SUB ATOMIC PARTICLES

Electron

Charge of an e^- : -1.6022×10^{-19} c
Mass of an e^- : 9.1×10^{-31} kg

Proton

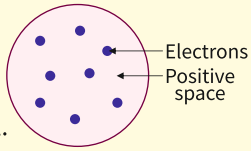
Charge of a p+ : $+1.6 \times 10^{-19}$C

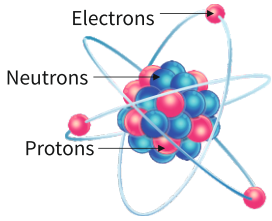
Neutron

Discovered by James Chadwick.
Charge on Neutron is 0
Mass of a Neutron : 1.6×10^{-27} kg

J.J. THOMSON

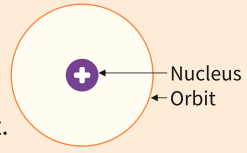
- Discovered electron(e^-)
- Proposed plum pudding Model.





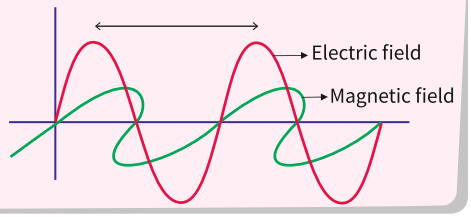
ERNEST RUTHERFORD

- α - partical experiment.
- Proposed Rutherford's model of an atom (1911).
- Atom consist of two parts nucleus and extra nucleus part.



ELECTRO-MAGNETIC WAVE THEORY

- **Wavelength**: Distance between successive crest and trough.
- **Frequency**: Number of waves passed through a point in 1 sec.



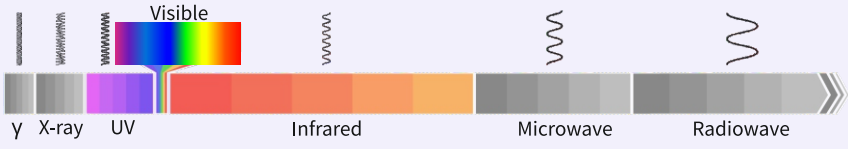
CHARACTERISITICS OF WAVE

a) Wavelength (λ)
b) wave no. ($\bar{\upsilon}$)
c) Frequency (υ)
d) Time Period (T)
e) Velocity (c)
f) Amplitude (A)

2. STRUCTURE OF ATOM

ELECTRO-MAGNETIC SPECTRUM

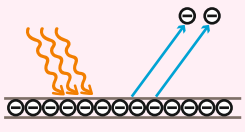
- Electromagnetic spectrum is a collection space electromagnetic waves arranged according to frequency and wavelength.
- Wavelength of visible light is from 400nm to 750nm.



Black Body Radiation

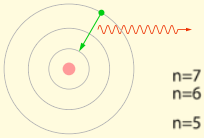
A perfect absorber or emitter of light. i.e Absorber or emits all type of frequency/ radiation.

Photoelectric Effect

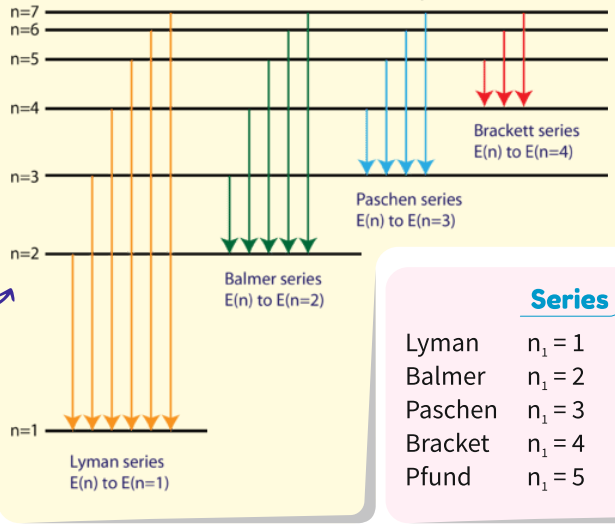


$W_0 = h\upsilon_0$
$h\upsilon = W_0 + KE$
$E = h\upsilon_0 + KE$

HYDROGEN SPECTRUM



Electron transitions for the Hydrogen atom



ATOMIC SPECTRA

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

EMISSION SPECTRA

Spectrum of radiation emitted by a substance that has absorbed energy.

ABSORPTION SPECTRA

It is like photographic negative of an emission spectra.

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	$n_1 = 4$	$n_2 = 5, 6...$
Pfund	$n_1 = 5$	$n_2 = 6, 7...$

Wavelength of radiation emitted when an e^- jumps from n_2 to n_1.

$$\frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

R_H = Rydberg's constant = 109677 cm^{-1}

BOHR'S MODEL OF AN ATOM

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

Radius (r) = $0.529 \times \frac{n^2}{Z}$ Å **Energy (E)** = $-13.6 \times \frac{Z^2}{n^2}$ ev

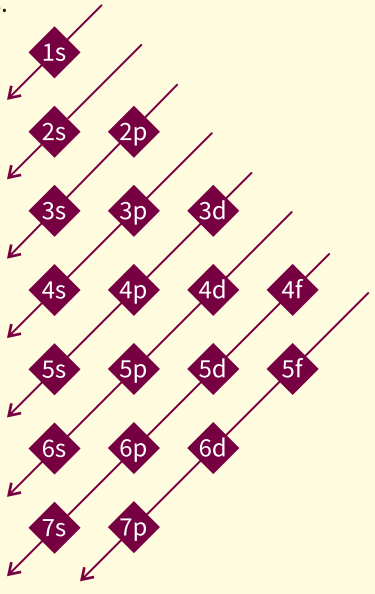
Velocity (v) = $2.18 \times 10^6 \times \frac{Z}{n}$ m/sec

LIMITATION

- Applicable to only one e- system eg: H, He+
- It could not explain Zeeman effect and stark effect.

RULES FOR ARRANGING ELECTRONS

a) **Aufbau principle**: Electrons occupy lowest energy level First and then move to the next energy level.
b) **Pauli Exclusion principle**: No two e- can have same set of all 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.



TOWARDS QUANTUM MECHANICAL MODEL

DUAL NATURE OF MATTER

- Every microscopic particle in the motion has dual nature (wave and particle nature) and produce matter waves.
- Wavelength of matter waves (De=Broglie's wavelength)

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

HEISENBERG'S UNCERTAINITY PRINCIPLE

It is impossible to measure simultaneously the exact momentum and exact position of a microscopic moving particle.

$$\Delta X \cdot \Delta P \geq \frac{h}{4\pi}$$

QUANTUM MECHANICS

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

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m}{h^2}(E - u)\psi = 0$$

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

QUANTUM NUMBER

1. Principle quantum No. (n) = 1, 2, 3, 4... shell = K, L, M,
2. Azimuthal Quantum No. (l) = for given value of n, l can have values from 0 to n - 1)
3. Magnetic quantum no. (m) = for subshells with 'l' value, m can have values from -l to +l and Total value of m= 2l +1
4. Spin quantum number = s = $+\frac{1}{2}$. $-\frac{1}{2}$

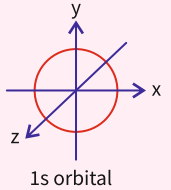
NODES

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

Types :-

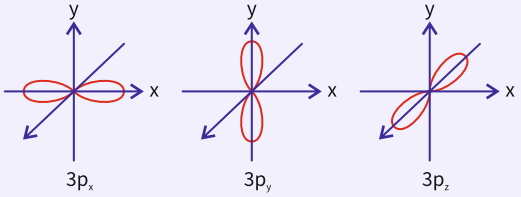
- Radial node = (n - *l* -1)
- Angular node = *l*
- Total node = n - 1

s-SHAPE OF ORBITAL



1s orbital

p- ORBITALS (DUMBELL SHAPE)



d-ORBITALS (Double Dumbell shape)