Physics – 6.4 Atomic Structure

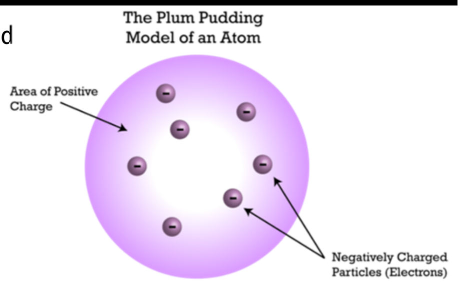
Section 1 – Structure of the Atom Key Terms

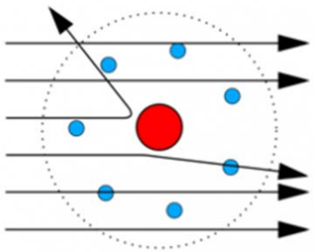
(Mass number) (Atomic number) $^{23}_{11}Na$

Key Term	Description
Size of the atom	$1x10^{-10}$ m
Nucleus	A positively charged basic structure of the atom composed of both protons and neutrons. The radius of the nucleus is 1/10000 the radius size of an atom. Where most the mass of an atom is.
Electrons	A negatively charged particle which orbits around the nucleus of an atom.
Mass number	The number of protons and neutrons in a nucleus
Atomic number	The number of protons in an atom. Sometimes called the proton number
Isotopes	Atoms with the same number of protons and different numbers of neutrons
Ion	A charged atom or molecule
Ionisation	A process in which atoms become charged.
Atom	A molecule with the same number of protons and electrons to give it no overall charge.

Section 2 – Development of the Model of the Atom

The plum pudding model – Positively charged matter is evenly spread about and electrons are buried inside.
The nuclear model – Negatively charged electrons orbit around a positively charged nucleus.





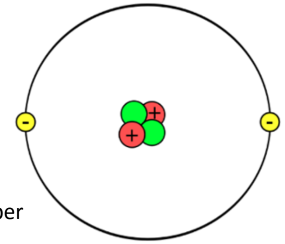
Rutherford used the **alpha** scattering experiments lead to the development of the nuclear model. Deflection by the **+ve** nucleus, unaffected by **–ve** electron cloud

Bohr found electrons surrounded the nucleus at different energy levels at specific distances away from the nucleus.

Section 3A – Types of Nuclear RadiationSection

Properties	Alpha	Beta	Gamma
Symbol	α	β	γ
Penetration	Low	Medium	High
Ionising Power	High	Medium	Low
Range in Air	Short	Medium	Long
Harm to Body	High if source is inside the body	Medium	Relatively low
What is Emitted	Helium nucleus $^{4}_{2}He$	Electron $^{0}_{-1}e$	Electromagnetic wave
Change of Mass on Decay	Decrease	No change	No change

Positive helium nucleus (no electrons)



Neutral Atom (equal number of electrons and protons

Section 3B – Nuclear Radiation Key Terms

Key Term	Definition
Unstable	Prone to change, opposite of stable.
Radioactive Decay	A nucleus giving out radiation as it changes to become more stable, the process is random.
Activity	The number of unstable atoms that decay per second in a radioactive source. Measured in Becquerel (Bq).
Count-Rate	The number of decays recorded each second by a detector (e.g. a Geiger-Muller tube).

Section 4 – Nuclear Equations

Emission is the giving out or discharge of something

Hydrogen-3 nuclei emit beta radiation and become nuclei of helium-3:

$${}^{3}_{1}H \rightarrow {}^{3}_{2}He + {}^{0}_{-1}e$$

Notice that:
- the mass number stays the same
- the atomic number goes up by 1

Uranium-230 nuclei emit alpha radiation and become nuclei of thorium-226:

$${}^{230}_{92}U \rightarrow {}^{226}_{90}Th + {}^{4}_{2}He$$

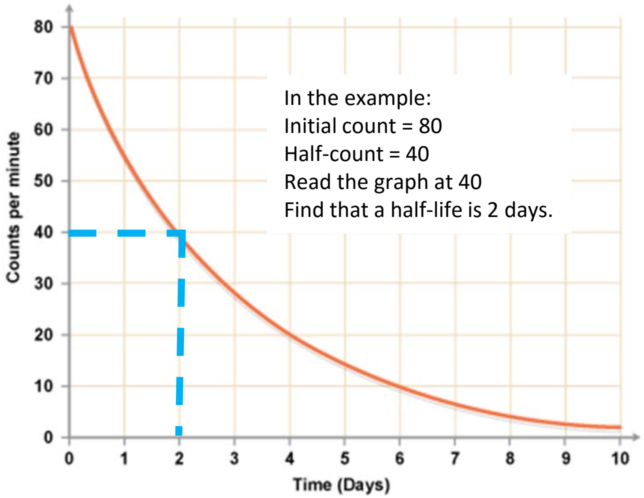
Notice that:
- the mass number goes down by 4
- the atomic number goes down by 2

Section 5 – Half-Life

Radioactive decay is random

Key Term	Description
Half-life	The time it takes for the number of nuclei of the isotope in a sample to half.
	The time it takes for the count-rate (or activity) from a sample containing the isotope to fall to half it's initial level.

Calculating half-life from a graph:



This half-life should not change for the same radioactive source. If you re-calculated from the new initial count rate you would get the same answer.

Section 6 – Radioactive Contamination

Key Term	Description
Radioactive Contamination	The unwanted presence of materials containing radioactive atoms on other materials.
Irradiation	Exposure of an object to ionising radiation.
Radiation Dose	Amount of ionising radiation a person receives.
Hazards	A danger or risk. This is due to the decay of contaminating atoms.

Hazards of radiation:

- Radiation Poisoning
  - Seizures
  - Internal bleeding
  - Inflammation of organs
  - Loss of white blood cells
- Cell mutation
  - Increased risk of cancer
- Burns

Protection against radiation:
- ❑ Keeping as far away from the radiation source as possible.
- ❑ Spending as little time as possible in at-risk areas.
- ❑ Shielding themselves using thick concrete barriers or thick lead plates.
- ❑ Storing radioactive materials in thick, lead-lined boxes.

Why is it important to peer review findings of the effect of radiation?
Findings can be checked by peers to ensure the same issues do not happen again and effects can be studied to aid survivors of radiation exposure. By checking with other scientists, the validity of ideas increases.

Using Radiation:
- o Smoke alarms – send out alpha particles in order to complete the alarm circuit. If smoke blocks the circuit then alpha particles cannot pass through, the circuit breaks and an alarm sounds. Beta or gamma radiation could not be used as they would pass through the smoke.
- o Checking thickness – Beta sources are used to measure the thickness of foil. The same count of beta radiation should be passing through the foil. If the foil is too thick, less beta radiation will pass through. Alpha can't be used as it wouldn't pass through the material. Gamma would pass through all of the material.