3-2 Solving Linear Equations by Graphing

Solve each equation by graphing.
1. \(-2x + 6 = 0\)

**SOLUTION:**
The related function is \(f(x) = -2x + 6\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = -2x + 6)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = -2(-4) + 6)</td>
<td>14</td>
<td>(-4, 14)</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = -2(-2) + 6)</td>
<td>10</td>
<td>(-2, 10)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = -2(0) + 6)</td>
<td>6</td>
<td>(0, 6)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = -2(2) + 6)</td>
<td>2</td>
<td>(2, 2)</td>
</tr>
<tr>
<td>3</td>
<td>(f(3) = -2(3) + 6)</td>
<td>0</td>
<td>(3, 0)</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = -2(4) + 6)</td>
<td>-2</td>
<td>(4, -2)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 3. So the solution is 3.
3-2 Solving Linear Equations by Graphing

2. \(-x - 3 = 0\)

**SOLUTION:**
The related function is \(f(x) = -x - 3\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = x - 3)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = -(4) - 3)</td>
<td>1</td>
<td>(-4, 1)</td>
</tr>
<tr>
<td>-3</td>
<td>(f(-3) = -(3) - 3)</td>
<td>0</td>
<td>(-3, 0)</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = -(2) - 3)</td>
<td>-1</td>
<td>(-2, -1)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = -(0) - 3)</td>
<td>-3</td>
<td>(0, -3)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = -(2) - 3)</td>
<td>-5</td>
<td>(2, -5)</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = -(4) - 3)</td>
<td>-7</td>
<td>(4, -7)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(-3\). So the solution is \(-3\).
3. $4x - 2 = 0$

**SOLUTION:**
Solve Graphically

The related function is $f(x) = 4x - 2$. To graph the function, make a table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 4x - 2$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>−4</td>
<td>$f(-4) = 4(-4) - 2$</td>
<td>−18</td>
<td>$(-4, -18)$</td>
</tr>
<tr>
<td>−2</td>
<td>$f(-2) = 4(-2) - 2$</td>
<td>−10</td>
<td>$(-2, -10)$</td>
</tr>
<tr>
<td>0</td>
<td>$f(0) = 4(0) - 2$</td>
<td>−2</td>
<td>$(0, -2)$</td>
</tr>
<tr>
<td>$\frac{1}{2}$</td>
<td>$f(2) = 4(2) - 2$</td>
<td>0</td>
<td>$\left(\frac{1}{2}, 0\right)$</td>
</tr>
<tr>
<td>2</td>
<td>$f(2) = 4(2) - 2$</td>
<td>6</td>
<td>$(2, 6)$</td>
</tr>
<tr>
<td>4</td>
<td>$f(4) = 4(4) - 2$</td>
<td>14</td>
<td>$(4, 14)$</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at $\frac{1}{2}$. So the solution is $\frac{1}{2}$.

**Solve algebraically**

$$4x - 2 = 0$$

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

$$4x = 2$$

$$\frac{4x}{4} = \frac{2}{4}$$

$$x = \frac{2}{4} = \frac{1}{2}$$
3-2 Solving Linear Equations by Graphing

4. \(9x + 3 = 0\)

**SOLUTION:**

Solve Graphically

The related function is \(f(x) = 9x + 3\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = -2x + 6)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = 9(-4) + 3)</td>
<td>-33</td>
<td>(-4, -33)</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = 9(-2) + 3)</td>
<td>-15</td>
<td>(-2, -15)</td>
</tr>
<tr>
<td>(-\frac{1}{3})</td>
<td>(f\left(-\frac{1}{3}\right) = 9\left(-\frac{1}{3}\right) + 3)</td>
<td>0</td>
<td>(\left(-\frac{1}{3}, 0\right))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 9(0) + 3)</td>
<td>3</td>
<td>(0, 3)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = 9(2) + 3)</td>
<td>21</td>
<td>(2, 21)</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = 9(4) + 3)</td>
<td>39</td>
<td>(4, 39)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(-\frac{1}{3}\). So the solution is \(-\frac{1}{3}\).

Solve algebraically

\[
\begin{align*}
9x + 3 &= 0 \\
9x + 3 - 3 &= 0 - 3 \\
9x &= -3 \\
\frac{9x}{9} &= \frac{-3}{9} \\
x &= \frac{-3}{9} = -\frac{1}{3}
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

5. \(2x - 5 = 2x + 8\)

**SOLUTION:**

Solve Graphically

\[
\begin{align*}
2x - 5 &= 2x + 8 & \text{Original equation} \\
2x - 2x - 5 &= 2x - 2x + 8 & \text{Subtract } 2x \text{ from each side.} \\
-5 &= 8 \quad & \text{Simplify.} \\
-5 - 8 &= 8 - 8 \quad & \text{Subtract 8 from each side.} \\
-13 &= 0 \quad & \text{Simplify.}
\end{align*}
\]

The related function is \(f(x) = -13\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
6. \(4x + 11 = 4x - 24\)

**SOLUTION:**

Solve Graphically

\[
\begin{align*}
4x + 11 &= 4x - 24 & \text{Original equation} \\
4x - 4x + 11 &= 4x - 4x - 24 & \text{Subtract 4x from each side.} \\
11 &= -24 & \text{Simplify.} \\
11 + 24 &= -24 + 24 & \text{Add 24 to each side.} \\
34 &= 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = 34\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

7. \(3x - 5 = 3x - 10\)

**SOLUTION:**
Solve Graphically

\[
\begin{align*}
3x - 5 &= 3x - 10 & \text{Original equation} \\
3x - 3x - 5 &= 3x - 3x - 10 & \text{Subtract } 3x \text{ from each side.} \\
-5 &= -10 & \text{Simplify.} \\
-5 + 10 &= -10 + 10 & \text{Add 10 to each side.} \\
5 &= 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = 5\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

8. \(-6x + 3 = -6x + 5\)

**SOLUTION:**
Solve Graphically

\[
\begin{align*}
-6x + 3 &= -6x + 5 & \text{Original equation} \\
-6x + 6x + 3 &= -6x + 6x + 5 & \text{Add } 6x \text{ to each side.} \\
3 &= 5 & \text{Simplify.} \\
3 - 5 &= 5 - 5 & \text{Subtract 5 from each side.} \\
-2 &= 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = -2\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.

9. **NEWSPAPERS** The function \(w = 30 - \frac{3}{4}n\) represents the weight \(w\) in pounds of the papers in Tyrone’s newspaper delivery bag after he delivers \(n\) newspapers. Find the zero and explain what it means in the context of this situation.

**SOLUTION:**
Solve Graphically

The related function is \(f(x) = 30 - \frac{3}{4}n\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 30 - \frac{3}{4}n)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(f(0) = 30 - \frac{3}{4}(0))</td>
<td>30</td>
<td>(0, 30)</td>
</tr>
<tr>
<td>10</td>
<td>(f(10) = 30 - \frac{3}{4}(10))</td>
<td>22.5</td>
<td>(10, 22.5)</td>
</tr>
<tr>
<td>20</td>
<td>(f(20) = 30 - \frac{3}{4}(20))</td>
<td>15</td>
<td>(20, 15)</td>
</tr>
<tr>
<td>30</td>
<td>(f(30) = 30 - \frac{3}{4}(30))</td>
<td>7.5</td>
<td>(30, 7.5)</td>
</tr>
<tr>
<td>40</td>
<td>(f(40) = 30 - \frac{3}{4}(40))</td>
<td>0</td>
<td>(40, 0)</td>
</tr>
</tbody>
</table>
The graph intersects the x-axis at 40. So the solution is 40. Tyrone must deliver 40 newspapers for his bag to weigh 0 pounds.

**Solve algebraically**

To find the zero of the function, substitute zero in for \(w\).

\[
w = 30 - \frac{3}{4}n
\]
\[
0 = 30 - \frac{3}{4}n
\]
\[
0 - 30 = 30 - 30 - \frac{3}{4}n
\]
\[
-30 = -\frac{3}{4}n
\]
\[
(-30)(-\frac{4}{3}) = \left(-\frac{4}{3}\right)\left(-\frac{3}{4}n\right)
\]
\[
\frac{-120}{-3} = n
\]
\[
40 = n
\]

This means that Tyrone must deliver 40 newspapers for his bag to weigh 0 pounds.
3-2 Solving Linear Equations by Graphing

Solve each equation by graphing.

10. \(0 = x - 5\)

**SOLUTION:**

Solve Graphically

The related function is \(f(x) = x - 5\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = x - 5)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>((-4) - 5)</td>
<td>-9</td>
<td>(-4, -9)</td>
</tr>
<tr>
<td>-2</td>
<td>((-2) - 5)</td>
<td>-7</td>
<td>(-2, -7)</td>
</tr>
<tr>
<td>0</td>
<td>((0) - 5)</td>
<td>-5</td>
<td>(0, -5)</td>
</tr>
<tr>
<td>2</td>
<td>((2) - 5)</td>
<td>-2</td>
<td>(2, -2)</td>
</tr>
<tr>
<td>4</td>
<td>((4) - 5)</td>
<td>-1</td>
<td>(4, -1)</td>
</tr>
<tr>
<td>5</td>
<td>((5) - 5)</td>
<td>0</td>
<td>(5, 0)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 5. So the solution is 5.

Solve algebraically

\[0 = x - 5\]
\[0 + 5 = x - 5 + 5\]
\[5 = x\]
3-2 Solving Linear Equations by Graphing

11. $0 = x + 3$

**SOLUTION:**
Solve Graphically

The related function is $f(x) = x + 3$. To graph the function, make a table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = x + 3$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-4$</td>
<td>$f(-4) = (-4) + 3$</td>
<td>$-1$</td>
<td>$(-4, -1)$</td>
</tr>
<tr>
<td>$-3$</td>
<td>$f(-3) = (3) + 3$</td>
<td>$0$</td>
<td>$(-3, 0)$</td>
</tr>
<tr>
<td>$-2$</td>
<td>$f(-2) = (-2) + 3$</td>
<td>$1$</td>
<td>$(-2, 1)$</td>
</tr>
<tr>
<td>$0$</td>
<td>$f(0) = (0) + 3$</td>
<td>$3$</td>
<td>$(0, 3)$</td>
</tr>
<tr>
<td>$2$</td>
<td>$f(2) = (2) + 3$</td>
<td>$5$</td>
<td>$(2, 5)$</td>
</tr>
<tr>
<td>$4$</td>
<td>$f(4) = (4) + 3$</td>
<td>$7$</td>
<td>$(4, 7)$</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at $-3$. So the solution is $-3$.

**Solve algebraically**

$0 = x + 3$

$0 - 3 = x + 3 - 3$

$-3 = x$
3-2 Solving Linear Equations by Graphing

12. $5 - 8x = 16 - 8x$

**SOLUTION:**

Solve Graphically

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5 - 8x = 16 - 8x$</td>
<td>Original equation</td>
</tr>
<tr>
<td>$5 - 8x + 8x = 16 - 8x + 8x$</td>
<td>Add $8x$ to each side.</td>
</tr>
<tr>
<td>$5 = 16$</td>
<td>Simplify.</td>
</tr>
<tr>
<td>$5 - 16 = 16 - 16$</td>
<td>Subtract 16 from each side</td>
</tr>
<tr>
<td>$-11 = 0$</td>
<td>Simplify.</td>
</tr>
</tbody>
</table>

Graph the related function, which is $f(x) = -11$.

The graph does not intersect the $x$-axis. Therefore, this equation has no solution.
13. \(3x - 10 = 21 + 3x\)

**SOLUTION:**

\[
\begin{align*}
3x - 10 &= 21 + 3x \\
3x - 3x - 10 &= 21 + 3x - 3x \\
-10 &= 21 \\
-10 - 21 &= 21 - 21 \\
-31 &= 0
\end{align*}
\]

Graph the related function, which is \(f(x) = -31\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

14. \(4x - 36 = 0\)

**SOLUTION:**
Solve Graphically

The related function is \(f(x) = 4x - 36\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 4x - 36)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>(f(-3) = 4(-3) - 36)</td>
<td>-48</td>
<td>(-3, -48)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 4(0) - 36)</td>
<td>-36</td>
<td>(0, -36)</td>
</tr>
<tr>
<td>3</td>
<td>(f(3) = 4(3) - 36)</td>
<td>-24</td>
<td>(3, -24)</td>
</tr>
<tr>
<td>6</td>
<td>(f(6) = 4(6) - 36)</td>
<td>-12</td>
<td>(6, -12)</td>
</tr>
<tr>
<td>9</td>
<td>(f(9) = 4(9) - 36)</td>
<td>0</td>
<td>(9, 0)</td>
</tr>
<tr>
<td>12</td>
<td>(f(12) = 4(12) - 36)</td>
<td>4</td>
<td>(12, 4)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 9. So the solution is 9.

**Solve Algebraically**

\[
\begin{align*}
4x - 36 &= 0 \\
4x - 36 + 36 &= 0 + 36 \\
4x &= 36 \\
\frac{4x}{4} &= \frac{36}{4} \\
x &= 9
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

15. $0 = 7x + 10$

**SOLUTION:**
Solve Graphically

The related function is $f(x) = 7x + 10$. To graph the function, make a table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 7x + 10$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-4$</td>
<td>$f(-4) = 7(-4) + 10$</td>
<td>$-38$</td>
<td>$(-4, -38)$</td>
</tr>
<tr>
<td>$-2$</td>
<td>$f(-2) = 7(-2) + 10$</td>
<td>$-24$</td>
<td>$(-2, -24)$</td>
</tr>
<tr>
<td>$-\frac{10}{7}$</td>
<td>$f\left(-\frac{10}{7}\right) = \left(-\frac{10}{7}\right) + 10$</td>
<td>$0$</td>
<td>$\left(-\frac{10}{7}, 0\right)$</td>
</tr>
<tr>
<td>$0$</td>
<td>$f(0) = 7(0) + 10$</td>
<td>$10$</td>
<td>$(0, 10)$</td>
</tr>
<tr>
<td>$2$</td>
<td>$f(2) = 7(2) + 10$</td>
<td>$4$</td>
<td>$(2, 4)$</td>
</tr>
<tr>
<td>$4$</td>
<td>$f(4) = 7(4) + 10$</td>
<td>$1$</td>
<td>$(4, 1)$</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at $-\frac{10}{7}$. So the solution is $-\frac{10}{7}$.

Solve algebraically

\[
\begin{align*}
0 &= 7x + 10 \\
0 - 10 &= 7x + 10 - 10 \\
-10 &= 7x \\
-\frac{10}{7} &= \frac{7x}{7} \\
x &= -\frac{10}{7} \text{ or } -1\frac{3}{7}
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

16. \(2x + 22 = 0\)

**SOLUTION:**

Solve Graphically

The related function is \(f(x) = 2x + 22\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 2x + 22)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-12</td>
<td>(f(-12) = 2(-12) + 22)</td>
<td>-2</td>
<td>(-12, -2)</td>
</tr>
<tr>
<td>-11</td>
<td>(f(-11) = 2(-11) + 22)</td>
<td>0</td>
<td>(-11, 0)</td>
</tr>
<tr>
<td>-10</td>
<td>(f(-10) = 2(-10) + 22)</td>
<td>2</td>
<td>(-10, 2)</td>
</tr>
<tr>
<td>-8</td>
<td>(f(-8) = 2(-8) + 22)</td>
<td>6</td>
<td>(-8, 6)</td>
</tr>
<tr>
<td>-6</td>
<td>(f(-6) = 2(-6) + 22)</td>
<td>10</td>
<td>(-6, 10)</td>
</tr>
<tr>
<td>-4</td>
<td>(f(-4) = 2(-4) + 22)</td>
<td>14</td>
<td>(-4, 14)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 2(0) + 22)</td>
<td>22</td>
<td>(0, 22)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at -11. So the solution is -11.

Solve Algebraically

\[
\begin{align*}
2x + 22 &= 0 \\
2x + 22 - 22 &= 0 - 22 \\
2x &= -22 \\
\frac{2x}{2} &= \frac{-22}{2} \\
x &= -11
\end{align*}
\]
17. \(5x - 5 = 5x + 2\)

**SOLUTION:**

\[
\begin{align*}
5x - 5 &= 5x + 2 & \text{Original equation} \\
5x - 5x - 5 &= 5x - 5x + 2 & \text{Subtract } 5x \text{ from each side.} \\
-5 &= 2 & \text{Simplify.} \\
-5 - 2 &= 2 - 2 & \text{Subtract 2 from each side.} \\
-7 &= 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = -7\)

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
18. \(-7x + 35 = 20 - 7x\)

**SOLUTION:**

\[
\begin{align*}
-7x + 35 & = 20 - 7x & \text{Original equation} \\
-7x + 7x + 35 & = 20 - 7x + 7x & \text{Add 7x to each side.} \\
35 & = 20 & \text{Simplify.} \\
35 - 20 & = 20 - 20 & \text{Subtract 20 from each side.} \\
15 & = 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = 15\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

19. \(-4x - 28 = 3 - 4x\)

**SOLUTION:**

\[
\begin{align*}
-4x - 28 &= 3 - 4x & \text{Original equation} \\
-4x - 28 + 4x &= 3 - 4x + 4x & \text{Add} \ 4x \ \text{to each side.} \\
-28 &= 3 & \text{Simplify.} \\
-28 - 3 &= 3 - 3 & \text{Subtract} \ 3 \ \text{from each side.} \\
-31 &= 3 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = -31\).

![Graph](image)

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

20. 0 = 6x − 8

**SOLUTION:**

Solve Graphically

The related function is \( f(x) = 6x - 8 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = 6x - 8 )</th>
<th>( f(x) )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>( f(-4) = 6(-4) - 8 )</td>
<td>-32</td>
<td>(-4, 14)</td>
</tr>
<tr>
<td>-2</td>
<td>( f(-2) = 6(-2) - 8 )</td>
<td>-20</td>
<td>(-2, 10)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = 6(0) - 8 )</td>
<td>-8</td>
<td>(0, 6)</td>
</tr>
<tr>
<td>( \frac{1}{3} )</td>
<td>( f(\frac{1}{3}) = 6\left(\frac{1}{3}\right) - 8 )</td>
<td>0</td>
<td>( \left(\frac{1}{3}, 0\right) )</td>
</tr>
<tr>
<td>2</td>
<td>( f(2) = 6(2) - 8 )</td>
<td>4</td>
<td>(2, 2)</td>
</tr>
<tr>
<td>4</td>
<td>( f(4) = 6(4) - 8 )</td>
<td>16</td>
<td>(4, -2)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at \( \frac{1}{3} \). So the solution is \( \frac{1}{3} \).

Solve Algebraically

\[
0 = 6x - 8 \\
0 + 8 = 6x - 8 + 8 \\
8 = 6x \\
\frac{8}{6} = \frac{6x}{6} \\
\frac{4}{3} = x \\
\]

\( x = \frac{4}{3} \) or \( 1\frac{1}{3} \)
3-2 Solving Linear Equations by Graphing

21. \(12x + 132 = 12x - 100\)

**SOLUTION:**

\[
\begin{align*}
12x + 132 &= 12x - 100 & \text{Original equation} \\
12x - 12x + 132 &= 12x - 12x - 100 & \text{Subtract.} \\
132 &= -100 & \text{Simplify.} \\
132 + 100 &= -100 + 100 & \text{Add.} \\
232 &= 0 & \text{Simplify.}
\end{align*}
\]

Graph the related function, which is \(f(x) = 232\).

The graph does not intersect the \(x\)-axis. Therefore, this equation has no solution.
3-2 Solving Linear Equations by Graphing

22. TEXT MESSAGING  Sean is sending text messages to his friends. The function \( y = 160 - x \) represents the number of characters \( y \) the message can hold after he has typed \( x \) characters. Find the zero and explain what it means in the context of this situation.

**SOLUTION:**
To find the zero of the function, substitute zero for \( y \). Then \( y = 160 - x \)

Solve Graphically

The related function is \( f(x) = 160 - x \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = -2x + 6 )</th>
<th>( f(x) )</th>
<th>( (x,f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( f(0) = 160 - (0) )</td>
<td>160</td>
<td>(0, 160)</td>
</tr>
<tr>
<td>20</td>
<td>( f(20) = 160 - (20) )</td>
<td>140</td>
<td>(20, 140)</td>
</tr>
<tr>
<td>90</td>
<td>( f(90) = 160 - (90) )</td>
<td>70</td>
<td>(90, 70)</td>
</tr>
<tr>
<td>100</td>
<td>( f(100) = 160 - (100) )</td>
<td>60</td>
<td>(100, 60)</td>
</tr>
<tr>
<td>130</td>
<td>( f(130) = 160 - (130) )</td>
<td>30</td>
<td>(130, 30)</td>
</tr>
<tr>
<td>160</td>
<td>( f(160) = 160 - (160) )</td>
<td>0</td>
<td>(160, 0)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at 160. So the solution is 160.

Solve algebraically

\[
egin{align*}
  & y = 160 - x \\
  & 0 = 160 - x \\
  & 0 - 160 = 160 - 160 - x \\
  & -160 = -x \\
  & 160 = x
\end{align*}
\]

This means that the text message is full after Sean has typed 160 characters.
3-2 Solving Linear Equations by Graphing

23. **GIFT CARDS** For her birthday Kwan receives a $50 gift card to download songs. The function \( m = -0.50d + 50 \) represents the amount of money \( m \) that remains on the card after a number of songs \( d \) are downloaded. Find the zero and explain what it means in the context of this situation.

**SOLUTION:**
To find the zero of the function, substitute zero in for \( m \). Then \( 0 = -0.50d + 50 \).

**Solve Graphically**

The related function is \( f(d) = -0.50d + 50 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( d )</th>
<th>( f(0) = -0.50(0) + 50 )</th>
<th>( f(d) )</th>
<th>( (d, f(d)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
<td>(0, 50)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>-50</td>
<td>40</td>
<td>(20, 40)</td>
</tr>
<tr>
<td>40</td>
<td>-50</td>
<td>30</td>
<td>(40, 30)</td>
</tr>
<tr>
<td>60</td>
<td>-50</td>
<td>20</td>
<td>(60, 20)</td>
</tr>
<tr>
<td>100</td>
<td>-50</td>
<td>0</td>
<td>(100, 0)</td>
</tr>
<tr>
<td>120</td>
<td>-50</td>
<td>-10</td>
<td>(120, -10)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at 100. So the solution is 100.

**Solve algebraically**

\[
\begin{align*}
m &= -0.50d + 50 \\
0 &= -0.50d + 50 \\
0 - 50 &= -0.50d + 50 - 50 \\
-50 &= -0.50d \\
\frac{-50}{-0.50} &= \frac{-0.50d}{-0.50} \\
100 &= d
\end{align*}
\]

This means she can download a total of 100 songs before the gift card is completely used.
3-2 Solving Linear Equations by Graphing

Solve each equation by graphing.

24. \(-7 = 4x + 1\)

**SOLUTION:**
Rewrite \(-7 = 4x + 1\) with zero on the left side \(0 = 4x + 8\).

Solve Graphically

The related function is \(f(x) = 4x + 8\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 4x + 8)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-4)</td>
<td>(f(-4) = 4(-4) + 8)</td>
<td>(-8)</td>
<td>((-4, -8))</td>
</tr>
<tr>
<td>(-2)</td>
<td>(f(-2) = 4(-2) + 8)</td>
<td>(0)</td>
<td>((-2, 0))</td>
</tr>
<tr>
<td>(0)</td>
<td>(f(0) = 4(0) + 8)</td>
<td>(8)</td>
<td>((0, 8))</td>
</tr>
<tr>
<td>(2)</td>
<td>(f(2) = 4(2) + 8)</td>
<td>(16)</td>
<td>((2, 16))</td>
</tr>
<tr>
<td>(4)</td>
<td>(f(4) = 4(4) + 8)</td>
<td>(24)</td>
<td>((4, 24))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(-2\). So the solution is \(-2\).

Solve algebraically

\[-7 = 4x + 1\]
\[-7 - 1 = 4x + 1 - 1\]
\[-8 = 4x\]
\[
\frac{-8}{4} = \frac{4x}{4} \quad \Rightarrow \quad -2 = x
\]
25. \( 4 - 2x = 20 \)

**SOLUTION:**
Rewrite \( 4 - 2x = 20 \) with 0 on the right side: \( -16 - 2x = 0 \).

Solve Graphically

The related function is \( f(x) = -2x - 16 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = -2x - 16 )</th>
<th>( f(x) )</th>
<th>((x,f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>( f(-10) = -2(-10) - 16 )</td>
<td>4</td>
<td>(-10, 4)</td>
</tr>
<tr>
<td>-8</td>
<td>( f(-8) = -2(-8) - 16 )</td>
<td>0</td>
<td>(-8, 0)</td>
</tr>
<tr>
<td>-4</td>
<td>( f(-4) = -2(-4) - 16 )</td>
<td>-8</td>
<td>(-4, -8)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = -2(0) - 16 )</td>
<td>-16</td>
<td>(0, -16)</td>
</tr>
<tr>
<td>2</td>
<td>( f(2) = -2(2) - 16 )</td>
<td>-20</td>
<td>(2, -20)</td>
</tr>
<tr>
<td>4</td>
<td>( f(4) = -2(4) 16 )</td>
<td>-24</td>
<td>(4, -24)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at -8. So the solution is -8.

Solve Algebraically

\[
\begin{align*}
4 - 2x &= 20 \\
4 - 4 - 2x &= 20 - 4 \\
-2x &= 16 \\
\frac{-2x}{-2} &= \frac{16}{-2} \\
x &= -8
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

26. \(2 - 5x = -23\)

**SOLUTION:**
Rewrite \(2 - 5x = -23\) with zero on the right side \(25 - 5x = 0\).

**Solve Graphically**

The related function is \(f(x) = -5x + 25\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = -2x + 25)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(f(0) = -5(0) + 25)</td>
<td>25</td>
<td>(0, 25)</td>
</tr>
<tr>
<td>1</td>
<td>(f(1) = -5(1) + 25)</td>
<td>20</td>
<td>(1, 20)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = -5(2) + 25)</td>
<td>15</td>
<td>(2, 15)</td>
</tr>
<tr>
<td>3</td>
<td>(f(3) = -5(3) + 25)</td>
<td>10</td>
<td>(3, 10)</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = -5(4) + 25)</td>
<td>5</td>
<td>(4, 5)</td>
</tr>
<tr>
<td>5</td>
<td>(f(5) = -5(5) + 25)</td>
<td>0</td>
<td>(5, 0)</td>
</tr>
<tr>
<td>6</td>
<td>(f(6) = -5(6) + 25)</td>
<td>-5</td>
<td>(6, -5)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 5. So the solution is 5.

**Solve algebraically**

\[
\begin{align*}
2 - 5x &= -23 \\
2 - 2 - 5x &= -23 - 2 \\
-5x &= -25 \\
\frac{-5x}{-5} &= \frac{-25}{-5} \\
x &= 5
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

27. 10 – 3x = 0

**SOLUTION:**
Solve Graphically

The related function is \( f(x) = -3x + 10 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = -3x + 10 )</th>
<th>( f(x) )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>( f(-4) = -3(-4) + 10 )</td>
<td>10</td>
<td>(0, 10)</td>
</tr>
<tr>
<td>1</td>
<td>( f(-2) = -3(-2) + 10 )</td>
<td>7</td>
<td>(1, 7)</td>
</tr>
<tr>
<td>2</td>
<td>( f(0) = -3(0) + 10 )</td>
<td>6</td>
<td>(2, 6)</td>
</tr>
<tr>
<td>3</td>
<td>( f(2) = -3(2) + 10 )</td>
<td>1</td>
<td>(3, 1)</td>
</tr>
<tr>
<td>( 3\frac{1}{3} )</td>
<td>( f \left( 3\frac{1}{3} \right) = -3 \left( 3\frac{1}{3} \right) + 10 )</td>
<td>0</td>
<td>( \left( 3\frac{1}{3}, 0 \right) )</td>
</tr>
<tr>
<td>4</td>
<td>( f(4) = -3(4) + 10 )</td>
<td>-2</td>
<td>(4, -2)</td>
</tr>
</tbody>
</table>

The graph intersects the x-axis at \( 3\frac{1}{3} \). So the solution is \( 3\frac{1}{3} \).

Solve Algebraically

\[
10 - 3x = 0
\]
\[
10 - 10 - 3x = 0 - 10
\]
\[
-3x = -10
\]
\[
-3x = -10
\]
\[
\frac{-3}{-3}
\]
\[
x = \frac{10}{3} \quad \text{or} \quad 3\frac{1}{3}
\]
3-2 Solving Linear Equations by Graphing

28. \(15 + 6x = 0\)

**SOLUTION:**
 Solve Graphically

The related function is \(f(x) = 6x + 15\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 6x + 15)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-4)</td>
<td>(f(-4) = 6(-4) + 15)</td>
<td>(-9)</td>
<td>((-4, -9))</td>
</tr>
<tr>
<td>(-2\frac{1}{2})</td>
<td>(f(-2\frac{1}{2}) = 6(-2\frac{1}{2}) + 15)</td>
<td>(0)</td>
<td>((-2\frac{1}{2}, 0))</td>
</tr>
<tr>
<td>(-2)</td>
<td>(f(-2) = 6(-2) + 15)</td>
<td>(3)</td>
<td>((-2, 3))</td>
</tr>
<tr>
<td>(0)</td>
<td>(f(0) = 6(0) + 15)</td>
<td>(15)</td>
<td>((0, 15))</td>
</tr>
<tr>
<td>(2)</td>
<td>(f(2) = 6(2) + 15)</td>
<td>(27)</td>
<td>((2, 27))</td>
</tr>
<tr>
<td>(4)</td>
<td>(f(4) = 6(4) + 15)</td>
<td>(39)</td>
<td>((4, 39))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(-2\frac{1}{2}\). So the solution is \(-2\frac{1}{2}\).

**Solve algebraically**

\[
\begin{align*}
15 + 6x &= 0 \\
15 - 15 + 6x &= 0 - 15 \\
6x &= -15 \\
\frac{6x}{6} &= \frac{-15}{6} \\
x &= -\frac{15}{6} = -\frac{5}{2} \text{ or } -2\frac{1}{2}
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

29. \( 0 = 13x + 34 \)

**SOLUTION:**
Solve Graphically

The related function is \( f(x) = 13x + 34 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = 13x + 34 )</th>
<th>( f(x) )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>( f(-4) = 13(-4) + 34 )</td>
<td>-18</td>
<td>(-4, -18)</td>
</tr>
<tr>
<td>(-\frac{8}{13})</td>
<td>( f\left(-\frac{8}{13}\right) = 13\left(-\frac{8}{13}\right) + 34 )</td>
<td>0</td>
<td>(-\frac{8}{13}, 0)</td>
</tr>
<tr>
<td>-2</td>
<td>( f(-2) = 13(-2) + 34 )</td>
<td>8</td>
<td>(-2, 8)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = 13(0) + 34 )</td>
<td>34</td>
<td>(0, 34)</td>
</tr>
<tr>
<td>2</td>
<td>( f(2) = 13(2) + 34 )</td>
<td>60</td>
<td>(2, 60)</td>
</tr>
<tr>
<td>4</td>
<td>( f(4) = 13(4) + 34 )</td>
<td>73</td>
<td>(4, 73)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at \(-2 - \frac{8}{13}\). So the solution is \(-2 - \frac{8}{13}\).

Solve Algebraically

\[
0 = 13x + 34 \\
0 - 13x = 13x - 13x + 34 \\
-13x = 34 \\
-13x \div -13 = \frac{34}{-13} \\
x = -\frac{34}{13} \text{ or } -2 - \frac{8}{13}
\]
3-2 Solving Linear Equations by Graphing

30. \(0 = 22x - 10\)

**SOLUTION:**
Solve Graphically

The related function is \(f(x) = 22x - 10\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 22x - 10)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>(f(-1) = 22(-1) - 10)</td>
<td>-32</td>
<td>((-1, -32))</td>
</tr>
<tr>
<td>(\frac{1}{2})</td>
<td>(f\left(-\frac{1}{2}\right) = 22\left(-\frac{1}{2}\right) - 10)</td>
<td>-21</td>
<td>(\left(-\frac{1}{2}, -21\right))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 22(0) - 10)</td>
<td>-10</td>
<td>((0, -10))</td>
</tr>
<tr>
<td>(\frac{5}{11})</td>
<td>(f\left(\frac{5}{11}\right) = 22\left(\frac{5}{11}\right) - 10)</td>
<td>0</td>
<td>(\left(\frac{5}{11}, 0\right))</td>
</tr>
<tr>
<td>1</td>
<td>(f(1) = 22(1) - 10)</td>
<td>12</td>
<td>((1, 12))</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = 22(2) - 10)</td>
<td>34</td>
<td>((2, 34))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(\frac{5}{11}\). So the solution is \(\frac{5}{11}\).

**Solve algebraically**

\[
0 = 22x - 10
\]
\[
0 - 22x = 22x - 22x - 10
\]
\[
-22x = -10
\]
\[
\frac{-22x}{-22} = \frac{-10}{-22}
\]
\[
x = \frac{10}{22} = \frac{5}{11}
\]
3-2 Solving Linear Equations by Graphing

31. \(25x - 17 = 0\)

**SOLUTION:**
Solve Graphically

The related function is \(f(x) = 25x - 17\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 25x - 17)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>(f(-2) = 25(-2) - 17)</td>
<td>-67</td>
<td>(-2, -67)</td>
</tr>
<tr>
<td>-1</td>
<td>(f(-1) = 25(-1) - 17)</td>
<td>-42</td>
<td>(-1, -42)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 25(0) - 17)</td>
<td>-17</td>
<td>(0, -17)</td>
</tr>
<tr>
<td>(\frac{17}{25})</td>
<td>(f\left(\frac{17}{25}\right) = 25\left(\frac{17}{25}\right) - 17)</td>
<td>0</td>
<td>(\left(\frac{17}{25}, 0\right))</td>
</tr>
<tr>
<td>1</td>
<td>(f(1) = 25(1) - 17)</td>
<td>8</td>
<td>(1, 8)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = 25(2) - 17)</td>
<td>33</td>
<td>(2, 33)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(\frac{17}{25}\). So the solution is \(\frac{17}{25}\).

Solve Algebraically

\[
25x - 17 = 0
\]
\[
25x - 17 + 17 = 0 + 17
\]
\[
25x = 17
\]
\[
\frac{25x}{25} = \frac{17}{25}
\]
\[
x = \frac{17}{25}
\]

32. \(0 = \frac{1}{2} + \frac{2}{3}x\)

**SOLUTION:**
Solve Graphically

The related function is \(f(x) = \frac{1}{2} + \frac{2}{3}x\). To graph the function, make a table.
3.2 Solving Linear Equations by Graphing

<table>
<thead>
<tr>
<th>x</th>
<th>( f(x) = \frac{1}{2} + \frac{2}{3}x )</th>
<th>( f(x) )</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td>( f(-6) = \frac{1}{2} + \frac{2}{3}(-6) )</td>
<td>-3.5</td>
<td>(-6, -3.5)</td>
</tr>
<tr>
<td>-3</td>
<td>( f(-3) = \frac{1}{2} + \frac{2}{3}(-3) )</td>
<td>-1.5</td>
<td>(-3, -1.5)</td>
</tr>
<tr>
<td>(-\frac{3}{4})</td>
<td>( f\left(-\frac{3}{4}\right) = \frac{1}{2} + \frac{2}{3}\left(-\frac{3}{4}\right) )</td>
<td>0</td>
<td>\left(-\frac{3}{4}, 0\right)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = \frac{1}{2} + \frac{2}{3}(0) )</td>
<td>0.5</td>
<td>(0, 0.5)</td>
</tr>
<tr>
<td>3</td>
<td>( f(3) = \frac{1}{2} + \frac{2}{3}(3) )</td>
<td>2.5</td>
<td>(3, 2.5)</td>
</tr>
<tr>
<td>6</td>
<td>( f(6) = \frac{1}{2} + \frac{2}{3}(6) )</td>
<td>4.5</td>
<td>(6, 4.5)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at \(-\frac{3}{4}\). So the solution is \(-\frac{3}{4}\).

Solve Algebraically

\[
0 = \frac{1}{2} + \frac{2}{3}x
\]

\[
0 - \frac{2}{3}x = \frac{1}{2} + \frac{2}{3}x - \frac{2}{3}x
\]

\[
\frac{2}{3}x = \frac{1}{2}
\]

\[
\frac{3}{2} \left( \frac{2}{3}x \right) = \frac{3}{2} \left( \frac{1}{2} \right)
\]

\[
x = -\frac{3}{4}
\]

3.  \( \frac{3}{4} - \frac{2}{5}x \)

**SOLUTION:**
Solve Graphically

The related function is \( f(x) = \frac{3}{4} - \frac{2}{5}x \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = \frac{3}{4} - \frac{2}{5}x )</th>
<th>( f(x) )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.5</td>
<td>( f(-2.5) = \frac{3}{4} - \frac{2}{5}(-2.5) )</td>
<td>1.75</td>
<td>(-2.5, 1.75)</td>
</tr>
<tr>
<td>-0.5</td>
<td>( f(-0.5) = \frac{3}{4} - \frac{2}{5}(-0.5) )</td>
<td>0.95</td>
<td>(-0.5, 0.95)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = \frac{3}{4} - \frac{2}{5}(0) )</td>
<td>0.75</td>
<td>(0, 0.75)</td>
</tr>
<tr>
<td>0.5</td>
<td>( f(0.5) = \frac{3}{4} - \frac{2}{5}(0.5) )</td>
<td>0.55</td>
<td>(0.5, 0.55)</td>
</tr>
<tr>
<td>( \frac{17}{8} )</td>
<td>( f\left( \frac{17}{8} \right) = \frac{3}{4} - \frac{2}{5}\left( \frac{17}{8} \right) )</td>
<td>0</td>
<td>( \left( \frac{17}{8}, 0 \right) )</td>
</tr>
<tr>
<td>2.5</td>
<td>( f(2.5) = \frac{3}{4} - \frac{2}{5}(2.5) )</td>
<td>-0.25</td>
<td>(2.5, -0.25)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at \( \frac{17}{8} \). So the solution is \( \frac{17}{8} \).

Solve Algebraically
3-2 Solving Linear Equations by Graphing

\[
0 = \frac{3}{4} - \frac{2}{5}x \\
0 + \frac{2}{5}x = \frac{3}{4} - \frac{2}{5}x + \frac{2}{5}x \\
\frac{2}{5}x = \frac{3}{4} \\
\frac{5}{2} \left( \frac{2}{5}x \right) = \frac{5}{2} \left( \frac{3}{4} \right) \\
x = \frac{15}{8} \text{ or } 1 \frac{7}{8}
\]
3-2 Solving Linear Equations by Graphing

34. $13x + 117 = 0$

**SOLUTION:**

Solve Graphically

The related function is $f(x) = 13x + 117$. To graph the function, make a table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 13x + 117$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-12$</td>
<td>$f(-12) = 13(-12) + 117$</td>
<td>$-39$</td>
<td>$(-12, -39)$</td>
</tr>
<tr>
<td>$-9$</td>
<td>$f(-9) = 13(-9) + 117$</td>
<td>$0$</td>
<td>$(-9, 0)$</td>
</tr>
<tr>
<td>$-6$</td>
<td>$f(-6) = 13(-6) + 117$</td>
<td>$39$</td>
<td>$(-6, 39)$</td>
</tr>
<tr>
<td>$-3$</td>
<td>$f(-3) = 13(-3) + 117$</td>
<td>$78$</td>
<td>$(-3, 78)$</td>
</tr>
<tr>
<td>$0$</td>
<td>$f(0) = 13(0) + 117$</td>
<td>$117$</td>
<td>$(0, 117)$</td>
</tr>
<tr>
<td>$3$</td>
<td>$f(3) = 13(3) + 117$</td>
<td>$156$</td>
<td>$(3, 156)$</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at $-9$. So the solution is $-9$.

**Solve Algebraically**

\[
\begin{align*}
13x + 117 &= 0 \\
13x + 117 - 117 &= 0 - 117 \\
13x &= -117 \\
\frac{13x}{13} &= \frac{-117}{13} \\
x &= -9
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

35. $24x - 72 = 0$

**SOLUTION:**

Solve Graphically

The related function is $f(x) = 24x - 72$. To graph the function, make a table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 24x - 72$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>$f(-4) = 24(-4) - 72$</td>
<td>-168</td>
<td>(-4, -168)</td>
</tr>
<tr>
<td>-2</td>
<td>$f(-2) = 24(-2) - 72$</td>
<td>-120</td>
<td>(-2, -120)</td>
</tr>
<tr>
<td>0</td>
<td>$f(0) = 24(0) - 72$</td>
<td>-72</td>
<td>(0, -72)</td>
</tr>
<tr>
<td>2</td>
<td>$f(2) = 24(2) - 72$</td>
<td>-24</td>
<td>(2, -24)</td>
</tr>
<tr>
<td>3</td>
<td>$f(3) = 24(3) - 72$</td>
<td>0</td>
<td>(3, 0)</td>
</tr>
<tr>
<td>4</td>
<td>$f(4) = 24(4) - 72$</td>
<td>24</td>
<td>(4, 24)</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at 3. So the solution is 3.

Solve Algebraically

\[
\begin{align*}
24x - 72 &= 0 \\
24x - 72 + 72 &= 0 + 72 \\
24x &= 72 \\
\frac{24x}{24} &= \frac{72}{24} \\
x &= 3
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

36. **SEA LEVEL** Parts of New Orleans lie 0.5 meter below sea level. After \( d \) days of rain, the equation \( w = 0.3d - 0.5 \) represents the water level \( w \) in meters. Find the zero, and explain what it means in the context of this situation.

**SOLUTION:**
To find the zero of the function, substitute zero in for \( w \): \( 0 = 0.3d - 0.5 \).

**Solve Graphically**

The related function is \( f(x) = 0.3d - 0.5 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( d )</th>
<th>( f(d) = 0.3d - 0.5 )</th>
<th>( f(d) )</th>
<th>( (d, f(d)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>( f(-3) = 0.3(-3) - 0.5 )</td>
<td>-1.4</td>
<td>(-3, -1.4)</td>
</tr>
<tr>
<td>-1</td>
<td>( f(-1) = 0.3(-1) - 0.5 )</td>
<td>-0.8</td>
<td>(-1, -0.8)</td>
</tr>
<tr>
<td>0</td>
<td>( f(0) = 0.3(0) - 0.5 )</td>
<td>-0.5</td>
<td>(0, -0.5)</td>
</tr>
<tr>
<td>1</td>
<td>( f(1) = 0.3(1) - 0.5 )</td>
<td>-0.2</td>
<td>(1, -0.2)</td>
</tr>
<tr>
<td>( \frac{5}{3} )</td>
<td>( f \left( \frac{5}{3} \right) = 0.3 \left( \frac{5}{3} \right) - 0.5 )</td>
<td>0</td>
<td>( \left( \frac{5}{3}, 0 \right) )</td>
</tr>
<tr>
<td>3</td>
<td>( f(3) = 0.3(3) - 0.5 )</td>
<td>0.4</td>
<td>(3, 0.4)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at \( \frac{5}{3} \). So the solution is \( \frac{5}{3} \).

**Solve Algebraically**

\[
w = 0.3d - 0.5 \\
0 = 0.3d - 0.5 \\
0 + 0.5 = 0.3d - 0.5 + 0.5 \\
0.5 = 0.3d \\
0.5 \div 0.3 = 0.3d \div 0.3 \\
1.67 \approx d
\]

This means that the water level in New Orleans has reached sea level after about 1.67 days of rain.
3-2 Solving Linear Equations by Graphing

37. CCSS MODELING An artist completed an ice sculpture when the temperature was \(-10^\circ\text{C}\). The equation \(t = 1.25h - 10\) shows the temperature, \(h\) hours after the sculpture’s completion. If the artist completed the sculpture at 8:00 a.m., at what time will it begin to melt?

**SOLUTION:**

To find the time the ice sculpture will melt, substitute 0 in for \(t\) because ice melts at \(0^\circ\text{C}\).

\[
0 = 1.25h - 10
\]

**Solve Graphically**

The related function is \(f(h) = 1.25h - 10\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(h)</th>
<th>(f(h) = 1.25h - 10)</th>
<th>(f(h))</th>
<th>((h, f(h)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-8</td>
<td>(f(-8) = 1.25(-8) - 10)</td>
<td>-20</td>
<td>((-8, -20))</td>
</tr>
<tr>
<td>-4</td>
<td>(f(-4) = 1.25(-4) - 10)</td>
<td>-15</td>
<td>((-4, -15))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 1.25(0) - 10)</td>
<td>-10</td>
<td>((0, -10))</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = 1.25(4) - 10)</td>
<td>-5</td>
<td>((4, -5))</td>
</tr>
<tr>
<td>8</td>
<td>(f(8) = 1.25(8) - 10)</td>
<td>0</td>
<td>((8, 0))</td>
</tr>
<tr>
<td>16</td>
<td>(f(16) = 1.25(16) - 10)</td>
<td>10</td>
<td>((16, 10))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 8. So the solution is 8.

**Solve Algebraically**

\[
\begin{align*}
t = 1.25h - 10 \\
0 = 1.25h - 10 \\
0 + 10 = 1.25h - 10 + 10 \\
10 = 1.25h \\
\frac{10}{1.25} = \frac{1.25h}{1.25} \\
8 = h
\end{align*}
\]

So, 8 hours after the sculpture was made it will start to melt. Therefore, it will start to melt at 4:00 P.M.
3-2 Solving Linear Equations by Graphing

Solve each equation by graphing. Verify your answer algebraically.

38. \(7 - 3x = 8 - 4x\)

**SOLUTION:**

Manipulate the equation so that there is a zero on either side.

\[
7 - 3x = 8 - 4x \\
7 - 3x + 3x = 8 - 4x + 3x \\
7 = -x + 8 \\
7 - 7 = -x + 8 - 7 \\
0 = -x + 1
\]

The related function is \(f(x) = -x + 1\).

To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = -x + 1)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = -(-4) + 1)</td>
<td>5</td>
<td>((-4, 5))</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = -(-2) + 1)</td>
<td>3</td>
<td>((-2, 3))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = -(0) + 1)</td>
<td>1</td>
<td>((0, 1))</td>
</tr>
<tr>
<td>1</td>
<td>(f(1) = -(1) + 1)</td>
<td>0</td>
<td>((1, 0))</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = -(2) + 1)</td>
<td>-1</td>
<td>((2, -1))</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = -(-4) + 1)</td>
<td>-3</td>
<td>((4, -3))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 1. So, the solution is 1.

Verify by substituting 1 in for \(x\) in the original equation.

\[
7 - 3x = 8 - 4x \\
7 - 3(1) = 8 - 4(1) \\
7 - 3 = -8 - 4 \\
4 = 4\]
3-2 Solving Linear Equations by Graphing

39. \(19 + 3x = 13 + x\)

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.

\[
\begin{align*}
19 + 3x &= 13 + x \\
19 + 3x - x &= 13 + x - x \\
19 + 2x &= 13 \\
19 - 13 + 2x &= 13 - 13 \\
2x + 6 &= 0
\end{align*}
\]

The related function is \(f(x) = 2x + 6\).

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 2x + 6)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = 2(-4) + 6)</td>
<td>-2</td>
<td>((-4, -2))</td>
</tr>
<tr>
<td>-3</td>
<td>(f(-3) = 2(-3) + 6)</td>
<td>0</td>
<td>((-3, 0))</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = 2(-2) + 6)</td>
<td>2</td>
<td>((-2, 2))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 2(0) + 6)</td>
<td>6</td>
<td>((0, 6))</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = 2(2) + 6)</td>
<td>10</td>
<td>((2, 10))</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = 2(4) + 6)</td>
<td>14</td>
<td>((4, 14))</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at \(-3\). So, the solution is \(-3\).

Verify by substituting \(1\) in for \(x\) in the original equation.

\[
\begin{align*}
19 + 3x &= 13 + x \\
19 + 3(-3) &= 13 + (-3) \\
19 - 9 &= 13 - 3 \\
10 &= 10 \checkmark
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

40. \(16x + 6 = 14x + 10\)

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.

\[
\begin{align*}
16x + 6 &= 14x + 10 \\
16x - 14x + 6 &= 14x - 14x + 10 \\
2x + 6 &= 10 \\
2x + 6 - 10 &= 10 - 10 \\
2x - 4 &= 0
\end{align*}
\]

The related function is \(f(x) = 2x - 4\).

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = 2x - 4)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>(f(-4) = 2(-4) - 4)</td>
<td>-12</td>
<td>(-4, -12)</td>
</tr>
<tr>
<td>-2</td>
<td>(f(-2) = 2(-2) - 4)</td>
<td>-8</td>
<td>(-2, -8)</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = 2(0) - 4)</td>
<td>-4</td>
<td>(0, -4)</td>
</tr>
<tr>
<td>2</td>
<td>(f(2) = 2(2) - 4)</td>
<td>0</td>
<td>(2, 2)</td>
</tr>
<tr>
<td>3</td>
<td>(f(3) = 2(3) - 4)</td>
<td>2</td>
<td>(3, 2)</td>
</tr>
<tr>
<td>4</td>
<td>(f(4) = 2(4) - 4)</td>
<td>4</td>
<td>(4, 4)</td>
</tr>
</tbody>
</table>

The graph intersects the \(x\)-axis at 2. So, the solution is 2.

Verify by substituting 2 in for \(x\) in the original equation

\[
\begin{align*}
16x + 6 &= 14x + 10 \\
16(2) + 6 &= 14(2) + 10 \\
32 + 6 &= 28 + 10 \\
38 &= 38
\end{align*}
\]
3-2 Solving Linear Equations by Graphing

41. $15x - 30 = 5x - 50$

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.

\[
15x - 30 = 5x - 50 \\
10x - 30 = -50 \\
10x - 30 + 50 = -50 + 50 \\
10x + 20 = 0
\]

The related function is $f(x) = 10x + 20$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 10x + 20$</th>
<th>$f(x)$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>$f(-4) = 10(-4) + 20$</td>
<td>-20</td>
<td>(-4, -20)</td>
</tr>
<tr>
<td>-2</td>
<td>$f(-2) = 10(-2) + 20$</td>
<td>0</td>
<td>(-2, 0)</td>
</tr>
<tr>
<td>0</td>
<td>$f(0) = 10(0) + 20$</td>
<td>20</td>
<td>(0, 20)</td>
</tr>
<tr>
<td>2</td>
<td>$f(2) = 10(2) + 20$</td>
<td>40</td>
<td>(2, 40)</td>
</tr>
<tr>
<td>3</td>
<td>$f(3) = 10(3) + 20$</td>
<td>50</td>
<td>(3, 50)</td>
</tr>
<tr>
<td>4</td>
<td>$f(4) = 10(4) + 20$</td>
<td>60</td>
<td>(4, 60)</td>
</tr>
</tbody>
</table>

The graph intersects the $x$-axis at $-2$. So, the solution is $-2$.

Verify by substituting $-2$ in for $x$ in the original equation.

\[
15(-2) - 30 = 5(-2) - 50 \\
-30 - 30 = -10 - 50 \\
-60 = -60\
\]

42. $\frac{1}{2}x - 5 = 3x - 10$

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.
3-2 Solving Linear Equations by Graphing

\[
\frac{1}{2}x - 5 = 3x - 10
\]

\[
\frac{1}{2}x - \frac{1}{2}x - 5 = 3x - \frac{1}{2}x - 10
\]

\[-5 = \frac{5}{2}x - 10
\]

\[-5 + 5 = \frac{5}{2}x - 10 + 5
\]

\[0 = \frac{5}{2}x - 5
\]

\[\frac{5}{2}x - 5 = 0
\]

The related function is \( f(x) = \frac{5}{2}x - 5 \). To graph the function, make a table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = \frac{5}{2}x - 5 )</th>
<th>( f(x) )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>( \frac{5}{2}(-4) - 5 )</td>
<td>-15</td>
<td>(-4, -15)</td>
</tr>
<tr>
<td>-2</td>
<td>( \frac{5}{2}(-2) - 5 )</td>
<td>-10</td>
<td>(-2, -10)</td>
</tr>
<tr>
<td>0</td>
<td>( \frac{5}{2}(0) - 5 )</td>
<td>-5</td>
<td>(0, -5)</td>
</tr>
<tr>
<td>2</td>
<td>( \frac{5}{2}(2) - 5 )</td>
<td>0</td>
<td>(2, 0)</td>
</tr>
<tr>
<td>3</td>
<td>( \frac{5}{2}(3) - 5 )</td>
<td>2.5</td>
<td>(3, 2.5)</td>
</tr>
<tr>
<td>4</td>
<td>( \frac{5}{2}(4) - 5 )</td>
<td>5</td>
<td>(4, 5)</td>
</tr>
</tbody>
</table>

The graph intersects the \( x \)-axis at 2. So, the solution is 2.

Verify by substituting 2 in for \( x \) in the original equation.

\[
\frac{1}{2}x - 5 = 3x - 10
\]

\[
\frac{1}{2}(2) - 5 = 3(2) - 10
\]

\[1 - 5 = 6 - 10
\]

\[-4 = -4\]
3-2 Solving Linear Equations by Graphing

43. \(3x - 11 = \frac{1}{3}x - 8\)

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.

\[
3x - 11 = \frac{1}{3}x - 8
\]

\[
3x - \frac{1}{3}x - 11 = \frac{1}{3}x - \frac{1}{3}x - 8
\]

\[
\frac{8}{3}x - 11 = -8
\]

\[
\frac{8}{3}x - 11 + 8 = -8 + 8
\]

\[
\frac{8}{3}x - 3 = 0
\]

The related function is \(f(x) = \frac{8}{3}x - 3\). To graph the function, make a table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(f(x) = \frac{8}{3}x - 3)</th>
<th>(f(x))</th>
<th>((x, f(x)))</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>(f(-3) = \frac{8}{3}(-3) - 3)</td>
<td>-11</td>
<td>(-3, -11)</td>
</tr>
<tr>
<td>-1</td>
<td>(f(-1) = \frac{8}{3}(-1) - 3)</td>
<td>(\frac{5}{3})</td>
<td>(-1, (\frac{5}{3}))</td>
</tr>
<tr>
<td>0</td>
<td>(f(0) = \frac{8}{3}(0) - 3)</td>
<td>-3</td>
<td>(0, -3)</td>
</tr>
<tr>
<td>1</td>
<td>(f(1) = \frac{8}{3}(1) - 3)</td>
<td>(\frac{1}{3})</td>
<td>(1, (\frac{1}{3}))</td>
</tr>
<tr>
<td>3</td>
<td>(f(3) = \frac{8}{3}(3) - 3)</td>
<td>5</td>
<td>(3, 5)</td>
</tr>
</tbody>
</table>

From the graph, the \(x\)-intercept appears to be 1. However, from the table above, we can see that it is not. Redraw the graph of \(f(x) = \frac{8}{3}x - 3\) so that you can see the \(x\)-intercept.
The intercept is between 1 and 1.2, but still difficult to determine. You can find the x-intercept algebraically.

\[ 0 = \frac{8}{3}x - 3 \quad \text{Related function} \]

\[ 0 + 3 = \frac{8}{3}x - 3 + 3 \quad \text{Add 3 to each side.} \]

\[ 3 = \frac{8}{3}x \quad \text{Simplify.} \]

\[ 3 \cdot \frac{3}{8} = \frac{8}{3}x \cdot \frac{3}{8} \quad \text{Multiply each side by } \frac{8}{3} \]

\[ \frac{9}{8} = x \quad \text{Simplify.} \]

The graph intersects the x-axis at \( \frac{9}{8} \) or \( 1 \frac{1}{8} \). So, the solution is \( \frac{9}{8} \) or \( 1 \frac{1}{8} \). Verify by substituting \( 1 \frac{1}{8} \) in for \( x \) in the original equation.

\[ 3x - 11 = \frac{1}{3}x - 8 \]

\[ 3\left(\frac{9}{8}\right) - 11 = \frac{1}{3}\left(\frac{9}{8}\right) - 8 \]

\[ \frac{27}{8} - \frac{88}{8} = \frac{3}{8} - \frac{64}{8} \]

\[ -\frac{51}{8} = -\frac{61}{8} \]
3.2 Solving Linear Equations by Graphing

44. HAIR PRODUCTS Chemical hair straightening makes curly hair straight and smooth. The percent of the process left to complete is modeled by \( p = -12.5t + 100 \), where \( t \) is the time in minutes that the solution is left on the hair, and \( p \) represents the percent of the process left to complete.

   a. Find the zero of this function.
   b. Make a graph of this situation.
   c. Explain what the zero represents in this context.
   d. State the possible domain and range of this function.

**SOLUTION:**

a. To find the zero of the function, substitute zero in for \( p \).

\[
\begin{align*}
p &= -12.5t + 100 \\
0 &= -12.5t + 100 \\
0 - 100 &= -12.5t + 100 - 100 \\
-100 &= -12.5t \\
-100 &= 12.5t \\
8 &= t
\end{align*}
\]

b. The solution must remain on the hair for 8 minutes to be completely effective.

d. A possible domain is \( \{ t \mid 0 \leq t \leq 8 \} \), because the time the solution is left on the hair varies from 0 to 8 minutes. A possible range is \( \{ p \mid 0 \leq p \leq 100 \} \) because the percentage of the process left to complete varies from 0 to 100.
3-2 Solving Linear Equations by Graphing

45. **MUSIC DOWNLOADS** In this problem, you will investigate the change between two quantities.
   a. Copy and complete the table.

<table>
<thead>
<tr>
<th>Number of Songs Downloaded</th>
<th>Total Cost ($)</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>
   
   b. As the number of songs downloaded increases, how does the total cost change?
   c. Interpret the value of the total cost divided by the number of songs downloaded.

   **SOLUTION:**
   a. Divide the total cost by the number of songs download to complete the last column in the table.

<table>
<thead>
<tr>
<th>Number of Songs Downloaded</th>
<th>Total Cost ($)</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>2</td>
</tr>
</tbody>
</table>

   b. As the number of songs downloaded increases by 2 the total cost increases by $4.
   c. The total cost divided by the number of songs download is 2 for each line. This costs represents the cost to download a song. The cost to download a song is $2.
46. **ERROR ANALYSIS** Clarissa and Koko solve \(3x + 5 = 2x + 4\) by graphing the related function. Is either of them correct? Explain your reasoning.

**SOLUTION:**
Koko is correct. She solved the equation so that there was a zero on one side. Then wrote the related function and graphed. Clarissa attempted to solve the equations so that there was a zero on one side. However, she added 5 to each side instead of subtracting the 5 from each. Therefore Clarissa’s related function and graph were incorrect.
3-2 Solving Linear Equations by Graphing

47. **CHALLENGE** Find the solution of \( \frac{2}{3}(x + 3) = \frac{1}{2}(x + 5) \) by graphing. Verify your solution algebraically.

**SOLUTION:**
Manipulate the equation so that there is a zero on either side.

\[
\frac{2}{3}(x + 3) = \frac{1}{2}(x + 5) \quad \text{Original equation}
\]
\[
6 \cdot \frac{2}{3}(x + 3) = 6 \cdot \frac{1}{2}(x + 5) \quad \text{Multiply each side by 6.}
\]
\[
4(x + 3) = 3(x + 5) \quad \text{Simplify.}
\]
\[
4x + 12 = 3x + 15 \quad \text{Distributive Property}
\]
\[
4x - 3x + 12 = 3x - 3x + 15 \quad \text{Subtract 3x from each side}
\]
\[
x + 12 = 15 \quad \text{Simplify.}
\]
\[
x + 12 - 12 = 15 - 12 \quad \text{Subtract 12 to each side.}
\]
\[
x = 3 \quad \text{Simplify.}
\]

The related function is \( f(x) = x - 3 \).

Graph the related function on a graphing calculator.

![Graph of f(x) = x - 3](image)

The solution is 3.

Verify Algebraically:

\[
\frac{2}{3}(x + 3) = \frac{1}{2}(x + 5)
\]
\[
\frac{2}{3}(x + 3) = \frac{1}{2}(x + 5) \quad \text{Original equation}
\]
\[
6 \cdot \frac{2}{3}(x + 3) = 6 \cdot \frac{1}{2}(x + 5) \quad \text{Multiply each side by 6.}
\]
\[
4(x + 3) = 3(x + 5) \quad \text{Simplify.}
\]
\[
4x + 12 = 3x + 15 \quad \text{Distributive Property}
\]
\[
4x - 3x + 12 = 3x - 3x + 15 \quad \text{Subtract 3x from each side}
\]
\[
x + 12 = 15 \quad \text{Simplify.}
\]
\[
x + 12 - 12 = 15 - 12 \quad \text{Subtract 12 to each side.}
\]
\[
x = 3 \quad \text{Simplify.}
3-2 Solving Linear Equations by Graphing

48. CCSS TOOLS Explain when it is better to solve an equation using algebraic methods and when it is better to solve by graphing.

SOLUTION:
It is better to solve an equation algebraically if an exact answer is needed. It is better to solve an equation graphically if an exact answer is not needed. Also, if the equation has fractions, it is easier to solve algebraically than graphically.
For example, solve \(-7 = 4x + 1\) graphically and \(0 = \frac{1}{2} + \frac{2}{3}x\) algebraically.

49. OPEN ENDED Write a linear equation that has a root of \(-\frac{3}{4}\). Write its related function.

SOLUTION:
If the root is \(-\frac{3}{4}\), then \(x = -\frac{3}{4}\).
Rewrite this equation so that there is an zero on the right side.

\[
\begin{align*}
x &= -\frac{3}{4} & \text{Original equation} \\
4 \cdot x &= -\frac{3}{4} & \text{Multiply each side by 4.} \\
4x &= -3 & \text{Simplify.} \\
4x + 3 &= -3 + 3 & \text{Add 3 to each side.} \\
4x + 3 &= 0 & \text{Simplify.}
\end{align*}
\]

Thus, \(3 + 4x = 0, y = 3 + 4x, \text{ or } f(x) = 3 + 4x\).

50. WRITING IN MATH Summarize how to solve a linear equation algebraically and graphically.

SOLUTION:
To solve a linear equation algebraically, solve the equation for \(x\). To solve a linear equation graphically, find the related function by setting the equation equal to zero. Then, make a table and choose different values for \(x\) and find the corresponding \(y\)-coordinate. Determine where the graph intersects the \(x\)-axis. This is the solution. If the graph does not intersect the \(x\)-axis, there is no solution.

Consider the function \(f(x) = 3x + 3\). Graphing can be used to find the solution easily.

Consider the function \(f(x) = \frac{1}{2} + \frac{2}{3}x\). Solving algebraically will give a more accurate answer.
3-2 Solving Linear Equations by Graphing

51. What are the $x$– and $y$–intercepts of the graph of the function?

![Graph of a line]

A $-3, 6$
B $6, -3$
C $3, -6$
D $-6, 3$

**SOLUTION:**
The $x$–intercept of the function is where it crosses the $x$–axis and the $y$–value is zero. This point is $(-3, 0)$. This means that choices C and D are not options. The $y$–intercept of the function is where it crosses the $y$–axis and the $x$–value is zero. This point is $(0, 6)$. This means that choice A is the correct option.

52. The table shows the cost $C$ of renting a pontoon boat for $h$ hours.

<table>
<thead>
<tr>
<th>Hours</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td>7.25</td>
<td>14.5</td>
<td>21.75</td>
</tr>
</tbody>
</table>

Which equation best represents the data?
F $C = 7.25h$
G $C = h + 7.25$
H $C = 21.75 - 7.25h$
J $C = 7.25h + 21.75$

**SOLUTION:**
The difference in $C$–values is $7.25$ times the difference of $h$–values. This suggests $C = 7.25h$. So, the equation for the relationship in function notation is $f(x) = 7.25h$. The equation for choice G would be $8.25$ for 1 hour, $9.25$ for 2 hours, and $10.25$ for three, which does not match the data. The equation for choice H would be $14.50$ for 1 hour, $7.25$ for 2 hours, and $0$ for 3 hours, which does not match the data. The equation for choice J is $29$ for 1 hour, $36.5$ for 2 hours, and $44$ for three hours. So the correct choice is F.
3-2 Solving Linear Equations by Graphing

53. Which is the best estimate for the \(x\)–intercept of the graph of the linear function represented in the table?

\[
\begin{array}{|c|c|}
\hline
x & y \\
0 & 5 \\
1 & 3 \\
2 & 1 \\
3 & -1 \\
4 & -3 \\
\hline
\end{array}
\]

A between 0 and 1  
B between 2 and 3  
C between 1 and 2  
D between 3 and 4

**SOLUTION:**
The \(x\)–intercept is where the linear function crosses the \(x\)–axis or when the \(y\)–value is zero. This will happen between (2, 1) and (3, –1). So the best estimate for the \(x\)–value is between 2 and 3. Therefore the correct choice is B.
3-2 Solving Linear Equations by Graphing

54. **EXTENDED RESPONSE** Mr. Kauffmann has the following options for a backyard pool.

![Diagram](image)

If each pool has the same depth, which pool would give the greatest area to swim? Explain your reasoning.

**SOLUTION:**
Find the area of each pool.

The area of the rectangular pool is found by:

\[
A = bh
= (12)(18)
= 216
\]

So, the area of the rectangular pool is 216 ft\(^2\).

The area of the circular pool is found by:

\[
A = \pi r^2
= \pi (9)^2
= \pi (81)
\approx 254.5
\]

So, the area of the circular pool is about 254.5 ft\(^2\).

Finally, the area of the rounded pool can be found by splitting it into a circle and a rectangle. So, it can be found by:

\[
A = \pi r^2 + bh
= \pi (6^2) + (10)(12)
= \pi (36) + 120
\approx 113.1 + 120
\approx 233
\]

So the area of the rounded pool is about 233.1 ft\(^2\).
Therefore, the circular pool would have the greatest area.
3-2 Solving Linear Equations by Graphing

Find the x– and y–intercepts of the graph of each linear equation.

55. \( y = 2x + 10 \)

**SOLUTION:**
To find the \( x \)–intercept, let \( y = 0 \).

\[
\begin{align*}
  y &= 2x + 10 & \text{Original equation.} \\
  0 &= 2x + 10 & \text{Replace} \ y \text{ with 0.} \\
  0 - 10 &= 2x + 10 - 10 & \text{Subtract 10 from each side.} \\
  -10 &= 2x & \text{Simplify.} \\
  \frac{-10}{2} &= \frac{2x}{2} & \text{Divide each side by 2.} \\
  -5 &= x & \text{Simplify.}
\end{align*}
\]

To find the \( y \)–intercept, let \( x = 0 \).

\[
\begin{align*}
  y &= 2x + 10 & \text{Original equation} \\
  y &= 2(0) + 10 & \text{Replace} \ x \text{ with 0.} \\
  y &= 0 + 10 & \text{Simplify.} \\
  y &= 10 & \text{Simplify.}
\end{align*}
\]

So, the \( x \)–intercept is \(-5\) and the \( y \)–intercept is \( 10 \).
3-2 Solving Linear Equations by Graphing

56. \(3y = 6x - 9\)

**SOLUTION:**
To find the \(x\)-intercept, let \(y = 0\).

\[
\begin{align*}
3y &= 6x - 9 & \text{Original equation} \\
3(0) &= 6x - 9 & \text{Replace } y \text{ with } 0. \\
0 &= 6x - 9 & \text{Simplify.} \\
0 + 9 &= 6x - 9 + 9 & \text{Add 9 to each side.} \\
9 &= 6x & \text{Simplify.} \\
9 &= \frac{6x}{6} & \text{Divide each side by 6.} \\
\frac{9}{6} &= x & \text{Simplify.}
\end{align*}
\]

To find the \(y\)-intercept, let \(x = 0\).

\[
\begin{align*}
3y &= 6x - 9 & \text{Original equation} \\
3y &= 6(0) - 9 & \text{Replace } x \text{ with } 0. \\
3y &= -9 & \text{Simplify.} \\
3y &= -9 & \text{Simplify.} \\
\frac{3y}{3} &= \frac{-9}{3} & \text{Divide each side by 3.} \\
y &= -3 & \text{Simplify.}
\end{align*}
\]

So, the \(x\)-intercept is \(\frac{3}{2}\), and the \(y\)-intercept is \(-3\).
3-2 Solving Linear Equations by Graphing

57. \( 4x - 14y = 28 \)

**SOLUTION:**

To find the \( x \)-intercept, let \( y = 0 \).

\[
4x - 14(0) = 28 \quad \text{Original equation}
\]

\[
4x = 28 \quad \text{Replace } y \text{ with } 0.
\]

\[
x = 7 \quad \text{Simplify.}
\]

To find the \( y \)-intercept, let \( x = 0 \).

\[
4(0) - 14y = 28 \quad \text{Original equation}
\]

\[
0 - 14y = 28 \quad \text{Replace } x \text{ with } 0.
\]

\[
-14y = 28 \quad \text{Simplify.}
\]

\[
y = -2 \quad \text{Divide each side by } -14.
\]

So, the \( x \)-intercept is 7, and the \( y \)-intercept is \(-2\).
3-2 Solving Linear Equations by Graphing

58. **FOOD** If 2% milk contains 2% butterfat and whipping cream contains 9% butterfat, how much whipping cream and 2% milk should be mixed to obtain 35 gallons of milk with 4% butterfat?

**SOLUTION:**
Let $m$ represent the gallons of milk needed and let $w$ represent the gallons of whipping cream needed. $m$ gallons of milk with 2% butterfat must be combined with $w$ gallons of whipping cream with 9% butterfat to get a 35-gallon mixture with 4% butterfat.

<table>
<thead>
<tr>
<th></th>
<th>amount</th>
<th>% butter fat</th>
<th>% butter fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>milk</td>
<td>$m$</td>
<td>0.02</td>
<td>0.02$m$</td>
</tr>
<tr>
<td>cream</td>
<td>$w$</td>
<td>0.09</td>
<td>0.09$w$</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td>0.00</td>
<td>0.04(35)</td>
</tr>
</tbody>
</table>

The equation would be, $0.02m + 0.09w = (0.04)(35)$. Substitute $35 - w$ for $m$. Then the equation would be $0.02(35 - w) + 0.09w = (0.04)(35)$.

\[
0.02(35-w) + 0.09w = (0.04)35 \quad \text{Original equation}
\]

\[
0.7 - 0.02w + 0.09w = 1.4 \quad \text{Distributive Property}
\]

\[
0.7 + 0.07w = 1.4 \quad \text{Simplify}
\]

\[
0.7 - 0.7 + 0.07w = 1.4 - 0.7 \quad \text{Subtract 0.7 from each side}
\]

\[
0.07w = 0.7 \quad \text{Divide each side by 25.}
\]

\[
\frac{0.07w}{0.07} = \frac{0.7}{0.07} \quad \text{Divide each side by 0.07.}
\]

\[
w = 10 \quad \text{Simplify}
\]

To find the gallons of milk, substitute 10 for $w$ in the original equation: $m = 35 - 10 = 25$. So, you need 10 gallons of whipping cream and 25 gallons of 2% milk to make a 35-gallon mixture that has 4% butterfat.

**Translate each sentence into an equation.**

59. The product of 3 and $m$ plus 2 times $n$ is the same as the quotient of 4 and $p$.

**SOLUTION:**

60. The sum of $x$ and five times $y$ equals twice $z$ minus 7.

**SOLUTION:**

\[
\text{Simplify.}
\]

61. \[
\frac{25}{10}
\]

**SOLUTION:**

\[
\frac{25}{10} = \frac{5}{2}
\]
3-2 Solving Linear Equations by Graphing

62. \(\frac{-4}{-12}\)

**SOLUTION:**
\[
\frac{-4}{-12} = \frac{1}{3}
\]

63. \(\frac{6}{-12}\)

**SOLUTION:**
\[
\frac{6}{-12} = \frac{-1}{2}
\]

64. \(\frac{36}{8}\)

**SOLUTION:**
\[
\frac{36}{8} = \frac{9}{2}
\]

Evaluate \(\frac{a-b}{c-d}\) for the given values.

65. \(a = 6, b = 2, c = 9, d = 3\)

**SOLUTION:**
\[
\frac{a-b}{c-d} = \frac{6-2}{9-3} = \frac{4}{6} = \frac{2}{3}
\]

66. \(a = -8, b = 4, c = 5, d = -3\)

**SOLUTION:**
\[
\frac{a-b}{c-d} = \frac{-8-4}{5-(-3)} = \frac{-12}{8} = \frac{-3}{2}
\]
3-2 Solving Linear Equations by Graphing

67. \( a = 4, b = -7, c = -1, d = -2 \)

**SOLUTION:**

\[
\begin{align*}
\frac{a - b}{c - d} &= \frac{4 - (-7)}{-1 - (-2)} \\
&= \frac{4 + 7}{-1 + 2} \\
&= \frac{11}{1} \\
&= 11
\end{align*}
\]