Chemistry: *Nuts & Bolts and Stoichiometry* Name_____
Hr____ Date_____

INTRODUCTION

Chemical reactions occur when a certain number of reactants react with a certain number of another reactant (given as coefficients in the balanced equation). We can se this information to determine the mass of reactants needed, and the mass of products formed if we know the average masses of the species involved. This is called stoichiometry. In this activity, you will consider the ideas of stoichiometry with nuts and bolts.

PROCEDURE

You have a cup with some nuts and bolts. The product that you are to make consists of two nuts on each bolt. Your goal is to make as many of the product as possible.

LAB QUESTIONS

1. Using ***N*** to symbolize the nuts and ***B*** to symbolize the bolts, write out an equation for the formation of the product and justify your answer. Make an analogy with chemical equations and pay attention to the difference between a coefficient and a subscript.

2. How many nuts did you have? How many bolts?
3. How many of the products could you make?
4. Which reactant (nut or bolt) was limiting? How did you determine this? Is it the reactant you had fewer of? Why or why not?
5. How much of which reactant did you have left over? How did you determine this?
6. Why does there have to be something left over in this case? That is, why couldn't you just make a product with fewer or more nuts? How does this relate to balancing a chemical equation?

Given that the average mass of a bolt is 10.64 g and the average mass of a nut is 4.35 g, answer the following questions:

7. What is the mass of all the bolts you were given? Mass of all nuts?
8. What is the mass of one product? What is the mass of all the products that you formed?
9. What is the mass of the left over reactant?
10. Given the mass of bolts you had, calculate the mass of the nuts you would need to use up all of the bolts.
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Friends of yours give you what they say is "about 1000 g" of nuts and "about 1000 g" of bolts. Answer the following questions:

12. How many nuts were you given? How many bolts?

13. Which reactant is limiting? Why is one limiting if you have equal masses of each?

14. What is the mass of the product you could make? How many is this?

15. How many of which reactant is left over? What is the mass of left over reactant?

16. Given the mass of bolts you had, calculate the mass of the nuts you would need to use up all the bolts.

17. Given the mass of nuts you had, calculate the mass of the bolts you would need to use up all of the nuts.

ADDITIONAL QUESTIONS (Post-lab)

1. An individual coefficient in a balanced equation is meaningless. Why?

2. Consider the reaction represented by the (unbalanced) equation.

$$NH_3 + O_2 \longrightarrow NO + H_2O$$

For every 1.00 mol of NH_3 that reacts, _____ mol of O_2 is required. (show work)

3. Which would produce a greater number of moles of product: a certain amount of hydrogen gas reacting with oxygen to make water, or the same amount of hydrogen gas reacting with nitrogen gas to make ammonia? Show your work.

4. Considering the reaction represented by the (unbalanced) equation

$$N_2(g) + H_2(g) \longrightarrow NH_3(g)$$

Determine the number of moles of $NH_3(g)$ that can be produced from the following:

a) 0.20 mol $N_2(g)$ reacts completely with $H_2(g)$

b) 0.30 mol $H_2(g)$ reacts completely with $N_2(g)$