N5 Chemistry: Unit 3 - Chemistry in Society

Part B - Fertilisers, Nuclear and Chemical Analysis

Lesson 3 - Nuclear Chemistry Revision

Learning Outcomes

By the end of this lesson you should know:

1. How to summarise the key concepts within the Nuclear Chemistry key area.
2. How to demonstrate your understanding by completing practise questions.

Success Criteria

You will have been successful in this lesson if you:

1. Watch the links provided.
2. Complete revision questions provided.
3. Complete and submit homework assigned (HW 15)

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

- N5 Unit 3: Nuclear Chemistry

Nuclear Chemistry Revision	Unit 3 – Nuclear	https://youtu.be/7ZfooOC99cU

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

Timed Revision Starter

The table at the bottom of the page contains a number of questions from different parts of the N5 course. They are scored differently dependent on when your learned them – the boxes are colour coded to help you identify them.

You have **twenty minutes** to answer as many questions from the table below correctly as you can.

Be honest with yourself and good luck!

Last week 1 point	Before Christmas break 2 point	Before October break 3 points

Write the word equation for the reaction between magnesium and hydrochloric acid.	Describe the penetration strength of alpha, beta and gamma radiations.	Balance the following equation: $C_3H_7OH + O_2 \rightarrow CO_2 + H_2O$
Write the nuclear equation to show the beta decay of calcium-45.	Calculate the energy released when 50cm^3 of water is heated from 10.3°C to 28.4°C. Include the correct units for your answer.	State the purpose of the ion bridge found in an electrochemical cell.
Calculate the percentage of aluminium found in the ore gibbsite, $Al(OH)_3$	Explain why radioactive substances emit radiation.	Write the chemical formula for antimony(III) oxide.

Nuclear Chemistry Revision Activities:

1. **Watch Summary Video (start at 1:15)**
   https://www.youtube.com/watch?v=KWAsz59F8gA

2. **Learning Outcomes and Question Booklet**
   Read through your N5 Unit 3 Nuclear Chemistry learning outcomes and answer the multiple-choice questions at the end of these. Remember to mark your answers!

3. **Scholar**
   Attempt **7.9 End of Topic Test**
   Teachers can check reports here so please complete this test as part of your work this week.

4. **Nuclear Chemistry Revision Mind-Map**

   Attempt this with no other learning materials around you. Complete as much as you can from memory – then use your notes to fill in the rest. This will help you to identify what you have learned and what you need to work on.

Chemistry Revision Mind Map Unit 3 – Nuclear Chemistry 4

Where does radioactive decay occur in an atom?

Unstable nuclei become more stable by giving out which three forms of radiation?

1.

2.

3.

Alpha particles are stopped by:

Beta particles are stopped by:

Gamma particles are stopped by:

Alpha particles are attracted to a _____ plate

Beta particles are attracted to a _____ plate.

Gamma particles are not deflected by an electric field.

An alpha particle can be represented as:

A beta particle can be represented as:

A proton can be represented as:

A neutron can be represented as:

Complete the following equations and decide whether the isotope is undergoing alpha or beta decay.

1. $^{242}_{94}Pu \longrightarrow ? + ^{4}_{2}He$

2. $^{234}_{90}Th \longrightarrow ? + ^{0}_{-1}e$

What does the term half-life mean?

What affect would increasing the temperature have on the half-life of an isotope?

16 g of a radioisotope has a half-life of 20 days. What mass of the original isotope will still be left after 60 days?

A luminous watch dial containing a material with a half life of 2.5 years has only 1/8th of its original glow. How old is the watch?

Further Reading

To learn more about nuclear chemistry, 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

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

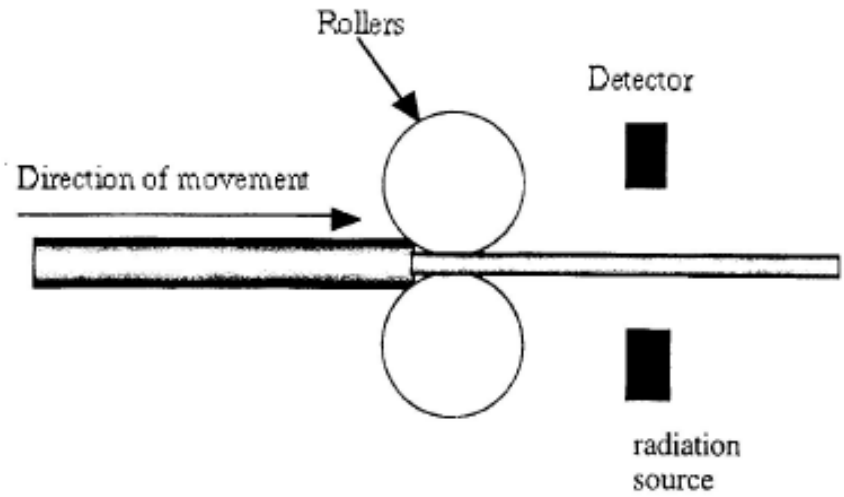
Username: snhs password: giffnock

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 9

1. Radioactive sources are often used industrially in equipment which helps to monitor the thickness of sheets of **metal** which are produced by rolling thick sheets into thin ones as shown below.



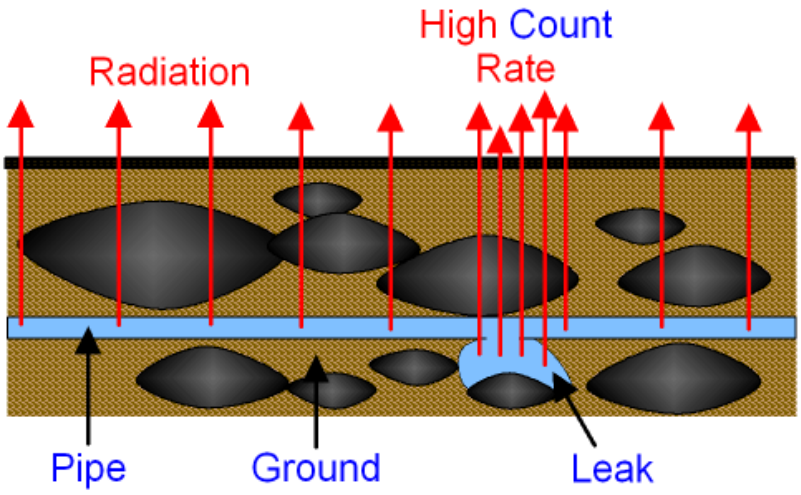
(a) What type of radiation should be used in the above apparatus? Explain your answer.

(b) After a few hours the amount of radiation being detected increases.

i. Why has this occurred?

ii. What would be done to the apparatus to get back to the original value?

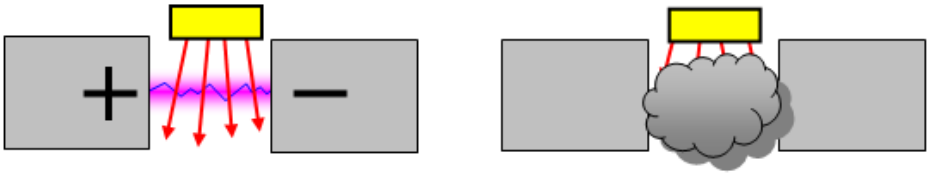
2. The diagram below shows a radioisotope being used to detect a leak in a pipeline. What piece of equipment would a scientist use to detect the radioactivity?



Self Check 9(continued)

3. Give a medical use of radiation produced from radioactive substances.

4. The diagrams below show a household smoke detector and how it works:



Radiation is absorbed by smoke and alarm sounds.

Americium-241 is the radioisotope used in smoke detectors.

(a) Should it be an alpha or gamma emitter?
Explain your answer.
(b) Will it have a short or long half-life?
Explain your answer.

5. The radioisotope iodine-151 is used in hospitals as tracer for diagnosing thyroid problems. It has a half-life of 8 days. A bag containing hospital bed sheets contaminated with iodine-151 was found to have a count rate of 320 cpm.

How long will it take for the count rate to fall to 80 cpm?

Self Check 9(continued)

6. The radioisotope tritium(hydrogen-3) is a beta emitter with a half-life of 12.4 years.

(a) Write a nuclear equation for the beta decay of tritium.
(b) A sample of tritium weighing 2g was sealed in a container, how long would it take for the mass of tritium in the container to fall to 0.5g?

Timed Revision Starter ANSWERS

Last week 1 point	Before Christmas break 2 point	Before Summer break 3 points
Magnesium + hydrochloric acid → magnesium chloride + hydrogen	**Alpha** – stopped by a thin piece of paper **Beta** – stopped by a few millimetres of aluminium **Gamma** – stopped by thick lead and even thicker concrete	$2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O$
$^{45}_{20}Ca \longrightarrow {}^{0}_{-1}e + {}^{45}_{21}Sc$	3.7829 or 3.78 kJ	The ion bridge completes the circuit.
34.6%	Radioactive substances are unstable and emit radiation to become stable.	Sb_2O_3

Self Check 9 ANSWERS

1. (*a*) Gamma particles would be used as alpha and beta particles cannot penetrate metal.

(*b*) i. The metal has become thinner.

ii. Less pressure should be applied by the rollers

2. A Geiger counter

3. To treat cancerous tumours

4. (a) Alpha, as beta particles would not be absorbed by the smoke and alarm would not go off.

(b) Long half-life so the radioactive emitter doesn't have to be replaced for a long time.

5. 16 days

6. (a) $^{3}_{1}H \longrightarrow ^{3}_{2}He + ^{0}_{-1}e$

(b) 24.8 year

Chemistry Revision Mind Map Unit 3 – Nuclear Chemistry 4

Where does radioactive decay occur in an atom?

nucleus

Unstable nuclei become more stable by giving out which three forms of radiation?

1. Alpha α
2. Beta β
3. Gamma γ

Alpha particles are stopped by:

Few cm of air / paper

Beta particles are stopped by:

Thin Al foil

Gamma particles are stopped by:

Thick concrete or Pb

Alpha particles are attracted to a negative plate

Beta particles are attracted to a positive plate.

Gamma particles are not deflected by an electric field.

An alpha particle can be represented as:

$^{4}_{2}\alpha$ or $^{4}_{2}He$

A beta particle can be represented as:

$^{0}_{-1}\beta$ or $^{0}_{-1}e$

A proton can be represented as:

$^{1}_{1}p$

A neutron can be represented as:

$^{1}_{0}n$

Complete the following equations and decide whether the isotope is undergoing alpha or beta decay.

1. $^{242}_{94}Pu \longrightarrow ^{238}_{92}U + ^{4}_{2}He$
2. $^{234}_{90}Th \longrightarrow ^{234}_{91}Pa + ^{0}_{-1}e$

What does the term half-life mean?

Time taken for half of the nuclei to decay

What affect would increasing the temperature have on the half-life of an isotope?

None

16 g of a radioisotope has a half-life of 20 days. What mass of the original isotope will still be left after 60 days?

16g $\xrightarrow{20days}$ 8g $\xrightarrow{20days}$ 4g $\xrightarrow{20days}$ 2g

A luminous watch dial containing a material with a half life of 2.5 years has only 1/8th of its original glow. How old is the watch?

1 $\xrightarrow{2.5\ years}$ ½ $\xrightarrow{2.5\ years}$ ¼ $\xrightarrow{2.5\ years}$ 1/8

3 x t½
= 3 x 2.5 years
=7.5 years