

# 5.3 Linear Function Patterns

**Essential Question** How can you use a linear function to describe a linear pattern?

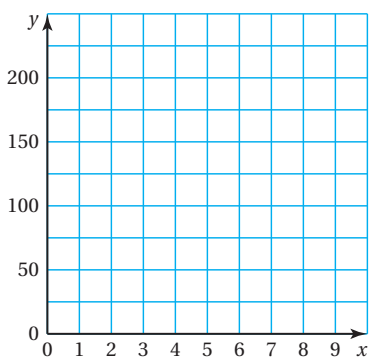
## 1 ACTIVITY: Finding Linear Patterns

Work with a partner.

- Plot the points from the table in a coordinate plane.
- Write a linear equation for the function represented by the graph.

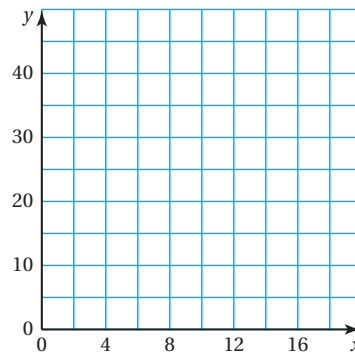
a.

<b>x</b>	0	2	4	6	8
<b>y</b>	150	125	100	75	50



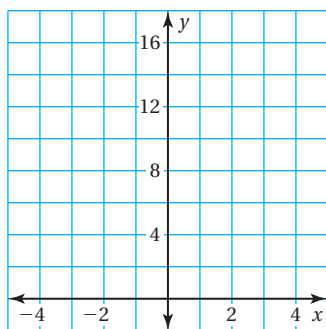
b.

<b>x</b>	4	6	8	10	12
<b>y</b>	15	20	25	30	35



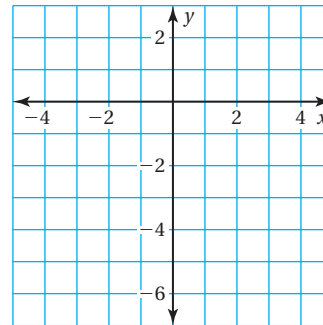
c.

<b>x</b>	-4	-2	0	2	4
<b>y</b>	4	6	8	10	12



d.

<b>x</b>	-4	-2	0	2	4
<b>y</b>	1	0	-1	-2	-3



### Functions

In this lesson, you will

- write linear functions from graphs or tables.
- solve linear functions.
- solve real-life problems.

Learning Standards

- 8.F.3
- 8.F.4
- F.BF.1a
- F.IE.2

## 2 ACTIVITY: Finding Linear Patterns

### Math Practice 4

#### Analyze Relationships

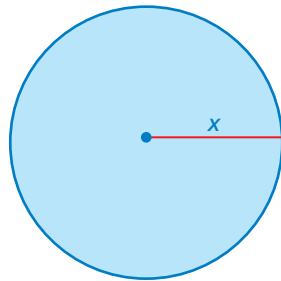
What is the relationship between the variables? How does this help you write a linear function?

Work with a partner. The table shows a familiar linear pattern from geometry.

- Write a linear function that relates  $y$  to  $x$ .
- What do the variables  $x$  and  $y$  represent?
- Graph the linear function.

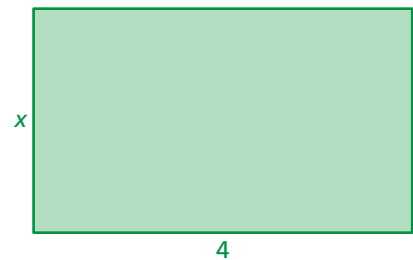
a.

$x$	1	2	3	4	5
$y$	$2\pi$	$4\pi$	$6\pi$	$8\pi$	$10\pi$



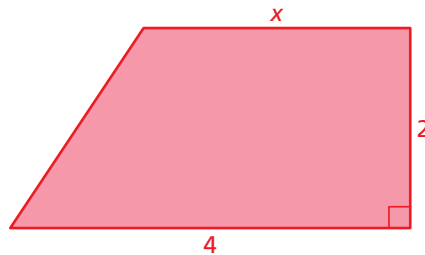
b.

$x$	1	2	3	4	5
$y$	10	12	14	16	18



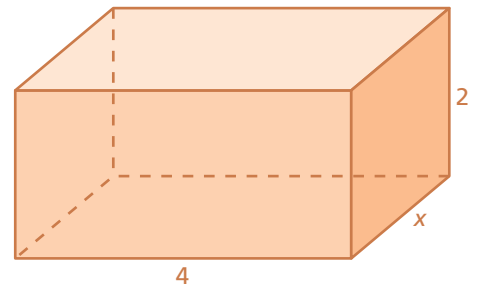
c.

$x$	1	2	3	4	5
$y$	5	6	7	8	9



d.

$x$	1	2	3	4	5
$y$	28	40	52	64	76



### What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you use a linear function to describe a linear pattern?
4. Describe the strategy you used to find the linear functions in Activities 1 and 2.

### Practice

Use what you learned about linear function patterns to complete Exercises 4 and 5 on page 220.

### Key Vocabulary

linear function,  
p. 218

A **linear function** is a function whose graph is a nonvertical line. A linear function can be written in the form  $y = mx + b$ .

## EXAMPLE 1 Finding a Linear Function Using a Graph

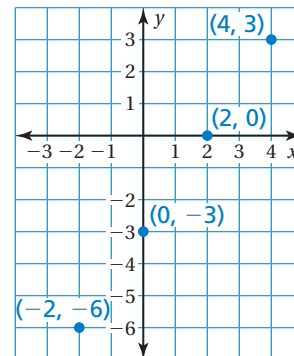
Use the graph to write a linear function that relates  $y$  to  $x$ .

The points lie on a line. Find the slope and  $y$ -intercept of the line.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{3 - 0}{4 - 2} = \frac{3}{2}$$

Because the line crosses the  $y$ -axis at  $(0, -3)$ , the  $y$ -intercept is  $-3$ .

So, the linear function is  $y = \frac{3}{2}x - 3$ .



## EXAMPLE 2 Finding a Linear Function Using a Table

Use the table to write a linear function that relates  $y$  to  $x$ .

$x$	-3	-2	-1	0
$y$	9	7	5	3

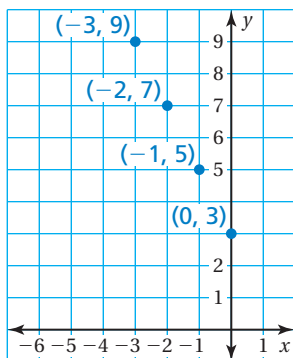
Plot the points in the table.

The points lie on a line. Find the slope and  $y$ -intercept of the line.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{9 - 7}{-3 - (-2)} = \frac{2}{-1} = -2$$

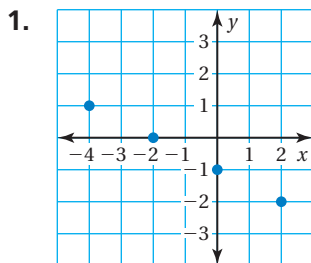
Because the line crosses the  $y$ -axis at  $(0, 3)$ , the  $y$ -intercept is 3.

So, the linear function is  $y = -2x + 3$ .



### On Your Own

Use the graph or table to write a linear function that relates  $y$  to  $x$ .



2. 

$x$	-2	-1	0	1
$y$	2	2	2	2

Now You're Ready  
Exercises 6–11

### EXAMPLE 3 Real-Life Application

Hours Kayaking, $x$	Calories Burned, $y$
2	600
4	1200
6	1800
8	2400

Graph the data in the table. (a) Is the domain discrete or continuous? (b) Write a linear function that relates  $y$  to  $x$ . (c) How many calories do you burn in 4.5 hours?

a. Plot the points. Time can represent any value greater than or equal to 0, so the domain is continuous. Draw a line through the points.

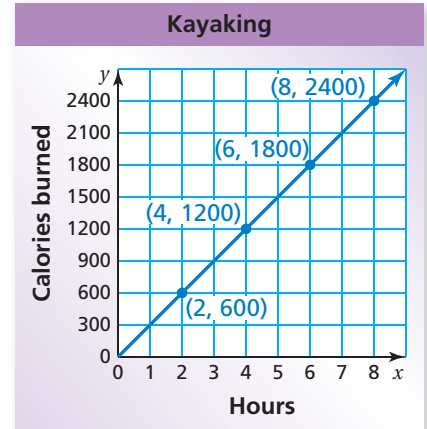
b. The  $y$ -intercept is 0 and the slope is  $\frac{1200 - 600}{4 - 2} = \frac{600}{2} = 300$ .

∴ So, the linear function is  $y = 300x$ .

c. Find the value of  $y$  when  $x = 4.5$ .

$$\begin{aligned}
 y &= 300x && \text{Write the equation.} \\
 &= 300(4.5) && \text{Substitute 4.5 for } x. \\
 &= 1350 && \text{Multiply.}
 \end{aligned}$$

∴ You burn 1350 calories in 4.5 hours of kayaking.



### On Your Own

Hours Rock Climbing, $x$	Calories Burned, $y$
3	1950
6	3900
9	5850
12	7800

3. Graph the data in the table.

- Is the domain discrete or continuous?
- Write a linear function that relates  $y$  to  $x$ .
- How many calories do you burn in 5.5 hours?

## Summary

### Representing a Function

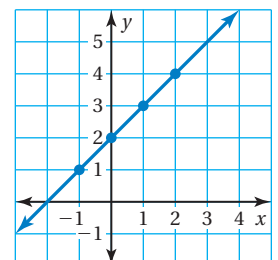
**Words** An output is 2 more than the input.

**Equation**  $y = x + 2$

### Input-Output Table

Input, $x$	-1	0	1	2
Output, $y$	1	2	3	4

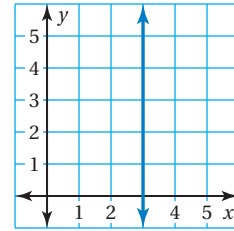
### Graph



# 5.3 Exercises

## Vocabulary and Concept Check

- VOCABULARY** Describe four ways to represent a function.
- VOCABULARY** Does the graph represent a linear function? Explain.
- REASONING** Do all linear functions have a  $y$ -intercept? Explain.



## Practice and Problem Solving

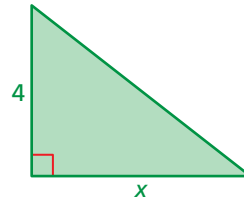
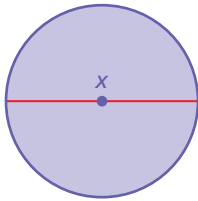
The table shows a familiar linear pattern from geometry. Write a linear function that relates  $y$  to  $x$ . What do the variables  $x$  and  $y$  represent? Graph the linear function.

4.

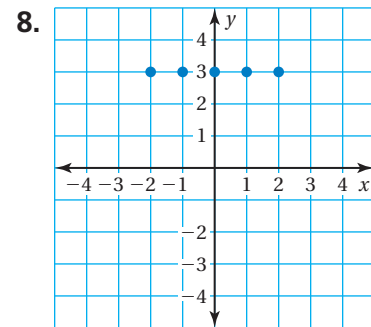
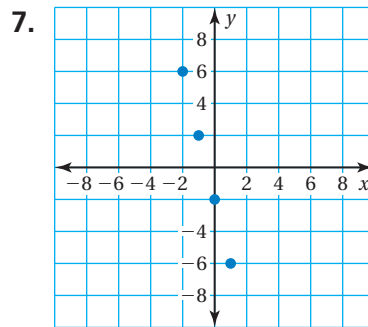
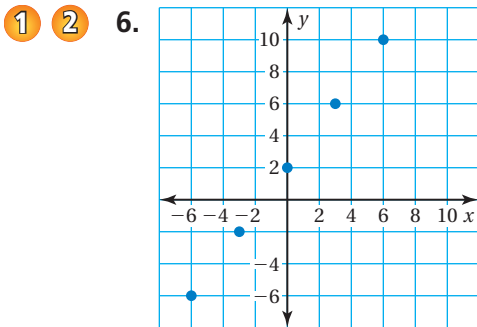
$x$	1	2	3	4	5
$y$	$\pi$	$2\pi$	$3\pi$	$4\pi$	$5\pi$

5.

$x$	1	2	3	4	5
$y$	2	4	6	8	10



Use the graph or table to write a linear function that relates  $y$  to  $x$ .



9.

$x$	-2	-1	0	1
$y$	-4	-2	0	2

10.

$x$	-8	-4	0	4
$y$	2	1	0	-1

11.

$x$	-3	0	3	6
$y$	3	5	7	9

12. **MOVIES** The table shows the cost  $y$  (in dollars) of renting  $x$  movies.

- Which variable is independent? dependent?
- Graph the data. Is the domain discrete or continuous?
- Write a function that relates  $y$  to  $x$ .
- How much does it cost to rent three movies?

Number of Movies, $x$	0	1	2	4
Cost, $y$	0	3	6	12

13. **BIKE JUMPS** A bunny hop is a bike trick in which the rider brings both tires off the ground without using a ramp. The table shows the height  $y$  (in inches) of a bunny hop on a bike that weighs  $x$  pounds.

Weight, $x$	19	21	23
Height, $y$	10.2	9.8	9.4

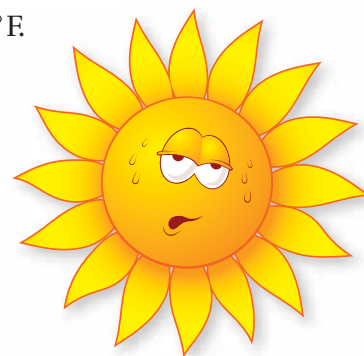


- Graph the data. Then describe the pattern.
  - Write a linear function that relates the height of a bunny hop to the weight of the bike.
  - What is the height of a bunny hop on a bike that weighs 21.5 pounds?
14. **REASONING** Can the graph of a function be a horizontal line? Explain your reasoning.

Years of Education, $x$	Annual Salary, $y$
0	28
2	40
4	52
6	64
10	88

15. **SALARY** The table shows a person's annual salary  $y$  (in thousands of dollars) after  $x$  years of education beyond high school.
- Graph the data. Then describe the pattern.
  - What is the annual salary of the person after 8 years of education beyond high school?

16. **Problem Solving** The Heat Index is calculated using the relative humidity and the temperature. For every 1 degree increase in the temperature from  $94^\circ\text{F}$  to  $98^\circ\text{F}$  at 75% relative humidity, the Heat Index rises  $4^\circ\text{F}$ .
- On a summer day, the relative humidity is 75%, the temperature is  $94^\circ\text{F}$ , and the Heat Index is  $122^\circ\text{F}$ . Construct a table that relates the temperature  $t$  to the Heat Index  $H$ . Start the table at  $94^\circ\text{F}$  and end it at  $98^\circ\text{F}$ .
  - Identify the independent and dependent variables.
  - Write a linear function that represents this situation.
  - Estimate the Heat Index when the temperature is  $100^\circ\text{F}$ .



## Fair Game Review

What you learned in previous grades & lessons

Evaluate the expression when  $x = -2, 0,$  and  $3$ . (*Skills Review Handbook*)

17.  $x - 2$

18.  $-3x + 2$

19.  $0.5x - 0.25$

20. **MULTIPLE CHOICE** Which expression has a value less than 1? (*Skills Review Handbook*)

(A)  $\frac{1}{5^{-2}}$

(B)  $5^{-2}$

(C)  $5^0$

(D)  $5^2$