

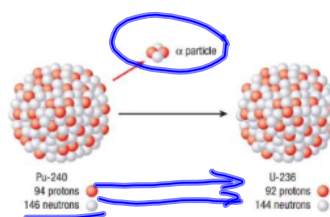
SPH3U 7.2 Radioactive Decay

## 1. Radioactivity

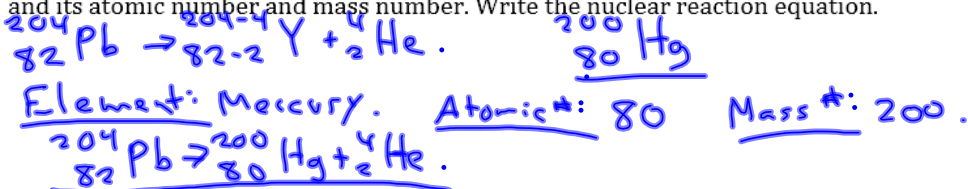
Radioactivity:	nucleus of an atom spontaneously disintegrates.
stable atom	strong nuclear force $\approx$ electrostatic force
atomic #	more $p^+$ $\rightarrow$ more electrostatic force $\rightarrow$ less stable.
3 types of decay	① Alpha ( $\alpha$ ), ② Beta ( $\beta$ ), ③ Gamma ( $\gamma$ ).

2. Alpha ( $\alpha$ ) decay

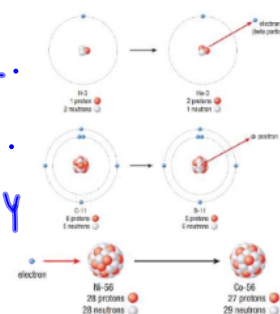
Alpha decay:	nucleus emits an $\alpha$ particle.
$\alpha$ particle	2 protons + 2 neutrons. ${}^4_2\text{He}$ .
plutonium-240 decay	${}^{240}_{94}\text{Pu} \rightarrow {}^{236}_{92}\text{U} + {}^4_2\text{He}$ .
general alpha decay	${}_Z^AX \rightarrow {}_{Z-2}^{A-4}Y + {}^4_2\text{He}$ .
X and Y	X: Parent atom, Y: Daughter atom.



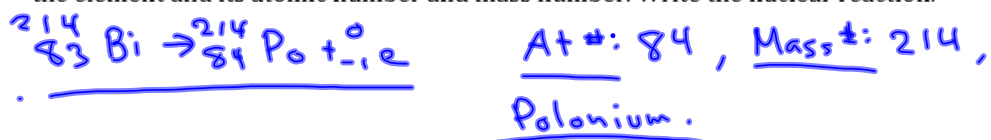
When lead-204 undergoes alpha decay, it produces a stable isotope. Determine the element and its atomic number and mass number. Write the nuclear reaction equation.

3. Beta ( $\beta$ ) decay

Beta decay:	$\beta$ particle is released or absorbed.
$\beta$ particle	electron ( $-1e$ ) or positron ( $+1e$ )
① Beta-negative decay:	electron emitted. ${}_Z^AX \rightarrow {}_{Z+1}^AY + {}^0_{-1}e$ .
② tritium H-3 decay	${}_1^3\text{H} \rightarrow {}_2^3\text{He} + {}^0_{-1}e$ .
Beta-positive decay:	positron emitted. ${}_Z^AX \rightarrow {}_{Z-1}^AY + {}^0_{+1}e$ .
③ carbon-11 decay	${}_6^{11}\text{C} \rightarrow {}_5^{11}\text{B} + {}^0_{+1}e$ .
Electron capture:	electron absorbed. ${}_Z^AX + {}^0_{-1}e \rightarrow {}_{Z-1}^AY$ .
Ni-56 decay	${}_{28}^{56}\text{Ni} + {}^0_{-1}e \rightarrow {}_{27}^{56}\text{Co}$ .



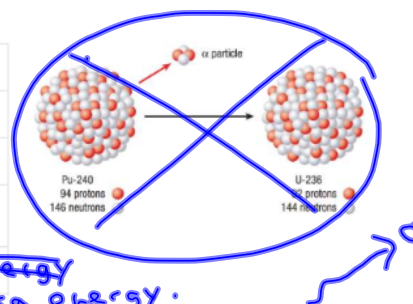
When bismuth-214 undergoes beta-negative decay, it produces a stable isotope. Determine the element and its atomic number and mass number. Write the nuclear reaction.



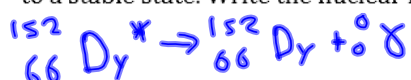
#### 4. Gamma ( $\gamma$ ) decay

(\*) Excited state.

Gamma decay:	$\gamma$ ray is released.
$\gamma$ ray	Light (photon).
He-3 decay	${}^3_2\text{He}^* \rightarrow {}^3_2\text{He} + {}^0_0\gamma$
general gamma decay	${}_Z^AX^* \rightarrow {}_Z^AX + {}^0_0\gamma$
excited state	<del>an electron is in a higher energy shell</del> the nucleus has extra energy.



When dysprosium-152 undergoes gamma decay, its nucleus changes from an excited state to a stable state. Write the nuclear reaction equation for this gamma decay.



#### 5. Characteristics of radioactive decay

Danger of radiation:	radiation can ionize (strip electrons from) atoms. $\rightarrow$ can cause burns, tumors, etc.
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Decay	Radiation	Electric charge	Penetrating ability
alpha	$\alpha$ particle, ${}^4_2\text{He}$	+2	penetrate skin or paper; slow.
beta-negative	electron, ${}^0_{-1}\text{e}$	-1	penetrate a few sheets of aluminum foil.
beta-positive	positron, ${}^0_{+1}\text{e}$	+1	
electron capture	gain electron.	—	penetrate a few cm of lead.
gamma	$\gamma$ ray, photon, ${}^0_0\gamma$	0	

Homework: page 329: #1-3, 5-6