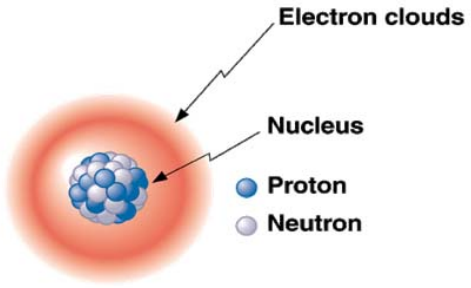
[The Atom
Chapter 2

Dalton's Atomic Theory (1803)

- Elements are made up of atoms that are indivisible and indestructible.
- All atoms of an element have the same mass. No two different elements have the same mass.
- Compounds consist of small whole number ratios of elements.
- Elements are not changed during chemical reaction.

Models of the Atom



Particle	symbol	Mass	location	charge
electron	e^-	1/1836 amu	orbital	-1
Proton	p^+	1 amu	nucleus	+1
neutron	n^0	1 amu	nucleus	+1

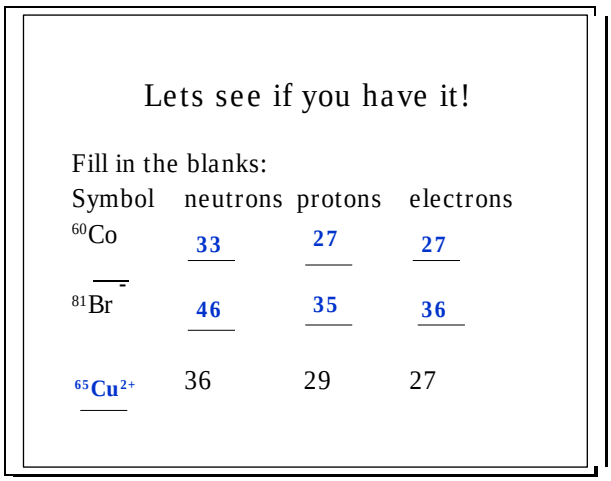
Describing Individual Atoms

$$\text{Mass Number}\ \text{Symbol}^{\text{Charge}}\ \text{Atomic number}$$

$$\text{protons}\ \ \text{neutrons}\ \text{Symbol}^{\text{protons- electrons}}\ \text{protons}$$

Example:

$$^{119}_{50}Sn^{2}$$



Isotopes

- Isotopes are atoms with the same number of protons but different numbers of neutrons.
    - Same element, different mass.
    - Some isotopes are stable, others are not.
    - The masses on the periodic table are weighted averages.

Isotopes of hydrogen and carbon.

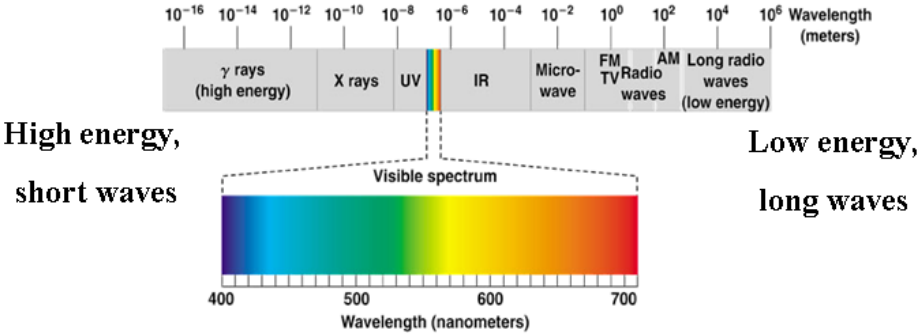
Chlorine

- Chlorine is 75% chlorine-35 and 25% chlorine-37. What is the average mass?

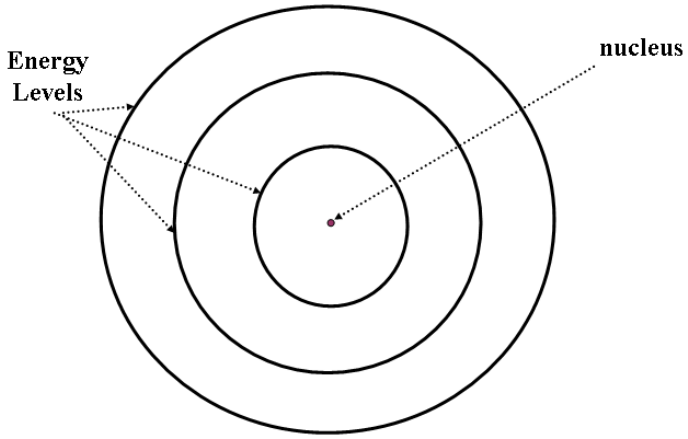
Wave Nature of Light

Wavelength – the distance light travels to complete one cycle.
Frequency – the number of wave cycles in one second.

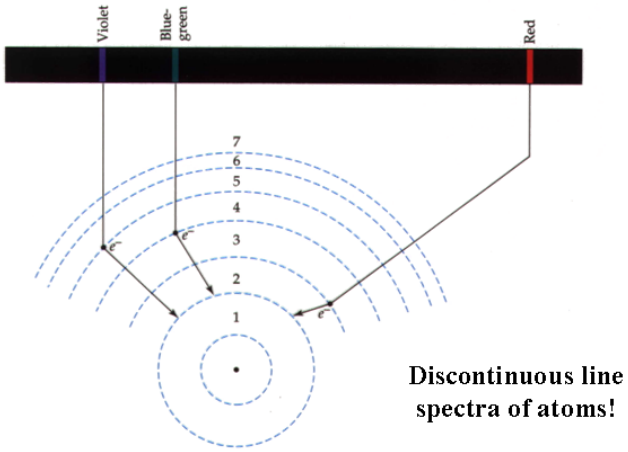
Radiant Energy Spectrum



Bohr Model of Atom (Year: 1913)



What was the evidence?



Final Statements on the Bohr model
(http://www.colorado.edu/physics/2000/quantumzone/bohr.html)

- Electrons orbit the nucleus the way the earth orbits the sun.
- The electrons are held to the nucleus by electrostatic attraction.
- Only certain orbits are allowed.
- The closer the orbit to the nucleus, the lower the energy (more stable.)
- First orbit can hold a maximum of two electrons. The second orbit, a maximum of 8 electrons and the third, a maximum of 18 electrons.

The electron as a wave
http://mooni.fccj.org/~ethall/quantum/quant.htm

- Einstein, "Light, a wave, can have particle like properties"
- De Brolie, "particles, like electrons, can have wave-like properties"
- Scrödinger, "Came up with an equation that describes an electron"

The outcome: 4 variables

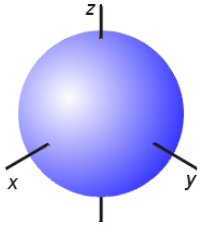
- n, principle quantum number. Correlates with shell of Bohr model
- l, subshell. Correlates with type of orbital, s p d or f.
- ml, orientation. px, py or pz.
- s, spin. ↑or ↓

Subshells and Orbitals

- Electrons exist in orbitals.
  - Most probable location for finding an electron.
- The number of orbitals depends on the subshell
- 2 electrons per orbital
- s orbitals come in groups of 1
- p orbitals come in groups of 3
- d orbitals come in groups of 5

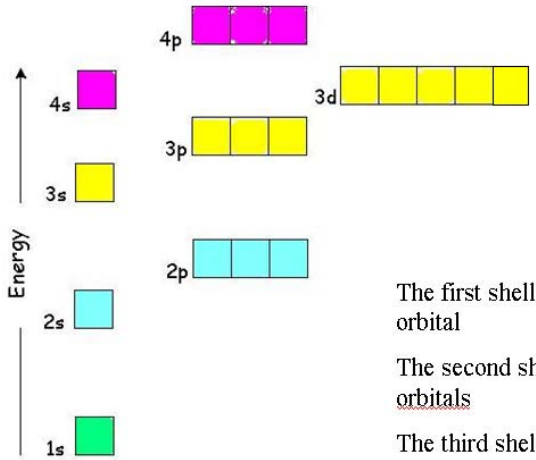
S orbitals

- S orbitals are spherical

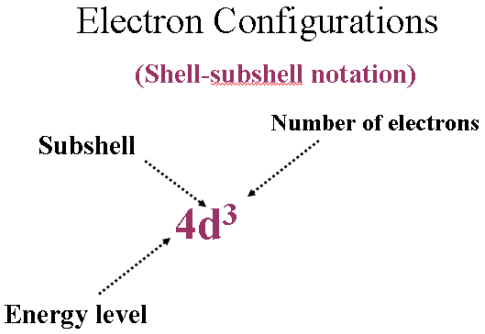


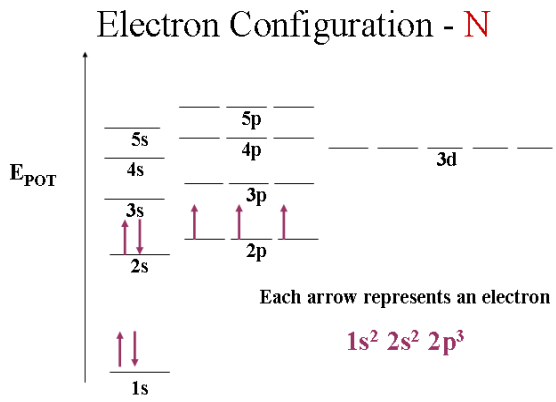
p Orbitals

Energy Level Diagram

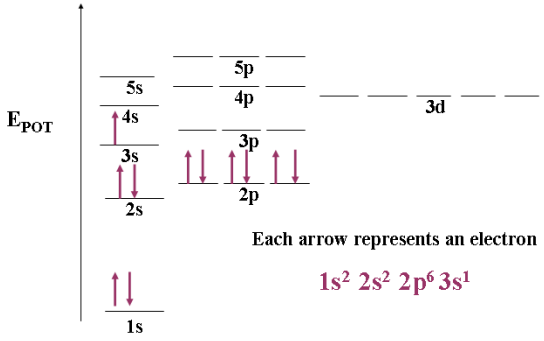


Within a shell, s orbitals are lower in energy than the p orbitals which are lower in energy than the d orbitals. The d orbitals are so high in energy; they actually overlap the next shell.

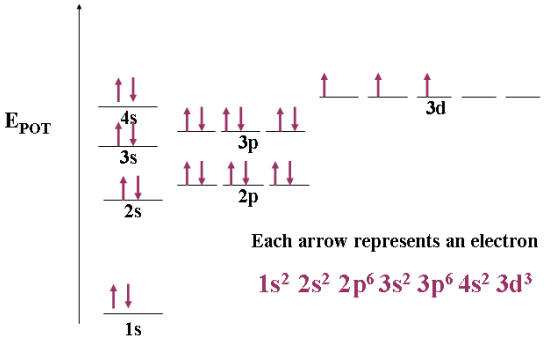




Electron Configuration - Na

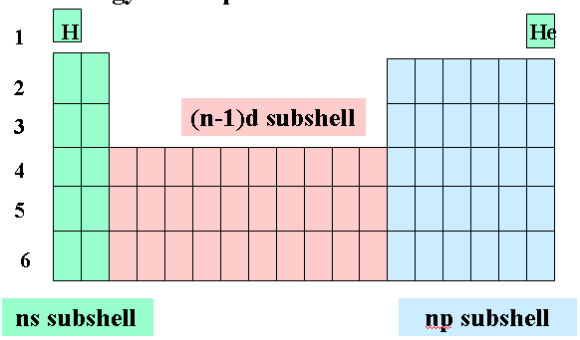


Electron Configuration - V

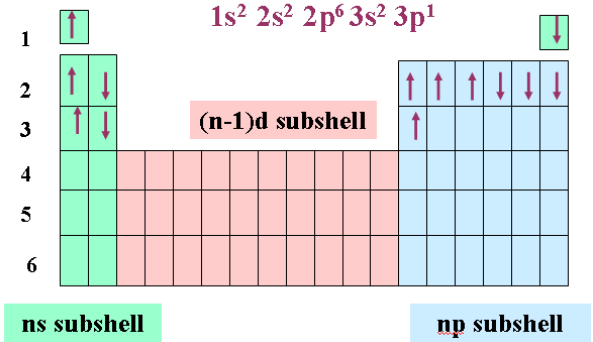


An Easier Way

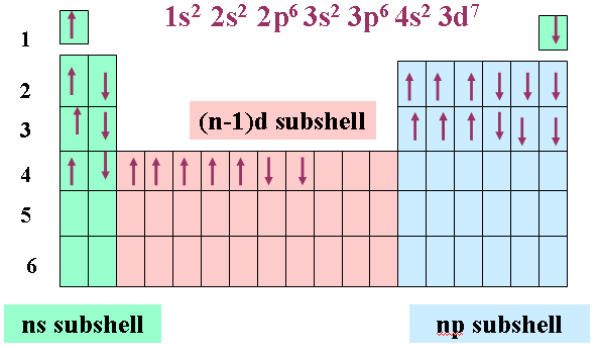
n = energy level = period number



Electron Configuration – Al



Electron Configuration - Co



Electron Configuration - Sr