NUCLEAR PROCESS DETAILED NOTES AND SAMPLE QUESTIONS

(I regret for any mistake if noted)

S4 TERM THREE LAST TOPIC

NEW LOWER SECONDARY CURRICULUM

(CHEMISTRY)

BY

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DEDICATED TO YOU

The attached questions are almost enough for a student to have a general idea/concept about this region(**content/subtopic**) in chemistry, however, I advise a student to search for more related questions about this content area for **better results.**

CONTENT:

1. **Nuclear processes.**
2. **Some sample questions on the above topic**
3. ***Try so hard to answer the sample questions and look for more qns.***

Don't say tomorrow, it will be too late for chemistry revision, and yesterday is gone forever, you have got today to revise your chemistry!
"Revise as if tomorrow is not there" May god bless you

Nuclear processes

Introduction

Nuclear chemistry is the study of the chemical and physical properties of elements which are influenced by the changes in the structure of the atomic nucleus.

The atomic nucleus is composed of protons and neutrons, the total number of protons in an element gives its atomic number and the sum of protons and neutrons gives the mass number of a particular element.

Elements with unstable nuclei in their atoms can go through nuclear changes and turn into different elements. This process involves nucleus in atoms and its therefore called **nuclear process.**

Nuclear process is the process that involves fusing or splitting of the nucleus.

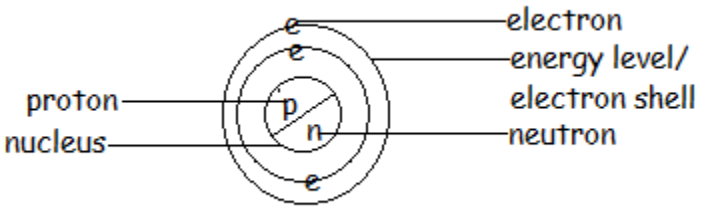
Atomic structure and nuclear reactions

Structure of an atom

An atomic has three major sub-atomic particles, these include;

- Protons
- Electrons
- Neutrons.

General structure of an atom



Mass, relative charge and location of the subatomic particles

Sub atomic particle	Mass (amu)	Relative charge	Location
Electron	0.0005485	-1	Outside the nucleus, on energy levels.
Proton	1	+1	Inside the nucleus
Neutron	1	Not charged	Inside the nucleus

Sample answered questions

State with a reason the region in an atom where the mass is concentrated.

- The mass is concentrated in the nucleus, this is because the mass is contributed by protons and neutrons which occupy the nucleus, electrons have a negligible mass.

Explain the following observations:

a) Atoms are electrically neutral yet they contain charged particles.

- Atoms contain the same number of positively charged particles (protons) and negatively charged particles (the electrons). The two opposite total charges therefore cancel out to zero, leaving the atom electrically neutral.

b) Atoms of different elements adopt different structures.

- Atoms of different elements differ in atomic structures because different elements have different atomic numbers.

Natural boron occurs as $^{10}_{5}B$ and $^{11}_{5}B$

a) Which term is used to describe the two forms of boron atoms?

- Isotopes.

b) What is the difference between the two forms?

- They have different numbers of neutrons.

c) State the meaning of the term nuclide?

- A nuclide is a species or class of atoms characterized by their number of protons, number of neutrons and their nuclear energy state.

Nuclear reactions

A nuclear reaction is a process in which two nuclei or a nucleus and an external subatomic particle collide to produce one or more new nuclides.

A nuclear reaction must cause a transformation of at least one nuclide to another.

Examples of nuclear reactions include

- Radioactive decay
- Nuclear fusion
- Nuclear fission
- Radiations
- Etc

Radiation

This is the emission or transmission of energy in the form of waves or particles through space.

Sunlight is the commonest radiation. Nevertheless, there are those radiations which are invisible and these include radio waves and television waves.

Forms of radiations.

There are majorly three forms of radiations, these are;

- Alpha radiation (α)
- Beta radiation (β)
- Gamma ray (γ)

These radiations differ in properties

Properties of radiations

Property	**Nature of radiation**		
	Alpha particle () Nature; helium particle (He). Charge; +2	**Beta particle () Nature; an electron (e). Charge; -1**	**Gamma ray () Nature; none Charge, no charge**
Penetration	Least	Moderate	Highest
Ionizing power	Highest	Moderate	Least
Effect on electric or magnetic field	Deflected by both fields	Deflected by both fields but the direction of deflection is opposite to that of alpha particles.	Not deflected by both fields

Changes on mass number and atomic number that occur to an atomic nucleus when it emits alpha, beta and gamma radiations.

Alpha particle;

The mass number decreases by four and the atomic number decreases by two.

Beta particle;

The atomic number increases by one and the mass number remains unchanged.

Gamma ray;

The atomic number and the mass number remain unchanged.

Nuclear fission.

Nuclear fission is a reaction in which the nucleus of an atom splits into two or more smaller nuclei.

The fission process is initiated (caused) by bombarding a heavy unstable nucleus by a slow-moving neutron which results in a large amount of energy being released.

The elements commonly used in nuclear fission reactions are majorly two;

- Uranium,
- Plutonium.

The results of nuclear fission are usually gamma photons and large amounts of energy.

How nuclear fission occurs.

The fission process is often initiated by bombarding a heavy unstable nucleus by a slow-moving neutron. The process releases more neutrons, which escape and move at a great speed. Once they collide with another radioactive heavy nucleus, the cause it to undergo fission with production of more neutrons, leading to a series of repeated steps.

Alternatively (how nuclear fission occurs)

The entire nucleus splits into two large fragments called "daughter nuclei". In addition to the 'daughter' products, two or three neutrons also explode out of the fission reaction and these can collide with other uranium nuclei to cause further fission reactions. This is known as a chain reaction.

There are some naturally occurring isotopes which will split spontaneously and release energy, such as Uranium 235 and 238. These isotopes are called **fissile.**

Nuclear fission of uranium.

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{144}_{56}Ba + ^{90}_{36}Kr + ^{1}_{0}n + energy$$

Sample question

Uranium atom decomposed as shown below

$$^{235}_{92}U + ^{1}_{0}a \rightarrow ^{X}_{Z}M + ^{92}_{36}Kr + 3^{1}_{0}n + energy$$

a) Identify the radioactive particle which caused the nuclear fission

- Neutron.

b) Find the value of x and z

- X = 235 – (92 + 3)
  = 235 – 95
  = 140

- Z = 92 – (36 + 0)
  = 92 – 36
  = 56

c) Use a periodic table to identify element M shown in the decay equation.

- Here we base on the atomic number which is 56, which element do you think has atomic number of 56 on the periodic table?
  Its barium.

d) How can the above equation be;

i. Useful
- It leads to formation of isotopes.

ii. Dangerous.
- The high energy particles generated can be harmful.

Nuclear fusion.

Nuclear fusion in everyday life.

Nuclear fusion exists naturally in stars including the sun, where hydrogen nuclei fuse and create helium while releasing the energy that lights and heats the earth. Did you know that even!!

Nuclear fusion has also been used in nuclear weapons.

Now;

Nuclear fusion is a reaction in which two or more atomic nuclei are combined to form one or more atomic nuclei and subatomic particles such as neutrons and protons.

The results of nuclear fusion are; large amounts of energy, heavier nuclei and subatomic particles mostly a neutron.

In the presence of the sun, high temperature and pressure causes nuclear fusion.

How nuclear fusion occurs.

The neutron increases the mass of the atom by raising the nucleon number and since the atom must neutrally contain a nucleus with equal number of neutrons and protons, it becomes highly unstable and thus splits up or disintegrates releasing energy.

There are two major elements that undergo nuclear fusion and these include majorly;

- Deuterium ($^{2}_{1}H$)
- Tritium ($^{3}_{1}H$)

Reaction equation

$^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

Advantages of nuclear reactions.

- Provide relatively low-cost energy
- Provide high energy density.
- Low pollution production
- They are reliable.
- Used in the development of energy using solar system.
- They provide light that help us to see.
- They are environmentally friendly.
- Source of fuel.

Disadvantages of nuclear reactions.

- Negative impact on the environment.
- Very high cost of building nuclear power plants or expensive initial cost.
- Security threats.
- Limited fuel supply.

Precautions to be taken while carrying out nuclear reactions.

- Use gloves always when working with radioactive materials.
- Stringent hygiene is required when handling radioactive materials.
- In radioactive labs, do not eat, drink, smoke, or do not use cosmetics.
- Do not pipette orally
- Wear disposable clothes if there is substantial contamination risk.
- Keep your lab coat separate from your everyday attire.

Radioactivity.

Radioactivity is the spontaneous disintegration of unstable atomic nuclei, giving out radiations and large amounts of energy.

The unstable atomic nucleus gives up some energy in order to attain stability.

The process is spontaneous (occurs on its own, without any energy input from the outside) and so is not influenced by external conditions like temperature and pressure.

Radioactivity is also known as radioactive decay. It occurs at random; it is impossible to predict when it will occur or decay.

Note;

Radioactive decay can either be natural or artificial.

Natural radioactive decay for example when nuclear reactions occur spontaneously.

Artificial radioactive decay for example bombarding a radioactive material like Uranium with a high-speed subatomic particle like neutron.

Types of radioactive decay.

There are three types;

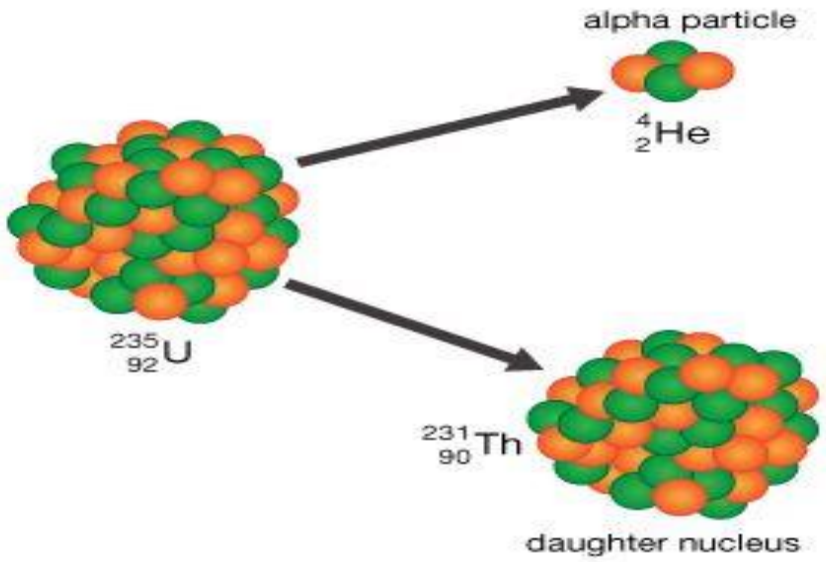
- Alpha decay
- Beta decay
- Gamma decay.

Alpha decay.

Alpha decay is a type of radioactive decay in which an atomic nucleus emits an alpha particle and transforms into a different atomic nucleus with a mass number that is reduced by four and atomic number reduced by two.

An alpha particle is a helium nucleus. It has a mass of 4 atomic mass units and atomic number is 2. It is represented as $^{4}_{2}He$.

Illustration for alpha decay



Equation.

$^{235}_{92}U \rightarrow {}^{231}_{90}Th + {}^{4}_{2}He$

Uranium disintegrated to form Thorium and Helium

Sample question;

Radium 226 undergoes radioactive decay as shown in the equation below.

$^{226}_{88}Ra \rightarrow {}^{X}_{Y}Q + {}^{4}_{2}He$

a) Complete the equation by finding the value of X and Y.
   - Value for x (mass number)
     226 = x + 4
     X = 226-4
     X = 224
   - Value for y (atomic number/proton number)
     88 = y + 2
     Y = 88 – 2
     Y = 86

b) Identify the element Q, which radium decays to. (use the periodic table provided)
   - Radon (Rn) is the element with atomic number 86.

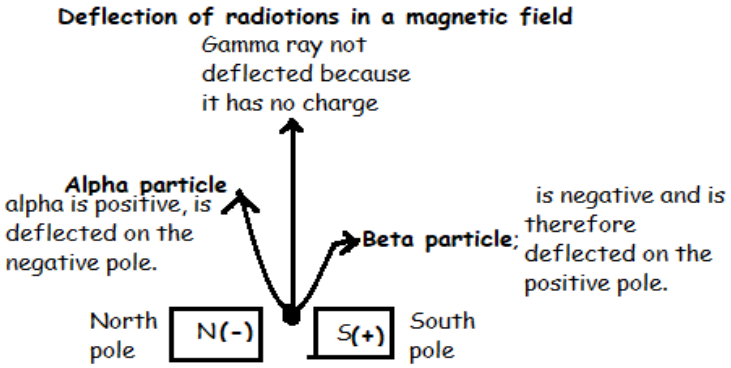
c) Explain why we consider the proton number/atomic number, not mass number in determining the new element formed.

- This is because the atomic number remains the same for all isotopes of an element, but the mass number changes with each isotope.

Properties of alpha particles

- They are positively charged. Each alpha particle has a charge of +2 and a mass of four units.
- Alpha particles are deflected towards the negative electric plate and repelled by the positive plate.
- Alpha particles are deflected by a magnetic field.

Illustration.



- The penetrating power of alpha particles is very poor since they are large particles. They can be stopped by a sheet of paper.
- Because of the high charge, alpha particles have a great ionizing power (the ability to change atoms into ions due to radiation effect).

Beta decay

Beta decay is a type of radioactive decay in which an atomic nucleus emits a beta particle, transforming into ***an isobar (isotopes of different elements but with the same atomic mass/ mass number)*** of that nuclide.

A beta particle is a fast-moving electron. It has negligible mass and a charge of -1.

When an atomic nucleus emits a beta particle, the atomic mass remains the same while the atomic number increases by 1.

Equation.

$${}^{8}_{8}O \rightarrow {}^{8}_{9}F + {}^{0}_{-1}e$$

Properties of beta particles.

- They are negatively charged. Each beta particle has a charge of -1 and negligible mass.
- Beta particles are deflected towards the positive electric plate and repelled by the negative plate.
- Beta particles are deflected by a magnetic field.
- The penetrating power of beta particles is moderate. They can be stopped by a block of wood.
- Because of the low charge, beta particles have an average ionizing power.

Sample questions

Lithium – 8 undergoes radioactive decay as shown below.

$^{8}_{3}Li \rightarrow {}^{a}_{b}X + {}^{0}_{-1}e$

a) Copy and complete the equation. (calculate the values of a and b and rewrite the equation with known values)
b) Identify element X, which lithium decays to.

Gamma decay.

Is a type of radioactivity in which some unstable atomic nuclei dissipate excess energy by a spontaneous electromagnetic process.

Gamma rays are not particles but electromagnetic waves with very short wavelength.

When an atomic nucleus emits gamma rays, there is no change in the atomic number or mass number but the energy associated with gamma emission leads to an extra stability of the atomic nucleus.

Properties of gamma rays.

- They are not charged, hence are not deflected by magnetic or electric field.
- Their penetrating power is very great.
- Their ionizing power is very low.

Trial Sample question.

Sodium – 25 undergoes gamma decay as shown in the equation.

$^{25}_{11}Na \rightarrow {}^{c}_{d}X + {}^{0}_{0}\gamma + {}^{0}_{-1}e$

a) Copy and complete the equation.
b) Identify element X and give a reason for your answer.

Half-life

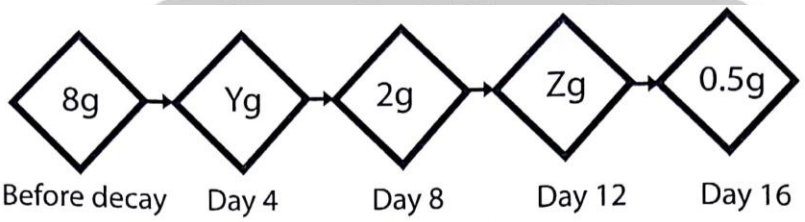
Half life is the time taken for a given mass of a radioactive substance to decay to half of its initial mass.

Different atomic nuclei undergo radioactivity at different rates. Some disintegrate very fast while others decay slowly.

For example, 2g of carbon-14 isotope take about 5,730 years to reduce to half of the initial quantity, that is 1g, while the same mass of sodium-25 takes only 1.0 minute to reduce to 1g.

The concept of half-life

Study and interpret the figure below.



a) What was the half-life of the radioactive material?
   - Four days

b) Work out the masses Y and Z obtained at day 4 and day 12, respectively.
   - Y = 4g
   - Z = 1g

c) What percentage of the radioactive material had been lost at day 8?

Lost mass = (8-2) g
= 6g

Total mass = 8g

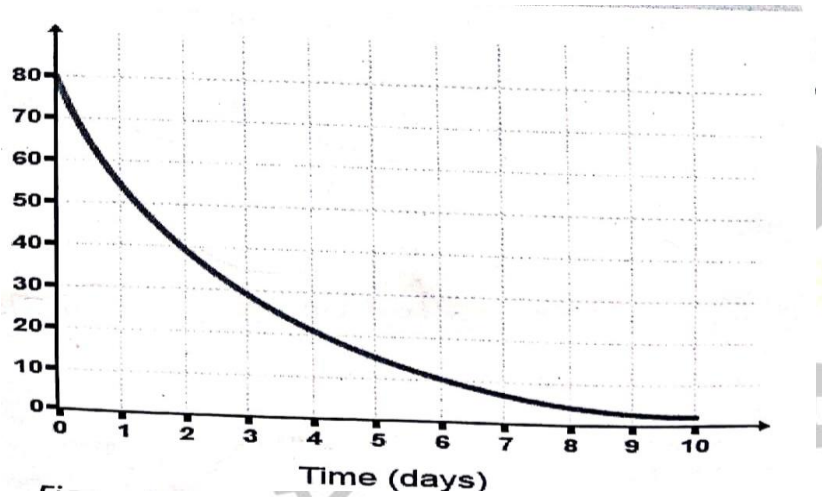
Percentage loss = $(\frac{6}{8}X100)\%$
= 75%

d) Predict the mass of the radioactive substance that will remain at day 20.
   - Since the half-life is four after every four days, we consider our initial mass at day 16 which 0.5g and will reduce to **0.25g**

Finding the time taken for an element to reduce to half of its original amount.

Trial

Study the graph below showing count rate of a radioactive substance H against time.



How long did it take for the count rate to reduce from;

a) 80 to 40
b) 40 to 20
c) 20 to 10
d) 10 to 5

Trial 2

Eight grams of substance D were initially present in a sample. The mass of D in the sample reduced to half in 8 days. Find the mass remaining after 24 days.

After 8 days, 4 grams remained

After 16 days, 2 grams remained

After 24 days, 1 gram remained.

Therefore 1 gram remained after 24 days.

Calculating Half life

After one half-life, one half-life of the original amount of a radioactive substance remains. After two half-lives, one half of the previous half remains or one quarter and so on.

After n half-lives, $\frac{1}{2^n}$ of the original amount of a radioactive substance remains.

General formulae;

For half-life

$$N(t) = N_0\left(\tfrac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$ – General

To get for half-life alone, we introduce logarithm on both sides.

first, divide N_0 on both sides

$$\frac{N(t)}{N_0} = \left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$

Introduce log.

$$\log\left[\frac{N(t)}{N_0}\right] = \log\left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$ – by law of log

$$\log\left[\frac{N(t)}{N_0}\right] = \frac{t}{t_{1/2}}\log\left(\tfrac{1}{2}\right)$$ → Multiply both sides by $t_{1/2}$

$$t_{1/2}\log\left[\frac{N(t)}{N_0}\right] = t\log\left(\tfrac{1}{2}\right)$$ → Divide both sides by $\log\left[\frac{N(t)}{N_0}\right]$

$$t_{1/2} = \frac{t\log\left(\frac{1}{2}\right)}{\log\left[\frac{N(t)}{N_0}\right]}$$ – Equation for half-life.

N(t) = quantity of substance remaining

N_o = initial quantity of the substance

t = time taken

$t_{\frac{1}{2}}$ = half-life of the substance.

Note;

The above equation can help you solve any calculation question in this topic, note it very well and understand it fit.

Kisjo will not calculate everything in these notes, kindly cooperate kino-Tuki gale.

For the activity (mass of substance that remained after decay)

Activity = $\frac{1}{2^n}$ X original mass of a radioactive substance.

Example.

A radioactive isotope has radioactive activity measured on a Geiger-Muller tube at 10,000 becquerels (Bq). What is the activity of the isotope after 3 half-lives?

Activity = $\frac{1}{2^n}$ X original mass of a radioactive substance.

Activity = $\frac{1}{2^3}$ X 10000

Activity = 1250 Bq

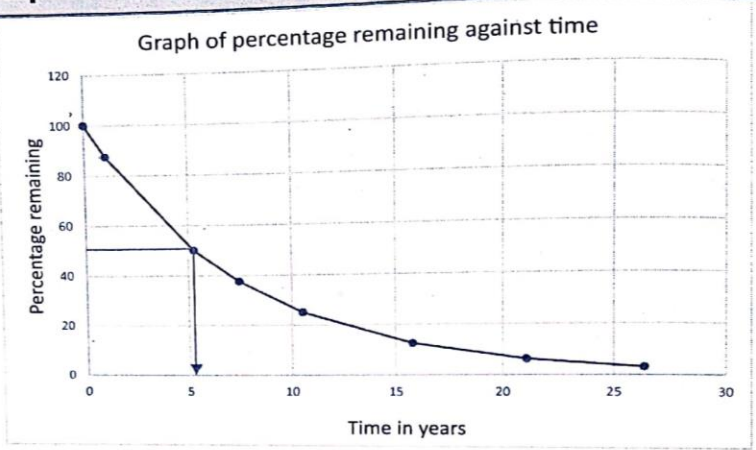
More sample questions

Table 6.2: Time taken for a substance to decay and the remaining percentages.

Time (years)	Percentage remaining	Time (years)	Percentage remaining
0	100	1.02	87.5
5.27	50	7.46	37.5
10.54	25	15.81	12.5
21.08	6.25	26.35	3.13

2. Plot an appropriate graph of the data in the above table.
3. From the graph they have drawn, let them determine the half-life of the substance.

Suggested responses



2. From the graph, the half-life of the substance is 5 years.

Exercise 6.1

The half-life of a certain radioactive isotope is 24 days. If the initial mass is 0.64 g, find;

a) the mass remaining after 120 days

b) how long it will take to have only 0.04 g remaining undecayed

Suggested responses

a) Number of half lives = $\frac{120}{24} = 5$

From the first principles:

Mass of the isotope remaining after 24 days = $\frac{0.64}{2} = 0.32g$;

Mass of the isotope remaining after 48 days = $\frac{0.32}{2} = 0.16g$;

Mass of the isotope remaining after 72 days = $\frac{0.16}{2} = 0.08g$;

Mass of the isotope remaining after 96 days = $\frac{0.08}{2} = 0.4g$;

Mass of the isotope remaining after 120 days = $\frac{0.04}{2} = 0.02g$.

Using nuclear power

Nuclear power is the energy in the nucleus of an atom.

People's perception of nuclear power.

- Nuclear energy produces dangerous radiations that affect the life of living organisms. The perception is purely negative.

Applications of radioactivity.

- Radiotherapy; gamma rays are used in the treatment of cancer and detecting breakages in bones.
- Sterilization; gamma rays are used to sterilize medical instruments.
- Archeology; living plants and trees take in radioactive carbon, when a plant dies, the carbon starts to decay. By measuring the radioactive activity, the age of the remains can be obtained.
- Environment; radioisotopes can be used to trace and analyse pollutants.
- Biochemistry and genetics; radioisotopes may be used as tracers to label molecules so that the chemical process like DNA replication (action of reproducing) can be traced.

Food for thought.

Radioactive isotopes for diagnosis of some organs

Organ	**Isotopes**	**Source**
Brain	Cobalt-60 Boron-10 Iodine-131	Bombarding cobalt-59 with neutrons Borax, kernite, and fruits
Kidney	Technetium-99m mercaptoacetyltriglycine (Tc-99m MAG3)	Nuclear reactor operation
Thyroid glands	Iodine-131	Nuclear fission
Liver	Technetium-99m sulfur colloid (injected through patients' veins)	
Lungs	Technetium-99m labeled human albumin microspheres	Xenon
Tumours	Arsenic-74	

Dangers of radioactivity.

- Affect eyesight.

- Causes cancer.
- Cause radiation skin burns.
- Damage the body cells and tissues.
- Gamma rays are most harmful since they penetrate deeply into the body.

Safety precautions.

- Exposure time should be short
- Radioisotopes should be handled by tongs with remote control.
- Personnel working in radioactive plants should wear lead jackets.
- Radiations should be directed away from the people around.

Note

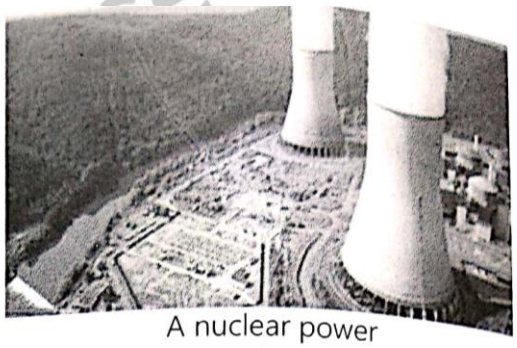
We are all exposed to background radiation due to cosmic rays, radiations from radioactive minerals (radon in the atmosphere, potassium-40 in the body) and X-rays from television screens.

Activities of integration and sample activity questions

Sample Activity of Integration

Due to increasing demand for power, agencies predict that East Africa could soon adopt the use of nuclear power for the smooth running of the increasing number of industries. Discussions among East African countries are underway to build nuclear power plants. However, there is little known about use of nuclear power by most people in East Africa and others have fears of its dangers.

Ugandans officials on a visit to the nuclear power plant in Fuqing, China



A nuclear power plant

Task:

Write an article to be published in a newspaper, informing the concerned agencies and entire community about;

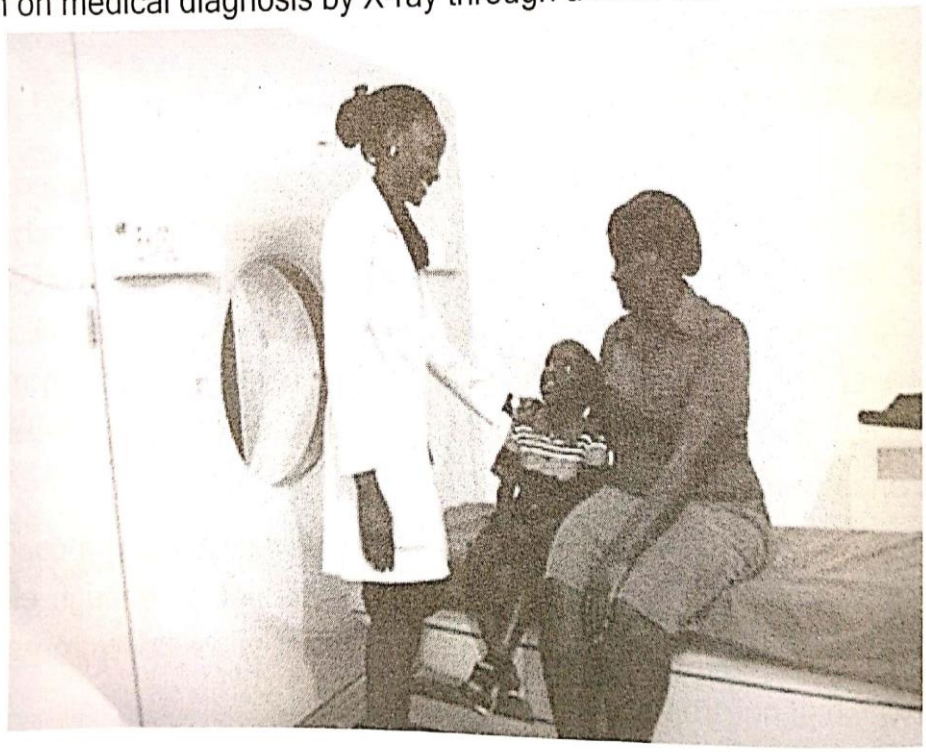
a) where a nuclear power plant can be built, citing reasons for the choice of such a location
b) the impact of the plant on the surrounding area and population
c) the advantages and disadvantages of nuclear power plants; suggest how industries can be managed to avoid nuclear accidents.

Sample Assessment Grid

Output	Basis of evaluation	Criterion 1: Relevance	Criterion 2: Accuracy	Criterion 3: Coherency	Criterion 4: Excellence
Article	Choice of location of a nuclear power plant, the impact of the plant on the sorrounding area and population, advantages and disadvantages of nuclear power plants and how industries can be managed to avoid nuclear accidents	**Score 3:** If a learner's article includes information on five or all of the following • where a nuclear power plant cna be built • why the plant can be built in such a location • the impact of the plant on the sorrounding area and population	**Score 3:** If the information given on the five or all of the six aspects is correct **Score 2** If the information given on the three or four aspects is correct	**Score 3:** If a learner explains well and there is logocal flow in the information given on the five or all the six aspects **Score 2:** If a learner explains well and there is logocal flow in the information given on the three or four aspects	**Score 1:** If a learner's article is concise and organised well and includes additional information that is relevant to the task

Activity of integration

A group of some young men came across brochure on nuclear process by which nuclear energy is released. The brochure contained limited information. It only outlined dangers of nuclear emissions such as causing cancer and uses of some radioactive isotopes such as medical screening of foetus in pregnant women. This information reached the pregnant mothers in the area. Many of the pregnant mothers still ask their doctors whether to X-ray or not to X-ray? This is because of the fear for the dangers of exposure to x-rays that causes cancer. The in-charge of the Health Centre IV in your Sub-County is organising an awareness campaign on medical diagnosis by X-ray through a radio talk show.



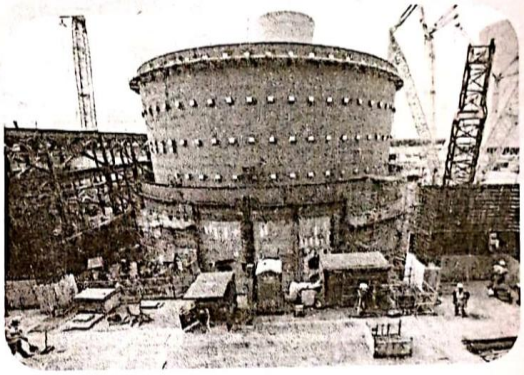
TASK

Prepare a message for his radio talk show. The message should include: a response to whether to or not to have X-rays and safety guidelines to reduce medical radiation risks.

Assessment grid

Output	Basis of evaluation	Relevance	Accuracy	coherence	Excellence
Written radio message	• Structure of the message	Score 3 if: the structure of the message has at least five of the following; greetings to the listeners, introduction of the presenter, What message being presented, why message is being presented, time frame, Concluding remarks	Score 3 if: the structure of the message correctly mentions at least five of the following; greetings to the listeners, introduction of the presenter, What message being presented, why message is being presented, time frame, Concluding remarks	Score 3 if: the structure of the message logically mentions at least five of the following; greetings to the listeners, introduction of the presenter, What message being presented, why message is being presented, time frame, Concluding remarks	Score 1 if: an additional information is given to clearly explain how health og pregnant mother can be monitored to avoid X-ray use.
		Score 2 if: the structure of the message has 3 to 4 of the above	Score 2 if: the structure of the message correctly mentions 3 to 4 of the above	Score 2 if: the structure of the message logically mentions 3 to 4 of the above	
		Scores 1 if: the structure of the message has at less than 3 of the above	Score 1 if: the structure correctly mentions less than 3 of the above.	Score 1 if: the structure logically mentions less than 3 of the above.	
		x/3	x/3	x/3	x/10

Sample Activity of Integration



Nuclear energy use is on the rise globally. Due to global climatic change, countries have increased research towards utilisation of this energy. Recently deposits of uranium, a radioactive element were discovered in your area.

People in the area believe that mining uranium will expose them to serious health effects and explosions.

Yesterday, they staged violent protests after getting information that government is constructing a nuclear power reactor in your area.

As a student of Chemistry, you have been contacted to address the people in the area on the matter. Prepare a radio script to present on the matter assuring the community of the benefits of the project.

Assessment Grid

Output	Basis of evaluation	Relevance	Accuracy	Coherence	Excellence
Radio script	◉ Atomic structure of uranium. ◉ radioactive decay of uranium. ◉ uses of nuclear energy. ◉ Condition for the reaction	**Scores 3** if the learner demonstrates ability to write 3 to 4 aspects of uranium of nuclear energy.	**Scores 3** if the learner accurately demonstrates ability to write 3 to 4 aspects of uranium of nuclear energy.	**Scores 3** if the learner logically demonstrates ability to write 3 to 4 aspects of uranium of nuclear energy.	**Scores 1** if an unsolicited for or unique but related idea has been presented.
		Scores 2 if the learner demonstrates ability to write 2 aspects of uranium of nuclear energy.	**Scores 2** if the learner accurately demonstrates ability to write 2 aspects of uranium of nuclear energy.	**Scores 2** if the learner logically demonstrates ability to write 2 aspects of uranium of nuclear energy.	
		Scores 1 if the learner demonstrates ability to write 1 aspects of uranium of nuclear energy.	**Scores 1** if the learner accurately demonstrates ability to write 1 aspects of uranium of nuclear energy.	**Scores 1** if the learner logically demonstrates ability to write 1 aspects of uranium of nuclear energy.	
Total		03	03	03	01

End of Chapter Questions

1. Explain each of the following terms:
   a) radioactive decay
   b) radiocarbon dating
2. For each of the following questions, choose the one correct answer:

a) The part of the atom that undergoes radioactive decay is the...
   (i) neutrons
   (ii) nucleus
   (iii) electrons
   (iv) entire atom

b) The radioactive isotope polonium-212 undergoes alpha decay. Which of the following statements is true?
   (i) The number of protons in the element remains unchanged.
   (ii) The number of nucleons after decay is 212.
   (iii) The number of protons in the element after decay is 82.
   (iv) The end product after decay is lead-208.

3. 20 g of sodium-24 undergo radioactive decay. Calculate the percentage of the original sample that remains after 60 hours.
4. Nuclear physics can be controversial. Many people argue that studying the nucleus has led to devastation and huge loss of life. Others would argue that the benefits of nuclear physics far outweigh the negative things that have come from it.
   a) Outline some of the ways in which nuclear physics has been used in negative ways.
   b) Outline some of the benefits that have come from nuclear physics.

study the table and answer the questions that follow

Time (hrs)	0	1	2	3	4	5
Count rate (counts min-1)	200	110	57	35	20	13

a. Using the table provided, plot a graph of count rate against time for the atom above.

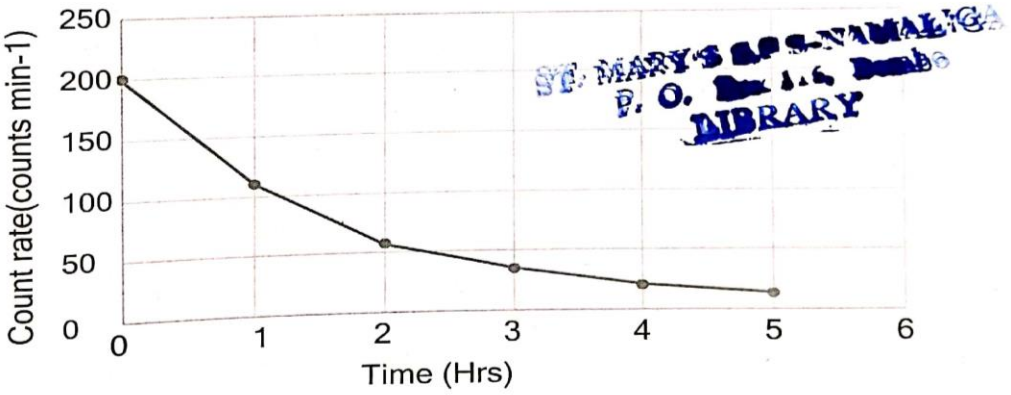
b. Explain the shape of the graph

c. Use the graph to determine the half life of the atom

d. Explain why the curve will finally level

Expected response

a. The graph showing the rate of decay for the atom



b. The count rate decreases from 200 counts min-1 at O hrs to 13 counts min-1 after 5 hrs.

c. any value which is 45(+ or -)1 but plot on a graph paper for accuracy.

d. The curve will finally level off because all the radioactive substance will be completely decayed.

EXERCISE 6.2:

1. The isotope $^{241}_{82}Pb$ undergoes radioactive decay and loses three alpha particles.

a) Write the chemical formula of the element that is produced as a result of the decay.

b) How many nucleons does this element contain?

2. Complete the following equation:

$$^{238}_{92}U \rightarrow \_\_\_ + {}^{4}_{2}He$$

3. Radium-228 decays by emitting a beta particle. Write an equation for this decay process.

4. Describe how gamma decay differs from alpha and beta decay.

Expected response

1.

a. $^{412}_{82}Pb \rightarrow 3\,{}^{4}_{2}He + {}^{229}_{76}Os$

b. The element has 229 nucleons (i.e. protons and neutrons together)

2. Completing the equation;

$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

3. $^{228}_{88}Ra \rightarrow \beta\,(^{0}_{-1}e) + {}^{228}_{89}Ac$

4. Gamma (γ) decay does not cause any change in the number of nucleons in the radioisotope, but emits electromagnetic waves. Alpha (α) decay causes a decrease by 4 units in the nucleon number and 2 units in the atomic number, while beta (β) decay does not cause any change in the nucleon number, but increases the atomic number by 1 unit.

End – Of – Chapter Questions

1. Explain each of the following terms:

a) electromagnetic force

b) radioactive decay

c) radiocarbon dating

2. For each of the following questions, choose the one correct answer:

a) The part of the atom that undergoes radioactive decay is the... i) neutrons ii) nucleus iii) electrons iv) entire atom

b) The radio-isotope Po-212 undergoes alpha decay. Which of the following statements is true?

i) The number of protons in the element remains unchanged.

ii) The number of nucleons after decay is 212. iii) The number of protons in the element after decay is 82. iv) The end product after decay is Po-208.

3. 20 g of sodium-24 undergoes radioactive decay. Calculate the percentage of the original sample that remains after 60 hours.

4. Nuclear physics can be controversial. Many people argue that studying the nucleus has led to devastation and huge loss of life. Others would argue that the benefits of nuclear physics far outweigh the negative things that have come from it.

a) Outline some of the ways in which nuclear physics has been used in negative ways.

b) Outline some of the benefits that have come from nuclear physics.

End of Chapter Questions

1 Write a decay equation for each of the following nuclear reactions.

a) Carbon-14, used in carbon dating, decays by beta emission.

b) Uranium-238 decays by alpha emission.

2 a) i) Distinguish between nuclear fission and nuclear fusion.

ii) Give the conditions for each to occur.

b) Give examples where fission and fusion processes occur naturally.

c) State the uses of nuclear fission and fusion reactions.

d) The following nuclear reaction takes place when a neutron bombards a sulphur atom.

$$^{34}_{16}S + ^{1}_{0}n \longrightarrow ^{a}_{b}Y$$

i) Describe the composition of nuclide Y formed.

ii) Nuclide Y decays by emission of an alpha particle and gamma rays. Find the changes in mass and atomic number of the nuclide.

3 a) Define the following terms

i) Radioactive decay

ii) Radioisotope

iii) Half-life

b) The following table shows the count rates of a certain radioactive material.

Count rate (s^{-1})	6400	5380	3810	2700	1910	1350
Tim (Min)	0	1	3	4	7	9

i) Plot a graph of count rate against time.

ii) Use the graph to find the half-life of the radioactive material.

4 a) Distinguish between alpha particles, beta particles and gramma rays.

b) What change in proton number and mass number occurs when a radioactive nuclide gives off:

i) an alpha particle

ii) a beta particle

c) Write a nuclear equation for the:

i) emission of an alpha particle

ii) emission of a beta particle

iii) successive emission of an alpha particle and a beta particle

5 a) Describe the composition of the atom.

b) A radioactive cobalt emits a beta particle and very high energy gamma rays to form an element Y. write a balanced equation for the reaction.

Remember your education is your life, guard it well. Proverbs 4:13

Work and read a lot to please your guardian who is paying your school fees, work hard and you will live to provide them with what they are missing as they sustain you to achieve education

I wish you success in your national exams.

Don't say tomorrow, it will be too late for chemistry revision, and yesterday is gone forever, you have got today to revise your chemistry!
"Revise as if tomorrow is not there" May god bless you