Structure of Atom

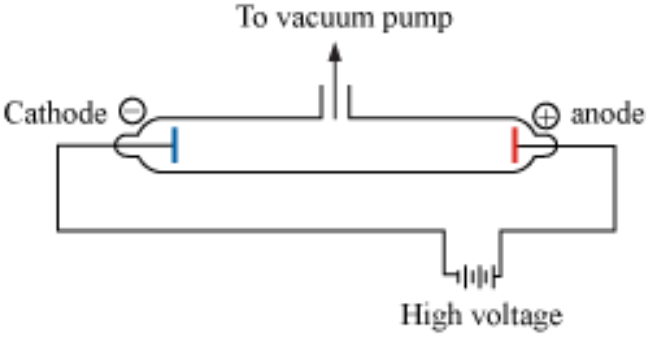
- **Atoms**

- **According to Dalton's atomic theory**
  - Matter is made up of very tiny particles and these particles are called atoms.
  - Atoms cannot be divided further i.e., atoms are indivisible
  - An atom can be defined as the smallest particle of matter that can neither be created nor destroyed by chemical means.

Sub-atomic particles:

Name	Symbol	Charge/C	Relative charge	Mass/kg
Electron	e	-1.6022×10^{-19}	−1	9.1094×10^{-31}
Proton	p	$+1.6022 \times 10^{-19}$	+1	1.6726×10^{-27}
Neutron	n	0	0	1.6749×10^{-27}

Discovery of Electron



- Glass tube is partially evacuated (Low pressure inside the tube)
- Very high voltage is applied across the electrodes

Results:

- Cathode rays move from the cathode to the anode.
- Cathode rays are not visible.
- These rays travel in a straight line in the absence of electric and magnetic fields.
- The behaviour of cathode rays is similar to negatively charged particles (electrons) in the presence of an electrical or a magnetic field.
- Characteristics of cathode rays do not depend upon: the material of the electrodes and the nature of the gas present in the tube

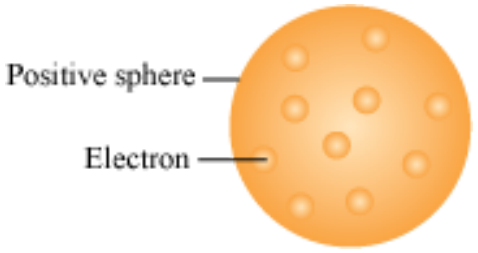
Charge to Mass Ratio of Electron:

$$\frac{e}{m} = 1.7558820 \times 10^{11}\ Ckg^{-1}$$

- Atoms are not indivisible and are composed of three fundamental particles. These particles are electrons, protons, and neutrons.

- **Charged particles in Matter**
  - Electrons are negatively-charged particles. They were discovered by J. J. Thomson, by cathode ray experiment.
  - Canal rays are positively charged radiation consisting of protons. Protons are positively-charged particles and were discovered by E. Goldstein.
  - The third fundamental particles present in an atom are neutrons. They are electrically-neutral and were discovered by J. Chadwick.
  - Various models were given to explain the structure of atom.

- **Thomson's atomic model**:
  - Thomson thought that an atom is a sphere of positive charge in which electrons are embedded.
  - An atom as a whole is electrically neutral because the negative and positive charges are equal in magnitude.



- **Rutherford's atomic model**:
  - On the basis of his experiments with alpha rays and gold foil, Rutherford concluded that Thomson's atomic model was incorrect.
  - He proposed an atomic model based on the results of his experiments.
  - In this model, all the positive charges (i.e., protons) were present at the centre of the atom, inside the nucleus, and the electrons were present in circular orbits around the nucleus.
  - He said that the electrons are not at rest and keep moving continuously in these circular orbits.
  - He also said that the size of the nucleus is very small as compared to that of the atom.

- **Drawbacks of Rutherford's Model**

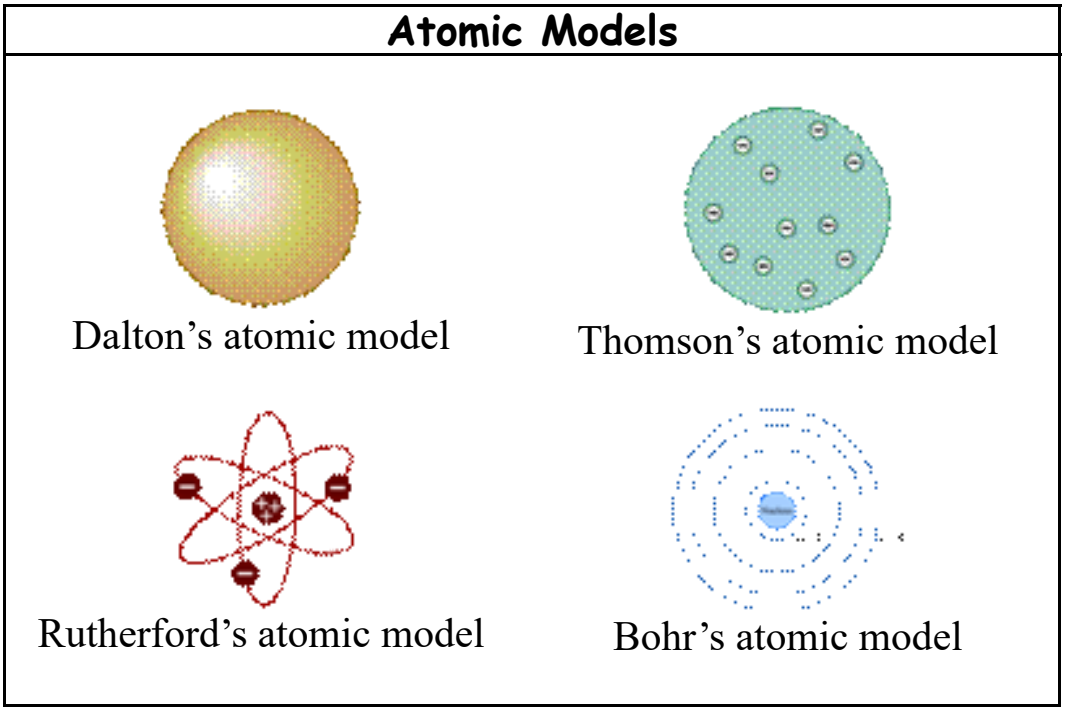
  - It cannot explain the stability of an atom on the basis of classical mechanics and electromagnetic theory.

  - If the electrons were stationary, then the strong electrostatic force of attraction between the dense nucleus and the electrons would pull the electrons towards the nucleus. Thus, it cannot explain the stability of an atom.

  - Rutherford's model does not give any idea about the distribution of electrons around the nucleus (i.e., the electronic structure of the atom), and about their energy.

- It cannot explain the atomic spectra.

- **Bohr's atomic model**:
  - Neils Bohr proposed that the electrons present around the nucleus revolve in specific orbits called energy levels.
  - He also stated that the electrons do not release energy while revolving. Thus, the resulting atom is a stable one.
  - The shells in which the electrons are present are known as K, L, M, N, and so on (or 1, 2, 3, 4, and so on), as proposed by Bohr and Bury.
  - Each shell contains a specific number of electrons, which can be calculated using the formula $2n^2$.



  - Valency is defined as the combining capacity of the atom of an element. Valency of an element depends upon the number of electrons present in the outermost shell of its atom.

- **Atomic number** of an element is equal to the number of protons present in the atom and atomic mass is equal to the sum of the number of protons and neutrons present in it.

- Valency is defined as the combining capacity of the atom of an element. Valency of an element depends upon the number of electrons present in the outermost shell of its atom.
- The combining capacity of an element is known as its **valency**.
- It has been observed that certain metals exhibit more than one valency. In such a situation, metals are said to exhibit variable valency.

- **Molecule**
  - A molecule is formed when two or more atoms of the same element or different elements get combined chemically.
  - The number of atoms that combine to form a molecule is called the atomicity of the molecule.

- **Ion**
  - An ion is a charged species in which an atom or a group of atoms possess a net electric charge (positive or negative).
  - Positively charged ions are called cations (basic radical) and negatively charged ions (acidic radical) are called anions.
  - Compounds in which molecules are formed by the combination of cations (positively charged ions) and anions (negatively charged ions) are known as ionic compounds.