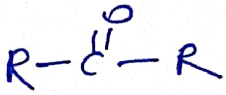
UNIT - IV

Carbonyl Compound (Aldehyde & ketones)

→ Carbony group is $C=O$. bonded c̄ C & H.

e.x. $R-CHO$,



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

Physical property

(1) smell → Lower aldehyde → unpleasant
  → increase size & molecule → fragrant

(2) **solubility**

→ Aldehyde & ketone upto 4 C atom are soluble in H_2O.

→ As the size of alkyl group ↑, solubility decreases.

(3) **B.P.**

→ Aldehyde & ketone have weak intermolecular forces of attraction, so have low B.P.

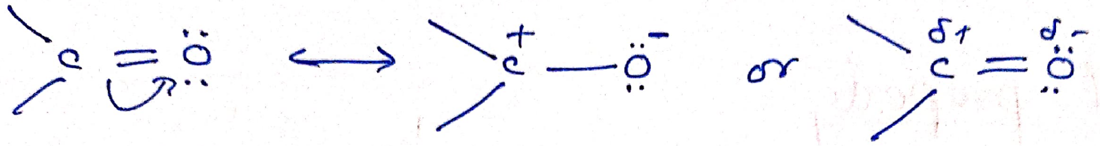
$CH_3CH_2CHO < CH_3COCH_3 < CH_3COOH$

(Propanal)	Propanone	Ethanoic acid
322 K	329 K	391 K

⇒ Natur of Carbonyl group

→ c, & o is sp^2 hybridized

→ C & O have one σ & one π bond.



→ electronegativity is much higher of O_2 so electron cloud shifted to O_2.

⇒ Nomenclature

① Aldehyde = suffix -al.

② Ketone = suffix -one

Ex. HCHO (formaldehyde) → Methanal

CH_3CHO (Acetaldehyde) → Ethanal

CH_3COCH_3 (Acetone) → Propanone

$CH_3COC_2H_5$ (Ethyl methyl keton) → Butanone

Preparation of aldehyde & ketone

(Aldehyde & ketone)

① Oxidation of alcohol
② Dehydrogenation of alcohol
③ Ozonolysis of alkenes.
④ Hydration of alkynes

① Oxidation of alcohol

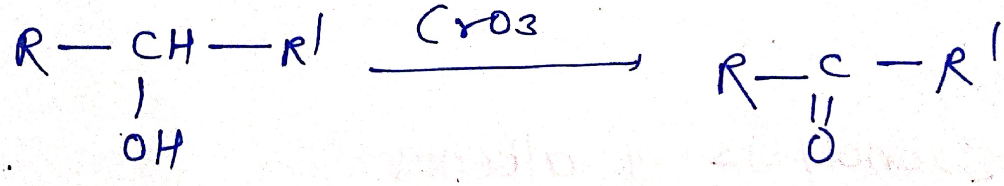
→ Aldehyde & ketones can be prepared by oxidation of 1° 2° 3° alcohol

1) $R\,CH_2OH \xrightarrow{CrO_3} RCHO$

e.g. $CH_3-CH_2OH \xrightarrow{CrO_3} CH_3-CHO$

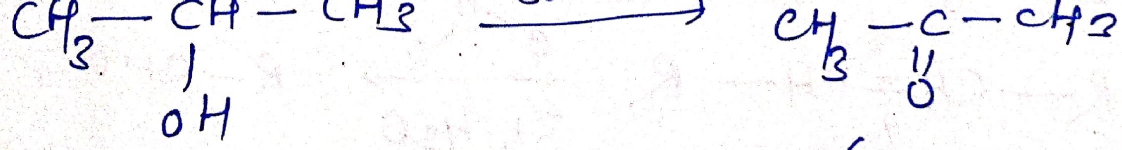
(ethanol) (1°- alcohol) (ethanal)

2)



$$R-\underset{\displaystyle OH}{\underset{|}{CH}}-R' \xrightarrow{CrO_3} R-\underset{\displaystyle O}{\underset{\|}{C}}-R'$$

e.g.



$$CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 \xrightarrow{CrO_3} CH_3-\underset{\displaystyle O}{\underset{\|}{C}}-CH_3$$

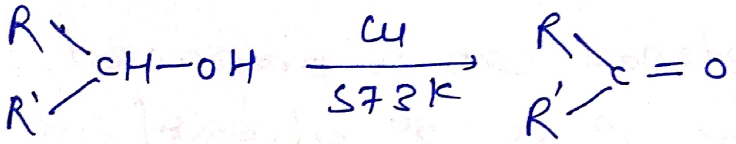
(2° alcohol) (Propanol)

(Propanone)

(II) Dehydrogenation of alcohol

- Alcohol vapours are passed over heavy metal catalyst (Ag/Cu).
- Primary and secondary alcohols give aldehyde & ketone.

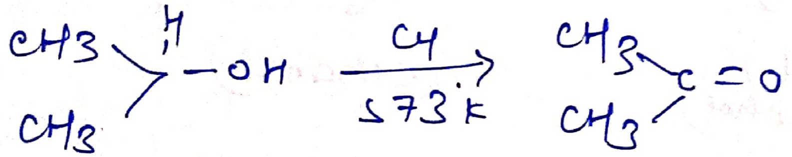
$$R-CH_2-OH \xrightarrow[573K]{Cu} RCHO$$



$$R(R')CH-OH \xrightarrow[573K]{Cu} R(R')C=O$$

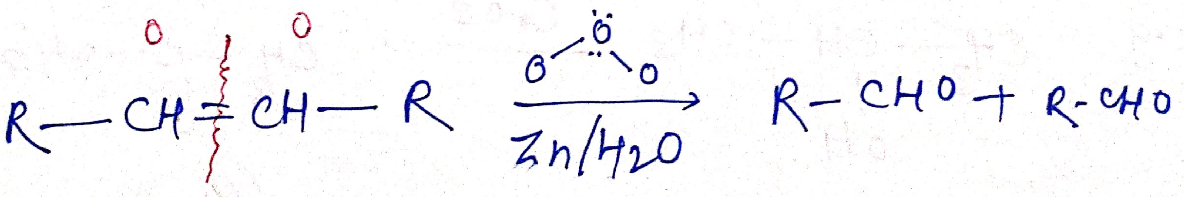
e.g.

(1°) $CH_3-CH_2-OH \xrightarrow[573]{Cu} CH_3CHO$ (Acetaldehyde)

(2°) 

$$(CH_3)_2CH-OH \xrightarrow[573K]{Cu} (CH_3)_2C=O$$ (ketone)

(III) By Ozonolysis of alkenes

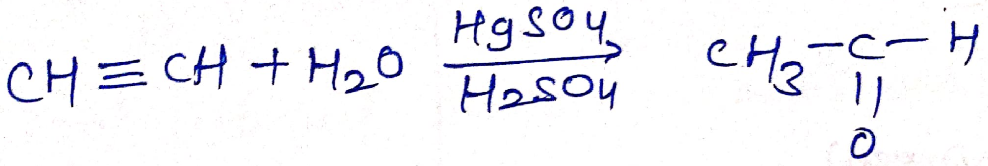


$$R-CH=CH-R \xrightarrow[Zn/H_2O]{O_3} R-CHO + R-CHO$$

e.g. $CH_3-CH=CH-CH_3 \xrightarrow[Zn/H_2O]{O_3} 2\,CH_3-CHO$

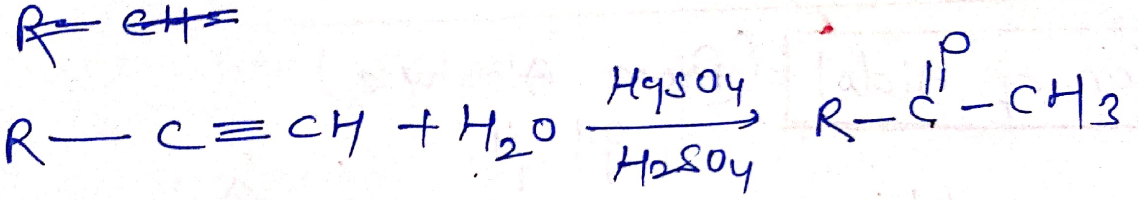
(IV) Hydration of alkynes

Acetylene on hydration give acetaldehyde and other alkyne give ketone.



$$CH\equiv CH + H_2O \xrightarrow[H_2SO_4]{HgSO_4} CH_3-\underset{\underset{O}{\parallel}}{C}-H$$

~~R— CH≡~~



$$R-C\equiv CH + H_2O \xrightarrow[H_2SO_4]{HgSO_4} R-\overset{\overset{O}{\parallel}}{C}-CH_3$$

Nucleophilic addition

→ It is a chemical reaction in c̲ a Nū forms a sigma (σ) bond c̄ an electron deficient species.

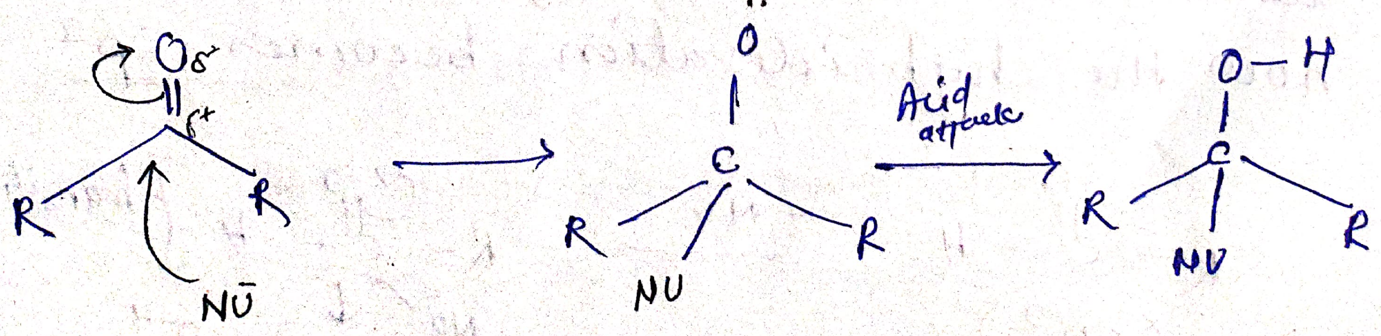
⇒ Carbonyl compounds are = $\overset{O}{\overset{||}{C}}-H$, $-\overset{O}{\overset{||}{C}}-$

⇒ **Steps**

1) Electrophillic carbonyl compound 'c' forms a sigma bond c̄ nucleophiles.

2) C=O, π bond broken down & forms a alkoxide intermediate (The bond pair electron is transfered to oxygen atom)

3) Protonation of alkoxide yields the alcohol derivatives.



(Carbonyl compound)

Alcohol

Example of Nucleophiles

1) $H\ddot{O}:^-$ → hydroxide ion
2) $H:^-$ → hydride ion
3) $R_3C:^-$ → Carbanion
4) $R-\ddot{O}:^-$ → alkoxide ion
5) $N\equiv C:^-$ → cyanide ion

} -vely charged

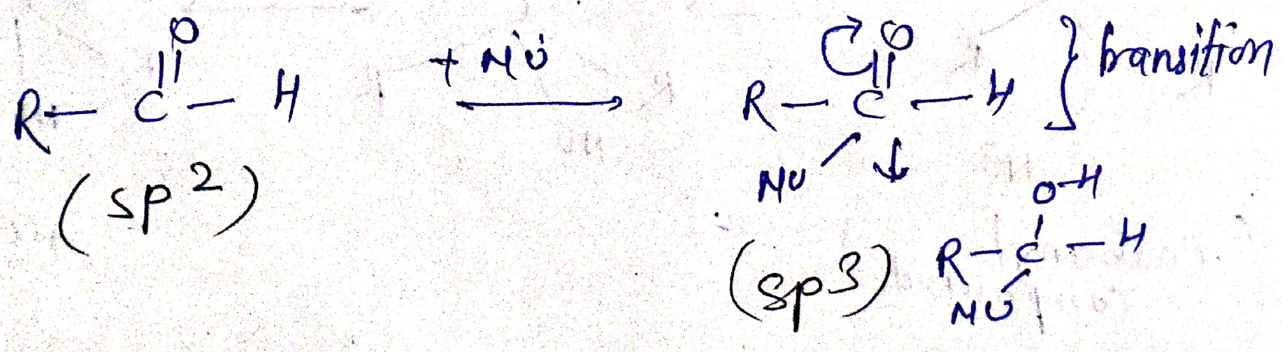
1) $H-\ddot{O}-H$ = H_2O
2) $R-\ddot{O}-H$ = alcohol
3) $H_3-N:$ = ammonia
4) $R\ddot{N}H_2$ = amine

} Neutral Nucleophiles

⇒ HYBRIDIZATION

→ Carbonyl group is a co-planar structure and it's carbon is sp² hybridized.

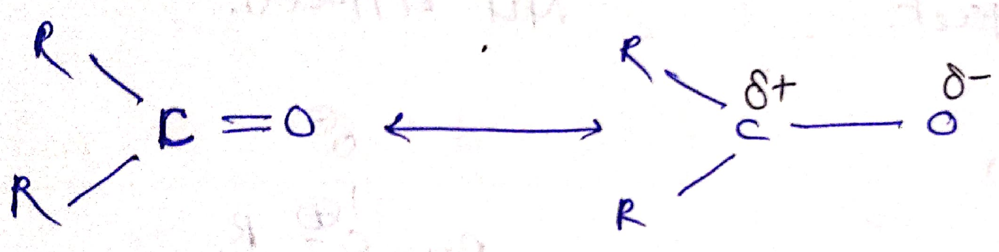
→ The nucleophillic attack on C=O group result into breakdown of π bond. so now the hybridization becomes sp³



Why Carbonyl compound undergoes Nucleophillic addition Reaction.

→ In Carbonyl Compound. carbon – oxygen bond is polar

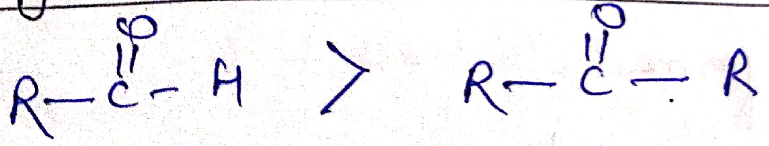
→ Electron density is higher around o atom so partially -ve charge on 'o' generalis along c̄ partially +ve on 'c' atom.



→ carbon behaves as electrophile .

→ Negative charge on oxygen is stabilized by protonation c̲ neutralised the -ve charge.

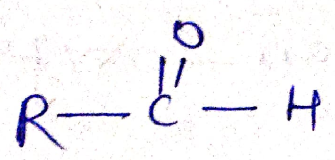
⇔ Aldehyde are more reactive than ketone


$$R-\overset{O}{\overset{\|}{C}}-H > R-\overset{O}{\overset{\|}{C}}-R$$

* ketone form 2° carbocation and are stabilized by adjescent 'R' group.

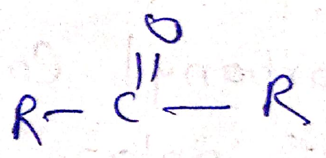
* while aldehyde forms i° carbocation which are less stable than 2° carbocation formed by keton. so it is more sueptible for

Nucleophillic attack.



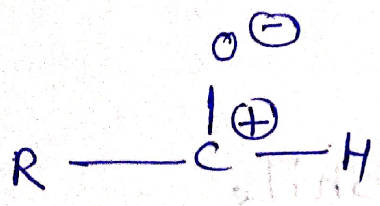
$R-\overset{O}{\overset{\|}{C}}-H$

- forms less stable carbocation.
- less steric hinderance.
- more susceptible for NU Attack



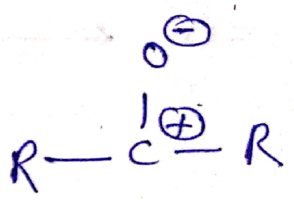
$R-\overset{O}{\overset{\|}{C}}-R$

- forms more stable carbocation
- more steric hinderance.
- Less susceptible for Nu attack.



$R-\overset{O^{\ominus}}{\overset{|}{C^{\oplus}}}-H$

(1° carbocation)
(less stable)



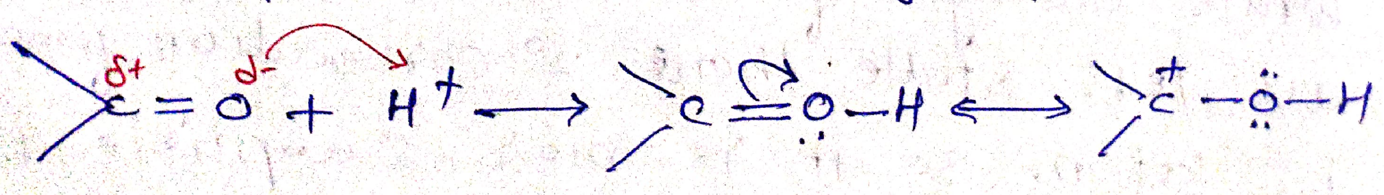
$R-\overset{O^{\ominus}}{\overset{|}{C^{\oplus}}}-R$

(2° carbocation)
(more stable)

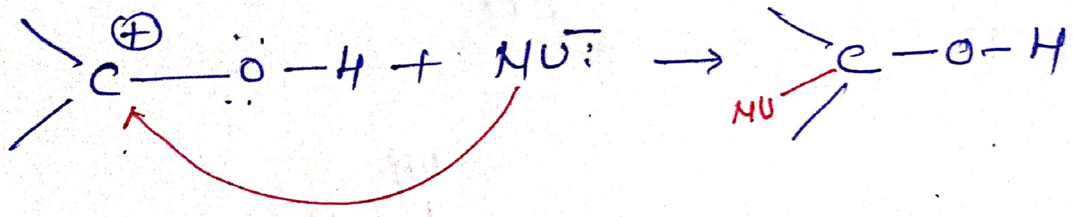
* If Nucleophil is weak then Acid catalysed reaction is performed.

Acid Catalysed addition

step 1 : Hydrogen ion from an acid attacks on negatively charged carbonyl oxygen to give protonated carbonyl group



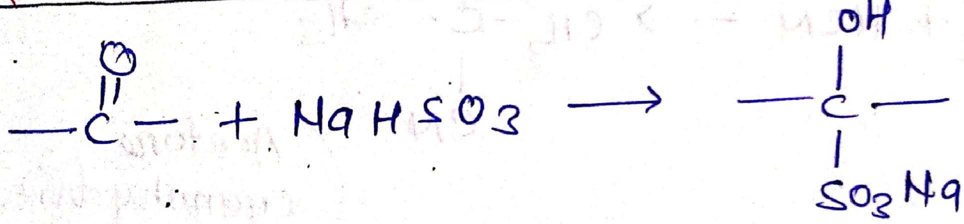
Step. II : Nucleophil attacks on protonated carbonyl group to form an addition product.



$$>\overset{\oplus}{C}-\ddot{O}-H + Nu^{-}: \rightarrow Nu-\overset{}{C}<-O-H$$

Addition Reactions of Carbonyl Compound

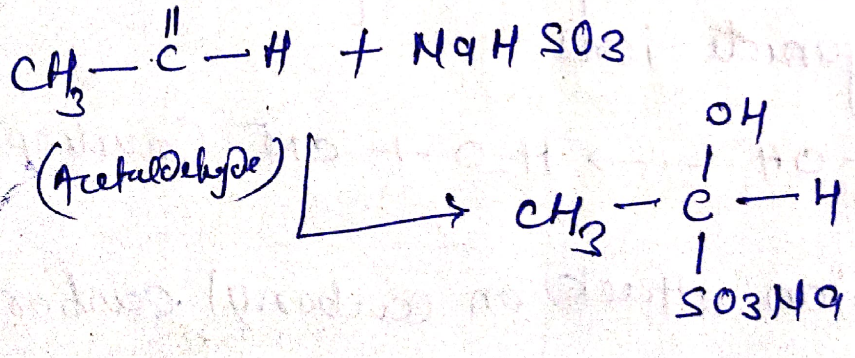
① Reaction c̄ Sod. bisulphite



$$-\overset{O}{\overset{\|}{C}}- + NaHSO_3 \longrightarrow -\underset{SO_3Na}{\overset{OH}{C}}-$$

(Bisulphite addition product)

e.g. 1

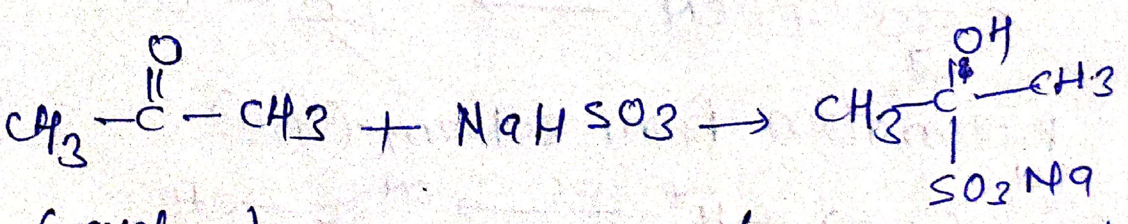


$$CH_3-\overset{O}{\overset{\|}{C}}-H + NaHSO_3 \longrightarrow CH_3-\underset{SO_3Na}{\overset{OH}{C}}-H$$

(Acetaldehyde)

Acetaldehyde bisulphite

e.g. 2.

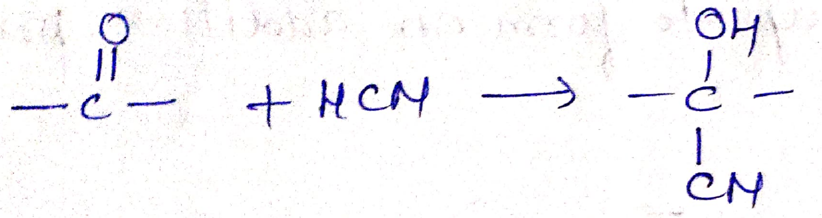


$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + NaHSO_3 \rightarrow CH_3-\underset{SO_3Na}{\overset{OH}{C}}-CH_3$$

(acetone)

(Acetone bisulphite)

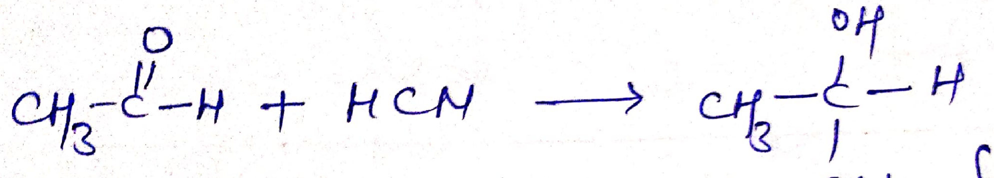
② Addition of Hydrogen Cyanide (HCN)



$$-\overset{\overset{O}{\|}}{C}- + HCN \longrightarrow -\underset{\underset{CN}{|}}{\overset{\overset{OH}{|}}{C}}-$$

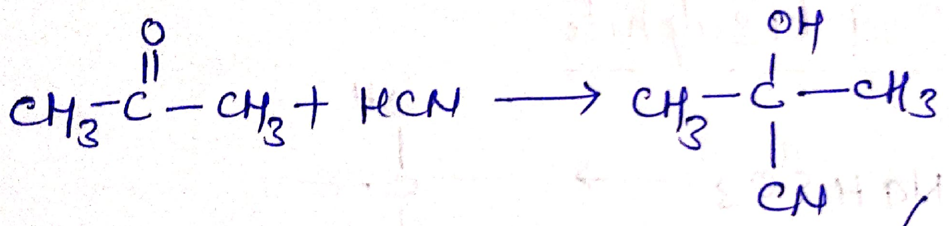
(cynohydrine)

eg.



$$CH_3-\overset{\overset{O}{\|}}{C}-H + HCN \longrightarrow CH_3-\underset{\underset{CN}{|}}{\overset{\overset{OH}{|}}{C}}-H$$

{Acetaldehyde cynohydrine}



$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + HCN \longrightarrow CH_3-\underset{\underset{CN}{|}}{\overset{\overset{OH}{|}}{C}}-CH_3$$

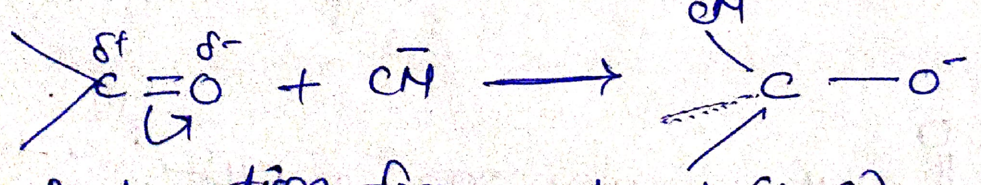
(Acetone cyanohydrine)

Mechanism

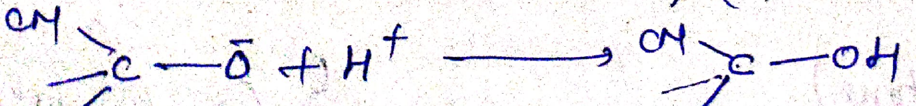
Step 1: Base remove a proton from HCN to produce cyanide ions.

$$HCN + OH^- \longrightarrow H_2O + CN^-$$ (nucleophile)

Step 2: cyanide ion attack on carbonyl carbon.



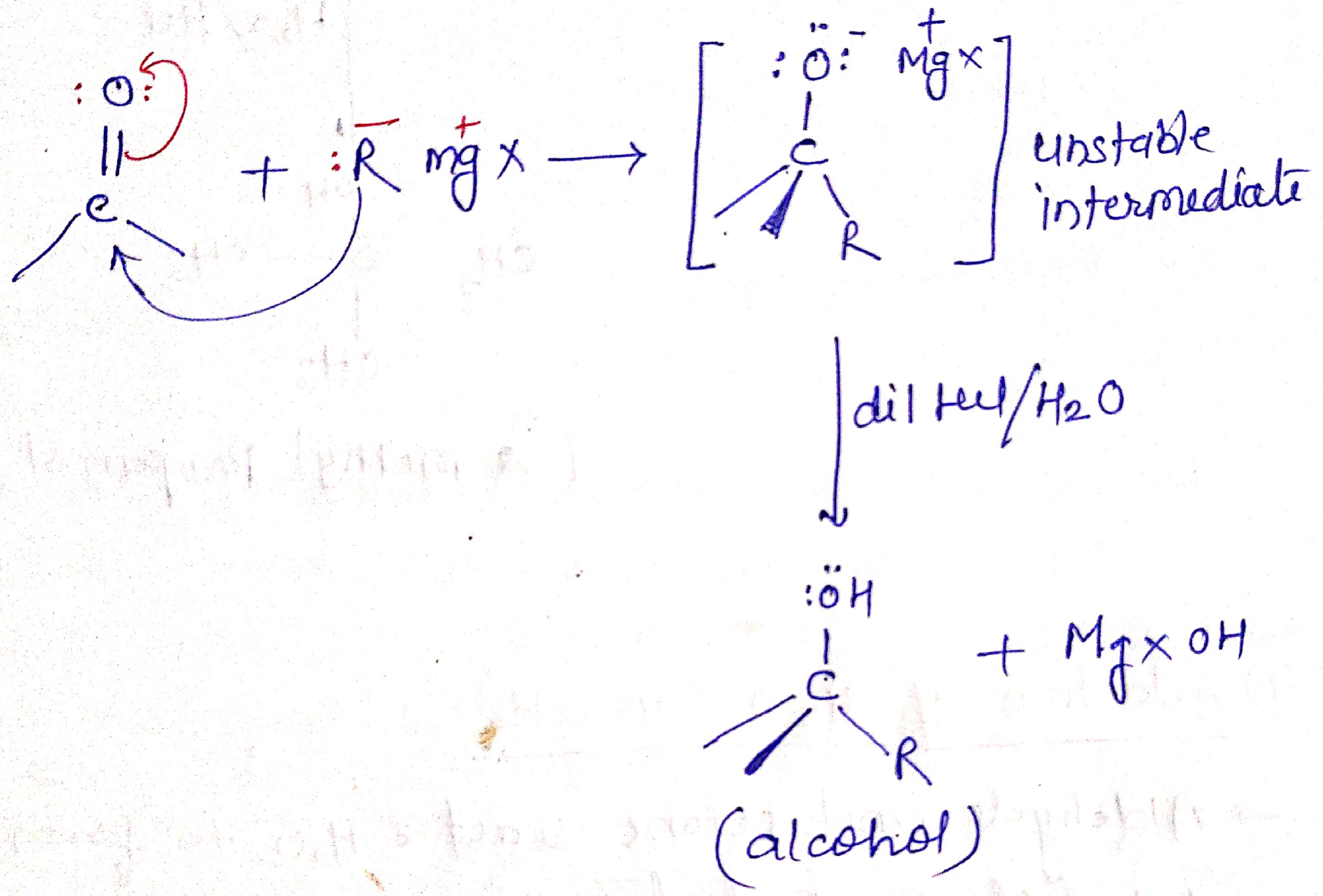
Step 3: Protonation from solvent (H_2O).



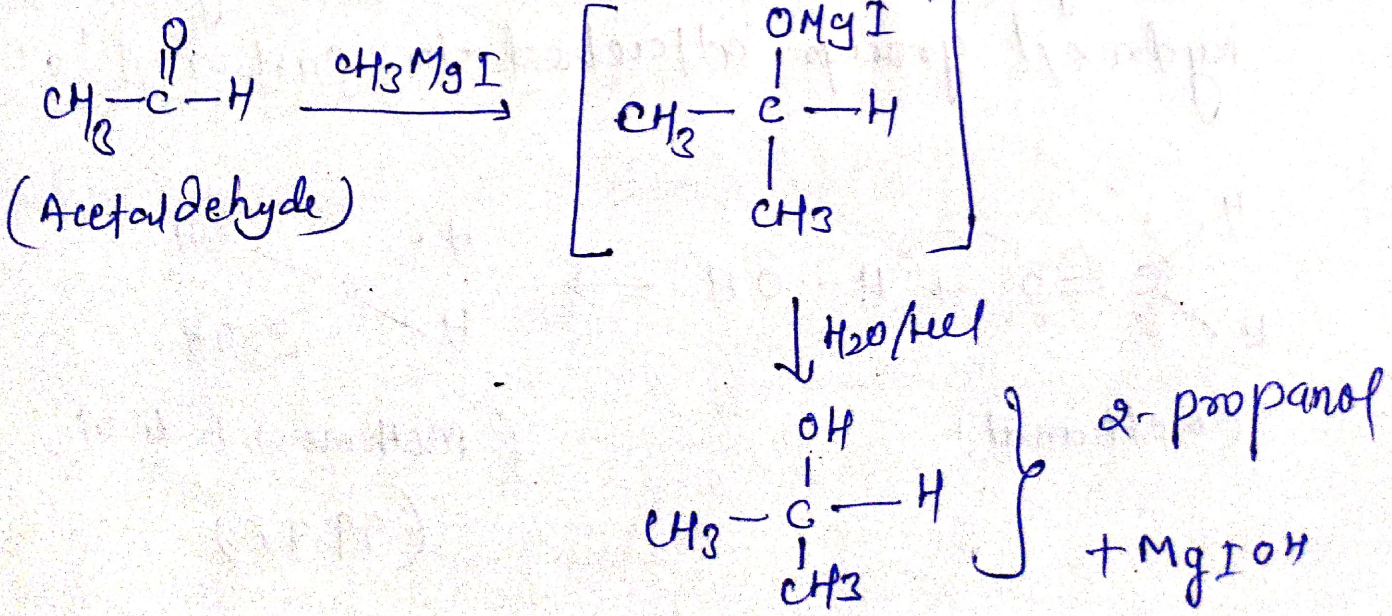
(cyanohydrin)

(3) Addition of Grignard Reagent (R-MgX)

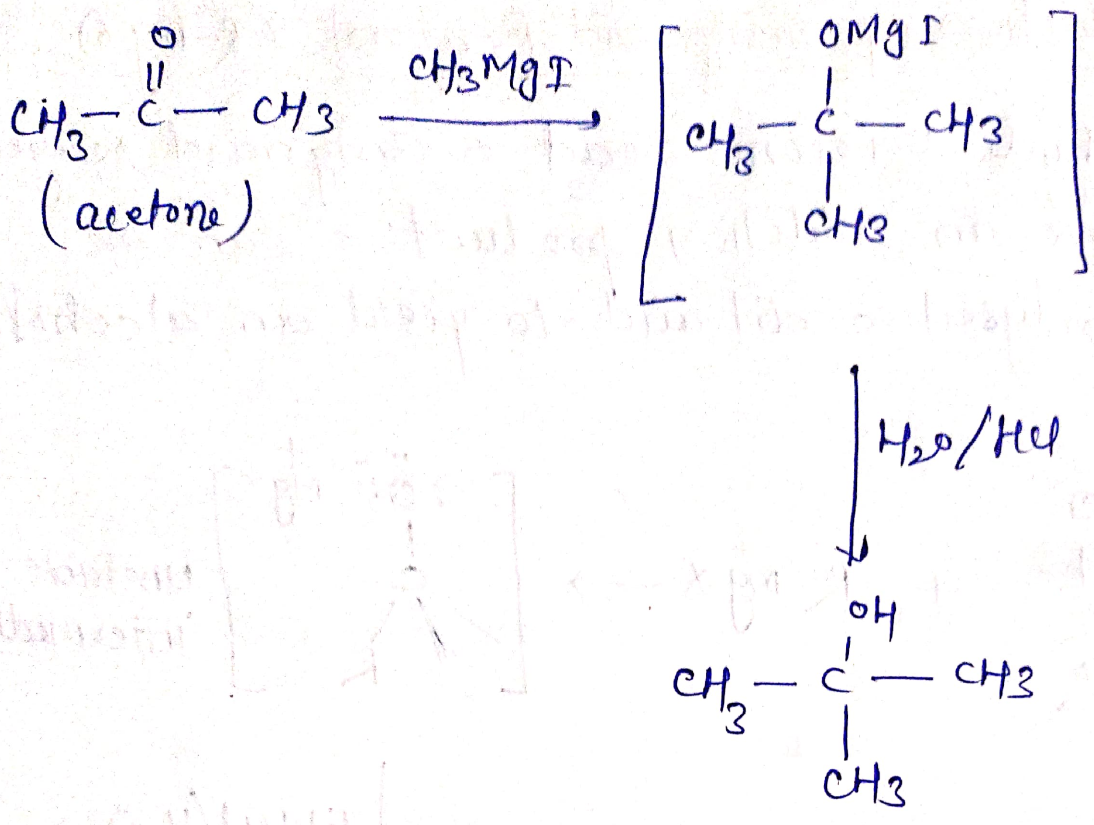
Aldehyde & ketone react c̄ Grignard reagent to give an addition product s̲ can be hydrolysed c̄ dil acid to yield an alcohol.



Ex.



(2)



$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{CH_3MgI} \left[CH_3-\overset{\overset{OMgI}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3\right] \xrightarrow{H_2O/HCl} CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

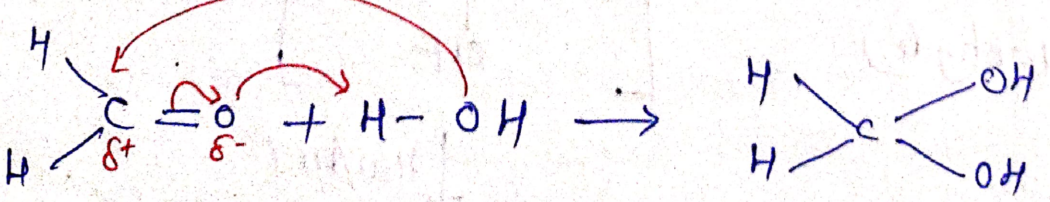
(acetone)

(2-methyl Propanol)

(4) Addition of H_2O (H–OH)

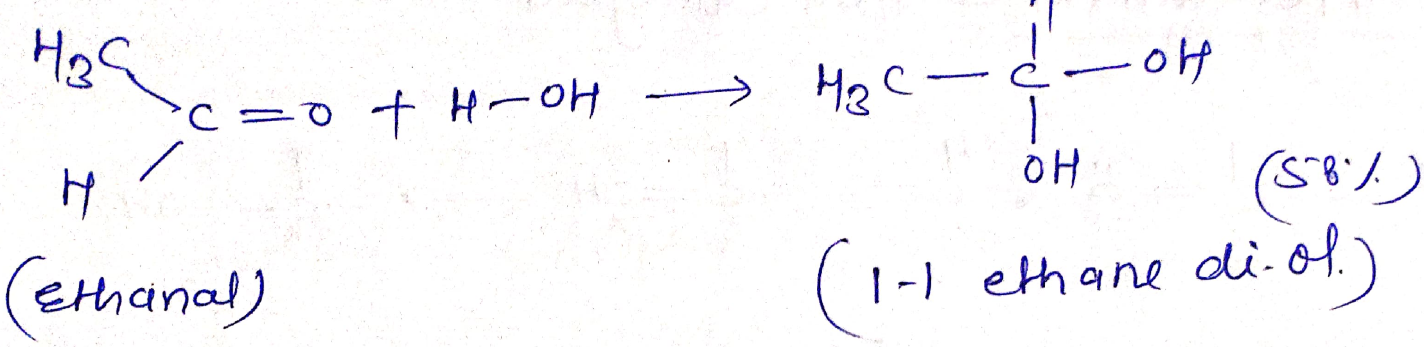
→ Aldehyde and ketone react c̄ H_2O to form 1-1 diol or hydrates.

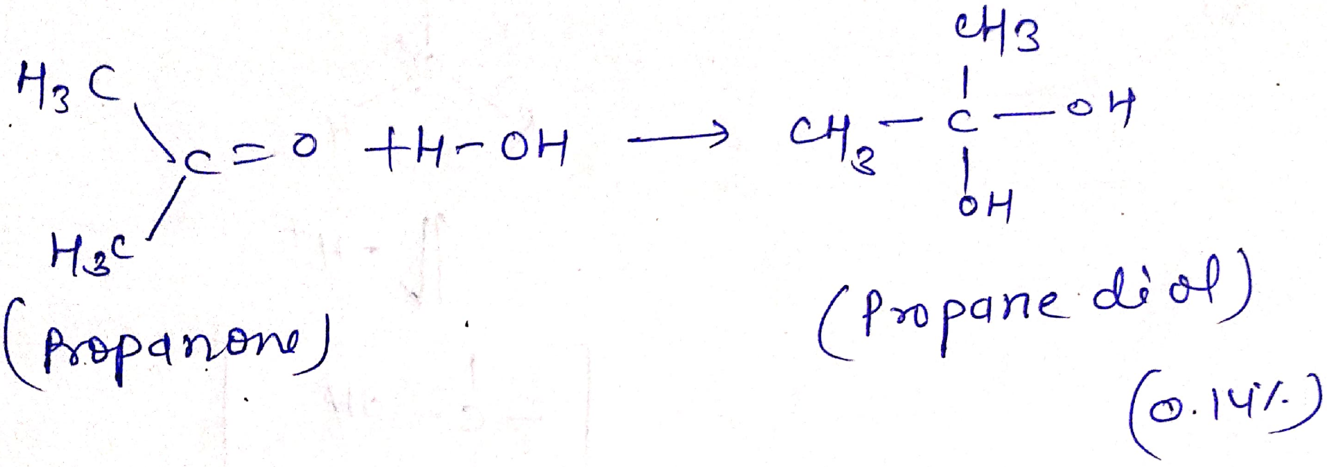
→ Hydrogen is attached to -vely charged O_2 & hydroxyl group attached to carbonyl 'c' atom.



(Methanal)

(Methane-1,1-di-ol)
(99.9%)





Note: Diol of Methanal is less crowded hence produce 99.96% while propanone forms much more crowded product, hence produce in less quantity.

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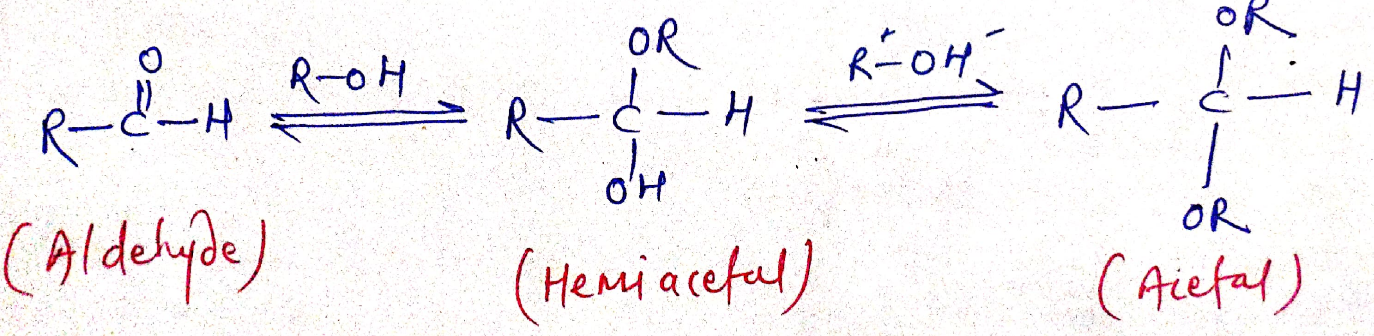
(5) Addition of alcohol

→ forms Hemiacetal or Acetal.

⇒ like H_2O, alcohol can also undergo addition reaction.

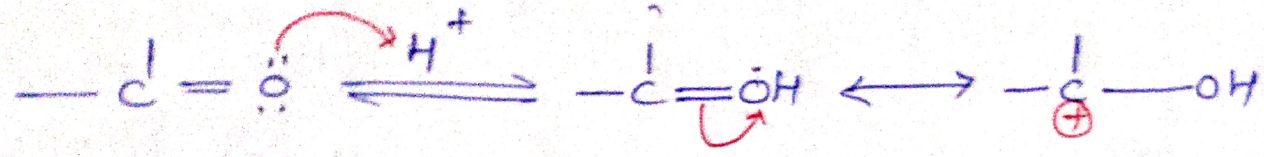
⇒ It is reversible reaction.

⇒ Product formed is Hemiacetal/Acetal.

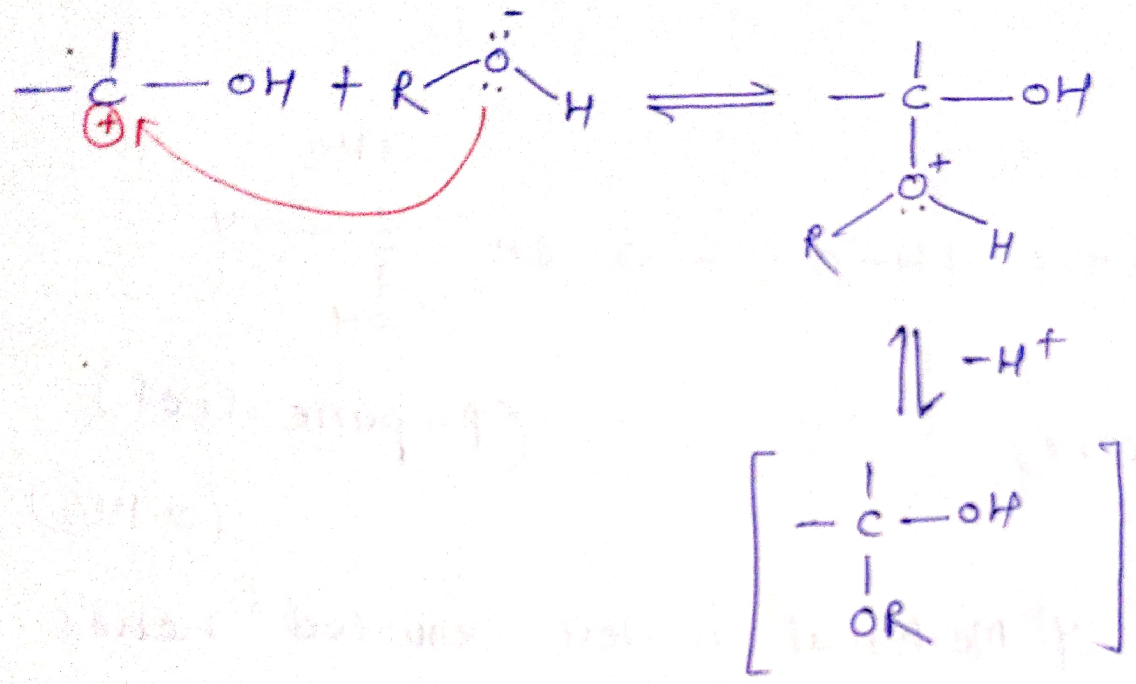


Mechanism → Acid catalysed (H^+)

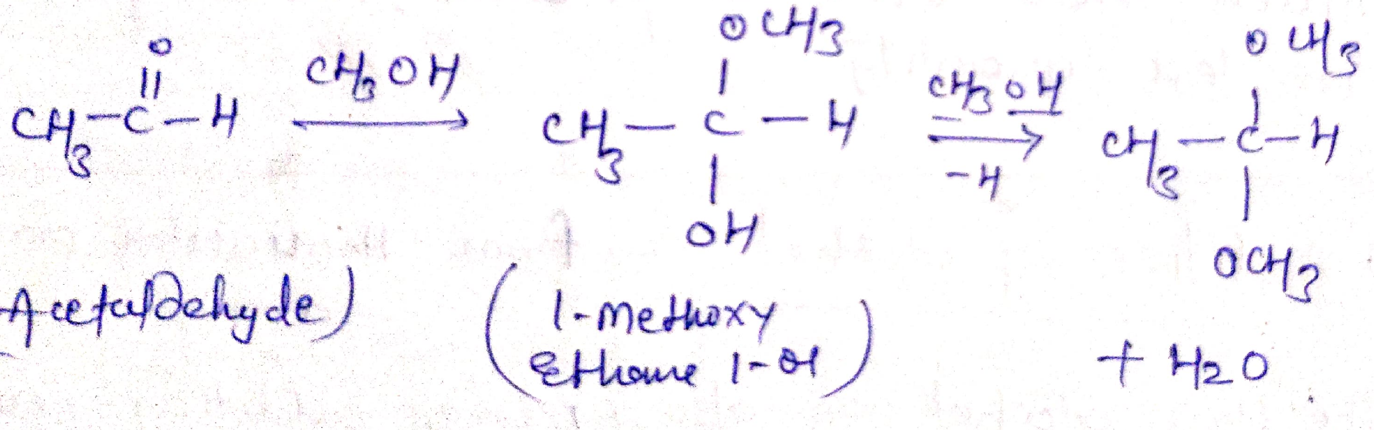
(I)



(II)



Ex.

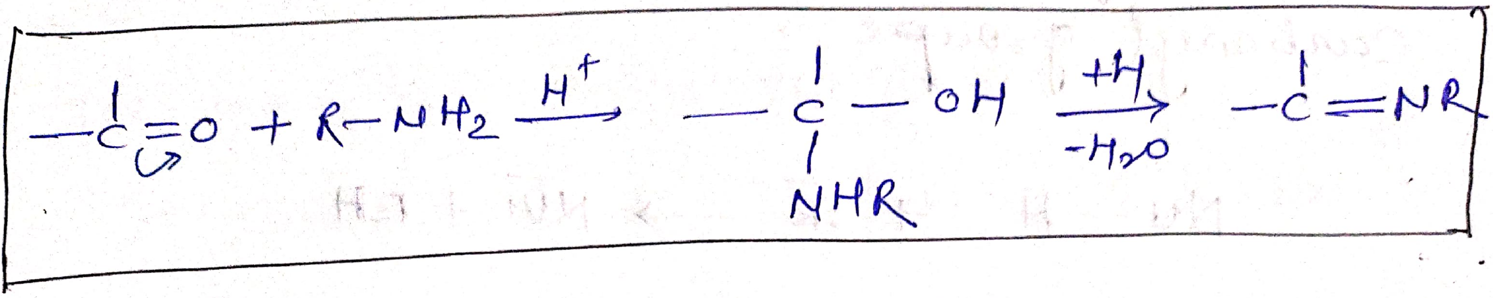


Reaction c̄ Amine

⇒ Reaction c̄ primary amine.

⇒ This reaction is catalysed by Acid.

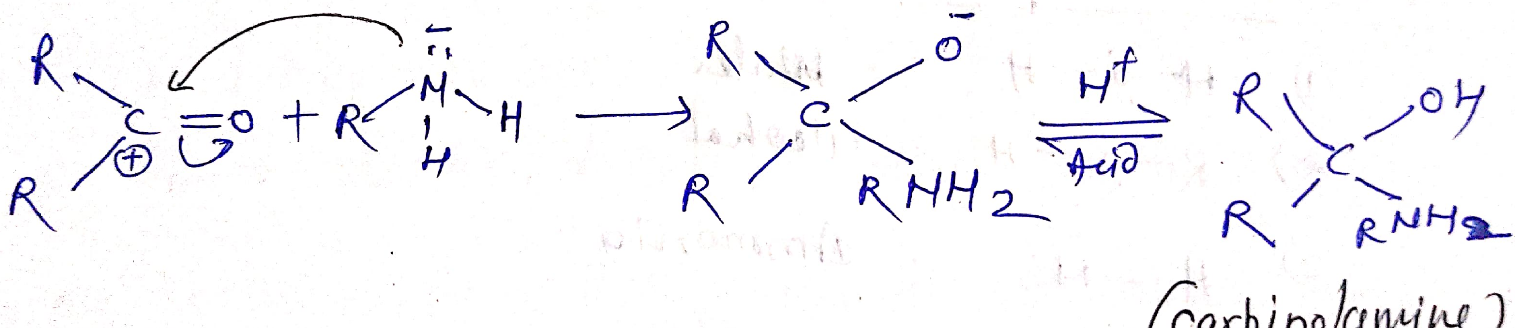
⇒ product is N-alkyl/N-aryl imine.



$$-\overset{|}{C}=O + R-NH_2 \xrightarrow{H^+} -\overset{|}{\underset{NHR}{C}}-OH \xrightarrow[-H_2O]{+H} -\overset{|}{C}=NR$$

Mechanism

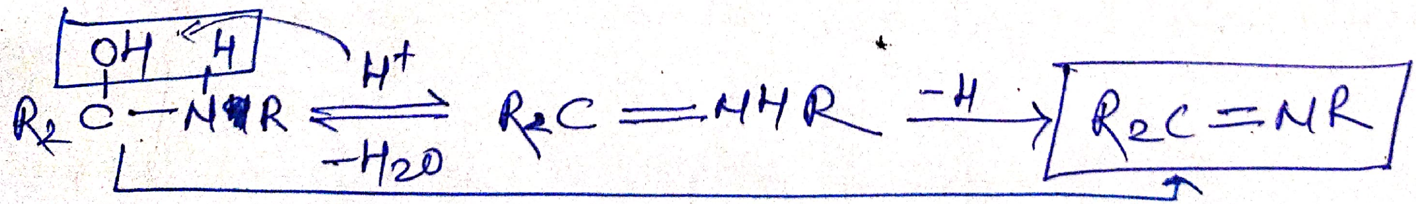
step: 1. formation of carbinolamine.



(Carbinolamine)

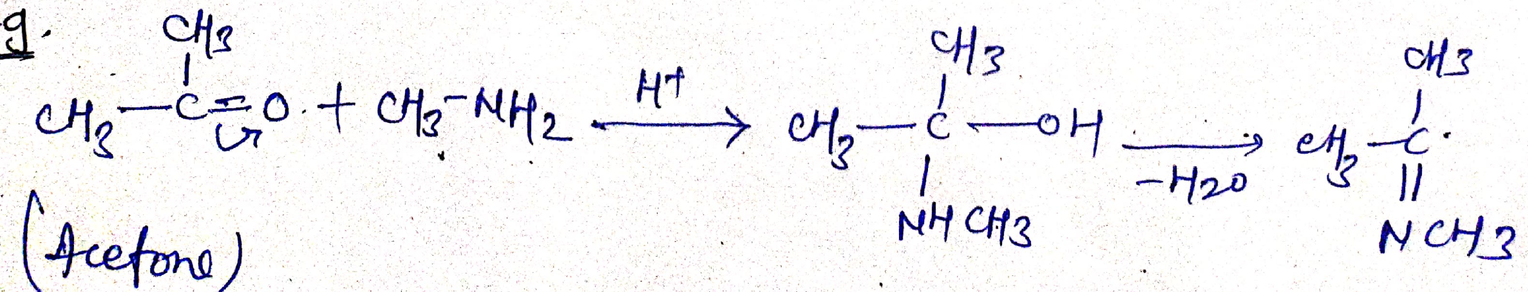
Step II

Carbinolamine eliminate H_2O & give imine.



$$R_2\overset{OH}{\overset{|}{C}}-\overset{H}{\overset{|}{N}}R \underset{-H_2O}{\overset{H^+}{\rightleftharpoons}} R_2C=\overset{+}{N}HR \xrightarrow{-H} \boxed{R_2C=NR}$$

eg.



$$CH_3-\overset{CH_3}{\overset{|}{C}}=O + CH_3-NH_2 \xrightarrow{H^+} CH_3-\overset{CH_3}{\overset{|}{\underset{NHCH_3}{\underset{|}{C}}}}-OH \xrightarrow[-H_2O]{} CH_3-\overset{CH_3}{\overset{|}{\underset{NCH_3}{\underset{\|}{C}}}}$$

(Acetone)

1 meth
2-2 dimethyl)

Electromeric Effect

Definition :

→ It can be defined as a temporary effect produced, when a reagent attacks the multiple bonded compound.

→ It causes a complete shift of π electron to either of two atom of bond.

→ Due to which shared pair of electron causes polarity.

→ This phenomenon is observed in compound c have double/triple bond in structure.

→ As it is a temporary effect & as reagent is removed, it return to original state & become unpolarised.

→ The reagent can be Electrophil/Nucleophiles.

→ This effect is k/as E-effect.

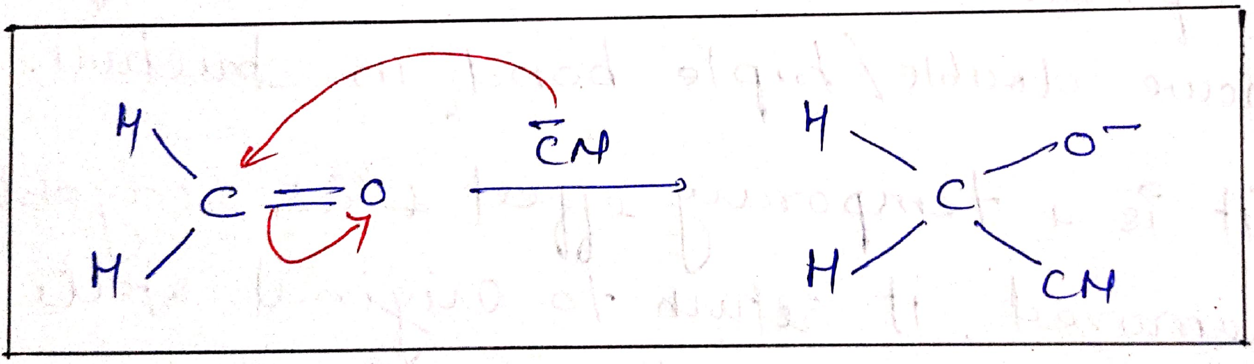
Example

⇒ when aldehyde containing carbonyl carbon in c carbon and Oxygen is attached by double bond.

⇒ when a -vely charged reagent attacks, the π e⁻ shift to the 'O_2'.

→ π e⁻ shift to oxygen as it is more electro-negative.

→ Movement of electron from one atom to another is called electromeric effect.



TYPES OF ELECTROMERIC EFFECT

→ It is based on the direction in c electron transfer occurs.

① +E effect

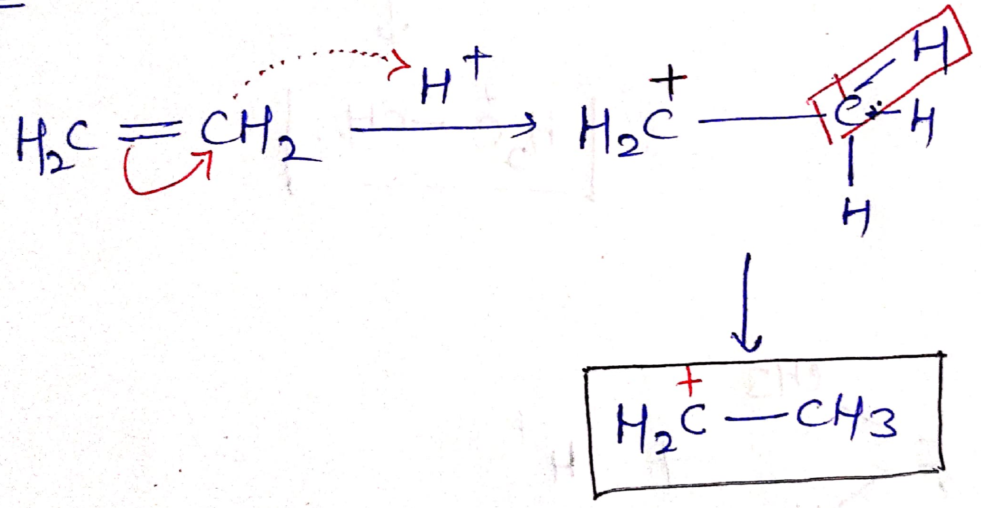
② -E effect

(1) +E - effect

condition : Attacking species have +ve charge.

- * shared pair of electron ~~form~~ directed towards positively charged reagent.
- * Reagent will form a bond c̄ pair of electron
- * Generally this reaction can be observed in reaction of addition of acid to alkenes.

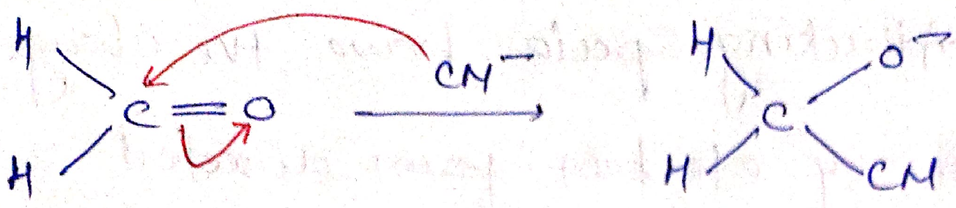
ex,



(2) -E. effect

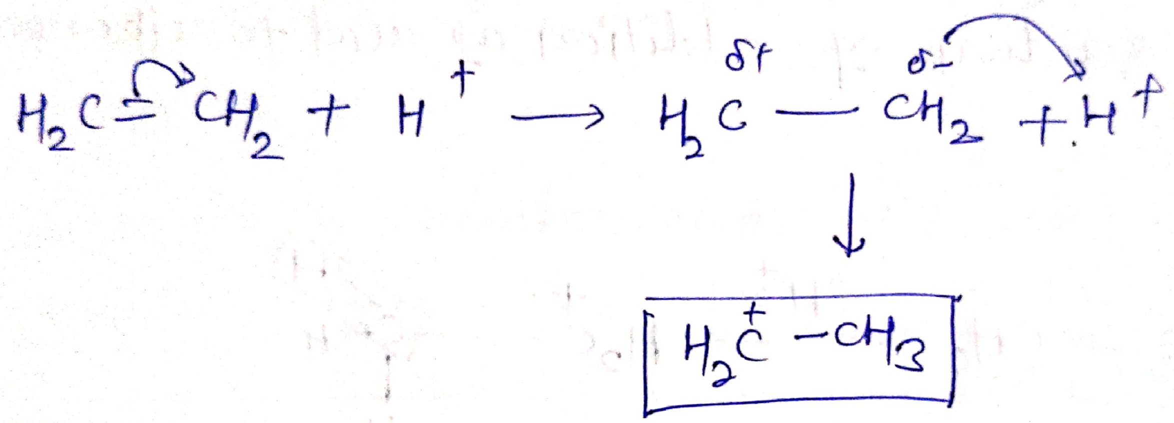
- * It is observed when attacking reagent have -ve charge.
- * bond electron shifted away from attacking nucleophile.
- * Generally observed in Aldehyde & ketone.

ex.

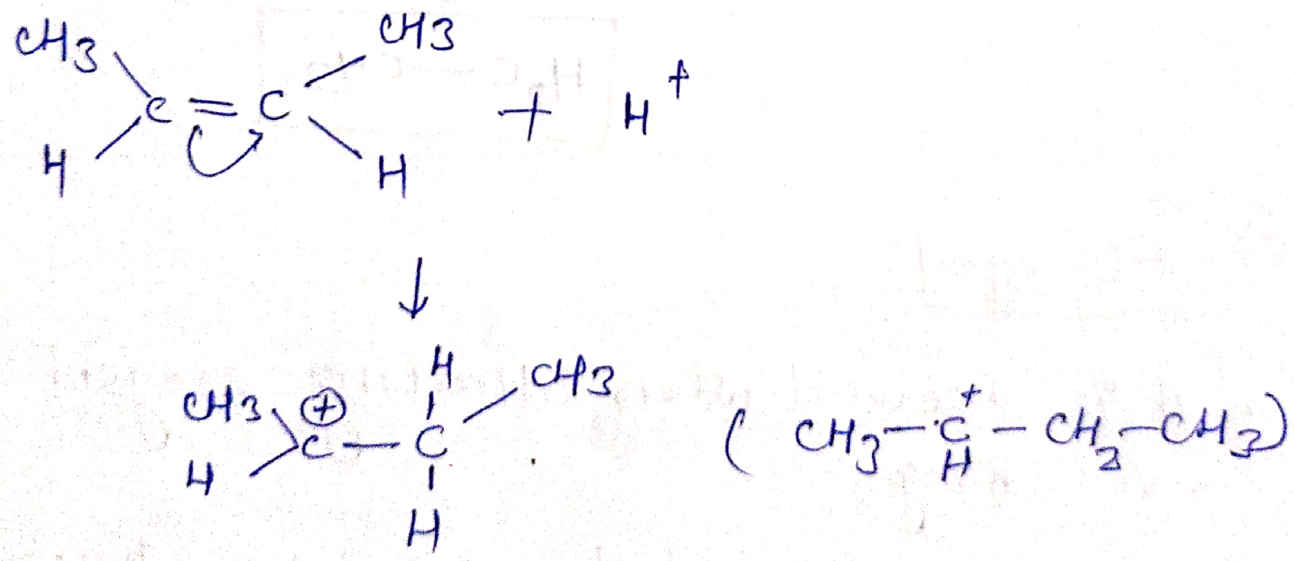


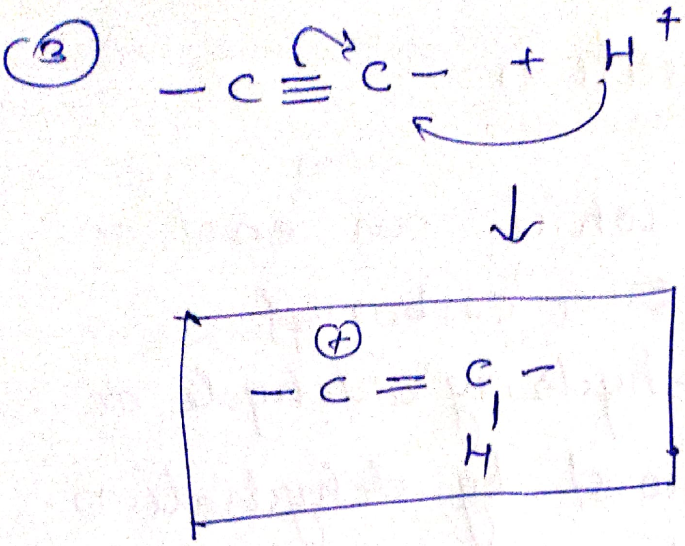
Examples of +E & -E effects

①



②



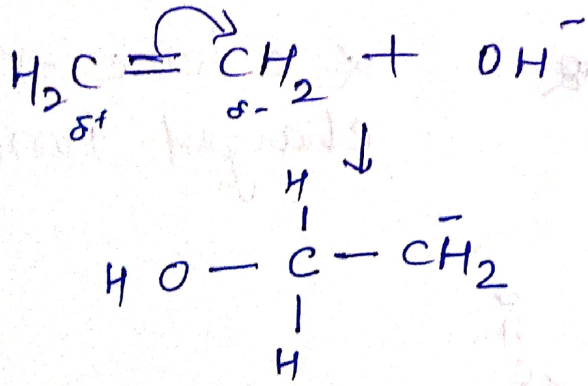
③ 

$-C\equiv C- + H^+ \rightarrow \boxed{-\overset{\oplus}{C}=\underset{H}{C}-}$

(Alkyne)

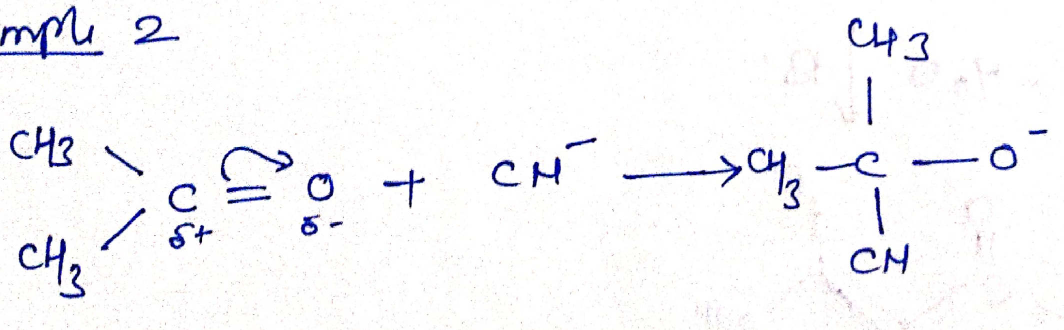
−E effect

example 1



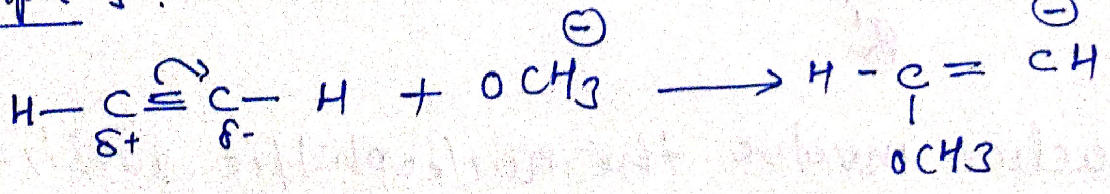
$H_2\underset{\delta+}{C}=\underset{\delta-}{CH_2} + OH^- \rightarrow HO-\underset{H}{\overset{H}{C}}-\overset{-}{CH_2}$

Example 2



$\underset{CH_3}{\overset{CH_3}{}}\!\!>\underset{\delta+}{C}=\underset{\delta-}{O} + CH^- \longrightarrow CH_3-\underset{CH}{\overset{CH_3}{C}}-O^-$

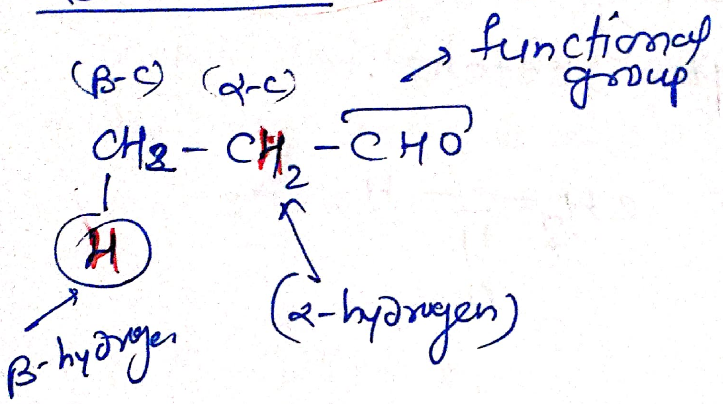
Example 3.



$H-\underset{\delta+}{C}\equiv\underset{\delta-}{C}-H + \overset{\ominus}{O}CH_3 \longrightarrow H-\underset{OCH_3}{C}=\overset{\ominus}{C}H$

Aldol CONDENSATION

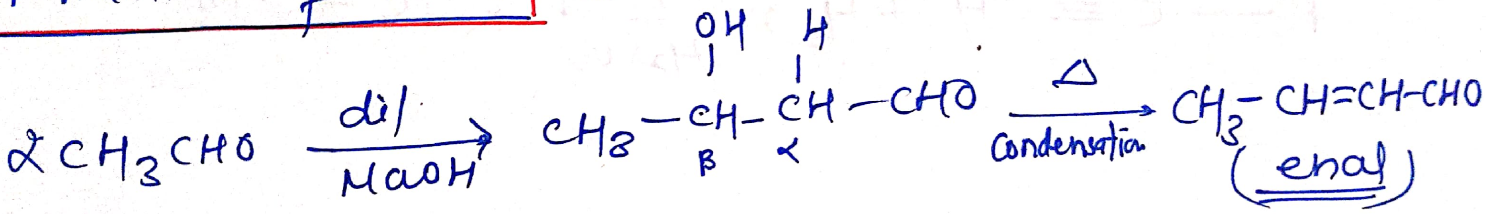
Remember



dil NaoH
Provides H^+OH^-

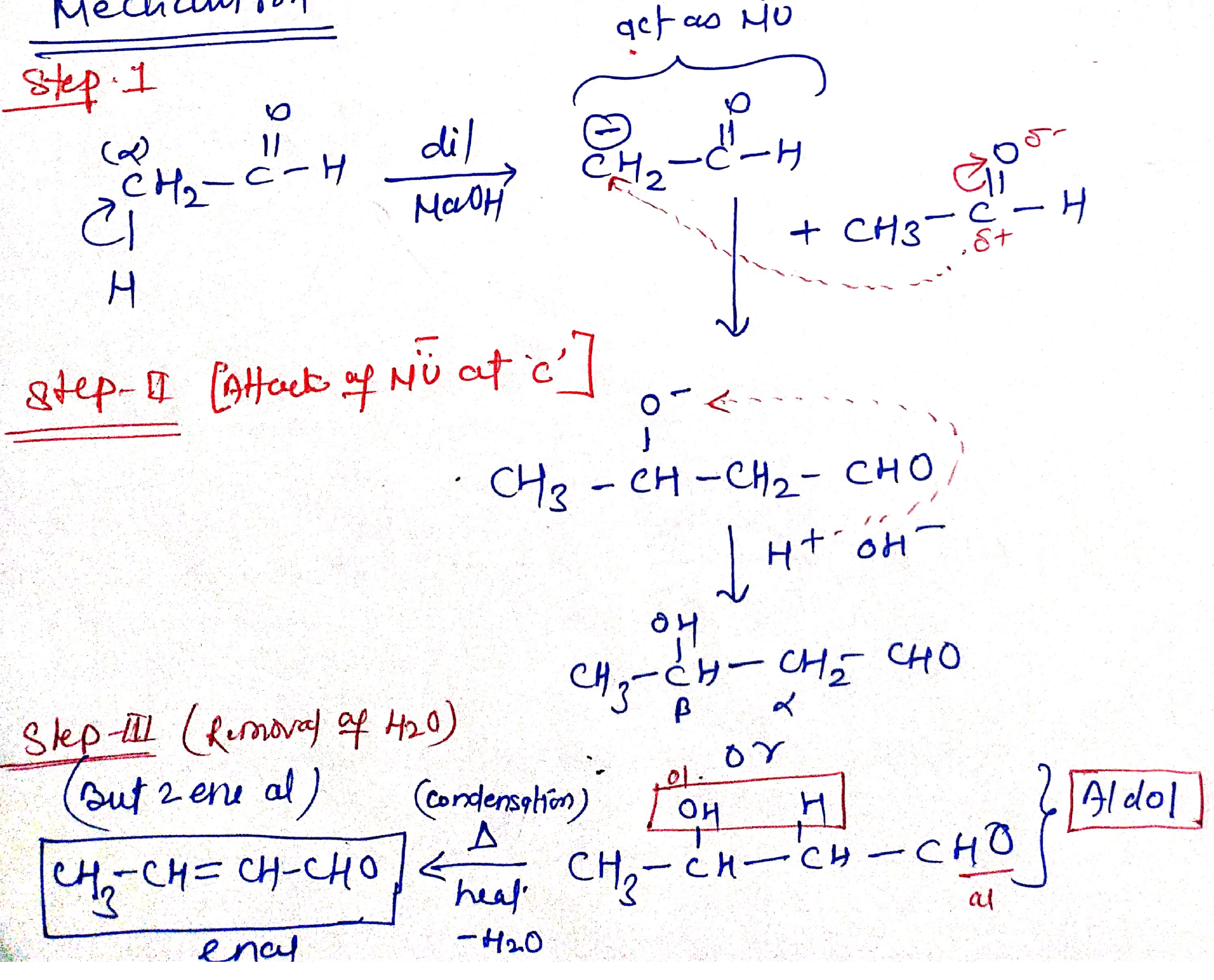
---

formation of Aldol (from Aldehyde)



$$2CH_3CHO \xrightarrow[NaOH]{dil} CH_3-\underset{\beta}{\overset{OH}{\overset{|}{C}H}}-\underset{\alpha}{\overset{H}{\overset{|}{C}H}}-CHO \xrightarrow[\text{condensation}]{\Delta} \underset{\text{(enal)}}{CH_3-CH=CH-CHO}$$

Mechanism



Step. 1

$$\underset{H}{\overset{(\alpha)}{C}H_2}-\overset{O}{\overset{||}{C}}-H \xrightarrow[NaOH]{dil} \underbrace{\overset{\ominus}{C}H_2-\overset{O}{\overset{||}{C}}-H}_{\text{act as } \ddot{Nu}} + CH_3-\overset{O^{\delta-}}{\overset{||}{\underset{\delta+}{C}}}-H$$

Step-II [Attack of $\ddot{Nu}$ at 'c']

$$CH_3-\overset{O^-}{\overset{|}{C}H}-CH_2-CHO$$

$$\downarrow H^+\ OH^-$$

$$CH_3-\underset{\beta}{\overset{OH}{\overset{|}{C}H}}-\underset{\alpha}{CH_2}-CHO$$

or

Step-III (Removal of H_2O)

(But 2 ene al)

$$\boxed{CH_3-CH=CH-CHO} \xleftarrow[\substack{heat \\ -H_2O}]{\substack{\text{(condensation)} \\ \Delta}} CH_3-\overset{OH}{\overset{|}{C}H}-\overset{H}{\overset{|}{C}H}-\underset{al}{CHO} \Big\} \boxed{Aldol}$$

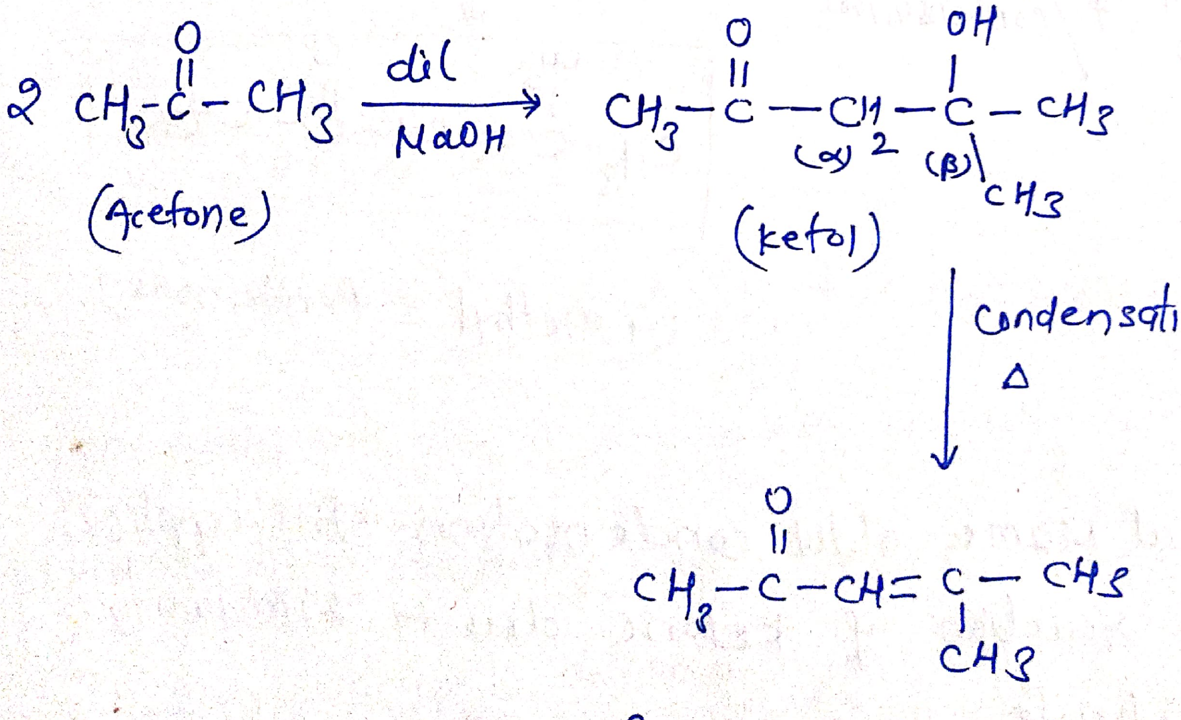
enal

⇒ Aldehyde and ketone c̲ have atleast one α-hydrogen undergoes an organic reaction in presenke of dil NaOH to form β-hydroxy aldehyde (Aldol) or Ketol. Reactⁿ is Aldol rexn.

→ final product have alcohol and aldehyde group so called Aldol.

⇒ finally after formation of aldol, on heating, H_2O molecule removed and the product formed is Enal. & Reaction is k/as Aldol condensation.

FORMATION OF KETOL

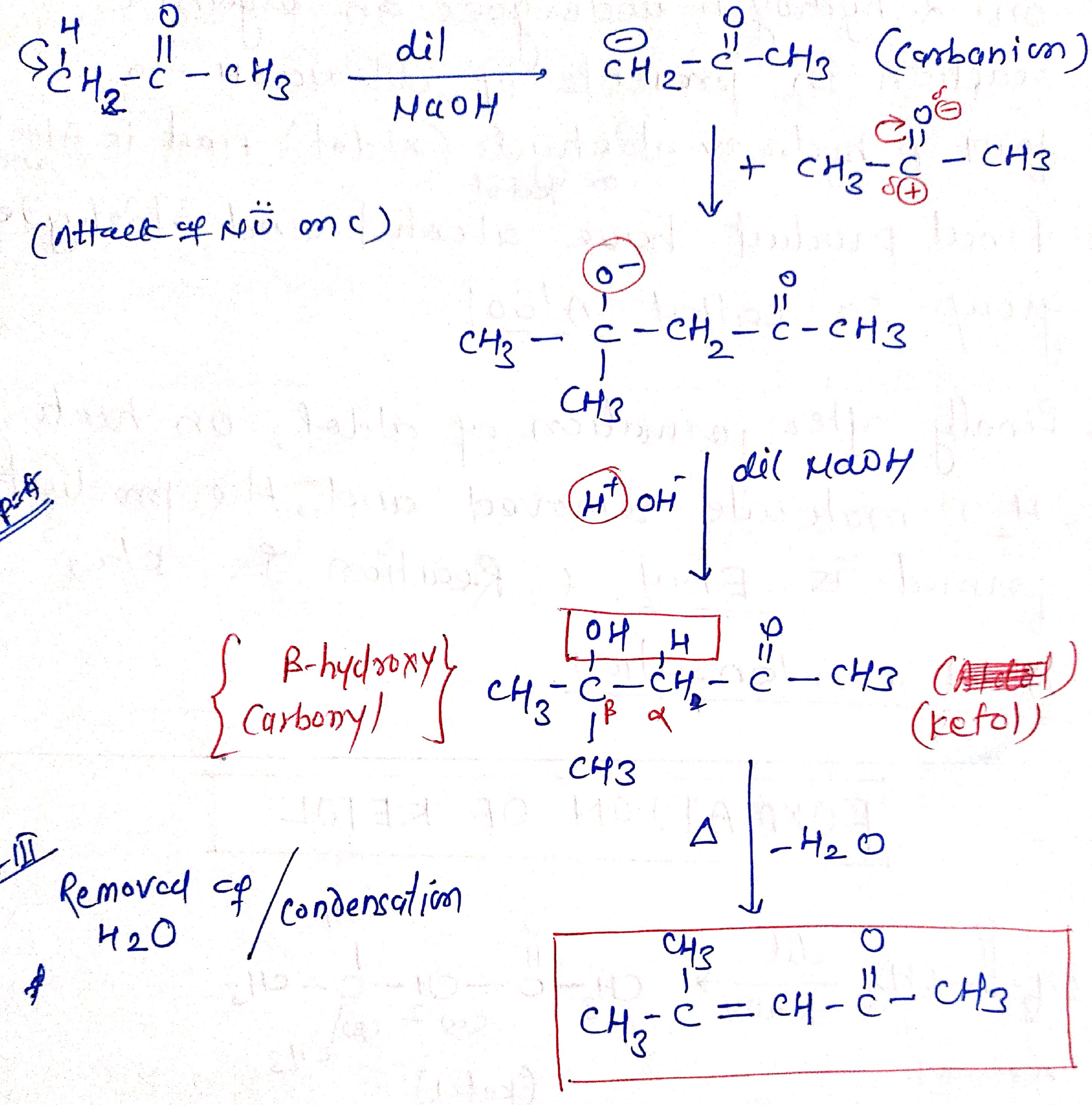


$$2\,CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[NaOH]{dil} CH_3-\overset{O}{\overset{\|}{C}}-\underset{(\alpha)}{CH_2}-\underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{\underset{(\beta)}{C}}}-CH_3$$

$$\xrightarrow[\Delta]{condensation} CH_3-\overset{O}{\overset{\|}{C}}-CH=\underset{\underset{CH_3}{|}}{C}-CH_3$$

(α-β unsaturated Carbonyl)

Mechanism (from ketone)



step-I $H-CH_2-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[NaOH]{dil} \overset{\ominus}{C}H_2-\overset{O}{\overset{\|}{C}}-CH_3$ (carbanion)

$+\ CH_3-\underset{\delta+}{\overset{O^{\delta-}}{\overset{\|}{C}}}-CH_3$

step-II (Attack of $\ddot{Nu}$ on C)

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

step-II

$H^+\ OH^-$ dil NaOH

{β-hydroxy carbonyl} $CH_3-\underset{CH_3}{\overset{OH}{C^{\beta}}}-\overset{H}{C}H_2^{\alpha}-\overset{O}{\overset{\|}{C}}-CH_3$ (~~Aldol~~) (ketol)

step-III Removal of H_2O / condensation

Δ $-H_2O$

$$\boxed{CH_3-\overset{CH_3}{C}=CH-\overset{O}{\overset{\|}{C}}-CH_3}$$

(4 methyl 3 Pentanone)

Note: General name aldol condensation still applies to the reaction of ketone due to similarity c aldehyde.

CROSS ALDOL CONDENSATION

→ when Aldol condensation is carried out between two different aldehyde & ketone. is called cross aldol condensation.

condition

1) If only one species have α-hydrogen than two product will be formed.

2) If both species have α- hydrogen then four product will be formed.

Example

(1) Reaction b/w different aldehyde

$$\overset{\alpha}{C}H_3CHO + HCHO \xrightarrow[NaOH]{dil}$$

(i) Self aldol Product

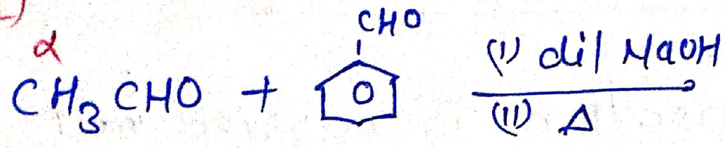
$$\overset{\alpha}{C}H_3CHO + \overset{\alpha}{C}H_3CHO \xrightarrow[\substack{NaOH \\ -H_2O}]{dil} CH_3-CH=CH-CHO$$

[one species will give 'O' & another one will give 2 Hydrogen]

(ii) CROSS Aldol Product

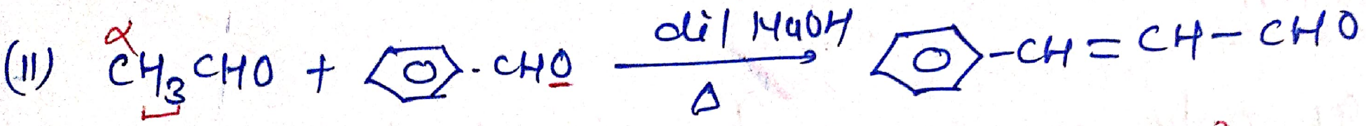
$$\overset{\alpha}{C}H_3CHO + HCHO \xrightarrow[-H_2O]{dil\ NaOH} CH_2=CH-CHO$$

(II)



(Self Product)

(i) $CH_3CHO + CH_3CHO \xrightarrow[(ii)\ \Delta]{(i)\ dil\ NaOH} CH_3-CH=CH-CHO$



(CROSS Aldol)

If Both species contain α-hydrogen, it give mixture of product.

$CH_3CHO + CH_3CH_2CHO \xrightarrow[\Delta]{dil\ NaOH}$

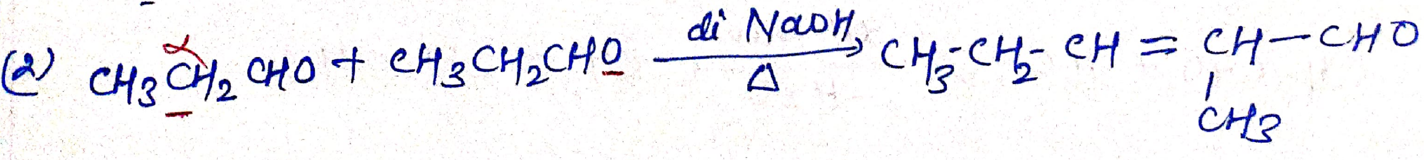
- Self Product
  - (i) from ethanal
  - (ii) from Propanal

+

- CROSS Product
  - (i) from 1 molecule of ethanal & 1 molecule of Propanal

Self Product

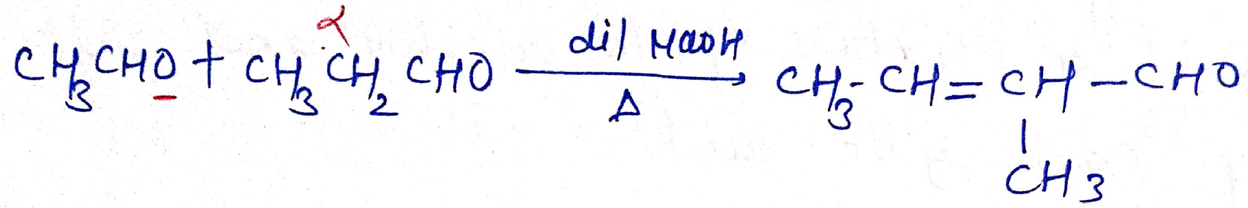
(1) $CH_3CHO + CH_3CHO \xrightarrow[\Delta]{dil\ NaOH} CH_3CH=CH-CHO$



(2) $CH_3\overset{\alpha}{C}H_2CHO + CH_3CH_2CHO \xrightarrow[\Delta]{dil\ NaOH} CH_3-CH_2-CH=\underset{CH_3}{\underset{|}{C}}-CHO$

(II) CROSS Aldol Product

(i) $\overset{\alpha}{C\underline{H}_3}CHO + CH_3CH_2CH\underline{O} \xrightarrow[\Delta]{\text{dil NaOH}} CH_3CH_2CH=CH-CHO$

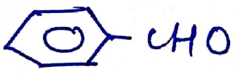
(ii) 

$CH_3CH\underline{O} + CH_3\overset{\alpha}{C}H_2CHO \xrightarrow[\Delta]{\text{dil NaOH}} CH_3-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}H-CHO$

CANNIZARO REACTION

→ It is just opposit of aldol condensation.

→ It shown by species $\underline{c}$ do not have α- hydrogen

Ex. HCHO, 

→ Reaction takes place in highly basic medium.
conc^n KOH + heat.

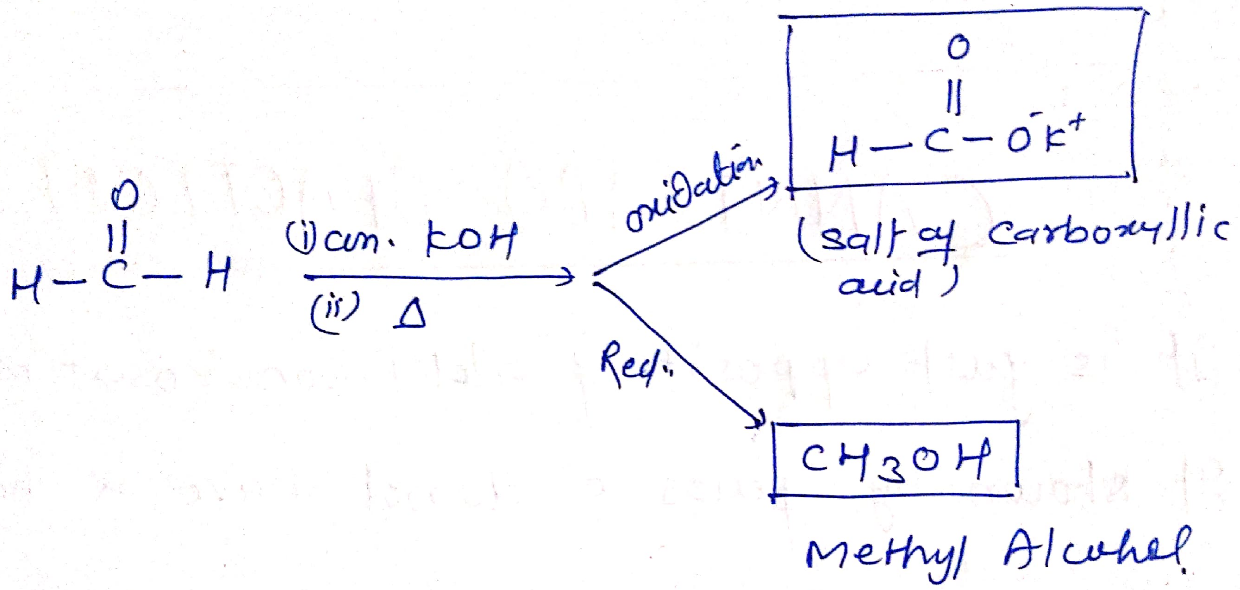
→ It is the disproportination of aldehyde, means simultaneous oxidation + reduction of same compound.

$$\text{Alcohol} \xleftarrow[\text{Red.}]{[H]} \text{Aldehyde} \xrightarrow[\text{(oxi)}]{[O]} \text{Carboxyllic acid}$$

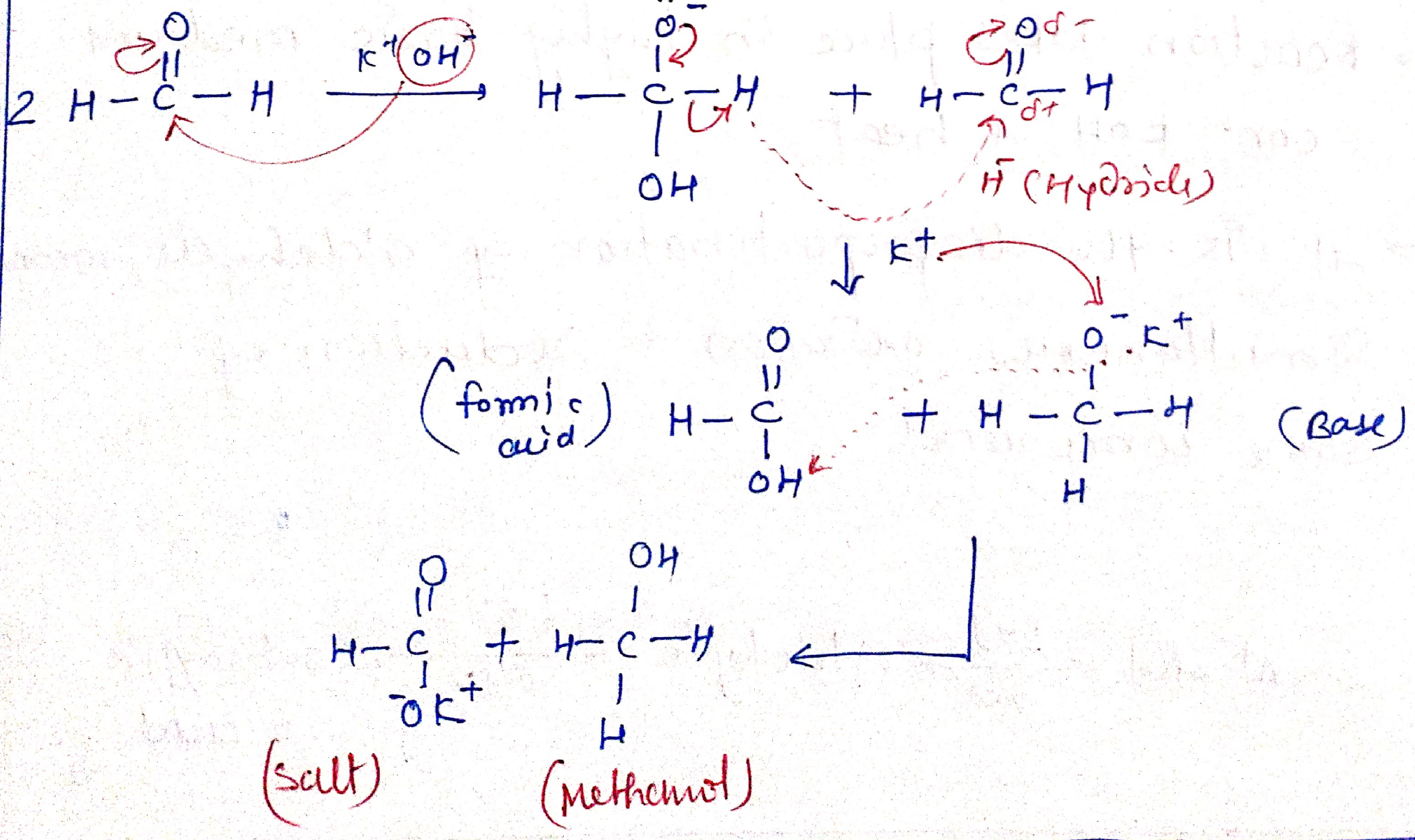
chemical reaction

→ It is performed in presence of strong alkali, aliphatic/aromatic aldehyde c̄ out α-hydrogen undergoes self oxidation, self reduction to yield a mixture of an alcohol and salt of carboxyllic acid.

ex.



Mechanism



CROSS CANNIZARO REACTION

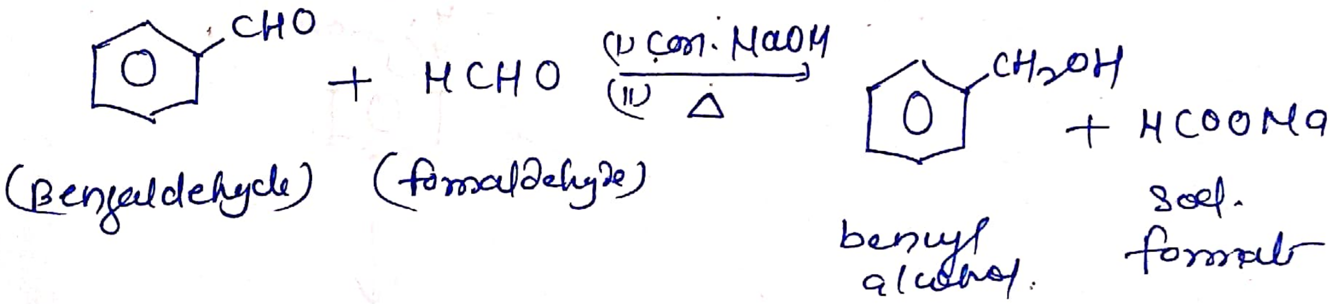
condition

1) There should be two different aldehyde.
2) Both shouldn't have α-hydrogen.
3) out of two compound one must be HCHO.
4) HCHO always undergoes oxidation & other one will undergo Reduction.

Ex.

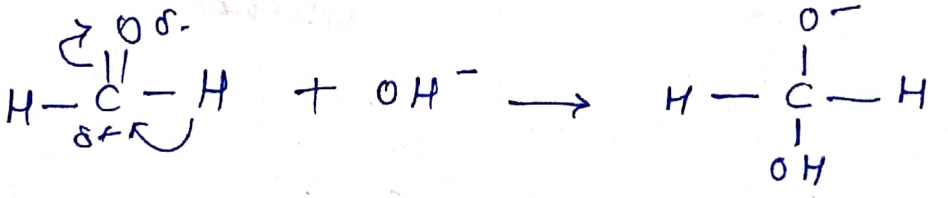
(1) Benzaldehyde React c̄ formaldehyde in presence of NaOH/KOH c̄ heat

→ Benzaldehyde goes for reduction & HCHO → oxidation.

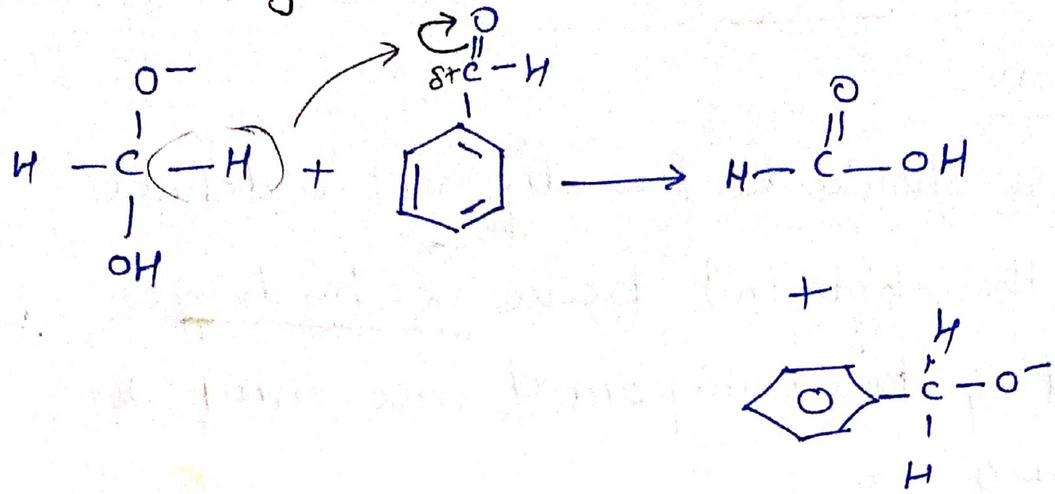


Mechanism

step 1 Attack of OH⁻ on aldehyde

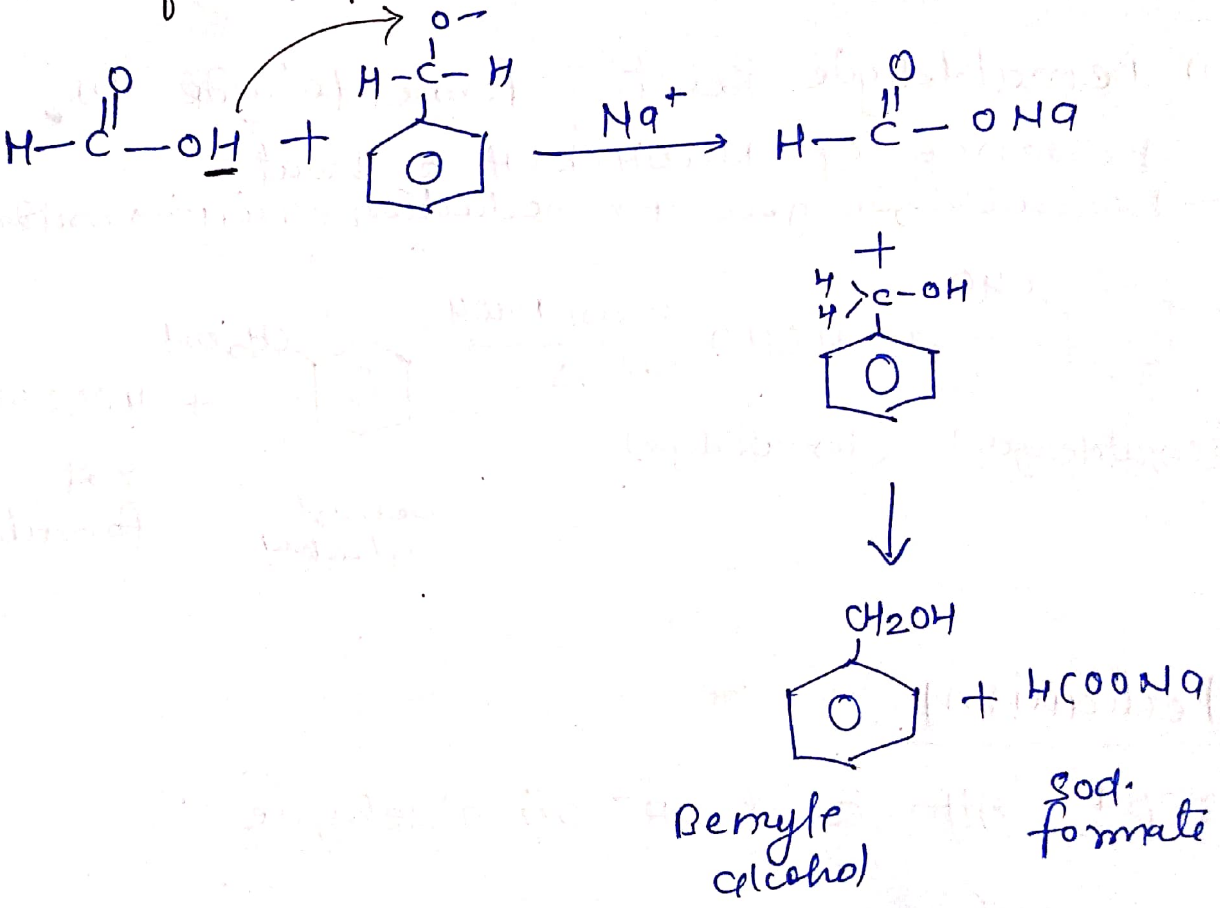


Step-II Hydride shift.



Step-III

Transfer of proton & Addition of Na⁺

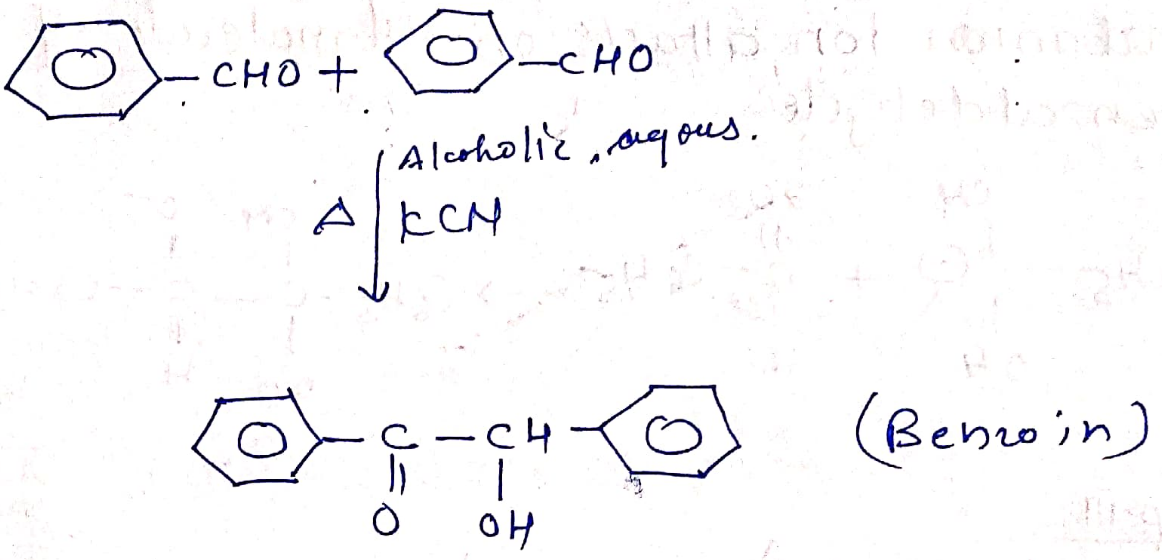


Benzoin Condensation

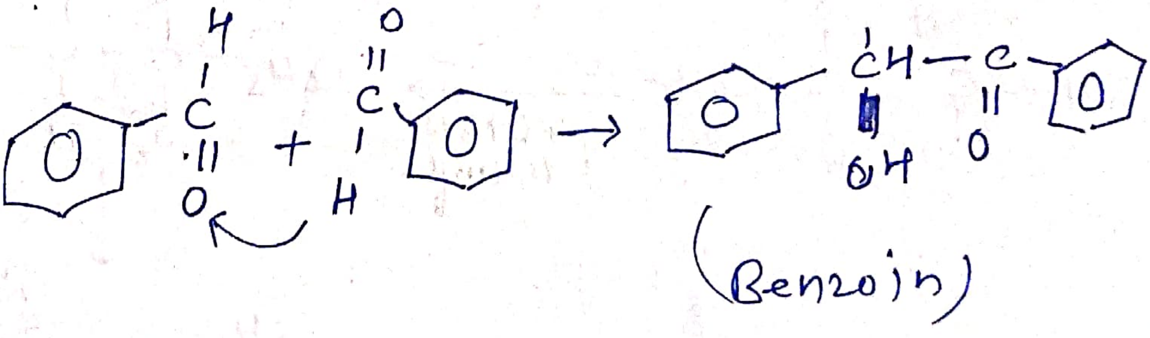
Benzoin condensation is a coupling reaction b/w two aldehyde molecules that further form α-hydroxy ketone.

Ex-

When benzaldehyde react c̄ each other in presence of KCN to form benzoin.



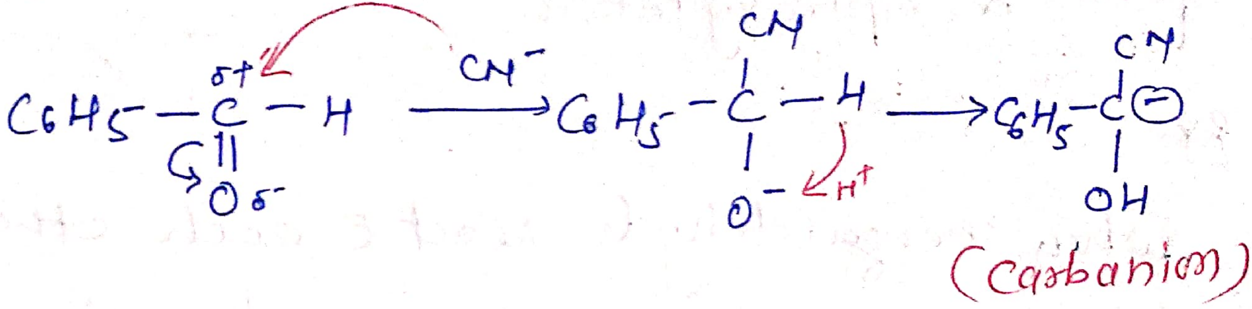
OR



Mechanism of Benzoin Condensation

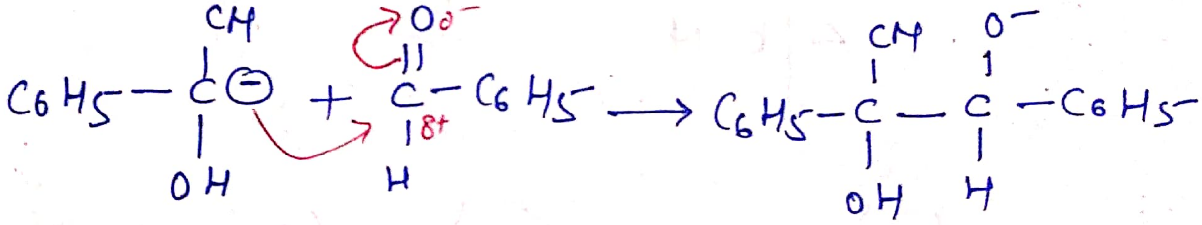
Step-I

cyanide ion attack on benzaldehyde to form Carbanion.



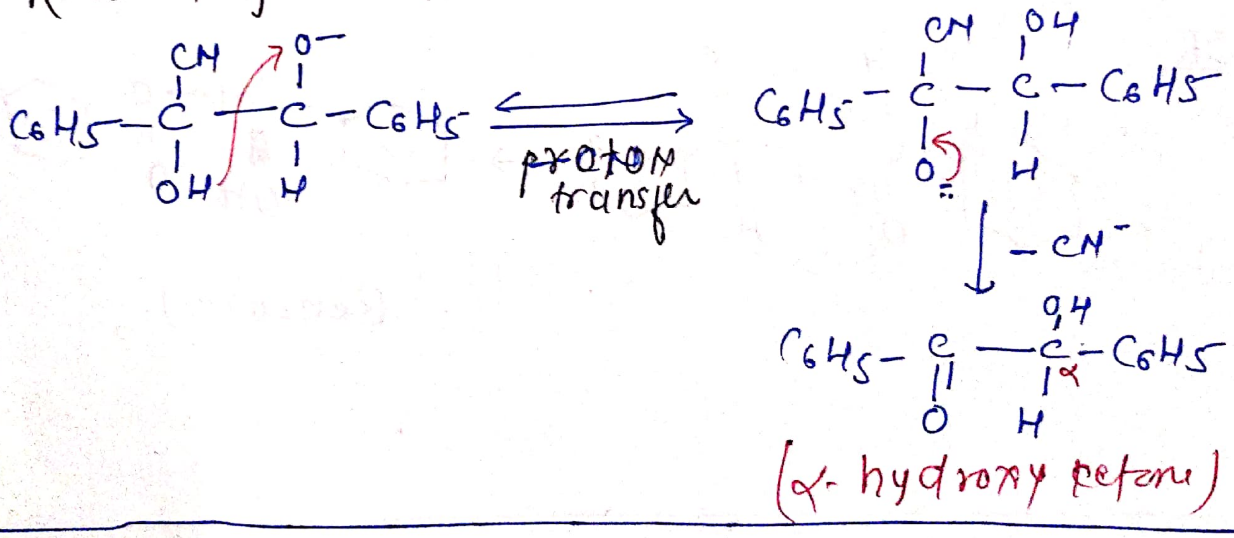
Step-II

carbanion ion attacks on 2nd molecule of Benzaldehyde



Step-III

Removal of CN$^-$ from benzoin

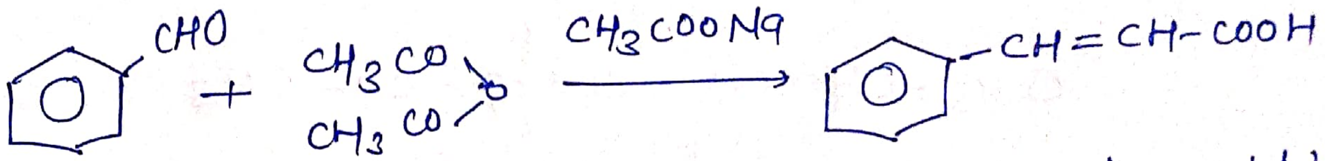


Perkin Condensation

In Perkin condensation aromatic aldehyde (Benzaldehyde) react c̄ acetic ~~acid~~ anhydride in the presence of Carboxylic acid salt to form α, β unsaturated acid & acetic acid.

$$\text{Aromatic Aldehyde} + \text{Anhydride of aliphatic acid} \xrightarrow[\text{acid}]{\text{Salt of aliphatic}} \alpha-\beta \text{ unsaturated acids}$$

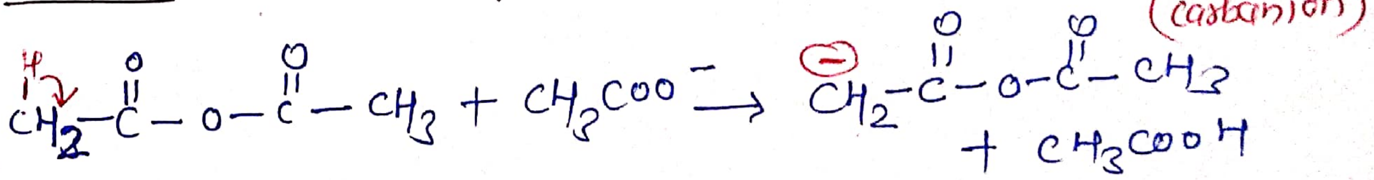
Ex-



(cinnamic acid)

Mechanism

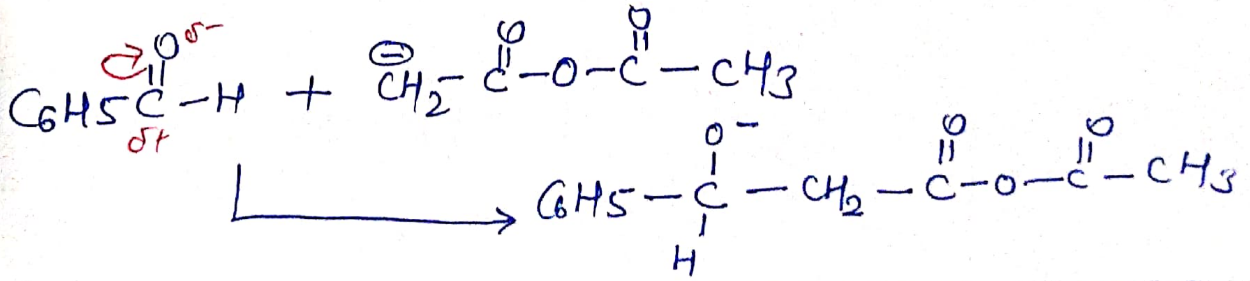
Step-I (Reaction of acetic anhydride & CH_3COO^-)



$$\overset{H}{C}H_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3COO^- \rightarrow \overset{\ominus}{C}H_2-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + CH_3COOH$$

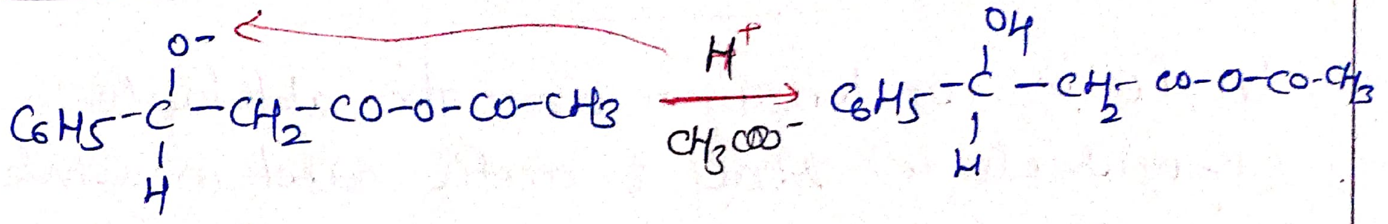
(carbanion)

Step-II (Reaction of Benzaldehyde + Carbanion)



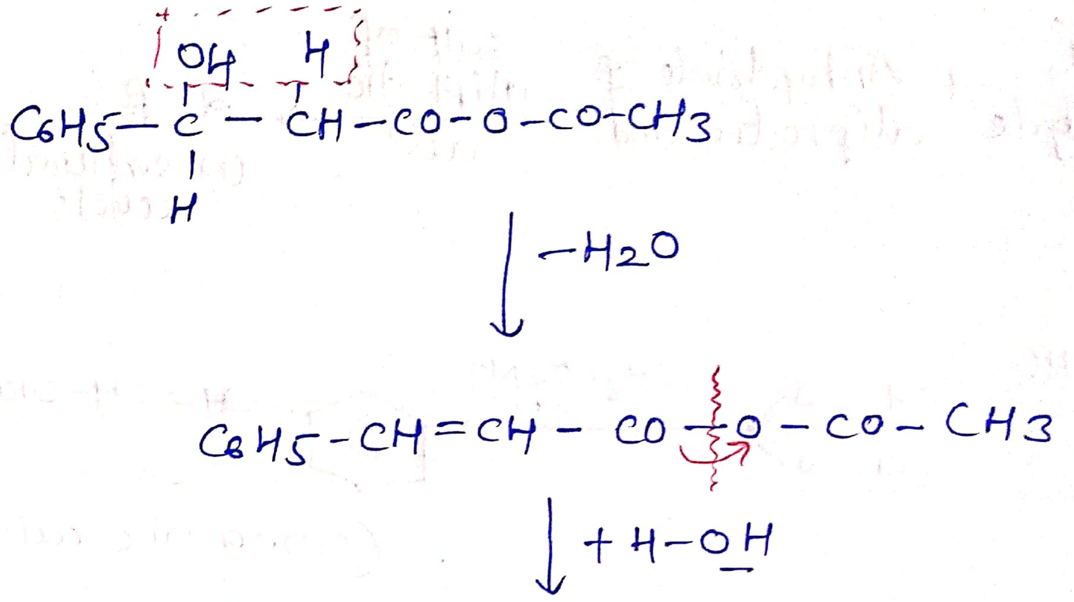
$$C_6H_5\underset{\delta+}{\overset{O^{\delta-}}{\overset{\|}{C}}}-H + \overset{\ominus}{C}H_2-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 \rightarrow C_6H_5-\underset{H}{\overset{O^-}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$$

Step-III (Protonation)



$$C_6H_5-\overset{O^-}{\underset{H}{C}}-CH_2-CO-O-CO-CH_3 \xrightarrow[CH_3COO^-]{H^+} C_6H_5-\overset{OH}{\underset{H}{C}}-CH_2-CO-O-CO-CH_3$$

Step-IV (Removal of H_2O)



$$C_6H_5-\overset{OH}{\underset{H}{C}}-\overset{H}{C}H-CO-O-CO-CH_3 \xrightarrow{-H_2O} C_6H_5-CH=CH-CO-O-CO-CH_3 \xrightarrow{+H-OH}$$

$\boxed{C_6H_5-CH=CH-COOH} + CH_3COOH$

(cinamic acid) (Acetic acid)

STRUCTURE AND USES OF FORMALDEHYDE

→ It is a simplest aldehyde made of C, H & O.

– Gen formula → CH_2O

→ It is a large family of volatile organic compound c̄ evaporate and become gaseous at room temperature.

→ It is a reactive molecule.

→ **Property**

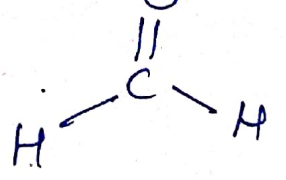
M·wt → 30.31 g/mol

B.P. → -19°c

M.P. → -92°c

Chemical formula } → HCHO

Structure



IUPAC: Methanal

Chemical Property

1) $2HCHO + NaOH \longrightarrow HCOONa + CH_3OH$

2) $6HCHO + 4NH_3 \longrightarrow (CH_2)_6N_4 + 6H_2O$
(formamidine)

Uses

1) Used in production of resins, usually urea-formaldehyde and phenol formaldehyde

2) Used as disinfactant, fungicide, fumigant and presewatives.

3) Used to make building material also.

Benzaldehyde

→ Simplest aromatic aldehyde having -CHO group

→ M. formula → C_7H_6O

→ IUPAC ⟶ Benzene carbaldehyde

⇒ Other name → Phenyl methanal, benzoic Ald.

Property

→ Smell ⇒ Almond like.

→ Solubility ⟶ miscible $\bar{c}$ volatile oils, ether + alcohol

→ It is colourless to yellow in colour

– M. weight → 106.12 g/mol

→ Highly reactive compound

Structure

USES

1) flavouring to items.
2) Precursor for additives & plastic
3) bee repalant.
4) Some cosmetic product have this
5) Production of dyes.
6) Used as additive in antibacterial & antifungal preservative.