

Isotopes and Nuclear Radiation

Isotopes

- Different forms of the same element. They have the same number of protons but a different number of neutrons:
- $^{16}_8\text{O}$ 8 protons, **8 neutrons**
 $^{18}_8\text{O}$ 8 protons, **10 neutrons**
- All** elements have isotopes but not all isotopes are stable.
- Unstable nuclei **decay** into other elements to become more **stable** emit (give out) radiation.

Radioactive Decay

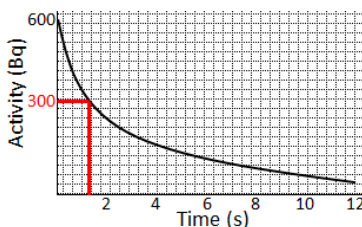
	Type of particle	Properties	How ionising	Uses
5.	Alpha α	alpha particle – two protons and two neutrons (helium nuclei).	Very	Smoke alarms. The α -particles ionises air particles, causing a current to flow. Smoke will bind to the ions, stopping the current so the alarm sounds.
6.	Beta β	Fast moving electron.	Moderate	Testing thickness of sheets of metal.
7.	Gamma γ	Electromagnetic waves.	Weakly	See EM waves sheet.

Decay

- Alpha** decay causes the **charge** and **mass** of the nucleus to **decrease**:
- Uranium-238** \rightarrow **Thorium-234** + α particle
- $^{238}_{92}\text{U} \rightarrow ^{234}_{94}\text{Th} + ^4_2\text{He}$
- Beta** decay causes the **charge** of the nucleus to **increase**.
- When an electron is lost a proton is changed into a neutron:
Carbon-14 \rightarrow **Nitrogen-14** + β particle
- $^{14}_6\text{C} \rightarrow ^{14}_7\text{N} + ^0_{-1}\text{e}$
- Gamma** rays do not change the mass or charge.

Half Life

- The time taken for the number of radioactive nuclei in an isotope to halve.
- Activity (the rate at which a source decays) is measured in becquerels Bq (1Bq = 1 decay per second).
eg. if the initial activity of a sample is 320Bq what will it be after two half-lives?
1st half life = $320 \div 2 = 160$ As a % this is
2nd half lives = $160 \div 2 = 80\text{Bq}$ $(80 \div 320) \times 100 = 25\%$



16. Finding half-life from a graph:

- Mark where half the activity level is.
- Find the corresponding time (1.8s in this example)

Irradiation and Contamination

- Radioactive sources should be kept in lead lined boxes to reduce exposure.
- Exposure to radiation (irradiation) can damage living cells by **ionising** atoms within them.
- Irradiation does not make something radioactive.
- Contamination** happens when radioactive atoms get into something.
- Touching a radioactive source without gloves will contaminate your hands.
- The contaminating atoms can then **decay**, releasing harmful radiation.