Date :- 14/01/022

CHEMISTRY

Atomic Number :- The number of protons present in the nucleus is equal to the number of electrons in extra nuclear part of the atom is called **atomic number** of an element.

It is denoted by Z.

$\therefore Z = p = e$

where, P = total number of protons present in the nucleus.

e = total number of electron present in the atom.

Atomic Mass Number :- The sum of the protons and Neutrons present in the nucleus of an atom of element is known as atomic mass number of an element.

It is denoted by A.

i.e, $A = p + n$.

H^{1}_{1} → 1 → Atomic mass Number. A; 1 → Atomic Number. Z

$_1H^1$ Atomic Number = 1.

Atomic Mass Number = 1

i.e, know that

$Z = p = e$

$1 = p = e$

No. of proton :- 1

No. of electron :- 1

$A = p + n$

$p + n = 1$

$1 + n = 1$

$n = 1 - 1$

$\Rightarrow 0$

No. of neutron = 0.

$_1D^2$ Atomic No. 1

Atomic Mass no. 2

$p = 1,\ e = 1,\ A = 2$

$p + n = A$

$1 + n = 2$

$n = 2 - 1$

$\therefore n = 1.$

No. of neutron ⇒ 1

$_1T^3$ Atomic No. 1

Atomic Mass No. 3

$p = 1,\ e = 1,\ A = 3$

$p + n = A$

$1 + n = 3$

$n = 3 - 1$

$n = 2.$

No. of neutron :- 2.

Here, we have three Isotopes of Hydrogen (H)

<u>protium.</u>	<u>Duterium.</u>	<u>Tritium.</u>
${}_1H^1$	${}_1D^2$	${}_1T^3$
$p = 1$	$p = 1$	$p = 1$
$e = 1$	$e = 1$	$e = 1$
$n = 0$	$n = 1$	$n = 2.$

Number of protons and electron are same but the no. of neutron are change.

<u>ISOTOPES</u> :- Atoms of the same element which have the same atomic number but different mass number are called Isotopes

<u>Example</u> :- C_6^{12} , C_6^{13} , C_6^{14}

Oxygen has 3 isotopes :-

O_8^{16}	O_8^{17}	O_8^{18}
Atomic no. 8	Atomic no. 8	Atomic no. 8
Mass no. 16	Mass no. 17	Mass no. 18
No. of proton = electron = 8	No. of p = e = 8	No. of p = e = 8

The atomic structure of the three isotopes can be represented as follow :-

Atomic structure of three isotopes of Oxygen.

ISOBARS :- Atoms of the element which have same mass number but different atomic number.

Example :- Ar^{40}_{18} , K^{40}_{19} , Ca^{40}_{20}

Ar^{40}_{18}	K^{40}_{19}	Ca^{40}_{20}
Mass no. = 40	Mass no. = 40	Mass no. 40
Atomic no = 18	Atomic no : 19	Atomic no = 20
No. of p = e = 18	No of p = e = 19	No. of p = e = 20
No. of neutron = 22	No. of neutron = 21	No. of neutron = 20.

* For finding how much electron we use the formula $2n^2$ where n = no of orbit.

Difference/Distinguish between Isotopes and Isobars :-

Isotopes	Isobars
1. They have the same atomic number but different mass number.	1. They have the same mass number but different atomic number.
2. They have identical electronic configuration.	2. They have different electronic configuration.
3. They occupy the same place in the ~~preiodic~~ periodic Table.	3. They occupy the different place in the periodic Table.
4. The have the same no. of protons and electrons but different no. of neutrons.	4. They have the different no. of protons, electrons and neutrons.
5. They have the same chemical properties	5. They have the different chemical properties.
6. Eg - $_1H^1$, $_1D^2$ & $_1T^3$	6. Eg -

BOHR'S ATOMIC MODEL

Atomic Models :- Neil's Bohr proposed atomic model in 1913. This atomic model is based on the following fundamental principles :-

1. An atom consists of a dens positively ~~char~~ charged in central part. It is called neclues.

2. The electrons revolving around the neclues in fixed circular path. It is called orbits or shells.

3. The electrostatic force of attraction between the neclues and electron is balance by the centrifugal force. Therefore the electron does not fall into the neclues and the atom remains stable.

4. An electron can rotate only in certain permitted orbit which are known as stationary states.

5. Each of the stationary states is associated with a definite amount of energy. Therefore, these are also called as energy level.

6. Electrons in the energy level nearest to the neclues have lower energy while electrons at a greater distance from the neclues have higher energy.

7. Electron ~~stage~~ stays in the same energy level the energy remains constant. The energy of an electron can change when it moves from one level to another level.

8. Angular momentum (mvr) of electron must be an integral multiple of $h/2\pi$.

9. The number of Bohr's possible orbits can be determined by using the following equation:-

$$mvr = \frac{nh}{2\pi}$$

where m = mass of the electron, v = velocity of the electron in its orbit, r = radius of orbit, h = planck's constant $\left[(6.62)\text{value} \times 10^{-34}\ j/s\right]$ n = principle contam no. of an orbit {value (1, 2, 3, 4, 5, 6)}.

10) An ~~exicted~~ excited electron can jump from lower to higher energy level by absorbing of Conta = h ~~x~~ v. where v is the frequency of radiation of energy. On the other hand the excited electron jump from higher to lower energy level by emitting or losing of energy $hv = E^2 - E^1$

$$hv = E^2 - E^1.$$

Energy level/shell.	Sub energy level/sub shell.
K (n=1)	1S
L (n=2)	2S, 2P
M (n=3)	3S, 3P, 3D
N (n=4)	4S, 4P, 4D, 4F

Sub shell → Grouping in the number of energy in main energy level.

Maximum number of electron in orbital. → 2L+1 to find orbital.

S < P < D < F.

S => 2 [ee]

P => 6 [ee|ee|ee]

D => 10 [ee|ee|ee|ee|ee]

F => 14 [ee|ee|ee|ee|ee|ee|ee]

Energy level :- Bohr's stationary orbits which have definite amount of energy are called energy level. It is designated by K, L, M, N, O, P etc. The order of energy level is K > L > M > N > O > P.

Sub-Energy level :- A electron energy in the main energy level can be divided into several levels is called sub-energy level. These are designated by s, p, d, f.

Energy level or shells.	Sub-energy level or sub-shells.
K = n = 1	1s
L = n = 2	2s, 2p
M = n = 3	3s, 3p, 3d.
N = n = 4	4s, 4p, 4d, 4f.

Distinguish between Energy level and Sub-energy level.

Energy level	Sub-energy level.
1. Bohr's staisnory orbit with definit amount energy are called energy level.	1. The close grouping of a number of energy levels in the main energy level are called sub-energy level.

2. These are denoted by K, L, M, N, etc.	2. These are denoted by s, p, d, f, etc.
3. The maximum number of electrons in the energy level is determined by $2n^2$.	3. The maximum number of electrons in sub-energy level are $s = 2, p = 6, d = 10, f = 14$.
4. Energy level are circular or ellectrical in shape around the nucleus.	4. Sub-energy level have different geometric shape of orbital that is 's' is spherical, 'p' is dumbell shape etc.

$$mvr = \frac{nh}{2\pi}$$ → formula.

Q. Determine no. of electron, proton and neutron of Na, K, Ca, Mg, Co atoms.

Soln. Na

atomic no of sodium (Na) = 11

$\therefore Z = e = p$

Atomic no. = electron = proton

11 = 11 = 11.

$\therefore A = 23.$

$A = p + n$

$23 = 11 + n \Rightarrow 23 - 11 = n \Rightarrow n = 12$ Ans.

∴ electron = 11

proton = 11

neutron = 12.

K

atomic no. of potassium = 19.

∴ $Z = e = p$

Atomic no. = electron = proton.

$19 = 19 = 19.$

$A = 39.$

$A = p + n$

$39 = 19 + n$

$39 - 19 = n$

$20 = n$

∴ electron = 19.

proton = 19.

neutron = 20.

Ca

atomic no. of Calcium = 20

∴ $Z = e = p$

Atomic no. = electron = proton.

$20 = 20 = 20$

$A = 40.$

$A = p + n$

$40 = 20 + n$

$40 - 20 = n$

$20 = n$

∴ electron = 20 , proton = 20 and neutron = 20.

Mg.

atomic no. of magnissium = 12.

∴ $Z = e = p$

$12 = 12 = 12$

$A = 24.$

$A = p + n$

$24 = 12 + n$

$24 - 12 = n$

$12 = n$

∴ electron = 12 , proton = 12 , neutron = 12.

Cu

atomic no. of copper = 29

∴ $Z = e = p$

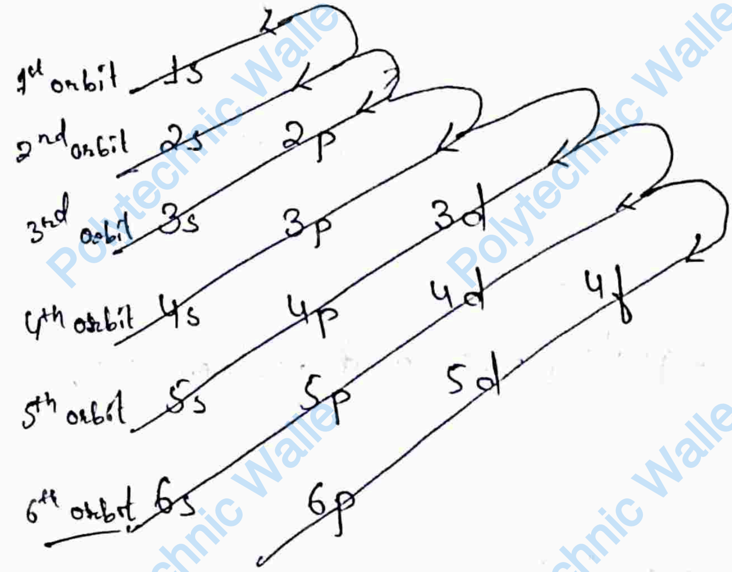
$29 = 29 = 29$

$A = 64.$

$A = p + n$

$64 = 29 + n$ → $64 - 29 = n$ → $35 = n.$

∴ electron = 29 , proton = 29 and neutron = 35.



Centrifugal force → Inside the body

Centripetel force → outside the body.

According to Aufbau principle electron filling method.

lower energy ⟶ higher energy.

$1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s.$

Quantum no:

① Principal Quantum no. (n)

② Azimuthal Quantum no. (l)

③ Magnetic Quantum no. (m)

④ Spin Quantum no. (s)

Write electronic configuration of the following elements

1. Al (13) $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
2. Na (11) $1s^2, 2s^2, 2p^6, 3s^1$
3. K (19) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$.
4. Ca (20) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
5. Cr (24) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^4, 4s^2$ → $3d^5, 4s^1$.
6. Fe (26) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2\ 3d^6$.
7. Cu (29) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^9, 4s^2$ → $3d^{10}, 4s^1$

Quantum No.

m = Formula $= 2l + 1$

magnetic quantum No.

$-l$ to $+l$ including 0.

Orbital	'l' value	Total no. of 'm' value	Range of magnetic Quantum no.
s	0	1	0.
p	1	3	-1, 0, +1.
d	2	5	-2, -1, 0, +1, +2.
f	3	7	-3, -2, -1, 0, 1, 2, 3.

Spin Quantum no. :- It determines the electron spinning around the nucleus.

The electron moves either clockwise (↑) or anti-clockwise (↓) direction. Therefore, it have two value $+\frac{1}{2}$ or $-\frac{1}{2}$.

In clockwise direction we use $+\frac{1}{2}$

while

In anti-clockwise direction we use $-\frac{1}{2}$.

(iii) It can indicated by arrow sign.

s = [↑↓]

p = [↑↓ | ↑↓ | ↑↓]
px py pz

d = [↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓]
$d_{xy}, d_{yz}, d_{zx}, d_{x^2-y^2}, d_{z^2}$.

Date
21 Feb 2022

Chemistry

mass of electron = 9.1×10^{-31} kg.

mass of proton = 1.67×10^{-27} kg. } both are approximately equal.

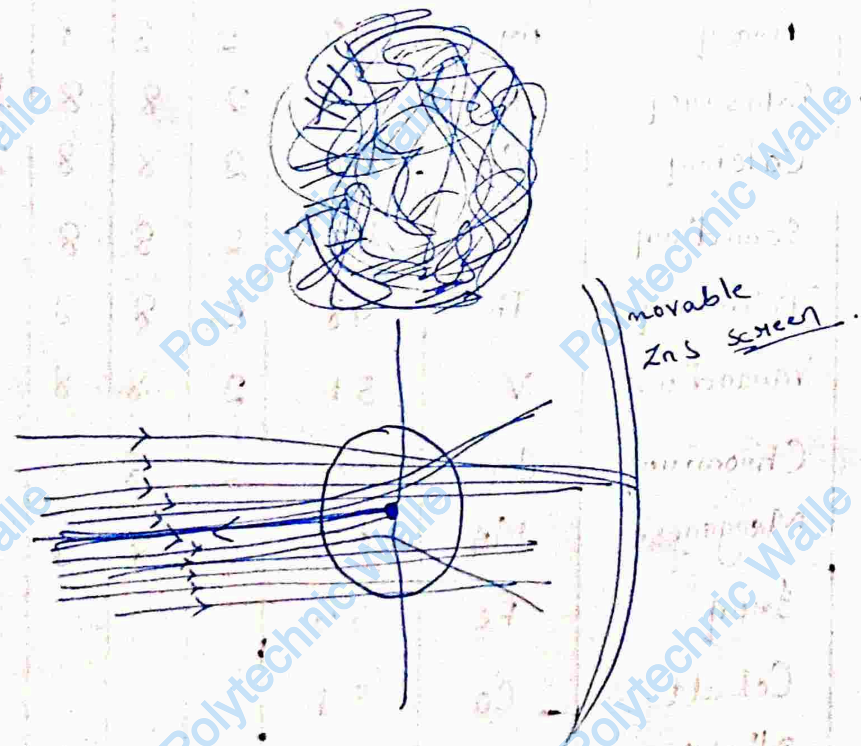
mass of nutron = 1.67×10^{-27} kg

relative charge of electron = (−1)

" " " proton = (+1)

" " " neutron = (0).

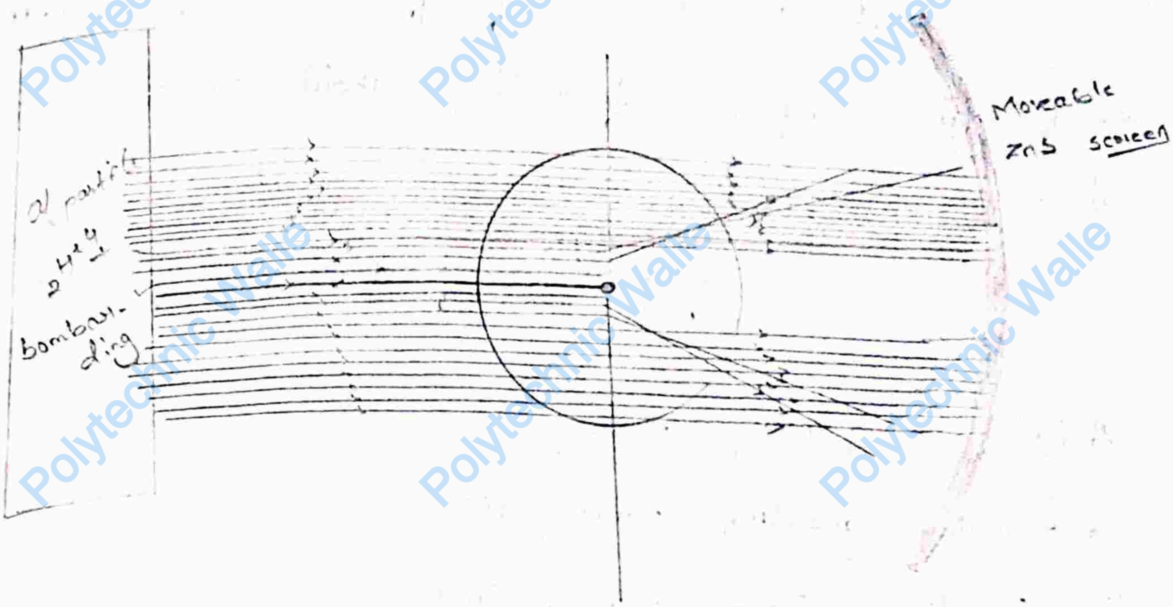
Rutherford Scattering Experiment



Date
21 Feb 2022.

Chemistry.

Rutherford Scattering Experiment.



OBSERVATIONS.

i) Most of the α-particles passed straight way through the gold foil deflection and some α-particles suffered little deflection and some of the α-particles suffered a voilent deflection of angle 90° or greater.

ii) One α-particles out of 20,000 particles suffered a Complete deflection through 180°.

iii) As most of the α-particles passed almost straight though the foil, indicating that an atom is extra-ordinary hollow with a lot of empty space.

Date

QUANTUM NUMBERS

It is a set of four number (n, l, m, s) which give complete information about electron and atoms.

There are four types of Quantum Numbers they are:-

i) Principal quantum number (n).
ii) Azimuthal quantum number (l).
iii) Magnetic quantum number (m).
iv) Spin quantum number (s).

All the four quantum numbers are discussed briefly as follows:-

i) Principal quantum number (n):-

i) It determines size of an electron of an atom.
ii) It determines average distance of an electrons from nucleus.
iii) It has positive integer value 1, 2, 3, 4 etc.
iv) We can find maximum number of electron from 'n' value by using $2n^2$.

Shell	Maximum no. of electrons	n
K	2	1
L	8	2
M	18	3
N	32	4

ii) Azimuthal quantum number (l):-

i) It is also called angular quantum number.
ii) It is denoted by (l)
iii) It is determines shape of orbital.
iv) It determine angular momentum of orbital.
v) 'l' value depends on 'n' value.
vi) The range of 'l' value can be determine by 0 to (n-1).

n value	l value
1	0
2	0,1
3	0,1,2
4	0,1,2,3.

iii) Magnetic quantum number (m):-

i) It determines the orientations of orbital.
ii) It is denoted by 'm'.
iii) 'm' value depends on 'l' value.
iv) The number of magnetic quantum number determine by 2l+1 and its range is -l to +l inc 0.

Orbital	'l' value	'm' value	Range of magnetic quantum no.
s	0	1	0
p	1	3	-1, 0, +1
d	2	5	-2, -1, 0, +1, +2
f	3	7	-3, -2, -1, 0, +1, +2, +3.

iv) Spin quantum number (s) :-

i) It determines electron spinning around the nucleus.

ii) The electrons moves either clockwise or anti-clockwise direction.

iii) It has two value $+\frac{1}{2}$ and $-\frac{1}{2}$.

iv) It can indicated by arrow sign (↑)(↓)

s = [↑↓]

p = [↑↓|↑↓|↑↓]
P_x, P_y, P_z

d = [↑↓|↑↓|↑↓|↑↓|↑↓]
$d_{xy}, d_{yz}, d_{zx}, d_{x^2-y^2}, d_{z^2}$.

PAULI'S EXCLUSION PRINCIPLE

This principle state that know to electrons of same atoms or orbital have same set of four quantum number (n, l, m, s).

For example :- K shell, the electron association in s orbital have same 3 quantum number (n, l, m) but different spin quantum number.

Quantum Number	1st electron	2nd electron
n	1	1
l	0	0
m	0	0
s	$+\frac{1}{2}$	$-\frac{1}{2}$

HUND'S RULE OF MAXIMUM MULTIPLICITY:

Hund's rule state that the electrons fills first in all available orbital singularly then we pairing it.

For example :- If p orbital have four electrons then first we fill 3 electron in all orbital then start pair.

p^4 = [↑↓ | ↑↓ |] wrong ✗

p^4 = [↑↓ | ↑ | ↑] Right ✓

AUFBAU PRINCIPLE

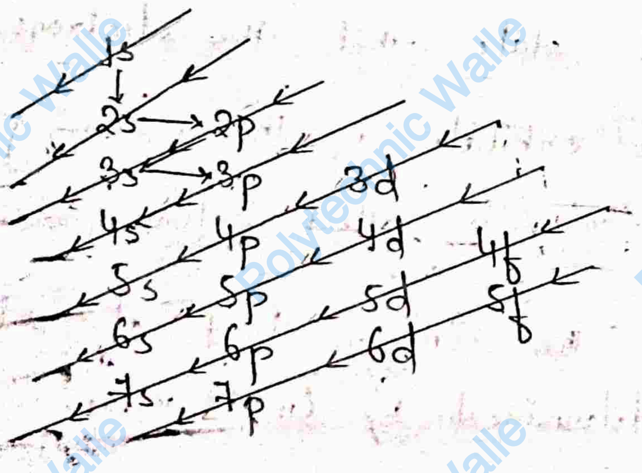
It state that the electrons occupy the available orbitals in the increasing order of energies, this is called Aufbau principle.

The energy level of orbitals can be determined by $(n+l)$ value.

Increasing order means → [lower energy to higher energy].

For finding energy → $eV = -13.6 \times \frac{Z^2}{n^2}$ (Z → Atomic no., n^2 → no. of shell.)

n	l (0 to n-1)	m (-l to +l inc. 0)	s	No. of electrons
1	0 (s)	0	+½, -½	2
2	0 (s)	0	+½, -½	2 } 8
	1 (p)	-1, 0, +1	+½, -½	6
3	0 (s)	0	+½, -½	2 } 18
	1 (p)	-1, 0, +1	+½, -½	6
	2 (d)	-2, -1, 0, +1, +2	+½, -½	10
4	0 (s)	0	+½, -½	2 } 32
	1 (p)	-1, 0, +1	+½, -½	6
	2 (d)	-2, -1, 0, +1, +2	+½, -½	10
	3 (f)	-3, -2, -1, 0, +1, +2, +3	+½, -½	14



Symbol	Electronic Configuration
H	$1s^1$
He	$1s^2$
Li	$1s^2, 2s^1$
Be	$1s^2, 2s^2$
B	$1s^2, 2s^2, 2p^1$
C	$1s^2, 2s^2, 2p^2$
N	$1s^2, 2s^2, 2p^3$
O	$1s^2, 2s^2, 2p^4$
F	$1s^2, 2s^2, 2p^5$
Ne	$1s^2, 2s^2, 2p^6$
Na	$1s^2, 2s^2, 2p^6, 3s^1$
Mg	$1s^2, 2s^2, 2p^6, 3s^2$
Al	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
Si	$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
P	$1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
S	$1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
Cl	$1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
Ar	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
K	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
Ca	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
Sc	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$
Ti	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$
V	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$
Cr	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
Mn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
Fe	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$
Co	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^7$
Ni	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$
Cu	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$
Zn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$

ol	Electronic Configuration
	$1s^1$
	$1s^2$
	$1s^2, 2s^1$
	$1s^2, 2s^2$
	$1s^2, 2s^2, 2p^1$
	$1s^2, 2s^2, 2p^2$
	$1s^2, 2s^2, 2p^3$
	$1s^2, 2s^2, 2p^4$
	$1s^2, 2s^2, 2p^5$
	$1s^2, 2s^2, 2p^6$
	$1s^2, 2s^2, 2p^6, 3s^1$
	$1s^2, 2s^2, 2p^6, 3s^2$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^7$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$
	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$

Symbol	Electronic Configuration
H	$1s^1$
He	$1s^2$
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B	$1s^2, 2s^2, 2p^1$
C	$1s^2, 2s^2, 2p^2$
N	$1s^2, 2s^2, 2p^3$
O	$1s^2, 2s^2, 2p^4$
F	$1s^2, 2s^2, 2p^5$
Ne	$1s^2, 2s^2, 2p^6$
Na	$1s^2, 2s^2, 2p^6, 3s^1$
Mg	$1s^2, 2s^2, 2p^6, 3s^2$
Al	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
Si	$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
P	$1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
S	$1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
Cl	$1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
Ar	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
K	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
Ca	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
Sc	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$
Ti	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$
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Mn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
Fe	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$
Co	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^7$
Ni	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$
Cu	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$
Zn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$

CHEMICAL BONDING

Valency :- According to octet rule the number of electrons gaining or lossing to complete its outtermost shell is called valency.

For example :-

(Valency of Na). Electronic Configuration - $1s^2, 2s^2, 2p^6, 3s^1$

Therefore it losses one electron to acquire stable configuration.

$$Na - e \longrightarrow Na^+$$

(2,8,1) (2,8)

∴ Valency of Na is +1.

(Valency of Cl)

Electronic Configuration = $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

Therefore, it require one electron to acquire stable configuration.

$$Cl + e^- \longrightarrow Cl^-$$

(2,8,7) (2,8,8)

∴ valency of Cl is -1.

Name of elements	Atomic Mass no.	Symbol	Electronic Configuration
Hydrogen	1	H	$1s^1$
Helium	4	He	$1s^2$
Lithium	7	Li	$1s^2, 2s^1$
Beryllium	9	Be	$1s^2, 2s^2$
Boron	11	B	$1s^2, 2s^2, 2p^1$
Carbon	12	C	$1s^2, 2s^2, 2p^2$
Nitrogen	14	N	$1s^2, 2s^2, 2p^3$
Oxygen	16	O	$1s^2, 2s^2, 2p^4$
Fluorine	19	F	$1s^2, 2s^2, 2p^5$
Neon	20	Ne	$1s^2, 2s^2, 2p^6$
Sodium	23	Na	$1s^2, 2s^2, 2p^6, 3s^1$
Magnesium	24	Mg	$1s^2, 2s^2, 2p^6, 3s^2$
Aluminium	27	Al	$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
Silicon	28	Si	$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$
Phosphorous	31	P	$1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
Sulphur	32	S	$1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
Chlorine	35	Cl	$1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
Argon	40	Ar	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
Potassium	39	K	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
Calcium	40	Ca	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
Scandium	45	Sc	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$
Titanium	48	Ti	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$
Vanadium	51	V	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$
Chromium	52	Cr	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
Manganese	55	Mn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
Iron	56	Fe	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$
Cobalt	59	Co	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^7$
Nickel	59	Ni	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$
Copper	63	Cu	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$
Zinc	65	Zn	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$

There are three types of Valency :

1. Electrovalency (Electrovalent bond or Ionic bond)
2. Co-valency (Covalent bond).
3. Co-ordinate Valency (Co-ordinate bond).

1. Electrovalency :- The number of electron lossing or gaining to acquire its last orbit is called electrovalency.

- The bond formed by transfer of electron between two atoms [redacted] (of two different element) is called electrovalent or Ionic bond.

For example :-

Formation of NaCl Compound.

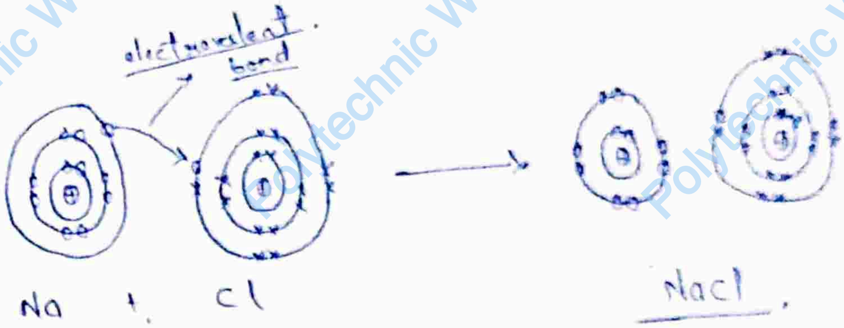
Sodium chloride compound is formed by the combination of one sodium and one chlorine atom. The electronic ~~cof~~ configuration of Na is 2,8,1 and chlorine is 2,8,7.

Therefore, Na atom losses one electron to acquire positive charge and stable configuration (2,8).

Similarly, Cl atom gains one electron to acquire negative charge and stable configuration (2,8,8).

The electrostatic force of attraction between Na^{+} and Cl^{-} to produce electrovalent compound NaCl.

$$Na^{+1} + Cl^{-1} \longrightarrow NaCl$$



① Formation of $CaCl_2$ compound.

② Formation of $AlCl_3$ compound.

③ Formation of KOH compound.

Formation of $CaCl_2$ Compound

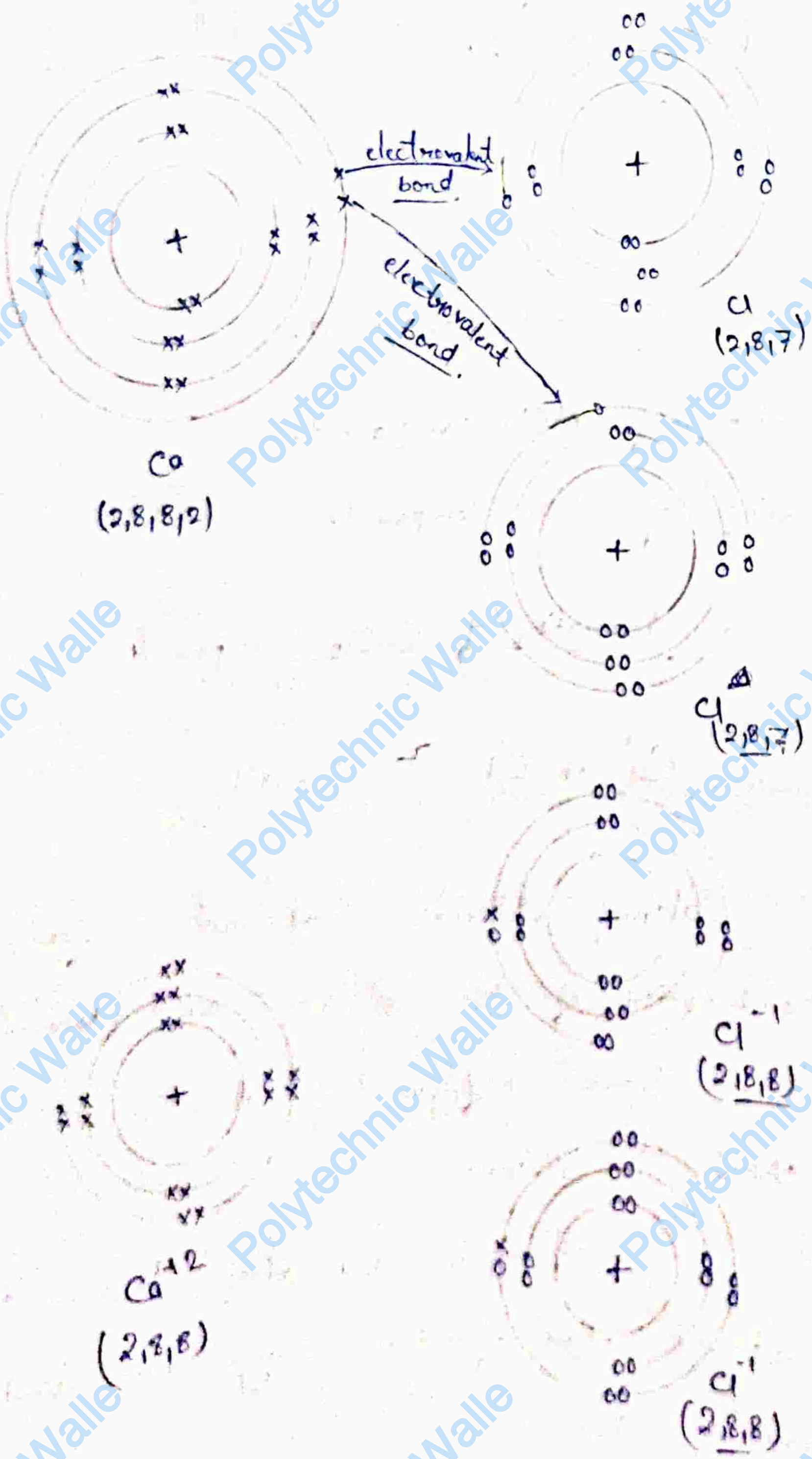
$$Ca^{+2} + Cl^{-1} \longrightarrow CaCl_2$$

Calcium chloride compound is formed by the combination of one calcium and two chlorine atom. The electronic configuration of Ca is 2,8,8,2 and chlorine is 2,8,7.

Therefore, Ca atom losses two electron to acquire two positive charge and stable configuration (2,8,8).

Similarly two Cl atom gains two electron to acquire two negative charge and stable configuration (2,8,8).

The electrostatic force of attraction between Ca^{+2} and Cl^{-1} to produce electrovalent compound $CaCl_2$.



Formation of $AlCl_3$ Compound

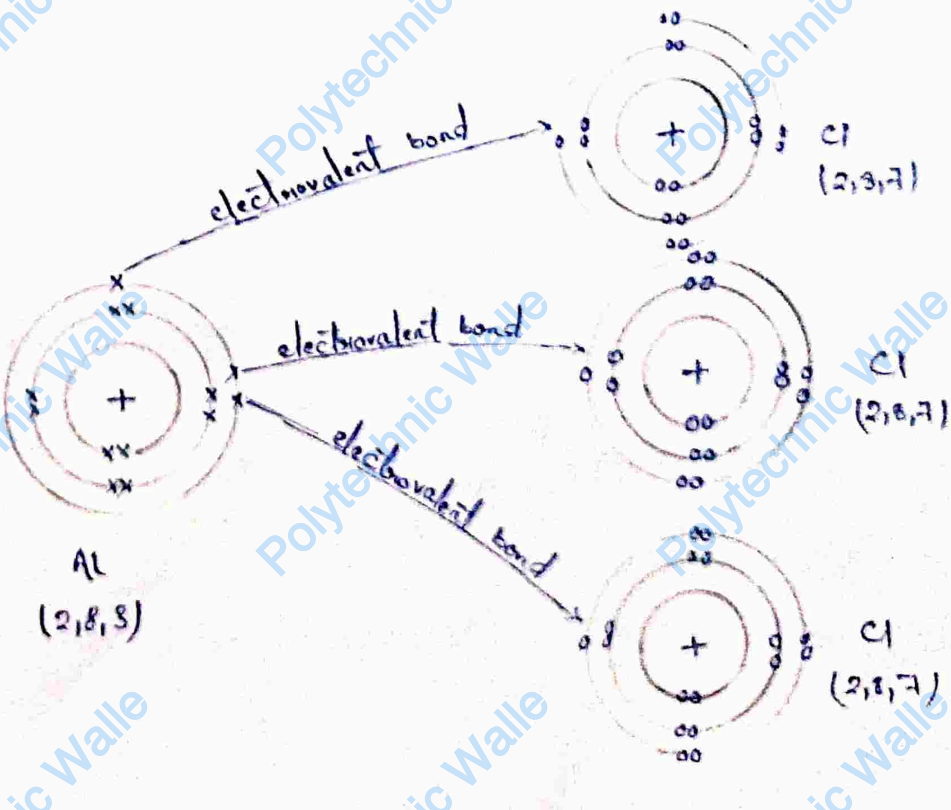
$$Al^{+3} + Cl^{-1} \longrightarrow AlCl_3$$

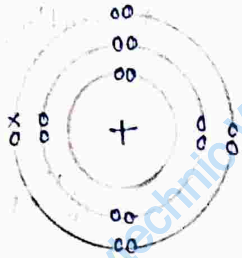
Aluminium chloride compound is formed by the combination of one Aluminium and three Chlorine atom. The electronic configuration of Al is (2,8,3) and chlorine is (2,8,7).

Therefore, Al atom losses three electron to acquire three positive charge and stable configuration (2,8).

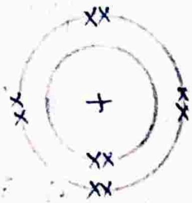
Similarly, three Cl atom gains three electron to acquire three negative charge and stable configuration (2,8,8).

The electrostatic force of attraction between Al^{+3} and Cl^{-1} to produce electrovalent compound $AlCl_3$.

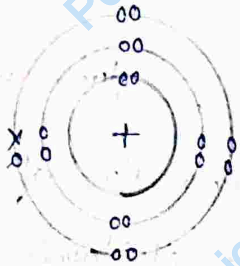




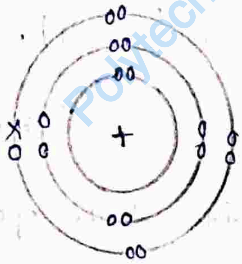
Cl^{-1}
(2,8,8)



Al^{+3}
(2,8)



Cl^{-1}
(2,8,8)



Cl^{-1}
(2,8,8)

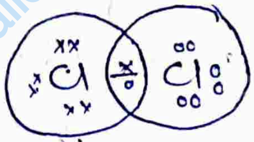
Formation of KOH Compound

$$K^{+1} + OH^{-1} \longrightarrow KOH.$$

Covalent Bond :-

The bond formed by mutual sharing of electrons between two similar or dis-similar atoms.

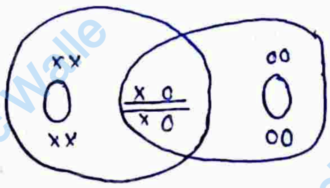
Cl_2 molecule.



$\longrightarrow Cl-Cl \longrightarrow Cl_2$.

↓ Single covalent bond.

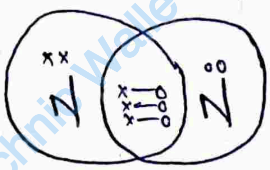
O_2 molecule.



$\longrightarrow O=O \longrightarrow O_2$.

↓ double covalent bond.

N_2 molecule.



$\longrightarrow N\equiv N \longrightarrow N_2$

↓ Triple covalent bond.

~~for example~~ There are three types of covalent bond.

① Single covalent bond :→ Hello.

Name of glassware and equipment.

1. Beaker.
2. Burette.
3. Funnel.
4. Burette stand
5. pipette.
6. pipette stand.
7. test tube.
8. test tube stand.
9. test tube holder.
10. Conical flask.
11. Round bottom flask.
12. Reagent bottle.
13. Capillary tube.
14. Filter paper.
15. Measuring Cyllinder.
16. PH. meter.
17. PH. electrode
18. Stirrer cut hot plate.
19. Hot air oven.
20. Glass rod.
21. Burner.
22. Spirit lamp.
23. Wire gauge.
24. tripod stand.

Q1/ To prepare 0.5 N 500 ml oxalic acid solution.

25. Copper electrode.
26. Zinc electrode.
27. Ameter.
28. Electronic Balance (Measuring
29. Conductivity meter.

2Q/ To prepare 0.1 N 1000 ml oxalic acid.

3Q/ To prepare 0.1 N 500 ml NaOH solution.

① To prepare 0.5 N 500 ml oxalic acid solution.

$C_2O_4H_2$

$(24+64+2)$

90 gm.

$\frac{90}{2} = 45$ gm.

~~Normal solution = 1 gm equi wt. in 1000 gm of water dissolving.~~

Normal solution:- 1 gm equivalent weight of a substance dissolve in 1 litre solvent is known as 1 Normal solution.

Equivalent weight = $\frac{\text{molecular weight}}{\text{valency}}$.

Molecular weight of oxalic acid.

$(COOH)_2 \cdot 2H_2O$.

$= 2\times12 + 6\times16 + 6\times1$

$= 24 + 96 + 6$

$= 30 + 96$

$= 126$.

$\frac{\text{Cation (+ve)}}{\text{Anion (-ve)}}$.

- Oxidation takes place at Anode.
- Reduction takes place at cathode.

∴ Equivalent weight of oxalic acid = $\frac{\text{Molecular weight}}{\text{valency}}$

$= \frac{\cancel{126}^{63}}{\cancel{2}} = 63\text{gm.}$

∴ To prepare 1 N oxalic acid solution 63gm oxalic acid required in 1000 ml water solution.

To prepare 0.5N oxalic acid solution 63×0.5gm oxalic acid 1000ml.

To prepare 0.5 N oxalic solution 31.5 in 1000ml

To prepare 0.5 N oxalic solution $\frac{31.5}{1000}$ oxalic 1ml.

To prepare 0.5 N oxalic solution $\frac{31.5}{\cancel{1000}_{2}} \times \cancel{500}$

$= \frac{31.5}{2} = 15.75\text{gm.}$

NaOH

Mol. wt. → $23+16+1 = 40.$

equi wt. $= \frac{40}{1}.$

→ 40×0.1

→ 4

$\frac{\cancel{4}^{2}}{\cancel{1000}_{2}} \times \cancel{500}$

$= 2\text{gm}$

Date :- 4 March 2022.   Chemistry.

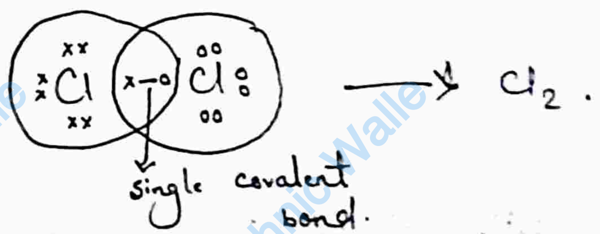
There are three types of Co-valent bond :-

1) **Single Co-valent Bond** :- If two similar or dissimilar atom sharing single electron then the bond is known as single covalent bond.

For example :-

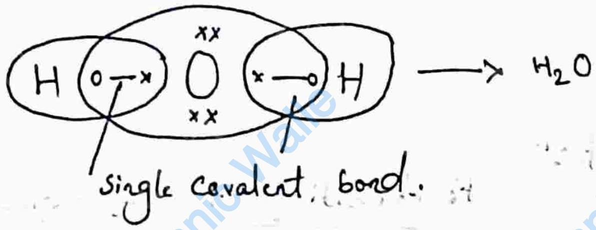
Formation of Cl_2 molecule :-

Cl_2 molecule is formed by combination of two chlorine atom. The valence electron of chlorine is 7. Therefore, it require one electron to complete octet in outermost orbit. Both chlorine atom share one electron and form a single covalent bond between them. It is denoted by (–) line.



Formation of H_2O molecule.

H_2O molecule is formed by the combination of two Hydrogen and one Oxygen atom. The valence electron of hydrogen and Oxygen is 1 and 6. Hydrogen atom require one electron to complete duplete and oxygen require two electrons to complete octate. in its outermost orbit. Hydrogen ~~one~~ Two atom share ~~one~~ two electron with oxygen atom and oxygen share two electron with two hydrogen atom and formed single covalent bond.



H–O–H ⟶ H_2O .

Formation of NH_3 molecule

NH_3 molecule is formed by combination of one Nitrogen and 3 hydrogen. The valence electron of Nitrogen and hydrogen is 5 and 1 respectively. Therefore, Nitrogen requires three electron ~~and~~ to complete octet in the outermost orbit and three hydrogen require three electron to complete duplete in the outermost orbit. Both nitrogen and hydrogen share three electron two each other and form single covalent bond.

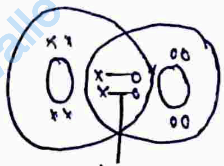
Double Covalent bond :-

The bond formed by mutual sharing of two electrons between two similar or dissimilar atoms is known as double co-valent bond.

For example :-

Formation of O_2 molecule.

O_2 molecule is formed by combination of two Oxygen ~~molecule~~ atom. The valence electron of Oxygen is 6. Therefore, it require two electron to complete octet in outermost orbit. Both Oxygen atom share two electrons two each other and form double covalent bond.



double covalent bond.

Formation of C_2H_4

Ethene is formed by the combination of two Carbon and four hydrogen atom. The valence electron of carbon and hydrogen is 4 and 1 respectively. Carbon atom require 4 electrons to complete octet and hydrogen require 1 electron to complete duplete of its outermost shell. Therefore, two carbon atoms share two electrons and formed double covalent bond and carbon and hydrogen atom share one electron and form single covalent bond between carbon and hydrogen atom.

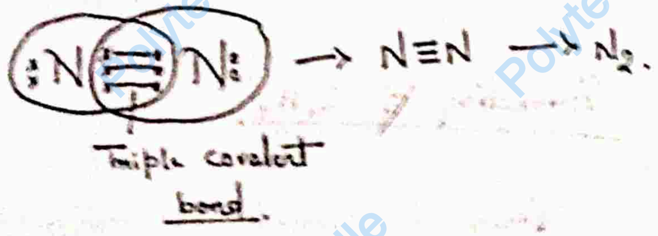
Triple Coralent bond :-

The bond formed by mutual sharing of three electrons between two similar or dissimilar atoms is known as triple covalent bond.

For example :-

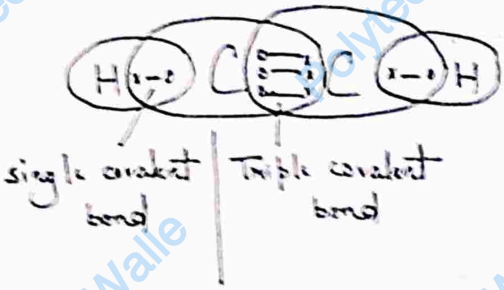
Formation of N_2 molecule

N_2 molecule is formed by combination of two Nitrogen atom. The valence electron of Nitrogen is 5. Therefore, it requires three electron to complete octet in outermost orbit. Both nitrogen atom share three electrons to each other and form triple covalent bond.



Formation of C_2H_2 molecule

It consist of two carbon and two hydrogen atoms. The valance elector of carbon and hydrogen is 4 and 1 respectively. Therefore, carbon require 4 electrons to complete the octet in the outermost orbit while hydrogen require 1 electron to complete the duplete in the outermost orbit. Carbon atom share 3 electrons with other carbon atom and form triple covalent bond while carbon atom also share 1 electron with hydrogen atom and form single covalent bond.



$\longrightarrow$ H-C≡C-H $\longrightarrow$ C_2H_2.

Ion :- The atom which carry charges is called ion. Ion are basically two types:-

(i) Cation.
(ii) Anion.

(i) **Cation** :- The ion which carry positive charge is known as cation. It is formed by loss of electron. For example :-

eg Sodium losses one electron to produce sodium ion.

$$Na - \bar{e} \longrightarrow Na^{+}$$

eg Calcium losses two electron to produce calcium ion.

$$Ca - 2\bar{e} \longrightarrow Ca^{+2}.$$

ii) Anion :- The ion which carry negative charge is known as Anion. It is formed by gain of electron. For example :-

a) Chlorine gains one electron to produce chloride ion.

$$Cl + \bar{e} \longrightarrow Cl^-$$

b) Oxygen gains two electron to produce oxide ion.

$$O + 2\bar{e} \longrightarrow O^{-2}$$

Ionisation :- The process of breaking up of an electrovalent compound into ions, is known as Ionisation.

Electrolytic dissociation :- The process of spiliting up of an electrovalent compound when dissolved in solvent like water is known as electrolytic dissociation.

Arrhenius theory of Ionisation

Arrhenius gave a theory of electrolysis the main postulates of the theory are given below:-

(i) The molecules like Acid, Bases & salts when dissolved in water (H_2O) they split up into two types of ions one is positive ion (+ve) and other is negative ion (-ve). positive ion (+ve) also known as cation while negative ion (-ve) also known as Anion.

(ii) Cations are generally metallic radicals and it is formed by loss of electrons. Anions are generally non-metallic radicals and it is formed by gain of electron.

(iii) The total no. of cation is equal to the total no. of anion. Hence, the solution is electrically neutral.

(iv) The ion present in solution after re-uniting they form un-dissociated molecules. For example :-

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$HCl \rightleftharpoons H^+ + Cl^-$$

Degree of Ionisation :-

The fraction of the total no. of molecules that ~~inosies~~ ionises in solution is known as degree of ionises.

$$\text{Degree of fraction} = \frac{\text{total no. of molecule ionised}}{\text{total no. of molecule dissolved}}$$

1 strong solution. <1 weak solution.

Factors affecting Degree of Ionisation :-

The following factors which affect the degree of Ionisation :-

(i) Nature of solute :- The degree of Ionisation depends on the nature of solute. Electrovalent compounds such as strong acid, strong base and inorganic salts are highly ionised in solution while weak acid like CH_3COOH, weak base like NH_4OH and salts like NH_4Cl are partially ionised in solution.

strong acid :- HCl, HNO_3, H_2SO_4 are high degree of Ionisation.

(2) Nature of solvent :- Degree of ionisation depends on the nature of solvent. This effect of solvent form which forces of binding the two ions break them is known as its dyelectric constant.

Dyelectric constant is defined as the capacity of solvent to weaken the forces of attraction between two ions. The polar solvent like water ionises electrovalent compound highly because the dyelectric constant of water is about 80.

(3) Concentration of the solution :- The degree of ionisation is inversly proportional to the concentration of the solution. The degree of ~~increases~~ ionisation increases after dilution. The ratio of the solute molecule and solvent molecule is less in dilute solution therefore, they sperate the ion highly.

$\frac{\text{solute}}{\text{solvent}}$

$$\text{Degree of Ionisation} \propto \frac{1}{\text{Concentration of the solution}}$$

(4) Temperature :- The degree of ionisation is directly proportional to temperature. The temperature of the solution increases the degree of ~~ions~~ ionisation is also increase because the velocity of molecule increase.

$$\text{Temperature} \propto \text{Concentration of the solution.}$$

Date 14/3/22.

Strong electrolyte :- Completely dissolve in water.

Weak electrolyte :- Partially dissolve in water.

Electrolyte :- A substance either in fused state or in aquous solution conduct the electricity is known as electrolyte.

On the basis of degree of Ionisation electrlytes are basically two types:-

i) strong electrolyte. ii) weak electrolyte.

i) Strong electrolyte :- The electrolyte which is completely Ionised in the solution is known as strong electrolyte. For example:- strong acid HCl, HNO_3 etc. strong base NaOH and the salts like NaCl, KCl etc.

ii) Weak electrolyte :- The electrolyte which is partially Ionised in the solution is known as weak electrolyte. For example :- weak acid like CH_3COOH or weak base NH_4OH and the salts NH_4Cl etc.

Electrode Potential :- When a metal M is dipped into an electrolytic solution it may either oxidation or reduction takes place. If the oxidation takes place the metal get oxidised and goes to the solution as metal ion (M^{n+}) therefore a negative charge (-ve) developed on the metal surface so it attract positive charge (+ve) from the solution.

A double layer is formed on the metal surface. This layer is known as Helmholtz electrical double layer [EDL].

A potential difference is produced between electrode and electrolytic solution. This potential difference is known as electrode potential.

Mechanism of Electrolysis

According to Arrhenius theory, the electrolyte dissociated into two types of ion – cation and anion.

The ions which moves towards cathode is known as cation and the ions which moves towards anode is known as anion during electrolysis. For example:-

NaCl dissociates into Na^+ and Cl^-

At Cathode – The Na^+ acquire electrons to reduce into sodium

$$Na^+ + e^- \longrightarrow Na \text{ (Reduction)}$$

At Anode – The Cl^- loss electron to produce Cl.

$$Cl^- - e^- \longrightarrow Cl \text{ (oxidation)}$$

Electrode :- A substance or rod in which electric current is passed easily from one end to another end without any chemical changes.

For example :- All metals like Fe, Cu, Zn and Graphite etc.

Electro chemical series (Activity series) :-

When the electrodes are arranged in the order of increasing reduction potential then this arrangement is known as electro chemical series.

CELL

Cell are basically two types :-

(i) Electrolytic cell :-
(ii) Electrochemical cell :-

(i) **Electrolytic cell :-** The cell in which non-spontaneous chemical reaction is produced by passing external source of electric current is known as electrolytic cell. ~~For example~~ :-

Application of electrolytic cell :-

This cell is used for production of H_2 gas, Cl_2 gas, O_2 gas, NaOH, extraction of metal, purification of impure metal etc.

(ii) **Electrochemical cell :-** The cell in which electricity can be generated by spontaneous chemical reaction is known as electrochemical cell.

For example :- Dry cell, lead-Acid storage cell, Galvanic cell etc.

30 March 22

Electrolysis of Copper sulphate solution (By using Platinum electrode) :-

The copper sulphate solution contains 4 types of ions Cu^{2+}, SO_4^{2-}, H^+, OH^-. According to activity series the Cu^{2+} ion discharged in preference to H^+ ion. At anode OH^- ions discharged in preference to SO_4^{2-} ion and oxygen gas liberated at anode. The reaction during electrolysis are given below:-

Ionisation :-

$$CuSO_4 \longrightarrow Cu^{2+} + SO_4^{2-}$$

$$H_2O \longrightarrow H^+ + OH^-$$

At cathode :-

$$Cu^{2+} + 2e^- \longrightarrow Cu(s)$$

(Reduction)

At anode :-

$$4OH^- - 4e^- \longrightarrow 2H_2O + O_2$$

(Oxidation)

Final product formed

$$2H^+ + SO_4^{2-} \longrightarrow H_2SO_4$$

The net result of electrolysis are given below :-

(i) Copper ~~dipo~~ deposited at cathode and oxygen gas liberated at anode during electrolysis.

(ii) The concentration of the solutions increases with H^+ ion and ~~OH^- ion~~ SO_4^{2-} ion. Therefore, the blue solution of $CuSO_4$ ~~is~~ is slowly converted into colourless solution of H_2SO_4.

Electrolysis of Copper sulphate solution (By using copper electrode) :-

The solutions of $CuSO_4$ contains 4 types of ions Cu^{2+} ion, SO_4^{2-} ion, H^+ ion, OH^- ion. According to activity series Cu^{2+} ion discharged in preference to H^+ ion and Cu deposited at cathode. At anode Cu get oxidised into Cu^{2+} ion in solution.

Ionisation :-

$$CuSO_4 \longrightarrow Cu^{2+} + SO_4^{2-}$$
$$H_2O \longrightarrow H^+ + OH^-$$

At cathode :-

$$Cu - 2e^- \longrightarrow Cu^{2+}(aq.)$$
(oxidation)

At anode :-

$$Cu^{2+} + 2e^- \longrightarrow Cu(s)$$
(Reduction)

The net result of electrolysis are given below :-

(i) The dissolution of Cu into Cu^{2+} ion takes place at anode and Cu^{2+} discharged at cathode.

(ii) SO_4^{2-} ion do not discharge in the solution therefore, the strength of $CuSO_4$ solution remain same.

Distinction between Electrolytic cell and Electrochemical cell:-

Electrolytic cell	Electrochemical cell
1. It converts electrical energy into chemical energy.	1. It converts chemical energy into electrical energy.
2. It is used to bring about non-spontaneous chemical reaction by electrolysis.	2. It is used to produce electricity from spontaneous chemical reaction.
3. Electrical energy is consumed/ used e.g. production of metals, electroplating etc.	3. Electrical energy is produced e.g. lead accumulators, dry cells.
4. These cells are also applicable in many engineering and military appliances.	4. Dry cell and daniel cell are electrochemical cells. Dry cells are used for torches, Calculators, transistors, etc. Daniel cell is used for protection of metals from corrosion.