

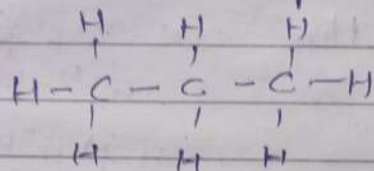
# 9. Structural & nomenclature

## Alkanes:-

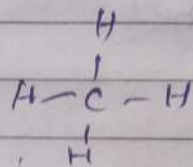
- Alkanes are the simplest organic compound made up of carbon & hydrogen only.
- They have the general formula  $C_nH_{2n+2}$

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

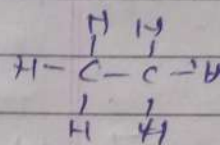
The first three members of this class can be represented as



Propane



methane



ethane

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

## nomenclature:-

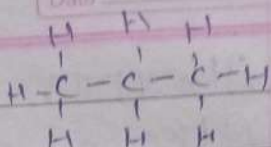
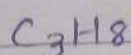
### (i) Common name-

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

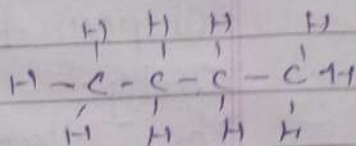
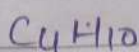
SNO	Name	molecular formula	Structure
1	methane	$CH_4$	$\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{H} \\   \\ \text{H} \end{array}$
2	ethane	$C_2H_6$	$\begin{array}{c} \text{H} & \text{H} \\   &   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   &   \\ \text{H} & \text{H} \end{array}$



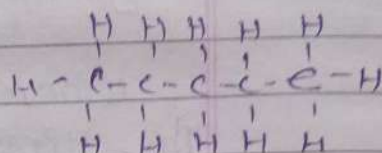
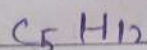
3 Propane



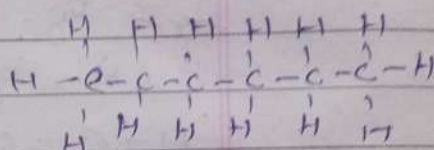
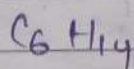
4 Butane



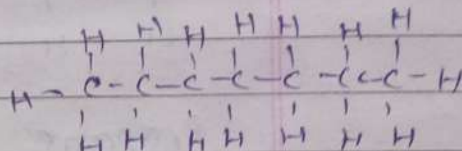
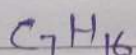
5 Pentane



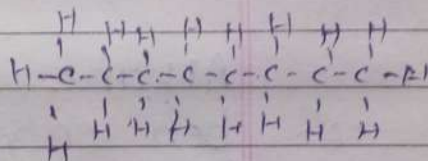
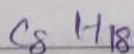
6 Hexane



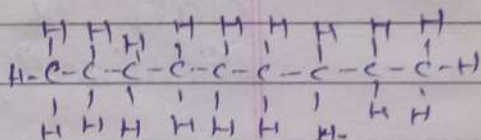
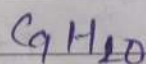
7 Heptane



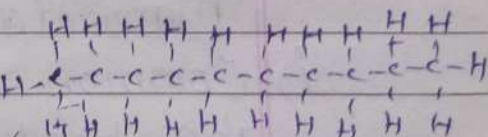
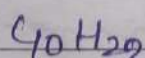
8 Octane



9 Nonane



10 Decane



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

i) A Carbon atom attached to one another carbon is called primary Carbon. (1° Carbon)

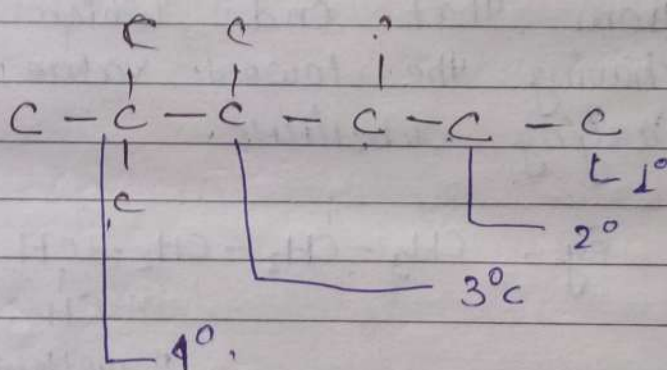


Page No. 53  
Date           

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

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

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



04/12/21

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

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

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

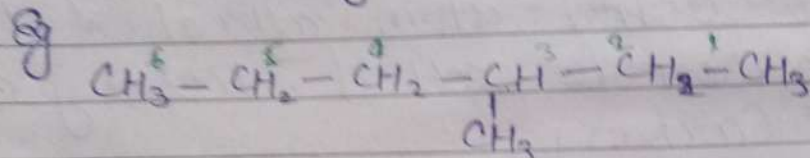
— In order to devise a system of nomenclature that could be used for even the most complicated compounds committees of chemists have met periodically.



Page No. 57  
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→ The IUPAC System is much the same for all families of organic compound

Step I Name the longest chain

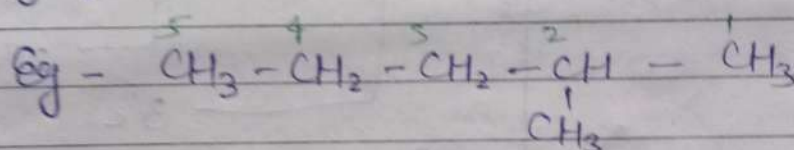


3-methylheptane

Step II

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 carrying substituents.

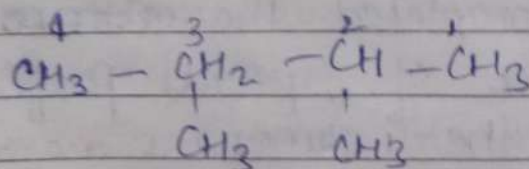


2-methylpentane

eg

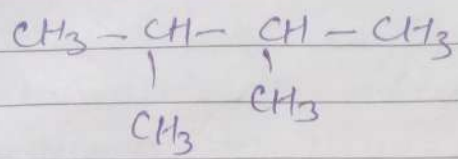
Step III located and name the substituent

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 Combined the longest chain and substituent into the name

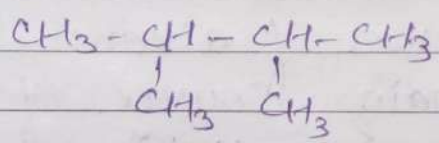
The position and the name of substituent are added to the name of the longest chain



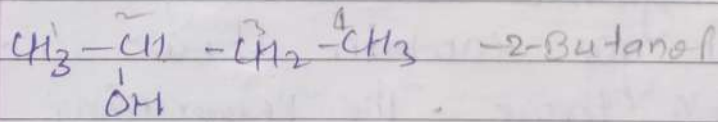
2,3-dimethyl butane

step I: Indicate the number and position of substituent.

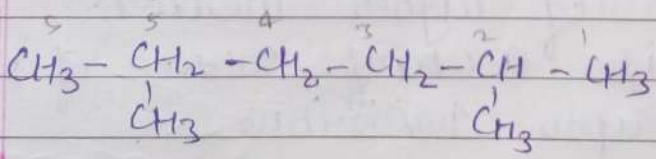
if the same substituent is present two or more times in the molecule the number of this substituent is indicated by a prefix di, tri, tetra etc



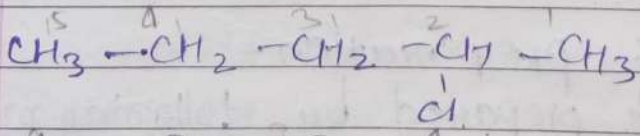
eg  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  — Butane



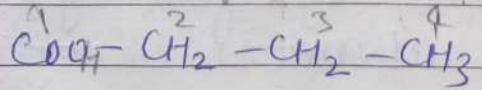
2-Butanol



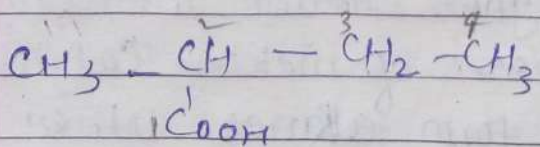
2,5-dimethyl hexane



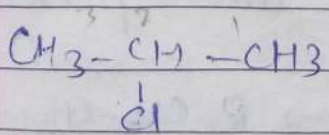
2-chloropentane



tetroic acid

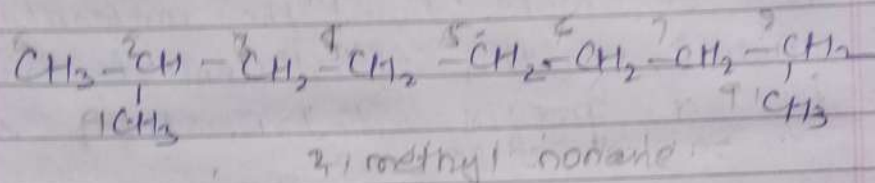
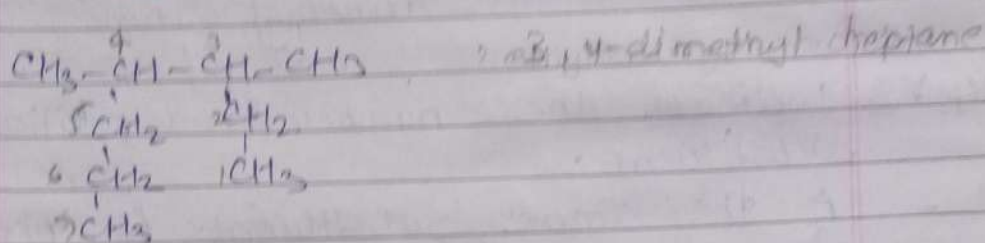
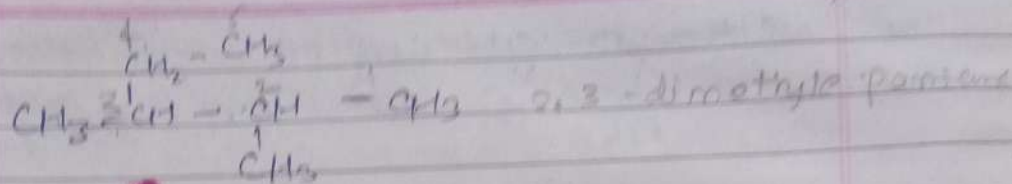


2-methyl Butanoic Acid



2-chloropropane





✱ ✱ Natural Source of alkane  
 — The two main source of alkane  
 natural gas & petroleum

both of these substance are fringedly  
 found together in underground deposit.  
 natural gas contain about 80% methane  
 and 10% ethane. The remaining 10%  
 is mixture of higher member.

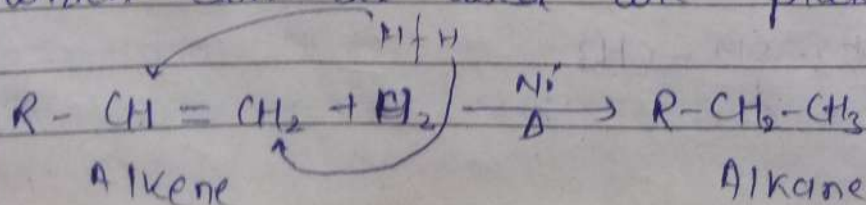
— Petroleum is a chief source of alkane  
 containing upto 40% carbon

11/12/23 ✱ ✱ Method of preparation—

— Alkane are prepared by following method

(i) → Hydrogenation of alkene(=) or alkyne(≡).

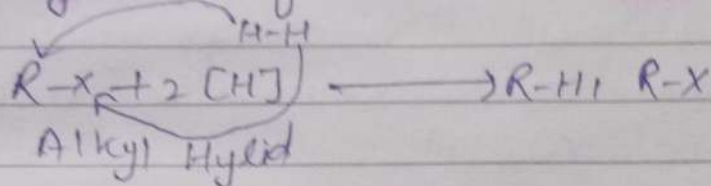
→ Alkenes or alkynes react with hydrogen  
 in the presence of nickel catalyst at  
 200-300°C to form alkanes. Other catalyst  
 which can be used are platinum (Pt)





## (ii) Reduction of alkyl Halide-

→ Alkyl halides undergo reduction with nascent hydrogen to form alkanes



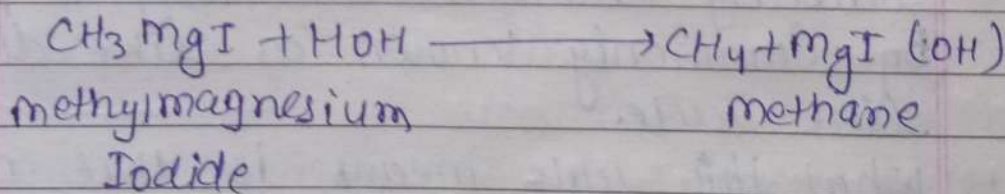
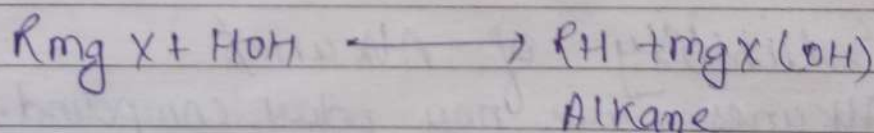
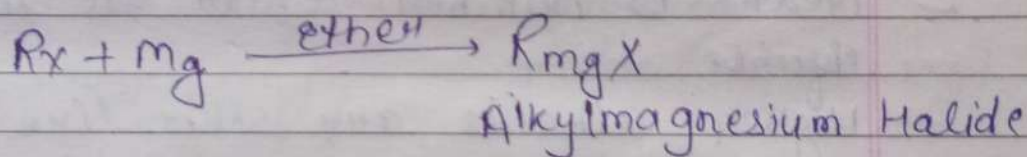
Alkyl

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

## (iii) Hydrolysis of Grignard Reagent.

→ Alkyl magnesium halide (Grignard Reagent) are obtained by treating alkyl halide with magnesium in dry ether.

→ these treatment with water give alkane



## 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 of two alkyl groups to yield a symmetrical



alkane having an given even number of carbon atom

### Physical Properties:-

- First four alkane, methane, ethane, propane, butane are gaseous
- Next 15 number  $C_5$  to  $C_{15}$  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 dissolve 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

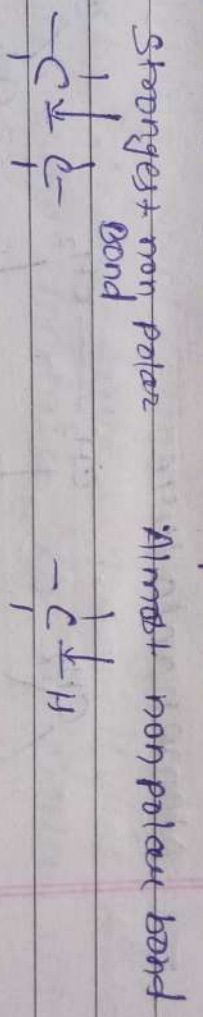


insoluble in polar solvent such as water.

### Chemical properties of Alkane —

→ It's already absorbed alkane are relatively stable to common reagent such as — acid, 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 (C-H) are practically equal shared shared between them and the bond is almost non-polar.



### \* Methane — (CH<sub>4</sub>)

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 pressure in many coal. The coal mines are called it fire damp.



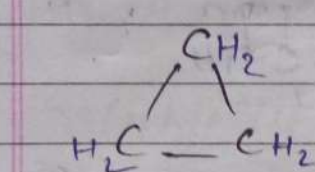
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## ★ Cyclo alkane:-

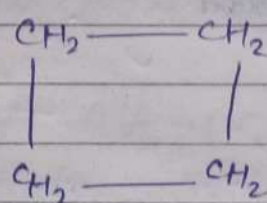
Cyclo alkane or, Cyclo paraffin are saturated hydrocarbons in which the carbon atoms are joints by single co-valent bond to form a ring

- They are also called alicyclic Compound
- The prefix - ali is added because of their similar to aliphatic compounds.
- The unsubstituted cyclo alkane form a homologous series with general formula  $(C_nH_{2n})$
- The first member of these series is cyclo propane  $C_3H_6$

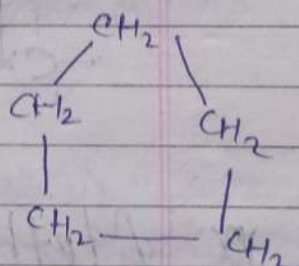
## — Nomenclature



Cyclo propane



Cyclo Butane



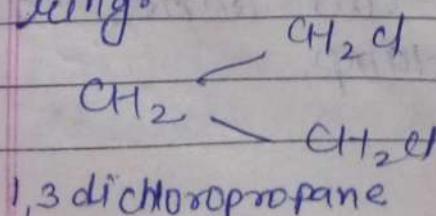
Cyclo pentane

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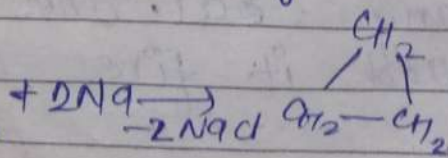
## Method of preparation —

### (i) from dihalide:-

Terminal dihalide when treated with Sodium (Na) or, Zinc (Zn) form cyclo alkane. This reaction is an extension of ~~the~~ Wurtz-Fittig reaction and it is useful for the preparation of 3-6 membered ring.



1,3 dichloropropane

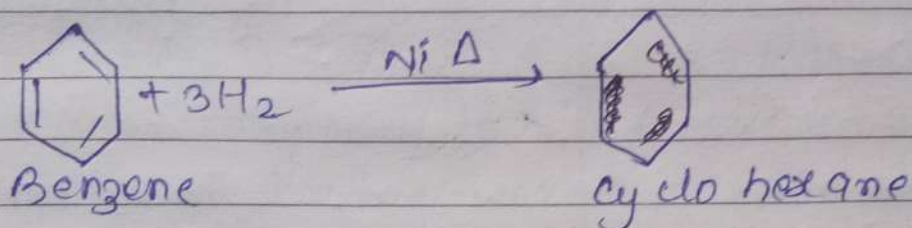


cyclo propane



ii) From aromatic hydrocarbon—

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



Physical properties—

i) ~~Cyclo pro alkane~~

(i) Cyclo propane & cyclo Butane are gaseous at room temperature the remaining cycloalkanes are liquid.

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

(iii) Cycloalkane are insoluble in water but dissolve in ethanol & ether.

\*) ~~Alkene~~ Chemical properties.



### \* Alkene :-

- Alkenes are hydrocarbon that contain a  $C=C$  double bond in their molecules.
- They have the general formula -  
 $C_nH_{2n}$
- The Incompression to  $C_nH_{2n+2}$  of alkane.
- Alkenes contain two hydrogen atom less than alkane.

### Structural :-

- Let us consider  $CH_2=CH_2$  ( $C=C$ ) of illustrating the orbital makeup of alkene.
- In ethylene the carbon atom are  $sp^2$  hybridized.
- They are attached to each other by  $\sigma$  bond and  $\pi$  bond.
- The  $\sigma$  bond results from the