

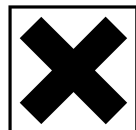
Volumetric Analysis 2

To standardise hydrochloric acid

Introduction

In the last practical you prepared a standard solution of sodium carbonate. Today, you will use it to find the concentration of dilute hydrochloric acid by titration. This process is known as **standardising** the hydrochloric acid.

The reaction between sodium carbonate and hydrochloric acid takes place in two stages:



Two indicators are needed to cover both stages:

- in stage 1, phenolphthalein is most suitable, and will respond to the pH change associated with the formation of sodium hydrogencarbonate, NaHCO_3 .
- in stage 2, methyl orange is most suitable, and will respond to the pH change associated with the final formation of sodium chloride, NaCl .

As a result, this practical gives you experience of titration using two different indicators (the phenolphthalein colour change is easy to spot, whereas the methyl orange colour change is quite difficult to judge).

Apparatus

Goggles
Bench mat
100cm³ beaker
250cm³ beaker
250cm³ conical flask
25cm³ bulb pipette
Pipette filler
Burette
Burette stand and holder

Plastic filter funnel
White tile
Teat pipette
Access to:
your standard sodium carbonate solution
dilute hydrochloric acid to standardise
phenolphthalein indicator solution
methyl orange indicator solution

Methods

1. Transfer a 25cm³ aliquot (portion) of your sodium carbonate solution to a 250cm³ capacity conical flask. Add a few drops of phenolphthalein indicator solution.
2. Titrate with the hydrochloric acid. The end-point of the titration is when the solution just changes from pink to colourless. Note the titre, then add a few drops of methyl orange.
3. Titrate with the hydrochloric acid. The end-point of the titration is when the solution just changes from yellow to red. Note the second titre.
4. Repeat steps 1 - 3 until concordance (i.e. until the readings are the same or within 0.1cm³). Tabulate your titrations as described in *The Burette* sheet. You will need two sets of tables.
5. After tidying away, do the calculations described overleaf.

Calculations

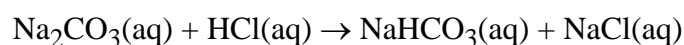
1. Calculate the M_r of Na_2CO_3 .

$$A_r(\text{Na}) = 23 \quad A_r(\text{C}) = 12 \quad A_r(\text{O}) = 16$$

2. Look back at the accurate mass of sodium carbonate you used in the last practical. Using your answer to step 1, calculate the number of moles of Na_2CO_3 that you dissolved in 250cm^3 of water during *Volumetric Analysis 1*.
3. Use your answer to step 2 to calculate the number of moles of Na_2CO_3 in the 25cm^3 transferred to the conical flask.

Stage 1 Phenolphthalein results

4. The equation for the first stage of the reaction between sodium carbonate and hydrochloric acid is shown below again:



From the equation, you can see that 1 mole of Na_2CO_3 will react with 1 mole of HCl.

How many moles of HCl will react with the number of moles of Na_2CO_3 calculated in step 3?

5. The answer to step 4 tells you how many moles of HCl were in your first mean titre. Divide this number by the volume of the first mean titre: this is the concentration of HCl in mol dm^{-3} .

Stage 2 Methyl orange results

6. The equation for the second stage of the reaction between sodium carbonate and hydrochloric acid is shown below again:



From the equation, you can see that 1 mole of NaHCO_3 will react with 1 mole of HCl.

The number of moles of NaHCO_3 is equal to the number of moles of Na_2CO_3 .

How many moles of HCl will react with the number of moles of NaHCO_3 calculated in step 3?

7. The answer to step 6 tells you how many moles of HCl were in your second mean titre. Divide this number by the volume of the second mean titre: this is also the concentration of HCl.
8. Your answers to steps 5 and 7 should be identical. Comment on your findings.

Volumetric Analysis 2
To standardise hydrochloric acid

Name

Date

Results

1. Phenolphthalein indicator (first part of each run)

Burette reagent	<i>Approx. 0.075M hydrochloric acid</i>
Conical flask reagent	<i>Standard sodium carbonate solution</i>
Indicator	<i>Phenolphthalein</i>

	Run 1	Run 2	Run 3	Run 4
Final volume (cm ³)				
Initial volume (cm ³)				
Titre (cm ³)				
Mean titre (cm ³)				

2. Methyl orange indicator (second part of each run)

Burette reagent	<i>Approx. 0.075M hydrochloric acid</i>
Conical flask reagent	<i>Standard sodium carbonate solution</i>
Indicator	<i>Methyl orange</i>

	Run 1	Run 2	Run 3	Run 4
Final volume (cm ³)				
Initial volume (cm ³)				
Titre (cm ³)				
Mean titre (cm ³)				

3. Notes and observations