

## Investigating Which Reactant is in Excess

### Introduction:

Zinc reacts exothermically with hydrochloric acid to produce zinc chloride and hydrogen gas. This balanced chemical tells you that one mole of Zn reacts with 2 moles of HCl to form one mole of ZnCl<sub>2</sub> and one mole of H<sub>2</sub>. **Stoichiometry** is the calculation of quantitative (measurable) relationships of the reactants and products in a chemical reaction. In a chemical reaction the reactant that runs out first is the **limiting reagent**. The reactant that is left over, or remaining, is the **excess reagent**.

The concentration of a solution is the "strength" of a solution. A solution typically refers to the dissolving of some solid substance in a liquid, such as dissolving salt in water. The concentration of a solution is typically given in molarity. **Molarity (M)** is defined as the number of moles of solute (what is actually dissolved in the solution) divided by the liters of solution (the total volume of what is dissolved and what it has been dissolved in).

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

So a solution of 3 M HCl is really 3 moles of HCl dissolved in 1 liter of water. So the number of moles of HCl in 37.5 ml would determine:

3M HCl = 3 moles HCL/ 1 liter

### Objectives:

- Calculate the number of moles of each reactant
- Predict which reactant is in excess
- Relate the mathematical results with actual results observed in the lab.

### Materials:

100ml beaker  
Balance  
Laboratory apron  
Safety goggles  
Zinc pieces  
6 M hydrochloric acid (HCl)

### Procedure:

1. Weigh the mass of zinc
  - a. Place it into your beaker
  - b. Determine the moles of Zinc you are starting with.
2. Measure out 10 ml of 6M HCL
  - a. Determine the moles of HCL you are starting with.
3. Pour the 10 ml of HCL to your beaker containing the piece of Zinc.
  - a. Making a drawing of the beaker and its contents in your lab book, labeling all of the substances present.
4. Empty the liquid contents of your beaker into the sink and thoroughly away any remaining Zinc into the trash. Rinse the beaker and graduated cylinder with running water.
5. Before leaving the Laboratory, wash your hands thoroughly.

### Prelab Questions:

1. Write the balanced equation for a reaction of a solution of HCl and Zn pieces. Include the state of each reactant and product.
2. What type of reaction is this?
3. Calculate the number of moles in 2.65 g of Zinc.
4. Calculate the number of moles of HCl in 37.5 ml of 6M HCl.
5. What is the limiting reactant in this example?
6. How much of the excess reactant is remaining?
7. How much of each product is produced?

### Data and Observations:

- At the beginning of the reaction make a drawing of the beaker and its contents. Label all substances present.
- Describe what takes place in the beaker containing the zinc after you have added the HCl.
- Make another drawing of the beaker and its contents after the reaction has completed. Label the substances present.

Data Table	
Mass of Zinc Piece	
Moles of Zinc	
ml of 6M HCl	
Moles of HCl	

### Calculations:

Show all work!

1. Calculate the moles of Zinc you used?
2. How many moles of HCl did you use?
3. Determine the limiting reactant mathematically. What did you observe to be the limiting reactant during the reaction in the lab?
4. Determine how much reactant should be remaining.
5. Determine how much of each product you produced.
6. How did your mathematical prediction compare with your actual lab results? Explain your answer.
7. There are two possible explanations for having no zinc left after the reaction. What are they?