**BONUS UNIT: Nuclear Chemistry – Chapter 25**

* Identify the Types of Emission Particles
* Balancing Nuclear Equations
* Predict Nuclear Decay Products
* Calculate the Half-Life of a Given Process

Nuclear Decay

* Some isotopes are stable, some are not
* Band/Zone of stability allows for predictions



Types of Decay Particles

* Alpha Particles
* Beta Particles
* Positrons
* Gamma Rays
* Neutrons
* Protons

Types of Nuclear Decay

* Positron production

 $ $

* Electron capture

 $ →$



* Alpha Decay

α- particle production

 $$

* b-particle production

$$$$

* g-ray production

 Excited nucleus 🡪 ground state nucleus

* Spontaneous fission

 $$ 🡪 lighter nuclides and neutrons

Fission

When \_\_\_\_\_\_\_\_\_\_\_\_ nuclei \_\_\_\_\_\_\_\_\_\_\_\_

Fusion

When \_\_\_\_\_\_\_\_\_\_\_ nuclei \_\_\_\_\_\_\_\_\_\_\_

Nuclear Chain Reaction: Self-sustaining fission process

* Subcritical – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ neutron per event
* Critical – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ neutron per event to produce another neutron
* Supercritical – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_neutron from each event causes more events to occur

Balancing Nuclear Equations

1. $$
2. $+→$
3. $+→+ \\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$
4. $+→+4$

Predicting Products of Nuclear Reactions

1. The alpha decay of iridium-174
2. The beta decay of platinum-199
3. Positron emission from sulfur-31
4. Krypton-76 undergoes electron capture

Rate of Nuclear Decay: The Equation of a Straight Line

y = mx + b



ln[N] = -kt + ln[N0]

ln(N/N0) = -kt

t1/2  = 0.693/k

Rate = kN

Example 1

Technetium 99 is used to form pictures of internal organs in the body and is often used to assess heart damage. The rate constant for $$ is known to be 1.16 x 10-1 hours. What is the half life of this nuclide?

Example 2

The half-life of moybdenum-99 is 67.0 hours. How much of a 1.000 mg sample of $$ remains after 335 hours?

Example 3

A wooden artifact from a Chinese temple has a carbon-14 activity of 24.9 counts per minute as compared with an activity of 32.5 counts per minute for a standard zero age. From a half-life of 5715 yr, determine the age of the artifact.

Example 4

The half life of Iodine-131 is 8 days. How much of a 100 g sample will remain after 32 days?

Applications of Nuclear Chemistry

* Dating… how old is an object?
* Medical… dyes detcted because contrasts to what’s already in your body
* Energy… Nuclear Power Plants
* Weapons… Very destructive

Exciting Technology – ENERGY!!! And lots of it!

* Example: The formation of the oxygen nucleus

 8 protons and 8 neutrons

Mass of proton = 1.67262 x 10-27 kg

Mass of neutron = 1.67493 x 10-27 kg

Mass of oxygen atom = 2.65535 x 10-26 kg

* \*mass defect\* when the atom forms, it loses mass

E =Δ mc2

* Energy per mol?
* Compare to energy per mole of CH4 = \_\_\_\_\_\_\_\_\_\_ kJ/mole
* \_\_\_\_\_\_\_\_\_\_\_\_ times MORE energy from nuclear reactions than chemical reactions

HOMEWORK: p. 802, 1-6; p.806, 7 and 8; p. 808, 12-14; p. 819, 21 and 22



12.

11.

10.

9.



