Nuclear Chem.

* As stated previously - unlike chem. rxns that only involve the sharing or transfer of electrons, radioactivity involves the loss or gain of energy & particles that change the elements involved into new elements.

- Unstable radioactive atoms emit radiation in the form of energy or particles (α, β, or γ)

mass # → $^{4}_{2}He$ ← Atomic #

(α) Alpha particles are often written as $^{4}_{2}He$ because the particles are made of 2 neutrons & 2 protons & thus have a 2+ charge

- Atoms that emit a α particle lose 4 from its mass & 2 from atomic #.

Beta particles (β) often written as β or e^-, as the represent the loss of 1 electron (1-) or $^{0}_{-1}e$

- Atoms that emit a e^- particle gain 1 atomic #.

Gamma radiation (γ) - are massless quanta of energy that usually coinside w/ α or β emission.

- account for most energy lost in radioactive decay.

* Each of these decay types is used as the nucleus' way of reaching stability

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Nuclear Equations

- Just like in chemical rxns, we can summarize & abbreviate how nuclear rxns take place.

(1) Alpha (α) Decay

- when an α particle is released, the atomic # decreases by 2 & mass decreases by 4

ex) $^{238}_{92}U \xrightarrow{decay} {}^{4}_{2}He + {}^{234}_{90}Th + \gamma$
($^{4}_{2}He$ = α)

★ Notice that $\frac{238 = 4 + 234}{92 = 2 + 90}$, they must balance

& new atomic # of 90, tells us that U → Th

ex) $^{211}_{83}Bi \rightarrow {}^{4}_{2}He + {}^{207}_{81}Tl$

2. Beta (β) decay

- when a β particle is released/emitted, the atomic # increases by 1 & mass is unchanged

ex) $^{227}_{89}Ac \rightarrow {}^{0}_{-1}e + {}^{227}_{90}Th$
($^{0}_{-1}e$ = β)

★ Notice that $\frac{227 = 0 + 227}{89 = -1 + 90}$

ex) $^{209}_{82}Pb \rightarrow {}^{0}_{-1}e + {}^{209}_{83}Bi$

3. Beta (β) capture

- Occurs when a β particle combines w/a proton (p^+) to form a neutron (n^0).

- Atomic # decreases by 1 & mass is unchanged ex) $^{201}_{80}Hg + ^{0}_{-1}e \rightarrow ^{201}_{79}Au$

★ Notice that $\dfrac{201 + 0 = 201}{80 + -1 = 79}$

ex) $^{68}_{32}Ge + ^{0}_{-1}e \rightarrow$ ______________