

Gravimetric Analysis of a Metal Carbonate

Inquiry Guidance and AP* Chemistry Curriculum Alignment



Introduction

A large variety of analytical techniques and procedures, ranging from instrumental methods such as spectroscopy and chromatography to more classical processes, such as qualitative or gravimetric analysis, have been developed to assist chemists in identifying compounds.

Opportunities for Inquiry

Determining the identity of a compound through gravimetric means is an experiment that ties together principles and concepts from several “big ideas” in chemistry, including stoichiometry, chemical reactions and solubility. Gravimetric analysis emphasizes science practice skills involving mathematical reasoning and data analysis.

These concepts and skills should be highlighted or emphasized when adapting the experiment to an inquiry-based lab activity.

- Introduce the lab by demonstrating the general setup for reacting and collecting calcium carbonate. Guide students to design the actual experimental procedure through a series of leading questions. What data is needed to calculate the molar mass of an unknown substance? What variables will influence experimental data? What factors will affect the accuracy of the results and how may these be investigated and controlled?
- Inquiry is already included in the experiment! Take away the data table and post-lab questions. Replace the worksheet calculations with a detailed overview of the experiment describing the general calculations: “The purpose of this experiment is to determine the identity of an unknown group 1 metal carbonate. The carbonate ion will be precipitated by a reaction with excess calcium chloride. The mass of the calcium carbonate will be measured. The moles of the unknown group 1 metal carbonate may be determined through stoichiometry, and the identity of the group 1 metal can be found by calculating the molar mass of the unknown.”
- Make the lab a challenge! Rather than having students determine the identity of an unknown group 1 element, challenge them to determine the percent composition of a mixture of sodium carbonate and potassium carbonate. Students must work from the understanding that the apparent molar mass of the mixture is a weighted average based on the respective molar masses of sodium carbonate and potassium carbonate.
- Extend the lab to incorporate consumer products by analyzing a calcium supplement or the amount of calcium ion in foods or beverages.

Alignment with AP Chemistry Curriculum Framework—Big Ideas 1 and 3

Enduring Understandings and Essential Knowledge

All matter is made of atoms. There are a limited number of atoms; these are the elements. (Enduring Understanding 1A)

1A2: Chemical analysis provides a method for determining the relative number of atoms in a substance, which can be used to identify the substance or determine its purity.

Atoms are conserved in physical and chemical processes. (Enduring Understanding 1E)

1E2: Conservation of atoms makes it possible to compute the masses of substances involved in physical and chemical processes. Chemical processes result in the formation of new substances, and the amount of these depends on the number and the types and masses of elements in the reactants, as well as the efficiency of the transformation.

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Chemical changes are represented by a balanced chemical equation that identifies the ratios with which reactants react and products form. (Enduring Understanding 3A)

3A2: Quantitative information can be derived from stoichiometric calculations that utilize the mole ratios from the balanced chemical equations. The role of stoichiometry in real-world applications is important to note, so that it does not seem to be simply an exercise done only by chemists.

Learning Objectives

- 1.2 The student is able to select and apply mathematical routines to mass data to identify or infer the composition of pure substances and/or mixtures.
- 1.3 The student is able to select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance.
- 1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution.
- 3.3 The student is able to use stoichiometric calculations to predict the results of performing a reaction in the laboratory and/or analyze deviations from the expected results.

Science Practices

- 2.2 The student can apply mathematical routines to quantities that describe natural phenomena.
- 4.3 The student can collect data to answer a particular scientific question.
- 5.1 The student can analyze data to identify patterns or relationships.
- 6.1 The student can justify claims with evidence.

The *Gravimetric Analysis of a Metal Carbonate*—AP Chemistry Classic Laboratory Kit is available from Flinn Scientific, Inc.

| Catalog No. | Description |
|-------------|---|
| AP6378 | Gravimetric Analysis of a Metal Carbonate—AP Chemistry Classic Laboratory Kit |

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