**YEAR 12 PRACTICAL**

**HOMEWORK EXERCISE 1**

DETERMINATION OF THE WATER OF CRYSTALLISATION IN A SAMPLE OF SODIUM CARBONATE

**ANALYSING AND EVALUATING**

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# Introduction

A sample of sodium carbonate was known to be the monhydrate Na2CO3.H2O. A chemist was asked to confirm the identity of the sample by titration of a solution of the sodium carbonate with hydrochloric acid.

The chemist rinsed a weighing bottle with de-ionised water and transferred sodium carbonate to the bottle until 0.25 g had been added. The content of the weighing bottle were then tipped into a conical flask. About 30 cm3 of de-ionised water were added to the conical flask, and the mixture was shaken until all of the sodium carbonate had dissolved.

The chemist filled a burette with 0.100 moldm-3 hydrochloric acid. The sodium carbonate solution was titrated with the acid solution using phenolphthalein as indicator.

The chemist then repeated the above procedure using a further 0.25 g portions of the sodium carbonate sample. The following results were obtained.

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| Titration number | 1 | 2 | 3 | 4 | 5 |
| Final burette reading/cm3 | 19.60 | 19.20 | 19.35 | 19.15 | 25.85 |
| Initial burette reading/cm3 | 0.05 | 0.05 | 0.05 | 0.10 | 6.75 |
| Titre/cm3 |  |  |  |  |  |

# Analysis

1. Using the conditions of the titration, sodium carbonate and hydrochloric acid react in a 1:1 mole ratio to form sodium hydrogencarbonate, NaHCO3, write an equation for the reaction, representing sodium carbonate as NaHCO3.

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2. Use all the concordant results in the table to determine an average titre.

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3. Use the average titre to calculate the number of moles of sodium carbonate present in 0.25 g of the sample.

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4. Using your results from part 3, determine the relative molecular mass Mr of the hydrated sodium carbonate

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5. Using your results from part 4, calculate the number of moles of water of crystallisation in one mole of hydrated sodium carbonate.

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6. Assume that the maximum errors for the apparatus used in the experiment

were:

 balance total error = ± 0.01 g

 burette total error = ± 0.15 cm3

 Calculate the maximum percentage error in using the balance and burette in this experiment and hence the overall maximum percentage error

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**Evaluation**

1. Comment on the consistency of the titrations.

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2. Calculate the difference between the experimental Mr value determined by the

chemist and the actual Mr value of Na2CO3.H2O. Express this as a percentage of the actual Mr value of Na­2CO3.H2O. (If you could not complete the calculation in part 4 of the analysis, you should assume that the experimental Mr value is 133. This is not the correct answer).

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3. Comment on the significance of the difference between the actual Mr of the hydrated

sodium carbonate and your calculated value. Assume that this difference is **not** due to impurities.

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4. State two ways of improving the chemist’s method of weighing out the sodium

carbonate and explain why the accuracy of the experiment would be improved.

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