

LESSON
8.4

Writing and Solving Proportions

BEFORE

You learned how to write ratios.

Now

You'll solve proportions using equivalent ratios and algebra.

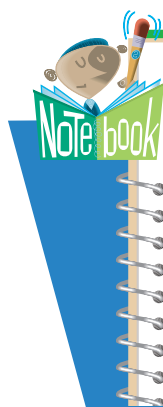
WHY?

So you can find the width of a Viking ship, as in Ex. 24.

Word Watch
proportion, p. 387

In the Real World

Sports A person burned about 150 calories while skateboarding for 30 minutes. About how many calories would the person burn while skateboarding for 60 minutes? In Example 1, you will use a *proportion* to answer this question.



Proportions

Words A **proportion** is an equation that states that two ratios are equivalent.

Numbers $\frac{3}{5} = \frac{6}{10}$

The proportion is read
"3 is to 5 as 6 is to 10."

Algebra $\frac{a}{b} = \frac{c}{d}$, where b and d are nonzero numbers.

Using Equivalent Ratios When one of the numbers in a proportion is unknown, you can find the number by *solving the proportion*. One way to solve a proportion is to use mental math to find an equivalent ratio.

EXAMPLE 1 Using Equivalent Ratios

To find the number C of calories the person would burn while skateboarding for 60 minutes, solve the proportion $\frac{150}{30} = \frac{C}{60}$.

① Ask yourself: What number can you multiply 30 by to get 60?

$$\frac{150}{30} = \frac{C}{60}$$

↘ × ?

② Because $30 \times 2 = 60$, multiply the numerator by 2 to find C .

$$\frac{150}{30} = \frac{C}{60}$$

↗ × 2

ANSWER Because $150 \times 2 = 300$, $C = 300$. So, the person would burn about 300 Calories while skateboarding for 60 minutes.



Using Algebra The same method you used to solve division equations in Lesson 7.4 can also be used to solve proportions that have the variable in the numerator.

HELP with Notetaking

As you learn different methods for solving a proportion, remember to write an example of each method in your notebook.

EXAMPLE 2 Solving Proportions Using Algebra

xy Solve the proportion $\frac{6}{10} = \frac{x}{25}$.

$\frac{6}{10} = \frac{x}{25}$ Write original proportion.

$25 \cdot \frac{6}{10} = 25 \cdot \frac{x}{25}$ Multiply each side by 25.

$\frac{150}{10} = x$ Simplify.

$15 = x$ Simplify fraction.

ANSWER The solution is 15.

Your turn now Use equivalent ratios to solve the proportion.

1. $\frac{1}{5} = \frac{z}{20}$ 2. $\frac{8}{3} = \frac{k}{18}$ 3. $\frac{27}{c} = \frac{9}{12}$ 4. $\frac{9}{n} = \frac{99}{22}$

Use algebra to solve the proportion.

5. $\frac{4}{14} = \frac{m}{49}$ 6. $\frac{25}{30} = \frac{x}{12}$ 7. $\frac{h}{33} = \frac{2}{6}$ 8. $\frac{b}{8} = \frac{7}{28}$

Setting Up a Proportion There are different ways to set up a proportion. Consider the following problem.

**Yesterday you bought 8 bagels for \$4.
Today you want only 5 bagels. How much will 5 bagels cost?**

The information is arranged in the two tables below, in which x represents the cost of 5 bagels. The proportions that follow from the tables appear below the tables.

	Yesterday	Today
Cost	4	x
Bagels	8	5

Proportion: $\frac{4}{8} = \frac{x}{5}$

	Bagels	Cost
Today	5	x
Yesterday	8	4

Proportion: $\frac{5}{8} = \frac{x}{4}$



Watch Out!



You cannot write a proportion that compares bagels to dollars and dollars to bagels.

$\frac{\text{bagels}}{\text{dollars}} \neq \frac{\text{dollars}}{\text{bagels}}$



EXAMPLE 3 Writing and Solving a Proportion

Empire State Building At maximum speed, the elevators in the Empire State Building can pass 80 floors in 45 seconds. Follow the steps below to find the number of floors that the elevators can pass in 9 seconds.

- 1 Write a proportion. Let x represent the floors passed in 9 seconds.

$$\frac{80}{45} = \frac{x}{9} \quad \begin{array}{l} \leftarrow \text{floors} \\ \leftarrow \text{seconds} \end{array}$$

- 2 Solve the proportion.

$$\frac{80}{45} = \frac{x}{9} \quad \text{Write original proportion.}$$

$$9 \cdot \frac{80}{45} = 9 \cdot \frac{x}{9} \quad \text{Multiply each side by 9.}$$

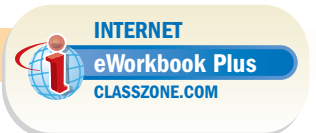
$$\frac{720}{45} = x \quad \text{Simplify.}$$

$$16 = x \quad \text{Simplify fraction.}$$

ANSWER The elevators can pass 16 floors in 9 seconds.

8.4 Exercises

More Practice, p. 712



Getting Ready to Practice

- Vocabulary** Copy and complete: A(n) ? is an equation that states that two ratios are equivalent.
- Writing** Describe two different methods for solving a proportion.

In Exercises 3–6, match the proportion with its solution.

3. $\frac{5}{6} = \frac{x}{18}$

4. $\frac{15}{20} = \frac{x}{4}$

5. $\frac{x}{6} = \frac{4}{2}$

6. $\frac{x}{5} = \frac{5}{25}$

A. 3

B. 15

C. 1

D. 12

- Recipes** A recipe that makes 12 pints of salsa uses 35 tomatoes. Choose the proportion that you can use to determine the number t of tomatoes needed to make 2 pints of salsa.

A. $\frac{12}{35} = \frac{t}{2}$

B. $\frac{t}{35} = \frac{12}{2}$

C. $\frac{35}{12} = \frac{t}{2}$

HELP with Homework

Example	Exercises
1	8-11, 22-23
2	12-15, 22-23
3	17-19, 21-25

 **Online Resources**
CLASSZONE.COM

- More Examples
- eTutorial Plus



Practice and Problem Solving

Use equivalent ratios to solve the proportion.

8. $\frac{3}{7} = \frac{a}{21}$

9. $\frac{4}{36} = \frac{w}{9}$

10. $\frac{2}{s} = \frac{18}{45}$

11. $\frac{4}{c} = \frac{2}{10}$

Algebra Use algebra to solve the proportion.

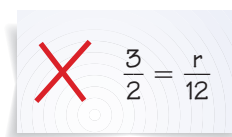
12. $\frac{h}{8} = \frac{3}{12}$

13. $\frac{k}{27} = \frac{4}{6}$

14. $\frac{6}{14} = \frac{m}{21}$

15. $\frac{20}{16} = \frac{n}{12}$

16. **Find the Error** To make orange food coloring, 2 drops of red are mixed with 3 drops of yellow. Describe and correct the error in the proportion used to find the number of drops r of red to add to 12 drops of yellow.



17. **Reading** Phoebe can read about 1250 words in 5 minutes. About how many words can she read in 15 minutes?
18. **Painting** It takes 4 quarts of paint to cover 560 square feet. How many quarts of the same paint are needed to cover 140 square feet?
19. **Apples** The average American eats 57 pounds of apples over 3 years. At this rate, how many pounds of apples does a person eat in 15 years?
20. **Critical Thinking** Is it possible to write a proportion using $\frac{11}{13}$ and $\frac{55}{65}$? Explain your reasoning.

21. **Dog Biscuits** The table lists the flour needed to make dough for a given number of dog biscuits. Copy and complete the table.

Biscuits	32	48	?
Flour (cups)	2	?	5

In Exercises 22 and 23, write and then solve the proportion.

22. 8 is to 3 as w is to 12.
23. 6 is to 16 as z is to 40.
24. **History** The remains of the Viking ship *Ladby* were discovered in 1935. The ratio of the width to the length of the ship was 3 to 20. If the ship had a length of 70 feet, what was its width?
25. **Population** In the United States, 21 out of every 100 people are under the age of 15. In a town of 20,000 people, how many people would you expect to be under the age of 15?



Challenge Solve the proportion.

26. $\frac{30}{v} = \frac{12}{16}$

27. $\frac{8}{x} = \frac{6}{15}$

28. $\frac{22}{33} = \frac{16}{y}$

29. $\frac{4}{24} = \frac{6}{z}$

30. **Cruise Liner** A cruise liner moves 6 inches for every gallon of fuel that it burns. How many gallons of fuel will it burn if it travels 100 miles?

Mixed Review

Order the numbers from least to greatest. (Lesson 4.7)

31. $0.6, \frac{12}{5}, 0.\bar{6}, \frac{6}{7}, 0.1$ 32. $0.5, \frac{5}{9}, \frac{9}{5}, 0.\bar{9}, 0.8$ 33. $1.1, \frac{2}{5}, 0.15, 0.\bar{1}$

Draw the line that has the given slope and passes through the given point. (Lesson 8.3)

34. slope = 4; (1, -4) 35. slope = $\frac{1}{2}$; (-1, 2) 36. slope = -2; (0, 3)

Basic Skills Copy and complete the statement using <, >, or =.

37. $2.22 \times 10^{11} \underline{\quad} 1.89 \times 10^{11}$

38. $623,000,000 \underline{\quad} 6.23 \times 10^9$

Test-Taking Practice

39. **Extended Response** The ratio of teachers to students at a school is 2 to 23. The ratio of female students to the total number of students is 4 to 9. If there are 621 total students, find the number of teachers and the number of female students at the school. Explain your reasoning.



BRAIN GAME

Shape Association

Use the two true statements below to copy and complete the proportions at the right.

$$\frac{\triangle}{\square} = \frac{\square}{\circ}$$

$$\frac{\circ}{\circ} = \frac{\triangle}{\square}$$

1. $\frac{\triangle}{\square} = \frac{?}{?}$

2. $\frac{\square}{\circ} = \frac{\triangle}{?}$

3. $\frac{\triangle}{\circ} = \frac{?}{\square}$

4. $\frac{?}{\circ} = \frac{\triangle}{?}$

