Natural Radioactivity

Aim

- to describe the types of naturally occurring radioactive decay

Notes

Natural radioactive decomposition - an unstable nucleus emits particles

★ Alpha decay - loss of an alpha particle
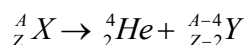 ☆ Alpha particle - helium nucleus
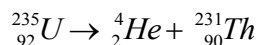   ✶ Structure
      ★ 2 protons
      ★ 2 neutrons
    ✶ Symbol - $_2^4He$
  ☆ Nuclear equations for alpha decay
    ✶ General format
    $$_Z^A X \rightarrow\ _2^4He +\ _{Z-2}^{A-4}Y$$
    ✶ Example
    $$_{92}^{235}U \rightarrow\ _2^4He +\ _{90}^{231}Th$$
      ★ loss of an alpha particle reduces the mass by 4 amu from 235 to 231
      ★ it also reduces the atomic number by 2 from 92 to 90
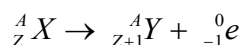   ★ the element with an atomic number of 90 is Thorium

★ Beta decay - loss of a beta particle
  ☆ Beta particle - electron formed from the decay of a neutron into a proton and an electron ($_0^1n \rightarrow\ _1^1p +\ _{-1}^0e$)
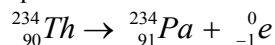   ✶ Symbol - $_{-1}^0e$
  ☆ Nuclear equations for beta decay
    ✶ General format
    $$_Z^A X \rightarrow\ _{Z+1}^A Y +\ _{-1}^0e$$
    ✶ Example
    $$_{90}^{234}Th \rightarrow\ _{91}^{234}Pa +\ _{-1}^0e$$
      ★ loss of a beta particle does not effect the mass
      ★ loss of a beta particle increases the atomic number by 1 from 90 to 91
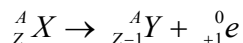   ★ the element with atomic number 91 is protactinium

★ Positron emission - conversion of a proton to a neutron ($_1^1p \rightarrow\ _0^1n +\ _{+1}^0e$)
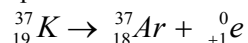 ☆ Positron - particle similar to an electron in mass and size, but with a positive charge
    ✶ Symbol - $_{+1}^0e$
  ☆ Nuclear equations for positron emission
    ✶ General format
    $$_Z^A X \rightarrow\ _{Z-1}^A Y +\ _{+1}^0e$$
    ✶ Example
    $$_{19}^{37}K \rightarrow\ _{18}^{37}Ar +\ _{+1}^0e$$
      ★ loss of a positron does not effect the mass
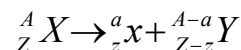   ★ loss of a positron decreases the atomic number by 1 from 19 to 18
      ★ the element with atomic number 18 is argon

Rules for writing nuclear equations
1. the masses on each side of the equation must be equal
2. the charges on each side of the equation must be equal

General Format

$$_Z^A X \rightarrow\ _z^a x +\ _{Z-z}^{A-a}Y$$

Answer the questions below by circling the number of the correct response

1. According to the equation $X \rightarrow {}^{208}_{82}Pb + {}^{4}_{2}He$, the nucleus correctly represented by X is

    (1) ${}^{204}_{80}Hg$　　　　　(3) ${}^{204}_{80}Bi$

    (2) ${}^{212}_{84}Po$　　　　　(4) ${}^{212}_{84}Pb$

2. In the reaction ${}^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + X$, the particle represented by tile letter X is
    1 a proton　　　　3 an electron
    2 a neutron　　　　4 a positron

3. When an atom emits a beta particle, the total number of nucleons
    1 decreases
    2 increases
    3 remains the same

4. When a beta particle (${}^{0}_{-1}e$) is emitted by the nucleus of an atom the mass number of the atom
    1 decreases
    2 increases
    3 remains the same

5. According to Reference Table F, a product of the radioactive decay of ${}^{226}_{88}Ra$ is

    (1) ${}^{4}_{2}He$　　　　　(3) ${}^{0}_{-1}e$

    (2) ${}^{226}_{89}U$　　　　　(4) ${}^{230}_{90}U$