

Atoms and Atomic Structure

- Atom : Smallest particle of an element that can exist either alone or in combination.

- Constituents of atoms

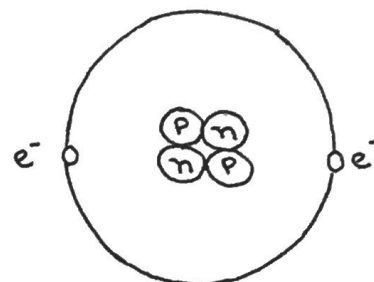
A) Nucleus : protons and neutrons

B) electrons

- Mass_{proton} ~ Mass_{neutron}

Mass_{electron} ~ Mass_{proton} / 2000

[$m_p = 1.67 \times 10^{-24}$ gm, $m_e = 9.11 \times 10^{-28}$ gm]



- Charge : p : +ve; e : -ve; n : no charge

- Atom is electrically neutral

i.e. No. of p's = No. of e's

- Atomic weight = No. of (p + n)

- Atomic number = No. of p's

- $^{12}\text{C}_6$: 6p + 6n

- Isotope : Same atomic number but different atomic weight.

e.g. $^{15}\text{O}_8$, $^{16}\text{O}_8$, $^{17}\text{O}_8$

Structure of the Atom

- Simple model

- nucleus at the center (size $\sim 10^{-13}$ cm)
 - electrons in orbits or shells (size $\sim 10^{-8}$ cm)
- (Most of the atom is empty space)
- electrons can orbit only in discrete levels or shells
 - electron orbits have definite energy
 - the ground state has the lowest energy [Ground state : $n = 1$]
 - further the e^- is from the nucleus greater is its energy
 - maximum number of electrons in a given level (n) is $2n^2$

- Excitation : An electron jumps from lower energy orbit (level) to higher energy orbit (level).

- i) by absorbing a photon with the right amount of energy
- ii) gaining energy from another atom through collision

- De-excitation : An electron jumps from higher energy level to lower level

- i) by emitting a photon having the difference in energy of the two levels.
- ii) losing energy by colliding with another atom

- Ionization : electron leaves the atom (atom becomes +ve charged)

e.g. OI : neutral oxygen

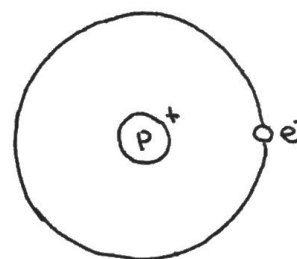
OII : singly ionized oxygen (1 e^- missing)

Spectral Lines

- Absorption Line : produced when an electron jumps from a lower to higher energy level by absorbing a photon
- Emission Line : produced when an electron jumps from a higher to lower energy level by emitting a photon.

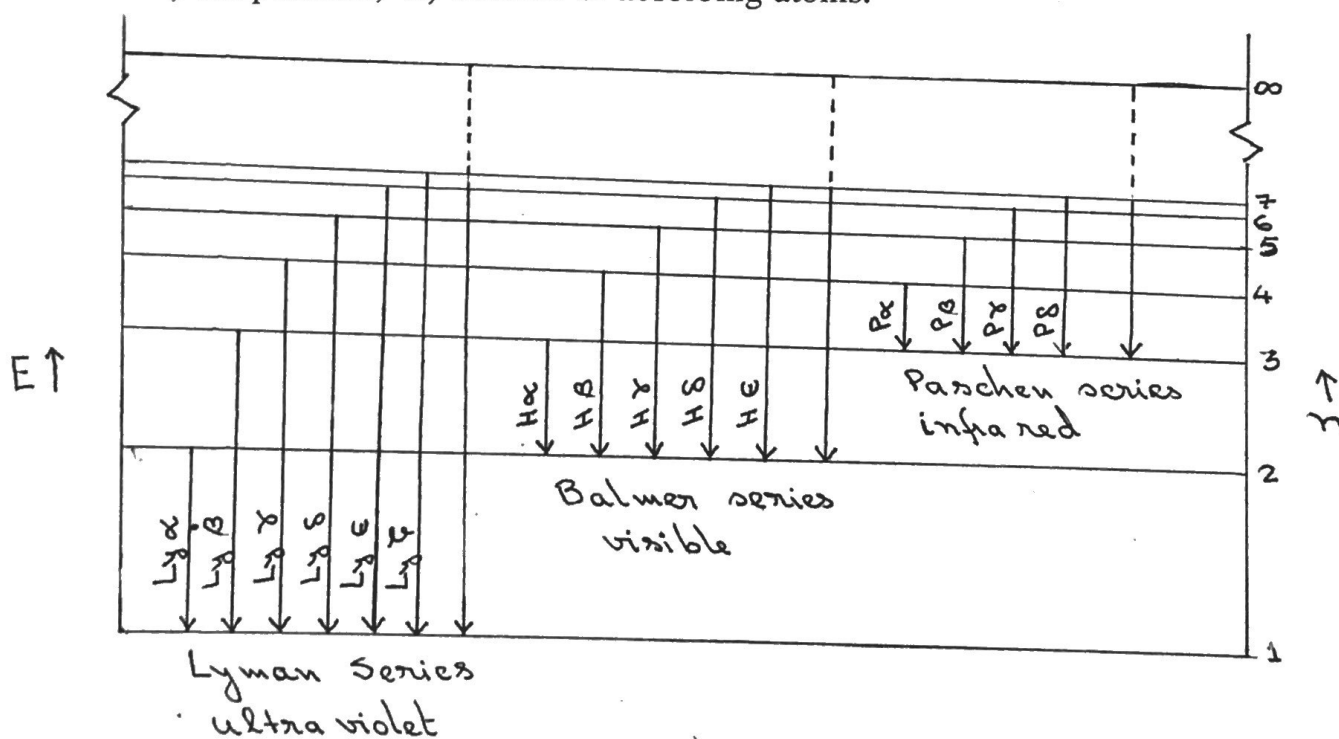
- Energy Level Diagram

- Hydrogen Atom : most common element in the universe
simplest structure : 1 proton + 1 electron



- Hydrogen Spectra

- Strength [width and the brightness or darkness] of a spectral line depends on : i) temperature, ii) number of absorbing atoms.



$$H\alpha = 6563 \text{ \AA}, \quad H\beta = 4861 \text{ \AA}, \quad H\gamma = 4340 \text{ \AA}$$