Class 9 Science – Chapter 4: Structure of the Atom (Detailed Notes)

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1. Matter and Atoms – Basic Idea

We already know that **matter is made of particles**. These particles are so small that we cannot see them with naked eyes. Scientists called these smallest particles **atoms**.

The word *atom* comes from the Greek word **"atomos"**, which means *indivisible*. But later discoveries proved that atoms **can be divided** into smaller particles.

So, an atom is **not solid throughout**. It has an internal structure.

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2. What is an Atom?

An **atom** is the smallest unit of an element that takes part in chemical reactions.

- Atoms are extremely small in size (~10^{-10} m)
- Atoms of different elements are different
- Atoms combine to form molecules

Example:
Hydrogen atoms combine to form H_2 molecule.

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3. Subatomic Particles

Atoms are made of three fundamental particles:

(a) Electron (e^-)

- Discovered by **J.J. Thomson (1897)**
- Negatively charged particle
- Very small mass
- Moves around the nucleus

(b) Proton (p^+)

- Discovered through **canal rays experiment** (E. Goldstein)
- Positively charged
- Mass nearly equal to neutron
- Present inside nucleus

(c) Neutron (n^0)

- Discovered by **James Chadwick (1932)**
- No charge (neutral)

- Mass similar to proton
- Present inside nucleus

Particle	Charge	Relative Mass	Position
Electron	–1	Very small	Outside nucleus
Proton	+1	1	Inside nucleus
Neutron	0	1	Inside nucleus

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4. Thomson's Model of Atom

Thomson compared the atom to a **plum pudding** or **watermelon**.

Main Points

- Atom is a positively charged sphere
- Electrons are embedded in it
- Total positive charge = total negative charge → atom is neutral

Drawback

- Could not explain how positive charge is arranged
- Failed to explain Rutherford's experiment

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5. Rutherford's Alpha Scattering Experiment

Rutherford bombarded **alpha particles** on a thin gold foil.

Results

1. Most particles passed straight → atom mostly empty
2. Some deflected → presence of positive charge
3. Few bounced back → very small, heavy center

Conclusions

- Atom has a **tiny, dense nucleus**
- Nucleus contains protons
- Electrons revolve around nucleus
- Most of atom is empty space

Limitation

Electrons moving in circular paths should lose energy and fall into nucleus → atom would collapse (but this doesn't happen).

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6. Bohr's Model of Atom

Niels Bohr solved Rutherford's problem.

Postulates

1. Electrons revolve in fixed paths called **shells or orbits**
2. Each shell has fixed energy → called **energy levels**
3. Shells are named: **K, L, M, N**
4. Maximum electrons in a shell = $\mathbf{2n^2}$

Shell	n	Max Electrons
K	1	2
L	2	8
M	3	18
N	4	32

Electrons do not lose energy while moving in these shells.

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7. Atomic Number (Z)

Atomic number = **Number of protons** in nucleus.

In a neutral atom:
Protons = Electrons

Example:
Carbon has 6 protons → Atomic number = 6

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8. Mass Number (A)

Mass number = Protons + Neutrons

$$A = p + n$$

Example:
If atom has 8 protons and 8 neutrons:
Mass number = 16

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9. Symbolic Representation

$$^{A}_{Z}X$$

X = Element symbol
A = Mass number
Z = Atomic number

Example:

$$^{35}_{17}Cl$$

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10. Distribution of Electrons (Electronic Configuration)

Rules

1. Maximum electrons = $2n^2$
2. Outer shell ≤ 8 electrons
3. Shells fill from inner to outer

Examples

Element	Atomic No.	Configuration
H	1	1
He	2	2
Li	3	2,1
Be	4	2,2
B	5	2,3
C	6	2,4
N	7	2,5
O	8	2,6
F	9	2,7
Ne	10	2,8

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11. Valency

Valency = combining capacity.

- If outer electrons ≤ 4 → Valency = electrons
- If > 4 → Valency = 8 – electrons

Element	Configuration	Valency
Na	2,8,1	1
Mg	2,8,2	2
O	2,6	2
Cl	2,8,7	1

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12. Isotopes

Same atomic number but different mass number.

Example of Hydrogen:

- ^{1}H (Protium)
- ^{2}H (Deuterium)
- ^{3}H (Tritium)

Uses

- Cobalt-60 → cancer treatment
- Uranium-235 → nuclear fuel
- Iodine-131 → thyroid treatment

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13. Isobars

Same mass number but different atomic numbers.

Example:

^{40}_{18}Ar \quad and \quad ^{40}_{20}Ca

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14. Difference: Isotopes vs Isobars

Isotopes	Isobars
Same element	Different elements
Same Z	Same A
Different A	Different Z

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15. Important Concepts for Exams

- Atom mostly empty

- Nucleus very small but heavy
- Electrons revolve in shells
- Atomic number identifies element
- Valency depends on outer electrons
- Isotopes have same chemical but different physical properties

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16. Quick Revision Points

✓ Electron is lightest particle
✓ Proton and neutron form nucleus
✓ K shell holds max 2 electrons
✓ Stable atoms have complete outer shell
✓ Mass number = p + n