ST. ANDREWS SCOTS SR. SEC. SCHOOL

9^{th} Avenue ,I.P. Extension , Patparganj , Delhi -110092

Class IX Structure of atom

Introduction

All matter around us is made up of very tiny particles called atoms. The word *atom* comes from the Greek word *"atomos"*, which means *indivisible*. Earlier, atoms were considered indivisible, but later experiments proved that atoms are made up of smaller sub-atomic particles.

Early Ideas About the Atom

Indian philosophers like Maharishi Kanad proposed that matter is made of very small particles called *parmanu*. Greek philosopher Democritus also suggested that matter consists of indivisible particles called atoms. However, these ideas were philosophical and not based on experiments.

Dalton's Atomic Theory

In 1808, John Dalton gave the first scientific atomic theory.

Main Postulates

Atoms are very tiny and indivisible particles.

Atoms of the same element are identical in mass and properties.

Atoms of different elements have different masses and properties.

Atoms combine in simple whole-number ratios to form compounds.

Atoms can neither be created nor destroyed in a chemical reaction.

Limitations

Dalton's theory could not explain:

- The existence of sub-atomic particles
- Isotopes
- Electrical nature of atoms

Discovery of Sub-Atomic Particles

Electron

In 1897, J.J. Thomson discovered electrons using a cathode ray tube experiment.

Electrons are negatively charged particles present in all atoms.

Proton

E. Goldstein discovered positively charged rays called canal rays, which led to the discovery of protons.

Protons carry a positive charge.

Neutron

In 1932, James Chadwick discovered neutrons.

Neutrons have no charge and are present in the nucleus of atoms.

Thomson's Model of Atom (Plum Pudding Model)

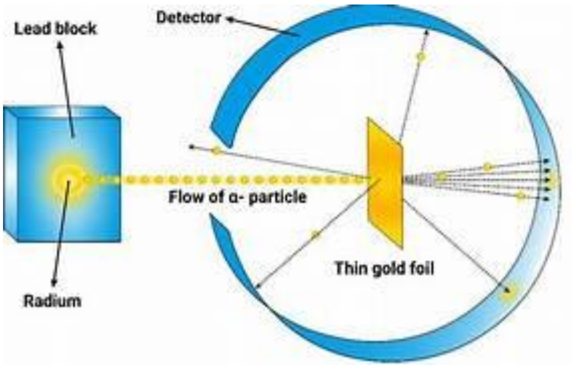
J.J. Thomson proposed that an atom is a positively charged sphere in which negatively charged electrons are embedded like plums in a pudding.

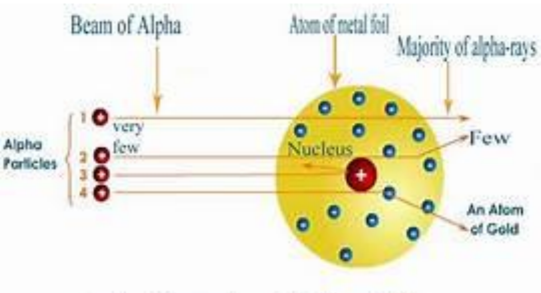
Limitations

- Could not explain the results of Rutherford's experiment
- Failed to explain the stability of the atom

Rutherford's Alpha Particle Scattering Experiment

Ernest Rutherford bombarded alpha particles on a thin gold foil.





Rurtherfords experiment of Gold metal foil

Observations

1. Most alpha particles passed straight through the foil.

2. Some were deflected through small angles.

3.Very few were deflected back.

Conclusions

1.Most of the atom is empty space.

2.Positive charge and most of the mass are concentrated in a very small region called the nucleus.

3.Electrons revolve around the nucleus.

Limitations

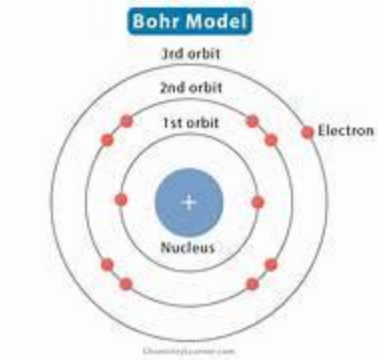
According to classical physics, revolving electrons should lose energy and fall into the nucleus, making atoms unstable.

Could not explain the distribution of electrons.

Bohr's Model of Atom

Niels Bohr proposed a more stable atomic model.

Postulates



1.Electrons revolve around the nucleus in fixed circular paths called orbits or energy levels.

2.Each orbit has a definite amount of energy.

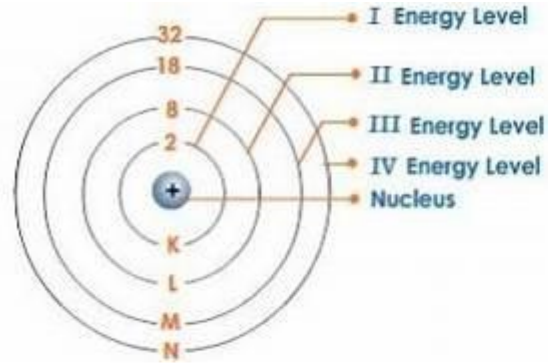
3.Electrons do not radiate energy while revolving in permitted orbits.

4.Energy is absorbed or emitted only when an electron jumps from one orbit to another.

Energy Levels

These orbits are named K, L, M, N (or n = 1, 2, 3, 4).

Distribution of Electrons (Bohr–Bury Scheme)



The maximum number of electrons in a shell is given by $2n^2$, where *n* is the shell number.

The outermost shell can have a maximum of 8 electrons.

Electrons fill the inner shells first before moving to outer shells.

Atomic Number

The atomic number (Z) is the number of protons present in the nucleus of an atom.

In a neutral atom, number of protons = number of electrons.

Example**:**

Hydrogen → Atomic number = 1

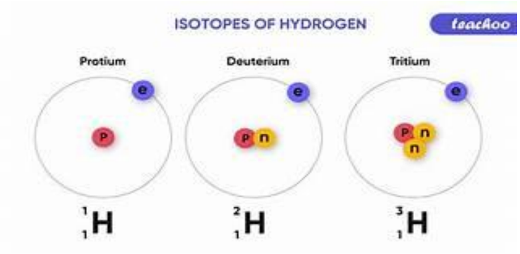
Carbon → Atomic number = 6

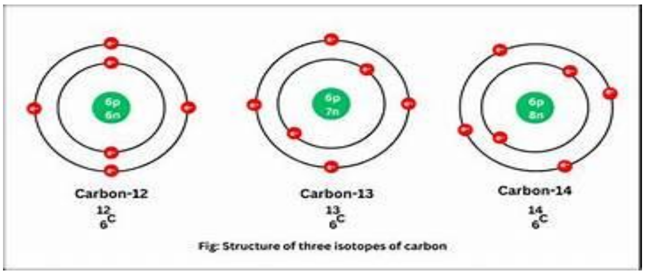
Mass Number

The mass number (A) is the total number of protons and neutrons in the nucleus.

Mass number = Number of protons + Number of neutrons

Isotopes





Atoms of the same element having the same atomic number but different mass numbers are called isotopes.

Properties

Chemical properties are the same.

Physical properties are different.

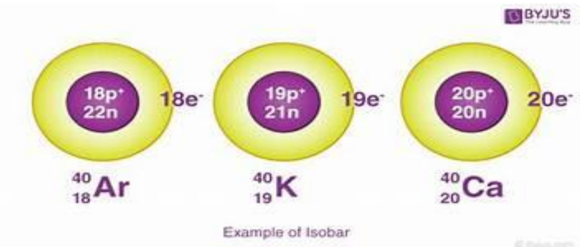
Uses

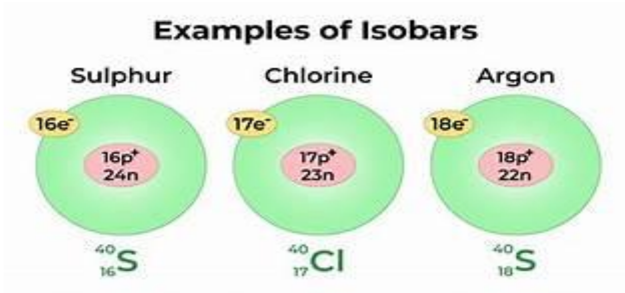
Isotope of uranium is used as nuclear fuel.

Isotope of iodine is used to treat thyroid disorders.

Isotope of cobalt is used in cancer treatment.

Isobars





Atoms of different elements having the same mass number but different atomic numbers are called isobars.

Example:

Argon and Calcium with mass number 40.

Valency

The valency of an element is its combining capacity.

It depends on the number of electrons in the outermost shell.

If outer shell electrons $\leq 4 \rightarrow$ valency = number of electrons

If outer shell electrons $> 4 \rightarrow$ valency = 8 − number of electrons

Importance of Atomic Structure

Helps in understanding chemical bonding.

Explains chemical reactions.

Forms the basis of modern chemistry and physics.