EXPERIMENT NO. 5

Quantitative Analysis

Read through the whole method before starting any practical work. Where appropriate, prepare a table for your results in the space provided.

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

1 In this experiment you will determine the percentage by mass of an impure sample of sodium hydrogencarbonate, $NaHCO_3$.
You will do this by titration with hydrochloric acid, HC*l*. The impurity in the sample is **X**. **X** is a sodium compound which does not react with HC*l*.

FB 1 is a mixture containing sodium hydrogencarbonate and **X**.
You are supplied with approximately 4.0 g of **FB 1**.
FB 2 is 0.105 mol dm^{-3} hydrochloric acid, HC*l*.
methyl orange indicator

(a) Method

Preparing a solution of FB 1

- Weigh the 100 cm^3 beaker. Record the mass.
- Add between 2.8 g and 3.0 g of **FB 1** to the beaker.
- Reweigh the beaker with **FB 1**. Record the mass.
- Calculate and record the mass of **FB 1** used.
- Add approximately 50 cm^3 of distilled water to **FB 1** in the beaker.
- Stir the mixture with a glass rod until all the **FB 1** has dissolved.
- Transfer this solution into the 250 cm^3 volumetric flask.
- Wash the beaker with distilled water and transfer the washings to the volumetric flask.
- Add distilled water to the volumetric flask up to the mark.
- Shake the flask thoroughly.
- This solution of impure sodium hydrogencarbonate is **FB 3**. Label the flask **FB 3**.

Titration of FB 3

- Fill the burette with **FB 2**.
- Pipette 25.0 cm^3 of **FB 3** into a conical flask.
- Add approximately 5 drops of methyl orange indicator.
- Carry out a rough titration.
- Record your burette readings and the rough titre in the space below.

The rough titre is ..... cm^3.

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the precision of your practical work.
- Record in a suitable form below all of your burette readings and the volume of **FB 2** added in each accurate titration.

I	
II	
III	
IV	
V	
VI	
VII	
VIII	

[8]

(b) From your accurate titration results, obtain a suitable value for the volume of **FB 2** to be used in your calculations.
Show clearly how you obtained this value.

25.0 cm^3 of **FB 3** required ..... cm^3 of **FB 2**. [1]

(c) Calculations

(i) Give your answers to **(ii)**, **(iii)**, **(iv)** and **(v)** to the appropriate number of significant figures. [1]

(ii) Calculate the number of moles of hydrochloric acid, HC*l*, in the volume of **FB 2** calculated in **(b)**.

moles of HC*l* = ... mol [1]

(iii) Complete and balance the equation for the reaction of sodium hydrogencarbonate with hydrochloric acid. Include state symbols.

....$NaHCO_3$..... + ...HC*l*..... → ....NaC*l*..... + ...CO_2..... + ...

Deduce the number of moles of sodium hydrogencarbonate that reacted with the number of moles of HC*l* calculated in **(ii)**.

moles of $NaHCO_3$ = ... mol [1]

(iv) Use your answer to **(iii)** to calculate the number of moles of sodium hydrogencarbonate in the **FB 1** that you weighed out.

moles of $NaHCO_3$ in **FB 1** used = ... mol [1]

(v) Calculate the percentage by mass of $NaHCO_3$ in **FB 1**.

percentage by mass of $NaHCO_3$ in **FB 1** = ... % [1]

[Total: 14]