Chapter 6 Summary Notes

Main Concepts

- ***Electromagnetic Spectrum*:** radiant energy can travel without matter

  $c = \lambda\nu$ c = speed of light = 3.0×10^8 m/s

  λ = wavelength (m)

  ν = frequency (Hz)

- ***Planck's Theory*:** Blackbody radiation can be explained if energy can be released or absorbed in packets of a standard size called *quanta*

  $\Delta E = h\nu = \frac{h\,c}{\lambda}$ h = Planck's constant = 6.63×10^{-34} J-s

- ***Photoelectric Effect*:** As first explained by Einstein in 1905, the photoelectric effect is the spontaneous emission of an electron from metal struck by light if the energy is sufficient

- ***Atomic Emission Spectra*:** spectrum for specific wavelengths of light emitted from pure substances

- ***Bohr's Model of the H Atom*:** Bohr applied idea of quantization of energy transfer to atomic model, theorizing that electrons travel in certain "orbits" around the nucleus Allowed orbital energies are defined by:

  $E_n = \frac{-R_H}{n^2} = \frac{-2.178 \times 10^{-18}}{n^2}$ n = principal quantum number = 1, 2, 3 ...

  R_H = Rydberg's constant = 2.178×10^{-18} J

  - ***Line Series*:** transitions from one level to another

- ***Heisenberg's uncertainty principle:*** The position and momentum of a particle cannot be simultaneously measured with accuracy.

- ***Schrödinger's wave function:*** Relates probability (Ψ^2) of predicting position of e- to its energy.

  $E = -\frac{h^2}{2m}\frac{d^2\Psi}{dx^2} + U\Psi = ih\frac{d\Psi}{dt}$ U = potential energy, x = position, t = time, m = mass, i = √(-1)

- ***Matter as a Wave:***

  $m = h / c\lambda$ Particles (with mass) have an associated wavelength

  $\lambda = h / mc$ Waves (with a wavelength) have an associated mass and velocity

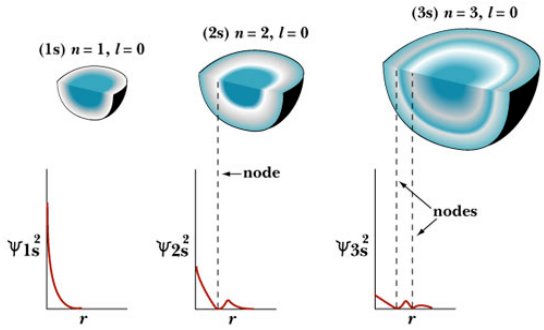
Explanations

***Atomic Emission Spectra* for H**

Hydrogen: contains 1 red, 1 green, 1 blue and 1 violet.

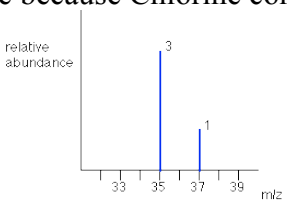
Line Series	Transition down to (emitted) or up from (absorbed)…	Type of EMR
Lyman	1	UV
Balmer	2	Visible
Paschen	3	IR
Brackett	4	Far IR

Probability Plots for 1s, 2s, and 3s Orbitals



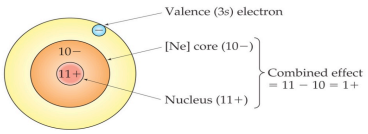
Summary of the page and Important things to remember:

- ***Pauli Exclusion Principle***: no two charges in an atom can have the same set of four quantum numbers n, l, m1, ms.
- ***Effective Nuclear Charge***: the net positive charge acting on the outermost electron.
- ***Shielding Effect***: inner electrons shielding the outer electron from the full charge of the nucleus.
- ***Electron Configuration***: the way the electrons are distributed among the various orbitals of an atom.
  - The most stable, or ground, electron configuration is one in which the electrons are in the lowest possible energy states.
- ***Hund's Rule***: for degenerate orbitals (orbitals with the same energy), the lowest energy is attained when the number of electrons with the same spin is maximized.
- The periodic table is your best guide to the order in which orbitals are filled.
  - s-block and p-block contain the representative (main group) elements.
  - The ten columns in the middle that contain transition metals, elements in which d-orbitals are being filled.
  - f-block metals are the ones in which the f-orbitals are being filled.
- ***Diamagnetic*:** paired electrons
- ***Paramagnetic*:** unpaired electrons
- ***Mass Spectroscopy:*** Helps identify # and abundance of isotopes and structures of different compounds. Chlorine has two isotopes, ^{35}Cl and ^{37}Cl, in the approximate ratio of 3 atoms of ^{35}Cl to 1 atom of ^{37}Cl. You might suppose that the mass spectrum would look like this but that is not the case because Chlorine consists molecules that

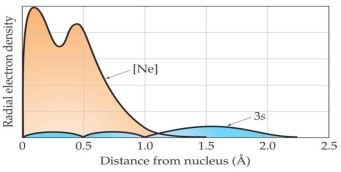


fragment (chemguide.co.uk)

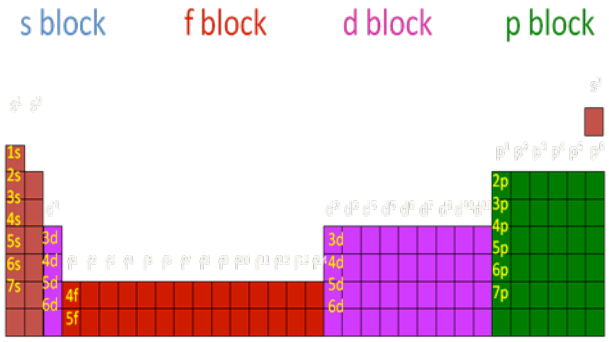
You could have the following mass fragments--35 + 35 = 70, 35 + 37 = 72, 37 + 37 = 74. So the actual mass spectrograph will look like the one on the right.



(a)



Ex: Give ground state electron configurations for the following: Ni^{2+} and Ni^{3+}
Ans: Ni^{2+} = [Ar]3d8, Ni^{3+}= [Ar]3d7



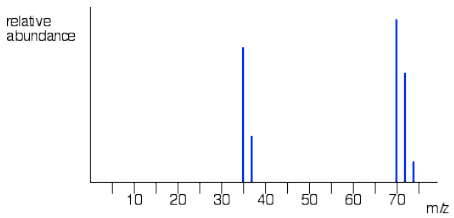
Notable Exceptions:

Cr & Mo: [Ar] $4s^1\ 3d^5$ not [Ar] $4s^2\ 3d^4$

Cu, Ag, & Au: [Ar] $4s^1 3d^{10}$ not [Ar] $4s^2 3d^9$

Ex: Is Cupric ion dia or paramagnetic? Why?
Paramagnetic, due to an unpaired d e.

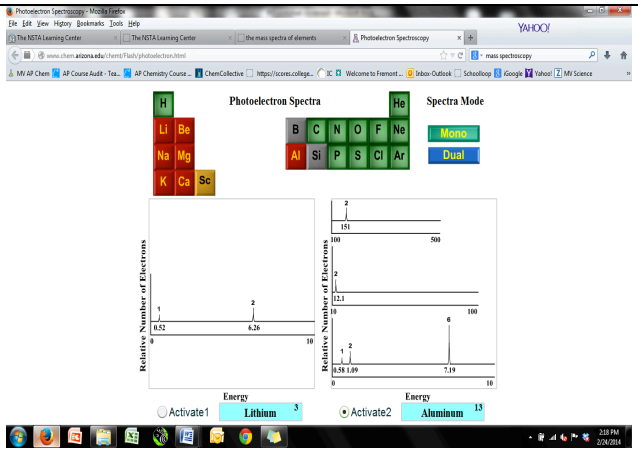
Mass Spectrograph for Chlorine (Cl_2)



(chemguide.co.uk)

Summary of the page and Important things to remember:

- ***Photoemission Spectroscopy (PES)***
  In a photoelectron spectroscopy experiment any electron can be ionized when the atom is excited. Unlike the first ionization, in this experiment any electron can be removed, not just the electron that requires the least amount of energy. PES gives insight into the structure of atom. Each peak in PES indicates the number of electrons and the position of the peak indicates the amount of energy required to remove those electrons. Note that s electrons will require more energy than p electrons due to higher ENC hence s electrons will be farther out on the energy axis.
  http://www.chem.arizona.edu/chemt/Flash/photoelectron.html



Summary of the page and Important things to remember: