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 this experiment 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.

Equipment/Materials

- 0.1M $Pb(NO_3)_2$
- 0.1M KI
- 5 % HNO_3
- Filter paper
- 10mL automatic pipets
- 50 mL beakers
- Stirring rod
- Funnel
- Side-armed Erlenmeyer flask
- Hot plate
- Analytical balance
- Wash bottle of DI water

Safety

- Goggles must be worn at all times in the laboratory.
- Pour any leftover solution in the designated containers.
- Follow your instructor's directions for the disposal of the precipitates.

Guiding Questions

Which trial(s) will give the most precipitate? Why?

Procedure

1. In this experiment the stoichiometry of the lead nitrate – potassium iodide system will be investigated. The volume of the potassium iodide will be held constant while the volume of the lead nitrate is varied. The concentration of both solutions will be 0.1000 M. Each lab group will be asked to prepare two combinations in the following table. Make note of the ones that are assigned to your group.

Trial (Group)	mL $Pb(NO_3)_2$	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. Use an automatic pipet to dispense the following into a 50mL beaker:
   a. 10mL of 5% HNO_3
   b. 10mL 0.1M KI
   c. the correct amount of 0.1M $Pb(NO_3)_2$ for the trail. (See the chart above.)

3. Stir the soution and put the beaker on a hot plate for 2 – 3 min at a medium setting. At this point, most of the precipitate will have settled to the bottom of the beaker. Stir occasionally. **Do not let the contents of the beaker boil.**

4. Write the class period number and the initials of the goup members at the edge of a piece of filter paper. Find the mass of this filter paper on an analytical balance, and record the value in your data table. Record all digits.

5. Fold the paper, and place it in a funnel. Wet the paper with distilled water so that it will stick to the funnel.

6. Using a stirring rod, pour the liquid from the beaker into the funnel. Carefully transfer as much of the precipitate as possible to the funnel. Rinse the beaker and stirring rod with DI water. Use additional water to rinse the precipitate.

7. After all the water has passed through the funnel, transfer the filter paper to a location given to you by your instructor. The product must dry completely before completing the experiment.

8. Mass the dry product and filter paper on an analytical balance, and record the value.

9. Using the class data, plot the mass of the precipitate on the y-axis and the number of moles of $Pb(NO_3)_2$ on the x-axis. Draw the best straight-line curve through the plotted points on the two regions of the graph. The point of intersection will be the stoichiometric point for the system. It will give the number of moles of $Pb(NO_3)_2$ that react with the 0.00100 moles of KI used in each trial.

Data

Individual Data	**Trial Number**	**Trial Number**
Volume 0.100 M KI		
Moles KI		
Volume 0.100 $Pb(NO_3)_2$		
Moles $Pb(NO_3)_2$		
Mass of Precipitate and Filter Paper		
Mass of Filter Paper		
Mass of Precipitate		

Class Data

Trial	Vol. $Pb(NO_3)_2$	Moles $Pb(NO_3)_2$	Mass Precipitate
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Calculations and Questions

1. Calculate the number of moles of KI in the 10.00 mL of 0.100 M KI solution.

2. Calculate the number of moles of $Pb(NO_3)_2$ at the stoichiometric point on the graph.

3. What is the ratio for the reactants being studied?

4. Which product of the reaction is likely to be the one that precipitated? Why?