UNIT 13

FUNDAMENTAL PRINCIPLES OF ORGANIC CHEMISTRY

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Organic Chemistry:-

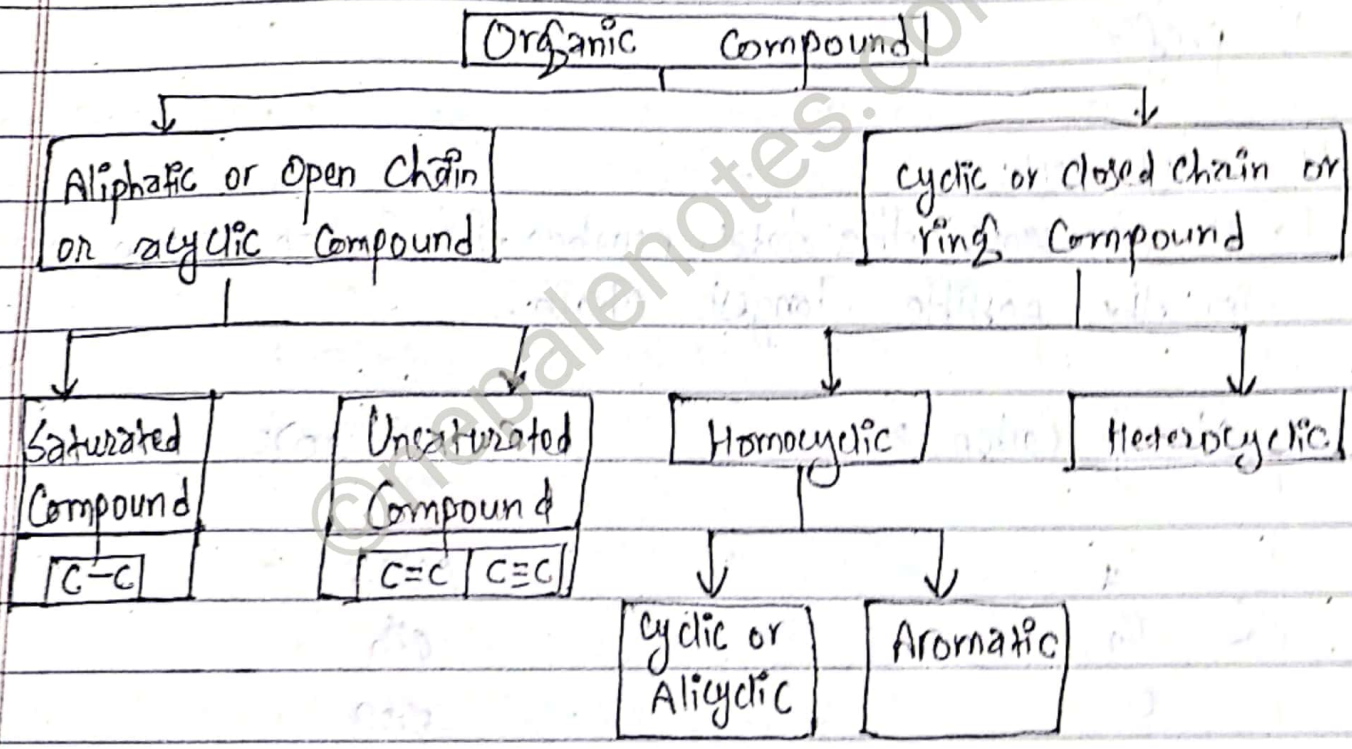
↳ The branch of chemistry which deals about the study of hydrocarbon and their derivatives is called Organic Chemistry.

Organic Compound:-

↳ Carbon containing compound is called organic compound.

e.g CH_4 – Methane CH_3CH_2OH – ethanol

CH_3-CH_3 – ethane



Nomenclature of Organic Compound:-

↳

[1] Common System of Nomenclature:-

↳ According to common (trivial) system the organic compound were named according to their source of origin.

eg (HCOOH) Formic acid ⟶ derived from red ants (formica = Ant)

(CH_3COOH) Acetic acid ⟶ acetum (acetum = vinegar)

[b] IUPAC System of nomenclature:-

↳ International Union for Pure and Applied Chemistry the latest and widely accepted system for giving systematic names of organic compounds in IUPAC system of nomenclature.

IUPAC system of nomenclature of aliphatic organic compounds. It contains three(3) part:-

1) Word root
2) Suffix
3) prefix

[1] Word root:-

↳ It represents the total number of Carbon atom present in the possible longest chain.

No. of Carbon atom	word root
C_1	Meth
C_2	eth
C_3	prop
C_4	but
C_5	pent
C_6	hex
C_7	hept
C_8	oct
C_9	non
C_{10}	dec

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[2] Suffix:-

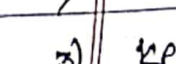
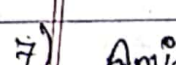
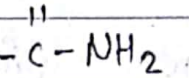
↳ There are two types of suffix

i) Primary Suffix:

↳ It indicates nature of Carbon-carbon bond

Nature of Carbon to carbon bond	primay suffix	
C – C	– ane	- Alkane
C = C	– ene	– Alkene
C ≡ C	– yne	– Alkyne

ii) Secondary Suffix:-

	Organic Compounds	Functional group	Secondary Suffix
1)	Alcohol (ROH)	– OH	– ol
2)	Aldyhyde (RCHO)	– CHO or 	– al
3)	Ketone ()		– one
4)	Carboxylic acid (R-COOH)	 or – COOH	– oic acid
5)	ester (R-COOR)	– COOR' or 	– oate
6)	Acid anhydride ()		– oic anhydride
7)	Amides ()		– amide
8)	cyanide (R-CN)	– CN	– nitrile
9)	amine ($R-NH_2$)	$-NH_2$	– amine

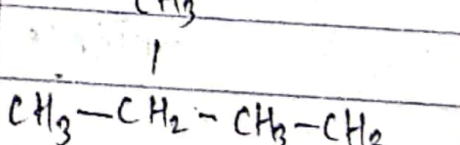
[3] prefix:-

↳ All atoms or group except principle functional group present in longest chain before retwen the word root are called substituents or prefix or side chain.

Groups	prefix
$-CH_3$	-Methyl
$-CH_2-CH_3$	-ethyl
$-Cl$	-Chloro
$-Br$	-Bromo
$-I$	-iodo
$-NO_2$	-Nitro
$-OR$	-Alkoxy
$-OCH_3$	-Methoxy
$-NH_2$	-Amino
$-OH$	-Hydroxy
$-C=O$	-keto
$-CN$	-cyano
$-CHO$	-Formyl

* IUPAC name of organic Compound generally contain following terms

[prefix + word root + primary suffix + Secondary suffix]



W.r. = but
P.S. = ane
prefix = 2-methyl
SS = x

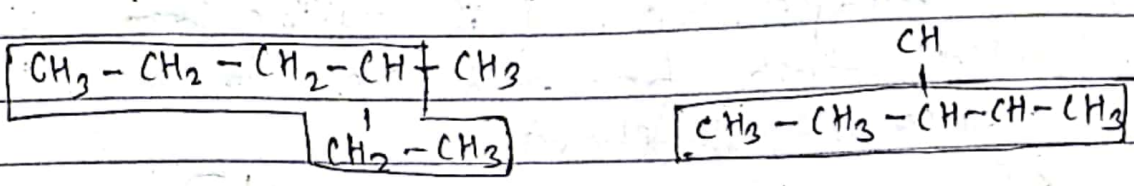
— 2-Methyl butane

Rule for writing IUPAC Name:-

[1] Selection of longest Continuous Carbon chain:-

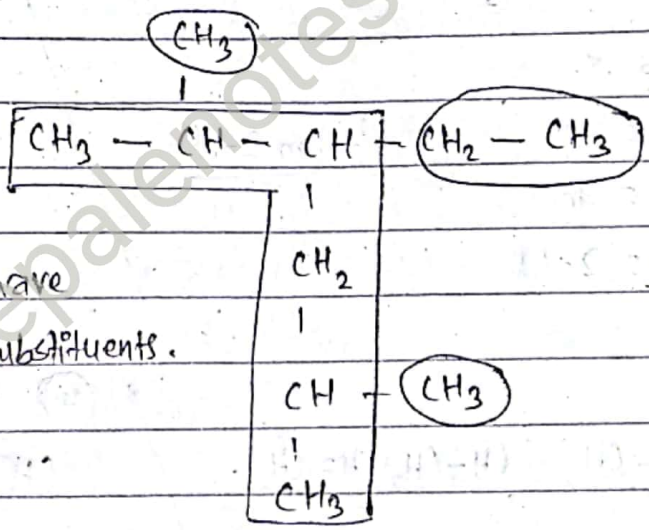
↳ Select the longest possible Continuous Carbon Chain ~~with~~ which determines the word root and primary suffix.

e.g.



[2] If more than one equal chain of carbon are possible then select one which contains maximum number of substituents.

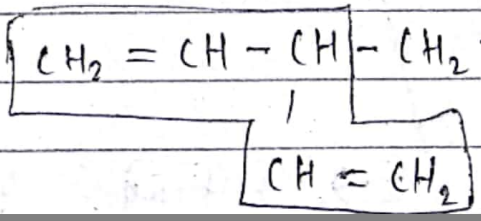
e.g.



This structure have maximum three substituents.
So, it is selected.

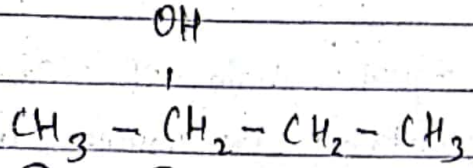
[3] If more than one multiple bonds are present then select one which contains maximum number of multiple bond

e.g.



[4] Numbering is started from terminal of the chain by which functional group if present gets lowest possible number.
If functional group is absent then from end closer to multiple bond & if multiple bond is also not present then from end closer to the side chain (suffix & substituents).
e.g.

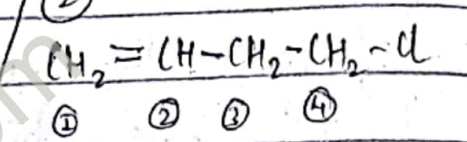
(1)



P.f = x
w.r. = but
P.s. = ane
S.s. = 2-ol

⇒ butan 2-ol

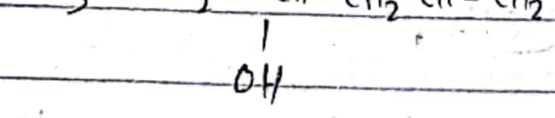
(2)



P.f = 4-chloro
w.r. = but
P.s. = 1-ene
S.s = x

⇒ 4-Chloro butene

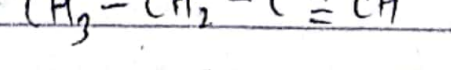
(3)



w.r. = Hex
P.s. = 5-ene
S.s = 3-ol
P.f = x

⇒ Hex 5-en 3-ol

(4)



w.r. = but
P.s = 1-yne
S.s = x

⇒ butyne.

⑤ $CH_3-CH_2-\underset{\textcircled{3}}{CH}(Cl)-CH_3$ (④ ③ ② ①)

w.r. = but
p.s = ane
S.s. = ✗
prefix = 2-chloro
⇒ 2-chloro butane

⑥ $CH_2=\underset{\textcircled{3}}{C}(CH_3)-CH=CH_2$ (① ② ③ ④)

p.f = 2-Methyl
w.r. = but
P.s. = (1,3) diene, S.s = ✗
⇒ 2-Methyl but 1,3-diene

⑦ $CH_2=CH-\underset{\textcircled{3}}{CH}(OH)-CH=CH_2$ (⑤ ④ ③ ② ①)

p.f. = ✗
w.r. = pent
p.s. (1,4)-diene
S.s. = 3-ol
⇒ pent 1,4-diene 3-ol

[5] If a Compound is Symmetrical from the point of view of functional group, numbering Can be done from either side However if multiple bond is also present the preference goes to multiple bond. Similarly if a compound is symmetrical from the point of view of multiple bond and Content a Substituents also then preference goes to Substituents.

functional group > double bond > triple bond > Substituents

e.g.

① $CH_2=\underset{\textcircled{2}}{C}(CH_3)-\underset{\textcircled{3}}{CH}(OH)-CH_2-CH_2$ (① ② ③ ④ ⑤)

w.r. = pent
p.s. = 1,4-diene
S.S. = 3-ol
p.f = 2-Methyl
⟹ 2-Methyl pent 1,4-dien-3-ol

(2)

$$CH_2=CH-\underset{\underset{OH}{|}}{CH}-CH_2-CH_2-Cl$$

w.r. = pent
prefix = 5-chloro
p.s. = ene
s.s. = 3-ol
⇒ 5-chloro pentene 3-ol

[b] If Carbon containing functional group is present then give lowest number except ketones, esters.
e.g.

(1)

$$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{CH}}-CH=CHO$$

w.r. = but
p.s. = ane
s.s. = al
prefix = 2-ethyl
⇒ 2-ethyl butanal

(2)

$$CH_3-\underset{\underset{COOH}{|}}{CH}-\underset{\underset{CH_2}{||}}{CH}-CH_3$$

w.r. = but
p.f = (2,3)-dimethyl
p.s. = 3-ene
s.s. = oic acid
⇒ 2,3-dimethyl but 3-en-oic acid

(3)

$$CH_3-\overset{\overset{O}{||}}{C}-CH_2-CH_2-CH_3$$

⇒ pentan 2-one

(4)

$$CH_3-CH_2-CH_2-CH-CHO$$
$$\qquad\qquad\quad |$$
$$\qquad\qquad\quad CH_2-CH_3$$

⇒ 2-ethyl pentan 1-al

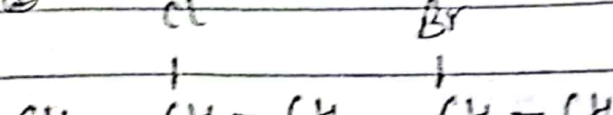
(5)

$$CH_2=CH-CH-CH_2-CH_3$$
$$\qquad\quad |$$
$$\qquad\quad COOH$$

⇒ 2-ethyl pent 3-en oic acid

[7] If two or more same or different side chain or substituents are present in a compound & no functional group or multiple bond is present then numbering done according to lowest set of locant rule.

e.g. ①

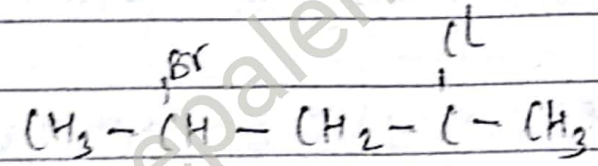


Note:-
[Here prefix are arranged by alphabetical order. like Bromo is written before chloro]

2, 4, 5, = 11 (Left to right)
1, 2, 4 = 7 (right to left) ✓

⇒ 2-Bromo 1,4-dichloro pentane

②

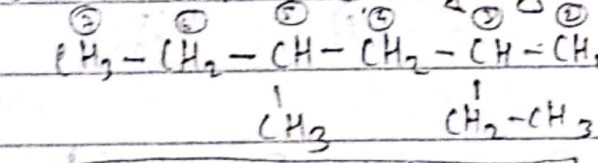


2, 2, 4 = 8 ✓
2, 4, 4 = 10

⇒ 4 Bromo · 2-chloro-2-methyl pentane

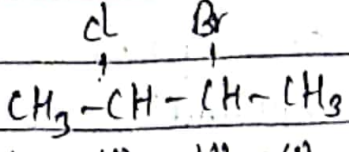
[8] However if two different side chain are present at symmetrical position the numbering is done from the end to which side chain coming first in alphabetical order.

e.g. ①

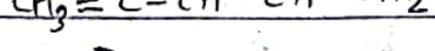


⇒ 3-Ethyl 5-methyl heptane

(2)



⇒ 2-Bromo 3-chloro butane



1,2,4 = 7 ✓
1,3,4 = 8

⇒ pent 1,2,4-triene

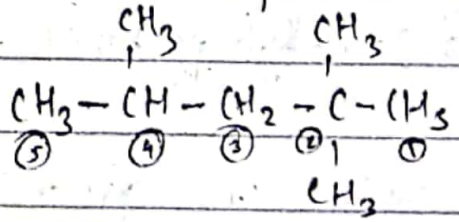
→ If two or more same substituents are present then di, tri etc. are used and their position are separated by(,).

→ Name and position of substituents are separated by(-).

→ di, tri Can be used if more than one double or triple bond present in compound.

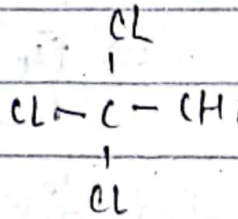
Some Examples:-

(1)



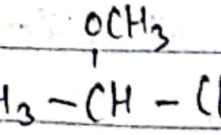
⇒ 2,2,4-trimethyl pentane

(2)



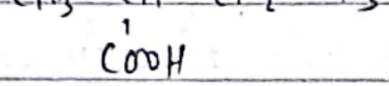
⇒ 2,2,2-trichloro methanal

(3)

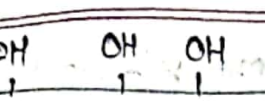


⇒ 2-Methoxy propanal

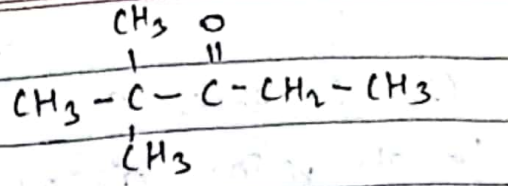
(4)



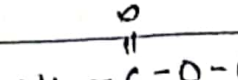
⇒ 2-Methyl butane oic acid

(5) 

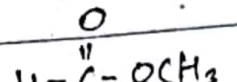
⇒ propane 1,2,3-triol

(6) 

⇒ 2,2-dimethyl pentan 3-one

(7) 

⇒ Methyl ethanoate

(8) 

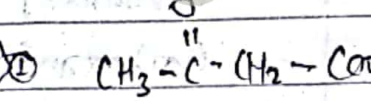
⇒ Methyl methanoate

Polyfunctional Compound:-

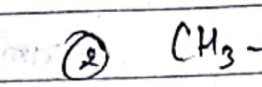
↳ If two or more different functional group are present in a compound then numbering is started from the end to which the group senior to them is closer and remaining functional group are considered as substituent.

$-COOH > -SO_3H > -(CO)_2O > COOR > -COCl > -CONH_2 > -CN > -CHO > -\overset{O}{\overset{\|}{C}}- > -OH > -SH > -NH_2$

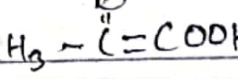
↳ Acid anhydride $(CH_3-CO)_2O$

e.g. (1) 

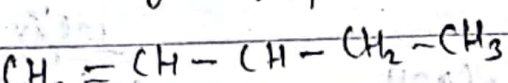
⇒ 3-keto butanoic acid

(2) 

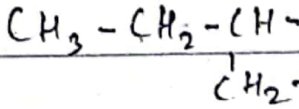
⇒ 2-hydroxy propan oic acid

(3) 

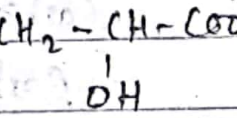
⇒ 2-Keto propenoic acid

(4) 

⇒ 2-ethyl but-3-en-al

(5) 

⇒ 2-ethyl butanal

(6) 

⇒ 2-hydroxy propanoic acid
3-cyano

(7) $CH_3-\overset{O}{\overset{\|}{C}}-CH-CH_2-CN$

⇒ 4-Keto pentane Nittrile

(8) $COOH-CH_2-CH_2-\underset{COOH}{\underset{|}{CH}}-CH_2-COOH$

⇒ Butane 1,2,4-tri Carboxylic acid

Formula	Suffix	prefix
-OH	-ol	hydroxy
-COOH	-oic acid	Carboxy
-CHO	-al	Aldo or Formyl
$-\overset{O}{\overset{\|}{C}}-$	-one	Keto or Oxo
-OR	-	Alkoxy
-CN	-nitrile	cyano
$-SO_3H$	-Sulphonic acid	Sulpho
-COOR	-oate	Carbalkoxy
$-CONH_2$	-amide	Carboxamide
-COCl	-oyl chloride	Chloroformyl

	prefix
-COOH	-Carboxylic acid
-COOR	-Carboxylate
-CHO	-Carbaldehyde
-CN	- Carbonitrile
$-CONH_2$	- Carboxamide
-COCl	- Carbonyl chloride

Examples:-

① $COCl-CH_2-CH_2-CH(COCl)-CH_2-COCl$

⇒ Butane-1,2,4-tricarbonyl chloride

② $CH(COOH)-CH(COOH)-CH_2COOH$

⇒ propane-1,2,3-tricarboxylic acid

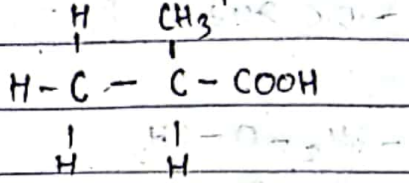
③ $COOH-CH_2-CH_2-CH(CH_2COOH)-CH_2-COOH$

⇒ 3-(Carboxymethyl hexane dioic acid

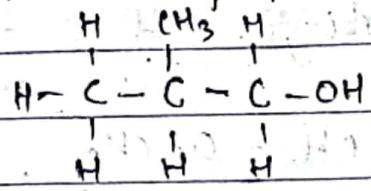
Structure making:-

↳ e.g.

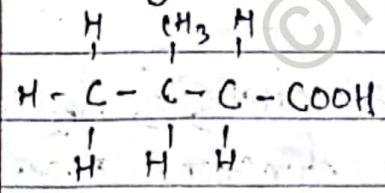
① 2-Methyl propanoic acid



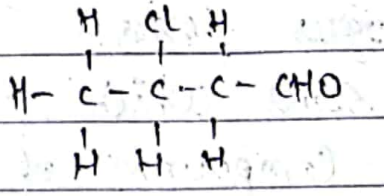
② 2-Methyl propan 1-ol



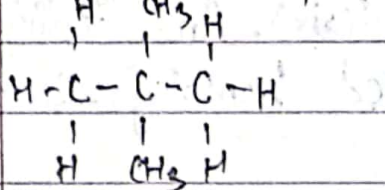
③ 3-Methyl butanoic acid



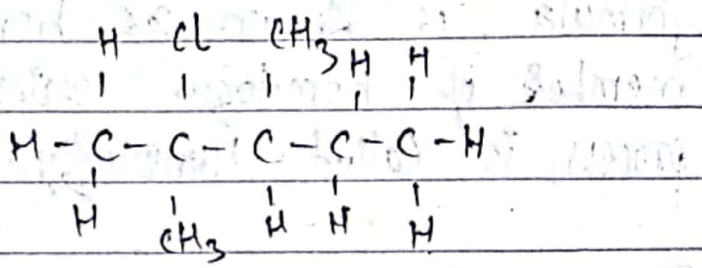
④ 3-Chloro butanal



⑤ 2,2-dimethyl propane.



⑥ 2-Chloro-2,3-dimethylpentane



Functional group:-

↳ Atom or group of atoms that determines the characteristic property of given organic compound are called functional group.

e.g

$-OH$ (alcoholic F.G.)

$-COOH$ (Carboxylic F.G.)

Name	Symbol	Secondary Suffix
Alcohol	$-OH$	-ol
Aldehyde	$-CHO$	-al
ether	$-O-$	x
Ketones	$-\overset{\overset{O}{\|\|}}{C}-$	-one
Carboxylic acid	$-COOH$	-oic acid

① CH_3-O-CH_3 ⇒ Methoxy methane

② $CH_3-CH_2-O-CH_3$ ⇒ Methoxy ethane

Homologus Series:-

V.V.I

↳ The series which is obtained by arranging different organic compound of a class (same functional group) in the increasing order of their molecular weight. and successive member differ by CH_2 units. In their molecular formula is known as homologus series. An individual member of homologus series is called homologe. and process is called Homology.

For example, Homologus series of alkane and alcohol can be represented as,

Alkane (C_nH_{2n+2})	Alcohol ($C_nH_{2n+1}OH$)
CH_4	CH_3OH
CH_3-CH_3	CH_3CH_2OH
$CH_3-CH_2-CH_3$	$CH_3-CH_2-CH_2OH$
$CH_3-CH_2-CH_2-CH_3$	$CH_3-CH_2-CH_2-CH_2OH$

Characteristics/features of homologus series:-

N.V.I

[1] All members of homologus series contains the same element and same functional group.

[2] All Compounds in series can be represented by same general formula.

For. e.g. Alcohol ($C_nH_{2n+1}OH$)

[3] All members of series can be prepared by similar method.

[4] All Compound of series have similar chemical properties due to the presence of same functional group.

[5] The homologus series have gradual increase in physical properties such as boiling point, melting point etc. because of the different molecular weight.

[6] All members are differ by CH_2 units.

Qualitative Analysis of organic Compound:-

↳ Carbon, hydrogen and oxygen are the Common element present in organic Compound but some times N, S, Halogen may present rarely in some Compounds which are called heteroelement and foreign element.

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The detection of the heteroelement present in organic Compounds involves the following steps/stages.

[1] Preparation of Sodium extract :-

↳ In general, the heteroelement in organic compounds are bonded with covalent bond to Carbon atom. At first, covalent bond should be converted into ionic form. For that purpose we have to treat the given organic compound with highly reactive fused Sodium(Na) metal. The reaction involves are as shown below :-

$$Na + X(F, Cl, Br, I) \longrightarrow NaX\ (aq)$$
$$Na + C + N \longrightarrow NaCN\ (aq)$$
$$2Na + S \longrightarrow Na_2S\ (aq)$$
$$Na + C + N + S \longrightarrow NaCNS\ (aq)$$

The fused mass of organic compounds with Sodium metal contain the ionic species like NaX, NaCN, Na_2S, NaCNS in the form of aqueous solution and is called Sodium extract. The Sodium extract solution is taken as the test solution to determine whether N, S and halogen elements are present or not present as shown in below :-

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Test of Nitrogen(N):-

Ans ↳ 2 ml of Sodium extract is taken in test tube and is made alkaline if necessary by adding NaOH. Then freshly prepare $FeSO_4$ solution is added so that a dirty green ppt. is seen which after boiling and cooling $FeCl_3$ solution is added the development of prussian blue or green colour indicate the presence of Nitrogen in organic compound. Otherwise, absence of Nitrogen. Sodium extract is generally alkaline because the excess sodium extract react with water to give NaOH solution. Which makes the solution alkaline.

① $H_2O + Na \longrightarrow NaOH + \frac{1}{2} H_2$

② $Na + C + N \xrightarrow{\Delta} NaCN \rightleftharpoons Na^+CN^-$

③ $FeSO_4 + 2\,NaOH \longrightarrow Fe(OH)_2 \downarrow + Na_2SO_4$
(dirty green)

④ $Fe(OH)_2 + 6\,NaCN \longrightarrow Na_4[Fe(CN)_6] + 2\,NaOH$
(Sodium Ferrocyanide)

⑤ $3\,Na_4[Fe(CN)_6] + 4\,FeCl_3 \longrightarrow Fe_4[Fe(CN)_6]_3 + 12\,NaCl$
(Ferric ferrocyanide)
(prussian blue).

Test of Sulphur(S):-

↳ Sodium extract is taken in test tube and acidified with dilute CH_3COOH (acetic acid) the lead Acetate solution is added if black ppt is formed, then the presence of Sulphur in organic compound is confirmed.

$$2Na + S \longrightarrow Na_2S$$

$$(CH_3COO)_2Pb + Na_2S \xrightarrow{\text{dil. } CH_3COOH} CH_3COONa + PbS\downarrow$$

(Sodium acetate) (black ppt.)

Test of Helogen (x-Cl, Br, I):-

↳ When $AgNO_3$ is added to solution of sodium extract, a white or light(pale) yellow ppt or yellow ppt may be seen. which indicates the presence of helogen in organic compound.

$$Na + X \xrightarrow{\Delta} NaX$$

(1) $$NaCl + AgNO_3 \longrightarrow AgCl\downarrow + NaNO_3$$

(White ppt)

The appearence of white ppt which gets dissolve with ammonium hydroxide (NH_4OH) indicates the presence of Chloride(Cl).

(2) $$NaBr + AgNO_3 \longrightarrow AgBr\downarrow + NaNO_3$$

(Light(pale) yellow ppt)

Light (pale) yellow ppt. are formed which are partially dissolved in ammonium hydroxide (NH_4OH) indicates the presence of Bromide(Br).

(3) $$NaI + AgNO_3 \longrightarrow AgI + NaNO_3$$

(yellow ppt)

Yellow ppt. are formed which are insoluble in ammonia solution (NH_4OH) indicates the presence of iodine/iodide(I).

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Preliminary idea of reaction (rxn) mechanism:-

Reaction mechanism:-

↳ The actual path way of Conversion of reactants into products through in intermediate is called reaction mechanism.

e.g. $N_2 + H_2 \xrightarrow{Ni/Pt} NH_3$

Bond fission:-

↳ The breaking of chemical bond is called bond fission. It is of two types:-

[1] Homolytic/Homolysis bond fission:-

↳ In this fission the covalent bond is broken in such a way that, each resulting species gets each one electron. Homolytic bond fission results free redical Such fission can be observed in symmetrical molecule.

$$A : B \xrightarrow[\text{Energy}]{\Delta} A^{\cdot} + B^{\cdot}$$

(Free radical)

e.g. $Cl : Cl \xrightarrow[\text{Energy}]{\Delta} Cl^{\cdot} + Cl^{\cdot}$

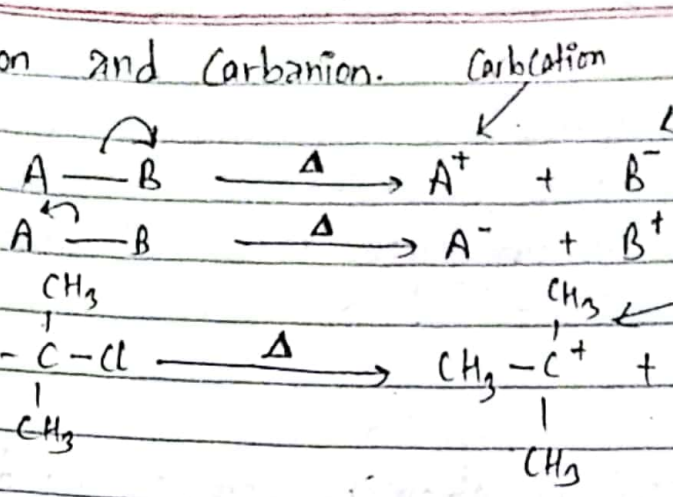
(Free radical)

[2] Heterolytic/Heterolysis bond fission:-

↳ In this fission the covalent bond breaks asymmetrically in such a way that one of the atom takes both shared pair of electron is called Heterolytic bond fission/ Heterolysis bond fission.

In heterolytic bond fission, the resulting species are

Carbcation and Carbanion.



Electrophile [E^+] :-

↳ Electrophiles are electron loving group. They are electron defiecient species and can accept electron pair. Electrophiles usually carry positive charge but some are neutral too. For e.g. Cu^{++}, Ag^+, CH_3^+, NO_2^+, Cl^+, Br^+, $AlCl_3$, etc.

Nucleophile (Nu^-) :-

↳ Nucleophiles are nucleus loving group. They are electron rich species and can donate electron pair. Nucleophiles usually carry negative charge but some are neutral too. For e.g. Cl^-, Br^-, I^-, NO_3^-, $H_2\ddot{O}:$, $:NH_3$, etc.

Inductive effect :-

↳ When a covalent bond is formed between two atoms of different electronegativity, shared paired of electrons or bond pair of electrons shifted more towards element having highes electronegativity. As a result, small negative charge developed on it and equivalent positive charge developed on another atom. This →

permanent displacement of electron pair towards more electronegative element inducing polarity is known as inductive effect.
It is also known as I effect. It is of two types:-

[1] Positive inductive effect (+I effect):-
↳ When less electronegative element is bonded to carbon atom then it donates electron towards carbon atom and such atom or group atoms are called electron donating group or electron releasing group. The inducting effect caused by electron donating group is known as +I effect. For e.g. alkyl groups are electron donating group.

[2] Negative inductive effect (-I effect):-
↳ When more electronegative element is bonded to carbon atom then it withdraws electron from carbon atom and such atom are electron withdrawing groups. The inductive effect caused by electron withdrawing group is known as -I effect. For e.g. $-NO_2$, $-CN$, $-COOH$, $-I$, $-Cl$, $-F$, $-Br$, etc.

Application of inductive effect:-

[i] It is used to explain relative strength of organic acids and bases. For e.g. Chloro acetic acid is stronger than acetic acid.
[ii] It helps to calculate dipole moment of molecules.

Nomenclature of organic compounds:-

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1) Alkane :- (C_nH_{2n+2})

Formula	IOPAC Name	Common name
CH_4	Methane	Marsh gas
CH_3-CH_3	Ethane	Ethane
$CH_3-CH_2-CH_3$	propane	propane
$CH_3-CH_2-CH_2-CH_3$	Butane	n-butane
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$	2-methyl propane	Iso-butane
$CH_3-CH_2-CH_2-CH_2-CH_3$	pentane	n-pentane
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_3$	2-Methyl butane	Iso-pentane
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle CH_3}{\overset{\vert}{C}}}}-CH_3$	22-dimethyl propane	Neo-pentane
$CH_3-CH-CH_2-CH_2-CH_3$ (CH₃ on C2)	3-Methyl hexane	

2) Alkene :- (C_nH_{2n})

Formula	IUPAC Name	Common Name
C_2H_4	Ethene	Ethylene
C_3H_6	propene	propylene
$H_2C=CH-CH_2-CH_3$	But-1-ene	α-butylene
$H_3C-CH=CH-CH_3$	But-2-ene	β-butylene
$(CH_3)_2C=CH_2$	2-Methyl propene	Iso-butylene
$CH_2=CH-CH_2-CH_2-CH_3$		
$CH_3-CH=CH-CH_2-CH_3$		
$CH_2=CH-CH=CH_2$	1,3-Butadiene But-1,3-diene	

3) Alkyne :- [C_nH_{2n-2}]

Formula	IUPAC Name	Common Name
C_2H_2; $CH\equiv CH$	Ethyne	Acetylene
C_3H_4 $CH\equiv C-CH_3$	propyne	Methyl acetylene
$HC\equiv C-CH_2-CH_3$	But-1-yne	Ethylacetylene
$H_3C-C\equiv C-CH_3$	But-2-yne	dimethyl acetylene

4) Alkyl halides :- $C_nH_{2n+1}X$ [Where X = Cl, Br, I etc]

Compounds	IUPAC Name	Common Name
CH_3-Cl	Chloro methane	methyl chloride
CH_3-CH_2-Br	bromo-ethane	ethyl bromide
$CH_3-CH(CH_3)-CH_2-Cl$	1-chloro-2-methyl propane	Iso-butyl chloride
$CH_3-C(CH_3)_2-CH_2-Br$		

5) Alcohol :- $[C_nH_{2n+1}OH]$

Compound's	IUPAC name	Common name
CH_3OH	Methanol	Methyl alcohol
C_2H_5OH	Ethanol	Ethyl alcohol
$CH_3-CH_2-CH_2-OH$	1-propanol	n-propyl alcohol
$CH_3-CH(OH)-CH_3$	2-propanol	Iso propyl alcohol
$CH_3-CH_2-CH(CH_3)-OH$	2-propanol	Sec butyl alcohol
$CH_2(OH)-CH_2(OH)$	Ethane-1,2-diol	Ethylene glycol
$CH_2(OH)-CH(OH)-CH_2(OH)$	propan-1,2,3-triol	glycerol/glycerin

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6) Ether :- [$C_nH_{2n+1}OC_nH_{2n+1}$]

Compounds	IUPAC name	Common name
CH_3-O-CH_3	methoxymethane	Dimethyl ether
$CH_3-O-CH_2-CH_3$	methoxyethane	Ethyl methyl ether
$CH_3-CH_2-O-CH_2-CH_3$	ethoxyethane	Diethylether
$CH_3-CH_2-CH_2-O-CH_2-CH_3$	1- Ethoxypropane	ethyl-n-propylether
$CH_3-\underset{CH_3}{\underset{\vert}{CH}}-O-CH_2-CH_3$	2-ethoxy propane	Ethyl Isopropylether

7) Aldehyde :- [$C_nH_{2n+1}CHO$]

Compound	IUPAC name	common name
HCHO	methanal	Formaldehyde [Formalin]
CH_3CHO	ethanal	Acetaldehyde
CH_3-CH_2-CHO	propanal	propionaldehyde
$CH_3-CH_2-CH_2-CHO$	butanal	Butyraldehyde
$CH_3-\underset{CH_3}{\underset{\vert}{CH}}-CHO$	2-Methyl propanal	Iso-butyl aldehyde
$CH_3-CH_2-CH_2-CH_2-CHO$	pentanal	n- Valeralaldehyde

8) Ketones:- $[C_nH_{2n+1}COC_nH_{2n+1}]$

Compounds	IUPAC name	Common name
CH_3COCH_3	propanone	Acetone
$CH_3-CH_2-\overset{\overset{O}{\|\|}}{C}-CH_3$	2-butanone	Ethyl methyl ketone
$CH_3-CH_2-\overset{\overset{O}{\|\|}}{C}-CH_2-CH_3$	3-pentanone	Dimethyl ketone
$CH_3-\overset{\overset{O}{\|\|}}{C}-CH_2-CH_2-CH_3$	2-pentanone	Methyl n propyl ketone
$CH_3-CH(CH_3)-\overset{\overset{O}{\|\|}}{C}-CH_3$	3-methyl butan-2-one	methyl Isopropyl ketone

9) Carboxylic acids:- $[C_nH_{2n+1}]COOH$

Compounds	IUPAC	Common
$H-COOH$	Methanoic acid	Formic acid
CH_3-COOH	Ethanoic acid	Acetic acid (vinegar)
$CH_3-CH_2-CH_2-COOH$	Butanoic acid	n-Butyric acid
CH_3-CH_2-COOH	propanoic acid	propionic acid
$CH_3-CH(OH)-COOH$	2-hydroxy propanoic acid	α-hydroxy propanoic acid
$COOH-COOH$	Ethane dioic acid	Oxylic acid

Derivatives of Carboxylic acid

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10) Esters :- [$C_nH_{2n+1}COOR'$]

Compounds	IUPAC Name	Common Name
$H-COOR'$	Alkyl methonoate	Alkyl Formate
CH_3-COOR'	Alkyl ethanoate	Alkyl acetate
CH_3-CH_2-COOR'	Alkyl propanoate	Alkyl propianate
$CH_3-\overset{O}{\overset{\|\|}{C}}-OC_2H_5$	Ethyl ethanoate	Ethyl acetate

11) Acid-halide :- [$C_nH_{2n+1}COX$]

Compounds	IUPAC name	Common name
$HCOX$	methanoyl halide	Farmyl halide
CH_3-COX	ethanoyl halide	acetye halide
CH_3-CH_3-C-X	propanoyl halide	propion halide

12) Amide :- [$C_nH_{2n+1}CONH_2$]

Compounds	IUPAC name	Common name
$H-\overset{O}{\overset{\|\|}{C}}-NH_2$	Methanamide	Farmamide
CH_3-CONH_2	ethanamide	acetamide
$CH_3-CH_2-CONH_2$	propanamide	propionamide

13) Anhydride :- [$C_nH_{2n+1}COCOC_nH_{2n+1}$]

Compound	IUPAC name	Common name
$CH_3-C(=O)-O-C(=O)-CH_3$	ethanoic anhydride	acetic anhydride

14) Amines :- [$C_nH_{2n+1}NH_2$]

Compounds	IUPAC name	Common name
CH_3-NH_2	methanamine	methylamine
$CH_3-CH_2-NH_2$	ethanamine	Ethylamine
$CH_3-CH_2-CH_2-NH_2$	1-propanamine	amine propane
$CH_3-CH(CH_3)-NH_2$	2-amino propane	Iso-propyl amine

15) Nitro Compound :- [$C_nH_{2n+1}NO_2$]

Compound	IUPAC name	Common name
CH_3NO_2	Nitromethane	—
$CH_3CH_2NO_2$	Nitroethane	—
$CH_3-CH_2-CH_2-NO_2$	1-Nitro propane	—
$CH_3-CH(NO_2)-CH_3$	2-nitropropane	—

i. $(CH_3)_2C=CH-CHO$

$CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CHO \longrightarrow$ 3-methyl-2-Butenal

ii. $H-\overset{\overset{O}{\parallel}}{C}-CH=CH-\overset{\overset{O}{\parallel}}{C}-H \longrightarrow$ But-2-ene-1,4-dial

iii. $CH_3-\underset{OCH_3}{\underset{|}{C}}-\overset{\overset{O}{\parallel}}{C}-H \longrightarrow$ 2-Methoxy propanal

iv. $Cl-\underset{Cl}{\underset{|}{C}}-\overset{\overset{O}{\parallel}}{C}-H \longrightarrow$ 2,2,2-trichloroethanal

v. $(CH_3)_3-CCHBrCH_2CH_3$

$CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3,Br}{\overset{|}{C}}}}-CH-CH_2-CH_3 \rightarrow$ 3-Bromo-2,2-dimethyl pentane.

vi. $(CH_3)_3-CCOCH_2CH_3$

$CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-\overset{\overset{O}{\parallel}}{C}-CH_2-CH_3 \longrightarrow$ 2,2-dimethyl

(1) $CH_3COONH_3 \longrightarrow$ methyl ethanoate

(2) $CH_3CONH_2 \longrightarrow$ Ethanamide

(3) $(CH_3)_2CH-O-CH_3$

$CH_3-\underset{CH_3}{\underset{|}{CH}}-O-CH_3 \longrightarrow$ 2-methoxy propane

(4) $CH_3-\overset{\overset{O}{\parallel}}{C}-CH_2-\overset{\overset{O}{\parallel}}{C}-OH \rightarrow$ 3-Keto butanoic acid

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⑤ $H_3C-O-\underset{CH_3}{\underset{|}{CH}}-CH_3$ ⟶ 2-methoxy propane

⑥ $H_3C-\underset{CH_3}{\underset{|}{C}}=CH-\overset{O}{\overset{||}{C}}-CH_3$ ⟶ 4-methyl pent-3-en-2-one

⑦ $(CH_3)_2C=CH-CHO$

$CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CHO$ ⟶ 3-methyl 2-butenal

⑧ $CH_2=CH-CH=CH_2$ ⟶ But-1,3,-diene

⑨ $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-\underset{CH_3}{\underset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_3$ ⟶ 2,2,4-trimethyl pentane

⑩ $H-\overset{O}{\overset{||}{C}}-OCH_3$ ⟶ methylmethanoate

⑪ $CH_3-CH_2-\underset{CH_3}{\underset{|}{C}}=\underset{OH}{\underset{|}{C}}-CH_2-OH$ ⟶ 3-methyl pentene-1,2-diol

⑫ $CH_3-\underset{CH_3}{\underset{|}{\underset{CH_3}{\underset{|}{C}}}}-CO-CH_2CH_3$ ⟶ 2,2-dimethyl pentan-3-one

⑬ $\overset{OH}{\overset{|}{CH_2}}-\overset{OH}{\overset{|}{CH}}-\overset{OH}{\overset{|}{CH_2}}$ ⟶ 1,2,3-propanol

⑭ $CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}=\underset{CH_3}{\underset{|}{C}}-CH_3$ ⟶ 3-Bromo-2,4-dimethyl pent-2-ene

$CH_3CH_2-O-CH_2-CH_3$ ⟶ ethoxy ethane

$CH_3-CH_2-CH_2-O-CH_3$ ⟶ methoxy propane.

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Isomerism :-

↳ The organic compounds having same molecular formula but different structure, physical and chemical properties are called isomers and this phenomenon is called isomerism.

★ Structural isomerism :-

↳ The organic compounds having same molecular formula but different structural formula are called structural isomers.

Types of structural isomerism :-

1) Chain isomerism
2) Posidion isomerism
3) Functional isomerism
4) Metamerism

[1] **Chain isomerism** :- The organic compounds having same molecular formula but different arrangement of carbon atoms within the molecule are known as chain isomers and phenomenon is known as chain isomerism. For e.g.

① $CH_3-CH_2-CH_2-CH_3$ ⟶ Butane

② $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}-CH_3$ ⟶ 2-methyl propane

① $CH_3-CH_2-CH_2-CH_2-CH_3$

② $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}-CH_2CH_3$ ⟶ 2-methyl butane

③ $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}-CH_3$ ⟶ 2,2-dimethyl propane.

[2] Position isomerism :- The organic compounds having same molecular formula but different position of functional group are called position isomers and this phenomenon is called position isomerism.
For. e.g. ① C_3H_8O

(I) $CH_3-CH_2-CH_2-OH$ → 1-propanol

(II) $CH_3-\overset{OH}{\underset{|}{C}}H-CH_3$ → 2-propanol

② C_3H_7Cl

(I) $CH_3-CH_2-CH_2-Cl$ → 1-chloro propane

(II) $CH_3-\overset{Cl}{\underset{|}{C}}H-CH_3$ → 2-Chloro propane

[3] Functional isomerism :- The organic compounds having same molecular formula but different functional group are called functional isomers and this phenomenon is called functional isomerism.
For. e.g.

① C_2H_6O

(I) CH_3-CH_2-OH → ethanol

(II) CH_3-O-CH_3 → methoxy methane

② C_3H_8O

(I) $CH_3-CH_2-CH_2-OH$ → 1-propanol

(II) $CH_3-CH_2-O-CH_3$ → methoxy ethane

③ Aldehyde & ketone

(I) CH_3CH_2CHO → propanol $[C_3H_6O]$

(II) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ → propanone

④ Carboxylic acid & ester (I) CH_3COOH → ethanoic acid

(II) $HCOOCH_3$ → methyl methanoate

[4] **Metamerism** :- The organic compounds having same molecular formula but different alkyl group attached to functional group are called metamers and this phenomenon is called metamerism. For e.g.

① $C_5H_{10}O$

(I) $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3$ → 2-pentanone

(II) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$ → 3-pentanone

② $C_5H_{10}O$

(I) $CH_3-CH_2-O-CH_2-CH_3$ → ethoxy ethane

(II) $CH_3-O-CH_2-CH_2-CH_3$ → methoxy propane

③ $C_4H_{10}O$

(I) $CH_3-CH_2-O-CH_3$ → Methoxy ethane

(II) $CH_3-O-CH_2-CH_3$ →