Academic Chemistry **Name ________________________**
Chapter 5 – Electrons in Atoms Notes **Date _________________________**

ATOMIC MODEL

- *See Atomic Model Timeline worksheet for specifics.*

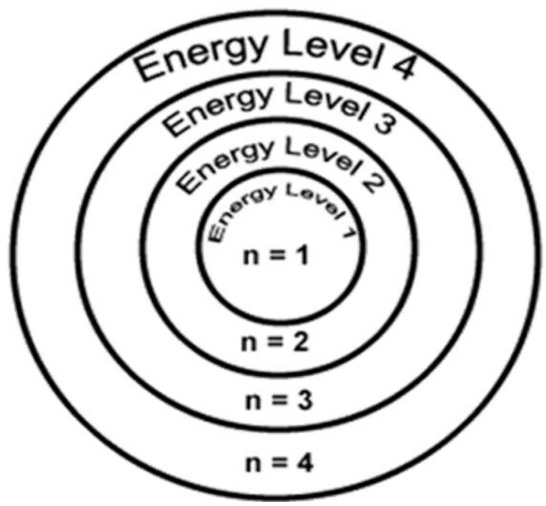
ELECTRONS

- **<u>Quantum Mechanical (QM) Model</u>**- This is the currently accepted model of the atom.
  - Erwin Schrödinger wrote an equation which describes ________________________________ ____.
    - These locations are not definite because of the Heisenberg Uncertainty Principle.

- Each of the following terms gives a *more specific* description of where an electron *probably* is.

  In Chemistry… **In CB South, for example…**

  - Energy level, *n*
  - Sublevel, *l*
  - Orbital, m_l
  - Spin, *s*
- **<u>Energy Levels, *n*</u>**-
  - An electron may NOT be found _____ ________________________________.
  - Higher *n* = higher energy (typically)
  - To determine how many electrons fit into a given energy level, use this **formula**: _____
  - The maximum number of electrons is **32**.
  - Electrons will occupy the _________________________________ first.



- **<u>Sublevels (subshells), *l*</u>**-
  - Energy levels contain __________________ consisting of ________________ (shapes) where there is a ________________ probability of finding an __________________.
  - Orbitals can hold up to _____________ electrons.
  - Sublevels hold the orbitals and can hold 1, 3, 5, or 7 orbitals.

	***s* Sublevel**	***p* Sublevel**	***d* Sublevel**	***f* Sublevel**
Shape				
Appears				
# of Orbitals				
Capacity				

ELECTRON CONFIGURATIONS

- **Writing Electron Configuration NOTES**

Electron Configuration	Shorthand Configuration	Orbital Notation
H		
He		
Li		
Be		
B		
C		
Cl		
Ti		
Kr		

Electron Configuration	Shorthand Configuration	Orbital Notation
O		
Ne		
Al		
Na		
Br		
Zr		
Ba		
Rn		

SHORTHAND NOTATION

- Steps to write in *shorthand* electron configuration notation:
  - 1st – Find the ________________ that is in the row above the element you want
  - 2nd – Write that noble gas's __________ in [brackets]
  - 3rd – Then continue with the e^- configuration starting with the next element
    - Ex- Scandium: **Long:** $1s^22s^22p^63s^23p^64s^23d^1$

      Shorthand:

    - Ex- Chlorine: **Long:** $1s^22s^22p^63s^23p^5$

      Shorthand:

ELECTRON EXCEPTIONS

- Write the configuration for the following:
  - **Cr:**
  - **Cu:**
- ***What they actually are:***
  - **Cr:**
  - **Cu:**
- **Reason –** __________________ sublevels are the most __________________.
  _____________________ sublevels are not as stable as filled, but more stable than others.

ORBITAL NOTATIONS & THE RULES

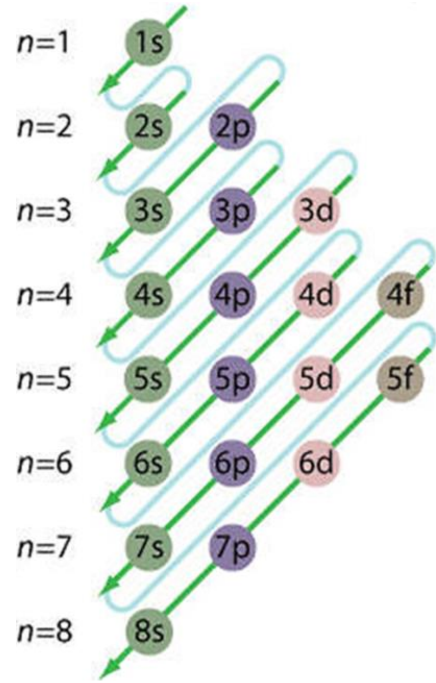
- **Orbital Notations**
  - Use a ________________ to represent each _____________________.
    - s orbitals have _________ line
    - p orbitals have _________ lines
    - d orbitals have _________ lines
    - f orbitals have _________ lines
  - Use up/down arrows to represent _________________________.
  - Each line can hold a maximum of _____________ electrons.
  - **Example**

    Titanium: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

    1*s* 2*s* 2*p* 3*s* 3*p* 4*s* 3*d*

FILLING RULES

- **<u>Aufbau Principle</u>**-



  - This is the order we get from "reading" the Periodic Table.

- **<u>Pauli Exclusion Principle</u>**-

  - This is the electron "spin." Either +½ or –½

- **<u>Hund's Rule</u>** –

  - They'd rather spread out.

ELECTRON CONFIGURATION PRACTICE

- Sulfur (S)
- Cobalt (Co)
- Strontium (Sr)
- Molybdenum (Mo)
- Antimony (Sb)
- Chlorine (Cl)
- Calcium (Ca)
- Chromium (Cr)
- Zinc (Zn)
- Selenium (Se)
- Mercury (Hg)
- $1s^2 2s^2 2p^6 3s^2 3p^4$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$

ELECTRON IN ATOMS

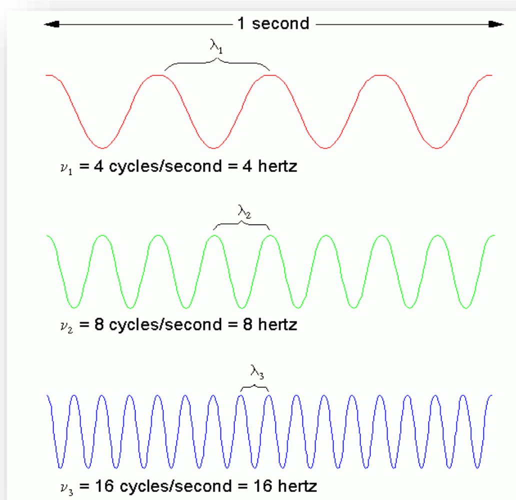
- **Electron Demonstration –** *try to identify key concepts for electrons moving within an atom…*

- **Flame Tests**
  - Elements give off characteristic ________________ which can be used to identify them.
  - Electrons ____________ energy from the flame (or other heat source).
  - When a certain amount of energy is reached, which is called a __________________, electrons jump to a higher energy level called the _______________________________.
  - When the electrons ___________ energy in the form of ______________, this is also called a **photon** or unit of light, they fall back to the lowest, most ________________ energy level called the ____________________________.

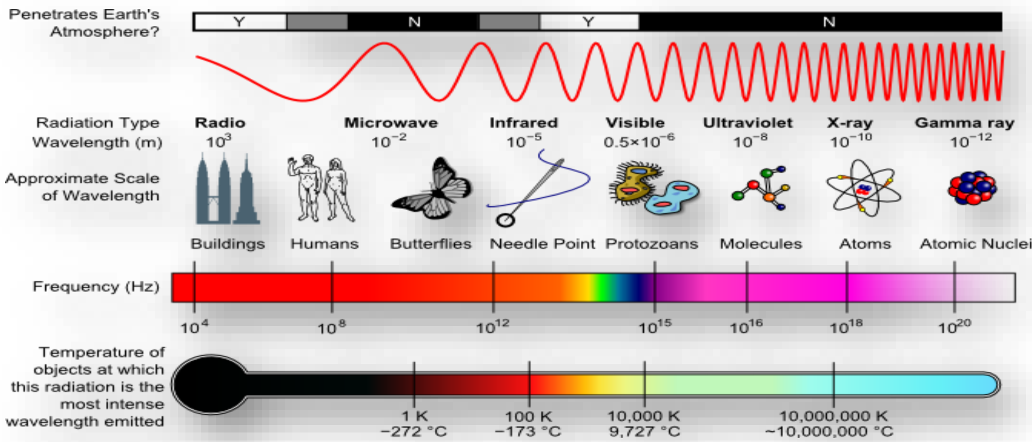
VISIBLE LIGHT & THE EM SPECTRUM

- Visible light exists as a narrow band of ____________________ that our eyes can detect.
  - The colors of the rainbow ________________________.
  - **Red light** has a wavelength of about _____________ nanometers and represents _________________ frequencies.
  - **Violet light** has a wavelength of about _____________ nanometers and represents _________________ frequencies.

- **Wave Statistics**
  - **Amplitude –** the __________________ of the wave from zero to crest.
  - **Wavelength –** the distance between ________________________ points in phase.
    - Unit:
    - Symbol:
  - **Frequency –** the number of cycles (wave peaks) that occur in a unit of time.
    - Unit:
    - Symbol:
  - Wavelength & frequency are ______________________ related, meaning that ____________ wavelengths go with ____________ frequencies and ____________ wavelengths go with ____________ frequencies.



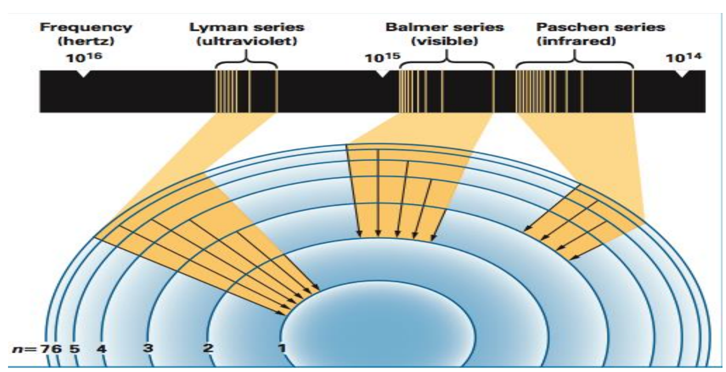
- **Wave Equation**
  - Formula:
  - Speed of light is always:
  - **Example 1 -** If the frequency of radiation for yellow light is 5.10 x 10^{14} Hz, what is the wavelength?
  - **Example 2 -** What is the frequency of radiation with a wavelength of 5.00 x 10^{-8} m?
- **Electromagnetic Spectrum –** a grouping of all waves that travel at the speed of light.



ATOMIC EMISSION SPECTRA

- Electrons returning from an __________________ energy level emit _______________ of specific ________________________ (specific bands of color).
- Each element has a ____________________ emission spectra and therefore is a good way to ________________ an element!

- Additional transitions exist, but we can't see them because our eyes only detect visible light. These series of transitions are called Lyman, Balmer and Paschen.



- **Energy –** as an electron falls from excited states they release a **quantum** of energy that can be calculated using Plank's constant and the frequency of the transition.
  - *We will not be calculating these energy transitions in this class.*