Nuclear equations

Nuclear equations show radioactive decay. Like chemical equations the mass before the decay must equal the mass after decay.

Alpha (α) decay

An alpha particle has two protons and two neutrons. This is the same as a nucleus of a helium atom.

We represent the alpha particle as:

$$^{4}_{2}He$$

4 — mass of particle

2 — number of protons, size of charge

Here is the equation for the decay of uranium - 238 into thorium - 234.

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

Uranium — Thorium — Alpha particle

The mass number on the left of the equation equals the sum of the mass numbers on the right of the equation. The number of protons (or charge) are also balanced.

In alpha decay, the atomic number decreases by 2 and the mass number decreases by 4.

Example calculation

Here is the nuclear decay showing the decay of Americium into Neptunium. Calculate the mass number and the number of protons for Neptunium.

$$^{241}_{95}Am \longrightarrow Np + {}^{4}_{2}He$$

Americium — Neptunium — Alpha particle

Mass of Np = 241 - 4 = 237

Number of protons of Np = 95 - 2 = 93

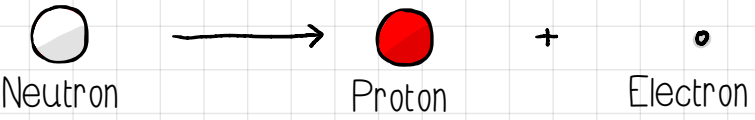
$$^{237}_{93}Np$$

Neptunium

Nuclear equations...

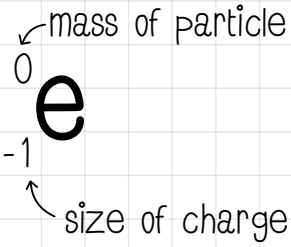
Beta (β) decay

In beta decay a neutron changes into a proton and an electron



The change from the neutron to a proton lowers the energy level of the nucleus. The excess energy is emitted from the nucleus as an electron. This electron is called a beta particle.

The beta particle is represented as:



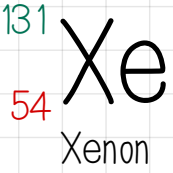
Here is the nuclear equation for the decay of carbon into nitrogen

In beta decay the atomic number increases by 1 and but the mass number stays the same.

Example calculation

Here is the nuclear equation for the decay of iodine into Xenon.
Calculate the mass number and the number of protons for Xenon.

Mass number of Xenon = 131 - 0 = 131
Number of protons of Xenon - 1 = 53
Number of protons of Xenon = 53 + 1 = 54



Gamma (γ) decay

In gamma decay, the atomic number and mass number are unchanged.

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