What You'll Learn

To write ratios and use them to compare quantities

New Vocabulary ratio, equivalent ratios

Why Learn This?

The keys on a music keyboard have a repeating pattern of five black keys and seven white keys. You can use ratios to describe patterns.

The ratio of black keys to white keys in the pattern is 5 to 7. What is the ratio of black keys to all keys in the pattern?



| 5 | 7 |
|---|----|
| | 12 |

KEY CONCEPTS

Ratio

A ratio is a comparison of two quantities by division. You can write a ratio in three ways.

Arithmetic

5 to 7 5: 7
$$\frac{5}{7}$$

Algebra

$$a ext{ to } b ext{ } a : b ext{ } \frac{a}{b}$$

where
$$b \neq 0$$

EXAMPLE Writing Ratios



Music Using the pattern shown above, write the ratio of black keys to all keys in three ways.

$$\begin{array}{cccc} \mathsf{black}\;\mathsf{keys} \to & 5\;\mathsf{to}\;12 & \leftarrow \mathsf{all}\;\mathsf{keys} \\ \mathsf{black}\;\mathsf{keys} \to & 5:12 & \leftarrow \mathsf{all}\;\mathsf{keys} \\ & & \frac{5}{12} & \leftarrow \mathsf{black}\;\mathsf{keys} \\ & & \leftarrow \mathsf{all}\;\mathsf{keys} \end{array}$$

| 5 | 7 |
|---|----|
| | 12 |

Example

Writing Ratios There are 7 red stripes and 6 white stripes on the flag of the United States. Write the ratio of red stripes to white stripes in three ways.

```
red stripes \rightarrow
                                  ← white stripes
                     7 to 6
red stripes \rightarrow
                                  ← white stripes
                      7:6
                                  ← red stripes
                                  ← white stripes
```

Quick Check

- 1. Write each ratio in three ways. Use the pattern of piano keys shown at the right.
 - a. white keys to all keys



b. white keys to black keys

7 to 5, 7:5,
$$\frac{7}{5}$$

Two ratios that name the same number are equivalent ratios. In a previous course, you learned to write equivalent fractions. You can find equivalent ratios by writing a ratio as a fraction and finding an equivalent fraction.

EXAMPLES Writing Equivalent Ratios

2 Find a ratio equivalent to $\frac{4}{5}$.

$$\frac{4 \times 2}{5 \times 2} = \frac{8}{10}$$
 \leftarrow Multiply the numerator and denominator by 2.

Write the ratio 2 yd to 20 ft as a fraction in simplest form.

$$\begin{split} \frac{2 \text{ yd}}{20 \text{ ft}} &= \frac{2 \times 3 \text{ ft}}{20 \text{ ft}} &\leftarrow \text{There are 3 ft in each yard.} \\ &= \frac{6 \text{ ft}}{20 \text{ ft}} &\leftarrow \text{Multiply.} \\ &= \frac{6 \text{ ft} \div 2}{20 \text{ ft} \div 2} &\leftarrow \text{Divide by the GCF, 2.} \\ &= \frac{3}{10} &\leftarrow \text{Simplify.} \end{split}$$

Examples

Writing Equivalent Ratios Find a ratio equivalent to $\frac{14}{4}$.

$$\frac{14 \div \boxed{2}}{4 \div \boxed{2}} = \frac{\boxed{7}}{\boxed{2}}$$

← Divide the numerator and denominator by 2.

Writing Equivalent Ratios Write the ratio 2 lb to 56 oz as a fraction in simplest form.

$$\frac{2 \text{ lb}}{56 \text{ oz}} = \frac{2 \times 16 \text{ oz}}{56 \text{ oz}} \qquad \leftarrow \text{There are 16 oz in each pound.}$$

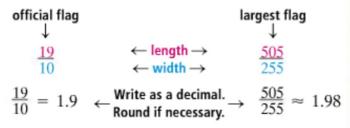
$$= \frac{32}{56 \text{ oz}} \qquad \leftarrow \text{Multiply.}$$

$$= \frac{32}{56 \div 8} \frac{\cdot 8}{\text{oz}} \qquad \leftarrow \text{Divide by the GCF, 8 oz.}$$

$$= \frac{4}{7} \qquad \leftarrow \text{Simplify.}$$

EXAMPLE Comparing Ratios

Social Studies An official U.S. flag has a length-to-width ratio of 19: 10. The largest U.S. flag measures 505 ft by 255 ft. Is this an official U.S. flag?



Since 1.98 is not equal to 1.9, the largest flag is not an official U.S. flag.



Omparing Ratios The ratio of girls to boys enrolled at King Middle School is 15:16. There are 195 girls and 208 boys in Grade 8. Is the ratio of girls to boys in Grade 8 equivalent to the ratio of girls to boys in the entire school?

| | Entire Sch | ıool | | | Grade 8 |
|--------|-------------------|--------------|---------------------|---------------|---------------------|
| | 15 | \leftarrow | girls | \rightarrow | 195 |
| | 16 | \leftarrow | boys | \rightarrow | 208 |
| 15 = [| 0.9375 |]← ! | Write as a decimal. | \rightarrow | 195 208 = 0.9375 |

Since the two decimals are equal, the ratio of girls to boys in Grade 8 is **equivalent** to the ratio of girls to boys in the entire school.

Quick Check

2. Find a ratio equivalent to $\frac{7}{9}$.

Answers may vary. Sample answer: $\frac{14}{18}$.

3. Write the ratio 3 gal to 10 qt as a fraction in simplest form.

6 5

4. Tell whether the ratios below are equivalent or not equivalent.

a. 7:3,128:54

b. $\frac{180}{240}, \frac{25}{34}$

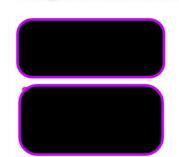
c. 6.1 to 7, 30.5 to 35

not equivalent

not equivalent

equivalent

Check Your Understanding



- 1. Vocabulary How are equivalent ratios like equivalent fractions?
- 2. Number Sense Do all ratios compare a part to a whole? Explain.

Find an equivalent ratio for each ratio.

Write each ratio as a fraction in simplest form.

8.
$$\frac{4 \text{ min}}{90 \text{ s}}$$

Tell whether the ratios are equivalent or not equivalent.

9.
$$\frac{12}{24}$$
, $\frac{50}{100}$

You have an assignment worksheet, and time to begin working on it now.

| Pra | | | | | | |
|---------------------------|---|--|---|--|---------------------------------|------|
| | ctice 4-1 | | | | | Rati |
| Writ | e a ratio for e | ach situation i | in three way | s. | | |
| 1. | Ten years ago | in Louisiana, | schools aver | aged 182 pupils fo | every 10 teachers. | |
| 2. 1 | Between 1899 | and 1900, 284 | out of 1,000 | people in the Un | ted States were 5–17 years old. | |
| - | | | | | | |
| Use | the chart belo | w for Exercise | es 3-4. | | | |
| Thre | e seventh-gra | de classes wer | e asked whe | ther they wanted | hicken | |
| or pa | asta served at | their awards t | oanquet. | | | |
| Ro | om Number | Chicken | Pasta | | | |
| | 201 | 10 | 12 | | | |
| | 202 | 8 | 17 | | | |
| | | | | | | |
| | students who | prefer pasta? | | s who prefer chick | - | |
| 4. | In room 201, v students who | what is the rati prefer pasta? totals for all the | io of student | s who prefer chick What is the ratio of the number of stu | the | |
| 4. (| In room 201, v students who Combine the t number of stu who prefer ch | what is the rati prefer pasta? totals for all the dents who pre- ticken? | nree rooms. V | What is the ratio of the number of stu | the | |
| 4. (| In room 201, v students who Combine the t number of stu who prefer ch | what is the rati prefer pasta? totals for all the | nree rooms. Vefer pasta to | What is the ratio of the number of stu | the | |
| 4. (| In room 201, v students who profer ch | what is the rationerfer pasta? totals for all the dents who precicken? | io of student inree rooms. Vefer pasta to simplest for 6. 81:27 | What is the ratio of the number of stum. | the | |
| 4. 4. 4. Writt 5. Tell 8. | In room 201, v students who prefer ch umber of stu who prefer ch 12 to 18 whether the ratio at 12:24,50:100 | what is the ratiprefer pasta? totals for all the dents who precicken? s a fraction in atios are equiv | io of student aree rooms. In fer pasta to simplest for 6. 81:27 | What is the ratio of the number of stumber of stumber. | the | |
| 4. 4. 4. Writt 5. Tell 8. | In room 201, v students who prefer ch umber of stu who prefer ch 12 to 18 whether the ratio at 12:24,50:100 | what is the ration prefer pasta? totals for all the dents who prefer pasta? s a fraction in the state of th | io of student aree rooms. In fer pasta to simplest for 6. 81:27 | What is the ratio of the number of stumber of stumber. | the | |
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| 4. (| In room 201, v students who Combine the t number of stu who prefer ch | what is the rationerfer pasta? totals for all the dents who precicken? | nree rooms. Vefer pasta to | What is the ratio of the number of stu | the | |