CH 1 3 Introduction to Organic Chemistry

Saturday, 20 December 2025   4:12 PM

Organic chemistry

Study of hydrocarbons and their derivatives

Hydrocarbon $\longrightarrow$ Alkane

H C $\boxed{\text{only}}$ Alkene

Alcohol -OH

① Alkane C_nH_{2n+2} (General formule)

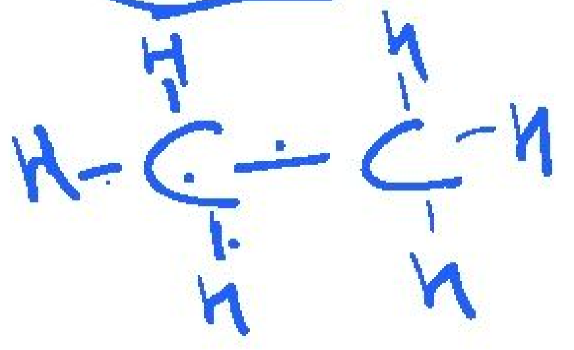
C-C

Suffix -ane C_2H_6 C

ethane $CH_3-OH \downarrow$

M.F C_2H_6 $\boxed{CH_4O}$

Display



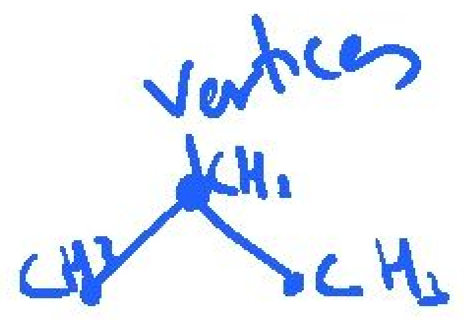
$$\begin{array}{ccccc} & H & & H & \\ & | & & | & \\ H- & C & - & C & -H \\ & | & & | & \\ & H & & H & \end{array}$$

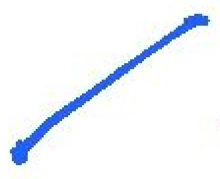
CH_3-OH

Condense CH_3CH_3 =   Pentane

✓ Skeletal

Rules



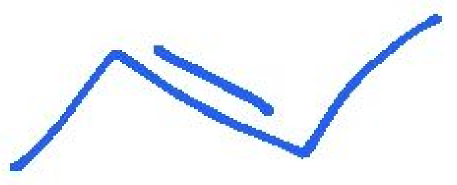


M.F,

(1) Never represent C & H in this formula C-H bonded together, never represent them.

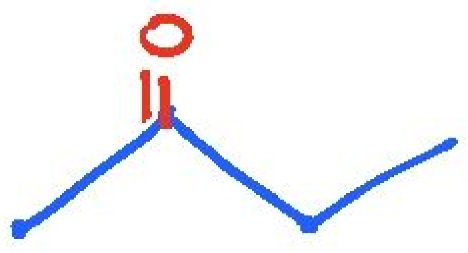
(2) if H is bonded to some other atom like N O then you represent that hydrogen.

(3)



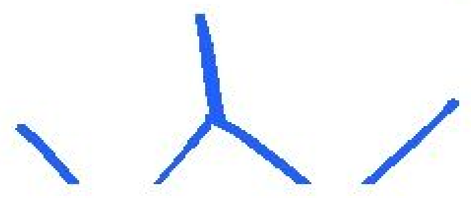
(

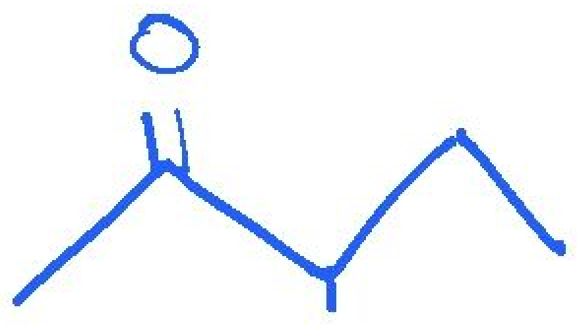
$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

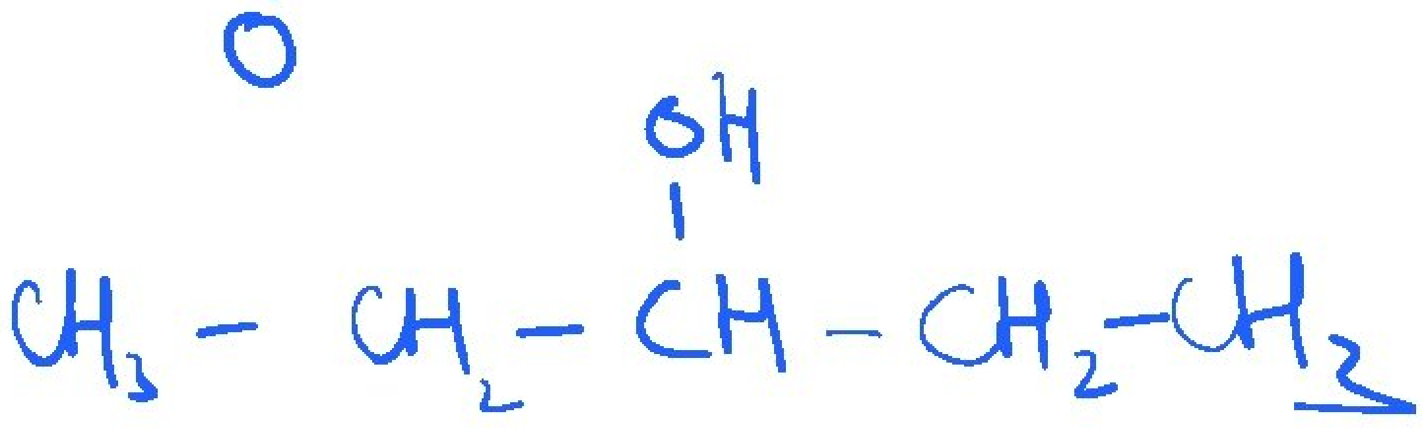


$\overset{\times}{C}\ \overset{\times}{H}$

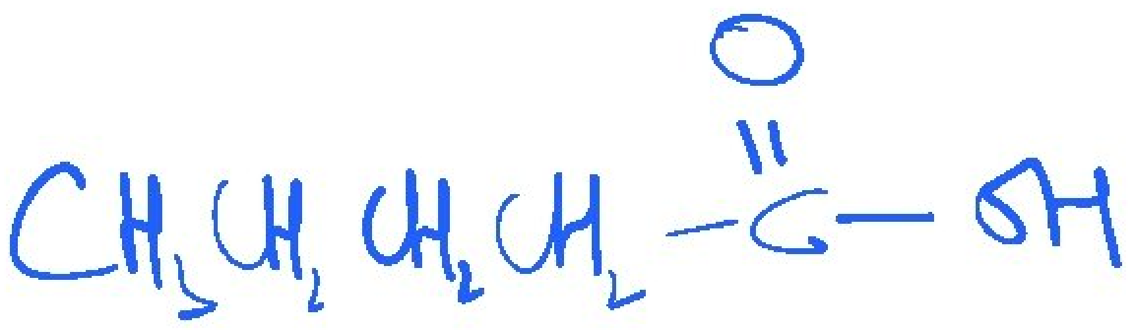
$CH_3-\overset{O}{\overset{\|}{C}}-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$





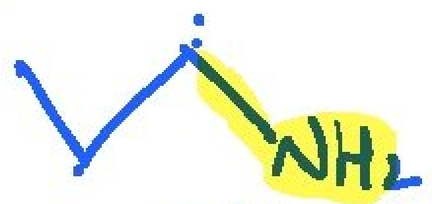


$CH_3-CH_2-\overset{OH}{CH}-CH_2-CH_3$

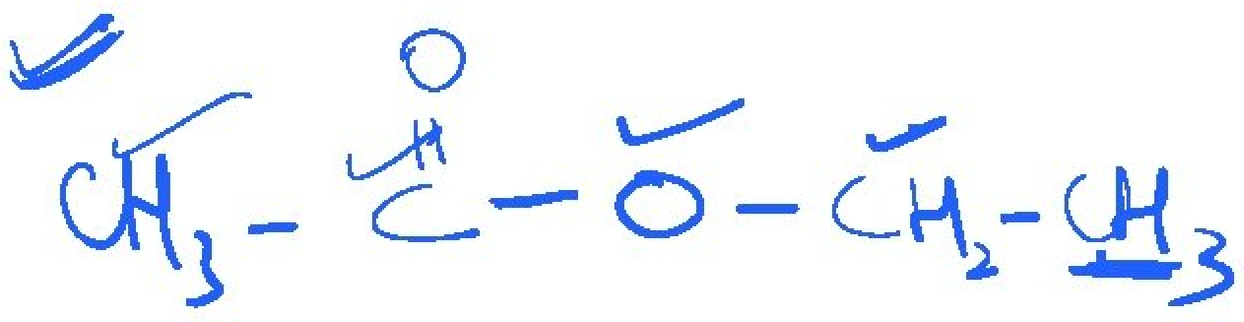


$CH_3CH_2CH_2CH_2-\overset{O}{\overset{\|}{C}}-OH$

$CH_3-CH_2CH_2\boxed{NH_2}$



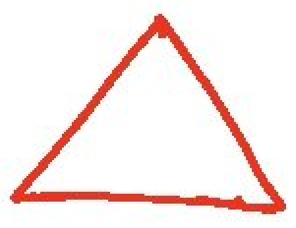
$CH_3-CH_2CH_2-OH$



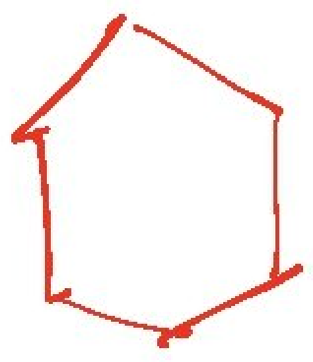
$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

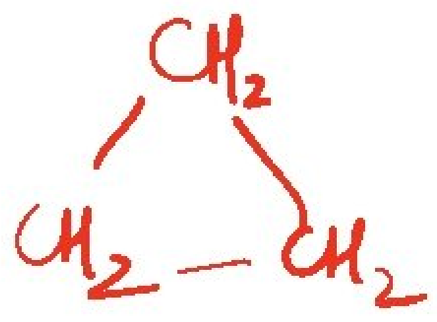
Cycloalkane

Cyclopropane



G.F $\boxed{C_nH_{2n}}$

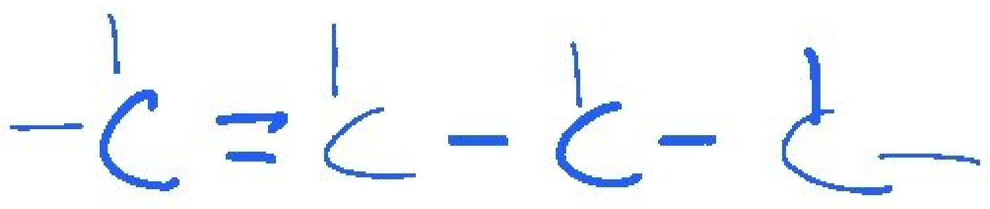




② Alkene $C=C$

suffix -ene

G.F $\boxed{C_nH_{2n}}$



$-\overset{|}{C}=\overset{|}{C}-\overset{|}{C}-\overset{|}{C}-$

$\boxed{But}$-1-ene

M.F C_4H_8

Display.F

Condense.F

Skeletal.F

③ Alcohol $-OH$ suffix (-ol)

G.F $C_nH_{2n+1}OH$ / $C_nH_{2n+2}O$

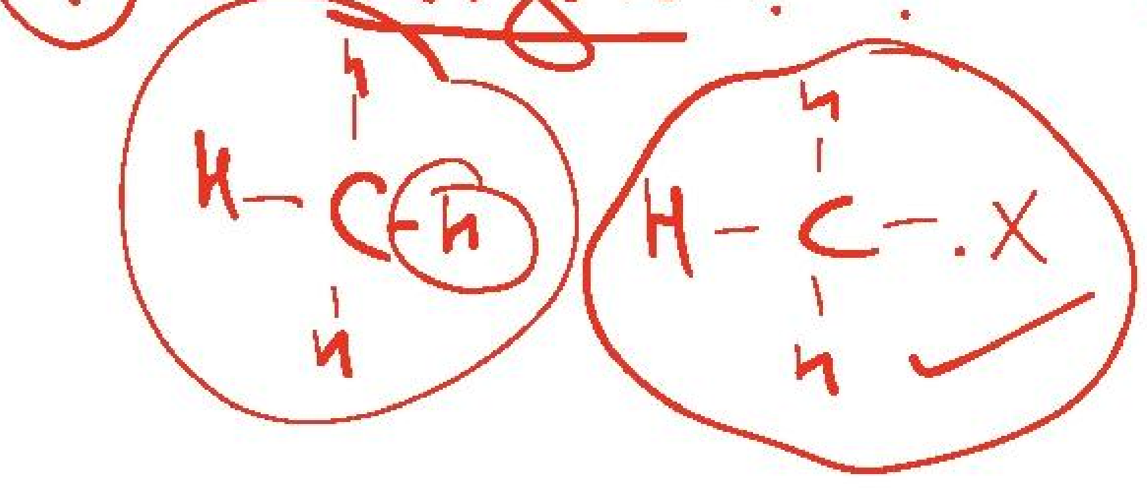
M.F $C_5H_{12}OH$ Pentan-2-ol

Display.F $C_5H_{12}O$ OH

Condense $CH_3CH(OH)CH_2CH_2CH_3$

skeletal. $CH_3CH(OH)(CH_2)_2CH_3$

④ Halogenoalkane $(-X)$ $X = F, Cl, Br, I$



Fluoro
chloro
Bromo
Iodo

$-O-$

G.F $C_nH_{2n+1}X$

2-Bromo butane

M.F C_4H_9Br

Carbonyl compounds

⑤ Aldehyde & Ketones

(Carbonyl Carbon)

no need specify position of F.G

Active site to react

need to specify its position

→ suffix -one.

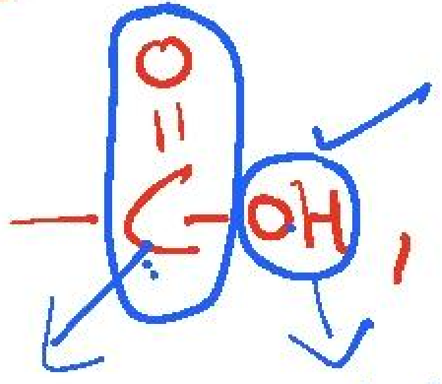
→ suffix -al

G.F same $C_nH_{2n}O$

Hexanal 3-hexanone

⑥ Carboxylic Acid (organic acids) weak Acids

suffix (-oic acid)



, $-COOH$, $-CO_2H$

active site

Propanoic acid

G.F $C_nH_{2n}O_2$

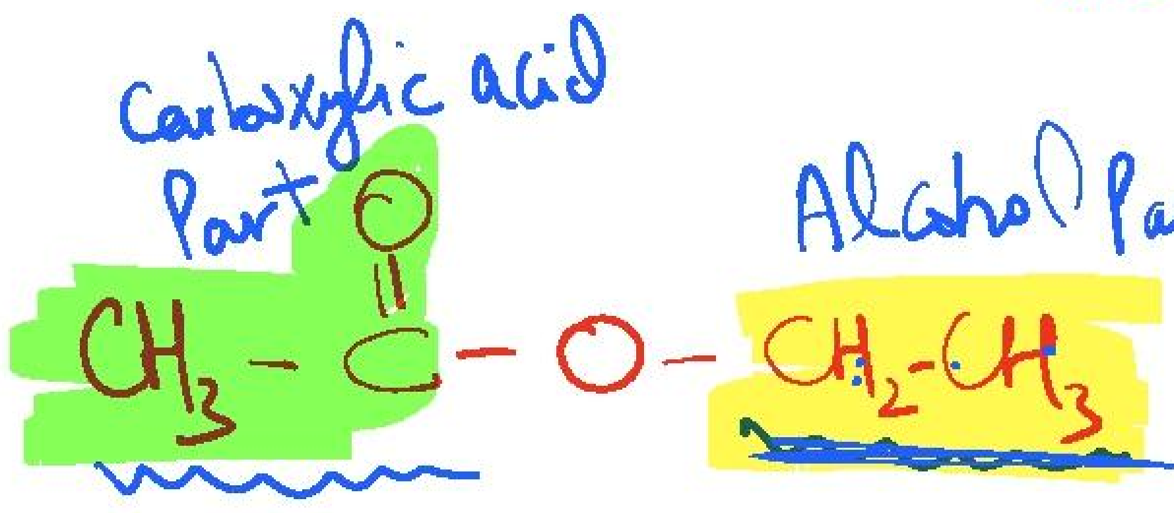
M.F

Display

Condense formula

Skeletal

⑦ Ester Carboxylic acid + Alcohol → Ester + H_2O



Alcohol
suffix -yl
name first

Carboxylic Part.
suffix
-oate

Ethyl ethanoate

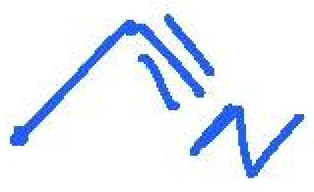
$\overset{\cup}{R}/H - \overset{O}{\overset{\|}{C}} - O - \underline{R'}$ R → Alkyl

Alkyl = Alkane
one H less   terminal C
-yl $-CH_3$ CH_4 end

$-C_2H_5-$ C_2H_6

⑧ Amines $-NH_2$

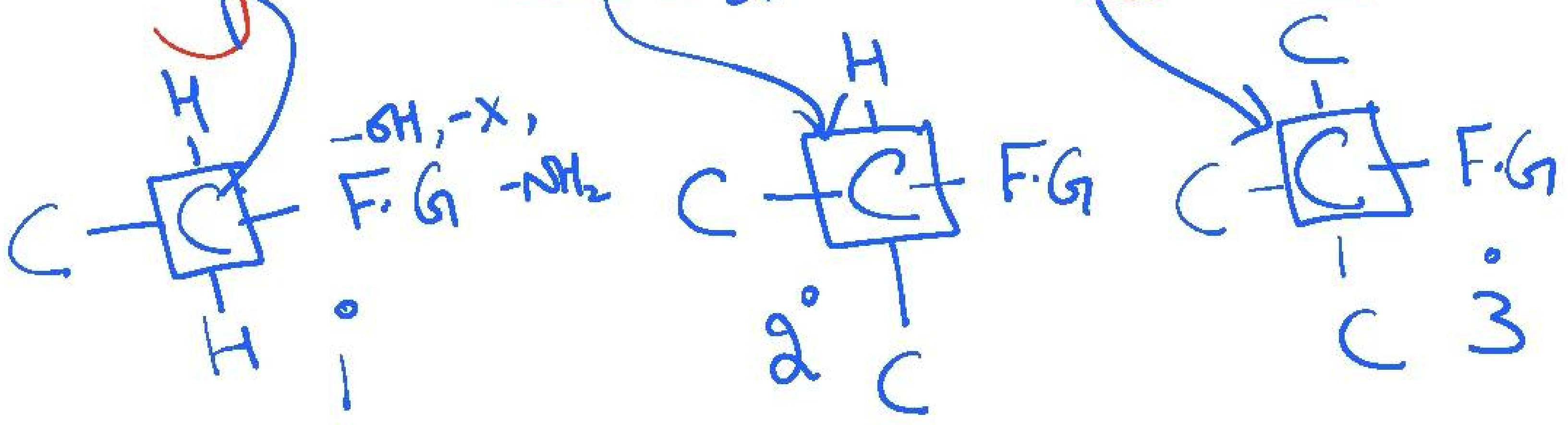
$-C\equiv N$
nitril
ethanenitril



ethyl amine

$CH_3-CH_2-NH_2$.

Primary 1°   F.G   Alcohol / Halogen   Sec 2°   tertiary amine

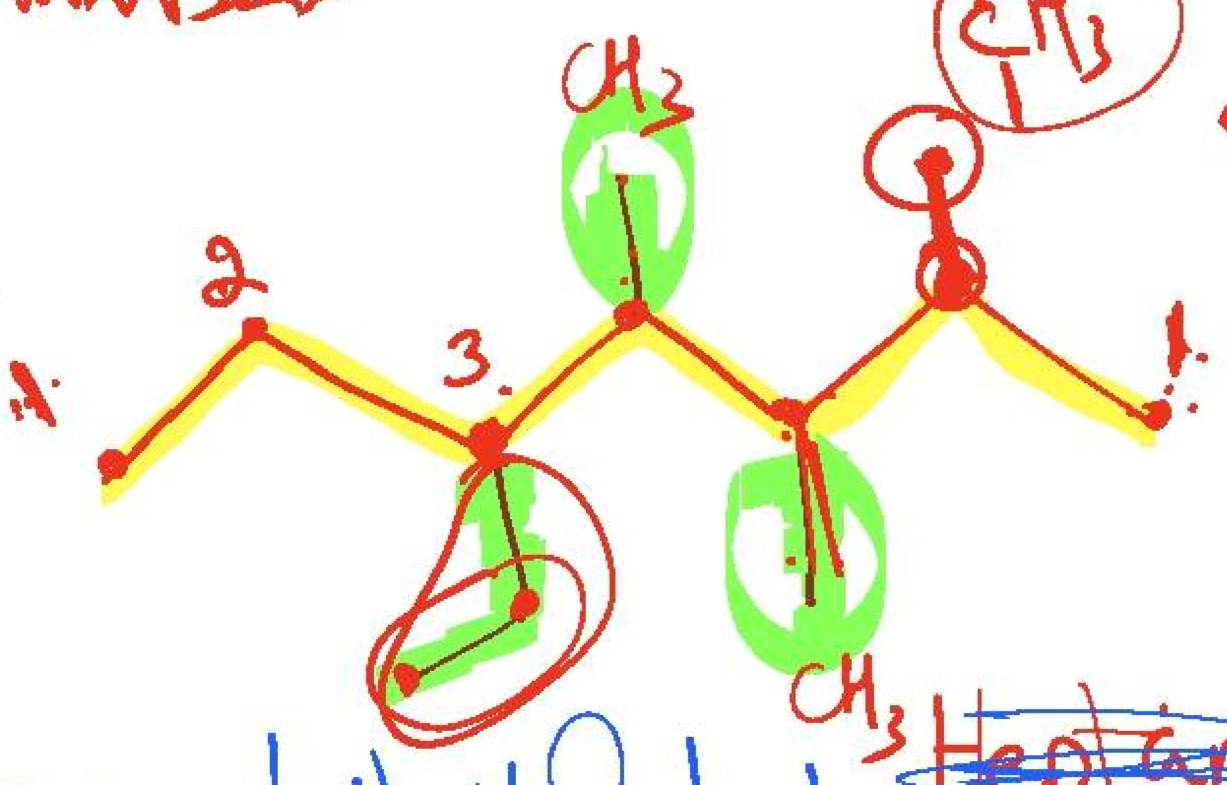


Nomenclature IUPAC

Rules.

(1) Select longest ~~continuous chain~~ Parent chain continuous chain

(2) While naming the compound, F.G will always be given least number



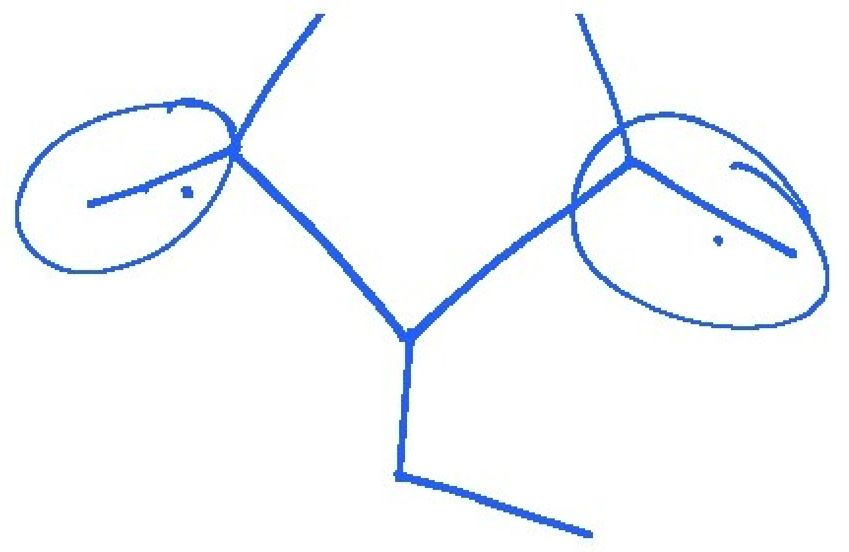
Methyl
ethyl

5-ethyl 2,3,4-trimethyl heptane ~~Heptane~~

2 Methyl
3 〃
4 〃
5. ethyl

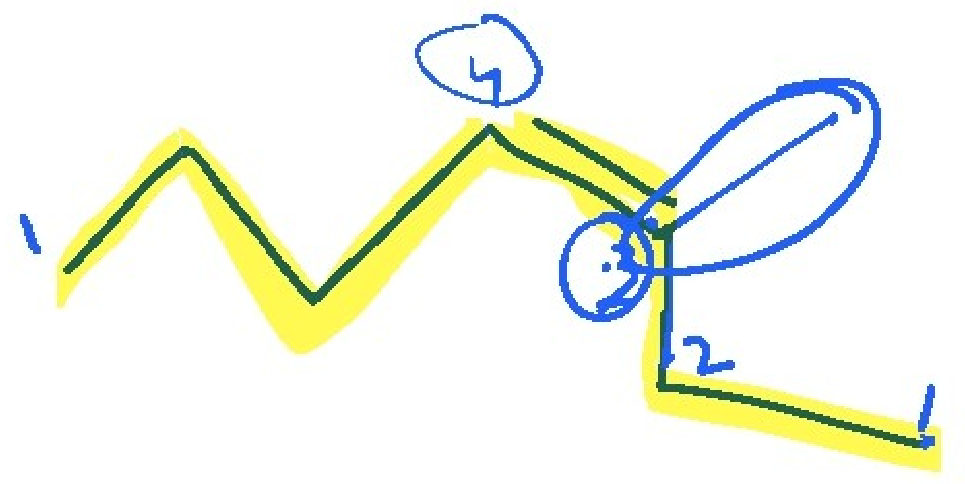
right
branch   Parent
Varsha   Kumari

methyl
ethyl

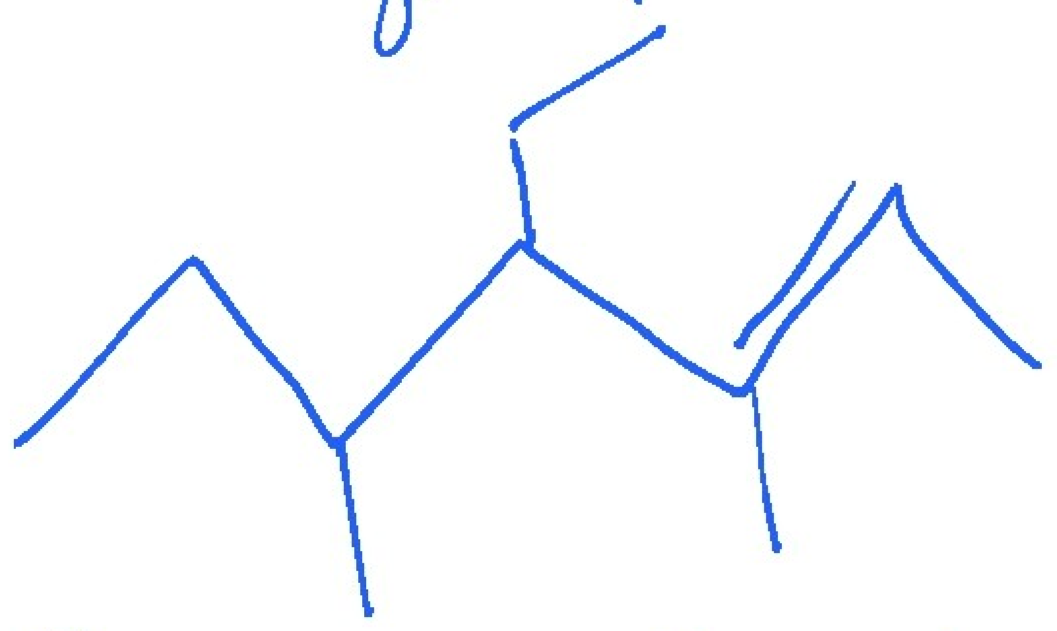


Pentane

3-ethyl-2,4-dimethyl Pentane

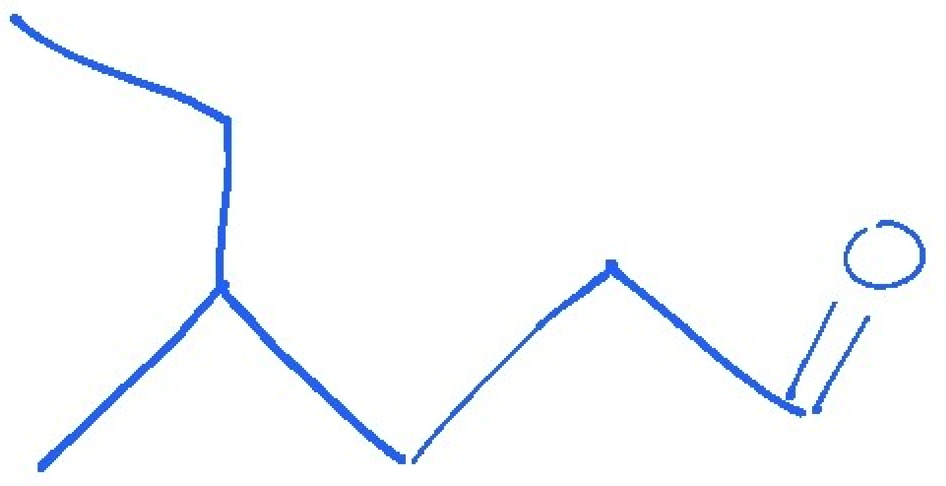


3-Methyl hep-3-ene

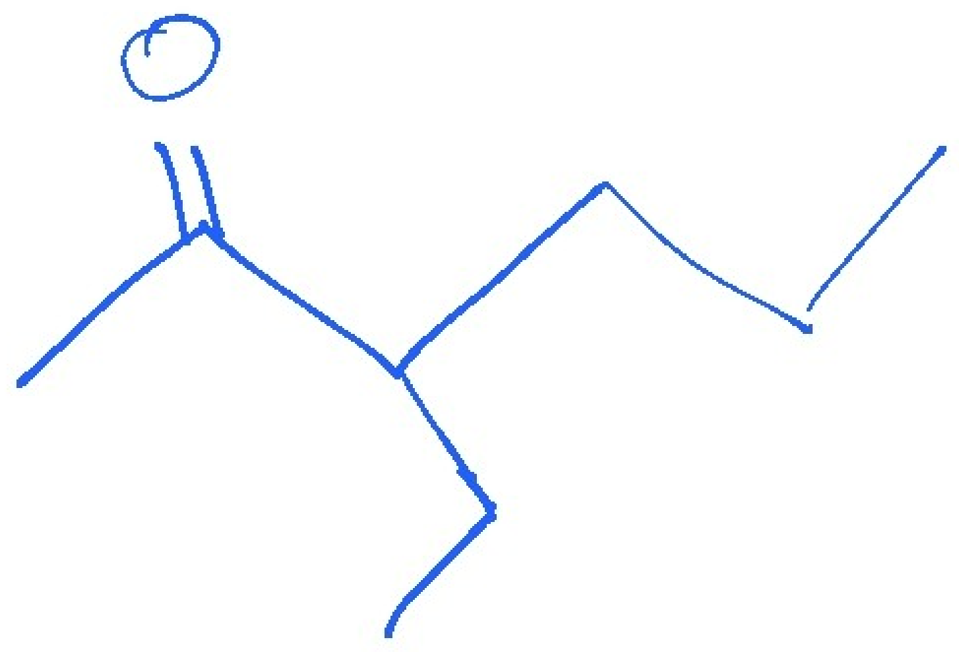


4-ethyl-3,5-dimethyl Hept-2-ene

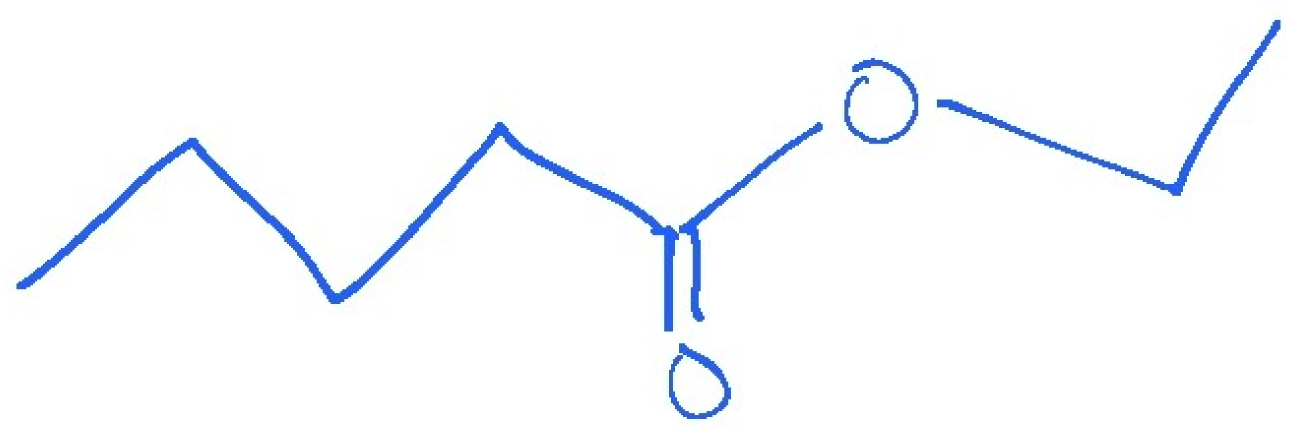
(1)



(2)



(3)



topic

Isomerism

Same M.F but different Structure

Structural

→ M.F Same

→ Structural formula is different

Stereoisomerism

→ same M.F

→ same S.F

but different arrangement

different

Chain   Position   F.G

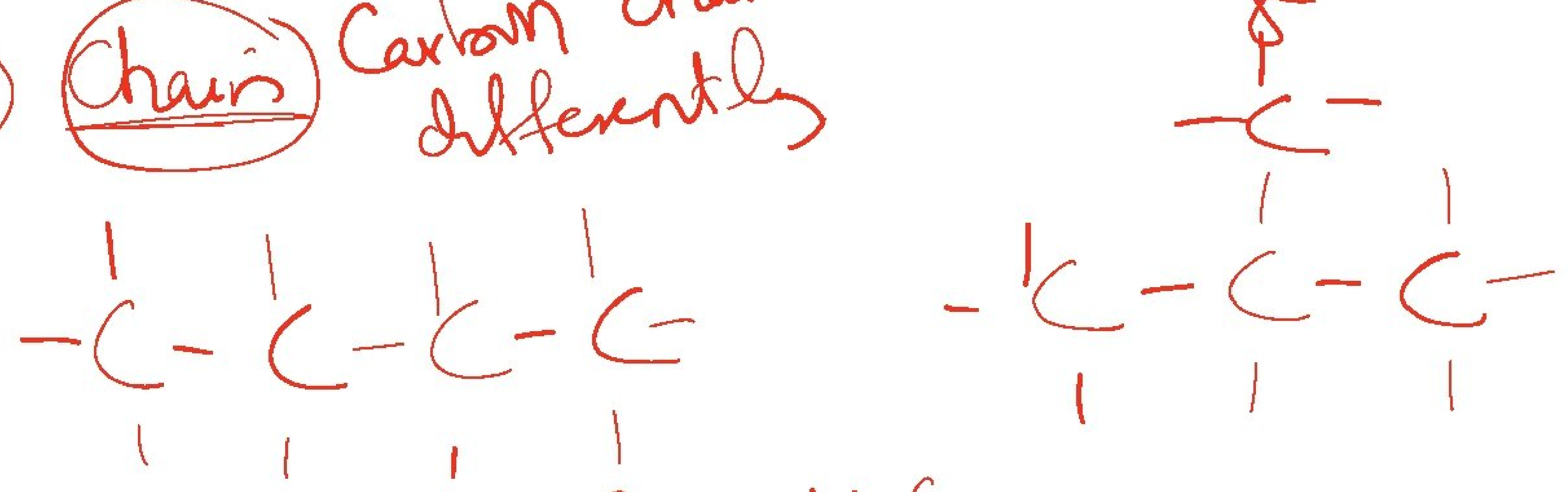
of atoms in space.

different spatial arrangement.

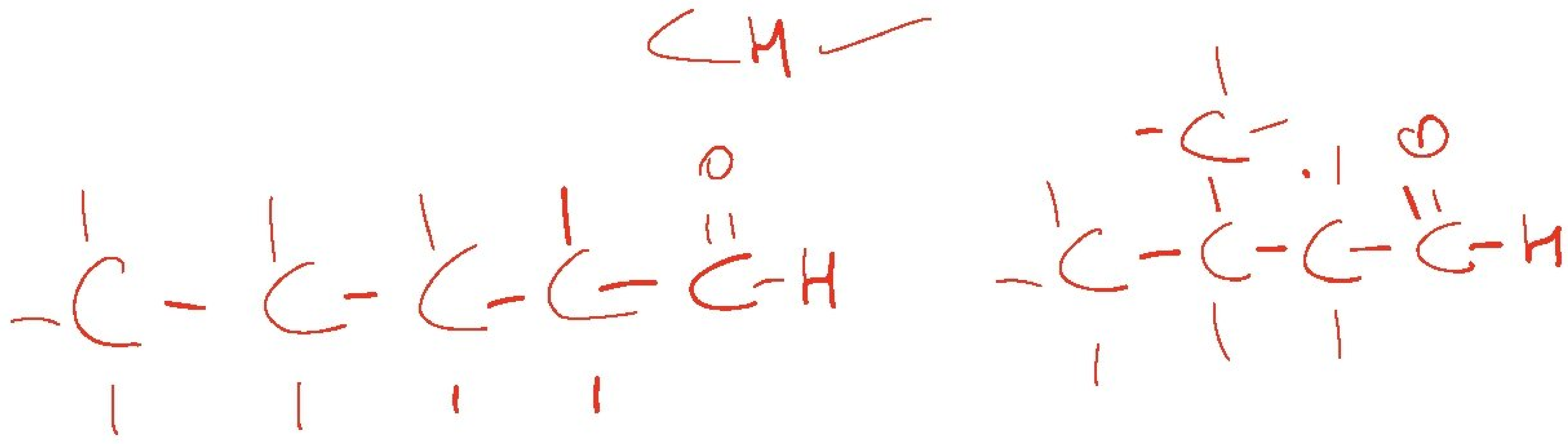
Geometrical isomerism   optical

cis/trans.

① **Chain** Carbon chains are arrange differently



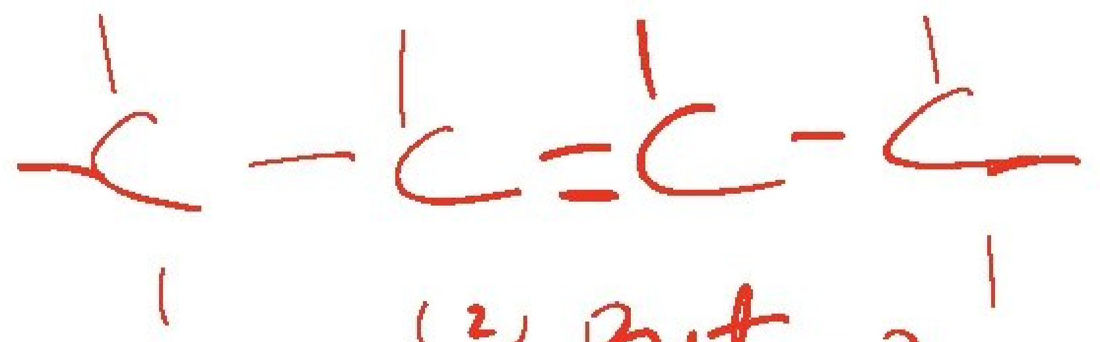
Same M F



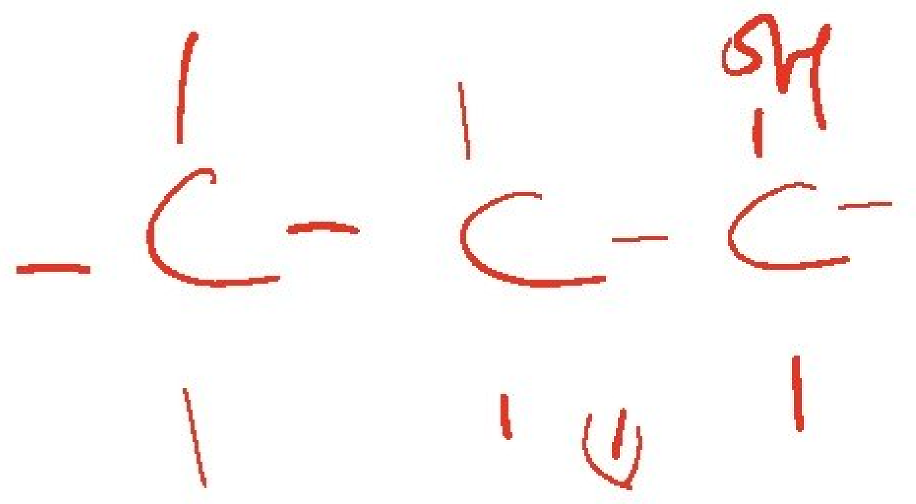
② Position Isomerism

F.G attached to Carbon chains at different positions

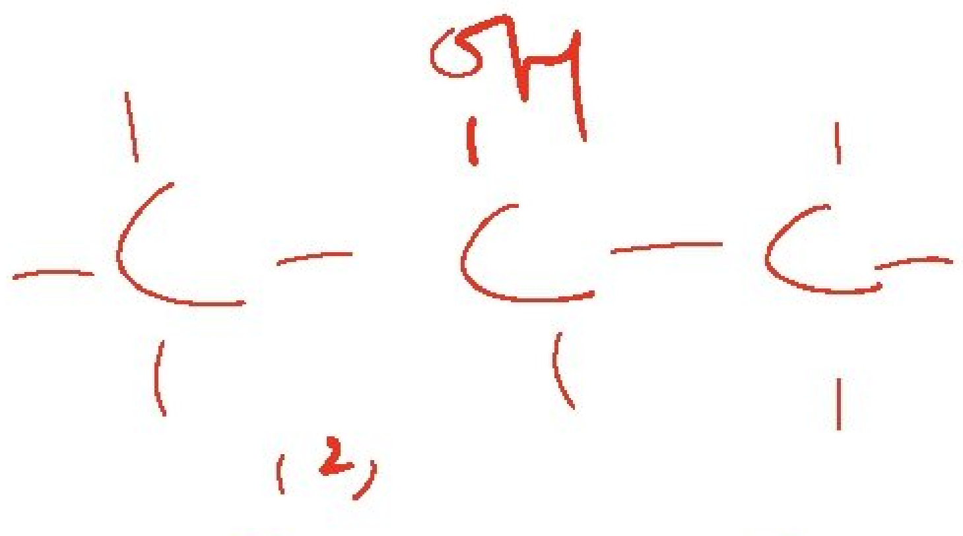
(1) But-1-ene



(2) But-2-ene



Propan-1-ol



Propan-2-ol

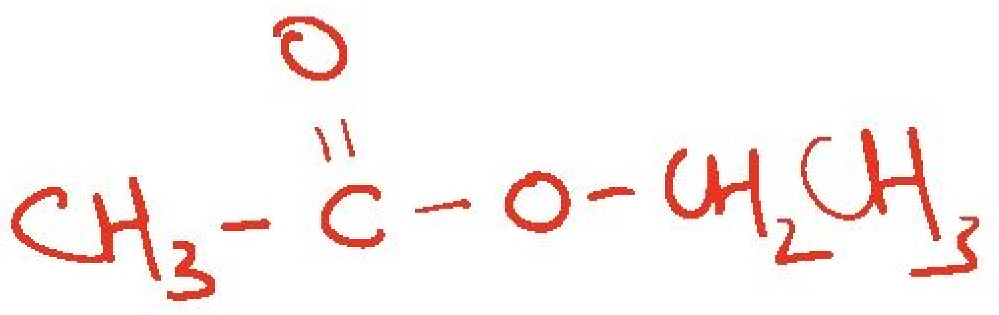
(3) F.G isomerism

The atoms arrange to give different function groups

① Alkene & cycloalkane

② Carboxylic acid and ester $\boxed{C_nH_{2n}O_2}$

$C-C-C-\overset{O}{\overset{\|}{C}}-OH$



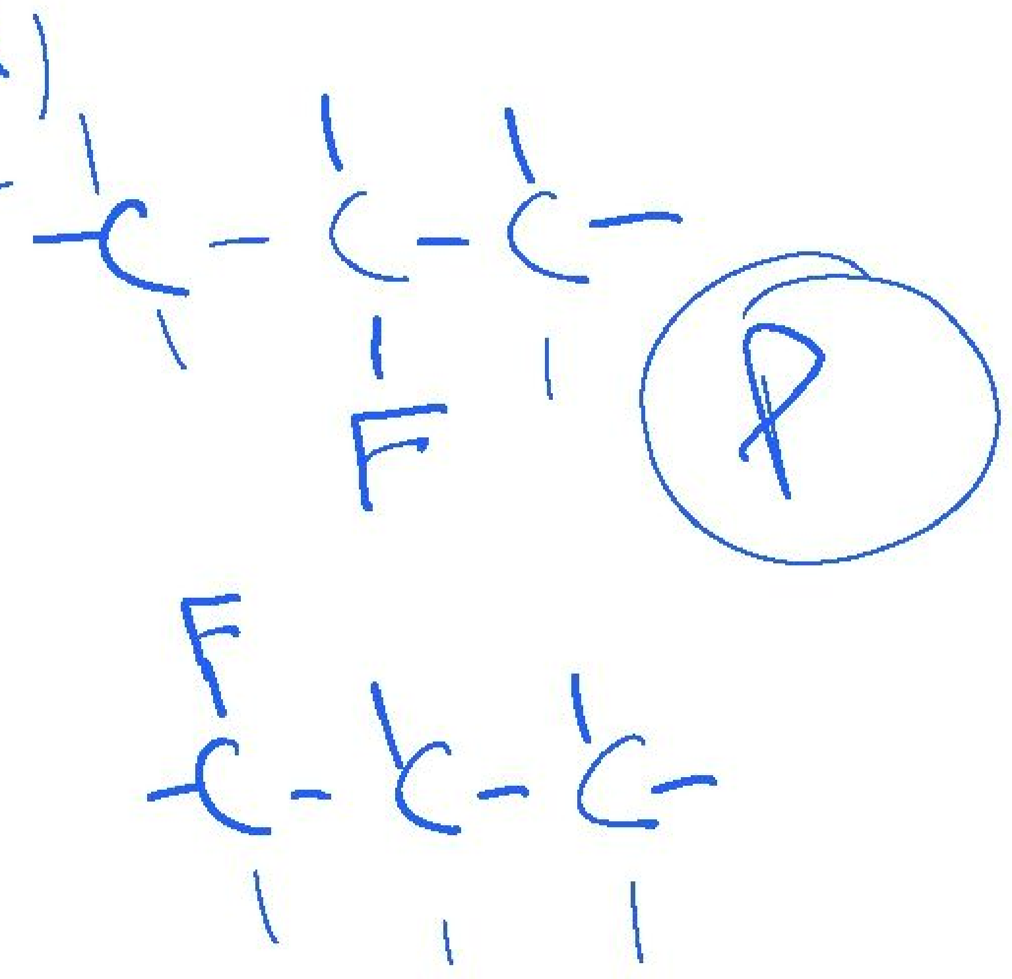
$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2CH_3$

③ Aldehyde & ketone

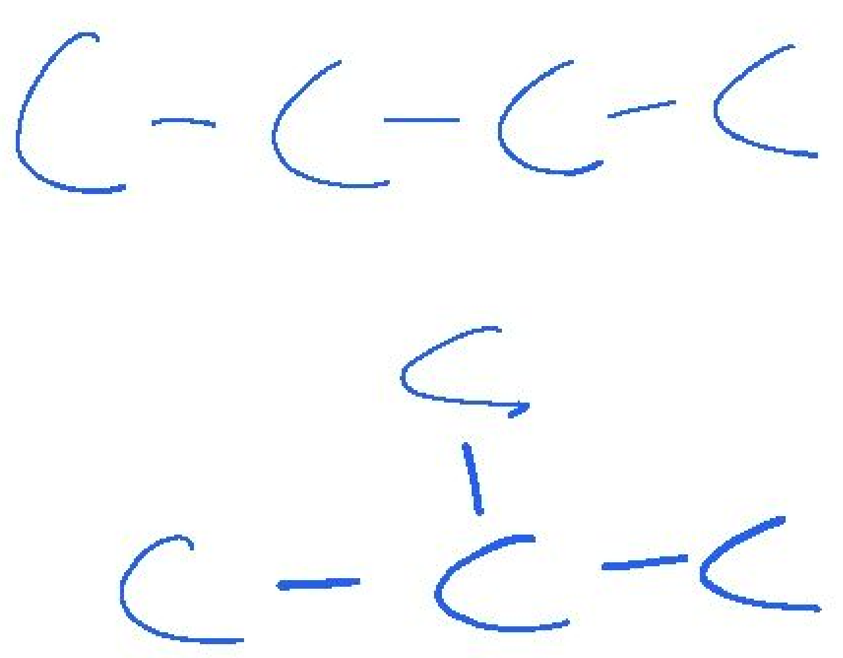
④ Alcohol & $\boxed{\text{ether}}$ $R-O-R'$

CH_3-CH_2-OH CH_3-O-CH_3

(a)



(b)

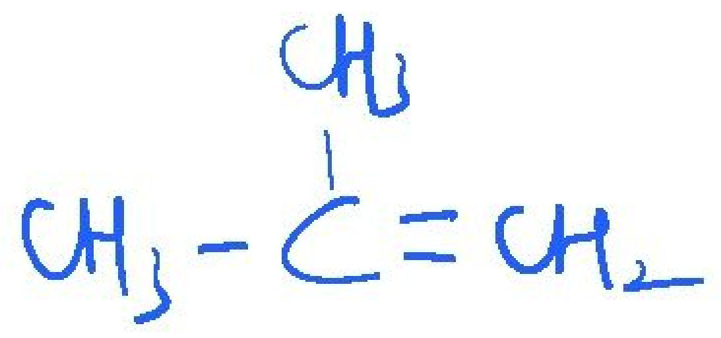


(c) CH_3O-CH_3

CH_3CH_2OH

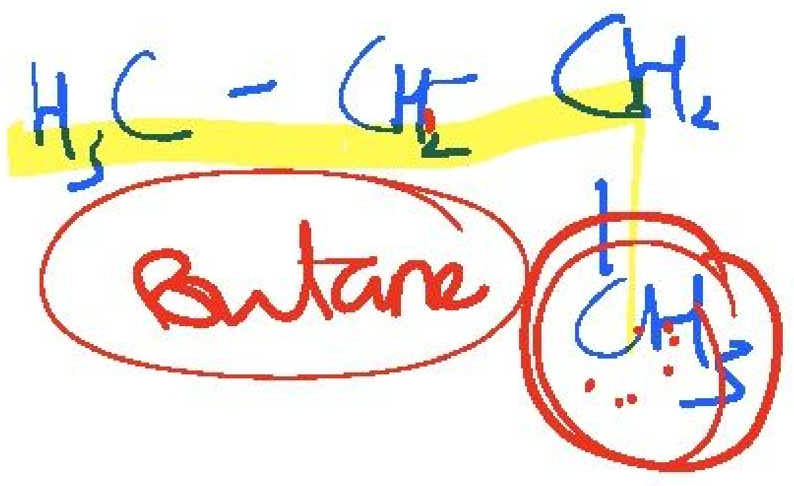
✓ $\boxed{CH_3-CH_2CH_2CH_3}$ Butane

~~(1)~~



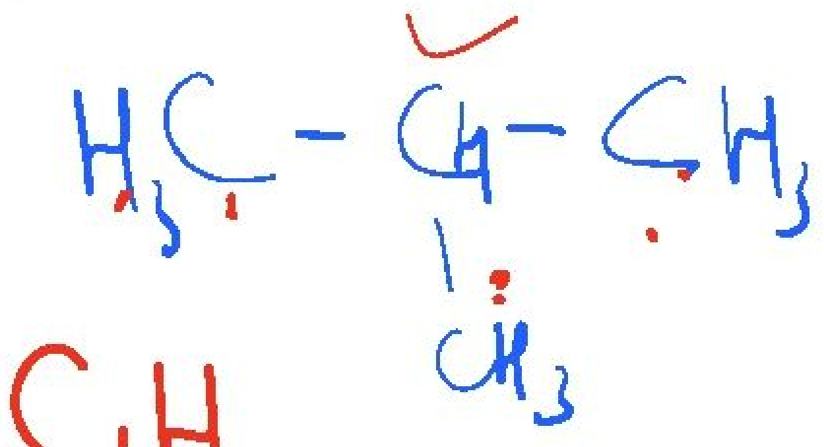
$CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2$

(2)



$H_3C-CH_2-\underset{CH_3}{\underset{|}{CH_2}}$

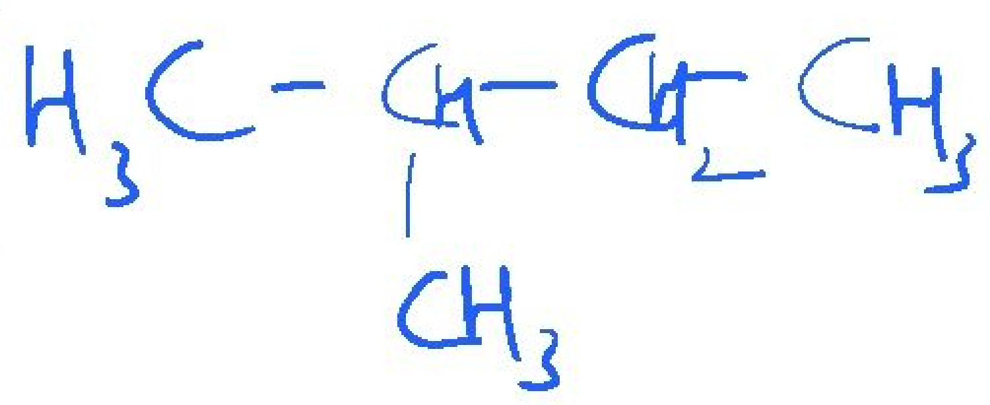
✓ (3)



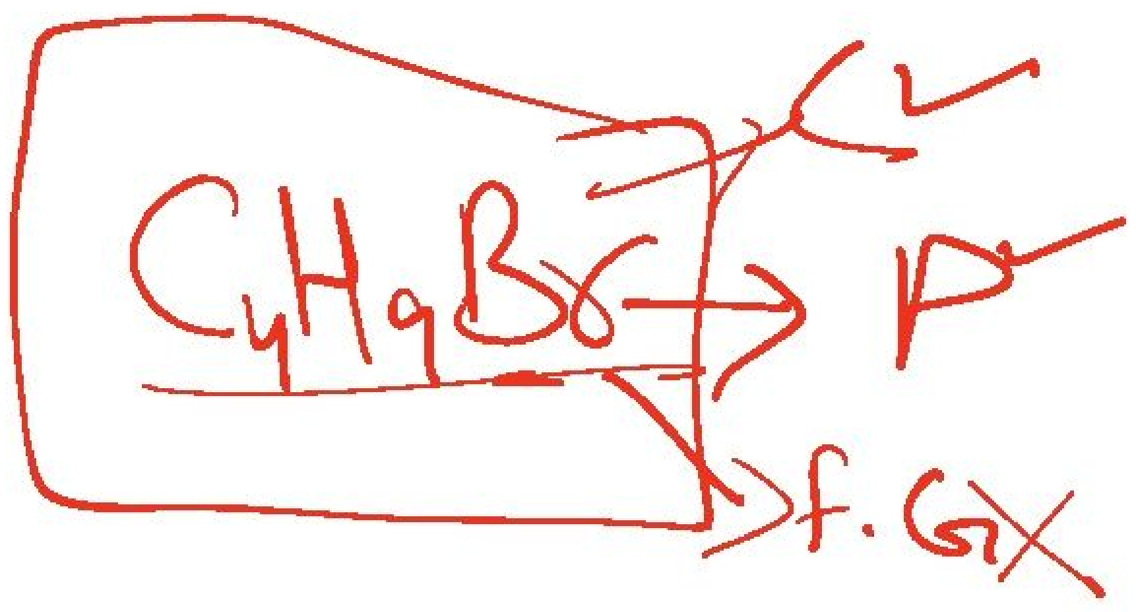
$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH_3$

C_4H_{10}

~~(4)~~



$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH_2CH_3$

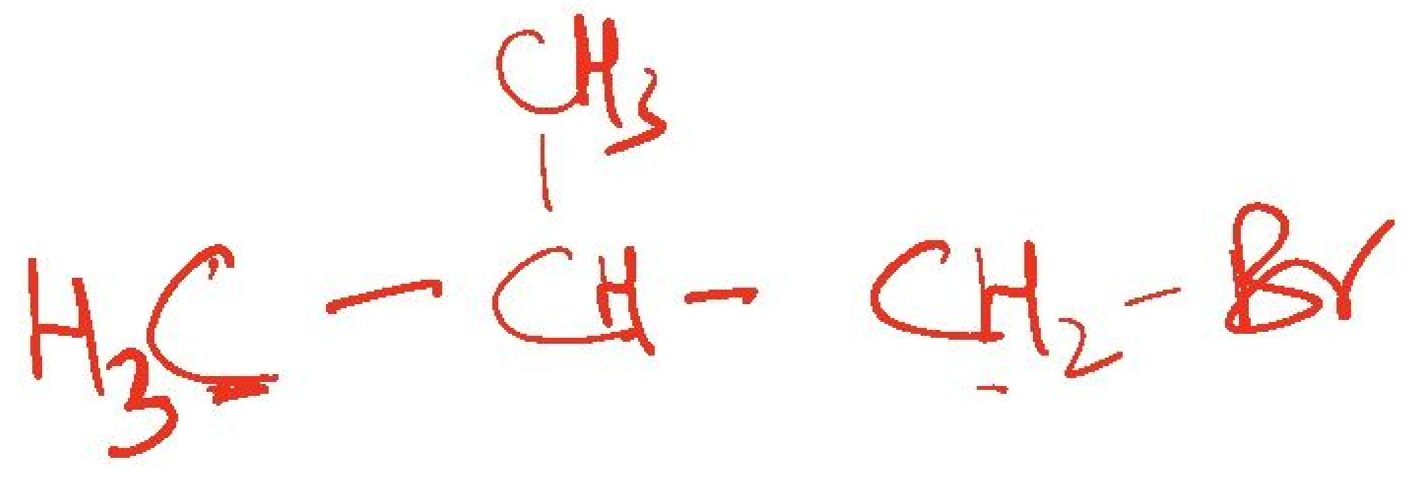


[illegible] isomers

$\boxed{C_6H_{14}}$ H.W

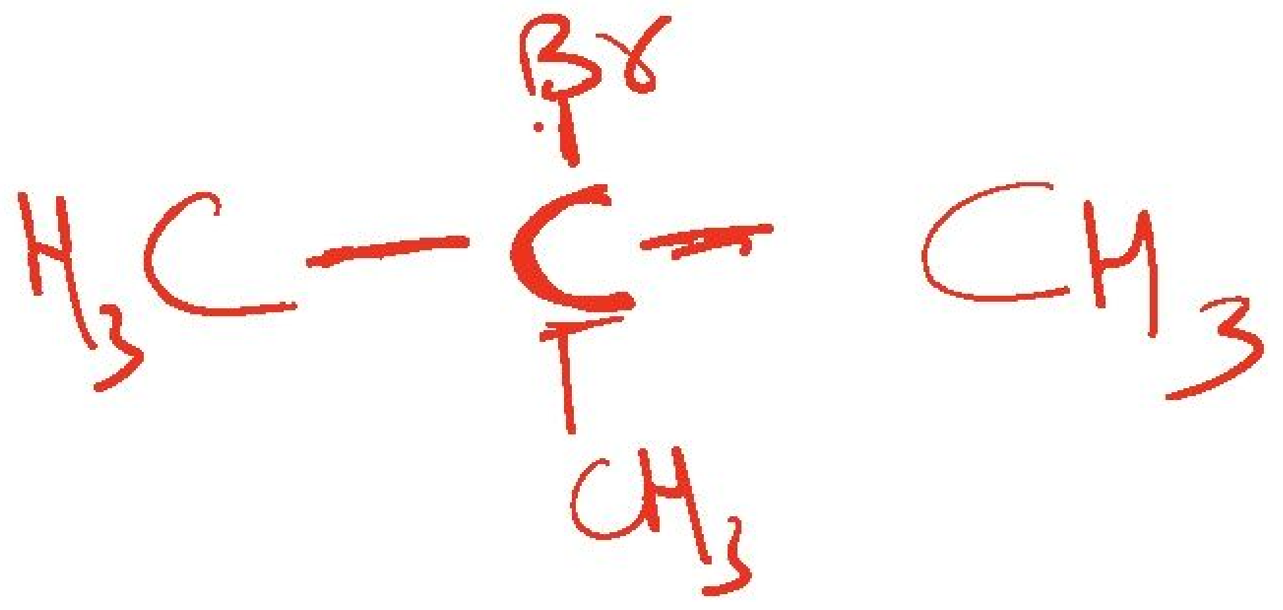
C

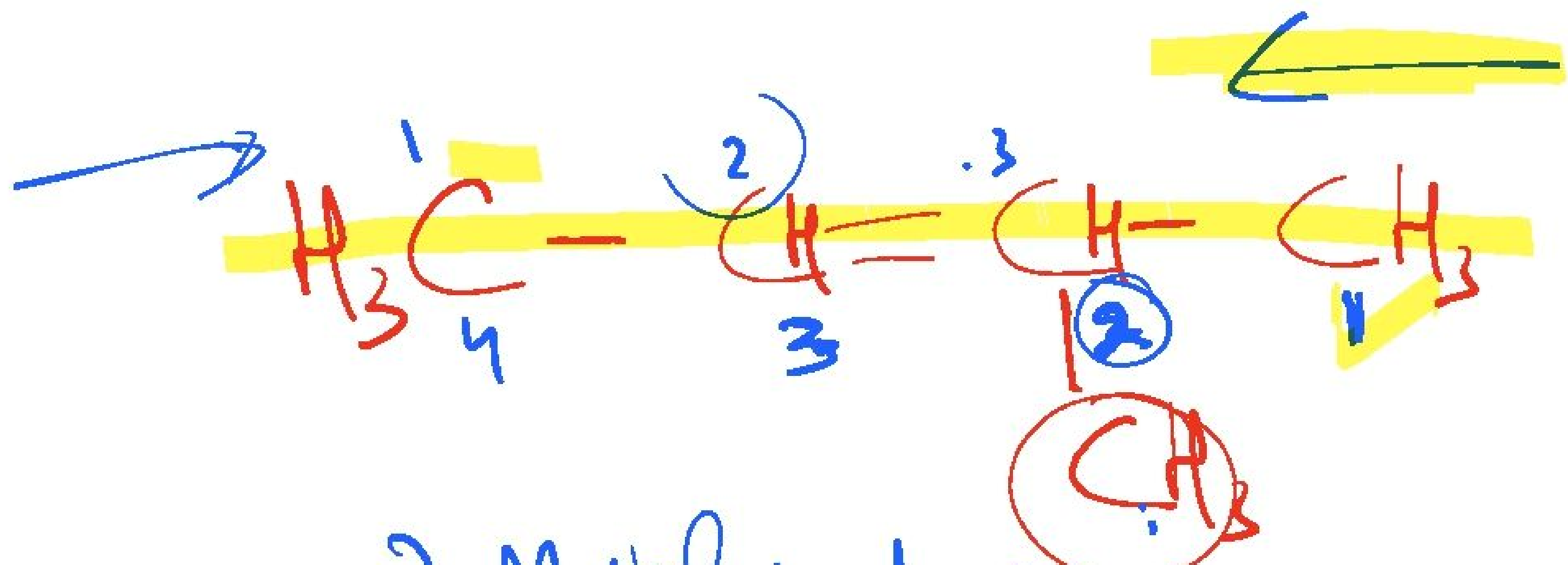
(1) ✗ C – C – C – C – Br

(2) ✗

$H_3C-\overset{CH_3}{\overset{|}{C}H}-CH_2-Br$

(3)

$C-C-\overset{Br}{\overset{|}{C}}-C$

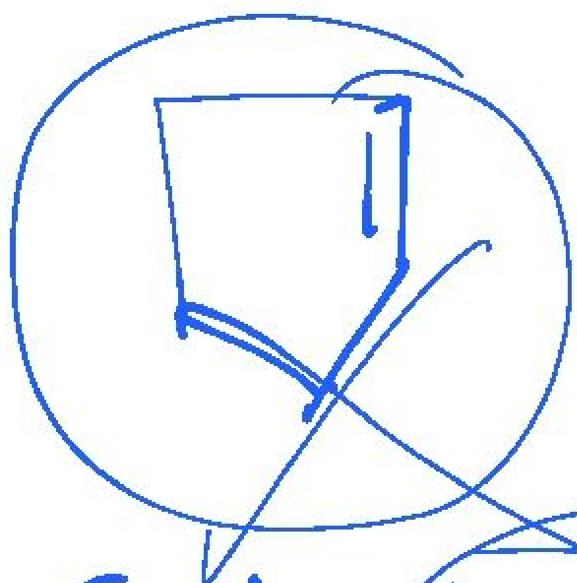
(4)

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



2-Methyl but-2-ene

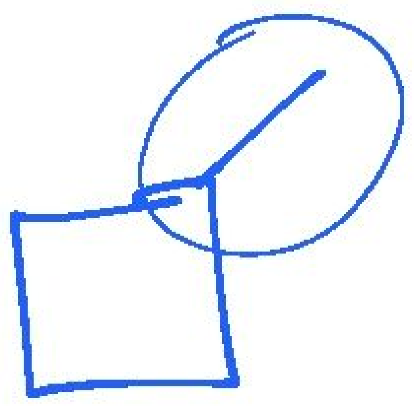
F.G → Alkene & Cycloalkane

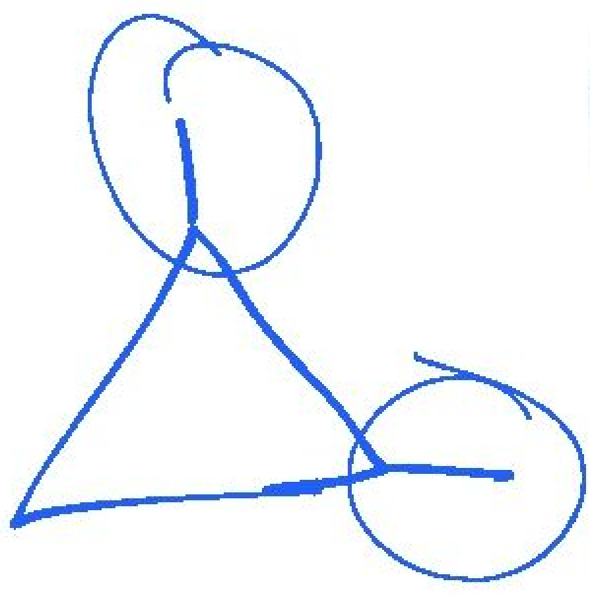
C_5H_{10}

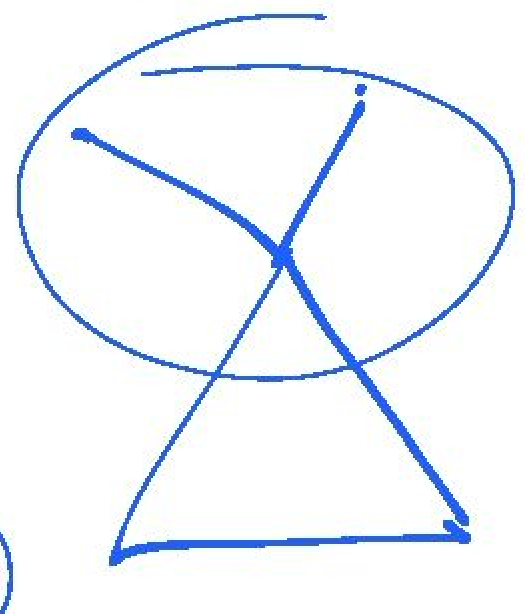


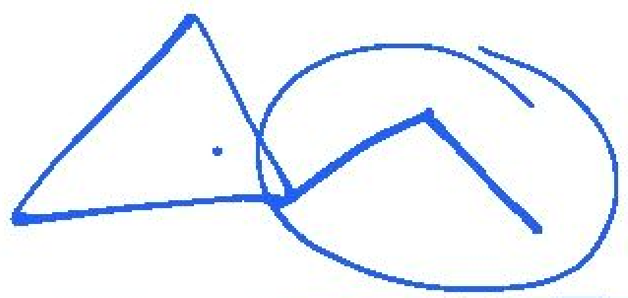
Cycloalkene

C_5H_{10}







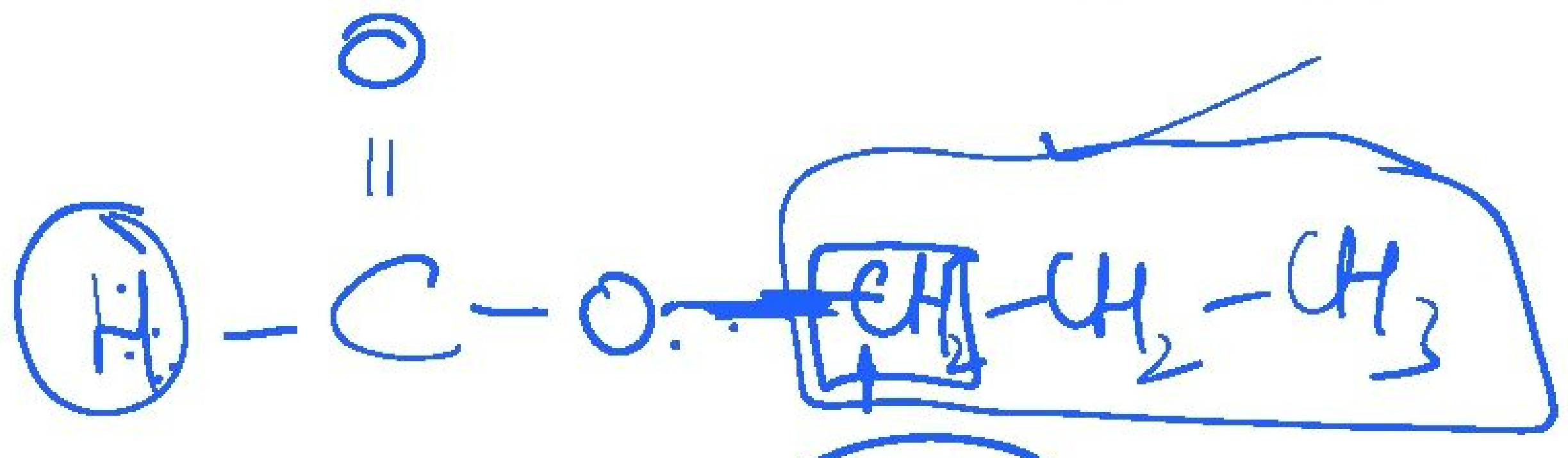


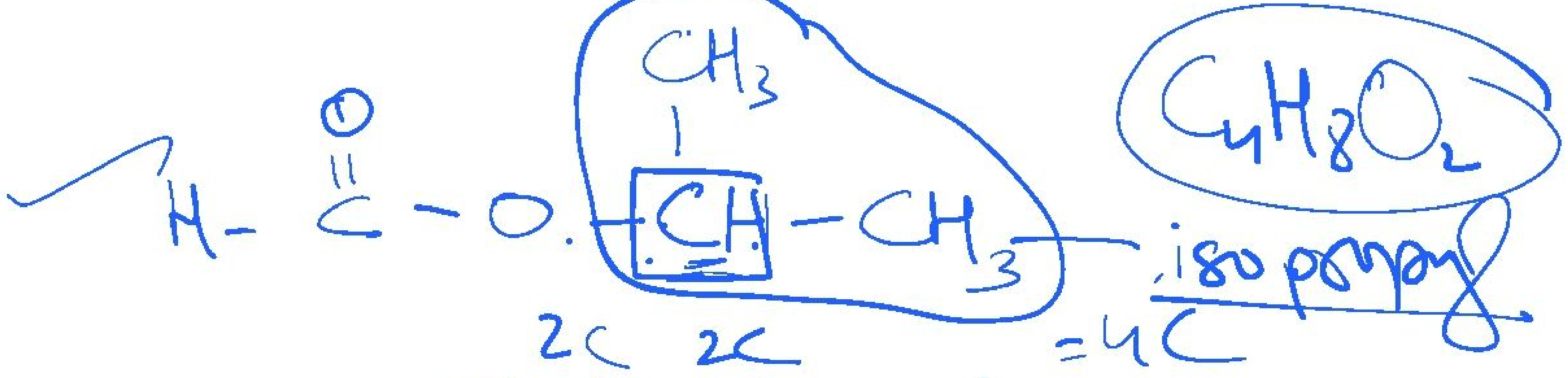
$\boxed{C_6H_{14} \quad C_5H_{10}}$ Home task

$C_4H_8O_2$ ester

$\overset{O}{\overset{\|}{C}}-OH$

Y





W = Ethyl ethanoate

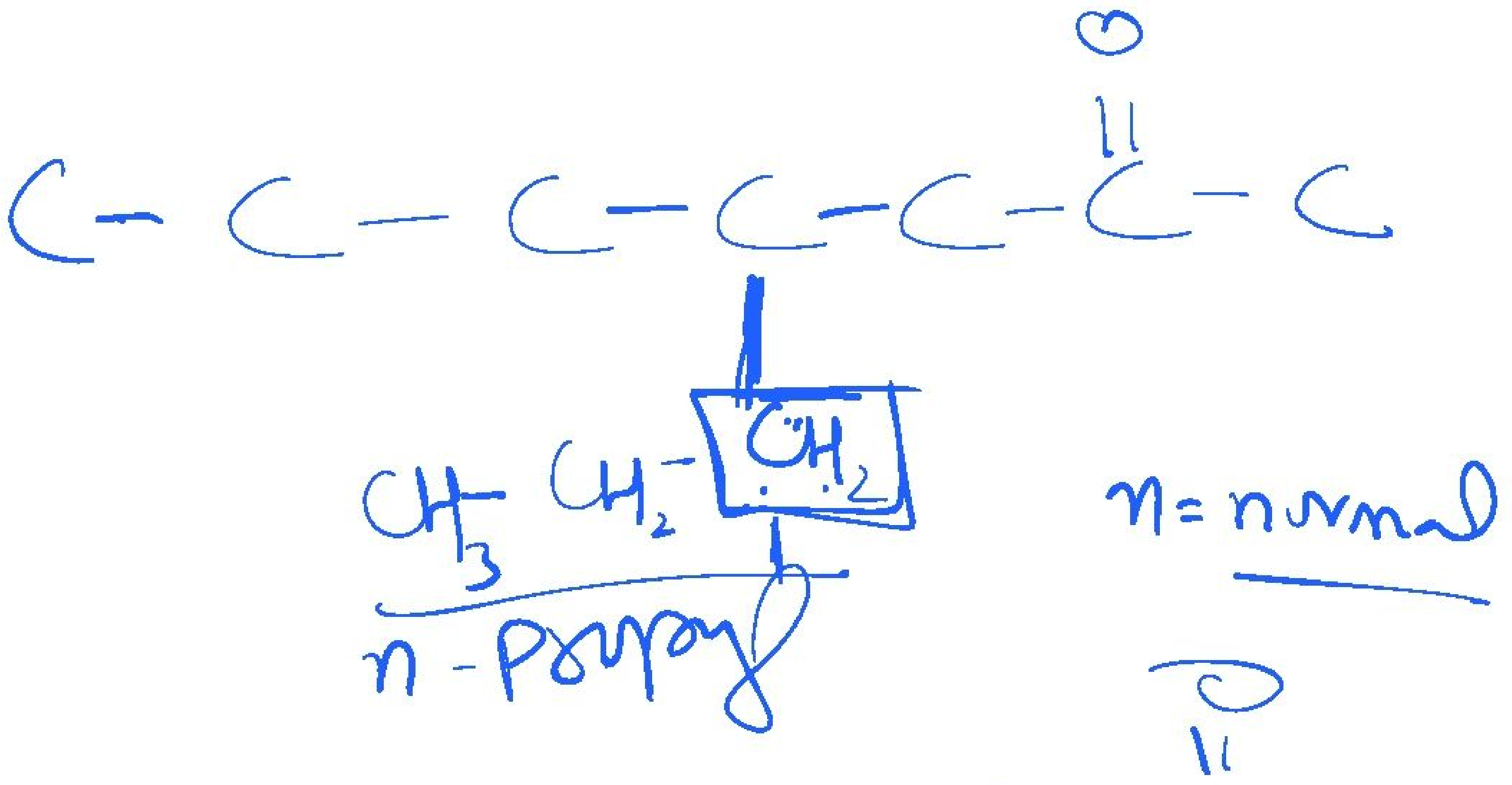
1C + 3C = 4C

X = Methyl Propanoate

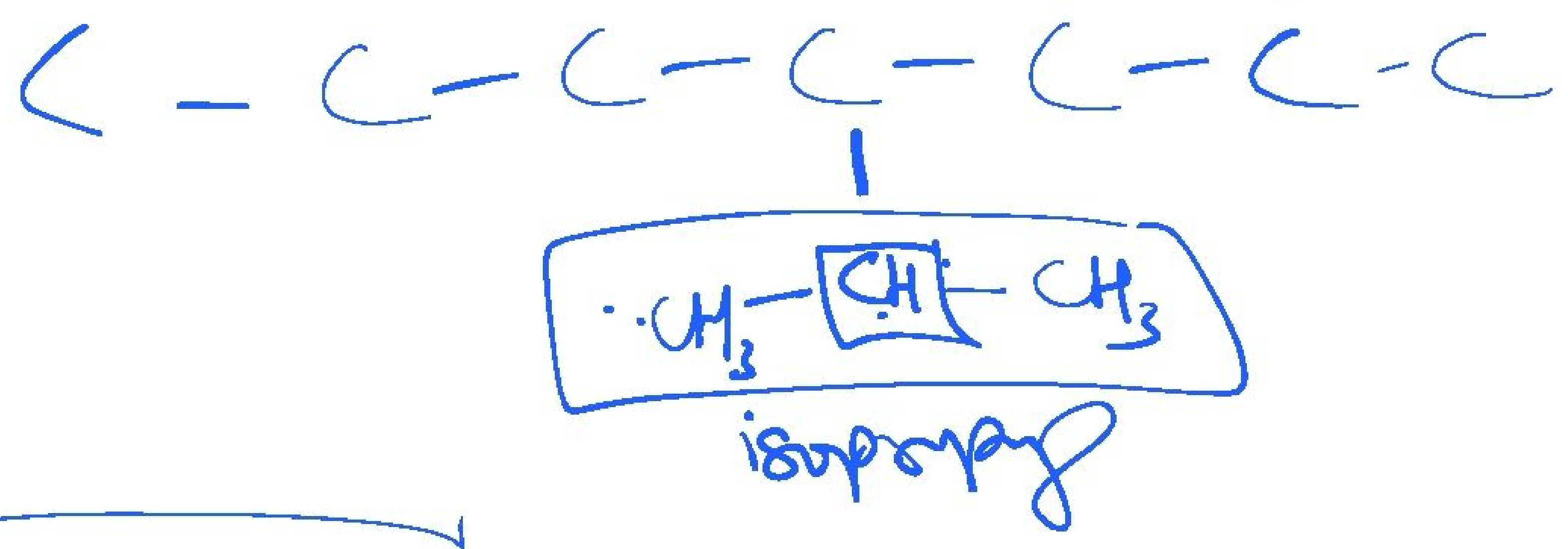
3C + 1C

Y = Propyl methanoate

Propyl in branch form then it is called isopropyl.



n = normal



C_4H_9Br

Same M.F
different S.F.

Stereoisomerism — Geometrical

→ Same M.F   optical

→ Same S.F

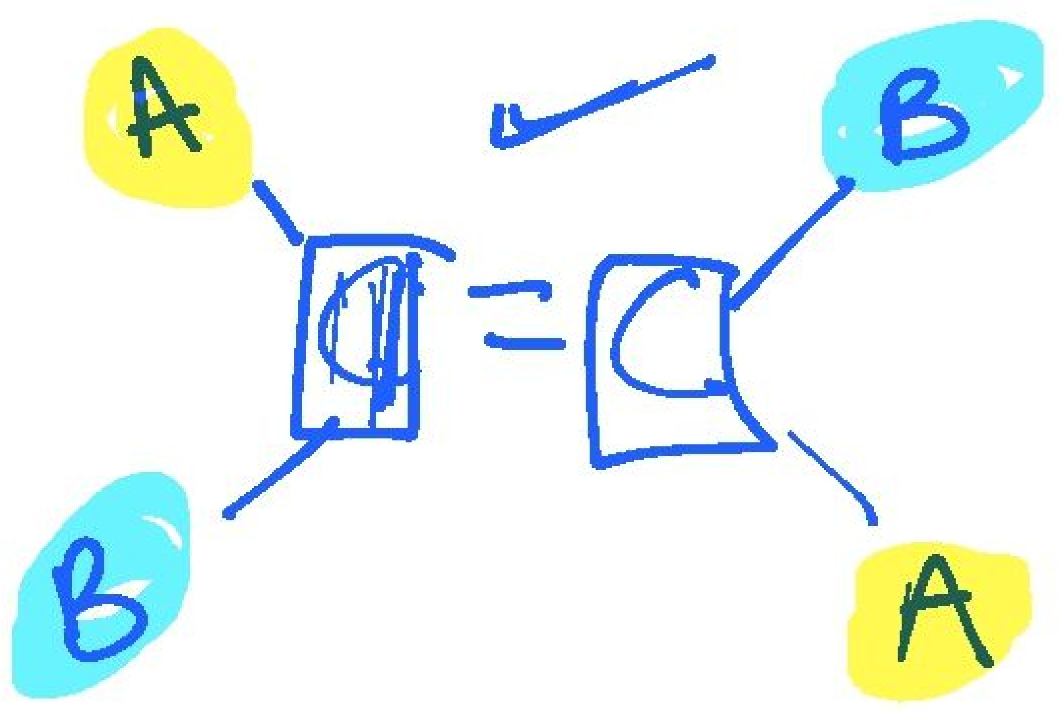
→ arrangement of atoms must be different

Geometrical Isomerism (Cis/trans)

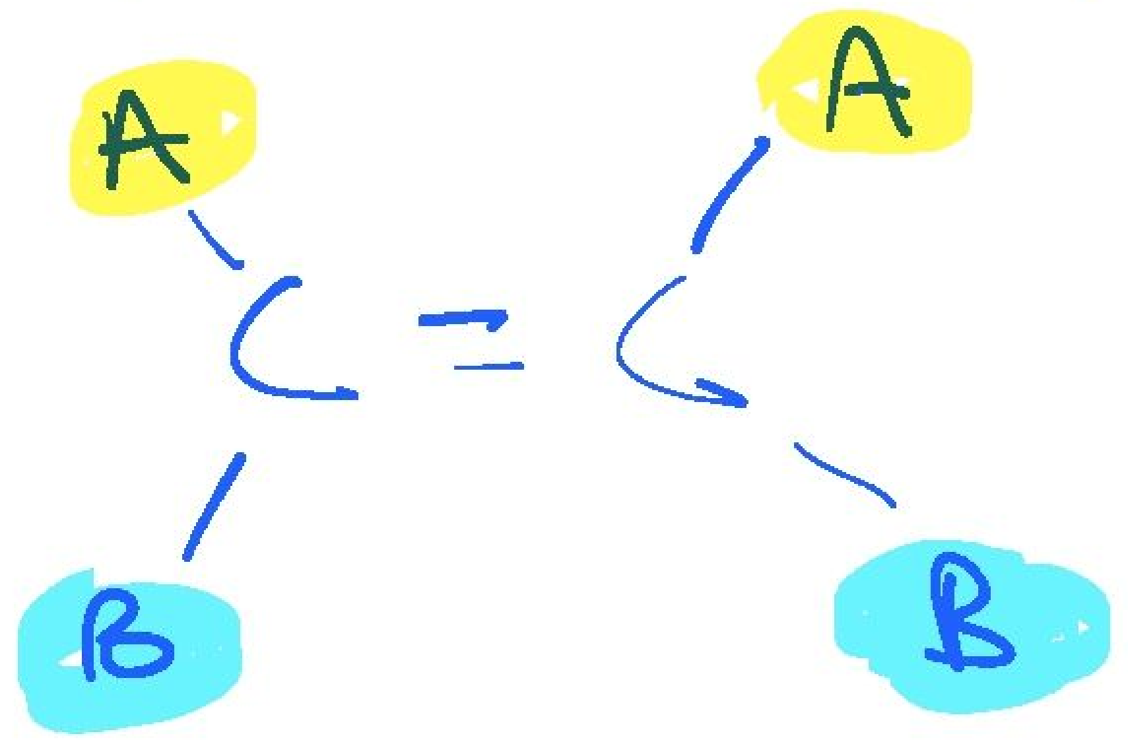
(2 Conditions)

⇒ restricted rotation around C=C

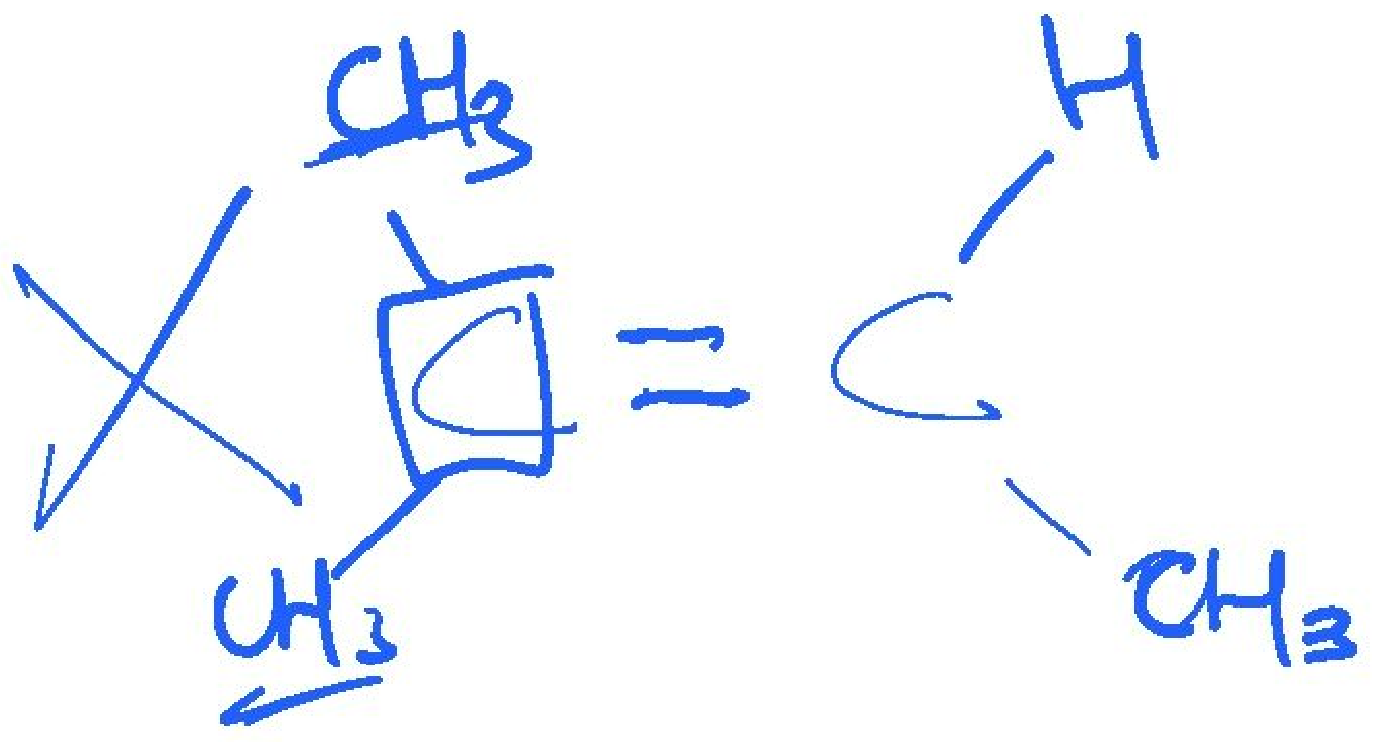
⇒ Each C=C must contain 2 different groups attached to them.

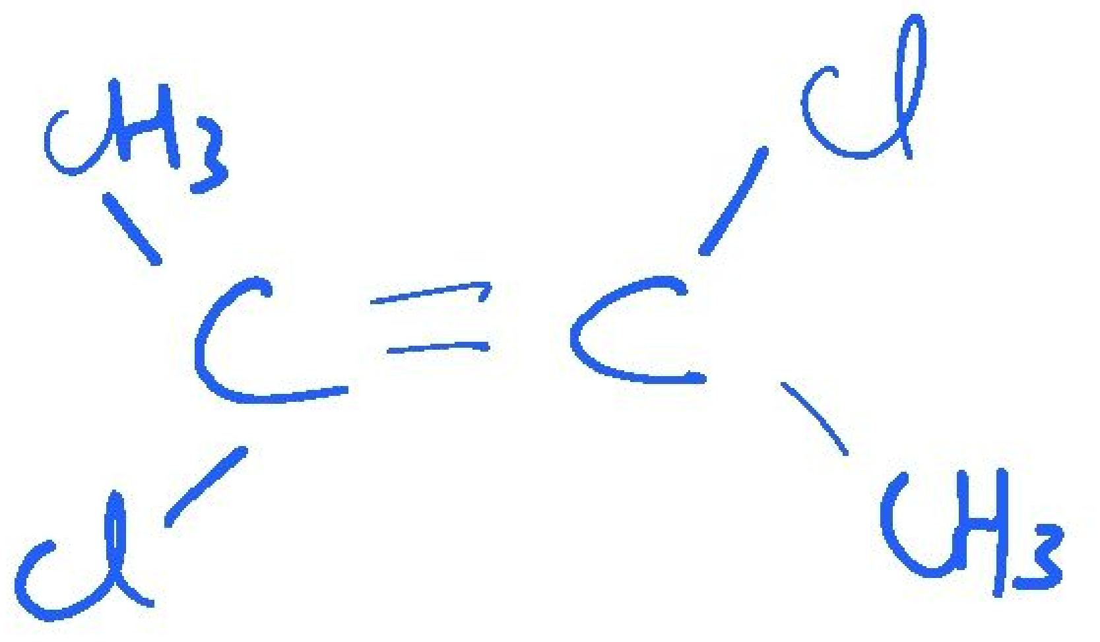


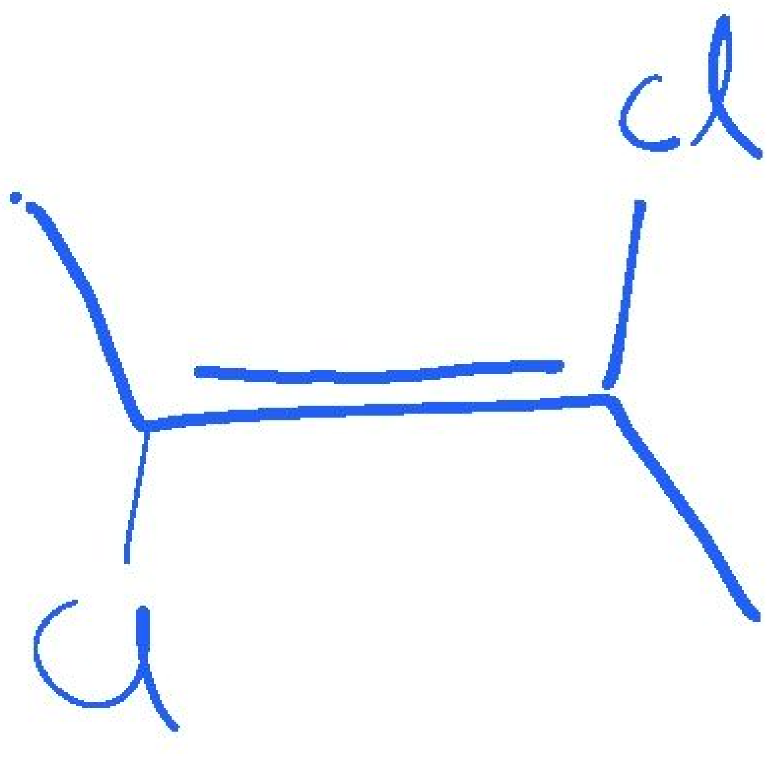
Trans (opposite)

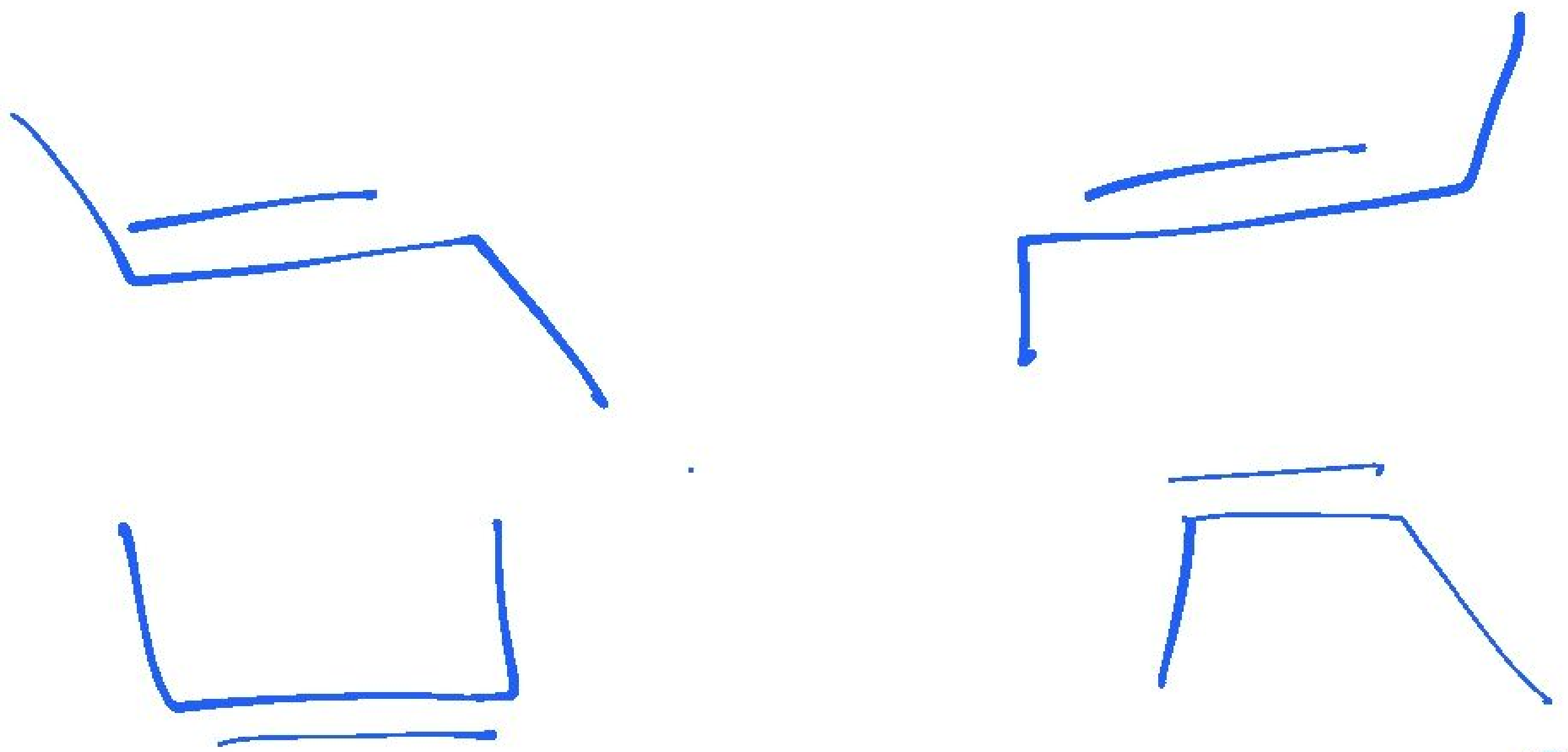


Cis (~~on~~ same side)



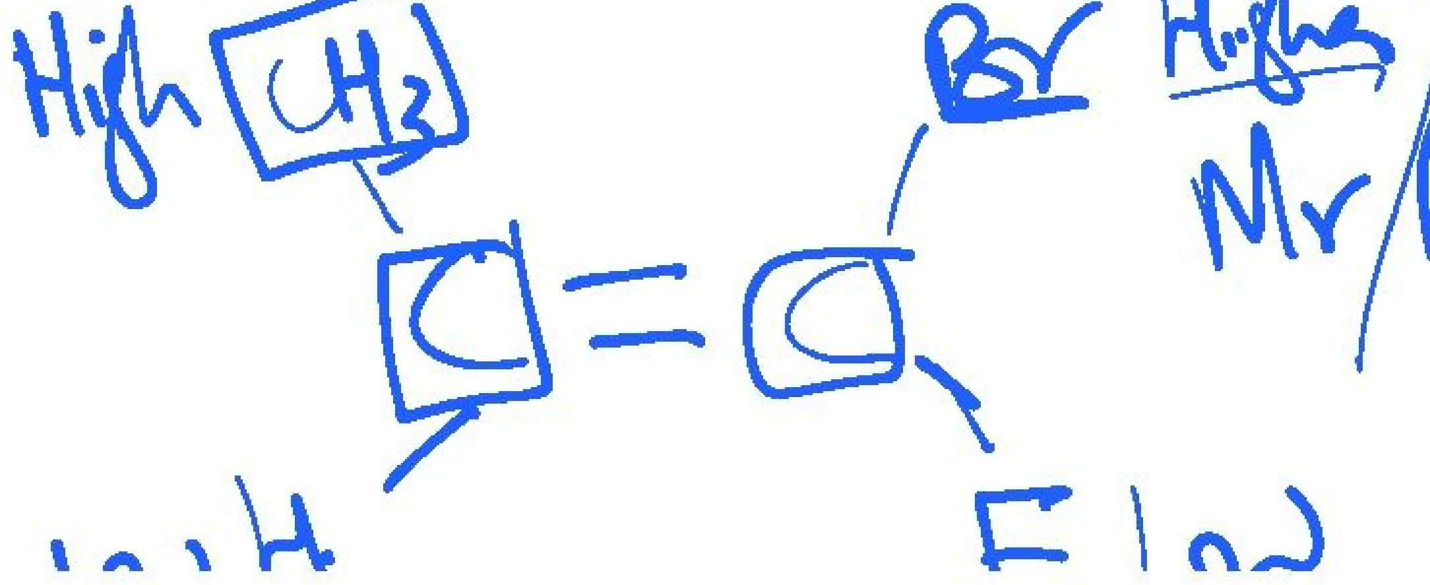






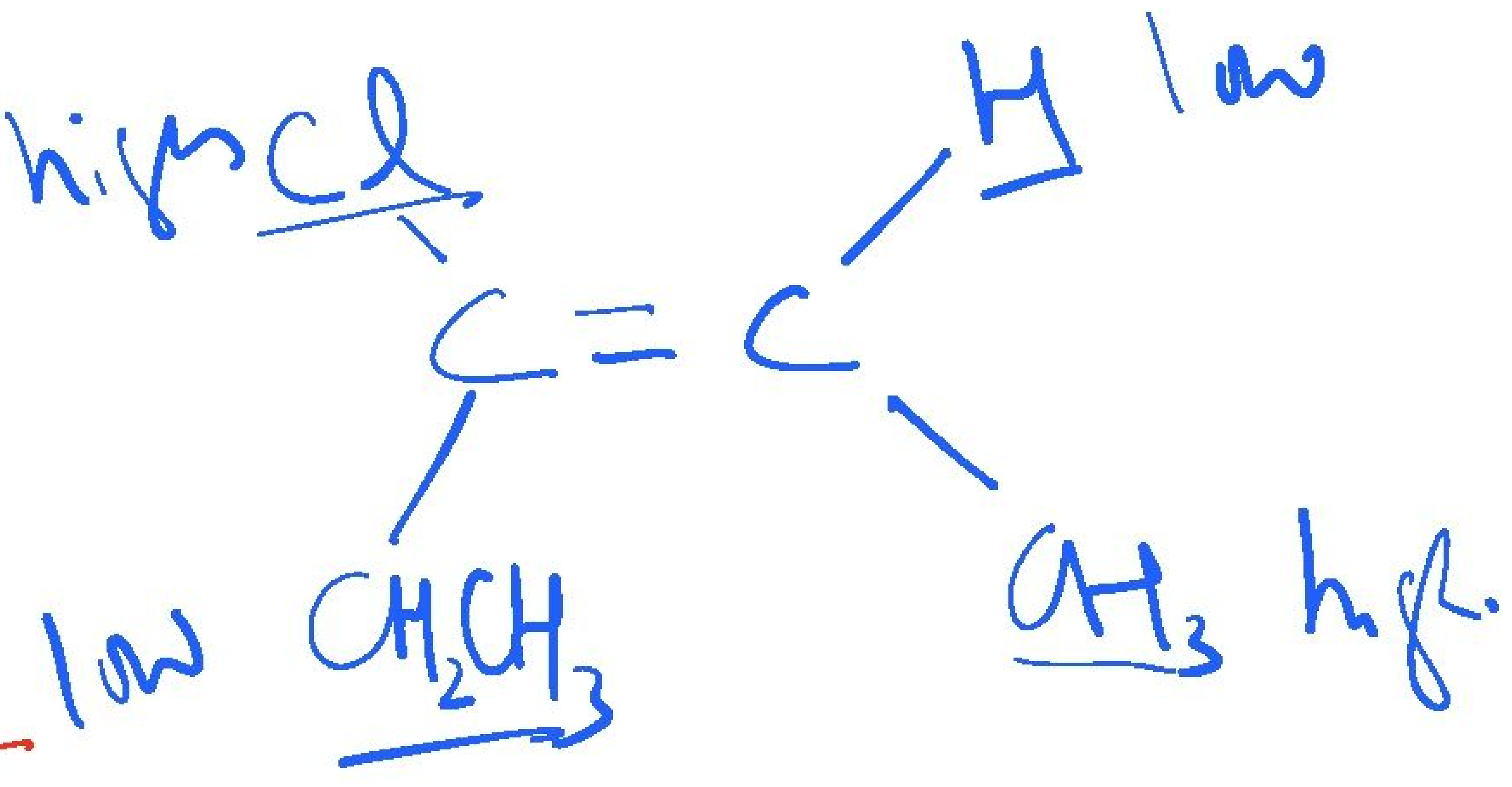
CTP Rule (Cahn Ingold Prelog Rule)

Mr/Ar (Atomic Mass)



low I

Cis



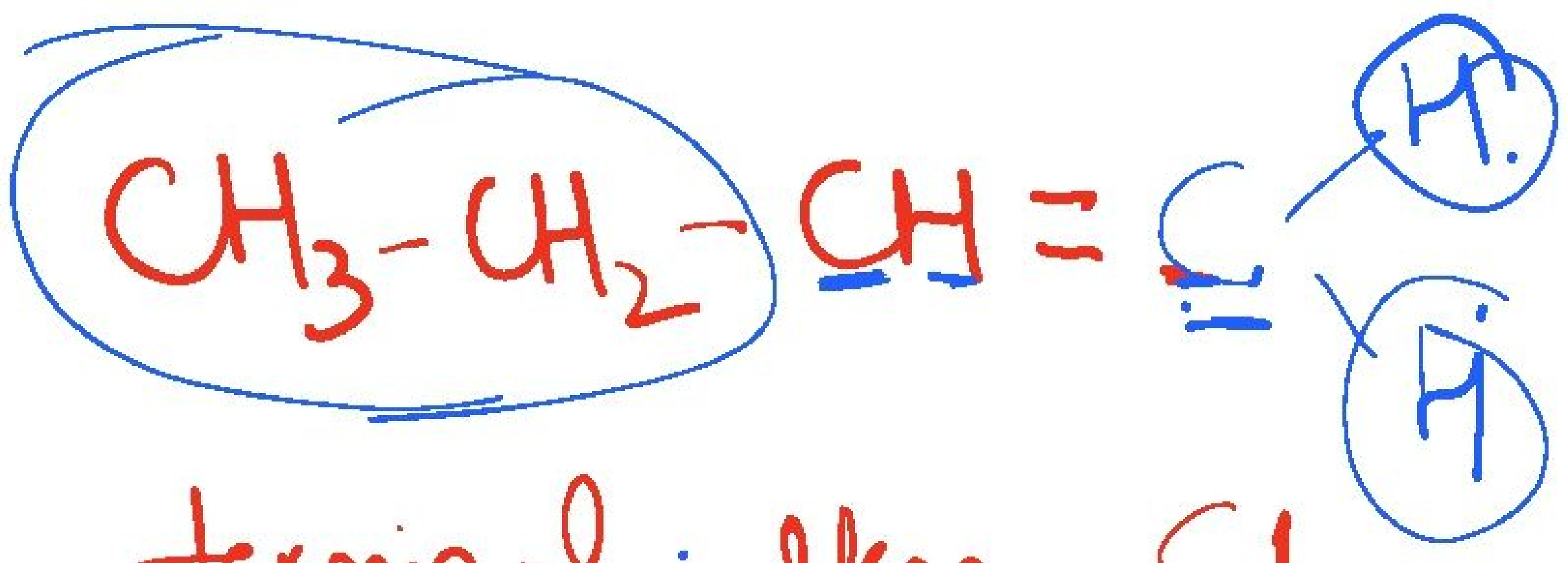
CCl_4

O=C=O nonpolar

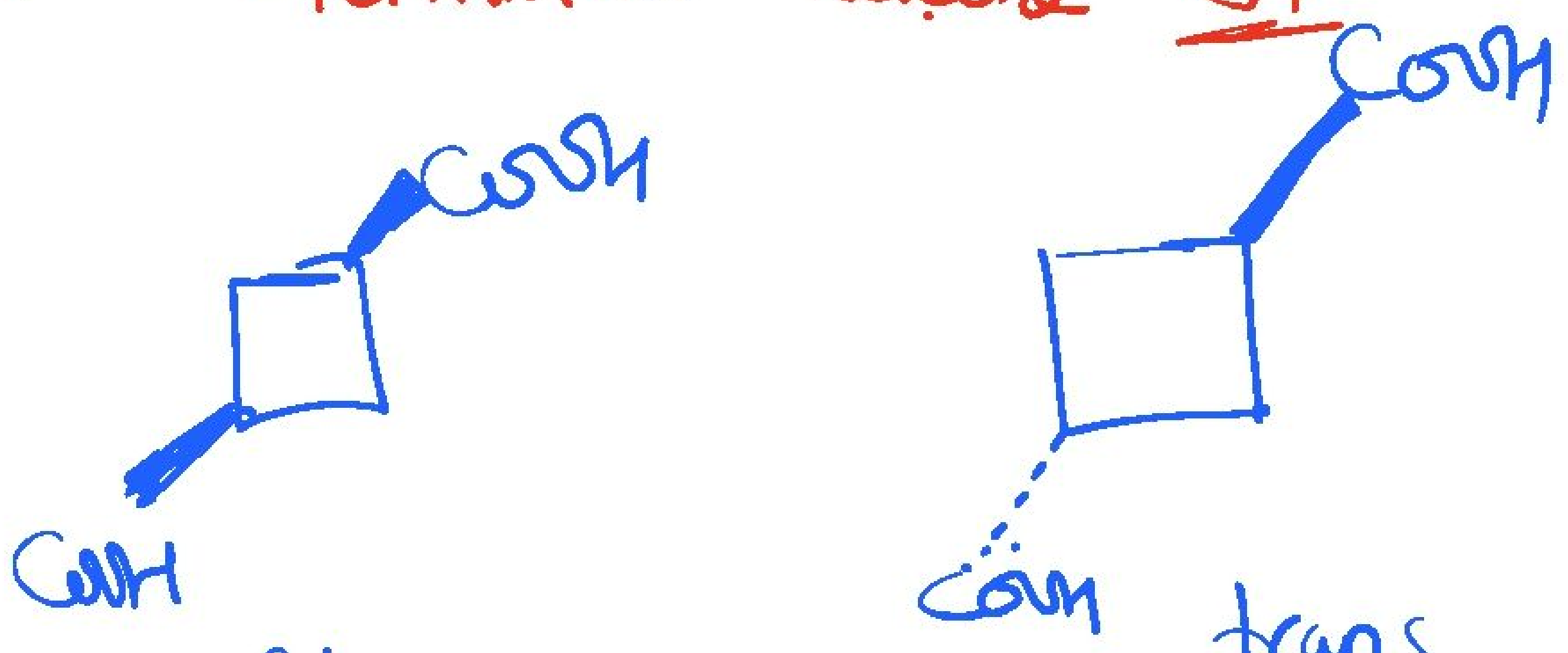
Trans.

less Polar
Trans

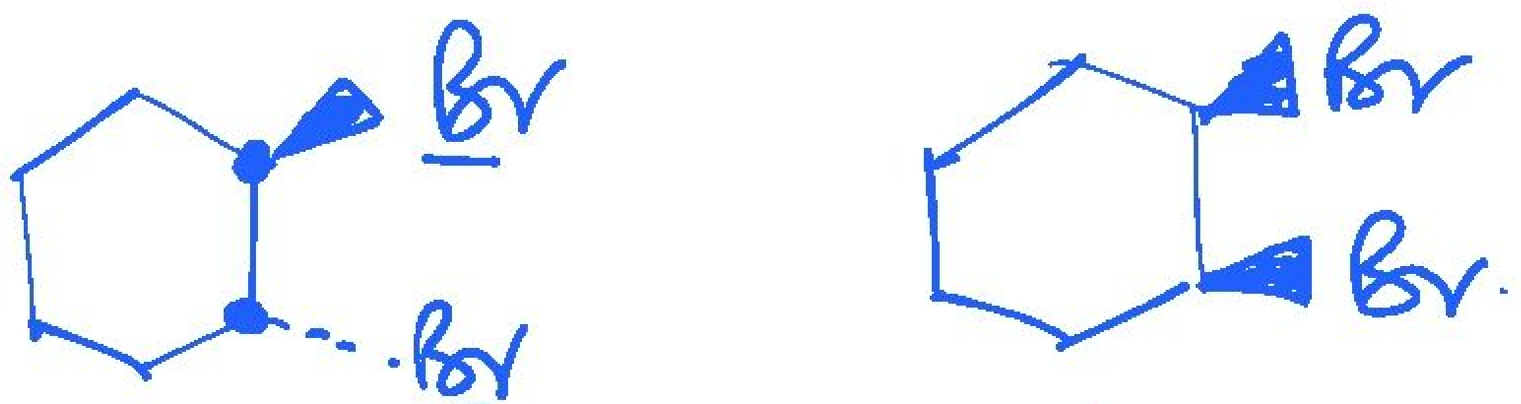
More Polar



Note: terminal alkene C1



Cis trans

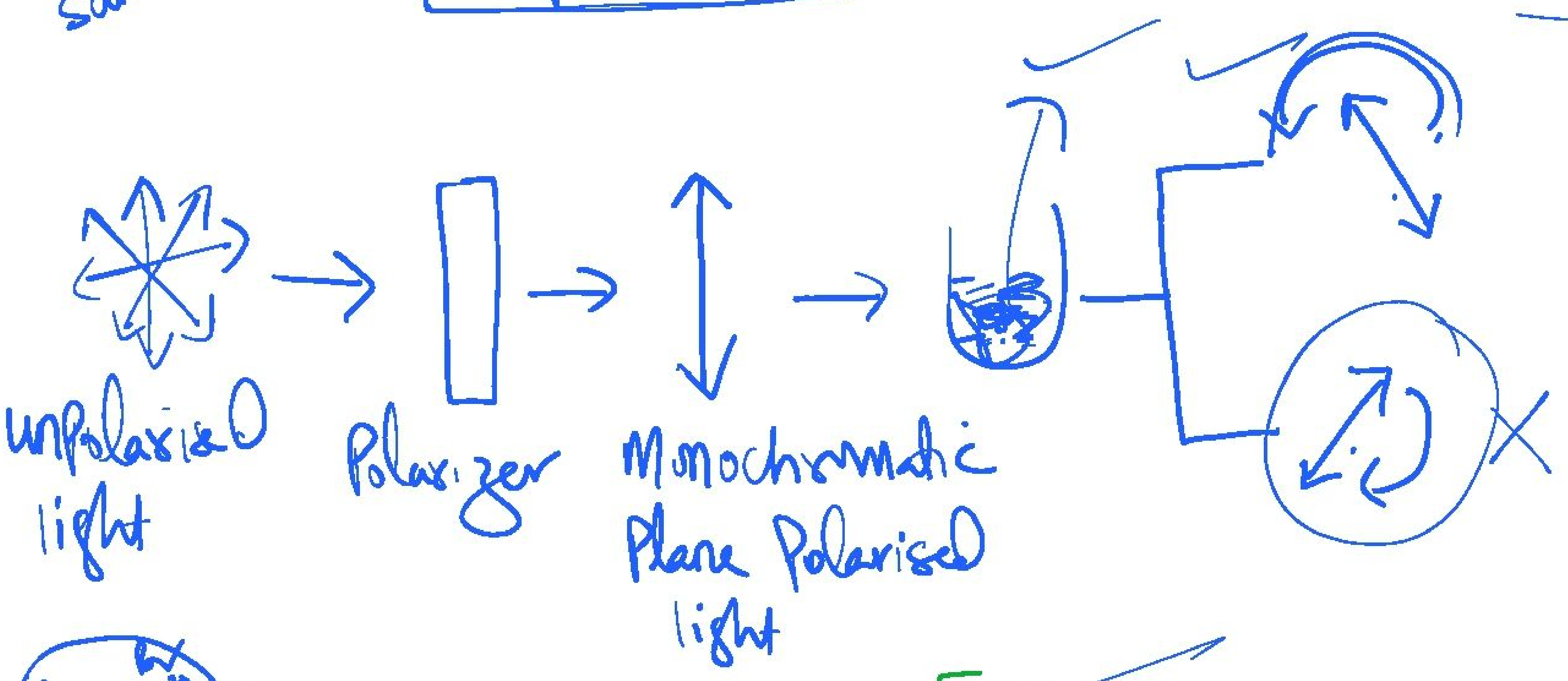


Trans Cis

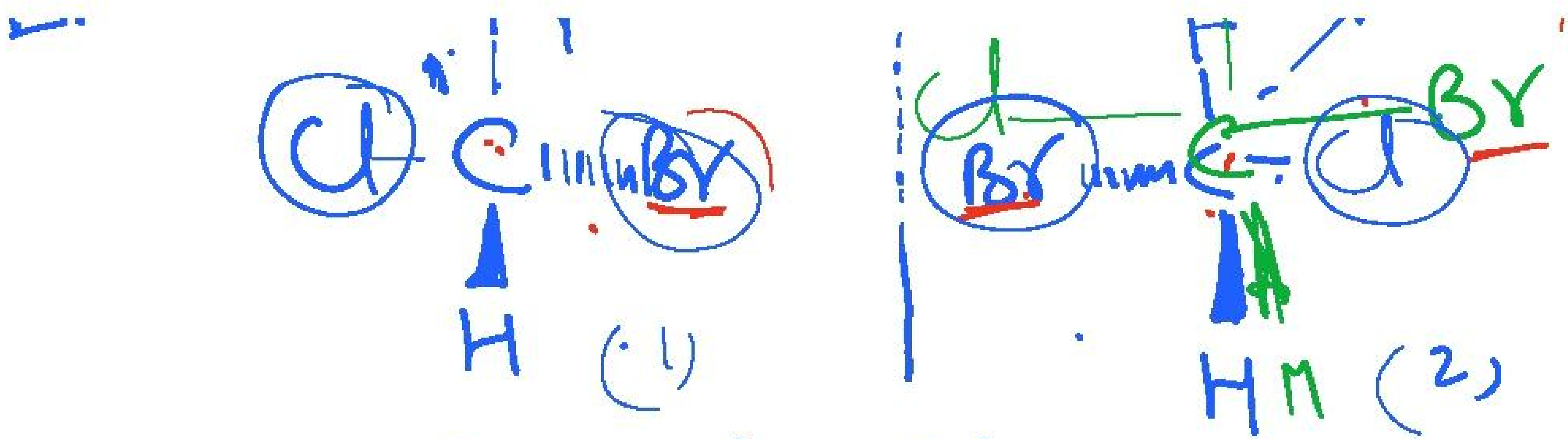
same M.F
same S.F

Optical Isomerism

drug industry



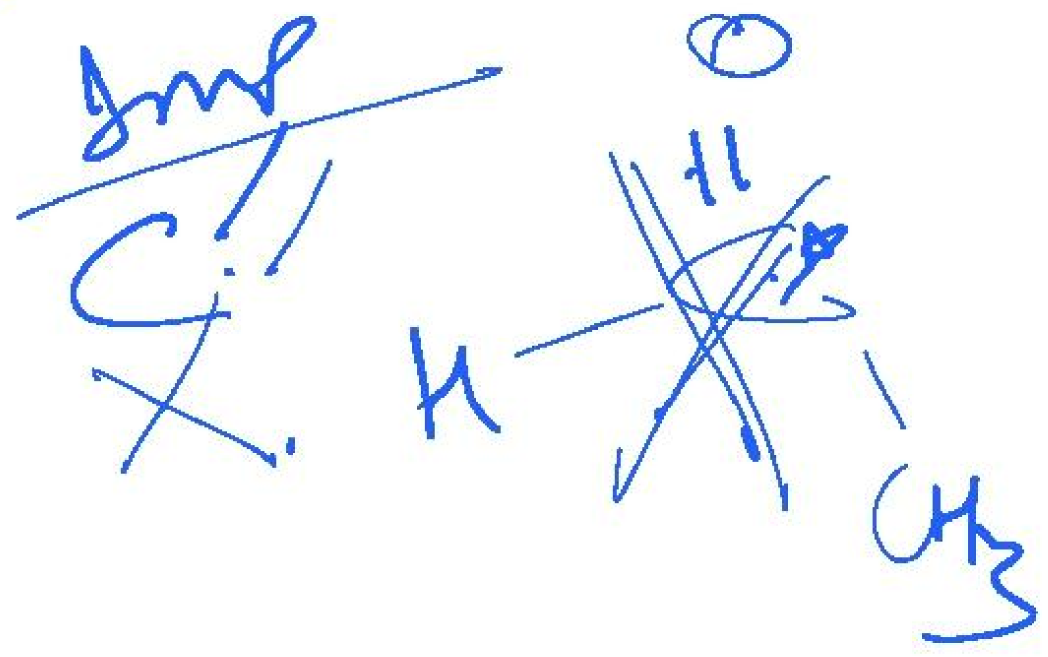
Fr F



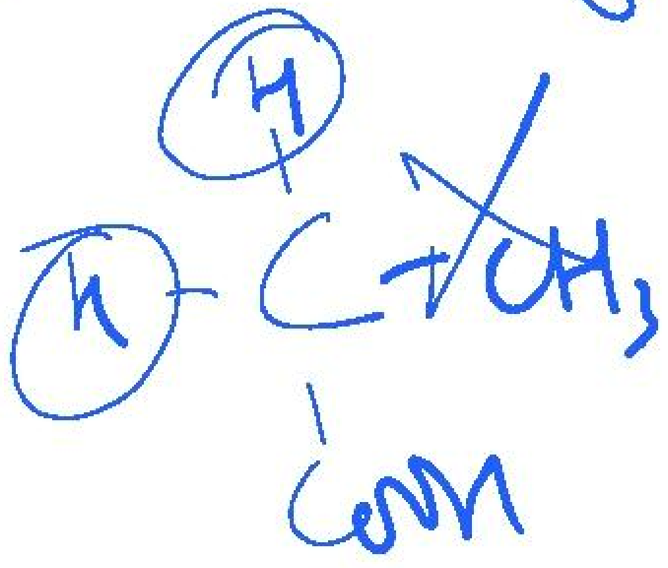
non superimposable

① Asymmetric Carbon

→ Chiral Carbon (which is bonded to ④ different groups

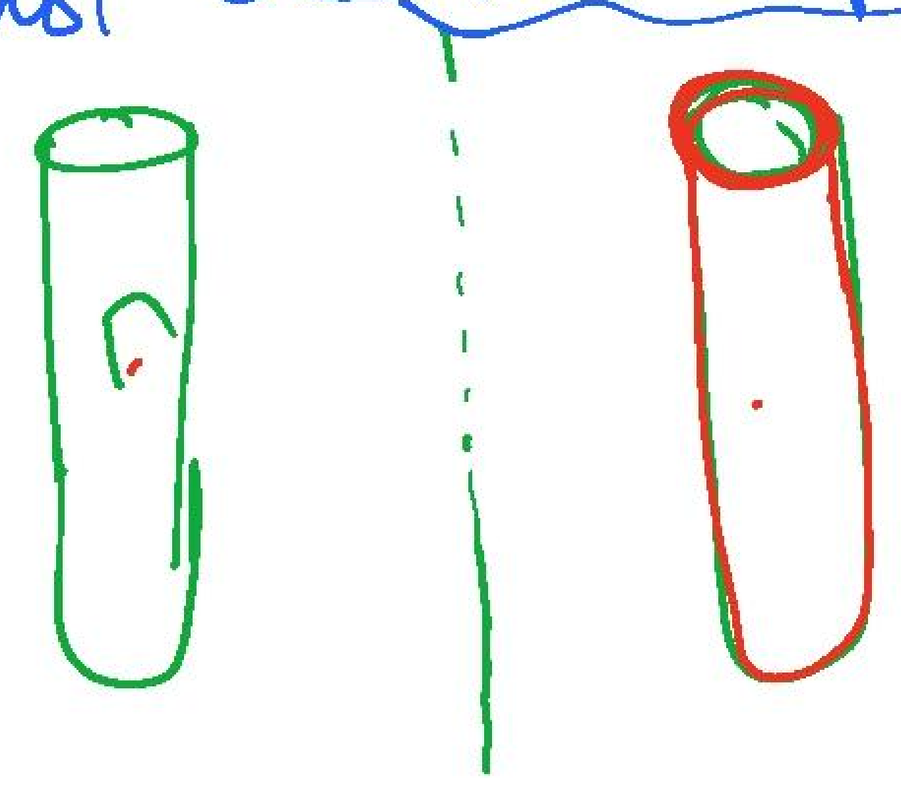


wedge & hash



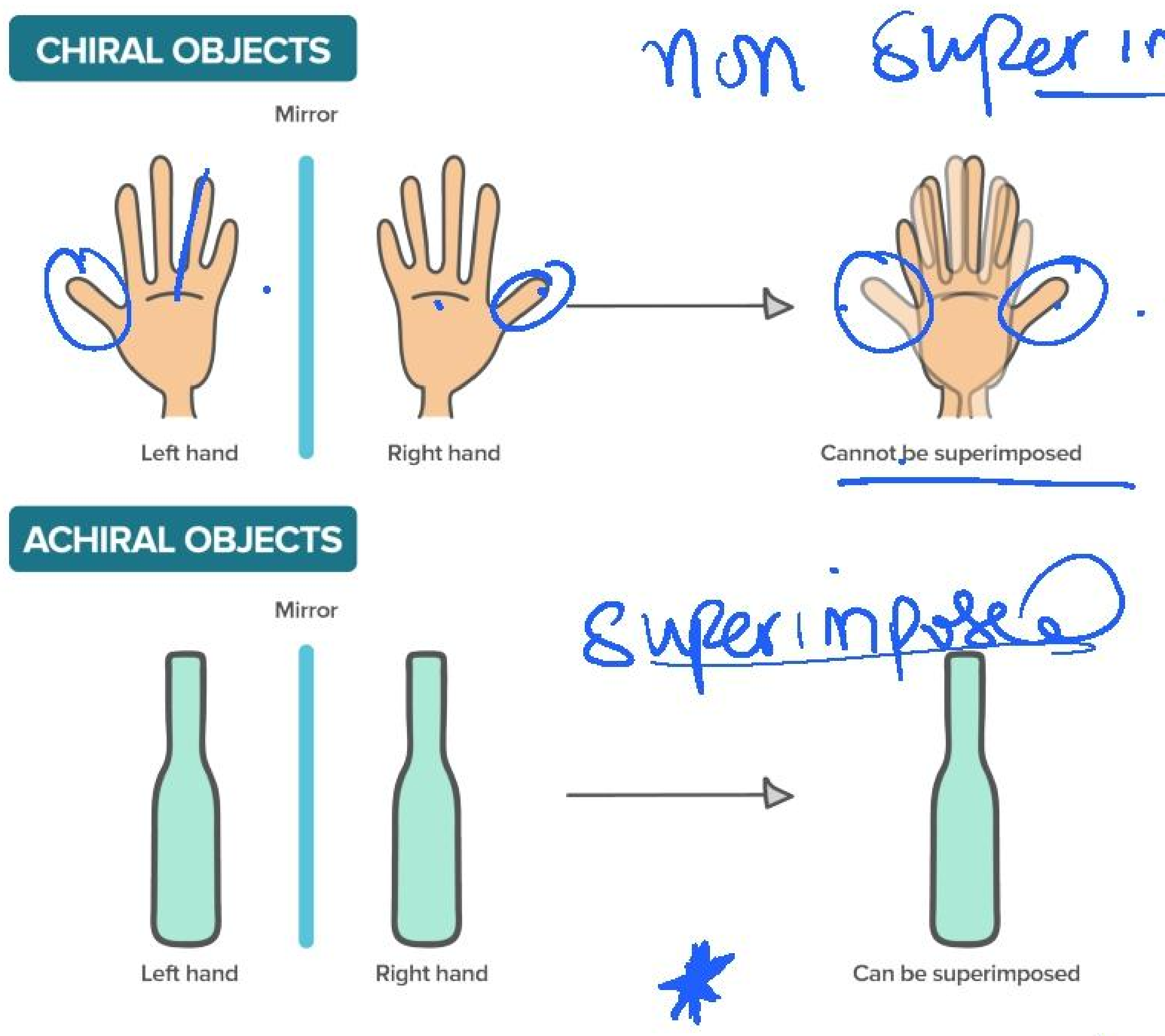
They must be non superimposable able

② mirror image



Superimpose mirror images

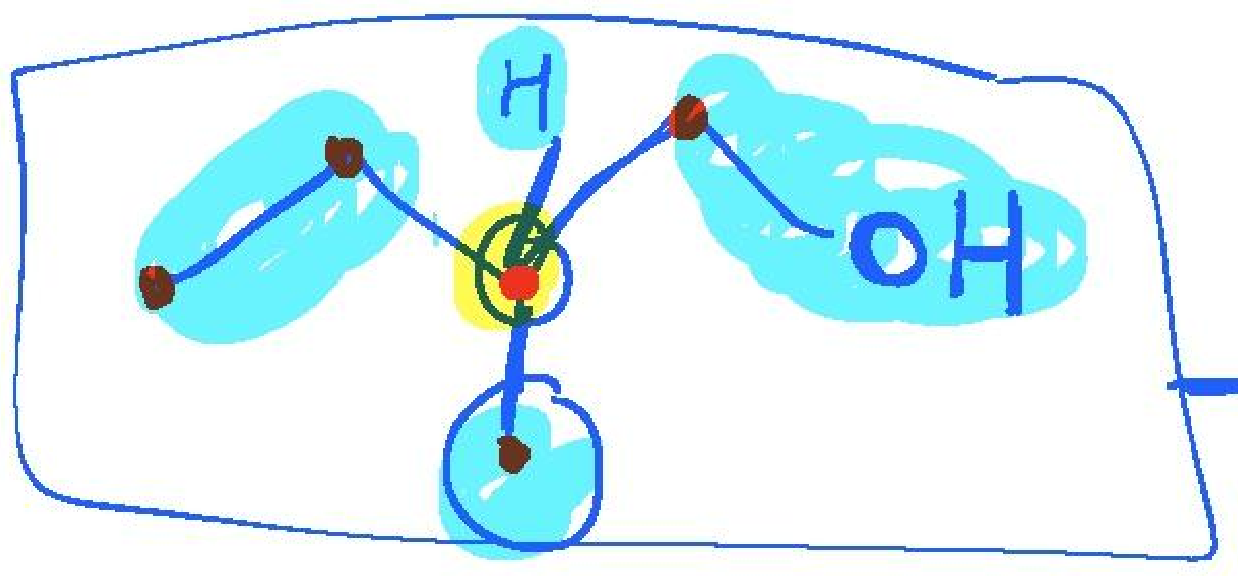
non superimposed



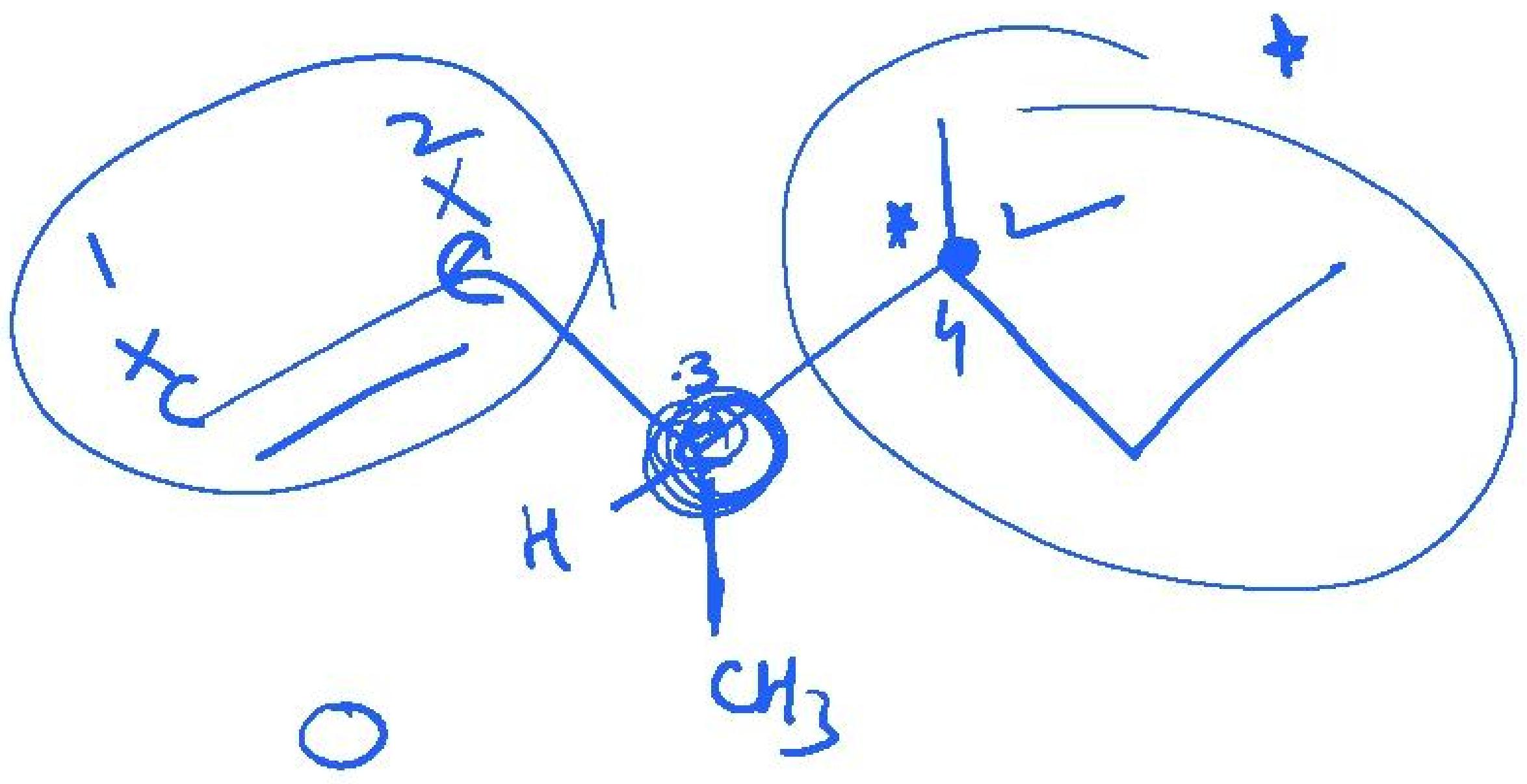
superimposed

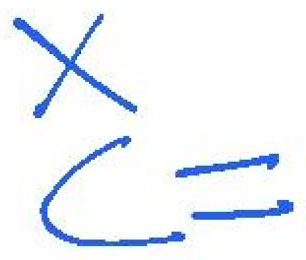
*

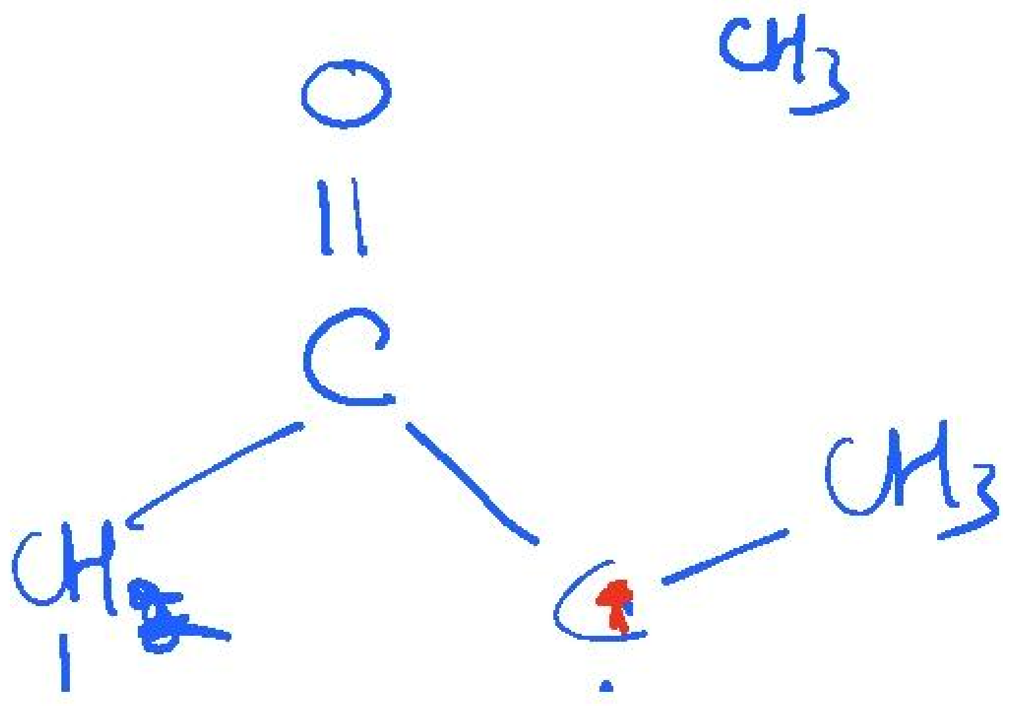
Chiral Centre

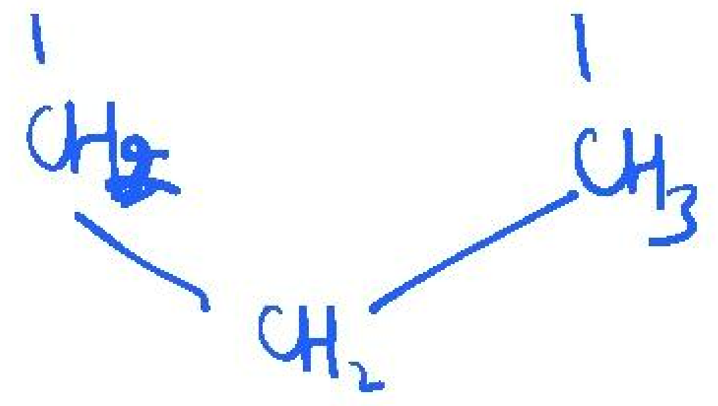


Display Structure

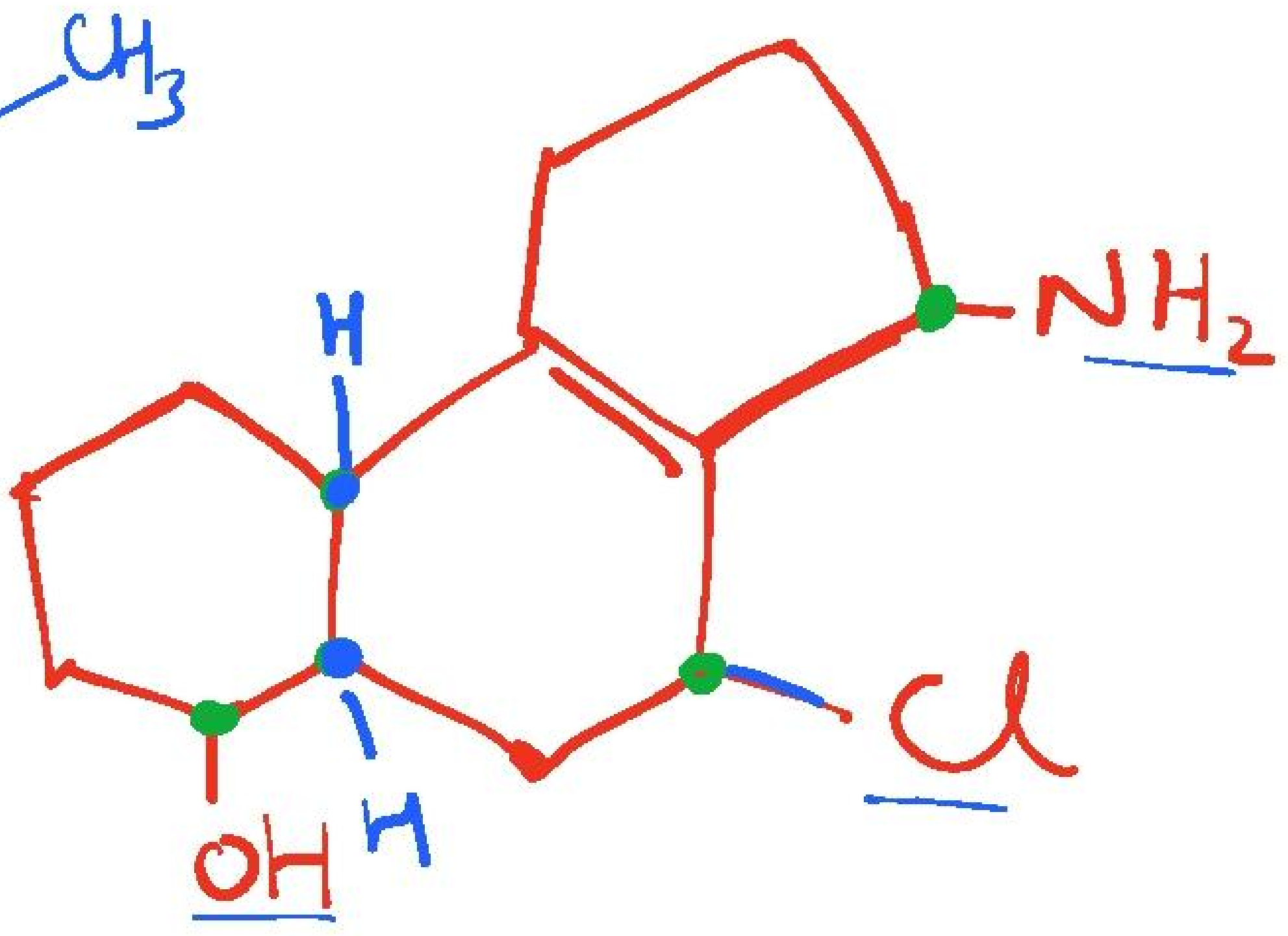




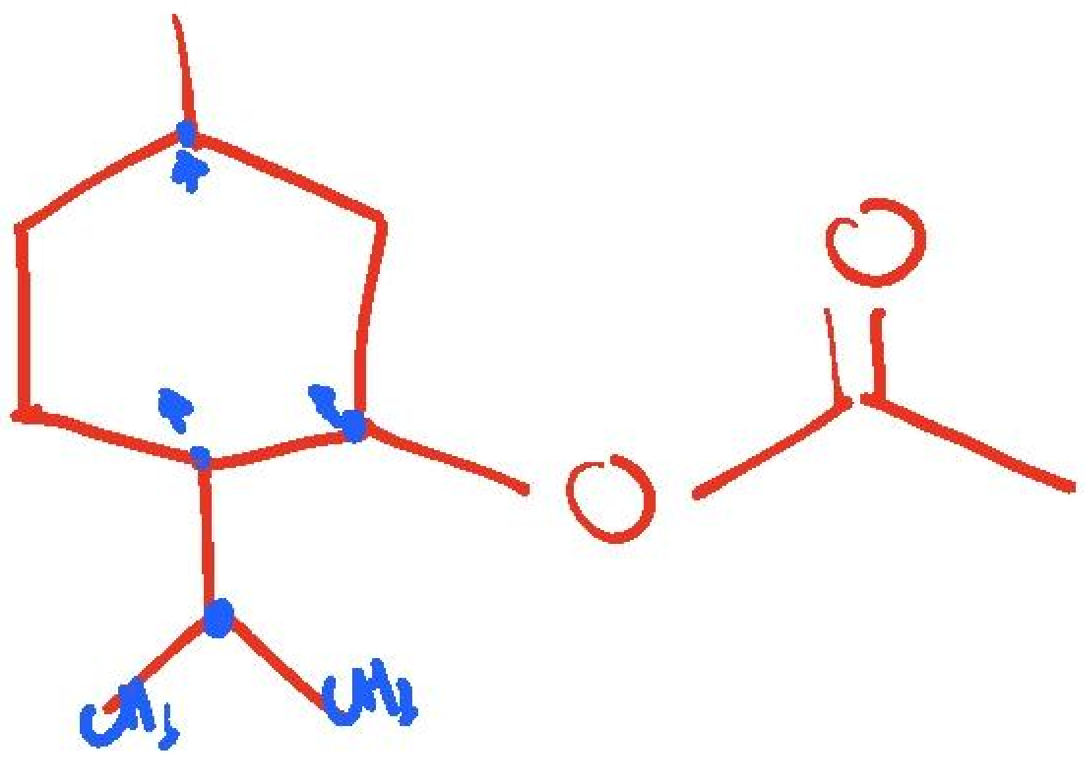




5 chiral C



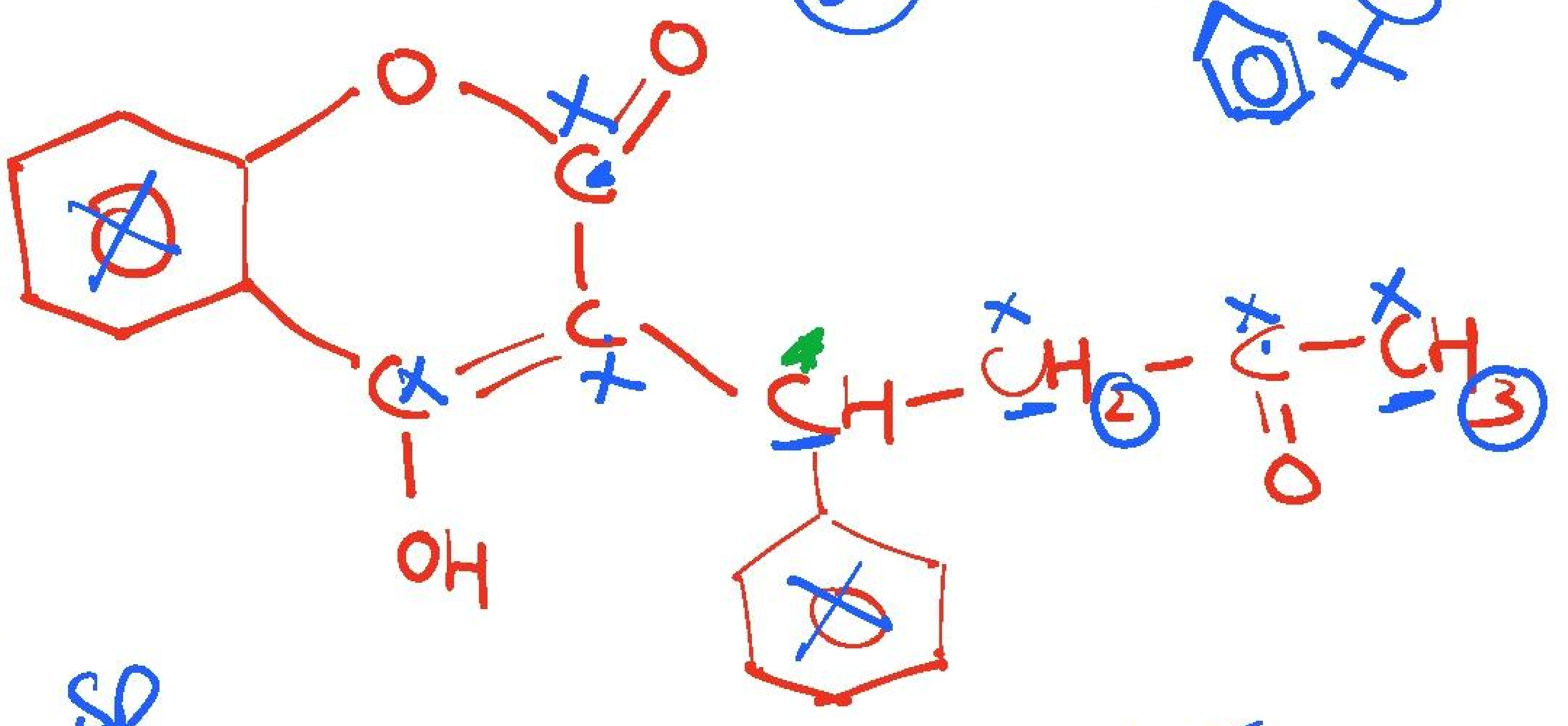
✓ 3 ✗ 4 chiral centres



① C= X

② Benzene ring X

⌬ X



sp^3 sp^2 sp

Hybridization

Haleem

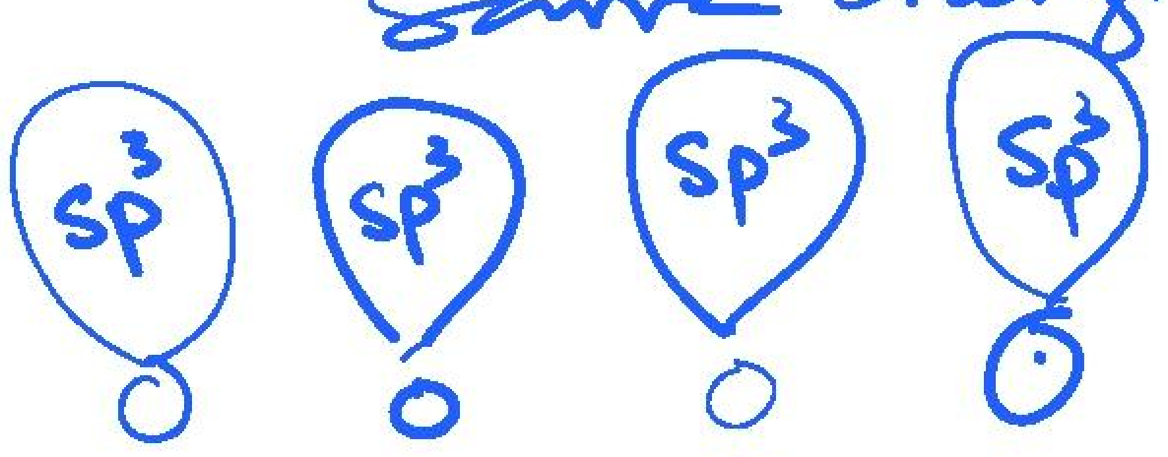
$CH\ 3 / CH\ 13$

Different Textiles having different colours $\xrightarrow[\text{Cook}]{\text{mix}}$ Haleem having same texture and same colour

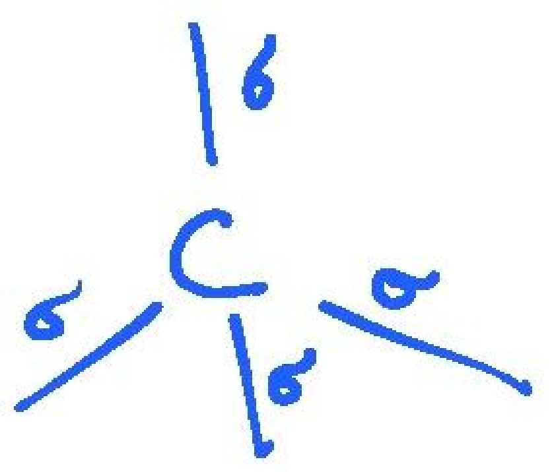
Different orbitals (s, p) having different shapes and different energies $\xrightarrow{\text{Intermix}}$ Hybrid orbitals having same shape and same energies

$1S + 3P \xrightarrow[\text{Alkane}]{sp^3}$

4

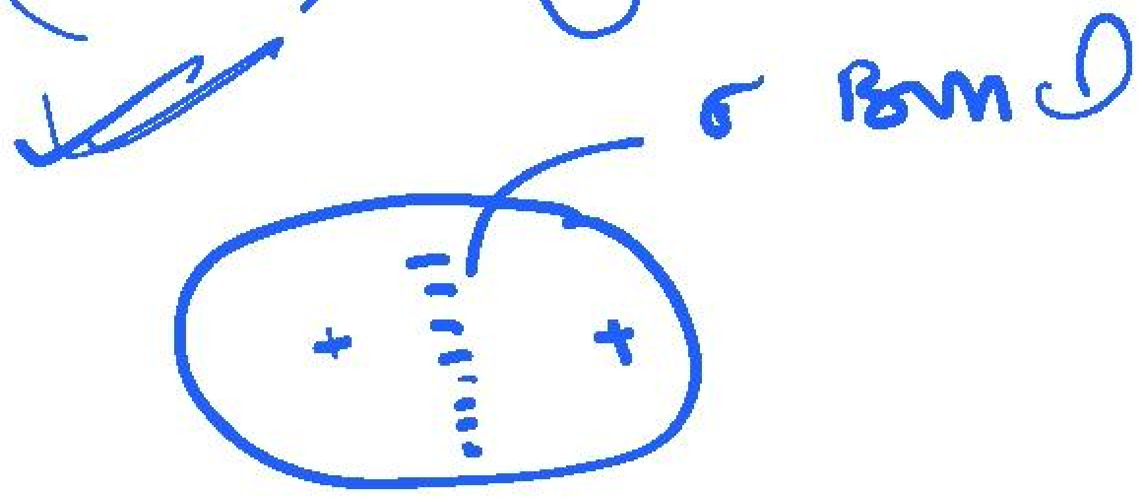


4 hybrid orbitals



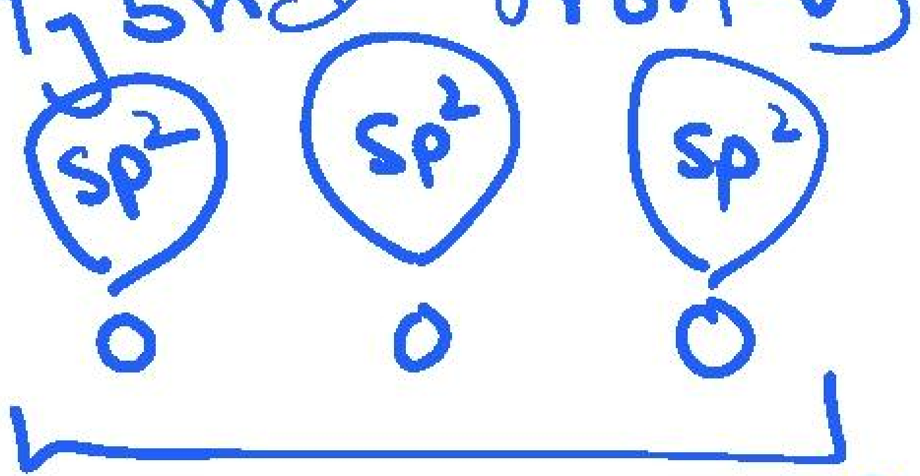
Tetrahedral
109.5°

(σ) Sigma Bonds

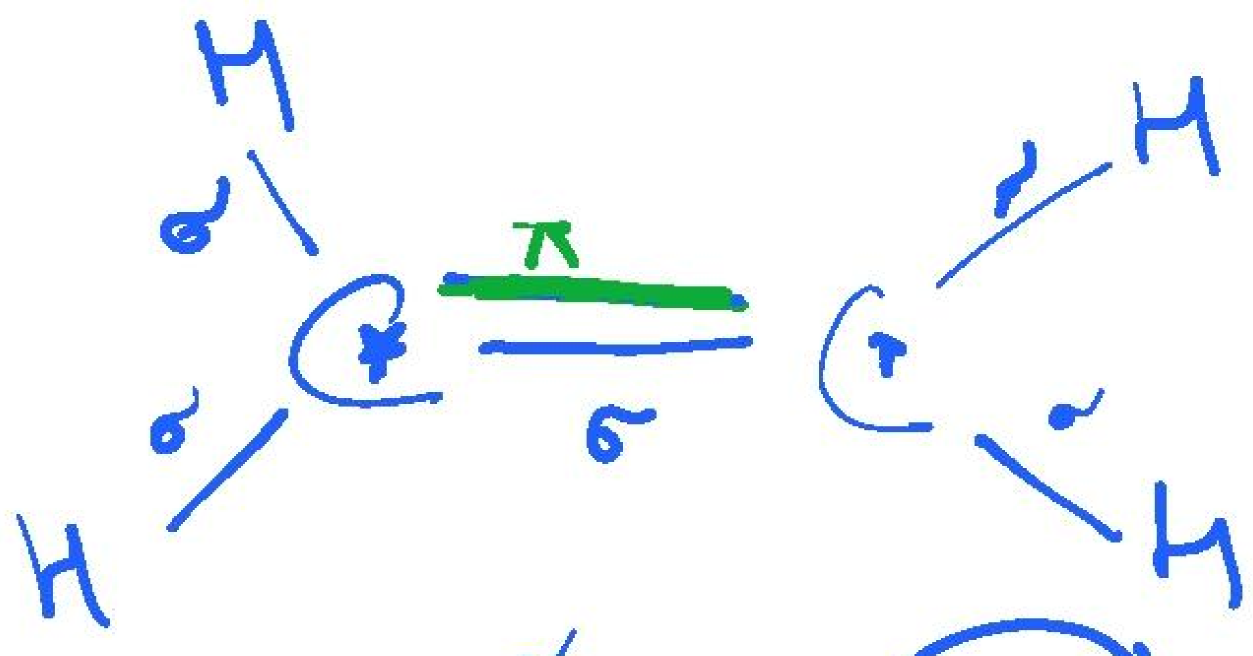


Sp^2

1S + 2P $\xrightarrow{\text{Intermix}}$ Hybrid orbitals



3 σ Bonds



1S + 2P

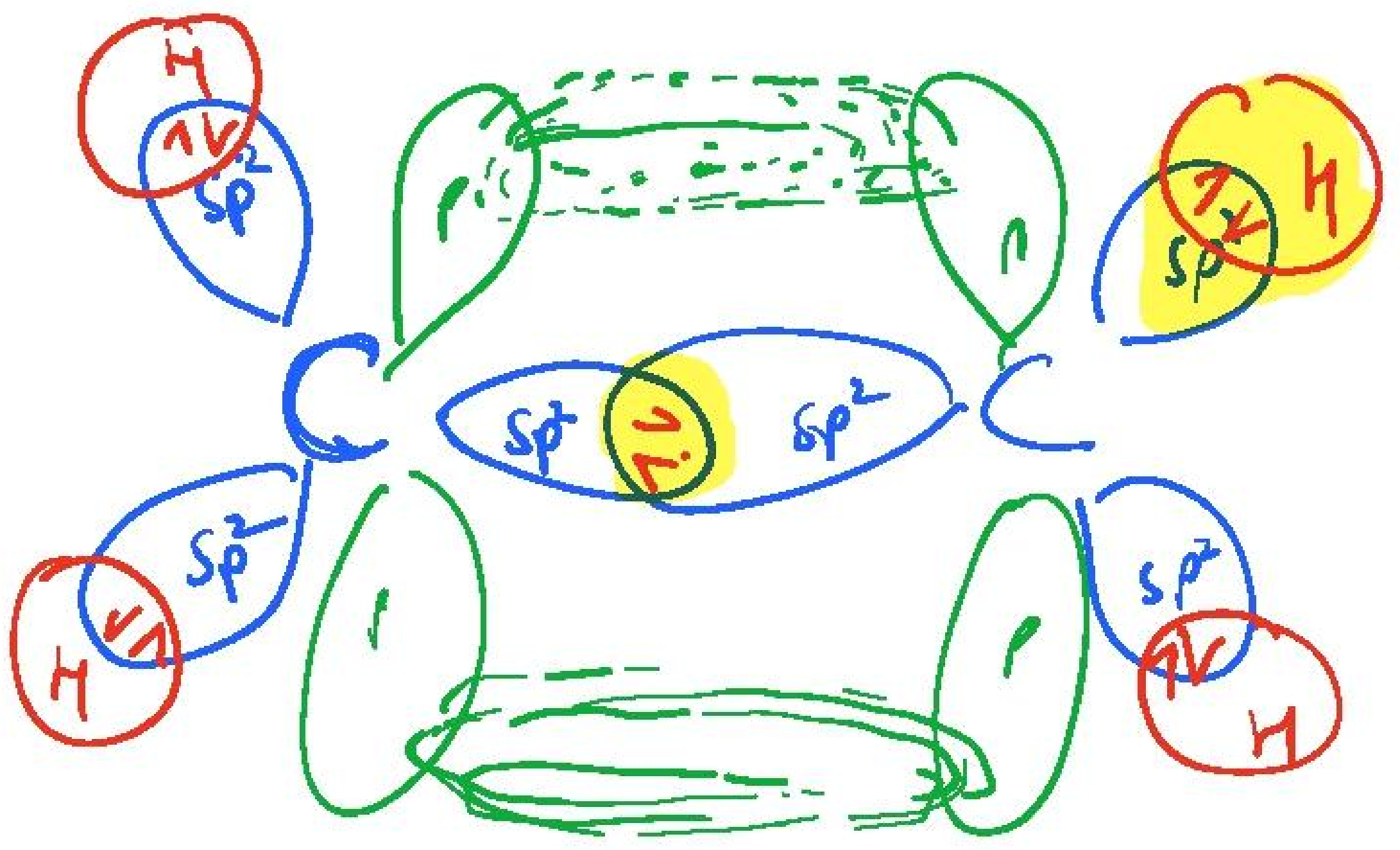
G.S = $1s^2, 2s^2\ 2p^2$

E.S = $\boxed{1}$ $\boxed{1}\boxed{1}\boxed{1}$

2S 2Px 2Py 2Pz

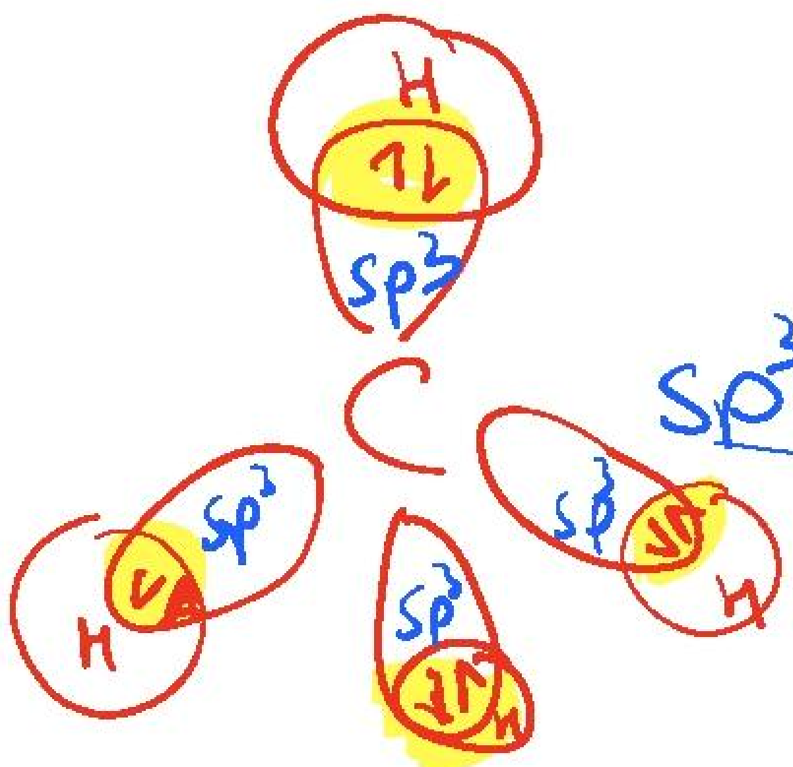
sp² sp² sp² 2Pz

$\boxed{1}\boxed{1}\boxed{1}$ $\boxed{1}$ unhybrid orbital
↓
— Bond



orbital overlap
S-Sp^2

Sp^3



Sp^3-S overlapping

Trick to detect Hybridization in any Compound

Hybridization = number of atoms attached to central + lone pair on central atom.

$\boxed{C_2H_4}$

$C = C$

sp^2

atm

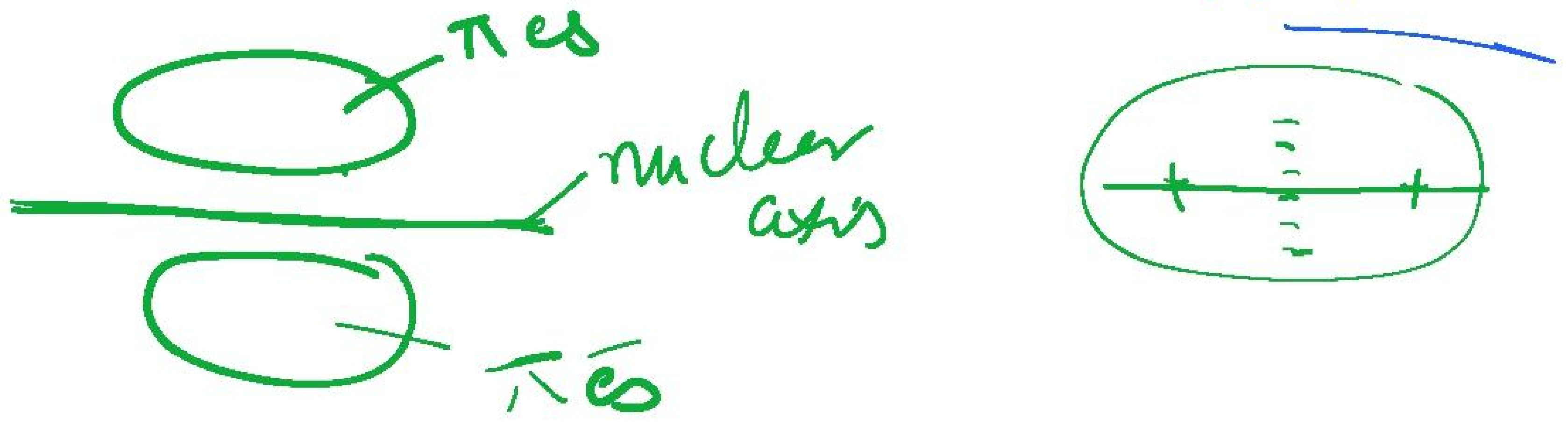
$2 + 0 = ②$

$3 + 1 = ④$

$2 + ② =$

$H-\underline{C}\equiv N$

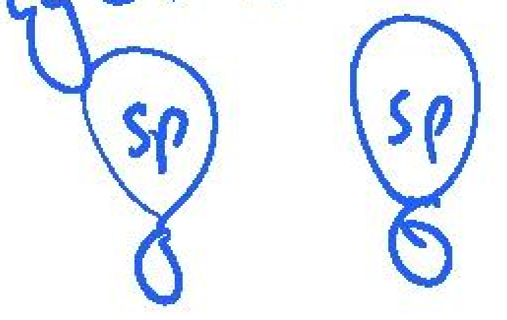
$\boxed{C_2H_4}$



Sigma Bond	π Bond
S-S S-P P-P	P-P
H-H H-Cl Cl-Cl	• Sidwise overlapping
Head to head overlap	→ weaker Bond
	→ π bond is dependent on σ bond for its formation
→ stronger bond	
→	

SP

$1S + P \longrightarrow$ 2 hybrid orbitals



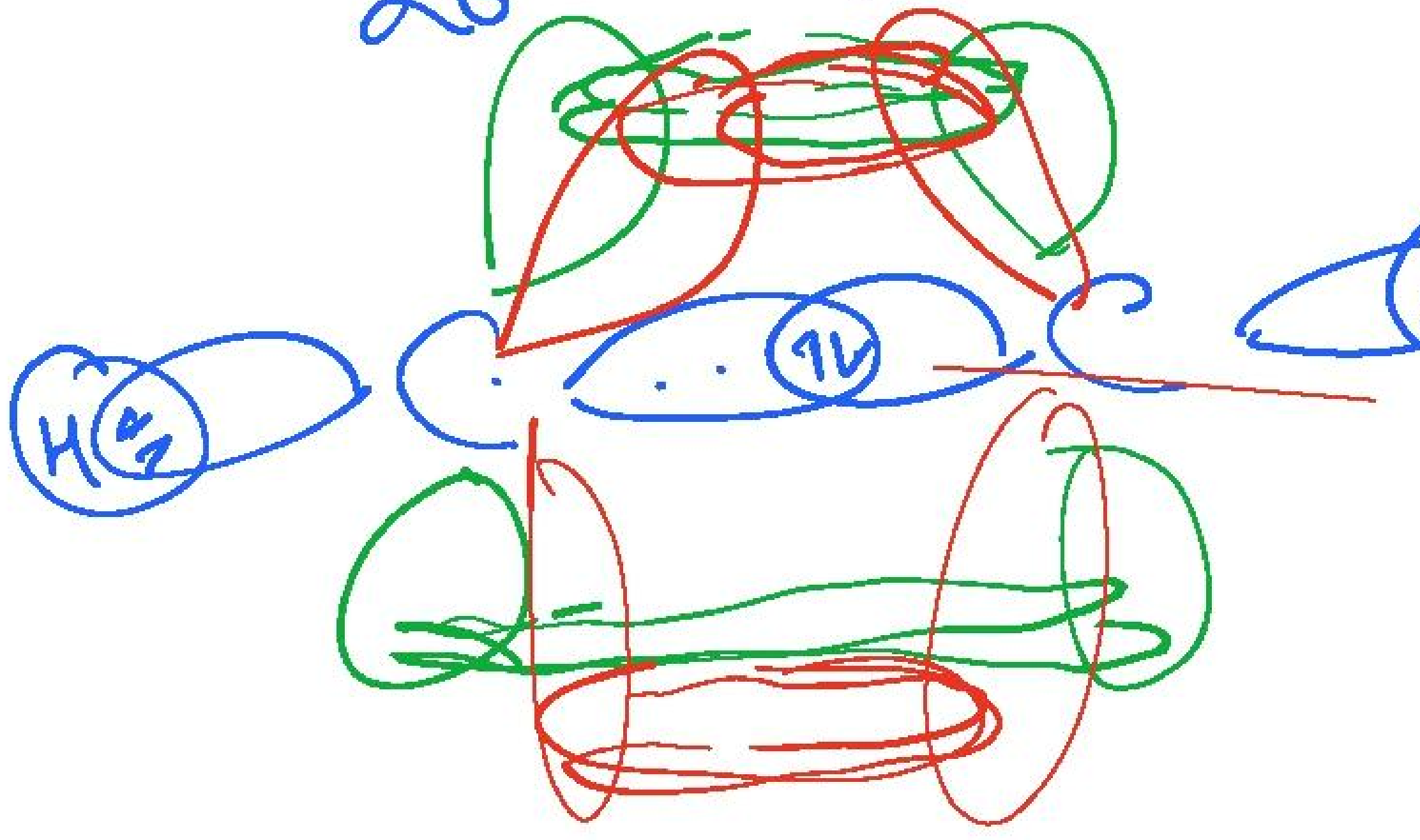
${}_6C_{G.S} = 1s^2, \overset{\curvearrowright}{2s^2, 2p^2}$

$C_{E.S} = \boxed{\uparrow}\ \boxed{\uparrow|\uparrow|\uparrow}$

$\boxed{\uparrow|\downarrow}$ hybrid $\boxed{\uparrow|\uparrow}$ Unhybrid

2σ 2π

Alkyne



$H-C\equiv C-H$

CO_2

3   sp^2 SP $BeCl_2$

sp Tetrahedral 109.5°

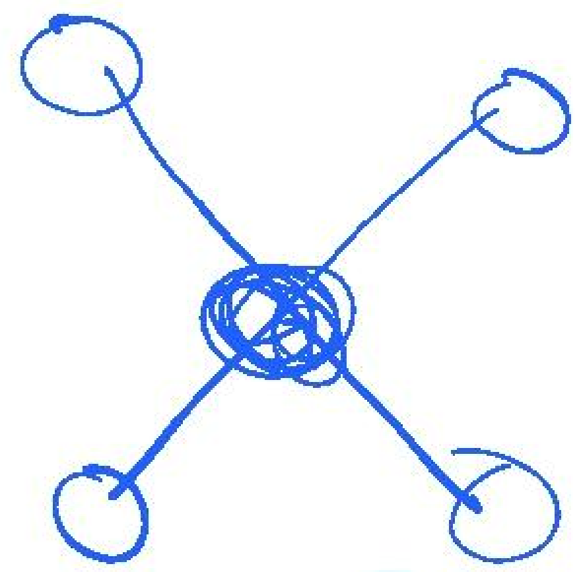
sp Trigonal planer 120°

linear 180°

Planer Molecules (2D)

① Linear ③ Bent

② Trigonal planer ④ square planer



= geom

chiral C optical

Stereocentres

n
2−4

symmetrical molecule

$\overset{1}{CH_3-C=CH}\ \overset{2}{CH=CHCH_3}$

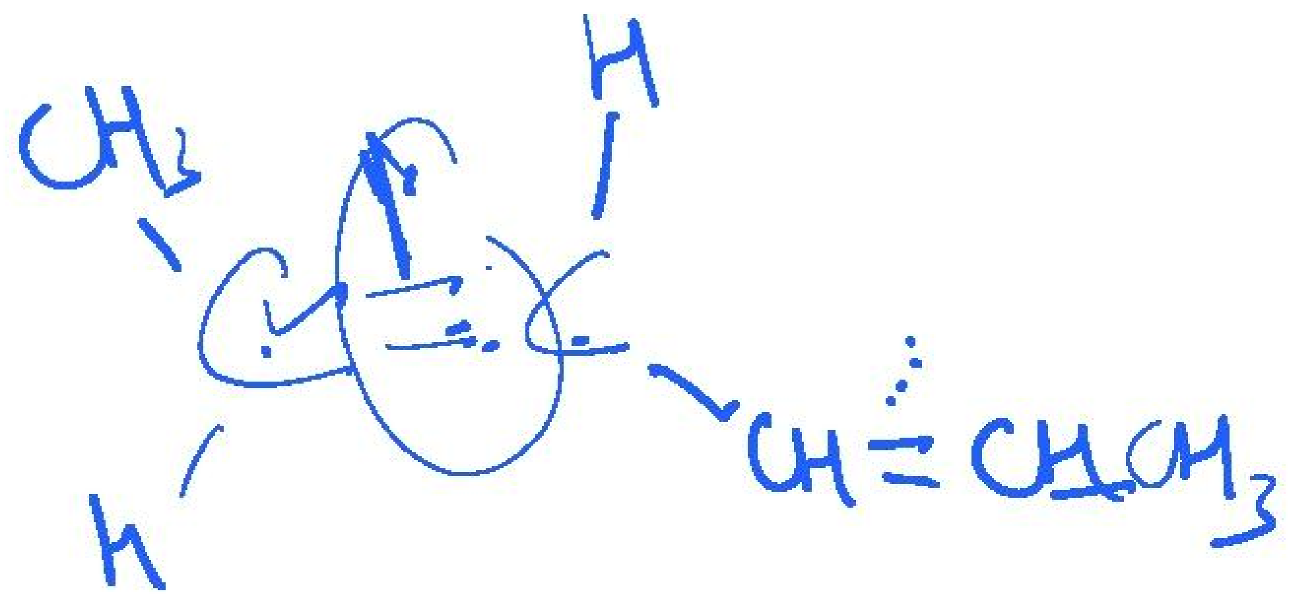
H

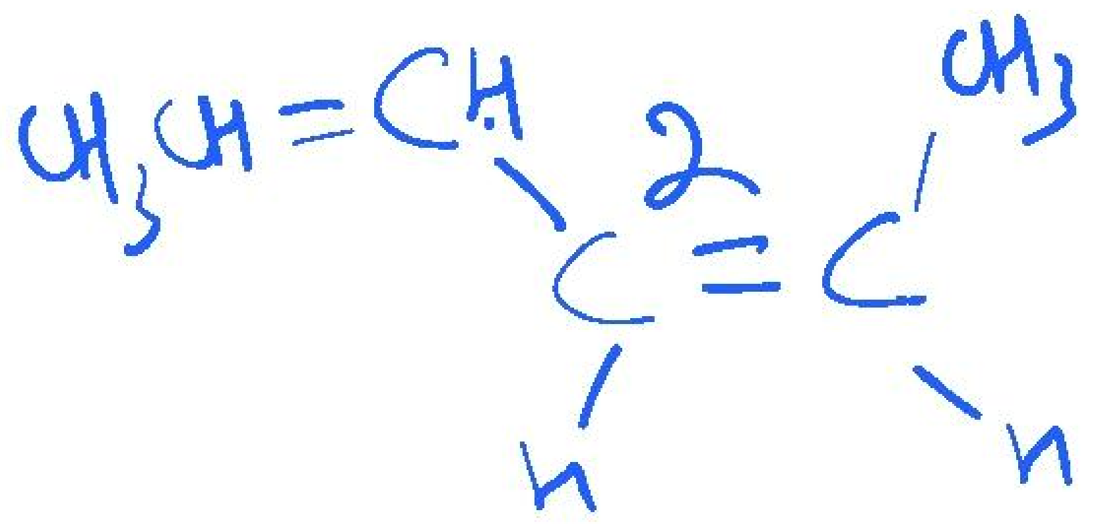
(A) none (B) 2 (C) 3 (D) 4.

n 2 : 2

2x2=4

2
2−1
4−1=3





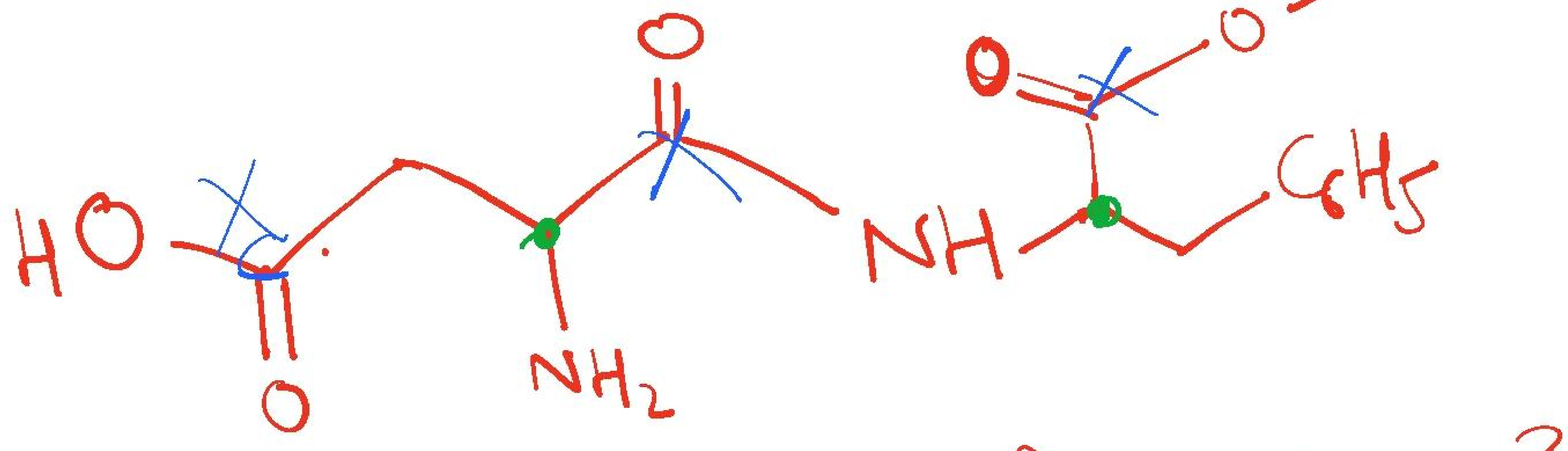
n
2−1
2
2−1

2x2 −1
4−1 = 3

σ π ?

H.W.

$HCCCH_2CH_2CHC(CH_3)_2$



How many chiral centres ?

Homologous Series

Alkane

Homologous Series (Family)

methan
ethan
propan
butan

members of organic compounds having same general formula, same functional group and same chemical properties

→ They show trends in physical properties.

→ Each successive member differ from each other by CH_2 group

CH_4] CH_2 | 14
C_2H_6] CH_2
C_3H_8

Functional Group

$\boxed{-\overset{O}{\overset{\|}{C}}-OH}$

An atom or group of atoms which gives characteristic properties to organic compounds.

⇒ Organic compounds chemical properties depend on $\boxed{F.G.}$

⇒ In physical/inorganic chemical properties is link to number of outer shell electrons

$A \overset{\cdot}{\underset{\times}{-}} B \rightarrow \underbrace{H + B}$

Free Radicals

$H - \boxed{\overset{\cdot}{\times}} - B \rightarrow \underbrace{H + B}$

less E.N   More E.N   ions

→ Highly reactive/unstable → Polar Compounds

→ Non Polar compound ~~Band~~

$H \overset{\cdot}{\underset{\times}{-}} Cl \rightarrow \overset{+}{H} + \overset{-}{Cl}$

→ Alkane
(free radical)

Substitution → reaction type
Free radical → Mechanism

$Cl \overset{\cdot}{\underset{\times}{-}} Cl \rightarrow \dot{Cl} + \dot{Cl}$

(Photochemical reactions)

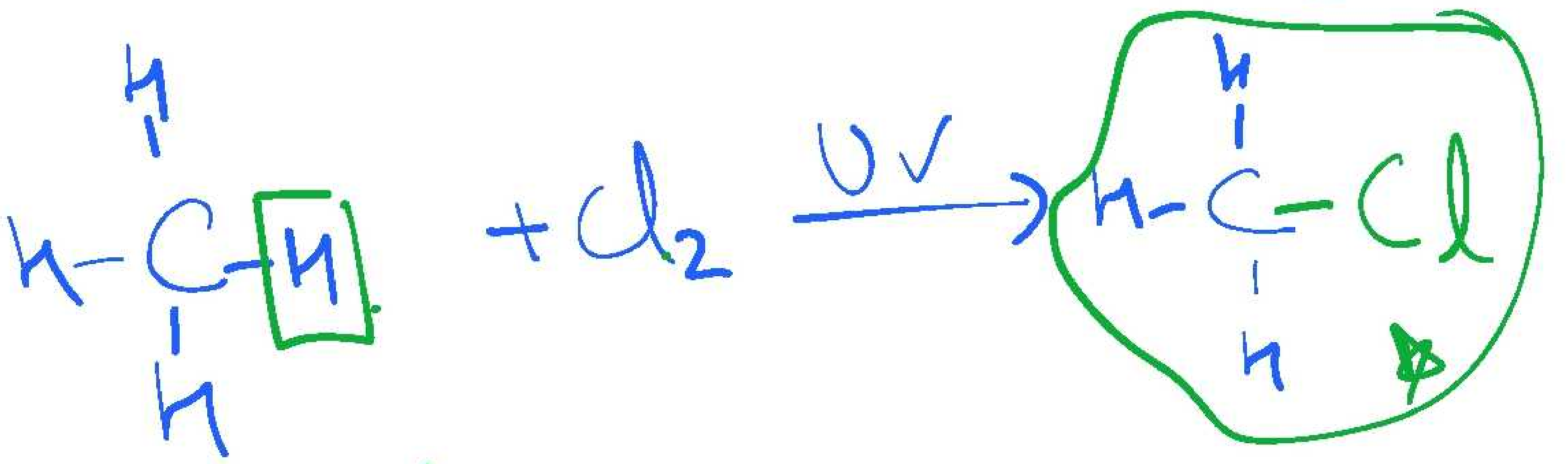
(Chain reactions) Free Radical Substitution

Alkane | Homolytic fissions

Initiation
→ formation of
→ free radical
→ needs sunlight (UV)

Propagation
→ Continuous Process
→ each product will be formed in $\boxed{2 \text{ Steps}}$

Termination
→ finish the reaction
→ 2 free radicals react together to form multiple products.



$CH_4 + Cl_2 \xrightarrow{UV} CH_3Cl$

Mechanism means reaction Pathway

(1) Initiation

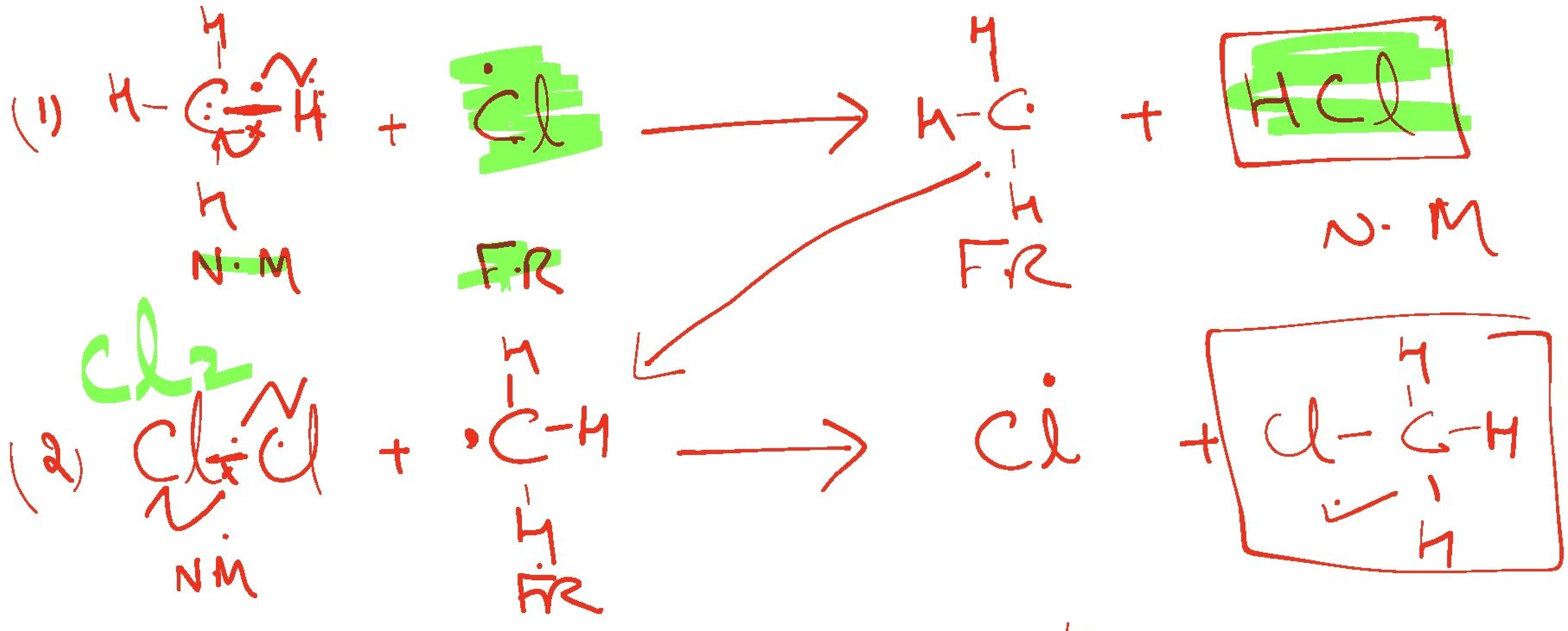
$\underbrace{Cl \overset{\cdot}{\underset{\times}{-}} Cl} \xrightarrow{UV} \underbrace{\dot{Cl} + \dot{Cl}}$

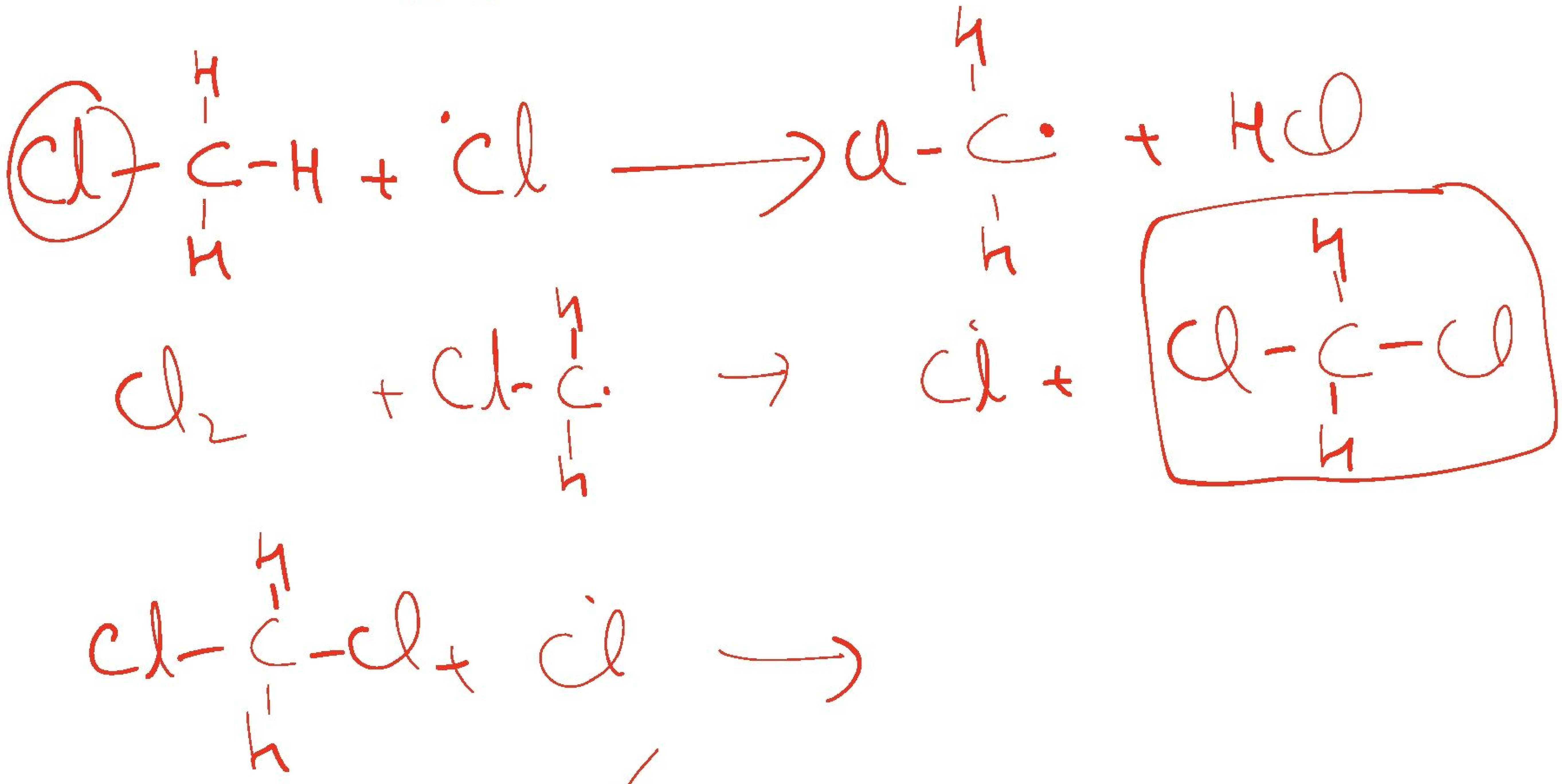
N.M   Free radicals

N M

2) Propagation   C–H non polar

$N\cdot M + F\cdot R \longrightarrow F\cdot R + N\cdot M$





(3) Termination (Multiple products)

Ea is very low

$\dot{Cl} + \dot{Cl} \rightarrow Cl_2$

$\dot{C}H_3 + \dot{Cl} \rightarrow CH_3Cl$

$\dot{C}H_3 + \dot{C}H_3 \rightarrow CH_3-CH_3$

$\dot{C}H_2Cl + \dot{Cl} \rightarrow CH_2Cl_2$

Reaction type

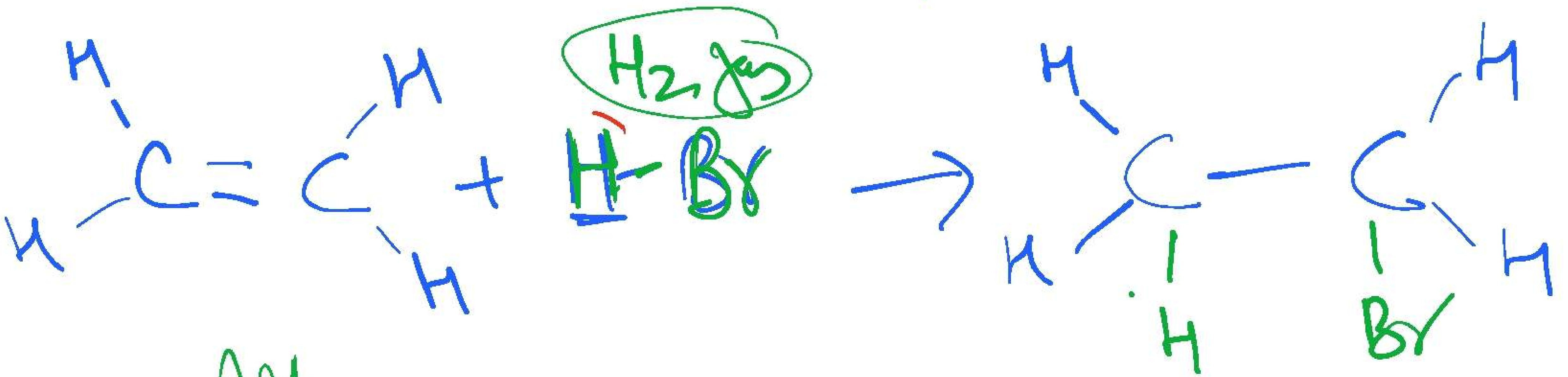
Addition Reaction

→ Aldehyde and Ketones $:Nu$

→ Alkene (electrophil

2+2 = 4

Mechanism → electrophilic addition

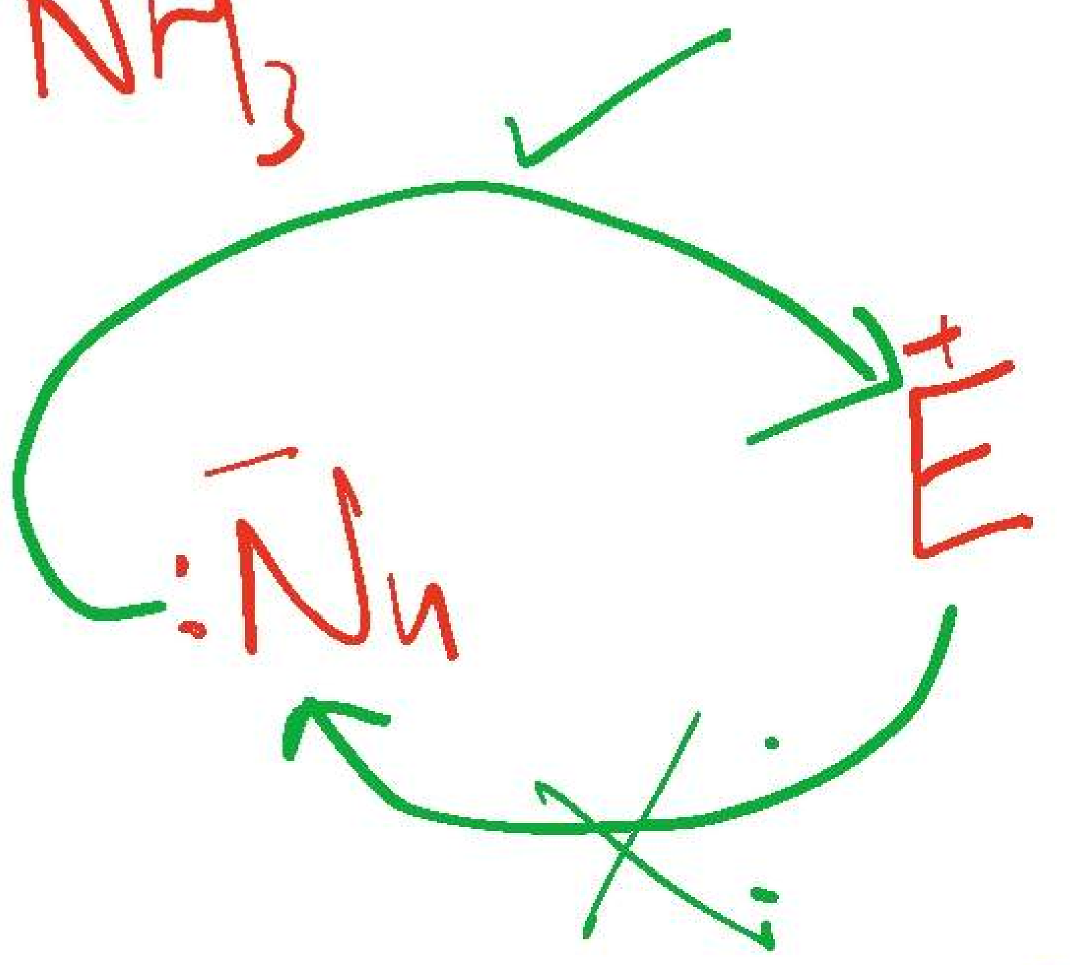


Alkene

Alkane

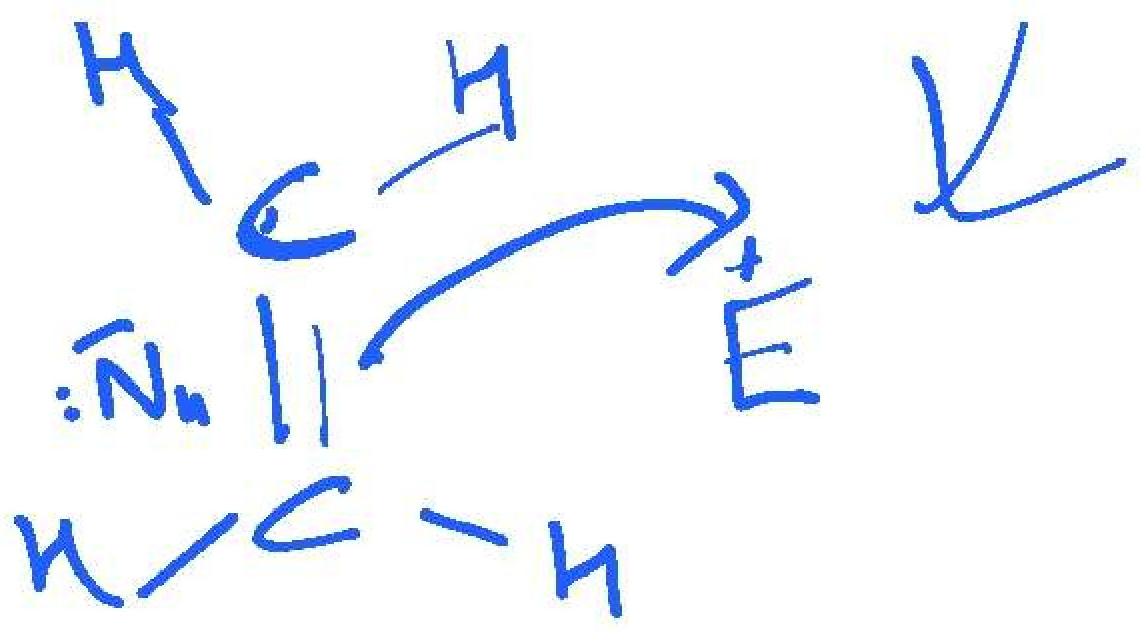
Halogenoalkane

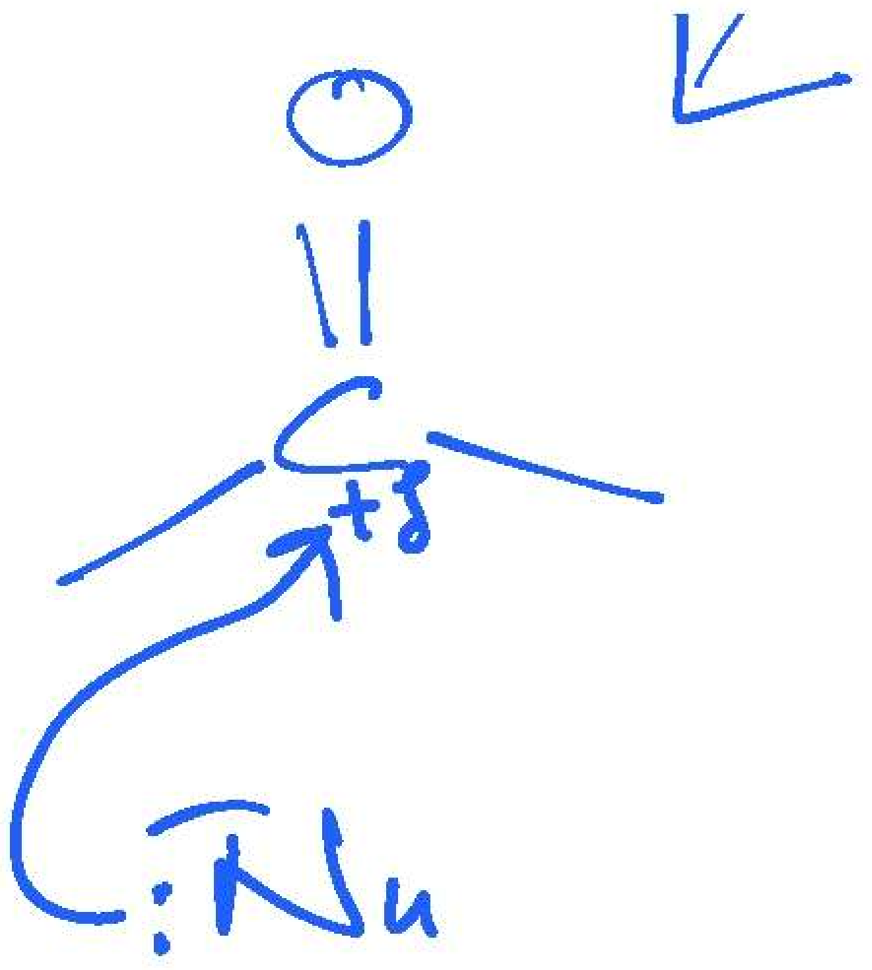
(ē rich species) Nucleophile	ē deficient species Electrophile
nucleus loving	ē loving
→ negative charge / lone pair of es	are positively charge
→ $:\bar{N}u$	→ $\overset{+}{E}$
→ $:\bar{O}H$, $H_2\ddot{O}:$, $\ddot{N}H_3$	→ $\overset{+}{Cl}$, $\overset{+}{H}$



Both Alkene & Aldehyde and Ketones show Addition reaction but

{ Alkene show electrophilic addition
Aldehyde & Ketones show nucleophilic addition }

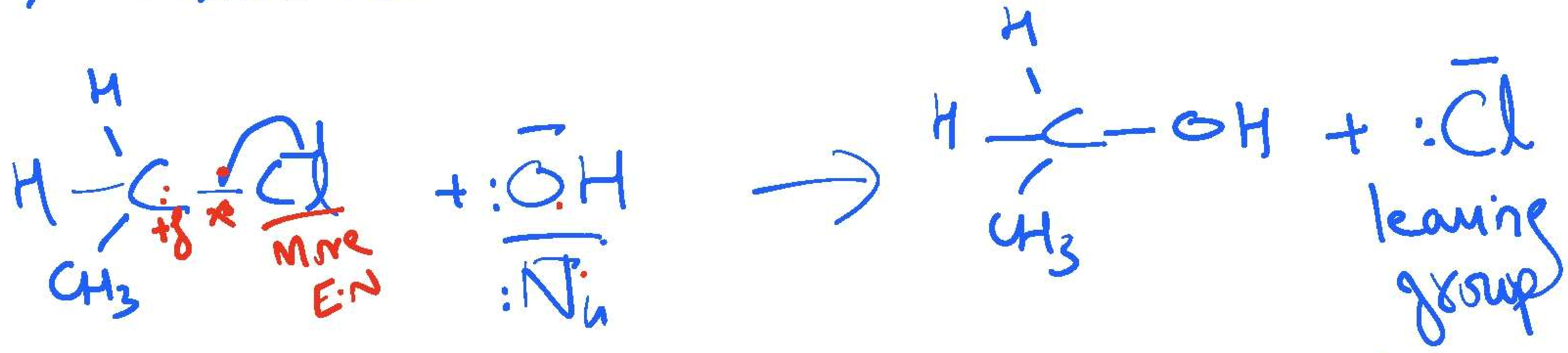




Nucleophilic Substitution Reactions

$:\bar{Nu}$

→ Halogenoalkane
→ Alcohol



In these reactions ē rich nucleophile will displace halogen atom (leaving group)

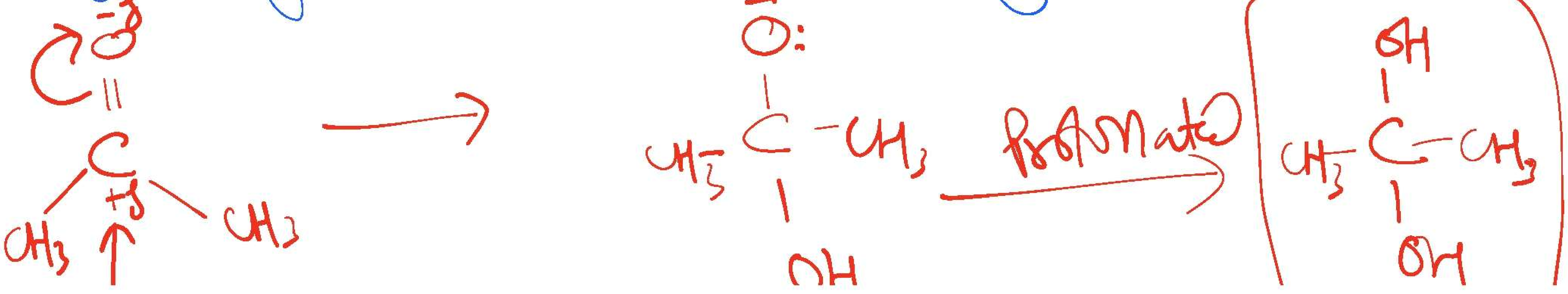
Difference b/w :Base & :Nu

$:\bar{Nu}$ always attack on carbocation
$:\bar{B}$ always attack on hydrogen.

Nucleophilic Addition

$\underset{+\delta}{C}=\overset{-\delta}{O}$ More EN

A reaction in which nucleophile attacks ē deficient site in a molecule followed by addition of small molecule to give you one product only.

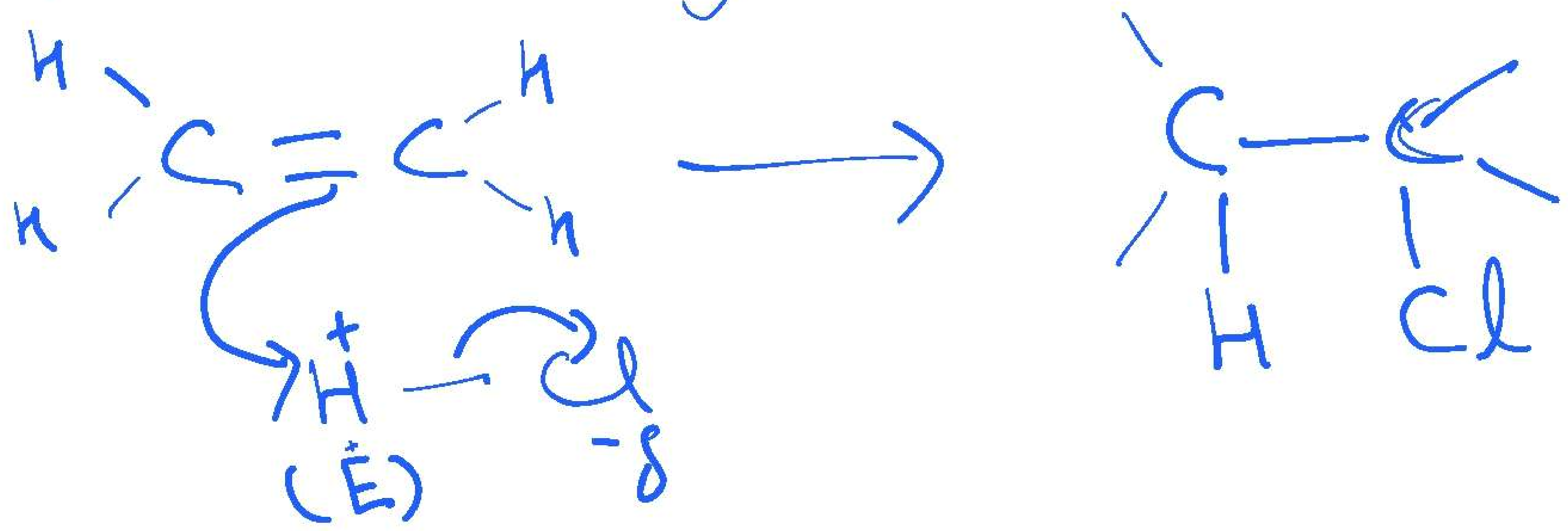


one

Propane 2,2-diol

Electrophilic Addition

electron rich region (π ēs) is attacked by electrophile follow by addition of small molecule to give only single product only



Alkane → Free radical substitution

Alkene → electrophilic addition

Halogenoalkane → [Nucleophilic substitution]

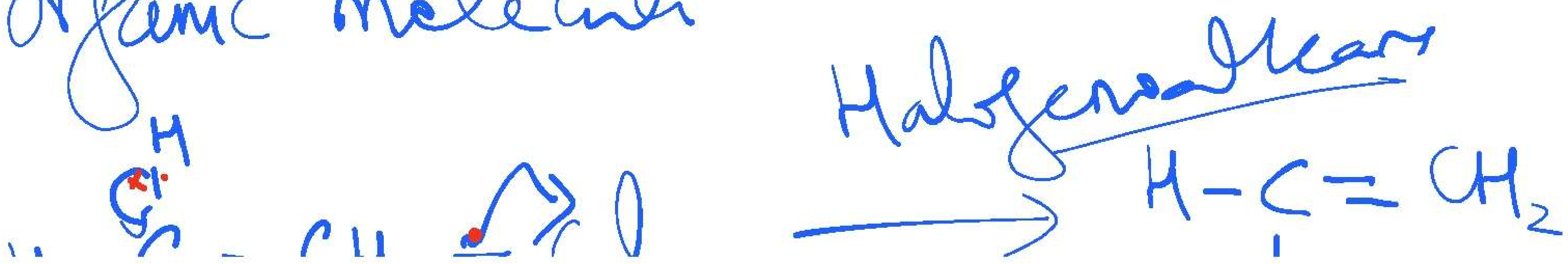
Alcohol →

Aldehyde & Ketone → Nucleophilic addition

Elimination Reaction

Halogenoalkal

A small molecule such as H_2O or HCl is removed from an organic molecule



H—C — CH_2 ×

H H^+ :Cl   + HCl

Hydrolysis

Condensation Reaction

→ 2,4 DNPH Test
Aldehyde & ketone

→ making ester (carboxylic acid)

Two organic molecules join together and remove/eliminate small molecule (H_2O, HCl)

Oxidation

[O] ← oxidising agent
$KMnO_4$
$K_2Cr_2O_7$

- → loss of ē
- → gain of Oxygen → Increase in oxidation number
- → loss of H

Reduction

[H] ← Reducing agent
→ $LiAlH_4$
→ $NaBH_4$

→

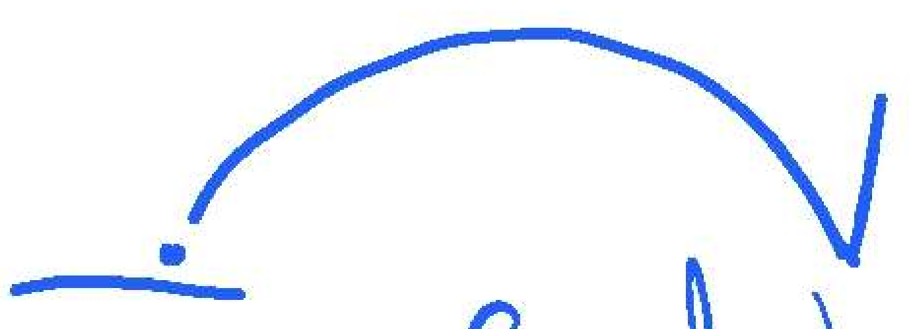
oxidation

$$\underbrace{CH_3CH_2OH}_{6H} + [O] \longrightarrow \underbrace{CH_3CHO}_{4H} + H_2O$$

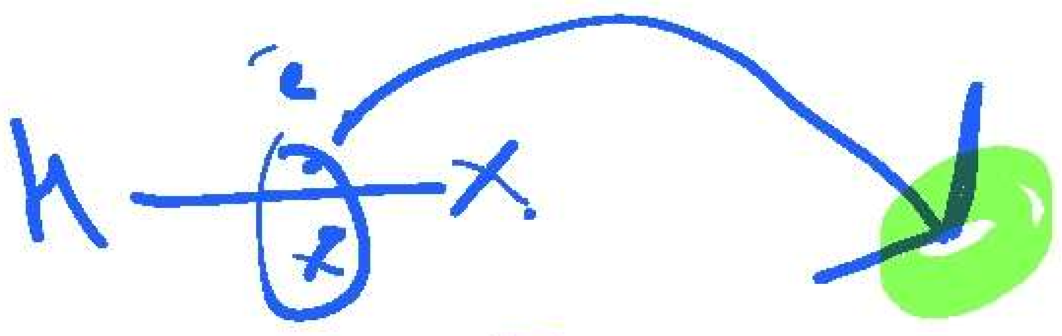
Reduction

$$\underbrace{CH_3CHO}_{4H} + [H] \longrightarrow \underbrace{CH_3CH_2OH}_{6H}$$

Mechanisms



Curly half arrow



full curly arrow