

Chapter: Nuclear Chemistry

Section 2: Radioactive Decay

Radioactive Decay: spontaneous changing (disintegration) of unstable nuclei into stable nuclei of a different element

Nuclear radiation: particles or electromagnetic radiation emitted from the nucleus during radioactive decay

Radioactive nuclide: unstable nucleus that undergoes radioactive decay

Radioisotopes: isotopes that are radioactive

Alpha particle (α): two protons and two neutrons bounded together and are emitted from the nucleus...stream of helium radiation

- Represented with the symbol
 - 4 = protons plus neutrons
 - 2 = protons
- Restricted to very heavy nuclei

Beta particle (β): an electron emitted from the nucleus

- Fast electrons and there is no mass change
- Elements above the band of stability are unstable because they have too many neutrons...way to decrease # of neutrons
- represented with the symbol
 - 0 = no mass (very little mass)
 - -1 = negative charge

Electron capture: an inner orbital electron that is captured by the nucleus of its own atom

- represented with the symbol
- similar to the beta particle...just different symbol

Positron: particle that has the same mass as an electron, but has a positive charge

- represented with the symbol
 - 0 = no mass (very little mass) in amu
 - 1 = positive charge

Gamma rays (γ): high-energy electromagnetic waves emitted from a nucleus as it changes from an excited state to a ground energy state

- Represented with the symbol

Proton: represented with the symbol

- 1 (top) = relative mass in amu
- 1 (bottom) = charge

Neutrons: represented with the symbol

- 1 = relative mass in amu
- 0 = charge

Electrons are only emitted from a nucleus when it undergoes a nuclear reaction

- Nucleus does not contain electrons

Half-life ($t_{1/2}$): the time required for half the atoms of a radioactive nuclide to decay

- continue to decay until a negligible amount remains
- more stable nuclides decay slowly and have long half-lives
- less-stable nuclides decay quickly and have short half-lives

Decay series: series of radioactive nuclides produced by successive radioactive decay until stable nuclei are reached

Parent nuclide: the heaviest nuclide of each decay series

- 3 natural decay series parent nuclides
 - Uranium – 238
 - Uranium – 235
 - Thorium – 232

Daughter nuclide: the nuclides produced by the decay of the parent nuclides

Artificial radioactive nuclides: radioactive nuclides not found naturally on Earth

- Made by **artificial transmutations:** bombardment of stable nuclei with charged and uncharged particles
 - Production of technetium and promethium
 - Large amounts of energy are required to bombard nuclei

- Accelerate particles in a magnetic or electrical field of a particle accelerator (called atom smashers)

Transuranium elements: elements with more than 92 protons in their nuclei

- Are radioactive
- Thorium, Protactinium, Uranium are the only elements in Actinide series that are found in nature naturally
 - Occur after uranium (where it gets its name from)