Chem 160: Nuclear Chemistry

FAQs:

1. What is Nuclear Chemistry?
   - Simply speaking, it is changing something in the nuclei, whereas other reactions we have studied have been changing electrons or breaking/forming bonds
2. What is radioactivity?
   - Unstable elements will emit radiation. There are four types of radiation we will talk about.

Decay Type	Radiation Emitted/Symbol	Change in Atomic #	Change in Neutron #	Change in Mass #
Alpha Decay	$^{4}_{2}He$ or α	-2	-2	-4
Beta Decay	$^{0}_{-1}e^{-}$ or β^{-}	+1	-1	0
Positron Decay	$^{0}_{+1}e^{-}$ or β^{+}	-1	+1	0
Gamma Decay	$^{0}_{0}\gamma$	0	0	0

Table Summary

- **Alpha Decay** is:
  - When an atom losses 2 protons, losses 2 neutrons, and thus losses a total of 4 atm
  - Because Helium (He) has 2 protons, 2 neutrons, and weighs 4 amus, we say that alpha decay is emitting a He atom
  - Example:
    - $^{137}_{56}Ba \rightarrow {}^{4}_{2}He + {}^{133}_{54}Xe$
- **Beta Decay** is:
  - When an atom gains one proton, losses one neutron, and thus no net gain of weight
  - Example:
    - $^{137}_{56}Ba \rightarrow {}^{0}_{-1}e^{-} + {}^{137}_{57}La$
- **Positron Decay** is:
  - When an atom losses one proton, losses one neutron, and thus no net gain of weight
  - Example:
    - $^{137}_{56}Ba \rightarrow {}^{0}_{+1}e^{-} + {}^{137}_{55}Cs$
- **Gamma Decay** is:
  - When an atom emits a gamma ray. There is no change in the mass number or the atom number
  - Example:
    - $^{137}_{56}Ba \rightarrow {}^{0}_{0}\gamma + {}^{137}_{56}Ba$

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Let's Practice!

1. What type of decay did the following atoms undergo?
   a. $^{64}_{29}Cu \rightarrow {}^{0}_{-1}e^{-} + {}^{64}_{30}Zn$
   b. $^{268}_{105}Db \rightarrow {}^{4}_{2}e^{-} + {}^{264}_{103}Lr$
   c. $^{23}_{11}Na \rightarrow {}^{0}_{0}\gamma + {}^{23}_{11}Na$
   d. $^{108}_{47}Ag \rightarrow {}^{0}_{+1}e^{-} + {}^{108}_{46}Pd$
   e. $^{237}_{93}Np \rightarrow {}^{4}_{2}e^{-} + {}^{233}_{91}Pa$

2. Fill in the missing part of the following nuclear equations:
   a. $^{238}_{92}U \rightarrow {}^{4}_{2}He + ___$
   b. $___ \rightarrow {}^{0}_{-1}e^{-} + {}^{80}_{35}Br$
   c. $^{184}_{74}W \rightarrow {}^{0}_{+1}e^{-} + ___$
   d. $^{222}_{86}Rn \rightarrow ___ + {}^{222}_{86}Rn$
   e. $^{201}_{80}Hg \rightarrow ___ + {}^{201}_{81}Tl$

3. Write the full balanced nuclear equation for the following atoms undergoing alpha decay:
   a. Praseodymium (Pr):
   b. Nobelium (No):
   c. Radon (Rn):

4. Write the full balanced nuclear equation for the following atoms undergoing beta decay:
   a. Cobalt (Co):
   b. Arsenic (Ar):
   c. Potassium (K):

5. Write the full balanced nuclear equation for the following atoms undergoing positron decay:
   a. Tin (Sn):
   b. Erbium (Er):
   c. Krypton (Kr):