

## Source of organic Compound :-

- i) Animal & plants
- ii) Natural gas & petroleum
- iii) coal
- iv) Fermentation
- v) Synthesis

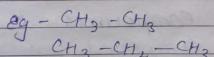
### iii) Fermentation:-

→ Fermentation is defined as the reproduction of chemical & by the action of microorganism.  
eg- Alcohol, vitamins, Antibiotics

### \* Classification of organic Compound:-

- It is classified on 5 categories
- i) Aliphatic Compound

→ It is those compound which can form open chain of carbon atom are called aliphatic compound



### ii) Saturated & unsaturated compounds:-

- Compounds which contain only C, H, are called hydrocarbon.
- A hydrogen carbon is said to be saturated if it contains only C-C single bond.
- A hydrocarbon is said to be unsaturated

## Structure of atom

- The atomic structure was 1st described by "John Joseph, Thomson" & "Ernest" 1900"
- This model of atom is still used as basis of modern atomic theory.
- Atoms are nothing but building blocks of matter atomic theory which has mass & takes up space
- Atoms are nothing but building blocks.
- All the matter is made up of atom
- The word 'Atom' is obtained from Greek and each individual.
- Atomic structure of an atom mainly consists of 3 particles such as - electron, proton, neutrons
- Atoms are particle of elements or substance these cannot be broken further without changing the chemical nature of the substance
- Proton have +ve electric charge and it should be much larger than electron.
- Neutron have no electric charge and it has much behaviour and larger like proton
- Electron are very small trying & lighter particles and it has -ve electric charge

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If it contains C=C & C≡C multiple bonds are called unsaturated.

### iii) Aromatic Compounds:-

→ Benzene and all compound that have structural & chemical properties resembling benzene are called aromatic compound.



Benzene



Aniline



Naphthalene

### iv) Alicyclic Compound:-

→ Which consist only of C-atoms are called alicyclic compound.



cyclo  
Propane



cyclo  
butane



cyclo  
pentane



cyclo  
hexane

### v) Heterocyclic Compound:-

→ It is a compound in which the ring atom of carbon & some other element are called heterocyclic compound.



Ethyl oxide



Nitrobenzene

Crypline

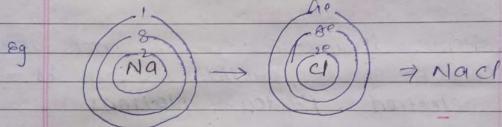
## Types of bond:-

- i) Ionic or electrovalent bond
- ii) Co-valent bond
- iii) Co-ordinate bond

### i) Ionic or Electrovalent bond:-

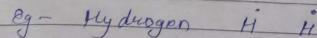
→ Ionic bond are formed by transfer of valence e<sup>-</sup> from one atom to another. Excess electron than the other.

→ This type of bond unites two atoms one of which has excess electron than the stable no (2 O<sub>1</sub>, 8) and the other is short of electrons.



### ii) Co-valent Bond:-

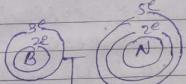
→ Co-valent bond are formed by mutual sharing of electron this type of bond unites two atom both of which are short of e<sup>-</sup> the two atoms contributed one electron each and then share the resulting pair of electron.



### iii) Co-ordinate Bond

→ Co-ordinate bond is also formed by mutual sharing of electron but in this case the two electron but that

are shared come from the same atom



co-ordinate bond.

10/11/21

### \* Atomic orbital :-

The three dimensional region or shape that is volume around the nucleus of an atom where probability of finding electron having a certain energy is maximum (90-95%) is called atomic orbital.

### \* Orbit :-

As postulated by Bohr's an orbit is a definite circular path at a definite distance from the nucleus in which the electron revolves around the nucleus to which the orbit are numbered as 1, 2, 3, 4 from the nucleus and are designated by the Capital letter K, L, M, N, ... etc

→ An orbit indicates an exact position / location of an electron in an atom

Eg - According to Bohr's theory an electron of hydrogen is found at the distance of  $0.53\text{\AA}$  from the nucleus.

### Orbital :-

As postulated by wave nature of an electron an orbital is defined as 3-dimensional region or space around the nucleus within which the possibility/probability of finding an electron with a certain energy is maximum.

→ An orbital does not specify the definite exact position of an electron in an atom since the electron due to its wave nature can not be found at a fixed distance from the nucleus.



### St. of Bohr's atomic model

#### Molecular orbital

→ The goal of molecular orbital to describe molecules in a similar way to how we describe atoms that is in terms of orbital.

→ Orbital diagram and electronic configuration

→ Molecules can share 1, 2 or 3 pairs of electrons

→ Sing bond - 1  
Double bond - 2

Triple bond - 3  
Other type of bonds are formed by charge atoms that is ionic and metallic atoms.

### Orbital mixing :-

When atoms share electrons to form a bond their atomic orbitals mixed to form molecular bond in order for these orbital to mix they must have similar energy level overlap well well closed together.

### Molecular orbital Theory (MOT)

→ Atomic orbital mixed together and make

#### i) Bonding orbitals

electrons in this orbital help hold atom near each other.

#### ii) Antibonding orbitals

electrons in this orbital push atom apart from each other.

Non bonding orbital (like lone pair) electron in this orbitals have no effect on bonding

Molecular orbital can

- be Sigma ( $\sigma$ ) or,  $\pi(\pi)$
- be spread over multiple atoms

### Principle of molecular orbital theory

→ In molecules atomic orbital combine to form molecular orbitals which surround the molecules.

(a) Bonding  $\sigma \sigma \rightarrow \sigma \sigma$  Bonding

(b) Antibonding  $\sigma \sigma \rightarrow \sigma \sigma$

→ Molecular bonds have lower potential energy than in separate atomic orbitals.

→ Thus electrons prefer to stay in a molecular bonds.

- Equal no. of orbitals
- order of energy
- atomic orbitals, a like energy
- Following both the Pauli exclusion principle and Hund's rules
- $\sigma$  Bond (Sigma)

→ They are symmetrical about the axis.

#### \* $\pi$ Bond ( $\pi$ )

→ The  $\pi(\pi)$  bonding bonds as a side to side overlap which then causes their density above the and below the axis.

### Hybrid orbitals

The strength of equivalent bond stems from the exchange of electrons b/w two atoms.

→ The magnitude of this exchange energy is proportional to the amount of the overlap of atomic orbital structure constituting the bond.

→ Atoms bond result will result in the strongest bond consequently the bond formed by a given orbital

will tend to lie in the direction in which the orbital has the maximum value called hybrid orbitals.

### ii) Intermolecular force:-

We must remember that the particular method of mentally building molecules that we are learning to use in artificial. It is a purely intellectual process involving imaginary overlap of imaginary orbitals.

There are other equally artificial ways that use different mental or physical models. Our method is the one that so far has seemed to work out best for the chemist.

But however we arrive at be see the actual structure of a molecule to be the net result of a combination of repulsive & attractive forces. We are related to charge & electron spin.

### \* Repulsive forces:- Electrons tend to

'stay as far apart as possible' because they have the same charge and also if they are paired because they have the same spin. (Pauli exclusion principle)

The like charge atomic nuclei to repel each other

\* Attractive force :- Electrons are attracted by atomic nuclei as are the nuclei by the electrons because of their opposite charge and hence tend to occupy the reason b/w two nuclei opposite spins permits electrons to occupy the same regions

### 3★ Bond dissociation energy

#### Bond Energy

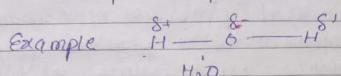
→ The bond energy is defined as the strength of the bond as it exists in a molecule or the contribution of the bond between a particular pair of atom A-B in a molecule to the total bond energy present in that molecule

### 4 Polarity of bonds :-

→ Besides the properties already discussed certain co-valent bonds have another properties polarity. Two atoms joined by a co-valent bond share electrons. Their nuclei are held by the same electrons but in most cases the two nuclei do not share the electrons equally.

→ The electron is deformed about one atom than the other. One end of the bond is relatively positive and other end is relatively negative. That is there is a negative pole and

positive pole. Such a bond is said to be a polar bond.



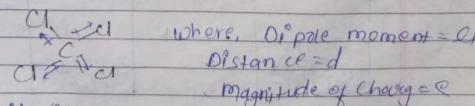
### \* Polarity of molecules:-

A molecule is polar if the centre of negative charge does not coincide with the centre of positive charge. Such a molecule constitutes a dipole to equal and opposite charges separated in a space.

→ A dipole is depicted symbolized by " $\rightarrow$ " where the arrow points from positive to negative.

→ The molecule possesses a dipole moment which is equal to the magnitude of charge electron multiplied by distance "D" between the centre of charge

→ Methane and Carbon teta Chloride ( $\text{CCl}_4$ ) and zero (0) dipole moment we naturally would expect the individual bonds of Carbon teta Chloride atleast to be polar because of the very symmetrical tetrahedral arrangement



$$M = Qd$$

$Q = \text{charge}$   
 $d = \text{distance}$

\* Structure and physical properties we have just discussed discussed on physical properties of compound dipole moment. Other physical properties like melting point boiling point or solubility in a particular solvent are also of concern to us.

→ The physical properties of a new compound give valuable structure. In attempting to synthesize a new compound

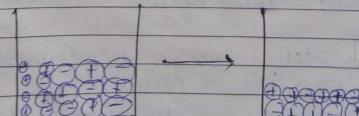
Example - A new

We must plan a series of reaction to convert a compound that we have into the compound that we want

### (a) melting point

In a crystalline the particles acting has structural unit ion or molecule are arranged in some very regular symmetrical way. There is a geometrical pattern repeated over and over within a crystal.

→ melting is the change from highly ordered arrangement of particles in the crystalline



Melting of an ionic crystal. The units are ion

~~21(12)~~ Boiling point :-

Boiling point :-

→ The particles in a liquid are arranged less regularly and are free to move about than in a crystal. Each particle is attracted by a number of other particles. Boiling involves the breaking away from the liquid of individual molecules or pairs of oppositely charged ions. This occurs when a temperature is reached at which the thermal energy of the particles is great enough to overcome the cohesive force that held them in the liquid.

Solubility:-

- Solubility:-

  - when solid or, liquid dissolved the structural unit ions or molecules become separate from each other. And the species of liquid in b/w become separate occupied by Solvent molecules in dissolution as in melting & boiling energy must be supplied to over come the inter-ionic or intra-molecular force.
  - The energy required to break the bonds b/w solute particles is supplied by the formation of bond. b/w the <sup>solute</sup> particles & the solvent molecules the attractive force are replaced by new molecules.
  - \* Inter molecular force :-  
what kinds of forces exists molecule to each other like inter ionic force these forces seems to be electrostatic in nature involving attraction of the

Unit  $\rightarrow$  2

## Stereochemistry

These compounds have the same molecular formula but differ from each other in physical or chemical properties, and are called isomers and the Phenomenon is called isomerism.

There are two main types of isomerism.

- (1) Structural isomerism.
  - (2) Stereoisomerism.

## Structural isomerism

Structural isomerism are compounds that have the same molecular formula but different structural formula is called structural isomerism.

They are five types of structural isomerism.

- (1) chain isomerism
  - (2) Position isomerism.
  - (3) functional isomerism.
  - (4) Metamerism.
  - (5) Tautomerism.

## Stereovinomerism

The stereoisomers have the same structural formulas but differ in arrangement of atoms in Space. is called Stereoisomerism.

Charge & negative charge. There are two kinds of intermolecular force Dipole & dipole interaction  
Hofmann- derwälts forces -

- i) Dipole-dipole interaction  
 ii) van der waals forces -

### i) Dipole - Dipole Interaction -

The attraction of the positive end of one polar molecule for the negative end of another polar molecule in hydrogen chloride.

For example - The relatively positive hydrogen of one molecule is attached to the relatively negative chlorine of another.

- As a result of dipole-dipole interaction polar molecules are generally held to each other more strongly than are non polar molecules of comparable molecular weight. This difference in strength of intermolecular force is reflected in the physical properties of the compound.

## (ii) Van-der-walls forces -

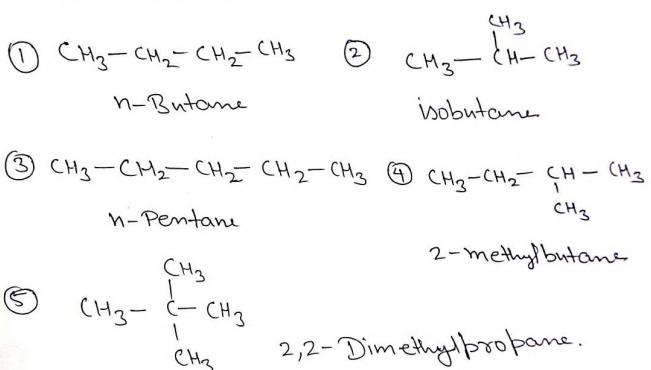
There, must be forces b/w the molecules of a non polar compound. Even such compounds can solidify. Such attraction are caused Vander-waals forces.

These are two types.

- (1) geometrical or cis-trans isomerism
  - (2) optical isomerism.

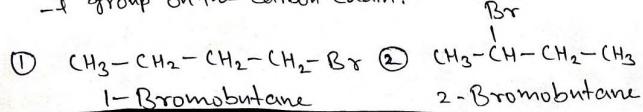
## (1) Chain isomerism.

Chain isomers have the same molecular formula but differ in the order in which the carbon atoms are bonded to each other.



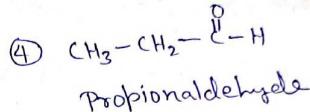
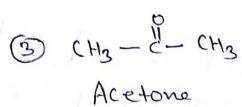
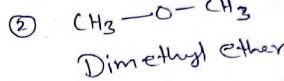
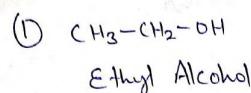
## (2) Position isomerism

Position isomers have the same molecular formula but differ in the position of a functional group on the carbon chain.



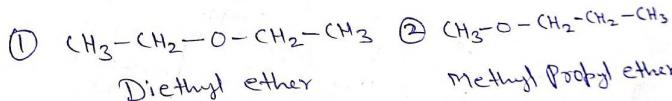
### (3) Functional Isomerism.

functional isomers have the same molecular formula but different functional groups.



### (4) Metamerism

This type of isomerism is due to the unequal distribution of carbon atoms on either side of the functional group. Members belong to the same homologous series.



→ Geometrical Isomerism (cis-Trans isomerism)

- Geometric isomerism (also called cis-trans isomerism) results from a restriction in rotation about double bonds, or about single bonds in cyclic compounds.

- The cis isomer is one in which two similar groups are on the same side of the double bond. The trans isomer is that in which two similar groups are on the

Active material is placed in the Polarimeter. The beam of polarized light is rotated through a certain number of degrees, either to the right (clockwise) or to the left (anticlockwise). The compound which rotates the plane of polarized light to the right (clockwise) is said to be Dextrorotatory, it is indicated by the sign (+).

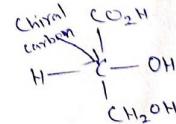
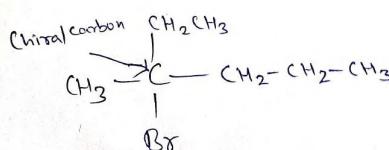
The compound which rotates the plane of polarized light to the left (anticlockwise) is said to be Levorotatory.

⇒ Chirality → A molecule is chiral if its two mirror-image forms are not superimposable in three dimensions.

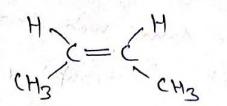
- A plane which divides an object into two symmetrical halves (mirror image) is said to be plane of symmetry.

### Chiral Carbon Atom.

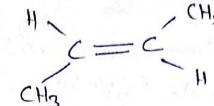
- A carbon atom which is bonded to four different groups is called a chiral (or Asymmetric) carbon atom. for example.



Opposite sides of the double bond.



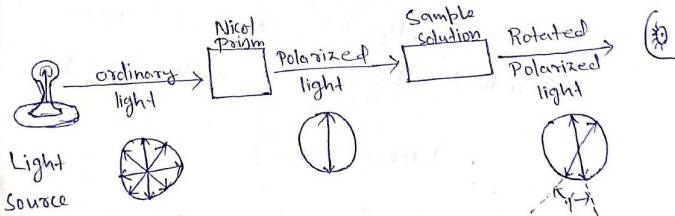
cis



trans

### ⇒ OPTICAL ACTIVITY

- Light from ordinary electric lamp is composed of waves vibrating in many different planes.
- Solutions of some organic compounds have the ability to rotate the plane of polarized light. These compounds are said to be optically active. This property of a compound is called optical activity.



Simple polarimeter in operation.

- Optical activity in a compound is detected and measured by means of a polarimeter. When a solution of a known concentration of an optically

The term chiral (Greek handedness, Pronounced kaɪrəl) carbon atom means that a carbon atom is bonded to four different groups and that a molecule of this type lacks a plane of symmetry. Such a molecule is also called dissymmetric or asymmetric.

- Chirality most often occurs in molecules that contain a carbon that is attached to four different groups.

## Q. Structural & nomenclature

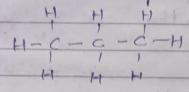
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### Alkane:-

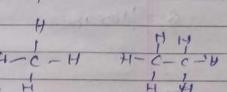
- Alkanes are the simplest organic compound made up carbon & hydrogen only.
- they have the general formula  $C_nH_{2n+2}$

Where  $n = 1, 2, 3, 4$

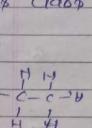
The first three members of this class can be represented as



Propane



Methane



Ethane

- Alkanes contain strong C-C and C-H bond covalent bond therefore, this class of hydrocarbon are relatively chemically inert.

### Nomenclature:-

#### (i) Common name-

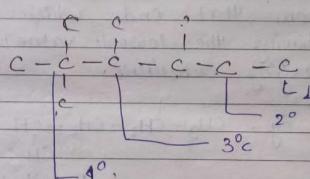
The first four members of this series are called by their common name methane, ethane, propane & butane.

S.No	Name	molecular form	Structure
1	Methane	$CH_4$	$H-C-H$
2	Ethane	$C_2H_6$	$\begin{array}{c} H \quad H \\   \quad   \\ H-C-C-H \\   \quad   \\ H \quad H \end{array}$

(ii) A carbon atom attached to two other carbon atom is called Secondary Carbon ( $2^\circ$  carbon)

(iii) A carbon atom attached to three other carbon is called Tertiary Carbon ( $3^\circ$  carbon)

(iv) A carbon atom attached to four carbon atom is called quaternary carbon ( $4^\circ$  carbon)



### IUPAC System:- (International Union of Pure & Applied Chemistry)

→ The common system has some limitation pentane has three isomers heptane has five isomers.

The more complex the alkane the greater the number of special prefix needed to name the isomer.

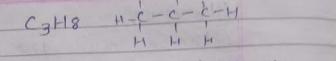
In order to device a system of nomenclature that could be used for even the most complexed compounds committee of chemist have meet periodically.

## Alkanes

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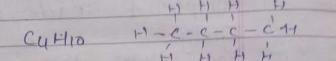
### 3 Propane

$C_3H_8$



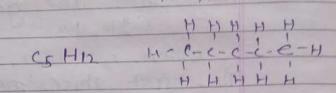
### 4 Butane

$C_4H_{10}$



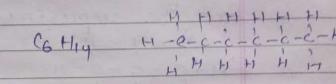
### 5 Pentane

$C_5H_{12}$



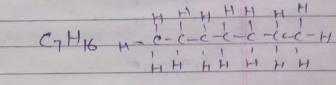
### 6 Hexane

$C_6H_{14}$



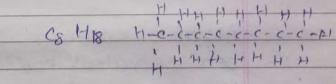
### 7 Heptane

$C_7H_{16}$



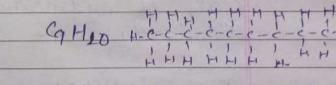
### 8 Octane

$C_8H_{18}$



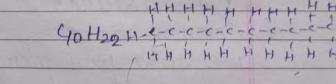
### 9 Nonane

$C_9H_{20}$



### 10 Decane

$C_{10}H_{22}$

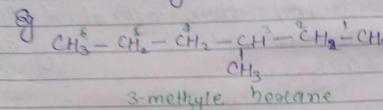


\* Primary carbon - Secondary & tertiary  
→ The structural formula of alkanes contain 4 types of carbon atoms

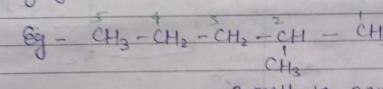
B) A carbon atom attached to one another carbon is called primary carbon. ( $1^\circ$  carbon)

→ The IUPAC system is much the same for all families of organic compound

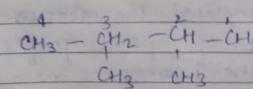
Step I Name the longest chain



Step II Number of the longest chain  
→ The carbon atoms in the longest chain are numbered. The numbering is started from that end which will give numbers having the lowest value to carbons bearing substituent.

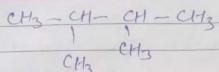


Step III locate and name the substituent  
each substituent is named and the position of each substituent is indicated by the number of carbon atom to which it is attached



Step IV Combine the longest chain and substituent into the name

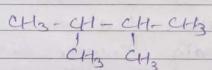
→ The position and the names of substituent are added to the name of the longest chain



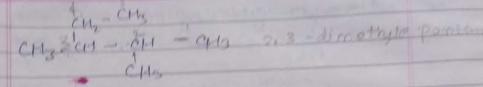
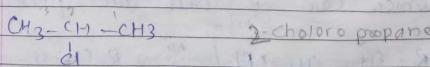
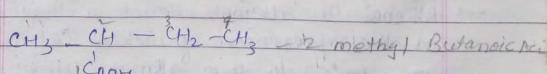
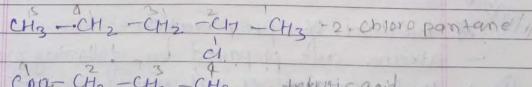
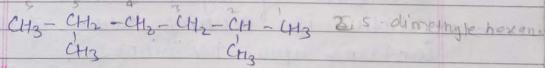
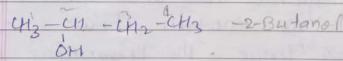
2,3-dimethyl Butane

Step IV Indicate the number and position of substituent.

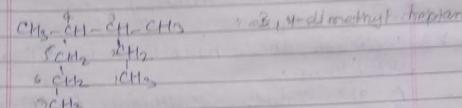
- If the same substituent is present two or more times in the molecule the number of this substituent is indicated by a prefix di, tri, tetra etc.



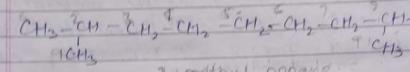
Eg.  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  — Butane



(ii) Red  
→ Alkyl  
hydrocarbons



(III) Hyd  
→ Al  
gen  
hal  
ide



(IV) Hyd  
→ Al  
gen  
hal  
ide

★ ★ Natural source of alkane

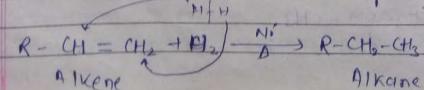
The two main source of alkane natural gas & petroleum both of these substance are principally found together in underground deposits natural gas contain about 80% methane and 10% ethane. The remaining 10% is mixture of higher member.

Petroleum is chief source of alkane containing upto 40 carbons

Method of preparation-

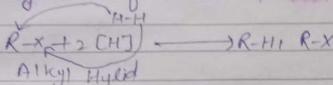
Alkane are prepared by following method

- Hydrogenation of alkene(=) or alkyne(≡).
- Alkenes or alkynes react with hydrogen in the presence of nickel catalyst at 200-300°C to form alkanes. Other catalyst which can be used are platinum (Pt)



#### (i) Reduction of alkyl Halide-

→ Alkyl halides undergo reduction with recent hydrogen to form alkenes

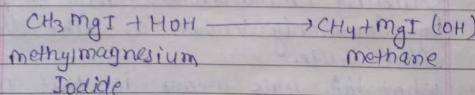
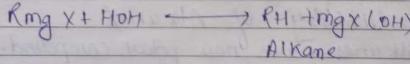
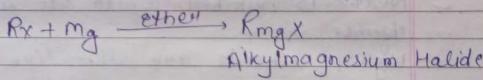


Alkyl

where  $X = \text{I}, \text{Br}, \text{Cl}$

#### (ii) Hydrolysis of Grignard Reagent.

→ Alkyl magnesium halide (Grignard Reagent) are obtained by treating alkyl halide with magnesium in diethyl ether. These treatment with water give alkane



#### (iii) Wurtz Reaction (Synthesis)

→ Higher alkanes are produced by heating a alkyl halide ( $\text{R-X}$ ) with sodium metal in dry ether solution. Two molecules of the alkyl halide lose their halogen atom. The net result is the joining two alkyl group to yield a symmetrical

alkane having an even number of carbon atom

#### Physical Properties:-

→ First four alkane — methane, ethane, propane, butane are gaseous

→ Next 15 numbers C<sub>5</sub> to C<sub>19</sub> are colourless liquid.

→ Higher alkanes are wax like solid.

#### Solubility of Alkanes

→ Alkanes are non polar compound. Their solubility characteristic may be predicted by commonly known as like dissolves like rule.

→ What this rule means is that non polar compound are soluble in the other non polar solvent and that polar compound are generally soluble in other polar solvent.

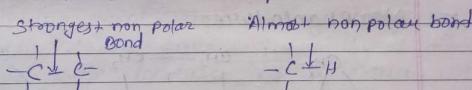
→ Thus alkanes are soluble in the non polar solvent like carbon tetrachloride and benzene but they are

In soluble in polar solvent such as water.

**Chemical properties of Alkane-**

- As already discussed alkane are relatively stable to common reagent such as - acids, alkali, oxidizing agent, at room temperature.

This is due to the fact that the electro negativity of carbon (2.60) any hydrogen (2.1) do not differ. Thus, the bond electron in carbon-Hydrogen ( $\text{CH}_3$ ) are practically equal shared shared between them and the bond is almost non-polar.



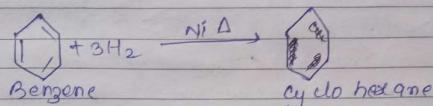
### \* Methane - ( $\text{CH}_4$ )

Methane is the first member of alkane series. It is also called "marsh gas" because it is found bubbling from marshy place where it is produced as a result of bacteria decomposition of dead vegetable.

- It also occurs under presence in many coal. The coal mines are called fire damp.

### ii) From aromatic hydrocarbon-

6 membered cyclo alkane can be prepared by catalytic reduction of benzene and its derivative.



### b) Physical properties -

#### i) Cyclo pro alkane

Cyclo propane & cycle Butane are gaseous at room temperature the remaining cyclo alkanes are liquid.

ii) Melting point and boiling point of cyclo alkane are gradually increase with the increase in molecular wt.

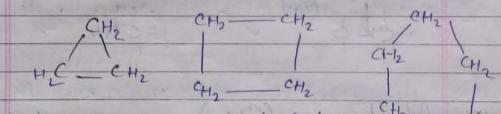
iii) Cyclo alkane are insoluble in water but dissolve in ethanol & ether.

### \* Alkene Chemical properties.

17/10/21 \* **Cyclo alkane:-**  
Cyclo alkane or, cyclo paraffin are saturated hydrocarbons in which the carbon atoms are joined by single covalent bond to form a ring.

- They are also called ali-cyclic Compounds
- The prefix - ali is added because of their similarity to aliphatic compounds.
- The unsubstituted cyclo alkane form a homologous series with general formulae ( $\text{C}_n\text{H}_{2n}$ )
- The first member of these series is cyclo propane  $\text{C}_3\text{H}_6$

### - Nomenclature

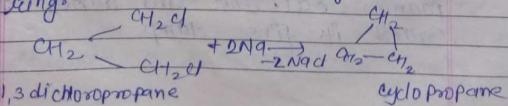


cyclo propane      cyclo Butane      cyclo pentane

### 6/10/22 Method of preparation -

#### i) From dihalid.

Terminal dihalid when treated with sodium ( $\text{Na}$ ) or zinc ( $\text{Zn}$ ) form cyclo alkane. This reaction is an extension of the Wurtz method and it is useful for the preparation of 3-6 membered ring.



17/10/21 \* **Alkene :-**  
→ Alkenes are hydrocarbon that contain a  $\text{C}=\text{C}$  double bond in their molecules.  
→ They have the general formula -  $[\text{C}_n\text{H}_{2n}]$   
→ In comparison to  $\text{C}_n\text{H}_{2n+2}$  of alkane.  
→ Alkenes contain two hydrogen atom less than alkane.

**Structural :-**  
→ Let us consider  $\text{CH}_2=\text{CH}_2$  ( $\text{C}=\text{C}$ ) of illustrating the orbital makeup of alkene  
- In ethylene the carbon atom are  $\text{sp}^2$  hybridized.  
- They are attached to each other by sigma bond and pi( $\pi$ ) bond.  
- The sigma bond results from the