

PHYSICAL CHEMISTRY

ATOMIC STRUCTURE

Planck's Quantum Theory :

$$\text{Energy of one photon} = h\nu = \frac{hc}{\lambda}$$

Photoelectric Effect :

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

Bohr's Model for Hydrogen like atoms :

1. $mvr = n \frac{h}{2\pi}$ (Quantization of angular momentum)

2. $E_n = -\frac{E_1}{n^2} z^2 = -2.178 \times 10^{-18} \frac{Z}{n^2} \text{ J/atom} = -13.6 \frac{Z}{n^2} \text{ eV}$

$$E_1 = \frac{-2\pi^2 m e^4}{n^2}$$

3. $r_n = \frac{n^2}{Z} \times \frac{h^2}{4\pi^2 e^2 m} = \frac{0.529 \times n^2}{Z} \text{ \AA}$

4. $v = \frac{2\pi z e^2}{nh} = \frac{2.18 \times 10^6 \times z}{n} \text{ m/s}$

De-Broglie wavelength :

$$\lambda = \frac{h}{mc} = \frac{h}{p} \text{ (for photon)}$$

Wavelength of emitted photon :

$$\frac{1}{\lambda} = \bar{\nu} = RZ^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

No. of photons emitted by a sample of H atom :

$$\frac{\Delta n(\Delta n + 1)}{2}$$

Heisenberg's uncertainty principle :

$$\Delta x \cdot \Delta p > \frac{h}{4\pi} \quad \text{or} \quad m \Delta x \cdot \Delta v \geq \frac{h}{4\pi} \quad \text{or} \quad \Delta x \cdot \Delta v \geq \frac{h}{4\pi m}$$

Quantum Numbers :

- * Principal quantum number (n) = 1, 2, 3, 4 ... to ∞ .
- * Orbital angular momentum of electron in any orbit = $\frac{nh}{2\pi}$.
- * Azimuthal quantum number (ℓ) = 0, 1, to ($n - 1$).
- * Number of orbitals in a subshell = $2\ell + 1$
- * Maximum number of electrons in particular subshell = $2 \times (2\ell + 1)$
- * Orbital angular momentum $L = \frac{h}{2\pi} \sqrt{\ell(\ell+1)} = \hbar \sqrt{\ell(\ell+1)}$
 $\left[\hbar = \frac{h}{2\pi} \right]$