

Group Members' Names: \_\_\_\_\_

## Pizza Lab

### Limiting Reagents

Two atoms or molecules must come together in just the right way in order for them to react. As a result, it is virtually impossible to obtain 100% yield in a chemical reaction by combining the reactants in *exact* proportions. In order to increase the odds that at least one reactant will react completely, *we often add more than is needed of another reactant*. This reactant is said to be in **excess**. The reactant that is used up in the reaction is called the **limiting reactant or reagent** because it limits the amount of product formed.

In this activity, you will use a recipe for pizza as an analogy for a chemical equation in which reactants and products are in set proportions to each other. You will be given varying amounts of each reactant. One of these reactants will limit the number of pizzas you can produce. The other reactants will be in excess. After working with this culinary "reaction," you will be able to identify the limiting and excess reactants in chemical reactions.

### OBJECTIVES

- Investigate the concept of limiting reagents by constructing pizzas.

### PROCEDURE

1. Obtain a plastic bag of pizza ingredients. Record your group number. \_\_\_\_\_ Record the amount of each ingredient.

Pizza doughs \_\_\_\_\_ pepperoni \_\_\_\_\_ mushrooms \_\_\_\_\_ green peppers \_\_\_\_\_

2. Use the following recipe to perform a synthesis reaction using your ingredients.

#### Recipe for 1 Pizza

**1 pizza dough (chemical symbol D)**

**4 mushrooms (chemical symbol M)**

**6 pepperoni (chemical symbol P)**

**5 green peppers (chemical symbol G)**

2. Write a balanced equation for your reaction using the chemical symbols given.
3. Cause the reaction to go to completion by forming as many pizzas as possible.
4. How many products were you able to form?

## DISCUSSION

1. What was your limiting reactant?
2. Which starting materials were in excess?
3. Define, in your own words, what a limiting reactant is.
4. If you had unlimited quantities of pizza dough but the same amount of the other ingredients that you started with, how many pizzas could you have made? Explain your reasoning.
5. Suppose you had a bag of 15 pizzas doughs, 85 pepperoni, 58 mushrooms, and 73 green peppers.
  - a. How many pizzas can you make? Explain your reasoning.
  - b. What (if anything) will be left over, and how much of that item will there be? Explain your reasoning.
  - c. What item limits the number of pizzas you can make? Explain your reasoning.

## Exercises

Using the idea of a limiting reactant, answer the following exercises:

1. Ammonia (NH<sub>3</sub>) can be formed from the elements N<sub>2</sub> and H<sub>2</sub>, as shown below.  
**$$\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$$**
  - a. How many moles of ammonia can be made from one mole of N<sub>2</sub> and 3 moles of H<sub>2</sub> ?
  - b. Suppose we had 3 moles each of the N<sub>2</sub> and H<sub>2</sub> 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?
  - c. How many moles of ammonia could we make from one mole each of N<sub>2</sub> and H<sub>2</sub>?
  - d. What weight of ammonia could we make from 100 grams each of N<sub>2</sub> and H<sub>2</sub>?
2. Zinc and iodine react to form zinc (II) iodide (the reactants and the product are all solids at room temperature).
  - a) Write a balanced chemical equation for this reaction. Remember to ask yourself if any of the individual elements (the reactants) are one of the seven diatomic elements.
  - b) Suppose that 50.0 g of zinc and 50.0 g of iodine are used to form zinc (II) iodide.
    - 1) Assuming that the reaction goes to completion, which element will be totally consumed in the formation of the zinc (II) iodide?
    - 2) What is the limiting reagent?
    - 3) How many grams of zinc (II) iodide can be produced?
    - 4) How many grams of the excess element remain unreacted?