Discovery of electrons

By J.J Thomson Charge to Mass ratio of electrons= 1.758820 x 10^{11} C kg^{-1}

Charge on electron = 1.6022 x 10^{-19} C

Mass of Electron = 9.1094 x 10^{-31} Kg

Discovery of Neutron

By James Rutherford

Charge on Neutron = 0

Mass of Neutron = 1.675 x 10^{-27} kg

Rutherford's Nuclear Model of Atom

Postulates:

- Positive charge and most of the mass of atoms was densely concentrated in extremely small region i.e nucleus.
- Nucleus is surrounded by electrons that move around the nucleus with high speed in circular path caled orbits.
- Electrons and nucleus are held together by electrostatic forces of attraction.

Drawbacks:

- It connot explain the stability of an atom
- It does not say anything about the electronic structure of atoms

Isotopes

Atoms of different elements having same atomic number but different mass number. (Isotopes of Hydrogen) Protium $^1H_1$, Deuterium $^2D_1$ and Tritium $^3D_1$

Isobars

Atoms of different elements with different atomic number but same mass number. (Ca and Ar)

Quantum Mechanical Model of Atom

Postulates:

- Electron in H atoms can move around the nucleus in a circular path of fixed radius and energy called as orbits. these orbits are arranged concentrically around the nucleus.
- Each of these orbits has a definite energy known as energy levels or stationary states.
- When an electron jumps from a lower energy level to higher one, some energy is absorbed.

$v = \frac{E}{h} = \frac{E_2 - E_1}{h}$ Bohr's frequency rule.

Angular momentum of electrons: $m_e v_r = n\frac{h}{2\pi}$

n= 1,2,3.....

Limitations:

- Unable to account for finer details of H atom. Spectrum observed by sophisticated spectroscopic techniques.
- Could not explian the ability of atoms to form molecules by chemical bonds.

Schrodinger

Fundomental Equation was developed by Schrodinger as

$\hat{H}\psi = E\psi$ = where $\hat{H}$ = Hamiltonian

Quantum Number

(i) Principal Quantum number (n): n= 1,2,3,4..... Shell=K,L,M,N...

(ii)Azimuthal Qunatum number: For given value of n, l=0 to n-1

(iii) Magnetic Quantum number(m): For Subshel with 'l' value m_l= 2l + 1

(iii) Spin Qunatum Number (m_s): +1/2( ) ,-1/2( )

Electronic Configuration of Atom

(i) $s^a p^b d^c$...... notation

(ii)Orbital diagram

s p d

Energy of Orbitals

Lower the value of (n+1) for an orbital, lower is its energy.

Discovery of Protons

By Ernest Rutherford

Charge on Proton = 1.6022 x 10^{-19} C

Mass of Proton = 1.672 x 10^{-27} kg

Thomsons Model of Atom

Atoms posses a spherical shape in which the positive charge is uniformly distributed.

Atomic Number	Mass Number
Number of protons in (Z) + Number of neutrons (n)	Number of protons in nucleus of an atom or Number of electrons in a neutral atom

Bohr's Nuclear Model of Atom

- **Electrons revolve around the nucleus in certain definite orbits called stationary states having fixed energies.**
- **Electrons revolve only in those orbits for which the angular momentum is an integral multiple of $\frac{h}{2\pi}$.**
- **Radii of stationary states,** $r_n = \frac{a_0 n^2}{Z}$
- **Energies of different stationary states,** $E_n = \frac{-1312}{n^2} Z^2 \text{ kJ mol}^{-1}$
- **Velocity of electrons in n^{th} orbit,** $v_n = 2.188 \times 10^8 \times \frac{Z}{n} \text{ cm s}^{-1}$
- **No. of spectral lines** $= \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

Photoelectric effect

It was found by H.Hertz

It is the phenomenon of ejection of electrons from the surface of a metal when light of suitable frequency strikes on it.

Atomic Spectra

- Spectrum of radiation emitted by a substance Emission Spectra: that has absorbed energy.
- It is like photographic negative of an Absorption Spectra: emission spectra.
- Emission Spectra which do not show a Line / Atomic Spectra: continuous spread of wavelength from red to violet, rather they emit light only at specific wavelength with dark space between them.

$\bar{V} = 109677 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \text{ cm}^{-1}$ where

n_1=1,2...........n_2=n_1+1, n_1+2........

Series	n_1	n_2	Spectral Region
Lyman	1	2,3....	Ultravoilet
Balmar	2	3,4....	Visible
Paschen	3	4,5.....	Infrared
Brackett	4	5,6....	Infrared
Pfund	5	6,7....	Infrared

Filling of orbitals in atoms

- **Aufbau Principle:** In the ground state of atoms, the orbital's are filled according to increasing energies.
- **Pauli Exclusion Principle:** No 2 electrons in an atom can have same set of four quantum numbers.
- **Hund's Rule:** Pairing of electrons in the orbitals belonging to same subshell does not take place until each electron belonging to the subshell in singly occupied.

Shape of Orbitals