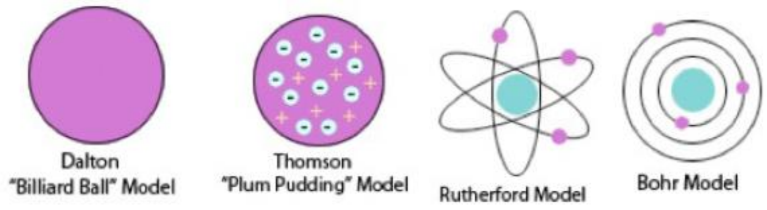
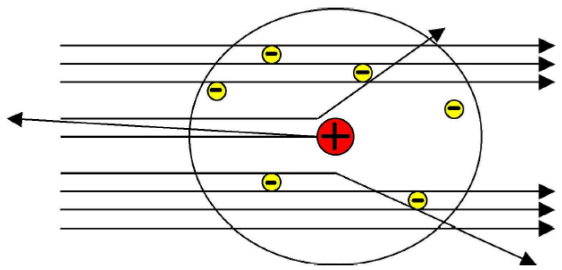
Physics: Radioactivity

1. Models	
Plum Pudding Model	Model of atomic structure proposed by J.J Thomson (1856-1940). He had discovered that atoms are complete objects, made of pieces with positive and negative charge, and that the negatively charged electrons within the atom were very small compared to the entire atom. He therefore proposed that atoms have structure similar to a plum pudding, with tiny negatively charged electrons surrounded by positive charge. **This model has been disproven.**
Rutherford Atomic Model	Ernest Rutherford (1871-1937) carried out experiments that suggested that atoms were mostly empty space with the majority of the mass being held in a central positive nucleus. Rutherford saw that alpha particles were deflected or bounced back instead of passing through a gold foil. The Rutherford model was superseded by the **Bohr** model.
2.	
Nucleons	Particles that are part of the nucleus-either protons or neutrons
Atomic Number	The number of protons in an atomic nucleus. The number defines the element and where it si positioned in the periodic table. In a neutral atom, the number of protons and electrons is equal
Atomic Mass	The total mass of the atom, found by adding the number of neutrons and protons together
Neutron number	Number of neutrons in the nucleus. Found by subtracting the atomic number from the atomic mass
Isotope	An element with the same number of protons, but differing numbers of neutrons. This can make the element unstable and radioactive. Isotopes are used in Carbon dating. E.g: Carbon-12 and Carbon-13 both have 6 protons but respectively 6 and 7 neutrons.
3.	
Electron Shells	The specific orbits that electrons occupy in the atom. Each shell requires amounts of different energy for the electrons to be present and is different for each atom. Electrons fill shells with the lowest energy (first shell) being filled first. Valencies: 1st shell: 2 electrons, 2nd shell: 8 electrons, 3rd shell: 8 electrons
Ion	An atom that has gained or lost electrons to become charged. The difference in charge is proportional to how many electrons lost or gained. Gaining electrons forms a negative ion, whilst losing electrons forms a positive ion.
Ionisation	The process of gaining or losing electrons. Electromagnetic radiation can cause ionisation when electrons absorb energy from the EM radiation. Each frequency of light can be absorbed by different electrons

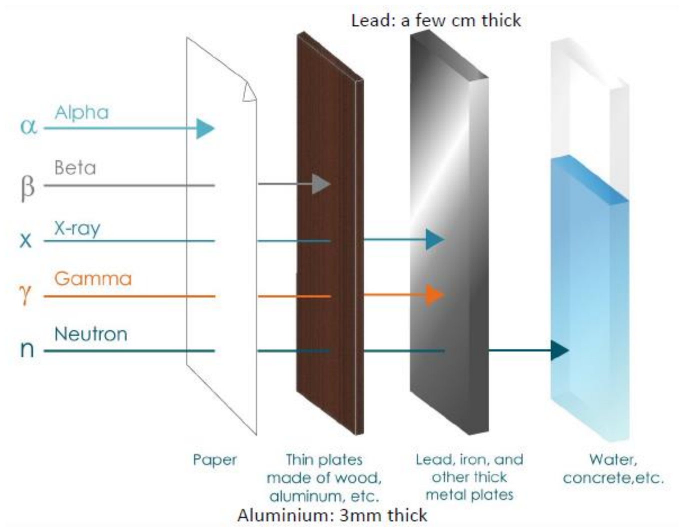
Ionising radiation	Radiation that has enough energy to permanently remove electrons from an atom to form ions
4.	
Background Radiation	Naturally occurring radiation from natural sources such as cosmic rays, X-rays, radioactive decay.
Radioactive decay	A random process where an unstable nucleus changes (usually by fission) and releases energy in the form of alpha, beta or gamma radiation
Half life	The amount of time taken for half of the nuclei in a sample to decay. It can be in the range of minutes to thousands of years.
Relay	Used to switch an electrical machine on or off, uses a small current on a machine with a larger current



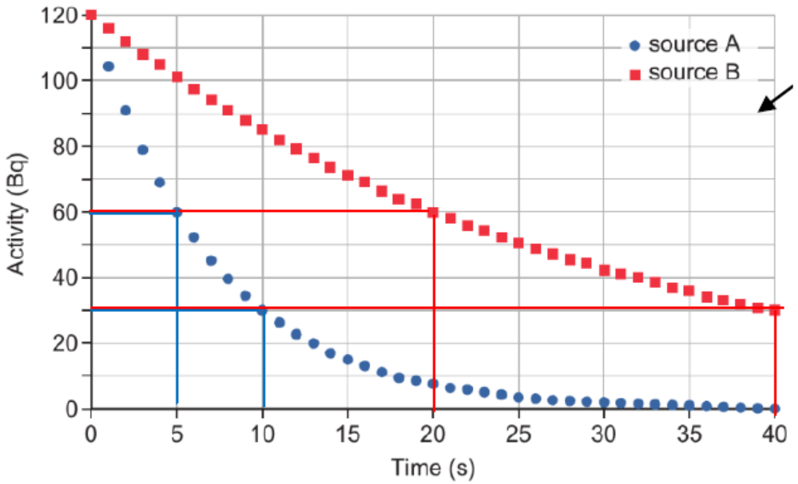
Subatomic particle	Location in atom	Relative charge	Relative mass
Proton	Nucleus	+1 (positive)	1
Neutron	Nucleus	0	1
Electron	Orbiting around nucleus	-1 (negative)	1/1835 (~0 or negligible)



Rutherford experiment: *Most alpha particles travel straight through the gold leaf, some are deflected (change direction) and very few are completely bounced back towards the source. This provides evidence of a central area of high positive charge in the*



Half-life graph: The half life the time taken for the activity to drop to half. For both samples the half-life is when the activity drops to 60 Bq. Source A = 5 minutes, Source B = 20 minutes



1. Models	
Radioactive Decay	When an unstable nucleus loses energy by emitting particles or electromagnetic radiation (gamma). Radioactive decay happens to make the nucleus more stable. It is a random process which means we cannot predict when a single nucleus will decay. If we have enough particles we can predict how many will probably decay in a certain time.
Penetrating Power	The distance that radiation can go into an object or material is known as penetrating power. The more penetrating the radiation os, the ticker the amount of material it can travel through. The denser the material the more stopping power it has. The more ionising the radiation the lower the penetration is.
Alpha Particles	Alpha particles contain two protons and two neutrons, but no electrons. Alpha particle are the same as the nucleus of a helium atom, having two neutrons and two protons. As they have no electrons they have a charge of 2+. They are written as α or . Alpha particles have the lowest penetration power but are the most dangerous internally
Beta Particles	Beta particles are made of high speed, high energy electrons which are emitted during radioactive decay. Their relative mass is 1/1835 and are written as β or . They can penetrate paper but are stopped by thin aluminium.
Positron	Particles that have the same mass as electrons but their charge is +1. They are written as β+ or . They have similar penetration power s beta radiation. Positrons are an example of antimatter.
Gamma Rays	High frequency electromagnetic waves which travel at the speed of light. They do not have any mass or charge and are the most penetrating type of radiation, requiring several cm of lead to stop them.
Isotope	An element with the same number of protons, but differing numbers of neutrons. This can make the element unstable and radioactive. Isotopes are used in Carbon dating. E.g: Carbon-12 and Carbon-13 both have 6 protons but respectively 6 and 7 neutrons.
Nuclear equations	An equation that shows what happens during radioactive decay. Like normal equations it has to be balanced on both sides-both mass and charge need to be the same before and after the reaction.
Daughter nucleus	The nucleus that is left after radioactive decay takes place.
Alpha decay	A radioactive nucleus decaying by the loss of an alpha particle. As a helium
Beta decay	
Gamma decay	
Half life	
Mutation	
Irradiation	

Alpha decay $${}^{a}_{b}X \rightarrow {}^{4}_{2}He + {}^{a-4}_{b-2}Y$$

B+ decay $${}^{a}_{b}X \rightarrow {}^{0}_{+1}e + {}^{a}_{b-1}Y$$

β- decay $${}^{a}_{b}X \rightarrow {}^{0}_{-1}e + {}^{a}_{b+1}Y$$