PHYSICAL CHEMISTRY

ATOMIC STRUCTURE

Planck's Quantum Theory :

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

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

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

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

De–Broglie wavelength :

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

Wavelength of emitted photon :

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

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

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

Heisenberg's uncertainty principle :

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

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 = $\frac{h}{2\pi}\sqrt{\ell(\ell+1)} = \hbar\sqrt{\ell(\ell+1)}$

$$\left[\hbar = \frac{h}{2\pi}\right]$$