Class 12 Physics – Atoms | Complete Study Guide

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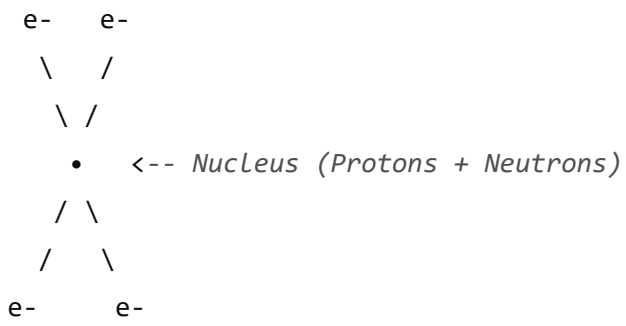
1. Theory in Simple Words with Visuals

Topic: Structure of Atom

- **Atom**: Smallest particle of an element that can take part in chemical reactions.
- **Analogy**: Think of an atom like a **solar system**.
  - Nucleus → Sun
  - Electrons → Planets orbiting around

Visual Representation:



Key Models of Atom

Model	Scientist	Concept	Analogy
Dalton's Model	John Dalton	Atom is indivisible, solid sphere	Like a **marble**
Thomson's Model (Plum Pudding)	J.J. Thomson	Electrons embedded in positive sphere	**Raisin pudding** 🍮
Rutherford Model	Rutherford	Tiny dense nucleus, electrons orbit	**Solar system** 🌞
Bohr Model	Niels Bohr	Electrons in fixed orbits with energy levels	**Steps on a ladder** 🪜

Example:

- Hydrogen atom has 1 proton and 1 electron.
- Electron moves in circular orbit around nucleus.

Atomic Spectra & Energy Levels

- Electrons can jump from **lower to higher energy level** → absorbs energy.
- Jump from **higher to lower level** → emits light → **spectral lines**.
- **Energy formula (Bohr's model):**

$$E_n = -\frac{13.6 \text{ eV}}{n^2} \quad \text{for hydrogen atom}$$

Visual: Energy Levels

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n=3  ---------
n=2  ------
n=1  --
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- Electron falls from n=3 to n=2 → emits **visible light**.

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2. Key Concepts & Formulas

Important Definitions:

- **Atomic Number (Z):** Number of protons in nucleus
- **Mass Number (A):** Protons + Neutrons
- **Isotopes:** Same Z, different A
- **Isobars:** Same A, different Z

Formulas:

Concept	Formula	Notes
Energy of electron in orbit	$E_n = -\frac{13.6}{n^2}$ eV	n = principal quantum number
Radius of orbit	$r_n = n^2 a_0/Z$	$a_0 = 0.529 \times 10^{-10}$ m
Velocity of electron	$v_n = \frac{2.18\times10^6}{n}$ m/s	For H atom
Frequency of spectral line	$\nu = \frac{E_i - E_f}{h}$	h = Planck's constant

Mnemonic:

- **"PEM"** → **P**rotons, **E**lectrons, **M**ass number

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3. Solved Numerical Problems

Problem 1:
Calculate the radius of the first orbit of hydrogen.

Given:

$$n = 1, Z = 1, a_0 = 0.529 \times 10^{-10} m$$

Solution:

$$r_1 = \frac{n^2 a_0}{Z} = \frac{1^2 \times 0.529 \times 10^{-10}}{1} = 0.529 \times 10^{-10}\ \text{m}$$

Tip: Always check **units**.

Problem 2:
Energy emitted when electron falls from n=3 to n=2 in hydrogen.

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

$$E_3 = -\frac{13.6}{9} = -1.51\ \text{eV}, \quad E_2 = -\frac{13.6}{4} = -3.4\ \text{eV}$$

$$\Delta E = E_2 - E_3 = -3.4 - (-1.51) = -1.89\ \text{eV}$$

Answer: 1.89 eV emitted (negative = emission)

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4. Previous Years' Board Questions (Solved)

Example Questions:

1. Draw Bohr's model for hydrogen atom and write energy levels.
2. Calculate wavelength of first line in Lyman series.
3. Define isotopes with examples.

Patterns:

- Always asked: Bohr's model, energy level calculations, spectral series, isotopes.

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5. Quick Revision Notes / Important Points

- Atom = nucleus + electrons
- Bohr model → electrons in **quantized orbits**
- Energy formula: $E_n = -13.6/n^2$ eV
- Radius formula: $r_n = n^2 a_0/Z$
- **Lyman → UV, Balmer → Visible, Paschen → IR**
- Common shortcut: $\Delta E = 13.6(1/n_f^2 - 1/n_i^2)$

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6. Predicted / Likely Questions

- Draw & explain Bohr's model
- Solve energy & radius problems for hydrogen atom
- Explain spectral series
- Define isotopes & isobars with examples

- Numerical questions on **electron transitions**

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7. Exam Tips & Tricks

- Always **write units** (m, eV, nm)
- Remember **energy sign**: negative → bound, positive → free
- Use **stepwise formula substitution**
- Draw **small diagrams** for every question about transitions
- Quick formula for **H-atom transitions**:

$$\Delta E = 13.6\,(\frac{1}{n_f^2} - \frac{1}{n_i^2})$$

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8. Visual & Kid-Friendly Learning Style

- Think **"atom = solar system"**
- **Energy levels** = "stairs electron jumps"
- **Spectral lines** = electron singing light
- Use **tables, colors, mnemonics** for quick memory

✅ Summary Table: High-Yield Points

Topic	Key Formula / Concept	Quick Mnemonic
Energy Levels	$E_n = -13.6/n^2$	**"E negative bound"**
Radius of Orbit	$r_n = n^2 a_0/Z$	"Step ladder"
Spectral Lines	$\Delta E = E_i - E_f$	"Jump & light"
Isotopes	Same Z, different A	"Z same, A changes"