STRUCTURE OF ATOM

J.J. THOMSON

- Discovered electron(e^-)
- Proposed Plum Pudding Model

e^-
Charge of an e^- = -1.6022×10^{-19} C

P^+
Charge of a Proton P^+ = $+1.6 \times 10^{-19}$ C

Mass of an e^- -9.1×10^{-31} kg

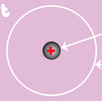
Mass of an P^+ 1.6×10^{-27} kg

Neutron
Discovered by James Chadwick. Charge on Neutron is 0

Mass of an Neutron is 1.6×10^{-27} kg

ERNEST RUTHERFORD

- Discovered Proton (P^+)
- α-partical experiment
- Proposed Rutherford's model of an atom (1911)
- Atom consist of two parts Nucleus and extra Nucleus part



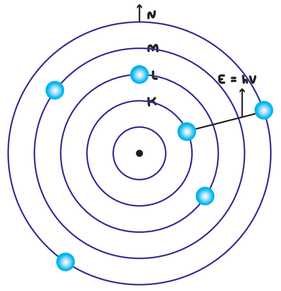
BOHR'S MODEL OF AN ATOM

- Electron in H atom can move around the nucleus in a circular path of fixed radius
- Each orbits has a definite energy known as energy level or stationary levels.
- When an electron jumps from a lower energy level to to higher one, energy is absorbed.
- Angular momentum of electron = $m_e V_r = n \frac{h}{2\pi}$ $n = 1, 2, 3$

Radius = $r = 0.529 \times \frac{n^2}{z}$ Å Energy = $E = -1.36 \times 10^6 \times \frac{z^2}{n^2}$ J/Mol

Velocity = $V = 2.18 \times 10^8 \times \frac{z}{n}$ cm/sec

STATIONARY STATES



LIMITATION

- Applicable on only one e^- system eg: H, He^+
- If could not able to explain dual nature of n atom

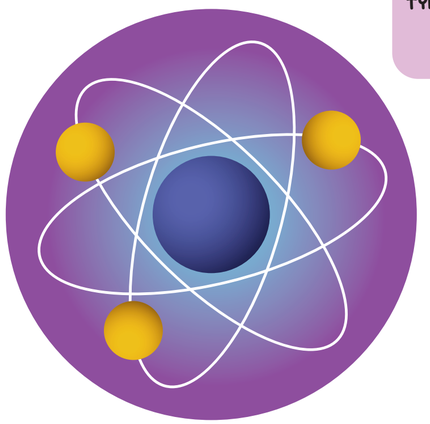
NODES

Space or region, wher finding the probability of e^- is zero

TYPES:-
- Radial Node = (N - l -1)
- Angular Node = l
- Total Node = N - 1

SERIES

Lyman: $n_1 = 1, n_2 = 2, 3...$
Balmer: $n_1 = 2, n_2 = 3, 4...$
Paschen: $n_1 = 3, n_2 = 4, 5$
Bracket: $n_1 = 4, n_2 = 5, 6$



TOWARDS QUANTUM MECHANICAL MODEL

DUAL NATURE OF MATTER

- Every Material Particle in the motion has dual Nature (Wave and Particle Nature)
- de=Broglie's wavelength

$$\lambda = \frac{h}{mv} = \frac{h}{p}$$

HEISENBERG'S UNCERTAINITY PRINCIPLE

- Every Material Particle in the motion has dual Nature (Wave and Particle Nature)
- de=Broglie's wavelength

$$\Delta x \cdot \Delta p \geq \frac{h}{7\pi}$$

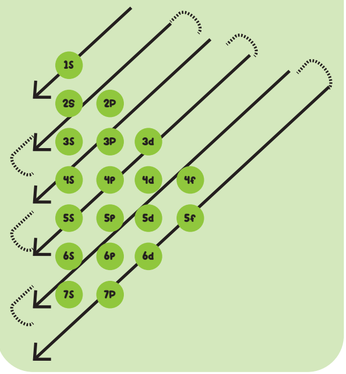
QUANTUM MECHANICS

- Fundamental equation was developed by Schrodinger know as Schrodinger wave equation.

$$\left[\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m}{h^2}(E - U)\psi = 0\right]$$

- The electrons in an atom have quantized values of energy.
- By evaluating ψ^2 at different points around the nucleus in a atom, we can predict the probability of finding the electron is maximum.

ENERGY LEVEL



QUANTUM NUMBER

1. Principle Quantum No.: n = 1, 2, 3, 4... Shell = K, L, M, N
2. Azimuthal Quantum No.: l = for given value of N, l =0 to N - 1)
3. Magnetic Quantum No.: M = for Subshells with 'l' value.
   $Ml = 2_l + 1$
4. Spin Quantum Number = $S = +\frac{1}{2}(1), -\frac{1}{2}(1)$

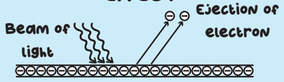
PLANK'S CONSTANT (H)

$E = h\nu$
$h = 6.623 \times 10^{-34}$ JS

Found by H. Hertz

PARTICLE NATURE OF ELECTRON MAGNETIC RADIATITION

PHOTOELECTRIC EFFECT



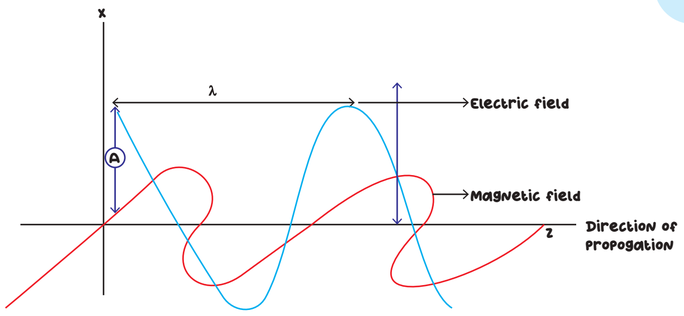
KINETIC ENERGY OF EJECTED e^-

$h\nu = h\nu_0 + \frac{1}{2} m_e v^2$

$E = h\nu_0 + K.E.$

BLACK BODY RADIATION

A PERFECT OBSORBER OR EMITTER OF LIGHT.
I.E ABSORBER OR EMITS ALL TYPE OF frequency/ radiation



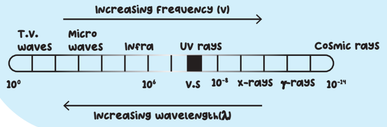
CHARACTERISITICS OF WAVE

(a) Wavelength (λ)
(b) Wave no. ($\bar{\nu}$)
(c) Frequency (ν)
(d) Time Period (T)
(e) Velocity (c)
(f) Amplitude (a)

$\lambda = \frac{c}{\nu}$

ELECTRO-MAGNETIC SPECTRUM

Electromagnetic Spectrum is a collection ofall electromagnetic waves arranged according to frequency and wavelength.



ATOMIC SPECTRA

EMISSION SPECTRA

Spectrum of tansition emitted by a substance that has absorbed energy

Spectrum of the electromagnetic radiation emitted or absorbed by an electron during transition from one energy level to another

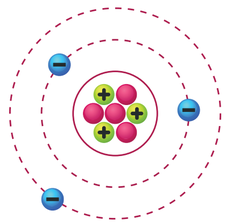
$\nu = 109677 \left[\frac{1}{N_1^2} - \frac{1}{N_2^2}\right] CM^{-1}$

ABSORPTION SPECTRA

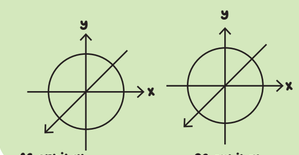
It is like Photographic Negative of an emission Spectra

RULES FOR ARRANGING ELECTRON

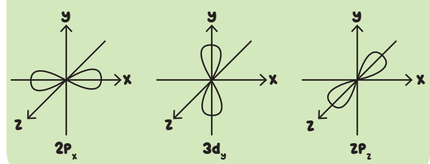
(a) Aufbau Principle: Electron occupy lowest energy level available
(b) Pauli Exclusion Principle: No two e- can have Same Set of 4 quantum numbers.
(c) Hund's rule: If two or more orbitals of equal energy available, then electron will occupy them singly before filled in pairs.



SHAPE OF ORBITALS



P ORBITAL (DUMBELL SHAPE)



D ORBITALS