

INTRODUCTION TO ORGANIC CHEMISTRY

- Hydrocarbons are compounds of carbon and hydrogen.
- Organic compounds are compounds which contain carbon in them and are obtained from living beings. They are derivatives of hydrocarbons.
- Organic chemistry is the study of organic compounds.

TYPES OF ORGANIC COMPOUNDS

ORGANIC COMPOUNDS

OPEN CHAIN OR ALIPHATIC
ORGANIC COMPOUNDS

- ALKANES
- ALKENES
- ALKYNES

CLOSED CHAIN OR CYCLIC
ORGANIC COMPOUNDS

HOMOCYCLIC
COMPOUNDS

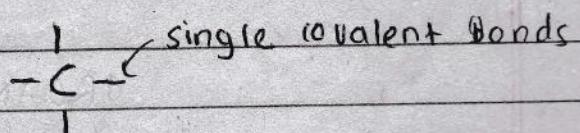
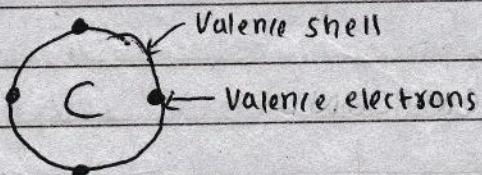
HETERO CYCLIC
COMPOUNDS

ALICYCLIC ORGANIC
AROMATIC ORGANIC

- Alkanes (C_nH_{2n+2}) : saturated with sigma bonds, less reactive
- Alkenes (C_nH_{2n}) : unsaturated with pi bonds, reactive
- Alkynes (C_nH_{2n-2}) : unsaturated with pi bonds, most reactive.
- Single bond, double bond and triple bond.

UNIQUE NATURE OF CARBON

- Carbon can form a large number of compounds, so to make their study systematic, their study has been separated into branch of organic chemistry.
- Carbon can't lose or gain electrons to become octet, so it shares electrons in covalent bonds to become stable. This is tetravalency.



Group 14 (IVA)

C

Si

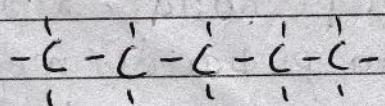
Ge

Sn

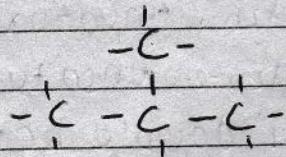
Pb

Here, carbon is the only non metal with smallest atomic size. It maintains 4 covalent bonds but other elements don't due to their larger atomic size and thus, weaker nuclear force.

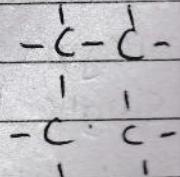
- Carbon atoms can link together with each other to form very long carbon chains due to its covalent bonds. This property of self linking of atoms of elements through covalent bonds is called catenation.



Straight chain



Branched chain



Closed chain

- + Only carbon can utilize max. no of electrons to form covalent bonds.
- + Its small size makes strong nuclear force high forming strong and stable compounds.

IUPAC NOMENCLATURE

- + International Union of Pure and Applied Chemistry.
 - + Scientific and systematic nomenclature of organic compound
 - + A complete IUPAC name :
- Prefix + Word root + Primary suffix + Secondary suffix
Base name

Root words : Indicates number of carbon atoms present in a molecule.

1 - Meth	11 - Undec
2 - Eth	12 - Dodec
3 - Prop	13 - Tridec
4 - But	14 - Tetradec
5 - Pent	15 - Pentadec
6 - Hex	16 - Hexadec
7 - Hept	17 - Heptadec
8 - Oct	18 - Octadec
9 - Non	19 - Nonadec
10 - Dec	20 - Icos

Primary suff

Primary suffix (1 degree suffix) : Indicates degree of saturation or unsaturation in main chain.

Saturated ($C-C$) → ane

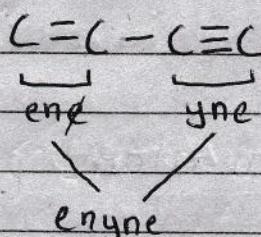
Unsaturated ($C=C$) → tene

Unsaturated ($C=C-C=C$) → diene

Unsaturated ($C\equiv C$) → yne

Unsaturated ($C\equiv C-C\equiv C$) → diyne.

triene, tetraene, pentaene, hexaene..... etc.

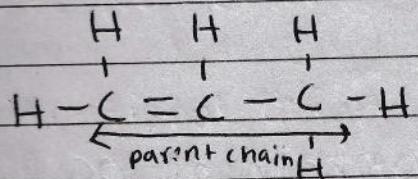


Nomenclature of straight chain hydrocarbons.

- Only requires word root and primary suffix.
- Example : Methane, Butene, Decyne.
- General formula (C_nH_{2n}) becomes molecular when n is an integer greater than 0.
- Molecular formula is actual number of atoms of element present in a molecule.
- Structured formula : Displayed formula, Condensed formula and skeleton formula.
- Displayed formula indicates position of all atoms including their bonds.

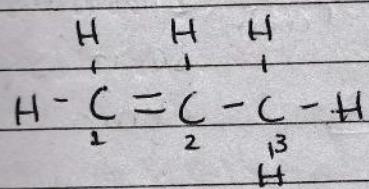
Steps

- Selection of longest continuous carbon chain
→ Longest possible chain including unsaturated bonds must be selected.



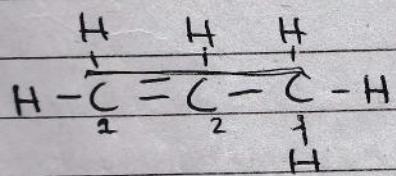
- Numbering of carbon atoms

→ Numbering must be done such that double and triple bond must get least number.

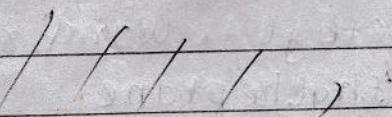


- Naming of compound

→ Naming follows pattern, Word root + Primary suffix



Prop -1-ene [where 1 indicates position & is optional]

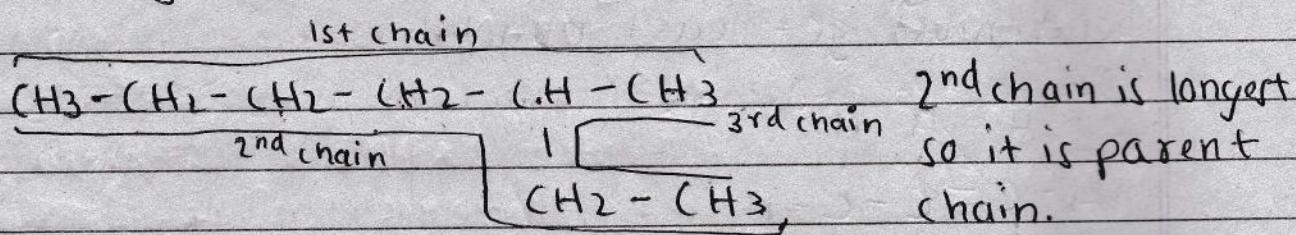


Nomenclature of branched chain hydrocarbon.

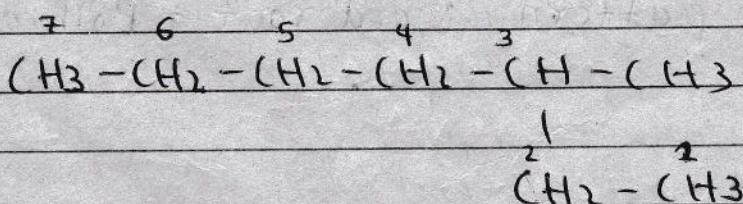
- Requires prefix, word root and primary suffix.
 - carbon atoms inside chains should be represented as alkyl radicals.

Steps

- Select longest possible carbon chain as parent chain. Sometimes multiple chains might be possible. In such cases, choose chain that gives max. number of branchings.



- Do numbering as usual to parent chain with branches getting least position.

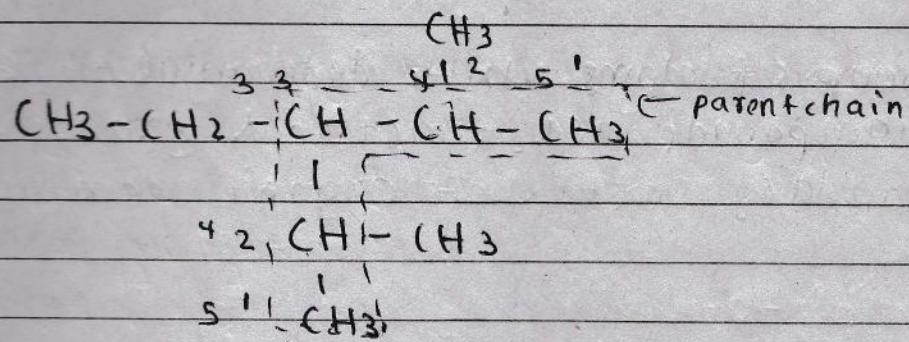


- Name compound using prefix, word root & suffix

Prefix = 3-methyl, Word root - Hept, Pri suffix-ane

Name = 3-methylheptane

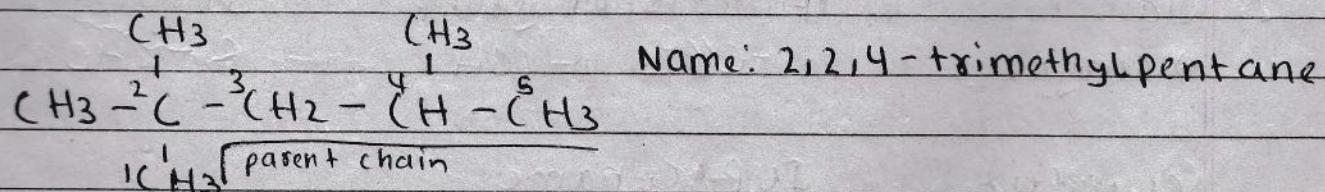
Lowest sum rule



Here, numbering from top to bottom gives the sum of positions of branches to be $2 + 3 + 4 = 9$, and numbering from bottom to top also gives same sum. So, both numberings are valid. In cases where sums are different, numbering giving least sum must be considered.

Name: 3-ethyl-2,4-dimethylpentane

Since, e comes before m, ethyl is included before methyl.



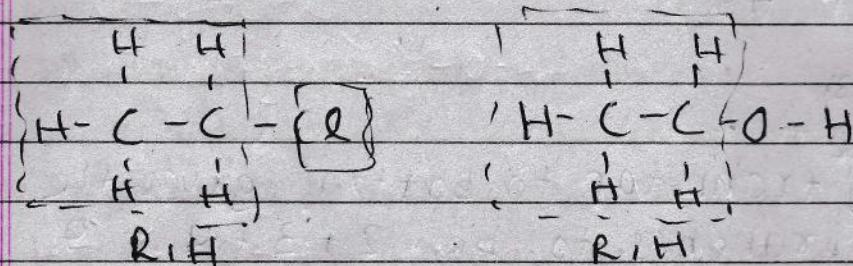
Prefixes like di, tri, don't matter in alphabetically sorting the alkyl groups.

Eg: ethyl will still come before dimethyl.

1 1 3

FUNCTIONAL GROUPS

Atoms or group of atoms which determine the properties of organic compounds are functional groups. They give the secondary suffix of organic compounds.



1. Class	Functional group	Structure
Alcohol	-O-H	R-O-H

Sec. suffix IUPAC name
-ol Alkanol

2. Class	Functional group	Structure
Aldhyde	-C(=O)H , -COH	R-CHO

Sec. suffix IUPAC name
-al Alkanal

3. Class	Functional group	Structure
Ketone	>C=O , -CO-	R-CO-R'

Sec. suffix IUPAC name
-one Alkanone

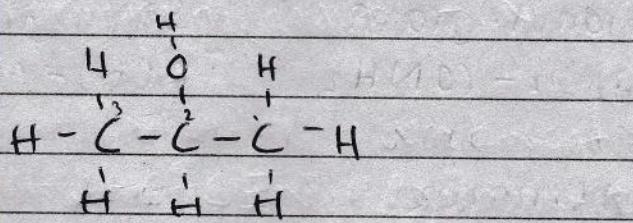
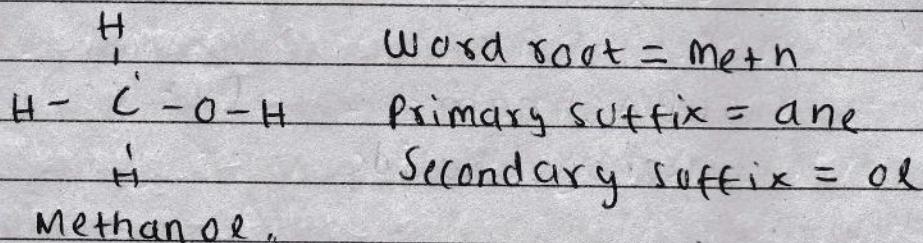
4. Class (carboxylic acid)	Functional group $-C(=O)-H$, $-(COOH)$	Structure $R(H)-COOH$
Sec. suffix -oic acid	IUPAC name Alkanoic acid.	
5. Class Acid halide	Functional group $-C(=O)X$, $-(COX)$	Structure $R(H)-COX$
Sec. suffix -oyl halide	IUPAC name Alkanoyl halide	[$X = Cl, Br, F, I$]
6. Class Amide	Functional group $-C(=O)NH_2$, $-(CONH_2)$	Structure $R(H)-CONH_2$
Sec. suffix -amide	IUPAC name Alkanamide	
7. Class Ester	Functional group $-C(=O)O-R'$, $-(COOR')$	Structure $R(H)-COOR'$
Sec. suffix -oate	IUPAC name Alkyl Alkanoate	
8. Class Nitriles	Functional group $-C\equiv N$, $-(CN)$	Structure $R(H)CN$
Sec. suffix -nitrile, cyano-	IUPAC name Alkanenitrile, Cyanoalkane	

Nomenclature of organic compound with functional group

Word root + Primary suffix + Secondary suffix

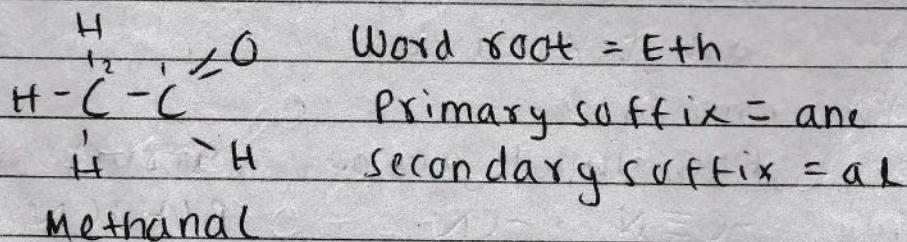
i) Alcohol

Functional group : -O-H



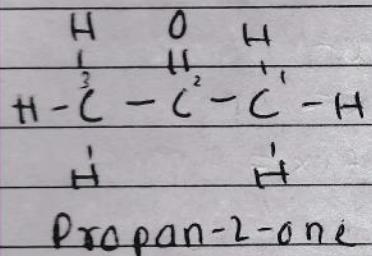
ii) Aldehyde

Functional group : -CHO



iii) Ketone

Functional group: -CO-



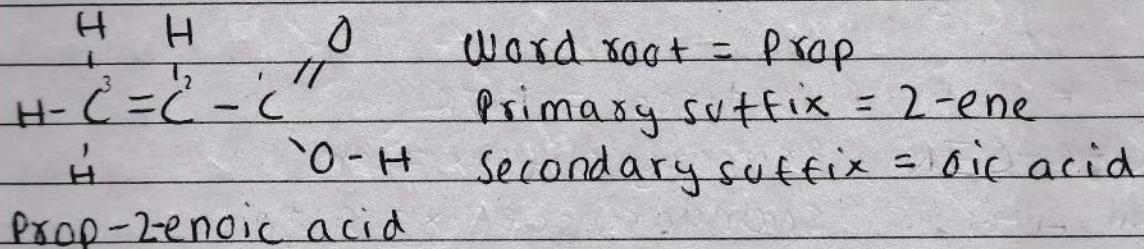
Word root = prop

Primary suffix = one

Secondary suffix = 2-one

iv) Carboxylic acid

Functional group: -COOH



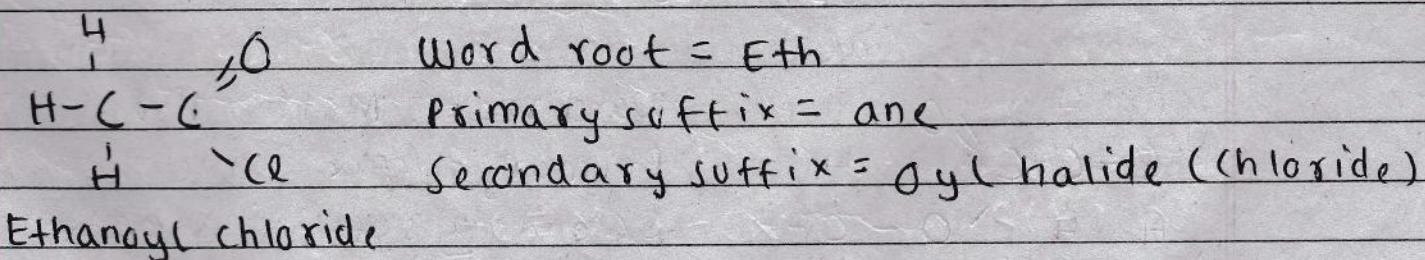
Word root = prop

Primary suffix = 2-ene

Secondary suffix = oic acid

v) Acid halide

Functional group: -COX



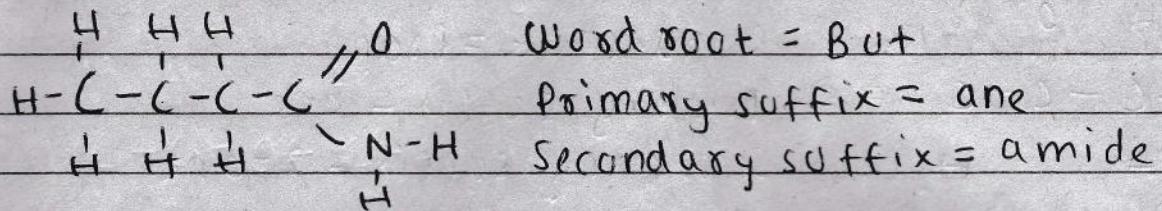
Word root = Eth

Primary suffix = one

Secondary suffix = oyl halide (chloride)

vii) Amide

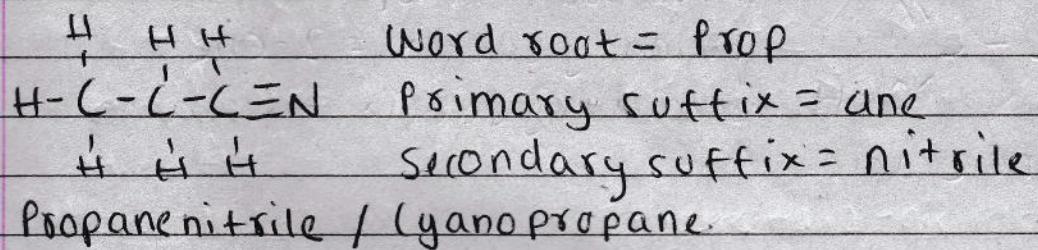
Functional group : -CONH₂



Butanamide.

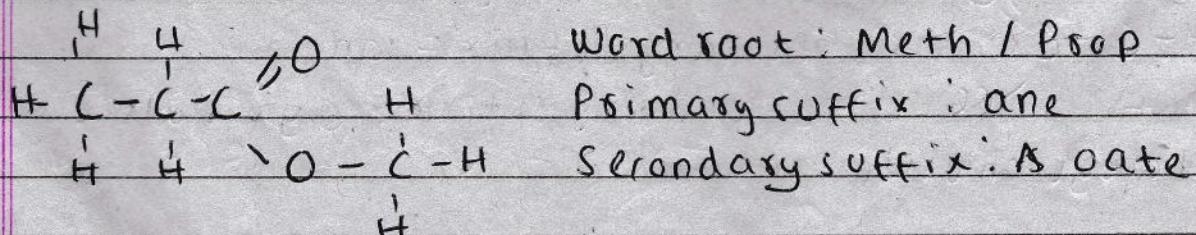
viii) Nitriles

Functional group : -CN



viii) Ester

Functional group : -COOR'



Methylpropanoate

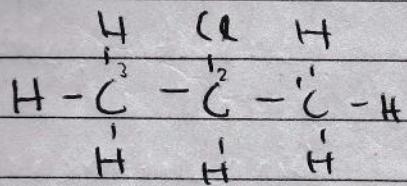
Some functional groups are treated as prefixes.

i) Halo

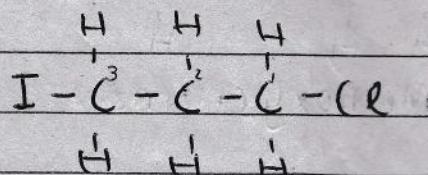
Functional group : -X [X = I, Br, Cl, F]

Prefix : Halo

IUPAC name : Haloalkane



2-chloropropane



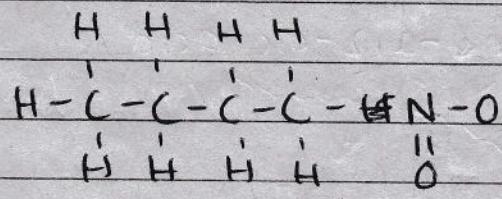
(chloro-3-iodopropane)

ii) Nitro

Functional group : -NO₂, -N=O

Prefix : Nitro

IUPAC name : Nitroalkane



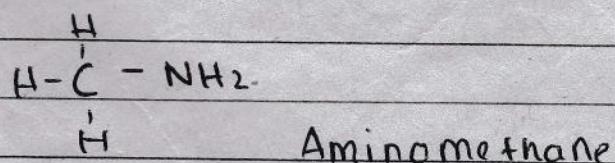
Nitrobutane

iii) Amino

Functional group : -N-H, -NH₂

Prefix : Amino

IUPAC name : Aminoalkane



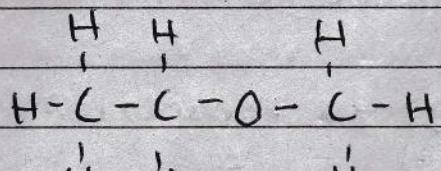
Aminomethane

iv) Ether

Functional group: -O-

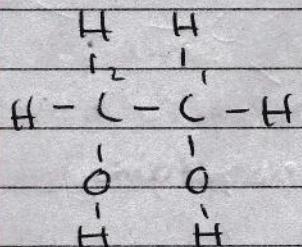
Prefix: Alkoxy

IUPAC name: Alkoxyalkane

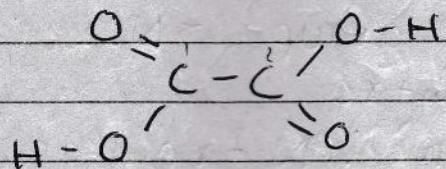


Methoxyethane

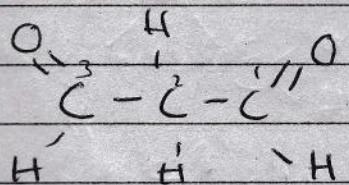
Naming of compounds with two or more functional group of same type.



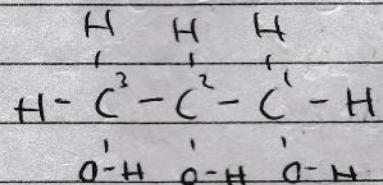
Ethane-1,2-diol



Ethane-1,2-dioic acid

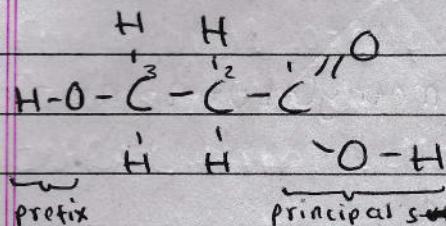


Propane-1,3-dial



Propane-1,2,3-triol (Glycerol)

Naming of organic compounds with two or more functional groups.



Word root - Prop Primary suffix - ane
 Sec. suffix - oic acid Prefix - 3-hydroxy
 3-Hydroxypropanoic acid

Priority order of functional groups

$-\text{COOH} > -\text{COR} > -\text{SO}_3\text{H} > -\text{OX} > -\text{ONH}_2 > -\text{HO} > -\text{NH} > \text{C=O}$
 $-\text{OH} > -\text{NH}_2 > -\text{OR} > \text{C}=\text{C} > \text{C}\equiv\text{C} > -\text{NO}_2 > -\text{X} > -\text{R}$

Functional group

$-\text{CHO}$

$-\text{CN}$

$>\text{C=O}$

$-\text{OH}$

$-\text{NH}_2$

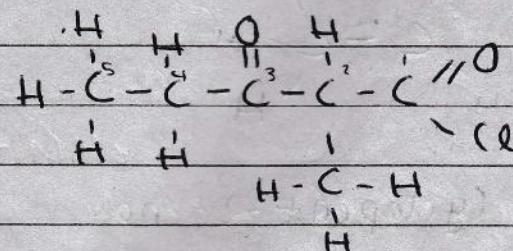
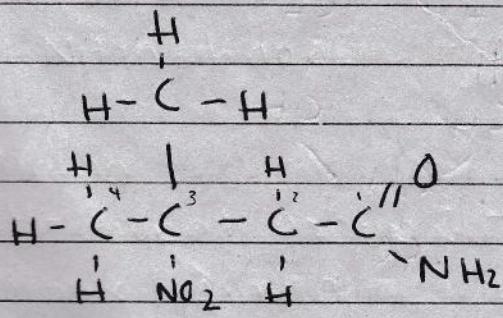
Prefix

formyl or aldo
 (yano)

keto or oxo

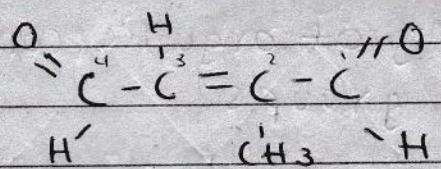
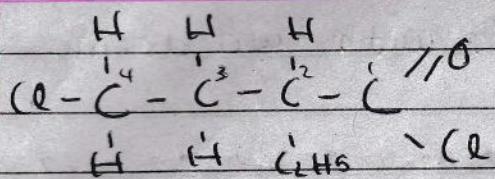
Hydroxy

Amino



3-methyl-3-nitrobutanamide

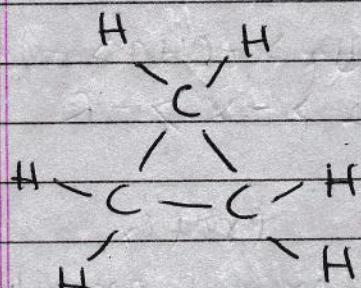
3-Keto-2-methylpentanoyl chloride



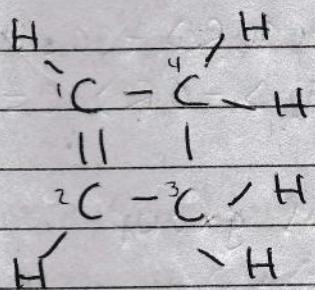
4-chloro-2-ethylbutanoyl chloride 2-methyl-but-2-en e-1,4-dia

Nomenclature of cyclic compounds.

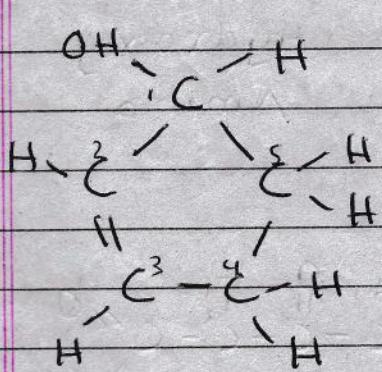
Prefix + (cleft + word root + primary suffix + sec. suffix)



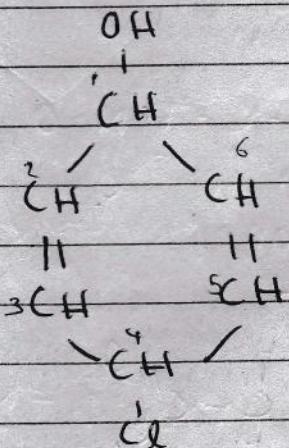
Cyclopropane



Cyclobutene



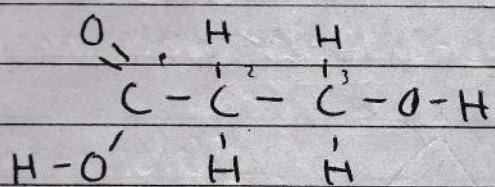
Cyclopent-2-enol



4-chlorocyclohexa-2,5-dienal

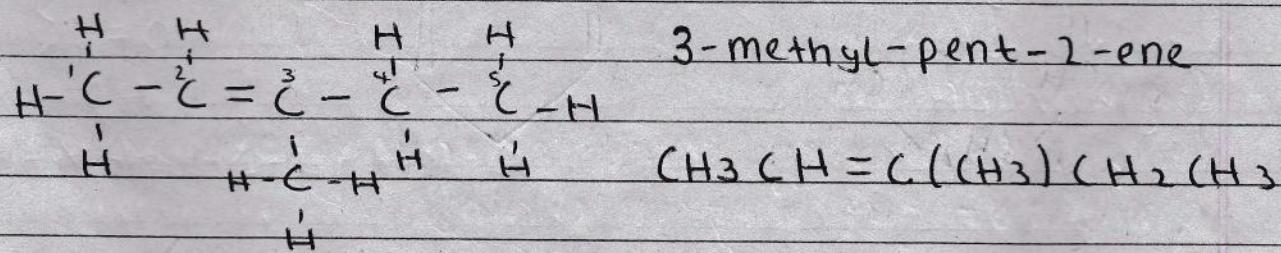
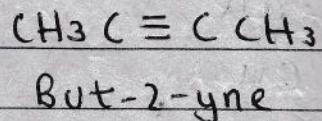
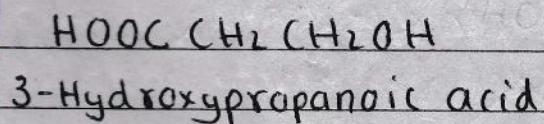
TYPES OF FORMULA IN ORGANIC CHEMISTRY

1) Displayed formula : position of all atoms and all bondings are clearly shown.

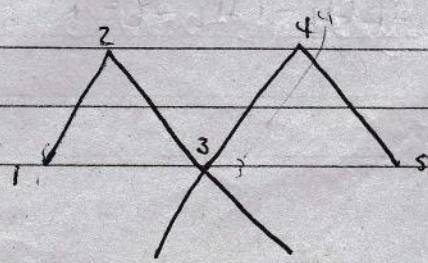
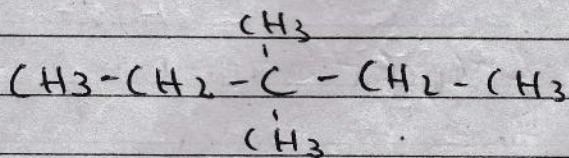
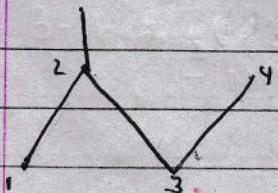
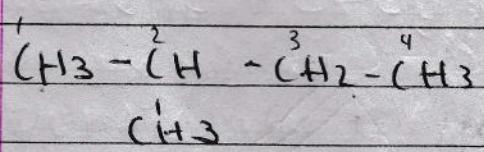


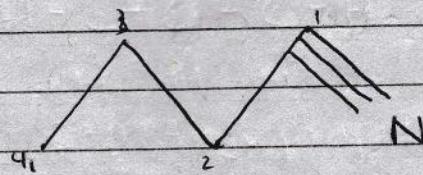
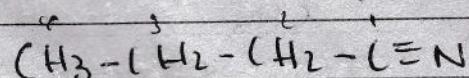
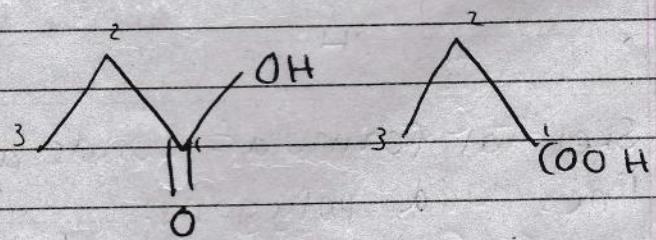
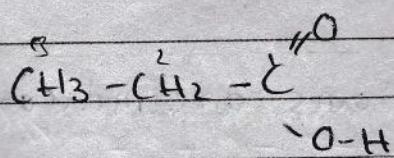
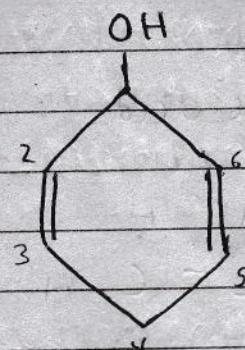
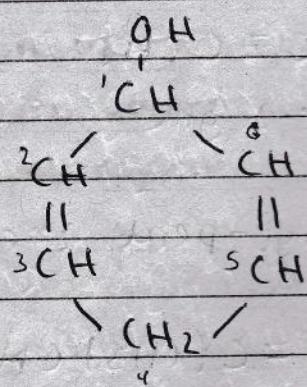
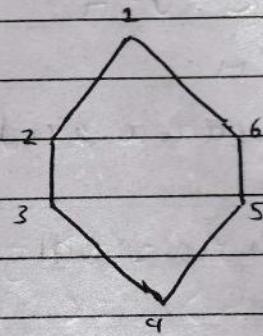
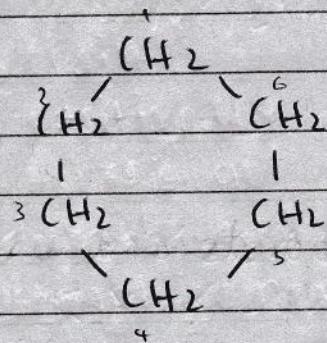
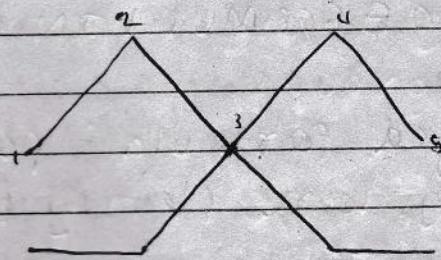
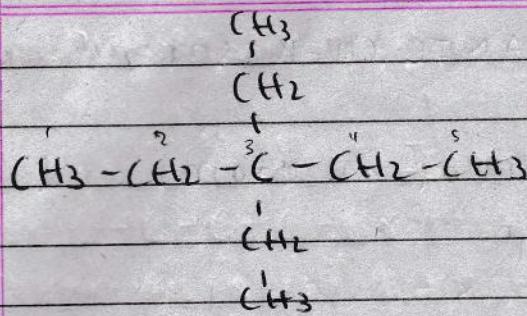
3-Hydroxypropanoic acid.

2) Condensed formula : Only some bonds and branchings are shown.

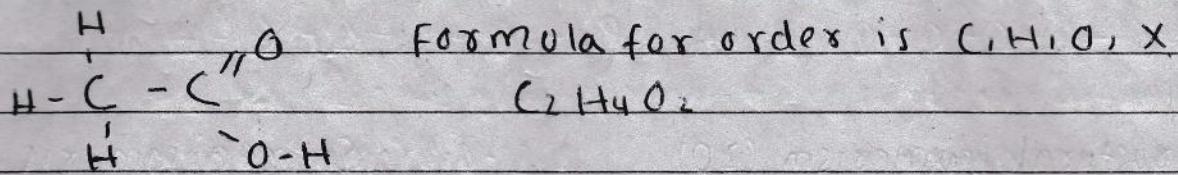


3) Skeletal formula : Bonds and atoms are indicated using lines and polygons.





4) Molecular formula: Represents the total number and kind of atoms present in a molecule.

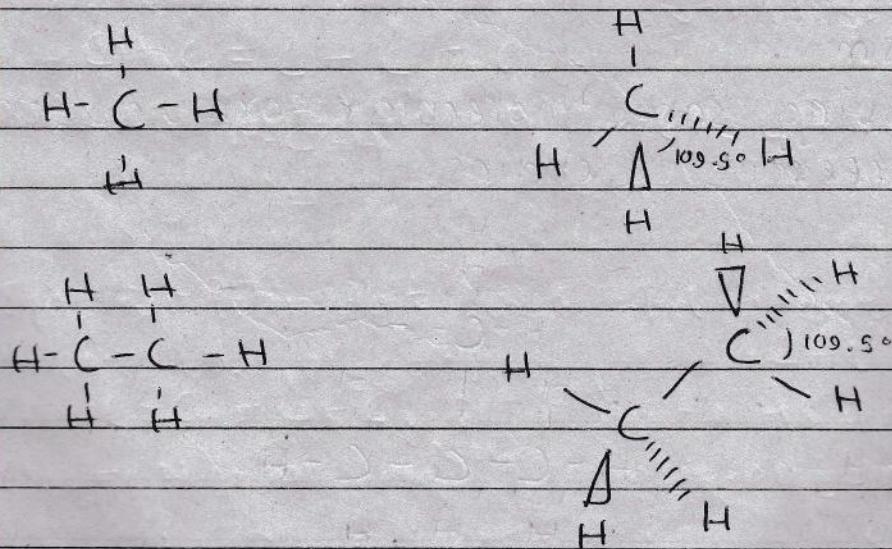


5) Empirical formula: It is the simplest whole number ratio of different atoms present in a molecule

$$\text{Molecular formula} = \text{C}_2\text{H}_4\text{O}_2 \quad [2:4:2]$$

$$\text{Empirical formula} = \text{CH}_2\text{O} \quad [1:2:1]$$

6) Three dimensional formula: position of all atoms, all bondings and bond angles are shown in a three dimensional plane.



ISOMERISM

Isomerism

Structural isomerism (2D)

- Chain
- Positional
- Functional

Stereoisomerism (3D)

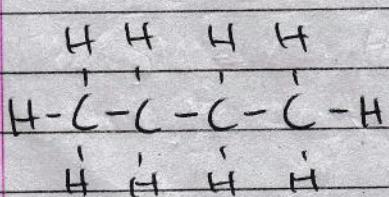
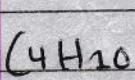
- Geometric
- Optical

Structural isomerism

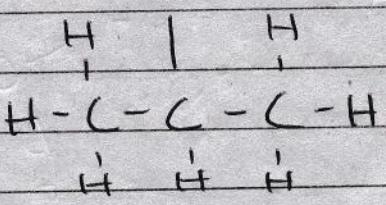
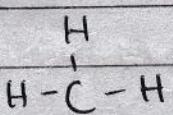
Compounds having same molecular formula but different structural formula are structural isomers. This phenomenon is called structural isomerism.

→ Chain isomerism

Compounds having same molecular formula, functional group but different in chains.

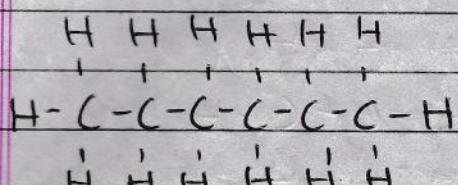


Butane

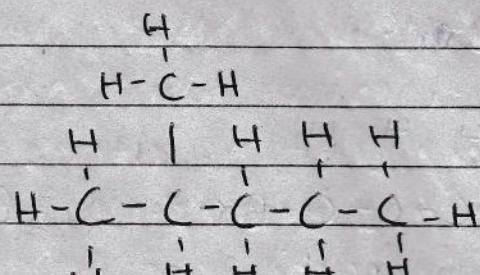


2-methyl propane

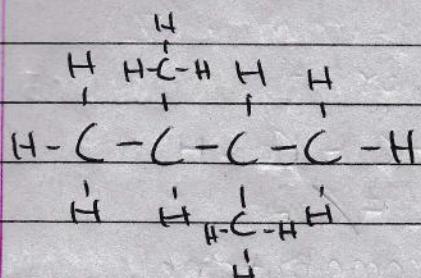
C_6H_{14}



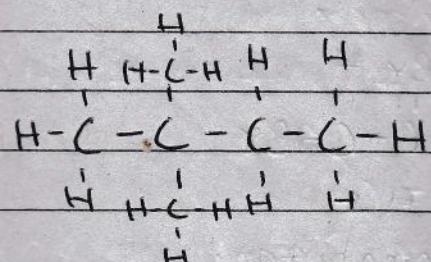
Hexane



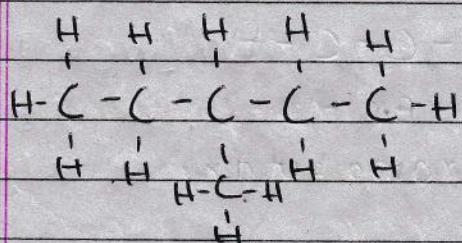
2-methyl pentane



2,3-dimethylbutane



2,2-dimethyl butane

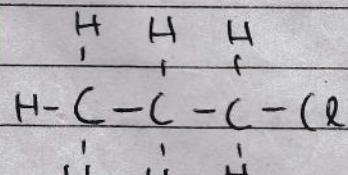


3-methylpentane

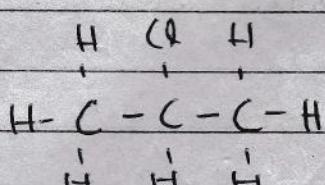
- Position isomerism

Isomers having same carbon chains but different position of functional group.

C_3H_7Cl

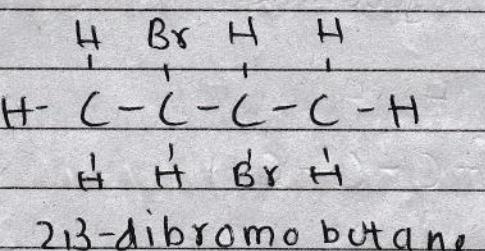
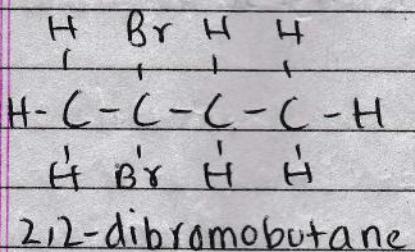
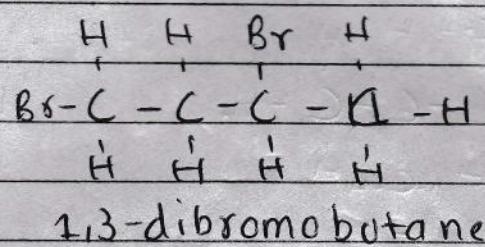
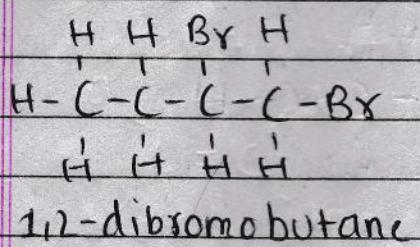
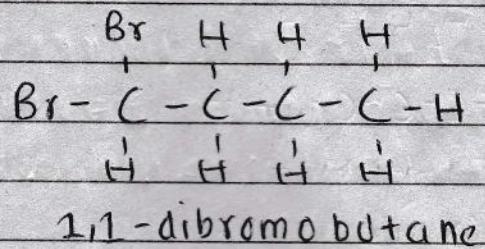
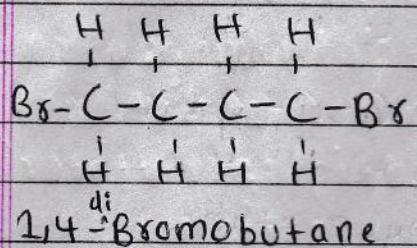


Chloropropane



2-chloropropane

$C_4H_8Br_2$



+ Functional isomerism

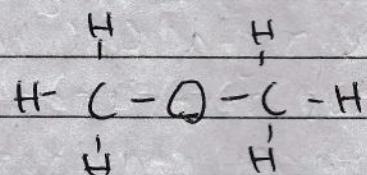
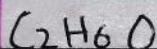
Compounds having same molecular formula but different functional groups.

Rule/Formula

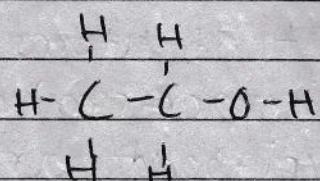
alcohol - ether

aldehyde - Ketone

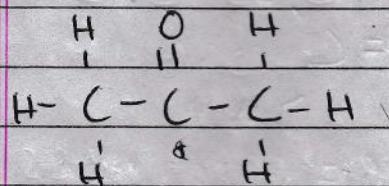
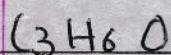
carboxylic acid - ester



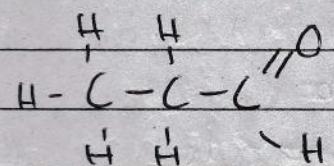
Methoxymethane



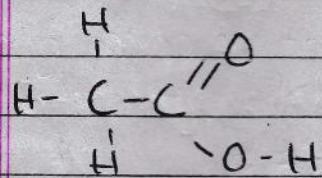
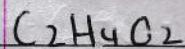
Ethanol



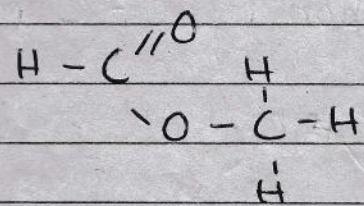
Propan-2-one



Propanal



Ethanoic acid



Methylmethanoate

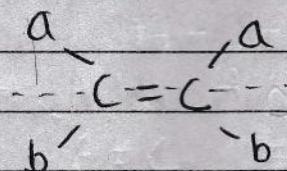
Stereoisomerism (Space isomerism)

Compounds having same molecular formula but different arrangement of atoms in space.

+ Geometric isomerism

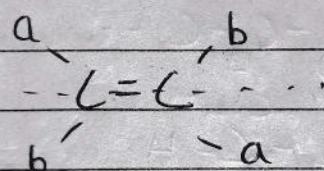
Stereoisomerism which arises due to different geometric arrangement of atoms around a rigid $C=C$ bond. (cis-trans isomerism). $C=C$ allows restricted rotation as pi bonds are weaker and could break.

cis-isomer (E)



Same grp. on one side

Trans-isomer (Z)

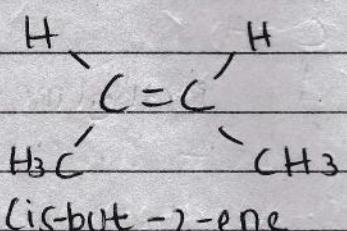


Different grp. on side.

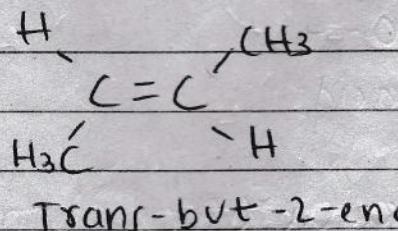
Conditions

+ Compound must have $C=C$.

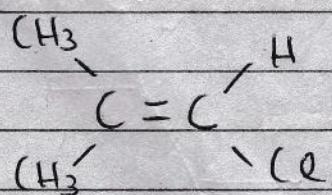
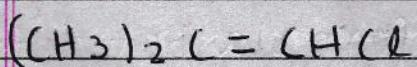
+ Single carbon in $C=C$ mustn't have two same groups.



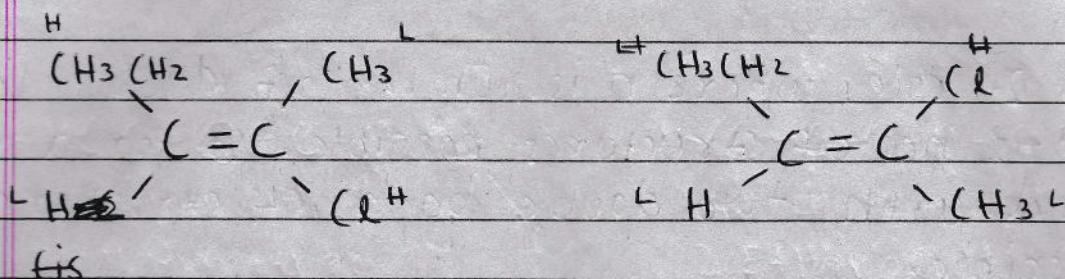
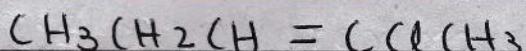
(cis-but-2-ene)



trans-but-2-ene

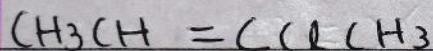


Not possible.



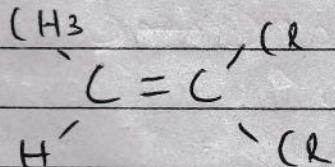
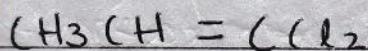
Trans-2-chloro-pent-2-ene cis-2-chloro-pent-2-ene

- * Here H and L indicate high mass and low mass. This system is used during presence of dissimilar groups.



Trans-2-chlorobut-2-ene cis-2-chlorobut-2-ene

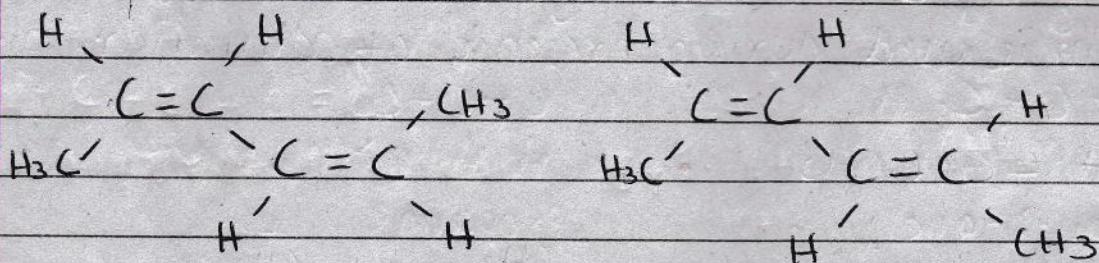
- * Here mass concept is not used due to presence of similar (CH_3 group).



Not possible

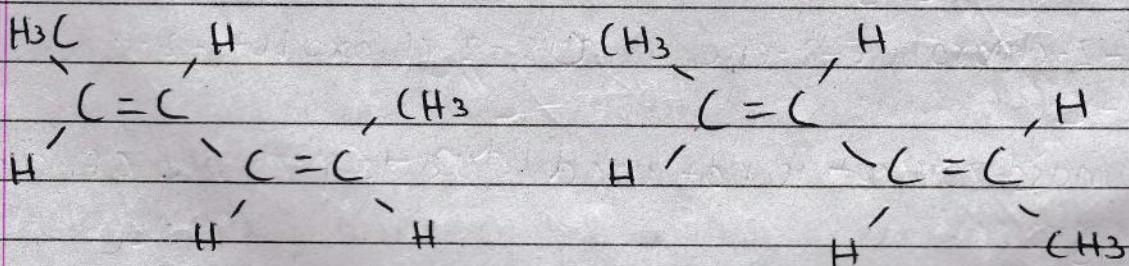
Geometric isomerism with two or more double bonds.

Follows 2^n rule, where n is number of double bonds and 2^n is no. of structures possible. So for a compound with two double bonds, 4 structures are possible.



cis,cis-hexa-2,4-diene

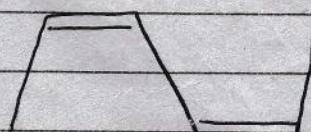
cis,trans-hexa-2,4-diene



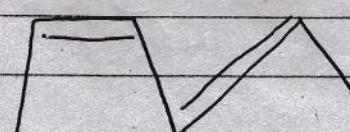
trans,cis-hexa-2,4-diene

trans,trans-hexa-2,4-diene

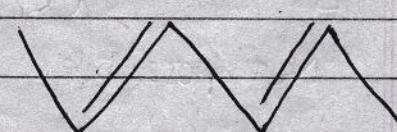
However, cis,trans and trans,cis are same so only three geometric isomers possible.



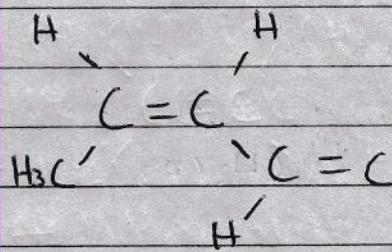
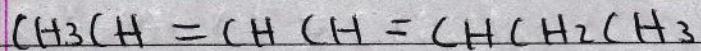
cis,cis



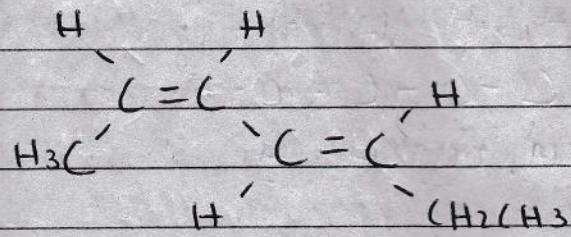
cis,trans



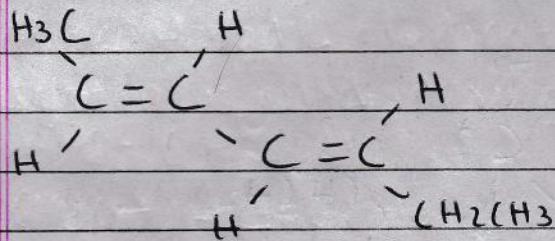
trans,trans



cis, cis - hepta - 2,4 - diene



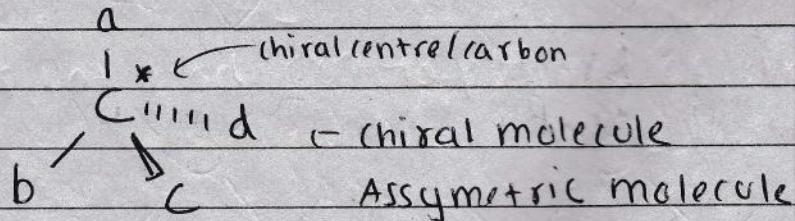
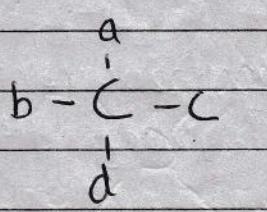
cis, trans - hepta - 2,4 - diene



trans, cis - hepta - 2,4 - diene

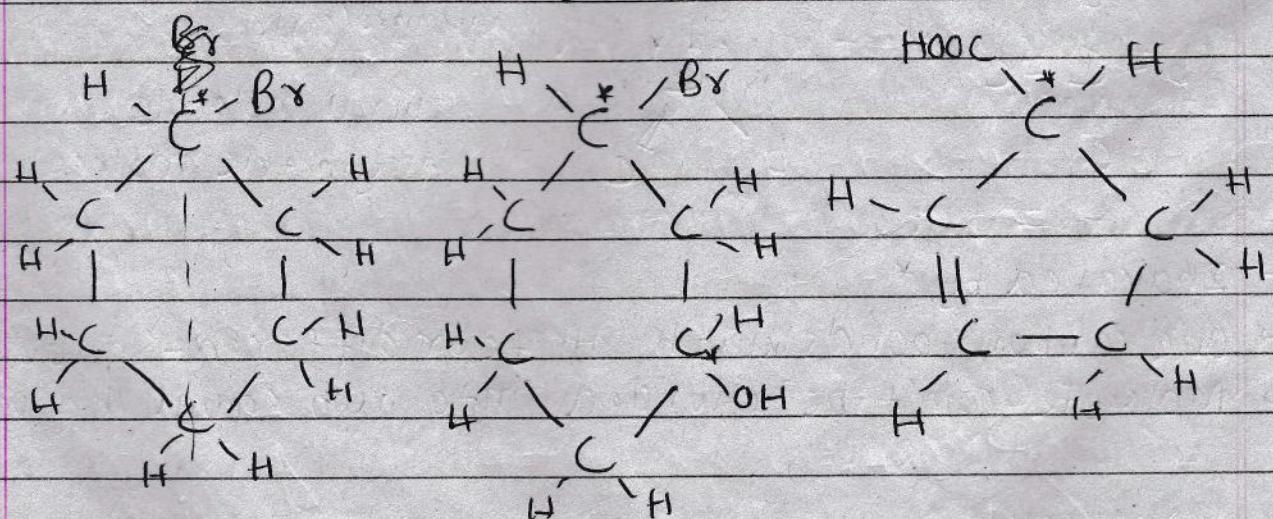
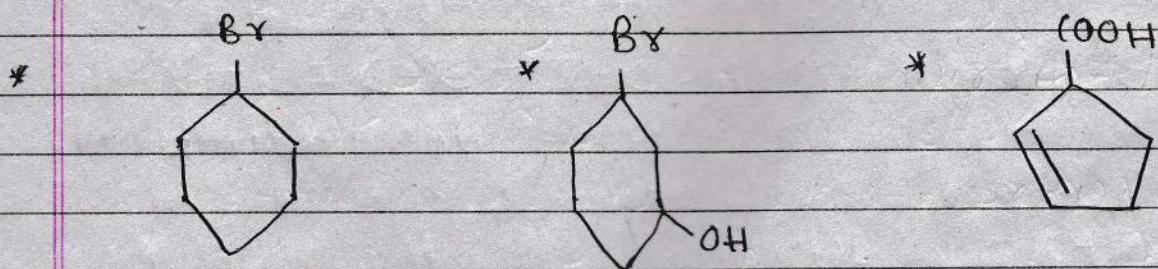
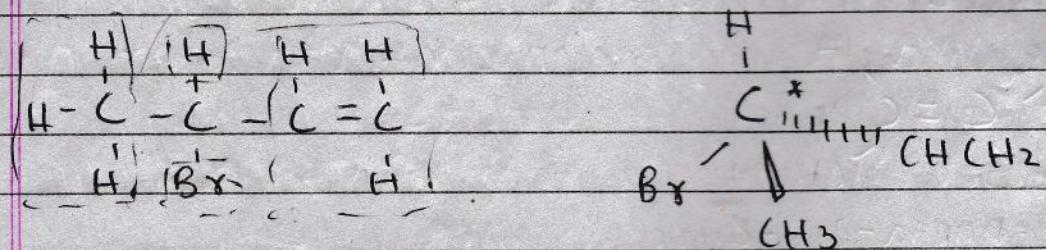
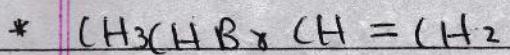
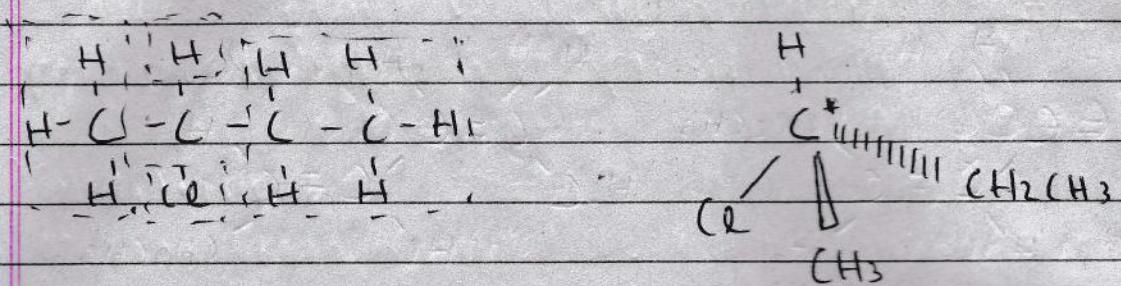
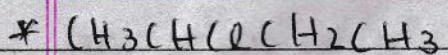
→ Optical isomerism

Chiral centre

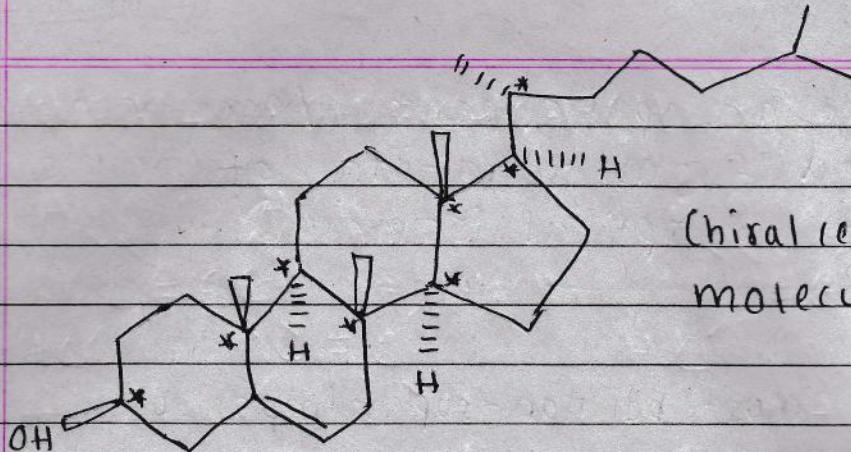


→ Indicated by *

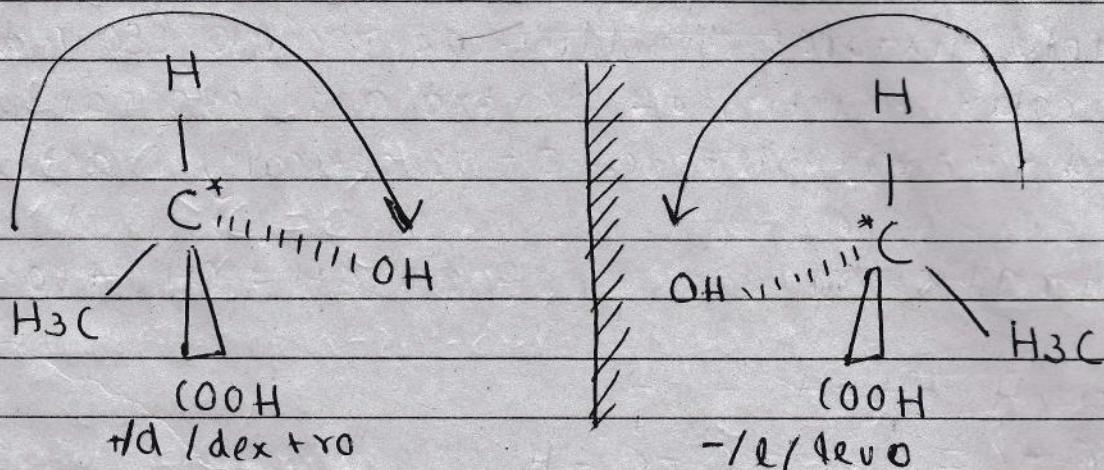
- One carbon bonds with all four different groups
- Molecule can't be divided into two equal halves.



//)

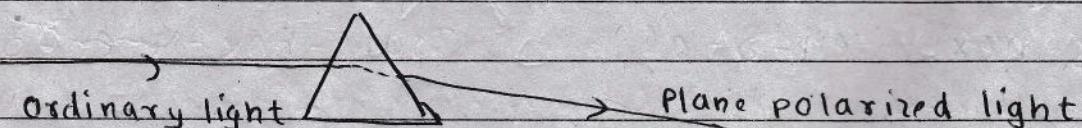


Chiral centres in cholesterol molecule.

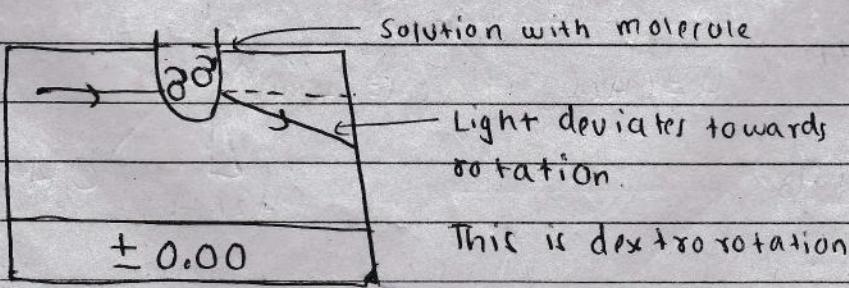


Despite being the same molecule their rotations are different. This is optical isomerism.

Plane polarized light



Polarimeter



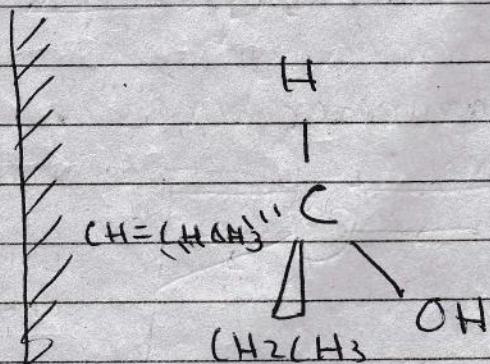
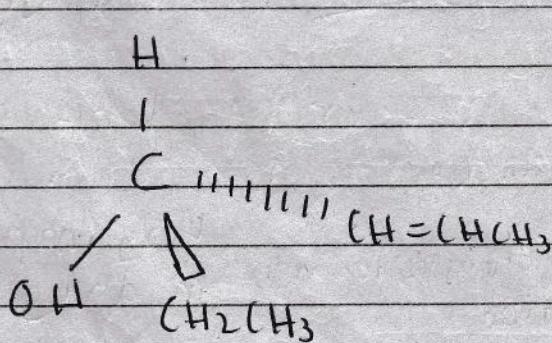
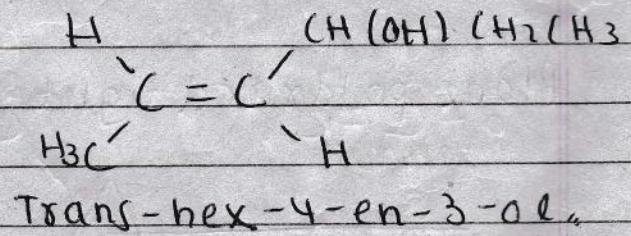
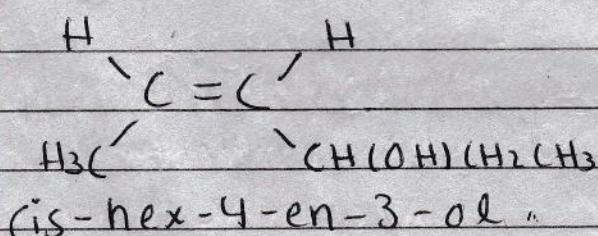
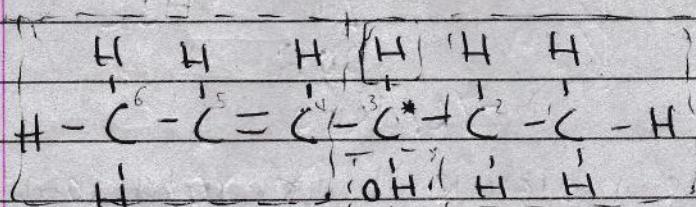
Very important
in drug manufacturing
If object & image can be
overlapped, its superimpos-
able

The given samples are optical isomers/enantiomers. Isomers obtained from rotation of plane polarized light are optical isomers.

Conditions

- + Mirror images must be non-superimposable.
 - + Presence of chiral centre.
 - + Sample mixtures shouldn't be racemic (50% d, 50% L)
Equimolar quantity of dextro and levo sample is called racemic mixture. It is optically inactive.

Write all stereoisomers of $\text{CH}_3\text{CH}=\text{CHCH(OH)CH}_2\text{CH}_3$



TERMINOLOGY

→ Types of reagent : Chemicals used to change organic compounds' functional groups are reagents.

→ Nucleophilic reagent : Reagent which provides nucleophile.

→ Nucleophile (Nu^-) : I^- , Br^- , I^- , CN^- , OH^- , NH_3 , H_2O , RNH_2 , R_2N , R_3N

Atom or group of atoms having lone pair of e^- are called nucleophiles. They maybe -ve charged or neutral, they're attracted towards +ve charge or nucleus.

They have lone pair of e^- so are lewis base.

→ Electrophilic reagent : Reagent which provides electrophile.

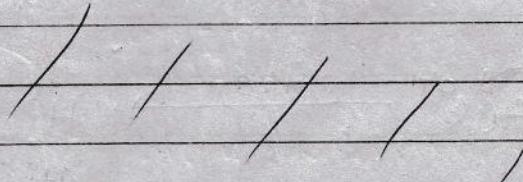
→ Electrophile : Cl^+ , Br^+ , I^+ , NO_2 , SO_3^2- , CH_3C^+ , AlCl_3 , FeCl_3 , AlBr_3 , FeBr_3

Atom or group of atoms lacking pair of e^- are called electrophiles (E^+). They're attracted towards elec electrons, and are +ve charged or neutral. They are also lewis acid.

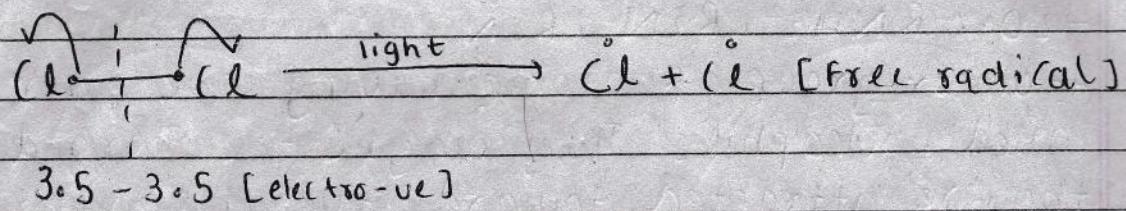
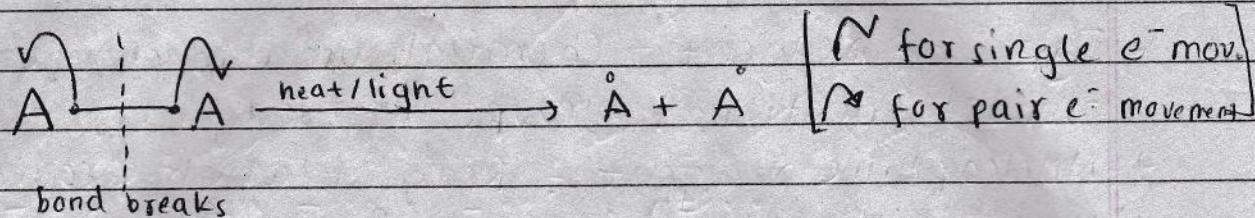
→ Free radical : $\text{Cl}\cdot$, $\text{Br}\cdot$, $\text{CH}_3\cdot$, $\text{CH}_3\text{CH}_2\cdot$

Atom or group of atoms having odd electrons or unpaired electrons. They are extremely reactive and are formed by homolytic fission.

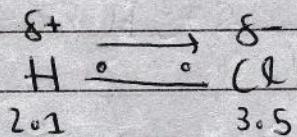
→ Breaking (cleavage) of covalent bond : To form new bonds in product, bonds in reactant must break.



→ Homolytic fission : Non polar bonds and same electroneg.



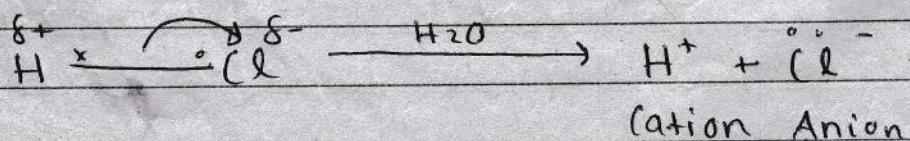
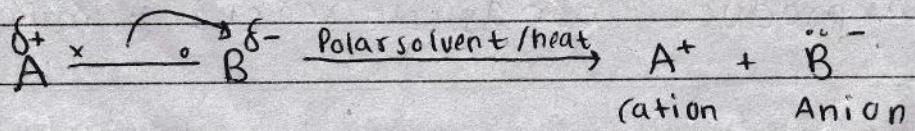
Non polar as electrons are not shifted towards only one side.



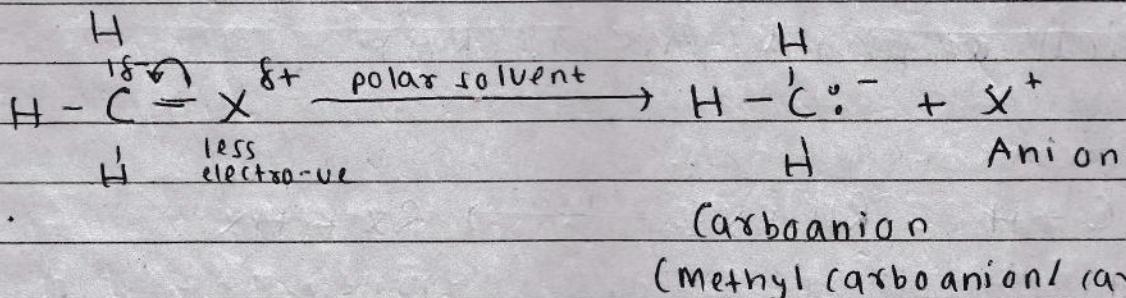
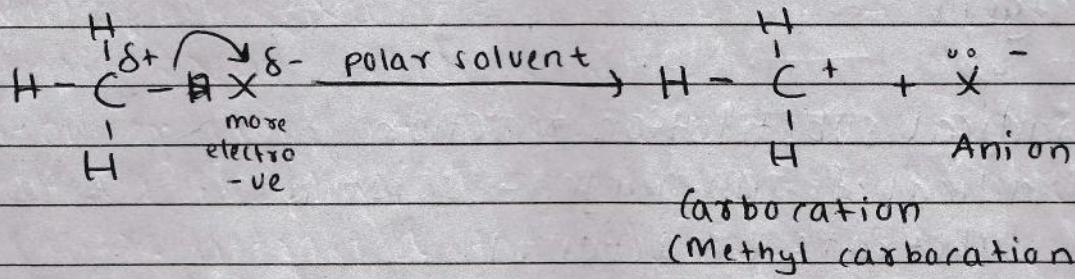
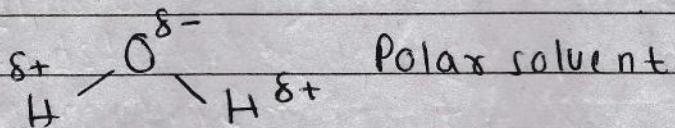
Polar compound

It is a symmetrical fission, where bonded e^- in bond is shifted towards each of bonded atom. We get free radicals from this. Requires heat and light.

→ Heterolytic fission : Assymetrical fission in which both e^- shift towards more electro-ve atom.



Polar compounds are formed. Cations and anions formed in presence of polar solvent.



ORGANIC REACTIONS

Reactant + Reagent \longrightarrow Intermediate \longrightarrow Products.
(substrate)

In organic reactions, intermediates are present as these reactions are slower.

Types of reactions.

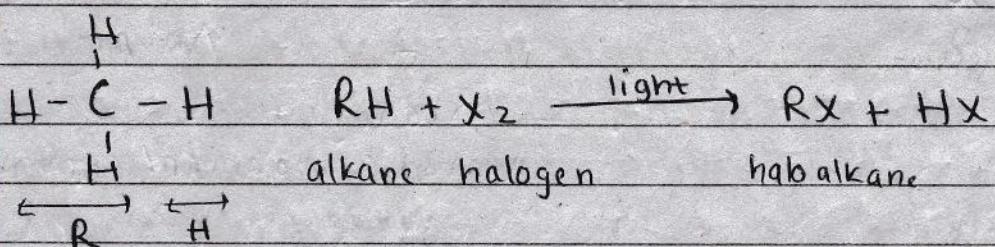
- (i) Substitution : Nucleophilic substitution reaction
Electrophilic substitution reaction
Free radical substitution reaction

- (ii) Addition : Nucleophilic addition reaction
Electrophilic addition reaction
- (iii) Elimination
- (iv) Oxidation, Reduction
- (v) Condensation
- (vi) Hydrolysis

Free radical substitution reaction

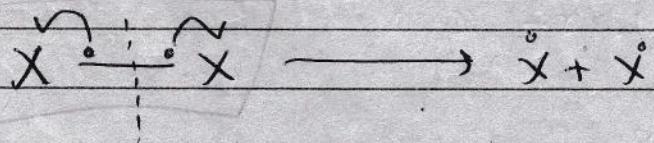
Free radical from reagent substitutes free radical from substrate (reactant).

Typical compound: Alkane (RH)

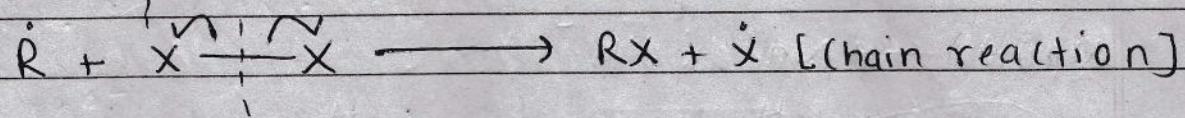
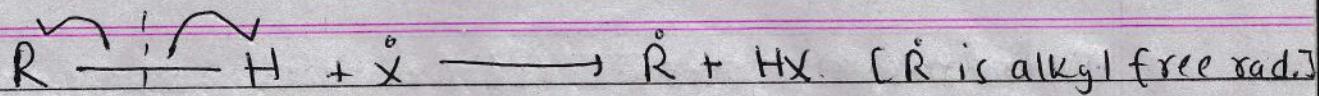


Mechanism

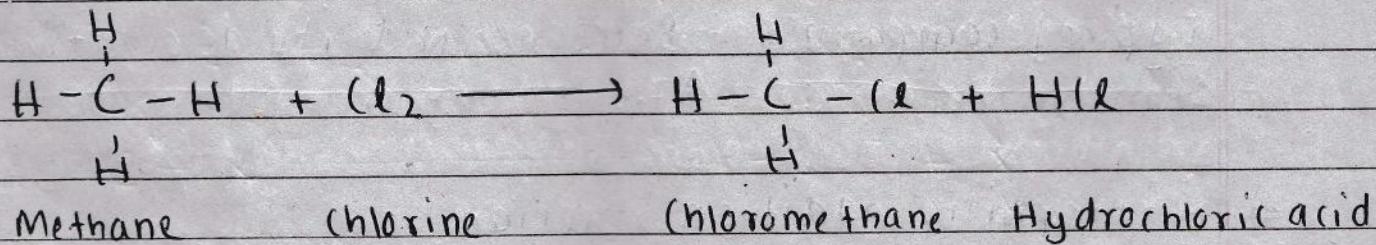
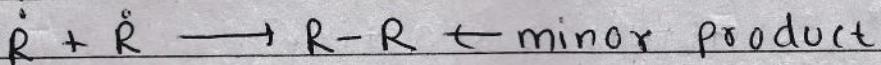
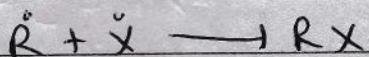
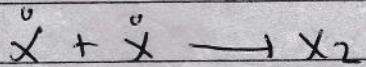
→ Initiation / Chain initiation: Free radicals are formed from reagent by homolytic fission.



→ Propagation / Chain propagation: free radicals from reagent produces another free radical (alkyl) which reacts with halogen to produce halogen free radical.



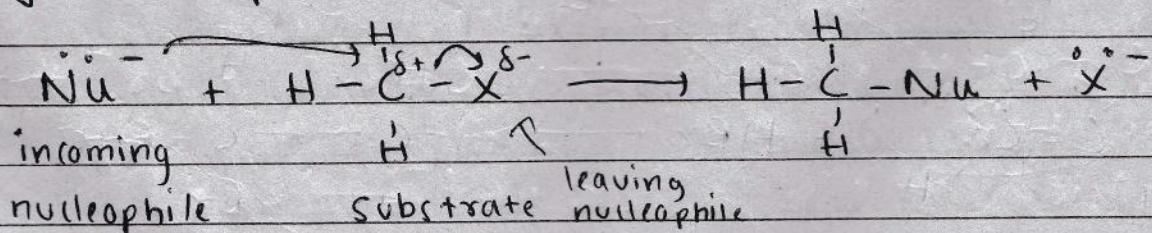
→ Termination



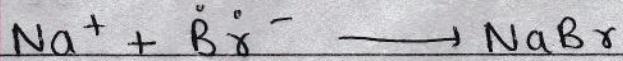
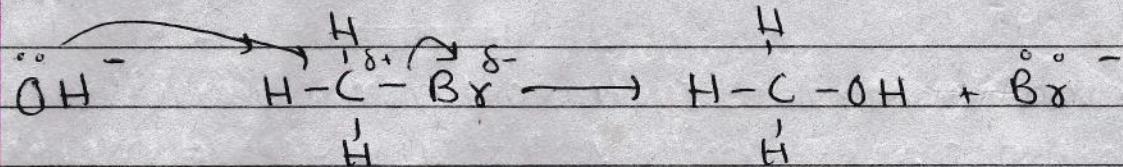
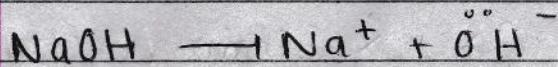
Nucleophilic substitution reaction

Nucleophile in reagent + substitutor another nucleophile from substrate.

Typical compound: Haloalkanes



Mechanism



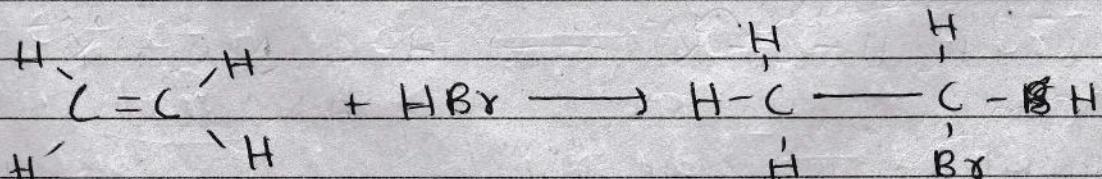
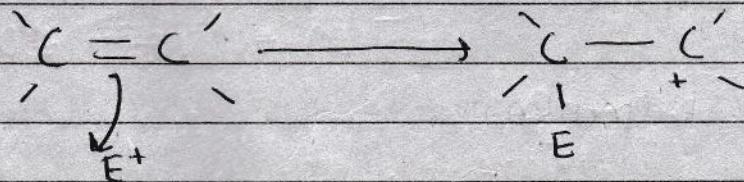
Electrophilic substitution reaction

Typical compound : Benzene and its derivatives
 ↓ Azo ↓

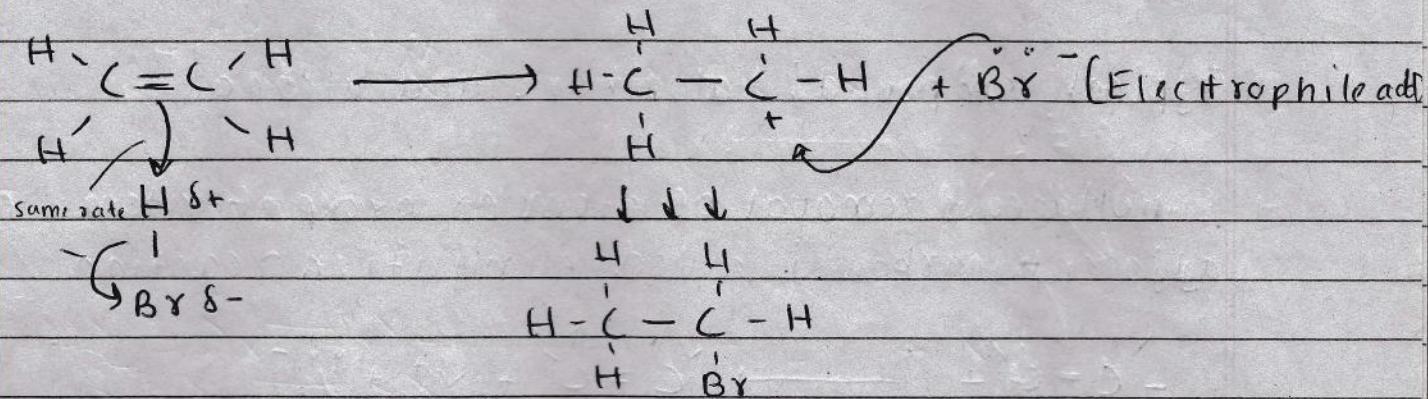
Electrophilic addition reaction

Electrophile adds to the substrate.

Typical compound : Alkene and Alkyne

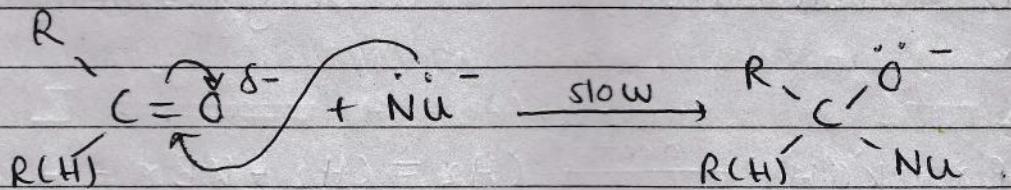


Mechanism



Nucleophilic addition reaction

Typical compound: Aldehydes and ketone

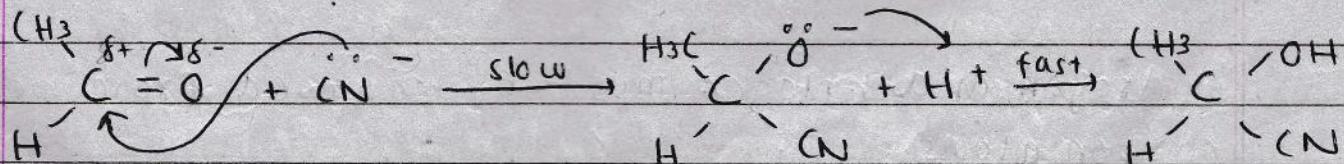
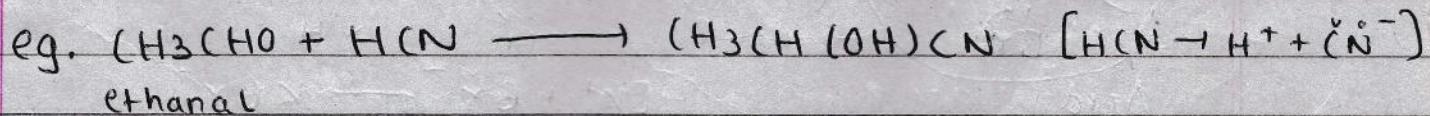


RH is aldehyde

RR is ketone

Has permanent polarity.

Neutral to charged molecule conversion is slow while charged to neutral is fast.



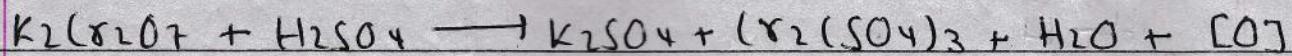
Oxidation reaction

Addition of oxygen or removal of hydrogen from substrate. Needs oxidizing agent.

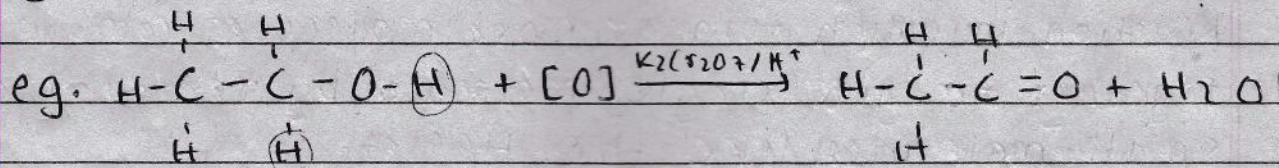
(reagent)
Oxidizing agent : acidified KMnO_4 ($\text{KMnO}_4 / \text{H}^+$)

acidified $\text{K}_2\text{Cr}_2\text{O}_7$ ($\text{K}_2\text{Cr}_2\text{O}_7 / \text{H}^+$)

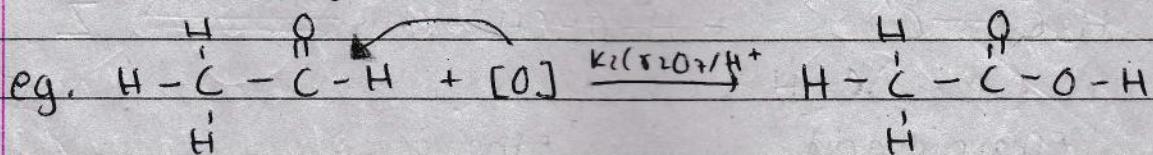
Role of reagents is to provide nascent oxygen.



Typical compound : alcohol, aldehyde, ketone etc.



Removal of hydrogen.



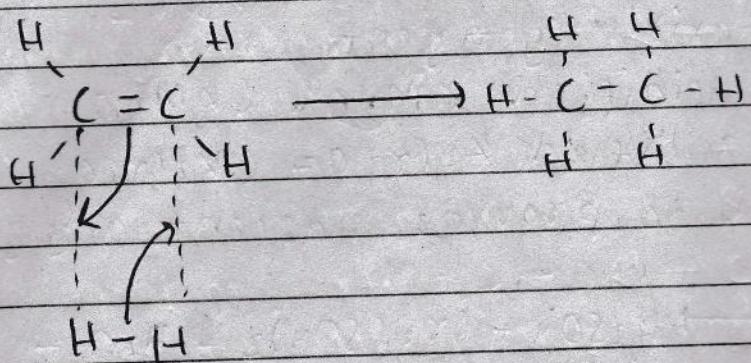
Addition of oxygen.

Reduction reaction

Addition of hydrogen or removal of oxygen from the substrate. Requires reducing agents. LiAlH_4 in dry ether (lithium tetrahydrido aluminate); NaBH_4 / heat (Sodium tetrahydrido borate) H_2 / Ni at 200°C ; $\text{HCl} / \text{Sn} / \text{CH}_3\text{CH}_2\text{OH} / \text{Na}$.

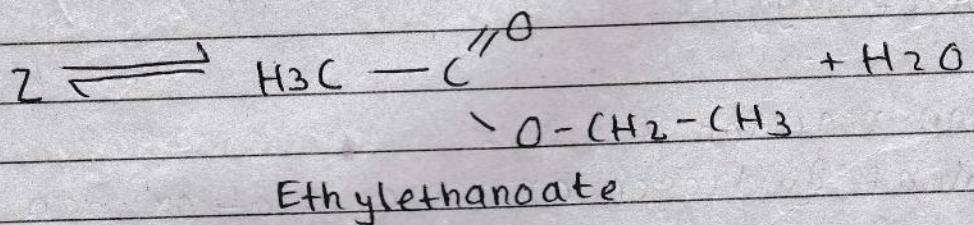
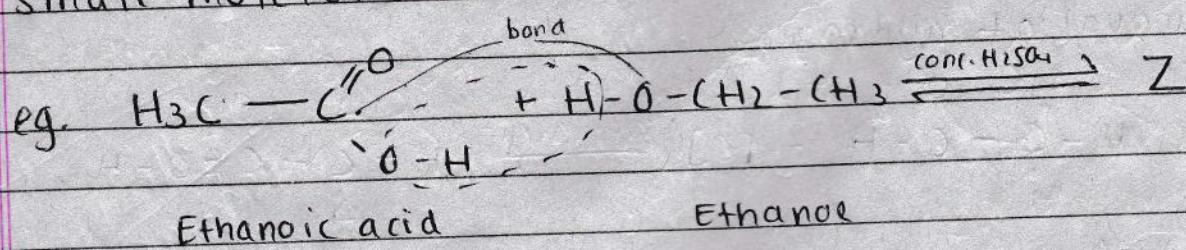
They provide nascent hydrogen.

$$\text{e.g. } \text{CH}_2 = \text{CH}_2 + \text{H}_2 \xrightarrow{\text{Ni}/200^\circ} \text{CH}_3\text{CH}_3$$



Condensation reaction

Condensation reaction: Reaction in which two or more molecules combine together to give single molecule by removal of small molecules like H_2O , HCl etc.



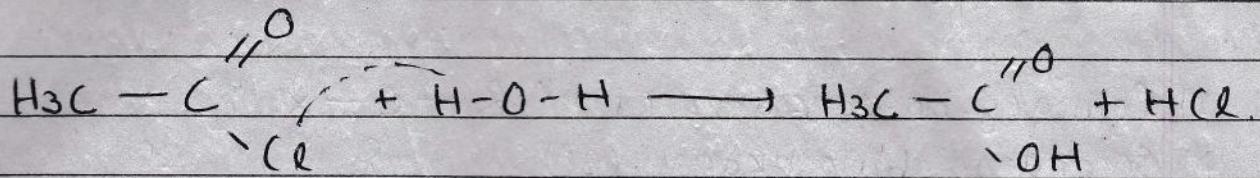
Hydrolysis reaction

Hydro - water, lysis - breaking, fission.

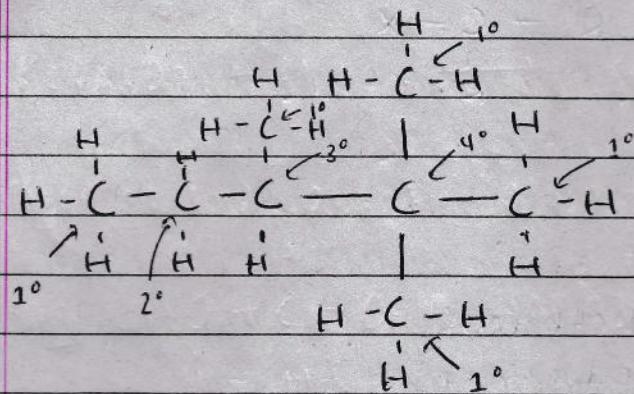
Hydro - water lysis - breaking down of
Reaction which takes place by breaking down of
water molecules.

Reaction in which water acts as one of the reactant is hydrolysis reaction.

e.g.



^x_m
¹⁷_e
²_o) DEGREE OF CARBON



1) Primary carbon (1°): $\text{R}-\text{C}$

2) Secondary carbon (2°): $\text{R}-\text{C}-\text{R}'$

3) Tertiary carbon (3°): $\begin{array}{c} \text{R} \\ | \\ \text{C} \\ | \\ \text{R}' \quad \text{R}'' \end{array}$

4) Quaternary carbon (4°): $\begin{array}{c} \text{R} \\ | \\ \text{R}'-\text{C}-\text{R}'' \\ | \\ \text{R}''' \end{array}$

DEGREE OF HYDROGEN

1) Primary hydrogen (1°) - Bonded to 1°C

2) Secondary hydrogen (2°) - Bonded to 2°C

3) Tertiary hydrogen (3°) - Bonded to 3°C

4) Quaternary hydrogen (4°) - can't exist

A

DEGREE OF HALO ALKANES ($R-X$)

1) Primary haloalkanes (1°): $R - C - X$

2) Secondary haloalkanes (2°): $\begin{array}{c} R \\ | \\ R' - C - X \end{array}$

3) Tertiary haloalkanes (3°): $\begin{array}{c} R \\ | \\ R' - C - X \\ | \\ R'' \end{array}$

DEGREE OF ALCOHOL

1) Primary alcohol (1°): Methanol

2) Secondary alcohol (2°): Ethanol

3) Tertiary alcohol (3°): α -Methyl-ethanol

*Submitted
U-1-022
SKD*