Half life

Stage 1 Physics

Recap Radioactivity

- Definition; ***Radioactivity*** *is the emission of ionising radiation or particles caused by the spontaneous disintegration of atomic nuclei.*
- Definition; ***Ionising radiation*** *is radiation consisting of particles, x-rays, or gamma rays with sufficient energy to cause ionisation in the medium through which it passes.*

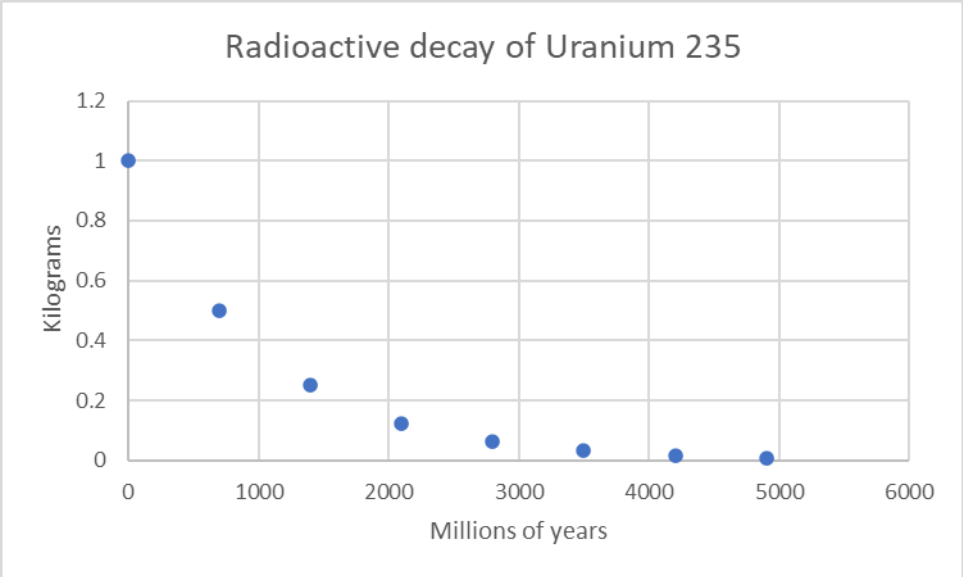
- Remember; Unstable Nuclei will undergo radioactive decay in which particles and/or electromagnetic radiation are emitted

Recap radioactivity

- Radioactive or unstable Nuclei will undergo radioactive decay. A process whereby the nuclei decays into other elements.
- As a result, if you start with 1kg of Uranium 235, in 700 million years you will only have 0.5kg of Uranium 235 and the rest will be made up of emitted energy and daughter particles
- It will however take another 700 million years for the next 0.25kg to decay
- And then another 700 million years for the next 0.125kg to decay

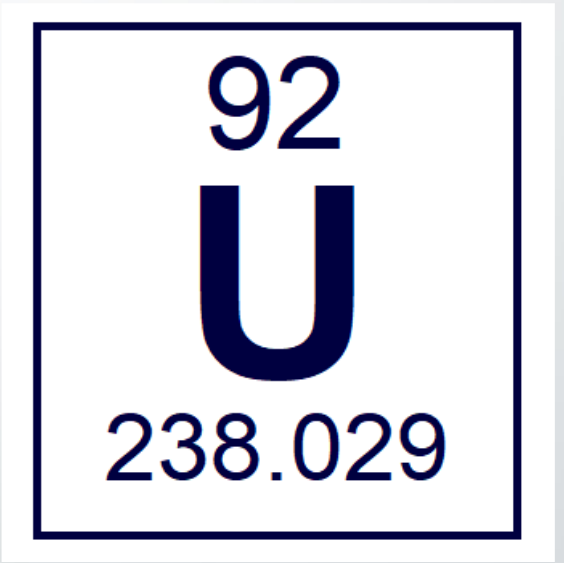
Exponential decay

- The mass of Uranium 235 decays exponentially over time
- The exponential step is determined by its half life
- Calculations are completed using the same mathematical formula that is used for calculating compound interest over time



Quick discussion of Uranium

- Uranium is the 92nd element on the Periodic Table
  - It has 92 Protons
- The 'average' Isotope is 238.029
  - Thus, it has an average of 146.029 Neutrons
- Uranium is a dense, hard metallic element that is silvery white in colour. It is ductile, malleable, and capable of taking a high polish.
- Isotopes U235 and U238 both occur naturally. U235 is fissile and this makes it a useful fuel (more on that later)
  - Fissile – able to undergo nuclear fission



Half life “doesn’t care”

- The half life of a nucleus is independent of the physical or chemical state of the atom.
- This is because it is a property of the nucleus. What the Electrons are doing (chemical bonding) does not affect the nuclear structure which is held together by the Strong Force which is much greater than chemical bonding
- The physical state (solid, liquid or gas) also has little effect on the nuclear bonding and therefore, also does not change the half life

Calculations

- A good starting point for understanding is Tyler DeWitt's video.
- He uses what I would call a brute force method, but he clearly demonstrates what is happening
  - https://www.youtube.com/watch?v=WAsmY4ocWSA