Warm Up

Find the slope of the line through each pair of points.

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- **1.** (1, 5) and (3, 9) 2
- **2.** (-6, 4) and (6, -2)

Solve each equation.

- **3.** 4x + 5x + 6x = 45
- **4.** $(x 5)^2 = 81$ x = 14 or x = -4

5. Write $\frac{16}{24}$ in simplest form. $\frac{2}{3}$

Objectives

Write and simplify ratios. Use proportions to solve problems.

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A <u>ratio</u> compares two numbers by division. The ratio of two numbers *a* and *b* can be written as *a* to *b*, *a*:*b*, or $\frac{a}{2}$, where $b \neq 0$. For example, the ratios 1 to 2, 1:2^{*b*} and 1 all represent the same comparison. $\frac{1}{2}$



Example 1: Writing Ratios

Write a ratio expressing the slope of ℓ .

Slope =
$$\frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$$

= $\frac{-2 - 3}{2 - (-1)}$ Substitute the given values.
= $\frac{-5}{3} = -\frac{5}{3}$ Simplify.



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Example 2: Using Ratios

The ratio of the side lengths of a triangle is 4:7:5, and its perimeter is 96 cm. What is the length of the shortest side?

Let the side lengths be 4x, 7x, and 5x. Then 4x + 7x + 5x = 96. After like terms are combined, 16x = 96. So x = 6. The length of the shortest side is 4x = 4(6) = 24 cm.



Check It Out! Example 2

The ratio of the angle measures in a triangle is 1:6:13. What is the measure of each angle?

$$x + y + z = 180^{\circ}$$

$$x + 6x + 13x = 180^{\circ}$$

$$20x = 180^{\circ}$$

$$x = 9^{\circ}$$

$$y = 6x$$

$$z = 13x$$

$$y = 6(9^{\circ})$$

$$z = 13(9^{\circ})$$

$$z = 117^{\circ}$$

A **proportion** is an equation stating that two ratios are equal. In the proportion $\frac{a}{b} = \frac{c}{d}$, the values *a* and *d* are the **extremes**. The values *b* and *c* are the **means**. When the proportion is written as a:b = c:d, the extremes are in the first and last positions. The means are in the two middle positions. In Algebra 1 you learned the Cross Products Property. The product of the extremes *ad* and the product of the means *bc* are called the <u>cross</u> **products**.

Cross Products Property

In a proportion, if
$$\frac{a}{b} = \frac{c}{d}$$
 and b and $d \neq 0$, then $ad = bc$.

$$\frac{a}{b} \frac{c}{d}$$

$$a = bc$$

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Example 3A: Solving Proportions

Solve the proportion.

$$\frac{7}{x} = \frac{56}{72}$$

- 7(72) = *x*(56) *Cross Products Property*
 - 504 = 56x Simplify.
 - x = 9 Divide both sides by 56.



Example 3B: Solving Proportions

Solve the proportion.

$$\frac{z-4}{5} = \frac{20}{z-4}$$

- $(z 4)^2 = 5(20)$ Cross Products Property
- $(z 4)^2 = 100$ Simplify.
 - $(z 4) = \pm 10$ Find the square root of both sides.

(z - 4) = 10 or (z - 4) = -10 Rewrite as two eqns.

z = 14 or z = -6 Add 4 to both sides.



Check It Out! Example 3a

Solve the proportion.

$$\frac{3}{8} = \frac{x}{56}$$

- 3(56) = 8(x) Cross Products Property
 - 168 = 8x Simplify.
 - x = 21 Divide both sides by 8.



Check It Out! Example 3b

Solve the proportion.

$$\frac{2y}{9} = \frac{8}{4y}$$

- 2y(4y) = 9(8) Cross Products Property
 - $8y^2 = 72$ Simplify.
 - $y^2 = 9$ Divide both sides by 8.
 - $y = \pm 3$ Find the square root of both sides.
 - y = 3 or y = -3 Rewrite as two equations.



Check It Out! Example 3d

Solve the proportion.

$$\frac{x+3}{4} = \frac{9}{x+3}$$

- $(x + 3)^2 = 4(9)$ Cross Products Property
- $(x + 3)^2 = 36$ Simplify.
 - $(x + 3) = \pm 6$ Find the square root of both sides.
 - (x + 3) = 6 or (x + 3) = -6 Rewrite as two eqns.
 - x = 3 or x = -9 Subtract 3 from both sides.

The following table shows equivalent forms of the Cross Products Property.

Properties of Proportions	
ALGEBRA	NUMBERS
The proportion $\frac{a}{b} = \frac{c}{d}$ is equivalent to the following:	The proportion $\frac{1}{3} = \frac{2}{6}$ is equivalent to the following:
ad = bc	1 (6) = 3 (2)
$\frac{b}{a} = \frac{d}{c}$	$\frac{3}{1} = \frac{6}{2}$
$\frac{a}{c} = \frac{b}{d}$	$\frac{1}{2} = \frac{3}{6}$

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Example 4: Using Properties of Proportions

Given that 18*c* = 24*d*, find the ratio of *d* to *c* in simplest form.

18c = 24d	
$\frac{18}{24} = \frac{d}{c}$	Divide both sides by 24c.
$\frac{3}{4} = \frac{d}{c}$	Simplify.



Example 5: Problem-Solving Application

Marta is making a scale drawing of her bedroom. Her rectangular room is $12\frac{1}{2}$ feet wide and 15 feet long. On the scale drawing, the width of her room is 5 inches. What is the length?



The **answer** will be the length of the room on the scale drawing.



Example 5 Continued

2 Make a Plan

Let x be the length of the room on the scale drawing. Write a proportion that compares the ratios of the width to the length.

 $\frac{\text{width of room on scale drawing}}{\text{length of room on scale drawing}} = \frac{\text{width of full-size room}}{\text{length of full-size room}}$

$$\frac{5}{x} = \frac{12\frac{1}{2}}{15}$$



Example 5 Continued



$$\frac{5}{x} = \frac{12.5}{15}$$

5(15) = *x*(12.5) *Cross Products Property*

- 75 = 12.5x Simplify.
 - x = 6 Divide both sides by 12.5.

The length of the room on the scale drawing is 6 inches.

Lesson Quiz

1. The ratio of the angle measures in a triangle is 1:5:6. What is the measure of each angle?

Solve each proportion.

15°, 75°, 90°

2. $\frac{80}{120} = \frac{2}{x}$ **3** $\frac{x+3}{8} = \frac{5}{x-3}$ **7 or -7 4.** Given that 14*a* = 35*b*, find the ratio of *a* to *b* in $\frac{5}{2}$ simplest form.

5. An apartment building is 90 ft tall and 55 ft wide. If a scale model of this building is 11 in. wide, how tall is the scale model of the building?

18 in.

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