
\[
6x - y = 7 \quad \text{Equation 2}
\]
\[
6x - 6x - y = -6x + 7
\]
\[
- y = -6x + 7
\]
\[
-1(-y) = -1(-6x + 7)
\]
\[
y = 6x - 7
\]

The lines intersect at the point (2, 5).
Elimination by addition:

\[4x + y = 13\]  \hspace{1cm} \text{Equation 1}

\[6x - y = 7\]  \hspace{1cm} \text{Equation 2}

\[10x = 20\] \hspace{1cm} \text{Add equations}

\[10x \div 10 = \frac{20}{10}\] \hspace{1cm} \text{Divide each side by 10.}

\[x = 2\] \hspace{1cm} \text{Simplify.}

Substitute \(x = 2\) into \(4x + y = 13\) to find \(y\).

\[4(2) + y = 13\]  \hspace{1cm} \text{Equation 1}

\[8 + y = 13\]

\[y = 5\]

So, the solution is \((2, 5)\).

Substitution:

Solve \(4x + y = 13\) for \(y\).

\[4x + y = 13\]  \hspace{1cm} \text{Equation 1}

\[4x - 4x + y = -4x + 13\]

\[y = -4x + 13\]

Substitute \(-4x + 13\) for \(y\),

\[6x - y = 7\]  \hspace{1cm} \text{Equation 2}

\[6x - ( -4x + 13) = 7\] \hspace{1cm} \text{Substitution}

\[6x + 4x - 13 = 7\]

\[10x - 13 = 7\]

\[10x - 13 + 13 = 7 + 13\]

\[10x = 20\]

\[\frac{10x}{10} = \frac{20}{10}\]

\[x = 2\]

Substitute \(x = 2\) into \(4x + y = 13\) to find \(y\).
6-5 Applying Systems of Linear Equations

\[ 4x + y = 13 \quad \text{Equation 1} \]
\[ 4(2) + y = 13 \]
\[ y = 5 \]

So, the solution is \((2, 5)\).

24. WRITE A QUESTION A classmate says that elimination is the best way to solve a system of equations. Write a question to challenge his conjecture.

**SOLUTION:**
Sample answer: Would another method work better if one of the equations is in the form \(y = mx + b\)?

25. WHICH ONE DOESN’T BELONG? Which system is different? Explain.

| \(x - y = 3\) | \(-x + y = 0\) |
| \(x + \frac{1}{2}y = 1\) | \(5x = 2y\) |
| \(y = x - 4\) | \(y = x + 1\) |
| \(y = \frac{2}{x}\) | \(y = 3x\) |

**SOLUTION:**
The third system; this system is the only one that is not a system of linear equations.

26. WRITING IN MATH How do you know what method to use when solving a system of equations?

**SOLUTION:**
Sample answer: You can analyze the coefficients of the terms in each equation to determine which method to use. If one of the variables in either equation has a coefficient of 1 or -1, then substitution could be used. If a variable in both equations has coefficients that are opposites, then elimination using addition may be the most convenient method. If a variable in both equations has coefficients that are the same, elimination using subtraction may be the most convenient method. If none of these conditions are met, elimination using multiplication could be used. If both equations are written in slope-intercept form, graphing might be another solution option.
27. If $5x + 3y = 12$ and $4x - 5y = 17$, what is $y$?

A $-1$
B 3
C $(-1, 3)$
D $(3, -1)$

**SOLUTION:**
Use elimination by multiplication to eliminate the $x$ terms and solve for $y$.

\[
egin{align*}
5x + 3y &= 12 \quad \text{Multiply by 4} \Rightarrow \quad 20x + 12y &= 48 \\
4x - 5y &= 17 \quad \text{Multiply by } -5 \Rightarrow \quad -20x + 25y &= -85
\end{align*}
\]

\[
\begin{align*}
37y &= -37 \\
\frac{37y}{37} &= -\frac{37}{37} \\
y &= -1
\end{align*}
\]

The correct choice is A.

28. **STATISTICS** The scatter plot shows the number of hay bales used on the Bostwick farm during the last year.

![Hay Bales Used](image)

Which is an invalid conclusion?

F The Bostwicks used less hay in the summer than they did in the winter.

G The Bostwicks used about 629 bales of hay during the year.

H On average, the Bostwicks used about 52 bales each month.

J The Bostwicks used the most hay in February.

**SOLUTION:**
Looking at the scatter plot, choice F is valid because months 5–9 are summer months and the number of bales used is lowest. The sum of the bales of hay used in the year is about 629 bales of hay for the year. So, choice G is valid. Dividing 629 by the number of months (12) results in an average of about 52 bales used each month. So, choice H is valid. February is month 2 and the Bostwicks used about 65 bales of hay that month. More hay was used in months 1, 3, 4, 11, and 12. So, choice J is an invalid conclusion.

The correct choice is J.
6-5 Applying Systems of Linear Equations

29. SHORT RESPONSE At noon, Cesar cast a shadow 0.15 foot long. Next to him a streetlight cast a shadow 0.25 foot long. If Cesar is 6 feet tall, how tall is the streetlight?

**SOLUTION:**

\[
\frac{0.15}{6} = \frac{0.25}{x} \\
0.15x = 1.50 \\
x = 10
\]

The streetlight is 10 ft. tall.

30. The graph shows the solution to which of the following systems of equations?

![Graph](image)

A  \( y = -3x + 11 \)  
  \( 3y = 5x - 9 \)  

B  \( y = 5x - 15 \)  
  \( 2y = x + 7 \)  

C  \( y = -3x + 11 \)  
  \( 2y = 4x - 5 \)  

D  \( y = 5x - 15 \)  
  \( 3y = 2x + 18 \)

**SOLUTION:**

Looking at the graph, the solution to the system of equation appears to be (3, 2).

Since each system has an equation solved for \( y \), use substitution to find the exact solution for each system of equations algebraically.

For A, substitute \(-3x + 11\) for \( y \) in the second equation to find the value of \( x \), then substitute it for \( x \) to find the value of \( y \).

\[
3y = 5x - 9 \quad \text{Equation 2} \\
3(-3x + 11) = 5x - 9 \quad \text{Substitute.} \\
-9x + 33 = 5x - 9 \quad \text{Distributive Property} \\
-14x = -42 \quad \text{Subtract.} \\
x = 3 \quad \text{Divide.}
\]

\[
y = -3x + 11 \quad \text{First equation} \\
y = -3(3) + 11 \quad \text{Substitute.} \\
y = 2 \quad \text{Simplify.}
\]
The solution for the system of equations in A is (3, 2).
For B, substitute $5x - 15$ for $y$ in the second equation to find the value of $x$, then substitute it for $x$ to find the value of $y$.

\[
2y = x + 7 \quad \text{Equation 2}
\]

\[
2(5x - 15) = x + 7 \quad \text{Substitute.}
\]

\[
10x - 30 = x + 7 \quad \text{Distributive Property}
\]

\[
y = 5x - 15 \quad \text{Equation 1}
\]

\[
y = 5\left(\frac{41}{9}\right) - 15 \quad \text{Substitute}
\]

\[
x = 4\frac{1}{9} \quad \text{Divide.}
\]

\[
y = 5\frac{5}{9} \quad \text{Simplify.}
\]

The solution for the system of equations in B is \(\left(\frac{41}{9}, \frac{5}{9}\right)\).

For C, substitute $-3x + 11$ for $y$ in the second equation to find the value of $x$, then substitute it for $x$ to find the value of $y$.

\[
2y = 4x - 5 \quad \text{Equation 2}
\]

\[
2(-3x + 11) = 4x - 5 \quad \text{Substitute.}
\]

\[
-6x + 22 = 4x - 5 \quad \text{Distributive Property}
\]

\[
y = -3x + 11 \quad \text{Equation 1}
\]

\[
y = -3(2.7) + 11 \quad \text{Substitute.}
\]

\[
x = 2.7 \quad \text{Divide.}
\]

\[
y = 2.9 \quad \text{Simplify.}
\]

The solution for the system of equations in C is (2.7, 2.9).

For D, substitute $5x - 15$ for $y$ in the second equation to find the value of $x$, then substitute it for $x$ to find the value of $y$.

\[
3y = 2x + 18 \quad \text{Equation 2}
\]

\[
3(5x - 15) = 2x + 18 \quad \text{Substitute.}
\]

\[
15x - 45 = 2x + 18 \quad \text{Distributive Property}
\]

\[
y = 5x - 15 \quad \text{Equation 1}
\]

\[
y = 5\left(\frac{11}{13}\right) - 15 \quad \text{Substitute}
\]

\[
x = \frac{411}{13} \quad \text{Divide.}
\]

\[
y = 9\frac{3}{13} \quad \text{Simplify.}
\]

The solution for the system of equations in D is \(\left(\frac{411}{13}, 9\frac{3}{13}\right)\).

Only the system of equations in A has a solution that appears to be represented by the graph. So, the correct choice is A.
Use elimination to solve each system of equations.

31. \( x + y = 3 \)
\( 3x - 4y = -12 \)

**SOLUTION:**

\[
\begin{align*}
\text{Equation 1: } & \quad x + y = 3 \\
\text{Equation 2: } & \quad 3x - 4y = -12
\end{align*}
\]

Multiply by \(-3\) \(\Rightarrow\)

\[
\begin{align*}
-3x - 3y = & \quad -9 \\
3x - 4y = & \quad -12
\end{align*}
\]

Add the equations \(\Rightarrow\)

\[
\begin{align*}
-7y = & \quad -21 \\
y = & \quad 3
\end{align*}
\]

Now, substitute 3 for \(y\) in either equation to find the value of \(x\).

\[
\begin{align*}
x + y & = 3 \\
x + 3 & = 3 \\
x + 3 - 3 & = 3 - 3 \\
x & = 0
\end{align*}
\]

The solution is \((0, 3)\).

32. \(-4x + 2y = 0\)
\(2x - 3y = 16\)

**SOLUTION:**

\[
\begin{align*}
\text{Equation 1: } & \quad -4x + 2y = 0 \\
\text{Equation 2: } & \quad 2x - 3y = 16
\end{align*}
\]

Multiply by 2 \(\Rightarrow\)

\[
\begin{align*}
-4x + 2y & = 0 \\
4x - 6y & = 32
\end{align*}
\]

Add the equations \(\Rightarrow\)

\[
\begin{align*}
-4y & = 32 \\
y & = 8
\end{align*}
\]

Now, substitute \(-8\) for \(y\) in either equation to find the value of \(x\).

\[
\begin{align*}
-4x + 2y & = 0 \\
-4x + 2(-8) & = 0 \\
-4x - 16 & = 0 \\
-4x + 16 & = 16 \\
-4x & = 16 \\
\frac{-4x}{-4} & = \frac{16}{-4} \\
x & = -4
\end{align*}
\]

The solution is \((-4, -8)\).
6-5 Applying Systems of Linear Equations

33. \(4x + 2y = 10\)
\(5x - 3y = 7\)

**SOLUTION:**
\[
\begin{align*}
4x + 2y &= 10 & \text{Multiply by 3} & 12x + 6y &= 30 \\
5x - 3y &= 7 & \text{Multiply by 2} & 10x - 6y &= 14 \\
\hline
22x &= 44 & \Rightarrow x &= \frac{44}{22} \\
22x &= 44 & \Rightarrow x &= 2
\end{align*}
\]

Now, substitute 2 for \(x\) in either equation to find the value of \(y\).

\[
4x + 2y = 10 \quad \text{Equation 1}
\]
\[
4(2) + 2y = 10
\]
\[
8 + 2y = 10
\]
\[
8 - 8 + 2y = 10 - 8
\]
\[
2y = 2
\]
\[
\frac{2y}{2} = \frac{2}{2}
\]
\[
y = 1
\]

The solution is \((2, 1)\).
34. **TRAVELING** A youth group is traveling in two vans to visit an aquarium. The number of people in each van and the cost of admission for that van are shown. What are the adult and student prices?

<table>
<thead>
<tr>
<th>Van</th>
<th>Number of Adults</th>
<th>Number of Students</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>5</td>
<td>$77</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>7</td>
<td>$95</td>
</tr>
</tbody>
</table>

**SOLUTION:**

Let \(a\) represent the adult price and \(s\) represent the student price.

\[2a + 5s = 77, \quad 2a + 7s = 95\]

Because the coefficient for \(a\) is the same in both equations, multiply the second equation by \(-1\) and add to solve.

\[
\begin{align*}
2a + 5s &= 77 \quad \text{Equation 1} \\
(+) -2a + -7s &= -95 \\
-2s &= -18 \\
\frac{-2s}{-2} &= \frac{-18}{-2} \quad \text{Divide each side by } -2 \\
s &= 9 \quad \text{Simplify}
\end{align*}
\]

Now, substitute \(9\) for \(s\) in either equation to find the value of \(a\).

\[
\begin{align*}
2a + 5s &= 77 \quad \text{Equation 1} \\
2a + 5(9) &= 77 \\
2a + 45 &= 77 \\
2a + 45 - 45 &= 77 - 45 \\
2a &= 32 \\
\frac{2a}{2} &= \frac{32}{2} \\
a &= 16
\end{align*}
\]

So, the adult price is $16 and the student price is $9.
6-5 Applying Systems of Linear Equations

Graph each inequality.

35. \( y < 4 \)

**SOLUTION:**

\( y < 4 \)

Because the inequality involves \(<\), graph the boundary using a dashed line. Choose \((0, 0)\) as a test point.

\( 0 < 4 \)

Since 0 is less than 4, shade the half-plane that contains \((0, 0)\).

36. \( x \geq 3 \)

**SOLUTION:**

\( x \geq 3 \)

Because the inequality involves \(\geq\), graph the boundary using a solid line. Choose \((0, 0)\) as a test point.

\( 0 \not\geq 3 \)

Since 0 is not greater than or equal to 3, shade the half-plane that does not contain \((0, 0)\).
6-5 Applying Systems of Linear Equations

37. \(7x + 12y > 0\)

**SOLUTION:**
Solve for \(y\) in terms of \(x\).

\[
7x + 12y > 0
\]
\[
7x - 7x + 12y > 0 - 7x
\]
\[
12y > -7x
\]
\[
\frac{12y}{12} > \frac{-7x}{12}
\]
\[
y > -\frac{7}{12}x
\]
Because the inequality involves \(>\), graph the boundary using a dashed line. \((0, 0)\) falls on the line, so choose \((1, 0)\) as a test point.

\(7(1) + 12(0) > 0\)
\(7 > 0\)
Since 7 is greater than 0, shade the half-plane that contains \((1, 0)\).

38. \(y - 3x \leq 4\)

**SOLUTION:**
Solve for \(y\) in terms of \(x\).

\[
y - 3x \leq 4
\]
\[
y - 3x + 3x \leq 4 + 3x
\]
\[
y \leq 3x + 4
\]
Because the inequality involves \(\leq\), graph the boundary using a solid line. Choose \((0, 0)\) as a test point.

\(y - 3(0) \leq 4\)
\(0 \leq 4\)
Since 0 is less than or equal to 4, shade the half-plane that contains \((0, 0)\).
6-5 Applying Systems of Linear Equations

Find each sum or difference.

39. \((-3.81) + (-8.5)\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
-3.81 \\
\underline{+ (-8.50)} \\
-12.31
\end{align*}
\]

40. \(12.625 + (-5.23)\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
12.625 \\
\underline{+ (-5.230)} \\
7.395
\end{align*}
\]

41. \(21.65 + (-15.05)\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
21.65 \\
\underline{+ (-15.05)} \\
6.60
\end{align*}
\]

42. \((-4.27) + 1.77\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
-4.27 \\
\underline{+ 1.77} \\
-2.50
\end{align*}
\]

43. \((-78.94) - 14.25\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
-78.94 \\
\underline{- 14.25} \\
-93.19
\end{align*}
\]

44. \((-97.623) - (-25.14)\)

\[
\text{\textit{SOLUTION:}} \\
\begin{align*}
-97.623 \\
\underline{- (-25.140)} \\
-72.483
\end{align*}
\]