1. \( \frac{5}{3}(3x - 6) - (6 - 4x) = (5x - 10) - 6 + 4x = 9x - 16 \)

2. \( 3(x^2 - 4) + 7(x - 2) = 3(5^2 - 4) + 7(5 - 2) = 45 - 16 \)

3. \( x - 2x + 3x - 4x + 5x \)

4. \( a^2 + a + a^2 \)

5. \( 2x + 3y - 5x + 2y \)

6. \( 5(a - 2b) - 3(a - 2b) \)

7. \( 3(2x - 3) + 2 + 5(x - 3) \)

Simplify each expression.

8. \( 4y - 6 = 2y + 8 \)

9. \( 3(2z + 1) = 35 \)

10. \( 5(3w - 2) - 7 = 23 \)

11. \( t - 2(10 - 2t) = 2t + 9 \)

12. \( 5s - 60 - 24 = 3s + 6 \)

Solve each equation.

13. \( 3(2x - 4) + 5x - 15 = 6x - 12 + 8x - 15 \)

14. \( \frac{5s - 84 + 35 + 2s}{2s - 90} = \frac{6}{45} \)

15. \( \frac{5s - 60 - 24}{3s + 6} = \frac{3s + 84 - 3s + 84}{2s - 90} \)

Savings Briania and her sister Molly both want to buy the same model bicycle. Briana needs $73 more before she can afford the bike. Molly needs $65 more. If they combine their money, they will have just enough to buy one bicycle that they could share. What is the cost of the bicycle?

16. \( x + 7 = x + 7 \) always

17. \( 5a - 1 - 3a = 2a + 1 \)

18. \( 3x + 17 \geq 5 \)

19. \( 25 - 2x < 11 \)

20. \( \frac{5x < -6}{5x > 2} \)

21. \( 2 < 10 - 4d \leq 6 \)

22. \( 4 - x = |2 - 3x| \)

23. \( 5|3w + 2| - 3 > 7 \)

24. Writing Describe the relationships among these sets of numbers: natural numbers, whole numbers, integers, rational numbers, irrational numbers, and real numbers.

25. Reasoning Justify each step by identifying the property used.

26. Reasoning The first four figures of a pattern are shown.

Describe the tenth figure in the pattern.
18. \( x \geq -4 \)

19. \( x > 7 \)

20. \( x < -16 \) or \( x > 2/5 \)

21. \( 1 < d < 2 \)

22. \(-1, 3/2\)

23. \( w < -4/3 \) or \( w > 0 \)

\[
\begin{align*}
5 | 3w + 2 | - 3 & > 7 \\
3 & + 3 \\
\frac{5 | 3w + 2 |}{5} & > 10 \\
|3w + 2| & > 2 \Rightarrow 3w + 2 > 2 \text{ or } 3w + 2 < -2 \\
-2 & -2 \\
\frac{3w}{3} & > 0 \\
\frac{3}{3} & \frac{3}{3} \\
w & > 0
\end{align*}
\]
1-1 Patterns and Expressions

Quick Review
You can represent patterns using words, diagrams, numbers, and algebraic expressions. You can identify a pattern by looking for the same type of change between consecutive figures or numbers. It often helps to make a table.

Example
Identify a pattern by making a table of inputs and outputs. Include a process column. 7, 14, 21, 28, 35, ...

<table>
<thead>
<tr>
<th>Input</th>
<th>Process Column</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 · 7</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>2 · 7</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>3 · 7</td>
<td>21</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>n</td>
<td>n · 7</td>
<td>7n</td>
</tr>
</tbody>
</table>

The nth output is 7n.

Exercises
Identify a pattern and find the next three numbers in the pattern. Adding 5 to the previous.
5. 5, 10, 15, 20, ...
6. 3, 4, 5, 6, ...
7. 25, 30, 35
Copy and complete the table. Then find the output when the input is n.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>n</td>
<td>n + 8</td>
</tr>
</tbody>
</table>

9. Finance If you put $20 in your savings account each week, how much have you saved after n weeks?

1-2 Properties of Real Numbers

Quick Review
The natural numbers, whole numbers, integers, rational numbers, and irrational numbers are all subsets of the real numbers.

You can use properties such as the ones listed below to simplify and evaluate expressions.

Commutative Properties
-3 + 5 = 5 + (-3)
2 × 9 = 9 × 2

Associative Properties
3 + (5 + 7) = (3 + 5) + 7
4 × (8 × 11) = (4 × 8) × 11

Distributive Property
5(7 + 9) = 5(7) + 5(9)

Example
Identify the property illustrated by the equation.
4 · x = x · 4 Commutative Property of Multiplication

Exercises
Name the subset(s) of real numbers to which each number belongs.
10. 8.1π
11. -79
12. √121
13. 12\frac{7}{8}

Compare the two numbers. Use < or >.
14. -√61, -8
15. 5, √32

Name the property of real numbers illustrated by each equation.
16. \frac{9}{4} \cdot \frac{4}{9} = 1 Inverse Prop. of Multiplication
17. (8 \cdot \frac{1}{3}) \cdot 12 = 8 \cdot (\frac{1}{3} \cdot 12) Associative Prop. of Multiplication
1-6 Absolute Value Equations and Inequalities

Quick Review
To rewrite an equation or inequality that involves the absolute value of an algebraic expression, you must consider both cases of the definition of absolute value.

Example
Solve $|3x - 5| = 4 + 2x$. Check for extraneous solutions.

$3x - 5 = 4 + 2x$ or $3x - 5 = -(4 + 2x)$

$3x - 5 = 4 - 2x$

$5x = 1$

$x = \frac{1}{5}$

$|3(9) - 5| \geq 4 + 2(9)$

$|27 - 5| \geq 22$

$|22| = 22 \checkmark$

$\left| \frac{22}{5} \right| = \frac{22}{5} \checkmark$

Exercises
Solve each equation. Check for extraneous solutions.

27. $|2x + 8| = 3x + 7$

28. $|x - 4| + 3 = 1$

29. $|3x + 10| = 6$

30. $|x - 7| = x - \frac{8}{2}$ or $|x - 7| = \frac{x}{2}$

Solve each inequality. Graph the solution.

31. $|3x - 2| + 4 \leq 7$

32. $4|y - 9| > 36$

33. $|7x| + 3 \leq 21$

34. $\frac{1}{2} |x + 2| > 6$

35. The specification for a length $x$ is 43.6 cm with a tolerance of 0.1 cm. Write the specification as an absolute value inequality.

$|x - 43.6| \leq 0.1$

30 continued

$x - \frac{7}{2} = \frac{x}{2} - 4$

$x - \frac{7}{2} = -\frac{x}{2} + 4$

Neither work.

$x + \frac{7}{2} + \frac{7}{2} = \frac{x}{2} + \frac{7}{2} + \frac{7}{2}$

So no solution.

$\frac{x}{2} = 3 \Rightarrow x = 6$ ($3x = 11 \frac{2}{3}$)

$x = 2\frac{2}{3}$
2-1 **Lesson Quiz**

1. **Do you UNDERSTAND?** The numbers of tickets sold for a talent show were grade 9: 22; grade 10: 32; grade 11: 41; and grade 12: 30. How can you represent this relation as a mapping diagram?

2. What are the domain and range in Problem 1?

3. **Do you UNDERSTAND?** Is the relation a function? Explain.
   \[ \{(-2, 3), (-1, 2), (0, 2), (-2, 9)\} \]
   No; -2 is paired with 2 numbers, 3 and 9.

4. Which graph(s) represent a function?
   a. [Graph A]
   b. [Graph B]
   a. Function
   b. Not a function

5. Bowling costs $4.50 per game. Shoe rental costs $3.75. The total cost is a function of the number of games. What function rule models the total cost of games and shoe rental? Evaluate the function for 3 games.
   \[ f(g) = 4.50g + 3.75 \]
   \[ f(3) = 4.50(3) + 3.75 = 14.25 \]
Assignment 2-1  Relations and Functions

At the end of this assignment, you should be able to do the following:
- Determine whether each relationship is a function.
- Determine the domain and range of a function.

Part I: Practice

Determine whether each relation is a function.

1. Domain: 3, 5, 6, 8  
   Range: -6, -2, 15, 21
   a function

2. Domain: -9, 3, 5, 11  
   Range: -6, -2, 8, 21
   not a function

3. {(3, -9), (11, 21), (121, 34), (34, 1), (23, 45)}
   a function

Use the vertical-line test to determine whether each graph represents a function.

4. not a function

5. a function

Find the domain and range of each relation, and determine whether it is a function.

6. \(D = (-\infty, \infty)
   \ R = [0, \infty)
   a function

7. not a function
   \(D = [-3, 3]
   \ R = [-1, 1]
Evaluate each function for the given value of x, and write the input x and output f(x) as an ordered pair.

10. \( f(x) = 17x + 3 \) for \( x = 4 \) \( \left( 4, 71 \right) \)

\[
17(4) + 3 = 68 + 3 = 71
\]

11. \( f(x) = 2x - 33 \) for \( x = 9 \) \( \left( 9, -15 \right) \)

\[
2(9) - 33 = 18 - 33 = -15
\]

12. \( f(x) = \frac{7}{3}x - 9 \) for \( x = 3 \) \( \left( 3, -2 \right) \)

\[
\frac{7}{3}(3) - 9 = 7 - 9 = -2
\]

13. \( f(x) = 11x - 11 \) for \( x = -11 \) \( \left( -11, -132 \right) \)

\[
11(-11) - 11 = -121 - 11 = -132
\]

14. \( f(x) = 17x + 3 \) for \( x = 4 \) \( \left( 4, 71 \right) \)

\[
17(4) + 3 = 68 + 3 = 71
\]

15. \( f(x) = -\frac{2x+1}{3} \) for \( x = -5 \) \( \left( -5, 3 \right) \)

\[
= -\frac{2(-5)+1}{3} = -\frac{-10+1}{3} = -\frac{-9}{3} = 3
\]

---

**Part II: Application and Problem Solving**

Every year, the Rock and Roll Hall of Fame and Museum inducts legendary musicians and musical acts to the Hall. The table shows the number of inductees for each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Inductees</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>11</td>
</tr>
<tr>
<td>2002</td>
<td>8</td>
</tr>
<tr>
<td>2003</td>
<td>9</td>
</tr>
<tr>
<td>2004</td>
<td>8</td>
</tr>
<tr>
<td>2005</td>
<td>7</td>
</tr>
<tr>
<td>2006</td>
<td>6</td>
</tr>
</tbody>
</table>

16. Represent the data using each of the following:

a. A mapping diagram

```
Input: Year
1    2    3    4    5    6
\( \{1, 11\}, \{2, 8\}, \{3, 9\}, \{4, 8\}, \{5, 7\}, \{6, 6\} \)
```

b. Ordered pairs

```
(1, 11), (2, 8), (3, 9), (4, 8), (5, 7), (6, 6)
```

c. A graph on the coordinate plane

---

17. What are the domain and range of this relation?

\[ D = \{1, 2, 3, 4, 5, 6\} \]
\[ R = \{6, 7, 8, 9, 11\} \]
18. **Think About a Plan** A cube is a solid figure with six square faces.

   a. If the edges of a cube have length 1.5 cm, what is the surface area of the cube?
   
   \[(1.5)(1.5) \times 6 = 13.5 \text{ cm}^2\]

   b. What is the relationship between the length of the edges and the area of each face?
   
   
   \[\text{read student responses}\]

   c. What is the relationship between the area of one face and the surface area of the whole cube?
   
   \[\text{read student responses}\]

20. **Geometry** The volume of a sphere is a function of its radius, \(V = \frac{4}{3} \pi r^3\). Evaluate the function for the volume of a volleyball with radius 10.5 cm.

   \[V = \frac{4}{3} \pi (10.5)^3 \approx 4849.05 \text{ cm}^3\]

21. **Temperature** The relationship between degrees Fahrenheit \(F\) and degrees Celsius \(C\) is described by the function \(F = \frac{9}{5}C + 32\). In the following ordered pairs, the first element is degrees Celsius and the second element is its equivalent in degrees Fahrenheit. Find the unknown measure in each ordered pair.

   a. \((43, m)\)  
   \[\begin{align*}
   m & = \frac{9}{5}(43) + 32 \\
   &= 77.4
   \end{align*}\]

   b. \((-12, n)\)  
   \[\begin{align*}
   n & = \frac{9}{5}(-12) + 32 \\
   &= 4.8
   \end{align*}\]

   c. \((p, 12)\)  
   \[\begin{align*}
   12 & = \frac{9}{5}p + 32 \\
   \Rightarrow p & = -\frac{160}{9} = -17.78
   \end{align*}\]

   d. \((q, 19)\)  
   \[\begin{align*}
   19 & = \frac{9}{5}q + 32 \\
   \Rightarrow q & = -\frac{70}{9} = -7.78
   \end{align*}\]

22. **Car Rental** You are considering renting a car from two different rental companies. Proxy car rental company charges $.32 per mile plus an $18 surcharge. YourPal rental company charges $.36 per mile plus a $12 surcharge.

   \[C = \text{cost} \times m + \text{surcharge}\]

   a. Write a function that shows the cost the cost of renting a car from Proxy.

   \[C_p = 0.32m + 18\]

   b. Write a function that shows the cost the cost of renting a car from YourPal.

   \[C_y = 0.36m + 12\]

   c. Which company offers the best deal for an 820-mile trip?

   \[\begin{align*}
   C_p &= 0.32(820) + 18 \\
   &= 280.40
   \\
   C_y &= 0.36(820) + 12 \\
   &= 307.20
   \end{align*}\]

   Proxy Car Rental offers the best deal.
2-3 Lesson Quiz

1. What is the slope of the line that passes through \((-2, 3)\) and \((4, -5)\)?
   \[
   \frac{-5 - 3}{4 - (-2)} = \frac{-8}{6} = -\frac{4}{3}
   \]

2. What is an equation of the line with slope 4 and \(y\)-intercept at \((0, -3)\)?
   \[y = 4x - 3\]

3. Write the equation \(12 - y = 2x - 5\) in slope-intercept form. What are the slope and \(y\)-intercept?
   \[-y = 2x - 17\]
   \[\text{slope} = -2; \quad \text{y-intercept} = (0, 17)\]
   \[y = -2x + 17\]

4. What is the graph of \(5x = 2y - 20\)?

5. Do you UNDERSTAND? Can a horizontal line have an \(x\)-intercept? What if the line passes through the origin? Explain.
   No. A horizontal line cannot have an \(x\)-intercept. Even if the horizontal line is the \(x\)-axis itself, it will not have an \(x\)-intercept, because the \(x\)-intercept is defined as the point at which a line crosses the \(x\)-axis.

\[
y = \frac{5}{2}x + 10
\]
Assignment 2-3  Linear Functions and Slope-Intercept Form

At the end of this assignment, you should be able to do the following:
- Find the slope of the line through a given pair of points.
- Write an equation of a line in slope-intercept form.
- Find the slope and y-intercept of a line given a linear equation or graph.

Part I: Practice

Find the slope of the line through each pair of points.

1. $(-4, -3)$ and $(7, 1)$
   \[
   \frac{3 - (-3)}{-4 - 7} = \frac{6}{11}
   \]

2. $(1, 2)$ and $(2, 3)$
   \[
   \frac{2 - 3}{1 - 2} = -1
   \]

3. $(-3, 5)$ and $(4, 5)$
   \[
   \frac{5 - 5}{-3 - 4} = 0
   \]

Write an equation for each line.

4. $m = 3$ and the y-intercept is $(0, 2)$
   \[
   y = 3x + 2
   \]

5. $m = \frac{5}{6}$ and the y-intercept is $(0, 12)$
   \[
   y = \frac{5}{6}x + 12
   \]

6. \[
   y = -\frac{1}{3}x - 2
   \]
   \[
   (0, -2) \quad (-3, 0)
   \]

7. \[
   y = 3
   \]

8. \[
   y = -\frac{1}{4}x + 3
   \]
   \[
   (0, 3) \quad (4, 2)
   \]

Write each equation in slope-intercept form. The find the slope and y-intercept of each line.

9. $-3x + 2y = 7$
   \[
   \begin{align*}
   +3x & \\
   \frac{2y}{2} & = \frac{3x + 7}{2}
   \end{align*}
   
   \[
   y = \frac{3}{2}x + \frac{7}{2}
   \]
   \[
   m = \frac{3}{2}
   \]
   \[
   y\text{-int} = (0, \frac{7}{2})
   \]

10. $8x + 6y = 5$
   \[
   \begin{align*}
   -8x & \\
   \frac{6y}{6} & = -\frac{8x + 5}{6}
   \end{align*}
   
   \[
   y = -\frac{4}{3}x + \frac{5}{6}
   \]
   \[
   m = -\frac{4}{3}
   \]
   \[
   y\text{-int} = (0, \frac{5}{6})
   \]

11. $y = 7$
   \[
   m = 0
   \]
   \[
   y\text{-int} = (0, 7)
   \]
Graph each equation

12. \(-2x + 5y = -10\)
   \[ -2(0) + 5y = -10 \]
   \[ 5y = -10 \]
   \[ y = -2 \]

13. \(\frac{2}{3}x + \frac{y}{3} = -\frac{1}{3}\)
   \[ -2x + 5(0) = -10 \]
   \[ -2x = -10 \]
   \[ x = 5 \]
   \[ \left(0, -\frac{1}{2}\right), \left(\frac{15}{2}, 0\right) \]

14. \(x = 5\)

15. \(2.4 = -3.6x - 0.4y\)
   \[ 2.4 = -3.6(0) - 0.4y \]
   \[ 2.4 = -3.6x \]
   \[ x = -\frac{2}{3} \]
   \[ \left(0.7, -\frac{2}{3}\right), \left(\frac{2}{3}, 0\right) \]

Find the slope of the line through each pair of points.

16. \(\left(\frac{3}{2}, \frac{1}{2}\right)\) and \(\left(\frac{2}{3}, \frac{1}{3}\right)\)
   \[ m = \frac{\frac{1}{2} - \frac{1}{3}}{\frac{3}{2} - \frac{2}{3}} = \frac{5}{13} \]

17. \((0, -\frac{1}{2})\) and \(\left(\frac{7}{5}, 10\right)\)
   \[ m = \frac{\frac{10}{5} - \frac{-1}{2}}{\frac{7}{5} - 0} = \frac{\frac{15}{2}}{\frac{7}{5}} = \frac{75}{14} = \frac{15}{2} \]
Find the slope and y-intercept of each line.

18. \( x = -3 \) undefined  
   slope: no \( y \)-intercept

19. \( y = 0 \) zero slope
   y-int: (0, 0)

20. \(-Ax + By = -C\)
   \[ y = \frac{Ax}{B} - \frac{C}{B} \]
   y-int: \( (0, -\frac{C}{B}) \)

**Part II: Application and Problem Solving**

21. **Think About a Plan.** Suppose the equation \( y = 12 + 10x \) models the amount of money in your wallet, where \( y \) is the total in dollars and \( x \) is the number of weeks from today. If you graphed this equation, what would the slope represent in the situation? Explain.
   - Is the equation in slope-intercept form? **(yes)**
   - What units make sense for the slope?
     - dollars/week
   
   The slope would represent the amount of money you put in your wallet each week.

22. The equation \( d = 4 - \frac{1}{15}t \) represents your distance from home, \( d \), for each minute you walk, \( t \).
   
   a. If you graphed this equation, what would the slope represent? Explain.
      
      The rate at which you walk home; the slope is the same change in distance divided by the change in time.
   
   b. Are you walking towards or away from your home? Explain.
      
      Towards your home; the slope is negative and the distance \((y\text{-value})\) decreases as the time \((x\text{-value})\) increases.

23. **Reasoning.** Use the graph to find the slope between the following points on the line.

   a. P and Q \((-3, -5); (0, -2)\)
      \[ \frac{-5 - (-2)}{3 - 0} = -\frac{3}{3} = 1 \]

   b. Q and S \((0, -2); (4, 2)\)
      \[ \frac{2 - (-2)}{4 - 0} = \frac{4}{4} = 1 \]

   c. S and P \((4, 2); (-3, -5)\)
      \[ \frac{7}{7} = 1 \]

   d. R and Q \((1, -1); (0, -2)\)
      \[ \frac{1 - (-2)}{1 - 0} = \frac{1}{1} = 1 \]

   e. Make a conjecture based on your answers to parts (a) through (d).
      
      Any two points on a line can be used to find the slope of a line.