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Structure of Atoms

Atoms

Atoms are the building blocks of matter. it is the smallest unit of matter that is composed of three sub-atomic particles: that proton, the neutron, and the electron.

Electron:

- the electron is negetively charged sub-atomic particle of an atom.
- the mass of an electron is considered to to be neglible and its charge is -1.
- the symbol of electron is e^-.
- electron are extremly small.
- they are found outside the nucleus.

Discovery

the existence of electron in an atom was shown by J.J. Thomson in 1897.

cathode ray experiments

Thomson explained the formation of cathode ray as follow:

the gas taken in the discharge tube consists of atoms, all the atoms contains electron. when high electrical voltage is applied, the electrical energy pushes out some of the electrons from the atoms of gas. these fast moving electron form cathode ray. thus the formation of cathode ray shows that one of the subatomic particles presents in all the atom is negatively charge electron

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Proton

Proton is positively charge particles having different masses and charge.
the existence of positievly charge particles in the atoms was shown by E. Goldstein.
The formation of protons can be explained as follow:
Hydrogen gas consists of hydrogen atoms.
When high electrical voltage is applied to hydrogen gas, the electrical energy removes the electron from the hydrogen atom.
After the removal of negatively charged electron from a hydrogen atom, a positevly charged particles called proton is formed.

- the fast moving proton form the anode rays.
- the relative mass of a proton is 1 u.

the charge of an electron is equal and opposite to the charge of proton.

- the relative charge of a proton is +1.

Neutron

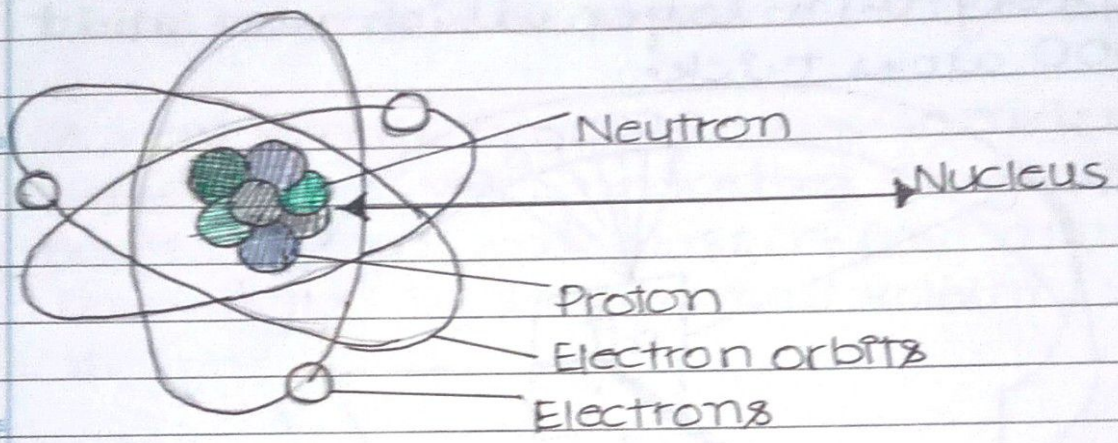
the neutron is a neutral particles found in the neucleus of an atom.

- the sub atomic particles not present in a hydrogen atom is neutron.
- the discovery of Neutron was shown by Jemes chadwick.
- the mass of neutron is equal to the mass of proton.
- the absolute mass of the neutron is 1.6×10^{-2} gram.

→ Neutron has no charge.

Structure of Atom.

the discovery of electrons and protons suggested that atoms are divisible and they do have an inner structure.



THOMSON'S MODEL OF THE ATOM.

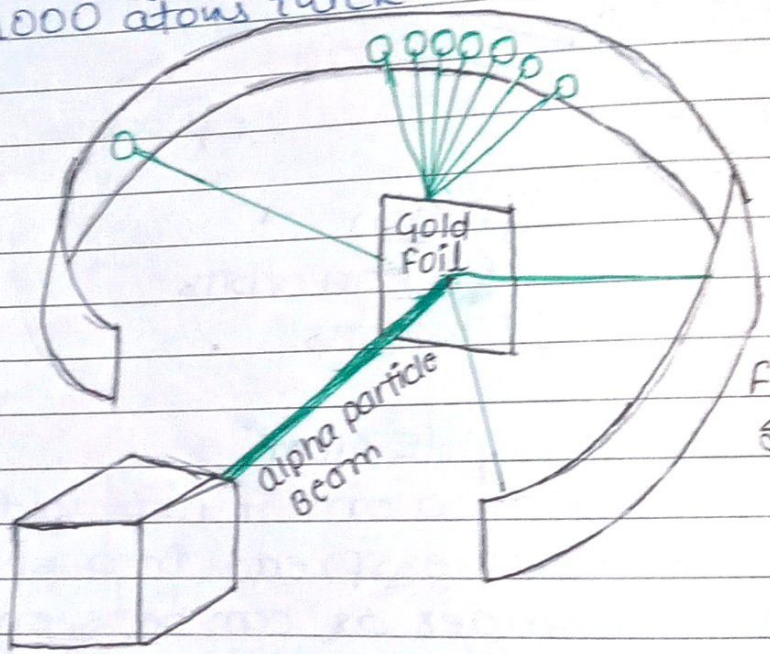
In this model of an atom it was told as the electrons were spread in a shpere of positive charges as can be seen in a watermelon the whole ~~watermelon~~ red part of the watermelon will be supposed to the positive charge and the seeds are supposed to be the electrons.

→ An atom consists of positively charged sphere and the electrons are embedded in it.
Negative and positive charge are Equal in magnitude and makes the atom neutral as a whole. this was proposed by J.J thompson.

Rutherford's Experiment :- Discovery of Nucleus.

In this model the scientist experiment by dropping the Alpha particles on a thin Gold foil.

→ Gold foil was selected because it can be very thin layer which was about 1000 atoms thick.



Observations

1) Most of the fast moving α particles passed straight through the Gold foil.

2) Some of the α-particles were deflected by the foil by small angles.

3) Surprisingly one out of every 12000 particles Appeared to rebound.

Conclusion

① Most of the space inside the atom is empty because most of the α-particles passed through the Gold foil without getting deflected.

II) Very few particles were deflected from their path. Indicating that the positive charge of the atoms occupies very little space.

III) A very small fraction of α-particles were deflected by 180°, Indicating that all the positive charge and mass of Gold atom were Concentrated in a very small volume with in the atoms.

On the basis of the experiments: Ruther ford put forward the nuclear model of the atoms. which had the following Features:

I) There is a positively charged centre in an atom called the nucleus. Nearly all the mass of an atoms resides in the nucleus.

III) The size of the nucleus is very small as compared to the size of the atoms.

II) The electrons are revolve around the nucleus in well-defined orbits.

Drawback of Rutherford's model of the atom

The orbital revolution of the electrons is not exepted to be stable. Any particles in a circular Orbit would undergo Acceleration. During acceleration, charged particles would radiate energy. thus, the revolution revolving electron would lose energy and finally fall into the nucleus. If this were so, the atom should be highly unstable and hence matter would not exist in the form that we know. We know that atoms are quite sutable.

→ According to the Rutherford, electrons are revolve round to the neucleus in well-defined Orbits, but electrons being charged particles will lose their energy and finally will fall into the nucleus. this will make the atoms highly unstable.

→ this was major drawback of Rutherford which was unexplained by him.

Neils Bohr's Model of the Atoms.

to Overcome drawbacks of Rutherford's Model, Neil Bohr in 1972 proposed modified model of the structure of Atom.
he made the following Assumptions :

I. → Only certain special orbits known as ~~describe~~ discrete orbits of electrons are followed inside the atoms.

II. → While revolving in discreate Orbits, the electrons do not radiate energy.

III. → Energy is emitted or absorbed by an atom only when an electron moves from One Orbit to Another.

Atomic Number

The total number of protons lying in the nucleus of any atom is called the atomic number.

→ An atomic number is the identity of an atom, Changing atomic number mecms changing the atoms.

→ Atomic number is denoted by 'Z'. (Z=no of Proton)

→ for a neutral atom, no of protons and electrons Are equal.

Mass Number

It is the sum of total number of protons and no. of neutrons lying in the nucleus of an atom.

→ Mass number = No. of protons No. of neutrons.
it is denoted by 'A'. ($A = n_p + n_N$)

Mass N.O
[Protons + Neutron] ^{24}

$$Mg$$

$_{12}$

Atomic Number
[Protons]

Date

Electronic configuration of Elements

The arragements of electrons in the various shells (on energy levels) of an atom of the elements known as electronic configuration of the elements.

In other ~~word~~ to write doum the electronic configrations of an elements, we should know two things:

1. We should know the number of electron in one atom of the elements.
11. We should know the maximum number of electron that can be accomd

→ The maximum number of electron which can be put in a particular energy levels or shell was Given by Bohr and Bury.

A/Q to the Bohr and Bury scheme:

1. the maximum number of electrons which can be accomodated in any energy leval of the atom is Given by $2n^2$ (Where n is the number of that energy leval.

for 1st energy leval → $n=1$
→ $2n^2$
→ 2×1^2
→ 2

11. For 2nd energy leval → $n=2$
→ $2n^2$
→ 2×2^2
→ 8

iii] for 3rd energy leval, $n=3$

$\rightarrow 2n^2$

$\rightarrow 2\times 3^2$

$\rightarrow 18$

iv] for 4rT energy leval - $n=4$

$\rightarrow 2n^2$

$\rightarrow 2\times 4^2$

$\rightarrow 32$

II. the outermost shell of an atom cannot accommodate more than 8 electrons, even if thas the capicity to accomodate more electrons.

III. Electrons in an atom do not occupy a new shell unless all the inner shells are completely filled with electrons.

Velence Electrons (or valency Electrons]

the outermost electrons shell of atom is known as valence shell. the electrons presents in the outermost shell of an atom are known as valency because they decide the valency (combining capicity) of the atom.

Only the valency electrons of an atom take part in a chemical reactions because they have more energy than all the inner electrons of the atom.

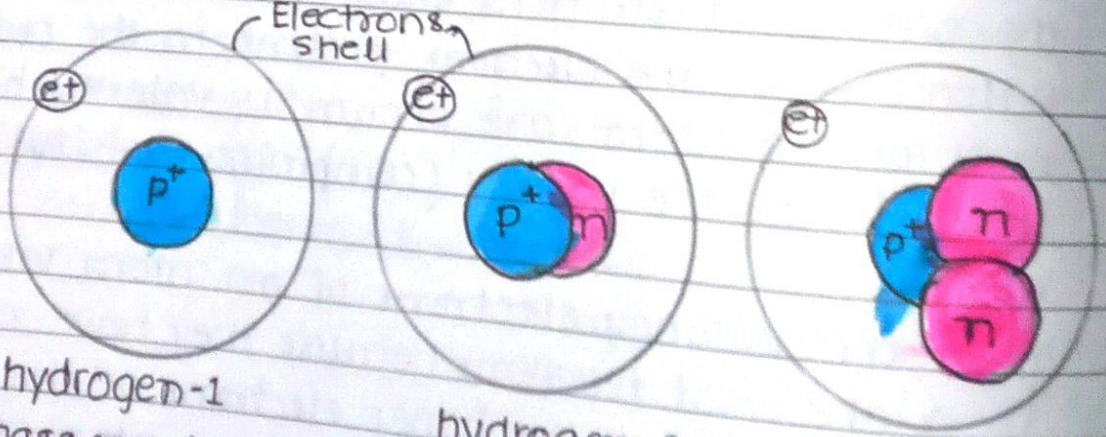
let us take an example of sodium atom to understand the meaning of valence electrons clearly.

→ the atomic number of sodium is 11. which means that one sodium atom has 11 electrons in it. so, the electronic configuration of sodium ~~is 11 electrons in it~~ atom will be K, L, M.
2, 8, 1

→ In order to find out the number of valency electrons in an atom of the elements, we should write down the electronic configuration of the element by using its atomic number. the outermost shell will be the valence shell and the number of electrons present in it will give us the number of valency.

Isotopes and Isobars.

Isotopes are defined as the atoms of the same elements, having the same atomic number (number of protons) but different mass numbers (N.O of protons + neutrons). for example: In the case of hydrogen we have:



hydrogen-1
mass number: 1

hydrogen-2
deuterium
mass n.o-2

hydrogen-3
tritium
mass n.o-3

Eg: Chlorine has two isotopes of mass number 35 and 37 respectively $^{35}_{17}Cl$ and $^{37}_{17}Cl$.

Uses of isotopes

i) Uranium isotopes is used to fuel in nuclear Rector.

ii) Isotopes of Cobalt is useful in treatment of cancer

iii) An Isotopes of Iodine is used in the treatments of Goiter.

Isobars

Isobars are the atoms of differents elements having different atomic numbers but the same mass number (or some atomic mass).