Limiting Reagent Lab with S'mores

Introduction

A delicious treat known as a **S'more** is constructed from the following ingredients:

2 Half Graham Crackers
3 Chocolate Bars
1 Large Marshmallow

Suppose we find that these ingredients are available only in full packages, each of which contains one dozen of the item. The packages of ingredients have the following weights:

12 Half Graham Crackers	1 lb.
12 Chocolate Bars	4 lb.
12 Marshmallows	¼ lb.

Start-up Exercise

Each group will build S'mores out of the packages of ingredients that you receive from your teacher. Please do not eat the S'mores yet!

Questions (You may use your S'mores to help you visualize these problems)

1. Using the symbols, G for the graham crackers, C for the chocolate bars, and M for the marshmallows, develop an equation that would represent the production of S'mores from the starting materials. Remember to balance your equation

2. How many S'mores are we able to make?

3. Based on the information given, which of the three ingredients weighs the most? Which weighs the least?

4. If we have 12 graham crackers (one package), how many chocolate bars and how many marshmallows do we need to make S'mores with all the graham crackers?

5. Suppose we have one package of each of the ingredients. How many S'mores can we make? Will any of the ingredients be left over? How much?

6. Suppose we have 4 lbs of each of the ingredients. Which item do you have the most of? The least? Explain your reasoning.

7. If we make S'mores from the materials described in #5, which ingredient will you run out of first? (This item is known to chemists as the **limiting reagent**)

8. In your own words, define limiting reagent.

9. In your own words, define excess reagent.

10. Is it correct to say that if we start with 4 lb each of G, C, and M, we should end up with 3 x 4 = 12 lb of S'mores? If not, why not?

Follow-up Exercise

Now let's apply the same concepts to a chemical situation:

Ammonia (NH_3) can be formed from the elements N_2 and H_2 , as shown below. Model this process using any unused S'mores ingredients to represent the reactants. For example, let graham crackers be N atoms and marshmallows H atoms. Improvise!

N_2 + 3 H_2 ---------- > 2 NH_3

How many moles of ammonia can be made from one mole of N_2 and 3 moles of H_2 ?

Suppose we had 3 moles each of the N_2 and H_2 available to react. Which of the reactants would be the limiting reagent?

How many moles of ammonia could we make? Would any of the reactants be left over? How many moles?

How many moles of ammonia could we make from one mole each of N_2 and H_2 ?

What mass of ammonia could we make from 100 grams each of N_2 and H_2 ? (hint: you need 2 calculations for this)