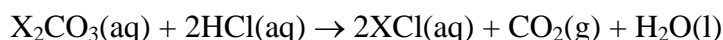


## Volumetric Analysis 3

### To determine the relative molecular mass of a soluble base

#### Introduction

In *Volumetric Analysis 1 & 2* you prepared a standard solution of sodium carbonate and used it to standardise an unknown concentration of dilute hydrochloric acid. In this practical you will use your new-found skills to find out the relative molecular mass of an unknown group 1 carbonate – the mysterious “Substance Z”. Group 1 carbonates are soluble in water (although  $\text{Li}_2\text{CO}_3$  is only sparingly soluble) and will react with dilute hydrochloric acid according to the overall equation below:



(X represents a group 1 element)

If you know the amount of hydrochloric acid that will react with a known amount of Substance Z, you should be able to determine the  $M_r$  of Substance Z and so identify the group 1 element in it.

You will need to make careful notes about your experiment as you go along today.

#### Apparatus

Consult your notes from *Volumetric Analysis 1 & 2* to decide upon the apparatus you need. Make sure that your practical write-up includes the apparatus you use today.

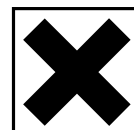
#### Method

Consult your notes from *Volumetric Analysis 1 & 2* and *The Burette* to remind yourself of the procedures needed for safe and accurate working.

Make sure that your practical write-up includes the methods you use today.

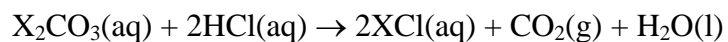
1. Weigh out accurately between 1.3g and 1.7g of Substance Z.  
Record your weighings in a suitable form. Dissolve your weighed Substance Z in de-ionised water, and make up the solution to  $250\text{cm}^3$  in a volumetric flask.
2. Clean your burette with de-ionised water and then with the standard 0.100M hydrochloric acid to be used for the titration.
3. Pipette  $25\text{cm}^3$  of the Substance Z solution into a clean conical flask.  
Using methyl orange indicator, titrate with the standard hydrochloric acid.
4. Repeat step 3 until concordant results are obtained.  
Record your results as in *Volumetric Analysis 2*.

After cleaning and clearing away, determine the identity of Substance Z as described overleaf.



## Analysis

As in *Volumetric Analysis 2*, 1 mole of  $X_2CO_3$  will react with 2 moles of HCl (see equation below):



(X represents a group 1 element)

1. Calculate the number of moles of HCl there were in your mean titre.
2. Calculate the number of moles of HCl that would react with the entire  $250\text{cm}^3$  of Substance Z solution.
3. Work out the number of moles of  $X_2CO_3$  were there in the  $250\text{cm}^3$  of Substance Z solution.

You now know:

- the mass of  $X_2CO_3$  in your Substance Z solution; and
  - the number of moles of  $X_2CO_3$  in your Substance Z solution.
4. Calculate the mass of one mole of  $X_2CO_3$ .
  5. What is Substance Z, and why?

## Volumetric Analysis 3

### To determine the relative molecular mass of a soluble base

#### Technician's Notes

#### **Prior to practical**

##### Sodium carbonate\*

Heat required amount of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) to drive off water of crystallisation.

Either: heat in an evaporating dish over a Bunsen burner for 30 minutes approx., or  
heat in a drying oven at about  $110^\circ\text{C}$  for 1 hour.

Agitate the solid periodically with a clean glass rod.

Transfer to a desiccator after heating, and label it "Substance Z - Harmful".

**Care:** Use tongs and eye protection.

Beware of hot solid and apparatus.

Sodium carbonate forms caustic alkaline solutions with water; if spilt on skin wash with plenty of water.

##### Analytical balances

Please check cleanliness and correct functioning of analytical balances.

##### De-ionised water

Please check 6th Form wash bottles are clean and filled with de-ionised water.

Make sure that additional de-ionised water is available in the aspirator.

##### Burettes

Please check the cleanliness and correct functioning of the burettes.

#### **Per class**

Sodium carbonate solid (see above). Allow approx. 2.5g per student.

Analytical balances (see above).

Top pan digital balances (minimum of two if possible).

De-ionised water (see above).

0.100M hydrochloric acid\* ( a good home-made solution should suffice for this practical).

Allow  $200\text{cm}^3$  per student.

Methyl orange indicator solution (the more bottles the better).

#### **Per student**

(Normally found in lab anyway)

1 x pair of safety goggles

1 x bench mat

2 x  $100\text{cm}^3$  beaker

2 x  $250\text{cm}^3$  beaker

1 x  $250\text{cm}^3$  conical flask

1 x glass funnel (check that it will enter the neck of the volumetric flask easily)

### **Per student**

(Additional apparatus to put out)

- 1 x glass rod (long)
- 1 x 250cm<sup>3</sup> volumetric flask with stopper to fit
- 1 x 25cm<sup>3</sup> bulb pipette
- 1 x pipette filler (check correct functioning)
- 1 x burette (see overleaf)
- 1 x burette stand
- 1 x weighing bottle with lid
- 1 x 6th Form wash bottle containing de-ionised water
- 1 x small spatula
- 1 x white tile
- 1 x small plastic filter funnel
- 1 x copy of N-ch1-37 (student guide to practical)

### **\*Health and Safety Notes**

#### **Hydrochloric acid**

Corrosive.

Use pre-prepared standard solution, or refer to Hazcards for correct method to prepare an accurate 0.100M solution.

#### **Sodium carbonate** (solutions and solid)

Sodium carbonate solutions are alkaline and therefore caustic.

Exercise care in handling - wear eye protection and, if spilt, wash with a lot of water.