# 3.1 Ratios and Rates



## Essential Question How do rates help you



describe real-life problems?

### The Meaning of a Word





When you rent snorkel gear at the beach, you should pay attention to the rental **rate**. The rental rate is in dollars per hour.

### 1 ACTIVITY: Finding Reasonable Rates

#### Work with a partner.

- **a.** Match each description with a verbal rate.
- **b.** Match each verbal rate with a numerical rate.
- **c.** Give a reasonable numerical rate for each description. Then give an unreasonable rate.

| Description   | Verbal Rate       | Numerical Rate |
|---|-------------------|----------------|
| Your pay rate for washing cars                      | inches per month  | m<br>sec       |
| The average rainfall rate of Tampa                  | pounds per acre   | people<br>yr   |
| Your average driving rate from<br>Miami to Key West | meters per second | lb acre        |
| The growth rate for the length of a baby alligator  | people per year   | mi<br>h        |
| Your running rate in a<br>100-meter dash            | dollars per hour  | in.<br>yr      |
| The population growth rate of Naples                | dollars per year  | in.<br>mo      |
| The average pay rate for an Orlando Magic player    | miles per hour    | \$ h           |
| The fertilization rate for an orange grove          | inches per year   | \$ yr          |

### **2 ACTIVITY:** Unit Analysis

Work with a partner. Some real-life problems involve the product of an amount and a rate. Find each product. List the units.

**a.** Sample: 
$$6 \text{ h} \times \frac{\$12}{\text{h}} = 6 \text{ h} \times \frac{\$12}{\text{h}}$$

Divide out "hours."

Multiply. Answer is in dollars.

**b.** 6 mo 
$$\times \frac{$700}{mo}$$

**c.** 
$$10 \text{ gal} \times \frac{22 \text{ mi}}{\text{gal}}$$

**d.** 9 lb 
$$\times \frac{\$3}{lb}$$

**e.** 
$$13 \min \times \frac{60 \sec}{\min}$$

### 3 ACTIVITY: Writing a Story

Work with a partner.

- Think of a story that compares two different rates.
- Write the story.
- Draw pictures for the story.

## What Is Your Answer?

- **4. RESEARCH** Use newspapers, the Internet, or magazines to find examples of salaries. Try to find examples of each of the following ways to write salaries.
  - **a.** dollars per hour
- **b.** dollars per month
- **c.** dollars per year
- **5. IN YOUR OWN WORDS** How do rates help you describe real-life problems? Give two examples.
- **6.** To estimate the annual salary for a given hourly pay rate, multiply by 2 and insert "000" at the end.

Sample: \$10 per hour is about \$20,000 per year.

- **a.** Explain why this works. Assume the person is working 40 hours a week.
- **b.** Estimate the annual salary for an hourly pay rate of \$8 per hour.
- **c.** You earn \$1 million per month. What is your annual salary?
- **d.** Why is the cartoon funny?



"We had someone apply for the job. He says he would like \$1 million a month, but will settle for \$8 an hour."

Practice

Use what you discovered about ratios and rates to complete Exercises 7–10 on page 102.

### 3.1 Lesson



**Key Vocabulary** ■

ratio, p. 100 rate, p. 100 unit rate, p. 100 A **ratio** is a comparison of two quantities using division.

$$\frac{3}{4}$$
, 3 to 4, 3:4

A **rate** is a ratio of two quantities with different units.

A rate with a denominator of 1 is called a **unit rate**.

$$\frac{30 \text{ miles}}{1 \text{ hour}}$$

#### **EXAMPLE**

### 1 Finding Ratios and Rates

There are 45 males and 60 females in a car on the Miami Metrorail. The Metrorail travels 2.5 miles in 5 minutes.

- a. Find the ratio of males to females.
- b. Find the speed of the Metrorail.

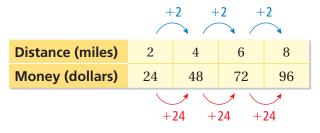
**a.** 
$$\frac{\text{males}}{\text{females}} = \frac{45}{60} = \frac{3}{4}$$

- $\therefore$  The ratio of males to females is  $\frac{3}{4}$ .
- **b.** 2.5 miles in 5 minutes =  $\frac{2.5 \text{ mi}}{5 \text{ min}} = \frac{2.5 \text{ mi} \div 5}{5 \text{ min} \div 5} = \frac{0.5 \text{ mi}}{1 \text{ min}}$ 
  - The speed is 0.5 mile per minute.

#### **EXAMPLE**

#### Finding a Rate from a Table

The table shows the amount of money you can raise by walking for a charity. Find your unit rate in dollars per mile.



Use the table to find the unit rate.

$$\frac{\text{change in money}}{\text{change in distance}} = \frac{\$24}{2 \text{ mi}}$$
The money raised increases by \$24 every 2 miles.
$$= \frac{\$12}{1 \text{ mi}}$$
Simplify.

Your unit rate is \$12 per mile.

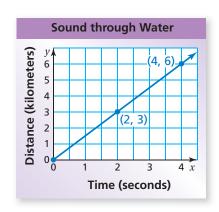




- 1. In Example 1, find the ratio of females to males.
- **2.** In Example 1, find the ratio of females to total passengers.
- **3.** The table shows the distance that the International Space Station travels while orbiting Earth. Find the speed in miles per second.

| Time (seconds)   | 3    | 6    | 9    | 12   |
|------------------|------|------|------|------|
| Distance (miles) | 14.4 | 28.8 | 43.2 | 57.6 |

## **EXAMPLE** 3 Finding a Rate from a Line Graph



The graph shows the distance that sound travels through water. Find the speed of sound in kilometers per second.

**Step 1:** Choose a point on the line.

The point (2, 3) shows you that sound travels 3 kilometers in 2 seconds.

**Step 2:** Find the speed.

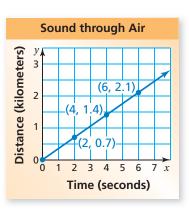
$$\frac{\text{distance traveled}}{\text{elapsed time}} = \frac{3}{2} \frac{\text{kilometers}}{\text{seconds}}$$

$$= \frac{1.5 \text{ km}}{1 \text{ sec}} \quad \text{Simplify.}$$

: The speed is 1.5 kilometers per second.

#### On Your Own

- **4. WHAT IF?** In Example 3, you use the point (4, 6) to find the speed. Does your answer change? Why or why not?
- 5. The graph shows the distance that sound travels through air. Find the speed of sound in kilometers per second.
- **6.** Does sound travel faster in water or in air? Explain.







# Vocabulary and Concept Check

- 1. **VOCABULARY** How can you tell when a rate is a unit rate?
- **2. WRITING** Why do you think rates are usually written as unit rates?
- **3. OPEN-ENDED** Write a real-life rate that applies to you.

#### Estimate the unit rate.

**4.** \$74.75



**5.** \$1.19



**6.** \$2.35





# Practice and Problem Solving

#### Find the product. List the units.

7. 
$$8 \text{ h} \times \frac{\$9}{\text{h}}$$

**8.** 8 lb 
$$\times \frac{\$3.50}{\text{lb}}$$

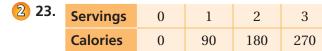
**9.** 
$$14 \sec \times \frac{60 \text{ MB}}{\sec}$$
 **10.**  $6 \text{ h} \times \frac{19 \text{ mi}}{\text{h}}$ 

**10.** 
$$6 \text{ h} \times \frac{19 \text{ m}}{\text{h}}$$

#### Write the ratio as a fraction in simplest form.

#### Find the unit rate.

#### Use the table to find the rate.

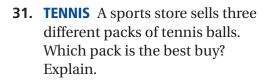


| 24. | Days   | 0 | 1   | 2   | 3   |
|-----|--------|---|-----|-----|-----|
|     | Liters | 0 | 1.6 | 3.2 | 4.8 |

- **27. DOWNLOAD** At 1 P.M., you have 24 megabytes of a movie. At 1:15 P.M., you have 96 megabytes. What is the download rate in megabytes per minute?
- **28. POPULATION** In 2002, the population of Florida was 16.7 million people. In 2007, it was 18.3 million. What was the rate of population change per year?

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- **29. TICKETS** The graph shows the cost of buying tickets to a concert.
  - **a.** What does the point (4, 122) represent?
  - **b.** What is the unit rate?
  - **c.** What is the cost of buying 10 tickets?
- **30. CRITICAL THINKING** Are the two statements equivalent? Explain your reasoning.
  - The ratio of boys to girls is 2 to 3.
  - The ratio of girls to boys is 3 to 2.







180

150

120

90

60

Cost (dollars)

Concert

3 4 5

**Tickets** 

(6, 183)

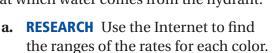
122)

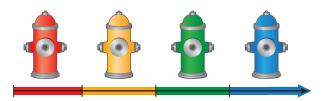


8 x

| Beverage     | Serving<br>Size | Calories | Sodium |
|--------------|-----------------|----------|--------|
| Whole milk   | 1 cup           | 146      | 98 mg  |
| Orange juice | 1 pt            | 210      | 10 mg  |
| Apple juice  | 24 fl oz        | 351      | 21 mg  |

- **32. NUTRITION** The table shows nutritional information for three beverages.
  - a. Which has the most calories per fluid ounce?
  - **b.** Which has the least sodium per fluid ounce?
- **33. Open-Ended** Fire hydrants are painted four different colors to indicate the rate at which water comes from the hydrant.





**b.** Research why a firefighter needs to know the rate at which water comes out of the hydrant.



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

Plot the ordered pair in a coordinate plane.

- **34.** A(-5, -2)
- **35.** *B*(−3, 0)
- **36.** *C*(-1, 2)
- **37.** *D*(1, 4)
- **38. MULTIPLE CHOICE** Which fraction is greater than  $-\frac{2}{3}$  and less than  $-\frac{1}{2}$ ?
  - $-\frac{3}{4}$
- **B**  $-\frac{7}{12}$
- $\bigcirc$   $-\frac{5}{12}$
- $\bigcirc$   $-\frac{3}{8}$