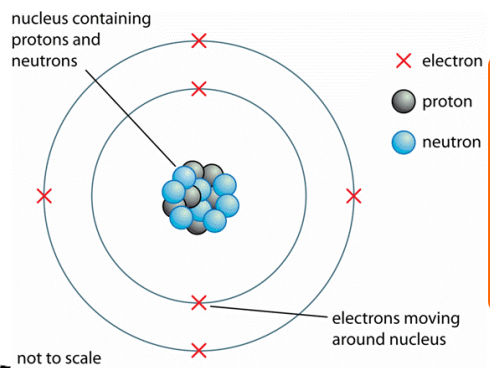


GCSE Science – Atomic Structure – Foundation

START

Atomic Structure



Particle	Mass	Charge
proton	1	+1
neutron	1	0
electron	almost 0	-1

Isotopes:

- Atoms that have the same number of protons (element), but different numbers of neutrons



Key words:

- Atoms - an atom has no overall charge
- Mass number = protons + neutrons
- Atomic number = protons (also = electrons)
- Isotopes – atoms of the same element with the same numbers of protons and electrons but different numbers of neutrons.
- Background radiation – low level radiation present at all times.
- Irradiation – exposing an object to a radioactive source.
- Contamination – unwanted radioactive atoms on an object.
- Half-life – the time taken for the number of radioactive nuclei in a sample to halve.

Development of the model of the atom;
New experimental evidence may lead to the model being changed or replaced.

Early ideas:
Before the discovery of the electron atoms were tiny spheres, they couldn't be divided

Plum pudding:
After the electron was discovered the atom became a ball of positive charge with negative electrons scattered in it



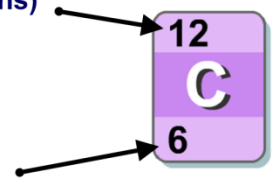
Niels Bohr:
Adapted the nuclear model suggesting electrons in orbitals at set distance

Nucleus development:
Experiments now show nucleus is made of smaller particles of positive charge

James Chadwick:
Evidence to show the existence of neutrons in the nucleus

Alpha particle scattering:
Showed that the mass of an atom was concentrated in the centre, it was charged too

Mass number
(= protons + neutrons)



Atomic number
(= number of protons = number of electrons).

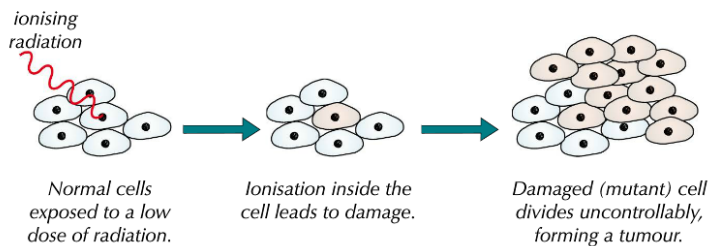
So in carbon:
Protons = 6
Electrons = 6 (same as protons)
Neutrons = 12 – 6 = 6

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Lower doses tend to cause minor damage without killing the cell. This can give rise to mutant cells which divide uncontrollably — see Figure 1. The cells keep dividing, making more cells and forming a tumour — this uncontrolled cell division is cancer.



Alpha (α) radiation

Description	2 neutrons, 2 protons <i>Note:</i> — An alpha particle is the same as a helium nucleus
Electric charge	+2
Relative atomic mass	4
Penetrating power	Stopped by paper or a few centimetres of air
Ionizing effect	Strongly ionizing
Effect of magnetic/ electric field	Weakly deflected

Beta (β) radiation

Description	High energy electron
Electric charge	-1
Relative atomic mass	1/1860
Penetrating power	Stopped by a few millimetres of aluminium
Ionizing effect	Weakly ionizing
Effect of magnetic/ electric field	Strongly deflected

Half Life

the time taken for the number of radioactive nuclei in a sample to halve.

Radioactive decay is random.

Gamma (γ) radiation

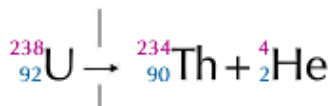
Description	High energy electromagnetic radiation
Electric charge	0
Relative atomic mass	0
Penetrating power	Stopped by several centimetres of lead or several metres of concrete
Ionizing effect	Very weakly ionizing
Effect of magnetic/ electric field	Not deflected

Nuclear Equations

Alpha Decay:

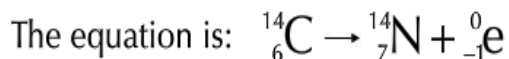
Uranium-238 can decay into thorium-234 by emitting an alpha particle. Uranium has 92 protons and thorium has 90 protons.

The nuclear equation for this decay looks like this:

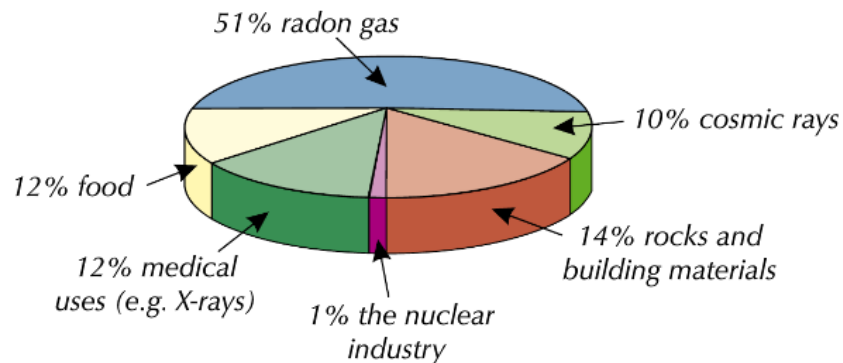


Beta Decay:

Carbon-14 can decay into nitrogen-14 by emitting a beta particle (when a neutron turns into a proton).



Sources of background radiation



GCSE Science – Atomic Structure Questions

The Atomic Model

True or false? People used to believe that atoms were tiny spheres that couldn't be broken apart.

Describe Rutherford and Marsden's experiment which disproved the plum pudding model.

What happens to an electron in an atom if it releases EM radiation?

Who provided evidence to suggest the existence of the neutron?

True or false? Electrons make up most of the mass of an atom.

What is the overall charge of an atom?

What happens to an atom if it loses one or more of its electrons?

Nuclear Decay and Half-life

Which number defines what element an atom is: the atomic number or the mass number?

What is the atomic number of an atom? What is the mass number of an atom?

What is an isotope? Are they usually stable?

For the three types of ionising radiation, give: a) their ionising power, b) their range in air.

Draw the symbols for both alpha and beta radiation in nuclear equations.

What is the activity of a source? How does activity relate to count-rate?

Define half-life and describe how to find a source's half-life, given a graph of its activity over time.

Dangers of Radiation

Define irradiation and contamination.

Give two examples of how to protect against: a) contamination, b) irradiation.

Compare the hazards of being irradiated and contaminated by:

a) an alpha source, b) a gamma source.