Inorganic chemistry
3-stage
Lec. 2

Dr- leaqaa

Chemical bonds types:

Most chemical bonds fall into 2 categories depending on whether the valence e(s) are transferred or shared.

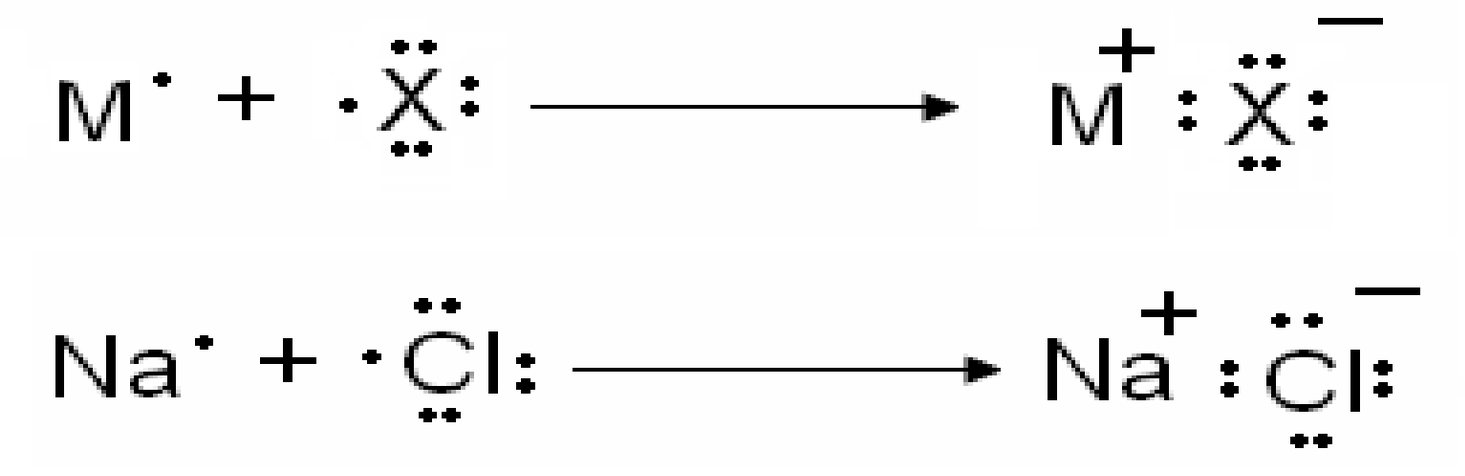
Electron in ionic bond are effectively transferred from one atom to another.

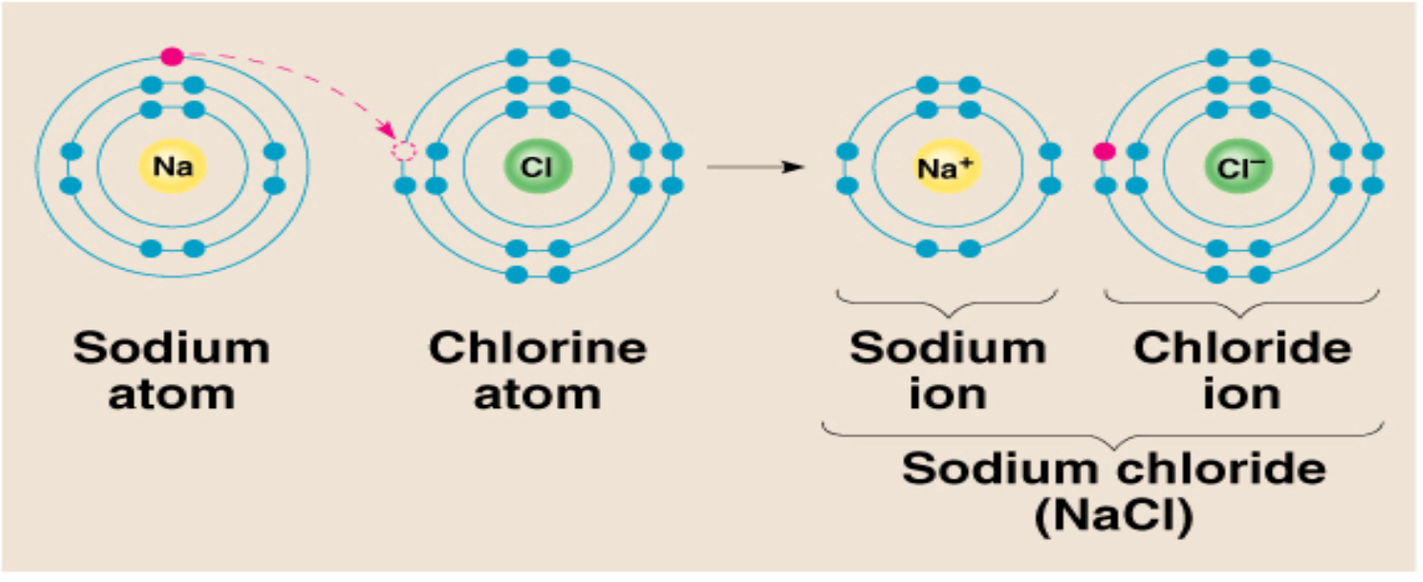
In covalent bond the e(s) are shared (.) atoms.

1- Ionic bond:

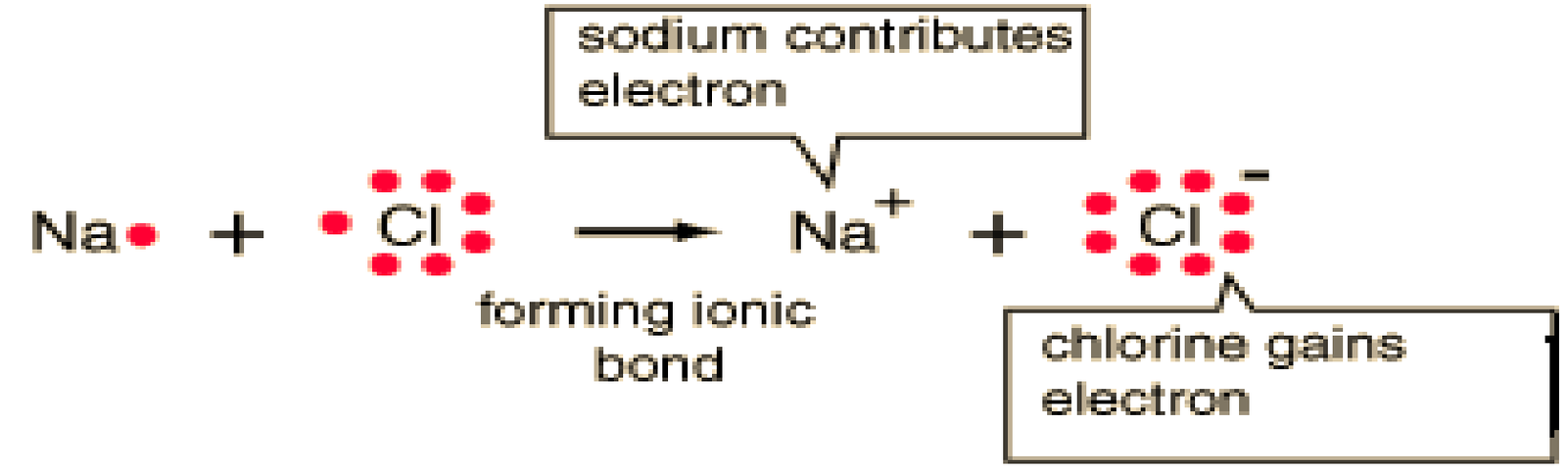
- electrostatic forces that exists (.) 2 chemical entities of opposite charge.

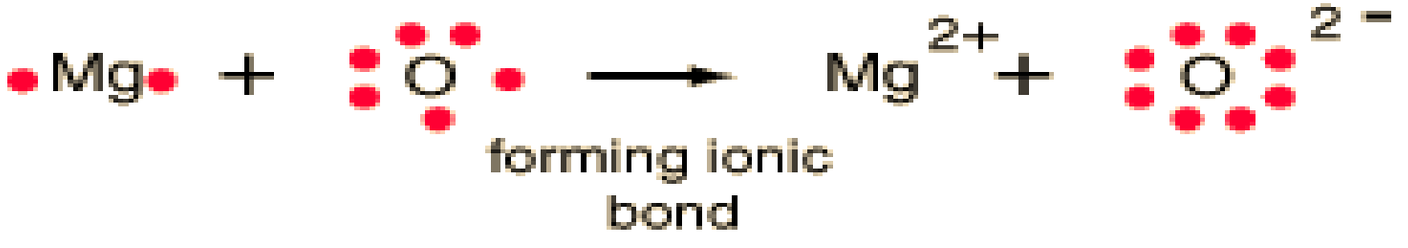
strongly electropositive elements & nonmetalic ,strongly electronegative elements.

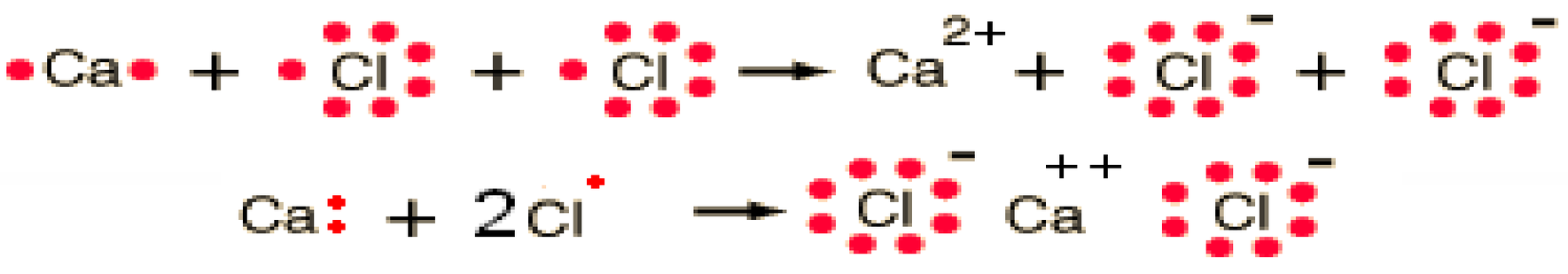




* Ionic bond – electron from Na is transferred to Cl, this causes a charge imbalance in each atom. The Na becomes (Na+) and the Cl becomes (Cl^-), charged particles or ions.

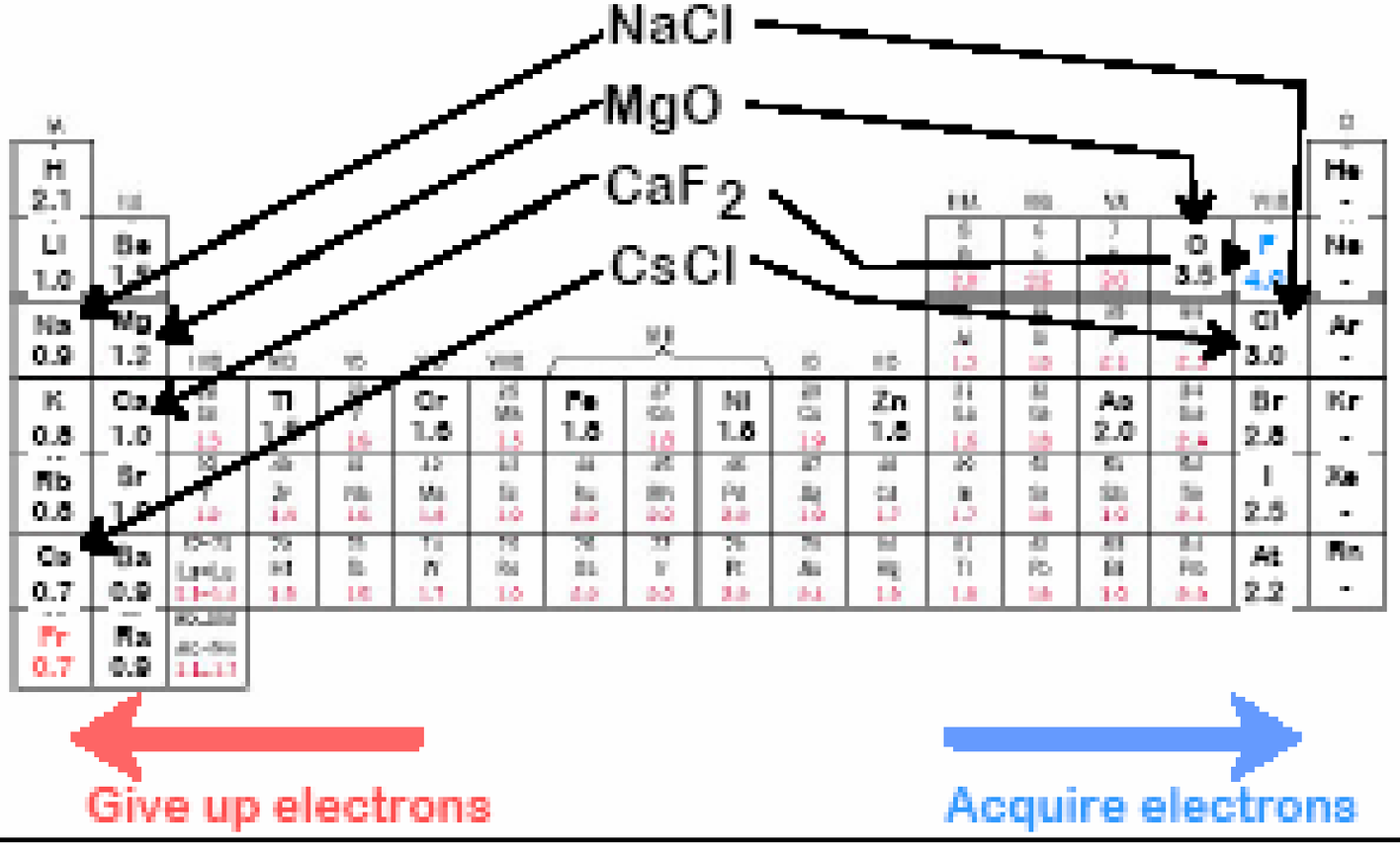






$CaCl_2$ Geometry is linear b its most stable electrostatic arrangement.

Chemical Bonds: Ionic Bonding



2-Covalent Bonding

Covalent bond: sharing a couple of electrons by the two bonding atoms

∧is type is prevails wn ∧ electronegativity differences (.) 2 atoms is not sufficient to produce ions.

* inorganic cpds.

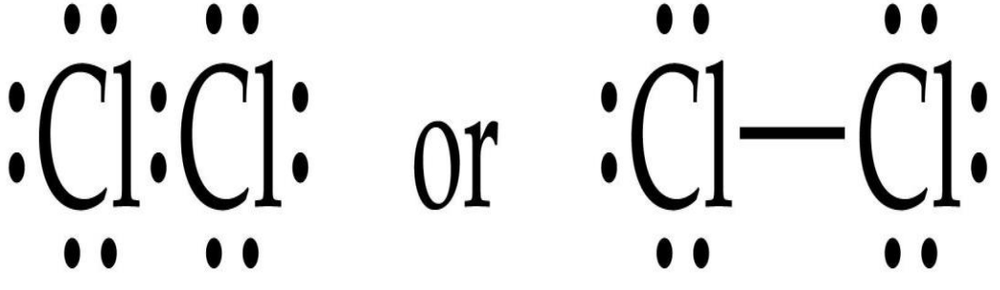
* prevails in organic chemistry

The sharing of the electrons is not always equal between both atoms.

Single Covalent bond

*Each molecule a single pair of electrons is shared between the atoms.

*homonuclear



COVALENT BONDING

Non-polar Covalent

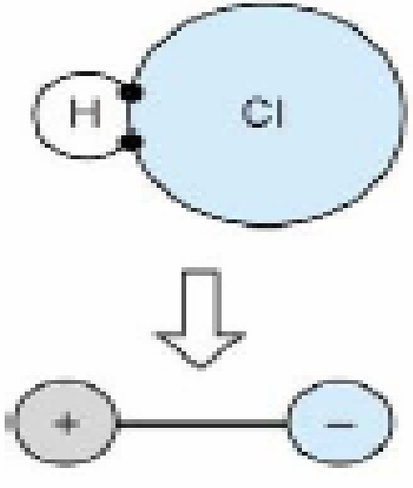
The pair of electrons is shared equally by both atoms.(homonuclear)

F—F, H—H, O_2 ,S_8, P_4

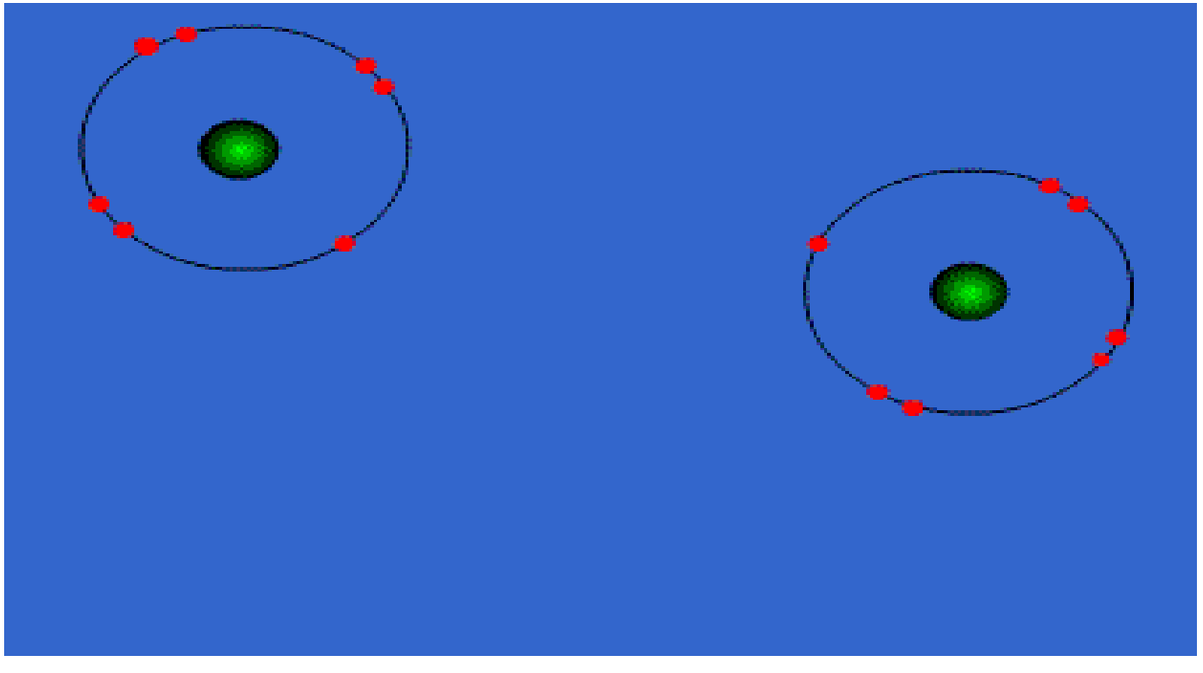
Polar Covalent

The electron pair is not shared equally; the chlorine atom has a greater attraction for the shared electrons than the hydrogen atom.

H—Cl



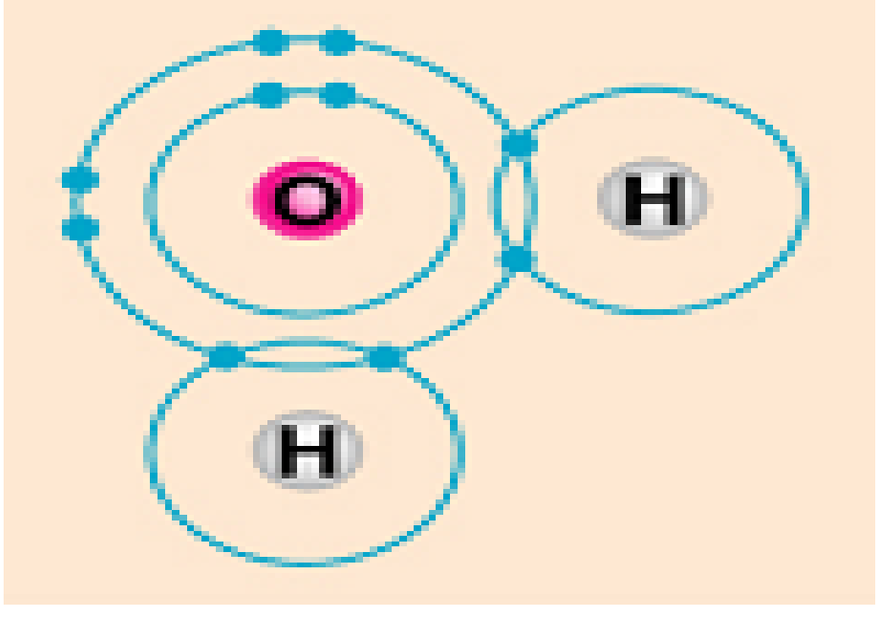
The idealistic covalent bonds occur in homonuclear diatomic molecules such as H_2, Cl_2, N_2

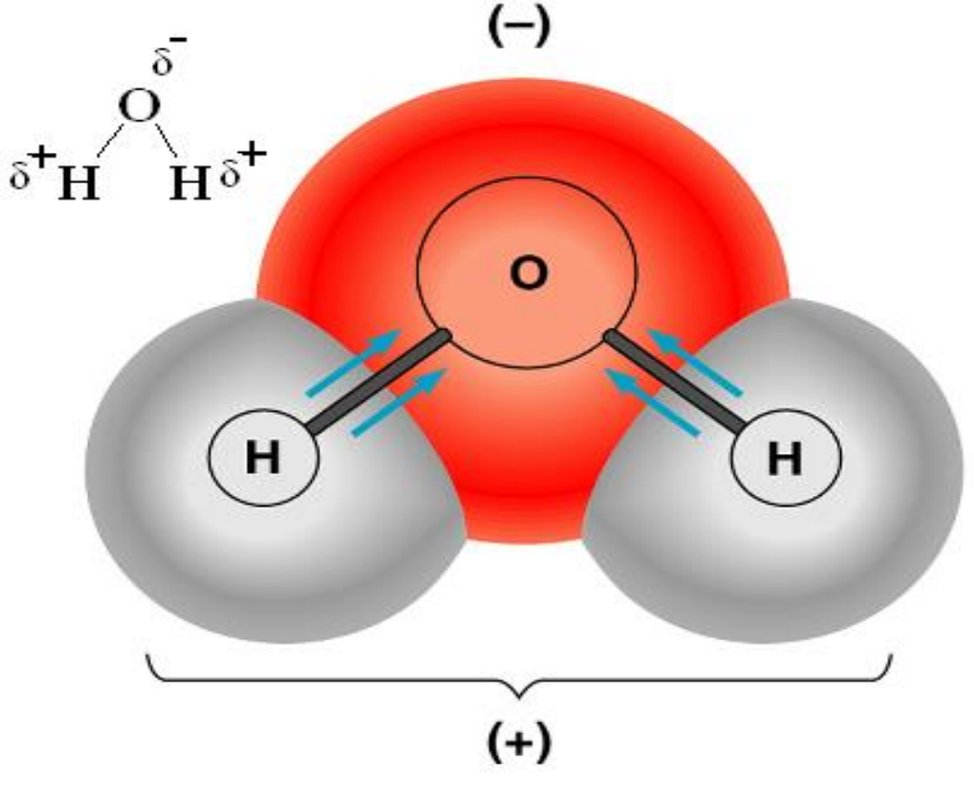


Covalent bonds- Two atoms share one or more pairs of outer-shell electrons.

POLAR COVALENT BONDS

when electrons are shared but shared *unequally* *H_2O [* water is a *polar molecule* because oxygen is more electronegative than hydrogen, and therefore electrons are pulled closer to oxygen].





This type of bond is also found as double and triple covalent bonds.

CO_2 , HCN

Coordination covalent bond

• (also donor-acceptor bond) Both bonding electrons provided by one of the atoms (donor), whereas the other atoms provides an empty orbital (akceptor)

3-Coordinate covalent bonding:

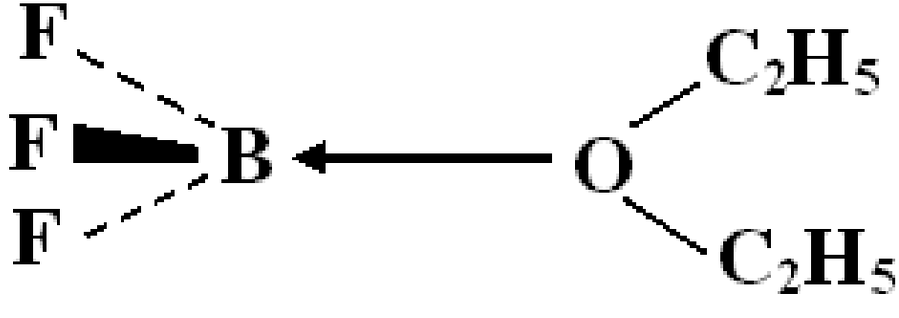
- covalent interaction but, in this case, both e(s) in the bond arise from a single orbital on one of the atoms forming the bond.

(.) complex chemical entities.the entity providing the pair of e(s) is generally referred to as donor species. The acceptor spec. is e(s) deficient and has an empty orbital w can overlap w orbital from the donor.[donor-acceptor complex,coordination cpds].

e.g.complex BF_3 etherate

This type of bond also occurs in acid-base chemistry (one bond (.) S &O.

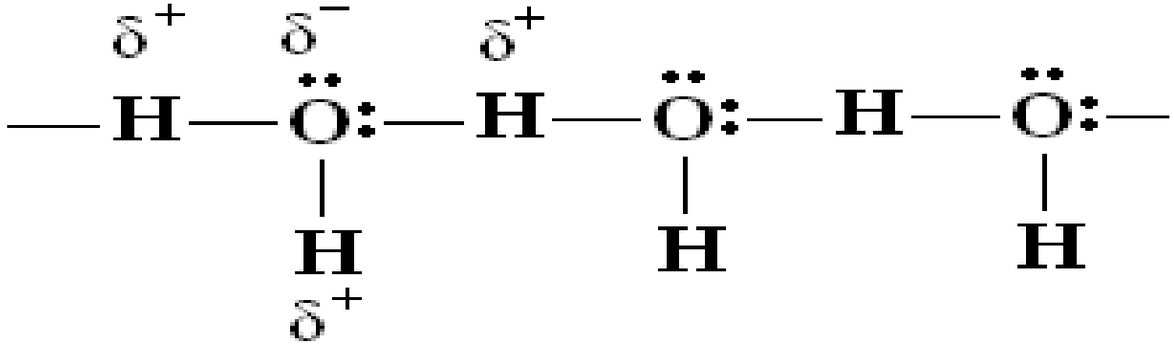
e.g. oxyacid [sulfuric,nitric chloric &phosphoric acid].



4- Hydrogen bonding:

is a 2ry interaction. It as an attractive force that occur (.) certain types of molecules.

Wn H is covalent w¯ more electronegative atom such as O,F,N,Cl



*association unlike molecule

*important role in solution formation & in water crystalization.

*H bonding (.) complex molecules & 2ry str. Of proteins,also 2ry binding force in D-R interaction.

5- Van der wals(London) forces

Very weak of electrical forces sometimes referred to as induced dipol-induced dipole interactions.

Van der waals forces r virtually the only attractive force (.) nonpolar molecules.

* association (.) Ar. hydrocarbon molecules such as Benz.(small disturbances in the electrical balance r present in these molecules b of motion of ¶ e(s).

* nuclear replusion known as van der walls replusion

Coordination (complex) ion ions s

- central atom of transition metal providing empty orbitals
- ligands providing free electron pairs
- Number of ligands (coordination number) is usually 4 or 6

$$[Fe(CN)_6]^{4-}$$

e.g.ferrocyanide

Names of of coordination compounds

- Names of neutral ligands:
  - H_2O aqua
  - NH_3 ammin
  - NO nitrosyl
  - CO carbonyl

- Names of anionic ligands always end in –o:
  - F^- fluoro
  - Cl^- chloro
  - Br^- bromo
  - I^- iodo
  - OH^- hydroxo
  - CN^- cyan

Names of of coordination compounds

1. Complex particle is cation:

e.g. $[Cu(NH_3)_4]SO_4$ = Tetraamminecopper(II) sulfate

2. Complex particle is anion: e.g. $K_3[CoF_6]$

Potassium hexafluorocobaltate(III)

Werner′r theory

(the most widely accepted theory of formation complex ion) by Alfred werner (werner′ complex)

*Central metal ion has 2 types of valency:

1- 1ry valence(principle valence) (ionizable)
[oxidation state on central metal atom]

2- 2ry valence(nonionizable):
electron pairs

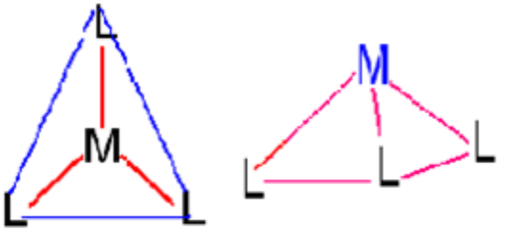
$[Co(NH_3)_6]Cl_3$ 1° ry valence = 3 Cl^- =3,

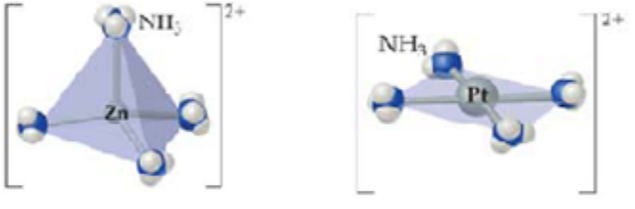
2°ry valence = 6

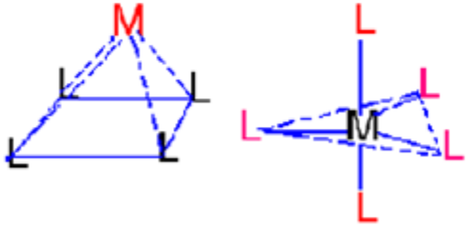
*-the ligands r- arranged around ∧ metallic ion in certain cc geometry

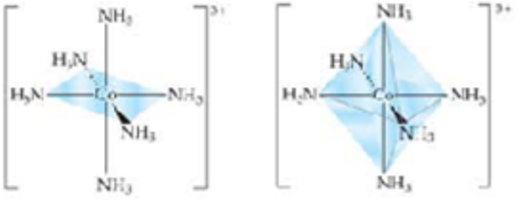
geometry ⊥ on coordination #.

coordination #	geometry
2	linear or angular
3	trigonal-coplanar or trigonal-pyramidal
4	T_h or square-planar
5	squre-pyramidal or trigonal-bipyramidal
6	O_h







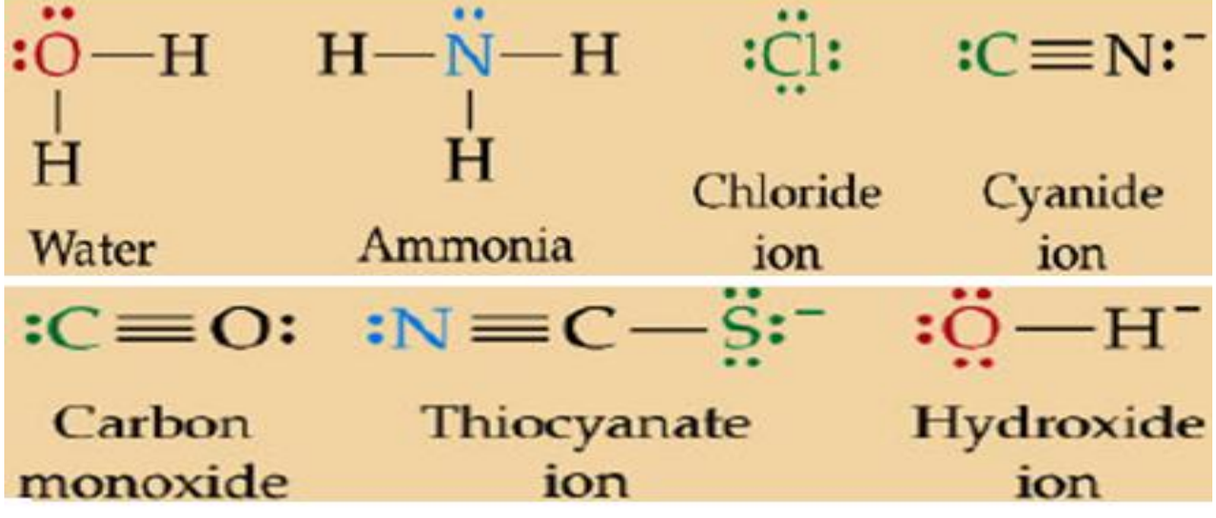


Ligands:

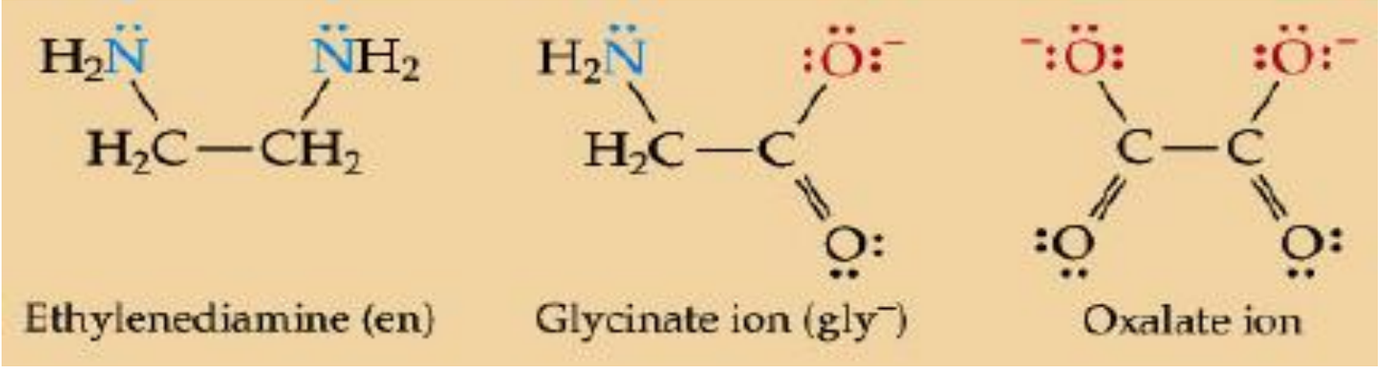
classified according to the number of donor atoms :

Type of ligands:

1- Monodentate ligands :- bond using the electrone pairs of single atom.

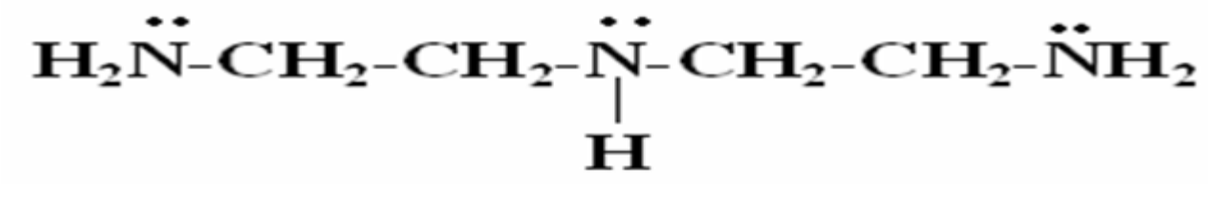


- Bidentate ligands bond using the electron pairs of two atoms.



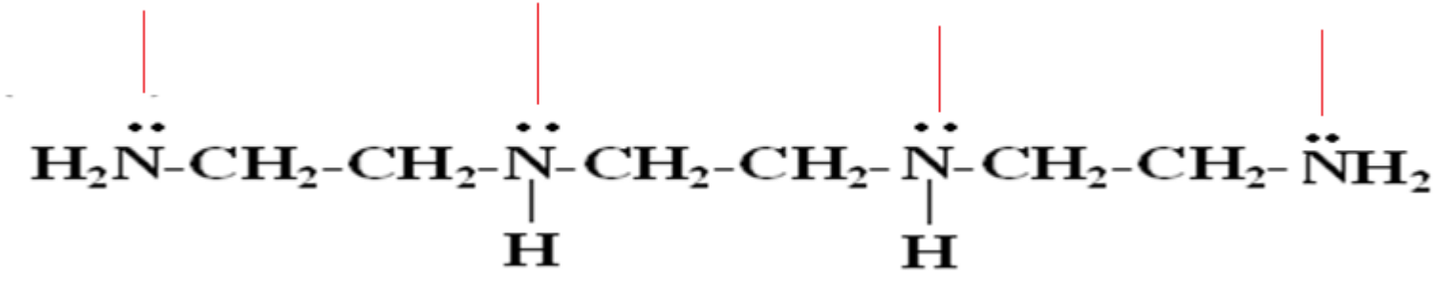
-Tridentate ligand

Diethylenetriamine (den)



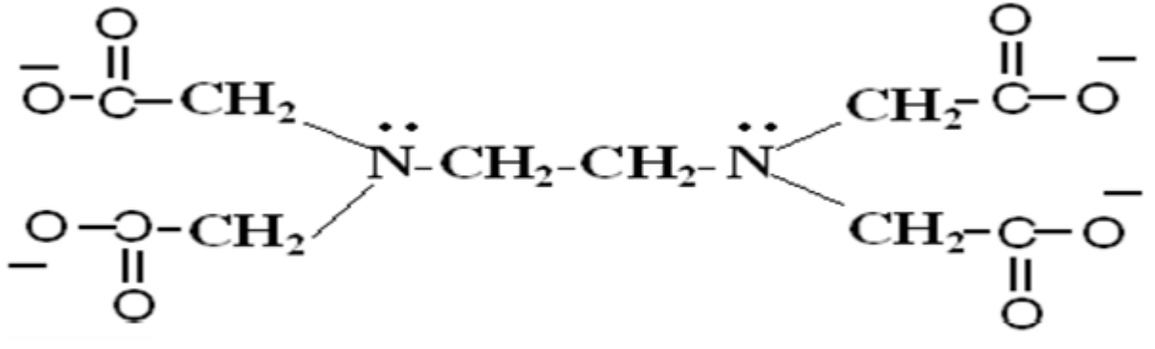
Tetradentate :

Triethylenetetramine (trien)



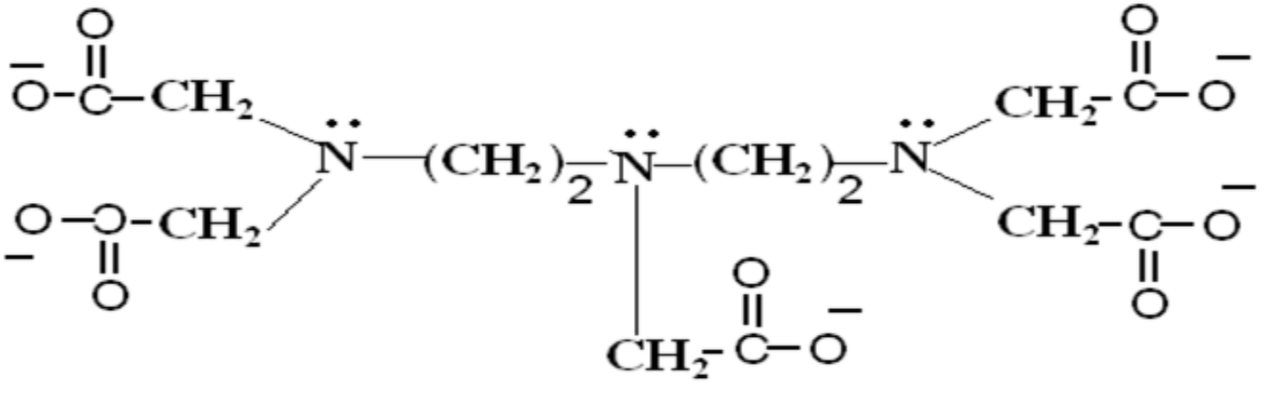
Hexadentate ligand

EDTA



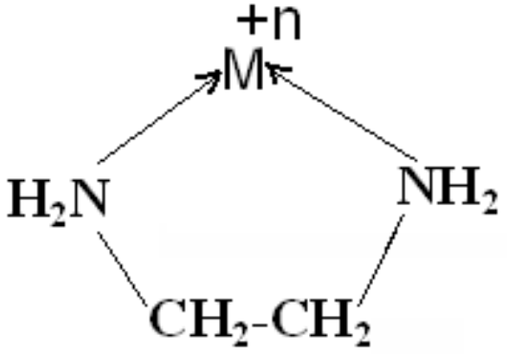
Octadentate ligand

Diethylenetriaminepentaacetate(DTPA)



* polydentate ligands are also known as Chelating agents

Polydentate form with metal = ring structure



totale # of atoms in ∧ ring including ∧ metal r- 5,6 or 7.
more stable chelate .
4&8-membered rings r- usually unstable

-

***polydentate ligands used for :
chelate forma∧ ----chelating agent [w_ use in pharmaceutical & in drug therapy].