Name _____ Date _____ Class _____

Formula of Lead Iodide

Small Scale Lab 19

Text reference: ***Chapter 7***

Introduction

In 1808, John Dalton published *A New System of Chemical Philosophy* in which he presented his atomic theory of matter. According to Dalton's theory, chemical compounds form when atoms combine with each other. Another postulate of Dalton's atomic theory is that a given compound always has the same relative numbers and kinds of atoms.

The chemical formula of an ionic compound shows the relative number and kinds of atoms as a whole number ratio. The ratio of elements in a compound can be determined experimentally. Once the ratio is known, the formula for the compound is easily written. In this experiment, you will be reacting sodium iodide and lead nitrate together in various ratios to produce the precipitate, lead iodide. By plotting the data, you will be able to find the ratio that produces the most precipitate. This will be the correct ratio of atoms in lead iodide. From this ratio, you can determine the chemical formula of lead iodide.

Pre-Lab Discussion

Read the entire laboratory investigation and the relevant pages of your textbook. Then answer the questions that follow.

1. How does Dalton's atomic theory of matter apply to this investigation? _____

2. Why should you let the reaction stand for 5 minutes before measuring the height of the precipitate in each test tube? _____

3. How will the graph help you interpret your data? _____

4. What is a subscript and what does it mean in the formula of an ionic compound? _____

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5. Why do lead compounds require caution in handling and disposal?

_____

_____

_____

_____

Problem

Can you determine the chemical formula for lead iodide?

Materials

chemical splash goggles
laboratory apron
9 small test tubes
marking pen
well plate
micropipet
sodium iodide (NaI), 0.1 *M*
distilled water
latex gloves
lead nitrate ($Pb(NO_3)_2$), 0.1 *M*
metric ruler

Safety

Wear your goggles and lab apron at all times during the investigation. Lead compounds are toxic. Wear latex gloves when working with them. Do not dispose of any lead nitrate or lead iodide wastes down the drain, but place them in labeled waste containers provided by your teacher. Note the caution alert symbols here and with certain steps of the Procedure. Refer to page *xi* for the specific precautions associated with each symbol.

Procedure

1. Put on your goggles and lab apron. Label nine test tubes 1–9 with the marking pen, and place them in a well plate that will serve as a test-tube holder.
2. Fill the micropipet with 0.1 *M* sodium iodide (NaI) solution. Following Table 19–1 as a guide, add the indicated number of drops to each test tube. For example, place 18 drops in tube 1, 16 drops into tube 2, etc., until all nine tubes are done.

3. Put on your gloves. Rinse the micropipet four times with distilled water. Then fill it once with 0.1 *M* lead nitrate ($Pb(NO_3)_2$) solution and immediately discard this solution in the lead waste beaker. **CAUTION:** *Lead nitrate is toxic. Wear gloves. Do not let this substance come in contact with your skin.*
4. Fill the micropipet again with 0.1 *M* lead nitrate ($Pb(NO_3)_2$) solution. Following Table 19–1 as a guide, add the indicated number of drops to each test tube. For example, place 2 drops in tube 1, 4 drops into tube 2, etc., until all nine tubes are done.

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TABLE 19–1

Test Tube	Drops of NaI Solution	Drops of $Pb(NO_3)_2$ Solution
1	18	2
2	16	4
3	14	6
4	12	8
5	10	10
6	8	12
7	6	14
8	4	16
9	2	18

5. Allow the nine test tubes to stand for 5 minutes. If necessary, tap the test tubes gently to help the precipitates settle to the bottom.
6. With a metric ruler, measure the height of the precipitate in each test tube. Record the heights in your Data Table.

7. Dispose of all chemicals according to your teacher's instructions. Clean up your work area and wash your hands before leaving the laboratory.

Observations

DATA TABLE

Test Tube	Height of Precipitate (mm)	Ratio of Drops $Pb(NO_3)_2$:NaI
1		
2		
3		
4		
5		
6		
7		
8		
9		

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Calculations

1. Compute the ratio of drops of lead nitrate solution to drops of sodium iodide solution in each test tube and record these ratios in the data table. (Hint: Set up each ratio to give the number of drops of sodium iodide solution that would correspond to one drop of lead iodide solution.)
2. Graph your data. Plot the test tube numbers on the horizontal axis and the height of the lead iodide precipitate on the vertical axis. Beside each data point, record the drop ratios for $Pb(NO_3)_2$:NaI.

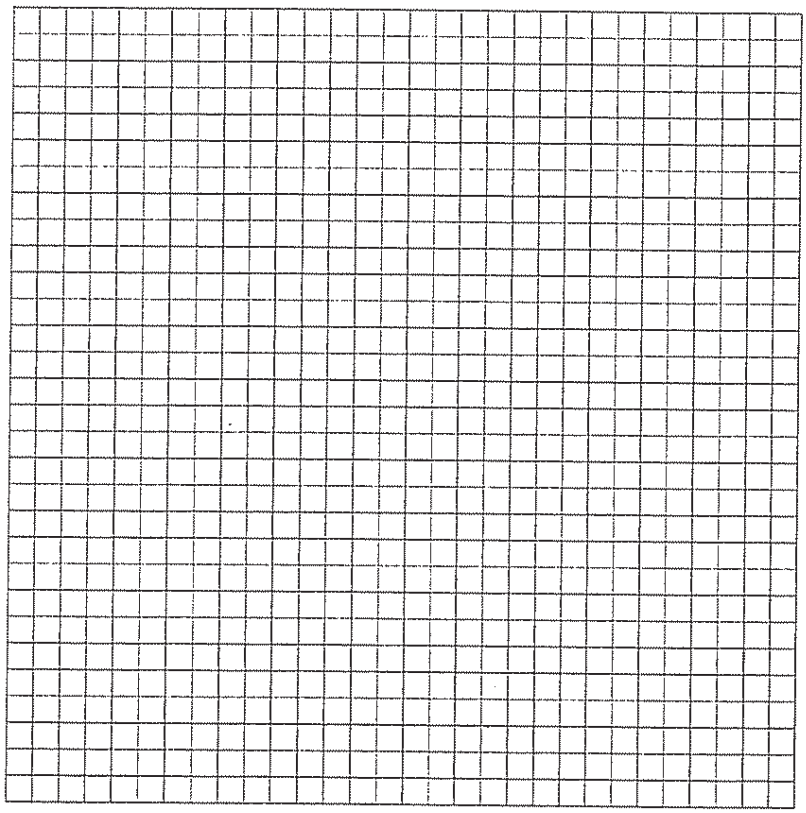

Figure 19–1

Critical Thinking: Analysis and Conclusions

1. Which reactant ratio(s) yielded the greatest amount of precipitate? *(Interpreting data)* _____
2. What can you conclude from your graph of precipitate heights and reactant ratios? *(Interpreting diagrams)* _____

_____

_____

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_____

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3. Based on the ratio that you determined in response to Question 1, what is the correct formula for lead iodide? *(Making inferences)* _____

_____

4. Which reagent ran out first in tube 2? In tube 7? *(Interpreting data)*

_____

Critical Thinking: Applications

1. Why is it important that the proper ratio be used when writing the formula of a substance? *(Evaluating)* _____

_____

2. Would the procedure you used in this investigation work for any compound? Give an example of a type of compound for which this procedure would not work. Explain. *(Designing experiments)* _____

_____

_____

3. Making an apple pie calls for a reaction among certain ratios of ingredients. How is making an apple pie different from making lead iodide? *(Making comparisons)* _____

_____

_____

Going Further

1. Recipes indicate the ratios of ingredients that are to be used. Analyze some of your favorite recipes to see what ratios are involved. Classify the products according to whether they are compounds or mixtures. Explain why the ratios are not so critical when only mixtures are involved.