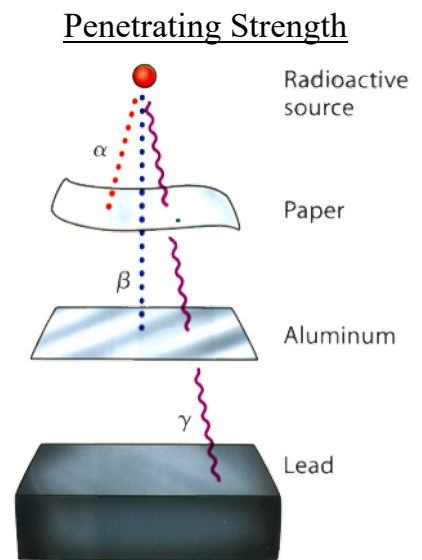
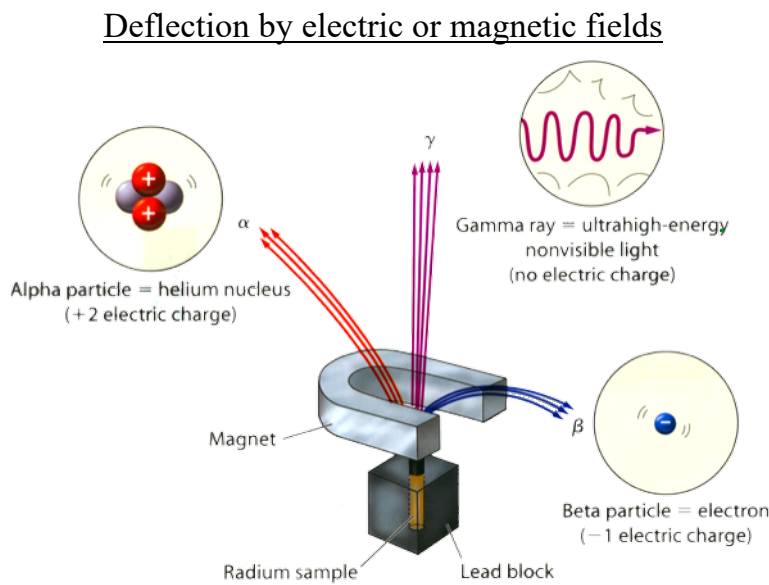


Notes 5-1: Nuclear Chemistry: Geiger Counter & α , β , γ Radiation; Nuclear Decay Equations

- Radioactivity: Unstable nucleus spontaneously emits **nuclear radiation** (comes out of nucleus)
 - Any isotope that emits nuclear radiation is **radioactive nuclide**.
 - Resulting nucleus is different, more stable element (transmutation)
 - Nuclei continue emitting radiation until stable nucleus is reached
- Types of Radioactive Decay

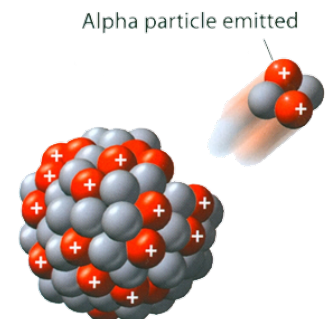
Radiation	Composition	Symbols	Charge	Mass	Penetrating Strength
Alpha particle					
Beta particle					
Positron					
Gamma ray					



- Decay Equations (Spontaneous Transmutation)

a) Alpha decay/emission: Too-large nucleus *emits* 2 p⁺ and 2 n⁰ (${}^4_2\text{He}$)

- ${}^{227}_{88}\text{Ra} \rightarrow {}^4_2\text{He} + {}^A_Z\text{X}$
 - Total mass # (A) and atomic # (Z) both need to balance
 - atomic # _____ and mass # _____
 - New Z gives identity of unknown element



b) Beta decay/emission: neutron emits high energy electron (${}^0_{-1}e$) and becomes proton

- ${}^1_0n \rightarrow {}^1_1p + {}^0_{-1}e$
- ${}^{18}_8O \rightarrow {}^0_{-1}e +$
 - atomic # _____ and mass # _____
 - Note: we ignore the antineutrino that is also emitted



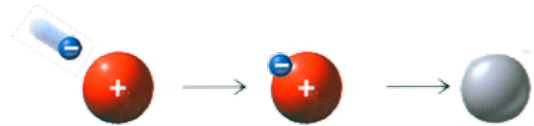
c) Positron decay: proton emits *positive electron* (${}^0_{+1}e$) and becomes neutron

- ${}^1_1p \rightarrow {}^1_0n + {}^0_{+1}e$
- ${}^{11}_6C \rightarrow {}^0_{+1}e +$
 - atomic # _____ and mass # _____
 - neutrino is ignored
- Sometimes called “β-plus”



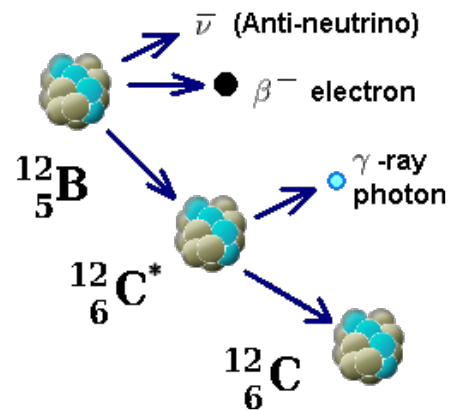
d) Electron capture: Unstable electron, ${}^0_{-1}e$ (a *reactant*) captured by proton and becomes a neutron

- ${}^{38}_{18}Ar + {}^0_{-1}e \rightarrow$
 - result looks the same as _____

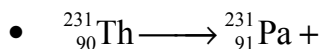


e) Gamma radiation: γ , ${}^0_0\gamma$: high energy nucleus emits energy

- ${}^{12}_5B \rightarrow {}^0_{-1}e + {}^{12}_6C^* \rightarrow {}^{12}_6C + {}^0_0\gamma$
 - * Indicates excited state (excess energy)
- No particles emitted, _____



• Can identify decay type (particle) if given starting and ending nuclei:



- Since positron emission and electron capture have the same result, I would need to specify whether it is an emission or capture process to answer the question—or I could ask for both (see problem 24 on HW)