Honors Chemistry Hour\_\_\_\_\_ Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Dr. Wexler  
Lab: Observing a Limiting Reactant (HS-PS1-7; HSN-Q.A.1)  
Date\_\_\_\_\_

**Brief Background:**   
When two substances react, they react in exact amounts. You can predict what amounts of the two reactants are needed to react completely with each other by means of mole ratios based on the balanced chemical equation for the reaction.

In the laboratory, precise amounts of the reactants are rarely used in a reaction. Usually, there is an excess of one of the reactants. As soon as the other reactant is used up, the reaction stops. The reactant that is used up is called the limiting reactant.

Based on the quantities of each reactant and the balanced chemical equation, you can predict which substance in a reaction is the limiting reactant.

**Objectives:  
Calculate** the number of moles of each reactant.  
**Write** a balanced chemical equation for the reaction of hydrochloric acid and magnesium.  
**Predict** the volume of 3M HCl required to completely react with the magnesium.  
**Compare** the actual results with your predicted results.

**Special Materials:**3M HCl  
Magnesium ribbon (5 cm)  
Test tube in beaker  
  
**Making your Prediction:**1. Magnesium metal and hydrochloric acid react to form magnesium chloride and hydrogen gas. Write the balanced chemical equation for the reaction.

2. Measure the mass of a 5cm strip of magnesium ribbon = \_\_\_\_\_\_\_\_\_\_\_\_\_\_g  
  
3. Convert grams of magnesium to moles. Show your calculations

4. How many moles of HCl are required to completely react with the magnesium, based on the balanced chemical equation and your mole calculation for magnesium. Hint: Your answer is based on the stoichiometry of the balanced chemical equation.

5. What volume of 3M HCl (in milliliters) do you predict will be required to completely react with the magnesium. Show your calculations.   
Hint: Use the formula: volume HCl (L) = moles HCl ÷ 3moles/Liter. Then multiply by 1000 to convert liters to milliliters.   
For example, if you predict that you will require 0.01moles of HCl, then the volume required is 0.01moles/3moles/L = 0.0033L. 0.0033L x 1000mL/L = 3.3mL  
Note: Use a grid for your calculations

**Procedure and Results:**1. Cut up the preweighed magnesium ribbon into small pieces and place the pieces into a test tube. Be absolutely sure that **all** the pieces go into the test tube.  
2. Add the volume of 3M HCl you predicted would be sufficient to completely react the magnesium.   
3. After the bubbling has completely stopped (which may take 10 minutes or longer), was the magnesium completely gone or was some metal left over?

Did this indicate that you added the correct volume of 3M HCl for the mass of magnesium or did you add too little acid?

4. Add a small piece of magnesium. Did it react or not react? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
A. If the second piece of magnesium did not react, then it proves that all the HCl was used up in the reaction with the first piece. If this were the case, then what would be the limiting reactant – HCl or Mg?

6. Suppose that the second piece of Mg did react. This would prove that HCl was in excess and some was left over after using up the Mg in the first reaction. In this case, what would be the limiting reactant – HCl or Mg?

**Required Supplemental Research Question:**How is the idea of limiting reactants relevant to the efficient operation of an automobile (internal combustion engine type)? Hint: the chemical reaction involves the combustion of gasoline (hydrocarbon + oxygen 🡪 carbon dioxide + water). Find out what happens in the carburetor (the gas is aerosolized) – which of the above two reactants must be limiting in order for the combustion reaction to be efficient (and therefore minimize emissions of compounds other than carbon dioxide and water)?