**Ratios and Proportions**

A ratio is a relationship between two numbers. It indicates how many of the first number is included in the

second number. Ratios can be written in three different ways: words, fractional notation, and colon notation.

Example: A recipe calls for 1 cup of milk to 3 cups of flour.

Words: 1 to 3

Fractional Notation: 

Colon Notation: 1 : 3

# Writing a Ratio as a Fraction

The order of the quantities in a ratio is important. In order to write a ratio as a fraction, use the following steps.

**Step 1:**Write the first number in the ratio in the numerator **Step 2:**Write the second number in the denominator

*Example:*

Write the ratio 2 to 3 as a fraction.



**Hint:**

+ The order of the numbers is very important. The ratio 2 to 3 is . The fraction  is incorrect.

# Simplifying Ratios

Ratios can be simplified by writing them in lowest terms. In order to do so, use the following steps.

**Step 1:**Write the ratio as a fraction

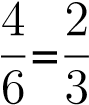
**Step 2:**Reduce the fraction to lowest terms **Step 3:**Rewrite the fraction as a ratio

*Example:* Write the ratio 4 to 6 in simplest form.

+ First, we write the ratio as a fraction:



+ Second, we reduce the fraction to lowest terms:



+ Third, we rewrite the new fraction as a ratio:

2 to 3

# Rates

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| A special type of ratio is a rate.  Rates are used to compare different kinds of quantities. For example, you can purchase 3 boxes of cereal for 5 dollars. This can be written as follows.  3 boxes  5 dollars |

**Hint:**

+ When comparing quantities with different units, write out the units as part of the ratio. They do no cancel out.

3 dollars1

Same Units: 6 dollars=2

3 dollars 1 dollars

Different Units: =

6 box 2 box

# Unit Rate

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| A unit rate is a rate with a denominator of 1. A common example of a unit rate is driving speed. For example, 20 mph, read as ”20 miles per hour” can be written as follows.  20 miles  1 hour  In order to write a rate as a unit rate, use the following steps.  **Step 1:**Write the rate as a fraction  **Step 2:**Divide the numerator by the denominator |

*Example:*

A trucker drove 100 miles in 2 hours. Find the unit rate.

+ First, we write the rate as a fraction:

100 miles

2 hours

+ Second, we reduce the fraction to lowest terms:

100 miles 50 miles

=

2 hours 1 hours

The trucker is driving at a rate of 50mph

# Proportions

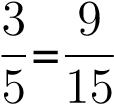
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| A proportion is an equation stating that two ratios or rates are equal. It is written in the following form.    If this equation is true, than the two ratios are equivalent.  This proportion can also be read as ”a is to b as c is to d.” The ratios are separated by the word ”as.” |

# Cross Products

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| A cross product, also known as cross multiplying, is a technique that can be used to determine whether a proportion is true or to solve an equation. A cross product can be performed using the following steps.  **Step 1:**Write out the proportion    **Step 2:** Find the product of ”a” and ”d” and set that equal to the product of ”b” and ”c”    **Hints:**  + You can think of a cross product as multiplying on a diagonal across the equals sign.  + If the cross products are equal, then the proportion is true |

*Example:*

Is the following proportion true?



+ First, we perform the cross product:

3 ∗ 15 = 9 ∗ 5

+ Second, we simplify the equation:

45 = 45

The original proportion is true.

# Problem Solving using Proportions

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| Writing proportions can be used to solve various word problems. If given a ratio or rate of two quantities, a proportion can be used to determine an unknown quantity. In order to do so, use the following steps.  **Step 1:**Translate the word problem into a proportion, using x as the unknown quantity.  **Step 2:**Find the cross product  **Step 3:**Solve the equation  **Step 4:**Interpret the answer  **Hint:**  + Remember that, when writing the proportion, both numbers in the numerator must have the same units. Both numbers in the denominator must have the same units as well. |

*Example:*

It takes 5 cups of flour to make 3 batches of cookies. If you want to make 4 batches of cookies, how many cups of flour will you need?

+ First, we write out the word problem as a proportion:

5 cups of flour *x* cups of flour

=

3 batches of cookies 4 batches of cookies + Second, we cross multiply:

5 cups \* 4 batches = x cups \* 3 batches

+ Third, we solve for x:

x cups = 6  cups

+ Fourth, we interpret the results:

We need 6  cups of flour.

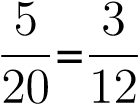
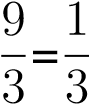
**Now Give It a Try!**

1. Write the ratio 5 to 6 as a fraction
2. Write the fraction  as a ratio in colon notation
3. Write the ratio 4 to 3 as a fraction
4. Write the ratio 4 to 8 in simplest terms

Rewrite the following rates as a unit rate.

1. 100 passengers to 5 trains
2. 3 boys to 2 girls
3. 1 tank of gas to 40 miles

Are the following proportions true?

1.  9. 

10. It takes 3 hours to drive 180 miles. How long will it take to drive 330 miles?

AnswerKey:

1.

5

6

2.

7:11

3.

4

3

4.

2

to

1

5.

20

passengerspertrain

6.

1.5

boyspergirl

7.

0.025

tankofgaspermile

8.

Thisproportionistrue

9.

Thisproportionisfalse

10.

5.5

hours