Nuclear Physics

↙ Mass # = # of Protons + Neutrons ← If no neutrons, Then just raise lower number to top (e.g. $^{1}_{1}H$)

$^{4}_{2}He$

↖ atomic # = # of protons

Isotopes: Same # of Protons, different Neutrons (e.g. $^{12}_{6}C$ vs. $^{14}_{6}C$)

alpha Particles (α): $^{4}_{2}He$ (identical to He nucleus) Has no electrons

So alpha particles are +2 charged. (Weakest)(don't move fast. Paper Stops Them)

Beta Particles (β): Electrons (Medium) (move faster Than α, Foil stops Them)

Gamma Rays (γ): Photons of electromagnetic energy (goes through anything) (Speed of light. Lead stops)

α decay: $^{212}_{83}Bi \longrightarrow {}^{208}_{81}Tl + {}^{4}_{2}He$

Big hint: Add em up!

β decay: $^{95}_{36}Kr \longrightarrow {}^{95}_{37}Rb + {}^{0}_{-1}e$ (neutrinos are also released from β decay, Tiny, neutral particles - No mass)

(A neutron becomes a proton and an electron is created) β^- decay

β decay: $^{1}_{0}n \longrightarrow {}^{1}_{1}p + {}^{0}_{-1}e$ (n: neutron, p: Proton, e: Electron)

β decay: $^{15}_{8}O \longrightarrow {}^{15}_{7}N + {}^{0}_{+1}e$ (a proton becomes a neutron and a positron is created) β^+ decay

gamma decay: $^{61}_{28}Ni \longrightarrow {}^{61}_{28} + \gamma_{(gamma\ Ray)}$ (Mass + Proton #'s don't change)

De Broglie wave equations for photons

P = momentum
E = Energy
h = Plancks constant
c = speed of light

$$P = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$$ ← memorize These formulas

$$\lambda = \frac{h}{P} = \frac{h}{mv}$$

$$E = mc^2 = hf$$

Who's Who

Thermodynamics:

Watt – Steam engine

Carnot – Carnot Cycle of engines. Not all heat can be converted into useable energy

Joule – Mechanical Work converted into chemical energy

Electricity/Magnetism:

Faraday – You can induce a current in a loop by changing the number of magnetic field lines passing through the loop (or changing the loop's size or changing the loop's orientation in the B field)

Lenz – Builds on Faraday's Law: The induced emf (voltage) set up in the loop has a current which creates a magnetic field in the opposite direction to the magnetic field which created the current. This keeps the energy conserved (1st law of thermo)

Maxwell – Electromagnetic waves are produced by accelerating charges. The resulting electric and magnetic fields are in phase with each other, but are perpendicular to each other.

Modern Physics/Atomic/Quantum:

JJ Thompson – Thinks atoms are a "plum pudding" with protons and electrons in a central nucleus. Uses cathode ray tubes. Basically discovers the electron.

Rutherford – Gold foil experiments of Alpha Particle scattering shows that Thompson is incorrect. He proves that central nucleus is Protons. Electrons circle around it.

Bohr – Solar system model of atoms. Quantized energy levels

Planck – Father of quantum physics. Predicts observed distribution of black body (a perfect absorber and emitter of radiation) curves. Energy occurs in only integral multiples of "hf" Where h is Planck's constant and f is frequency. $E = hf$. Leads to "quanta" or packets idea of light – eg. photons.

Einstein – particle nature of light. Expands Plancks ideas. Photoelectric effect – photons can do work. Act like particles.

Debroglie – Moving particles also have wavelike characteristics. Electrons can be considered to be waves around an atom $\lambda = h/p$ where h is plancks constant and p is momentum (mass x velocity). This equation will help you to answer a lot of the multiple choice questions. Here are some other forms of it:

$P = E/c = hf/c = h/\lambda$ (P is momentum. C is speed of light ($3x10^8$m/s) E is energy)

Diffraction type experiments prove the wave nature of light and electrons

Schrodinger – Used Debroglie's idea that electrons are waves/particles at the same time. He develops wave function equations which give the probability of finding and electron at a given place around the nucleus. These regions are called orbitals.

Heisenberg – Uncertainty principle states that it is impossible to determine the position and velocity (or momentum) of an electron or another subatomic particle at the exact same moment. You can know one, but not the other.

Pauli – Exclusion Principle: No two electrons can have the exact same set of quantum numbers. He is the father of the "spin" of 2 electrons occupying the same orbital.

Davisson and Germer – Used a crystal to diffract a beam of electrons and thereby demonstrated Debroglie's idea of wavelike properties.

Compton – Found that x-rays when scattered have a slightly longer wavelength than they did when they entered the scattering place. This lends credibility to the particle nature of light.

Millikan – finds mass of electron to be 1/1836 th of a proton. Oil drop experiment