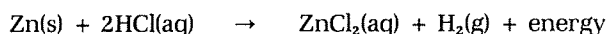


# Investigating which Reactant is in Excess

When a reaction occurs, an equation for the reaction can be written to indicate the chemical changes that are taking place. For example, you learned in a previous experiment that zinc reacts exothermically with hydrochloric acid to produce zinc chloride and hydrogen gas.



The balanced equation indicates that on a microscopic level one atom of Zn reacts with two molecules of HCl to produce one molecule of ZnCl<sub>2</sub> and one molecule of H<sub>2</sub>. This also means that one mole of Zn reacts with two moles of HCl to produce one mole of ZnCl<sub>2</sub> and one mole of H<sub>2</sub>.

When these two reactants are combined, the reaction will continue to occur until one reactant is used up. At this time the other reactant also may be used up. If not, the reactant that remains is said to be in *excess*, because more of that reactant was present than the amount required to react.

In this experiment, you will measure the amount of each reactant carefully and predict which reactant will be in excess.

## OBJECTIVES

1. to make careful measurements of the amounts of each reactant
2. to calculate the number of moles of each reactant
3. to predict which reactant is in excess
4. to relate macroscopic observations to microscopic events
5. to use drawings to relate microscopic events, to write chemical equations that represent those microscopic events
6. to learn how to measure the volume of a liquid using a buret

## MATERIALS

### Apparatus

test tube (18- x 150-mm)  
beaker (150-mL)  
buret  
centigram balance  
forceps  
safety goggles  
lab aprons  
plastic gloves  
full face shield

### Reagents

zinc pieces  
3M HCl

## PRELAB

Answer questions 1-3 on the Report Sheet.

## PROCEDURE

### Part I

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**CAUTION:** Hydrochloric acid is corrosive to skin, eyes, and clothing. When handling hydrochloric acid, wear safety goggles, full face shield, gloves, and lab apron. Wash spills and splashes off your skin and clothing immediately using plenty of water. Call your teacher.

1. Put on your laboratory apron, safety goggles, plastic gloves, and face shield.
2. Determine the mass of a clean, dry 18- x 150-mm test tube and record your data on the Report Sheet.
3. Add one piece of zinc to the test tube and determine the mass of the test tube and zinc. Record your data on the Report Sheet.
4. Read the volume of the HCl in the buret to the nearest 0.1 mL and record the reading on the Report Sheet.
5. Add between 5 and 20 mL of 3M HCl to the test tube and record the new reading on the Report Sheet.
6. Record your observations on the Report Sheet.
7. Make a drawing of the test tube and its contents on the Report Sheet and label all the substances present.
8. Store the test tube in a beaker so it remains upright.
9. Before you leave the laboratory wash your hands thoroughly with soap and water; use a fingernail brush to clean under your fingernails.

### Part II (the following day)

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1. Put on your lab apron, safety goggles, plastic gloves, and face shield.
2. Observe your test tube and contents. Make a drawing of the test tube and label the contents.

### POST LAB DISCUSSION

If you correctly predicted that zinc would be in excess, then there should be some solid zinc remaining in your test tube. If you correctly predicted there would be HCl in excess, then there should be no zinc remaining in the test tube.

# Investigating which Reactant is in Excess

Name \_\_\_\_\_

Class \_\_\_\_\_ Date \_\_\_\_\_

## PRELAB QUESTIONS

1. Calculate the number of moles in 2.65 g of zinc.
2. Calculate the number of moles of HCl in 37.5 mL of 3.00M HCl.
3. How many moles of HCl are required to react with 0.244 moles of zinc?

## DATA

1. Mass of clean, dry test tube \_\_\_\_\_
2. Mass of test tube and zinc \_\_\_\_\_
3. Initial buret reading for 3M HCl \_\_\_\_\_
4. Final buret reading for 3M HCl \_\_\_\_\_

## OBSERVATIONS

### Part I

1. Describe what takes place in the test tube containing zinc after you have added hydrochloric acid.

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2. Make a drawing of the test tube and its contents before you store it.

Label all substances present.



## Part II

1. Describe the test tube and its contents.

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2. Make a drawing of the test tube and its contents. Label all substances present.



### CALCULATIONS

1. Calculate the mass of zinc added to the test tube. \_\_\_\_\_

2. Calculate the number of moles of zinc added to the test tube. \_\_\_\_\_

3. Calculate the volume of 3M HCl added to the test tube. \_\_\_\_\_

4. Calculate the number of moles of HCl added to the test tube. \_\_\_\_\_

5. Predict which reactant will be in excess. \_\_\_\_\_

\_\_\_\_\_

## CONCLUSIONS

1. Based on your macroscopic observations of the test tube and contents, which reactant is in excess?

Explain. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. Was the prediction you made in item 5 of your calculations correct? \_\_\_\_\_

Explain. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## SYNTHESIS

1. Calculate the theoretical yield of zinc chloride. \_\_\_\_\_

2. Design an experiment to isolate and measure the actual yield of zinc chloride.