CONCEPT: BAND OF STABILITY: ALPHA DECAY & NUCLEAR FISSION

- Isotopes that lie outside the Band (Valley) of Stability are considered _____ , _____ isotopes.
  - □ These isotopes will alter their number of _____ and/or _____ to move closer to the Band (Valley) of Stability.
  - □ They do this predominantly by alpha decay, nuclear fission, _____ decay, _____capture, or _____ emission.

Alpha Decay

- **Alpha Decay** happens for isotopes in the _____ corner of the N/Z plot.
  - □ These isotopes have an _____ of neutrons and protons.

Neutron-to-Proton Plot

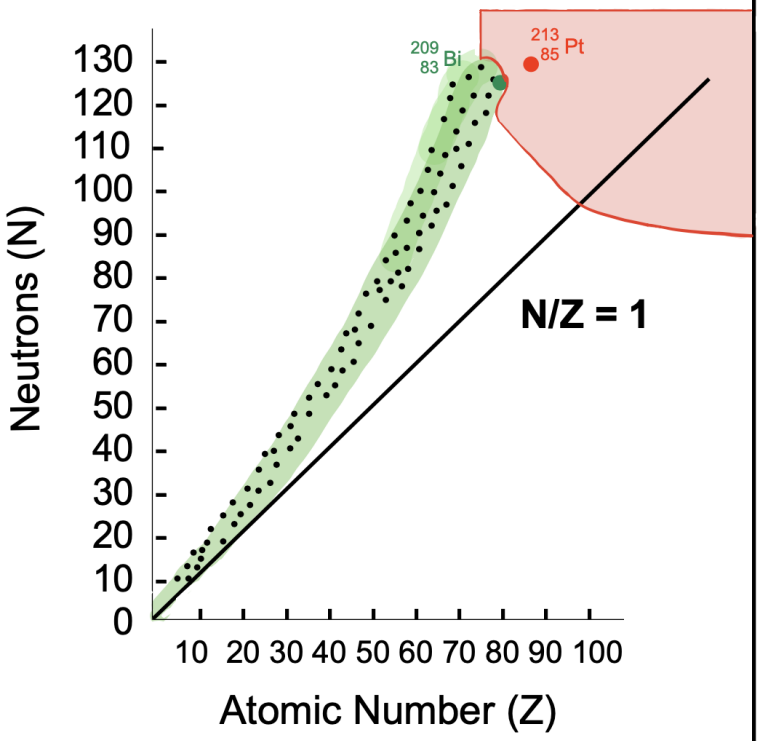
α–decay

$$^{213}_{85}\text{Pt} \longrightarrow {}^{209}_{83}\text{Bi} + {}^{4}_{2}\alpha$$

parent nuclide — daughter nuclide

☐ Isotopes with atomic masses ≥ _____ amu

☐ Helps to ____ the total number of nucleons



EXAMPLE: Which daughter nuclide would reside in the band of stability created from the alpha decay of lead-212?

a) Polonium-216 b) Mercury-208 c) Thallium-212 d) Lead-209

CONCEPT: BAND OF STABILITY: ALPHA DECAY & NUCLEAR FISSION

Nuclear Fission

- Under **Nuclear Fission** a(n) ____ is shot at the nucleus of an isotope and _____ an extremely large amount of energy.
  - □ **Additional Benefit**: large heavy elements (greater than _____ amu) are split into 2 lighter daughter nuclides.
    - Drastically ___ the total number of nucleons for an isotope.

Neutron-to-Proton Plot

Nuclear Fission

□ A ____ is injected into the nucleus of the isotope

$$^{239}_{94}Pu + ^{1}_{0}n \longrightarrow ^{240}_{94}Pu$$

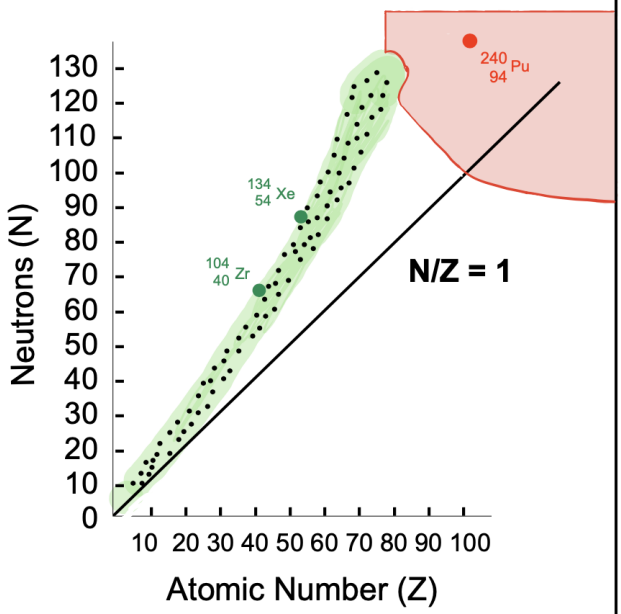
(parent nuclide)

□ The **Parent nuclide** undergoes nuclear fission

$$^{240}_{94}Pu \longrightarrow ^{103}_{40}Zr + ^{134}_{54}Ba + 3\,^{1}_{0}n + 207.1\ MeV$$

(parent nuclide) (daughter nuclides)

□ _____: the newly created **neutrons** further react



EXAMPLE: Nuclear fission is a commonly occurring process for uranium-235. Provide the identity of the missing daughter nuclide produced at the end of the reaction.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{236}_{92}U \longrightarrow \boxed{^{A}_{Z}X} + ^{141}_{56}Ba + 3\,^{1}_{0}n + 202.5\ MeV$$

a) Cesium-77 b) Krypton-92 c) Bromine-81 d) Krypton-94

PRACTICE: Which of the following is a potential daughter nuclide created from the nuclear fission of uranium-233 that resides near the band of stability?

a) Strontium-94 b) Radon-222 c) Curium-247 d) Thorium-232