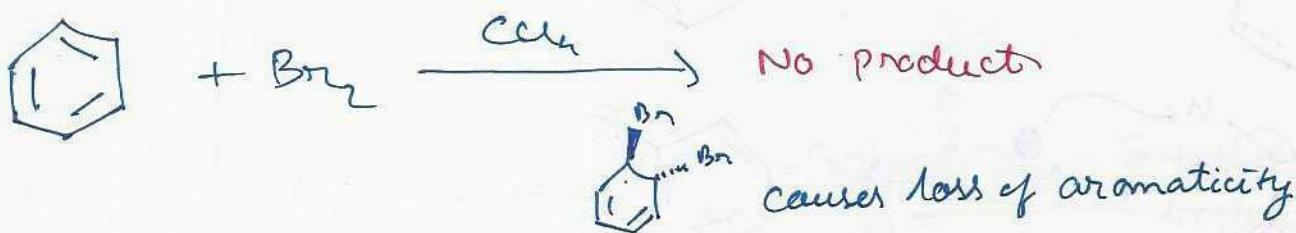
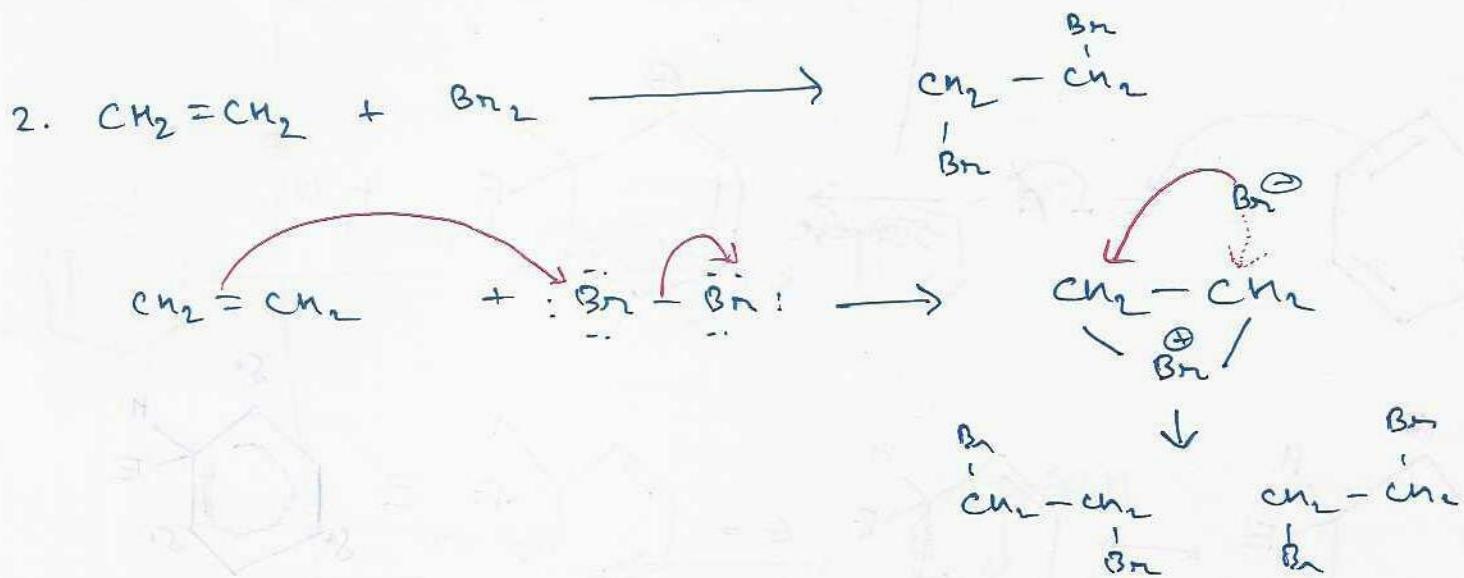
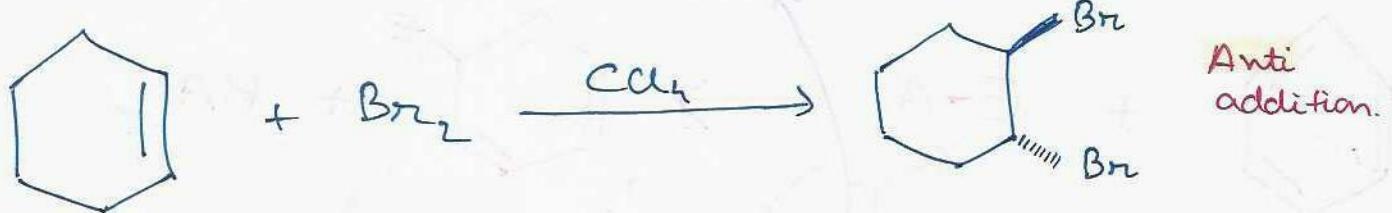


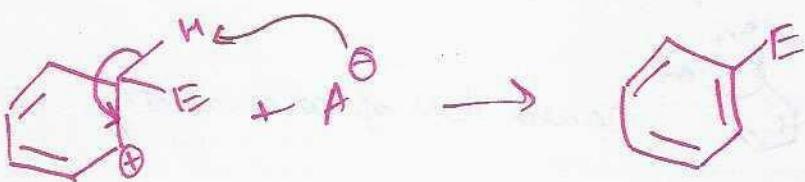
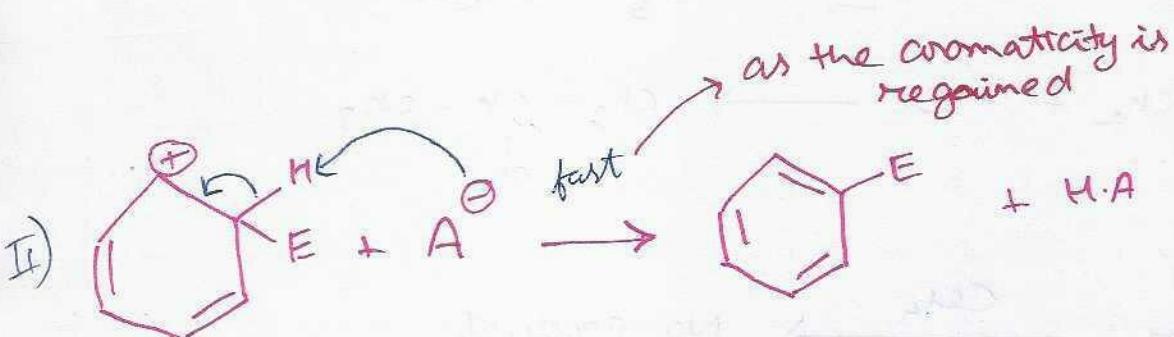
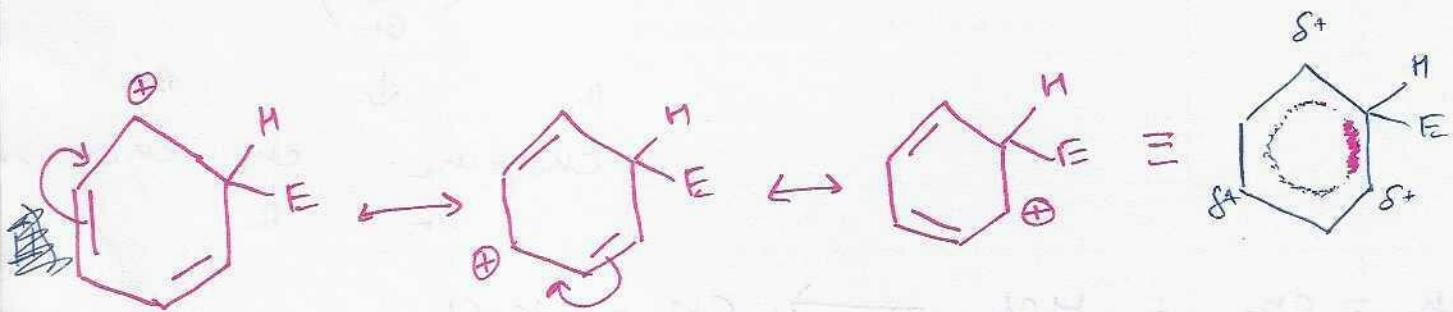
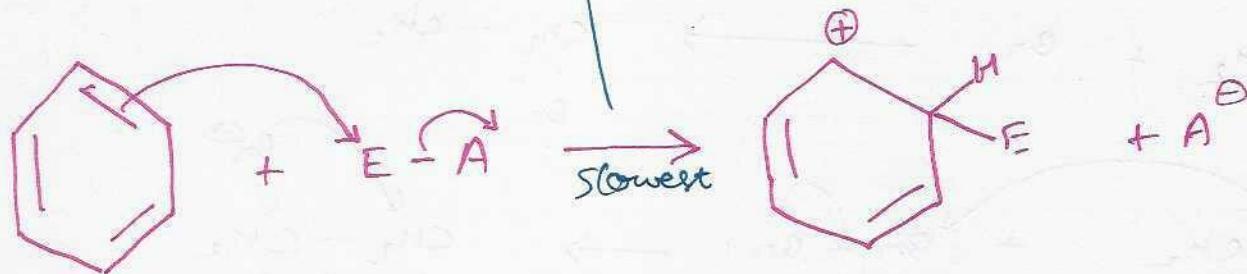
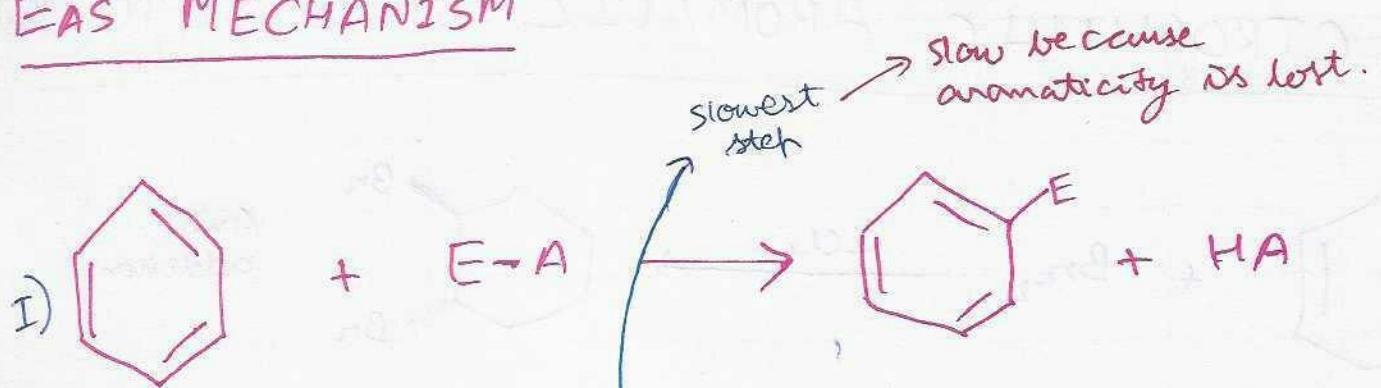
NAME: _____ STD.: _____ SEC.: _____ ROLL NO.: _____ SUB.: _____

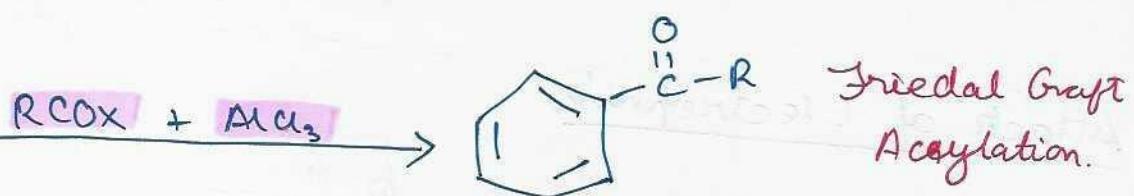
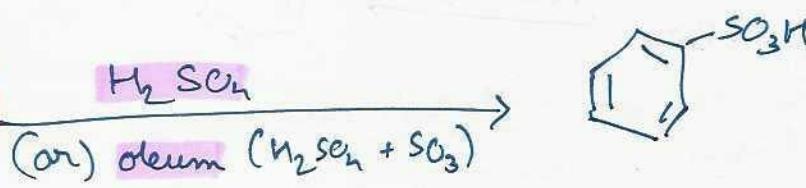
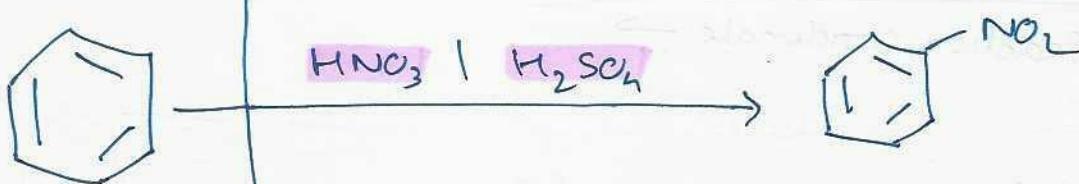
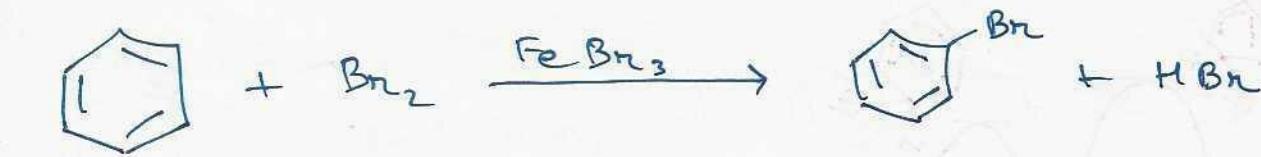
ELECTROPHILIC AROMATIC SUBSTITUTION

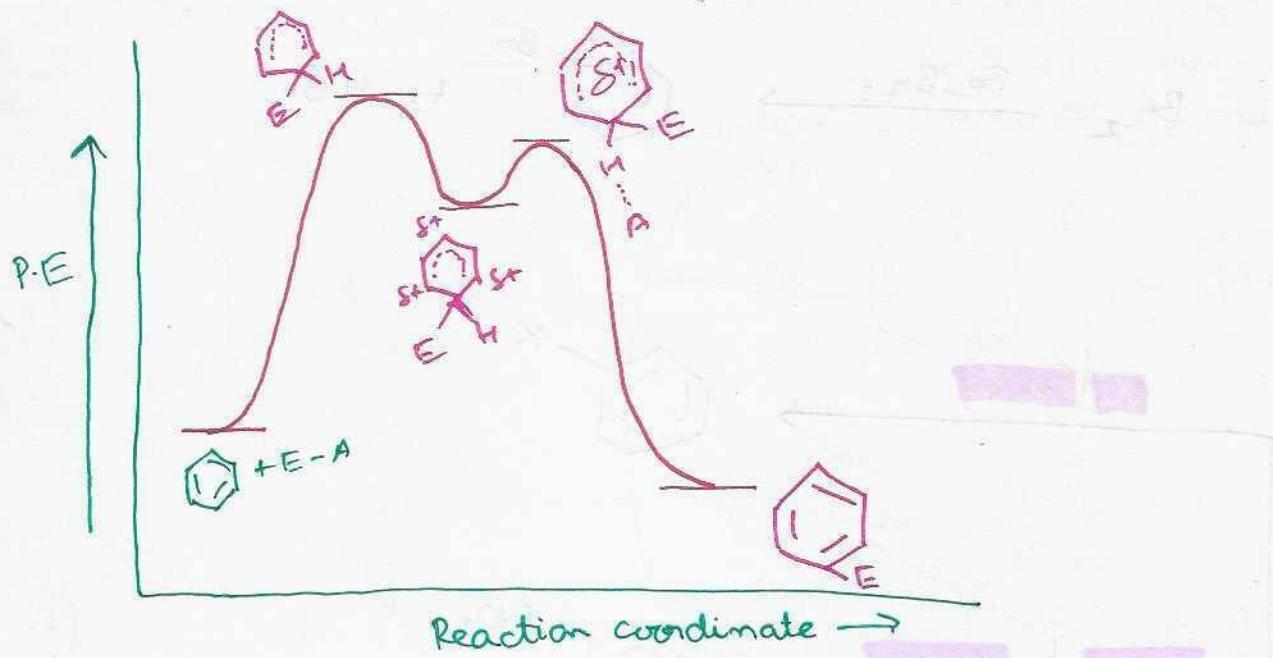


EAS MECHANISM

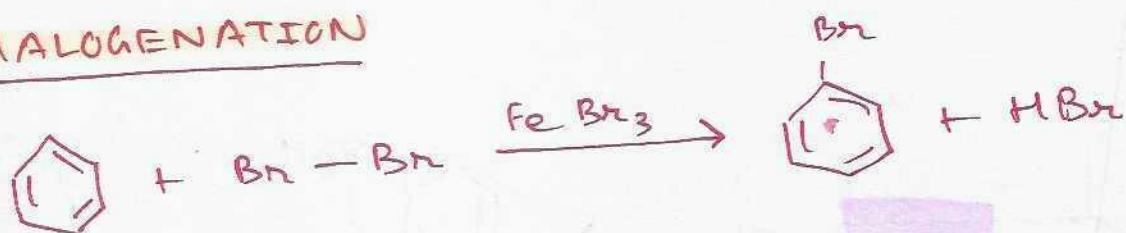
BY - 3.





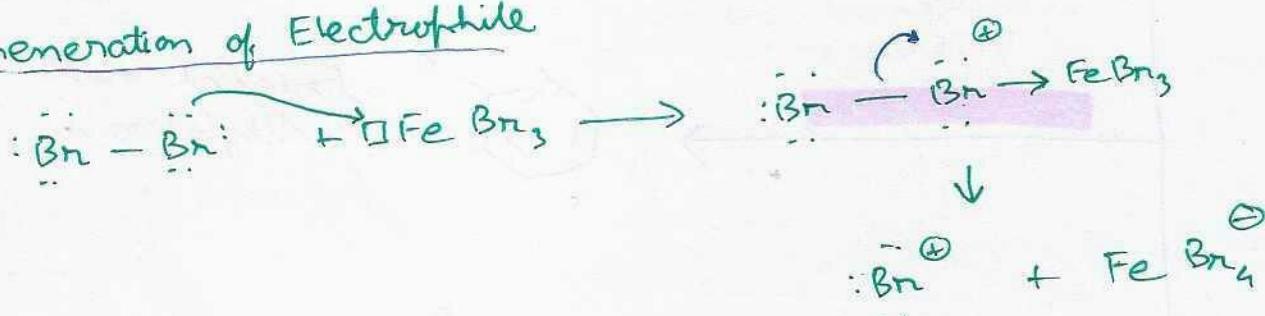


I. HALOGENATION

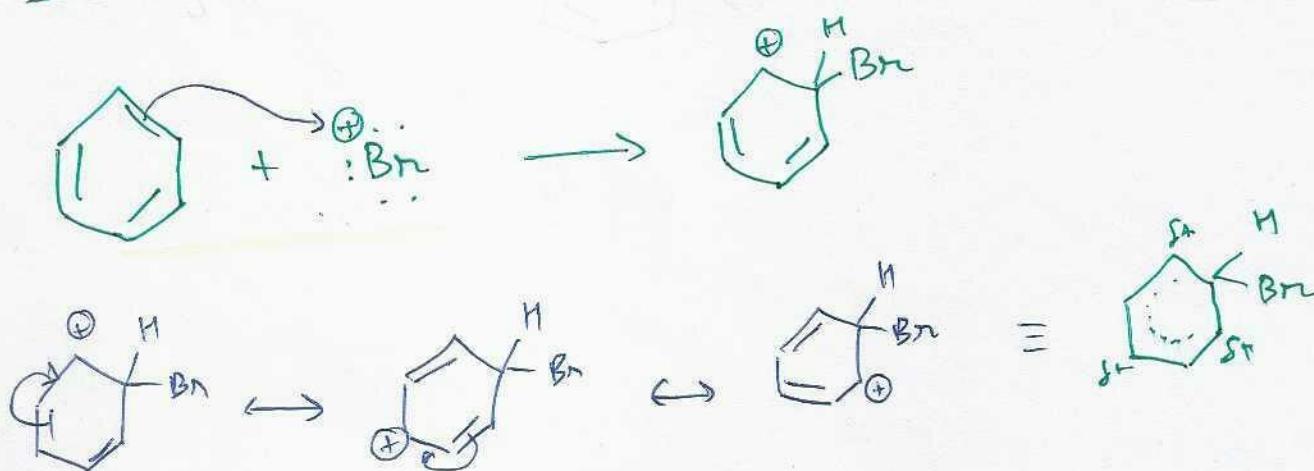


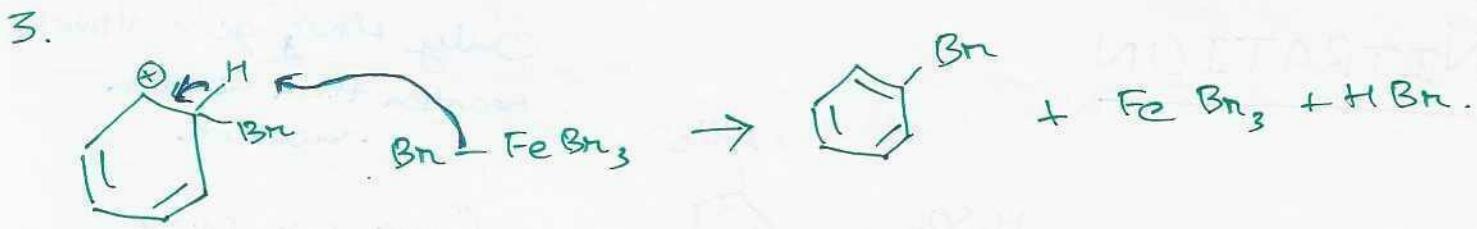
Mechanism

1. Generation of Electrophile

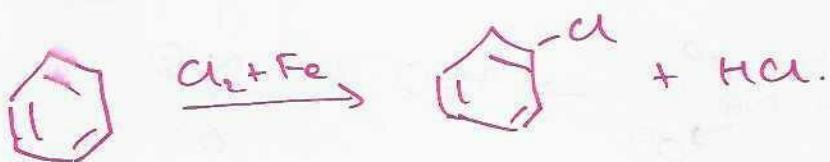


2. Attack of Electrophile



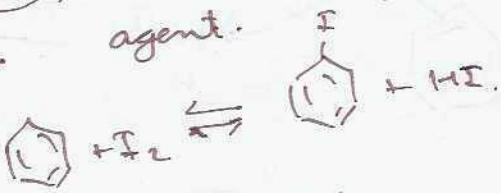


I^+ is not electrophilic.

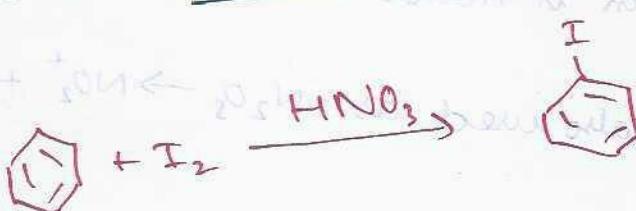
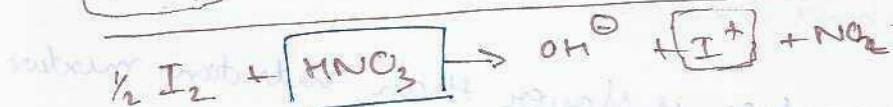


(F₂) Highly reactive \rightarrow Explosive reaction.

(I₂) very slow - Reversible reaction. \rightarrow HI is a strong reducing agent. I⁺ has less tendency to be formed.

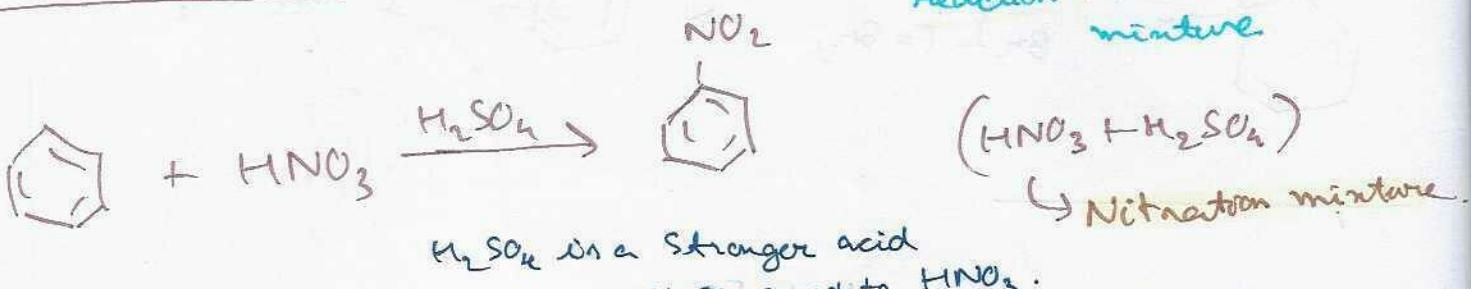


Can be carried out in presence of strong oxidizing agent.

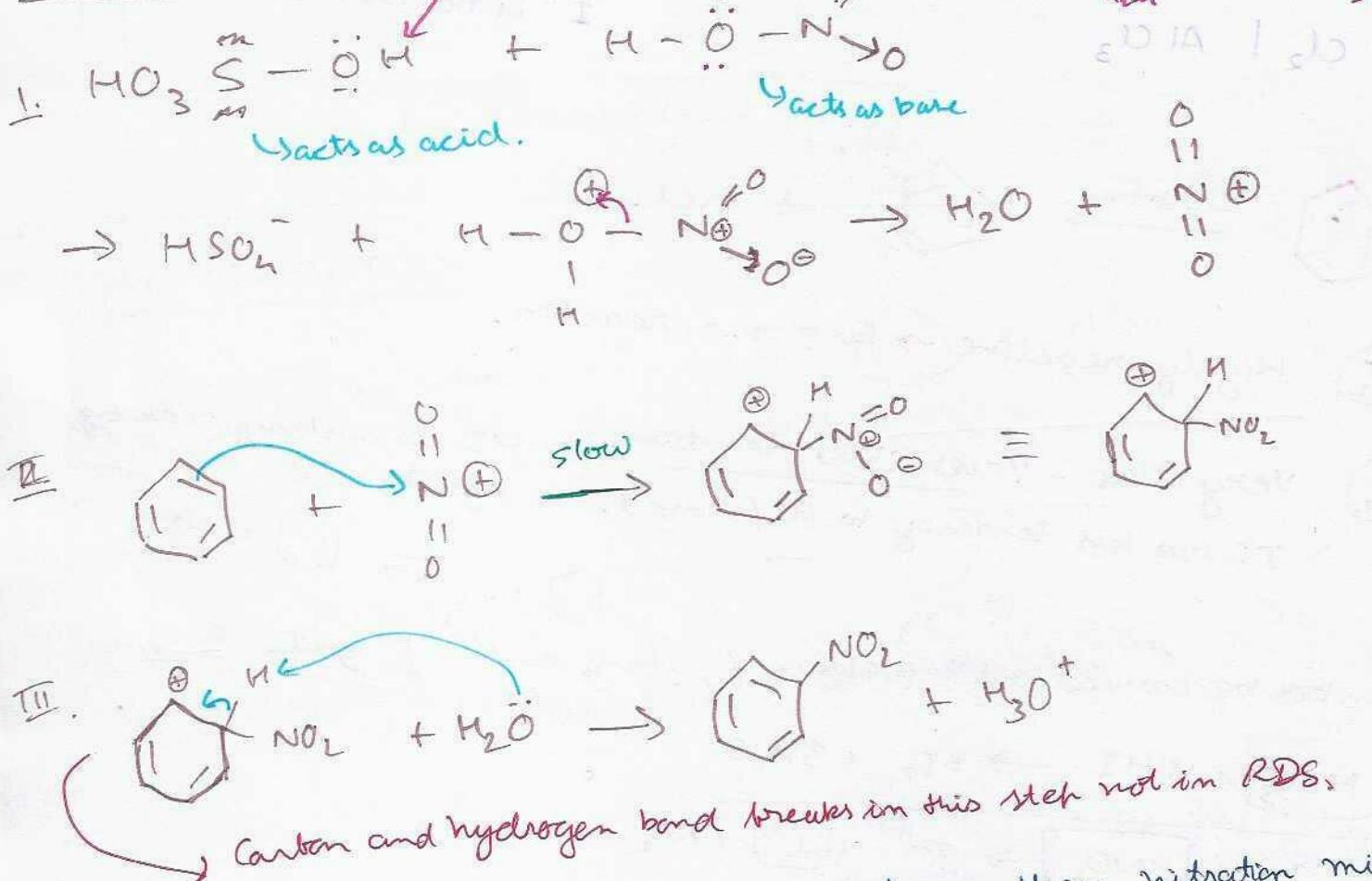


INITRATION

Only HNO_3 gives slower reaction than nitration mixture.



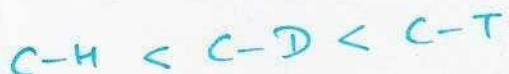
Mechanism



HNO_3 alone \rightarrow nitration reaction is slower than nitration mixture.

N_2O_5 in non-polar solvent is also used as $\text{N}_2\text{O}_5 \rightarrow \text{NO}_2^+ + \text{NO}_3^-$

Bond dissociation energies.



However

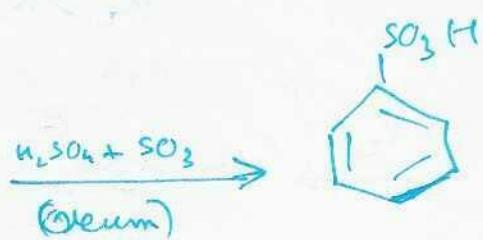
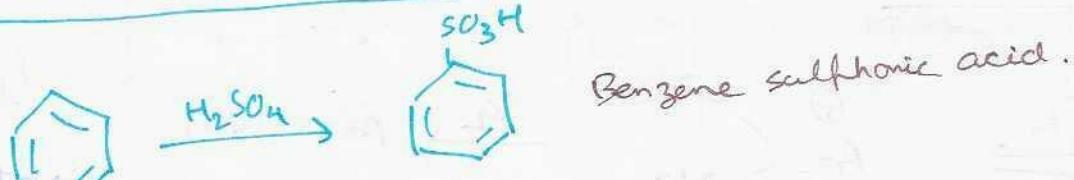


$$k_{\text{H}} = k_{\text{D}} = k_{\text{T}}$$

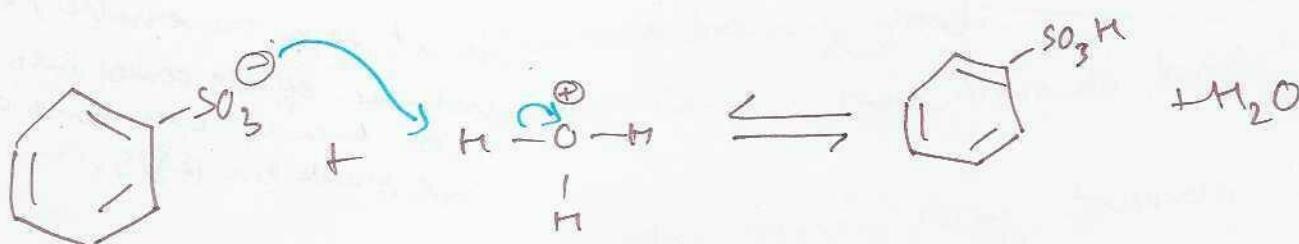
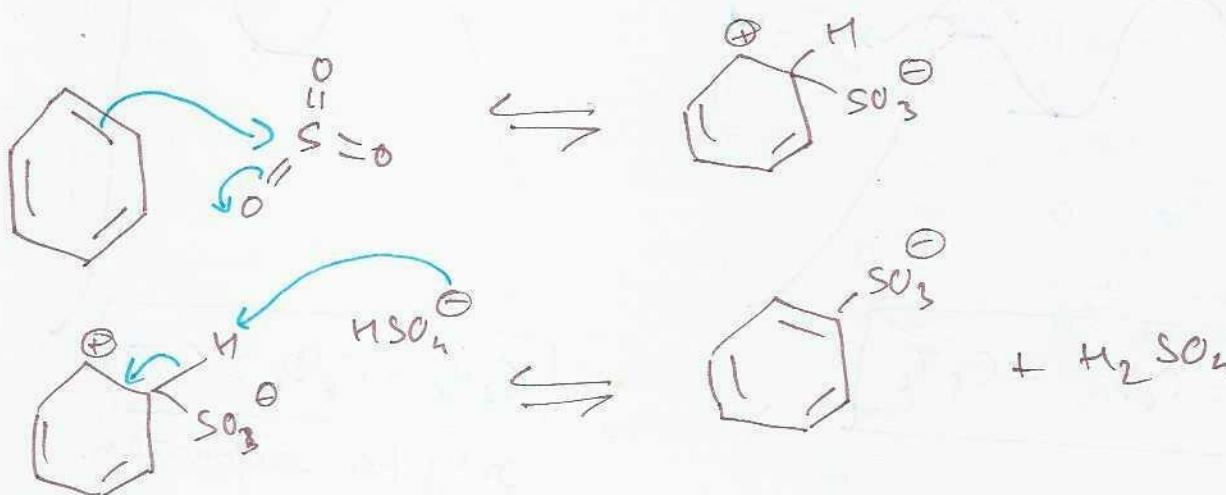
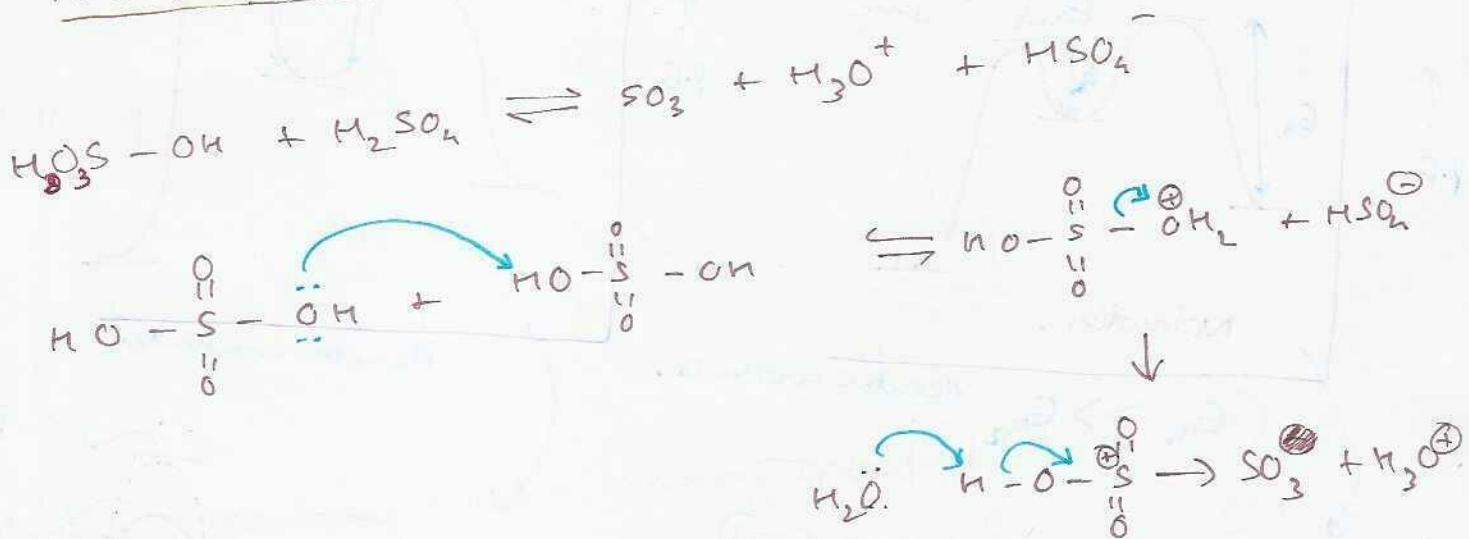
Rate of substitution

Rate is decided by Carbon and hydrogen bond breaking does not take place in (lowest step) rate determining step.

III. SULPHONATION

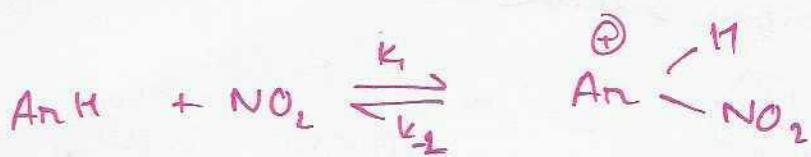


Reversible process



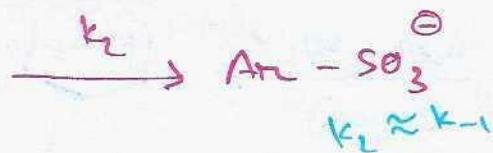
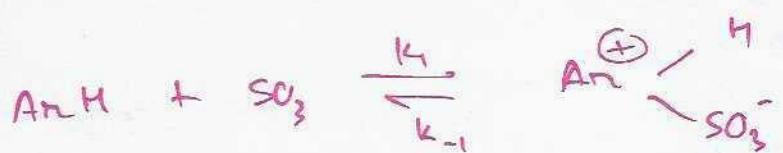
Nitration is not reversible

Sulphonation is reversible



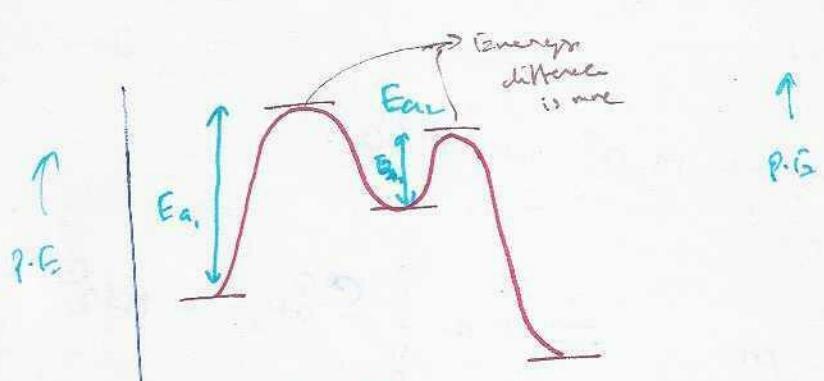
$$k_2 > k_{-1}$$

Not reversible



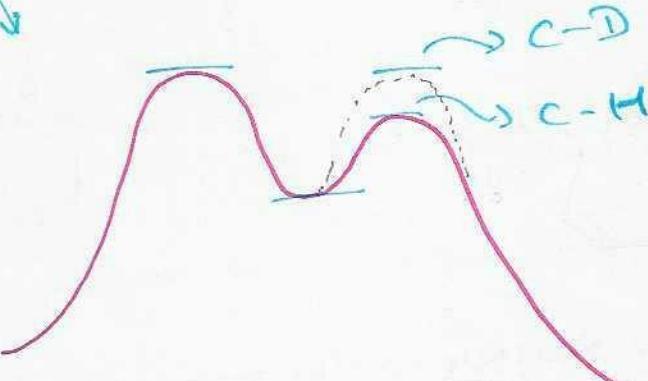
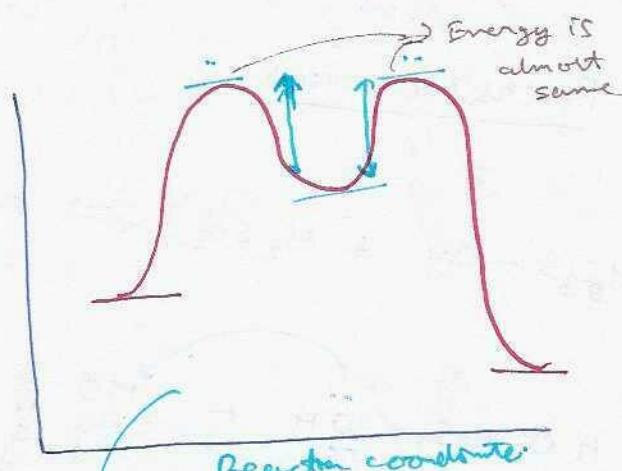
$$k_2 \approx k_{-1}$$

Reversible



$$E_{a1} \gg E_{a2}$$

reaction coordinate.

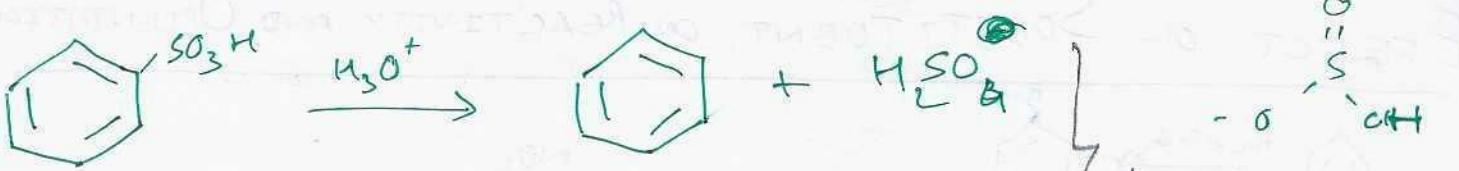


$$C_6H_6 = C_6D_6 = C_6T_6$$

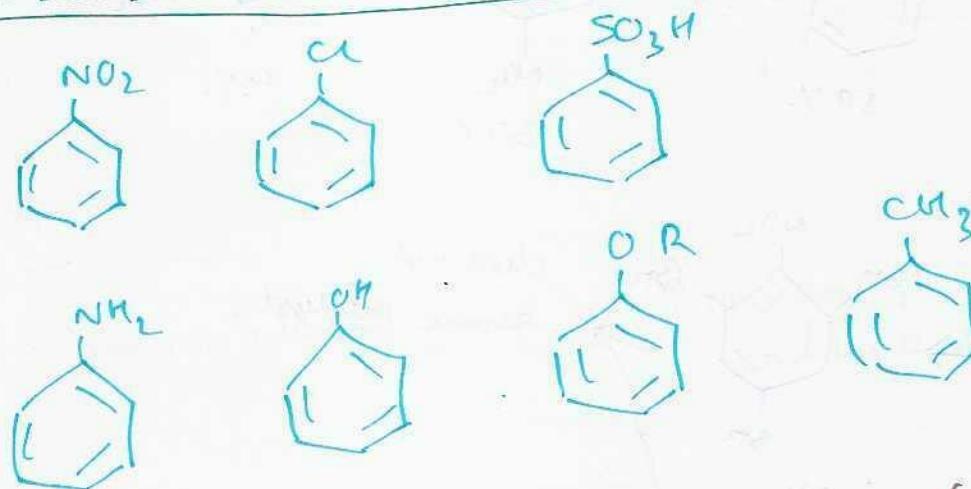
$$C_6H_6 > C_6D_6 > C_6T_6$$

Only for sulfonation.

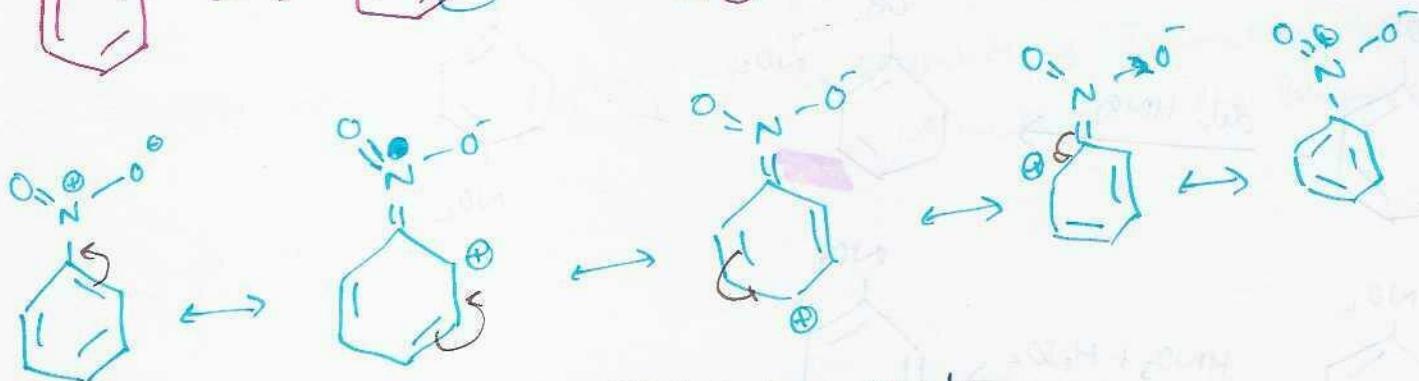
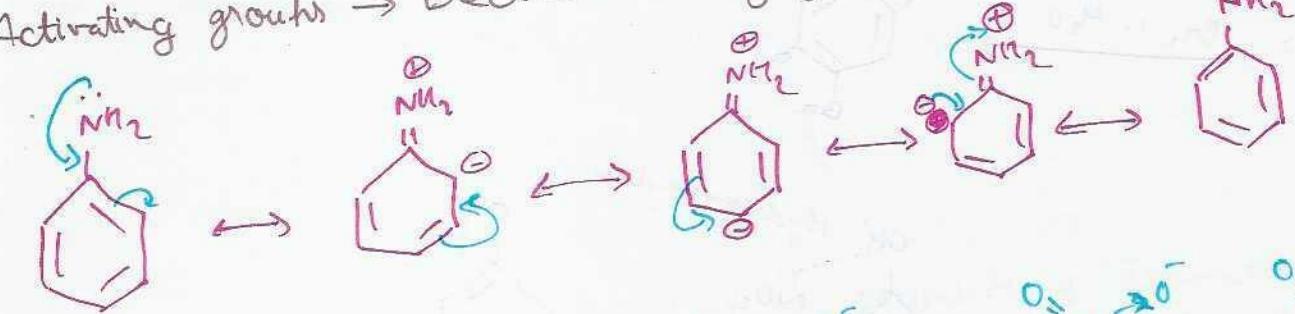
As it is a reversible process entropic effects comes into action even if C-N bond does not break in RDS.



EFFECTS OF SUBSTITUENTS ON REACTION



Activating groups → Electron releasing groups (+M, +I, +H)

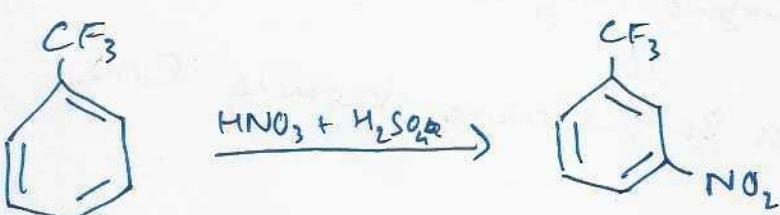
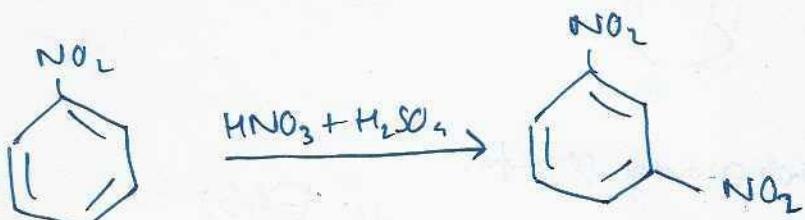
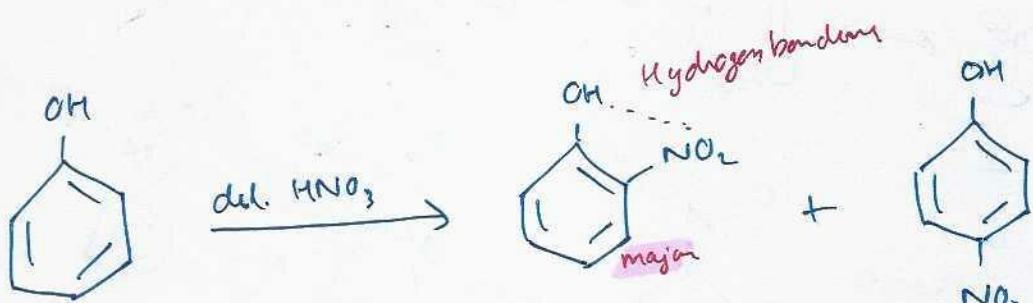
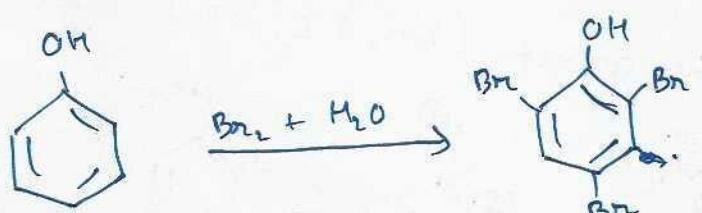
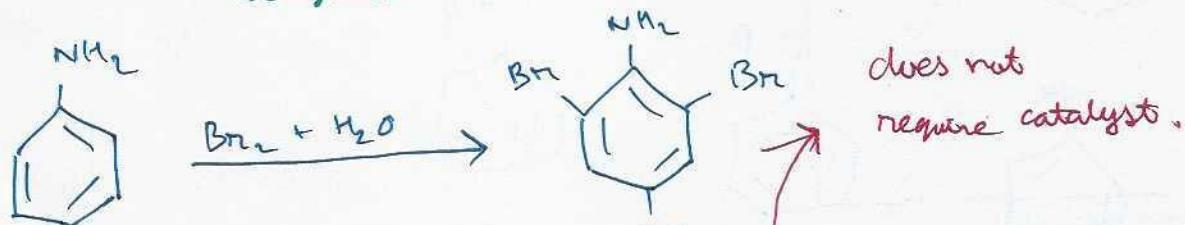
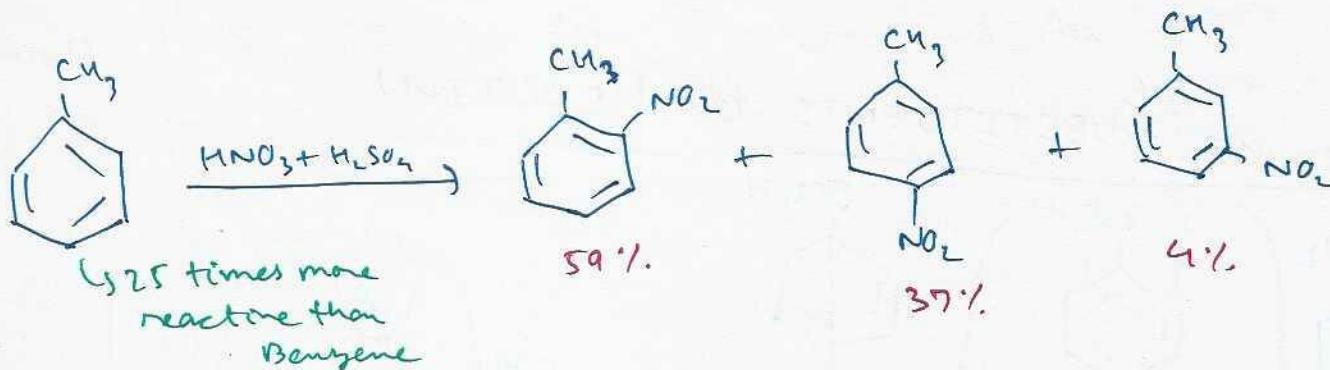
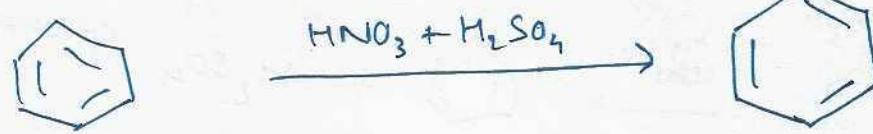
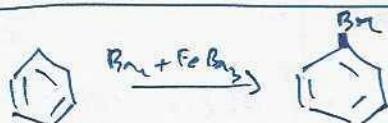


Deactivating groups → Electron withdrawing groups.

+M, +H, +I → activates Benzene ring towards EAS.

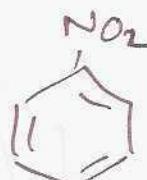
-M, -I, -F → deactivates Benzene ring towards EAS

EFFECT OF SUBSTITUENT ON REACTIVITY AND ORIENTATION

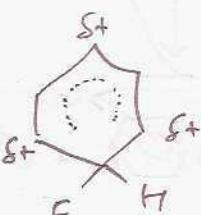
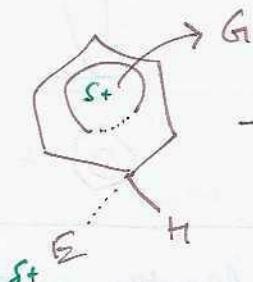




Activating group



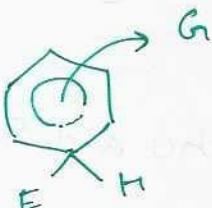
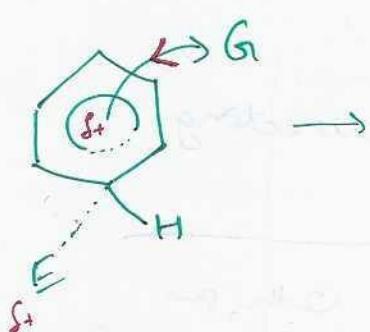
Deactivating group



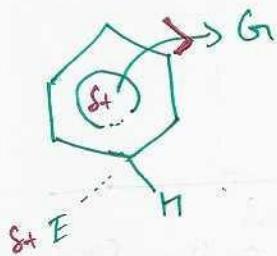
Arenium ion.

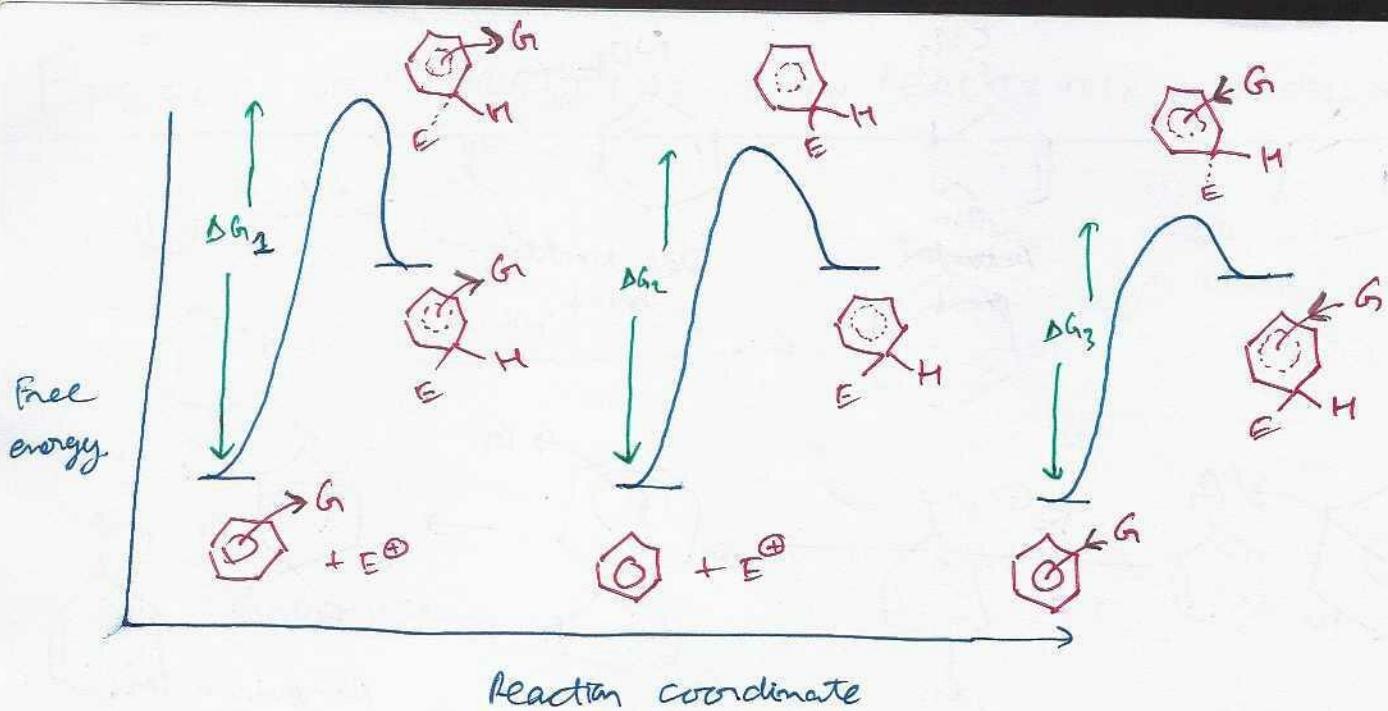


G_1 = Electron releasing group \rightarrow \uparrow stability of Transition state
activates Benzene ring.



G_1 = Electron withdrawing group \rightarrow \downarrow stability of Transition state
deactivates the Benzene ring





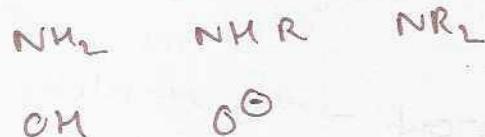
$$\Delta G_1 > \Delta G_2 > \Delta G_3$$

Activating groups \rightarrow Ortho and Para directing

Deactivating groups \rightarrow Meta directing

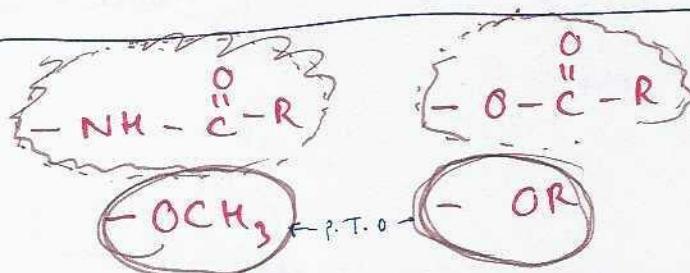
Halogens (deactivating) \rightarrow Ortho and Para directing.

Strongly
Activating



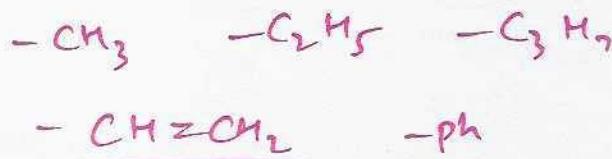
Ortho, para

Moderately
Activating



Ortho, para

Weakly
deactivating

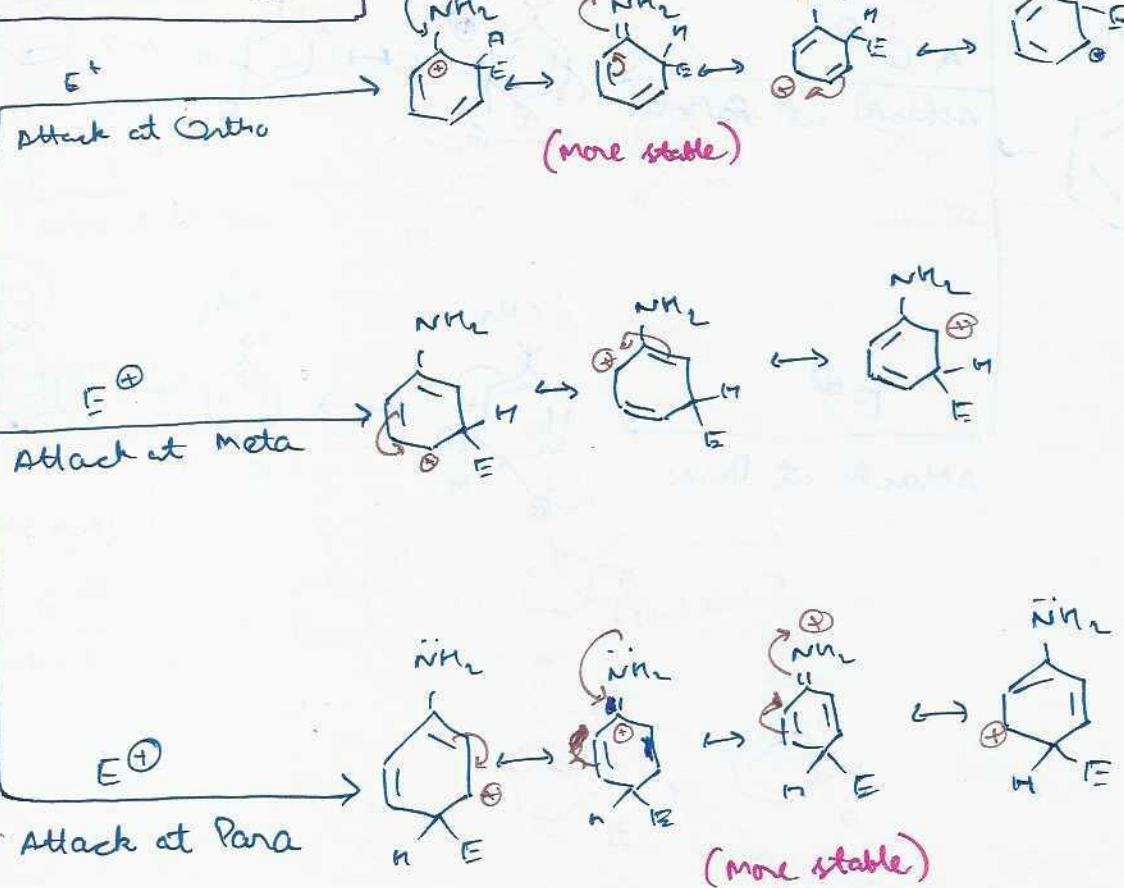
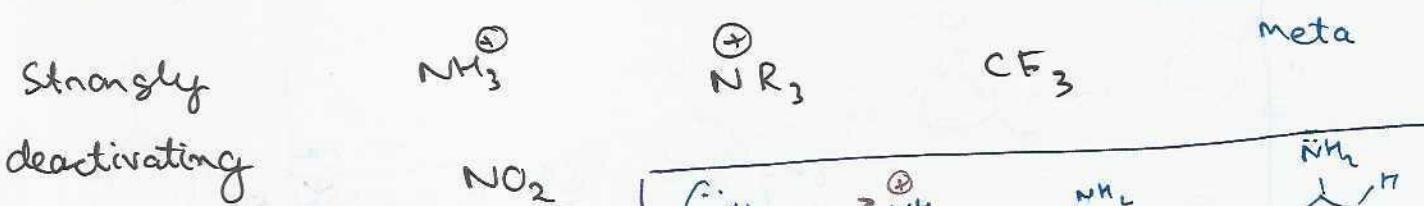
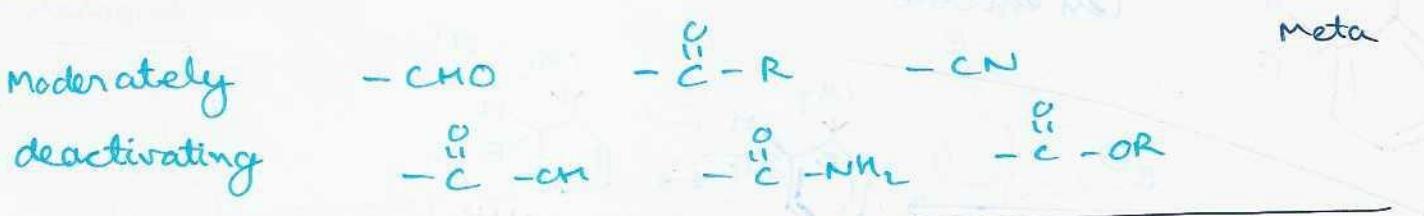
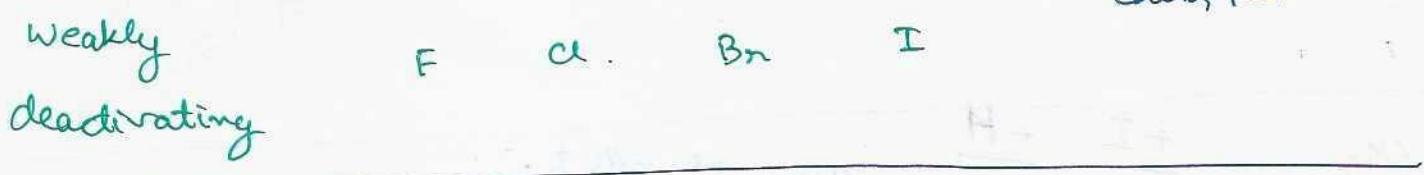
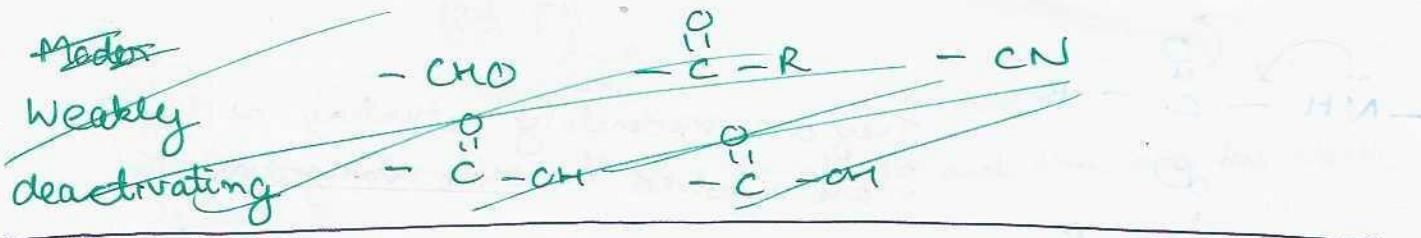


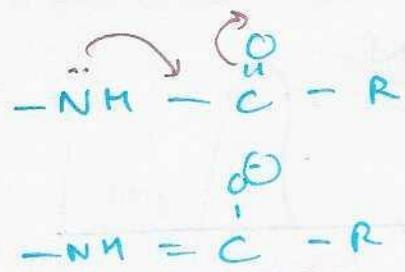
Ortho, para



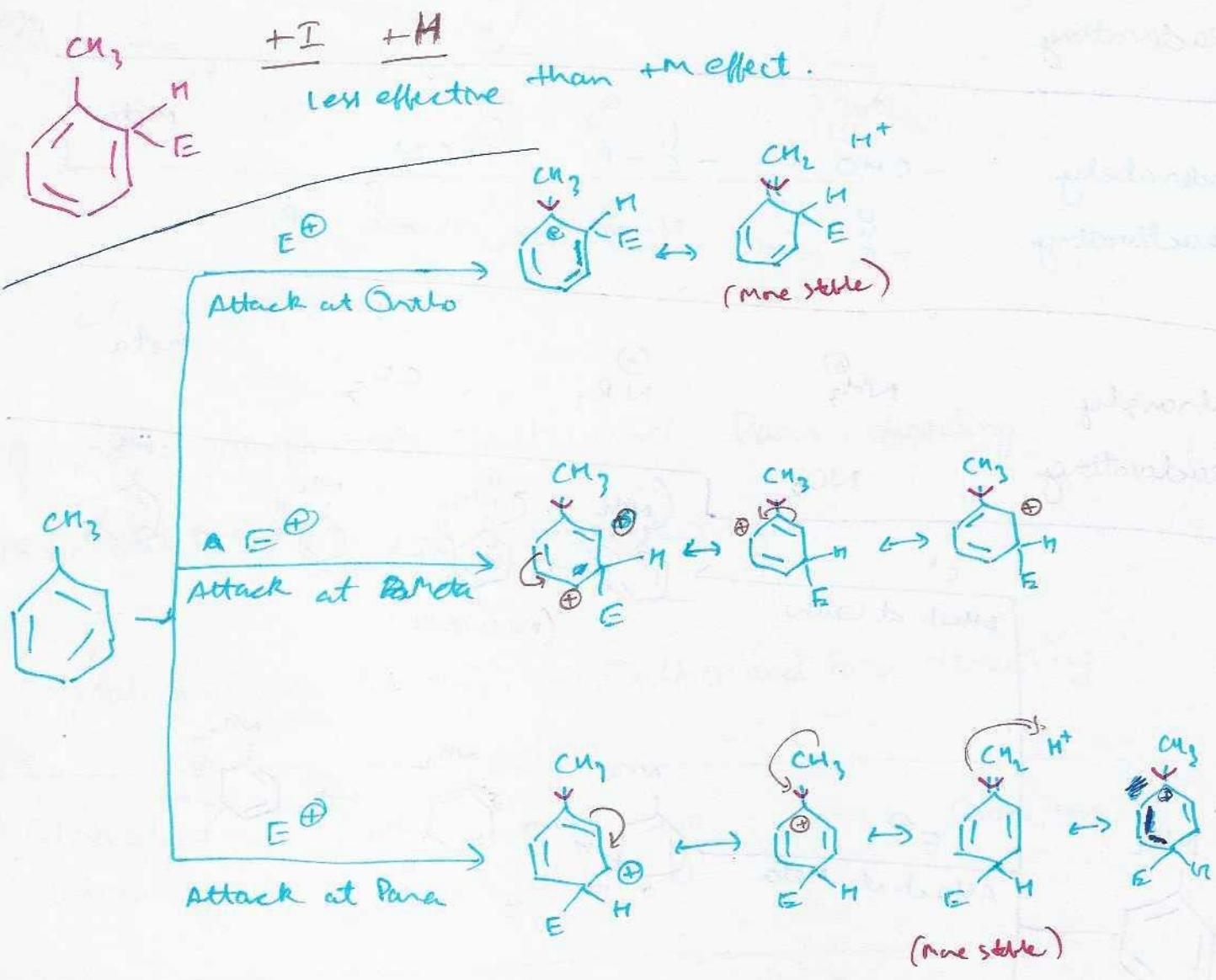
X more E.N than $Y \rightarrow$ Ortho para directing ($NH_2, NHR, O-COHR, NR_2, OCH_3, CN$)

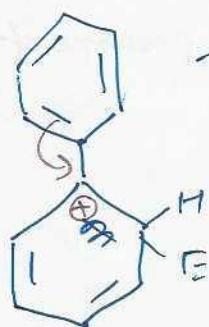
X less E.N than $Y \rightarrow$ Meta directing ($Cl, Br, COOH, -C_6H_5, CONH_2, COOR, NO_2$)





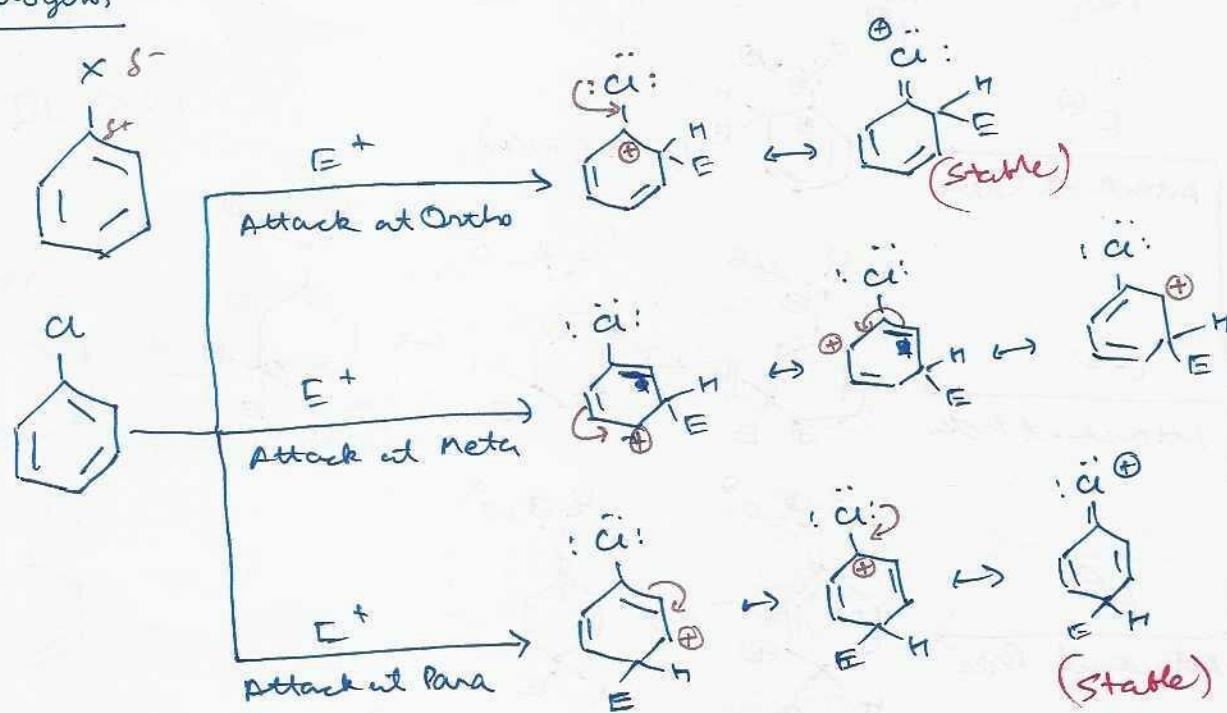
They are moderately activating as they are involved in cross conjugation.



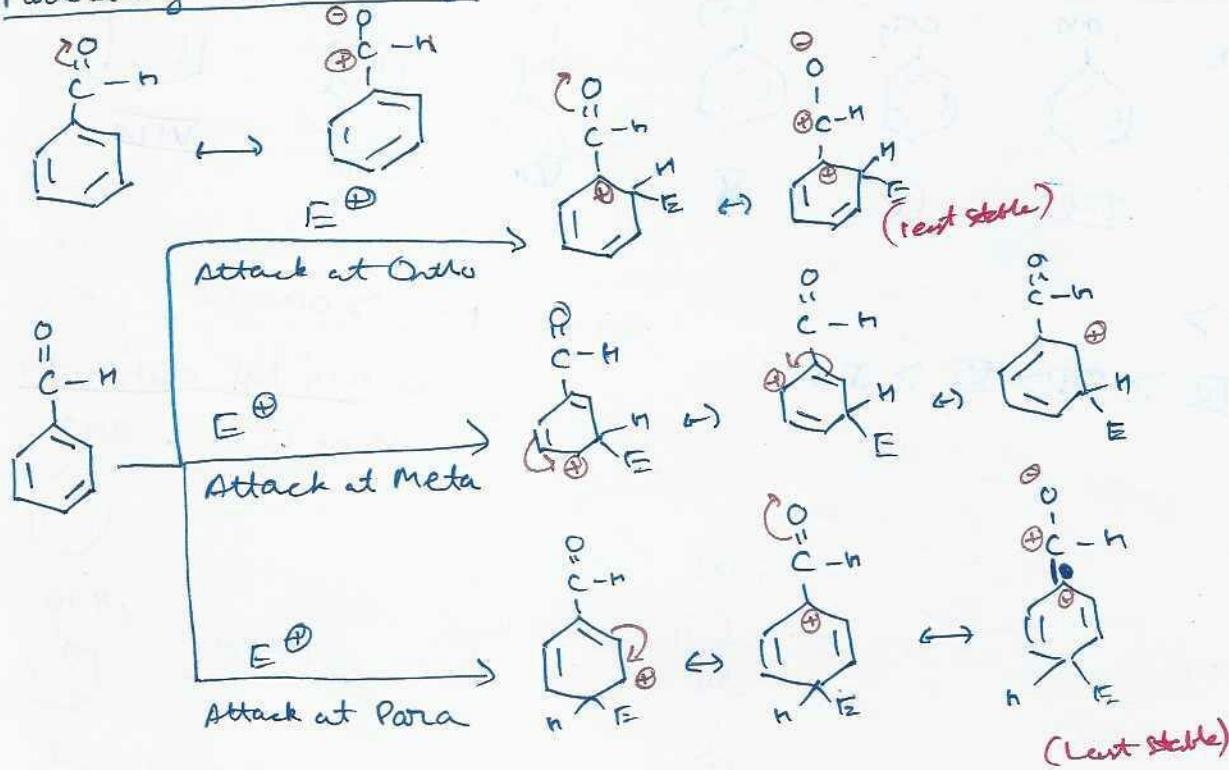


They lose their aromaticity and thus are less stable
→ weakly activating group

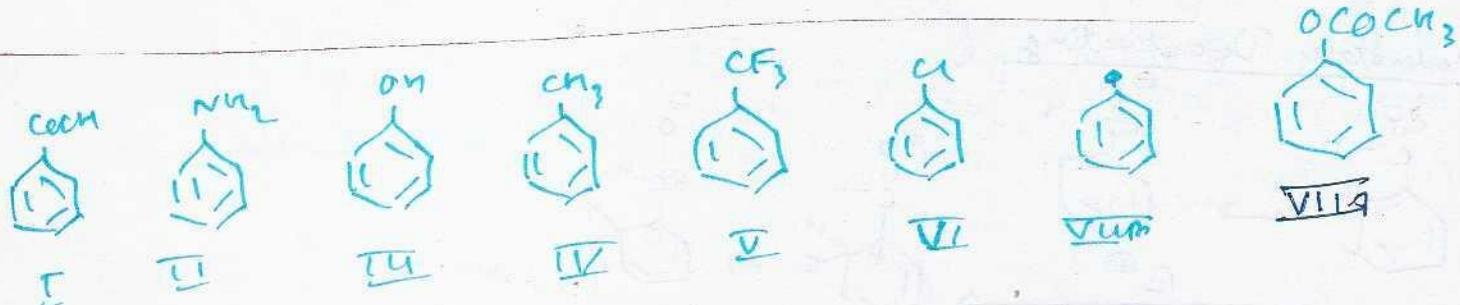
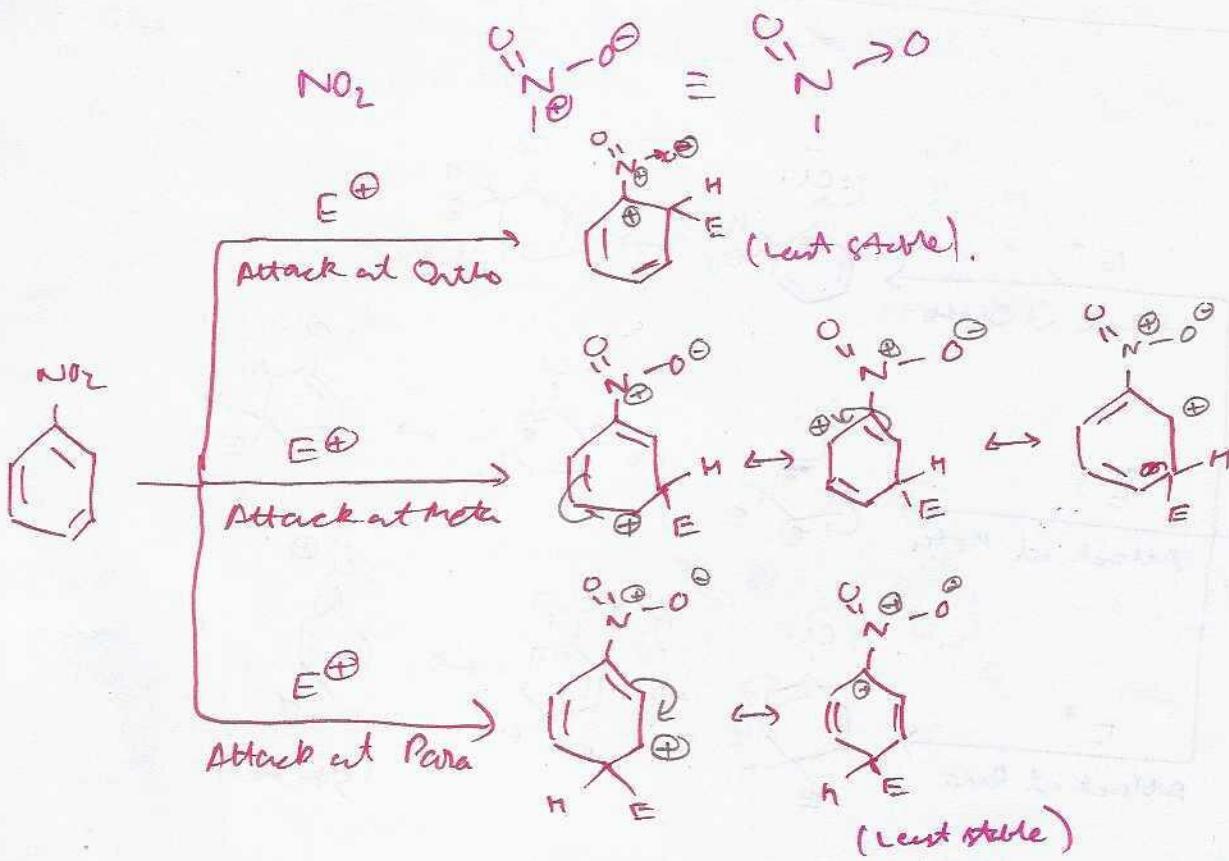
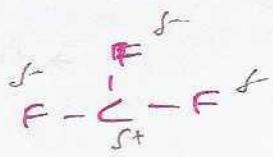
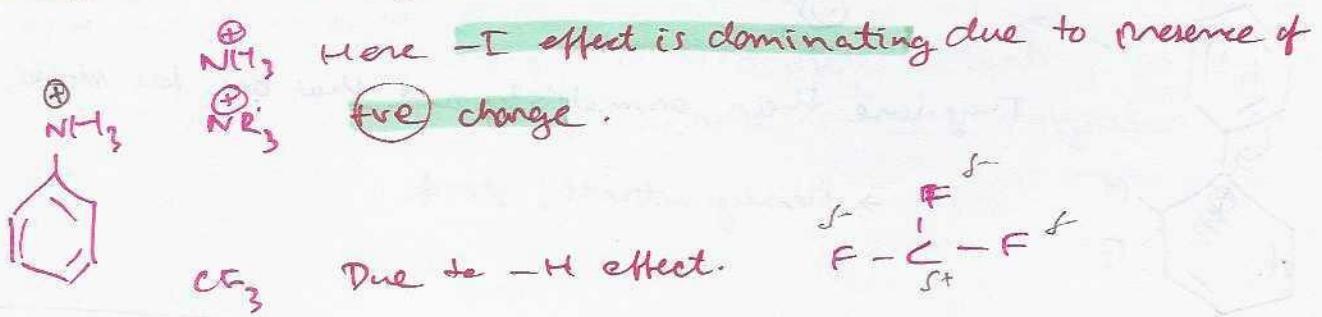
Halogens



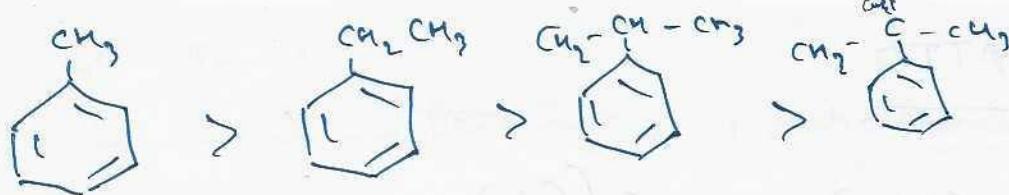
Moderately Deactivating



Strongly Deactivating

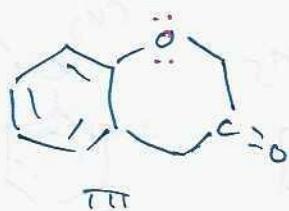
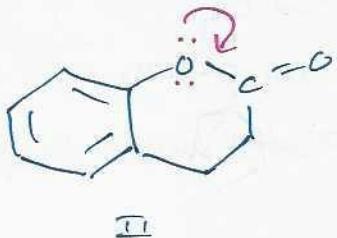
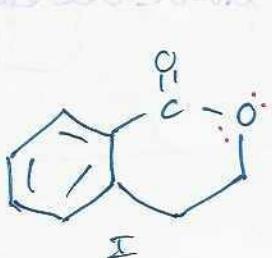


$\text{NH}_2 > \text{OH}$
 as N is less electronegative
 than O.

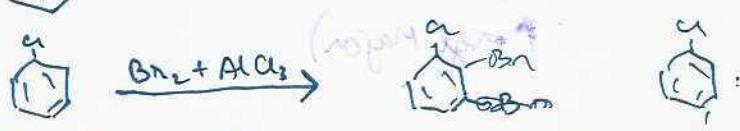
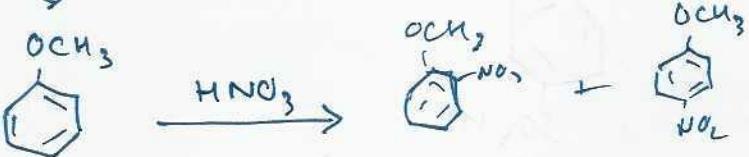
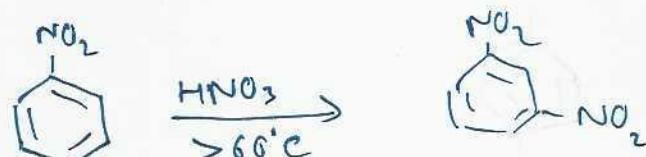
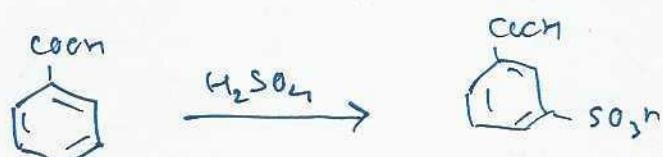
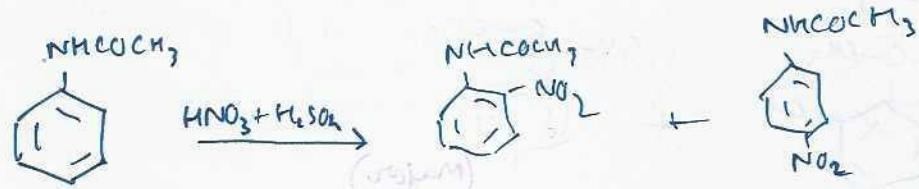
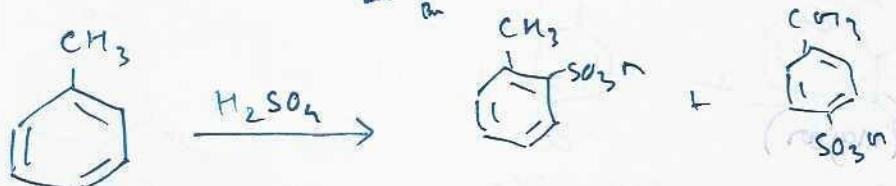
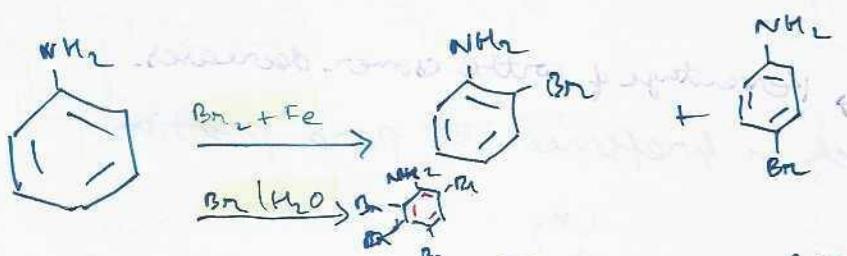


Proprietary

more electrons enter



Deactivating



ORTHO, PARA RATIO

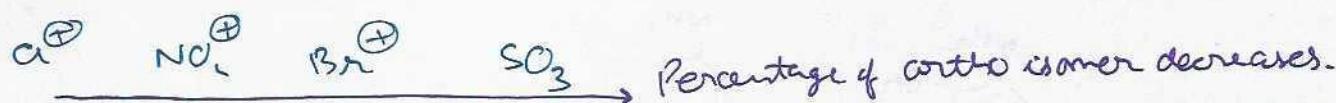


Percentage of ortho isomer decreases.

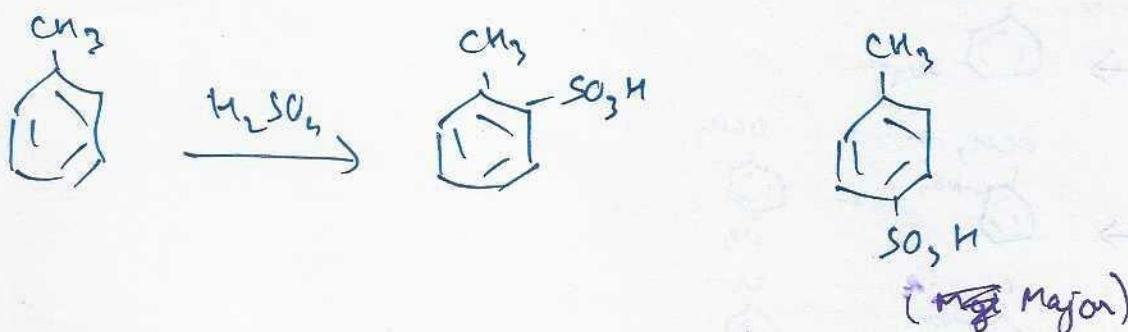
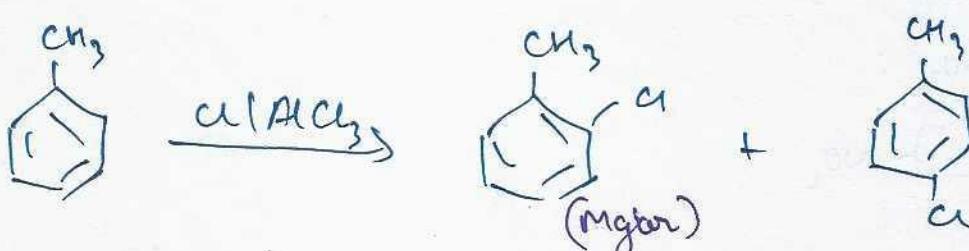
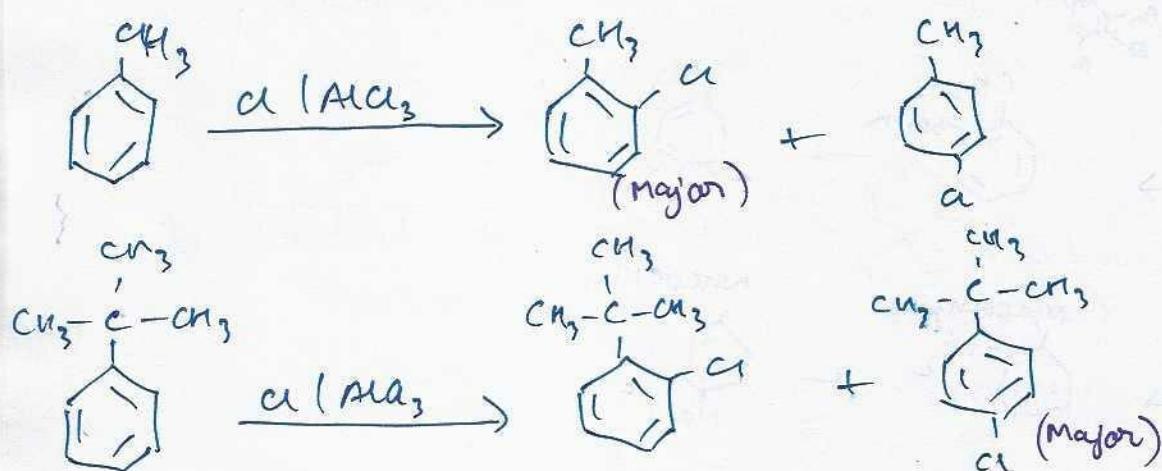


Percentage of ortho isomer decreases.

Percentage of para isomers increases.

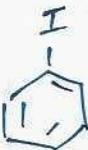
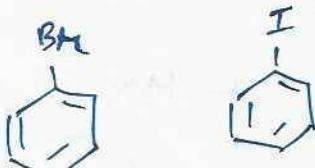
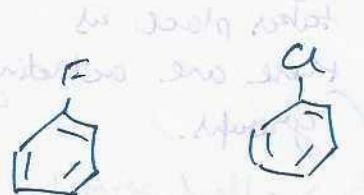


If electrophile is bulky, attack is preferred at para position.



F a Br I

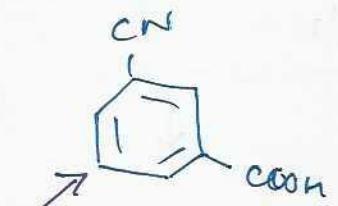
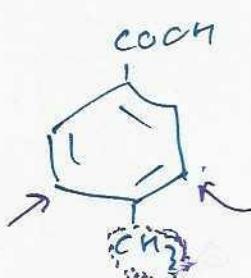
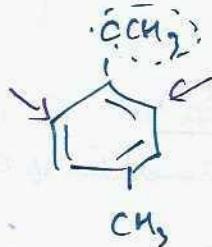
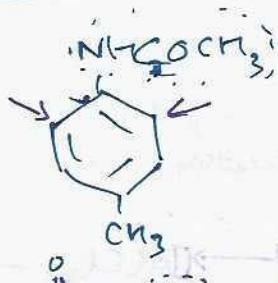
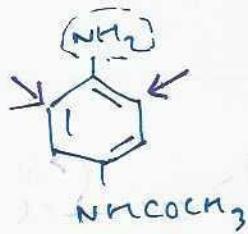
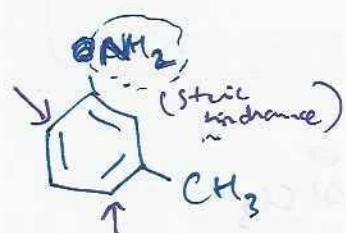
→ Percentage of ortho increases.



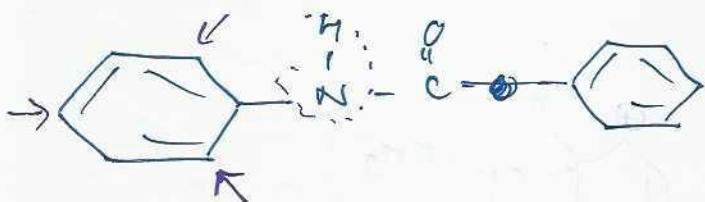
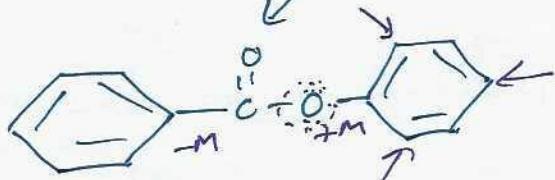
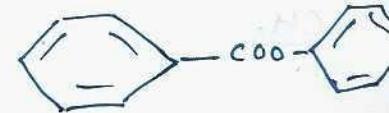
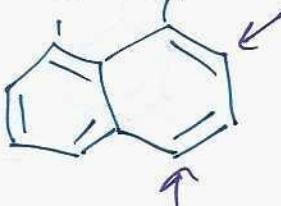
-I effect of fluorine is maximum.

→ -I effect destabilization decreases.

SUBSTITUTION AT DISUBSTITUTED BENZENE



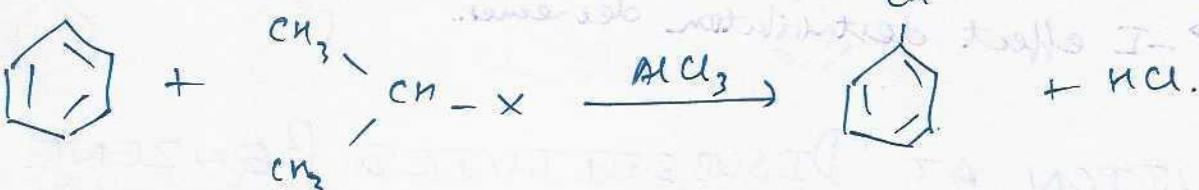
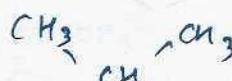
(Here product yield
is less as two
deactivating groups
are present)



FRIEDAL CRAFT ALKYLATION

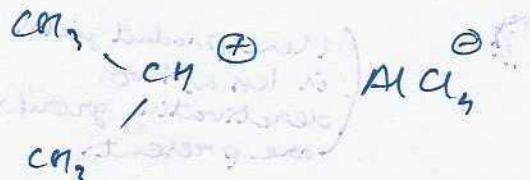
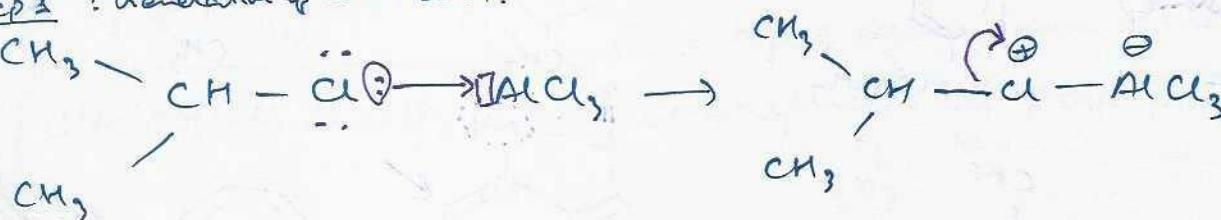


Poly alkylation takes place as there are activating groups.

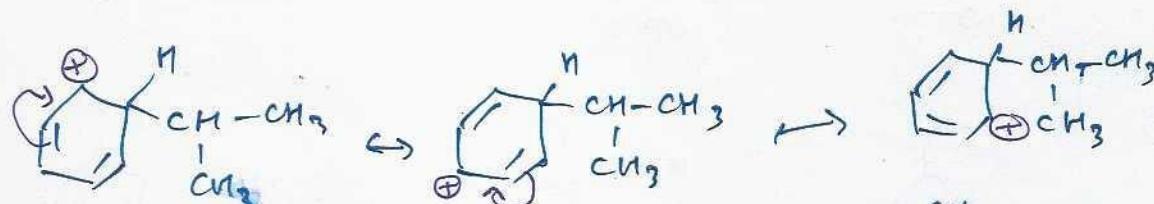
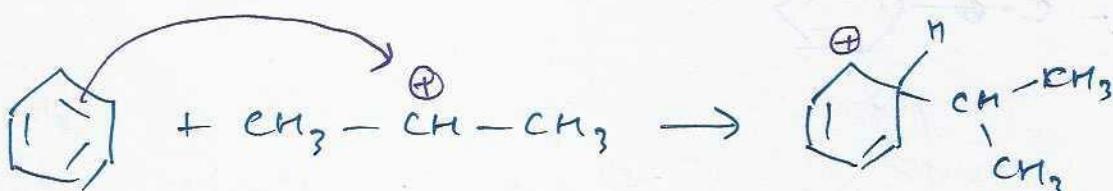


Mechanism

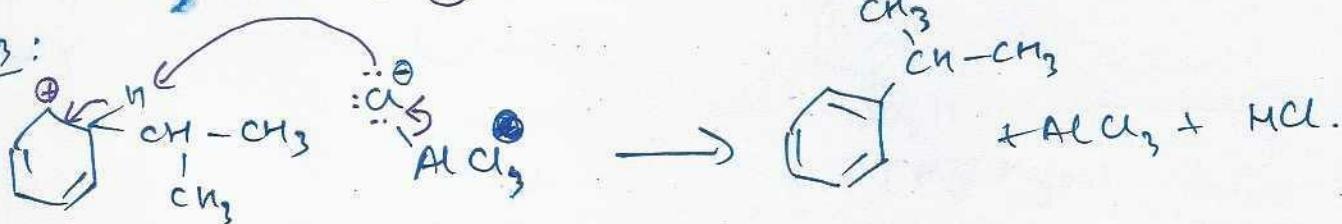
Step 1: Generation of carbocation.

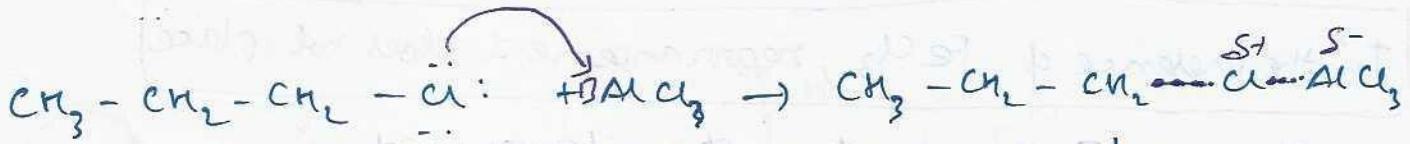
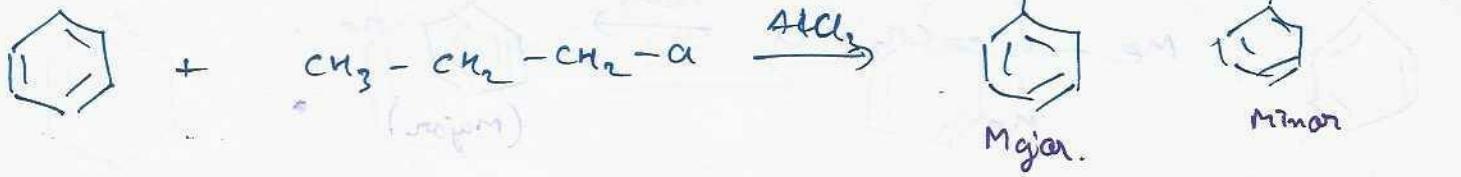


Step 2:

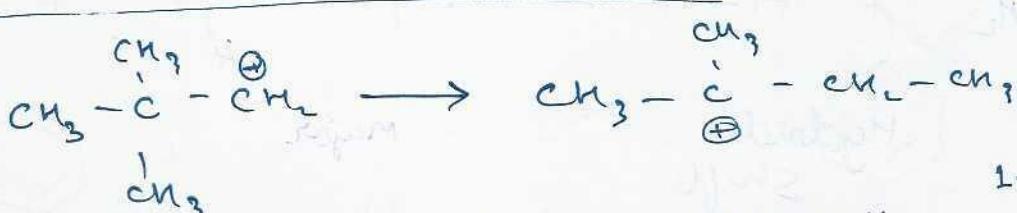
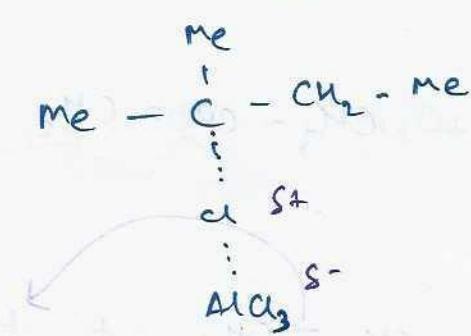
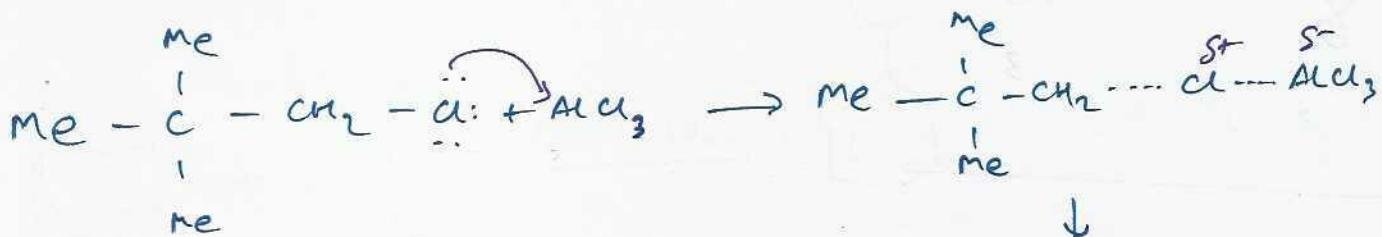
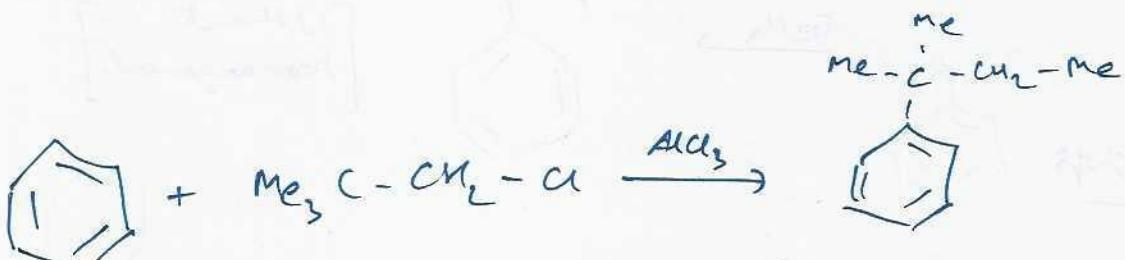
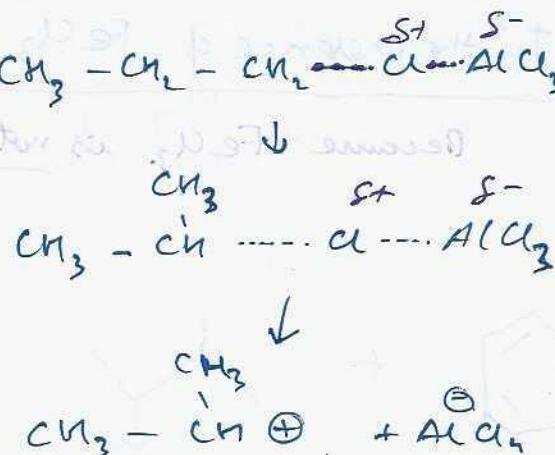


Step 3:





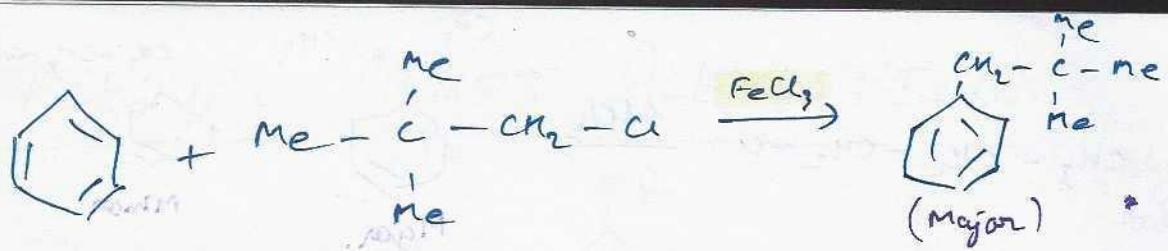
Primary carbocation is not formed. Rearrangement takes place before formation of carbocation.



1-2 methyl shift

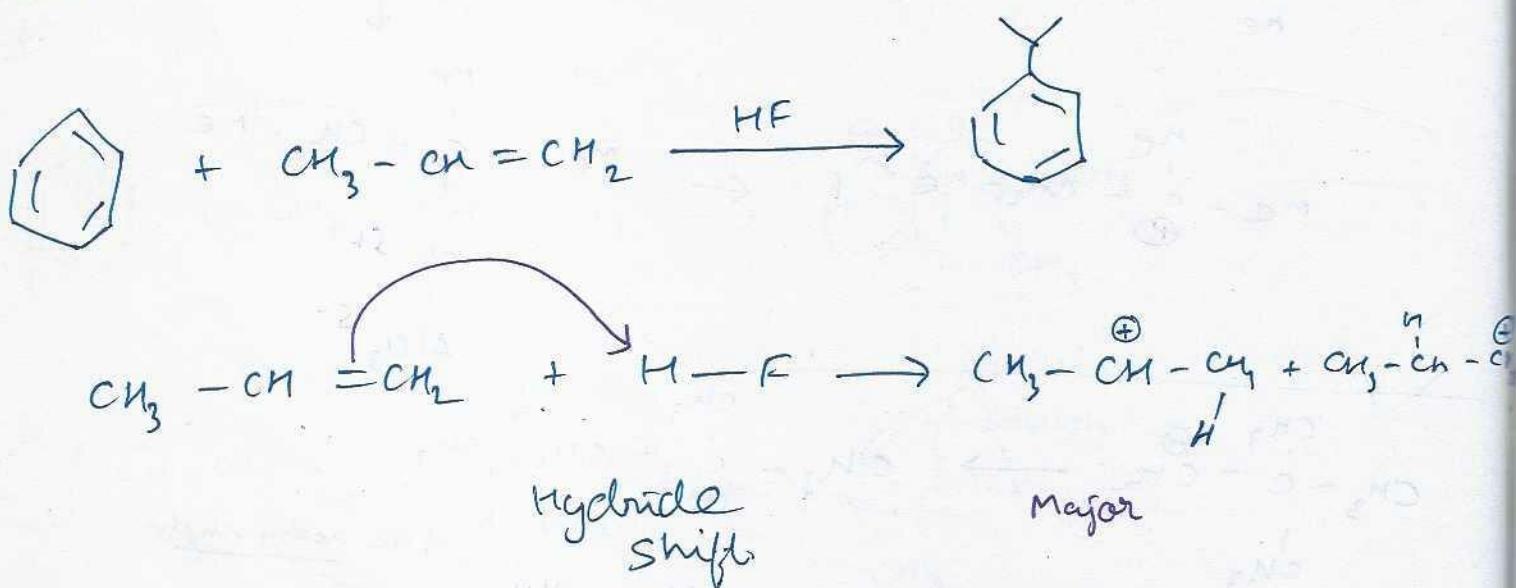
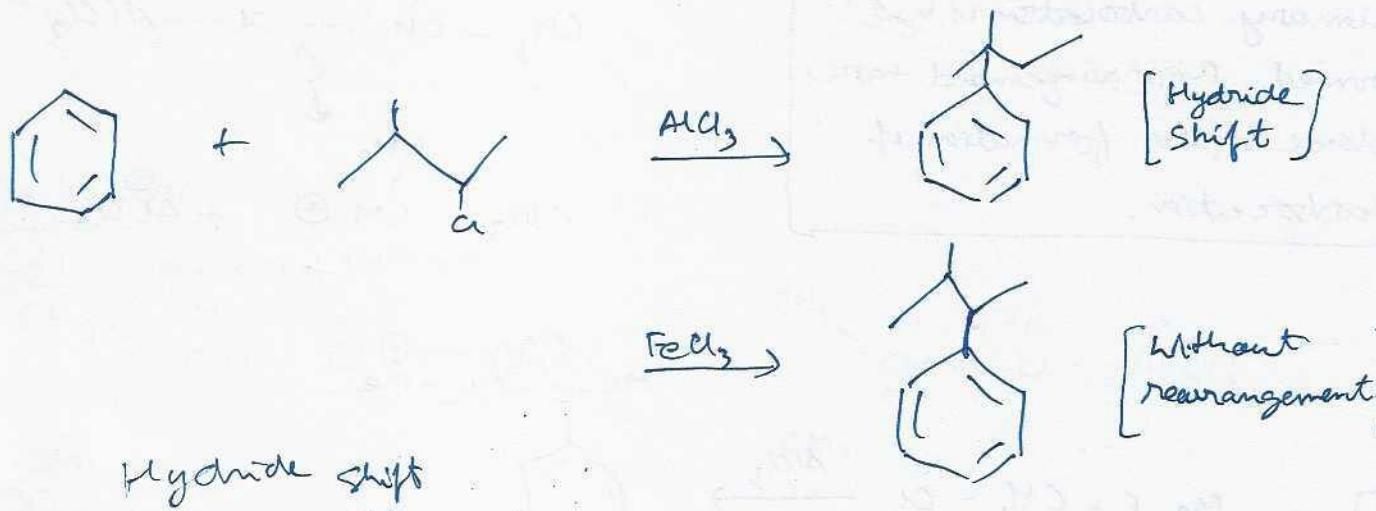
Does not actually happen in this way. Just for representation.

Primary carbocation is not formed. Rearrangement takes place in transition state.



In the presence of FeCl_3 , rearrangement does not place.

Because FeCl_3 is not a strong Lewis acid.

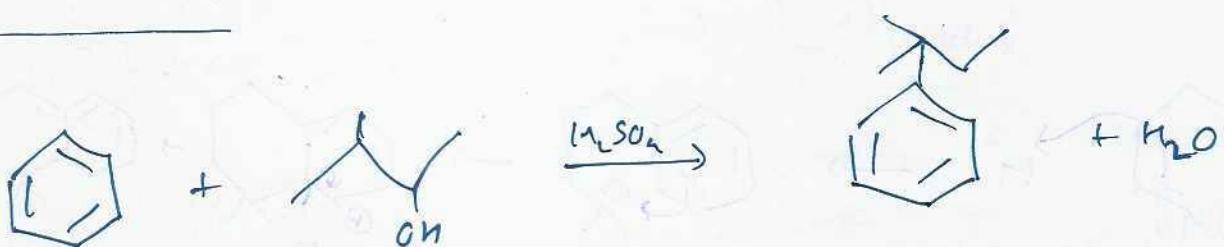
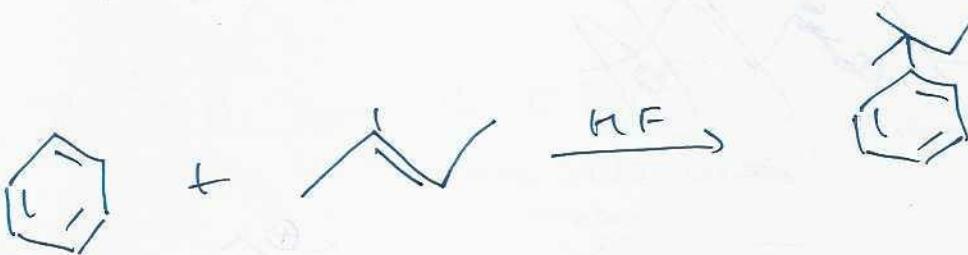
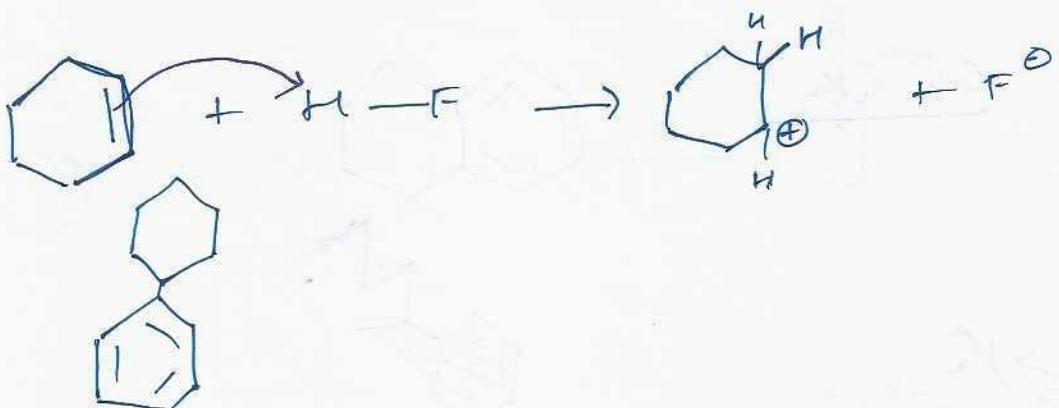


Hydride shift

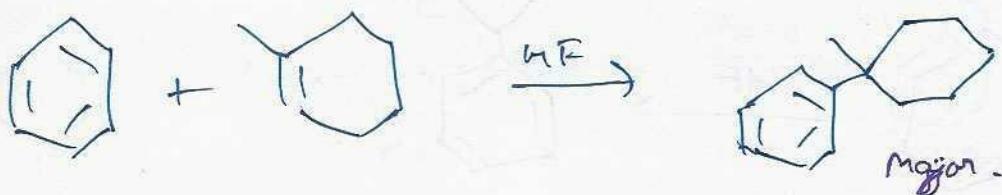
Major

Hydride shift does not occur in the presence of strong acid.

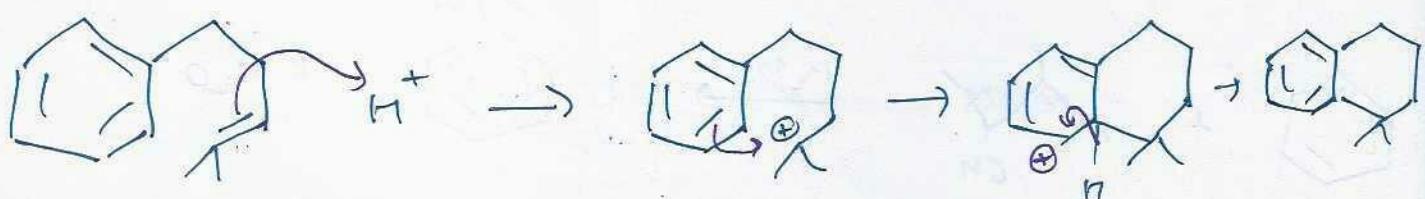
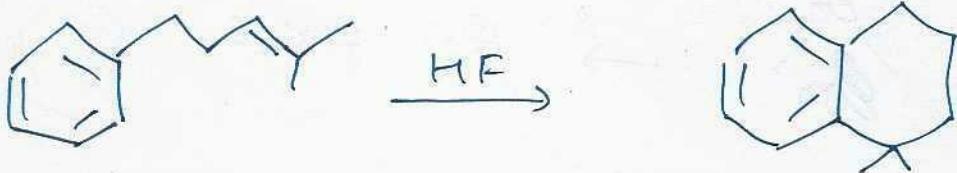
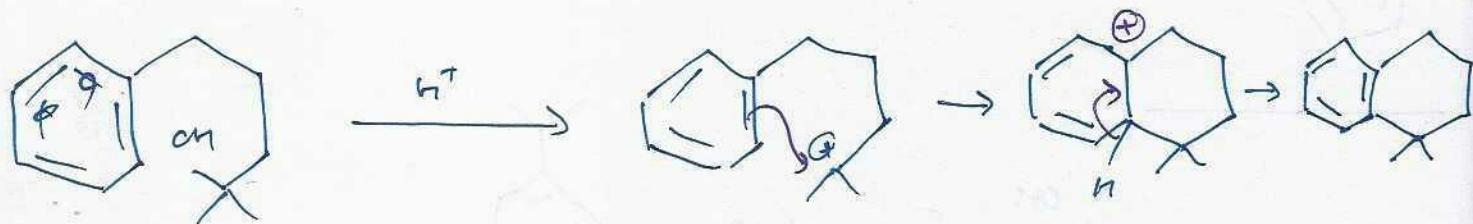
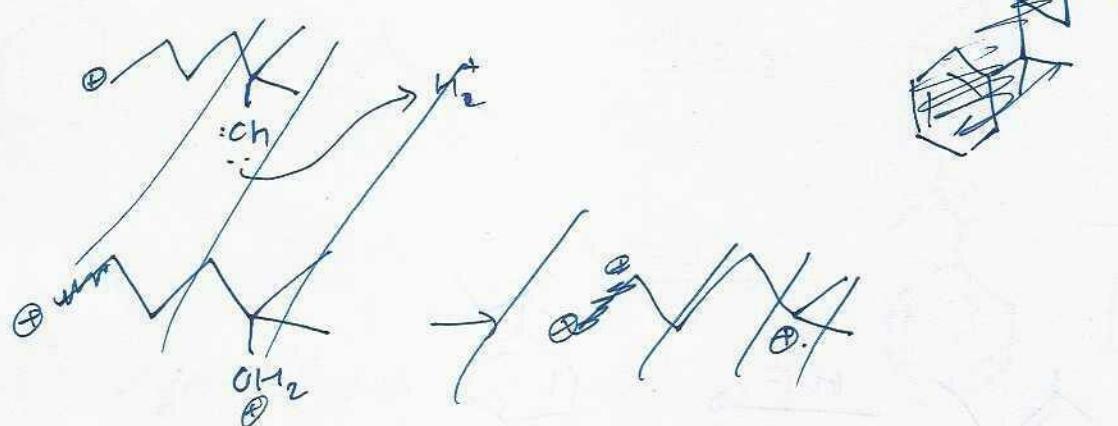
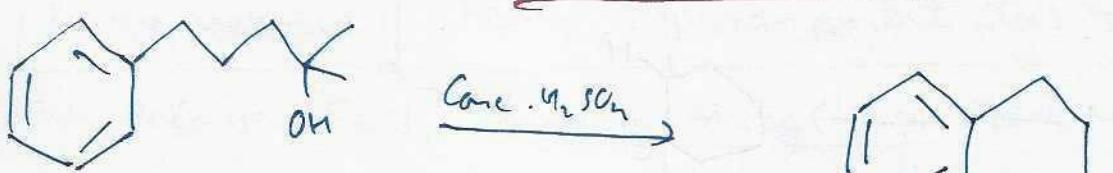
As well as the general name, this is also called protonic acid rearrangement.



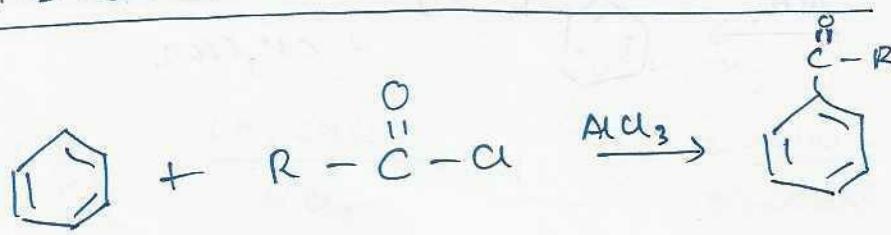
$\text{OH} \text{ in } \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{O}=\text{CH}_2 \text{ good leaving group}$



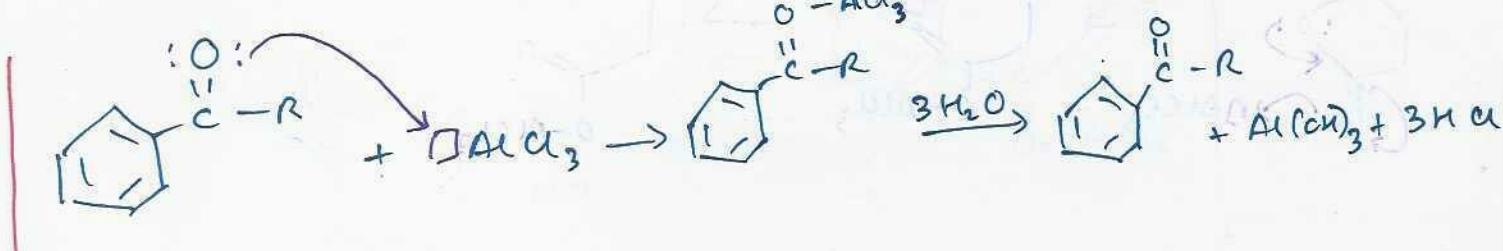
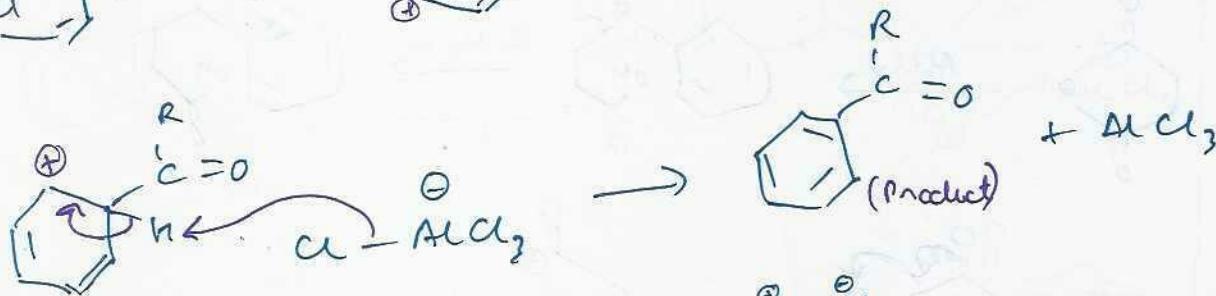
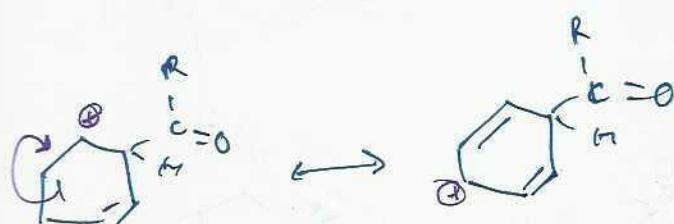
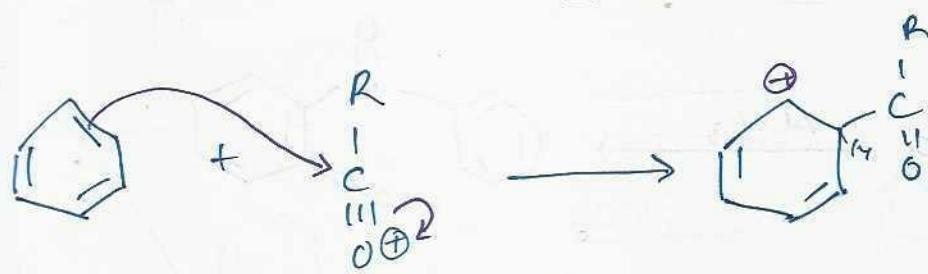
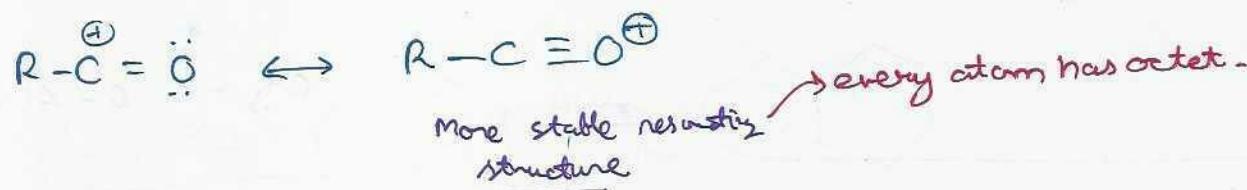
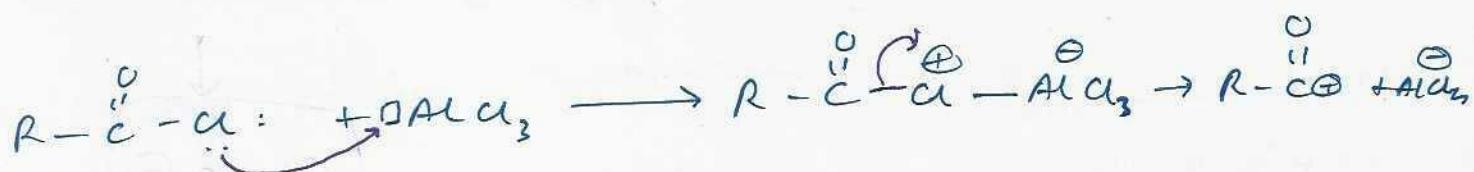
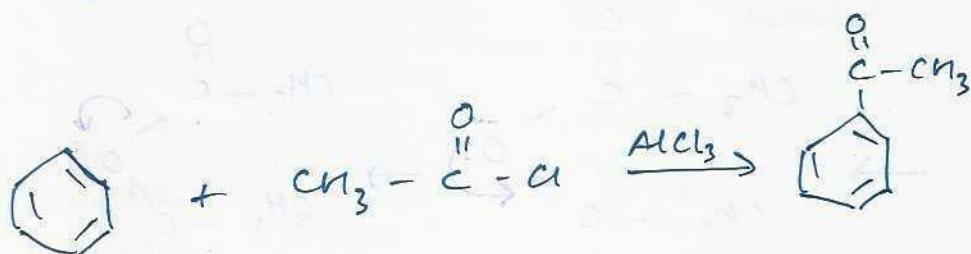
RING CLOSING

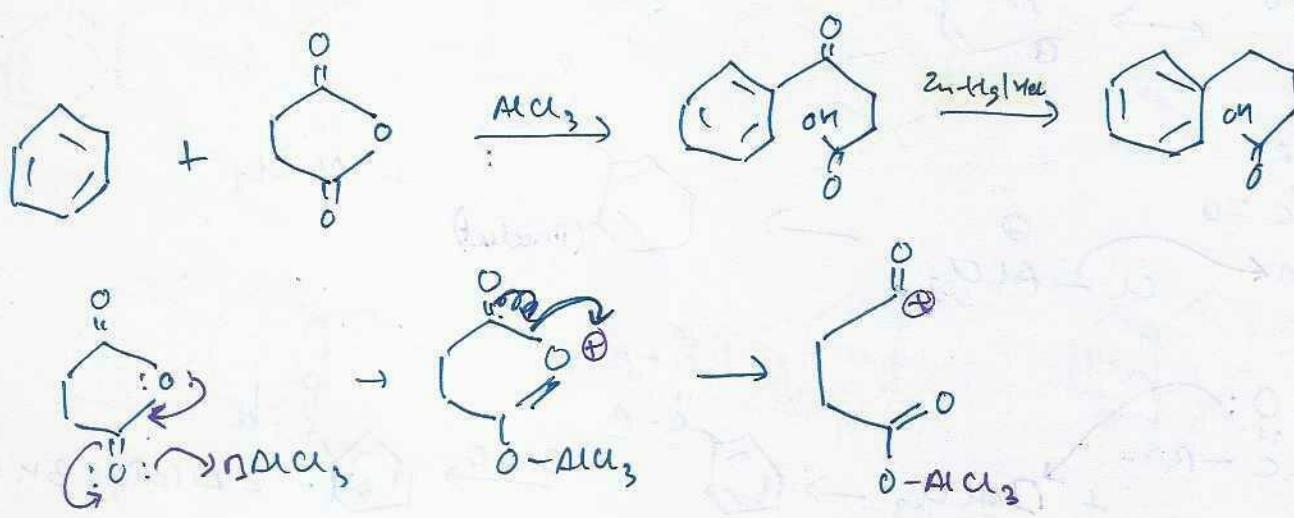
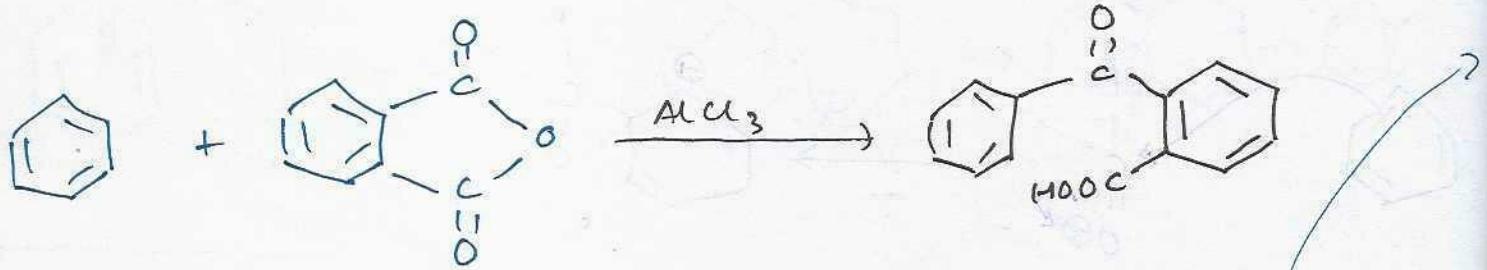
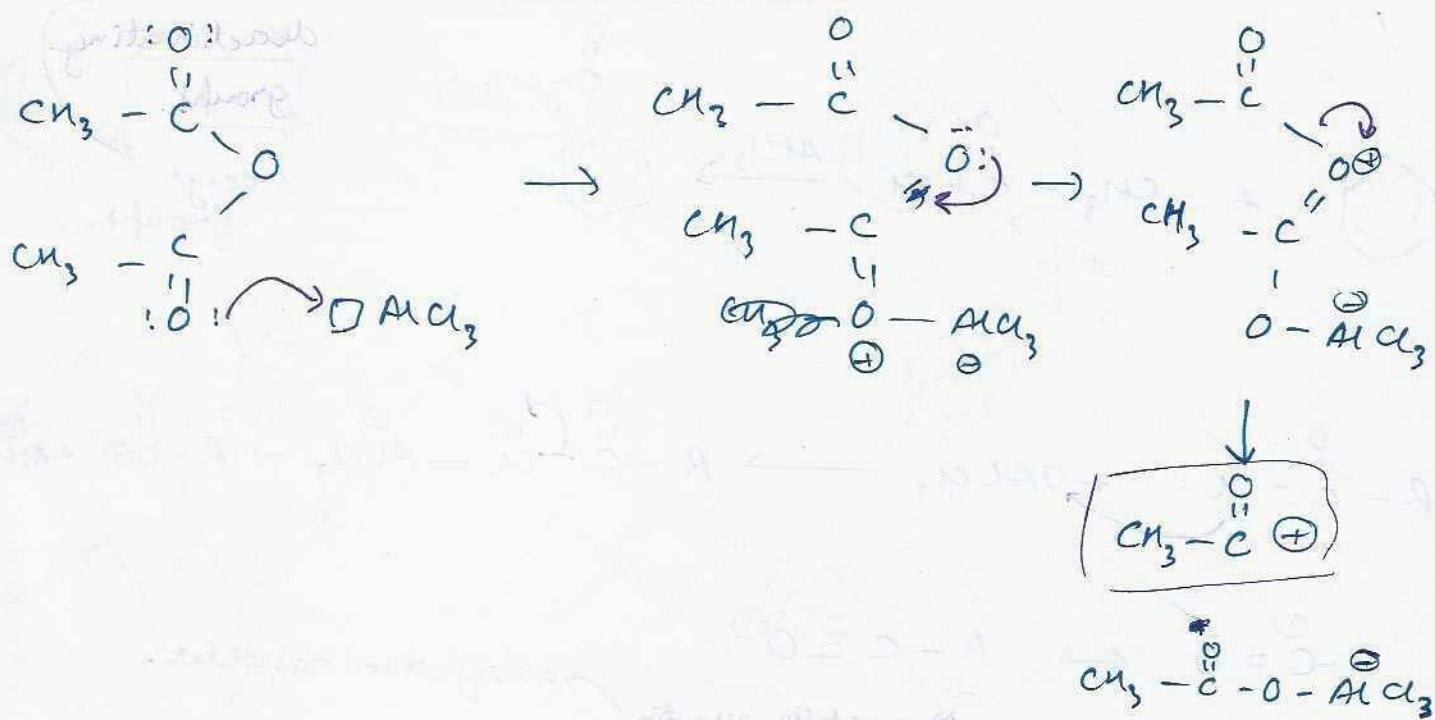
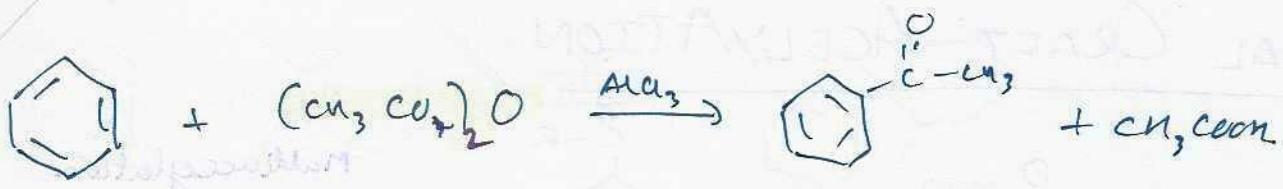


FRIEDEL CRAFT ACETYLATION

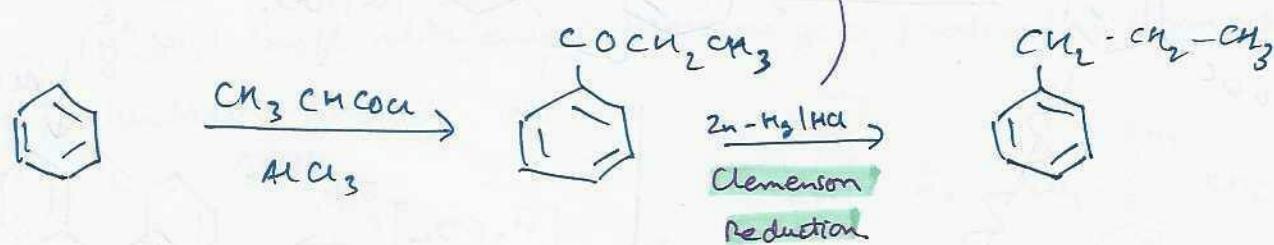


Multiacetylation does not take place as these are deactivating groups.
acetyl groups.





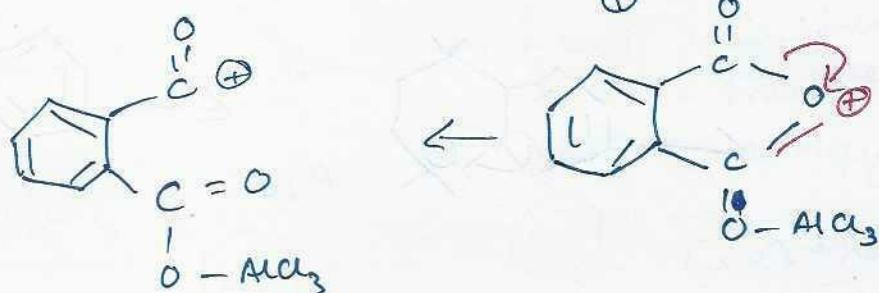
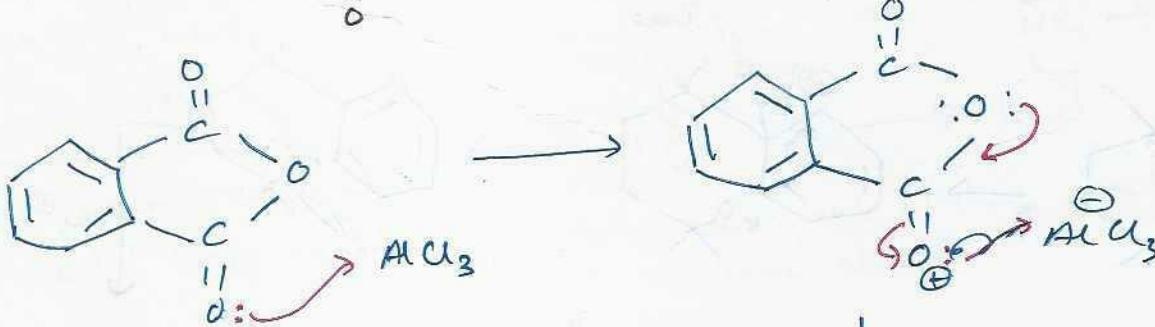
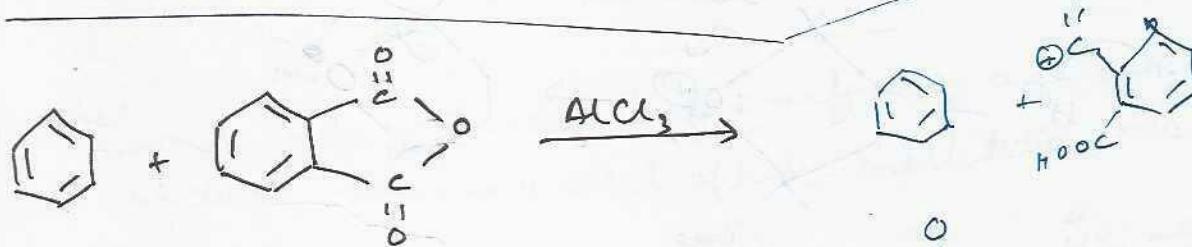
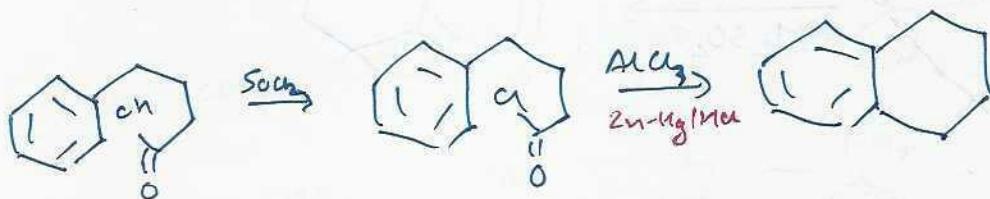
To prepare *n*-methyl Benzene

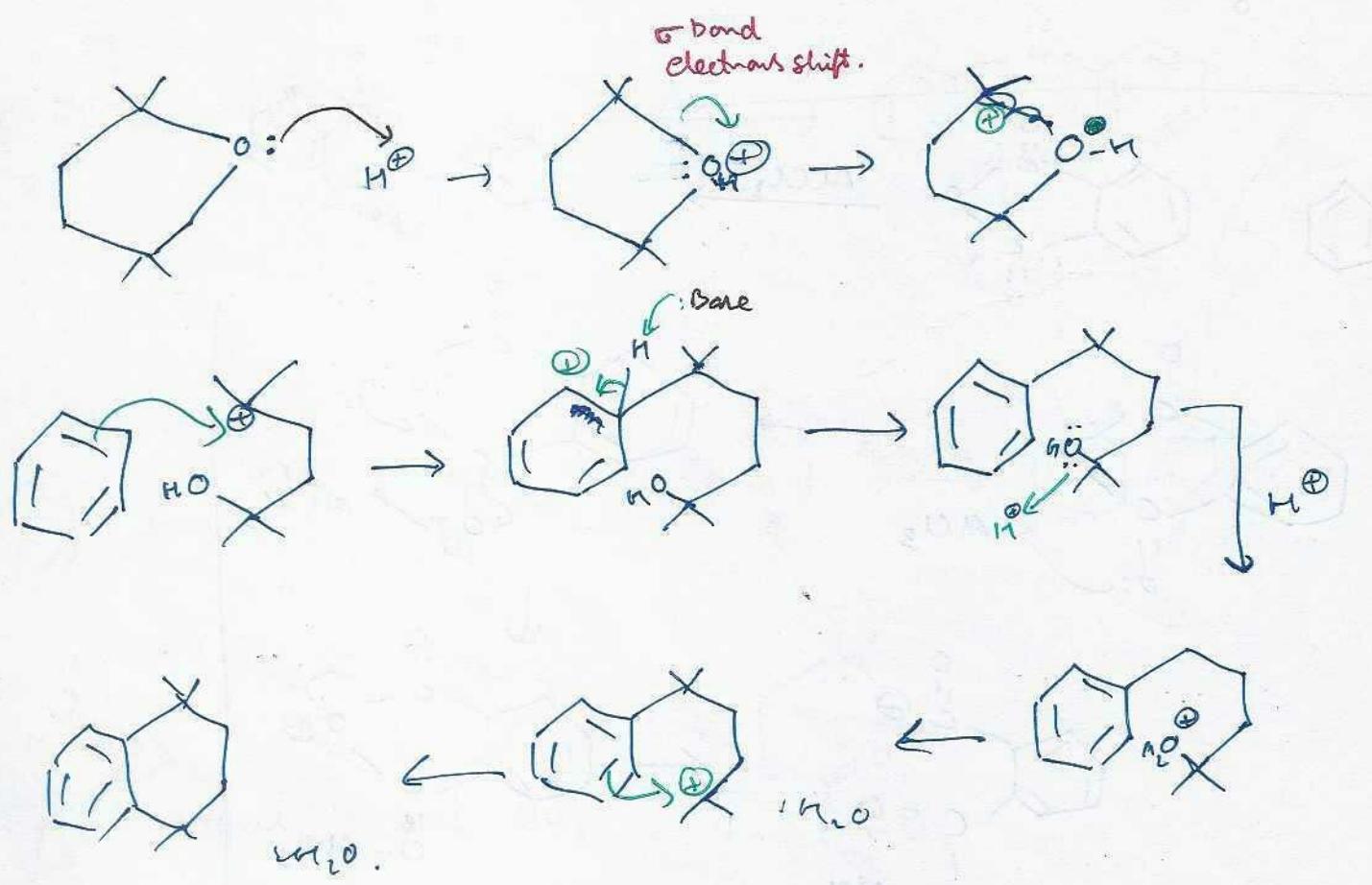
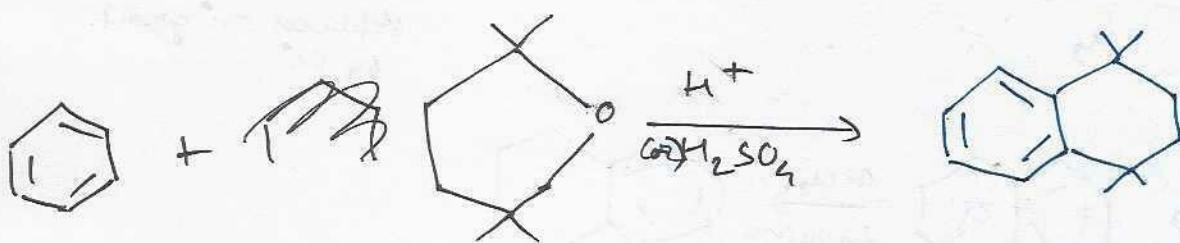
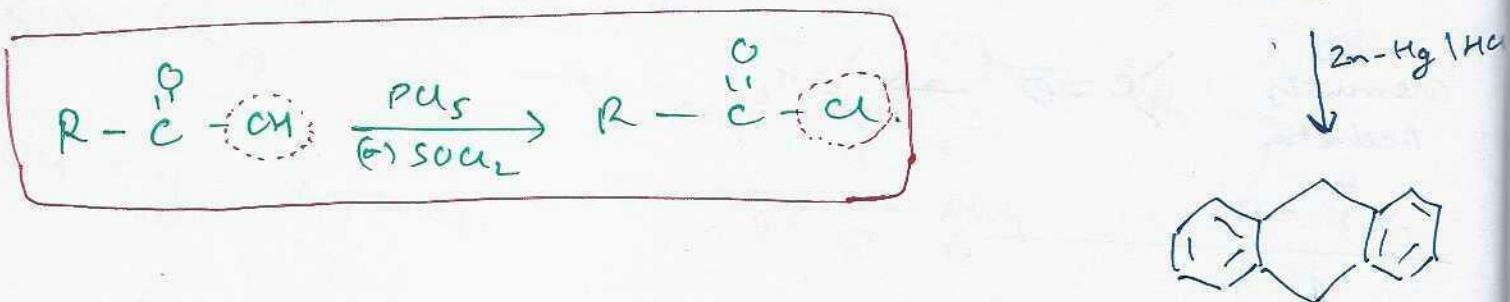
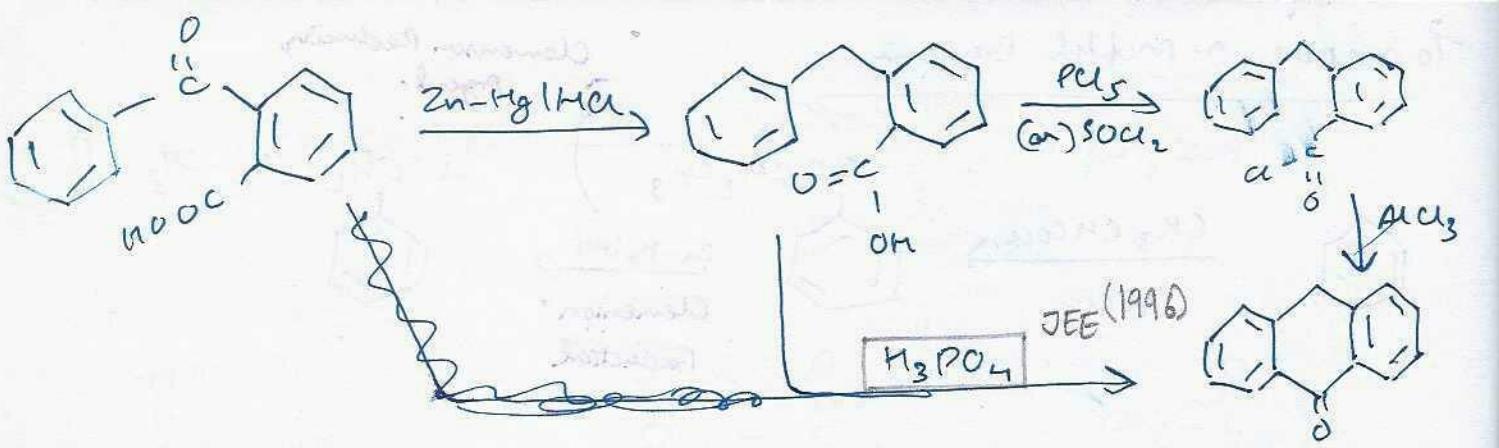


Clemson
Reduction



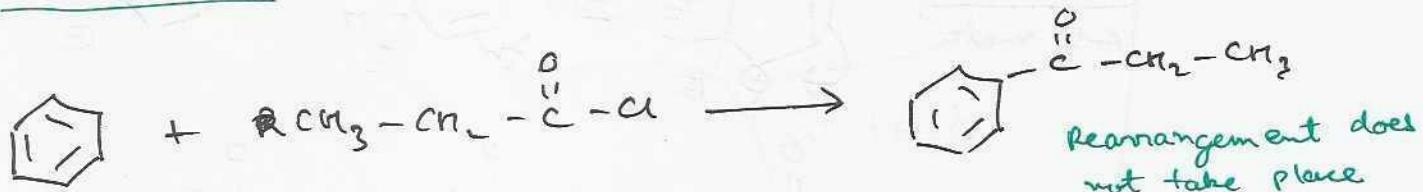
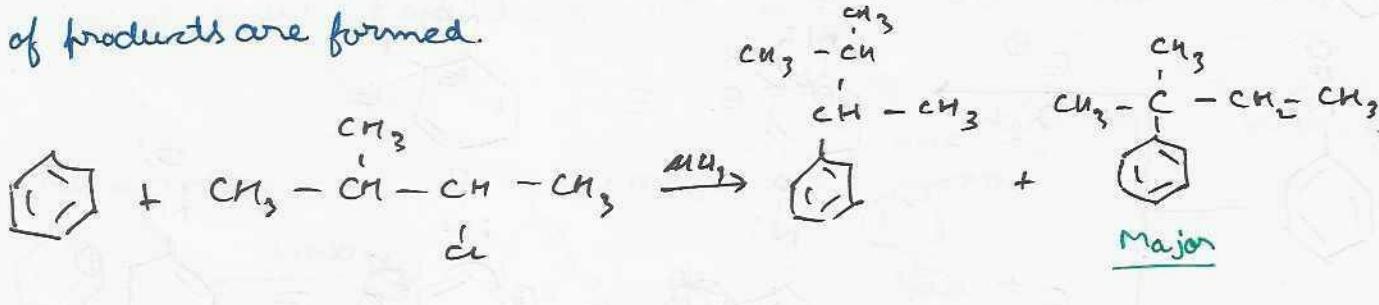
Replaces CO° group
by Cl° .



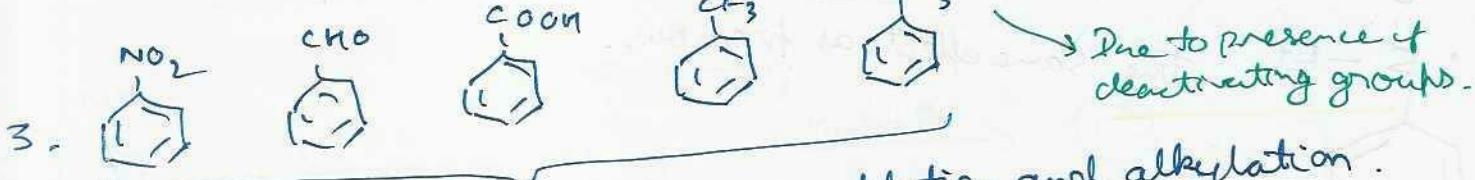
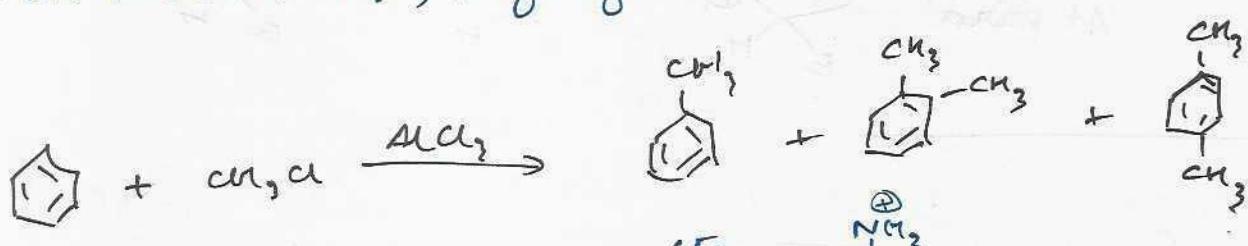


LIMITATIONS

1. In Friedel-Crafts Alkylation rearranged product is formed, mixture of products are formed.

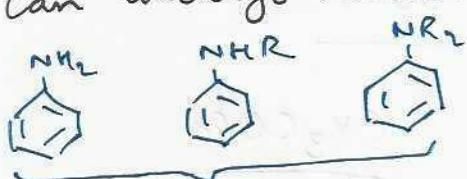


2. In Friedel-Crafts, Polyalkylation is possible.

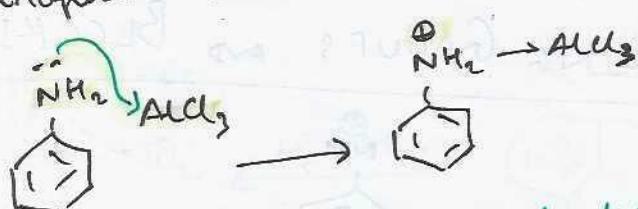


Cannot undergo Friedel-Crafts acylation and alkylation.

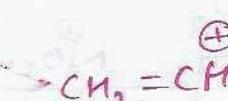
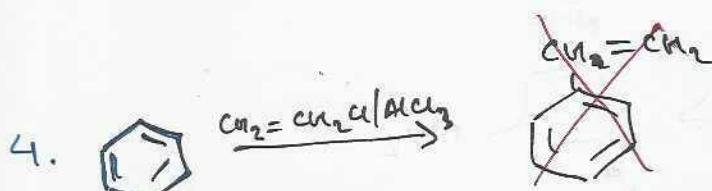
Can undergo remaining electrophilic substitution reaction.



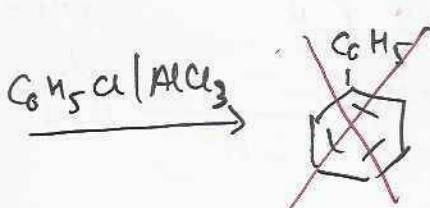
Also cannot undergo Friedel-Crafts reactions.



Becomes deactivating group due to presence of \oplus ve charge.



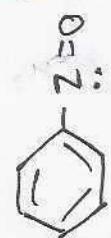
Can't undergo Friedel-Crafts alkylation as they are less stable



(+ve) charge on $=\text{C}$ makes it less stable.

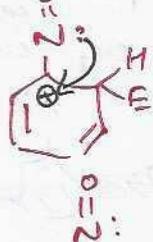


→ Deactivates Benzene ring through strong -I effect of N and O

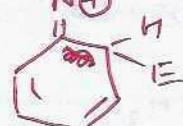


Orientation → Ortho and Para Directing.

E^+
At Ortho



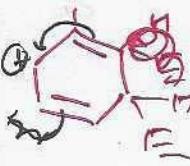
=



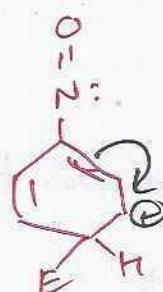
E^+
At meta



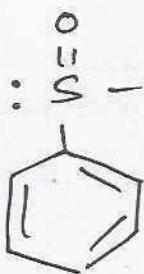
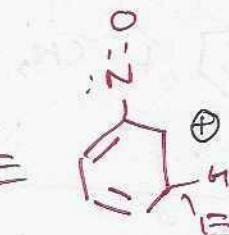
=



E^+
At para



=

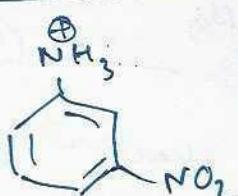


The same effect as previous.

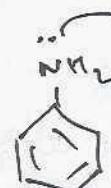
PROTECTING GROUPS AND BLOCKING GROUPS



HNO_3



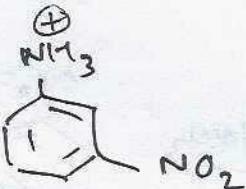
CH_3COCl



H^+



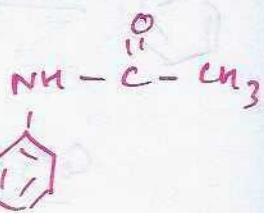
NO_2

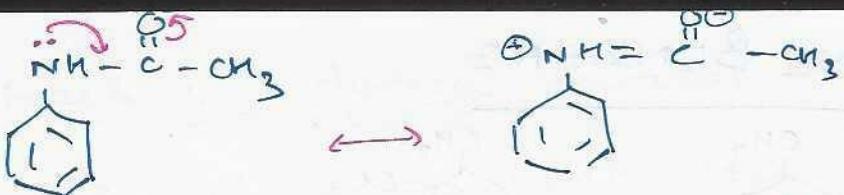


$CH_3-C(=O)-Cl$

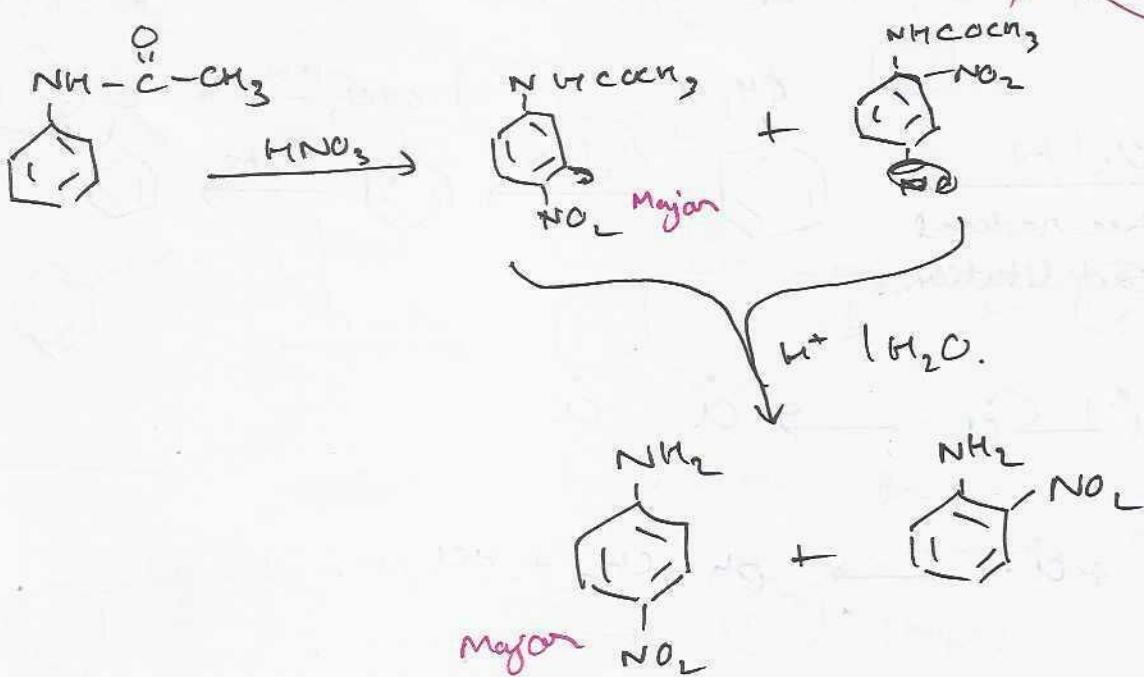


$-H^+$

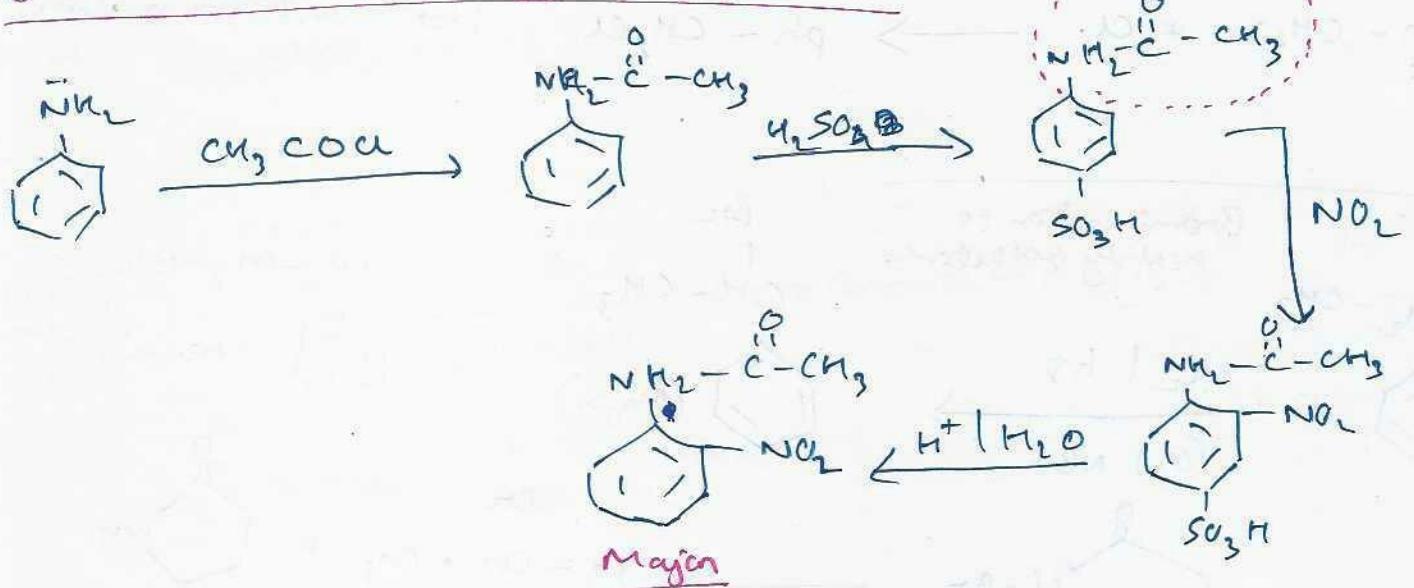




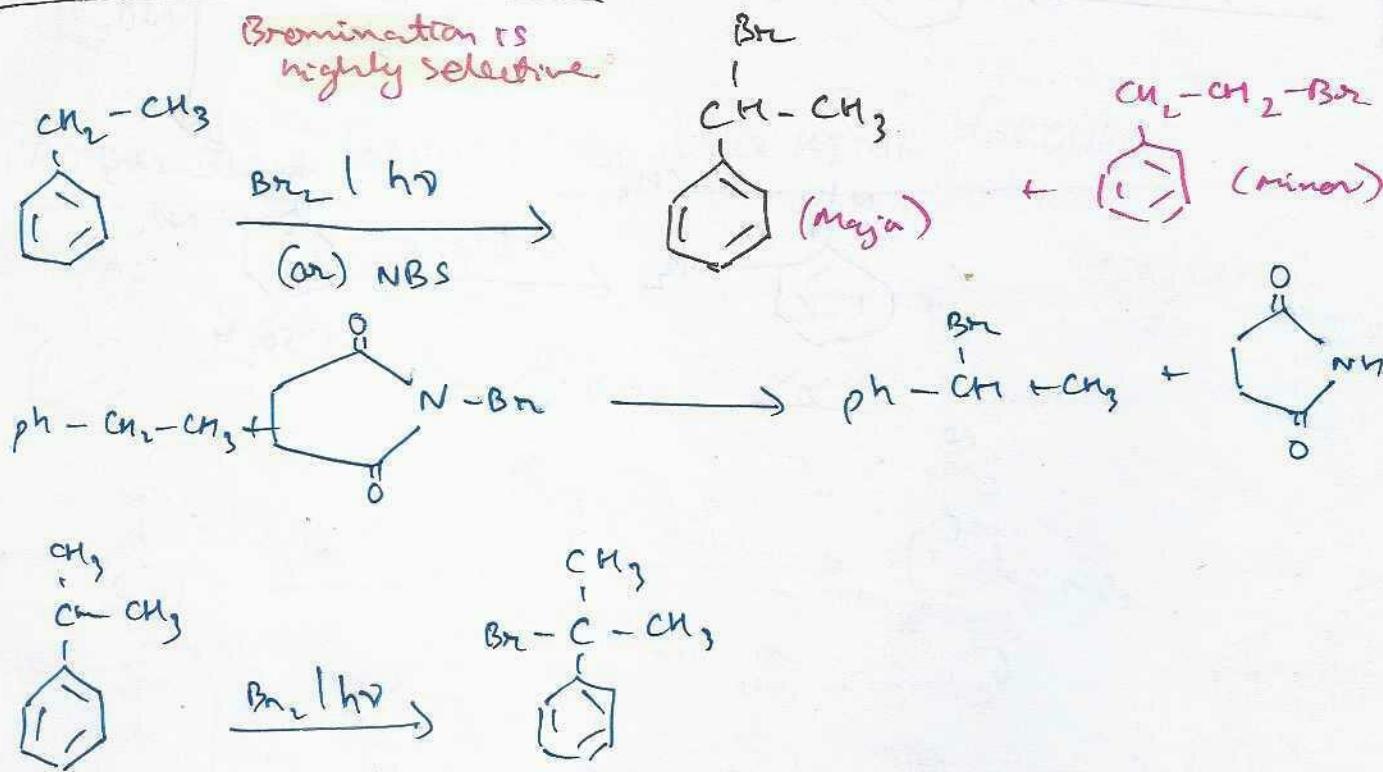
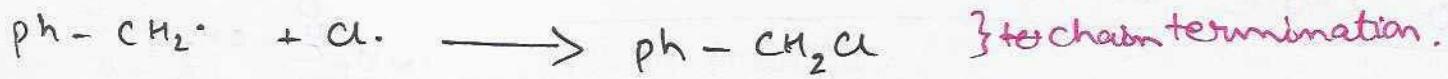
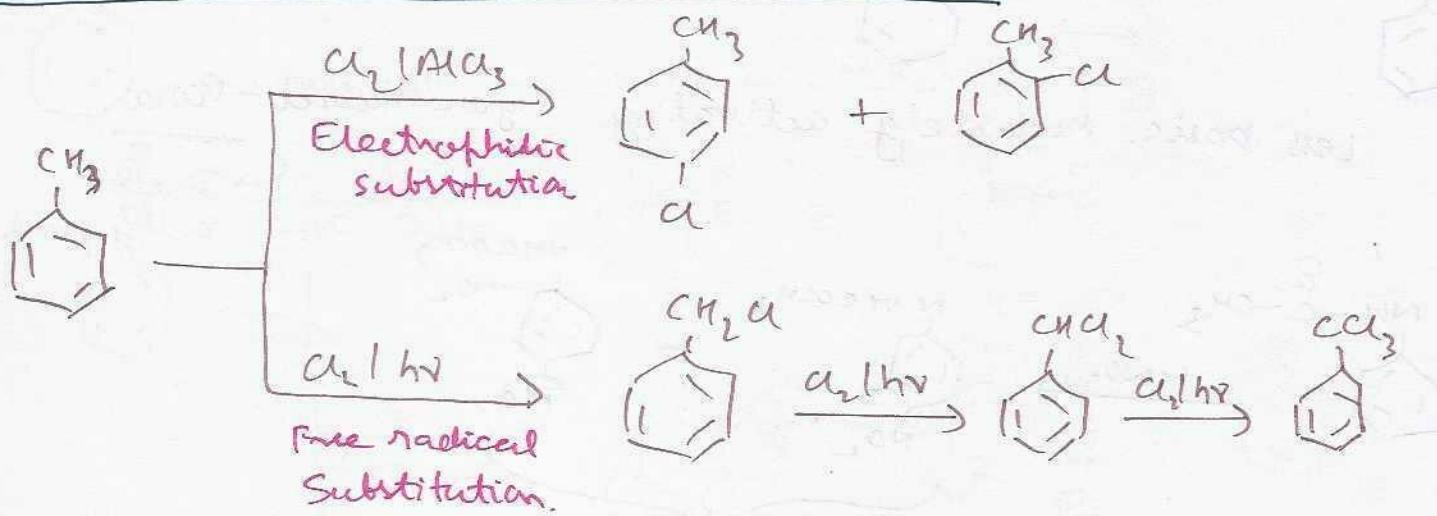
Less basic. Moderately activating. Major Product - Para.

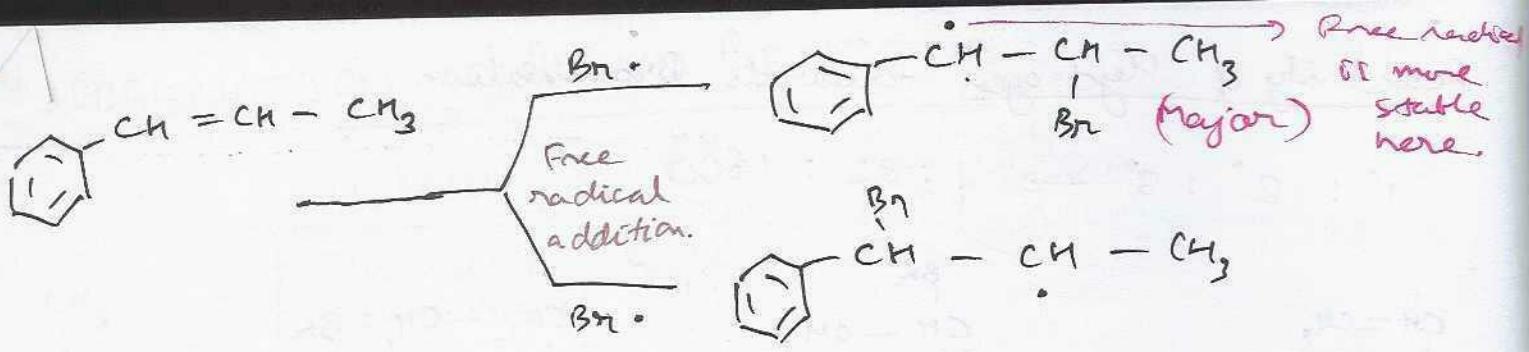


To Make Ortho Nitro Aniline

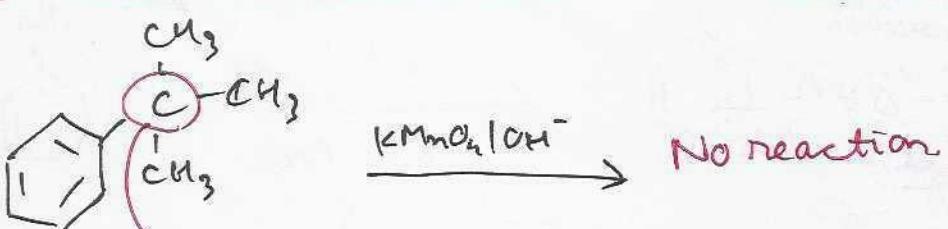
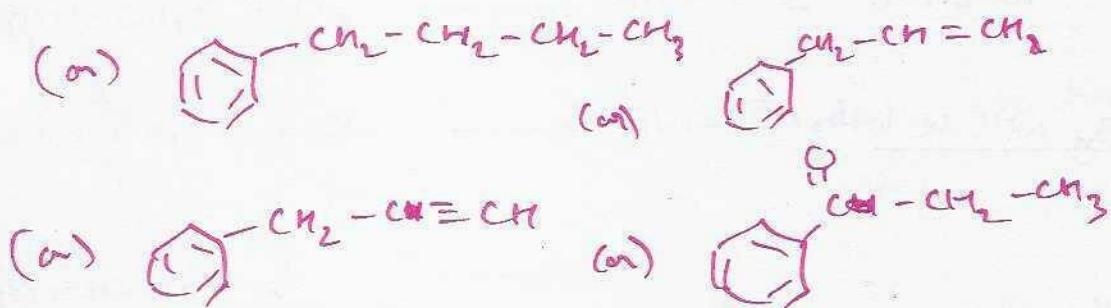
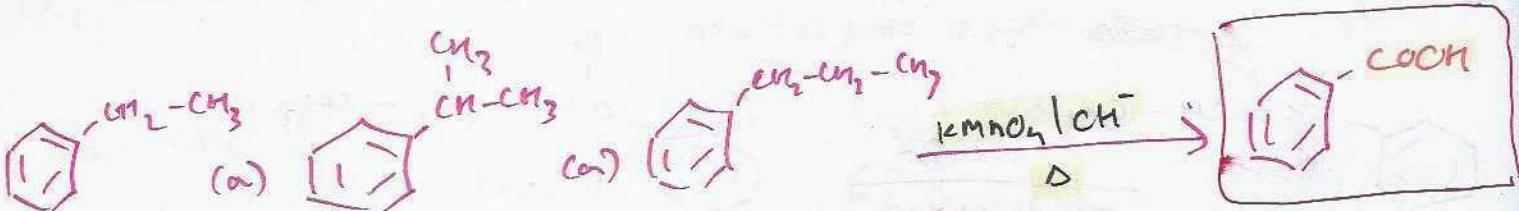
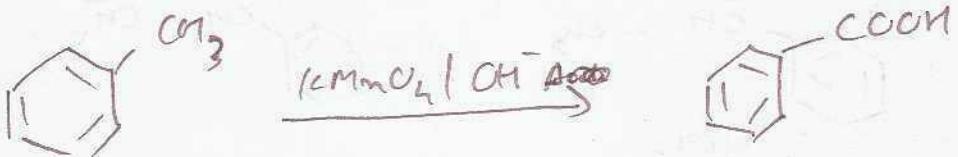


HALOGENATION OF ALKYL BENZENE

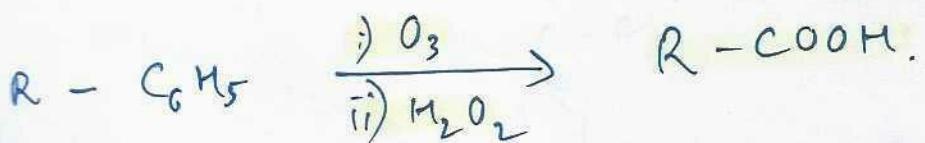




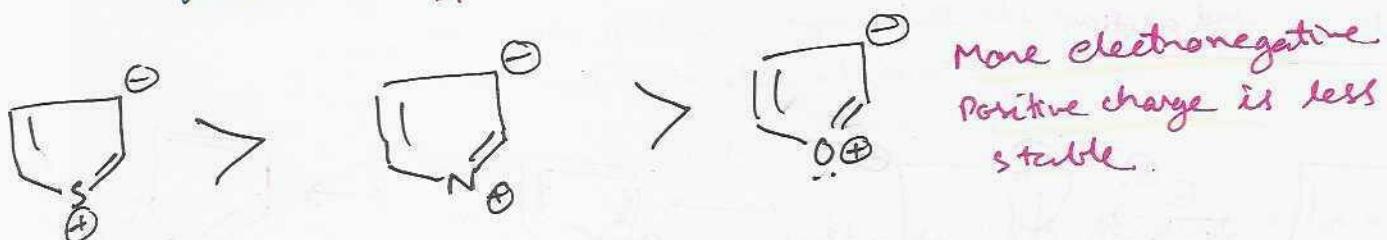
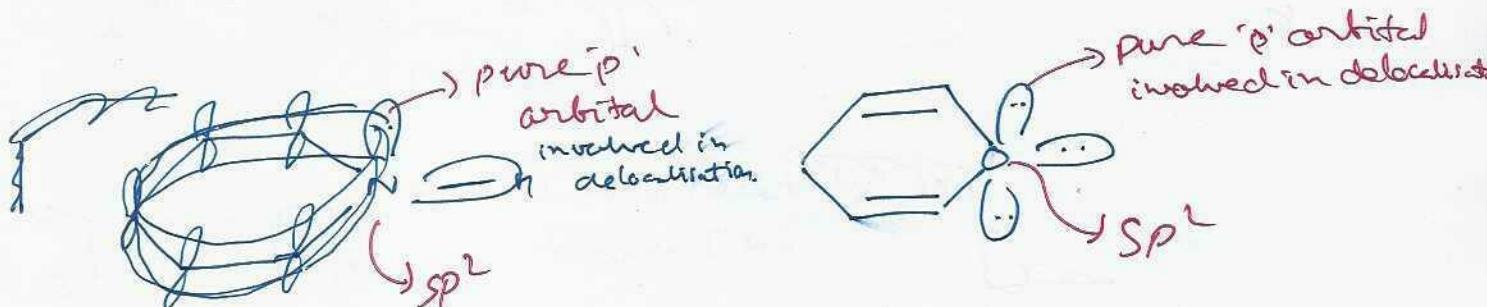
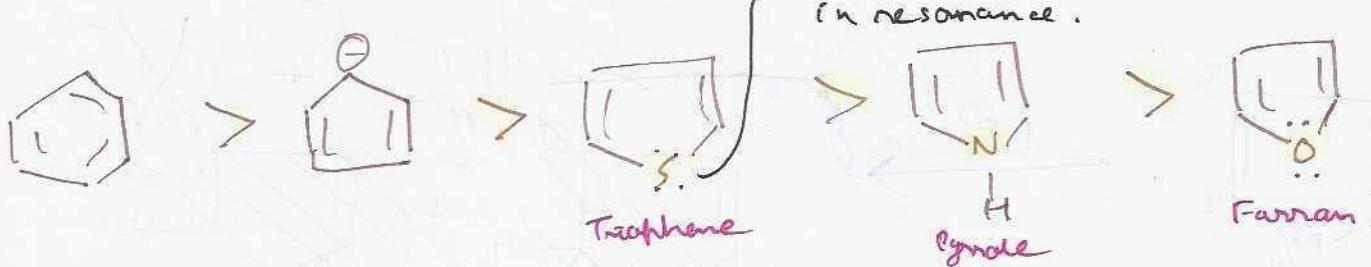
OXIDATION OF SIDE CHAIN (OXIDATION OF ALKYL BENZENE)



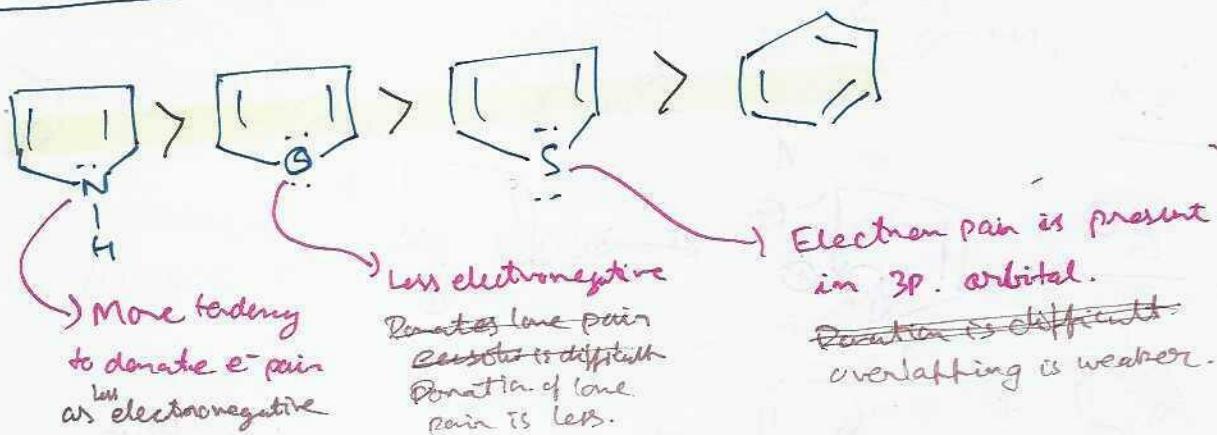
Has no bonded hydrogen atoms.



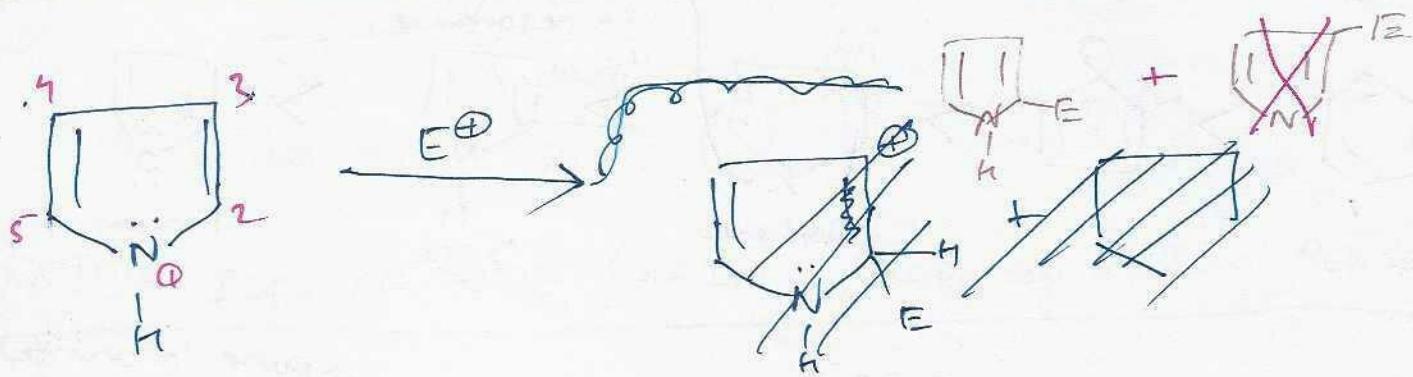
DELOCALISATION ENERGY ORDER (or) RESONANCE ENERGY ORDER



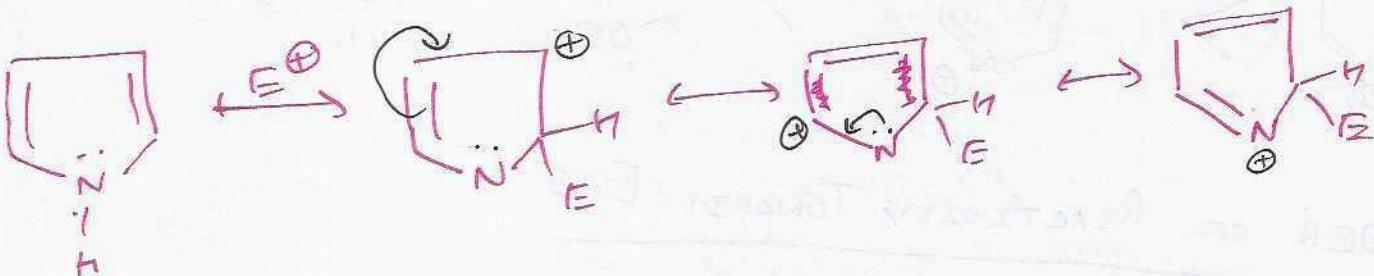
ORDER OF REACTIVITY TOWARDS EAS



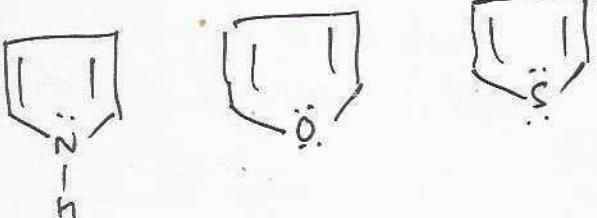
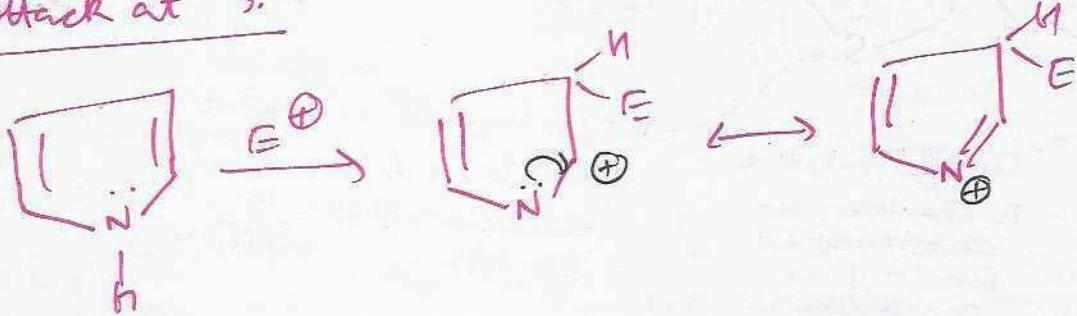
ORIENTATION IN HETERO CYCLIC COMPOUNDS



Attack at 2nd position

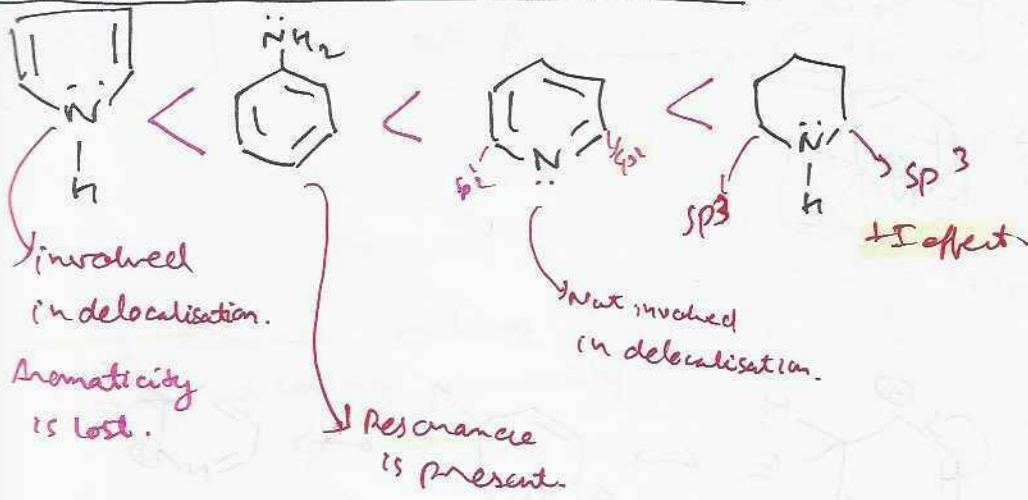


Attack at 3rd



All are more reactive than Benzene, EAS takes place in 2nd position in all compounds.

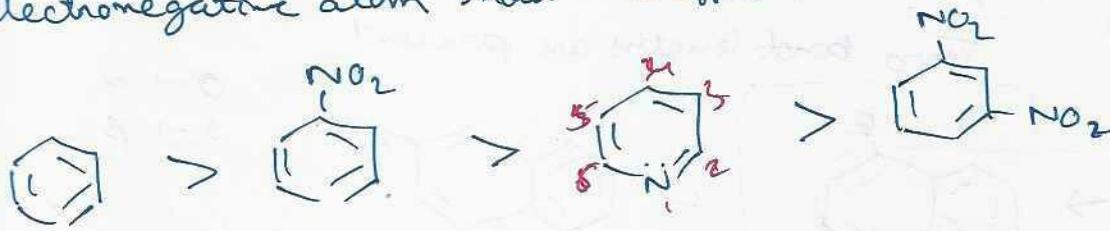
ORDER OF BASIC CHARACTER



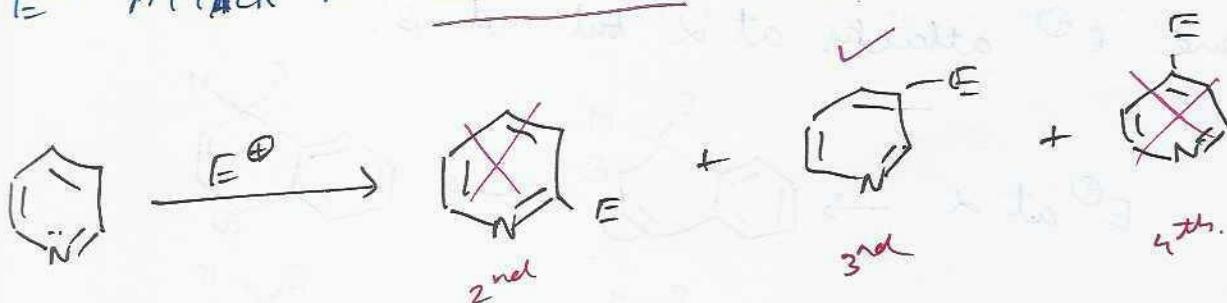
i) Lone pair present in hybridised orbital
 Not involved in delocalisation.

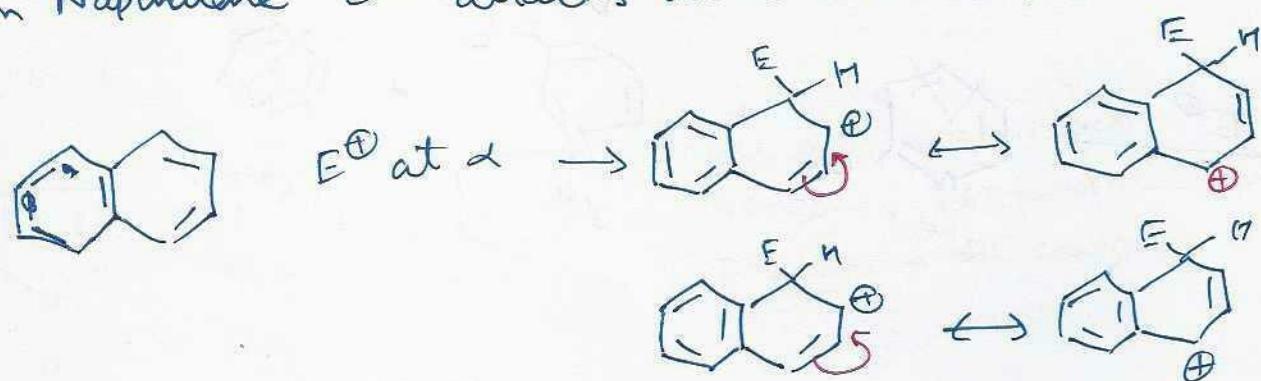
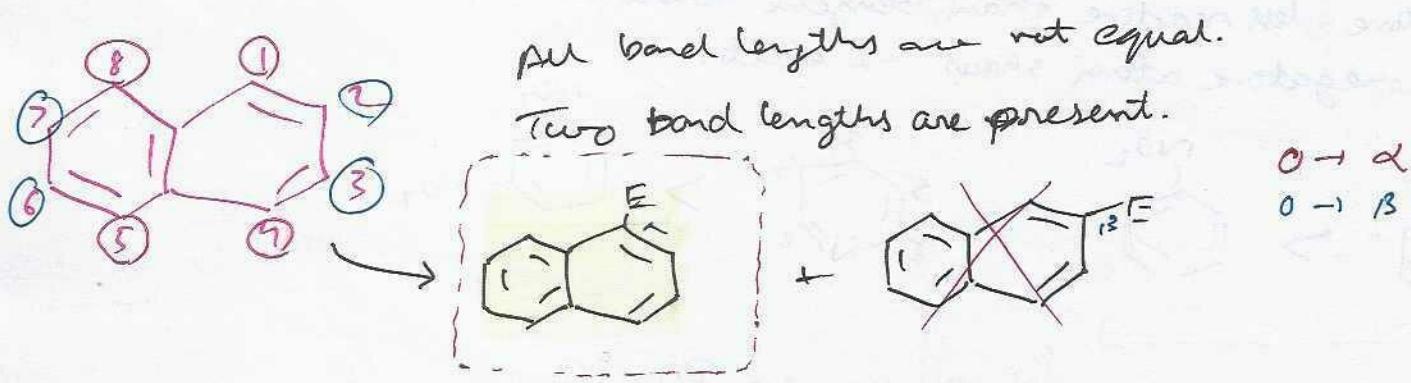
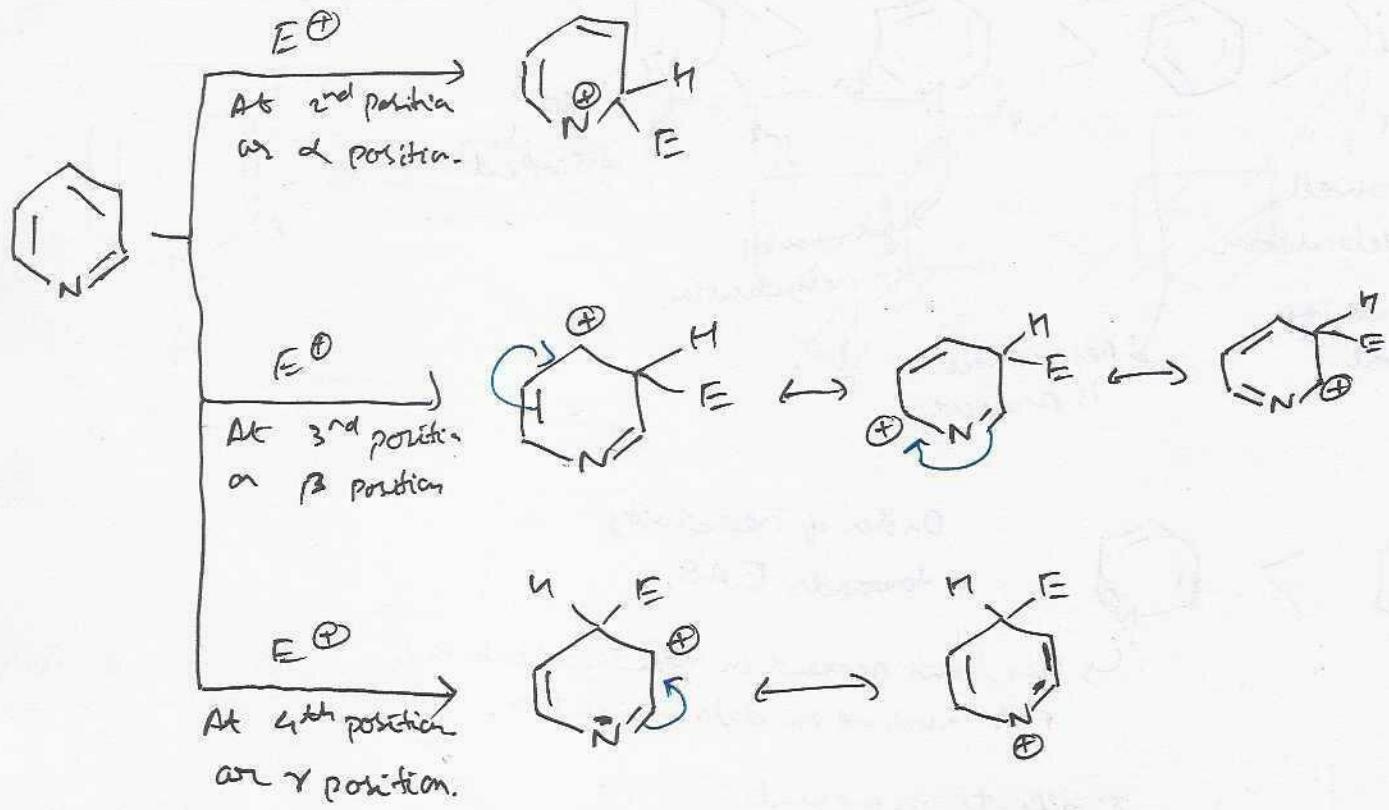
-I effect is present

Pyridine less reactive than Benzene towards EAS because N is more electronegative atom shows -I effect.

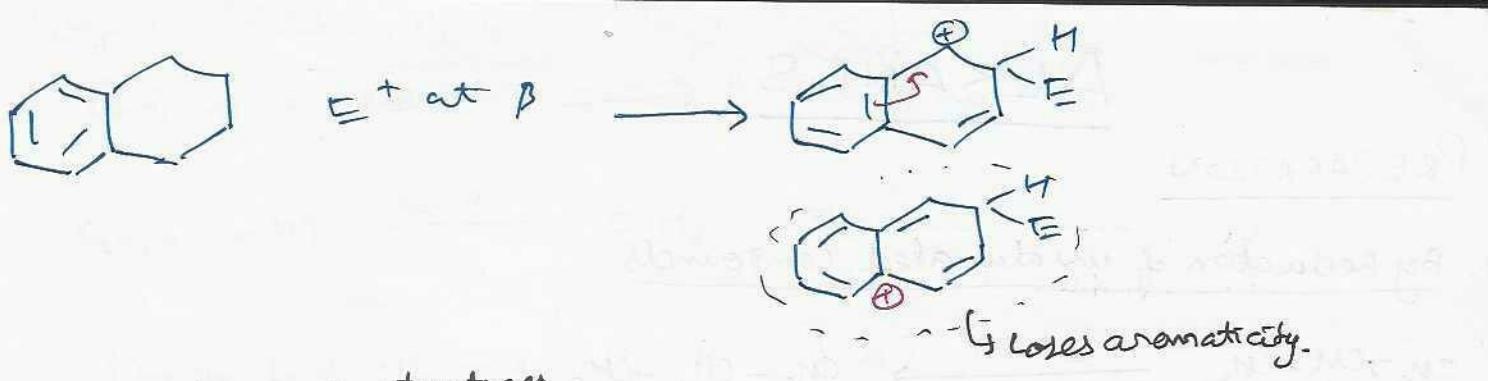


E⁺ ATTACK AT 3rd Position in Pyridine





4 resonance structures without losing aromaticity.



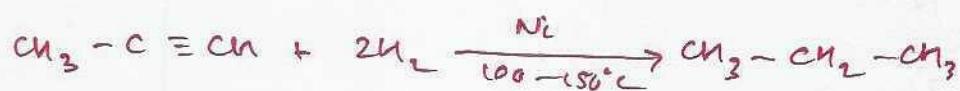
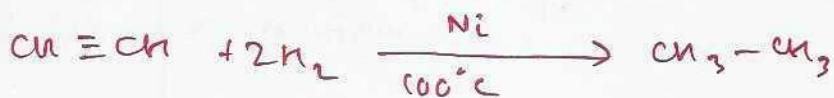
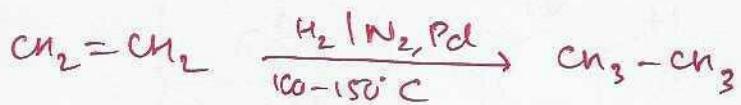
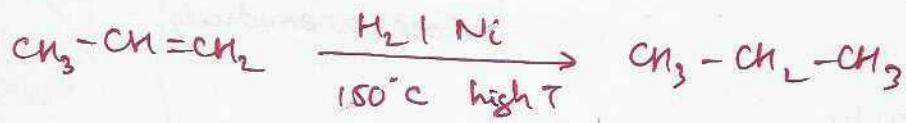
2 Resonance structures
 without losing aromaticity.

\rightarrow loses aromaticity.

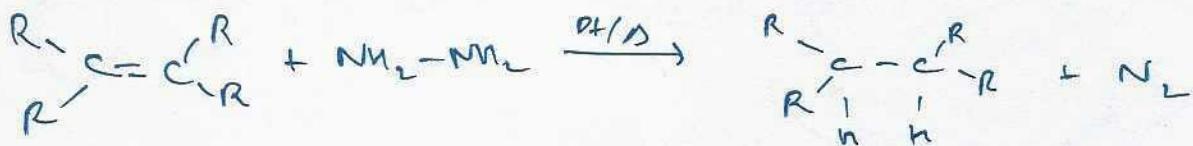
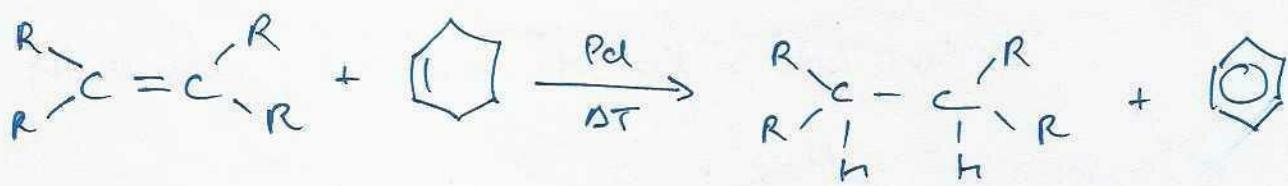
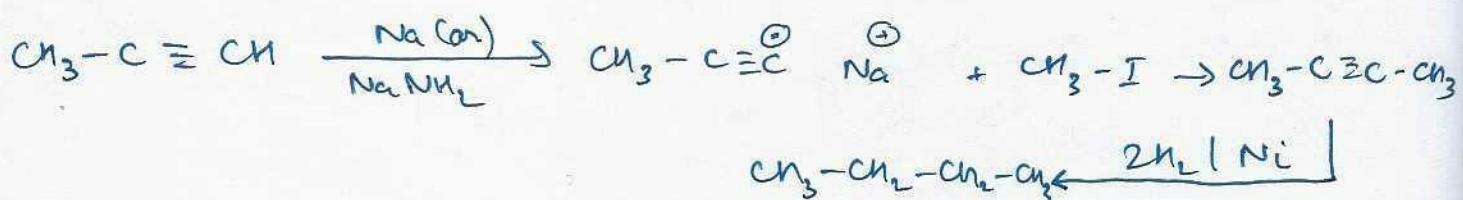
ALKANES

PREPARATION

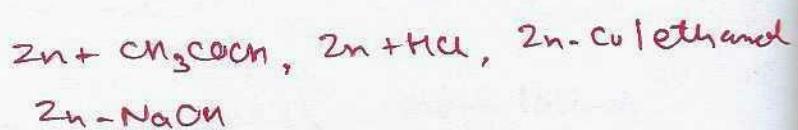
1. By Reduction of unsaturated compounds



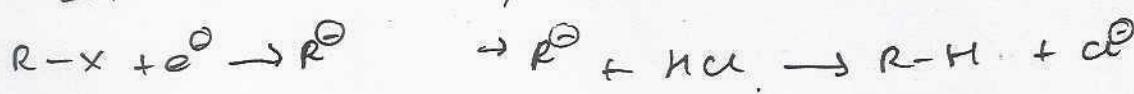
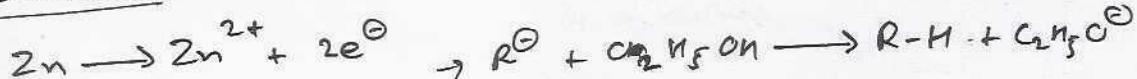
Sabatier's Bunder's Reaction

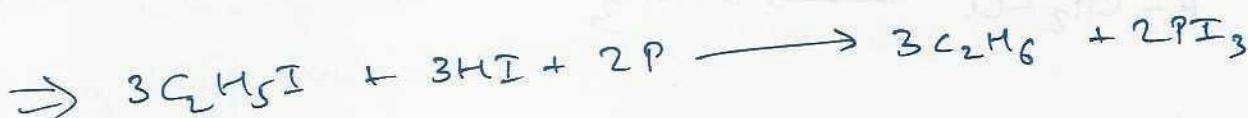
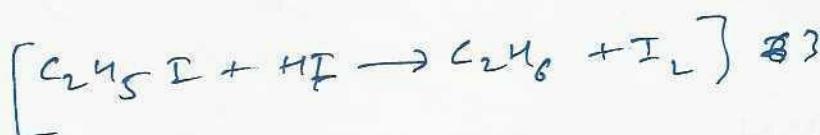
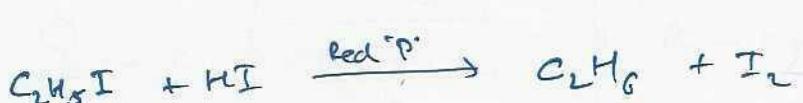


2 From Alky Halides

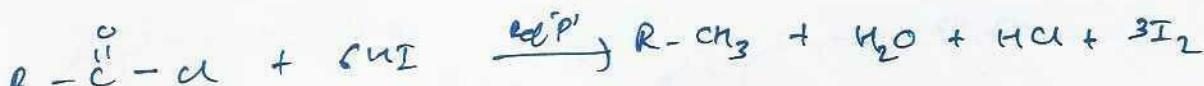
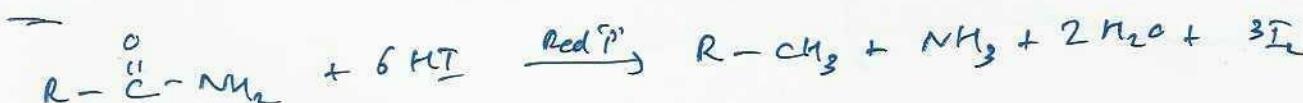
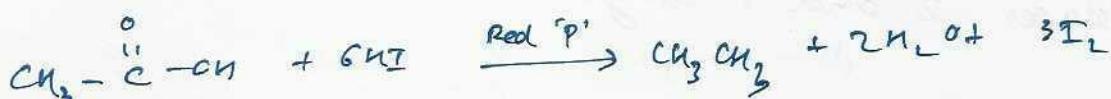
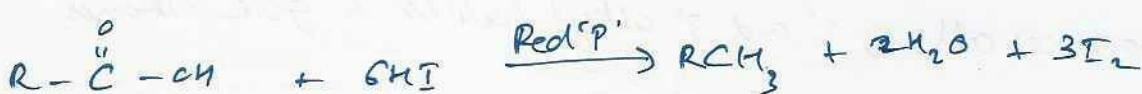
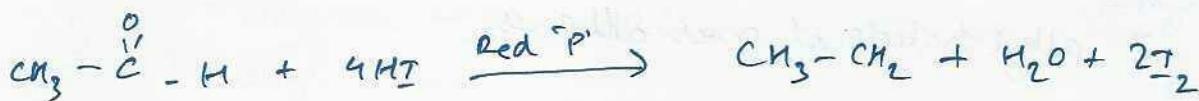


Mechanism

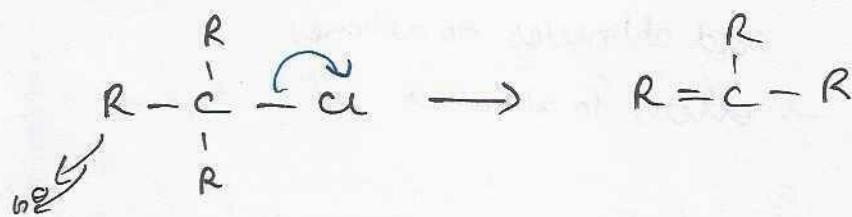
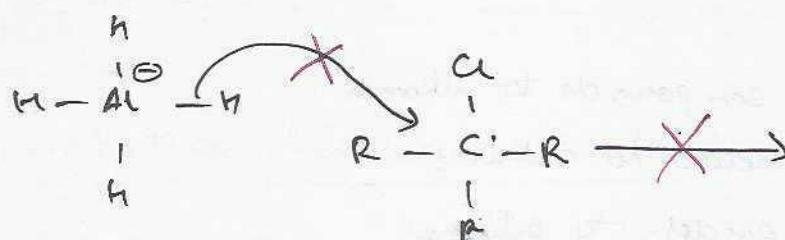
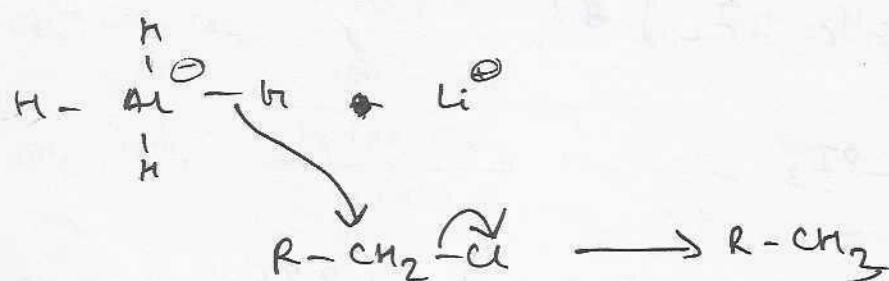




Red P/HI Reduces carbonyl compounds to alkanes
carboxylic acids to alkanes.
esters to alkanes
acid chlorides to alkenes
nitriles to alkanes



LiAlH_4 , NaBH_4 , ~~Ph_3SnH~~ also reduce RX to alkane.



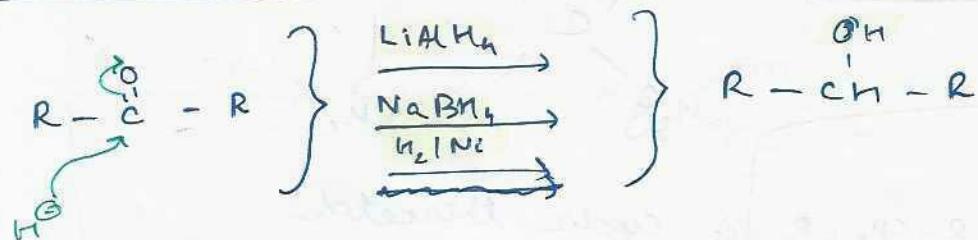
LiAlH_4 can ^{reduce} give 1° and 2° alkyl halides to give alkanes

But with 3° alkyl halide it gives alkenes.

But ~~Ph_3SnH~~ reduces all 1° , 2° and 3° alkyl halides to give alkanes.

NaBH_4 reduces 2° and 3° alkyl halides.

From CARBONYL Compounds



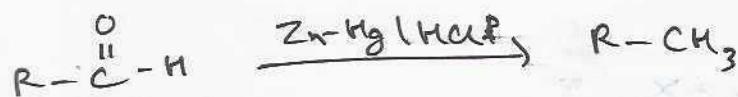
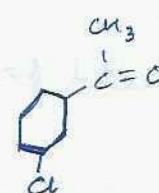
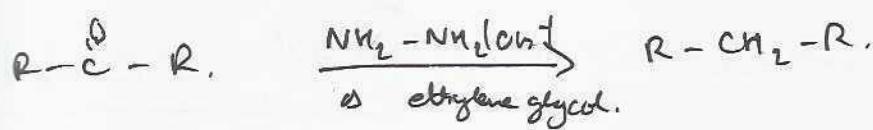
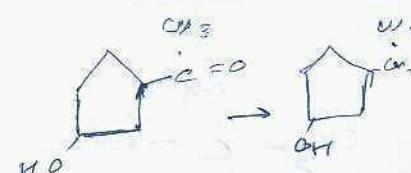
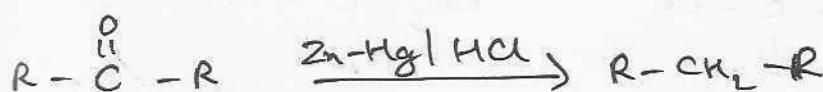
CLEMENSON'S REAGENT $\xrightarrow{\text{Zn-Hg/HCl}}$

RD Clemenson's Reduction

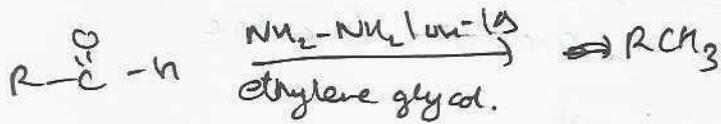
Zn-Hg/HCl .

Withey Koth Kishner Reduction

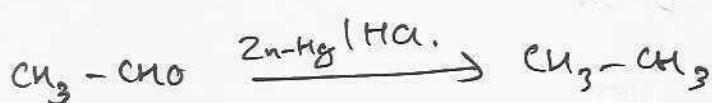
$\text{NH}_2-\text{NH}_2/\text{Cn}^{\text{I}}\Delta.$



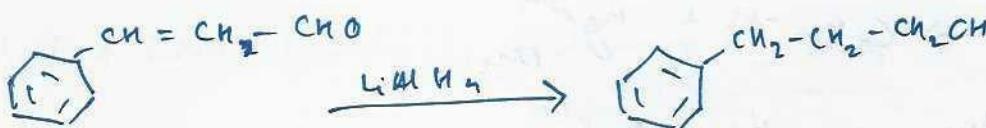
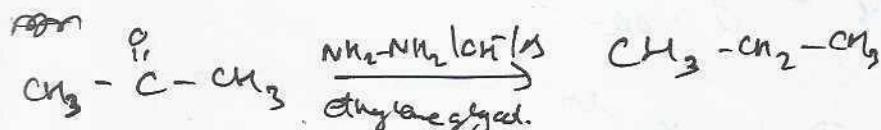
Ethylene glycol.

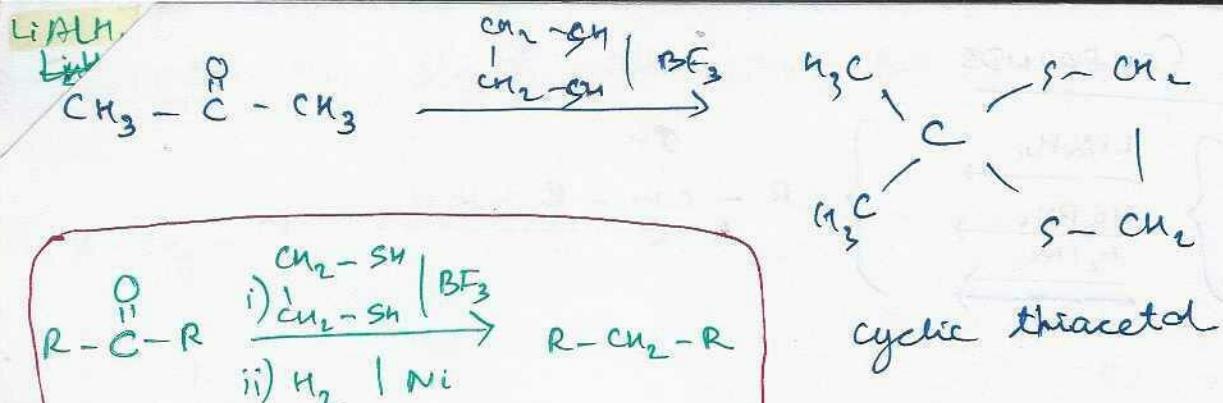


CH_2-OH

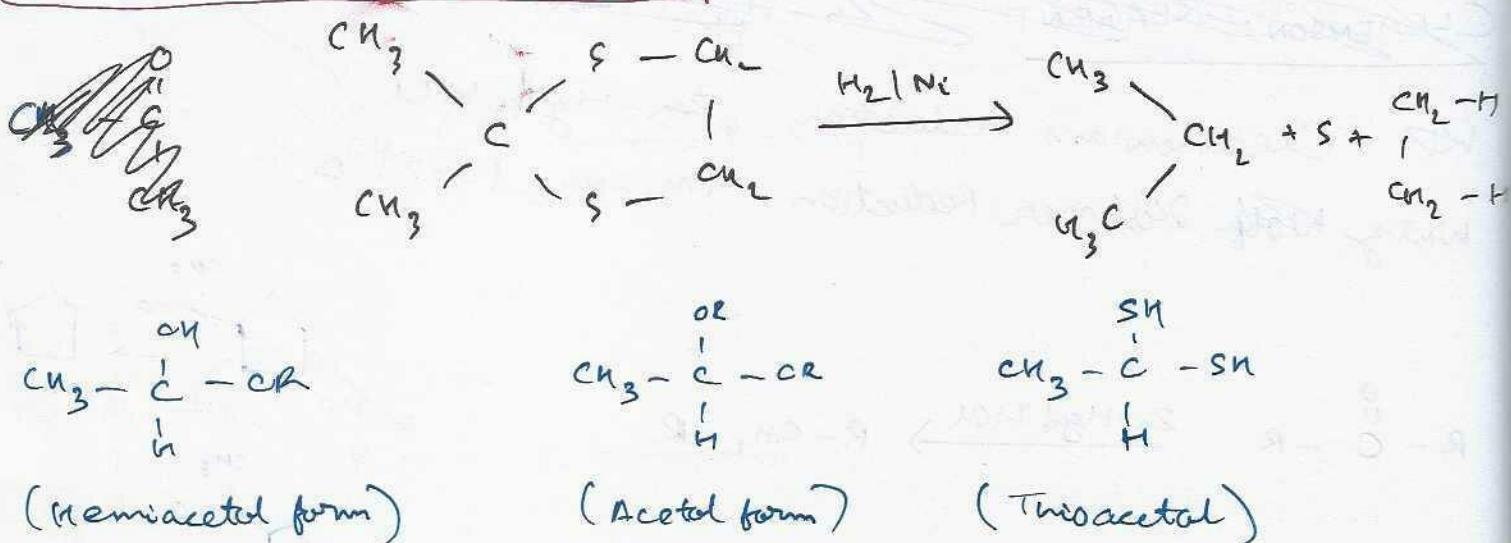


CH_2-OH



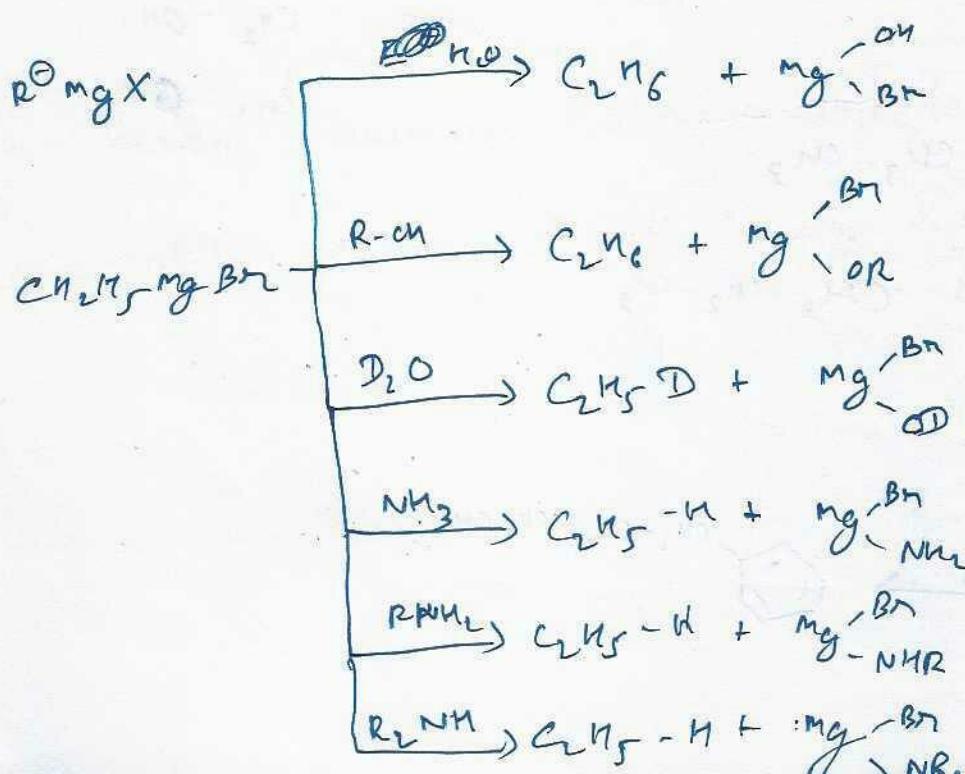
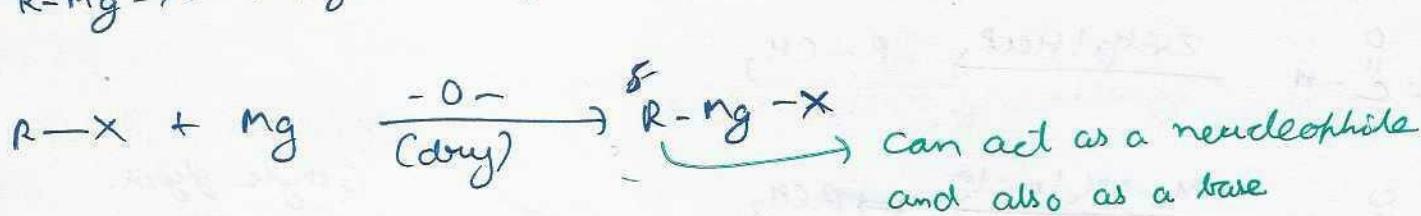


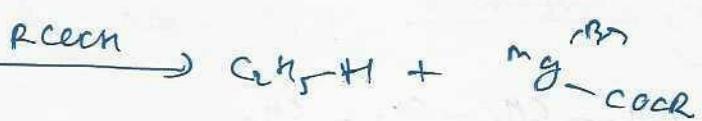
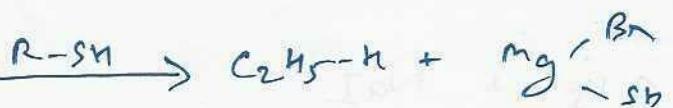
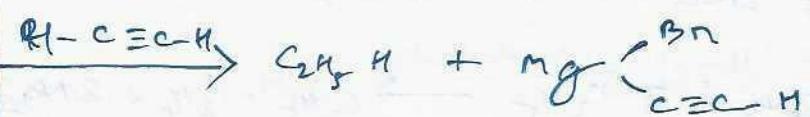
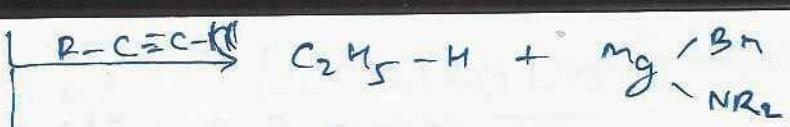
cyclic thiacetal



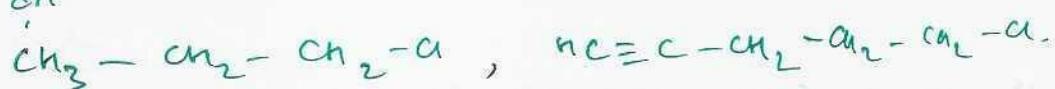
From GRIGNARD REAGENT

R-Mg-X (alkyl Be Magnesium halide)

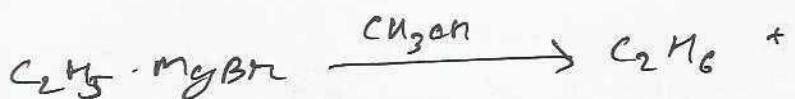




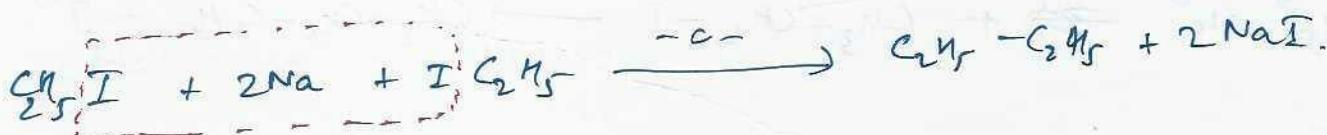
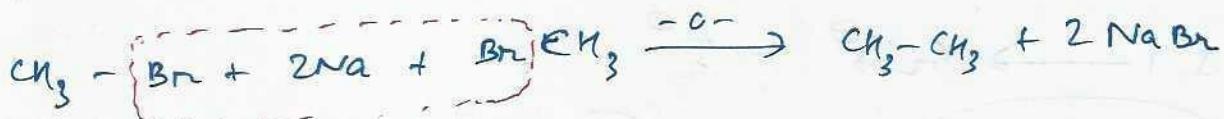
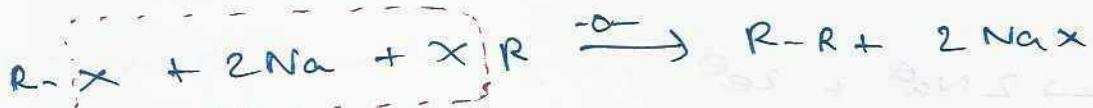
on



Can't be used
to make Grignard
reagent

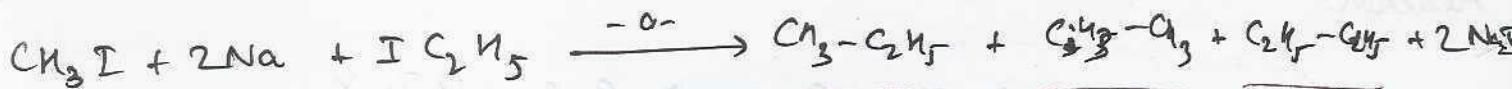


WURTZ REACTION (Na, Cu, Ag)



Only symmetrical alkanes can be prepared.

- ↳ Even number of carbon containing hydrocarbons can be prepared
- ↳ Odd number of carbon containing hydrocarbons can't be prepared



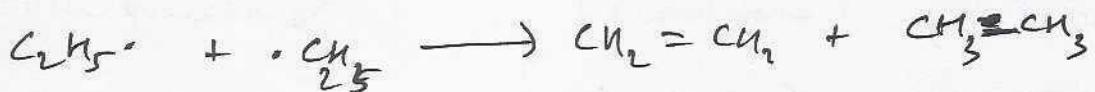
CH_n cannot be prepared by this method.

Mechanism

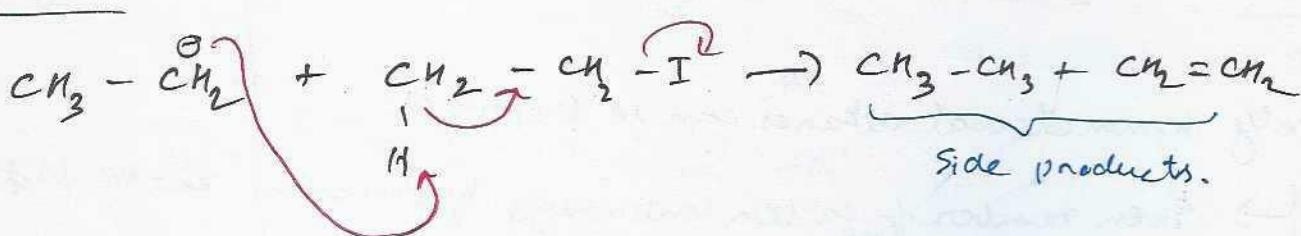
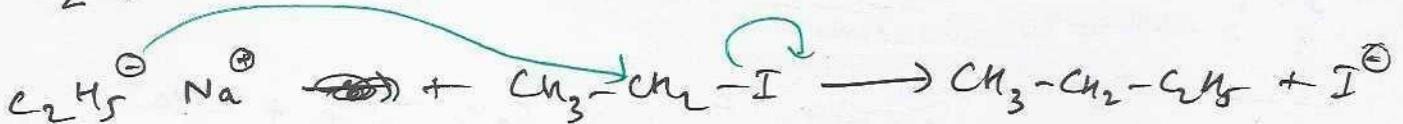
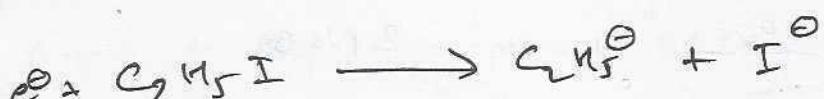
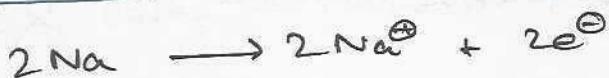


Side products: C_2H_6 and C_2H_4 are also formed.

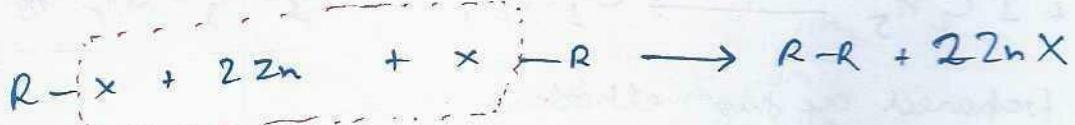
One of the characteristic property is can undergo dehydrogenation



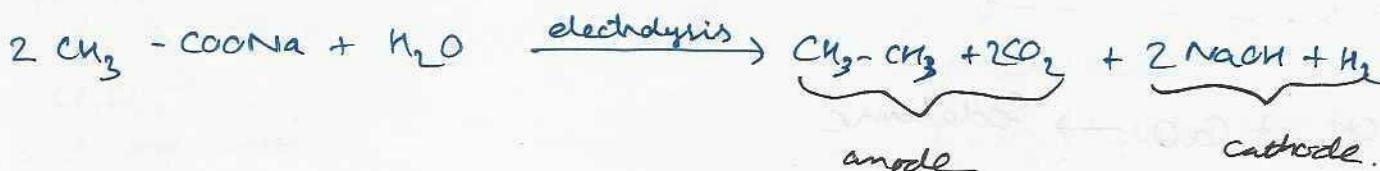
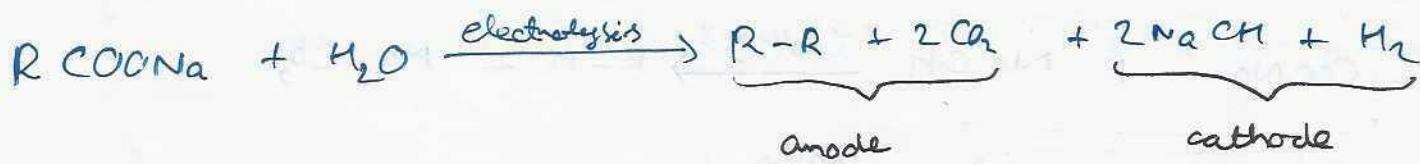
ii) Ionic Method:



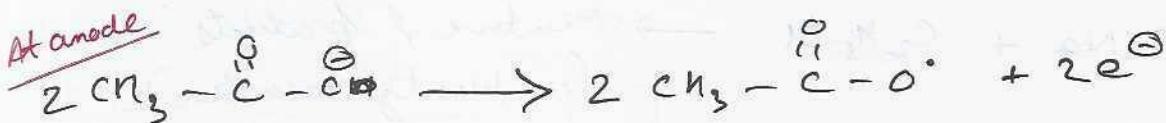
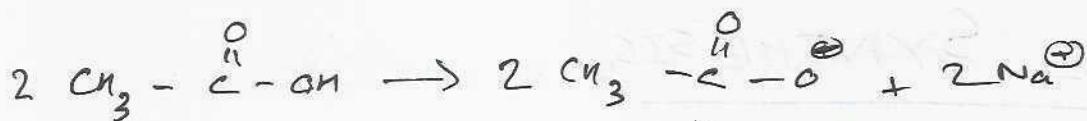
In place of Na, if we use Zn, the reaction is known as Frankland reaction.



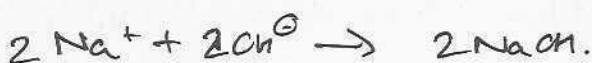
KOLBE'S ELECTROLYSIS



Mechanism



At cathode

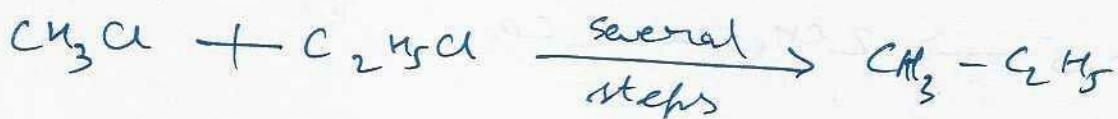
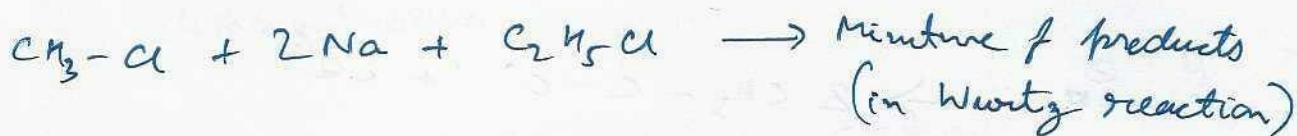


From 'Na' SALTS or CARBOXYLIC ACIDS



Function of CaO → to keep NaOH dry.

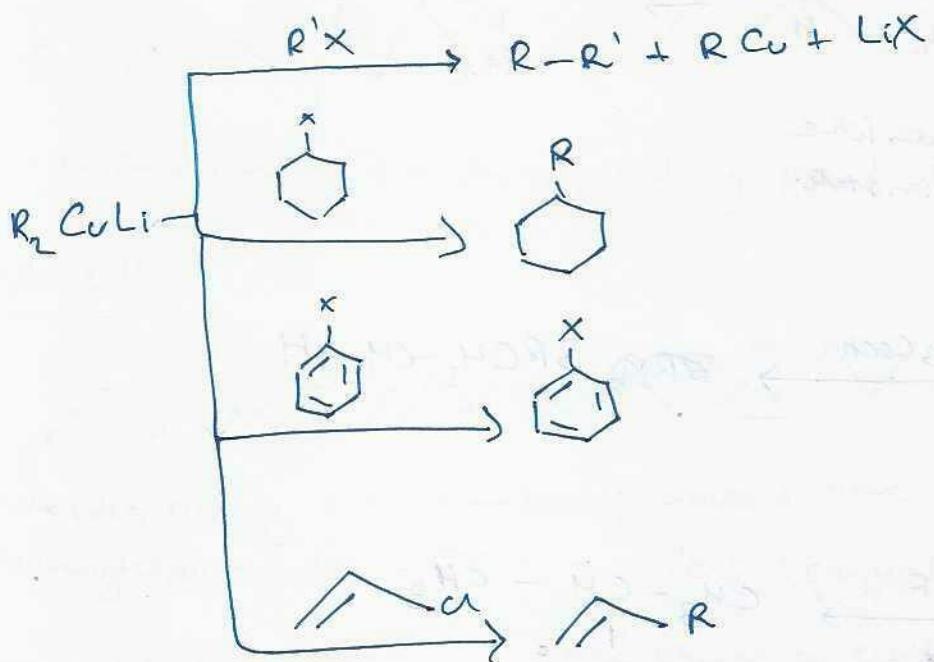
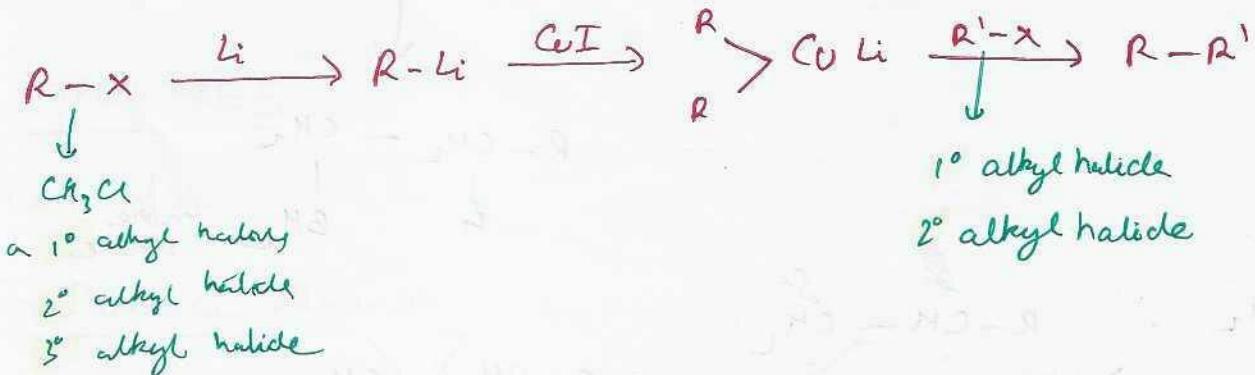
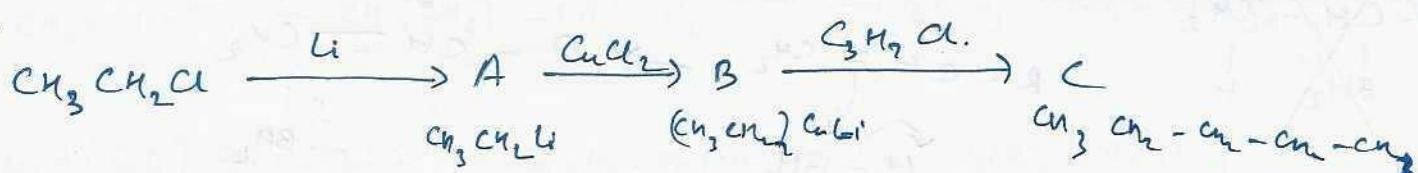
COREY - HORSE SYNTHESIS



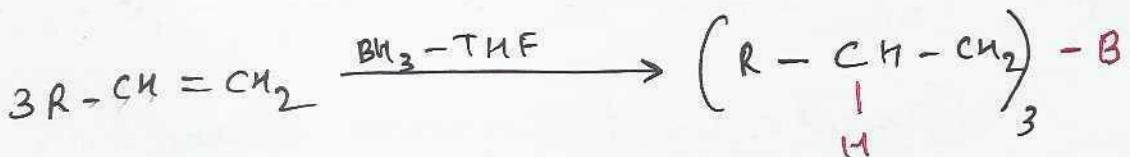
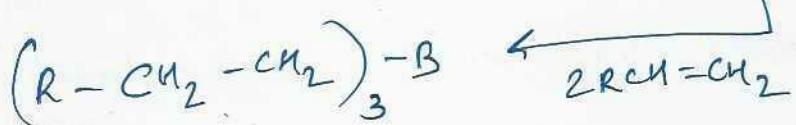
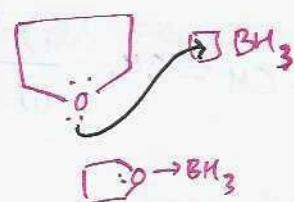
dimethyl cuprate lithium iodide

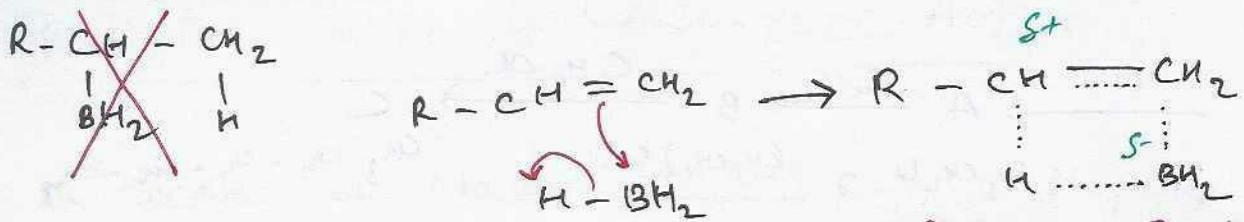


Q.

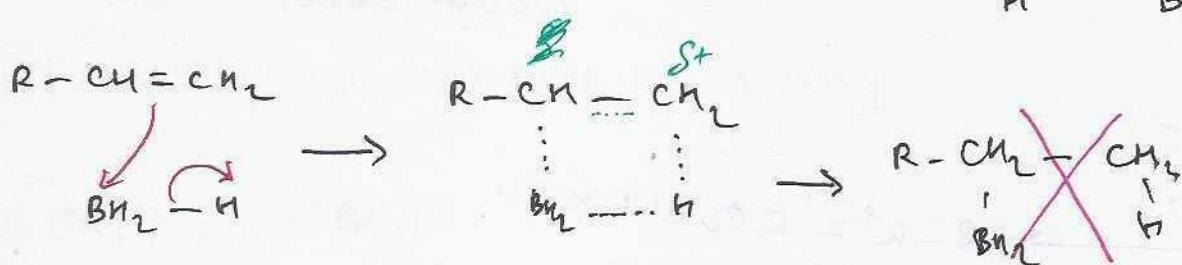
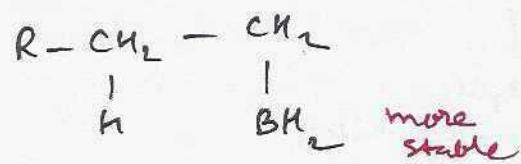


HYDROBORATION - (REDUCTION OF ALKYL BORANES)

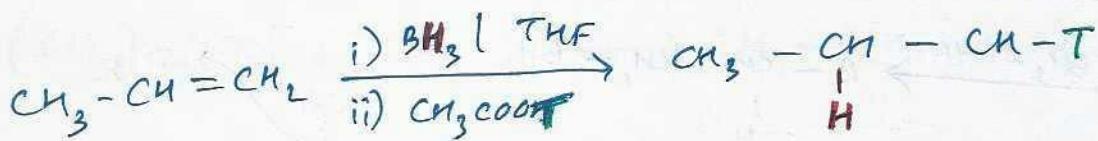
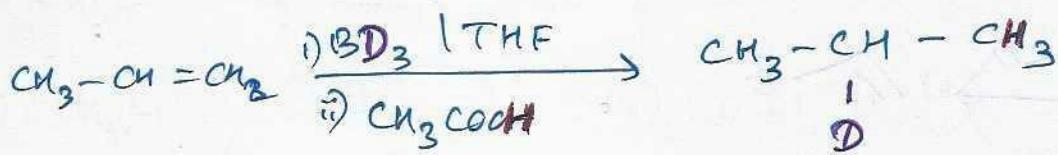
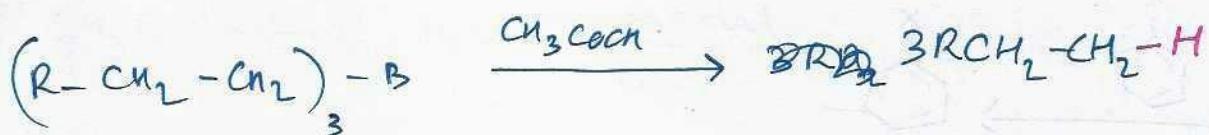


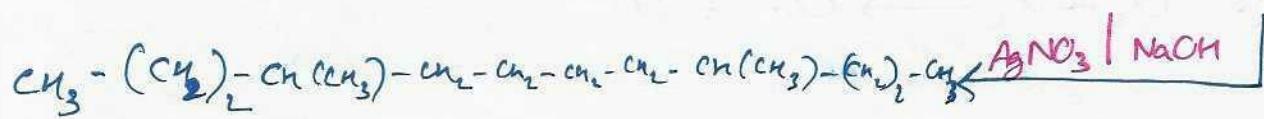
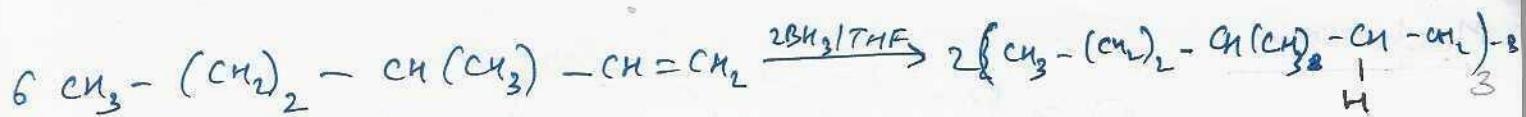


2° Carbocation-like Transition state.



1° Carbocation-like
Transition state.

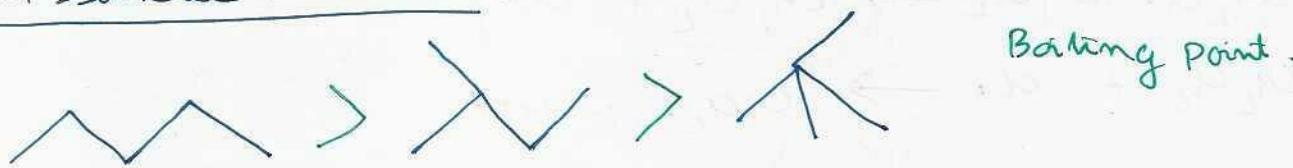




PROPERTIES

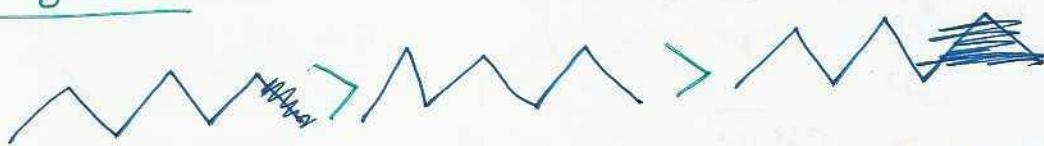
- Non Polar

In Isomeric Alkanes



With increase in branching, boiling point decreases.

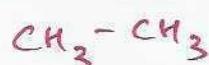
Melting Point



Molecules having even number of carbons, have higher melting point than its neighbouring two alkanes. → Perfect crystalline structure.

Same reason. PCl_4^+ and PCl_6^- exist in solid state.

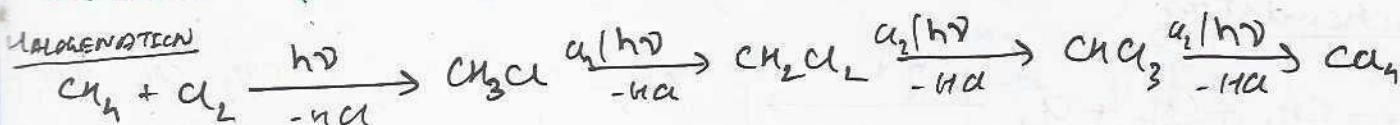
CHEMICAL PROPERTIES



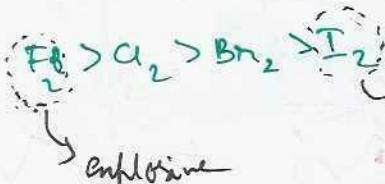
Paraffin → little affinity towards reactions.

Addition is not possible in alkanes

Can react in presence of Heat, light, Electricity, Peroxides → Free radical reactions.

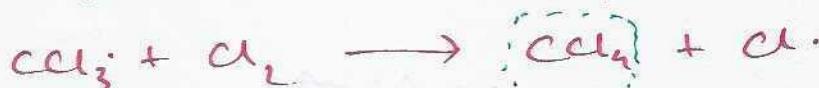
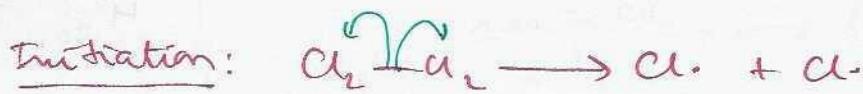


Free radical substitution.
(Chain reaction)



reversible, slow.

Mechanism



Chain Termination



MONOHALOGENATION

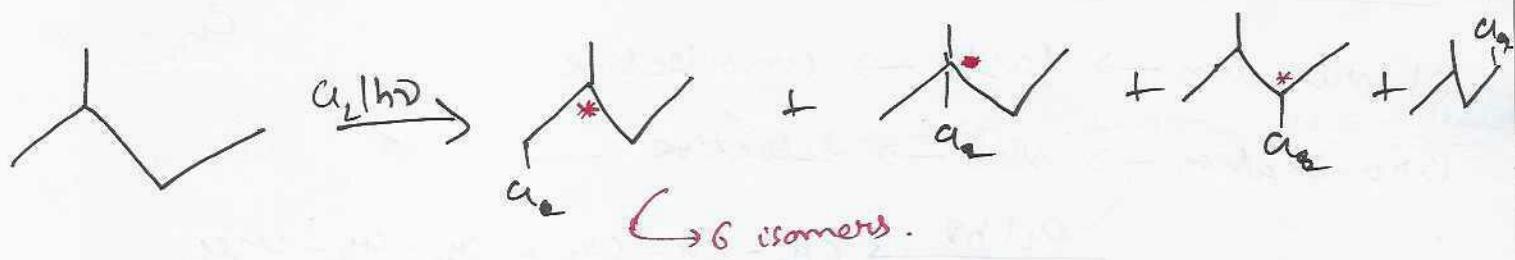
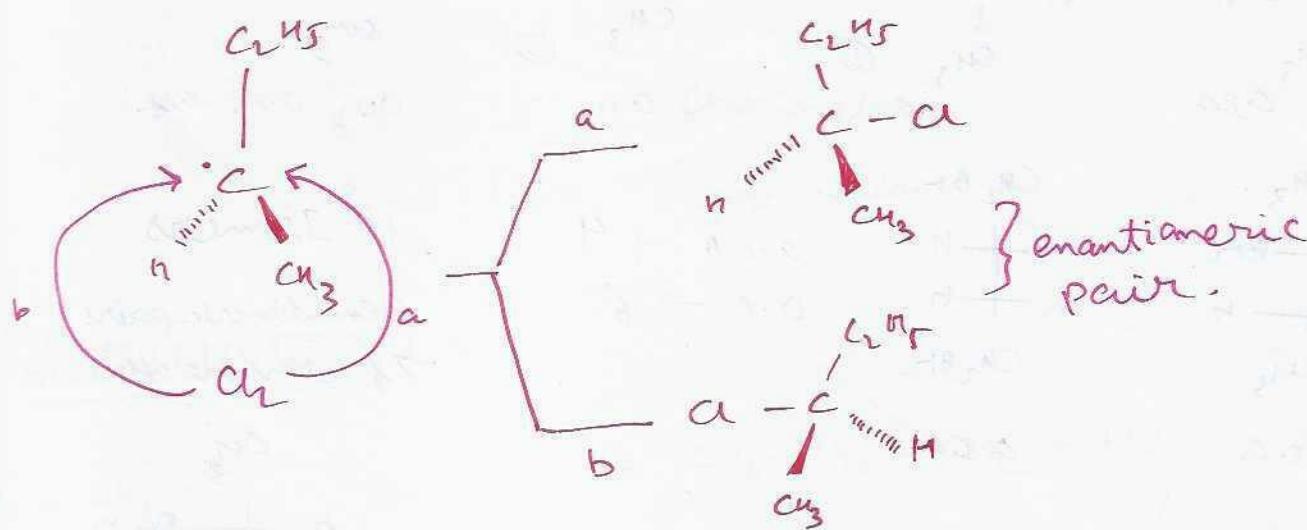
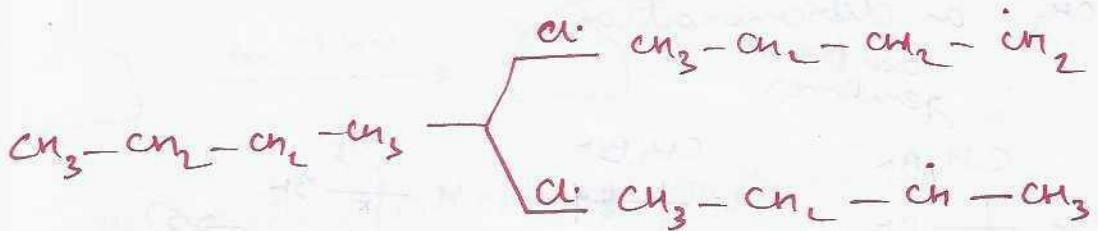
Possible by taking excess alkane



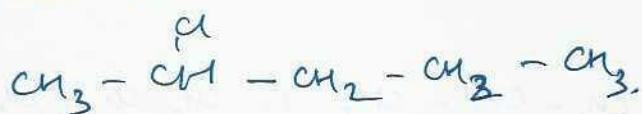
(excess)

Stereochemistry

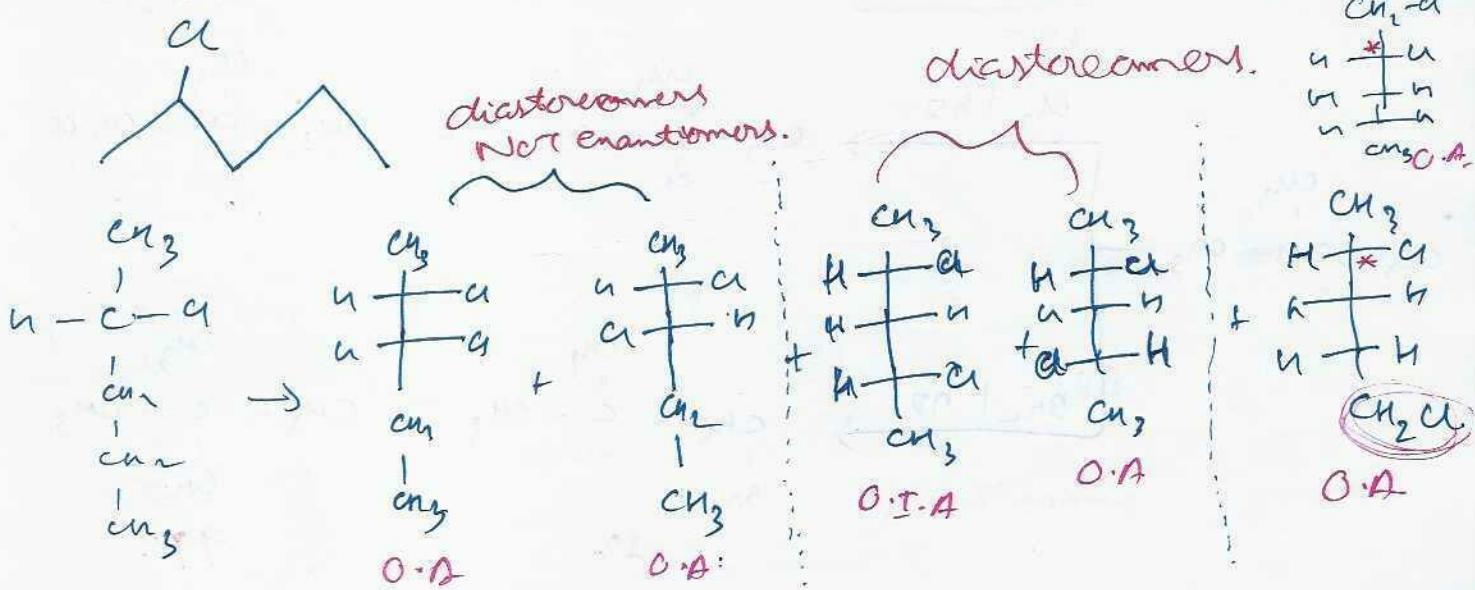




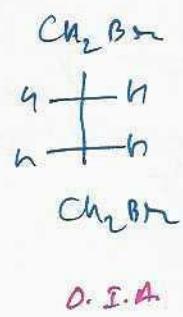
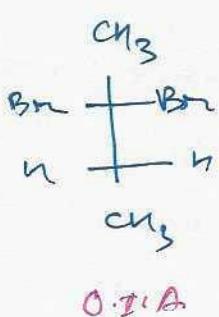
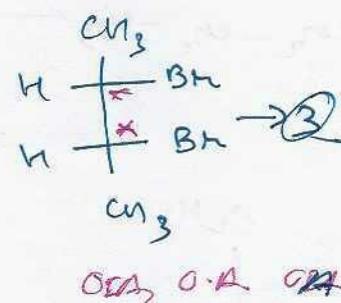
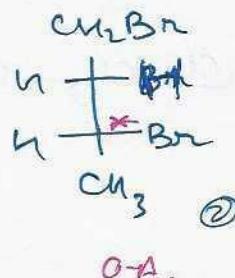
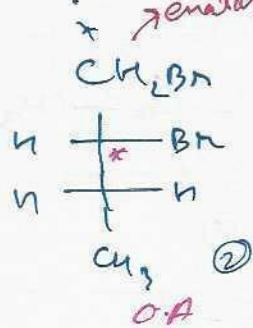
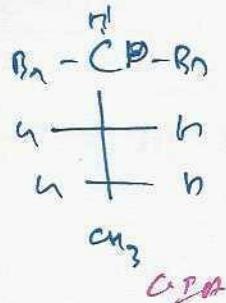
S - 2-chloropentane



Q. Mono chlorination on ~~the~~ carbon.

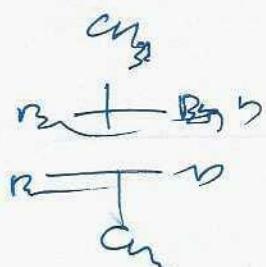


$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ on dibromination
will form
enantiomers



O.I.A. \rightarrow 4
O.D. \rightarrow 6.

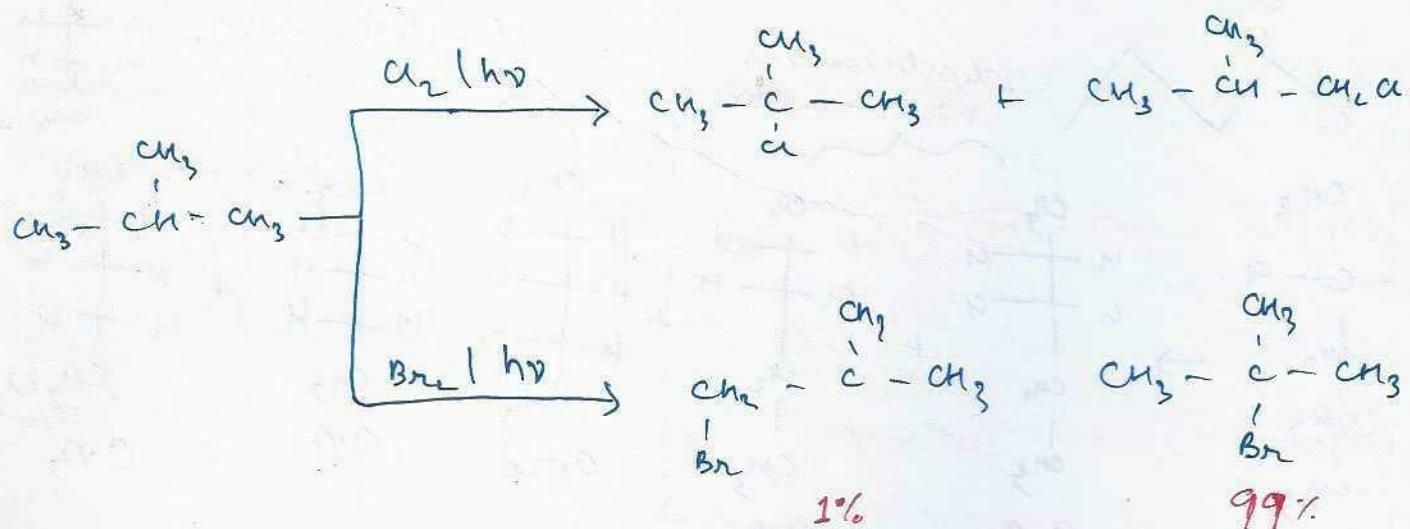
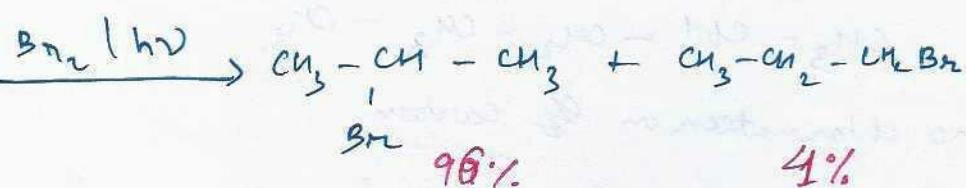
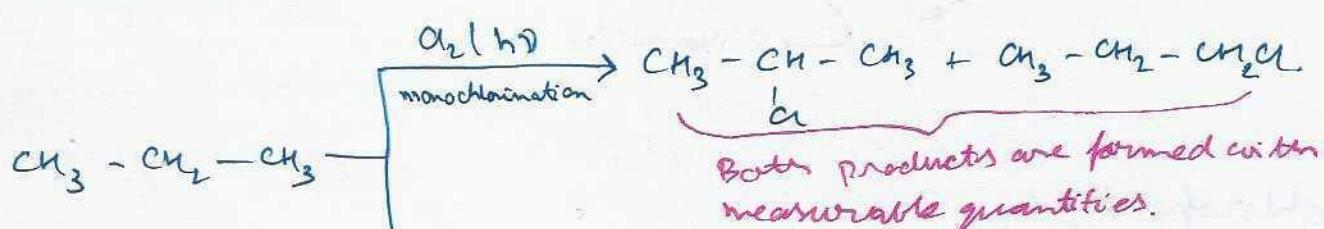
10 Isomers
3 enantiomeric pairs
7 fractions are obtained

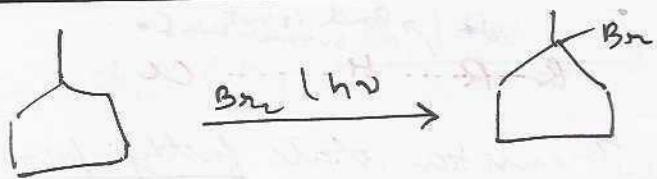


SOLUBILITY - REACTIVITY

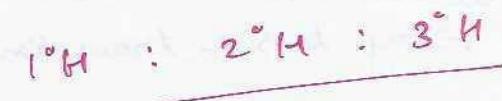
Chlorination \rightarrow fast \rightarrow unselective

Bromination \rightarrow slow \rightarrow selective

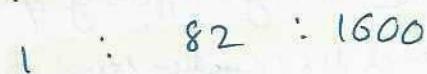




Tertiary hydrogen is replaced by Bromine.

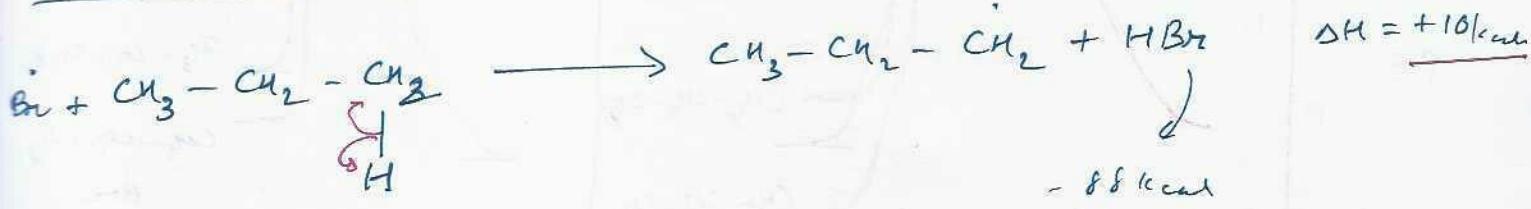


Chlorination.

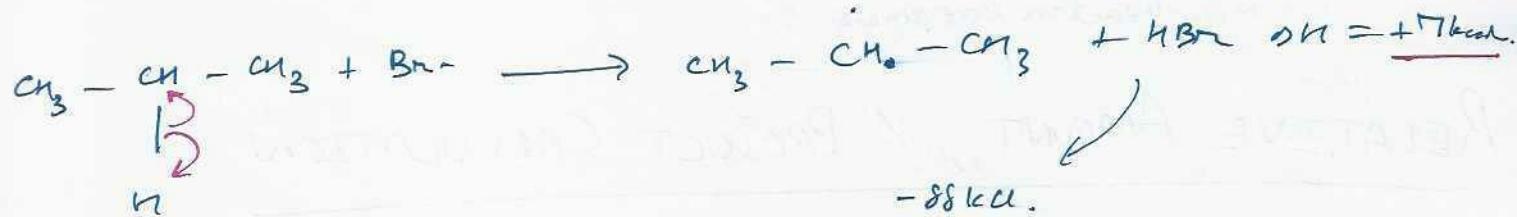


Bromination

BROMINATION



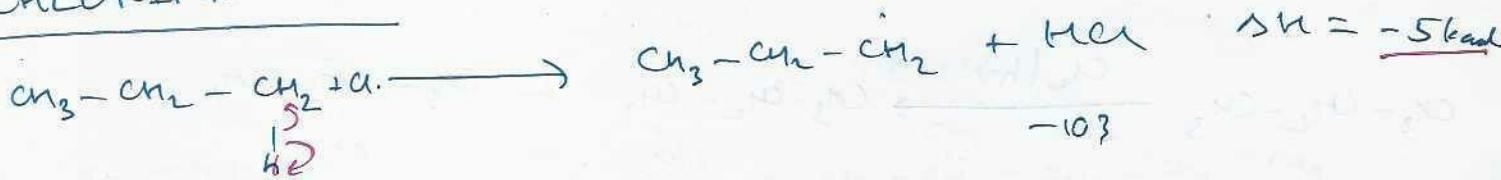
$\Delta D_E = +98 \text{ kcal}$



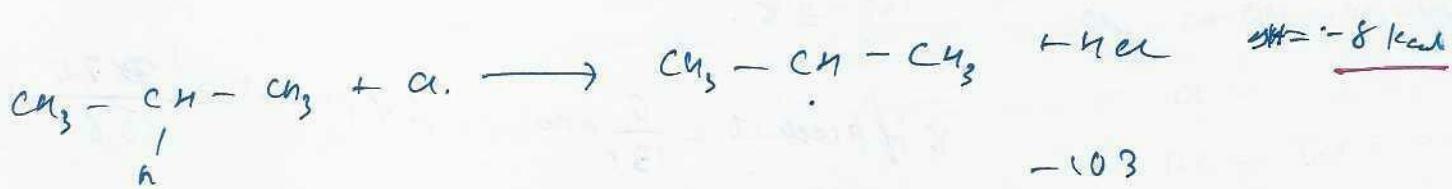
$\Delta D_E = +95 \text{ kcal}$

Exothermic

CHLORINATION

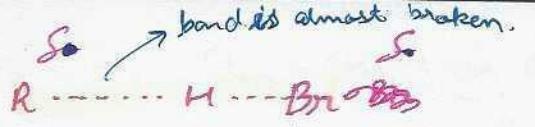


$\Delta D_E = +98 \text{ kcal}$



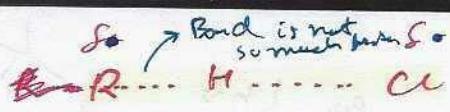
$\Delta D_E = +95$.

Exothermic



Transition state slowly formed
 (looks like product)

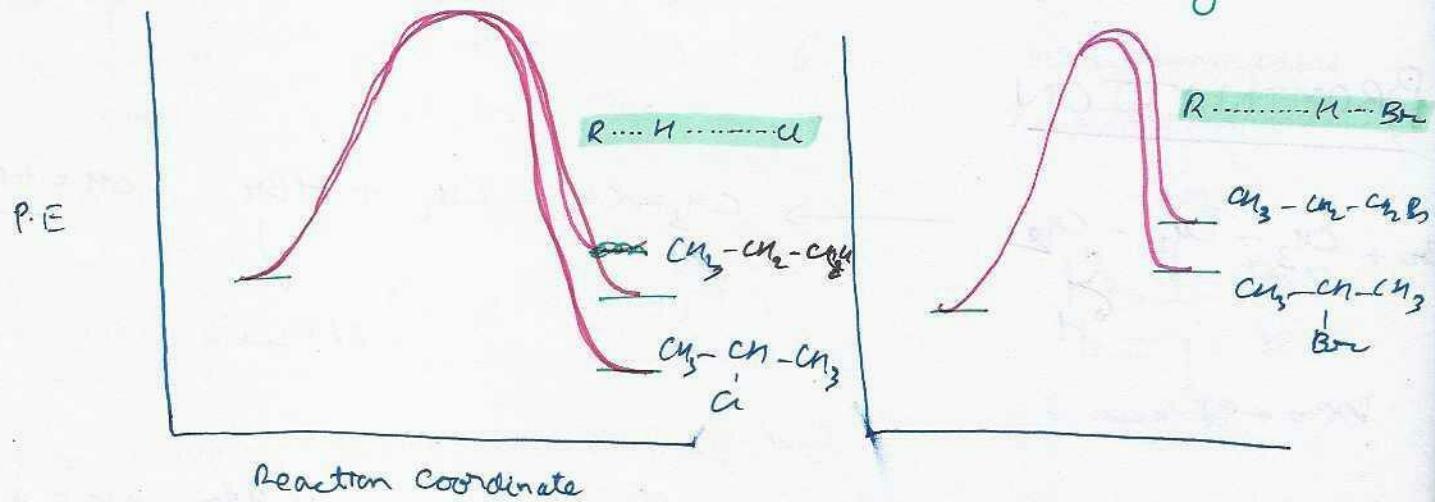
Transition state has more free radical character



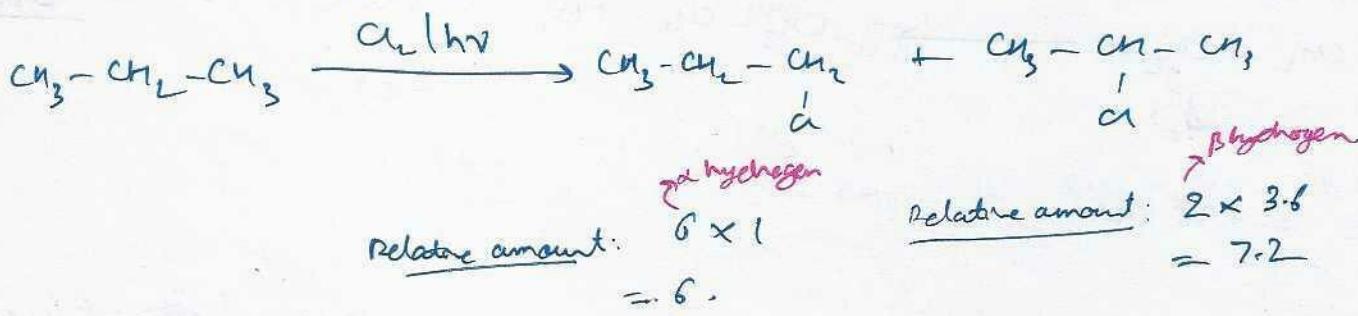
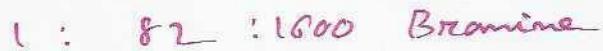
Transition state fastly formed
 (looks like reactant)

Free radical character is very less in transition state

Due to high affinity of chlorine and the reaction being exothermic.

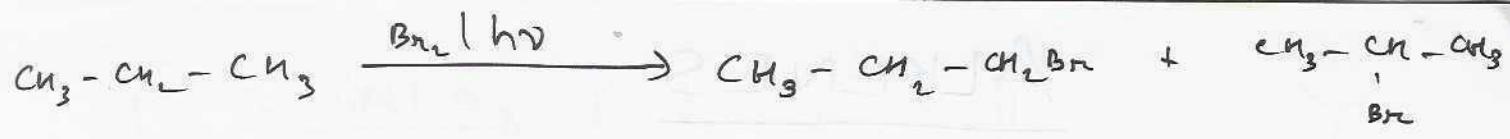


RELATIVE AMOUNT, % PRODUCT CALCULATION



$$\% \text{ of Product} = \frac{6}{13.6} \times 100 = 44.1\%$$

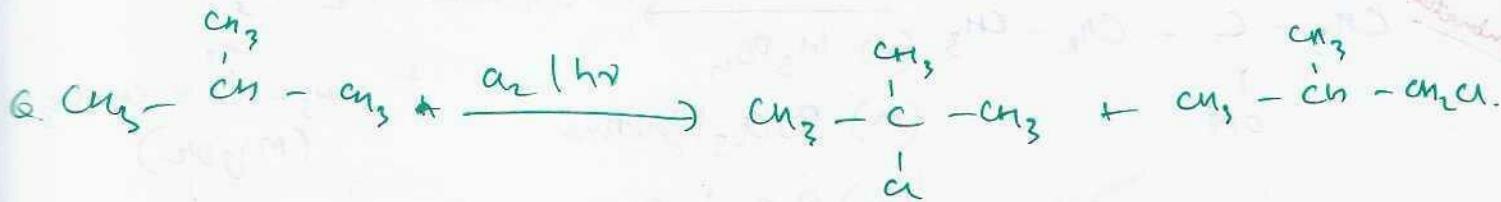
$$\% \text{ of Product} = \frac{7.2}{13.6} \times 100 = 55.9\%$$



Relative amount = $\frac{6}{170} \times 100$ Relative amt = 2×82
~~6~~ = 164

$$\% = \frac{6}{170} \times 100 \quad \% = 96.5\%$$

$$= 3.5\%$$

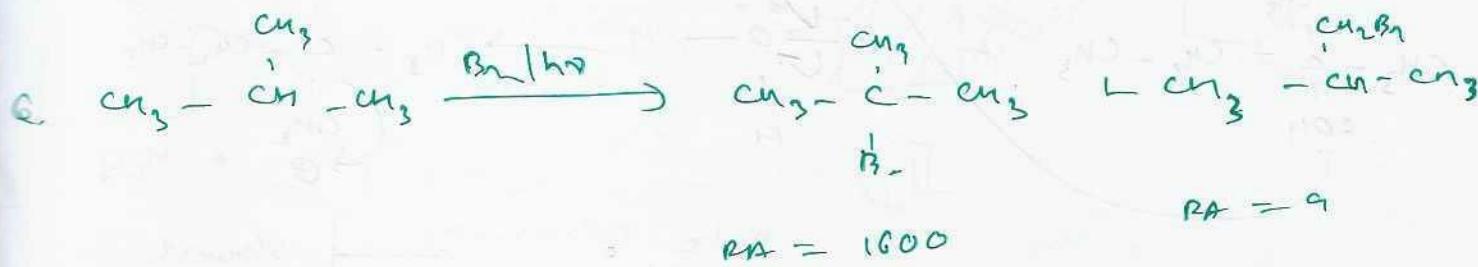


~~RA = 600~~ RA = 1600

$$= 5 \quad \% = 9.$$

$$\% = \frac{5}{1600} \times 100 \quad \% = \frac{9}{1600} \times 100$$

$$= 35.7\% \quad \% = 64.3\%$$

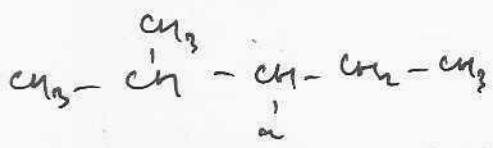
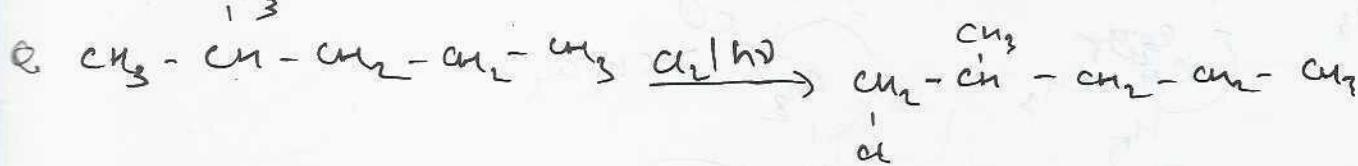


$$RA = 9$$

$$RA = 1600$$

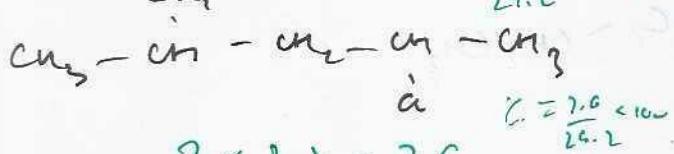
$$\% = \frac{1600}{1600} \times 100 \quad \% = 0.6\%$$

$$= 99.4\%$$



$$RA = 2 \times 3.8 = 7.6$$

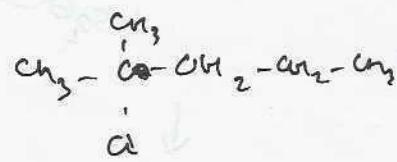
$$\% = \frac{7.6}{29.2} \times 100.$$



$$2 \times 3.8 = 7.6$$

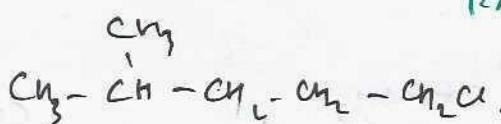
$$RA = 8 \times 1 \\ = 8.$$

$$\% = \frac{8}{29.2} \times 100$$



$$RA = 1 \times 5 = 5$$

$$\% = \frac{5}{29.2} \times 100$$



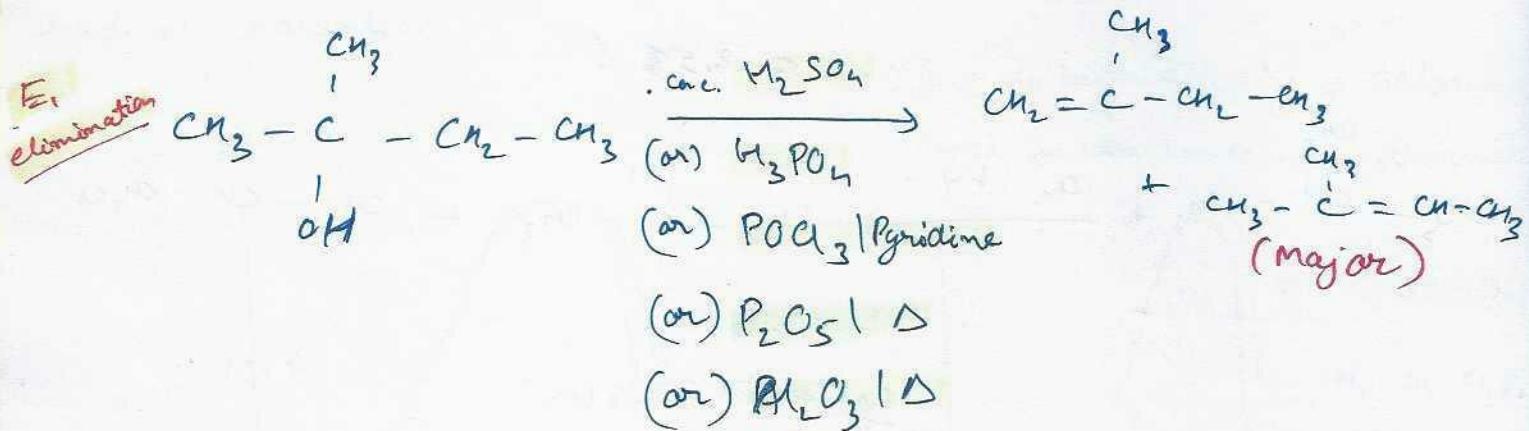
$$RA = 3 \times 1 = 3.$$

$$\% = \frac{3}{29.2} \times 100$$

ALKENES

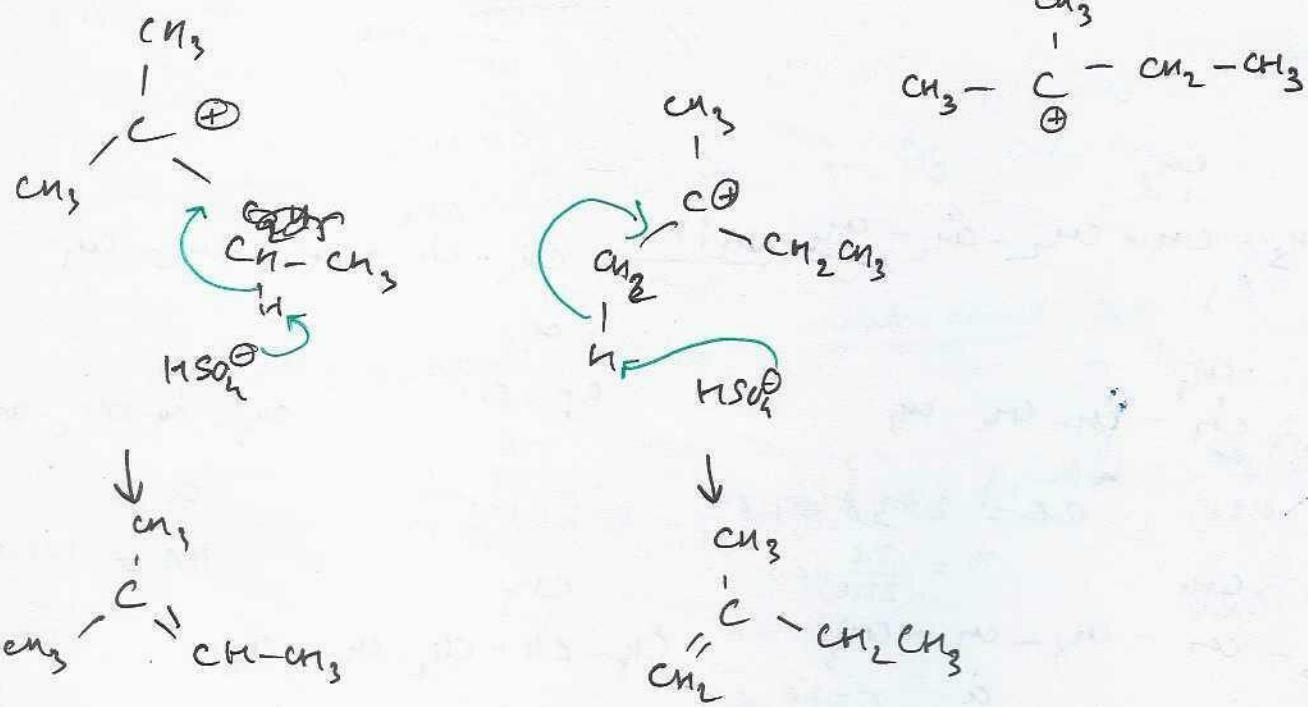
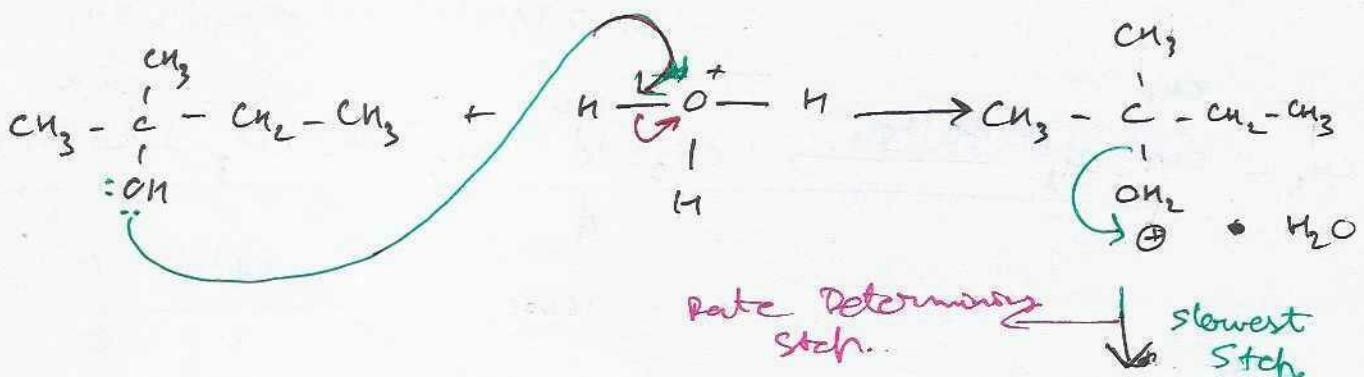
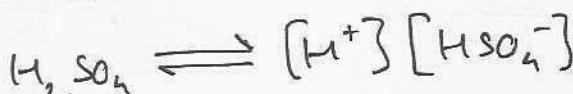
PREPARATION OF ALKENES

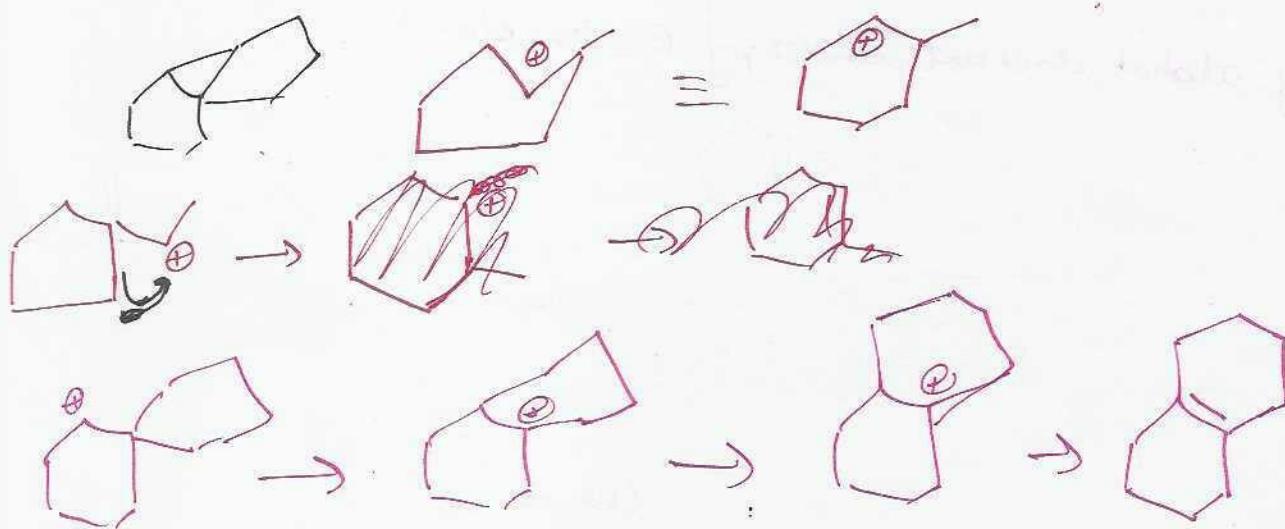
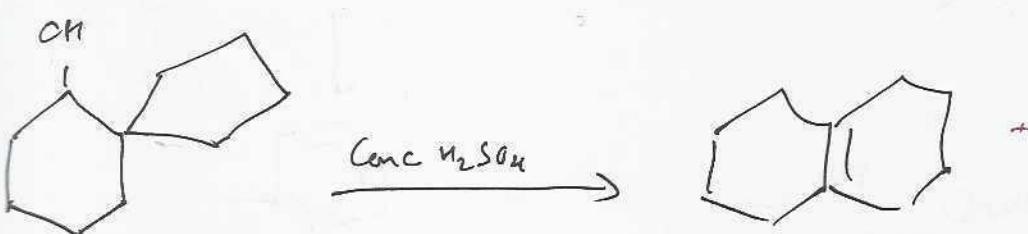
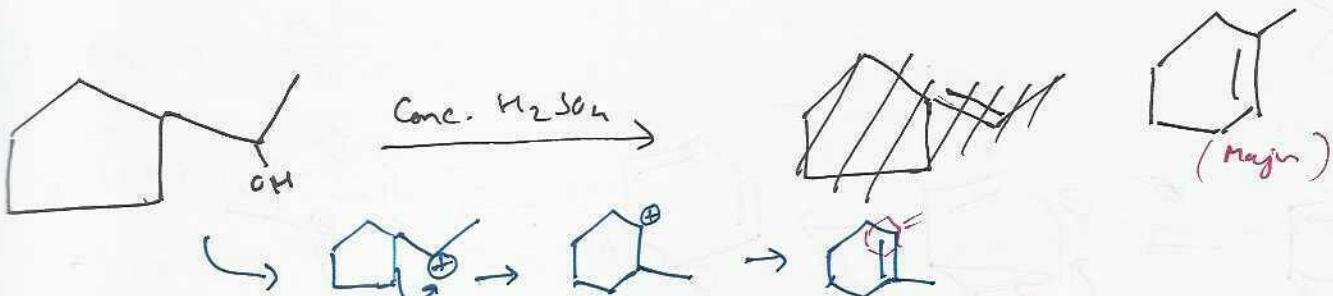
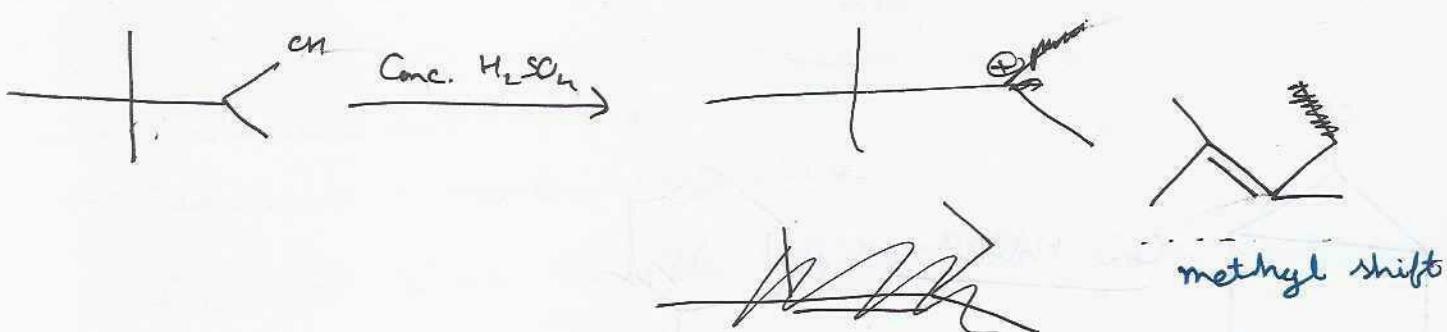
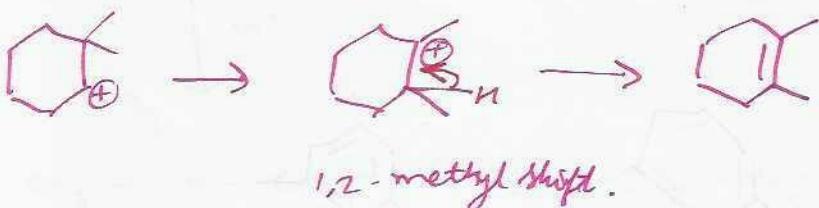
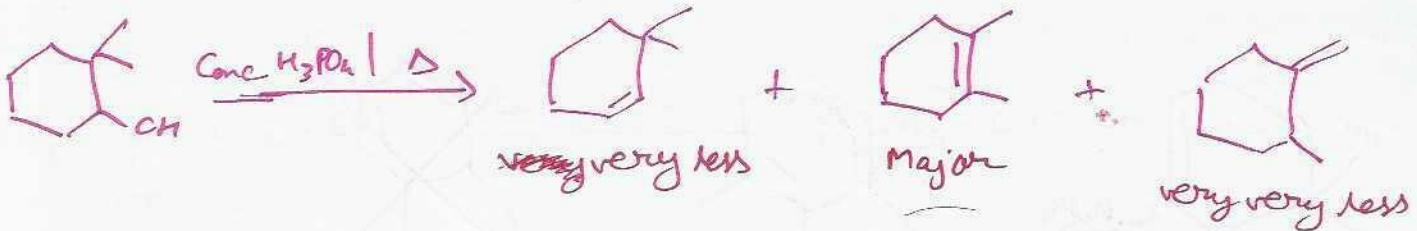
① From dehydrogenation of Alcohols

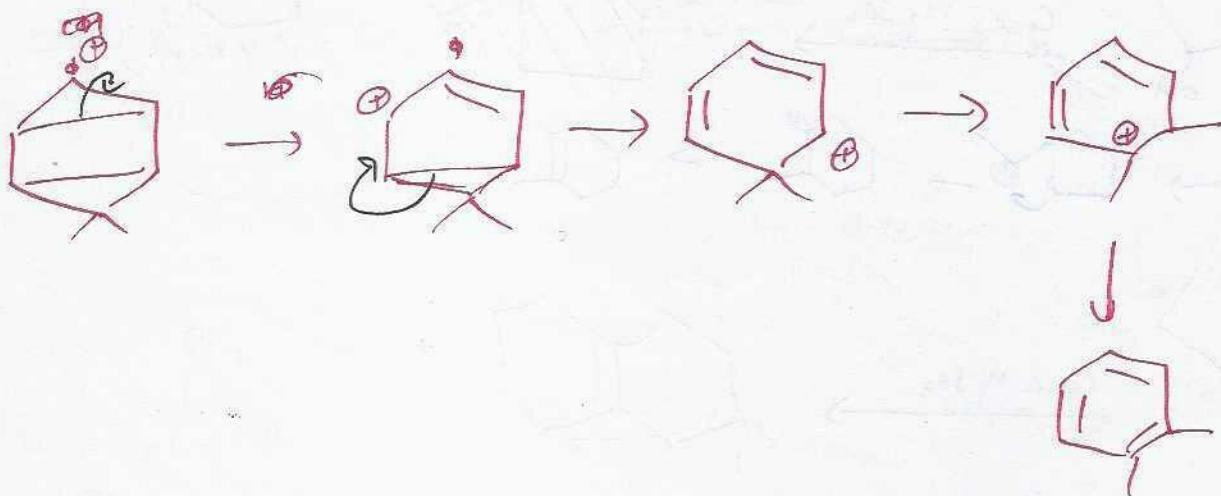
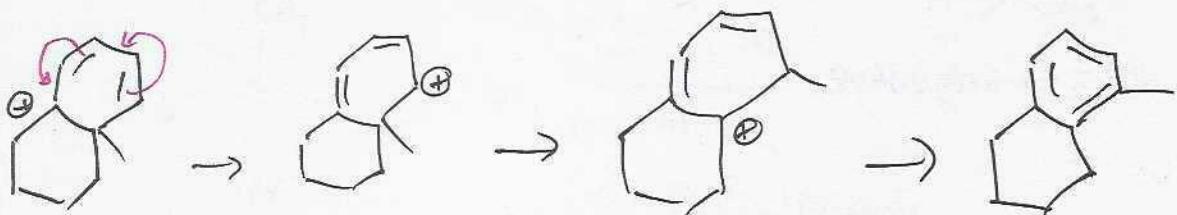
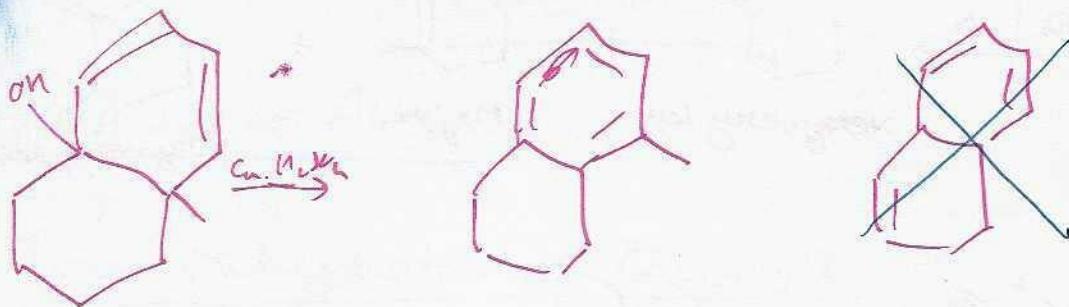


Mechanism

$E_1 \rightarrow$ slowest step depends on only one reactant.

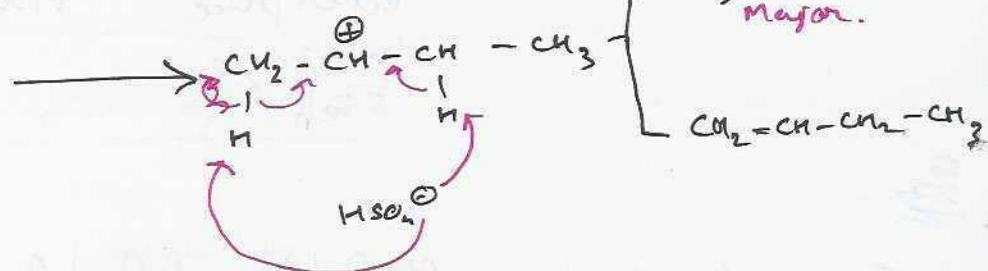
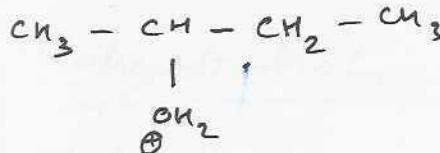
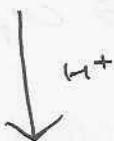
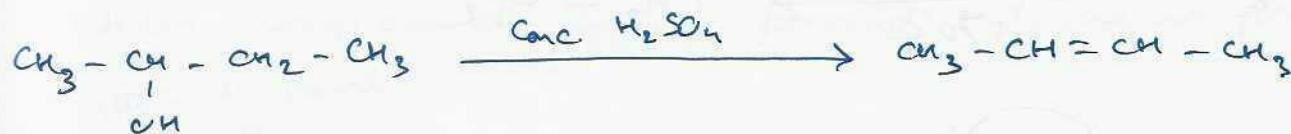






Primary alcohol does not undergo E_1 mechanism.

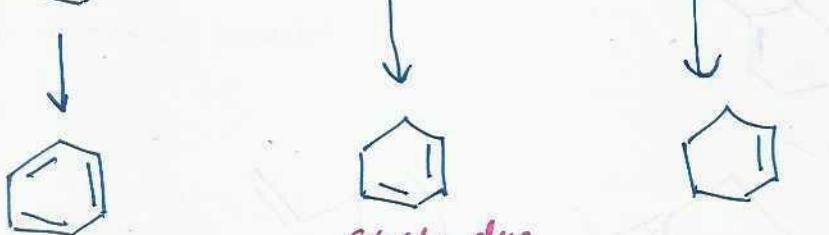
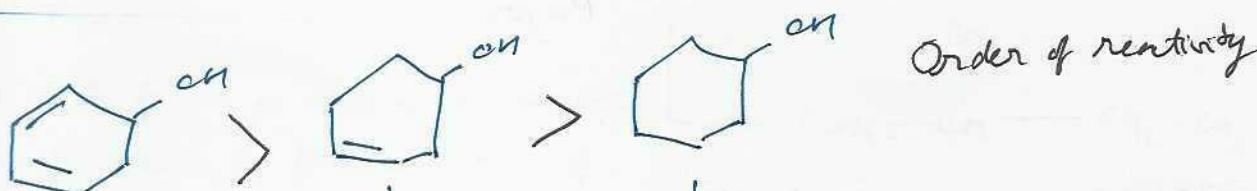
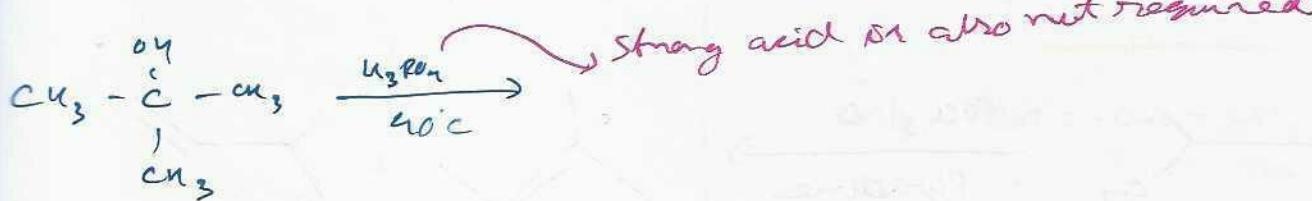
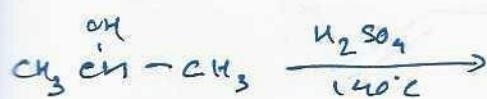
E₁



E₁ → Carbocation intermediate

→ Favourable at higher temperature

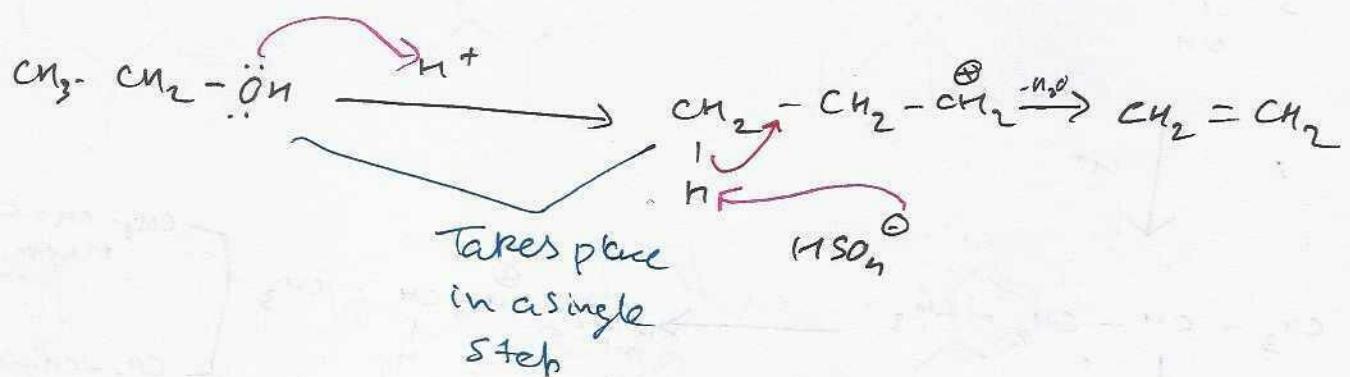
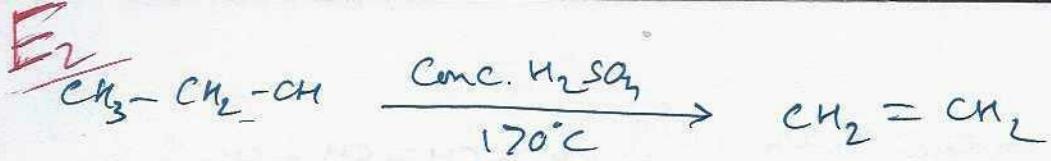
$3^\circ \text{ OH} > 2^\circ \text{ OH} > 1^\circ \text{ OH}$: E₁ reactivity



formed very less

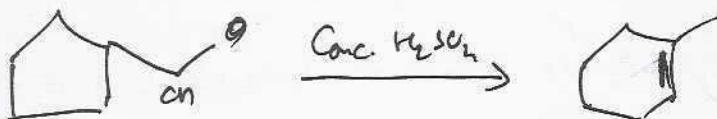
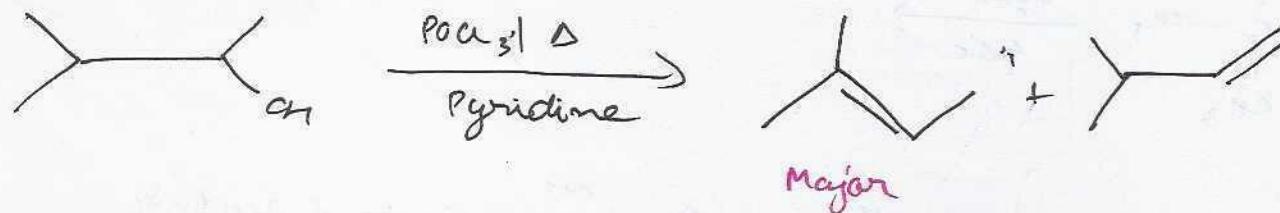
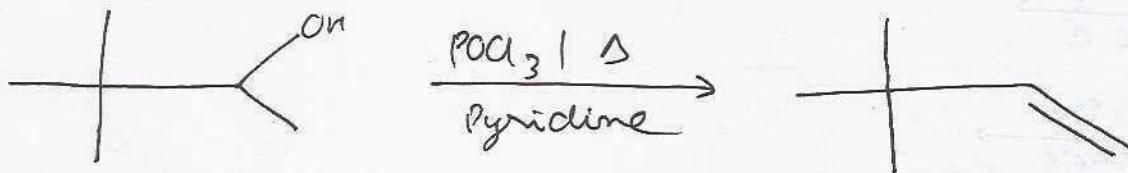


(formed very less)



In addition to this $\text{Al}_2\text{O}_3 | \Delta$, $\text{P}_2\text{O}_5 | \Delta$, $\text{POCl}_3 | \text{Pyridine} | \Delta$.

→ Rearrangement does not take place as carbocation is not formed.
e.g. ring expansion methyl shift do not happen.



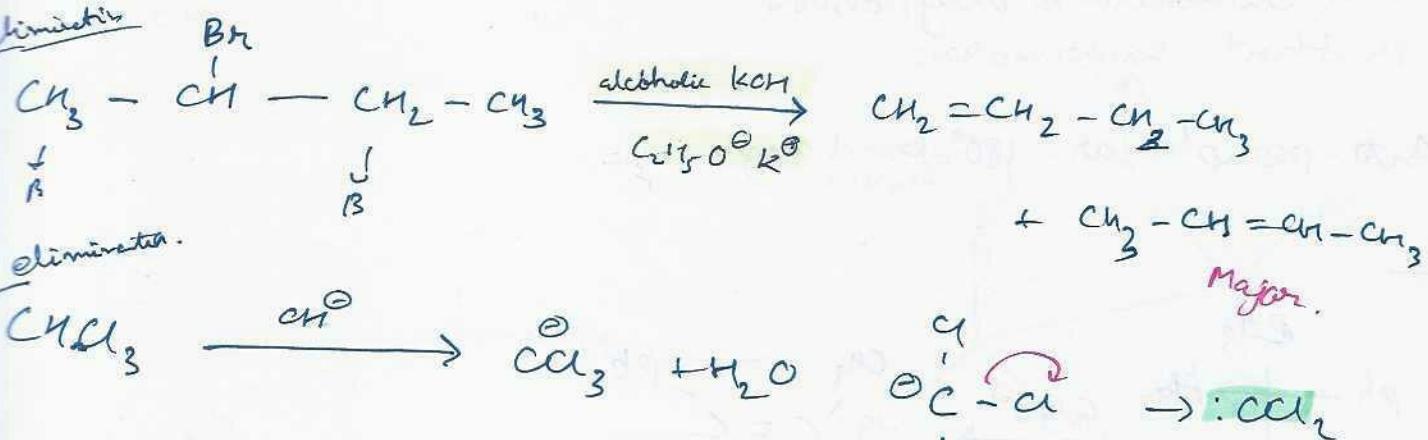
Regioselectivity

When two products can be formed but one is formed in major amount.

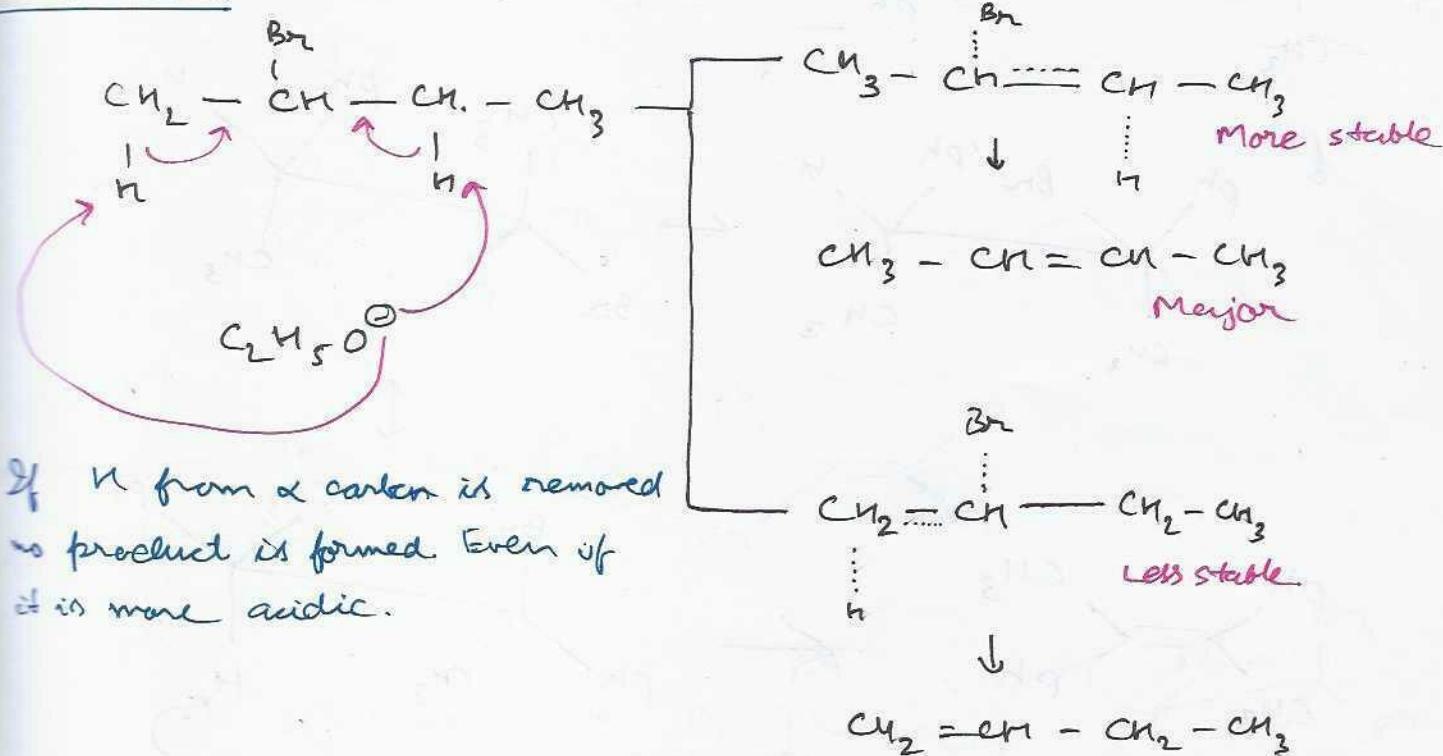
Dehydration of RX

2 Dehydrohalogenation of RX

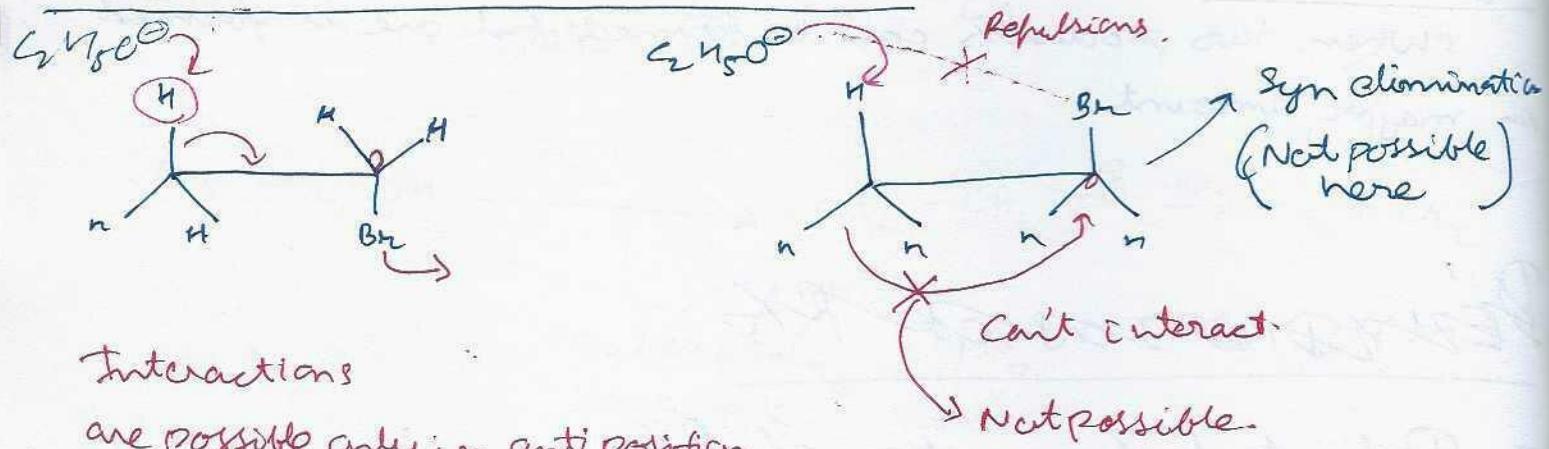
Schmitt's



Mechanism



E_2 elimination is anti elimination

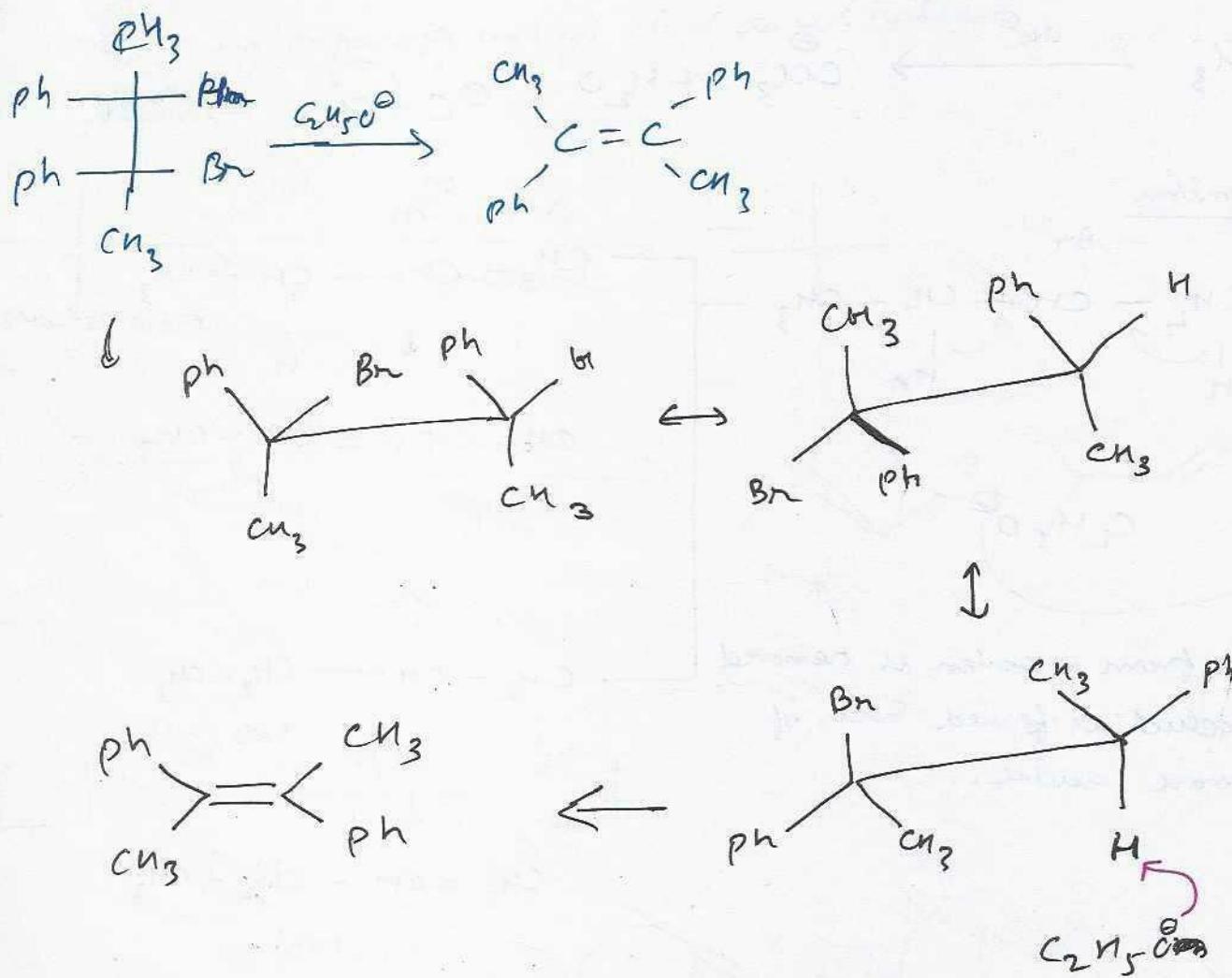


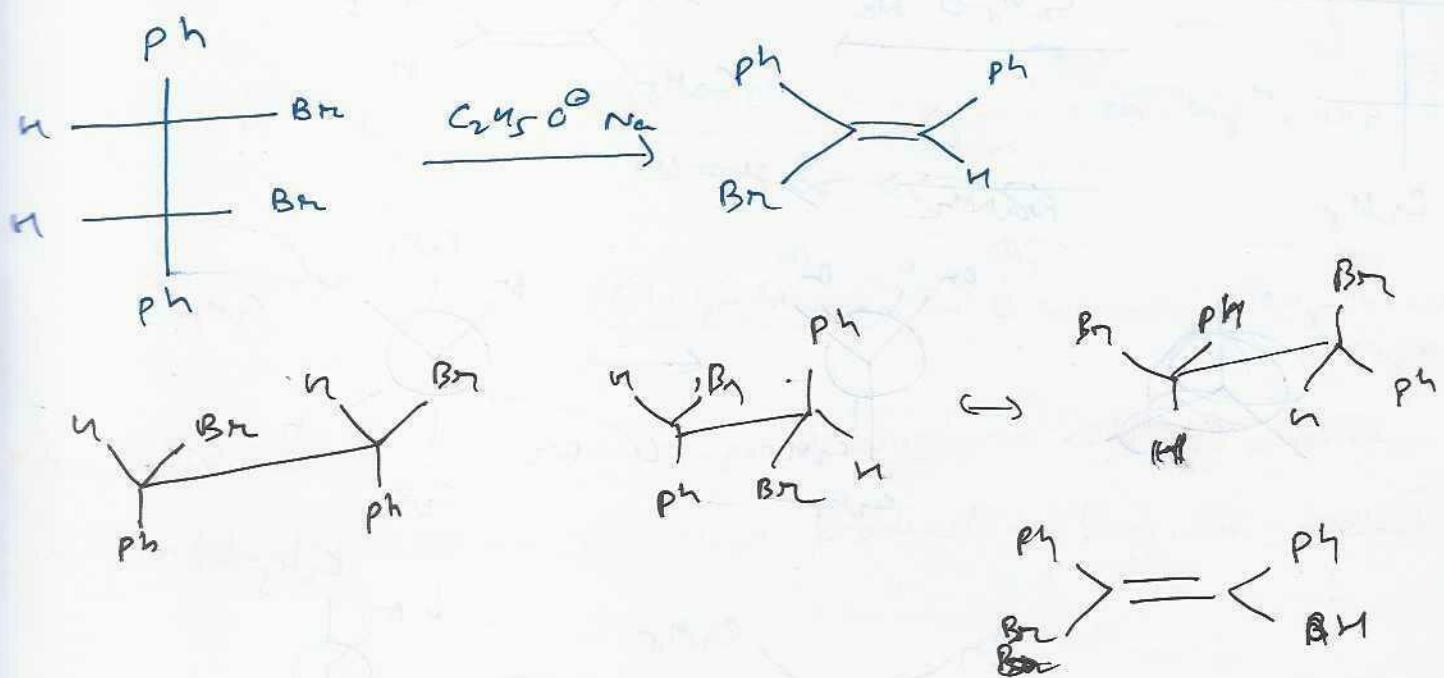
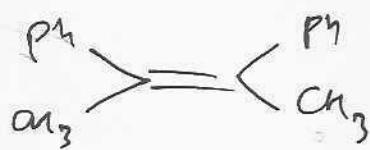
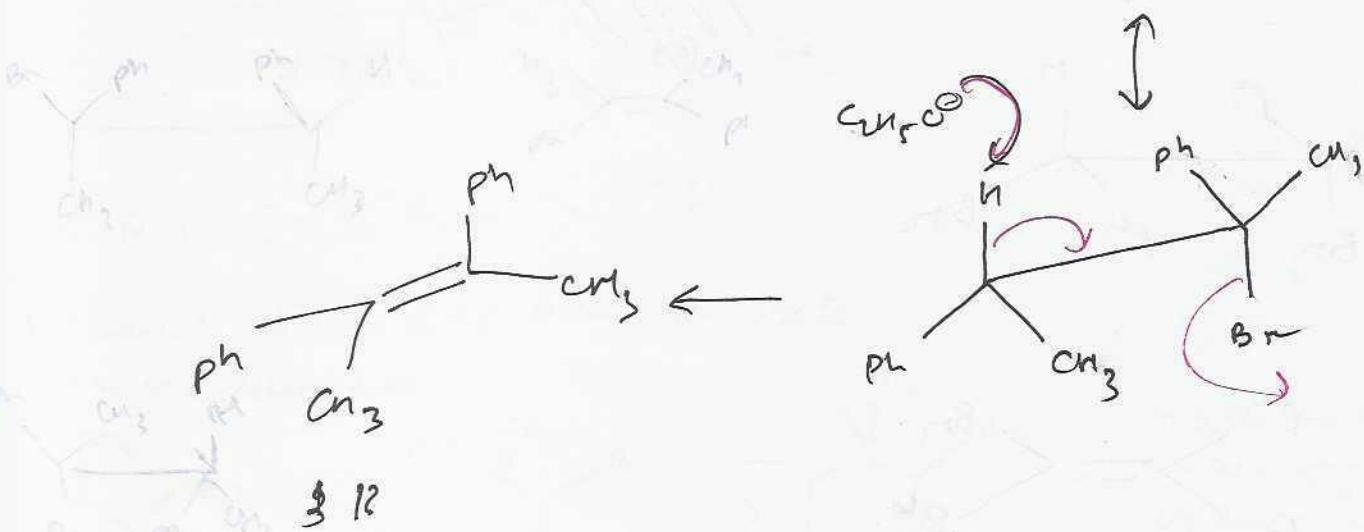
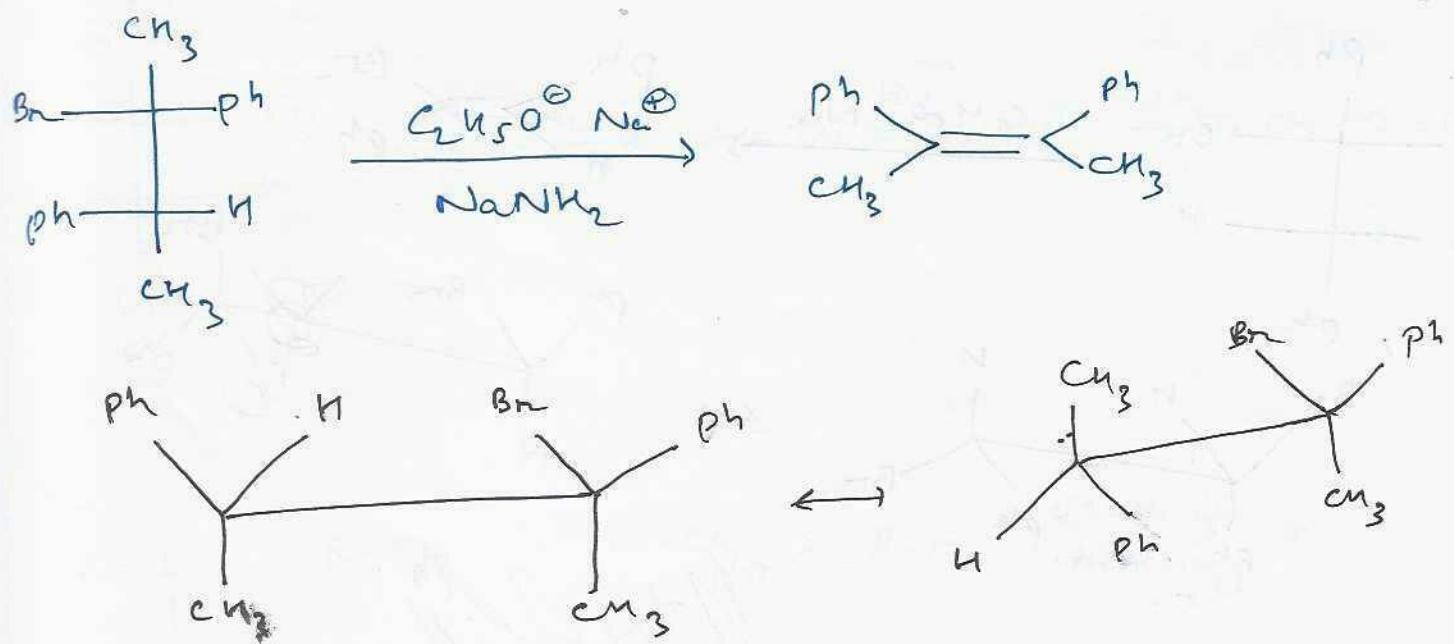
Interactions

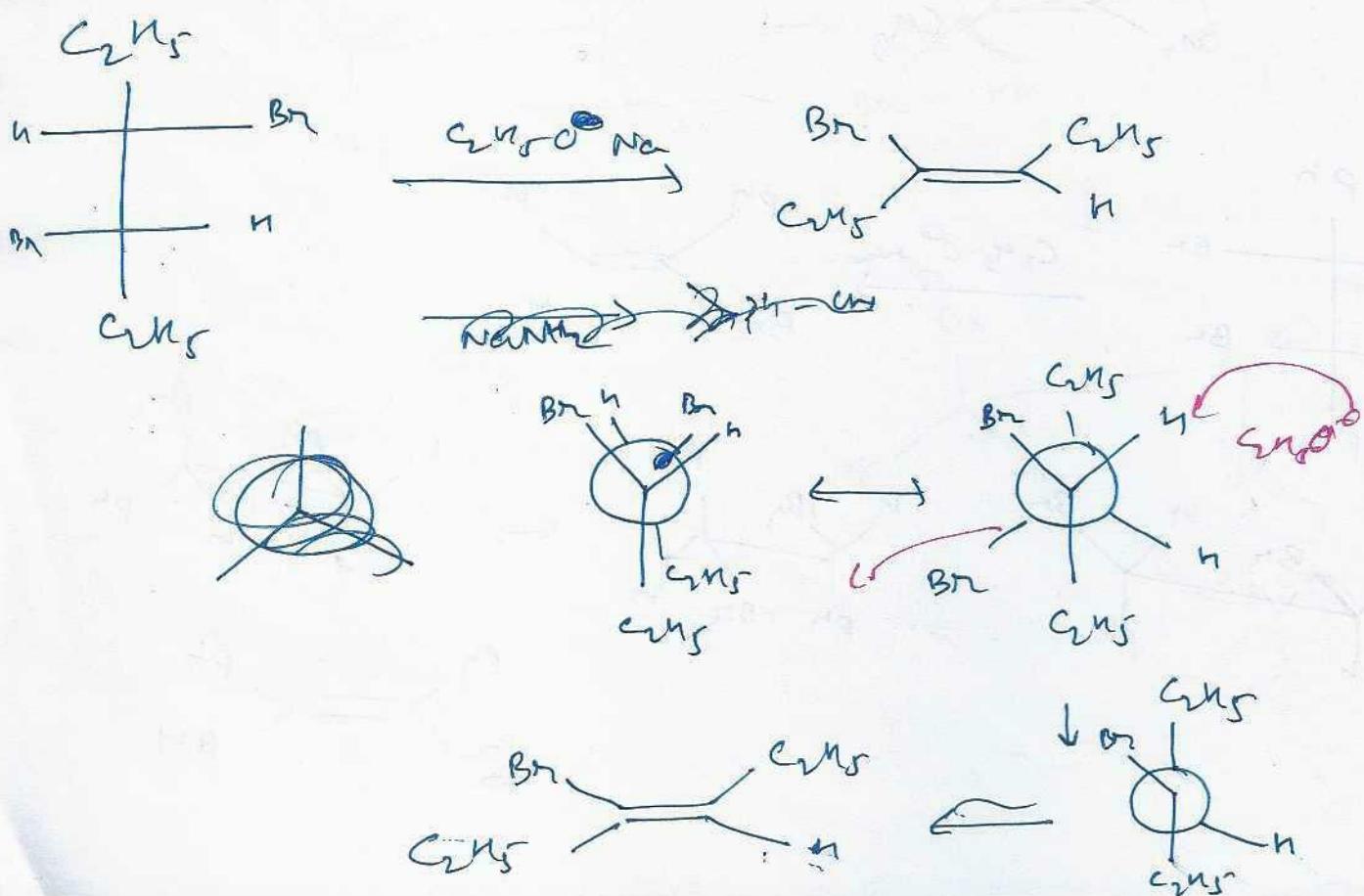
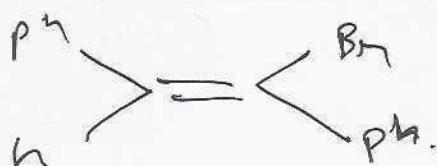
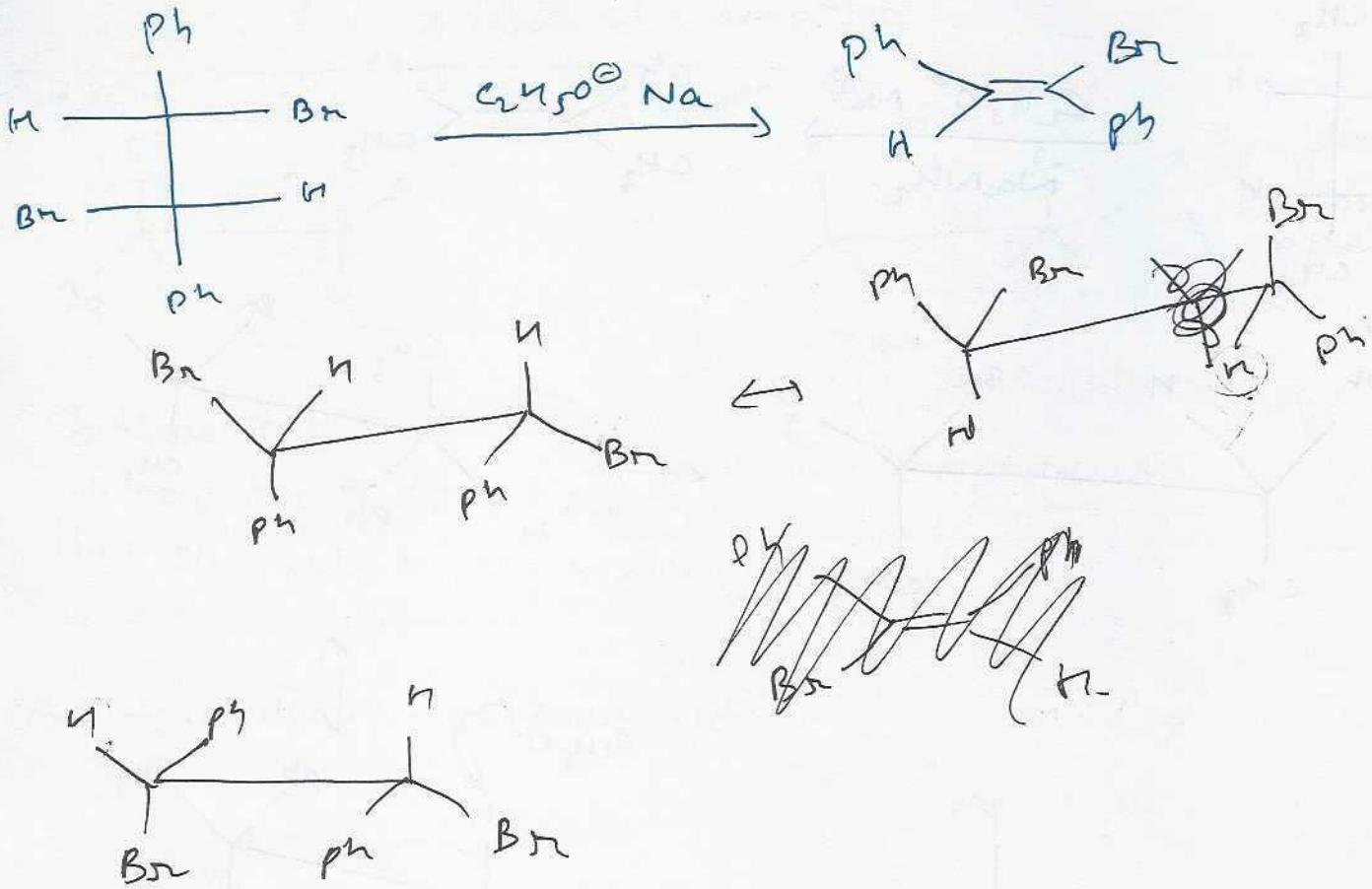
are possible only in anti position

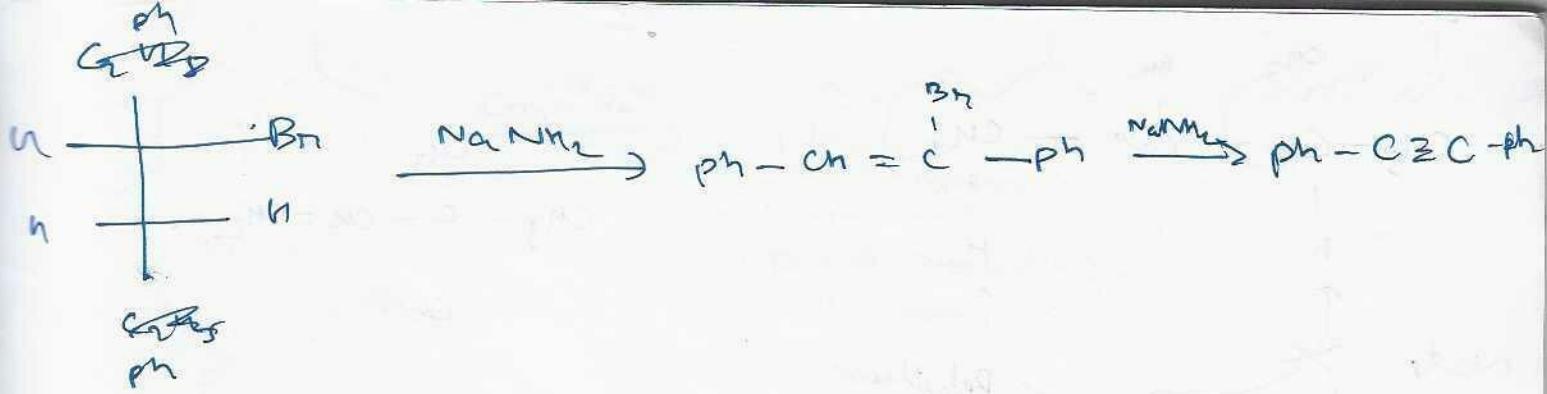
Thus, Elimination is only possible
in that conformation

Anti-periplanar - 180° bond angle

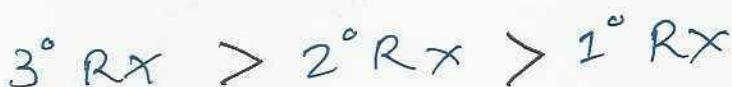
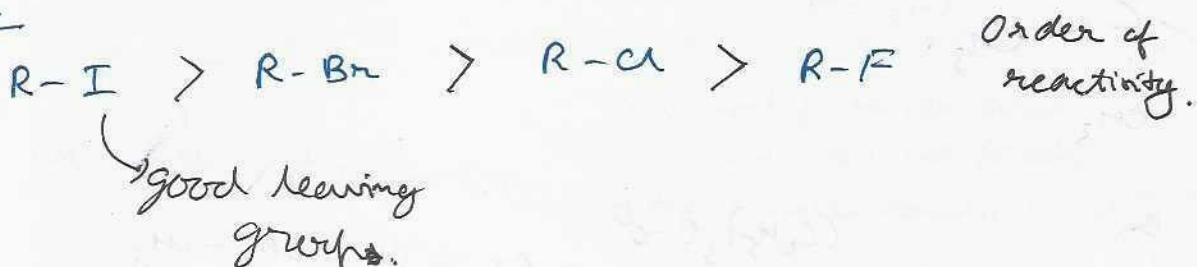




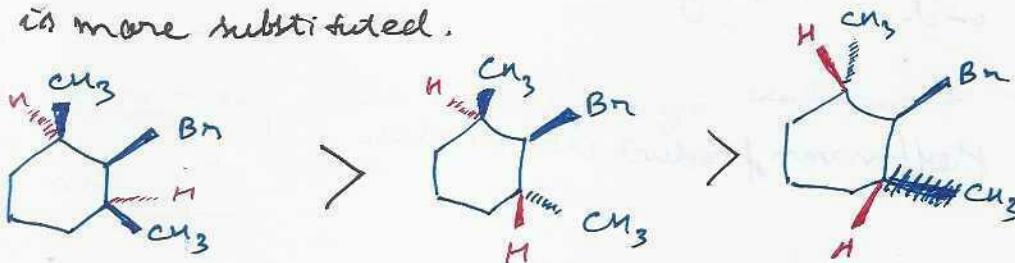




E_r

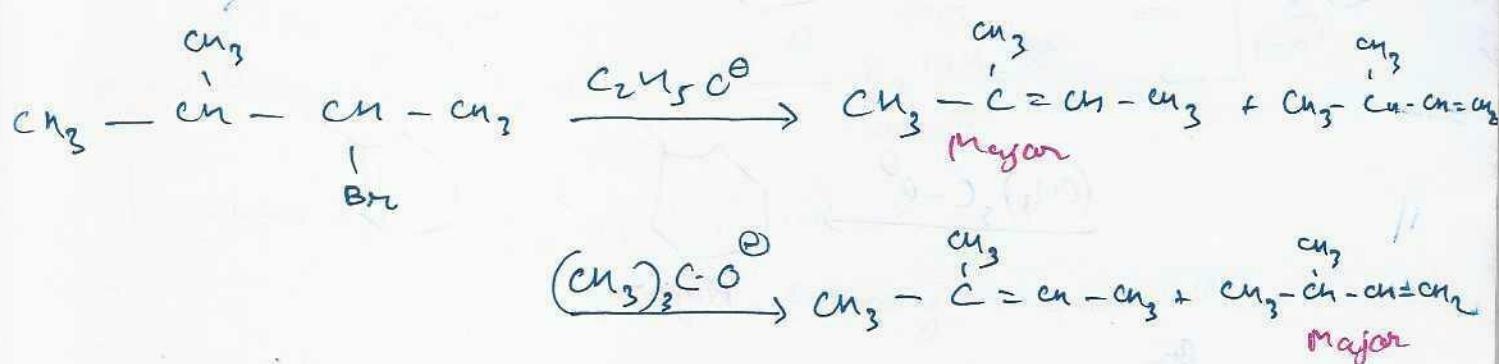


Because alkene like transition state is more substituted.



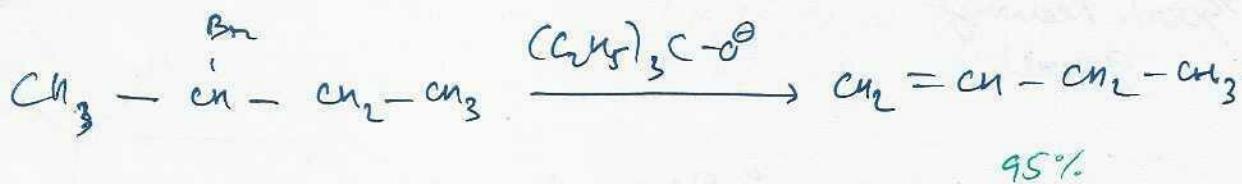
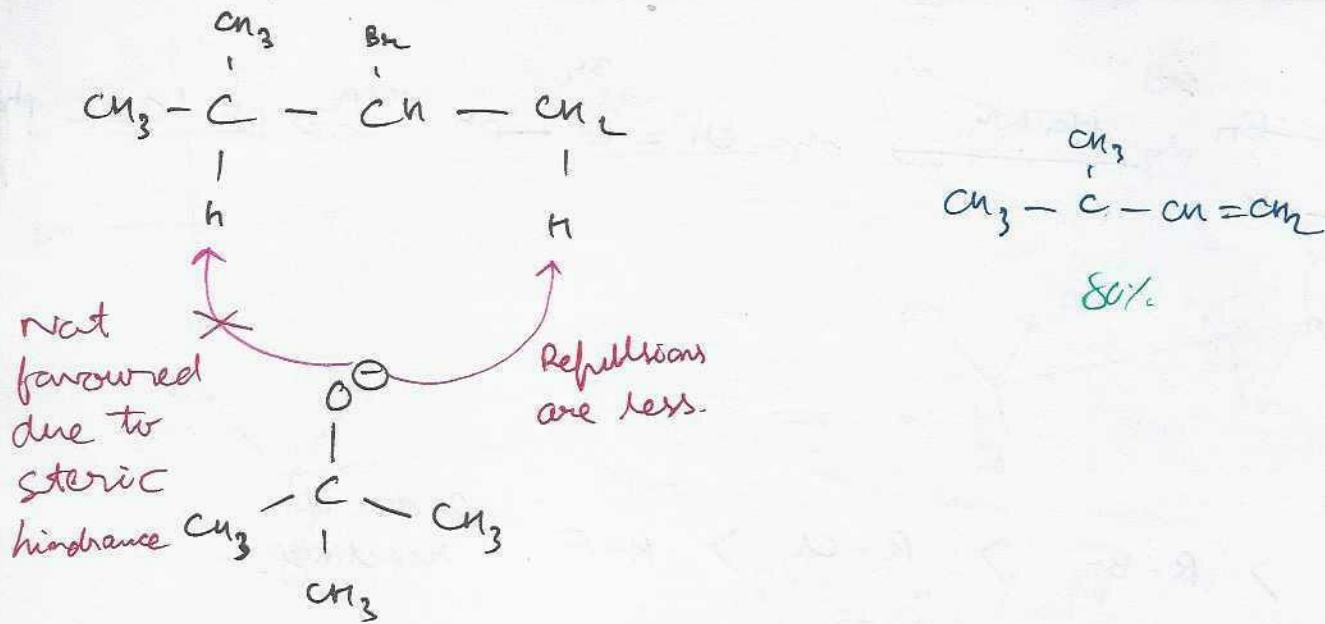
Matom in anti eclipsed conformation increases reactivity

Polar aprotic solvent is more favoured → Cannot solvate the base.



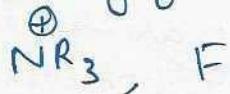
More substituted alkene as major product → Zaitseff-product

Less substituted alkene as major product → Hoffman product.

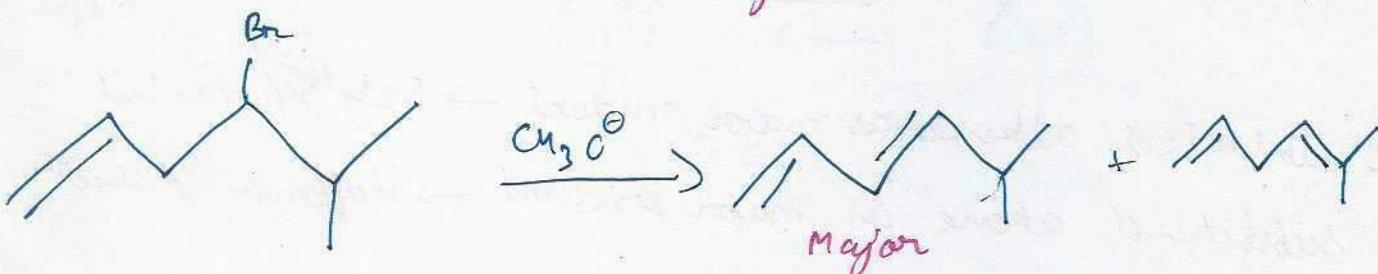
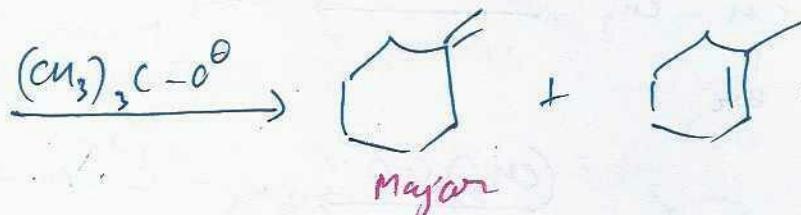
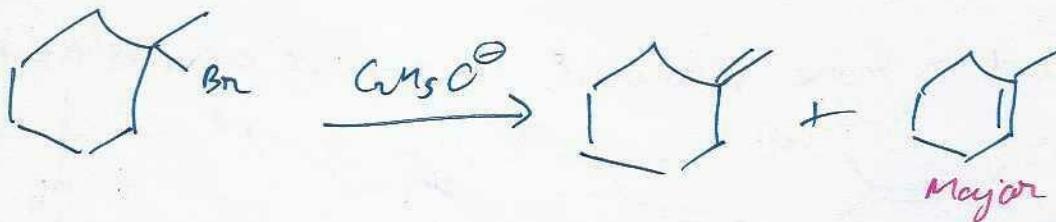


Hoffmann Elimination

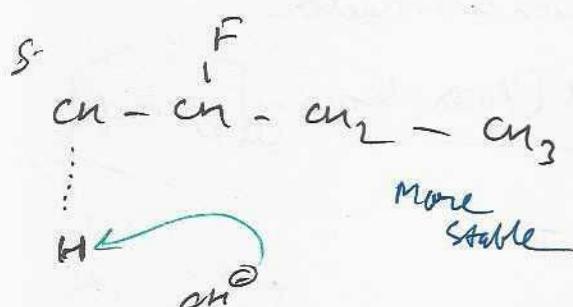
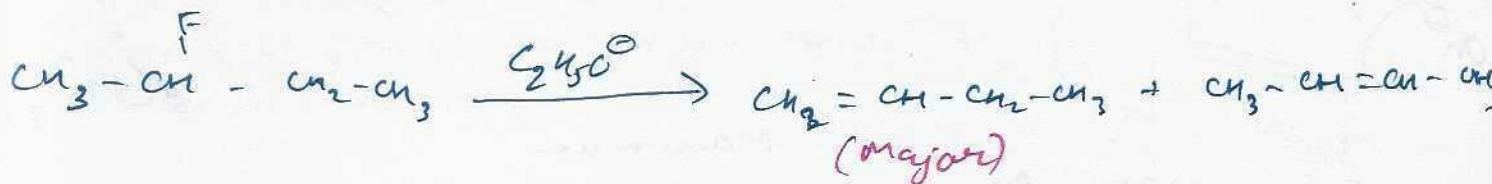
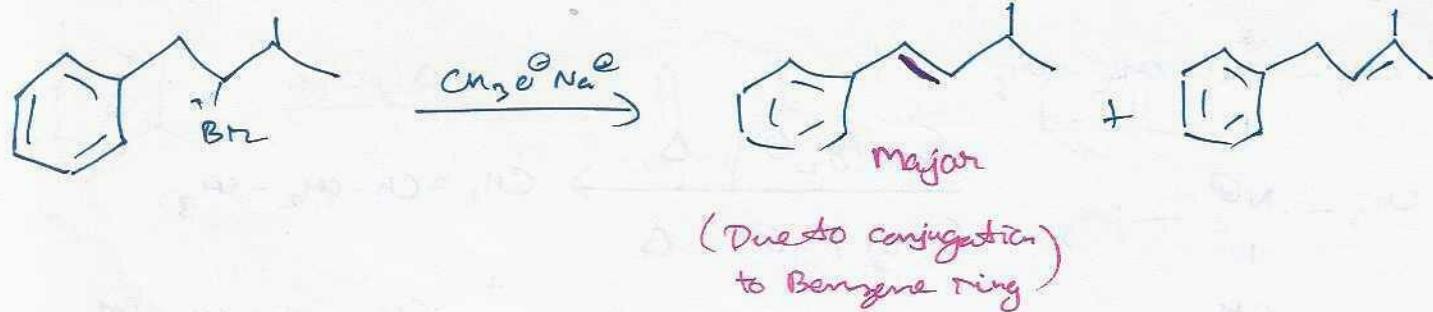
Poor leaving groups and bulky base are used.



Hoffmann product dominates.

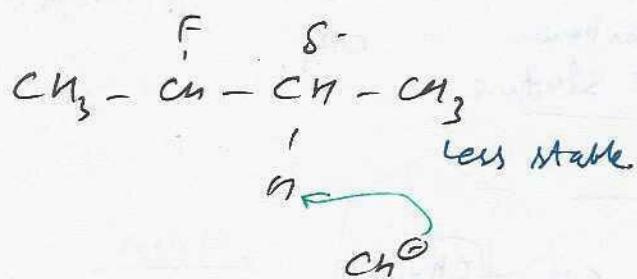


Due to resonance stabilization.

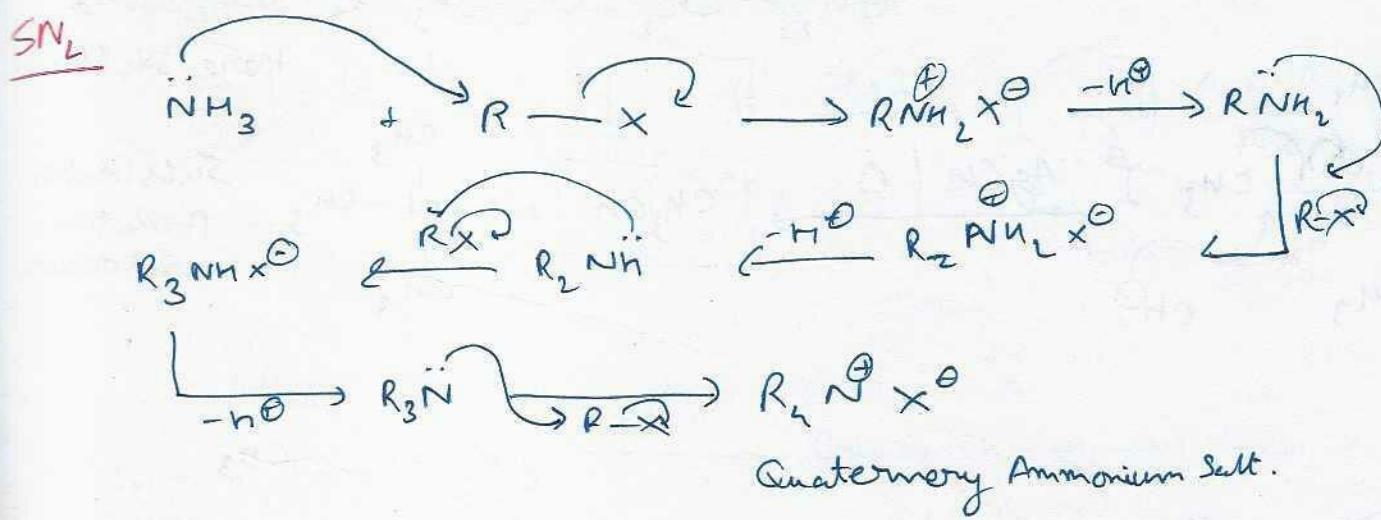


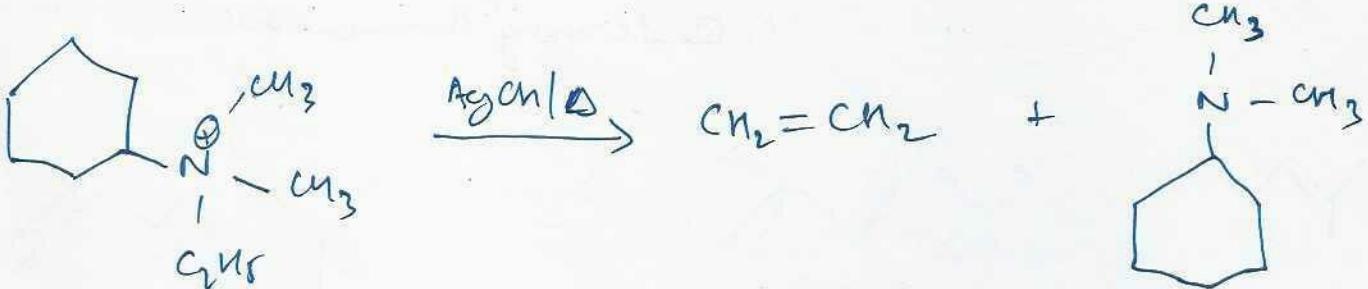
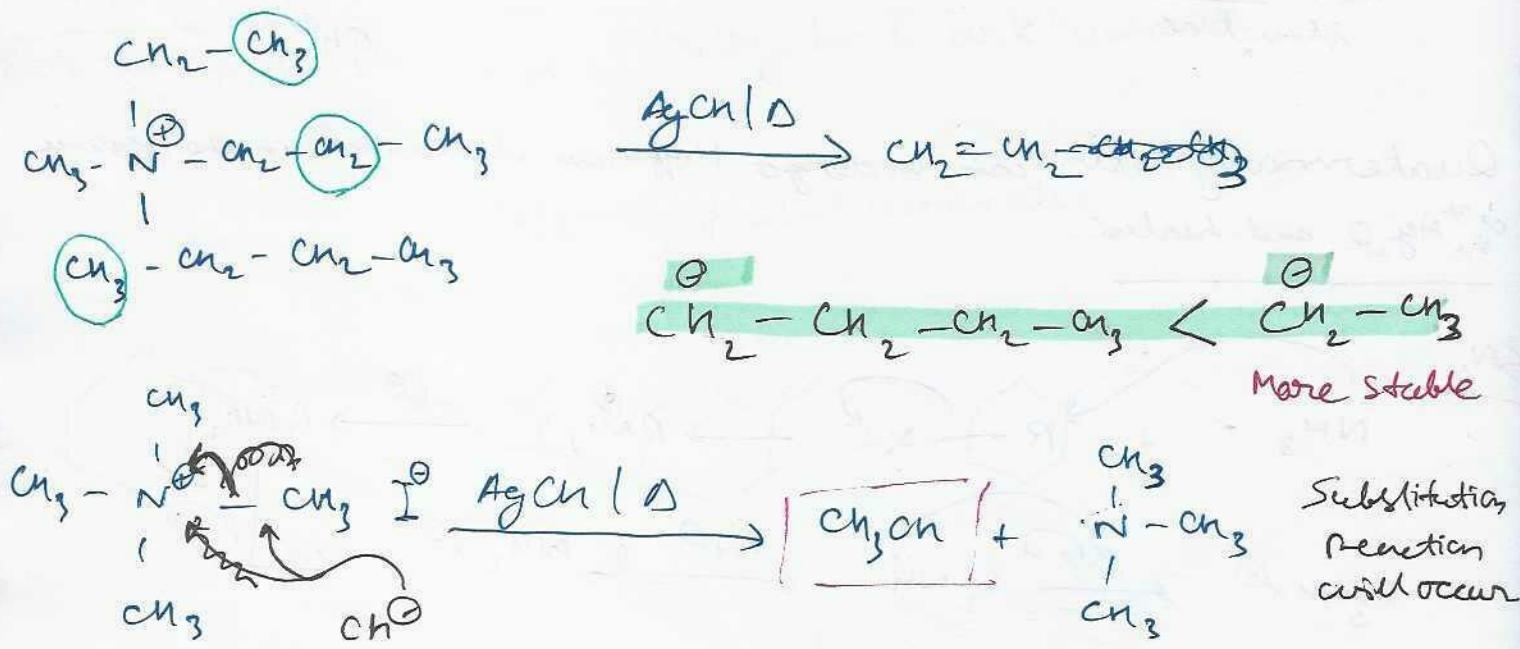
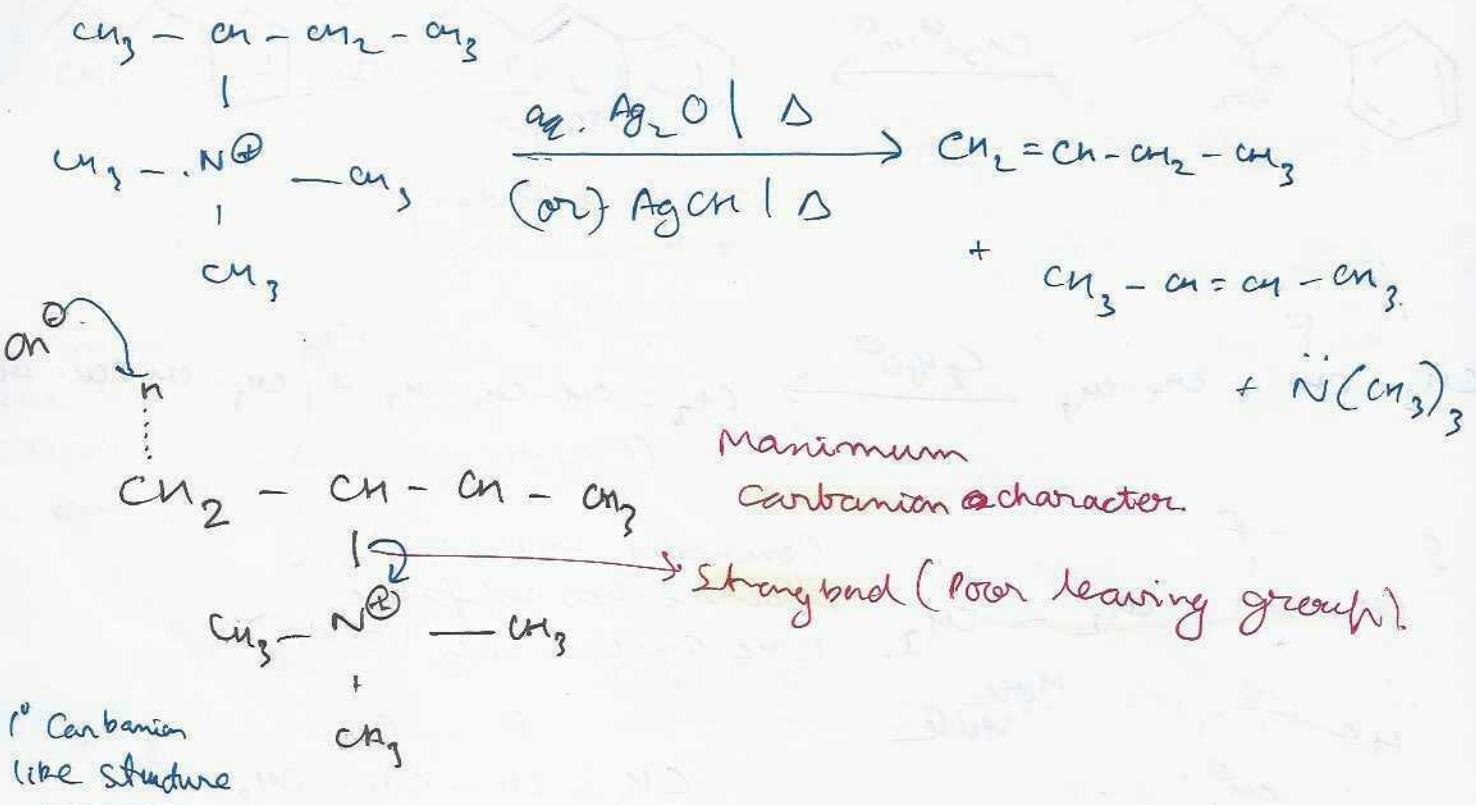
Transition state has more carboanion like structure

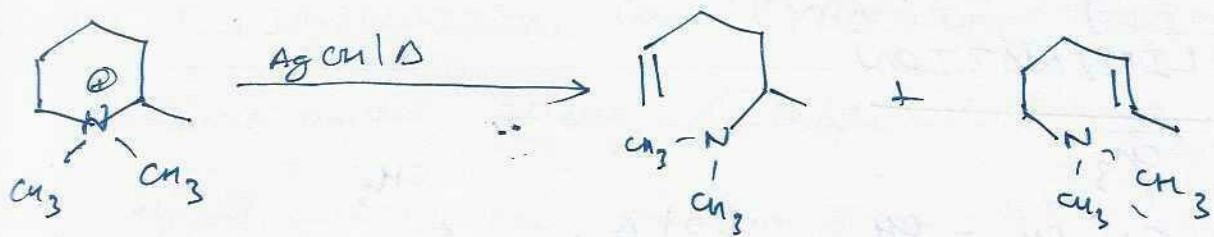
Removal of carbon and fluorine does not take place simultaneously. ($E_{\text{stability}}$)



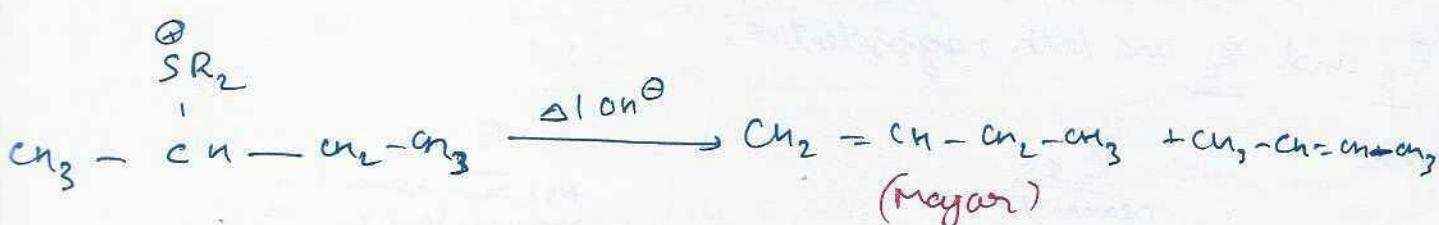
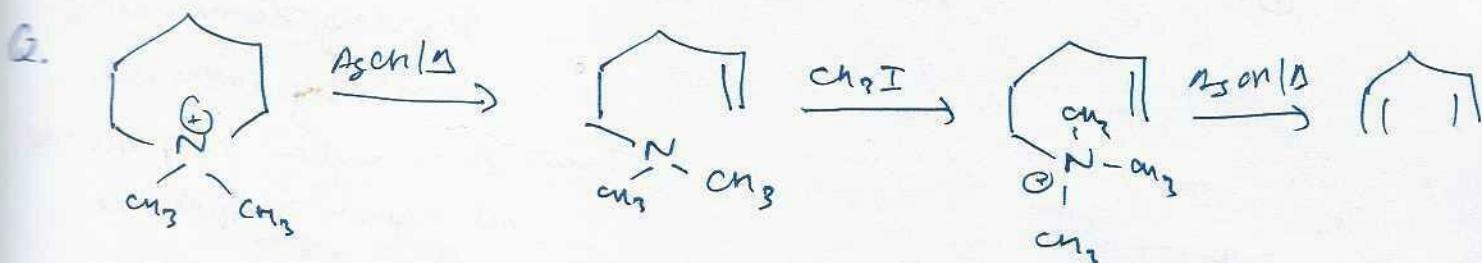
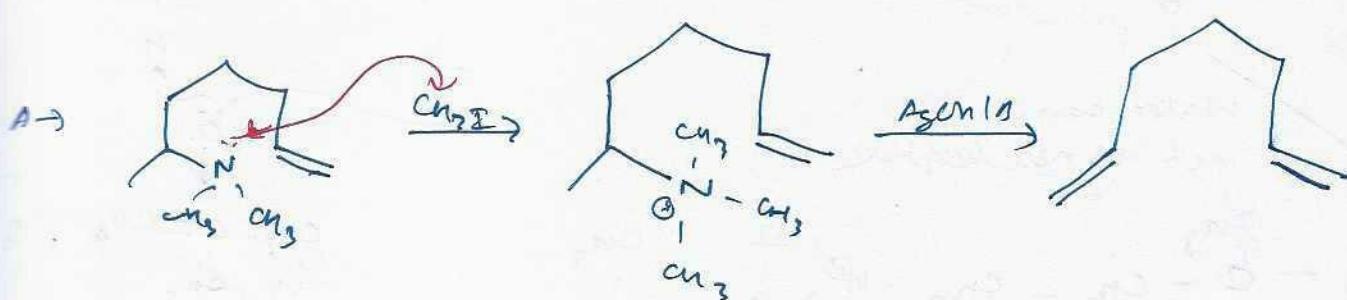
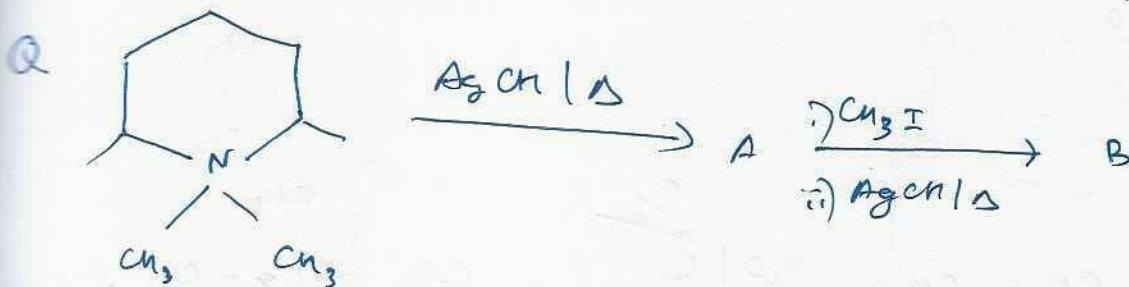
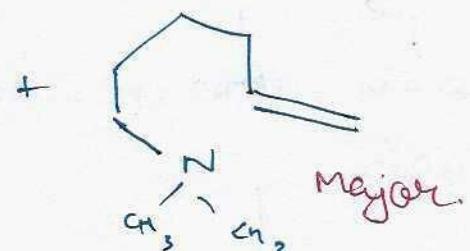
Quaternary salts can undergo Hoffmann elimination in the presence of Ag_2O and heated.







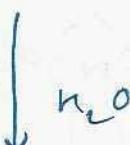
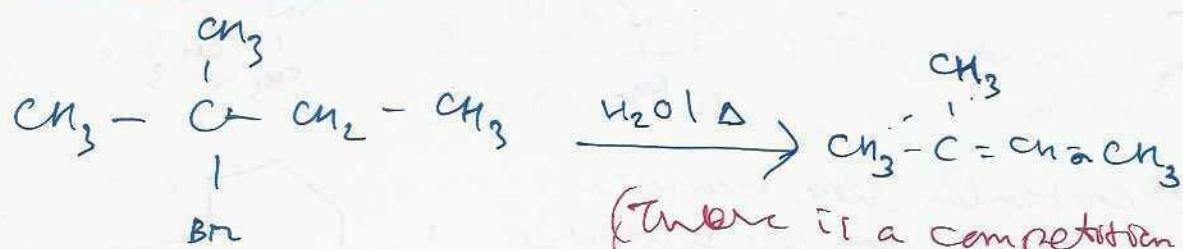
More carbanion-like transition state is formed, so less substituted carbon is more stable.



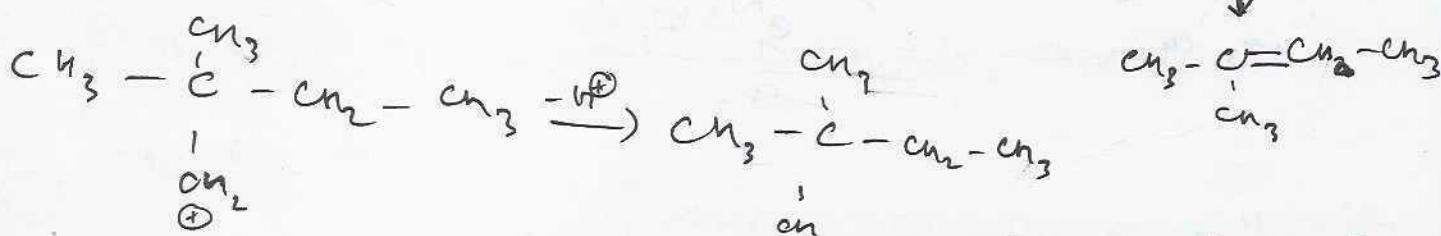
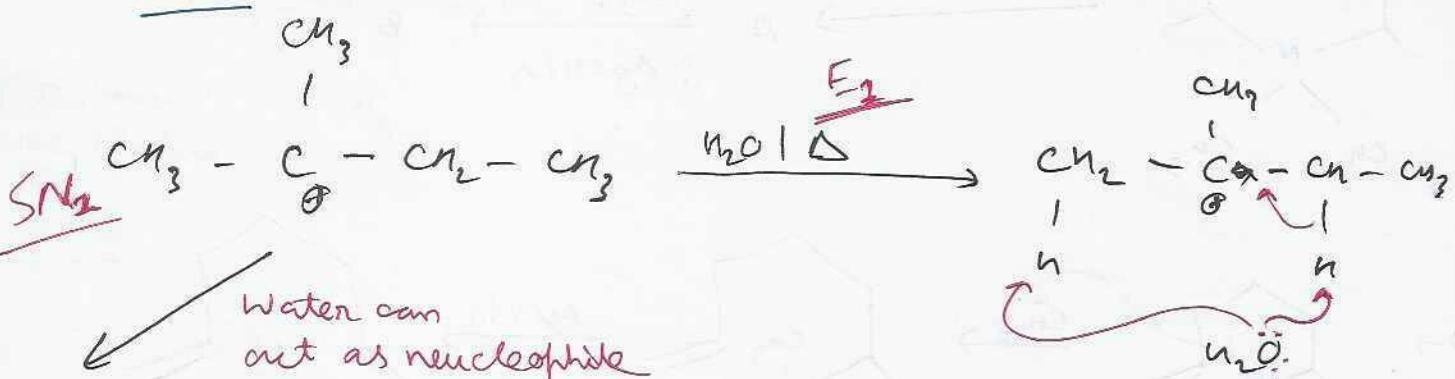
- NR_2^-
- SR_2^-
- F

Hoffmann elimination is dominating when these are used.

E₁ ELIMINATION



R.D.S



During elimination, entropy increases.

Thus elimination is preferred at higher temperature.

E₁ and E₂ are both regioselective.

regio

gives only one stereoisomer
 one stereoisomer is major
 $3^\circ \text{RX} > 2^\circ \text{RX} > 1^\circ \text{RX}$
 Polar protic weak base

E₂
 rearrangement
 regioselective

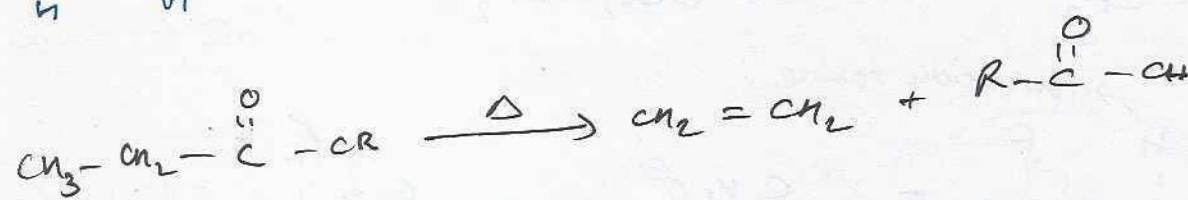
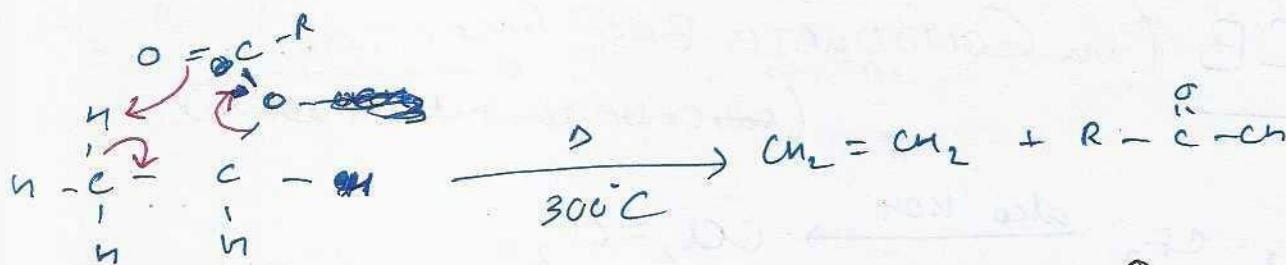
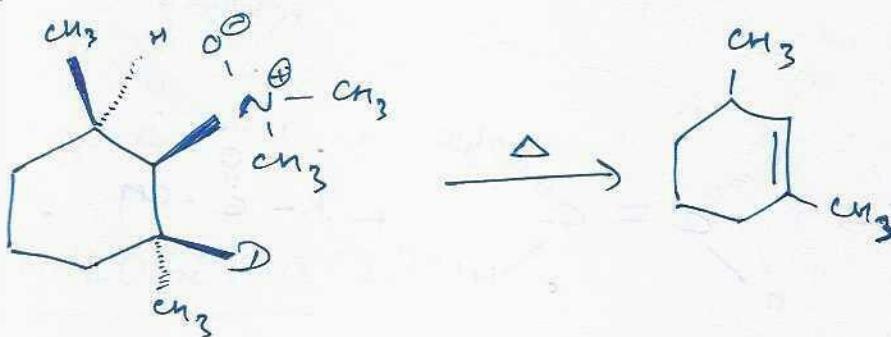
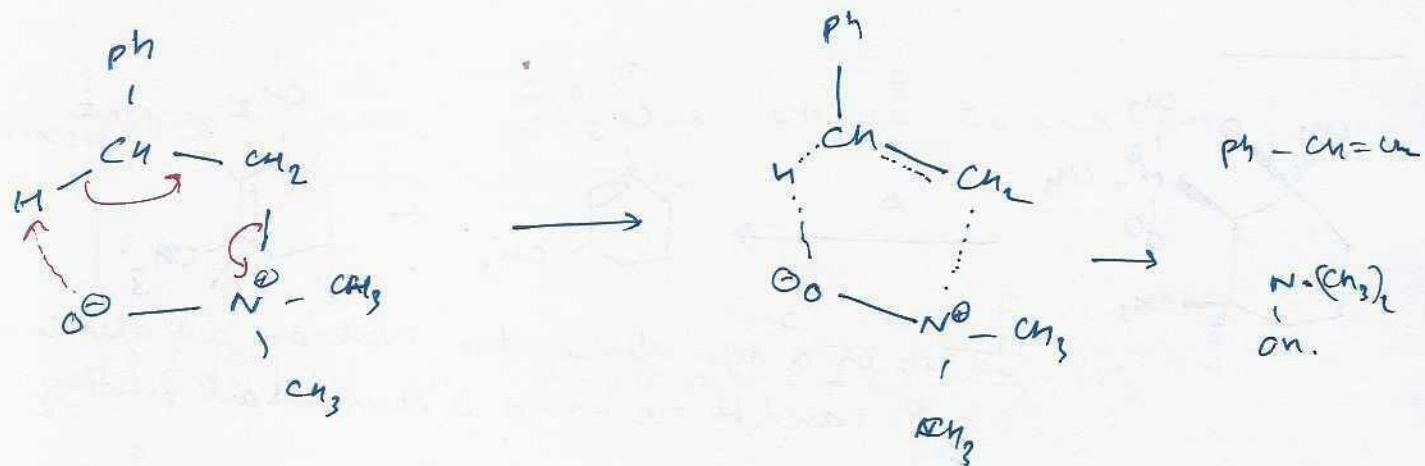
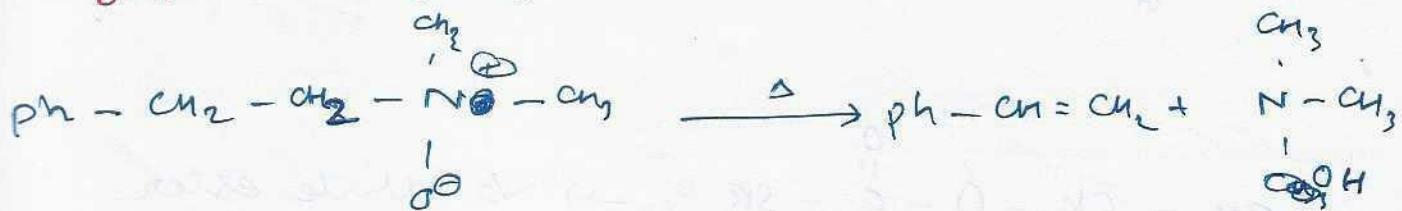
E₁
 no rearrangement.
 regioselective

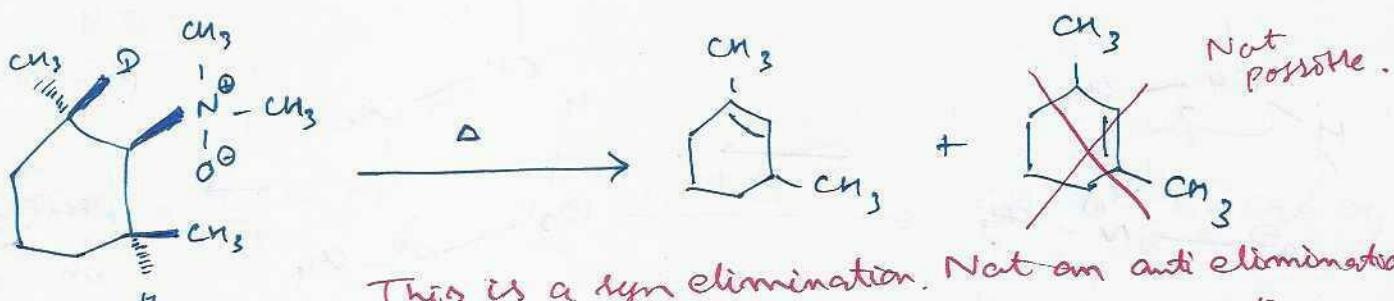
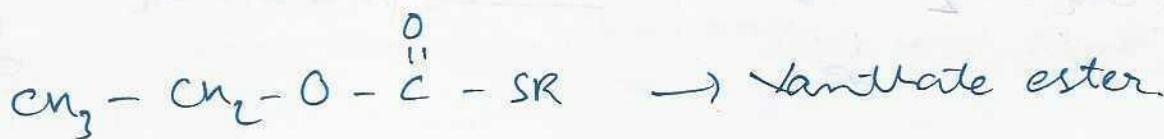
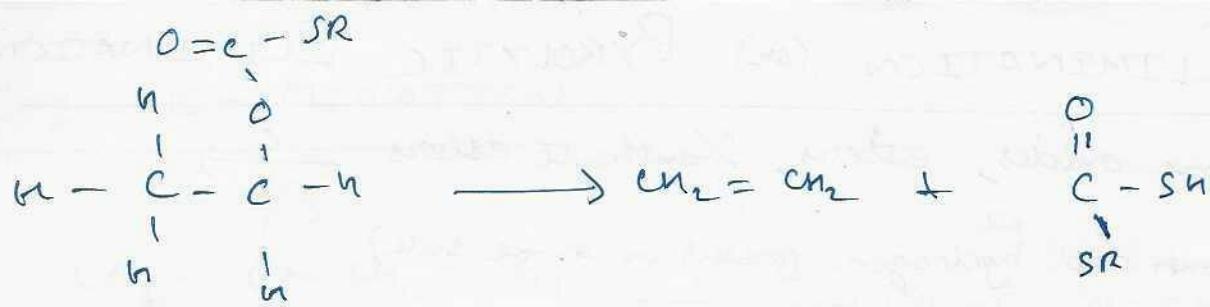
stereoselective.
 stereospecific → only one stereoisomer is possible
 isotropic effect
 $3^\circ \text{RX} > 2^\circ \text{RX} > 1^\circ \text{RX}$
 Polar aprotic strong base

SYN ELIMINATION (or) PYROLYTIC ELIMINATION

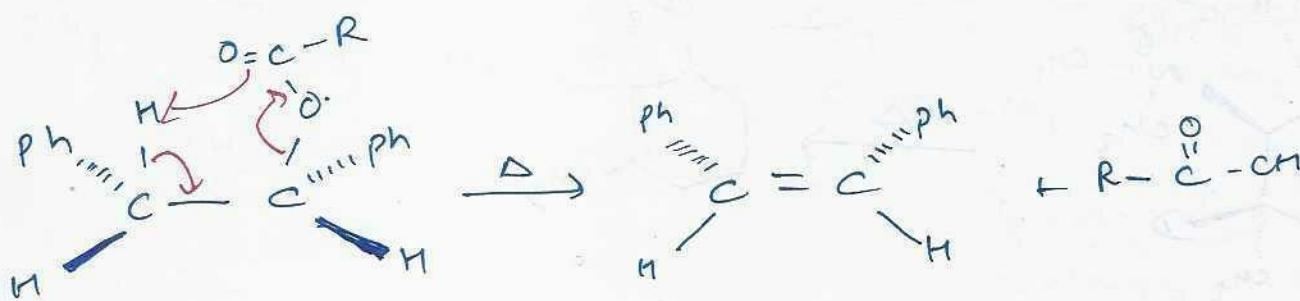
Amine oxides, esters, Xanthate esters $\xrightarrow{\Delta}$

(leaving group and hydrogen present on same side)

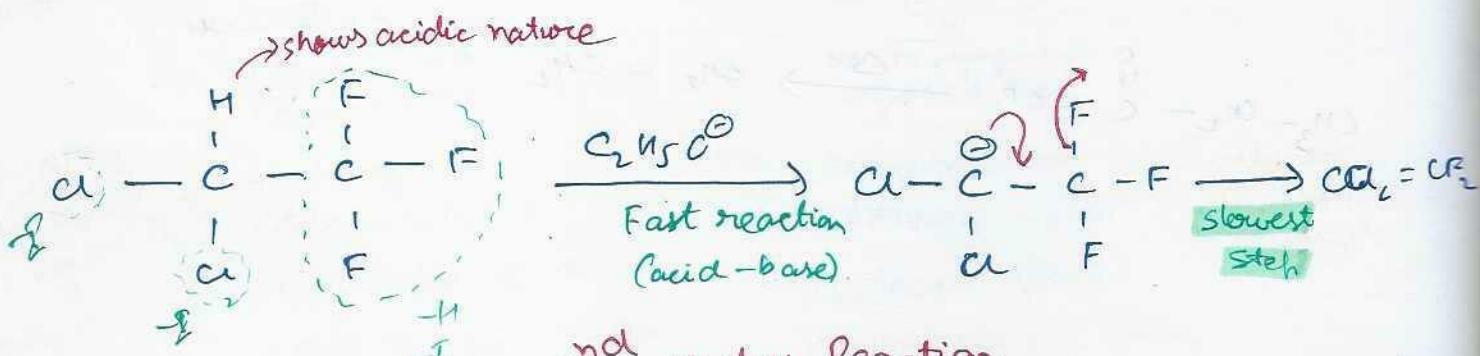
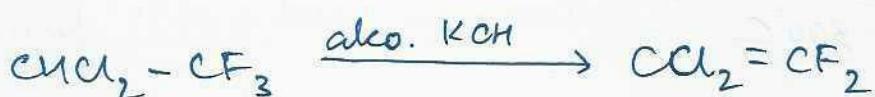




This is a syn elimination. Not an anti elimination.
So H can't be removed at its anti position.



E₁ CB (via CONJUGATE BASE FORMATION) (carbanion intermediate)

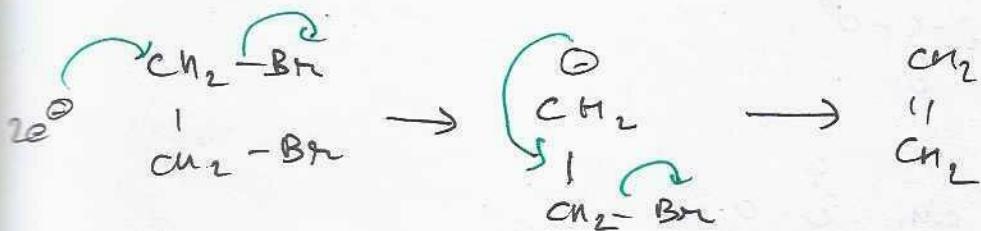
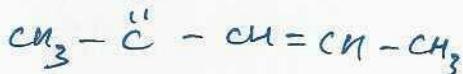
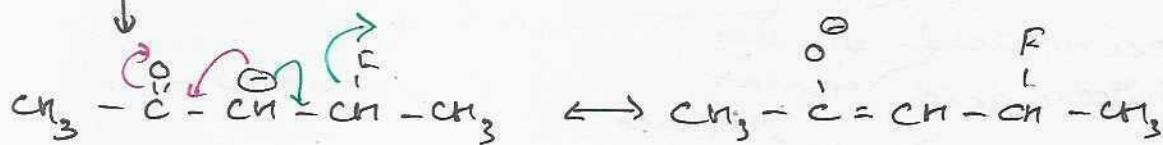
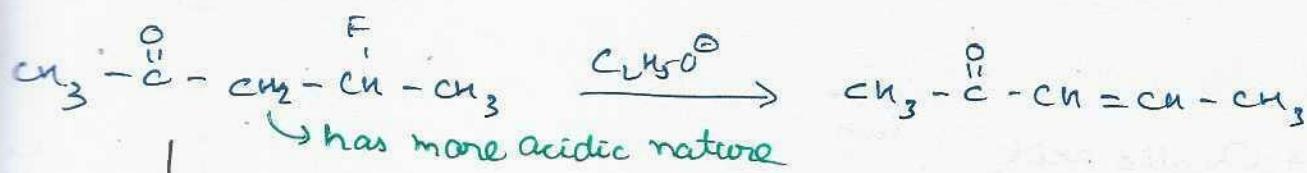
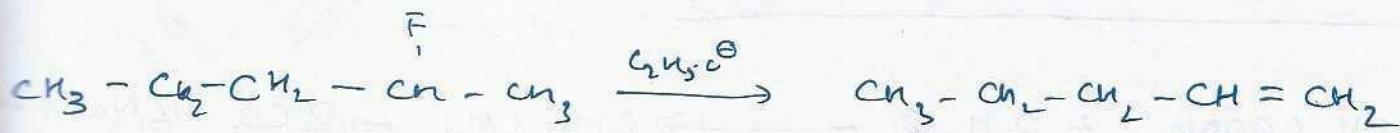


Rate can't be expressed
in terms of intermediate.

$$2^{\text{nd}} \text{ order Reaction} \\ \text{Rate} \propto [\text{CCl}_2\text{CF}_3] \Rightarrow \text{Rate} \propto [\text{Substrate}][\text{C}_2\text{H}_5\text{O}^-]$$

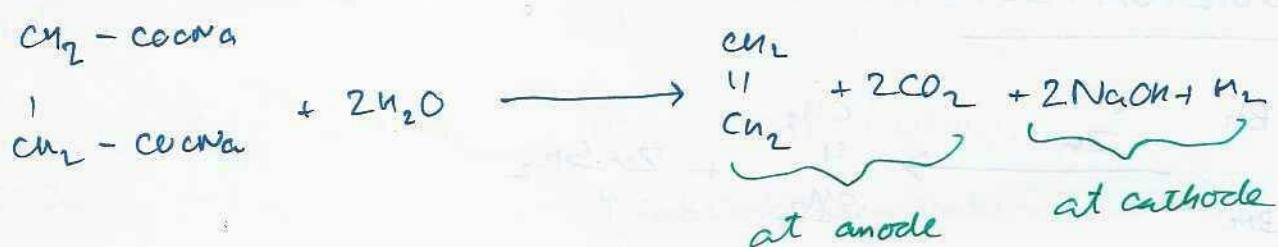
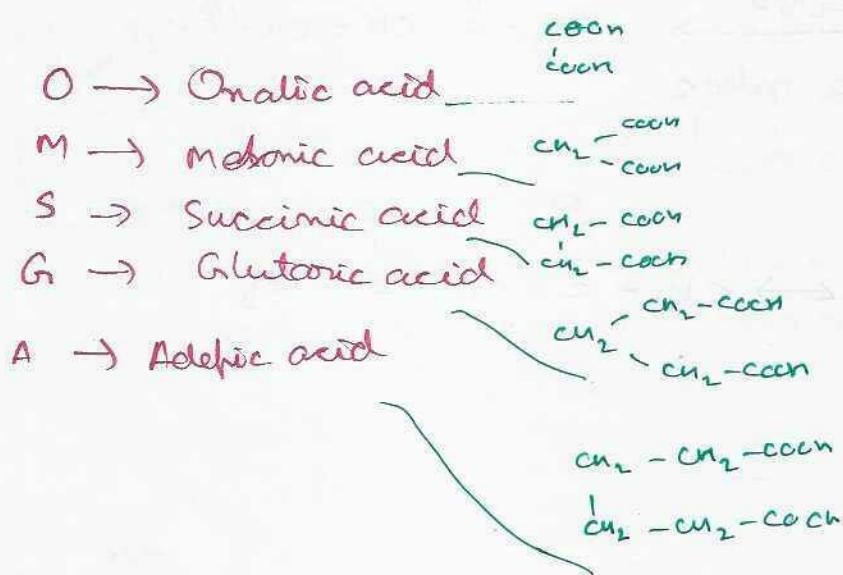
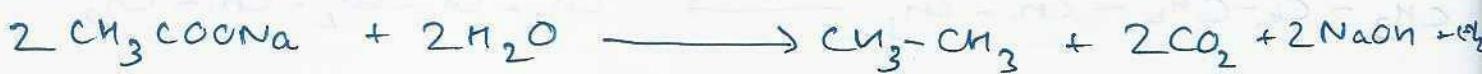
$$k_{eq} = \frac{[\text{carbanion}]}{[\text{C}_2\text{H}_5\text{O}^-][\text{R}]}$$

$$[\text{carbanion}] = k_{\text{eq}} [C_2H_5CO][R] \Rightarrow \text{2nd order reaction.}$$

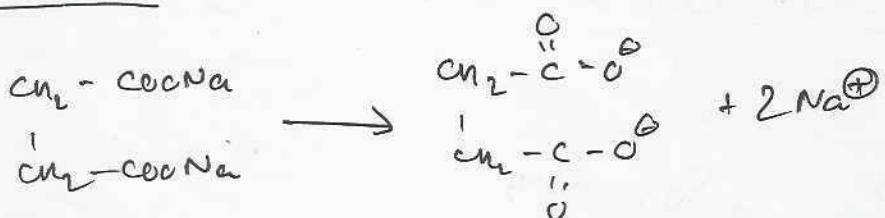




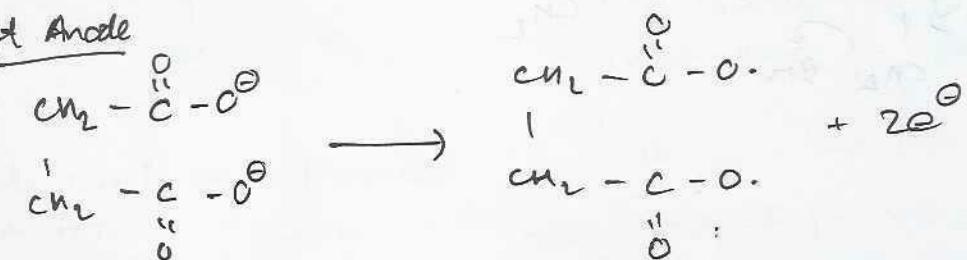
KOLBE'S ELECTROLYSIS

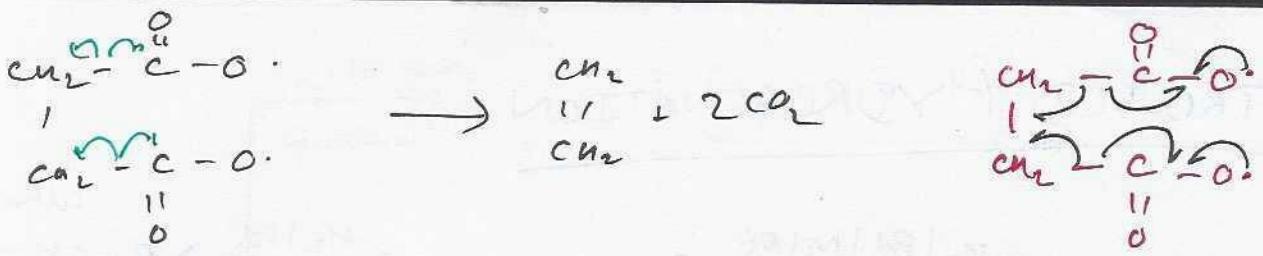


Mechanism

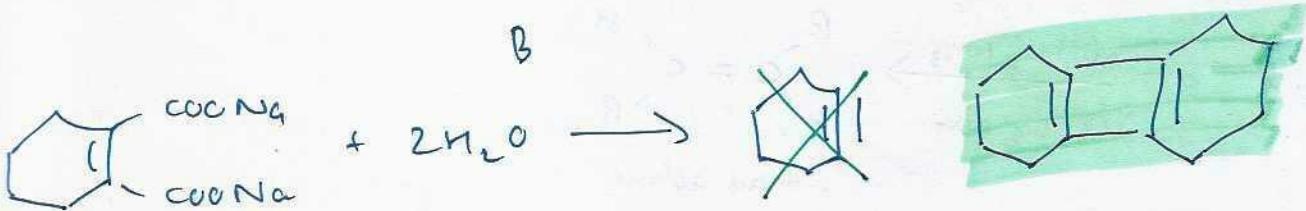
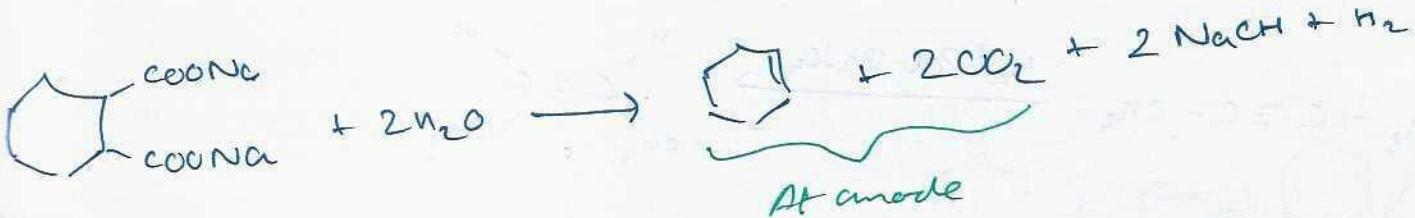
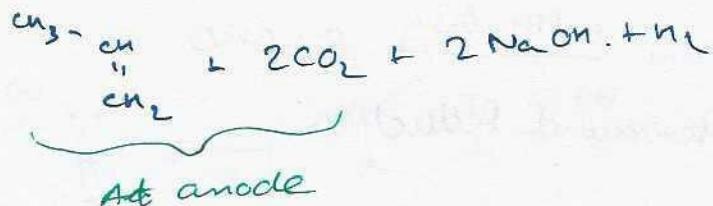
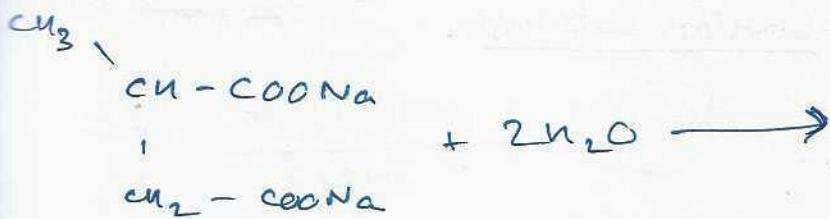
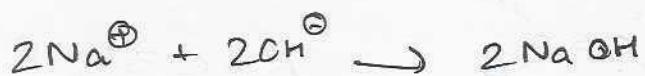


At Anode

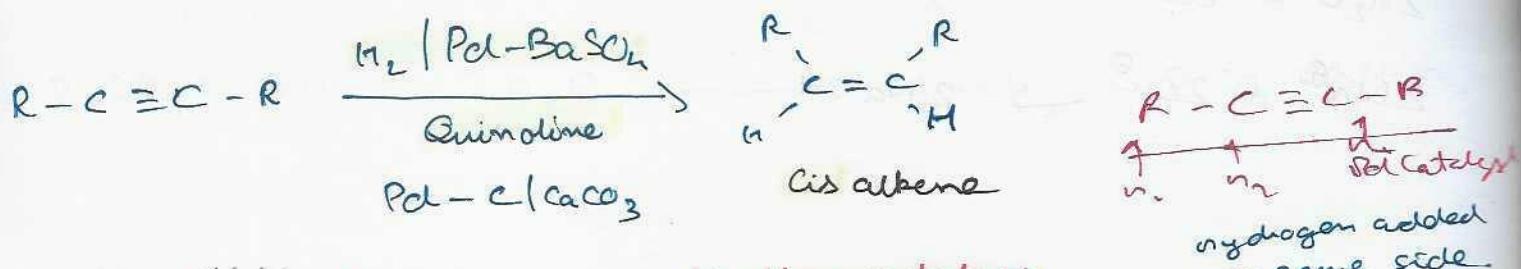
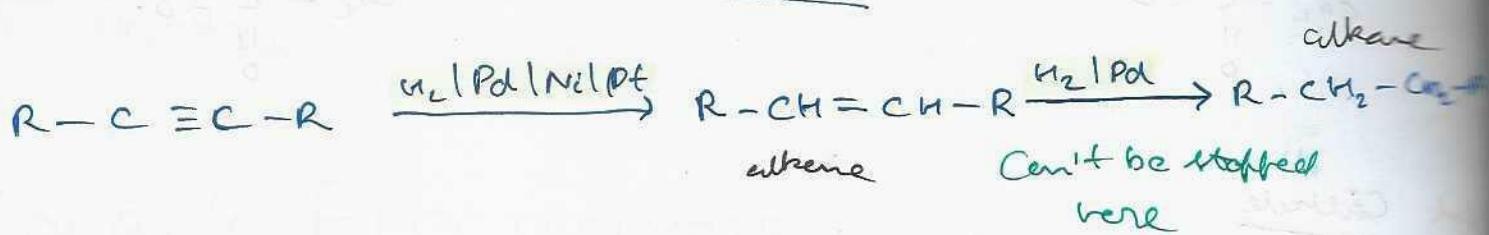




At Cathode



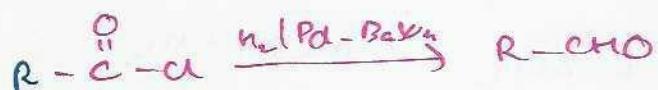
CONTROLLED HYDROGENATION



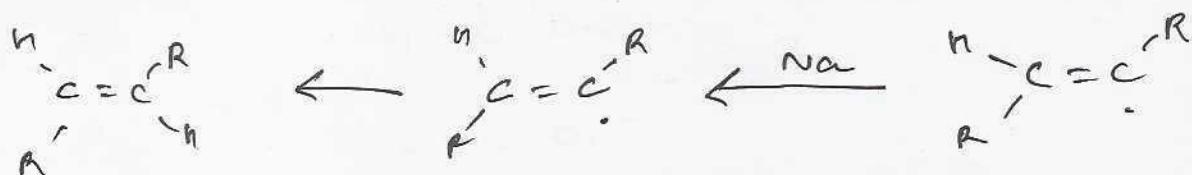
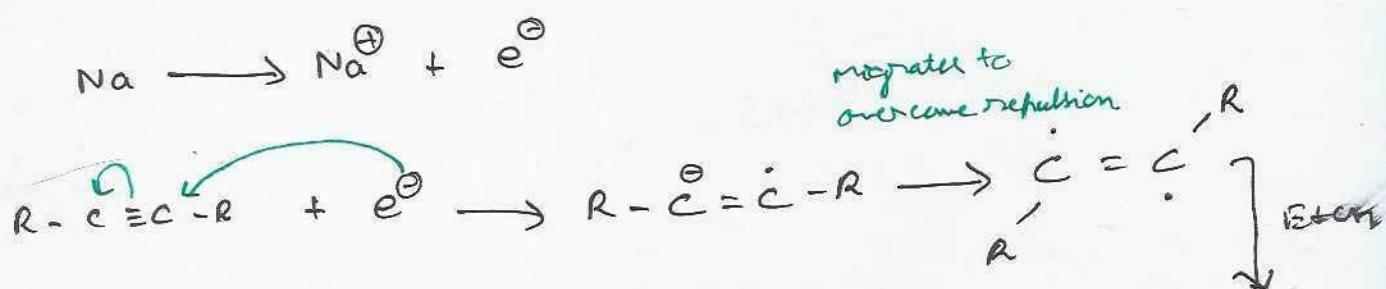
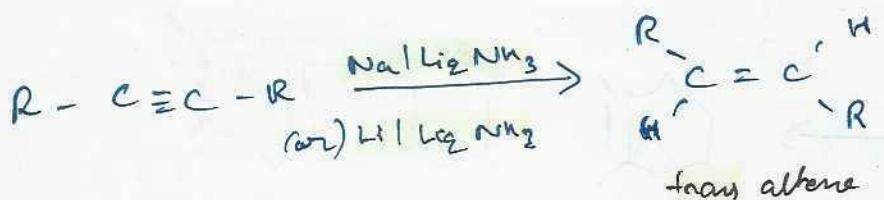
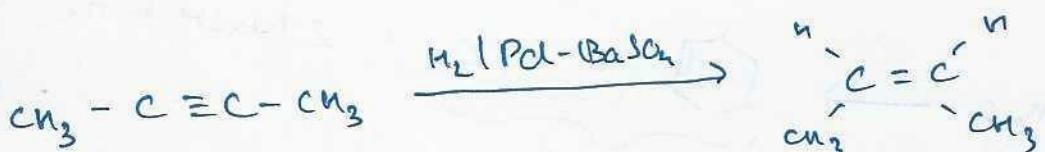
$H_2-Pd[BaSO_4]$ Quinoline \rightarrow Lindlar catalyst.

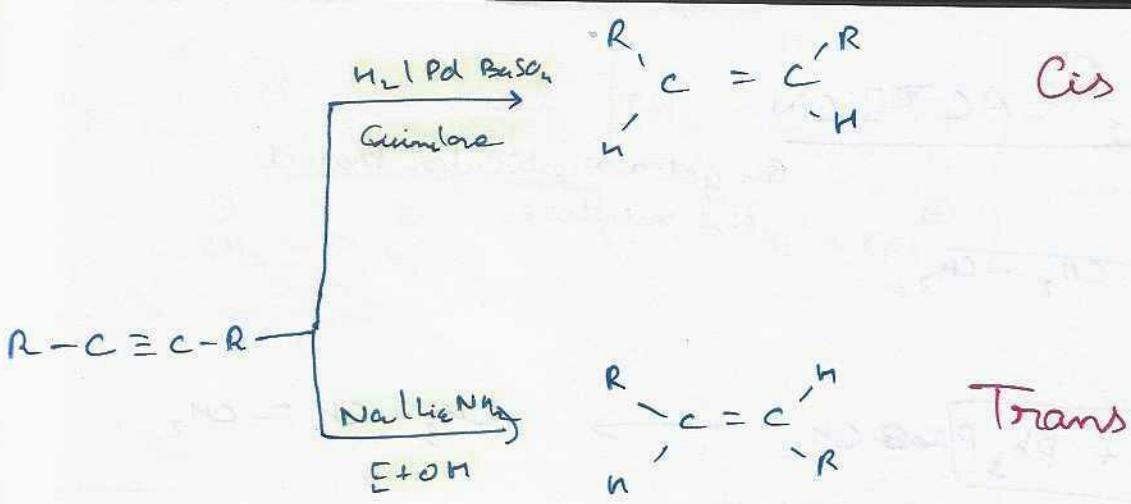
catalytic poison.

$R-C\equiv C-R$
 $\xrightarrow[H_2]{\text{Pd Catalyst}}$
 hydrogen added
on same side.

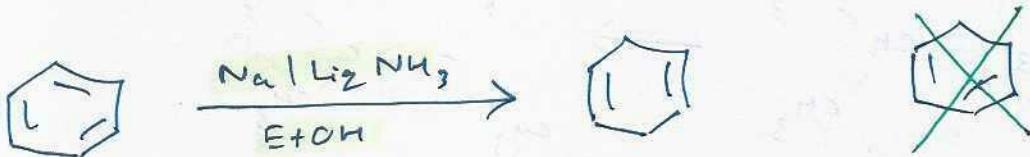


Rossmann Reduction

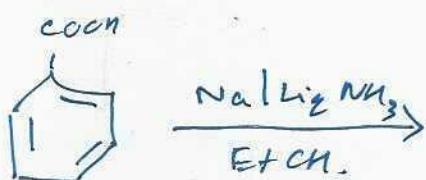
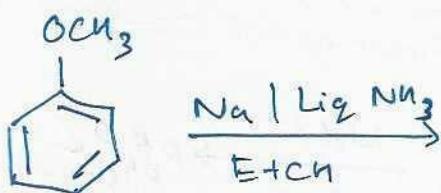
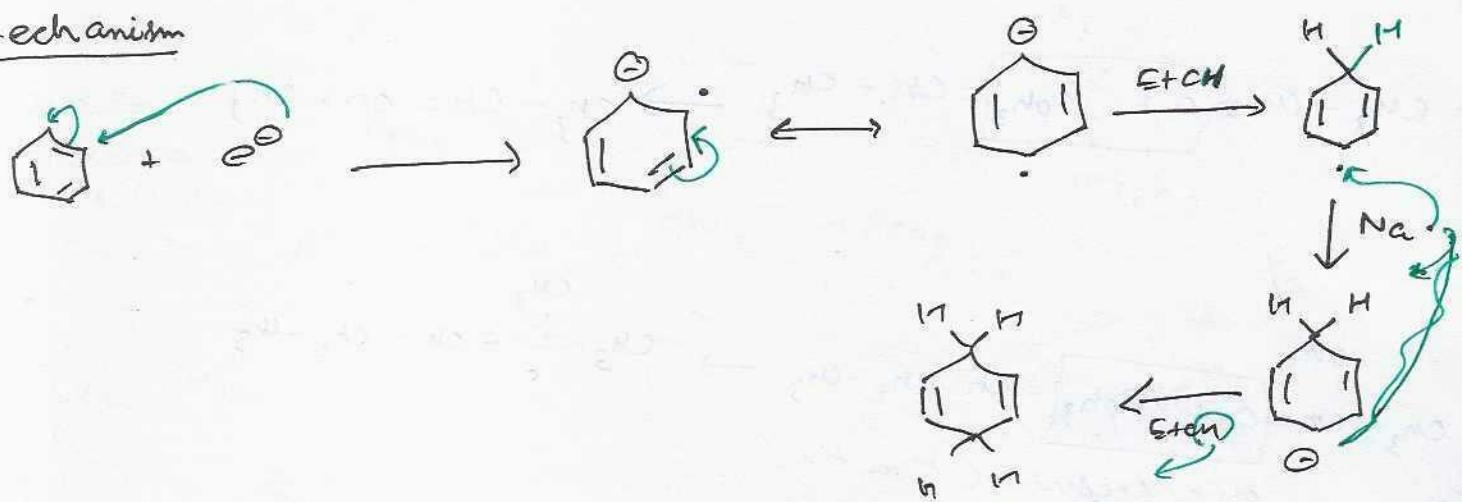




BIRCH REDUCTION

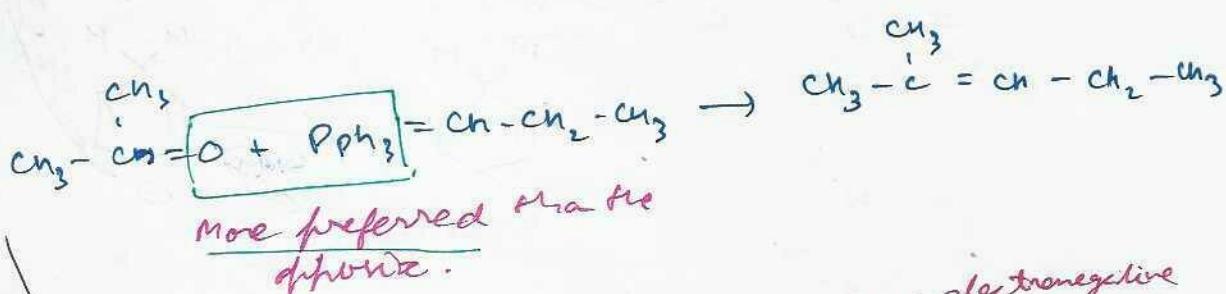
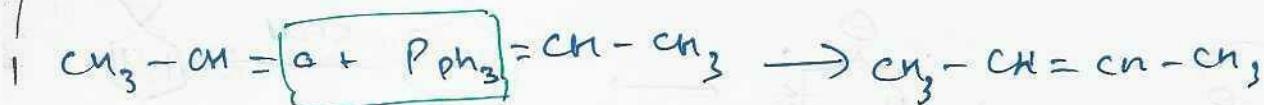
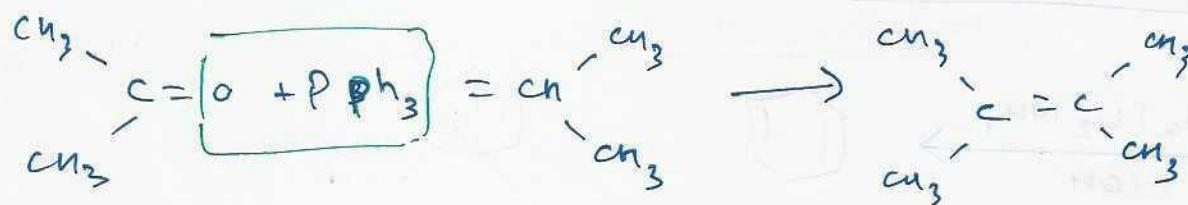
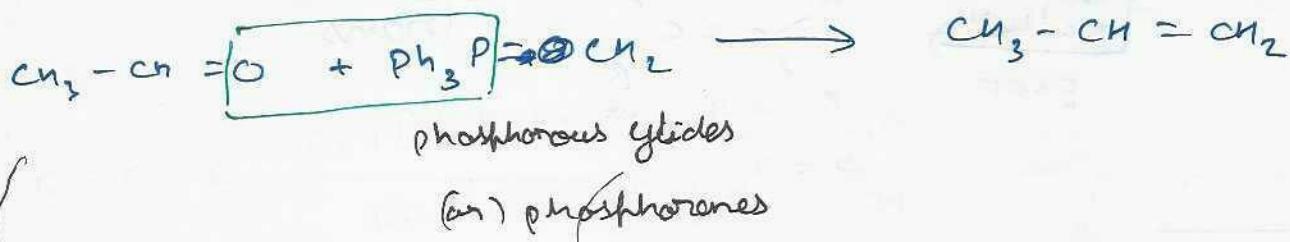
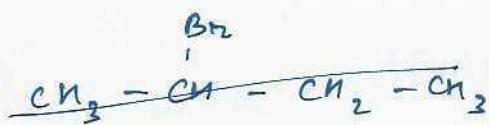


Mechanism

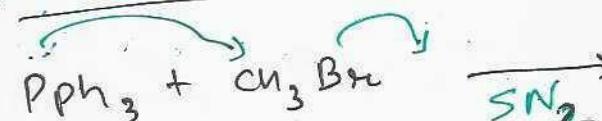


WITTING REACTION

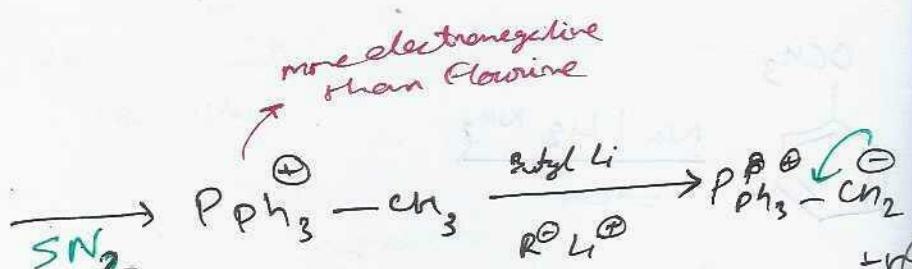
Can get a particular Product.
Not mixture.



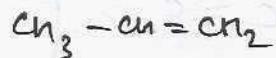
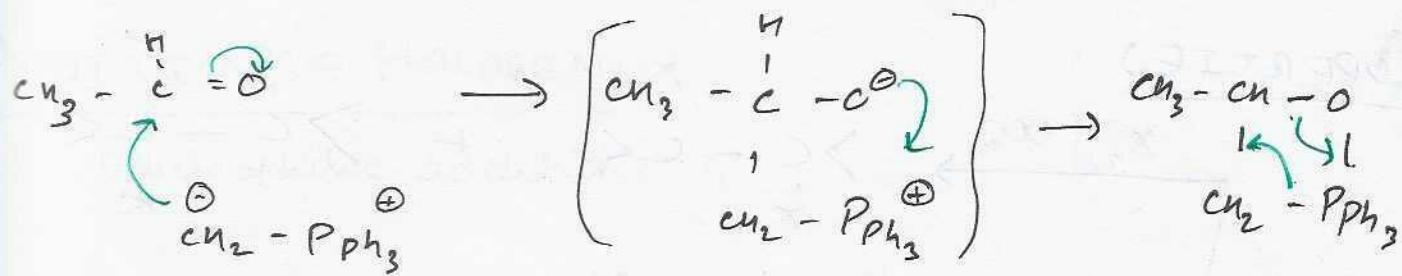
Mechanism



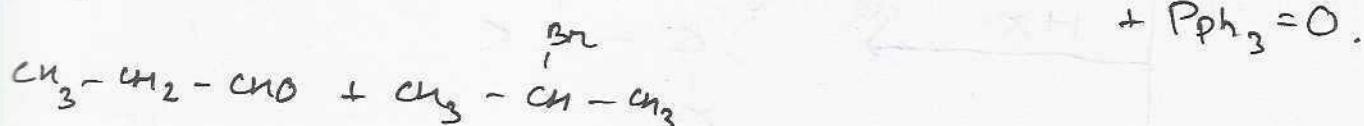
good nucleophile
(weak base.)



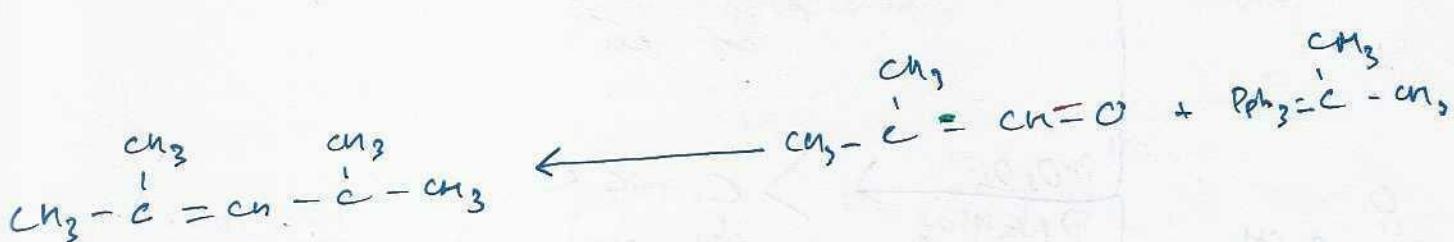
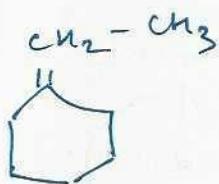
$$\text{PPh}_3 = \text{CH}_2$$



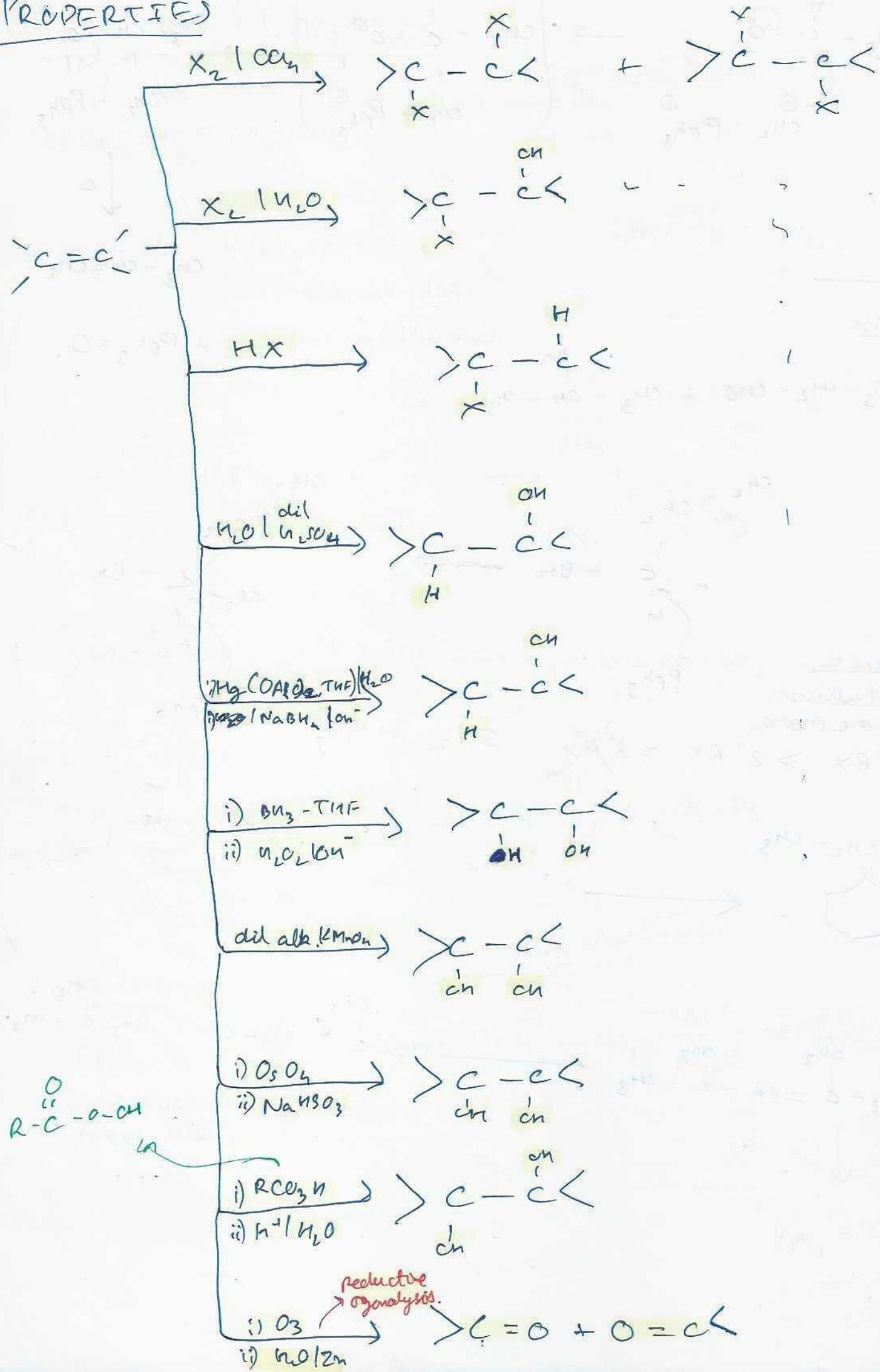
Reverse



steric
Repulsions
core more
 $1^\circ \text{RX} > 2^\circ \text{RX} > 3^\circ \text{RX}$

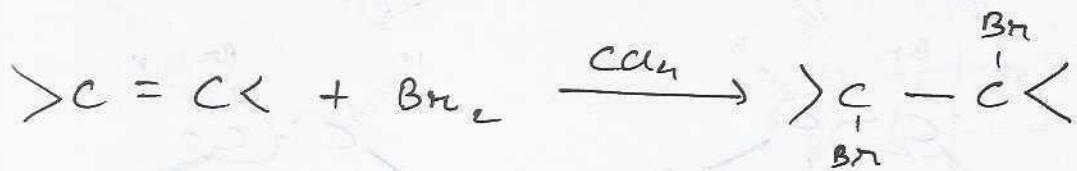


PROPERTIES



ADDITION OF HALOGEN

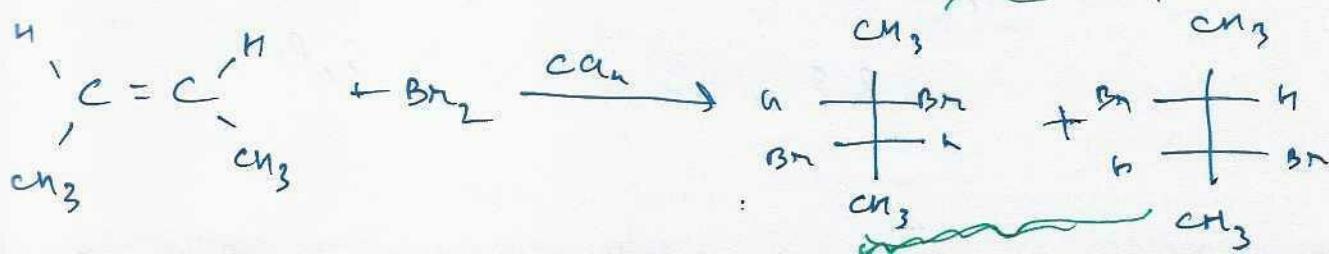
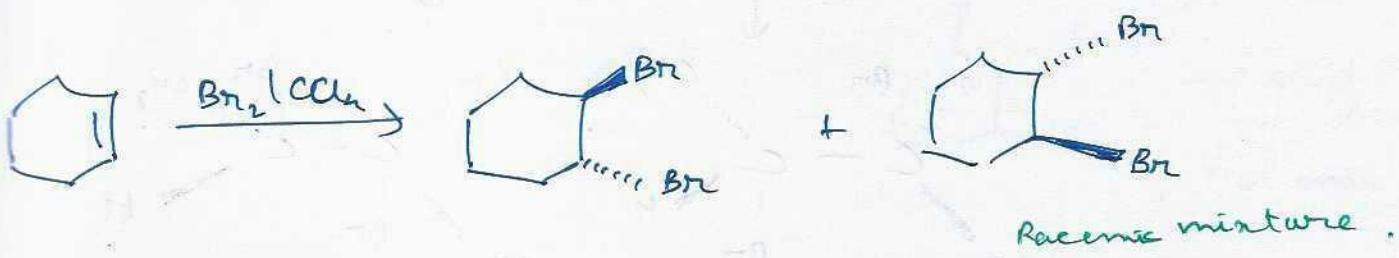
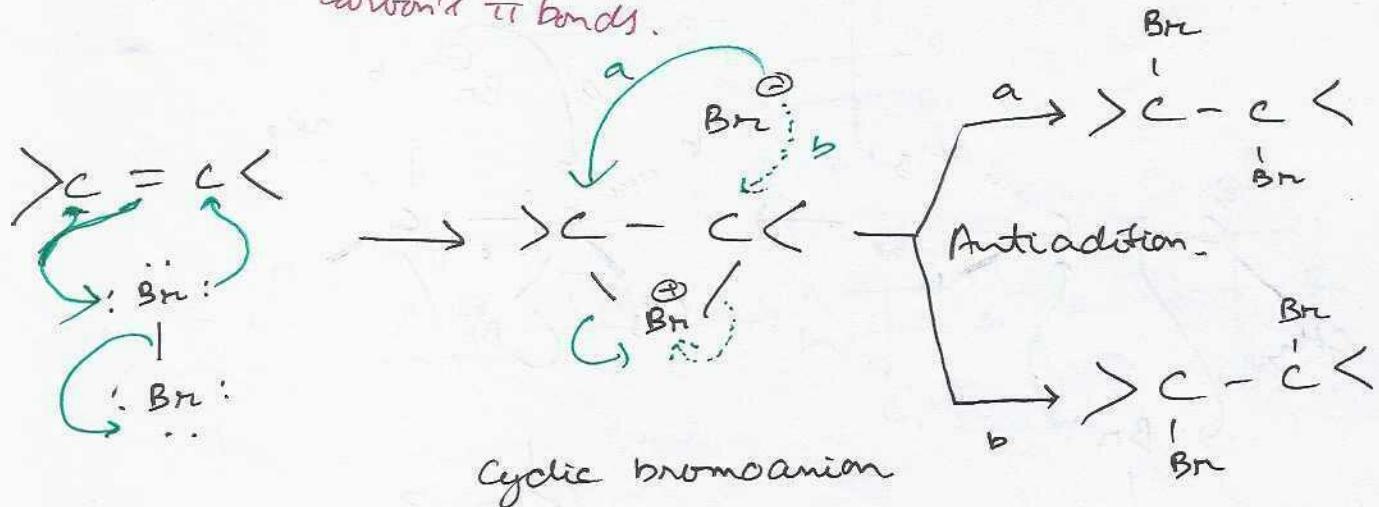
Electrophilic addition.

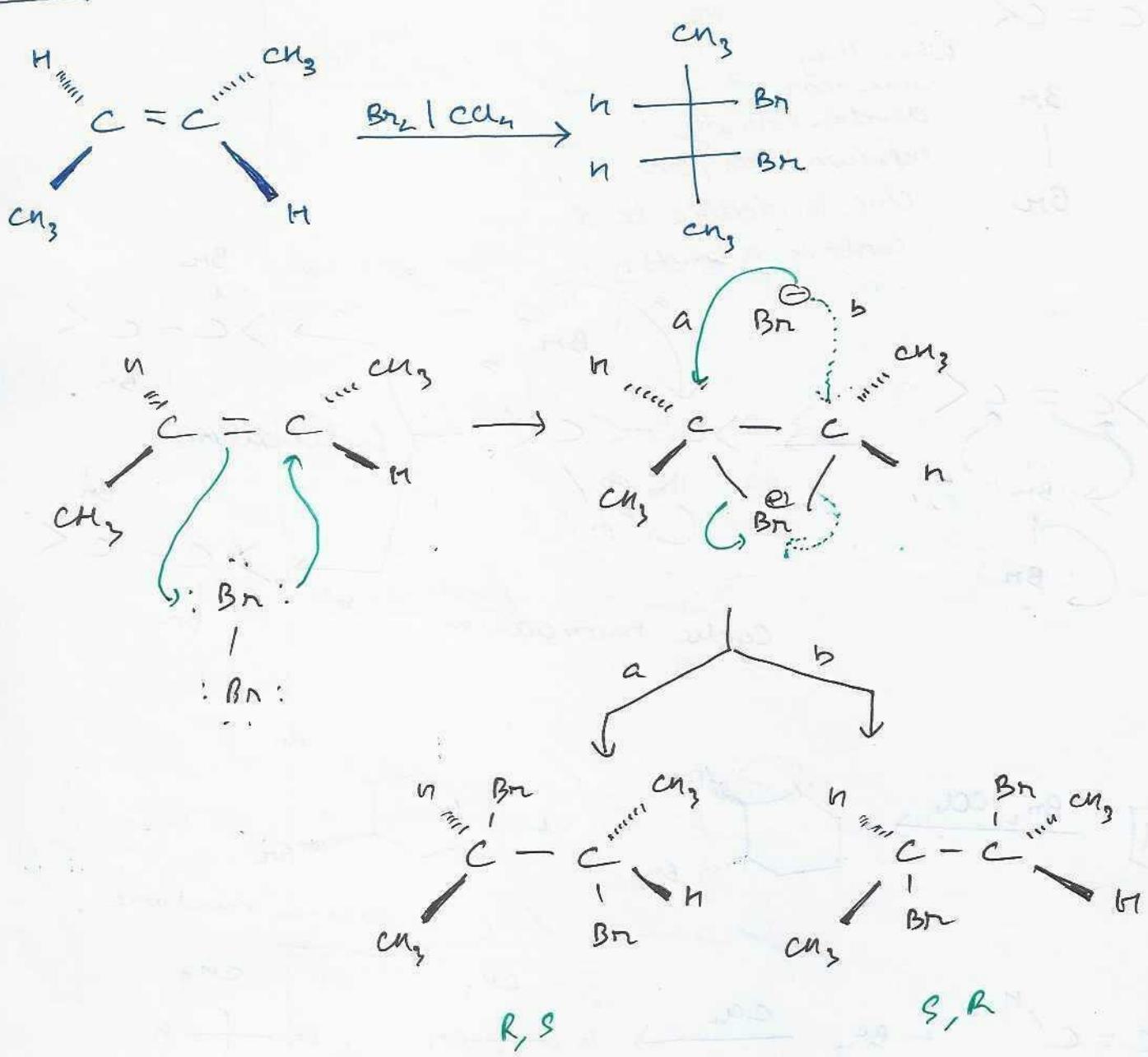
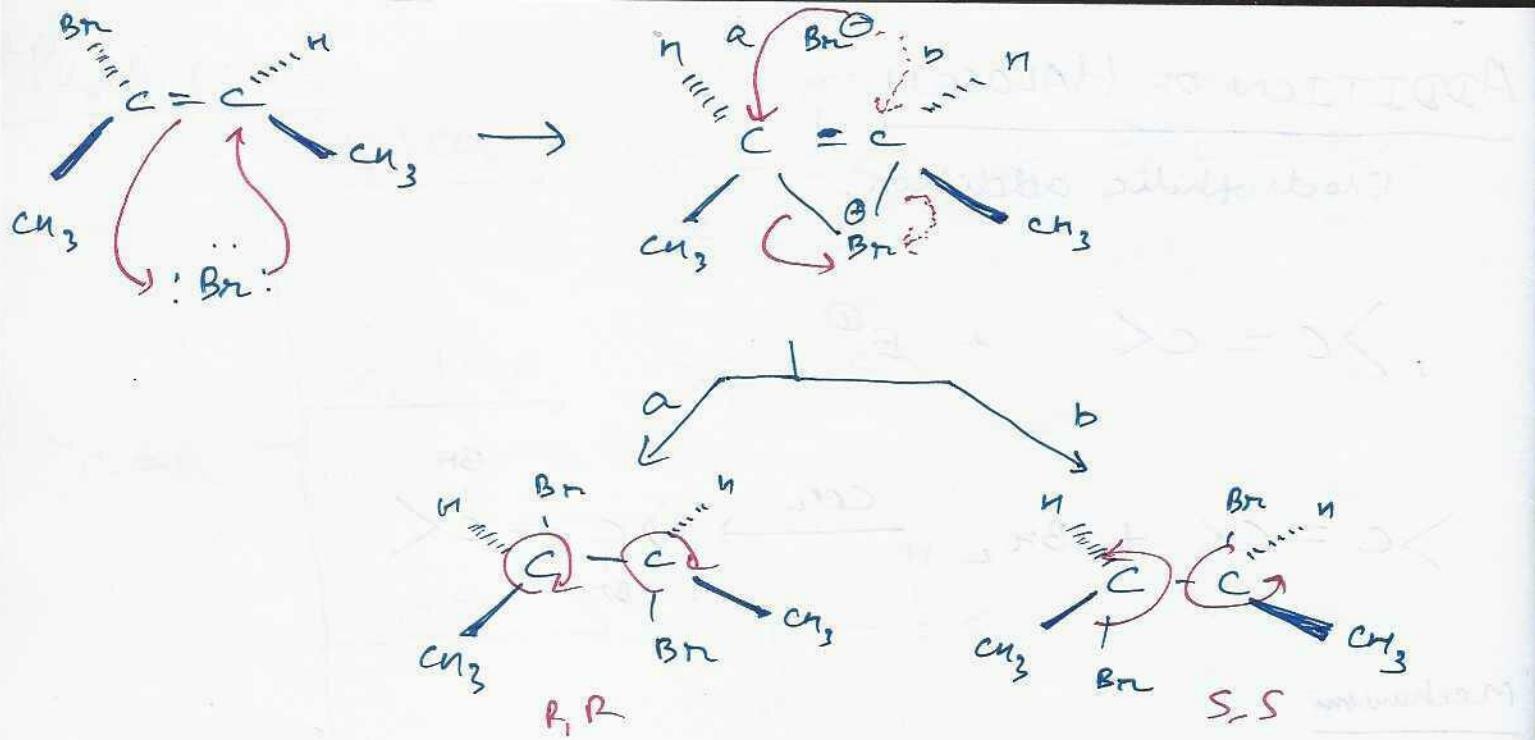


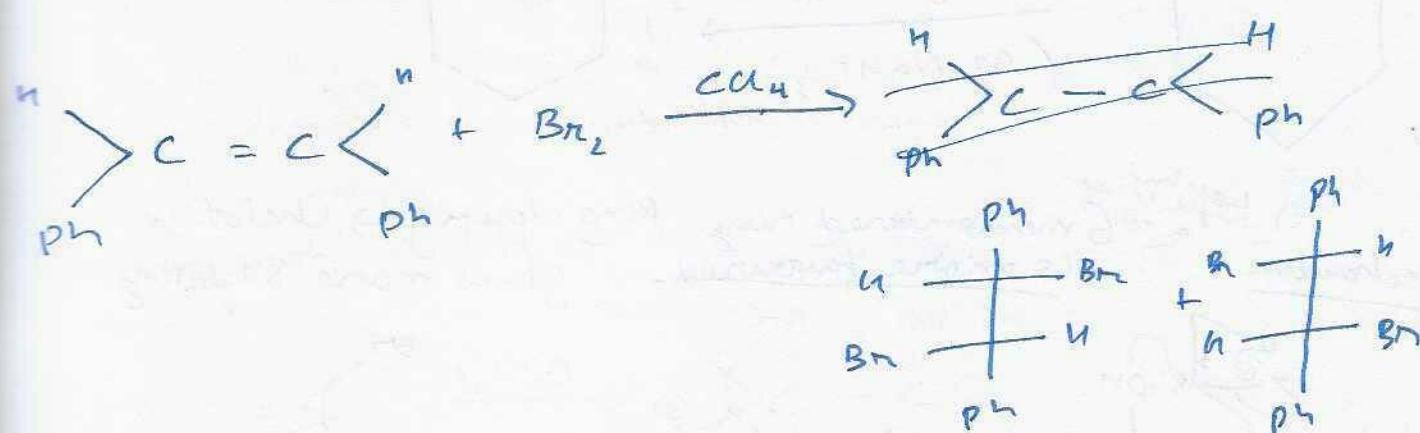
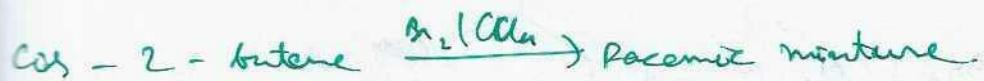
Mechanism



When they come near develop polarity repulsion takes place due to double bond carbon's π bonds.

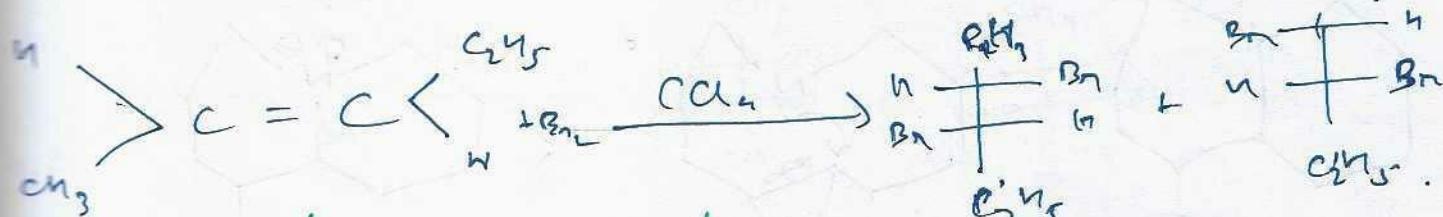
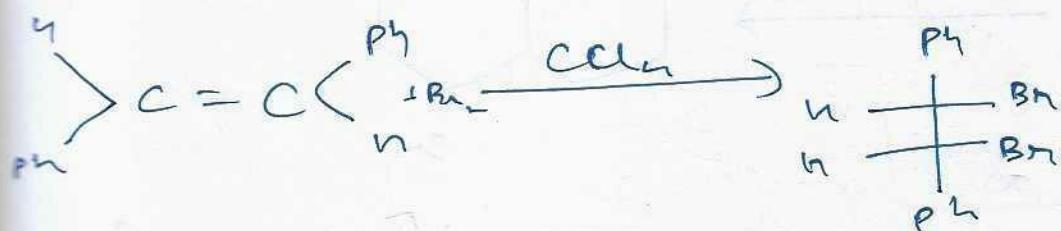
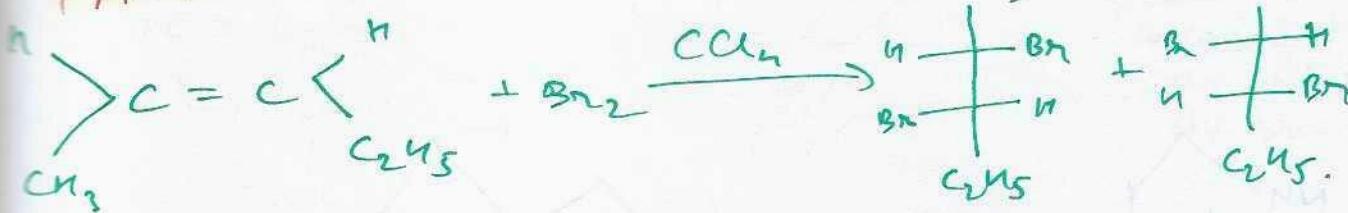






CAR \rightarrow Cis - Antiaddition - Racemic mixture

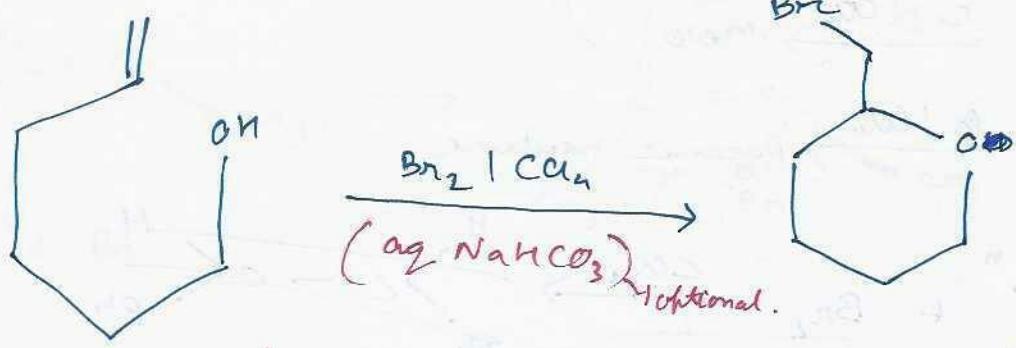
TAM \rightarrow Trans - Antiaddition - Meso (Only for same groups across double bond)



Racemic mixture
due to presence of
different groups.



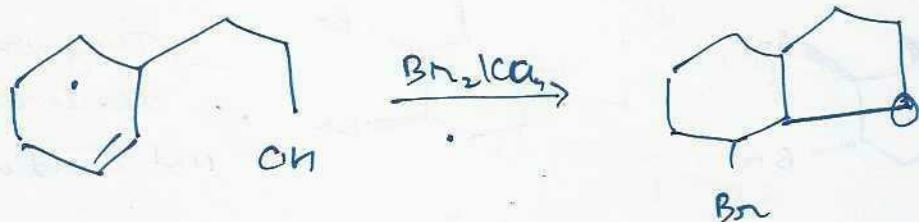
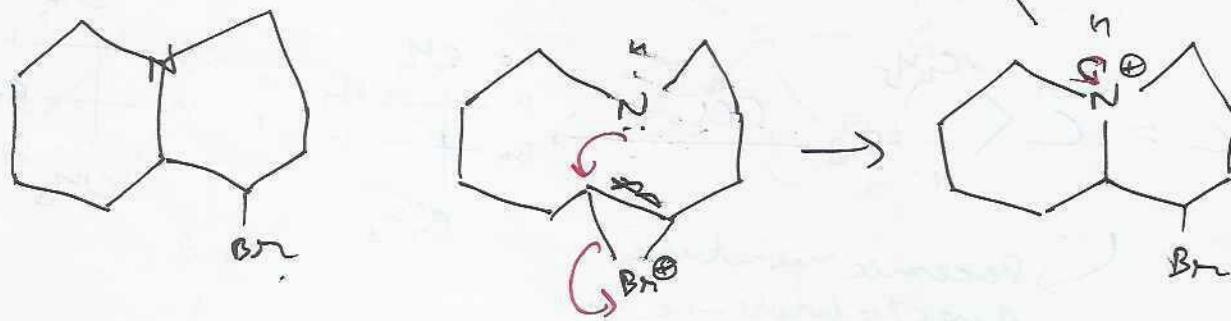
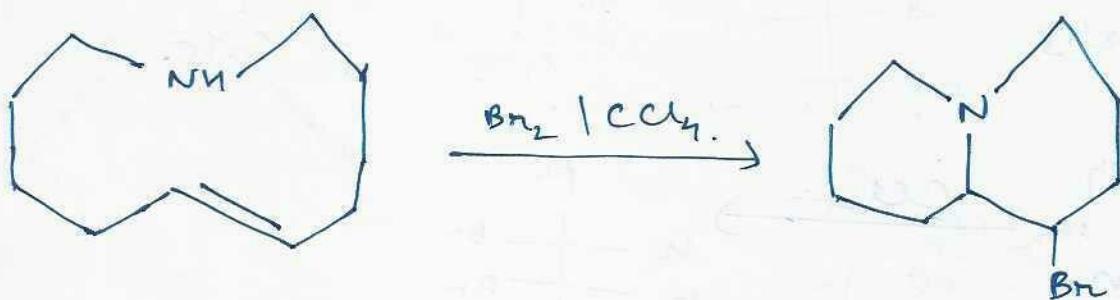
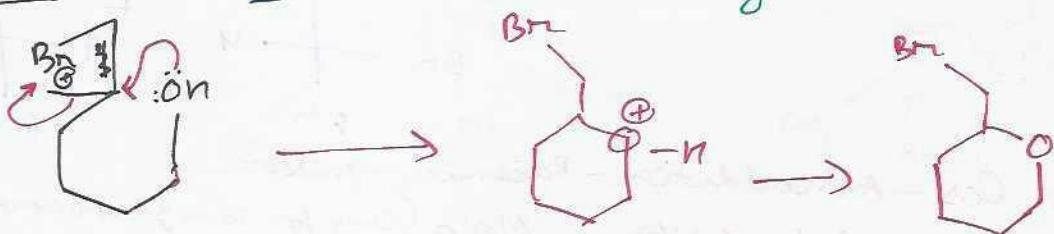
\rightarrow They are
diastereomers.
Not enantiomers.



Mechanism

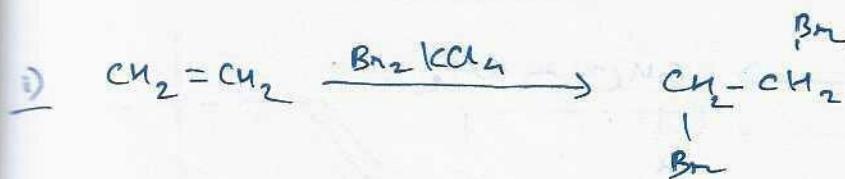
less bond angle strain
6 membered ring
is more favoured.

Ring closing \rightarrow Chelation
gives more stability

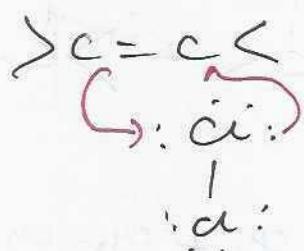
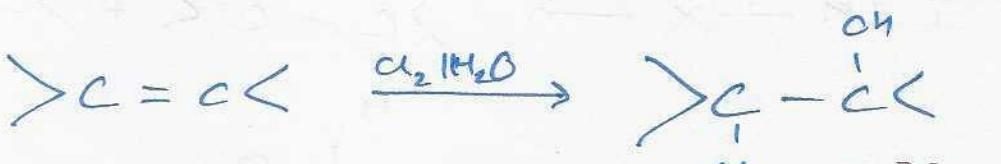


5 is more favoured
than 7.

TEST FOR UNSATURATION

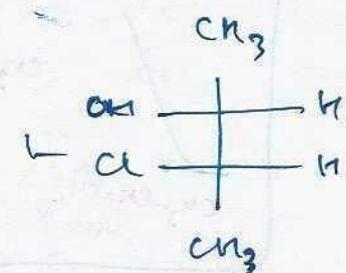
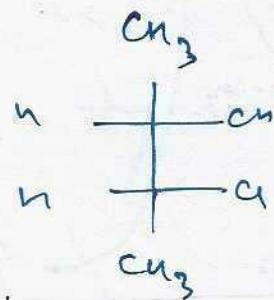
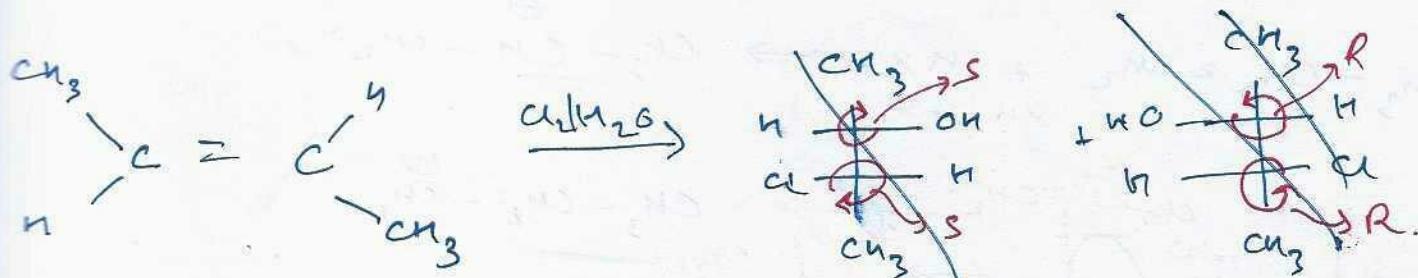
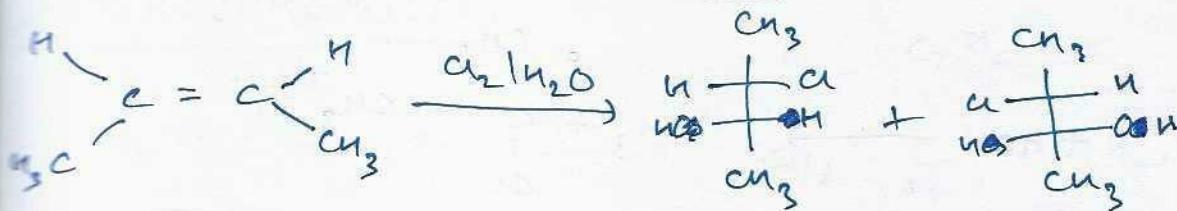
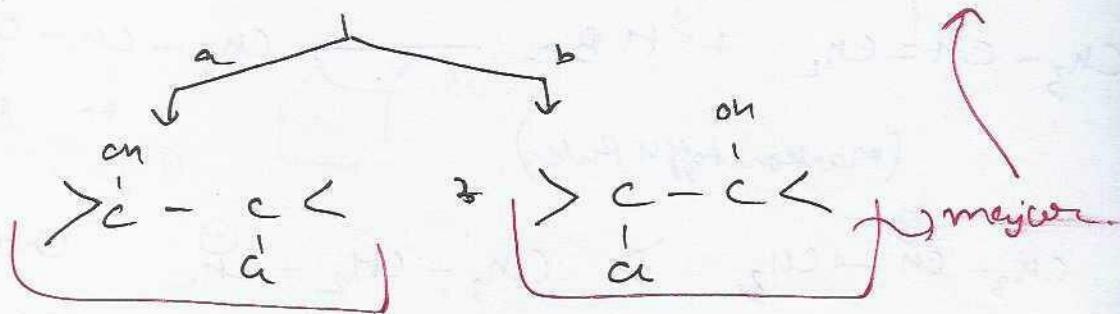


Reddish brown colour disappears.



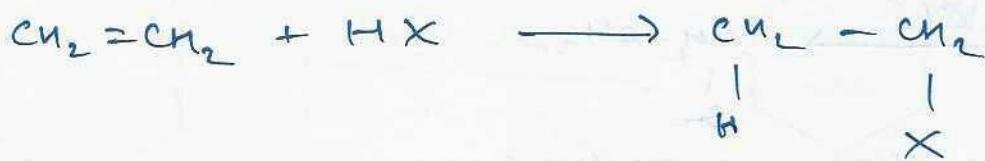
little amount of
1,2-dicloro is also
formed.

As concentration of
water is more since
it is solvent

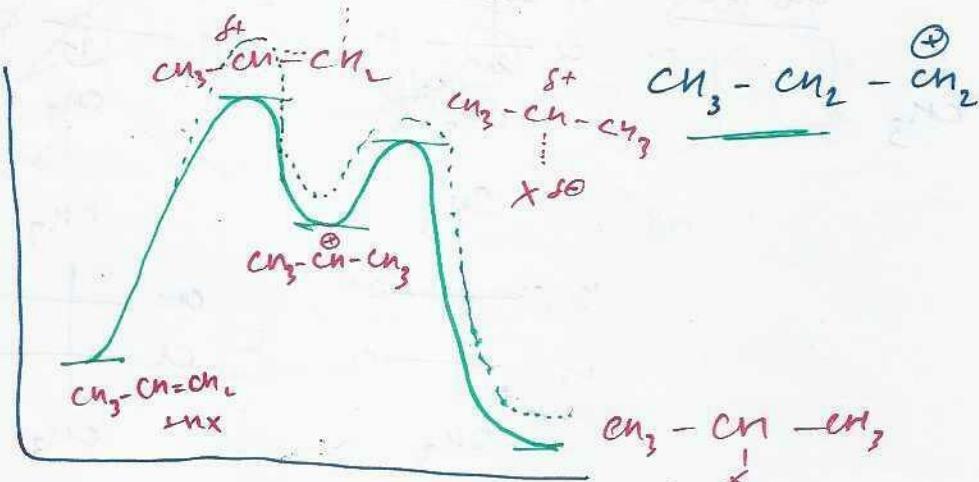
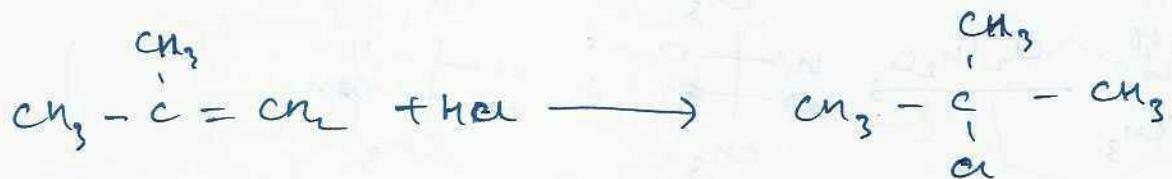
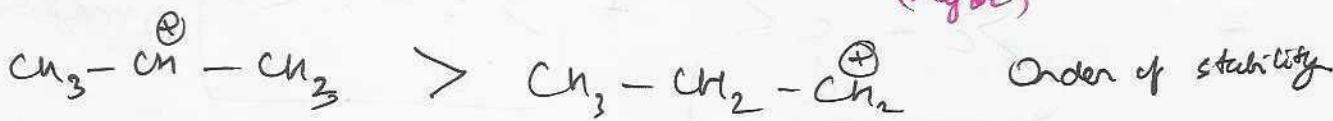
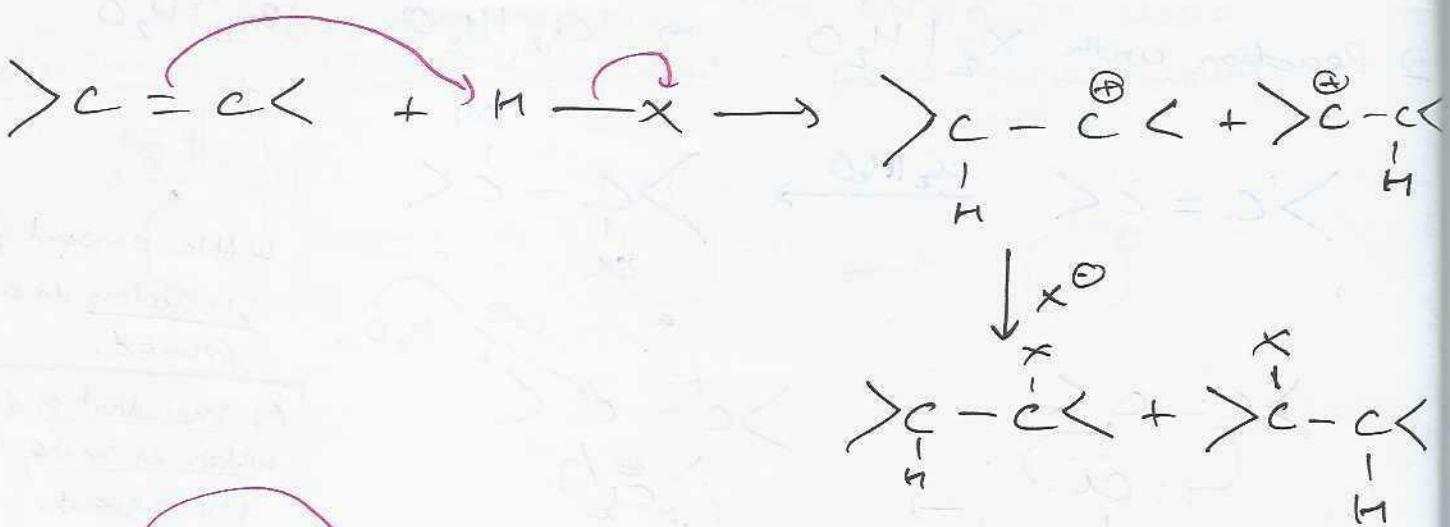


Addition of HX

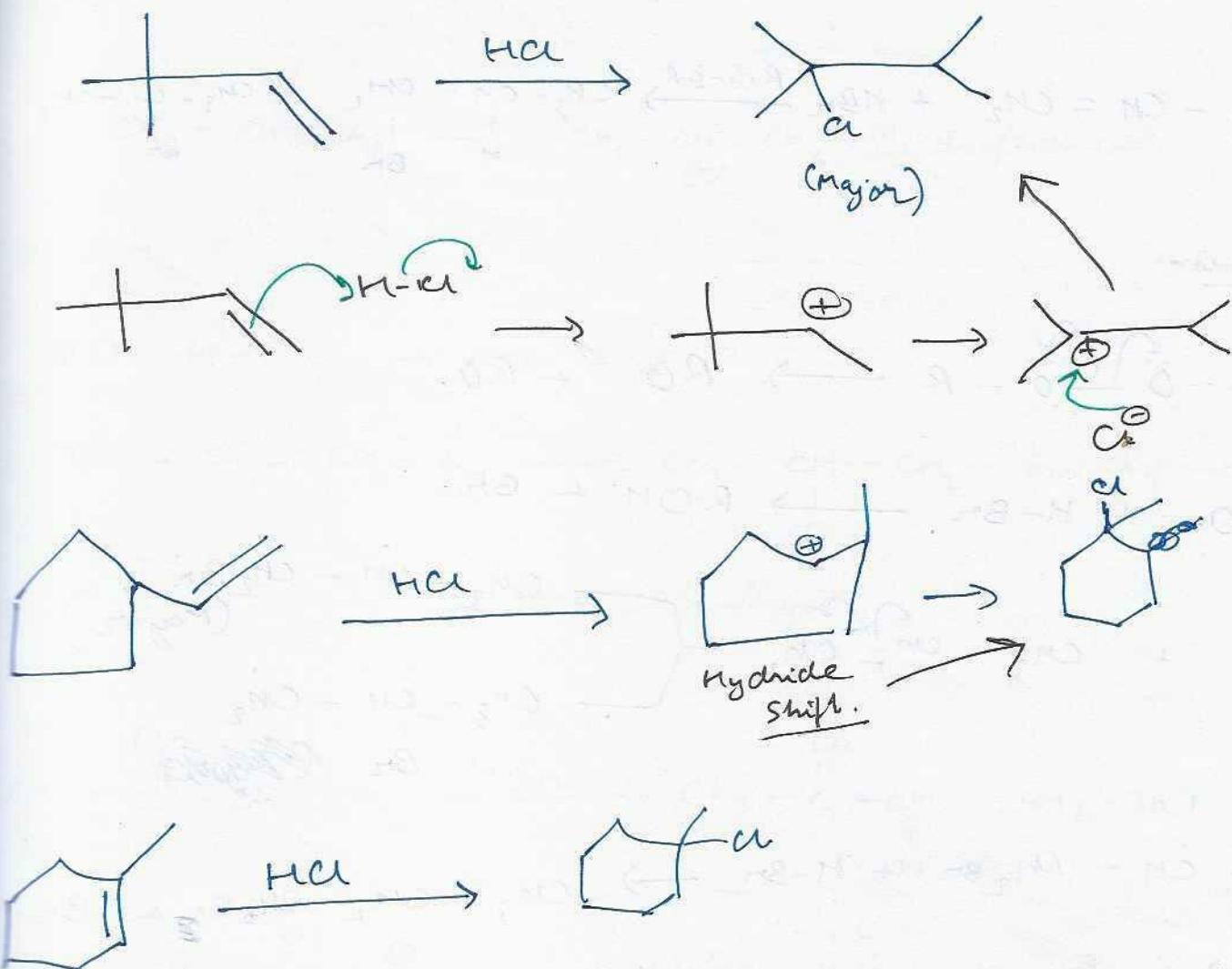
HI > HBr > HCl Order of reactivity.



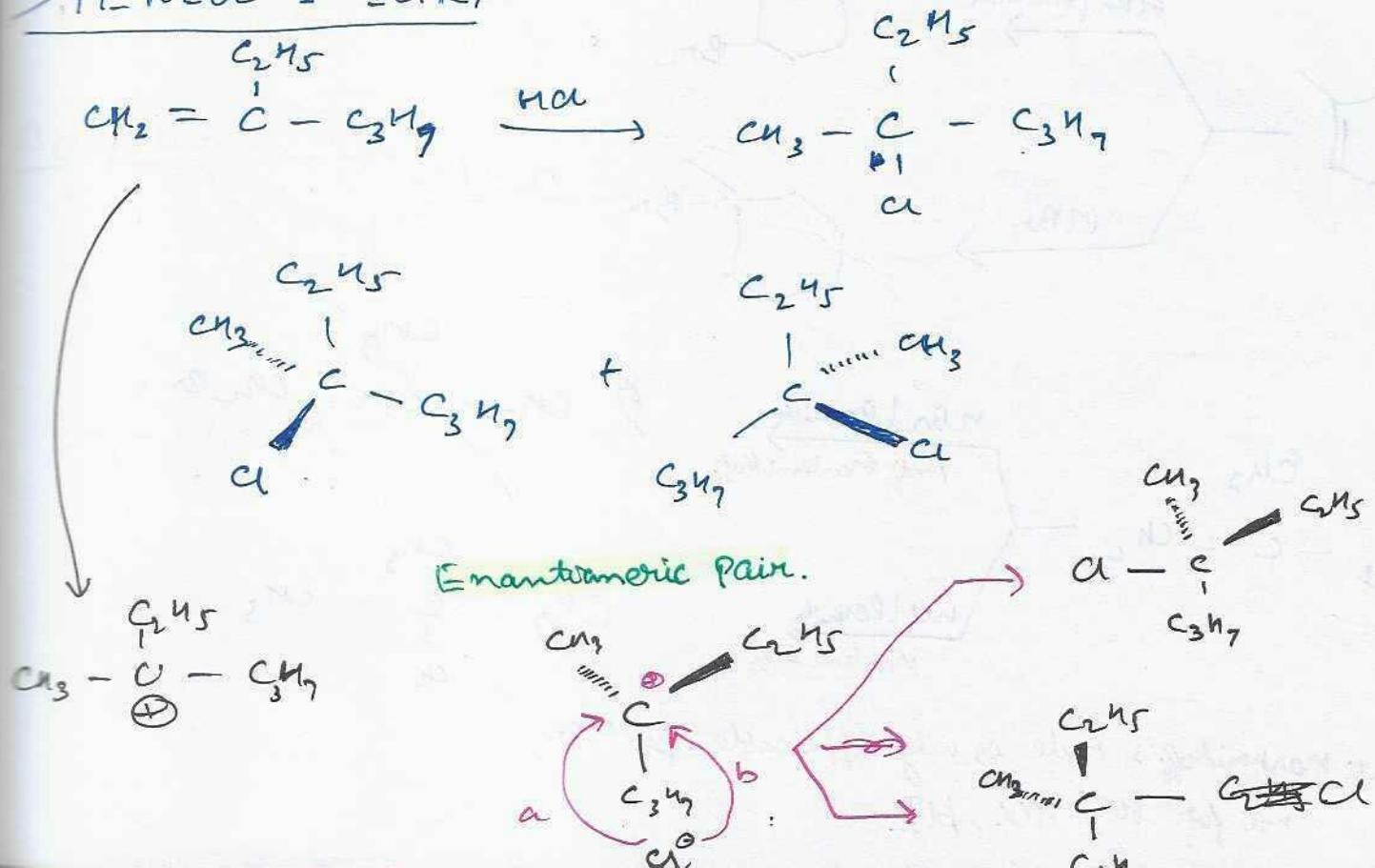
Mechanism



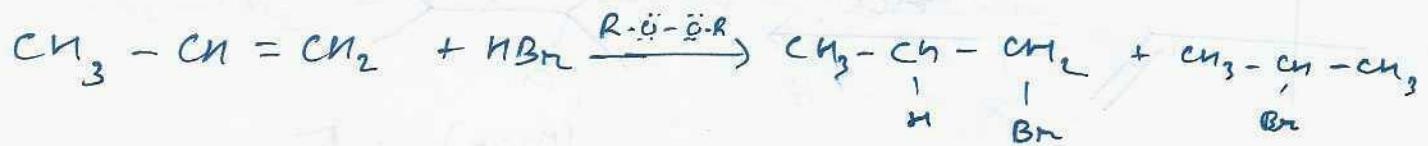
Carbocation intermediate → Rearrangement.



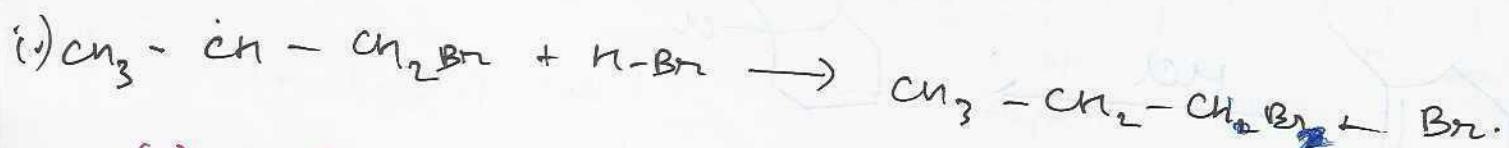
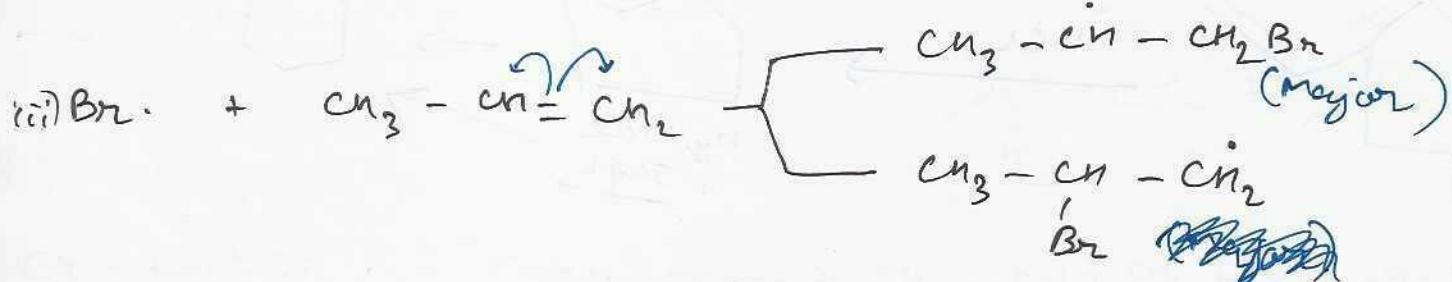
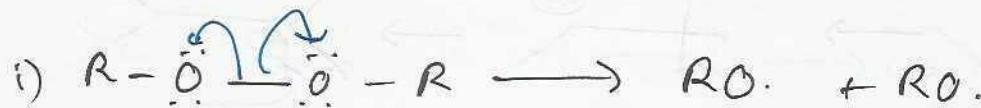
Stereochemistry



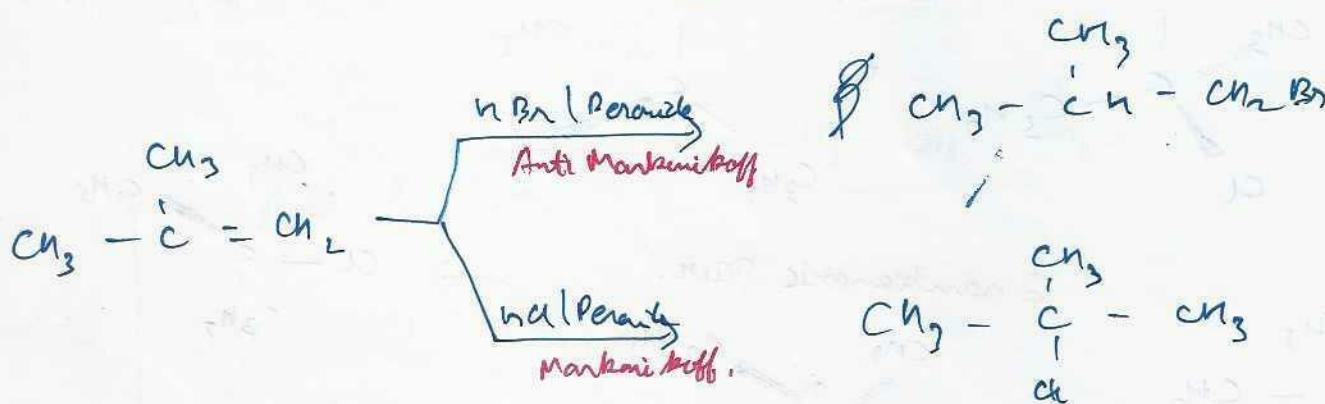
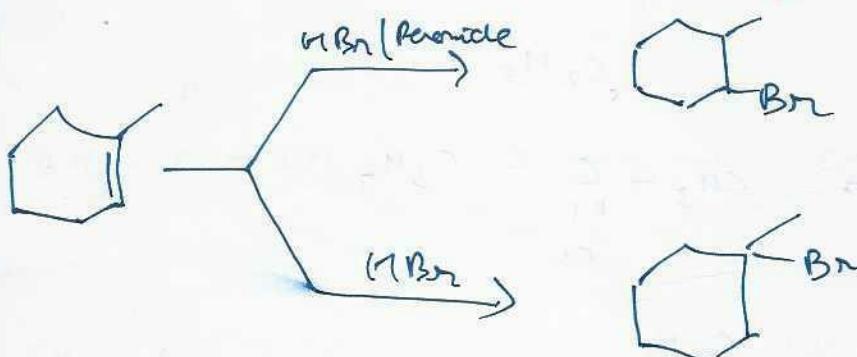
ADDITION OF HBr IN THE PRESENCE OF PEROXIDES



Mechanism

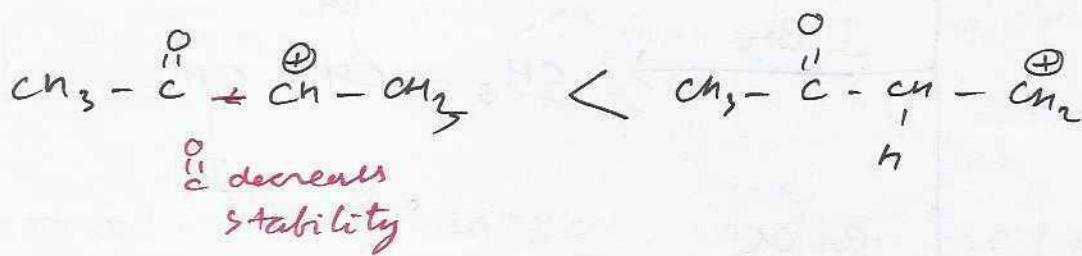
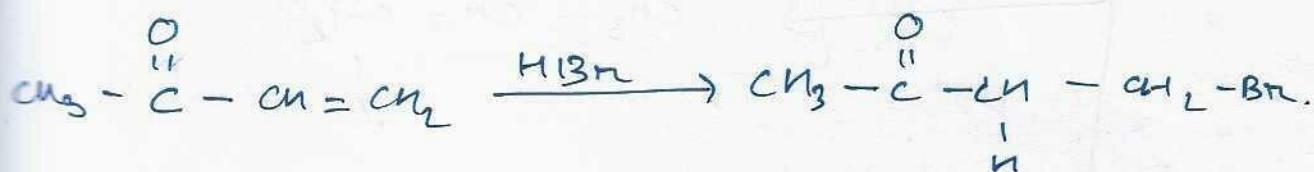
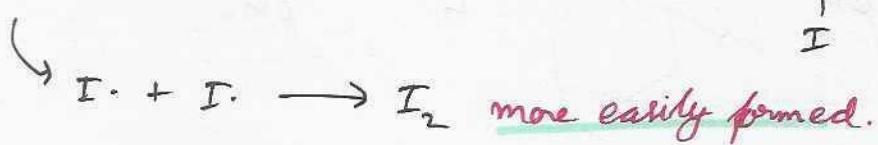
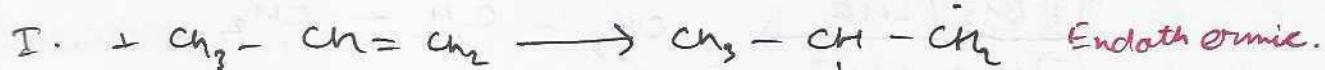
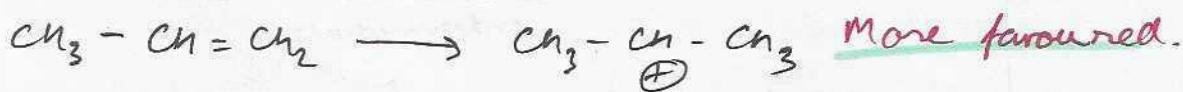
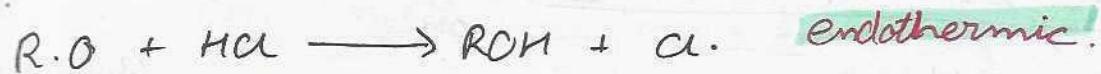


(iii) and (iv) take place repeatedly

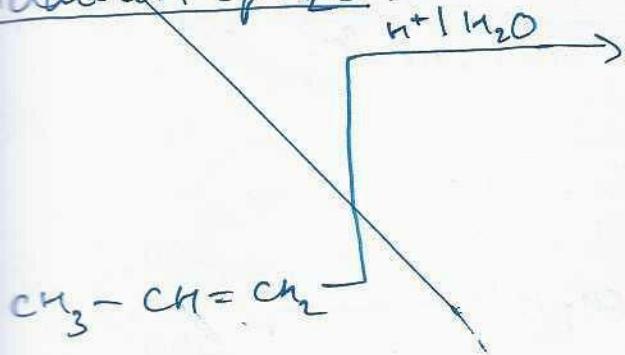


Anti Markovnikoff's rule is only applicable for HBr
not for HF, HCl, HI.

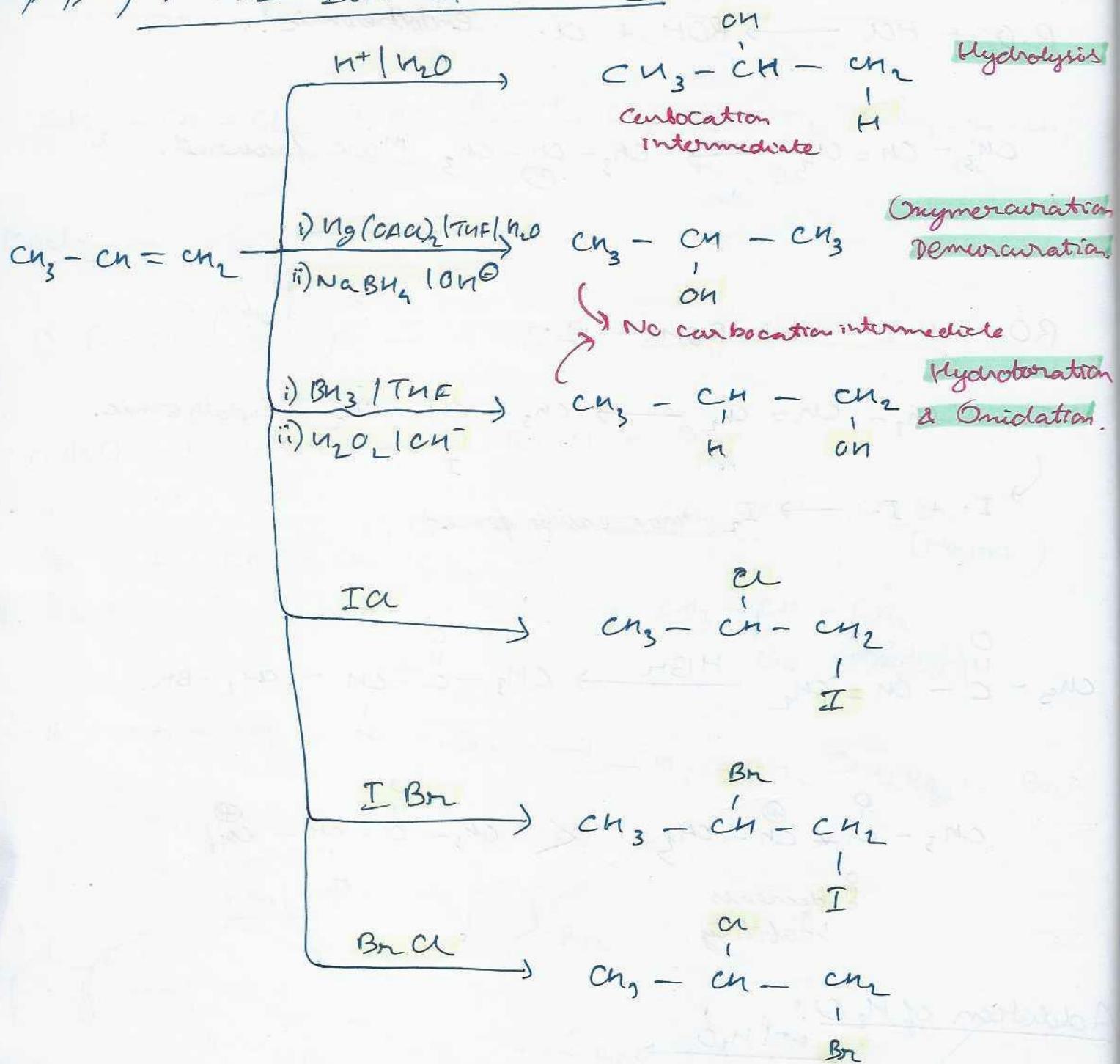
Reason



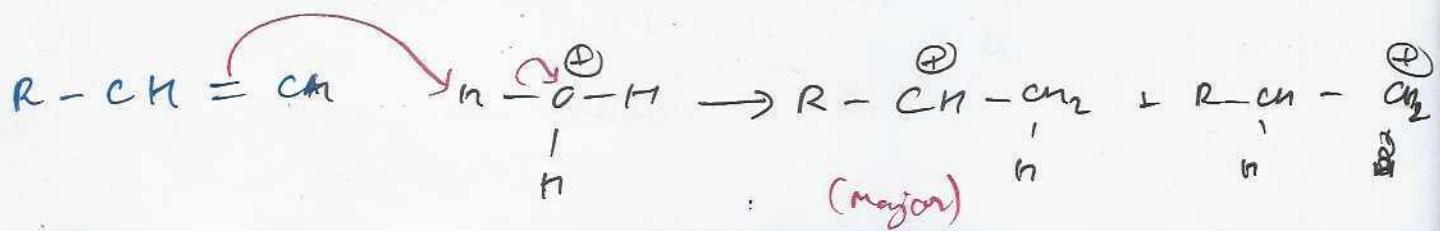
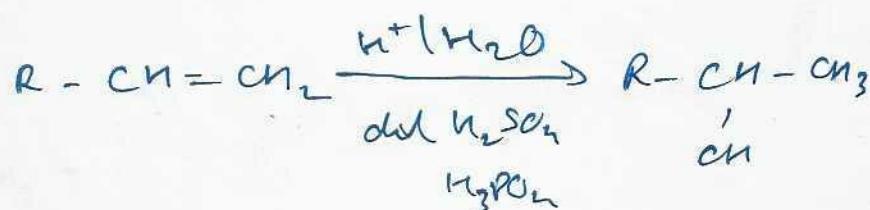
Addition of H_2O .

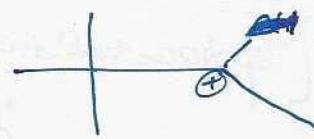
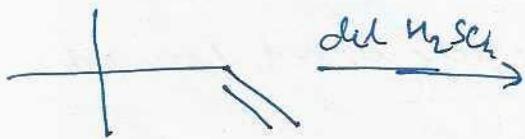
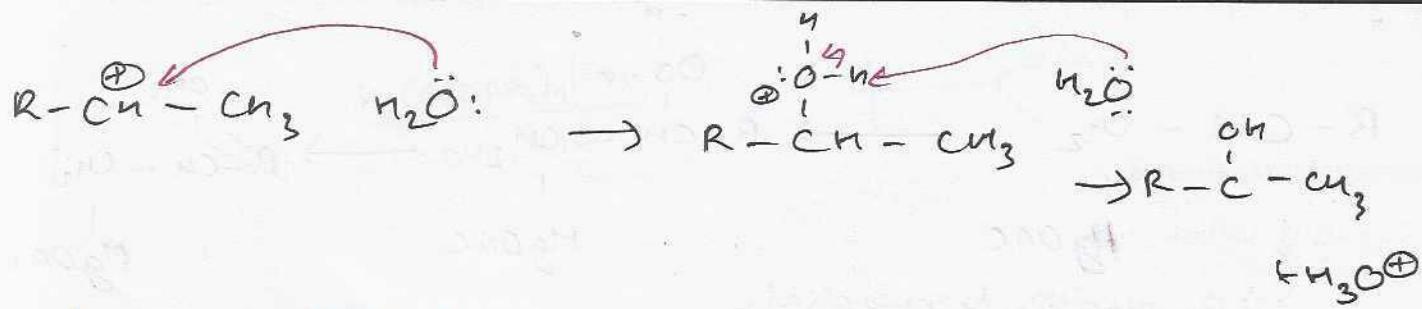


iv), v), vi) ADDITION OF WATER

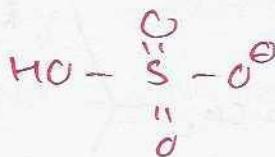
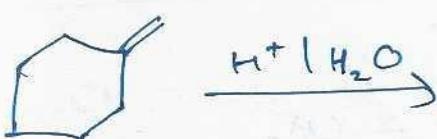
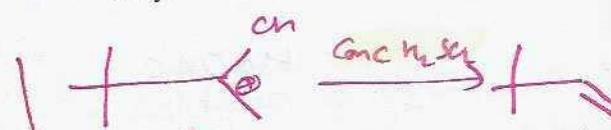
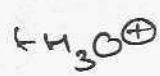
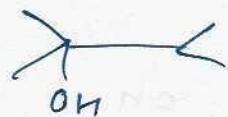


HYDROLYSIS





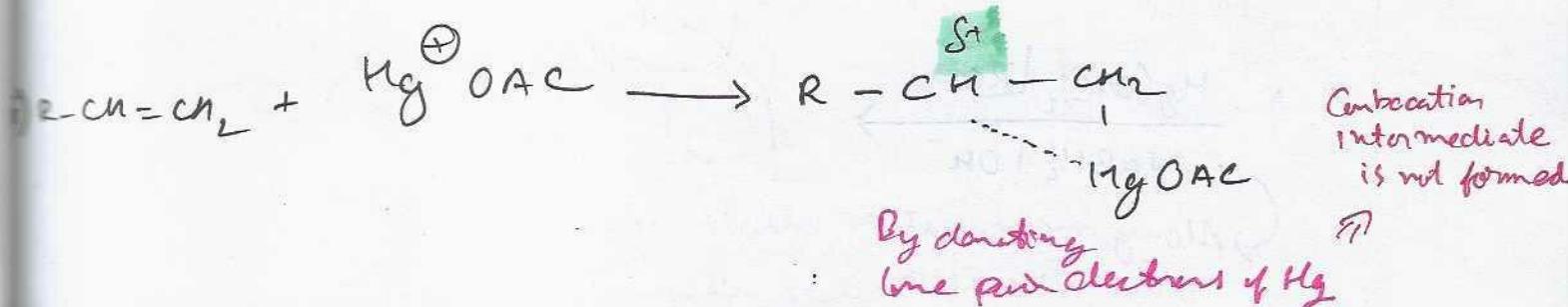
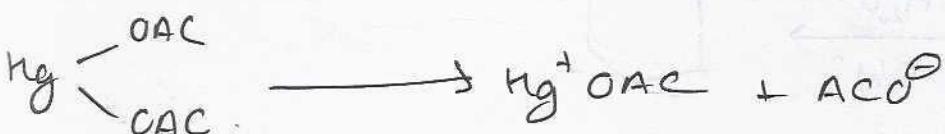
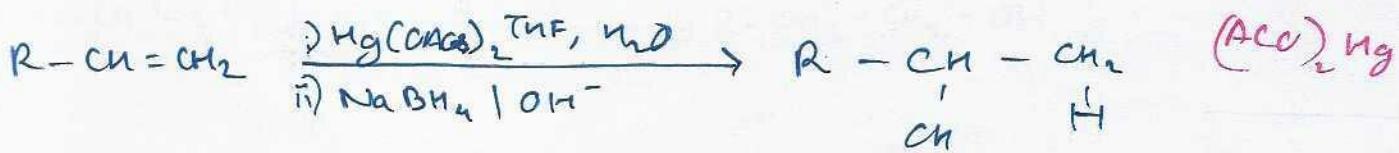
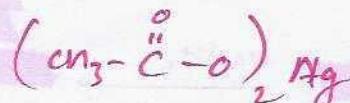
methyl shift

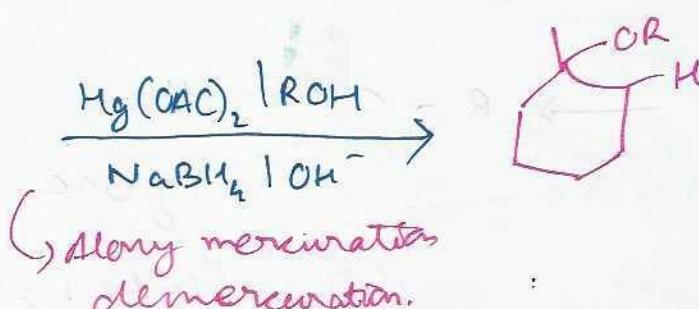
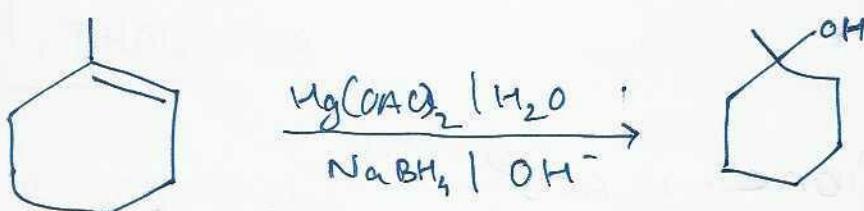
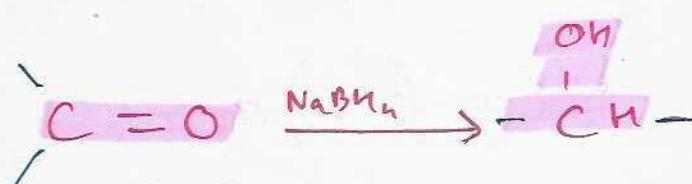
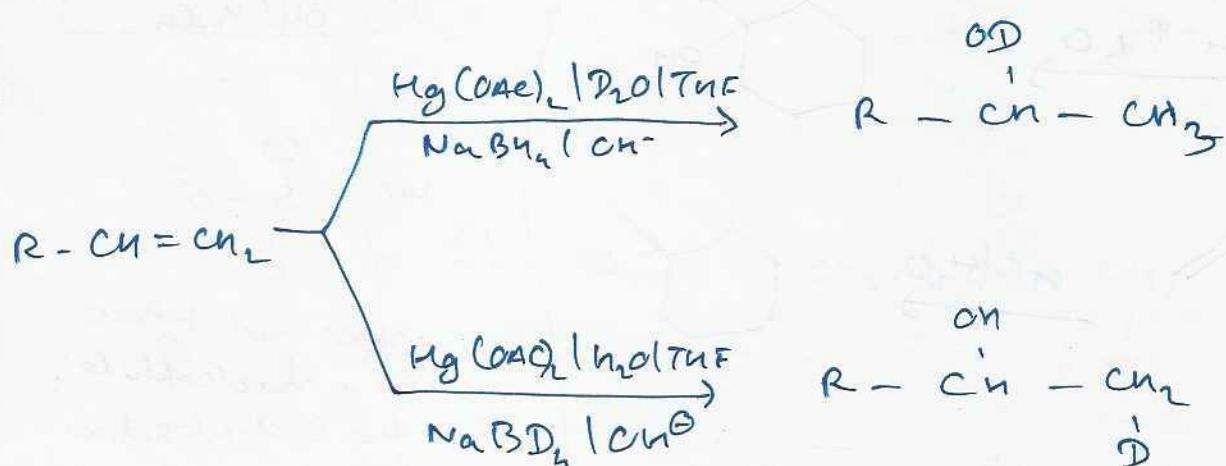
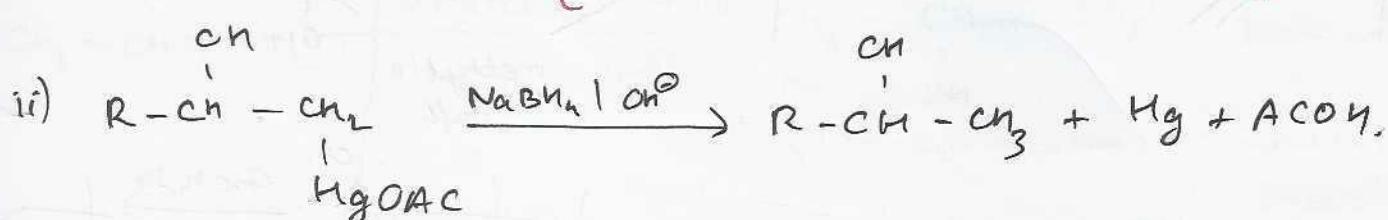
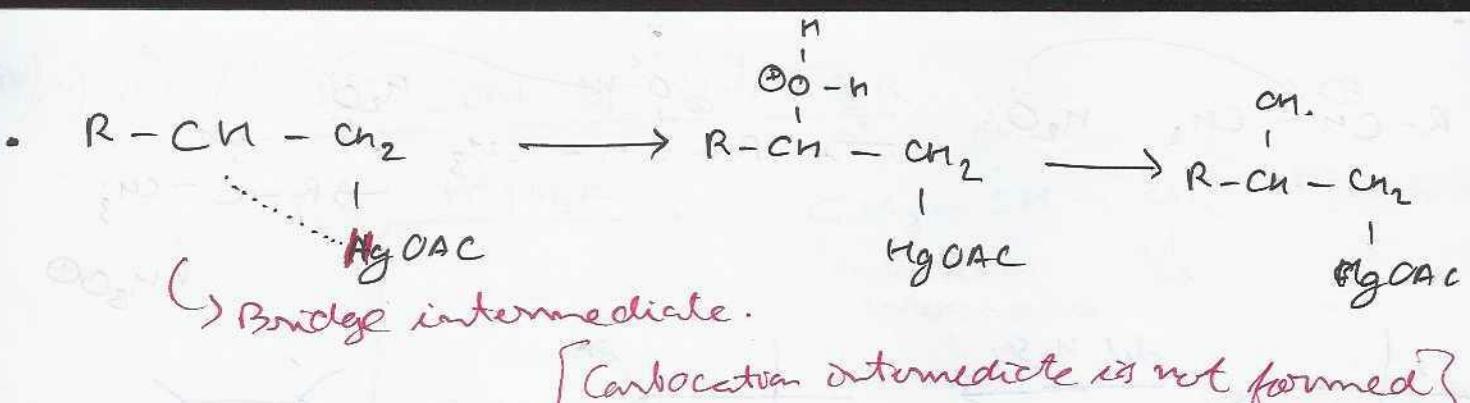


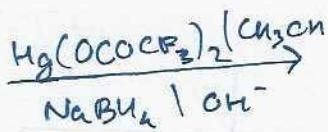
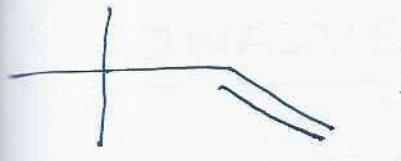
does not behave
as a nucleophile.
due to stabilisation
by resonance.



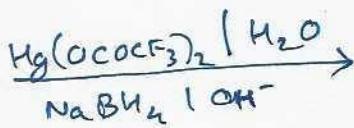
OXIDATION - DEMERCURATION



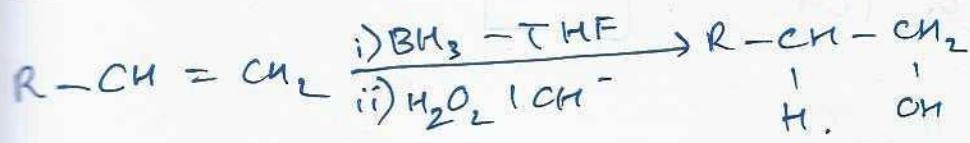




No rearrangement takes place.



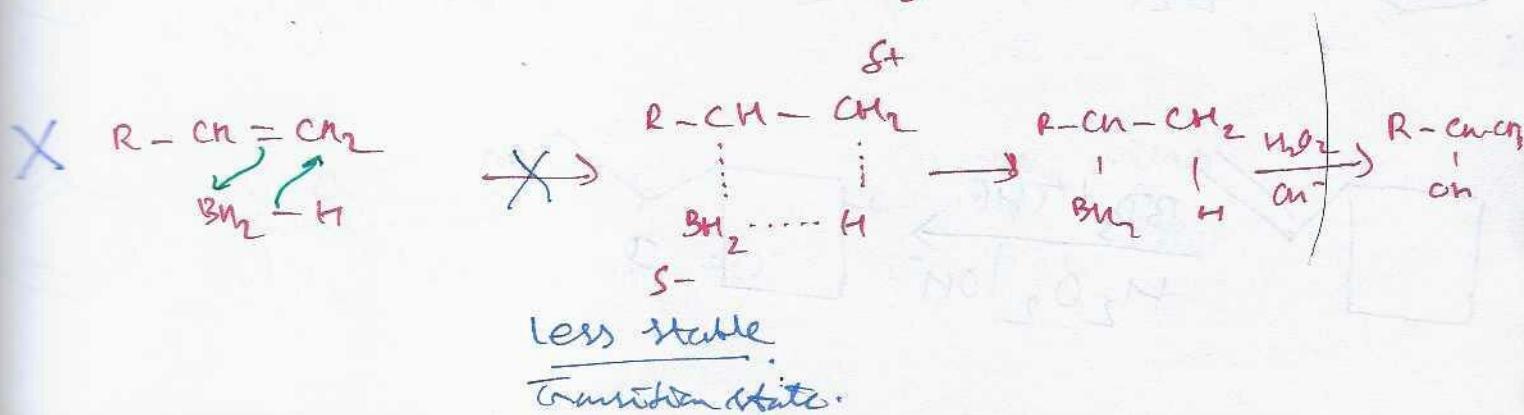
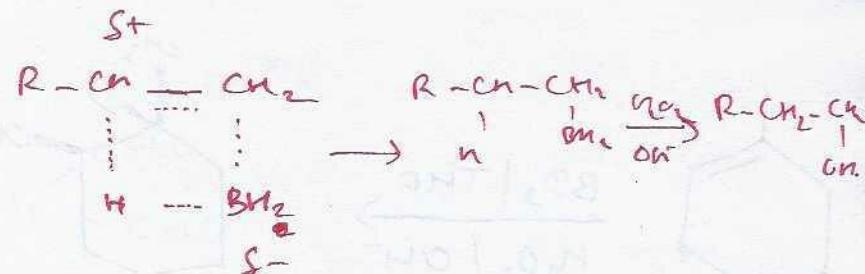
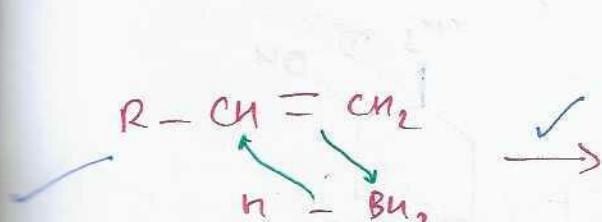
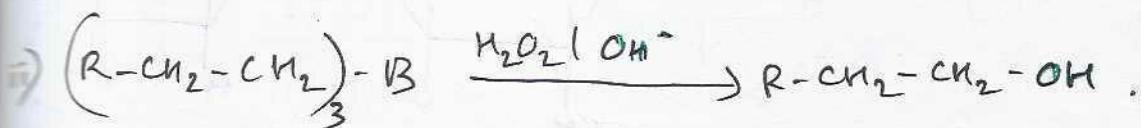
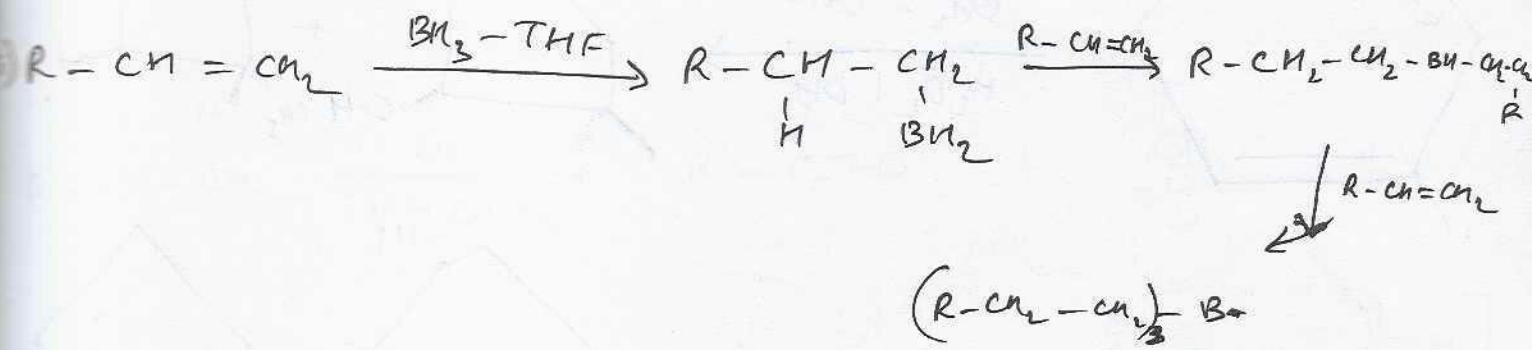
HYDROBORATION - OXIDATION

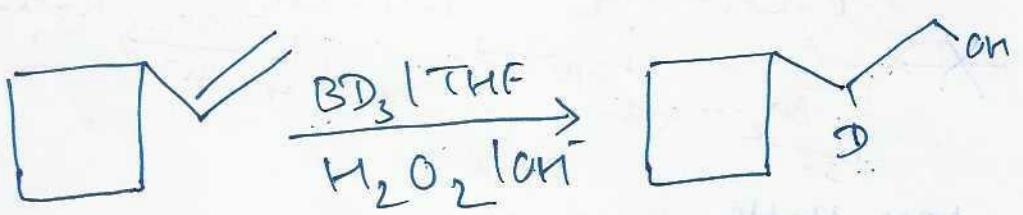
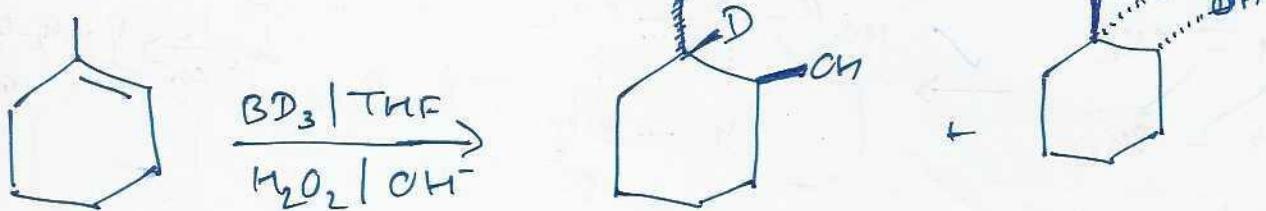
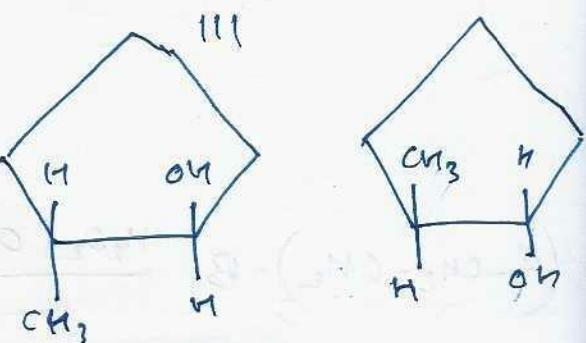
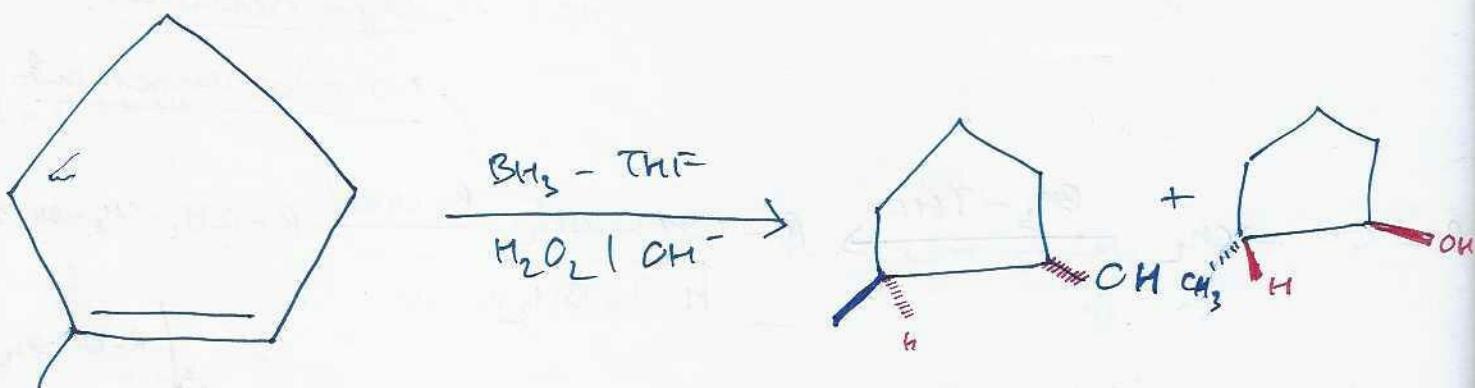
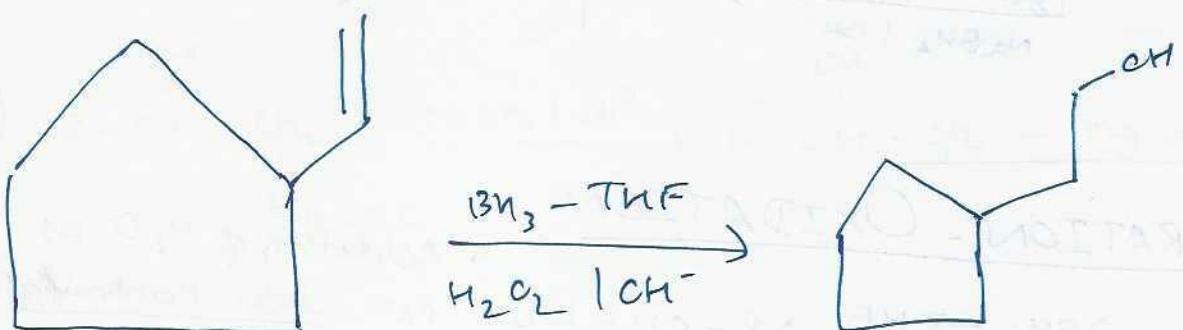
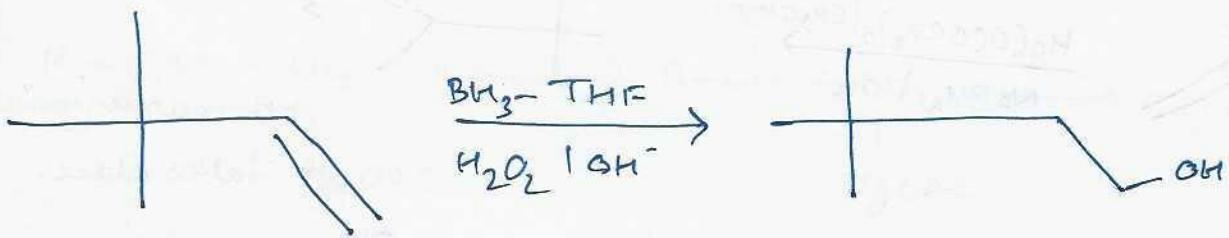


- Addition of H_2O as per anti-Markovnikoff Rule.

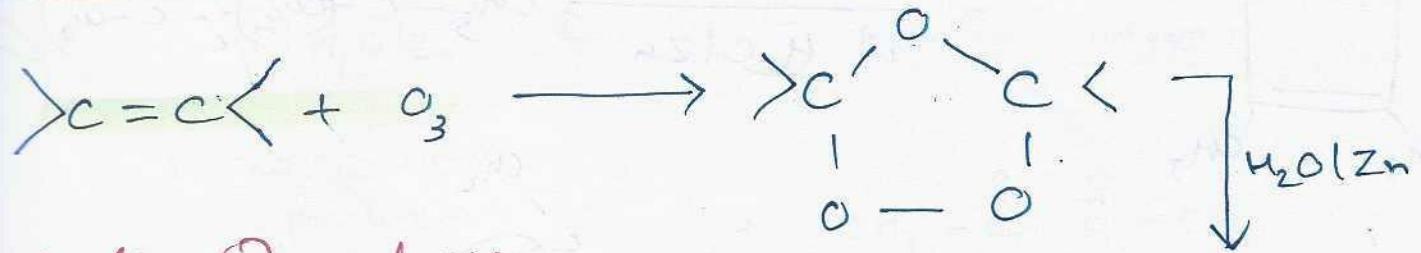
- Sync addition.

- No rearrangement.

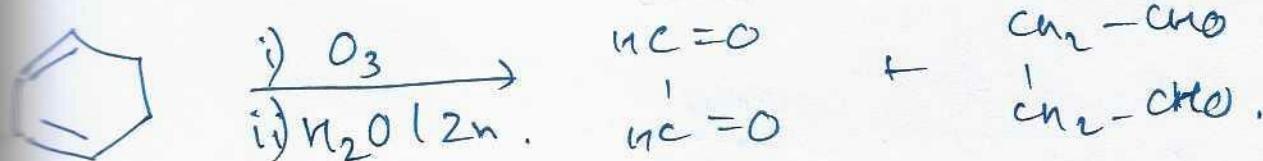
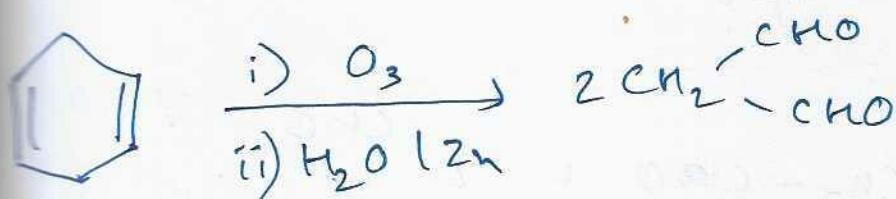
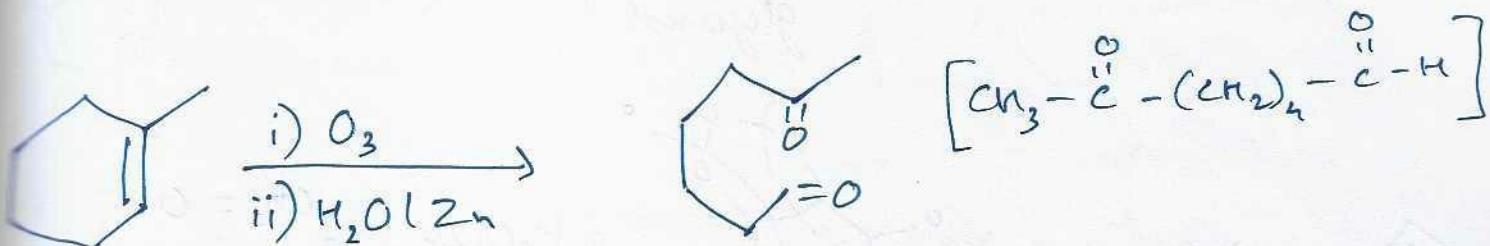
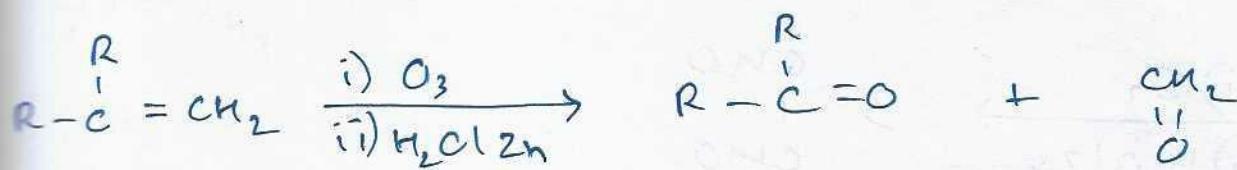
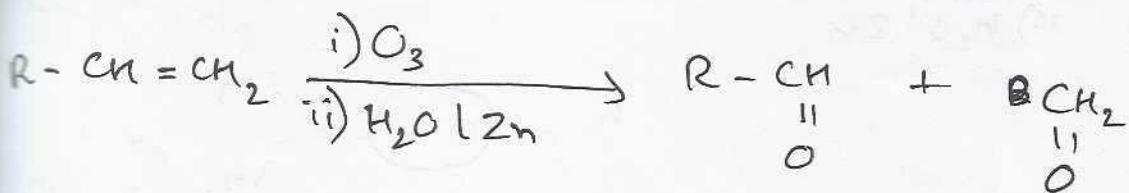
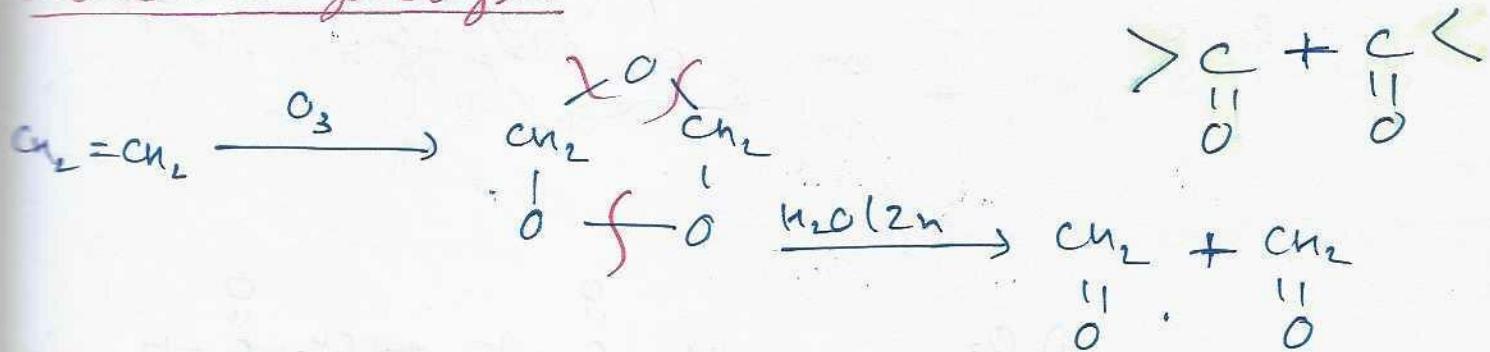


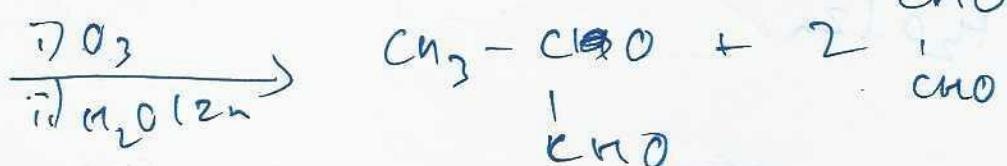
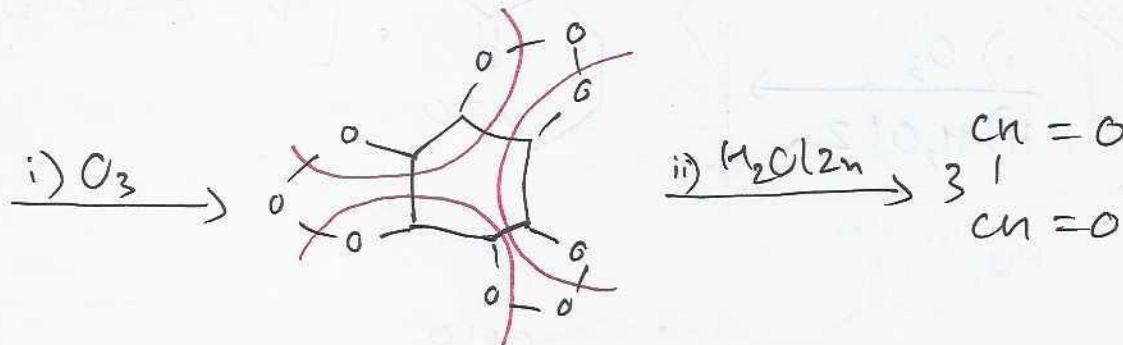
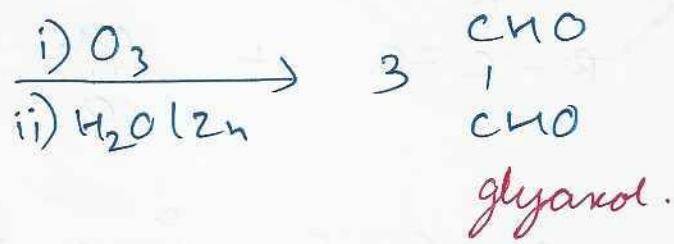
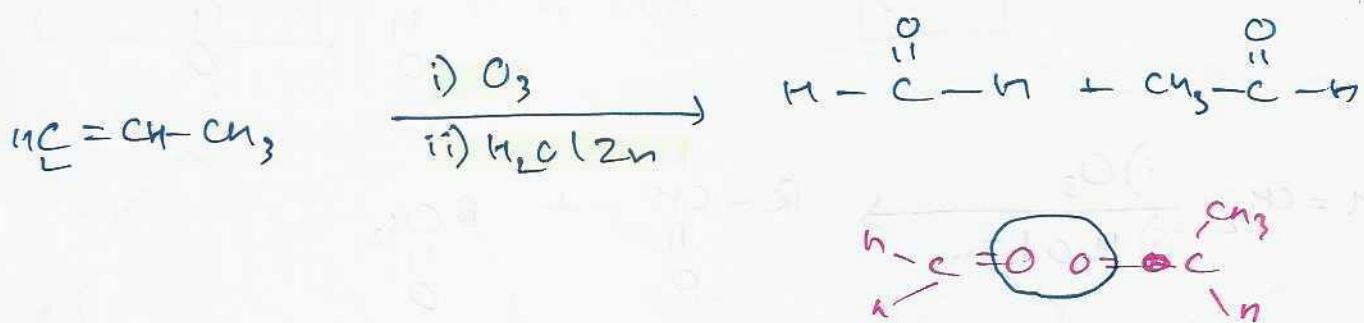
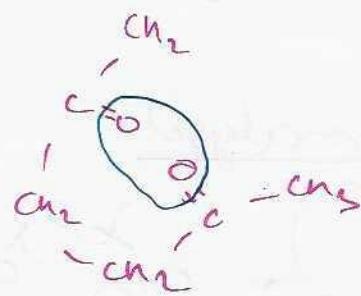
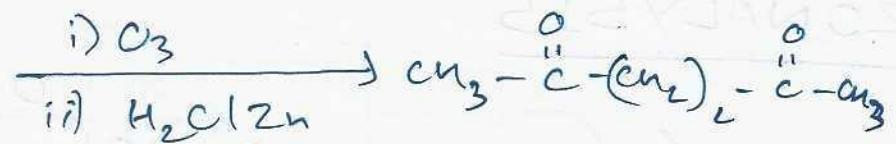
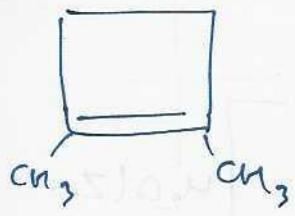


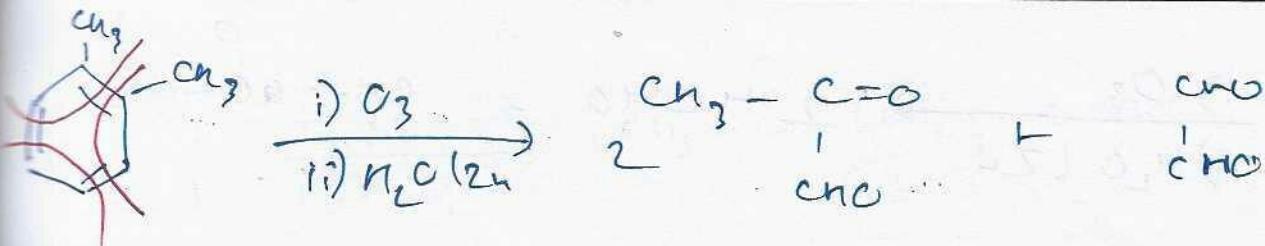
OZONALYSIS



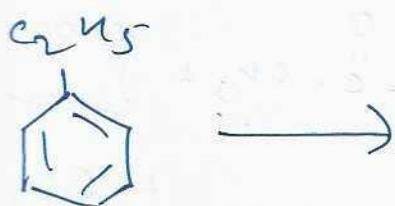
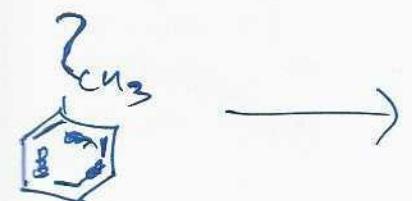
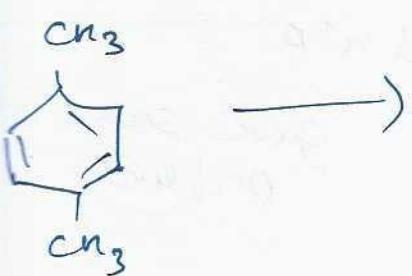
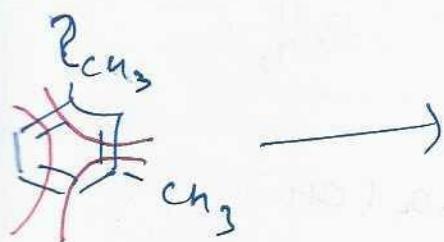
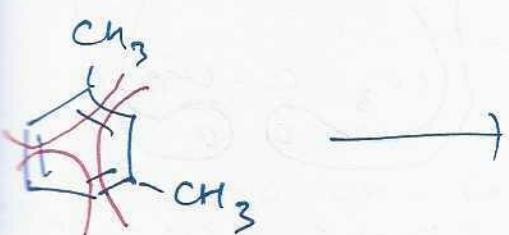
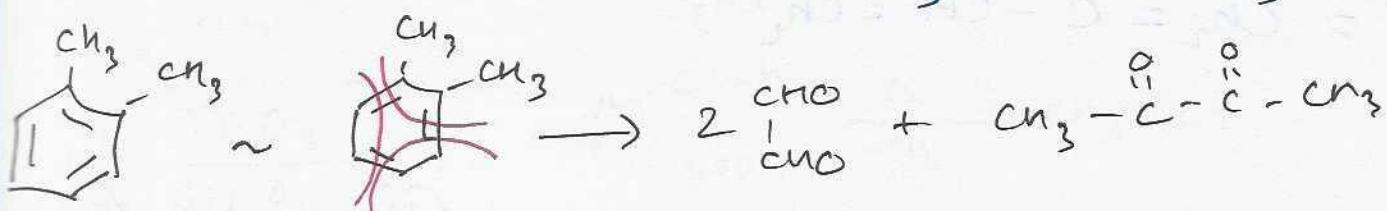
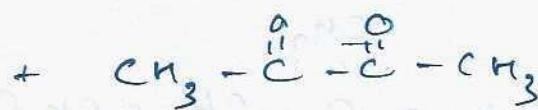
Reductive Ozonolysis

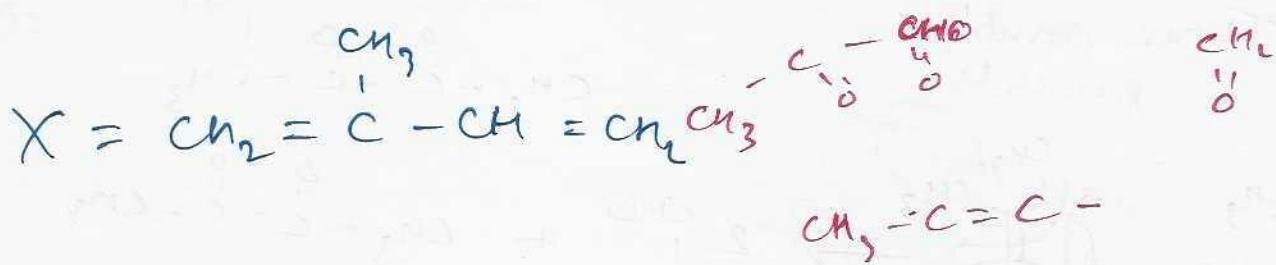
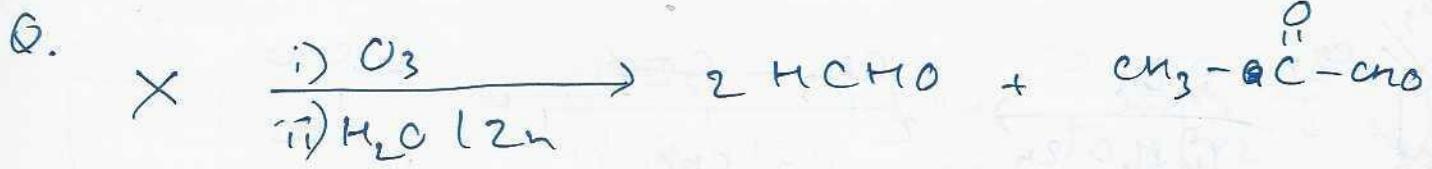






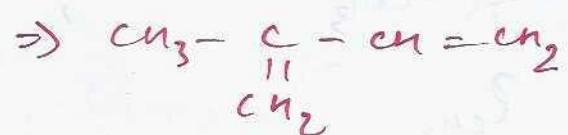
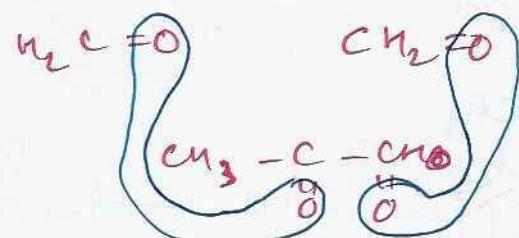
Three possible products





$\text{H}_2\text{O } | \text{Me}_2\text{S}$

can also be used
for reductive ozonolysis.



Oxidative Ozonolysis

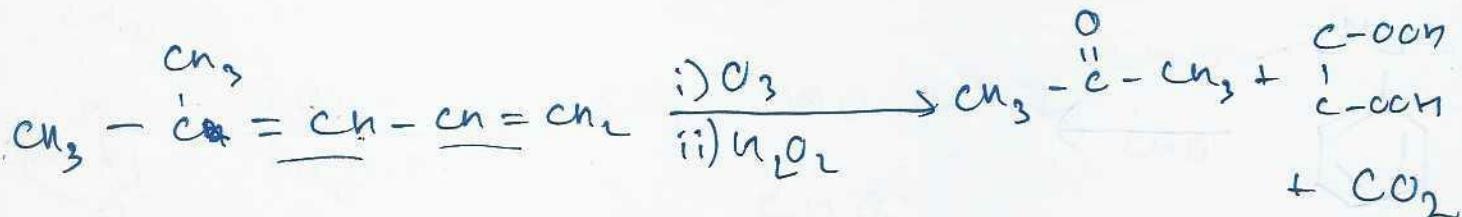
i) O_3

✓ Hot conc. $\text{KMnO}_4 (\text{CH}_3^-)$

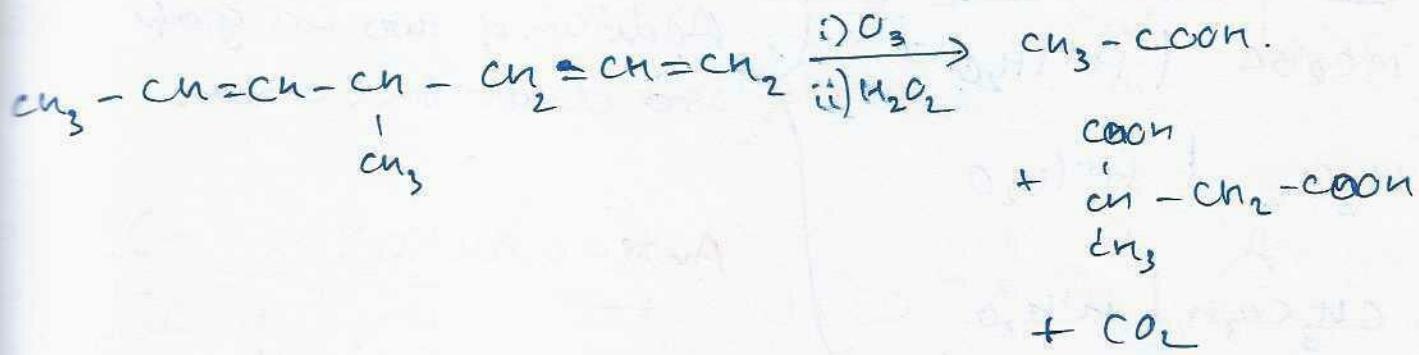
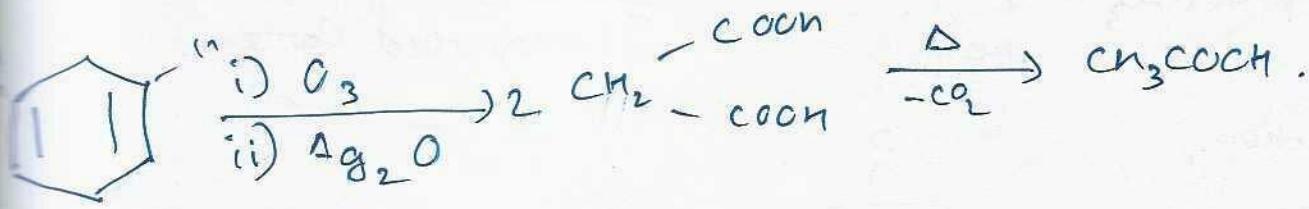
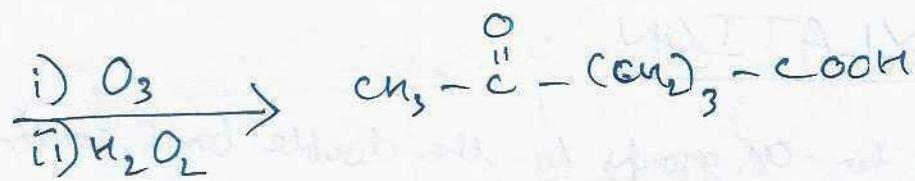
ii) H_2O_2 (or) Ag_2O

✓ ~~KMnO₄~~ $\text{KMnO}_4 (\text{H}^+ \text{A})$

give same
product.



$\xrightarrow[\Delta]{\text{KMnO}_4 (\text{CH}_3^-)}$ same.

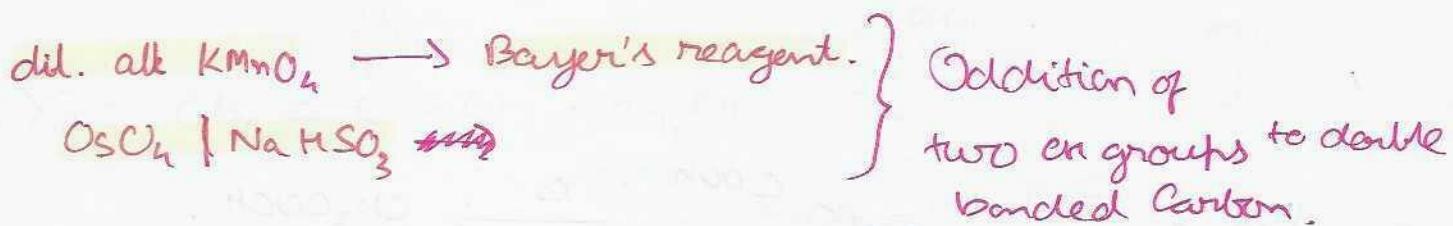


Q2

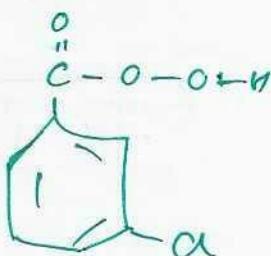
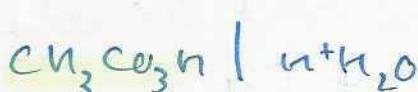


HYDROXYLATION

Addition of two -OH groups to the double bond carbon.



Syn addition.

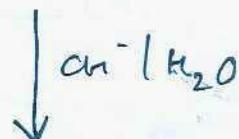
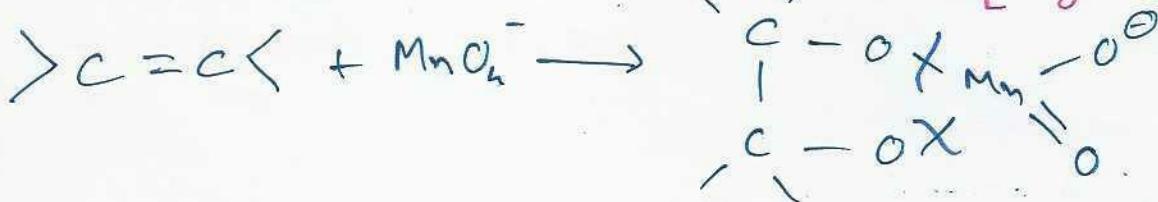


Addition of two OH groups to double bond carbon.

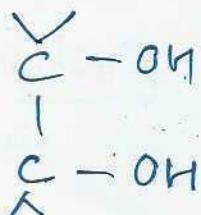
Anti-addition.

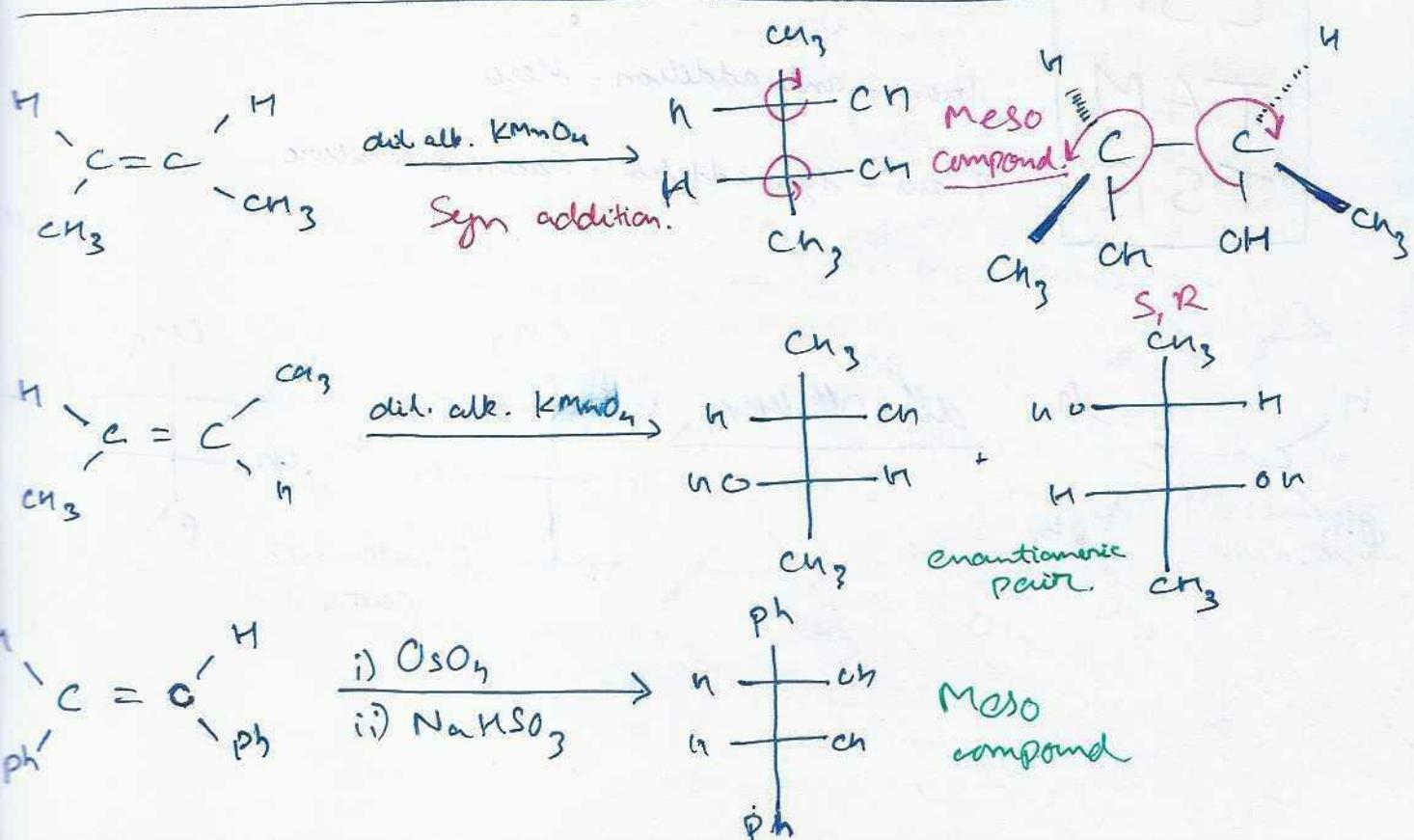
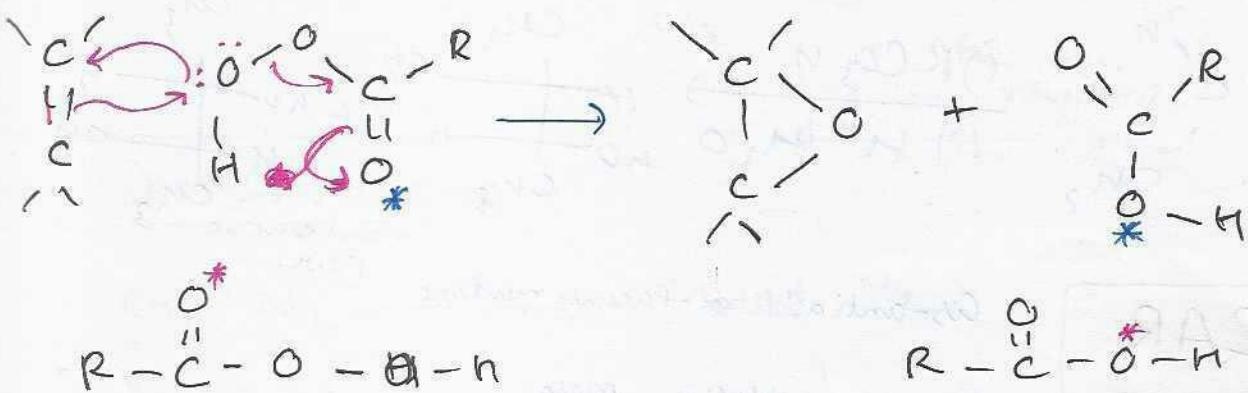
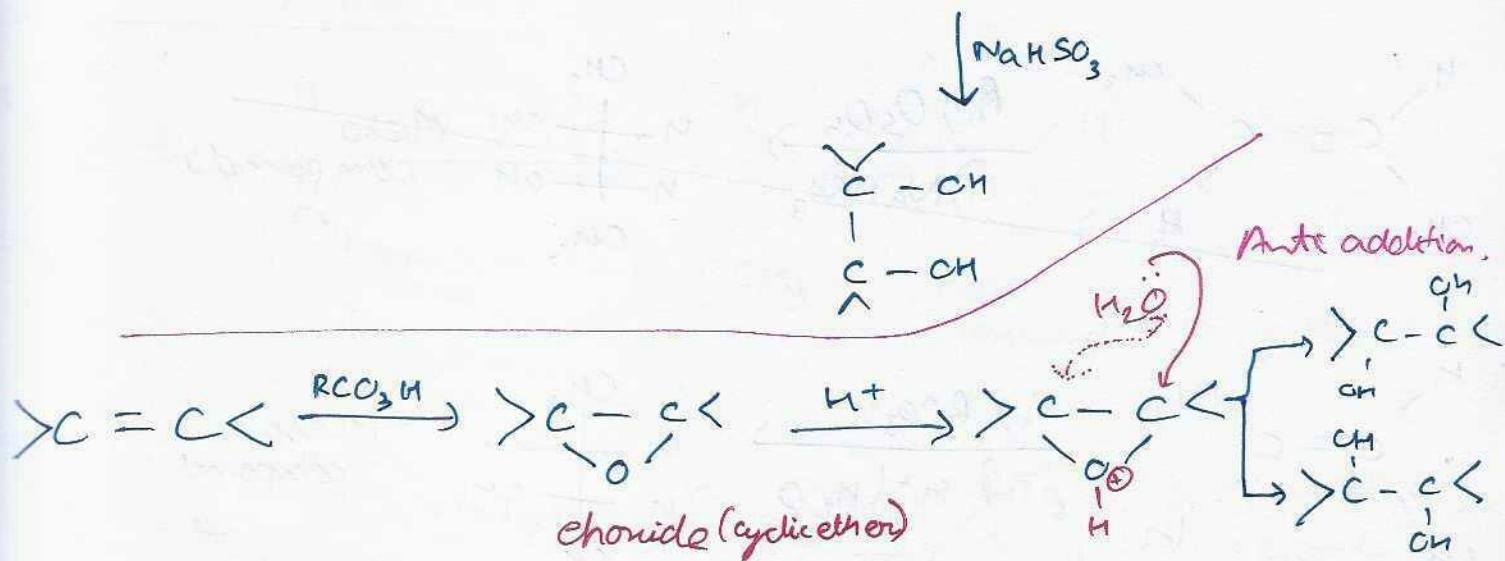
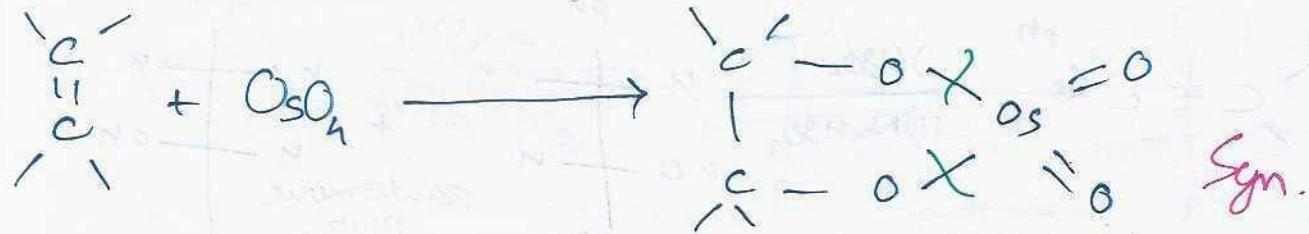
With dil. alk. KMnO_4 (Bayer's reagent)

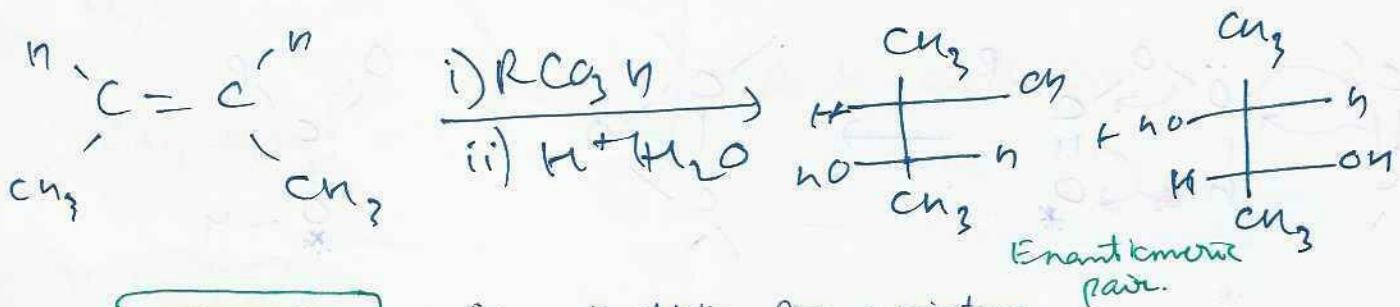
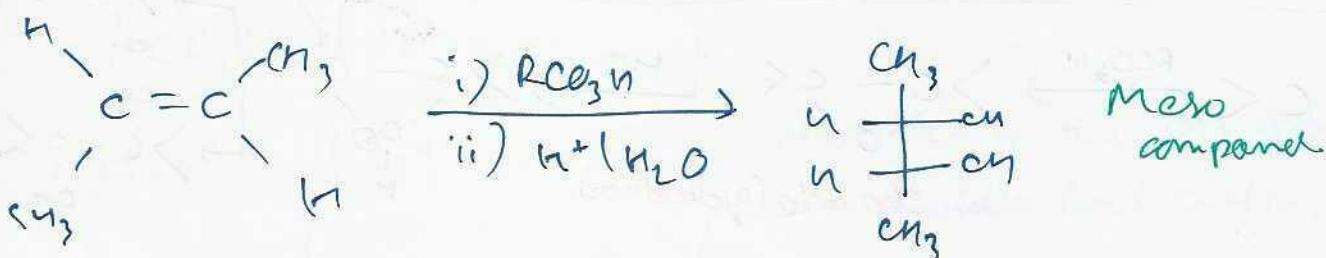
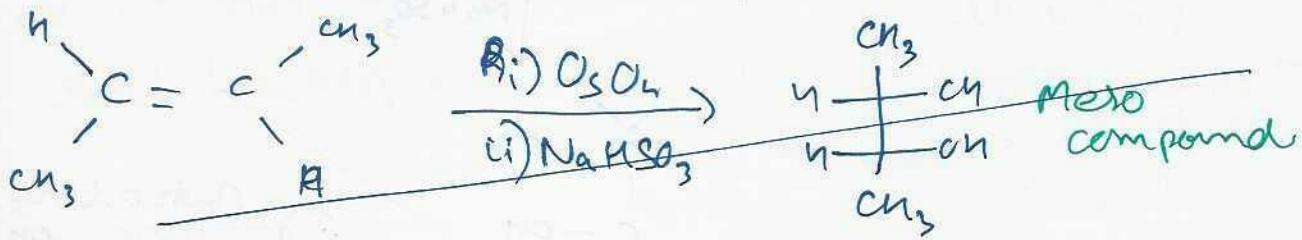
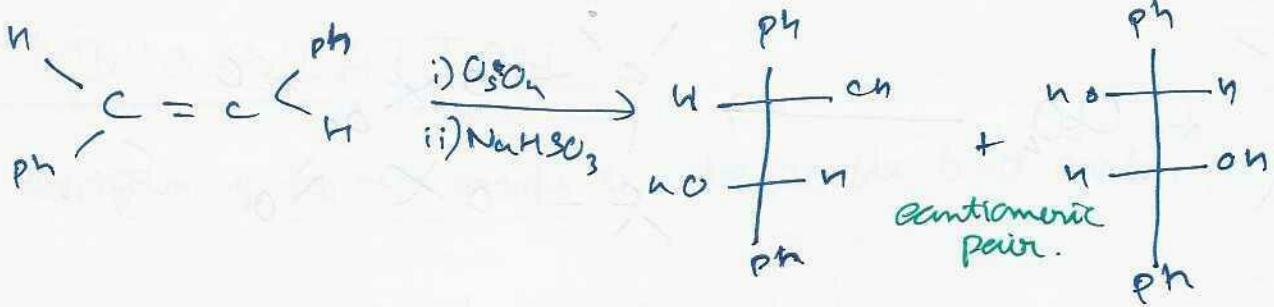
Pink colour
Used for distinguishing saturated and unsaturated hydrocarbons.



Syn.







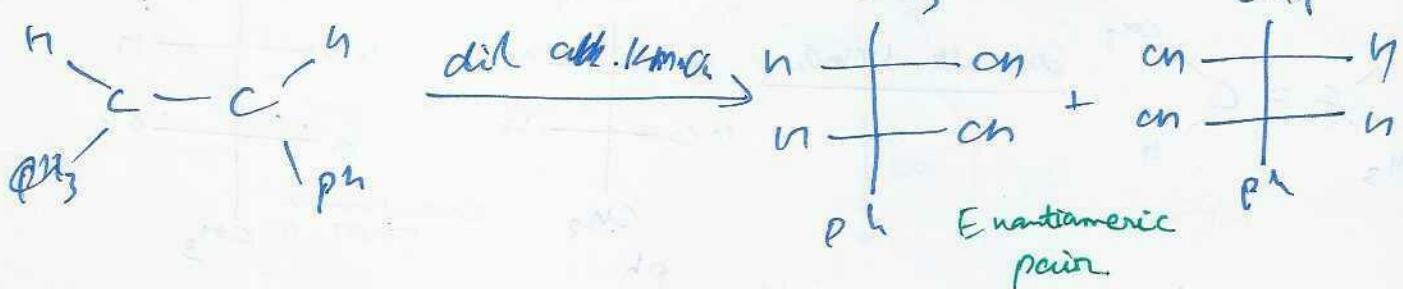
CAR
CSM
TAM
TSR

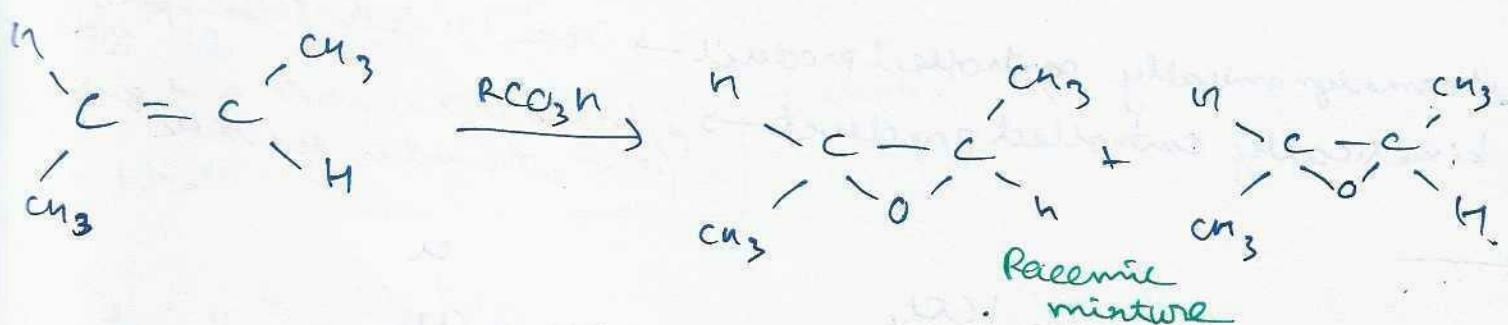
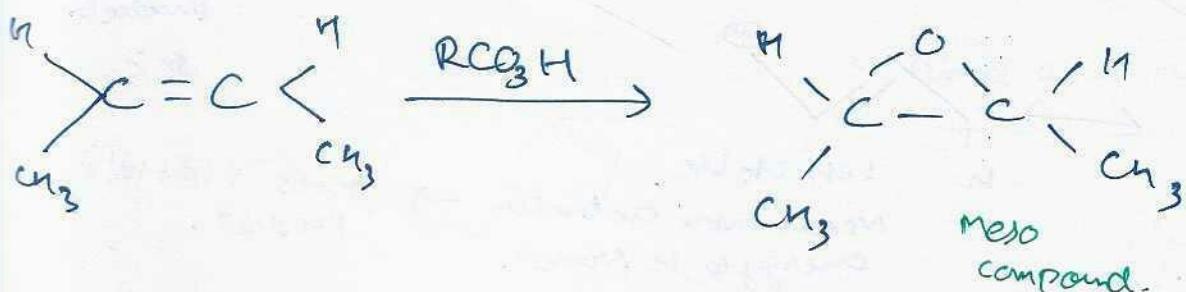
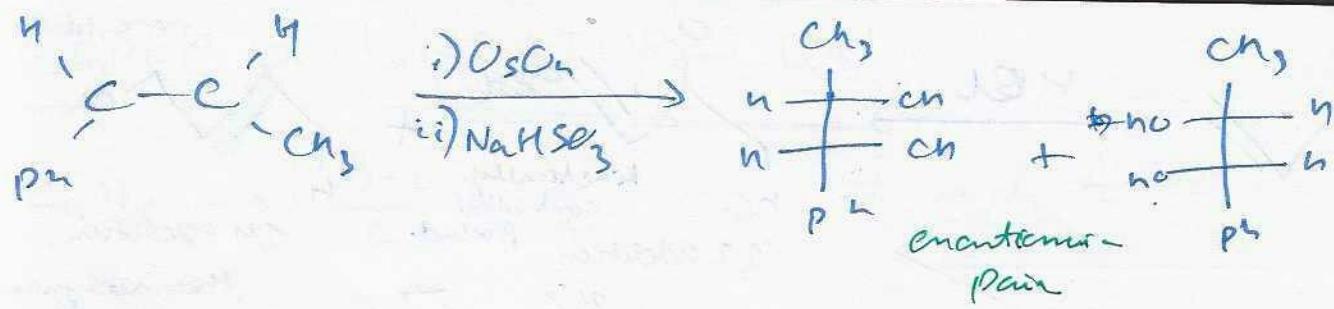
Cis - anti addition - Racemic mixture

Cis - syn addition - Meso

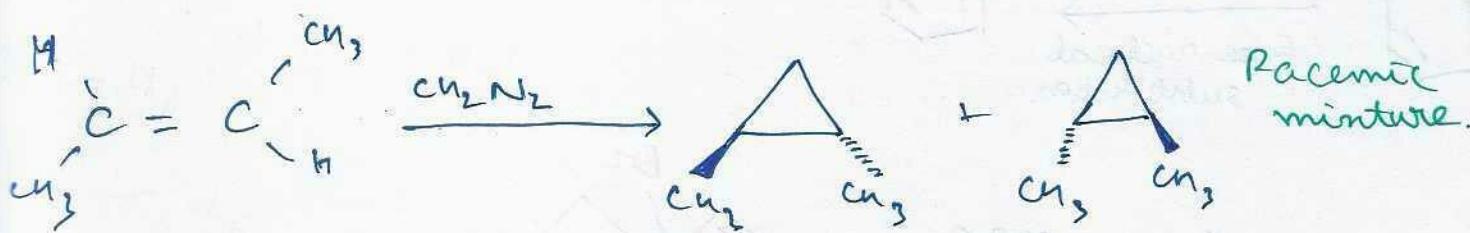
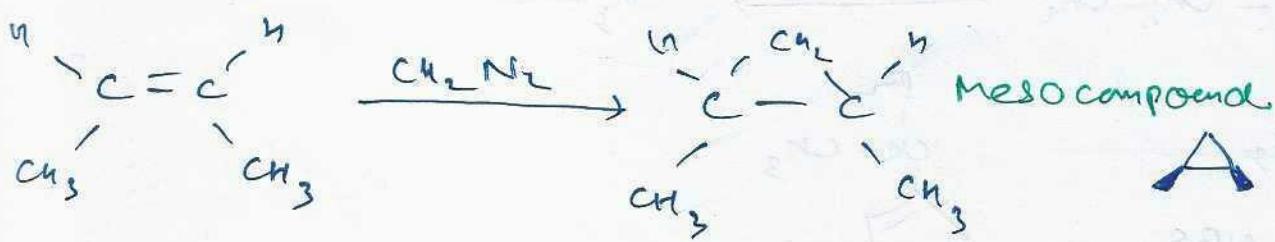
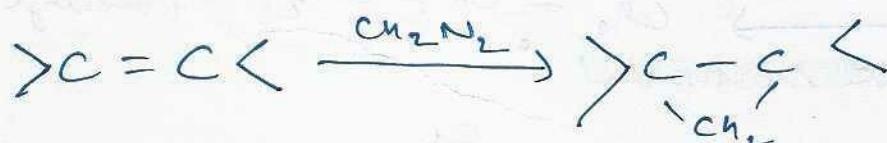
Trans - anti addition - Meso

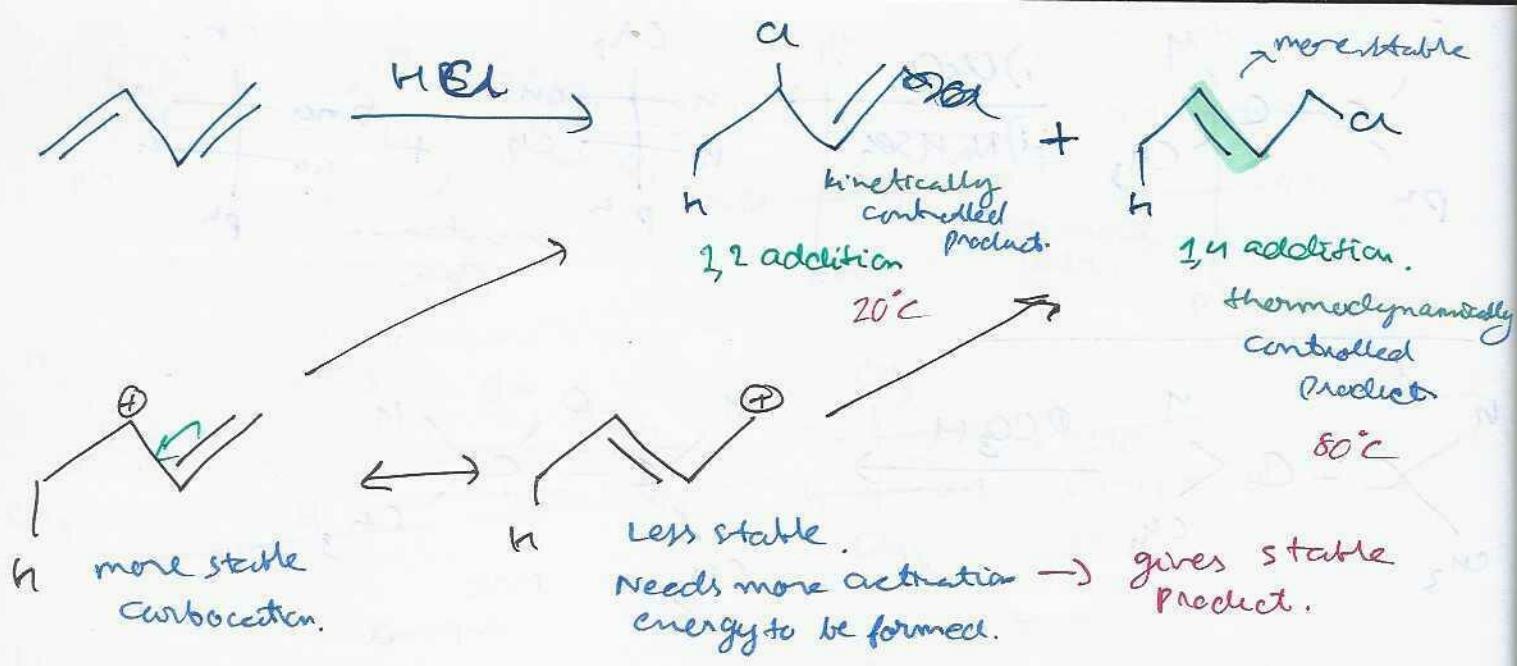
Trans - syn addition - Racemic mixture



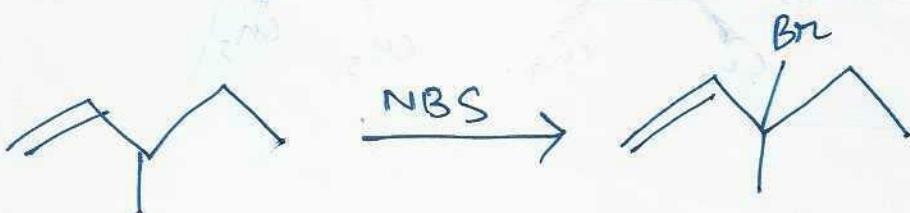
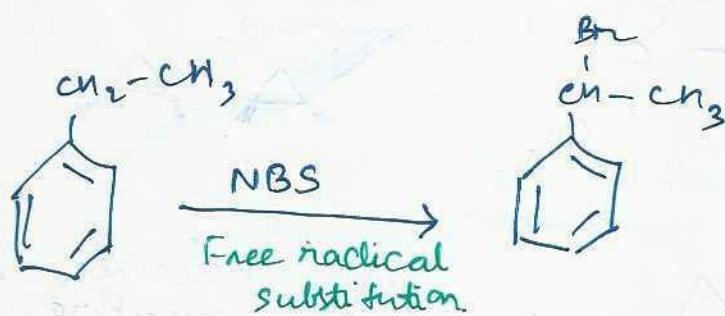
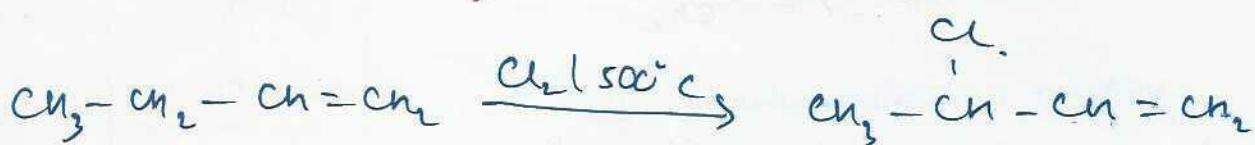
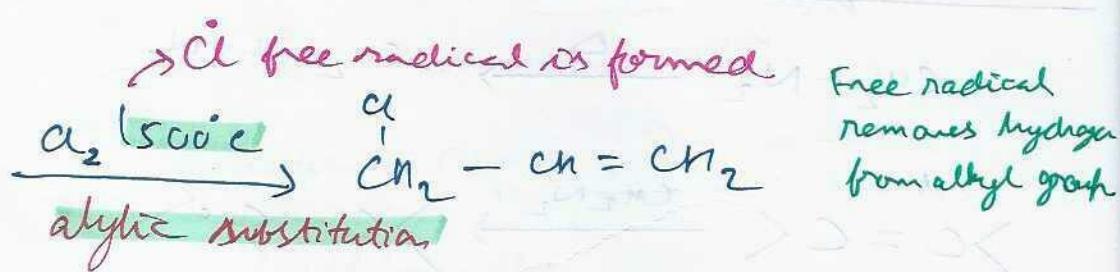
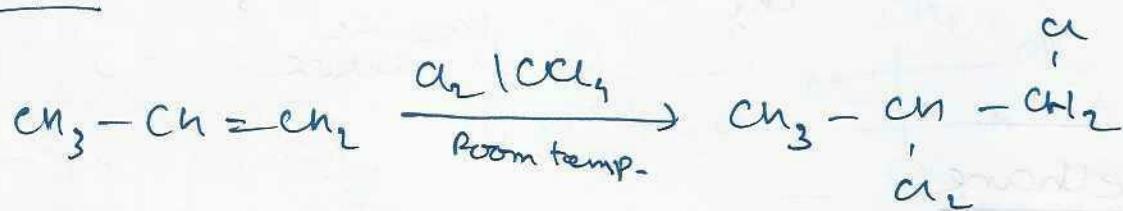


With Dragomethane



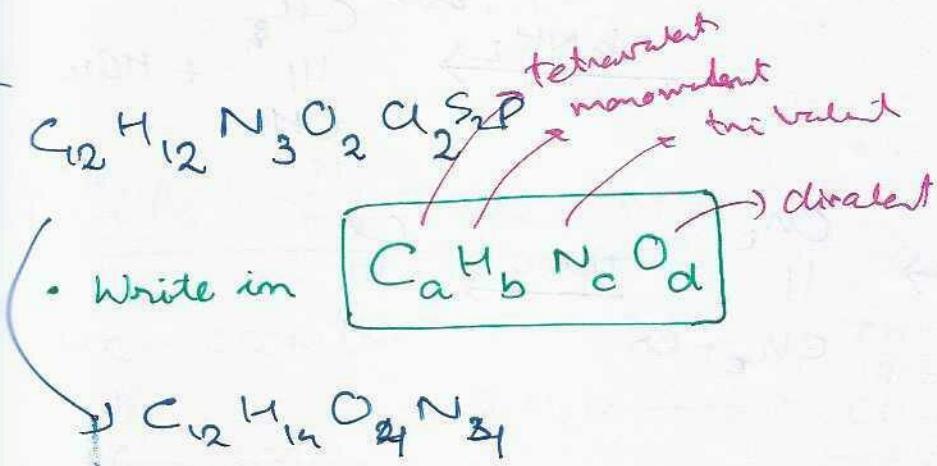
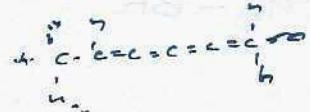


thermodynamically controlled product \rightarrow Product is stable. Intermediate less stable.
 kinetically controlled product \rightarrow Intermediate is stable and quickly formed. Product is less stable.



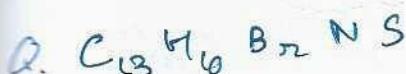
DEGREE OF UNSATURATION

$C_6H_6 \rightarrow \frac{10-6}{2} = 2$. \Rightarrow = and =
 C_6H_{10} = zero and ring
 ring and ring.

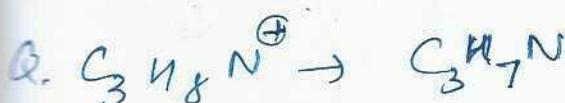


- Remove Nitrogen and Oxygen. For every nitrogen removed, remove two hydrogen.

$$C_{12}H_{10} \rightarrow \frac{16}{2} = 8$$



$$\frac{28-10}{2} = 9$$

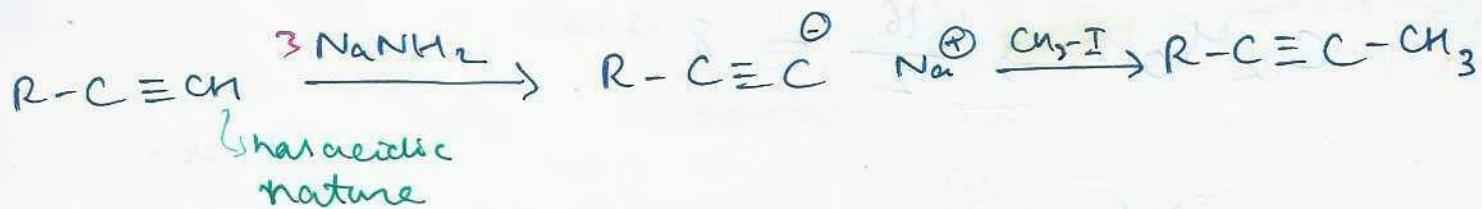
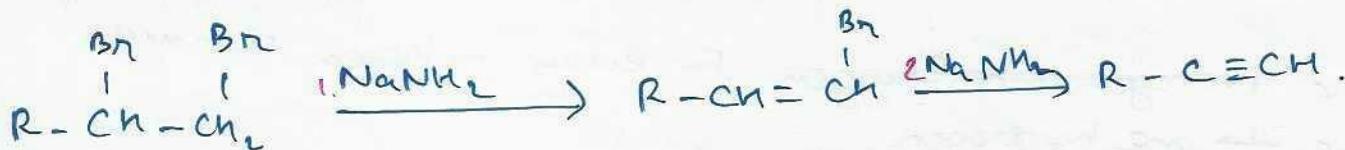
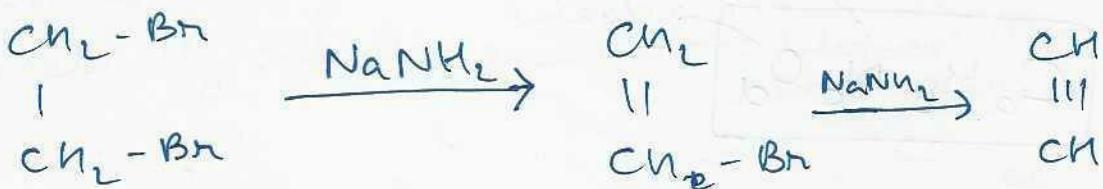
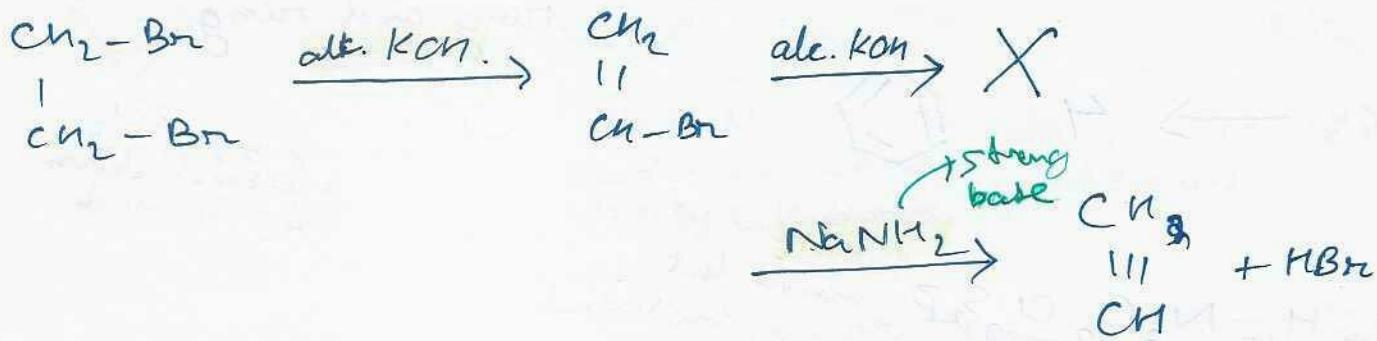


ALKYNES

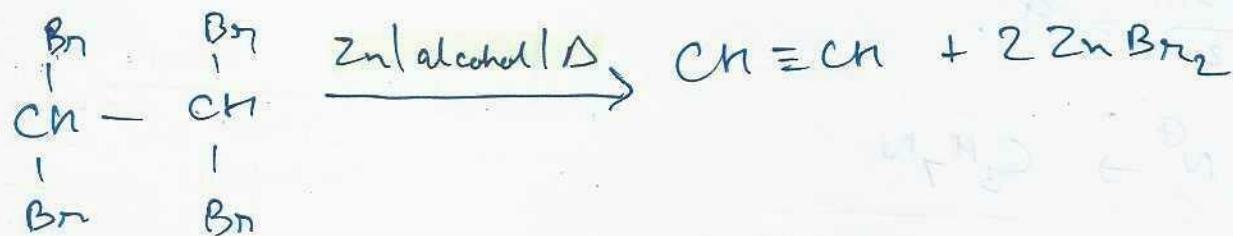
ALKYNES

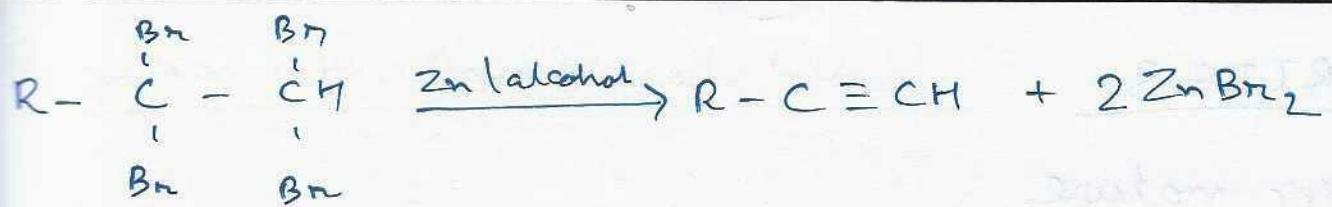
① Dehydrohalogenation

1,2-dihalogen compounds.

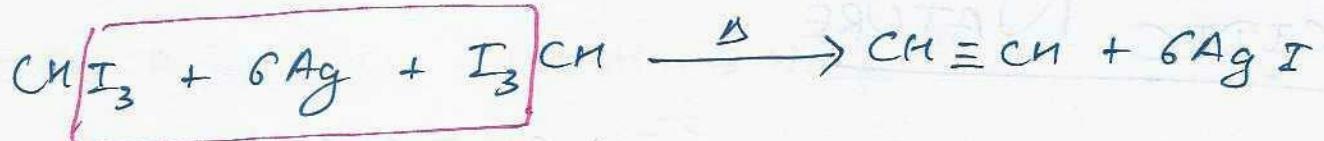


② Dehalogenation

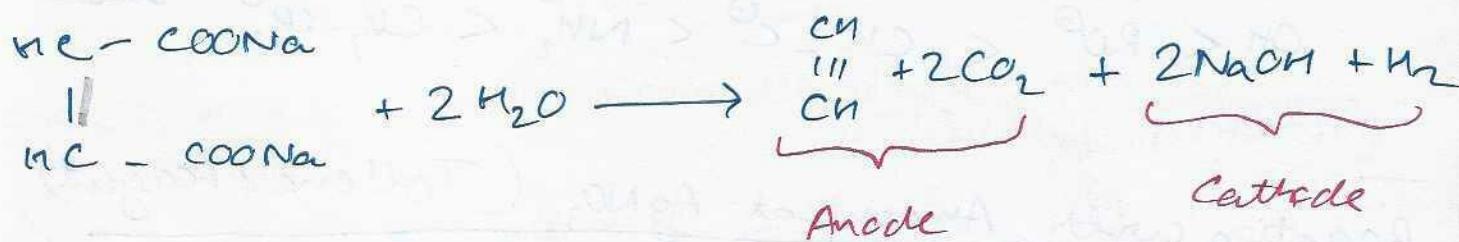




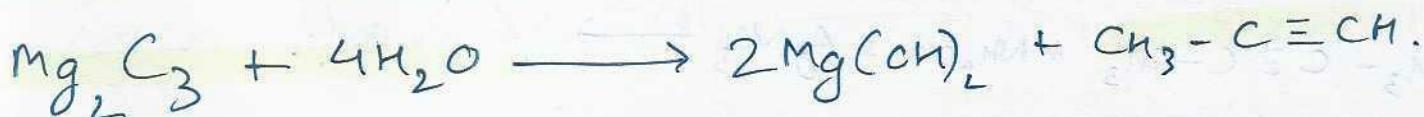
③ Heating Silver Powder with CH_3I_3



④ KOLBE'S ELECTROLYSIS



⑤ Hydrolysis of CaC_2



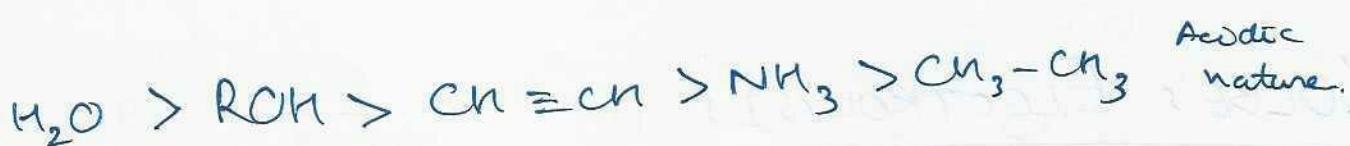
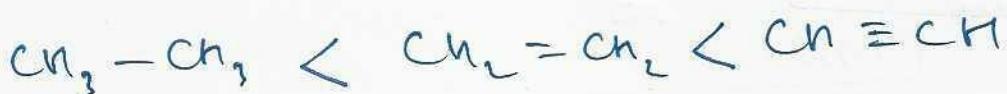
PROPERTIES

Acidic nature

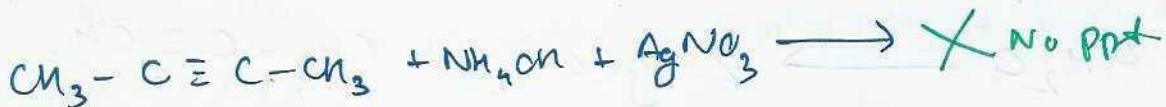
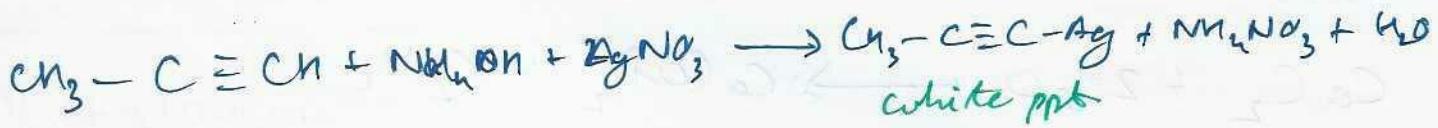
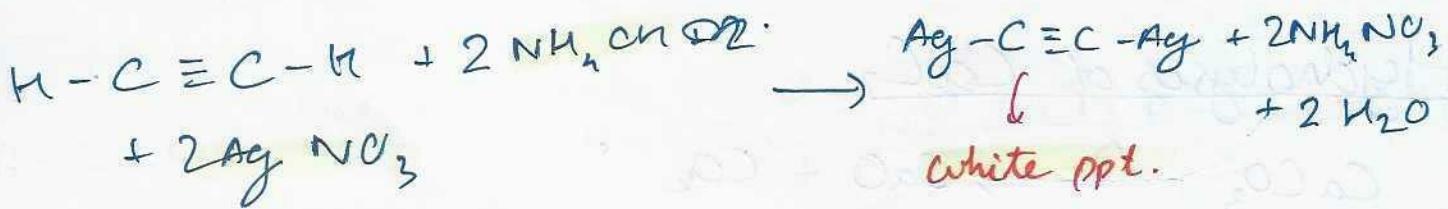
Toulene's test.

Ammonical Cu_2Cl_2

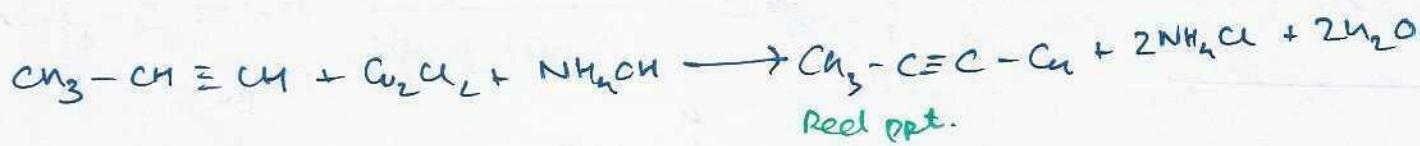
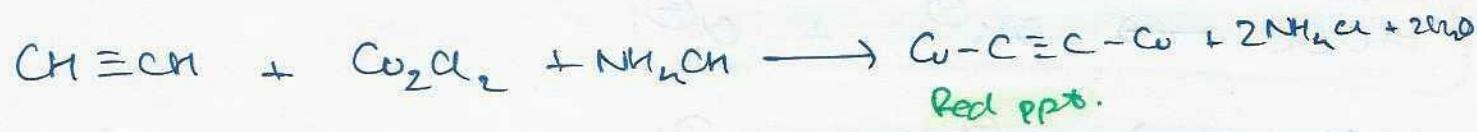
ACIDIC NATURE



Reaction with Ammonical AgNO_3 (Tollene's Reagent)

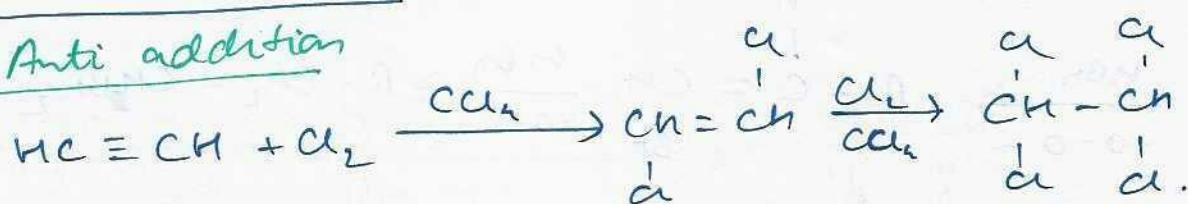


Reaction with Ammonical Cu_2Cl_2

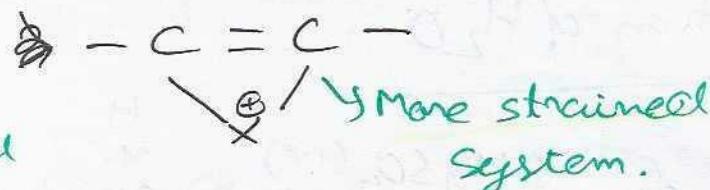
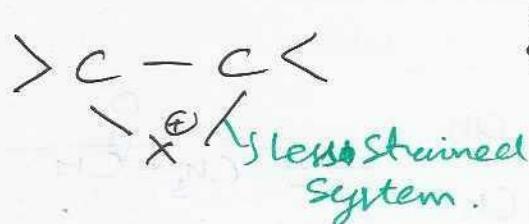


Addition of X_2

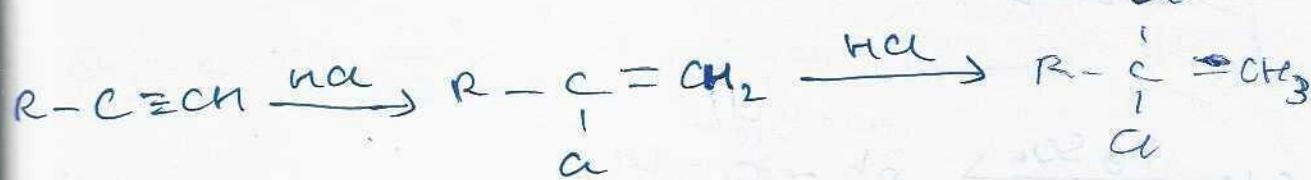
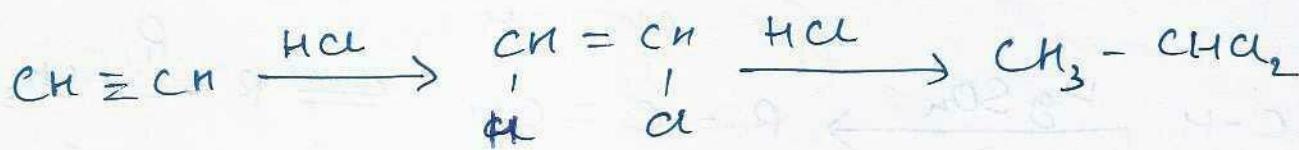
Anti addition

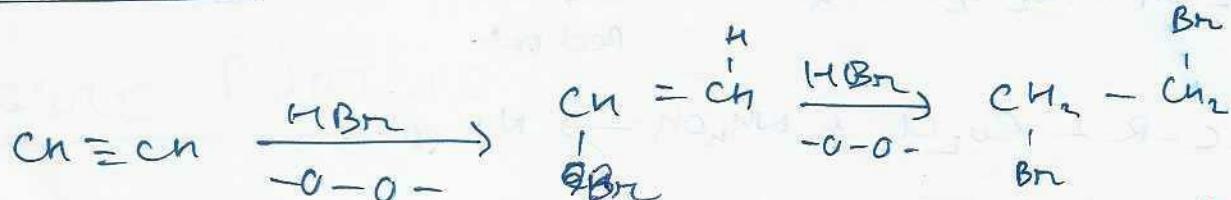
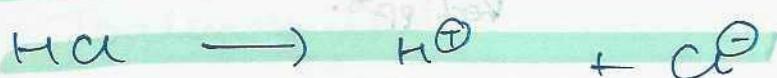
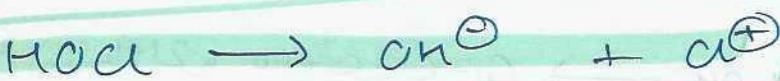
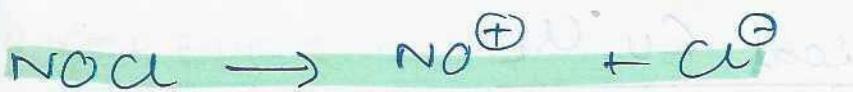


Alkene is more reactive compared to alkyne with X_2 .
(electrophilic addition).

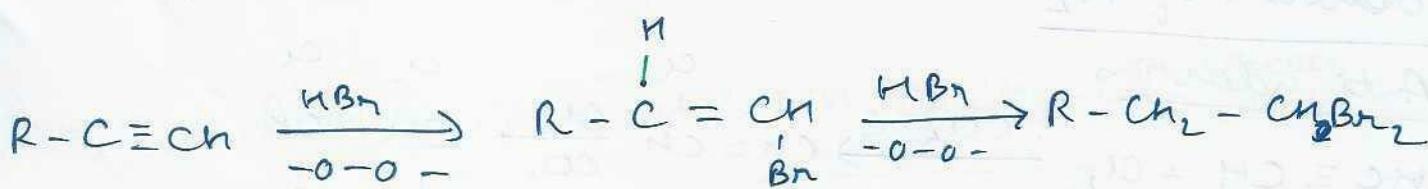


Addition of HX

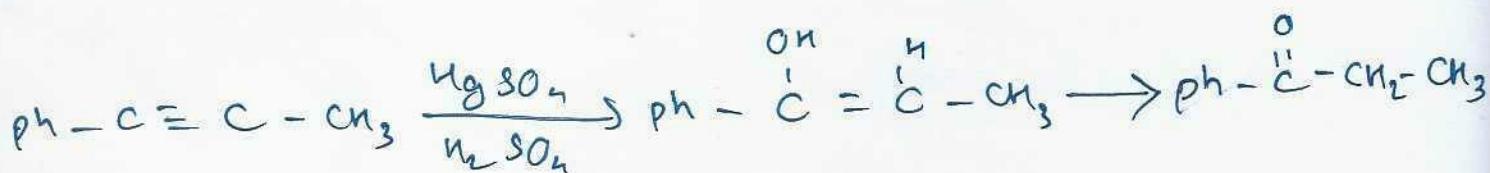
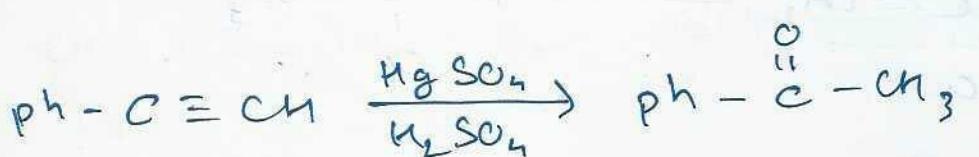
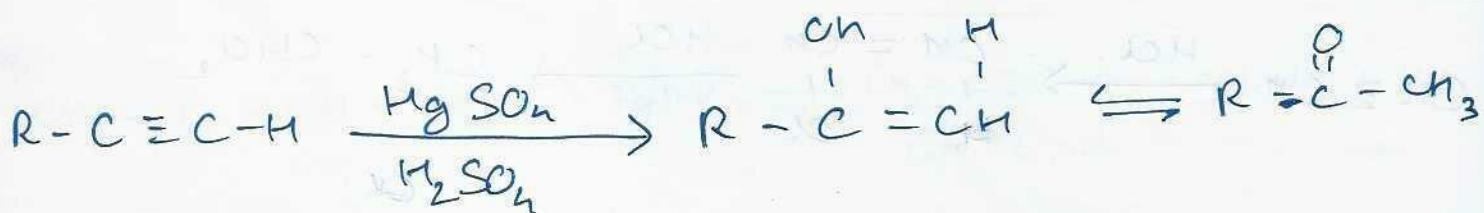
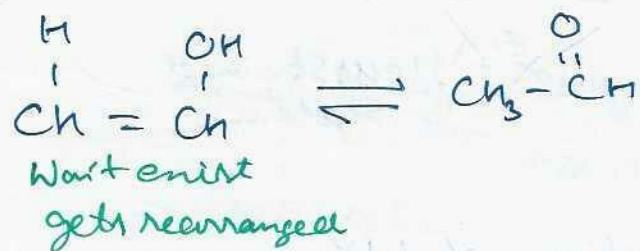
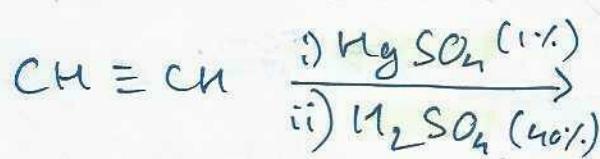




Anti Markovnikoff

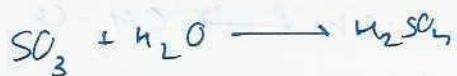


Addition of H₂O



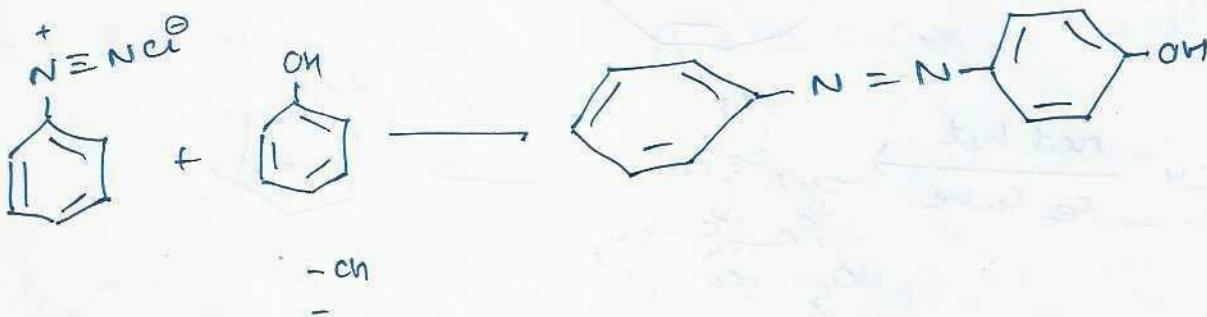
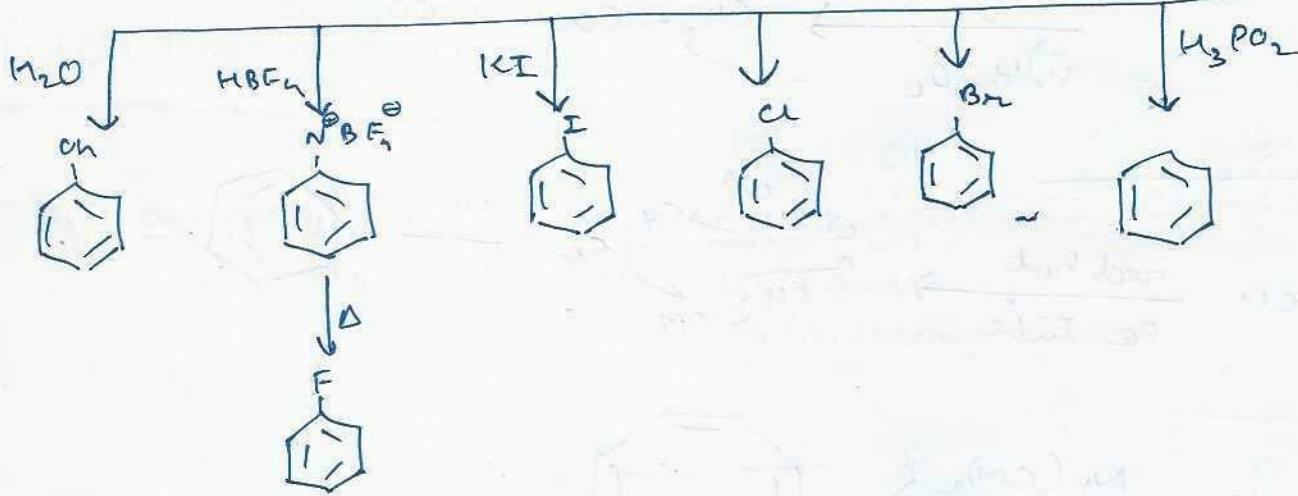
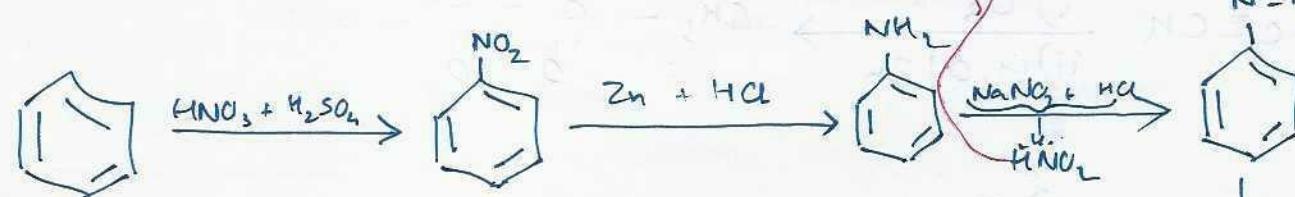
London smog

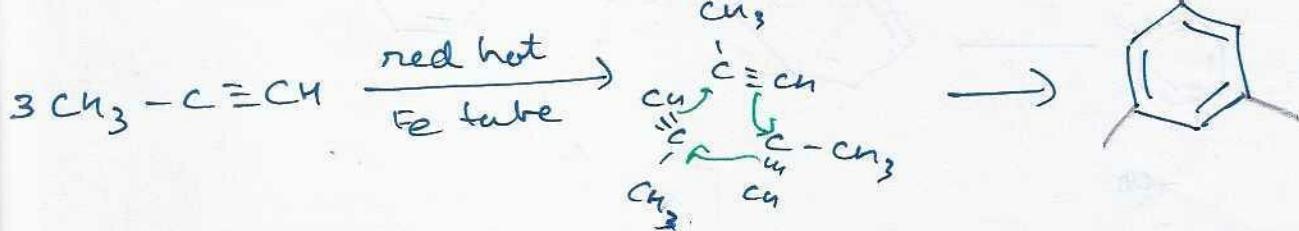
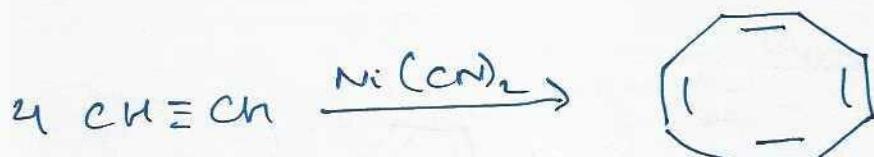
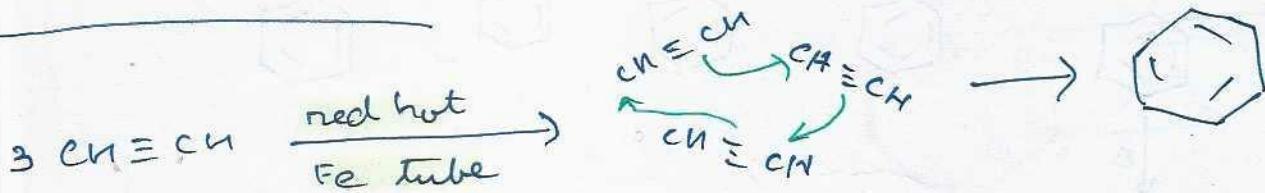
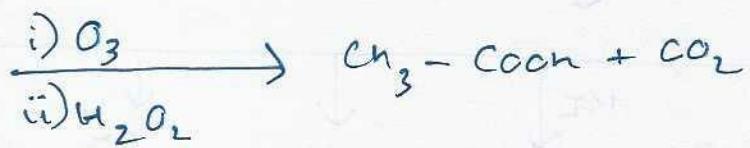
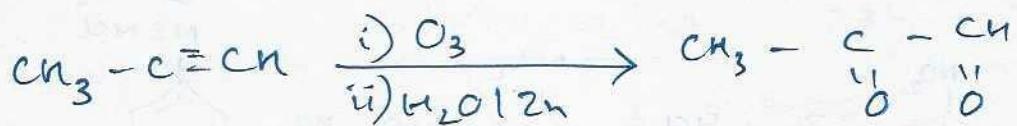
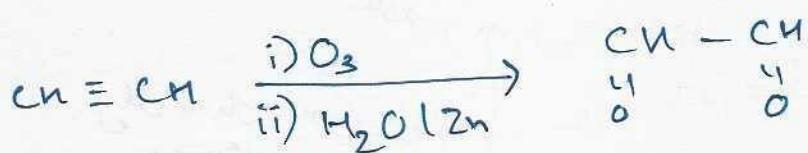
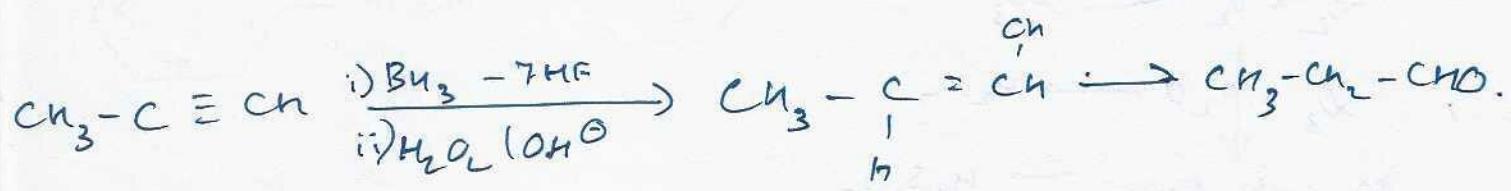
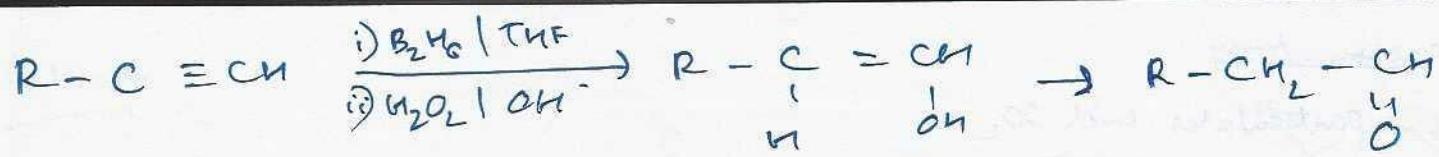
particulates and SO_2



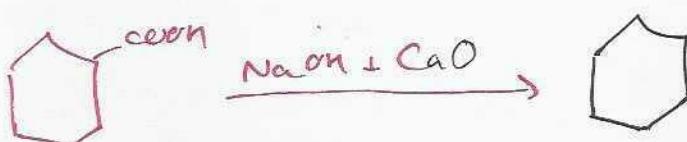
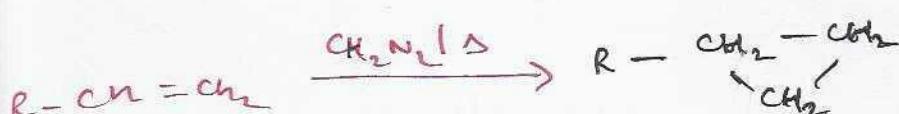
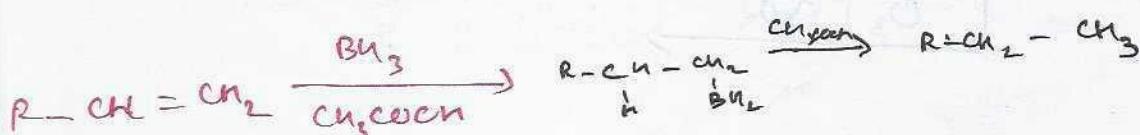
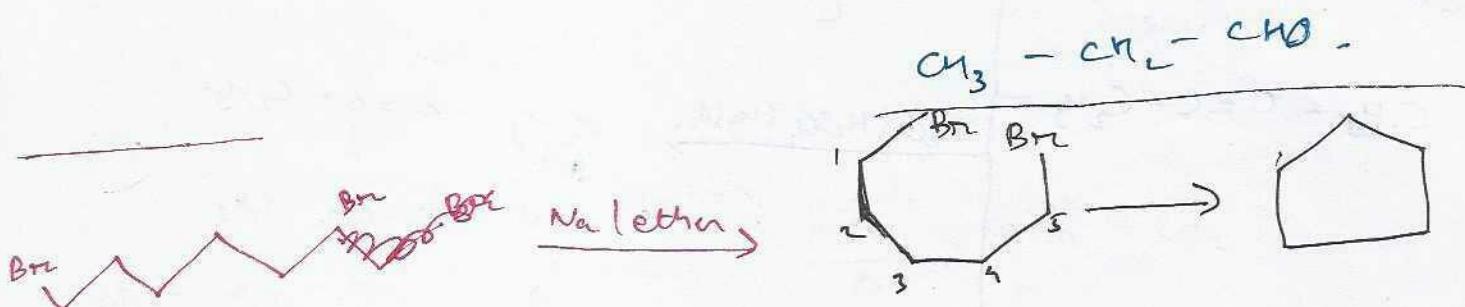
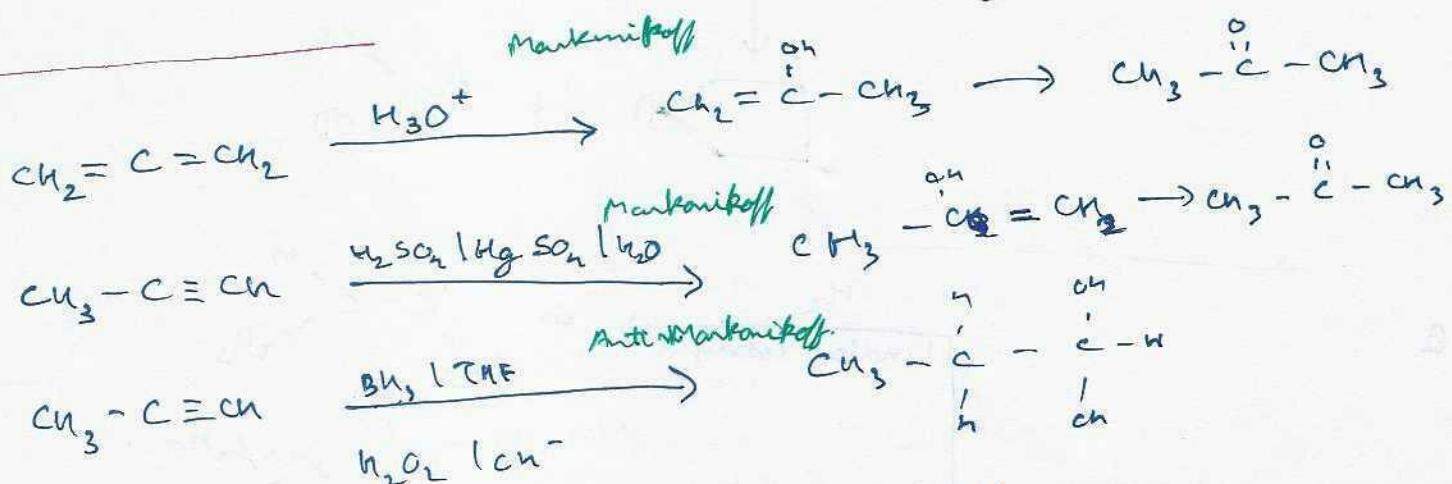
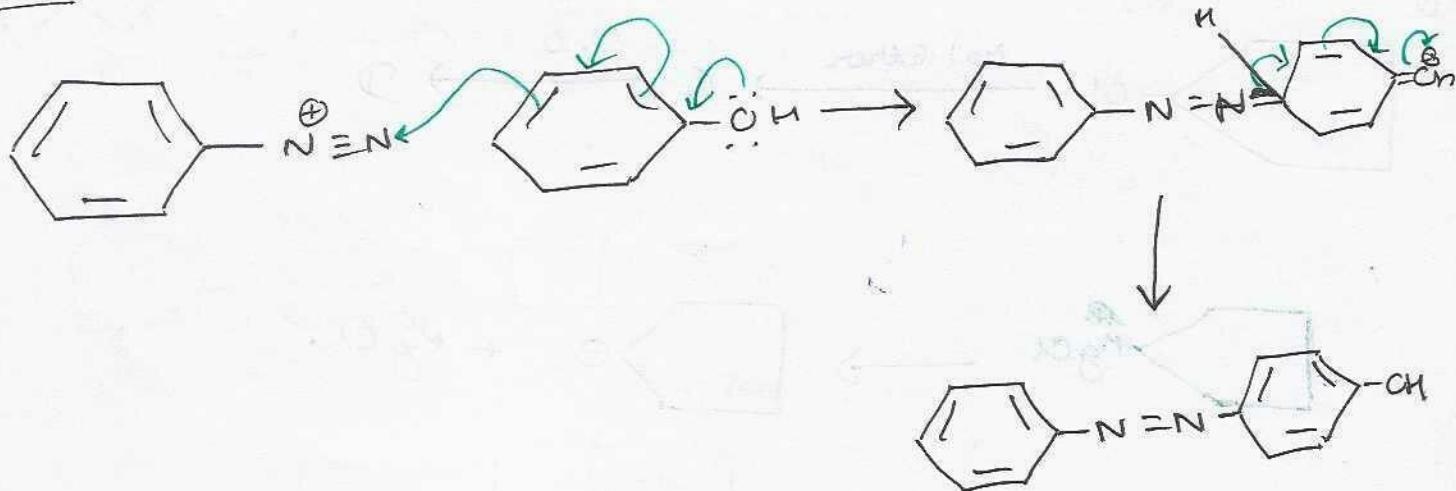
needs to be
made in situ.

not taken directly.
can undergo
disproportionation.

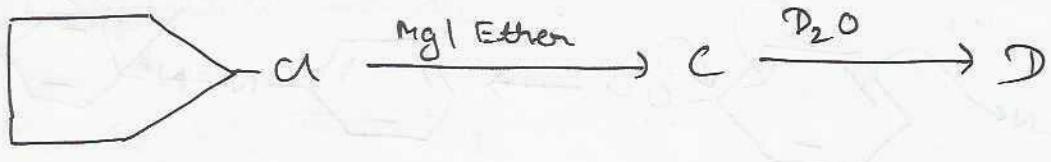




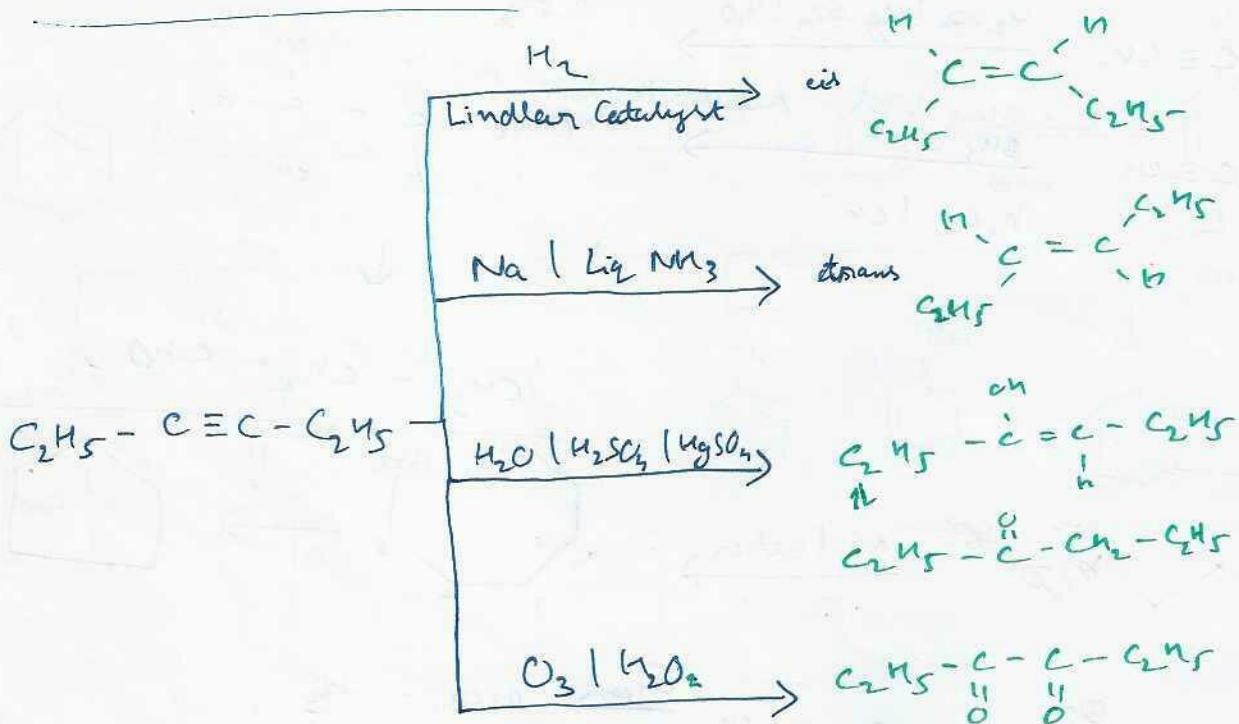
mechanism



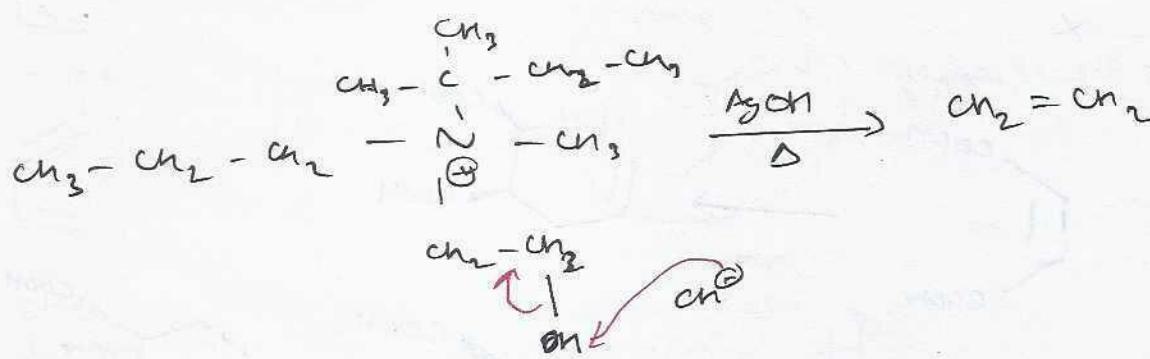
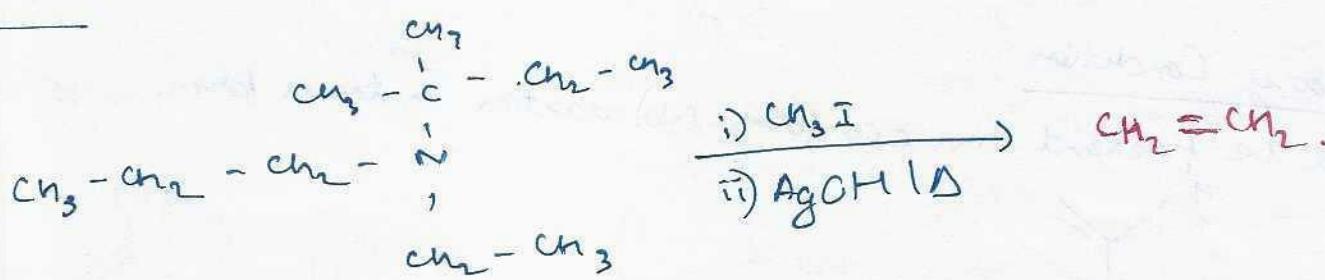
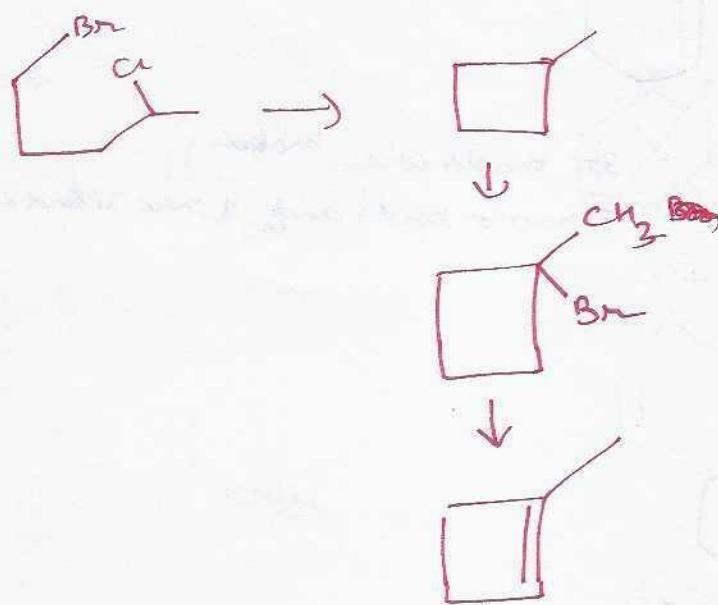
Q



Q

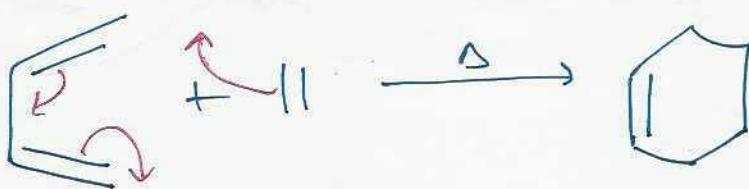


$\text{CH}_2=\text{CH}_2 \rightarrow$ Markovnikoff's Rule is not applicable.



DIELS - ALDER REACTION

concerted reaction : reaction which takes place in a single step



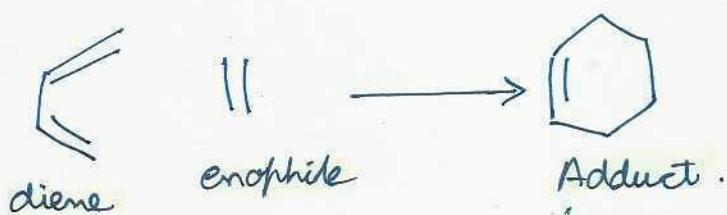
either clockwise or anticlockwise



3π bonds are broken

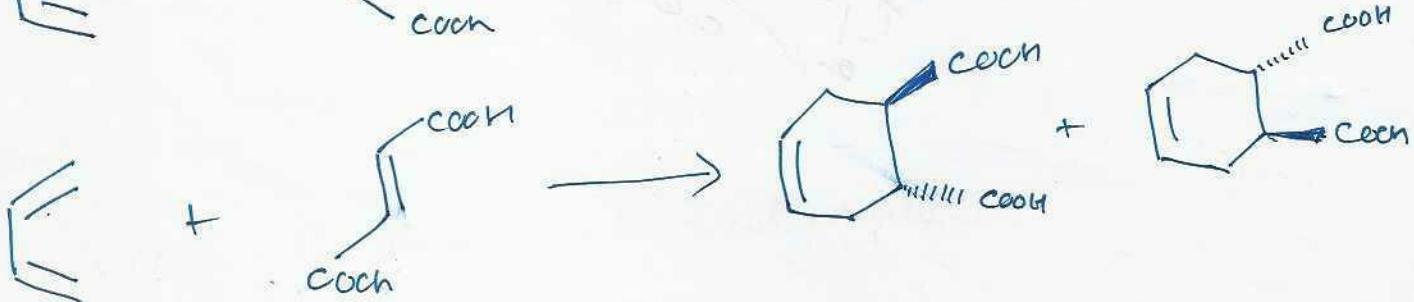
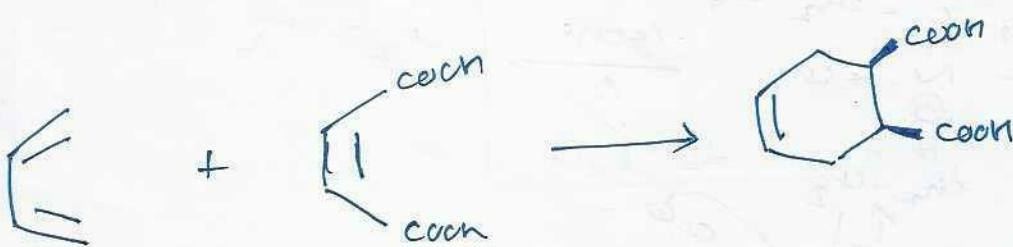
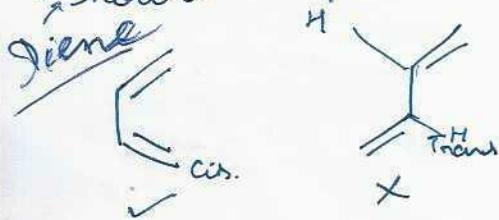
2 new σ bonds and 1 new π bond is formed.

Transition state.

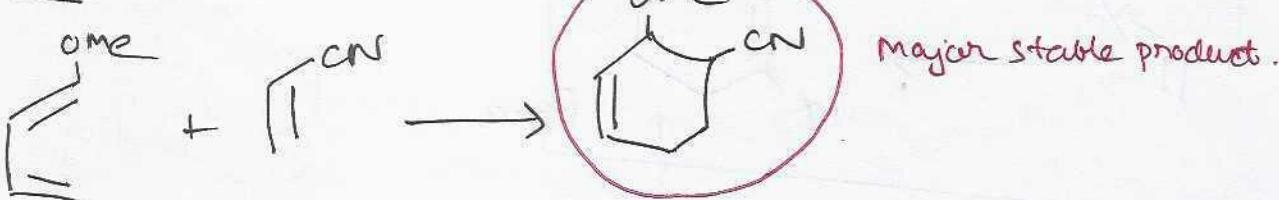
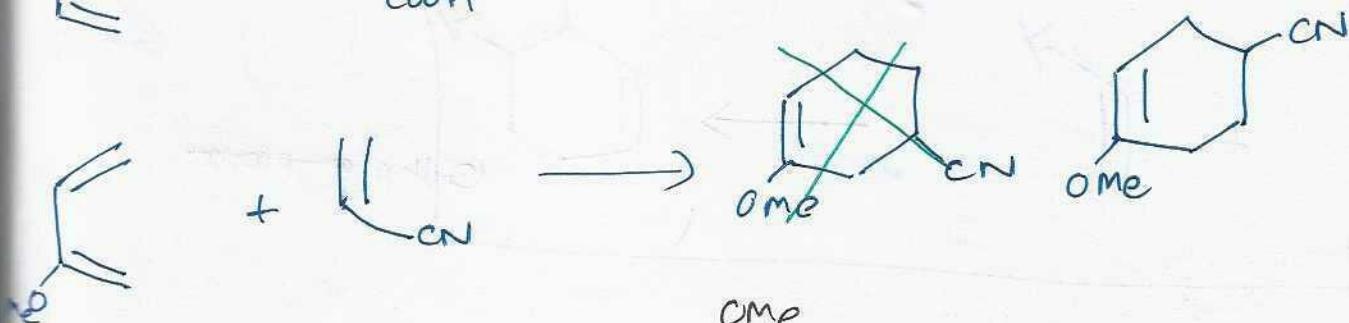
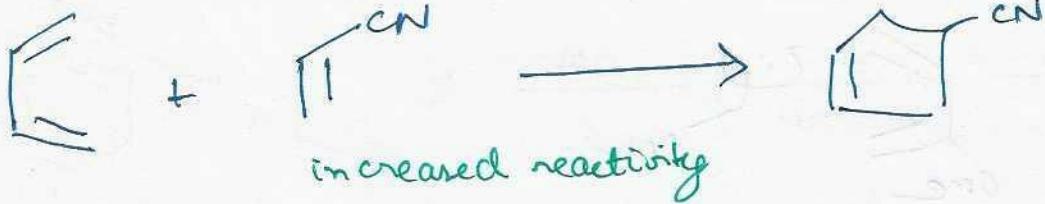


Necessary Condition

Should be present in cis form. No reaction in trans form.

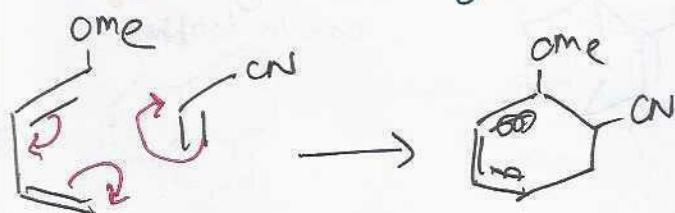


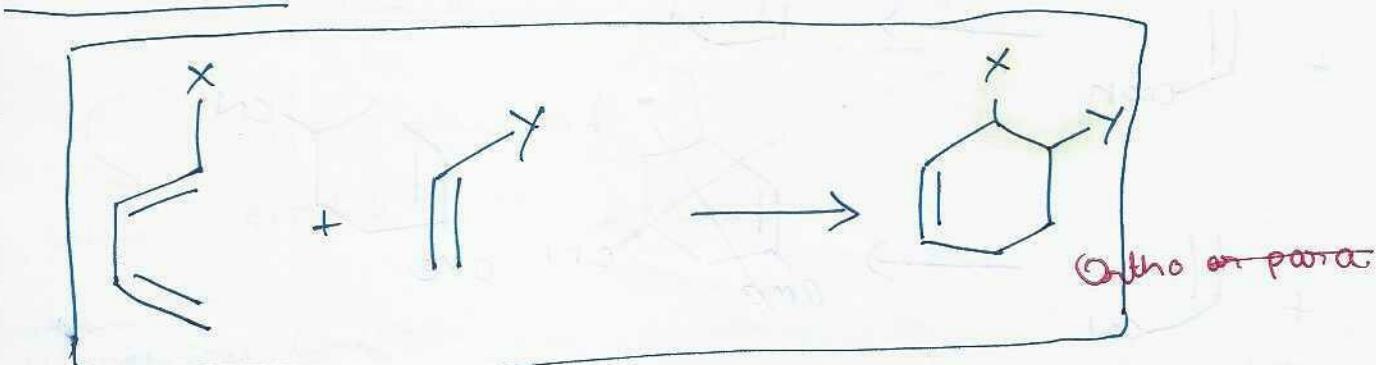
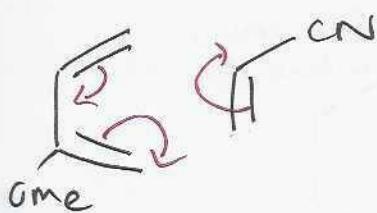
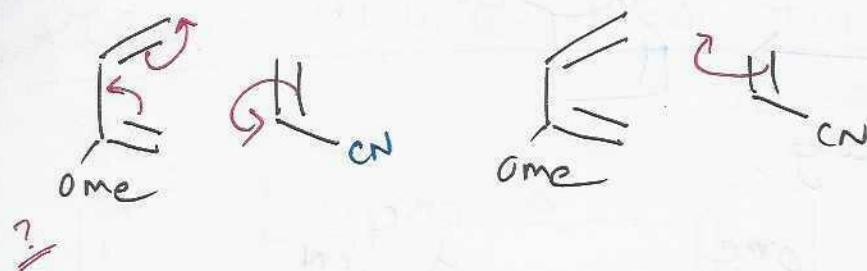
On enophile, if electron withdrawing groups are present CN, COOH, NO₂, they increase reactivity of enophile.



CN destabilizes
the partial +ve charge

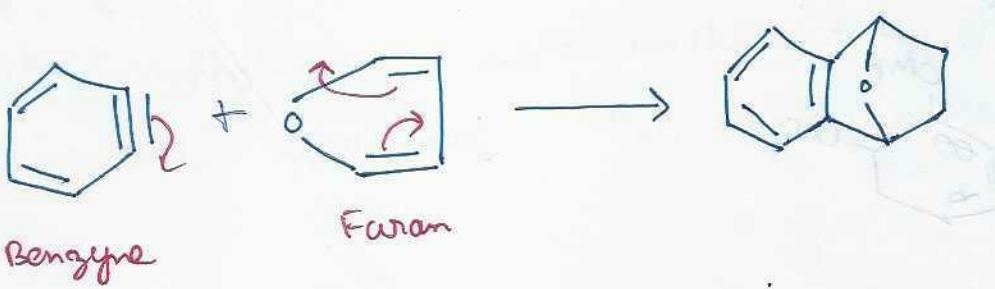
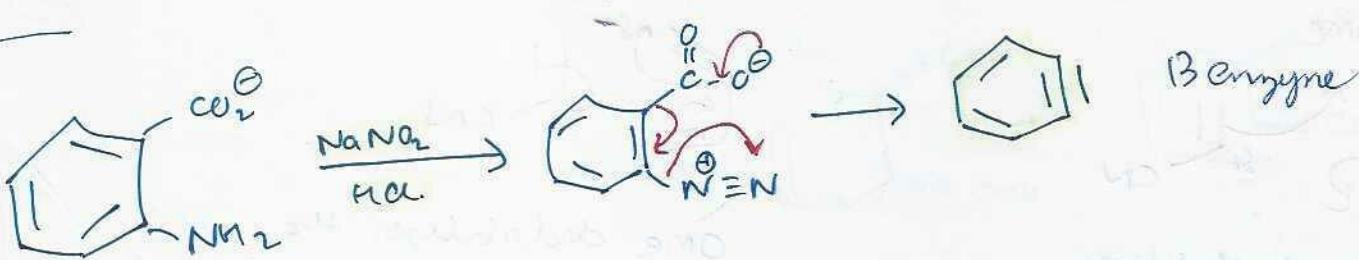
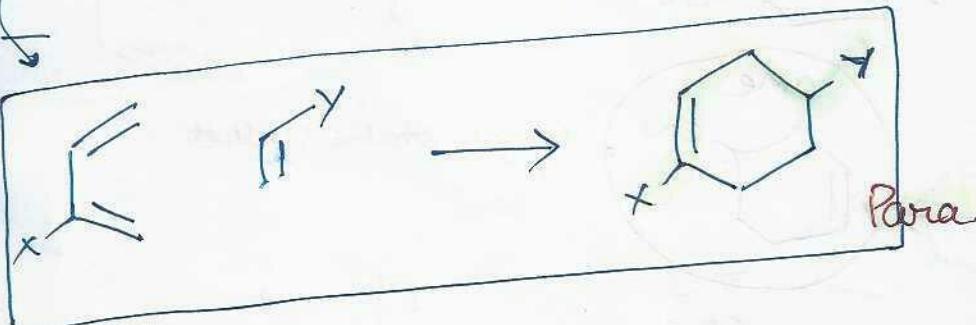
OME destabilizes the
-ve charge.



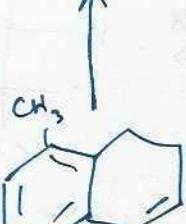
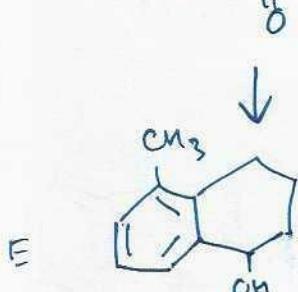
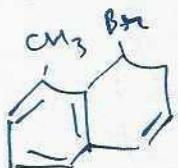
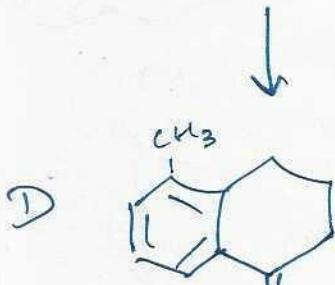
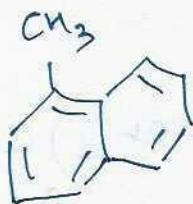
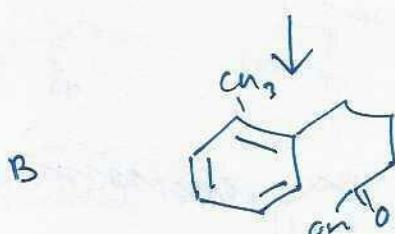
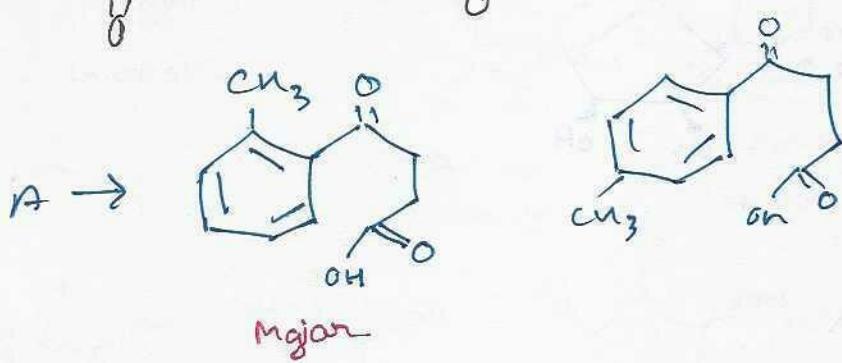
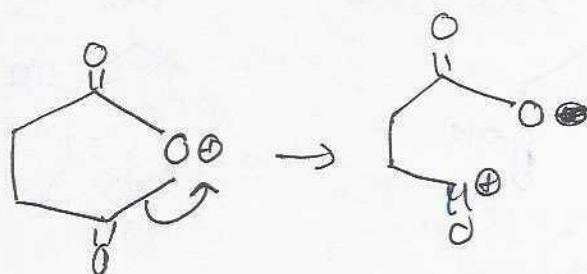
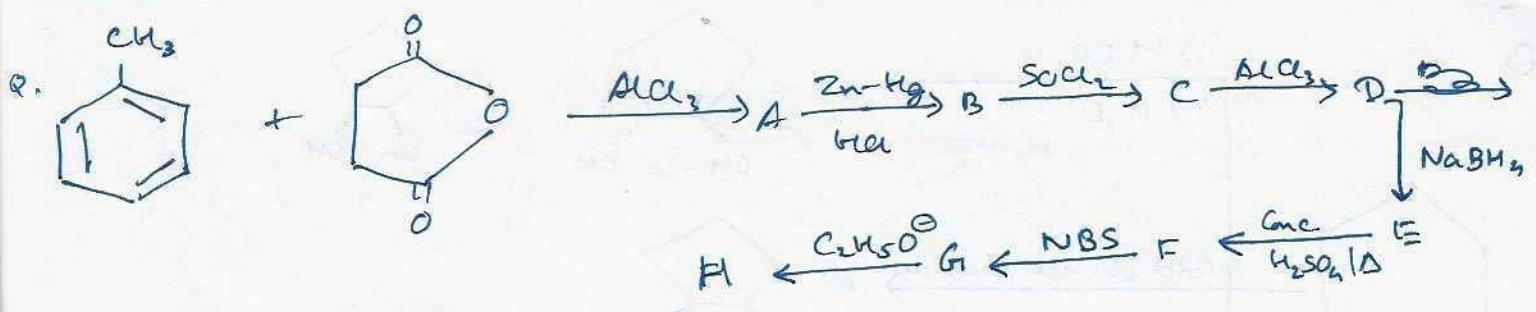


$X \rightarrow$ electron releasing group

$Y \rightarrow$ electron withdrawing group.

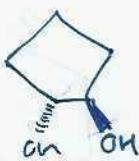
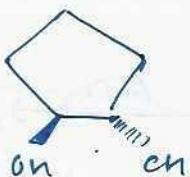
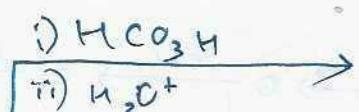


This way benzyne can be trapped.

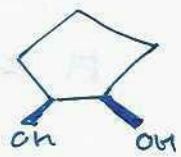
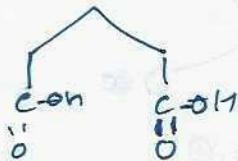
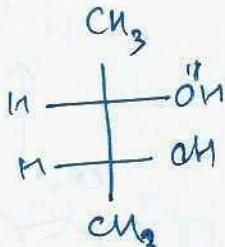
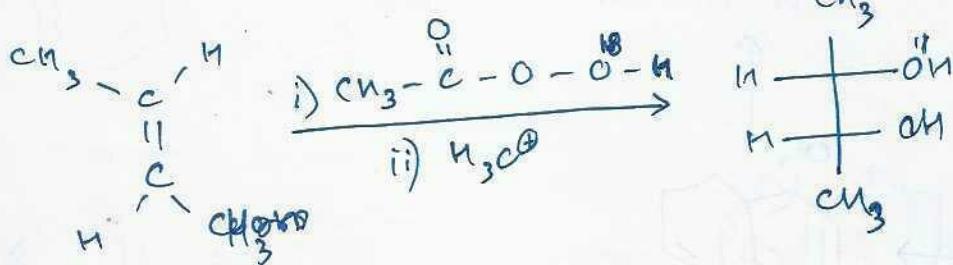
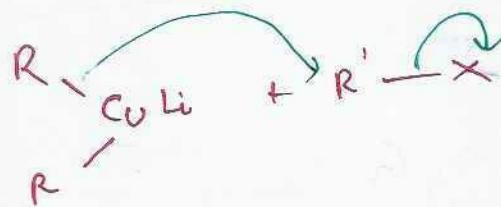
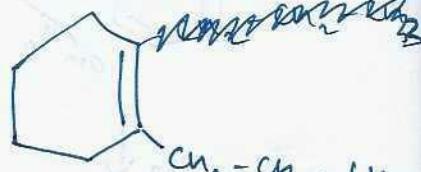
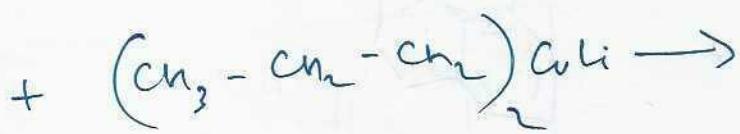
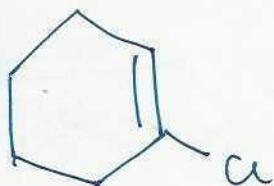
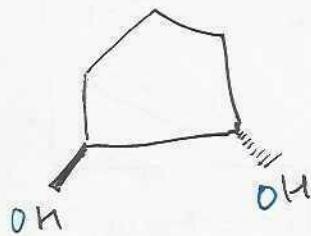
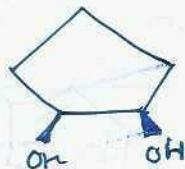


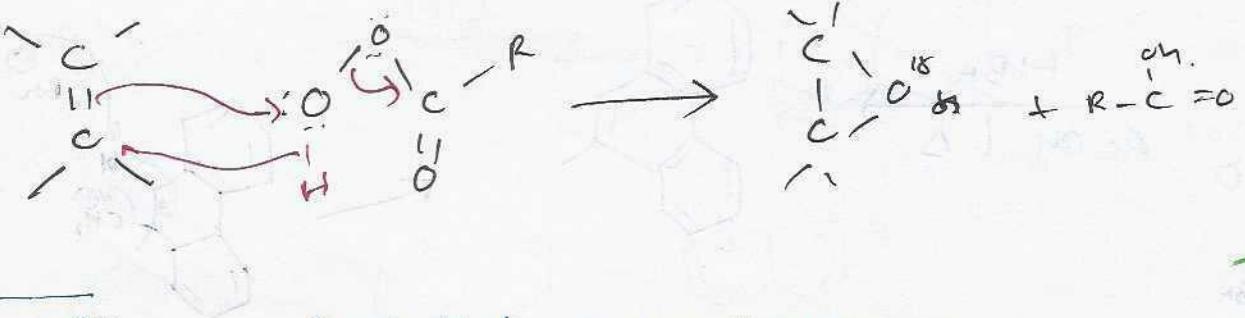
F

Q.

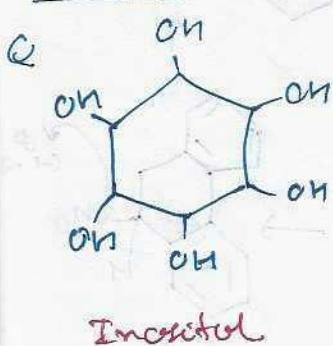


Cold dil alk. ammonia

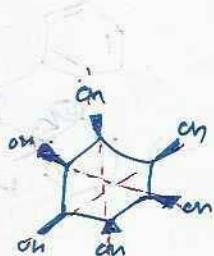
hot conc. KMnO_4 i) OsO_4
ii) NaHSO_3 / alcohol



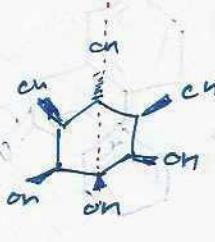
Find total possible stereoisomers.



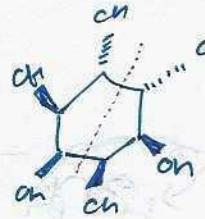
Inositol



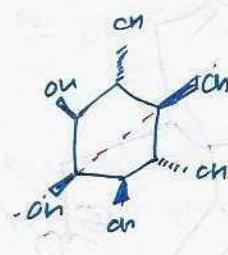
all up
achiral



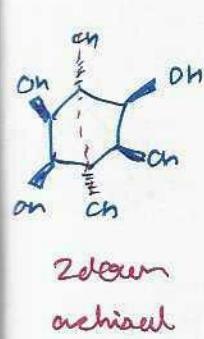
1 down
achiral



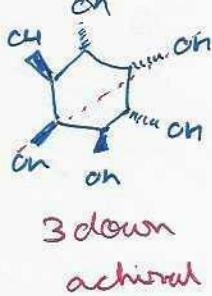
2 down
achiral



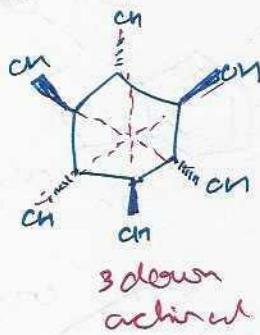
2 down
achiral



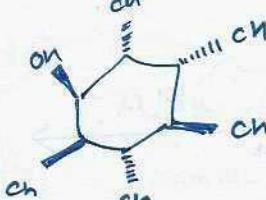
2 down
achiral



3 down
achiral



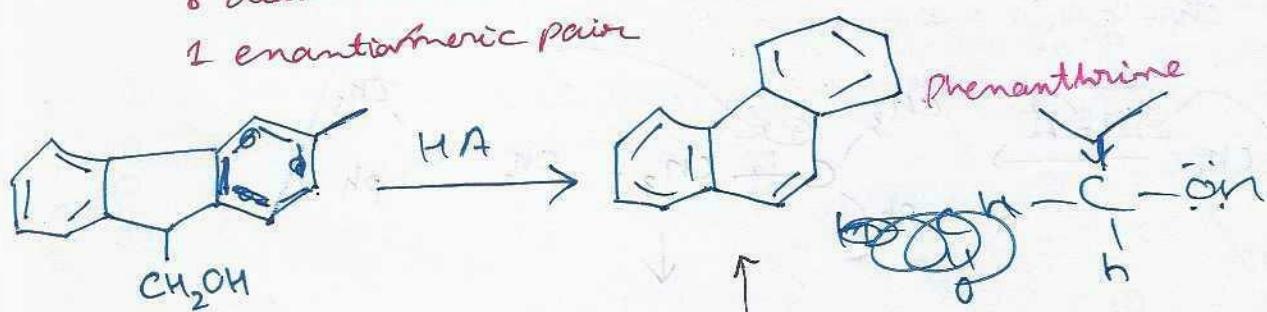
3 down
achiral



chiral.

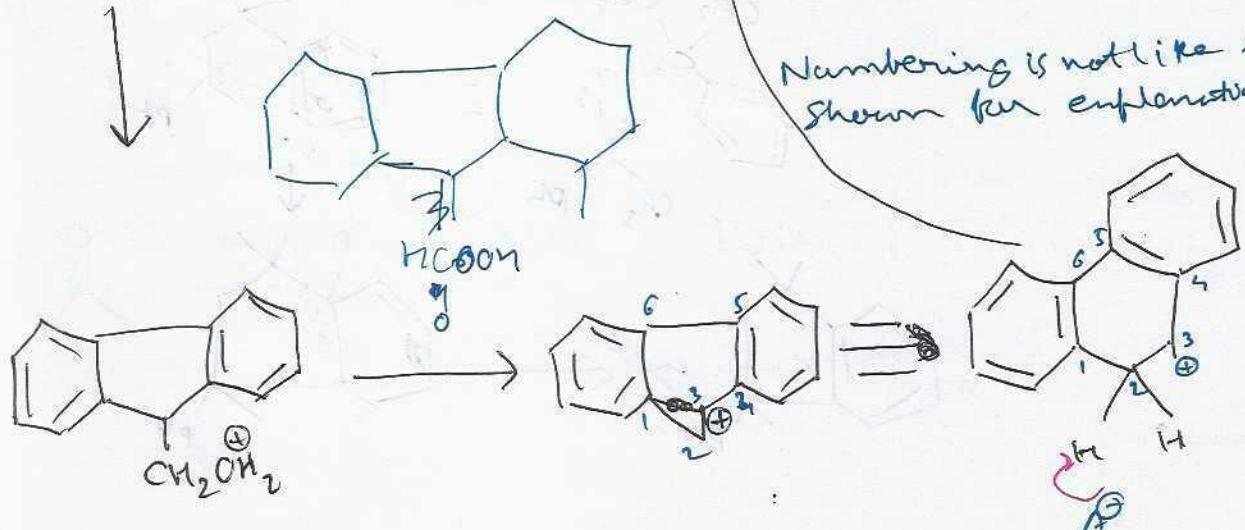
8 diastereomers.

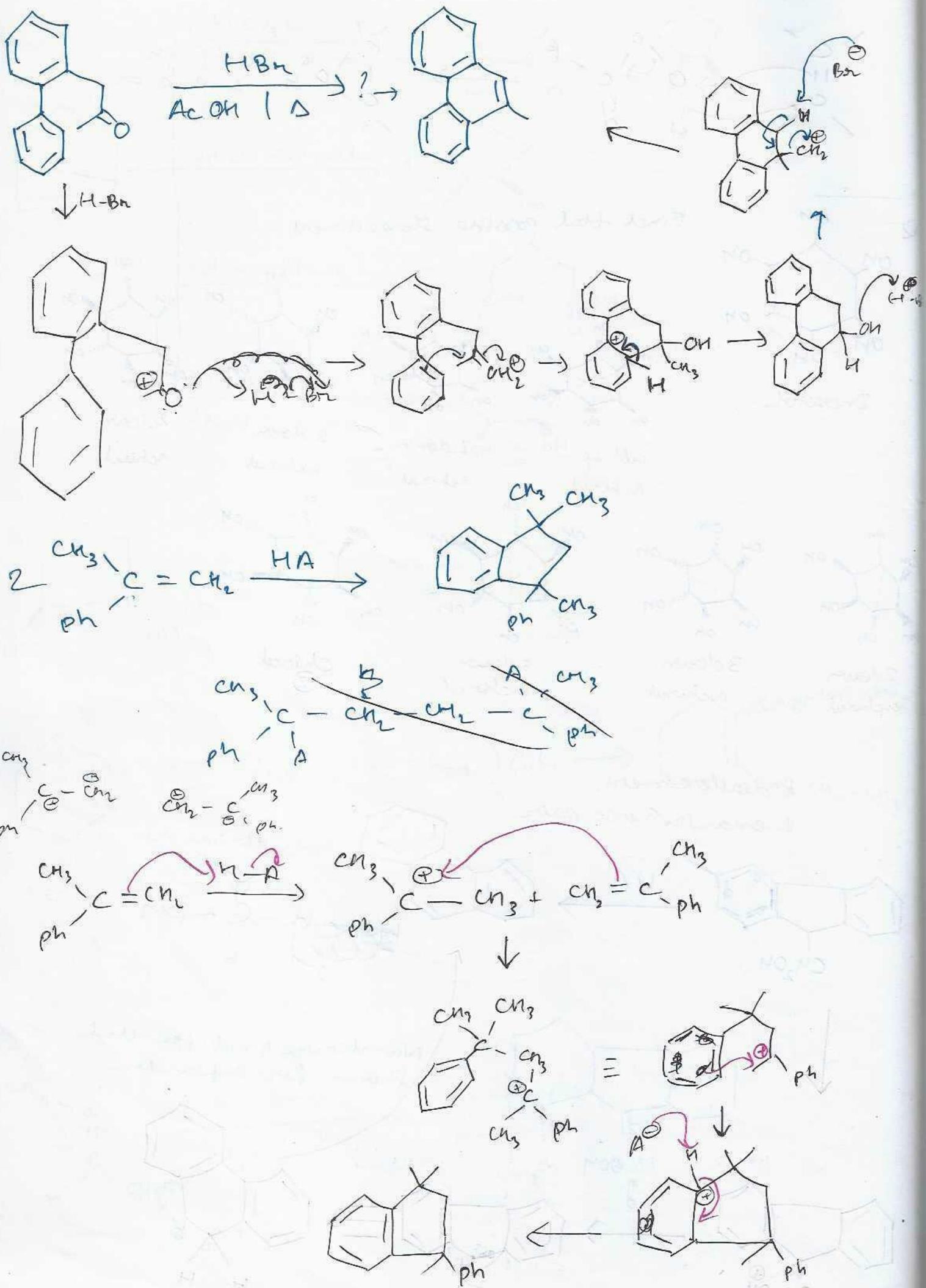
1 enantiomeric pair

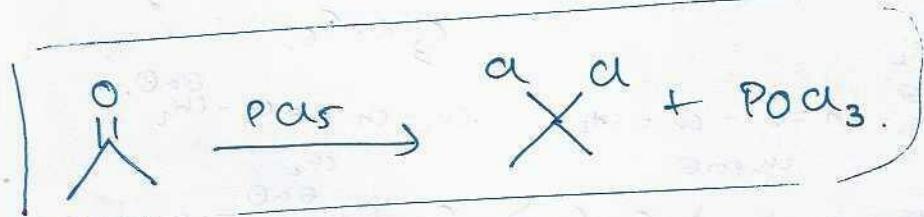
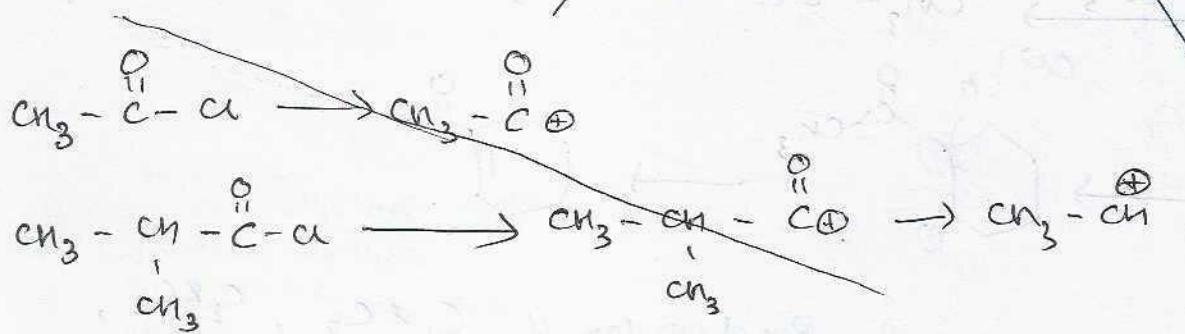
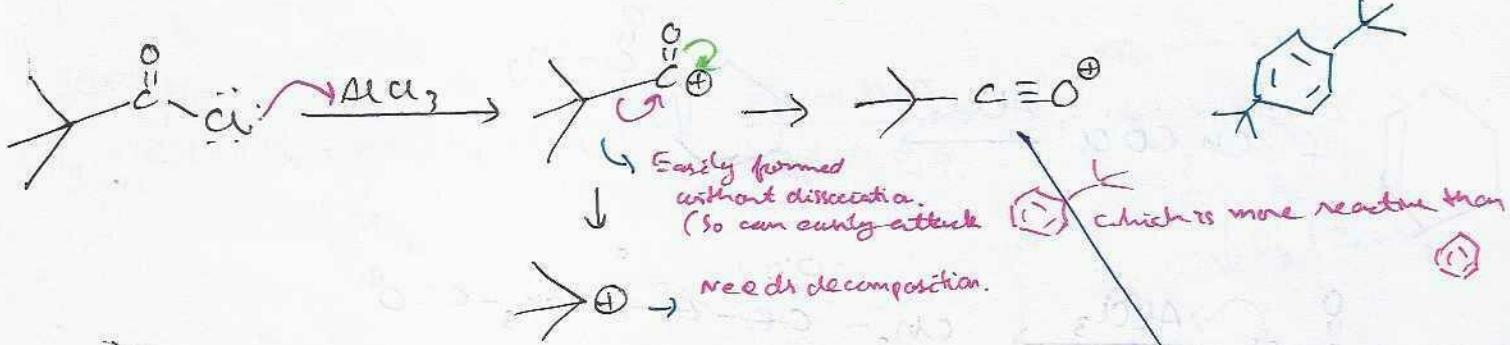
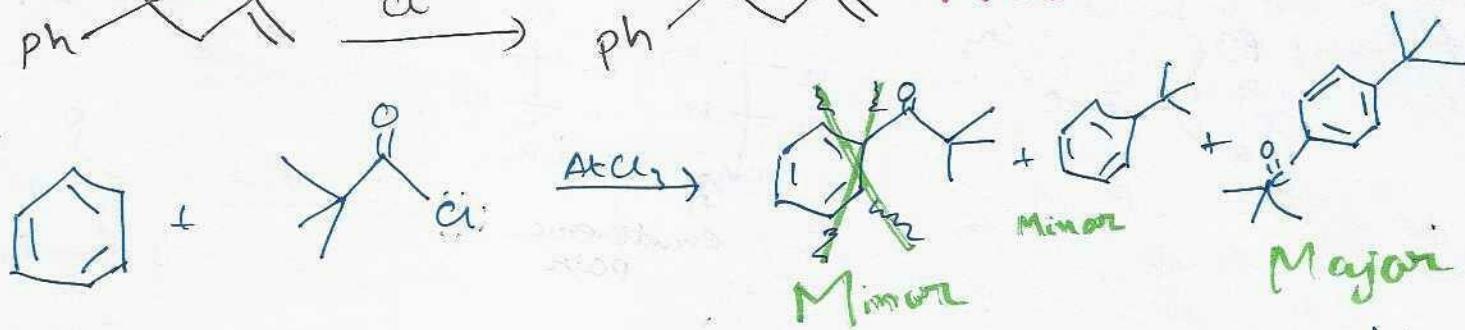
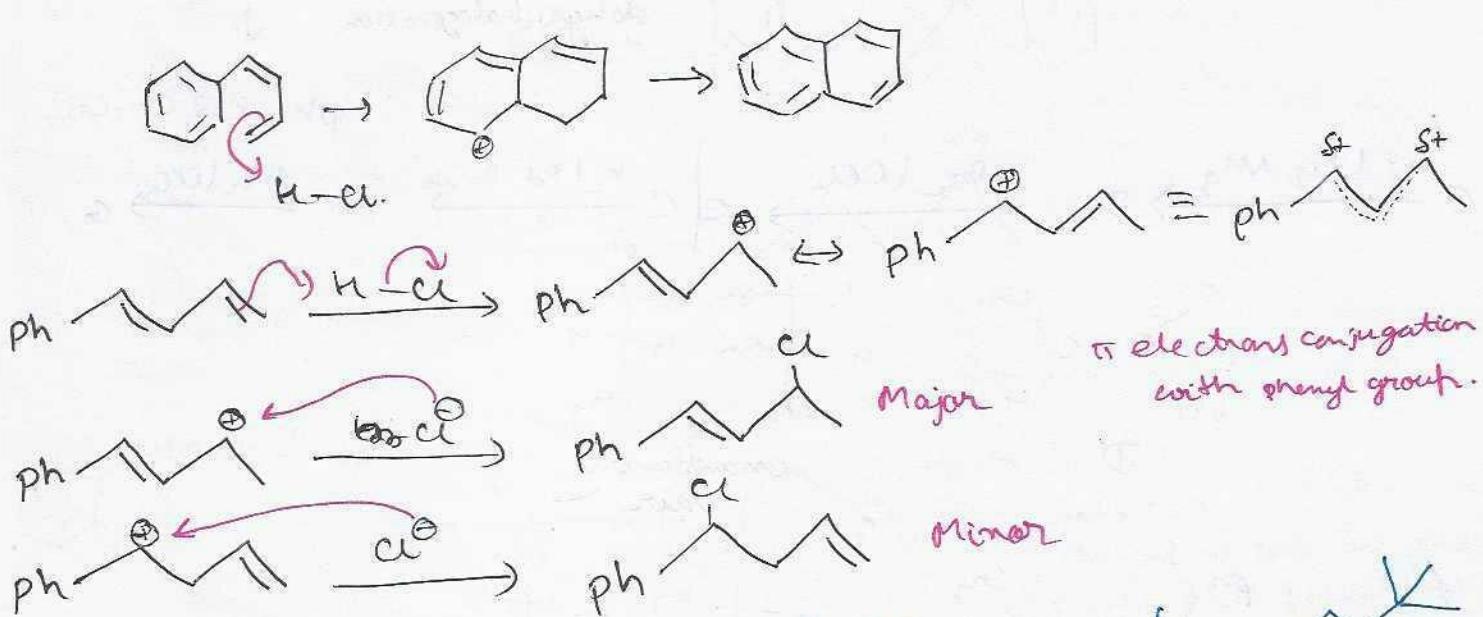


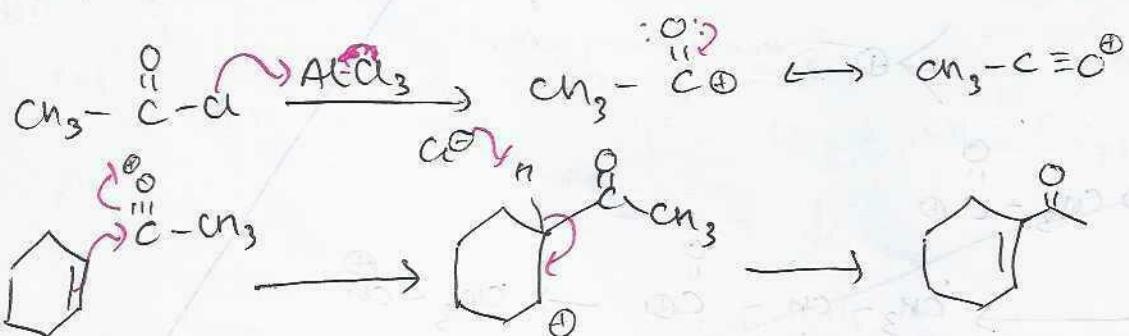
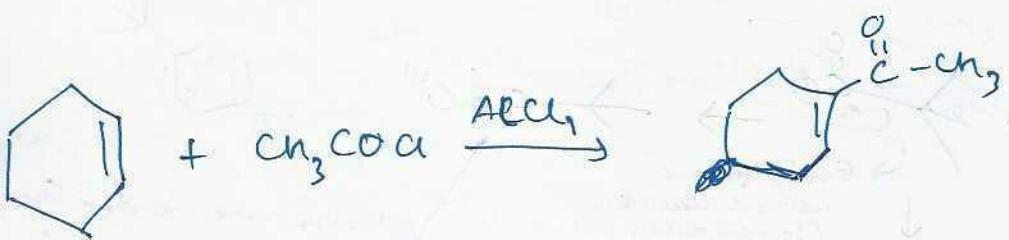
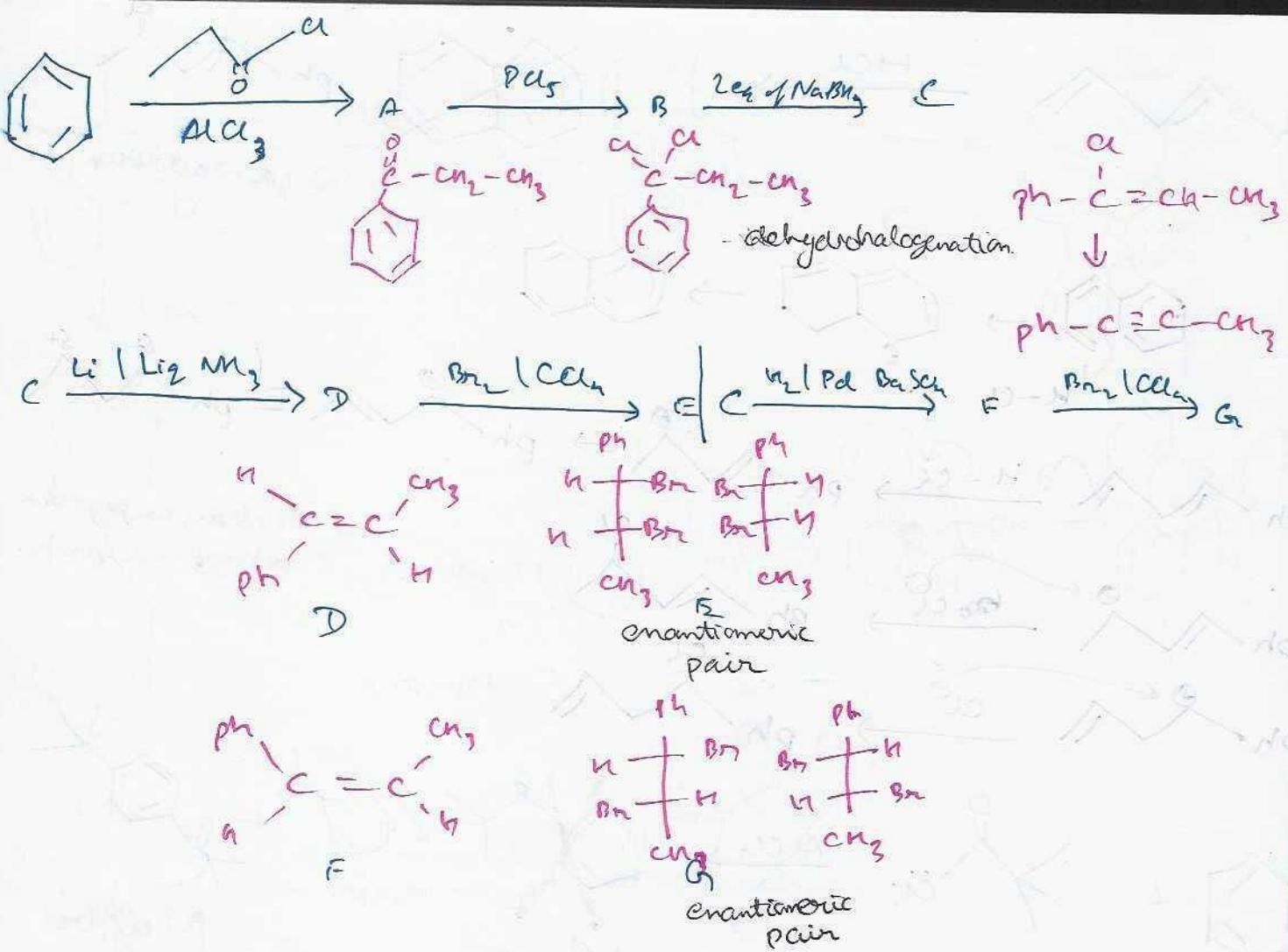
phenanthrene

Numbering is not like that shown for explanation..

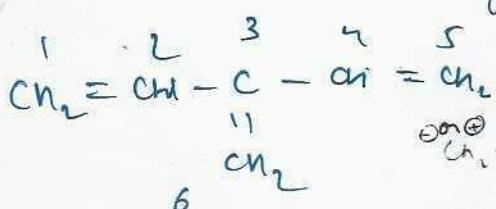




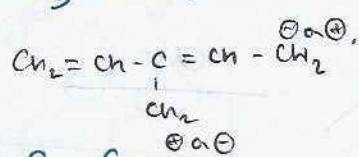
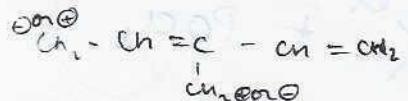




6



Order of bond order of $C_1 \& C_2$, $C_2 \& C_3$,
 $C_3 \& C_6$.

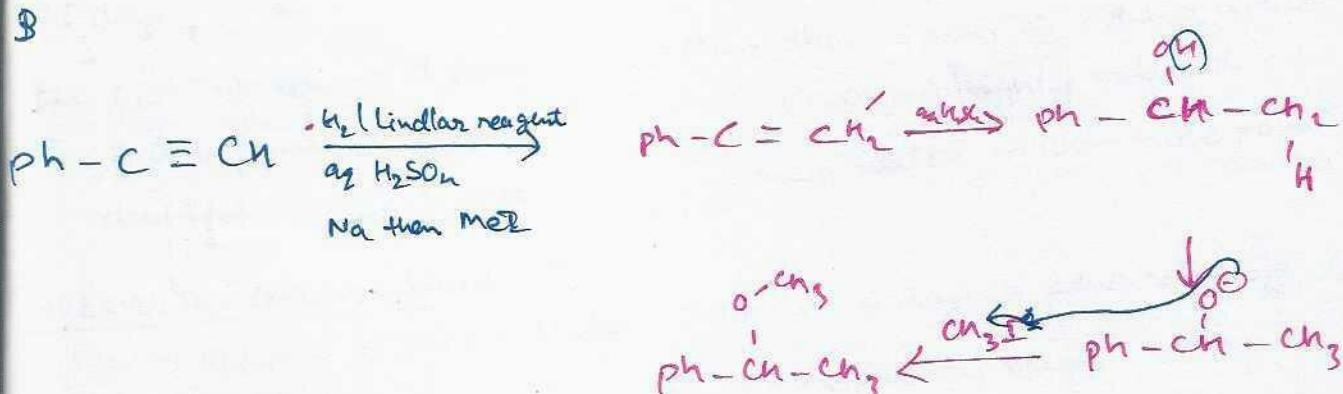
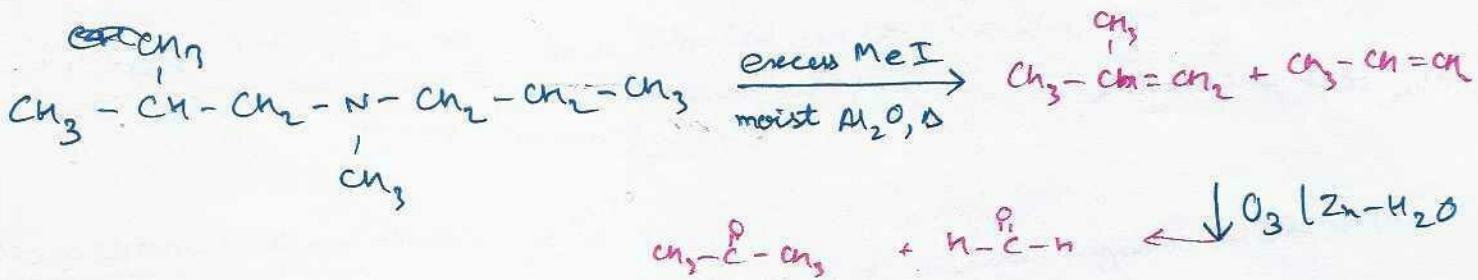
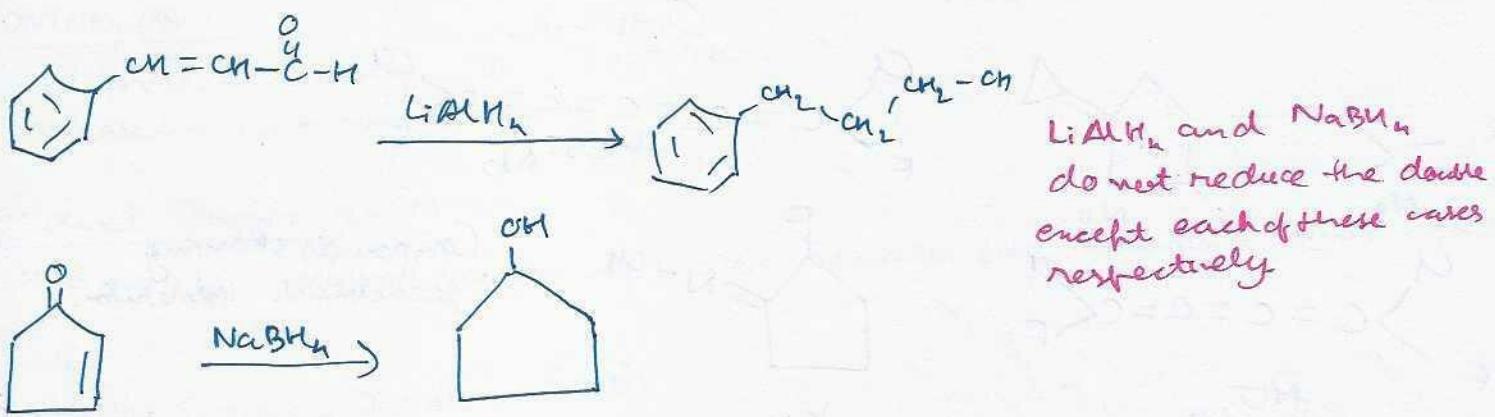
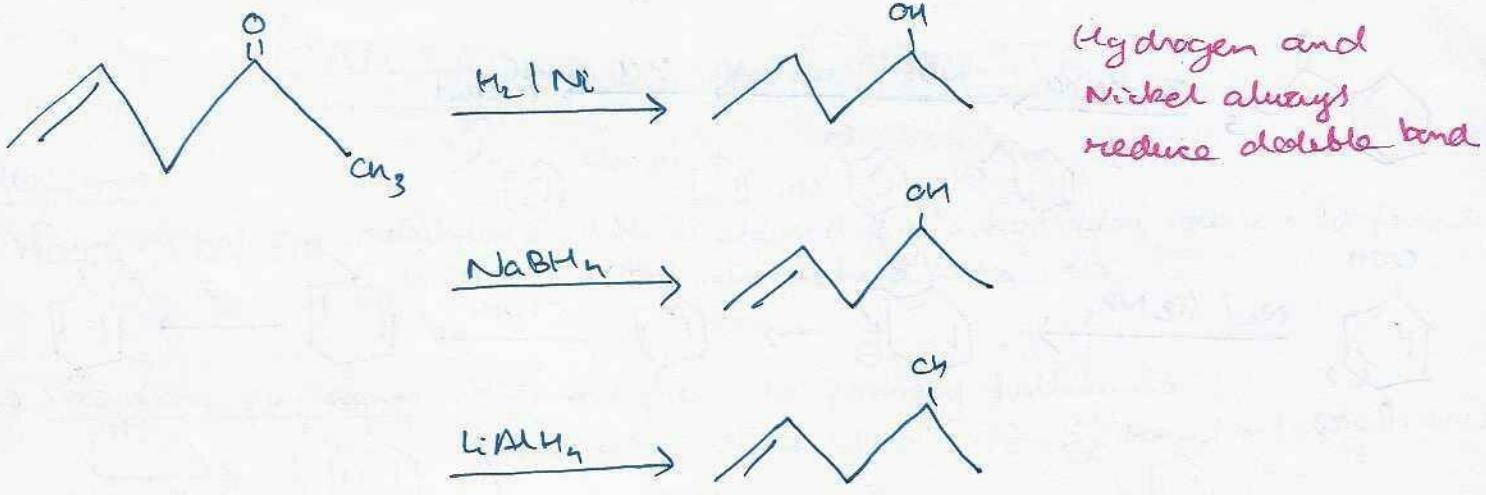


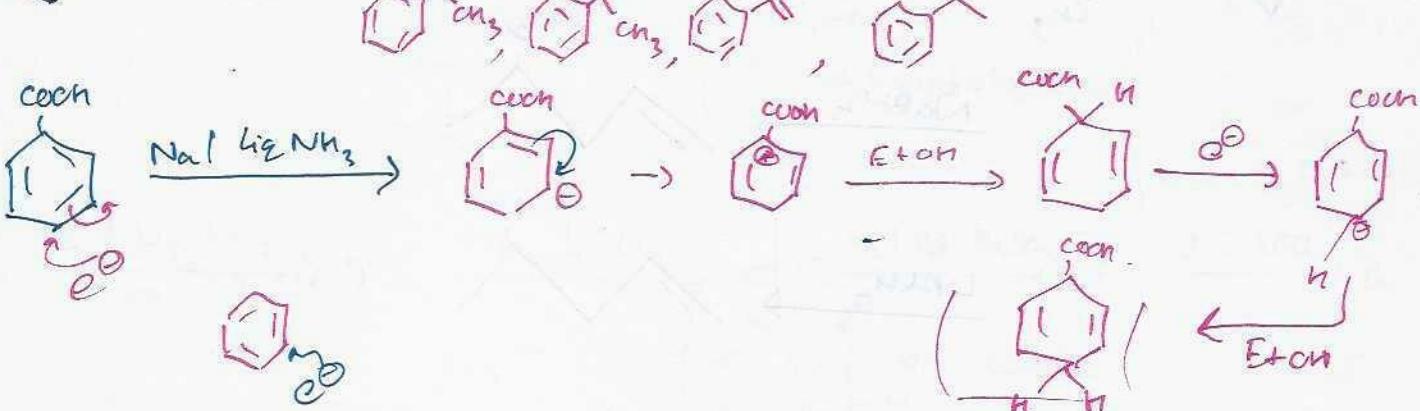
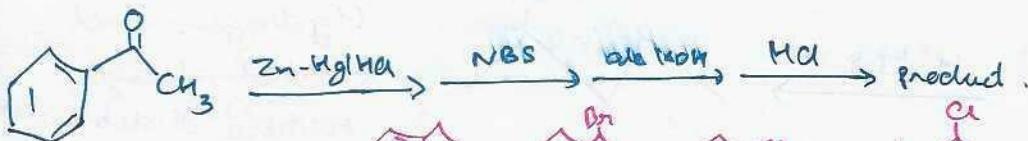
Example of
Cross Congruence

Bandorder: $c_1 - c_2 \Rightarrow c_3 - c_6 > c_2 - c_3$.

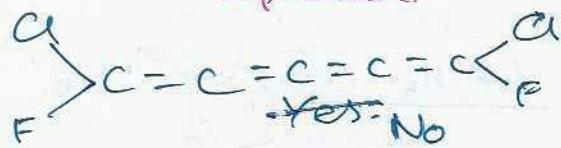
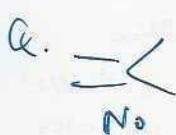
1.9 1.8 1.3



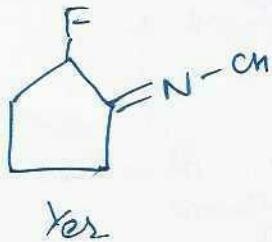
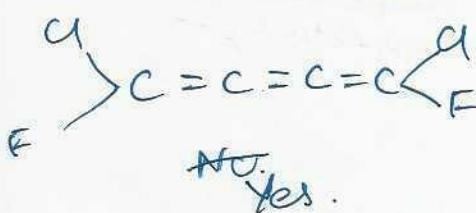




Optical.



Yes.



Compounds showing
geometrical isomerism

Odd No of double bonds
show geometrical isomerism



ENVIRONMENTAL CHEMISTRY

Pollutant

- Primary pollutant: Substance which is released from a particular source and present as it is in the atmosphere. SO₂, NO_x
- Secondary pollutants: Released from the primary pollutants.
Peroxy acetyl Nitrate (PAN), Peroxy benzyl nitrate (PBN)
 $\text{CH}_3 - \overset{\text{O}}{\underset{\text{O}}{\text{C}}} - \text{ONO}_2$
Biodegradable & Nonbiodegradable

CONTAMINANT

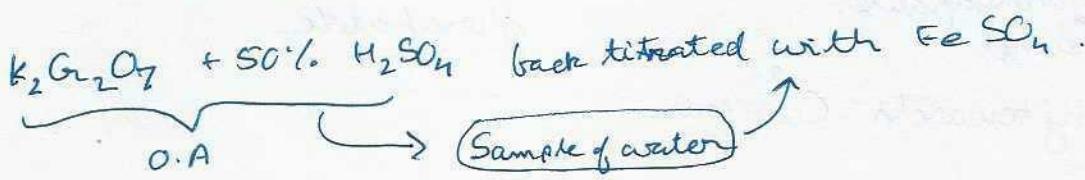
Not present initially. DDT, pesticides.
released due to human activity.

Dissolved Oxygen (DO)

4-5 mg/L dissolved oxygen in water → enough for respiration of aquatic organisms

Chemical Oxygen Demand (COD)

Amount of oxygen required to oxidise organic matter in water.



Biological Oxygen Demand (BOD)

Amount of oxygen utilised by microorganisms to oxidise organic matter in 5 days of time.

For pure water → 1 ppm
fairly pure → 3 ppm
doubtful → 5 ppm

More than 5 ppm → Polluted water

17 ppm → highly polluted

Sewage water → 100 - 4000 ppm

Threshold Limiting Value (TLV)

Person exposed to this pollution 7-8 hours a day is adversely affected.
(Minimum value). Less TLV value, ⇒ more poisonous nature.

Receptor: Medium affected by pollutant. e.g. Lungs, Eyes.

CO is a better ligand than O₂ and thus has more affinity for haemoglobin.

sink: Medium which can react with the pollutant.

e.g. microorganisms are sink for dead bodies, sea water for CO_2 ,
soil microorganisms sink for CO .

4 Environmental Segments

66 million years.

Atmosphere Lithosphere Hydrosphere Biosphere

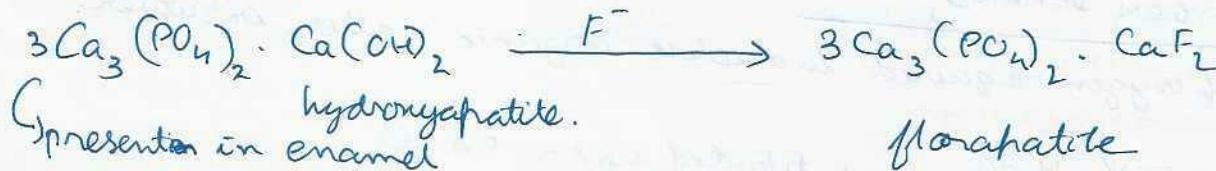
- Troposphere (0 - 12 km)
 - Stratosphere (12 - 50 km) → Ozone layer
 - Mesosphere (50 - 85 km) — Sound waves are not propagated. → ^{Some} Present in form of ions
 - Thermosphere (85 - 500 km) → 1473 K → all gasses present in ionic form.

Eutrophication

Bioamplification: excess growth of algae and weeds.

Bioamplification: Transfer of Pollutants from lower animal to higher animal through the food chain.

F if more than 3ppm in water can cause yellow stains on teeth.



has more affinity towards Ca^{2+} ions.

Causes fluorosis.

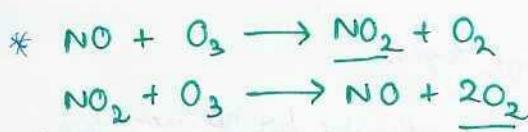
Weakening of bones and teeth. $2F^- + Ca^{2+} \rightarrow CaF_2$

ALAZARIN S-DYE: Colour intensity decreases when added to water if it contains more than 3ppm F^- .

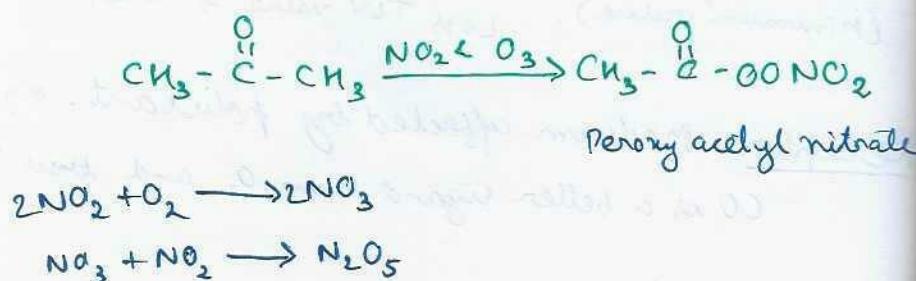
12-5 ppm can be reduced $\xrightarrow{\text{by using exchange Resin - defforan - I}}$ 2 ppm

- defloran - I
 - defloran - II

- activated charcoal
 - ↳ absorbs fluoride ion.
- Nalgonda
 - ↳ Bleaching powder,
lime, alum
 ↓
 Fluoride precipitated out



Photochemical smog.



C



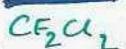
10 ppm \rightarrow TLV causes curling of leaves, photosynthesis badly affected.

1000 ppm \rightarrow immediate death.

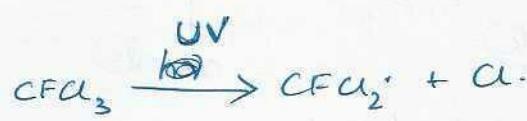
CO_2 \rightarrow greenhouse gas.

NO_2 , NO \rightarrow released from aeroplanes, rockets, jets.
also released from thunderstorms. *

Freons \rightarrow released from refrigerators.

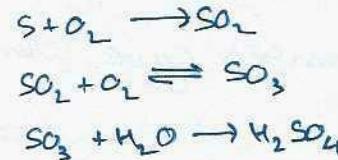


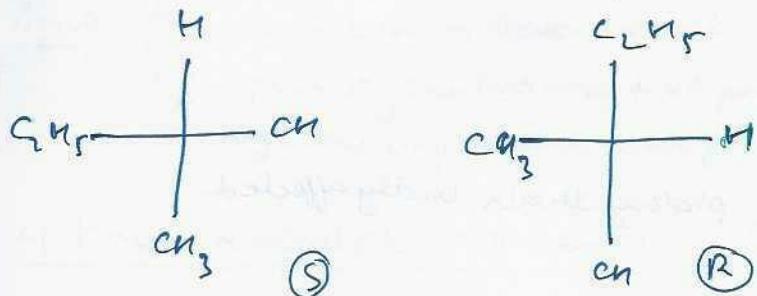
chlorofluoro hydrocarbons.



1 molecule of freons can decompose $\rightarrow 10^5$ molecules of ozone

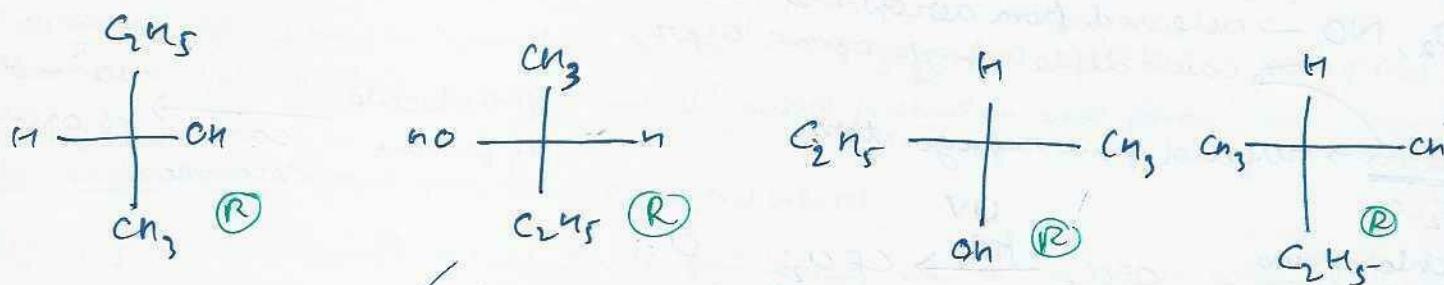
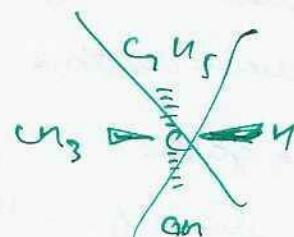
SO_2 and NO_2 cause acid rain.





enantiomeric pair.

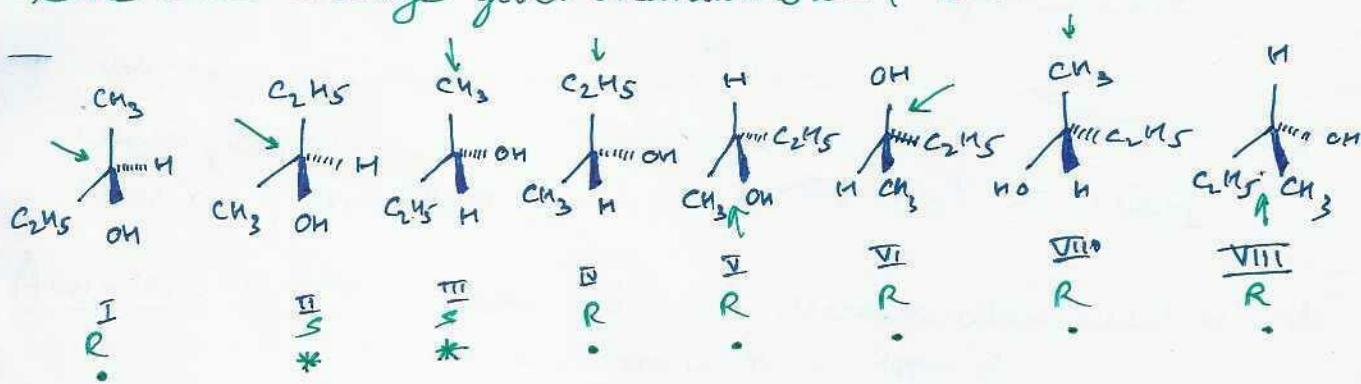
90° rotation on the paper gives enantiomeric pair.



All are identical

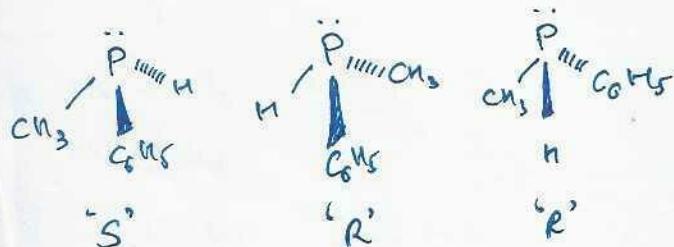
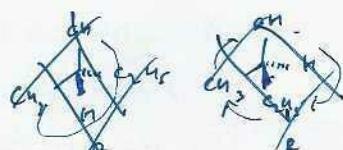
- On the plane rotation by 180° gives identical molecule.
- Two interchanges give identical molecule

→ One interchange gives enantiomeric pair



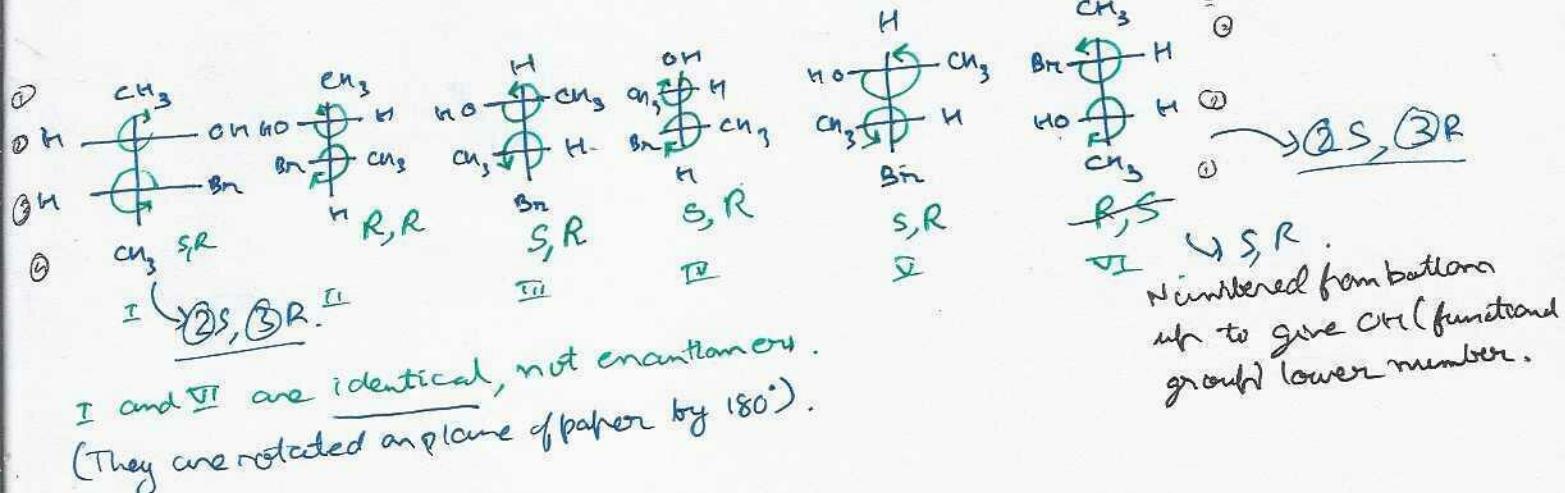
I & III, I & IV are enantiomers.

Hints: Make one interchange and write the opposite configuration.





Chiral.
O.A.



Q. 1.79 mg of organic compound.

$$\frac{1.79 \times 10^{-3}}{90} = n \quad \frac{1.34}{22400}$$

