Year 11

Physics booklet

Topic 1 – Atomic structure and radioactivity

Name: _____

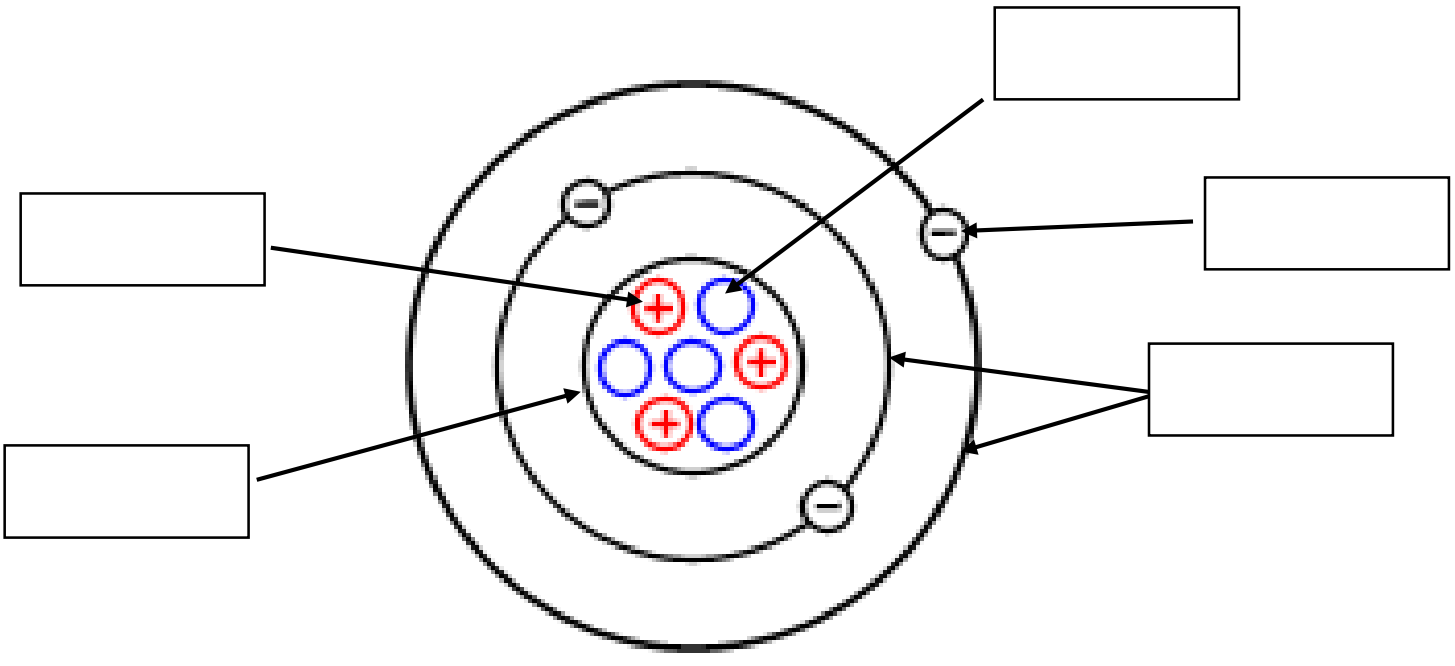
Atomic structure and radioactivity

Give a definition for each of these key words:

Atom	
Isotope	
Proton	
Neutron	
Electron	
Atomic nucleus	
Radioactivity	
Radioactive decay	
Ionising radiation	
Alpha	
Beta	
Gamma	
Half-life	
Background radiation	
Nuclear fission	
Nuclear fusion	
Chain reaction	

Atomic structure

Element	Electrons	Protons	Neutrons
$^{14}_{7}N$	7		
	1		0
		1	1
$^{223}_{87}Fr$		87	
$^{35.5}_{17}Cl$			18 and 20
		53	73 and 75



Timeline of atomic models

Date	**460BC**		**1897**	**1911**		**1932**
Name		**John Dalton**			**Niels Bohr**	
Discovery made						
Atomic sketch						

An isotope is an atom of the same _____ with a different number of _____. Examples are Carbon-___ which has 6 protons and 6 neutrons, and Carbon-14 which has ___ protons and ___ neutrons. Some isotopes are unstable because of the number of neutrons, so they can break down or _____. These isotopes are _____.

There are 3 types of ionising radiation; _____, _____ and gamma.

Alpha particles have a mass of _____ and a charge of _____

Beta particles have a mass of _____ and a charge of _____

α, β & γ Level Assessed Task

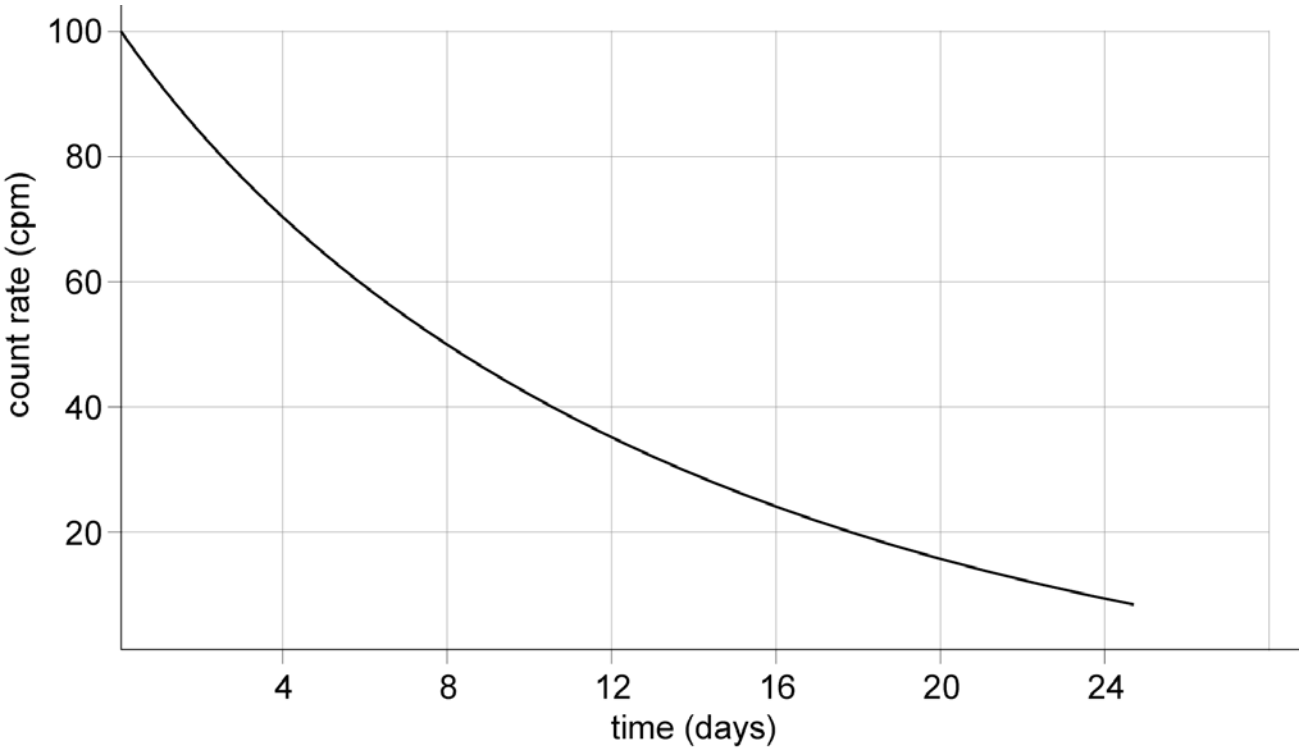
Task:
Design a poster to show the properties of the three types of ionising radiation, explaining the changes that occur to the nuclei of atoms when radioactive decay occurs. You should include diagrams to illustrate your answers.

Key words: Alpha, beta, gamma, proton, neutron, electron, atomic number, mass number, penetrating power, ionising power, stability.

Grade ladder:
What is your target grade? Use the grade ladder to help you reach it:

To get grade	You might have:
4-5	• Drawn a labelled diagram to show each type of ionising radiation. • Identified the atomic and mass number of each type of ionising radiation. • Stated which ionising radiation is the most penetrating. • Stated and illustrated what material is required to stop each type of ionising radiation. • Stated which ionising radiation is the most ionising. • Stated how to detect ionising radiation.
6-7	• Described the structure of an atom in terms of protons, neutrons and electrons and used symbols to describe particular nuclei. • Explained what an isotope is, giving an example. • Identified the charge of each type of ionising radiation. • Constructed an example decay equation for each type of ionising radiation. • Identified the changes to the nucleus of an atom during radioactive decay.
8-9	• Explained the charge of each type of ionising radiation. • Explained why some atoms are unstable. • Explained the changes to the atomic number and mass number during radioactive decay. • Used the size and charge of each type of ionising radiation to explain the link between ionising power and penetrating power. • Described the changes to the nucleus of an atom during radioactive decay.

Half-Life



1 Look at the graph. It shows a theoretical decay curve for iodine-131.

Follow these steps to calculate the half-life of iodine-131.

- **i** What is the activity of iodine-131 at the beginning?
- **ii** How long does it take for the activity to drop to a half of this value?
- **iii** What value does this give for the half-life of iodine-131?

Now you can check your result.

- **i** What is the activity of the iodine-131 at a time of 4 days?
- **ii** How long does it take for the activity to drop to a half of this value?
- **iii** What value does this give for the half-life of iodine-131?

Do your answers for the half-life agree?

Nuclear fission

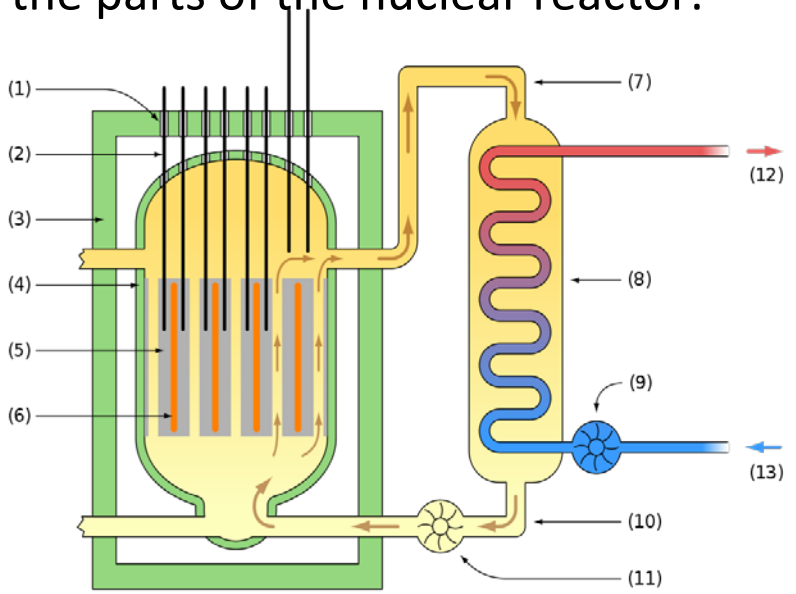
What is nuclear fission?
Which radioactive isotopes do we use in nuclear reactors?
1.
2.

How does one nuclear fission reaction lead to a chain reaction of fission events?

What are the safety issues with nuclear fission?

Why is the reactor surrounded by a large concrete container?

Label the parts of the nuclear reactor:



What are the fuel rods?

What are the control rods?

What does the coolant do? What do we use?

What is a moderator? What do we use?

Nuclear fusion

What is nuclear fusion?

Where does nuclear fusion happen in nature?

Why can we not use nuclear fusion as an energy resource on Earth?

What is a plasma and why is it difficult for us to create and sustain one on Earth?

What conditions need to be met for nuclear fusion to happen?

What happens if these conditions are not met?

What are the advantages of nuclear fusion over nuclear fission as an energy resource?

1.

2.

3.

What are the steps of nuclear fusion that happens in stars?

1.

2.

3.

4.