N5 Chemistry: Unit 3 – Chemistry in Society

Part B – Fertilisers, Nuclear and Chemical Analysis

Lesson 1 – Types of Radiation

Learning Outcomes

By the end of this lesson you should:

1. Have completed a short revision of nuclide notation and isotopes.
2. Be able to identify and describe the three types of radiation.

Success Criteria

You will have been successful in this lesson if you:

1. Read and learn the notes given – Copy any in you need
2. Watch the links provided
3. Complete and mark self-check questions

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:

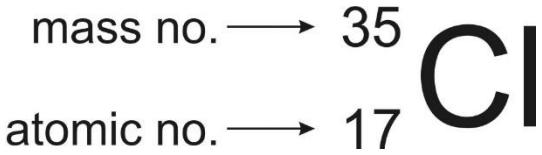
- N5 Unit 1: Nuclide notation and Isotopes

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

Nuclide Notation/Isotope Revision

You already have notes on this so you do not need to copy these but you should read through them and check you understand before moving on to the new material.

Nuclide notation is a way of representing information about an element.
E.g. chlorine



Isotopes are atoms of the same element with the same atomic number but different mass numbers. This means they have the same number of protons but different numbers of neutrons.

The atoms of most elements have isotopes. The mass numbers given in the data booklet are relative atomic masses made from the proportion and mass of each isotope present.

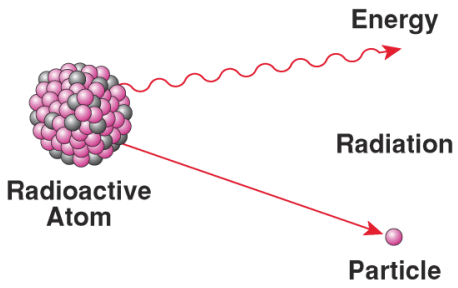
E.g. Magnesium exists as 3 isotopes: ^{24}Mg, ^{25}Mg and ^{26}Mg

The mass of magnesium given in the data booklet is 24.3 so the most abundant isotope is ^{24}Mg.

Please use the following information to fill in the blanks in your printed notes booklet.

Nuclear Chemistry

Nuclear chemistry is the study of **radioactive** substances. Radioactive substances are unstable and will **release (emit) radiation** to become **stable.**



This process is known as radioactivity.

The radiation released is usually made up of smaller particles and energy.

Background Radiation

Background radiation is all around us; we are constantly being bombarded by particles and rays. Most background radiation comes from **natural sources** such as rocks in the ground or cosmic rays from space.

Measuring Radiation

The level of radiation can be measured using a Geiger counter.

Video showing Geiger Counter

Types of Radiation

Radioisotopes are radioactive isotopes of an element.

There are three different types of radiation that can be emitted by radioisotopes:

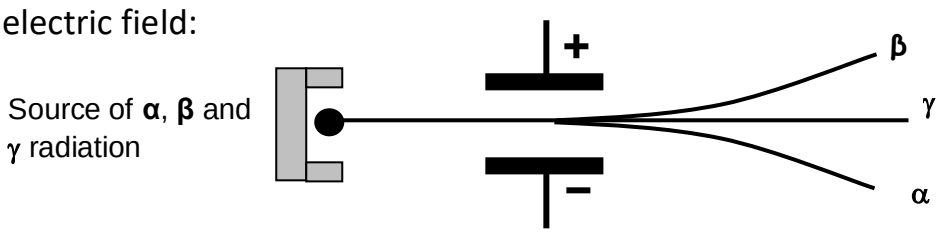
1. Alpha (α) particles
2. Beta (β) particles
3. Gamma (γ) rays

Properties of Radiation

Property	**Type of Emission**		
	Alpha	**Beta**	**Gamma**
Composition	Alpha particle (helium nucleus)	Beta particle (electron)	High-energy electromagnetic radiation
Symbol	α, $^{4}_{2}He^{2+}$	β, $^{0}_{-1}e$	γ
Charge	**2+**	**-1**	**0**

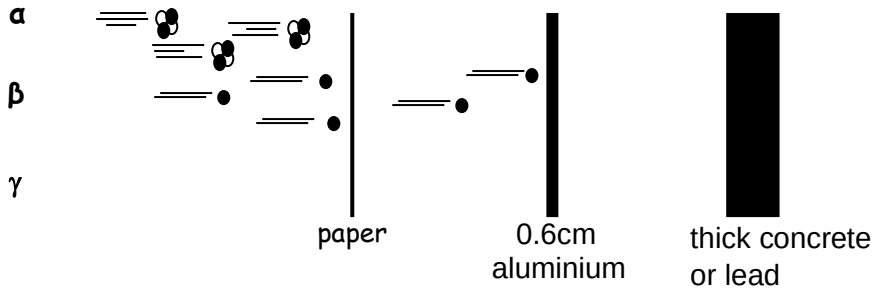
Effect in an Electric Field

This diagram shows how the three types of radiation are deflected in an electric field:



Penetration Strength

Alpha, beta and gamma radiations also have different penetration strength:



1. Alpha particles are the biggest and they can be stopped by a thin piece of paper.
2. Beta particles are smaller and they can travel a few metres through the air but will be stopped by a few millimetres of aluminium.
3. Gamma waves have no mass and charge and can travel long distances. They are only stopped by thick lead and even thicker concrete.

Further Reading

To learn more about types of radiation, try the following online resources:

BBC Bitesize: https://www.bbc.co.uk/bitesize/guides/zxxrng8/revision/1

Scholar: Log in through GLOW

National 5 Chemistry → Chemistry in Society → Nuclear Chemistry → read content 7.1-7.3

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

Username: snhs password: giffnock

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

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

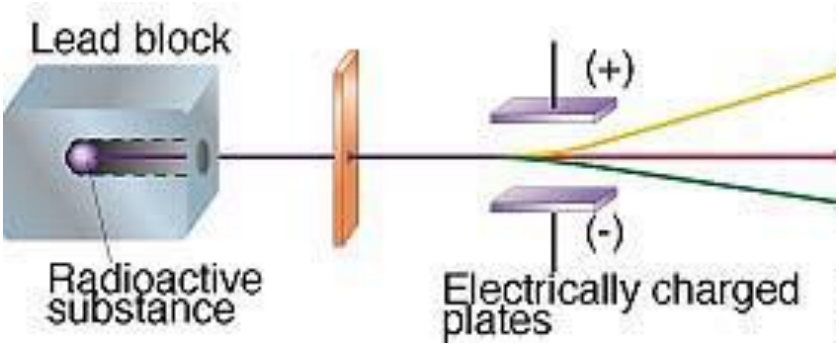
Self Check 6

1. Atom **A** has an atomic number of 93 and a mass number of 239.
Atom **B** has an atomic number of 94 and a mass number of 239.

(a) How many protons are present in atom **A**?
(b) How many neutrons are present in atom **B**?
(c) Are **A** and **B** isotopes? Explain your answer.

2. Chlorine has two isotopes, one with a mass of 35 and one with a mass of 37.
The relative atomic mass of chlorine is 35·5.
From this information what can you say about the proportion of each isotope in chlorine?

3. A radioactive substance emitting α, β, *and* γ radiation was placed in an electric field and the radiation was deflected as follows:



1.
2.
3.

(a) Why do Radioisotopes emit radiation?

(b) Identify the three types of radiation in the above diagram.

4. Comparing α, β, and γ radiation:

(a) Which has no electrical charge?

(b) Which has the largest mass?

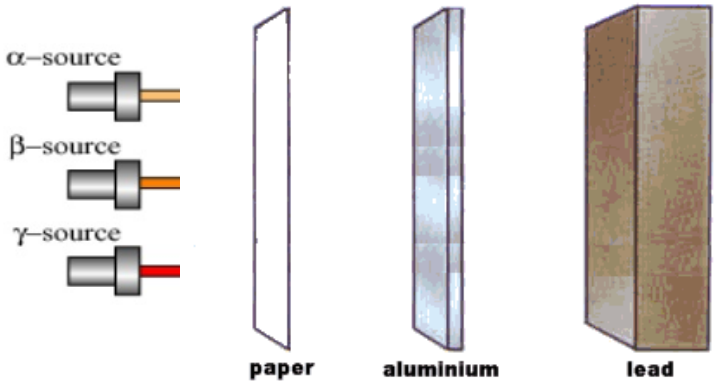
(c) Write out the nuclide notation (symbol, atomic number, mass number and charge) to represent an alpha particle.

(d) Which is not made up of particles?

(e) Why are beta particles not like normal electrons?

5. A sheet of paper, a sheet of aluminium 5mm thick and a sheet of lead 2cm thick are placed in front of a Geiger Muller tube and connected to a counter.

A stream of gamma rays, beta and alpha particles are directed towards the paper.



(a) Which radiation(s) pass through the paper?

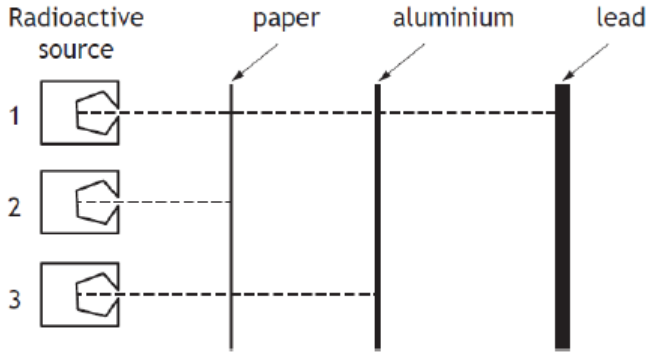
(b) Which radiation passes through the aluminium?

*Now complete **Homework 14: Radiation** and submit to your class teacher via Teams (or your usual channel). Your work should be submitted by **3pm on Friday 26th January.***

Radiation 14

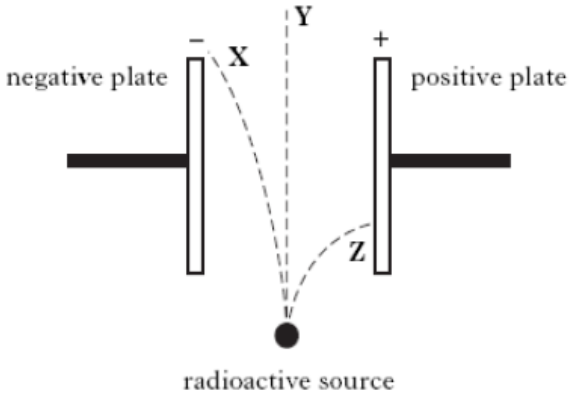
1. Comparing α, β and ϒ and radiation.
   (a) Which has a positive electrical charge?
   (b) Which has the smallest mass?
   (c) Which has zero mass?
   (d) Which can pass through several centimetres of lead?
   (e) Which is stopped by a sheet of paper?

2. Different types of radiation have different penetrating properties. An investigation was carried out using three radioactive sources.



Name the type of radiation emitted by source **2**.

3.



The diagram shows the paths of alpha, beta and gamma radiation as they move through an electric field. Which path, X, Y or Z, would be made by:

(a) An alpha particle?
(b) A beta particle?
(c) A gamma paticle?

Self Check 6 ANSWERS

1. (a) 93
(b) 145
(c) No, because they do not have the same Atomic Number and therefore are not atoms of the same element.

2. There are a larger proportion of isotopes with a mass of 35 compared to a mass of 37.

3. (a) Radioisotopes emit radiation because they are unstable.
(b) 1 is Beta, 2 is Gamma and 3 is Alpha.

4. (a) Gamma
(b) Alpha
(c) $^{4}_{2}He^{2+}$
(d) Gamma
(e) Beta particles are emitted from the nucleus not from electron shells.

5. (a) Beta and Gamma
(b) Gamma