

4.1 - Structure of an Atom	
Protons	Found in the nucleus , mass = 1 , charge = +1 .
Neutrons	Found in the nucleus , mass = 1 , charge = 0 .
Electrons	Found on the energy levels , mass = very small , charge = -1 .
Atom	Overall charge = zero , radius = 1.0×10^{-10} m .
Nucleus	Overall charge = positive , radius = 1.0×10^{-14} m (very small compared to whole atom -> 1/10000 the size).
Electron absorbs/emits EM radiation	Absorbs = moves to higher energy level (further from nucleus). Emits = moves to lower energy level (closer to nucleus).
4.2 - Atomic Number, Mass Number and Isotopes	
Atomic number	Number of protons .
Mass number	Total number of protons and neutrons .
Isotopes	Atoms of same element , with same number of protons , different numbers of neutrons .
4.3 - Development of the Model of the Atom	
Plum Pudding Model	Electron discovered by JJ Thomson -> negative electrons embedded in a ball of positive charge .
Rutherford's Experiment	Fired positive alpha particles at thin gold foil . Most passed straight through , small number deflected .
Rutherford's Nuclear Model	Tiny positively charged nucleus -> nearly all mass is concentrated here -> most of atom is empty space .
Bohr's Nuclear Model	Electrons orbit the nucleus in energy levels at specific distances from the nucleus.
Chadwick	Discovered neutrons .
4.4 - Radioactive Decay	
Radioactive decay	Random process -> unstable nuclei emit nuclear radiation -> alpha particles , beta particles , gamma rays and neutrons .
Activity	Number of nuclei that decay per second , measured in becquerels (Bq)
Count-rate	Number of radiation counts reaching a detector per second , measured in counts per min or counts per s .
Half-Life	Time it takes for number of nuclei to halve , or time it takes for activity (or count rate) to fall to half its initial level .

4.5 - Alpha, Beta and Gamma	
Alpha particle	Made up of 2 protons and 2 neutrons (a helium nucleus).
Alpha properties	Range in air = a few cm , low penetration (absorbed by paper), highly ionising (large and positive charge)
Beta particle	Electron emitted from nucleus when neutron turns into proton .
Beta properties	Range in air = a few m , moderate penetration (absorbed by a few mm of aluminium), moderately ionising .
Gamma ray	EM waves emitted from nucleus -> travel at speed of light .
Gamma properties	Range in air = infinite , high penetration (absorbed by few cm of lead or few m of concrete), weakly ionising .
4.6 - Nuclear Decay Equations	
Alpha decay equation	Mass number decreases by 4. Atomic number decreases by 2.
Beta decay equation	Mass number does not change . Atomic number increases by 1.
Gamma Decay Equation	Mass number does not change . Atomic number does not change .
	${}^4_2\text{He}$ ${}^0_{-1}\text{e}$ ${}^0_0\gamma$
4.7 - Dangers of Nuclear Radiation	
Ionising power	Radiation can knock electrons off atoms, creating positive ions .
Cell damage	Radiation can ionise atoms in cells -> causes cell damage . Can cause cancer if atoms in DNA are ionised .
Irradiation	Object/person is exposed to radiation .
Contamination	Object/person gets radioactive source in or on them.
Inside Body	Alpha is most dangerous -> absorbed by cells -> highly ionising .
Outside Body	Gamma and beta most dangerous -> can penetrate body .
Reducing Risk	Reduce exposure time , increase distance , increase shielding .
Working with radiation	Use tongs , store in lead boxes , use remote controlled arms , wear a film badge , wear a full body suit , leave the room, stand behind barrier .

GCSE Science

Physics P4 – Atomic Structure

