English Spanish

3.5 Solving Proportions

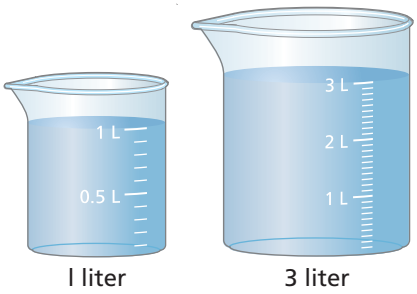
Essential Question How can you use ratio tables and cross products to solve proportions in science?

1 ACTIVITY: Solving a Proportion in Science

SCIENCE Scientists use *ratio tables* to determine the amount of a compound (like salt) that is dissolved in a solution. Work with a partner to show how scientists use cross products to determine the unknown quantity in a ratio.

a. Sample: Salt Water

Salt Water	1 L	3 L
Salt	250 g	x g



1 liter 3 liter

$\frac{3\,\cancel{L}}{1\,\cancel{L}} = \frac{x\,\cancel{g}}{250\,\cancel{g}}$ Write proportion.

$3 \cdot 250 = 1 \cdot x$ Set cross products equal.

$750 = x$ Simplify.

∴ So, there are 750 grams of salt in the 3-liter solution.

b. White Glue Solution

Water	$\frac{1}{2}$ cup	1 cup
White Glue	$\frac{1}{2}$ cup	x cups

c. Borax Solution

Borax	1 tsp	2 tsp
Water	1 cup	x cups

d. Slime (see recipe)

Borax Solution	$\frac{1}{2}$ cup	1 cup
White Glue Solution	y cups	x cups

Recipe for SLIME

1. Add $\frac{1}{2}$ cup of water and $\frac{1}{2}$ cup white glue. Mix thoroughly. This is your white glue solution.
2. Add a couple drops of food coloring to the glue solution. Mix thoroughly.
3. Add 1 teaspoon of borax to 1 cup of water. Mix thoroughly. This is your borax solution (about 1 cup).
4. Pour the borax solution and the glue solution into a separate bowl.
5. Place the slime that forms in a plastic bag and squeeze the mixture repeatedly to mix it up.

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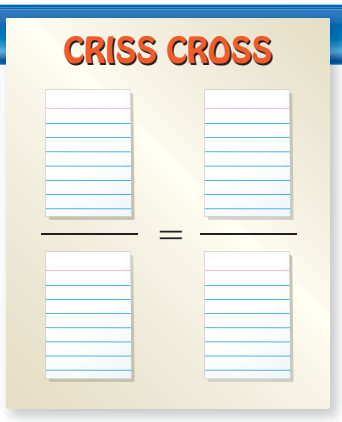
2 ACTIVITY: The Game of Criss Cross



Preparation:

- Cut index cards to make 48 playing cards.
- Write each number on a card.

  1, 1, 1, 2, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 5, 6, 6, 6, 7, 7, 7, 8, 8, 8, 9, 9, 9, 10, 10, 10, 12, 12, 12, 13, 13, 13, 14, 14, 14, 15, 15, 15, 16, 16, 16, 18, 20, 25

- Make a copy of the game board.

To Play:

- Play with a partner.
- Deal 8 cards to each player.
- Begin by drawing a card from the remaining cards. Use four of your cards to try to form a proportion.
- Lay the four cards on the game board. If you form a proportion, say "Criss Cross" and you earn 4 points. Place the four cards in a discard pile. Now it is your partner's turn.
- If you cannot form a proportion, then it is your partner's turn.
- When the original pile of cards is empty, shuffle the cards in the discard pile and start again.
- The first player to reach 20 points wins.

What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you use ratio tables and cross products to solve proportions in science? Give an example.

4. **PUZZLE** Use each number once to form three proportions.

1	2	10	4	12	20
15	5	16	6	8	3

Practice Use what you discovered about solving proportions to complete Exercises 10–13 on page 126.

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3.5 Lesson

Check It Out
Lesson Tutorials
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Key Idea

Solving Proportions

Method 1 Use mental math. *(Section 3.4)*

Method 2 Use the Multiplication Property of Equality. *(Section 3.5)*

Method 3 Use the Cross Products Property. *(Section 3.5)*

EXAMPLE 1 Solving Proportions Using Multiplication

Solve $\frac{5}{7} = \frac{x}{21}$.

$\frac{5}{7} = \frac{x}{21}$ Write the proportion.

$21 \cdot \frac{5}{7} = 21 \cdot \frac{x}{21}$ Multiply each side by 21.

$15 = x$ Simplify.

∴ The solution is 15.

On Your Own

Now You're Ready
Exercises 4–9

Solve the proportion using multiplication.

1. $\frac{w}{6} = \frac{6}{9}$
2. $\frac{12}{10} = \frac{a}{15}$
3. $\frac{y}{6} = \frac{2}{4}$

EXAMPLE 2 Solving Proportions Using the Cross Products Property

Solve each proportion.

a. $\frac{x}{8} = \frac{7}{10}$

$x \cdot 10 = 8 \cdot 7$ Use the Cross Products Property.

$10x = 56$ Multiply.

$x = 5.6$ Divide.

∴ The solution is 5.6.

b. $\frac{9}{y} = \frac{3}{17}$

$9 \cdot 17 = y \cdot 3$

$153 = 3y$

$51 = y$

∴ The solution is 51.

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On Your Own

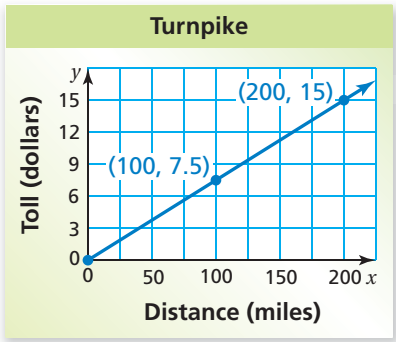
Now You're Ready
Exercises 10–21

Solve the proportion using the Cross Products Property.

4. $\frac{2}{7} = \frac{x}{28}$ **5.** $\frac{12}{5} = \frac{6}{y}$ **6.** $\frac{40}{z+1} = \frac{15}{6}$

EXAMPLE 3 Real-Life Application

The toll due on a turnpike is proportional to the number of miles driven. How much does it cost to drive 150 miles?



Method 1: Interpret the slope as a unit rate.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x}$$

$$= \frac{7.5}{100} \qquad \text{Substitute.}$$

$$= 0.075 \qquad \text{Divide.}$$

The unit rate is \$0.075 per mile. Multiply to find the total cost.

$$150 \text{ mi} \cdot \frac{\$0.075}{1 \text{ mi}} = \$11.25$$

∴ It costs \$11.25 to drive 150 miles on the turnpike.

Method 2: Write and solve a proportion.

$$\frac{7.5}{100} = \frac{x}{150}$$ ← dollars, ← miles — Use (100, 7.5) to write a proportion.

$$150 \cdot \frac{7.5}{100} = 150 \cdot \frac{x}{150} \qquad \text{Multiply each side by 150.}$$

$$11.25 = x \qquad \text{Simplify.}$$

∴ It costs \$11.25 to drive 150 miles on the turnpike.

On Your Own

7. WHAT IF? In Example 3, how much does it cost to drive 75 miles on the turnpike?

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3.5 Exercises

Check It Out
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Vocabulary and Concept Check

1. **WRITING** What are three ways you can solve a proportion?
2. **OPEN-ENDED** Which way would you choose to solve $\frac{3}{x} = \frac{6}{14}$? Explain your reasoning.
3. **NUMBER SENSE** Does $\frac{x}{4} = \frac{15}{3}$ have the same solution as $\frac{x}{15} = \frac{4}{3}$? Use the Cross Products Property to explain your answer.

Practice and Problem Solving

Solve the proportion using multiplication.

1 4. $\frac{9}{5} = \frac{z}{20}$ 5. $\frac{h}{15} = \frac{16}{3}$ 6. $\frac{w}{4} = \frac{42}{24}$

7. $\frac{35}{28} = \frac{n}{12}$ 8. $\frac{7}{16} = \frac{x}{4}$ 9. $\frac{y}{9} = \frac{44}{54}$

Solve the proportion using the Cross Products Property.

2 10. $\frac{a}{6} = \frac{15}{2}$ 11. $\frac{10}{7} = \frac{8}{k}$ 12. $\frac{3}{4} = \frac{v}{14}$ 13. $\frac{5}{n} = \frac{16}{32}$

14. $\frac{36}{42} = \frac{24}{r}$ 15. $\frac{9}{10} = \frac{d}{6.4}$ 16. $\frac{x}{8} = \frac{3}{12}$ 17. $\frac{8}{m} = \frac{6}{15}$

18. $\frac{4}{24} = \frac{c}{36}$ 19. $\frac{20}{16} = \frac{d}{12}$ 20. $\frac{30}{20} = \frac{w}{14}$ 21. $\frac{2.4}{1.8} = \frac{7.2}{k}$

22. **ERROR ANALYSIS** Describe and correct the error in solving the proportion $\frac{m}{8} = \frac{15}{24}$.

✗
$$\frac{m}{8} = \frac{15}{24}$$
$$8 \cdot m = 24 \cdot 15$$
$$m = 45$$

23. **PENS** Forty-eight pens are packaged in four boxes. How many pens are packaged in nine boxes?

24. **PIZZA PARTY** How much does it cost to buy 10 medium pizzas?

Solve the proportion.

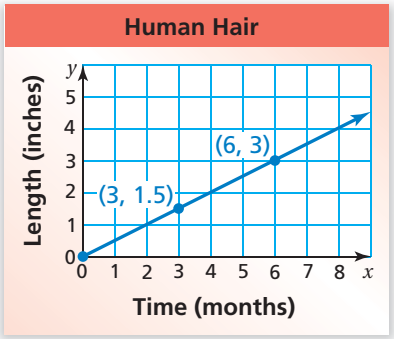
25. $\frac{2x}{5} = \frac{9}{15}$ 26. $\frac{5}{2} = \frac{d-2}{4}$ 27. $\frac{4}{k+3} = \frac{8}{14}$

28. **TRUE OR FALSE?** Tell whether the statement is *true* or *false*. Explain.

If $\frac{a}{b} = \frac{2}{3}$, then $\frac{3}{2} = \frac{b}{a}$.

29. **CLASS TRIP** It costs \$95 for 20 students to visit an aquarium. How much does it cost for 162 students?

30. **GRAVITY** A person who weighs 120 pounds on Earth weighs 20 pounds on the moon. How much does a 93-pound person weigh on the moon?



31. **HAIR** The length of human hair is proportional to the number of months it has grown.

a. How long does it take hair to grow 8 inches?

b. Use a different method than the one in part (a) to find how long it takes hair to grow 20 inches.

32. **CHEETAH** Cheetahs are the fastest mammals in the world. They can reach speeds of 70 miles per hour.

a. At this speed, how long would it take a cheetah to run 17 miles?

b. **RESEARCH** Use the Internet or library to find how long a cheetah can maintain a speed of 70 miles per hour.

33. **AUDIENCE** There are 144 people in an audience. The ratio of adults to children is 5 to 3. How many are adults?

34. **LAWN SEED** Three pounds of lawn seed covers 1800 square feet. How many bags are needed to cover 8400 square feet?

35. Critical Thinking Consider the proportions $m = \frac{1}{2}$ and $k = \frac{1}{4}$. What is the ratio $\frac{m}{k}$? Explain your reasoning.

Fair Game Review What you learned in previous grades & lessons

Copy and complete. SKILLS REVIEW HANDBOOK

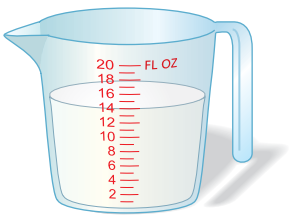
36. 530 cm = ____ m

37. 6.4 kg = ____ g

38. 56 oz = ____ lb

39. $1\frac{1}{2}$ mi = ____ ft

40. **MULTIPLE CHOICE** How many cups of milk are shown? SKILLS REVIEW HANDBOOK



(A) $\frac{7}{10}$ c

(B) $\frac{7}{8}$ c

(C) $1\frac{3}{4}$ c

(D) 14 c