MAA OMWATI DEGREECOLLEGE

HASSANPUR

NOTES

CLASS:- B.SC 1ST SEM

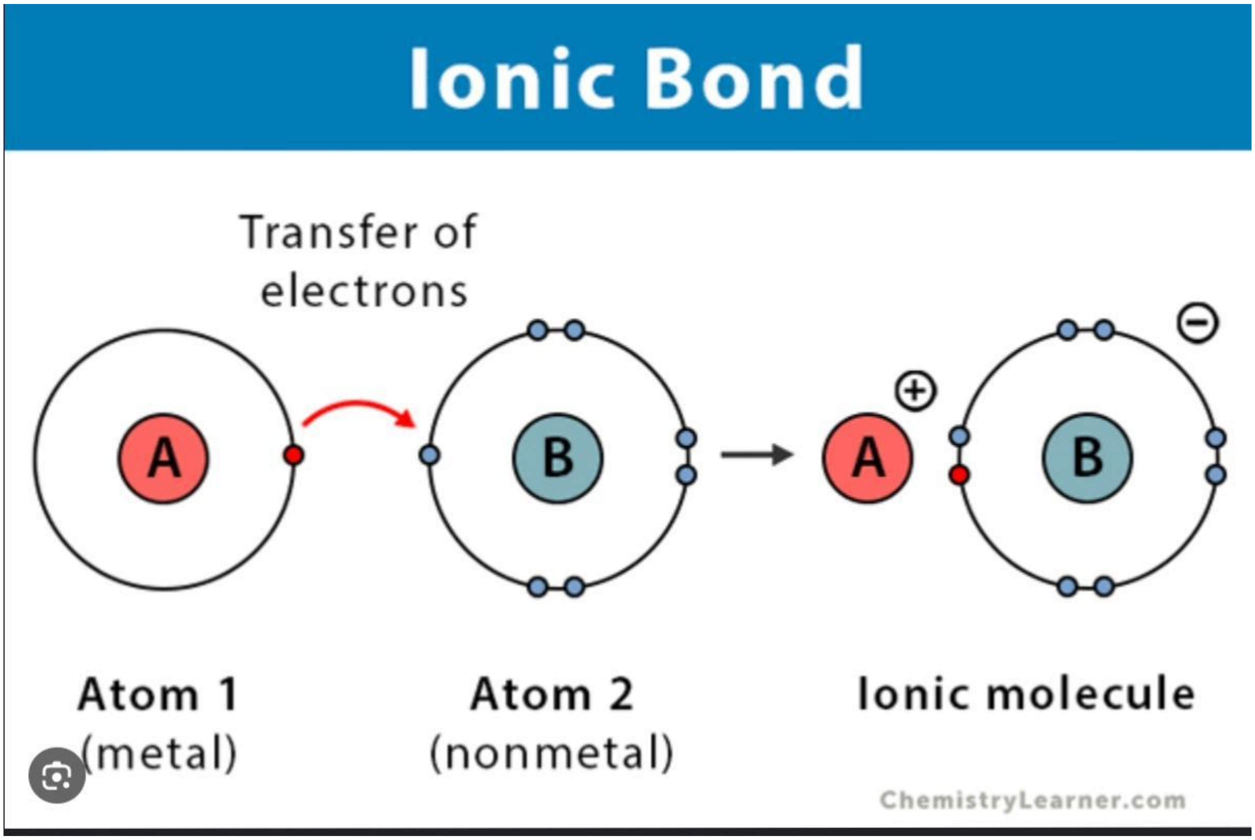
SUBJECT: CHEMISTRY (FUNDAMENTAL CHEMSITRY) (MC)

MAA OMWATI COLLEGE HASSANPUR

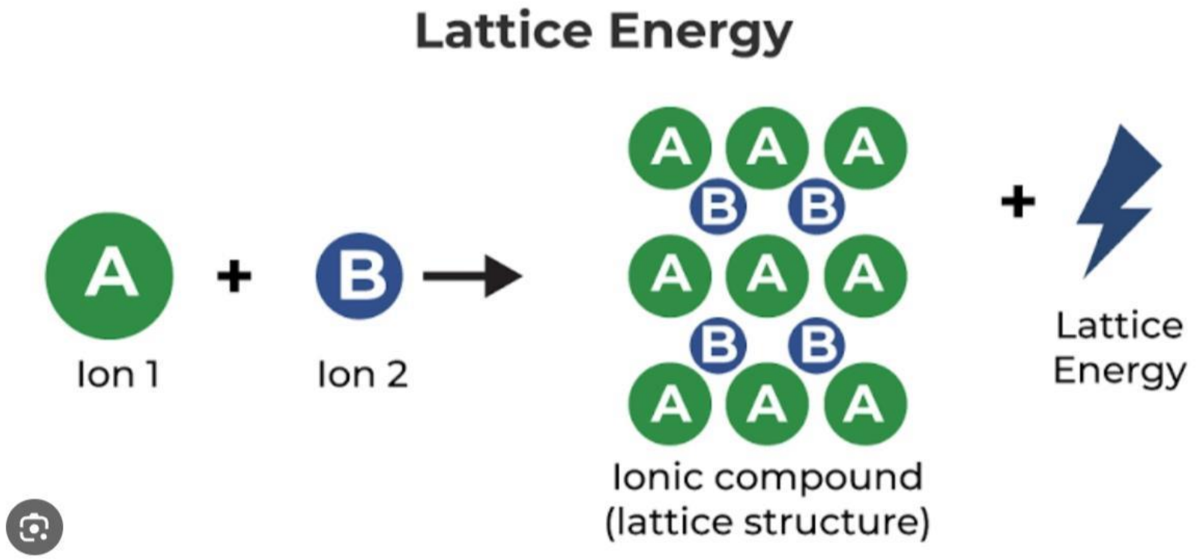
(B.sc chemistry notes by devender kumar)

B.SC CHEMISTRY NOTES 2024-2025

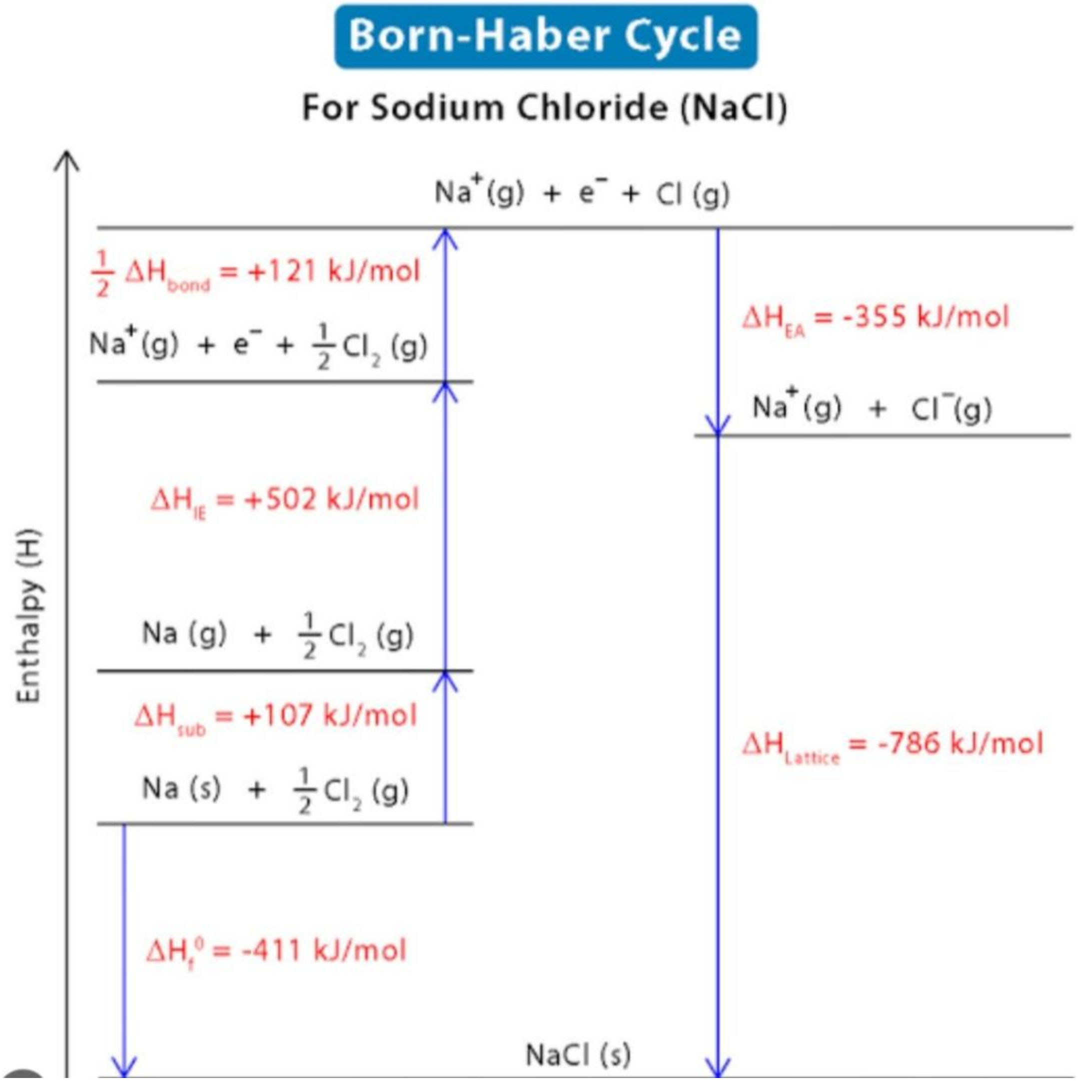
IONIC BOND: The ionic bond consist of the transfer of polar covalent bonding electron transfer one atom to another atom is called ionic bond.



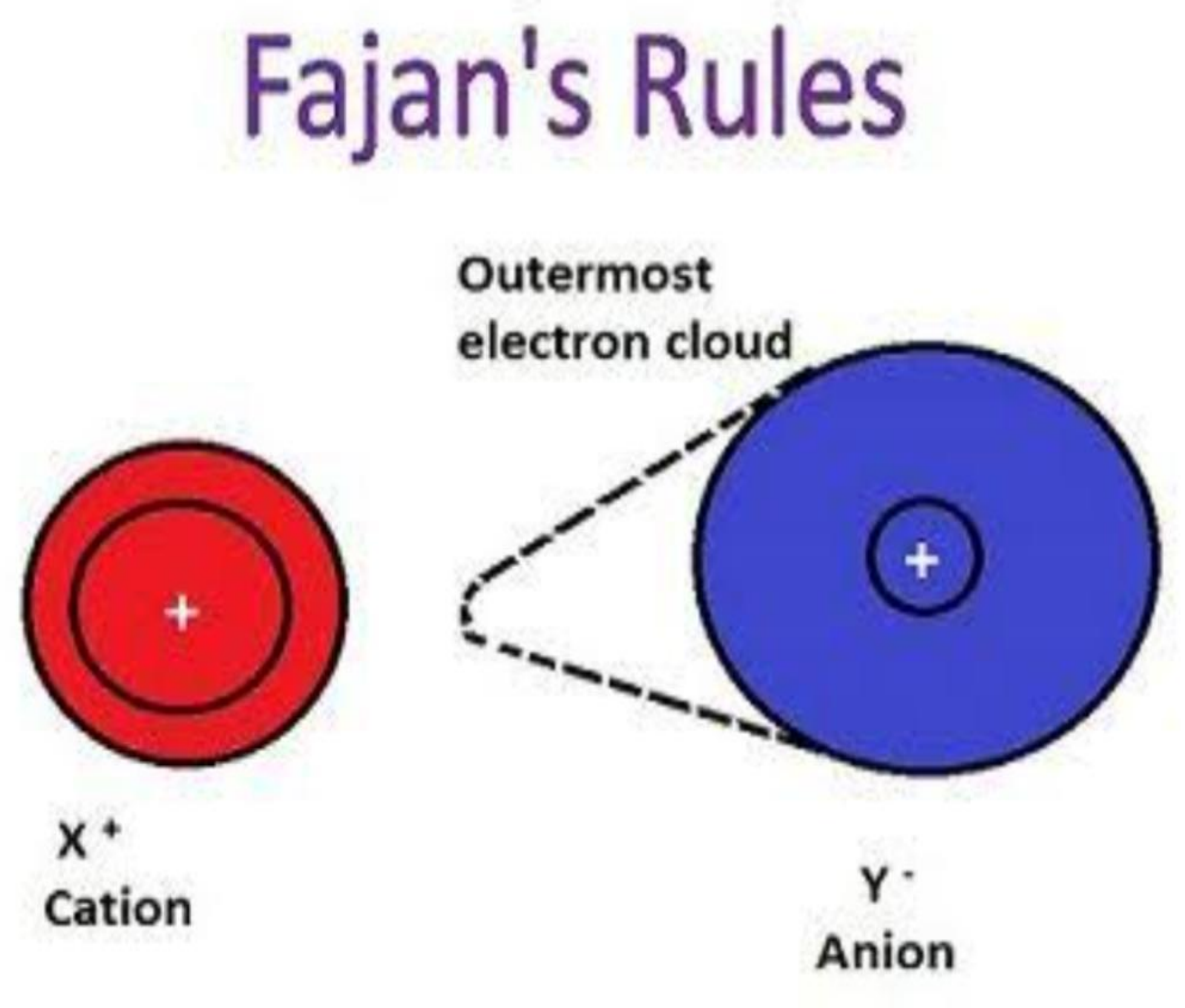
LATTICE ENERGY: The lattice energy is required to break an ionic crystal into consist ions.



BORN HABER CYCLE: Born Haber is the used in primary calculating the lattice energy which cannot is the measured otherwise.the lattice energy is the enthalpy changed in the formation of ionic solids from gaseous ions.



FAJAN,S RULES:according to the fajan rules an ionic bond is a compound with a low positive charge ,such that a large cation or a small anion is a covalent bonding is a formed of a compound with a high positive charge.



HYDRATION ENERGY: Hydration energy is also known as Hydration enthalpy, it is defined as the Hydration energy the amount of energy is released when one mole of ions undergoes Hydration. It is a special case of dissolution energy with a solvent being of water.

BOND MOMENTS: It is a vectors showing the magnitude and direction of shifting of an electron pairs between atoms in a molecules.example c2cl2h2.

DIPOLE MOMENT: It is the measured of net molecular polarity which is the magnitude of the charge a at an either end of the molecules dipole time the distance relationship between the changes $x=a\times r$

RESONANCE: The concepts of hybridization of two or more conventional valenced bond structure to arrive at an entirely new and indivisiual structure is term as resonance.

PROPERTIES OF RESONANACE:

1.STABILITY:A resonance hybrid is a always more stable than any of the contralateral structure.

2.RESONANCE ENERGY:It is defined as the diffrence in energy between the energy of the resonance hybrid and it's stable contributing structure.

3.BOND LENGTH:The bond length are diffrence from these in the contribution struture.

MOLECULAR ORBITAL THEORY: These are molecules that generally involve some form of resonance. Resonance implies that a bond is neither single nor double bond but some hybrid of the valence bond theory only describe the bonding of the single or double or triple bond.

_Rules of molecular orbitals theory:

1.The no of molecular orbitals produced is always equal to the no of atomic orbitals brought by the atom that have combined.

2.bonding molecular orbitals are equal in energy that the parents of the atomic brought diffrence the atoms and the anti bonding orbitals the higher in energy.

3.electron of the molecules are assigned to orbitals from lowestsuccessfullly higher energy.

BONDING MOLECULAR THEORY : BOND electron make up bonding molecules make up bonding molecules orbitals.

ANTI-BONDING MOLECULAR THEORY:Antibonding molecules orbitals don't contibute to bonding and hence they are found located external to the bond.

:-DIFFRENCE BETWEEN BONDING AND ANTI BONDING MOLECULAR ORBITALS-:

*BONDING MOLECULAR ORBITALS:

1.Bonding molecular orbitals are a form of a molecules orbitals that paly a role in chemical bond formation.

2.The stability of BMO is much higher than the anti bonding molecule orbitals.

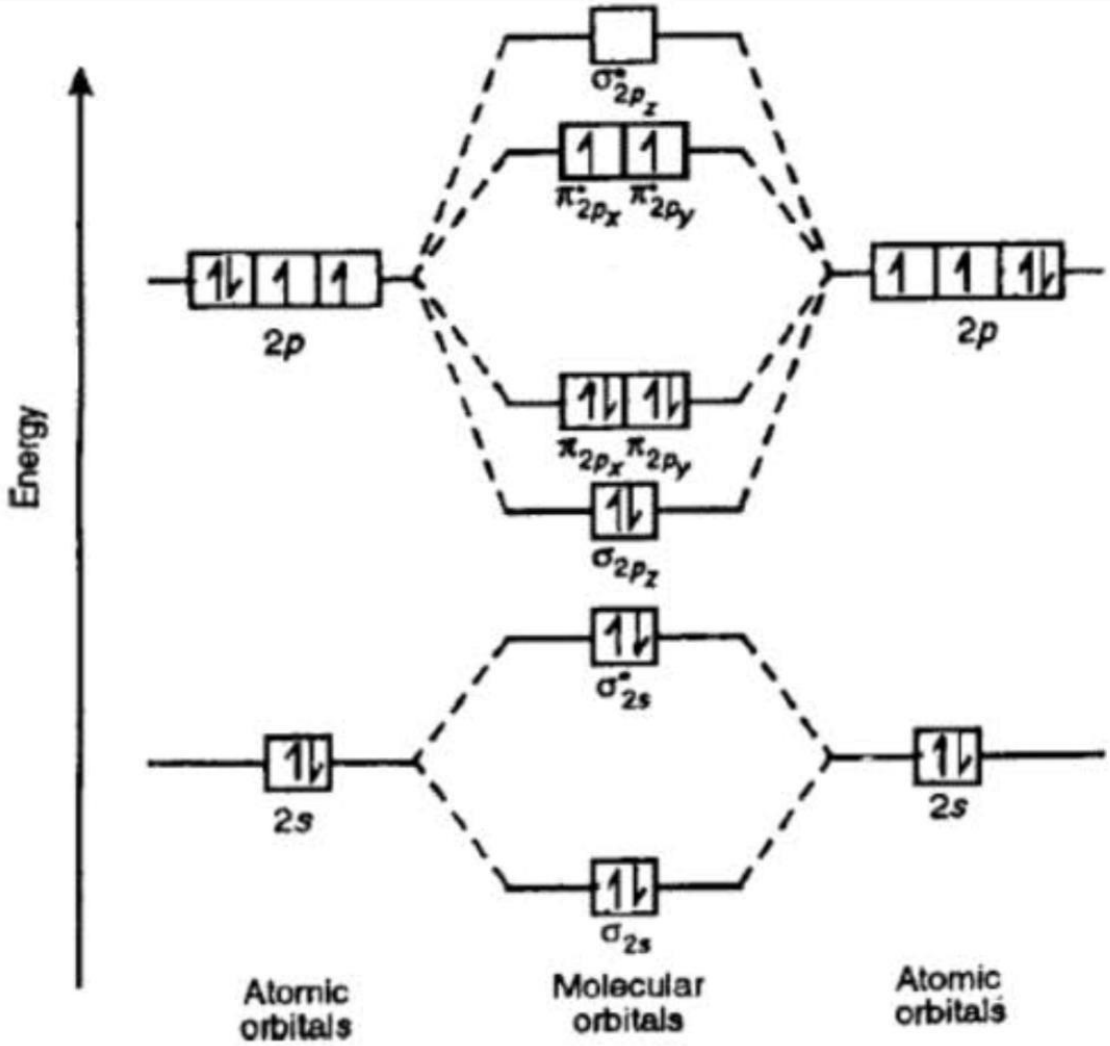
3.The molecules are in geometry shape.

*ANTI-BONDING MOLECULAR ORBITALS:

1.Anti bonding ,molecules orbitals have higher energy comparatively.

2.molecules in geometry shape.

3.compared to the BMO anti bonding ,molecules orbitals stability is lower.



FIRST PERIODS HOMONUCLEAR DIATOMIC : In the first row periodic table.the valence atomic orbitals 1s.these are two possible homonuclear diatomic orbitals.

1.Dihydrogen:This is the simplest diatomic orbitals. It has only two electron and nature in diatomic.it bond length decrease expect molecular orbitals theory if bond length increase to one electron to subtract and add in one electron

Note-Dihydrogen bond length order 1.

2.Dihelium:This molecule has bond length zero is equal to number of electron bonding and anti-bonding orbitals.like other nobel gases, he exist in the atomic bond does not form bonds at temperature and pressure.

SECOND PERIOD HOMONUCLEAR DIATOMIC: The second period element span from Lito ne. The valence electron are 2s and 2p.in their molecule orbitals diagram,non valence orbitals. For example-li2,be2,b2,c2,n2,etc.

HETERONUCLEAR OF MOLECULAR ORBITALS OF CARBON MONO OXIDES: carbon monoxide is a heteronuclar diatomic molecule ,and it’s molecular orbitals diagram can be constructed using the valence orbitals of its constituent atoms ,carbon and oxygen. Some point to be noted molecules orbitals of carbon mono oxides and hetero nuclear diatomic molecules.

1.construction:The molecular orbitals diagram of monoxide is similar to those for bicarbonate or dioxygen,but the oxygen orbitals have a lower potential energy than the carbon orbitals.

2.orbital labeling:molecule orbitals are labeled with serial according to their type such as sigma or pi

3.electronegativity:In hetronuclear diatomic molecules ,the atomic orbitals of the more electronegatively atom are placed lower than the atom.

4.bonding molecular orbitals:In hetronuclear diatomic of the type AB ,where A is more electronegatively than B,the bonding molecular orbitals resembles Amore than B.

UNIT-2 CHAPTER-1

TOPIC-OXIDE OF NITROGEN: Nitrogen react with oxygen to form a number of nitrogen oxides it exist difference oxidation state in oxides range from 1 to 5 oxides of nitrogen having nitrogen in higher oxidation state are more oxidize than lower oxidation states.

FOR EXAMPLE-$N_2+O_2=2NO$, $2NO+O_2=2NO_2$

1.NITRIC OXIDE: No is a colorless gas compound it's bonding structure include in the paired electron and it belong to the class of hydrogen nuclear by atomic molecules .No is the prepared by the reduced of dilute nitric acid with a copper 2nano2+2feso4+3h2so4-f

2.NITRIC DIOXIDE: N2o3 is a deep blue solid with an acidic nature it is only soluble at a low temperature in the liquid and solid phase at a temperature increase the equilibrium fever to the formation of constituent gas.N2o3 is prepared by the mixing equal part of nitric oxide and nitrogen dioxide further colling the mixture below. $NO+NO_2-N_2O_3$

3.NITROGEN OXIDE(NO2): No2 is a reddish PHOSPHORUS:It is a chemical element with the symbol of B and atomic number 15 measured to form white and red phosphorous however reactivity is never found as a free element on a earth.

brown gas that has a characteristics sharp bitting odor is a prominent air pollutant. It is a acidic nature having for oxidation state.No2 is prepared by the thermal decomposition. 2pb(no3)2-2pbo+4reduced.

4.N2O2:Dinitrogen oxides is colourless with neutral properties it is commonly known as a Laughlin gas no2 is prepared by the decomposition of ammonium nitrate a high temperature. $NH_4+NO_2+2H_2O$

TOPIC-STRUCTURE OF OXIDES AND OXAACID NITROGEN AND PHOSPHORUS.

OXAACID: Oxoacids are acid that contains oxygen one of these element is phosphorus ,which can be found and various oxoacids' . For example-H3po4,H3po5

PHOSPORUS: It is a chemical element with the symbol of B and measure to from white and red phosphorus however rectivity

isnever found as free elements on a earth.

1.phosphorus oxaacids: if oxides phosphorus bond cannot be ionic to form h plus ions on the other hand h atoms linked to oxygen p oh form are ionisable as a result basicity can be defined as the property H atom in a contact with oxygen. AGNO3+2H2O+H3PO2=4AG +4HNO3+H3PO4. There are seven types of phosphorus oxaacids.

1.Hypophorus=H3po2

2.Orthophorus=H3po3

3.Pyrophorus=H3p3o5

4.Hypophosphoric=H4p2o6

5.Ortho phosphoric =H3po4

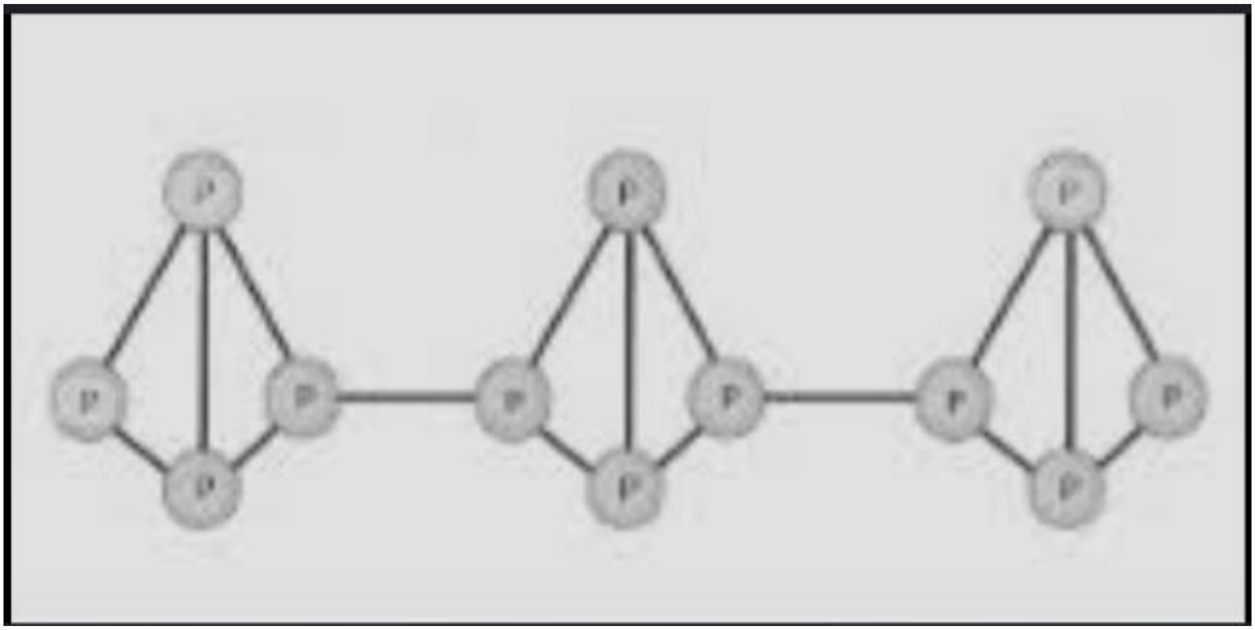
6.Meta phosphoric=Hpo3

7.Pyrophosphoric

TOPIC-STRUCTURE OF WHITE RED AND YELLOW PHOSPHORUS

RED PHOSPHORUS-: Red phosphorus is the one of the most common allotropes of phosphorus and is consider to be derivate of p4 molecules it exist in an enormous network of p4 phosphorus .atoms is the found to be most able then white phosphorus and red phosphorus is characteristics by deep colorless powdered testure.

STRUCTURE:



PROPERTIES:Some important and physical and chemical properties of red phosphorus tebiluted blue.

1.Red phosphorus is odorless

2.It has deep colorless.

3.It has not possineus of human and contrast.

4.Red phosphorus heat temperature 300 degree Celsius.

5.Red phosphorus is a crystallinegation.

WHITE PHOSPHORUS-:Application of red phosphorus-

1.when mixed with MG and with a binder red phosphorus used as a smoke device that can quickly create a smoke screen.

2.It is also used as a production of methamphetamines .

3.Red phosphorus used flame retardant many thermoplasticand thermostatic plastic.

PROPERTIES -:

1.Trilucent white waxy solid,

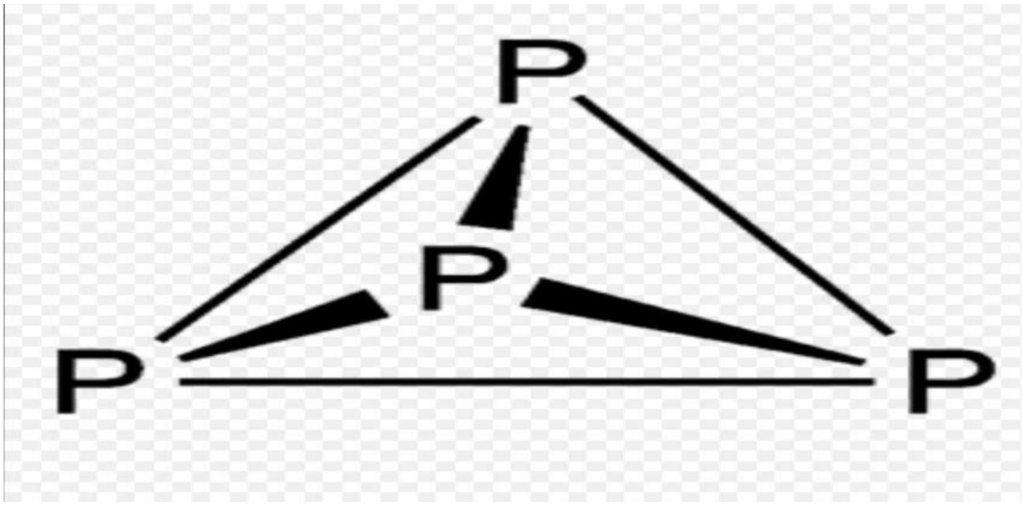
2.poisnous in a nature.

3.less stable and more stable.

4.does not dissolved in water.

5.It has a discreate tetrahedral p_4 molecules.

STRUCTURE-:



PRODUCTION-:

1.The white allotropes can be produce using several method.

2.In the industrial process phosphate rock is heated in electric of fuel fired furnace in the presence of carbon and silica.

3.Element of phosphorus is then liberated as a vapour and collected undergoes phosphorus acilibe.

:-TOPIC-OXYACIDS OF SULPHUR STRUCTURE AND H_2O_2 STRUCTURE PROPERTIES-:

They shows a tetrahedral structure with respect to the oxygen generally these axacids have a minimum of the s=o bond OH single bond be have also terminal peroxide groups terminal and s=o terminal bridging in these oxaacids.

1.Sulphuric acids-: H_2so_4 is possible the most common sulphuric acid we have seen lot of application of this acid .it is a diprotic acid it is signify properties into ionisation in sulphuric acid .one atom of sulphuric acid. One atom of sulphuric atom two hydroxly group these shows tetra hedral geometry .they have the length sulphur oxygen bond s=o is quite less compare to bond length aas single bond OH.

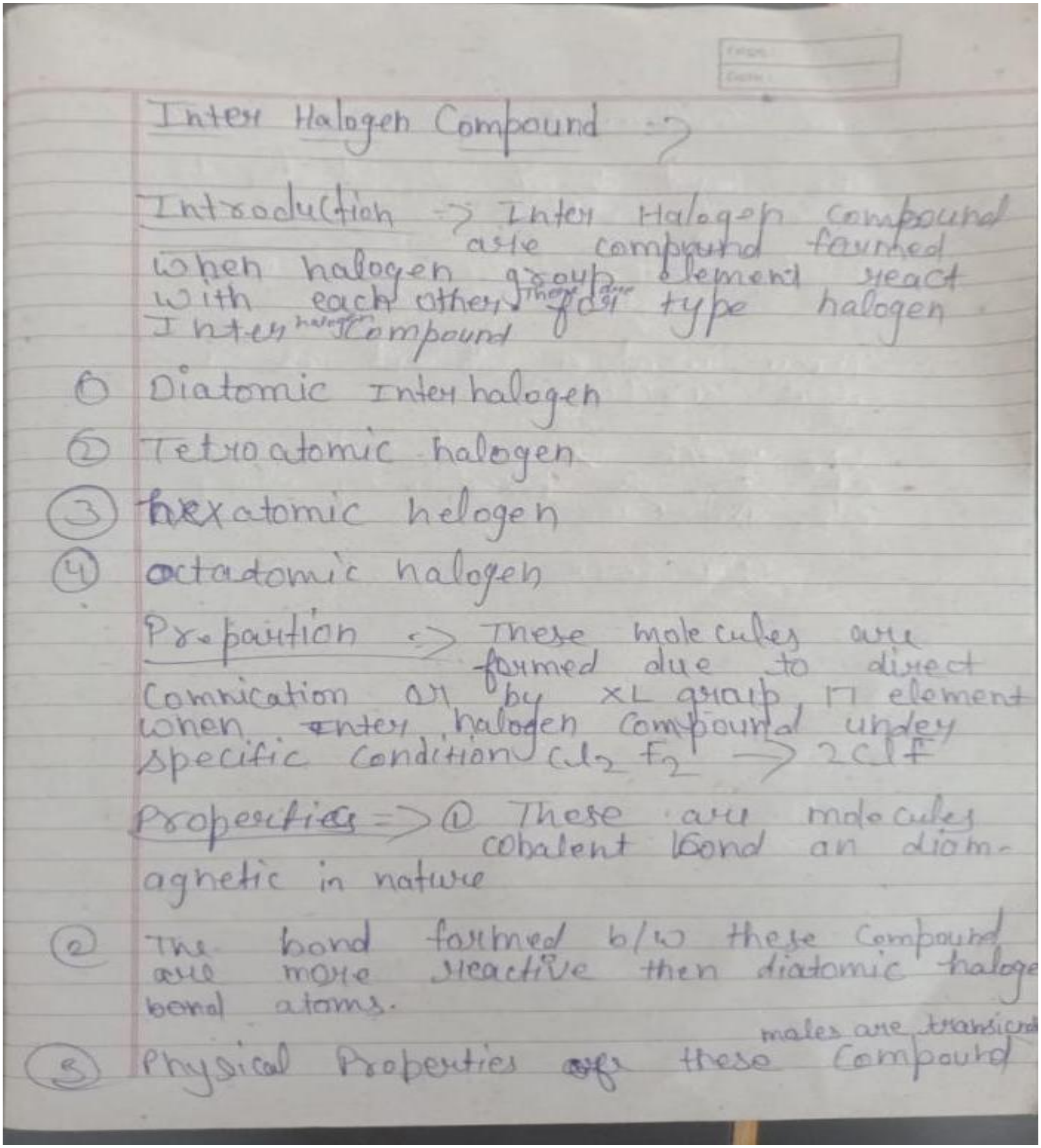
2.Sulphorus acid-: H2so3 acid is a diprotic acid and these give rise to two and two proton. IN the sulphur's acid one atom of sulphur's with two hydroxly group. Also one oxygen atom form a pie bond with the sulphur atom.we prepare this by dissolving sulphur dioxide in gaseous phase.

3.Peroxide sulphuric acid-: H2so2 acid contain sulphuric in plus6 oxidation state .it a strong oxidizing agent .it contain one peroxide that acts a bridge between the two sulphur atom .each connected on hydroxly roup s-oh-and two bond sulphur atoms. Each connected on hydroxly group s-oh-and two oxygen s=o. 2clso3h+h2o2=h2s2o8

4.Pyrosulphuric acid -: H2s2o7 acid is also known as oleum. It's molar mass is 178.13gram Mol. It is an anhydride of sulphur acid is a color less crystalline solid. He has a melting bond 36degree .it is prepare by realize excels sulphur trioxide with sulphuric acid.h2so4+so3=h2s2o7

Uses-: It also uses petroleum retring It corrective in nature.

Topic-basic properties of halogen and inter halogen compound and properties.



Inter Halogen Compound :->

Introduction -> Inter Halogen compound are compound formed when halogen group element react with each other. They are four type halogen Inter halogen Compound

① Diatomic Inter halogen

② Tetroatomic halogen

③ hexatomic helogen

④ octadomic halogen

Prepairtion => These molecules are formed due to direct comnication or by XL group, 17 element when ~~Inter~~ halogen compound under specific condition $Cl_2\ F_2 \longrightarrow 2ClF$

Properties => ① These are molecules cobalent Bond an diamagnetic in nature

② The bond formed b/w these Compound are more reactive then diatomic haloge bond atoms.

③ Physical Properties ~~of~~ these males are transicn Compound are constituent.

④ The bond length depend upon the size of constant.

Used ⇒ They are used an non-equas solvent

② There used a cattelast as a few reactions

③ UF_6 Which is used in the reactment of 235_u is preduce by using ClF_3 and BrF_3

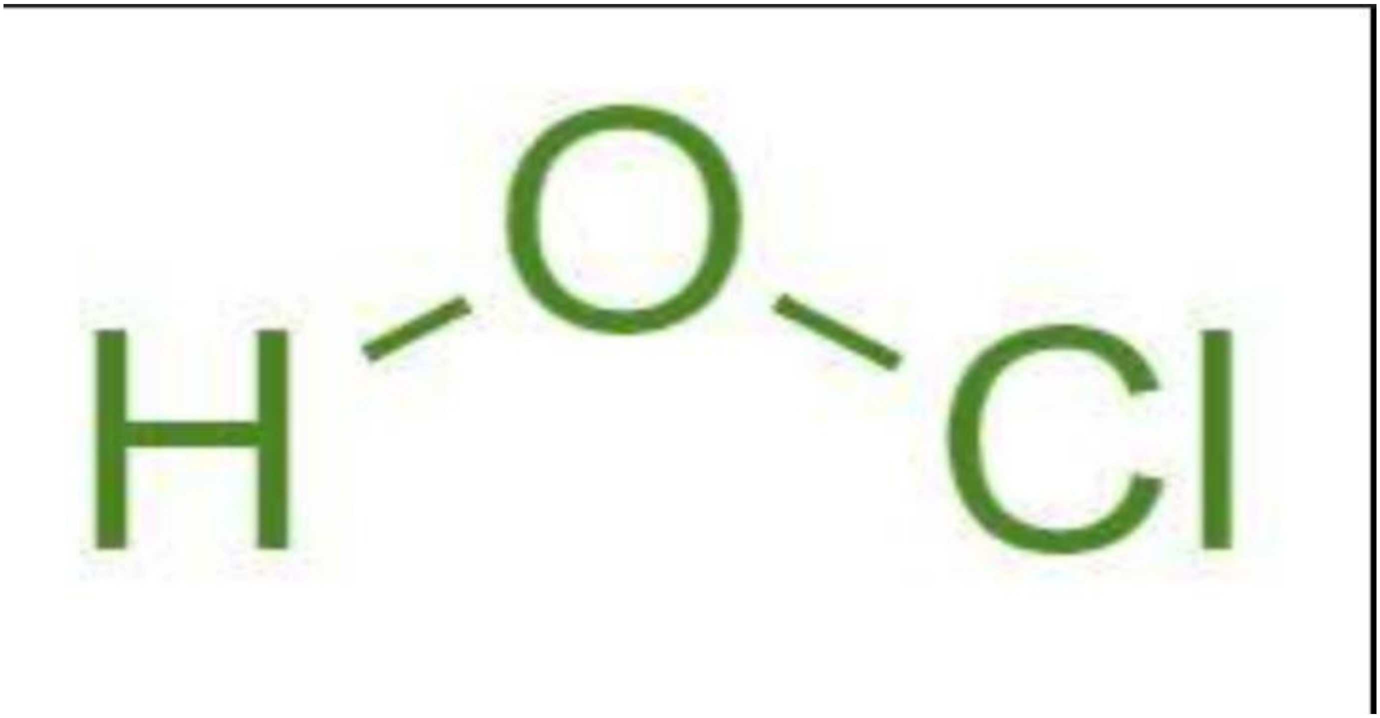
$$U + 3ClF_3 \longrightarrow UF_6 + 3ClF$$

:-TOPIC-OXYACIDS OF CHLORINE AND STRUCTURE-:

An oxoacid is a compound that contains at least one oxygen, hydrogen, and no less than one other element. These have at least one hydrogen molecule bound to oxygen. This hydrogen can separate into the H+ cation and the anion of the respective acid. Halogens form oxoacids of different types; the general formula of such oxoacids are Hypohalous acid (HOX), halous acid (HOXO), halic acid (HOXO2) and perhalic acid (HOXO3). These oxoacids are stable only in aqueous

FOUR OXYACID OF CHLORINE-:

1.Hypocholorus acid-:When chlorine gas is passed through water, a hydrolytic disproportionation reaction takes place that leads to the formation of hydrochloric acid and hypochlorous acid. It is a reversible reaction, so the hydrochloric acid is then precipitated using mercuric oxide, and hypochlorous acid is extracted. The chemical reaction involved is given below



Hypochlorous acid is a simple molecule that contains oxygen in the centre which connects with the chlorine and hydrogen atoms through a single bond.

IUPAC name	Hypochlorous acid or chloric (I) acid or chloranol.
Chemical Formula	HClO
Molar mass	52.46gmol–1
pKa value	7.53
Solubility	Water-soluble

View more

Uses

1. Hypochlorous acid is used as a disinfectant and sanitiser.
2. It heals the wound.
3. It is used for water treatment in swimming pools.
4. Hypochlorous acid is tested to remove up to 99% of foul odours, including garbage, rotten meat, toilet, stool, and urine.

2. Chlorous acid (HOClO or HClO2)

Preparation

Chlorous acid is prepared through the reaction of barium or lead chlorite and dilute sulphuric acid. It is a powerful oxidising agent.

$Ba(ClO2)2+H2SO4 \rightarrow BaSO4+2HClO2$

$Pb(ClO2)2+H2SO4 \rightarrow PbSO4+2HClO2$

Chlorous acid is an inorganic compound having a weak acidic character, it contains one CI=O bond and another oxygen connect with the chlorine and hydrogen atoms through a single bond.

Properties

IUPAC name	Chlorous acid
Chemical Formula	HCIO2
Molar mass	68.46gmol–1
pKa value	1.96
Solubility	Water-soluble

View more

Uses

1. Chlorous acid acts as an effective bleaching agent. Because of this, it is used for the removal of lignin and non-carbohydrate components from wood pulp without any action on carbohydrates.
2. The sodium salt of chlorite ion is used in the industrial production of chlorine dioxide.

3. Chloric acid ($HOClO_2$ or $HClO_3$)

Preparation

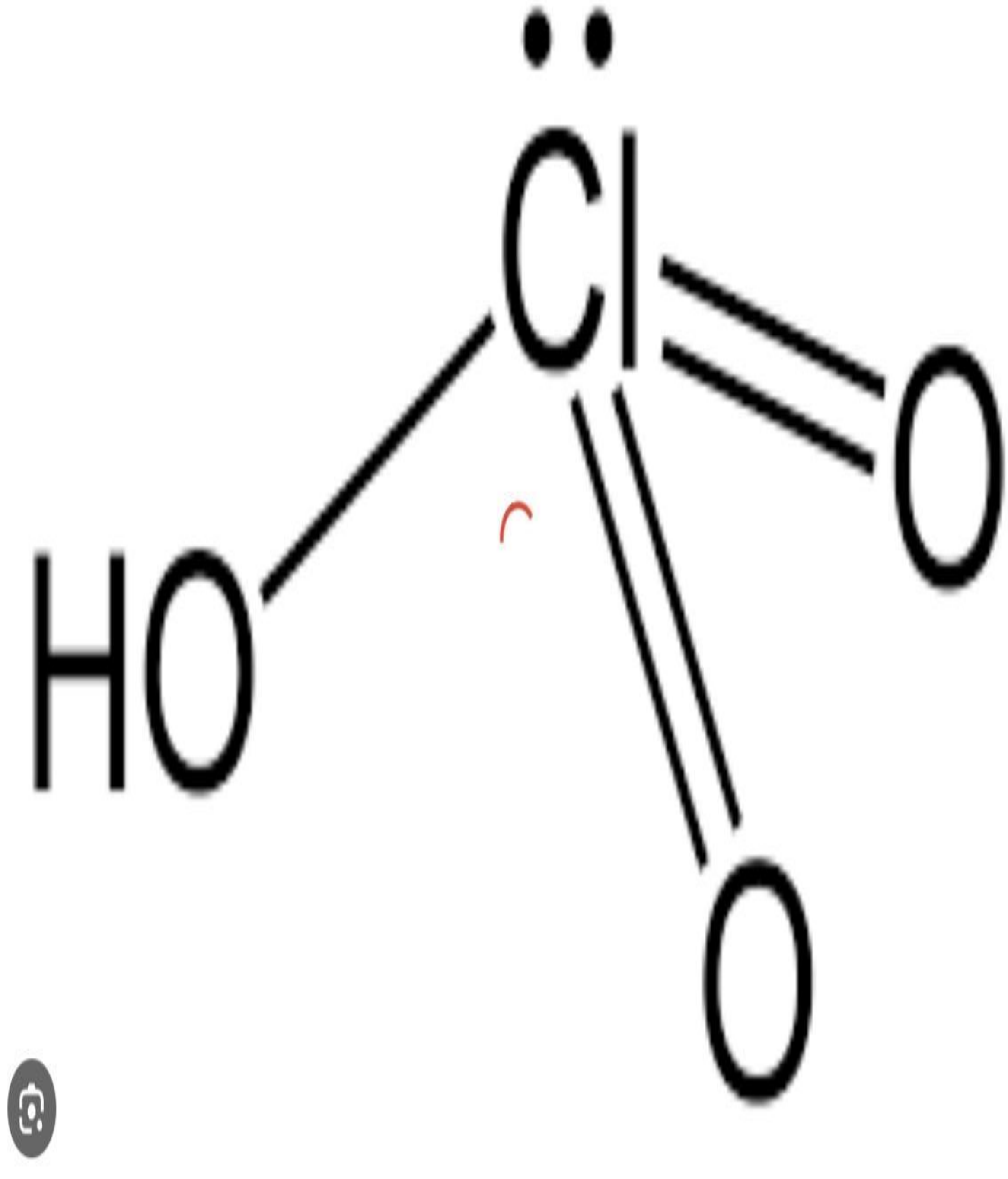
Chloric acid is prepared by the reaction of sulphuric acid with barium chlorate; later on, the insoluble barium sulphate is removed by precipitation:

$Ba(ClO_3)_2+H_2SO_4 \rightarrow BaSO_4+2HClO_3$

Another method for producing chloric acid and hydrogen chloride is by heating hypochlorous acid.

$3HClO \rightarrow HClO_3+2HCl$

Structure



Chloric acid is an oxoacid of chlorine that contains two Cl=O bonds and one Cl−OH bond along with a lone pair of electrons.

Properties

IUPAC name	Chloric (V) acid or Chloric acid
Chemical Formula	HCIO3
Molar mass	84.459gmol−1
pKa value	Approx (−1)
Solubility	soluble in water

View more

Uses

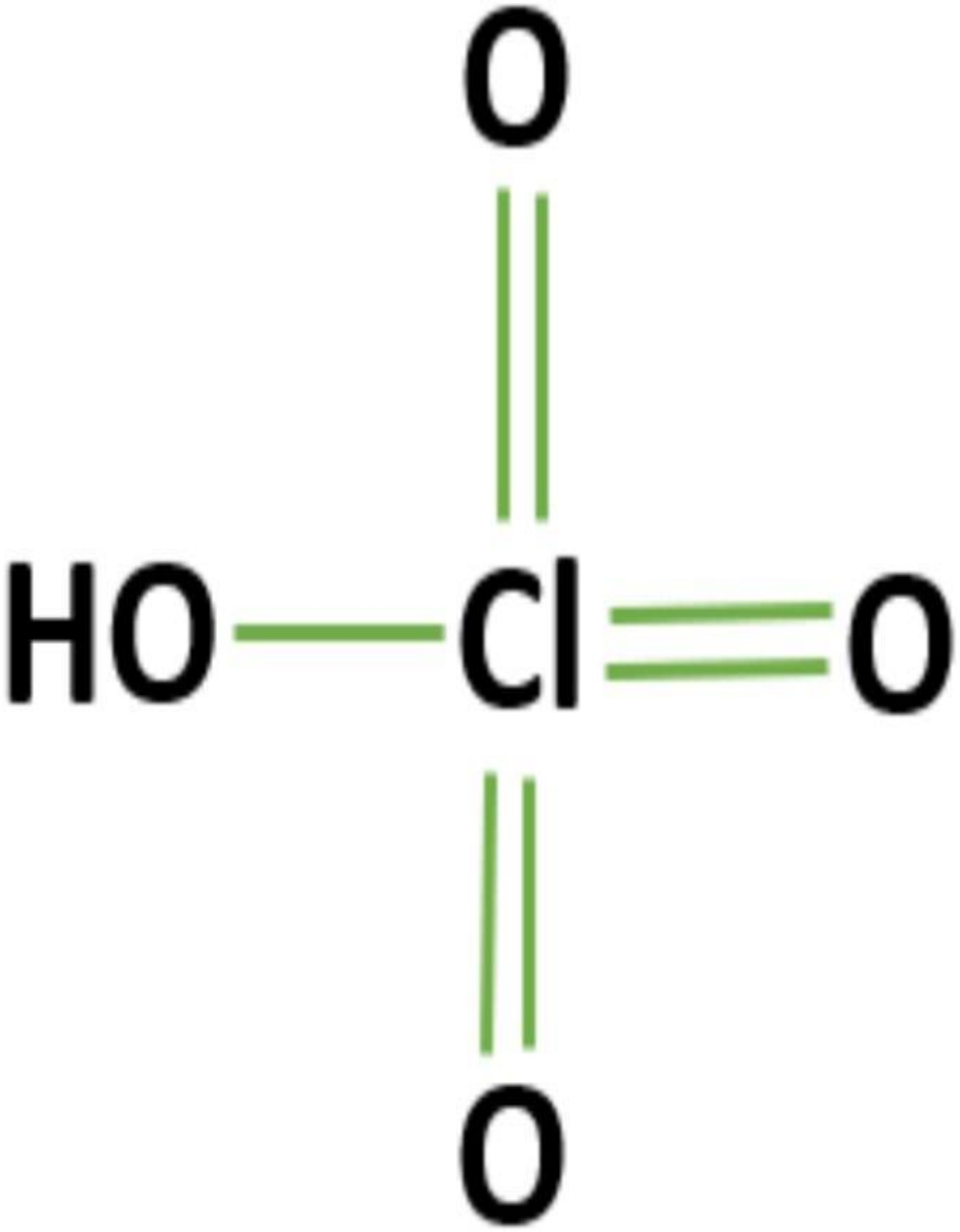
1. Chloric acid is used as a reagent in chemical analysis and to prepare other chemicals.
2. It will accelerate the combustion of combustible materials, and most of them can be ignited on contact only.

4. Perchloric acid ($HOClO_3$ or $HClO_4$)

Preparation

Treatment of barium perchlorate with sulphuric acid gives the precipitate of barium sulphate, leaving behind perchloric acid. The chemical reaction is given below:

$Ba(ClO_4)_2+H_2SO_4 \rightarrow BaSO_4+2HClO_4$


O
HO
Cl
O
O

Perchloric acid is an oxoacid of chlorine that contains three Cl=O bonds and one Cl–OH bond.

Properties

IUPAC name	Perchloric acid or Chloric (VII) acid or Hyperchloric acid
Chemical Formula	HClO4
Molar mass	100.46gmol−1
pKa value	−10
Solubility	Water-soluble

View more

Uses

1. Perchloric acid is used in rocket fuel as it is mainly produced as a precursor to ammonium perchlorate.
2. Perchloric acid is one of the most proven materials for cutting metals to create designs or a pattern in them, which is used in critical electronics applications as well as for ore extraction.
3. Perchloric acid may also be called a superacid; it is one of the strongest Bronsted–Lowry acids.
4. It is used as an eluent in ion-exchange chromatography.
5. It is used for electropolishing or etching metals like aluminium, molybdenum, etc.

Stability of Oxoacids of Chlorine

The stability order of the oxoacids of chlorine are:

HOCI<HClO2<HClO3<HClO4

Perchloric acid is the most stable oxoacid of chlorine because it has a maximum number of resonating structures of its conjugate base. It has the lowest oxidising power too.

Acidic Strength of Oxoacids of Chlorine

The acidic strength of oxoacids of chlorine depends upon the oxidation number. As the oxidation number increases, the acidic character also increases. The increasing order of their acidic strength is:

HOCI<HClO2<HClO3<HClO4

Summary

In short, we can say that an oxoacid is a compound that contains at least one oxygen, hydrogen, and one another element. One hydrogen atom is attached to the oxygen, and this hydrogen can dissociate into the hydrogen cation and anion of the acid in an aqueous solution. Most of the halogens form oxoacids, such as Hypohalous acid, halous acid, halic acid, and perhalic acid. As an exception to other halogens, Fluorine forms only one oxoacid, i.e., HOF, due to the absence of vacant d-orbitals.

Chlorine forms four types of oxoacids such as hypochlorous acid $HOCl$, chlorous acid $HOClO$ or $HClO_2$, chloric acid $HOClO_2$ or $HOClO_3$ and perchloric acid $HOClO_3$ or $HOClO_4$. Oxoacids of chlorine are prepared both in the laboratory and on an industrial scale. Some important uses of these oxoacids are: Hypochlorous acid is used as disinfectant and sanitiser, chlorous acid is an effective bleaching agent that is used in the paper industry, chloric acid and perchloric acid is highly flammable and used in rocket fuels, in etching of metals, etc. Perchloric acid is a very dangerous explosive and needs to be handled with care.

Frequently Asked Questions (FAQs)

Q.1. How many oxoacids are formed by chlorine?

Ans. There are four oxoacids of chlorine; these are hypochlorous acid ($HOCl$), chlorous acid $HOClO$ or $HClO_2$, chloric acid $HOClO_2$ or $HCIO_3$ and perchloric acid $HOClO_3$ or $HClO_4$.

Q.2. What are the formulas of oxoacids of chlorine?

Ans: The chemical formulas of four oxoacids of chlorine are: Hypochlorous acid ($HOCl$), Chlorous acid $HOClO$ or $HClO_2$, Chloric acid $HOClO_2$ or $HClO_3$ and Perchloric acid $HOClO_3$ or $HClO_4$.

Q.3. What are the different oxoacids formed by chlorine, and what is the oxidation state of chlorine in each of them?

Ans: There are four different types of oxoacids of chlorine. The oxidation state of chlorine in hypochlorous acid ($HOCl$) is +1, the oxidation state of chlorine in chlorous acid $HOClO$ or $HCIO_2$ is +3, the oxidation state of chlorine in chloric acid $HOClO_2$ or $HCIO_3$ is +5, and the oxidation state of chlorine in perchloric acid $HOClO_3$ or $HClO_4$ is +7.

Q.4. What are the oxoacids of halogen?

Ans: Halogens form oxoacids that are of different types; the general formula of such oxoacids are Hypohalous acid (HOX), halous acid ($HOXO$), halic acid ($HOXO_2$) and perhalic acid $HOXO_3$. These oxoacids are stable only in aqueous solutions or in the form of their salts. The acidic strength of oxoacids increases with an increase in the oxidation number of halogens. Fluorine is an exception to this property as it forms only one oxoacid, i.e., HOF, due to the absence of vacant d-orbitals.

Q.5. Which oxoacid of chlorine is the strongest acid?

Ans: Perchloric acid is the strongest acid among all the oxoacids of chlorine. It is highly reactive and explosive in nature. As the thermal stability of perchloric acid ($HClO_4$) is very high, and its oxidising power will be the least.

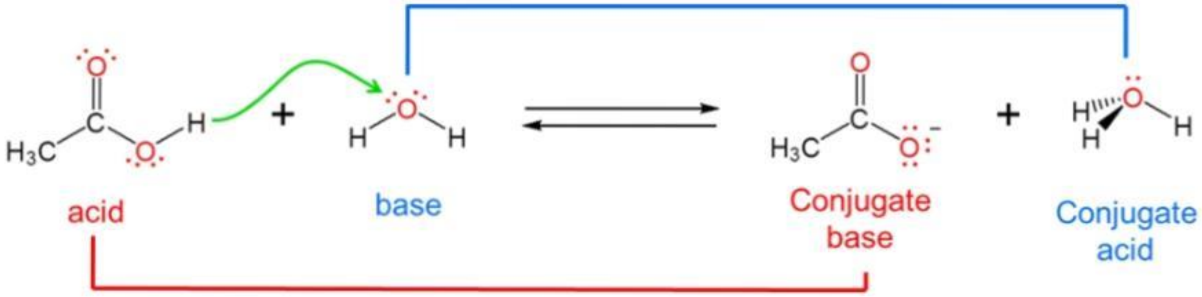
Q.6. Which oxoacid of chlorine is most stable?

Ans: Perchloric acid is the most stable oxoacid of chlorine because it has a maximum number of resonating structures of its conjugate base. It has the lowest oxidising power too

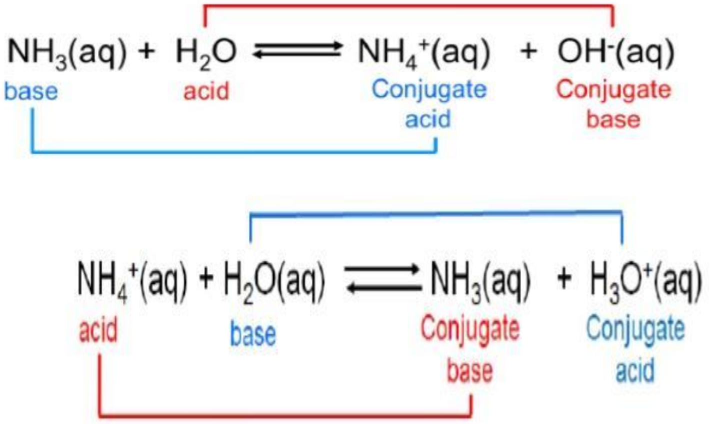
Previous

1.BRONSTED LOWERY CONCEPT: The bronsted Lowery acid base concept ,an acid is a substance of h+ ions accept and an bases of a substance of h-ions loses by base when it is reacts because of bronsted Lowry concept is concerned with h+ions transfer rather than creation of a particular of chemical species,in facts from the viewpoint of bronsted Lowry concept,arrhenius acid and base just a special case involving of hydrogen ions donating and accept involving in water.arrhenius acids donate h+ions which has bronsted base is accepting it is give to h3o+.

Ha(aqueous)+h2o=h3o++a(aq)

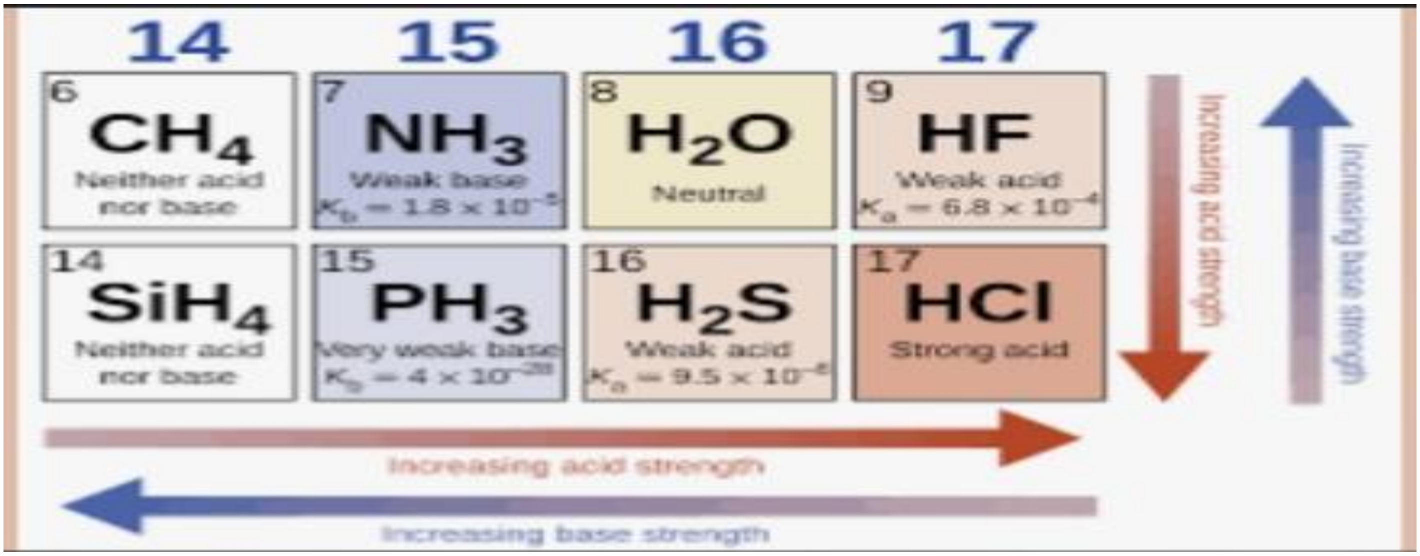


CONJUGATE ACID AND BASE: ACID and base in term of hydrogen ions donation and acceptance,the bronsted lowery concept system makes an easy to recognized that when acid it's electro losses it's hydrogen ions becomes that a substance that is capable of receiving of its again namely a base consider for example the base dissociation ammonium in water when ammonium reacts as a bronsted base receive of hydrogen on water ,ammonium and hydroxide are formed.



The ammonium on reacts with a weak acid that can under dissociation. In the case of ammonium and ammonia ions are conjugate acid and base in pairs.

STRENGTH AND BASE: The relative strength of acid and base of reflect in the magnitude of ionization constant.The stronger of acid or base,the larger is ionization constant.a reciprocal relation exist between the strength of a conjugate acid and base pair:The stronger the acid weaker is the conjugate base.



EFFECT OF SUBSTITUENT AND SOLVENTS:The size of cation and the nature of substituents were found to be the influence the enthalpy and binding energy to the system for complex.in the gas phase ,the cation pi bond interaction was found to be exothermic and whereas in the presence of polar solvent interaction was highly endothermic.

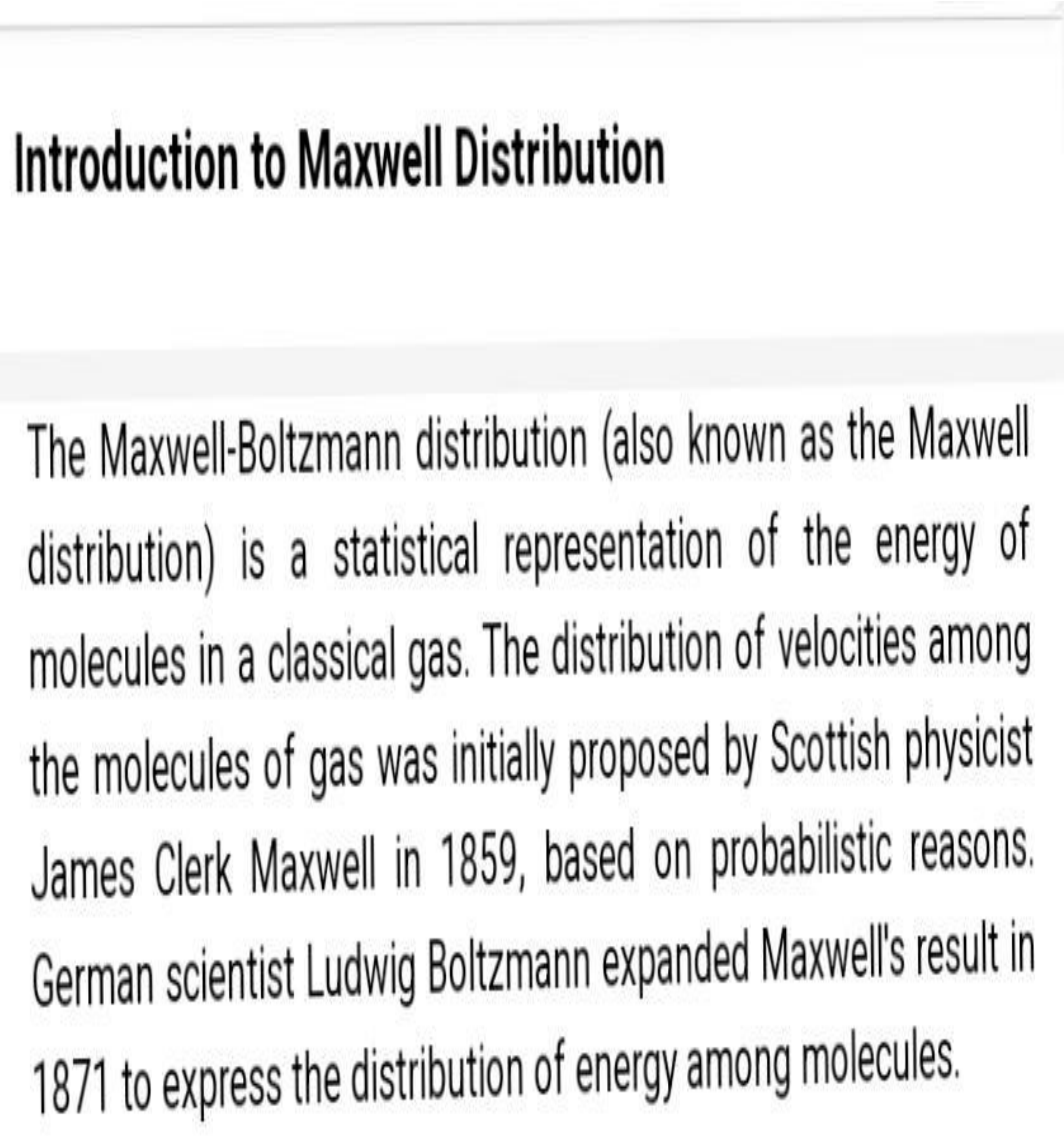
DIFFRENTIATING AND LEVELING SOLVENT:In differentiating solvent, various acid dissociation to different degrees and thus have different strength. IN leveling solvent,various acid dissociation are completely and thus same are strength. A weakly basic solvent has less tendency than a strong basic to one accept a proton.

LEWIS ACID AND BASE CONCEPT:A lewis acid is therefor any substance ,such as h+ions that accept a pair non bonding electron. OR A lewis acid in electron pair acceptor. A lewis base is any substance such as the oh ions,that can a pair of non bonding electron.

LUX -FLOOD CONCEPT:According to this theory,acid and base are defined as acid is being an oxide acceptor and the base being an oxide donor. For example-calcium oxide(cao) reacts with a silicon dioxide (sio2) to form calcium silicate (casio3).

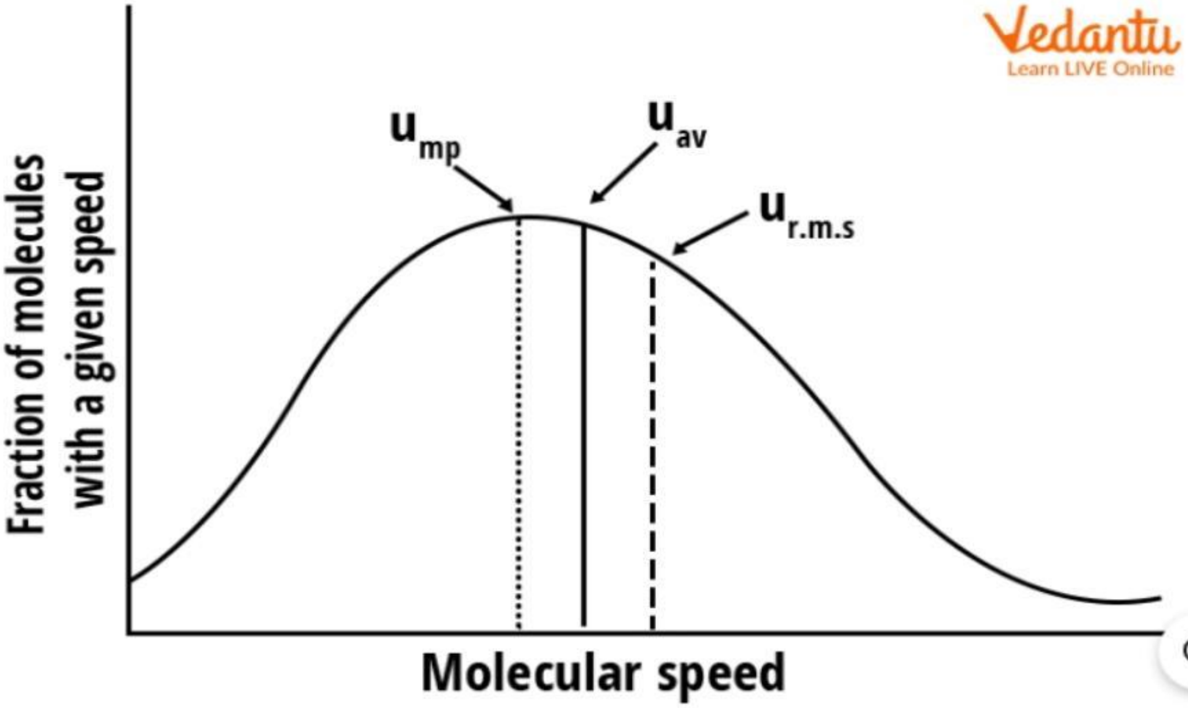
UNIT-3 GASEOUS STATE -:

Topic-Maxwell distribution of velocities and energy-:



Introduction to Maxwell Distribution

The Maxwell-Boltzmann distribution (also known as the Maxwell distribution) is a statistical representation of the energy of molecules in a classical gas. The distribution of velocities among the molecules of gas was initially proposed by Scottish physicist James Clerk Maxwell in 1859, based on probabilistic reasons. German scientist Ludwig Boltzmann expanded Maxwell's result in 1871 to express the distribution of energy among molecules.



Maxwell Distribution of Velocities

The following are the key characteristics of the Maxwell distribution of velocities:

(i) The fraction of molecules with extremely low or extremely high velocities is extremely small.

(ii) The fraction of molecules with higher velocities increases until it reaches a plateau, at which point it begins to decline.

(iii) The maximum fraction of molecules has a velocity, which corresponds to the curve's peak. This is referred to as the most likely velocity.

Thus, the most likely speed of a gas is the speed of the greatest fraction of gas molecules at a given temperature.

Maxwell Distribution of Molecular Velocities Derivation

The Most Probable Speed

The most probable speed of a gas's molecules is the speed possessed by the greatest fraction of the total number of molecules in the gas.

For example, if the speeds of ten molecules of a gas are 1, 2, 2, 3, 3, 3, 4, 5, 6, 6, km/s, the most likely speed is 3 km/s, because the maximum fraction of total molecules poses this speed, i.e. most probable speed , $C_{mp} = 3\,\frac{km}{s}$. It should be noted that the subscript maximum refers to the maximum fraction of molecules, not the maximum speed.

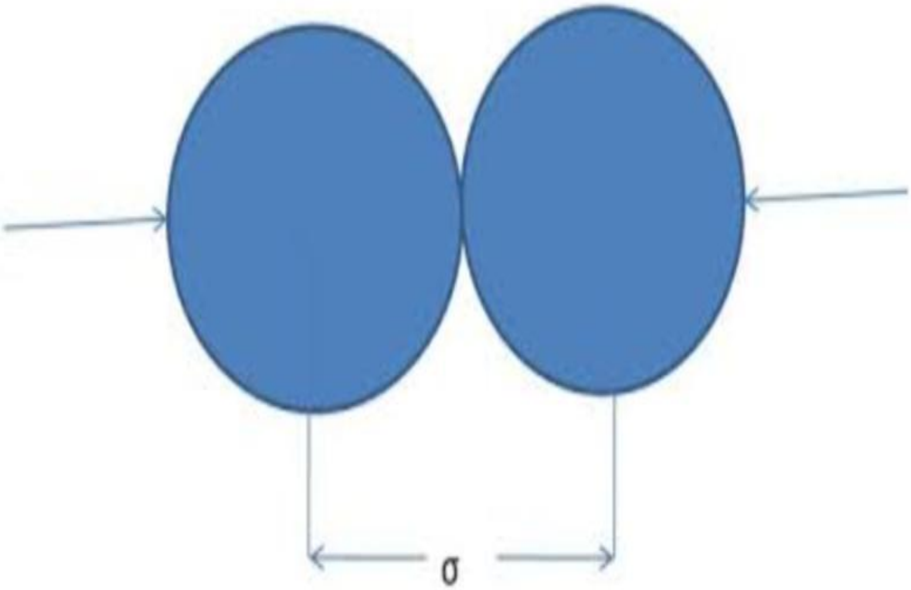
It can be shown that,

$$C_{mp} = \sqrt{\frac{2k_BT}{m}}$$

Where m is the molecule's mass, k_B is the Boltzmann constant and T is the gas's temperature. For a given gas, the value of most likely speed v_{max} decreases as temperature rises.

Collision diameter

The closest distance of approach between the centres of the molecules taking part in a collision is called collision diameter.it is usally represented by σ.



Collision Number and Collision frequency

- The no of collision which a single molecules makes with other molecules in one second is called collision number.
- On the basis of kinectic theory of gases,it can be shown that in gas containing n identical molecules per cm^3,the no of collision which a single molecules will undergo with other molecules in one sec is given by

$$N_c = \sqrt{2}\pi v \sigma^2 n$$

Where v=average velocity of the gas molecules in cm per sec

σ=molecular diameter in cm

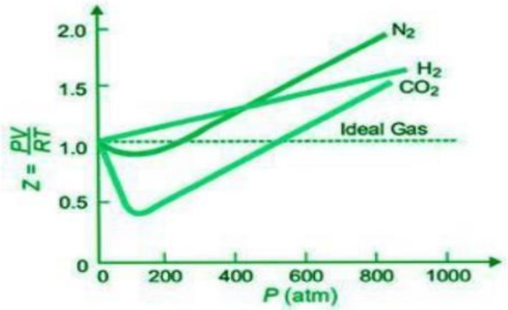
n=no of molecules/cm3

TOPIC-DEVIATION OF REAL GAS FROM IDEAL BEHAVIOUR-:

The deviation of real gas from ideal gas behaviour occurs due to the assumption that if pressure increases the volume decreases.

Effect of Pressure Variation on Deviations

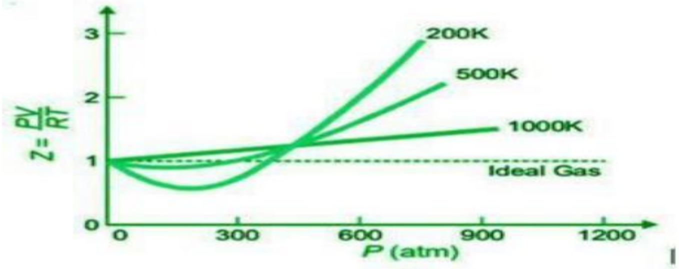
In the graph below, the compressibility factor, Z, for **H_2, N_2, and CO_2** at constant temperature is plotted against pressure.



- For all of these gases, Z is practically equal to one at very low pressure.
- Real gases behave almost perfectly at low pressures (up to 10 atm).
- As the pressure rises, H_2 exhibits a steady increase in Z (from Z=1). As a result, the H_2 curve is higher than the ideal gas curve at all pressures.
- For N_2 and CO_2, Z decreases at first (Z<1), then reaches a minimum, and finally increases with increasing pressure (Z>1).
- Because CO_2 is the most easily liquefied gas, it has the greatest drop in the curve.

Effect of Temperature on Deviations

The graph below shows plots of Z or PV/RT against P for N_2 at various temperatures.



- As the temperature rises, the deviations from ideal gas behaviour become smaller and smaller, as shown by the shape of the graphs.
- At lower temperatures, the curve dips significantly, and the slope of the curve is negative. In this situation, $Z<1$.
- As the temperature rises, the dip in the curve decreases. The curve's minimum vanishes at a certain temperature and remains horizontal for a wide range of pressures.
- At this temperature, PV/RT is nearly equal, thus Boyle's law is satisfied. As a result, Boyle's temperature refers to the temperature of the gas.
- Each gas has its own Boyle temperature, such as 332K for N_2.

Important facts:

- **Real gases perform approximately ideal at low pressures and relatively high temperatures, and the ideal-gas equation is obeyed.**
- **A real gas deviates greatly from ideality at low temperatures and sufficiently high pressures, and the ideal-gas equation is no longer valid.**
- **As the gas approaches the liquefaction point, the departure from ideal behaviour grows.**

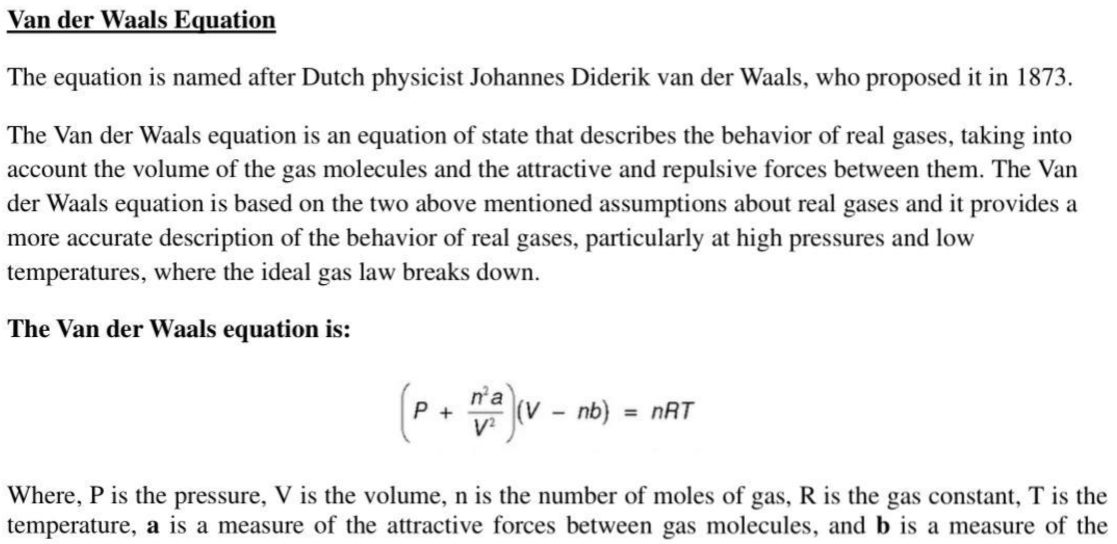
Causes of Real Gas Behaviour

The causes of deviations from ideal behaviour may be due to the following two assumptions of kinetic theory of gases-

- **The volume occupied by gas molecules is negligibly small as compared to the volume occupied by the gas.**
- **The forces of attraction between gas molecules are negligible**.

- **Volume of gas molecules:** The first assumption is valid only at low pressures and high temperature, when the volume occupied by the gas molecules is negligible as compared to the total volume of the gas. But at low temperature or at high pressure, the molecules being in compressible the volumes of molecules are no more negligible as compared to the total volume of the gas. This means that the actual volume occupied by the gas is slightly less than the volume of the container.
- **Intermolecular forces:** The second assumption is not valid when the pressure is high and temperature is low. But at high pressure or low temperature when the total volume of gas is small, the forces of attraction become appreciable and cannot be ignored. Thus, in real gases, there are attractive and repulsive forces between gas molecules, which affect the behavior of the gas. The attractive forces between gas molecules cause the gas molecules to be attracted to each other, which reduces the pressure of the gas. The repulsive forces between gas molecules cause the gas molecules to repel each other, which increases the pressure of the gas.

TOPIC-VANDER WALL EQUATION AND ITS APPLICATION -:



Van der Waals Equation

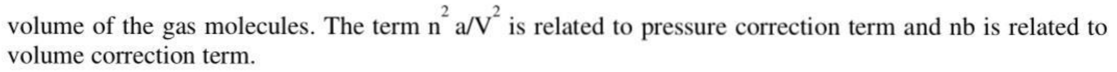
The equation is named after Dutch physicist Johannes Diderik van der Waals, who proposed it in 1873.

The Van der Waals equation is an equation of state that describes the behavior of real gases, taking into account the volume of the gas molecules and the attractive and repulsive forces between them. The Van der Waals equation is based on the two above mentioned assumptions about real gases and it provides a more accurate description of the behavior of real gases, particularly at high pressures and low temperatures, where the ideal gas law breaks down.

The Van der Waals equation is:

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

Where, P is the pressure, V is the volume, n is the number of moles of gas, R is the gas constant, T is the temperature, **a** is a measure of the attractive forces between gas molecules, and **b** is a measure of the



volume of the gas molecules. The term $n^2 a/V^2$ is related to pressure correction term and nb is related to volume correction term.

APLLICATION-: keeping the inert gases in a solid or liquid form. Due to the attracting force exerted at the ends of their feet, geckos can quickly and easily scale smooth surfaces. Spiders are similar in structure.

BOYLE TEMPERATURE-The temperature at which a real gas obeys ideal gas law over an appreciable range of pressure is called Boyle temperature”. Formula-TB=Rab.

REAL GASES BEHAVIOUR OF USING VANDER WALL EQUATION-:van der Waal explains the behavior of a real gas and the proportionality between particle surface and number density.

CRITICAL PHENOMENON-:

CRITICAL TEMPERATURE-: Critical temperature (of a substance) can be defined as the highest possible temperature value at which the substance can exist as a liquid. At temperatures above the critical temperature of a given gaseous substance, it can no longer be liquified, regardless of the amount of pressure applied to it.

CRITICAL PRESSURE-: Critical pressure is the temperature above which, a gas cannot be converted to liquid even by application of pressure. At the critical temperature, the pressure required to convert the gas into liquid is known as the critical pressure.

CRITICAL VOLUME-: Critical volume (VC) is the volume occupied by one gram mole of gaseous substances at critical temperate and pressure.

PV ISOTHERM OF REAL GASES-: When pressure is raised at a constant temperature, volume decreases and vice versa. Isotherms are P-V curves that exist at a constant temperature. At high temperatures and low pressures, actual gases satisfy the ideal gas equation $PV = RT$.

CONTINUITY OF STATES-: The continuity of the state is the property of the transfer of matter between two states, such as between gases and liquids, at which time there is no sudden change in physical properties.

RELATION BETWEEN CRITICAL CONSTANT AND VAN DER WALL CONSTANT-: Van der Waals constants and critical constants are both important concepts in the study of real gases and their behaviour’s,

Van der Waals Equation-:

$(P+a/v2m)(vm-b)=RT$,

Where,

P=pressure

T=temperature

Vm=molar volume

A= Van der walls constant represent between two particle force attraction

B=Van der walls constant represent the volume occupied.

Critical Constants-:

The critical constants of a substance are the pressure, volume, and temperature at which the distinction between liquid and gas phases disappears. At the critical point:

Pc = critical pressure,

Vc = critical molar volume,

Tc = critical temperature.

Relationship Between Van der Waals and Critical Constants

The Van der Waals constants A and B Are related to the critical constants through the following relationships

1.critical pressure=a/27bsqpressu.

2.critical temperature =8a/Rb

3.critical volume=3b

Summary

The Van der Waals constants A and B Are parameters that help to describe the behavior of real gases.

The critical constant ,pressure ,temperature and volume Can be derived from these Van der Waals constants.

ISOTHERM OF VAN DER WALL EQUATION-: If the isotherm is represented by P=AVm−BBV.IFA and B is the depend of the temperature.

UNIT-4 BASIC OF ORGANIC CHEMISTRY AND STEREOCHEMISTRY

TOPIC-: -electronic displacement and its application-:

An electronic displacement occurs when electron move towards the one-sided or the part of molecules .electronic displacemt often responsible for the chemical reactivity of some molecules and the relative of some molecules and the relative inertness of others.

Topic-concept of isomerism and types of isomerism-:

Isomerism is the phenomenon in which more than one compounds have the same chemical formula but different chemical structures. Chemical compounds that have identical chemical formulae but differ in properties and the arrangement of atoms in the molecule are called isomers.

Topic-optical isomerism-:

Optical isomerism occurs when substances have the same molecular formula and structural formula, but one cannot be superimposed on the other.

Topic-optical activity-:

Optical activity is the ability of a compound to rotate the plane of polarized light.

Topic-chiral and achiral molecules with two stereogenic centres-:

Chiral molecules are asymmetric at one or more centres. Achiral molecules are symmetric at all the centres. Chiral molecules rotate plane polarised light in a clockwise or anticlockwise direction. Achiral molecules don’t rotate plane polarised light in any direction.

Topic-stereogenic centre-:

A stereocenter (stereogenic canter) is an atom that contains at least three different substituents, which produces a stereoisomer when two substituents are interchanged. Chirality is a geometric property of a physical, chemical, or biological object, which is not superimposable on its mirror image.

Topic-chirality-:

Chirality is a geometric property of a physical, chemical, or biological object, which is not superimposable on its mirror image.

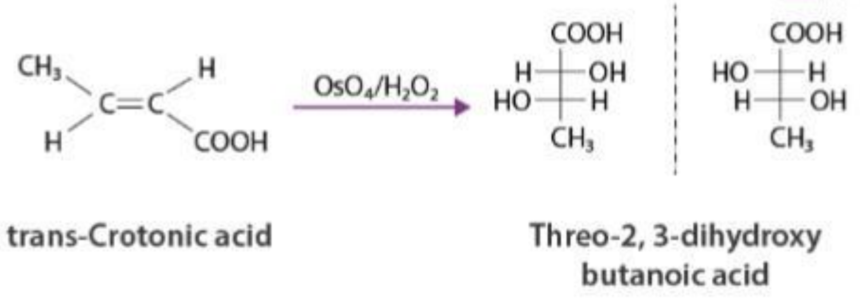
Topic-diastereomers-:

Diastereomers are defined as compounds which have the same molecular formula and sequence of bonded elements but which are nonsuperimposable, non-mirror images.

Topic-threo and erythro diastereomers-:

A Diastereomer is called erythro if its Fischer projection shows similar groups on the same side of the molecule. It is called threo if similar groups are on the opposite sides of the Fischers projection.

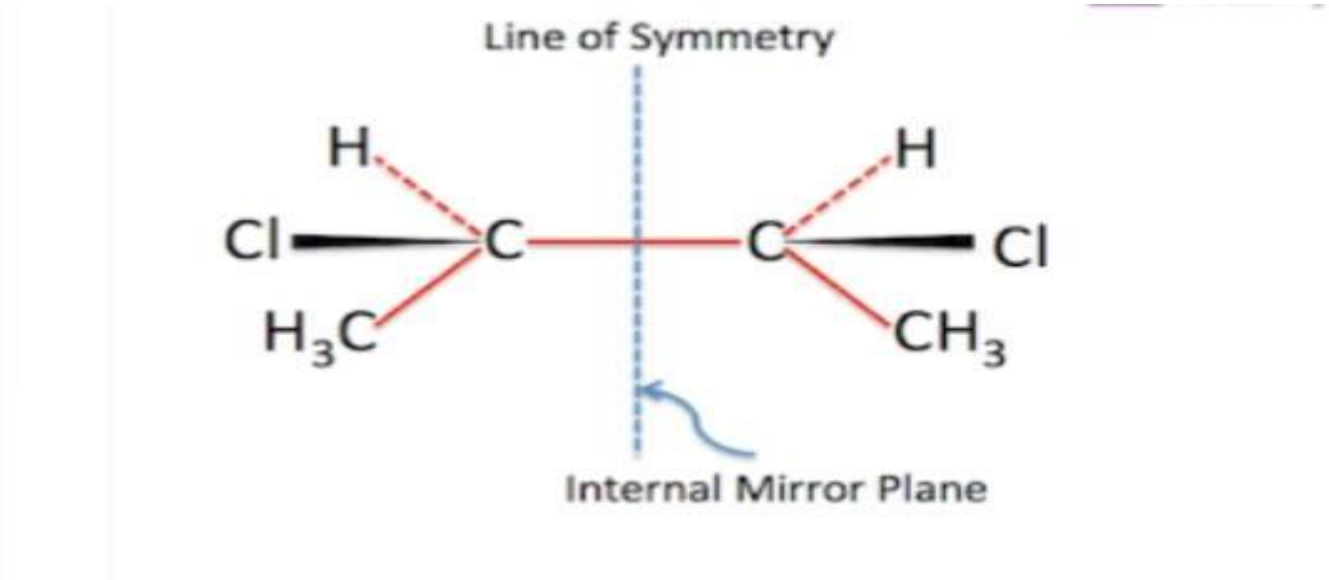
Example-hydroxylation of trans-crotonic acid gives two enantiomers of the threo-2,3-dihydroxybutanoic acid, whereas the same reaction with cis-crotonic acid gives the erythro enantiomers.



Topic-meso compound-:

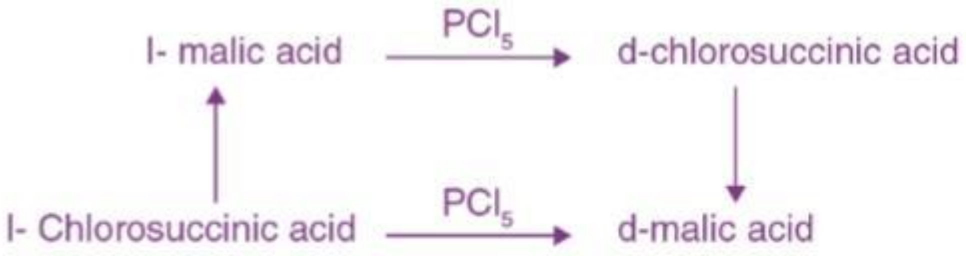
An achiral compound with chiral centres is known as a meso compound. Although it has two or more stereocenters, a meso compound has an internal plane of symmetry that makes it superimposable on its mirror image and is optically inactive.

Example-Meso compounds feature chiral centres (sp3 hybridised tetrahedral atoms bound to four distinct groups), yet they are achiral generally due to symmetry.



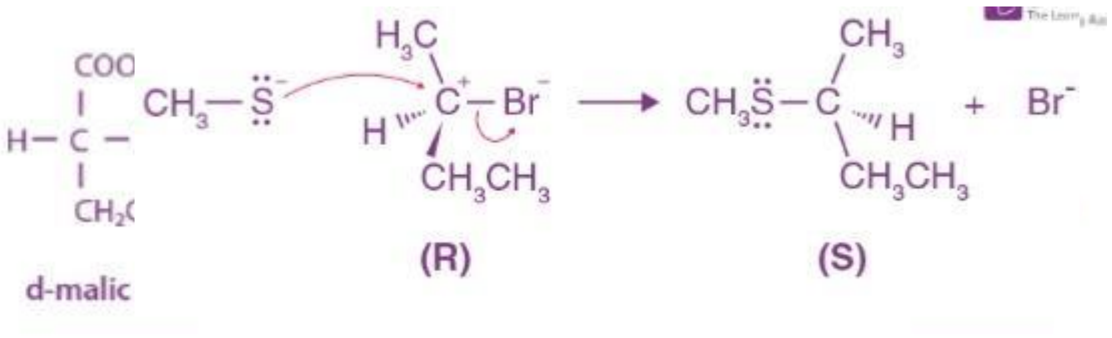
Topic-inversion-:

In 1896, Walden reported an inversion of optical rotation in the conversion of malic to chlorosulfonic acid by reaction with phosphorus pentachloride.



Walden inversion has been extensively studied with numerous reactants and optically active substances. Perhaps the most satisfactory explanation for the change in configuration was suggested by Werner in 1911 and is commonly known as the opposite face mechanism for the Walden inversion.

For example,-



A Walden inversion occurs at a tetrahedral carbon atom during an SN2 reaction when the entry of the reagent and the departure of the leaving group are synchronous. The result is an inversion of configuration at the centre under attack.

Walden Inversion Mechanism

The stereochemical course of an SN2 reaction's inversion of configuration is explained below.

Nearly 100 years ago, Paul Walden demonstrated that (+) malic acid could be converted to either (+) or (-) chlorosuccinic acid (2-chlorobutanedioic acid) with different reagents. Although the absolute configuration of each substance was not known at the time, it was clear that one of these processes occurred by inversion of configuration at the stereocenter and the other by retention.

A series of investigations definitely showed that the stereochemistry of a chiral substance is normally inverted during the course of an SN2 reaction.

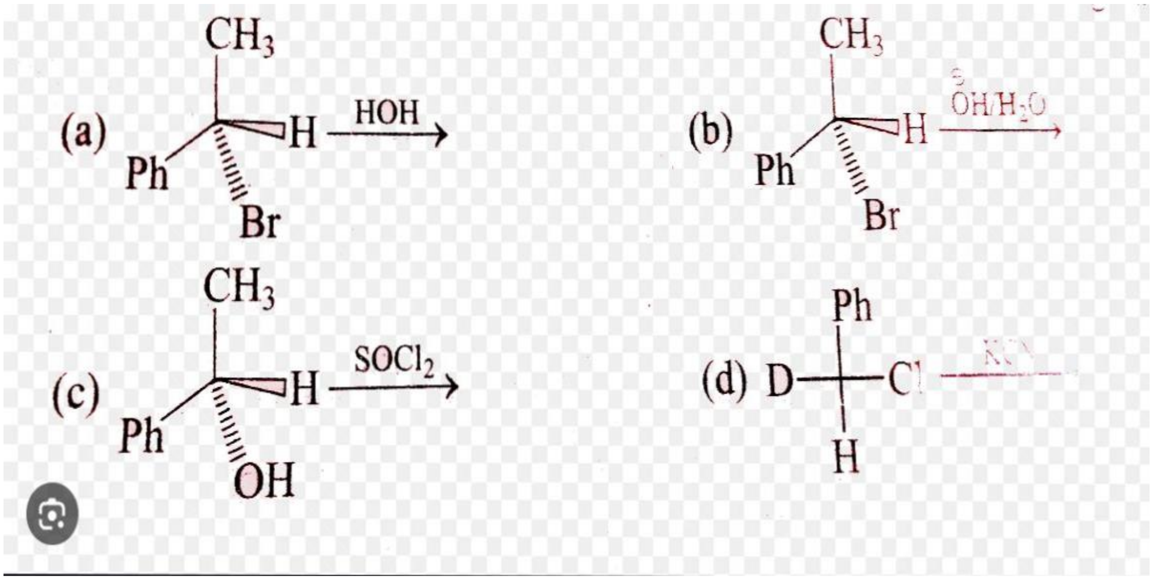
Topic-Racemisation and retention-:

Racemisation is defined as “a process by which an optically active substance either dextro or levorotatory, is directly converted into a racemate”. Resolution is the method when a racemic modification is divided into its constituent enantiomers. Racemisation is a thermodynamically favourable method, and it proceeds spontaneously if a suitable pathway is accessible for the interconversion of the enantiomersRacemic is a sample of a chiral compound that consists of a 1:1 mixture of enantiomers is known as racemic. The racemisation is to become racemic. A sample whose enantiomeric excess decreases in the course of a reaction (S), or a stereocentre whose configurational purity decreases in the course of a reaction (A).The process of racemisation involves the conversion of half of its dextro form into laevo form so that the mixture is optically inactive due to the presence of equal amounts of the two enantiomers. Racemisation can be brought about by

Retention-:

: A process in which the relative configuration or absolute configuration of an atom is retained.

Diagram-:



Topic- R and S configration and nomenclature-:

Name the enantiomers of a compound unambiguously, their names must include the "handedness" of the molecule. The method for this is formally known as R/S nomenclature.

Introduction

The method of unambiguously assigning the handedness of molecules was originated by three chemists: R.S. Cahn, C. Ingold, and V. Prelog and is also often called the Cahn-Ingold-Prelog rules. In addition to the Cahn-Ingold system, there are two ways of experimentally determining the absolute configuration of an enantiomer:X-ray diffraction analysis. Note that there is no correlation between the sign of rotation and the structure of a particular enantiomer.

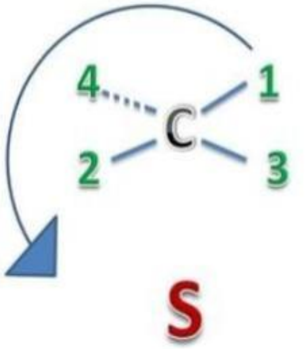
Chemical correlation with a molecule whose structure has already been determined via X-ray diffraction.

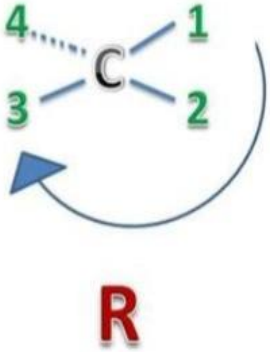
However, for non-laboratory purposes, it is beneficial to focus on the R/S system. The sign of optical rotation, although different for the two enantiomers of a chiral molecule, at the same temperature, cannot be used to establish the absolute configuration of an enantiomer; this is because the sign of optical rotation for a particular enantiomer may change when the temperature changes.

Stereocenters are labeled R or S

The "right hand" and "left hand" nomenclature is used to name the enantiomers of a chiral compound. The stereocenters are labeled as R or S.

Consider the first picture: a curved arrow is drawn from the highest priority (1) substituent to the lowest priority (4) substituent. If the arrow points in a counterclockwise direction (left when leaving the 12 o' clock position), the configuration at stereocenter is considered S ("Sinister" → Latin= "left"). If, however, the arrow points clockwise,(Right when leaving the 12 o' clock position) then the stereocenter is labeled R ("Rectus" → Latin= "right"). The R or S is then added as a prefix, In parenthesis, to the name of the enantiomer of interest. For example: ®-2-Bromobutane and (S)-2,3- Dihydroxypropanal.





Sequence rules to assign priorities to substituents

Before applying the R and S nomenclature to a stereocenter, the substituents must be prioritized according to the following rules:

Rule 1

First, examine at the atoms directly attached to the stereocenter of the compound. A substituent with a higher atomic number takes precedence over a substituent with a lower atomic number. Hydrogen is the lowest possible priority substituent, because it has the lowest atomic number.

When dealing with isotopes, the atom with the higher atomic mass receives higher priority.

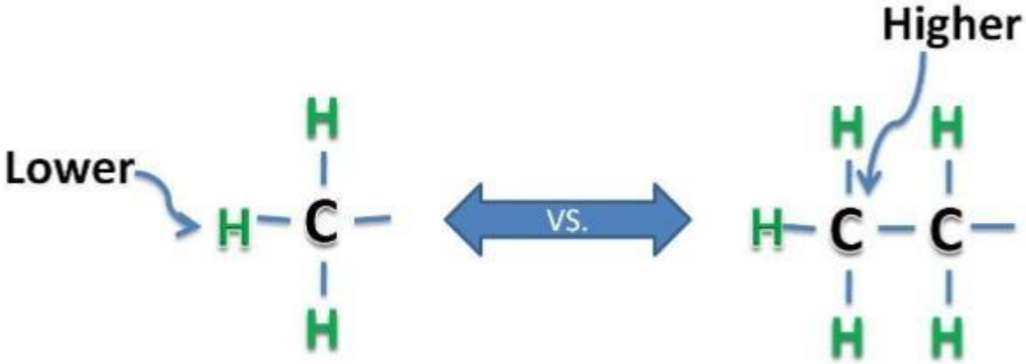
When visualizing the molecule, the lowest priority substituent should always point away from the viewer (a dashed line indicates this). To understand how this works or looks, imagine that a clock and a pole. Attach the pole to the back of the clock, so that when when looking at the face of the clock the pole points away from the viewer in the same way the lowest priority substituent should point away.

Rule 2

If there are two substituents with equal rank, proceed along the two substituent chains until there is a point of difference. First, determine which of the chains has the first connection to an atom with the highest priority (the highest atomic number). That chain has the higher priority.

If the chains are similar, proceed down the chain, until a point of difference.

For example: an ethyl substituent takes priority over a methyl substituent. At the connectivity of the stereocenter, both have a carbon atom, which are equal in rank. Going down the chains, a methyl has only has hydrogen atoms attached to it, whereas the ethyl has another carbon atom. The carbon atom on the ethyl is the first point of difference and has a higher atomic number than hydrogen; therefore the ethyl takes priority over the methyl.



The "H-" (left) ranks lower than the "C-" (right) based on the first point of difference and their relative molecular weights