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| **Radiation - Summary** | | | |
|  | **α - radiation** | **β - radiation** | **γ - radiation** |
| **Reason for unstable nucleus** | Electromagnetic force is one of the four fundamental forces; it dictates how magnetic and charged objects interact. Importantly, similarly charged objects repel each other. This is the case with the protons within a nucleus, whose positive charges repel each other. A nucleus can stay bound due to strong nuclear force, the strongest of the fundamental forces.  As the number of protons within a nucleus increases, the electromagnetic force eventually overcomes the residual strong nuclear force between the nucleons, and thus the nucleus becomes unstable. | Free-floating neutrons are (surprisingly) unstable. With a half-life of about 15 minutes, they decay into protons, which have a lower mass than it. The process that these neutrons undergo to become protons is beta decay.  To add to that, a neutron-heavy nucleus in energetically unfavourable, as the neutrons begin to occupy higher and higher energy nuclear shells, whereas decaying into a proton would lower the total amount of energy in that system by allowing it to drop into a lower energy shell. | Gamma radiation occurs when a nucleus is excited (not in its ground state). This means that there is a nucleon in a higher energy nuclear shell than is necessary. By dropping down into a lower shell, it produces energy, which is emitted as a photon; gamma decay. |
| **Description of particles released from the nucleus** | An alpha particle is identical to a helium-4 nucleus. 2 neutrons and 2 protons. | A beta particle is just an electron. | Just a photon/ray. Identical to X-rays except for the fact that X-rays originate in the electron cloud and gamma rays from the nucleus. |
| **General equation** |  |  |  |
| **Example equation** |  |  |  |
| **Particle properties:**   * Speed * Ionising ability * Penetrating power * Description of substance that can shield (stop the particle) the particle * Potential for biological harm | * Low speed * High ionisation * Low penetration * A sheet of paper can block it * Outside of the human body, it is mostly harmless as it is unable to penetrate the skin. However, when inside the human body, it can wreak havoc on the internal processes due to its high ionisation power. | * Medium speed * Medium ionisation * Medium penetration * Aluminium * Similar to alpha decay | * High speed * Low ionisation * High penetration * **Mostly** by lead * Unlike the earlier two, gamma radiation is especially dangerous due to its ability to pass through the human body. This allows an external gamma emitter to destroy the body’s internal processes. |

