Electronic Configurations of Atoms.

The distribution of electrons in different orbitals of an atom is called the electronic configuration of the atom. The filling of electrons in orbitals is governed by the following rules.

(1) Pauli's exclusion principle

"It states that no two electrons in an atom can have all the four quantum number (n, l, ml and ms) the same."

It means each quantum state of an electron must have a different set of quantum numbers n, l, ml and ms. This principle sets an upper limit on the number of electrons that can occupy a shell.

$N_{\max}$ in one shell = 2n2; Thus Nmax in K, L, M, N .... shells are 2, 8, 18, 32,

Note: The maximum number of electrons in a subshell with orbital quantum number l is 2(2l + 1).

(2) Aufbau principle

Electrons enter the orbitals of lowest energy first.

As a general rule, a new electron enters an empty orbital for which (n + l) is minimum. In case the value $(n + l)$ is equal for two orbitals, the one with lower value of n is filled first.

Thus the electrons are filled in subshells in the following order (memorize)

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p, ...

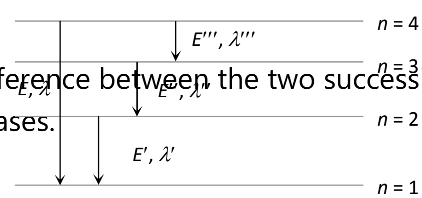
(3) Hund's Rule

When electrons are added to a subshell where more than one orbital of the same energy is available, their spins remain parallel. They occupy different orbitals until each one of them has at least one electron. Pairing starts only when all orbitals are filled up.

Pairing takes place only after filling 3, 5 and 7 electrons in p, d and f orbitals, respectively.

Concepts

With the increase in principal quantum number the energy difference between the two successive energy level decreases, while wavelength of spectral line increases.



$E' > E'' > E'''$

$\lambda' < \lambda'' < \lambda'''$

$E = E' + E'' + E'''$

$\frac{1}{\lambda} = \frac{1}{\lambda'} + \frac{1}{\lambda''} + \frac{1}{\lambda'''}$

Rydberg constant is different for different elements

R (=1.09 × 107 m–1) is the value of Rydberg constant when the nucleus is considered to be infinitely massive as compared to the revolving electron. In other words, the nucleus is considered to be stationary.

In case, the nucleus is not infinitely massive or stationary, then the value of Rydberg constant is given as $R' = \frac{R}{1 + \frac{m}{M}}$ where m is the mass of electron and M is the mass of nucleus.

Atomic spectrum is a line spectrum

Each atom has its own characteristic allowed orbits depending upon the electronic configuration. Therefore photons emitted during transition of electrons from one allowed orbit to inner allowed orbit are of some definite energy only. They do not have a continuous graduation of energy. Therefore the spectrum of the emitted light has only some definite lines and therefore atomic spectrum is line spectrum.

Just as dots of light of only three colors combine to form almost every conceivable color on T.V. screen, only about 100 distinct kinds of atoms combine to form all the materials in the universe.