Chemistry: *S'more Chemistry* Name_____
Hr____ Date_____

An introduction to Stoichiometry

You have spent a lot of time studying the various types of reactions that can occur in chemistry. You have also become experts in balancing chemical equations.

In this activity, you will be introduced to simple stoichiometry. Stoichiometry is the chemical term to describe calculations that allow us to find the amounts of chemicals involved in a given reaction. *After you finish this worksheet, bring it to your teacher to check your answers, when finished you may make your S'more.*

In stoichiometry, you must always start with a balanced equation! We will use the following balanced recipe (equation):

$$2\ Gc + 1\ M + 4\ Cp \longrightarrow 1\ Sm$$

Where: Gc = graham cracker Cp = chocolate pieces
M = marshmallow Sm = S'more

1. Notice that to make this recipe you have 7 pieces (reactant) to the left of the arrow and 1 piece (product) to the right. This is supposed to represent a balanced equation, so how can 7 = 1? Explain.
2. If each student is to make one S'more, and I have 20 students, how much of each ingredient will I need? Explain your logic – using a chemical equation.

For questions 3 – 4a, b USE DIMENSIONAL ANALYSIS

3. If I have 20 graham crackers, how many marshmallows and chocolate pieces will I need to make S'mores? How many S'mores can I make?

_____

4a. You decide to make a large batch of S'mores. You have 85 chocolate pieces. How much of each other ingredient do you need? How many S'mores can you make? Round to the nearest whole number!

_____

4b. While getting out the ingredients for the above batch you find you have only 30 graham crackers. How does this effect the number of S'mores you can make?

_____

5. How many S/mores can you make from these combinations?

2 Gc + 1 M + 4 Cp = _____ Sm

4 Gc + 2 M + 8 Cp = _____ Sm

10 Gc + 5 M + 20 Cp = _____ Sm

6. Continue to figure the possible number of S'mores. Use the spaces to the left of the equation to tell how much of each ingredient will be left over.

_____ **2 Gc + 1 M + 5 Cp = _____ Sm**

_____ **3 Gc + 1 M + 4 Cp = _____ Sm**

_____ **5 Gc + 2 M + 9 Cp = _____ Sm**

7. A reactant that is left over is said to be in **excess** and those that are used up limit the amount of product that can be made and are thus called **limiting reactants**. The maximum number of S'mores you could make is called the **theoretical yield**. For example, if you had 17 graham crackers, 7 marshmallows, and 20 chocolate pieces, what would the theoretical yield be? Which reactants are in excess and which are all used up and thus limiting reactants.

   Theoretical Yield:

   Excess Reactants:

   Limiting Reactants:

You are now ready to bring this sheet to your teacher for checking!

After it is checked, go to a bunsen burner and obtain a wooden splint and S'more ingredients. You can use a paper towel as a clean surface for your ingredients.

Step 1) Break your graham cracker into 2 pieces and break your chocolate into 4 pieces. Put your chocolate onto 1 of your graham crackers.

Step 2) Roast your marshmallow over the bunsen burner – DO NOT MELT!

Step 3) Quickly place the marshmallow onto the chocolate pieces and cover it with your second graham cracker. Wait for it to cool and enjoy the sweet taste of success in chemistry!

Chemistry: *S'more Chemistry* **KEY**

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$$2\ Gc + 1\ M + 4\ Cp \longrightarrow 1\ Sm$$

Where: Gc = graham cracker Cp = chocolate pieces
M = marshmallow Sm = S'more

1. Notice that to make this recipe you have 7 pieces (reactant) to the left of the arrow and 1 piece (product) to the right. This is supposed to represent a balanced equation, so how can 7 = 1? Explain. ***The pieces combine to form one whole.***
This would represent a synthesis reaction.

2. If each student is to make one S'more, and I have 20 students, how much of each ingredient will I need? Explain your logic – using a chemical equation.

2 Gc + 1 M + 4 Cp → 1 Sm (Use the ratio of the coefficients)
40 20 80 20

For questions 3 – 4a, b USE DIMENSIONAL ANALYSIS

3. If I have 20 graham crackers, how many marshmallows and chocolate pieces will I need to make S'mores? How many S'mores can I make?

2 Gc + 1 M + 4 Cp → 1 Sm (Use the ratio of the coefficients)
20 x M x Cp

$$x\,M = 20\,Gc\left(\frac{1M}{2\,Gc}\right) = 10\,M \qquad x\,Cp = 20\,Gc\left(\frac{4\,Cp}{2\,Gc}\right) = 40\,Cp$$

10 M & 40 Cp

4a. You decide to make a large batch of S'mores. You have 85 chocolate pieces. How much of each other ingredient do you need? How many S'mores can you make? Round to the nearest whole number!

2 Gc + 1 M + 4 Cp → 1 Sm (Use the ratio of the coefficients)
X Gc x M 85 Cp x Sm

$$x\,Gc = 85\,Cp\left(\frac{2\,Gc}{4\,Cp}\right) = 42.5\,Gc \qquad x\,M = 85\,Cp\left(\frac{1M}{4\,Cp}\right) = 21.25\,M$$

$$x\,Sm = 85\,Cp\left(\frac{1\,Sm}{4\,Cp}\right) = 21.25\,M$$

Need 43 Gc & 22 M to make 21 Sm

4b. While getting out the ingredients for the above batch you find you have only 30 graham crackers. How does this effect the number of S'mores you can make?

2 Gc + 1 M + 4 Cp → 1 Sm (Use the ratio of the coefficients)
30 x Sm

$$x\ \text{Sm} = 30\ \text{Gc}\left(\frac{1\ \text{Sm}}{2\ \text{Gc}}\right) = 15\ \text{Sm}$$

15 Sm

5. How many S/mores can you make from these combinations?

2 Gc + 1 M + 4 Cp = 1 Sm

4 Gc + 2 M + 8 Cp = 2 Sm

10 Gc + 5 M + 20 Cp = 5 Sm

6. Continue to figure the possible number of S'mores. Use the spaces to the left of the equation to tell how much of each ingredient will be left over.

1 Cp excess	**2 Gc + 1 M + 5 Cp =**	**1 Sm**
1 Gc excess	**3 Gc + 1 M + 4 Cp =**	**1 Sm**
1 Gc & 1 Cp excess	**5 Gc + 2 M + 9 Cp =**	2 **Sm**
	4 2 8	

7. A reactant that is left over is said to be in **excess** and those that are used up limit the amount of product that can be made and are thus called **limiting reactants**. The maximum number of S'mores you could make is called the **theoretical yield**. For example, if you had 17 graham crackers, 7 marshmallows, and 20 chocolate pieces, what would the theoretical yield be? Which reactants are in excess and which are all used up and thus limiting reactants.

Theoretical Yield: **2 Gc + 1 M + 4 Cp → 1 Sm Can Make ONLY**
17 Gc 7 M 20 Cp x Sm 5 Smores

$$x\ \text{Sm} = 17\ \text{Gc}\left(\frac{1\ \text{Sm}}{2\ \text{Gc}}\right) = 8.5\ \text{Sm} \qquad x\ \text{Sm} = 7\ \text{M}\left(\frac{1\ \text{Sm}}{1\ \text{M}}\right) = 7\ \text{Sm} \qquad x\ \text{Sm} = 20\ \text{Cp}\left(\frac{1\ \text{Sm}}{4\ \text{Cp}}\right) = 5\ \text{Sm}$$

Excess Reactants:

$$x\ \text{M} = 5\ \text{Sm}\left(\frac{1\ \text{M}}{1\ \text{Sm}}\right) = 85\ \text{M}$$ **needed but "HAVE" 7M Therefore, 2 M excess**

$$x\ \text{Gc} = 5\ \text{Sm}\left(\frac{2\ \text{Gc}}{1\ \text{Sm}}\right) = 10\ \text{Gc}$$ **needed but "HAVE" 7M Therefore, 3 Gc excess**

Limiting Reactants: **Cp**

2 Gc + 1 M + 4 Cp → 1 Sm

17 Gc 7 M 20 Cp
2 GC + 1 M + 4 Cp

8.5 7 5 [Limiting = smallest number] "NEED"

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