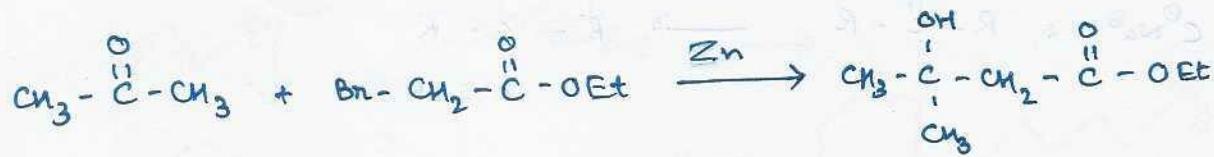
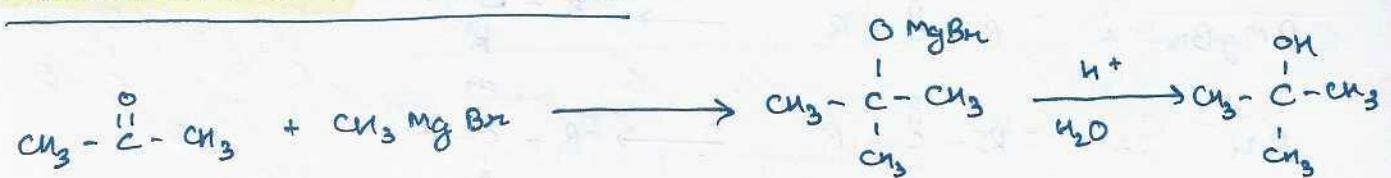


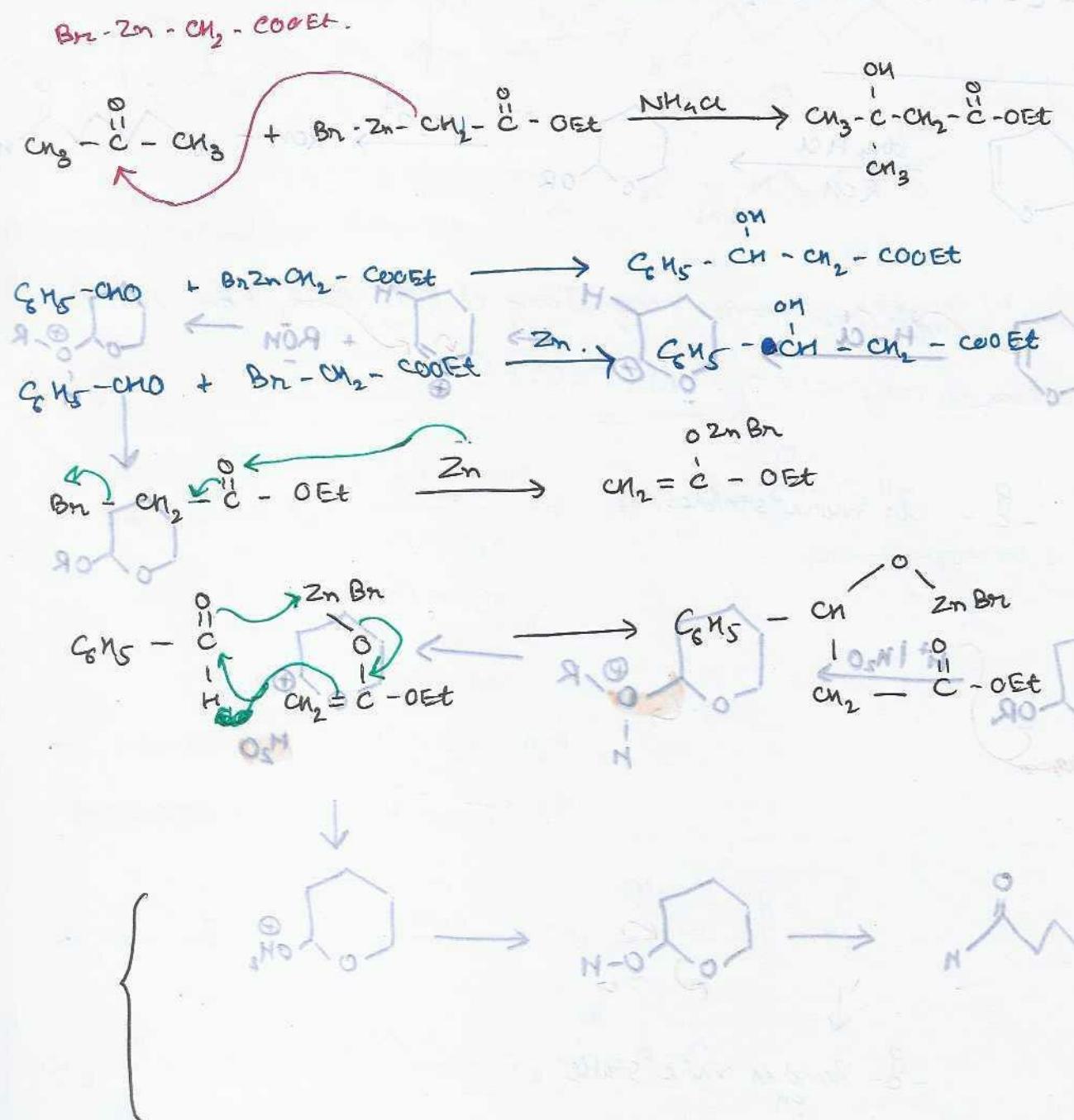
**I N D E X**

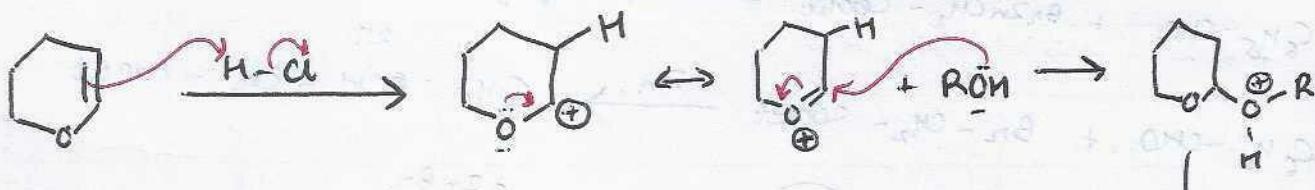
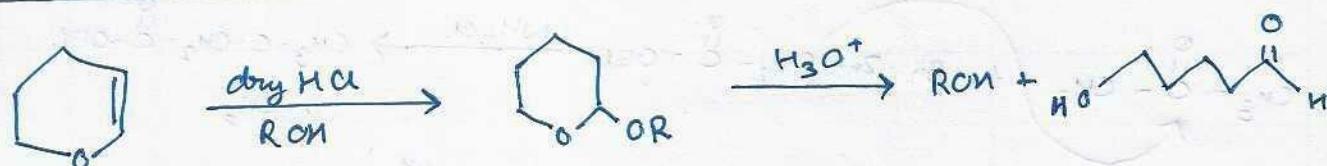
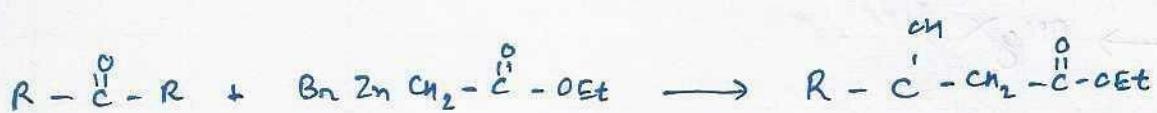
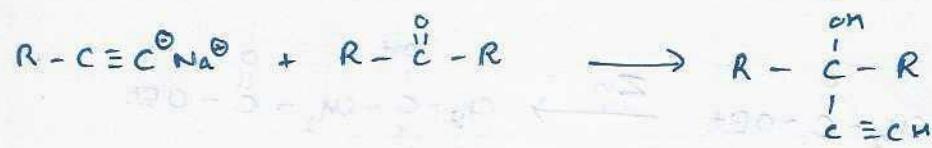
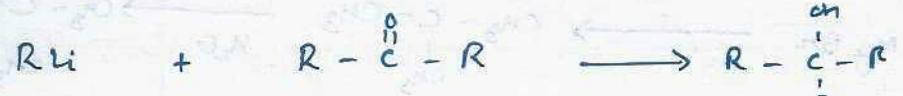
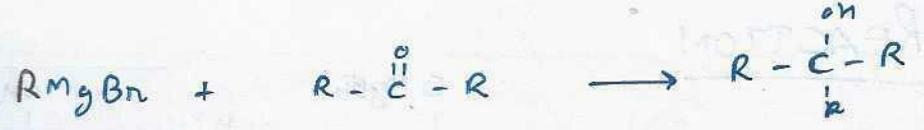
NAME: Shubhish  
Mahapatra STD.: \_\_\_\_\_ SEC.: \_\_\_\_\_ ROLL NO.: \_\_\_\_\_ SUB.: \_\_\_\_\_

# REFORMATSKY REACTION

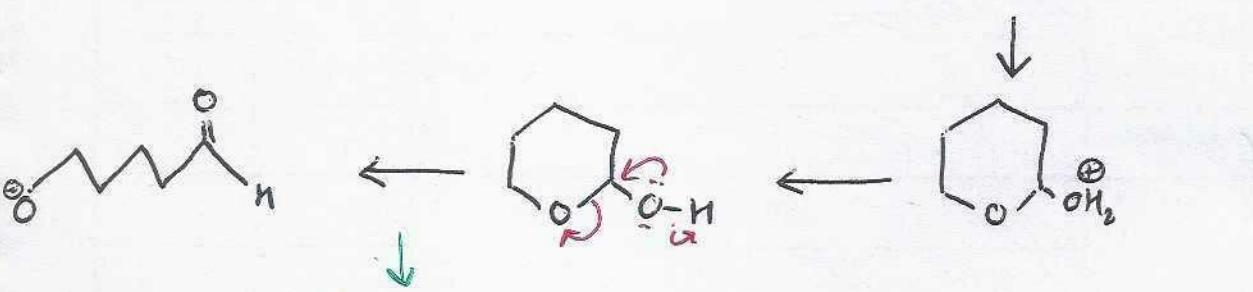
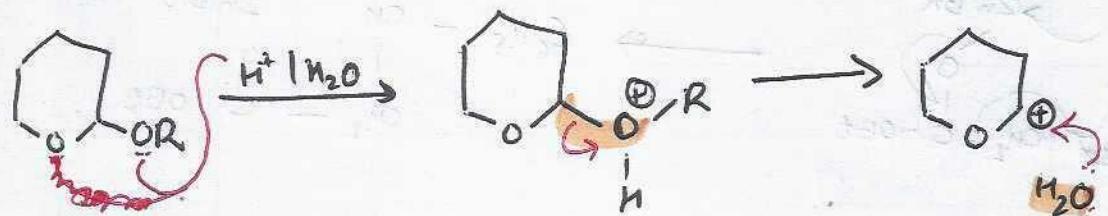


$\text{RX} \rightarrow \text{RMgX}$





$\text{-C}-$  is more stable



$\text{-C}-$  bond is more stable  
than  $\text{-C}-\text{OR}$  bond.

H<sub>2</sub>O

WDX

A →

Acetal  
for the  
reaction

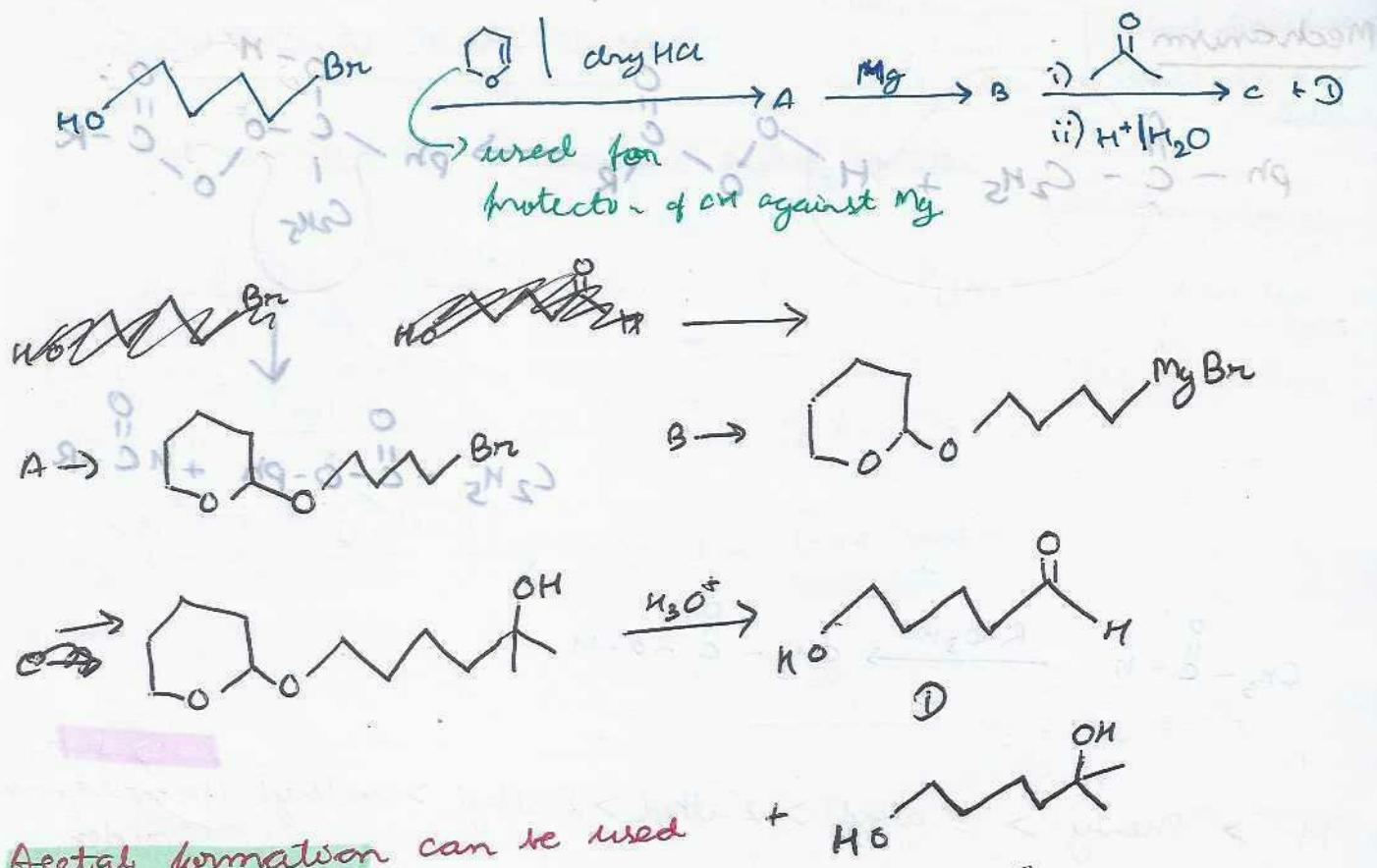
BAY

$\text{R}-\overset{\overset{O}{\text{C}}}{\text{C}}$

PE

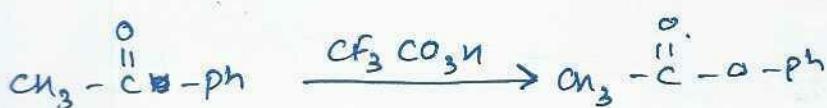
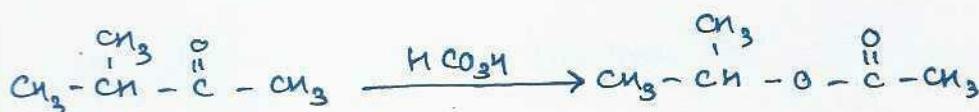
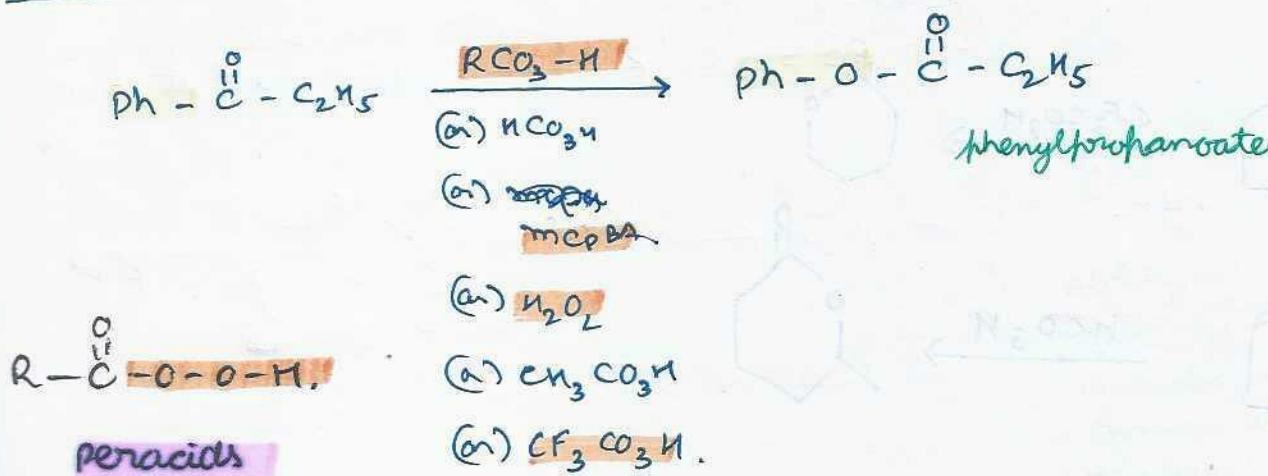
$\text{C}_3$

$\text{CH}_3$

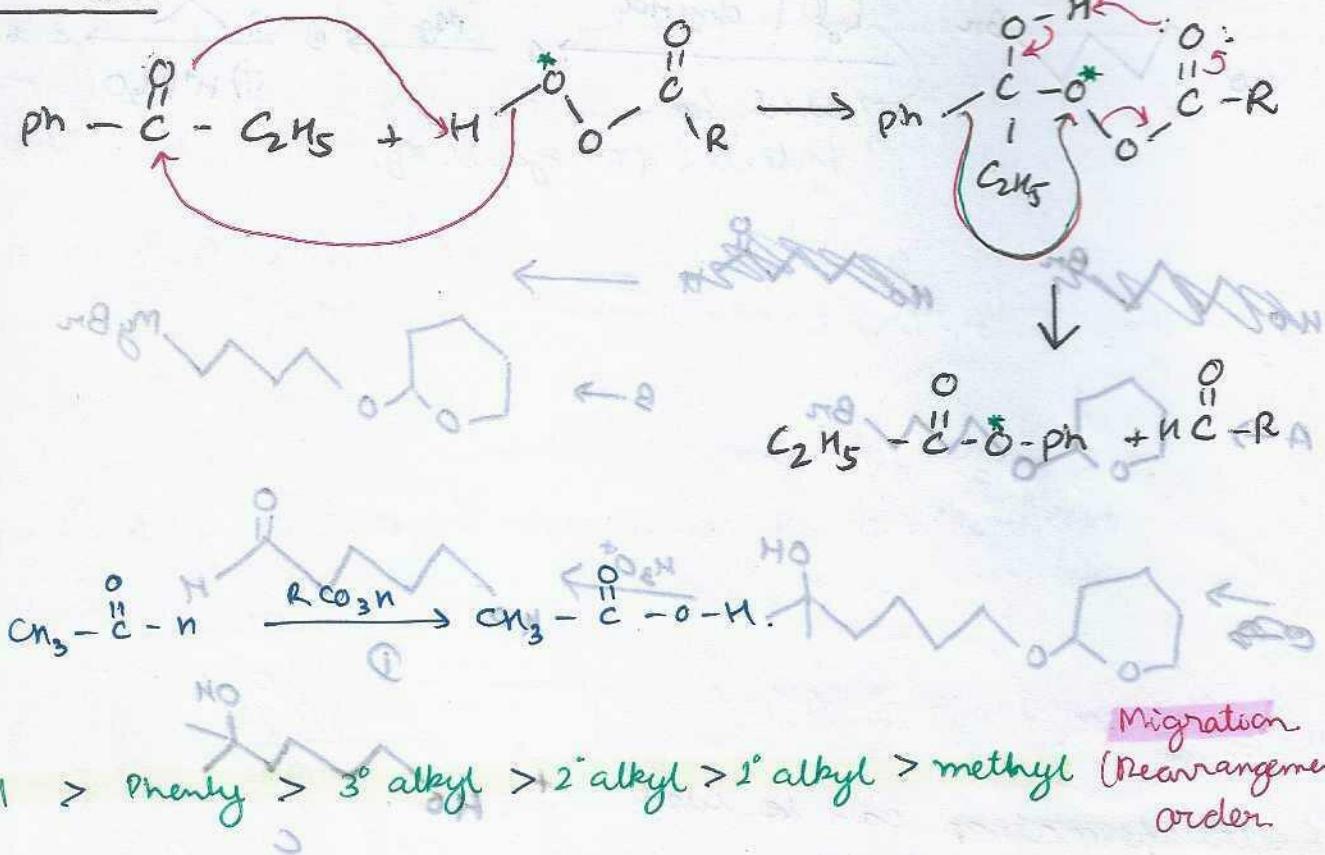


Acetal formation can be used  
 for protection of OH group.

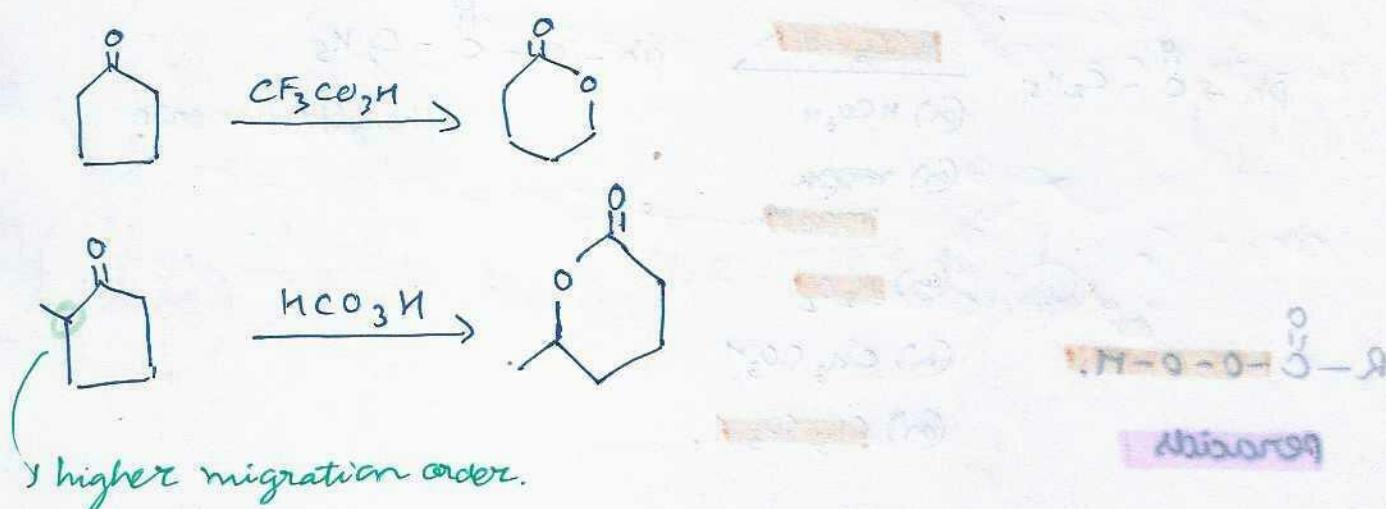
### BAYER - VILLEGER OXIDATION $\cdot$ betaripinac, nato $\cdot$



## Mechanism



Group which has more migrating ability, and can stabilize  $\text{O}^\bullet$  atom, is migrated.

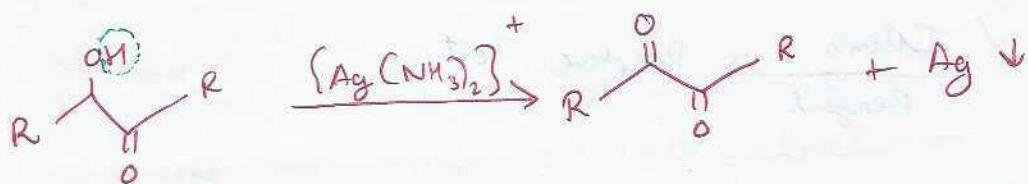
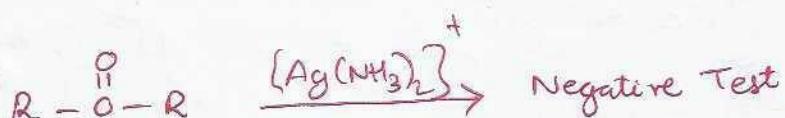
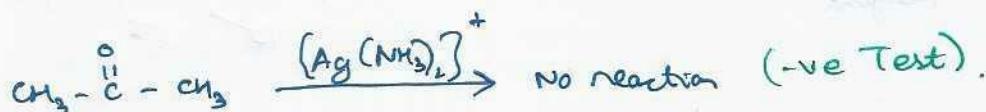
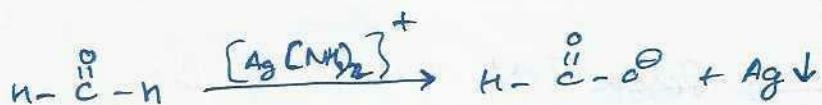
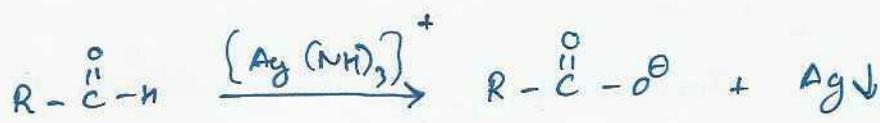


# OXIDATION OF ALDEHYDES

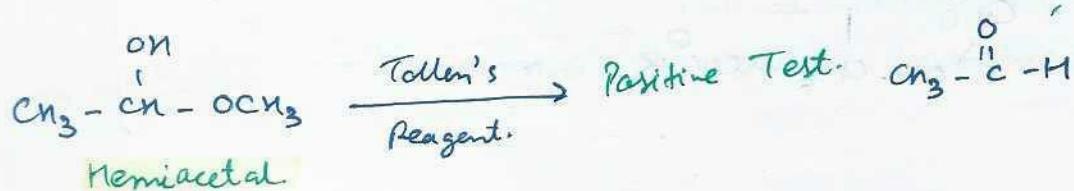
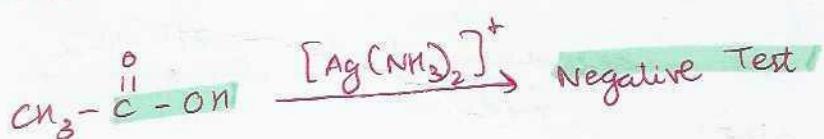
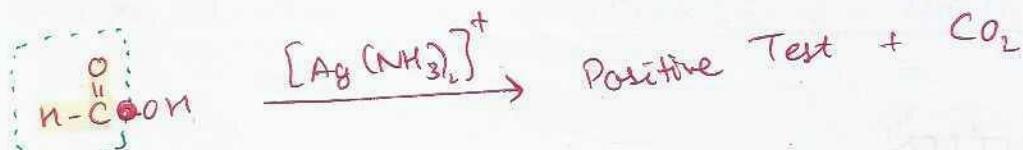
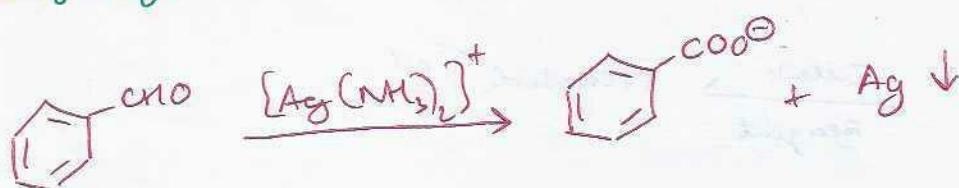
Tollen's Reagent  
Fehling Solution  
Benedict Solution } Used for detection  
of aldehydes and ketones.

Tollen's Reagent

Ammomical  $\text{AgNO}_3$  solution

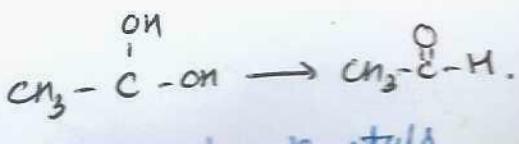


$\alpha$ -hydroxy ketones



Hemiacetals give positive test.

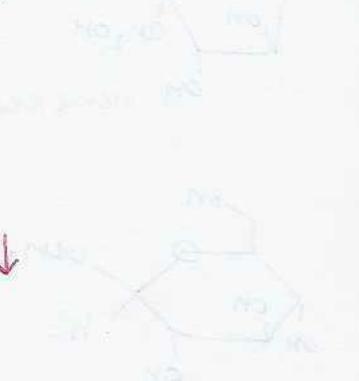
Ketones give negative test.



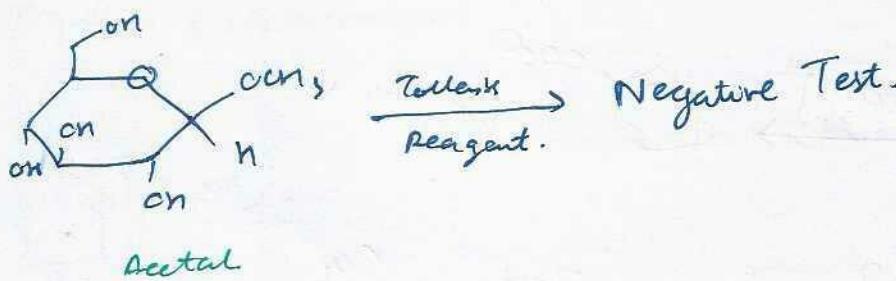
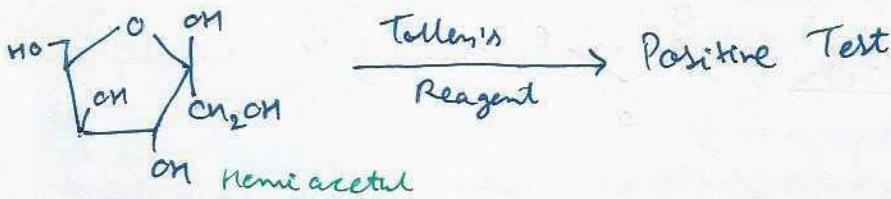
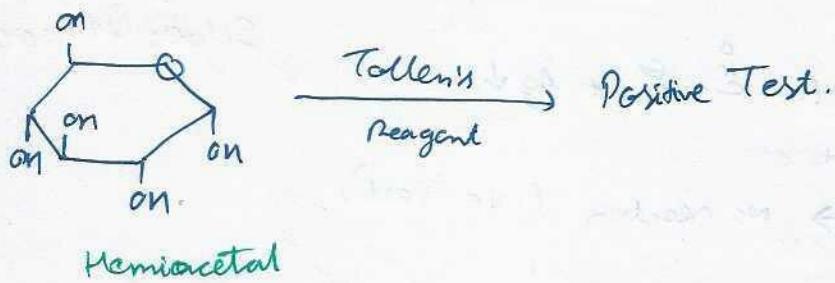
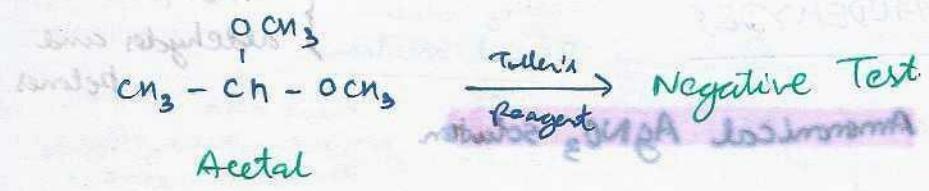
These are  
mild oxidising agents.  
Can't oxidise ketone.

Formed as a layer  
on the test tube  
surface.

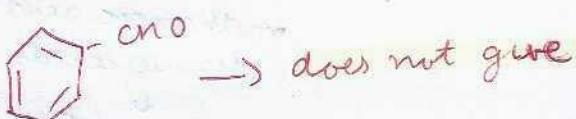
Silver Mirror



aldehydes  
 $\alpha$ -hydroxy ketones  
aromatic aldehydes  
methanoic acid  
Hemiacetals  
Positive Test

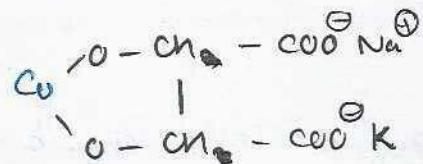


## FEHLING SOLUTION

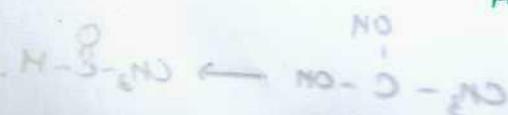


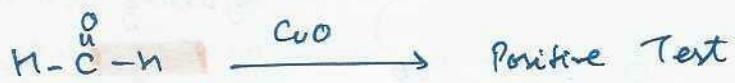
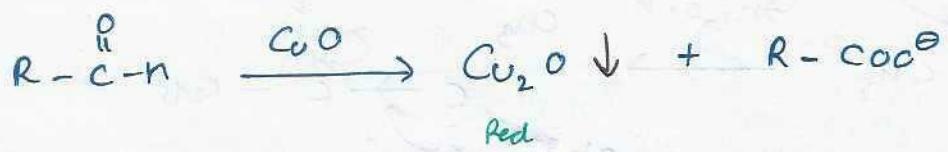
gives disphenolates on alkaline medium

Cupric ion is complexed with Na K Tartarate

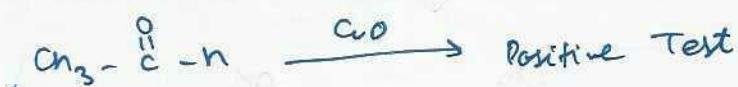


Aromatic aldehydes give negative test.

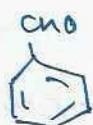




**Aldehyde**  
**Hemiacetal**  
**Formic acid**



↓  
Positive Test.



(Same as Tollen's Reagent).

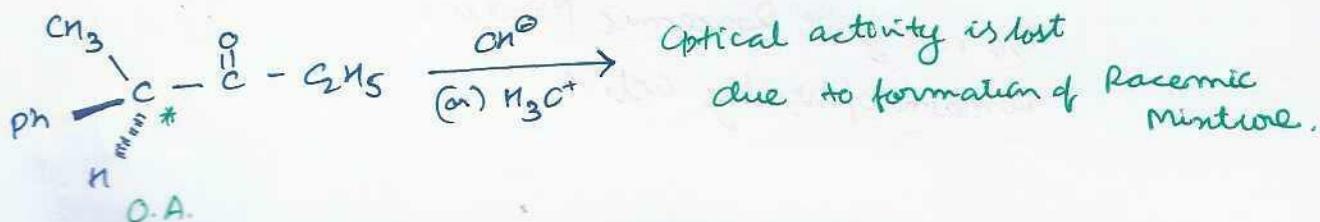
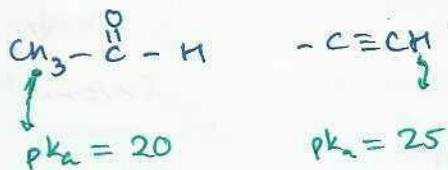
## BENEDICT'S SOLUTION

Cupric ion complexed with citrate ion.

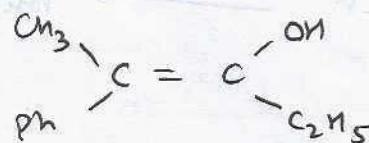
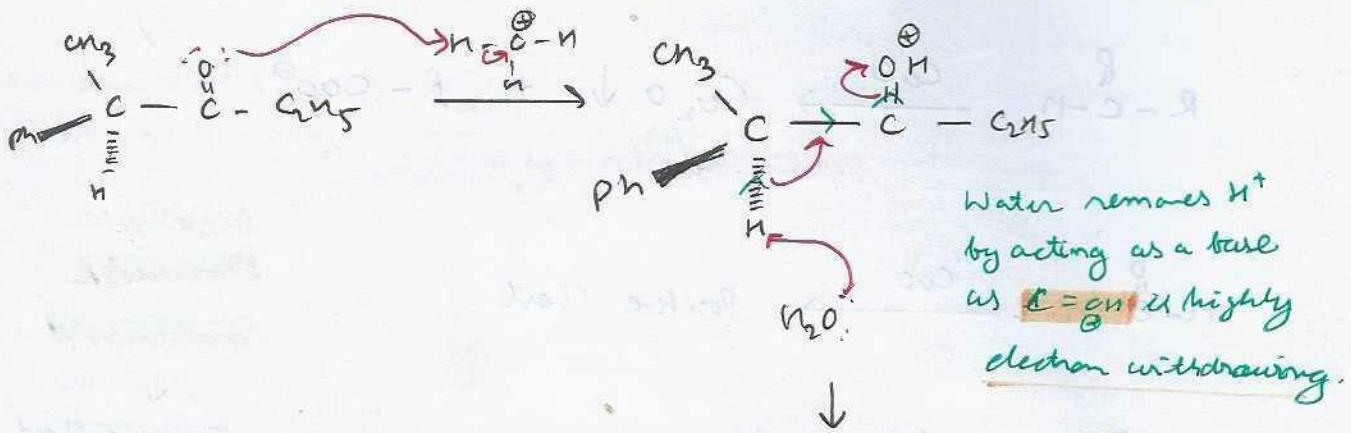
Benzaldehydehyde → Negative Test.

Others same as Tollen's Reagent.

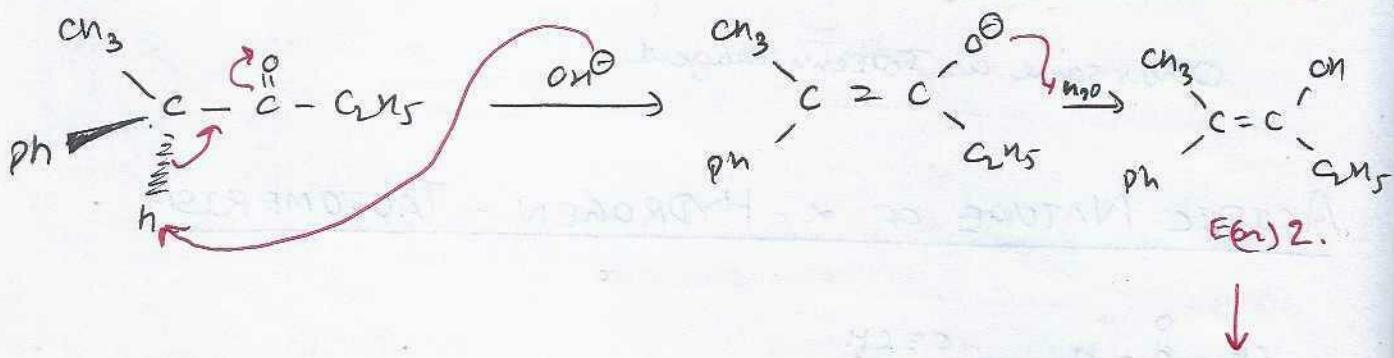
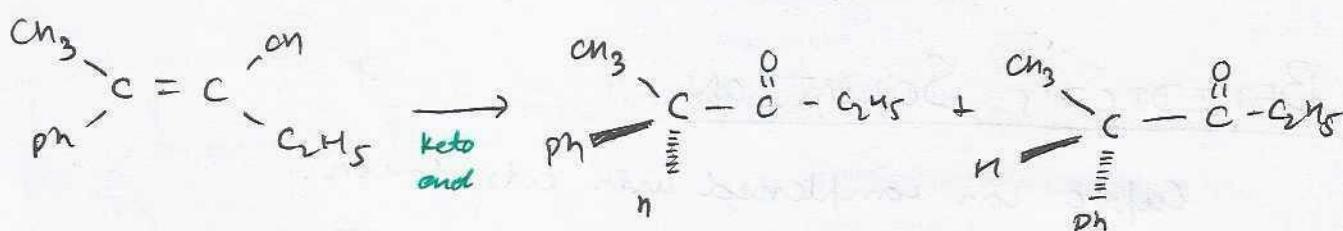
## ACIDIC NATURE OF $\alpha$ -HYDROGEN - TAUTOMERISM



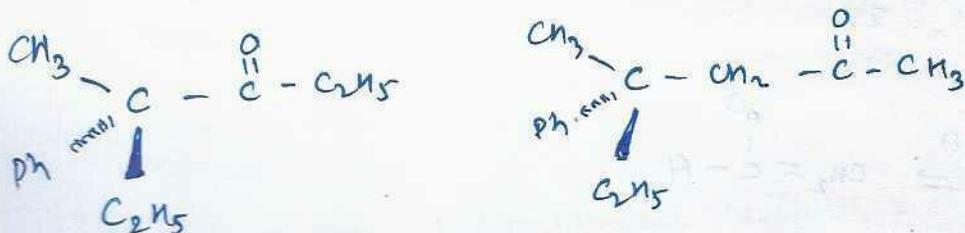
Reason: Tautomerism



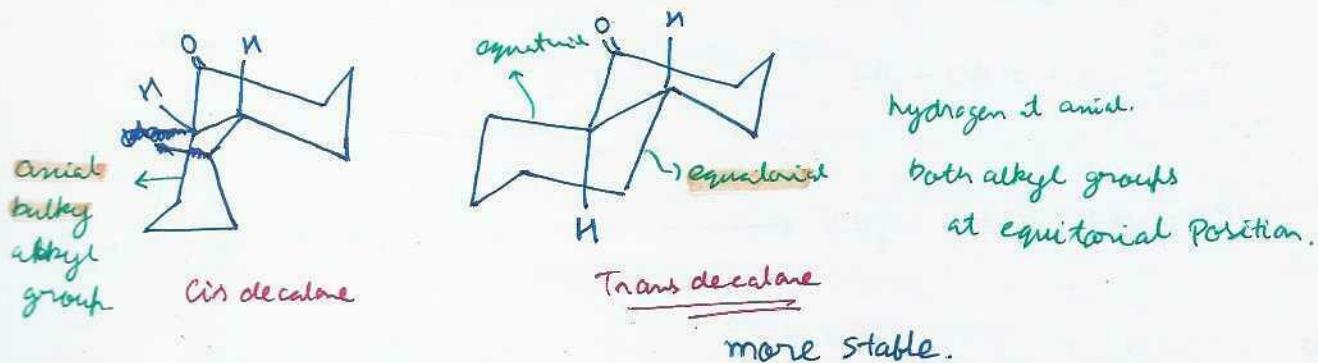
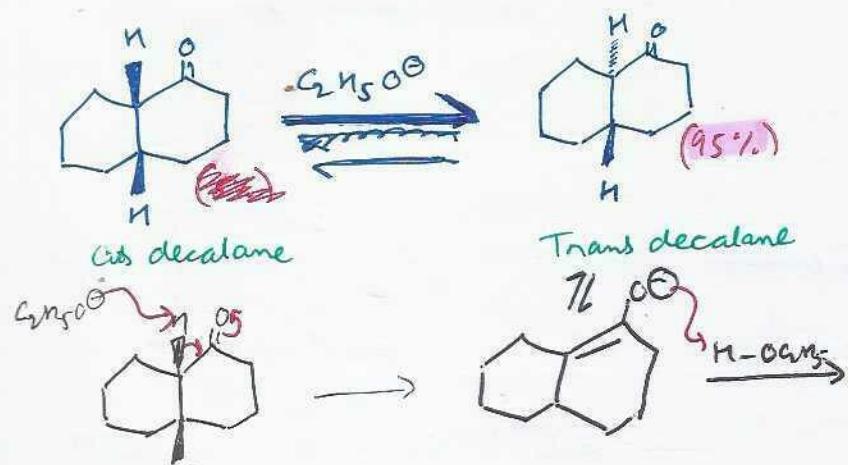
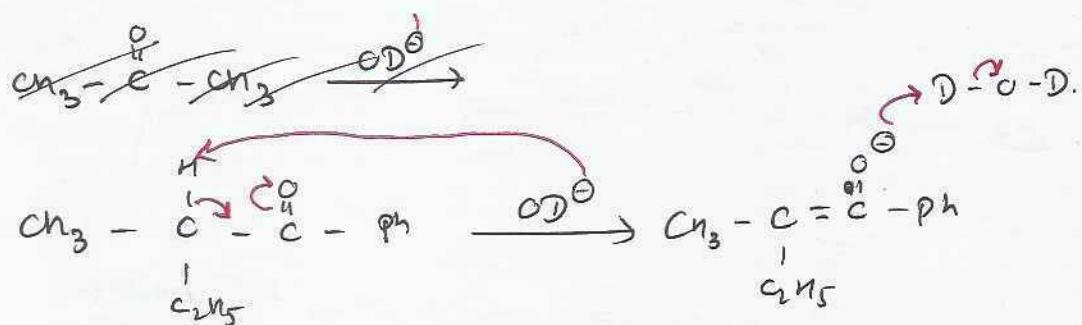
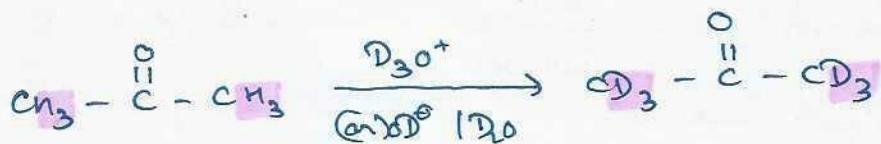
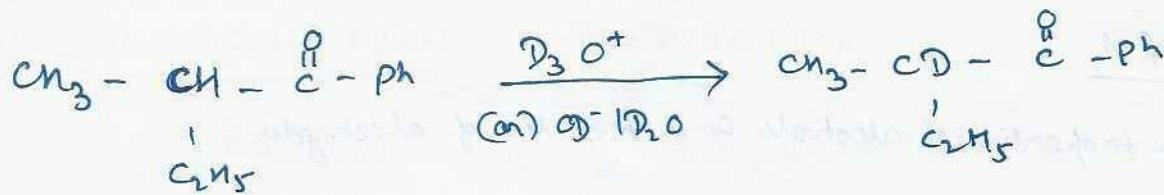
E(α) 2. Both are possible  
(free rotation).



Racemic mixture



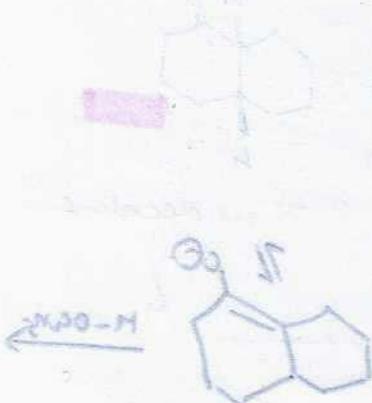
Do not give Racemic Mixture.  
 Remain optically active.



## HALOFORM

Refer in properties of alcohols and properties of aldehydes.

AL

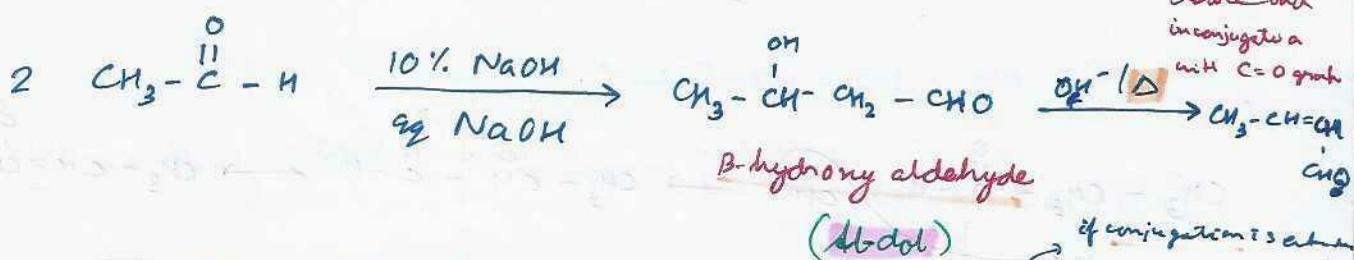


$\xleftarrow{NaNO_2 - H}$

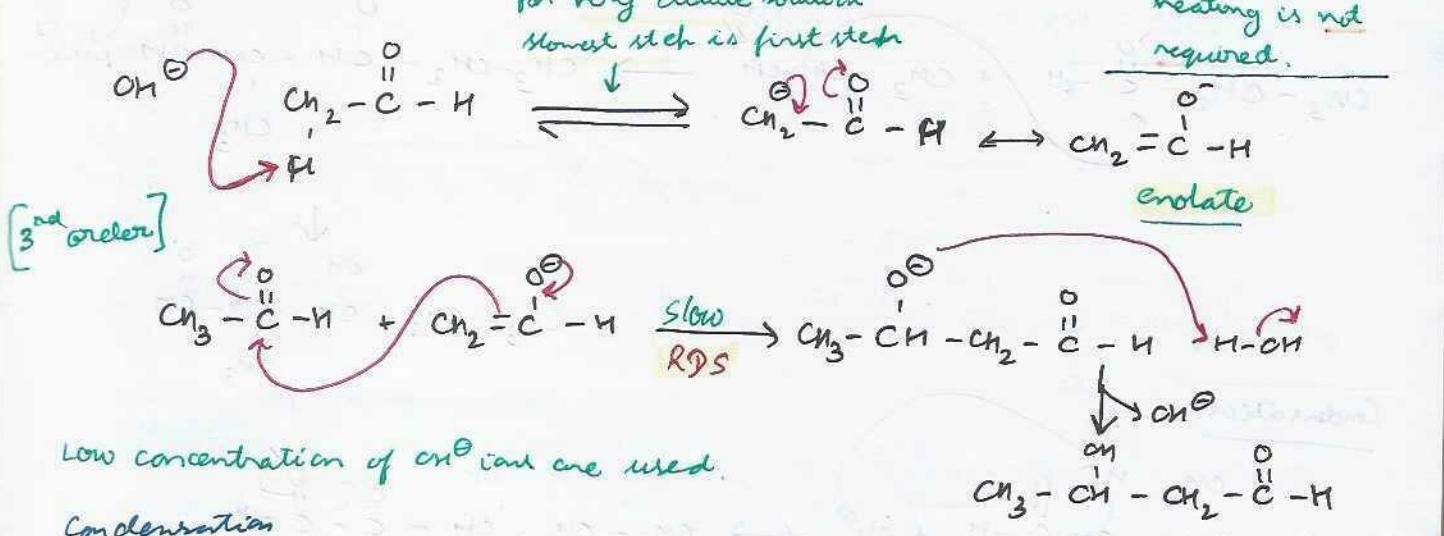


# ALDOL REACTION / CONDENSATION

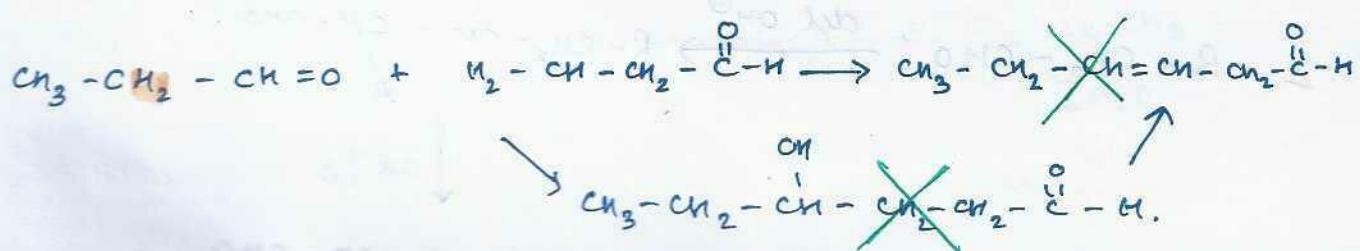
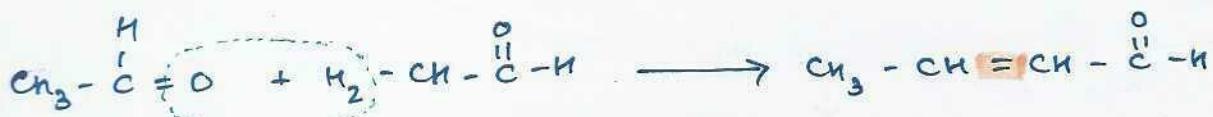
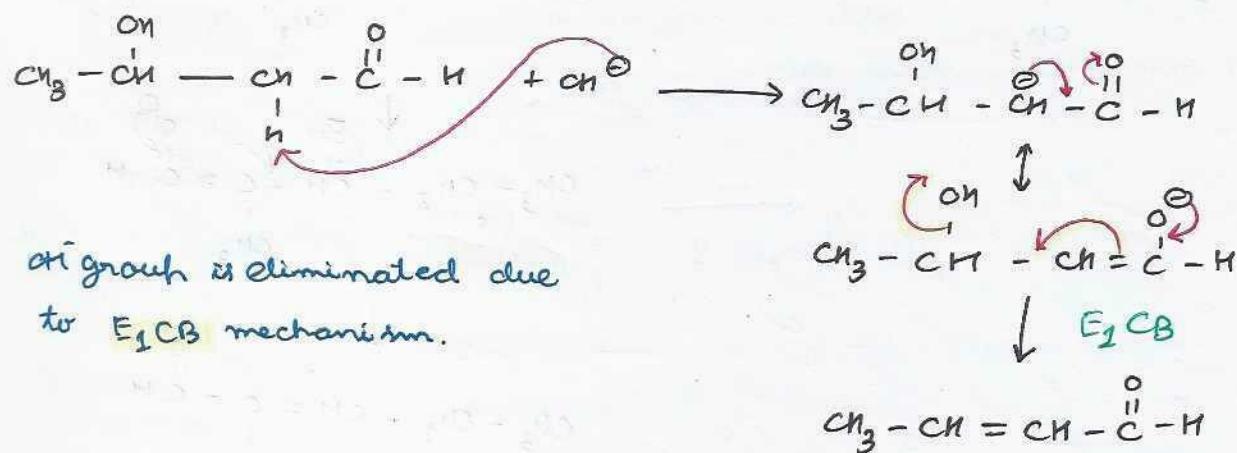
only  $\alpha$ -hydrogen containing aldehydes and ketones.



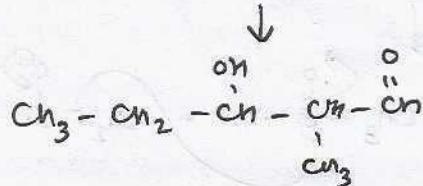
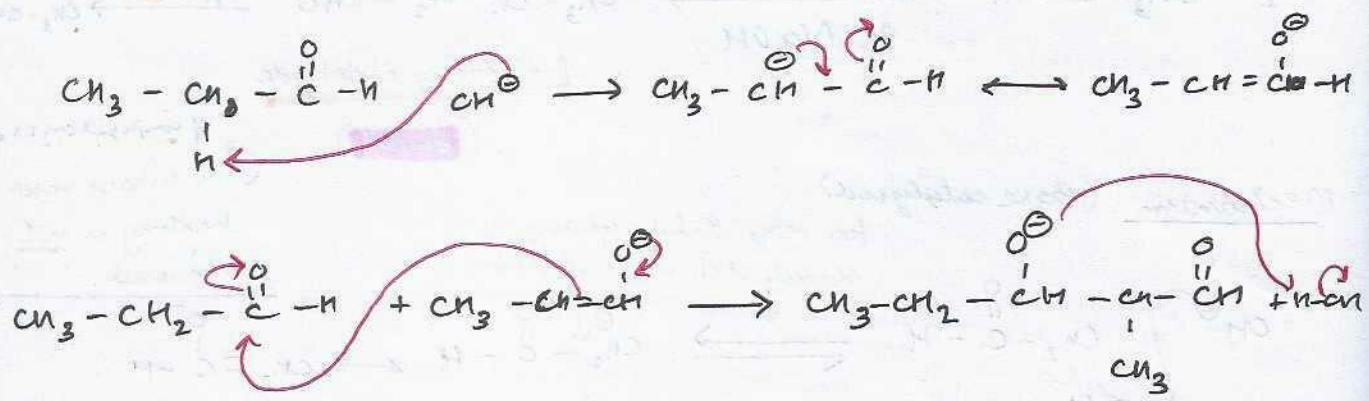
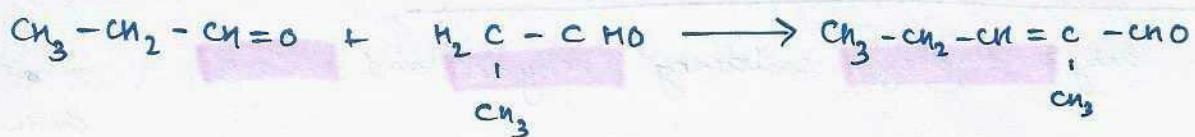
Mechanism (Base catalysed)



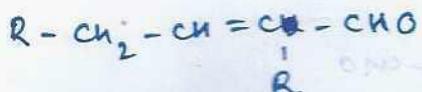
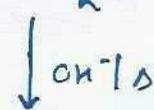
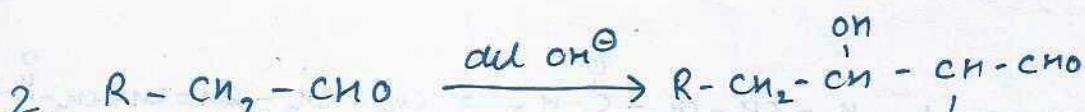
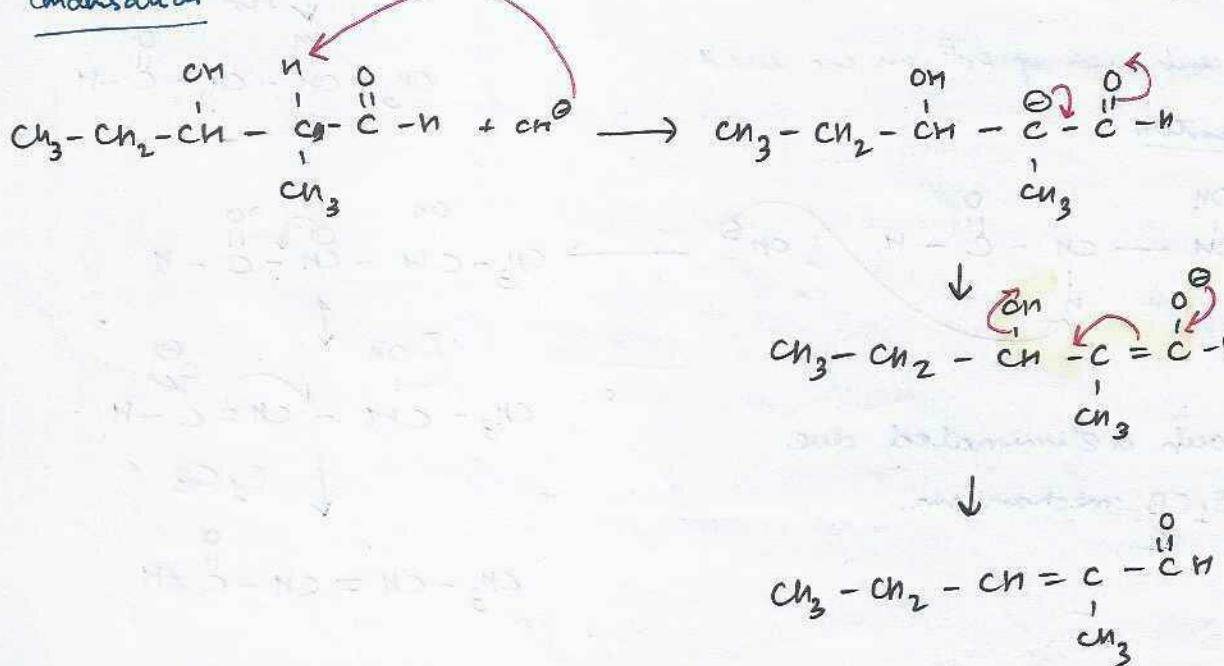
Condensation

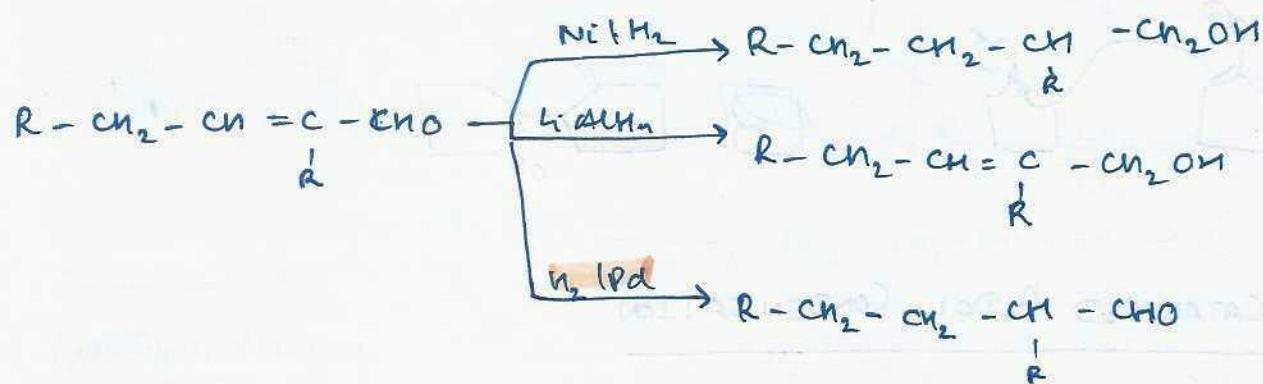
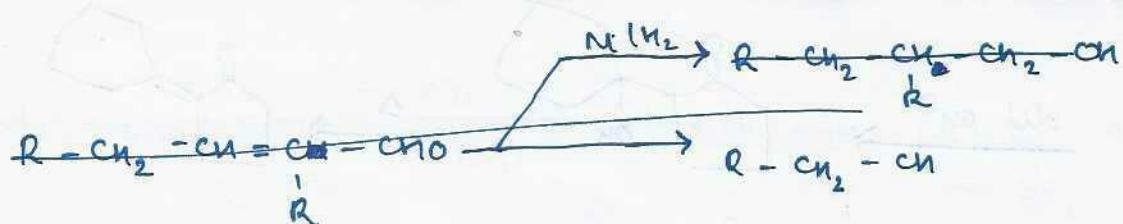


2  $\text{CH}_3-\overset{\text{OH}}{\underset{\text{H}}{\text{C}}}-\text{CHO}$   
5  $\alpha$ -hydrogen

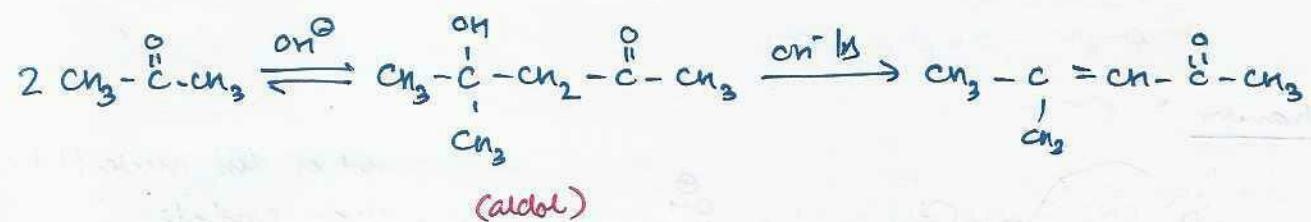


Condensation



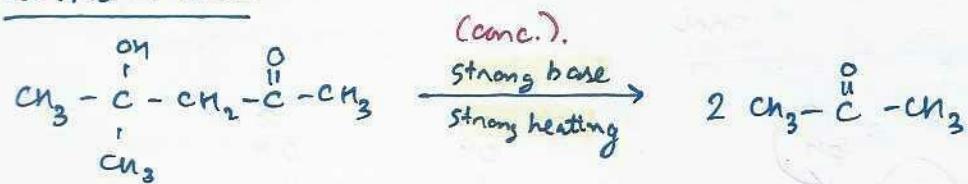


Reaction is less favoured for ketones.

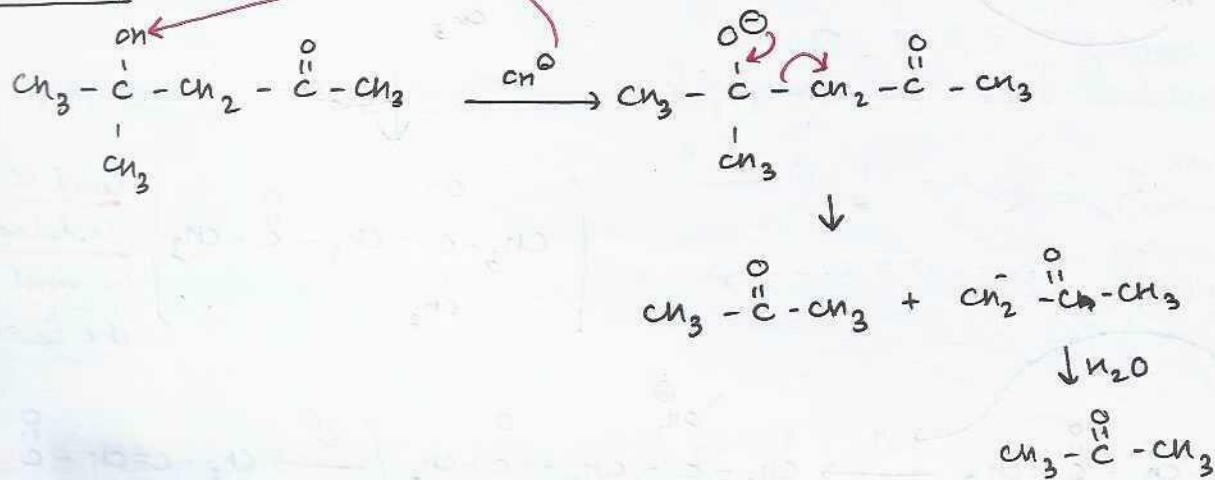


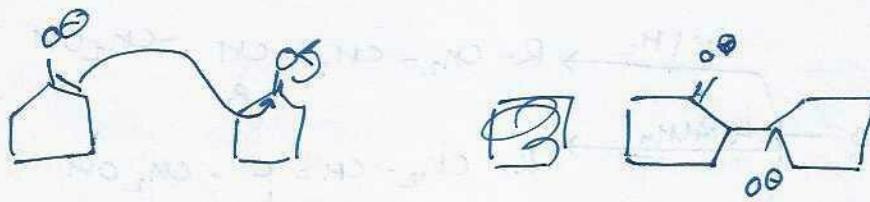
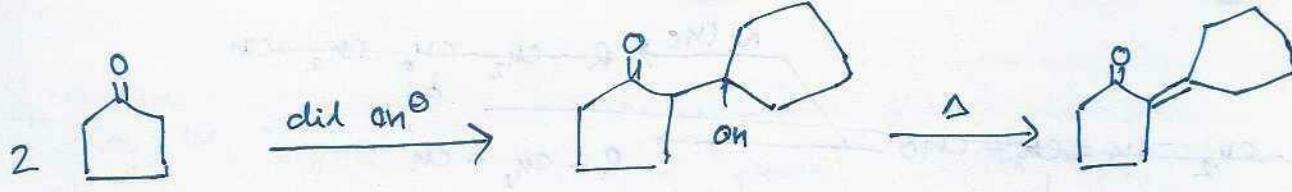
If one  $\alpha$ -hydrogen is there, reaction will stop at aldol.  $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}=\text{CH}-\text{CHO}$ .  
condensation will not take place.

### RETRO - ALDOL

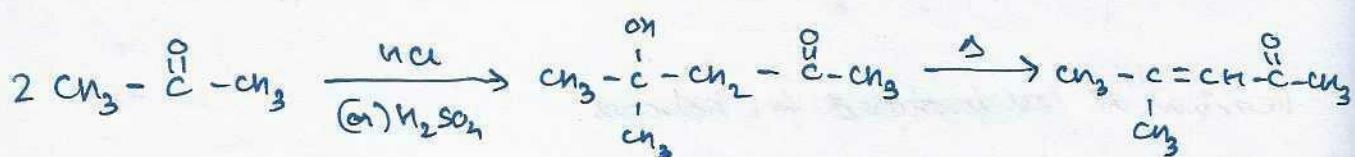


### Mechanism

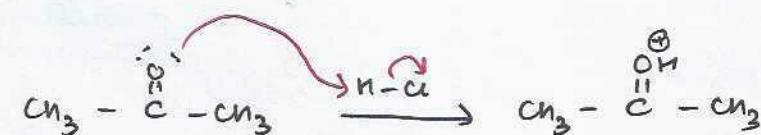




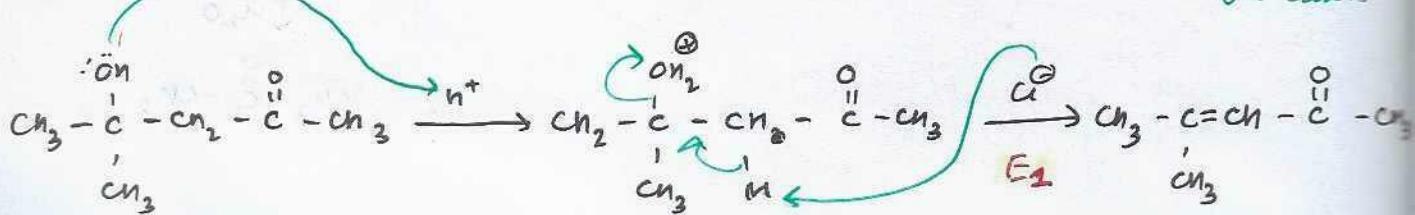
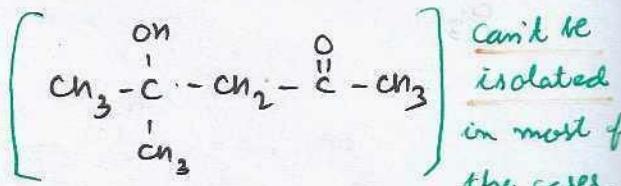
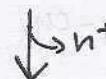
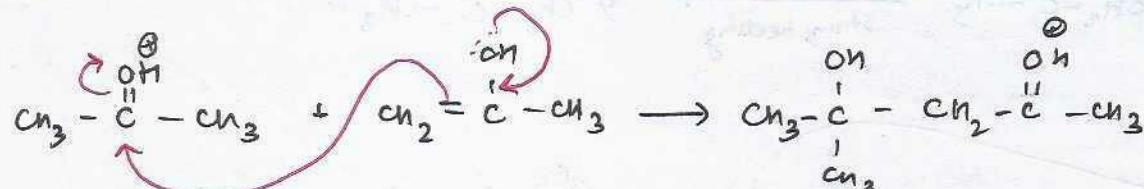
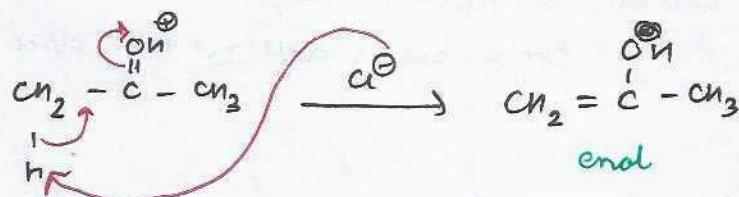
### ACID CATALYSED ALDOL CONDENSATION

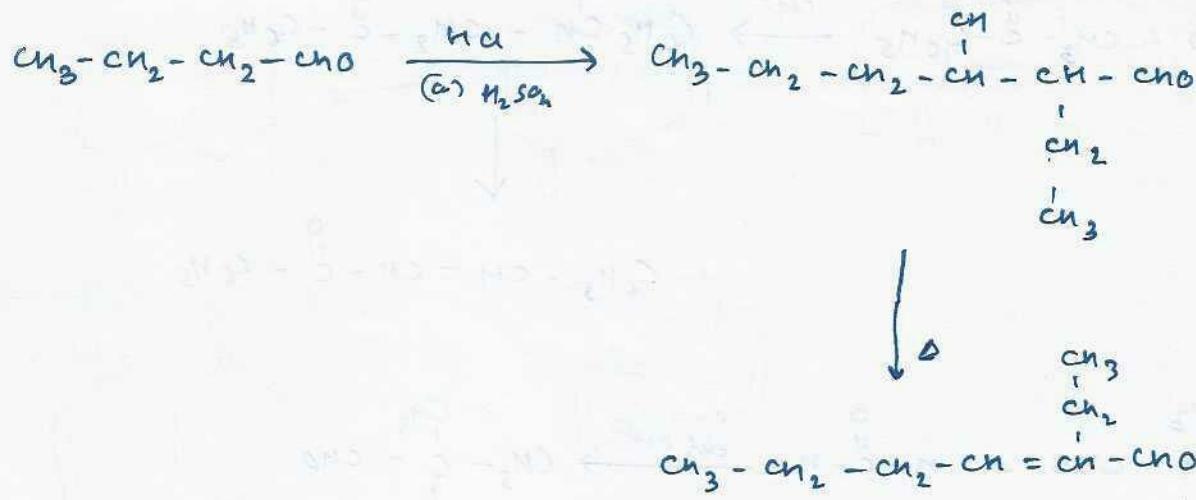


#### Mechanism

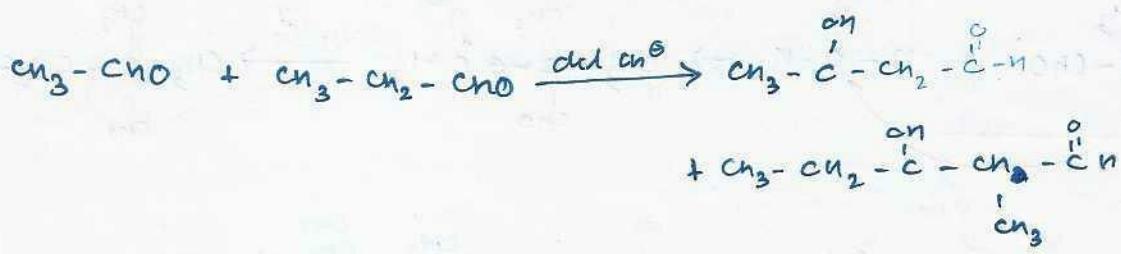


enol is less nucleophilic than enolate

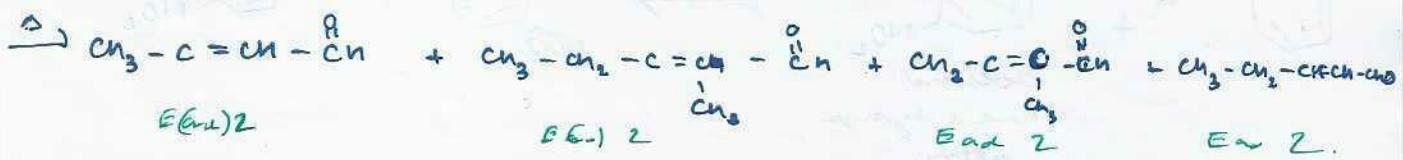
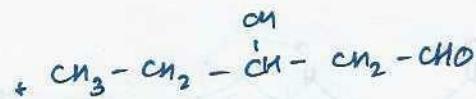
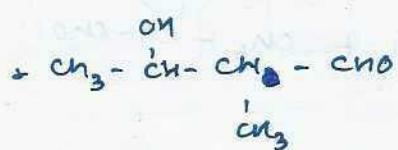




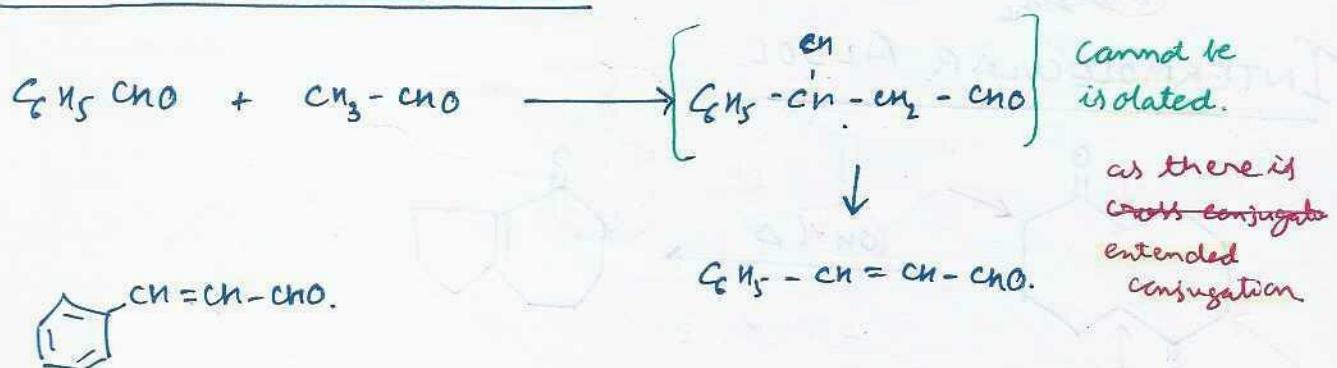
### CROSSED ALDOL



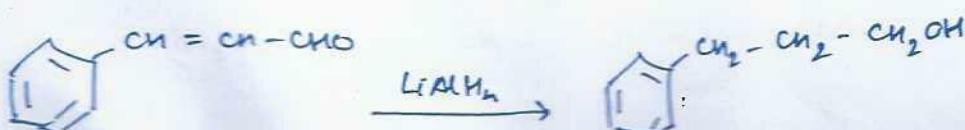
synthetically it is not  
feasible as it is difficult to  
isolate

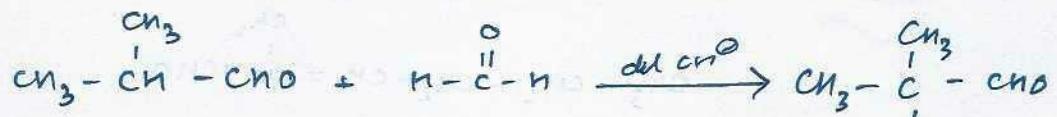
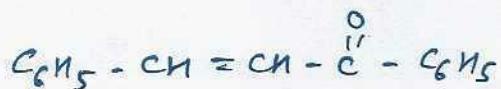
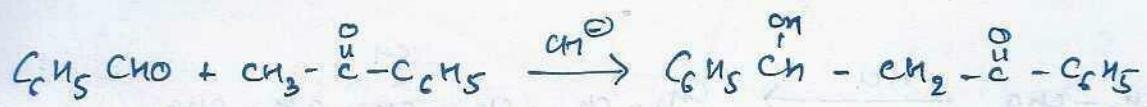


### PRACTICALLY CROSSED ALDOL

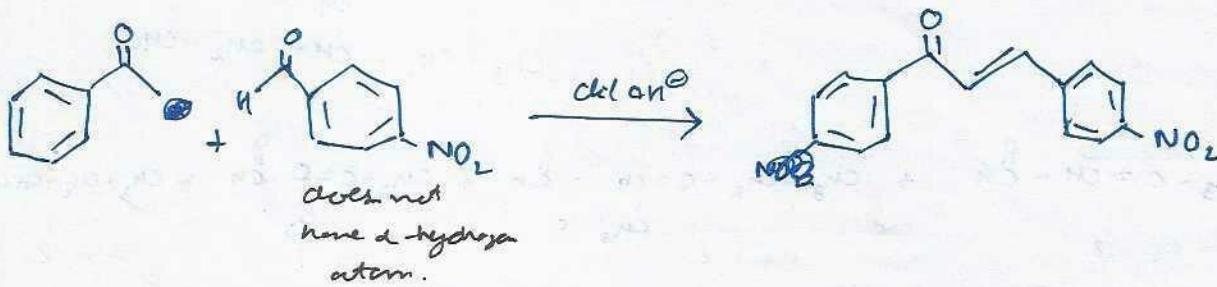
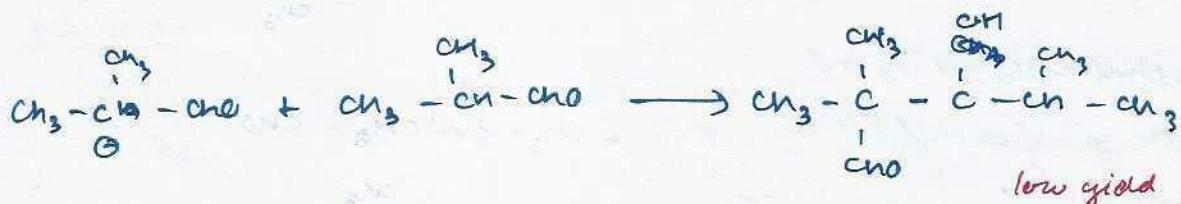
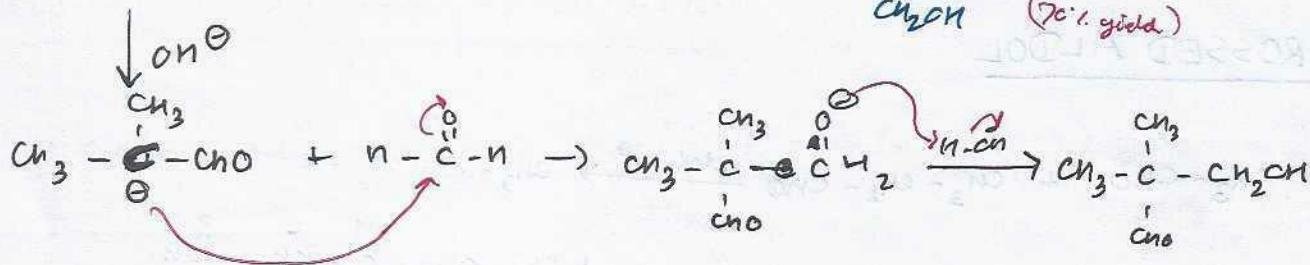


First  $\text{C}_6\text{H}_5\text{CHO}$  is added, then  $\text{CH}_3\text{-CHO}$  is added slowly to prevent self condensation

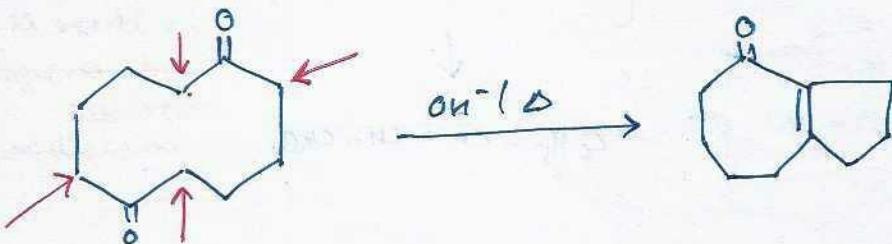




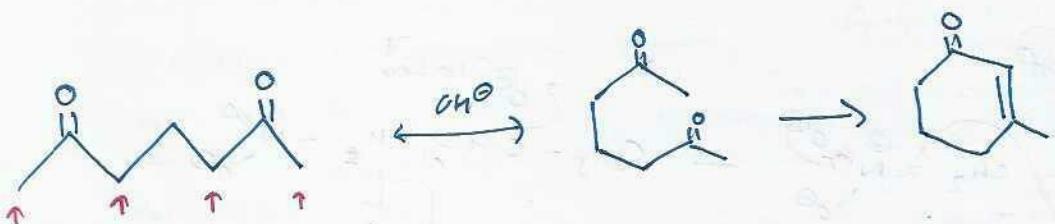
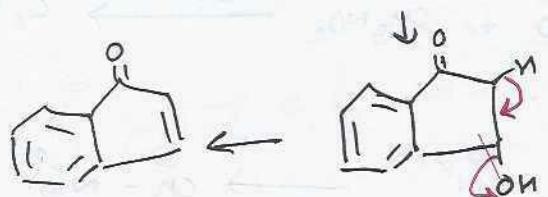
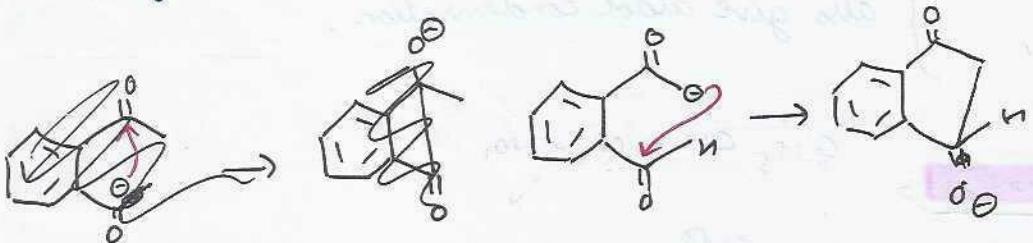
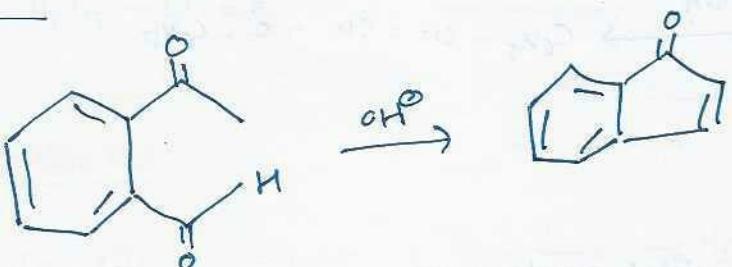
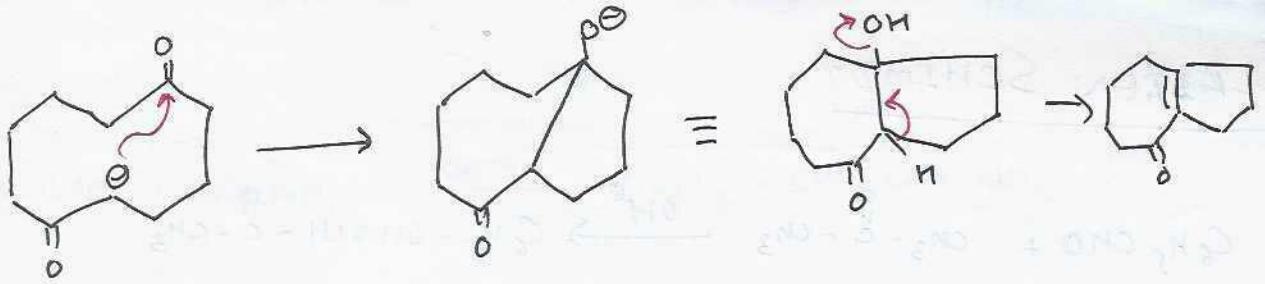
$\text{CH}_2\text{ON}$  (70% yield)



## INTERMOLECULAR ALDOL



one type of  $\alpha$ -hydrogen is present.

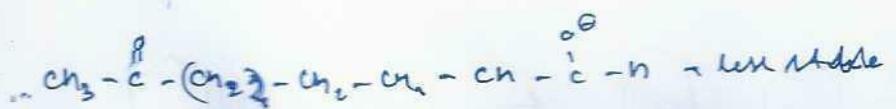
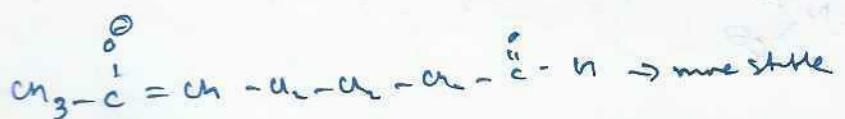
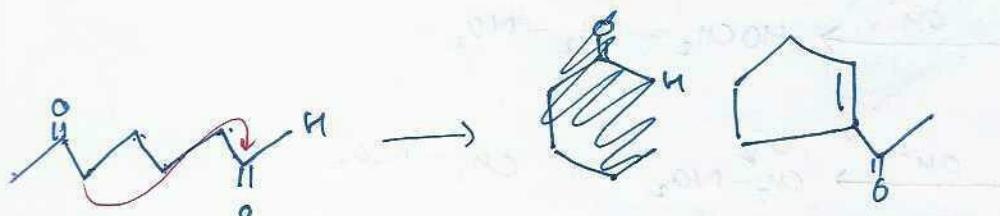


2 tighe & 2-hydrogen

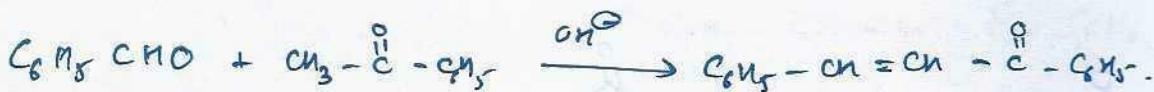
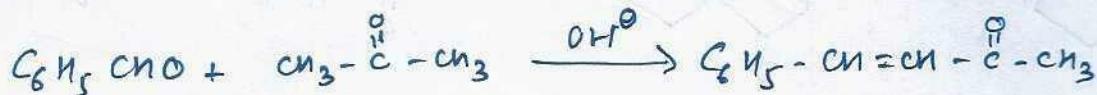
5 carbon ~~closed~~ closed chain

is more stable than

7 membered ring.



# CLASSEN SCHIMDT



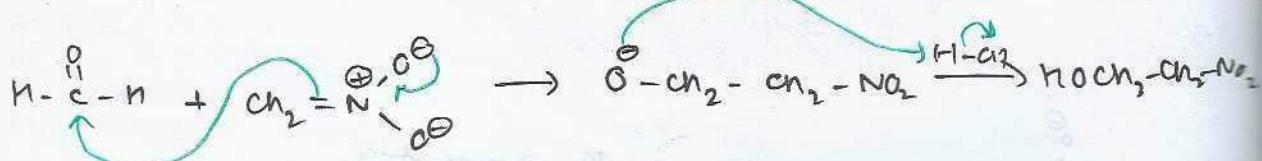
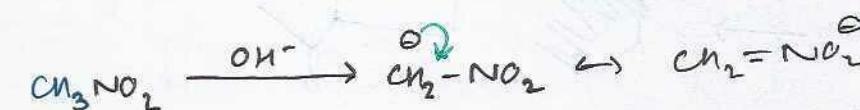
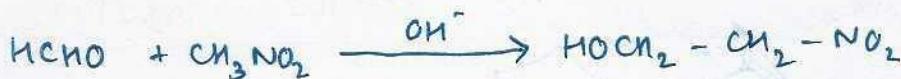
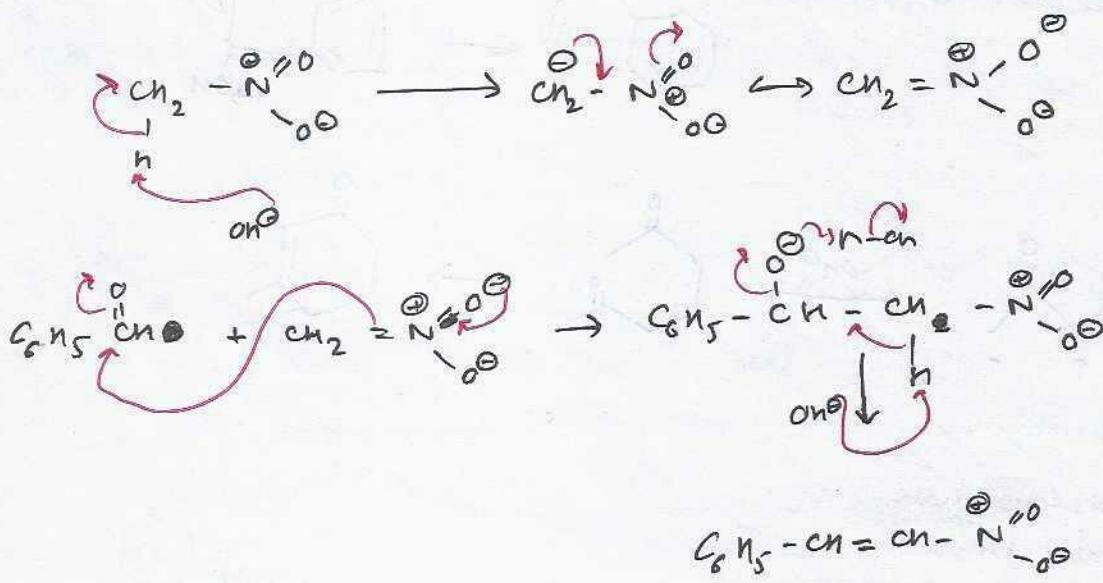
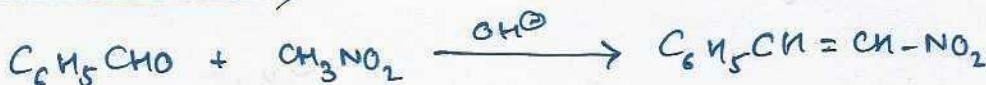
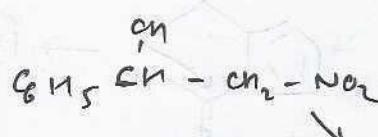
Nitro compounds

Nitriles

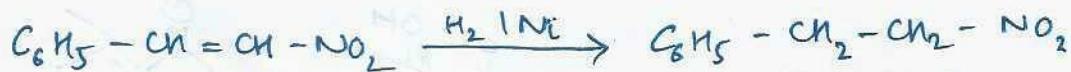
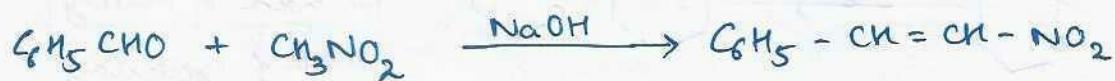
cyclic esters  
(lactones)

} also give aldol condensation.

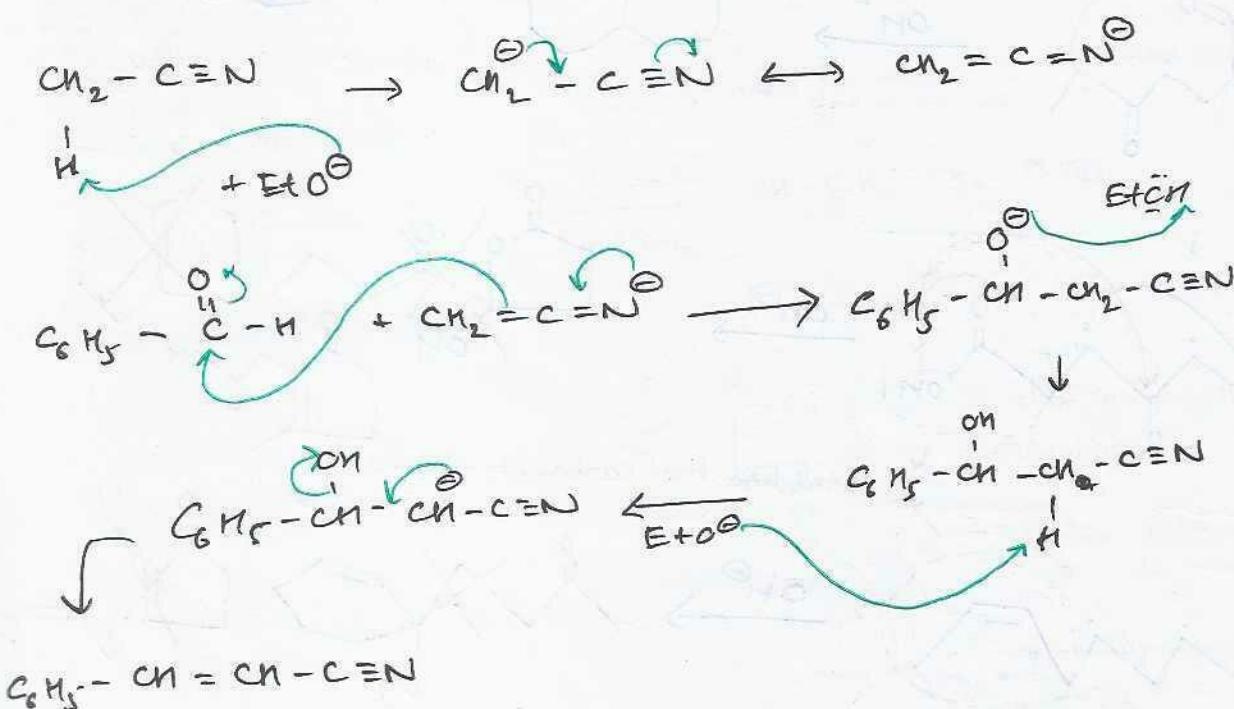
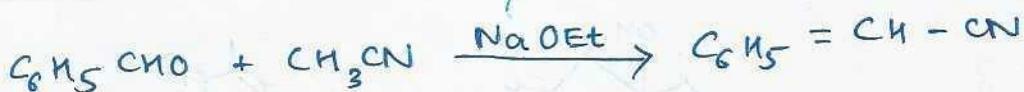
## NITRO COMPOUNDS



## Applications

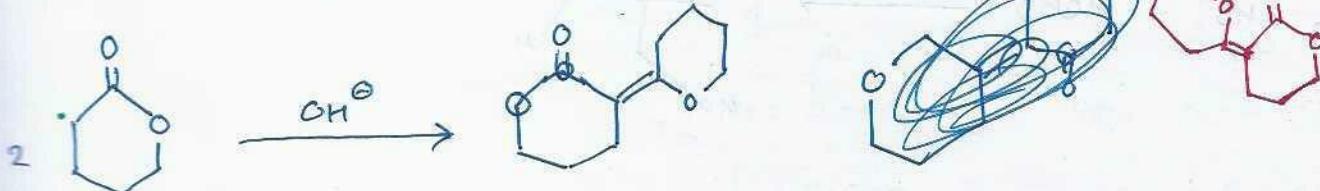


## NITRILES



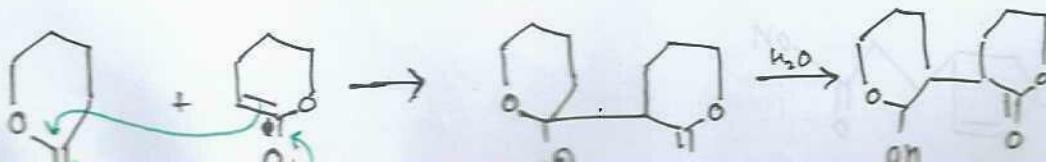
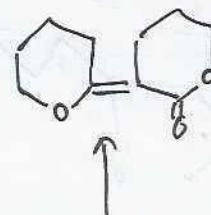
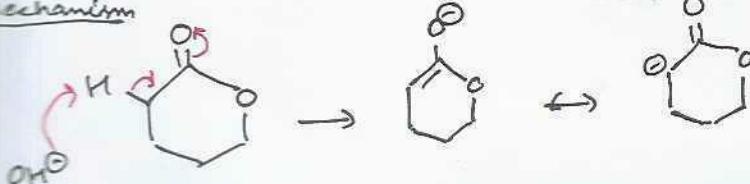
## LACTONES

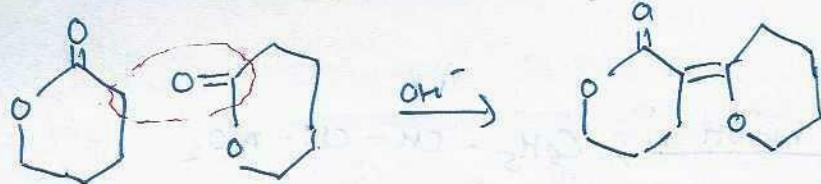
(not normal esters)  $\rightarrow$  only cyclic esters.



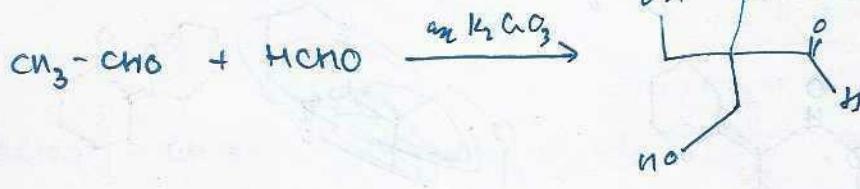
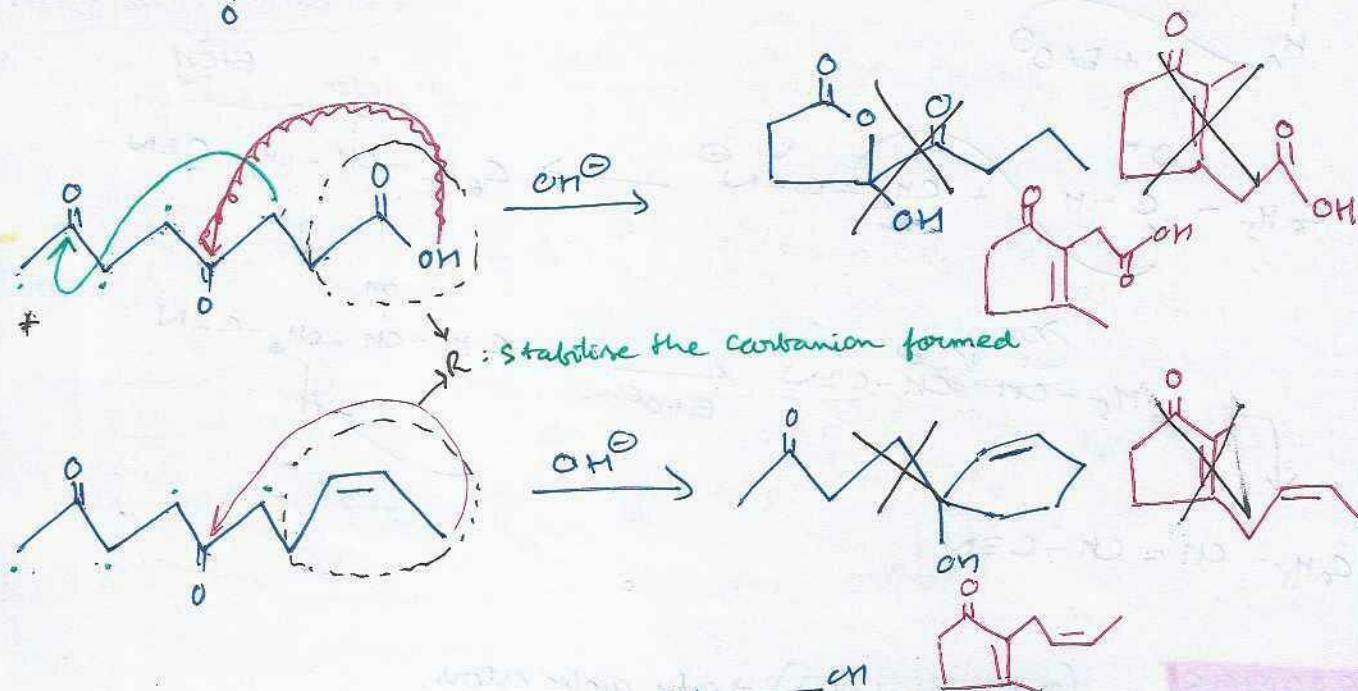
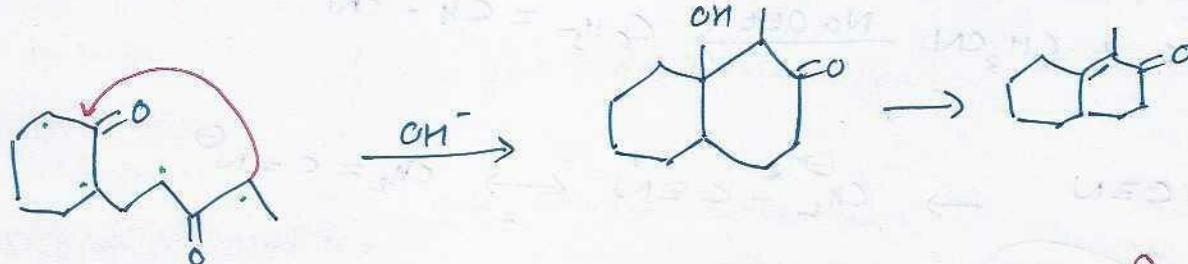
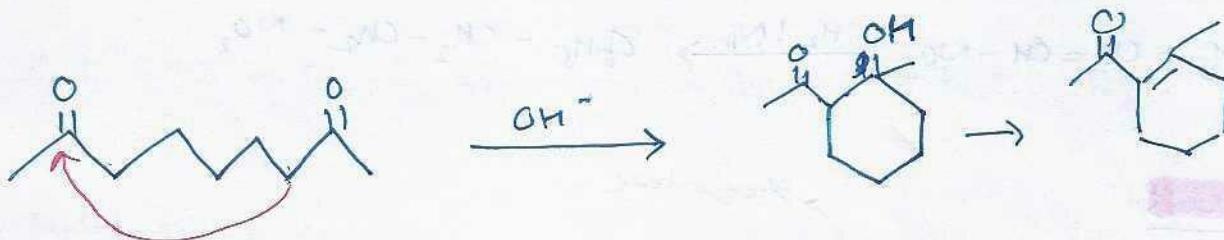
- ~~hydrox~~ show acidic nature.

mechanism



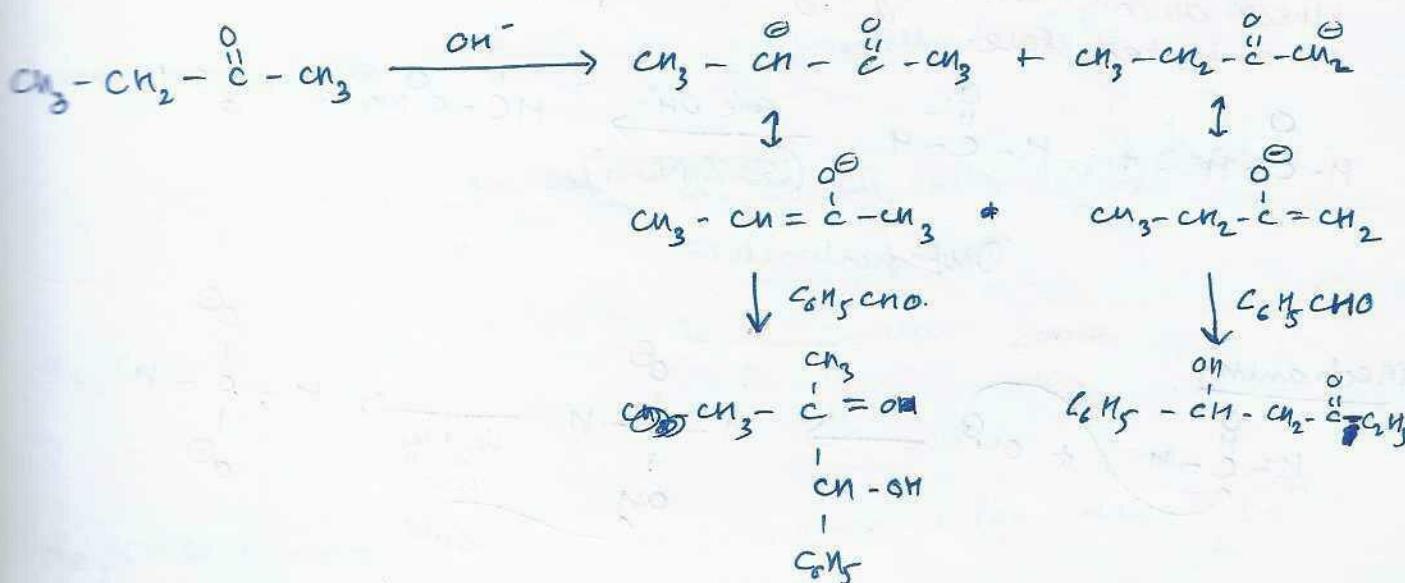
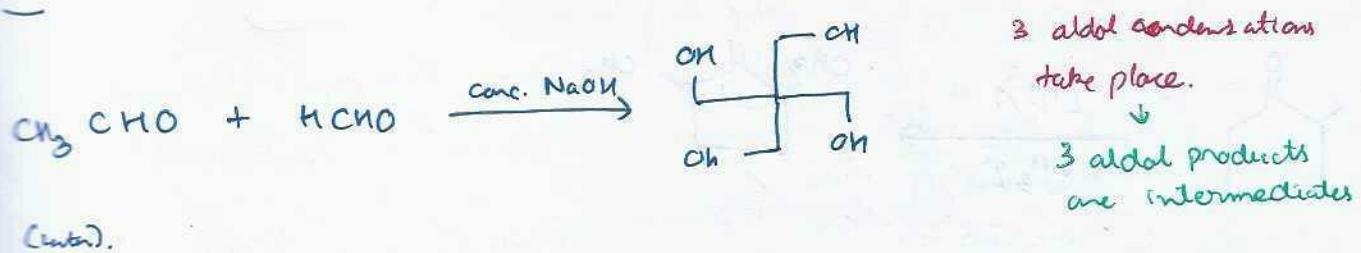
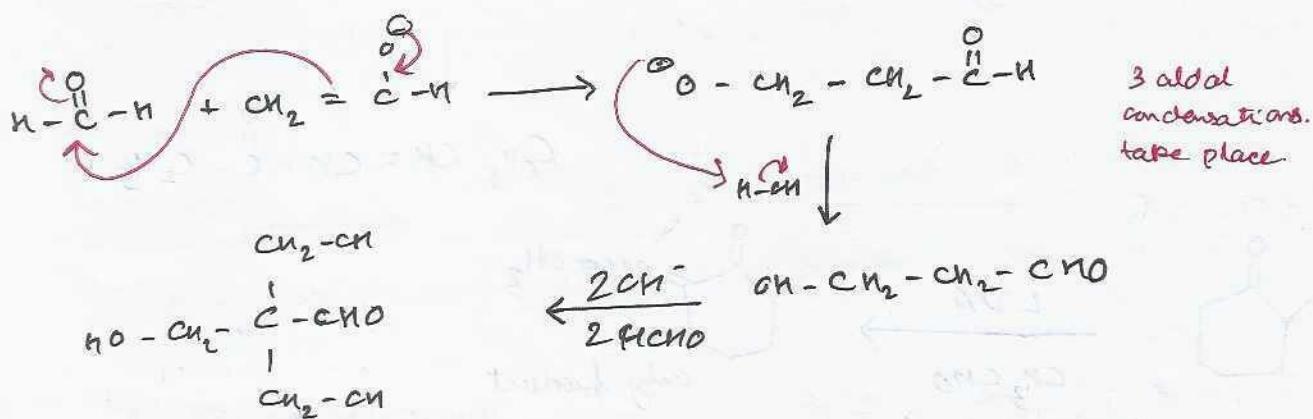
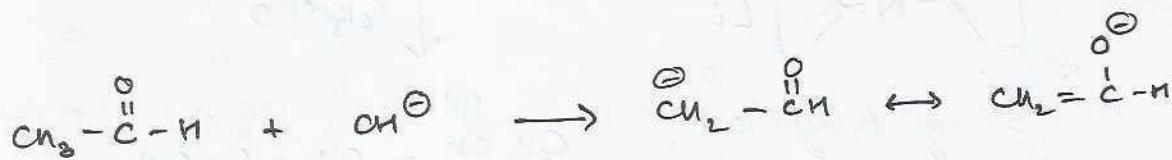
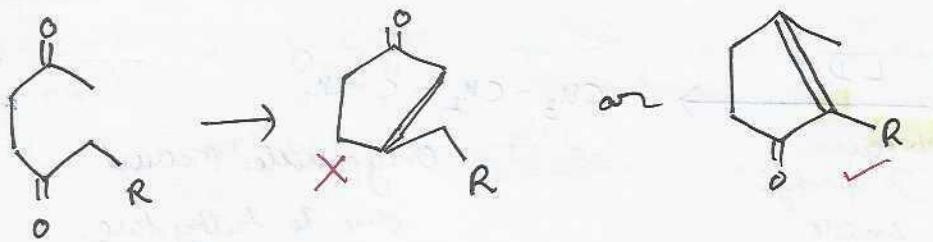


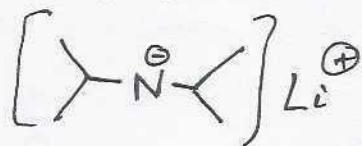
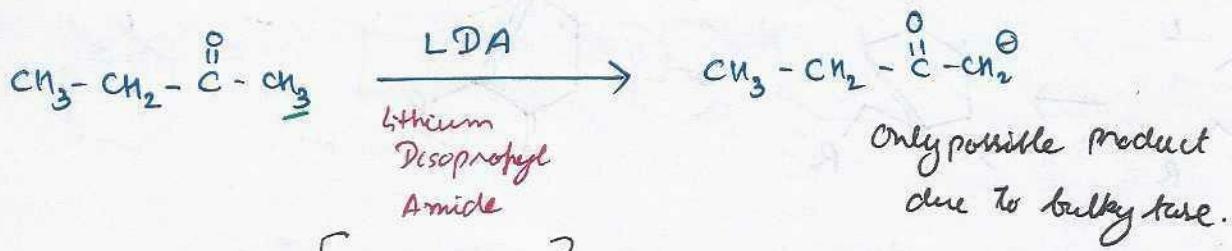
No need of heating  
in case of cyclization



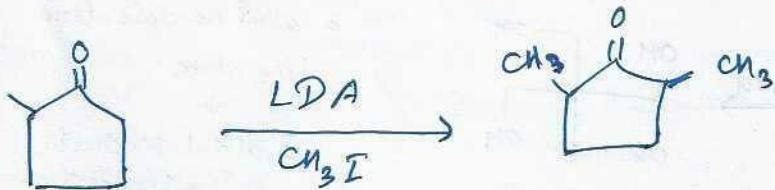
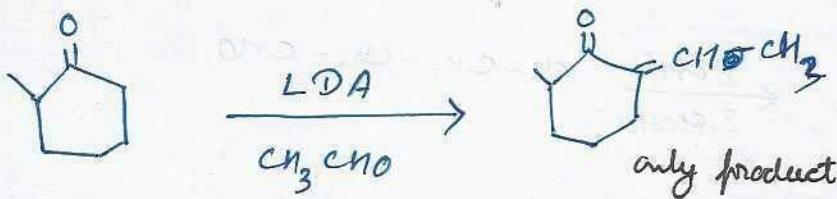
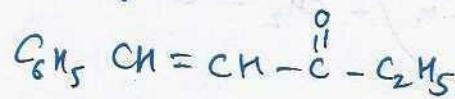
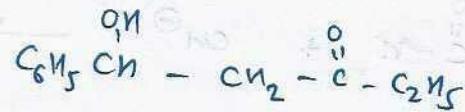
$\text{COO}^-$  is resonance stabilized.







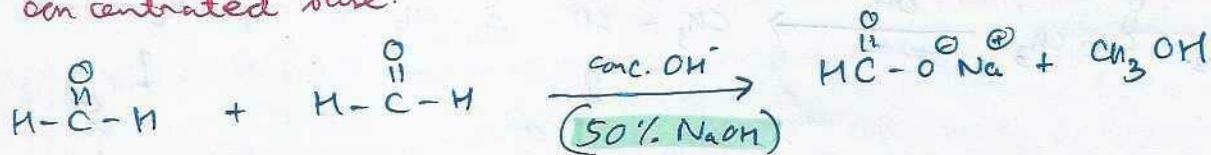
Strong bulky base.



## CANNIZARO REACTION

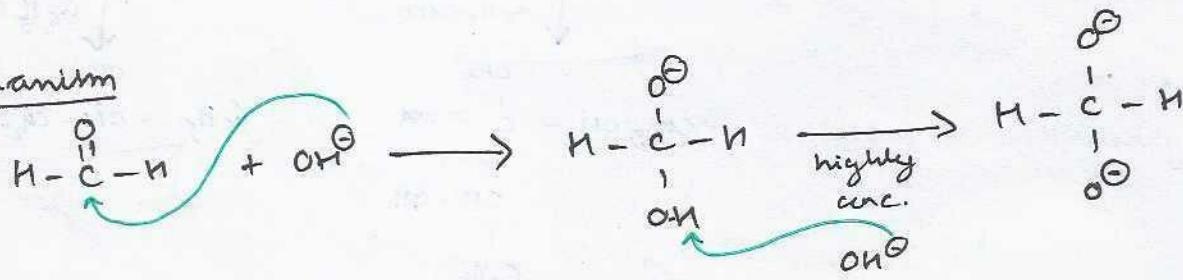
yield as 50-60%

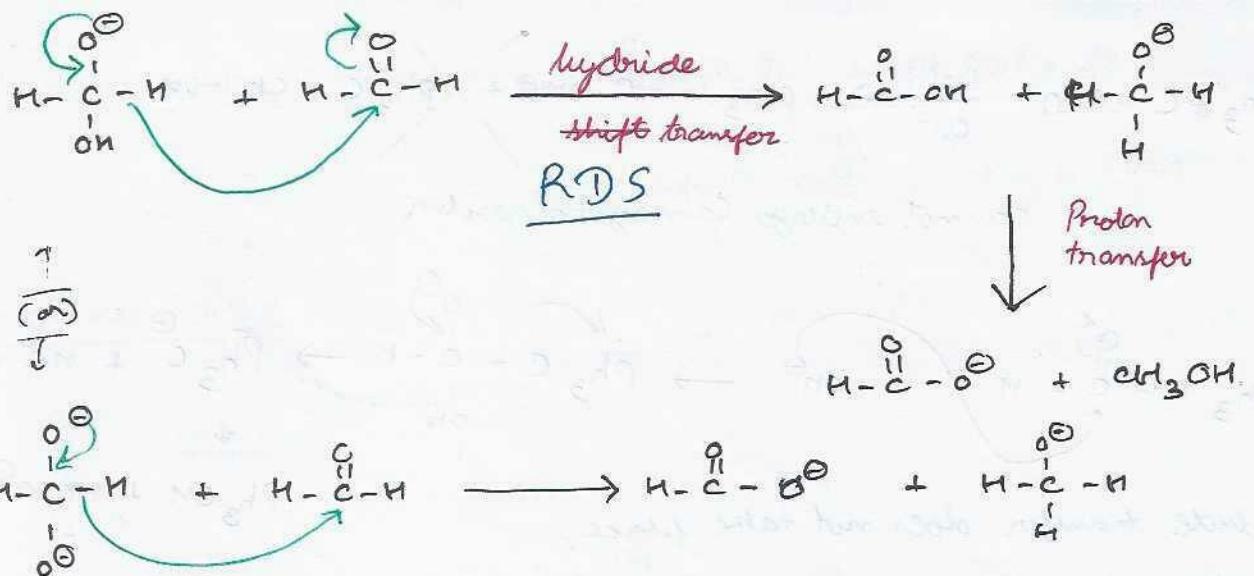
which do not have  $\alpha$ -hydrogen can undergo Cannizaro reaction with concentrated base.



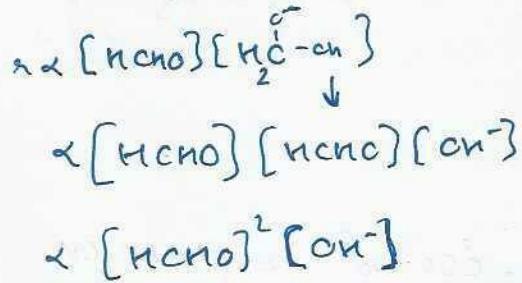
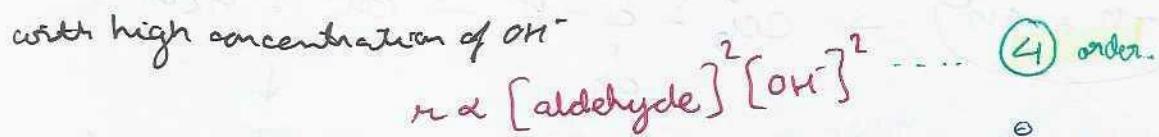
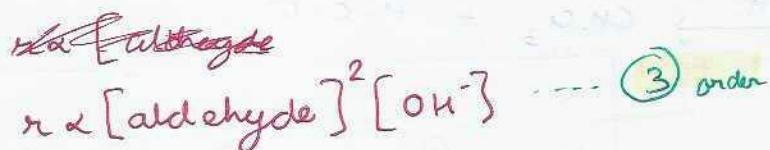
Dissproportionation

### Mechanism

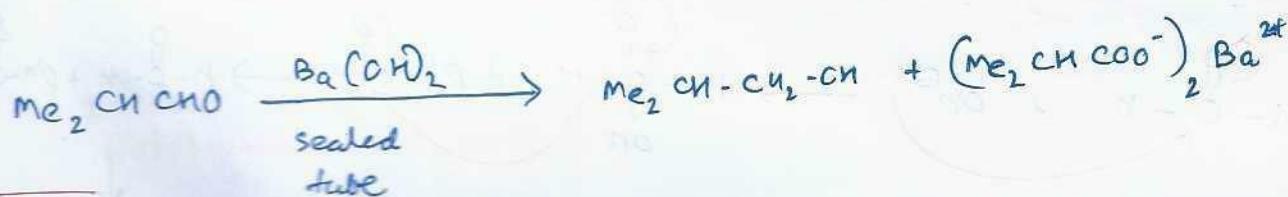
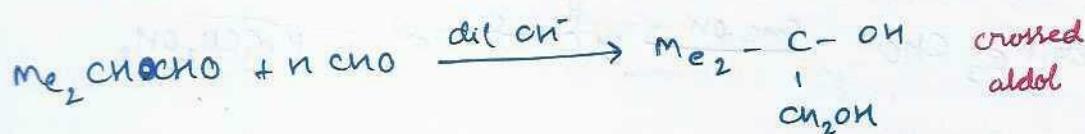
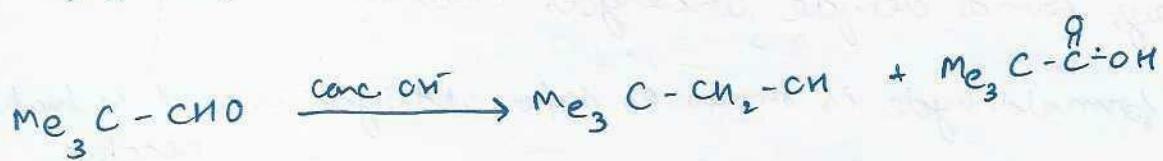
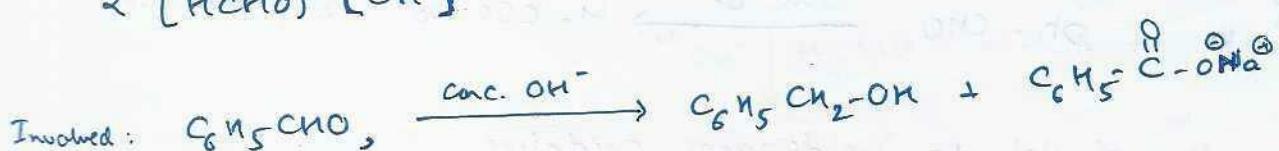




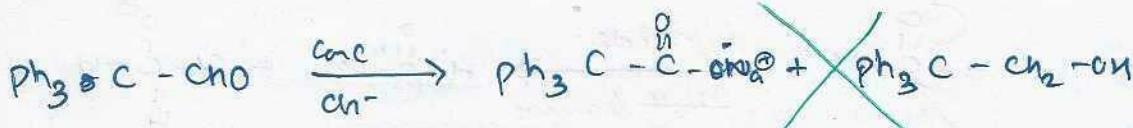
Order of Reaction.



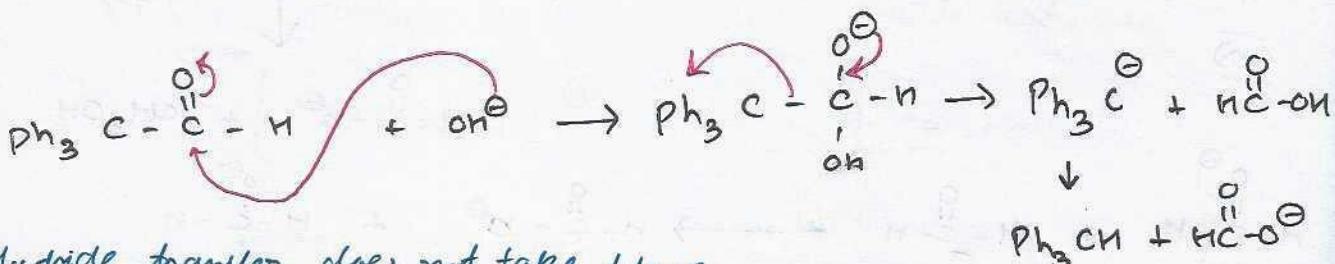
$$K_{eq} = \frac{[H_2C=O]}{[HCHO][OH^-]}$$



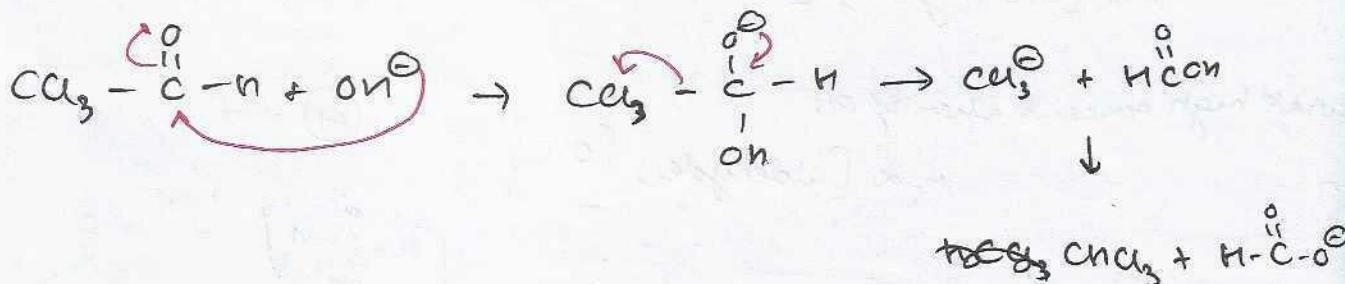
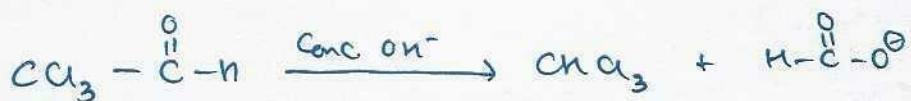
only one  $\alpha$ -hydrogen availability  $\rightarrow$  reversible reaction.



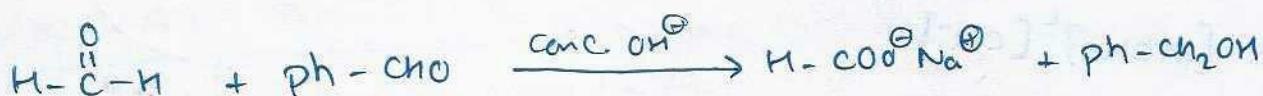
cannot undergo Cannizzaro reaction



Hydride transfer does not take place,  
so it is not a Cannizzaro reaction

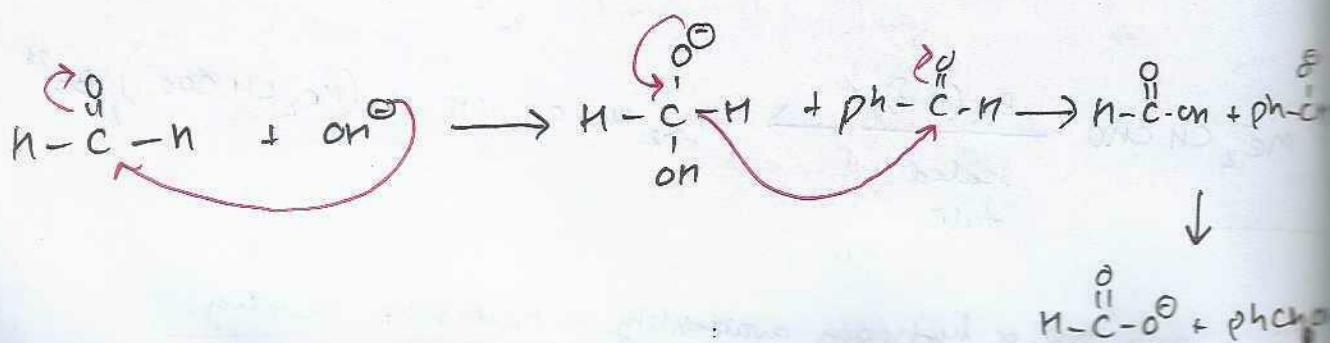
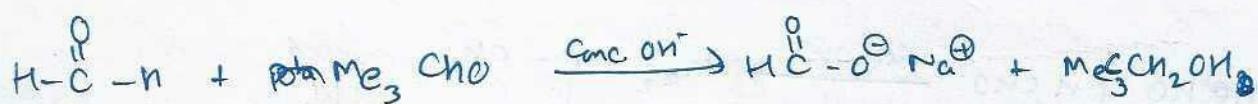


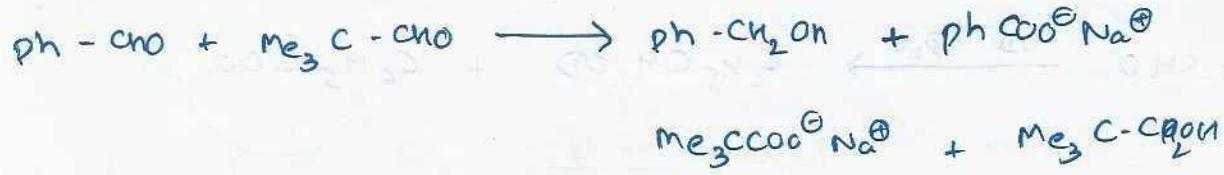
### CROSSED CANNIZARO



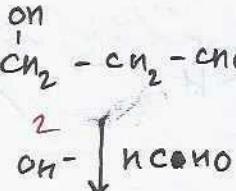
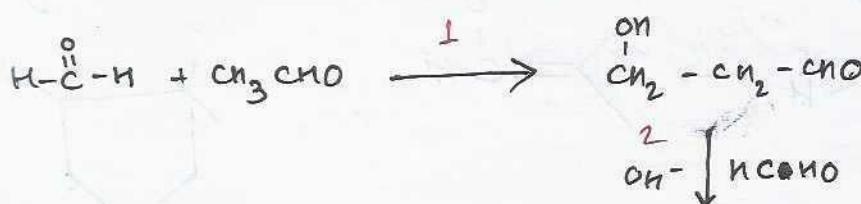
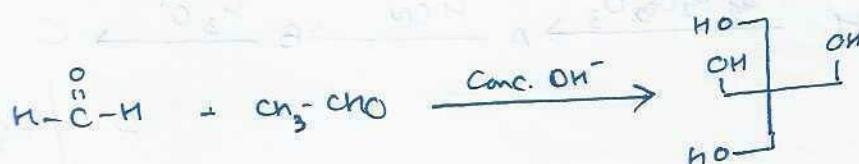
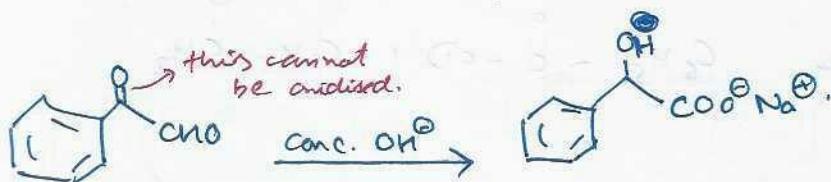
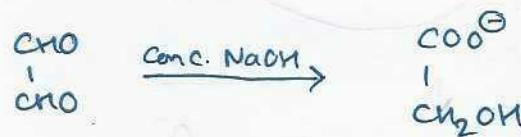
always formaldehyde undergoes oxidation.

formaldehyde is known as super aldehyde  $\rightarrow$  as it is highly reactive.

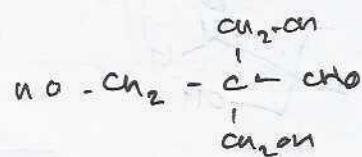
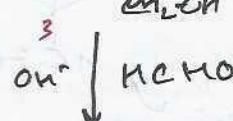
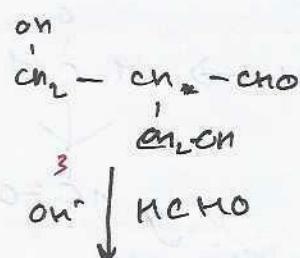




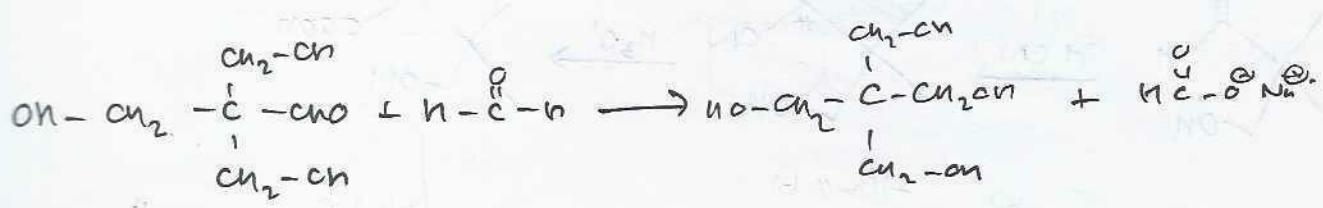
### INTRAMOLECULAR



3 aldol condensation reaction

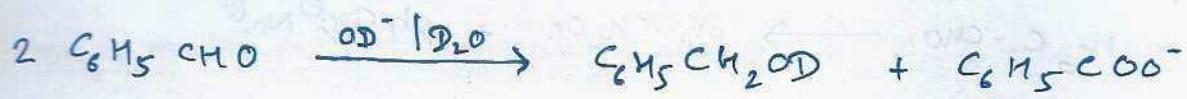


1 Cannizzaro reaction.

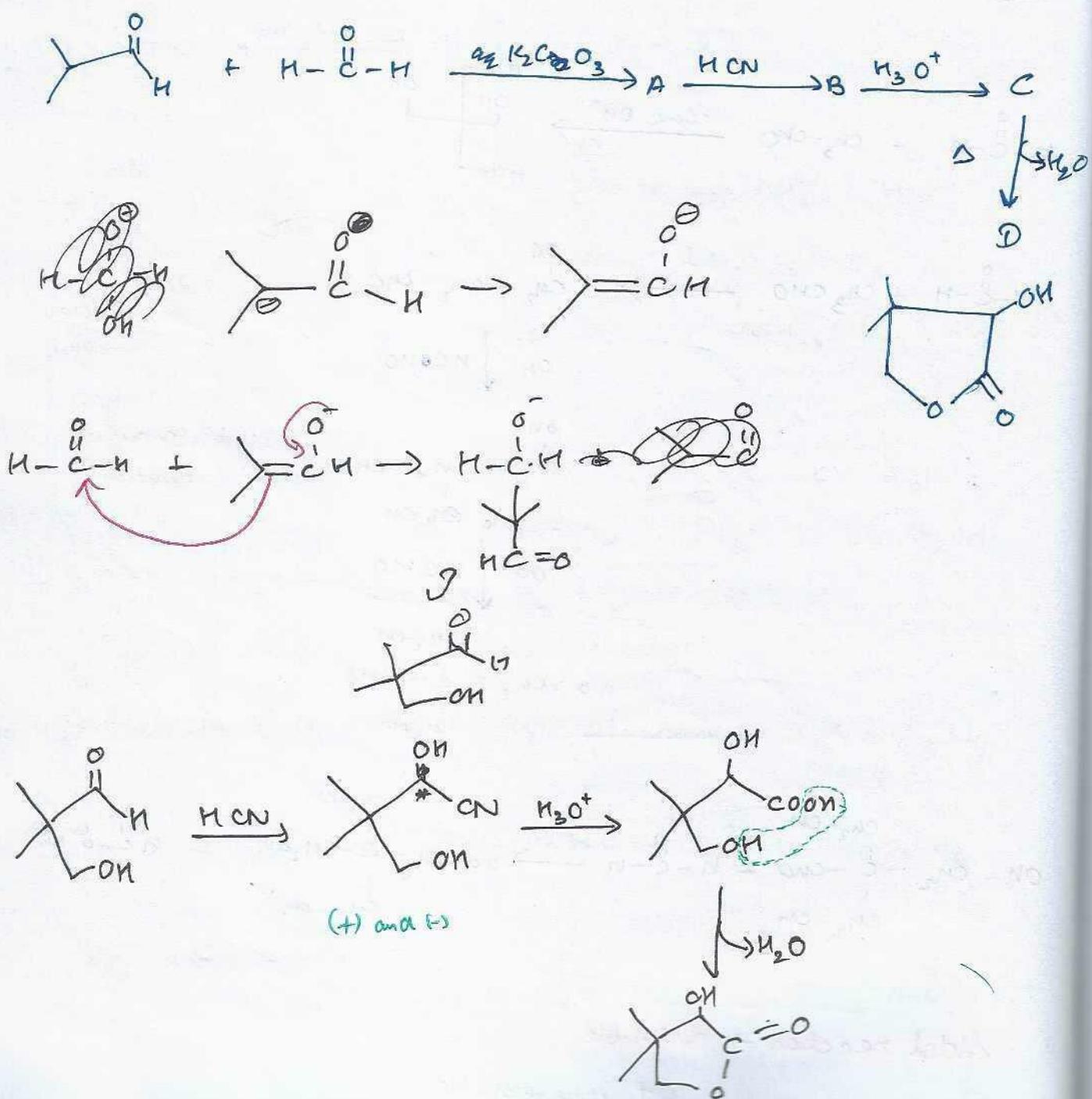
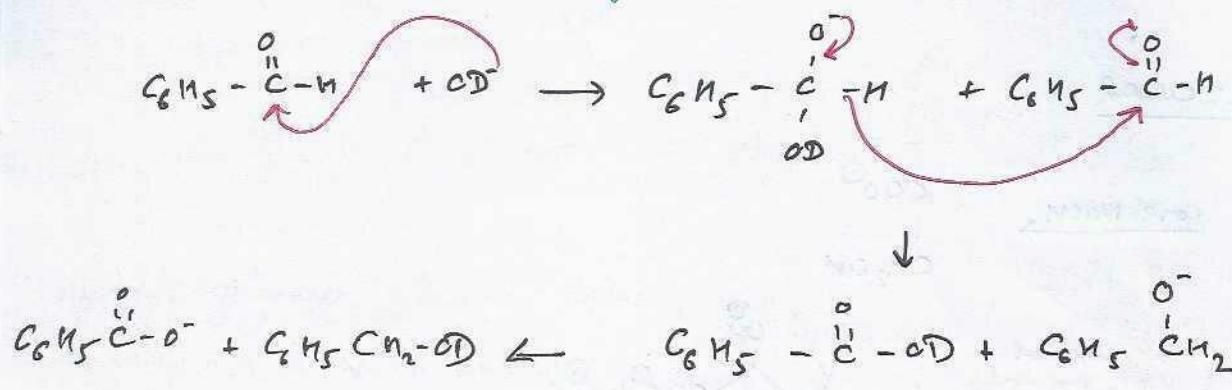


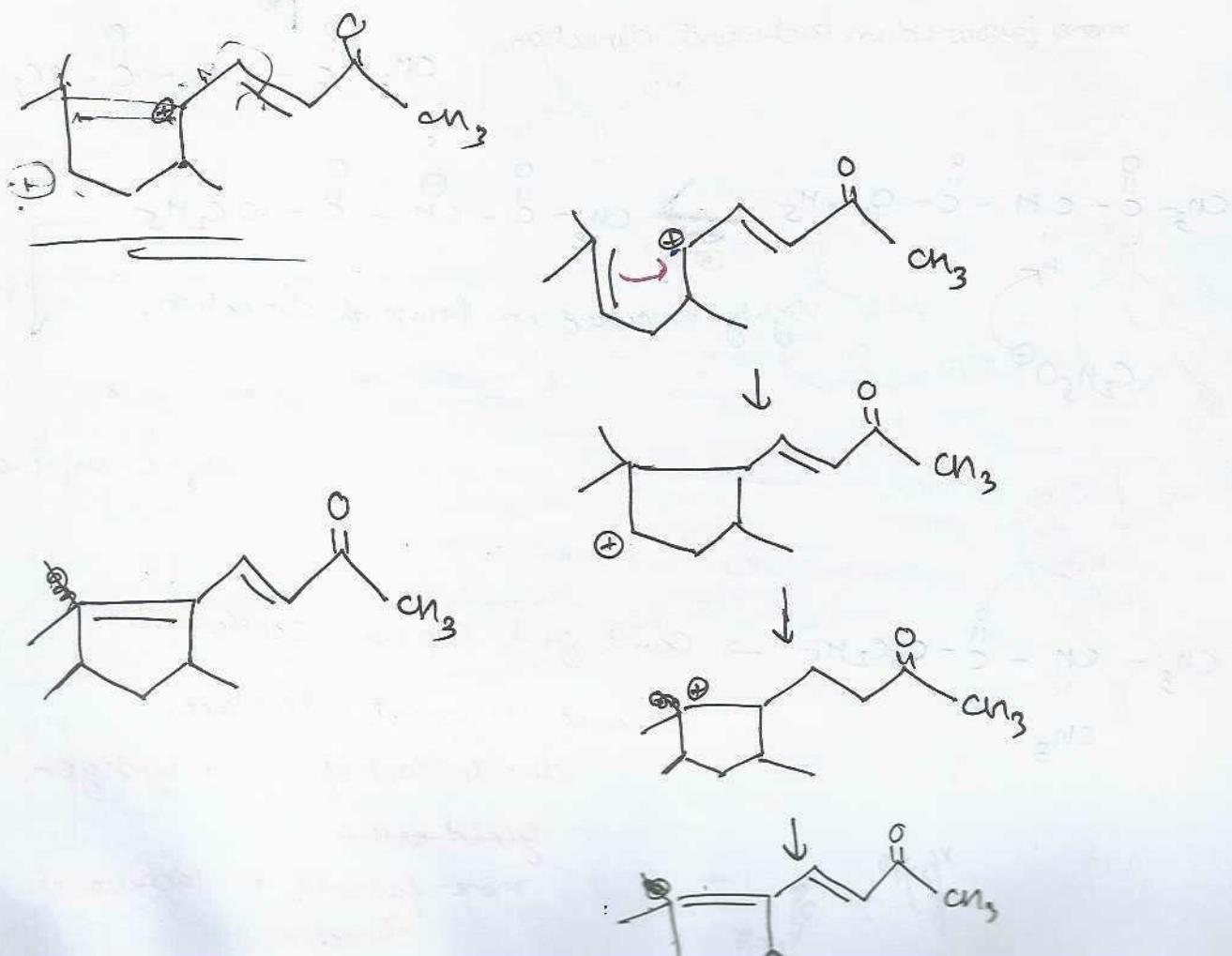
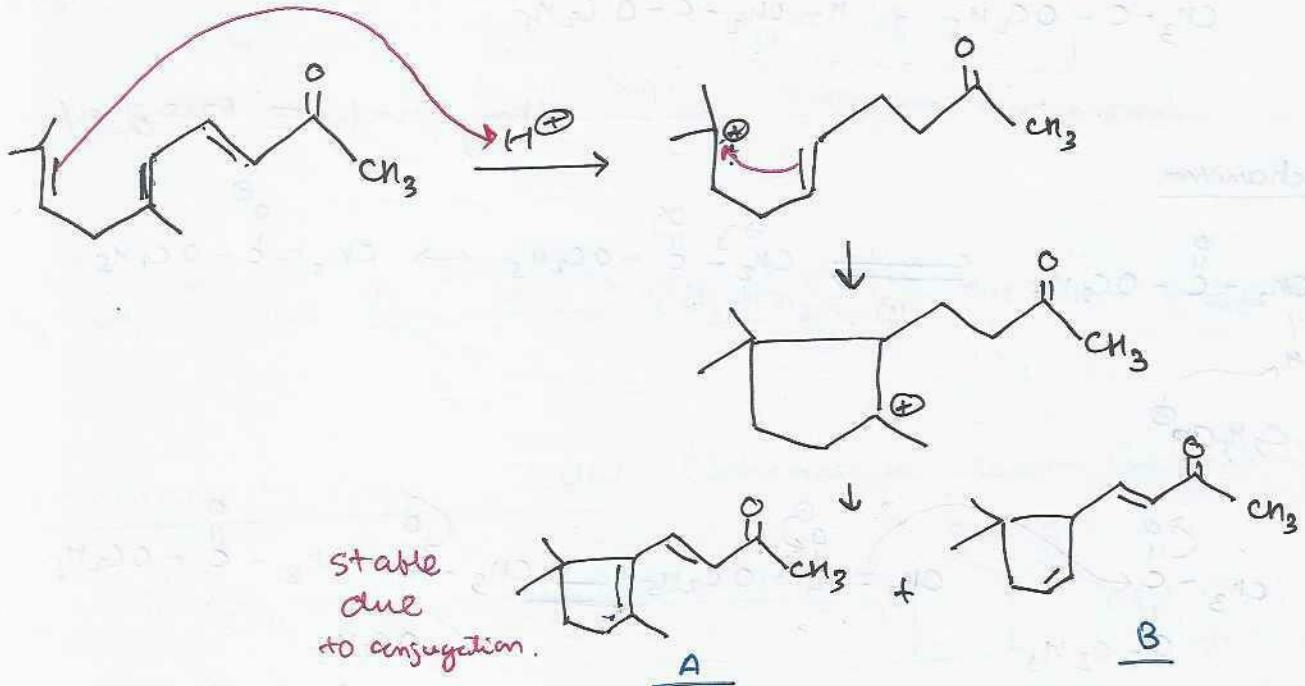
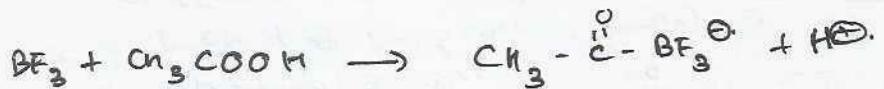
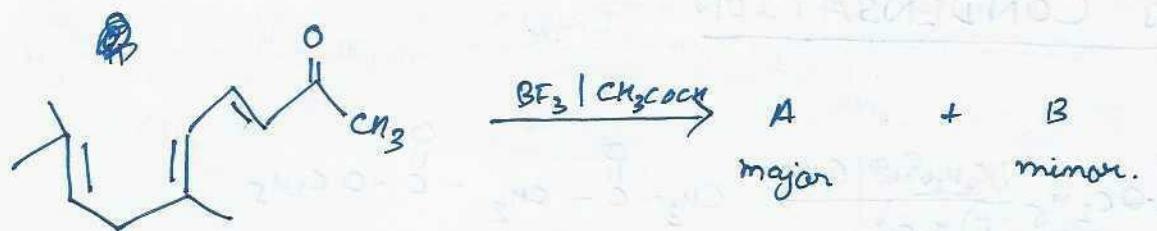
Aldol reaction  $\rightarrow$  Reversible

Cannizzaro  $\rightarrow$  Slow but irreversible

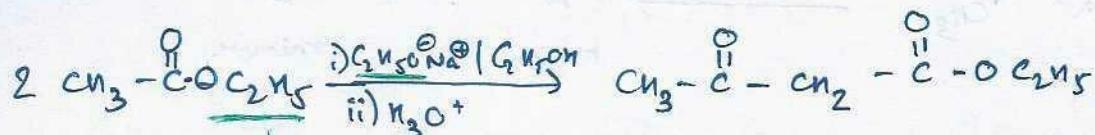


hydride transfer.





# CLAISEN CONDENSATION

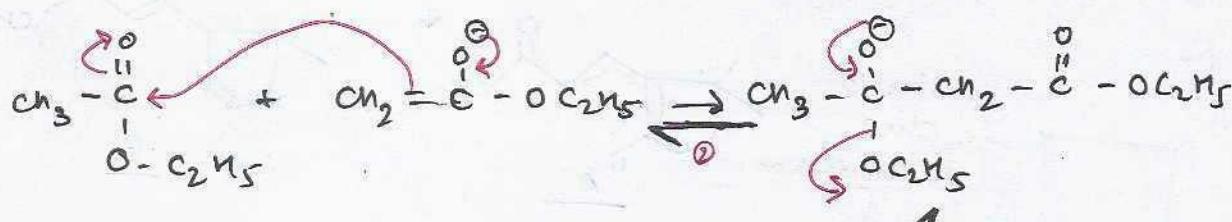
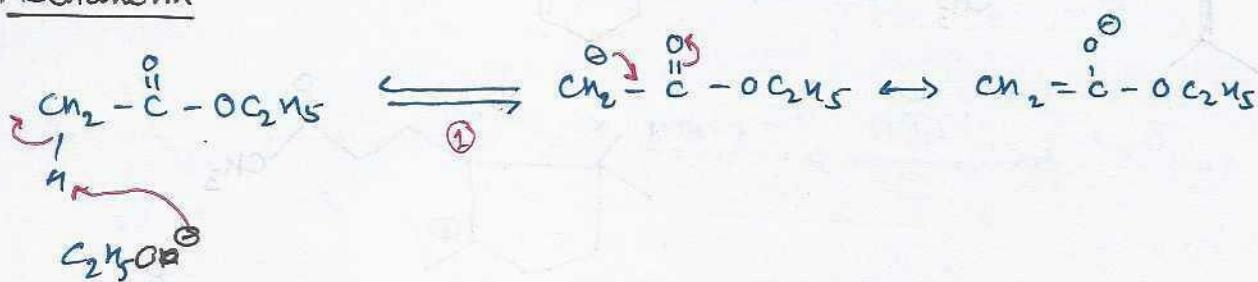


Some base is used as  
(alkoxy). this group to prevent  
trans esterification.

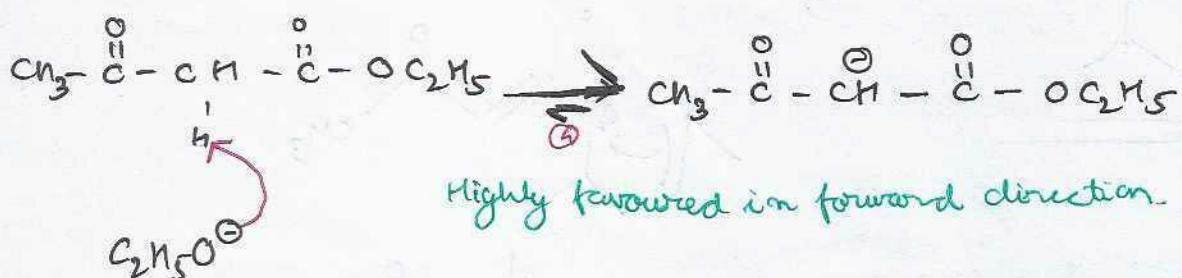
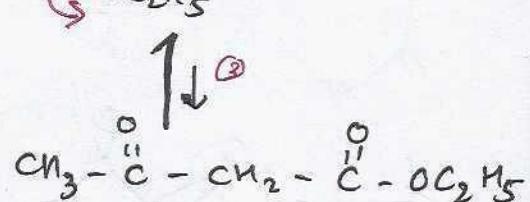


alkoxy group  $\equiv$  base group.

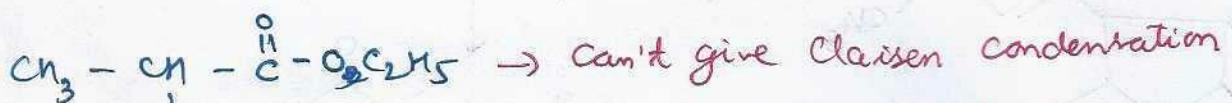
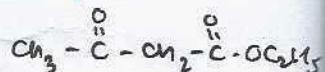
## Mechanism



more favoured in backward direction



60-70% yield

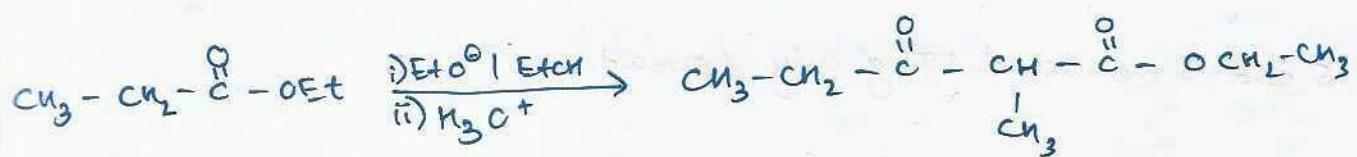
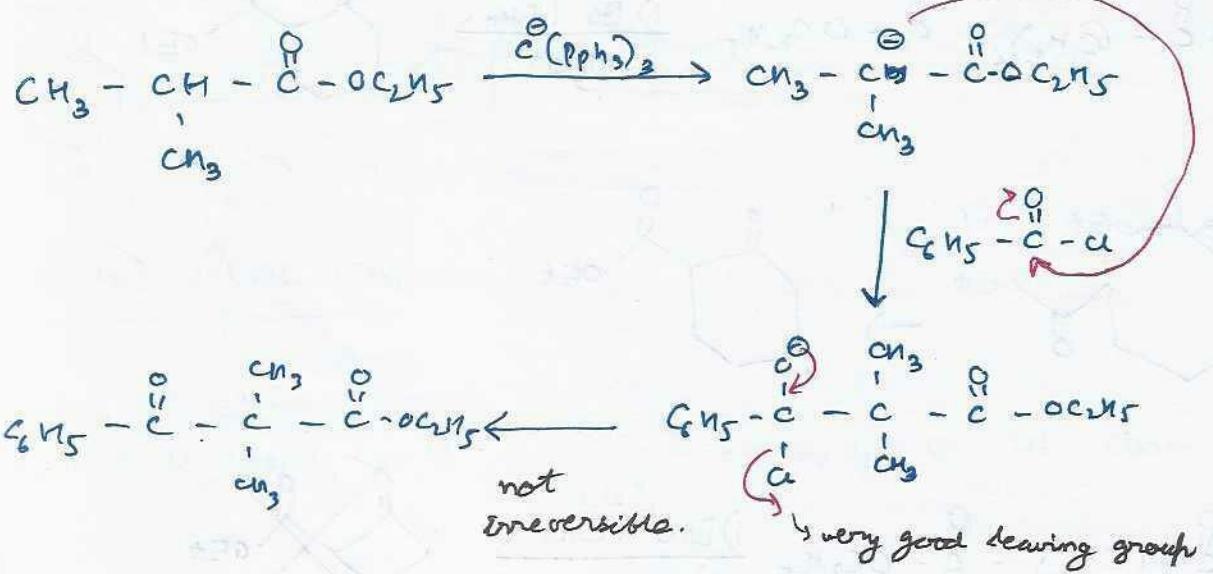


Because ④ cannot take place.

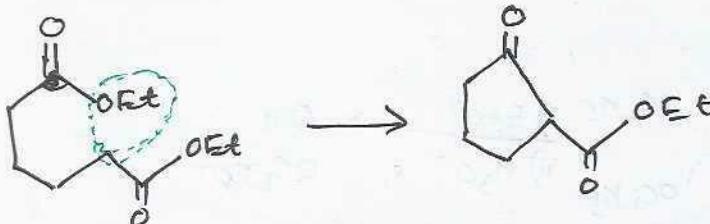
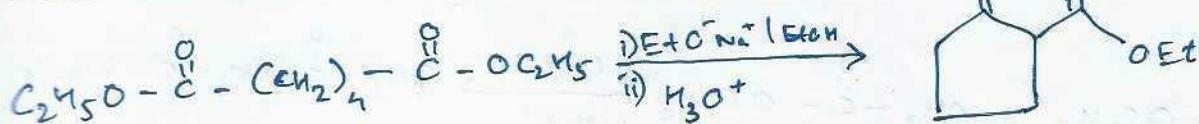
due to lack of acidic hydrogen.

Yield will be

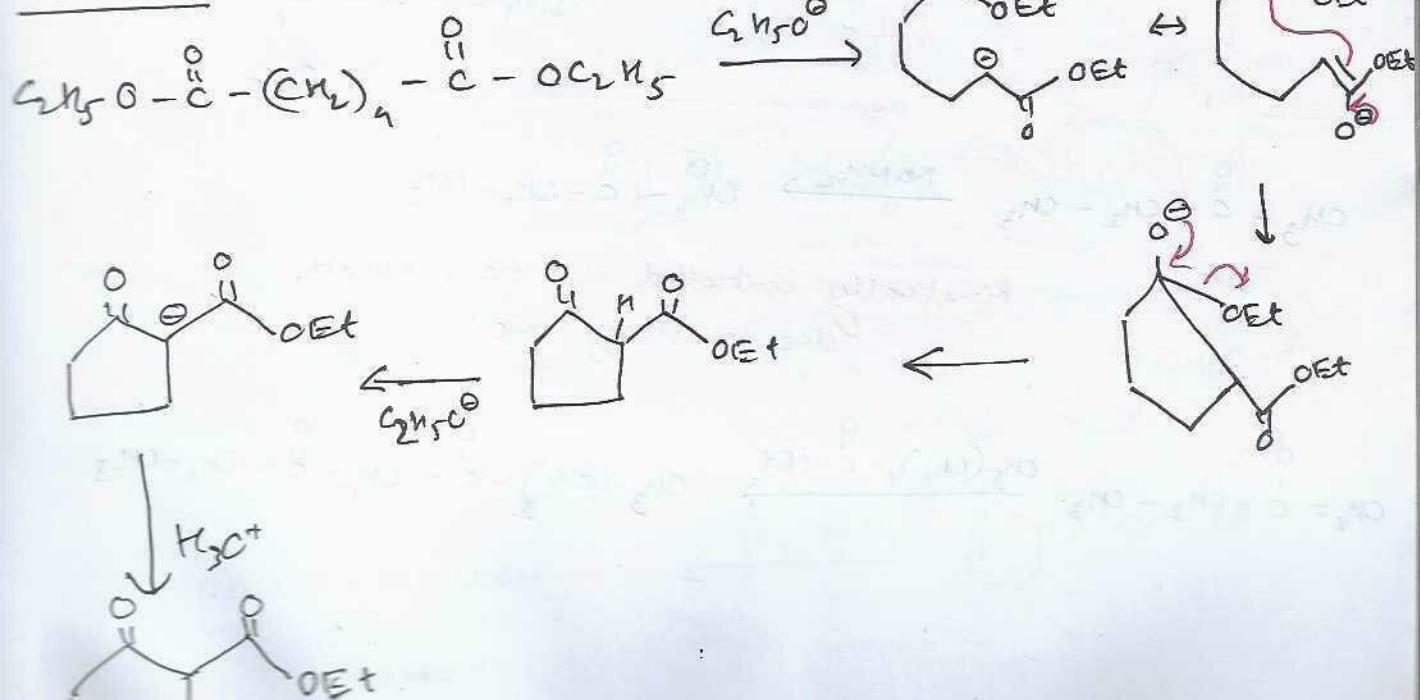
more favoured in backward direction

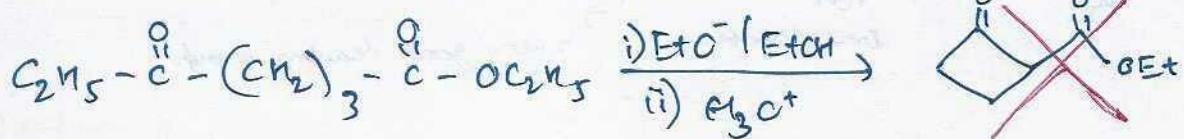
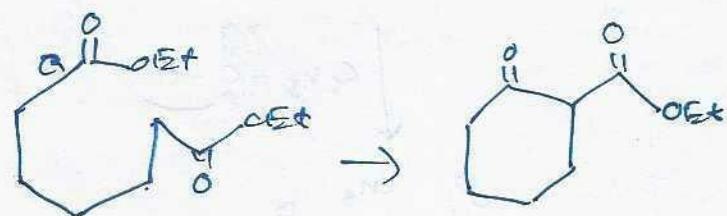


### DIECKMANN CONDENSATION (Intramolecular Claisen Condensation).



#### Mechanism

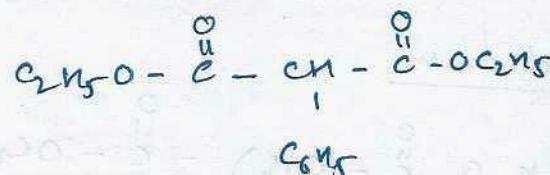
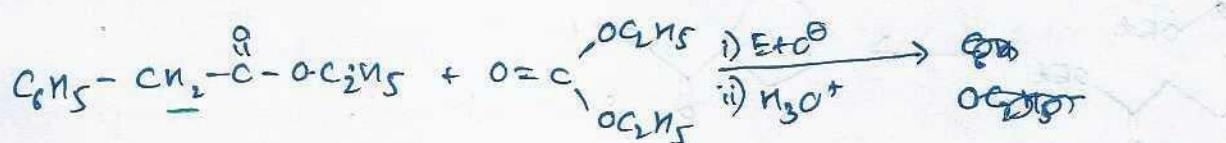




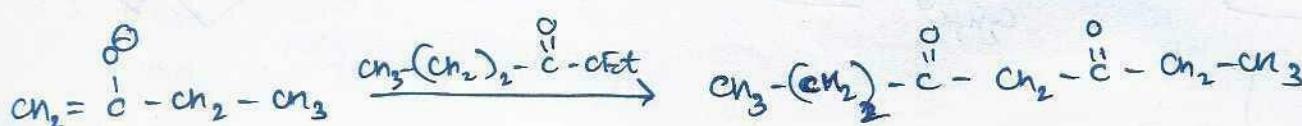
5 and 6 membered ring only formed.

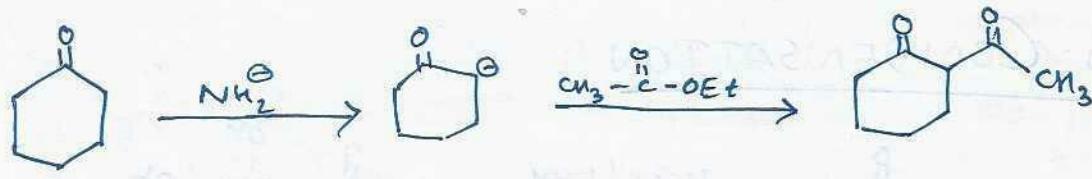
3, 4 → due to strain

7, 8 → entropically disfavoured



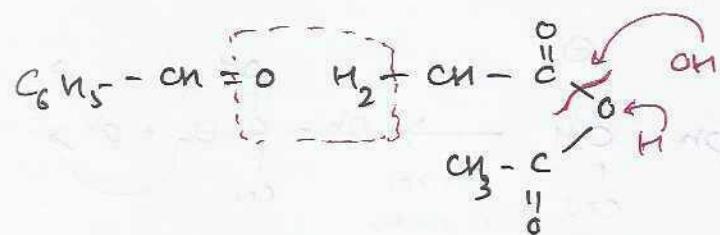
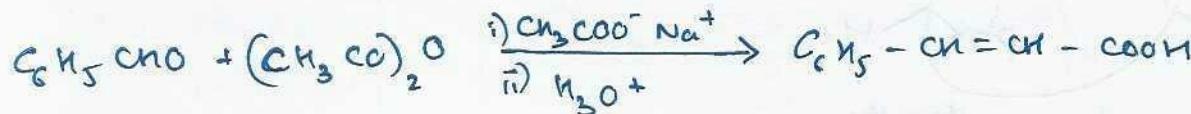
Kinetically controlled is more favoured  
due to strong base



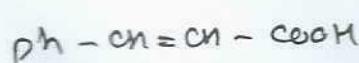
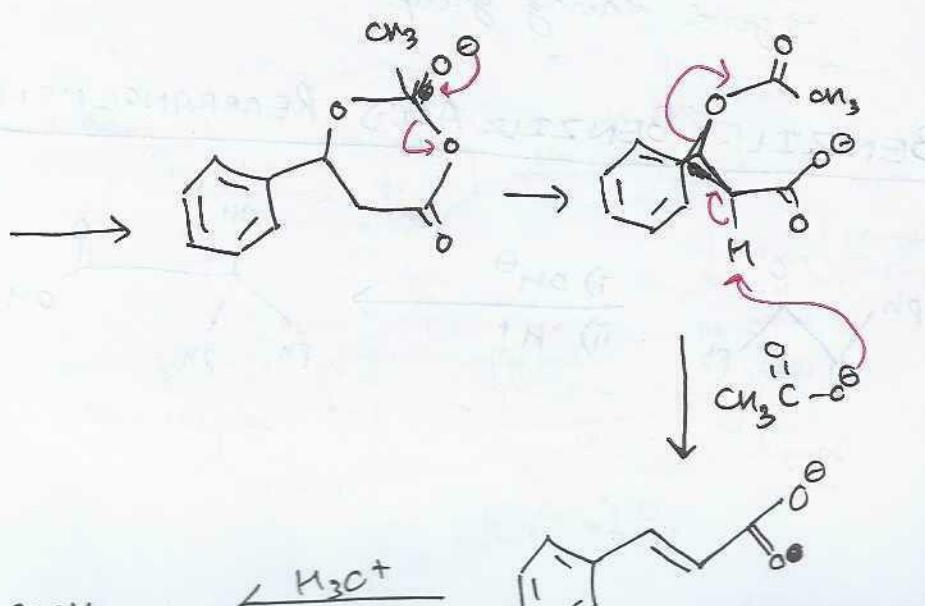
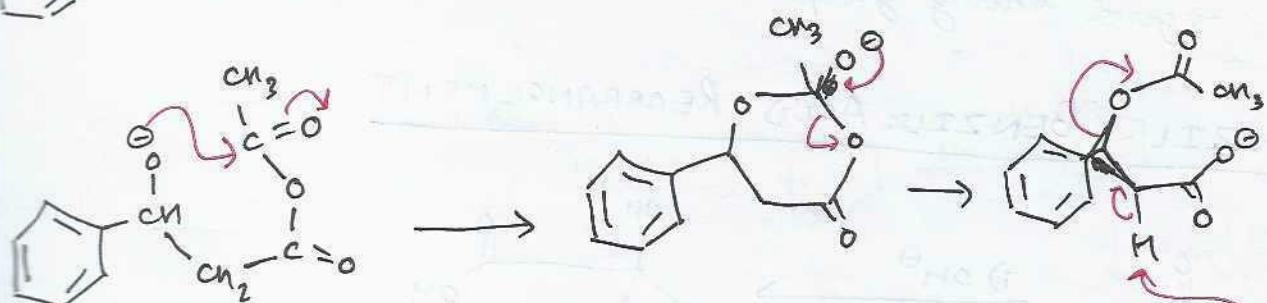
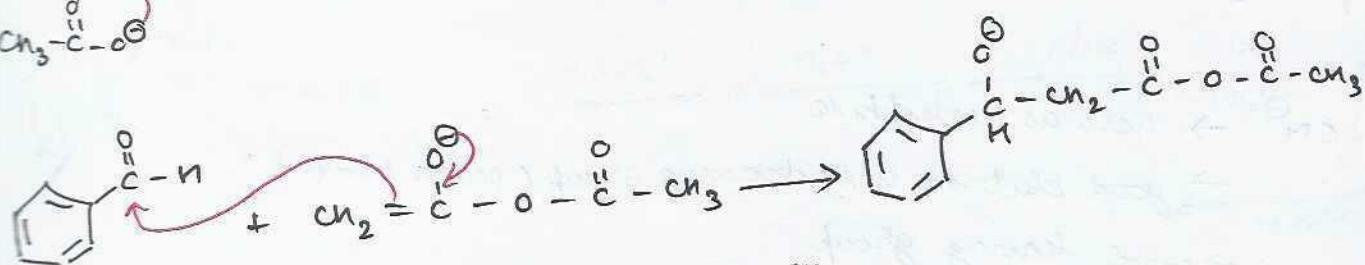
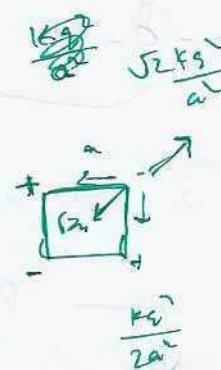
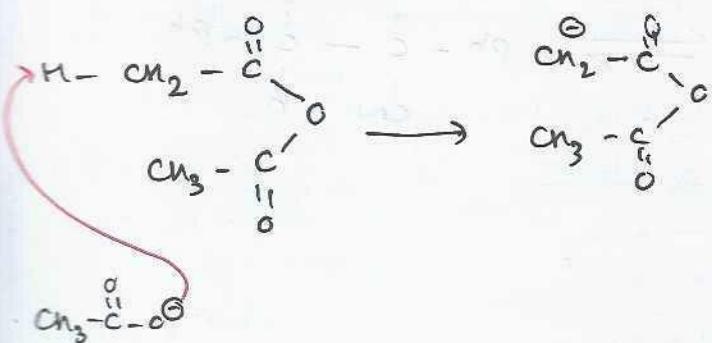


## PERKIN REACTION

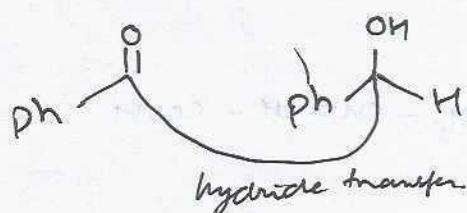
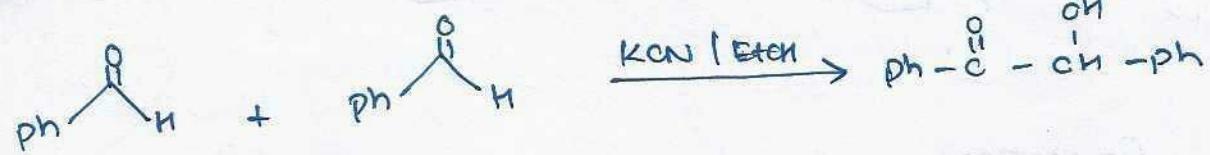
(only given by aromatic aldehydes)



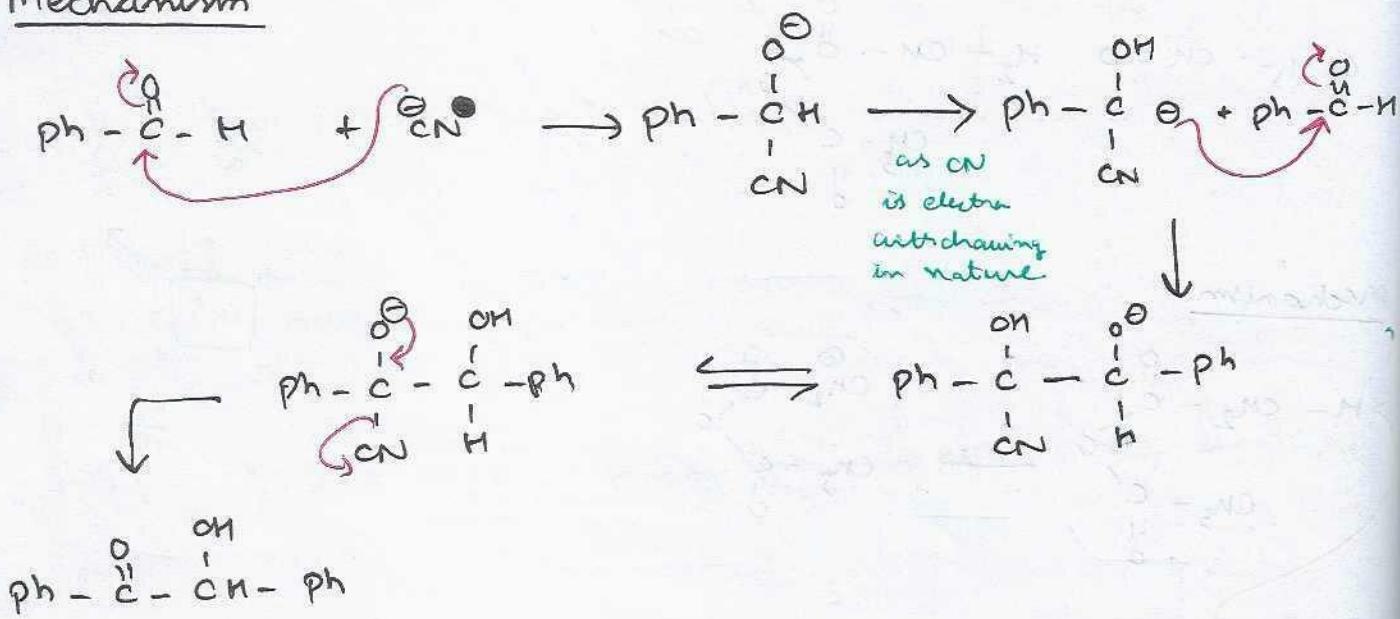
### Mechanism



# BENZOIN CONDENSATION

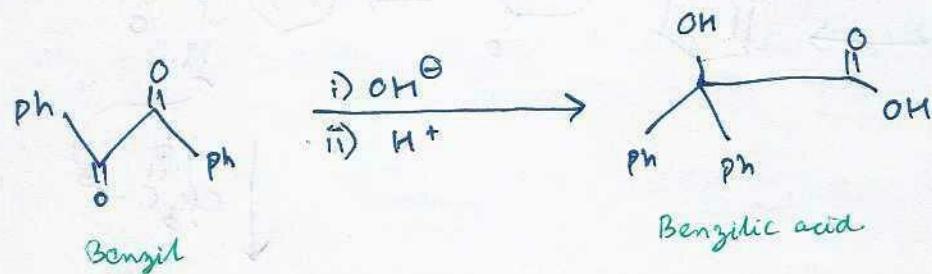


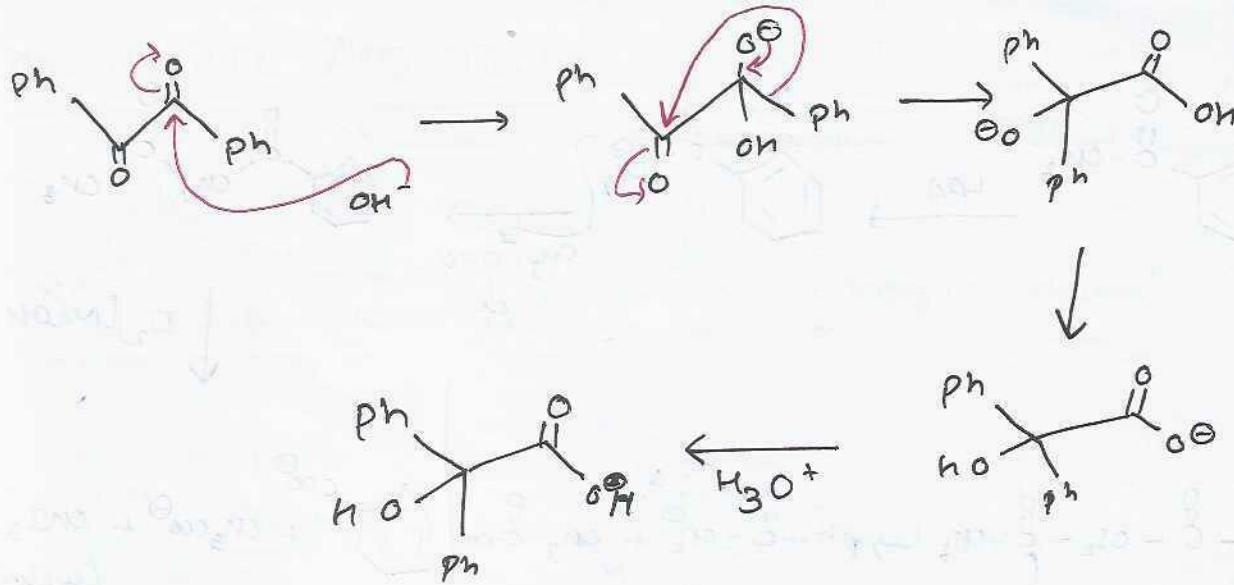
## Mechanism



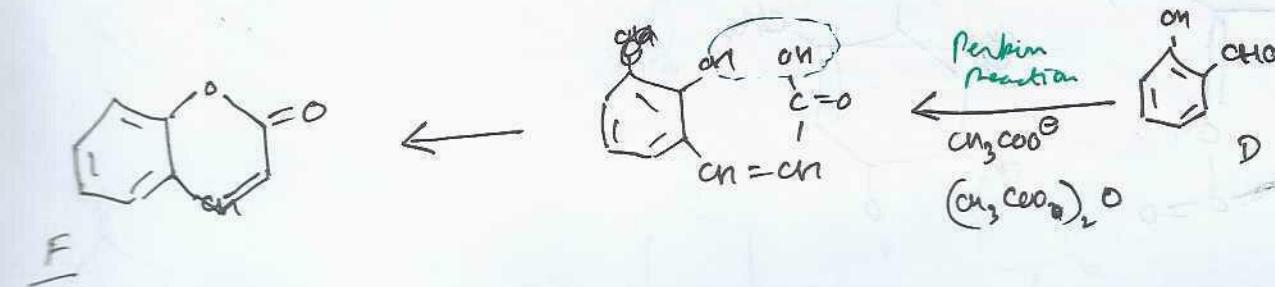
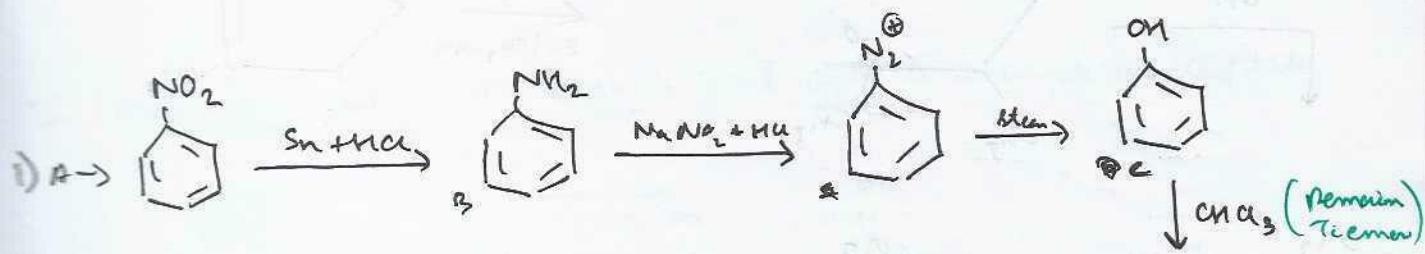
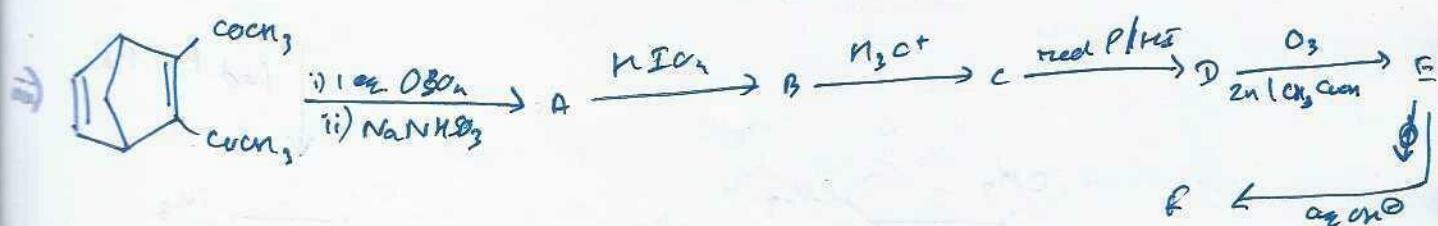
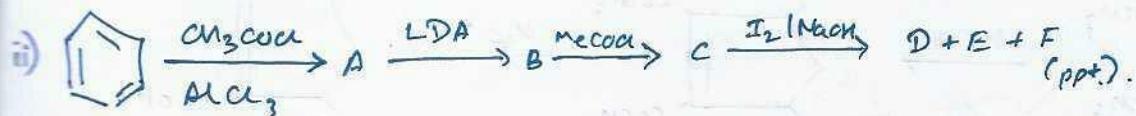
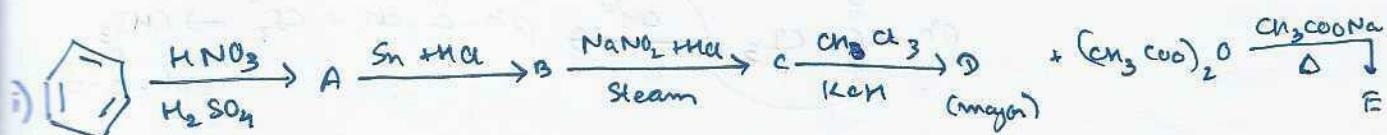
$\text{CN}^-$  → acts as nucleophile  
→ good electron withdrawing group (proton transfer)  
→ good leaving group

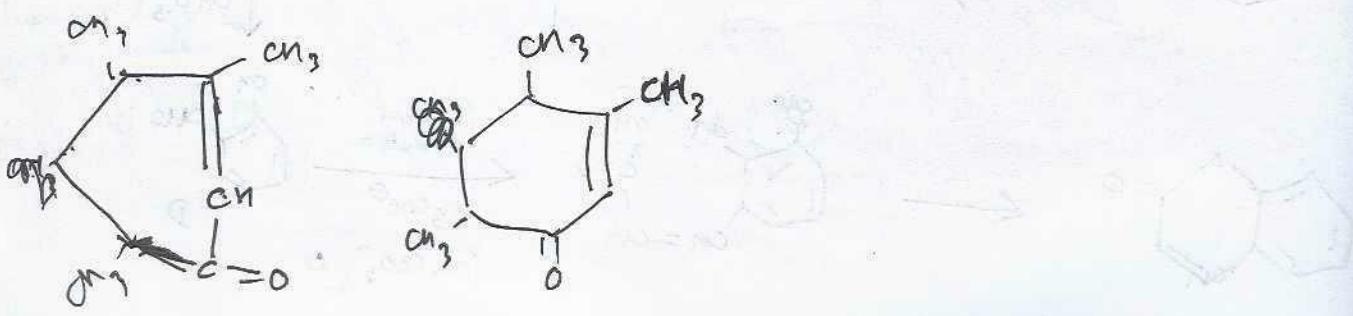
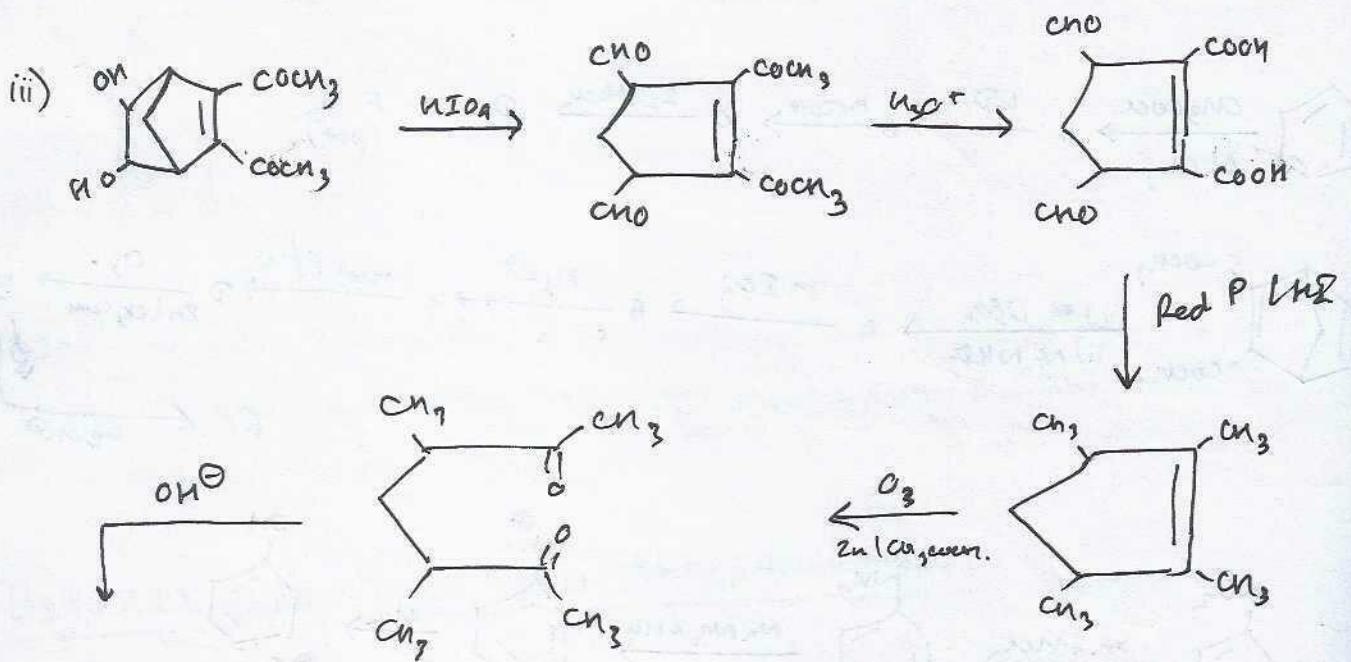
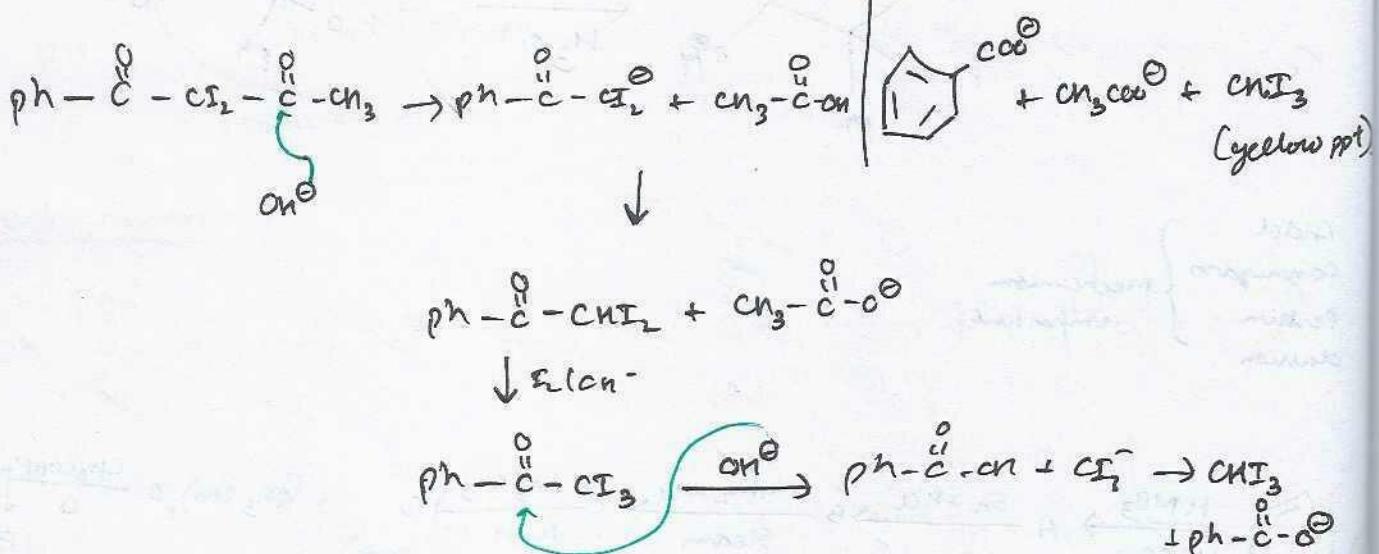
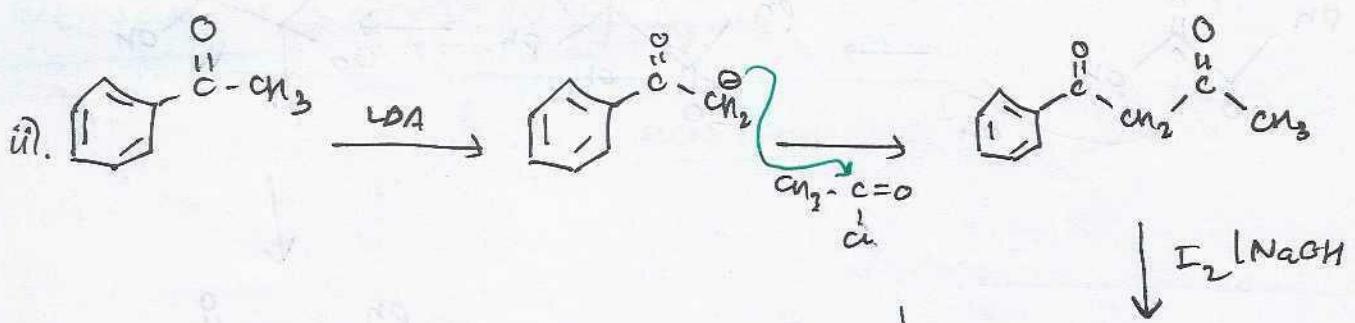
# BENZIL - BENZILIC ACID REARRANGEMENT



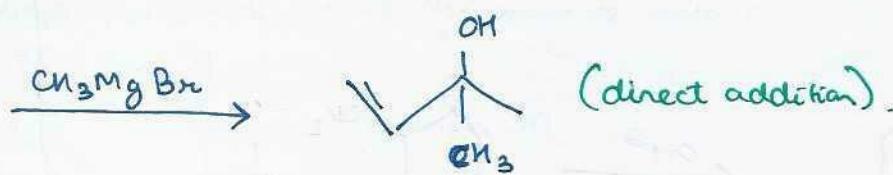


Add  
Cannizzaro  
Perkin  
classical } Mechanism  
important.



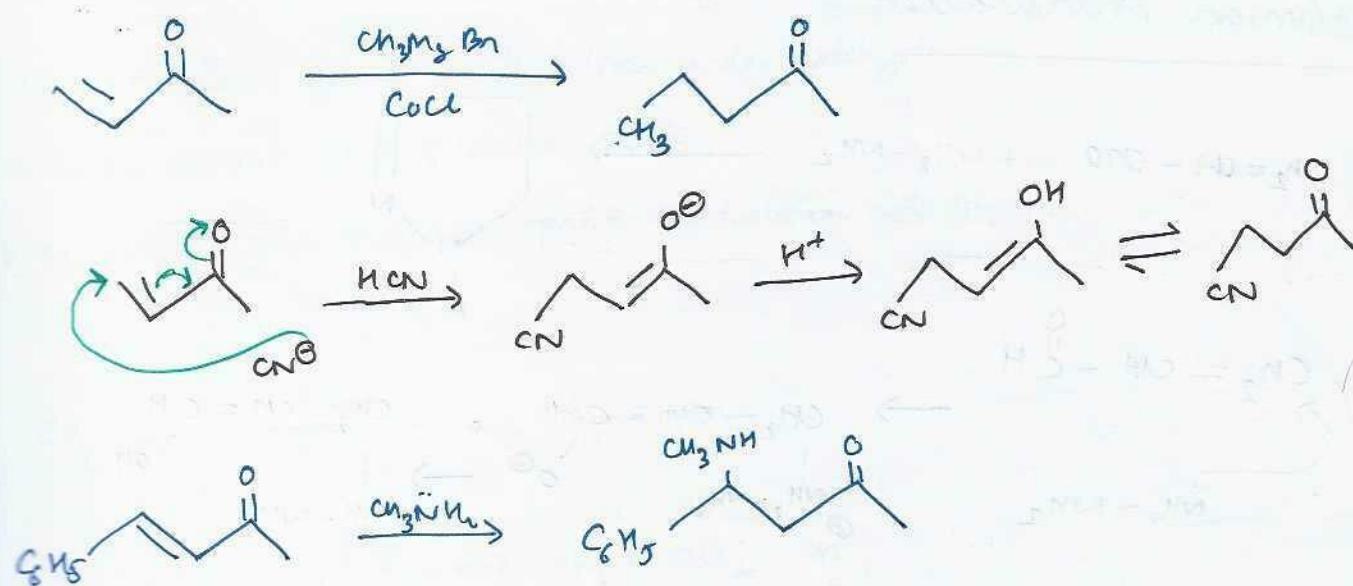


# CONJUGATE ADDITION

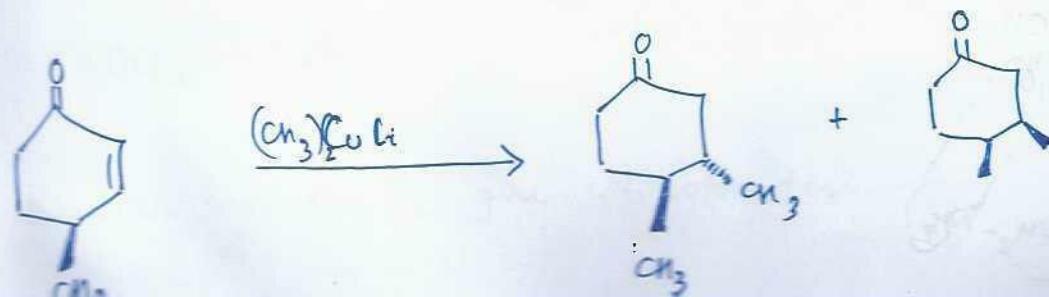
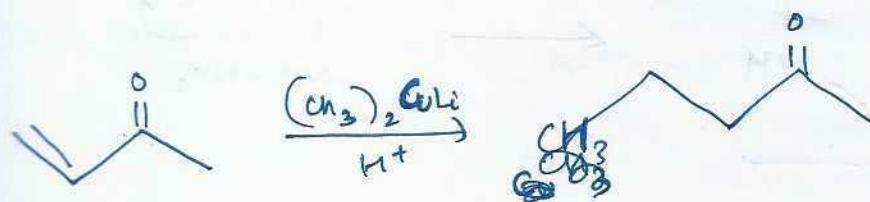


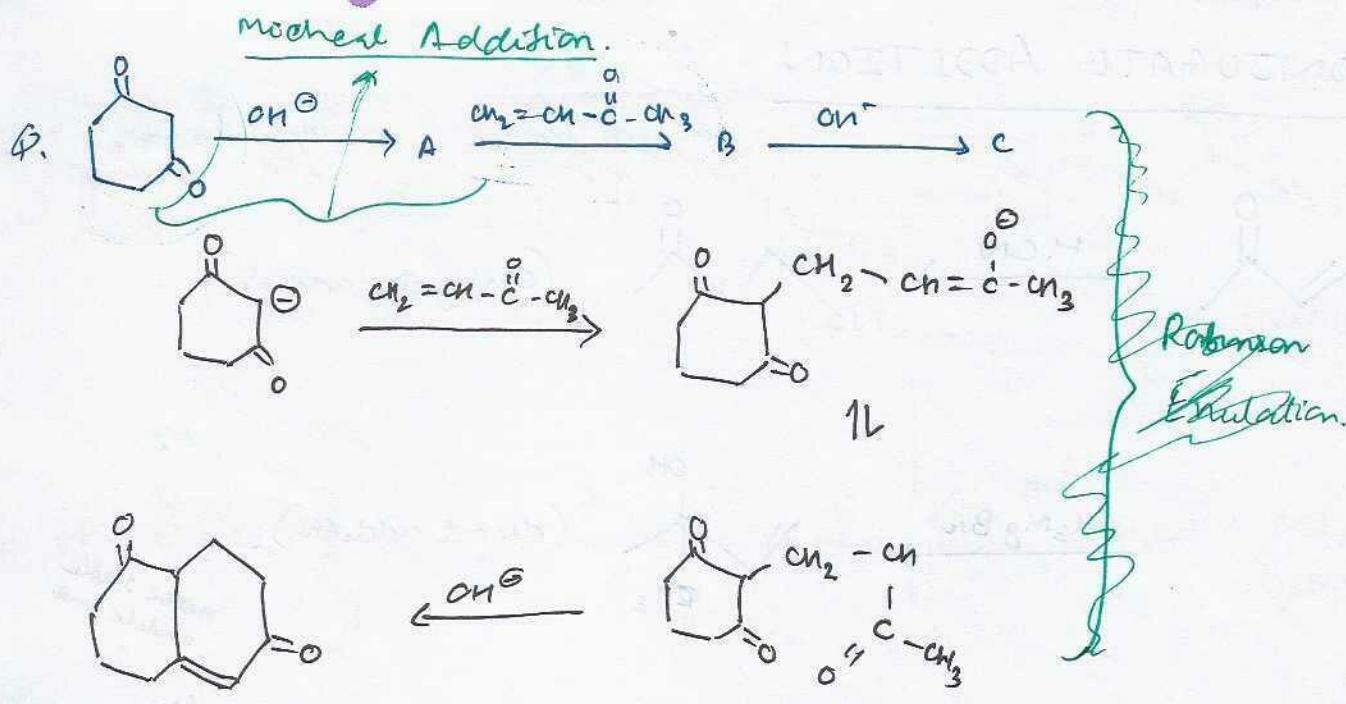
Weak nucleophile  $\longrightarrow$  Conjugate addition (like 1,4-addition) (thermodynamically controlled)

Strong nucleophile  $\longrightarrow$  Direct addition (kinetically controlled).



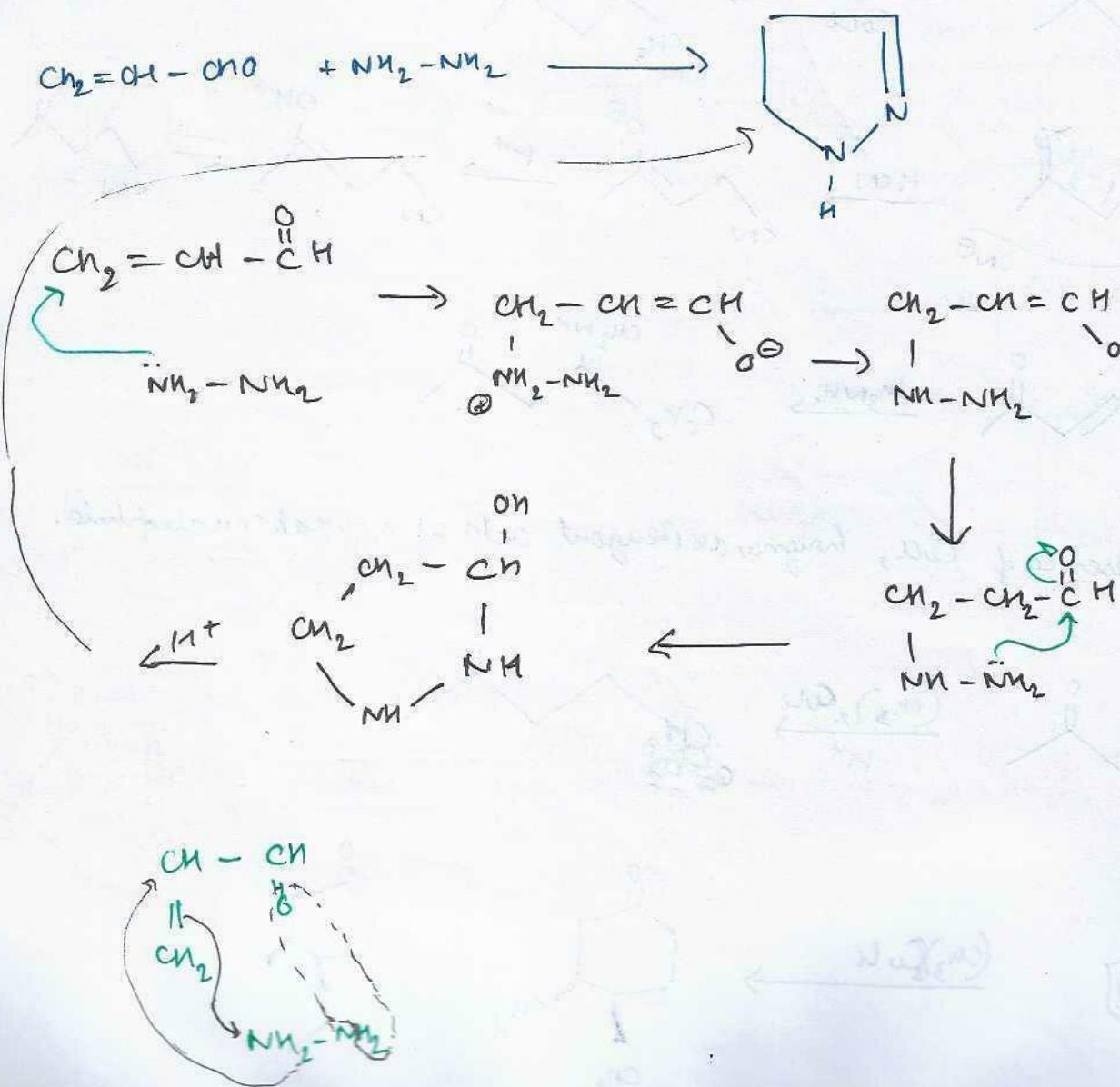
In presence of  $\text{CuCl}$ , Grignard Reagent acts as a weak nucleophile.

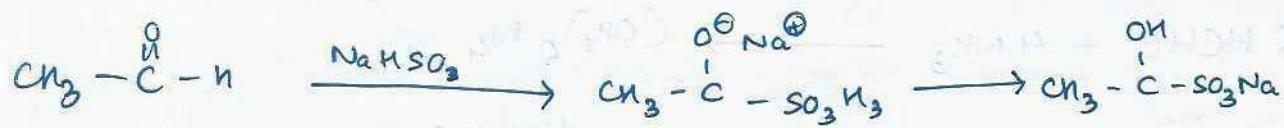




Michael Donor Michael Donor

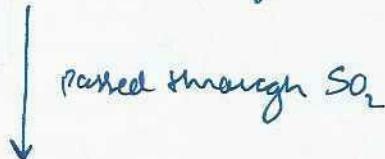
## Robinson Annotation





## SHIFF'S TEST

alkaline para rosaniline hydrochloride solution (pink colour)



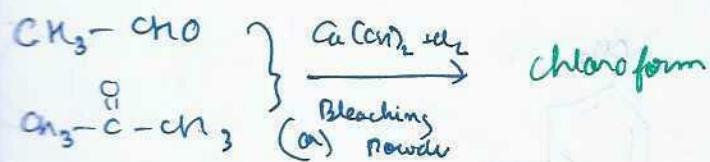
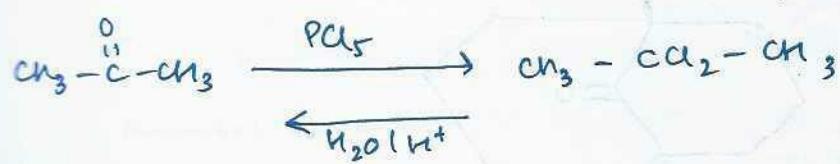
Pink colour disappears.



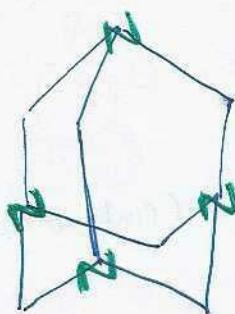
Shiff's Reagent gives pink colour with aldehyde.

Ketones do not give positive test.

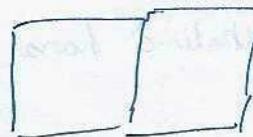
Hemiacetals give positive test, acetals do not give.



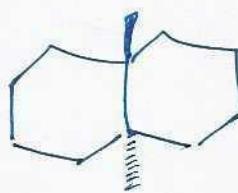
$\text{NaOCl}$  and  $\text{CaOCl}_2$  gave chloroform test.



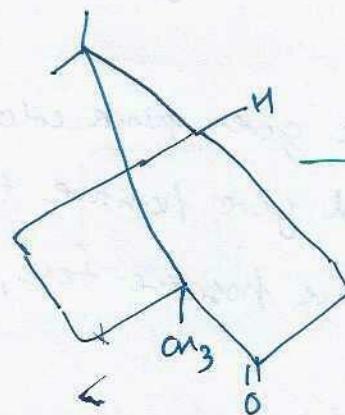
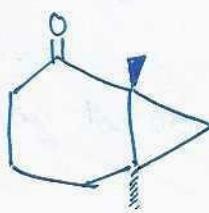
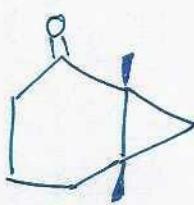
adenosine like structure.



*cis*  
*and*  
*trans*  
not  
possible

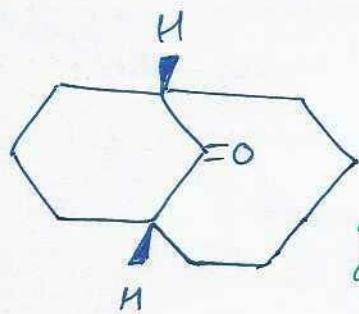


*trans* more stable

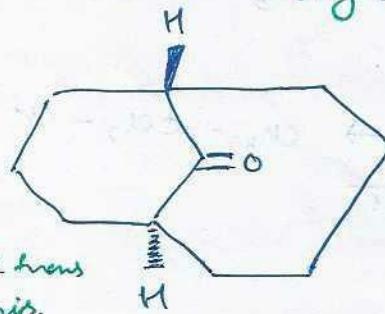


*trans*  
not possible

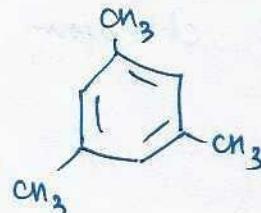
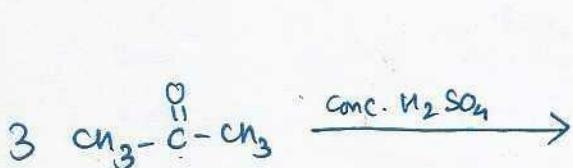
only *cis* possible

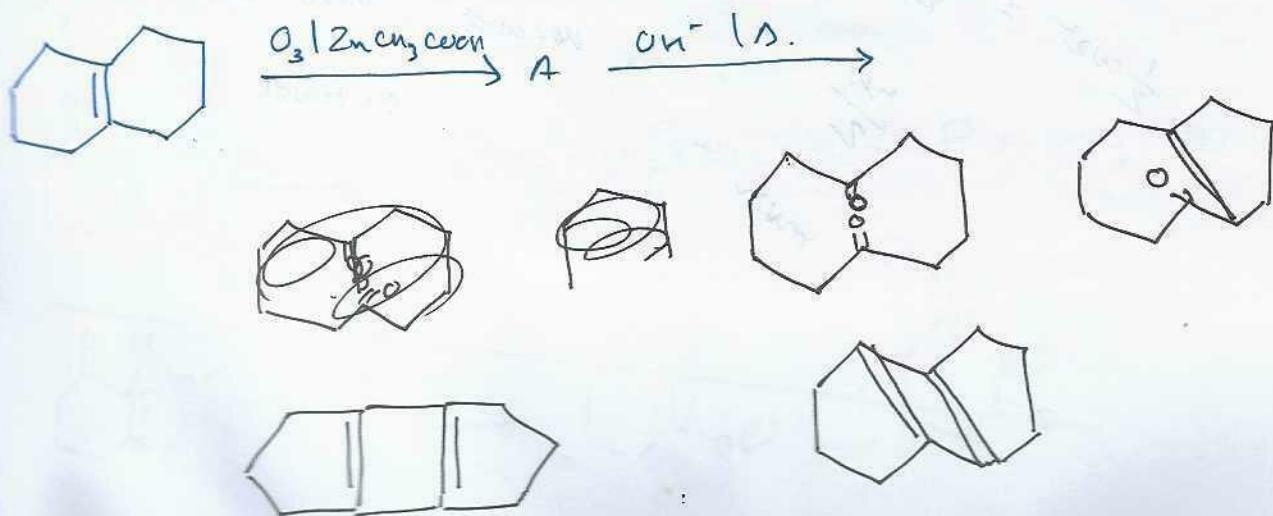
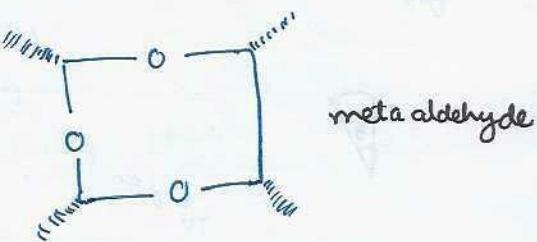
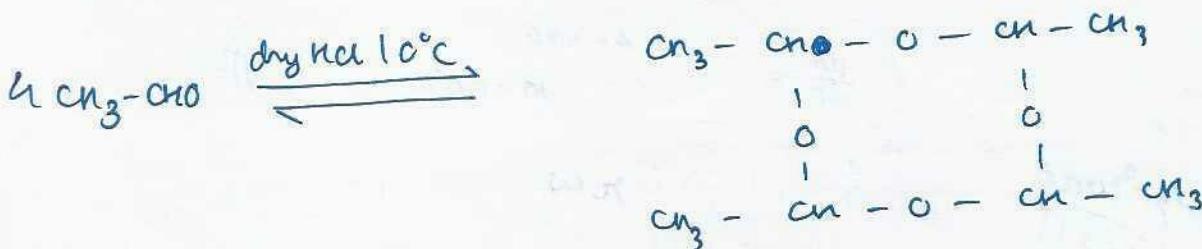
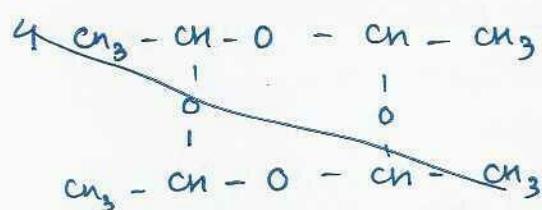
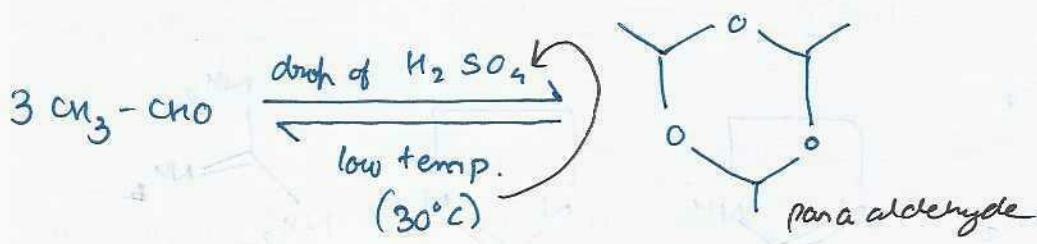
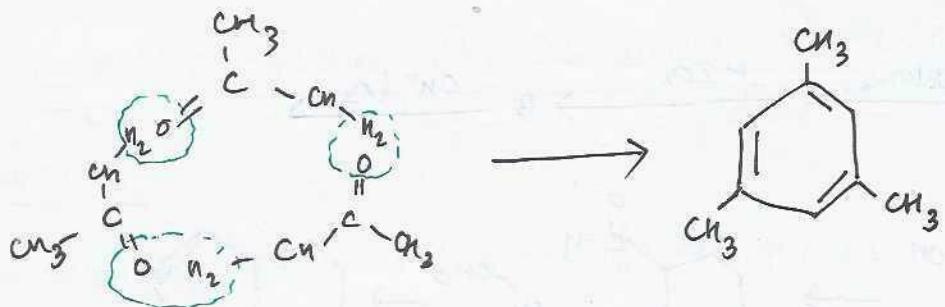


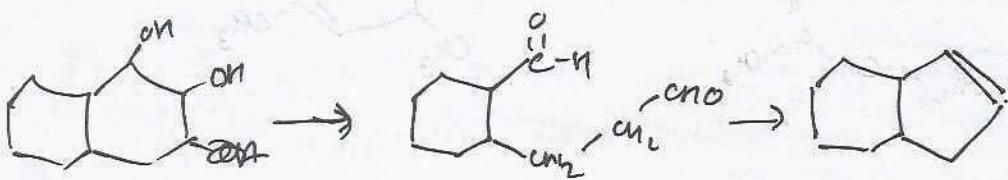
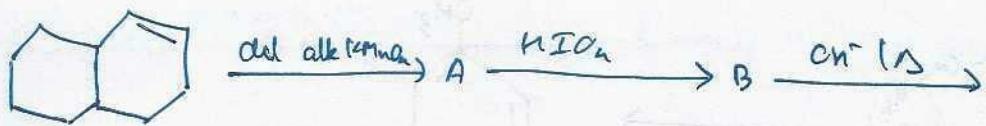
can  
show  
*cis* and *trans*  
isomers.



→ 4 isomers







PREPAR

1. From

R-C

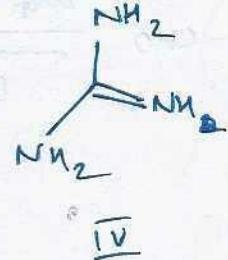
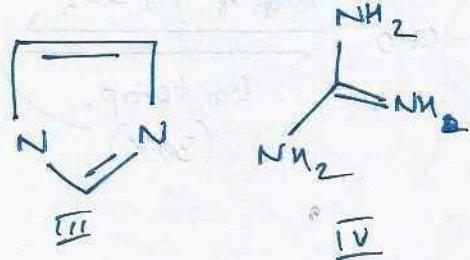
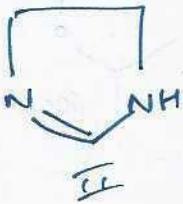
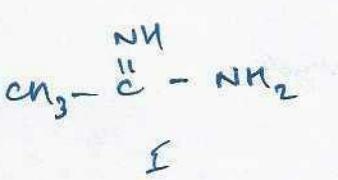
R-C

CH<sub>3</sub>-

R-CH

R-C

CH<sub>3</sub>-



$\frac{d\theta}{dt} \neq 0^\circ$

$$\frac{dA}{dt} =$$

$$A = \pi d\theta = \pi r^2 \omega dt$$

$$V =$$

$$A = \pi d\theta = \pi r^2 \omega dt$$

$$\frac{dA}{dt} = \pi r^2 \omega \ddot{\theta}$$

$$\omega r^2 = C$$

$$\omega = \frac{L}{2m}$$



$$\frac{d\theta}{dt} \neq 0^\circ$$



$$\omega$$

$$V = \omega r$$

$$\frac{1}{2} I \omega^2 = \frac{mv^2}{r}$$

$$d\theta = \omega dt$$

$$mv^2 \\ mvr^2 = C$$

$$A = mr\omega^2 t$$



$$\frac{r\omega}{2}$$

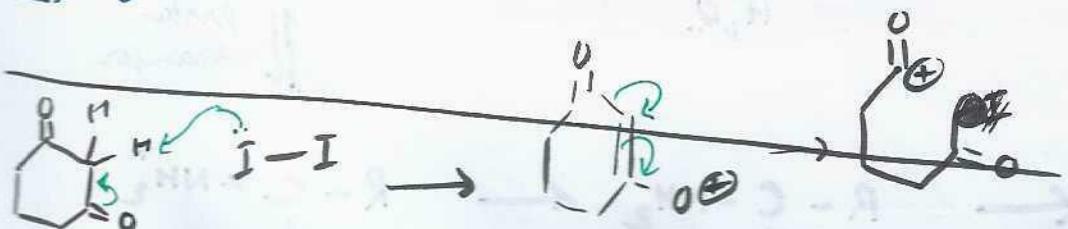
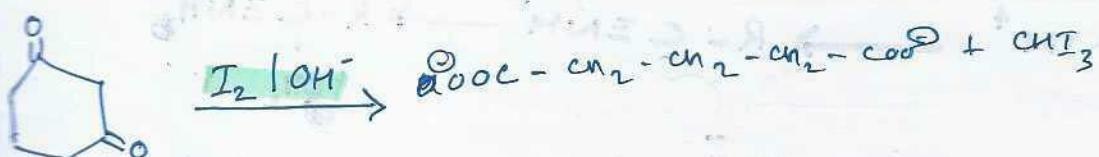
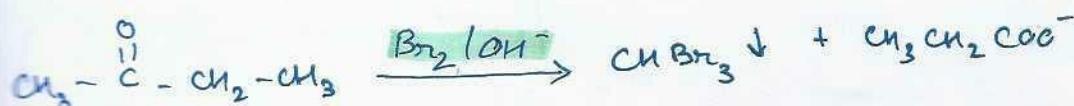
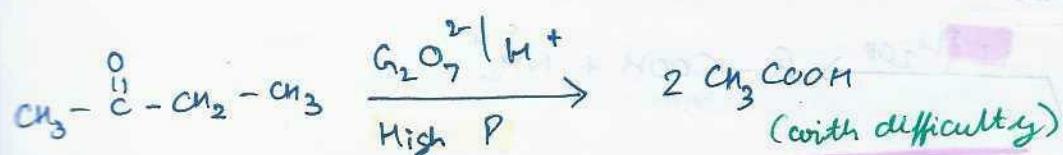
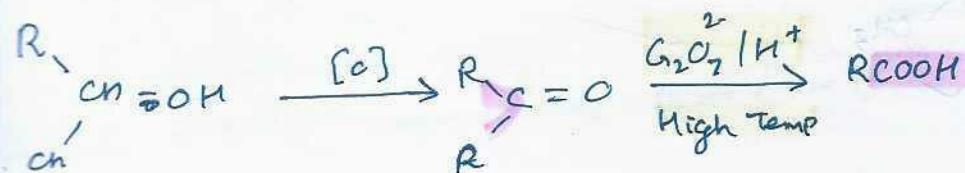
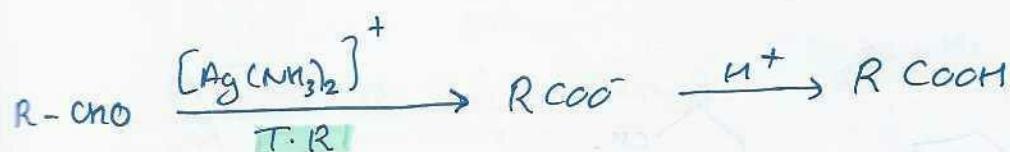
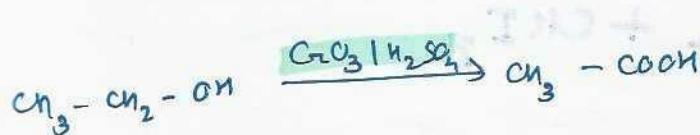
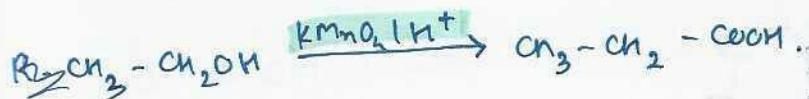
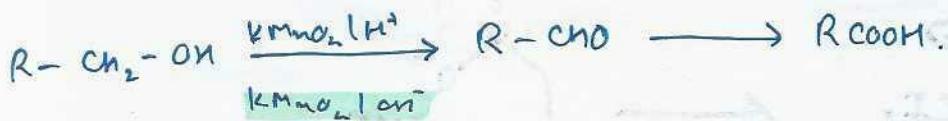
$$mr^2$$

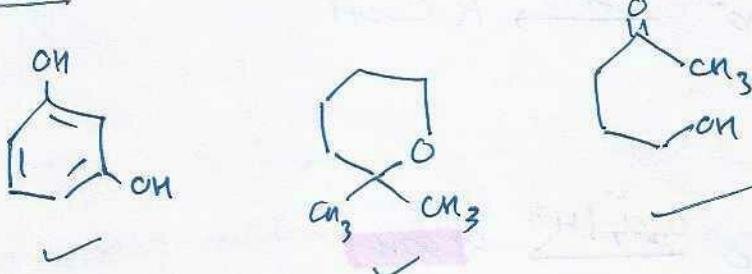
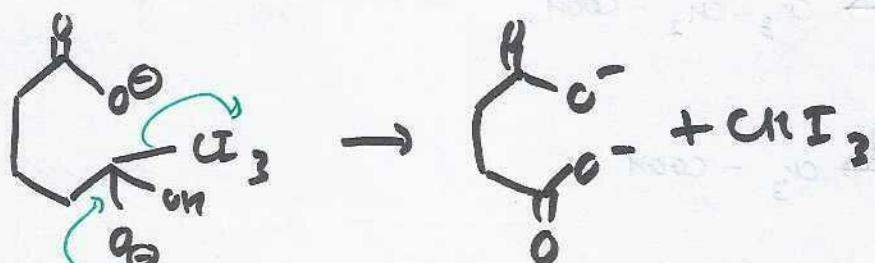
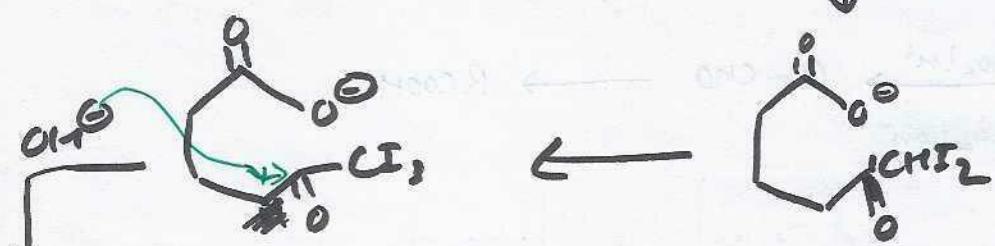
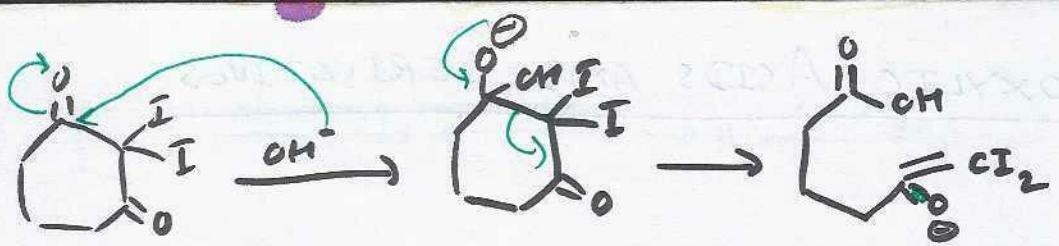


# CARBOXYLIC ACIDS AND DERIVATIVES

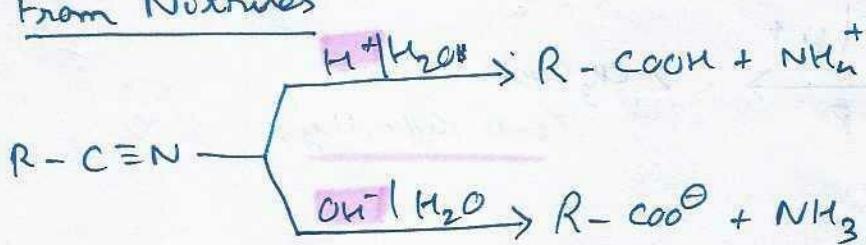
## PREPARATION

1. From alcohols, aldehydes and methyl keto groups

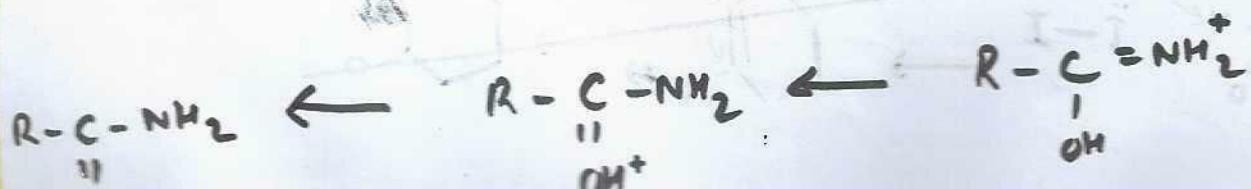
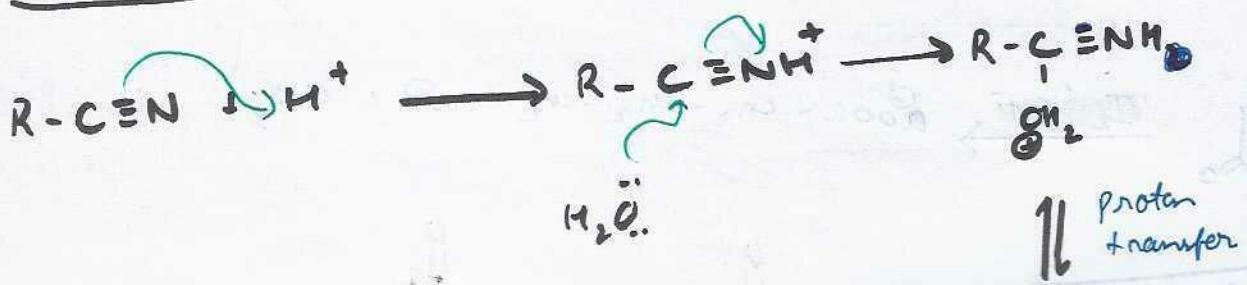


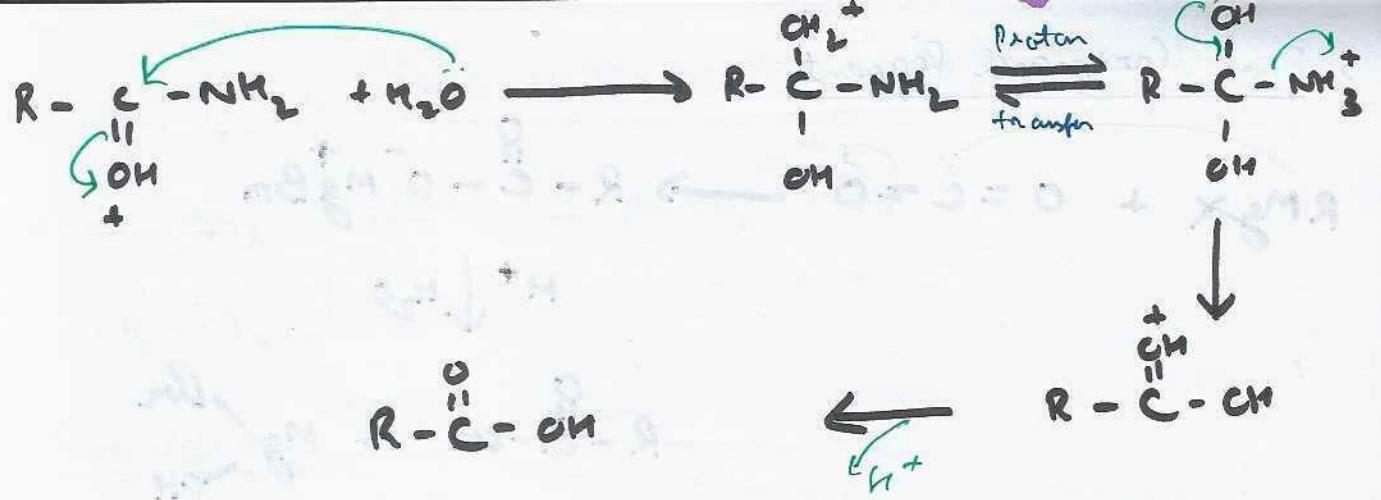


## 2. From Nitriles

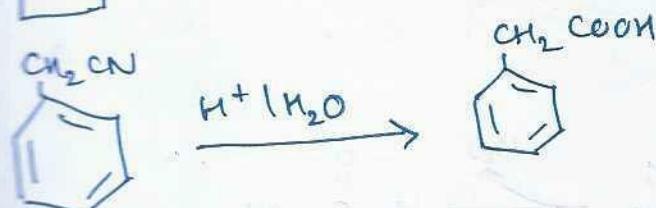
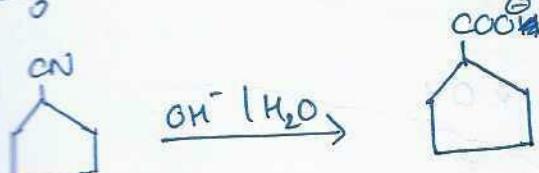
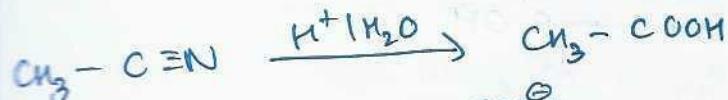
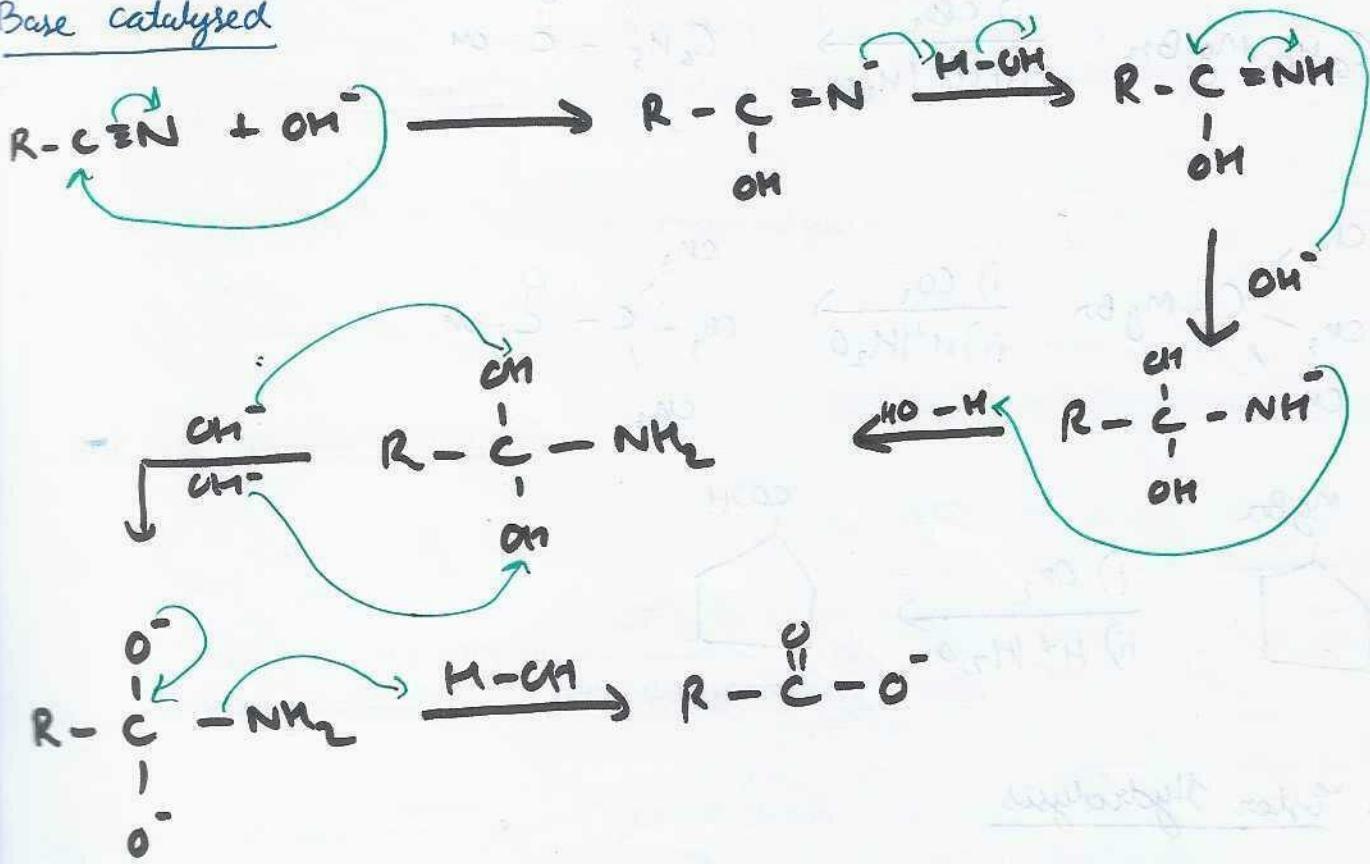


## Mechanism

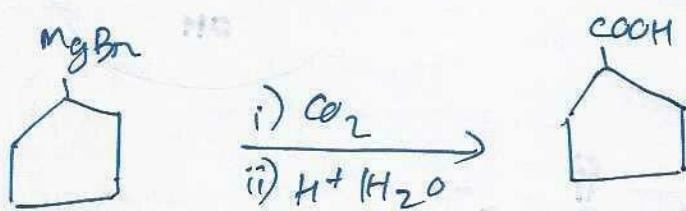
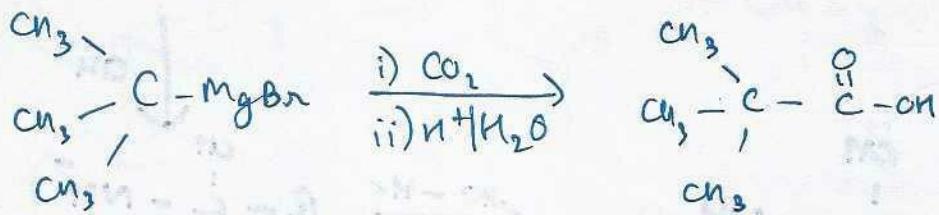
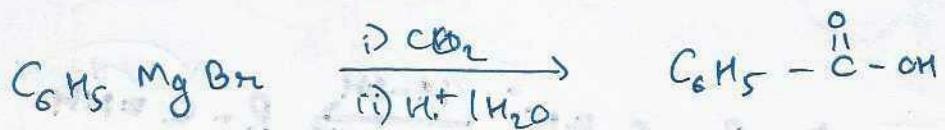
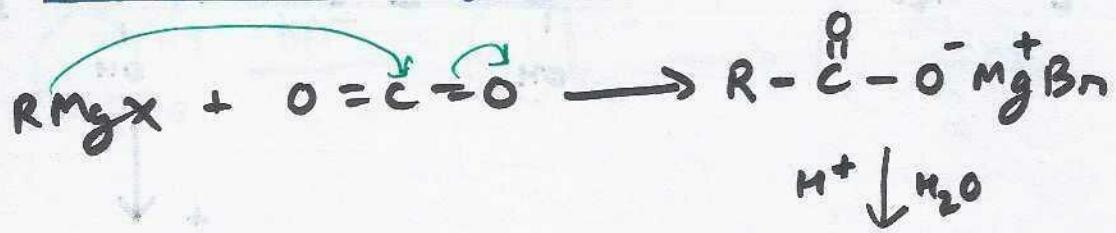




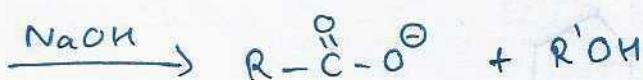
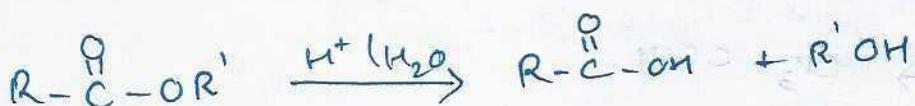
Base catalysed



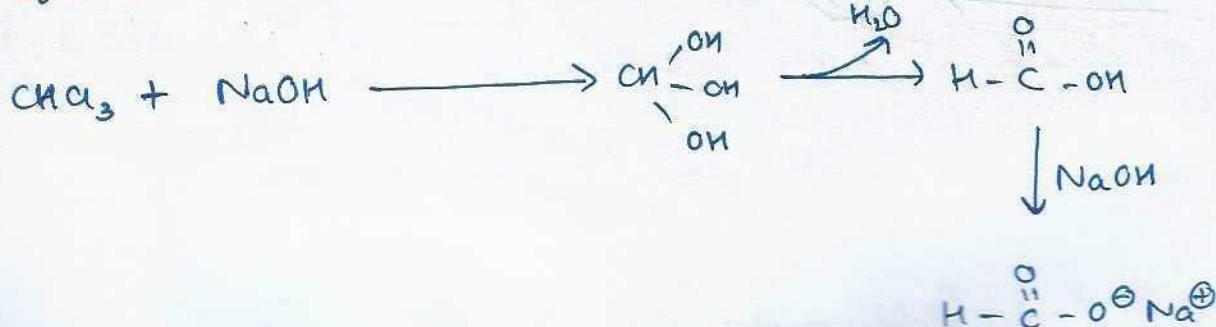
### 3. From Grignard Reagent

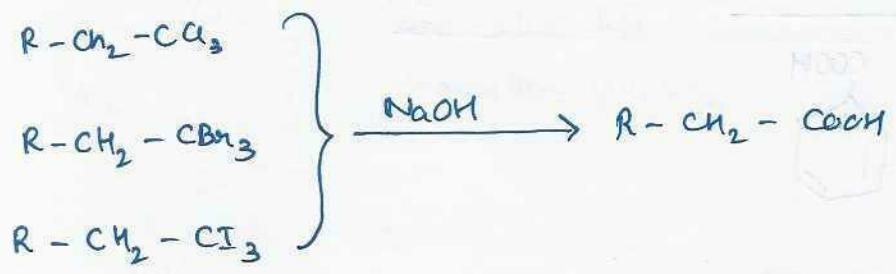


### 4. Ester Hydrolysis

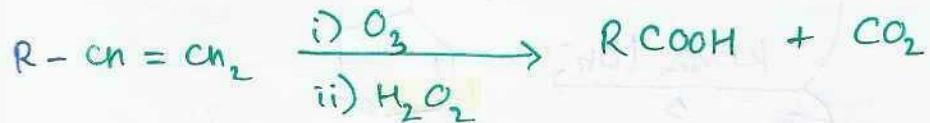


### 5. Hydrolysis of Tri Halo Alkanes

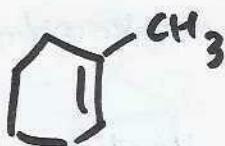
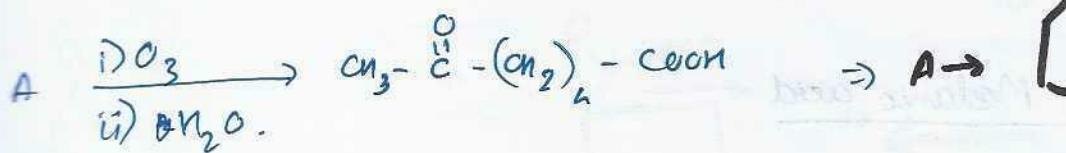
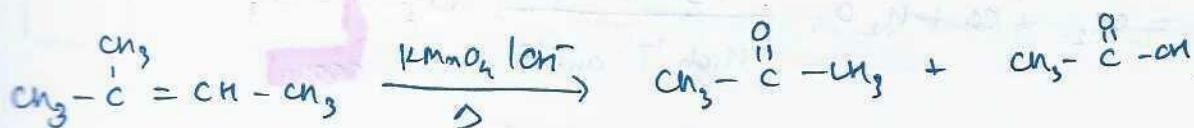
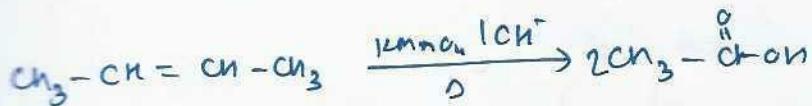
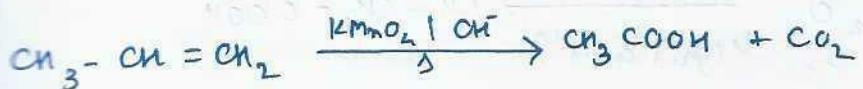




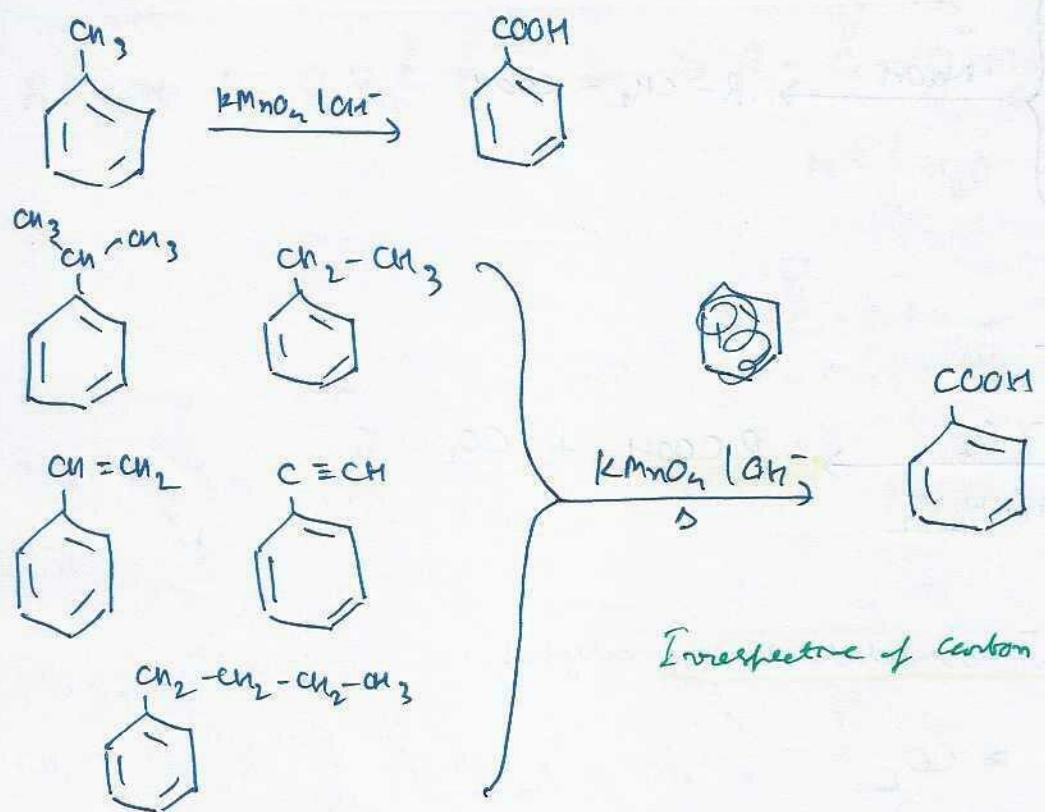
### 5. From Alkenes



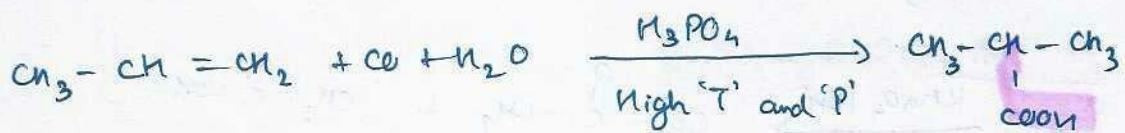
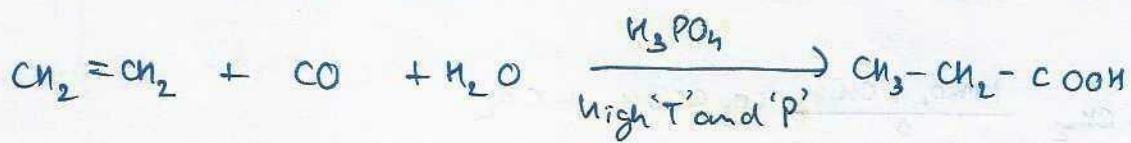
$\text{KMnO}_4 | \text{OH}^- \rightarrow$  oxidative organanalysis.



## 6. Oxidation of Alkyl Benzenes

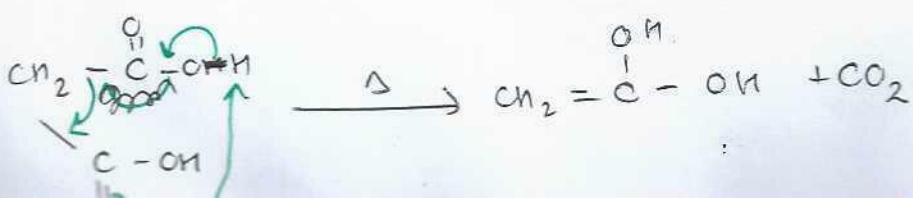
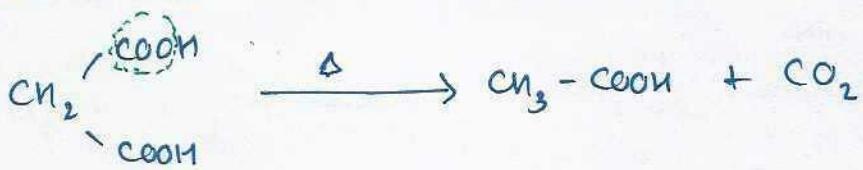


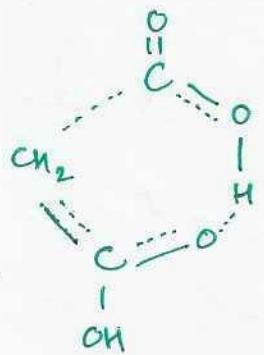
## 7. KOCH REACTION



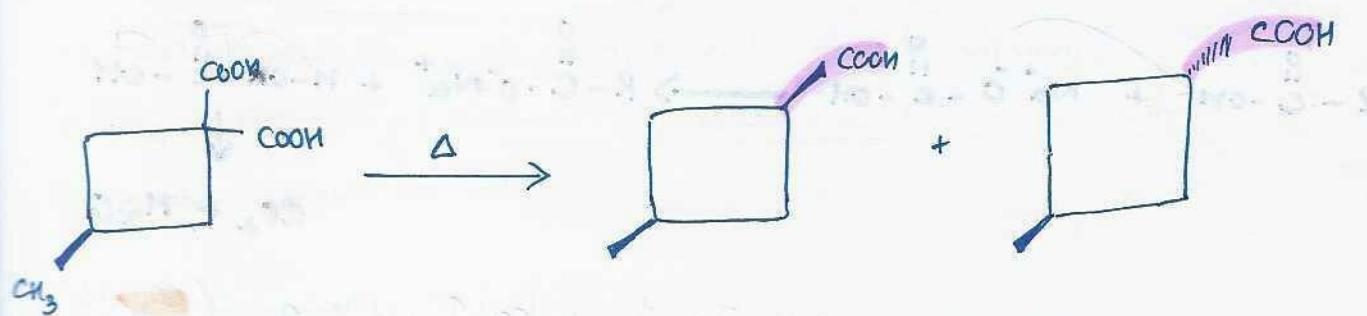
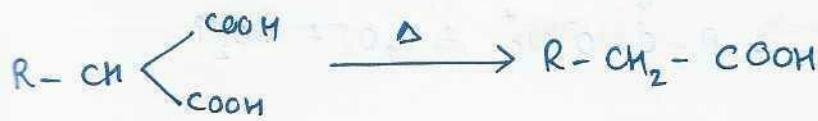
Markovnikoff addition.

## 8. By Heating Melanic acid



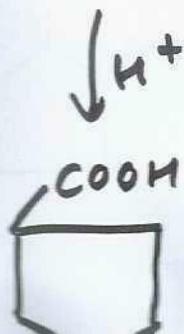
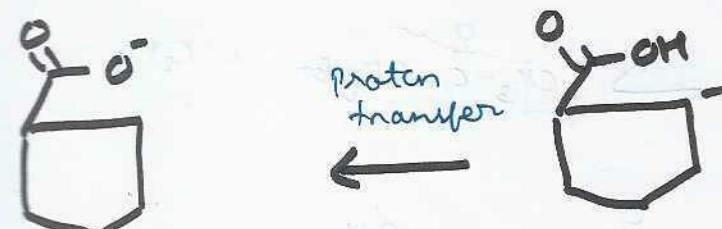
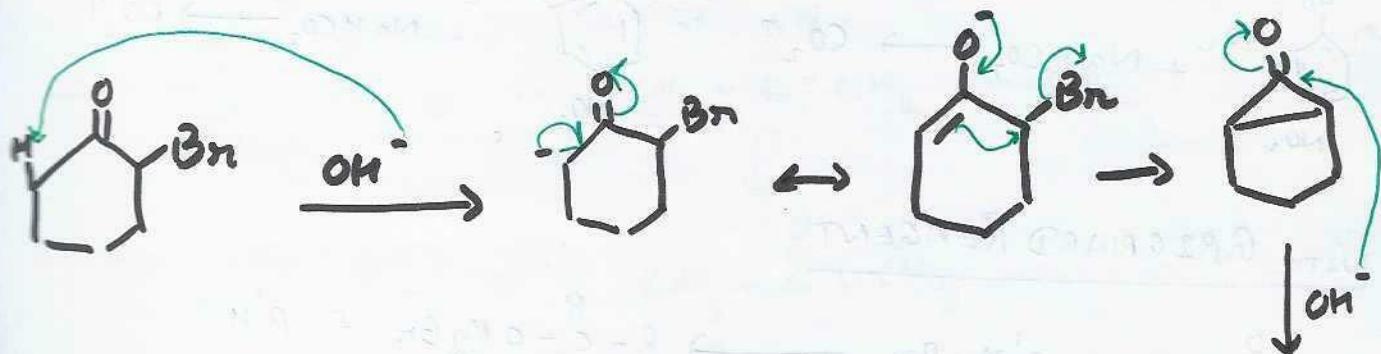
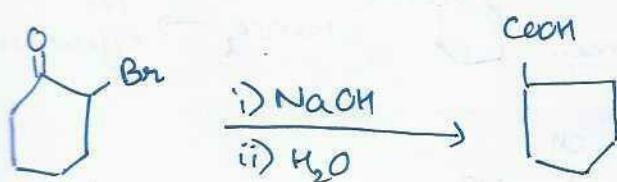


aromatic like  
transition stability.



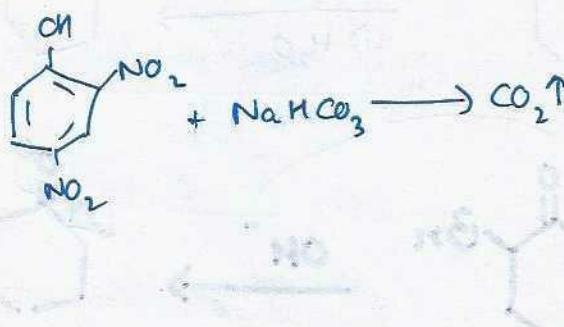
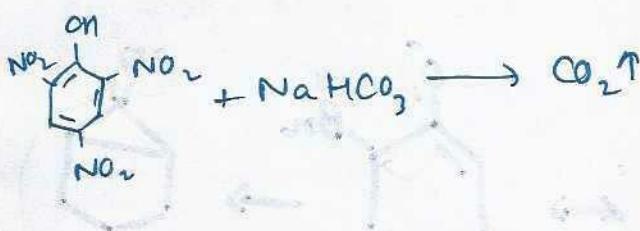
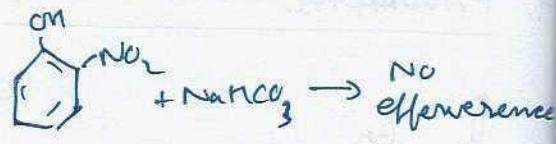
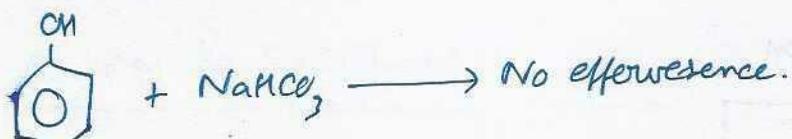
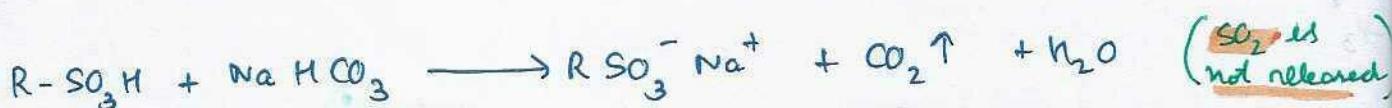
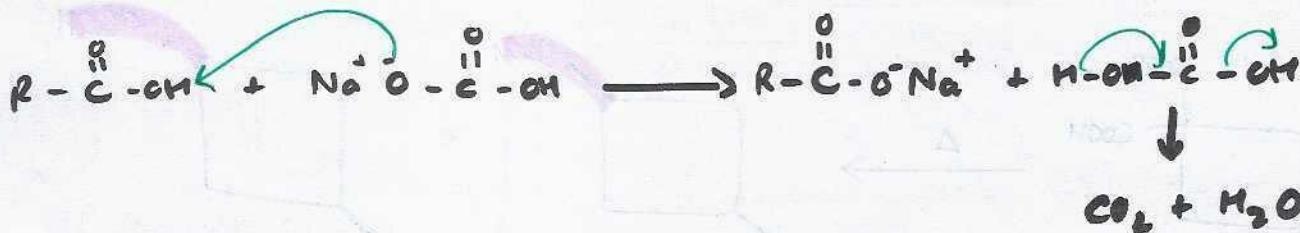
### 9. FAVORASKY REARRANGEMENT

(2-halo ketones)

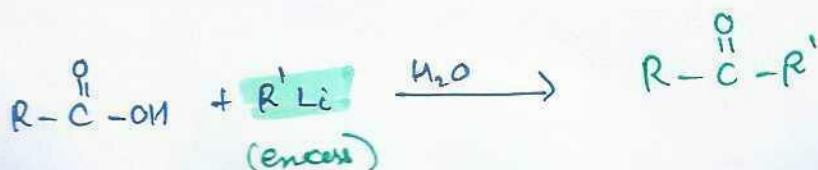
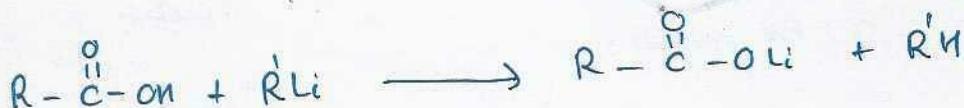


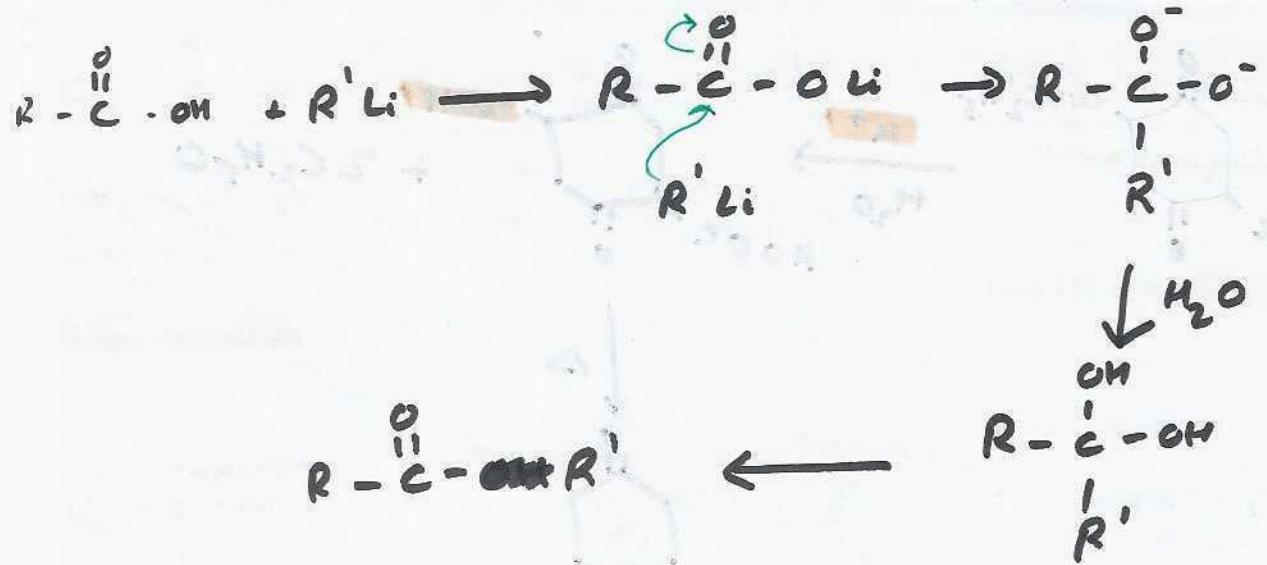
# PROPERTIES OF CARBOXYLIC ACIDS

## ACIDIC NATURE



## WITH GRIGNARD REAGENT

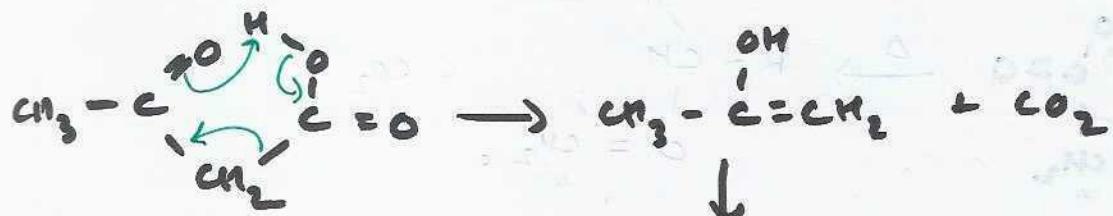




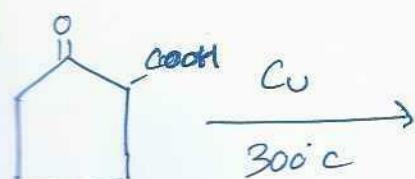
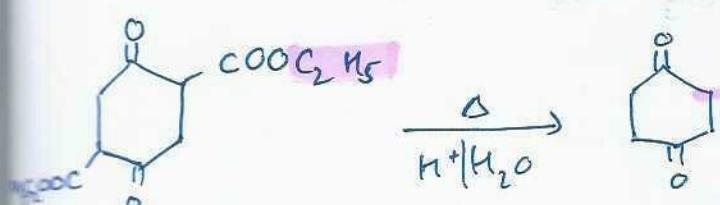
Grignard Reagent is weak compared to Alkyl Lithium.

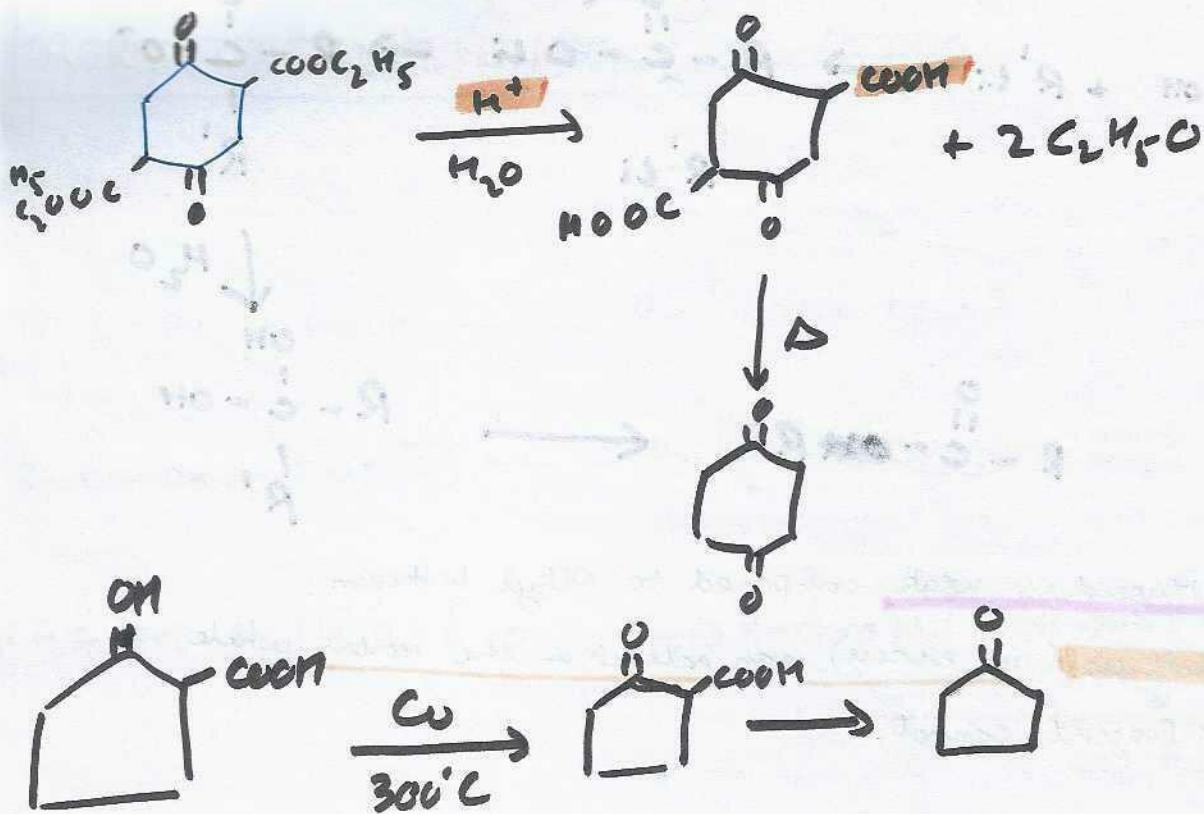
So alkyl lithium (in excess) can attack on the carbon while Grignard Reagent cannot.

## DECARBOXYLATION

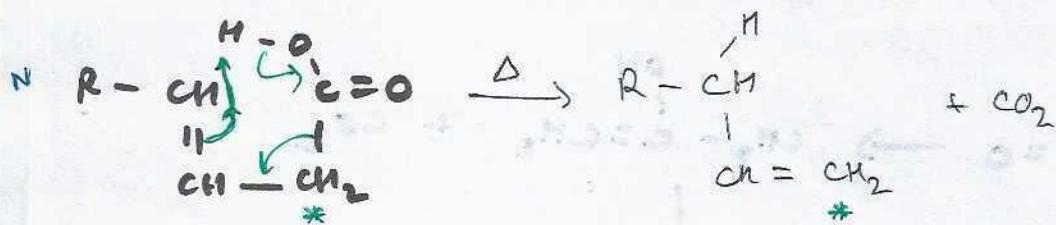


6-atom cyclic transition state

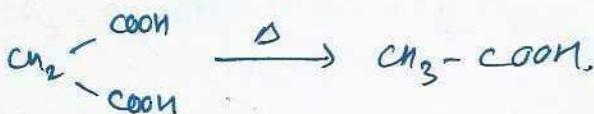




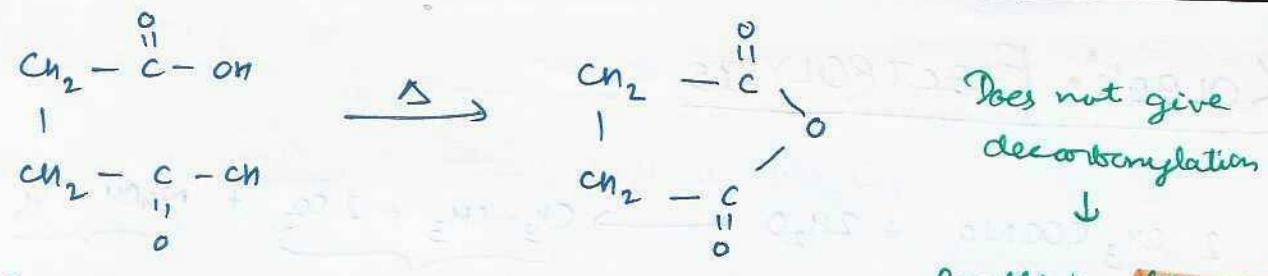
$\beta,\gamma$  both unsaturated acids  $\xrightarrow{\Delta}$  decarbonylation.



6- membered ring like transition state.



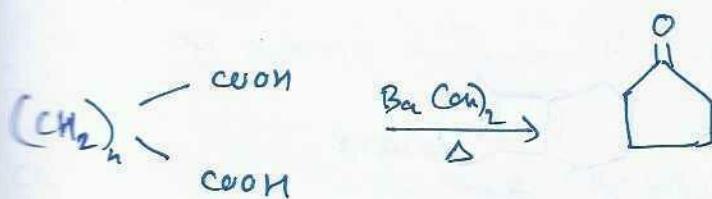
O  
M  
S  
G  
A



## (Succinic acid)



(Glutaric acid)



## Decarbonylation

## Dehydration.

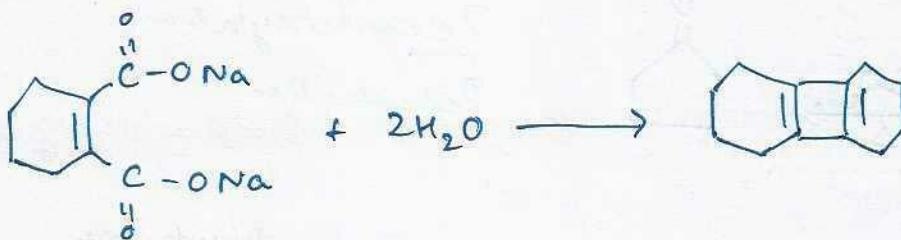
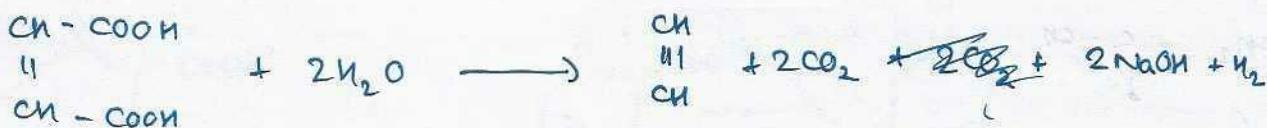
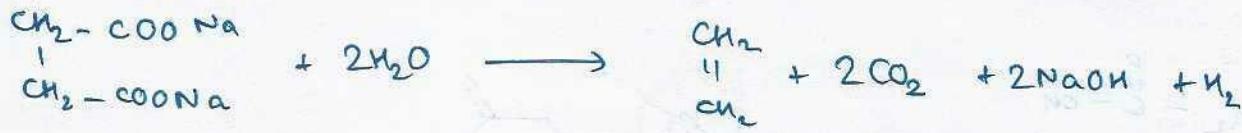
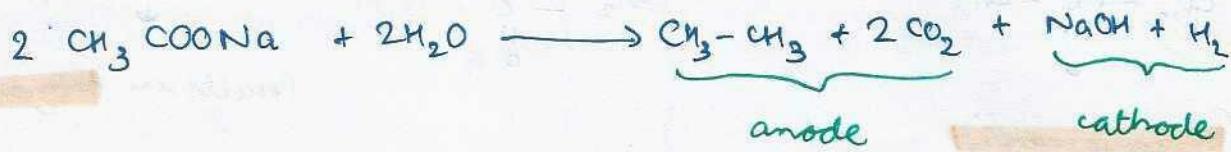
$\text{C}_3 \rightarrow$  decarbonylation

1,4 } dehydratson  
1,5

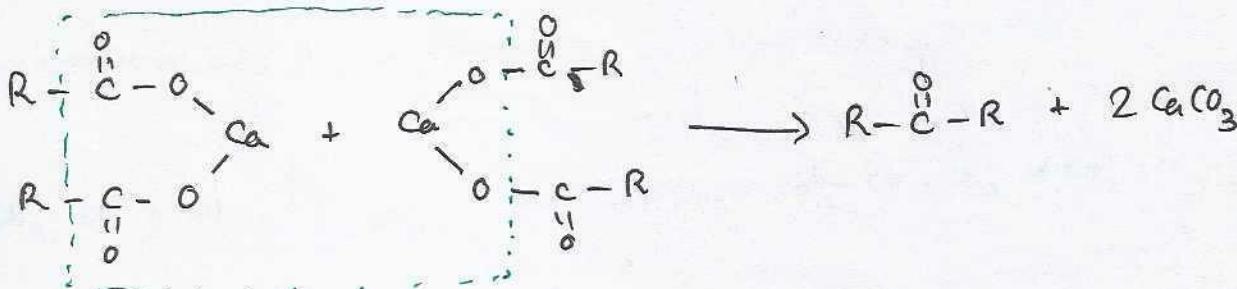
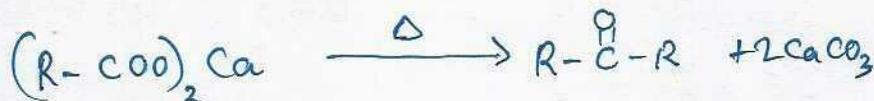
1,6 →

dehydration  
decarboxylation

# KOLBE'S ELECTROLYSIS



## DISTILLATION OF 'Ca' SALTS OF CARBOXYLIC ACID



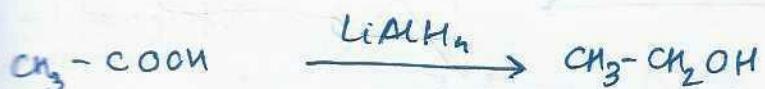
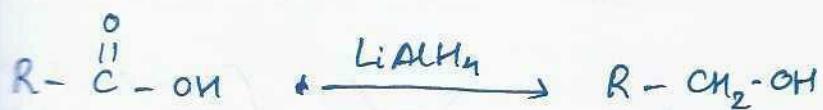
## SODA LIME



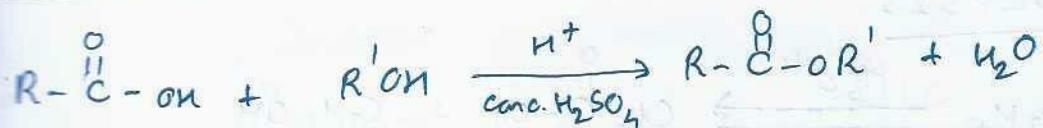
CaO is used to prevent hydration of NaOH.



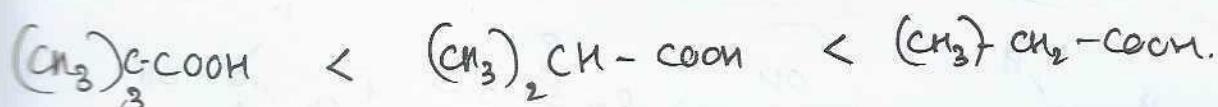
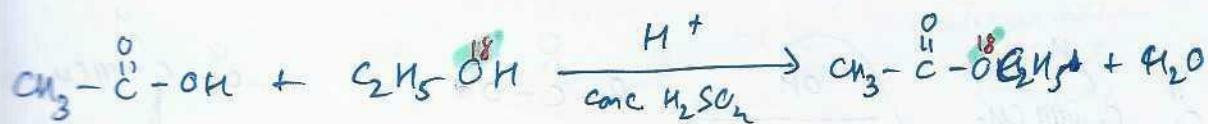
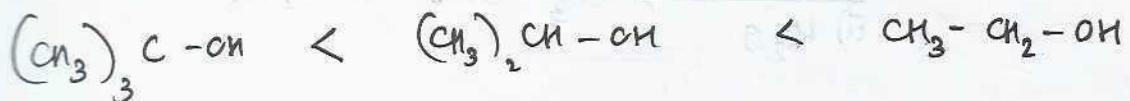
## REDUCTION



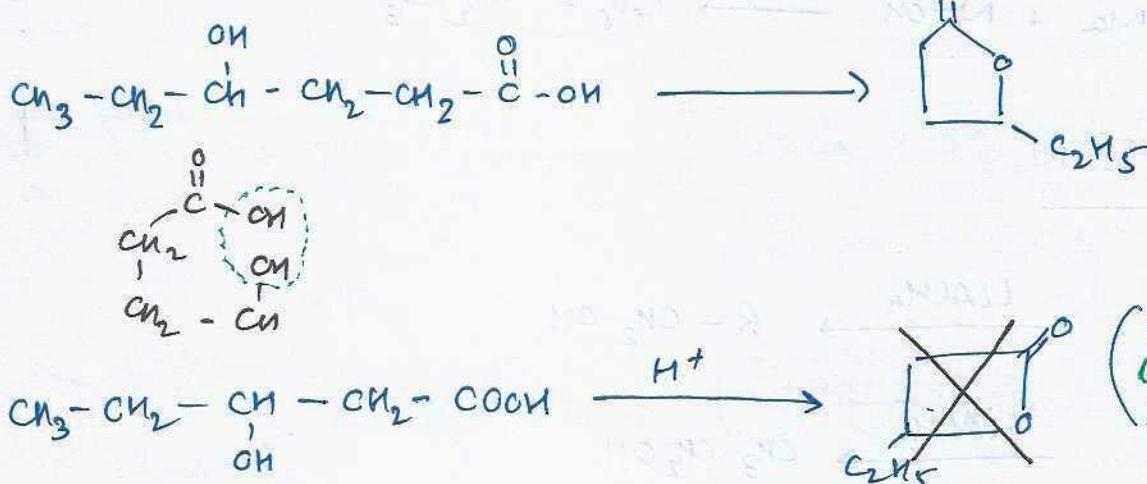
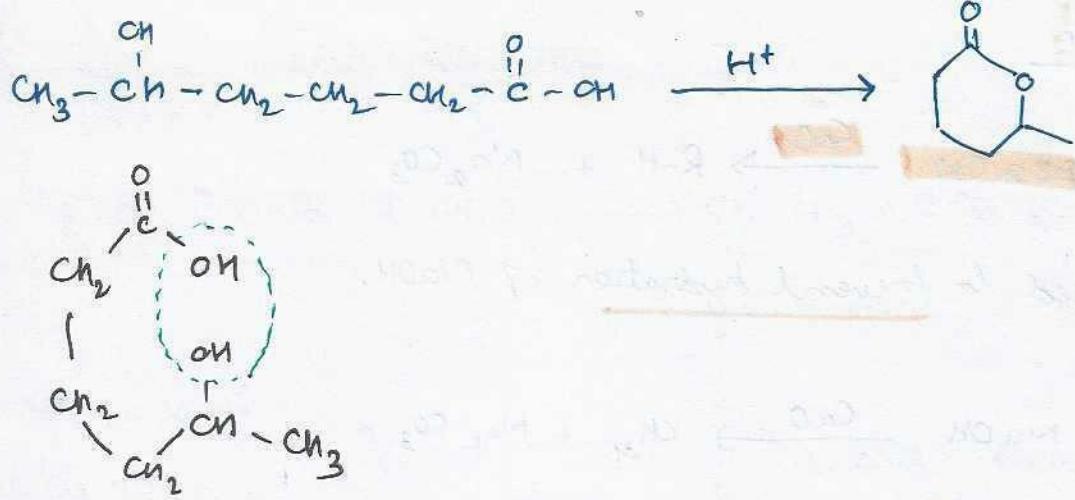
## ESTERIFICATION



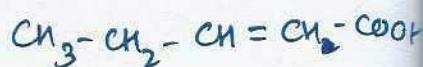
Reactivity decreases with increase in alkyl group of alcohol.



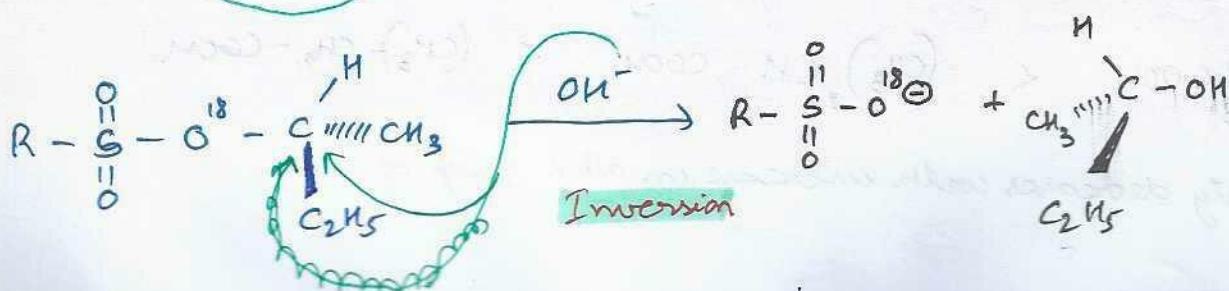
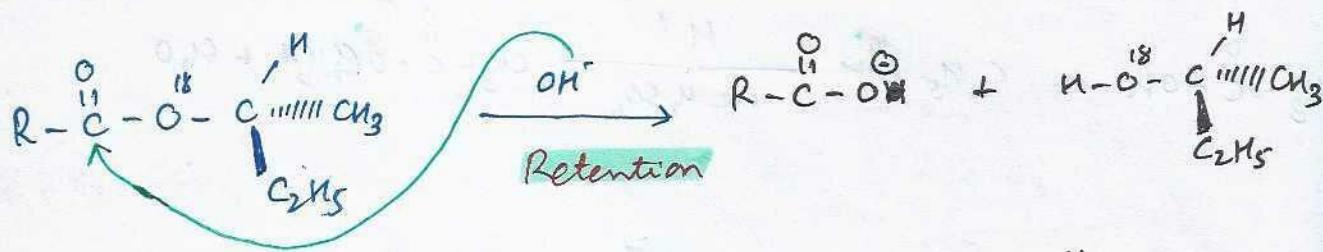
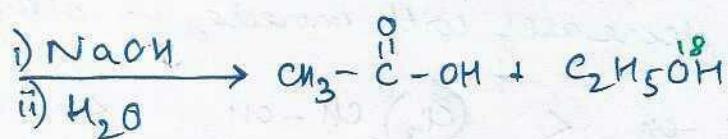
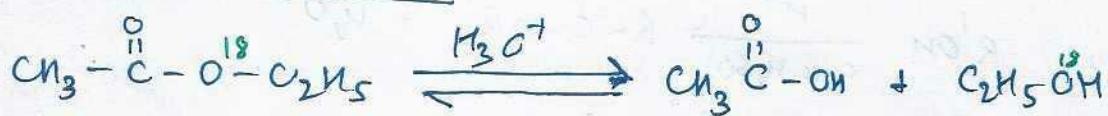
Reactivity decreases with increase in alkyl group of acids.

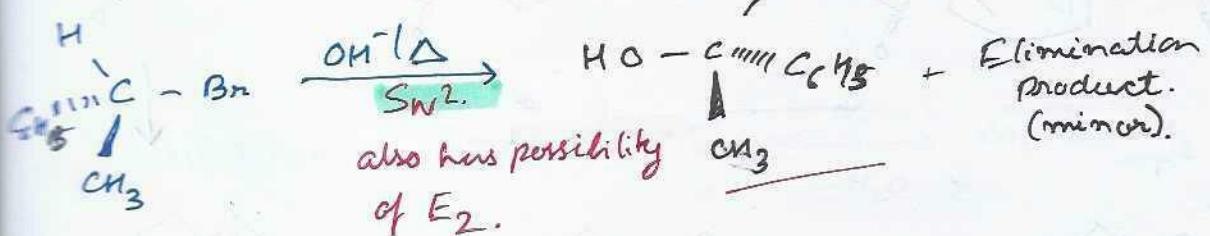
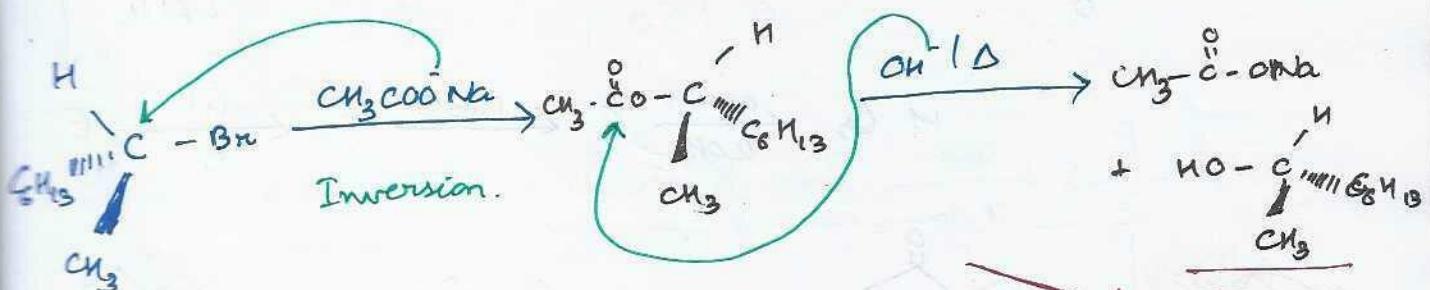
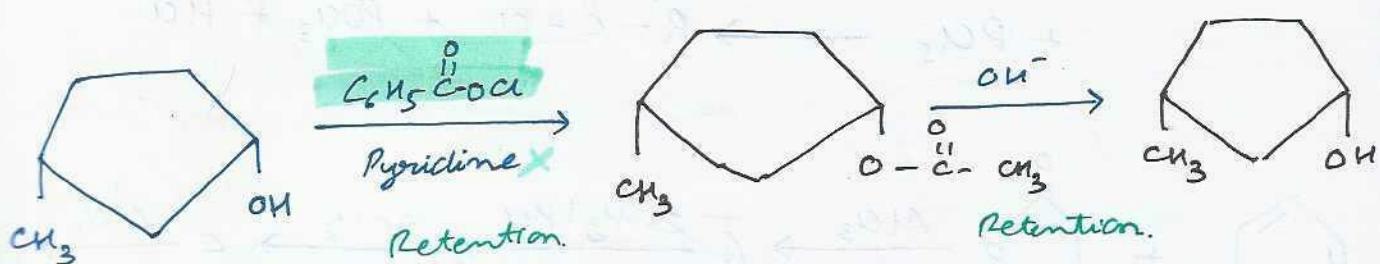
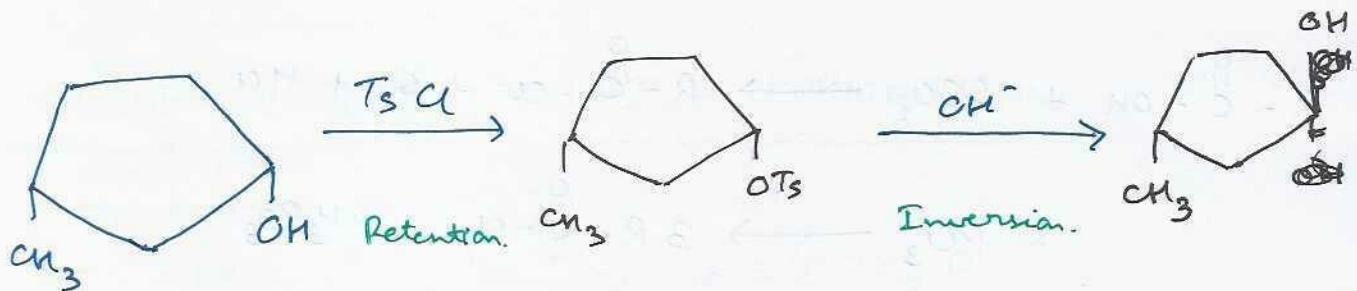
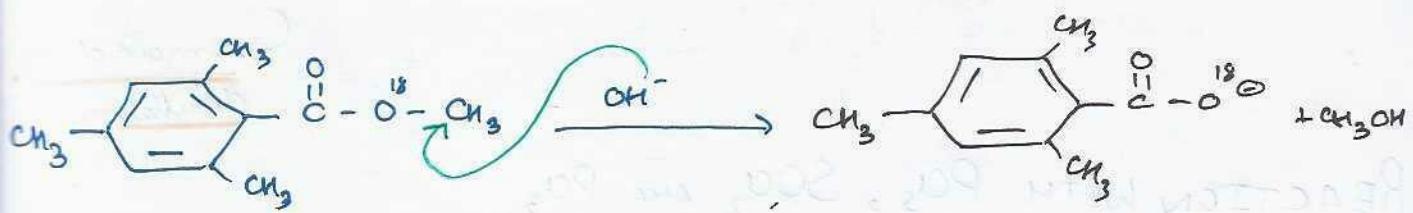
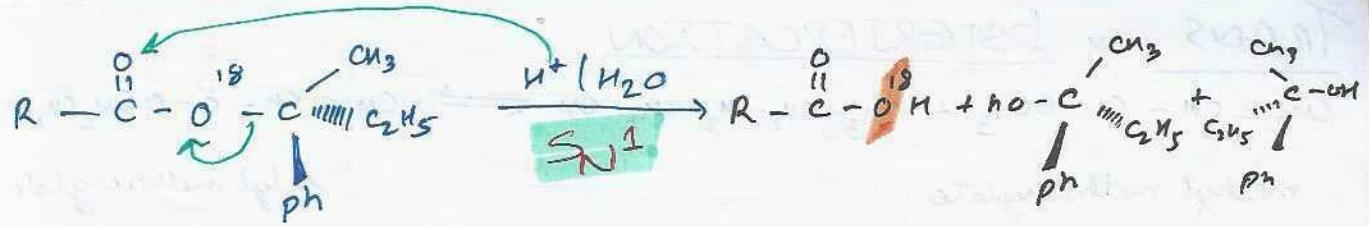


(can exist  
but cannot be  
prepared by  
this method)

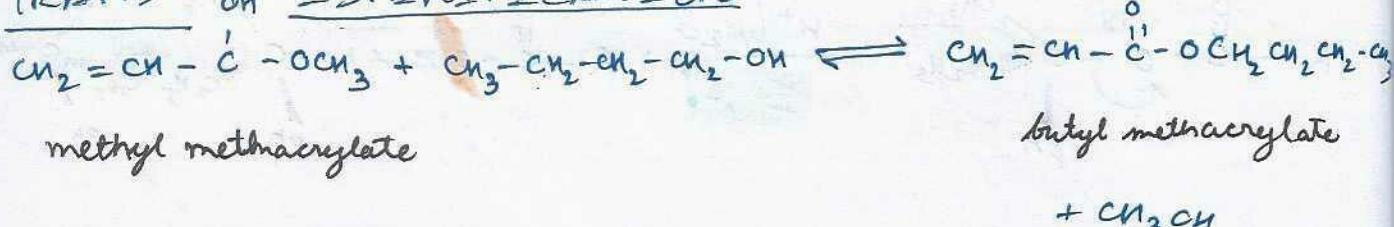


## ESTER HYDROLYSIS



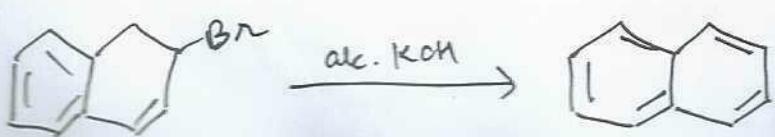
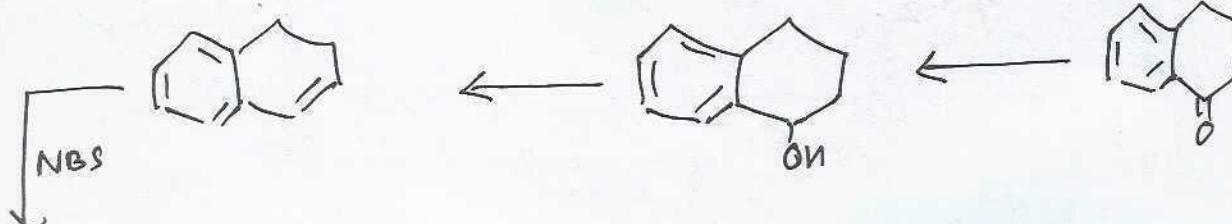
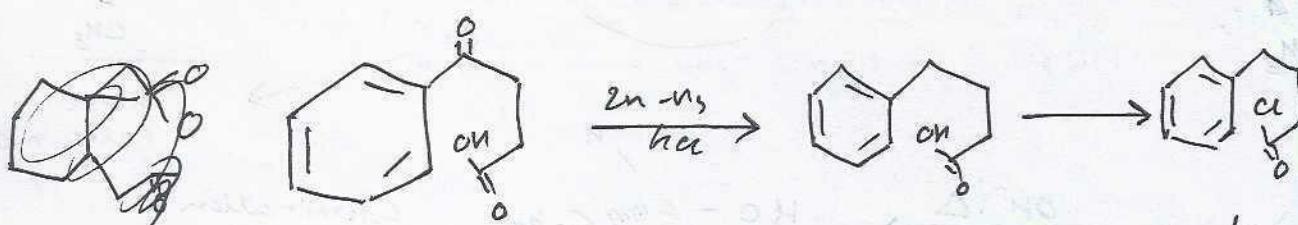
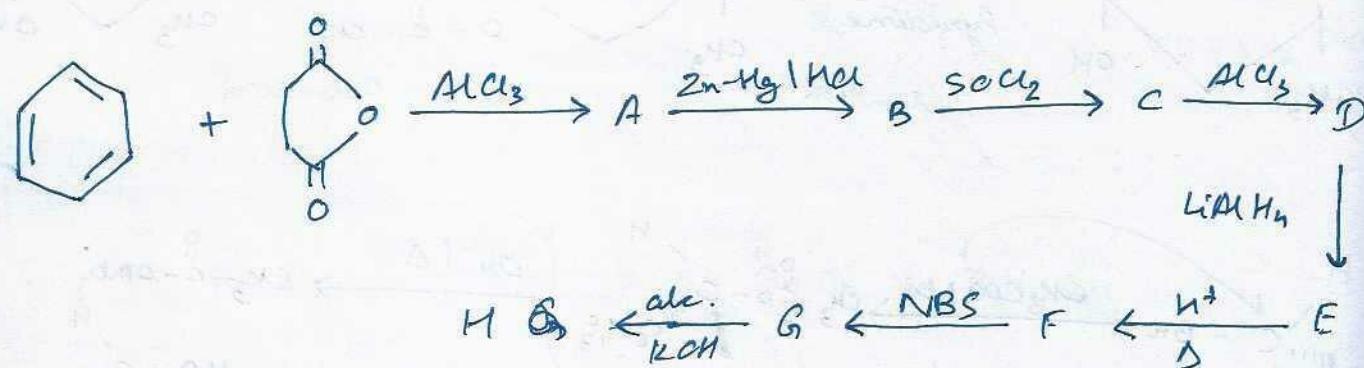
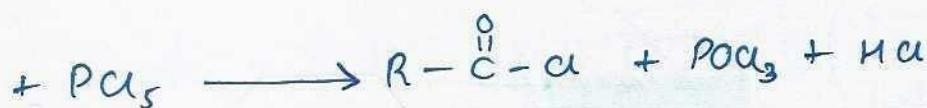
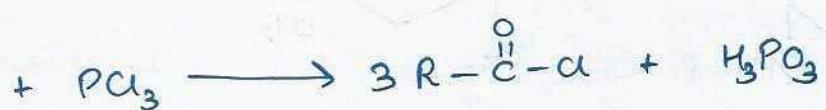


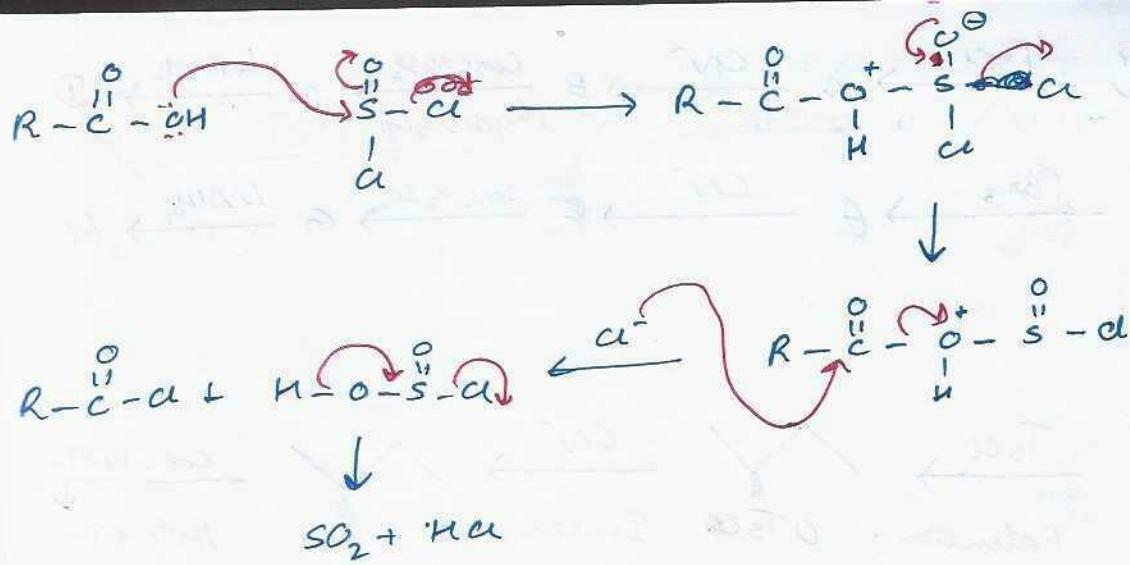
## TRANS on ESTERIFICATION



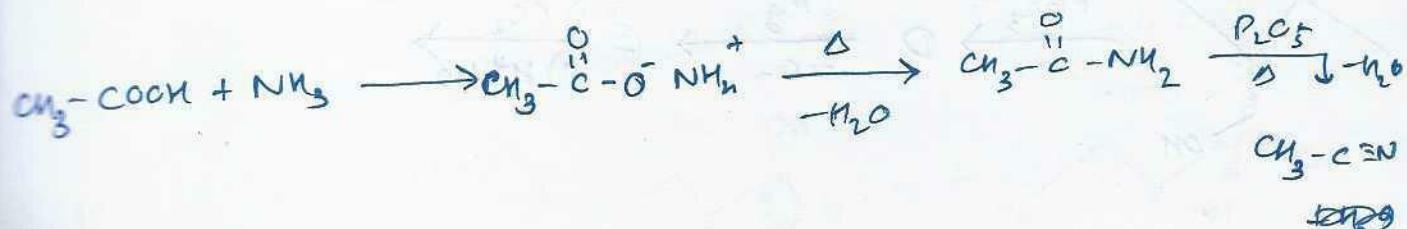
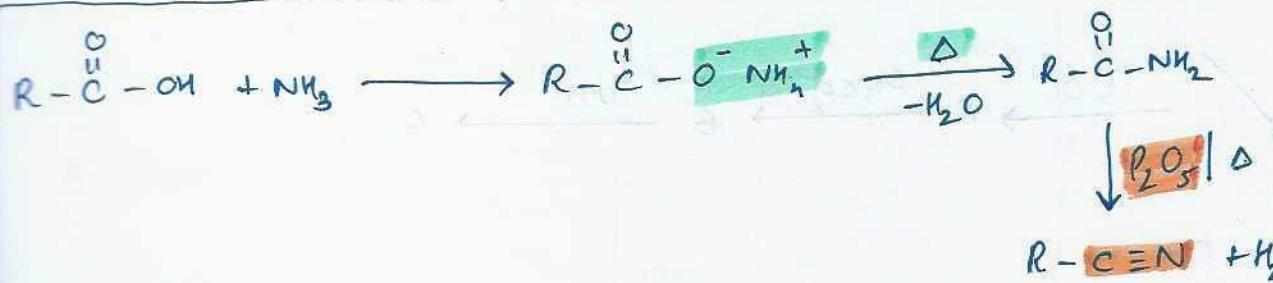
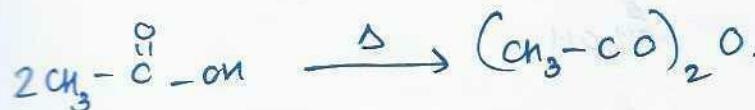
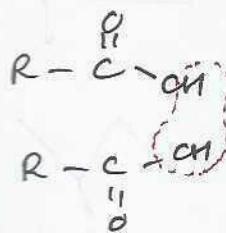
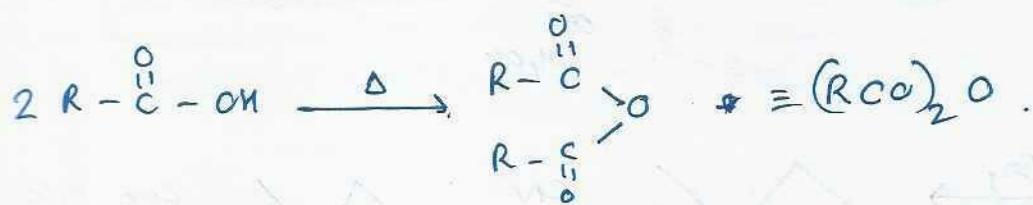
(removed by  
distillation.

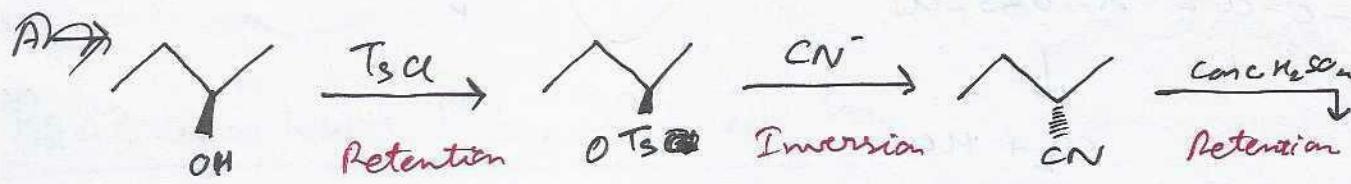
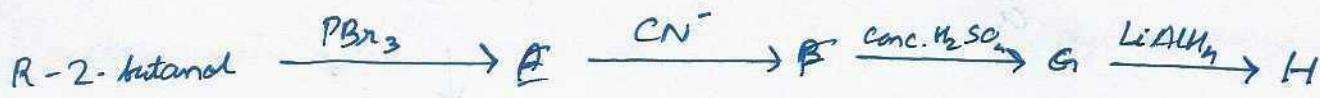
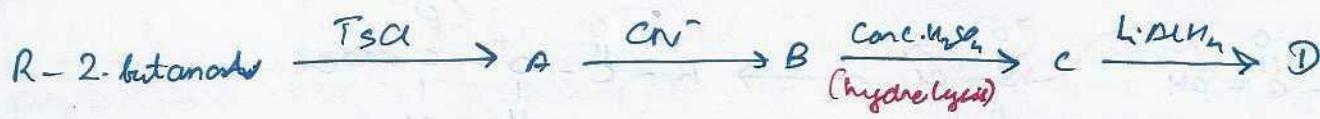
## REACTION WITH $\text{PCl}_5$ , $\text{SOCl}_2$ AND $\text{PCl}_3$



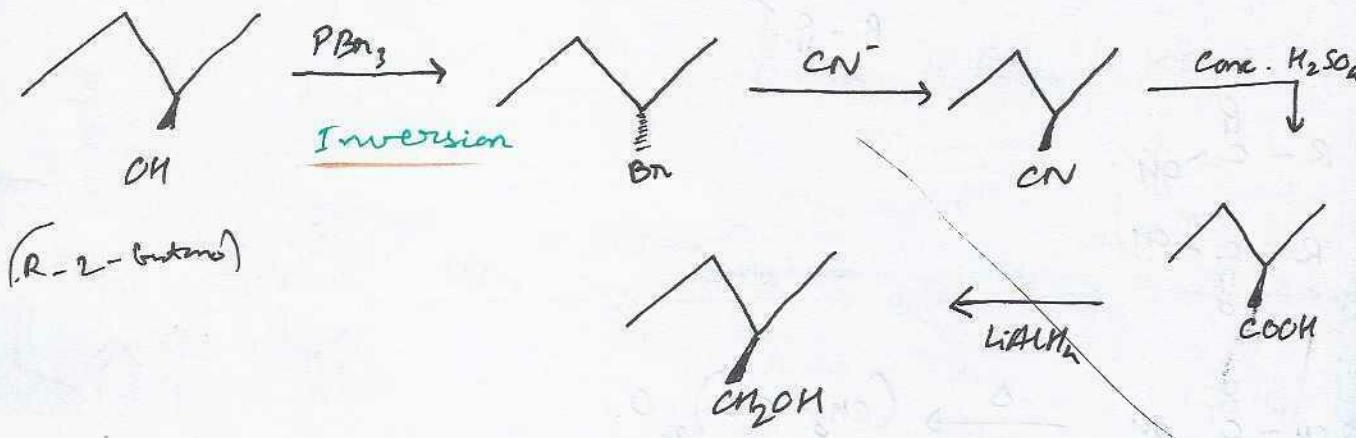
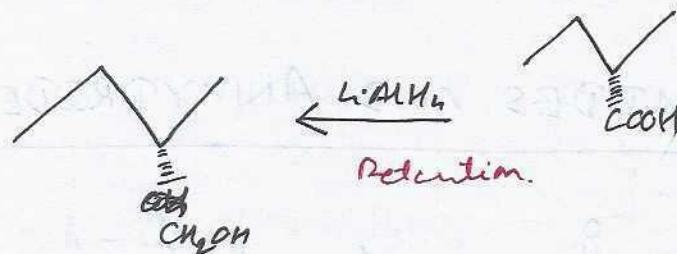


## AMIDES AND ANHYDRIDE FORMATION

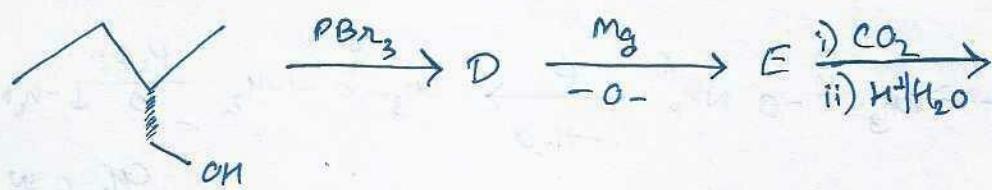
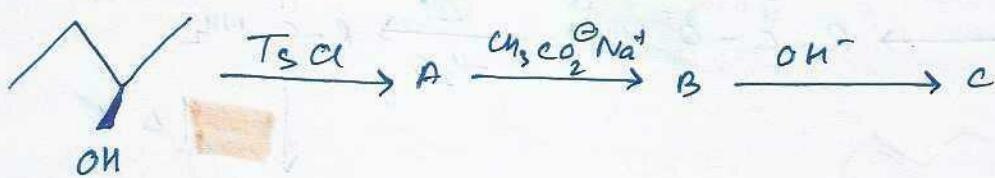


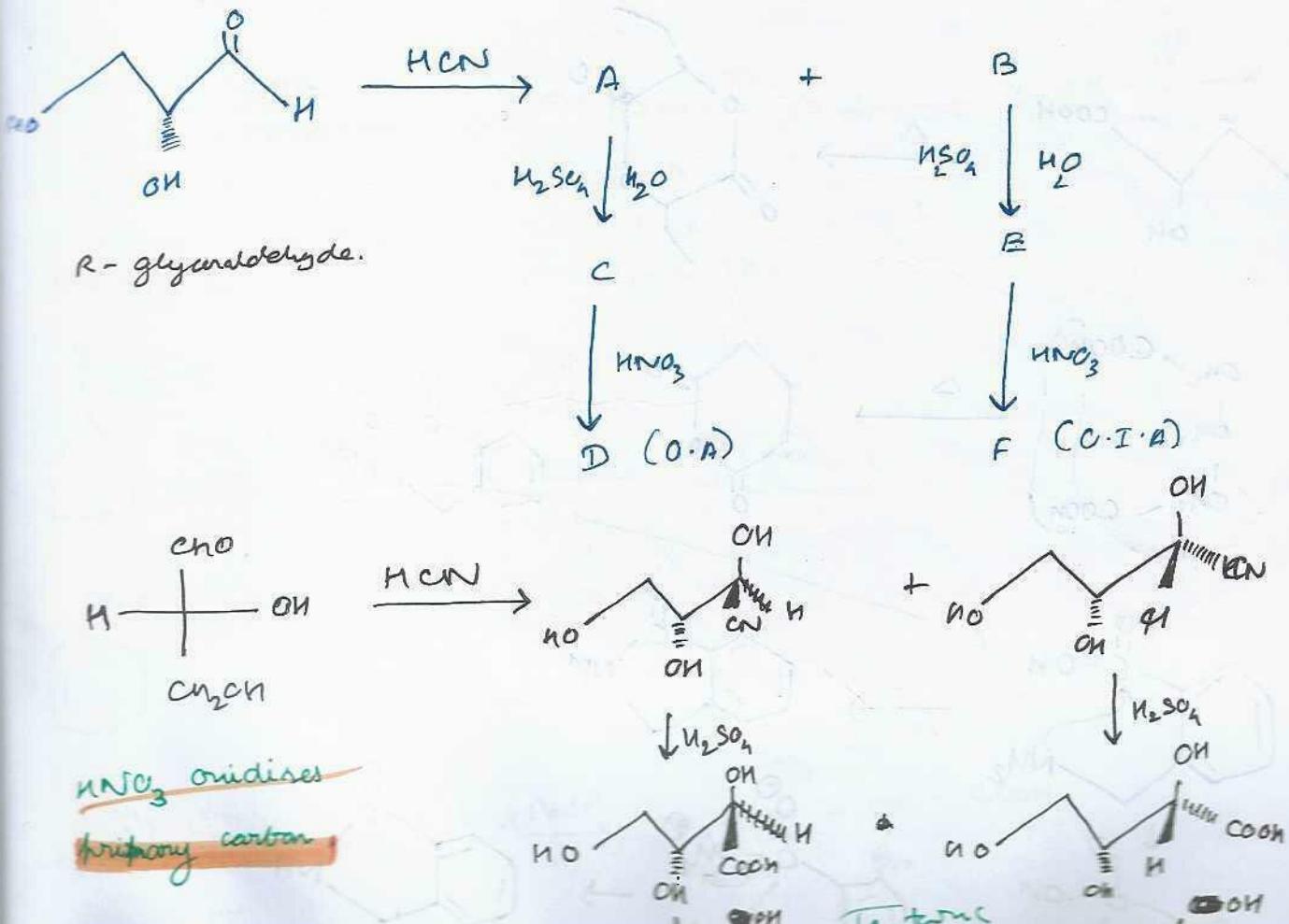
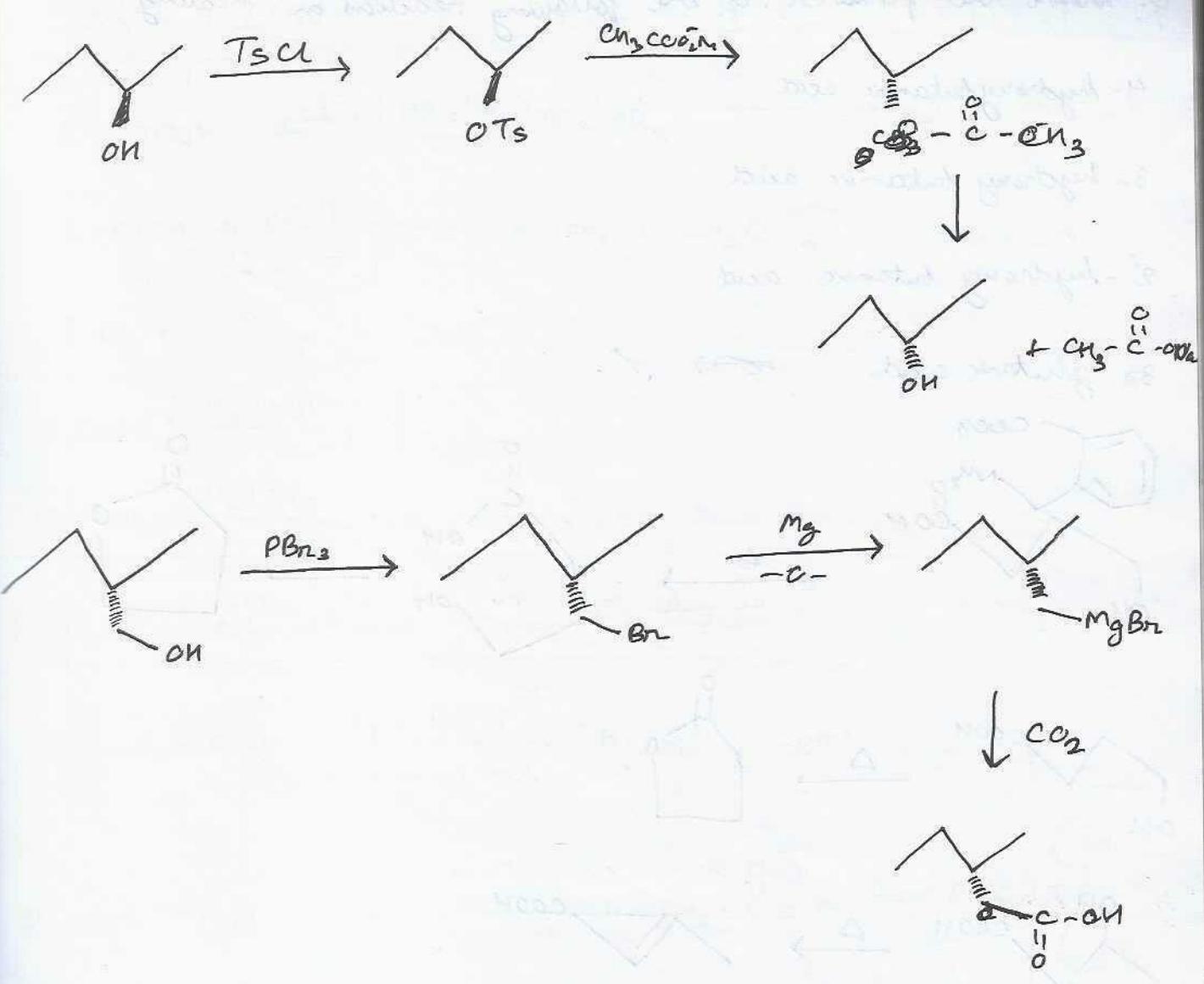


(R-2-butanol)



(R-2-butanol)





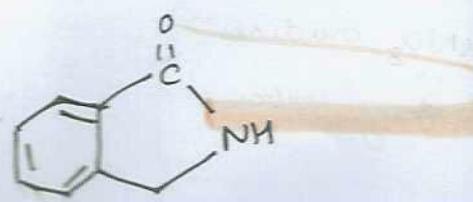
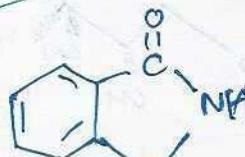
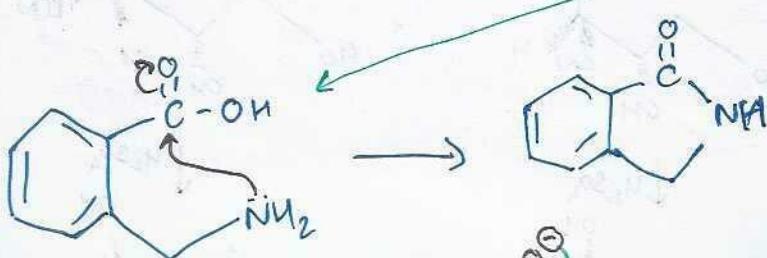
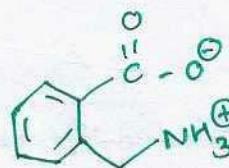
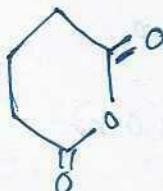
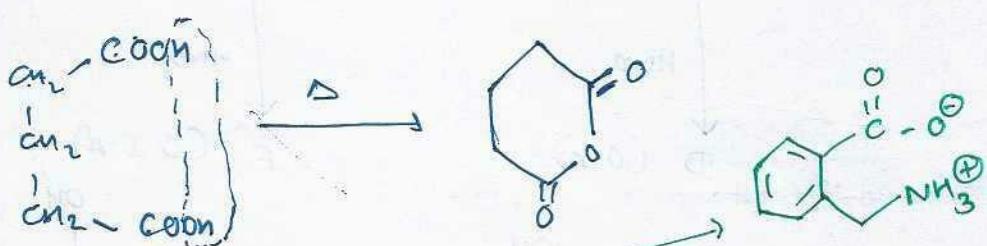
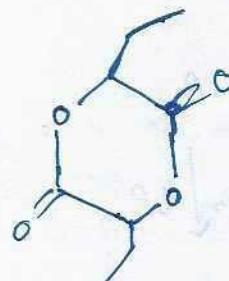
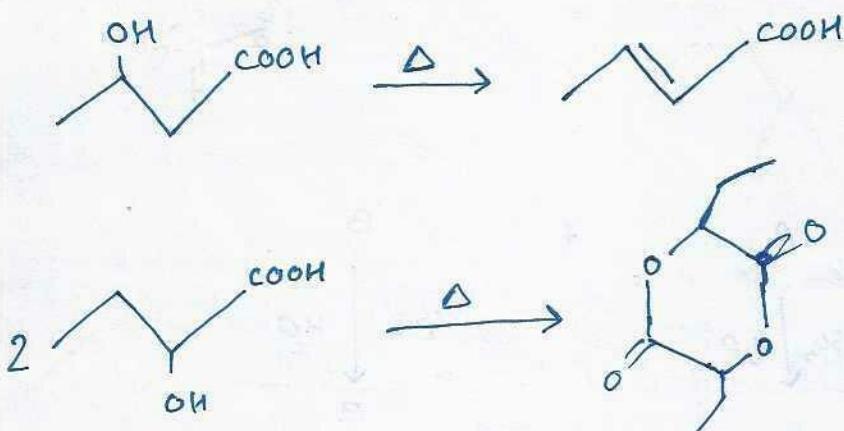
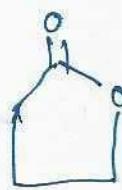
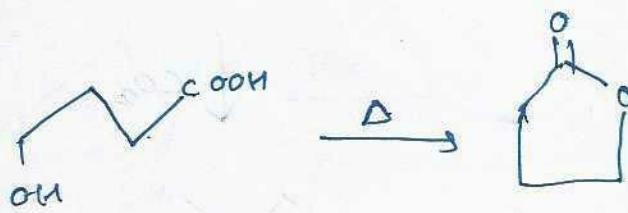
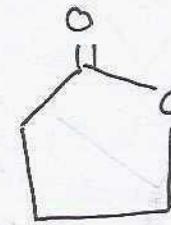
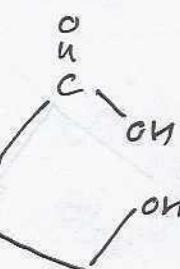
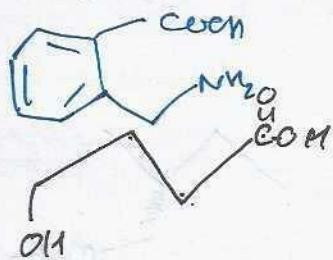
Q. Write the product of the following reactions on heating

4-hydroxybutanoic acid

3-hydroxy butanoic acid

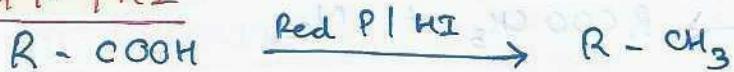
2-hydroxy butanoic acid

3z glutamic acid

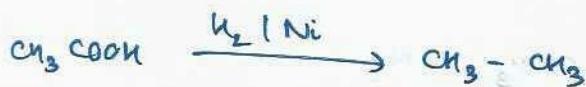
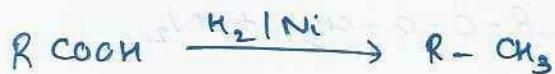


# REDUCTION

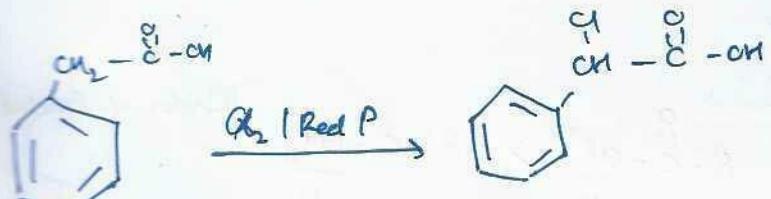
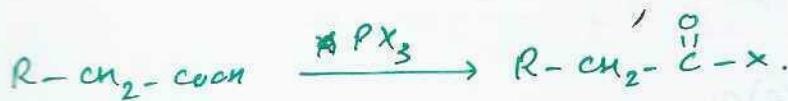
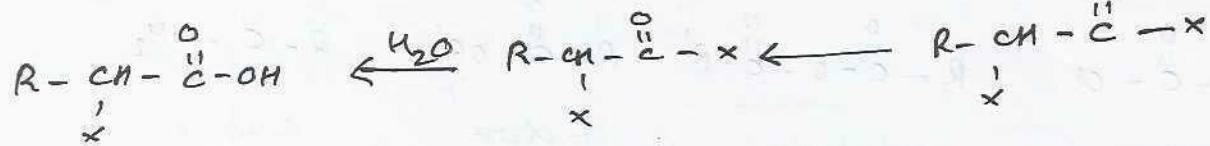
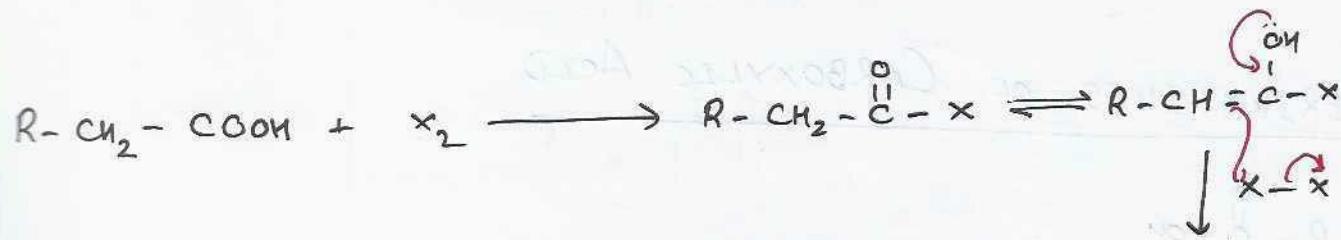
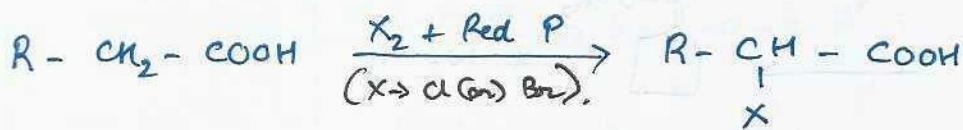
## Red P / HI



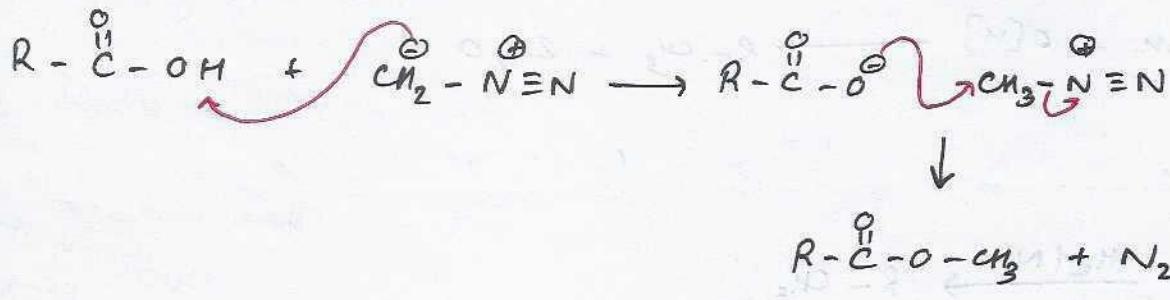
## H<sub>2</sub> / Ni



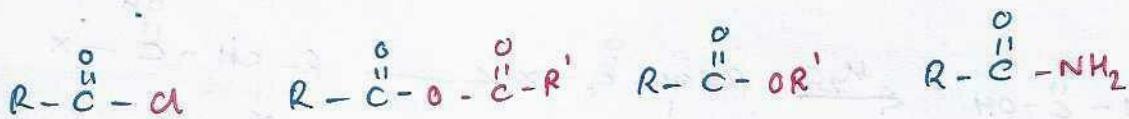
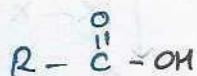
## HVZ (Hell-Volhard-Zelansky) Reaction



## WITH DIAZOMETHANE



## DERIVATIVES OF CARBOXYLIC ACID

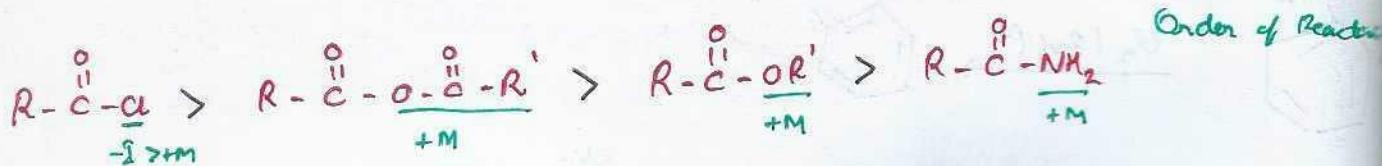
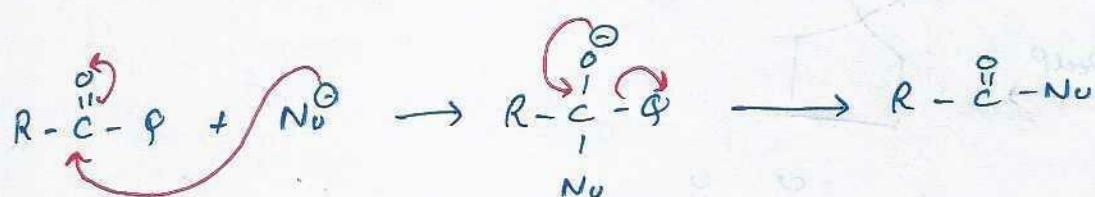
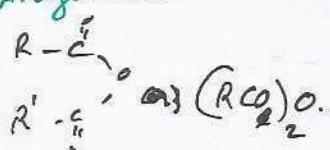


Acid chloride

Anhydrides

Esters

Amides.

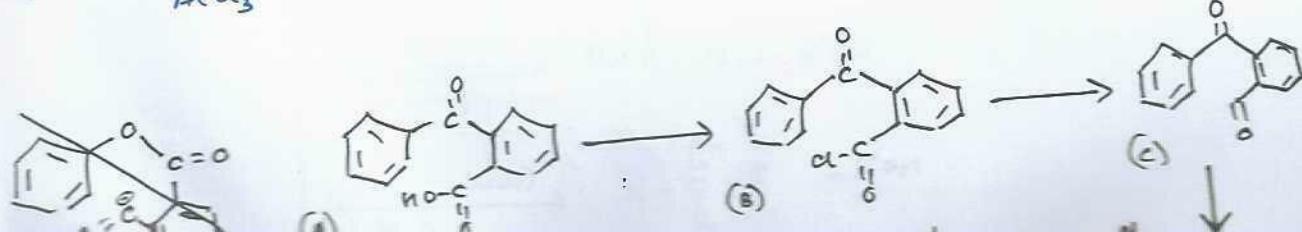
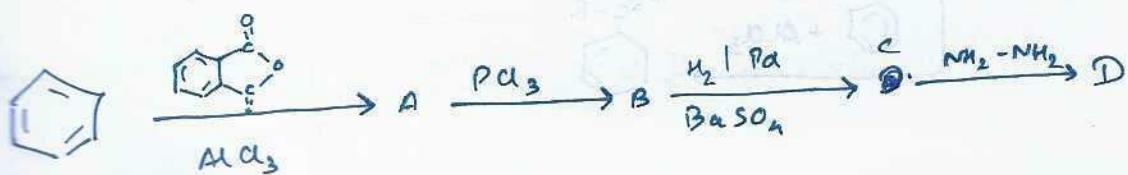
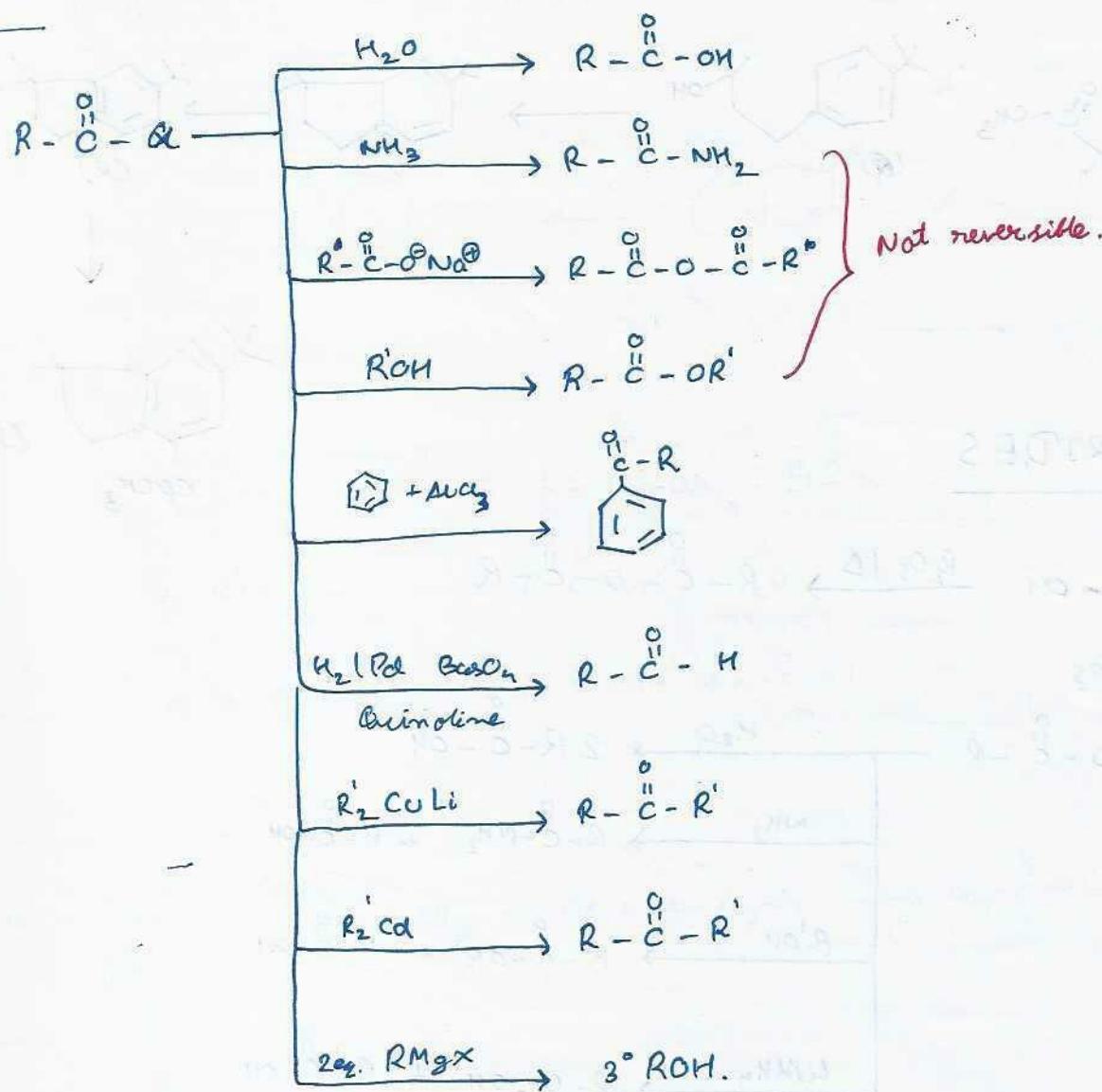


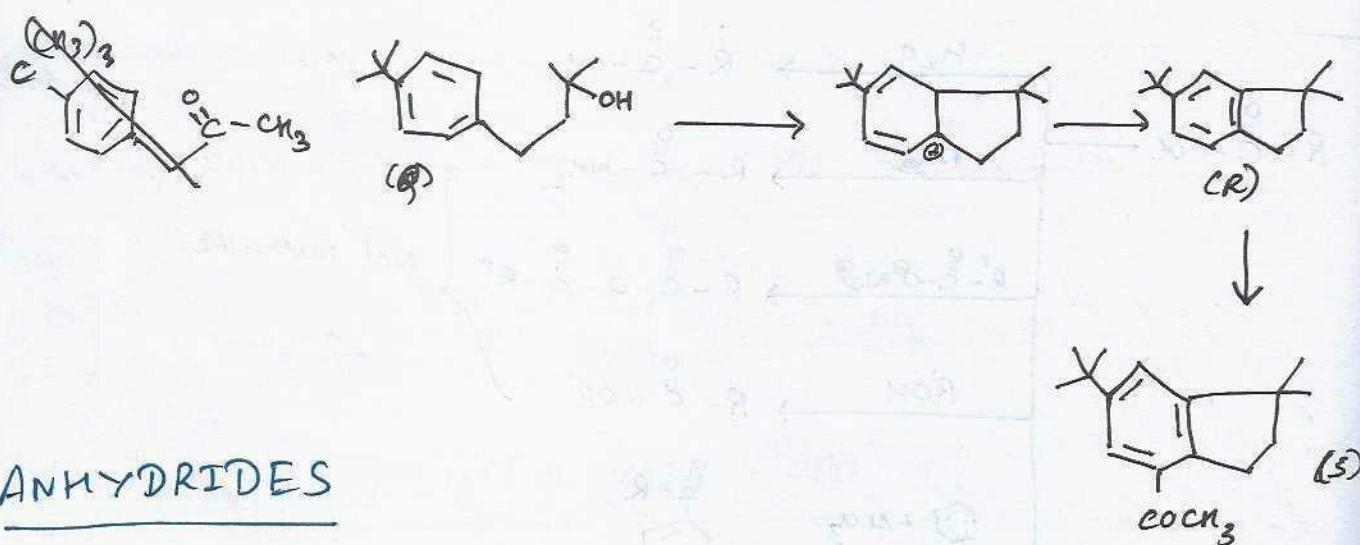
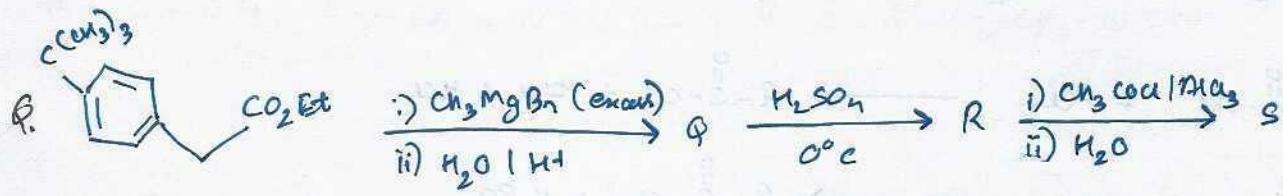
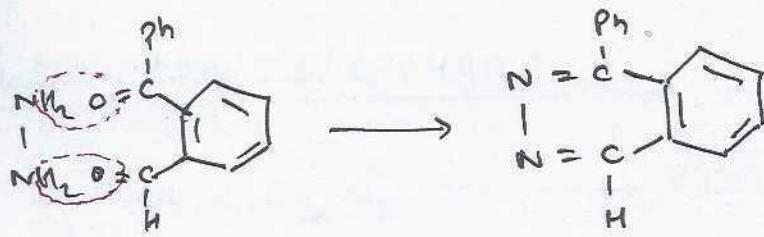
Weaker base  $\rightarrow$  Better leaving group.

$(-\text{O}-\overset{\text{O}}{\underset{\text{II}}{\text{C}}}-\text{R}' < -\text{OR}' < -\text{NH}_2 (+\text{M}))$

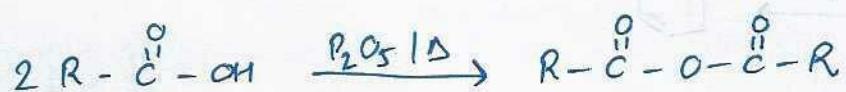
# PREPARATION

## ACID CHLORIDE

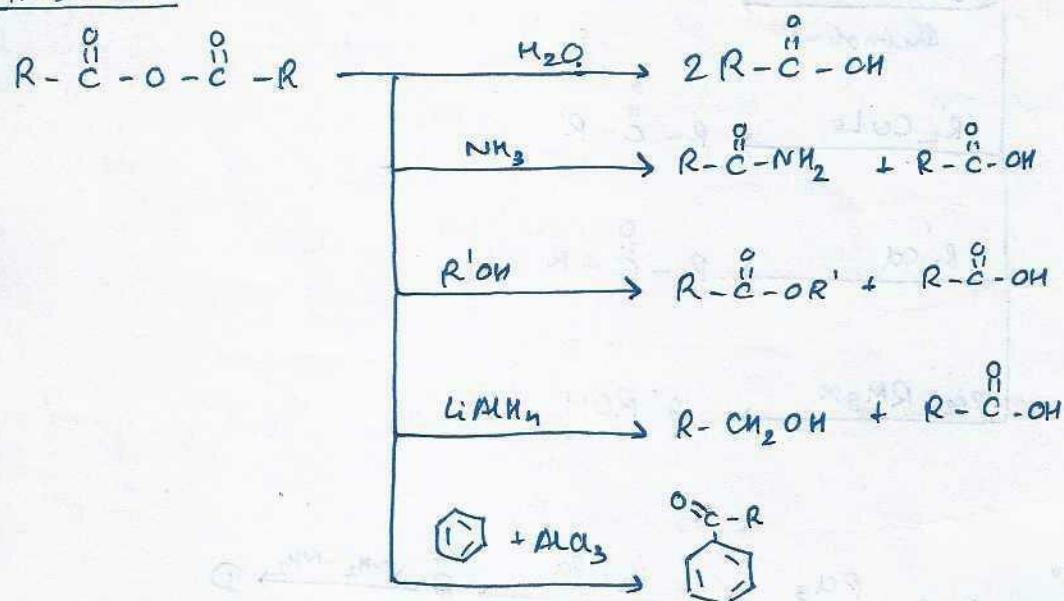


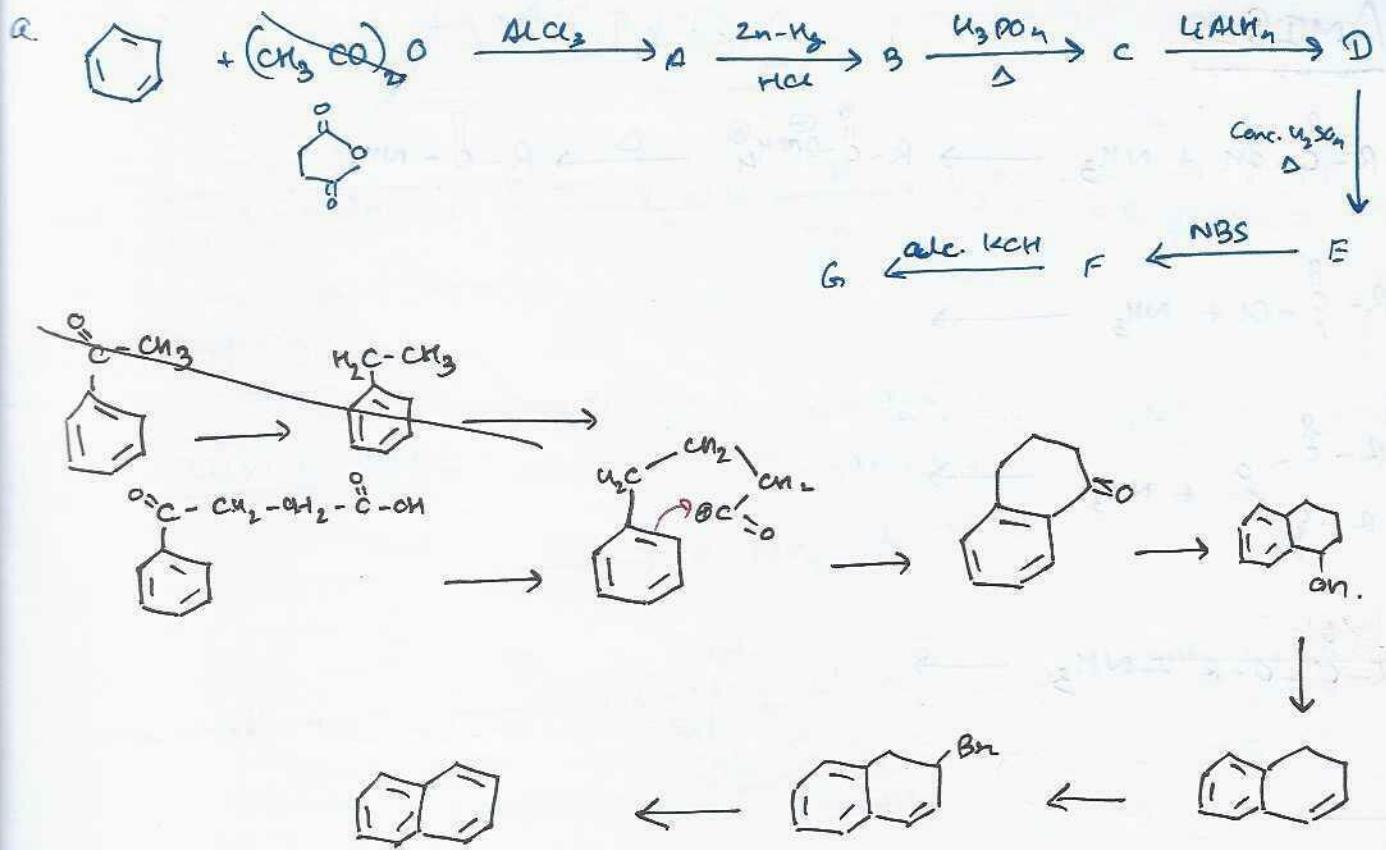


## ANHYDRIDES



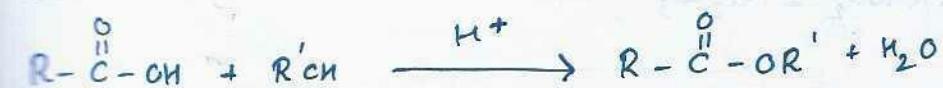
## PROPERTIES



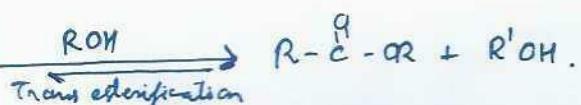
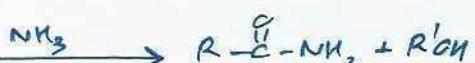
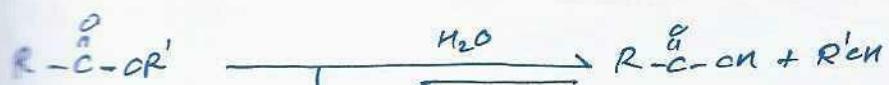
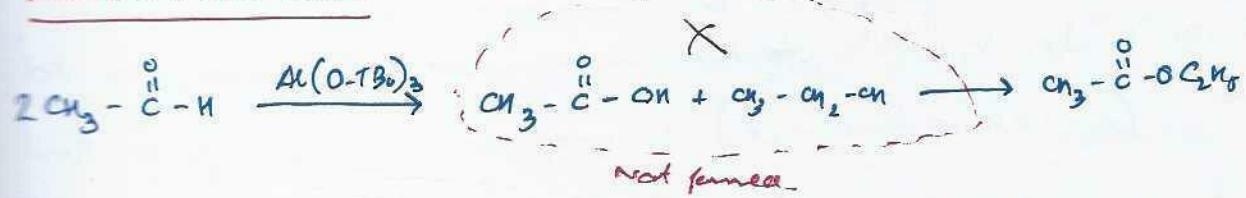


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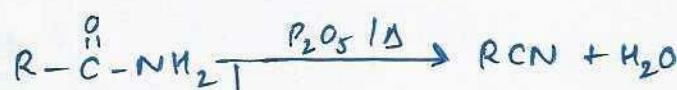
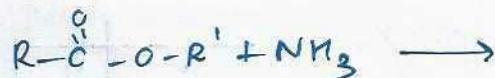
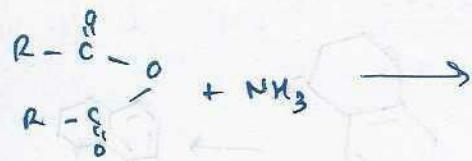
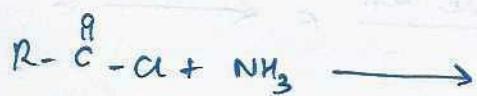
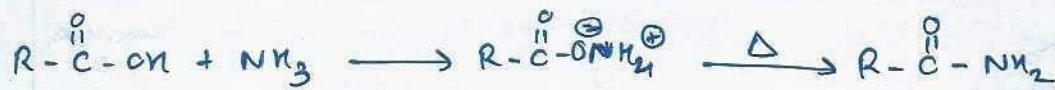
(5)



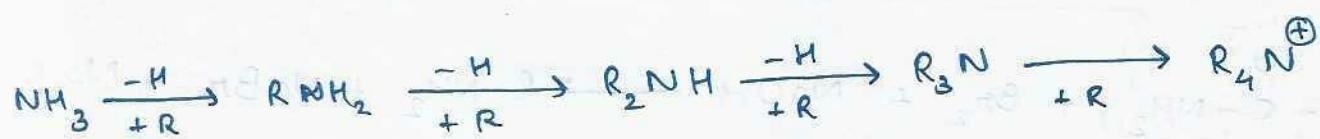
### TISENKO REACTION



## AMIDES

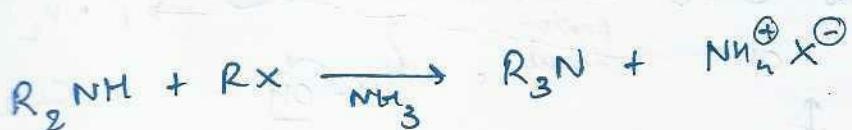
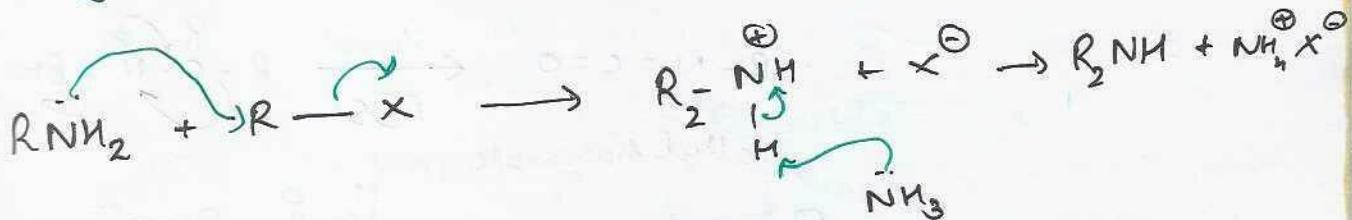
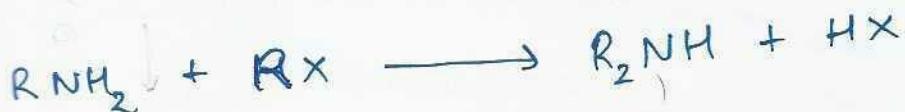
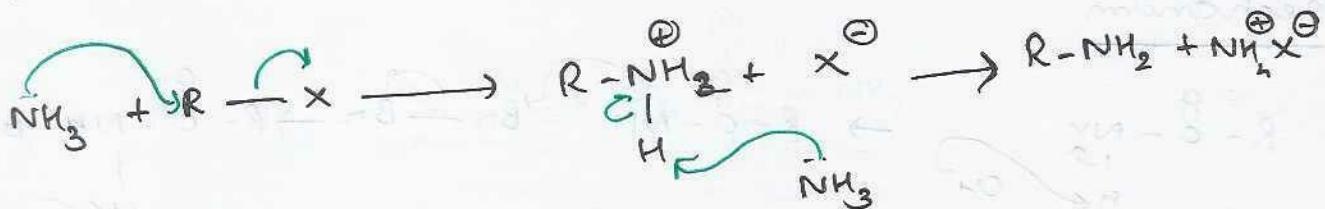


# AMINES



## PREPARATION

### FROM ALKYL HALIDE



Not favoured, as reaction cannot be stopped at  $1^\circ$  or  $2^\circ$  amines.  
Mixture of products are formed ( $1^\circ$ ,  $2^\circ$  and  $3^\circ$  amines).

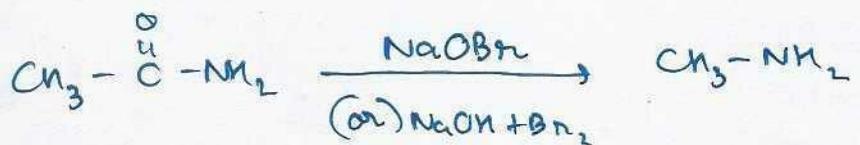
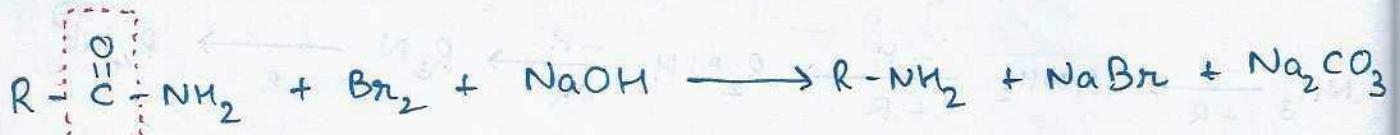
If  $\text{NH}_3$  is taken in <sup>large</sup> excess, primary amines are formed.



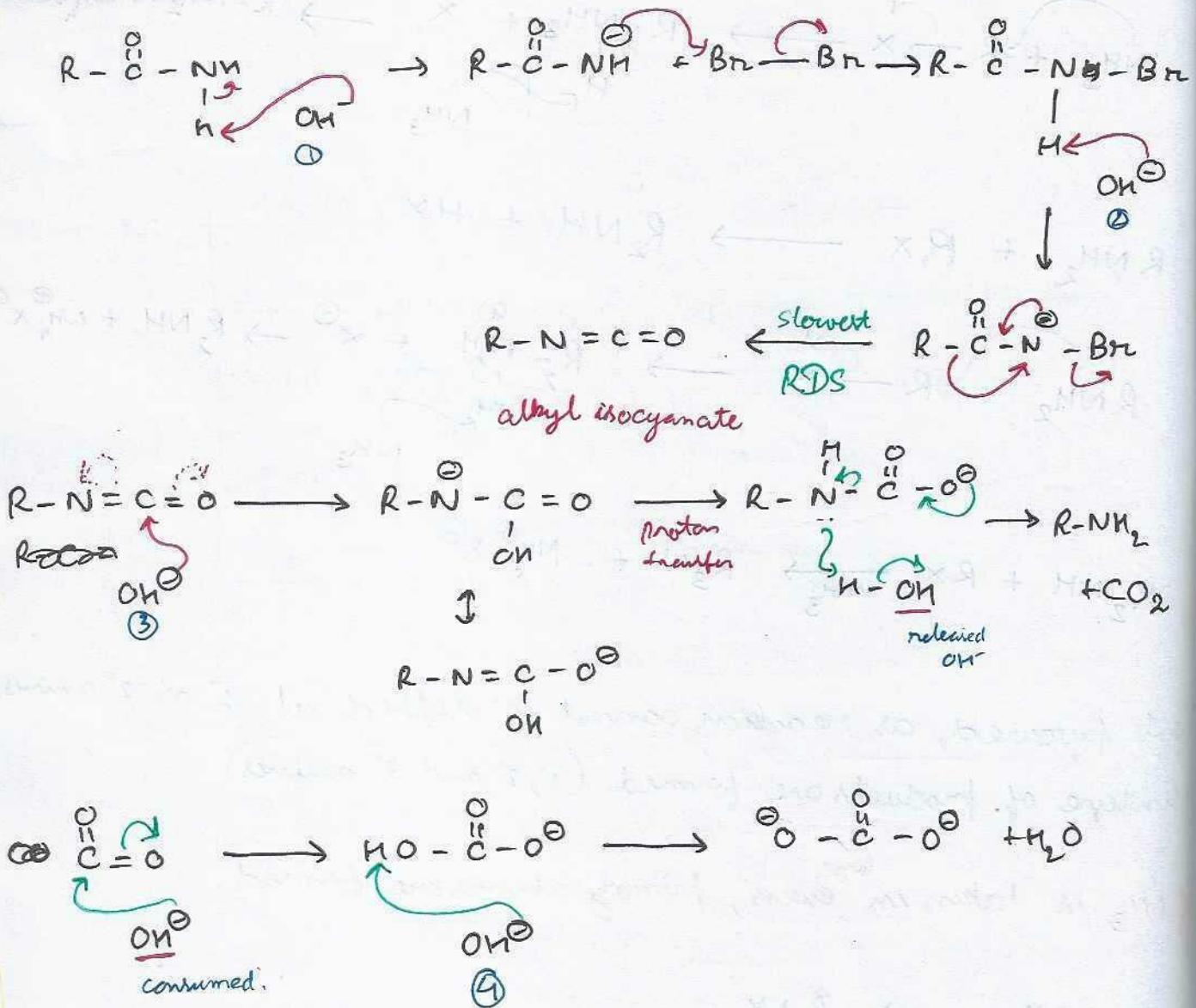
(1mol) (3mol)

# HOFFMAN BROMIDE DEGRADATION

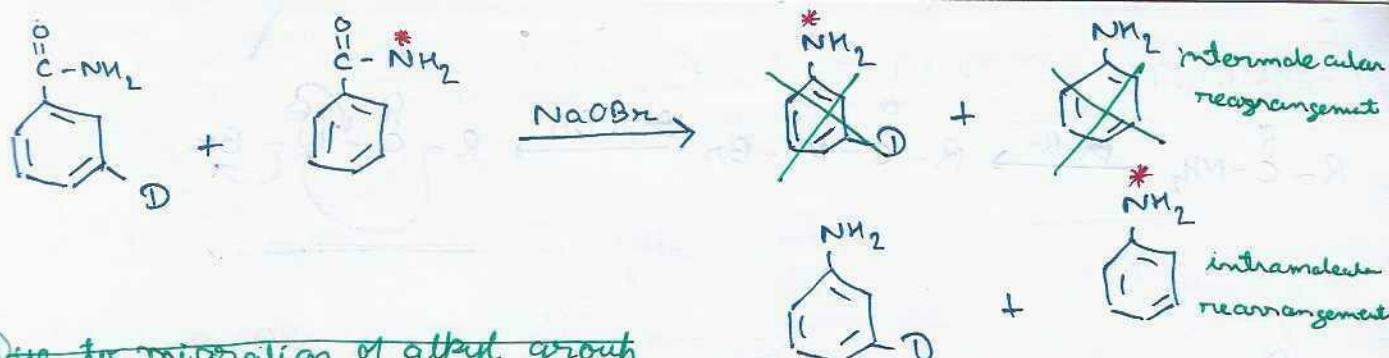
(<sup>1°</sup> Amines Preparation)



## Mechanism



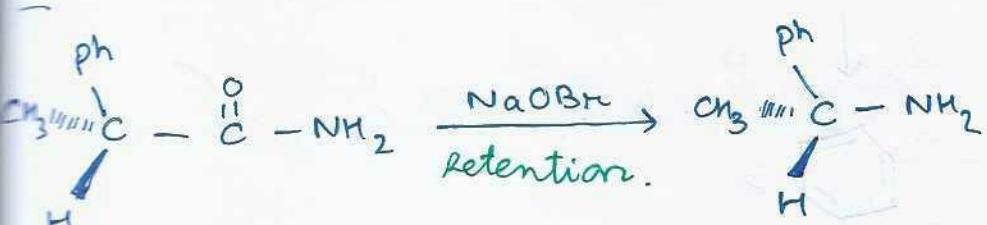
Total 4 moles of OH<sup>-</sup> ions are consumed.



Due to migration of alkyl group.  
(strong)

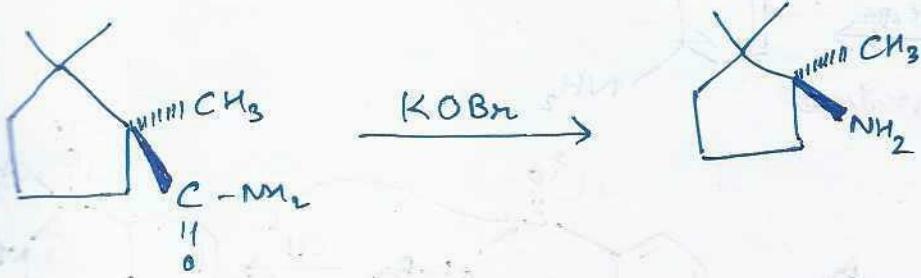
Intermolecular rearrangement does not take place.

Only intramolecular rearrangement products are formed.

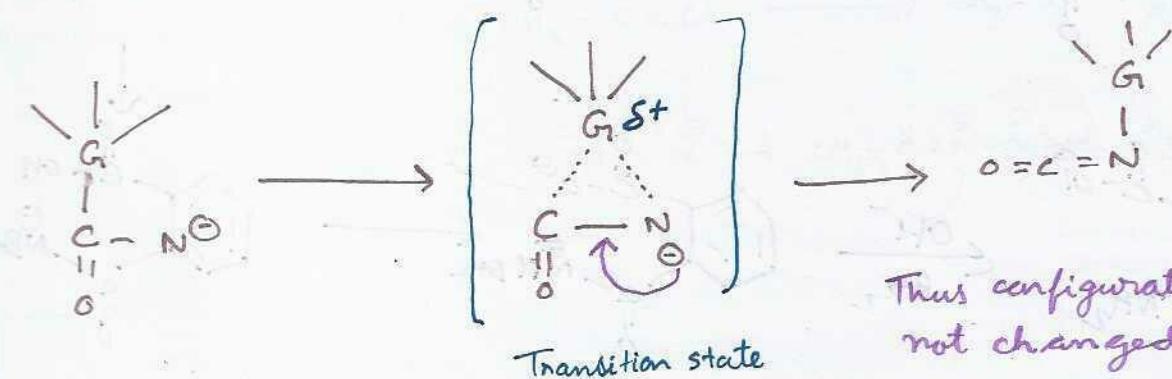


Optical activity is not lost.

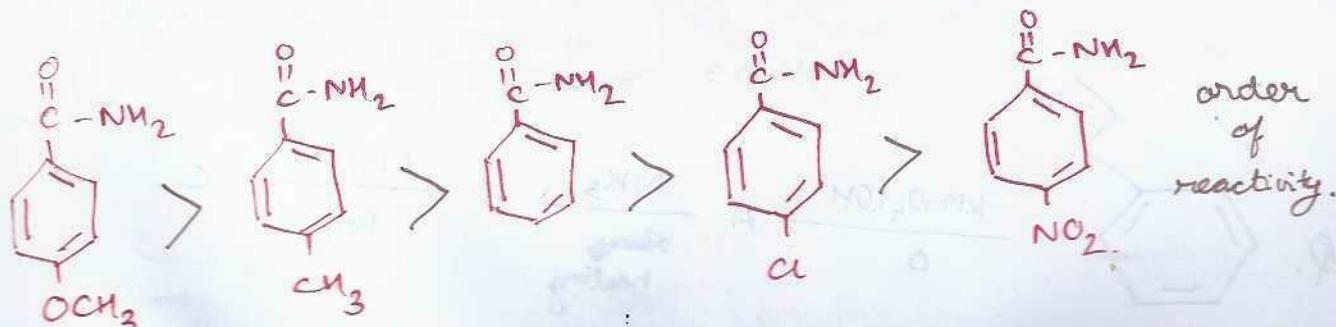
Configuration is retained.



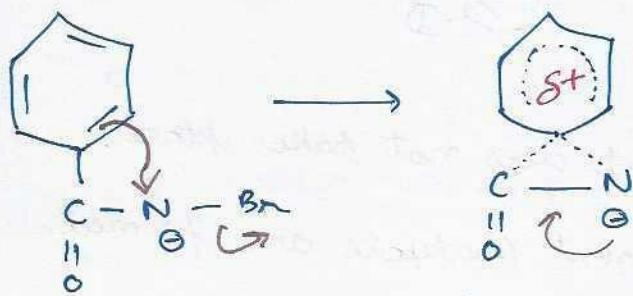
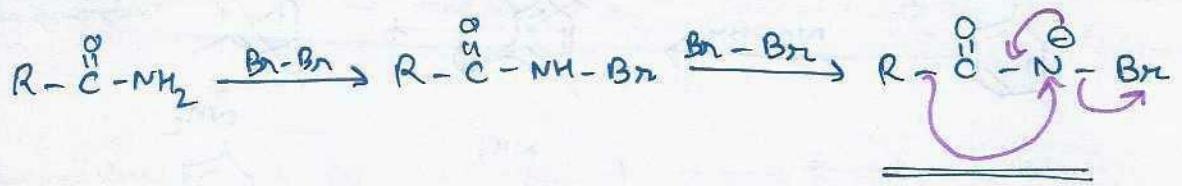
### Mechanism



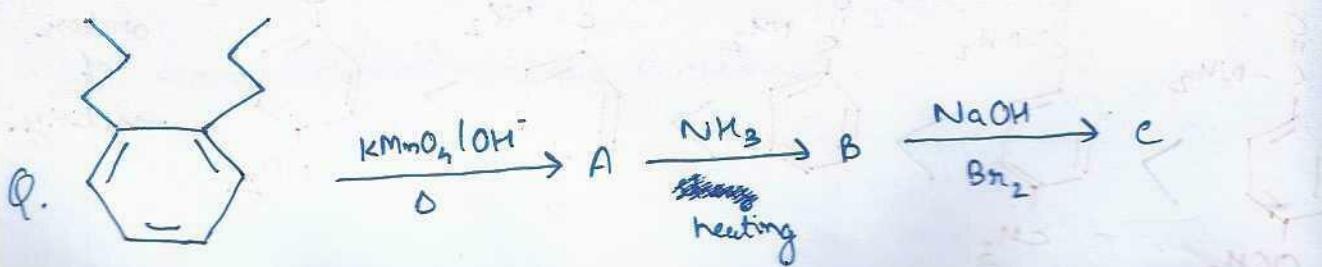
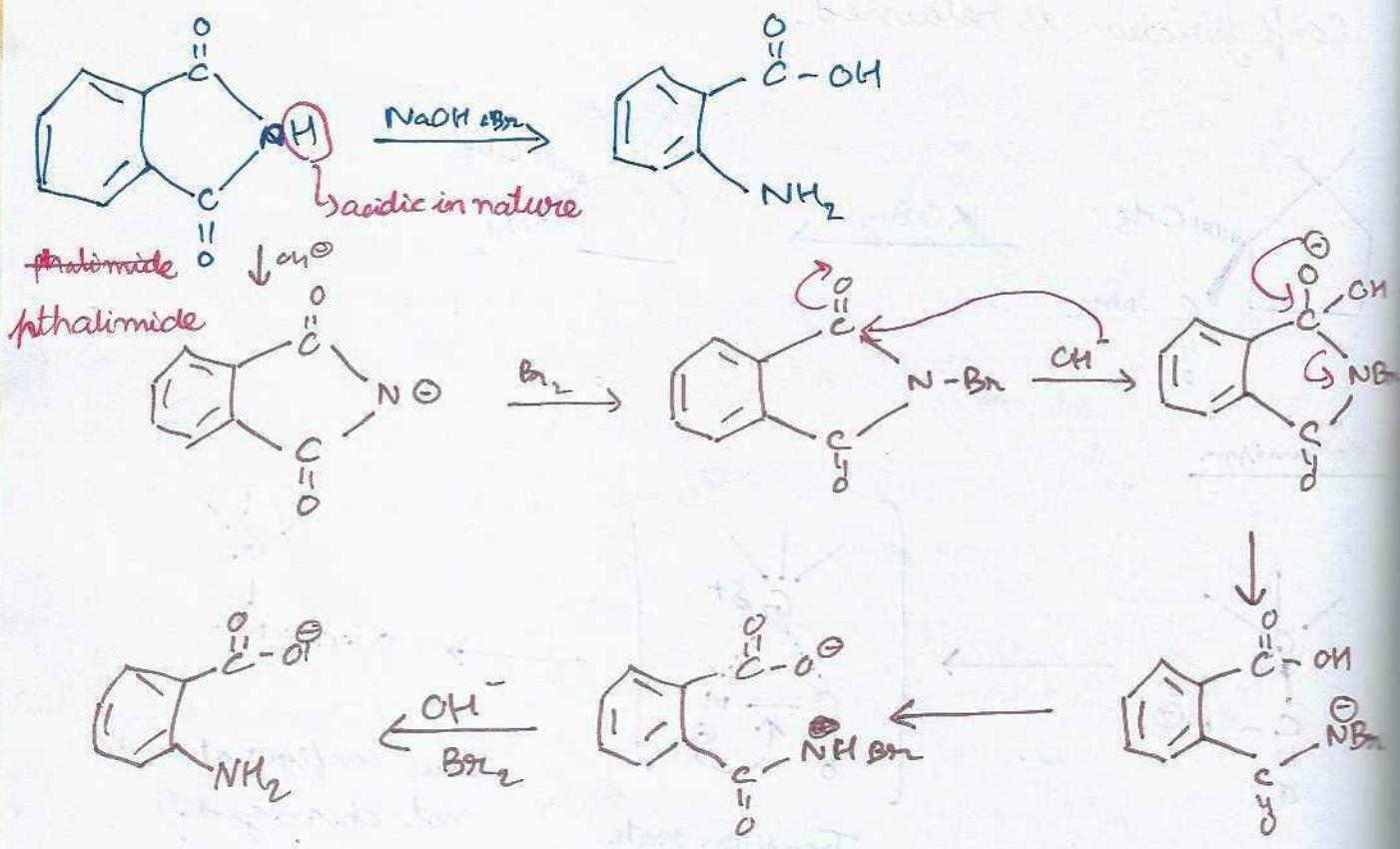
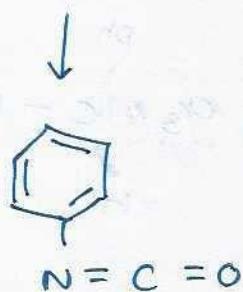
Thus configuration is not changed.

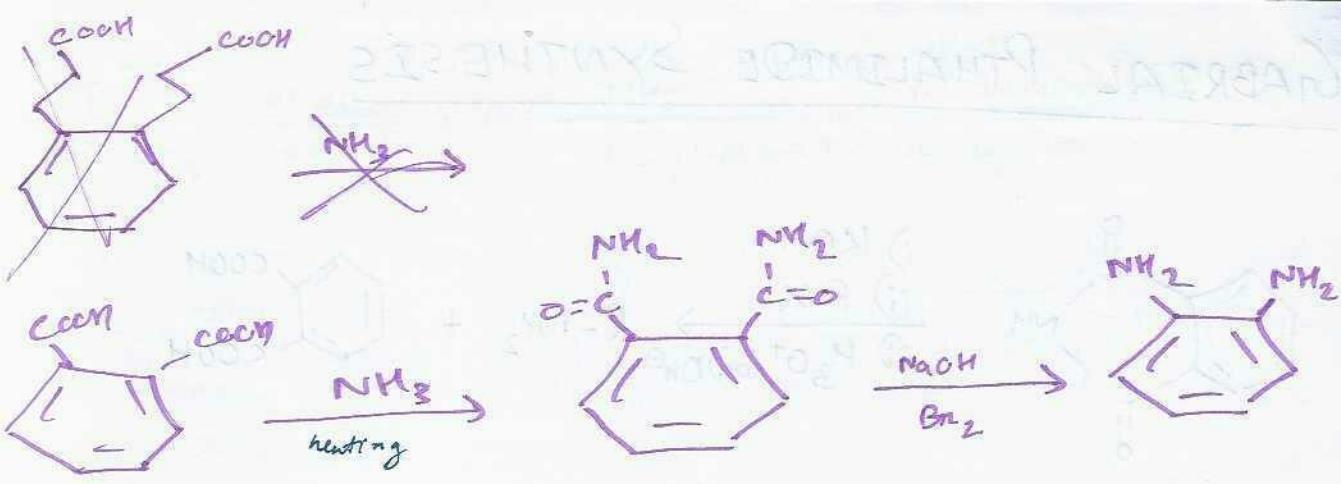


order of reactivity.

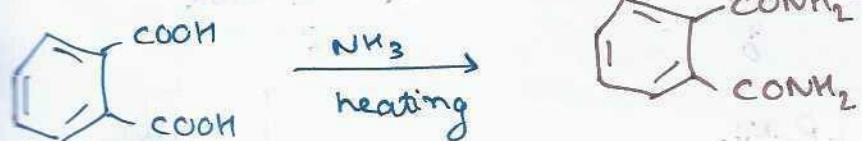
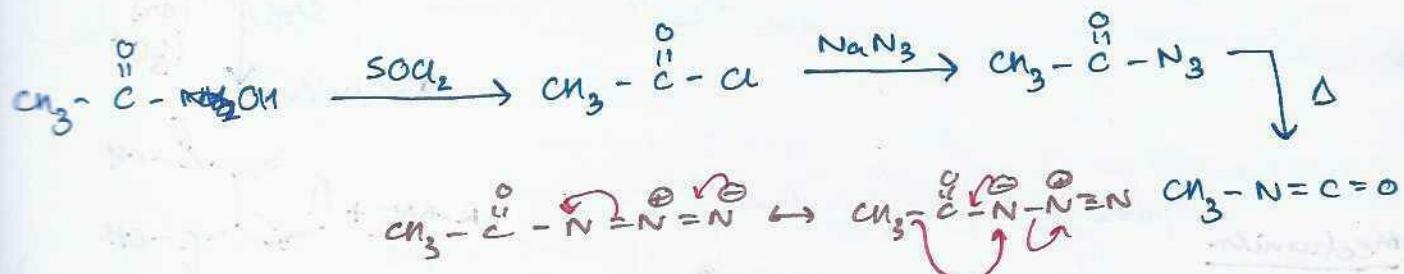
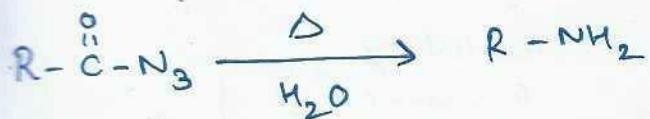
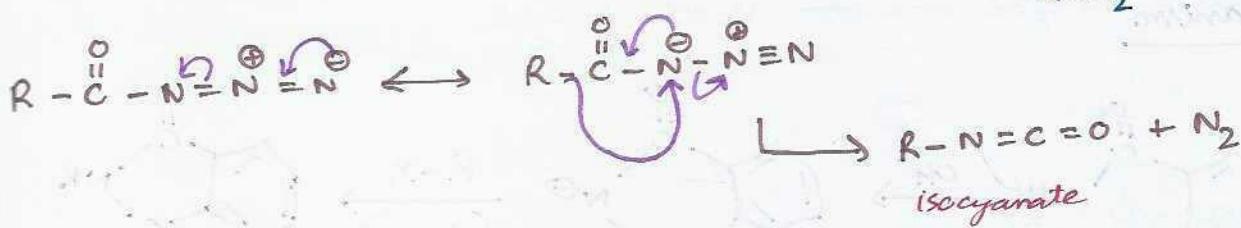
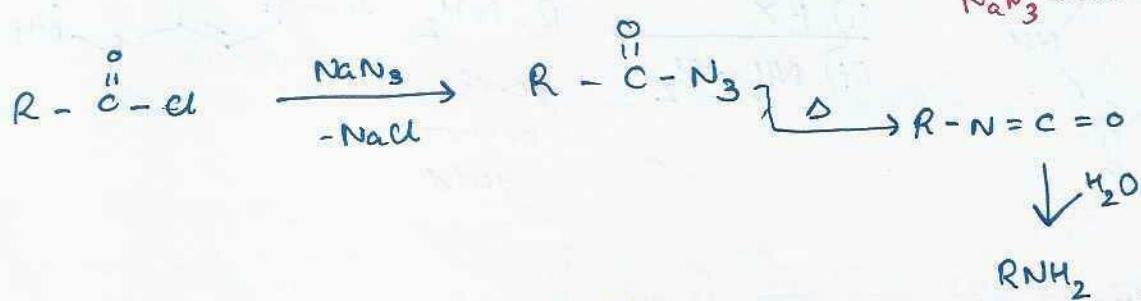


Thus electron releasing group stabilises the partial positive charge of the transition state  
↓  
increases reactivity.

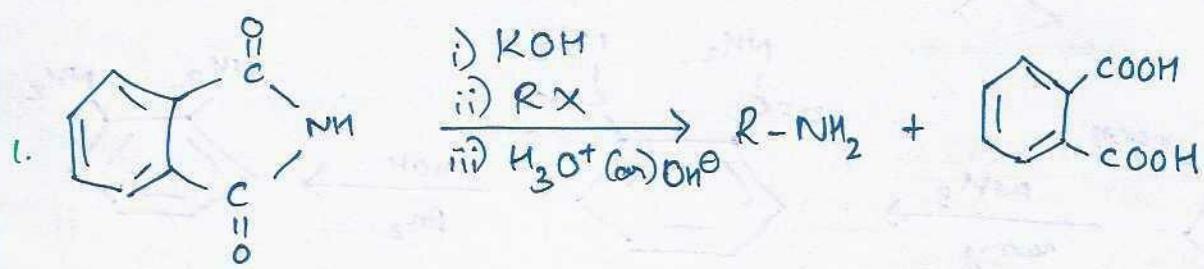




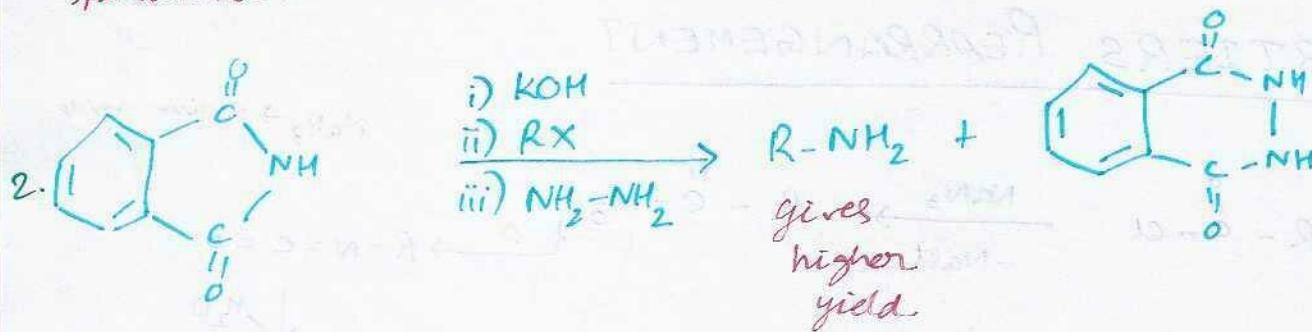
## CARTIER'S REARRANGEMENT



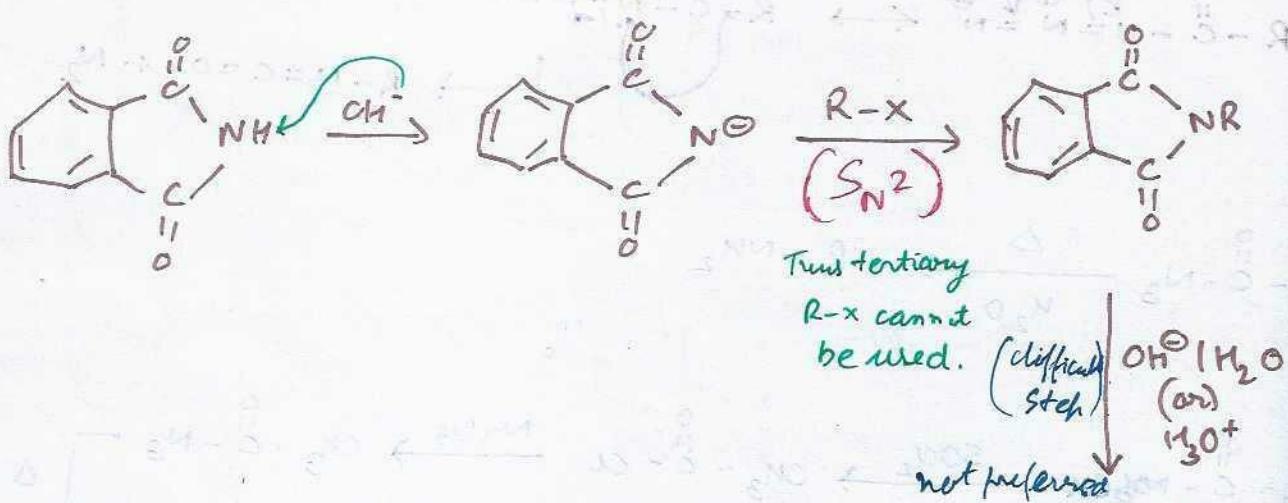
# GABRIAL PHTHALIMIDE SYNTHESIS



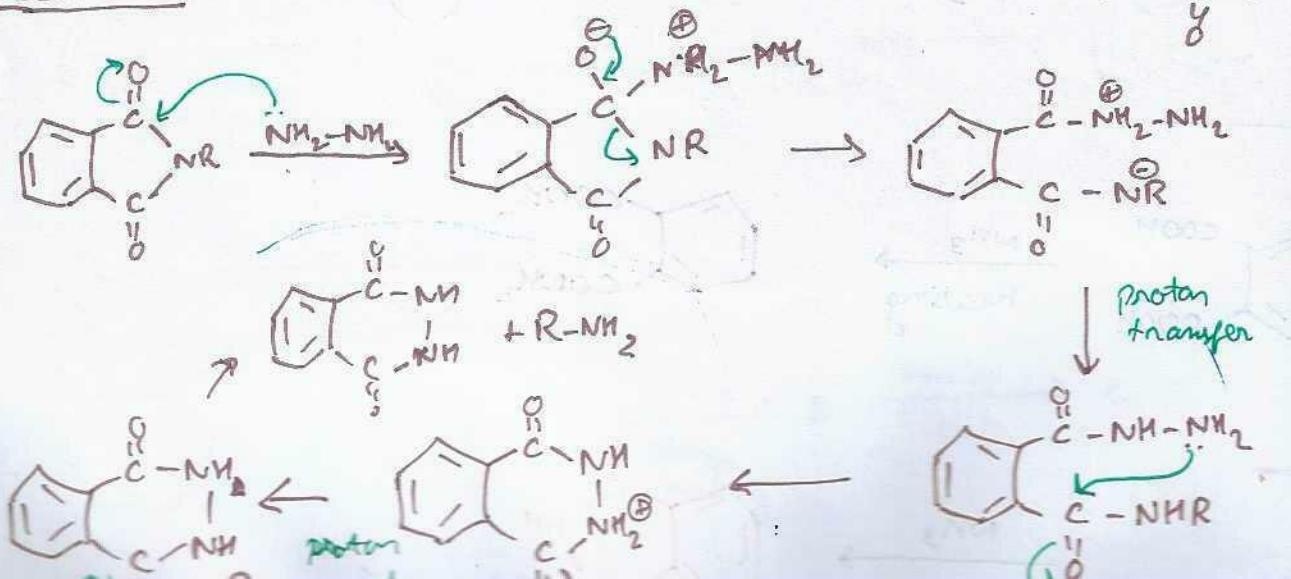
phthalimide.

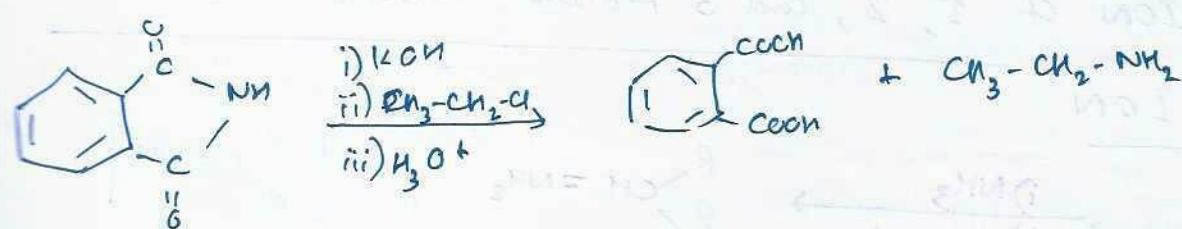
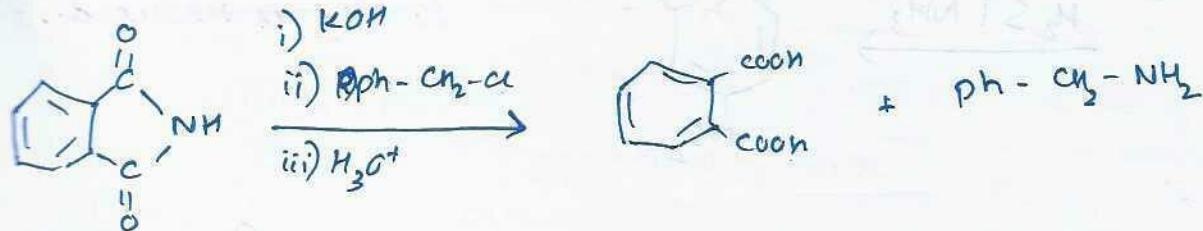
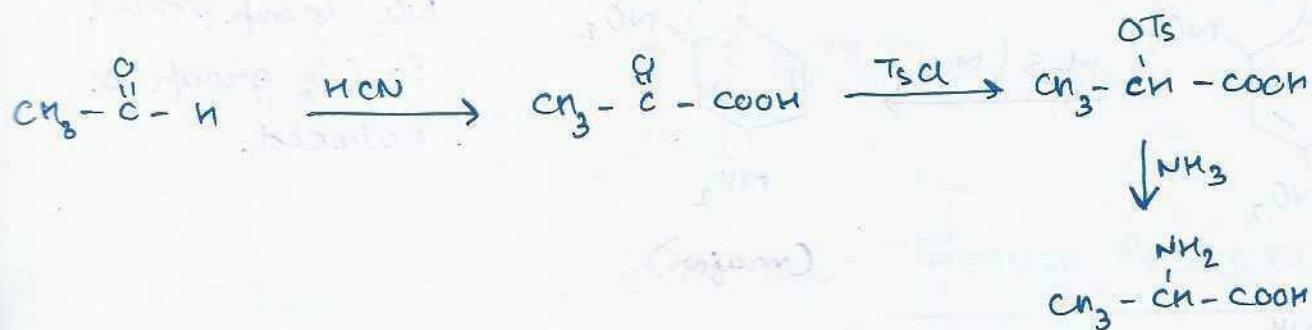
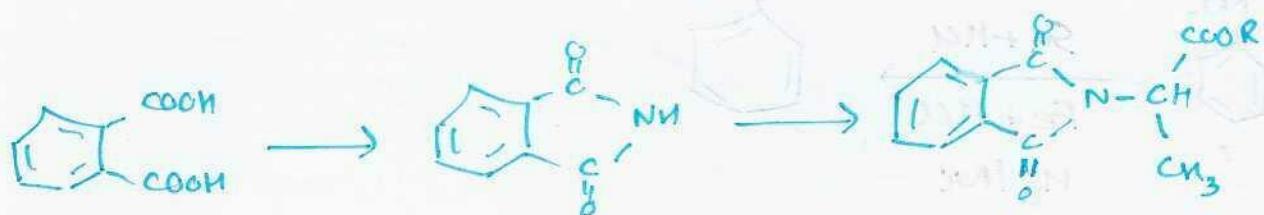
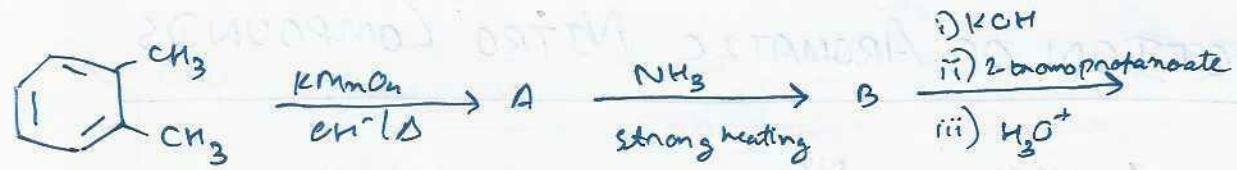


## 1. Mechanism

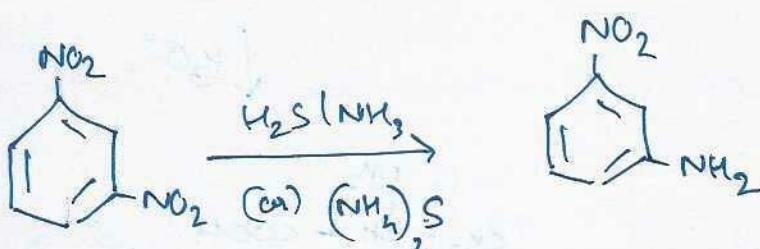
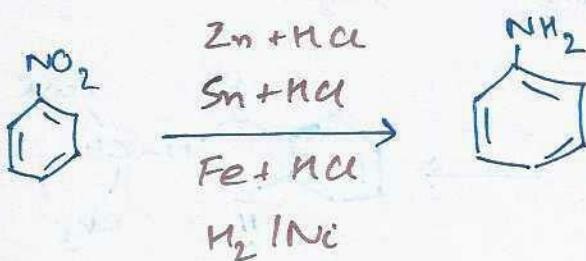


## 2. Mechanism

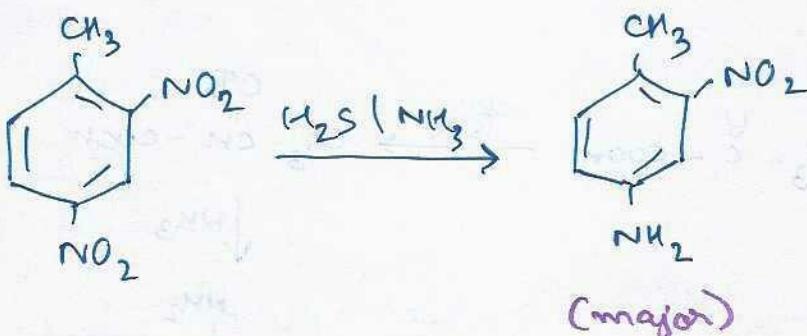




# REDUCTION OF AROMATIC NITRO COMPOUNDS

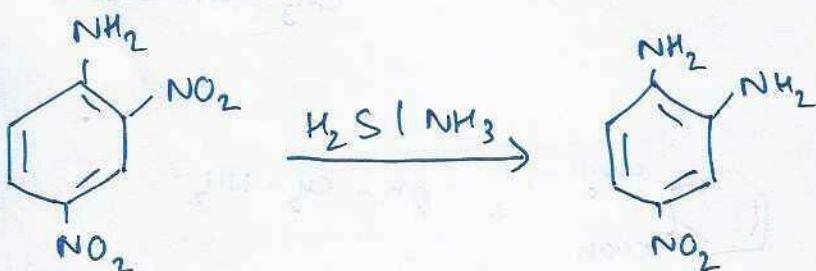


in calculated quantity



NO<sub>2</sub> group parallel to CH<sub>3</sub> group is reduced.

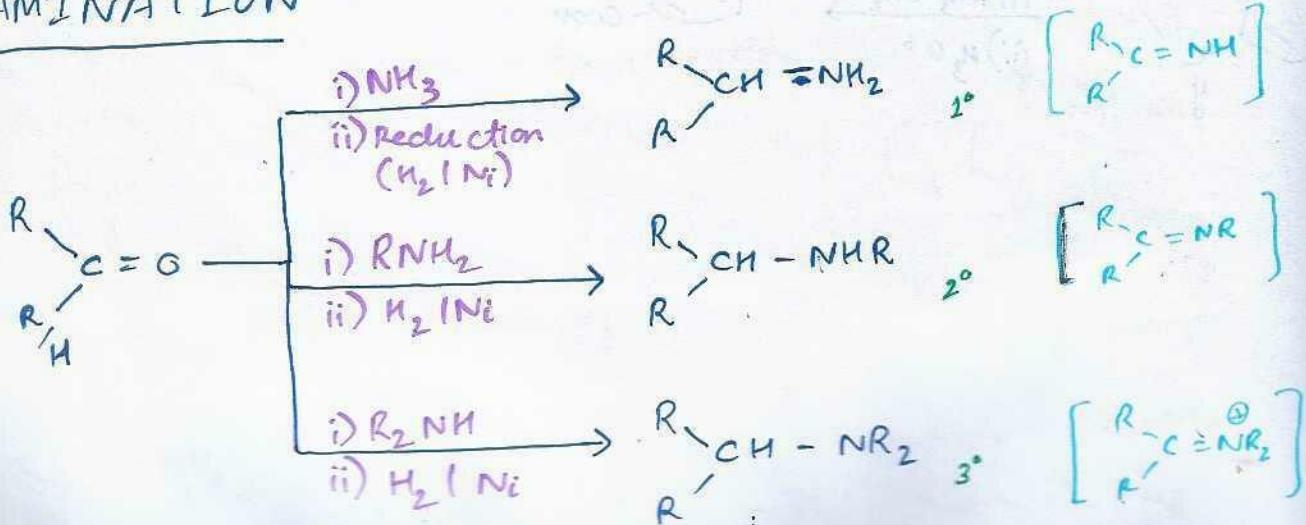
(Major)

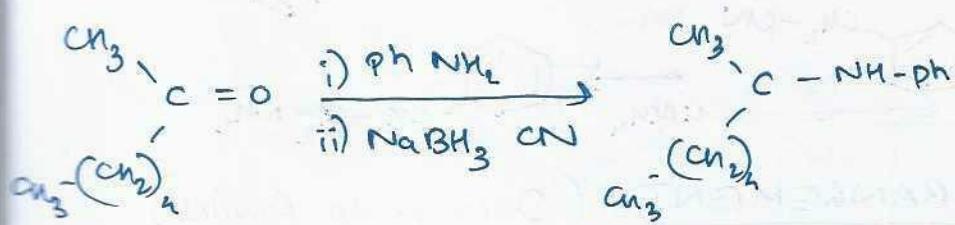
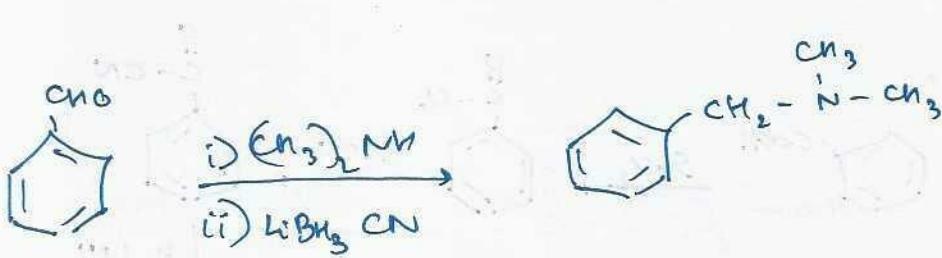
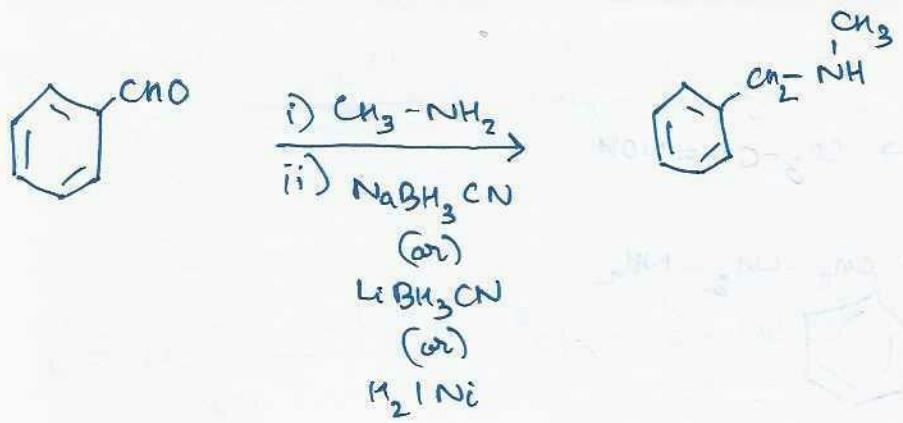


NO<sub>2</sub> group adjacent to NH<sub>2</sub> is reduced.

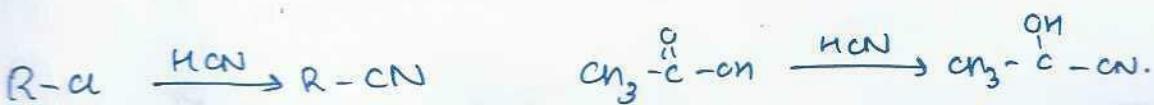
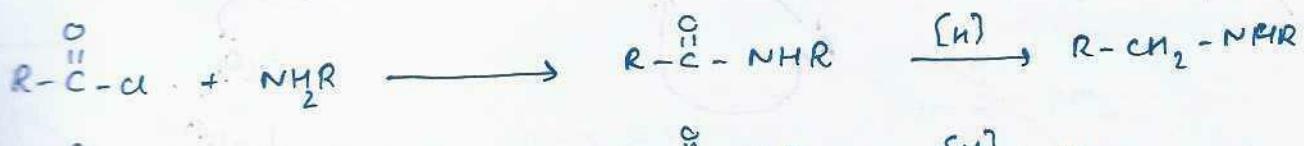
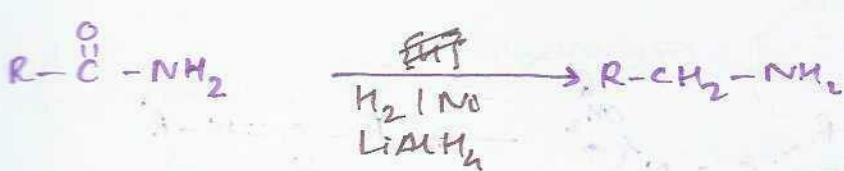
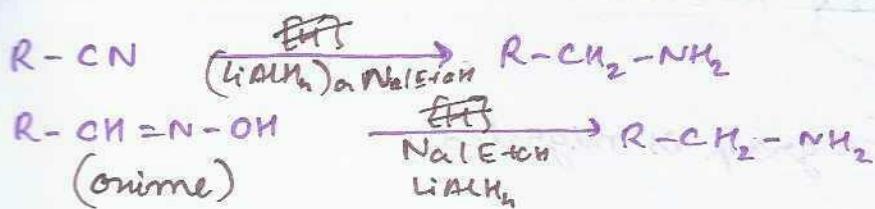
## PREPARATION OF 1°, 2°, and 3° AMINE THROUGH REDUCTIVE AMINATION

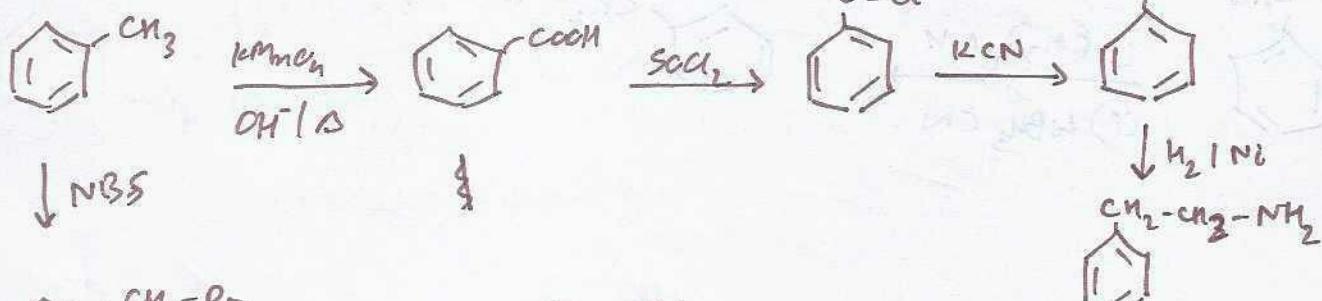
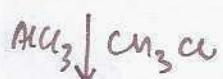
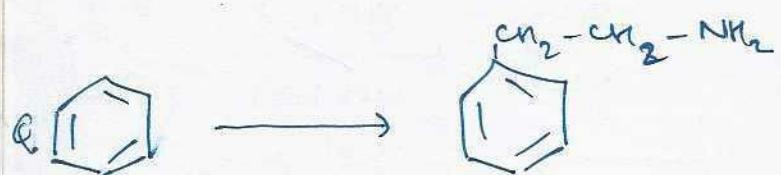
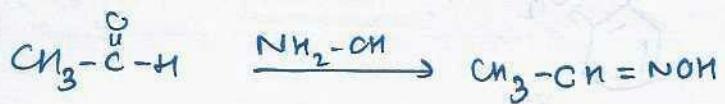
### AMINATION



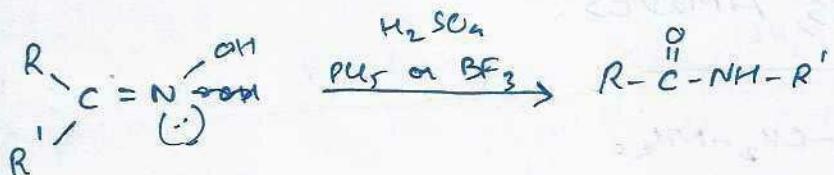
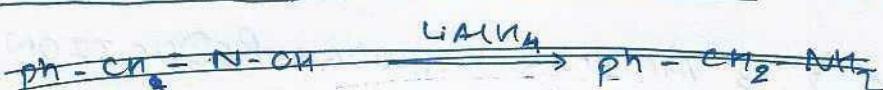


## PREPARATION OF $1^\circ$ , $2^\circ$ , $3^\circ$ AMINES THROUGH REDUCTION OF NITRILES, OXIMES, AMIDES.



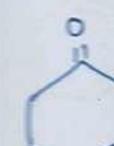
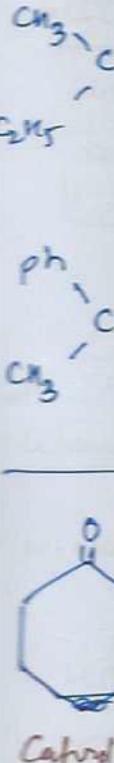
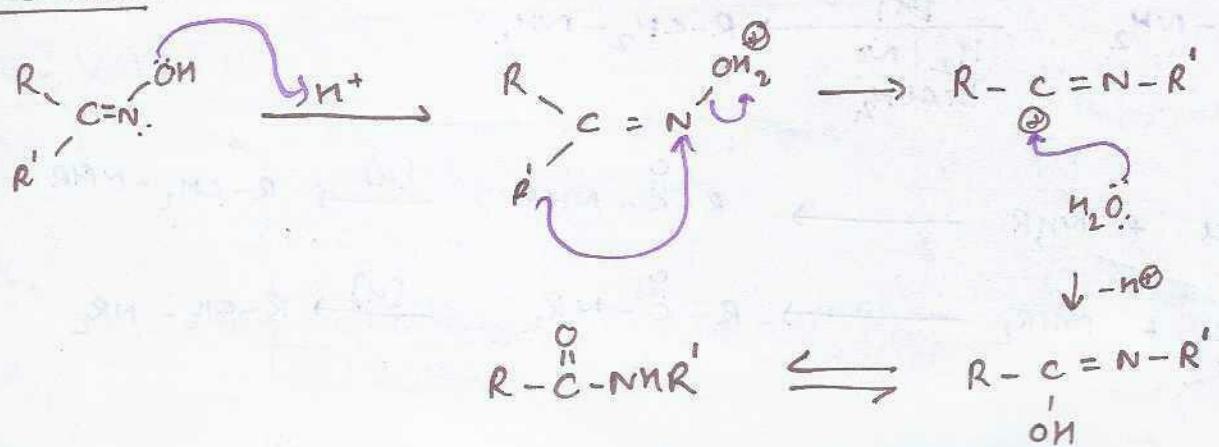


### BECKMANN REARRANGEMENT (Onimes to Amides)

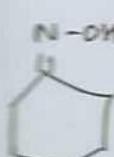


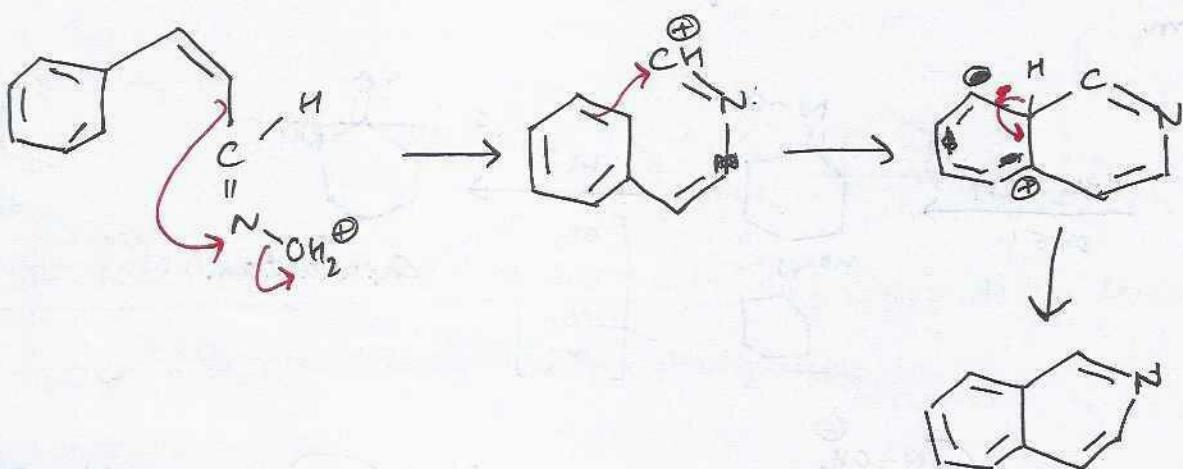
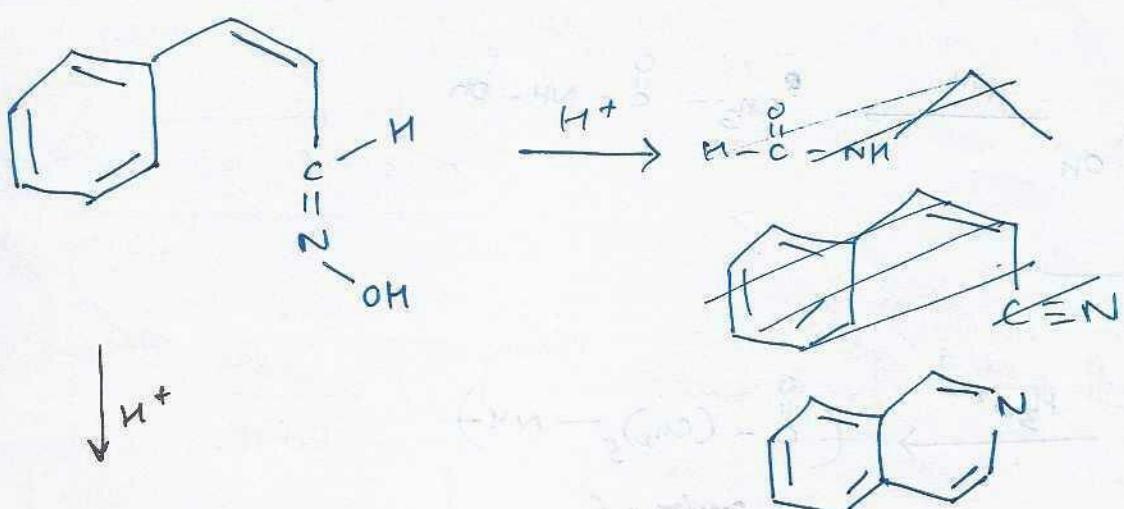
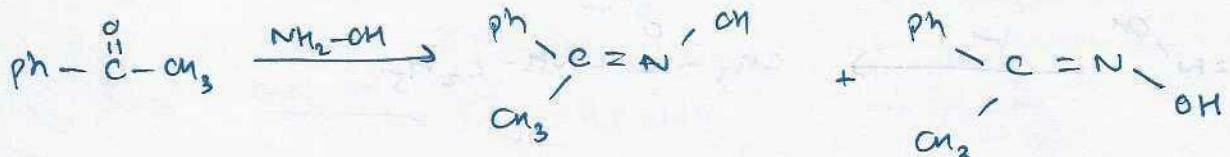
alkyl group anti to OH group is migrated.

### Mechanism



### Mechanism

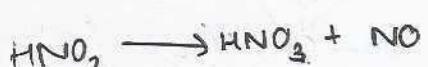
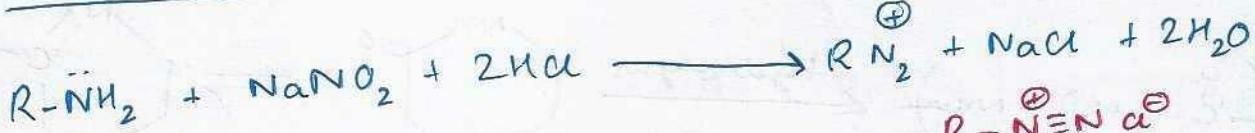




## PROPERTIES OF AMINES

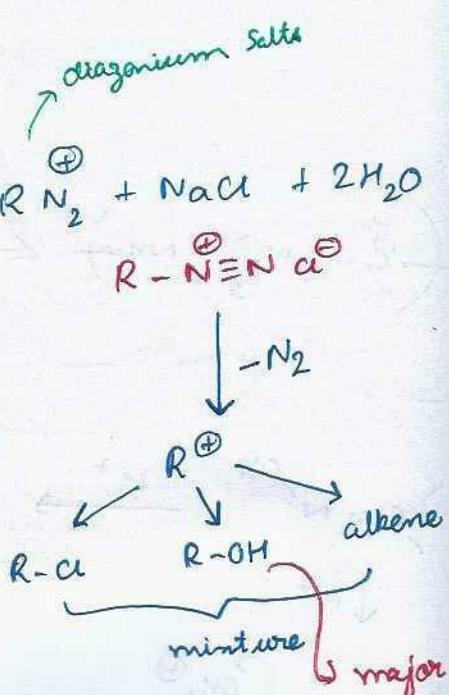
### 1. WITH NITROUS ACID

#### a) WITH 1° AMINE

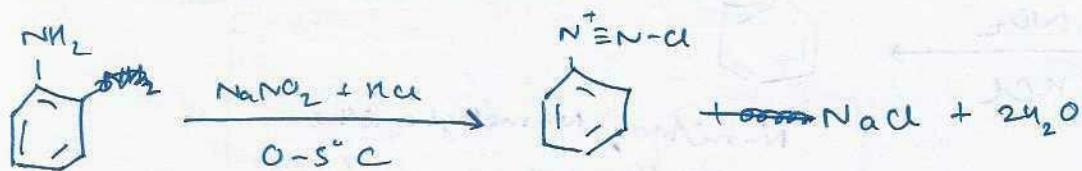


disproportionation.

- Stable diazonium salts are not formed
- less synthetic application.

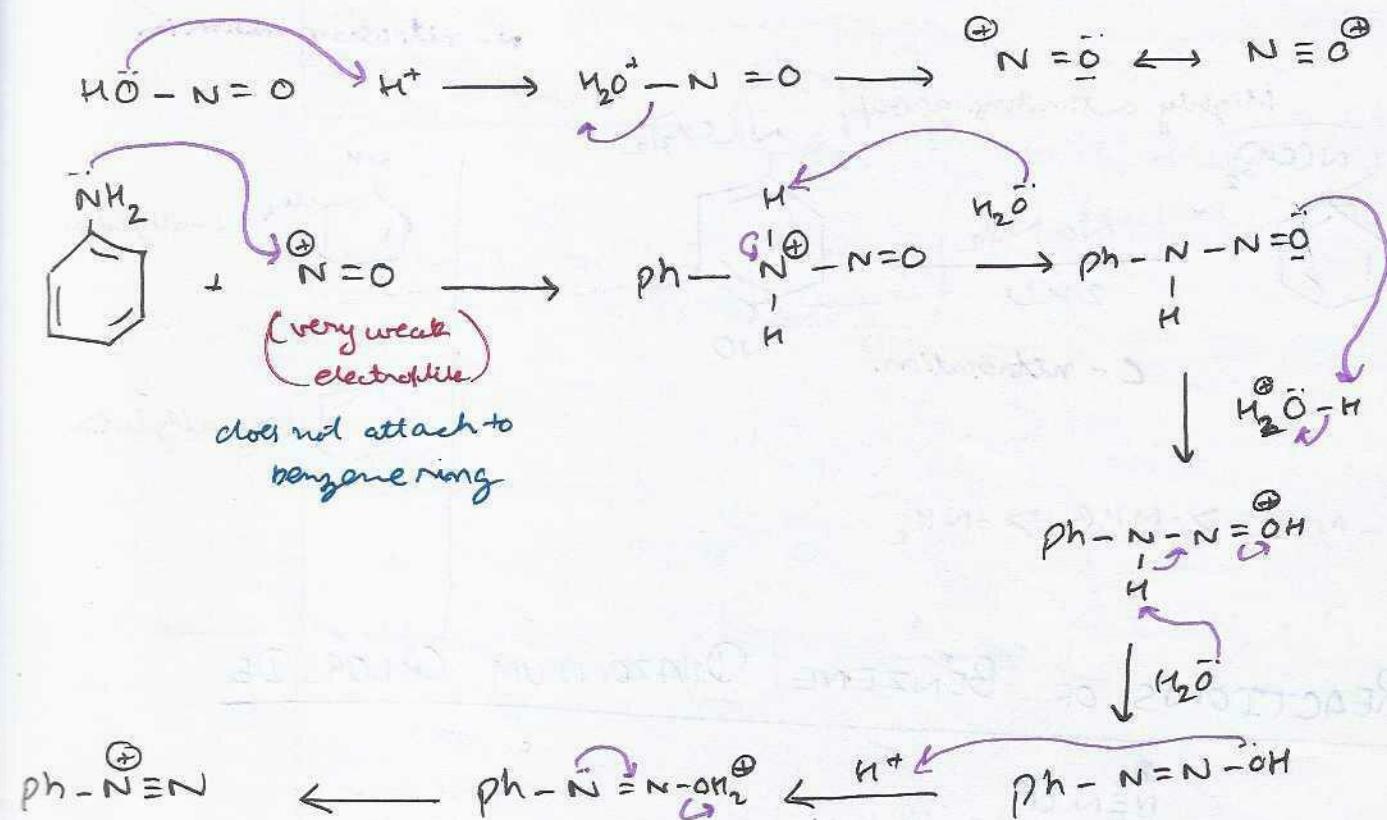


## WITH AROMATIC PRIMARY AMINES



benzene diazonium chloride → can be isolated in low temperature ( $0-5^\circ\text{C}$ )

### Mechanism



## WITH 2° AMINES

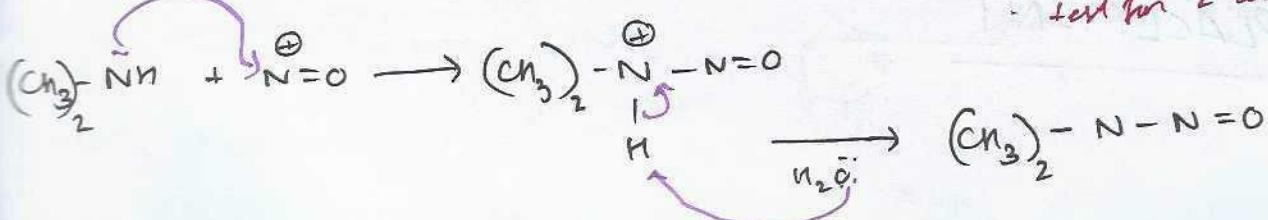


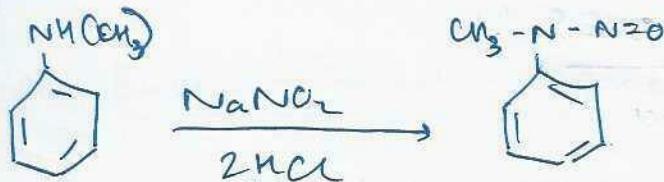
N-nitroso- $N,N$ -dimethyl amine

yellow colour oily liquid

test for 2° amines.

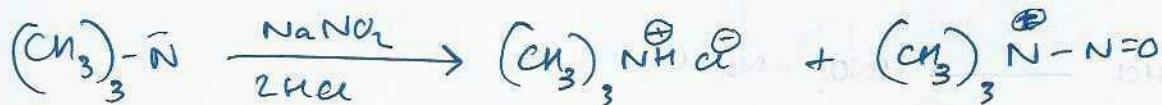
### Mechanism





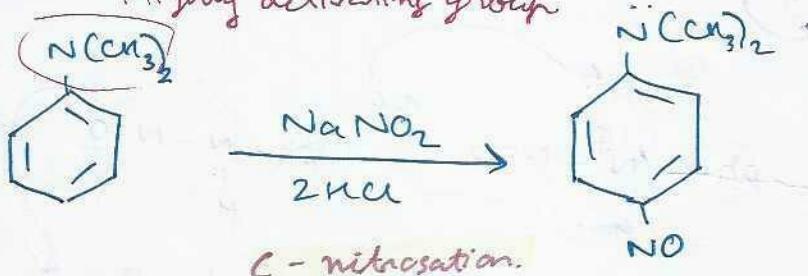
*N-nitroso-N-methyl aniline*  
*yellow colour oily liquid*

## d) WITH $3^\circ$ AMINES



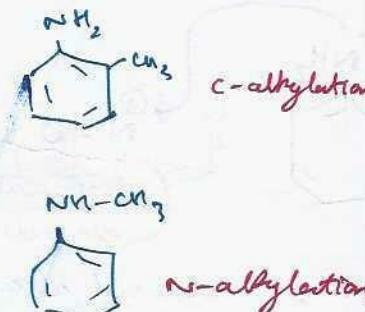
*N-nitroseammonium ion*

*Mighty activating group*

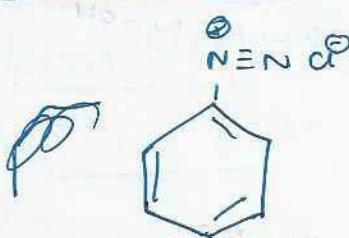


*C-nitrosation.*

*-NMe<sub>2</sub> > -NHR > -NH<sub>2</sub>*



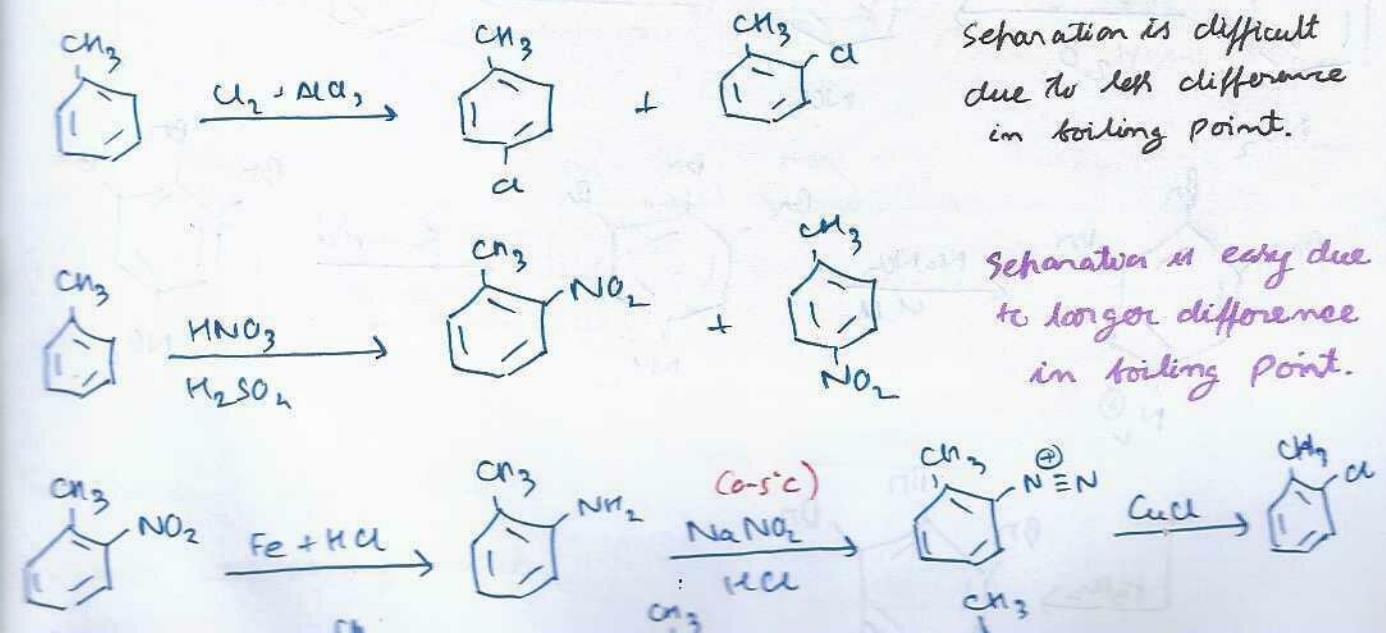
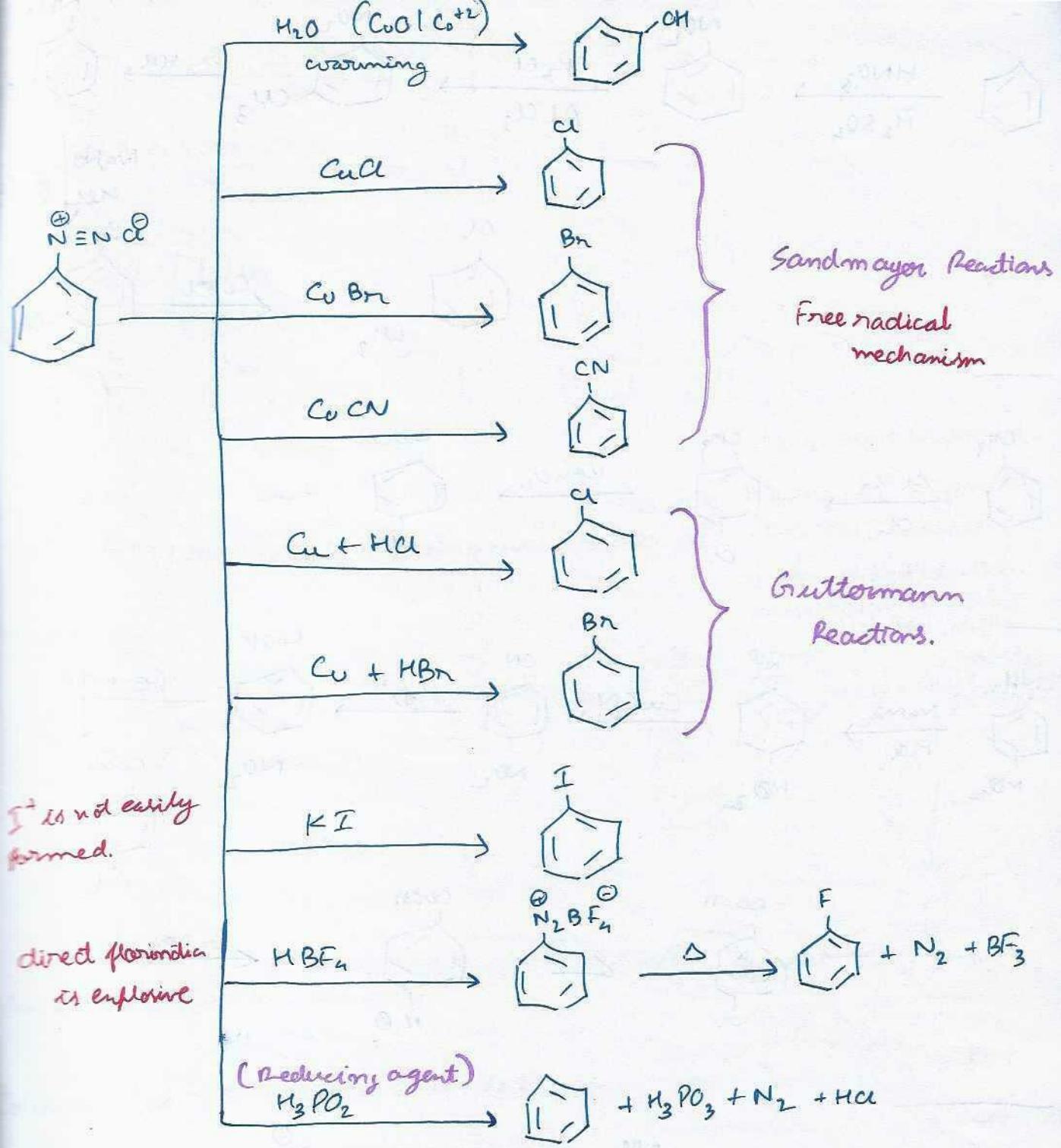
## REACTIONS OF BENZENE DIAZONIUM CHLORIDE

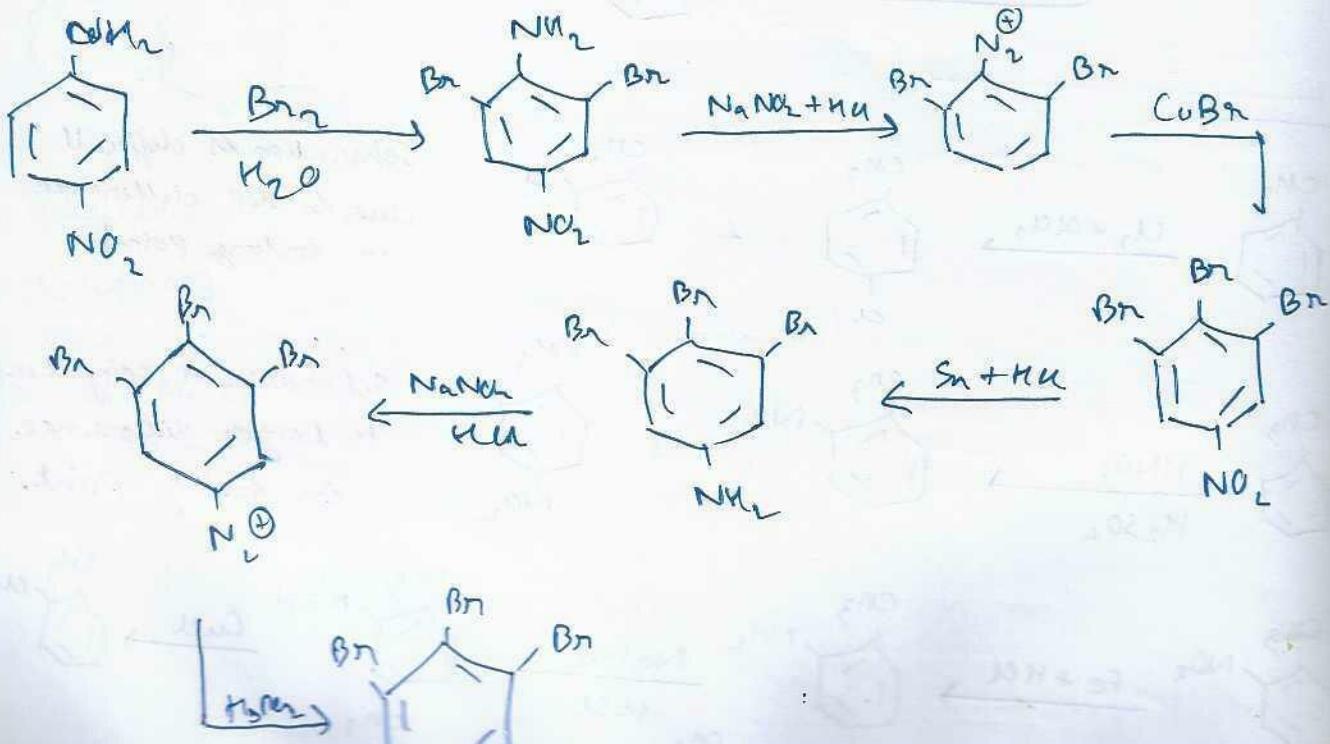
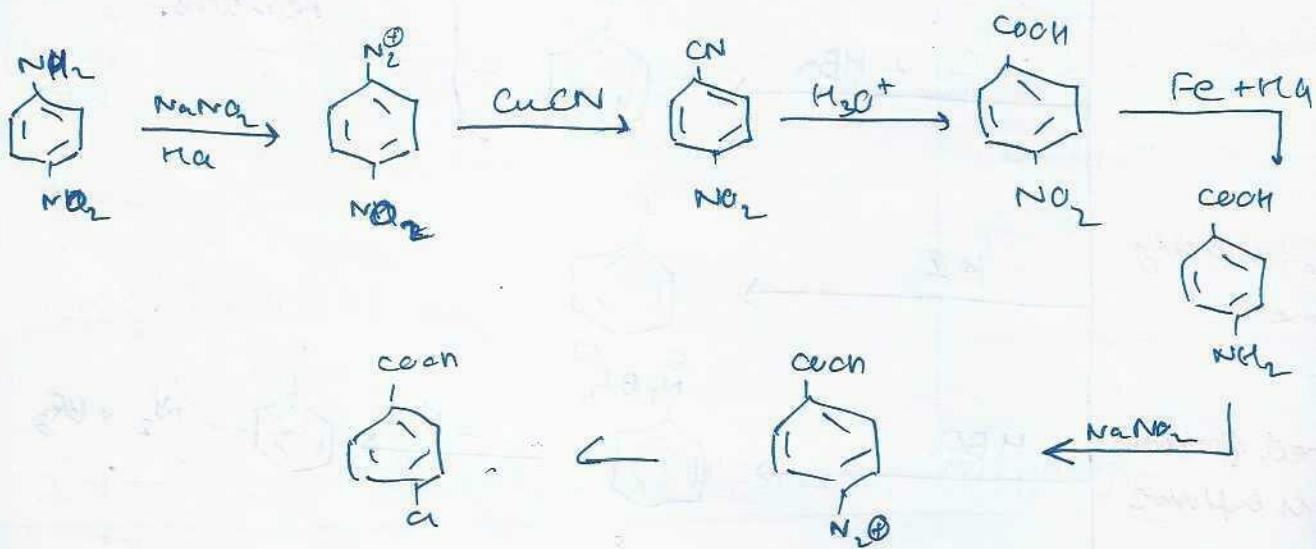
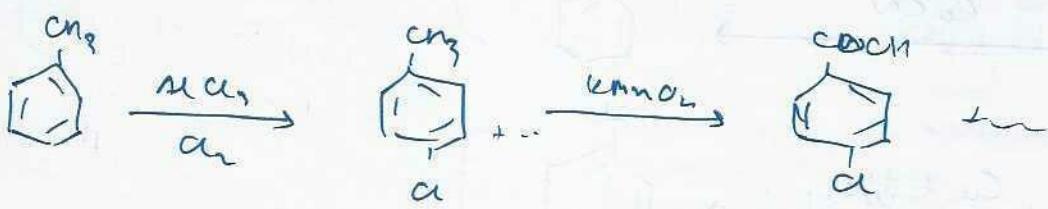
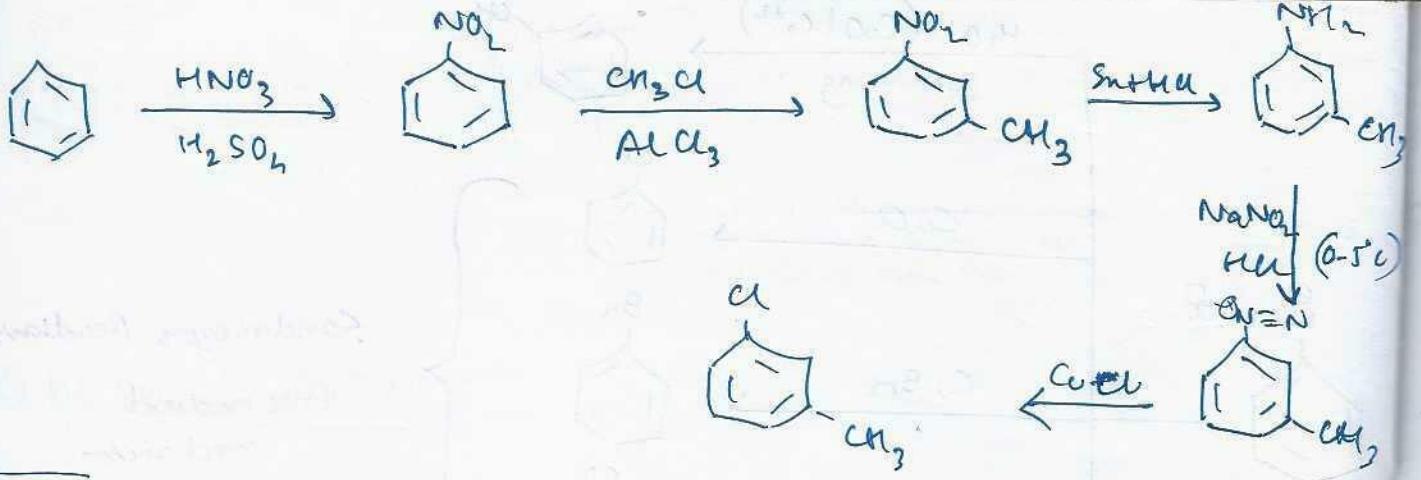


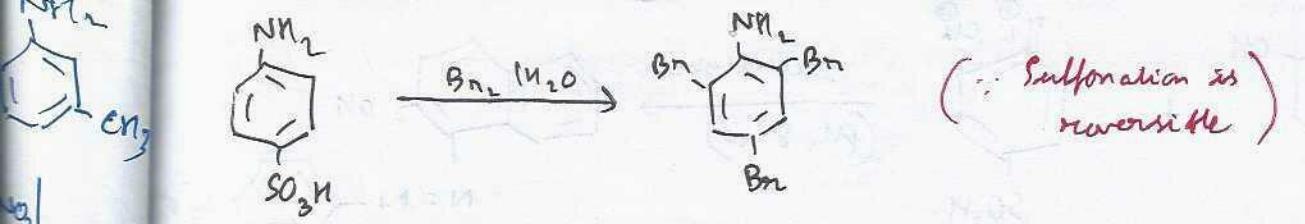
1. Displacement

2. Coupling

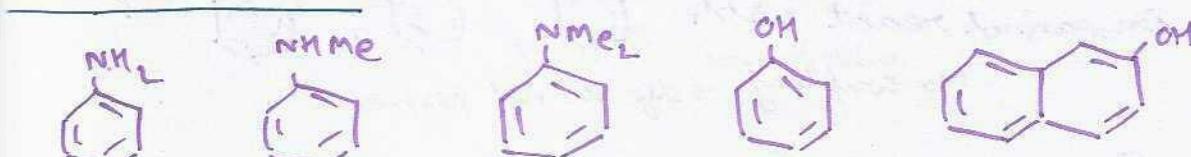
## DISPLACEMENT







## COUPLING



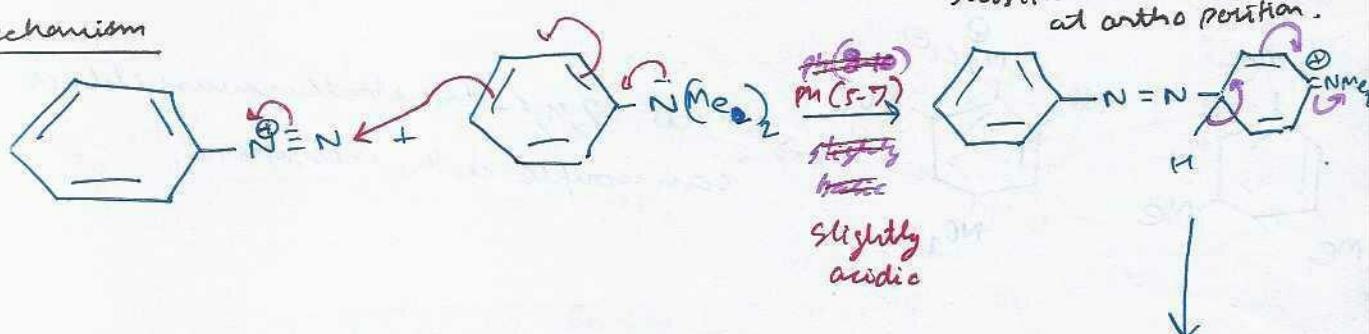
can couple with above compounds.

Para more preferred

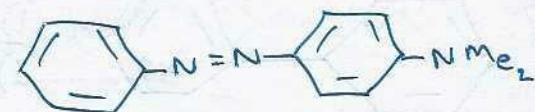
Ortho not preferred  
due to bulkiness.

If para is blocked then substitution takes place at ortho position.

### Mechanism

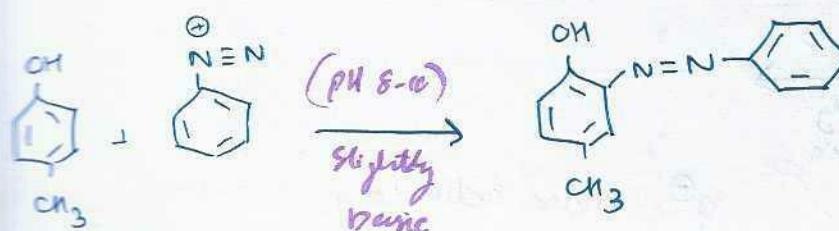
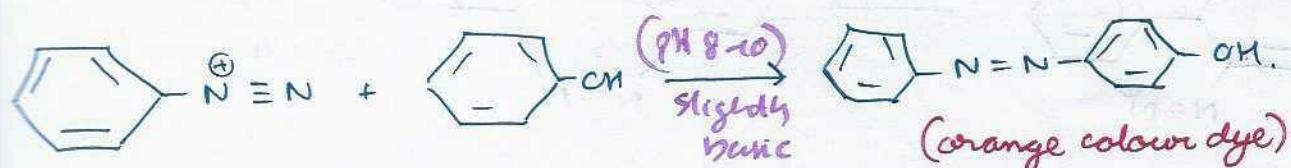


Para blocked → Substitution at ortho.



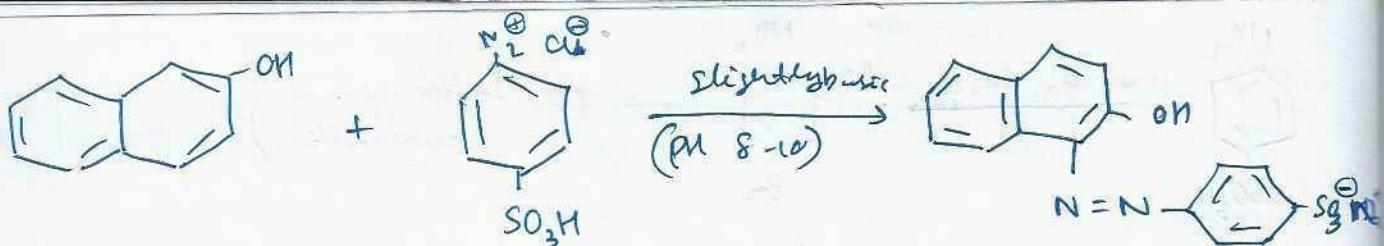
(yellow colour dye)

Coloured dyes → conjugation extended



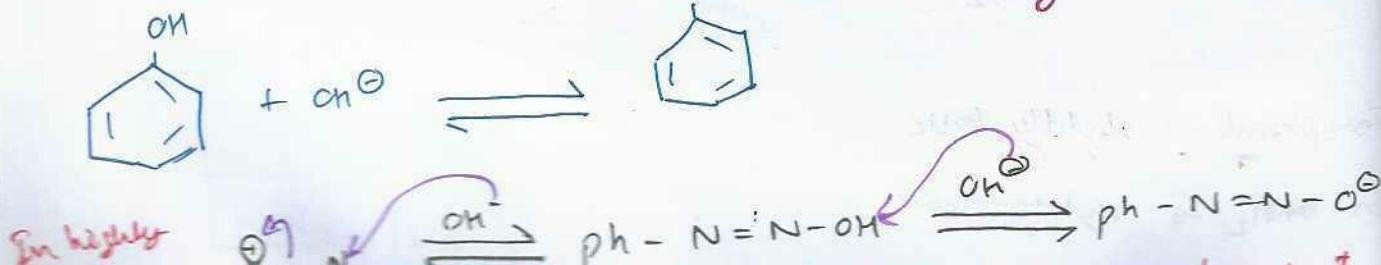
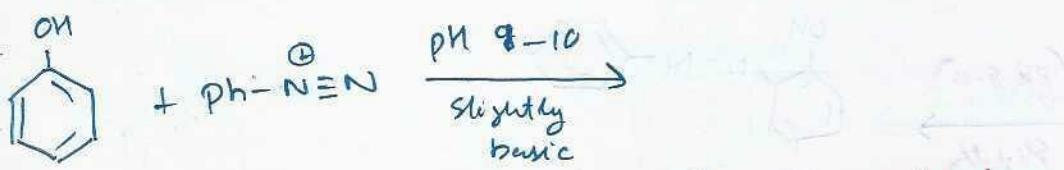
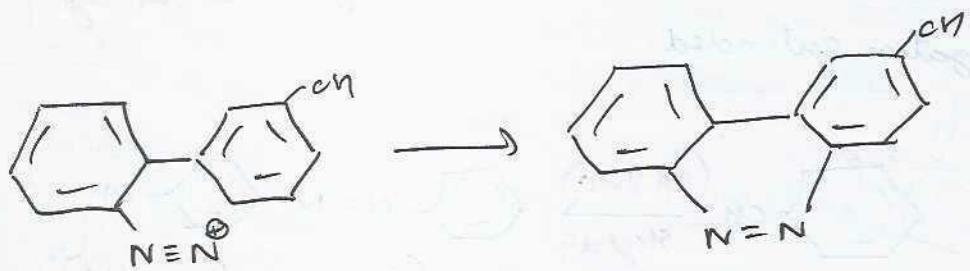
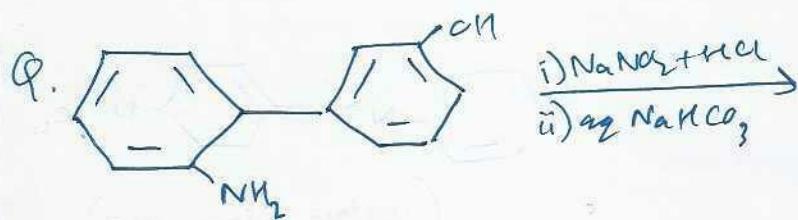
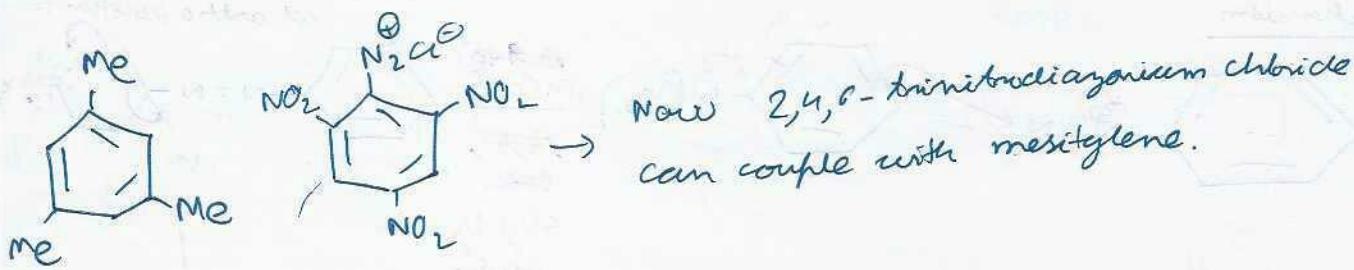
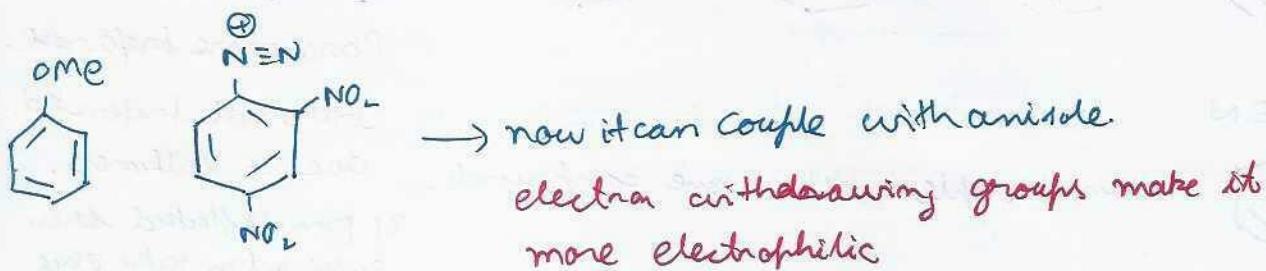
For phenols → slightly basic

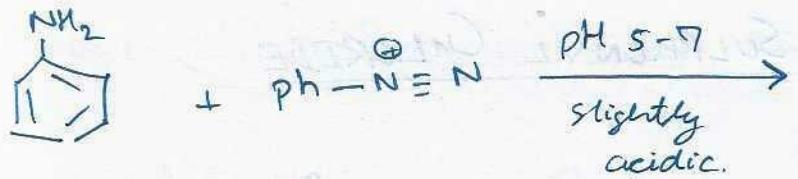
For  $\text{NMe}_2$  → slightly acidic



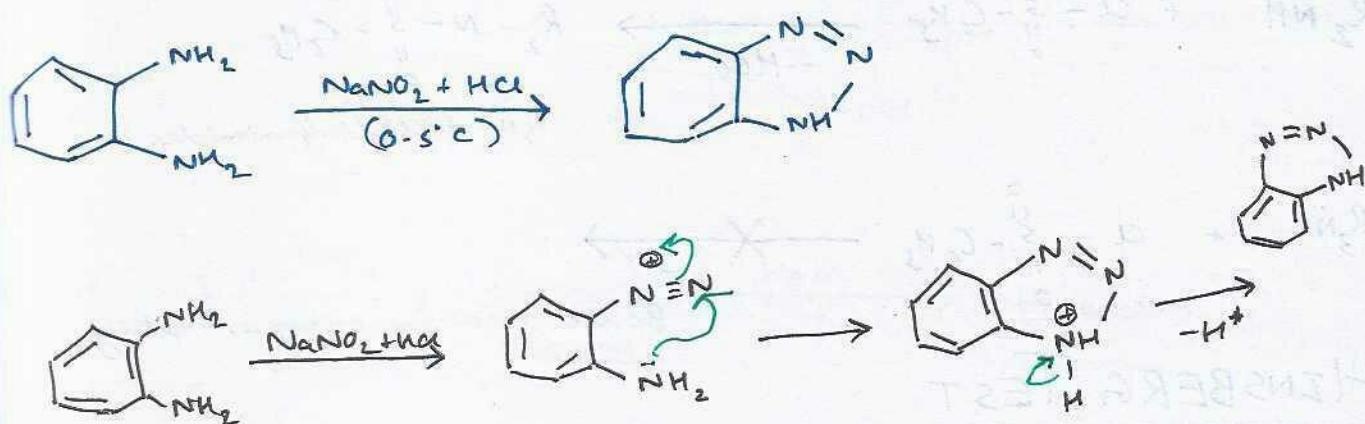
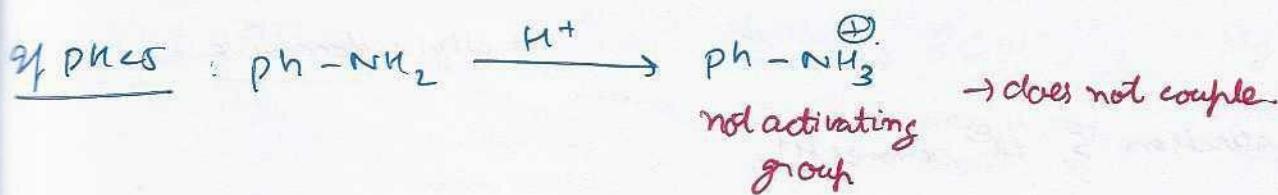
Diarylium ion cannot react with , , 

No coupling  $\rightarrow$  dye is not formed

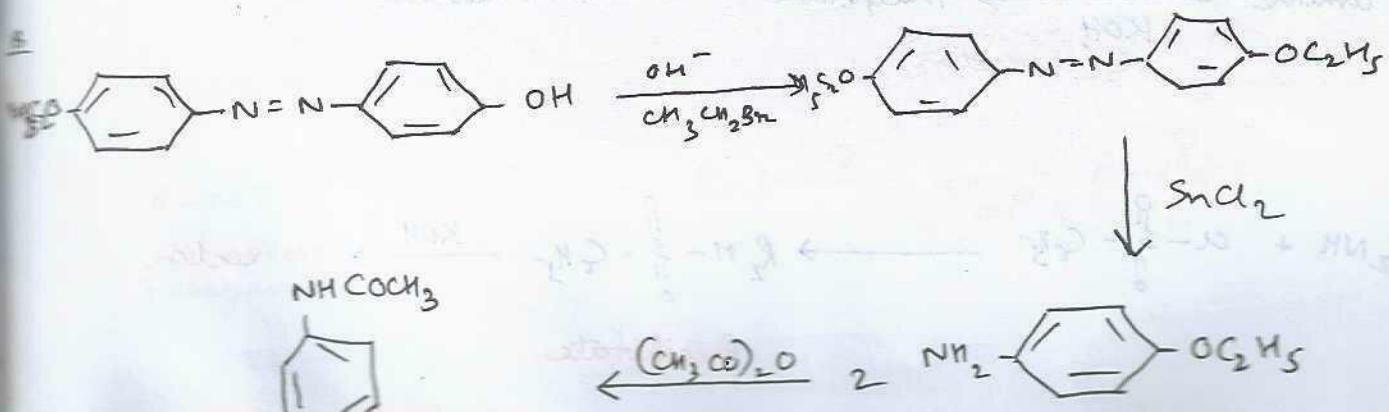
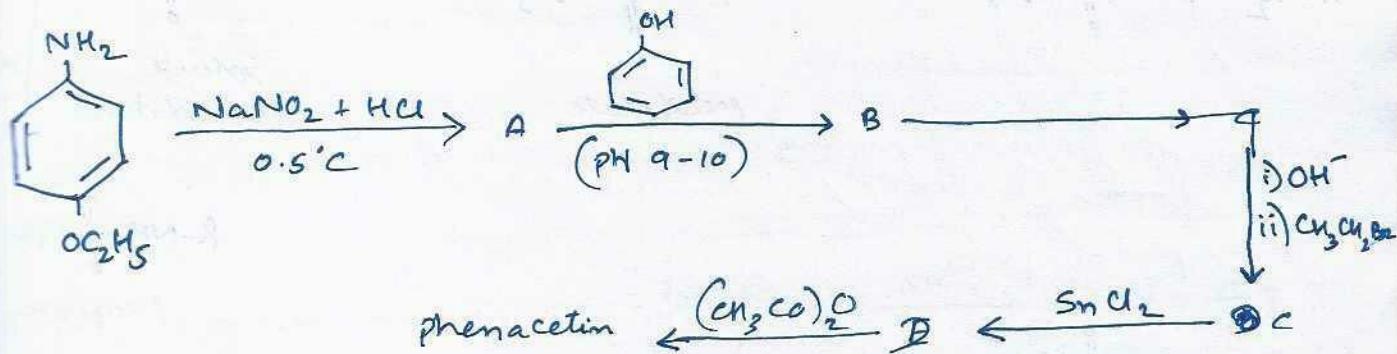
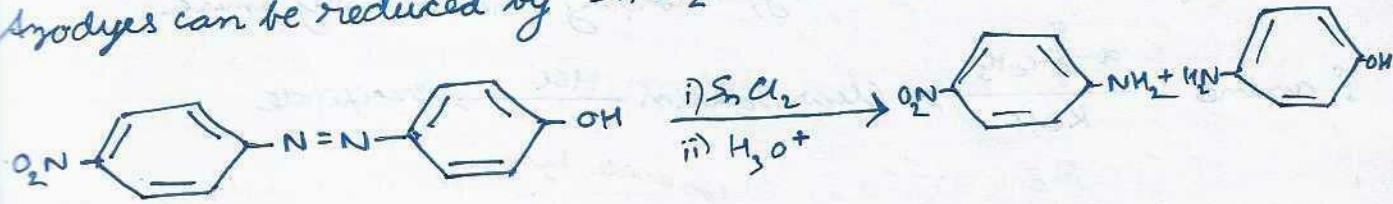




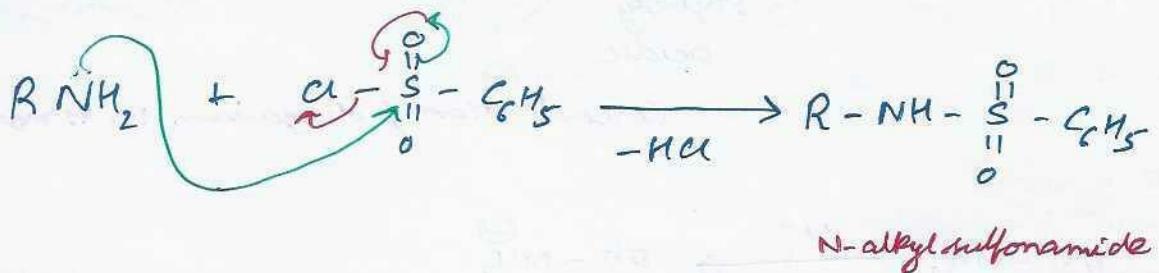
Concentration of diazonium ion is more.



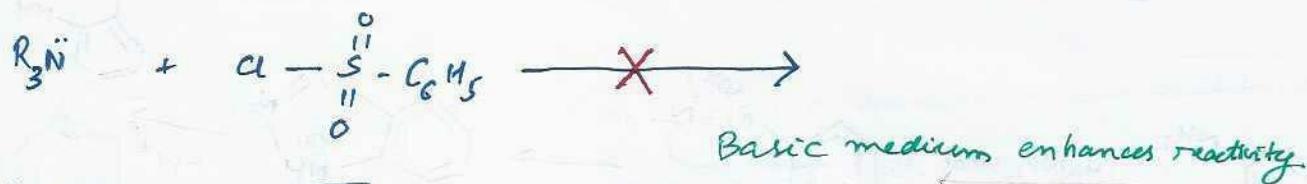
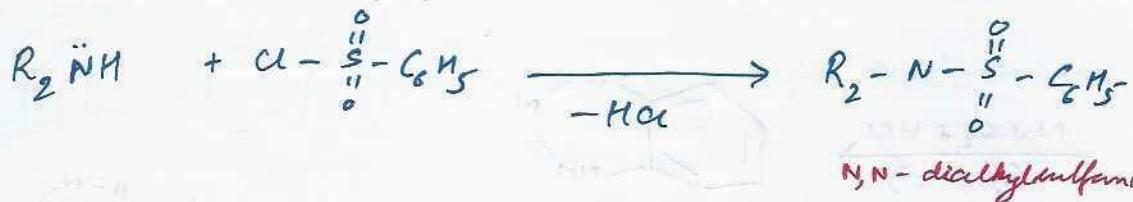
Azodyes can be reduced by  $\text{Sn Cl}_2$



# REACTION WITH BENZENE SULPHONYL CHLORIDE

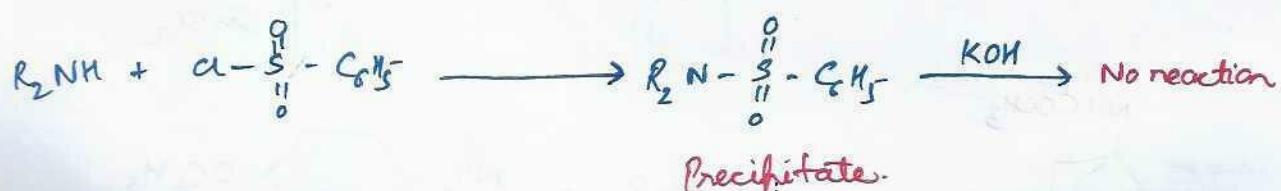
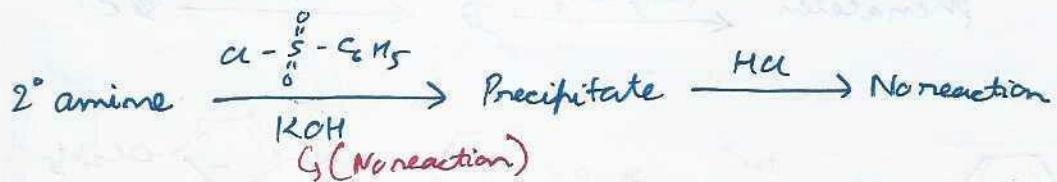
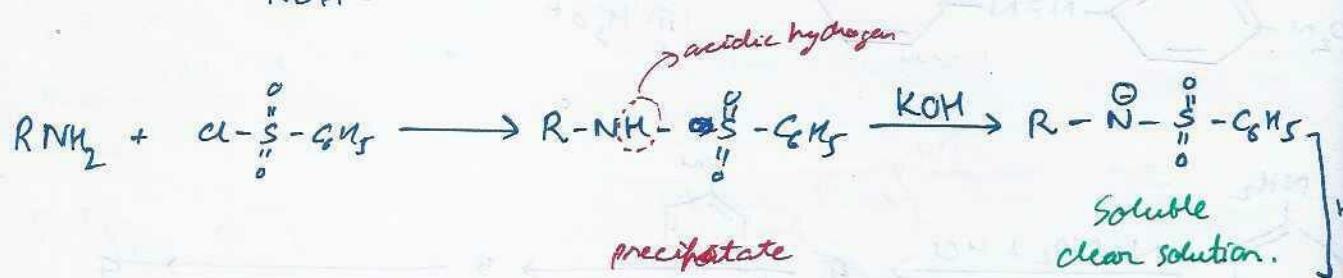
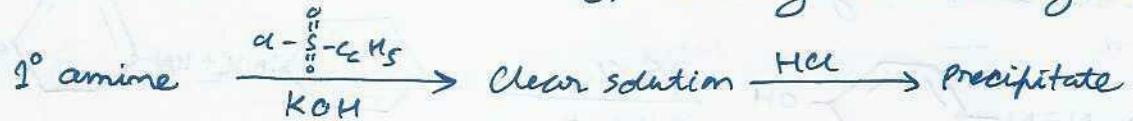


- NH<sub>2</sub> attacks on S, Cl<sup>⊖</sup> removes H<sup>+</sup>.



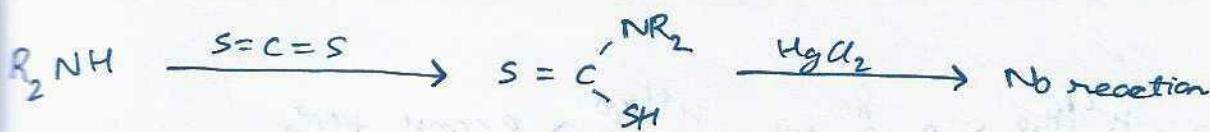
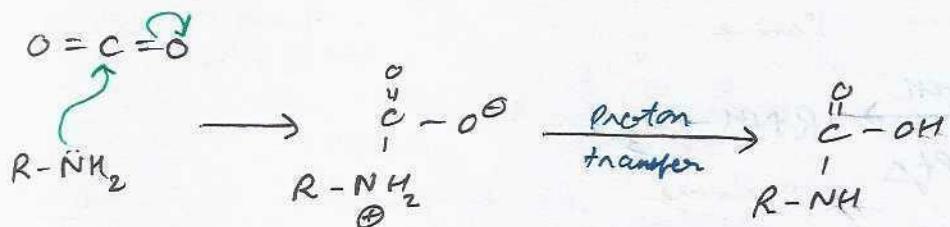
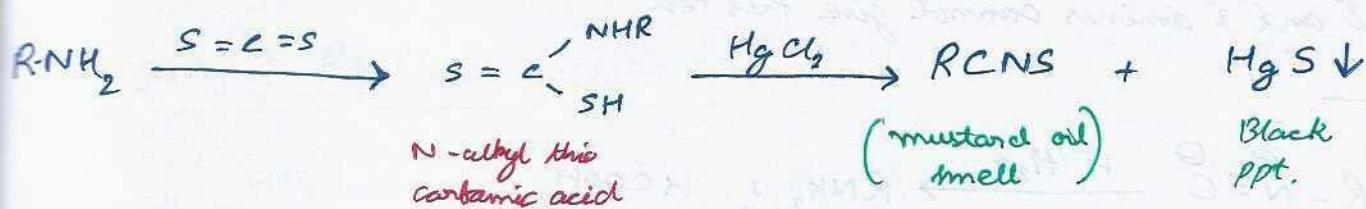
## HINSBERG TEST

Distinguish between primary, secondary and tertiary amine





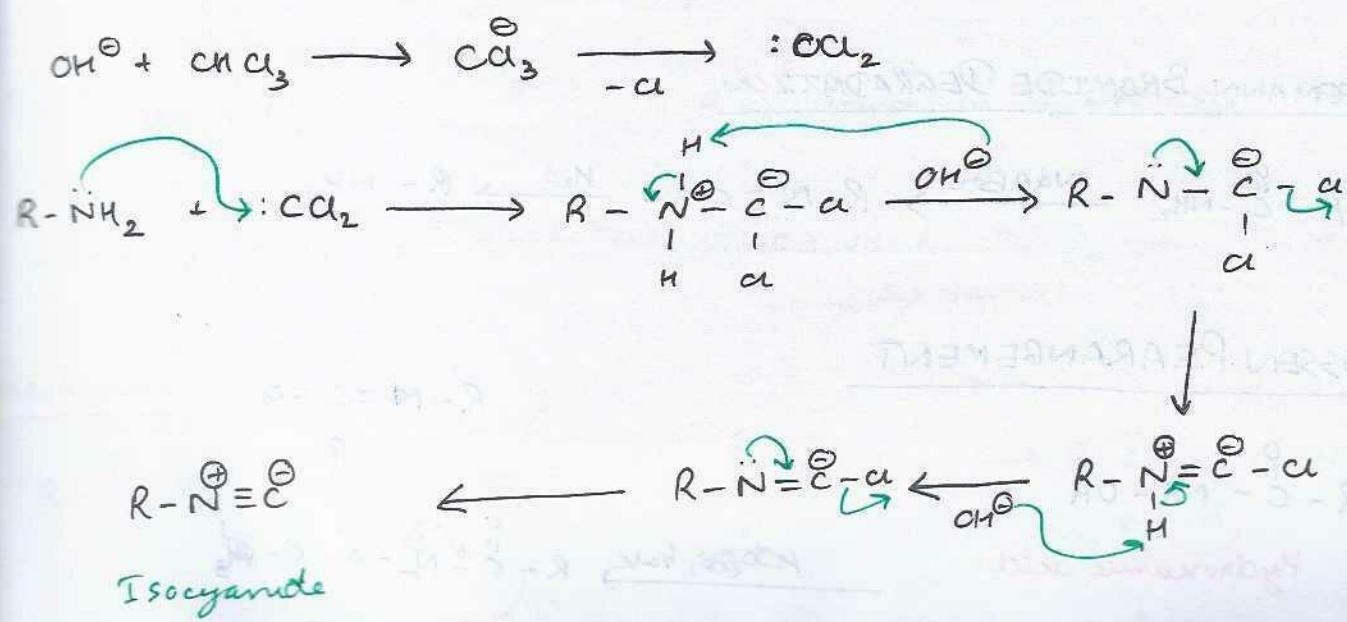
## Hoffmann Mustard Oil



## CARBYL AMINE TEST (Isocyanides) [given by only $1^{\circ}$ Amine]



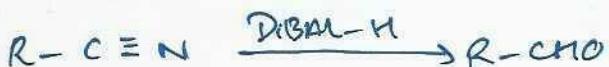
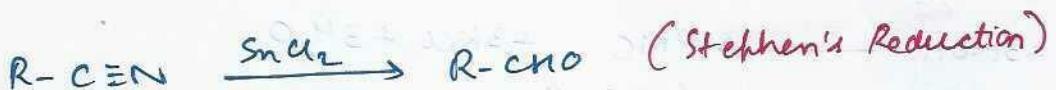
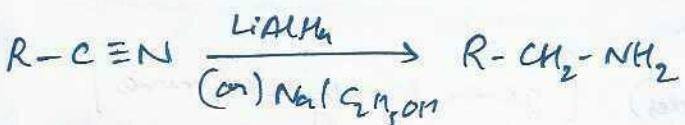
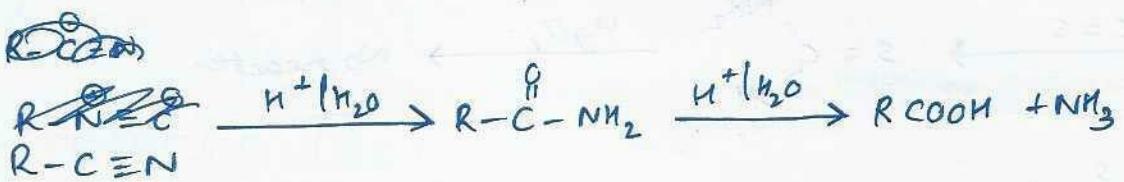
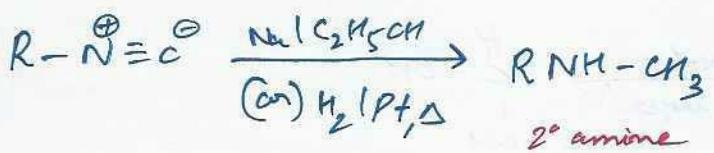
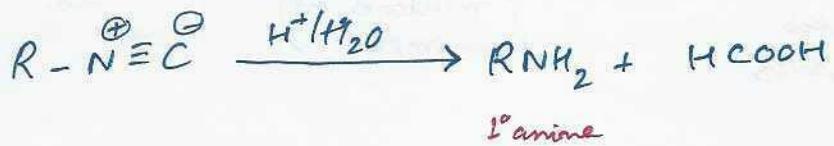
}  $\text{KOH}$  mechanism



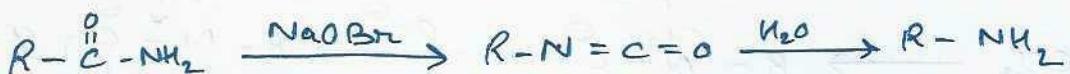


### (Phenyl Isocyanide Test)

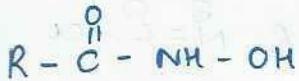
$1^\circ$  and  $3^\circ$  amines cannot give this test.



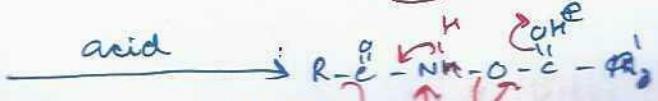
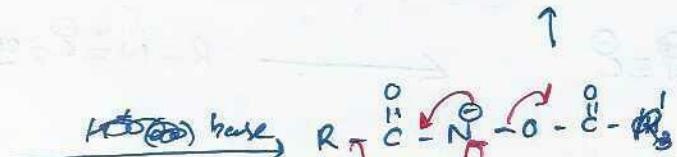
### HOFMANN BROMIDE DEGRADATION



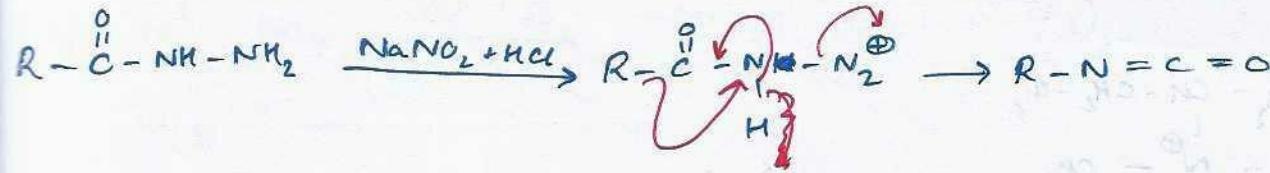
### LOSSEN REARRANGEMENT



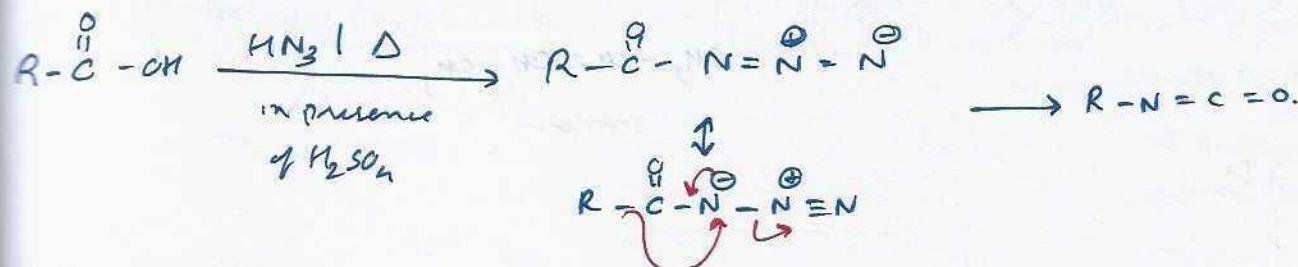
Hydronamic acid



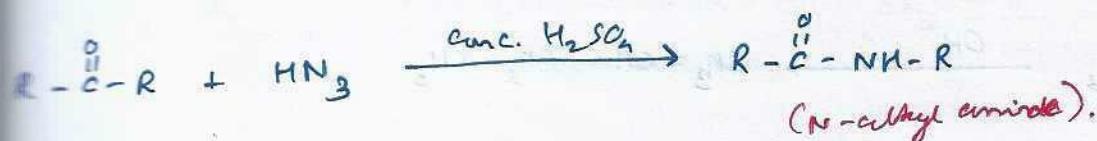
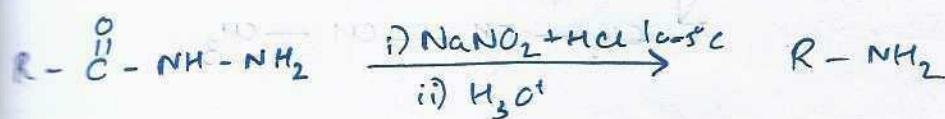
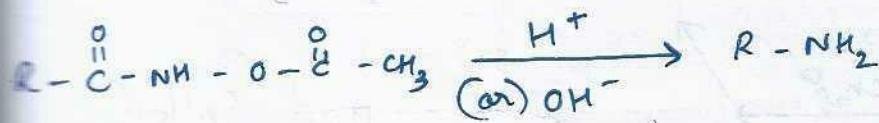
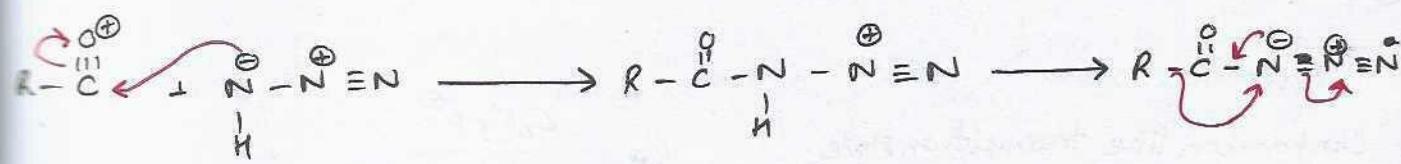
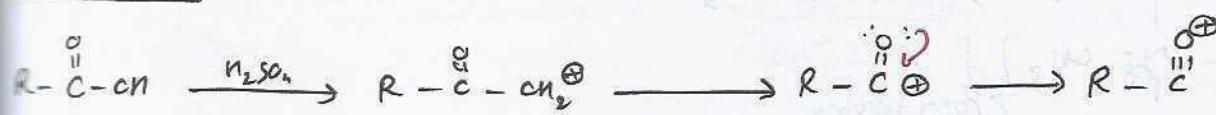
$\xrightarrow{+ \text{H}_2\text{O}}$  CURTIUS'S REARRANGEMENT



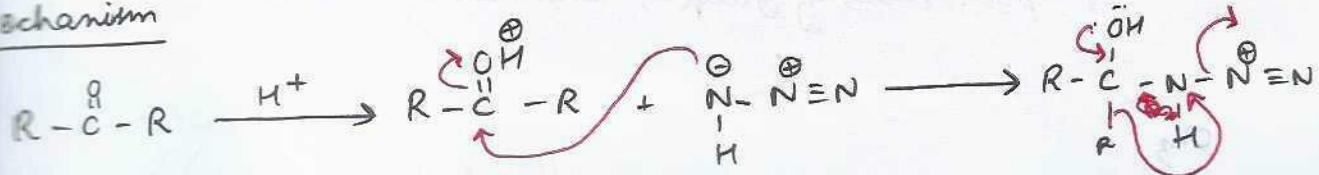
SCHIMDT REARRANGEMENT



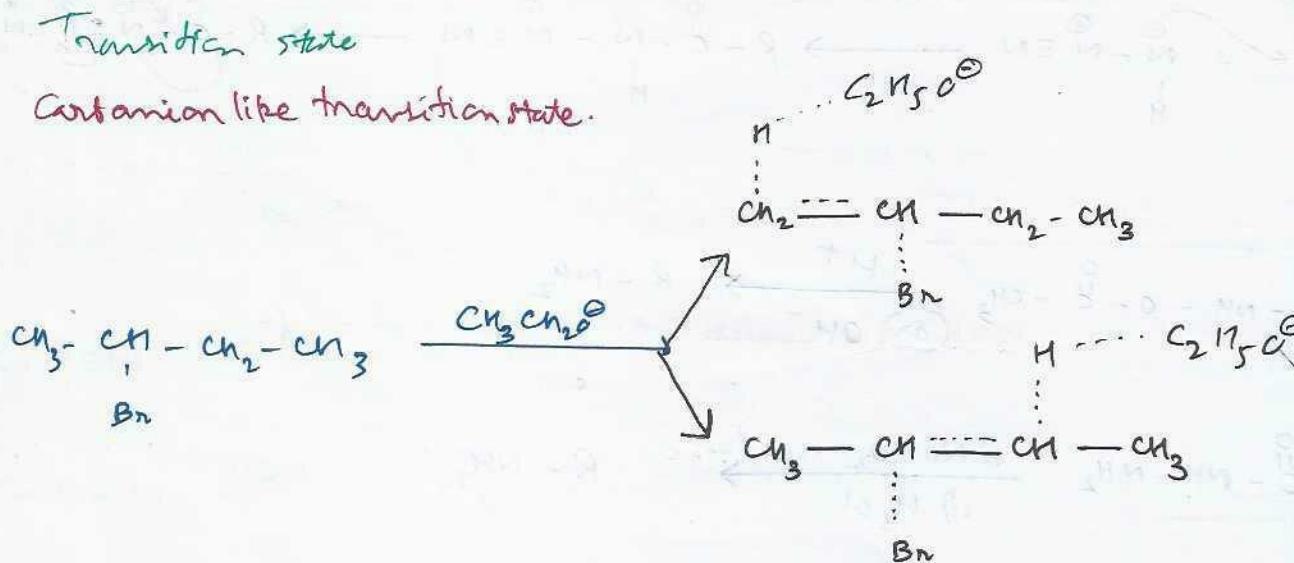
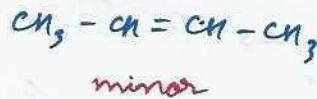
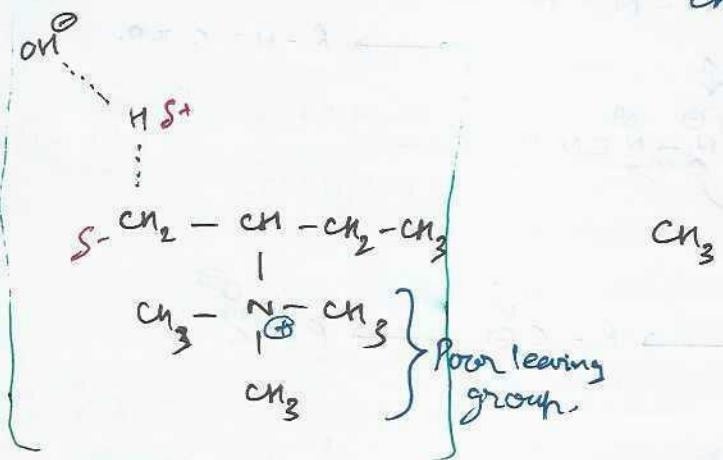
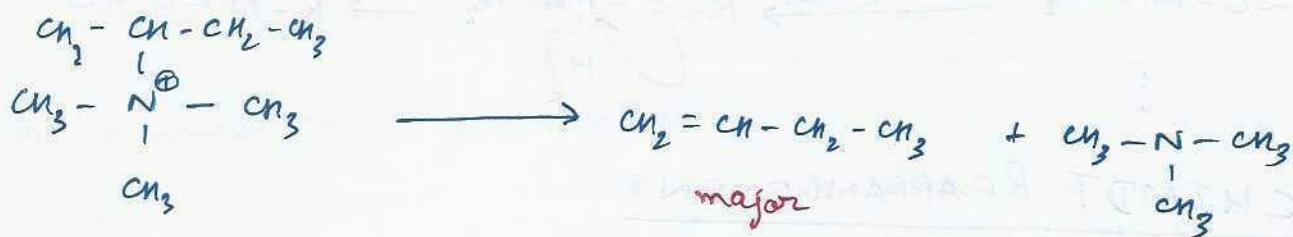
Mechanism



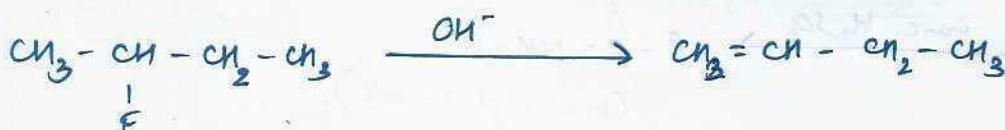
Mechanism



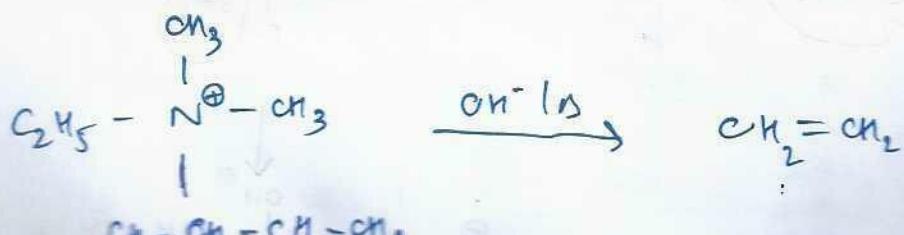
# Hoffmann Elimination

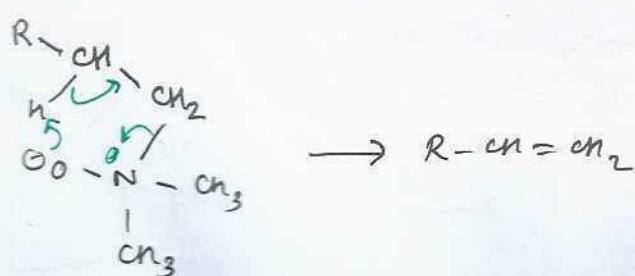
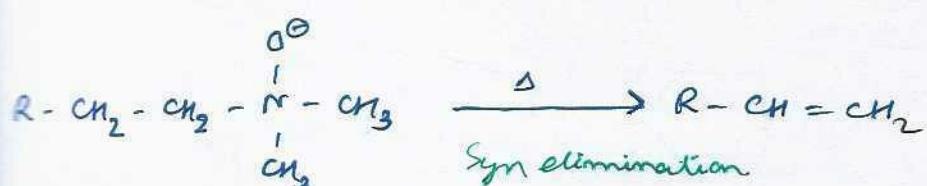
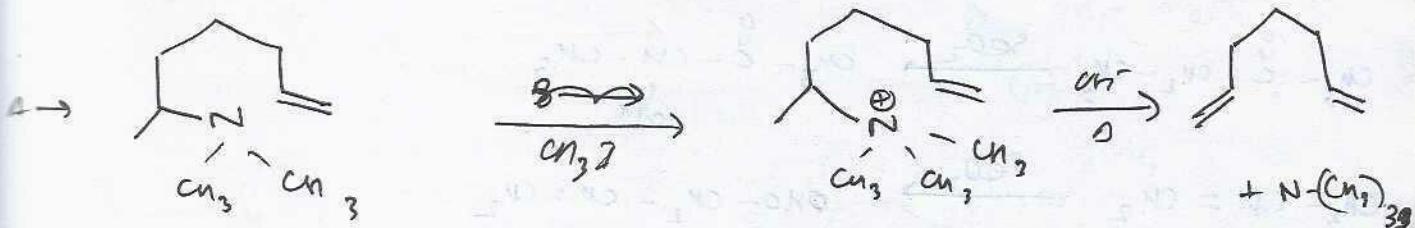
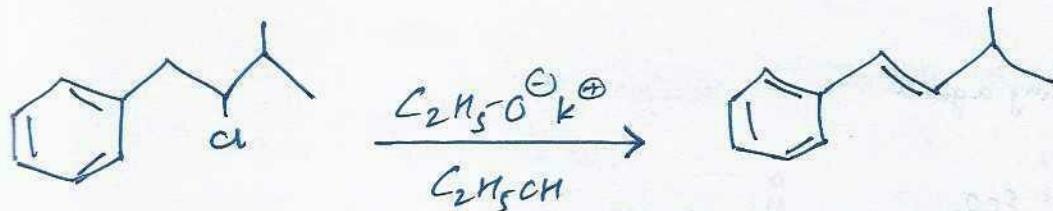
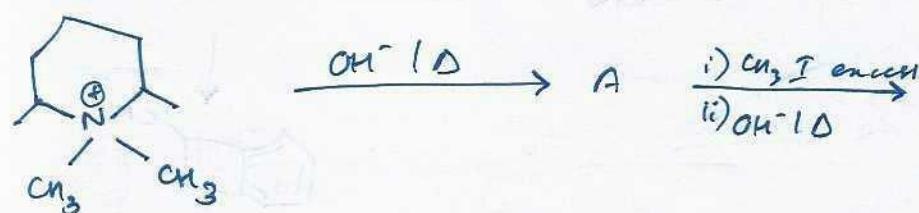
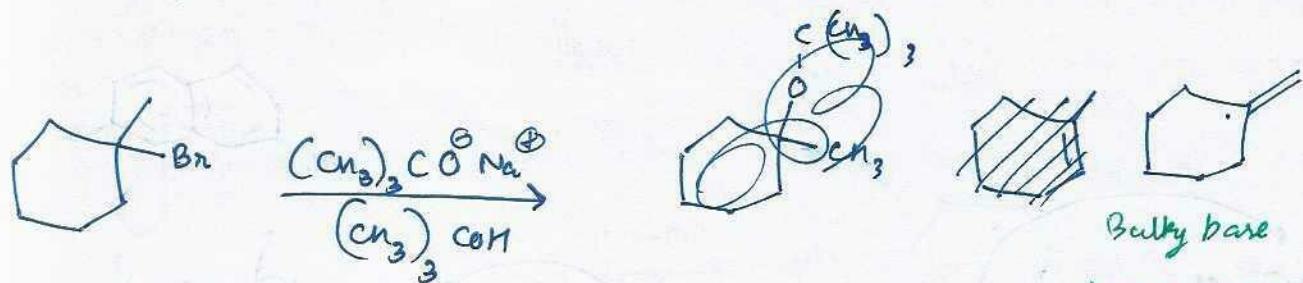
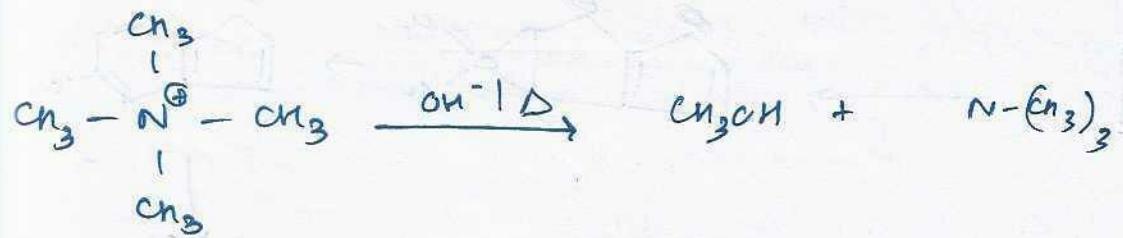


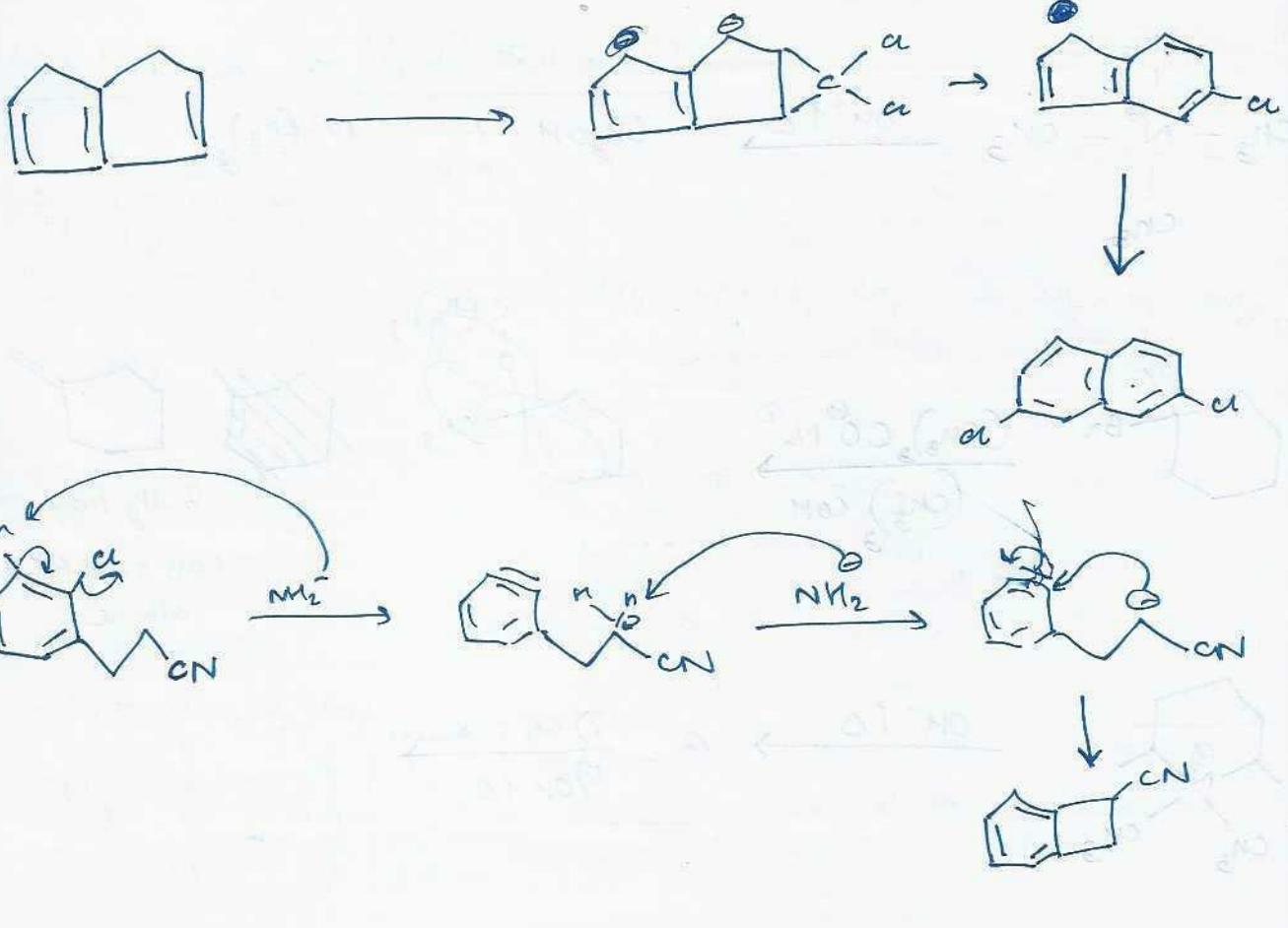
Alkene-like Transition state



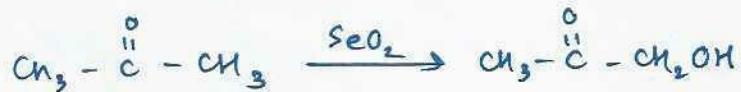
$\text{F}^-$  poor leaving group  $\rightarrow$  Cation-like transition state.

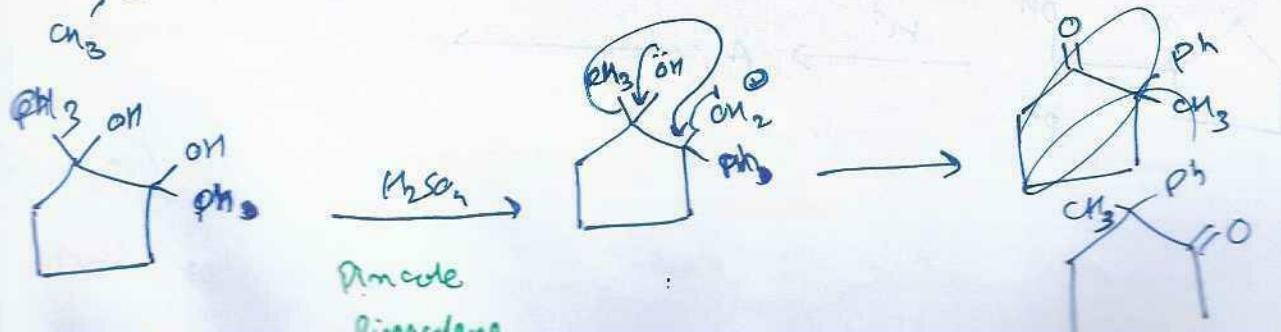
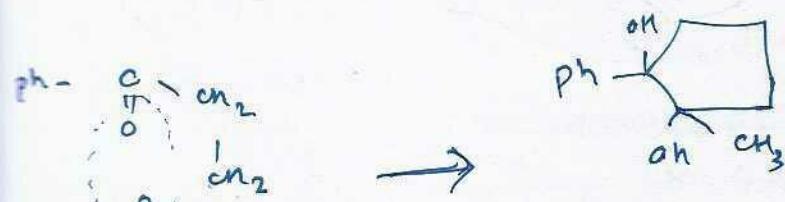
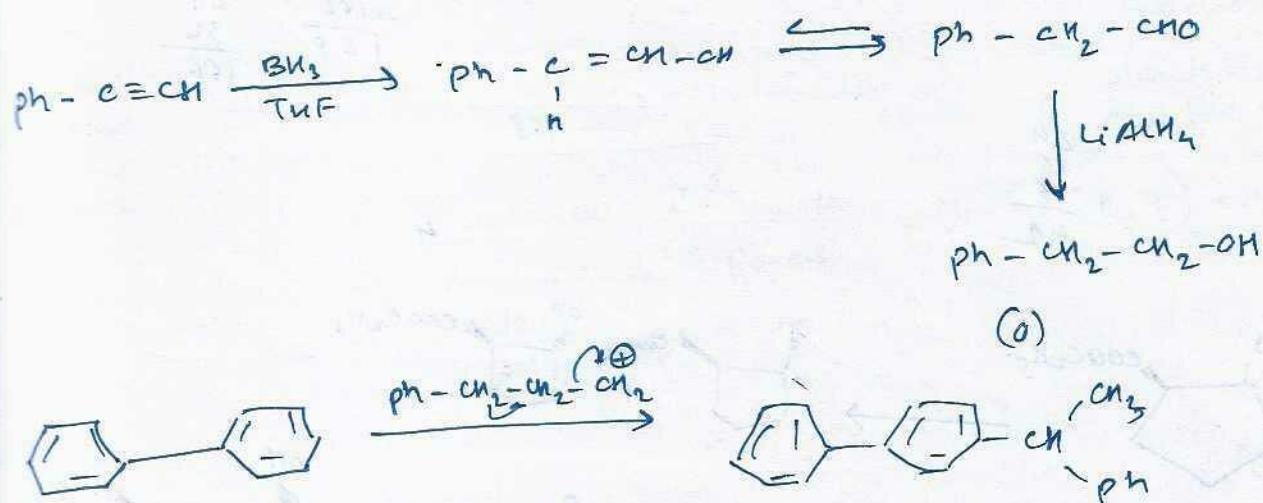
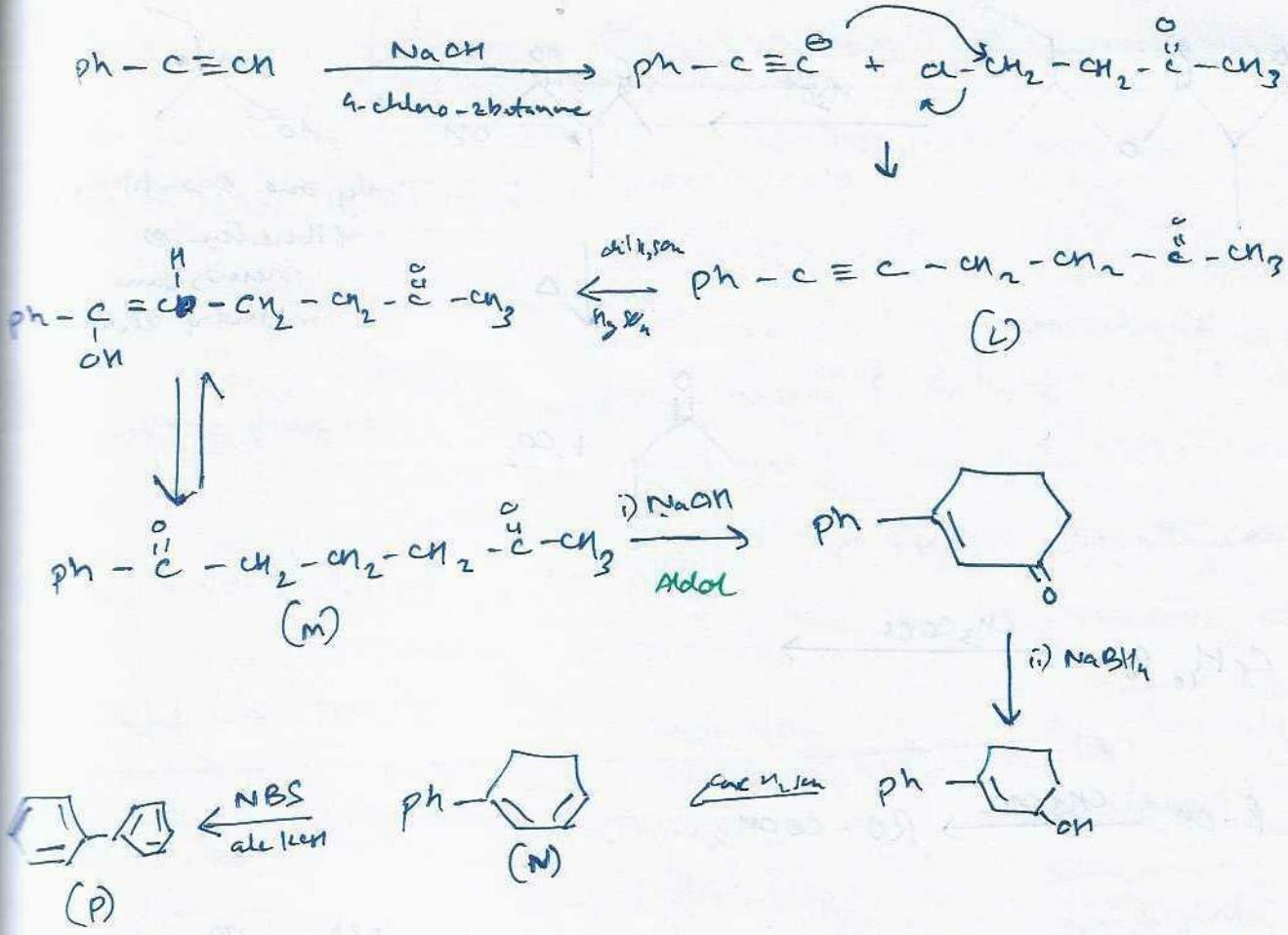


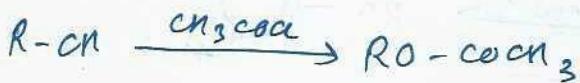
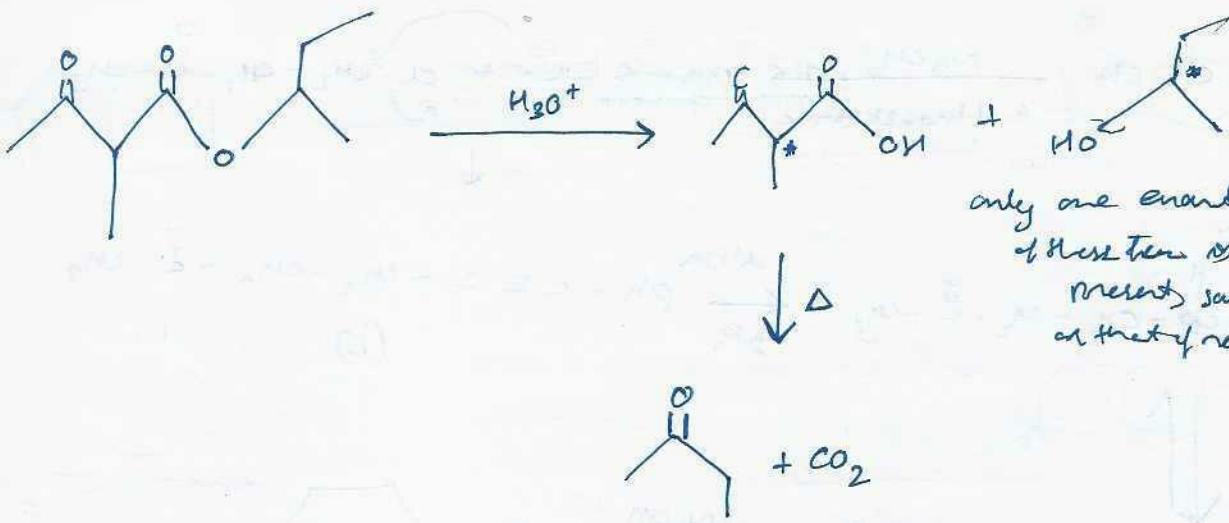




SeO<sub>2</sub> is a oxidizing agent.





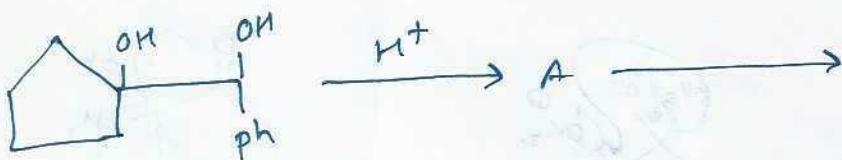
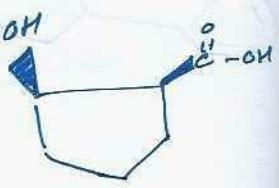
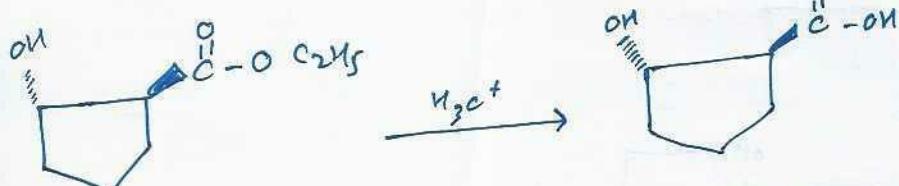
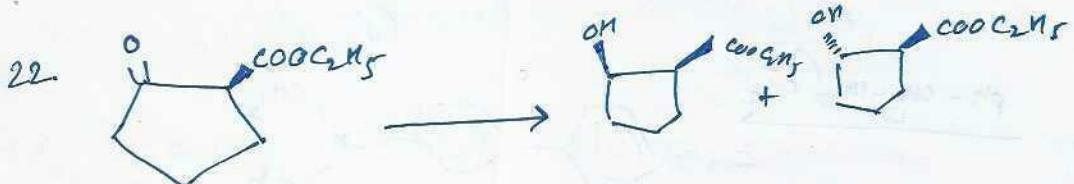


$$\begin{array}{r} 334 \\ -166 \\ \hline 168 \end{array} \quad \begin{array}{r} 20 \\ 64 \\ 92 \\ \hline 166 \end{array}$$

$\frac{24}{16}$   
 $\frac{16}{8}$   
 $\frac{8}{4}$

168

4



# BIOMOLECULES

## CARBOHYDRATES

hydrates of carbon  $C_n(H_2O)_y$

monosaccharides

glucose fructose mannose galactose }  $C_6H_{12}O_6$   $C_6(H_2O)_6$

disaccharides

sucrose maltose lactose }  $C_{12}H_{22}O_{11}$

Carbohydrates are

monosaccharides

Oligosaccharides

Polysaccharides

sugars (sweet/tart)

non sugars.  
tasteless

Glucose -  
fructose -  
mannose  
galactose

have 2-10 units  
of monosaccharides

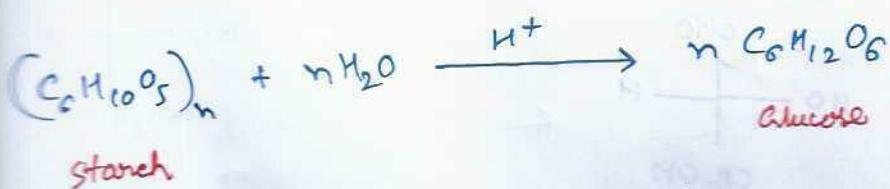
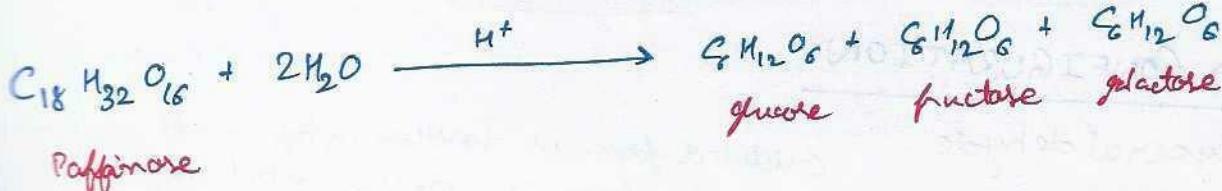
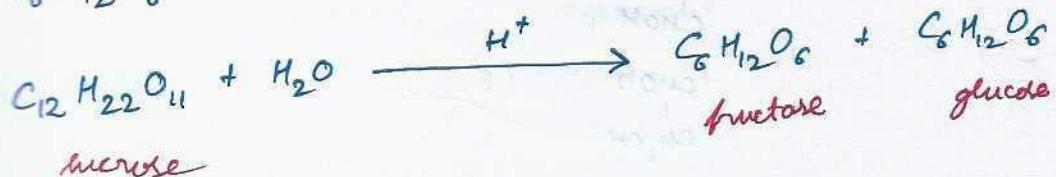
$(C_6H_{10}O_5)_n \rightarrow$  Starch

disaccharides      trisaccharides

sucrose -  
maltose -  
lactose -

Paffinose

starch -  
cellulose -



## CLASSIFICATION OF MONOSACCHARIDES

Polyhydroxy aldehydes or Polyhydroxy ketones  $\rightarrow$  definition of carbohydrates.

1. No. of carbon atoms
2. Nature of function group. (type of functional group).

$C_3 \rightarrow$  Triose

$C_4 \rightarrow$  Tetrose

$C_5 \rightarrow$  Pentose

$C_6 \rightarrow$  Hexose

$C_7 \rightarrow$  Heptose

$C_8 \rightarrow$  Octose

aldehyde

aldehyde

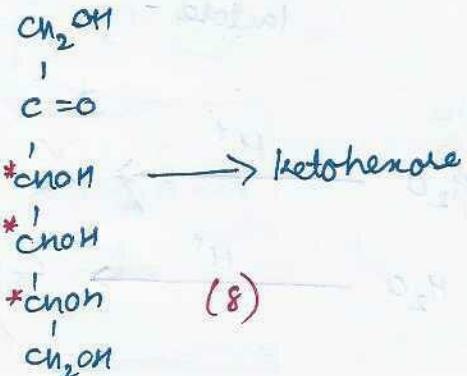
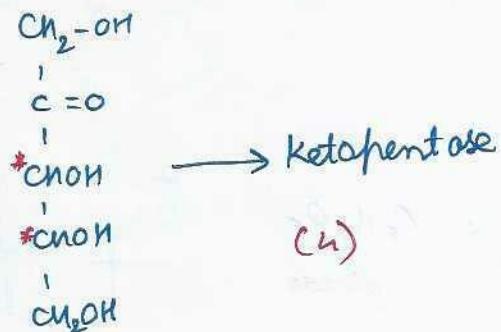
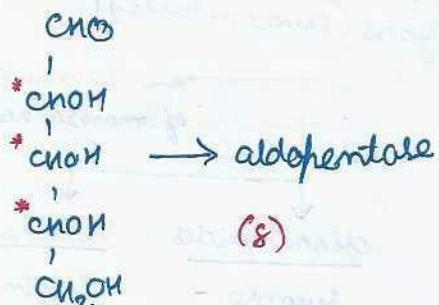
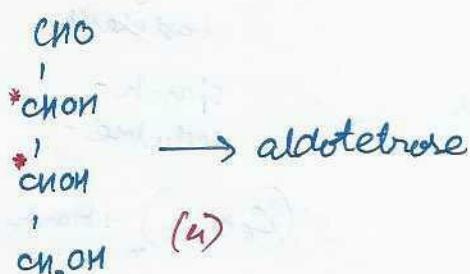
-C-H

$\rightarrow$  aldose

ketone

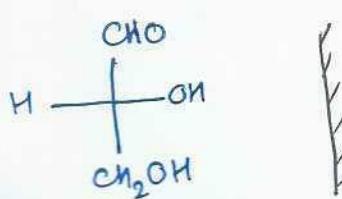
$\text{O}$   
-C-

$\rightarrow$  ketose

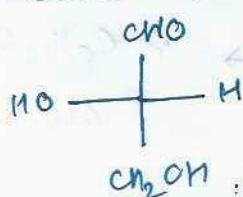


## D, L $\rightarrow$ CONFIGURATION

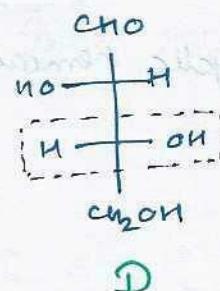
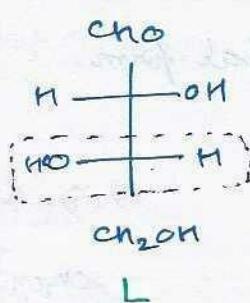
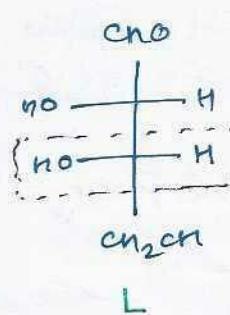
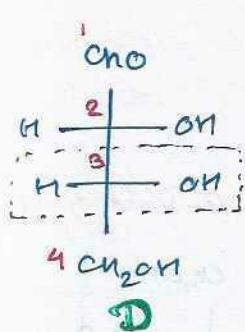
glyceraldehyde



oxidised form is written in top  
reduced form is written in bottom

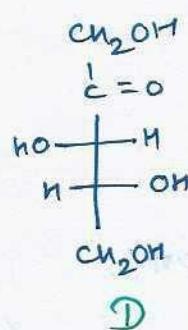
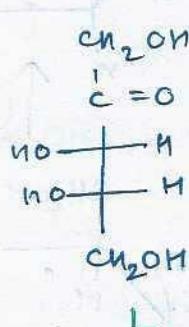
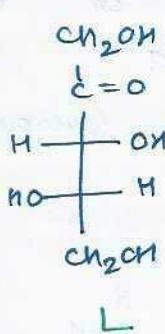
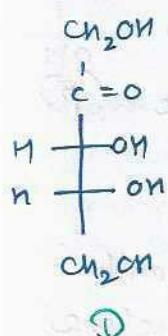


$D$ ,  $R$ , (+) are not necessarily related.

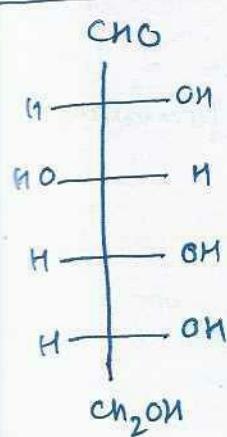


Highest numbered stereocenter's configuration.

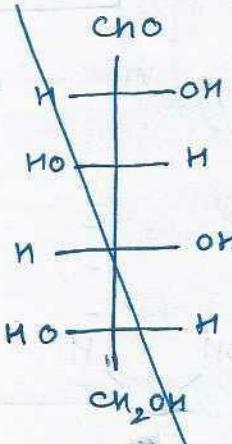
Rotation is decided by both the chiral centres.



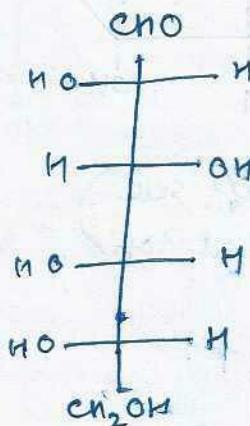
### GLUCOSE



**D-glucose**

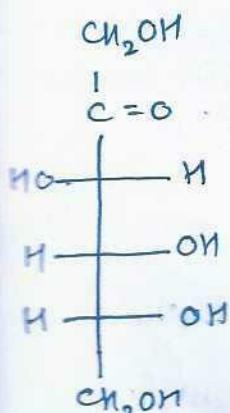


**L-glucose**



**L-glucose**

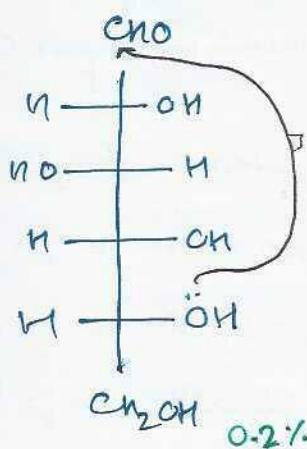
### FRUCTOSE



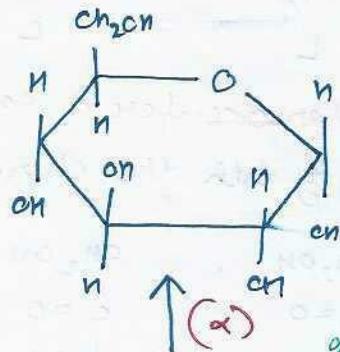
**D-fructose**

# STRUCTURAL FORMULA OF GLUCOSE

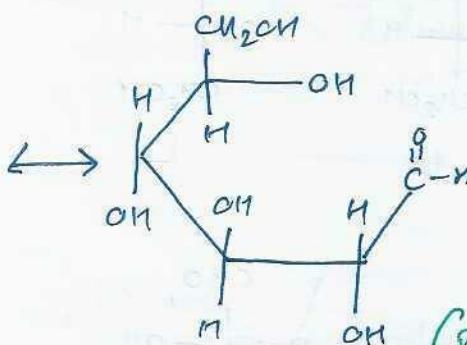
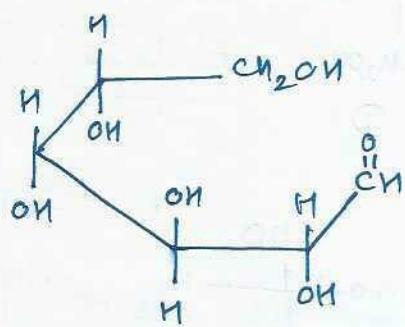
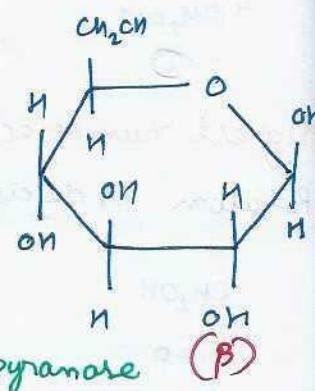
Exists in cyclic hemiacetal form



$\alpha$ -D-(+)-glucopyranose



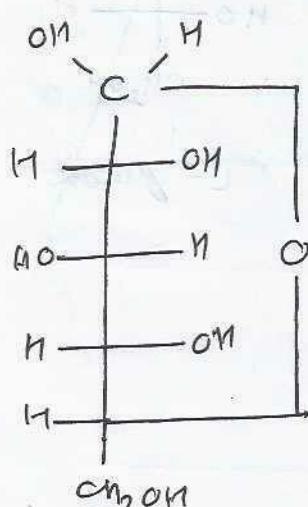
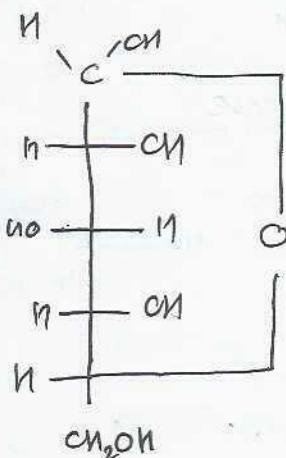
$\beta$ -D-(+)-glucopyranose



Howarth  
structure

(present in  
chain conformation)

(Group on left side  
is written at top)



$\alpha$ -isomer

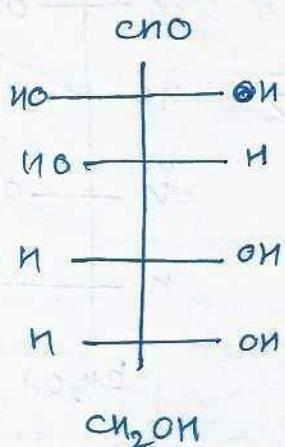
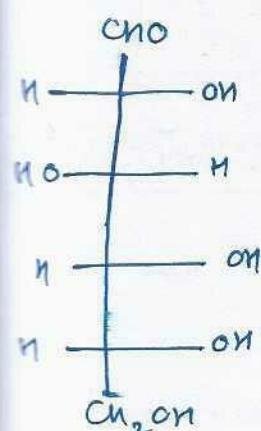
enamers

$\beta$ -isomer

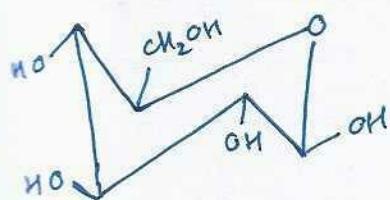
(difference in C carbon).

enamers  $\rightarrow$  different configuration of C<sub>1</sub> carbon

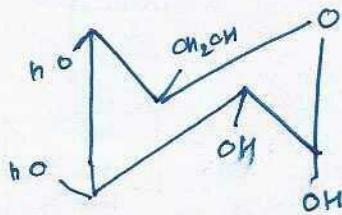
epimers  $\rightarrow$  different configuration in <sup>any one</sup> other carbon atoms (C<sub>2</sub>, C<sub>3</sub>, ...) except C<sub>1</sub>.



C<sub>2</sub> epimers



B-D-(+)-glucopyranose  
more stable  
structure



α-D-(+)-glucopyranose

Open chain form  $\approx 0.2\%$ .

Fehling's Reagent, Benedict's Test  $\rightarrow$  Basic medium  
Convert hemiacetal to aldehyde

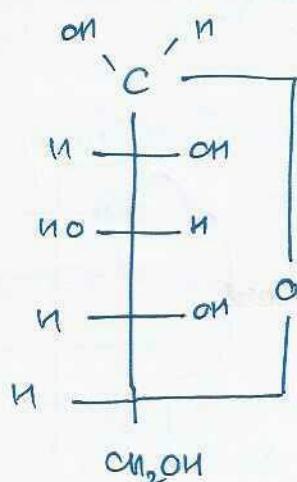
(Glucose is a non reducing sugar)  
(does not give positive Test)

Give positive test  
for aldehyde.

Tollens reagent  $\rightarrow$  does not give positive test.



# MUTAROTATION



(+) $18.7^\circ$

Melting point  $\rightarrow 150^\circ\text{C}$

(84%)

(+) $52.7^\circ$

Rotation of  
equilibrium  
mixture.

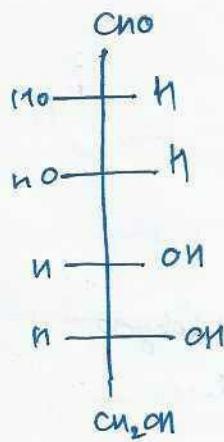
(+) $112^\circ$

Melting point  $\rightarrow 146^\circ\text{C}$

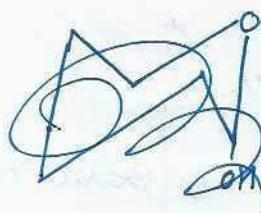
GLYC

64%  $\rightarrow \beta$ -isomer

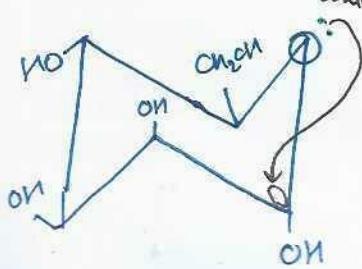
36%  $\rightarrow \alpha$ -isomer



D-mannose

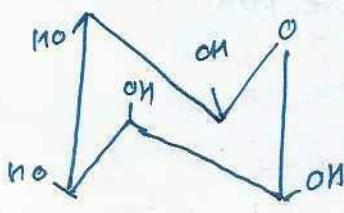


Anomeric effect

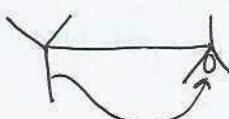


L-D-mannose

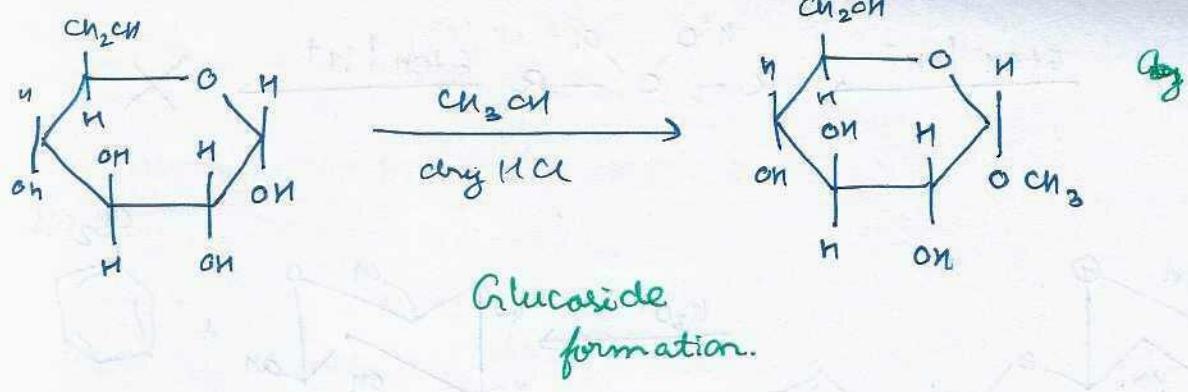
bonding  
antibonding  
interaction



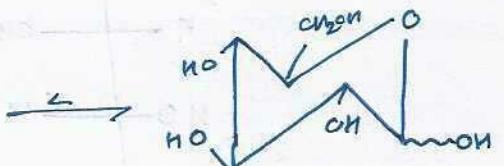
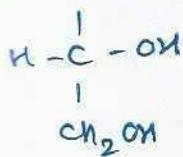
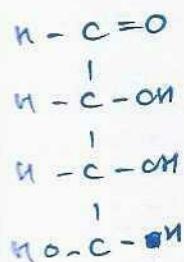
Beta-D-mannose



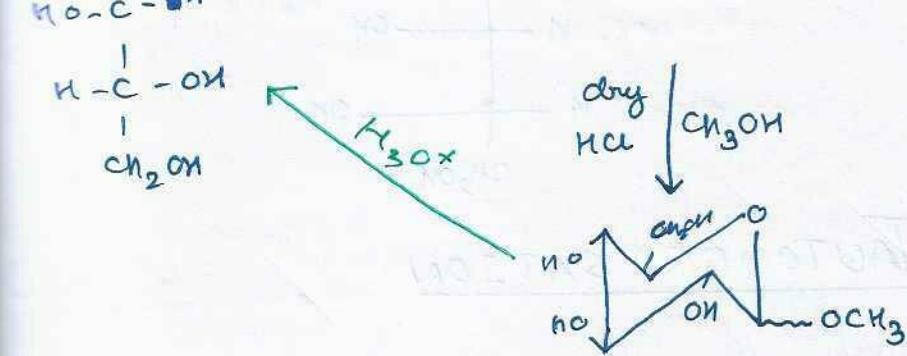
only possible  
rotation in  
amide



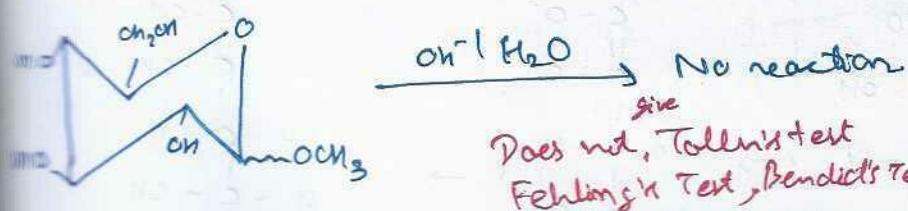
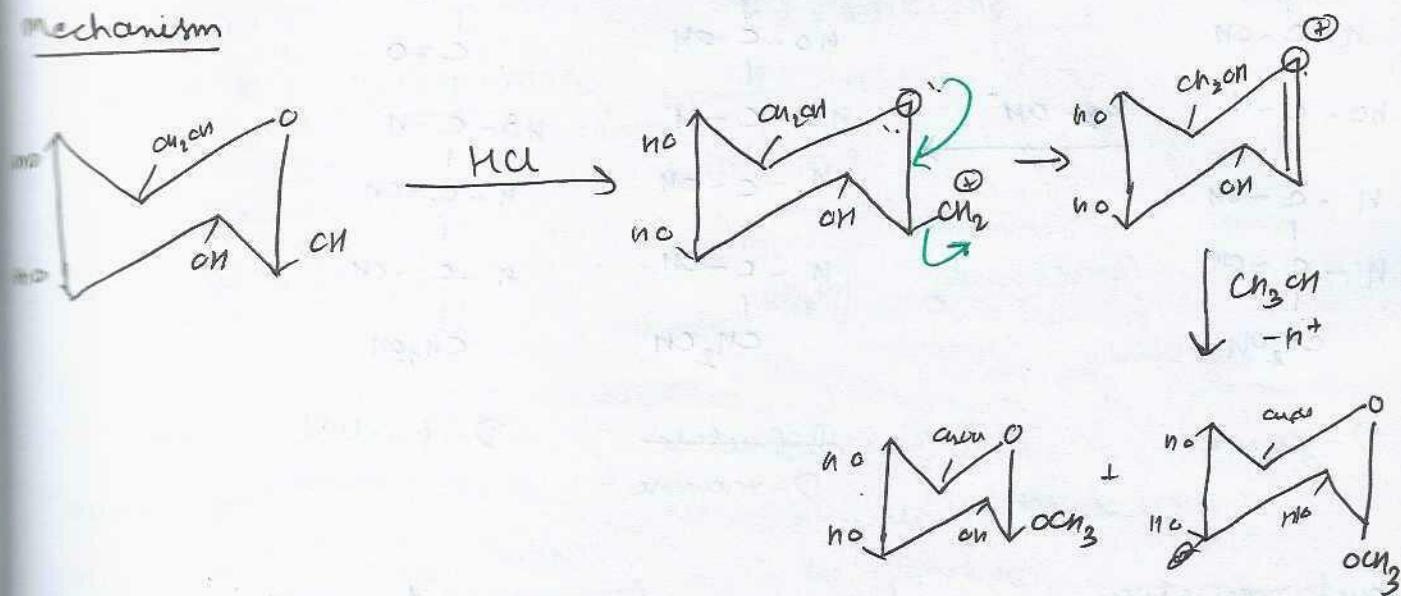
## GLYCOSIDE FORMATION



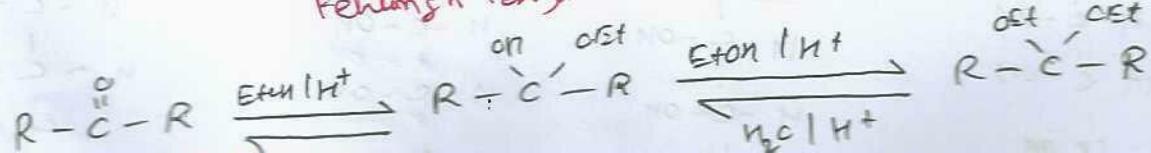
~OH → position not specified  
can be either equatorial or axial.

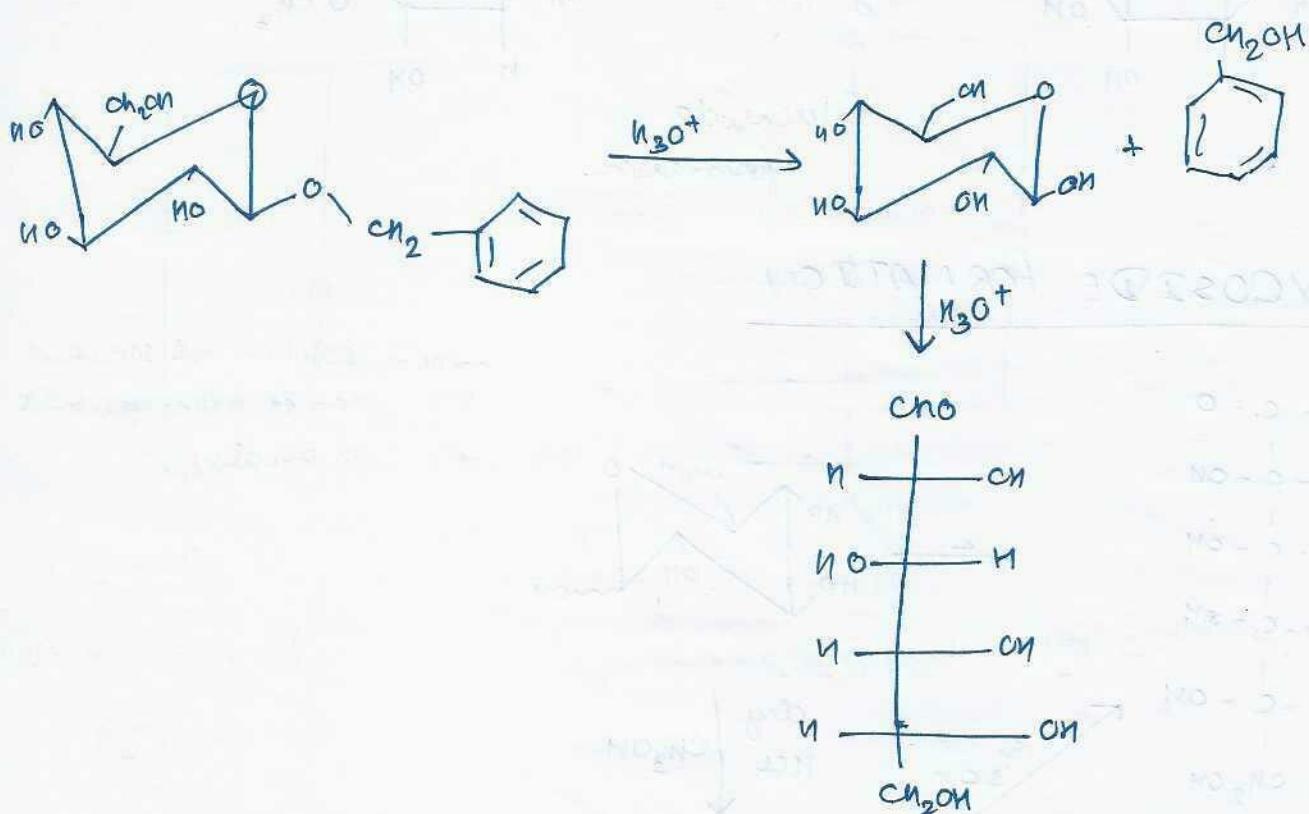
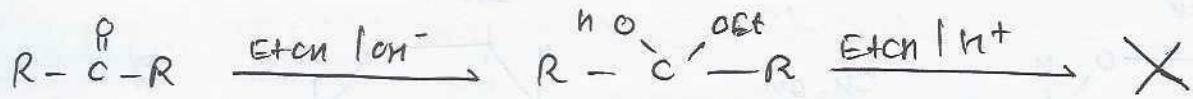


### Mechanism

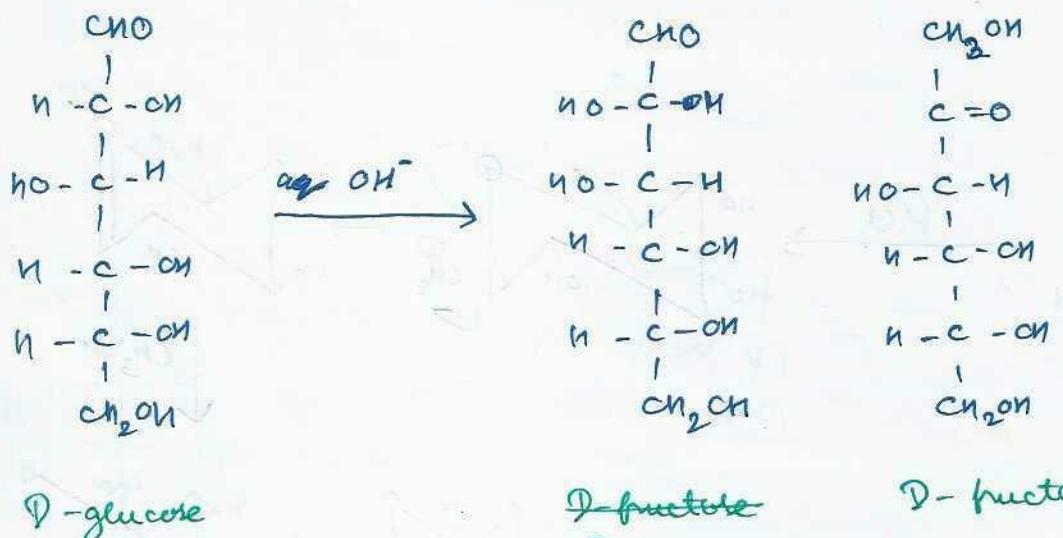


Stable in basic medium.  
Does not undergo mutarotation.

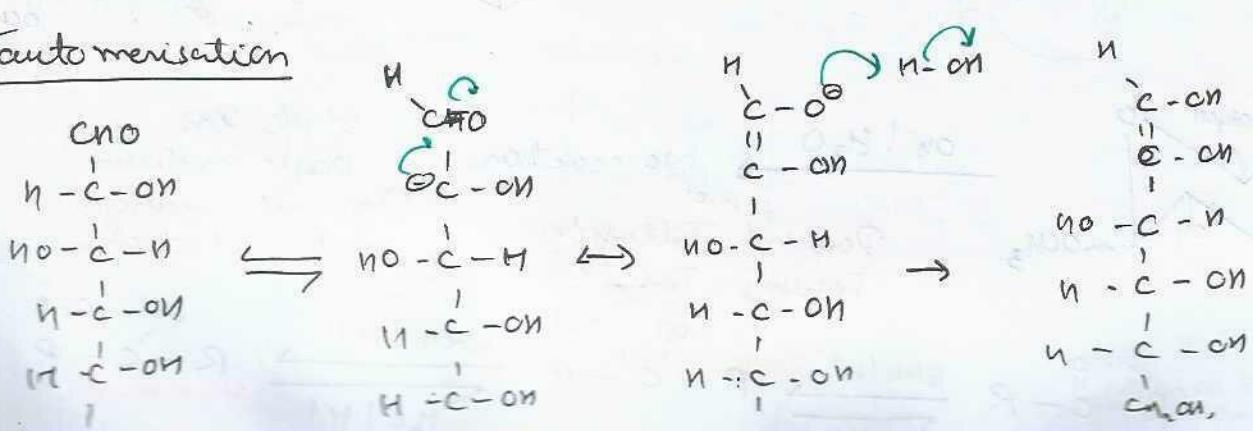


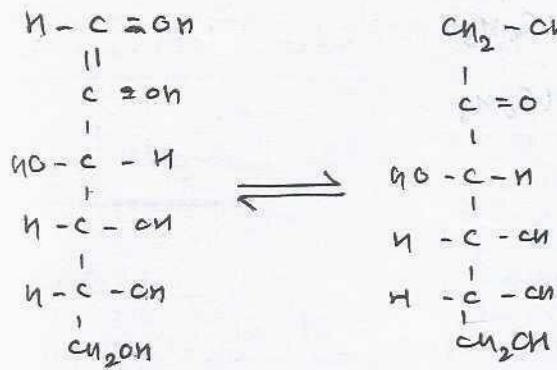


## ENOLISATION AND TAUTOMERISATION



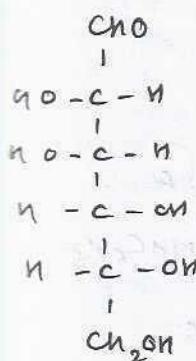
## Tautomerisation





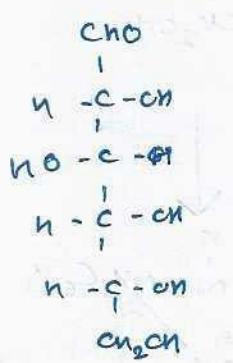
D-fructose

||

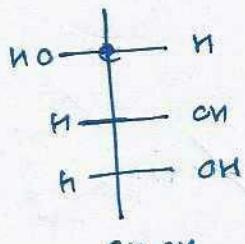


D-manno

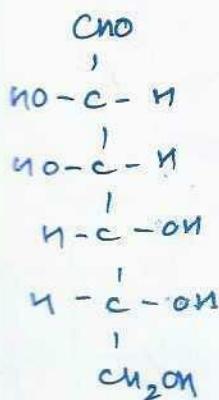
### OSAZONE FORMATION



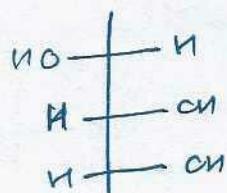
$3 \text{C}_6\text{H}_5\text{-NNNH}_2$



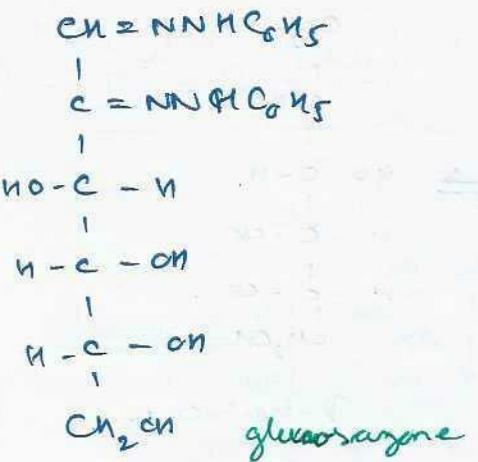
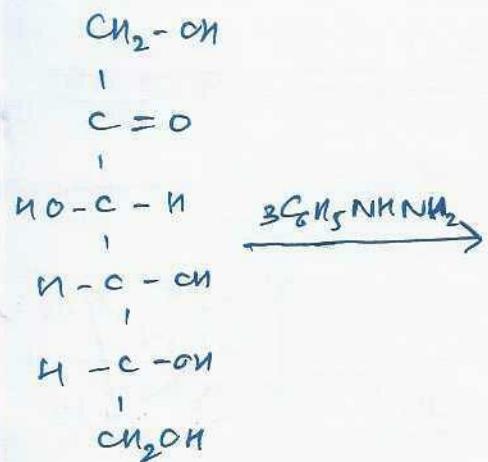
glucosazone



$3 \text{C}_6\text{H}_5\text{-NNNH}_2$

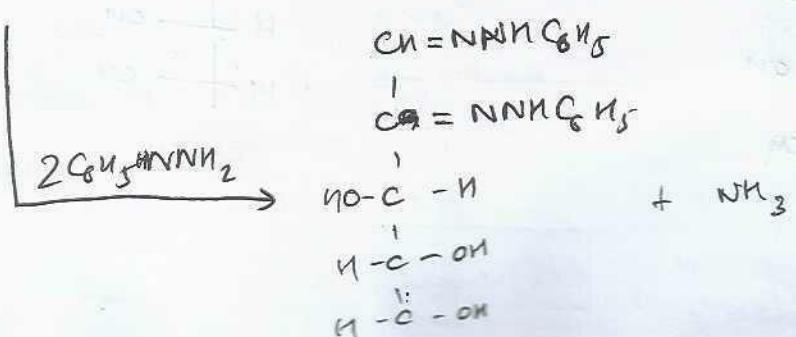
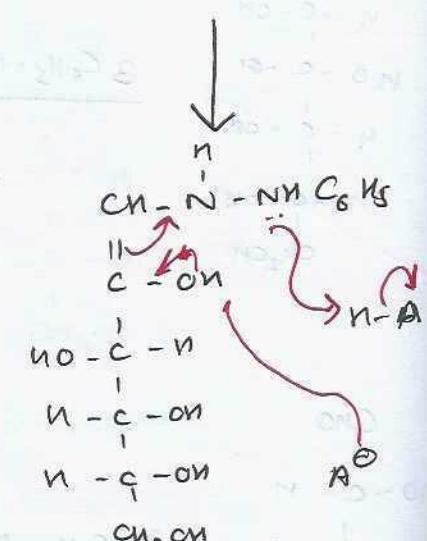
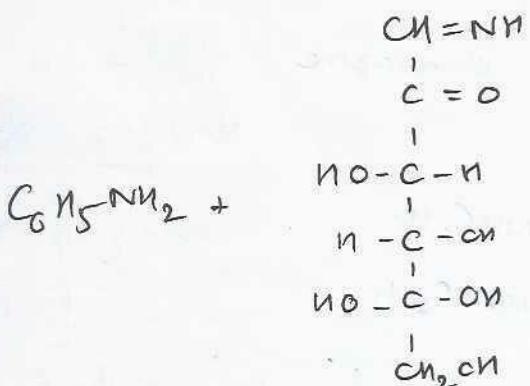
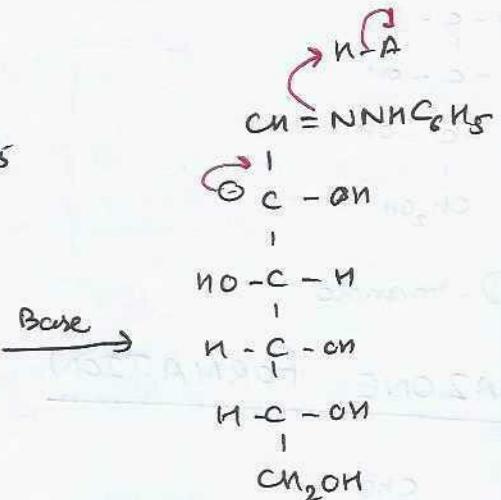
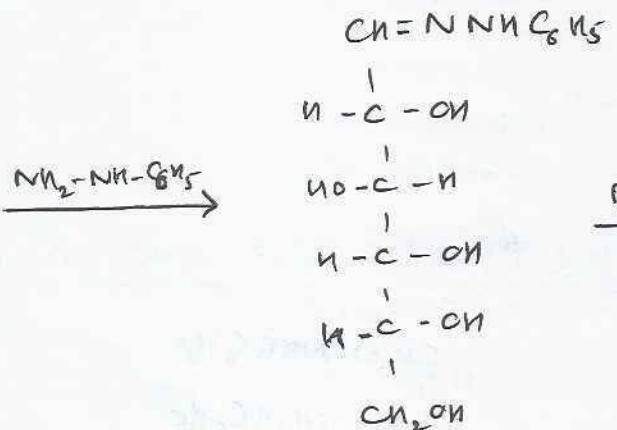
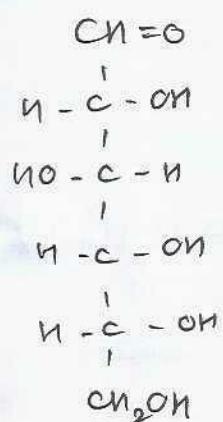


glucosazone

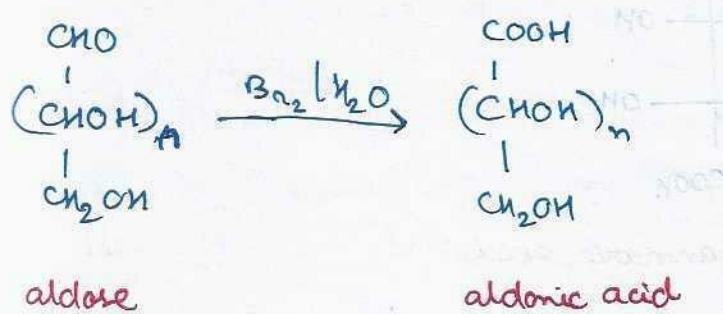
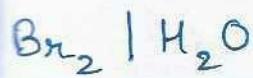


If compounds give the same osazone then they may be different only at C<sub>1</sub> and/or C<sub>2</sub>.

### Mechanism



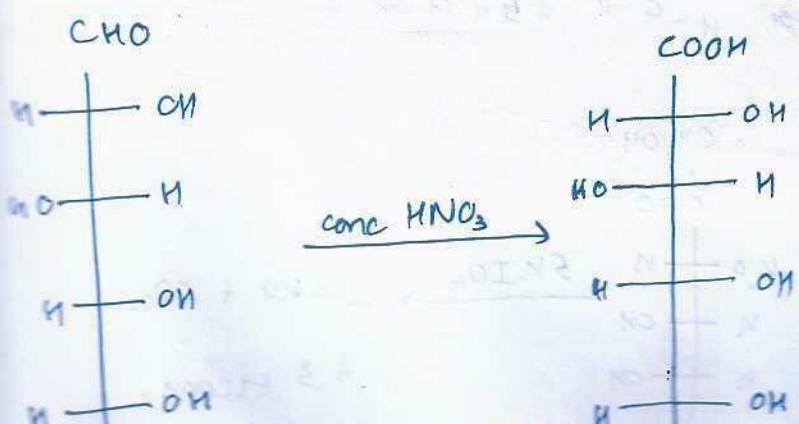
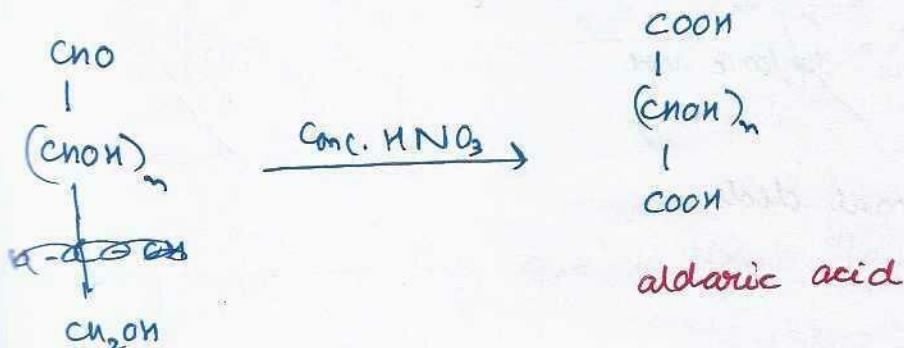
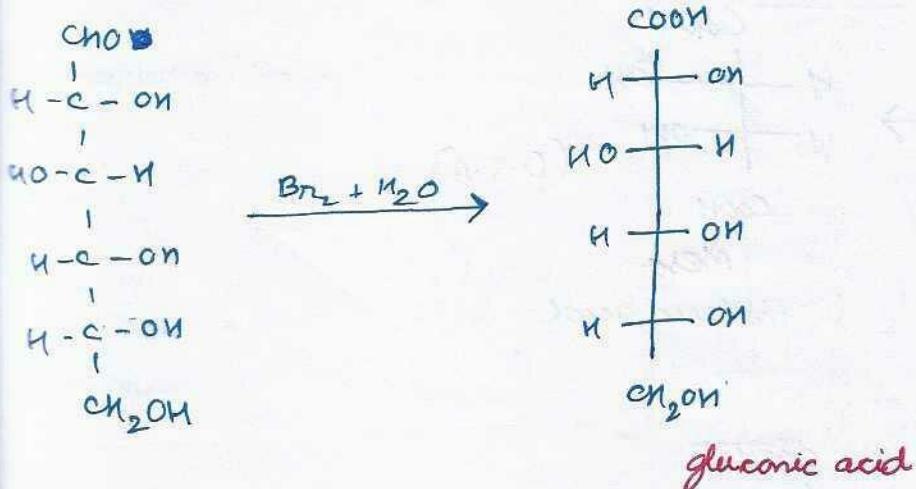
# OXIDATION



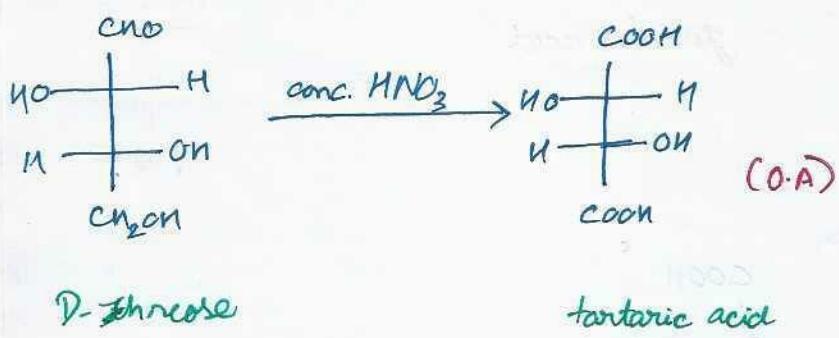
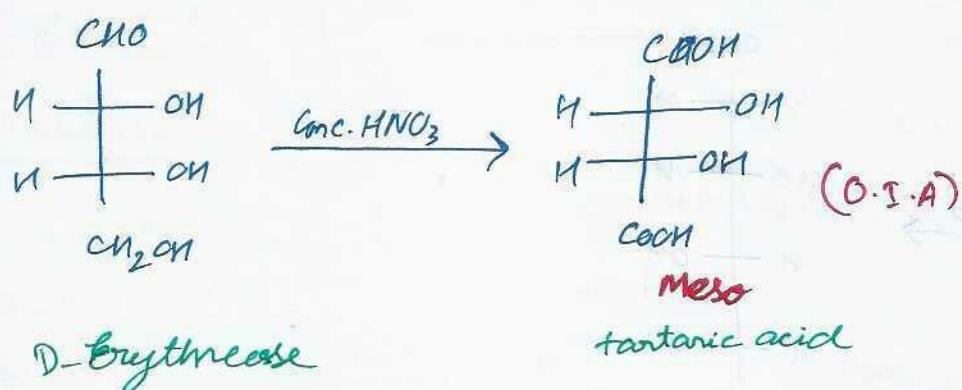
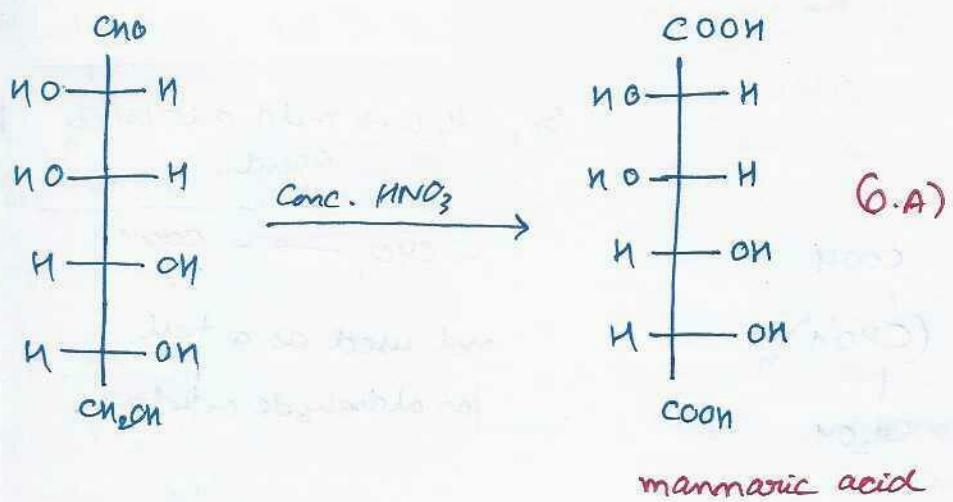
$\text{Br}_2 + \text{H}_2\text{O} \rightarrow$  mild oxidising agent.



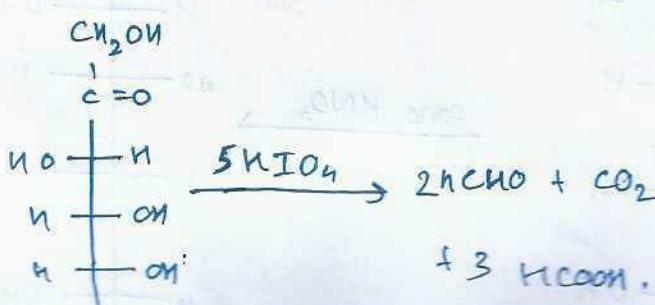
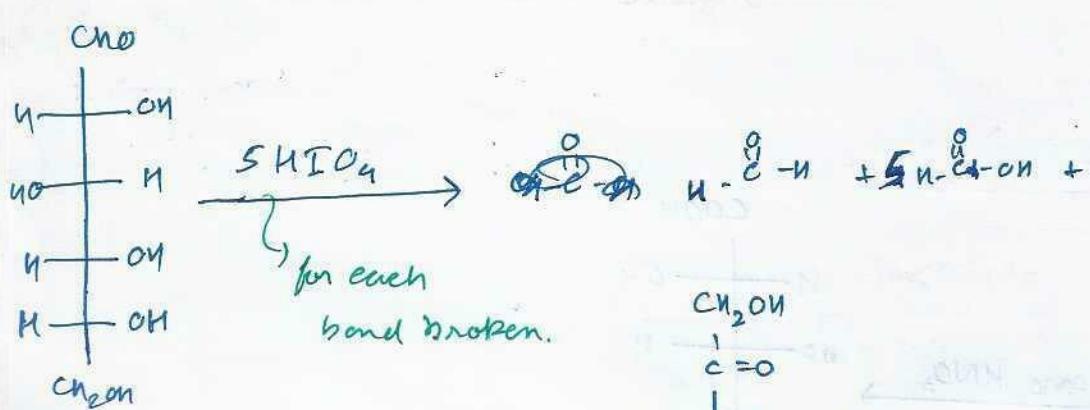
not used as a test  
for aldehyde or ketone.



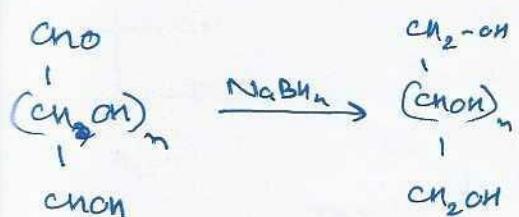
RED



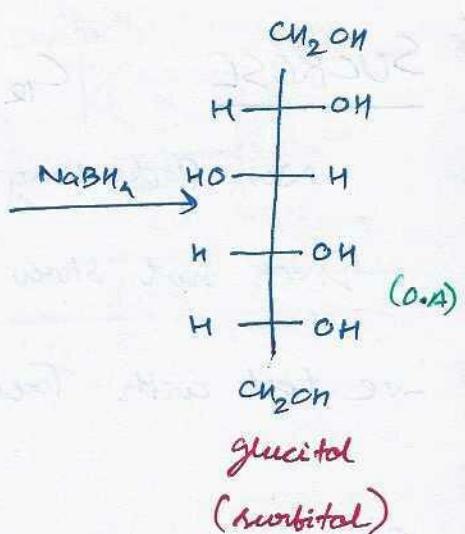
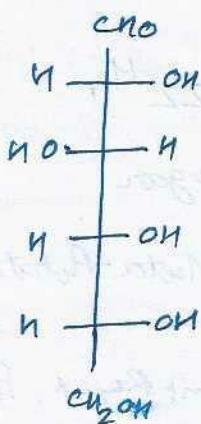
$\text{HIO}_4$  → oxidises vicinal diols.



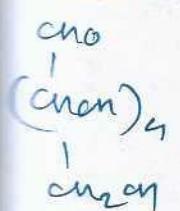
# REDUCTION



Additol

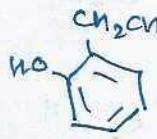
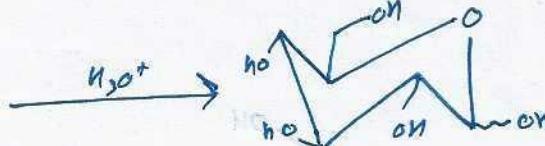
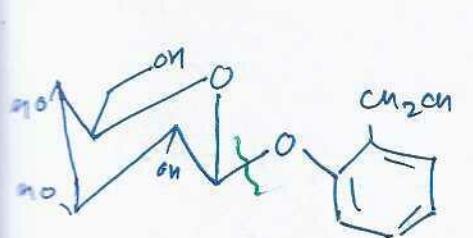
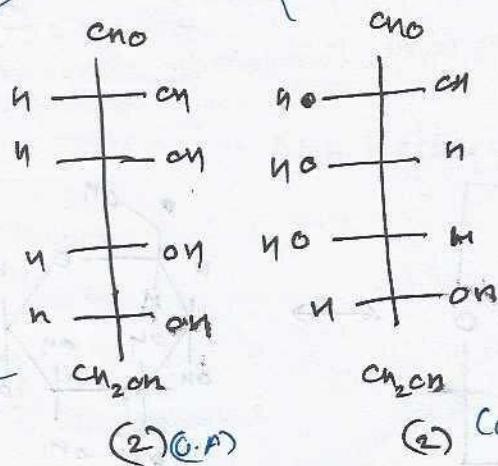


~~Glucose~~  $\xrightarrow{\text{NaBH}_4}$

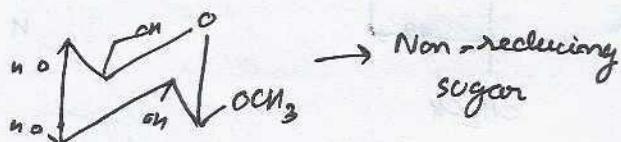
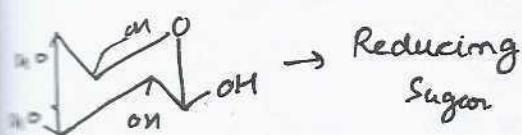


Glucitol

O-I.A.  
A. Colitox (2)



Reducing sugar  $\rightarrow$  They give Tollen's Test.



# DISACCHARIDES

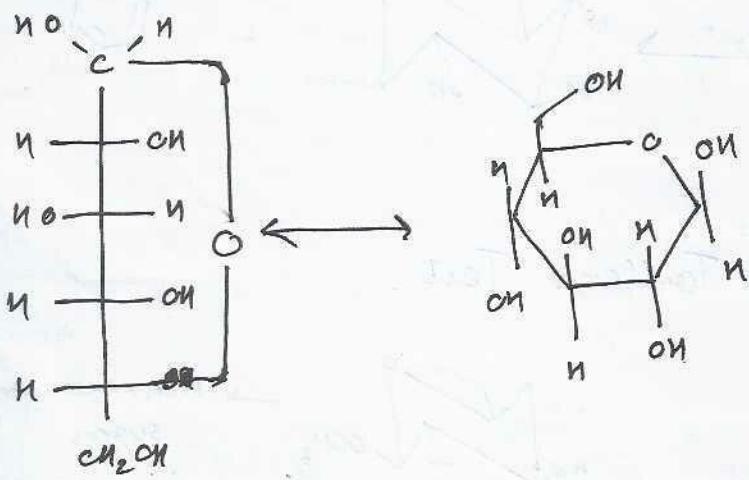
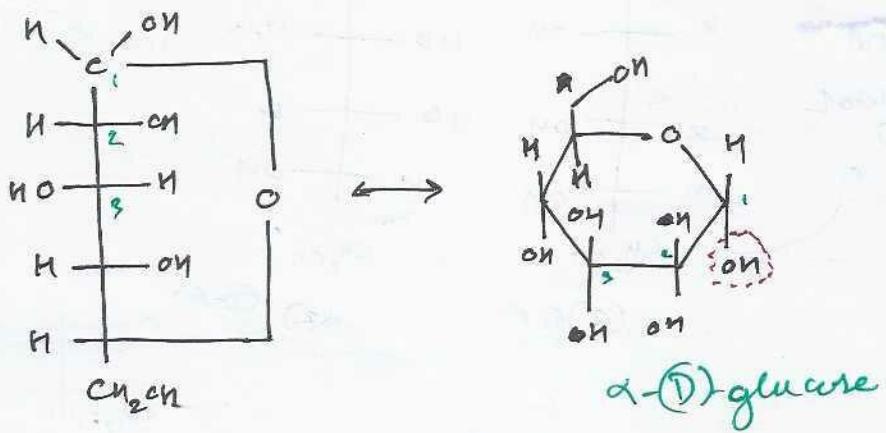
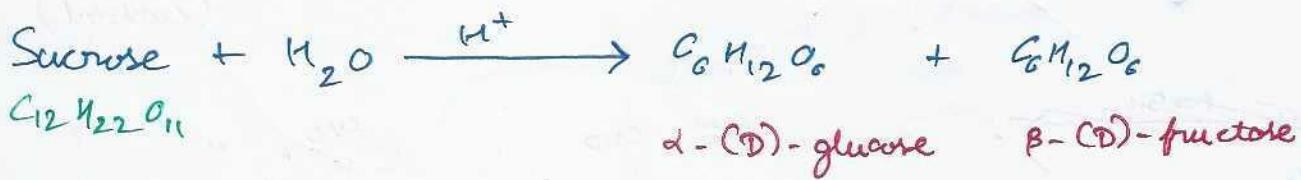
SUCROSE

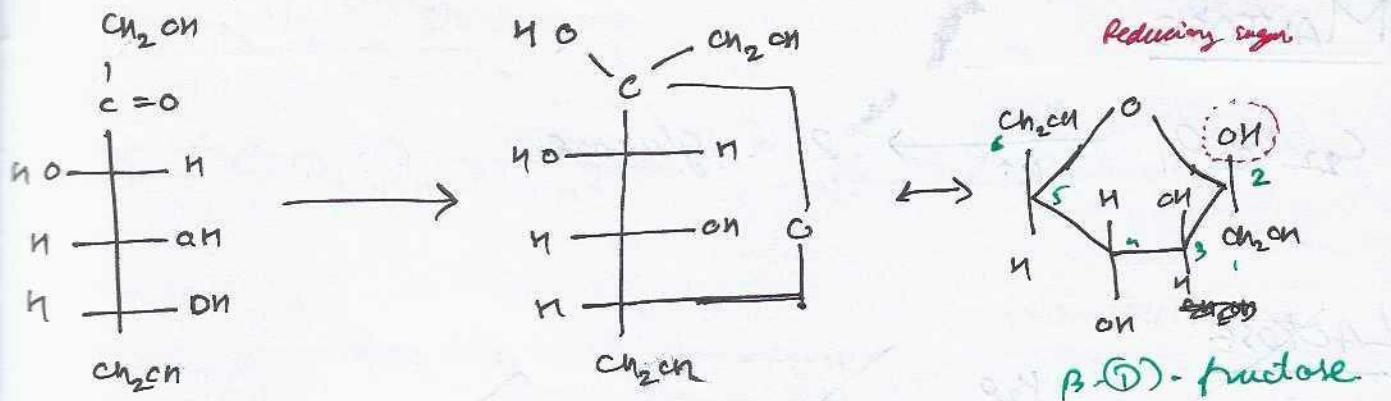


Non Reducing Sugar

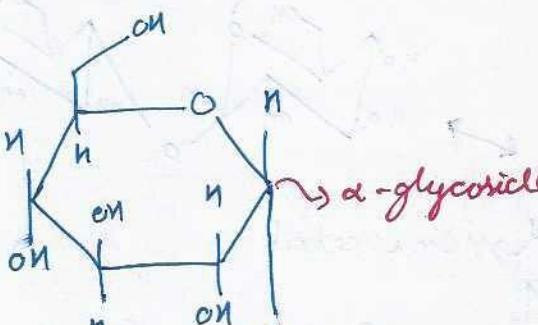
Does not show Meata-Rotation

-ve test with Tollen's Reagent, Fehling's Solution, Benedict's Solution



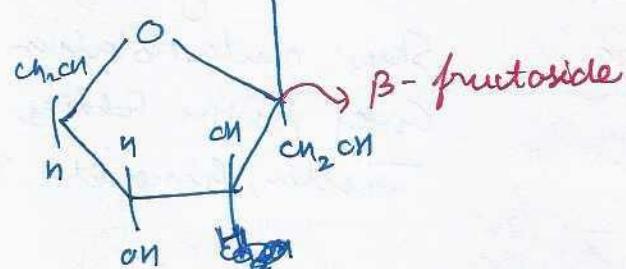


5-membered hemiacetal is more stable here.



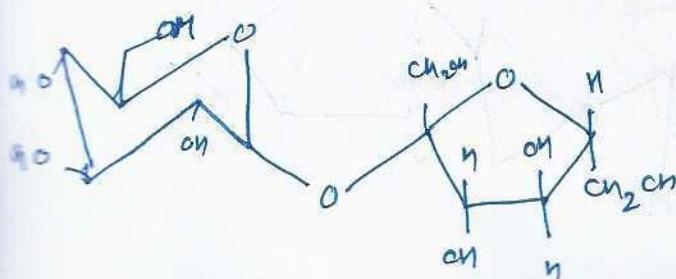
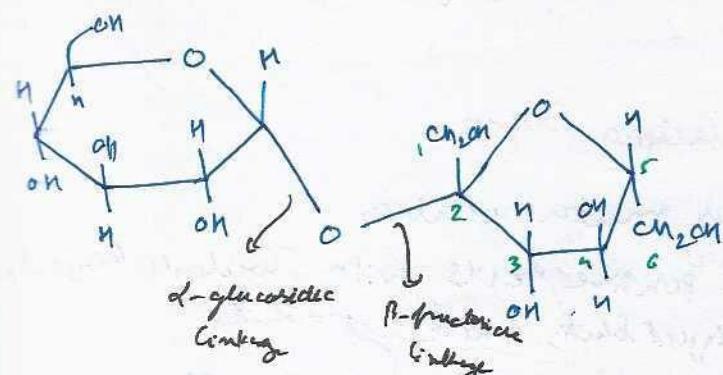
Acetal form

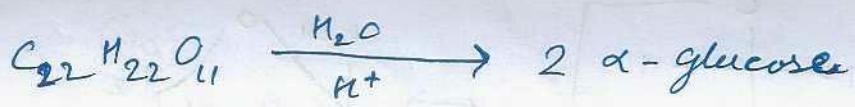
→ does not show mutarotation



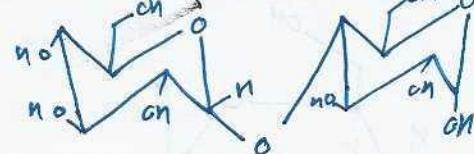
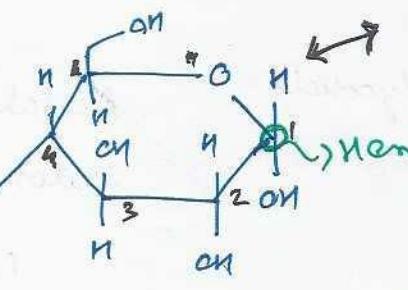
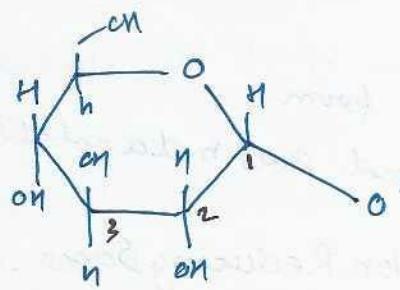
Non Reducing Sugar.

Sucrose is only disaccharide which does not give positive test.





## LACTOSE



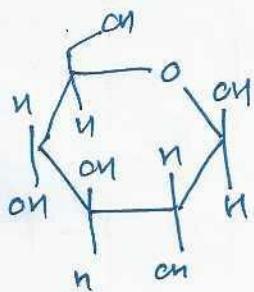
Reducing Sugar

Shows mutarotation

Gives positive Fehling,

Torulene, Benedict's Test.

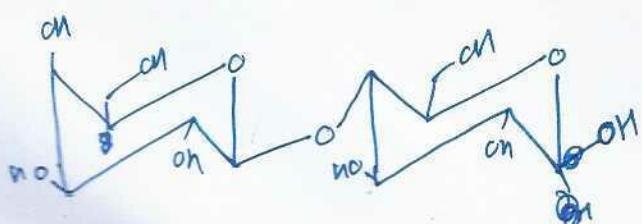
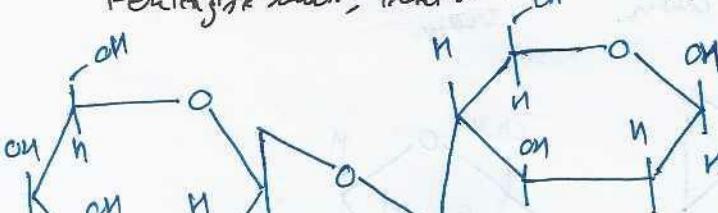
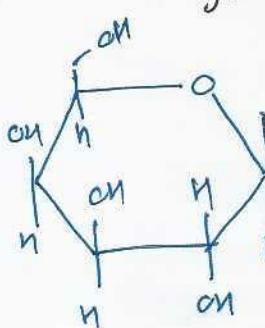
## LACTOSE



Reducing Sugar

Shows mutarotation

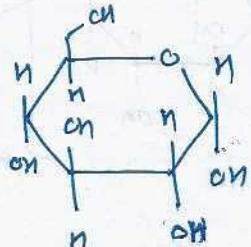
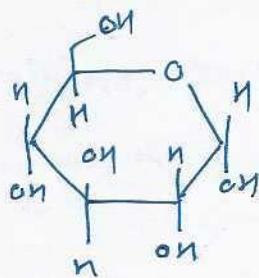
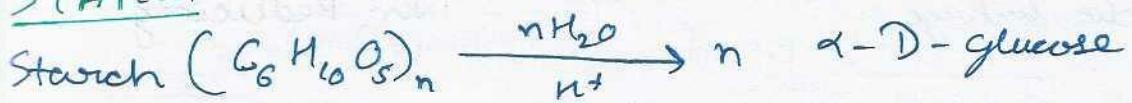
Gives positive tests with Toulene's Reagent,  
Fehling's Reagent, Benedict's Solution



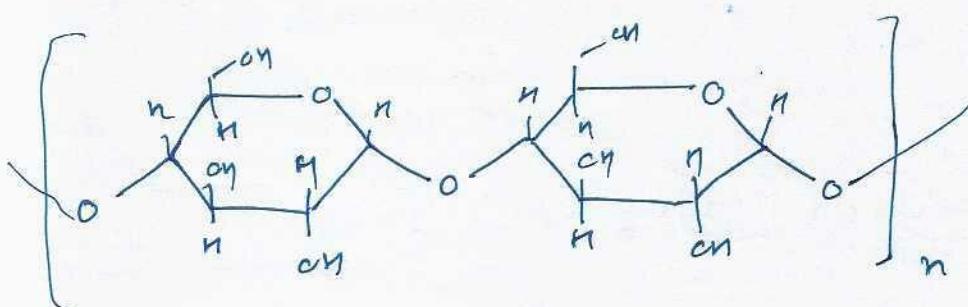
1,4 glycosidic linkage.

# POLYSACCHARIDES

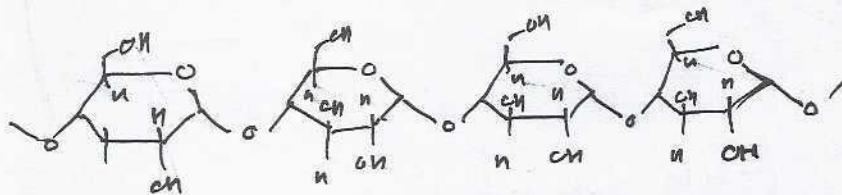
## STARCH



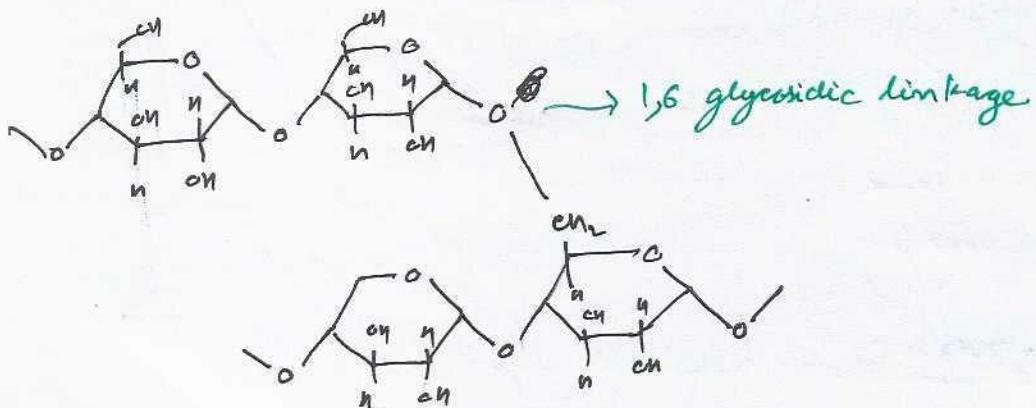
Non Reducing



## Amylose



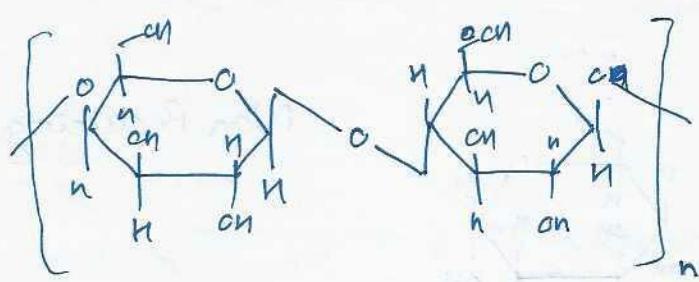
## Amylopectin



# CELLULOSE

$\beta$ -glycosidic linkage

Non Reducing



Con  
N

ADD  
Blye  
C

Co

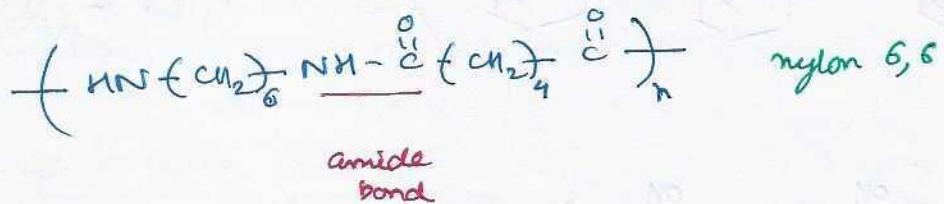
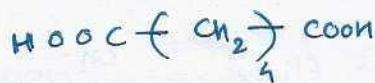
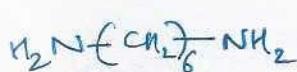
Poly  
no

# POLYMERS

CONDENSATION POLYMER (Bi-functional molecules) (Step growth) (Two groups) Elimination of small group

Nylon 6,6

Hexamethylene diamine + Adipic acid



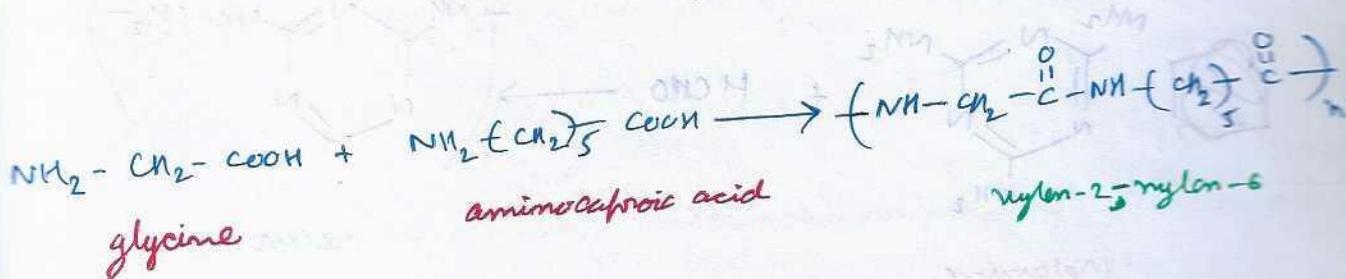
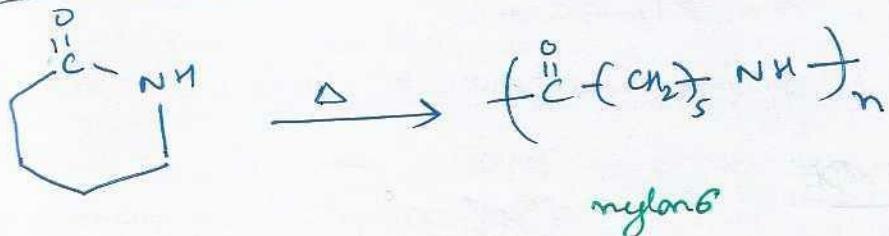
O  
M  
S  
G  
A

ADDITION POLYMER (Chain growth) No elimination of small group

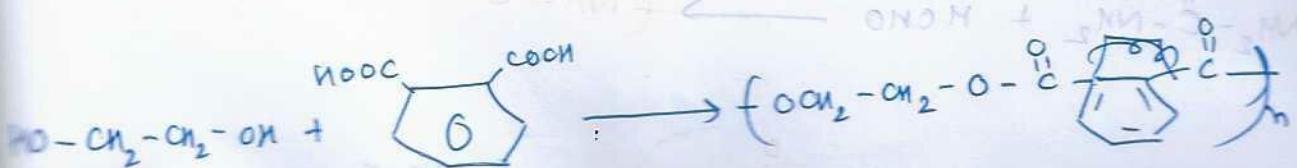
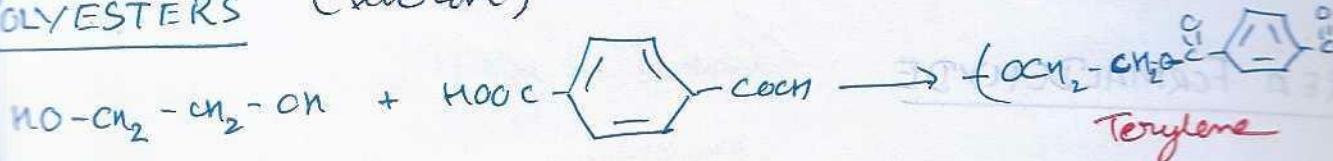
Polyethylene



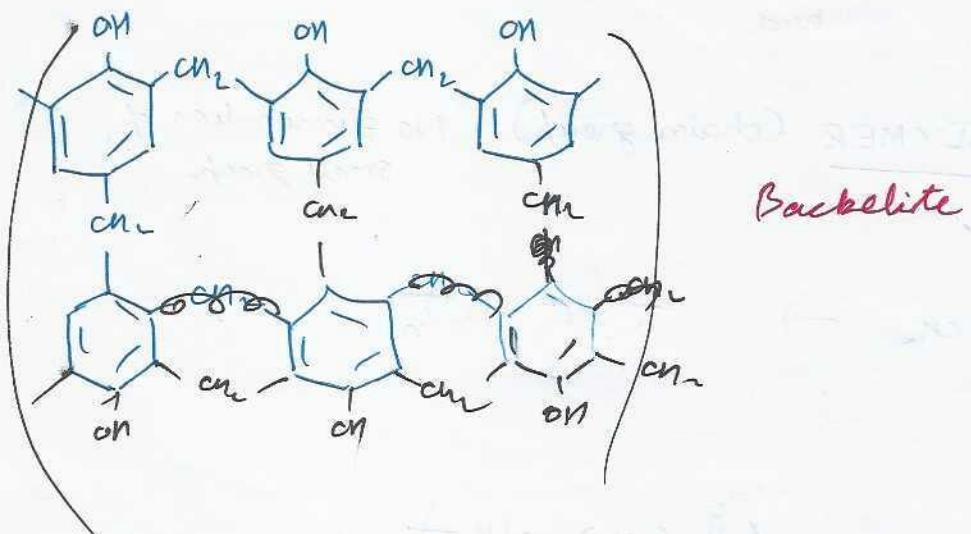
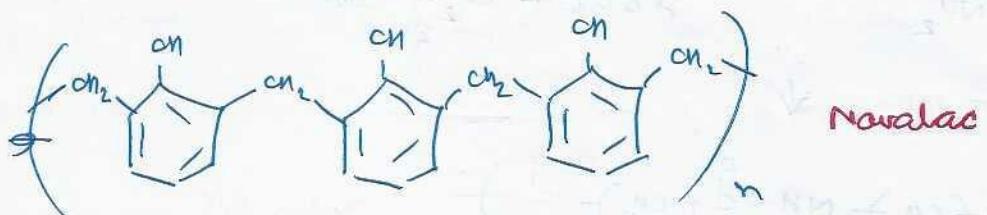
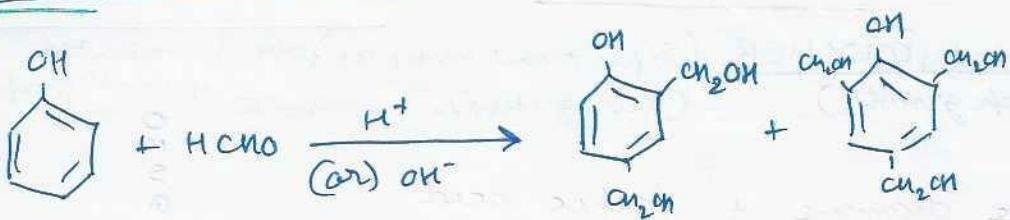
Condensation



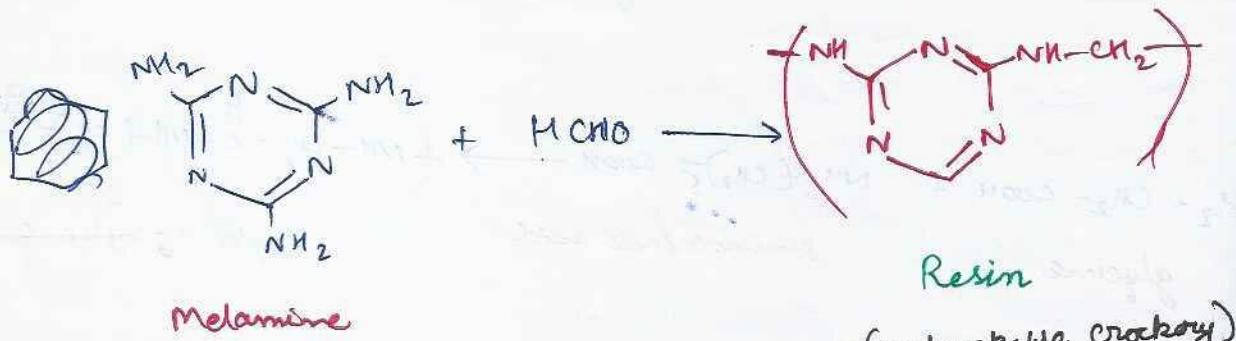
POLYESTERS (Ester)



## PHENOL FORMALDEHYDE



## MELAMINE FORMALDEHYDE



## UREA FORMALDEHYDE



# CLASSIFICATION OF POLYMERS

## Based on Source

- Natural Polymers: Starch, cellulose, Natural rubber
- Semisynthetic: Cellulose rayon, cellulose nitrate
- Synthetic: Polyethylene, PVC.

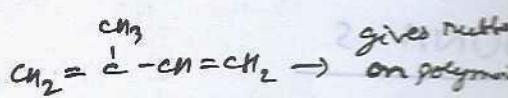
## Type of Polymerization

- Addition Polymers: PVC    polyethylene    PTFE
- Condensation Polymer: urea formaldehyde, melamine formaldehyde  
nylon G, G.

## By Based on Intermolecular forces

- Elastomers (weak intermolecular forces - Van der Waals)

Rubber, BUNA-S  
 $(H_2C=CH-CH=CH_2 + CH_2=CH_2) \rightarrow$



- Fibres (strong intermolecular forces) - like H-bond.

nylon 6, nylon 6,6

- Thermoplastics (intermediate intermolecular forces).

PVC, polystyrene, Polyacrylonitrile

- Thermosetting plastics (not remolded)

Bakelite, Melamine formaldehyde,

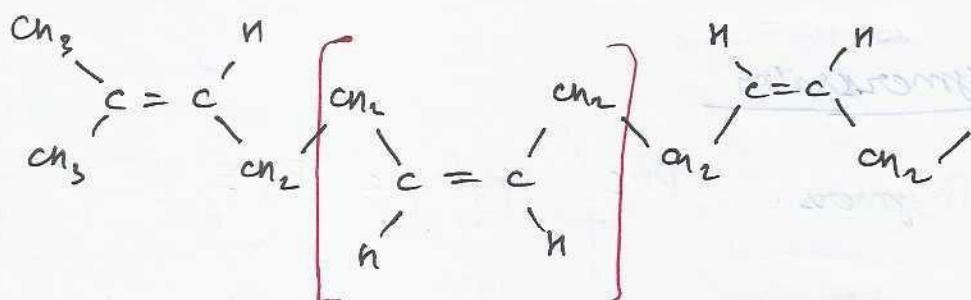
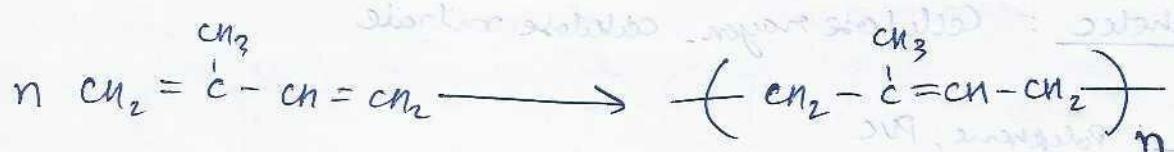
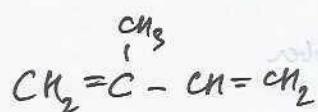
# NATURAL RUBBER

29 Jan 2023 is most as it is real

500

Made up of isoprene units.

isoprene is made

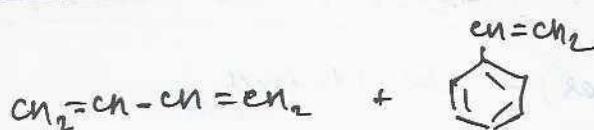


Natural rubber  $\rightarrow$  cis form

Trans form of rubber  $\rightarrow$  gutta percha

Vulcanisation  $\rightarrow$  Heating rubber with sulphur

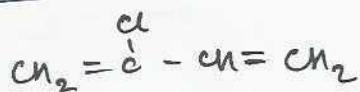
## BUNA - S



## BUNA - N



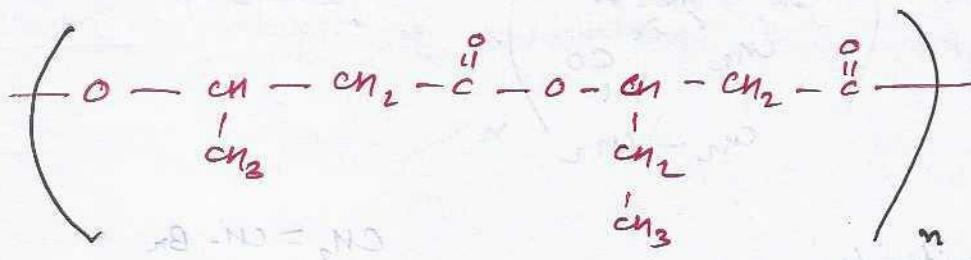
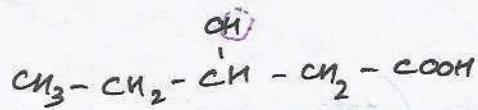
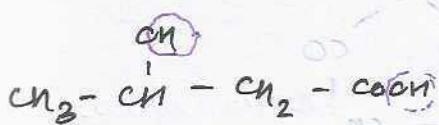
## NEOPRENE



(chlorinated form)

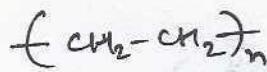
## BIO DEGRADABLE POLYMERS

PHBV  $\rightarrow$  Poly- $\beta$ -hydroxybutyrate Co- $\beta$ -hydroxy- valerate.



### Name of Polymer

Polythene



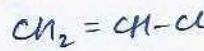
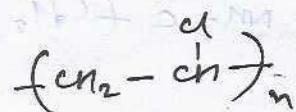
LDPE : squeeze bottles, (linear)

HDPE : containers (branching)

### Monomer



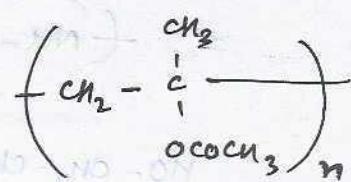
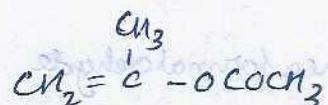
### 2. Poly Vinyl chloride



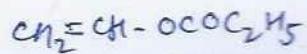
### 3. PTFE (Polytetrafluoroethylene)



### 4. PMMA (Polymethylmethacrylate)

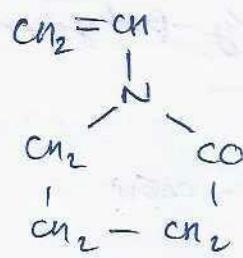
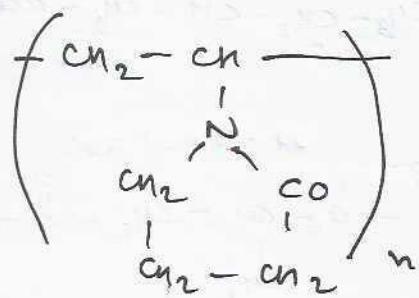


### 5. Polyethoxylate

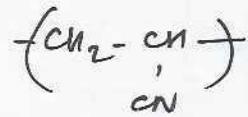


## ~~6. Polyvinylpyrrolidone~~

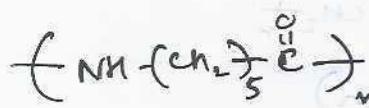
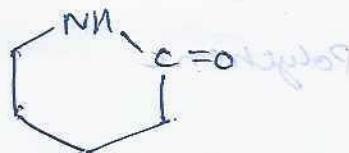
### 6. Polyvinylpyrrolidone



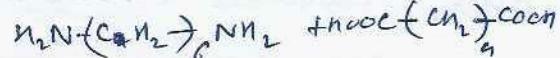
### 7. Polyacronitrile



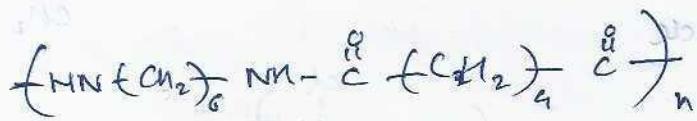
### 8. nylon 6



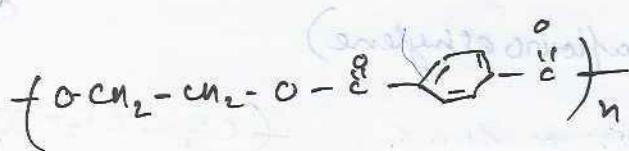
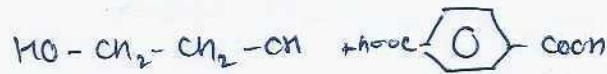
(grind and)



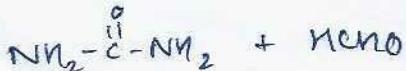
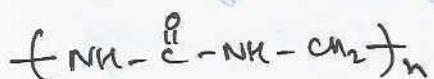
### 9. nylon 6,6



### 10. Dacron

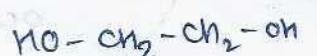


### 11. urea-formaldehyde

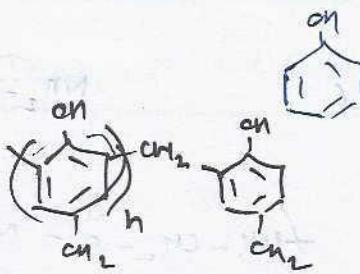


(at low temperature)

### 12. glyptal

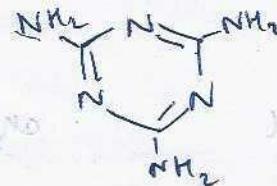
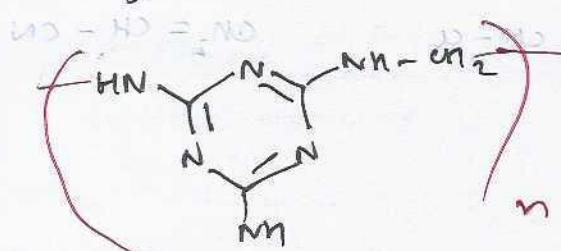


13. Phenol-formaldehyde

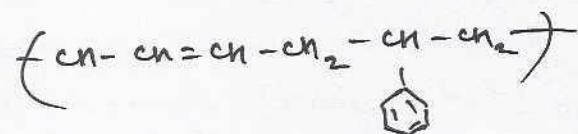
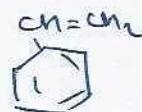


HCHO

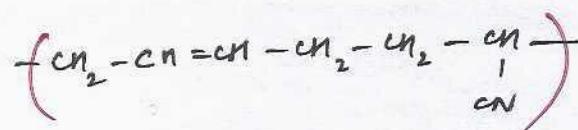
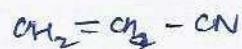
14. Melamine formaldehyde.



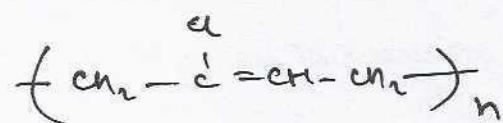
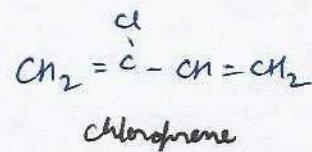
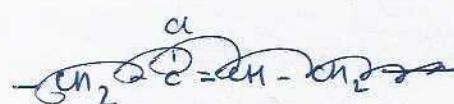
15. BUNA - S



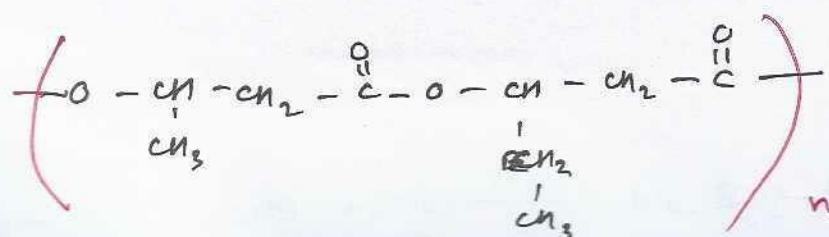
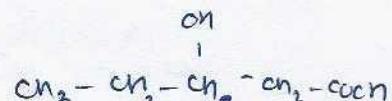
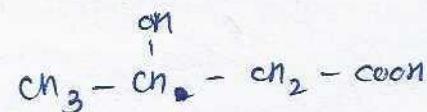
16. BUNA - N



17. Neoprene



18. PHBV





# DETECTION OF ELEMENTS

C, H, N, S, X

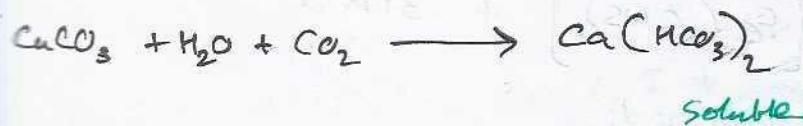
$$\% \text{ of C} = \frac{12}{44} \times \frac{\text{weight of } \text{CO}_2}{\text{weight of organic compound}} \times 100$$

$$\% \text{ of H} = \frac{2}{18} \times \frac{\text{weight of } \text{H}_2\text{O}}{\text{weight of organic compound}} \times 100$$

C

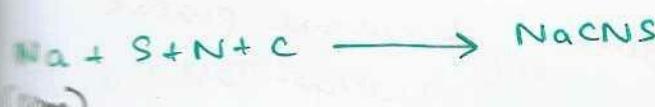
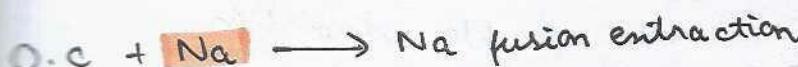


H



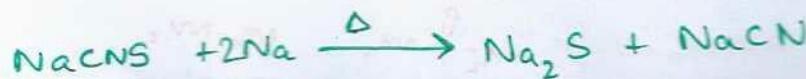
N, X, S

## LASSIGN'S TEST



Na is used

(am)

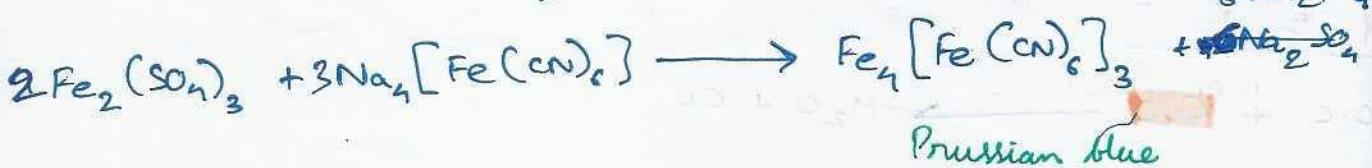
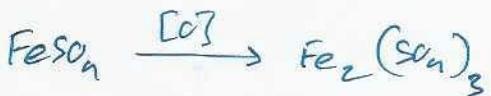
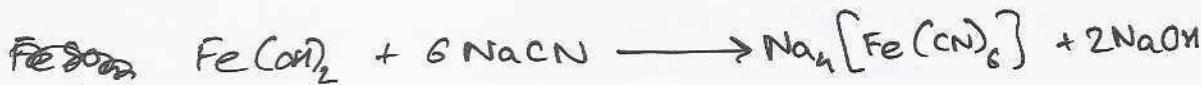


N

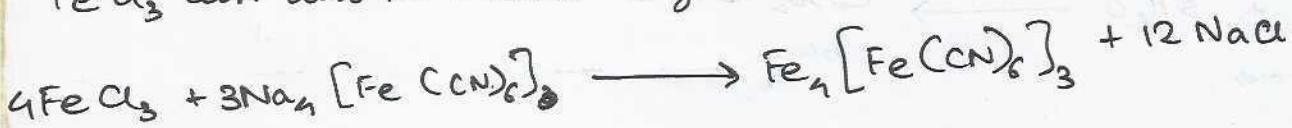
Freshly prepared  $\text{FeSO}_4$



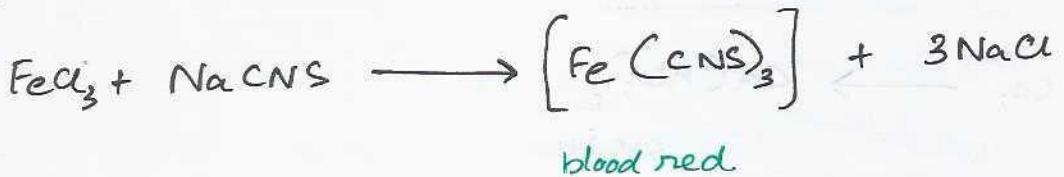
Formed  $\text{Fe(OH)}_2$  reacts with  $\text{NaCN}$



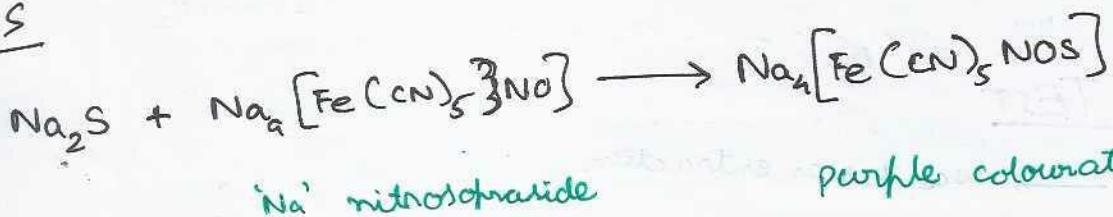
$\text{FeCl}_3$  can also be added to give  $\text{Fe}^{3+}$ .



S, N



S



Benzene diazonium chloride, urea, hydrazine do not give positive  
Leydig's Test.



X



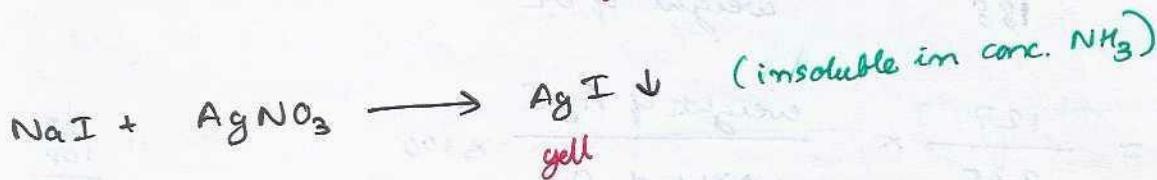
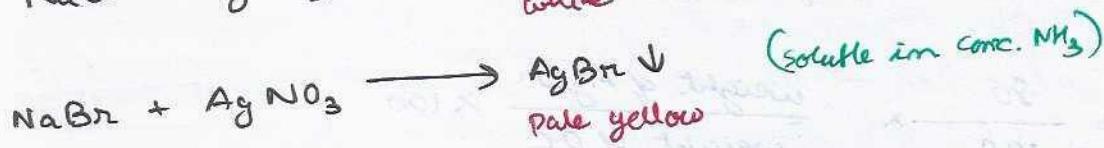
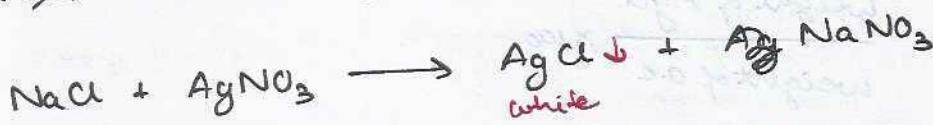
S and N need to be removed, if any is present, in the mixture



as  $\text{S}^{2-}$  and  $\text{CN}^-$  interfere with the halide test.

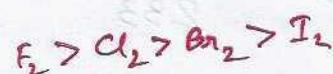


~~EXTRA~~  $\text{AgNO}_3$  solution is added

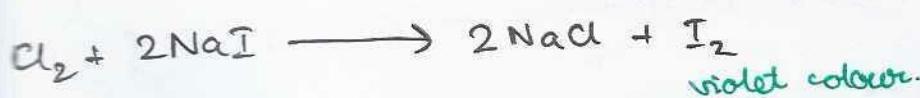
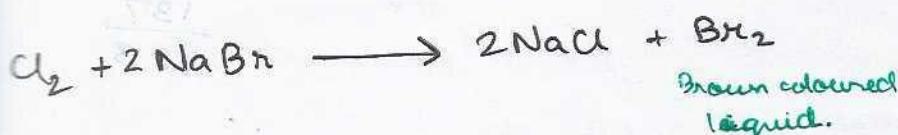


F does not give this test.

### $\text{Br}^-$ , $\text{I}^-$ CHLORINE WATER TEST (in $\text{CCl}_4$ medium)

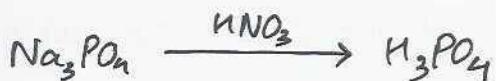


oxidising power

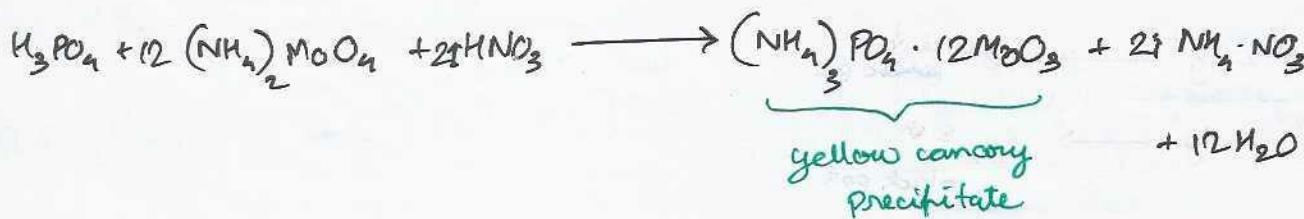


Colour is found in organic layer.

P



Ammonium molybdate is added



$$\% \text{ of Cl} = \frac{35.5}{143.5} \times \frac{\text{weight of AgCl}}{\text{weight of O.C}} \times 100$$

$$\% \text{ of Br} = \frac{80}{188} \times \frac{\text{weight of AgBr}}{\text{weight of O.C}} \times 100$$

$$\% \text{ of I} = \frac{127}{235} \times \frac{\text{weight of AgI}}{\text{weight of O.C}} \times 100$$

$$\% \text{ of S} = \frac{32}{233} \times \frac{\text{weight of BaSO}_4}{\text{weight of O.C}} \times 100.$$

## FUNCTIONAL GROUPS

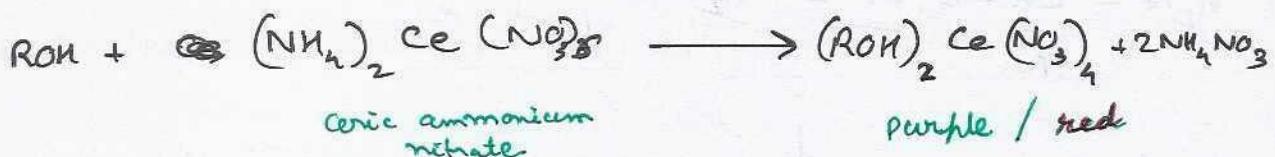
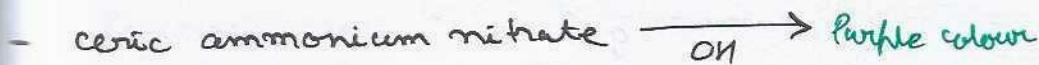
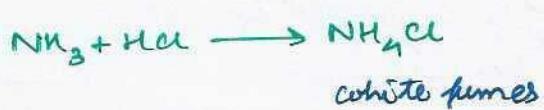
### -OH (Alcohol)

1. Na
2. acetyl chloride
3. ceric ammonium nitrate





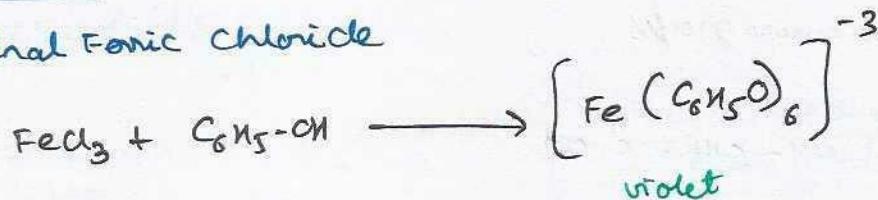
↳ released HCl gas  
on exposed glass rod  
dipped with  $\text{NH}_3$ .  
gives white fumes.  
due to formation of  
 $\text{NH}_4\text{Cl}$ .



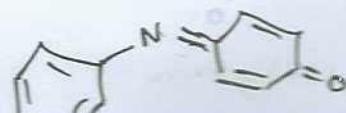
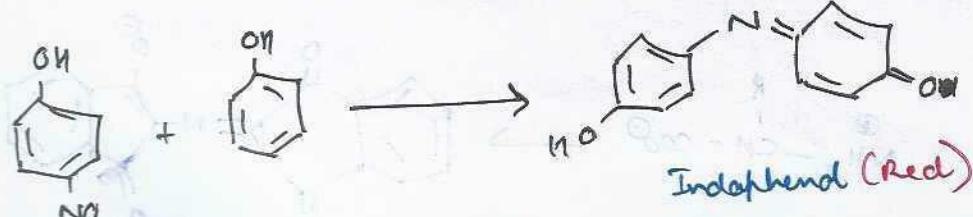
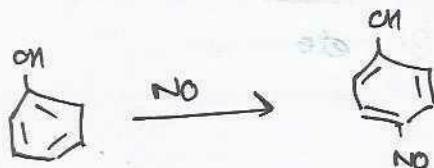
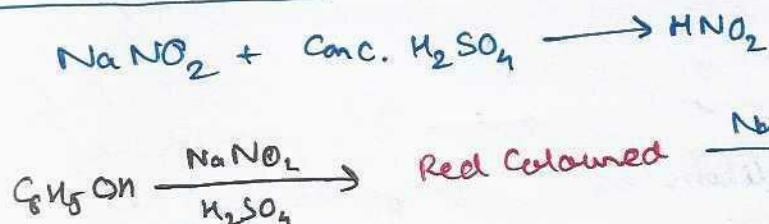
Distinguish : Lucas Reagent (conc HCl + zinc ch) and Victor Mayer

## PHENOLS

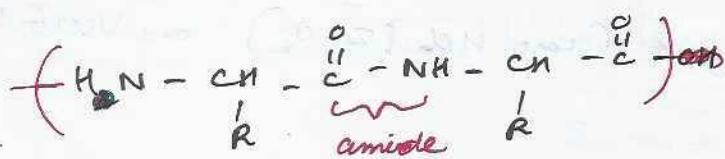
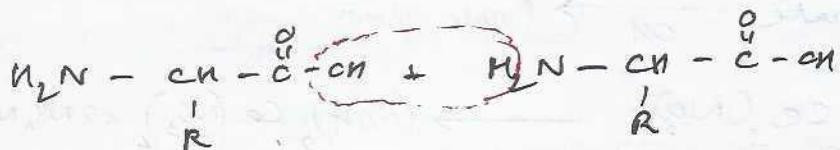
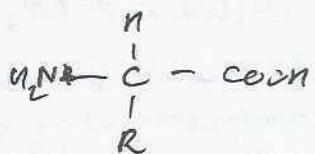
Neutral Feric Chloride



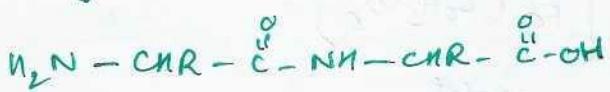
## LEBERMANN'S TEST



# PROTEINS



dipeptide → two amino groups



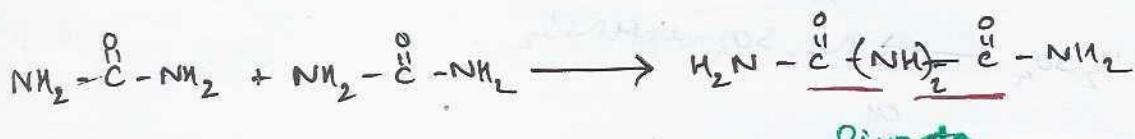
Polypeptides → Proteins

## BIURET TEST

aq  $\text{CuSO}_4$  in alkaline medium

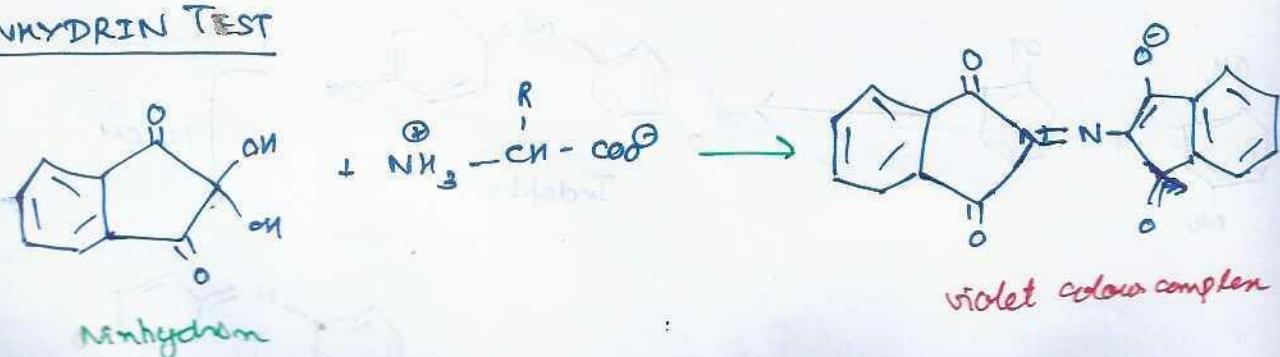
gives purple colour

given by  $-\overset{\text{O}}{\text{C}}-\text{NH}-$  linkage



Should have minimum two amide linkages.

## NINHYDRIN TEST





### XANTHOPROTIC TEST

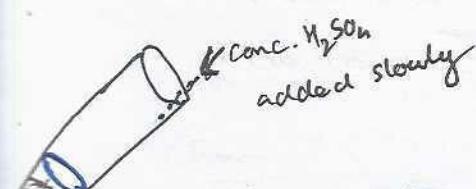


due to presence of Benzene ring in amino acid.

Tyrosine, tryptophan, phenylalanine

### CARBOHYDRATES

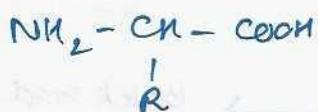
#### MOLISCH TEST



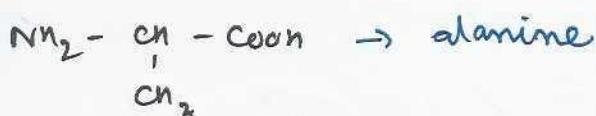
→ violet ring is formed  
 at the meeting point.  
 junction

# AMINO ACIDS

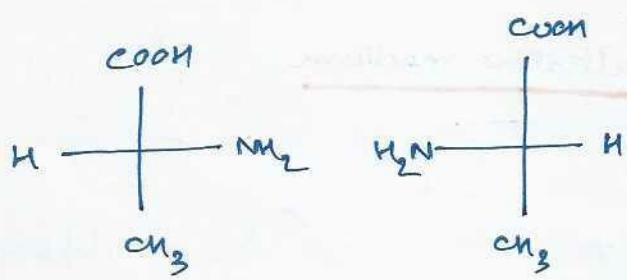
Naturally occurring amino acids have L configuration.



$R \rightarrow H$  → glycine

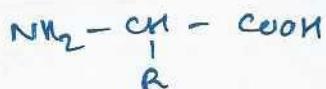


Proline  $\rightarrow$  2° amine

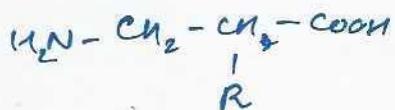


In our body all amino acids are L-amino acids.

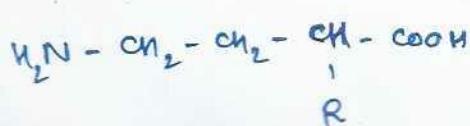
## $\alpha$ -Amino acids



## $\beta$ -Amino acids



## $\gamma$ -Amino acids

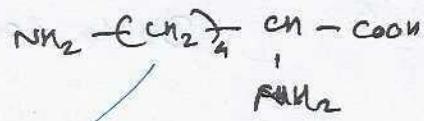


## Neutral Amino acids

1 NH<sub>2</sub> and 1 COOH

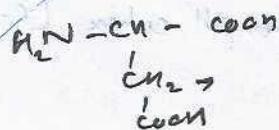
## Basic Amino acid

2 NH<sub>2</sub> and 1 COOH



## Acidic Amino acid

1 NH<sub>2</sub> and 2 COOH.

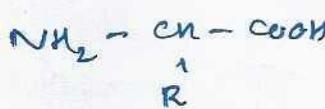


## ESSENTIAL AMINO ACIDS

Leucine, isoleucine, valine

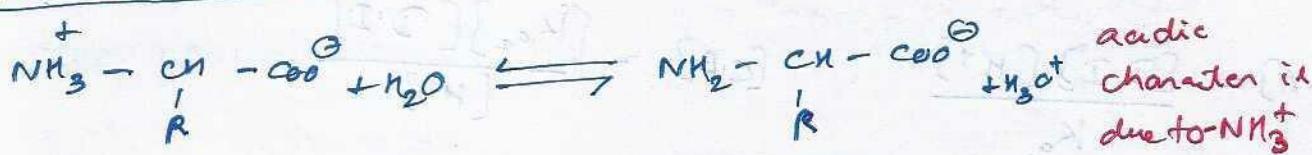
## NON ESSENTIAL

Glycine, alanine, phenylalanine



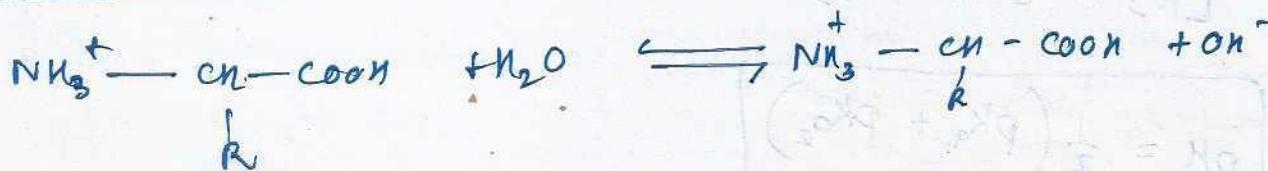
dipolar ion

## Acidic Character



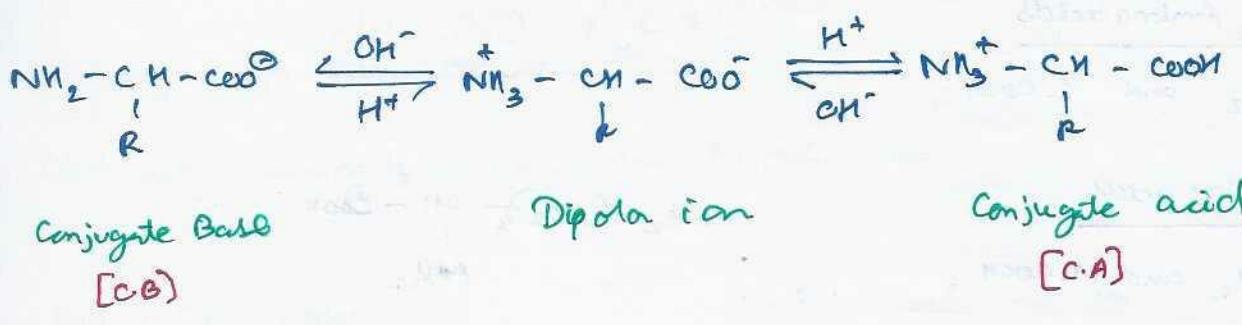
$$K_a = \frac{[\text{NH}_2 - \text{CH} - \text{COO}^\ominus][\text{H}_3\text{O}^+]}{[\text{Dipolar ion}]}$$

## Basic character



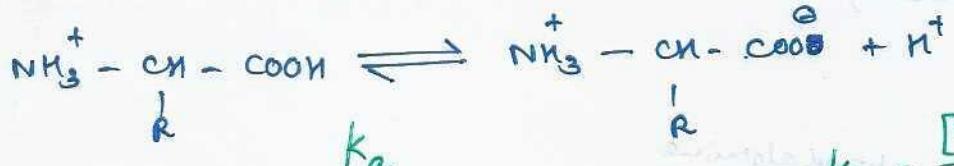
$$K_b = \frac{[\text{NH}_3^+ - \text{CH} - \text{COO}^-][\text{OH}^-]}{[\text{Dipolar ion}]}$$

Basic character is due to  $\text{COO}^\ominus$ .

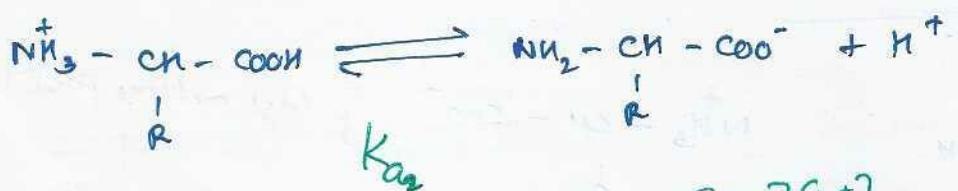


Isoelectric point : when  $[C \cdot A] = [C \cdot B]$

$$pK = \frac{pK_{a_1} + pK_{a_2}}{2}$$



$$K_{a_1} = \frac{[D \cdot I][H^+]}{(C \cdot A)}$$



$$K_{a_2} = \frac{[C \cdot B][H^+]}{[D \cdot I]}$$

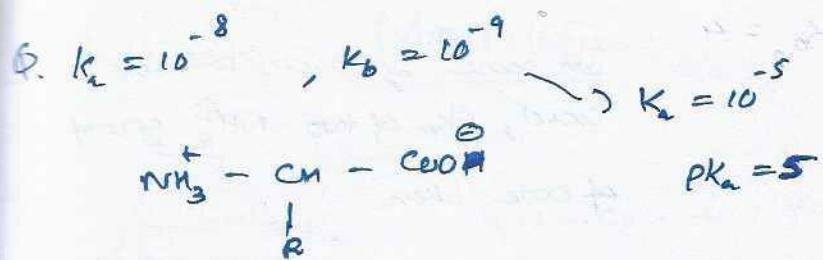
$$[C \cdot A] = \frac{[D \cdot I]}{K_a} [n^+]$$

$$[C \cdot B] = \frac{[K_{a_2}][D \cdot I]}{[H^+]} \quad (1)$$

$$\Rightarrow \frac{[D \cdot I][H^+]}{K_{a_1}} = \frac{[K_{a_2}][D \cdot I]}{[H^+]}$$

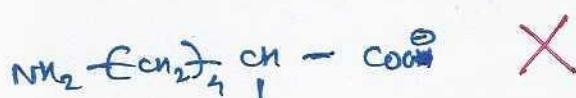
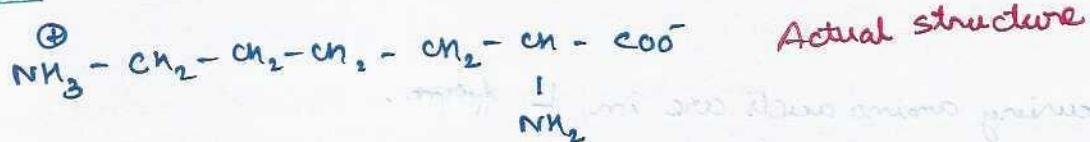
$$\Rightarrow [H^+]^2 = [K_{a_1}][K_{a_2}]$$

$$\Rightarrow \boxed{pK = \frac{1}{2}(pK_{a_1} + pK_{a_2})}$$



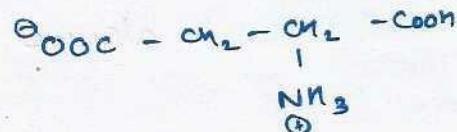
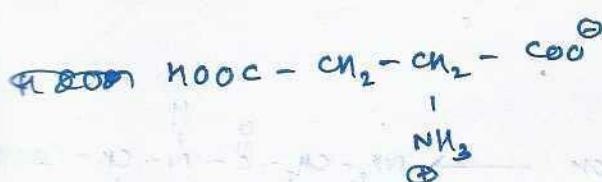
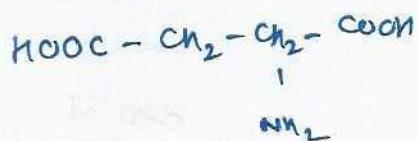
$$\text{pH} = \frac{8+5}{2} = \frac{13}{2} = 6.5$$

### Lysine



$\text{NH}_3^+ \rightarrow \text{NH}_2$  adjacent to electron withdrawing -COOH group  
 decreases basic strength.

### Glutamic acid

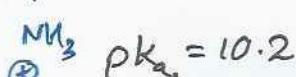


X

Actual form

-NH<sub>2</sub> group is an electron withdrawing group, increases acidic character of adjacent -COOH.

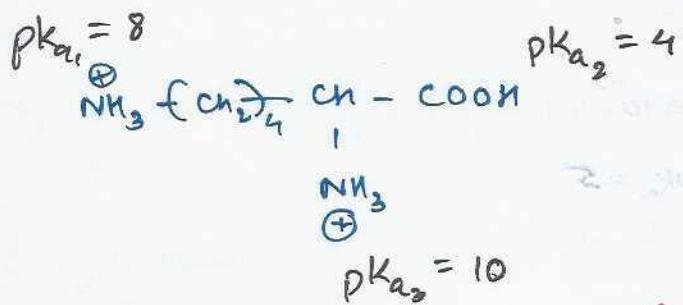
$$pK_{a_1} = 4.8 \quad pK_{a_2} = 2.2$$



$$\text{pH} = \frac{2.2 + 4.8}{2} = 3.5$$

$pK_a$  of two COOH groups are taken in case of acidic amino acids.

Isoelectric point lies on the acidic side as there are two acidic groups.

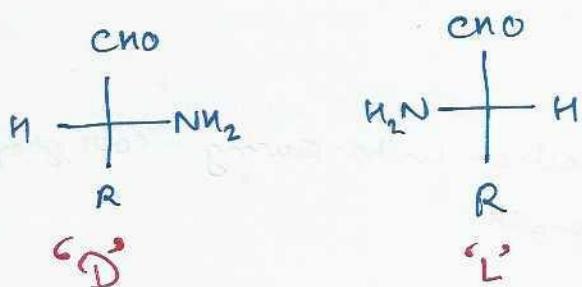


In case of basic amino acid,  $\text{p}K_a$  of two  $-\text{NH}_3^+$  groups are taken.

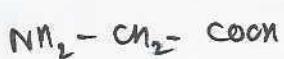
$$\text{pH} = \frac{8+10}{2} = 9$$

Piolytic point will lie towards basic side because there are two basic groups.

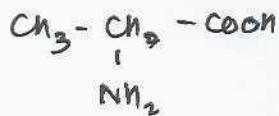
Naturally occurring amino acids are in L form.



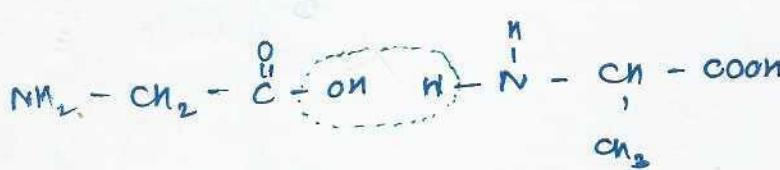
## PROTEIN STRUCTURE



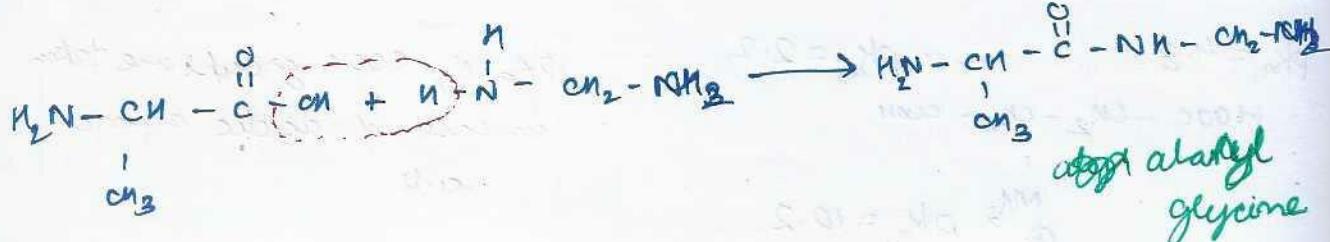
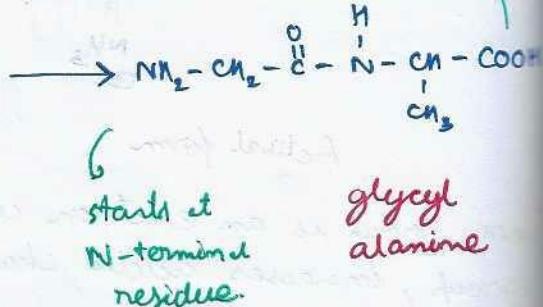
glycine



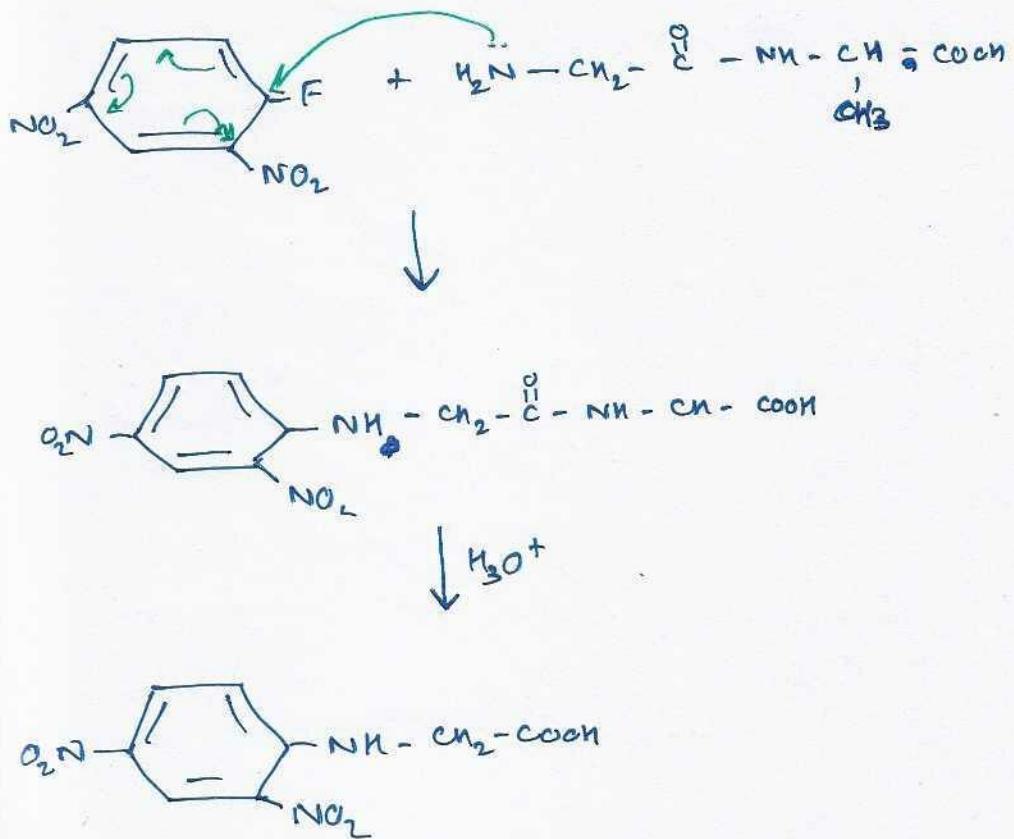
alanine



ends at C-terminal residue



## SANGER's METHOD



## MILLAN'S TEST

Mercurous nitrate       $\longrightarrow$  Red precipitate  
 < Mercuric nitrate.  
 For amino acids having phenol functional group.  
 eg Tyrosine.