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

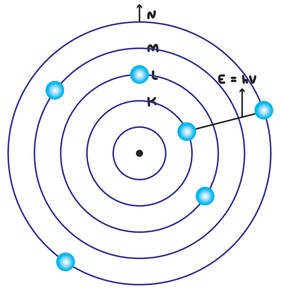
BOHR'S MODEL OF AN ATOM

- 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

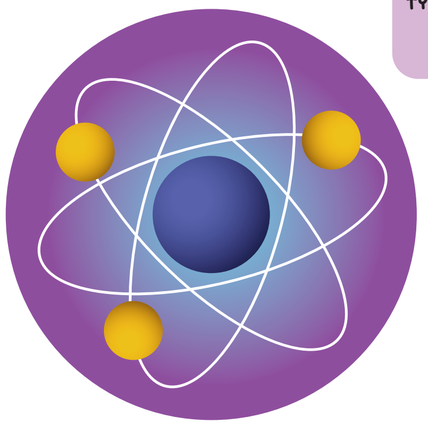
NODES

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

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

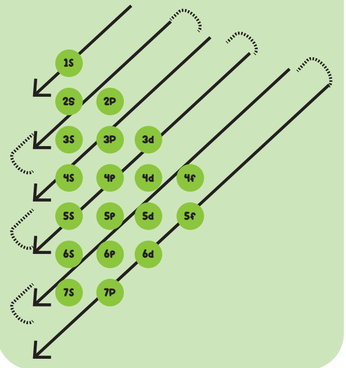
QUANTUM MECHANICS

- 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

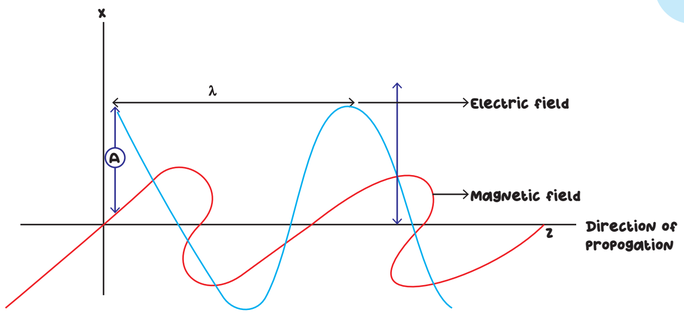


QUANTUM NUMBER

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.
   $m_l = 2_l + 1$
4. Spin quantum number = $S = +\frac{1}{2}(1), -\frac{1}{2}(l)$

ELECTRO-MAGNETIC WAVE THEORY

- Wavelength: Distance between Successive crest of trough
- Frequency: Number of waves passed through a point in 1 Sec.



PLANK'S CONSTANT (H)

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

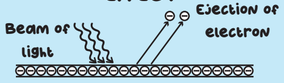
Found by H. Hertz

PARTICLE NATURE OF ELECTRON MAGNETIC RADIATITION

BLACK BODY RADIATION

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

PHOTOELECTRIC EFFECT



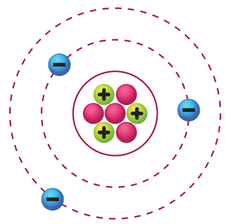
KINETIC ENERGY OF EJECTED e^-

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

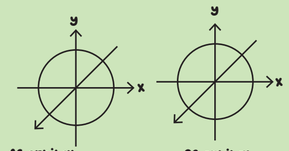
$E = h\nu_0 + K.E.$

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



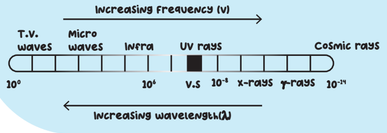
CHARACTERISITICS OF WAVE

(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

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

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

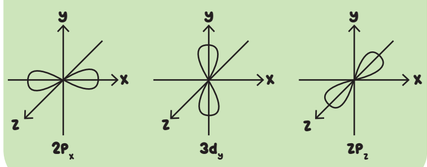
EMISSION SPECTRA

Spectrum of tansition emitted by a substance that has absorbed energy

ABSORPTION SPECTRA

It is like Photographic Negative of an emission Spectra

P ORBITAL (DUMBELL SHAPE)



D ORBITALS