2 In this experiment you will determine the percentage by mass of a sodium halide impurity present in a sample of sodium hydrogencarbonate by titration.

$$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

FB 4 is an aqueous solution made by dissolving 17.20 g of the impure sodium hydrogencarbonate in each dm^3 of solution.
FB 5 is 0.200 mol dm^{-3} hydrochloric acid, HC*l*.
FB 6 is methyl orange indicator.

(a) Method

- Fill the burette with **FB 5**.
- Pipette 25.0 cm^3 of **FB 4** into a conical flask.
- Add several drops of **FB 6** to the conical flask.
- Perform a rough titration and record your burette readings 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 all your burette readings and the volume of **FB 5** added in each accurate titration.

Keep FB 4 for use in Question 3.

Results

I	
II	
III	
IV	
V	
VI	
VII	

[7]

(b) From your accurate titration results, calculate a suitable mean value to be used in your calculations.
Show clearly how you obtained this value.

25.0 cm^3 of **FB 4** required ..... cm^3 of **FB 5**. [1]

(c) Calculations

(i) Give your answers to **(c)(ii)** and **(c)(iii)** to an appropriate number of significant figures. [1]

(ii) Use your answer to **(b)** to calculate the amount, in mol, of hydrochloric acid in your mean titre.

amount of HC*l* = ... mol

Hence determine the amount, in mol, of sodium hydrogencarbonate present in 25.0 cm^3 of **FB 4**.

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

(iii) Calculate the mass of sodium hydrogencarbonate present in each dm^3 of solution.

mass of $NaHCO_3$ = ... g

Hence calculate the percentage by mass of the sodium halide impurity in **FB 4**.
Show your working.

percentage by mass = ... %
[2]

(d) A student carries out the experiment in Question 1 using the impure sodium hydrogencarbonate dissolved to make **FB 4**.
State how this affects the value of ΔH_1 determined in **1(b)(iii)** compared to the value the student would get if pure sodium hydrogencarbonate were used.

.....

.....

State what assumption you have made about the sodium halide impurity.

.....

.....
[2]

[Total: 14]

Qualitative analysis

For each test you should record all your observations in the spaces provided.

Examples of observations include:
- colour changes seen
- the formation of any precipitate and its solubility (where appropriate) in an excess of the reagent added
- the formation of any gas and its identification (where appropriate) by a suitable test.

You should record clearly at what stage in a test an observation is made.

Where no change is observed, you should write 'no change'.

Where reagents are selected for use in a test, the name or correct formula of the element or compound must be given.

If any solution is warmed, a boiling tube must be used. If any solid is heated a hard-glass test-tube must be used.

Rinse and reuse test-tubes and boiling tubes where possible.

No additional tests should be attempted.