

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, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. When it is stored it loses some of its water of crystallisation to leave $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$. 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.



FB 1 is an aqueous solution containing 11.30 g dm^{-3} of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$.

FB 2 is $0.100 \text{ mol dm}^{-3}$ 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 cm³ of **FB 1** required 23.40 cm³ of **FB 2**. [1]

(c) Calculations

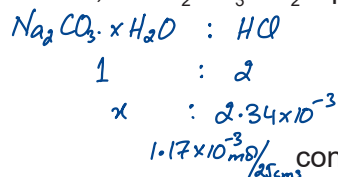
- (i) Give your answers to (c)(ii), (c)(iii) and (c)(iv) to an appropriate number of significant figures. [1]
- (ii) Calculate the number of moles of hydrochloric acid present in the volume of **FB 2** you calculated in (b).

$$n = cV$$

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

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 Na₂CO₃·xH₂O present in **FB 1**.



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

concentration of Na₂CO₃·xH₂O = 0.0468 mol dm⁻³ [1]

- (iv) Calculate the value of x in this sample of Na₂CO₃·xH₂O.

Show your working.

$$\frac{\text{Mr of Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}}{\text{Mr} = \frac{m}{n}}$$

$$= \frac{11.30}{0.0468}$$

$$\boxed{241.5}$$

$$x \text{ H}_2\text{O} = \text{Mr of Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} - \text{Mr of Na}_2\text{CO}_3$$

$$= 241.5 - 106$$

$$\boxed{135.5}$$

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

$$= 7.53$$

x = 7.53 [3]

[Total: 14]