9.4 Graphs

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

1 ACTIVITY: Interpreting a Graph

Work with a partner. Use the graph to test the truth of each statement. If the statement is true, write an equation that shows how to get 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."

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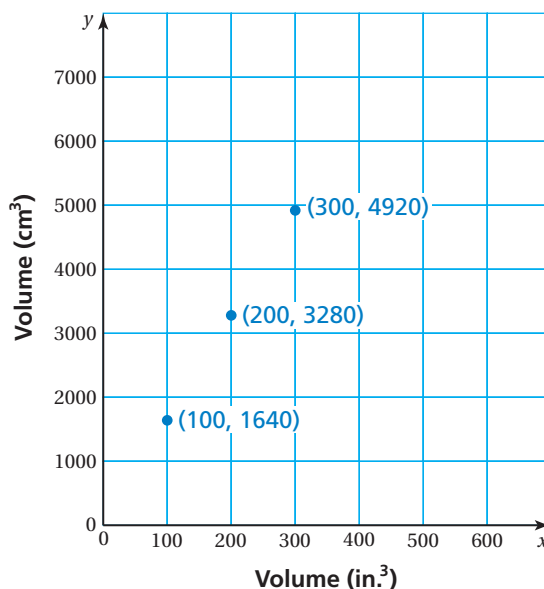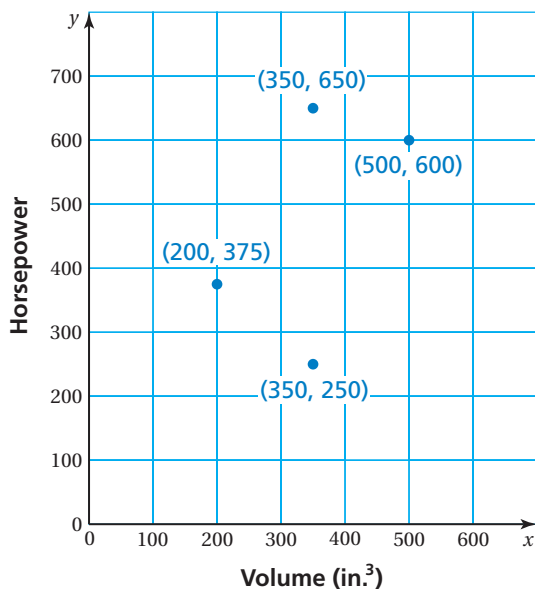
2 ACTIVITY: Interpreting a Graph

Work with a partner. The table shows the average speeds of the winners of the Daytona 500. Graph the data. Does the graph allow you to predict future winning speeds? Explain why or why not.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Speed (mi/h)	156	162	143	134	156	135	143	149	153

ACTIVITY: Conducting an Experiment

Work with a partner.

Collect Materials:
- Metal washer
- String (at least 15 in. long)
- Stopwatch

Perform the Experiment:
- Tie one end of the string securely around the washer.
- Hold the string 6 inches from the washer. Swing the washer and measure the time it takes to swing back and forth 10 times.
- Record your result in a table.
- Repeat the experiment when holding the string at lengths of 7 in., 8 in., 9 in., 10 in., 11 in., and 12 in.
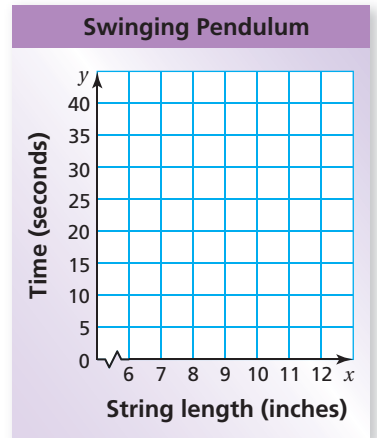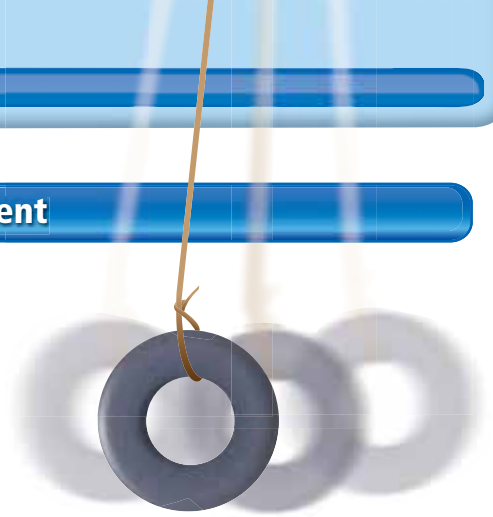
Analyze the Results:
- Make a graph of your data.
- Describe the graph.

Use Your Results to Predict:
- Use your graph to predict how long it will take a 14-inch pendulum to swing 10 times.

Test Your Prediction:
- Hold the string 14 inches from the washer and repeat the experiment. How close was your prediction?

Swinging Pendulum

(graph with y-axis "Time (seconds)" marked 0, 5, 10, 15, 20, 25, 30, 35, 40 and x-axis "String length (inches)" marked 6, 7, 8, 9, 10, 11, 12)
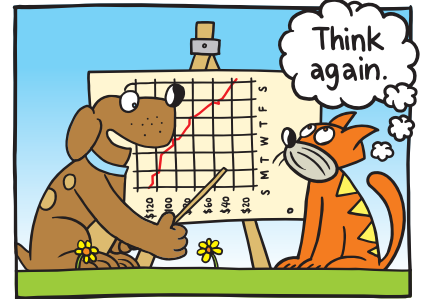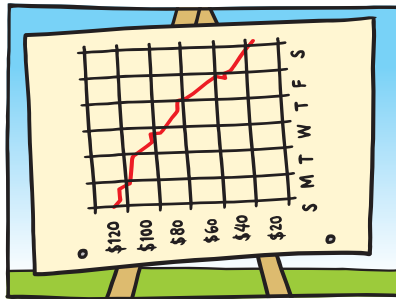
What Is Your Answer?

4. IN YOUR OWN WORDS How can you use a graph to describe a function? Find a graph in a magazine, in a newspaper, or on the Internet that allows you to predict the future.
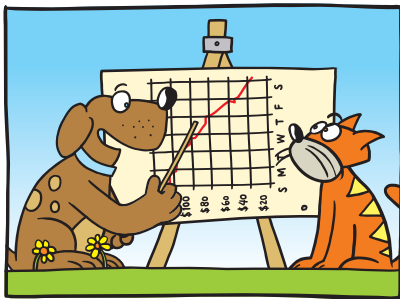
"I graphed our profits."

"And I am happy to say that they are going up every day!"

Think again.

Practice Use what you learned about graphs to complete Exercises 4–7 on page 390.

Key Vocabulary 🔊
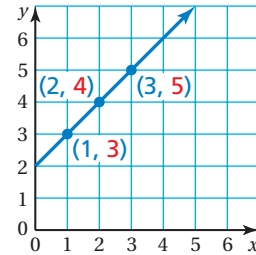graph, *p. 388*

🔑 Key Idea

Graph of a Function

A function can be represented by a **graph**. The graph below is for the function $y = x + 2$.

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

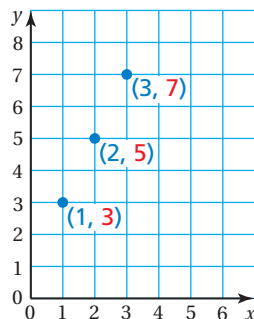When you draw a line through the points, you graph *all* of the solutions of $y = x + 2$.

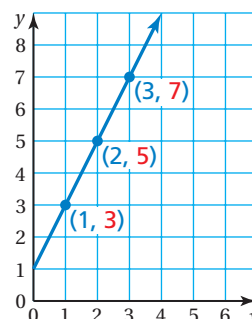**EXAMPLE 1** — Graphing a Function

Graph $y = 2x + 1$.

Make an input-output table. Use the values 1, 2, and 3 for x.

x	$y = 2x + 1$	y	(x, y)
1	$y = 2(1) + 1$	3	$(1, 3)$
2	$y = 2(2) + 1$	5	$(2, 5)$
3	$y = 2(3) + 1$	7	$(3, 7)$

Plot the ordered pairs.   Draw a line through the points.

🔴 **On Your Own**

Now You're Ready
Exercises 8–15

Graph the function.

1. $y = x + 1$ **2.** $y = 3x$ **3.** $y = 3x + 2$

🔊 Multi-Language Glossary at BigIdeasMath ✓com.

EXAMPLE **2** — **Graphing a Function**

Use the function $p = 20g$ to find the number of pounds p of carbon dioxide produced by burning g gallons of gasoline. Graph the function.
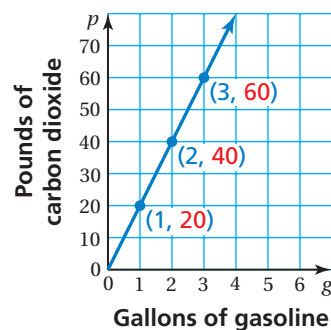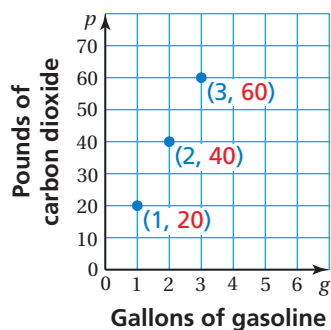
Make an input-output table.
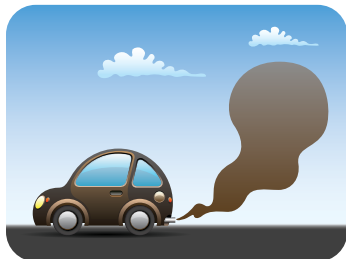
Input, g	$p = 20g$	Output, p	Ordered Pair, (g, p)
1	$p = 20(1)$	20	$(1, 20)$
2	$p = 20(2)$	40	$(2, 40)$
3	$p = 20(3)$	60	$(3, 60)$

Plot the ordered pairs.   Draw a line through the points.

Reading

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

On Your Own

Now You're Ready
Exercise 17

4. Use the function $d = 35t$ to find the distance d (in miles) and time t (in hours) for a boat. Graph the function.

Summary

Representing a Function

There are several ways to represent a function.

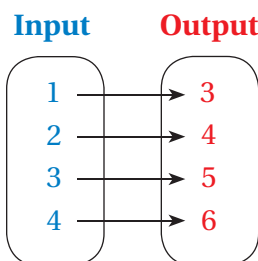**Words**   Each output is 2 more than the input.
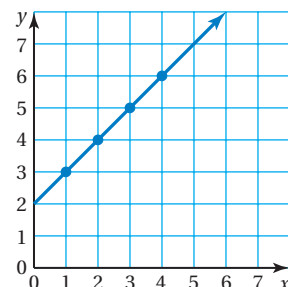
Equation $y = x + 2$

Input-Output Table

Input, x	Output, y
1	3
2	4
3	5
4	6

Mapping Diagram

Input	Output
1	3
2	4
3	5
4	6

Graph

✓ Vocabulary and Concept Check

1. **VOCABULARY** Describe steps you can use to draw a graph of a function.

2. **OPEN-ENDED** Describe four ways to represent the function $y = 4x + 5$.

3. **WRITING** You are given the graph of a function. Explain how you could find the function rule that describes the graph.

Practice and Problem Solving

Graph the data.

4.

Input, x	0	2	4	6
Output, y	0	4	8	12

5.

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

6.

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

7.

Input, x	Output, y
2	0.5
4	1
6	1.5
8	2

Graph the function.

① 8. $y = x + 4$

9. $y = 2x$

10. $y = 5x + 3$

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

12. $y = 2x + 5$

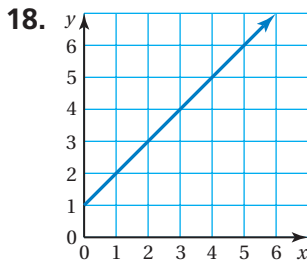13. $y = x - 1$

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

15. $y = 1 + 0.5x$

16. **ERROR ANALYSIS** Describe and correct the error in graphing the line from the input-output table.

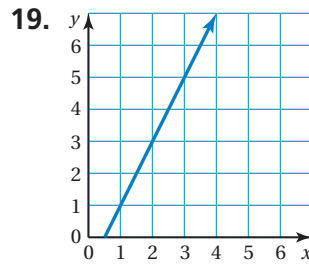| Input, x	1	2	3	4
Output, y	1	3	5	7
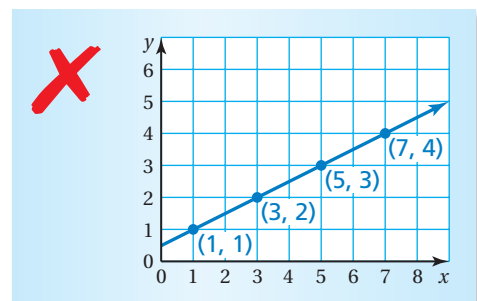
② 17. **DOLPHIN** Use the function $p = 30d$ to find the number of pounds p of fish that a dolphin eats in d days. Graph the function.
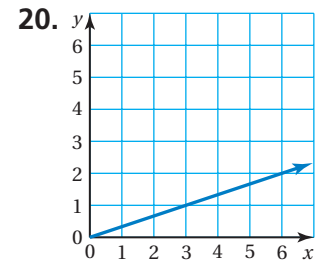
Match each graph with a function.

18.

19.

20.

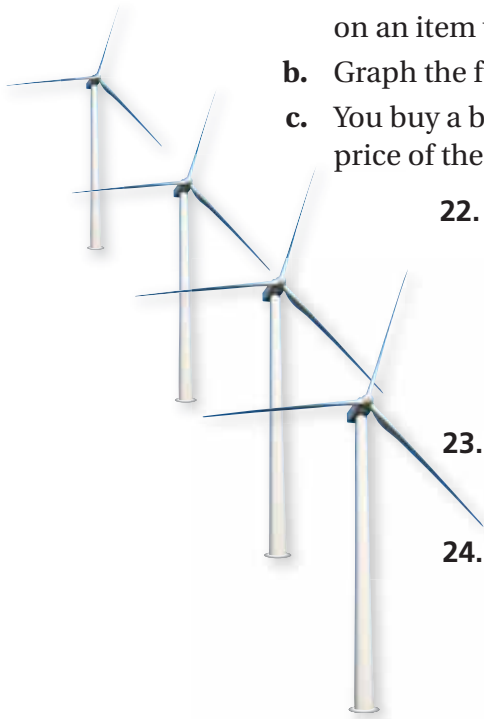**A.** $y = \dfrac{x}{3}$

B. $y = x + 1$

C. $y = 2x - 1$

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

    a. Write a function that you can use to find 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?

22. WIND TURBINE The table shows the number of rotations a wind turbine makes in x minutes.

Minutes, x	1	2	3	4	5
Rotations, y	25	50	75	100	125

    a. Graph the data.

    b. Find a function to describe the data.

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

24. **Critical Thinking** Make an input-output table where the input is the side length of a square and the output is the *perimeter*. Make a second input-output table where the input is the side length of a square and the output is the *area*. Graph both functions in the same coordinate plane. Compare the functions and graphs.

Fair Game Review What you learned in previous grades & lessons

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

25. $y = x + 2; \ x = 4$

26. $y = 4x - 3; \ x = 3$

27. $y = 3x + 1; \ x = 6$

28. $y = 16x; \ x = 7$

29. MULTIPLE CHOICE The rectangular rug has a perimeter of 224 inches. What is the width of the rug? Ž

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(A) 3.5 in.

(B) 36 in.

(C) 48 in.

(D) 96 in.

64 in.