

Nuclear Chemistry 16.1

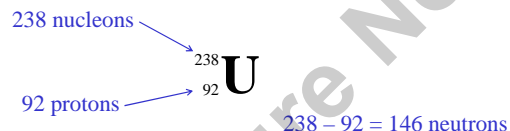
Modes of Nuclear Decay

The Nucleus

The nucleus contains:

- Protons (+ charge)
- Neutrons (no charge)

Protons and neutrons are known as nucleons.



Nuclear Decay

An unstable nucleus undergoes a change and a reduction in energy to become more stable.

Four types of nuclear decay.

- 1) Alpha Decay
- 2) Beta Decay
- 3) Positron Emission
- 4) Electron Capture

Ex) Alpha (α) Decay

The nucleus emits an alpha particle.

Ex) Uranium-238 undergoes alpha (α) decay.



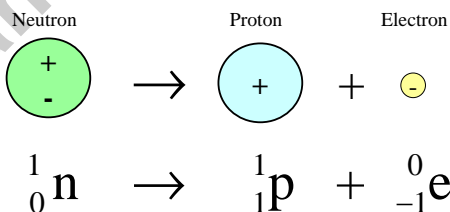
Number of nucleons must balance ($234 + 4 = 238$)

Number of protons must balance ($90 + 2 = 92$)

Beta (β) Decay

A high speed electron is ejected from a neutron.

This turns the neutron into a proton.



Ex) Beta (β) Decay

An electron is ejected from a neutron.

This turns the neutron into a proton.

Ex) Iodine-131 undergoes beta (β) decay.






Number of nucleons must balance ($131 + 0 = 131$)

Number of positive charges must balance ($54 - 1 = 53$)

Positron Emission
Beta Positive (β^+) Decay

A high speed positron is ejected from a proton.
This turns the proton into a neutron.

Proton	→	Neutron	+	Positron
				
${}^1_1\text{p}$	→	${}^1_0\text{n}$	+	${}^0_{+1}\text{e}$

Ex) Positron Emission
(β^+) Decay

A positron is ejected from a proton.
This turns the proton into a neutron.




Ex) Fluorine-17 undergoes beta (β^+) decay.

$${}^{17}_9\text{F} \rightarrow \quad + \quad {}^0_{+1}\text{e}$$

Number of nucleons must balance ($17 + 0 = 17$)
Number of positive charges must balance ($8 + 1 = 9$)

Electron Capture

A proton absorbs an electron.
This turns the proton into a neutron.

Proton	+	electron	→	Neutron
				
${}^1_1\text{p}$	+	${}^0_{-1}\text{e}$	→	${}^1_0\text{n}$

Ex) Electron Capture

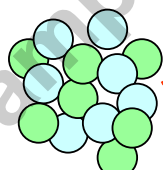
A proton absorbs an electron.
This turns the proton into a neutron.

Ex) Xenon-118 undergoes electron capture.

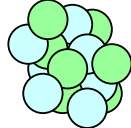
$${}^{118}_{54}\text{Xe} + {}^0_{-1}\text{e} \rightarrow$$

Number of nucleons must balance ($118 + 0 = 118$)
Number of positive charges must balance ($54 - 1 = 53$)

Gamma Ray (γ) Emission



The nucleus is unstable immediately after any type of decay.



Nucleus' stability increases after this energy is released.

Emits high energy electromagnetic radiation to reduce energy.

γ