EXTRA LAB # 1

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 Washing soda consists of hydrated sodium carbonate, $Na_2CO_3 \cdot 10H_2O$. When it is stored it loses some of its water of crystallisation to leave $Na_2CO_3 \cdot xH_2O$. Since water has been lost x is no longer an integer.

You will carry out a titration to determine the value of x. You will titrate a solution of the sodium carbonate with hydrochloric acid.

The equation for the reaction is shown.

$$Na_2CO_3 \cdot xH_2O(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(aq) + (x+1)H_2O(l)$$

FB 1 is an aqueous solution containing 11.30 g dm^{-3} of $Na_2CO_3 \cdot xH_2O$.
FB 2 is 0.100 mol dm^{-3} hydrochloric acid, HCl.
bromophenol blue indicator

(a) Method

- Fill the burette with **FB 2**.
- Pipette 25.0 cm^3 of **FB 1** into a conical flask.
- Add a few drops of bromophenol blue indicator.
- Carry out a rough titration and record your burette readings in the space below.

final burette reading / cm^3	24.20
initial burette reading / cm^3	0.00
titre / cm^3	24.20

The rough titre is 24.20 cm^3.

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

final burette reading / cm^3	47.60	26.50	
initial burette reading / cm^3	24.20	3.10	
titre / cm^3	23.40	23.40	
best titres	✓	✓	

I	
II	
III	
IV	
V	
VI	
VII	

[7]

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

$$\frac{23.40 + 23.40}{2}$$

25.0 cm^3 of **FB 1** required ..23.40..... cm^3 of **FB 2**. [1]

(c) Calculations

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

(ii) Calculate the number of moles of hydrochloric acid present in the volume of **FB 2** you calculated in **(b)**.

$n = cV$

$= 0.100 \times \frac{23.40}{1000}$

moles of HCl = ...2.34×10^{-3}..... mol [1]

(iii) Use the equation on page 1, and your answer to **(c)(ii)**, to calculate the concentration, in mol dm^{-3}, of $Na_2CO_3 \cdot xH_2O$ present in **FB 1**.

$Na_2CO_3 \cdot xH_2O$: HCl

1 : 2

x : 2.34×10^{-3}

1.17×10^{-3} mol / 25 cm^3

$c = \frac{n}{V} = \frac{1.17 \times 10^{-3}}{25.0/1000}$

concentration of $Na_2CO_3 \cdot xH_2O$ = ... 0.0468 ..... mol dm^{-3} [1]

(iv) Calculate the value of x in this sample of $Na_2CO_3 \cdot xH_2O$.

Show your working.

M_r of $Na_2CO_3 \cdot xH_2O$

$M_r = \frac{m}{n}$

$= \frac{11.30}{0.0468}$

241.5

xH_2O = M_r of $Na_2CO_3 \cdot xH_2O$ − M_r of Na_2CO_3

= 241.5 − 106

135.5

$x = \frac{135.5}{18}$

$= 7.53$

x = ...7.53..... [3]

[Total: 14]