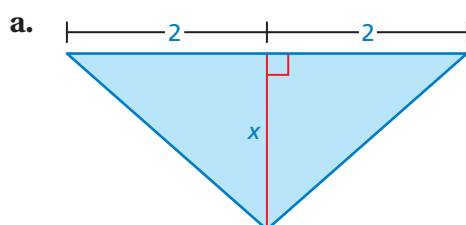# 6.2 Representations of Functions
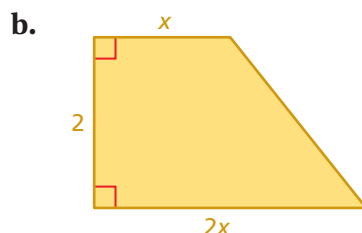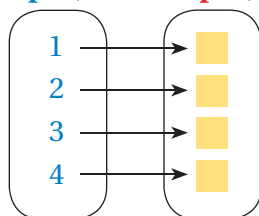
Essential Question How can you represent a function in different ways?

1 ACTIVITY: Describing a Function

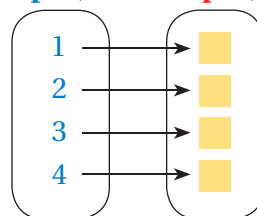Work with a partner. Copy and complete the mapping diagram for the area of the figure. Then write an equation that describes the function.

a.

Input, x	Output, A
1	
2	
3	
4	

b.

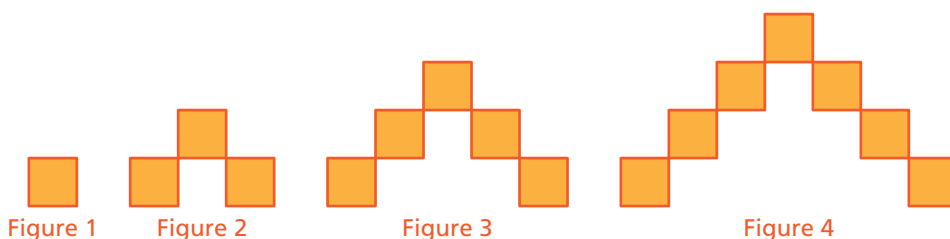| Input, x	Output, A
1	
2	
3	
4	

2 ACTIVITY: Using a Table

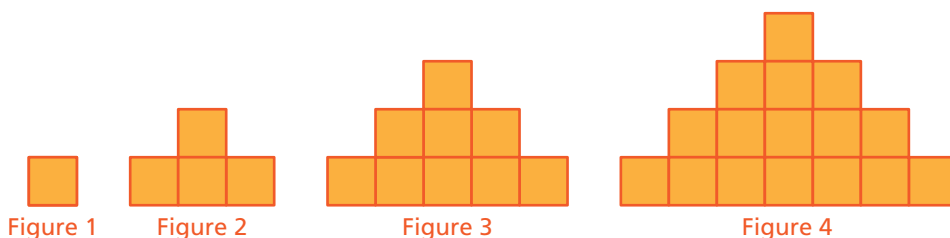Work with a partner. Make a table that shows the pattern for the area, where the input is the figure number x and the output is the area A. Write an equation that describes the function. Then use your equation to find which figure has an area of 81 when the pattern continues.

☐ 1 square unit

a.

Figure 1   Figure 2   Figure 3   Figure 4

b.

Figure 1   Figure 2   Figure 3   Figure 4

3 ACTIVITY: Using a Graph

Work with a partner. Graph the data. Use the graph to test the truth of each statement. If the statement is true, write an equation that shows how to obtain one measurement from the other measurement.

a. "You can find the horsepower of a race car engine if you know its volume in cubic inches."

Volume (cubic inches), *x*	200	350	350	500
Horsepower, *y*	375	650	250	600

b. "You can find the volume of a race car engine in cubic centimeters if you know its volume in cubic inches."

| Volume (cubic inches), *x*	100	200	300
Volume (cubic centimeters), *y*	1640	3280	4920

4 ACTIVITY: Interpreting a Graph

Work with a partner. The table shows the average speeds of the winners of the Daytona 500. Graph the data. Can you use the graph to predict future winning speeds? Explain why or why not.
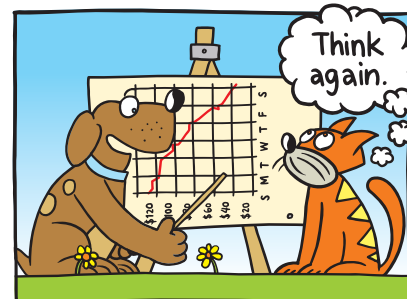
Year, *x*	2004	2005	2006	2007	2008	2009	2010	2011	2012
Speed (mi/h), *y*	156	135	143	149	153	133	137	130	140

What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you represent a function in different ways?
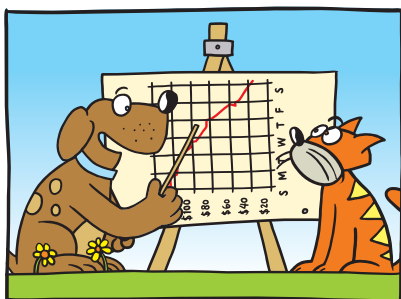
"I graphed our profits."
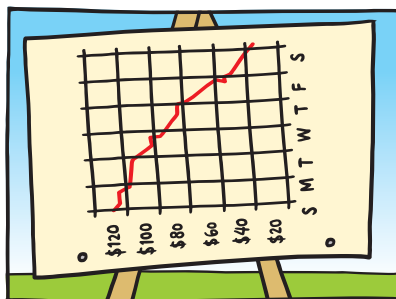
"And I am happy to say that they are going up every day!"

Think again.

Practice Use what you learned about representing functions to complete Exercises 4–6 on page 253.

Key Vocabulary 🔊
function rule, *p. 250*

Remember

An independent variable represents a quantity that can change freely. A dependent variable *depends* on the independent variable.

🔑 **Key Idea**

Functions as Equations

A **function rule** is an equation that describes the relationship between inputs (independent variable) and outputs (dependent variable).

Input $\xrightarrow{-2}$ Function Rule: $y = 3x$ $\xrightarrow{-6}$ Output
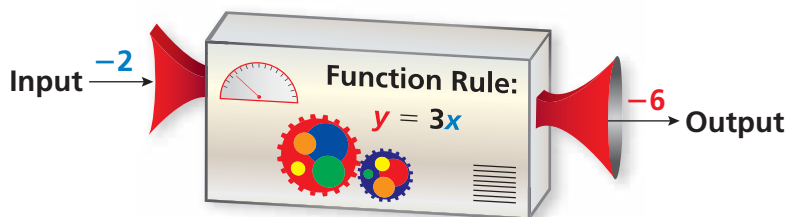
EXAMPLE 1   Writing Function Rules

a. Write a function rule for "The output is five less than the input."

   Words   The output is five less than the input.

   Equation y $=$ x $- 5$

   ⋮• A function rule is $y = x - 5$.

b. Write a function rule for "The output is the square of the input."

   Words   The output is the square of the input.

   Equation y $=$ x^2

   ⋮• A function rule is $y = x^2$.

EXAMPLE 2   Evaluating a Function

What is the value of $y = 2x + 5$ when $x = 3$?

$y = 2x + 5$ Write the equation.

$= 2(3) + 5$ Substitute 3 for *x*.

$= 11$ Simplify.

⋮• When $x = 3$, $y = 11$.

🔴 **On Your Own**

Now You're Ready
Exercises 7–18

1. Write a function rule for "The output is one-fourth of the input."

Find the value of *y* when $x = 5$.

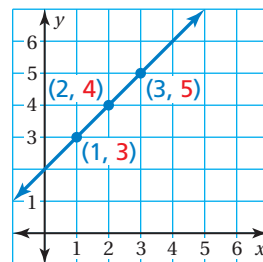2. $y = 4x - 1$ 3. $y = 10x$ 4. $y = 7 - 3x$

🔊 **Multi-Language Glossary at BigIdeasMath.com**

Key Idea

Functions as Tables and Graphs

A function can be represented by an input-output table and by a graph. The table and graph below represent the function $y = x + 2$.

Input, x	Output, y	Ordered Pair, (x, y)
1	3	$(1, 3)$
2	4	$(2, 4)$
3	5	$(3, 5)$

By drawing a line through the points, you graph *all* of the solutions of the function $y = x + 2$.
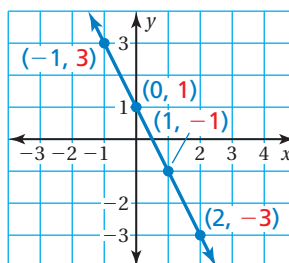
EXAMPLE 3 · Graphing a Function

Graph the function $y = -2x + 1$ using inputs of $-1, 0, 1,$ and 2.

Make an input-output table.

Input, x	$-2x + 1$	Output, y	Ordered Pair, (x, y)
-1	$-2(-1) + 1$	3	$(-1, 3)$
0	$-2(0) + 1$	1	$(0, 1)$
1	$-2(1) + 1$	-1	$(1, -1)$
2	$-2(2) + 1$	-3	$(2, -3)$

Plot the ordered pairs and draw a line through the points.

On Your Own

Graph the function.

5. $y = x + 1$ **6.** $y = -3x$ **7.** $y = 3x + 2$

EXAMPLE **4** — **Real-Life Application**

The number of pounds *p* of carbon dioxide produced by a car is 20 times the number of gallons *g* of gasoline used by the car. Write and graph a function that describes the relationship between *g* and *p*.

Write a function rule using the variables *g* and *p*.

Words	The number of pounds of carbon dioxide	is	20	times	the number of gallons of gasoline used.
Equation	p	$=$	20	$\cdot$	g

Make an input-output table that represents the function $p = 20g$.

Input, *g*	20*g*	Output, *p*	Ordered Pair, (*g*, *p*)
1	20(1)	20	(1, 20)
2	20(2)	40	(2, 40)
3	20(3)	60	(3, 60)

Plot the ordered pairs and draw a line through the points.

Because you cannot have a negative number of gallons, use only positive values of *g*.
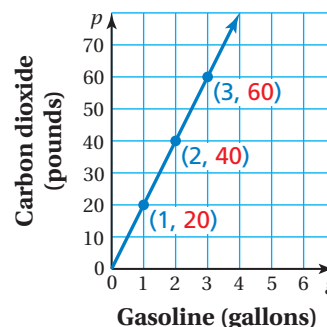
On Your Own

8. **WHAT IF?** For a truck, *p* is 25 times *g*. Write and graph a function that describes the relationship between *g* and *p*.

Summary

Representations of Functions

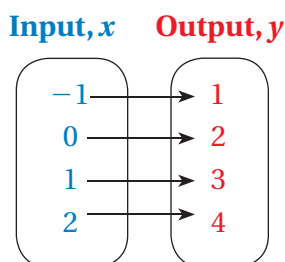**Words**   An output is 2 more than the input.

Equation $y = x + 2$

Input-Output Table

Input, *x*	Output, *y*
−1	1
0	2
1	3
2	4

Mapping Diagram

Graph
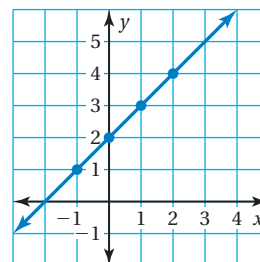
Vocabulary and Concept Check

1. **VOCABULARY** Identify the input variable and the output variable for the function rule $y = 2x + 5$.

2. **WRITING** Describe five ways to represent a function.

3. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

What output is 4 more than twice the input 3?	What output is twice the sum of the input 3 and 4?

What output is the sum of 2 times the input 3 and 4?	What output is 4 increased by twice the input 3?

Practice and Problem Solving

Write an equation that describes the function.

4.
Input, x	Output, y
0	0
1	4
2	8
3	12

5.
Input, x	Output, y
1	8
2	9
3	10
4	11

6.
Input, x	Output, y
1	0
3	−2
5	−4
7	−6

Write a function rule for the statement.

7. The output is half of the input.

8. The output is eleven more than the input.

9. The output is three less than the input.

10. The output is the cube of the input.

11. The output is six times the input.

12. The output is one more than twice the input.
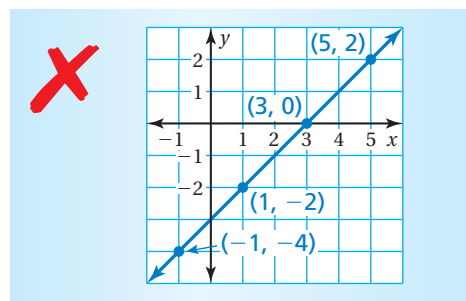
Find the value of y for the given value of x.

13. $y = x + 5;\ x = 3$

14. $y = 7x;\ x = -5$

15. $y = 1 - 2x;\ x = 9$

16. $y = 3x + 2;\ x = 0.5$

17. $y = 2x^3;\ x = 3$

18. $y = \dfrac{x}{2} + 9;\ x = -12$

Graph the function.

19. $y = x + 4$

20. $y = 2x$

21. $y = -5x + 3$

22. $y = \dfrac{x}{4}$

23. $y = \dfrac{3}{2}x + 1$

24. $y = 1 + 0.5x$

25. ERROR ANALYSIS Describe and correct the error in graphing the function represented by the input-output table.

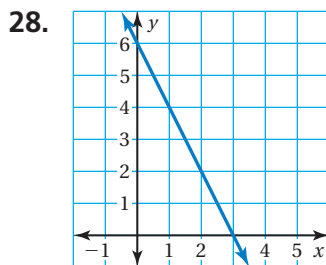| Input, x	-4	-2	0	2
Output, y	-1	1	3	5

26. DOLPHIN A dolphin eats 30 pounds of fish per day.

    a. Write and graph a function that relates the number of pounds p of fish that a dolphin eats in d days.

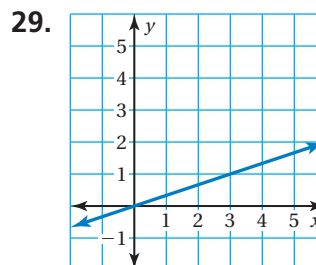   **b.** How many pounds of fish does a dolphin eat in 30 days?

Match the graph with the function it represents.

27.

A. $y = \dfrac{x}{3}$

28.

B. $y = x + 1$

29.
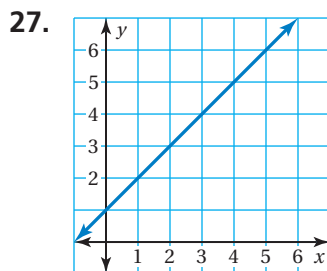
C. $y = -2x + 6$

Find the value of x for the given value of y.

30. $y = 5x - 7;\ y = -22$

31. $y = 9 - 7x;\ y = 37$

32. $y = \dfrac{x}{4} - 7;\ y = 2$

33. BRACELETS You decide to make and sell bracelets. The cost of your materials is $84. You charge $3.50 for each bracelet.

    a. Write a function that represents the profit P for selling b bracelets.

    b. Which variable is independent? dependent? Explain.

    c. You will *break even* when the cost of your materials equals your income. How many bracelets must you sell to break even?

34. SALE A furniture store is having a sale where everything is 40% off.

    a. Write a function that represents the amount of discount d on an item with a regular price p.

    b. Graph the function using the inputs 100, 200, 300, 400, and 500 for p.

   **c.** You buy a bookshelf that has a regular price of $85. What is the sale price of the bookshelf?

35. AIRBOAT TOURS You want to take a two-hour airboat tour.

    a. Write a function that represents the cost G of a tour at Gator Tours.

    b. Write a function that represents the cost S of a tour at Snake Tours.

    c. Which is a better deal? Explain.

36. REASONING The graph of a function is a line that goes through the points (3, 2), (5, 8), and (8, y). What is the value of y?

37. CRITICAL THINKING Make a table where the independent variable is the side length of a square and the dependent variable is the *perimeter*. Make a second table where the independent variable is the side length of a square and the dependent variable is the *area*. Graph both functions in the same coordinate plane. Compare the functions and graphs.

38. **Puzzle** The blocks that form the diagonals of each square are shaded. Each block is one square unit. Find the "green area" of Square 20. Find the "green area" of Square 21. Explain your reasoning.
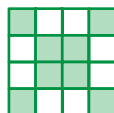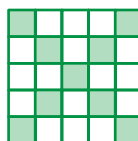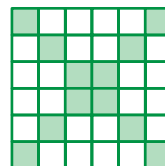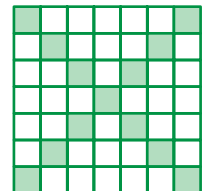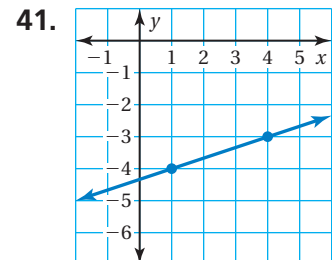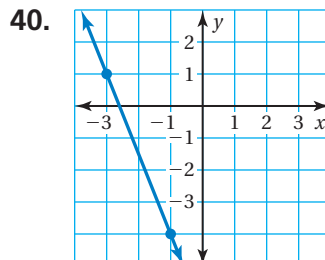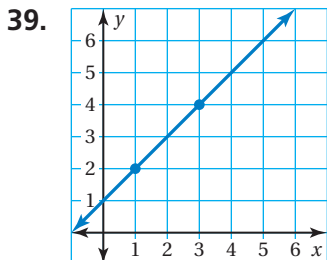
Square 1   Square 2   Square 3   Square 4   Square 5

Fair Game Review What you learned in previous grades & lessons

Find the slope of the line. *(Section 4.2)*

39.

40.

41.

42. MULTIPLE CHOICE You want to volunteer for at most 20 hours each month. So far, you have volunteered for 7 hours this month. Which inequality represents the number of hours h you can volunteer for the rest of this month? *(Skills Review Handbook)*

    (A) $h \geq 13$ **(B)** $h \geq 27$ **(C)** $h \leq 13$ **(D)** $h < 27$