

4-1

Ratios and Rates

Main IDEA

Express ratios as fractions in simplest form and determine unit rates.



Targeted TEKS 8.3

The student identifies proportional or nonproportional linear relationships in problem situations and solves problems. **(B) Estimate and find solutions to application problems involving percents and other proportional relationships such as similarity and rates.** Also addresses TEKS 8.1(B).

NEW Vocabulary

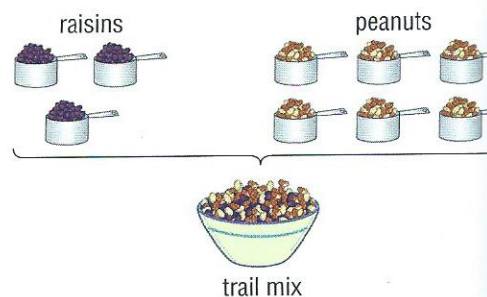
ratio
rate
unit rate

READING Math

Ratios In Example 1, the ratio 2 out of 7 means that for every 7 cats, 2 are Siamese.

GET READY for the Lesson

TRAIL MIX The diagram shows a batch of trail mix that is made using 3 scoops of raisins and 6 scoops of peanuts.



- To make the batch of trail mix, how many scoops of raisins should you use for every 1 scoop of peanuts? Explain your reasoning.

A **ratio** is a comparison of two numbers or quantities by division. If a batch of trail mix contains 3 scoops of raisins and 6 scoops of peanuts, the ratio comparing raisins to peanuts can be written as follows.

$$3 \text{ to } 6 \quad 3:6 \quad \frac{3}{6}$$

Since a ratio can be written as a fraction, it can be simplified.

EXAMPLES Write Ratios in Simplest Form

Express each ratio in simplest form.

- 8 Siamese cats out of 28 cats
 $\frac{8 \text{ cats}}{28 \text{ cats}} = \frac{2}{7}$ Divide the numerator and denominator by the greatest common factor, 4. Divide out common units.

The ratio of Siamese cats to cats is $\frac{2}{7}$ or 2 out of 7.

- 10 ounces of butter to 1 pound of flour

When writing ratios that compare quantities with the same kinds of units, convert so that they have the same unit.

$$\begin{aligned} \frac{10 \text{ ounces}}{1 \text{ pound}} &= \frac{10 \text{ ounces}}{16 \text{ ounces}} && \text{Convert 1 pound to 16 ounces.} \\ &= \frac{5 \text{ ounces}}{8 \text{ ounces}} && \text{Divide the numerator and the denominator by 2.} \\ &&& \text{Divide out common units.} \end{aligned}$$

The ratio of butter to flour in simplest form is $\frac{5}{8}$ or 5:8.

CHECK Your Progress

- 16 pepperoni pizzas out of 24 pizzas
- 30 minutes of commercials to 2 hours of programming

A **rate** is a ratio that compares two quantities with different types of units such as \$5 for 2 pounds or 130 miles in 2 hours. When a rate is simplified so it has a denominator of 1, it is called a **unit rate**. An example of a unit rate is \$6.50 *per hour*, which means \$6.50 *per 1 hour*.

EXAMPLE Find a Unit Rate

- 3 TRAVEL** Darrell drove 187 miles in 3 hours. What was Darrell's average rate of speed in miles per hour?

Write the rate that expresses the comparison of miles to hours. Then find the average speed by finding the unit rate.

$$\frac{187 \text{ miles}}{3 \text{ hours}} \approx \frac{62 \text{ miles}}{1 \text{ hour}}$$

Divide the numerator and denominator by 3 to get a denominator of 1.

Darrell drove an average speed of about 62 miles per hour.

- CHECK Your Progress** Express each rate as a unit rate.

- c. 24 tickets for 8 rides d. 4 inches of rain in 5 hours

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Real-World EXAMPLE Compare Unit Rates

- 4 CIVICS** In 2000, the population of Texas was about 20,900,000, and the population of Kentucky was about 4,000,000. There were 32 members of the U.S. House of Representatives from Texas and 6 from Kentucky. In which state did a member represent more people?

For each state, write a rate that compares the state's population to its number of representatives. Then find the unit rates.



$$\frac{20,900,000 \text{ people}}{32 \text{ representatives}} \approx \frac{650,000 \text{ people}}{1 \text{ representative}}$$



$$\frac{4,000,000 \text{ people}}{6 \text{ representatives}} \approx \frac{670,000 \text{ people}}{1 \text{ representative}}$$

A member represented more people in Kentucky than in Texas.

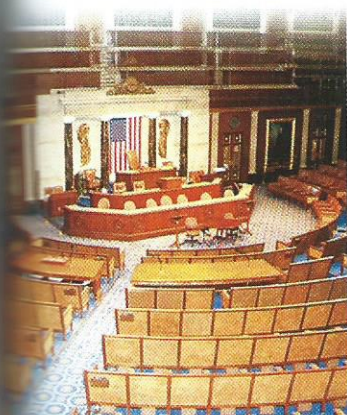
- CHECK Your Progress**

SHOPPING Decide which is the better buy. Explain your reasoning.

- e. a 17-ounce box of cereal for \$4.89 or a 21-ounce box for \$5.69
f. 6 cans of green beans for \$1 or 10 cans for \$1.95

READING Math

Math Symbols The symbol \approx is read *approximately equal to*.



Real-World Link

In the U.S. House of Representatives, the number of representatives from each state is based on a state's population in the preceding census.

Source: www.house.gov



CHECK Your Understanding

Examples 1, 2
(p. 190)

Express each ratio in simplest form.

- 12 missed days out of 180 days
- 12 wins to 18 losses
- 6 inches of water for 7 feet of snow
- 3 quarts of soda: 1 gallon of juice

Example 3
(p. 191)

Express each rate as a unit rate.

- \$50 for 4 days of work
- 3 pounds of dog food in 5 days

Example 4
(p. 191)

- SHOPPING** You can buy 4 Granny Smith apples at Ben's Mart for \$0.95. SaveMost sells 6 of the same quality apples for \$1.49. Which store has the better buy? Explain your reasoning.

Exercises

HOMEWORK HELP

For Exercises	See Examples
8-11	1
12-15	2
16-21	3
22-23	4

Express each ratio in simplest form.

- 14 chosen out of 70 who applied
- 28 out of 100 doctors disagree
- 33 stores open to 18 closed
- 56 boys to 64 girls participated
- 1 cup vinegar in 8 pints of water
- 2 yards wide: 10 feet long
- 20 centimeters out of 1 meter cut
- 2,500 pounds for 1 ton of steel

- BASEBALL** In 2005, Hank Aaron was still the MLB career all-time hitter, with 3,771 hits in 3,298 games. What was Aaron's average number of hits per game?

- CARS** Manufacturers must publish a car's gas mileage or the average number of miles one can expect to drive per gallon of gasoline. The test of a new car resulted in 2,250 miles being driven using 125 gallons of gas. Find the car's expected gas mileage.

Express each rate as a unit rate.

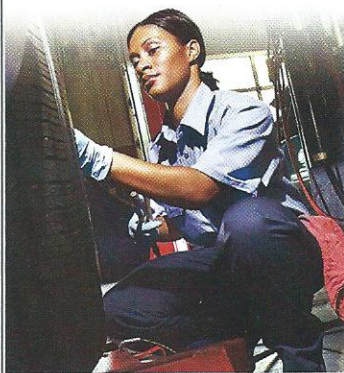
- 153 points in 18 games
- 350 miles on 15 gallons
- 100 meters in 12 seconds
- 1,473 people entered in 3 hours

- ELECTRONICS** A 20-gigabyte digital music player sells for \$249. A similar 30-gigabyte player sells for \$349. Which player offers the better price per gigabyte of storage? Explain.

- TRACK** Logan ran a 200-meter race in 25.24 seconds, and Scott ran a 400-meter race in 52.77 seconds. Who ran faster, Logan or Scott? Explain.

Convert each rate.

- 60 mi/h = ft/s
- 180 gal/h = oz/min



Real-World Link

Gas mileage can be improved by as much as 3.3% by keeping tires inflated to the proper pressure.

Source:
www.fueleconomy.gov

EXTRAPRACTICE

See pages 703, 731.

Math  **online**Self-Check Quiz at
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26. **TRAVEL** Three people leave at the same time from Rawson to travel to Huntsville. Sarah averaged 45 miles per hour for the first third of the trip, 55 miles per hour for the second third, and 75 miles per hour for the last third. Darnell averaged 55 miles per hour for the first half of the trip and 70 miles per hour for the second half. Megan drove at a steady speed of 60 miles per hour the entire trip. Who arrived at Huntsville first? Explain.

H.O.T. Problems

27. **Which One Doesn't Belong?** Identify the situation that does not describe the same type of relationship as the other two. Explain your reasoning.

She reads two pages for every one page he reads.

Sam has three more chips than Wes has.

Jana has half as many CDs as Beth has.

28. **CHALLENGE** Luisa and Rachel have some trading cards. The ratio of Luisa's cards to Rachel's cards is 3:1. If Luisa gives Rachel 2 cards, the ratio will be 2:1. How many cards does Luisa have? Explain.
29. **WRITING IN MATH** Write about a real-world situation that can be represented by the ratio 2:5.

 **TEST PRACTICE**

30. Lucy typed 210 words in 5 minutes, and Yvonne typed 336 words in 8 minutes. Based on these rates, which statement is true?
- A Lucy's rate was 3-words-per-minute slower than Yvonne's rate.
B Lucy's rate was 25.2-words-per-minute faster than Yvonne's rate.
C Lucy's rate was about 15.8-words-per-minute faster than Yvonne's rate.
D Lucy's rate was equal to Yvonne's rate.
31. Mr. Volquez bought two 3-pound bags of yellow onions for \$3. If white onions sold for \$0.59 per pound, why did Mr. Volquez make the better buy?
- F Yellow onions cost \$0.09 less per pound than white onions.
G Yellow onions cost \$0.41 less per pound than white onions.
H Yellow onions cost \$0.09 more per pound than white onions.
J Fewer white onions will fit in a 3-pound bag than yellow onions.

 **Spiral Review**

Graph each pair of ordered pairs. Then find the distance between the points. Round to the nearest tenth. (Lesson 3-7)

32. (1, 4), (6, -3) 33. (-1, 5), (3, -2) 34. (-5, -2), (-1, 0) 35. (-2, -3), (3, 1)

36. **GYMNASTICS** A square floor exercise mat measures 40 feet on each side. Find the length of the mat's diagonal. (Lesson 3-6)

 **GET READY for the Next Lesson**

PREREQUISITE SKILL Write each expression as a decimal. (Lesson 2-1)

37. $\frac{19}{5}$

38. $\frac{3}{8}$

39. $\frac{12.4}{4}$

40. $\frac{2.5}{5}$