**Atomic  Theory of matter :-**

                                            According to this theory , atom is the ultimate particle of matter , also known as Dalton’s  Atomic theory (1808).

**Cathode ray discharge tube experiments: -**

1.     Cathode rays start from cathode and move toward anode.

2.     These rays are not visible but there behaviour can be observed with fluorescent or phosphorus sent material.

3.     In the absence of magnetic or electric field these travels in strait lines

4.     In the presence or magnetic or electric field the behaviour of cathode rays in similar TO Negatively charged  particles  which suggest that these rays contain negatively charge particles called electron

5.     Cathode rays (electrons) do not depend on  the martial of the electrode and  nature of the gas tin the tube so electro us are basic constituent of all atoms.

**Charge (e) to mass (me) ratio of electron**

 Measured by  J. J. Thomson (1897).

 By using cathode ray tube ; applying electrical & magnetic field perpendicular to each other also perpendicular to path of electrons.

 He proposed  deviation of particles from their path in presence of magnetic or electrical field depend upon the following

1.     **Magnetic of  – ve  charge on particle**

i.e. it magnitude of charge on particles is greater than interaction with magnetic or electric field is greater so deflection is also grater.

2.      **Mass of particles**

i.e. particle is lighter then deflection is greater.

                 3.  **Strength of magnetic or electric field.**

i.e. it strength of magnetic  field or voltage at electron is increases then deflection of                                            e- also increases

        =>  value of e/me = 1.758820× 1011 C kg-1

**Charge of electron**

 Determine by  R. A. Millikan

 By oil drop experiment (1906-1914)

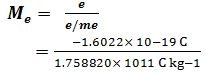
 Charge on e- =  -1.6× 10-19 C

Present accepted value , e-= -1.6022× 10-19 C

**Mass of electron**

 From charge on e- & e/me

 We get,

**[](https://1.bp.blogspot.com/-v-hIVEXkTWo/VO18eY9PeJI/AAAAAAAABUE/T8JsoW6q9sI/s1600/MASS%2BOF%2BELECTRON.png)**

**Me =**9.1094  10-31 kg

**Discovery of protons**

 Discovered by E. Goldstein.

 In modified cathode ray tube gives +ve charge carrying particles known as canal rays.

 Lithest & smallest +ve ion obtained from Hydrogen called proton.

**Characteristics**

1)    Depend upon, nature of gas present in cathode ray tube.

2)    Charge to mass ratio of particles depends on gas from which these originate.

3)    Some of +ve charged particles carry a multiple unit of electrical charge.

4)    Behavior of protons in magnetic or electric field is opposite to election behavior.

**Discovery of neutrons**

 Discovered by Chadwick (1932).

 By bombarding a thin sheet of beryllium by alpha particles.

 Electrically neutral particles were emitted known as neutrons.

**Thomson model of atom**

 Give by J.J Thomson (1898)

 According to J.J. Thomson atoms posses a spherical shape with radius about 10-10m, in which + ve charge is uniformly distributed.

 Electrons are embedded in such a manner to give most stable electrostatic arrangement.

 Other names of this model plum pudding raisin pudding watermelon.

 Mass is assumed to be uniformly distributed in atom.

**Rutherford’s nuclear model of atom**

 Given by Rutherford & his students Ernest Marsden and Hans Geiger.

 By α- particles scattering experiment-

|  |
| --- |
| [Rutherford nuclear model of atom](https://4.bp.blogspot.com/-rEra3W3Sz7Q/VO1-PYVkp7I/AAAAAAAABUQ/R_5Hycr4CT8/s1600/Rutherford%E2%80%99s%2Bnuclear%2Bmodel%2Bof%2Batom.png) |
| **Rutherford’s nuclear model of atom** |

 When beam of high energy α- particles was directed at gold foil then tiny flash of light observed at photographic plate.

**Rutherford observed that-**

1)    Most of the α-  practical  passed  through gold foil undeflected :

2)    A small fraction of α- particles was deflected by small angles.

3)    A very few α- particles (about 1 in 20000) bounced back means deflected by nearly 1800

**From above observations he concludes the structure of atom.**

1)    Most of space in atom is empty because most of α- particles passed undeflected.

2)    Few +ve charged α- particles were deflected.

Because + ve charge of the atom present in center in very small volume that repelled & deflected the +ve charged α- particles.

3)    Volume of nucleus is negligible as compared to total volume of atom

i.e.  radius of atom = 10-10m  (approx)

radius of nucleus =  10-15m  (approx)

**On the basis of observation &  conclusion Rutherford proposed model of atom as-**

1)    +ve charge & most of mass present in the center of atom known as nucleus.

2)    Electrons moves around nucleus with very high speed in circular paths known as orbits.

3)    Electrons and nucleus (protons) are held together by electrostatic force of attraction .

**Atomic number (Z)** = no of protons in the nucleus of an atom

                                       = no of electrons in a neutral atom

**Mass number** **(A) =**number of protons (z) + number of electron (n)

**Isobars :-**

              These are atoms with same mass number but different atomic number.

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**Isotopes: -**

               These are atoms with same atomic number but  different atomic mass no.

[https://3.bp.blogspot.com/-MlcevnGHcSE/VO1_-0u7AKI/AAAAAAAABUk/H-x59U2VE8Y/s1600/isotope.png](https://3.bp.blogspot.com/-MlcevnGHcSE/VO1_-0u7AKI/AAAAAAAABUk/H-x59U2VE8Y/s1600/isotope.png)

**Wave nature of electromagnetic radiations: -**

First explanation gives by James Maxwell (1870)

1)    Oscillating magnetic & electric fields produced by the oscillating charged particles are perpendicular to each other and both also perpendicular to the wave direction of propagation.

2)    These waves do not require medium i.e. electromagnetic wave can travel in vacuum.

3)    Electromagnetic radiation differs from one another in frequency or wavelength gives electromagnetic spectrum.

4)    Different units are used to represent electromagnetic radiation.

                                  = frequency,

                                 = wavelength.

**Particle nature of electromagnetic radiation :-**

                                                                        Also known as Planck’s  Quantum theory

Planck suggested that the atoms and molecules can absorb or emit energy in discrete quantities nit in continuous manner. Planck gives it name as quantum. Energy (E) of  quantum of  radiation is directly proportional to its frequency()

 i.e.            E=h

Where,      h = planks constant = 6.626× 10-34 js

**Photo electric effect:-**

 given by H. Hertz(1887)

 When a beam of light strike a metal surface then electrons were ejected. This phenomena is known as photo electric effect.

1.     Electrons ejected from metal surface when beam of  light strike the metal surface

2.     Number of electron ejected is directly proportional to intensity (or brightness) of light

3.     There is characteristic minimum frequency (0 threshold frequency) below which photoelectric effect is not observed.

4.     If  > 0 then electrons comes out with kinetic energy which increases with increase in frequency of light.

Kinetic energy of ejected electrons is given by-

h  = h 0+ ½(meV2)

**Spectroscopy:-**

                      study of  absorption or emission spectra is called spectroscopy .

**Bohr’s model for hydrogen atom:-**

 Explain by nails Bohr (1913).

 Postulates for Bohr’s modal are,

1.     Electron in hydrogen atom move around nucleus in circular path of fixed radius and energy. these paths are called orbits

2.     Energy of e does not change with time.

However, when electron move from lower to higher stationary state it absorbed sub amount of energy and energy release when it comes back.

3.     Frequency of radiations emitted or absorbed when transition of e occur is given by

[bohr model](https://2.bp.blogspot.com/-fBF6nvpWK8A/VO2BZGiDf7I/AAAAAAAABUw/vOQ37J4IQUA/s1600/bohr%2Bmodel%2B1.png)

Where, e1 & e2 is lower & higher energy state.

4.     Angular momentum of n electron in given stationary state is given by

[bohr model](https://1.bp.blogspot.com/-CVyRA__jlR8/VO2BnYrIeNI/AAAAAAAABU4/AYF777lHM54/s1600/bohr%2Bmodel%2B2.png)

[Where n =1,2,3.....]

**Limitation of Bohr’s model:-**

1.     Bohr model fail to explain finer detail of hydrogen atom spectrum observed by spectroscopic, techniques.

2.     It fails to explain spectrum of other atom except hydrogen atom.

3.     It fails to explain splitting of the spectral lines in presence of electric (stark effect) or magnetic field ( Zeeman effect )

4.     Fell to explain formation of molecules from atoms by chemical bonding.

**Dual behaviour of matter :-**

 Explain by de Broglie (1924)

 He explain that matter also behave like radiation and exhibit dual behavior means both like particle and wave like properties .

*Relation*

[dual behavior of matter](https://1.bp.blogspot.com/-9dpS5XmRAq4/VO2CdgHUnAI/AAAAAAAABVE/M66cowqI9sE/s1600/dual%2Bbehavior%2Bof%2Bmatter.png)

   Where   =  wavelength.

             m = mass of particle ,

             v = velocity of particle,

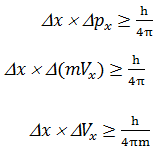
              p = momentum

**Heisenberg’s uncertainty principle:-**

 Given by Werner Heisenberg (1927)

He explain that it is impossible to determine simultaneously the exact positive and exact momentum (or velocity) of an electron

*Mathematical explanation*

[](https://1.bp.blogspot.com/-G77UsGzrfvo/VO2DJGS7MYI/AAAAAAAABVM/FPt-nH5iBc8/s1600/Heisenberg%E2%80%99s%2Buncertainty%2Bprinciple.png)

     Where,  x= uncertainty  in position

                   Vx= uncertainty in velocity or momentum

**Quantum mechanical model of atom:-**

Branches of science which explain duel behavior of Metter is called quantum mechanics .

 Quantum mechanics independently developed by Werner Heisenberg and Erwin Schrodinger (1926)

Fundamental equation developed by Schrodinger (won Nobel Prize 1933)

Equation for a system (atom or molecules was energy does not change with time)

**Principle quantum number ‘n’ :-**

        It is a positive Integer with value of n = 1,2,3......

        It determine size and energy of orbital

        It also identifies the shell with increase in an , number of allowed orbital increase. And given by n2

N      =1,    2,    3,    4........

Shell = k,    l,    m,    l......

        Size of orbital increase with increase in an  n.

**Azimuthal quantum no.‘p’  :-**

        It is also known as orbital angular momentum or subsidiary quantum no.

        It defined 3d shape of orbital of orbital

        For given value of n possible value of

        L= 0,1,2,3,4,5,----------(n-1) ,

                    Ex :- if   n=1   then   l=0

                             if   n=2   then   l=0,1

                             if   n=5   then   l=0,2,3,4

        Each shell consists of one or more sub-shells or sub-shells.

        No of sub-shells = value of  n

If  n= 1  then  1 sub-shell =  (l=0)

If  n= 2  then  2 sub-shell =  (l=0,1)

If  n= 3  then  3 sub-shell =  (l=0,1,2)

                      Value of    l =  0,  1,  2,  3,  4,  5  ----------

     Notation for sub-shell= s, p, d,   f,   g, h--------------

        Sub-shell notation

|  |  |  |
| --- | --- | --- |
| **n** | **l** | **Sub-shell   notation** |
| 1 | 0 | 1s |
| 2 | 0 | 2s |
| 2 | 1 | 2p |
| 3 | 0 | 3s |
| 3 | 1 | 3p |
| 3 | 2 | 3d |
| 4 | 0 | 4s |
| 4 | 1 | 4p |
| 4 | 2 | 4d |
| 4 | 3 | 4f |

**Magnetic orbital quantum no ‘mi’ :-**

        This quantum no (mi) gives information about orientation of  the  orbital .

        Ml = (2l+1) i.e. if value of   l  is  1 then value of  ml = 2×1+1=3=(-1,0,1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Value of p | 0 | 1 | 2 | 3 | 4 | 5 |
| Sub-shell notation | S | P | D | F | G | H |
| No of orbital’s | 1 | 3 | 5 | 7 | 9 | 11 |

**Electron spin quantum (ms)  :-**

        Proposed by G. Uhlen beck & S. Goodsmit (1925)

        Electrons spins around its own axis

        Mshave two value +1/2 & -1/2

        Ms gives information about orientation of the spin of   the electron.

**Aufbau principle   :-**

                              According to this principle in the ground state of the atoms the orbital’s are filled in order of their increasing energies means electrons enter higher energy orbital’s  so order in which orbital’s are filled is 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p.

**Pauli exclusion principle  :-**

         given by W. Pauli (1926).

        Two electrons in an atoms can’t have same set of 4-quantum no.

        Only two electrons may exist in same orbital and these electrons must have opposite spin.

**Hund’s  rule of maximum multiplicity :-.**

        According to this rule pairing of  electron in the orbital’s belonging to the same sub-shell (p, d or f)

        Does not take place until each orbital belonging to that sub-shell has got one electron each i.e. it is singly occupied.