

STRUCTURE OF ATOM

➤ ATOM

- It is the smallest particle of an element which can take part in a chemical reaction and is considered the basic unit of matter. It shows all the characteristic properties of an element.

Eg- H, C, N

Atomic number (Z):

- ◆ Atomic number is the number of protons (equal to the number of electrons)
- ◆ Unique property of an element.
- ◆ It gives the electronic configuration of an element.
- ◆ No two elements have the same atomic number.

Mass number (A)

- Calculated as the total number of protons + neutrons

ELEMENT - Is a pure substance made up of only one kind of atoms having the same atomic number and which cannot be broken down.

MOLECULE The smallest particle which can exist independently. Eg- H_2, O_2

COMPOUNDS-Substances formed by the combination of two or more elements through chemical reactions.

Law of conservation of mass(Lavoisier) - Mass is neither created nor destroyed in a chemical reaction.

Law of definite proportions (joseph Proust) -a given chemical compound always contains its component elements in fixed ratio (by mass)

Law of constant proportion- There exists a simple whole number ratio between the masses of combining elements in a compound.

Law of multiple proportions(Dalton)- if two elements combine to form more than one compound, the masses of one element that combine with the fixed mass of the other element are in the ratio of small whole numbers

Eg:- hydrogen combines with oxygen to form two compounds namely water and hydrogen peroxide

- Hydrogen + oxygen → water

2g 16g 18g

- Hydrogen + oxygen → hydrogen peroxide.

2g 32g 34g

- Here masses of oxygen (16g and 32g) which combine with the fixed mass of hydrogen (2g) bear a simple ratio that is 16:32 1:2

Gay lussacs law of gaseous volumes:

- When gases combine or are produced in a chemical reaction, they do so in a simple ratio by volume provided all gases are at the same temperature and pressure.

- Hydrogen + oxygen → water.

100ml 50ml 100ml

- Here, 100ml of hydrogen combines with 50ml of oxygen to give 100ml of water vapour bear

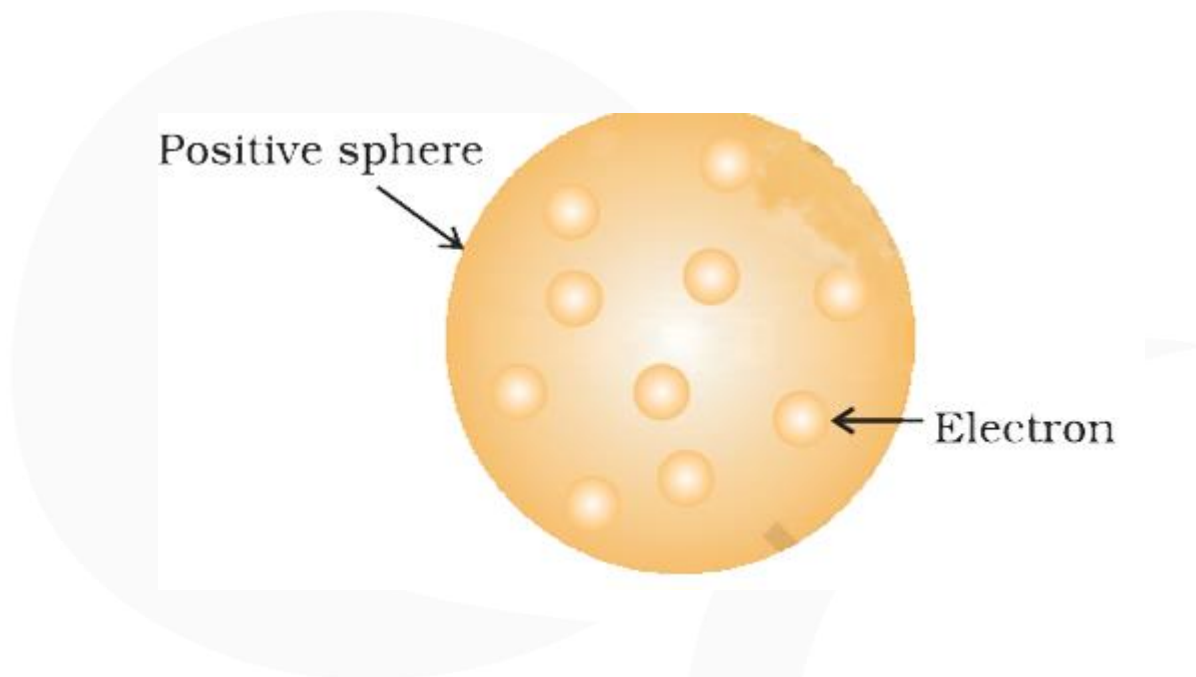
Avogadro's law: Equal volumes of all gases at the same temperature and pressure contain equal number of molecules.

DALTONS ATOMIC THEORY

- Matter is composed of very small and indivisible particles called atoms.
- Atoms can neither be created nor be destroyed.
- Atom of same elements will be identical in all aspects and atoms of different elements have different properties
- Atoms of an element combine in small numbers to form molecules.
- Atoms are the smallest units of matter that can take part in chemical reaction.
- Atoms of two or more elements combine in a simple ratio to form compounds.
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THOMSON'S MODEL OF ATOM (plum pudding model)

- Compared the distribution of electrons to plum pudding
 - Atom is a sphere of positive charge in which the negatively charged electrons are embedded
 - The total number of units of positive charge of the sphere are equal to the number of negatively charged electrons. Hence an atom is electrically neutral.



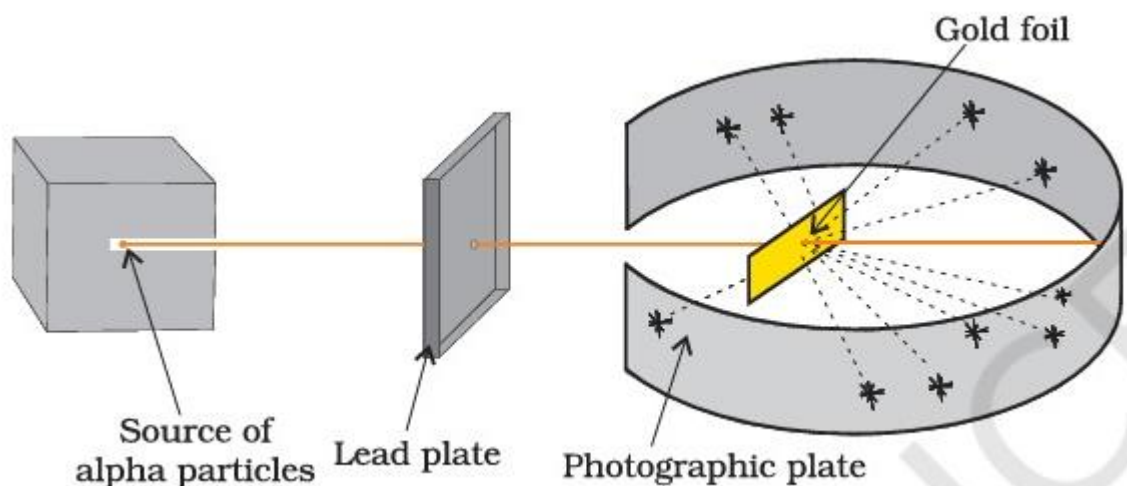
- Explained the presence of electrons and neutral nature of atoms.

Limitations of Thomson's model:

- Thomson's atomic model failed to explain how the positive charge holds on the electrons inside the atom. It also failed to explain an atom's stability.
- The theory did not mention anything about the nucleus of an atom.

RUTHERFORD'S MODEL OF ATOM: (planetary model of atom)

- Rutherford conducted gold foil experiment by making positively charged alpha particles fall on a thin gold foil. A photographic film was placed around the gold foil to observe the deviations from the trajectory of alpha particles.
- Source of alpha particle- radium.
- Alpha particles - positively charged helium atoms containing 2 protons and 2 neutrons



OBSERVATION	INFERENCE
Most of the alpha particles passed through the gold foil without any deviation	Most of the spaces in an atom is empty.
Some alpha particles deviated in small angles	Since positively charged alpha particles are deflected, there are positively charged particles in an atom. Deflected, there
Only a small portion of alpha particles got bounce back.	There is a small centre in an atom which composed of entire mass and positive charge. The positively charged particles moving towards the centre will be deflected

Rutherford's postulates:

- An atom has a centre called nucleus.
- Compared to the size of atom, the size of the centre is too small.
- All positively charged particles and most of the mass is concentrated in the nucleus of atom
- Negatively charged electrons revolve around the nucleus in circular paths called orbits.
- Electrons and nucleus are held together by electrostatic force of attraction.

Limitations of Rutherford's model:

- Failed to explain the stability of atom.
- Didn't explain about the electronic structure of atom.
- Didn't show quantized energy levels.
- Didn't explain about the dual nature of atom.

BOHR'S MODEL OF ATOM:

- Two developments lead to formation of Bohr's model
1. Dual character of the electromagnetic radiation
 2. Experimental results regarding atomic spectra which can be explained only by assuming quantized electron energy level in an atom.
 - Electrons revolve around the nucleus in a fixed path called as orbits or shells.
 - Electrons in each shell have a definite energy. So shells are called the energy levels.
 - As long as the electrons revolve in a particular orbit, its energy remains constant
 - The energy of the shell increases as the distance from the nucleus increases.
 - When the electrons absorb energy, they move from lower energy state to higher.
 - When the electrons loses energy, they move from higher energy state to lower.

Limitations of Bohr Atomic Model Theory

- It violates the Heisenberg Uncertainty Principle. The Bohr atomic model theory considers electrons to have both known position and momentum at the same time, which is impossible according to Heisenberg.
- The Bohr atomic model theory made correct predictions for smaller sized atoms like hydrogen, but poor spectral predictions are obtained when larger atoms are considered.
- Was not able to explain the splitting of spectral lines in the presence of magnetic field (ZEEMAN effect) or electric field.(stark effect)
- It couldn't explain the ability of atoms to form molecules by chemical bonds

Chadwick-confirmed the presence of neutral particles within the nucleus of atom- neutrons.

SUBATOMIC PARTICLES.

Particle	Invented by	Charge	Mass
Neutron	Chadwick	0	$9.1 \times 10^{-31} \text{ kg}$
Electron	Thomson.	$1.6 \times 10^{-19} \text{ coulombs}$	$1.67 \times 10^{-27} \text{ kg}$
Proton	Rutherford	$1.6 \times 10^{19} \text{ coulombs}$	$1.67 \times 10^{-27} \text{ kg}$

Electrons

- Described as cathode rays- negatively charged particles, travel in straight line move from negative electrode towards positive electrode(cathode to anode), deflected by both electric and magnetic field.
- (Example of cathode rays, rays from television picture tube)
- Have kinetic energy.
- Charge of one mole of electron $(1.603 \times 10^{-19}) \times (6.023 \times 10^{23}) = 96487 \text{c/mole}$.

Protons

- Was discovered through gold foil experiment.

Neutron

- In the Nucleus of the atom there are particles which possess no charge, but have the mass almost equal to that of the protons. This confirmed the existence of neutrons. Found to be as heavy as protons.
- Neutrons = protons + neutrons.

QUESTIONS:

➤ Rutherford's model of atom are correct?

- (i) Considered the nucleus as positively charged.
- (ii) Established that the α -particles are four times as heavy as a hydrogen atom.
- (iii) Can be compared to solar system.
- (iv) Was in agreement with Thomson's model.

A. i) and (iii)

B. (ii) and (iii)

C. (i) and (iv)

D. Only (i)

➤ Why was the Thomson's Model of an atom failed?

- i. It could not explain the screening of negative charges from that of positive
- ii. It did not tell about the presence of electrons
- iii. It did not give an idea about the discrete energy levels
- iv. It explained the atom as a whole to be electrically neutral

Choose the correct option from the following:

A. Only (iii)

B. Both (i) & (iii)

C. Only (i)

D. Both (ii) & (iv)

➤ Which of the following statement is always correct?

A An atom has equal number of electrons and protons.

B. An atom has equal number of electrons and neutrons.

C. An atom has equal number of protons and neutrons

D. An atom has equal number of electrons, protons and neutrons.

- In an alpha scattering experiment ,few alpha particles rebounded because :
- a. Most of the space in the atom is occupied
 - b. Positive charge of the atom very little space**
 - c. The mass of the atom is concentrated in the centre
 - d. All the positive charge and mass of the atom is concentrated in small volume