2024 – 25

Atoms

Recall what did you study in previous class

BOHR'S MODEL

Postulates

(a) $\frac{q^2}{4\pi\varepsilon_0 r^2} = \frac{mv^2}{r}$

(b) $mvr = \frac{nh}{2\pi}$

(c) $E_i - E_f = hv = \frac{hc}{\lambda}$

Radius of n^{th} orbit, $r_n = \frac{\varepsilon_0 h^2 n^2}{\pi m e^2 Z} \Rightarrow r_n \alpha \frac{n^2}{Z}$

Orbital speed, $V_n = \frac{nh}{2\pi m r_n} = \frac{Ze^2}{2\varepsilon_o hn} \Rightarrow v_n \alpha \frac{Z}{n}$

Energy of n^{th} orbit, $E_n = -\frac{me^4 Z^2}{8\varepsilon_0^2 h^2 n^2} \Rightarrow E_n \alpha \frac{Z^2}{n^2}$

Note: Total energy of the e– in an atom is negative, that implies it is bound.
Total Energy = –Kinetic Energy
Potential Energy = 2 × Total Energy

Spectral Series

- $\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$
- where, R = Rydberg's constant, $R = \frac{me^4}{8\varepsilon_0^2 h^3 c} = 1.09 \times 10^7\ m^{-1}$

(i) $n_1 = 1, n_2 = 2, 3, \ldots$ for Lyman series (UV region)
(ii) $n_1 = 2, n_2 = 3, 4, \ldots$ for Balmer series (visible region)
(iii) $n_1 = 3, n_2 = 4, 5, \ldots$ for Paschen series (Infra-red region)
(iv) $n_1 = 4, n_2 = 5, 6, \ldots$ for Brackett series (Infra-red region)
(v) $n_1 = 5, n_2 = 6, 7, \ldots$ for Pfund series (Infra-red region)

PW Web/App - https://smart.link/7wwosivoicgd4
Library- https://smart.link/sdfez8ejd80if