

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Honors S'mores Stoichiometry Lab

**Show all work with units and correct significant figures on separate note book paper. Answer recorded on lab sheet will NOT be accepted**

### Introduction:

In this experiment, you will explore the principles of stoichiometry by building S'mores, the delicious, chocolate, marshmallow, and graham cracker treats.



**Definitions:** 'Stoichio' means element and 'metry' means the process of measuring. The mass and quantity relationships among reactants and products in a reaction are found using the process of stoichiometry.

### Purpose:

To determine the limiting reactant in the synthesis of S'mores.

**Prelab Questions:** Show all work with units and correct significant figures on separate note book paper. Answer recorded on lab sheet will NOT be accepted

- What does a chemical equation tell us?
- What do the coefficients in a balanced chemical equation represent?
- For this lab, we will consider a s'more to consist of 2 graham cracker squares (Gr), 1 marshmallow (Mm) and 1 miniature chocolate (Ch) bar. 1 s'more = 1 Gr<sub>2</sub>MmCh
  - $\underline{\hspace{1cm}} \text{Gr} + \underline{\hspace{1cm}} \text{Mm} + \underline{\hspace{1cm}} \text{Ch} \rightarrow \underline{\hspace{1cm}} \text{Gr}_2\text{MmCh}$  [Balance Reaction]
  - According to the balanced equation complete the following ratios:
 

$\underline{\hspace{1cm}}$ Gr = $\underline{\hspace{1cm}}$ Mm	$\underline{\hspace{1cm}}$ Gr = $\underline{\hspace{1cm}}$ Gr <sub>2</sub> MmCh
$\underline{\hspace{1cm}}$ Ch = $\underline{\hspace{1cm}}$ Mm	$\underline{\hspace{1cm}}$ Mm = $\underline{\hspace{1cm}}$ Gr <sub>2</sub> MmCh
$\underline{\hspace{1cm}}$ Ch = $\underline{\hspace{1cm}}$ Gr	$\underline{\hspace{1cm}}$ Ch = $\underline{\hspace{1cm}}$ Gr <sub>2</sub> MmCh
- Calculating the unit mass of the s'more (using the unit mass below).
  - Calculate the mass on ONE s'more.
  - Is there a relationship between the mass of a S'more and the masses of the reactants used to make it?
  - If so, what is the relationship?
  - What law have you studied in this course that might define this relationship?

### Materials:

Miniature Chocolate bars  
Marshmallows  
Bunsen Burner

Graham cracker Square  
Paper Towels  
Wooden skewers

### Reference Data:

Substance	Symbol	Unit mass (molar mass) m	Package Mass
Graham Cracker Squares	Gr	8.50 g	408 g
Marshmallow	Mm	7.125 g	285 g
Miniature Chocolate Bar	Ch	12.00 g	348 g

\*\* for the purposes of this lab the UNIT mass and MOLAR mass are the same thing

### Procedure: Write all answers and work on separate piece of paper.

- Perform a synthesis reaction (forming **one** s'more). For this lab, we will consider a s'more to consist of 2 graham cracker squares, 1 marshmallow and 1 miniature chocolate bar.
- Predicting the limiting reactant:
  - Complete the data table below based on the materials provided for your group. **(Copy on the sheet with your work and answers from prelab questions.)**

Substance	Quantity received	# of S'mores it COULD make
Graham Cracker Squares		
Marshmallow		
Miniature Chocolate Bar		

- b) How many S'mores do you predict that you will be able to make using your reagents
  - c) What will the limiting reactant be?
  - d) How many of EACH of the other substances will remain after completing the reaction.
3. Determining the limiting reactant experimentally:
    - a) Test your hypothesis by performing the s'more synthesis reaction until one reactant is used up. Were you correct? Why or why not?
  4. You may now consume your products while completing the post lab questions

**Post Lab Questions: Write all answers and work on separate piece of paper.**

5. S'more synthesis reaction
  - a. If given 102 g of graham cracker squares, 85.5 g marshmallows, and 96 g chocolate, what is the limiting reactant in this S'more synthesis reaction? {HINT: convert grams into units (moles) and determine the number of S'mores each would make}
6. Marshmallow madness
  - a. Determine the units of graham crackers and chocolate segments are needed to consume 570 grams of marshmallows.
  - b. Using the unit masses determine the mass of graham crackers and chocolate segments needed.
  - c. Using the package mass determine the number of packages of graham crackers and chocolate segments that you would need to consume an entire package of marshmallows.
7. Graham Cracker Insanity
  - a. Determine the units of marshmallows and chocolate segments are needed to consume 816 grams of graham crackers.
  - b. Using the unit masses determine the mass of marshmallows and chocolate segments needed to consume the entire mass of graham crackers.
  - c. How many bags of marshmallows and bags of miniature chocolate bars are needed?
8. Simple Stoichiometry

If we were to add a piece of solid copper to an aqueous solution of silver nitrate, the Silver would be replaced in a single replacement reaction forming aqueous copper (II) nitrate and solid silver. How much silver is produced when 15.00 grams of copper is added to the solution of excess silver nitrate?

  - a. Write and balance the chemical equation:
  - b. Determine the grams of silver produced from 15.00 g of copper
  - c. If silver metal sells for \$4.50/ounce [ $\$4.50 = 1$  ounce and  $1$  gram = 0.0353 oz], How much would the silver be worth?
9. Using the following synthesis reaction: 2.50 L gaseous nitrogen react with 3.75 L gaseous hydrogen to produce 0.65 g ammonia ( $\text{NH}_3$ )
  - a. Write and balance the chemical equation:
  - b. Identify the limiting reactant
  - c. Find the theoretical yield of ammonia from this reaction.
  - d. Find the percent yield of ammonia.

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Teacher Notes:

**Primary Learning Outcome:**

Students will be able to identify and demonstrate the Law of Conservation of Matter.

Students will be able to write and balance a chemical equation for a synthesis reaction.

Students will be able to define and identify the limiting reactant of a reaction.

Students will be able to solve stoichiometry problems relating mass to moles and mass to mass.

**Assessed GPS:**

**SPS2. Students will explore the nature of matter, its classifications, and its system for naming types of matter.**

d. Demonstrate the Law of Conservation of Matter in a chemical reaction.

e. Apply the Law of Conservation of Matter by balancing the following types of chemical equations:

- Synthesis

**SC2. Students will relate how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.**

a. Identify and balance the following types of chemical equations: • Synthesis

d. Identify and solve different types of stoichiometry problems, specifically relating mass to moles and mass to mass.

e. Demonstrate the conceptual principle of limiting reactants.

**Duration:**

Preparation: 15 minutes

Pre-Lab: 10 minutes

Laboratory Assignment: 30 minutes

Post-Lab: 10 minutes

**Total Class Time: 50 minutes**

**Materials and Equipment:**

For Teacher Preparation:

1. Hershey's Chocolate bars
2. Marshmallows (large)
3. Graham crackers
4. Paper Plates
5. Bunsen Burner
6. Wooden skewers