## Domain 2 • Lesson 14

# **Unit Rates**



### Getting the Idea

A **rate** is a ratio that compares two quantities with different units of measure. Some examples of rates are shown below:

- Miles per gallon: 540 miles on 18 gallons of gas, <u>540 miles</u> <u>18 gallons</u>
- Cost: \$3.60 for 4 pounds, or  $\frac{$3.60}{4 \text{ pounds}}$
- Pay rate: \$285 for 30 hours, or  $\frac{$285}{30 \text{ hours}}$

Rates are often given as a **unit rate**, which is a rate in which the second measure is 1 unit. Each of the rates listed above can be simplified as unit rates.

- Miles per gallon:  $\frac{540 \text{ miles}}{18 \text{ gallons}} = \frac{30 \text{ miles}}{1 \text{ gallon}}$
- Cost:  $\frac{\$3.60}{4 \text{ pounds}} = \frac{\$0.90}{1 \text{ pounds}}$
- Pay rate:  $\frac{$285}{30 \text{ hours}} = \frac{$9.50}{1 \text{ hour}}$

In general, for every ratio *a*:*b*, the corresponding unit rate is  $\frac{a}{b}$ , where  $b \neq 0$ .

For example, if there are 4 cups of cranberry juice to every 5 cups of orange juice in a punch recipe, the ratio of cranberry juice to orange juice is 4:5, or  $\frac{4}{5}$ . That means that there is  $\frac{4}{5}$  cup of cranberry juice for every 1 cup of orange juice. You can see this mathematically by multiplying each quantity by 5:

 $\frac{\frac{4}{5}}{\frac{1}{5}} = \frac{\frac{4}{5} \times 5}{\frac{1}{5} \times 5} = \frac{4}{5}$ 

# Example 1

A recipe for trail mix uses 5 ounces of mixed nuts, 6 ounces of dried fruit, and 4 ounces of granola. How many ounces of granola are there for every ounce of dried fruit?

StrategyWrite a ratio. Then find the unit rate.Step 1Write the ratio of granola to dried fruit.<br/>For every 4 ounces of granola, there are 6 ounces of dried fruit.<br/>The ratio of granola to dried fruit is 4:6, or  $\frac{4}{6}$ .<br/>In simplest form,  $\frac{4}{6} = \frac{2}{3}$ .Step 2Interpret the ratio as a unit rate.<br/>The ratio 2:3 means that there is  $\frac{2}{3}$  ounce of granola for every ounce of<br/>dried fruit.

#### Step 3 Check your work.

Multiply by 6.

$$\frac{\frac{2}{3}}{\frac{1}{1}} = \frac{\frac{2}{3} \times 6}{1 \times 6} = \frac{4}{6}$$

For every 4 ounces of granola, there are 6 ounces of dried fruit.

### Solution There is $\frac{2}{3}$ ounce of granola for each ounce of dried fruit.

To find a unit price, identify the quantities you want to compare and write a rate. Then simplify the rate to find the unit price.

### **Example 2**

Mr. Wilson spent \$252 to stay 3 nights at Pavia Pavilions. At that rate, how much will he spend to stay 7 nights?

Strategy	Find the unit price. Then multiply by 7 nights.
Step 1	Find the rate. The rate is \$252 for 3 nights, or $\frac{252}{3}$ .
Step 2	Find the unit rate, or unit price. Divide 252 by 3 to find the price for one night. $ \begin{array}{r} 84\\ 3)\overline{252}\\ -\underline{24}\\ 12\\ -\underline{12}\\ 0\end{array} $
Step 3	The unit price is \$84 per night. Multiply the unit price by 7. $7 \times 84 = 588$
Solution	Mr. Wilson will spend \$588 to stay 7 nights at Pavia

In Example 2, you could also have set up equivalent ratios to solve the problem. Let *x* represent the cost of staying 7 nights.

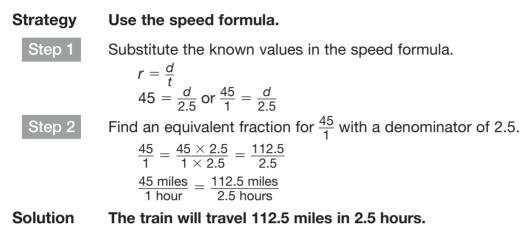
 $\frac{252}{3} = \frac{x}{7}$   $3 \times x = 252 \times 7 \quad \longleftarrow \text{ Cross multiply.}$   $3x = 1,764 \quad \longleftarrow \text{ Divide both sides by 3.}$  x = 588

Pavilions.

A common use of rate is the speed formula  $r = \frac{d}{t}$ , or rate  $= \frac{\text{distance}}{\text{time}}$ .

### **Example 3**

A train is traveling at a constant speed of 45 miles per hour. How far will the train travel in 2.5 hours?



You can rewrite the speed formula  $r = \frac{d}{t}$  to solve for either distance, d, or time, t. If  $r = \frac{d}{t}$ , then  $d = r \times t$ . If  $r = \frac{d}{t}$ , then  $t = \frac{d}{r}$ . In Example 3, you could have used the formula  $d = r \times t$  to solve the problem.  $d = r \times t$   $d = 45 \times 2.5$ d = 112.5

**Coached Example** 

<sup>7</sup> Tanya walked 15 laps on an indoor track in 30 minutes. What was Tanya's average speed in laps per minute?

The speed formula is r =\_\_\_\_.

The distance is \_\_\_\_\_ laps.

The time is \_\_\_\_\_ minutes.

Substitute the known values into the speed formula.

*r* = \_\_\_\_\_.

Simplify the fraction.

Tanya's average speed was \_\_\_\_\_ laps per minute.