

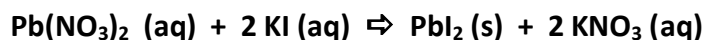
## THE STOICHIOMETRY OF A REACTION

### Introduction

This experiment provides a method to determine the mole ratio in which two substances combine chemically. Such information is helpful in determining the stoichiometry of a reaction, i.e. the balanced chemical equation and the information that can be derived from it.

The principle underlying is based on keeping the quantity of one reactant constant while varying the quantity of a second reactant. The mass of the precipitate produced is then used as an indicator of the effect of varying the quantity of the second reactant. When enough of the second reactant has been added to completely react with the first reactant, there will be no further increase in the amount of the precipitate produced, regardless of how much of the second one is added.

Like a gymnast on a beam, the amounts of material involved in a chemical reaction must be properly balanced. An unbalanced gymnast will fall off the beam; an unbalanced chemical reaction will waste chemical reactants. In this experiment, you will examine the stoichiometry—the relationship between amount of materials—of the reaction between lead nitrate and sodium iodide. The balanced equation is:



Each student will be assigned a designated volume of Lead (II) Nitrate solution which will be added to a given volume of Potassium Iodide solution. The resulting precipitate will be filtered, washed, dried, and massed. Data will be exchanged between students and will be plotted to find the stoichiometric point of the system.

### Purpose

The purpose of this experiment is to determine the mole ratio relationship and limiting reactant in the reaction between  $\text{Pb}(\text{NO}_3)_2$  and KI.

### Pre-Laboratory Questions

1. Calculate the molar mass for lead (II) nitrate.
2. Calculate the molar mass for potassium iodide.
3. Calculate the molar mass for lead (II) chloride.

### Procedure

1. The volume of the potassium iodide will be held constant while the volume of the lead (II) nitrate is varied. Each lab group will be assigned a trial. Make note of the trial that is assigned to your laboratory group.

Trial	mL $\text{Pb}(\text{NO}_3)_2$	mL KI
1	1.00	10.00
2	2.00	10.00
3	3.00	10.00
4	4.00	10.00
5	5.00	10.00
6	6.00	10.00
7	7.00	10.00
8	8.00	10.00
9	9.00	10.00
10	10.00	10.00

2. Using a graduated cylinder, dispense 10.00 mL of KI solution into a clean, dry 50 mL beaker. From a second graduated cylinder, dispense the assigned volume of  $\text{Pb}(\text{NO}_3)_2$  into a second clean, dry, small beaker. While stirring one solution, slowly add the other to it. Rinse the empty beaker with 10 mL of distilled water.
3. Find the mass of a piece of filter paper, and record the mass into a data table. Fold the paper and place it in a funnel. Wet the paper with distilled water.

- Using a stirring rod, pour the liquid from the beaker into the funnel. Carefully transfer the precipitate to the funnel. Rinse the beaker and stirring rod with distilled water. Use additional water to rinse the precipitate.
- After all the water has passed through the funnel, transfer the filter paper to a beaker with your information on the label and place it in the designated area of the laboratory to dry overnight.
- After the precipitate is completely dried, mass the filter paper and precipitate. Record the mass.
- Determine the mass of the precipitate formed by subtracting the mass of the filter paper/precipitate from the mass of the filter paper. Record the mass of the precipitate.

### Data Table

Table 1: Student Data

Mass of the Empty Filter Paper	g
Mass of Filter Paper w/ Lead (II) Chloride	g
Mass of Lead (II) Chloride	g

Table 2: Class Data

Trial	Moles $\text{Pb}(\text{NO}_3)_2$	Moles KI	Mass Precipitate (Actual Yield)
1	0.0001	0.0010	
2	0.0002	0.0010	
3	0.0003	0.0010	
4	0.0004	0.0010	
5	0.0005	0.0010	
6	0.0006	0.0010	
7	0.0007	0.0010	
8	0.0008	0.0010	
9	0.0009	0.0010	
10	0.0010	0.0010	

### Calculations

- Based on the balanced chemical reaction, what are the mole ratios for the chemical reaction?
- Using the Limiting Reactant Calculation, determine the theoretical yield of  $\text{PbI}_2$  for each trial. PLEASE SHOW ALL WORK FOR EACH TRIAL.
- Based on the actual yield for each trial and the calculated theoretical yield from #2, what is the percent yield for each trial?

### Questions

- Which product of the reaction is likely to be the one that precipitated? Why?
- Does the theoretical yield match the amount of the actual yield of the precipitate found during the experiment for each trial from the calculations?
- How could a scientist improve on the percent yield of this experiment based on the procedures?

### Final Analysis

- During the experiment, Lead (II) Nitrate was varied and the Potassium Iodide remained constant. Explain what you think would happen if the Lead (II) Nitrate remained constant and Potassium Iodide was varied.