

Proportions

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

Numbers: $\frac{2}{3} = \frac{8}{12}$

Algebra: $\frac{a}{b} = \frac{c}{d}$, where $b \neq 0$ and $d \neq 0$

Equivalent Ratios: If one of the numbers in a proportion is unknown, you can solve the proportion to find the unknown number. One way to solve a proportion is to use mental math to find an equivalent ratio.

Example 1: Solve the proportion $\frac{5}{6} = \frac{x}{18}$.

Compare denominators.

$$\frac{5}{6} \quad \frac{x}{18}$$

Find x.

$$\frac{5}{6} \xrightarrow{\times 3} \frac{x}{18}$$

Because $5 \times 3 = 15$, $x = 15$.

Using Algebra: You can use the same methods you used to solve equations to solve proportions that have a variable in the numerator.

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

Yesterday you rode your bike 18 miles in 2.5 hours. Today you plan to ride for 3.5 hours. If you ride at the same rate as yesterday, how far will you ride?

The tables below show two ways of arranging the information from the problem. In each table, x represents the number of miles that you can ride in 3.5 hours. The proportions follow from the tables.

	Today	Yesterday
Miles	x	18
Hours	3.5	2.5

Proportion: $\frac{x}{3.5} = \frac{18}{2.5}$

	Miles	Hours
Today	x	3.5
Yesterday	18	2.5

Proportion: $\frac{x}{18} = \frac{3.5}{2.5}$

When writing a proportion, make sure you use comparable ratios. For example, you cannot write a proportion to compare $\frac{\text{miles}}{\text{hours}}$ and $\frac{\text{hours}}{\text{miles}}$.

Solving Proportions Using Cross Products

Every pair of ratios has two cross products. A **cross product** of two ratios is the product of the numerator of one ratio and the denominator of the other ratio.

Ratios: $\frac{3}{5}, \frac{6}{10}$ $\frac{2}{3}, \frac{6}{11}$

Cross products: $3 \cdot 10$ $5 \cdot 6$ $2 \cdot 11$ $3 \cdot 6$

Notice that for the ratios $\frac{3}{5}$ and $\frac{6}{10}$, the ratios are equal and their cross products are also equal.

For the ratios $\frac{2}{3}$ and $\frac{6}{11}$, the ratios are not equal, and neither are their cross products.

You can use cross products to tell whether two ratios form a proportion. If the cross products are equal, then the ratios form a proportion.

Cross Products Property

Words: The cross products of a proportion are equal.

Numbers: Given that $\frac{2}{5} = \frac{6}{15}$, you know that $2 \cdot 15 = 5 \cdot 6$.

Algebra: If $\frac{a}{b} = \frac{c}{d}$, where $b \neq 0$ and $d \neq 0$, then $ad = bc$.