Basic Organic Chemistry

Aliphatic Hydrocarbons containing σ-bonds

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Basic Organic Chemistry and aliphatic hydrocarbons containing σ-bond

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UNIT-3 Chapter – 5

Nomenclature of organic compounds (Only Acyclic - IUPAC-1993)

Electronic displacements: Inductive effect, electromeric effect, mesomeric effect and hyper conjugation. Applications of inductive effect to bond length, dipole-moment, reactivity of alkyl halides, relative strength of acid, basicity of amines

Homolytic and heterolytic fission, curly arrow rules

Reaction intermediates: Carbocation, carbanion, free radical, carbenes and benzynes (Formation by cleavage type, structure, relative stabilities, generation)

Types of organic reagents: Nucleophiles and electrophiles.

Types of organic reactions: Substitution, addition, elimination and rearrangement.

Nucleophilic substitution reaction mechanism (SN1 & SN2) for alkyl halides

Introduction to Stereochemistry: Configuration, Fischer projection formula, homomers and enantiomers, geometrical isomerism: cis–trans, C.I.P rules with E/Z notations.

Introduction

Organic Chemistry

Subdiscipline of chemistry
Study of C atoms

Bonds

Essential feature of Organic Compounds
Single, multi-polar, polar or nonpolar

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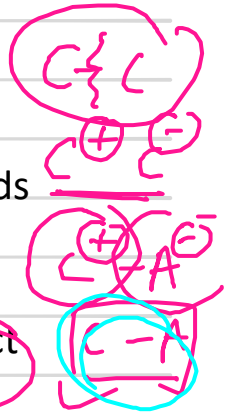
Substrate + reagent -> products

Chemical reaction



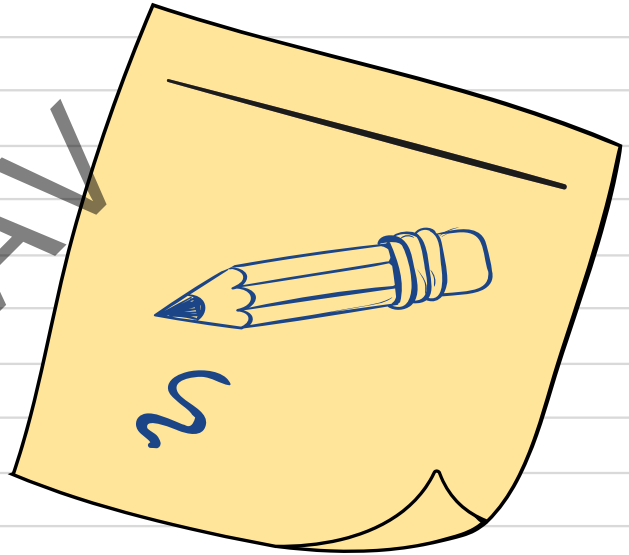
Breaking or cleavage of bonds in substrate
Intermediates
New bonds forms -> product

Mechanism

Steps for breaking and making of bonds

Substrate -> intermediates -> products

IUPAC!



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INTERANTIONAL UNION OF
PURE AND APPLIED CHEMISTRY

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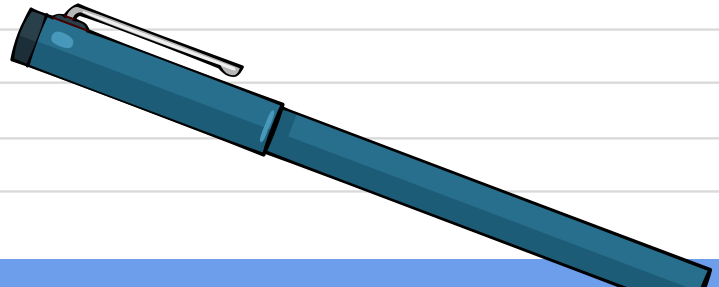
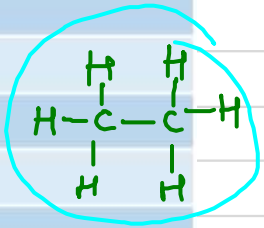


ALKANES

C_nH_{2n+2}

Name	Molecular Formula (C_nH_{2n+2})	Condensed Structural Formula
methane	CH_4	CH_4
ethane	C_2H_6	CH_3CH_3
propane	C_3H_8	$CH_3CH_2CH_3$
butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$
pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$
hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$
heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$



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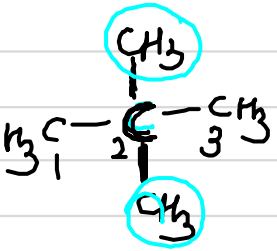
Some important terms



Neopentane

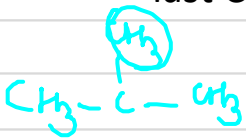
Prefix "n" (normal)

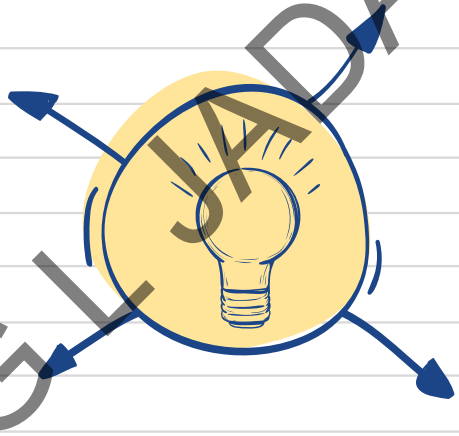
n = normal /straight C in one continuous chain

n-propane

Prefix "Iso"

Methyl ($-CH_3$) attached to second last C atom





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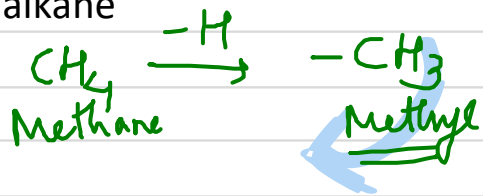
meaning of "Neo"

Two methyl attached to 2nd last C atom

Alkane – H = Alkyl

Alkyl group

Removal of H from alkane



IUPAC RULES & NOMENCLATURE

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BASICS

5. e 3. m octane

IUPAC Rules for naming alkanes (C_nH_{2n+2})

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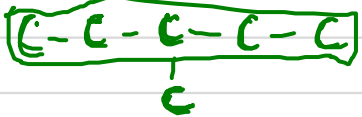
Alphabet a b c d ... e ethyl (m)

Rule-1

Longest Continuous Chain



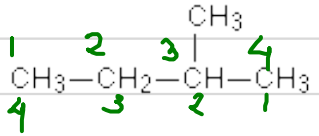
Rule-2

Name longest chain

Butane

Rule-3

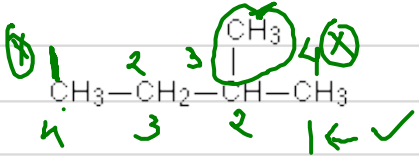
Number the longest chain



3,5

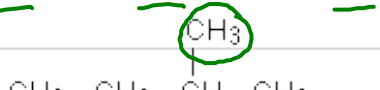
Rule-4

Identify the substituent



Rule-5

Prefix, position and name



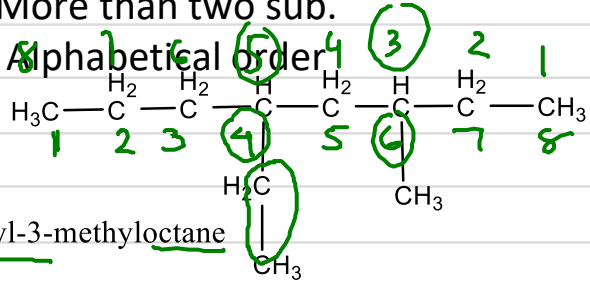
2- methylbutane

Rule-6

5-ethyl 3-methyl

More than two sub.

Alphabetical order

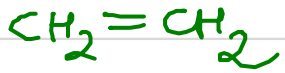


5-ethyl-3-methyloctane

IUPAC Nomenclature of alkenes (C_nH_{2n})

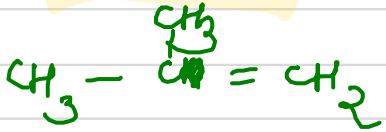
Formula : alkane – ane + ene = Alkene

Ethene

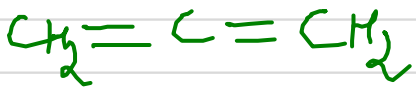


propene

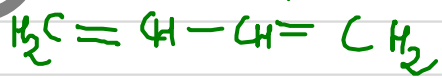
2-methylpropene



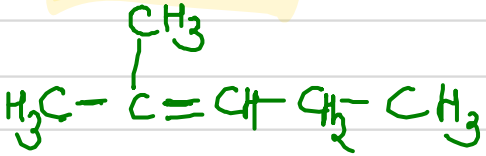
1,2-propadiene



1,3-butadiene



2-methyl-2-pentene



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IUPAC Nomenclature of alkyne (C_nH_{2n-2})

$C \equiv C$

Formula : alkane – ane + yne = Alkyne

$CH \equiv CH$

Ethyne

$CH_3 - C \equiv CH$

propyne

$CH_3^{4} - C^{3} \equiv C^{2} - CH_3^{1}$

2-butyne

$CH^{1} \equiv C^{2} - C^{3} \equiv CH$

1,3 – butadyne

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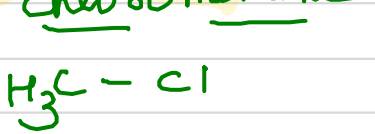
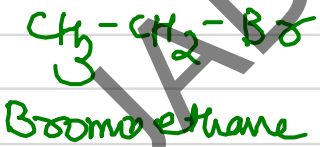
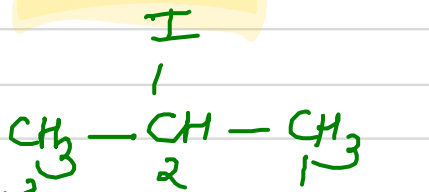
IUPAC Nomenclature of Alkyl halide

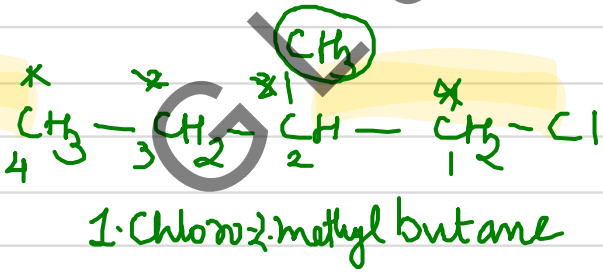
Prefix = "halo" (Chloro, flouro, bromo, iodo)

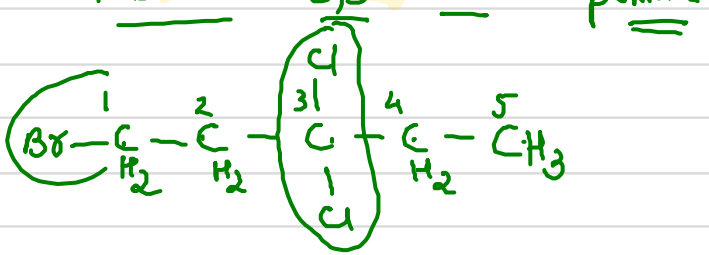
Formula : halo + alkane = Haloalkane











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IUPAC Nomenclature of Alcohols

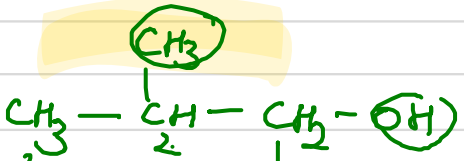
$-OH$

Sufix = "ol"

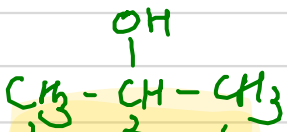
Formula : alkane – e + ol = alkanol

CH_3-OH

CH_3CH_2-OH

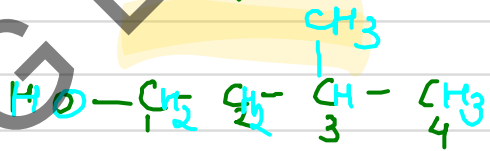


2. methyl propanol



2-propanol

3-methyl-1-butanol



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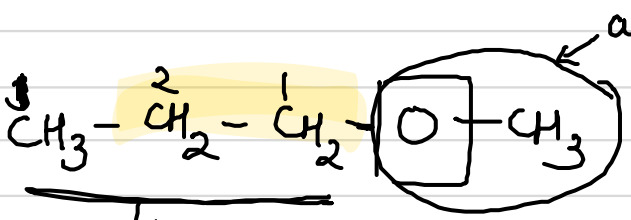
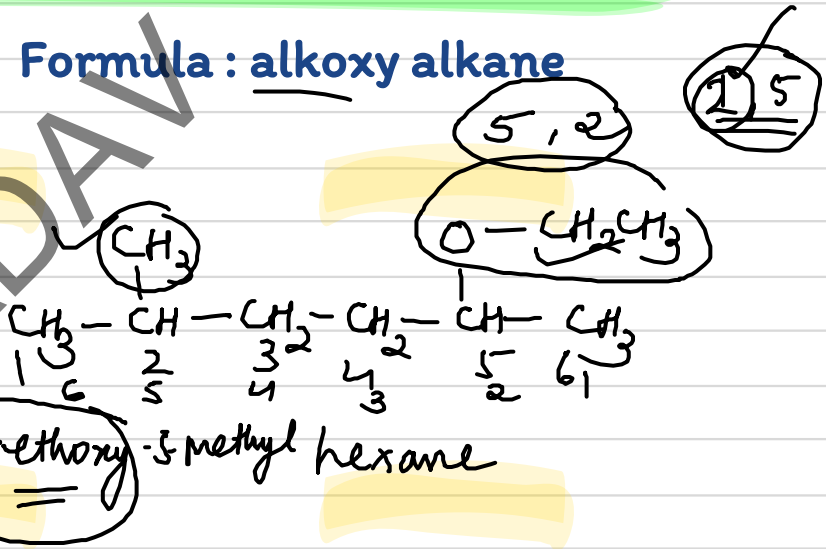
IUPAC Nomenclature of Ethers

C — O — C



1-methoxy propane

Formula : alkoxy alkane



2-ethoxy-5-methyl hexane

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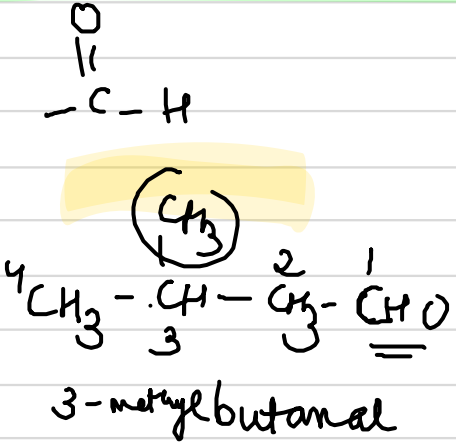
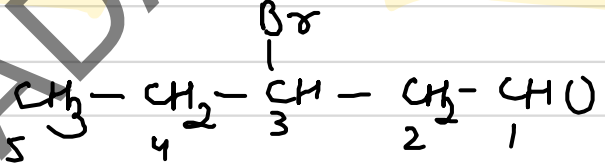
IUPAC Nomenclature of Aldehydes

Sufix = "al"

Formula : alkane – e + al = alkanal

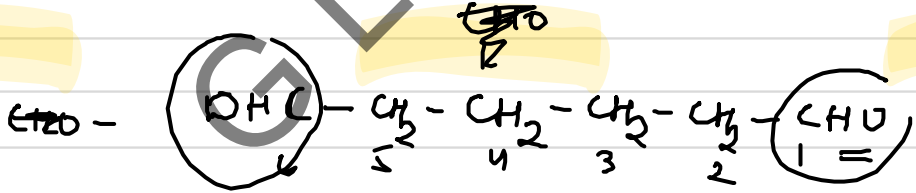


3-methylbutanal



3-Bromo petanal

-al
-dial



~~Hexan~~ Hexane

Hexanal

1,6-Hexanedial

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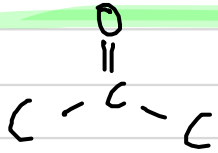
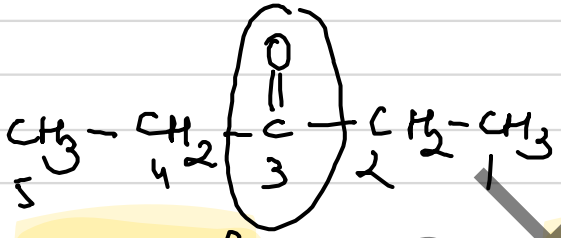
IUPAC Nomenclature of ketones

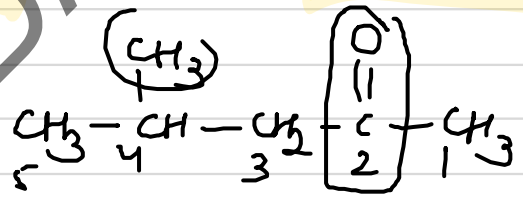


Sufix = "one"

Formula : alkane – e + one = alkanone



3- Pentanone



4-methyl-2-petanone

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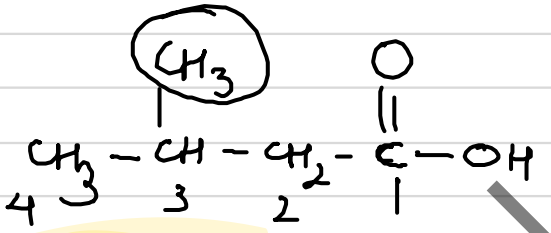
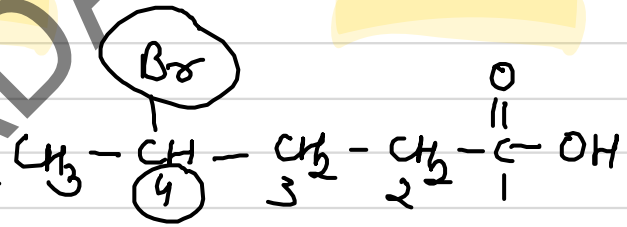
IUPAC Nomenclature of Carboxylic acids

Sufix = "oic acid"

Formula : alkane – e + oic acid = alkanoic acid



3-Methylbutanoic acid



4-Broomo Pentanoic acid

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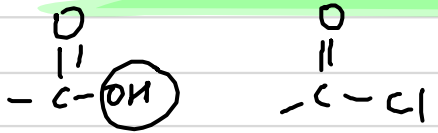
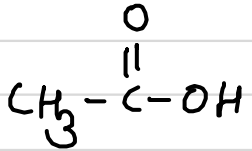
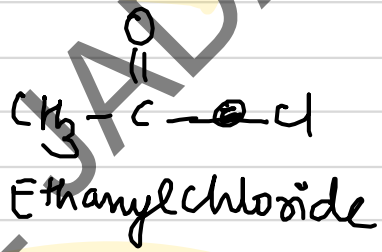
IUPAC Nomenclature of Carboxylic acids derivatives

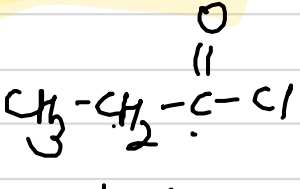


Acid Chlorides

Formula : alkane – e + yl chloride= alkanyl chloride







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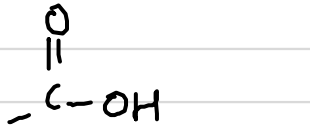
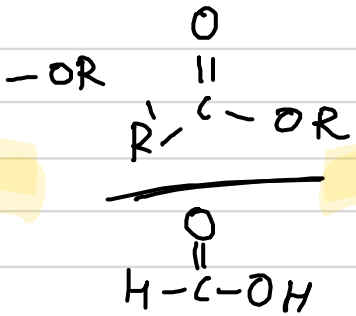
IUPAC Nomenclature of Carboxylic acids derivatives

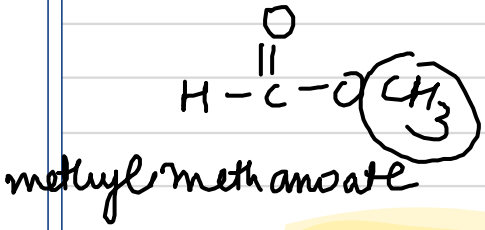


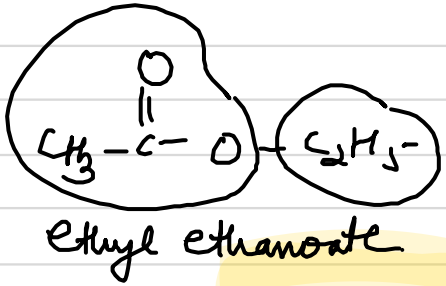


Ester

Formula : alkyl + alkanoate

ic acid → ate





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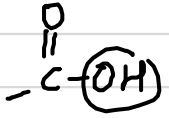
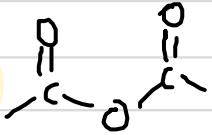
IUPAC Nomenclature of Carboxylic acids derivatives

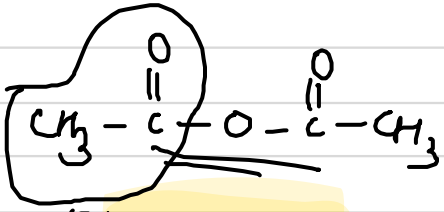


– OCOR



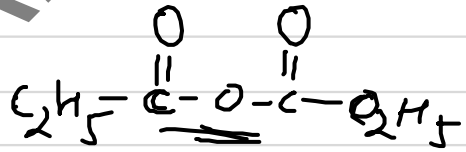
Anhydrides

Formula : Alkanoic + anhydride

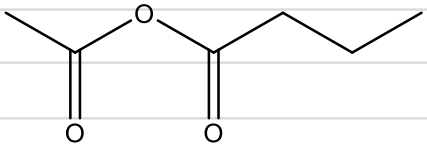


Ethanoic anhydride

or



Propanoic anhydride



acetic butyric anhydride

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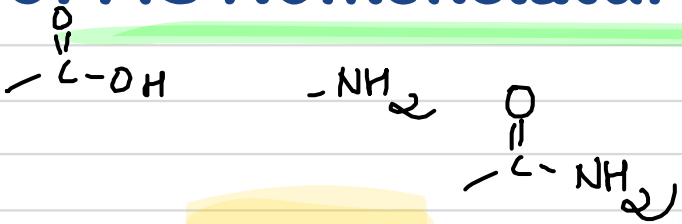
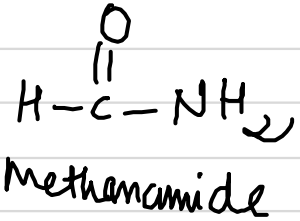
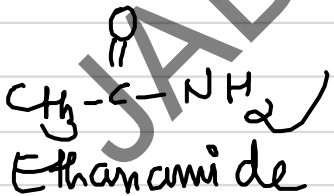
IUPAC Nomenclature of Carboxylic acids derivatives



Amides

Formula : Alkane – e + amide





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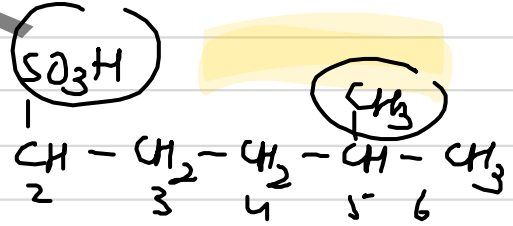
IUPAC Nomenclature of Sulfonic Acids

Formula : Alkane + sulfonic acid

$-SO_3H$

$CH_3CH_2 \cdot SO_3H$

Ethane sulfonic acid



5-methyl - 2-hexanesulphanoic acid

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IUPAC Nomenclature of Nitro Compounds

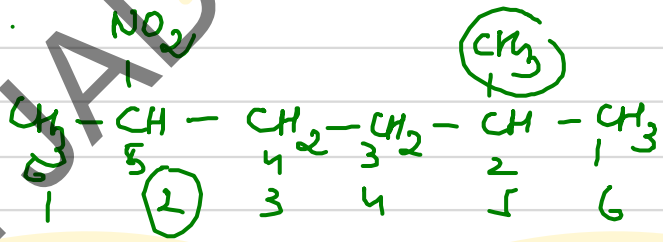
Prefix: Nitro

Formula : Nitro + Alkane

$-NO_2$

CH_3NO_2

Nitromethane



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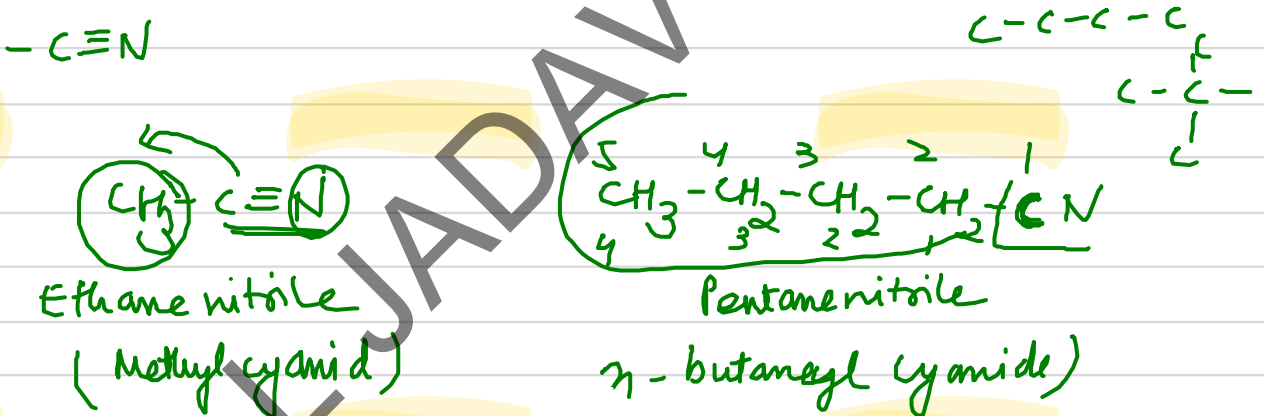
IUPAC Nomenclature of Cyanides or nitriles



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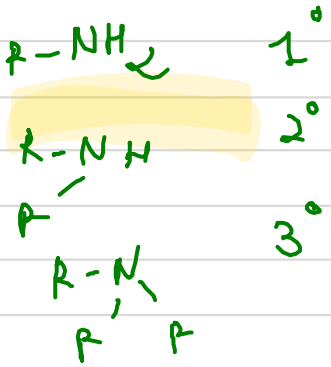
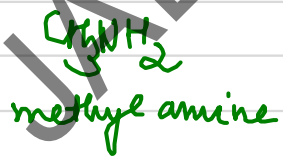
IUPAC Nomenclature of Amines

Suffix: amine

Formula : Alkane + amine





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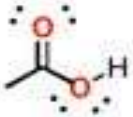
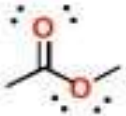
Polyfunctional Compounds

Priority table

HIGHEST PRIORITY

Group	Prefix	Suffix	Example
 carboxylic acid	carboxy-	-carboxylic acid -oic acid	ethanoic acid
 ester	(R)-oxycarbonyl	-oate	methyl ethanoate
 acid chloride	halocarbonyl-	-oyl halide	ethanoyl chloride
 amide	carbamoyl-	-carboxamide -amide	ethanamide

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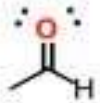
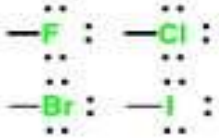
—C≡N : **nitrile**	cyano-	-nitrile	ethanonitrile
 **aldehyde**	formyl-	-al -carbaldehyde	ethanal
 **ketone**	oxo-	-one	2-propanone
 **alcohol**	hydroxy-	-ol	methanol
 **thiol**	mercapto-	-thiol	methanethiol
—N(H, R)$_2$ **amine**	amino-	-amine	methylamine
 **alkene**	alkenyl	-ene	propene

G L JADAV

	 alkyne	alkynyl	-yne	butyne
EVERYTHING FROM HERE ON BELOW ENDS IN "–ANE"	 alkane	alkyl	-ane	butane
	 ether	alkoxy	-ane	methoxy methane (or methyl methyl ether)
	 alkyl halide	halo-	-ane	bromomethane
	 nitro	nitro-	-ane	nitromethane

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02

ELECTRONIC DISPLACEMENT

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Displacements

Permanent

Inductive effect,
Resonance effect,
hyperconjugation effect

Electronic Displacement

Reaction depends on electronic density
Polarity
Nucleophilic or electrophilic

Temporary

Electromeric effect

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Inductive effect (I effect)

- Involves σ electrons
- Electrons of covalent bond between the two atoms
- Differences in electronegativity arise of this effect
- Degree of polarity
- Partial negative charge
- Partial positive charge

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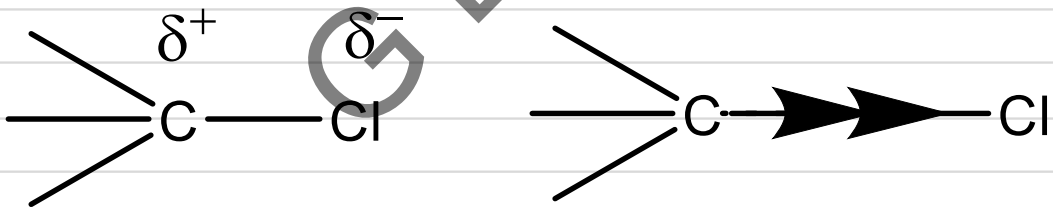
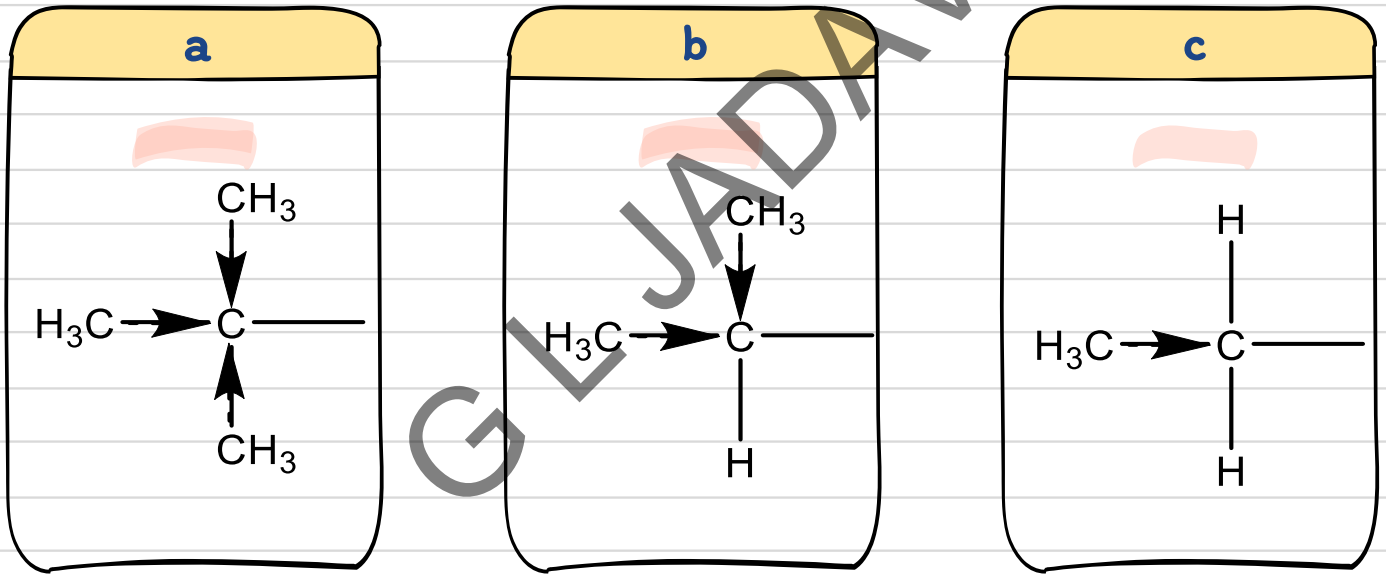
- Carbon-chlorine bond



Positive Inductive Effect (+I effect)

Electron Releasing Groups



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$3° > 2° > 1°$

Negative Inductive effect (-I effect)

- Group draws electrons away from carbon atom
- Electron withdrawing groups or electron attracting groups
  - -I effect containing groups

$-NO_2$, -F, -Cl, -Br, -I, -OH, $-C_6H_5$

Effect not Confined to one bond only
Transmitted along a chain of C atoms

(-I GROUP)

G L JADAV

RESONANCE OR MESOMERIC EFFECT

Involves π electrons of double bond and triple bonds
Refers to polarity due to interaction between two π-bonds or a π- electron and lone pair

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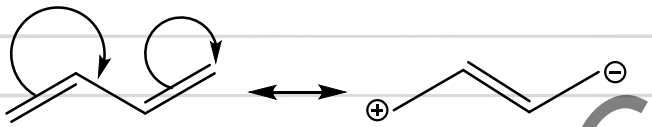
Possibility of Resonance

1

Resonance between conjugated double bonds



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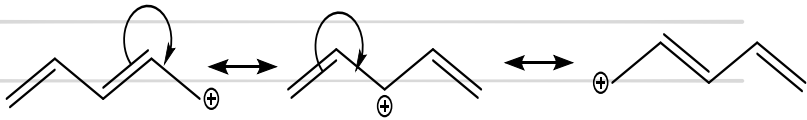
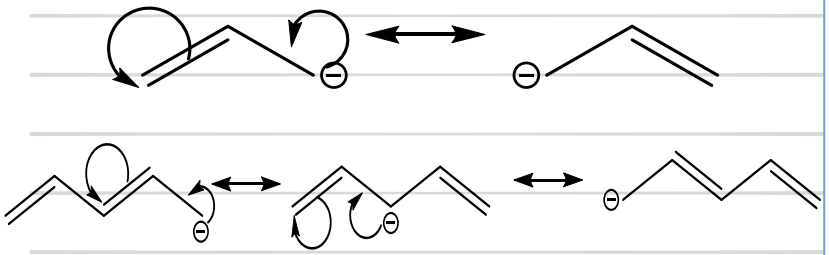
2

Double bond is in conjugation with positive charge



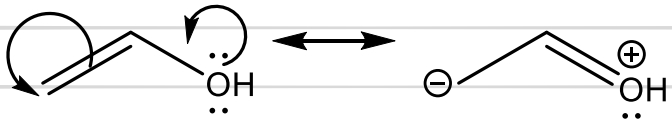
3

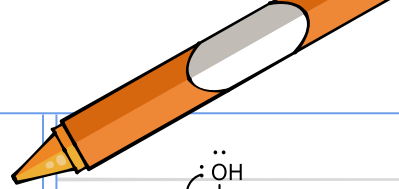
Double bond is in conjugation with negative charge

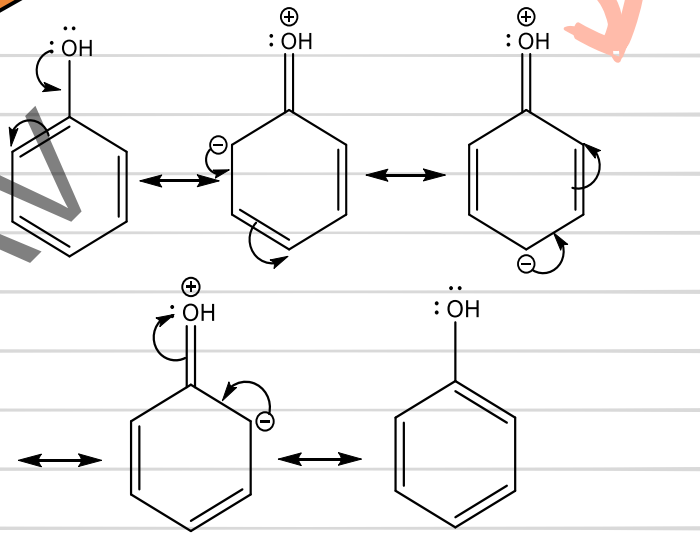


4

Double bond is in conjugation with Lone pair







5

Double bond is in conjugation with free radicals

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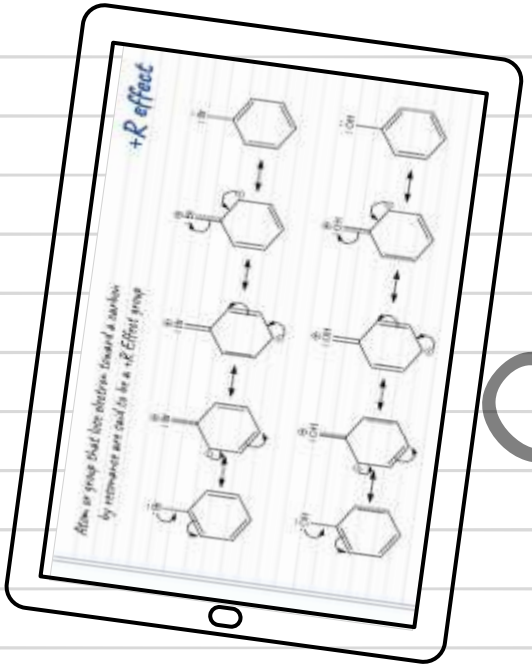
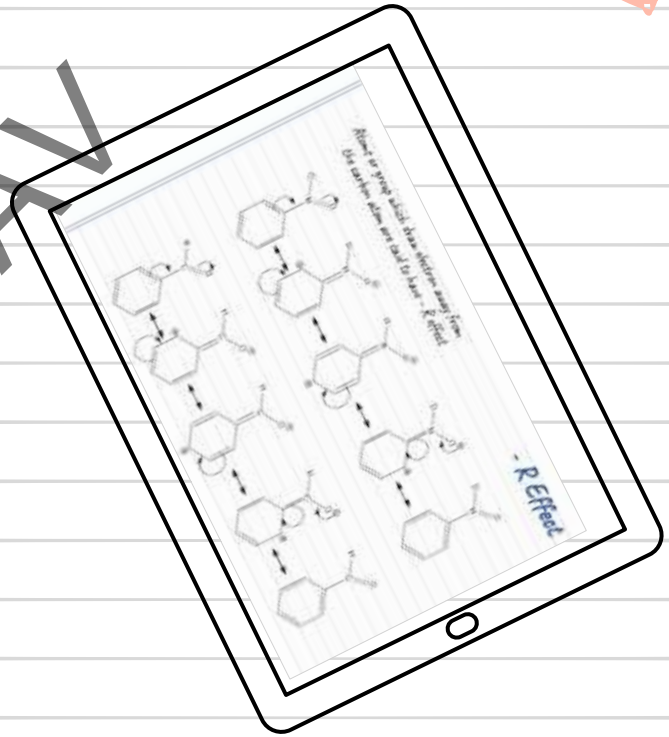
Types of Resonance Effect





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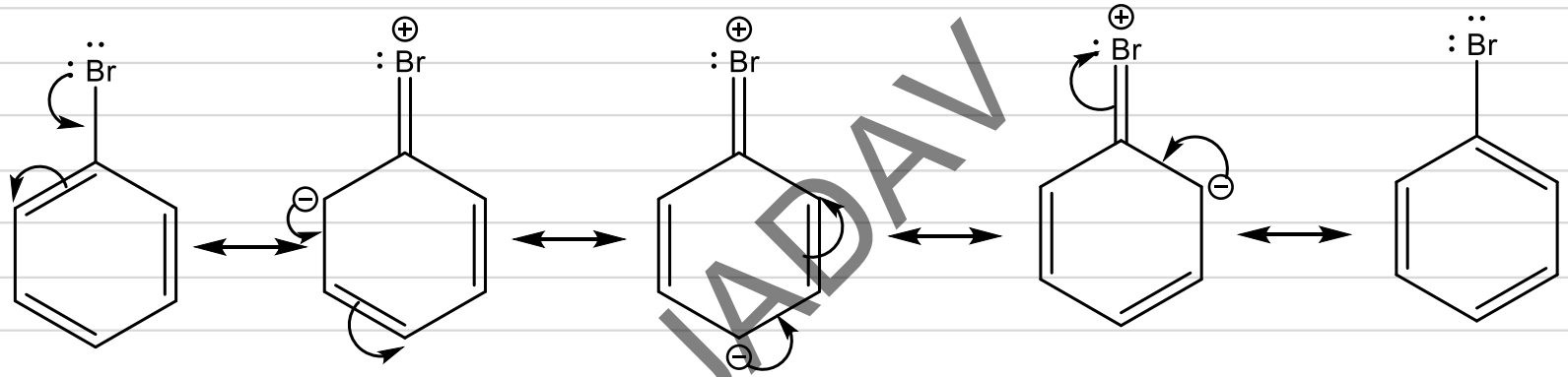
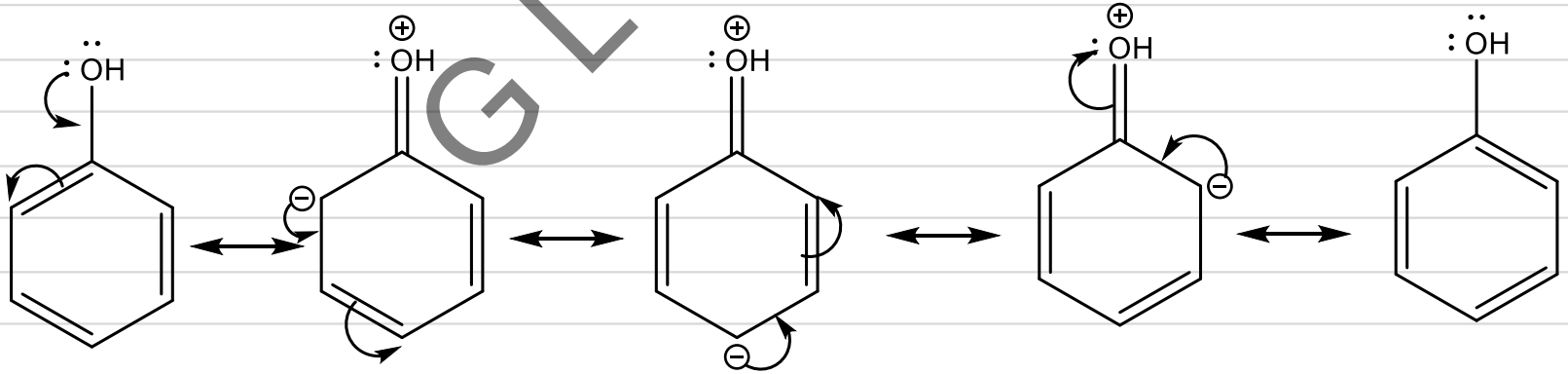
+R effect

Atom or group that lose electron toward a carbon by resonance are said to be a +R Effect group





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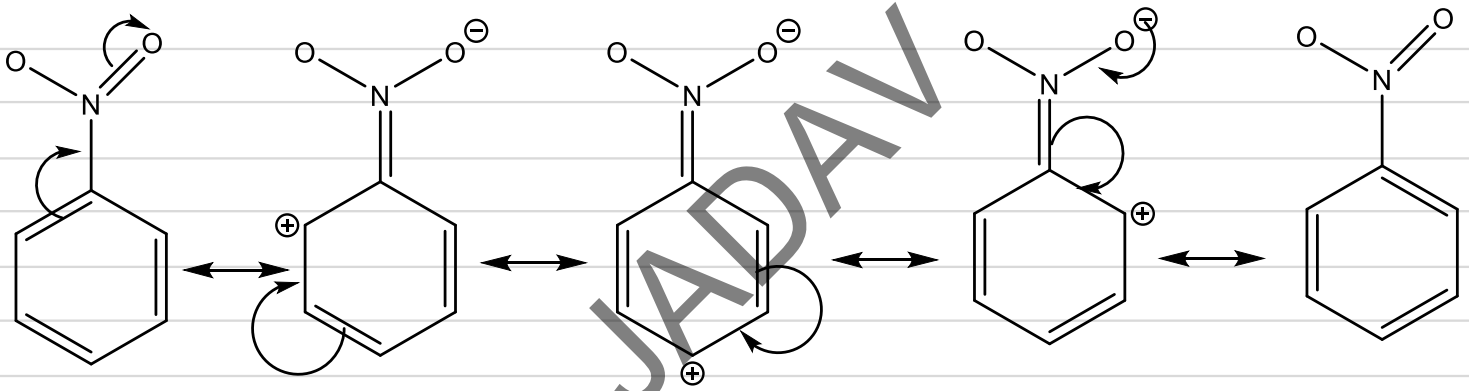
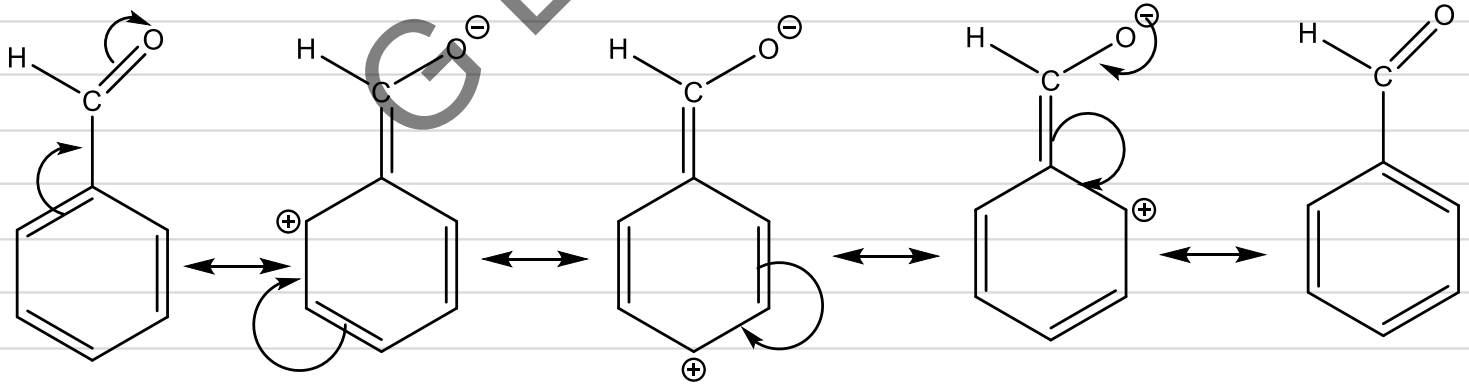
Atoms or group which draw electron away from the carbon atom are said to have – R effect

– R Effect





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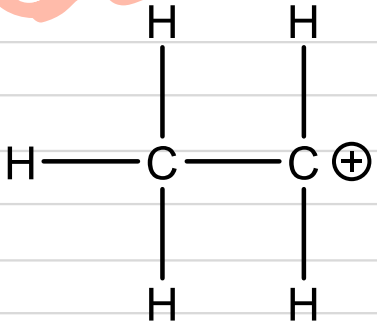
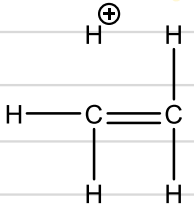
Hyperconjugation

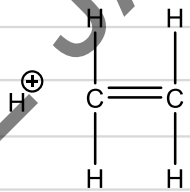


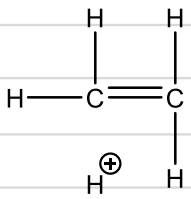
Carbonium ions can show no bond resonance with adjacent C-H bond

Positivity is thus dispersed, and known as Hyperconjugation or No-bond resonance

Baker and Nathan effect







Similarly, Isopropyl carbonium ion = six structures

Tertiary butyl carbonium ion = nine structures

$$(CH_3)_3C^{\oplus} > (CH_3)_2CH^{\oplus} > CH_3CH_2^{\oplus} > CH_3^{\oplus}$$

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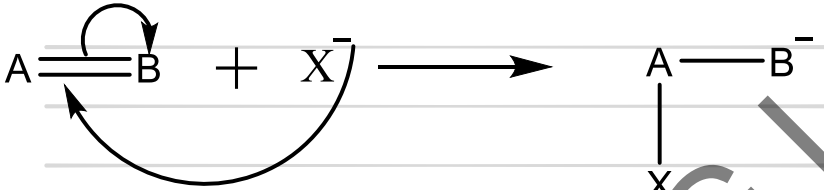
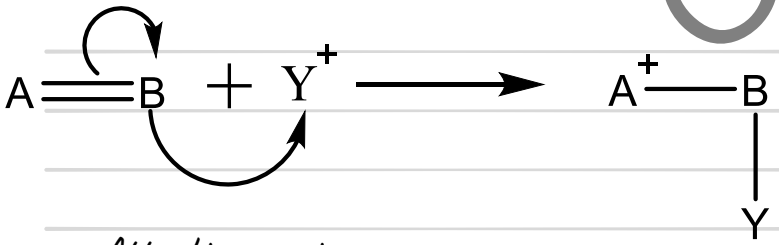
Electromeric Effect

Temporary effect

Complete and instantaneous transfer of π electrons of the multiple bonds

Eg. C=C, C=O, C=N etc



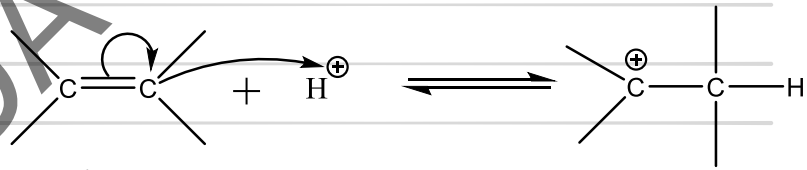


Attacking species

Intermediate

+ E effect

π-electron transfer towards the attacking reagent



Attacking species

Intermediate

- E effect

π-electron transfer from the attacking reagent

Attacking species

Intermediate

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03

Application of inductive effect

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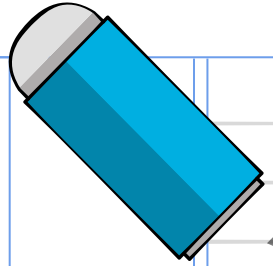
Relative acid strength of carboxylic acid



Reason

Alkyl group = electron releasing (+I)

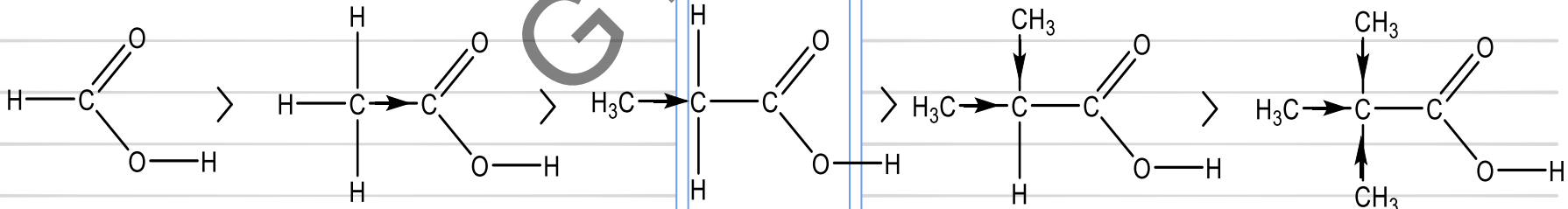
Electron density on O increases

Release of H+ is difficult

Greater number of alkyl group

Greater is +I effect

+I EFFECT



+I effect Increases

Acid Strength Decreases

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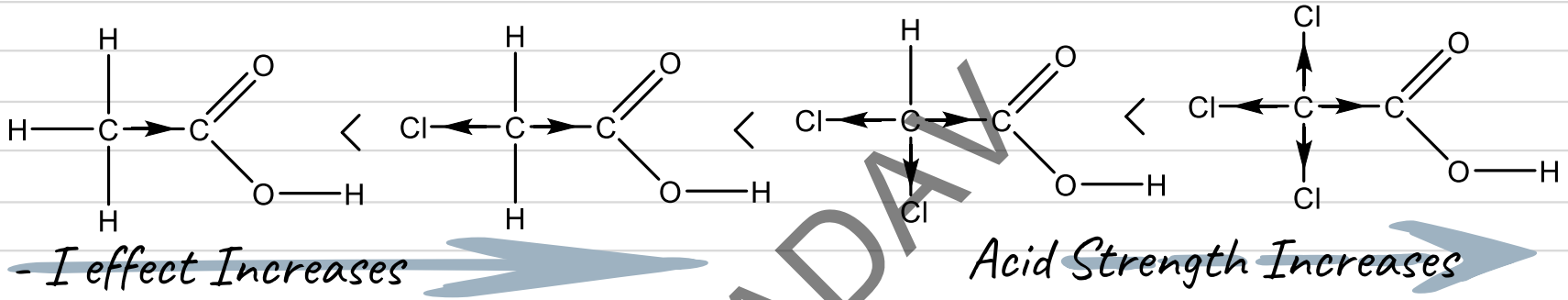

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$$F\text{-}CH_2\text{-}COOH > Cl\text{-}CH_2\text{-}COOH > Br\text{-}CH_2\text{-}COOH > I\text{-}CH_2\text{-}COOH$$

- I effect Increases

Acid Strength decreases

Effect of Dipole Moment

Inductive effect

- Dipole moment increases with increase in inductive effect
  - H_3C-I (1.64 D)
  - H_3C-Br (1.79 D)
  - H_3C-Cl (1.83 D)

Relative Basic Strength of amines (Basicity of amines)

- Primary amines are relatively stronger basic than ammonia

$H-NH_2$

H_3C-NH_2 (+I effect)

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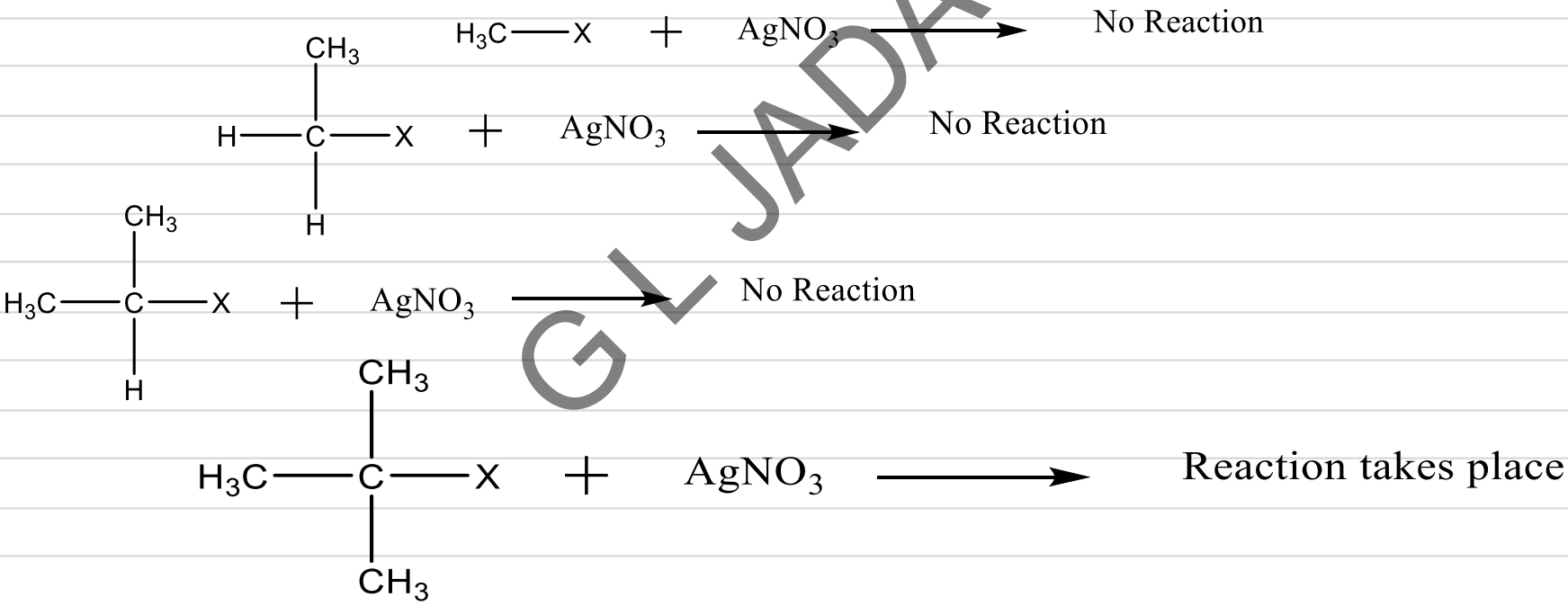
Reactivity of alkyl halide

Reactivity of alkyl halide depends on the carbocation formed after the leaving of halogen group



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Reaction involves Making and Breaking of bonds

Breaking = fission

Breaking bond = breaking the molecular orbital to give atomic orbital

+

Homolytic Fission

Heterolytic fission

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Curly arrow rules

G L JADAV

Curved arrow is used to indicate the movement of electron pair

Arrow in chemical drawing has specific meaning

Reaction Intermediates

G L YADAV

Short lived Fragments

Reaction Intermediates

Carbocation

+vely charged C Atom

Heterolysis

Carbanion

-vely Charged C Atom

Heterolysis

Free Radicals

Neutral C Atom

Homolysis

Carbene

2 bond 2 electron system

Benzyne

Neutral

Electrophillic

Nitrene

Uncharged

6 e^- N atom

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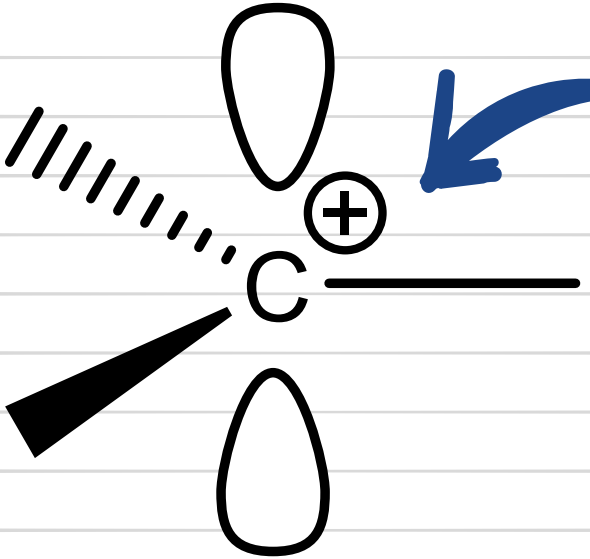
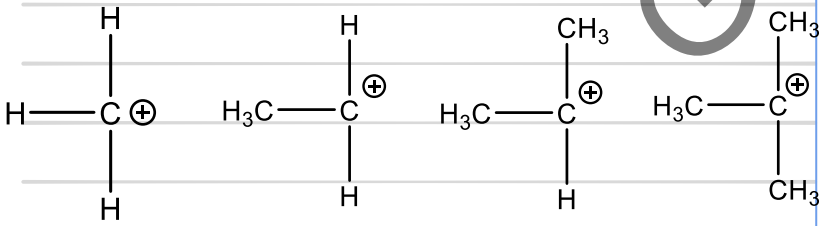


sp2



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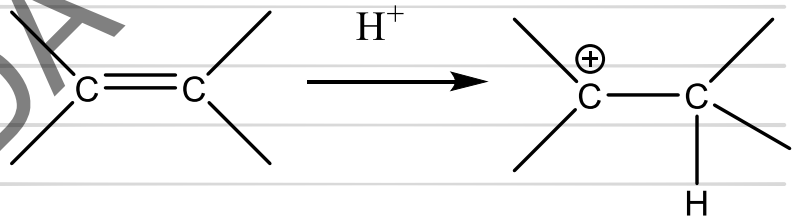
Carbocation

C Containing +ve charge are called carbocation or carbonium ions Formed by Heterolytic fission

Generation of Carbocation

From alkene



Stability

Influenced by resonance and inductive effect

e.g. allyl and benzyl carbocation are more stable than is propyl carbocation

From Alkyl halide

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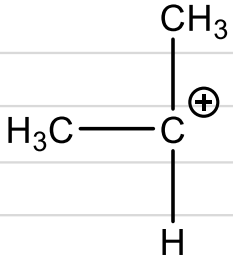
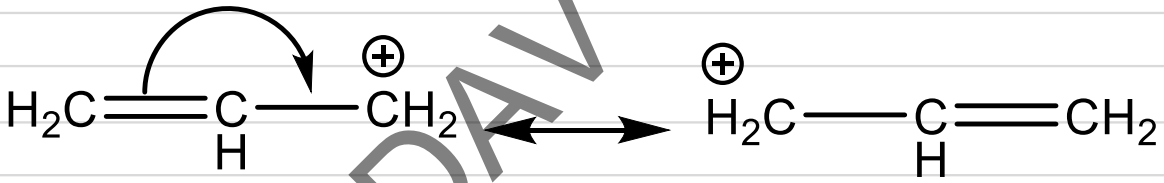
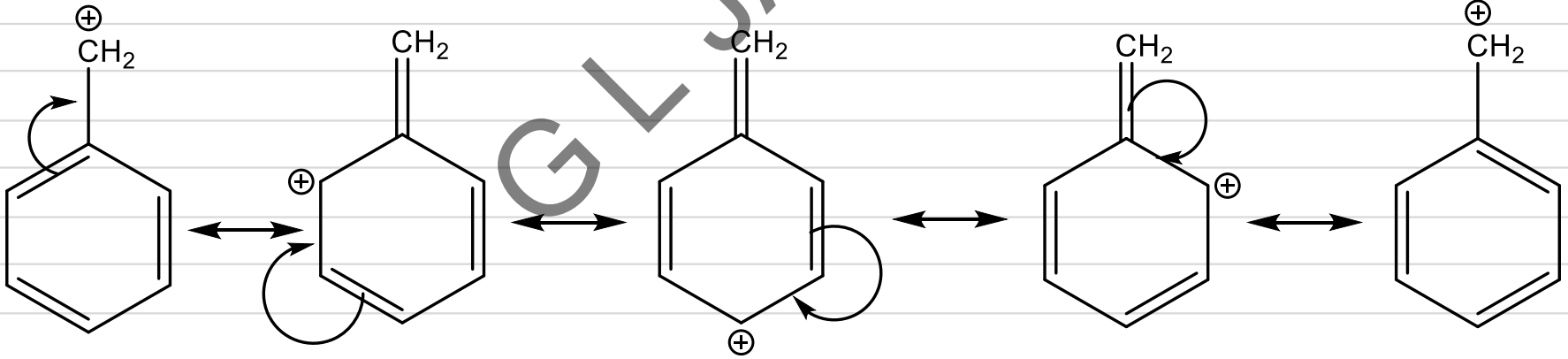
Explain why allyl and benzyl carbonium ions are more stable than isopropyl carbonium ion?







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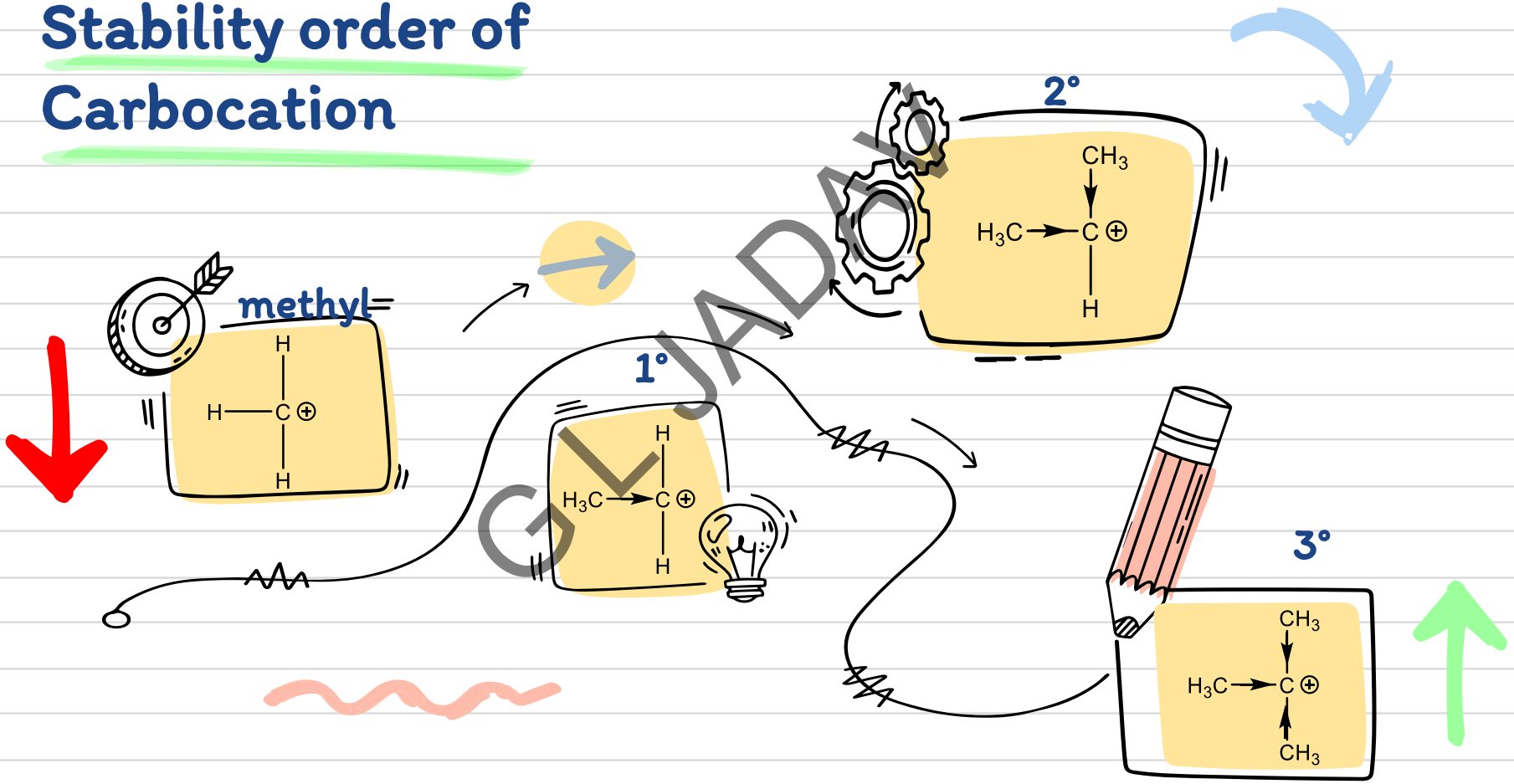
Stability order of Carbocation



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Reaction Intermediates

Carbocation

+vely charged C Atom

Heterolysis

Carbanion

-vely Charged C Atom

Heterolysis

Free Radicals

Neutral C Atom

Homolysis

Carbene

2 bond 2 electron system

Benzyne

Neutral

Electrophillic

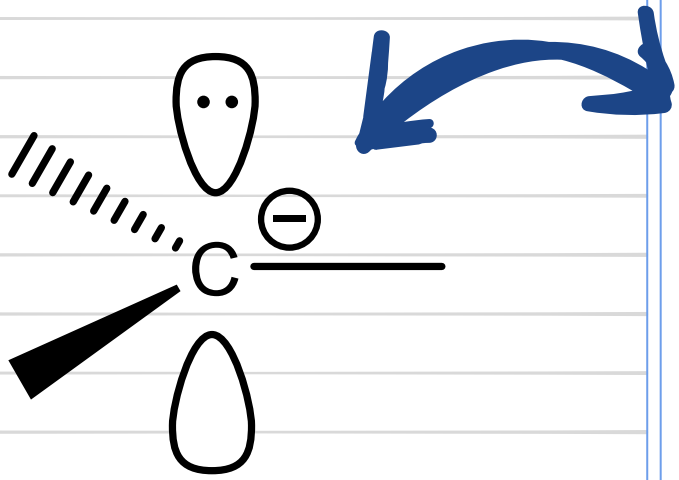
Nitrene

Uncharged

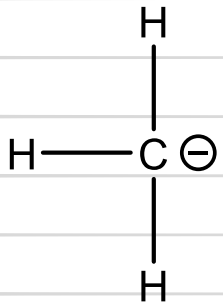
6 e^- N atom

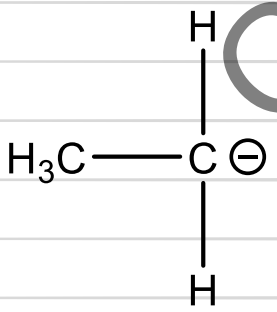
G L JADAV

Carbanion



C Containing -ve charge are called carbanion Formed by Heterolytic fission





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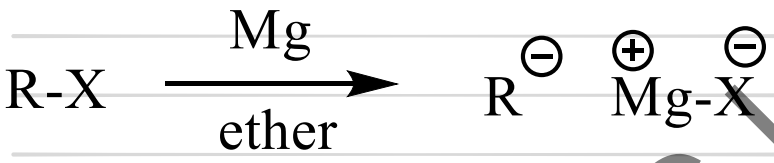
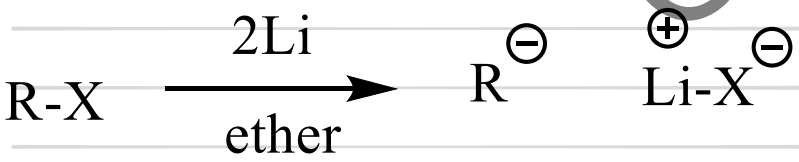
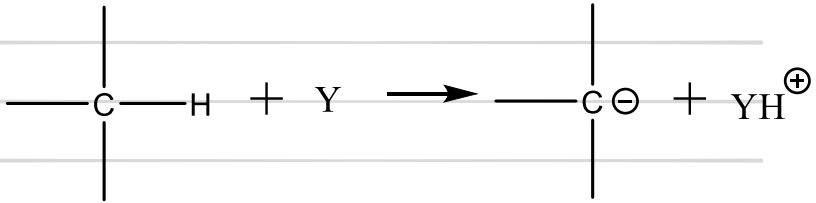
Generation of Carbanion

By formation of organo metallic compound





By removal of acidic hydrogen



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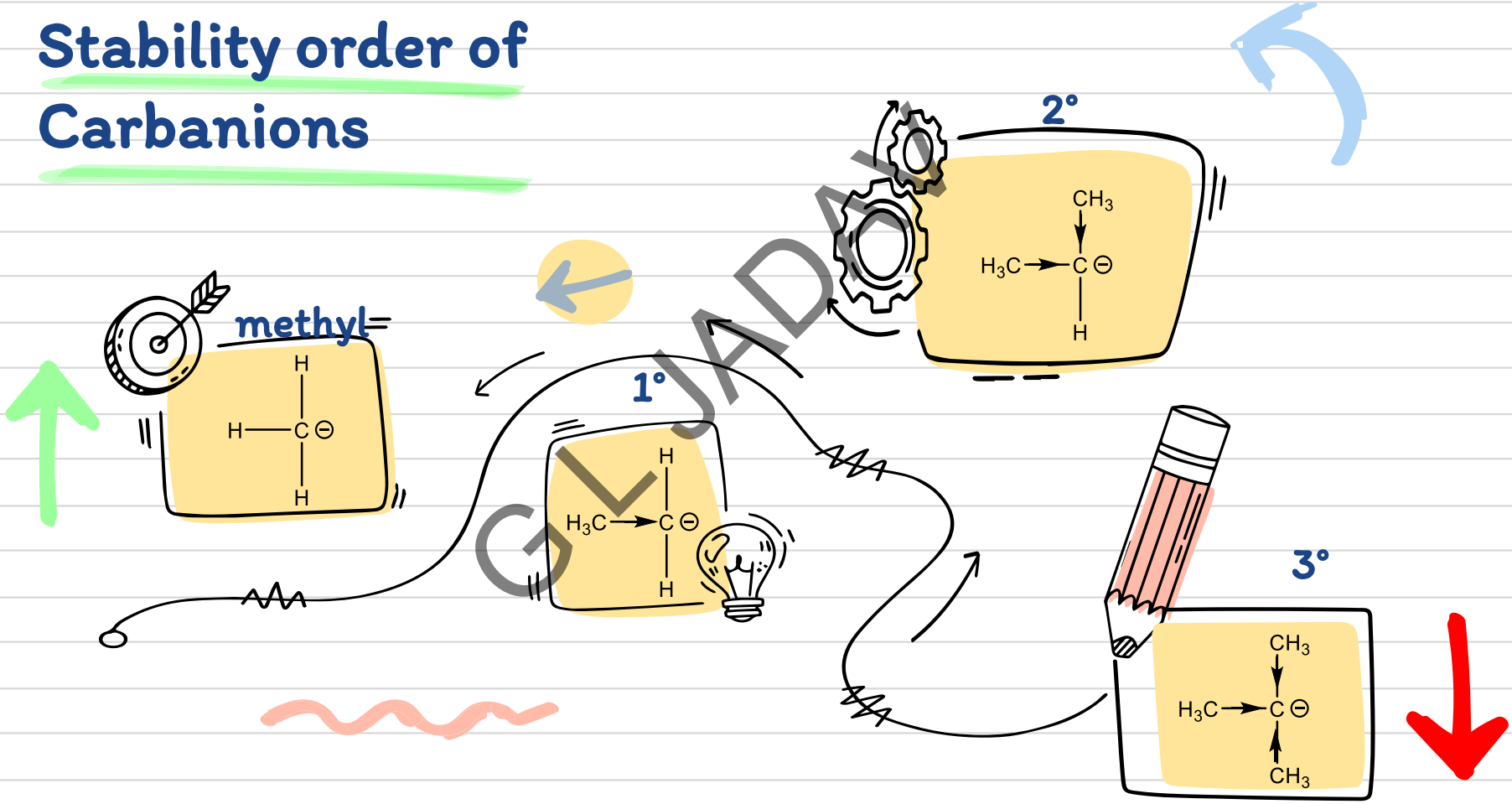
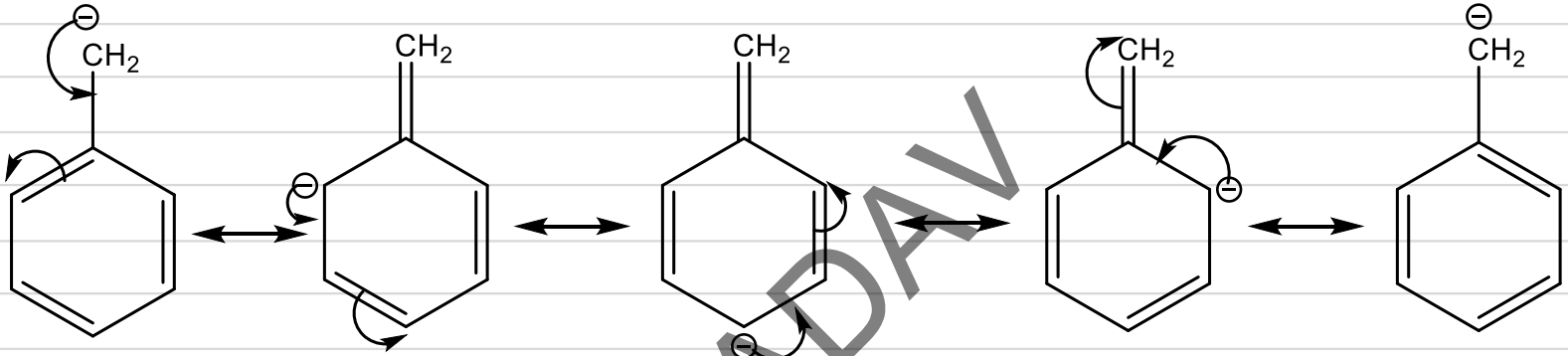
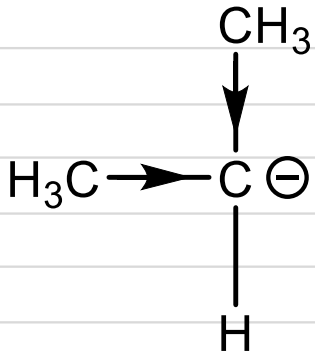
Stability order of Carbanions



GLJADA

Stability of Carbanion





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Resonance Effect

Reaction Intermediates

Carbocation

+vely charged C Atom

Heterolysis

Carbanion

-vely Charged C Atom

Heterolysis

Free Radicals

Neutral C Atom

Homolysis

Carbene

2 bond 2 electron system

Benzyne

Neutral

Electrophillic

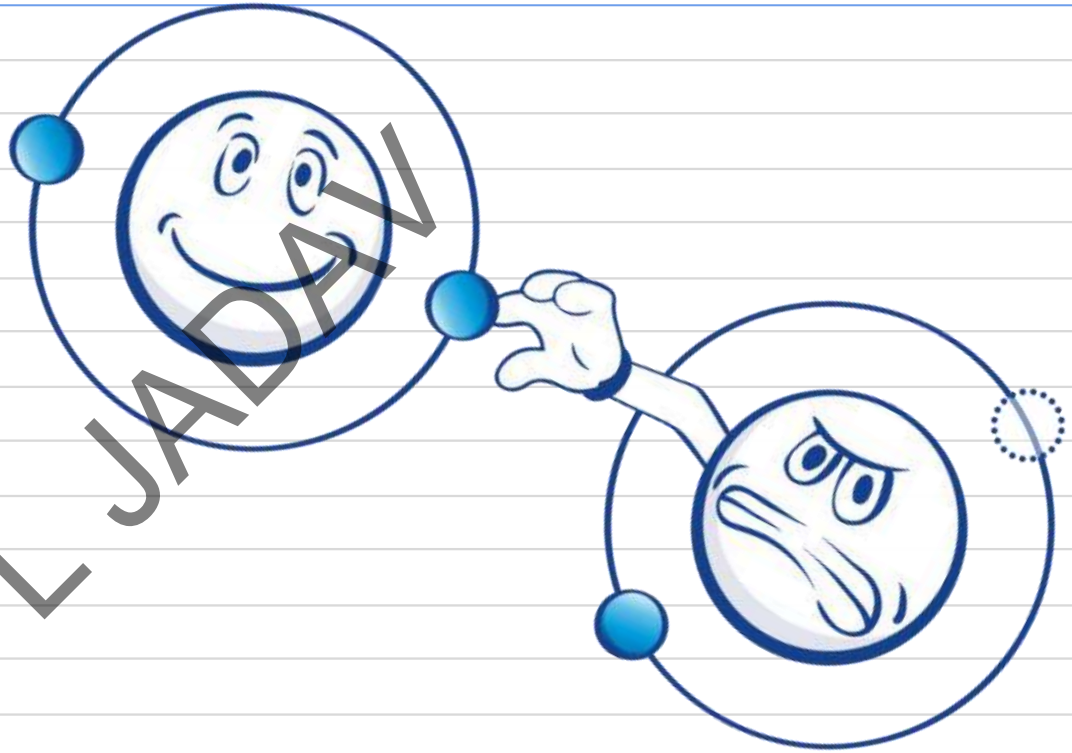
Nitrene

Uncharged

6 e^- N atom

G L JADAV

Free Radicals



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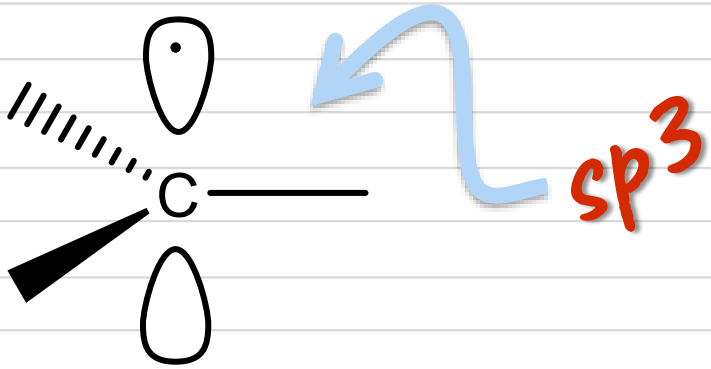
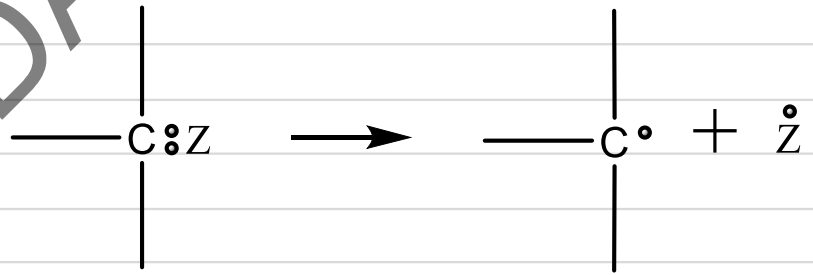
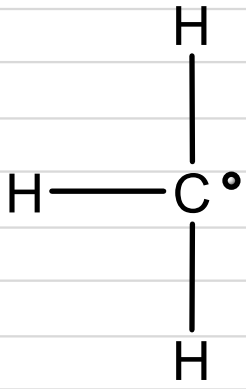
Neutral

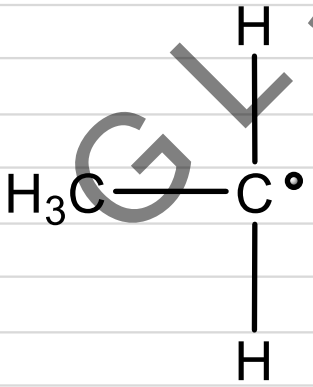
No Charge

Homolytic fission









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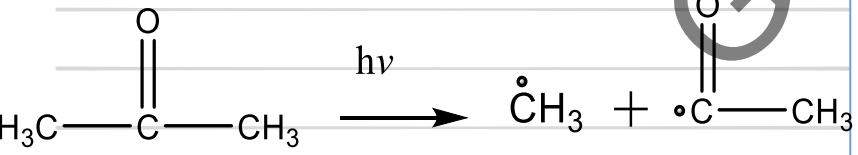
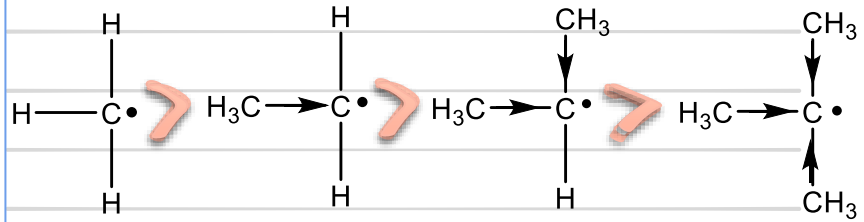
Generation and Stability

By Photolysis



Stability order

- Similar to Carbonium ions



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Reaction Intermediates

Carbocation

+vely charged C Atom

Heterolysis

Carbanion

-vely Charged C Atom

Heterolysis

Free Radicals

Neutral C Atom

Homolysis

Carbene

2 bond 2 electron system

Benzyne

Neutral

Electrophillic

Nitrene

Uncharged

6 e^- N atom

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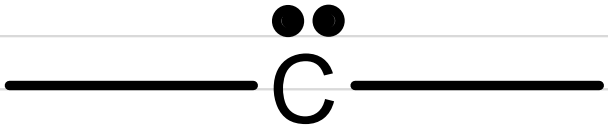
Carbene



- Two bond two electron system

  Eg. Methylene (: CH_2)

- Highly reactive
- Act as electrophiles , accept e- pair to complete outer shell

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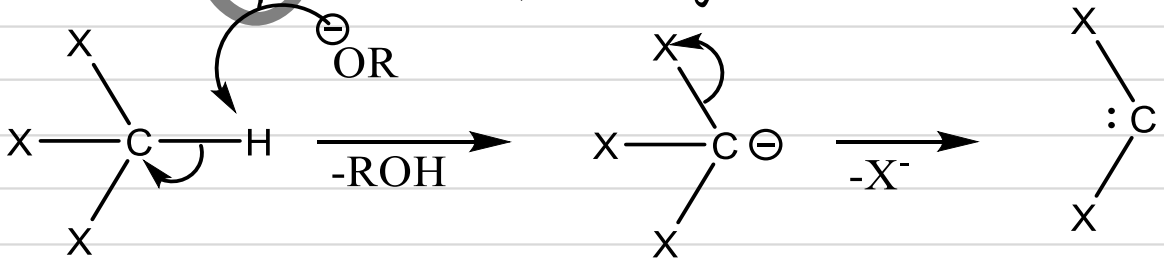
Generation

- Chloroform in the presence of strong alkali



Reaction Intermediates

Carbocation

+vely charged C Atom

Heterolysis

Carbanion

-vely Charged C Atom

Heterolysis

Free Radicals

Neutral C Atom

Homolysis

Carbene

2 bond 2 electron system

Benzyne

Neutral

Electrophillic

Nitrene

Uncharged

6 e^- N atom

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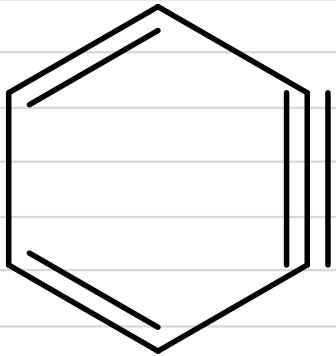
Benzyne

- Neutral species
- Electrophilic in nature, gives nucleophilic addition reaction
- Highly reactive, π bond strain



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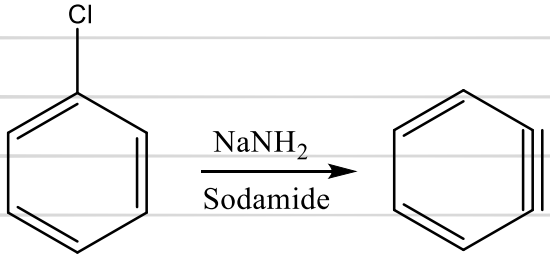
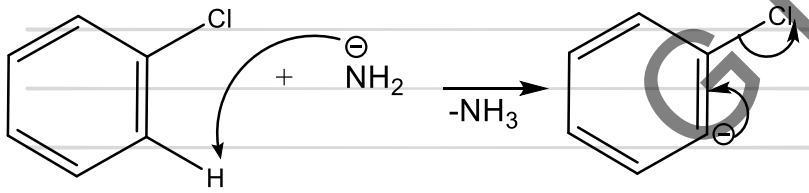
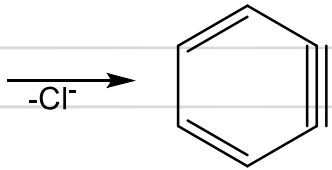
Generation

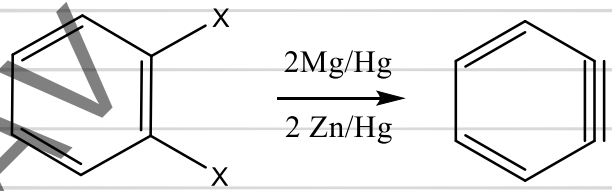
(a) From Halobenzene



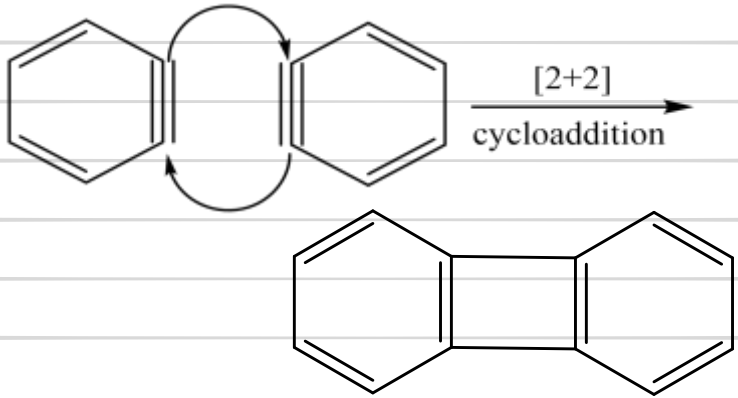




(b) From 1,2-dihalobenzene



- Since Benzyne is highly reactive species it undergoes Dimerization



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##

Types of Organic Reagents

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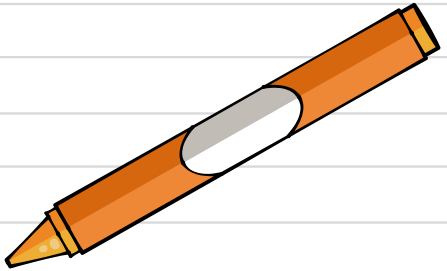

Categorized in two groups

Electrophiles (E^+)

- Accept electron pair
- Electron-loving = electrophile
- Electron deficient
- Positive ions, neutral molecules with electron deficient centers

H^+, Cl^+, NO_2^+, R_3C^+, $^+SO_3H$, $AlCl_3$, BF_3

Nucleophiles (Nu^-)

- Donate electron pair
- Nucleous loving
- Attacks on low electron density (positive centers)
- Electron rich
- Negative ions, neutral molecules with free electron pairs

Cl^-, Br^-, I^-. CN^-, OH^-, RCH_2^-, RNH_2, H_2O, ROH

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Types of organic reactions

Substitution reactions

Replacement of atom or group by another atom or group

Addition reactions

Atom or group are added to double or triple bond

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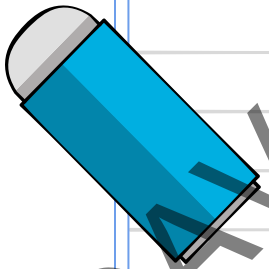
Types of organic reactions

Elimination Reaction

Removal of atom or group from two adjacent carbon atoms



Rearrangement reaction

Movement of bond giving migration of atom or group within the molecule

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Substitution Reactions

Definition

Reactions in which an atom or group of atom directly attached to a carbon in the substrate molecule is replaced by another atom or group of atoms

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Nucleophilic substitution reaction

Sub. Involves attacks be nucleophiles

SN = substitution and Nucleophile

$$R\text{-}X + OH^- \rightarrow R\text{-}OH + X^-$$

Classes

1. S_N2 Reactions
2. S_N1 Reactions

S_N2 Reaction Bimolecular Nucleophilic substitution

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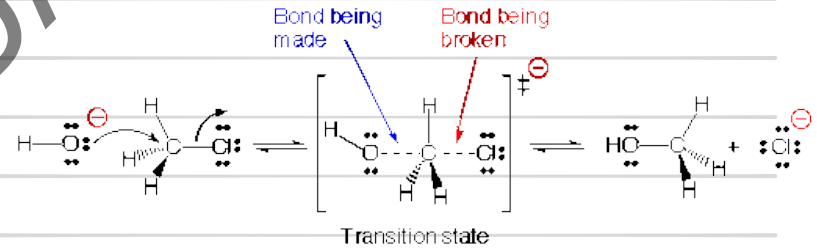
S_N2

Rate of Nucleophilic reaction depends on the concentration of both, the substrate and the Nucleophile

Second order reaction

$$Rate \propto [substrate][Nucleophile]$$



SN^2 Reactivity

1 > 2 > 3

S_N1 Reaction
Unimolecular Nucleophilic substitution

S_N1

Rate of Nucleophilic reaction depends on the concentration of only the substrate (alkyl halide)

First order reaction

Rate $\propto$ [*subtrate*]

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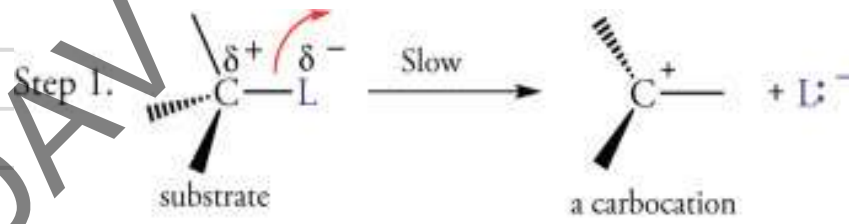
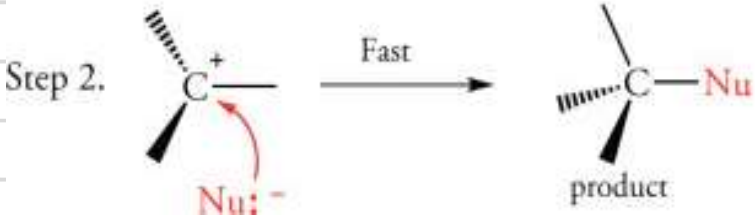
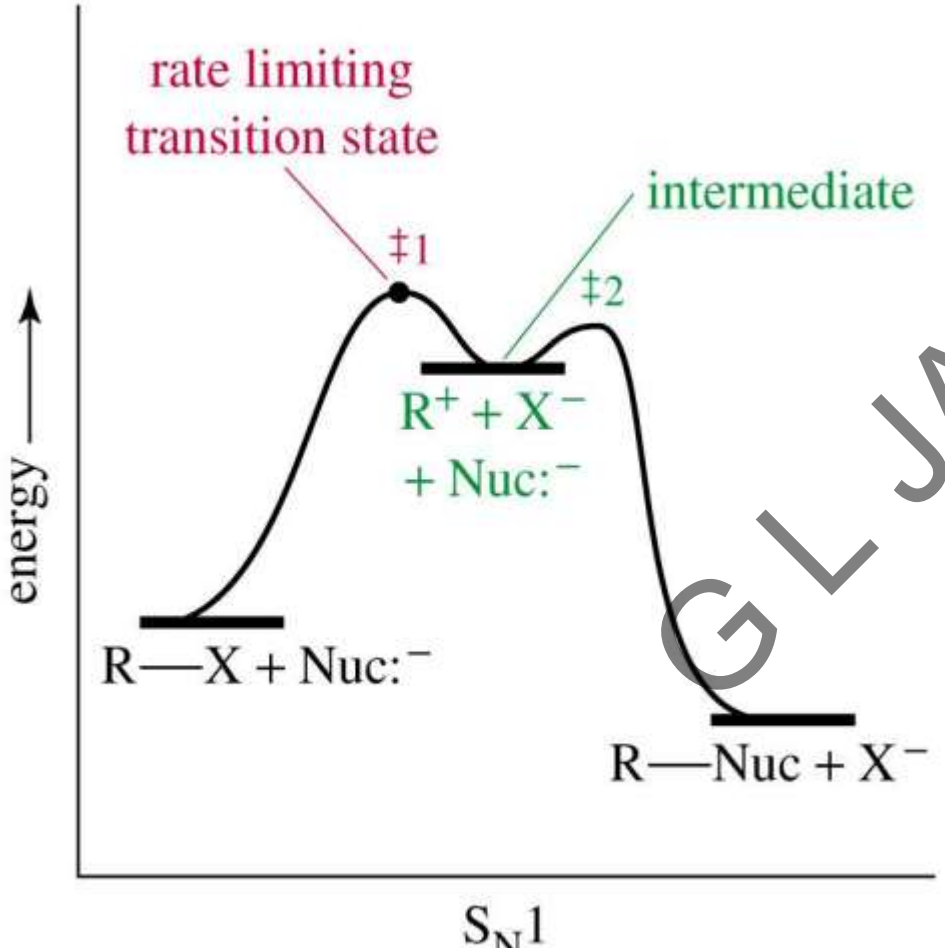
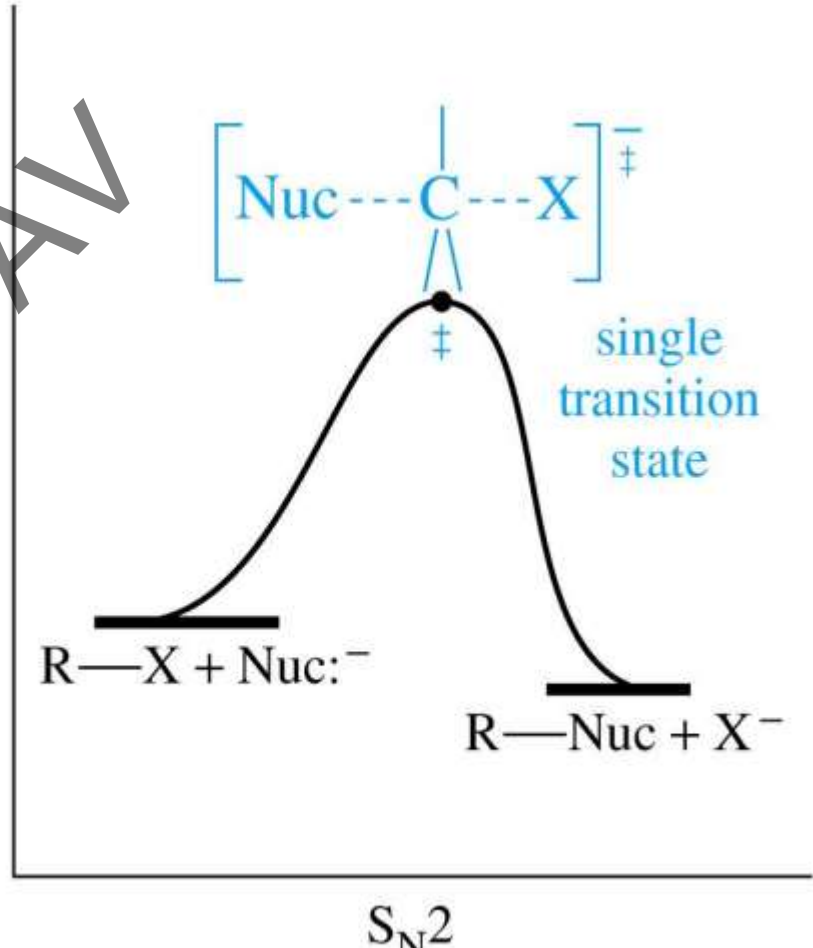




SN 1 Reactivity

3 > 2 > 1


rate limiting
transition state
intermediate
‡1
‡2
energy
R⁺ + X⁻
+ Nuc:⁻
R—X + Nuc:⁻
R—Nuc + X⁻
SN1


Nuc---C---X
‡
single
transition
state
R—X + Nuc:⁻
R—Nuc + X⁻
SN2

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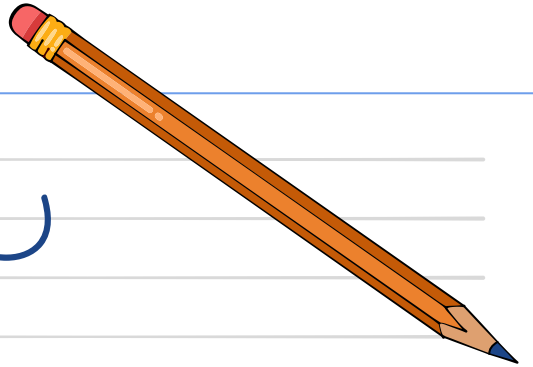
Comparison of SN^2 & SN^1



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SN^2

Substitution Nucleophilic
Bimolecular Reaction

Kinetics

Rate
Both reactant
Second order reaction

SN^1

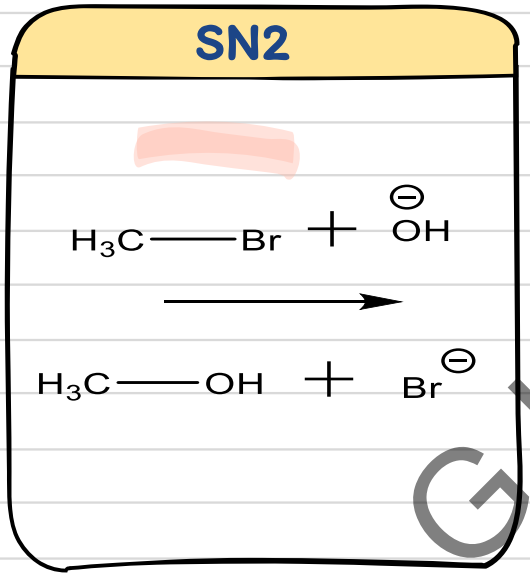
Substitution Nucleophilic
Unimolecular Reaction

Kinetics

Rate
Only one reactant
First order reaction

examples

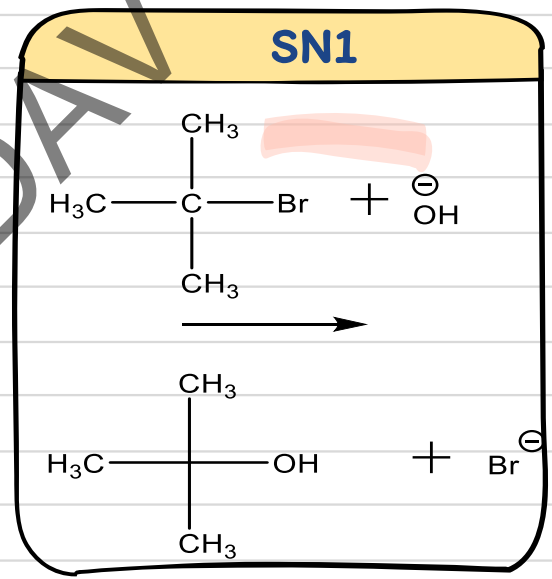
SN2



$$Rate \propto [CH_3Br][OH^-]$$

Rate determining step involves two reagents
Bimolecular reaction

SN1



$$Rate \propto [(CH_3)_3Br]$$

Rate determining step involves one reagent
Bimolecular reaction

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SN2

Pentavalent transition state
is formed
sp2 hybridized C atoms

Powerful Nucleophile favors
SN2

Eg. Alkoxide, hydroxide ion

SN1

Carbonium ion is formed
Hydroxide ion attack from
either face
Mixture of product is obtained

Weak nucleophile favors SN1
Water, alcohol

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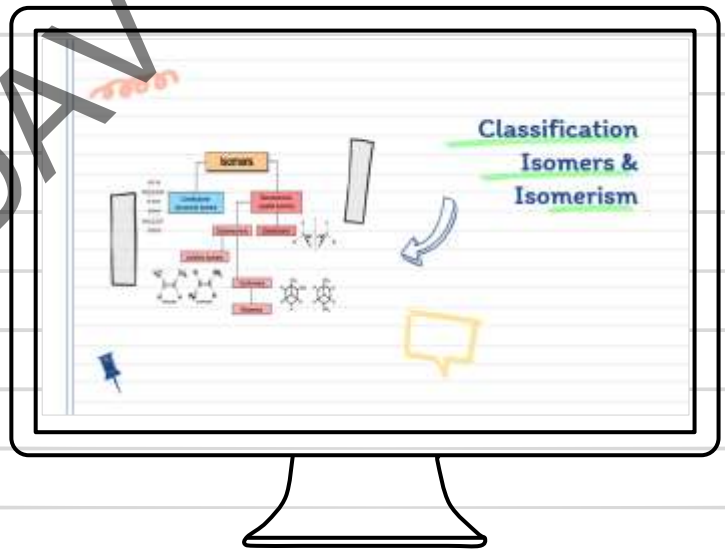
Stereo Chemistry

The study of the relative spatial arrangement of atoms that form the structure of molecules



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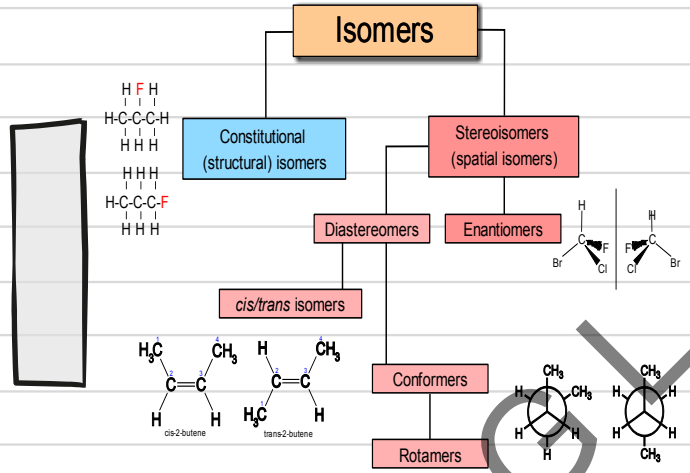
Classification Isomers & Isomerism



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Important Terms

Chirality

Greek--- Cheir = hand
Kelvin (1884)
Object & Mirror image relationship of a left and right hand

Non-superimposable mirror images
Chiral and chirality
Superimposable mirror image = Achiral (non-chiral)

Enantiomer

Non-superimposable mirror images isomer.
Isomerism is enantiomerism.

Diastereomer

Stereo isomers which are not mirror images of each other are called diastereomers.

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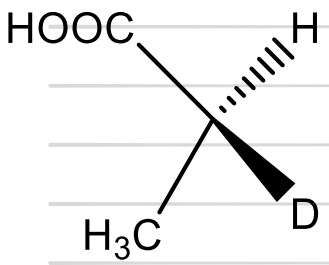
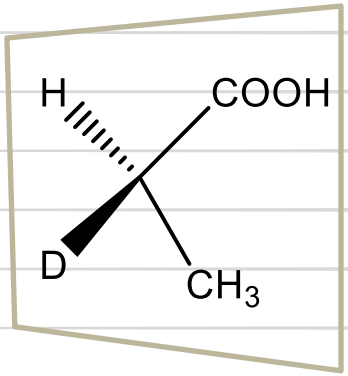
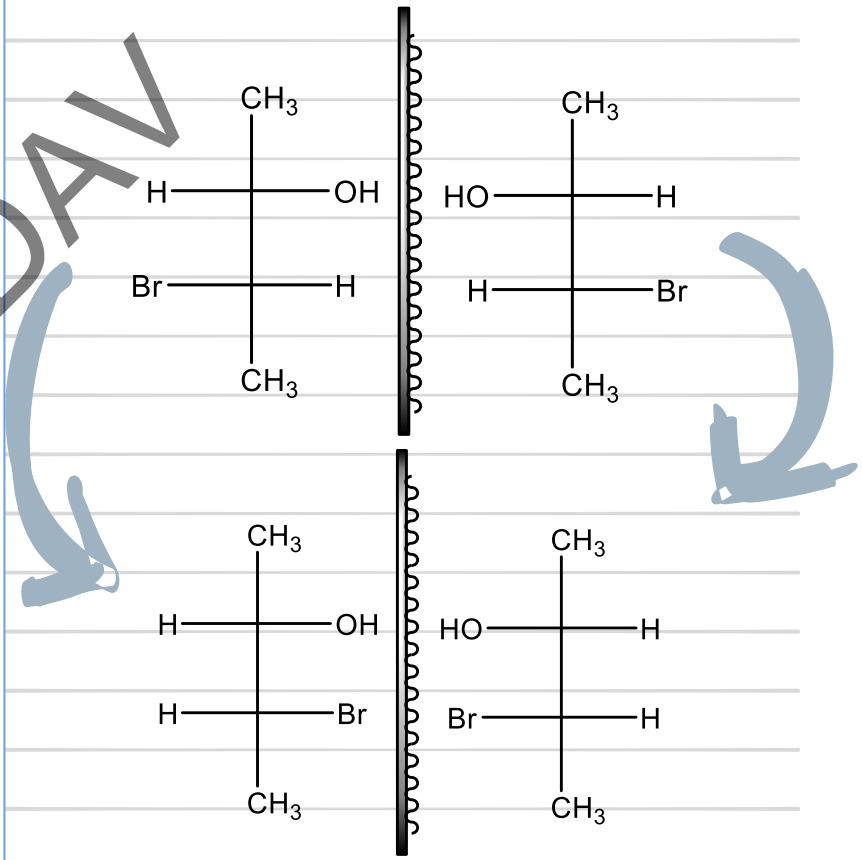
Enantiomer





Diastereomers



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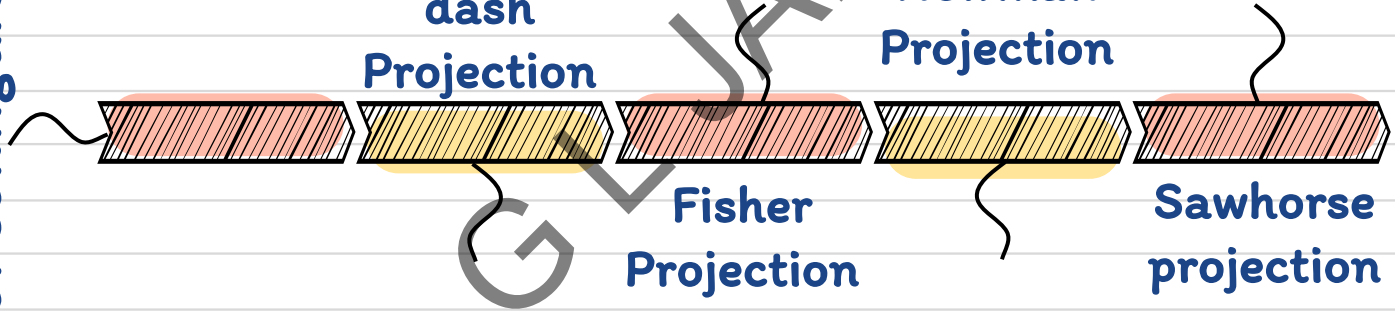
Configuration

The 3D arrangement of atoms around the stereo center of the molecule is called configuration

Representation of configuration



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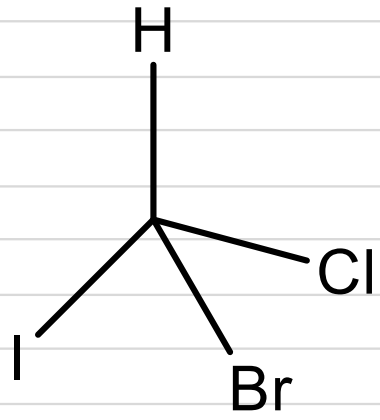
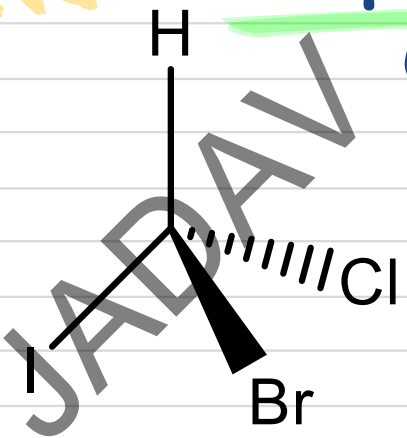
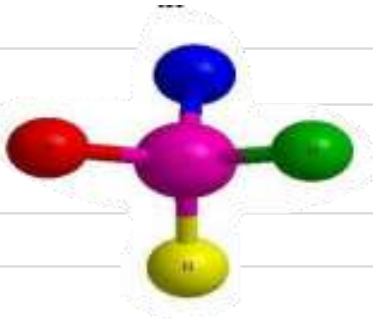
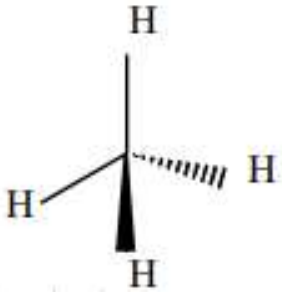
Representation of Configuration









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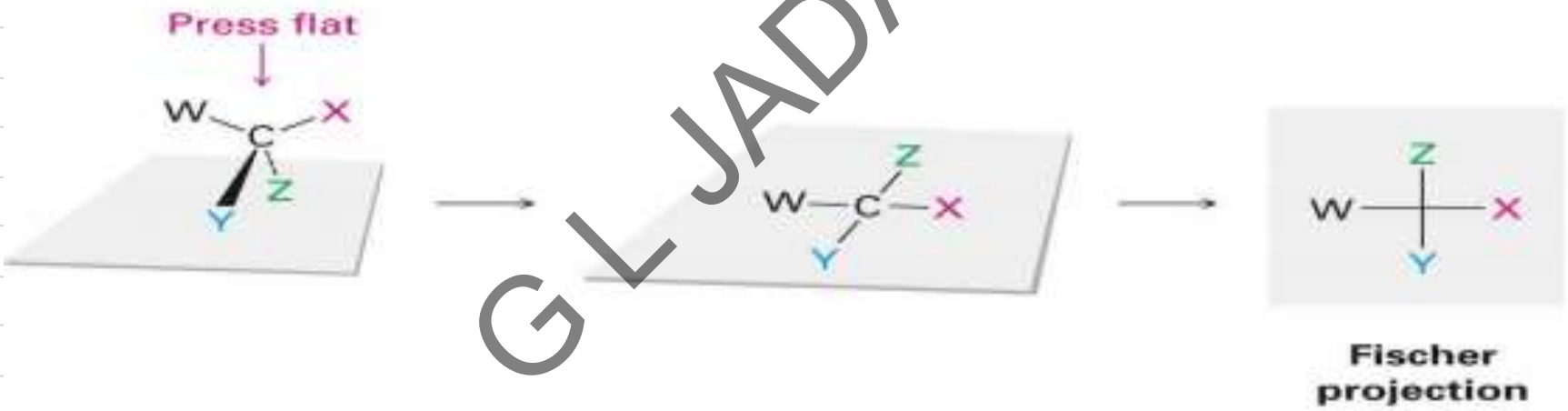
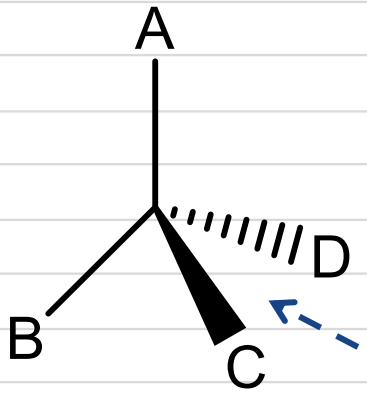
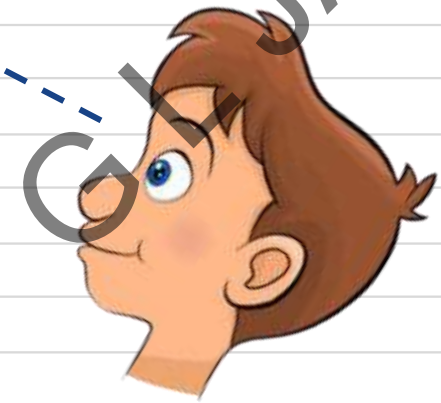
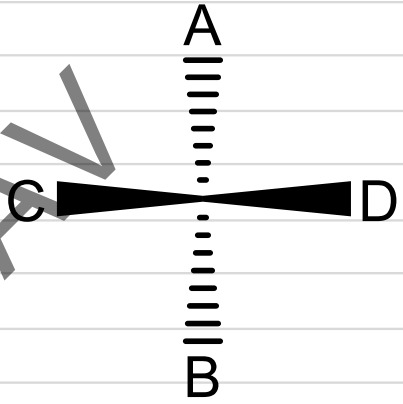
Fischer Projection Formula

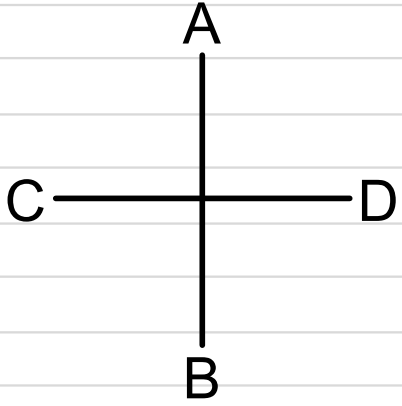


G L JADAV



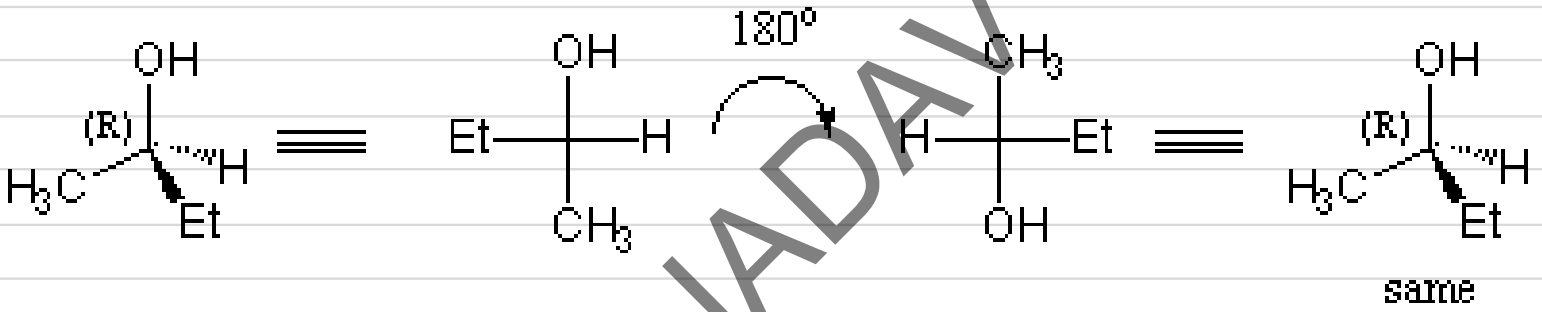






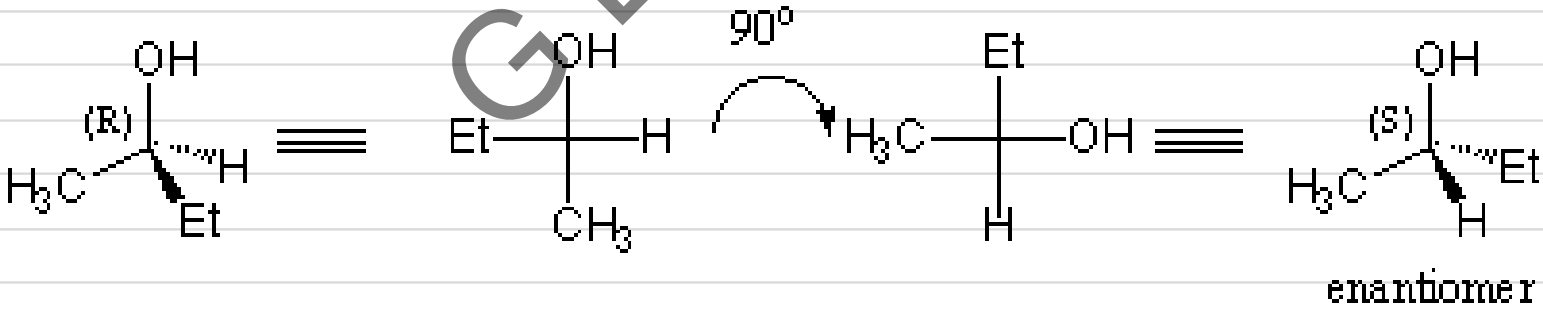
G.H.JADAV

1. Rotation by 180° is allowed



same

2. Rotation by 90° is not allowed



enantiomer

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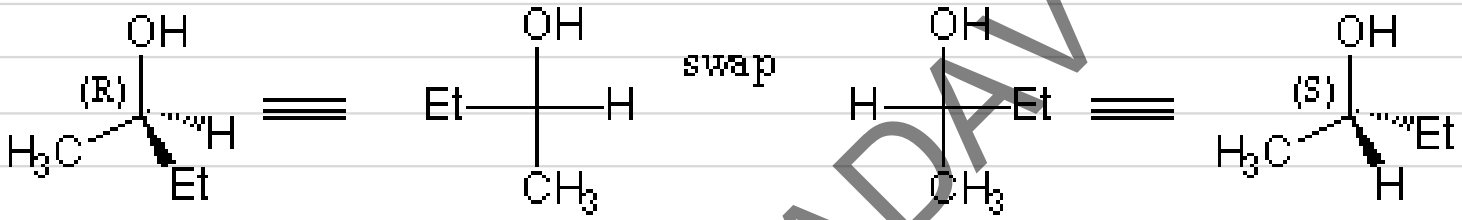
3. Enantiomer results from swapping left and right bonds



enantiomer

4. Meso compounds can be found by examining symmetry about horizontal plane

meso (achiral) chiral

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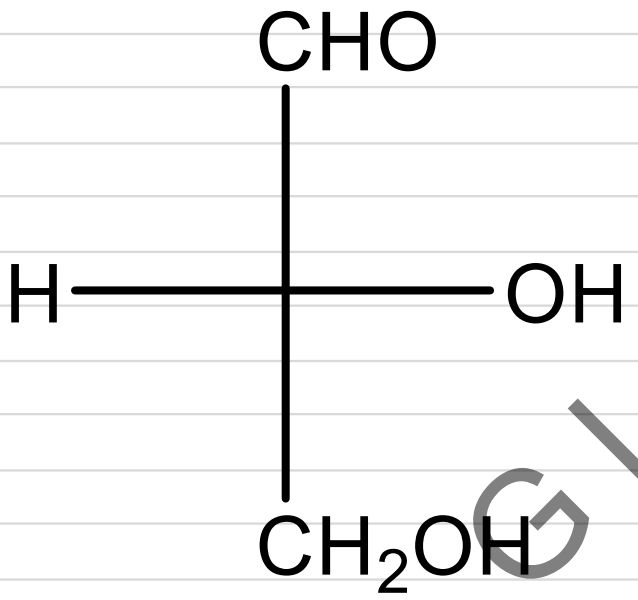
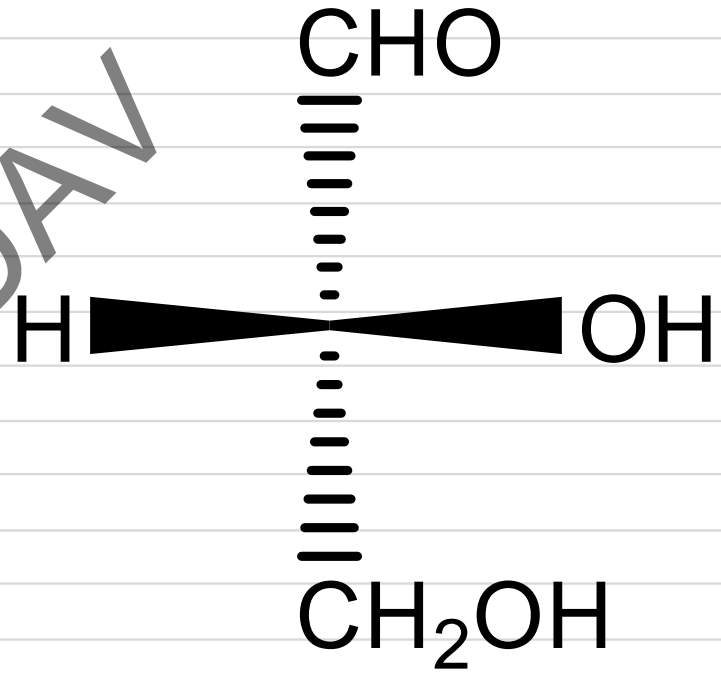
Glyceraldehyde





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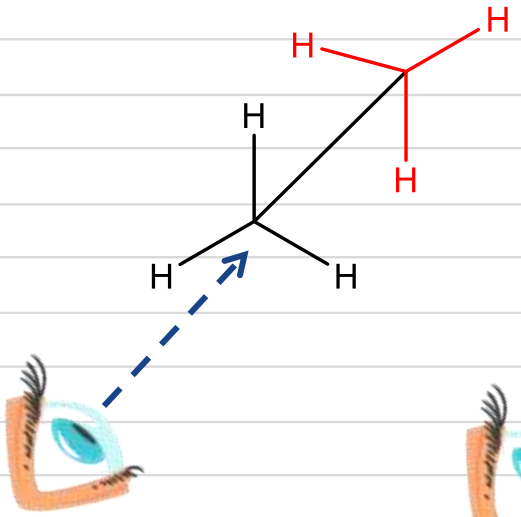

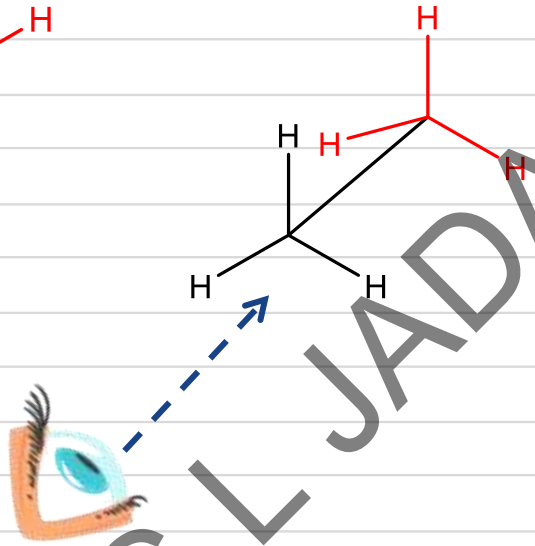

SAWHORSE FORMULA

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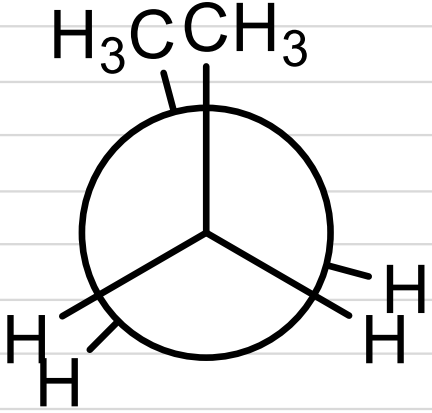
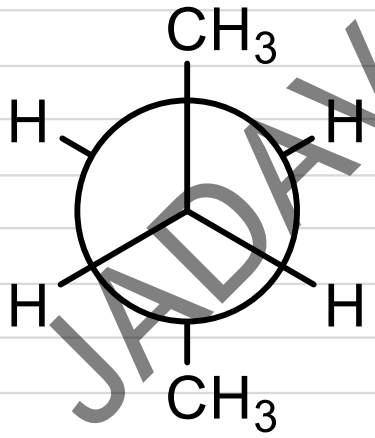
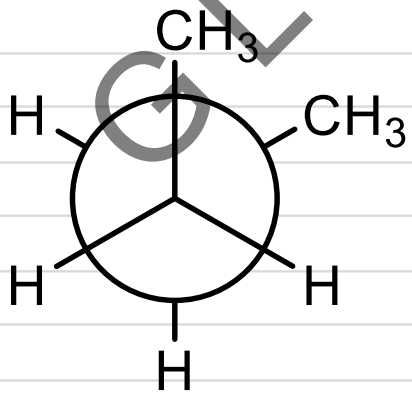
NEWMAN PROJECTION







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NOMENCLATURE
OF
ISOMERS
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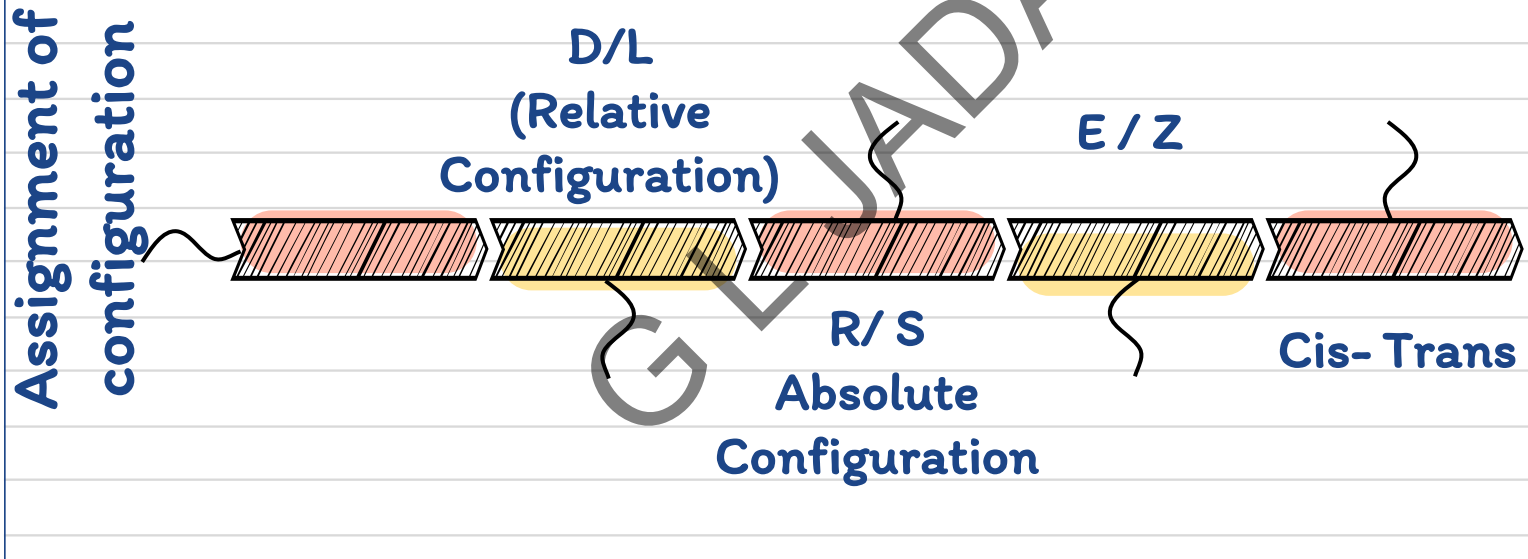
Configuration

The 3D arrangement of atoms around the stereo center of the molecule is called configuration



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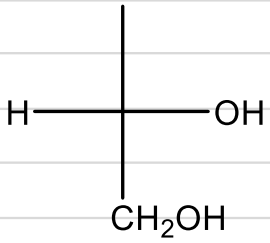
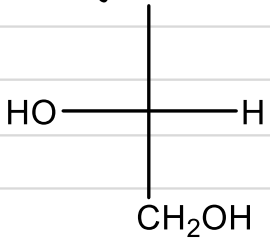
D, L SYSTEM OF NOMENCLATURE

- mainly used in sugar chemistry or optically active polyhydric carbonyl compounds.

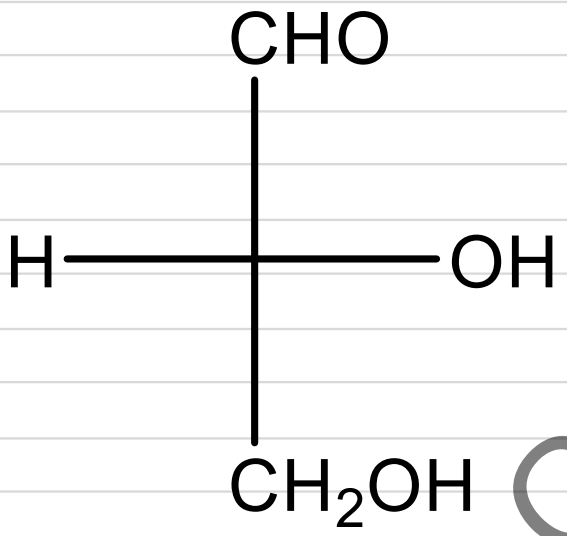
OH group on the right hand side of the chiral atom belong to the **D-series**



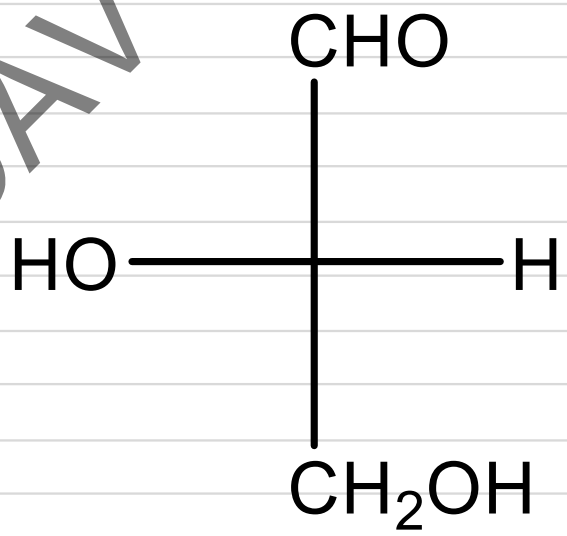
OH is on the left hand side, then the sugar belongs to the **L-series**



GL JADAV



D(+) glyceraldehyde



L(-) glyceraldehydes

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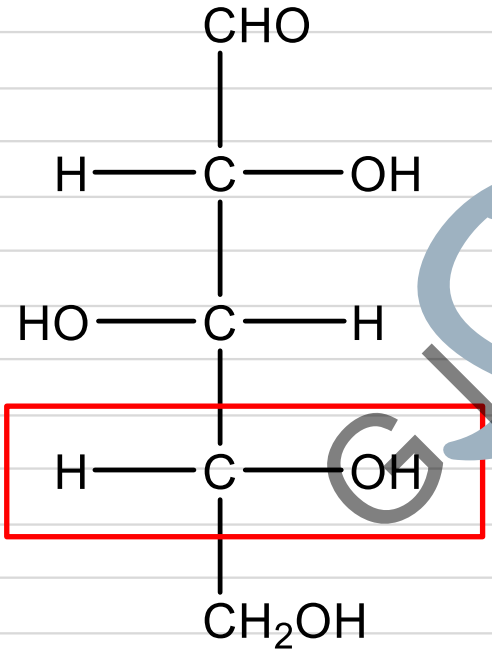
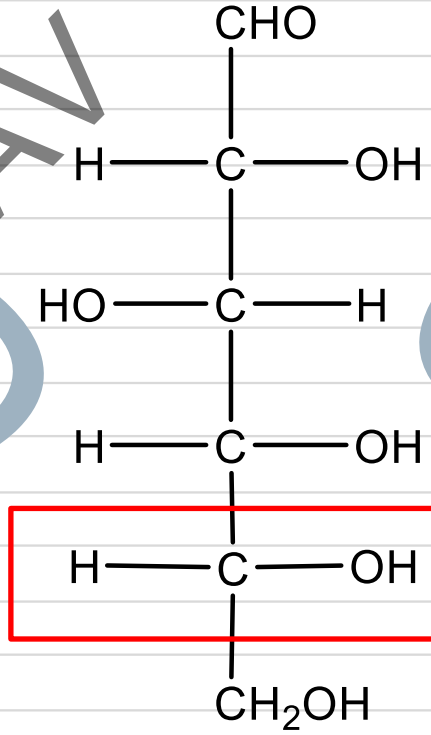
Highest number of chiral center



Highest no of chiral center



Highest no of chiral center

D

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Absolute configuration

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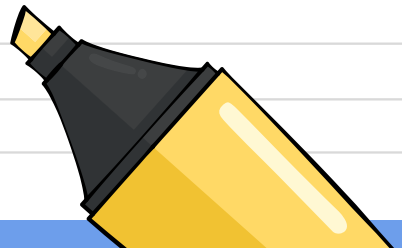
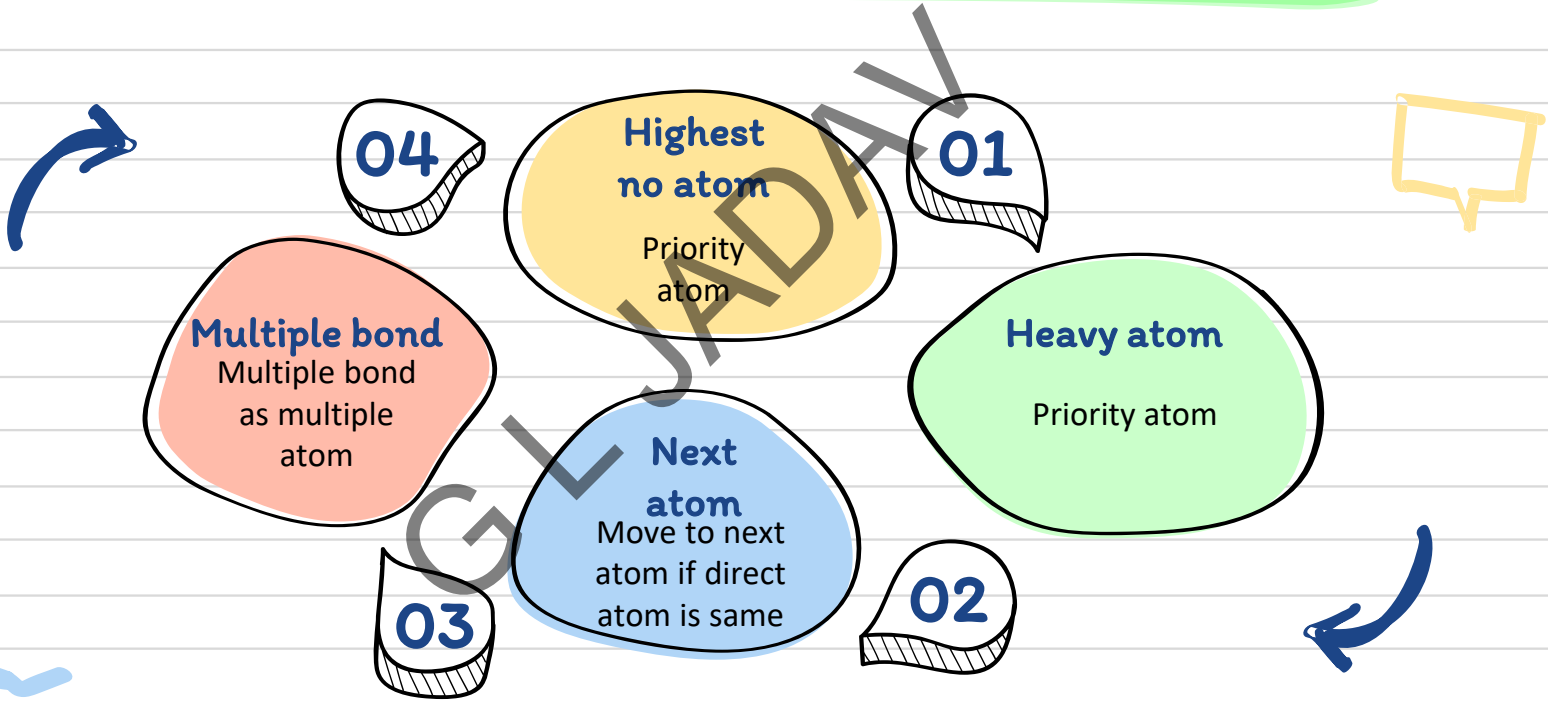
R / S
R = rectus
S = sinister
3D arrangement
CIP and Chirality rules



Cahn-Ingold-Prelog rules(Sequence rule)



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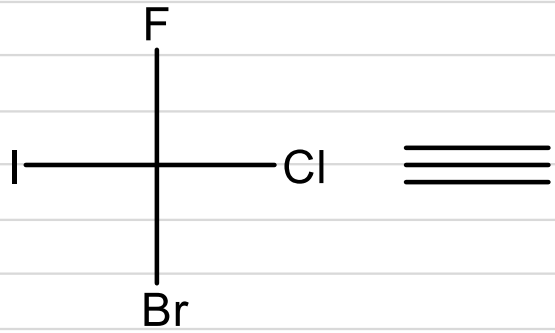
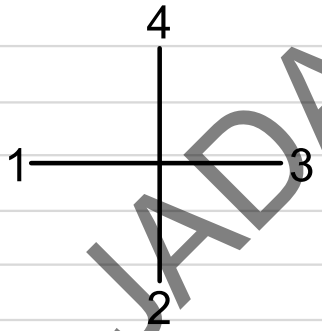
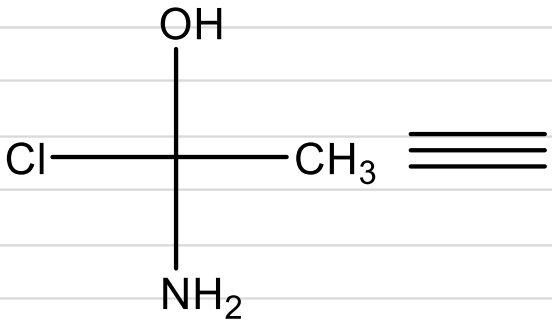
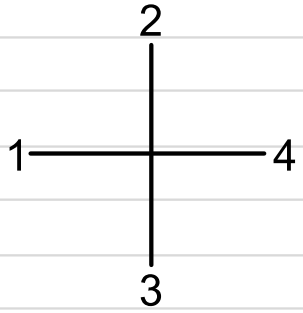
Highest number of atom-highest priority





$I > Br > Cl > F$





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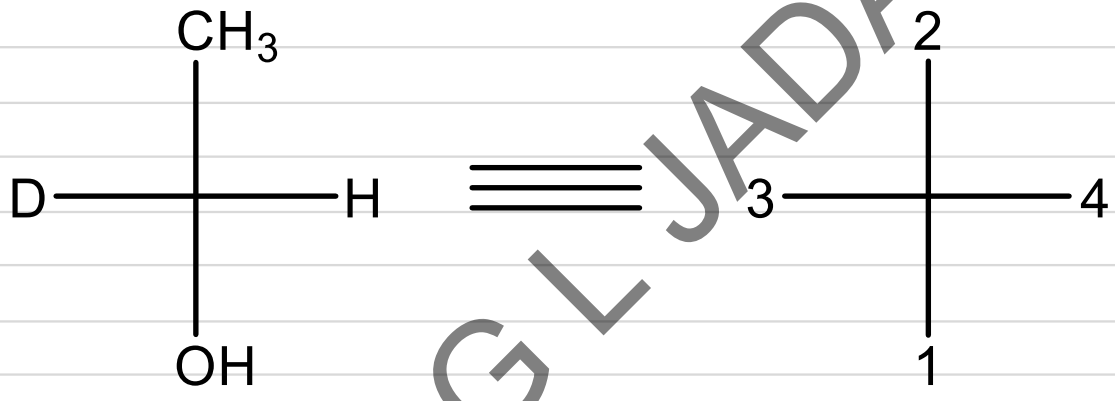
Heavier the isotope more the priority



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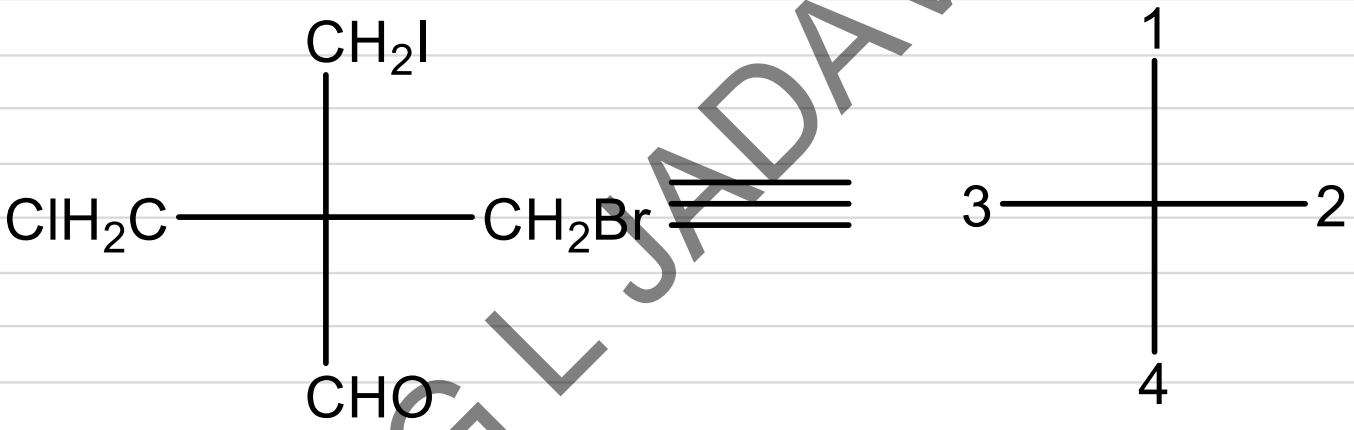
T > D > H

Move towards next atom



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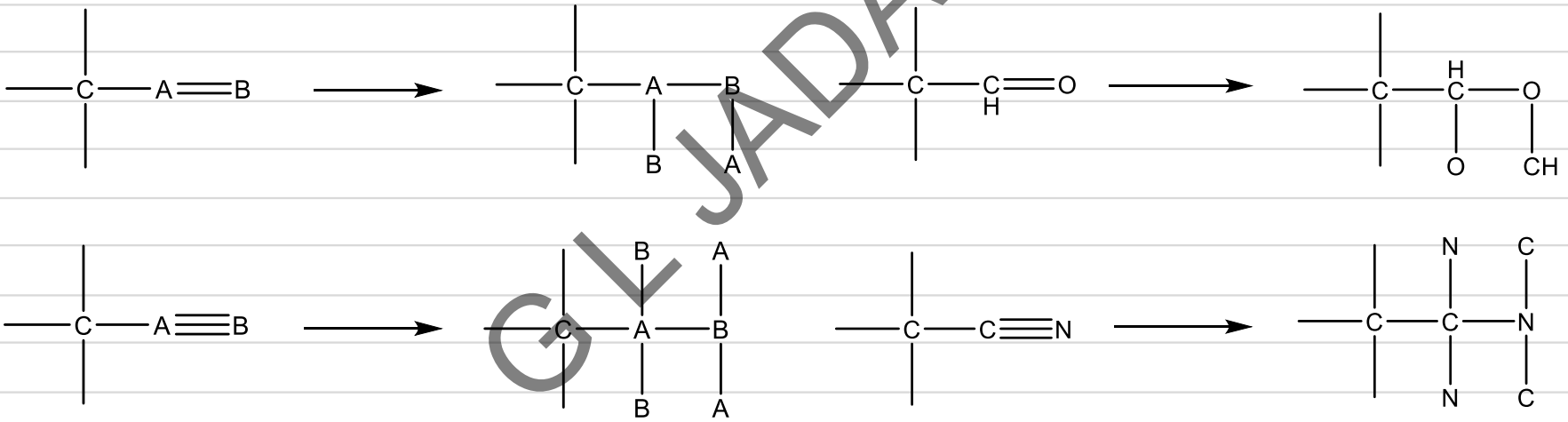
Multiple bond treated as multiple atoms



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