

ORGANIC COMPOUNDS : → Hydrocarbons → Contains  
and their  
derivatives

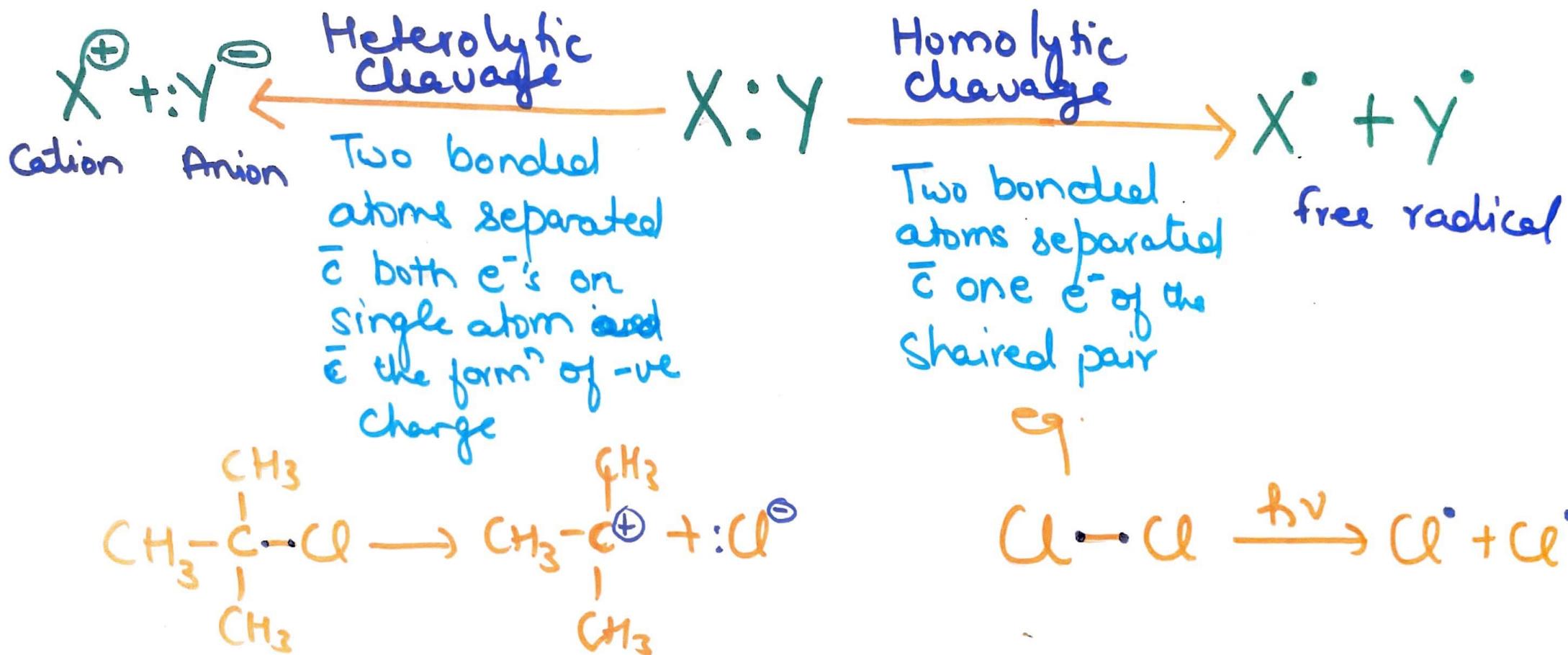
Covalent  
bond

Bond  
break

depending on  
difference in electro  
-negativity

Homolytic  
cleavage  
(No diff. in electronegativity)

Heterolytic  
cleavage  
(Difference exist)



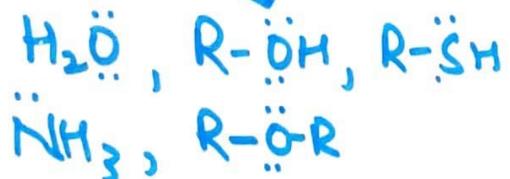
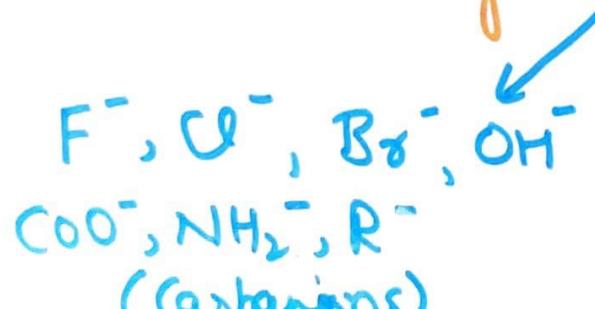
# Attacking Reagents:

Substrate + Attacking Reagent → Product

Substance which get attacked

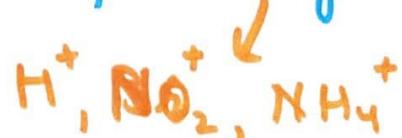
Nucleophile: $\text{Nu}^\ominus$ / $\text{:Nu}$

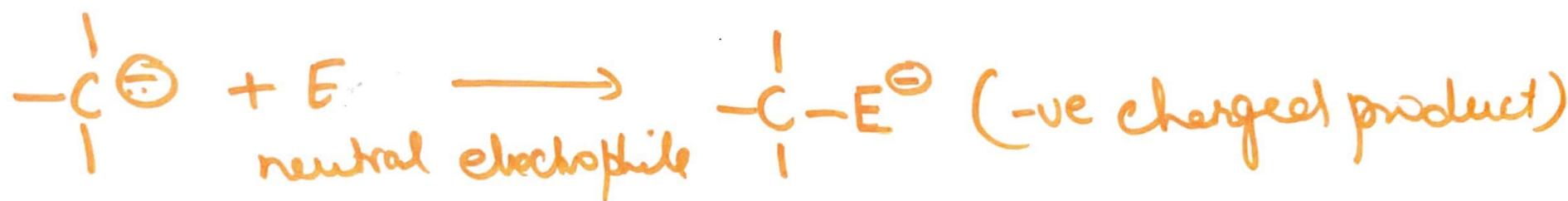
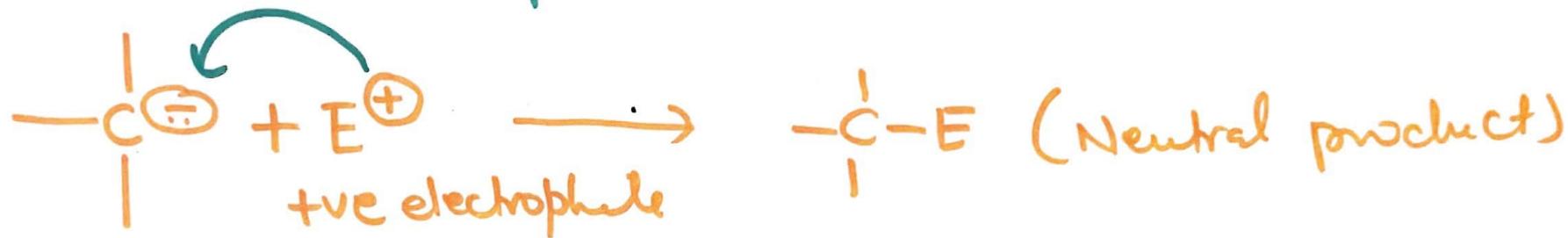
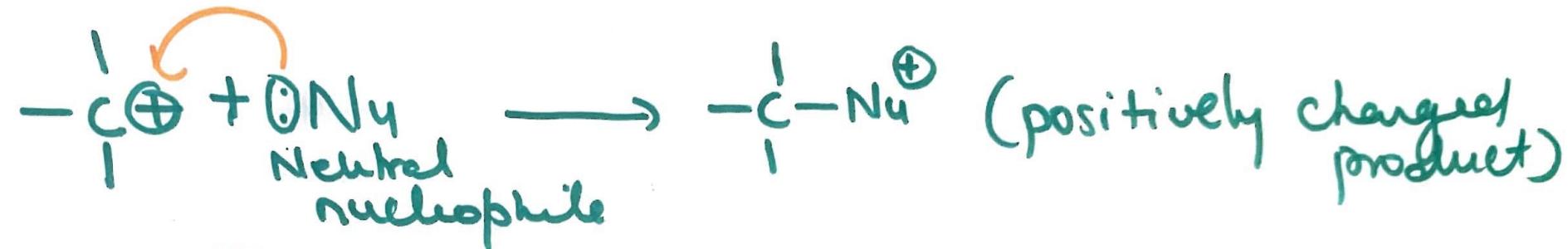
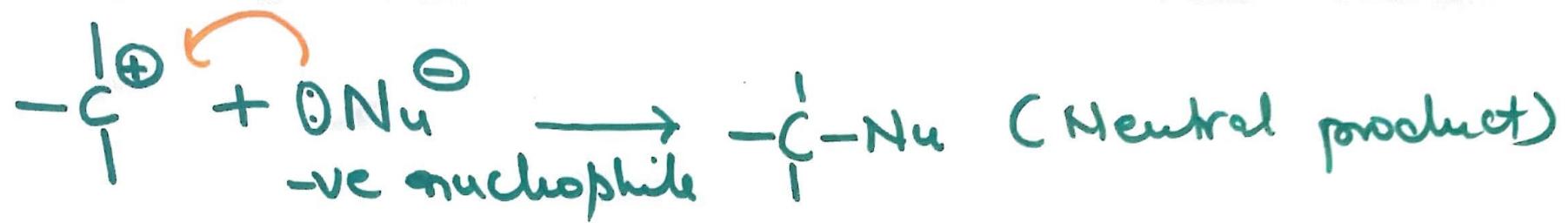
- Nucleus loving
- Electron rich
- Capable to donate  $e^-$  pairs
- Lewis bases
- Negatively charged / Neutral species



Electrophile  $\text{E}^\oplus$  /  $\text{E}$

- Electron loving
- Electron deficient
- Capable to accept  $e^-$ 's
- Lewis acid
- positively charged / Neutral





# ORGANIC REACTIONS

## Addition Reactions

Unsaturated Compd  $\rightarrow$  Saturated Compd.

- Electrophilic add<sup>n</sup> Rxn
- Nucleophilic add<sup>n</sup> Rxn
- Free Radical add<sup>n</sup> Rxn

## Substitution Reactions

Replacement of atom/group from a molecule

- Nucleophilic Sub<sup>n</sup> Rxn  
 $SN_1$  &  $SN_2$
- Electrophilic Sub<sup>n</sup> Rxn

## Elimination Reactions

Saturated Compd  $\rightarrow$  Unsaturated Compd

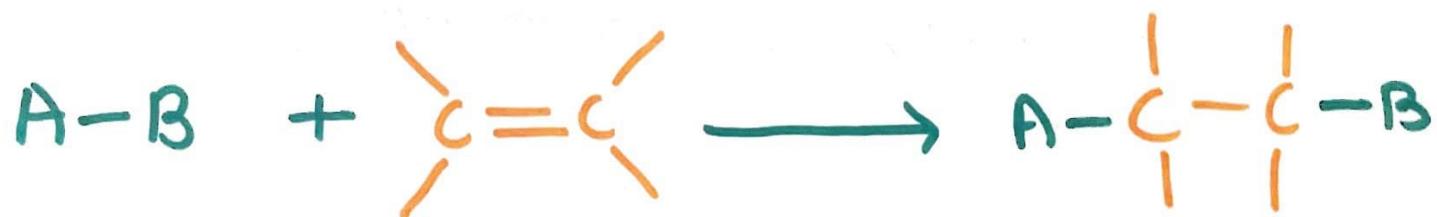
- $\alpha$ -Elimination E<sub>1</sub>
- $\beta$ -Elimination E<sub>2</sub>
- $\gamma$ -Elimination E<sub>1CB</sub>

## Addition Rxn :

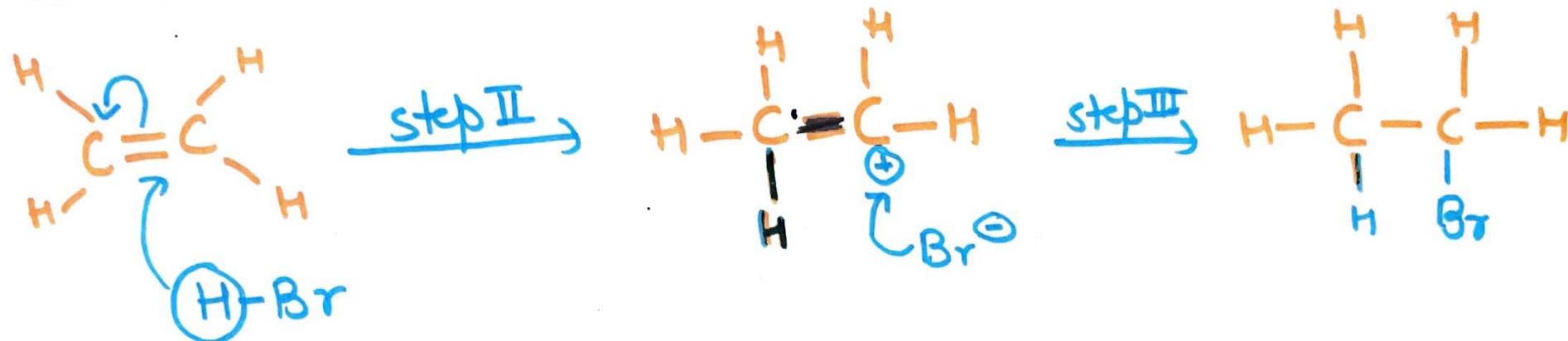
- atoms / group of atoms are added to a molecule without elimination of any atom / gp.
- converts unsaturated compds to saturated compds.
- limited to compds with double / triple bonds

e.g. alkenes, alkynes, carbonyl, imine etc.

- Reverse of add" rxn is elimination rxn.



## Electrophilic add<sup>n</sup> Rxns . typical rxns of alkenes/alkynes



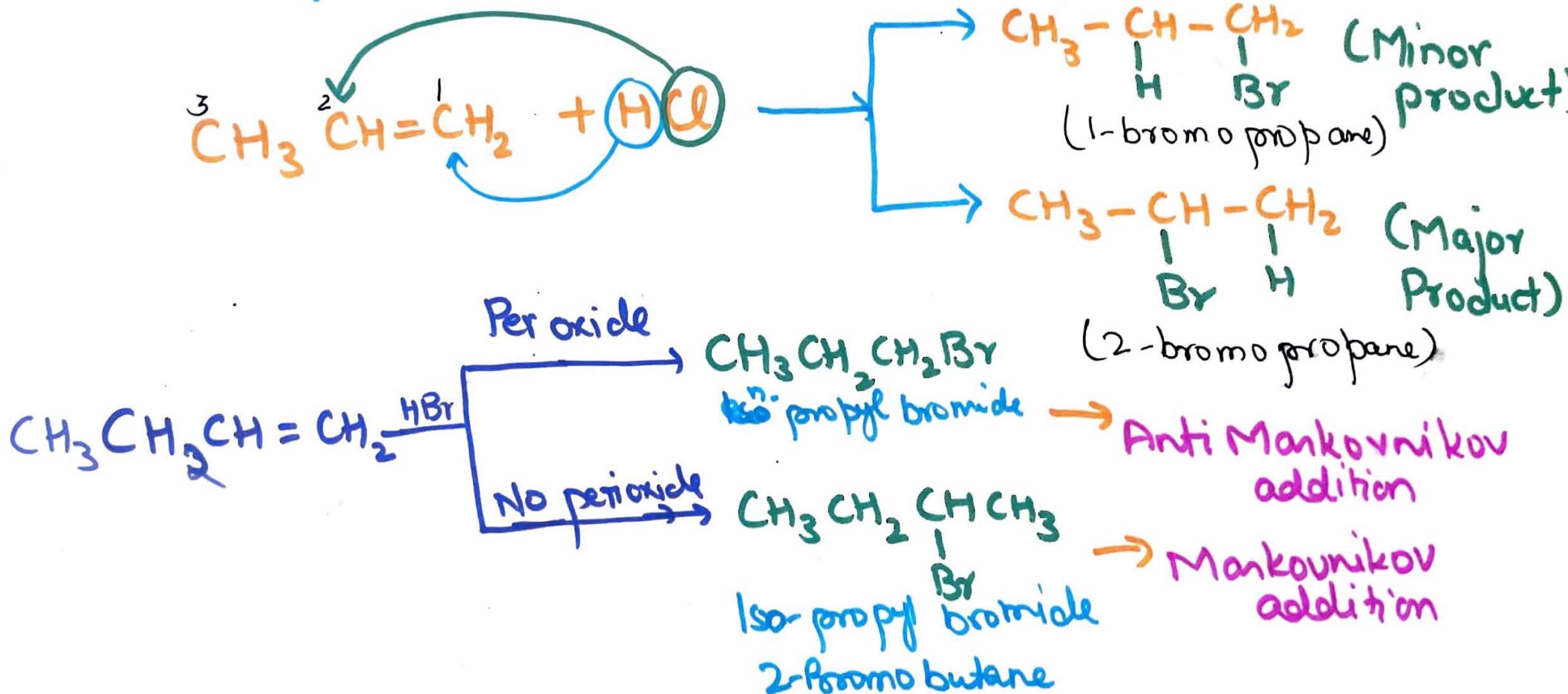
Step I → Ionisation of hydrogen halide generating electrophile & nucleophile    H-Br → H<sup>+</sup> + Br<sup>-</sup>

Step II → Attack of electrophile to form carbocation

Step III → Nucleophile attack carbocation to form add<sup>n</sup> product  
∴ Electrophilic add<sup>n</sup> rxns is started by the attack of electrophile and followed by nucleophilic attack.

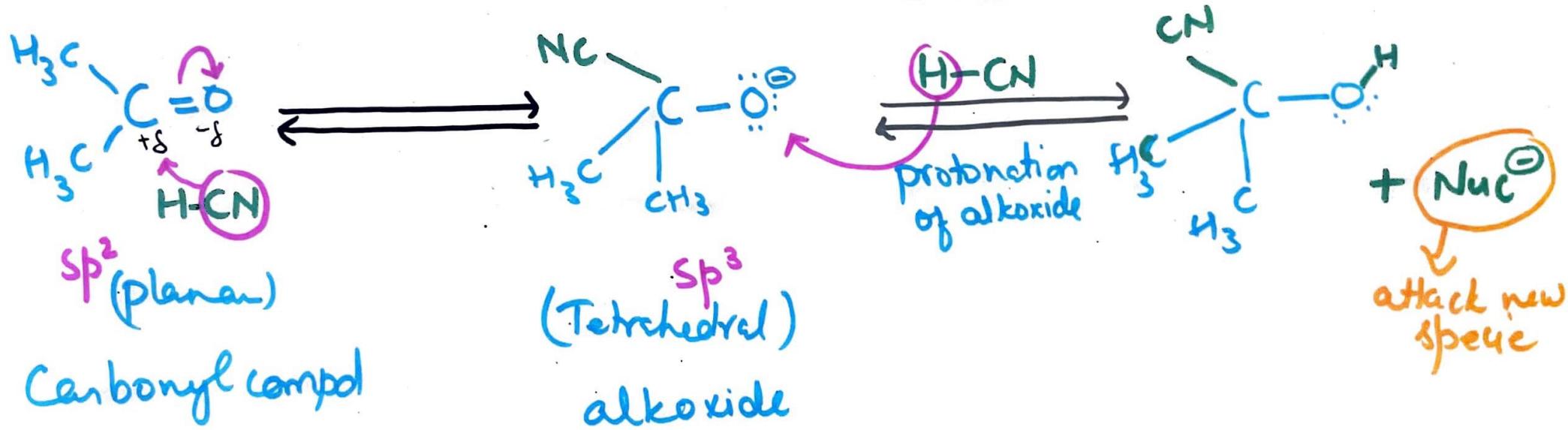
Markovnikov's Rule → applicable for an unsymmetrically substituted alkene with a HX

- Halogen (X) adds to carbon with lesser hydrogens
- Hydrogen (H) " " " " more hydrogens



## Nucleophilic Add<sup>n</sup> Rxn

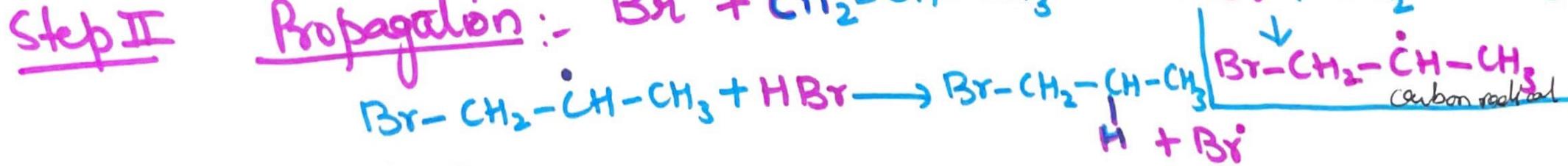
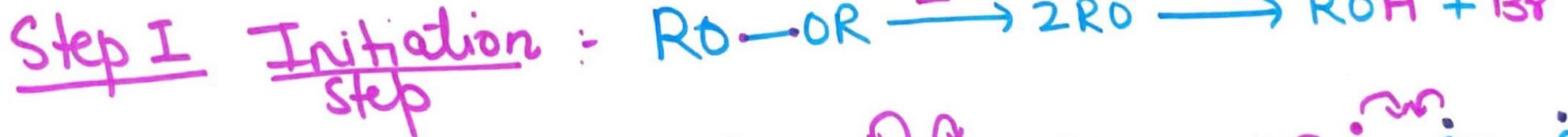
- initiated by a nucleophile followed by add<sup>n</sup> of electrophile
- typical rxns of aldehydes / Ketones
- characteristic of C-hetero atom bond



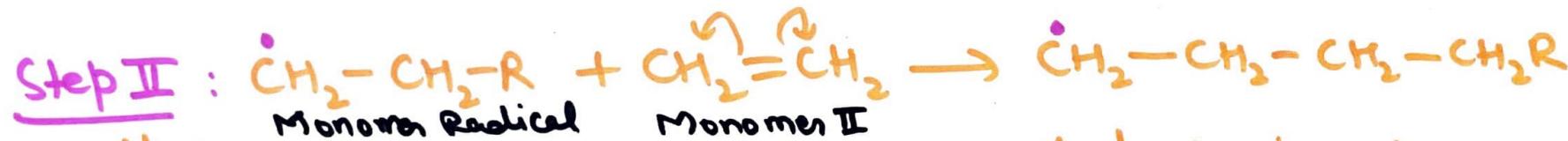
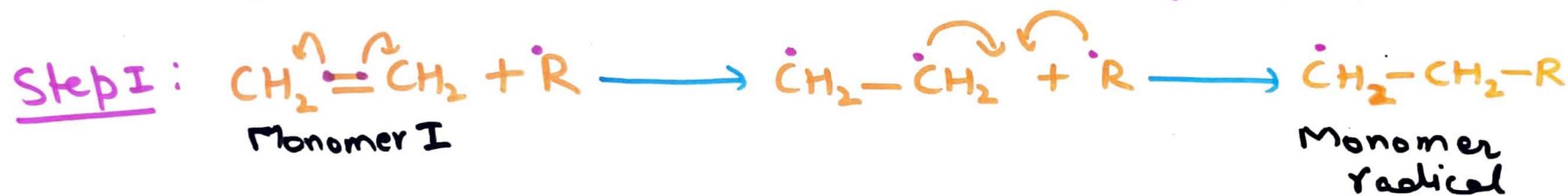
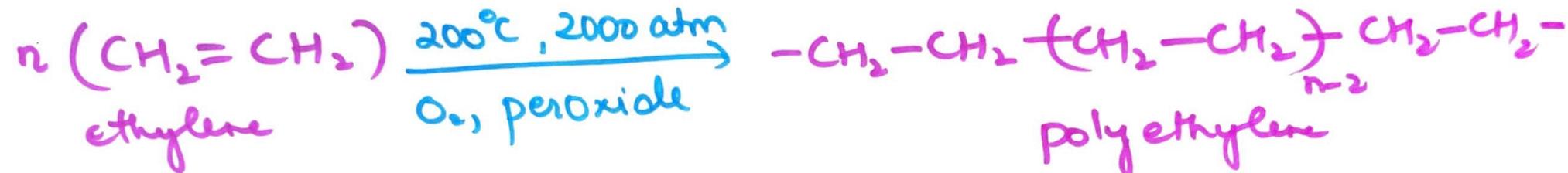
Free Radical Add<sup>n</sup> :- brought by free radical  
 → k/d as Kharash peroxide effect  
 → highly reactive due to trace of unpaired  $e^-$



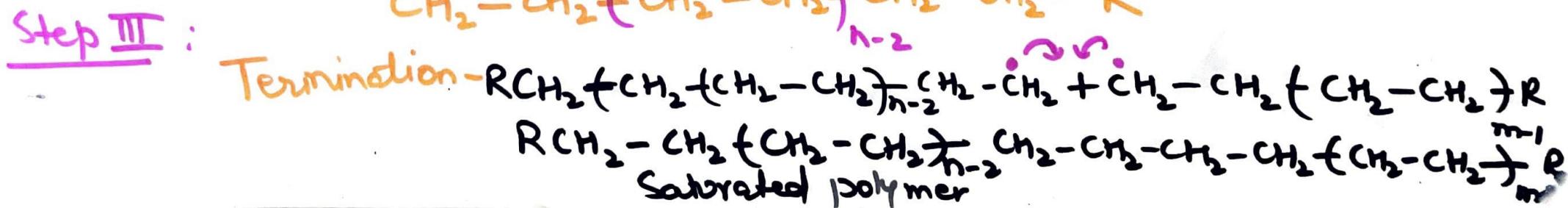
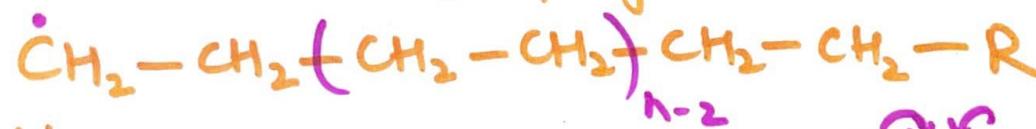
{ Hydrogen peroxide }  
 { Benzoyl peroxide }



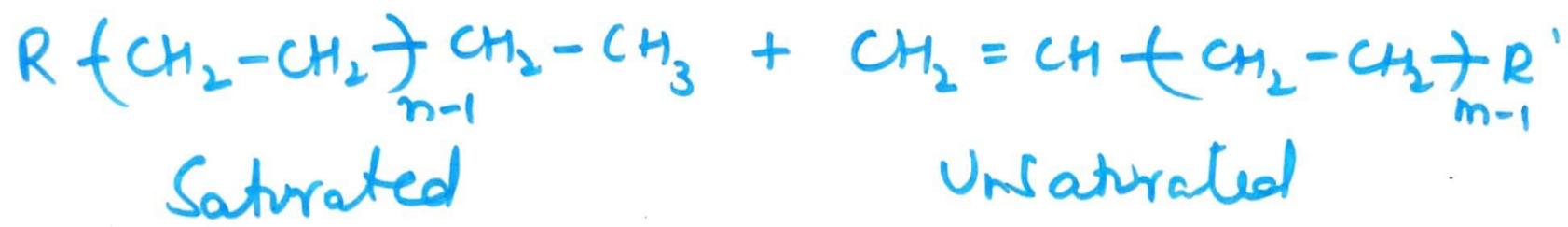
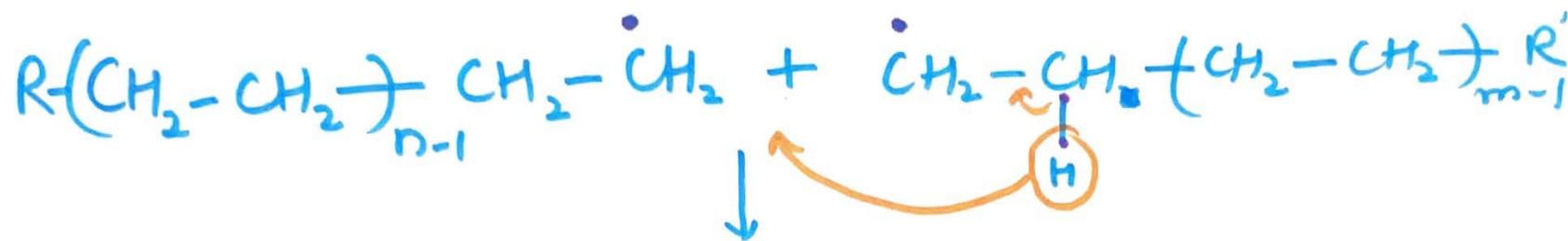
# Polymerization of ethylene to form polyethylene



If  $n$  no. of monomer, then propagated chain will be -



By disproportion: One saturated & one unsaturated polymeric chain is obtld.



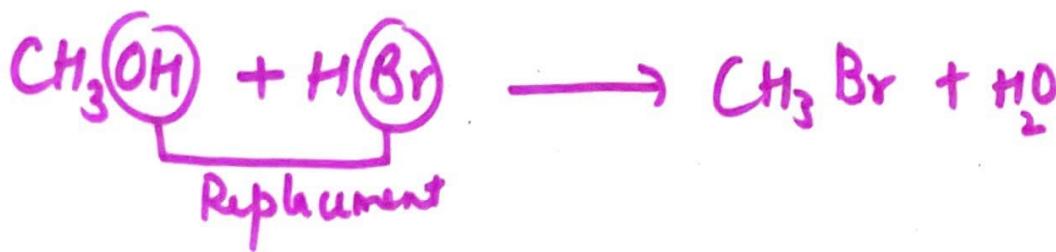
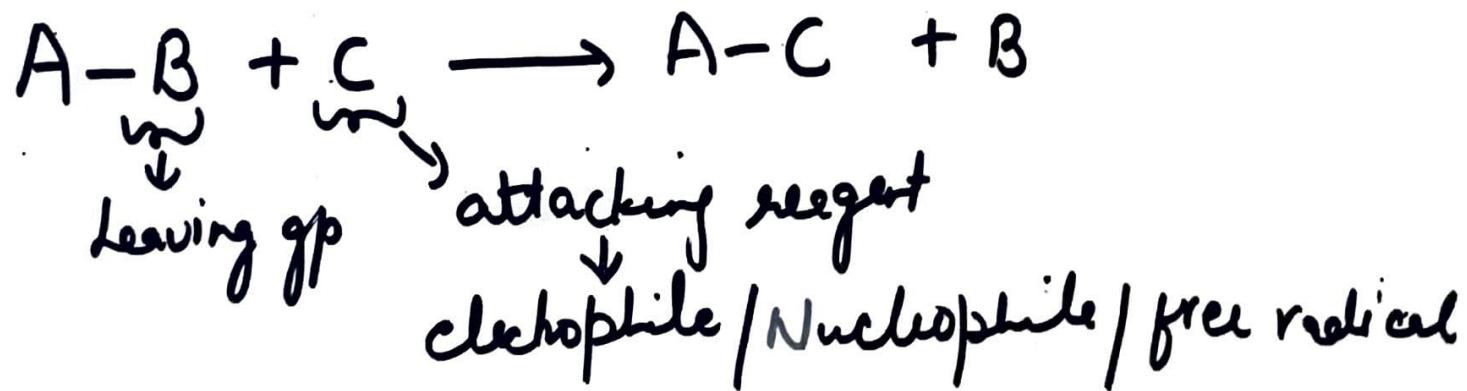
Thank you

S

# Substitution Reactions

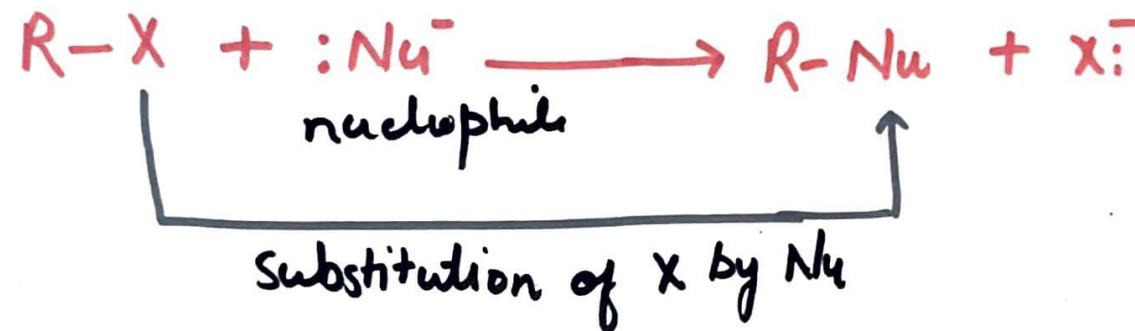
## Substitution Rxn / Single displacement Rxn -

Involves replacement of an atom/group from a molecule by other atom/gp.



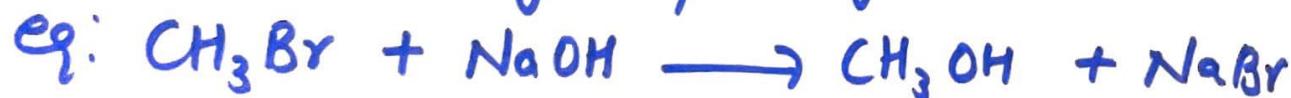
## Nucleophilic substitution Reaction

→ Alkyl halides undergo nucleophilic substitution reaction



In the above rxn, one σ bond is broken & other σ bond  
is formed  $(R-X)$   $(R-Nu)$

Basically involves displacement rxn brought about by strong  
nucleophile, thereby displacing weaker nucleophile from the molecule



Nucleophilic Sub" Rxn can be  $SN_1$ ,  $SN_2^+$ ,  $SN_i$ ,  $SN_{ii}^-$

Substitution Nucleophilic  
unimolecular Rxn

Substitution Nucleophilic  
bimolecular Rxn

$SN_1$  Rxn → When rate of nucleophilic sub" rxn depends upon the conc. of alkyl halide and independent of conc. of nucleophile, the rxn is said to proceed through unimolecular mechanism

Rate of  $[R-X]$

Involves two step

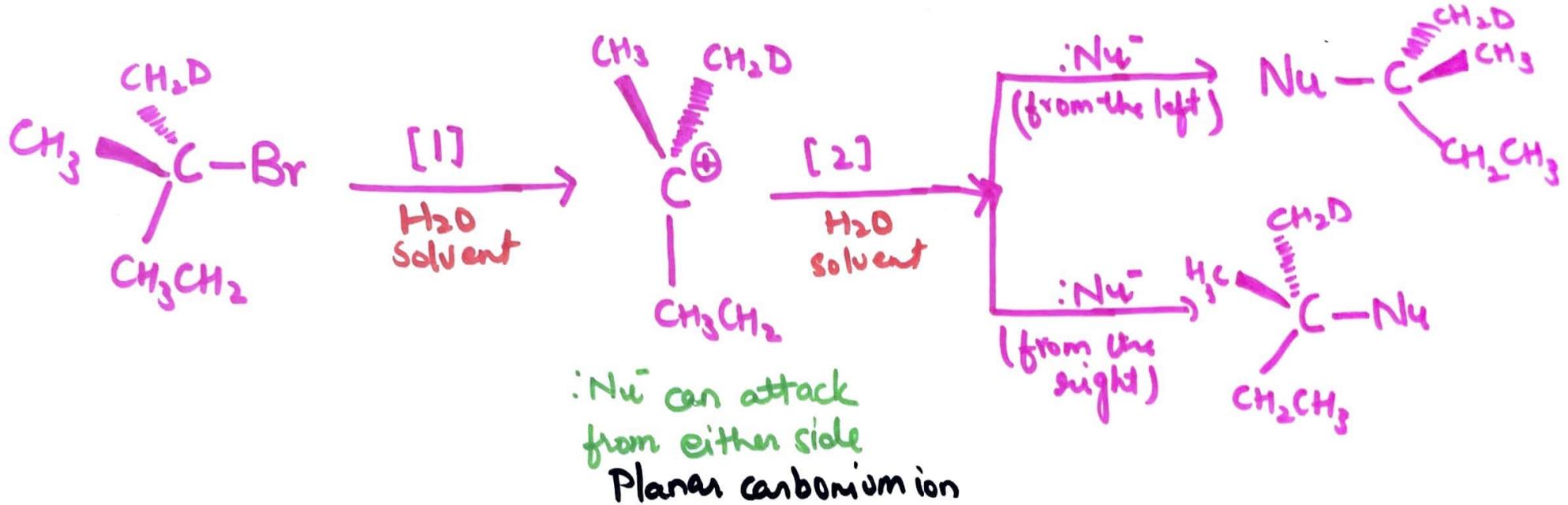
Loss of leaving gp /

① formation of carbocation / Bond breaking  
planar (slow step) step

② Attack of Nucleophile / Bond formation step

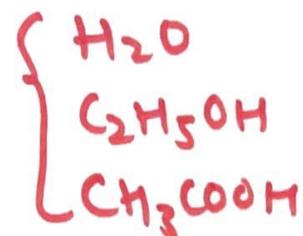
slow step is rate determining step (RDS)

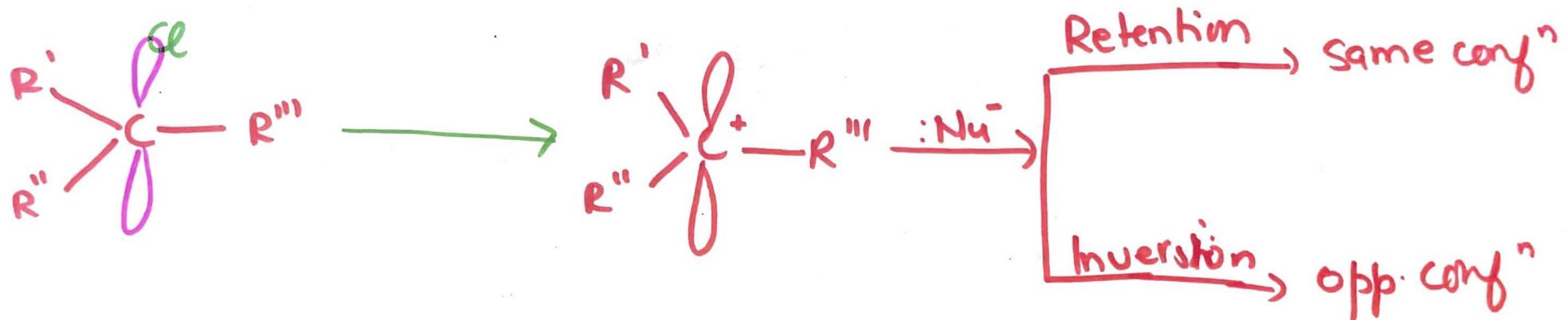
\* Bond breaking occurs before bond form".



→ Involves Polar protic solvent

- ↓  
dielectric constant  
which decreases  
the attraction b/w σ bond  
(C-Br)
- ↓  
provides H+  
Surround  
the leaving gp  
after breaking of  
σ bond  
↓  
so that it will not  
link with electrophile





As there is no preference of for  $:Nu^-$  attack from either dir<sup>n</sup> → two enantiomers are formed → k/d racemic mixture



Racemization has occurred.

What does configuration mean? Are both "R" & "S" same? What is the meaning of enantiomer?

What is the difference between enantiomer and diastereomer?

Rate of Rxn for  $SN^1$  Rxn is affected by

① Type of alkyl halide      Rate of stable alkyl halide



Stability increases, so rate also increases  
 $SN^1$  Rxn

$3^\circ$  Alkyl halide  $\rightarrow$  undergo  $SN^1$  Rxn rapidly

$2^\circ$  " "  $\rightarrow$  react more slowly

$1^\circ$  & methyl  $\rightarrow$  do not undergo  $SN^1$  rxn, as have very less stability

## Characteristics of S<sub>N</sub>I Rxn

Kinetics : First order Rxn , Rate =  $k[R-X]$

Mechanism : Two steps

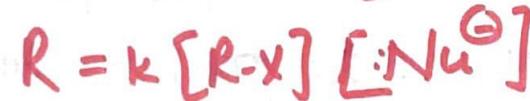
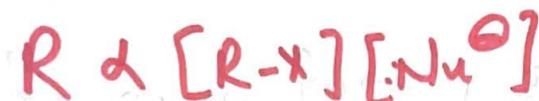
Stereochemistry : Trigonal planar carbocation (Intermediate)  
Racemization at a single stereogenic centre

Solvent : Polar protic solvent (which can provide H<sup>+</sup>)

Identify of R More substituted halides react fastest.

$SN^2 Rxn$  : Bond breaking occurs <sup>and</sup> after bond making / form<sup>"</sup> occur at same time.

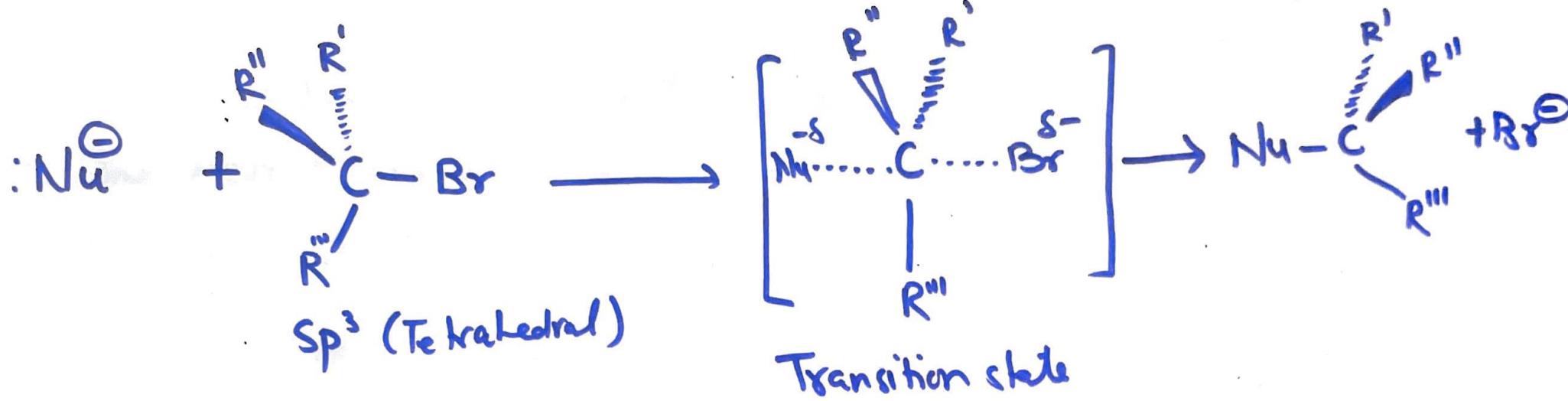
- One step rxn
- Rate of rxn depends upon the conc<sup>n</sup> of both the reactants
- Rate equation is second order



→ Solvent → polar aprotic

→ No form<sup>"</sup> of carbocation

→ Transition state involves



Transition state

:Nu<sup>-</sup> & Br<sup>-</sup> are at 180° away

As in  $SN^2$ , one side is occupied by  $Br^-$ , therefore  $:Nu^-$  will join from opposite side  $\rightarrow$  resulting in inversion of config<sup>n</sup> at a stereogenic centre.

## Characteristics of $SN_2$ Rxn

- Second order kinetics, Rate =  $k [R-X][Nu^-]$
- One step mechanism
- Backside attack of nucleophile
- Inversion of config' at a stereogenic centre
- Unhindered halides react fastest



Rate  $\propto \frac{1}{\text{steric hindrance}}$

- Polar aprotic solvent

{ Acetone  
DMSO  
DMF