INDEX

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Std.: 11 Div: 'F' Roll No.: 3

School/collage:

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Unit-1

Basic concept of Organic compounds.

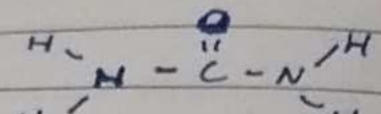
Inorganic compound	Organic compound
Obtained from non-living source.	Obtained from living source.
Sodium Chloride, Calcium carbonate, etc.	Carbohydrate, protein, etc.

* Vital force theory
- Supported by Berzelius

=> It states that "The organic compounds are produced in animals and plants (living organisms) through the operation of vital force" (Natural, Mysterious).
Such compound cannot be prepared in the laboratory

In 1828, Wahler heated ammonium cynate to obtain urea (well known organic compound found in the urine of animals)

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- $NH_4CNO \xrightarrow[\Delta]{\text{Rearrangement}}$ 

Ammonium cyanate — Urea

- $(NH_4)_2SO_4 + 2KCNO \longrightarrow 2NH_4CNO + K_2SO_4$

Potassium Cyanate

- After this many organic compounds are prepared in lab and vital force theory was discredited completely.

* List of elements and no of ~~the~~ bonds ~~formula~~ formed (in organic compounds)

Elements	No of bonds
Carbon	4
Hydrogen	1
Oxygen	2
Nitrogen	3
X	1

∴ (x = Br, I, a or f)

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Modern defination of organic compounds and organic chemistry:

⇒ The hydrocarbons and the derivatives are called as organic compounds.

⇒ The branch of chemistry which deals with the study of hydrocarbons and their derivaties are called organic chemistry.

- Hydrocarbons → compounds formed by combination of C & H only

Eg → CH_4, CH_3-CH_3, $CH_2=CH_2$, $CH_3-CH_2-CH_3$ etc.

- Derivaties of hydrocarbons :- Replacement of one or more hydrogen atoms by same no of functional groups.

Eg → CH_3-Cl, CH_3-CH_2-OH, $CH_3-CH_2-CH_2-NH_2$

- Functional group :- Atom or group of atoms present in organic compound which determines main properties (chemical properties) of that compound is called Functional group.

Eg → $-Cl$, $-OH$, $-NH_2$ etc

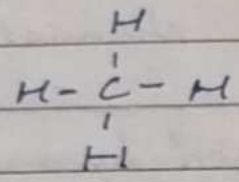
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Representation of organic compounds.

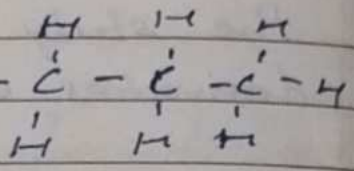
(1) Molecular formula : x

(2) Structural formula : arrangement of atoms within the molecules.

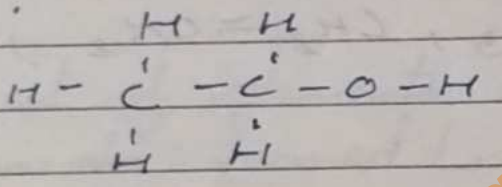
(a)



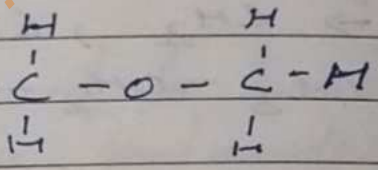
(b)



(c)



(d)

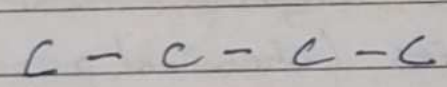


(3) Condensed formula :- short form of structural formula

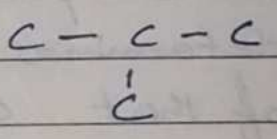
(a) CH_4 (b) $CH_3 - CH_2 - CH_3$ (c) $CH_3 - CH_2 - OH$

(4) Skeleton formula

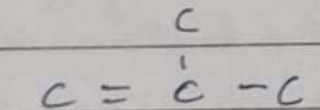
a)



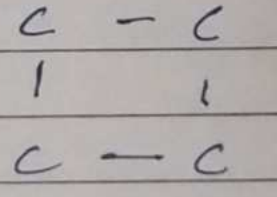
b)



c)



d)

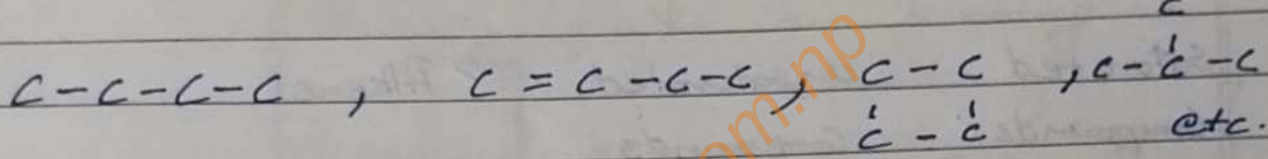


(5) Line formula

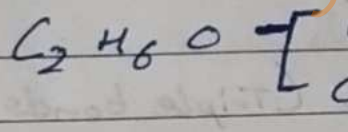
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Reasons for very large no of organic compounds:

① **Catenation** :- The carbon atoms have wonderful capacity to unite with one another to form straight chain compounds, branched chain compounds, naturated compounds as well as unsaturated compounds, ring compounds. The self linking tendency (property) of carbon atoms is called catenation.



② **Isomerism** :- The compounds having same molecular formula but different chemical and physical properties are called isomers and this phenomenon is called Isomerism.



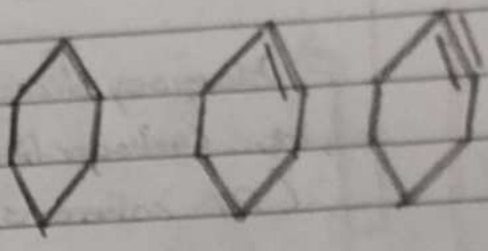
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Classification of hydrocarbons

- Openchain compounds or acyclic compounds or aliphatic compounds (Ends are free)
  - Saturated Compounds
    - Alkanes
    - C-C (single bonds)
    - G.F → C_nH_{2n+2}
  - Unsaturated Compounds
    - Alkenes
    - C=C (Double bonds)
    - G.F → C_nH_{2n}
    - Alkyne
    - C≡C (Triple bonds)
    - G.F → C_nH_{2n-2}
- Closed chain compounds or cyclic compounds (Ends are joined together)

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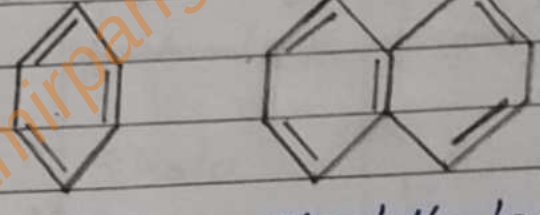
→ Alicyclic compound
(similar as aliphatic compounds)



→ Aromatic compound

→ Sooty flame on burning

→ Having benzene ring (ring of six C atoms having alternate single & double bonds.)

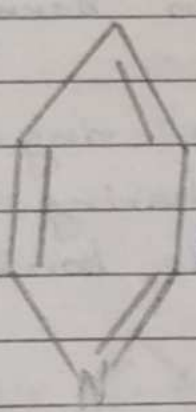


Benzene Mephthalene

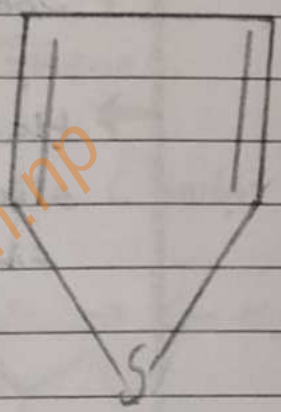
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- Classification of cyclic compounds

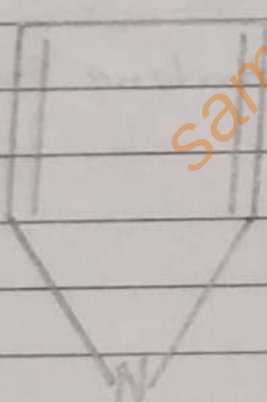
  - Homocyclic compounds
    or, Carbocyclic compounds
    (All corners → C atoms)
    Eg:- Alicyclic hydrocarbons & aromatic hydrocarbons.
  - Heterocyclic compounds (at least one corner)
    (other atom like :- N or S or O)



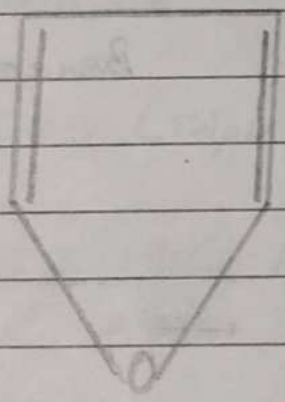
Pyridine



Thiophene



Pyrrole



Furan

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Alkyl group (-R)

Alkane $\xrightarrow{-H}$ Alkyl group → The group obtained by removal of one H atom from alkane is called -R (Alkyl group).

G.F of $-R \rightarrow C_nH_{2n+1}$ $(n = 1, 2, 3, \ldots)$

$CH_4 \xrightarrow{-H} -CH_3$
Methane — Methyl

$CH_3-CH_3 \xrightarrow{-H} -CH_2-CH_3$
Ethane — Ethyl

S.N	Functional Group	Name of functional grp	General structure of compound	Family or class
1/	-X	halo	R-X	Alkyl halides
	-F	Fluoro		
	-Cl	Chloro		
	-Br	Bromo		
	-I	Iodo		
2/	-OH	Hydroxy or Hydroxyl	R-OH	Alcohols
3/	$-NH_3$	Amine or Amino	$R-NH_3$	Alkylamines

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A–A
– Covalent bond
: → Coordinate Covalent bond

B.P ·Ö· L.P
↖ ‖ ↗
·N:4O:
Power accepter

SN	Functional Group	Name of Functional Grp	General structure of Compound	Family or class
4//	$-\overset{O}{\overset{\|\|}{C}}-H$	Aldehyde	$(R \text{ or } H)-\overset{O}{\overset{\|\|}{C}}-H$	Aldehydes
5//	$-\overset{O}{\overset{\|\|}{C}}-$	ketone	$R_1-\overset{O}{\overset{\|\|}{C}}-R_2$	ketones
6//	$-\overset{O}{\overset{\|\|}{C}}-OH$	Carboxyl	$(R \text{ or } H)-\overset{O}{\overset{\|\|}{C}}-OH$	Carboxylic acid
7//	$-\overset{O}{\overset{\|\|}{C}}-NH_2$	Aonide	$(R \text{ or } H)-\overset{O}{\overset{\|\|}{C}}-NH_2$	Amides
8//	$-\overset{O}{\overset{\|\|}{C}}-OR$	Ester	$(H \text{ or } R_1)-\overset{O}{\overset{\|\|}{C}}-OR$ $-R_1 = -R$ or $-R_1 \neq R$	Ester
9//				
10//	$-\overset{O}{\overset{\|\|}{C}}-O-\overset{O}{\overset{\|\|}{C}}-$	Acid anhydride	$(R_1 \text{ or } H)-\overset{O}{\overset{\|\|}{C}}-O-\overset{O}{\overset{\|\|}{C}}-(R_1 \text{ or } H)$	Acid anhydrides
11//	$-C \equiv N$	Cyanide or Cyano or nitrite	$R-C \equiv N$	Alky ~~Cyanit~~ Cyanide

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S.N	Functional Group			
12//	$-N\overset{+}{=}C$	isocyanide	$R-N\overset{+}{=}C$	Alkyl isocyanide
13//	$-\overset{\ddots}{N}\rightarrow C$	Nitro	$R-\overset{\ddots}{N}\rightarrow C$	Nitro compound
14//	$-O-N=O$	Nitrite	$R-O-N=O$	Alkyle Nitrite
15//	$-N=N-$	Azo	$R_1-N=N-R_2$	Azo compound
16//	$-N=O$	Nitroso	$R-N=O$	Nitroso compound
17//	$-O-$	Ether or Oxy	R_1-O-R_2	Ethers
18//	$-S-$	Thioether	R_1-S-R_2	Thioethers
19//	$-SH$	Thialcohol	$R-SH$	Thio alcohol
20//	$-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-S-N$	Sulphonic acid	$R-SO_3H$	Sulphoric acid.
21//	$\dot{C}=C\dot{}$	Carbon Carbon double bond	$(R_3 \text{ or } H)(R_4 \text{ or } H)C=C(R_1 \text{ or } H)(R_2 \text{ or } H)$	Alkenes

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22.	$-C\equiv C-$		$(R_2 \text{ or } H)-C\equiv C-(R_1 \text{ or } H)$	Alkynes
23.	$-R\bullet$	Alkyl	$R-(H \text{ or } R_1)$	Alkanes
24.	$-C\equiv N\rightarrow O$	Cyanate	$R-C\equiv N\rightarrow O$	Alkyl Cyanate
25.	$-N\equiv C=O$	iso cyanate	$R-N=C=O$	alkyl.

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Difference between organic and inorganic compounds

Name	Organic compounds	Inorganic compounds
Elements	Limited no of elements N, S, O, X, L, H etc	All elements
Number	→ 5 millions	around 1 lakh
Bond	Covalent	ionic (generally)
isomerism	Applicable	not applicable
MP & BP	Low	High
Rate of Reaction	slow	fast
Combustibility	Combustile	Non-combustile
Solubility	Insoluble in water and solube in organic solvents.	Soluble in water (generally)
Color	Colourless	Coloured (generally)
Functional grp	Present	Absent

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Tetravalency of Tetracovalency of C.

C (ground state) $1s^2\ 2s^2\ 2p^2$

1S	2S	$2P_x$	$2P_y$	$2P_z$
↿⇂	↿⇂	↑	↑	

The C does not take part in bond formation in ground state

C (excited state) 1S 1S $2P_x$ $2P_y$ $2P_z$

↿⇂ ↑ ↑ ↑ ↑

No of unpaired electron = No of bonds formed.

Homologous series

When the organic compounds of same class are arranged in the increasing order of their molecular weight then a series of compounds are obtained in which two successive members are differed by $-CH_2-$ unit in their molecular formulas. This series is called homologous series. This phenomenon is called homology. The members of this series are called homologues.

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Examples

Homologous series of Alkanes	Homologous series of Alcohol
CH_4	CH_3-OH
CH_3-CH_3	CH_3-CH_2-OH
$CH_3-CH_2-CH_3$	$CH_3-CH_2-CH_2-OH$
$CH_3-CH_2-CH_2-CH_3$	$CH_3-CH_2-CH_2-CH_2-OH$
$CH_3-CH_2-CH_2-CH_2-CH_3$	$CH_3-CH_2-CH_2-CH_2-CH_2-OH$

Characteristics of series

(i) All members have same general formula.

(ii) All members have same functional group.

(iii) All members belong to same class.

(iv) All members have similar chemical properties

(v) The successive members are differed by $-CH_2-$ unit in their molecular formula and 14 units in their molecular weight.

(vi) There is regular gradation in their physical properties.

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Sources of organic compounds

1. Animals and plants
   - carbohydrates, fats, proteins, silk, cotton etc
2. Fossil fuels (Decay)
   - → Coal
   - → Natural gas → low boiling hydrocarbons (having lesser no of catons)
     - ↳ $CH_4 - CH_3 - CH_3 - CH_3 - CH_2 - CH_3$ etc
   - → Petroleum

Coal — Destructive distillation (500–1000°C, absence of air)
- → Coal gass (Mixture of H_2, CO & CH_4)
- → Coke (solid) carbon
- → Coal tar (L) gives more than 200 organic compounds (Mostly aromatic components)

Petroleum → Black, viscous & thick
- (Fractional distillation) → LPG, petrol, kerosene, mobil etc

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Cracking :- The process of decomposition of higher hydrocarbon (alkane) having high b.p to lower hydrocarbons having low b.p by heating is called cracking.

Cracking :
- → Thermal cracking or pyrolysis
  - ↳ occurs at high temᵛ (500–700°C)
- → Catalytic cracking
  - ↳ occurs at low temᵛ (400°C) in the presence of catalyst (Mixture of SiO_2, MnO_2 & P_2O_5)

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$C_{12}H_{26}$ —(500–700°C)→

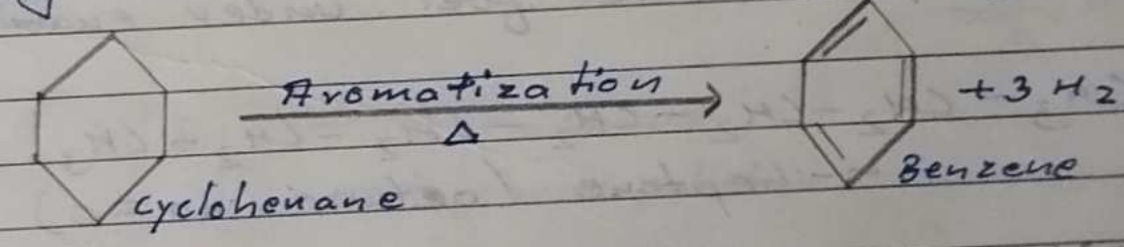
- C_6H_{14} (hexane) + C_6H_{12} (Hexene)
- C_7H_{16} (heptane) + C_5H_{10} (pentene)
- C_8H_{18} (octane) + C_4H_8 (Butene)
- C_9H_{20} (nonane) + C_3H_6 (propene)
- $C_{10}H_{22}$ (decane) + C_2H_4 (Ethene)

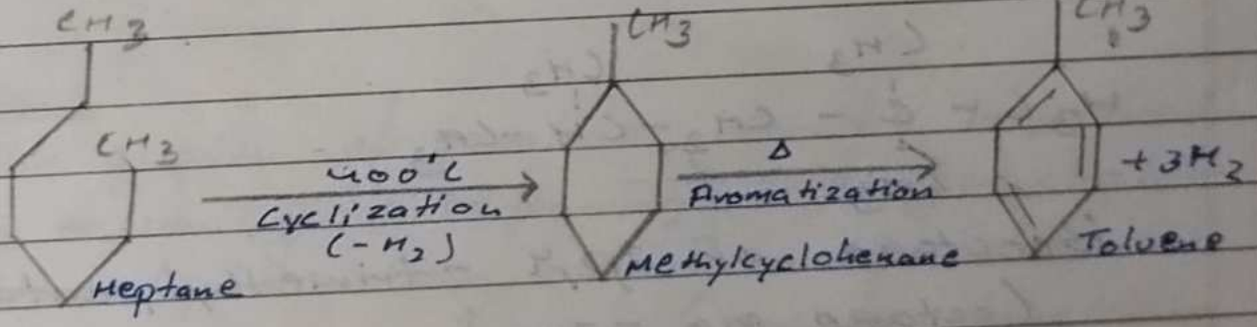
(Any type)

Reforming or Aromatization

⇒ The process of conversion of aliphatic hydrocarbon or cycloalkane (containing 6-8 no of Carbon atoms) to aromatic hydrocarbon at 400°C in the presence of catalyst (mixture of Al_2O_3 & Cr_2O_3) is called reforming when pt is used as catalyst then it is called platforming.

E.g (a) $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$ —(400°C, Cyclization $(-H_2)$)→ (Al_2O_3 & Cr_2O_3)





Fuels

Knocking

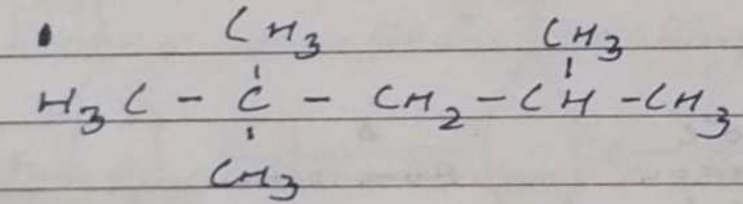
The engine gets power due to burning of fuel in the presence of air. When low grade fuel is used then doesnot burn smoothly (properly). Its a result of this explosive sound is produced which is called knocking.

High knocking → bad fuel
Low knocking → good fuel

Octane number

The octane number of gasoline (petrol) is defined as the percentage of isoctane in the mixture of isoocetane and n-heptane which has same knocking tendency as the fuel under examination.

$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
n-heptane (octane no = 0)



isooctane or 2,2,4 - trimethyl pentane
(octane no = 100)

Octane NO = 80 means it has same knocking tendency as the mixture containing 80% isooctane and 20% n-heptane

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Antiknocking agent or Gasoline Additive

⇒ The substance added to gasolin to reduce its knocking tendency is called antiknocking agent. E.g TEL → $Pb(CH_2-CH_3)_4$ → Tetra thyl lead.

Mechanism

$$Pb(CH_2-CH_3)_4 \longrightarrow Pb + 4\cdot CH_2-CH_3$$
(ethyl free radical)

Ethyl free radical + Straight chain hydrocarbon (High knocking)
→ Branch chain hydrocarbon (low knocking)

Pb → gets deposited in the engine. It is removed by CH_2Br-CH_2Br (1-2 dibromoethane) added to the gasoline.

$$Pb + CH_2Br-CH_2Br \longrightarrow PbBr_2 + CH_2=CH_2$$
(Ethene → low knocking)

$PbBr_2$ → Poisonous
→ Causes pollution

Note:
The quality of gasoline can be improved by reforming in reforming ⇒ straight chain hydrocarbon → Aromatic hydrocarbon (low knocking)

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Cetane no of fuel = 60 → It has same ignition tendency as the mixture containing 60 % of cetane of 40 % α - methylnephalene.

Cetane number.

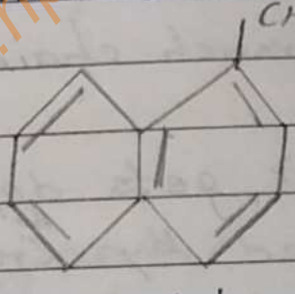
The cetane number of fuel (dissel) is defined as the % of centane in the minture of cetane and α-methyl neph-thalene which has same ignition tendency as the fuel under examination.

$CH_3-(CH_2)_{14}-CH_3$

Cetane no = 100

(cetane or Henadecane

High ignition.)



1 - methylnephthalene

α - methylnephthalene

Cetane no = 0

low ignition.

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Defection of foreign elements in the organic components.

Foreign elements → Hetero elements.
→ Covalenting bonded elements other than C, H & O in organic compounds
→ H, S. & X (Cl, Br, or I)

Lassaigne's Test

The small amount of Na is taken in a fusion tube. It is melted. The small amount of organic compound is added to it. It is heated slowly in beginning after that it is strongly heated till the between of fusion tube becomes red hot. It is transferred in a porcelain basin containing water (20ml). It is ground. It is filtered. The filtrate is called sodium extract.

Nature of sodium extact

→ Alkaline
→ $Na + H_2O \longrightarrow NaOH + H_2\uparrow$
(Unconsumed)

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Wash with dil HCl

$2HCl + Fe(OH)_2 \rightarrow FeCl_2 + 2H_2O$

Date / /

Page No.

Cause of preparation of sodium extract.

→ Conversion of covalent compound to ionic compound.

→ Ionic compound ⟶ Soluble in H_2O.

→ Fast reaction.

$Na + C + N \longrightarrow NaCN$ (Sodium cyanide)

$2Na + S \longrightarrow Na_2S$ (Sodium sulphide)

$Na + C + N + S \longrightarrow NaCNS$ (Sodium thiocyanate)

$Na + Cl \longrightarrow NaCl$ (Sodium chloride)

- Test of N → 2ml of sodium extract in test tube
  + few drops of NaOH
  + $FeSO_4$ sol^n freshly prepared
  ↓
  Boiled & cooled
  + dil HCl
  + $FeCl_3$ sol^n

Result → Prussian blue or blue or green → Presence of N

→ Blood red colour → Presence of N & S both.

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- **Test reaction for both N & S.**

$Na + C + N + S \longrightarrow NaCNS$

$3NaCNS + FeCl_3 \longrightarrow Fe(CNS)_3 + 3NaCl$

Blood red.

- **Test reaction for N.**

$Na + C + N \longrightarrow NaCN$

$2NaOH + FeSO_4 \rightarrow Fe(OH)_2 \downarrow + Na_2SO_4$

Dirty green

$Fe(OH)_2 + 2NaCN \rightarrow Fe(CN)_2 + 2NaOH$

$Fe(CN)_2 + 4NaCN \longrightarrow Na_4[Fe(CN)_6]$

$4FeCl_3 + 3Na_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 + 12NaCl.$

- **Test of I**

(a) Sodium extract (2ml) $\xrightarrow{\text{acidified by acetic acid}}$ + lead acetate solution (few drops)

$\longrightarrow$ Black ppt $\longrightarrow$ presence of S

$2Na + S \rightarrow Na_2S$

$Na_2S + Pb(CH_3COO)_2 \rightarrow PbS\downarrow + 2CH_3COONa$

lead acetate — Black

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b. Sodium extact (2ml) + Sodiumprussiide
violet color presence of S

$2Na + S \longrightarrow Na_2S$

$Na_2S + Na_2[Fe(CH)_5NO]$

Sodium Nitroprusside

$Na_4[Fe(CH)_5NOS]$

Sodium sulphonitroprussiide (violet)

Test of Cl

Sodium extract (2ml) + HNO_3 (dil) $\xrightarrow{\text{Boil/cold}}$

$\longrightarrow AgNO_3$ (few drops) $\longrightarrow$ white ppt $\longrightarrow$ soluble in NH_4OH

$\longrightarrow$ reappearance of white ppt on addition of dil. HNO_3 $\longrightarrow$ Presence of Cl.

$Na + Cl \longrightarrow NaCl$

$NaCl + AgNO_3 \longrightarrow AgCl\downarrow + NaNO_3$

white

$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$

Diamine silver (I) chloride (soluble)

$[Ag(NH_3)_2]_4 + 2HNO_3 \longrightarrow AgCl\downarrow + 2NH_4NO_3$

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Causes of addition of dil HNO_3

$NaCN + AgNO_3 \longrightarrow AgCN\downarrow + NaNO_3$

$Na_2S + 2AgNO_3 \longrightarrow Ag_2S\downarrow + 2NaNO_3$

$NaCN + HNO_3 \longrightarrow NaNO_3 + HCN\uparrow$

$Na_2S + 2HNO_3 \longrightarrow 2NaNO_3 + H_2S\uparrow$

Test of Br

AgBr
- Pale yellow ppt
- Sparingly soluble in NH_4OH

Test of I

AgI
- Deep yellow ppt
- insoluble in NH_4OH

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Int. Union of pure and applied chemistry

IUPAC – Nomenclature

Prefix(es) + word root + primary suffix + secondary suffix

SN	Priority order or seniority order of functional group	Secondary suffix	prefix
(1)	$-SO_3H$	Sulphonic acid	sulpho
(2)	$-\overset{O}{\overset{\|\|}{C}}-OH$	oic acid	carbony
(3)	$-\overset{O}{\overset{\|\|}{C}}-O-\overset{O}{\overset{\|\|}{C}}-$	oic anhydride	
(4)	$-\overset{O}{\overset{\|\|}{C}}-OR$	Alkyl .... oate	alkoxycarbonyl
(5)	$-\overset{O}{\overset{\|\|}{C}}-X$	oyl halide	Haloformyl
	$-\overset{O}{\overset{\|\|}{C}}-Cl$	oyl chloride	Haloarbonyl Chlorocarbonyl
(6)	$-\overset{O}{\overset{\|\|}{C}}-NH_2$	amide	carbonyl
(7)	$-\overset{O}{\overset{\|\|}{C}}-H$	al	formyl

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(8)	$-C \equiv N$	nitride	Cyano
(9)	$-\overset{\overset{O}{\|\|}}{C}-$	one	Keto or oxy
(10)	$-OH$	ol	hydroxy
(11)	$-NH_2$	amine	amino
(12)	$>C = C<$	—	—
(13)	$-C \equiv C-$	—	—
(14)	$-OR$	—	alkoxy
(15)	$-OCH_3$	—	methoxy
	$-X$	—	Halo
	$-Cl$	—	Chloro
	$-Br$	—	Bromo
(16)	$-NO_2$	—	Nitro
(17)	$-R$	—	Alkyl
	$-CH_3$	—	methyl
			Down methoxy
•	$-OCH_2-CH_3$		ethoxy
			Down Methyl
•	$-CH_2-CH_3$ =	C_2H_5	Ethyl

C_3H_7 = propyl

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Notes:

(1) 14 - 17 → order is not important
→ They are arranged alphabetically

(2) All prefixes are arranged alphabetically with suitable numbers

(3) For two similar groups → di
three similar groups → tri

(4) Considering alphabetical order di or tri (such number) is not important alphabetical order of main words are important.

(5) Terminal functional groups are (a) $-\overset{O}{\overset{\|}{C}}-H$ (e) $-\overset{O}{\overset{\|}{C}}-OR$
(f) $-C\equiv N$
(b) $-\overset{O}{\overset{\|}{C}}-X$ (c) $-\overset{O}{\overset{\|}{C}}-NH_2$ (d) $-\overset{O}{\overset{\|}{C}}-OH$
(no number is associated with secondary suffix for these functional groups)

(6) The 'e' of primary suffix is removed if sec suffix is started with the letter a, e, i, o, u or y.

(7) The senior most functional group
→ Secondary / suffix group

All other functional group → Prefixes

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Principal chain or main chain

i) Contains the greatest no of C atoms.

ii) Must include functional group.

No of C atoms in principal chain	1	2	3	4	5	6	7	8	9	10
Word root	Meth	Eth	Prop	But	Pent	Hex	Hep	Oct		Dec

For two or more than two double bonds in chain or for two or more than two triple bonds in chain

Add a after word root like buta, penta etc.

Primary Suffix

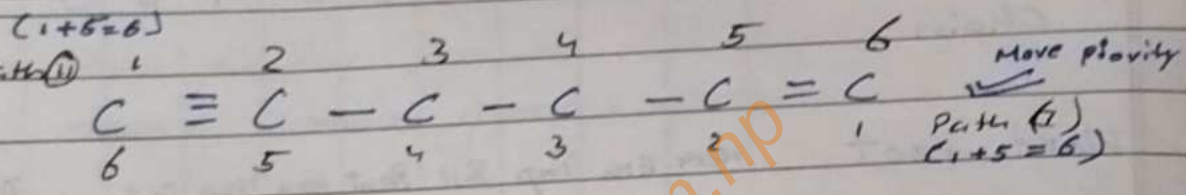
SN	Nature of C-C bond	P.S
1st	$-C-C-C-C$ (single bond)	ane
2nd	$-C=C-$ (double bond)	ene
3rd	$-C\equiv C-$ (Triple bond)	yne

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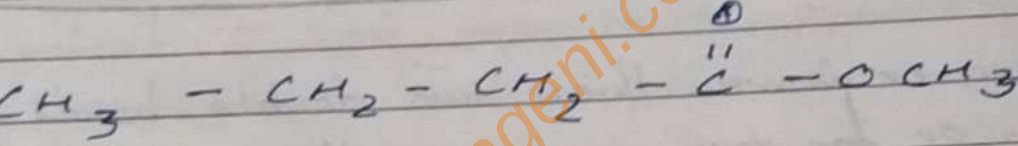
For numbering of C atom in the main chain:

a) Start from an end

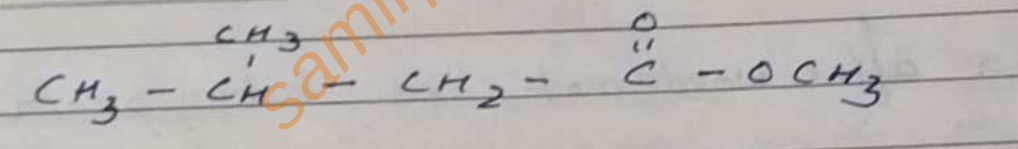
b) Give lower no of the main functional group.

- 

⇒ Hex-1-en-5-yne

- 

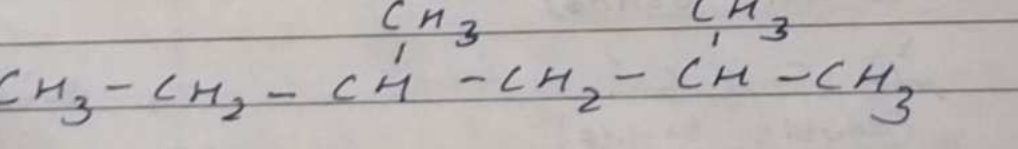
⇒ Methyl butanoate

- 

⇒ Methyl -3-methyl butanoate

- $CH_3 - CH_2 - CH_2 - OH$

⇒ 1- Methoxy propane.

- 

⇒ 2,4 Methyl hexane.

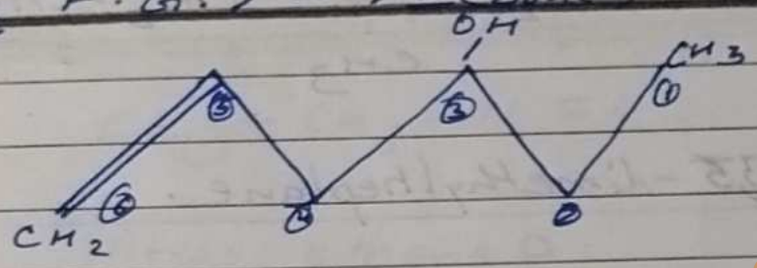
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$$H-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-H$$

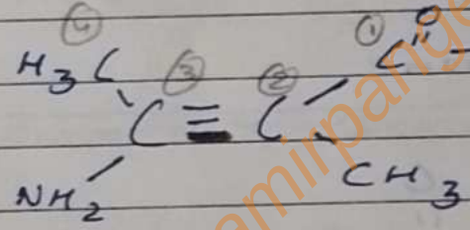
$\Rightarrow$ Pentane – 1,5 dial

Imans Prefix → word root → bond → Functional Grp.

Numbering F.G. > = / = (bond) > Suffix. [Priority]

- 

$\Rightarrow$ Hex – 5-en – 3-ol

- 

$\Rightarrow$ 3-amino – 2 – methyl/but – 2-enoic acid

- $H_3C-CH_2-CH(OCH_3)_2$ $CH_3-CH_2-\underset{OCH_3}{\overset{OCH_3}{CH}}$

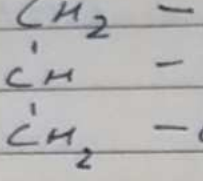
$\Rightarrow$ 1, 1 – dimethoxy propane

- $CH_3-(CH_2)_2-CH(CH_3)_2$

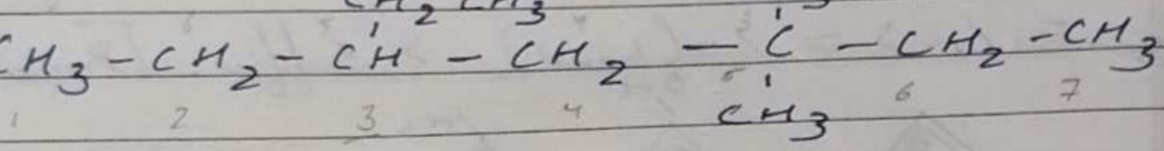
$CH_3-CH_2-CH_2-\underset{CH_3}{CH}-CH_3$

$\Rightarrow$ 2 – methyl/pentane.

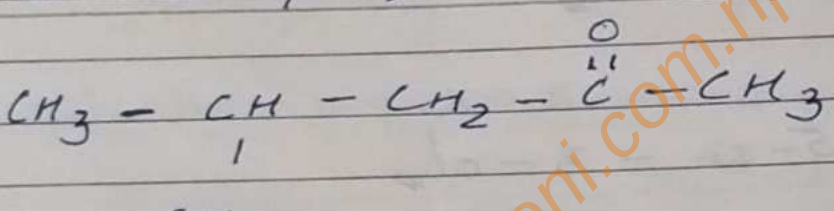
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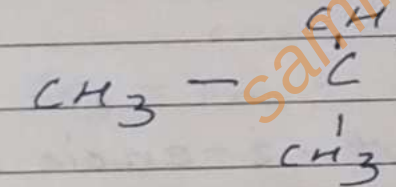
⇒ Propane - 1, 2, 3 triol.

1// 

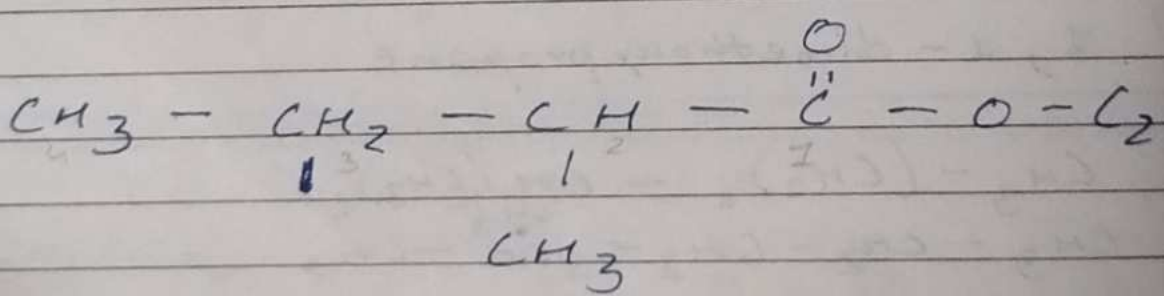
⇒ 5 - Ethyl - 3,5 - dimethyl heptane.

2// 

= 4 - Methyl pentanone

3// 

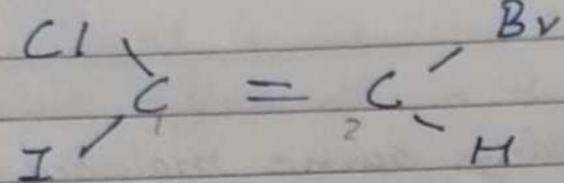
= 2,2 - dimethyl propanoic acid

4// 

⇒ Ethyl 2 - methyl butanoate.

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5//



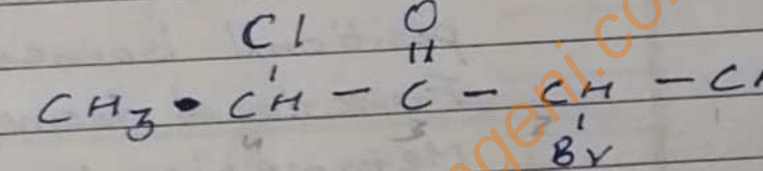
=> 2-Bromo - 1-chloro - 1 iodoethene

---

a. $CH_3 - CH_2 - N = O$

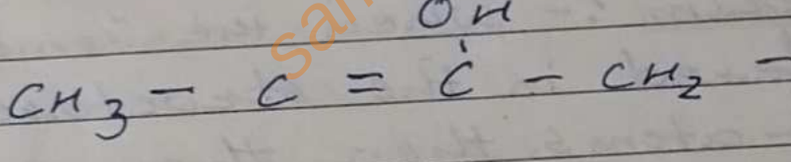
=> Nitroso ethane

b.



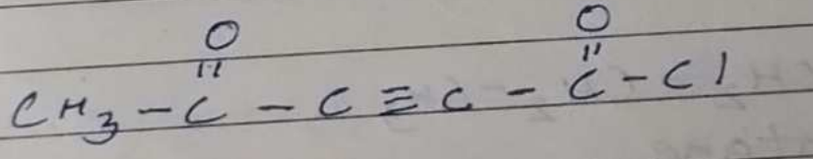
=> 2-Bromo - 4-chloro - 3- ketopentanal.

c.



=> 3 - hydroxy - Pent-3-enal.

d.



4-Ketopent-2-ynoylchloride

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Isomerism

⇒ The compounds having same molecular formula and different chemical and physical properties (due to different structural formulae) are called isomers and this phenomenon is called isomerism (structural isomerism)

Types of structural isomerism

- Chain isomerism
- positional isomerism
- Functional isomerism
- Metamerism isomerism
- Tautomerism isomerism

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- Chain isomerism :- When the isomers are differed in the structure of chain of C-atoms then they are called chain isomers and this phenomen is called chain isomerism.

$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

Pentane

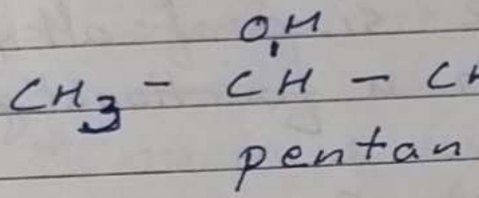
$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$

2-methyl butane

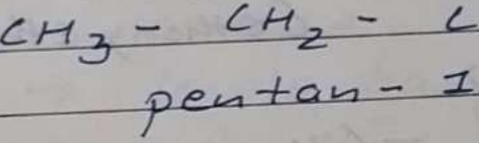
$H_3C - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3$

(2,2 dimethyl propane)

- **Positional isomerism** : When the isomers are differed in the position of functional group then they are called positional isomers and this phenomenon is called positional isomerism.



pentan-2-ol

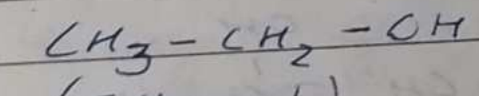


pentan-1-ol.

- **Functional isomerism**: When the isomers have different functional group then they are called functional isomers and this phenomenem is called functional isomerism

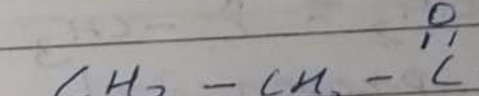
Functional pairs

- Alcohol & Esters



(Ethanol) & (Methoxy methane)

- Aldehyde & ketone



(propanal) & (propane)

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- Carbonylic acid & ester

$CH_3-CH_2-C(=O)-OH$ & $CH_3-C(=O)-OCH_3$
(Propanoic acid) (methyethanoate)

- Metamerism :- In metamerism isomers are differed in the size of alkyl groups joined with a functional group

a. $CH_3-CH_2-CH_2-O-CH_3$ & $CH_3-CH_2-O-CH_2-CH_3$
(1-Methoxypropane) (ethoxy ethane)

b. $CH_3-CH_2-CH_2-CH_2-C(=O)-CH_3$
(pentan-2-one)
& $CH_3-CH_2-C(=O)-CH_2-CH_3$
(pentan-3-one)

5 Tautomerism: In tautomerism one hydrogen atom is migrated from one pasition to other in the molecule, the isomer are called tautomers. The tautomers are in the dyamic equilibrium with each other

a. $CH_3-C(=O)-H \longleftrightarrow CH_2=C(OH)-H$

Ethanal Ethanal

b. $CH_3-C(=O)-CH_3 \longleftrightarrow CH_2=C(OH)-CH_3$
(pronanone) propen-2-ol

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Electrophiles and Nucleophiles

Nucleophile :- The substance which donates e^- pair is called nucleophile.

→ Symbol → $Nu:^{\ominus}$
→ -vely charged generally
→ nucleus loving
→ attracted towards e^- deficient centre
→ lewis base
→ eg: Cl^-, OH^-, $^-CH_3$ (Methylcarbanion), NH_3, H_2O, etc (chloride ion)

Electrophile :- The substance which accepts e^- pair is called electrophile.

→ Symbol → $E^{\oplus}$
→ +vely charged generally
→ e^- loving
→ attracted towards e^- rich centre.
→ lewis acid
→ eg: $Cl^{\oplus}$ (chloronium ion), $NO_2^{\oplus}$ (nitronium ion), $CH_3^{\oplus}$ (Methyl

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Carbocation or Carbonicmion
→ ion having +vely charged carbon

Carbonion → ion having -vely charged carbon.

Bond fission

Homolylic fission or Homolysis :

A covalent bond is broken symmetrically such that bonded electrons are equally distributed in the atoms.

Presence of heat or light
formation of free radicals.

A - A $\xrightarrow{\Delta \text{ or light}}$ A· + A·

Heterolytic fision or Heterolysis :

A covalent bond is broken unsymetri-cally such that one atom (more electronegative atom) gets both of the bonded electrons.

→ Presence of polar solvent
→ Formation of ions.

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$A-B \xrightarrow{\text{Polar solvent}} A:^{\ominus} + B^{\oplus}$ [EN(A) > EN(B)]

$A-B \xrightarrow{\text{Polar solvent}} A^{\oplus} + B:^{\ominus}$ [EN(B) > EN(A)]

Inductive effect: Inductive effect is defined as the permanent effect in which polarity is produced on the carbon atom and the substituent attached with due to minor displacement of bonding e⁻ pair towards one of the atoms (more electropesitive atom) caused by their different electro-negativities.

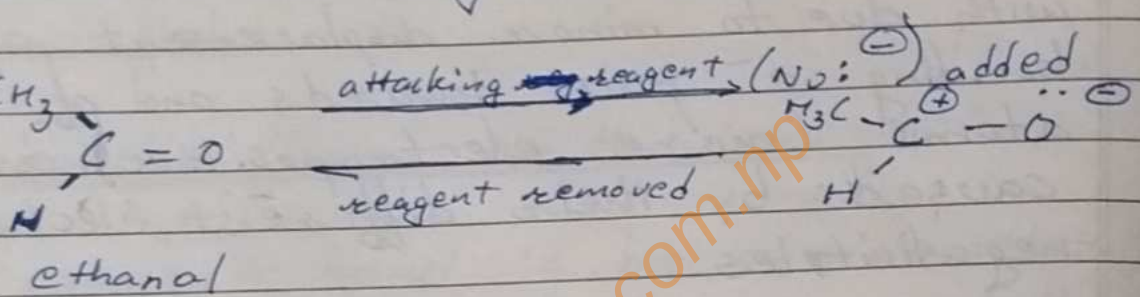
Types of inductive effects.

-I effect	+I effect
The e⁻ pair is displaced towards group from C atom.	The e⁻ pair is displaced towards carbon atom from group.
$-NO_2, -OH, -Cl, -NH_2$ etc.	$-CH_3, -CH_2, -CH_3$, $-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-H$ etc.
$\overset{\delta\delta\delta+}{C}-\overset{\delta\delta+}{C}-\overset{\delta+}{C}-\overset{\delta-}{C}\rightarrow C\rightarrow C\rightarrow C\rightarrow X$	$\overset{\delta\delta\delta-}{C}-\overset{\delta\delta-}{C}-\overset{\delta-}{C}-\overset{\delta+}{C}-C-X$
EN(X) > EN(C)	EN(X) < EN(C)

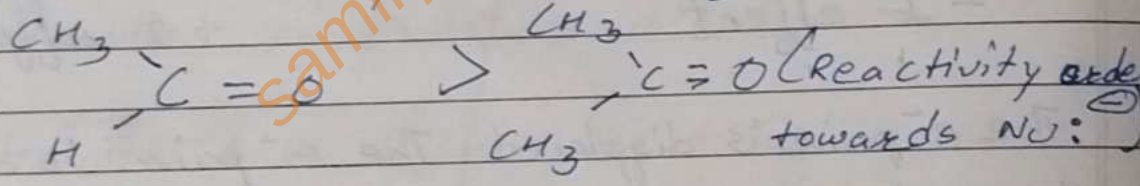
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(B)

Electromeric effect: It is a temporary effect in which there is complete transfer of π electrons towards more electronegative atom in the presence of attacking reagent. When the reagent is removed then molecule comes in the original state.

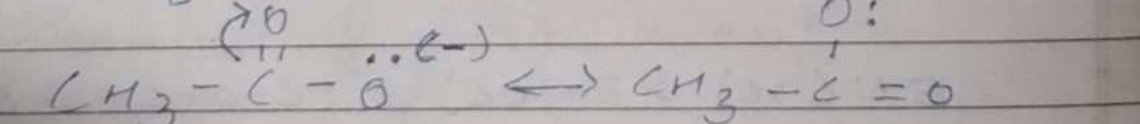


Steric hindrance :- It is a kind of effect in which the reactivity of molecules decreases due to the presence of bulky groups.



(Resonance effect)

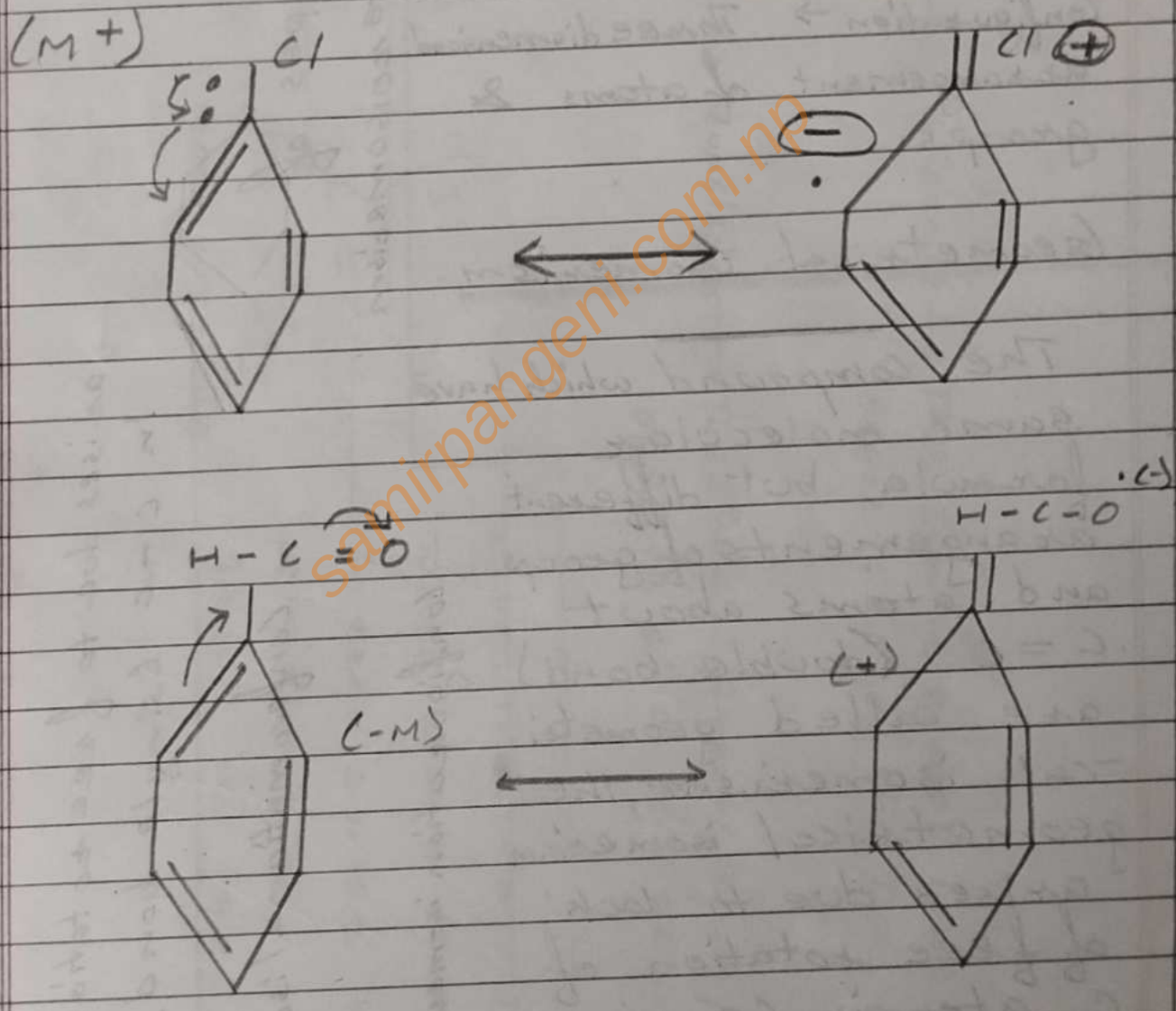
Mesomeric effect :- It refers the polarity produced in the conjugated molecule due to the redistribution of electrons between two π bonds or between a π bond and lone pair of electrons.



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Types of mesomeric effect

- -M or -R — Transfer of e⁻ towards group from C.
- +M or +R — Transfer of e⁻ towards C from group.



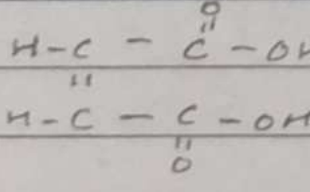
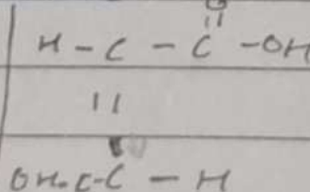
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Stereoisomerism : The compounds having same molecular formula, same structural formula but different spatial arrangements of atoms and groups are called stereoisomers and this phenomenon is called stereoisomerism.

Configuration → Three dimensional arrangement of atoms & groups.

Types of stereoisomerism

- Conformational isomerism
  - arises due to free rotation of C-atom in C-C (single bond)
- Configuration isomerism
  - Geometrical isomerism
    - The compound which have same molecular formula but different arrangements of groups and atoms about C=C (double bond) are called geometrical isomerism. The geometrical isomerism arises due to lack of free rotation of C atom in C=C (double bond).

	
Maleic acid	Fumaric acid

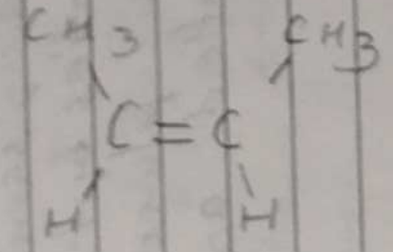
  - Optical

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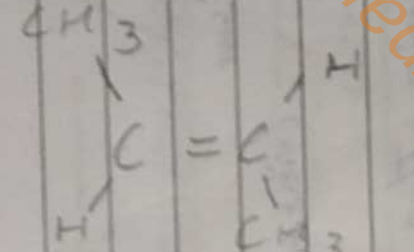
Types of geometrical isomers

→ cis isomer → The similar groups are present in the same side of the C=C in the isomer.

→ transisomer → The similar groups are present in the opposite sides of C=C in this isomer.



cis-but-2ene



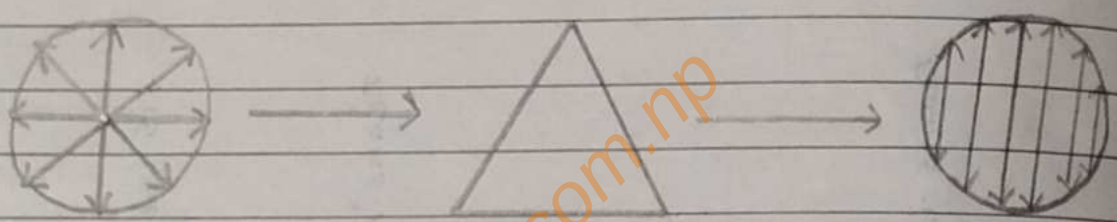
trans-but-2ene

Note: The transisomer is more stable than cisisomer In transisomer there is minimum rep betⁿ group as they are far apart.

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Optical - isomerism :- The compounds having same molecular formula, same structural formula, same chemical and physical properties but different behaviour towards plane polarized light (PPL) are called optical isomers.

PPL



Ordinary light (vibration → All planes) | Nicol prism | PPL (vibration → same plane)

Optically active substance :- The substance which rotates PPL is called optically active substance.

Achiral substance achiral object :- The substance or object which has plane of symmetry is called achiral substance or object. It's mirror image is super impossible. This phenomenon is called achirality.

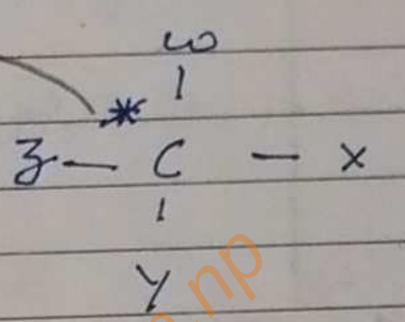
Chiral substance or chiral object :- The substance or object which does not have plane symmatry is called.

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chiral substance or object. It's mirror image is non-super impossible. This phenomenon is called chilarity

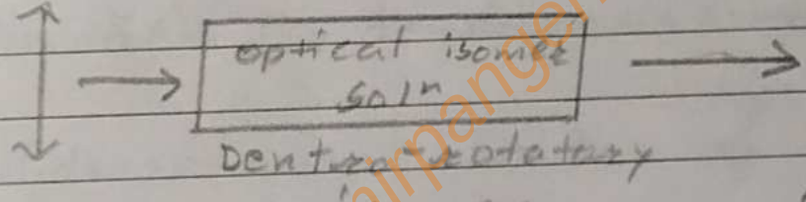
Causes of optical isomerism → Chirality.

Assymetric carbon.



Types of optical isomers.

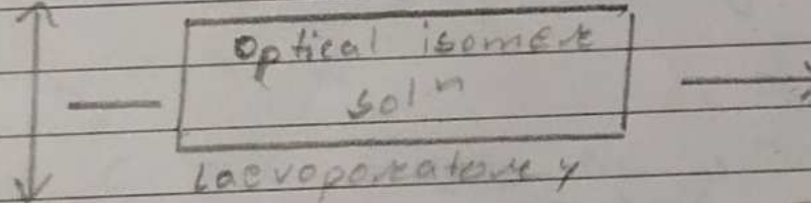
a)



Or, d-
Or, (+)-

Clockwise rotation of ppl

b)



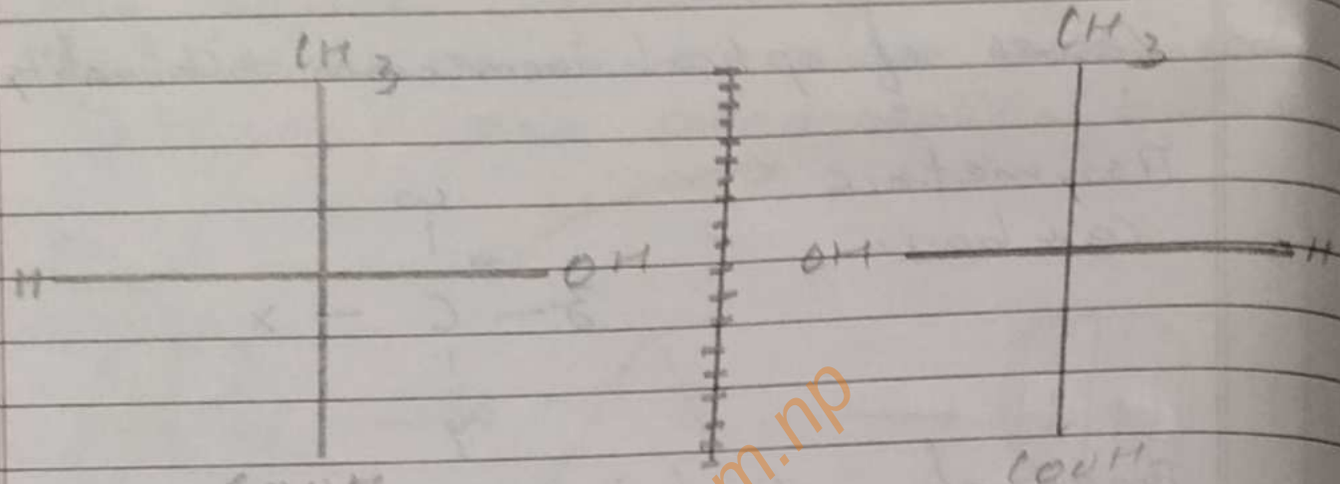
Or, l-
Or, (-)-

Anticlock rotation of ppl

Racemin mixture :- Equimolar mixture of d- & l- isomers is called racemin mixture. It is optically inactive.

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Enantiomers : The optical isomers which are mirror image of each other are called anantiomers.



d - lactic acid
(+)- lactic acid

l - lactic acid
(-)- lactic acid

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Alkanes

Introduction

→ C–C Single bonds
→ R–H –R → Alkyl group
→ R–R
→ C_nH_{2n+2} n = 1, 2, 3, 4 ....
→ Paraffins.

Methods of preparation:

1. Sabatier – Senderen's reaction.

- Hydrogenation: Addition of hydrogen
- Addition reaction: Addition of atoms & groups in the multiple bond to give saturated product.

a) $H_2C=CH_2 + H_2 \xrightarrow[250-300^\circ C]{Ni} H_3C-CH_3$

ethene → ethane

b) $HC\equiv CH + H_2 \xrightarrow[250-300^\circ C]{Ni} H_2C=CH_2$

ethyne → ethene

$H_2C=CH_2 \xrightarrow[\Delta]{Ni/H_2} H_3C-CH_3$

ethene → ethane

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Im?

2// Wurtz reaction :- When alkyl halide is reacted with sodium metal in the presence of dry ether then alkane is formed.

$$R-X + 2Na + X-R \xrightarrow{\text{Dry ether}} R-R + 2NaX$$

alkane

$$CH_3-Cl + 2Na + Cl-CH_3 \xrightarrow{\text{Dry ether}} CH_3-CH_3 + 2NaCl$$

Chloromethane — ethane

$$CH_3-CH_2-I + 2Na + I-CH_2-CH_3 \xrightarrow{\text{Dry ether}} CH_3-CH_2-CH_2-CH_3 + 2NaI$$

Iodoethane — Butane

$$CH_3-Cl + 2Na + Cl-CH_2-CH_3 \xrightarrow{\text{Dry ether}} CH_3-CH_2-CH_3 + 2NaCl + CH_3-CH_3 + CH_3=CH_2-CH_2-CH_3.$$

3// Reduction of alkyl halide

Reducing agent → Zn/HCl or Na/alcohol or Zn-Cu/alcohol or Ni/H_2 or $LiAlH_4$ (Lithium Aluminium hydride)

$$R-X \xrightarrow[[H]]{Zn/HCl} R-H + HX$$

$$CH_3-Cl \xrightarrow[(H)]{Zn/HCl} H-CH_3 + HCl$$

Chloromethane — methane

$$CH_3-CH_2-Br \xrightarrow[[H]]{Zn/HCl} CH_3-CH_3 + HBr$$

Bromoethane — ethane

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4) Reaction bet^n water & aluminium carbide.

$$Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$$

Methane

5) kabe's electrolysis

:- Electrolysis of aq. sol^n of sodium acetate.

$$CH_3-\overset{\overset{O}{\|}}{C}-ONa \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-O^{(-)} + Na^{(+)}$$

Sodium acetate (Sodiomethanoate) — Acetate ion

$$H_2O \rightleftharpoons H^+ + OH^-$$

- At anode,

$$CH_3-\overset{\overset{O}{\|}}{C}-O^{(-)} - e \rightarrow CH_3-\overset{\overset{O}{\|}}{C}-O$$ (acetate free radical - unstable)

$$CH_3-\overset{\overset{O}{\|}}{C}-O \rightarrow CH_3 + CO_2\uparrow$$ (methyl free radical - unstable)

$$H_3C\cdot + \cdot CH_3 \longrightarrow CH_3-CH_3$$ ethane

- At cathode,

a) Dilute sol^n

$$H_2O \rightleftharpoons H^+ + OH^- \quad]\times 2$$

$$2H^+ + 2e \rightarrow H_2$$

$$2H_2O + 2e \rightarrow 2OH^- + H_2\uparrow$$

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b) Conc^{n} Sol^{n}

$$Na^{+} + e \longrightarrow Na$$

$$Na + H_2O \longrightarrow NaOH + H_2\uparrow$$

6) Decarbonylation

:- When sodium acetate is heated with soda lime then methane is formed

$$CH_3-\overset{\overset{O}{\|}}{C}-ONa + NaOH \xrightarrow[\Delta]{CaO} Na_2CO_3 + CH_4$$

7) Clemensen reduction.

a) $$CH_3-\overset{\overset{O}{\|}}{C}-H \xrightarrow[[H]]{Zn/Hg,\ Conc\ HCl} CH_3-CH_3 + H_2O$$

b) $$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[[H]]{Zn-Hg/HCl} CH_3-CH_2-CH_3 + H_2O$$

8) Reduction of carbonylic acid with HI / Red phosphorus.

$$CH_3-\overset{\overset{O}{\|}}{C}-OH + 6HI \xrightarrow{Red\ P} CH_3-CH_3 + 3I_2 + 2H_2O$$

Ethanoic acid → Ethane

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Chemical properties of alkanes:

i. Combustion:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

ii. Sulphonation:

$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3 + H_2SO_4 (conc) \xrightarrow[SO_3]{350^\circ C} CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-SO_3H + H_2O$$

Hexane-1-sulphonic acid

iii. Nitration:

a) $CH_4 + HNO_3 \xrightarrow{400^\circ C} CH_3-NO_2 + H_2O$
(vapour) Nitromethane

b) $CH_3-CH_3 + HNO_3 \xrightarrow{400^\circ C} CH_3-CH_2-NO_2 + H_2O$
(vapour) Nitroethane $+ CH_3-NO_2$

iv. Halogenation:

a) Chlorination

i) $CH_4 + Cl_2 \xrightarrow{\text{Diffused sunlight}} CH_3-Cl + HCl$
(limited) Chloromethane

ii) $CH_4 + Cl_2 \xrightarrow{-HCl} CH_3-Cl \xrightarrow[-HCl]{Cl_2} CH_2Cl_2$

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ii) $CH_4 + Cl_2$ (excess) $\xrightarrow{-HCl} CH_3-Cl \xrightarrow[-HCl]{Cl_2} CH_2Cl_2$

Dichloromethane

$\xrightarrow[-HCl]{Cl_2} CHCl_3 \xrightarrow[-HCl]{Cl_2} CCl_4$

Trichloromethane Tetrachloromethane

(b) Bromination (slow)

$CH_3-CH_3 + Br_2 \xrightarrow{UV,\ 127^\circ C} CH_3-CH_2-Br + HBr$

Bromoethane

(c) Iodination

(i) Reversible (ii) difficult

(iii) Done in the presence of oxidising agent (conc HNO_3)

$CH_3 + I_2 \rightleftharpoons CH_3I + HI$

$2HNO_3 \rightarrow 2NO_2 + H_2O + [O]$

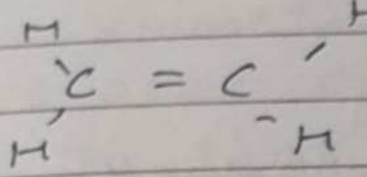
$2HI + [O] \rightarrow H_2O + I_2$

(d) Fluorination → (i) explosive

(ii) not done generally.

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Alkenes.



ethylene
(ethene)

Introduction

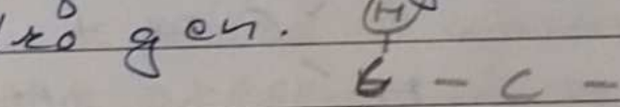
(a) $C=C$
(b) C_nH_{2n}
(c) unsaturated hydrocarbon.

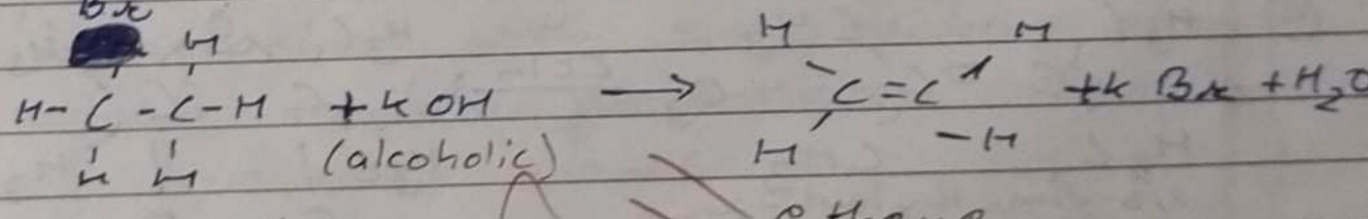
Methods of preparation of alkenes.

(1) Elimination reaction

→ Removal of atoms & groups to form unsaturated product.

→ Removal of functional group & β - hydrogen.





Bromoethane

ethene

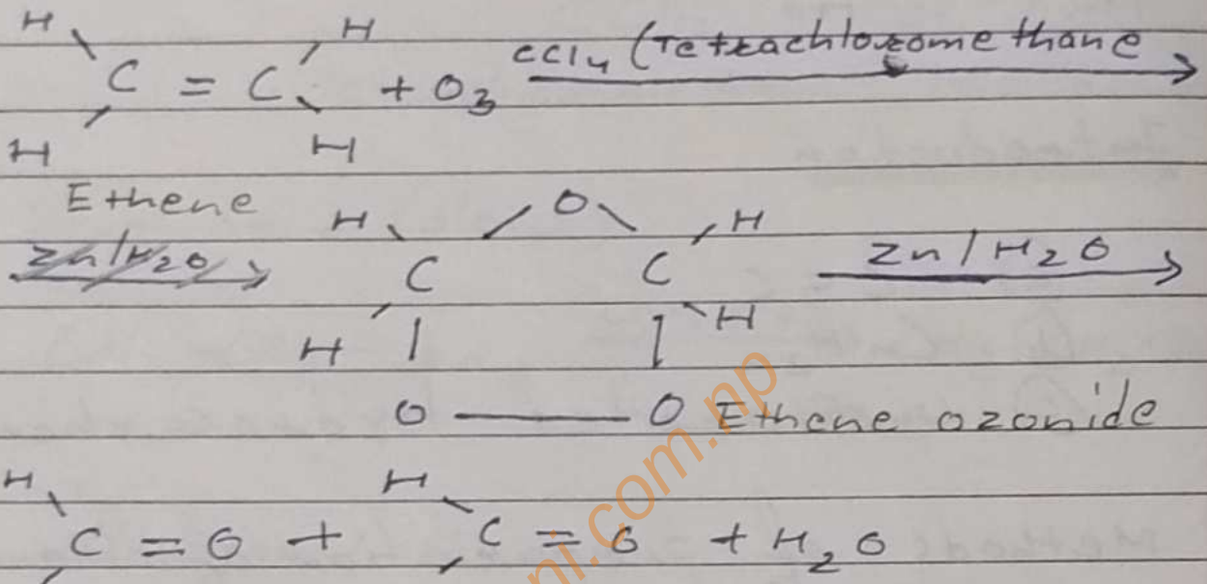
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Final term.

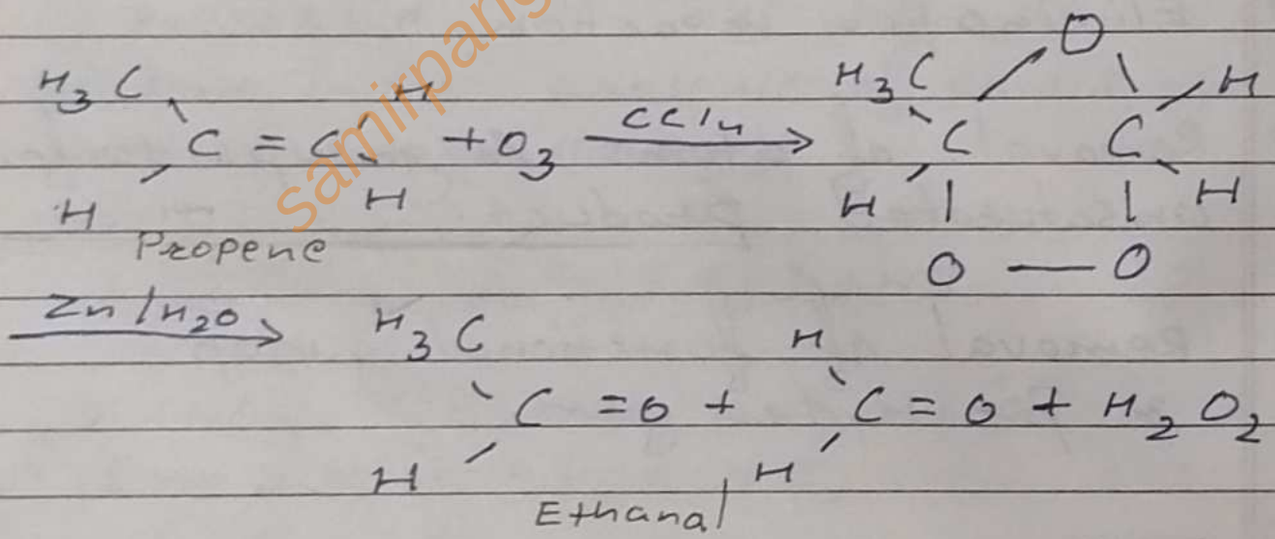
Chemical Properties.

I. Ozonolysis.

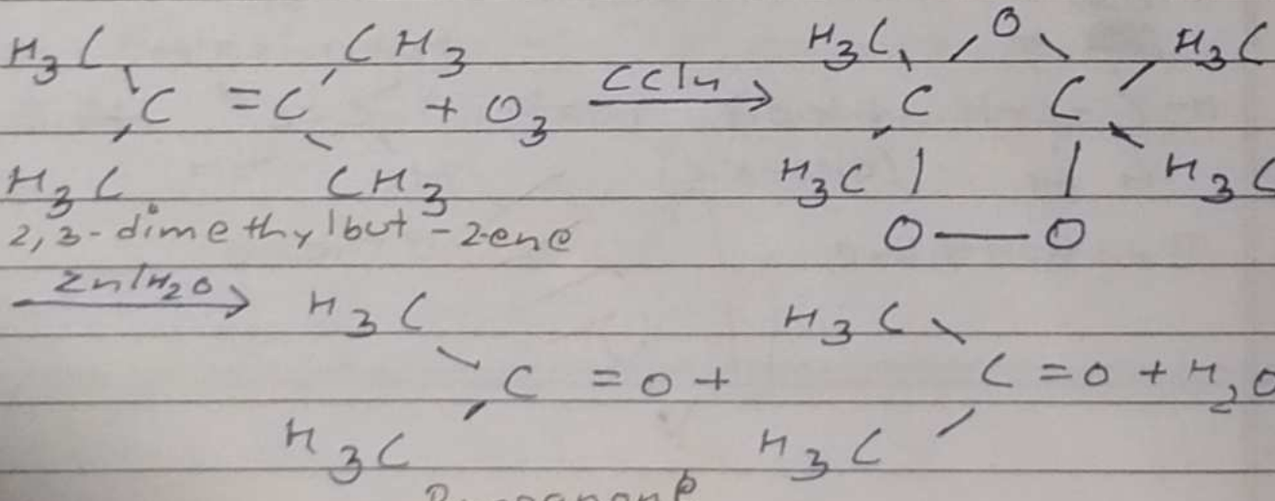
(a)



(b)

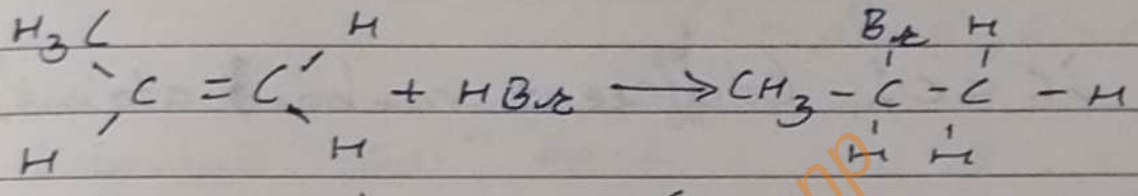


(c)

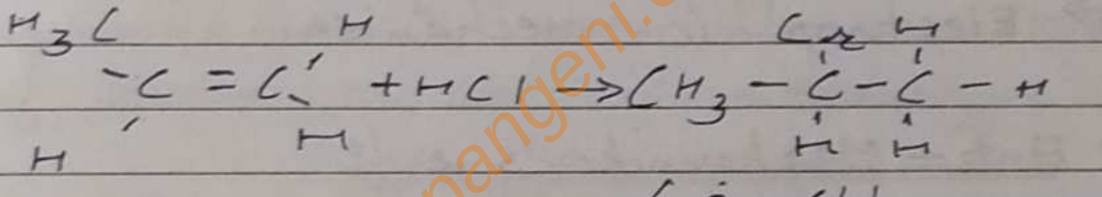


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2. **Markovnikov's rule** :- When unsymmetrical reagent is added to unsymmetrical alkene then the -ve part of reagent is attached with that carbon atom which contains lesser number of hydrogen atoms.



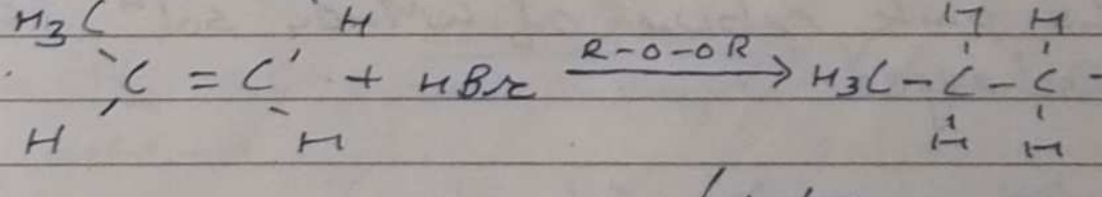
(propene) (2-bromopropane)



(2-Chloropropane)

Anti-Markovnikov's rule or ~~periodic~~ peroxide effect or Khatusch effect.

=> When HBr is added to unsymmetrical alkene in the presence of organic ~~periodic~~ (peroxide) then bromine (-ve point) is attached with that carbon atom which contains greater number of hydrogen atoms.



(1-bromopropane)

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Notes :-

i) Unsymmetrical reagent

→ HCl (H-Cl), HBr (H-Br), HI (H-I), H_2O (H-OH), H_2SO_4 (H-HSO_4)

ii) Unsymmetrical alkene

$\dot{C}=C\dot{}$ (different carbon atoms)

iii) Markovnikov's rule

→ Electrophilic mechanism.

iv) Anti-Markovnikov's rule

→ Free radicle mechanism.

---

(3) Baeyer's unsaturation test

Baeyer's reagent → Cold, dilute and alkaline $KMnO_4$ sol^n.

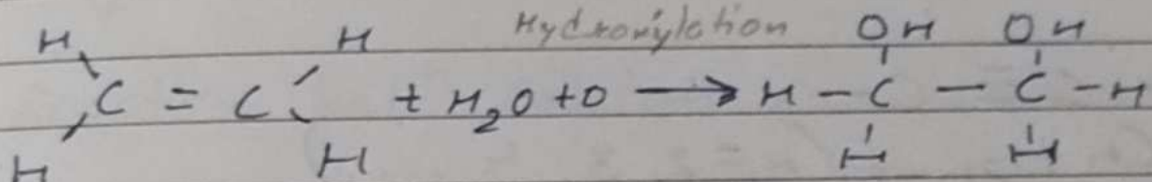
When ethene gas is passed in the cold, dilute and alkaline $KMnO_4$ sol^n then the pink colour of $KMnO_4$ sol^n is discharged

(Pink ⟶ Colourless)

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$2kMnO_4 + 2kOH \rightarrow 2k_2MnO_4 + H_2O + [O]$

Potassium permanganate — potassium manganate

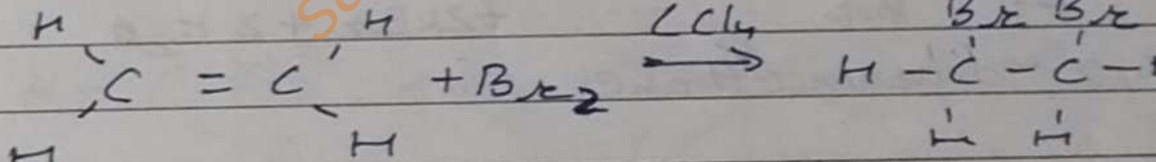


(ethene) — Ethane-1,2-diol (Ethylene glycol)

(4) Bromine sol^n test

When ethene gas is passed in the bromine sol^n then brown colour of bromine sol^n is discharged.

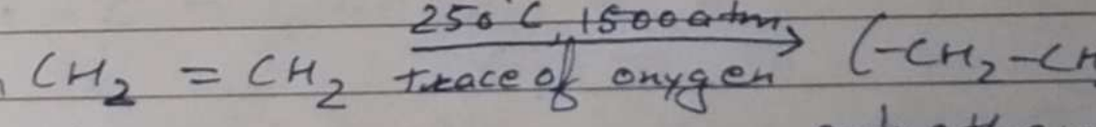
(Brown → Colourless)



1,2, dibromoethane.

(5) Catallytic hydrogenation of ethene → done (lesson → alkane)

(6) Polymerisation



ethene (monomer) — polyethene (polymer)

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Alkynes

Introduction

→ $-C \equiv C-$

→ C_nH_{2n-2} $(n = 2, 3, 4 \ldots)$

→ Unsaturated hydrocarbon.

$H-C \equiv C-H$

Acetylene ethyne

Preparation method

① β-elimination reaction.

$$H-\underset{H}{\overset{Br}{C}}-\underset{Br}{\overset{H}{C}}-H + 2KOH\,(alc) \longrightarrow H-C \equiv C-H + 2KBr + 2H_2O$$

1,2-dibromoethane

② Using Zn

$$H-\underset{Br}{\overset{Br}{C}}-\underset{Br}{\overset{Br}{C}}-H + 2Zn \xrightarrow{CCl_4} H-C \equiv C-H + 2ZnBr_2$$

1,1,2,2-tetrabromoethane

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③ Combinating of H_2 & C

$$H_2 + 2C \xrightarrow{\text{electric spark}} H-C\equiv C-H$$

④ Reaction bet^n calcium carbide & water

$$Ca(C\equiv C) + H-OH + H-OH \rightarrow H-C\equiv C-H + Ca(OH)_2$$

⑤ Heating chloroform or iodoform with silver powder

ⓐ $$H-CCl_3 + 6Ag + Cl-C-H \xrightarrow{\Delta}$$

Chloroform (trichloromethane)

$$H-C\equiv C-H + 6AgCl$$

ⓑ $$H-CI_3 + 6Ag + I-C-H \xrightarrow{\Delta}$$

iodoform (triiodomethane)

$$H-C\equiv C-H + 6AgI$$

⑥ Kolbe's electrolysis of sodium maleate and sodium fumarate.

$$H-C(=O)-C(=O)-ONa \quad (aq) \rightarrow \quad H-C(=O)-C(=O)-O^{\ominus} + 2Na^{\oplus}$$

$$H-C(=O)-C(=O)-ONa$$

Sodium onaleate

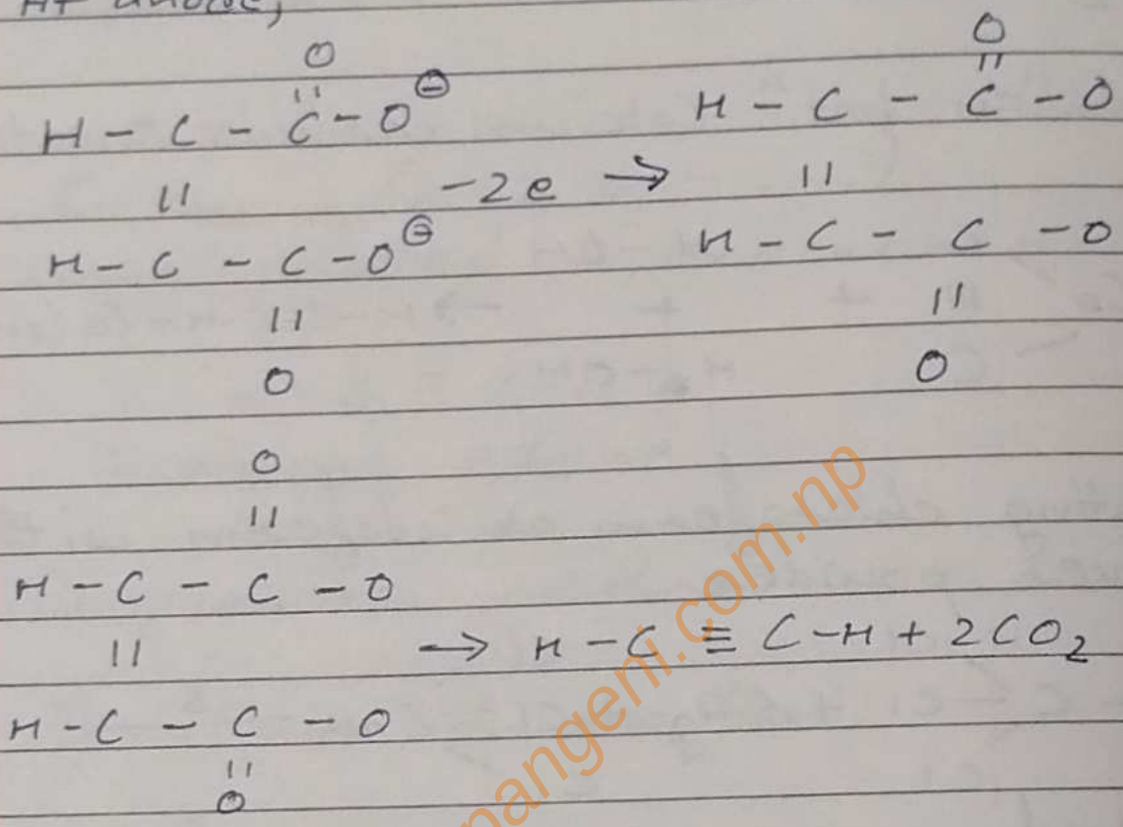
$$H-C(=O)-C(=O)-O^{\ominus}$$

maleate ion

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$$H_2O \rightleftharpoons H^{\oplus} + OH^{\ominus}$$

At anode,



At cathode → done
(kolbe's electrolysis of aq. sodium acetate)

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Chemical properties of alkynes.

(1) Bromine sol^n test
:- When ethyne gas is passed in the bromine sol^n then brown colour of this sol^n is discharged.

$$H-C\equiv C-H + Br_2 \xrightarrow{CCl_4} H-\underset{Br}{\overset{Br}{C}}-\underset{Br}{\overset{Br}{C}}-H$$

(Brown)

$\xleftarrow{Br_2}$ 1,1,2,2-tetrabromoethene (Colourless)

(2) Baeyer's test ⇒ When ethyne (Acetylene) gas is passed in the Baeyer's reagent then the pink colour of the sol^n is discharged. (Pink → Colourless)

$$2KMnO_4 + 2KOH \rightarrow 2K_2MnO_4 + H_2O + [O]$$

$$H-C\equiv C-H + 4[O] \rightarrow HO-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-OH$$

oxalic acid.
(Ethane-1,2-dioicacid)

(3) Catalytic hydrogenation of ethyne

→ done (lesson → ~~ethane~~ alkane)

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④ Controlled hydrogenation of ethyne
→ Lindlar catalyst → done
(Lesson → Alkene)

⑤ Formation of metal acetylides.

ⓐ When ethyne gas is passed in the ammoniacal (Tollen's reagent) then white ppt of silver acetylide is formed.

$$H-C\equiv C-H + 2NH_4OH + 2AgNO_3 \longrightarrow \underset{\text{white ppt}}{Ag-C\equiv C-Ag} + 2H_2O + 2NH_4NO_3$$

(silver acetylide)

ⓑ When ethyne gas is passed in the ammoniacal soln of cuprous chloride the red ppt of copper acetylide is formed.

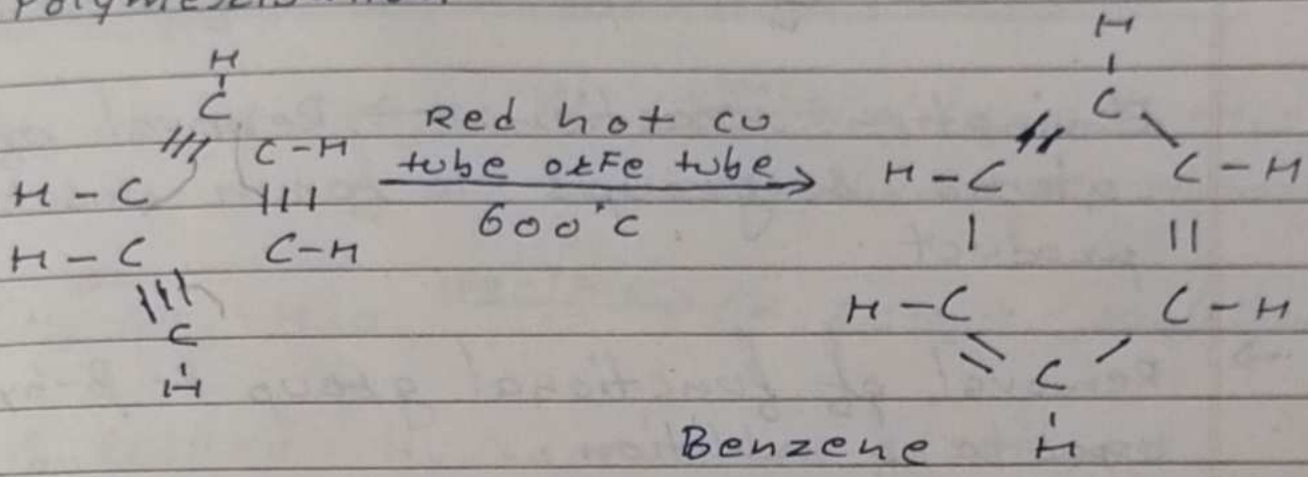
$$H-C\equiv C-H + 2NH_4OH + Cu_2Cl_2 \longrightarrow \underset{\text{red ppt copper acetylide}}{Cu-C\equiv C-Cu} + 2H_2O + 2NH_4Cl$$

ⓒ Reaction with Na

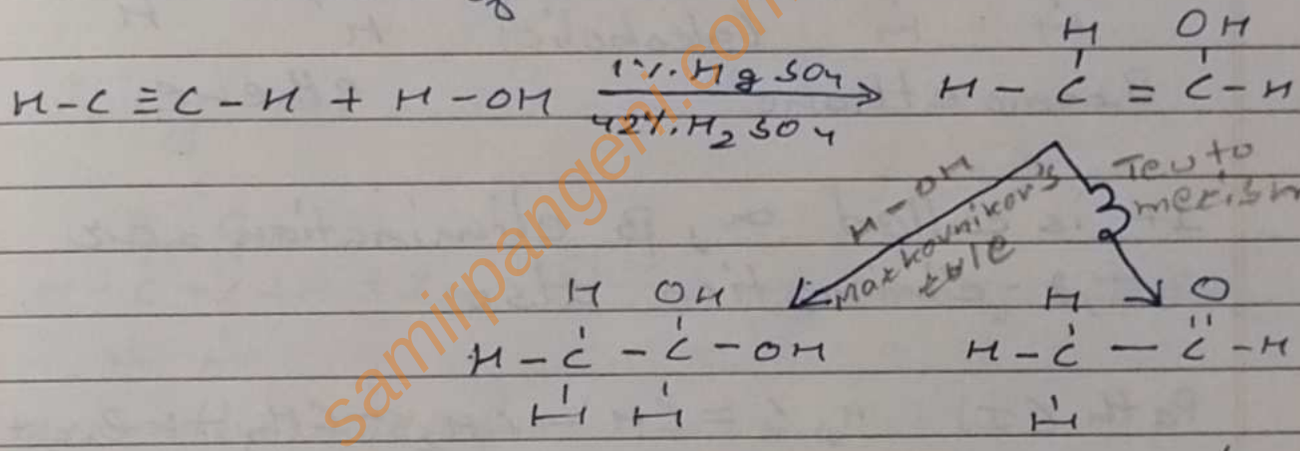
$$H-C\equiv C-H + 2Na \longrightarrow \underset{\text{sodium acetylide}}{Na-C\equiv C-Na} + H_2\uparrow$$

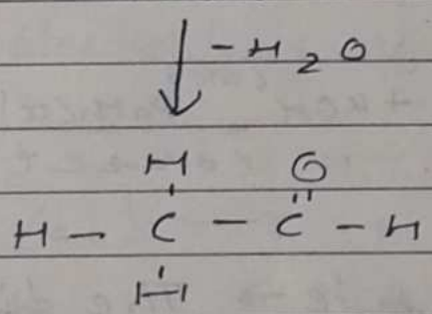
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(6) Polymerisation



(7) Catalytic hydration of ethyne.
(Addition of water)





ethanal

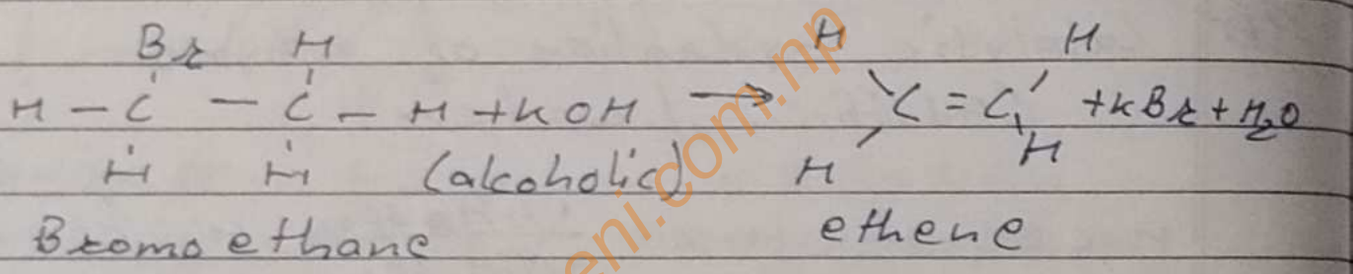
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Before

Methods of preparation of alkenes

Elimination reaction → Removal of atoms & groups to form unsaturated product.

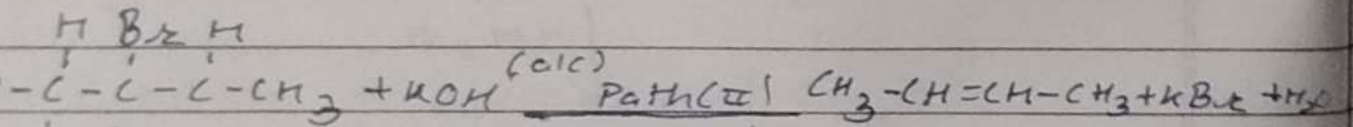
→ Removal of functional group & β-hydrogen opposite of addition.



It is called α, β elimination or 1,2-elimination also

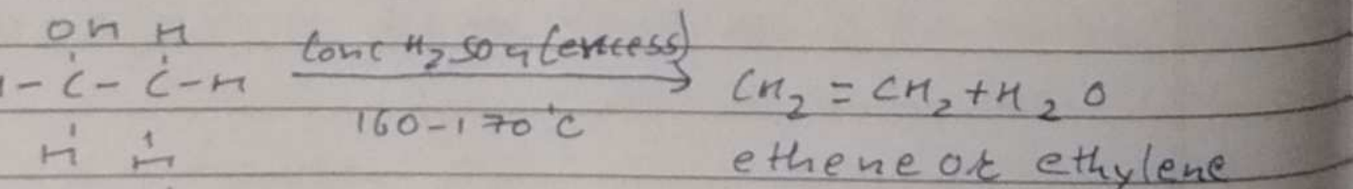
Path (I) $H_2C=CH-CH_2-CH_3 + KBr + H_2O$

But-1-ene



Saytzeff's rule → The highly substituted alkene is major product.

2. Dehydration of alcohol



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Mechanism:

$$CH_3-CH_2-OH + H_2SO_4(conc) \xrightarrow{100^\circ C} CH_3-CH_2-HSO_4 + H_2O$$

ethylhydrogensulphate

$$CH_3-CH_2-HSO_4 \xrightarrow{160-170^\circ C} CH_2=CH_2 + H_2SO_4 \text{ (ethene)}$$

3// Controlled hydrogenation of ethyne

$$H-C\equiv C-H + H_2 \xrightarrow[\text{Lindlar catalyst}]{Pd/BaSO_4} CH_2=CH_2$$

4// Using Zn

$$H-\underset{H}{\overset{H}{C}}-\underset{Br}{\overset{Br}{C}}-H + Zn \xrightarrow{CCl_4} H_2C=CH_2 + ZnBr_2$$

1,2-dibromoethane

5// Kolbe's electrolysis of sodium succinate

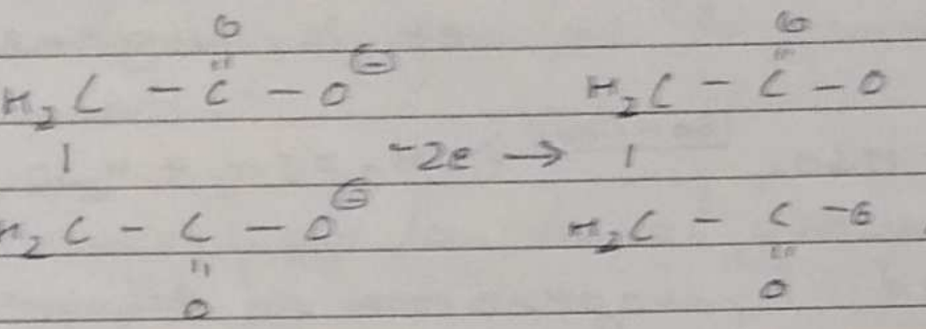
$$H_2C(-CH_2)_2(COONa)_2 \xrightarrow{(aq)} H_2C(-CH_2)_2(COO^-)_2 + 2Na^+$$

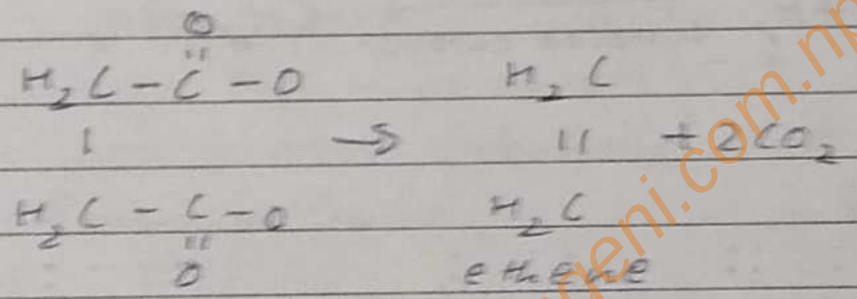
Sod. Succinate — Succinate ion

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$H_2O \rightleftharpoons H^+ + OH^-$

At anode,

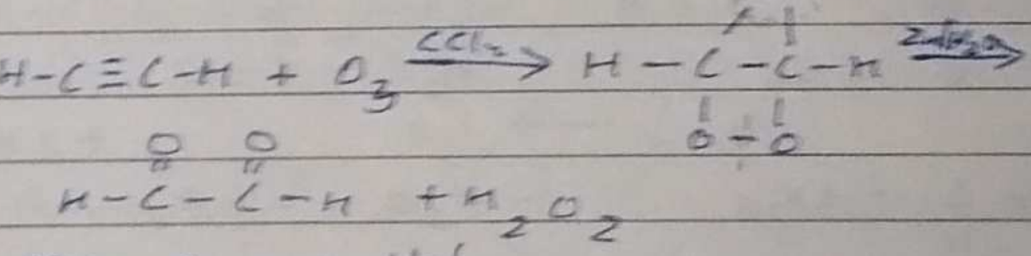




At cathode → Same as alkane.

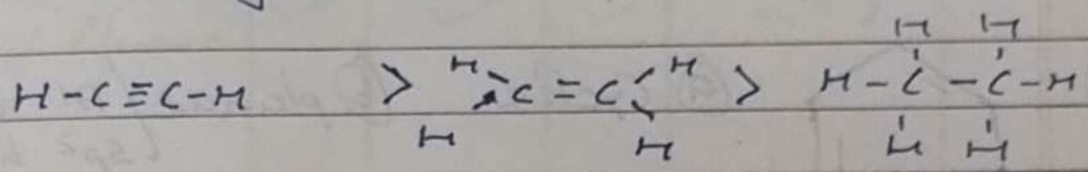
Alkynes.

(3) Ozonolysis



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(9) Acidic strength order



Hybridization of C.	SP	SP^2	SP^3
% S-character of C.	50%	33.33%	25%

EN ⟶ decreases (Electronegativity ∝ S-character)

Acidic Strength ⟶ decreases (The C-H bond of ethyne is broken most easily)

Aromatic Hydrocarbons.

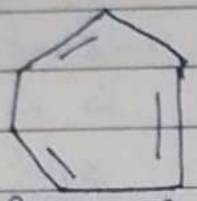
Huckel's rule for aromaticity of compound or ion.

The compound or ion is said to be aromatic if it fulfils the following conditions.

a. Cyclic
b. Planar
c. Conjugation (delocalization of π electron)
d. $(4n+2)$ π electrons $(n = 0, 1, 2, \ldots)$

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Examples.

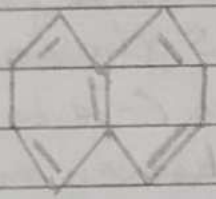
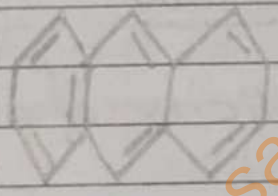
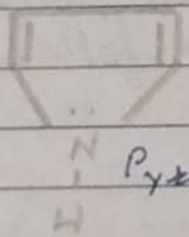
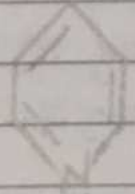
① 

Benzene

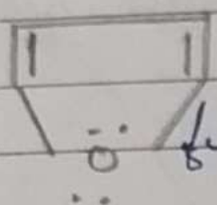
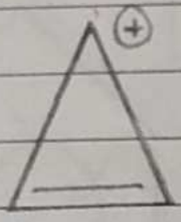
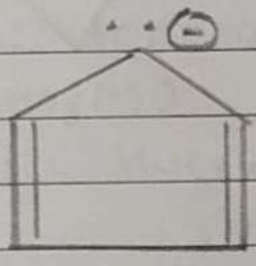
ⓐ Cyclic ⓑ planar (All C-atoms are sp^2 hybridized)

ⓒ Conjugation ⓓ $4n+2=6$ $\therefore n=1$

Result → Benzene → Aromatic compound.

S.N	Compound or ion.	Cyclic	conjugation	planes	$(4n+2)$ π electrons	Result
2.	 Naphthalene	✓	✓	✓	$4n+2=10$ $n=2$	Aromatic compound
3.	 anthracene	✓	✓	✓	$4n+2=14$ $n=3$	11
4.	 Pyrrole	✓	✓	✓	$4n+2=6$ $\therefore n=1$	11
5.	 Pyridine	✓	✓	✓	$4n+2=6$ $\therefore n=1$	11

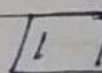
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6.	 Furan	✓	✓	✓	$4n+2=6$ $\therefore n=1$	(1)
7.	 Cyclopropenylcation	✓	✓	✓	$4n+2=2$ $\therefore n=0$	Aromatic cation
8.	 Cyclopentadienyl anion.	✓	✓	✓	$4n+2=6$ $\therefore n=1$	Aromatic anion.

Antiaromatic compounds

→ Conditions

(i) Cyclic
(ii) Planes
(iii) Conjugation
(iv) $4n$ π electrons ($n=1,2,3\ldots$)

Example →  Cyclobutadiene

$4n=4 \quad \therefore n=1$

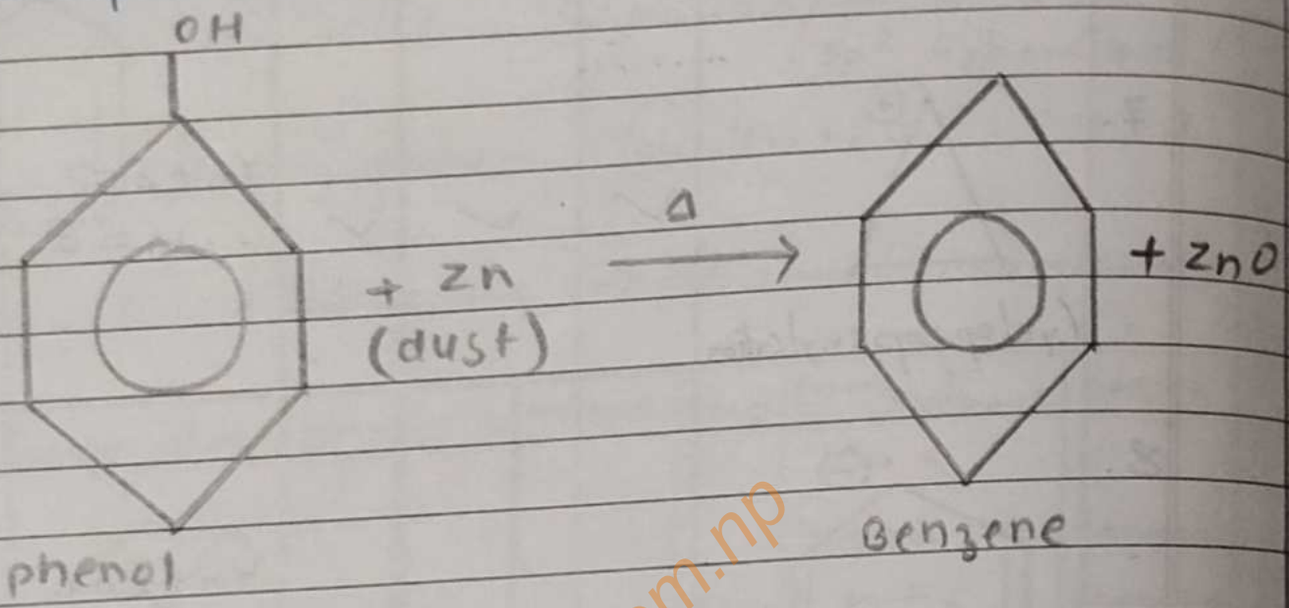
Non-aromatic compound

∴ Those compound which is neither aromatic nor antiaromatic.

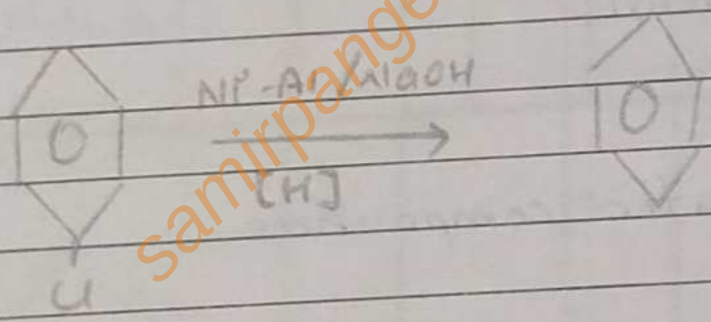
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Prepⁿ of Benzene

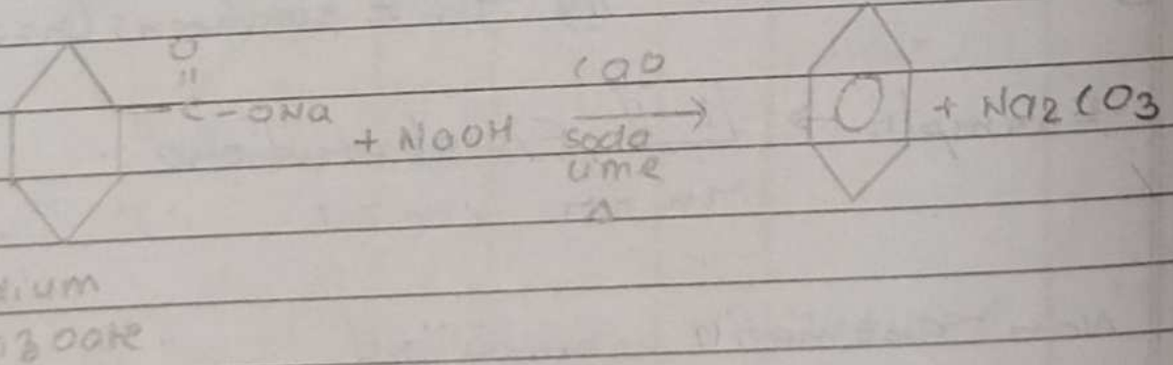
① From phenol



② From chlorobenzene



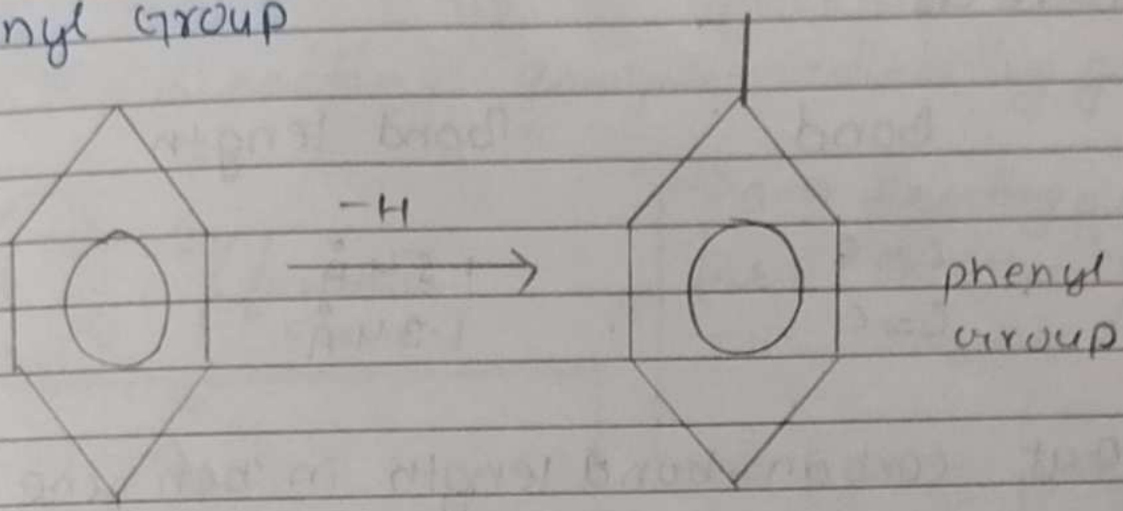
③ Decarboxylation



④ Polymerisation of ethyne → done.

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Phenyl Group



Benzene

Characteristics of aromatic compounds.

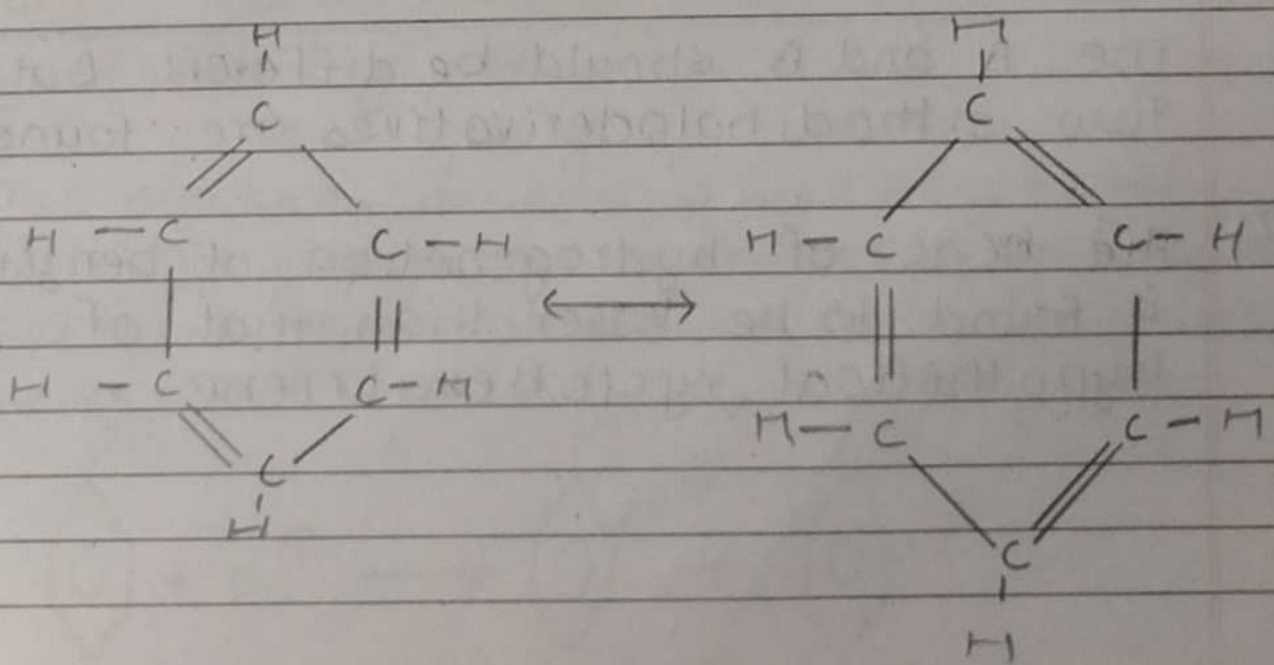
① Obeys Huckel's rule

② prefers substitution reaction

③ gives sooty flame on burning

④ stable.

Kekule's structure of benzene



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Defects

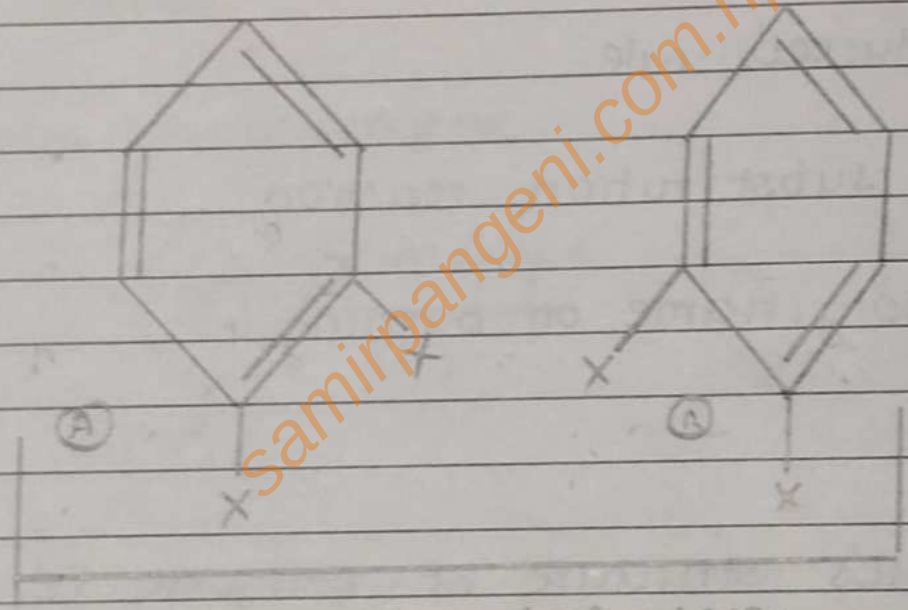
(i)

Bond	Bond length
C-C	1.54 Å
C=C	1.34 Å

But carbon bond length in benzene 1.39 Å

(ii) It prefers substitution reaction rather than addition reaction.

(iii)



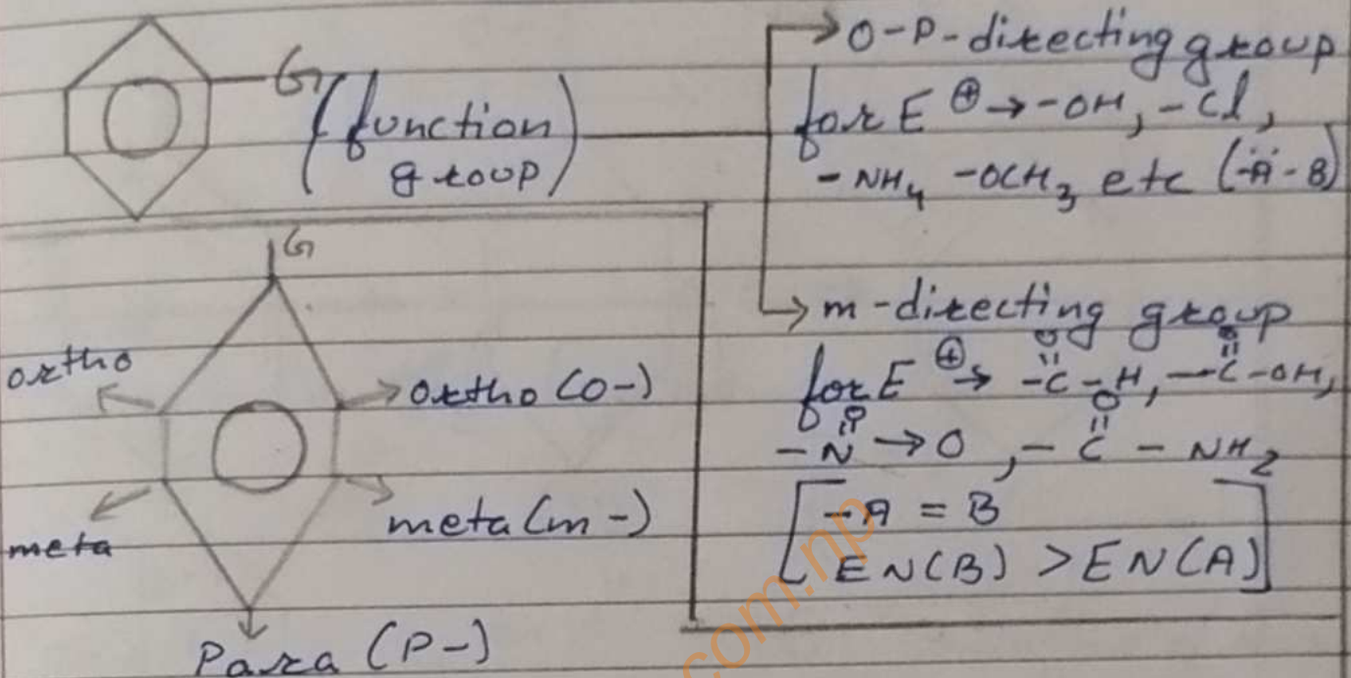
orthodihaloderivatives

The A and B should be different But no two orthodihaloderivatives are found.

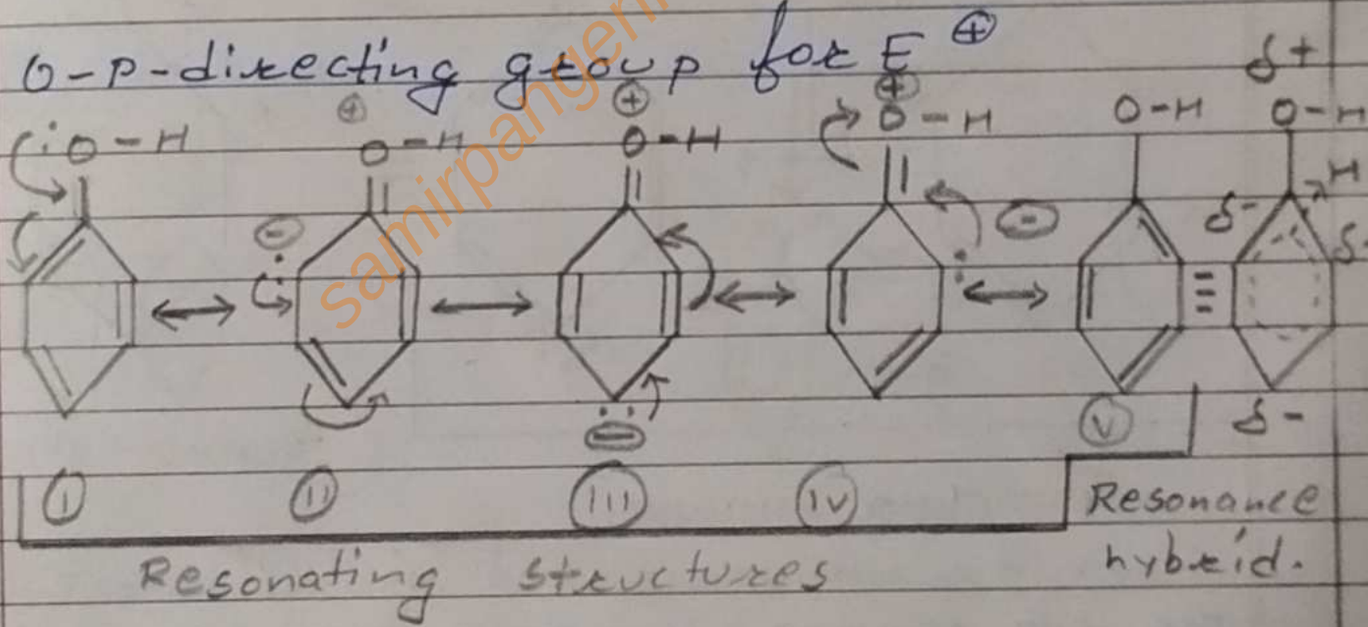
(iv) The heat of hydrogenation of benzene is found to be lesser than that of hypothetical cyclohexatriene.

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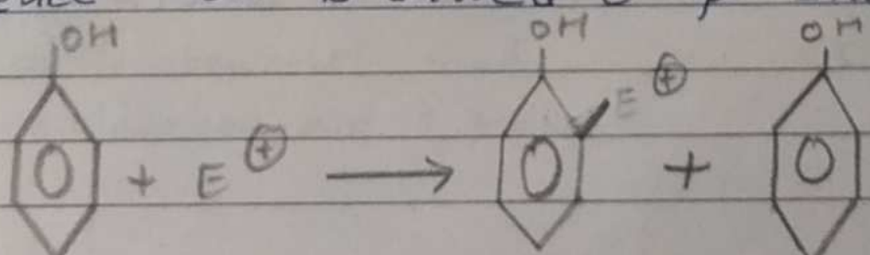
O-P-directing group & m-directing group



O-P-directing group for $E^{\oplus}$

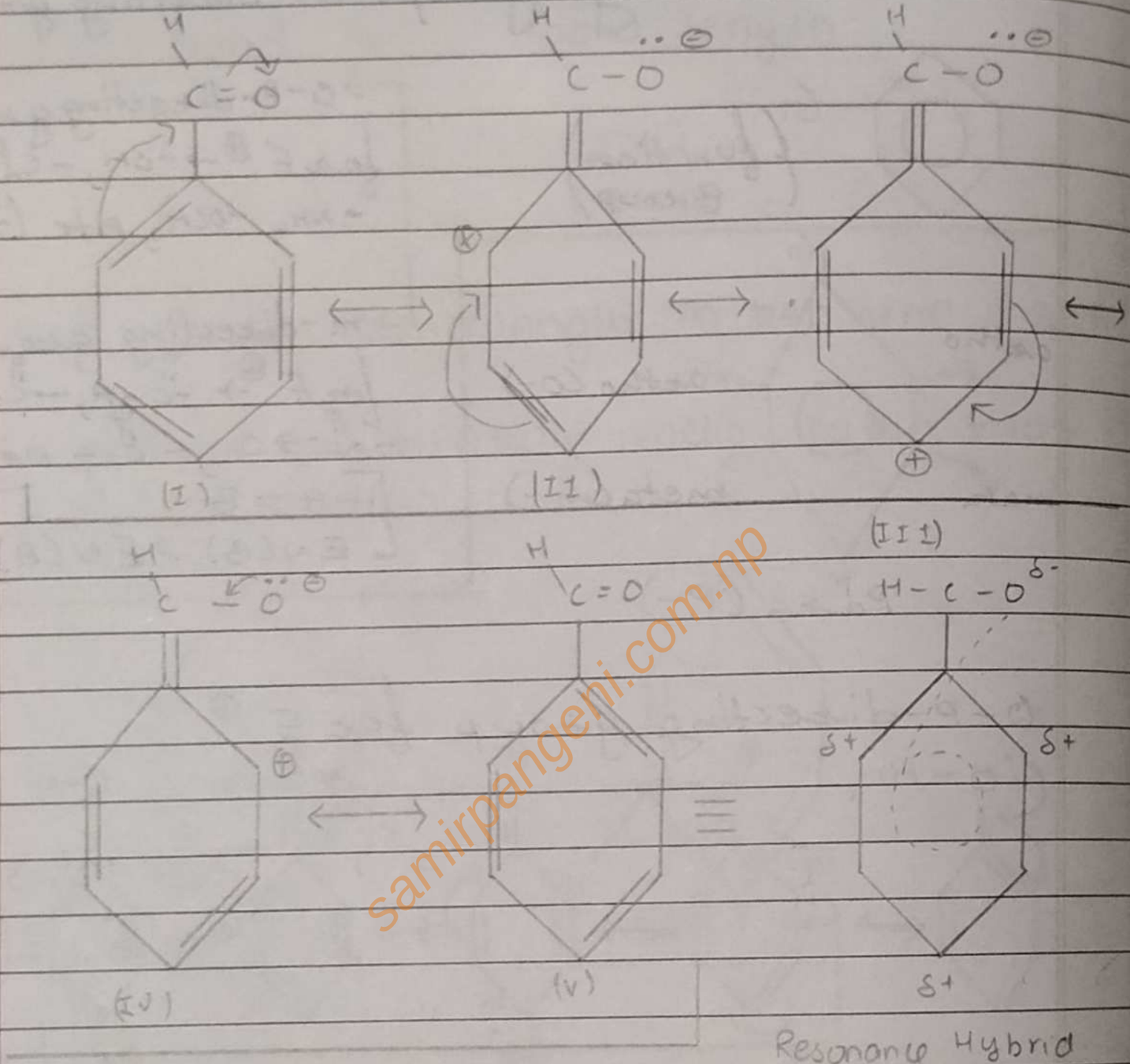


=> The electron density is high at o- and p- positions due to the presence of OH-. Therefore electrophilic attack on o- and p- positions. Hence -OH is called O-p-directing group



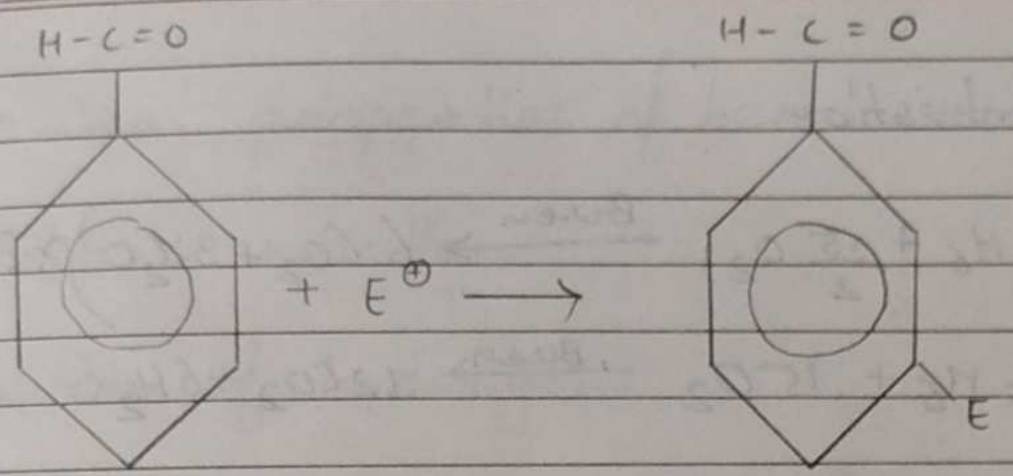
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Meta-directing group for E^+

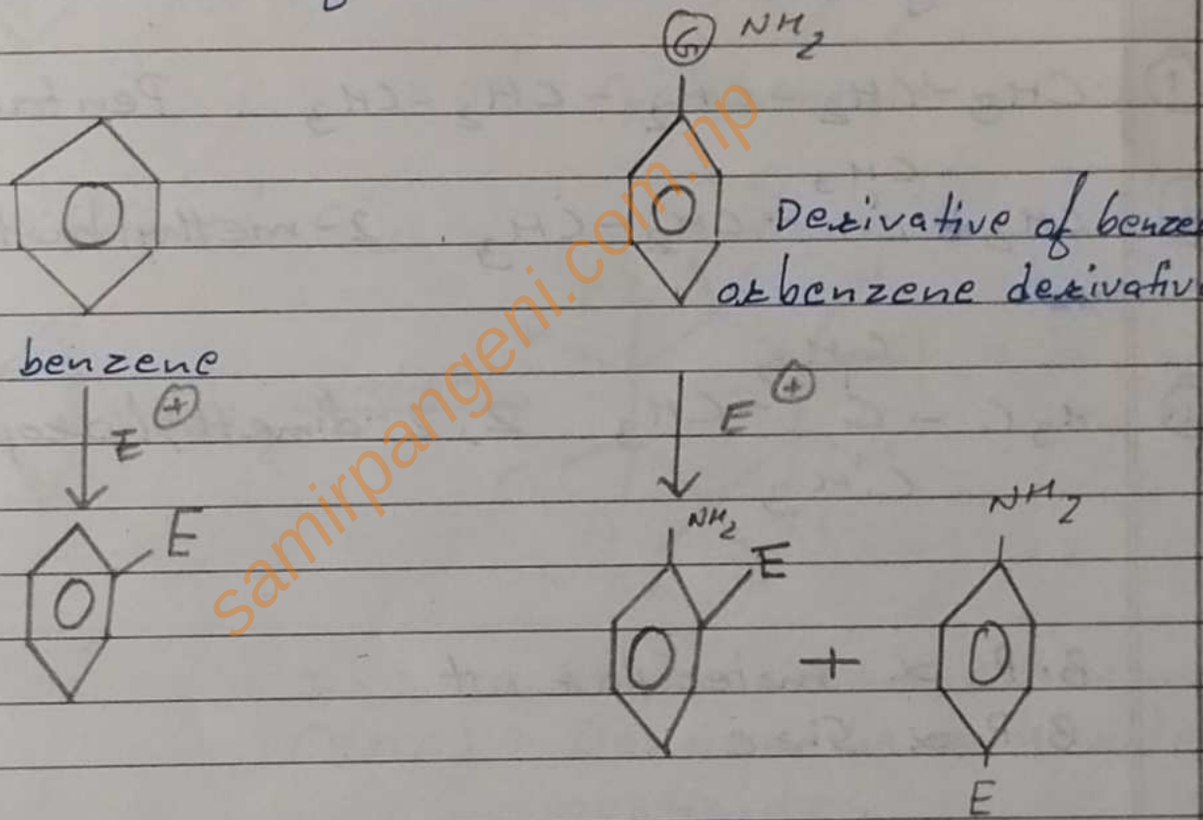


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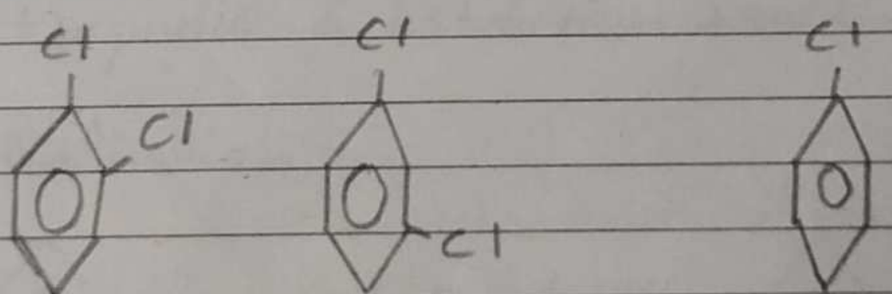
The +ve change is present at o- & p- positions due to the presence of $-\overset{\overset{O}{\|}}{C}-H$ group. The e^- density is relatively high at m-positions. Hence E^+ attack at m-position. Hence $-\overset{\overset{O}{\|}}{C}-H$ is called m-directing group for $E^{\oplus}$



Orientation of benzene derivative.



Isomerism in benzene derivatives.



O-dichlorobenzene m-di... Cl p-di....

Or, 1,2-diclorobenzene 1,3-di... 1,4-di....

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Combustion

$$\left(C_6H_6 + \frac{15}{2}O_2 \xrightarrow{\text{Burn}} 6CO_2 + 3H_2O\right) \times 2$$

$$2C_6H_6 + 15O_2 \xrightarrow{\text{Burn}} 12CO_2 + 6H_2O$$

Boiling point.

(i) $CH_3-CH_2-CH_2-CH_2-CH_3$ Pentane

(ii) $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3$ 2-methylbutane.

(iii) $H_3C-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-CH_3$ 2,2-dimethylpropane

B.P $\propto$ molecular wt

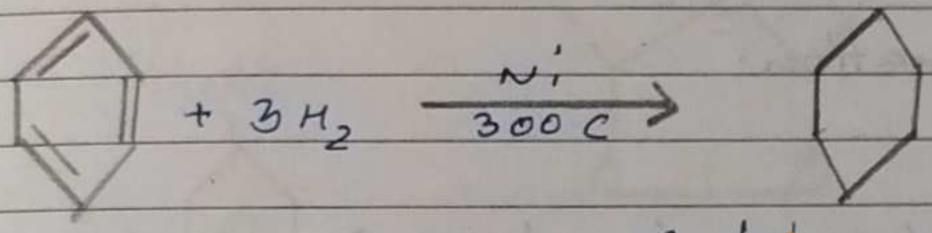
B.P $\propto$ Size

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Chemical properties of benzene

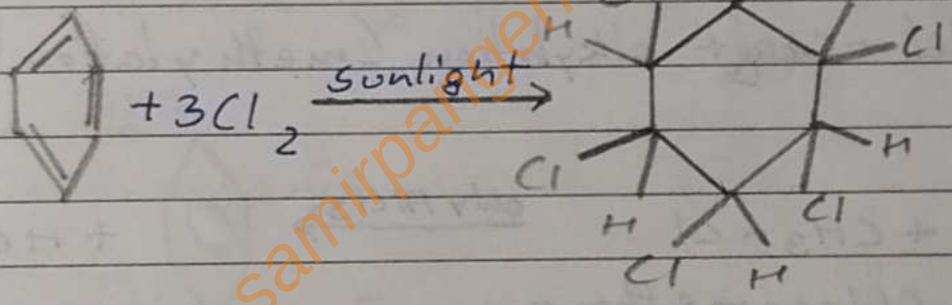
(1) Addition reaction.

a. Addition of hydrogen.



Cyclohexane

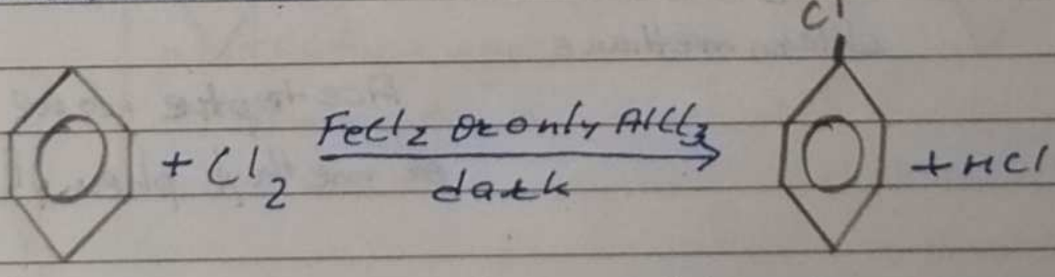
(b) Addition of Cl_2



1,2,3,4,5,6-hexachlorocyclohexane
(BHC) → Benzene hexachloride
pesticide.

(2) Electrophilic substitution reaction

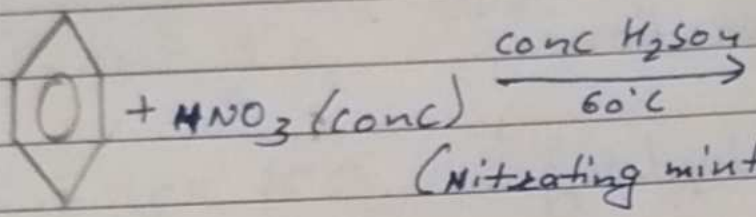
a Chlorination.



Chlorobenzene

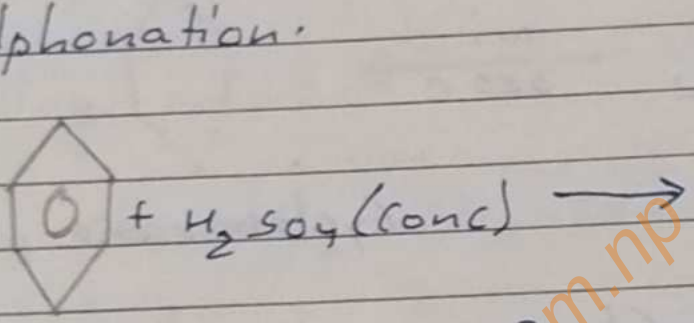
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b. Nitration



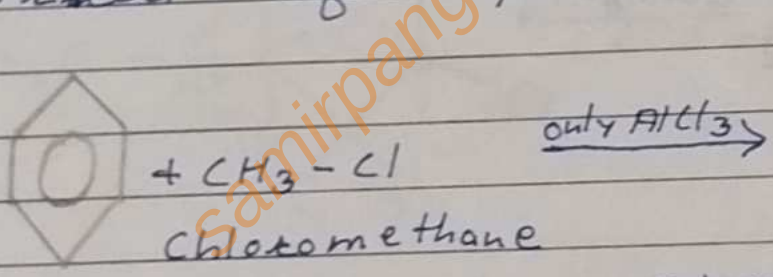
(Nitrating mixture) nitrobenzene

c. Sulphonation.



Benzene sulphonic acid.

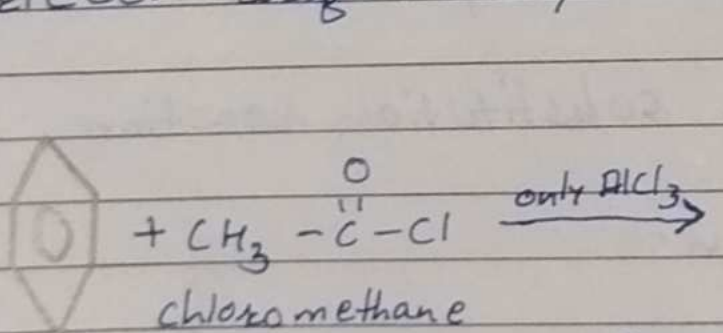
d. Friedel - craft alkylation (methylation)



Chloromethane

Toluene (Methyl benzene)

e. Friedel - craft (accetylation)



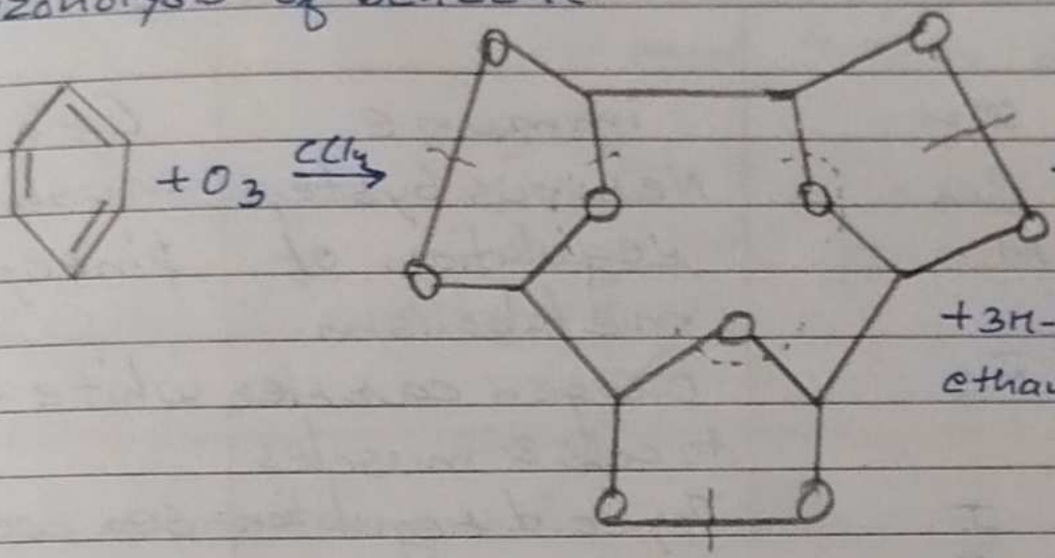
Chloromethane

Acetophenone

or methyl phenyl ketone

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3. Ozonolysis of benzene



4. Combustion.

$$\left[C_6H_6 + \frac{15}{2}O_2 \xrightarrow{\text{Burn}} 6CO_2 + 3H_2O\right] \times 2$$

Bio-inorganic

Element	Function	Source
Na.	Blood pressure	Salt
k.	Nervous system	banana
Ca	bone	Milk
Mg	regulate different biological reactions (enzymes reaction)	Almond (Dry fruit)
S.	antioxidant protection against cell damage	garlic · onion

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Micronutrients	Function	Source
Zn	immune	Crab
Cu	Nervous System	mushroom
Mn	regulation of metabolism	pineapple
Fe	Oxygen carrier to cells & muscles	white beans
I	Thyroid regulation	sea weeds
F	bone	crab
Se	protection against cell damage	Brazilnuts

Meta[Tonicity (Poisoning)

=> Harmful affect caused due to excess amount of metal in the body.

(i) Tonicity due to Fe
- Depression
- heart attack
- Liver Cancer

(ii) Tonicity due to As
- Skin Cancer
- Skin thickening
- Vomiting

(iii) Tonicity due to Hg
- Vomiting
- kidney damage.

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(iv) Toxicity due to Pb
- Cell damage
- DNA damage
- kidney damage

(v) Toxicity due to Cd
- Fever
- weakness
- dizziness
- kidney damage.

- Ion pumps
  - Sodium potassium pump → primary active transport
  - Sodium glucose pump → secondary active transport

with the help of this pump, the ions are allowed to move through cell membrane against these concentration gradient. (low conc^n to high conc^n)

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Sodium potassium pump

Extracellular fluid.

Na^+ ions → high conc^n
K^+ ions → low conc^n

(3) (2)

Na^+ ions → low conc^n
K^+ ions → high conc^n

cell membrane

cell

intracellular fluid
or interior of the cell

Energy obtained → ATP ⇌ ADP (Adenosine diphosphate)
(Adenosine triphosphate)

Sodium glucose pump.

Glucose molecules along with Na^+

(Diffusion of Na^+ ions)

Glucose → low conc^n

Glucose high

The energy is obtained due to conc^n gradient of Na^+ ions already created by sodium potassium pump.

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