N5 Chemistry: Unit 3 - Chemistry in Society

Part B - Fertilisers, Nuclear and Chemical Analysis

Lesson 1 - Chemical Analysis - Titration

Learning Outcomes

By the end of this lesson you should know:

1. How to identify common pieces of chemical apparatus.
2. How to carry out a titration experiment.
3. How to use the data from a titration to complete a calculation.

Success Criteria

You will have been successful in this lesson if you:

1. Read and learn the notes given here and your printed notes booklet
2. Watch the links provided

Chemical Analysis - Titration	**Unit 3 – Chemical Analysis (also Unit 1 – Acids and Bases)**	https://youtu.be/Bg_2bojp0m8

3. Complete revision questions provided

There is also a further reading section to help you gain more depth of understanding for this section.

If you have any questions about the content of this lesson, you should ask your class teacher either through your class MS team or via email. MS Teams will be monitored throughout the week by a chemistry teacher. If you need help or clarification with either the task or the content of the lesson, just ask.

Links to Prior Knowledge

You may wish to revise the following to help you understand this lesson:

- N5 Unit 1: Acids and Bases - Titration

Words written in italics do not need to be copied and are there to provide instruction.

Chemical Analysis

Chemists play an important role in society through the work of chemical analysis. This could include testing samples for quality control or contaminants.

There are a number of different techniques used by chemists to monitor our environment. These methods can be classified as quantitative (e.g. titration) or qualitative (e.g. flame testing).

There are some common pieces of chemical apparatus which are used both in professional laboratories and school laboratories.

Note: *You should have access to a copy of the National 5 Practical Techniques booklet and this contains images of the apparatus that you should be familiar with at N5 level.*

Chemical Apparatus Activity

Try the match-up activity on the following website (only difference is we refer to a 'clamp-stand' not a 'retort-stand'). Challenge yourself to see how many correct pairs you can get in 5 minutes!

https://matchthememory.com/laboratoryequipment

You should already have notes from Unit 1 on titrations, but please read the following carefully and check you understand each step in detail.

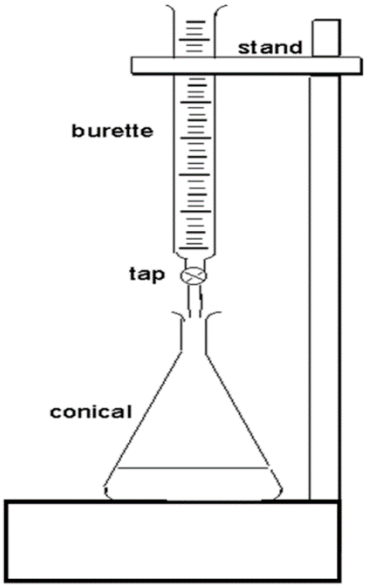
Titration

A titration is an analytical method used to determine, accurately, the volumes of solution required to reach the end-point of a chemical reaction. Many titrations also involve neutralisation reactions (N5 Unit 1).

In a titration, a **pipette filler** is used to fill a **pipette** with a known volume of a solution and this is transferred into a **conical flask**. An indicator is normally added to show when the end-point is reached.

A **standard solution** (a solutions of accurately known concentration) is added to the **burette** and this is added slowly to the conical flask.

Example Diagram:



When the end-point is reached the volumes are recorded.

A rough titration is always carried out first and then the experiment is repeated until the titre volumes are concordant (titre volumes within 0·2 cm^3 are considered concordant).

Example Results Table:

Titration	Start volume (cm^3)	Final volume (cm^3)	Volume added (cm^3)
Rough	0.0	15.9	15.9
First	15.9	31.1	15.2
Second	31.1	46.5	15.4

An average of the concordant results is used for the volume in a calculation (the rough titre is not used).

Titration Simulation Activity

Access the website link below and select 'Quickstart' then 'Titration Level 1'.

You should work through the material from this resource to help aid your understanding of standard solutions, titrations as well as revise some acids and bases material from Unit 1.

https://virtual.edu.rsc.org/titration/experiment/2

You should already have notes from Unit 1 on titration calculations, but please read the following carefully and check you understand each step in detail.

Titration Calculations

What is the concentration of hydrochloric acid (HCl) if 25 cm^3 is required to neutralise 40.7cm^3 of sodium hydroxide (NaOH) with a concentration of 2 mol l^{-1}?

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Molar Ratio 1 : 1

n = 0.0814	n = 0.0814
c = 2 mol l^{-1}	c = ?
v = 0.0407 l	v = 0.025 l

$$c = \frac{n}{v} = \frac{0.0814}{0.025} = \underline{\mathbf{3.256\ mol\ l^{-1}}}$$

Further Reading

To learn more about titrations, try the following online resources:

BBC Bitesize: https://www.bbc.co.uk/bitesize/guides/zx6csrd/revision/1

Scholar: Log in through GLOW

National 5 Chemistry → Chemistry in Society → Chemical Analysis

Evans2 chem web: https://www.evans2chemweb.co.uk/

Username: snhs password: giffnock

Select any teacher → revision → National 5 → Unit 3: Chemistry in Society → Chemical Analysis

Complete self-check exercises in your class work jotter and use the answers at the end of this document to mark.

Self Check 10

1. Name the following pieces of apparatus found in a lab:

A.

B.

C.

D.

E.

F.

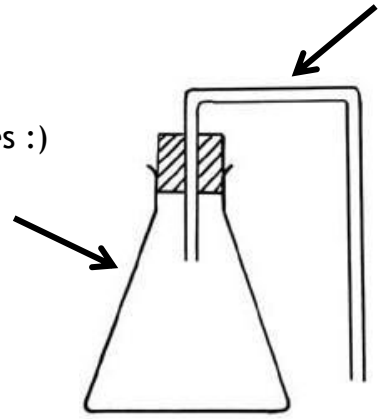
G.

H.

I.

J.

K. (2 pieces :)



Self Check 13

1. The results below show the volume of Hydrochloric acid used to neutralise 25cm^3 of Sodium hydroxide solution:

Titration	Initial burette reading (cm^3)	Final burette reading (cm^3)	Titre (cm^3)
1	1·2	18·0	16·8
2	18·0	33·9	15·9
3	0·5	16·6	16·1

(a) Why is the first titration value not used in any further calculation?
(b) What was the volume of Hydrochloric acid required to neutralise the alkali?

2. The results below show the volumes of alkali required during a titration experiment:

RESULTS TABLE

Run	Volume (cm^3)		
	Initial	Final	Titre
Rough	0.00	24.40	24.40
1	0.00	23.85	23.85
2	23.85	47.65	23.80
3	0.00	23.80	23.80

What volume of alkali should be used in the final titration calculation? Explain your answer.

3. Nitric acid reacts with Sodium hydroxide according to the equation:

$$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$$

Janet has 50cm^3 of a 0·5 mol l^{-1} solution of nitric acid.

(a) How many moles of nitric acid does she have?
(b) How many moles of sodium hydroxide would be needed to neutralise the acid?

Self Check 13(continued)

4. Sulphuric acid reacts with sodium hydroxide according to the equation:

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$$

Yasser has 100cm^3 of a 0·2 mol l^{-1} solution of sulfuric acid.

(a) How many moles of sulphuric acid does he have?
(b) How many moles of sodium hydroxide would be needed to neutralise the sulfuric acid?

5. Hydrochloric acid reacts with potassium hydroxide according to the equation:

$$HCl + KOH \longrightarrow KCl + H_2O$$

What is the concentration of a solution of hydrochloric acid if 12·5 cm^3 of hydrochloric acid is neutralised by 20 cm^3 of a 0·1 mol l^{-1}solution of potassium hydroxide?

6. Nitric acid reacts with sodium hydroxide according to the equation:

$$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$$

What volume of 0·5 mol l^{-1} nitric acid is needed to neutralise 100 cm^3 of an 0·2 mol l^{-1} solution of sodium hydroxide?

7. Hydrochloric acid reacts with calcium hydroxide according to the equation:

$$2HCl + Ca(OH)_2 \longrightarrow CaCl_2 + H_2O$$

50 cm^3 of a 0·5 mol l^{-1} solution of hydrochloric acid was neutralised by 100cm^{3}of calcium hydroxide solution. What was the concentration of the calcium hydroxide solution?

8. Sodium hydroxide reacts with sulphuric acid according to the equation:

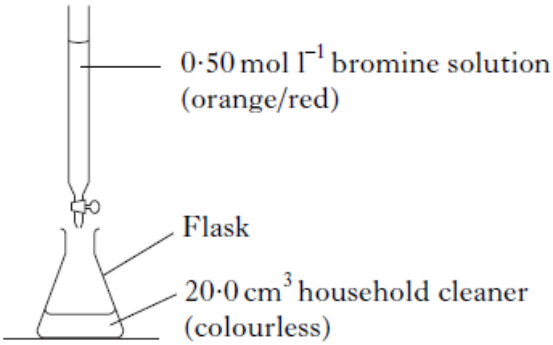
$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

What is the concentration of sodium hydroxide if 20 cm^3 of a solution of the alkali is neutralised by 35 cm^3 of a 0·5 mol l^{-1} sulphuric acid solution?

Self Check 13(continued)

9.

Using bromine solution, a student carried out titrations to determine the concentration of limonene in a household cleaner.



Titration	Initial burette reading (cm^3)	Final burette reading (cm^3)	Titre (cm^3)
1	0·5	17·1	16·6
2	0·2	16·3	16·1
3	0·1	16·0	15·9

The equation for the reaction between limonene and bromine solution is shown.

$$C_{10}H_{16}(aq) + 2Br_2(aq) \longrightarrow C_{10}H_{16}Br_4(aq)$$

Calculate the concentration of limonene in the household cleaner.

Self Check 10 ANSWERS

1. (a) Evaporating basin
   (b) Pipette filler
   (c) Boiling tube
   (d) Beaker
   (e) Burette
   (f) Measuring cylinder
   (g) Test tube
   (h) Filter funnel
   (i) Dropping pipette
   (j) Pipette
   (k) Conical flask and Delivery tube

Self Check 13 ANSWERS

1. (a) It is not used as it is a rough titration.
   (b) 16.0 cm^3

2. 23.80 cm^3 as this is the average of the 2 closest (concordant) results.

3. (a) 0.025 moles
   (b) 0.025 moles

4. (a) 0.02
   (b) 0.04

5. 0.16 $moll^{-1}$

6. 0.04 l

7. 0.125 $moll^{-1}$

8. 1.75 $moll^{-1}$

9. **0.2** $moll^{-1}$