بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

বিস্মিল্লাহির রাহ্মানির রাহীম





Class XI: Chemistry 1st Paper (Chapter-2)

Qualitative Chemistry Lecture:(C-02)

Instructor : Md. Sajjad Hossain Rozen EEE, BUET



Atomic Models and Basic Concepts





Rutherford's Alpha Particle (α) Scattering Test - 1911



Observation

(1) About 99% of the alpha particles penetrate the leaf and go straight away, illuminating the screen.
 (2) However, a few *α*-particles in the pot bend in their way.
 (3) A very small number of alpha particles (1 in about 20,000) return in the opposite direction.

Rutherford's Atomic Model - Solar Model - 1911





Limitations

(i) The planets of the solar system are charge neutral(ii) Maxwell's electromagnetic theory(iii) Interpretation of the hydrogen spectrum





POLL QUESTION-01

- 1. Which of the following is in Rutherford's atomic model?
 - A) There is a nucleus in the center
 - B) Protons and electrons are equal
 - C) Centrifugal force of attraction = centripetal force
 - D) All

Bohr's Atomic Model - 1913



Limitations

n = 13

1500

2000

2500

3000 3500

4000

- . Cannot explain the spectrum of elements or ions of multiple electrons.
- A spectral line divided into multiple fine lines magnetic fields (Zeeman effect) cannot explain it.
- iii. Although the concept of two-dimensional orbit has been found, the concept of threedimensional orbit has not been found.
- iv. Although D-Broglie's wave theory can be proved, Heisenberg's uncertainty principle cannot be proved.
- v. It is not explained how the value of the law of angular momentum of an electron in a stationary orbit came to be.
- vi. A spectral line divided into multiple fine lines the electric field (stark effect) - cannot explain

it.

POLL QUESTION-02



Success and Acceptance



Comparison Between Rutherford and Bohr Atomic Models

- i. Basics of the Atomic Model Alpha Particle Scattering (Rutherford) and the Rutherford Model, Max Planck and Einstein's Quantum Theory of Light Radiation (Bohr)
- ii. The concept of orbits of rotating electrons not obvious (Rutherford) and fixed circular orbits (bohr)
- iii. The stability of the atomic model no, because Maxwell's theory (Rutherford) and there, because - fixed orbit (bohr)
- iv. Comparison with the solar system yes and there is defect (Rutherford) and there is no such defect (bohr)
- v. Spectrum no explanation (Rutherford) and there is, one electron basaed atomic element or ion (bohr)



Application of Bohr Theory





Wave Mechanics and Schrodinger's Wave Equations About The Structure of Atoms

i. The Relationship of Particle Religion and Wave Religion of a Moving Object: De Broglie's Equation (1924)



Rotation of electrons in a circular path.



Explanation of The Wave Nature of Electrons



POLL QUESTION-03

- 3. De Broglie explains which of the following?
 - A) Explain the spectrum of atoms
 - **B)** Explain the electron configuration of an atom
 - C) Establish a relationship between the wave and particle wave of an electron

Heisenberg's Policy of Uncertainty - 1926



Schrodinger's Wave Equation - 1928





Quantum Mechanics Atomic Model - 1924-1927

(1) The existence of the nucleus, the center of the atomic model given by Rutherford.

(2) the concept of fixed orbits or orbitals of electrons in the atomic model given by Niels Bohr (1913 AD);

(3) The mass property and wave property of the electron-like dry particle-friend given by D-Bragley (1924 AD) i.e. the particle-wave duality of the electron.

Broglie's equation, $\lambda = h / (\text{momentum of the electron } (mv))$; Orbit, $2\pi r = n \times \lambda = nh / .$

: Kinetic momentum, $mvr = (n \times h) / 2\pi$

 $(x, y, z) = (Ze^{2}) / .$

(4) the equation of wave mechanics given by the scientist Schr dinger (1926 AD); (^ 2 ψ) / [[dx]] ^ 2 + (^ 2 ψ) / [[dy]] ^ 2 + (d ^ 2 ψ) / dz dz]] ^ 2 + (8 π ^ 2 m) / h ^ 2 (E - V) ψ = 0;

Here ψ (psi) = wave function of the electron, n = mass of the electron, h = constant constant, E = total energy of electron particle, V = static energy of electron particle at any point three dimensional

(5) The 'uncertainty principle' given by scientist Heisenberg (1926 AD) regarding the position and momentum in the orbital of a rotating electron.



(1) What is the angular momentum of a rotating electron in the 3rd energy level of a hydrogen atom?



(2) What is the angular momentum of the rotating electron in the L energy level of a hydrogen atom?



POLL QUESTION-04

4. What is the value of angular momentum for N energy level?
i) 2h / pi
ii) 3h / 2pi
iii) 4h / 2pi

iv) i + iii

(3) What will be the velocity of the electron rotating in the M orbit of an atom? Orbit radius 3.6×10^{-8} cm.



(4) What will be the velocity of the electron rotating in the 2^{nd} orbit of an atom? Orbit radius 2.5×10^{-8} cm.



(5) If the orbital radius of a hydrogen atom is 8.5×10^{-8} cm and the velocity of the electron is 5.4452×10^7 cms⁻¹, in which orbit is the electron rotating?



(6) If the energy difference between two different energy levels of a hydrogen atom is 245.9 kJ mol⁻¹, what will be the wavelength and frequency of the radiated light ray if the electron jumps from the higher energy level to the lower energy level?



(7) What is the radius of the second bore orbit of lithium atom, velocity of rotating electron, energy?



(8) What is the radius of 3rd energy level of hydrogen atom, velocity of rotating electron, energy?



(9) What is the energy of 3^{rd} energy shell if the 1^{st} shell's energy is -13.5815 eV?



লেগে থাকো সৎভাবে, স্বপ্ন জয় তোমারই হবে

'র্দ্দ্রান্স-উন্মেষ শিক্ষা পরিবার

