Writing Rules for Linear Functions

What You’ll Learn
To write function rules from words, tables, and graphs

Why Learn This?
A business owner can calculate the cost of a toll-free number if she can write a rule for the function.

Just as you can translate words to an equation, you can also translate words to a function rule. Be sure to identify the input and the output.

EXAMPLE Writing a Function Rule From Words

1. **Multiple Choice** A toll-free telephone number is $2.95 per month plus $.10 per minute. Which function rule represents the monthly cost?
   - A. \( y = 0.1 + 2.95x \)
   - B. \( y = 2.95 + 0.1x \)
   - C. \( y = 2.95 - 0.1x \)
   - D. \( y = 0.1x - 2.95 \)

**Words**
monthly cost = $2.95 plus $0.10 times number of minutes

**Let**
- \( x \) = number of minutes. ← input
- \( y \) = the monthly cost. ← output

**Function**
\[
y = 2.95 + 0.1x
\]

The correct answer is choice B.

2. What are the initial value and rate of change of the function?

The initial value, or y-intercept, of the function is $2.95, which represents the initial cost of the toll-free number. The rate of change, or slope, of the function is $0.10, which represents the cost per minute.

Quick Check

1. An orchestra buys music stands for $42 each with $298 in its bank account. Write a function rule that shows how the account balance depends on the number of stands bought. What are the initial value and rate of change of the function?
**Example: Writing a Rule From a Table**

2. The table at the left shows how the water level of a lake over time compares to its average water level. Write a function rule. What are the initial value and rate of change?

<table>
<thead>
<tr>
<th>Number of Days, x</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Level Compared to Average (inches), y</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>-2</td>
</tr>
</tbody>
</table>

Find the slope. Two points in the table are (2, 7) and (0, 10).

\[
slope = \frac{\text{change in } y}{\text{change in } x} = \frac{7 - 10}{2 - 0} = -\frac{3}{2}.
\]

The point (0, 10) lies on the graph of the function. So the \(y\)-intercept is 10.

Use slope-intercept form to write a function rule.

\[y = -\frac{3}{2}x + 10 \quad \text{← Substitute } -\frac{3}{2} \text{ for } m \text{ and } 10 \text{ for } b.\]

The initial value, or \(y\)-intercept, is 10, which indicates that the initial water level of the lake is 10 in. above average. The rate of change, or slope, is \(-\frac{3}{2}\) inches per day.

**Quick Check**

2. The table shows the number of inches of snow that fell during a snowstorm. Write a function rule. What are the initial value and rate of change?

<table>
<thead>
<tr>
<th>Number of Hours, x</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches of Snow, y</td>
<td>4.5</td>
<td>9</td>
<td>13.5</td>
<td>18</td>
</tr>
</tbody>
</table>

**Example: Writing an Equation From a Graph**

3. **Business** Malik is a car salesman. He earns a base salary and a commission for each car he sells. The graph shows this relationship. Write a function rule. What is Malik’s base salary? How much does he earn in commission for each car he sells?

The graph is linear so use the form \(y = mx + b\). Find \(m\) and \(b\).

The line intersects the \(y\)-axis at (0, 10,000). So the \(y\)-intercept is 10,000.

Find the slope. Two points on the line are (0, 10,000) and (6, 14,500).

\[
m = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} = \frac{14,500 - 10,000}{6 - 0} = \frac{4,500}{6} = 750
\]

The function rule is \(y = 750x + 10,000\).

Malik’s base salary is $10,000. The rate of change is $750, which is the amount of commission he earns for each car he sells.

**Quick Check**

3. The graph shows the height of a snowman over time. Write a function rule. What is the initial height of the snowman? What is the rate of change of his height over time?
1. **Vocabulary** How is slope-intercept form related to a linear function rule?

2. Use the graph at the left to find the slope and complete the equation for the line.
   
   \[ \text{a. slope } = \frac{y_2 - y_1}{x_2 - x_1} = \quad \text{b. } y\text{-intercept is } \quad \text{c. } y = \_\_x + \_\_ \]

**Homework Exercises**

For more exercises, see Extra Skills and Word Problems.

3. **Sales** Mrs. Savin receives a weekly base salary of $500, plus a commission of $1,200 on each car that she sells. Write a function rule relating her total weekly pay \( p \) to cars she sells \( c \). What are the initial value and rate of change?

4. **Ecology** Water flows over a dam at a rate of 500 gallons per minute. Write a function rule relating the amount of water \( a \) that flows over the dam to the number of minutes \( m \) that have passed. What are the initial value and rate of change?

The relationship between the \( x \)- and \( y \)-values in each table is linear. Write a function rule. Find the initial amount and rate of change.

<table>
<thead>
<tr>
<th>5.</th>
<th>Years, ( x )</th>
<th>4</th>
<th>7</th>
<th>8</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height, ( y ) (ft)</td>
<td>10</td>
<td>17.5</td>
<td>20</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6.</th>
<th>Weeks, ( x )</th>
<th>2</th>
<th>5</th>
<th>7</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coins, ( y )</td>
<td>29</td>
<td>41</td>
<td>49</td>
<td>61</td>
</tr>
</tbody>
</table>

Use the slope and two points to write an equation for each line. Find the initial amount and rate of change.

7. **Pablo's Earnings**

   \[ \begin{align*}
   \text{Amount Earned (in dollars)} \\
   \text{Number of Hours Worked}
   \end{align*} \]

   \((13, 1,062.5)\)

8. **Water Level in Pool**

   \[ \begin{align*}
   \text{Water Level (in inches)} \\
   \text{Number of Days}
   \end{align*} \]

   \((6, 82.5)\)

9. **Guided Problem Solving** Prices at a laundromat are $1.25 per load of wash and $.75 per 20 minutes of drying time. An average load takes 1 hour to dry. Write a function rule to describe the total cost of washing and drying as a function of the number of loads. What is the initial cost and rate of change?

   - What is the cost for one load of laundry to be washed and dried?
   - Let \( n \) be the number of loads. Let \( C \) be the cost of \( n \) loads.
10. **Art** At a fair, an artist draws caricatures. He pays the fair $30 for space to set up his table, and $2 for each drawing that he sells.
   a. Write a function rule to represent the artist’s total payment to the fair as a function of the number of drawings he sells. What is the initial payment and rate of change?
   b. **Reasoning** What input is paired with the output $54? What does this input represent?

**Writing in Math** Find the equation of each line with the given slope and passing through the given point. Write a word problem for each equation. Explain what the initial amount and rate of change mean in terms of the problem situation.

11. slope $= \frac{3}{4}$; $(2, -3)$

12. slope $= \frac{-1}{2}$; $(4, -6)$

13. **Challenge** A water theme park charges a $15 entrance fee and $1 per ride. The park also offers a plan with a $30 admission fee and a charge of $.50 per ride. Write and graph a function rule to show the total cost $C$ for $r$ rides for each plan. Which is the best plan for someone who intends to go on many rides? Explain.

---

**Test Prep and Mixed Review**

**Multiple Choice**

14. Gomez Plumbing’s total bill includes a service charge and an hourly rate. The graph shows this relationship. Which is the service charge and hourly rate?
   - A $100 service charge and $100 per hour
   - B $100 service charge and $50 per hour
   - C $50 service charge and $50 per hour
   - D $50 service charge and $150 per hour

15. The volume of a cube-shaped packing box is $216 \text{ cm}^3$. What is the length of the side of the box?
   - A 6 cm
   - B 15 cm
   - C 36 cm
   - D 216 cm

16. Which set of lengths can form the sides of a right triangle?
   - A 5 in., 12 in., 14 in.
   - B 10 in., 24 in., 26 in.
   - C 2 in., 4 in., 6 in.
   - D 8 in., 8 in., 10 in.

**Solve.**

17. $2x + 5 = 6x + 33$
18. $9y + 17 = 6y + 29$
19. $17z - 9 = 7z - 59$
20. $2a + 11 = -14a + 59$
Changing Representations

You can use words, graphs, tables, or equations to show algebraic relationships.

**EXAMPLE**

**Food Drive** A class collected cans for a food drive. The teacher brought in 15 cans to start the collection. Beginning the next day, the class brought in 6 cans every day. The table shows the number of cans collected for the first week. Make a graph and write an equation describing the number of cans \( c \) collected in \( d \) days. Interpret the rate of change and initial value.

<table>
<thead>
<tr>
<th>Number of Days, ( d )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cans, ( c )</td>
<td>15</td>
<td>21</td>
<td>27</td>
<td>33</td>
<td>39</td>
<td>45</td>
</tr>
</tbody>
</table>

**Graph:** Make a graph of the data with the number of days on the horizontal axis and the number of cans on the vertical axis.

**Function Rule:** The function is linear because the graph is a line. The \( y \)-intercept is 15, and the slope is \( \frac{21-15}{1-0} = 6 \). So the linear function rule is \( c = 6d + 15 \).

The rate of change, or slope of the line, is 6 cans per day. The initial value is the \( y \)-intercept of the line, or 15 cans.

**Exercises**

In Exercises 1–3, one representation of a function is given. Translate each function by representing it as a table, as a graph, and as a function rule. Interpret the rate of change and initial value.

1. | Day | Cards in Collection |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
</tr>
</tbody>
</table>

2. \( d = 40t \) miles where \( d \) represents distance traveled and \( t \) represents time in hours

3. **Temperature Change**

4. **Reasoning** When might it be more useful to use a graph rather than a function rule? A function rule rather than a graph?
Find the slope and y-intercept of the graph of each function.

1. \( y = 6x + 7 \)  
2. \( y = 2x - 3 \)  
3. \( y = \frac{2}{3}x - 1 \)  
4. \( y = \frac{1}{2}x \)

Write a function rule for the data in the table. Find the initial value and rate of change.

5. | Number of Days, \( x \) | 2 | 6 | 7 | 14 |
   | Height of Plant, \( y \) (cm) | 3 | 9 | 10.5 | 21 |

Find the slope of each line in the graph at the right.

6. line \( a \)  
7. line \( b \)  
8. line \( c \)

9. **Number Sense** Explain which hill is steeper:
   a hill with a rise of 5 and a run of 3 or a hill with a rise of 3 and a run of 5.

10. Your cousin works at a bookstore and earns $7 per hour.
    Make a table to show your cousin’s earnings as a function of the number of hours she works. Graph the data.

---

**MATH AT WORK**  
**Wildlife Biologist**

Wildlife biologists can model changes in an animal population. An animal population increases rapidly when conditions are good. However, as the number of animals increases, the food supplies decrease. Hunger and disease then lower the population.

Wildlife biologists take a special interest in extremes of animal populations. If the population of one species becomes too large, it may reduce the population of another species. A continuing decrease may result in an endangered or extinct species.

**Go Online** For information on wildlife biologists PearsonSuccessNet.com

133
Checking Skills You'll Need

1. Vocabulary Review
   What is a function?

Find the slope of the line through the points.
2. (2, 5), (3, 7)
3. (6, 8), (−2, 16)
4. (−3, −1), (1, 11)
5. (4, −4), (−6, −9)
6. (0, 12), (5, 0)

GO for Help
Lesson 4-1

What You’ll Learn
To compare properties of two functions represented in different ways

Why Learn This?
Functions can be represented using words, graphs, tables, or equations. Learning the relationships among these representations can help you compare the properties of two functions each represented in a different way.

The slope of a line describes the rate of change of that line. You can compare slopes of lines represented in different ways.

Comparing Rates of Change of Linear Functions

Which function has the greater rate of change?

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

\[ y = 4x + 2 \]

Step 1 Find slope from a table.

\[ \text{slope} = \frac{14 - 5}{4 - 1} = \frac{9}{3} = 3 \]

Step 2 Find the slope of an equation using \( y = mx + b \).

\[ y = 4x + 2 \]

The slope, \( m \), is 4.

Since \( 4 > 3 \), the function \( y = 4x + 2 \) has the greater rate of change.

Quick Check
1. Which function has the greater rate of change? Explain.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>3</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>5</td>
<td>13</td>
<td>17</td>
<td>25</td>
</tr>
</tbody>
</table>

\[ y = 2x + 1 \]
EXAMPLE

Comparing Initial Values of Linear Functions

2 Athletics Aki is trying to decide what baseball camp to attend. For each camp, the relationship between number of days and total cost is linear. Which camp has the greater initial cost?

<table>
<thead>
<tr>
<th>Bright Future Baseball Camp</th>
<th>Home Run Baseball Camp</th>
</tr>
</thead>
<tbody>
<tr>
<td>• $18 per day</td>
<td>• 2 days cost $121,</td>
</tr>
<tr>
<td>• $89 registration fee</td>
<td>• 7 days cost $236.</td>
</tr>
</tbody>
</table>

Bright Future Baseball Camp
According to the data in the table, there is a registration fee of $89. This is the initial cost.

Home Run Baseball Camp
Write the data in the table as ordered pairs: (2, 121) and (7, 236). The y-intercept of the line through these two points represents the initial cost. Use the ordered pairs to write an equation in slope-intercept form.

\[ m = \frac{236 - 121}{7 - 2} = \frac{115}{5} = 23 \]

\[ y = mx + b \]

\[ 121 = 23(2) + b \]

\[ 121 = 46 + b \]

\[ 75 = b \]

\[ \text{Find the slope.} \]

\[ \text{Use slope-intercept form.} \]

\[ \text{Substitute 23 for } m, 2 \text{ for } x, \text{ and 121 for } y. \text{ Simplify.} \]

\[ \text{Solve for } b. \]

The y-intercept is 75, so the initial cost is $75.

Since $89 > $75, the Bright Future Baseball Camp has the greater initial cost.

Quick Check

2. Steve’s Scooter Rentals charges $17 per hour plus a $29 rental fee. Scooter World charges $48 for 1 hour and $108 for 4 hours. Both relationships are linear. Which company has the greatest initial cost?

To compare functions, find where the functions increase or decrease; whether they are continuous; and the highest and lowest values.

EXAMPLE

Comparing Nonlinear Functions

3 Jack and Manny each have a savings account. The graph at the left represents Jack’s account. Manny deposited $500 and withdrew $20 each even-numbered day for 30 days. Compare the functions.

<table>
<thead>
<tr>
<th>Jack’s Account</th>
<th>Manny’s Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>increases and decreases</td>
<td>decreases</td>
</tr>
<tr>
<td>not continuous</td>
<td>not continuous</td>
</tr>
<tr>
<td>maximum $400; minimum $100</td>
<td>maximum $500; minimum $200</td>
</tr>
</tbody>
</table>
Quick Check

3. Vikram opened a savings account with $150. He deposits $150 every two weeks. Compare Vikram’s account to Jack’s account.

Example Comparing Proportional Functions

4. Bicycle Racing Arama and Francisco train for bicycle races. The graph at the left represents the distance Arama traveled during today’s training session. Francisco’s distance is given by the function \( d = 18.5t \), where \( d \) represents distance in miles and \( t \) represents time in hours. Who traveled at the faster rate?

The rate is equal to the slope of the graph of the function.

Arama
Find the slope. Use the two points \((0.5, 10)\) and \((2.5, 50)\).

\[ m = \frac{50 - 10}{2.5 - 0.5} = \frac{40}{2} = 20 \]

Arama traveled 20 miles per hour.

Francisco
The equation \( d = 18.5t \) is in slope-intercept form. The slope is 18.5.
Francisco traveled 18.5 miles per hour.

\( 20 > 18.5 \), so Arama traveled at the faster rate.

Quick Check

4. Jala and Caleb are having a card-house building competition. The functions below represent the number of levels each person built. Who built at the faster rate?

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Number of Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
</tr>
</tbody>
</table>

Jala’s Card House

Caleb’s Card House
1. **Reasoning** How can you find the rate of change from the graph of a linear function?

Match each linear function with its rate of change.

2. \[
\begin{array}{c|cccc}
\text{x} & 2 & 5 & 6 & 10 \\
\hline
\text{y} & 6 & 15 & 18 & 30
\end{array}
\]

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

4. \((5,6), (12,34)\)

5. John earns $25 plus $1 for every magazine subscription he sells.

---

**Homework Exercises**

For more exercises, see Extra Skills and Word Problems.

**Determine which function has the greater rate of change.**

6. \(y = 3x - 4;\)

7. \(y = 1.5x + 2;\)

\[
\begin{array}{c|cccc}
\text{x} & 1 & 2 & 3 & 4 \\
\hline
\text{y} & 8 & 10 & 12 & 14
\end{array}
\]

\[
\begin{array}{c|cccc}
\text{x} & 0 & 3 & 6 & 9 \\
\hline
\text{y} & 1 & 5 & 9 & 13
\end{array}
\]

8. Twin Lakes Pool has a membership fee of $150 and charges $7 per visit. Duck Pond pool charges $260 for 15 visits and $316 for 22 visits. Which pool has the greater initial cost?

9. The graph at the right models the distance Reggie jogs over time. Linda jogs 2.5 miles in 25 minutes and 4 miles in 40 minutes. Who jogs faster?

**Compare the functions with the graph at the left.**

10. When the value of \(x\) is 0, the value of \(y\) is 15. Each time the value of \(x\) increases by 1, the value of \(y\) increases by 3.

11. When the value of \(x\) is 0, the value of \(y\) is 640. Each time the value of \(x\) increases by 1, the value of \(y\) is halved.
12. **Guided Problem Solving** Order linear functions A, B, C, and D from least to greatest rate of change.
   - Find the slope of each function.
     - B: \( y = 0.5x - 0.25 \)
     - C: \[
     \begin{array}{c|c|c|c|c}
     x & -2 & 0 & 2 & 4 \\
     y & 7 & 9 & 11 & 13 \\
     \end{array}
     \]
     - D: As \( x \) increases by 3 units, \( y \) increases by 2 units.

   - T: \[
   \begin{array}{c|c|c|c|c}
   x & -4 & 0 & 4 & 8 \\
   y & 2 & 3 & 4 & 5 \\
   \end{array}
   \]
   - E: \( y = \frac{5}{3}x + 2 \)
   - W: As \( x \) increases by 3 units, \( y \) increases by 1 unit.

14. Order the stocks from greatest to least rate of price increase.

   **Alpha, Inc.**
   - Week | 0 | 1 | 2 | 3 | 4
   - Price($) | 16 | 19 | 22 | 25 | 28

   **Beta Co.**
   - A starting price of $54 decreases weekly by $2.50.

   **Gamma, Inc.**
   - \( d = 3.5w - 27 \)
   - \((w\) is weeks, \(d \) is dollars)

15. **Writing in Math** The functions below represent pricing plans for car rentals, where \( d \) is number of days and \( C \) is cost. Which plan is least expensive for a long-term rental? Explain your reasoning.
   - **Subcompact:** Total cost is $30 plus $25 per day.
   - **Compact:** \( C = 28d + 10 \)

16. **Challenge** Which of the following functions has the greatest rate of change? Explain your reasoning.
   - K: \( 2x + 3y = 9 \)
   - L: \( 3x + 2y = 4 \)
   - M: \( x + y = 11 \)

17. Which of the linear functions has the greatest rate of change?
   - A: The line that passes through (2, 7) and (5, 22)
   - B: \[
   \begin{array}{c|c|c|c|c}
   x & 5 & 8 & 12 & 13 \\
   y & 12 & 18 & 26 & 28 \\
   \end{array}
   \]
   - C: \( y = 6x - 4 \)
   - D: The function that models Kayla’s daily income. Kayla earns $30 plus $8 for every pet she walks.

18. Simplify each expression.
   - \( 5x + 3y - 18 + 2.5x - 4.8y \)
   - \( 3(x - 4) + 8x + 3.5(x + 17) \)
Linear Functions

For each rental plan, represent the relationship between the number of miles (from 20 to 45) and the cost. Use a linear function, a table of ordered pairs, and a graph (using the same coordinate grid). What conclusions can you draw about these plans?

What You Might Think

What do I know? What do I want to find out?

How can I write a function rule for each plan?

How can I make a table and graph?

What conclusions can be stated?

What You Might Write

Plan 1 costs $15 plus $.25 per mile. Plan 2 costs $8 plus $.45 per mile. I want to compare the two plans using function rules, tables, and graphs.

Let \( m \) = the number of miles driven. Let \( C \) = the cost of the rental in dollars.

Plan 1: \( C_1 = .25m + 15 \)

Plan 2: \( C_2 = .45m + 8 \)

I can use the function rule to get data points for the table. Then I can graph those points.

<table>
<thead>
<tr>
<th>( m )</th>
<th>( C_1 )</th>
<th>( C_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>30</td>
<td>22.5</td>
<td>21.5</td>
</tr>
<tr>
<td>35</td>
<td>23.75</td>
<td>23.75</td>
</tr>
<tr>
<td>45</td>
<td>26.25</td>
<td>28.25</td>
</tr>
</tbody>
</table>

The lines intersect at (35, 23.75). Plan 2 is better if you drive less than 35 miles.

Plan 1 is better if you drive more than 35 miles. The costs of Plans 1 and 2 are equal if you drive exactly 35 miles.
Think It Through

1. Could you have used other values for \( m \) in the table? Explain.

2. How was the conclusion arrived at? Are there other conclusions?

Exercises

Solve each problem. For Exercises 3 and 4, answer the questions first.

3. Population Assume the relationship between the year and number of senior citizens is a linear function. Use the data at the right to predict the number of senior citizens in the United States in 2020.
   a. Using the ordered pairs in the graph as endpoints, make a line graph showing years and number of senior citizens.
   b. Find the slope of the line and then write a function rule for the line. Use the rule to solve the problem.

4. A certain airplane can climb 3,000 feet for every mile it travels horizontally. If it maintains this rate of ascent, how far will the plane have traveled horizontally when it reaches 5 miles in altitude?
   a. What is the rate of ascent in feet per mile?
   b. Let \( m \) be the number of miles and \( A \) be the altitude. Write a function rule relating the number of miles traveled and the altitude. Be sure to use the correct units.

5. Student council members are raising funds by selling hats. They take a survey to see how many students will buy the hats at different prices. The results are below.

<table>
<thead>
<tr>
<th>Price (dollars)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buyers</td>
<td>400</td>
<td>325</td>
<td>250</td>
<td>175</td>
<td>100</td>
<td>25</td>
</tr>
</tbody>
</table>

Graph the data. Use the graph to estimate the number of hats that will be sold at $5.

6. Landfill A county landfill already contains 20,000 tons of trash. It is gaining 500 tons per month. How many months will it be until the landfill contains 50,000 tons of trash? Write a function rule and make a graph to solve the problem.
Interpreting Data

Many questions involve interpreting data in a table or a graph. Before you answer the question, be sure you understand the information the graph or table is displaying.

**Example**

Mr. Graham has a collection of old postcards. He adds more postcards to his collection each month. The graph shows this relationship. Which function represents the data shown in the graph?

- A. $y = 50x + 5$
- B. $y = 50x + 50$
- C. $y = 5x + 5$
- D. $y = 5x + 50$

Make sure you understand the question. You are asked to identify which function rule represents the data in the graph. The graph is linear, so you can use the form $y = mx + b$. Find $m$ and $b$.

The point $(0, 50)$ lies on the $y$-axis, so the $y$-intercept is 50.

Use $(2, 60)$ and $(6, 80)$ to find the slope $m$.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{80 - 60}{6 - 2} = \frac{20}{4} = 5$$

The function $y = 5x + 50$ represents the data shown in the graph.

The correct answer choice is D.

**Exercises**

Use the graph for Exercises 1–3.

1. Which function represents the data shown in the graph?
   - A. $y = 175,000x + 2,500$
   - C. $y = 2,500x + 150,000$
   - B. $y = 2,500x + 175,000$
   - D. $y = 2,000x + 175,000$

2. What is the initial value of the home?
   - 5. $2,500$
   - 6. $150,000$
   - 7. $175,000$
   - 8. $180,000$

3. What is the rate of change in the home value?
   - A. $2,000$ yr
   - B. $2,500$ yr
   - C. $2,750$ yr
   - D. $175,000$ yr
Chapter 4 Review

Vocabulary Review

linear function (p. 123)  
slope (p. 117)  
slope of a line (p. 117)  
slope-intercept form (p. 123)  
y-intercept (p. 123)

Choose the vocabulary term that completes the sentence.

1. The ___ describes the steepness of a line.
2. When an equation is written in the form $y = mx + b$ it is in ___.
3. The point where a graph crosses the $y$-axis is the ___.

Go Online
For vocabulary quiz
PearsonSuccessNet.com

Skills and Concepts

Lesson 4-1
• To find the slope of a line from a graph or table

The slope of a line is the steepness of the line. You can find the slope of a line by subtracting the coordinates of any two points on the line.

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

4. $(1, 2)$ and $(-3, 2)$  
5. $(5, 1)$ and $(0, -7)$
6. $(-4, 9)$ and $(10, 6)$  
7. $(8, -2)$ and $(-2, 8)$

Graph the data in each table and connect the points with a line. Then find the slope of the line.

8. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>-2</th>
<th>0</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>-6</td>
<td>0</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

9. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>11</td>
<td>19</td>
<td>27</td>
<td>35</td>
</tr>
</tbody>
</table>

Lesson 4-2
• To use tables and equations to graph linear functions

When a linear function is written in the form $y = mx + b$, it is said to be in slope-intercept form. The graph is a line with slope $m$ and $y$-intercept $b$. The $y$-intercept is the point where the graph crosses the $y$-axis.

Find the slope and $y$-intercept of the graph of each function.

10. $y = 3x + 5$  
11. $y = -\frac{1}{2}x - 4$  
12. $y = x + 7$  
13. $y = \frac{2}{3}x$

Graph each linear function.

14. $y = -x + 4$  
15. $y = \frac{3}{4}x + 6$  
16. $y = x - 5$  
17. $y = -3x$
A function can be represented using words, a table, a graph, or an equation. If a function is linear, its $y$-intercept represents the initial value and its slope represents the rate of change.

18. Mandy has $438 in her savings account. Each week she deposits $50 into her account. Write a function rule that shows the balance in her savings account over time. What is the initial value and rate of change?

Write a function rule for the data in the table. Find the initial value and rate of change.

19. Hours, $x$ | 3 | 7 | 8 | 12
Miles Traveled, $y$ | 171 | 399 | 456 | 684

20. Months, $x$ | 2 | 5 | 7 | 10
Stamps in Collection, $y$ | 28 | 43 | 53 | 68

21. The graph shows the amount of water in a water tank. Write a function rule. What is the initial value and the rate of change?

You can compare two linear functions by comparing their slopes or their $y$-intercepts. To compare two nonlinear functions, find where the functions increase or decrease; whether they are continuous; and the highest and lowest values.

Determine which function has the greater rate of change.

22. $y = 7x + 9$

23. $y = 1.8x - 12$

Compare the function described with the graph of the function at the left.

24. When the value of $x$ is 0, the value of $y$ is 5. Each time the value of $x$ increases by 2, the value of $y$ increases by 5.
Find the slope of each line.

1. \[ y = 3x - 2 \]

2. \[ y = x + 5 \]

For each function, find the slope and the \( y \)-intercept.

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

4. \( y = x + 5 \)

5. \( y = \frac{1}{3}x - 1 \)

6. \( y = 7x \)

7. A restaurant charges $6.95 for a pizza, plus $0.50 for each topping. Write a function rule relating the cost of a pizza \( c \) to the number of toppings ordered \( t \). What is the initial cost and the rate of change?

8. Which function has a greater rate of change?

\[
\begin{array}{c|c|c|c|c}
 x & 1 & 3 & 4 & 7 \\
 y & 4 & 10 & 13 & 22 \\
\end{array}
\quad y = 2x + \frac{2}{3}
\]

9. Which is steeper: a line with a slope of 7 or a line with a slope of \(-10\)? Explain.

10. Order functions E, F, G, and H from least to greatest rate of change.

E: \[ y = 3x - 1 \]

F: \[ y = \frac{3}{4}x - \frac{1}{2} \]

G: \[
\begin{array}{c|c|c|c|c}
 x & 1 & 3 & 4 & 7 \\
 y & 4 & 10 & 13 & 22 \\
\end{array}
\]

H: As \( x \) increases by 2 units, \( y \) increases by 3 units.

Graph each linear function.

11. \( y = 5x - 3 \)

12. \( y = -\frac{3}{4}x + 10 \)

13. \( y = x + 5 \)

14. \( y = \frac{2}{3}x \)

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

15. \((-4, 10)\) and \((6, 13)\)

16. \((2, 3)\) and \((9, -3)\)

17. \((5, 7)\) and \((-12, 4)\)

18. \((1, -1)\) and \((5, 6)\)

19. Make a table and a graph for the function \( y = 3x + 5 \)

20. The table shows the distance traveled by a person walking. Write a function rule. What is the initial value and rate of change?

\[
\begin{array}{c|c|c|c|c}
\text{Number of Minutes, } x & 2 & 5 & 12 & 20 \\
\text{Meters traveled, } y & 120 & 300 & 720 & 1,200 \\
\end{array}
\]

21. Graph the data in the table and connect the points with a line. Then find the slope.

\[
\begin{array}{c|c|c|c}
 x & -3 & -1 & 1 \\
 y & -6 & -2 & 2 \\
\end{array}
\quad 3
\]

22. Randy is deciding between the Get Fit gym and Healthy Life gym. For each gym, the relationship between number of days attended and total cost is linear. Which camp has the greater initial cost?

<table>
<thead>
<tr>
<th>Get Fit Gym</th>
<th>Healthy Life Gym</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8 per day</td>
<td>2 days cost $140.</td>
</tr>
<tr>
<td>$150 application fee</td>
<td>8 days cost $200.</td>
</tr>
</tbody>
</table>
Multiple Choice

For Exercises 1–5, write the letter of the correct answer on your paper.

1. Look at the graph. When was the change in speed nonlinear?

   ![Graph showing speed over time](image)

   - A) 0–8 min
   - B) 8–12 min
   - C) 12–16 min
   - D) 16–20 min

2. Use the function rule $y = 3x + 2$. What is the output when $x = 7$?

   - F) 12
   - G) 20
   - H) 21
   - I) 23

3. Which variable expression is equivalent to $3(x - 4) + 4x + 10$?

   - A) $5x + 14$
   - B) $5x + 6$
   - C) $7x - 2$
   - D) $7x - 22$

4. Each unit on the grid represents 2 mi. Juanita travels 2 units east from the store and then 2 units south. Caroline travels 8 units east from the library and then 1 unit south.

   To the nearest mile, how far apart are Juanita and Caroline?

   - F) 7 mi
   - G) 8 mi
   - H) 11 mi
   - I) 21 mi

Gridded Response

5. Leslie begins cycling along a trail that is 5 mi from her house. She cycles at a rate of 0.15 mi per minute. The function $d = 0.15t + 5$ gives the distance $d$ in miles after $t$ minutes that Leslie is from her home while cycling. How far is Leslie from her home after cycling for 20 minutes?

Short Response

6. At a farmer’s market, Nellie buys 2 pounds of tomatoes and 4 pounds of corn. Her sister Nia buys half as much. Write an expression to represent the total cost.

Extended Response

7. Mr. Zhang receives a weekly salary of $400 plus a commission of $1,100 for each car that he sells.

   a. Write a function rule relating Mr. Zhang’s total weekly pay $p$ to the number of cars he sells $c$.

   b. What is the initial value and rate of change? Explain how you determined these values.