

# 3.4 Solving Real-Life Problems



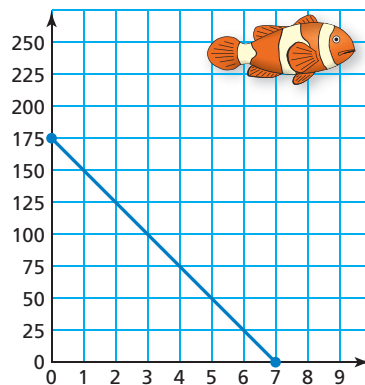
**Essential Question** How can you use a linear equation in two variables to model and solve a real-life problem?

## 1 EXAMPLE: Writing a Story

Write a story that uses the graph at the right.

- In your story, interpret the slope of the line, the  $y$ -intercept, and the  $x$ -intercept.
- Make a table that shows data from the graph.
- Label the axes of the graph with units.
- Draw pictures for your story.

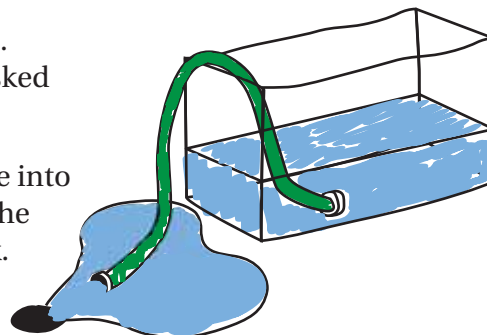
There are many possible stories. Here is one about a reef tank.



Tom works at an aquarium shop on Saturdays. One Saturday, when Tom gets to work, he is asked to clean a 175-gallon reef tank.

His first job is to drain the tank. He puts a hose into the tank and starts a siphon. Tom wonders if the tank will finish draining before he leaves work.

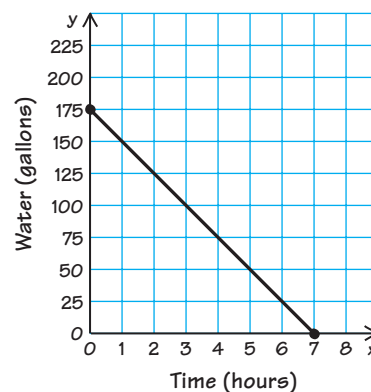
He measures the amount of water that is draining out and finds that 12.5 gallons drain out in 30 minutes. So, he figures that the rate is 25 gallons per hour. To see when the tank will be empty, Tom makes a table and draws a graph.



$x$ -intercept: number of hours to empty the tank

$x$	0	1	2	3	4	5	6	7
$y$	175	150	125	100	75	50	25	0

$y$ -intercept: amount of water in full tank



From the table and also from the graph, Tom sees that the tank will be empty after 7 hours. This will give him 1 hour to wash the tank before going home.

## 2 ACTIVITY: Writing a Story

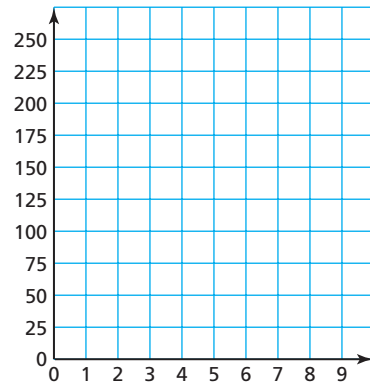
Work with a partner. Write a story that uses the graph of a line.

- In your story, interpret the slope of the line, the  $y$ -intercept, and the  $x$ -intercept.
- Make a table that shows data from the graph.
- Label the axes of the graph with units.
- Draw pictures for your story.

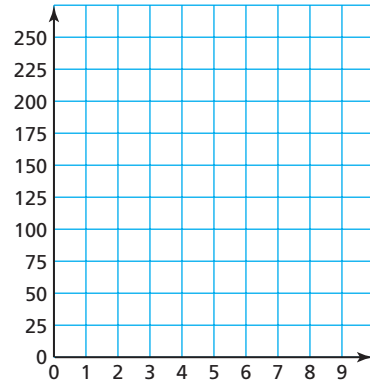
## 3 ACTIVITY: Drawing Graphs

Work with a partner. Describe a real-life problem that has the given rate and intercepts. Draw a line that represents the problem.

- a. Rate:  $-30$  feet per second  
 $y$ -intercept: 150 feet  
 $x$ -intercept: 5 seconds



- b. Rate:  $-25$  dollars per month  
 $y$ -intercept: \$200  
 $x$ -intercept: 8 months



## What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use a linear equation in two variables to model and solve a real-life problem? List three different rates that can be represented by slopes in real-life problems.

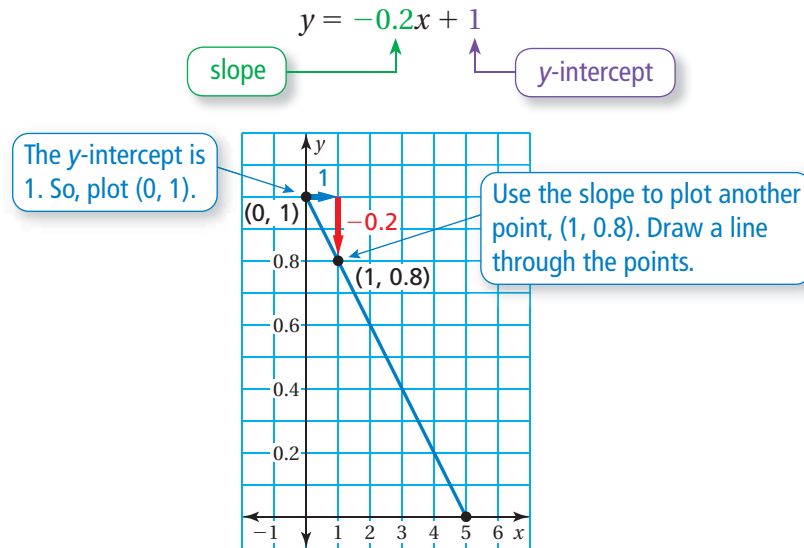
### Practice

Use what you learned about solving real-life problems to complete Exercises 4 and 5 on page 130.

**EXAMPLE 1** Real-Life Application

The percent  $y$  (in decimal form) of battery power remaining  $x$  hours after you turn on a laptop computer is  $y = -0.2x + 1$ . (a) Graph the equation. (b) Interpret the  $x$ - and  $y$ -intercepts. (c) After how many hours is the battery power at 75%?

- a. Use the slope and the  $y$ -intercept to graph the equation.



- b. To find the  $x$ -intercept, substitute 0 for  $y$  in the equation.

$$y = -0.2x + 1 \quad \text{Write the equation.}$$

$$0 = -0.2x + 1 \quad \text{Substitute 0 for } y.$$

$$5 = x \quad \text{Solve for } x.$$

- ❖ The  $x$ -intercept is 5. So, the battery lasts 5 hours. The  $y$ -intercept is 1. So, the battery power is at 100% when you turn on the laptop.

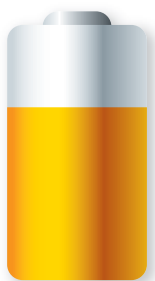
- c. Find the value of  $x$  when  $y = 0.75$ .

$$y = -0.2x + 1 \quad \text{Write the equation.}$$

$$0.75 = -0.2x + 1 \quad \text{Substitute 0.75 for } y.$$

$$1.25 = x \quad \text{Solve for } x.$$

- ❖ The battery power is at 75% after 1.25 hours.



75% Remaining

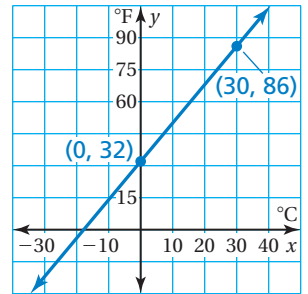
**On Your Own**

1. The amount  $y$  (in gallons) of gasoline remaining in a gas tank after driving  $x$  hours is  $y = -2x + 12$ . (a) Graph the equation. (b) Interpret the  $x$ - and  $y$ -intercepts. (c) After how many hours are there 5 gallons left?

**Now You're Ready**  
Exercise 6

## EXAMPLE 2 Real-Life Application

The graph relates temperatures  $y$  (in degrees Fahrenheit) to temperatures  $x$  (in degrees Celsius). (a) Find the slope and  $y$ -intercept. (b) Write an equation of the line. (c) What is the mean temperature of Earth in degrees Fahrenheit?



Mean Temperature:  
15°C

a.  $\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{54}{30} = \frac{9}{5}$

The line crosses the  $y$ -axis at  $(0, 32)$ .  
So, the  $y$ -intercept is 32.

∴ The slope is  $\frac{9}{5}$  and the  $y$ -intercept is 32.

b. Use the slope and  $y$ -intercept to write an equation.



∴ The equation is  $y = \frac{9}{5}x + 32$ .

c. In degrees Celsius, the mean temperature of Earth is 15°. To find the mean temperature in degrees Fahrenheit, find the value of  $y$  when  $x = 15$ .

$$y = \frac{9}{5}x + 32 \quad \text{Write the equation.}$$

$$= \frac{9}{5}(15) + 32 \quad \text{Substitute 15 for } x.$$

$$= 59 \quad \text{Simplify.}$$

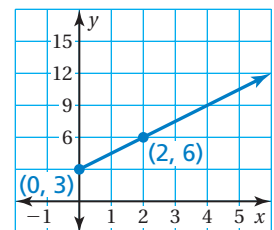
∴ The mean temperature of Earth is 59°F.

### On Your Own

Now You're Ready  
Exercise 7

2. The graph shows the height  $y$  (in feet) of a flag  $x$  seconds after you start raising it up a flagpole.

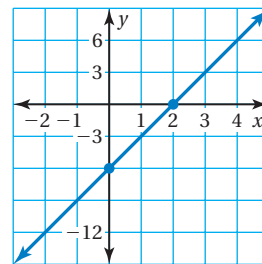
- Find and interpret the slope.
- Write an equation of the line.
- What is the height of the flag after 9 seconds?



## 3.4 Exercises

### Vocabulary and Concept Check

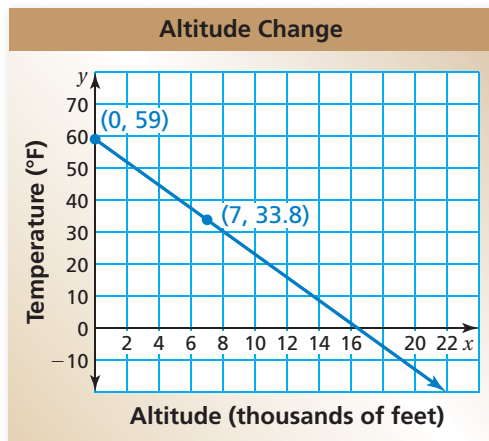
- REASONING** Explain how to find the slope,  $y$ -intercept, and  $x$ -intercept of the line shown.
- OPEN-ENDED** Describe a real-life situation that uses a negative slope.
- REASONING** In a real-life situation, what does the slope of a line represent?



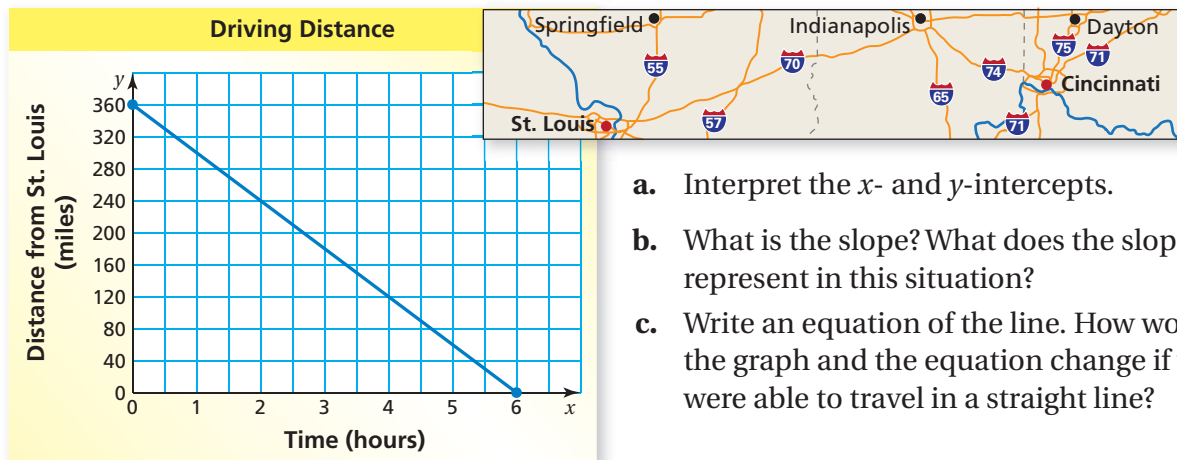
### Practice and Problem Solving

Describe a real-life problem that has the given rate and intercepts. Draw a line that represents the problem.

- Rate:  $-1.6$  gallons per hour  
 $y$ -intercept: 16 gallons  
 $x$ -intercept: 10 hours
- Rate:  $-45$  pesos per week  
 $y$ -intercept: 180 pesos  
 $x$ -intercept: 4 weeks
- DOWNLOAD** You are downloading a song. The percent  $y$  (in decimal form) of megabytes remaining to download after  $x$  seconds is  $y = -0.1x + 1$ .
  - Graph the equation.
  - Interpret the  $x$ - and  $y$ -intercepts.
  - After how many seconds is the download 50% complete?
- HIKING** The graph relates temperature  $y$  (in degrees Fahrenheit) to altitude  $x$  (in thousands of feet).
  - Find the slope and  $y$ -intercept.
  - Write an equation of the line.
  - What is the temperature at sea level?



8. **TRAVEL** Your family is driving from Cincinnati to St. Louis. The graph relates your distance from St. Louis  $y$  (in miles) and travel time  $x$  (in hours).



- Interpret the  $x$ - and  $y$ -intercepts.
- What is the slope? What does the slope represent in this situation?
- Write an equation of the line. How would the graph and the equation change if you were able to travel in a straight line?

9. **PROJECT** Use a map or the Internet to find the latitude and longitude of your school to the nearest whole number. Then find the latitudes and longitudes of: Antananarivo, Madagascar; Denver, Colorado; Brasilia, Brazil; London, England; and Beijing, China.

- Plot a point for each of the cities in the same coordinate plane. Let the positive  $y$ -axis represent north and the positive  $x$ -axis represent east.
- Write an equation of the line that passes through Denver and Beijing.
- In part (b), what geographic location does the  $y$ -intercept represent?

10. **Reasoning** A band is performing at an auditorium for a fee of \$1500. In addition to this fee, the band receives 30% of each \$20 ticket sold. The maximum capacity of the auditorium is 800 people.

- Write an equation that represents the band's revenue  $R$  when  $x$  tickets are sold.
- The band needs \$5000 for new equipment. How many tickets must be sold for the band to earn enough money to buy the new equipment?



## Fair Game Review what you learned in previous grades & lessons

Tell whether the system has *one solution*, *no solution*, or *infinitely many solutions*.  
(Section 2.5 and Section 2.6)

11.  $y = -x + 6$   
 $-4(x + y) = -24$

12.  $y = 3x - 2$   
 $-x + 2y = 11$

13.  $-9x + 3y = 12$   
 $y = 3x - 2$

14. **MULTIPLE CHOICE** Which equation is the slope-intercept form of  $24x - 8y = 56$ ?  
(Section 2.3)

(A)  $y = -3x + 7$

(B)  $y = 3x - 7$

(C)  $y = -3x - 7$

(D)  $y = 3x + 7$