

# Atomic Structure

---

## 1. Bohr's Radius (First Orbit Radius)

$$r_n = \frac{n^2 h^2 \epsilon_0}{\pi m e^2 Z}$$

- $r_n$  = radius of the nth orbit
  - $h$  = Planck's constant =  $6.626 \times 10^{-34} \text{ J} \cdot \text{s}$
  - $\epsilon_0$  = permittivity of free space =  $8.854 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$
  - $m$  = mass of electron =  $9.109 \times 10^{-31} \text{ kg}$
  - $e$  = charge of electron =  $1.602 \times 10^{-19} \text{ C}$
  - $Z$  = atomic number
  - SI unit: meter (m)
- 

## 2. Velocity of Electron in nth Orbit

$$v_n = \frac{Z e^2}{2 \epsilon_0 h n}$$

- SI unit: meter/second (m/s)
- 

## 3. Energy of Electron in nth Orbit

$$E_n = -\frac{13.6 Z^2}{n^2} \text{ eV}$$

- Energy is quantized and negative, showing a bound state.
  - For hydrogen ( $Z = 1$ ), ground state energy  $E_1 = -13.6 \text{ eV}$
  - SI unit: electronvolt (eV) or joule ( $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$ )
- 

## 4. Wavelength of Spectral Lines (Hydrogen Atom - Balmer, Lyman series etc.)

$$\frac{1}{\lambda} = R Z^2 \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

- $R$  = Rydberg constant =  $1.097 \times 10^7 \text{ m}^{-1}$
- $\lambda$  = wavelength in meters
- $n_2 > n_1$

---

## 5. de Broglie Wavelength

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

- $p$  = momentum
  - SI unit: meter (m)
- 

## 6. Energy of Photon

$$E = h\nu = \frac{hc}{\lambda}$$

- $\nu$  = frequency (Hz)
  - $c$  = speed of light =  $3 \times 10^8$  m/s
  - SI unit: joule (J)
- 

## 7. Conversion Between eV and Joule

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

---