Organic Chemistry

March 2017

2 Thursday

All the matter that occur in universe are chemical substances and are classified in to two types.

(I) In Organic Compounds

(II) Organic Compounds

(i) In-Organic Compounds :-

These are obtained from non-living materials like Rock, Salt etc. They also includes various minerals and ores.

→ They are not necessarily contain 'carbon'.

(II) Organic Compounds :-

These are the compounds obtained directly or Indirectly from living things like plants and animals.

→ They must contain carbon which are bonded to each other by co-valent bonding.

The branch of chemistry which deals with the organic compounds is known as Organic Chemistry

→ In 18th centuary It was believed that a natural agency of life called 'vital force' is responsible for the formation of Organic compound. They can not be synthesized in laboratory.

→ However In 1828 a German chemist Wohler performed an experiment in laboratory. He heated ammonium cyanate (NH_4CNO) which is purely an Inorganic compound and found that it is converted into a compound urea (NH_2CONH_2) which is an Organic compound.

$$NH_4CNO \xrightarrow{\Delta} NH_2CONH_2$$

Ammonium cyanate — Urea

→ Later a large number of organic compounds were prepared in Laboratory. i.e Till now three million organic compounds are known. Therefore It required separate branch to study.

→ This is because of a unique character of carbon to form long chain covalent bonds i.e They can self link to each other by co-valent bonding and that property is known as catenation.

* Tetha covalency of carbon atom :-

Carbon has the valency four i.e It can combine with four 'H' atom or any other Functional group by co-valent bonding.

Classification of Organic Compound :-

On the basis of carbon skeleton, organic compounds are classified into two groups,

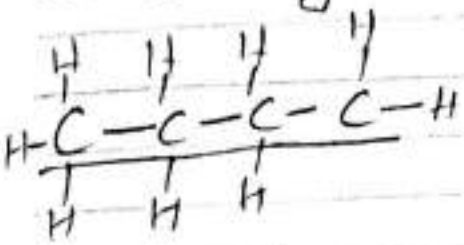
(I) Acyclic or open chain or Aliphatic

(II) Cyclic or close chain or Aromatic

(i) Acyclic / open chain / Aliphatic :-

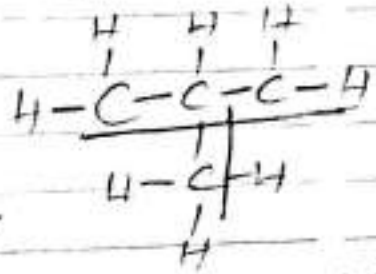
· In open chain compounds the first and last carbon atom do not directly bonded to each other. They may be (a) Straight (b) Branched.

(a) **Straight:-**

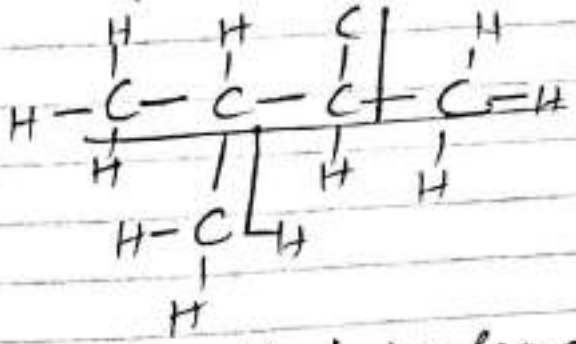


n-Butane.
(Straight chain)

(b) **Branched:-**



2-methyl propane
(Branched chain)



2,3-dimethyl butane.
(Branched)

NOTE: only carbon must considered in determining the straight and branched chain, not hydrogen or any other non-carbon functional group.

→ only carbon atom is considered as part of skeletal structure of organic compound.

Appointment

(II) Cyclic / Closed Chain Compound :-

For Cyclic compound the first and last carbon atoms are directly bonded to each other by co-valent bonding to form ring structure.

→ They are classified into two types.

(a) Alicyclic compounds

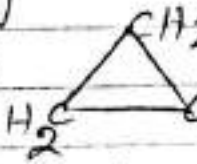
(b) Aromatic compounds.

(a) Alicyclic Compounds :-

These are the ring compounds having carbon atom at each corner of the ring.

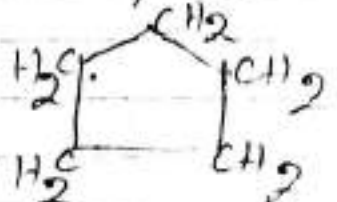
→ They are also known as carbocyclic compounds.

e.g.



cyclo propane

cyclo butane



cyclo pentane

(b) Aromatic Compounds / Aromatic Hydrocarbon

Q// What do you mean by Aromatic hydrocarbon? Give an example of it.

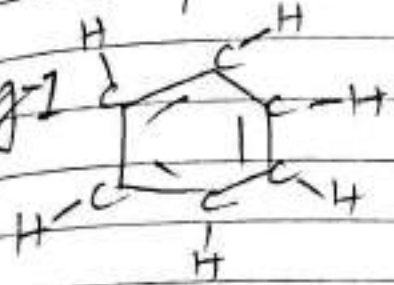
→ These are the ring compounds in which each corner is occupied by carbon.

→ They must obey Hückel's rule. i.e $(4n+2)\pi e$ where $n = 0, 1, 2, 3 \ldots$

→ The double bond and single bond in the compound must be in alternate manner.

⇒ The compound must be planner.

e.g 1

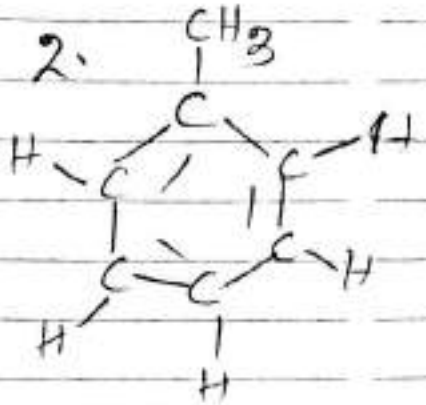


(C_6H_6)
(Benzene)

⇒ no of $\pi e^{\ominus} = 6$
(as it contain 3 π bond and 12 σ bond)

Applying Huckel's rule.
$(4n+2)\pi e^{\ominus} = 6\pi e^{\ominus}$
$\Rightarrow 4n+2 = 6$
$\Rightarrow 4n = 4$
$\Rightarrow n = 4/4 = 1$
$n = 1$ (obey Huckel's rule)

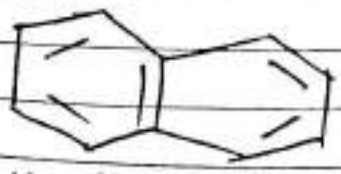
2.



Tolnene.
(C_7H_8)

no of π bond = 3
no. of π electron = 6
no of σ bond = 15
no of $\sigma e^{\ominus} = 30$
$\Rightarrow (4n+2)\pi e^{\ominus} = 6\pi e^{\ominus}$
$\Rightarrow (4n+2) = 6$
$\Rightarrow 4n = 6-2 \Rightarrow 4n = 4$
$\Rightarrow n = 4/4 = 1 \Rightarrow n = 1$

*3.



Napthalene.

⇒ no. of π bond = 5
no of π electron = 10
$(4n+2)\pi e^{\ominus} = 10\pi e^{\ominus}$
$\Rightarrow (4n+2) = 10$
$\Rightarrow 4n+2 = 10$
$\Rightarrow 4n = 8$
$n = 2$

4.

(Anthracene)
No of π bond = 7
No of π electron = 14 $e^{\ominus}$
$\Rightarrow (4n+2)\pi e^{\ominus} = 14\pi e^{\ominus}$
$\Rightarrow 4n+2 = 14$
$\Rightarrow 4n = 14-2$
$\Rightarrow 4n = 12$
$\Rightarrow n = 12/4 = 3$

Appointment

Functional Group :-

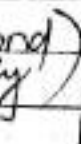
A function group may be a bond, an atom or a group of atoms which are responsible for the physical and chemical properties of the organic compounds.

e.g - =, ≡, Cl, Br, I, $-CH_3$, $-C_2H_5$ etc.

Compounds		Functional group.
Alkane	⟶	C–C
Alkene	⟶	C=C
Alkynes	⟶	C≡C
Alcohols	⟶	–OH
Aldehydes	⟶	–CHO
Ketones	⟶	>C=O
Acid	⟶	–COOH
Ethers	⟶	–O–
Carboxylic acid	⟶	RCOOH
Amines	⟶	$-NH_2$
Acid chloride	⟶	–COCl

Homologous Series :-

A homologous series may be defined as the organic compounds that have same general formula with similar chemical properties. They also contain same functional group in it.

Series	General Formula	Examples.
e.g - Alkane — (having single bond only)	C_nH_{2n+2}	CH_4 → 
		C_2H_6 → 

Series	General Formula	Examples
⇒ Alkene (having double bond in it.)	→ C_nH_{2n}	→ C_2H_4 → $H-\overset{H}{\underset{H}{C}}=\overset{H}{\underset{H}{C}}-H$ 9 C_3H_6 → $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}=\overset{H}{\underset{H}{C}}-H$ 10
⇒ Alkynes (having tripple bond in it.	→ C_nH_{2n-2}	→ C_2H_2 → $H-C\equiv C-H$ 11 C_3H_4 → $H-\overset{H}{\underset{H}{C}}-C\equiv C-H$ 12
⇒ Alkyl halides (contain a halide group in it	→ $C_nH_{2n+1}X$ (X = Cl, Br, I, F)	→ CH_3Cl → $H-\overset{H}{\underset{H}{C}}-\overset{Cl}{\underset{}{}}$ 13 → C_2H_5Br → $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{Br}{\underset{}{}}$ 14
⇒ Alcohol	→ $C_nH_{2n+1}OH$	→ CH_3OH, C_2H_5OH 15 $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-OH$ 16
⇒ Ether	→ $C_nH_{2n+1}-O-C_nH_{2n+1}$	→ $H_3C-O-CH_3$, $H_3C-O-C_2H_5$ 17
⇒ Aldehyde	→ $C_nH_{2n+1}CHO$	→ $HCHO$, CH_3CHO, C_2H_5CHO 18
⇒ Ketones	→ $R-CO-R^1$	→ $H_3C-CO-CH_3$, $H_3C-CO-C_2H_5$ 19
⇒ Carboxylic acid	→ $C_nH_{2n+1}COOH$	→ $HCOOH$, CH_3COOH, C_2H_5COOH 20 $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{}{C}}-COOH$

NOTE:- C_nH_{2n+2}, C_nH_{2n} ... .
Here n = no of 'C' atom in the compound.

Thursday — Appointment

Hydrocarbon and it's types :--

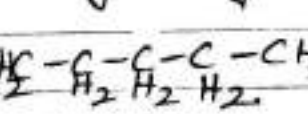
Imp
Q// What do you mean by Hydrocarbon ? Describe briefly the types of hydrocarbon.

Ans - Hydrocarbons are the componnds which are madde up only Hydrogen and carbon. They are the parent organic organic componnds. Other componds are derivid from them.

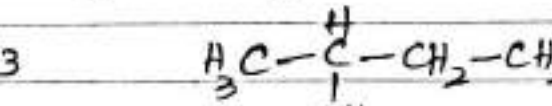
→ on the basis of structure hydrocarbons are mainly of two types (I) open chain or acyclic
(II) Closed chain or ring or cyclic

(I) Open chain or acyclic hydrocarbon :-

These are the hydrocarbon in which the first and last hydrocarbon do not directly joined to each other. They may be of two types (a) Straight (b) Branched

e.g 

n-Hexane (Straight)

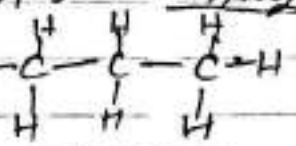


2-Methyl pentane (Branched)

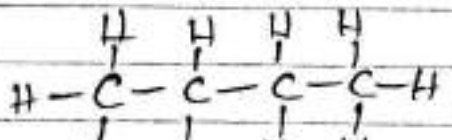
→ open chain is further sub devided into (a) Saturated (b) Unsaturated

(a) Saturated :- (single bond only)

These are the hydrocarbon contain C-C and C-H in it. They are also known as Alkanes. The general formula is C_nH_{2n+2}.

e.g- 

propane.



Butane

(b) Unsaturated (= bond or ≡ bond)

These are the hydrocarbon contain C=C and C≡C in it. They are also known as Alkene and Alkyne

respectively. The general formula for alkene – C_nH_{2n} and Alkyne – C_nH_{2n-2}

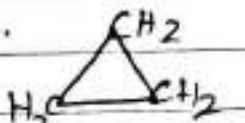
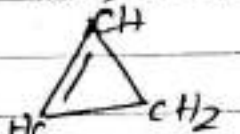
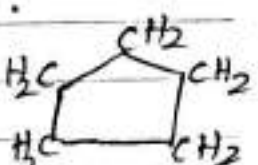
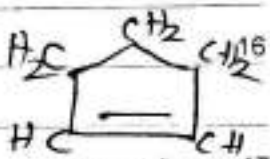
$H_2C=CH_2$ Ethene. $HC\equiv CH$ Ethyne $H_2C=CH-CH_3$ propene. $HC\equiv C-CH_3$ propyne

(II) Closed chain or cyclic hydrocarbon

The hydrocarbons in which the first and last carbon of the chain directly joined to each other are known as closed or cyclic hydrocarbon. They are divided into two types (a) Alicyclic (b) Aromatic.

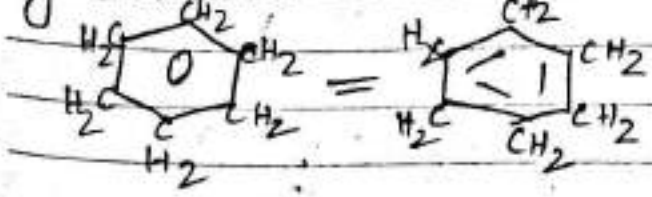
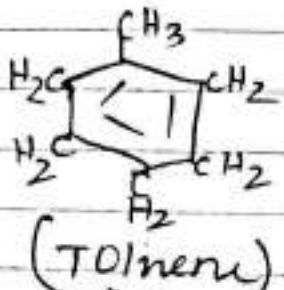
(a) Alicyclic :-

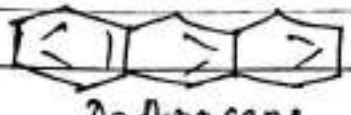
These are closed chain hydrocarbon, In which every corner is occupied by a 'C' atom in it. They may be saturated or unsaturated.

e.g.  Cyclopropane.  Cyclopropene.  Cyclopentane  Cyclopentene

(b) Aromatic :-

These are the hydrocarbon which must have a ring structure. It must obey Huckle's rule i.e $(4n+2)\pi e^{\ominus}$. Where $n = 0, 1, 2, 3 \cdots$. It must be planner and the double bond and single bond must be in alternate manner.

e.g Benzene   (Toluene)  Naphthalene

 Anthracene  Phenanthrene.

Appointment

Nomenclature of Organic Compounds :-

Nomenclature of organic compounds nothing but the naming of compounds. Two system of nomenclature are generally used.

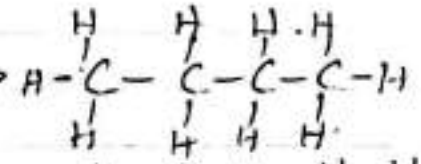
(i) Common or Trival name

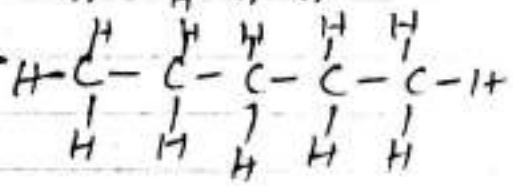
(ii) IUPAC nomenclature

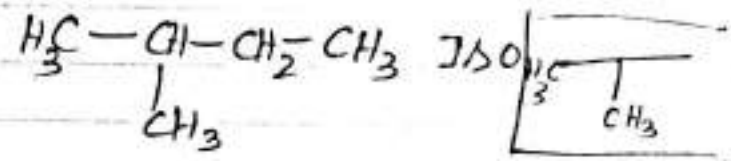
(i) Common or Trival System of nomenclature :-

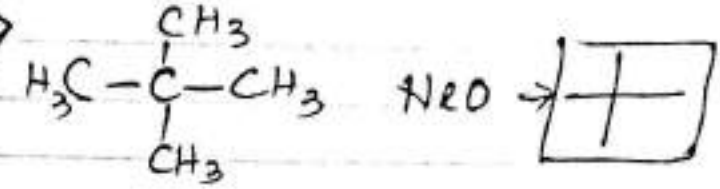
The name of the organic compounds with no systematic basis or rule are called common name.

e.g- CH_4 → Methane

⇒ C_4H_{10} → n- Butane → 

⇒ C_5H_{10} - n- pentane → 

⇒ C_5H_{10} → Iso pentane → 

⇒ C_5H_{10} - Neo pentane → 

⇒

C_6H_{14} - Iso hexane → $H_3C-CH(CH_3)-CH_2-CH_2-CH_3$

⇒ C_6H_{14} → Neo hexane → $H_3C-C(CH_3)_2-CH_2-CH_3$

Sunday

Appointment

→ C_6H_{14} → n-hexane → $H_3C-CH_2-CH_2-CH_2-CH_2-CH_3$

→ HCHO → Formaldehyde → $H-\underset{H}{\overset{H}{C}}=O$

→ H_3C-CH_2OH → Ethyl alcohol → H_3C-CH_2-OH

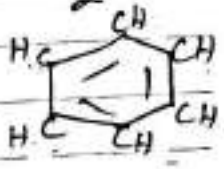
→ $H_3C-CH(OH)COOH$ → Lactic acid → $HC(H)(CH_3)(OH)-COOH$

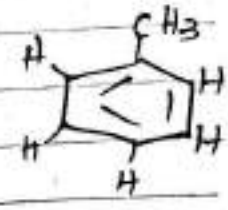
→ $HCCl_3$ → Chloroform → $Cl-\underset{Cl}{\overset{Cl}{C}}-H$

→ HCOOH → Formic acid → $H-\overset{O}{\overset{\|}{C}}-OH$

→ H_3CCOOH → Acetic acid → $H-\underset{H}{\overset{H}{C}}-\overset{O}{\overset{\|}{C}}-OH$

→ NH_2CONH_2 → Urea → $NH_2-\overset{O}{\overset{\|}{C}}-NH_2$

→ C_6H_6 → Benzene → 

→ $C_6H_5-CH_3$ → Tolmene → 

→ CH_2COCH_3 → Acetone → $H_3C-\overset{O}{\overset{\|}{C}}-CH_3$

→ $CH_2=CH$ → Vinyl gp

→ $CH_2=CH-CH_2$ → Allyl gp

Monday Appointment

IUPAC system of nomenclature :-

IUPAC - International union of pure and applied chemistry.

IUPAC system of nomenclature is consists of 3 parts.
(a) word root (b) Suffix (c) prefix

(a) Word root :-

It represents the no of carbon atoms present in the chain.

No of carbon atom		word root	No of carbon atom		word root
1	→	Meth	6	→	Hex
2	→	Eth	7	→	Hept
3	→	prop	8	→	Oct
4	→	But	9	→	Non
5	→	pent	10	→	Dec

(b) Suffix :-

Suffix is linked to the word root. Suffix may be of two types (i) primary (II) Secondary

(i) primary Suffix :-

It indicates the type of linkage in carbon chain.

linkage		Suffix
C-C only	→	ane
C-C + Functional gp	→	an
C=C only	→	ene
C=C + Functional gp	→	en
C≡C only	→	yne
C≡C + Functional gp	→	yn

NOTE:

→ When there are two or three double bond in a chain / diene or triene one must be written.

→ e.g- $H_2C-CH_2-CH_2-CH_3$ e.g- $H_2C-CH_2-H-CH_2$

Butane.
(only single bond with 4 'C' chain)

Butene.
[a double bond (ene) with 4 'C' chain but]

e.g-3 $H_2C-CH=C=CH_2$ $H_2C=C=C=CH_2$

* 1,2-Butadiene * 1,2,3-butatriene

→ However when there are more than one double or triple bond in a chain the word root will attach to 'a'. e.g- But → Buta in the above example

(1) Secondary suffix :-

Class	Functional Group	Sec suffix
Alcohol	$\longrightarrow$ -OH	$\longrightarrow$ -ol
Aldehyde	$\longrightarrow$ CHO	$\longrightarrow$ -al
Ketones	$\longrightarrow$ >C=O	$\longrightarrow$ -one
carboxylic acid	$\longrightarrow$ -COOH	$\longrightarrow$ -oic acid
Acid chloride	$\longrightarrow$ -COCl	$\longrightarrow$ -oyl chloride.
Esters	$\longrightarrow$ -COOR	$\longrightarrow$ -alkyl oate.
Nitrile	$\longrightarrow$ -C≡N	$\longrightarrow$ -nitrile.

(c) prefix :-

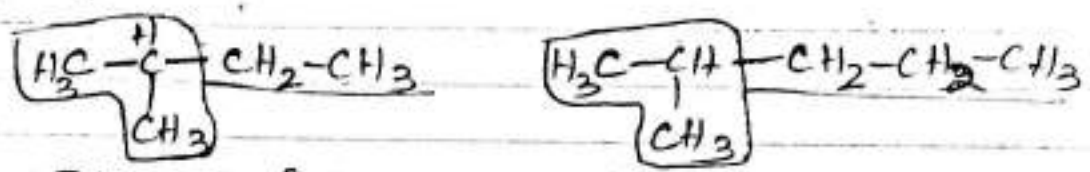
→ When the compound is a straigh chain; the prefix will be 'n'.

Appointment

e.g. $H_3C-CH_2-CH_3$ — n-propane. $H_3C-CH_2-CH_2-CH_2-CH_3$ — n-pentane.

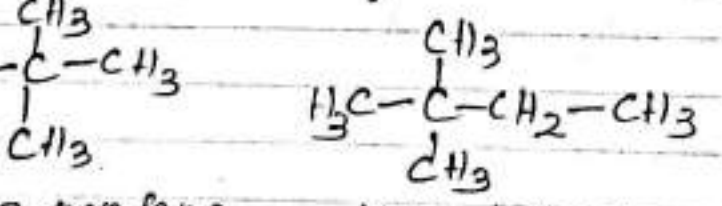
→ When the chain contains one methyl gp next to the last carbon atom of continuous chain, the prefix will be "Iso".

e.g.



Iso-pentane. Iso hexane.

→ "Neo"- prefix is used for those alkanes which have two methyl groups attached to the second last carbon atom of continuous chain.

e.g 

Neo-pentane. Neo-hexane.

Alkane

These are the hydrocarbons which contain C-C, C-H only.

→ They are also known as saturated hydrocarbon.

→ The general formula for it - C_nH_{2n+2}

No of C	Alkane	
1	CH_4 - Methane	
2	C_2H_6 - Ethane	
3	C_3H_8 - Propane	$H_3C-CH_2-CH_3$
:		
10	$C_{10}H_{22}$ - Decane	$H_3CCH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

→ Alkanes contain 4 types of carbon atoms. Appointment
(1) primary (1°) (2) Secondary (2°) (3) Tertiary (3°) (4) Quaternary (4°)

e.g $H_3C-\underset{2^\circ}{CH_2}-\underset{2^\circ}{CH_2}-\underset{1^\circ}{CH_3}$ (1° 2° 2° 1°)

e.g-2 - $1^\circ\ H_3C-\overset{3^\circ}{CH}(\overset{1^\circ}{CH_3})-\overset{2^\circ}{CH_2}-\overset{1^\circ}{CH_3}$

e.g-3 $1^\circ\ H_3C-\overset{4^\circ}{C}(CH_3)(CH_3)-\underset{2^\circ}{CH_2}-CH_3\ 1^\circ$

⇒ The hydrogen atoms attached to primary (1°), Secondary (2°) Tertiary (3°) and quaternary (4°) are known as 1°, 2°, 3° & 4° hydrogen respectively.

e.g $1^\circ\ H_3C-\overset{3^\circ}{CH}(CH_3)-\underset{2^\circ}{CH_2}-\underset{1^\circ}{CH_3}$ ⇒

- No of 1° H → 12
- " 2° H → 2
- " 3° H → 0
- " 4° H → 0

* Alkyl :—
→ Alkyl is the derivative of Akane
→ The general formula is C_nH_{2n+1}.
→ The Suffix for Alkyl is yl.
→ It is obtained by the removal of one hydrogen from Alkane.

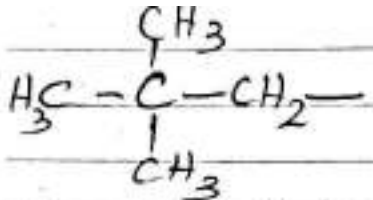
e.g- propane

- $-1^\circ H$ → 1-propyl radical
- $-2^\circ H$ → 2-propyl radical

e.g-2 → $H_3C-\overset{*}{CH}(CH_3)-CH_2-CH_3$ Sec-pentyl

$H_3C-\overset{CH_3}{\overset{|}{C}}(CH_3)-CH_2-CH_3$ Ter-pentyl

Appointment



Neo-pentyl

* **Alkene:-**

The unsaturated hydrocarbon which has C=C in it.

→ The Suffix is ene.

→ General formula – C_nH_{2n}

e.g $H_2C=CH_2$ Ethene

$H_3C-H_2C-H_2C-H=CH_2$ pentene.

$H_2C=CH-$ Ethenyl

$H_2C=CH-CH_2-$ propenyl

(a) **Symmetrical Alkenes:-**

When alkene has a mirror image in it.

e.g $H_2C=CH_2$ Ethene (symmetrical)

$H_3C-HC=CH-CH_2$ But-2-ene (symmetrical)

(b) e.g-2 **Unsymmetrical Alkenes:-**

Which do not have a symmetric form

e.g- $H_3C-CH=CH_2$ (propene) unsymmetrical

$H_2C=HC-CH_2-CH_3$ Butene (unsymmetrical)

* **Alkynes:-**

The unsaturated hydrocarbon having C≡C in it

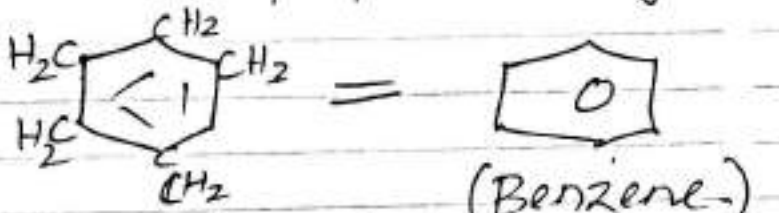
→ The Suffix is yne.

→ General formula – C_nH_{2n-2}

Q. Write the uses of Benzene, Tolnene, BHC, phenol, naphthalene, Anthracene, Benzoic acid in our daily life.

Ans- **Benzene;-**

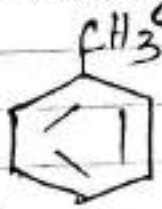
uses:- It is a major part of gasoline.
→ It is used to make plastics, synthetic fibres
→ It is used to prepare dyes
→ It is used to prepare detergents, drugs



(Benzene)

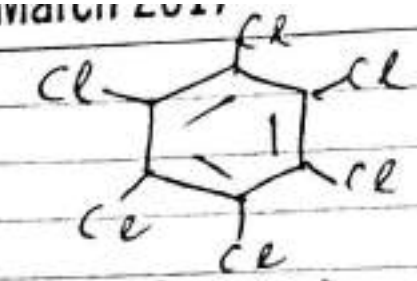
→ It is also used in explosive.

(II) Tolnene;-
It is a derivative of Benzene.
→ It is used in jet fuel.
→ It is used as solvent in paints, glue, nail polish remover
→ used in printing and leather tanning processes



(Tolnene)

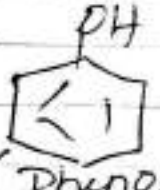
(III) BHC (Benzene hexa chloride)
→ It is mainly used in agricultural sector. to control pest.
→ It is used as pesticide
→ used to exterminating white ants, leaf hopper, termite etc.



(BHC)

(IV) Phenol :-

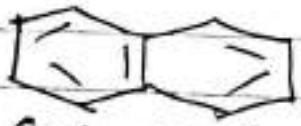
→ It is used largely in household products.
→ used as intermediate for Industrial synthesis
→ used as disinfectant in mouthwash & household cleaner
→ It is the first surgical antiseptic
→ used to preserve some vaccines



(Phenol)

(V) Napthalene :-

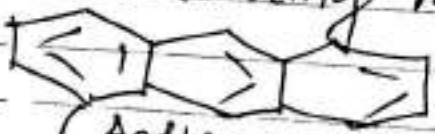
→ It is used to make mothballs, PVC, insecticides
→ It is also used in dyes.
→ It is also used as a household fumigant



(Napthalene)

(VI) Anthracene :-

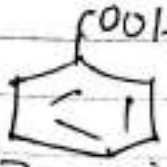
→ used as preservative in wood and lumber
→ used as insectiside for crops
→ It is used as coating material



(Anthracene)

(VII) Benzoic acid :-

→ It is used in perfumes, dyes,
→ used as insect repellents.
→ used as pH adjustor
→ as preservative in food, prevents growth of microbes in food



(Benzoic acid)

Chapter-14:- Chemicals in Agriculture

Appointment

Pesticides:-

pesticides are the chemical substances that are meant to kill pests.

→ In general, a pesticide is a chemical or biological agent such as virus, bacterium, antimicrobial or disinfectant that defers, kills pests

examples - Fungicides, Herbicides, Insecticides

(a) Fungicides:-

It is a specific type of pesticides that controls fungal disease by specifically inhibiting or killing the fungus causing the diseases. It inhibits their growth.

uses:-

It is used both in agriculture and to fight against fungal infections in animals.

examples: Mancozeb, Maneb, nabam, Zinebcaptan, Captafer etc.

→ They used to control Fungi that damage plants.
→ They are also used to control mold & mildew in other settings.

(b) Herbicides:-

A herbicide is a pesticide that used to kill unwanted plants.

→ It is of two types.

1) Selective Herbicides:- It kills certain targets while leaving the desired crop relatively unharmed.

Sunday
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(II) Non-selective herbicides:-
These are use to clear waste ground, Industrial and construction sites, railways and railway embankments as they kill all plants.

examples
→ 1. Dicamba - used on field corn.
2. Glufosinate ammonium - used to control weeds after the crop emerges or for total vegetation control on land not used for cultivation.

(C) Insecticides:-
These are the substances used to kill insects.
→ They include ovicides and larvicides, used against insect eggs and larvas respectively.

→ Used in agricultural sector to kill the insects
→ used as a medicine.

ex - Natural Insecticides - Nicotine, pyrethrum (made from plants as and neem extracts)
ex - DDT, BHC, Chlorobenzilate, cyclodiene

Bio-fertilizers:-
Biofertilizers are the substances that contains micro-organisms living or latent cells.

→ These increases the nutrients of host plants when applied to their seeds, plant surface or soil by colonizing the rhizosphere of plant.

→ these are more cost effective as compared to chemical fertilizers.

Examples:-
Rhizobium, Azotobacter, Azospirillum, phosphate solubilizing bacteria and mycorrhiza

Uses:-
→ The microorganisms in biofertilizers restores the soil's nutrient cycle and build soil's organic matter.

→ Biofertilizers such as Rhizobium inoculant is used for legumineous crops.
→ They fixes the nutrient availability of soil.

—o—