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**Quantitative Analysis of a Mixture of Carbonates  
(Inquiry-Based Approach)**

**Students’ Handout**

**Objective**

* To design and carry out an experiment to analyse the amounts of potassium carbonate and calcium carbonate in a given unknown mixture of the two carbonates.

**Tasks**

* To propose an experimental method to determine the ratio of potassium carbonate and calcium carbonate present in an unknown sample.
* To carry out an experiment to find out the ratio of potassium carbonate and calcium carbonate in the mixture.
* To compare and discuss the results obtained from other students or groups who carry out the determination with different methods.

**Introduction**

You are given a sample of white powder. It is a mixture of potassium carbonate and calcium carbonate, but the percentages of the two compounds are not known. Your task is to design an experimental method to find out the percentages. Since there is more than one possible approach, your classmates may use methods different from yours. Hence, you may compare your results with those obtained by your classmates after the determinations. You may also discuss the possible experimental errors of different methods.

**Curriculum Link**

Topic IV Acids and Bases

**Safety Precautions**

* Wear safety glasses, laboratory coats and disposable plastic gloves.
* Avoid the powdered substances getting into eyes.
* The acid (HCl) used in the experiment is corrosive. Handle it with care.

**Apparatus (per group)**

* Filter funnel × 1
* Glass rod × 1
* 100 cm3 Beaker × 1
* 250 cm3 Beaker × 1
* 250 cm3 Conical flasks × 2
* 50 cm3 Pipette × 1
* Burette × 2
* 50 cm3 Measuring cylinder × 1
* White tile × 1
* Hot plate × 1
* Stirrer bar × 1
* Spatula × 1
* Electronic balance × 1 (shared among groups)
* Oven × 1 (shared among groups)
* Filter papers × 3
* Disposable droppers × 4

*(You may not need to use all of the above items. Other apparatus may be provided upon request.)*

**Basic Chemicals (per group):**

* 0.200 M standard HCl(aq)
* 1.000 M standard HCl(aq)
* 0.200 M standard NaOH(aq)
* 1.0 M BaCl2(aq)
* Methyl orange indicator
* Phenolphthalein indicator
* Deionised water
* Sample (Mixture of potassium and calcium carbonates)

*(You may not need to use all of the above items. Other chemicals may be provided upon request.)*

**Guidelines**

1. Study the chemical and physical properties of potassium carbonate and calcium carbonate. Identify the similarities and differences among these two compounds.
2. Propose possible experimental methods that can determine (i) amount of potassium carbonate in the mixture; (ii) amount of calcium carbonate in the mixture; and (iii) total amount of carbonate ions in the mixture.
3. Investigate how the ratio of K2CO3 and CaCO3 in the mixture can be calculated from the experimental data.
4. Discuss the advantages and disadvantages of each method that you have proposed. Choose the one which you think is the best. Design step-by-step procedures to carry out the analysis.
5. Prepare an outline of your method including material list, procedures and safety measures. Obtain approval from your teacher before actually carrying out the experiment.
6. If time and materials are available, you may repeat the analysis by using the method that you consider as the second best. Compare the results and decide which one is actually the best.
7. After finishing the experiment and obtaining the results, compare your results with those obtained by your classmates who select a different method. Discuss with your classmates about what you have done and explain your choice of the best method. Discuss the possible experimental errors in different methods.