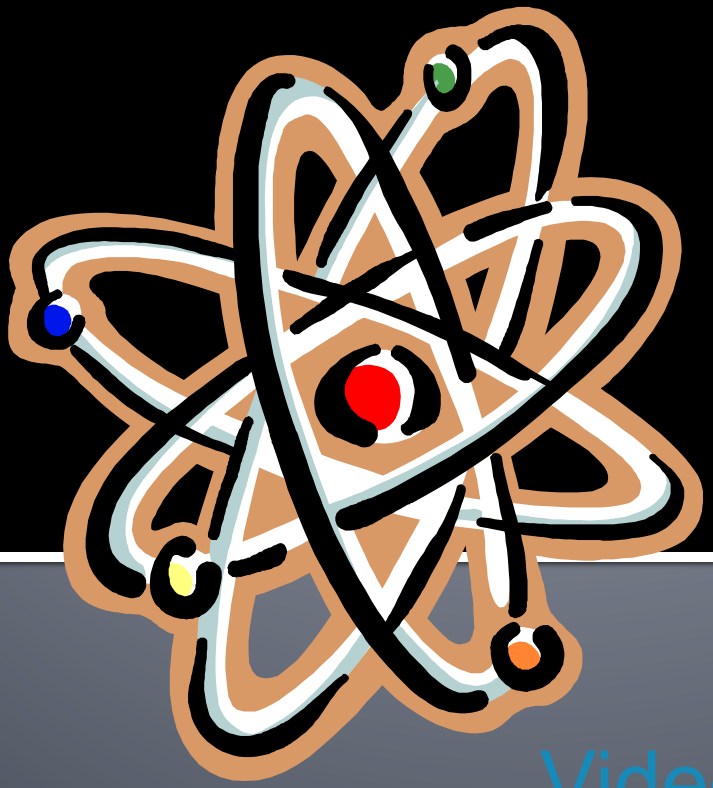
Nuclear Chemistry



Mrs. Nielsen
Honors Chemistry

Video: Nuclear Stability

What is a Nuclear Reaction?

- A nuclear reaction is a reaction that affects the nucleus of an atom

Result: **A more stable nucleus**

What makes a nucleus stable?

Low atomic # 1 proton : 1 neutron

Higher atomic # 1 proton : 1.5 neutrons

Nucleons

A nucleon is a particle in the nucleus (protons and neutrons)

Mass # = protons + neutrons

$^{228}_{88}Ra$ or Radium-228

Atomic # = protons

Q: What keeps the nucleons together?

A: A very strong attractive nuclear force, also known as NUCLEAR BINDING ENERGY

Radioactivity

- Radioactive Decay is the spontaneous disintegration of a nucleus into a slightly lighter nucleus, accompanied by the emission of particles, Electromagnetic Radiation, or both.

- A radioactive nuclide is an unstable nucleus that undergoes radioactive decay.

Types of Radioactive Decay

Type	Symbol	Charge
Alpha Particle	α or $^{4}_{2}He$	+2
Beta Particle	$^{0}_{-1}\beta$	-1
Positron	$^{0}_{1}\beta$	+1
Gamma Ray	$^{0}_{0}\gamma$	none
Electron Capture	$^{0}_{-1}e$	-1

New Symbols for Atomic Particles

Proton: ${}^{1}_{1}p$

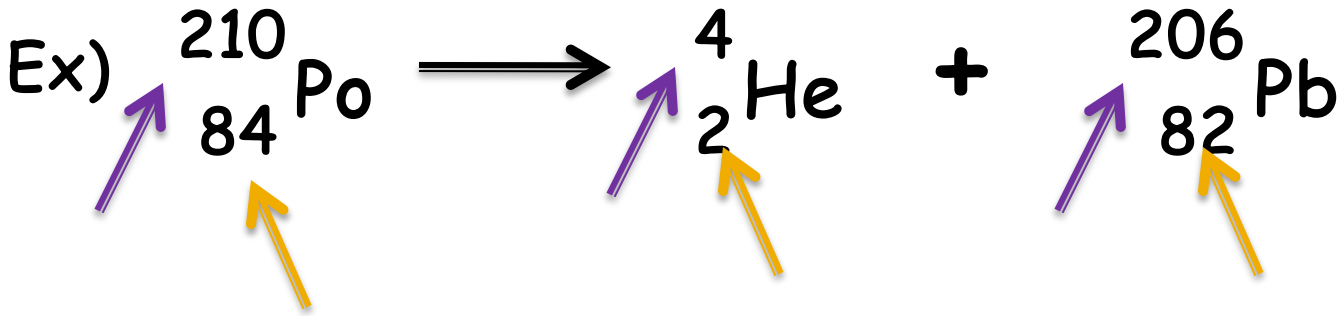
Neutron: ${}^{1}_{0}n$

Electron: ${}^{0}_{-1}e$

Alpha Decay (Alpha Emission)

$^{4}_{2}He$ α

* An α particle is a Helium nucleus
* The largest and heaviest particle
* Reduces # of $^{1}_{1}p$ and $^{1}_{0}n$



$^{0}_{-1}\beta$

Beta Decay (Beta Emission)

*If too many neutrons, a neutron gets converted into a $^{1}_{1}p$ and an $^{0}_{-1}e$, and the $^{0}_{-1}e$ is emitted

$$^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}\beta$$

Ex) $^{14}_{6}C \longrightarrow {}^{0}_{-1}\beta + {}^{14}_{7}N$

Superscripts add up

$^{0}_{1}\beta$ Positron Emission

* If too many protons, a $^{1}_{1}p$ is converted to a $^{1}_{0}n$ by emitting a positron

$$^{1}_{1}p \rightarrow {}^{1}_{0}n + {}^{0}_{1}\beta$$

Ex) $^{38}_{19}K \longrightarrow {}^{0}_{1}\beta + {}^{38}_{18}Ar$

Superscripts add up

$^{0}_{-1}e$ Electron Capture

* Nucleus unstable because too many protons

* Electron combines with a proton to form a neutron

$$^{0}_{-1}e + {}^{1}_{1}p \rightarrow {}^{1}_{0}n$$

Ex) $^{106}_{47}Ag + {}^{0}_{-1}e \longrightarrow {}^{106}_{46}Pd$

Superscripts add up

$^{0}_{0}\gamma$ Gamma Rays

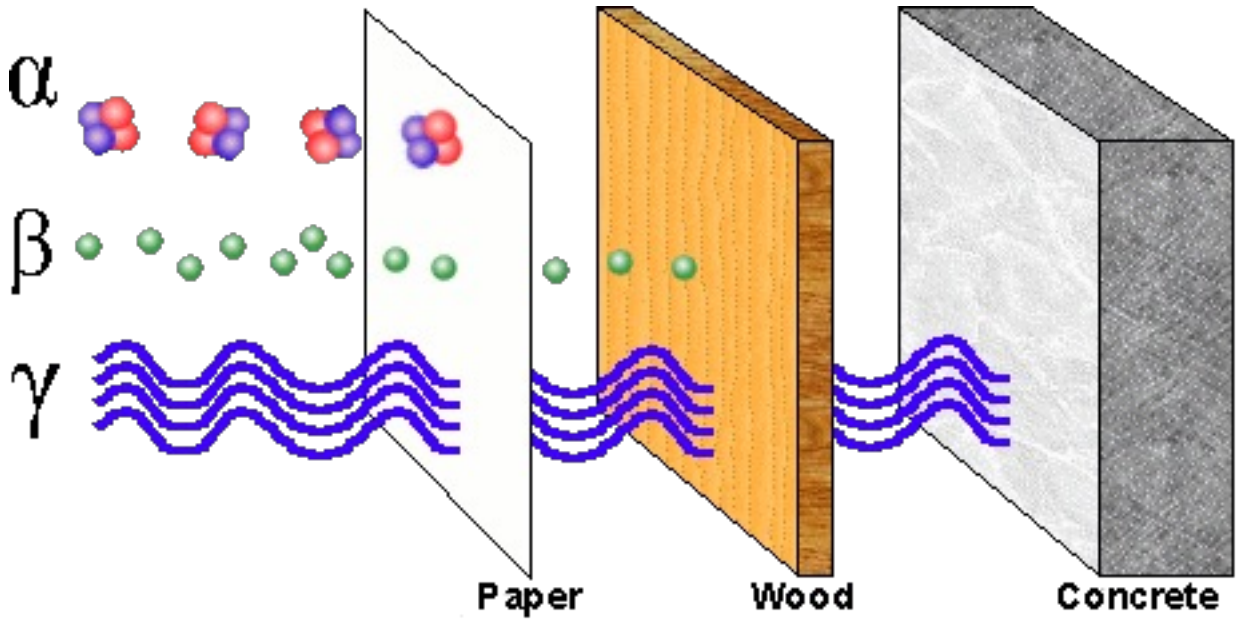
*High energy Electromagnetic waves emitted from a nucleus as it changes from excited state to ground state

*similar to $^{0}_{-1}e$ dropping energy levels (remember this?)

*usually occurs immediately following other types of decay

Ex) $^{38}_{19}K \longrightarrow {}^{0}_{1}\beta + {}^{38}_{18}Ar + {}^{0}_{0}\gamma$

Penetrating Ability



Mr. Wizard Video (1960s)

"Duck and Cover" Civil Defense Film (1951)