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**.	$^{4}_{2}He$
Beta decay equation	**Mass** number does **not change**. **Atomic** number **increases** by **1.**	$^{0}_{-1}e$
Gamma Decay Equation	**Mass** number does **not change**. **Atomic** number does **not change**.	$^{0}_{0}\gamma$

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