

9th Class

➤ Bohr's Model of an Atom

❖ Introduction:

- Proposed by Niels Bohr in 1913 as an improvement to Rutherford's nuclear model.
- Aimed to explain the stability of electrons in their orbits and the spectral lines of hydrogen.

❖ Key Postulates:

1. Quantization of Angular Momentum:

- Electrons move in circular orbits around the nucleus.
- Bohr introduced the idea that the angular momentum of an electron is quantized, $mvr = n\hbar/2\pi$, where m is the mass, v is the velocity, r is the radius of the orbit, n is an integer, and \hbar is the reduced Planck's constant.

2. Energy Levels:

- Electrons can exist only in certain energy levels or orbits.
- Each orbit corresponds to a specific energy level, and the energy of an electron is quantized.

3. Quantized Energy Transitions:

- Electrons absorb energy to move to higher energy levels (excitation) and emit energy when transitioning to lower levels (emission).
- The energy of emitted or absorbed photons is quantized and corresponds to the energy difference between the initial and final energy levels.

❖ Stability of Orbits:

- Bohr's model successfully explained the stability of certain electron orbits.
- Electrons in these orbits do not emit radiation and are considered stable.

❖ Limitations:

1. Applicability to Hydrogen Only:

- Bohr's model worked well for hydrogen-like ions (single-electron systems), but it failed to predict the spectral lines of multielectron atoms accurately.

2. Classical Mechanics Limitation:

- Bohr's model still relied on classical mechanics and did not account for the wave-particle duality of electrons.

❖ **Quantum Mechanics:**

- Bohr's model laid the foundation for quantum mechanics.
- Wave-particle duality and the uncertainty principle were later introduced in the development of quantum theory.

❖ **Modern View:**

- The modern atomic model, based on quantum mechanics, describes electrons not as particles in fixed orbits but as existing within probability distributions called orbitals.

❖ **Legacy:**

- Despite its limitations, Bohr's model was a critical step in the development of atomic theory.
- It bridged classical and quantum physics and inspired further research.

Conclusion: Bohr's Model of an Atom significantly contributed to the understanding of atomic structure, providing insights into the quantization of energy levels and the stability of electrons. While it had limitations, it paved the way for the more comprehensive quantum mechanical description of atomic behavior.