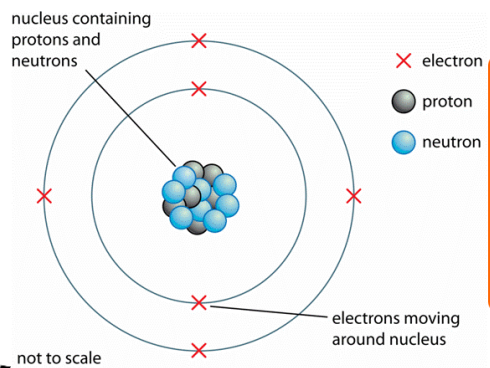


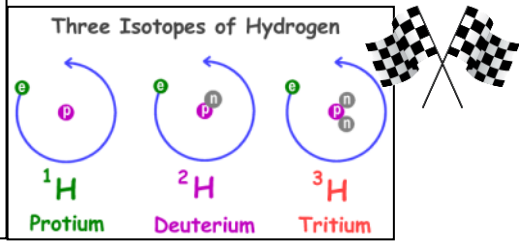
GCSE Science – Atomic Structure – Higher

START Atomic Structure



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

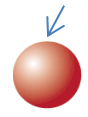
Isotopes;
 • Atoms that have the same number of protons (element), but different numbers of neutrons



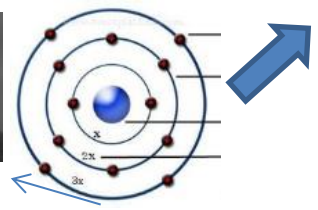
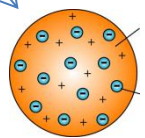
- Key words:**
1. **Atoms** - an atom has no overall charge
 2. **Mass number** = protons + neutrons
 3. **Atomic number** = protons (also = electrons)
 4. **Isotopes** – atoms of the same element with the same numbers of protons and electrons but different numbers of neutrons.
 5. **Background radiation** – low level radiation present at all times.
 6. **Irradiation** – exposing an object to a radioactive source.
 7. **Contamination** – unwanted radioactive atoms on an object.
 8. **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



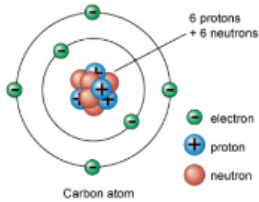
Plum pudding;
 After the electron was discovered the atom became a ball of positive charge with negative electrons scattered in it



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

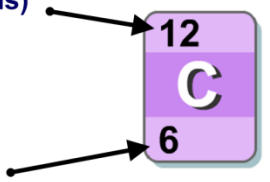
Nucleus development;
 Experiments now show nucleus is made of smaller particles of positive charge

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



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

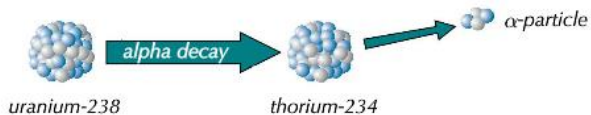
GCSE Science – Atomic Structure – Higher (page 2)

START

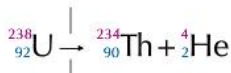
Nuclear Equations



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:



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



The equation is: ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_{-1}^0\text{e}$

Half Life

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

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

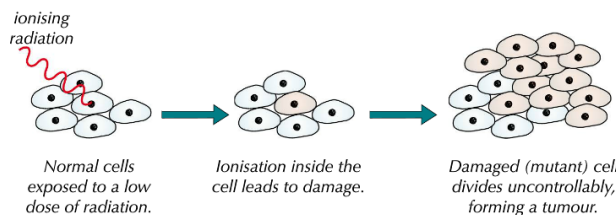
Beta (β) radiation

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

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

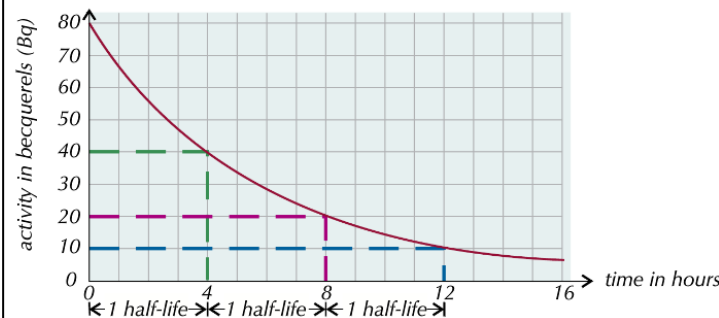
Lower doses tend to cause minor damage without killing the cell. This can give rise to mutant cells which divide uncontrollably — see Figure 1. The cells keep dividing, making more cells and forming a tumour — this uncontrolled cell division is cancer.



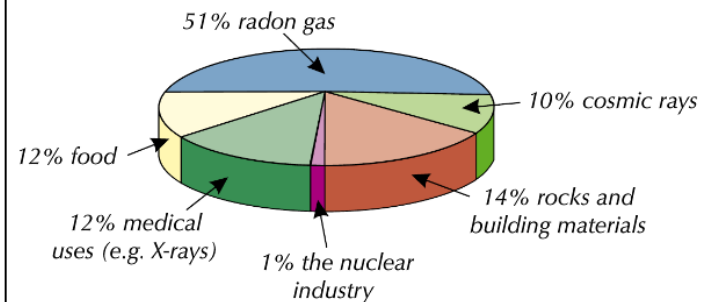
The initial activity is 80, so after one half-life it will be 40 (and after two it will be 20 and after three it will be 10).

To find the half-life of the sample, draw a line from 40 on the activity axis across to the curve and down to the time axis (green dotted line). This tells you that the half-life is 4 hours.

You can check you were right by doing the same for an activity of 20 and checking that you get a time of 8, and so on...



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.