Chemistry Chapter 22 – Nuclear Chemistry

1. **Radioactivity** – spontaneous breakdown of atomic nuclei, accompanied by release of some kind of radiation

2. **Roentgen** – he discovered **X Rays**
   a. **X Rays –** a very high energy form of light that's harmful for living tissue
3. **Becquerel –** credited with discovering radioactivity. Also discovered that uranium ores emit radiation that passes through objects
4. **Marie Curie –** Marie/Pierre worked w/ Becquerel, credited for naming radioactivity
   a. Won the Nobel prize in physics in 1903 (shared), and 1911 (discovering radium)
5. **Lawrence** – invented the cyclotron, used at Berkeley to make transuranium elements

6. **Half life** – the time required for half of a radioactive sample to decay. Does not depend on amount of substance
7. **Transmutation** – one element being converted into another by a nuclear change
8. **Nuclides** – isotopes of elements that are identified by the number of their protons/neutrons
9. **Emissions** – the particle(s) ejected from the nucleus of the radioactive element
10. **Decay series** – the sequence of nuclides that an element chances into until it forms a stable nucleus
11. **Radioactive dating** – using half-life information to determine the age of objects. C-14/C-12 is the most common
    a. In every living organism there is a constant ratio of C-12 to C-14
    b. When an organism dies, the amount of C-14 begins to decrease
    c. Using the half life of C-14 and the amount present, you can approximate the age of fossils
12. **Nuclear fission** – splitting a large nucleus into smaller parts, releasing large amounts of energy.
    a. The first atomic bomb, dropped on Hiroshima during WWII, was based on nuclear fission
    b. Scientists split Uranium 235 (U^{235}) to release massive amounts of energy
    c. Scientists split U^{235} by bombarding it with neutrons
13. **Nuclear fusion** - smashing two or more small nuclei together, releasing tremendous amounts of energy
    a. The hydrogen bomb is based on nuclear fusion, where two deuterium (H^2) molecules are combined
    b. Fusion is also the force that powers stars, including the Sun
    c. The most abundant element in the universe is Hydrogen (H), followed by Helium (He)
14. **Alpha Particle** – a particle with a Helium nucleus, has a mass of 4, and carries a +2 charge
    a. Alpha particles travel at $1/10^{th}$ the speed of light, relatively easy to stop easy to stop
    b. Denoted by the symbol ${}^4_2He$
15. **Beta Particle** – a high speed electrons, has a mass of 0.00055, and carries a -1 charge
    a. Beta particles travel at the speed of light, can be stopped by aluminum, 0/-1e
    b. Denoted by the symbol ${}^0_{-1}e$
16. **Gamma Rays** – a high energy form of light, has no mass, can be stopped by several centimeters of lead
17. **Positron** – a positive electron (No this is not a typo), denoted by the symbol ${}^0_{+1}e$
18. **Neutron –** a particle that has no charge and a mass of 1
    a. Denoted by the symbol ${}^1_0n$. ${}^3_0n$ signifies 3 neutrons
19. **Half Life Problem**s – 4 pieces of info: Total time, starting amount, half life, ending amount
    a. The half life graph has a characteristic curve for all substances
20. **Types of decay/why**
    a. **Too many protons compared to neutron**s – positron decay (change proton into neutron and positron)
    b. **Too many neutrons** – beta decay (change neutron into a proton and negative Beta particle)
    c. **Too many of both** – Alpha decay (lose 2 protons and two neutrons)
21. **Radioisotopes** – many substances can be radioactive and then traced as they move through the body
22. **Fission reactors** – produce heat which is used to water into steam and drive turbines
    a. **Moderator** – used to slow down neutron flow
    b. **Control Rods** – Absorbs Neutrons to control reaction speed
23. **Mass Defect** - During nuclear change, mass products is less than mass reactants, used in $E=mc^2$
    a. **The Equation:** Ln (ratio of beginning amount / amount final) = K (given constant) T (time)
24. Element Number 26, Iron (Fe) is the "line" between fusion and fission
    a. All elements before Iron (Atomic Number 1 – 25), in theory, can be combined using fusion
    b. All elements after Fe (Atomic Number 26 – 92), in theory, can be split using fission
    c. Please note that these numbers are theoretical. The energy it will take to split iron will probably be higher than the energy that the reaction will produce, hence making the reaction unlikely and uneconomical