CHAPTER 17

ORGANIC CHEMISTRY:

Q1. Write down the names of natural sources of organic compounds?

NATURAL SOURCES OF ORGANIC COMPOUNDS:

There are four natural sources of organic compounds.

1. Animal and plant Kingdom.

2. Coal.

i. Coal gas or oven gas. **ii. Coke.** **iii. Coal tar.**

3. Natural gas.

4. Petroleum gas.

Q2. Explain the following process.

i. Reforming of petroleum. **ii. Cracking (Pyrolysis)**

1. REFORMING OF PETROLEUM:

Petrol or gasoline is a mixture of hydrocarbons generally consisting of six to ten carbon atoms per molecule. It is a volatile liquid which is a common fuel.

Reforming is a process similar to the process of cracking by which octane-rating i.e. octane number of gasoline can be increased. The quality of petrol is measured in term of its octane-rating. By the process of reforming the straight chain hydrocarbons are converted into branched chain hydrocarbons.

2. CRACKING (PYROLYSIS):

If the alkanes of large molecular mass are heated to high temperature in the absence of air, the molecules breakup (cracks) into several smaller and more valuable of fragments.

$$C_{16}H_{34} \xrightarrow{\text{cracking}} C_8H_{18}+C_8H_{16}$$

Molecules with 16 carbon atoms cannot be used as gasoline but molecule with 8 carbons atom can.

Q3. What is fractional distillation of petroleum? Also write fractions along with range of carbon atom or molecules.

FRACTIONAL DISTILLATION OF PETROLEUM (REFINING OF PETROLEUM):

In this process, the petroleum or crude oil heated to above 400°C to vaporize. The resulting vapours are then carried to a fractionating column having different temperature zones i.e. fractionating column is divided into several compartment, each compartment has a specific range of temperature. More than five hundred hydrocarbons are separated from petroleum.

Draw a table of Petroleum Fractions.

S.NO.	BOILING RANGE	RANGE OF CARBON ATOMS PER MOLECULE	NAME OF THE FRACTIONS	USES
1.	Below 20°C	C_1-C_4	Petroleum gases mixture of methane ethane, propane and butane.	Fuels for homes and industries for heating and cooking. In the manufacture of petrochemicals.
2.	20°C-60°C 60°C-120°C	C_5-C_6 C_6-C_7	Petroleum ether(liquids). Light naptha (ligroin); liquids.	Both the products are used as organic solvents and as a cleaning material for textile fabrics.
3.	40°C-200°C	C_6-C_{10}	Gasoline or petrol.	Fuel for automobile engines.

4.	175°C -325°C	C_{11}-C_{18}	Kerosene.	As a fuel in domestive stoves, for lighting, in jet engines, as a solvent for grease and paints.
5.	250°C-400°C	C_{14}-C_{25}	Diesel oil or Gas oil.	As a fuel for diesel engines, for heating purposes and as a raw material for cracking.
6.	Above 400°C	C_{20}-C_{higher}	Lubricating or heavy oils non-volatile liquid.	For lubrication as grease in moving parts of engines and machines.

Q4. Define homologous series and functional group with example?

HOMOLOGOUS SERIES:

"*A homologous series is a family of similar organic compounds which flows a regular structure pattern, in which each successive member has a difference of (>CH_2>) group.*"

Example: The alkanes, alcohols and alkyl halides listed in the table below show the differences of methalyene group e.g. (>CH_2) and are thus homologous series.

No. of carbon.	Alkanes (R-H)	Alcohols (R- OH)	Alkyl halides (R-X)
01	Methane (CH_4)	Methyl alcohol (CH_3-OH)	Methyl Chloride (CH_3-Cl)
02	Ethane (C_2H_6)	Ethyl alcohol (C_2H_5-OH)	Ethyl Chloride (C_2H_5- Cl)
03	Propane (C_3H_8)	Prophy alcohol (C_3H_7-OH)	Prophy Chloride (C_3H_7- Cl)
04	Butane(C_4H_{10})	Butyl alcohol (C_4H_9-OH)	Butyl Chloride (C_4H_9- Cl)
.	.	.	.
.	.	.	.
.	.	.	.
n	C_nH_{2n+2}	$C_nH_{2n+1}OH$	C_nH_{2n+1}-X

FUNCTIONAL GROUP:

"*A functional group is an atom or group of atoms present in a molecule, which gives the molecules unique character and the properties and is therefore, referred as functional group.*"

The functional groups of some important compounds are given below:

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S.NO.	TYPES OF COMPOUNDS	GENERAL FORMULA	FUNCTIONAL GROUP	EXAMPLE	NAME OF EXAMPLE
1.	Organic acids	O || R-C-OH	O || C-OH (Carboxyl group)	O || CH_3-C-OH	Acetic acid
2.	Alcohols	R-OH	-OH (hydroxyl group)	CH_3-OH	Methyl Alcohol
3.	Alkyl halides	R-X	-X (Halide group)	C_2H_5-Cl	Ethyl chloride

Q5. What are hydrocarbons? Explain how are they classified?

HYDROCARBONS:

Compounds containing only two elements C and H are known as hydrocarbons. In terms of structural concept, they are further classified into three classes.

Hydrocarbons

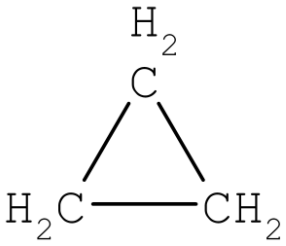
Aliphatic hydrocarbons | **Alicyclic hydrocarbons** | **Aromatic hydrocarbons**

1. ALIPHATIC HYDROCARBONS:

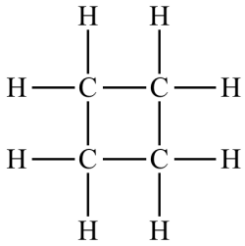
Aliphatic hydrocarbons are composed of open chains of carbon atoms, they are further classified in two classes, i.e; saturated hydrocarbon and unsaturated hydrocarbon.

2. ALICYCLIC COMPOUNDS:

Alicyclic hydrocarbons, are the compounds in which carbon atoms are arranged in the ring.



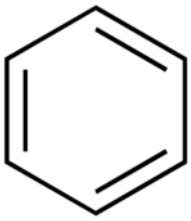
Cyclo Propane



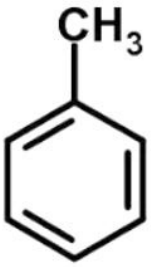
Cyclo Butane

3. AROMATIC COMPOUNDS:

Aromatic hydrocarbons, contain six membered ring (Benzene ring) into which, there are three carbon-carbon alternate double bonds.



Bezene (C_6H_6)



Toulene (C_6H_5-CH_3)

Q6. Explain further classification of aliphatic hydrocarbons (alkane, alkene, alkyne)?

FURTHER CLASSIFICATION OF ALIPHATIC HYDROCARBONS:

Aliphatic hydrocarbons are further classified into two classes.

1. **Saturated hydrocarbons.**
2. **Unsaturated hydrocarbons.**

1. SATURATED HYDROCARBONS:

"*Saturated hydrocarbons contain only single bonds, between the carbon atoms, it means the valence of carbon is fully utilized.*"

Alkanes are the example of saturated hydrocarbons.

i. ALKANES:

Alkanes are saturated hydrocarbons in which the various carbon atoms are liked by single covalent bonds to adjacent carbon atoms forming chains.

Alkanes have the general formula (CnH_{2n+2}). All alkanes are stable and unreactive. For this reason they are called paraffins from the Latin para means little and ffins means attraction.

2. UNSATURATED HYDROCARBONS:

"*Unsaturated hydrocarbons, are those which contain one or more double or triple bonds, it means that the valency of carbons is not fully utilized.*"

Alkenes and alkynes are examples of unsaturated hydrocarbon. Those which are double bond are called 'alkenes 'and which contain triple bond area called 'alkynes'.

i. ALKENES (ETHYLENE):

The unsaturated hydrocarbons which contain one double bond joining two carbon atoms somewhere in molecule are called alkenes.

The first member of alkenes is ethylene or ethene, hence alkenes are known as olefins (oil making). Alkenes have a general formula, of (C_nH_{2n}).

ii. ALKYNES (ACETYLENE):

The unsaturated hydrocarbons, which contain one triple bond joining two carbon atoms somewhere in molecules called alkynes.

The first member of alkynes is acetylene or ethyne hence alkynes are known as acetylene series. Alkynes have a general formula, (C_nH_{2n-2}).

Q7. Write down the names of first ten hydrocarbons(alkanes, alkenes, alkynes) with formulae?

FIRST TEN HYDROCARBONS:

No. of Carbon.	Molecular formula of alkane	Name of alkane	Molecular formula of alkene	Name of alkene	Molecular formula of alkyne	Name of alkyne
1.	CH_4	methane				
2.	C_2H_6	ethane	C_2H_4	ethene	C_2H_2	ethyne
3.	C_3H_8	propane	C_3H_6	propene	C_3H_4	propyne
4.	C_4H_{10}	butane	C_4H_8	butene	C_4H_6	butyne
5.	C_5H_{12}	pentane	C_5H_{10}	pentene	C_5H_8	pentyne
6.	C_6H_{14}	hexane	C_6H_{12}	hexene	C_6H_{10}	hexyne
7.	C_7H_{16}	heptane	C_7H_{14}	heptene	C_7H_{12}	heptyne
8.	C_8H_{18}	octane	C_8H_{16}	octene	C_8H_{14}	octyne
9.	C_9H_{20}	nonane	C_9H_{18}	nonene	C_9H_{16}	nonyne
10.	$C_{10}H_{22}$	decane	$C_{10}H_{20}$	decene	$C_{10}H_{18}$	decyne

Q8. What is methane (CH_4)? Write down its preparation, properties and uses?

METHANE:

"*Methane is simplest known stable compound of alkane family with a molecular, CH_4. It is called Marsh gas. Methane (CH_4) is a major component (94%) of natural gas.*"

PREPARATION:

1. Heating anhydrous sodium acetate with soda lime, (NaOH + CaO) produces methane.

$$CH_3\text{-}COONa + NaOH \xrightarrow[heat]{CaO} CH_4 + NaCO_3$$

2. Heating aluminium carbide with water, produces methane.

$$\underset{\text{(Aluminium carbide)}}{Al_4C_3} + 12H_2O \xrightarrow{heat} 3CH_4 + \underset{\text{(Aluminium hydroxide)}}{4Al(OH)_3}$$

PHYSICAL PROPERTIES:

1. Methane is light colorless, tasteless gas, odorless gas.
2. It is sparingly soluble in water (5ml in 100 mls)
3. Methane is symmetrical and have no dipole, moment hence it is non-polar.

USES OF METHANE:

1. Methane is used as an important industrial and domestic fuel.
2. It is mostly used in the preparation CH_3OH, $CHCl_3$, CCl_4 pure carbon and as a source | of H_2 for the production of fertilizers.

Q9. Define substitution and halogenations reaction? Explain the process of step wise chlorination of methane with equations?

SUBSTITUTION:

"*The reaction in which one or more atoms are replaced by other atoms is known as substitution reaction.*"

HALOGENATIONS:

"If the substitution occurs by halogens the reaction is known as halogenations."

PROCESS OF CHLORINATION OF METHANE:

Methane may be chlorinated or brominated by treatment, with Cl_2 or Br_2 in the presence of sunlight (S.L) or ultra violet light (U.V.L).

$$Cl_2 \xrightarrow[U.V.L]{S.L} 2Cl^{\circ}$$

$$CH_4+Cl_2 \xrightarrow[U.V.L]{S.L} CH_3\text{-}Cl+HCl$$

Methyl chloride (chloro methane)

$$CH_3-Cl+Cl_2 \xrightarrow{S.L} CH_2\text{-}Cl_2+HCl$$

Methyl chloride (di-chloro methane)

$$CH_2-Cl_2+Cl_2 \xrightarrow{S.L} CHCl_3+HCl$$

Methyl chloride (tri-chloro methane)

$$CH-Cl_3+Cl_2 \xrightarrow{S.L} CCl_4+HCl$$

Methyl chloride (Tetra-chloro methane)

Q10. What is ethene and ethyne? Write down their physical properties and uses.

ETHENE (ETHYLENE) ($CH_2=CH_2$):

INTRODUCTION:

The first member of alkene series is ethene, more commonly called ethylene. It is unsaturated because it contains one double bond between two carbon atoms.

PHYSICAL PROPERTIES:

1. Ethylene is colorless gas having pleasant smell.
2. It is slightly lighter than air, and burns with luminous flame.
3. It is soluble in water (1 ml in 4 ml) and is soluble in common organic solvents.
4. When inhaled it produces an anesthesia.

USES OF ETHENE:

1. Ethylene is used as starting material for the production of alcohol, glycol, ethyl chlorine.
2. It is used in welding and cutting metals, because of the intense heat of oxyethylene flame.
3. It is sued to give the appearance of ripeness to the fruits.
4. An ethylene – oxygen mixture which is used as an excellent, general anesthetic.
5. It is also used in manufacture of plastic, called polythene.

ETHYNE (ACETYLENE) ($HC \equiv CH$):

INTRODUCTION:

The first member of alkyne series is ethyne. It is more unsaturated than ethene, because it contains one triple bond between two carbon atoms.

PHYSICAL PROPERTIES:

1. Acetylene is colorless gas with garlic odour.
2. It is very slightly soluble in water, some what more in alcohol and ether.
3. Liquid acetylene explodes violently by shock or heat.
4. it is lighter than air.

USES OF ETHENE:

1. Acetylene is used as illuminant.
2. It is used in welding cutting iron and steel.
3. As starting material for the preparation of plastic rubber, P.V.C pipes.
4. For the preparation of organic compounds like acetic acid and ethyl alcohol (ethanol) etc.

Q11. What is meant by isomerism? How chain isomerism is formed? Explain with the help of examples?

ISOMERISM:

"The existence of two or more compounds with the same molecular formula but different molecular structure is called isomerism."

The different molecular structure of same compounds are called isomers.

CHAIN ISOMERISM:

The type of isomers in which two or more different compounds have the same molecular formula but differ in the arrangement of carbon atoms is called chain isomerism.

FORMATION:

ISOMERS OF PROPANE:

Propane has two isomers. The molecular formula of propane is C_3H_8. The isomers of propane is called n-propane and iso-propane.

$CH_3 - CH_2 - CH_3$ (n- propane)

CH_3-CH_2 with CH_3 below (iso-propane)

ISOMERS OF BUTANE:

Butane has two isomers. The molecular formula of butane is C_4H_{10}. The two isomers of butane are called n- butane (simple butane) and iso- butane.

$CH_3 - CH_2 - CH_2 - CH_3$

CH_3 above, $CH3 - CH - CH_3$ (Iso-butane)

Q12. Write the chemical properties of Ethene ($CH_2=CH_2$) and Ethyne (CH=CH).

CHEMICAL PROPERTIES OF ETHENE ($CH_2=CH_2$):

i. Addition of H_2:

Ethene adds H_2 in presence of catalyst Ni, Pt or Pd to form ethane. Such reactions are called catalytic reduction or hydrogenations.

$$CH_2 = CH_2 + H_2 \xrightarrow[300\,^\circ C]{Ni/Pt} CH_3 - CH_3$$

(ethane)

ii. Addition of X_2 (Cl_2, Br_2, I_2):

Ethene or ethylene adds a Cl_2 or Br_2 molecule to form ethylene di-bromide or ethylene dichloride.

$$CH_2 = CH_2 + Br_2 \longrightarrow Br - CH_2 - CH_2 - Br$$

(ethylene di-bromide)

$$CH_2 = CH_2 + Cl_2 \longrightarrow Cl - CH_2 - CH_2 - Cl$$

(ethylene dichloride)

CHEMICAL PROPERTIES OF ETHENE (CH≡CH):

i. **Addition of H_2 (Hydrogenation):**

In the presence of catalyst Ni, Pt or Pd, ethyne reacts with H_2 to give first ethene and then ethane.

$$HC \equiv CH + H_2 \xrightarrow[200\,^{\circ}C]{Ni} \underset{\text{(Ethene)}}{CH_2 = CH_2} + H_2 \xrightarrow[300\,^{\circ}C]{Ni} \underset{\text{(Ethane)}}{CH_3 - CH_3}$$

ii. **Addition of X_2 (Cl, Br, I):**

With Br and Cl_2 ethylne or acetylene reacts to gives first acetylene dichromide or dichrloride and then acetylene tetra bromide or tetrachloride.

$$HC \equiv CH + Br \longrightarrow Br - HC = CH - Br + Br_2 \text{ (acetylene di-bromide)}$$