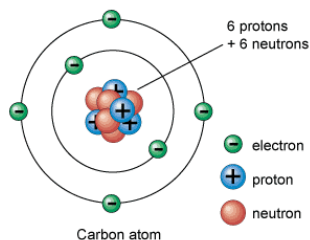


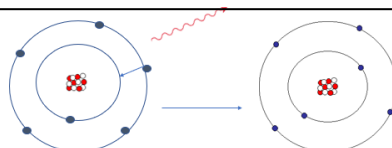
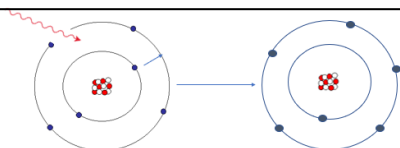
P4 – Atomic Structure

Atoms



- Atoms are tiny – around 10^{-10}m
- There is a positive nucleus made of protons and neutrons
- Electrons orbit in shells or energy levels
- The nucleus is 10,000 x smaller than the atom (4 orders of magnitude) so around 10^{-14}m

Electrons can move further away or closer to the nucleus



If EM waves (eg UV /light) are **absorbed** electrons can move up energy levels

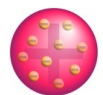
If EM waves are **emitted** by the atom, then electrons move closer to the nucleus

How the atomic model developed:

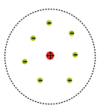
The atomic model has developed over time, when new evidence was discovered.



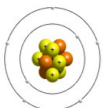
Atoms were first thought to be tiny spheres that could not be divided



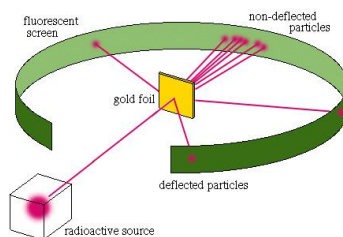
JJ Thomson then discovered the electron
Led to the plum pudding model
Atoms a cloud of positive charge with electrons randomly scattered



Rutherford discovered the positive charge is very small and in the nucleus
This discovery was from the Gold leaf experiment



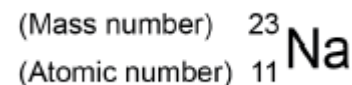
Chadwick discovered neutrons
Bohr discovered the electrons orbit in shells



Rutherford's experiment:

Alpha particles fired at gold leaf
Most went straight through
Some deflected to the side
Some came straight back
This told him that most of the atom was empty space and that the positive charge was in a tiny nucleus

- Atoms of the same element have the same number of protons.
- This is the atomic (proton number)
- In an atom, the number of electrons is equal to the number of protons.
- The total number of protons and neutrons is called the mass number



Sodium has :
11 protons
11 electrons
12 neutrons (23-11)

Isotopes

Isotopes are atoms with same number of **protons**, but different numbers of **neutrons** (different mass number)

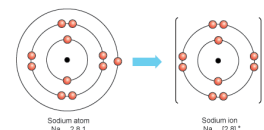
E.g.



These two isotopes both have 8 protons
One has 8 neutrons (16-8)
One has 10 neutrons (18 – 8)

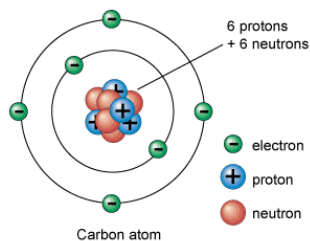
Ions

If atoms lose one or more outer electrons, they turn into positive ions

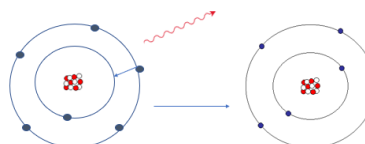
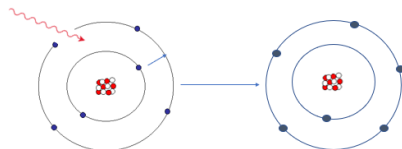


P4 – Atomic Structure

Atoms



1. What is the size of an atom?
2. What is in the nucleus?
3. What is the size of the nucleus?
4. How many orders of magnitude smaller than the atom is nucleus?



4. What can cause electrons to move further from the nucleus?

5. What can cause electrons to move closer to the nucleus?

1. What do all atoms of the same element have in common?
2. What does the bottom number on the elements in the periodic table represent?
3. What does the mass number show?
4. What is the number of electrons in an atom equal to?

1. What causes scientific ideas to change and develop?

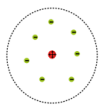


2. What was the thinking about atoms initially?

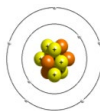


3. Which particle was discovered by JJ Thomson?

4. Where is the positive charge in this model?

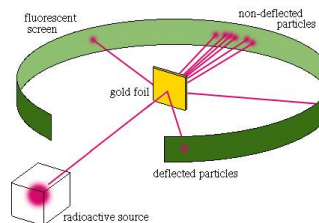


5. Where is the positive charge in this model?



6. Who discovered neutrons?

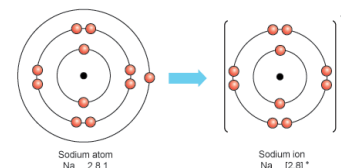
7. What was the discovery that Bohr made?



Rutherford's experiment:

1. What did Rutherford fire at gold leaf?
2. What happened to most of them?
3. What two conclusions did he come to?

5. What is an isotope?
6. What is an ion?
7. What type of ions are formed when atoms lose electrons?



P4 – Atomic Structure

Nuclear radiation

If an isotope is **unstable**, then **particles** and **energy** are emitted from the nucleus.

There are 3 main types :

Radiation	What is it?	How far does it travel?	Ionising power	Penetrating power
Alpha α	2 protons and 2 neutrons	A few cm	Strong	Stopped by paper
Beta β	A fast moving electron	Metres	Medium	Stopped by aluminium
Gamma γ	An electromagnetic wave	kilometres	Weak	Takes thick concrete or lead to stop it

Neutrons can also be emitted from the nucleus.

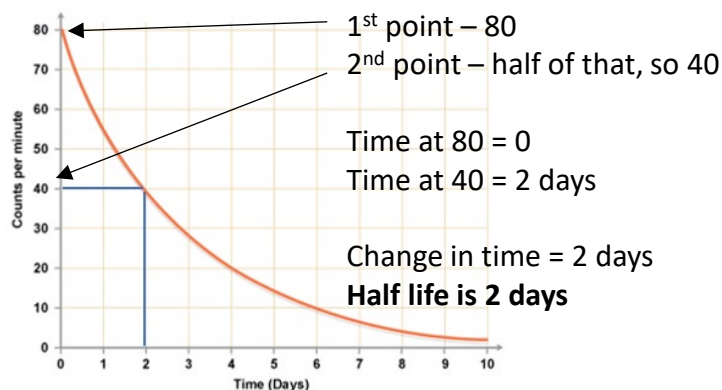
Half life

Radioactive decay is random.

The half life of an isotope is the time it takes for half of the atoms in the sample to decay OR for the count rate to fall by half

Half life is calculated from a graph by reading two points off the y axis – one value being half the other.

Read the corresponding change in time.



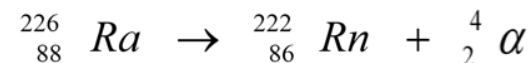
Isotopes are selected for use depending on their properties and half life – e.g. a medical tracer needs to have a short half life so it isn't in the body for very long

Alpha decay:

An unstable nucleus gives out 2 protons and 2 neutrons

An alpha particle is written as : ${}^4_2\alpha$

So when a particle gives out alpha radiation, it loses 2 from the proton number and 4 from the mass number
E.g



Beta decay:

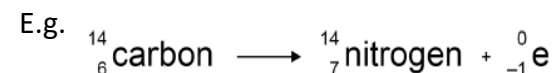
In an unstable nucleus, a neutron changes into a proton and an electron.

The electron is fired out as the beta particle

Beta particles are written as ${}^0_{-1}\beta$ or ${}^0_{-1}e$

The proton number increases

The mass number stays the same



The emission of a gamma ray **does not change the nucleus**

Irradiation is the exposure to alpha, beta or gamma radiation

Contamination is the presence of radioactive atoms on materials.

P4 – Atomic Structure

Nuclear radiation

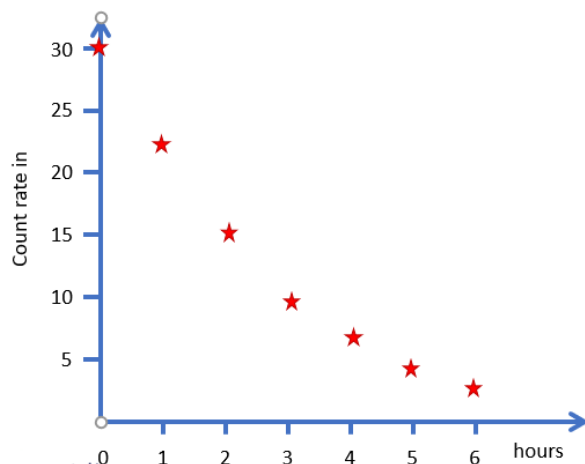
1. Why do atoms give out particles or energy from the nucleus?
2. Which radiation is the most strongly ionising?
3. What is an alpha particle made of?
4. Which radiation is the most difficult to stop?
5. Which radiation is a fast moving electron?
6. Which radiation can only travel a few cm?

Alpha decay:

1. How is an alpha particle written?
2. What happens to the proton number of an atom when alpha decay happens?
3. What happens to the mass number when alpha decay happens?
4. What happens in the nucleus during beta decay?
5. How is a beta particle written?

Half life

1. What is half life?
2. What is the unit missing from the Y axis on the graph opposite?
3. Draw a line of best fit onto the graph
4. What sort of half life would you want in an isotope being used as a medical tracer?



6. What happens to the proton number during beta decay?
7. What happens to the mass number during beta decay?
8. What is irradiation?
9. What is contamination?