Goal: Use graphs to represent relations and functions.

Vocabulary

Relation: ____________________________
Domain: ____________________________
Range: ____________________________
Input: ____________________________
Output: ____________________________
Function: ____________________________
Vertical line test: ____________________________

Example 1  Identifying the Domain and Range

Identify the domain and range of the relation represented by the table below that shows one Norway Spruce tree’s height at different ages.

<table>
<thead>
<tr>
<th>Age (years), x</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (ft), y</td>
<td>13</td>
<td>25</td>
<td>34</td>
<td>43</td>
<td>52</td>
</tr>
</tbody>
</table>

Solution

The relation consists of the ordered pairs ____________________________. The domain of the relation is the set of all ____________________________, or ____________________________. The range is the set of all ____________________________, or ____________________________.

Domain: ____________________________  Range: ____________________________
**8.1 Relations and Functions**

**Goal:** Use graphs to represent relations and functions.

<table>
<thead>
<tr>
<th>Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relation:</strong> A relation is a set of ordered pairs.</td>
</tr>
<tr>
<td><strong>Domain:</strong> The domain of a relation is the set of all inputs.</td>
</tr>
<tr>
<td><strong>Range:</strong> The range of a relation is the set of all outputs.</td>
</tr>
<tr>
<td><strong>Input:</strong> Each number in a domain is an input.</td>
</tr>
<tr>
<td><strong>Output:</strong> Each number in a range is an output.</td>
</tr>
<tr>
<td><strong>Function:</strong> A function is a relation with the property that for each input there is exactly one output.</td>
</tr>
<tr>
<td><strong>Vertical line test:</strong> The vertical line test says that if you can find a vertical line passing through more than one point of a graph of a relation, then the relation is not a function. Otherwise, the relation is a function.</td>
</tr>
</tbody>
</table>

**Example 1 Identifying the Domain and Range**

Identify the domain and range of the relation represented by the table below that shows one Norway Spruce tree’s height at different ages.

<table>
<thead>
<tr>
<th>Age (years), ( x )</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (ft), ( y )</td>
<td>13</td>
<td>25</td>
<td>34</td>
<td>43</td>
<td>52</td>
</tr>
</tbody>
</table>

**Solution**

The relation consists of the ordered pairs \((5, 13), (10, 25), (15, 34), (20, 43), \) and \((25, 52)\). The domain of the relation is the set of all inputs, or \( x \)-coordinates. The range is the set of all outputs, or \( y \)-coordinates.

**Domain:** 5, 10, 15, 20, 25  
**Range:** 13, 25, 34, 43, 52
Example 2  Representing a Relation

Represent the relation \((-3, 2), (-2, -2), (1, 1), (1, 3), (2, -3)\) as indicated.

a. A graph  
b. A mapping diagram

Solution

a. Graph the ordered pairs as \(\text{in a coordinate plane.}\)

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

b. List the inputs and the outputs in order. Draw arrows from the \(\text{to their }\).

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Example 3  Identifying Functions

Tell whether the relation is a function.

a. The relation in Example 1.

b. The relation in Example 2.

Solution

a. The relation \(\text{a function because }\). This makes sense, as a single tree can have \(\text{height at a given point in time.}\)

b. The relation \(\text{a function because }\).
Example 2  
**Representing a Relation**

Represent the relation \((-3, 2), (-2, -2), (1, 1), (1, 3), (2, -3)\) as indicated.

a. A graph  
b. A mapping diagram

**Solution**

a. Graph the ordered pairs as points in a coordinate plane.

![Graph of ordered pairs](image)

b. List the inputs and the outputs in order. Draw arrows from the inputs to their outputs.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>-2</td>
<td>-2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Example 3  
**Identifying Functions**

Tell whether the relation is a function.

a. The relation in Example 1.

b. The relation in Example 2.

**Solution**

a. The relation **is** a function because **every input is paired with exactly one output**. This makes sense, as a single tree can have **only one** height at a given point in time.

b. The relation **is not** a function because **the input 1 is paired with two outputs, 1 and 3**.
Checkpoint  Identify the domain and range of the relation and tell whether the relation is a function.

1. \((-5, 2), (-3, -1), (-1, 0), (2, 3), (5, 4)\)

2. \((-4, -3), (-3, 2), (0, 0), (1, -1), (2, 3), (3, 1), (3, -2)\)

Example 4  Using the Vertical Line Test

a. In the graph below, no vertical line passes through more than one point. So, the relation represented by the graph.

b. In the graph below, the vertical line shown passes through two points. So, the relation represented by the graph.
**Checkpoint** Identify the domain and range of the relation and tell whether the relation is a function.

1. \((-5, 2), (-3, -1), (-1, 0), (2, 3), (5, 4)\)
   - **Domain:** \(-5, -3, -1, 2, 5\)
   - **Range:** \(-1, 0, 2, 3, 4\)
   - **Function:** \(\text{function}\)

2. \((-4, -3), (-3, 2), (0, 0), (1, -1), (2, 3), (3, 1), (3, -2)\)
   - **Domain:** \(-4, -3, 0, 1, 2, 3\)
   - **Range:** \(-3, -2, -1, 0, 1, 2, 3\)
   - **Not a function:** \(\text{not a function}\)

---

**Example 4** *Using the Vertical Line Test*

**a.** In the graph below, no vertical line passes through more than one point. So, the relation represented by the graph is a function.

![Graph with points: (3, 3), (2, -1), (0, 1), (-3, 0), (-2, -3)]

**b.** In the graph below, the vertical line shown passes through two points. So, the relation represented by the graph is not a function.

![Graph with points: (3, 1), (1, 0), (3, -3), (3, 1), (3, -3)]
8.2 Linear Equations in Two Variables

**Goal:** Find solutions of equations in two variables.

<table>
<thead>
<tr>
<th>Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation in two variables:</td>
</tr>
<tr>
<td>Solution of an equation in two variables:</td>
</tr>
<tr>
<td>Graph of an equation in two variables:</td>
</tr>
<tr>
<td>Linear equation:</td>
</tr>
<tr>
<td>Linear function:</td>
</tr>
<tr>
<td>Function form:</td>
</tr>
</tbody>
</table>

**Example 1  Checking Solutions**

Tell whether \((5, -1)\) is a solution of \(x - 3y = 8\).

**Solution**

\[
x - 3y = 8 \quad \text{Write original equation.}
\]

\[
\square - 3(\square) \div 8 \quad \text{Substitute for } x \text{ and for } y.
\]

\[
\square \quad 8 \quad \text{Simplify.}
\]

**Answer:** \((5, -1) \square\) a solution of \(x - 3y = 8\).
Goal: Find solutions of equations in two variables.

Vocabulary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation in two variables:</td>
<td>An equation that contains two different variables</td>
</tr>
<tr>
<td>Solution of an equation in two variables:</td>
<td>A solution of an equation in x and y is an ordered pair ((x, y)) that produces a true statement when the values of (x) and (y) are substituted into the equation.</td>
</tr>
<tr>
<td>Graph of an equation in two variables:</td>
<td>The graph of an equation in two variables is the set of points in a coordinate plane that represent all the solutions of the equation.</td>
</tr>
<tr>
<td>Linear equation:</td>
<td>An equation whose graph is a line is called a linear equation.</td>
</tr>
<tr>
<td>Linear function:</td>
<td>A function whose graph is a nonvertical line is called a linear function.</td>
</tr>
<tr>
<td>Function form:</td>
<td>An equation solved for (y) is in function form.</td>
</tr>
</tbody>
</table>

Example 1 Checking Solutions

Tell whether \((5, -1)\) is a solution of \(x - 3y = 8\).

Solution

\[
x - 3y = 8 \quad \text{Write original equation.}
\]

\[
5 - 3(-1) = 8 \quad \text{Substitute for } x \text{ and for } y.
\]

\[
8 = 8 \quad \text{Simplify.}
\]

Answer: \((5, -1)\) is a solution of \(x - 3y = 8\).
**Checkpoint**

Tell whether the ordered pair is a solution of $2x - y = 5$.

<table>
<thead>
<tr>
<th></th>
<th>1. (0, -5)</th>
<th>2. (3, 2)</th>
<th>3. (-2, -9)</th>
</tr>
</thead>
</table>

**Example 2**

**Graphing a Linear Equation**

Graph $y = -x + 1$.

1. Make a table of solutions.

<table>
<thead>
<tr>
<th>$x$</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. List the solutions as ordered pairs.

$(−2,□), (−1,□), (0,□), (1,□), (2,□)$

3. Graph the ordered pairs, and note that the points lie on a □. Draw the □, which is the graph of $y = -x + 1$.

**Example 3**

**Graphing Horizontal and Vertical Lines**

Graph $y = -2$ and $x = 3$.

a. The graph of the equation $y = -2$ is □.

b. The graph of the equation $x = 3$ is □.
Checkpoint  Tell whether the ordered pair is a solution of \(2x - y = 5\).

<table>
<thead>
<tr>
<th></th>
<th>1. (0, -5)</th>
<th>2. (3, 2)</th>
<th>3. (-2, -9)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Example 2  Graphing a Linear Equation

Graph \(y = -x + 1\).

1. Make a table of solutions.

<table>
<thead>
<tr>
<th>(x)</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>-1</td>
</tr>
</tbody>
</table>

2. List the solutions as ordered pairs.

\((-2, 3), (-1, 2), (0, 1), (1, 0), (2, -1)\)

3. Graph the ordered pairs, and note that the points lie on a **line**. Draw the **line**, which is the graph of \(y = -x + 1\).

Example 3  Graphing Horizontal and Vertical Lines

Graph \(y = -2\) and \(x = 3\).

a. The graph of the equation \(y = -2\) is **the horizontal line** through \((0, -2)\).

b. The graph of the equation \(x = 3\) is **the vertical line** through \((3, 0)\).
Example 4  Writing an Equation in Function Form

Write $3x - y = 2$ in function form. Then graph the equation.

To write the equation in function form, solve for $y$.

$$3x - y = 2$$  Write original equation.

$$-y = -2$$  Subtract $y$ from each side.

$$y = 2$$  Multiply each side by $1$.

To graph the equation, use its function form to make a table of solutions. Graph the ordered pairs $(x, y)$ from the table, and draw a line through the points.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-1$</td>
<td></td>
</tr>
<tr>
<td>$0$</td>
<td></td>
</tr>
<tr>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>$2$</td>
<td></td>
</tr>
</tbody>
</table>

Checkpoint

4. Graph $y = 4$ and $x = -3$.
Tell whether each equation is a function.

5. Write $x - 2y = 4$ in function form.
Then graph the equation.
Example 4  Writing an Equation in Function Form

Write $3x - y = 2$ in function form. Then graph the equation.

To write the equation in function form, solve for $y$.

$$3x - y = 2$$

Write original equation.

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

Subtract $3x$ from each side.

$$y = 3x - 2$$

Multiply each side by $-1$.

To graph the equation, use its function form to make a table of solutions. Graph the ordered pairs $(x, y)$ from the table, and draw a line through the points.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>$-5$</td>
<td>$-2$</td>
<td>$1$</td>
<td>$4$</td>
</tr>
</tbody>
</table>

Checkpoint

4. Graph $y = 4$ and $x = -3$. Tell whether each equation is a function.

$y = 4$ is a function; $x = -3$ is not a function

5. Write $x - 2y = 4$ in function form. Then graph the equation.

$$y = \frac{1}{2}x - 2$$
Goal: Use \( x \)- and \( y \)-intercepts to graph linear equations.

Vocabulary
- \( x \)-intercept:
- \( y \)-intercept:

Finding Intercepts
To find the \( x \)-intercept of a line, substitute \( y \) for \( y \) in the line’s equation and solve for \( x \).
To find the \( y \)-intercept of a line, substitute \( x \) for \( x \) in the line’s equation and solve for \( y \).

Example 1
Finding Intercepts of a Graph

Find the intercepts of the graph of \( 2x - 5y = -10 \).

To find the \( x \)-intercept, let \( y = \square \) and solve for \( x \).

\[
\begin{align*}
2x - 5y &= -10 & \text{Write original equation.} \\
2x - 5(\square) &= -10 & \text{Substitute for } y. \\
\square &= -10 & \text{Simplify.} \\
x &= \square & \text{Divide each side by } \square.
\end{align*}
\]
Goal: Use \(x\)- and \(y\)-intercepts to graph linear equations.

**Vocabulary**

- **\(x\)-intercept:** The \(x\)-coordinate of a point where a graph crosses the \(x\)-axis is an \(x\)-intercept.
- **\(y\)-intercept:** The \(y\)-coordinate of a point where a graph crosses the \(y\)-axis is a \(y\)-intercept.

**Finding Intercepts**

To find the \(x\)-intercept of a line, substitute 0 for \(y\) in the line’s equation and solve for \(x\).

To find the \(y\)-intercept of a line, substitute 0 for \(x\) in the line’s equation and solve for \(y\).

**Example 1**  
Finding Intercepts of a Graph

Find the intercepts of the graph of \(2x - 5y = -10\).

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

\[
2x - 5(0) = -10 \quad \text{Write original equation.}
\]

\[
2x = -10 \quad \text{Substitute for } y.
\]

\[
x = -5 \quad \text{Simplify.}
\]

Divide each side by 2.
To find the y-intercept, let \( x = 0 \) and solve for \( y \).

\[ 2x - 5y = -10 \]  Write original equation.

\[ 2(0) - 5y = -10 \]  Substitute for \( x \).

\[ -5y = -10 \]  Simplify.

\[ y = \]  Divide each side by \( -5 \).

**Answer:** The x-intercept is \( \boxed{ } \), and the y-intercept is \( \boxed{ } \).

---

**Example 2**  Using Intercepts to Graph a Linear Equation

Graph the equation \( 2x - 5y = -10 \) from Example 1.

The x-intercept is \( \boxed{ } \), so plot the point \( (\boxed{ }, 0) \). The y-intercept is \( \boxed{ } \), so plot the point \( (0, \boxed{ }) \).

Draw a line through the two points.

---

**Checkpoint**  Find the intercepts of the equation’s graph. Then graph the equation.

1. \( 2x + 3y = 6 \)
2. \( 3x - 6y = 12 \)
To find the \(y\)-intercept, let \(x = 0\) and solve for \(y\).

\[
2x - 5y = -10 \quad \text{Write original equation.}
\]

\[
2(0) - 5y = -10 \quad \text{Substitute for } x.
\]

\[
-5y = -10 \quad \text{Simplify.}
\]

\[
y = 2 \quad \text{Divide each side by } -5.
\]

\textbf{Answer:} The \(x\)-intercept is \([-5]\), and the \(y\)-intercept is \(2\).

\section*{Example 2 \hspace{1cm} Using Intercepts to Graph a Linear Equation}

Graph the equation \(2x - 5y = -10\) from Example 1.

The \(x\)-intercept is \([-5]\), so plot the point \((-5, 0)\). The \(y\)-intercept is \(2\), so plot the point \((0, 2)\).

Draw a line through the two points.

\textbf{Checkpoint} \hspace{1cm} Find the intercepts of the equation’s graph. Then graph the equation.

\begin{align*}
1. & \quad 2x + 3y = 6 \\
\text{x-intercept:} & \quad 3 \\
\text{y-intercept:} & \quad 2 \\
\end{align*}

\begin{align*}
2. & \quad 3x - 6y = 12 \\
\text{x-intercept:} & \quad 4 \\
\text{y-intercept:} & \quad -2
\end{align*}
Example 3  Writing and Graphing an Equation

Fitness You run and walk on a fitness trail that is 12 miles long. You can run 6 miles per hour and walk 3 miles per hour. Write and graph an equation describing your possible running and walking times on the fitness trail. Give three possible combinations of running and walking times.

Solution

1. To write an equation, let \( x \) be the running time and let \( y \) be the walking time (both in hours). First write a verbal model.

\[
\begin{align*}
\text{Running time} & \quad \times \quad \text{Walking time} \\
\quad & \quad \quad + \\
\text{Running time} & \quad \times \quad \text{Walking time} \\
\end{align*}
\]

Then use the verbal model to write the equation.

2. To graph the equation, find and use the intercepts.

Find \( x \)-intercept:

Find \( y \)-intercept:

3. Three points on the graph are . So, you can .

Copyright © Holt McDougal. All rights reserved.
Fitness You run and walk on a fitness trail that is 12 miles long. You can run 6 miles per hour and walk 3 miles per hour. Write and graph an equation describing your possible running and walking times on the fitness trail. Give three possible combinations of running and walking times.

Solution

1. To write an equation, let \( x \) be the running time and let \( y \) be the walking time (both in hours). First write a verbal model.

\[
\begin{align*}
\text{Running time} & \quad \times \quad \text{Running rate} + \quad \times \quad \text{Walking rate} = \quad \text{Total distance} \\
\text{Walking time} & \quad \times \quad \text{Walking rate} \\
\end{align*}
\]

Then use the verbal model to write the equation.

\[6x + 3y = 12\]

2. To graph the equation, find and use the intercepts.

Find \( x \)-intercept: \[6x + 3y = 12\]
\[6x + 3(0) = 12\]
\[6x = 12\]
\[x = 2\]

Find \( y \)-intercept: \[6x + 3y = 12\]
\[6(0) + 3y = 12\]
\[3y = 12\]
\[y = 4\]

3. Three points on the graph are \((0, 4), (1, 2), \) and \((2, 0)\). So, you can not run at all and walk for 4 hours, or run for 1 hour and walk for 2 hours, or run for 2 hours and not walk at all.
8.4 The Slope of a Line

Goal: Find and interpret slopes of lines.

Vocabulary

Slope: 
Rise: 
Run: 

Example 1 Finding Slope

A building's access ramp has a rise of 2 feet and a run of 24 feet. Find its slope.

\[
slope = \frac{\text{rise}}{\text{run}} = \frac{2}{24} = \frac{1}{12}
\]

Answer: The access ramp has a slope of \(\frac{1}{12}\).

Slope of a Line

Given two points on a nonvertical line, you can find the slope \(m\) of the line using this formula.

\[
m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}}
\]

Example \(m = \frac{4 - 1}{5 - 3} = \frac{3}{2}\)
**Goal:** Find and interpret slopes of lines.

**Vocabulary**

- **Slope:** The slope of a line is the ratio of the line’s vertical change to its horizontal change.
- **Rise:** The line’s vertical change between two points is called its rise.
- **Run:** A line’s horizontal change between two points is called its run.

**Example 1** *Finding Slope*

A building’s access ramp has a rise of 2 feet and a run of 24 feet. Find its slope.

\[
\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{2}{24} = \frac{1}{12}
\]

**Answer:** The access ramp has a slope of \(\frac{1}{12}\).

**Slope of a Line**

Given two points on a nonvertical line, you can find the slope \(m\) of the line using this formula.

\[
m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}}
\]

**Example** \(m = \frac{4 - 1}{5 - 3} = \frac{3}{2}\)
Example 2  Finding Positive and Negative Slope

Find the slope of the line shown.

a. \( m = \frac{\text{rise}}{\text{run}} \)
   \[ = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} \]
   \[ = \frac{4 - 2}{7 - 1} \]
   \[ = \frac{2}{6} \]
   \[ = \frac{1}{3} \]

Answer: The slope is \( \frac{1}{3} \).

b. \( m = \frac{\text{rise}}{\text{run}} \)
   \[ = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} \]
   \[ = \frac{7 - 2}{3 - 7} \]
   \[ = \frac{5}{4} \]
   \[ = \frac{5}{4} \]

Answer: The slope is \( \frac{5}{4} \).

Checkpoint  Find the slope of the line through the given points.

1. \((2, -2), (0, 4)\)  2. \((7, 5), (3, 2)\)  3. \((-2, 4), (6, 2)\)
Example 2  Finding Positive and Negative Slope

Find the slope of the line shown.

a. \[ m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of y-coordinates}}{\text{difference of x-coordinates}} = \frac{7 - 2}{4 - 1} = \frac{5}{3} \]

Answer: The slope is \( \frac{5}{3} \).

b. \[ m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of y-coordinates}}{\text{difference of x-coordinates}} = \frac{-4 - 1}{7 - 2} = \frac{-5}{5} = -1 \]

Answer: The slope is \(-1\).

Checkpoint  Find the slope of the line through the given points.

1. \((2, -2), (0, 4)\)
2. \((7, 5), (3, 2)\)
3. \((-2, 4), (6, 2)\)

\(-3\)  \(\frac{3}{4}\)  \(-\frac{1}{4}\)
Example 3

Zero and Undefined Slope

Find the slope of the line shown.

a. \( m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} = \frac{2}{4} = \frac{1}{2} \)

Answer: The slope is \( \frac{1}{2} \).

b. \( m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} = \frac{3}{1} = 3 \)

Answer: The slope is 3.

Checkpoint

Find the slope of the line through the given points. Tell whether the slope is positive, negative, zero, or undefined.

4. \((3, -1), (3, 5)\)
5. \((-2, 5), (3, 4)\)
6. \((1, -1), (7, -1)\)
Example 3  
**Zero and Undefined Slope**

Find the slope of the line shown.

a. \[ m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} \]
\[ = \frac{2 - 2}{4 - (-2)} = \frac{0}{6} = 0 \]

**Answer:** The slope is 0.

b. \[ m = \frac{\text{rise}}{\text{run}} = \frac{\text{difference of } y\text{-coordinates}}{\text{difference of } x\text{-coordinates}} \]
\[ = \frac{2 - (-4)}{3 - 3} = \frac{6}{0} \]

**Answer:** The slope is undefined.

**Checkpoint**  Find the slope of the line through the given points. Tell whether the slope is positive, negative, zero, or undefined.

4. (3, -1), (3, 5)  
5. (-2, 5), (3, 4)  
6. (1, -1), (7, -1)

- undefined
- \(-\frac{1}{5}\), negative
- 0
**Example 1  Interpreting a Real-World Graph**

**Bathtub** The graph shows the amount of water in a bathtub. Describe what is happening over time.

![Graph of water in a bathtub over time]

**Solution**

The slopes of the segments in the graph represent the rates of change in the [ ] over [ ].

- **First 4 minutes:** The first two segments have [ ] slopes, so the bathtub is filling with water. The first segment is not as steep as the second, so the rate at which the water is filling the tub is [ ] between 0 and 2 minutes than between 2 and 4 minutes.

- **Next 10 minutes:** The slope of the third segment is 0, so the [ ] is not changing. The water has been shut off.

- **After 14 minutes:** The last two segments have [ ] slopes, so the water is draining from the bathtub. The fourth segment is steeper than the fifth segment, so the rate at which the water is draining from the tub is [ ] between 14 and 18 minutes than between 18 and 20 minutes.
Real-World Graphs

Goal: Interpret and create graphs representing real-world situations.

Example 1  Interpreting a Real-World Graph

Bathtub  The graph shows the amount of water in a bathtub. Describe what is happening over time.

Solution

The slopes of the segments in the graph represent the rates of change in the amount of water over time.

- **First 4 minutes:** The first two segments have positive slopes, so the bathtub is filling with water. The first segment is not as steep as the second, so the rate at which the water is filling the tub is less between 0 and 2 minutes than between 2 and 4 minutes.

- **Next 10 minutes:** The slope of the third segment is 0, so the amount of water is not changing. The water has been shut off.

- **After 14 minutes:** The last two segments have negative slopes, so the water is draining from the bathtub. The fourth segment is steeper than the fifth segment, so the rate at which the water is draining from the tub is greater between 14 and 18 minutes than between 18 and 20 minutes.
Example 2  Interpreting a Real-World Graph

Temperature  The graph shows the temperatures on a winter night from midnight until early the next morning. Describe what is happening.

![Graph of temperature over time](image)

Solution

The first four segments of the graph have alternating and slopes, so the temperature decreases, holds steady, decreases, and then holds steady again. The last two segments of the graph have slopes, so the temperature as morning approaches.

Example 3  Creating a Real-World Graph

Weekend Fun  One Saturday, a student starts from home and rides a bicycle 3 miles to a friend's house. After visiting for 5 minutes, the friends walk 1 mile to the park. Draw a graph representing this situation.

Solution

A reasonable biking speed would be 12 miles per hour, or 5 minutes per mile. A reasonable walking speed would be 3 miles per hour, or 20 minutes per mile.

The distance from home when the student travels 3 miles (minutes of biking) to the friend’s house, remains the same for 5 minutes, and then when the friends walk 1 mile (minutes of walking) to the park.
Example 2  
Interpreting a Real-World Graph

Temperature  The graph shows the temperatures on a winter night from midnight until early the next morning. Describe what is happening.

Solution
The first four segments of the graph have alternating negative and 0 slopes, so the temperature decreases, holds steady, decreases, and then holds steady again. The last two segments of the graph have positive slopes, so the temperature increases as morning approaches.

Example 3  
Creating a Real-World Graph

Weekend Fun  One Saturday, a student starts from home and rides a bicycle 3 miles to a friend’s house. After visiting for 5 minutes, the friends walk 1 mile to the park. Draw a graph representing this situation.

Solution
A reasonable biking speed would be 12 miles per hour, or 5 minutes per mile. A reasonable walking speed would be 3 miles per hour, or 20 minutes per mile.

The distance from home increases when the student travels 3 miles (15 minutes of biking) to the friend’s house, remains the same for 5 minutes, and then increases when the friends walk 1 mile (20 minutes of walking) to the park.
Goal: Graph linear equations in slope-intercept form.

**Slope-Intercept Form**

**Words** A linear equation of the form \( y = mx + b \) is said to be in slope-intercept form. The \( m \) is \( m \) and the \( b \) is \( b \).

**Algebra** \( y = mx + b \)  
**Numbers** \( y = 2x + 3 \)

---

**Example 1**  Identifying the Slope and \( y \)-Intercept

Identify the slope and \( y \)-intercept of the line.

a. \( y = 2x - 3 \)  
   b. \( 4x + 3y = 9 \)

**Solution**

a. Write the equation \( y = 2x - 3 \) as \( \underline{\text{______}} \).
   
   **Answer:** The line has a slope of \( \underline{\text{______}} \) and a \( y \)-intercept of \( \underline{\text{______}} \).

b. Write the equation \( 4x + 3y = 9 \) in slope-intercept form.
   
   \( 4x + 3y = 9 \)  
   Write original equation.
   
   \( 3y = \underline{\text{______}} \)  
   Subtract \( \underline{\text{______}} \) from each side.
   
   \( y = \underline{\text{______}} \)  
   Multiply each side by \( \underline{\text{______}} \).
   
   **Answer:** The line has a slope of \( \underline{\text{______}} \) and a \( y \)-intercept of \( \underline{\text{______}} \).

---

✓ **Checkpoint** Identify the slope and \( y \)-intercept of the line with the given equation.

1. \( y = -3x - 4 \)  
2. \( x - 2y = 10 \)
Goal: Graph linear equations in slope-intercept form.

**Slope-Intercept Form**

**Words** A linear equation of the form \( y = mx + b \) is said to be in **slope-intercept form**. The **slope** is \( m \) and the **y-intercept** is \( b \).

**Algebra** \( y = mx + b \)

**Numbers** \( y = 2x + 3 \)

---

**Example 1** *Identifying the Slope and y-Intercept*

Identify the slope and y-intercept of the line.

a. \( y = 2x - 3 \)

**Solution**

a. Write the equation \( y = 2x - 3 \) as \( y = 2x + (-3) \).

**Answer:** The line has a slope of \( 2 \) and a y-intercept of \( -3 \).

b. Write the equation \( 4x + 3y = 9 \) in slope-intercept form.

\[
4x + 3y = 9 \\
3y = -4x + 9 \\
y = \frac{-4}{3}x + 3
\]

**Answer:** The line has a slope of \( \frac{-4}{3} \) and a y-intercept of \( 3 \).

---

**Checkpoint** Identify the slope and y-intercept of the line with the given equation.

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

   - **slope**: \(-3\);
   - **y-intercept**: \(-4\)

2. \( x - 2y = 10 \)

   - **slope**: \( \frac{1}{2} \);
   - **y-intercept**: \(-5\)
Example 2  Graphing an Equation in Slope-Intercept Form

Graph the equation \( y = -\frac{3}{4}x + 2 \).

1. The y-intercept is \( \), so plot the point \( \).

2. The slope is \( \) = \( \). Starting at \( \), plot another point by moving right \( \) units and down \( \) units.

3. Draw a line through the two points.

Slopes of Parallel and Perpendicular Lines

Two nonvertical parallel lines have \( \). For example, the parallel lines \( a \) and \( b \) below \( \).

Two nonvertical perpendicular lines, such as lines \( a \) and \( c \) below, have slopes that are \( \).
Example 2  Graphing an Equation in Slope-Intercept Form

Graph the equation \( y = -\frac{3}{4}x + 2 \).

1. The \( y \)-intercept is \(2\), so plot the point \((0, 2)\).

2. The slope is \(\frac{-3}{4} = \frac{-3}{4}\).

Starting at \((0, 2)\), plot another point by moving right \(4\) units and down \(3\) units.

3. Draw a line through the two points.

**Slopes of Parallel and Perpendicular Lines**

Two nonvertical parallel lines have the same slope. For example, the parallel lines \(a\) and \(b\) below both have a slope of \(2\).

Two nonvertical perpendicular lines, such as lines \(a\) and \(c\) below, have slopes that are negative reciprocals of each other.

If \(m\) is any nonzero number, then the negative reciprocal of \(m\) is \(-\frac{1}{m}\). Note that the product of a number and its negative reciprocal is \(-1\):

\[m \left(-\frac{1}{m}\right) = -1\]
Example 3  Finding Slopes of Parallel and Perpendicular Lines

Find the slope of a line that has the given relationship to the line with the equation $5x + 2y = 10$.

a. Parallel to the line  

b. Perpendicular to the line

Solution

a. First write the given equation in slope-intercept form.

$5x + 2y = 10$

Write original equation.

$2y = -5x + 10$

Subtract \(-5x\) from each side.

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

Multiply each side by \(-\frac{1}{2}\).

The slope of the given line is \(-\frac{5}{2}\). Because parallel lines have \(-\frac{5}{2}\), the slope of the parallel line is also \(-\frac{5}{2}\).

b. From part (a), the slope of the given line is \(-\frac{5}{2}\). So, the slope of a line perpendicular to the given line is $\frac{2}{5}$ of \(-\frac{5}{2}\), or \(-1\).

Checkpoint  For the line with the given equation, find the slope of a parallel line and the slope of a perpendicular line.

3. $y = -5x - 4$

4. $2x - 3y = 6$
Example 3  Finding Slopes of Parallel and Perpendicular Lines

Find the slope of a line that has the given relationship to the line with the equation $5x + 2y = 10$.

a. Parallel to the line

b. Perpendicular to the line

Solution

a. First write the given equation in slope-intercept form.

$$5x + 2y = 10$$
Write original equation.

$$2y = -5x + 10$$
Subtract $5x$ from each side.

$$y = -\frac{5}{2}x + 5$$
Multiply each side by $\frac{1}{2}$.

The slope of the given line is $-\frac{5}{2}$. Because parallel lines have the same slope, the slope of the parallel line is also $-\frac{5}{2}$.

b. From part (a), the slope of the given line is $-\frac{5}{2}$. So, the slope of a line perpendicular to the given line is the negative reciprocal of $-\frac{5}{2}$, or $\frac{2}{5}$.

Checkpoint  For the line with the given equation, find the slope of a parallel line and the slope of a perpendicular line.

3. $y = -5x - 4$

$-5; \frac{1}{5}$

4. $2x - 3y = 6$

$-\frac{2}{3}; \frac{3}{2}$
**Graphs of Direct Variations**

**Goal:** Analyze a direct variation graph, and graph a direct variation equation.

### Example 1 Analyzing a Graph

**Buying Mulch** The graph shows the cost of buying mulch for landscaping. Tell whether the graph represents a direct variation. If so, tell which variable varies directly with the other. Also identify the constant of variation and interpret it both in relation to the graph and in relation to the real-world situation.

![Graph of Direct Variation](image)

**Solution**

Find the ratio \( \frac{y}{x} \) for each ordered pair shown on the graph:
\[
\frac{11.5}{10} = \underline{\quad} \quad \frac{23}{20} = \underline{\quad} \quad \frac{34.5}{30} = \underline{\quad}
\]

Because the ratios are the same, the graph represents a direct variation. Because \( y \) represents cost and \( x \) represents the weight of the mulch, the graph shows that the cost varies directly with the weight of the mulch. The constant of variation is 1.15. Because (0, 0) is a point on the graph, calculating the slope between this point and any other point on the graph results in the constant of variation. For instance:
\[
\frac{11.5-0}{10-0} = \frac{11.5}{10} = \underline{1.15}
\]

In relation to the graph, the constant of variation is the \( \frac{y}{x} \) ratio. In relation to the real-world situation, the constant of variation is the cost per pound of mulch, or cost per 10 pounds of mulch.
**Goal:** Analyze a direct variation graph, and graph a direct variation equation.

**Example 1**  
**Analyzing a Graph**

**Buying Mulch** The graph shows the cost of buying mulch for landscaping. Tell whether the graph represents a direct variation. If so, tell which variable varies directly with the other. Also identify the constant of variation and interpret it both in relation to the graph and in relation to the real-world situation.

![Graph of Cost vs. Weight of Mulch](image)

**Solution**

Find the ratio \( \frac{y}{x} \) for each ordered pair \((x, y)\) shown on the graph:

\[
\frac{11.5}{10} = 1.15 \quad \frac{23}{20} = 1.15 \quad \frac{34.5}{30} = 1.15
\]

Because the ratios are equal, the graph represents a direct variation. Because \(y\) represents cost and \(x\) represents the weight of the mulch, the graph shows that cost varies directly with the weight of the mulch. The constant of variation is \(1.15\). Because \((0, 0)\) is a point on the graph, calculating the slope between this point and any other point on the graph results in the constant of variation. For instance:

\[
\frac{11.5-0}{10-0} = \frac{11.5}{10} = 1.15
\]

In relation to the graph, the constant of variation is the slope. In relation to the real-world situation, the constant of variation is the cost per unit weight of mulch, or \(\$1.15\) per pound.
Chapter 8

Pre-Algebra Notetaking Guide

Example 2 Drawing and Using a Direct Variation Graph

Running  A runner is training for a race. In the direct variation equation \( y = 160x \), \( y \) represents the distance traveled (in meters) and \( x \) represents the running time (in minutes).

a. Graph the equation. Interpret the graph’s slope.

b. The running path is about 400 meters long. Use your graph to estimate the time it will take the runner to run the entire path.

Solution

a. You know that \((0, 0)\) is one point on the graph. Another point on the graph is \((1, 160)\). Plot the points and draw a line through them. The slope of the line is \(160\), which represents the runner’s average speed, \(160\) meters per minute.

b. Locate \((400, 160)\) on the \(y\)-axis. Move \((400, 160)\) to the graphed line and then \((400, 0)\) to the \(x\)-axis. You end up at \(x = 2.5\), so the time it takes for the runner to run the entire path is \(2.5\) minutes.
The graph of \( y = kx \) is in slope-intercept form, \( y = mx + b \). In this case, \( m = k \) and \( b = 0 \), so the graph of \( y = kx \) is a line having a slope of \( k \) and a \( y \)-intercept of 0.

### Example 2  Drawing and Using a Direct Variation Graph

**Running** A runner is training for a race. In the direct variation equation \( y = 160x \), \( y \) represents the distance traveled (in meters) and \( x \) represents the running time (in minutes).

a. Graph the equation. Interpret the graph’s slope.

b. The running path is about 400 meters long. Use your graph to estimate the time it will take the runner to run the entire path.

**Solution**

a. You know that \((0, 0)\) is one point on the graph. Another point on the graph is \((1, 160)\). Plot the points and draw a line through them. The slope of the line is 160, which represents the runner’s average speed, 160 meters per minute.

b. Locate 400 on the \(y\)-axis. Move **horizontally** to the graphed line and then **vertically** to the \(x\)-axis. You end up at \( x = 2.5 \), so the time it takes for the runner to run the entire path is 2.5 minutes.
8.6 Writing Linear Equations

**Goal:** Write linear equations.

**Vocabulary**

Best-fitting line:

**Example 1  Writing an Equation Given the Slope and y-Intercept**

Write an equation of the line with a slope of $-2$ and a y-intercept of $-5$.

\[ y = mx + b \]

Write general slope-intercept equation.

\[ y = \underline{m}x + \underline{b} \]

Substitute for $m$ and $b$.

\[ y = \underline{ } \]

Simplify.

**Checkpoint**

1. Write an equation of the line with a slope of 4 and a y-intercept of $-3$.

**Example 2  Writing an Equation of a Graph**

Write an equation of the line shown.

1. Find the slope $m$ using the labeled points.

\[ m = \underline{ } = \underline{ } \]

2. Find the y-intercept $b$. The line crosses the $\underline{ }$ at $\underline{ }$, so $b = \underline{ }$.

3. Write an equation of the form $y = mx + b$.

\[ y = \underline{m}x + \underline{b} \]
8.6 Writing Linear Equations

**Goal:** Write linear equations.

**Vocabulary**

Best-fitting line: The best-fitting line is the line that lies as close as possible to the points in a data set.

**Example 1** Writing an Equation Given the Slope and y-Intercept

Write an equation of the line with a slope of \(-2\) and a y-intercept of \(-5\).

\[
y = mx + b
\]

Write general slope-intercept equation.

\[
y = -2x + (-5)
\]

Substitute for \(m\) and for \(b\).

\[
y = -2x - 5
\]

Simplify.

**Checkpoint**

1. Write an equation of the line with a slope of \(4\) and a y-intercept of \(-3\).

\[
y = 4x - 3
\]

**Example 2** Writing an Equation of a Graph

Write an equation of the line shown.

1. Find the slope \(m\) using the labeled points.

\[
m = \frac{4 - 2}{3 - 0} = \frac{2}{3}
\]

2. Find the y-intercept \(b\). The line crosses the y-axis at \((0, 2)\), so \(b = 2\).

3. Write an equation of the form \(y = mx + b\).

\[
y = \frac{2}{3}x + 2
\]
Example 3  Writing Equations of Parallel or Perpendicular Lines

a. Write an equation of the line that is parallel to the line $y = 8x$ and passes through the point $(0, 3)$.

b. Write an equation of the line that is perpendicular to the line $y = -\frac{1}{2}x + 3$ and passes through the point $(0, -5)$.

Solution

a. The slope of the given line is , so the slope of the parallel line is also . The parallel line passes through $(0, 3)$, so its $y$-intercept is .

Answer: An equation of the line is .

b. Because the slope of the given line is , the slope of the perpendicular line is the negative reciprocal of , or . The perpendicular line passes through $(0, 5)$, so its $y$-intercept is .

Answer: An equation of the line is .

Checkpoint

2. Write an equation of the line through the points $(0, -3)$ and $(4, 5)$.

3. Write an equation of the line that is parallel to $y = 3x + 2$ and passes through the point $(0, 4)$.

4. Write an equation of the line that is perpendicular to $y = 3x + 2$ and passes through the point $(0, -2)$. 
Example 3  Writing Equations of Parallel or Perpendicular Lines

a. Write an equation of the line that is parallel to the line $y = 8x$ and passes through the point $(0, 3)$.

b. Write an equation of the line that is perpendicular to the line $y = -\frac{1}{2}x + 3$ and passes through the point $(0, -5)$.

Solution

a. The slope of the given line is $8$, so the slope of the parallel line is also $8$. The parallel line passes through $(0, 3)$, so its $y$-intercept is $3$.

Answer: An equation of the line is $y = 8x + 3$.

b. Because the slope of the given line is $-\frac{1}{2}$, the slope of the perpendicular line is the negative reciprocal of $-\frac{1}{2}$, or $2$. The perpendicular line passes through $(0, 5)$, so its $y$-intercept is $-5$.

Answer: An equation of the line is $y = 2x - 5$.

Checkpoint

2. Write an equation of the line through the points $(0, -3)$ and $(4, 5)$.

$y = 2x - 3$

3. Write an equation of the line that is parallel to $y = 3x + 2$ and passes through the point $(0, 4)$.

$y = 3x + 4$

4. Write an equation of the line that is perpendicular to $y = 3x + 2$ and passes through the point $(0, -2)$.

$y = -\frac{1}{3}x - 2$
Example 4  Approximating a Best-Fitting Line

Teachers  The table shows the number of elementary and secondary school teachers in the United States for the years 1992–1999.

<table>
<thead>
<tr>
<th>Years since 1992, ( x )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers (in ten thousands), ( y )</td>
<td>282</td>
<td>287</td>
<td>293</td>
<td>298</td>
<td>305</td>
<td>313</td>
<td>322</td>
<td>330</td>
</tr>
</tbody>
</table>

a. Approximate the equation of the best-fitting line for the data.
b. Predict the number of teachers in 2006.

Solution

a. First, make a scatter plot of the data pairs.

Next, draw the line that appears to best fit the data points. There should be about the same number of points above the line as below it. The line does not have to pass through any of the data points.

Finally, write an equation of the line. To find the slope, estimate the coordinates of two points on the line, such as (0, 280) and (7, 330).

\[
m = \frac{330 - 280}{7 - 0} \approx \frac{50}{7} \]

The line intersects the \( y \)-axis at \( 280 \), so the \( y \)-intercept is \( 0 \).

Answer: An approximate equation of the best fitting line is \( y = \frac{50}{7}x + 280 \).


Calculate \( y \) when \( x = 14 \) using the equation from part (a).

\[
y = \frac{50}{7} 
\]

Answer: In 2006, there would have been about \( \frac{50}{7} 	imes 14 + 280 \) teachers in the United States.
Teachers  The table shows the number of elementary and secondary school teachers in the United States for the years 1992–1999.

<table>
<thead>
<tr>
<th>Years since 1992, x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers (in ten thousands), y</td>
<td>282</td>
<td>287</td>
<td>293</td>
<td>298</td>
<td>305</td>
<td>313</td>
<td>322</td>
<td>330</td>
</tr>
</tbody>
</table>

a. Approximate the equation of the best-fitting line for the data.

b. Predict the number of teachers in 2006.

Solution

a. *First*, make a scatter plot of the data pairs.

*Next*, draw the line that appears to best fit the data points. There should be about the same number of points above the line as below it. The line does not have to pass through any of the data points.

*Finally*, write an equation of the line. To find the slope, estimate the coordinates of two points on the line, such as (0, 280) and (7, 330).

\[
m = \frac{330 - 280}{7 - 0} = \frac{50}{7} \approx 7.14
\]

The line intersects the y-axis at (0, 280), so the y-intercept is 280.

*Answer:* An approximate equation of the best fitting line is 

\[
y = 7.14x + 280
\]


Calculate \( y \) when \( x = 14 \) using the equation from part (a).

\[
y = 7.14(14) + 280 \approx 380
\]

*Answer:* In 2006, there would have been about 3,800,000 teachers in the United States.
Domain and Range of a Function

Goal: Analyze the domain and range of a linear function.

Identifying Discrete and Continuous Functions

A graph that consist of isolated points.

A graph that is unbroken.

Example 1  Graphing and Classifying a Function

Graph the function \( y = x - 2 \) with the given domain. Classify the function as discrete or continuous. Then identify the range.

a. Domain: 3, 4, 5

Solution

a. Make a table and plot the points.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( )</th>
<th>( )</th>
<th>( )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
</tbody>
</table>

The function is . The range is .

b. Domain: \( x \leq 0 \)

b. Plot \((0, -2)\) and draw the part of the line \( y = x - 2 \) that lines in Quadrant III. The \( y \)-values from as \( x \) from .

The graph is continuous. The range is .

As a general rule, you can tell that a function is continuous if you do not have to lift your pencil from the paper to draw its graph.
**Goal:** Analyze the domain and range of a linear function.

### Identifying Discrete and Continuous Functions

A **discrete function** has a graph that consists of isolated points.

A **continuous function** has a graph that is unbroken.

<table>
<thead>
<tr>
<th>$x$</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

The function is **discrete**. The range is $1, 2, 3$.

Example 1  **Graphing and Classifying a Function**

Graph the function $y = x - 2$ with the given domain. Classify the function as discrete or continuous. Then identify the range.

**Solution**

**a.** Domain: 3, 4, 5

- **Make a table and plot the points.**

<table>
<thead>
<tr>
<th>$x$</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

  The function is **discrete**. The range is $1, 2, 3$.

**b.** Domain: $x \leq 0$

- **Plot** $(0, -2)$ and draw the part of the line $y = x - 2$ that lines in Quadrant III. The $y$-values **decrease** from $-2$ as $x$ **decreases** from $0$.

  The graph is continuous. The range is $y \leq -2$.
Example 2  Classifying a Real-World Function

Write an equation for the function described. Tell whether the function is discrete or continuous. Then answer the question.

**Exercise** An athlete burns 180 calories lifting free weights and then burns 12 calories per minute on the elliptical machine. The total number of calories burned is a function of the number of minutes the athlete spends on the elliptical machine. How many minutes does the athlete need to spend on the elliptical machine if the goal is to burn a total of 420 calories?

**Solution**

1. Let \( x \) represent the number of minutes the athlete spends on the elliptical machine. Let \( y \) represent the total number of calories burned. The athlete has already burned \( 180 \) calories and will burn \( 12 \) calories per minute on the elliptical machine, so the equation for the total number of calories burned is given by:

\[
y = 180 + 12x
\]

2. You can burn fractional parts of calories, so the domain consists of \( \mathbb{R} \). So the function is \( \text{continuous} \).

3. To find the number of minutes the athlete needs to spend on the elliptical machine, substitute \( 420 \) for \( y \).

\[
180 = 420 - 12x
\]

Substitute.

\[
240 = -12x
\]

Subtract \( 180 \) from each side.

\[
-20 = x
\]

Divide each side by \( -12 \).

Answer \( 20 \) minutes
Write an equation for the function described. Tell whether the function is discrete or continuous. Then answer the question.

**Exercise** An athlete burns 180 calories lifting free weights and then burns 12 calories per minute on the elliptical machine. The total number of calories burned is a function of the number of minutes the athlete spends on the elliptical machine. How many minutes does the athlete need to spend on the elliptical machine if the goal is to burn a total of 420 calories?

**Solution**

1. Let $x$ represent the number of minutes the athlete spends on the elliptical machine. Let $y$ represent the total number of calories burned. The athlete has already burned 180 calories and will burn 12 calories per minute on the elliptical machine, so the equation for the total number of calories burned is given by:

   $$y = 180 + 12x$$

2. You can burn fractional parts of calories, so the domain consists of all real numbers greater than or equal to 0. So the function is continuous.

3. To find the number of minutes the athlete needs to spend on the elliptical machine, substitute 420 for $y$.

   $$420 = 180 + 12x$$
   Subtract 180 from each side.
   $$240 = 12x$$
   Divide each side by 12.

   Answer 20 minutes
Function Notation

Goal: Use function notation.

Vocabulary
Function notation:

Example 1  Working with Function Notation

Let $f(x) = 2x - 5$. Find $f(x)$ when $x = -3$, and find $x$ when $f(x) = 13$.

a. $f(x) = 2x - 5$  Write function.

\[
f(\underline{\quad}) = 2(\underline{\quad}) - 5\]

Substitute for $x$.

\[
= \underline{\quad}\]

Simplify.

Answer: When $x = -3$, $f(x) = \underline{\quad}$.

b. $f(x) = 2x - 5$  Write function.

\[
\underline{\quad} = 2x - 5\]

Substitute for $f(x)$.

\[
\underline{\quad} = 2x\]

Add $\underline{\quad}$ to each side.

\[
\underline{\quad} = x\]

Divide each side by $\underline{\quad}$.

Answer: When $f(x) = 13$, $x = \underline{\quad}$.

Checkpoint  Let $g(x) = -x + 7$. Find the indicated value.

1. $g(x)$ when $x = 4$  2. $x$ when $g(x) = 9$
8.7 Function Notation

Goal: Use function notation.

Vocabulary

Function notation: An equation written in function notation uses \( f(x) \) to represent the output of the function \( f \) for an input of \( x \).

Example 1 Working with Function Notation

Let \( f(x) = 2x - 5 \). Find \( f(x) \) when \( x = -3 \), and find \( x \) when \( f(x) = 13 \).

a. \( f(x) = 2x - 5 \) Write function.
   \[
f(-3) = 2(-3) - 5 \quad \text{Substitute for } x.
   \]
   \[
   = -11 \quad \text{Simplify.}
   \]
   Answer: When \( x = -3 \), \( f(x) = -11 \).

b. \( f(x) = 2x - 5 \) Write function.
   \[
   13 = 2x - 5 \quad \text{Substitute for } f(x).
   \]
   \[
   18 = 2x \quad \text{Add} \ 5 \ \text{to each side.}
   \]
   \[
   9 = x \quad \text{Divide each side by} \ 2.
   \]
   Answer: When \( f(x) = 13 \), \( x = 9 \).

Checkpoint Let \( g(x) = -x + 7 \). Find the indicated value.

1. \( g(x) \) when \( x = 4 \)

   \[
   3
   \]

2. \( x \) when \( g(x) = 9 \)

   \[
   -2
   \]
**Example 2  Graphing a Function**

Graph the function \( f(x) = \frac{5}{6}x - 3 \).

1. Rewrite the function as

2. The \( y \)-intercept is , so plot the point .

3. The slope is . Starting at , plot another point by moving right units and up units.

4. Draw a line through the two points.

**Checkpoint  Graph the function.**

3. \( g(x) = -\frac{2}{3}x + 2 \)

4. \( h(x) = \frac{3}{2}x - 1 \)
Example 2  

Graphing a Function

Graph the function \( f(x) = \frac{5}{6}x - 3 \).

1. Rewrite the function as
   \[
   y = \frac{5}{6}x - 3.
   \]

2. The y-intercept is \(-3\), so plot the point \((0, -3)\).

3. The slope is \(\frac{5}{6}\). Starting at \((0, -3)\), plot another point by moving right 6 units and up 5 units.

4. Draw a line through the two points.

Checkpoint  

Graph the function.

3. \( g(x) = -\frac{2}{3}x + 2 \)

4. \( h(x) = \frac{3}{2}x - 1 \)
**Example 3  ** *Writing a Function*

Write a linear function $g$ given that $g(0) = 10$ and $g(4) = -2$.

1. Find the slope $m$ of the function’s graph. From the values of $g(0)$ and $g(4)$, you know that the graph of $g$ passes through the points $\underline{\phantom{10}}$ and $\underline{\phantom{10}}$. Use these points to calculate the slope.

   \[ m = \underline{\phantom{10}} = \underline{\phantom{10}} = \underline{\phantom{10}} \]

2. Find the $y$-intercept $b$ of the function’s graph. The graph passes through $\underline{\phantom{10}}$, so $b = \underline{\phantom{10}}$.

3. Write an equation of the form $g(x) = mx + b$.

**Example 4  ** *Using Function Notation in Real Life*

You ride your bike at a speed of 12 miles per hour.

a. Use function notation to write an equation giving the distance traveled as a function of time.

b. How long will it take you to travel 30 miles?

**Solution**

a. Let $t$ be the elapsed time (in hours) since you started riding your bike, and let $d(t)$ be the distance traveled (in miles) at that time. Write a verbal model. Then use the verbal model to write an equation.

   \[ \underline{\phantom{10}} = \underline{\phantom{10}} \cdot \underline{\phantom{10}} = \underline{\phantom{10}} \]

b. Find the value of $t$ for which $d(t) = 30$.

   \[ d(t) = \underline{\phantom{10}} \quad \text{Write function for distance.} \]

   \[ \underline{\phantom{10}} = \underline{\phantom{10}} \quad \text{Substitute for } d(t). \]

   \[ \underline{\phantom{10}} = t \quad \text{Divide each side by } \underline{\phantom{10}}. \]

**Answer:** It will take you $\underline{\phantom{10}}$ hours to travel 30 miles.
Example 3  **Writing a Function**

Write a linear function \( g \) given that \( g(0) = 10 \) and \( g(4) = -2 \).

1. Find the slope \( m \) of the function’s graph. From the values of \( g(0) \) and \( g(4) \), you know that the graph of \( g \) passes through the points \((0, 10)\) and \((4, -2)\). Use these points to calculate the slope.

\[
m = \frac{-2 - 10}{4 - 0} = \frac{-12}{4} = -3
\]

2. Find the \( y \)-intercept \( b \) of the function’s graph. The graph passes through \((0, 10)\), so \( b = 10 \).

3. Write an equation of the form \( g(x) = mx + b \).

\[
g(x) = -3x + 10
\]

Example 4  **Using Function Notation in Real Life**

You ride your bike at a speed of 12 miles per hour.

a. Use function notation to write an equation giving the distance traveled as a function of time.

b. How long will it take you to travel 30 miles?

**Solution**

a. Let \( t \) be the elapsed time (in hours) since you started riding your bike, and let \( d(t) \) be the distance traveled (in miles) at that time. Write a verbal model. Then use the verbal model to write an equation.

\[
\text{Distance traveled} = \text{Speed of bike} \cdot \text{Time}
\]

\[
d(t) = 12t
\]

b. Find the value of \( t \) for which \( d(t) = 30 \).

\[
d(t) = 12t
\]

Write function for distance.

\[
30 = 12t
\]

Substitute for \( d(t) \).

\[
2.5 = t
\]

Divide each side by 12.

**Answer:** It will take you \( 2.5 \) hours to travel 30 miles.
Goal: Graph and solve systems of linear equations.

Vocabulary

System of linear equations: ______________

Solution of a linear system: ______________

Example 1  Solving a System of Linear Equations

Solve the linear system:  
\[
\begin{align*}
y &= x - 3 & \text{Equation 1} \\
y &= -\frac{1}{5}x + 3 & \text{Equation 2}
\end{align*}
\]

1. Graph the equations.

2. Identify the apparent intersection point, ______________.

3. Verify that ______________ is the solution of the system by substituting ______________ for \(x\) and ______________ for \(y\) in each equation.

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

Answer: The solution is ______________.
8.8
Systems of Linear Equations

Goal: Graph and solve systems of linear equations.

Vocabulary

System of linear equations: A system of linear equations consists of two or more linear equations with the same variables.

Solution of a linear system: A solution of a linear system in two variables is an ordered pair that is a solution of each equation in the system.

Example 1
Solving a System of Linear Equations

Solve the linear system: \( y = x - 3 \) \hspace{1cm} Equation 1
\[ y = -\frac{1}{5}x + 3 \] \hspace{1cm} Equation 2

1. Graph the equations.

2. Identify the apparent intersection point, \((5, 2)\).

3. Verify that \((5, 2)\) is the solution of the system by substituting 5 for \(x\) and 2 for \(y\) in each equation.

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

Answer: The solution is \((5, 2)\).
Example 2  \textbf{Solving a Linear System with No Solution}

Solve the linear system: \( y = -3x - 2 \) \hspace{1cm} \text{Equation 1}
\( y = -3x + 3 \) \hspace{1cm} \text{Equation 2}

Graph the equations. The graphs appear to be \underline{parallel} lines. You can confirm that the lines are \underline{parallel} by observing from their equations that they have the \underline{same} slope, \underline{but} \underline{different} \( y \)-intercepts, \underline{and} \underline{different} \( x \)-intercepts.

\textbf{Answer:} Because parallel lines \underline{are parallel}, the linear system has \underline{No Solution}.

Example 3  \textbf{Solving a Linear System with Many Solutions}

Solve the linear system: \( 2x + y = 4 \) \hspace{1cm} \text{Equation 1}
\( -6x + 3y = -12 \) \hspace{1cm} \text{Equation 2}

Write each equation in slope-intercept form and then graph the equations.

\textbf{Equation 1}
\( 2x + y = 4 \)
\( y = \underline{-2x + 4} \)

\textbf{Equation 2}
\( -6x + 3y = -12 \)
\( y = \underline{-2x - 4} \)

The slope-intercept forms of equations 1 and 2 are identical, so the graphs of the equations are \underline{identical}.

\textbf{Answer:} Because the graphs have infinitely many \underline{intersection points}, the system has \underline{Many Solutions}. Any \underline{point} on the line \underline{intersects} represents a solution.
Example 2  Solving a Linear System with No Solution

Solve the linear system: \( y = -3x - 2 \)  \hspace{1.5em} \text{Equation 1}  
\( y = -3x + 3 \)  \hspace{1.5em} \text{Equation 2}

Graph the equations. The graphs appear to be parallel lines. You can confirm that the lines are parallel by observing from their equations that they have the same slope, \(-3\), but different y-intercepts, \(-2\) and \(-3\).

**Answer:** Because parallel lines do not intersect, the linear system has no solution.

Example 3  Solving a Linear System with Many Solutions

Solve the linear system: \( 2x + y = 4 \)  \hspace{1.5em} \text{Equation 1}  
\( -6x + 3y = -12 \)  \hspace{1.5em} \text{Equation 2}

Write each equation in slope-intercept form and then graph the equations.

**Equation 1**
\[ 2x + y = 4 \]
\[ y = -2x + 4 \]

**Equation 2**
\[ -6x + 3y = -12 \]
\[ -3y = 6x - 12 \]
\[ y = -2x + 4 \]

The slope-intercept forms of equations 1 and 2 are identical, so the graphs of the equations are the same line.

**Answer:** Because the graphs have infinitely many points of intersection, the system has infinitely many solutions. Any point on the line \( y = -2x + 4 \) represents a solution.
### Checkpoint
Solve the linear system by graphing.

1. \[ y = -x + 3 \]
   \[ y = \frac{1}{3}x - 1 \]

2. \[ 5x + y = -3 \]
   \[ 10x + 2y = 8 \]

---

### Example 4
**Writing and Solving a Linear System**

An ecologist is studying the population of two types of fish in a lake. Use the information in the table to predict when the population of the two types of fish will be the same.

<table>
<thead>
<tr>
<th>Fish type</th>
<th>Current population</th>
<th>Change (number per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>340</td>
<td>-25</td>
</tr>
<tr>
<td>B</td>
<td>180</td>
<td>15</td>
</tr>
</tbody>
</table>

**Solution**

Let \( y \) be the number of fish after \( x \) years. Write a linear system.

Fish A population: 

Fish B population: 

Use a graphing calculator to graph the equations. Trace along one of the graphs until the cursor is on the point of intersection. This point is .

**Answer:** The number of fish will be the same after \( \square \) years when the population of each fish will be \( \square \).
**Checkpoint** Solve the linear system by graphing.

1. \( y = -x + 3 \)
   \[ y = \frac{1}{3}x - 1 \]

2. \( 5x + y = -3 \)
   \[ 10x + 2y = 8 \]

---

**Example 4**  **Writing and Solving a Linear System**

An ecologist is studying the population of two types of fish in a lake. Use the information in the table to predict when the population of the two types of fish will be the same.

<table>
<thead>
<tr>
<th>Fish type</th>
<th>Current population</th>
<th>Change (number per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>340</td>
<td>-25</td>
</tr>
<tr>
<td>B</td>
<td>180</td>
<td>15</td>
</tr>
</tbody>
</table>

**Solution**

Let \( y \) be the number of fish after \( x \) years. Write a linear system.

Fish A population: \( y = -25x + 340 \)

Fish B population: \( y = 15x + 180 \)

Use a graphing calculator to graph the equations. Trace along one of the graphs until the cursor is on the point of intersection. This point is \( (4, 240) \).

**Answer:** The number of fish will be the same after 4 years when the population of each fish will be 240.
8.9 Graphs of Linear Inequalities

**Goal:** Graph inequalities in two variables.

### Vocabulary

- **Linear inequality:**

- **Solution of a linear inequality:**

- **Graph of a linear inequality:**

### Example 1  Checking Solutions of a Linear Inequality

Tell whether the ordered pair is a solution of $3x - y > 2$.

#### a. $(3, 0)$

**Solution**

a. Substitute for $x$ and for $y$.

$$3x - y > 2$$

$$3\phantom{y} - \phantom{y} > 2$$

(3, 0) a solution.

#### b. $(-1, 5)$

**Solution**

b. Substitute for $x$ and for $y$.

$$3x - y > 2$$

$$3\phantom{y} - \phantom{y} > 2$$

(-1, 5) a solution.
**Goal:** Graph inequalities in two variables.

### Vocabulary

**Linear inequality:**

A linear inequality in two variables is the result of replacing the equal sign in a linear equation with $<, \leq, >,$ or $\geq$.

**Solution of a linear inequality:**

The solution of a linear inequality is an ordered pair $(x, y)$ that makes the inequality true when the values of $x$ and $y$ are substituted into the inequality.

**Graph of a linear inequality:**

The graph of a linear inequality in two variables is the set of points in a coordinate plane that represent the inequality’s solutions.

### Example 1

**Checking Solutions of a Linear Inequality**

Tell whether the ordered pair is a solution of $3x - y > 2$.

a. $(3, 0)$

**Solution**

a. Substitute for $x$ and for $y$.

$$3x - y > 2$$

$$3 \quad (3) \quad - \quad 0 \quad \geq \quad 2$$

$$9 \quad > \quad 2$$

$(3, 0)$ **is** a solution.

b. $(-1, 5)$

**Solution**

b. Substitute for $x$ and for $y$.

$$3x - y > 2$$

$$3 \quad (-1) \quad - \quad 5 \quad \geq \quad 2$$

$$-8 \quad \not\geq \quad 2$$

$(-1, 5)$ **is not** a solution.
**Checkpoint**  Tell whether the ordered pair is a solution of 
\(-x + 2y > 4\).

1. (1, 6)  2. (−7, −2)  3. (2, 3)

---

**Graphing Linear Inequalities**

1. Find the equation of the boundary line by replacing the 
inequality symbol with =. Graph this equation. Use a dashed 
line for < or >. Use a solid line for ≤ or ≥.

2. Test a point in one of the half-planes to determine whether it 
is a solution of the inequality.

3. If the test point is a solution, shade the half-plane that contains 
the point. If not, shade the other half-plane.

---

**Example 2  Graphing a Linear Inequality**

Graph \(y \geq -x + 1\).

1. Draw the boundary line \(y = -x + 1\). 
The inequality symbol is \(\geq\), so use a 

2. Test the point (0, 0) in the inequality.

\[
y \geq -x + 1
\]

\[
\begin{array}{c}
\geq \\
+ 1
\end{array}
\]

3. Because (0, 0) \(\square\) a solution, shade the half-plane that 

\[
\square
\]
**Checkpoint**  Tell whether the ordered pair is a solution of $-x + 2y > 4$.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (1, 6)</td>
<td>2. (−7, −2)</td>
<td>3. (2, 3)</td>
</tr>
<tr>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Graphing Linear Inequalities**

1. Find the equation of the boundary line by replacing the inequality symbol with $=$. Graph this equation. Use a dashed line for $<$ or $>$. Use a solid line for $\leq$ or $\geq$.

2. Test a point in one of the half-planes to determine whether it is a solution of the inequality.

3. If the test point is a solution, shade the half-plane that contains the point. If not, shade the other half-plane.

---

**Example 2**  **Graphing a Linear Inequality**

Graph $y \geq -x + 1$.

1. Draw the boundary line $y = -x + 1$. The inequality symbol is $\geq$, so use a **solid line**.

2. Test the point $(0, 0)$ in the inequality.

   $y \geq -x + 1$
   
   $0 \geq -(0) + 1$

   $0 \not\geq 1$

3. Because $(0, 0)$ **is not** a solution, shade the half-plane that does not contain $(0, 0)$. 
Graph $x > -2$ and $y \leq 3$ in a coordinate plane.

a. Graph $x = -2$ using a line. Use $(0, 0)$ as a test point.

$\quad \ y \leq 3$

Shade the half-plane.

b. Graph $y = 3$ using a line. Use $(0, 0)$ as a test point.

$\quad \ x > -2$

Shade the half-plane.

**Checkpoint** Graph the inequality in a coordinate plane.

4. $6x - 3y < 9$

5. $x \leq 4$
Example 3

Graphing Inequalities with One Variable

Graph $x > -2$ and $y \leq 3$ in a coordinate plane.

a. Graph $x = -2$ using a dashed line. Use $(0, 0)$ as a test point.

$$x > -2$$

$$0 > -2$$

Shade the half-plane that contains $(0, 0)$.

b. Graph $y = 3$ using a solid line. Use $(0, 0)$ as a test point.

$$y \leq 3$$

$$0 \leq 3$$

Shade the half-plane that contains $(0, 0)$.

Checkpoint

Graph the inequality in a coordinate plane.

4. $6x - 3y < 9$

5. $x \leq 4$
Give an example of the vocabulary word.

**Relation**

**Domain**

**Range**

**Input**

**Output**

**Function**

**Vertical line test**

**Equation in two variables**
### Words to Review

Give an example of the vocabulary word.

<table>
<thead>
<tr>
<th>Relation</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>A set of ordered pairs.</td>
<td>The domain of the relation (1, 5), (2, 10), (3, 15), (4, 20) is 1, 2, 3, and 4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>The range of the relation (1, 5), (2, 10), (3, 15), (4, 20) is 5, 10, 15, and 20.</td>
<td>Each number in the domain of the relation (1, 5), (2, 10), (3, 15), (4, 20) is an input. The inputs are 1, 2, 3, and 4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each number in the range of the relation (1, 5), (2, 10), (3, 15), (4, 20) is an output. The outputs are 5, 10, 15, and 20.</td>
<td>The relation (1, 5), (2, 10), (3, 15), (4, 20) is a function because every input is paired with exactly one output.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vertical line test</th>
<th>Equation in two variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>For a relation represented by a graph, if any vertical line passes through more than one point of the graph, then the relation is not a function. If no vertical line passes through more than one point of the graph, then the relation is a function.</td>
<td>An equation that contains two different variables, such as, $x + y = 4$.</td>
</tr>
</tbody>
</table>
Solution of an equation in two variables

An ordered pair that produces a true statement when the coordinates of the ordered pair are substituted for the variables in the equation. For example, (0, 4) is a solution of \( x + y = 4 \).

Linear equation

An equation whose graph is a line, such as \( x + y = 4 \)

Function form

\[ y = -x + 4 \]

y-intercept

The y-intercept of \( y = 2x + 4 \) is 4.

Rise

The rise between points (0, 0) and (3, 2) is 2.

Slope-intercept form

\[ y = 2x + 4 \]

Discrete function

A function whose graph consists of isolated points, such as \( y = x + 1 \) with domain: \(-1, 0, 1, \) and \( 2 \).

Graph of an equation in two variables

Linear function

A function whose graph is a nonvertical line, such as \( y = x + 1 \)

x-intercept

The x-intercept of \( y = 2x + 4 \) is \(-2\).

Slope

The slope of \( y = \frac{2}{3}x \) is \( \frac{2}{3} \).

Run

The run between points (0, 0) and (3, 2) is 3.

Best-fitting line

The line that lies as close as possible to the points in a data set.
Continuous function

Function notation

System of linear equations

Solution of a linear system

Linear inequality in two variables

Solution of a linear inequality in two variables

Graph of a linear inequality in two variables

Review your notes and Chapter 8 by using the Chapter Review on pages 466–469 of your textbook.
Continuous function
A function whose graph is unbroken, such as \( y = x + 1 \) with domain: \( x \geq 0 \)

System of linear equations
\[
\begin{align*}
y &= 2x + 4 & \text{Equation 1} \\
y &= -2x - 4 & \text{Equation 2}
\end{align*}
\]

Linear inequality in two variables
\( y \geq -x + 1 \)

Graph of a linear inequality in two variables

Function notation
\( y = 2x + 4 \) written using function notation is \( f(x) = 2x + 4 \).

Solution of a linear system
\[
\begin{align*}
y &= 2x + 4 & \text{Equation 1} \\
y &= -2x - 4 & \text{Equation 2}
\end{align*}
\]
Solution: \((-2, 0)\)

Solution of a linear inequality in two variables
An ordered pair that produces a true statement when the coordinates of the ordered pair are substituted for the variables in the inequality. For example, \((1, 2)\) is a solution of \( y \geq -x + 1 \).

Review your notes and Chapter 8 by using the Chapter Review on pages 466–469 of your textbook.