

Structure of Atom: one-page cheat sheet

NEET Chemistry · Unit 2 · Physical Chemistry

1 · Particles & rays

Cathode rays	electrons; $e/m = 1.76 \times 10^{11} \text{ C kg}^{-1}$ – same for every gas and electrode
Canal rays	positive ions; e/m depends on the gas (highest for H^+ = proton)
Constants	$e = 1.602 \times 10^{-19} \text{ C}$ (Millikan); $m_e = 9.109 \times 10^{-31} \text{ kg}$
Neutron	Chadwick 1932: ${}^9_4\text{Be} + {}^4_2\text{He} \rightarrow {}^{12}_6\text{C} + {}^1_0\text{n}$

2 · Radiation & Planck

$$c = \nu\lambda, \quad \bar{\nu} = \frac{1}{\lambda} = \frac{\nu}{c}$$

$$E = h\nu = \frac{hc}{\lambda} = hc\bar{\nu}, \quad h = 6.626 \times 10^{-34} \text{ J s}$$

Order of E Radio < Microwave < IR < Visible < UV < X-ray < γ

n photons $E = nh\nu$; one mole of photons: $N_A hc/\lambda$

3 · Photoelectric effect

$$h\nu = h\nu_0 + \text{KE}_{\text{max}} = W_0 + \frac{1}{2}m_e v^2, \quad W_0 = \frac{hc}{\lambda_0}$$

KE of electrons rises with **frequency** ν (needs $\nu \geq \nu_0$); **not** with intensity

Number of electrons proportional to **intensity** (brightness)

Trap · More intensity = more electrons per second, **same** KE and stopping potential.

4 · Bohr model ($\text{H}, \text{He}^+, \text{Li}^{2+}, \text{Be}^{3+}$ only)

$$m_e v r = \frac{nh}{2\pi}$$

$$r_n = \frac{52.9 n^2}{Z} \text{ pm}, \quad E_n = -13.6 \frac{Z^2}{n^2} \text{ eV} = -2.18 \times 10^{-18} \frac{Z^2}{n^2} \text{ J}$$

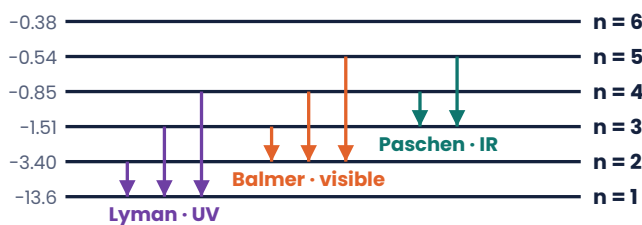
$$\frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right), \quad R_H = 1.097 \times 10^7 \text{ m}^{-1}$$

Series	n_1	Region
Lyman	1	UV
Balmer	2	Visible ($n_2 = 3$ to 6)
Paschen	3	Near IR
Brackett	4	IR
Pfund	5	Far IR

Total lines $\frac{n(n-1)}{2}$ from level n

Lines $\frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$ between n_2 and n_1

Hydrogen energy levels



Six traps to remember

- Cathode-ray e/m is fixed; canal-ray e/m changes with the gas.
- Intensity changes the **number** of photoelectrons, frequency changes their **KE**.
- Bohr formulas work only for **one-electron** species.

5 · Matter waves & uncertainty

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m \text{KE}}} = \frac{h}{\sqrt{2mqV}}$$

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

Trap · “Velocity known to $x\%$ ” means $\Delta v = v \times \frac{x}{100}$, not v itself.

6 · Quantum numbers

Number	Values	Tells you
n	1, 2, 3 ...	shell, size, energy
l	0 to $n - 1$	shape (0 s, 1 p, 2 d, 3 f)
m_l	$-l \dots 0 \dots +l$	orientation; $2l + 1$ orbitals
m_s	$+\frac{1}{2}, -\frac{1}{2}$	spin

Capacity subshell $2(2l + 1)$ electrons; shell $2n^2$

Orbital angular momentum $\sqrt{l(l+1)} \frac{h}{2\pi}$ (zero for s)

Spin-only moment $\mu = \sqrt{n(n+2)} \text{ BM}$, n = unpaired electrons

7 · Filling rules

Aufbau	fill by increasing $(n + l)$; same $(n + l) \rightarrow$ lower n first
Pauli	no two electrons share all four quantum numbers; max 2 per orbital, opposite spins
Hund	fill degenerate orbitals singly, parallel spins, before pairing

Trap · One-electron species (H, He^+): energy depends on n only, so $3s = 3p = 3d$. In many-electron atoms it follows $(n + l)$.

8 · Nodes

Radial $n - l - 1$	Angular l	Total $n - 1$
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Example 3p $n = 3, l = 1 \rightarrow$ radial = 1, angular = 1, total = 2

9 · Extra stability

Cr ($Z = 24$) $[\text{Ar}] 3d^5 4s^1$ (not $3d^4 4s^2$)

Cu ($Z = 29$) $[\text{Ar}] 3d^{10} 4s^1$ (not $3d^9 4s^2$)

Why symmetry and **maximum exchange energy**

Exchanges in d^5 $\frac{n(n-1)}{2} = \frac{5 \times 4}{2} = 10$

Seen in NEET 2025

Ratio of wavelengths absorbed by H for $2 \rightarrow 3$ and $4 \rightarrow 6$:

$$\frac{\lambda_1}{\lambda_2} = \frac{\frac{1}{16} - \frac{1}{36}}{\frac{1}{4} - \frac{1}{9}} = \frac{5/144}{5/36} = \frac{1}{4}$$

Wavelength is inverse to the energy gap, so flip the ratio.