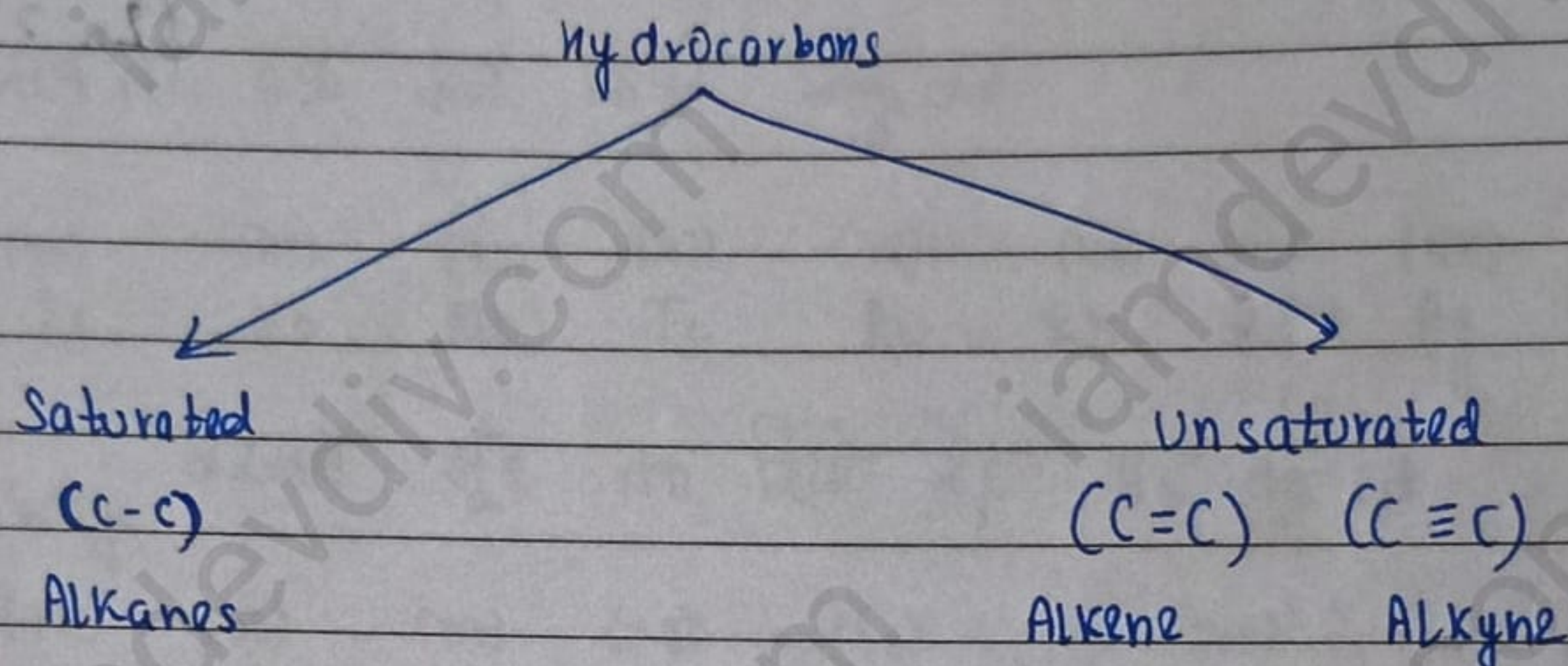


18/10/23

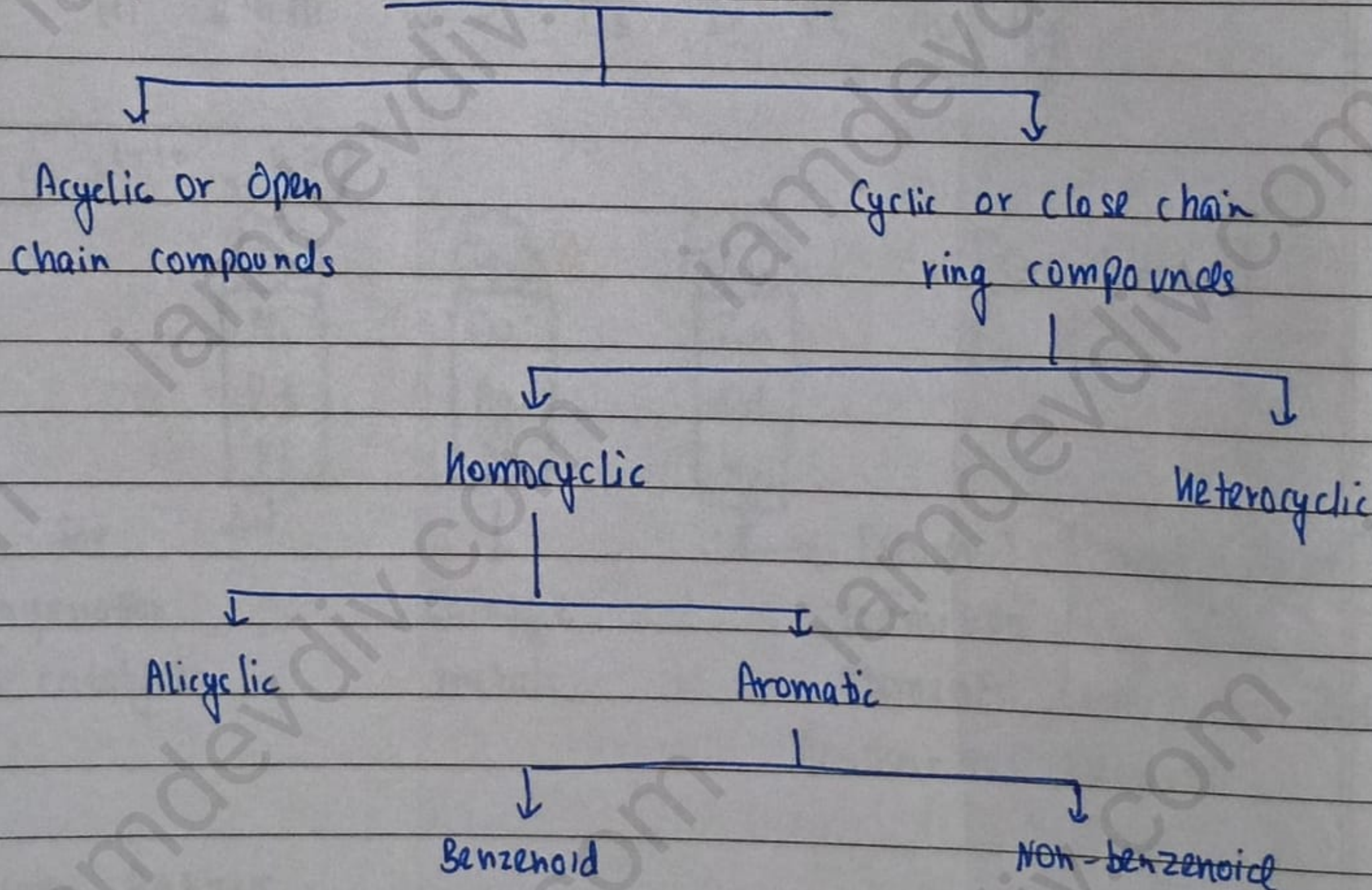
## CHAPTER - 6

## HALOALKANES AND HALOARENES

## ★ BASIC INTRODUCTION OF ORGANIC CHEMISTRY



## • CLASSIFICATION OF ORGANIC COMPOUNDS



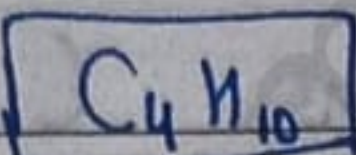
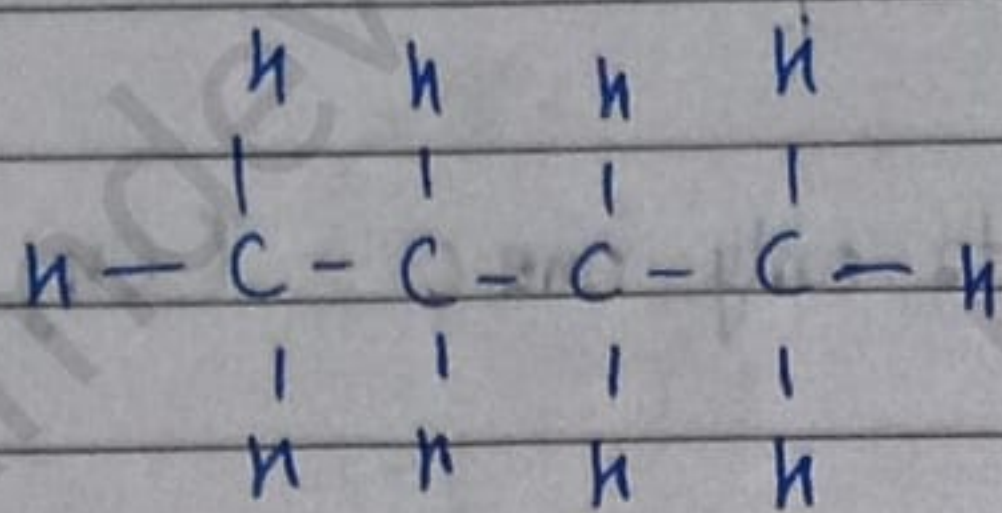
## • REPRESENTATION OF ORGANIC COMPOUNDS

## 1) Molecular formula

 $CH_4, C_2H_6, C_3H_8, C_4H_{10}$ 

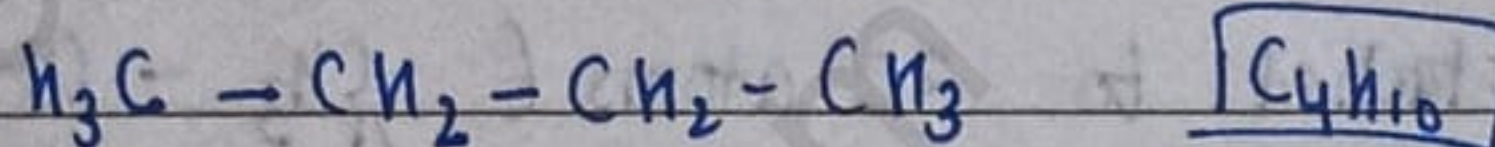
Total number of elements are represented in this formula

2) Expanded structural formula

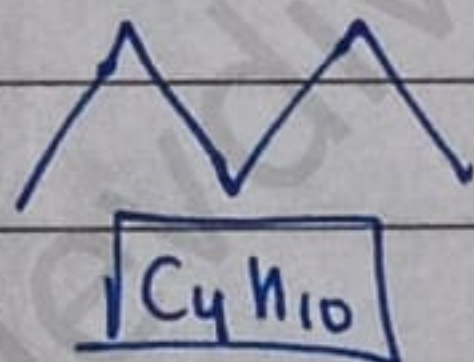


3) Condensed structural formula

Only carbon-carbon bond is visible



4) Bond line notation



### • HYBRIDISATION

No. of  $\sigma$  bonds + No. of lone pairs

Hybridisation

4

$sp^3$

3

$sp^2$

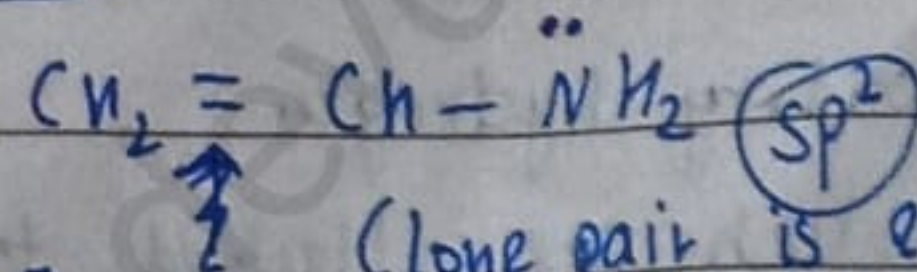
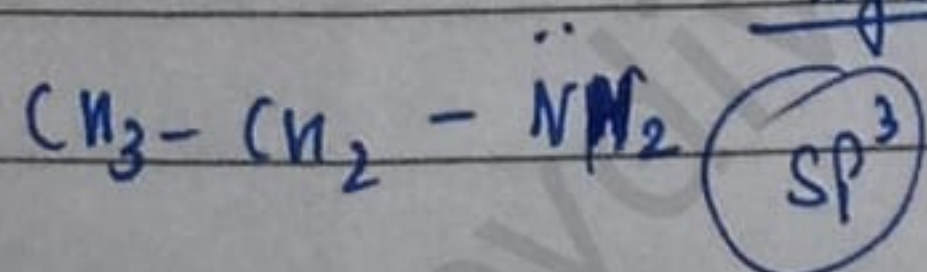
2

$sp$

\*  $\pi$  bonds are NOT included in hybridisation

\* If lp or  $-ve$  charge is present adjacent to  $\pi$  bond then it is not included in hybridisation

### Hybridisation of N



~~Exclude~~

(lone pair is excluded because it is on a carbon which is adjacent to a  $\pi$  bond)

[Lone pair starts rotating due to resonance]

• DEGREE OF CARBON

$1^\circ\text{C}$  Primary carbon  
IF C atom is attached to only one C ( $\text{CH}_3 - \text{CH}_3$ )

$2^\circ\text{C}$  Secondary carbon  
IF C atom is attached to 2C atoms  $(\text{CH}_3 - \text{CH}_2 - \text{CH}_3)$

$3^\circ\text{C}$  Tertiary carbon  
IF C is attached to 3C atoms  $(\text{CH}_3 - \text{C}(\text{CH}_3)_2 - \text{CH}_3)$

$4^\circ\text{C}$  Quaternary carbon  
IF C is attached to 4C atoms  $(\text{C}(\text{CH}_3)_4)$

• DEGREE OF HYDROGEN

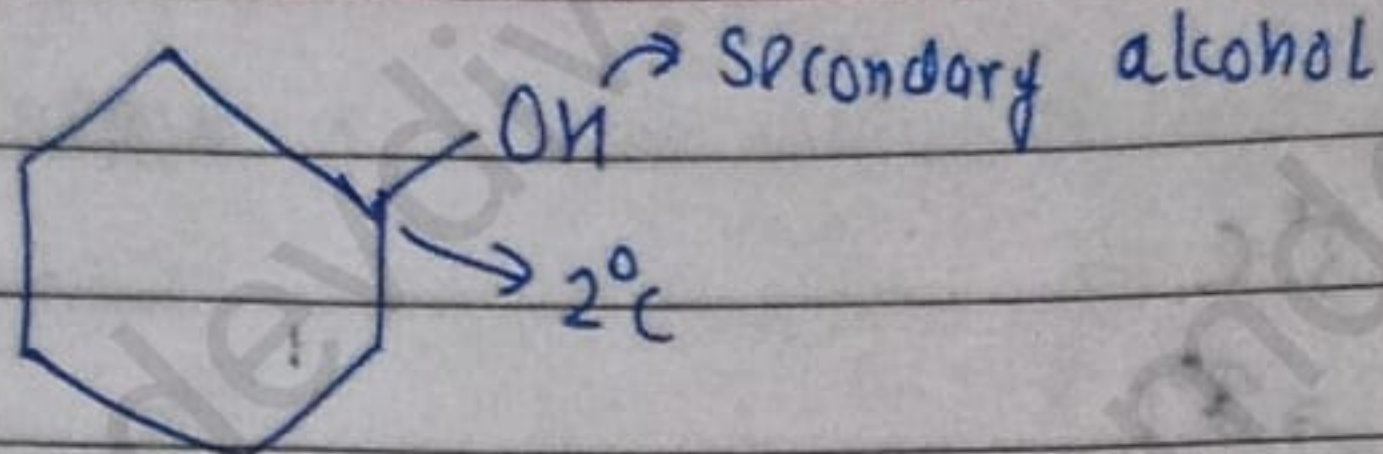
$1^\circ\text{H}$  Primary hydrogen  
H which is attached to  $1^\circ\text{C}$   $(\text{CH}_3 - \text{CH}_3)$

$2^\circ\text{H}$  Secondary hydrogen  
H which are attached to  $2^\circ\text{C}$

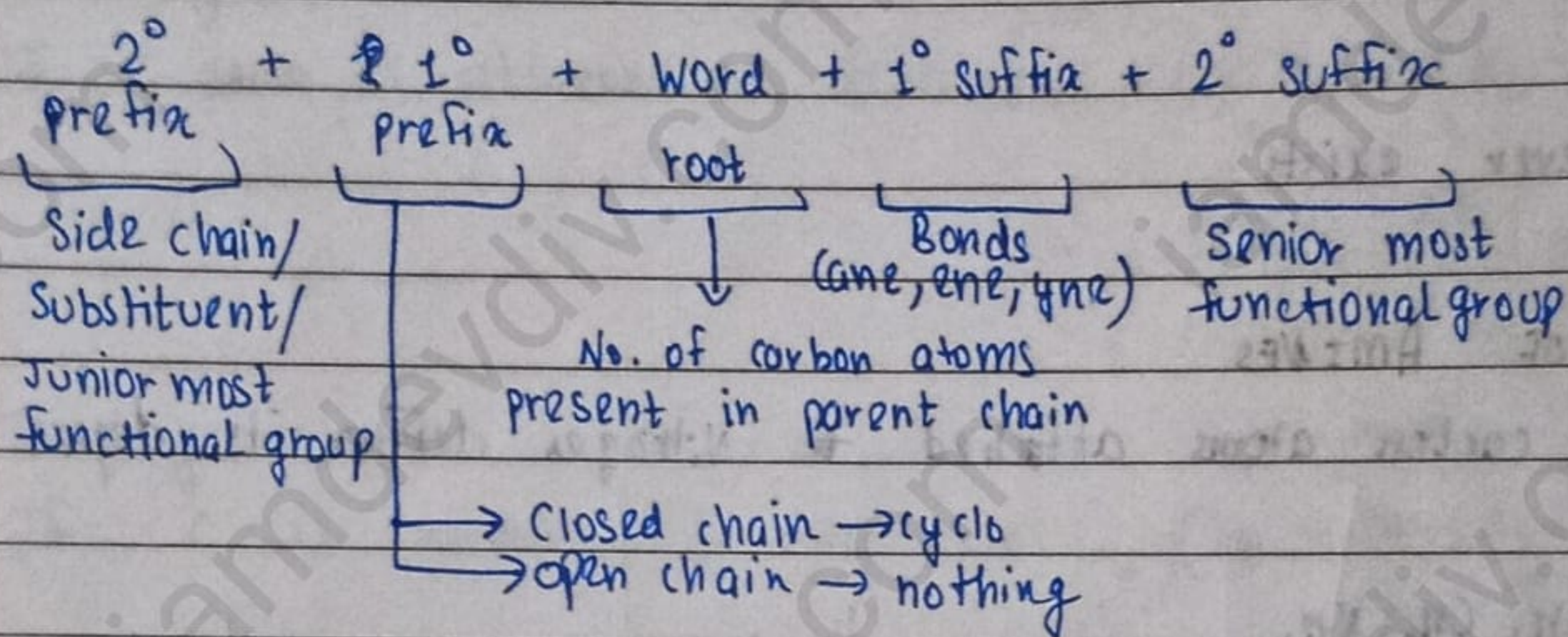
$1^\circ\text{C}$	$\rightarrow 2$
$1^\circ\text{H}$	$\rightarrow 6$



iii)



## IUPAC NOMENCLATURE

 $C_1 \rightarrow$  meth $C_2 \rightarrow$  Eth $C_3 \rightarrow$  Prop $C_4 \rightarrow$  But $C_5 \rightarrow$  Pent $C_6 \rightarrow$  Hex $C_7 \rightarrow$  hept $C_8 \rightarrow$  Oct $C_9 \rightarrow$  Non $C_{10} \rightarrow$  Dec $C_{11} \rightarrow$  Undec $C_{12} \rightarrow$  Dodec

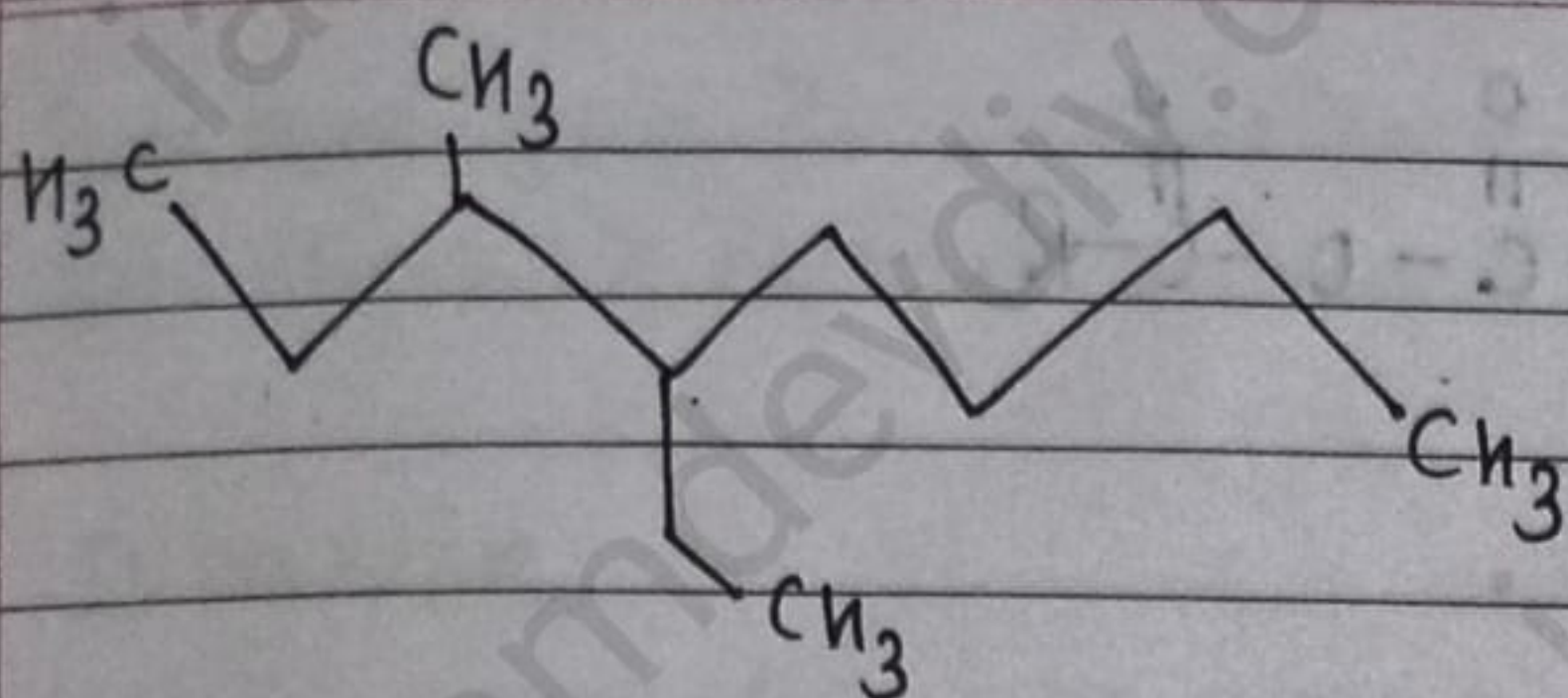
### 1. LONGEST CHAIN RULE

The longest carbon chain  $\rightarrow$  parent chain

### 2. LOWEST NUMBER RULE

The numbering of the parent chain is done in such a way that the substituents attached to the parent chain get the lowest possible position

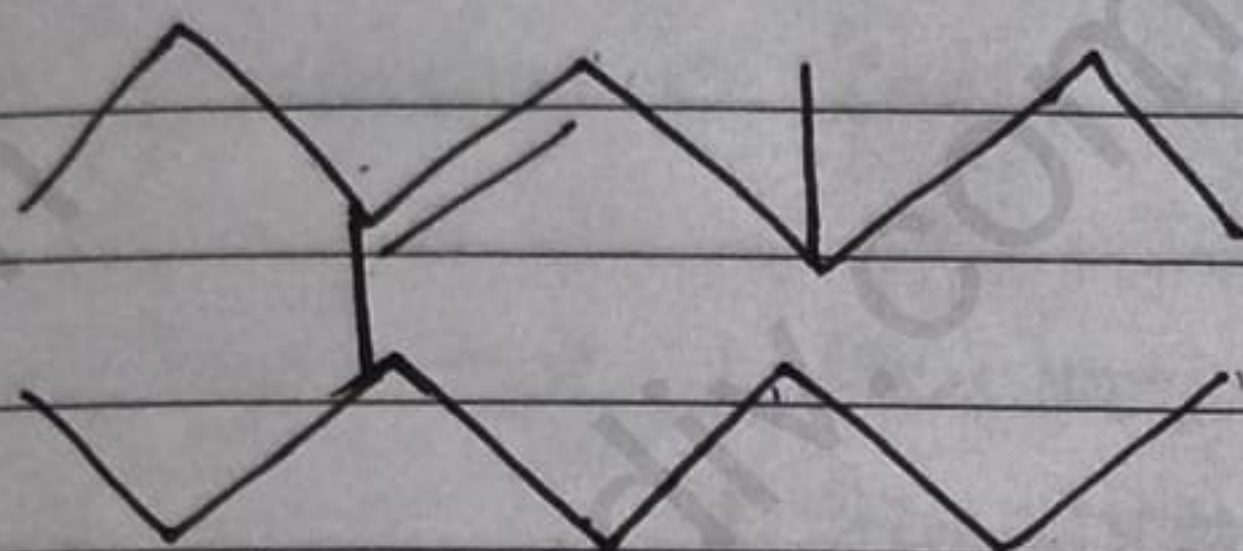
### 3. ALPHABETICAL ORDER OF THE SIDE CHAIN



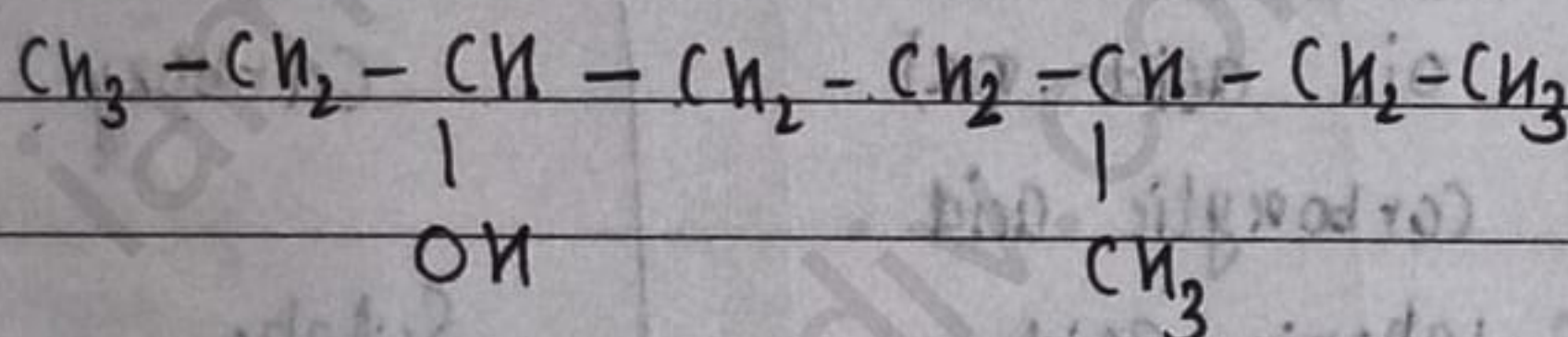
~~2,3-dimethyl-octane~~

4-ethyl-3-methyloctane

↑  
alphabetical order

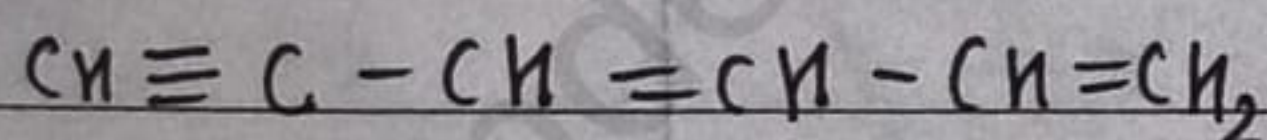


5,6-diethyl-3-methyldec-4-ene



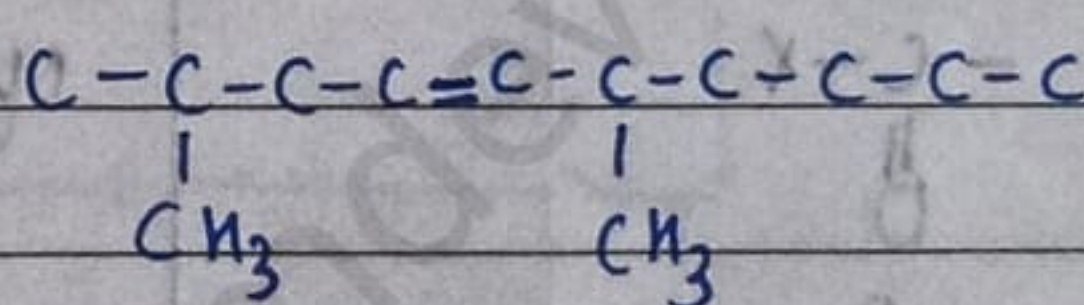
~~6-methyl-3-ol-octane~~

6-methyloctane-3-ol



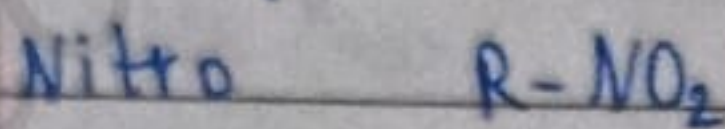
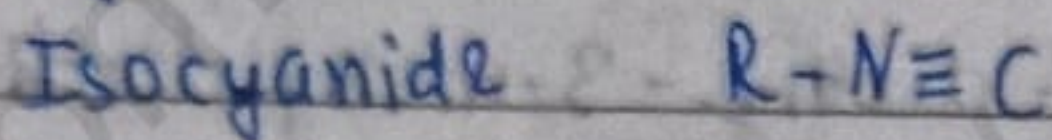
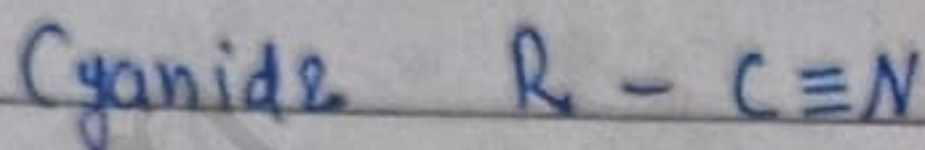
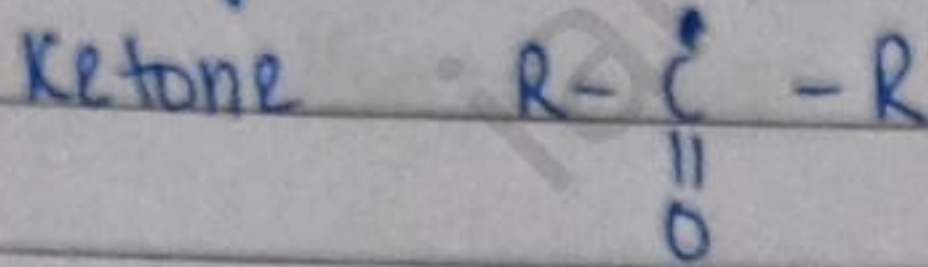
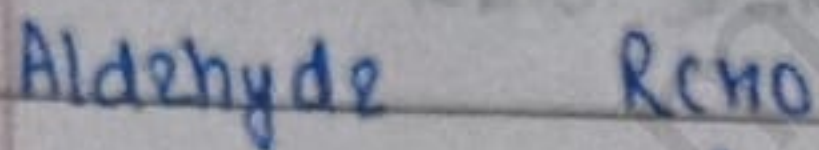
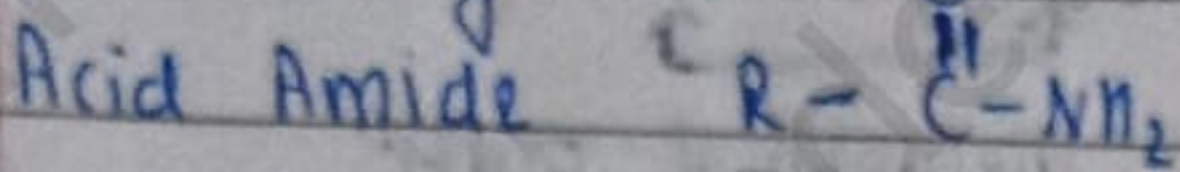
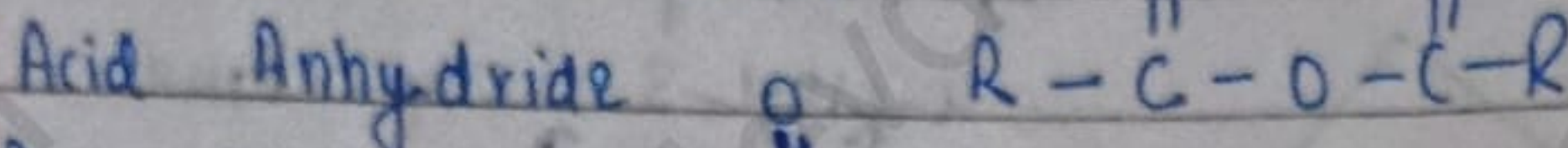
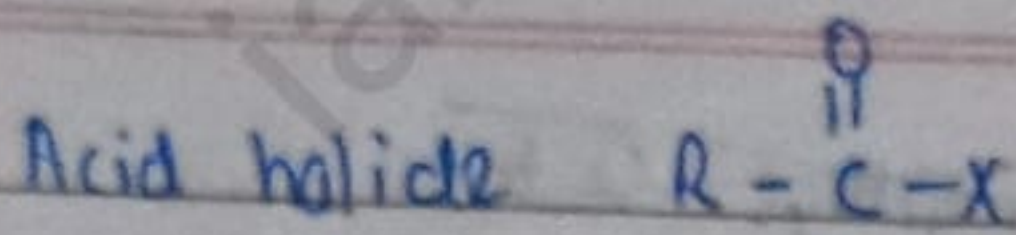
Hex-1,3-diene-5-yne

2,6-dimethyl-dec-4-ene



• IUPAC NOMENCLATURE OF FUNCTIONAL GROUP

Alcohol	R-OH
Thioalcohol	R-SH
Ether	R-O-R
Thioether	R-S-R
Carboxylic acid	RCOOH (OR) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$
Sulphonic acid	R-SO <sub>3</sub> H
<del>Sulphonic</del> Ester	R-C-OR
Sulphonic ester	$\text{R}-\overset{\text{O}}{\parallel}{\underset{\text{O}}{\text{S}}}-\text{OR}$



\* SENJORITY ORDER

	<u>FUNCTIONAL GROUP</u>	<u>SECONDARY SUFFIX</u>	<u>SECONDARY PREFIX</u>
①	$-COOH$	oic acid (or) carboxylic acid	Carboxy
②	$-SO_3H$	Sulphonic acid	Sulpha
③	$\begin{array}{c} -C-O-C- \\ \parallel \quad \parallel \\ O \quad O \end{array}$	oic anhydride	X
④	$\begin{array}{c} -C-O- \\ \parallel \\ O \end{array}$	oate	alkoxy carbonyl
⑤	$\begin{array}{c} -C-X \\ \parallel \\ O \end{array}$	oyl halide	halo carbonyl
⑥	$R-\overset{\overset{O}{\parallel}}{C}-NH_2$	amide	carbonyl
⑦	$C\equiv N$	nitrile	cyano
⑧	$-CHO$	al	formyl or oxo
⑨	$\begin{array}{c} -C- \\ \parallel \\ O \end{array}$	one	oxo or keto
⑩	$-OH$	ol	hydroxy
⑪	$-SH$	thiol	mercapto
⑫	$-NH_2$	Amine	Amino

Functional group > Unsaturation > max no. of C > max no. of substituents > Alphabetical order

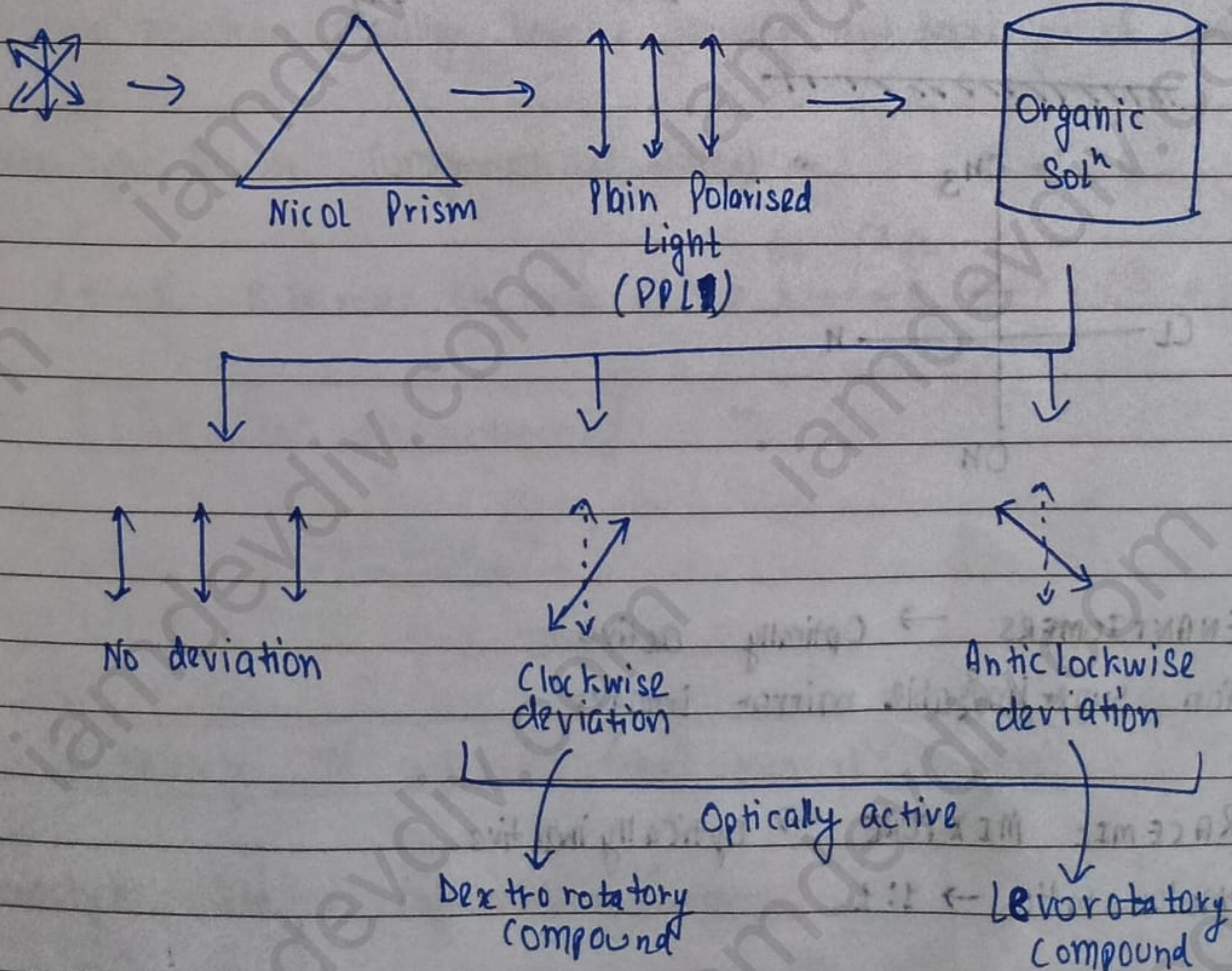
## • ISOMERISM

Organic compounds which have the same molecular formula but differ from each other in their properties are called isomers. The phenomenon is called isomerism.

Two types → 1. Structural isomerism  
2. Stereo isomerism

\* ONLY OPTICAL ISOMERISM IS RELEVANT IN CLASS XII

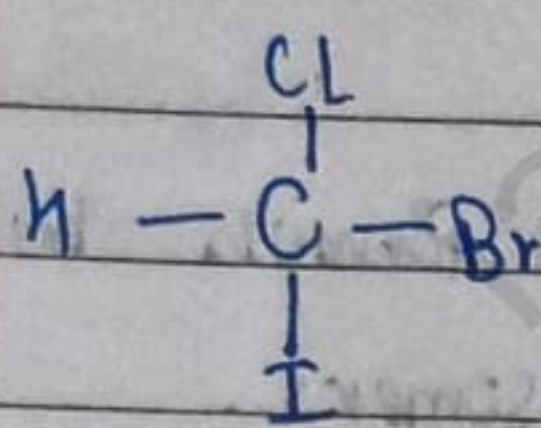
Ordinary light



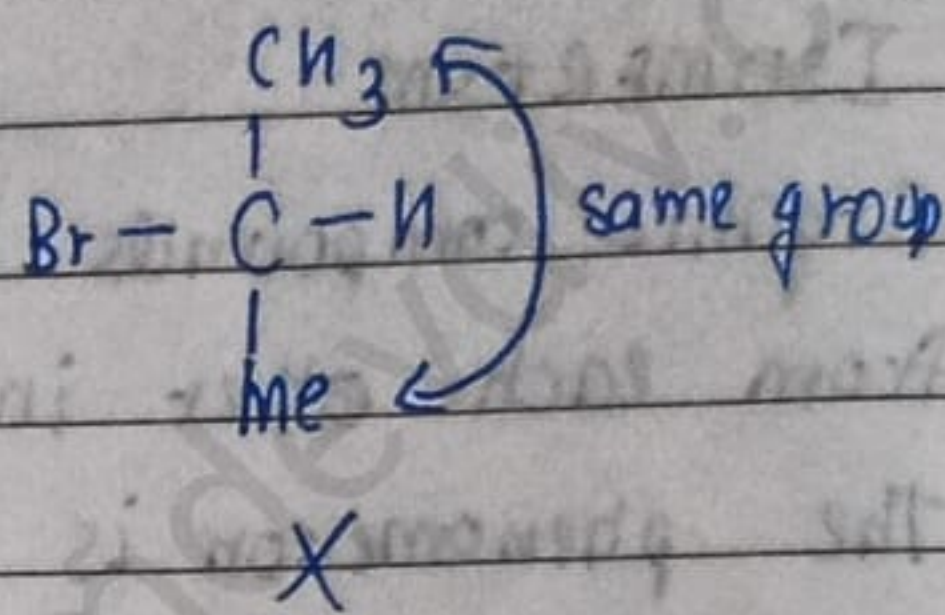
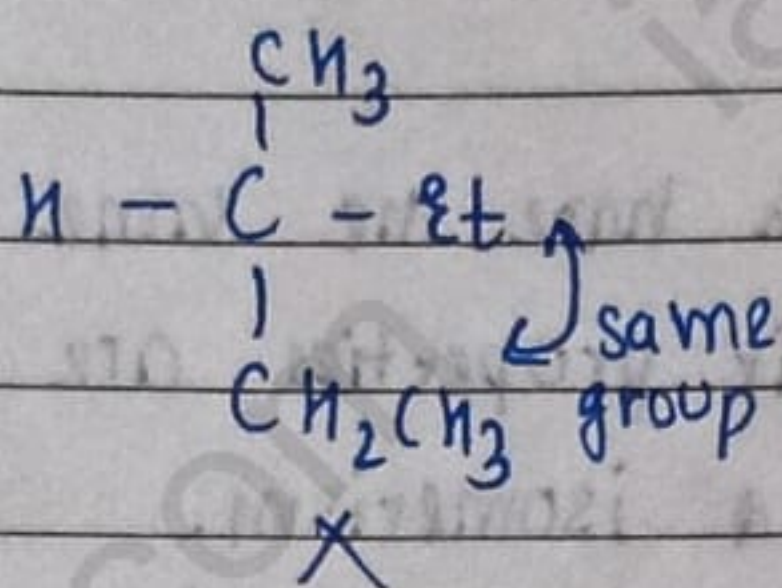


\* **ASYMMETRIC CARBON (CENTRAL C)**

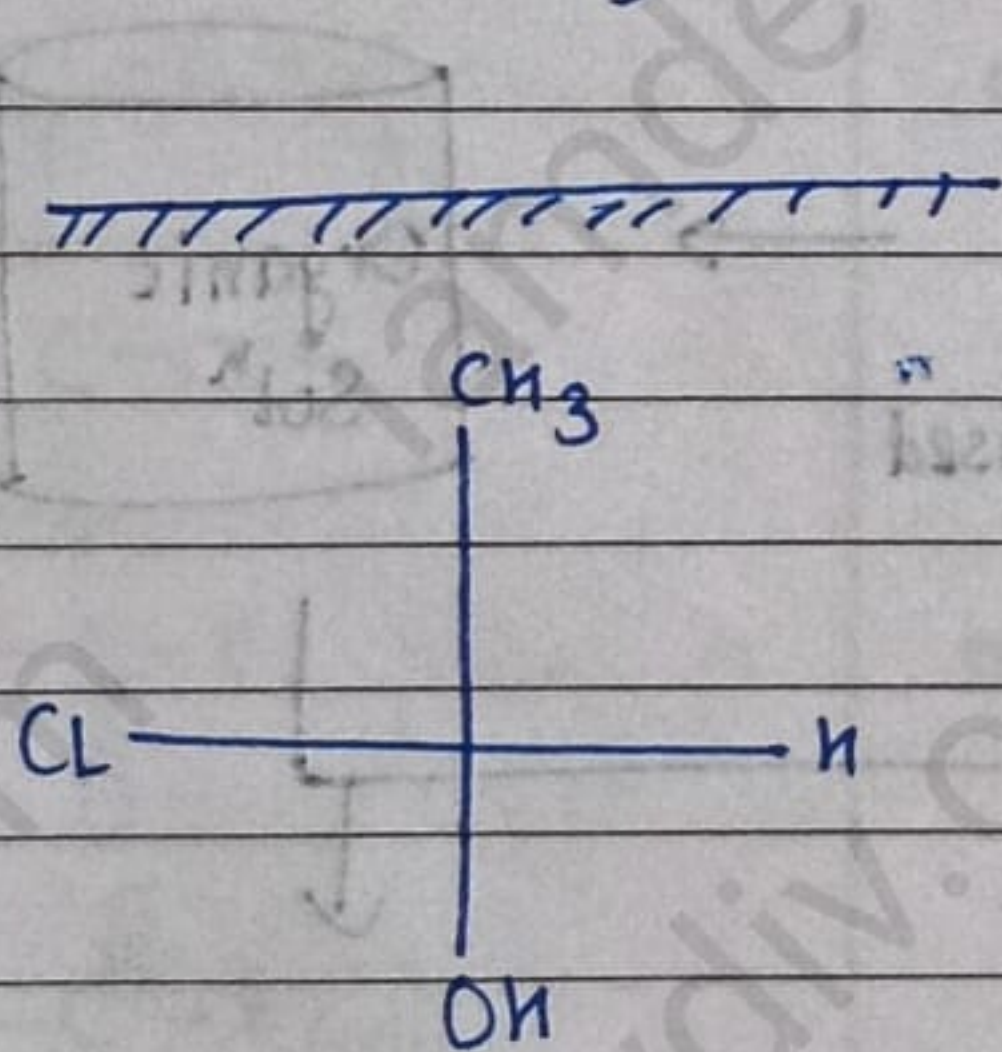
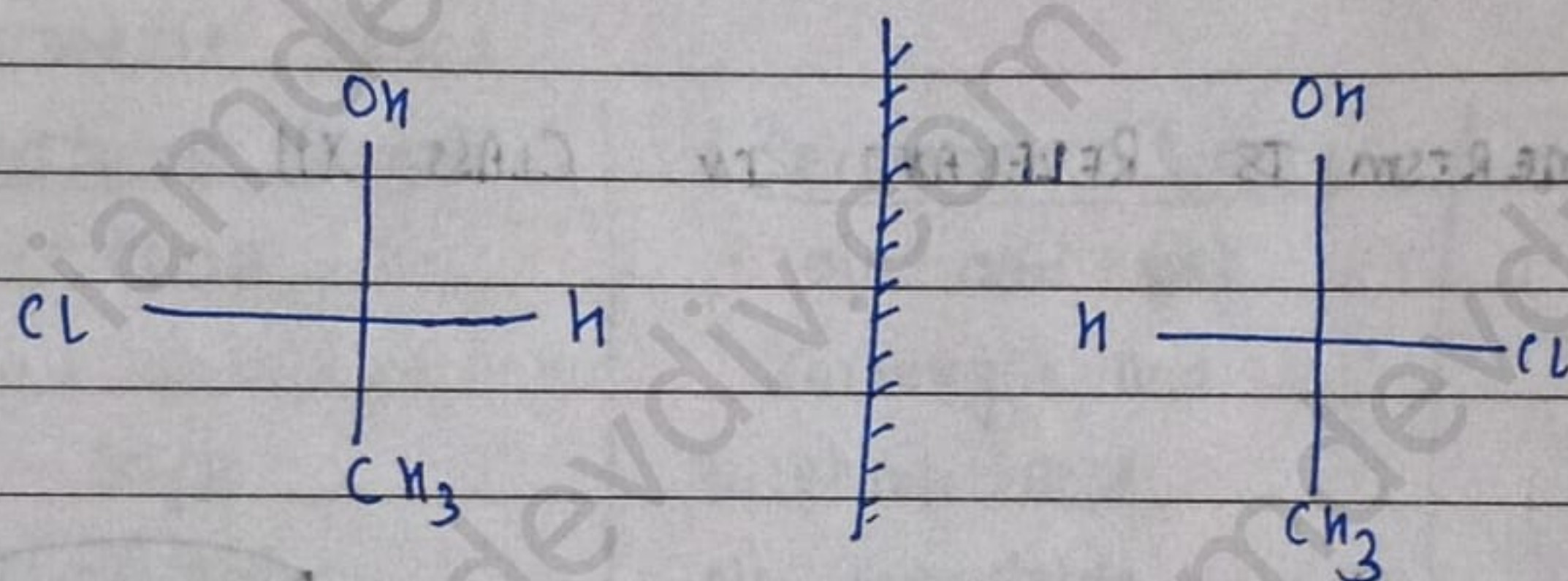
IF four different groups are attached to C atom



Asymmetric ✓



\* **MIRROR IMAGES**



\* **ENANTIOMERS** → Optically active  
Non superimposable mirror images

\* **RACEMIC MIXTURE** → Optically inactive  
Molar ratio → 1:1

\* **STEREISOMERISM**

Isomers which have same structural formula but have different relative

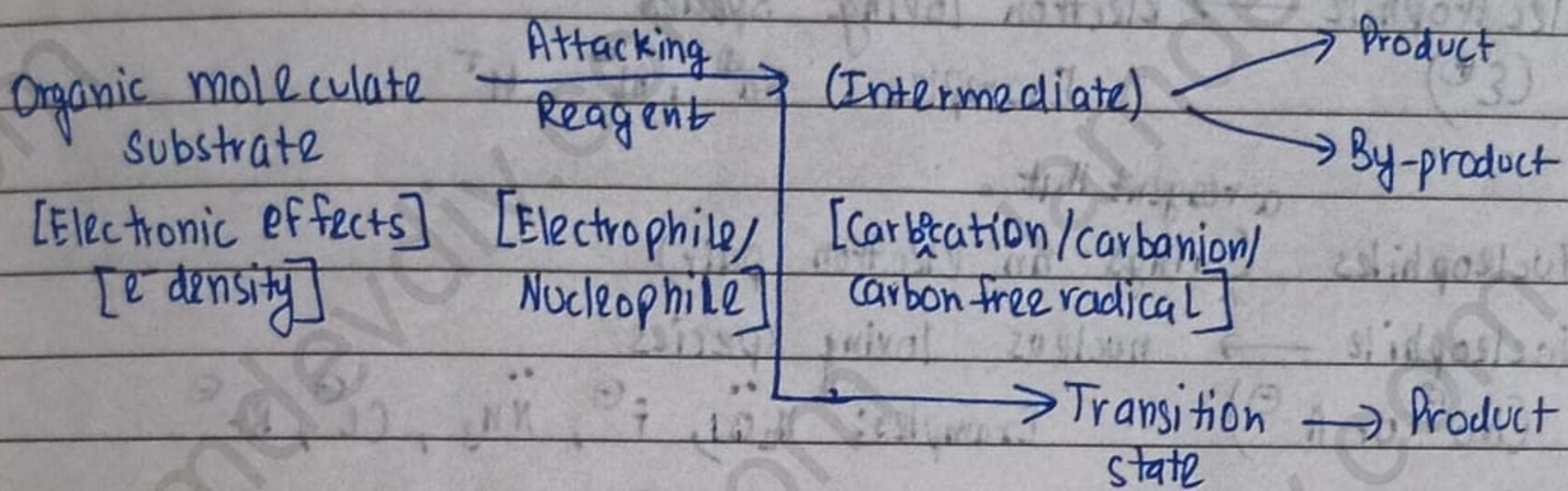
arrangement of atoms or groups in space are called stereoisomers.

Three types: 1. Geometrical isomerism

2. Conformational isomerism

3. Optical isomerism

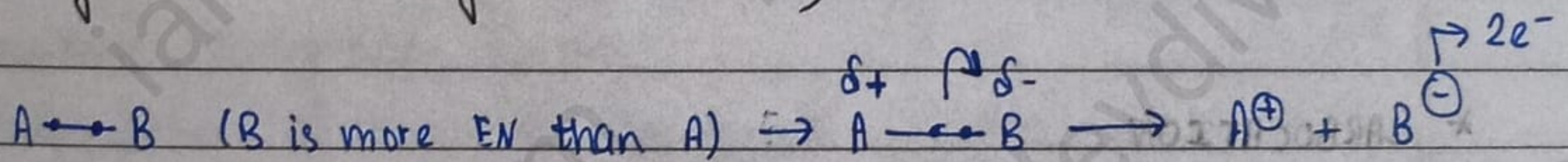
### FUNDAMENTAL CONCEPTS IN ORGANIC REACTION MECHANISM



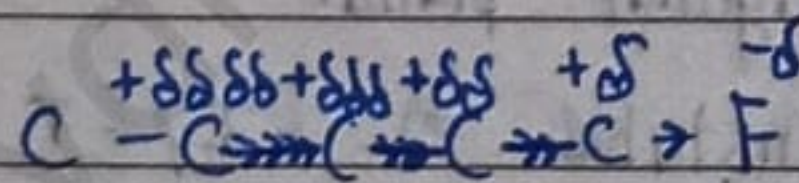
### \* FISSION OF A COVALENT BOND

Organic reaction usually involve making and breaking of covalent bonds.

(i) Heterolytic fission (unsymmetrical fission)



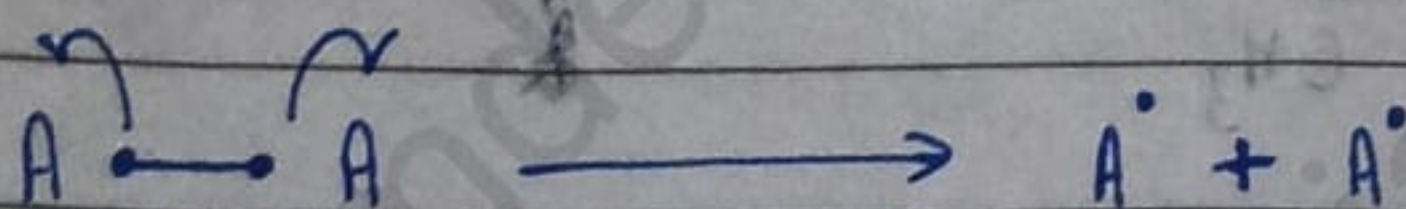
$\curvearrowright \rightarrow 2e^-$  displacement



upto four C atoms

$e^-$  density  $A^{\ominus} > A > A^{\oplus}$  (don't learn, it's obvious)

(ii) Homolytic fission (symmetrical fission)



$\curvearrowright \rightarrow 1e^-$  displacement

## \* TYPES OF ATTACKING REAGENTS

- (i) Electrophiles <sup>a reagent that</sup> (takes away an electron pair)  
 philec → loving  
 phobic → hating

Electrophile → electron loving species  
 ( $E^{\oplus}$ )

Examples:  $Na^{\oplus}$ ,  $Al^{+3}$ ,  $H^+$

- (ii) Nucleophiles <sup>a reagent that</sup> (brings an electron pair)

Nucleophile → nucleus loving species

( $Nu^{\ominus}$  or  $A^{\ominus}$ )

Examples:  $H_2O$ ,  $F^{\ominus}$ ,  $NH_3$ ,  $Cl^{\ominus}$ ,  $Br^{\ominus}$

## • ELECTRON DISPLACEMENT IN COVALENT BONDS

Permanent effect

Inductive effect

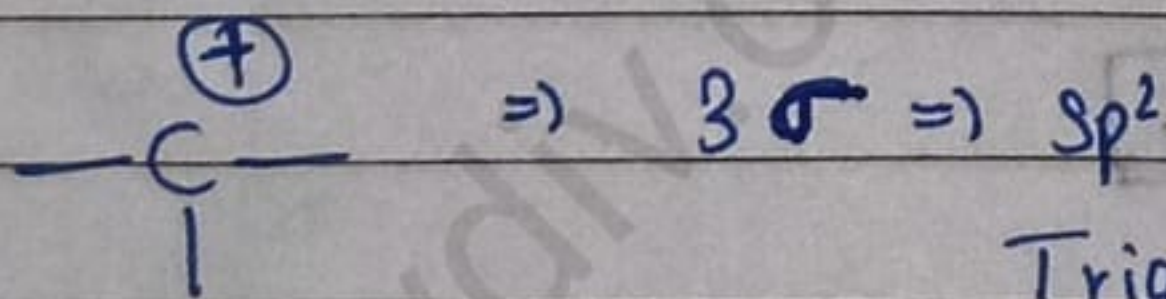
Hyperconjugation

Resonance or mesomeric effect

Temporary effect

Electromeric effect

## \* CARBOCATION



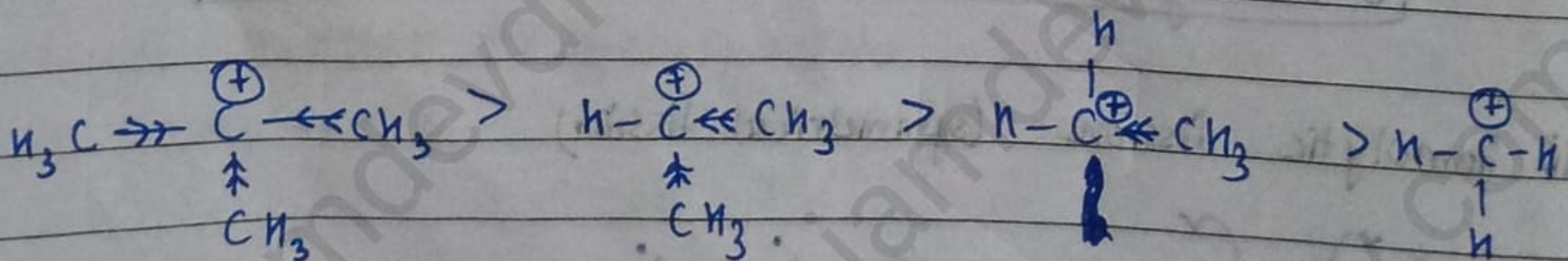
Trigonal planar

$6e^- \Rightarrow e^-$  deficient species  $\Rightarrow$  Unstable  $\Rightarrow$   $\pm I / -I$  effect

↓ give  $e^-$   
 ↓ take  $e^-$

Stability order

$3^\circ > 2^\circ > 1^\circ > CH_3$



Stability of carbocation  $\alpha + I \alpha + M$

Stability of carbocation  $\alpha \begin{array}{c} | \\ -I \\ \alpha \\ | \\ -M \end{array}$

Energy  $\alpha \begin{array}{c} | \\ \text{Stability} \end{array}$

### \* CARBANION

$CH_3 > 1^\circ > 2^\circ > 3^\circ$

Stability of carbanion  $\alpha - I \alpha - M$

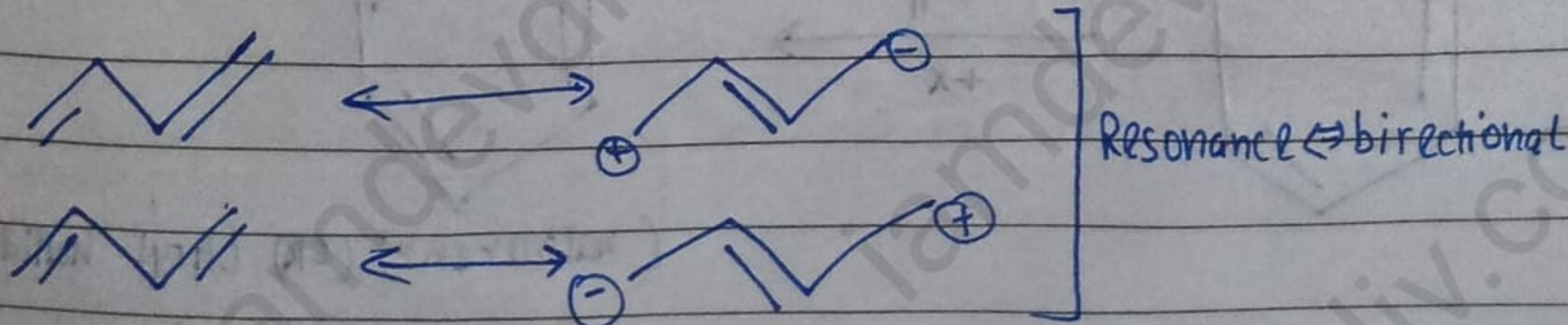
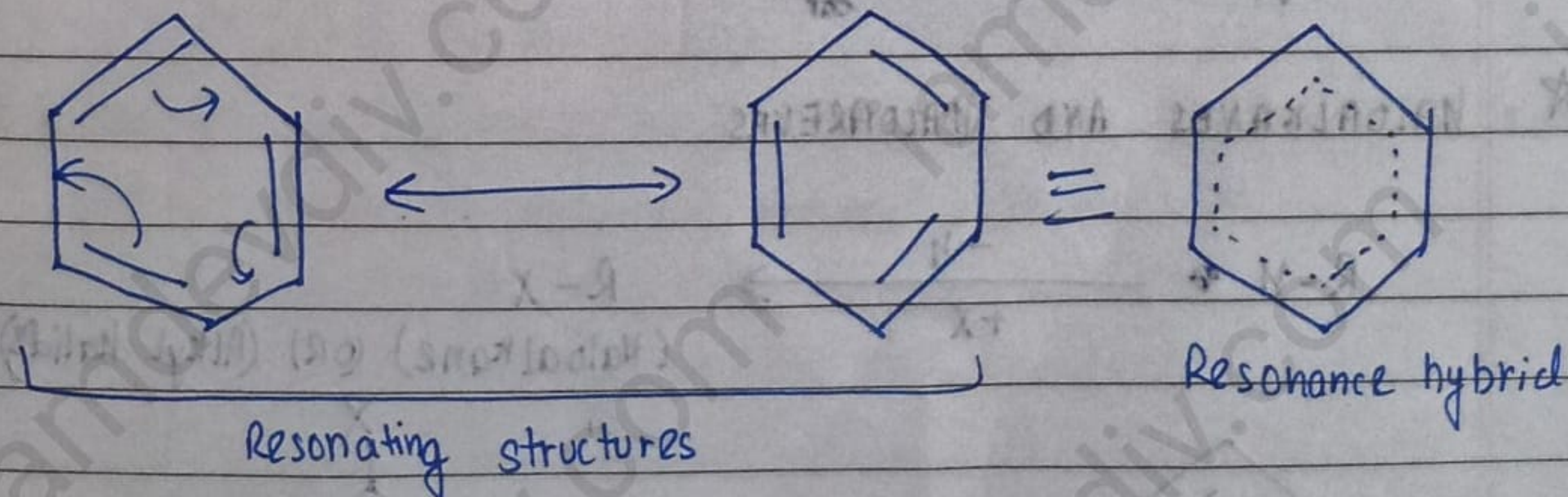
Stability of carbanion  $\alpha \begin{array}{c} | \\ +I \\ \alpha \\ | \\ +M \end{array}$

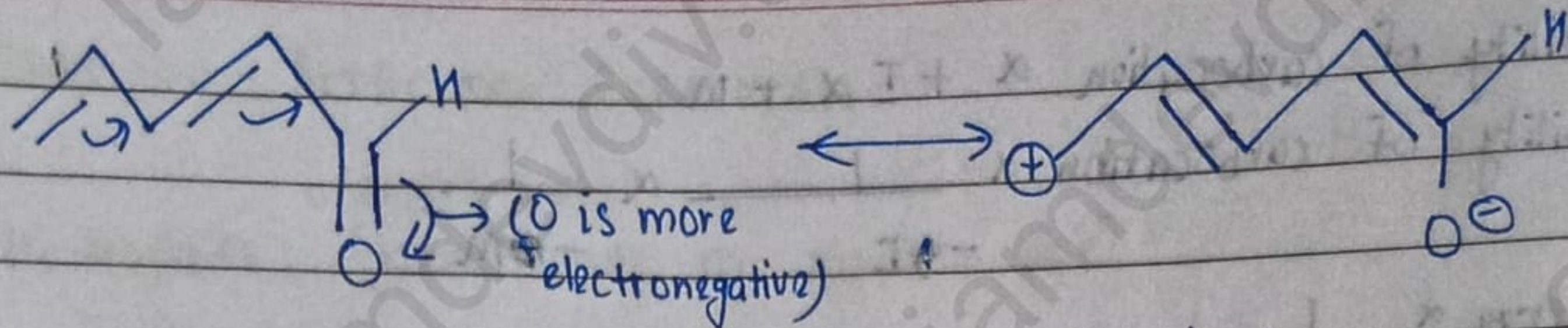
### \* APPLICATIONS OF INDUCTIVE EFFECT

1. Acidic and basic strengths of organic acids / bases
2. Stability of carbocations / carbanions
3. Reactivity of alkyl halides
4. Dipole moment, bp, mp

### \* RESONANCE / MESOMERIC EFFECT

Delocalisation of  $\pi e^-$  in conjugated system





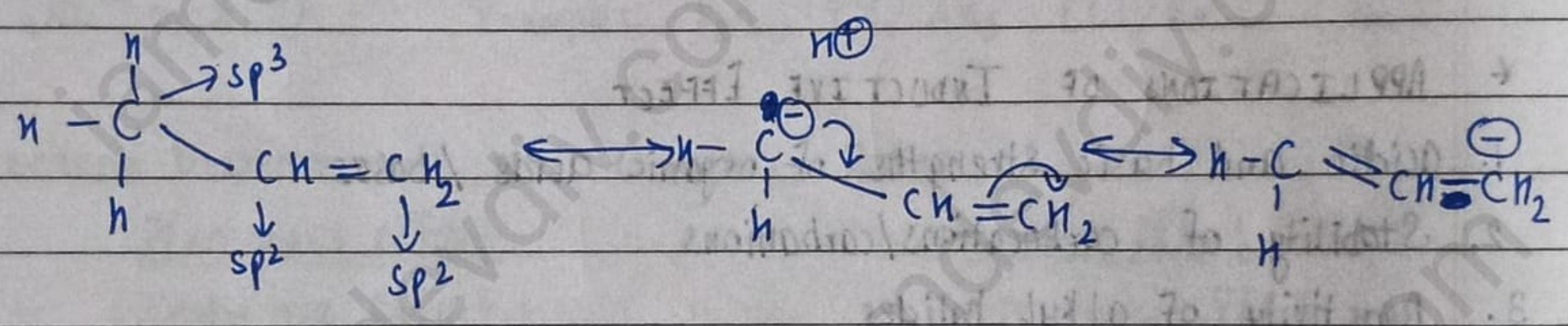
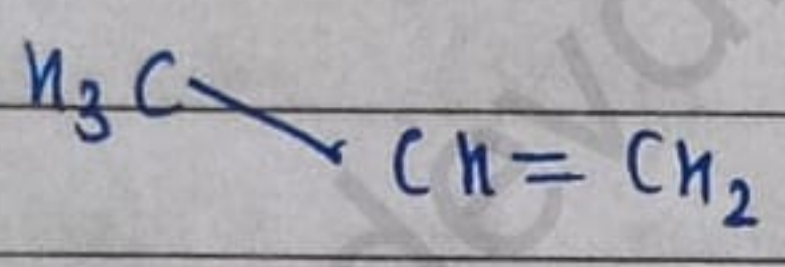
(O is more electronegative)

Mesomeric  $\Rightarrow$  Unidirectional

+R / +M  $\Rightarrow$  -OH, -OR, -NH<sub>2</sub>, -X

-I / -M  $\Rightarrow$  -CHO, -COOH, -COOR, -CN, -NO<sub>2</sub>, >C=O

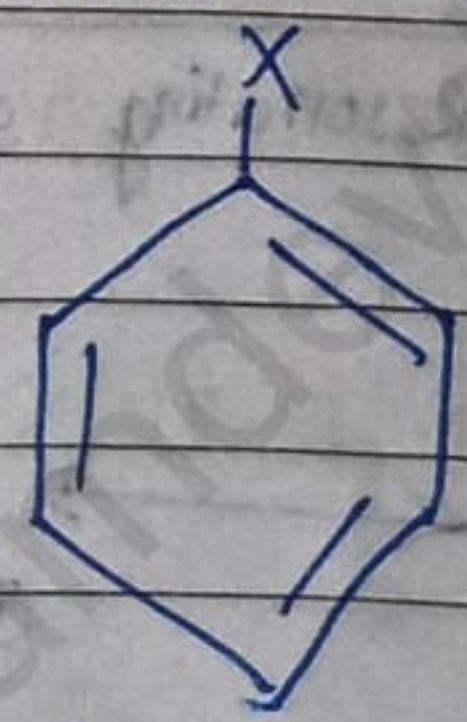
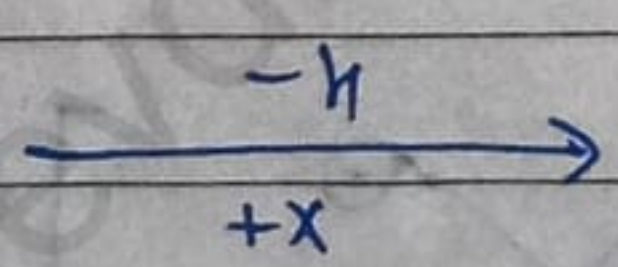
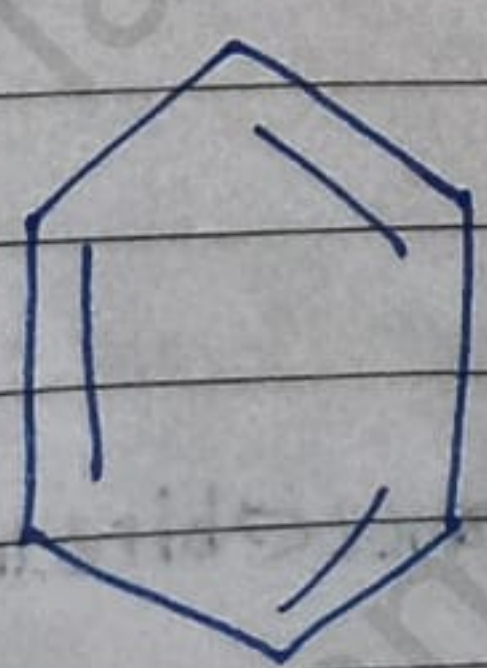
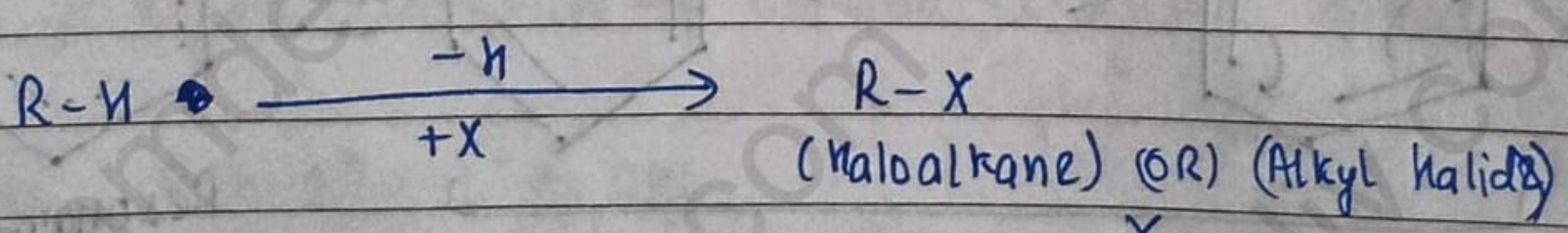
\* HYPERCONJUGATION



1. There should be a sp<sup>2</sup> hybrid carbon
2.  $\alpha$  carbon w.r.t sp<sup>2</sup> hybrid carbon should have at least one H atom  
More H atom  $\Rightarrow$  More stability

Stability order: CH<sub>3</sub> < 1<sup>o</sup>

\* HALOALKANES AND HALOARENES



(haloarene) (OR) (Aryl halides)

## • CLASSIFICATION OF HALOALKANES

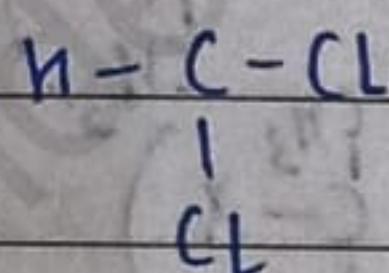
### \* ON THE BASIS OF NUMBER OF HALOGEN ATOM

A) Monohaloalkane  $\Rightarrow$  only one halogen atom is present ( $\text{CH}_3\text{Cl}$ ,  $\text{CH}_3\text{CH}_2\text{Br}$ )

B) Dihaloalkane  $\Rightarrow$  two halogen atoms are present

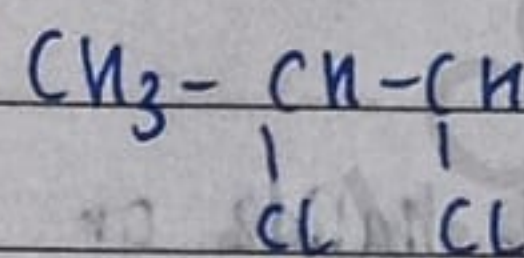
Geminal dihalide  
(gem dihalide)

[When two halogen atoms are present on same atom]



Vicinal dihalide

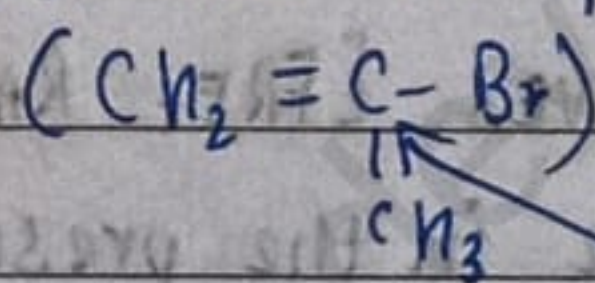
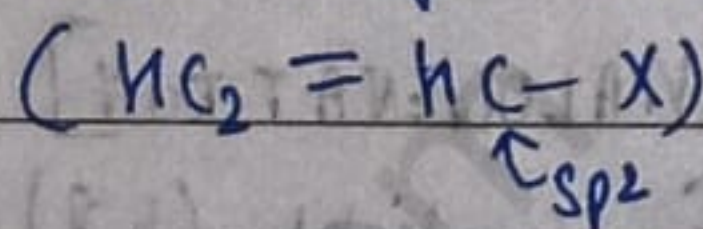
[When two halogen atoms are present on adjacent atom]



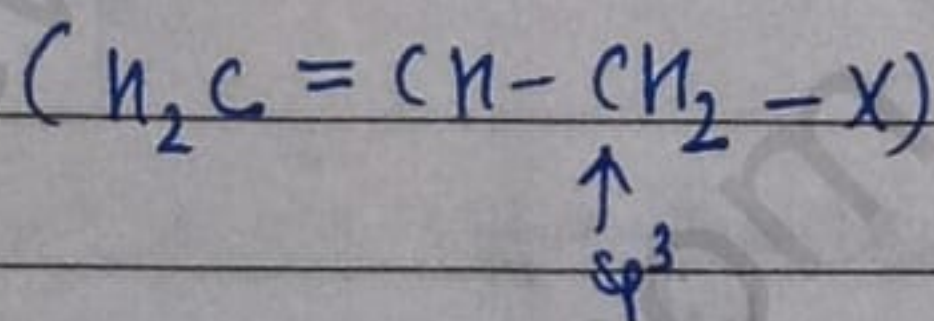
C) Trihaloalkane  $\Rightarrow$  three halogen atoms are present ( $\text{CCl}_4$ )

### \* ON THE BASIS OF HYBRIDISATION

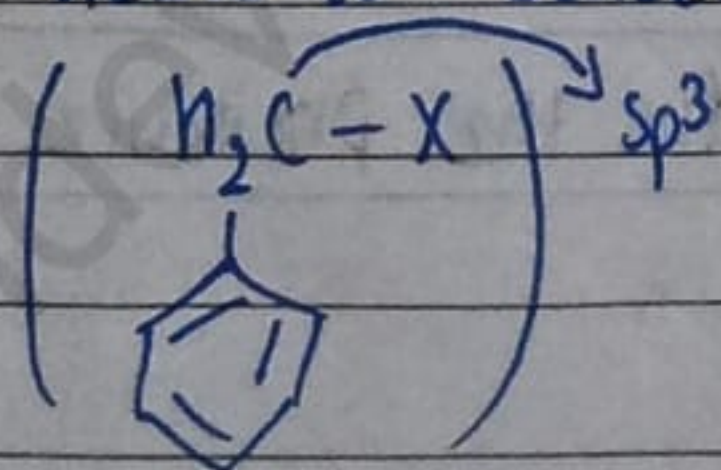
A) Vinylic halide  $\Rightarrow$  When halogen atom is attached to  $\text{sp}^2$  hybridised C atom



B) Allylic halide  $\Rightarrow$  When halogen atom is attached to a C atom which is further double bonded to another C atom

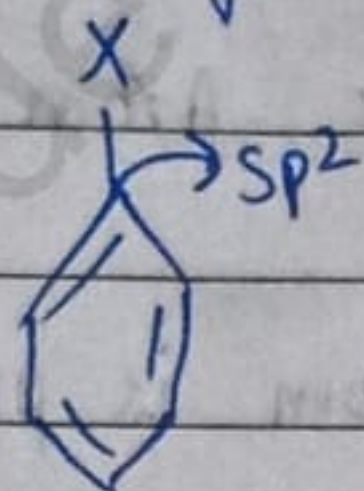


C) Benzylic halide  $\Rightarrow$  When halogen atom is attached to a C atom which is next to Benzene ring



~~D~~ ~~Argb~~ ~~tra~~

D) Aryl halide  $\Rightarrow$  When halogen atom is directly attached to Benzene



~~CLASS~~

\* ON THE BASIS OF DEGREE

A) 1° Alkyl halide or Primary haloalkane ( $\text{CH}_3-\text{CH}_2-\text{X}$ )

B) 2° Alkyl halide or Secondary haloalkane ( $\text{H}_3\text{C}-\underset{\text{CH}_3}{\text{CH}}-\text{X}$ )

C) 3° Alkyl halide or Tertiary haloalkane ( $\text{H}_3\text{C}-\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}}-\text{X}$ )

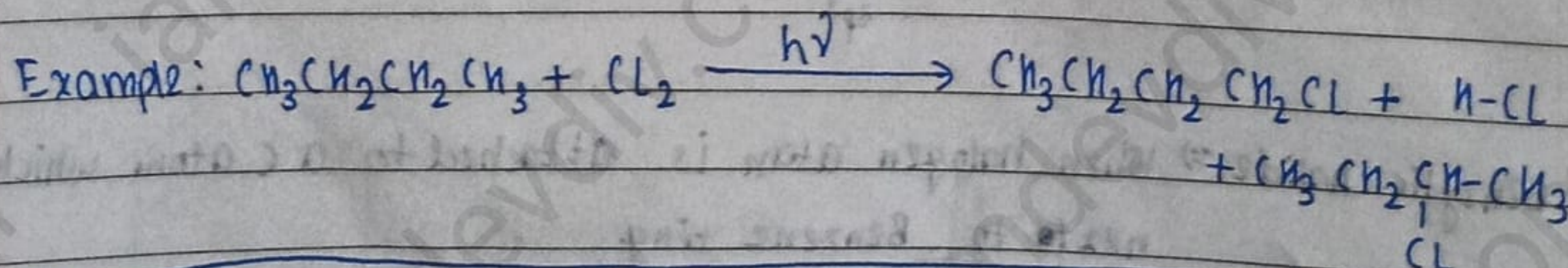
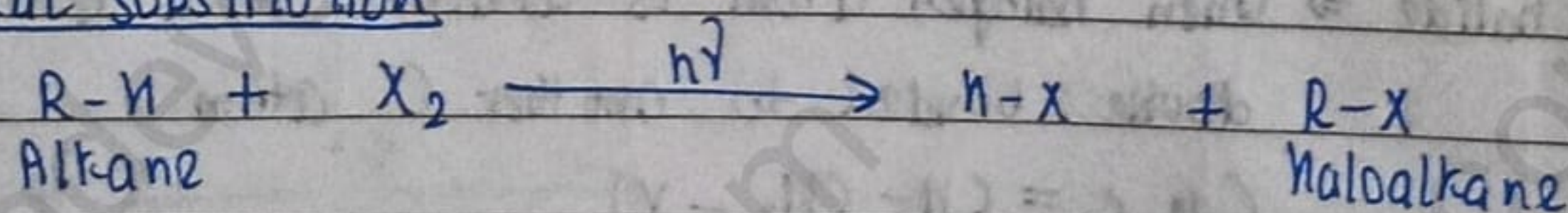
★ METHODS OF PREPARATION OF HALOALKANES

• FROM HYDROCARBONS

A) FROM ALKANES - [FREE RADICAL HALOGENATION]

Takes place in the presence of 'sunlight ( $h\nu$ )' or high temp'

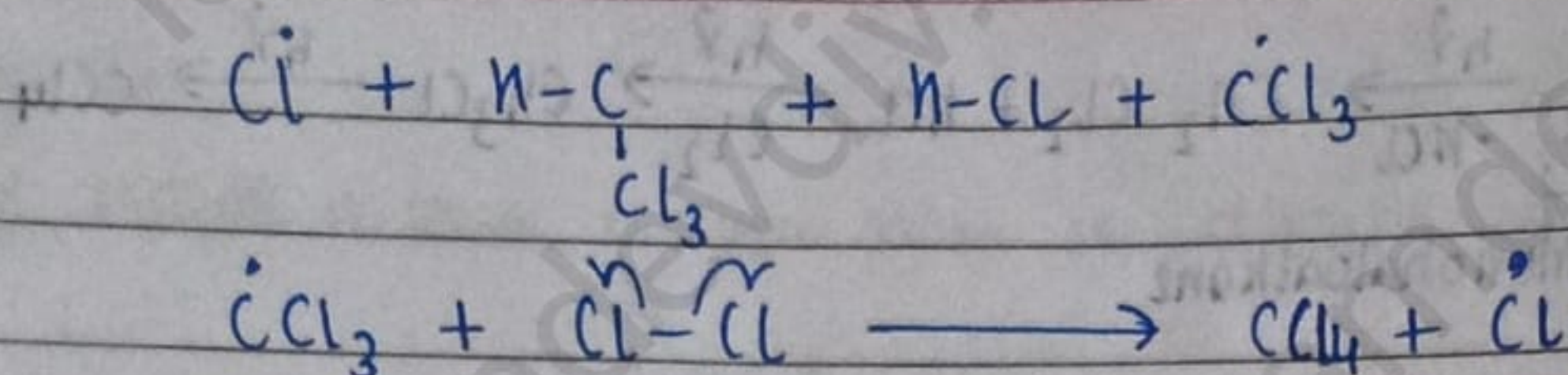
Free radical substitution



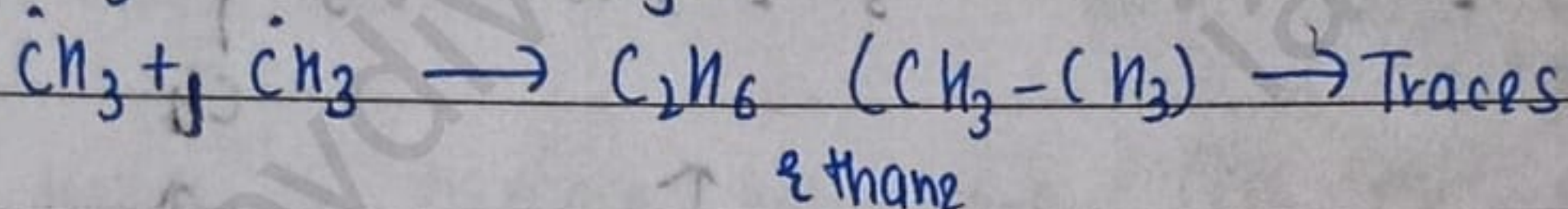
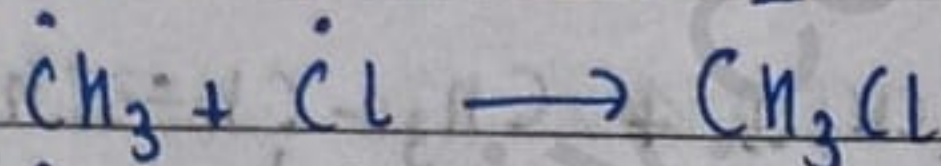
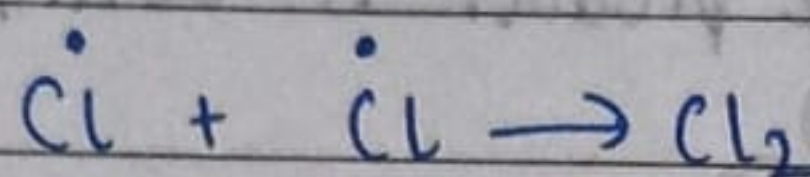
The reaction keeps going on due the presence of sunlight



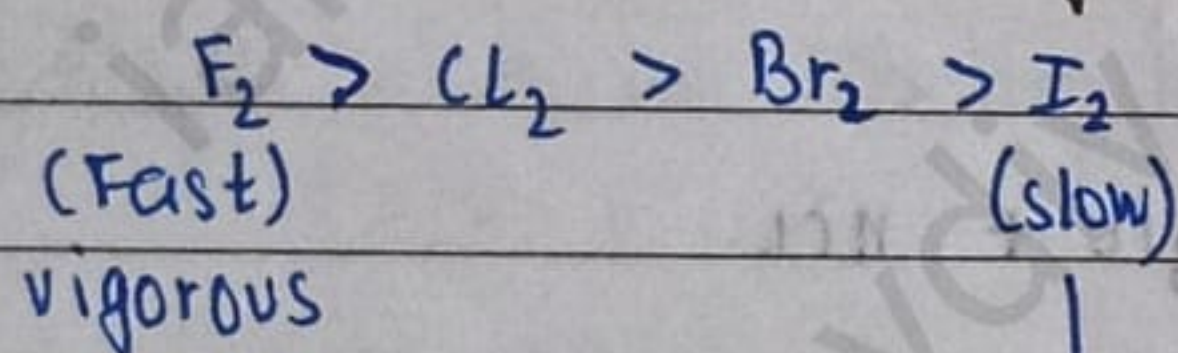




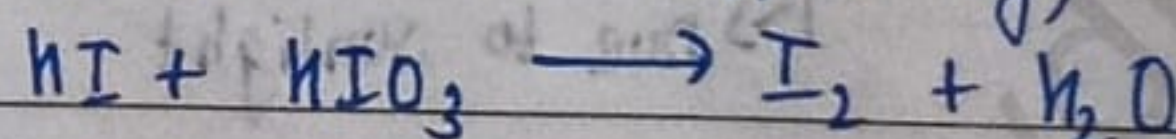
(iii) Termination step



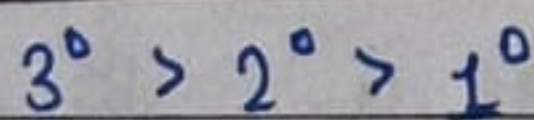
Rate of reaction wrt Halogen



Reverse reaction is stopped by,



Rate of reaction wrt Alkane

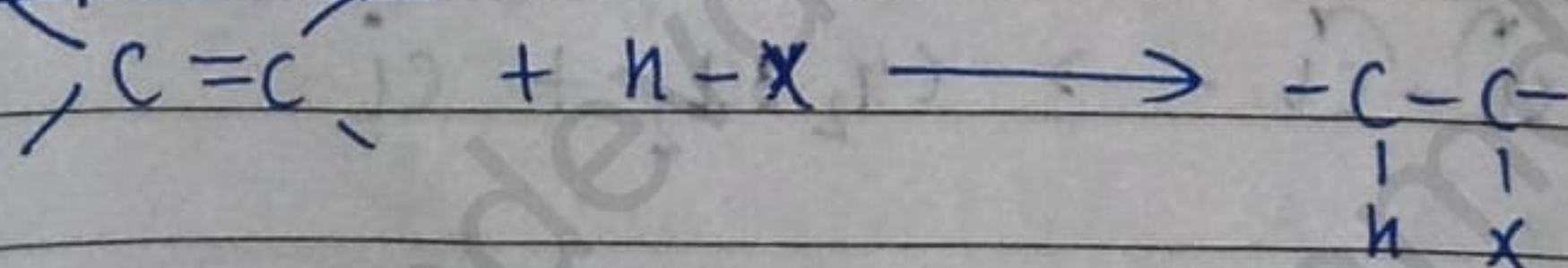


\* R-F is not prepared

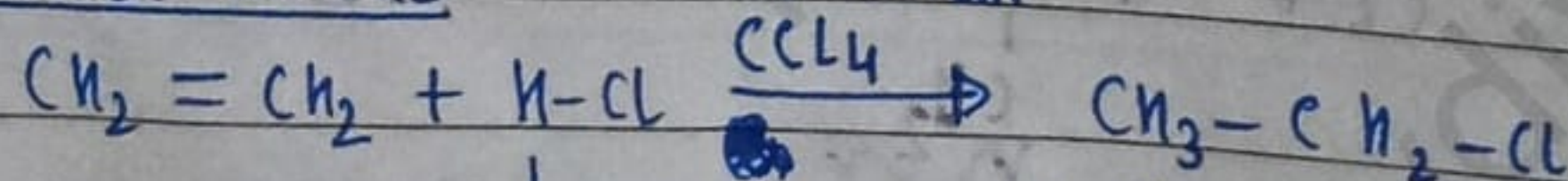
It is prepared using Swartz Reaction

B) FROM ALKENES [ADDITION OF H-X]

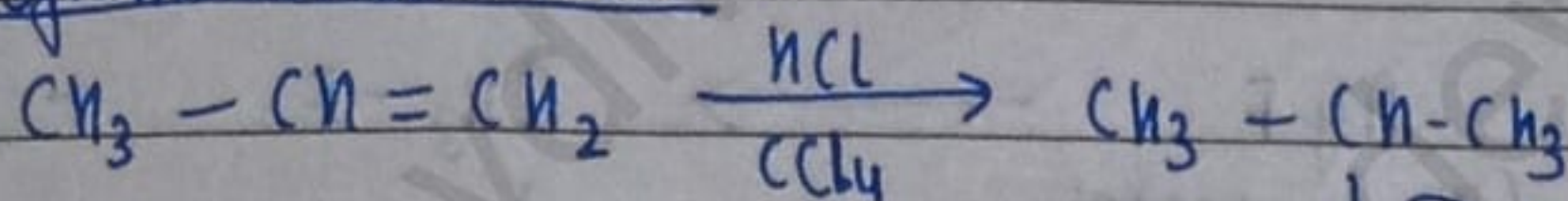
Electrophilic Addition reaction



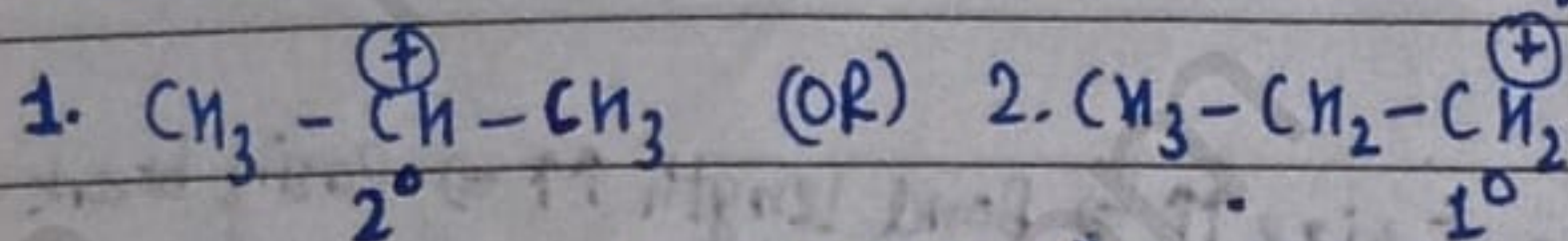
Example: Symmetrical Alkene



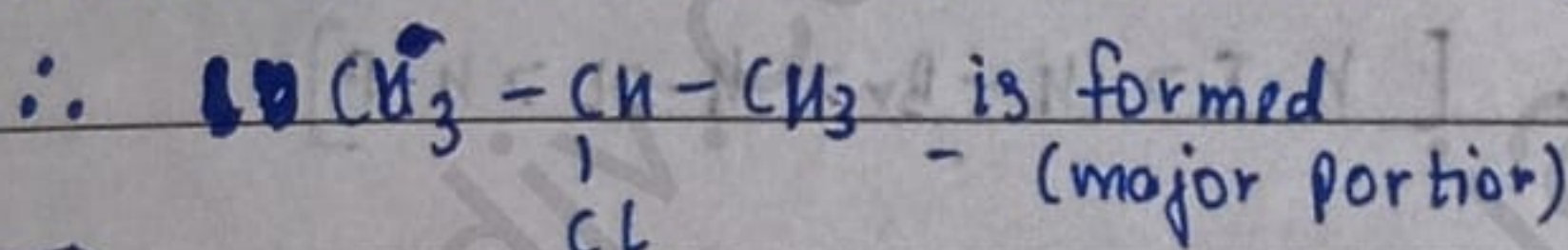
↳ electrophile (H<sup>+</sup>)

Unsymmetrical Alkene

Two possible arrangements  
 $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{H}^+$



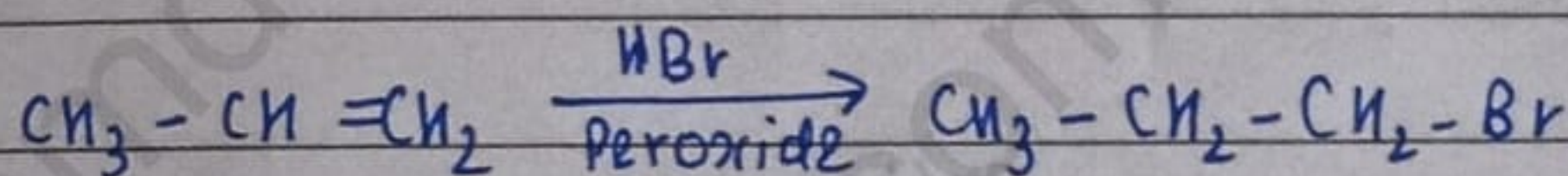
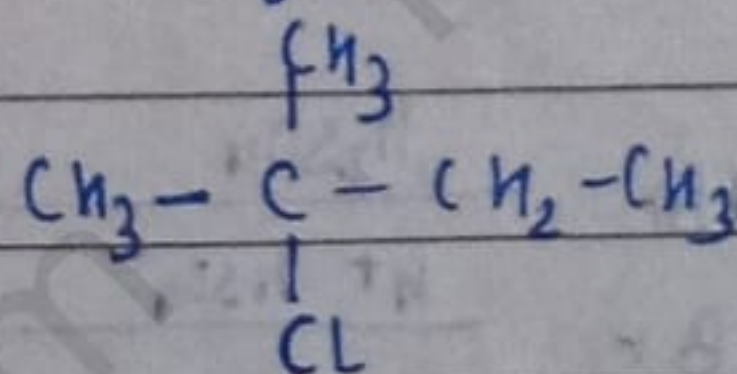
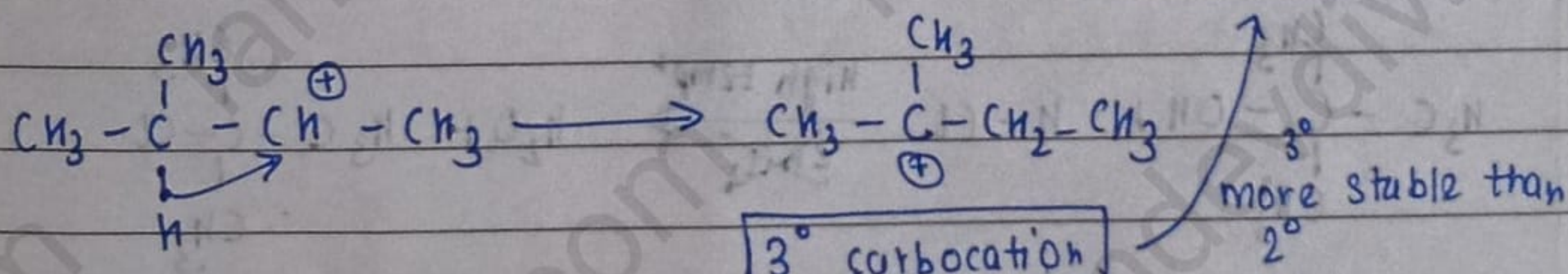
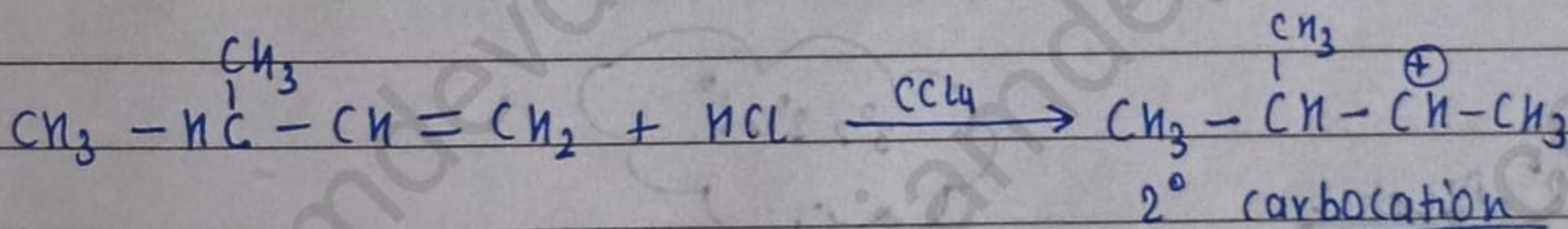
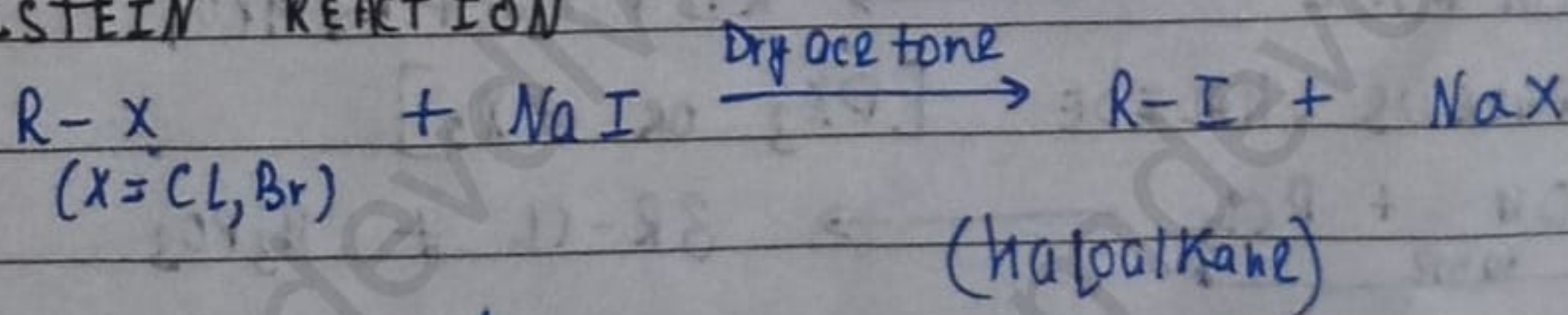
2° carbocation more stable than 1° carbocation

Markonikov Rule

-ve part will move to that = bonded C atom which has less no. of H atoms

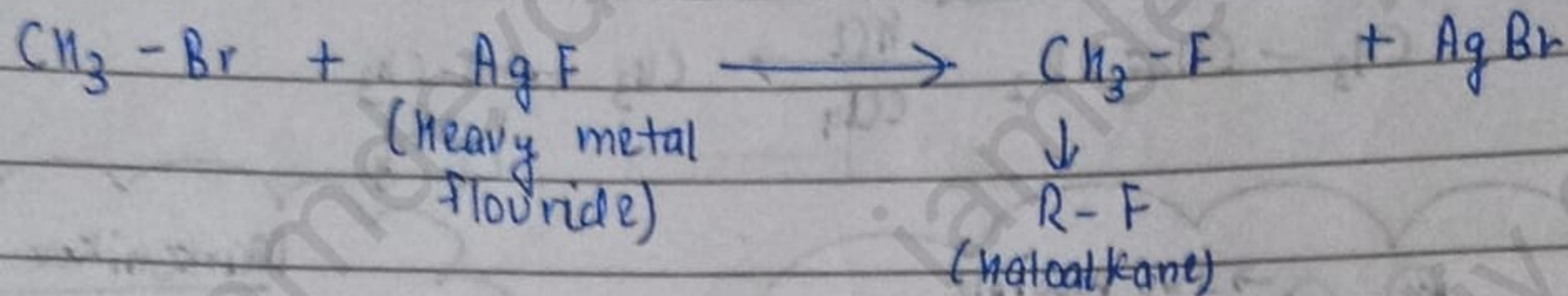
Antimarkonikov Rule

-ve part will go to that = bonded C atom which has more no. of H atoms (peroxide presence)

REARRANGEMENT / SHIFTINGc) FINKELSTEIN REACTION

NaCl and NaBr are not used because they form ppt.

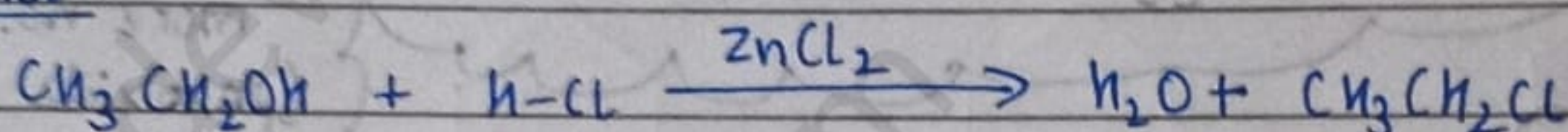
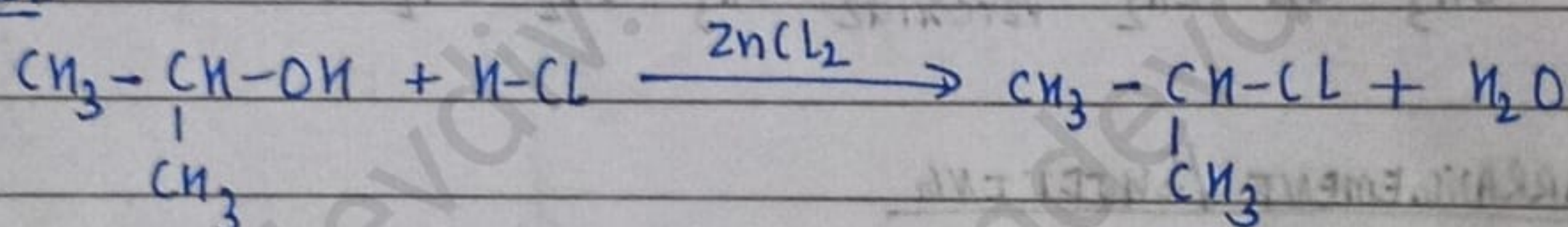
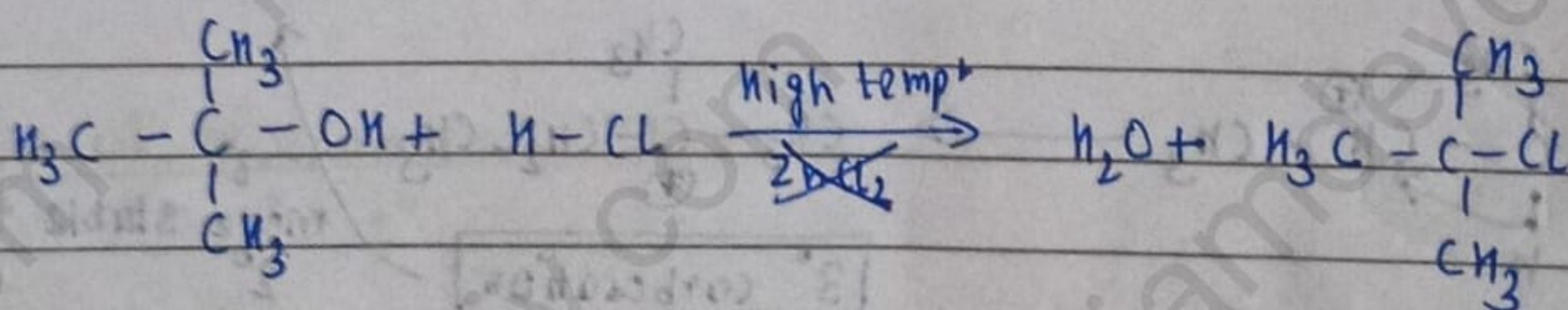
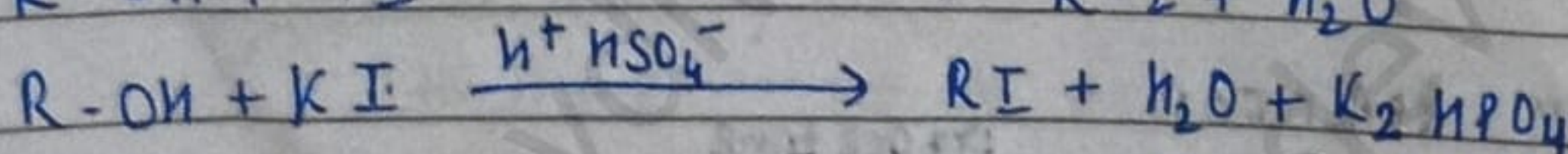
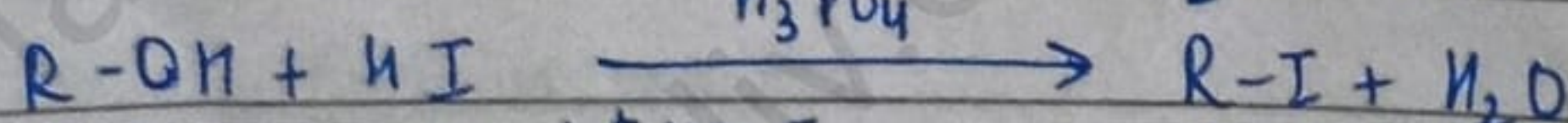
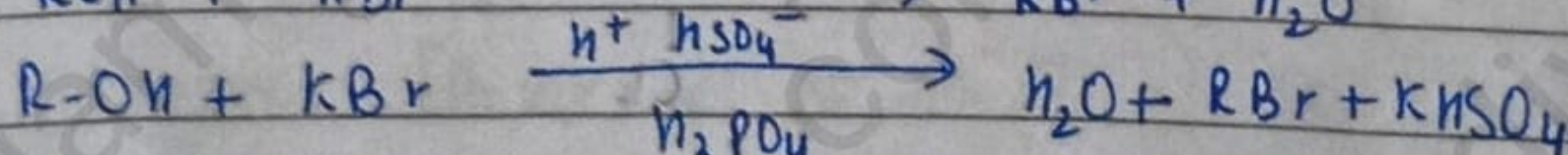
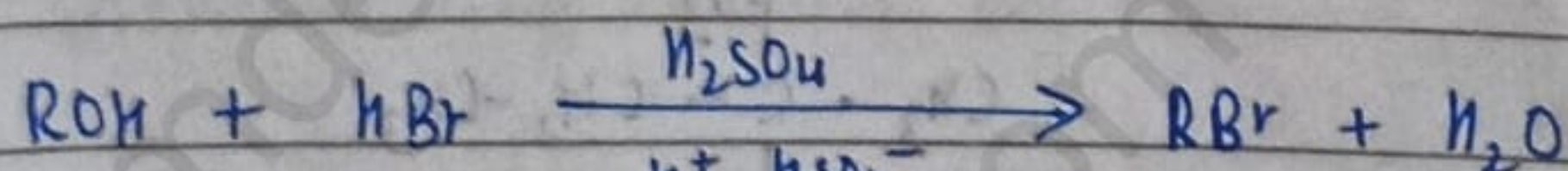
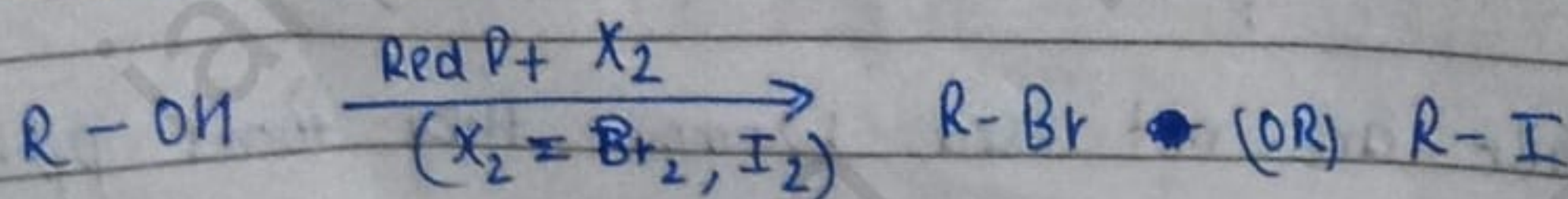
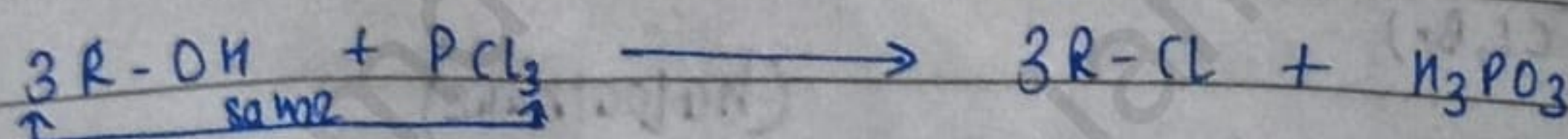
## D) SWARTZ REACTION



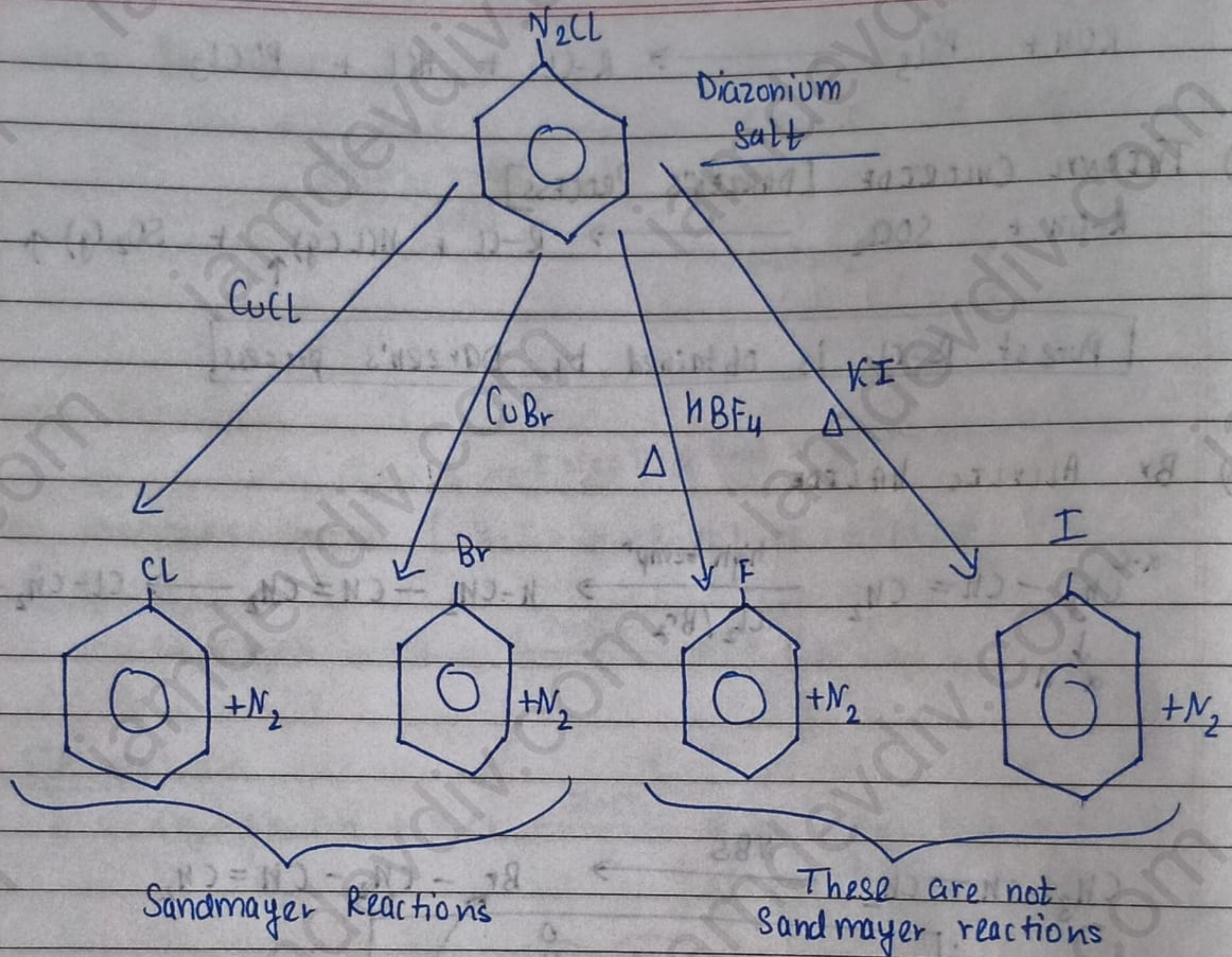
## • FROM ALCOHOLS

→ I size ↑ ⇒ Bond length ↑ ⇒ Easily break

## A) BY HYDROGEN HALIDE [H-I &gt; H-Br &gt; H-Cl &gt; H-F]

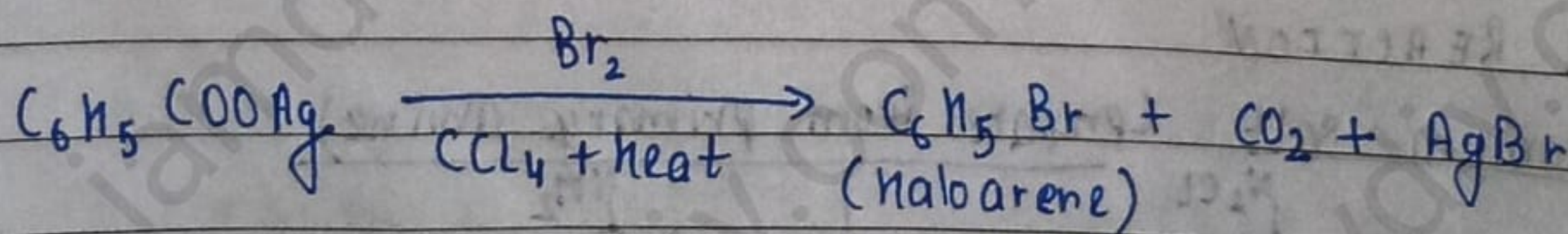
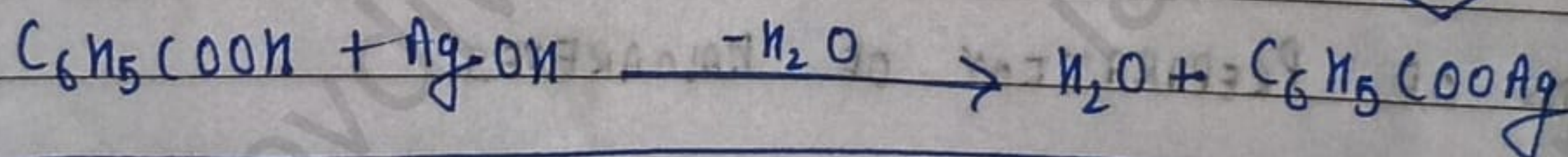
1° Alcohol2° Alcohol3° AlcoholOther hydrogen halidesB) BY PHOSPHORUS HALIDE [PX<sub>3</sub> OR PX<sub>5</sub>]



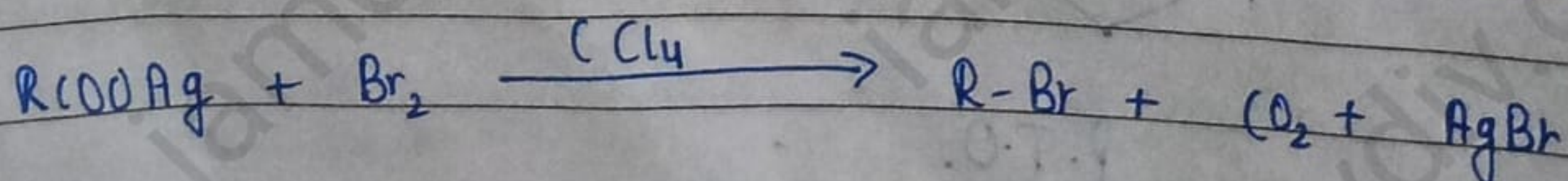


### B) HUNSDICKER REACTION

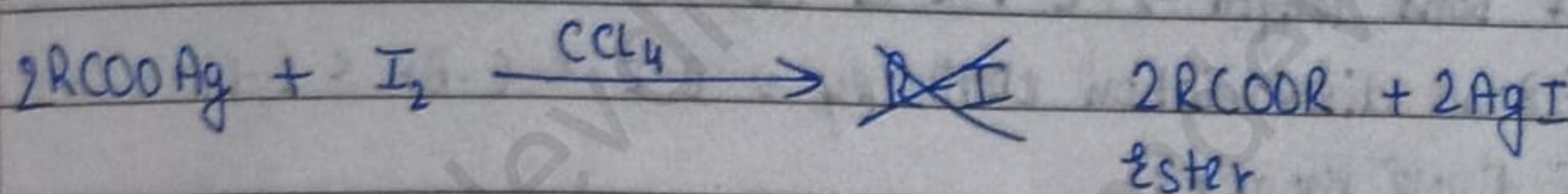
Required  $\rightarrow$  Fatty acidic salt of silver  $\rightarrow$



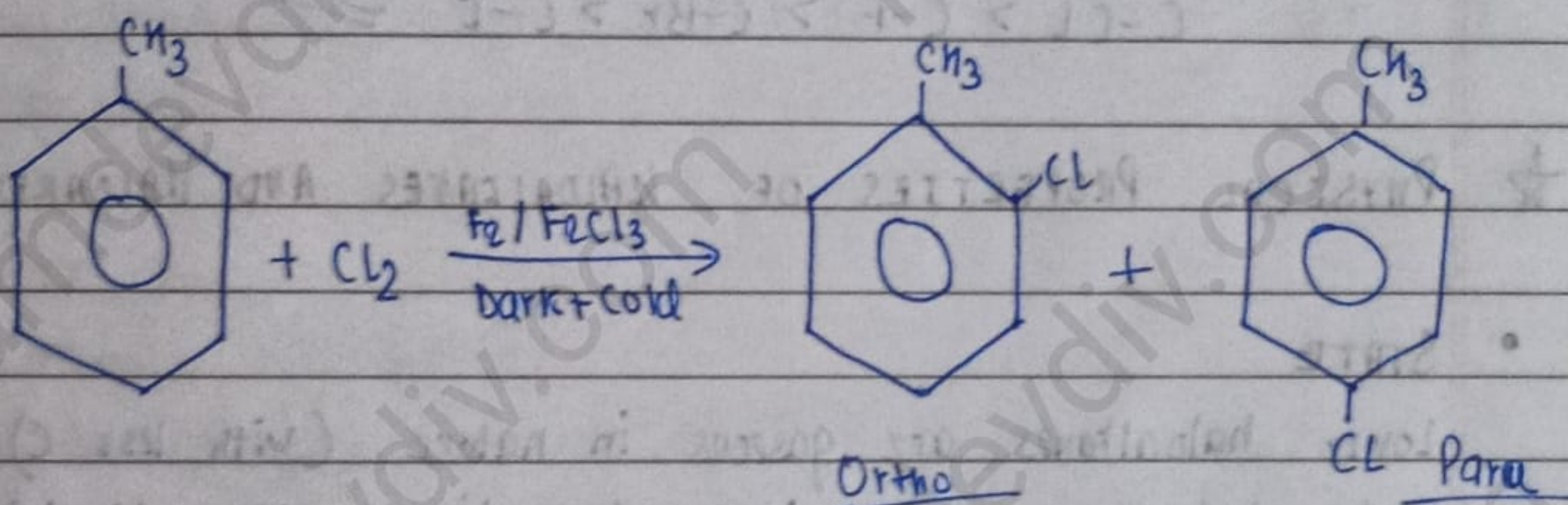
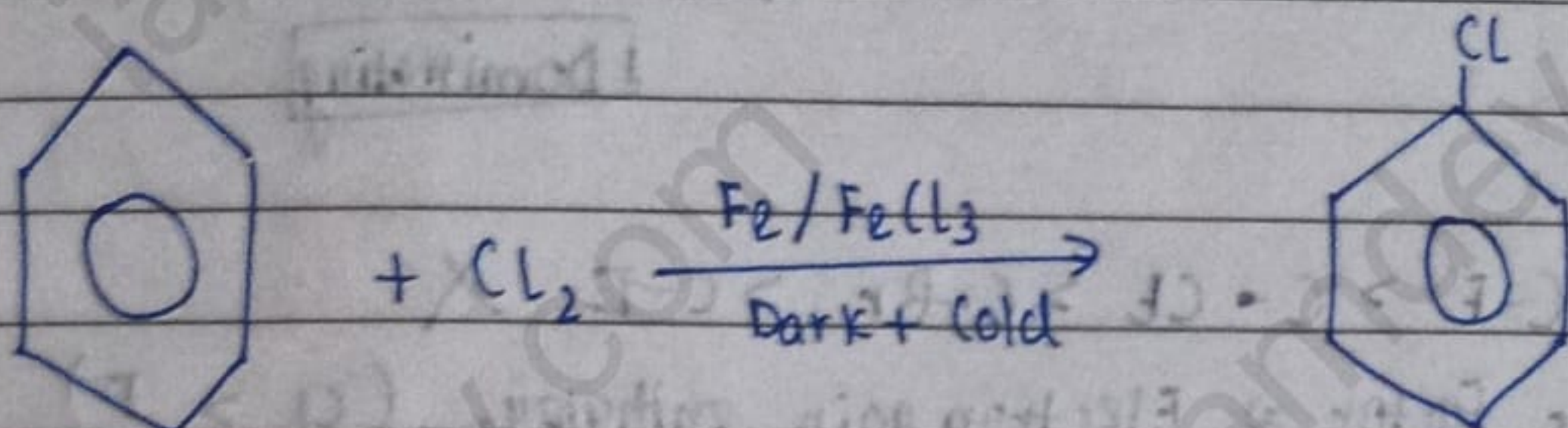
When Hunsdicker's reaction is used for preparation of haloalkane



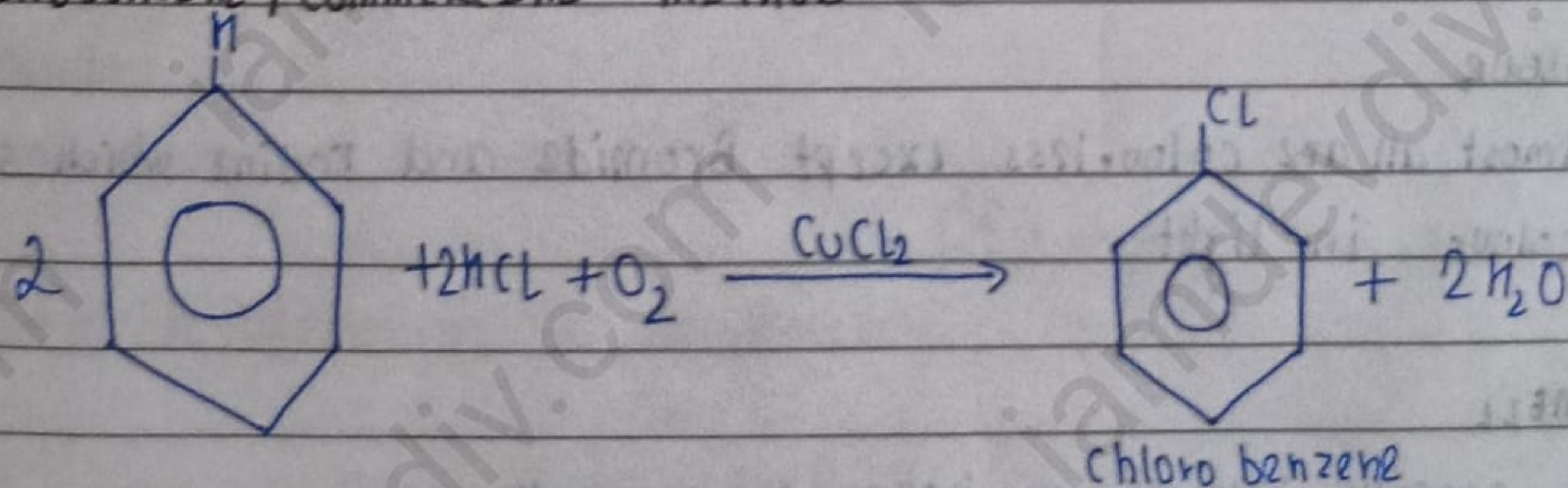
☆☆ Exception



c) DIRECT HALOGENATION

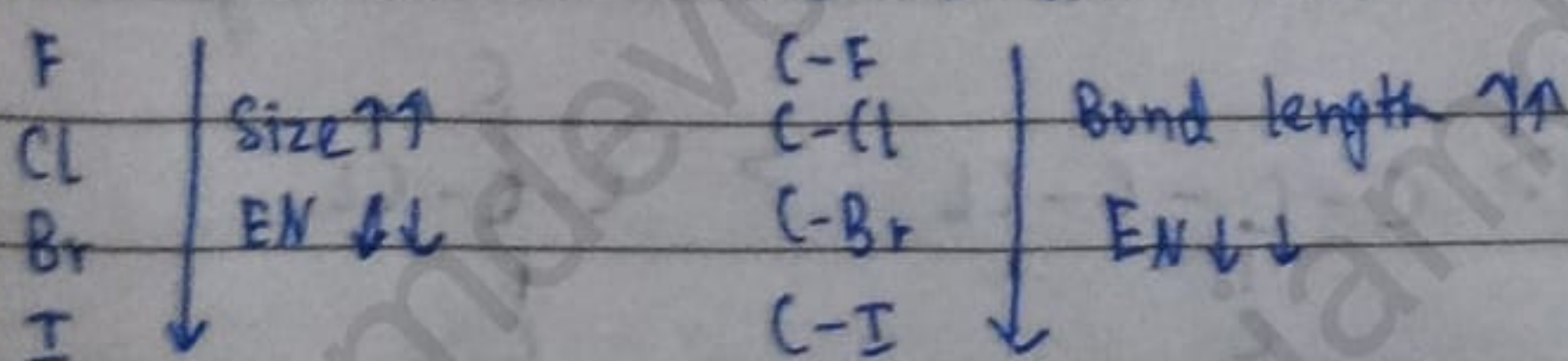
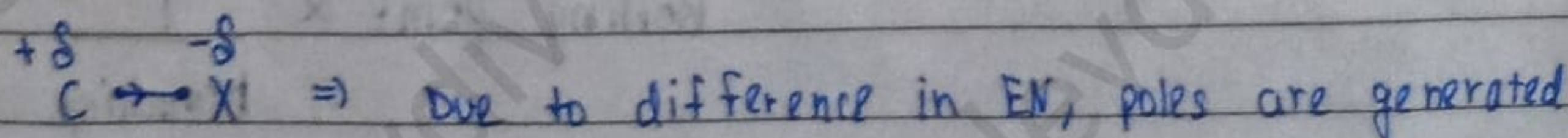


d) INDUSTRIAL / COMMERCIAL METHOD



★ NATURE OF C-X BOND

halogens are more electronegative than C



Order of bond length  $\Rightarrow$   $C-F < C-Cl < C-Br < C-I$

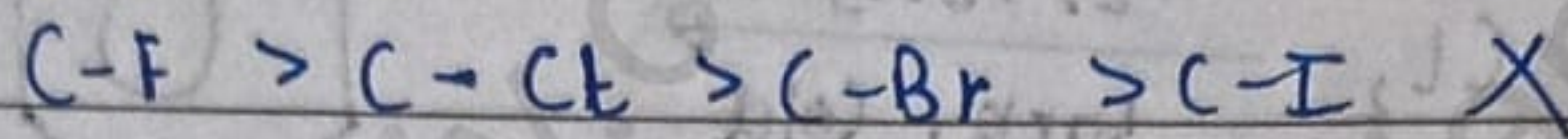
Order of Bond dissociation enthalpy  $\Rightarrow$   $C-I < C-Br < C-Cl < C-F$

Order of dipole moment

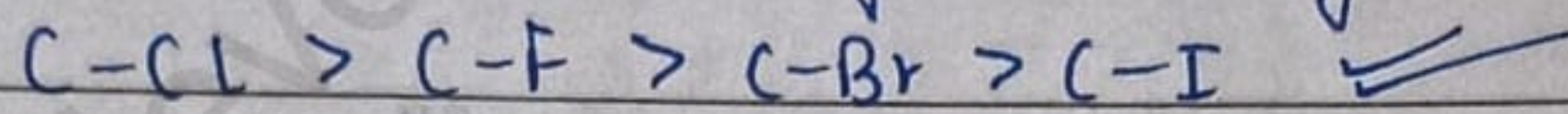
$$\mu = q \times d \quad \mu \propto EN$$

$d \uparrow \uparrow \quad \mu \uparrow \uparrow \quad \vee/s \quad EN \downarrow \downarrow \quad \mu \downarrow \downarrow$

Dominating



Another factor  $\Rightarrow$  Electron gain enthalpy ( $Cl > F$ )



## ★ PHYSICAL PROPERTIES OF HALOALKANES AND HALOARENES

### • STATE

Lower haloalkanes are gaseous in nature (with less C)

Higher haloalkanes have their state liquid either liquid or solid

Haloarenes are liquid or solid but not gaseous

### • COLOUR

Almost all are colourless except Bromide and Iodine which shows colour in light

### • SMELL

All gaseous haloalkanes have sweet smell

### • MELTING POINT AND BOILING POINT

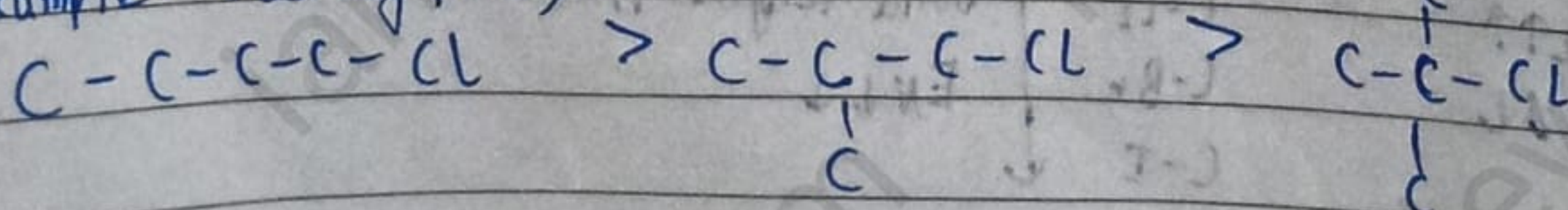
[Symmetry/ fit into  
crystal lattice]

[Vander wall force  $\propto$  molecular mass  $\propto$  BP]

★★

Boiling point  $\propto$  1  
branching

Example: (boiling point)



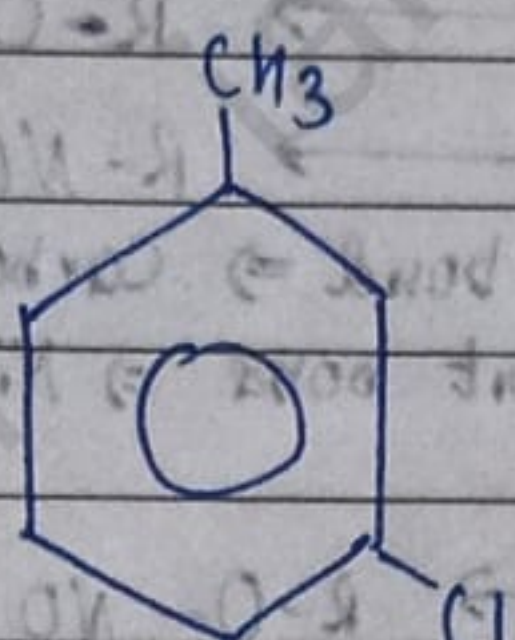
Melting point:  $\xrightarrow{\text{symmetry}}$  para > ortho > meta (pom)

Boiling point: ortho > para > meta (opm)

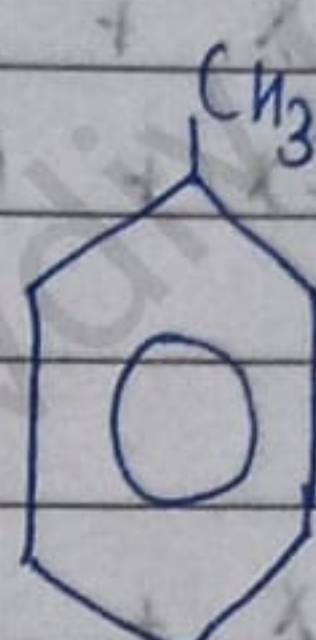
Example:



(A)



(B)



(C)

Melting point:  $C > A > B$

Boiling point:  $A > C > B$

**SOLUBILITY**

Water insoluble (~~H-bonding~~)

Soluble in non-polar solvent like  $CCl_4$  or Benzene

haloalkanes don't have enough energy to break H-bonding

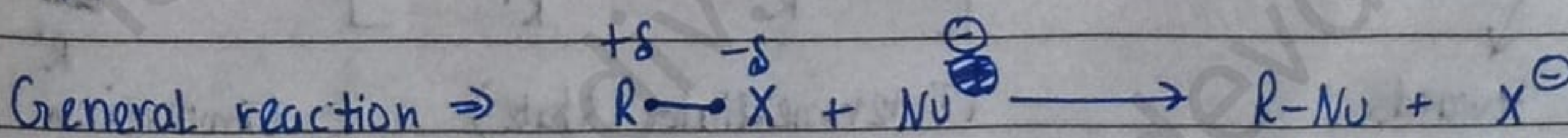
**DENSITY**

more number of C atoms  $\Rightarrow$  more density

**★ CHEMICAL PROPERTIES OF HALOALKANES**

**NUCLEOPHILIC SUBSTITUTION REACTION**  
 Nucleus loving      replace

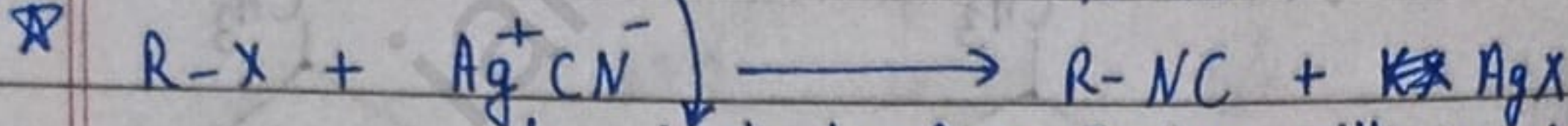
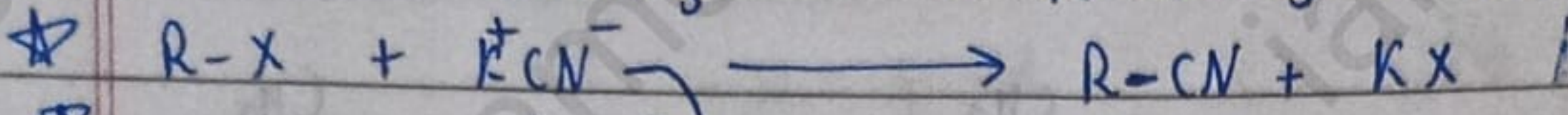
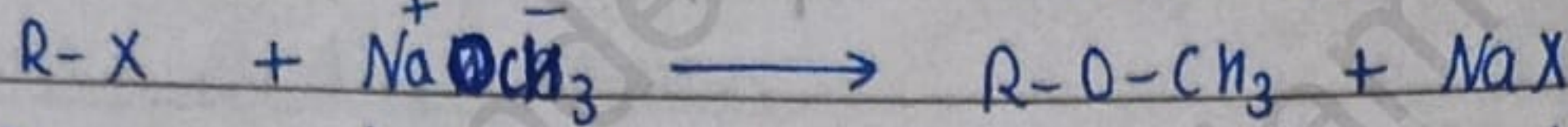
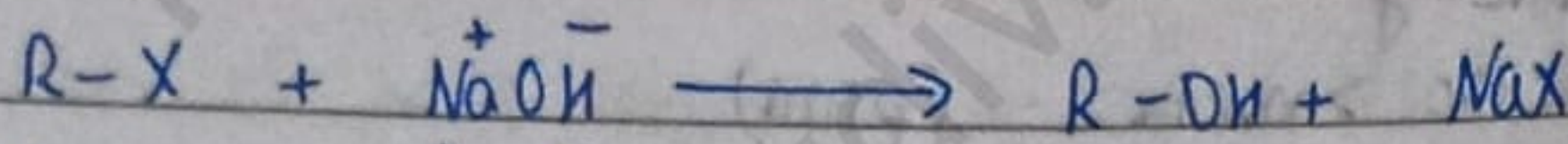
Nucleophile  $\Rightarrow N^{\ominus}$



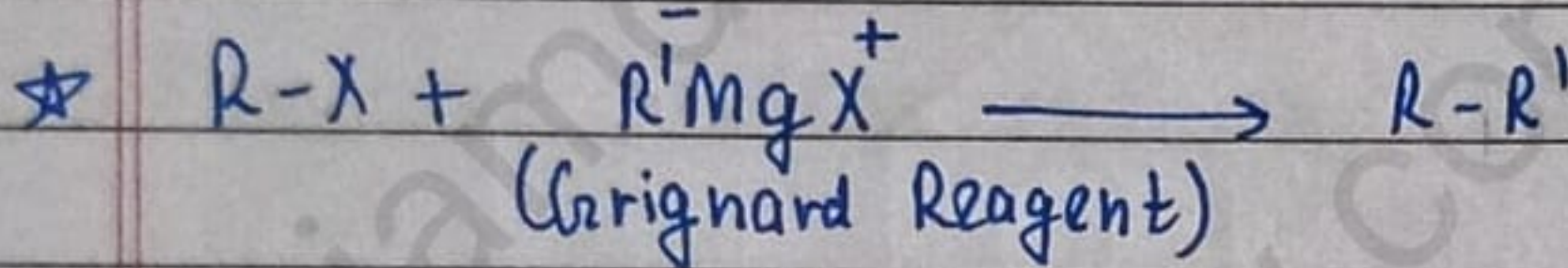
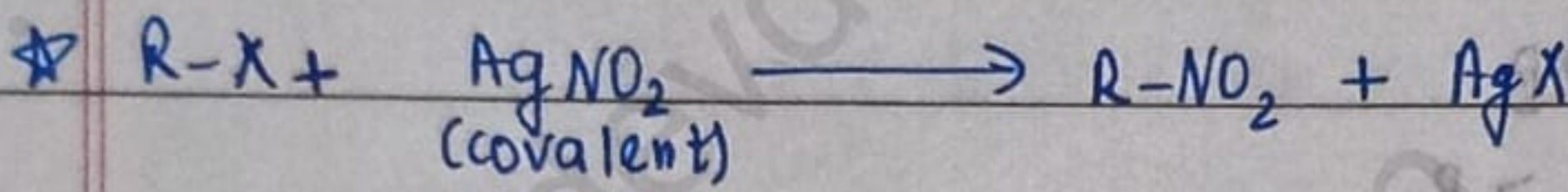
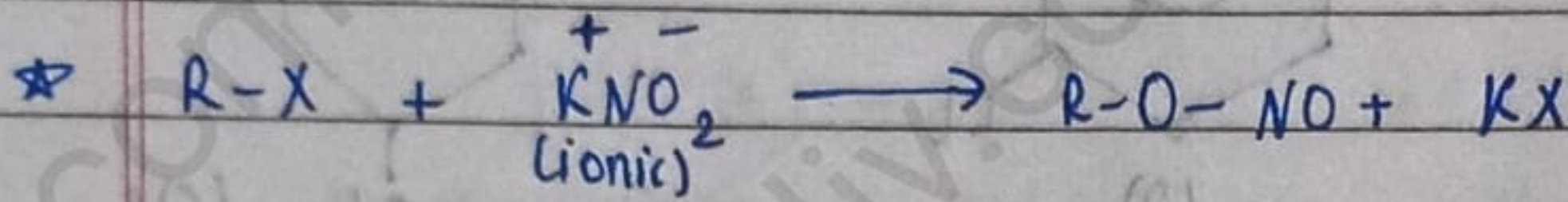
Two types  $\Rightarrow$   $SN^1 \rightarrow$  Unimolecular nucleophilic substitution reaction

$SN^2 \rightarrow$  Bimolecular nucleophilic substitution reaction





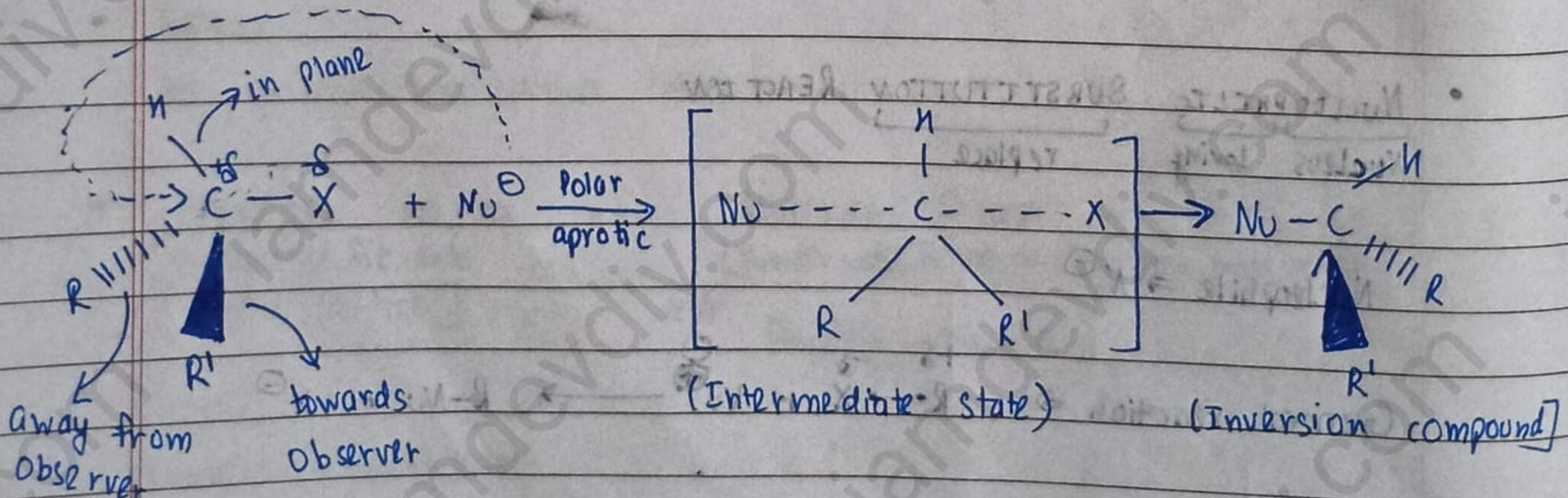
ionic bond  $\Rightarrow$  Carbon will create bond  
covalent bond  $\Rightarrow$  Nitrogen will create bond



### \* SN<sup>2</sup> REACTION

$\rightarrow$  Molecularity = 2

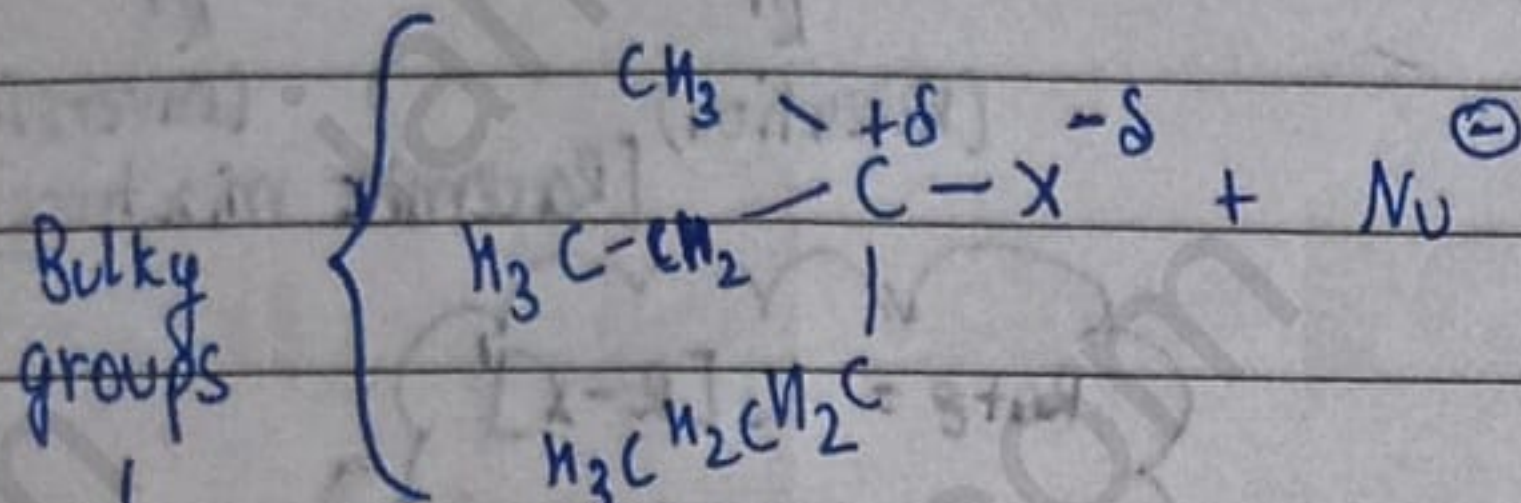
- Single step reaction. (Strong nucleophile is used).
- Front attack of nucleophile is not possible ( $e^-e^-$  repulsion).
- Back attack is possible.
- Inversion compound is formed.
- Optically active compound (chiral carbon) is required.  
 $\rightarrow$  carbon which is bonded with four different groups



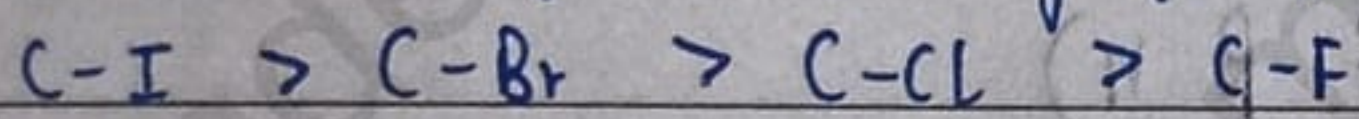
- Polar aprotic solvent is used, Example: Acetone  $\xrightarrow{\text{without proton (H+)}}$
- without hydrogen
- $$CH_3 - \overset{\delta+}{C} - CH_3$$
- $$\quad \quad \quad \parallel$$
- $$\quad \quad \quad O - \delta-$$

vii) ROR  $\propto$  1

steric hinderance

 $\rightarrow$  inefficiency in attack due to presence of bulky group $1^\circ > 2^\circ > 3^\circ$  $\rightarrow$  Difficult for nucleophile to attack  $\Rightarrow$  steric hinderance

viii) ROR with halogen (leaving group)

 $\rightarrow$  size  $\uparrow\uparrow \Rightarrow$  Bond length  $\uparrow\uparrow \Rightarrow$  easily break

$$\text{Rate} = k [\text{R-X}]^1 [\text{Nu}]^1$$

Order = 2

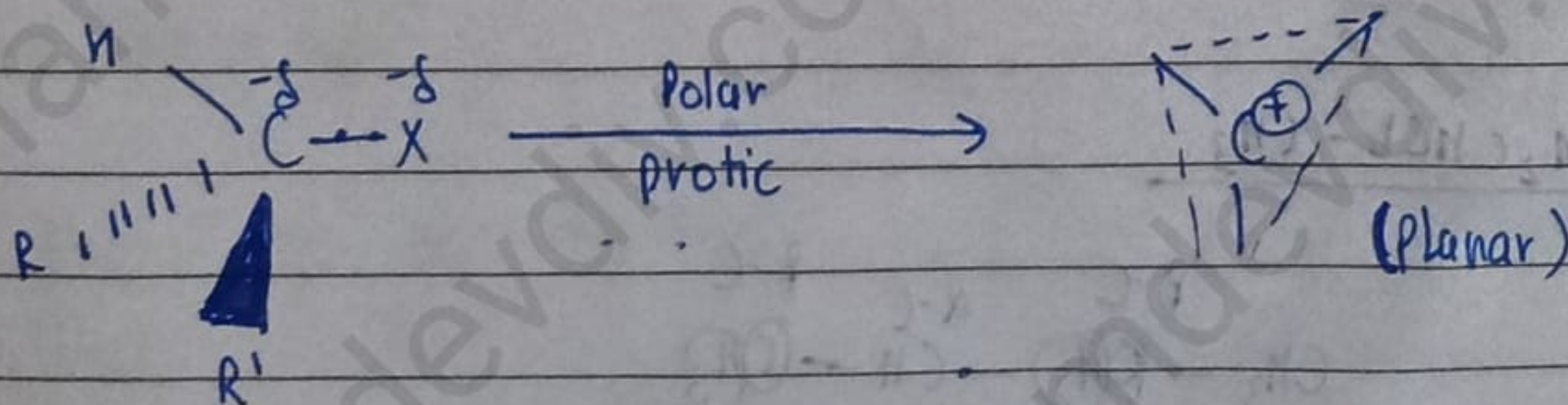
\*  $\text{S}_\text{N}1$  REACTION  
 $\rightarrow$  molecularity = 1

(i) Two step reaction (Weak nucleophile is used)

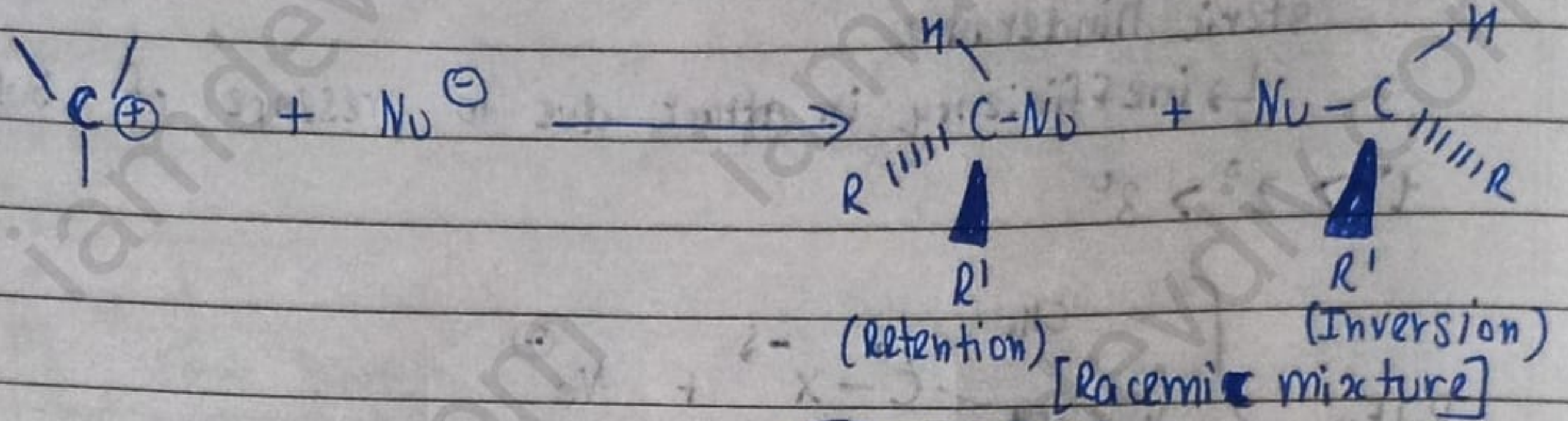
(ii) Attack from any side is possible.

(iii) Retention and inversion compounds are formed. (racemic mixture)

(iv) Optically active compound is required.

(v) Polar protic solvent is used. Example:  $\text{H}_2\text{O}$  $\rightarrow$  which can provide proton ( $\text{H}^+$ ) (dielectric strength is high which can easily break C-X bond)(i) Generation of carbocation (Rate determining step)  
[Slow step]

2) Attack of nucleophile (fast step)



$\text{Rate} = k[\text{R-X}]^1$   
 Order = 1

(vi) RORX Stability of  $\text{C}^{\oplus}$   
 $3^{\circ} > 2^{\circ} > 1^{\circ}$

~~Rate~~ Rate

ELIMINATION REACTION

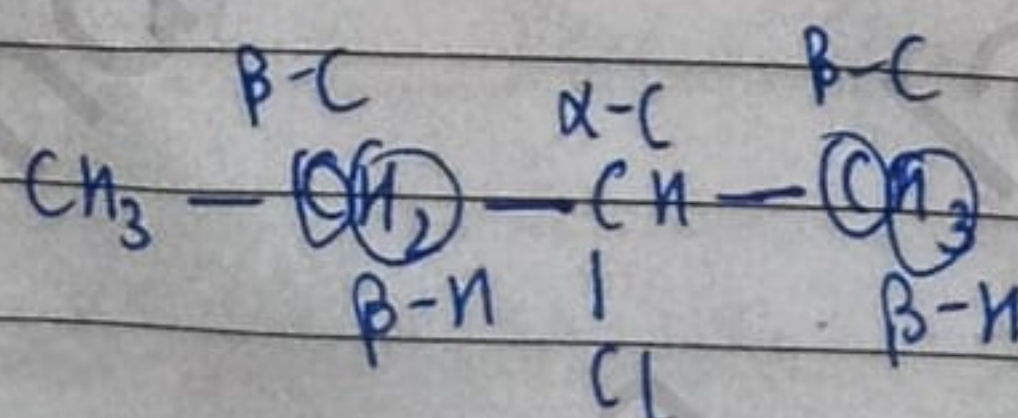
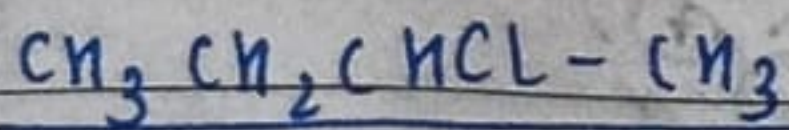
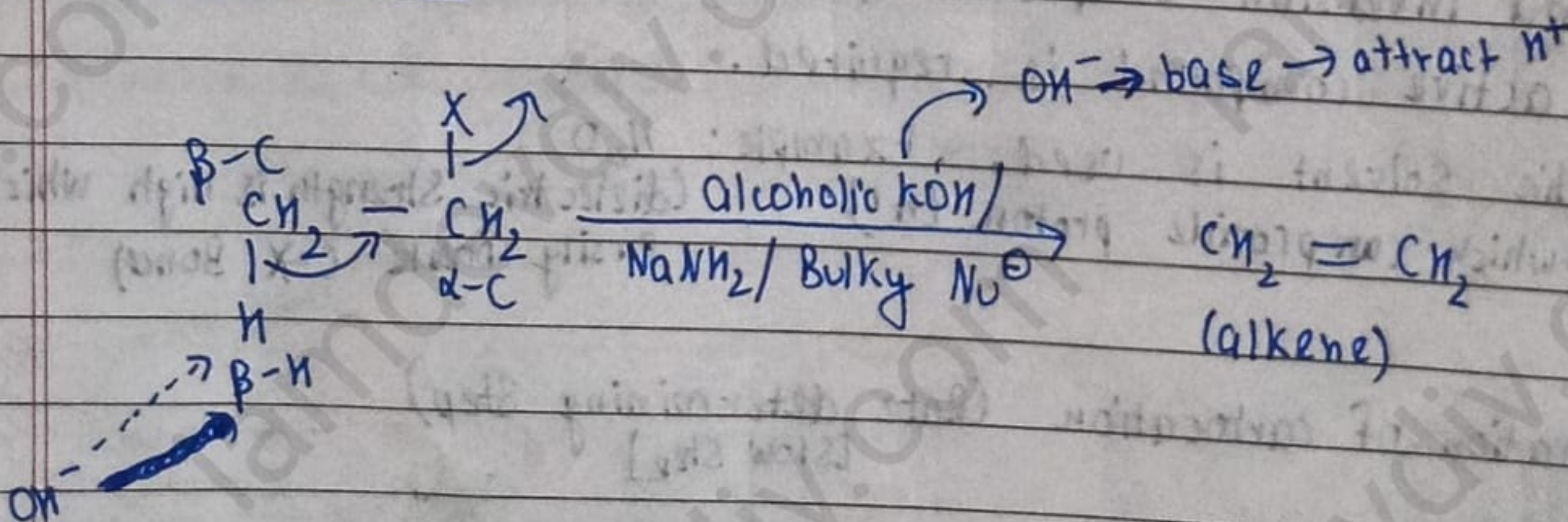
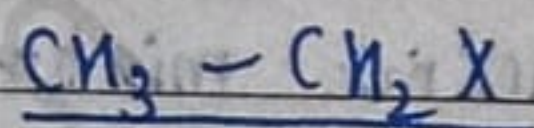
$\beta$  Elimination (removal of  $\beta$  H)

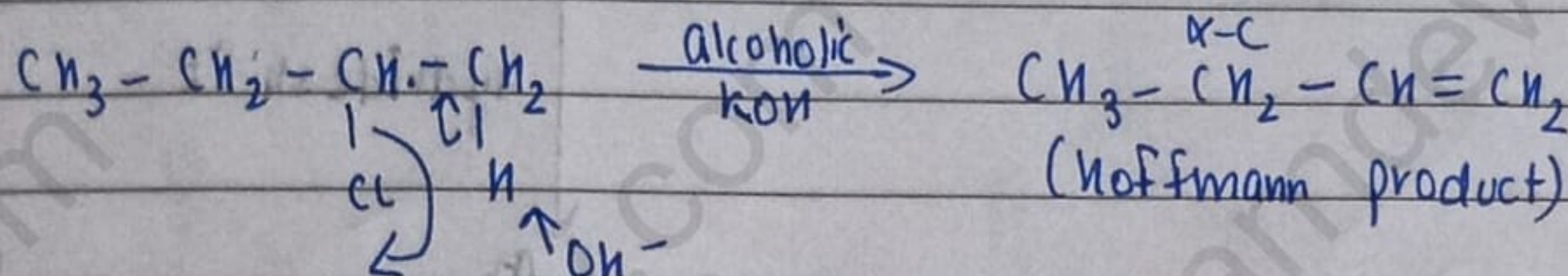
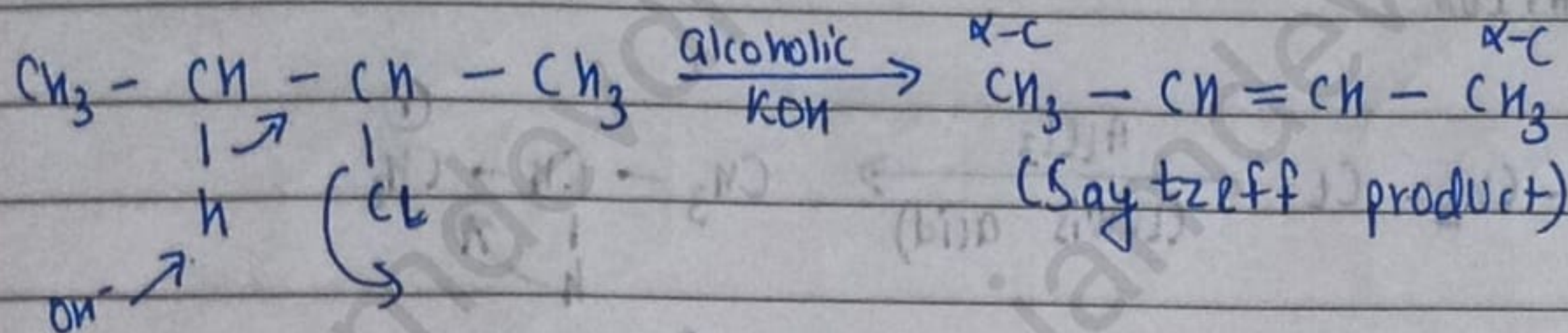
Dehydrohalogenation reaction

$\alpha$ -C  $\rightarrow$  Carbon to which halogen is bonded

$\beta$ -C  $\rightarrow$  Carbon to which  $\alpha$ -C is bonded

$\beta$ -H  $\rightarrow$  Hydrogen bonded to  $\beta$ -C

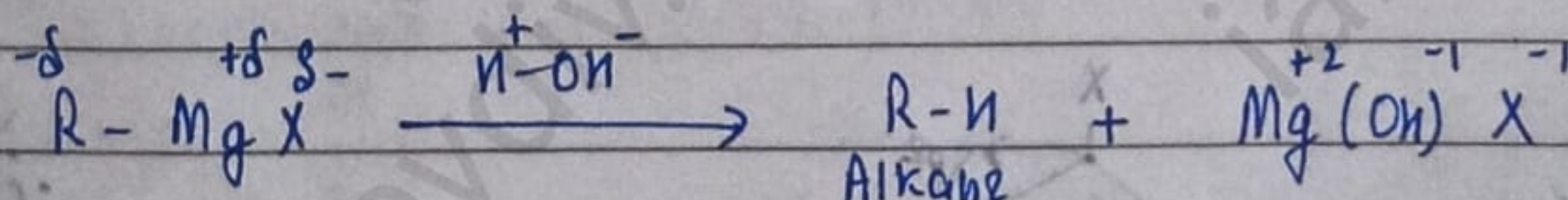
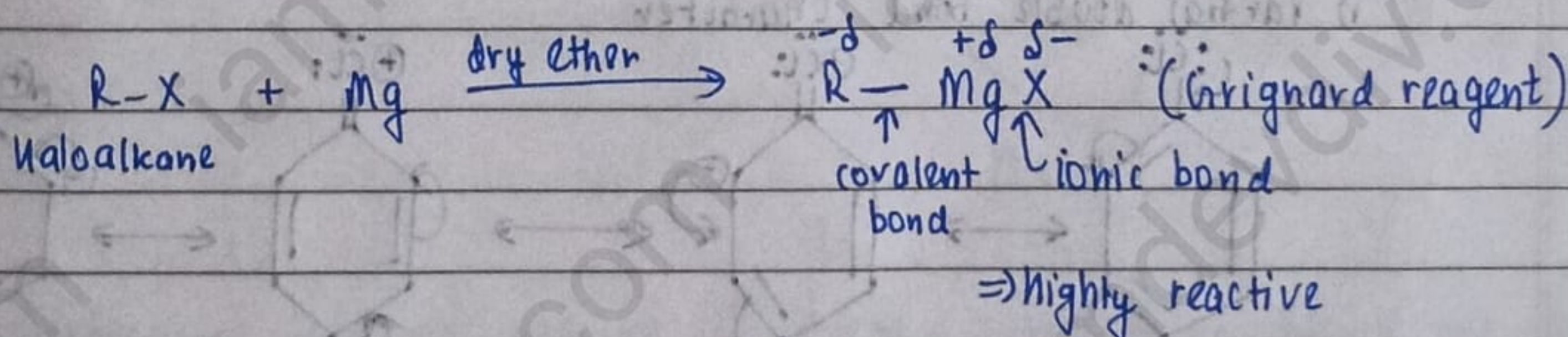




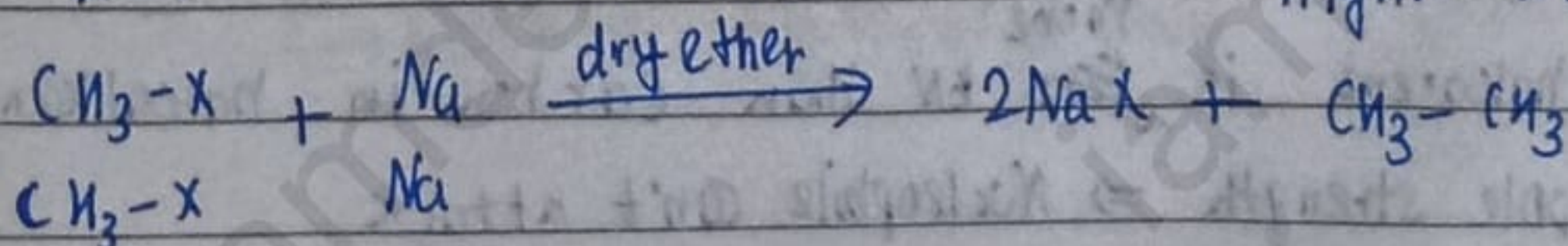
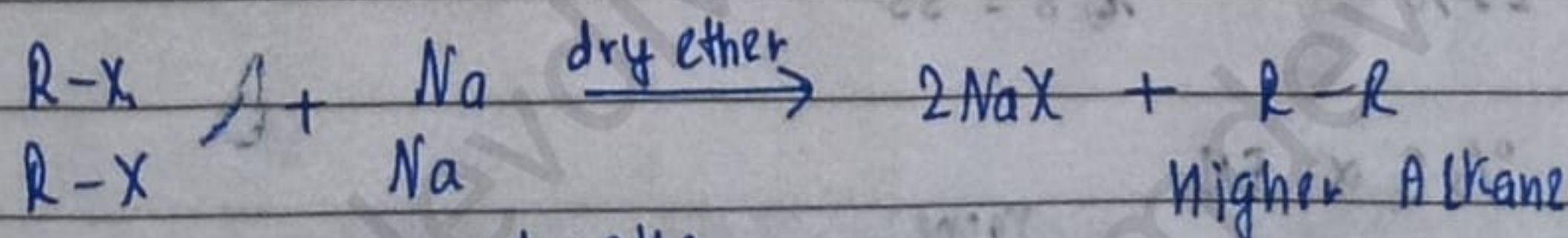
$\alpha\text{-H} \uparrow \uparrow \Rightarrow$  More stable

$\therefore$  Saytzeff product ( $\alpha\text{-H} = 6$ ) more stable than Hoffmann product ( $\alpha\text{-H} = 2$ )

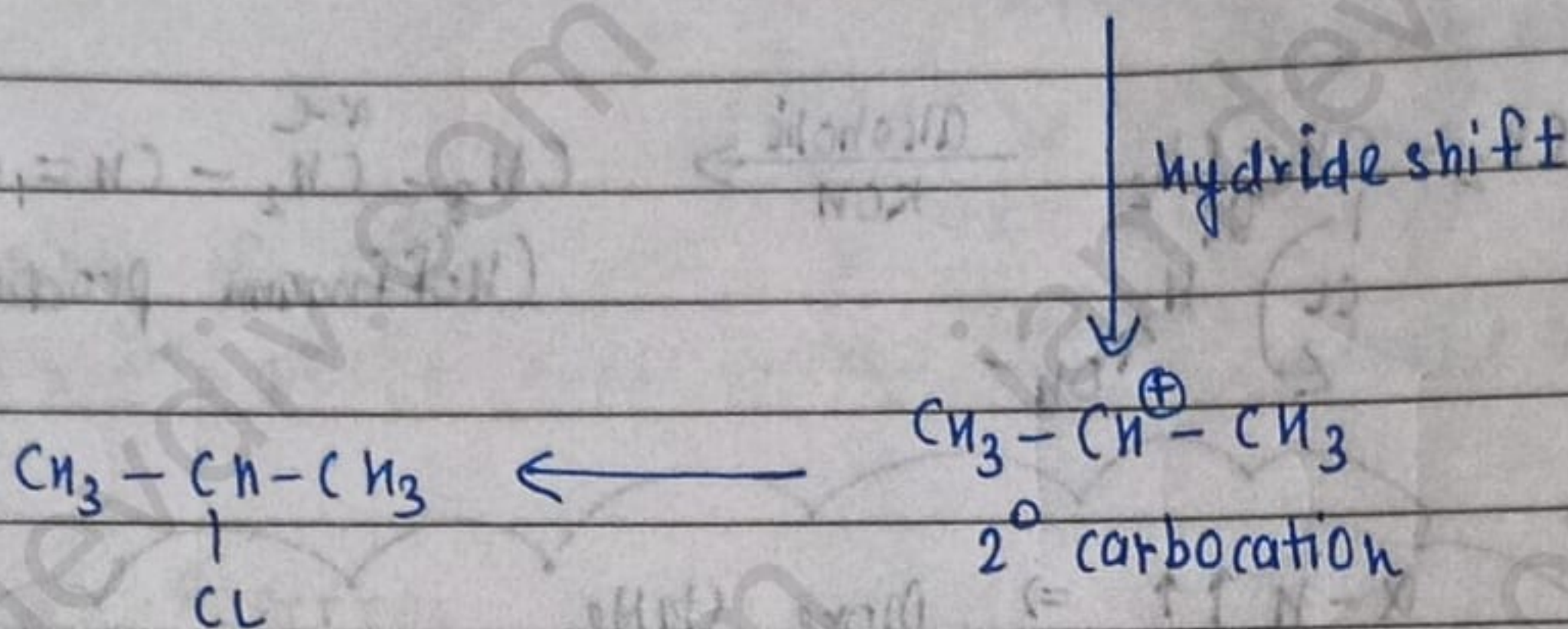
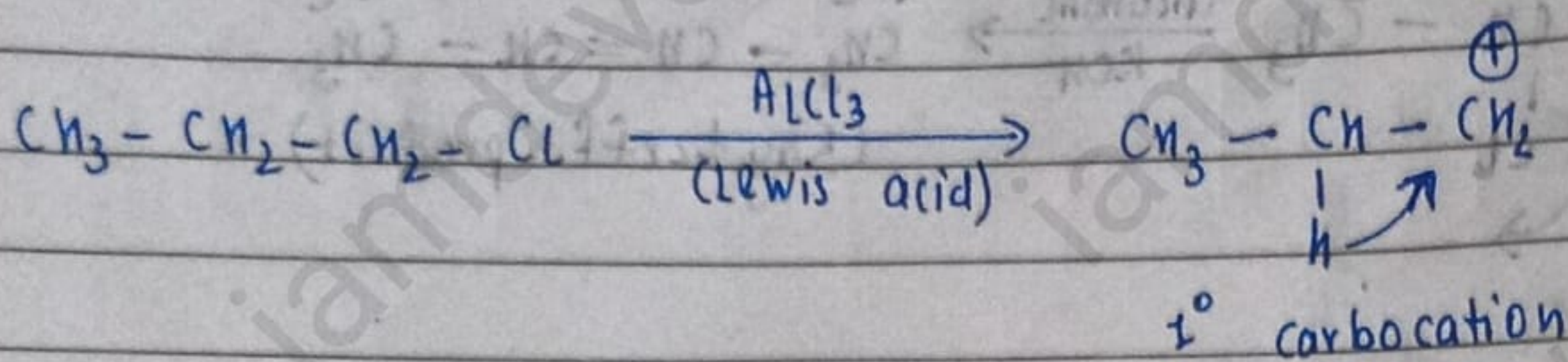
### REACTION WITH METALS (active metal)



### WURTZ REACTION



ISOMERISATION

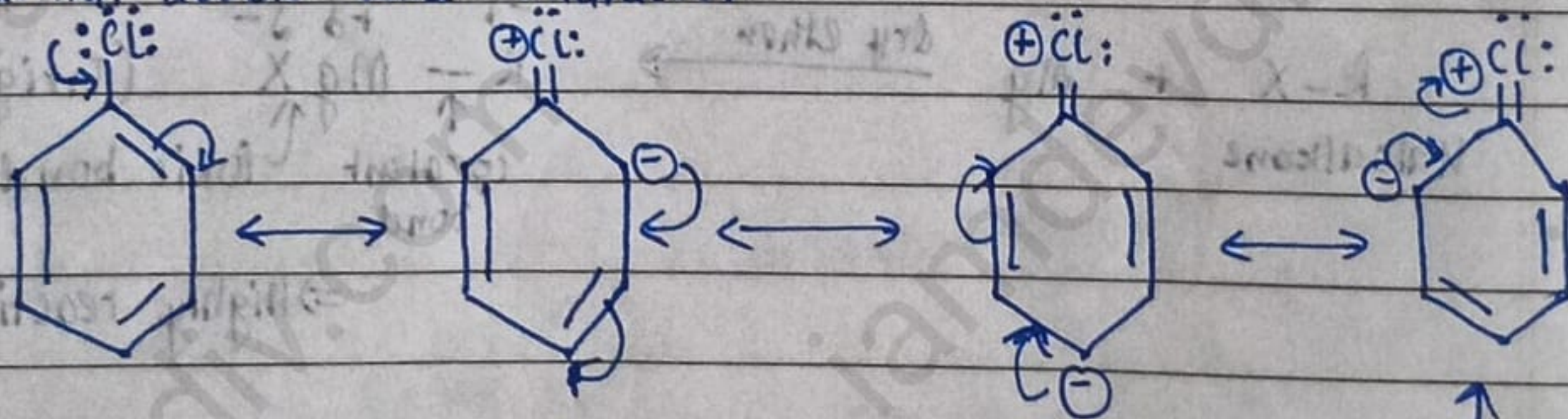


★ CHEMICAL PROPERTIES OF HALOARENES

# Haloarenes do not show Nucleophilic substitution reaction at normal conditions.

Reasons

1) Partial double bond character

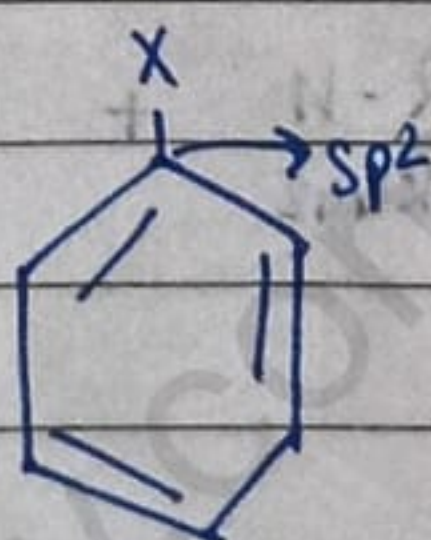


2) R-X



haloalkane

% s = 25%



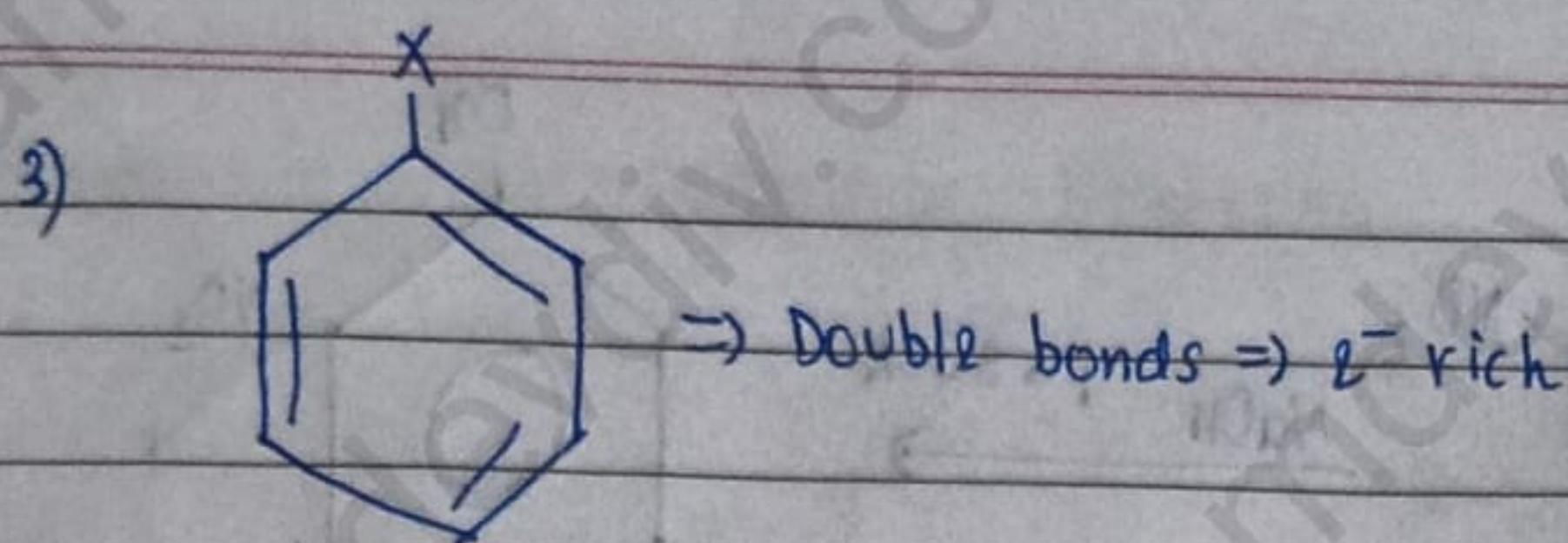
haloarene

% s = 33%

% s ∝ EN

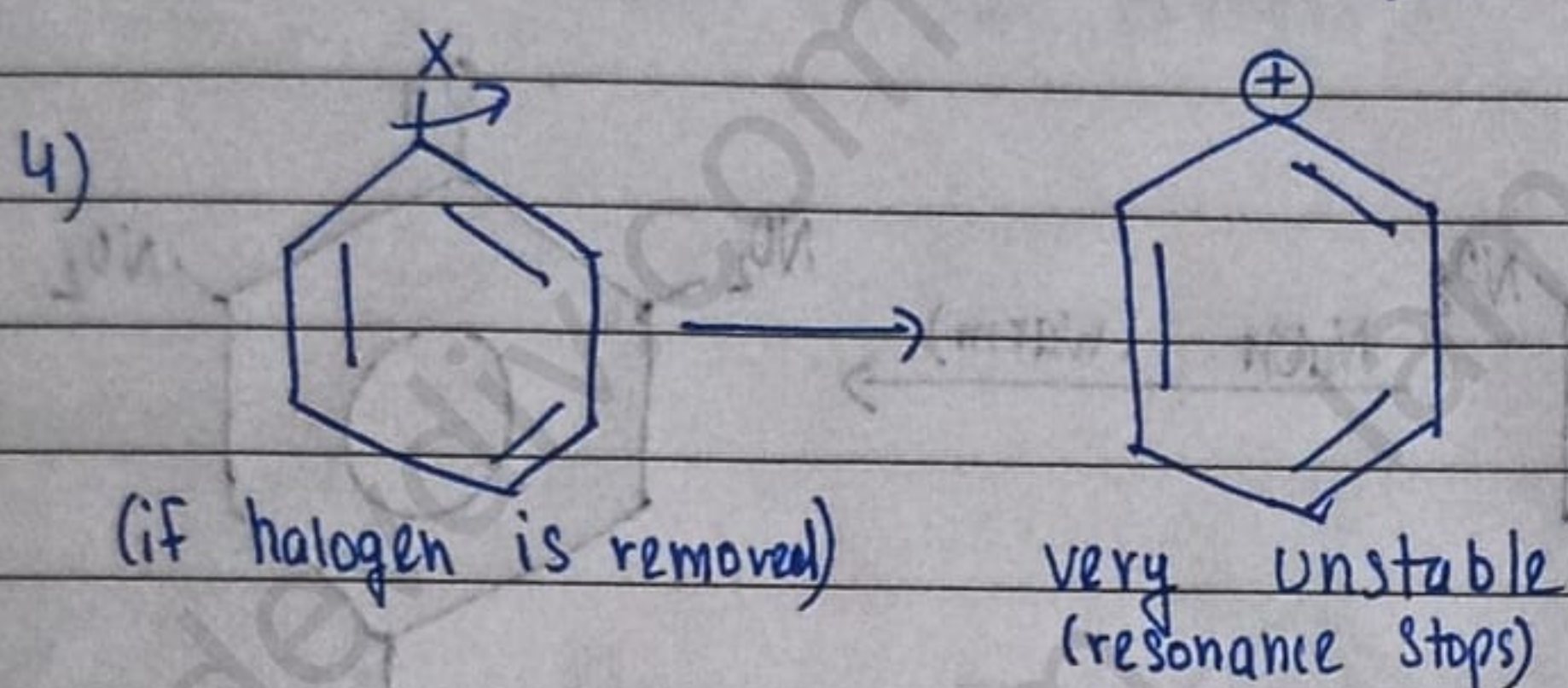
Carbon in haloarene is <sup>more</sup> EN than carbon in haloalkane

⇒ weak pole strength ⇒ Nucleophile can't attack

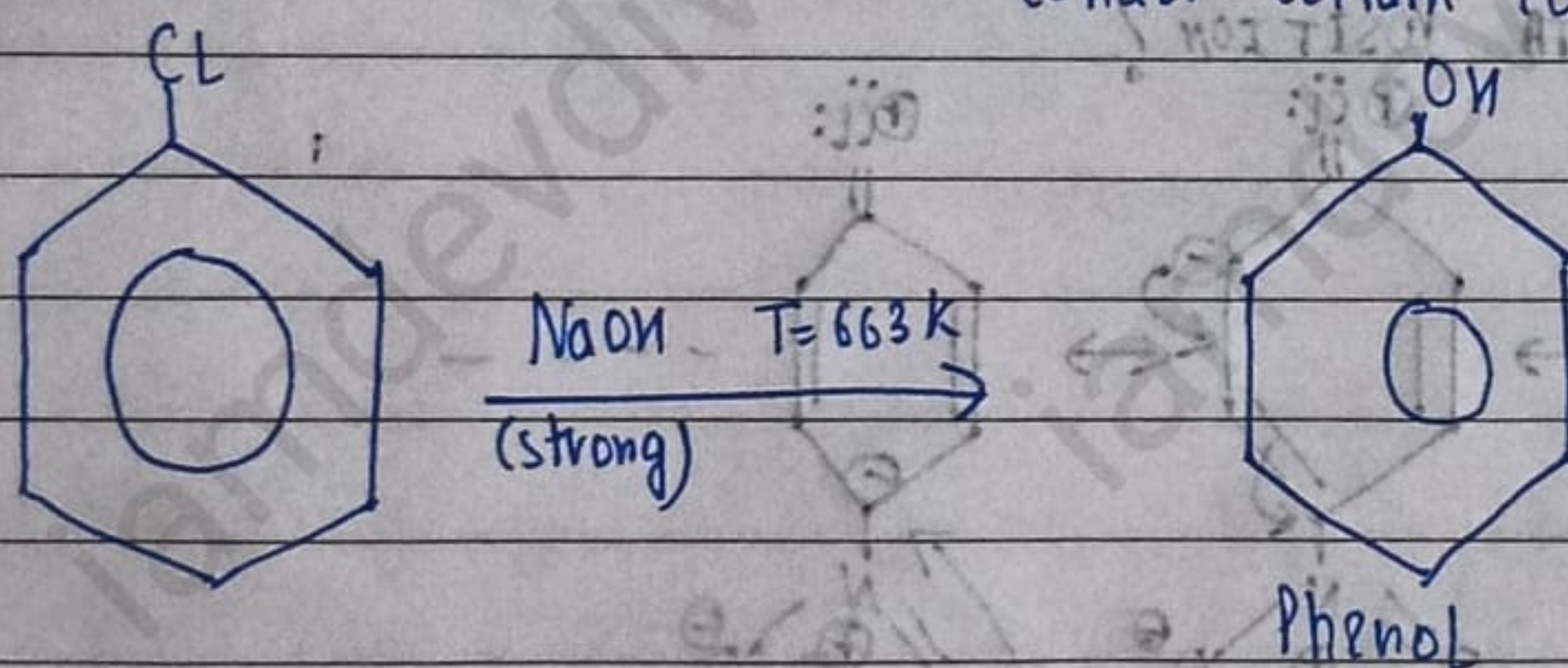


$Nu^- \Rightarrow e^-$  rich

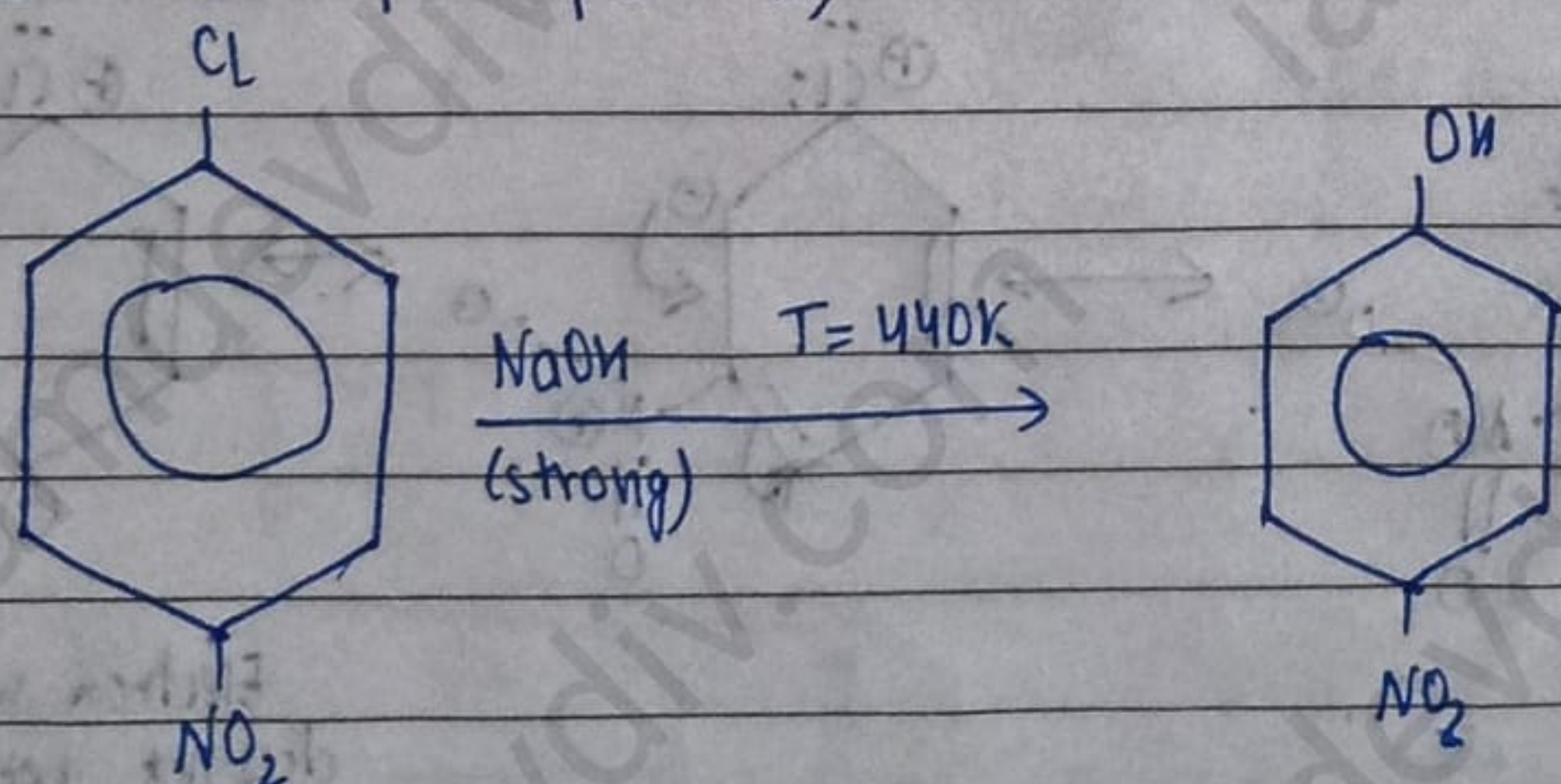
$\hookrightarrow$  can't attack due to repulsion



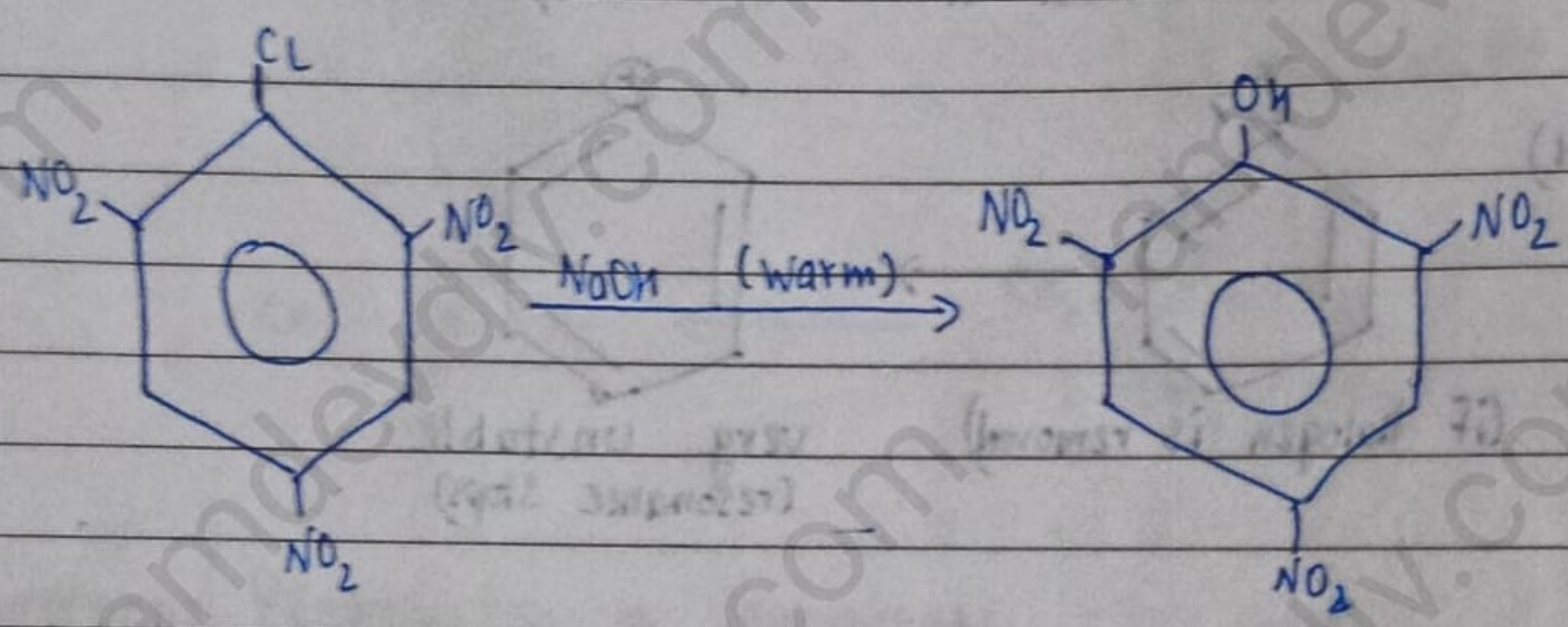
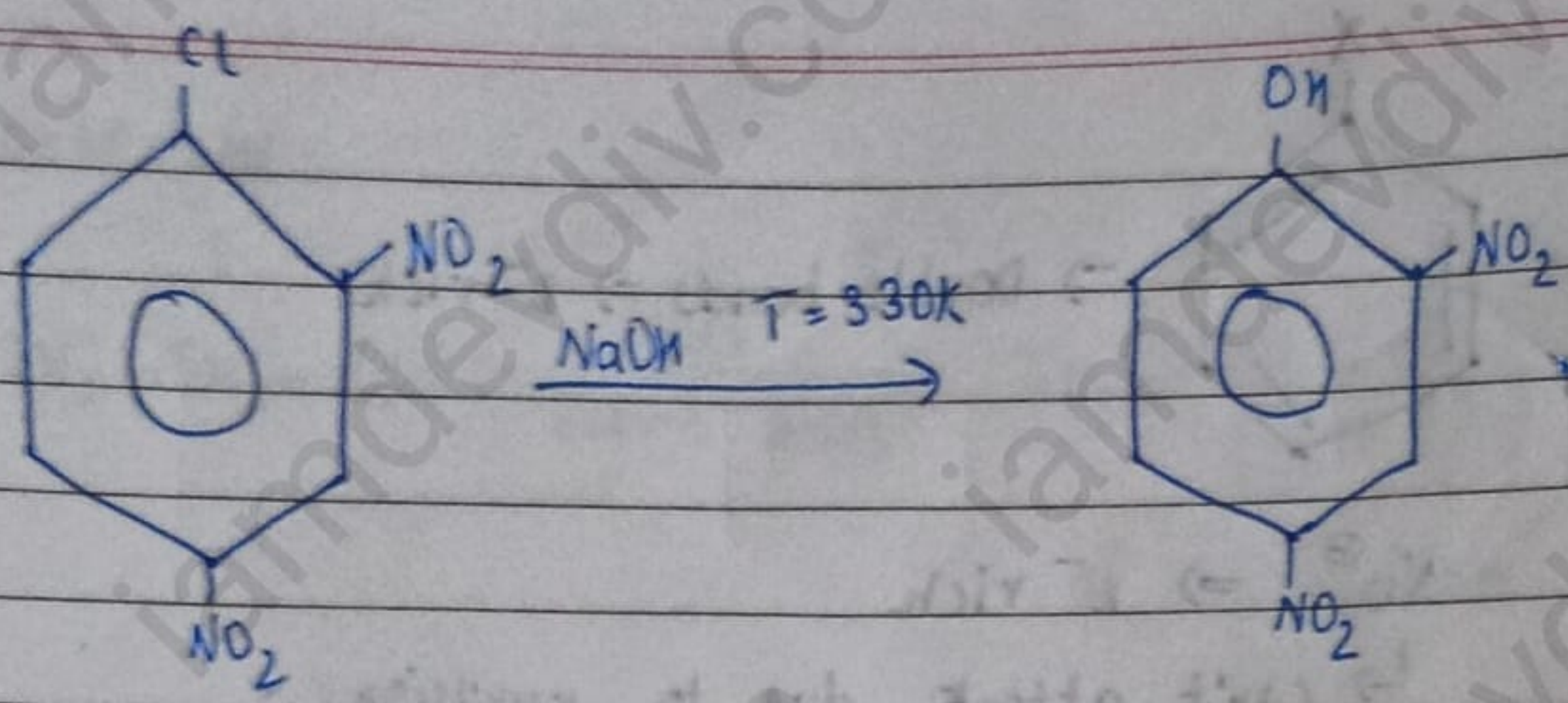
• NUCLEOPHILIC SUBSTITUTION REACTION  $[S_N^2]$   
(under certain conditions)



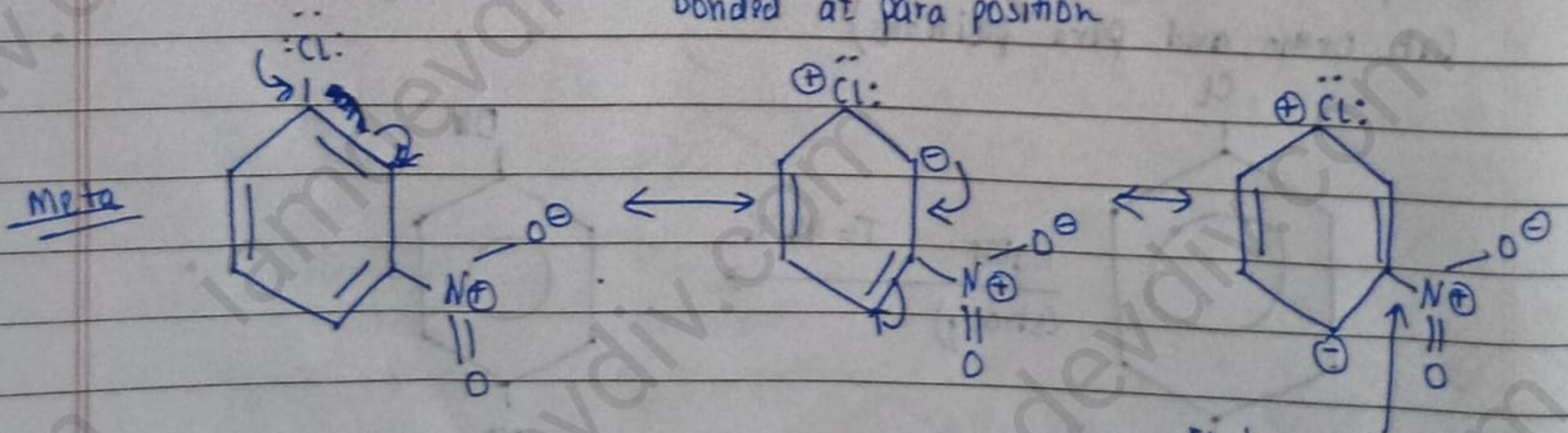
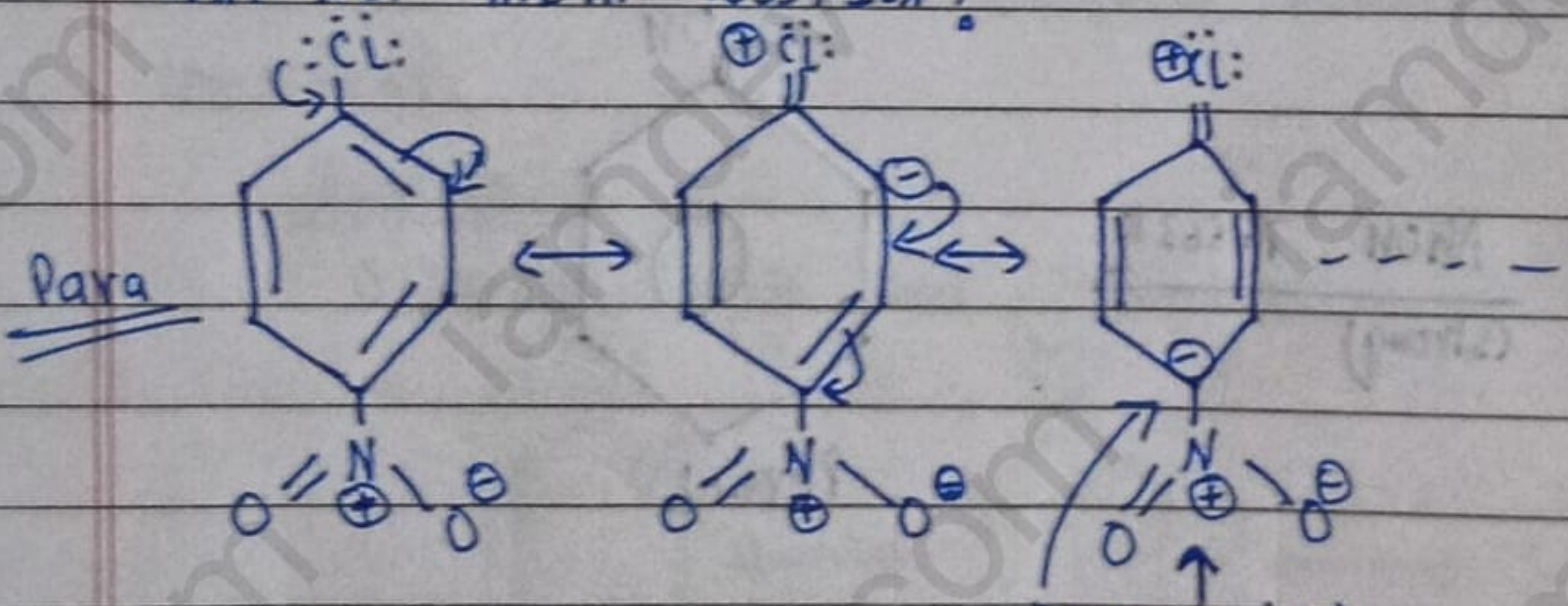
Temperature can be reduced if electron withdrawing groups are used  
(at ortho and para positions)



$\hookrightarrow$  electron withdrawing group

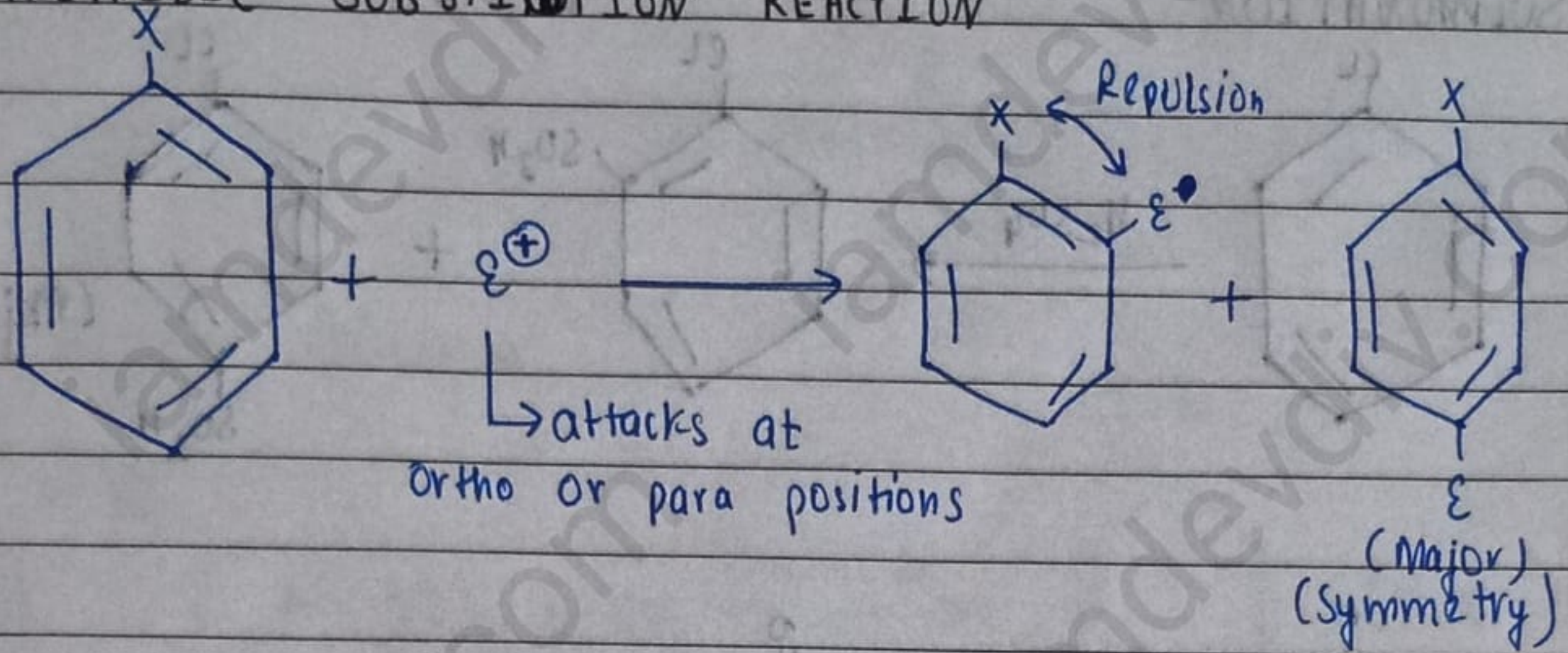


WHY NOT META POSITION?

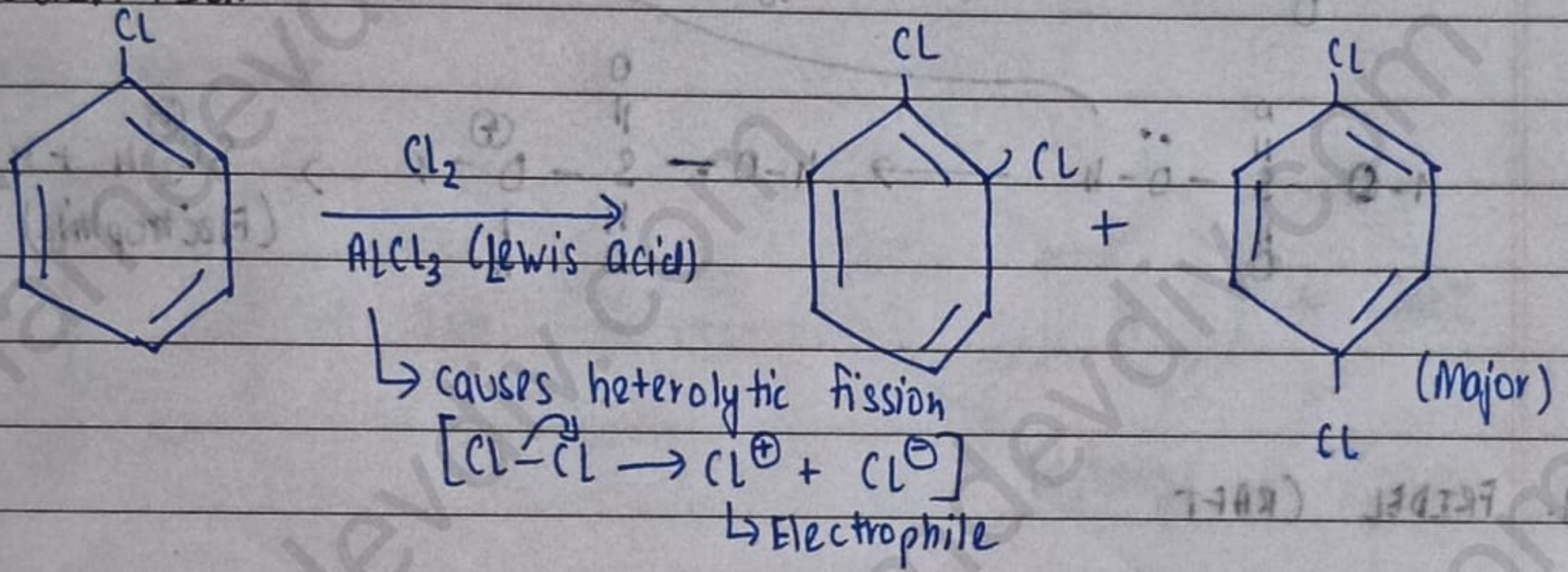


Electron withdrawing group does not get electron when bonded at meta position

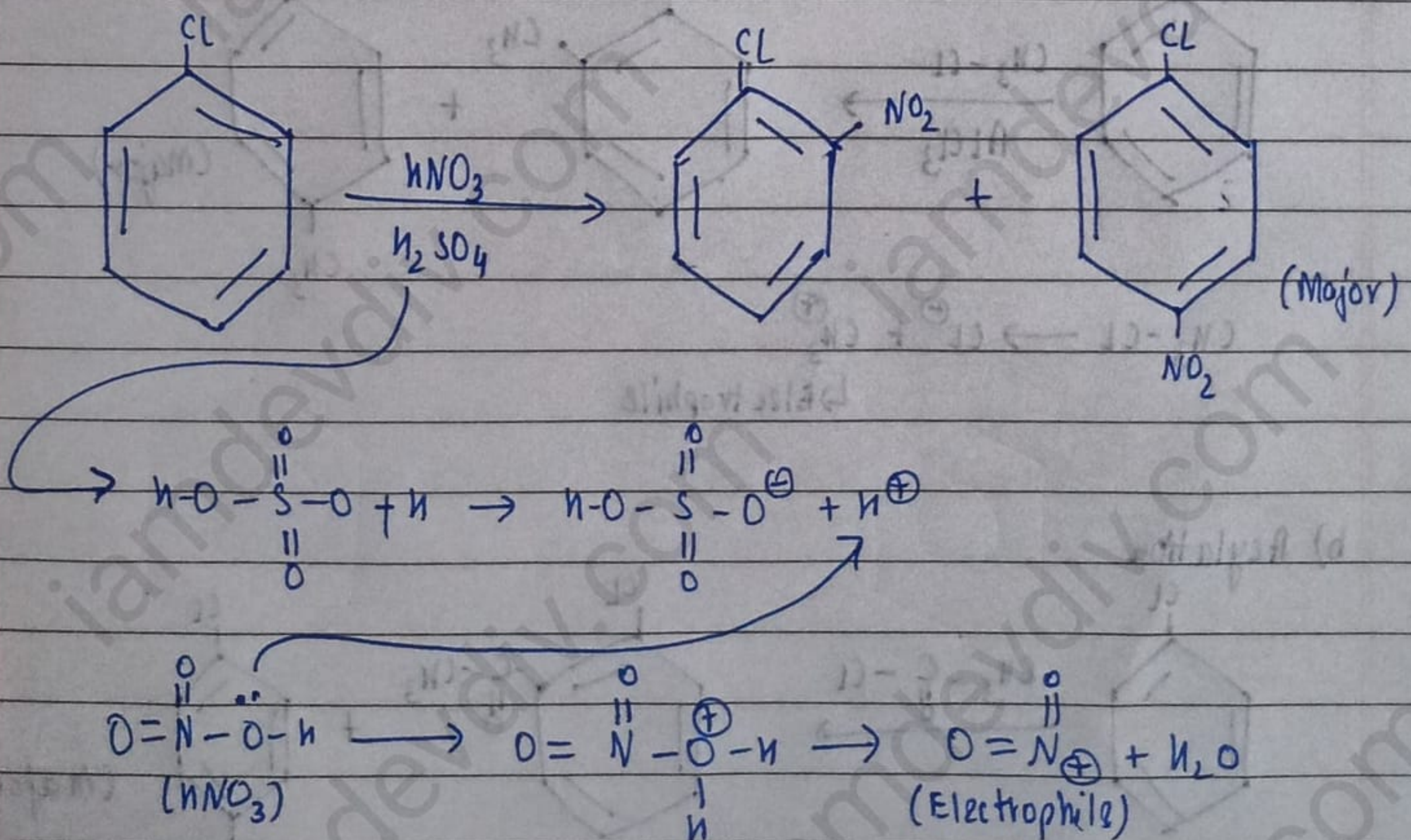
ELECTROPHILIC SUBSTITUTION REACTION



1. HALOGENATION

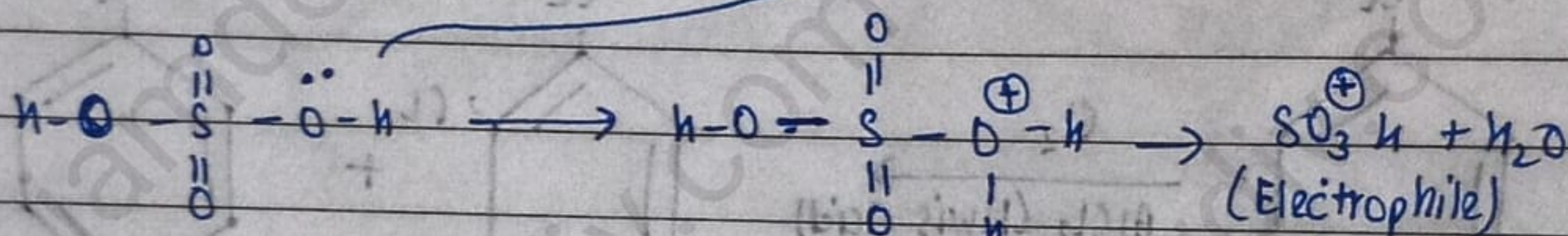
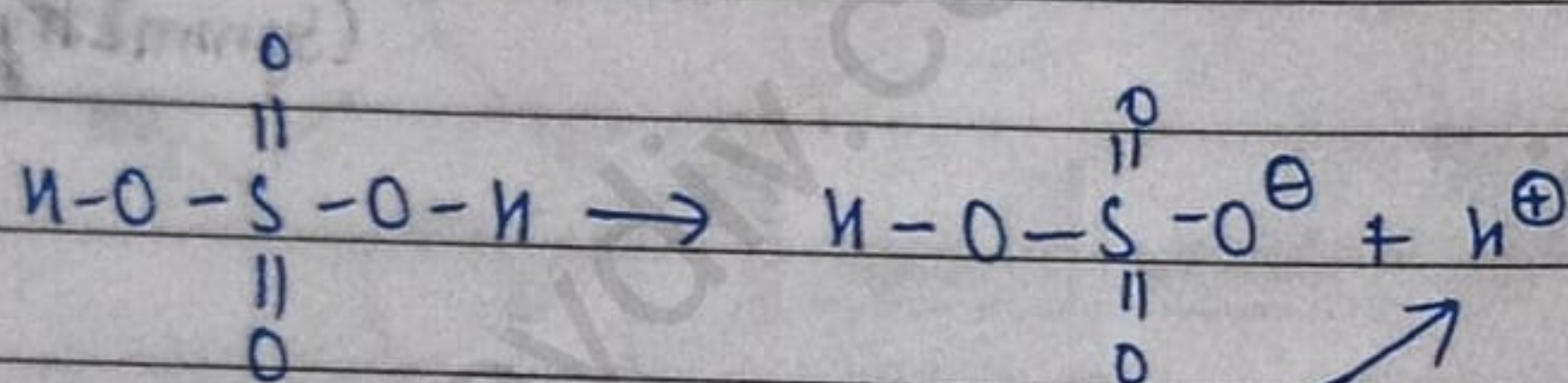
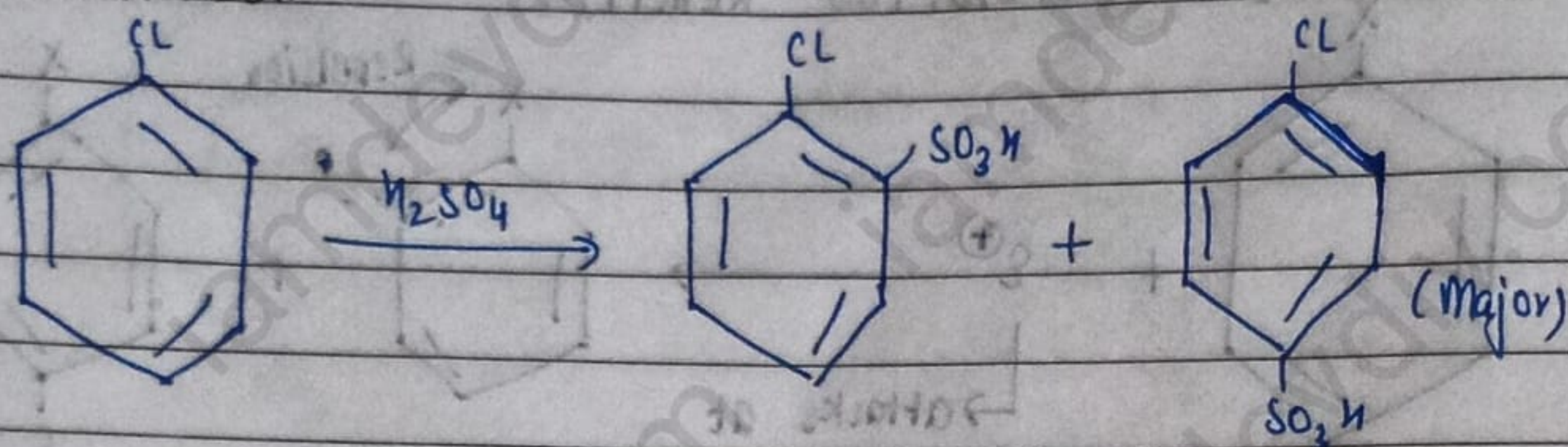


2. NITRATION



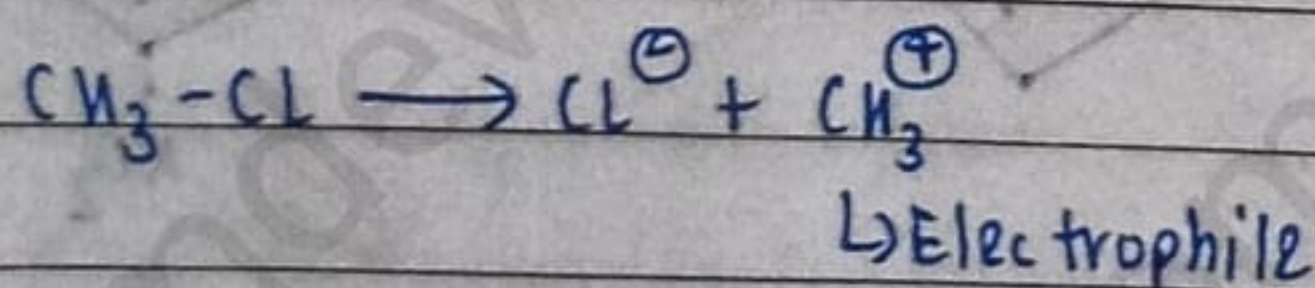
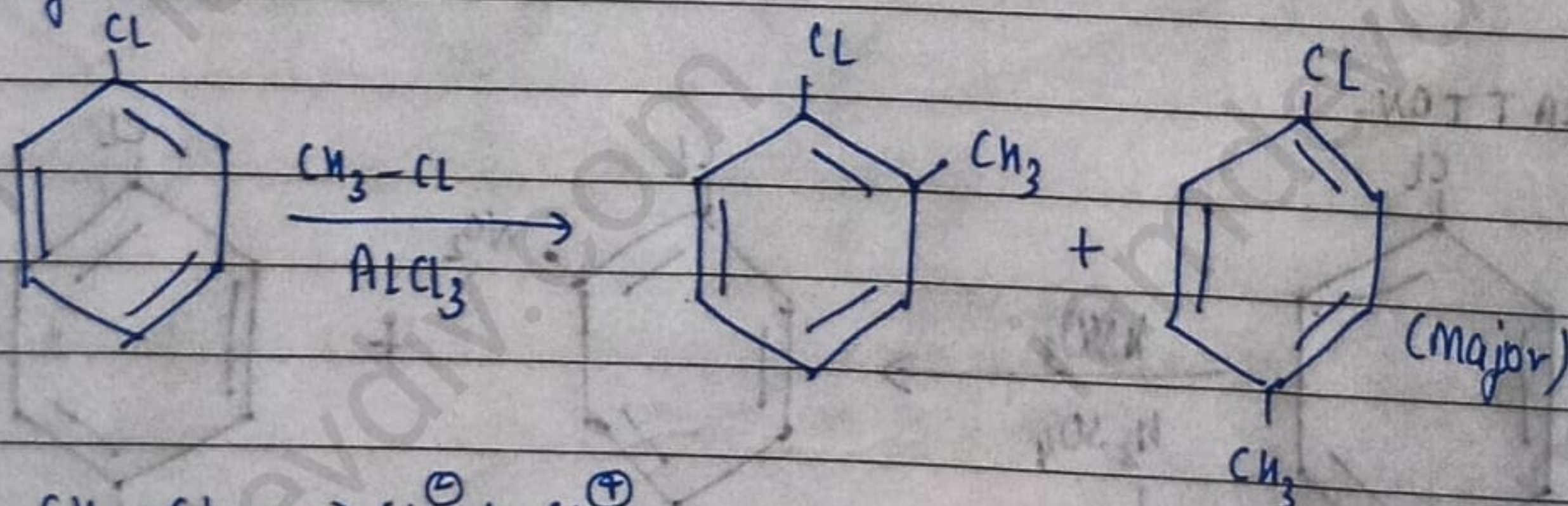


## 3. SULPHONATION

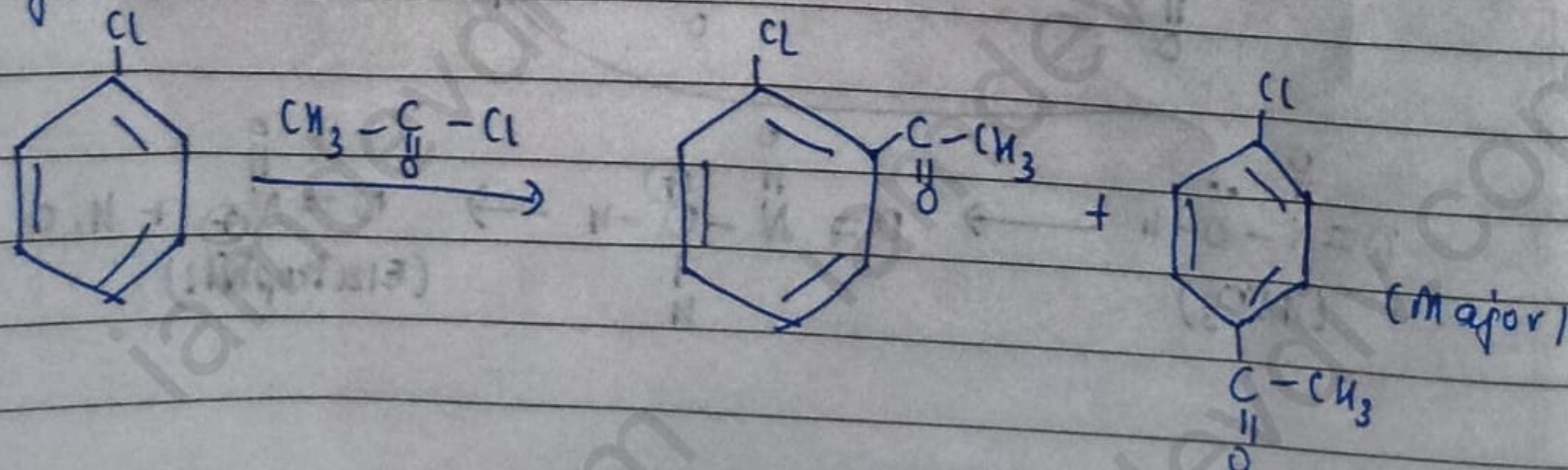


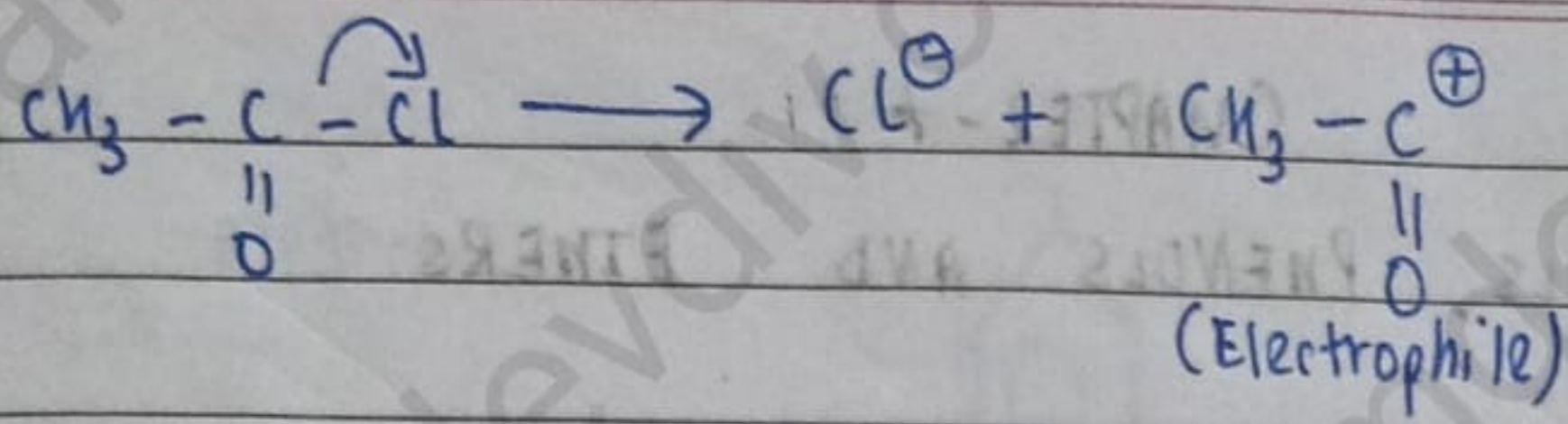
## 4. FRIDEL CRAFT

## a) Alkylation

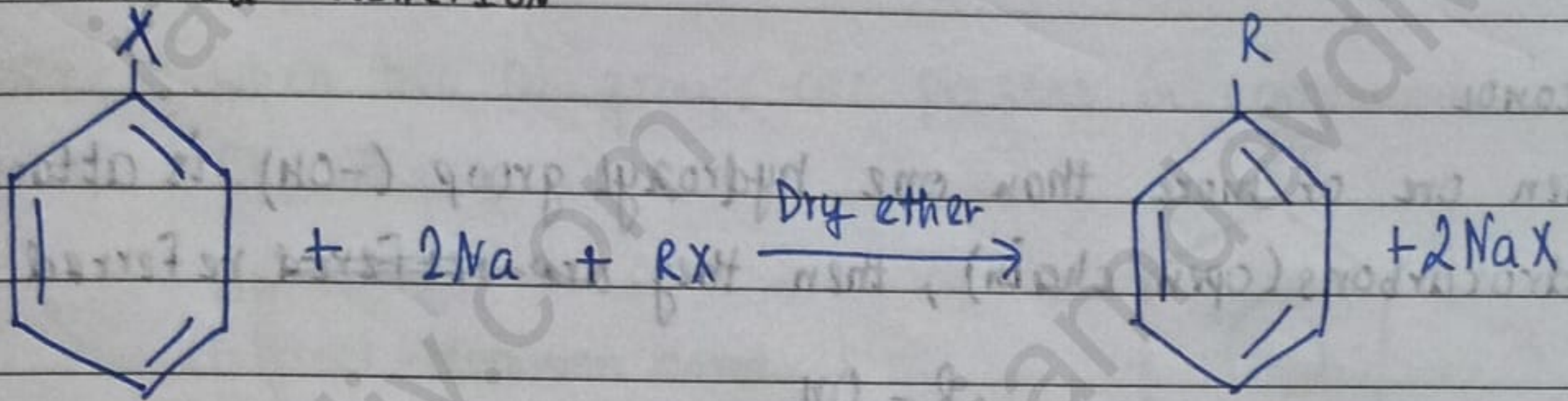


## b) Acylation

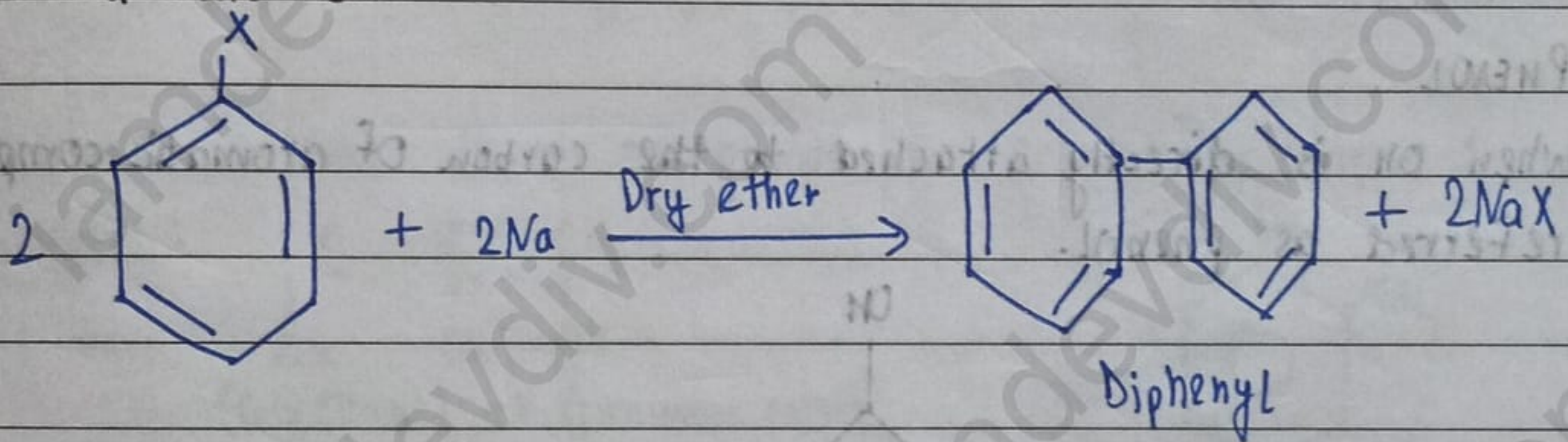




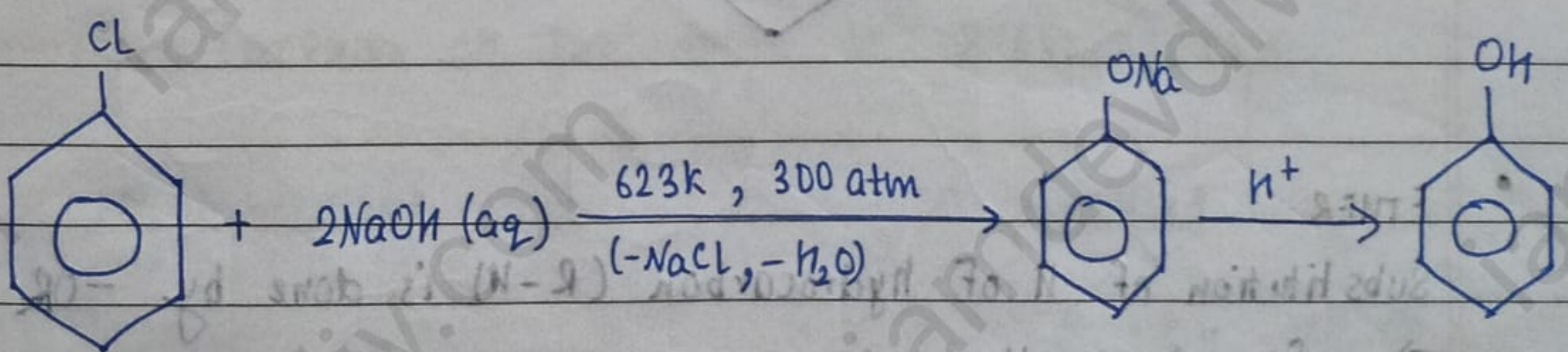
• WURTZ-FITTING REACTION



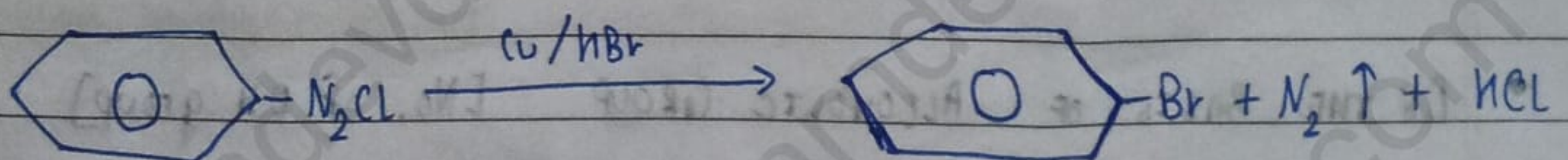
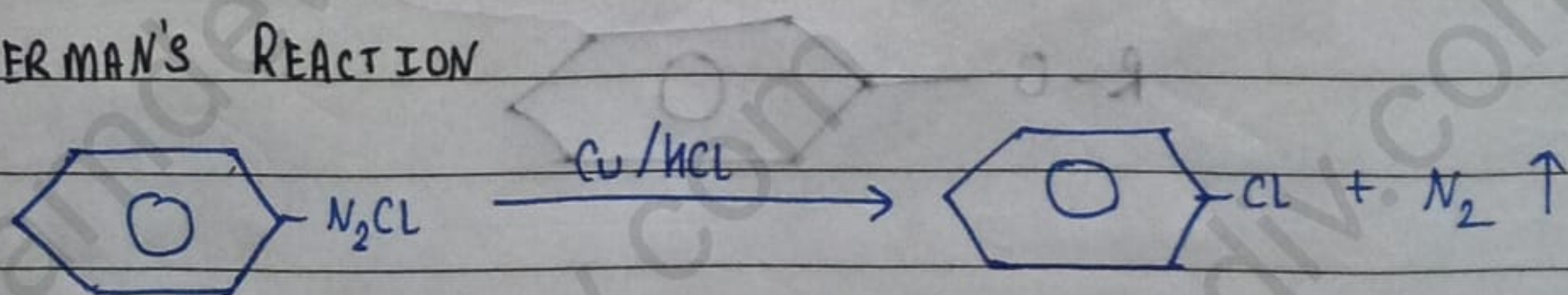
• FITTING REACTION



• DOW'S PROCESS



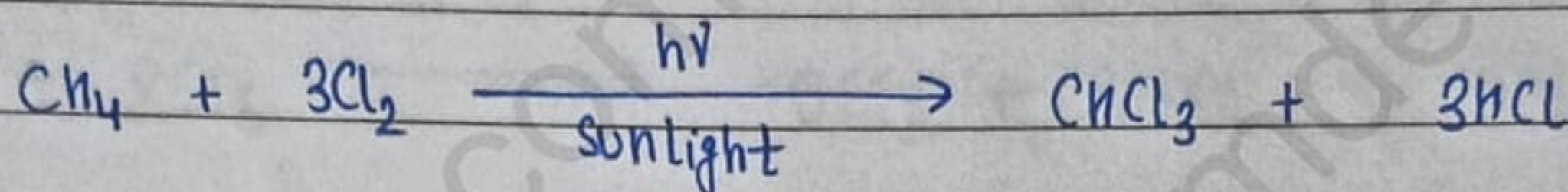
• GRATTERMAN'S REACTION



## ★ POLYHALOGEN COMPOUNDS

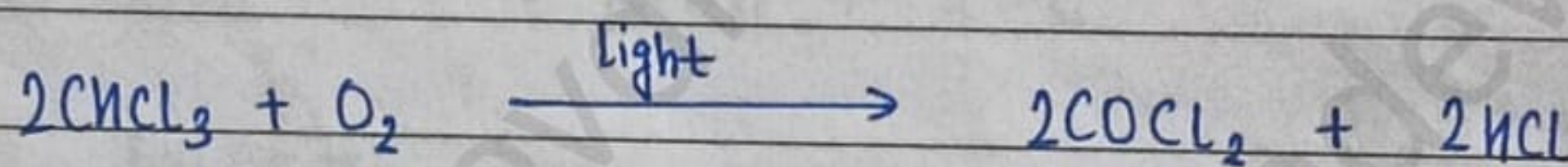
### • CHLOROFORM (TRICHLOROMETHANE)

It is manufactured by chlorination of methane followed by separation by fractional distillation.

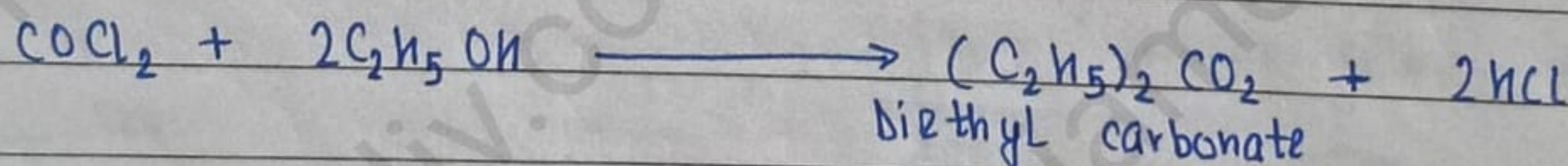


### \* PROPERTIES

- It is a sweet smelling liquid with boiling point  $61^\circ\text{C}$ .
- It is stored in dark coloured bottles because it gets oxidised in the presence of sunlight to form a poisonous gas, phosgene ( $\text{COCl}_2$ )



It is therefore stored in closed dark coloured bottles completely filled so that air is kept out. 1% ethanol is added so as to convert phosgene gas to diethyl carbonate which is non-volatile and non-toxic.

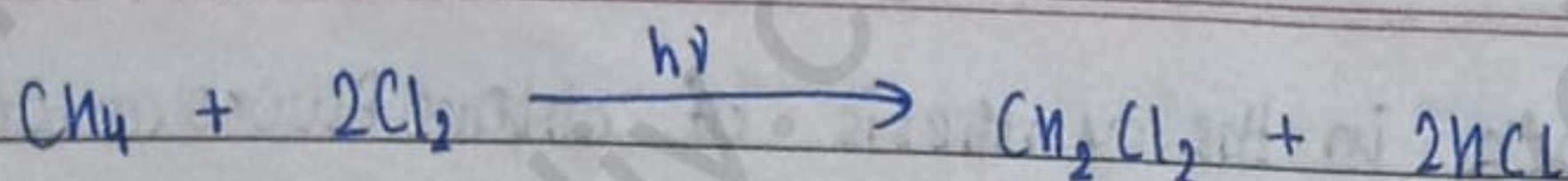


### \* USES

- It is widely used in industry as a solvent for fats, waxes, resins, rubber, etc.
- It was once used as an anaesthetic agent in surgery and as flavouring agent in cough syrups but now it is not used because it forms phosgene gas which is poisonous.

### • METHYLENE CHLORIDE (DICHLOROMETHANE)

It is prepared industrially by the direct chlorination of methane.



### \* USES

It is an effective solvent used in pharmaceutical and food industry.

### • IODOFORM (Triiodomethane)

Iodoform is prepared by the action of iodine and alkali on ethyl alcohol or acetone.

### \* PHYSICAL PROPERTIES

Iodoform is a yellow coloured solid having m.p. 392 K. It is insoluble in water but dissolves readily in organic solvents.

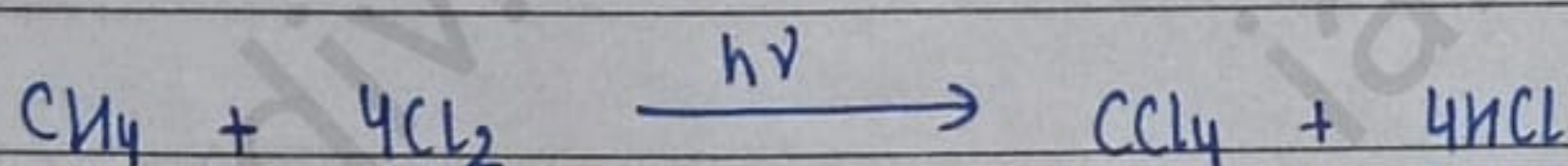
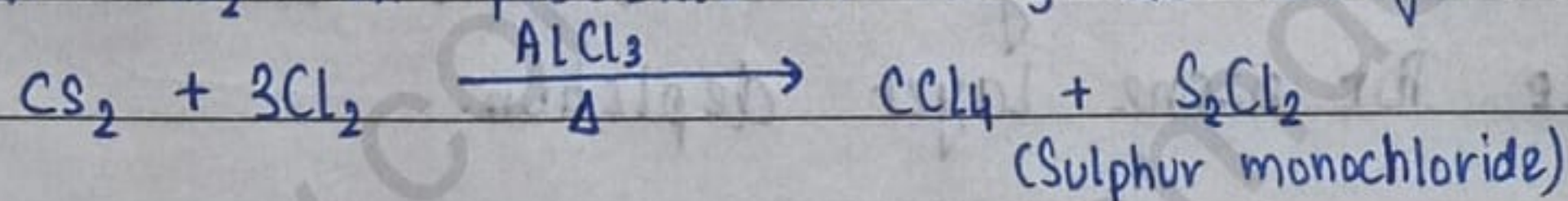
### \* USES

It is used as an antiseptic for dressing wounds.

The haloform reaction is commonly used to distinguish between methyl ketones or methyl carbinols from other ketones and alcohols.

### • CARBON TETRACHLORIDE (Tetrachloromethane)

It is prepared by chlorination of methane and by action of chlorine on  $\text{CS}_2$  in presence of  $\text{AlCl}_3$  as catalyst.



### \* PROPERTIES

(i)  $\text{CCl}_4$  is a colourless liquid with boiling point 350 K.

(ii) It has a sticky sweet smell.

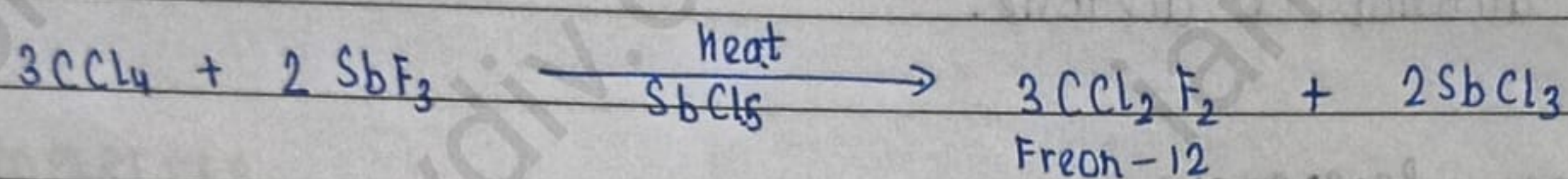
### \* USES

(i) It is produced in large quantities for use in the manufacture of refrigerants and propellants for aerosol cans.

- ii) Used as feed stock in the synthesis of chlorofluorocarbons and other chemicals.
- iii) Its exposure causes liver cancer in humans.
- iv) Depletes the ozone layer when released into the air.

### • FREON

The chlorofluorocarbon compounds of methane and ethane are collectively called freons. It is manufactured from  $\text{CCl}_4$  by Swarts reaction.



### \* PROPERTIES

- i) Dichlorodifluoromethane ( $\text{CCl}_2\text{F}_2$ , Freon-12) is one of the most common freons in industrial use.
- ii) They are extremely stable, unreactive, non-toxic, non-corrosive and easily liquifiable gases.

### \* USES

They have also been used extensively as propellants, for aerosols and foams to spray out deodorants, cleansers, hair spray, shaving creams. Use of freon is being reduced and banned because they are responsible for ozone layer depletion.

### • DDT

$p,p'$ -Dichlorodiphenyl trichloroethane  
(OR)

1,1'- (2,2,2-Trichloroethane-1,1-diyl) bis (4-chlorobenzene)  
(OR)  
1,1,1-Trichloro-2,2-bis(4-chlorophenyl) ethane

It is a white powder insoluble in water, but soluble in oil. It is used as an insecticide. It results in pollution due to its extreme stability. It is non-biodegradable. Many species of insects developed resistance to DDT, and it was also discovered to have high toxicity in fish.

The chemical stability of DDT and its fat solubility compounded the problem. DDT is not metabolised rapidly by animals.

