

NEATH PORT TALBOT COLLEGE COLEG CASTELL NEDD PORT TALBOT

School of Maths & Science Science Practical

The Determination of the Percentage Sodium Carbonate in Washing Soda

◆ Aim

1. At the end of the experiment you should be able to apply the technique of titrimetric analysis to determine the percentage of sodium carbonate in a sample of washing soda.
2. Standardise an acid.
3. Use the previously standardised acid in a titration against washing soda.
4. Calculate the percentage by mass of the sodium carbonate present in a sample of washing soda.
5. Comment on the possible sources of error and evaluate your answer.

◆ Introduction

It has been discovered that a washing powder company has been testing its products on animals. Some animal rights extremists have decided to target this company and a batch of washing powder has been deliberately spiked with too much sodium carbonate and this could be dangerous to consumers. You are given a sample of washing soda crystals which contains sodium carbonate, and your objective is to measure the concentration of the sodium carbonate by titration with sulfuric acid.

◆ Safety

Control Measures

- The wearing of **safety glasses** and a **laboratory coat at all times** will be sufficient to take account of most hazards and significant risks.
- Keep stoppers on bottles as much as is possible
- Keep flammable liquids away from flames
- You are reminded of the need of good laboratory practise in order to maintain a safe working environment.

Hazards

| | |
|---------------------------|-------------------------|
| (Highly) Flammable | Methyl orange solution |
| Corrosive | Sulfuric acid |
| Harmful/Irritant | Sodium Carbonate solid. |



◆ Apparatus and chemicals

You will need safety glasses and standard volumetric glassware: a 50 cm³ burette and funnel, a 25 cm³ pipette and filler and 250 cm³ conical flasks.

For the standardisation of the sulfuric acid you will be given a dried sample of analar sodium carbonate which you will find stored in a desiccator.

You are also provided with washing soda and sulfuric acid of approx. conc. 0.05 mol dm⁻³.

◆ Procedure

You will need to carry out the determination below. This will be done in two parts. The first will be the standardisation of the sulfuric acid and the second will be the analysis of the washing soda. Record the results for your results on a suitable form.

Part 1. Standardisation of the sulfuric acid

Prepare a 250 cm³ standard solution of sodium carbonate (*use between 1.25g and 1.35 g sodium carbonate in 250 cm³ water*). Titrate a 25 cm³ portion of this solution against sulfuric acid using methyl orange indicator.

Part 2. Determination of sodium carbonate in washing soda

You will need to make up a solution using between 3.9 and 4.1 g of washing soda crystals in 250 cm³ of water. This must be done accurately. 25 cm³ portions of this solution should then be titrated against the previously standardised sulfuric acid. Methyl orange is a suitable indicator.

◆ Calculations

1. Calculate the concentration of the standard sodium carbonate solution.
The molar mass of sodium carbonate is 106.0 g.
2. One mole of sodium carbonate is neutralised by one mole of sulfuric acid and so the concentration of the sulfuric acid may be calculated.
3. Again each mole of sodium carbonate in the washing soda solution is neutralised by one mole of sulfuric acid and so the number of moles sodium carbonate in a 25 cm³ aliquot of the washing soda solution can be found.
4. The total volume of washing soda solution made up is 250 cm³ and so we can find the no. of moles in this solution.
5. The mass of sodium carbonate in 250 cm³ of the washing soda solution can now be found.
6. The percentage of sodium carbonate in the crystals is given by:

$$\text{Percentage sodium carbonate} = \frac{\text{mass sodium carbonate}}{\text{mass washing crystals weighed out}} \times 100$$

◆ Supplementary Work: Errors in Practical Work

Use suitable computer packages such as 'Word' and 'Excel' to complete the following tasks. Help using excel can be found on the VLE wherever you see the icon on the right.



1. An analysis of the results obtained by your class for the analysis of washing soda

Part A: Analysis of the data using Excel.

- Collect the results (i.e. the student's percentage of sodium carbonate in the washing soda) of *twenty students* who have completed the practical.

N 2.1.1, 2.1.2,

- You will enter the results into a spreadsheet. Program the spreadsheet to calculate the *mean percentage of sodium carbonate* for the group together with the *difference of each student from the mean result*.



Entering formula

$$\text{Percentage error} = (\text{student result} - \text{mean result}) \times 100 / \text{mean result}$$

An example of such a spreadsheet is shown below: N 2.3.2

| | A | B | C | D | E | F | G | H |
|----|---|------------------|-----------------------|------------------|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | Name | % of Sodium Carbonate | Percentage Error | | | | |
| 3 | | Andrew Bale | 37.9 | | | | | |
| 4 | | Daniel Brown | 37.8 | | | | | |
| 5 | | Anthony | 38.7 | | | | | |
| 6 | | Kristian | 39.9 | | | | | |
| 7 | | Fran Era | 37.5 | | | | | |
| 8 | | Gareth Evans | 37.8 | | | | | |
| 9 | | Sam Hamer | 38.1 | | | | | |
| 10 | | Laura | 38.9 | | | | | |
| 11 | | Emily-Jayne | 37.7 | | | | | |
| 12 | | Huw Kealy | 38.7 | | | | | |
| 13 | | Beth Killa | 37.6 | | | | | |
| 14 | | Adrian | 38.5 | | | | | |
| 15 | | Ben Martin | 38.2 | | | | | |
| 16 | | Glenn Nicol- | 37.5 | | | | | |
| 17 | | Laura Perry | 38.7 | | | | | |
| 18 | | Gaby | 38 | | | | | |
| 19 | | Huw Thomas | 38 | | | | | |
| 20 | | Cennydd | 38.3 | | | | | |
| 21 | | Helen | 37.74 | | | | | |
| 22 | | Helen | 38.7 | | | | | |
| 23 | | | | | | | | |
| 24 | | Mean percentage= | | | | | | |



Displaying formula

- Save your spreadsheet using **your name** as the filename.
- Print down a copy of the spreadsheet showing **the formulae** used to obtain results. This must be attached as an appendix to your final Word report as a screen print (see next page)
- Use excel to generate a suitable graph or chart showing the error of each candidate. An example of a such a graph is shown below
- Assume that the expected error for the experiment based upon the tolerance of the equipment to be no more than 1.0 % from the mean result. Draw on the graph a tolerance line at +1.0 % and -1.0 %.
- Work out how many people are within the +/-1.0 % error and how many are outside. Make a pie chart showing this information. You will need to include the pie chart in your final report so make sure you save it!
- E-mail the spreadsheet to your tutor as an attachment to an e-mail. Make sure that the filename for the spread is your name.



Editing a chart



Drawing a pie chart in excel

Part B: Report in word

- Give your report a suitable heading
- Write a section entitled '**Introduction**' explaining the purpose of the report. You need to include the following points.
 - The aim of the experiment;
 - A brief description of how the experiment was carried out (no more than two paragraphs) **N 2.1.3**
- Add a second section to your report entitled '**My Results for the practical**' In this section state your value for the concentration of sulfuric acid. Look at the graph 'Apparatus error and titre values' and work out the percentage uncertainty for this result. **N2.1 (using chart/graph)**. Also state your value for the percentage of sodium carbonate. The uncertainty in this value is 1.0%.
- The third section of the report will be headed '**Analysis of the Class Results**'. It must include:
 - A copy of the table you generated in excel showing the class results, the mean result and error. **N2.3.2, 2.3.3**
 - A subsection entitled 'Check of Calculation' Show how to work out the mean in the *conventional way* using mathematical formula. This must be done in full. Also in this section show how you work out the error of two students from your class. Include formulas used. **N 2.2.1 N 2.2.2**
 - Your chart showing student errors **N2.3.2 N2.3.3**
 - A statement about how many people fell outside/ inside the expected error range (+/-1.0 %) Add your pie chart to the report. **N2.3.2**

- Finally include a section termed '**Sources of Error**'.

In this section discuss the likely sources of error in the results and how they can be minimised. Look at your results in particular and explain whether they are reliable and what you need to do to improve them next time. [N 2.3.4](#)

Add an appendix showing the formulas used in the spread sheet (see previous page). This is best done as a screen print

- Email the report to your tutor for checking. Again the filename must be your name!