2-7 Solving Proportions

Vocabulary

Review

Write each *unit rate* in words.

1. 65 mi/h — sixty-five _____ per _____
2. 7 ft/day — seven _____ per _____
3. $3.99/lb — three dollars ninety-nine _____ per _____
4. 11 km/s — eleven _____ per _____

Vocabulary Builder

proportion (noun) **pruh PAWR shun**

Definition: A **proportion** is an equation that states that two ratios are equal.

What It Means: Any equation of the form $\frac{a}{b} = \frac{c}{d}$, where $b \neq 0$ and $d \neq 0$, is a **proportion**. You read a proportion "a is to b as c is to d."

Related Word: proportional (adjective)

A **proportion** always has an **equal sign**.

$$\frac{1}{5} = \frac{6}{30}$$

Use Your Vocabulary

Complete each statement with the correct word from the list below.

proportion ratios proportional

5. A scaled map of the roads in a city is ? to the actual roads. _____
6. When making fruit punch, you have to be sure that the amount of ginger ale is in ? to the amount of fruit juice. _____
7. Because $\frac{5}{8}$ is not equal to $\frac{15}{20}$, the ? $\frac{5}{8}$ and $\frac{15}{20}$ do not form a proportion. _____

Problem 1 Solving a Proportion Using the Multiplication Property

Got It? What is the solution of the proportion $\frac{x}{7} = \frac{4}{5}$?

8. Use the justifications at the right to solve the proportion.

$\frac{x}{7} = \frac{4}{5}$	Write the original equation.
$\square \cdot \frac{x}{7} = \square \cdot \frac{4}{5}$	Multiply each side by $\square$.
$\square = \frac{28}{5}$	Simplify.
$x = \square$	Divide.

In the proportion $\frac{a}{b} = \frac{c}{d}$, the products ad and bc are called *cross products*. You can use the following property of cross products to solve proportions.

take note

Property Cross Products Property of a Proportion

9. Complete the table.

Words	The cross products of a proportion are equal.
Algebra	If $\frac{a}{b} = \frac{c}{d}$, where $b \neq 0$ and $d \neq 0$, then $ad = \square$.
Example	$\frac{2}{3} = \frac{8}{12}$, so $2 \cdot \square = 3 \cdot \square$, or $24 = \square$.

Problem 2 Solving a Proportion Using the Cross Products Property

Got It? What is the solution of the proportion $\frac{y}{3} = \frac{3}{5}$?

10. Use the model to help you find the cross products.

$5 \cdot \square \rightarrow \frac{y}{3} = \frac{3}{5} \leftarrow 3 \cdot \square$

11. Solve the proportion $\frac{y}{3} = \frac{3}{5}$.

Problem 3 Solving a Multi-Step Proportion

Got It? What is the solution of the proportion $\frac{n}{5} = \frac{2n + 4}{6}$?

12. Complete the reasoning model below.

Think	Write
First I write the original proportion.	$\frac{\square}{\square} = \frac{\square}{\square}$
Next I use the Cross Products Property.	$(\square)n = 5(\square)$
Then I use the Distributive Property.	$\square \cdot n = 10 \cdot \square + \square$
I subtract 10n from each side.	$6n - \square = 10n + \square - \square$
I simplify both sides.	$\square \cdot n = \square$
Now I divide each side by −4.	$\frac{\square}{-4} = \frac{\square}{-4}$
Finally, I simplify.	$n = \square$

When you model a real-world situation with a proportion, you must write the proportion carefully. Be sure that the order of what is compared in each ratio is the same.

Correct: $\frac{100 \text{ mi}}{2 \text{ h}} = \frac{x \text{ mi}}{5 \text{ h}}$ Incorrect: $\frac{100 \text{ mi}}{2\text{h}} = \frac{5 \text{ h}}{x \text{ mi}}$

13. Suppose you can buy 3 pounds of meat for $12. Cross out the proportion below that will NOT help you find the cost of 5 pounds of meat.

$\frac{12 \text{ dollars}}{3 \text{ lb}} = \frac{x \text{ dollars}}{5 \text{ lb}}$ $\frac{12 \text{ dollars}}{3 \text{ lb}} = \frac{5 \text{ lb}}{x \text{ dollars}}$ $\frac{3 \text{ lb}}{12 \text{ dollars}} = \frac{5 \text{ lb}}{x \text{ dollars}}$

14. Suppose you need 9 pieces of wood to build 4 birdhouses. Cross out the proportion below that will NOT help you find the number of pieces of wood you will need to build 15 birdhouses.

$\frac{15 \text{ birdhouses}}{x \text{ pieces}} = \frac{4 \text{ birdhouses}}{9 \text{ pieces}}$ $\frac{9 \text{ pieces}}{4 \text{ birdhouses}} = \frac{x \text{ pieces}}{15 \text{ birdhouses}}$ $\frac{9 \text{ pieces}}{15 \text{ birdhouses}} = \frac{x \text{ pieces}}{4 \text{ birdhouses}}$

15. Suppose you can knit 3 scarves from 5 packages of yarn. Let x = the number of scarves you can knit from 12 packages of yarn. Complete the proportion.

$\frac{5 \text{ packages}}{3 \text{ scarves}} = \frac{\square}{\square}$

Problem 4 Using a Proportion to Solve a Problem

Got It? An 8-oz can of orange juice contains about 97 mg of vitamin C. About how many milligrams of vitamin C are there in a 12-oz can of orange juice?

16. Let c = _____.

17. Circle the proportion you will use to solve this problem.

$\frac{8\text{ oz}}{12\text{ oz}} = \frac{c\text{ mg}}{97\text{ mg}}$ $\frac{12\text{ oz}}{8\text{ oz}} = \frac{c\text{ mg}}{97\text{ mg}}$ $\frac{8\text{ oz}}{97\text{ mg}} = \frac{12\text{ oz}}{c\text{ mg}}$ $\frac{12\text{ oz}}{8\text{ oz}} = \frac{97\text{ mg}}{c\text{ mg}}$

18. Solve the problem using the proportion you chose.

19. There are about _____ mg of vitamin C in a 12-oz can of orange juice.

Lesson Check • Do you UNDERSTAND?

Reasoning When solving $\frac{x}{5} = \frac{3}{4}$, Lisa's first step was to write $4x = 5(3)$. Jen's first step was to write $20\left(\frac{x}{5}\right) = 20\left(\frac{3}{4}\right)$. Will both methods work? Explain.

20. Circle the property that Lisa used. Underline the property that Jen used.

Multiplication Property Cross Products Property

21. Solve: $4x = 5(3)$.

22. Solve: $20\left(\frac{x}{5}\right) = 20\left(\frac{3}{4}\right)$.

23. Will both methods work? Explain.

_____

Math Success

Check off the vocabulary words that you understand.

☐ proportion ☐ cross products ☐ Cross Products Property

Rate how well you can solve proportions.