Master

Kirkcaldy High School

N4/5 Chemistry

Unit 3 - part 2

Chemistry in Society

Name: ______________________

Class: ______________________

Teacher: ______________________

Date: ________________

Plastics

Learning Intentions

- To learn about common polymers.

Success Criteria

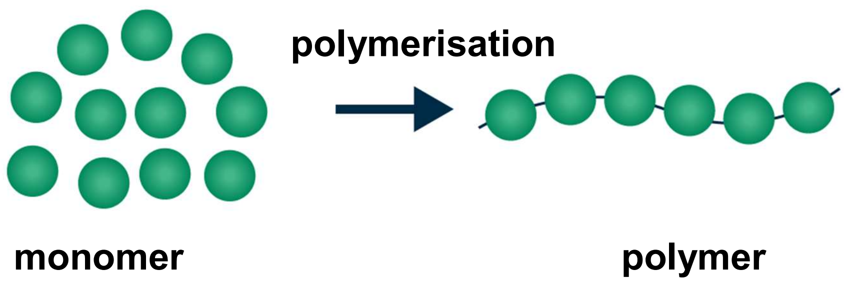
☐ I can identify addition polymerisation.

☐ I can name a polymer given the name of the monomer unit.

☐ I can write the a section of a polymer and repeating unit given a monomer.

Polymerisation

In this section, we'll explore the world of **polymerisation**, a key process in creating many of the **plastics** and materials we use every day. Polymers are **large molecules** made up of **repeating** structural **units**. These units are smaller molecules known as **monomers**.

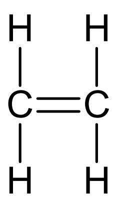


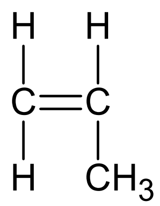
Addition Polymerisation

Monomers are small, often simple molecules with a **reactive feature** (**functional group**) that enables them to **bond** to other monomers.

> In **addition** polymerisation, these monomers are typically **unsaturated**, meaning they contain **double** or **triple** bonds.

Common examples of monomers used to make polymers through addition polymerisation are **ethene** and **propene**. These are drawn differently than we seen the in the 'homologous series' topic, as shown below:





Naming Polymers

The name of an addition polymer is usually derived from the monomer that it is made from. The name of the polymer with be given as **poly(*monomer*).**

For example:

The monomer for poly(ethene) is ethene (C_2H_4). The polymer name reflects what it is made from:

- Monomer: Ethene
- Polymer: Poly(ethene)

In the name "Poly(ethene)", the use of brackets around "ethene" indicates that this polymer is made up of repeating units of ethene.

Questions

1. **Describe** the difference between a monomer and a polymer.

2. **State** the name of the type of polymerisation where an unsaturated molecule is used as a monomer.

3. **Fill** out the following table to name the polymers from their monomer name and vice versa .

Monomer Name	Polymer Name
Ethene	
Propene	
Vinyl Chloride	
Styrene	
	Poly(butadiene)
	Poly(tetrafluoroethene)
	Poly(acrylonitrile)

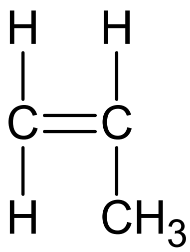
Monomer → Polymer → Repeating Unit

In the process of **addition** polymerisation, an **unsaturated** monomer unit, which has a **double** bond between carbon atoms, undergoes a reaction where these double bonds **break** and **form single** bonds, allowing the **monomers** to **link** together in a **chain** to create a long-chain **polymer**.

Your teacher will now demonstrate how to create a polymer from a given monomer unit below:

Monomer Name: propene

Monomer structure:



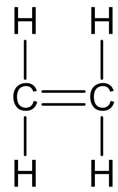
Polymer:
(3 repeating units)

Polymer Name: ________________

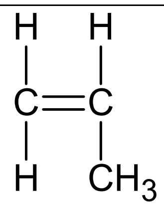
Repeating Unit:

Questions

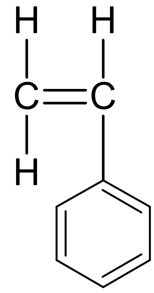
1.

Monomer Name:	ethene	**Monomer Structure:**	
Polymer (3 repeating units)			
Polymer Name:		**Repeating Unit:**	
Use of polymer (plastic)			

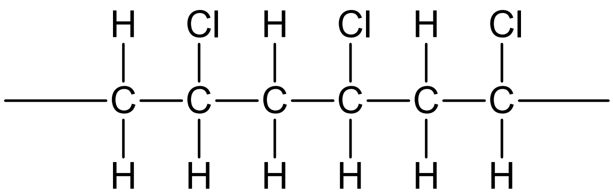
2.

Monomer Name:	propene	**Monomer Structure:**	
Polymer (3 repeating units)			
Polymer Name:		**Repeating Unit:**	
Use of polymer (plastic)			

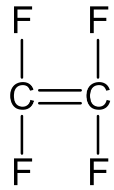
3.

Monomer Name:	styrene	**Monomer Structure:**	
Polymer (3 repeating units)			
Polymer Name:		**Repeating Unit:**	
Use of polymer (plastic)			

4.

Monomer Name:	vinyl chloride	**Monomer Structure:**	
Polymer (3 repeating units)			
Polymer Name:		**Repeating Unit:**	
Use of polymer (plastic)			

5.

<table>
<tr><td>Monomer Name:</td><td></td><td>Monomer Structure:</td><td>
</td></tr>
<tr><td>Polymer
(3 repeating units)</td><td colspan="3"></td></tr>
<tr><td>Polymer Name:</td><td>Poly(tetrafluoroethene)</td><td rowspan="2">Repeating Unit:</td><td rowspan="2"></td></tr>
<tr><td>Use of polymer (plastic)</td><td></td></tr>
</table>

6. *Remember to write the monomer in the "rugby goal post" format*

<table>
<tr><td>Monomer Name:</td><td>but-2-ene</td><td>Monomer Structure:</td><td></td></tr>
<tr><td>Polymer
(3 repeating units)</td><td colspan="3"></td></tr>
<tr><td>Polymer Name:</td><td></td><td rowspan="2">Repeating Unit:</td><td rowspan="2"></td></tr>
<tr><td>Use of polymer (plastic)</td><td></td></tr>
</table>

Date: ________________

Fertilisers

Learning Intentions

- To learn about producing synthetic fertilisers.

Success Criteria

- ☐ I can state the elements/nutrients required for health plant growth.
- ☐ I can state the properties of ammonia.
- ☐ I can describe the Haber and Ostwald processes and the catalysts involved.

Fertilisers

Fertilisers are substances which **restore elements**, essential for **healthy** plant **growth**, to the soil.

Growing plants require nutrients, including compounds containing elements: **nitrogen**, **phosphorus** or **potassium** (**N.P.K**).

They can be categorised into two types: **natural** and **synthetic** (man-made).

Natural fertiliser

Synthetic fertiliser

Natural Fertilisers

Natural fertilisers, also known as organic fertilisers, are derived from plant or animal sources. They include materials like manure, compost, bone meal, and seaweed.

Natural fertilisers enhance soil health and offer a **steady**, **eco-friendly** nutrient supply to plants, but their **lower** nutrient concentration requires **larger** quantities, and their **variable** composition can complicate precise **nutrient** management.

Synthetic Fertilisers

Synthetic fertilisers are manufactured **chemically** and are designed to provide **specific** nutrients in **concentrated** forms.

Synthetic fertilisers offer a **rapid**, **precise**, and **consistent** nutrient supply to plants, **tailored** to **specific** crop needs and are user-friendly in transportation and application.

However, they pose risks such as soil **degradation**, disruption of microbial life, potential environmental harm through **nutrient runoff** and water **pollution**, and the accumulation of **harmful** chemicals in soil with repeated use.

Ammonia (NH_3) and **nitric acid** (HNO_3) are important compounds used to produce **soluble**, **nitrogen** containing salts that can be used as **synthetic fertilisers**.

Questions

1. **State** the definition of fertilisers.

2. **Identify** the key nutrients in fertilisers.

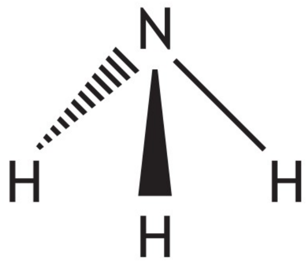
3. **Describe** the advantages and disadvantages of natural fertilisers.

4. **Describe** the advantages and disadvantages of synthetic fertilisers.

5. **Name** the important chemicals used to make synthetic fertilisers.

Ammonia

Ammonia (**NH_3**) is a pungent, clear, colourless gas
which dissolves in water to produce an **alkaline** solution.



1. **State** the colour universal indicator would turn in the presence of ammonia

2. **State** the name of the shape of a molecule of ammonia.

3. **Draw** a diagram, showing all outer electrons, to represent a molecule of ammonia, NH_3.

4. **State** the type of **bonding** and **structure** in ammonia.

5. **Explain** why this type of bonding and structure leads to low melting points and boiling points.

Your teacher may demonstrate the ammonia fountain experiment.

Reaction Title: Ammonia Fountain (p40 lab booklet)

Aim:

Method:

Results:

Conclusion:

Evaluation:

Making nitrogen-based fertilisers

In order to be able to use the nitrogen in ammonia to produce a nitrogen-based fertiliser, **ammonium** (**NH_4^+**) salts must be made from **ammonia** (**NH_3**). These salts must also be **soluble**.

Ammonia solutions react with acids to form **soluble salts**.

ammonia solution + an acid → an ammonium salt + water

Common fertilisers are:

	Ammonium nitrate	**Ammonium Phosphate**
Chemical Formula:	____________	____________

State why these would these ammonium salts in particular be useful as fertilisers.

Reason 1:____

Reason 2:____

There are two processes used to produce these ammonium salts from natural sources. These are the **Haber** process and the **Ostwald** process.

The Haber process, created by Fritz Haber, synthesises **ammonia** from atmospheric **nitrogen** and **hydrogen** from natural gas. This process was industrialised by Carl Bosch, becoming vital for large-scale fertiliser production.

The Ostwald process, developed by Wilhelm Ostwald, complements this by converting **ammonia** into **nitric acid**, a key step in forming various **ammonium**-based fertilisers.

These two processes together significantly advanced agricultural productivity by enabling the mass production of essential fertilisers in the 20th century.

The Haber process

The Haber process is used to produce the ammonia required for fertiliser production from **nitrogen** and **hydrogen**.

> The Haber process:
>
> $$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$
>
> An **iron** catalyst is used for this process
> The ⇌ symbol means that the reaction is **reversible**.

As the reaction is reversible, the forward or backword reaction can be **speeded** up depending on the **conditions**. At low temperatures the forward reaction is too **slow** to be economical. If the temperature is increased, the rate of reaction **increases** but, as the temperature increases, the backward reaction becomes more dominant which makes **less** ammonia. The temperature is fine tuned to make the **most** ammonia at the **cheapest** cost.

The Ostwald process

Ammonia is the starting material for the commercial production of **nitric acid**.

> The Ostwald process uses **ammonia**, **oxygen** and **water** to produce **nitric acid**.
>
> A **platinum** catalyst is used in this process.

The process is as follows:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

$$3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$$

Combining the processes to produce ammonium nitrate

The synthesis of ammonium nitrate involves a straightforward chemical reaction between ammonia and nitric acid, both products of the Haber and Ostwald processes:

> Combining the products of the Haber/Ostwald process:
>
> **Ammonia + nitric acid → ammonium nitrate**
>
> $$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Questions

1. **State** the product of the Haber process.

2. **Identify** the catalyst used in the Haber process.

3. **Explain** the significance of the $\rightleftharpoons$ symbol in the Haber process.

4. **Describe** the impact of temperature on the Haber process.

5. **Describe** the starting materials and main product of the Ostwald process.

6. **Name** the catalyst in the Ostwald process.

7. **Summarise** how ammonium nitrate is produced from the Haber and Ostwald. processes.

8. **Write** the chemical equation for the synthesis of ammonium nitrate.

Extension (% by mass practice)

9. **Calculate** the percentage by mass of nitrogen in ammonium nitrate (NH_4NO_3).

10. **Calculate** the percentage by mass of nitrogen in ammonium phosphate ($(NH_4)_3PO_4$).

11. **Determine** the Most Suitable Fertiliser for Nitrogen-Deficient Soil Based on Your Answers to Questions 9 and 10**. Explain** your answer.

Date: _______________

Nuclear Chemistry

Learning Intentions

- To learn about radioactive decay and its products.

Success Criteria

- ☐ I can state where radiactive decay occurs in an atom.
- ☐ I can represent alpha, beta and gamma radiation with nuclide notation
- ☐ I can identify alpha, beta and gamma radiation by how it behaves in a magnetic field.
- ☐ I can state the materials that stop alpha, beta and gamma radiation.
- ☐ I can write nuclear decay equations for alpha and beta decay
- ☐ I can state the definition of half-life
- ☐ I can perform half-life calculations and determine half-life from a decay graph.

Radiation

Radioactive decay involves **changes** in the **nuclei** of atoms.

Decay is caused by certain **isotopes** being **unstable** due to having particular combinations of the numbers of protons and neutrons in the nucleus. This instability causes the nuclei to fall apart (**decay**).

State the definition of isotopes:

____

____

Unstable nuclei (**radioisotopes**) can become more **stable** nuclei by giving out **alpha**, **beta** or **gamma** radiation.

Types of radiation

Alpha particles (**α**) consist of two protons (so it is a **helium** atom) and two neutrons and carry a double positive charge. This can be represented as:

Alpha: α	$^{4}_{2}He$	$^{4}_{2}He^{2+}$

Beta particles (**β**) are electrons ejected from the nucleus of an atom. This can be represented as:

Beta: β	$^{0}_{-1}e$

Gamma rays (**γ**) are high energy electromagnetic waves emitted from within the nucleus of an atom. This can be represented as:

Gamma: γ

Protons and **neutrons** can also be represented as:

Protons: $^{1}_{1}p$ **Neutrons:** $^{1}_{0}n$

Sources of radiation

Natural Sources:

The Earth is a natural source of radiation. Radon gas, emitted from the decay of uranium in the Earth's crust, is a prime example. Cosmic rays, high-energy particles from outer space, constantly bombard the Earth, contributing to background radiation levels. Even our own bodies are minor sources of radiation, due to the presence of naturally occurring isotopes, like carbon-14 and potassium-40.

Man-made Sources:

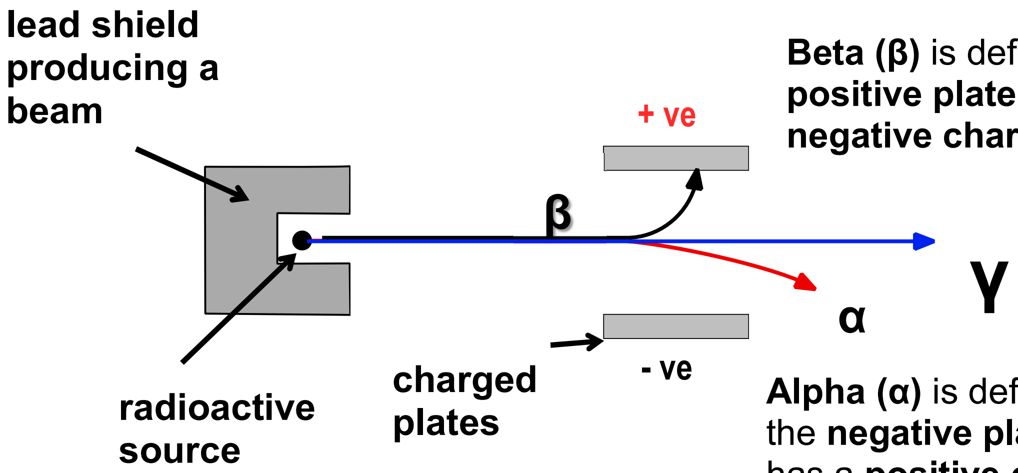
Medical imaging and treatment, such as X-rays and radiation therapy, are common sources. Nuclear power plants, while generating electricity, produce radiation as a byproduct.

Consumer Products:

Everyday items can emit radiation too. Smoke detectors often contain americium-241, a radioactive element.

Effect with Magnets

The following experiment investigates the electrical charge of alpha (α), beta (β) and gamma (γ) radiations.



Beta (β) is deflected towards the **positive plate** showing it has a **negative charge**.

Gamma (γ) is not deflected showing it does not have an electrical charge.

Alpha (α) is deflected towards the **negative plate** showing it has a **positive charge**.

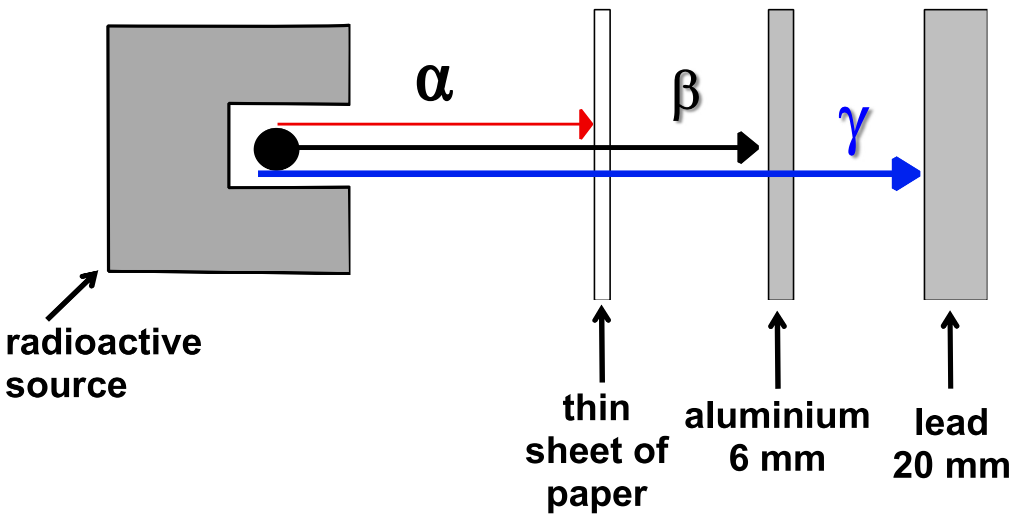
Beta (β) is deflected more than alpha (α) showing beta (β) has a lighter mass than alpha (α).

Alpha particles move towards _____________ charges

Beta particles move towards _____________ charges.

Gamma is not **deflected** by magnetic fields.

Penetration through materials



Alpha radiation is stopped by a **thin** sheet of **paper**, beta is stopped by a sheet of **aluminium** and gamma is stopped by **lead** or **concrete**.

Nuclear decay equations

During any type of decay, if the number of **protons** (**atomic** number) changes the **element** changes and therefore its **symbol** must change.

During an **alpha** decay, the radioisotope loses 2 protons and 2 neutrons to make an alpha particle. Therefore using nuclide notation, it loses 2 from the atomic number and 4 from the mass number as shown below:

- 4 from mass number

Alpha decay

Alpha decay: $$^{241}_{95}Am \rightarrow\ ^{237}_{93}Np +\ ^{4}_{2}He$$

- 2 from atomic number

Symbol change based on the atomic number

During an **beta** decay, the radioisotope converts a neutron to a proton, resulting the the mass number staying the same but the atomic number increaseing by 1. Therefore using nuclide notation, it gains 1 to its atomic number and releases a beta particle.

beta decay

Beta decay: $$^{131}_{53}I \rightarrow\ ^{131}_{54}Xe +\ ^{0}_{-1}e$$

+ 1 to atomic number

Symbol change based on the atomic number

Questions

Complete the following nuclear equations with the corresponding type of radiation

1. Americium-241 undergoes alpha decay:

$$^{241}_{95}Am \rightarrow$$

2. Iodine-131 undergoes beta decay:

$$^{131}_{53}I \rightarrow$$

3. Polonium-210 undergoes alpha decay:

$$^{210}_{84}Po \rightarrow$$

4. Strontium-90 undergoes beta decay:

$$^{90}_{38}Sr \rightarrow$$

5. Caesium-137 undergoes beta decay:

$$^{137}_{55}Cs \rightarrow$$

6. Uranium-235 undergoes alpha decay:

$$^{235}_{92}U \rightarrow$$

7. Uranium-238 undergoes alpha decay:

$$^{238}_{92}U \rightarrow$$

Half-life

The **half-life** is the time taken for **half** of the **nuclei** in a sample to **decay**.

The half-life of an **isotope** is a **constant**,
unaffected by chemical or physical conditions.

Radioactive isotopes can be used to date materials.

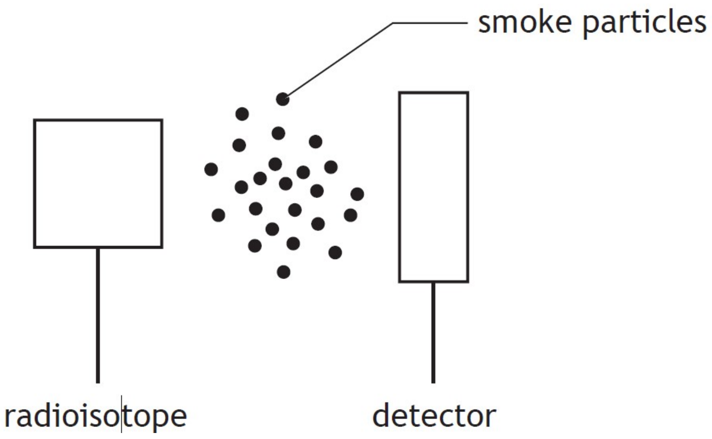
What is a short/long half life?

When we are discussing the lengths half-life, a ‘long’ half-life could be hundreds of millions or billions of years. Therefore, a relatively ‘short’ half-life could be hundreds or thousands of years.

Isotope	Half-Life	Is it a ‘short’ or ‘long’ Half-life?	Type of Decay	Stopped by? (paper, aluminium, lead)
Americium-241	432 years		Alpha	
Iodine-131	8 days		Beta	
Polonium - 210	138 days		Alpha	
Strontium-90	29 years		Beta	
Caesium-137	30 years		Beta	
Uranium-235	700 million years		Alpha	
Uranium-238	4.47 billion years		Alpha	

Questions

1. Some smoke detectors make use of radiation which is very easily stopped by tiny smoke particles moving between the radioactive source and the detector.



   Explain why americium-241 is an appropriate radioisotope to use for this purpose.

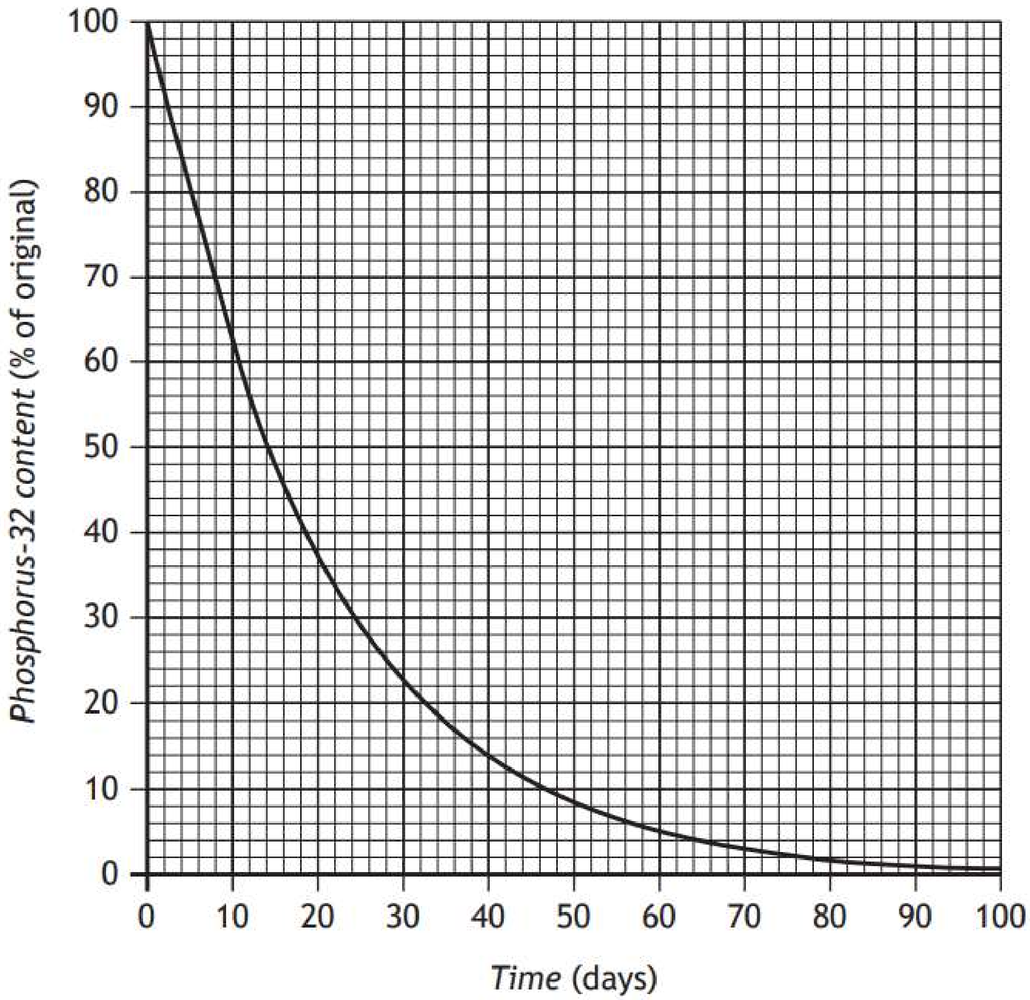
2. Iodine-131 is a radioisotope often used in medicine, especially for treating and diagnosing issues in the thyroid gland, located in the neck.

   The radiation must be able to escape the tissues after causing damage to the unwanted tissue.

   Explain why Iodine-131 is particularly suitable for these purposes

Finding Half-Life from a graph

The graph shows how the percentage of phosphorus-32 in a sample changes over a period of time.



1. Using the graph, calculate the half-life, in days, of phosphorus-32.

2. Using your answer to part 1, calculate the time, in days, it would take for the mass of a 20 g sample of the radioisotope to decrease to 2·5 g.

Calculating the age of a sample given what % or fraction is remaining

1. ^{14}C has a half life of 5600 years. An analysis of charcoal from a wood fire shows that its ^{14}C content is 25 % of that in living wood. **How many years have passed** since the wood for the fire was cut?

2. Strontium-90, a product of nuclear fallout, has a half-life of 28.8 years. If an environmental sample shows that the Strontium-90 level is at 12.5% of its original level, **calculate how many years have passed** since the nuclear event that created it.

3. A medical facility observed that a sample of iodine-131, used in diagnostic imaging, had reduced to 1/4 of its original activity. The half-life of iodine-131 is approximately 13 hours. **Calculate the age**, in hours, of the iodine-131 sample.

4. A paper manufacturer found a thallium-204 source had only 1/16 of its original activity. The half-life of thallium-204 is 3·7 years. **Calculate the age**, in years, of the source.

Calculating the mass of a sample remaining

1. Americium-242 has a half-life of 16 hours. A sample of americium-242 has a mass of 8 g. **Calculate the mass**, in grams, of americium-242 that would be left after 48 hours.

2. Cobalt-60, a radioisotope used in medical and industrial applications, has a half-life of 5 years. If a sample of Cobalt-60 has an initial mass of 5 g, **calculate the mass**, in grams, of Cobalt-60 that would remain after 15 years.

3. Cesium-137, a byproduct of nuclear reactions with a half-life of 30 years, is found in a 20-gram sample. **Calculate the mass**, in grams, of Cesium-137 that would remain after 90 years.

4. Iridium-192, used in industrial radiography, has a half-life of 74 days. If an industrial facility starts with a 10 g sample of Iridium-192, **determine the mass**, in grams, remaining after 222 days.

5. Polonium-210, a highly radioactive element, has a half-life of 138 days. If a laboratory has a 2 g sample of Polonium-210, **calculate the mass,** in grams, that would be left after 414 days.

Calculating the % or fraction the what would have decayed

1. Iodine-131 is a radioisotope with a half-life of 8 days and can be used in the treatment of thyroid cancer. Calculate the percentage of iodine-131 that would have **decayed** after 24 days.

2. Phosphorus-32 is a radioisotope with a half-life of 14 days, used in the treatment of specific blood disorders. Calculate the percentage of Phosphorus-32 that would have **decayed** after 42 days.

3. Carbon-14 is a radioisotope with a half-life of 5730 years and is used in radiocarbon dating. Determine the fraction of Carbon-14 that would have **decayed** in an archaeological sample after 17,190 years.

4. Sodium-24 is a radioisotope with a half-life of 15 hours, used in medical diagnostics. Calculate the percentage of Sodium-24 that would have **decayed** after 45 hours.

5. Strontium-90 is a radioisotope with a half-life of 28.8 years and is a byproduct of nuclear fallout. Calculate the fraction of Strontium-90 that would have **decayed** in an environmental sample after 86.4 years.

Date: ________________

Chemical analysis

Learning Intentions

- To recap all of the experimental information in National 5 chemistry

Success Criteria

☐ I can identify the metal present in a mixture based on its flame colour.

☐ I can state the tests for gases.

☐ I can identify the type of reaction given a chemical equation.

☐ I can identify common lab equipment.

☐ I can state and draw the apparatus used to collect gases.

☐ I can state the order of steps for producing crystals of copper sulfate.

☐ I can state the definition of a standard solution

☐ I can explain the process of performing a titration, use of concordant titres and the purpose of an indicator in a titration.

Identification of metals

If a sample contains a metal, it can be identified by the flame colour. These are found on page 6 of your data booklet.

Flame tests

Metal in Solution	Flame colour
Copper (Cu)	
Sodium (Na)	
Lithium (Li)	
Potassium (K)	
Calcium (Ca)	
Barium (Ba)	

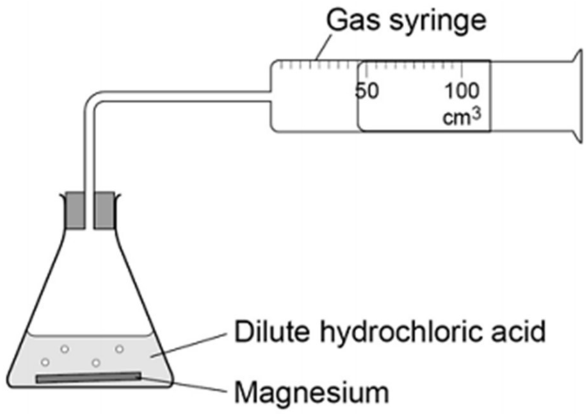
Testing for gases

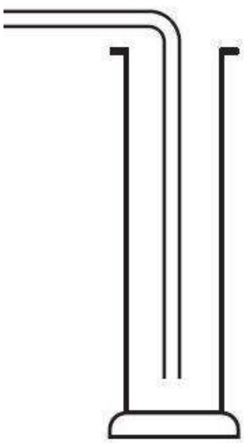
Gas	Test
Oxygen	**Relights a glowing splint**
Hydrogen	**Squeaky pop with a burning splint**
Carbon Dioxide	**Lime water turns cloudy** **or** **Puts out a burning splint**

Collecting gases

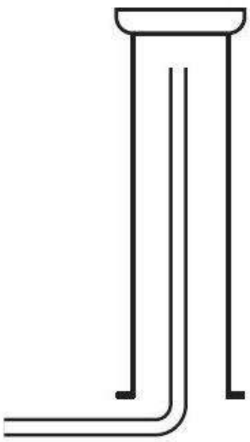
Methods for the collection of gases include:

- Gas syringe (any gas)
- Collection over water (for relatively insoluble gases)
- Downward displacement of air (for soluble gases that are less dense than air)
- Upward displacement of air (for soluble gases that are more dense than air)

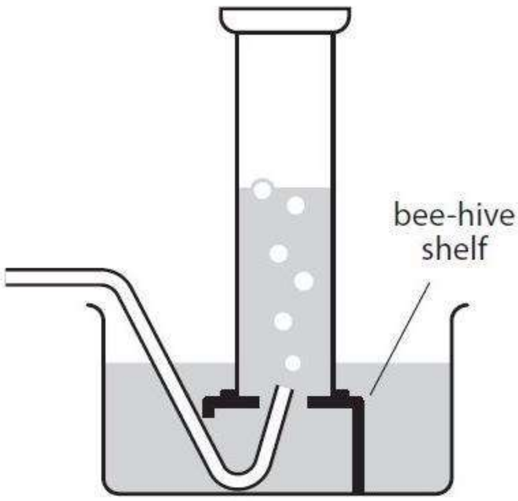




downward delivery (upward displacement of air)



upward delivery (downward displacement of air)



over water

Types of Reaction

Precipitation Reactions

- **Summary**: Precipitation reactions occur when two soluble salts react in solution to form one or more insoluble products, known as precipitates.
- **Example**: When solutions of silver nitrate ($AgNO_3$) and sodium chloride (NaCl) are mixed, silver chloride (AgCl), a white precipitate, forms:

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

Neutralisation Reactions

- **Summary**: Neutralisation reactions involve an acid and a base reacting to form a salt and water. These reactions are often used to balance pH levels.
- **Example**: When hydrochloric acid (HCl) reacts with sodium hydroxide (NaOH), they form sodium chloride (NaCl) and water (H_2O):

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

Combustion Reactions

- **Summary**: Combustion reactions involve a fuel, usually a hydrocarbon, reacting with oxygen to produce carbon dioxide, water, and heat. These reactions are exothermic.
- **Example**: The combustion of methane (CH_4) in oxygen (O_2) produces carbon dioxide (CO_2) and water (H_2O):

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

Displacement Reactions

- **Summary**: Displacement reactions occur when a more reactive element displaces a less reactive element from its compound.
- **Example**: When zinc (Zn) is added to copper sulfate ($CuSO_4$), zinc displaces the copper, forming zinc sulfate ($ZnSO_4$) and copper (Cu):

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

Addition Reactions

- **Summary**: Addition reactions occur when two or more substances combine to form a single product. These reactions are common in chemistry involving carbon and hydrogen, particularly with unsaturated molecules like alkenes.
- **Example**: When ethene (C_2H_4) reacts with hydrogen (H_2) in the presence of a catalyst, it forms ethane (C_2H_6):

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$

Questions

1. Based on the information from the previous page, identify and label each type of reaction presented in the table.

Chemical Equation	Type of Reaction
$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$	
$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$	
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$	
$2Al(s) + 3CuCl_2(aq) \rightarrow 2AlCl_3(aq) + 3Cu(s)$	
$C_2H_4(g) + Br_2(l) \rightarrow C_2H_4Br_2(l)$	
$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	
$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$	
$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$	
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$	
$HCl(aq) + NaHCO_3(aq) \rightarrow NaCl(aq) + CO_2(g) + H_2O(l)$	

2. For each, identify the type of reaction and then identify the spectator ions.

   a) Type of reaction: ________________

   $$NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_2O(l)$$

   Spectator ions: ___________________

   b) Type of reaction: ________________

   $$KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + H_2O(l)$$

   Spectator ions: ____________________

   c) Type of reaction: ________________

   $$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

   Spectator ions: ____________________

d) Type of reaction: ________________

$$AgNO_3(aq) + KCl(aq) \rightarrow AgCl(s) + KNO_3(aq)$$

Spectator ions: ____________________

e) Type of reaction: ________________

$$Ca(NO_3)_2(aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaNO_3(aq)$$

Spectator ions: ____________________

Apparatus

Here is a table describing the uses of various laboratory equipment:

Equipment	Diagram	Uses
Conical Flask		Used for mixing or heating chemicals; its narrow neck prevents splashes.
Beaker		Commonly used for stirring, mixing, and heating liquids.
Measuring Cylinder		Used for accurately measuring liquid volumes.
Delivery Tube		Transfers gases or liquids from one container to another.
Dropper		Used to add small amounts of liquid, drop by drop.
Test Tubes/Boiling Tubes		Used to hold, mix, or heat small quantities of solid or liquid chemicals.

Funnel/ filter paper		Used in filtration to separate solids from liquids.
Evaporating Basin		Used for evaporating liquids from a mixture to leave behind a solid residue.
Pipette with Safety Filler		Used for accurately measuring and transferring liquids.
Burette		Used for dispensing precise volumes of liquids, especially in titrations.
Thermometer		Measures the temperature of various substances.

Questions

1. **State** the piece of equipment specifically designed for accurate measurement of liquid volumes.

2. **Explain** the primary use of a conical flask in a laboratory.

3. **State** the laboratory equipment commonly used for stirring, mixing, and heating liquids.

4. **State** the equipment you would use to transfer gases or liquids from one container to another.

5. **Describe** the laboratory tool ideal for adding small amounts of liquid, drop by drop.

6. **Describe** the use of test tubes or boiling tubes in a laboratory.

7. **State** the equipment used in filtration to separate solids from liquids

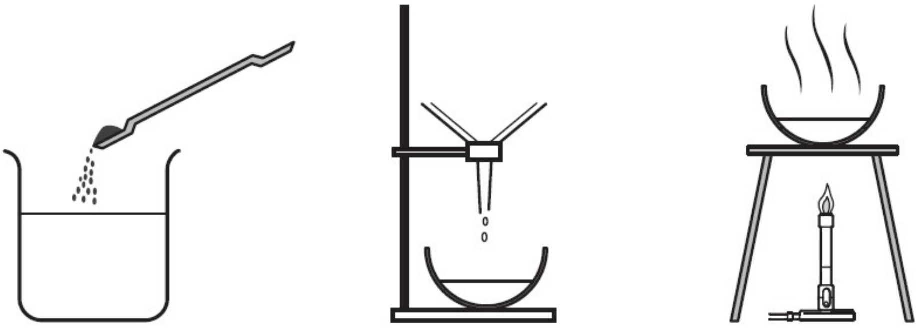
8. **State** the appropriate equipment for evaporating liquids from a mixture to leave behind a solid residue.

9. **State** the most appropriate piece of equipment for accurately measuring and transferring liquids.

10. **State** the piece of equipment essential for dispensing precise volumes of liquids, especially in titrations.

Making crystals

A sample of copper sulfate crystals can be formed by reacting excess copper carbonate with sulfuric acid. The following procedure must be followed. The solution must be filtered before evaporating to **remove excess** copper carbonate.



React copper carbonate with sulfuric acid | **Filter** | **Evaporate the solvent to form crystals**

Standard Solutions

A standard solution is a chemical solution with a **accurately** known concentration.

The **accuracy** of the standard solution's concentration is crucial, as it directly affects the **reliability** of the experimental results obtained through its use.

Titrations

Titrations are a procedure used in chemistry to determine the **concentration** of **unknown** solutions.

This process involves gradually adding a solution of **known** concentration (from a **standard** solution) to a solution of unknown concentration until the reaction between the two solutions is complete at the **end-point**.

The volume of the solution of known concentration is measured and the experiment is repeated multiple times to achieve concordant volumes/titres.

Titre volumes within 0.2 cm^3 are considered **concordant** and an **average** is taken for **accuracy**.

The end-point is determined by using an **indicator** where a **sudden** colour **change** is observed.

To attempt a virtual titration before your teacher shows you how to perform it in the lab, click here or visit https://virtual.edu.rsc.org/titration/experiment/2

Date: ________________

Chemistry in Society – Summary

Use the space below to summarise key points before doing past paper questions and extension work.

Extension questions:
Chemcord purple books (N5): page 135-157
SCHOLAR

Topic	2015	2016	2017	2018	2019
Chemistry in Society	**MC** – 4,17,19, 20 **S2** – 2,5,7a,14b	**MC** – 14,17,18, 19,20 **S2** – 1cii,2,8b, 9a,12c	**MC** – 17,18,19, 20 **S2** – 5,13bi	**MC** – 15,20,21, 22,24,25 **S2** – 2,10,12, 14bi&ii	**MC** – 9,21,22, 23,24,25 **S2** – 4, 5biii, 12a-b

MC = multiple choice section, S2 = section 2, the written section.