#### Chapter 21: Nuclear Chemistry

#### 21.1: The Nature of Nuclear Reactions

<u>Nucleons</u>: - the particles that make up a nucleus of an atom (protons, (!p" or !H) and neutrons, (!n)).

Isotopes: - atoms that have different mass number but the same atomic number or number of protons.

Nuclide: a particular atom or isotope containing specific numbers of protons and neutrons

Mass Number (# of  $p^*$  and #)  $\longrightarrow A$  Element Symbol (based on Atomic #)

Radioactivity: - the particles and/or electromagnetic radiation that are emitted due to unstable nuclei.
- all elements having atomic number 84 (Polonium) and greater are radioactive.

Nuclear Transmutation: - a process where radioactivity is resulted from the bombardment of nuclei by neutrons, protons or other nuclei.

- in most cases, heavier elements are synthesized from lighter elements.

#### History of Radioactivity

- In 1896, Wilhelm Roentgen discovered X-ray by examining ray emitting from the outside of the
  cathode ray glass tube. It has the capability of passing through solid materials, but can be blocked by
  denser matters. It can also be exposed to photographic plate, resulting from an image of "seeing
  through" an container made of less dense material.
- In the same year, Antoine Becquerel discovered that uranium emits a ray onto a photographic plate in the absence of sunlight or other forms of energy.
- A few years later, <u>Marie and Pierre Curie</u> demonstrated that radiation can be emitted by other elements. They discovered two new elements (polonium and radium) based on their tendency to emit radiation (<u>radioactivity</u>).

#### Types of Radioactive Particle and Decay

Alpha Particle (α particle): - basically a helium nucleus ( He), commonly found during radioactive decay from heavier nuclide (the net result is to increase the neutron to proton ratio – more explanation in the next section).

Example: 218 Po -> 214 Pb + 4 He

Beta Particle (β particle): - basically an electron ( "e or "β) that is emitted when the neutron to proton ratio is higher than the zone of stability (a neutron is transformed to a proton and an electron as a result — more explanation in the next section).
 - electrons have a mass number of 0 and an atomic number assignment of -1, due to its charge.

Example:  $^{214}_{62} Pb \rightarrow ^{214}_{63} Bi + ^{8}_{-1} e$   $(^{1}_{6} n \rightarrow ^{1}_{1} p + ^{8}_{-1} e)$ 

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Roger S. Macomber

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