

LESSON  
**8.3**

# Solving Proportions

**Goal:** Write and solve proportions.



**Vocabulary**

Proportion: *two ratios set equal to each other*

Cross products: *ex:  $\frac{3}{4} = \frac{6}{8}$*



*"3 is to 4 as six is to 8"*

**Cross Products Property**

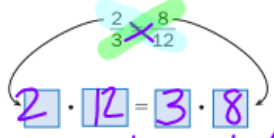
**Words** In a proportion, the cross products are equal.

**Algebra**

$\frac{p}{q} = \frac{r}{s}$ , where  $q$  and  $s$  are nonzero.

$p \cdot s = q \cdot r$

**Numbers**



$24 = 24 \checkmark$

**EXAMPLE 1** Checking a Proportion

*do form a proportion*

Use cross products to decide whether the ratios form a proportion.

The proportion  $\frac{5}{12} = \frac{20}{48}$  in part (a) of Example 1 is read "5 is to 12 as 20 is to 48."

a.  $\frac{5}{12} = \frac{20}{48}$   
 $5 \cdot 48 = 12 \cdot 20$   
 $240 = 240$

The cross products **are** equal, so the ratios **do** form a proportion.

*"yes, they form a proportion!"*

b.  $\frac{4}{7} = \frac{24}{50}$   
 $4 \cdot 50 = 7 \cdot 24$   
 $200 \neq 168$

The cross products **aren't** equal, so the ratios **don't** form a proportion.

*"No, they don't form a proportion!"*

$\neq \rightarrow$  are not equal

**EXAMPLE 2 Solving Using Mental Math**

Solve the proportion  $\frac{3}{15} = \frac{30}{x}$ .

**Solution**

**Method 1** Use equivalent ratios.

**Method 2** Use cross products.

$3 \times 10$   
 $\frac{3}{15} = \frac{30}{150}$   
 $15 \times 10$

You multiply 3 by 10 to get 30, so multiply 15 by 10 also.

$\frac{3}{15} \times \frac{30}{x}$   
 $3x = 15 \cdot 30$   
 $3x = 450$   
 $\frac{3x}{3} = \frac{450}{3}$   
 $x = 150$

Ask, "3 times what number equals 450?"

**Answer:** The solution is  $x = 150$

**Your turn now** Solve the proportion.

<p>1. <math>\frac{m}{3} = \frac{9}{27}</math></p> <p><math>\div 9</math></p> <p><math>m = 1</math></p>	<p>2. <math>\frac{16}{12} = \frac{4}{c}</math></p> <p><math>\div 4</math></p> <p><math>c = 3</math></p>	<p>3. <math>\frac{42}{y} = \frac{7}{10}</math></p> <p><math>\cdot 6</math></p> <p><math>y = 60</math></p>	<p>4. <math>\frac{22 \cdot 8}{5 \cdot 8} = \frac{t}{40}</math></p> <p><math>t = 176</math></p>
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**EXAMPLE 3 Solving Using a Verbal Model**

**Trains** A passenger train has traveled 180 miles in 3 hours. At that same rate, how long will it take to travel the total distance of 300 miles?

**Solution**

Use a proportion. Let  $t$  represent the total time it will take to travel 300 miles.

$$\frac{\text{Distance traveled}}{\text{Time traveled}} = \frac{\text{Total distance}}{\text{Total time}} \quad \text{Write a verbal model.}$$

$$\frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} \quad \text{Substitute values.}$$

$$\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} \quad \text{Rewrite proportion without units.}$$

$$\boxed{\phantom{00}} = \boxed{\phantom{00}} \quad \text{Write the cross products. They are equal.}$$

$$\boxed{\phantom{00}} = \boxed{\phantom{00}} \quad \text{Solve using mental math.}$$

**Answer:** It will take  $\boxed{\phantom{00}}$  hours to travel 300 miles.

**EXAMPLE 4 Solving Using a Related Equation**

Solve the proportion  $\frac{35}{10} = \frac{x}{8}$ .

**Solution**

$$\frac{35}{10} = \frac{x}{8} \quad \text{Write original proportion.}$$

$$\boxed{\phantom{00}} = \boxed{\phantom{00}} \quad \text{Write the cross products. They are equal.}$$

$$\boxed{\phantom{00}} \div \boxed{\phantom{00}} = \boxed{\phantom{00}} \quad \text{Write the related division equation.}$$

$$\boxed{\phantom{00}} = \boxed{\phantom{00}} \quad \text{Divide.}$$

**Answer:** The solution is  $\boxed{\phantom{00}}$ .

Need help writing a related equation? See page 687 of your textbook.

**Your turn now** Solve the proportion.

5.  $\frac{x}{12} = \frac{20}{8}$

6.  $\frac{18}{y} = \frac{30}{50}$

7.  $\frac{40}{15} = \frac{b}{9}$

8.  $\frac{36}{30} = \frac{42}{s}$