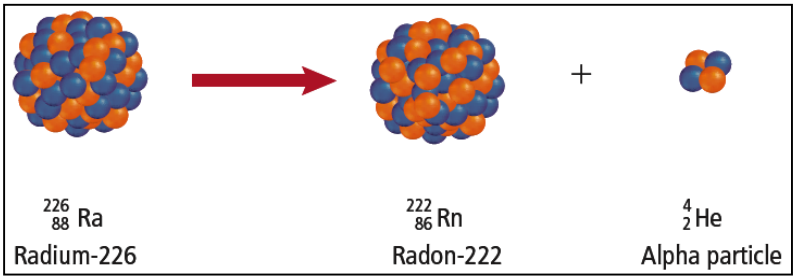
Date: _____ Name: _____

1) Alpha Decay (α)

Releases a **charged** helium **nucleus** known as an alpha particle, α.

Definition	Radiation type (symbol)	Charge of Radiation	What is emitted?	Special characteristics
- Emits a helium nucleus (alpha particle)	- Alpha particle (α)	- +2 (two protons and two neutrons in a helium nucleus)	- A helium nucleus - $^{4}_{2}He$	- Slow - Stopped by paper or skin



Example:

$^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$

- The masses (when added up) are the SAME on both sides
- The charges on both sides are the SAME

When an alpha particle is **emitted**, it will crash into other **particles** until it finds two electrons –it will become a **Helium atom**.

Parent nucleus: the **original** radioactive atom present **before** decay occurs

Daughter nucleus: the **product** atom of radioactive decay

*Label the **parent nucleus** and **daughter nucleus** in the above reaction*

$^{210}_{84}Po$ **:the parent nucleus**

$^{206}_{82}Pb$ **:the daughter nucleus**

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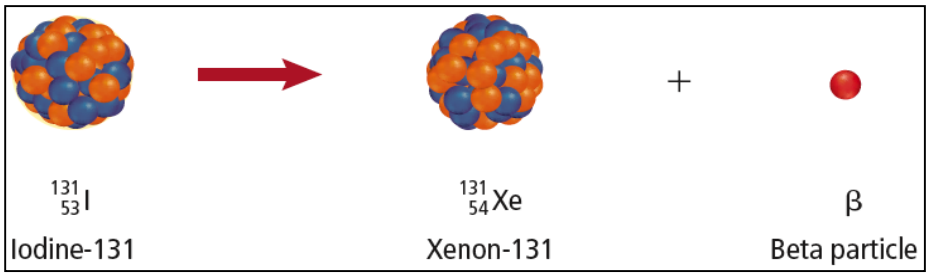
2) Beta Decay (β)

Releases an **electron** known as a beta particle, β. The emitted beta particle has a **mass** of 0 and a **charge** of -1 because it is an electron.

In this reaction, a **neutron** is very **unstable** and can turn into an **electron**, **proton**, and **neutrino**. When that happens, the proton stays put, while the electron is **released**.

Definition	Radiation type (symbol)	Charge of Radiation	What is emitted?	Special characteristics
- Unstable nucleus emits a beta particle (electron)	- Beta particle (β)	-1 (electron)	- Electron - $_{-1}^{0}e$	- Can penetrate a few sheets of Al foil



Example:

$$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

- The mass and the charges are the SAME on both sides

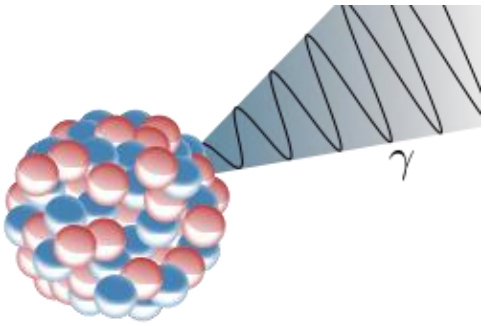
3) Gamma Decay

Does not release a particle, it releases **energy** known as a **gamma** ray (γ). The nucleus has **extra** energy (in excited state) and **releases** it in the form of a gamma ray.

This type of radiation produces **extremely high** energy.

Date: _____ Name: _____

Definition	Radiation type (symbol)	Charge of Radiation	What is emitted?	Special characteristics
An excited state atom emits its extra energy through emitting a gamma ray	Gamma ray (γ)	0 (no charge)	Energetic wave ('light') $^{0}_{0}\gamma$	Can penetrate a few cm of lead



**Note: an asterisk (*) is used to show an excited state particle*

Example:

$^{237}_{93}\text{Np}^{*} \rightarrow {}^{237}_{93}\text{Np} + {}^{0}_{0}\gamma$

- The mass and the charges are the same on both sides

Summary: Radioactivity is **nothing** like a chemical reaction. New atoms are **made**, not just **rearranged**!

Two things to look out for:

1) The sum of the mass numbers never change
   Ex. $^{128}_{52}\textbf{Te} \rightarrow {}^{4}_{2}\textbf{He} + {}^{124}_{50}\textbf{Sn}$ **124+4=128 (r.s = l.s)**

2) The sum of the charges in the nucleus never changes
   Ex. $^{128}_{52}\textbf{Te} \rightarrow {}^{4}_{2}\textbf{He} + {}^{124}_{50}\textbf{Sn}$ **50+2=52 (r.s = l.s)**

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Practice:

Complete the following nuclear equations. Label each as alpha, beta or gamma decay in the space provided.

1. $^{212}_{84}$ Po → $^{208}_{82}$ Pb + ___$^{4}_{2}$ **He**___ _____**alpha**_____

2. $^{90}_{38}$ Sr → $^{90}_{39}$ Y + __$^{0}_{-1}$ **β**__ _____**beta**_____

3. $^{12}_{6}$ K* → ___$^{12}_{6}$ **K** __ + $^{0}_{0}$ γ _____**gamma**_____

4. $^{144}_{60}$ Nd → _$^{140}_{58}$ **Ce** _ + $^{4}_{2}$ He _____**alpha**_____

5. $^{239}_{93}$ Np → __$^{239}_{94}$ **Pu**_ + $^{0}_{-1}$ β _____**beta**_____

Complete the following radioactive decay equations using the given type of decay.

1. (alpha decay) $^{255}_{103}$ Lr → _____$^{251}_{101}$ **Md**____ + _____$^{4}_{2}$ **He**_____

2. (beta decay) $^{13}_{5}$ B → _____$^{13}_{6}$ **C**____ + _____$^{0}_{-1}$ **β**____

3. (gamma decay) $^{257}_{104}$ Rf* → _____$^{257}_{104}$ **Rf**____ + _____$^{0}_{0}$ **γ**____