

Lesson 1

Rates

What You'll Learn

Scan the lesson. Predict two things you will learn about rates.

Essential Question

HOW can you show that two objects are proportional?



Vocabulary

rate
unit rate



Common Core State Standards

Content Standards

7.RP.2, 7.RP.2b

Mathematical Practices

1, 3, 4, 5



Real-World Link



Pulse Rate You can take a person's pulse by placing your middle and index finger on the underside of their wrist. Choose a partner and take their pulse for two minutes.



- Record the results in the diagram below.

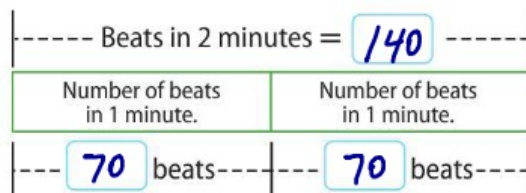


$$\frac{140}{2} \div \frac{2}{2} = \frac{70}{1}$$



- Use the results from Exercise 1 to complete the bar diagram and determine the number of beats per minute for your partner.

$$\begin{array}{r} 70 \\ \swarrow \downarrow \\ 60 + 10 \\ 30 + 5 = 35 \end{array}$$



So, your partner's heart beats **70** times per minute.



- Use the results from Exercise 1 to determine the number of beats for $\frac{1}{2}$ minute for your partner. **35 BEATS PER $\frac{1}{2}$ MIN**



Find a Unit Rate

A ratio that compares two quantities with different kinds of units is called a **rate**. When you found each other's pulse, you were actually finding the heart rate.

$$\frac{160 \text{ beats}}{2 \text{ minutes}}$$

The units *beats* and *minutes* are different.

When a rate is simplified so that it has a denominator of 1 unit, it is called a **unit rate**.

$$\frac{80 \text{ beats}}{1 \text{ minute}}$$

The denominator is 1 unit.

The table below shows some common unit rates.

Rate	Unit Rate	Abbreviation	Name
$\frac{\text{number of miles}}{1 \text{ hour}}$	miles per hour	mi/h or mph	average speed
$\frac{\text{number of miles}}{1 \text{ gallon}}$	miles per gallon	mi/gal or mpg	gas mileage
$\frac{\text{number of dollars}}{1 \text{ pound}}$	price per pound	dollars/lb	unit price



Example



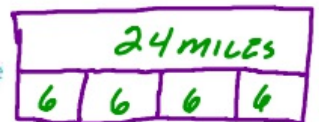
1. Adrienne biked 24 miles in 4 hours. If she biked at a constant speed, how many miles did she ride in one hour?

$$\begin{aligned} 24 \text{ miles in 4 hours} &= \frac{24 \text{ mi}}{4 \text{ h}} \\ &= \frac{24 \text{ mi} \div 4}{4 \text{ h} \div 4} \\ &= \frac{6 \text{ mi}}{1 \text{ h}} \end{aligned}$$

Write the rate as a fraction.

Divide the numerator and the denominator by 4.

Simplify.



Adrienne biked 6 miles in one hour.

STOP and Reflect

Circle the unit rate below that represents 18 cans for \$6.

$$\frac{9 \text{ cans}}{\$3} \quad \frac{3 \text{ cans}}{\$1} \quad \frac{4 \text{ cans}}{\$1}$$

Show your work.

Got It? Do these problems to find out.



$$\frac{300}{6} \div \frac{6}{6} = \frac{50}{1}$$

Find each unit rate. Round to the nearest hundredth if necessary.

a. \$300 for 6 hours

b. 220 miles on 8 gallons

$$\begin{array}{r} 50 \\ 6 \overline{)300} \\ \underline{30} \\ 0 \end{array}$$

$$\frac{\$50}{1 \text{ hr}}$$



Example

2. Find the unit price if it costs \$2 for eight juice boxes.



$$\begin{aligned} \$2 \text{ for eight boxes} &= \frac{\$2}{8 \text{ boxes}} \\ &= \frac{\$2 \div 8}{8 \text{ boxes} \div 8} \\ &= \frac{\$0.25}{1 \text{ box}} \end{aligned}$$

Write the rate as a fraction.

Divide the numerator and the denominator by 8.

Simplify.

The unit price is \$0.25 per juice box.



Got It? Do this problem to find out.

- c. Find the unit price if a 4-pack of mixed fruit sells for \$2.12.



Example

3. The prices of 3 different bags of dog food are given in the table. Which size bag has the lowest price per pound rounded to the nearest cent?

Dog Food Prices	
Bag Size (lb)	Price (\$)
40	49.00
20	23.44
8	9.88

- 40-pound bag
 $\$49.00 \div 40 \text{ pounds} \approx \1.23 per pound
- 20-pound bag
 $\$23.44 \div 20 \text{ pounds} \approx \1.17 per pound
- 8-pound bag
 $\$9.88 \div 8 \text{ pounds} \approx \1.24 per pound

The 20-pound bag sells for the lowest price per pound.

COST
QUANTITY



Got It? Do this problem to find out.

- d. Tito wants to buy some peanut butter to donate to the local food pantry. Tito wants to buy as much peanut butter as possible. Which brand should he buy?

Peanut Butter Sales	
Brand	Sale Price
Nutty	12 ounces for \$2.19
Grandma's	18 ounces for \$2.79
Bee's	28 ounces for \$4.69
Save-A-Lot	40 ounces for \$6.60

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GRANDMA'S
 $\frac{\$2.79}{18} = 0.155 \approx 0.16$

SAVES-A-LOT
 $\frac{\$6.60}{40} = 0.165 \approx 0.17$

BEE'S
 $\frac{\$4.69}{28} = 0.1675 \approx 0.17$

$$\begin{array}{r} 2.12 \\ \swarrow \quad \searrow \\ 2.00 \quad 0.12 \\ \downarrow \div 4 \quad \downarrow \\ 0.50 + 0.03 = 0.53 \end{array}$$

$$\frac{\$2.12}{4 \text{ PACK}} \div \frac{4}{4} = \frac{\$0.53}{1 \text{ PACK}}$$

Show your work.

c. GALLON OF GAS *THOUSANDS*
 $\$5.099 \text{ PER GALLON}$
 $\$5.10$

Alternative Method

One 40-lb bag is equivalent to two 20-lb bags or five 8-lb bags. The cost for one 40-lb bag is \$49, the cost for two 20-lb bags is about $2 \times \$23$ or \$46, and the cost for five 8-lb bags is about $5 \times \$10$ or \$50. So, the 20-lb bag has the lowest price per pound.

NUTTY
 $\frac{\$2.19}{12} = 0.1825$

$\approx \$0.18 \text{ PER OZ.}$
 $\approx \$0.16 \text{ PER OZ.}$
 $\approx \$0.17 \text{ PER OZ.}$
 $\approx \$0.17 \text{ PER OZ.}$

HUNDRETHS
↓ 7 IS MORE THAN HALF
WAY TO 10
 $2.137 \approx \$2.14$

ROUND UP
5, 6, 7, 8, 9

↓ 2 IS LESS THAN HALF OF 10
 $2.132 \approx \$2.13$



Example



4. Lexi painted 2 faces in 8 minutes at the Crafts Fair. At this rate, how many faces can she paint in 40 minutes?

Method 1 Draw a Bar Diagram



$$\frac{40}{4} = 10 \text{ FACES}$$

It takes 4 minutes to paint one face. In 40 minutes, Lexi can paint $40 \div 4$ or 10 faces.

Method 2 Find a Unit Rate

$$2 \text{ faces in 8 minutes} = \frac{2 \text{ faces} \div 8}{8 \text{ min} \div 8} = \frac{0.25 \text{ face}}{1 \text{ min}} \quad \text{Find the unit rate.}$$

Multiply the unit rate by 40 minutes.

$$\frac{0.25 \text{ face}}{1 \text{ min}} \cdot 40 \text{ min} = 10 \text{ faces} \quad \text{Divide out the common units.}$$

Using either method, Lexi can paint 10 faces in 40 minutes.

$$\frac{\text{MILES}}{\text{HOURS}}$$

Guided Practice



1. CD Express offers 4 CDs for \$60. Music Place offers 6 CDs for \$75. Which store offers the better buy? (Examples 1–3)

Show your work.

2. After 3.5 hours, Pasha had traveled 217 miles. If she travels at a constant speed, how far will she have traveled after

$$\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}}$$

4 hours? (Example 4) 244 miles

$$\frac{217}{3.5} = \frac{61 \text{ miles}}{1 \text{ hour}}$$

$$61(4) =$$

3. Write 5 pounds for \$2.49 as a unit rate. Round to the nearest hundredth. (Example 2)

4. **Building on the Essential Question** Use an example to describe how a *rate* is a measure of one quantity per unit of another quantity.

Rate Yourself!

Are you ready to move on?
Shade the section that applies.

YES

?

NO

For more help, go online to access a Personal Tutor.

