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Where Minds Pollinate

Class 11
Chemistry

Chapter 19
Carbonyl Compounds
Handwritten Notes

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Chap: 19

"Carbonyl Compound"

Organic compound containing carbonyl group ($-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-$) are called aldehydes and ketones.

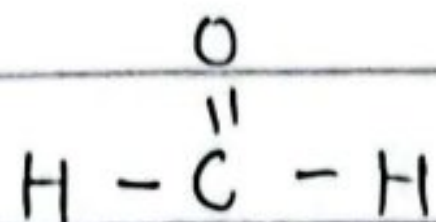
Aldehydes (Alkanal)

1) Compounds in which carbonyl group is bonded to atleast one hydrogen atom.

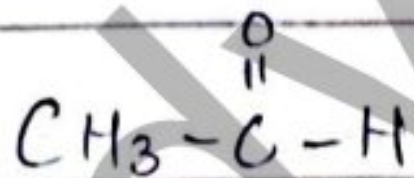
2) They are denoted by $\text{R}-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{H}$

3) They have general formula $\text{C}_n\text{H}_{2n}\text{O}$

E.g:-



Formaldehyde (C.N)
or
Methanal



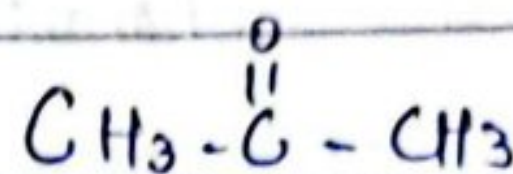
Acetaldehyde or Ethanal

Ketones (Alkanones)

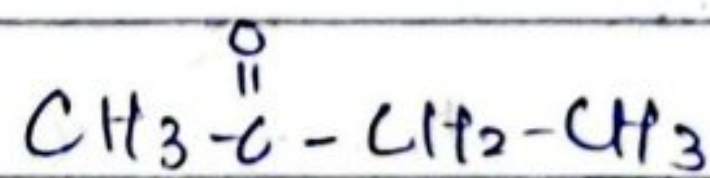
1) Compound in which carbonyl group is bonded with two alkyl group.

2) They are denoted by $\text{R}-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{R}$

3) They have general formula $\text{C}_n\text{H}_{2n}\text{O}$



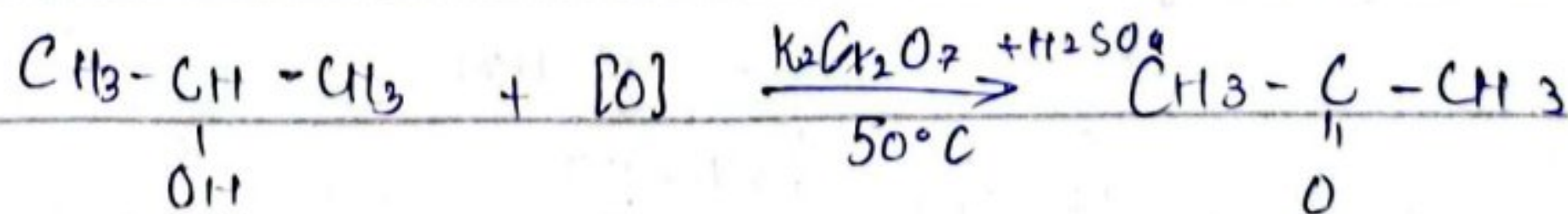
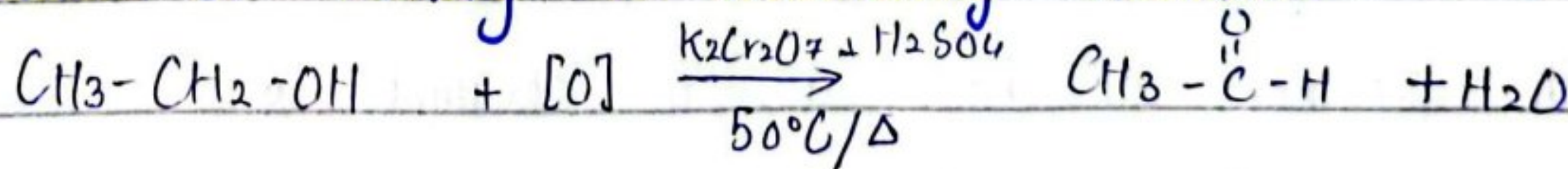
Acetone (C.N)
or
propanone (IUPAC)



Ethyl methyl ketone
or
2-Butanone.

Preparation of Aldehydes and Ketones:-

* Oxidation of Primary & Secondary Alcohol:-



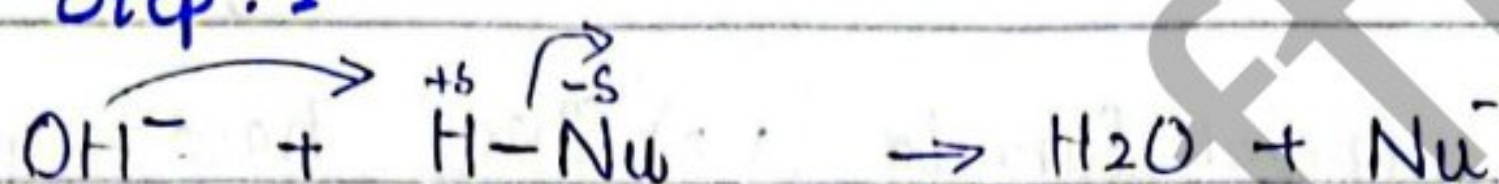
Reactions of Carbonyl Compounds:-

Nucleophilic Addition reactions:-

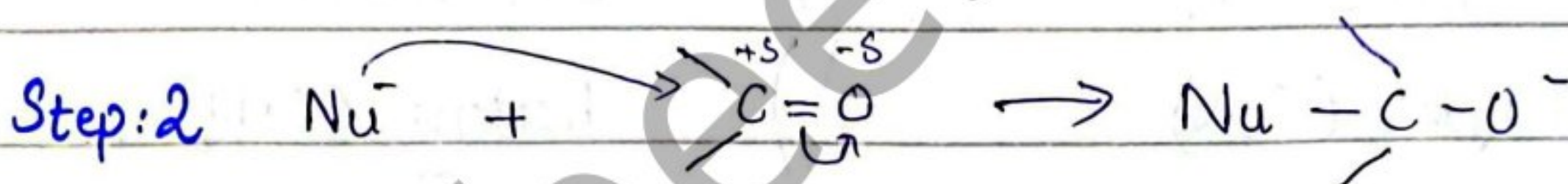
- Base catalysed nucleophilic addition reaction
- Acid catalysed nucleophilic addition reaction

Q) Give ^{v. imp} general mechanism of base catalysed nucleophilic addition reactions of carbonyl compound?

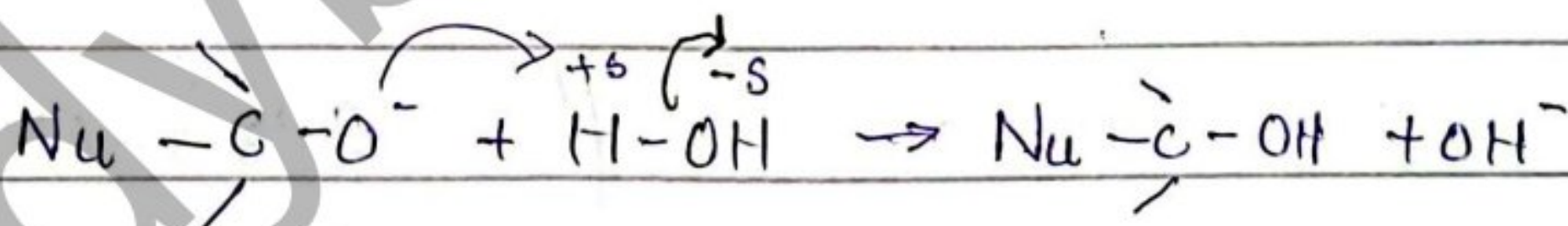
Ans:- Step: 1



* When base is used as catalyst, it increases nucleophilic character of reagent.



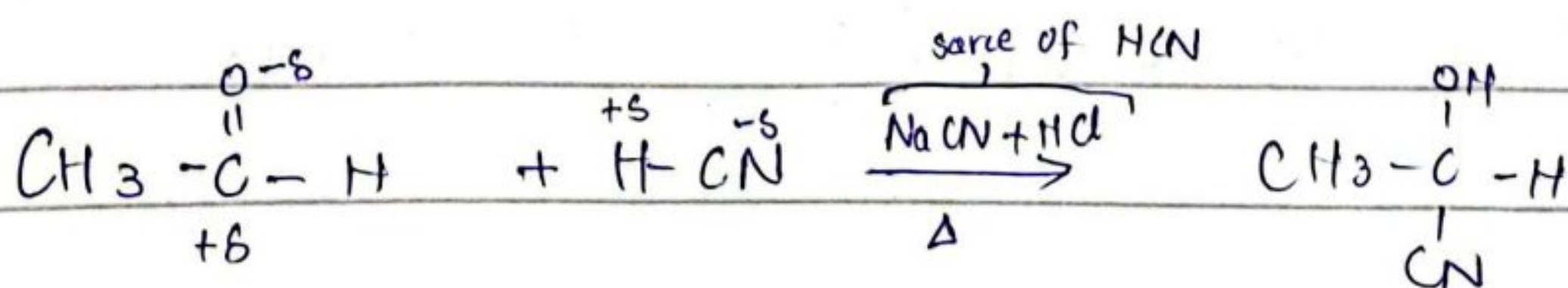
Step: 3



1- Addition of Hydrogen cyanide:-

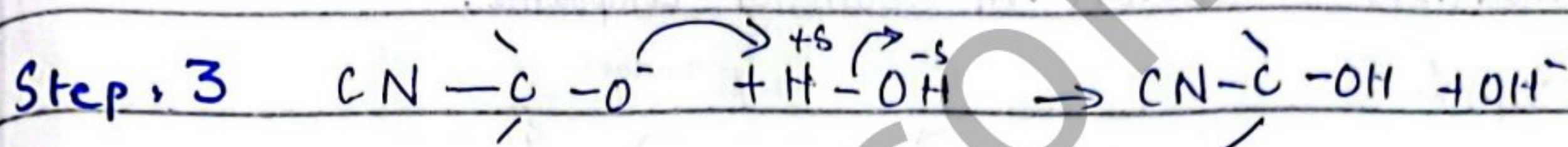
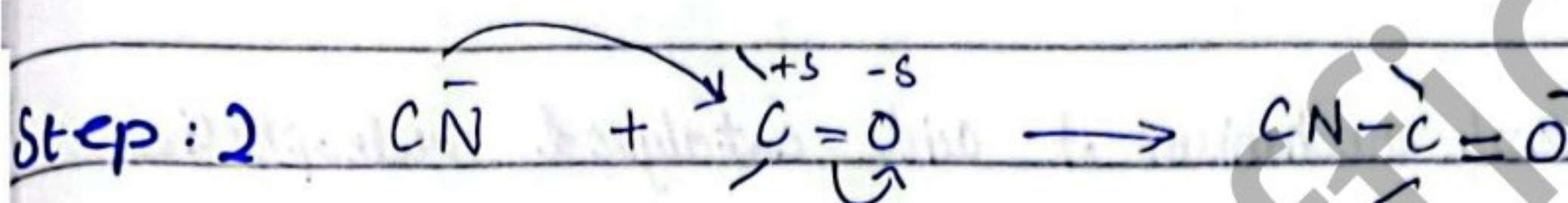
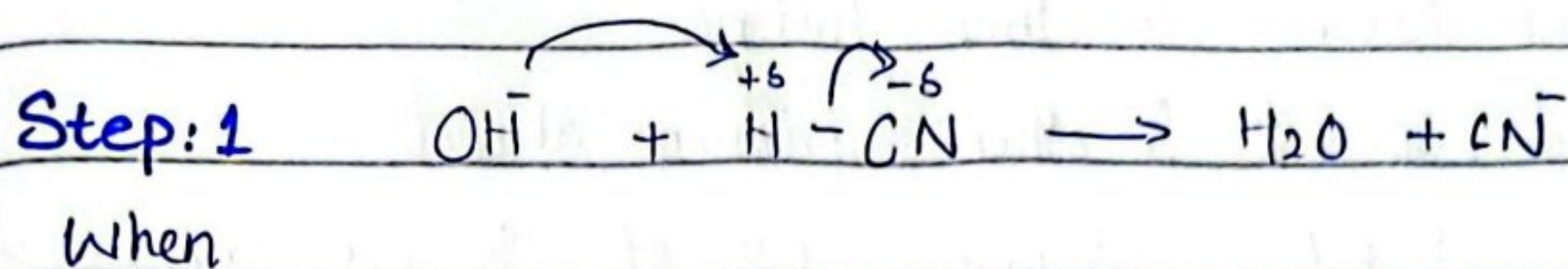
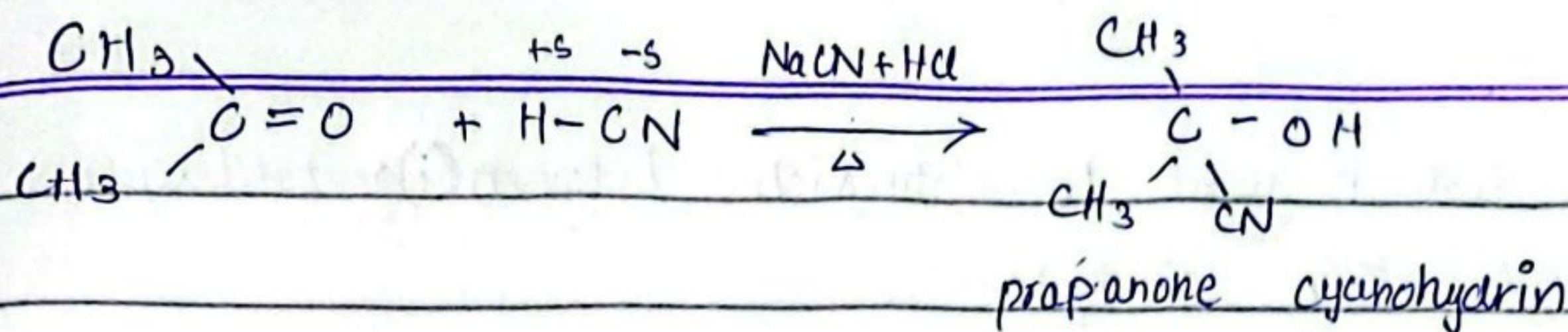


* Aldehyde and ketone react with HCN in the presence of base as a catalyst and produce Cyanohydrine.



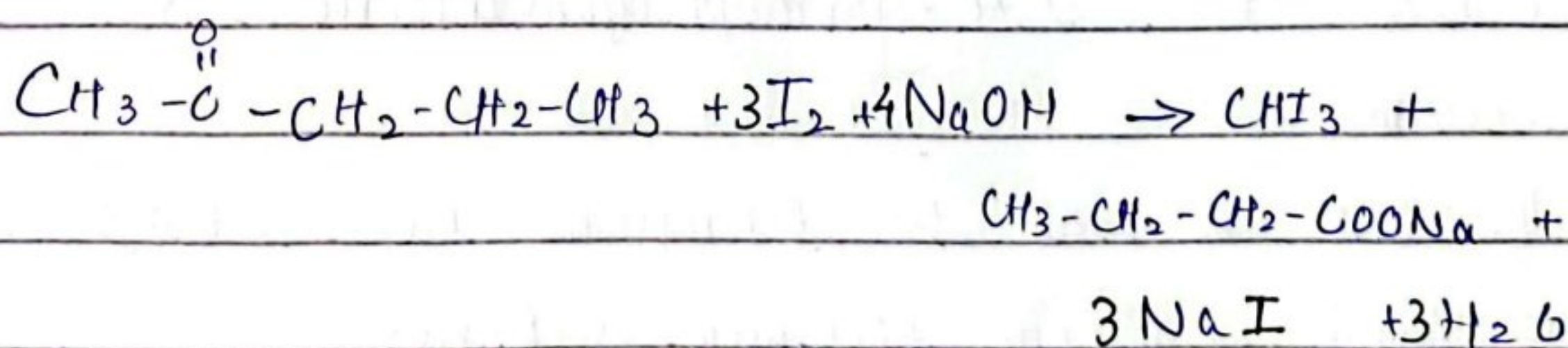
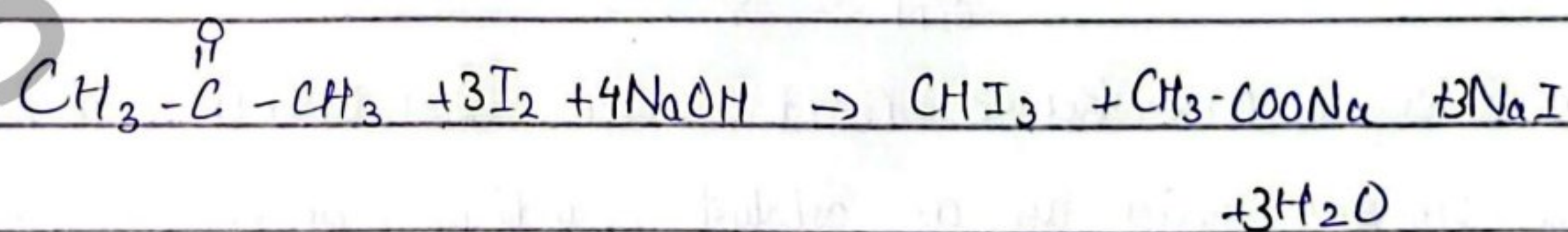
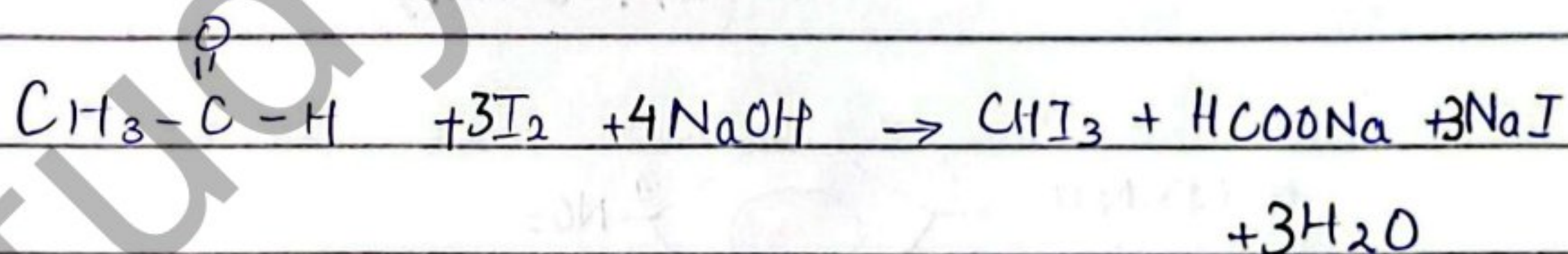
Acetaldehyde or

Acetaldehyde cyanohydrin or



2. Haloform reaction :- or Iodoform test :-

Only acetaldehyde and methyl ketone ($\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{R}$) react with I_2 in the presence of NaOH produce yellow ppt of iodoform.



balancing code = 34 3 3

This test is used to distinguish between (i) acetaldehyde and other aldehyde

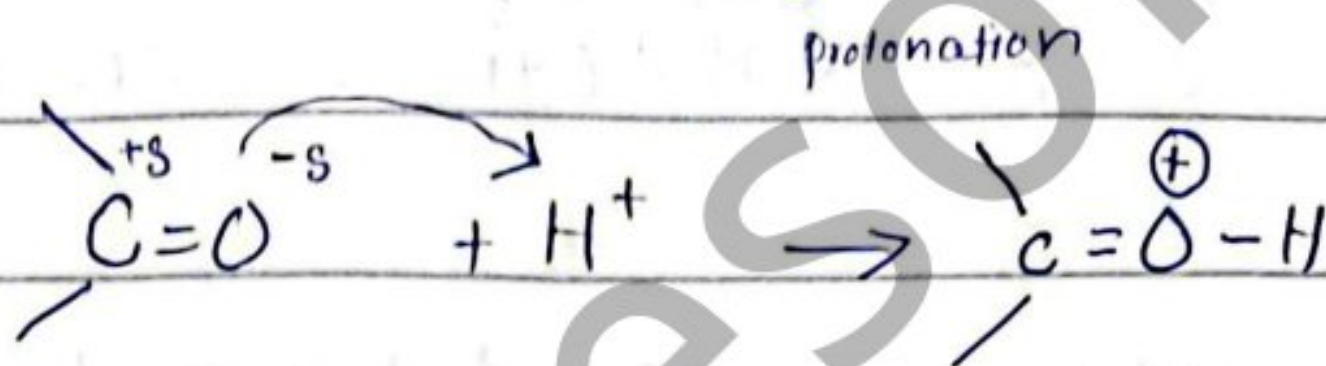
ii) Methyl ketone & other ketone

iii) Ethyl alcohol & other primary alcohol

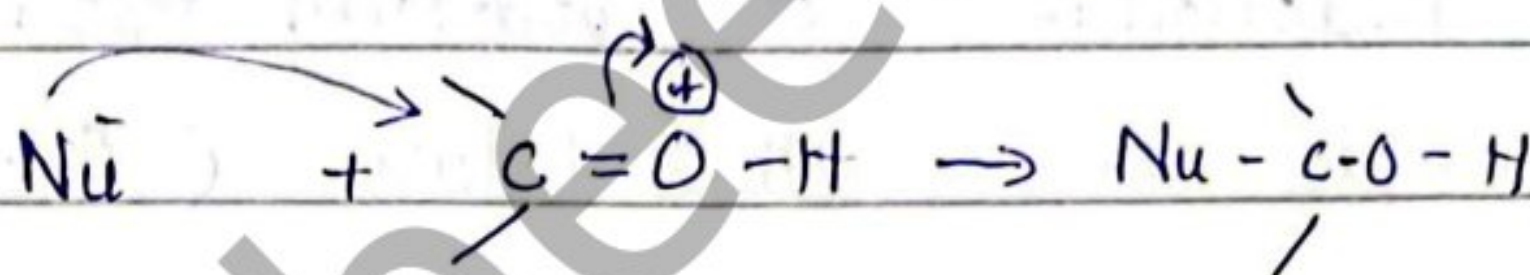
iv) Sec-alcohol containing OH at second carbon and other sec-alcohol

Q) Give general mechanism of acid catalysed nucleophilic addition reaction of carbonyl compound?

Step: 1

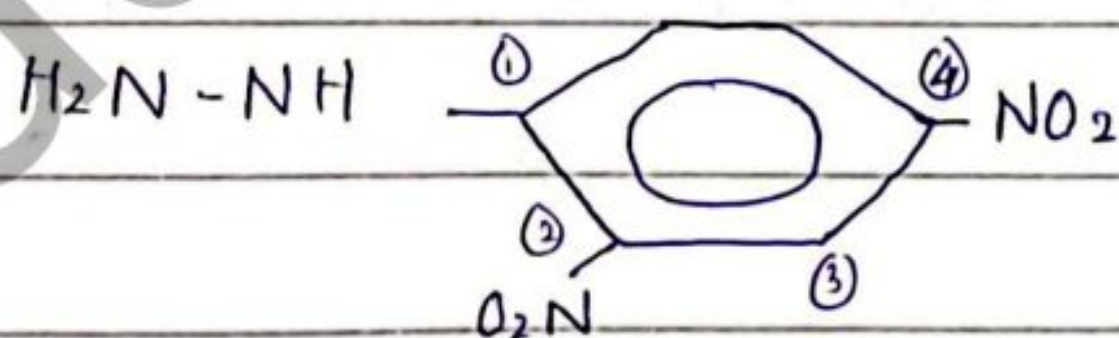


Step: 2



book

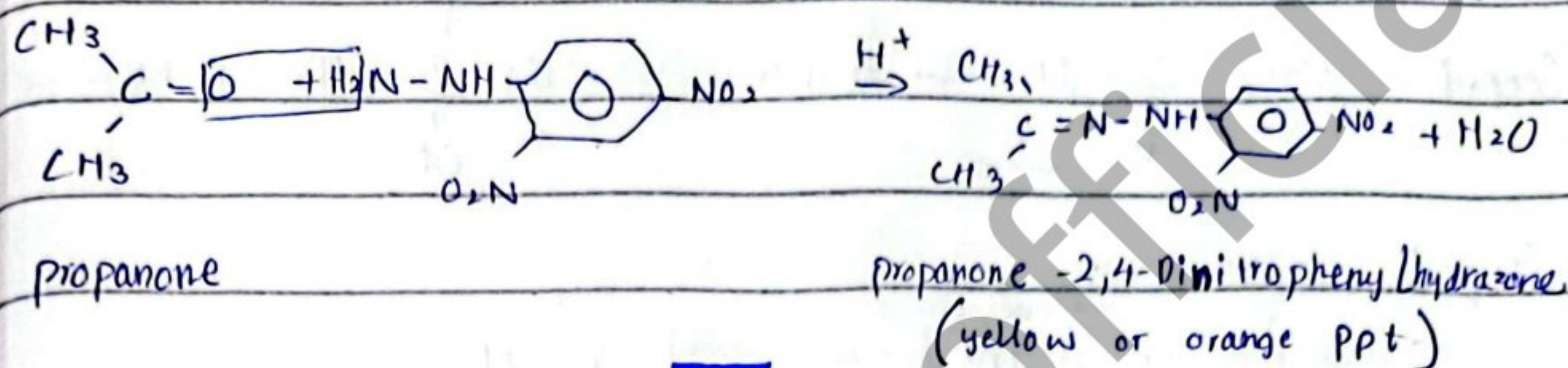
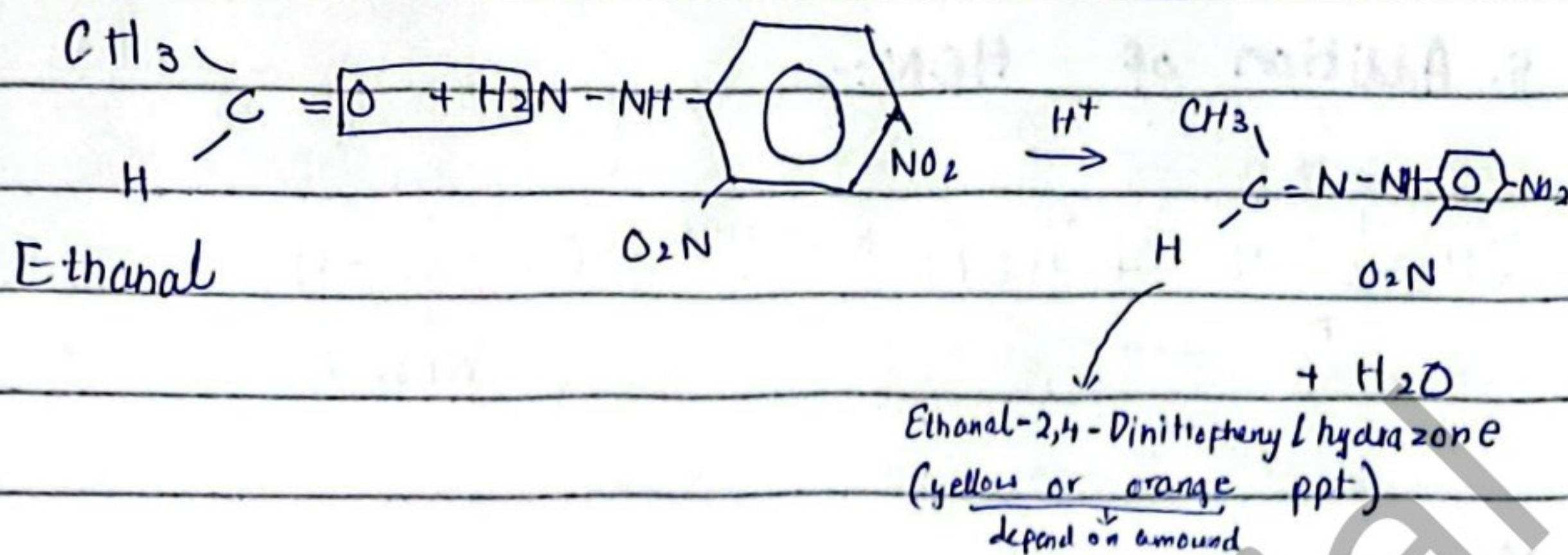
3/1. Reaction with -2,4-Dinitrophenylhydrazine or (2,4 DNPH)



→ Aldehyde and Ketone react with 2,4-DNPH in the presence acid as a catalyst, yellow or orange precipitate of 2,4-Dinitrophenylhydrazone are obtained.

→ This test is used to distinguish b/w carbonyl compound and non-carbonyl compound.

→ water loss condensation reaction



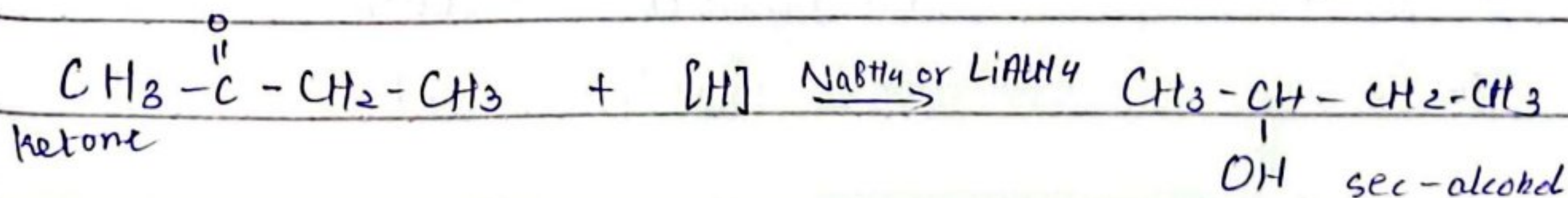
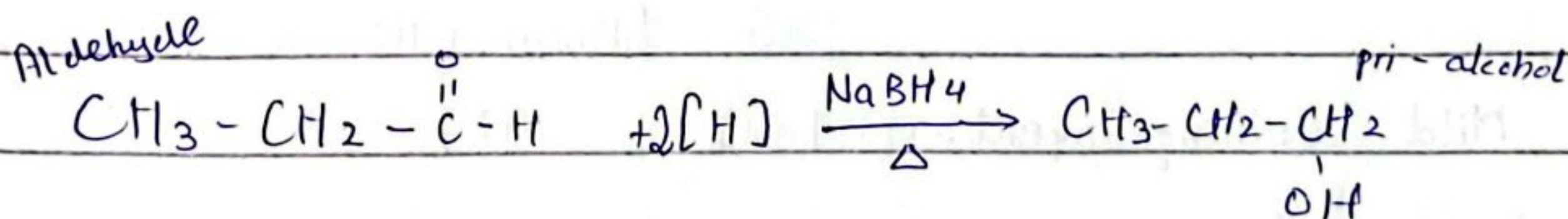
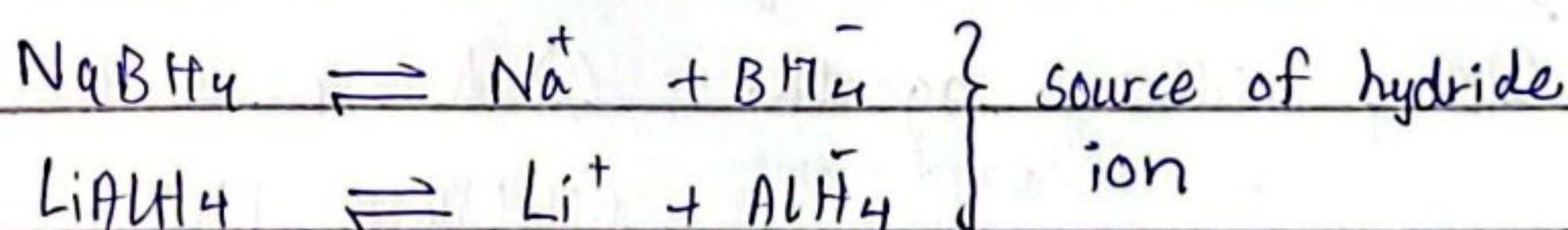
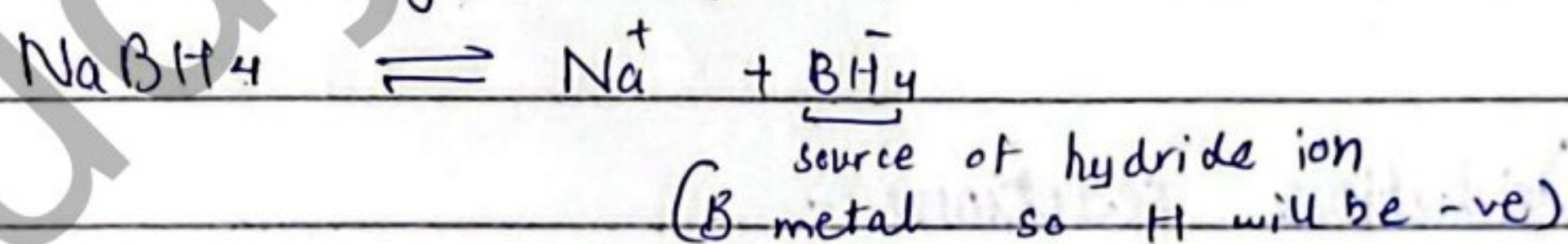
4- Reduction Reaction:-

Aldehydes are reduced into primary alcohol

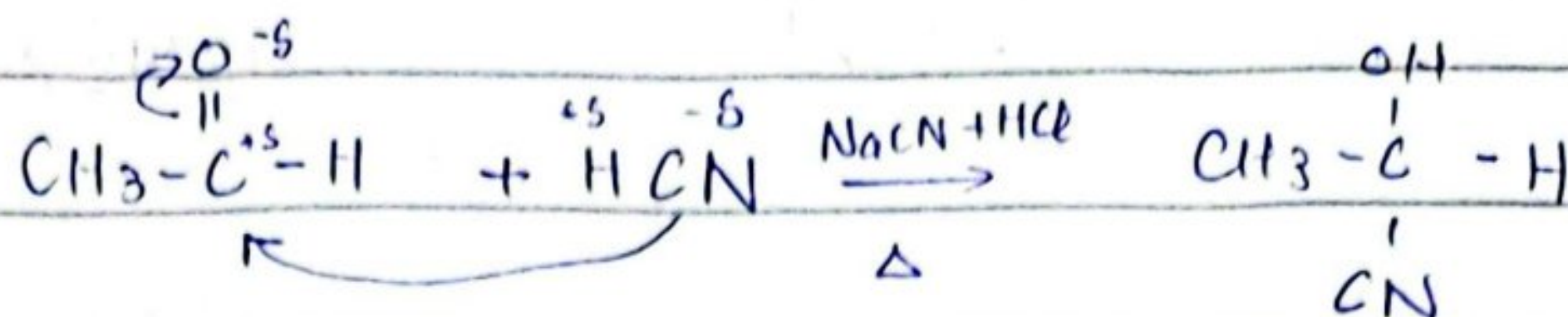
Ketone are reduced into secondary alcohol

reducing agent = i) NaBH_4 ii) LiAlH_4 (strong)

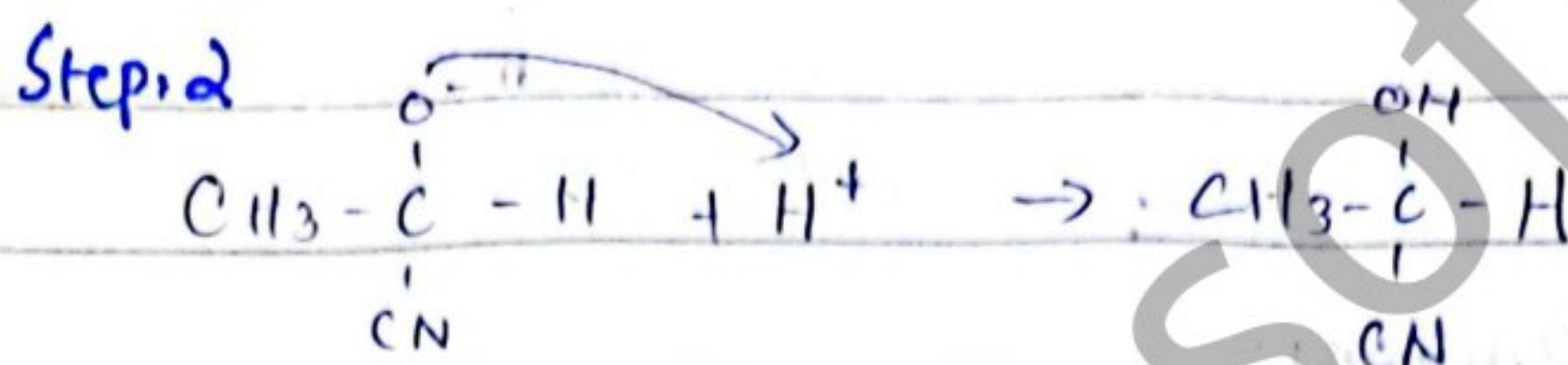
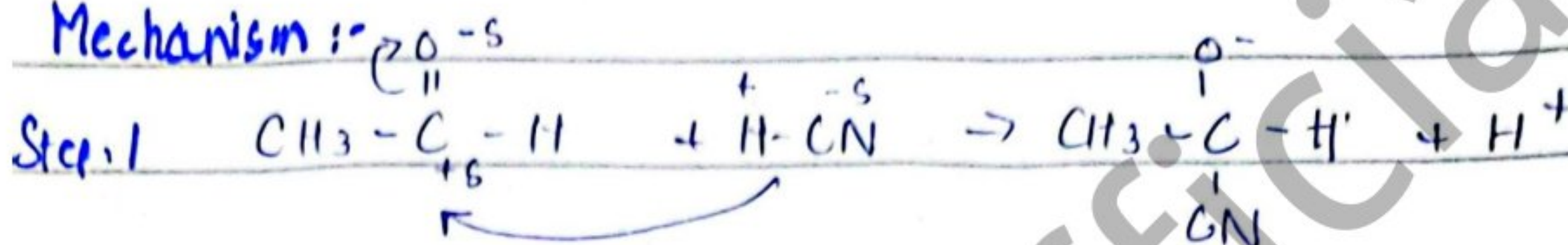
LiAlH_4 is stronger reducing agent than NaBH_4



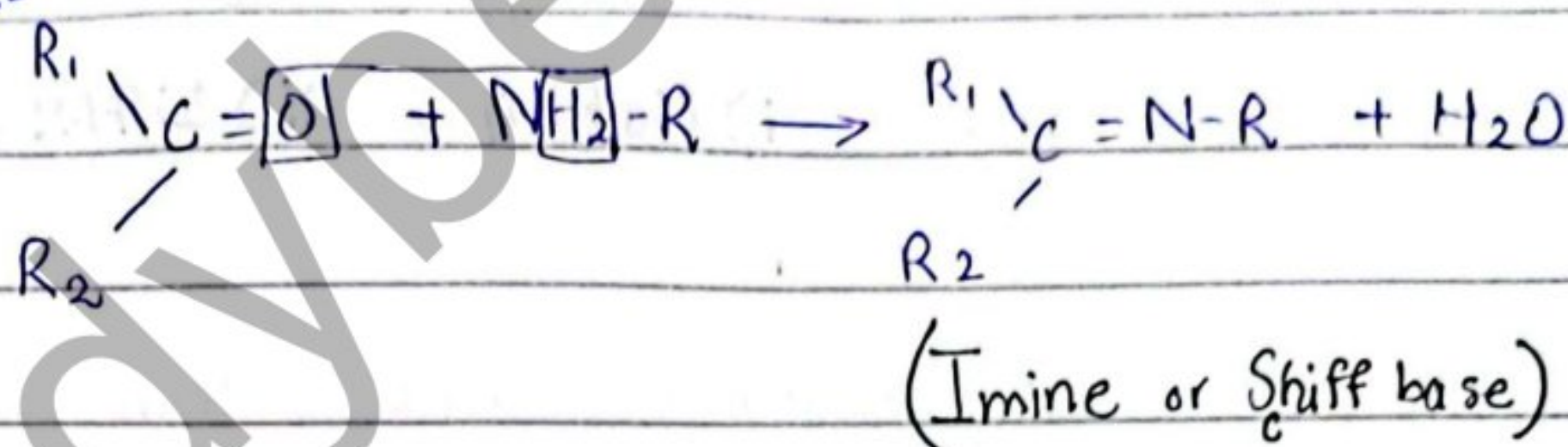
5. Addition of HCN:-



Mechanism:-



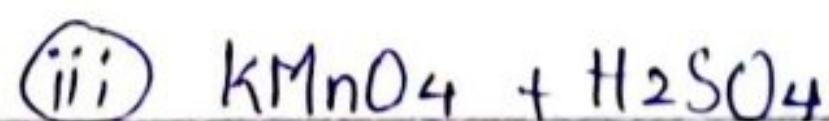
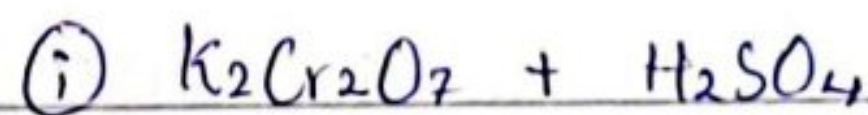
6. Reaction of primary amine with aldehyde and ketone:-



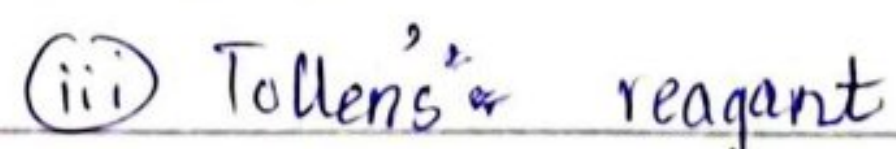
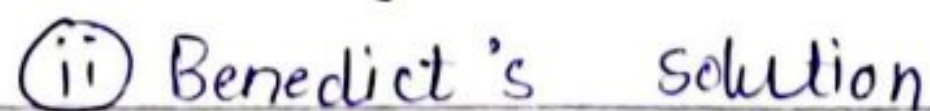
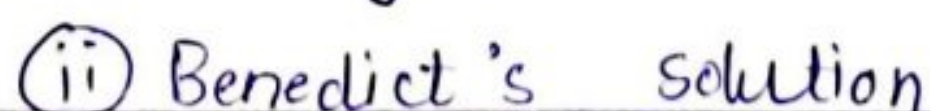
Oxidation reactions:-

7) Oxidation of aldehyde:-

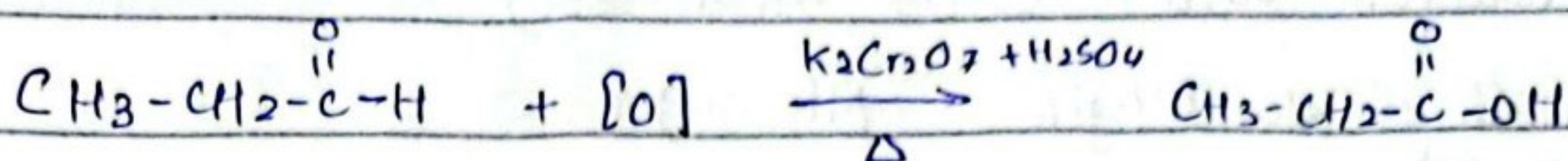
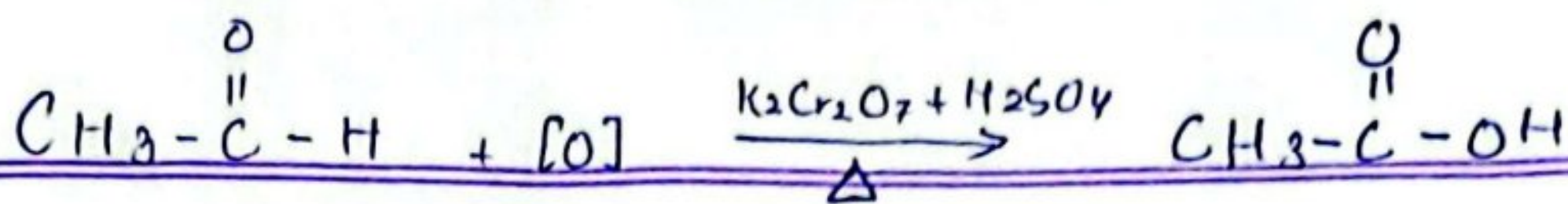
Strong oxidizing agents:-
can oxid both aldehyde and ketone



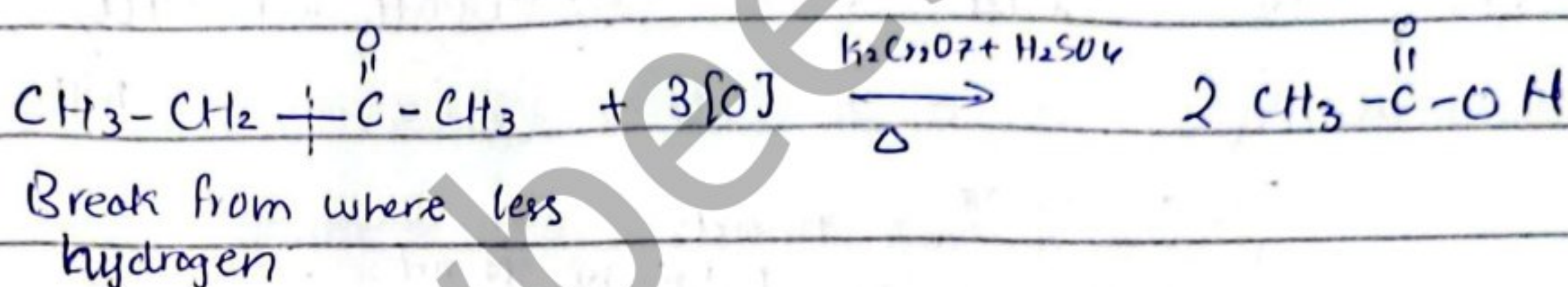
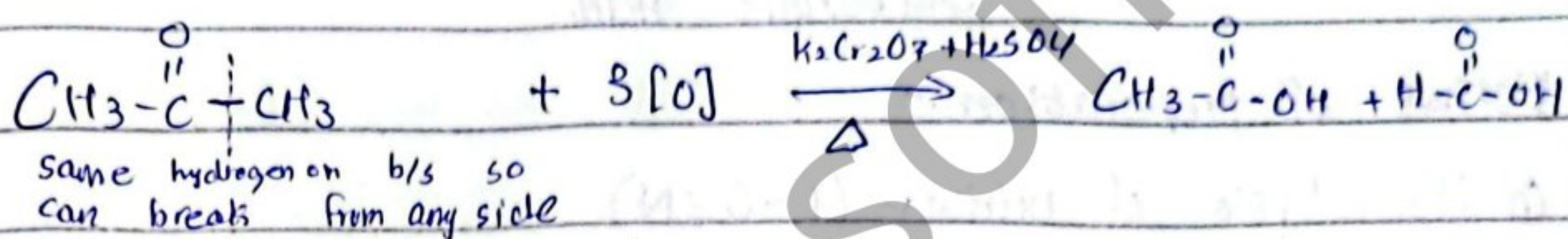
Mild oxidizing agents:-
only oxid aldehyde



Aldehyde $\Rightarrow$ Carboxylic acid



b) **Oxidation of ketone:-** ketone do not oxidize with mild oxidizing agent because they require high energy to break carbon-carbon bond however, they are oxidized with strong oxidizing agent and produce mixture of carboxylic acid.

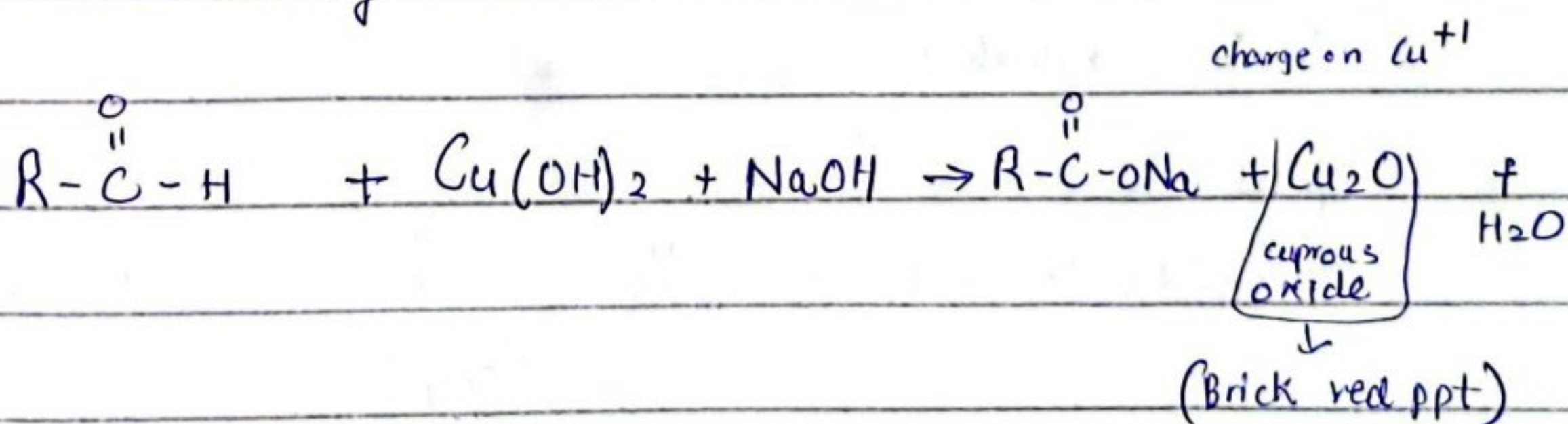


Test for distinguish b/w aldehyde & ketone:-

i) **Fehling solution:-** ^{blue color}

composition (CuSO₄ + NaOH + Tartaric acid)

Alkaline solution containing cupric tartrate complex ion is called Fehling solution.

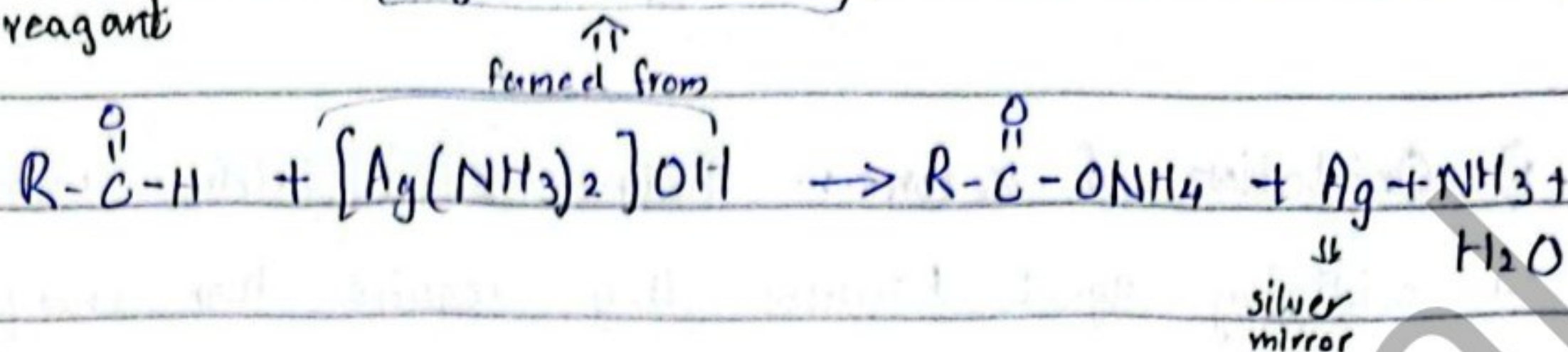


Ketone do not undergo this reaction.

Benedict's same test as Fehling but use citric acid

ii) Tollen's test :- (Silver mirror test)

Composition of Tollen reagent $(AgNO_3 + NH_4OH) \xleftarrow[NH_4OH]{NH_3}$



Ketone do not undergo this test.

Carboxylic Acid

Method of Preparation:-

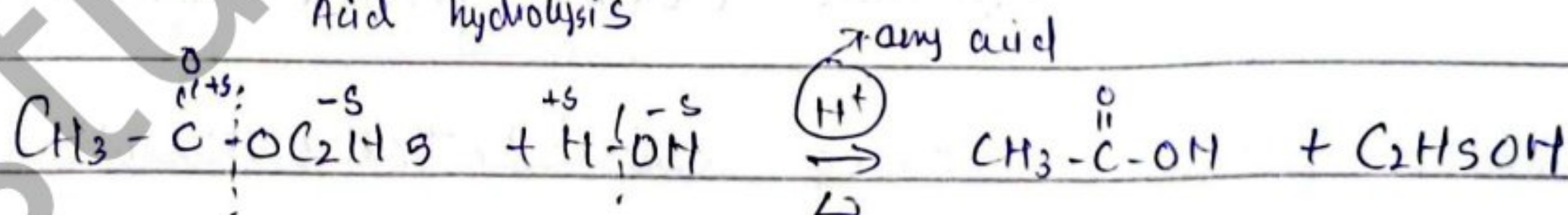
① Hydrolysis of nitrile:- $(R-C \equiv N)$



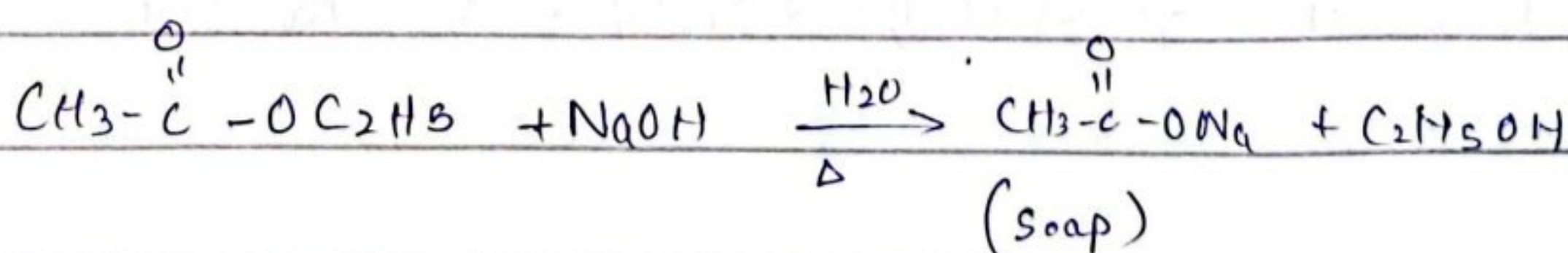
This group replace by $-COOH$ and N reacts with HCl to form NH_4Cl or if not react so NH_3

② Hydrolysis of ester :- $(R-\overset{\overset{O}{\parallel}}{C}-OR)$

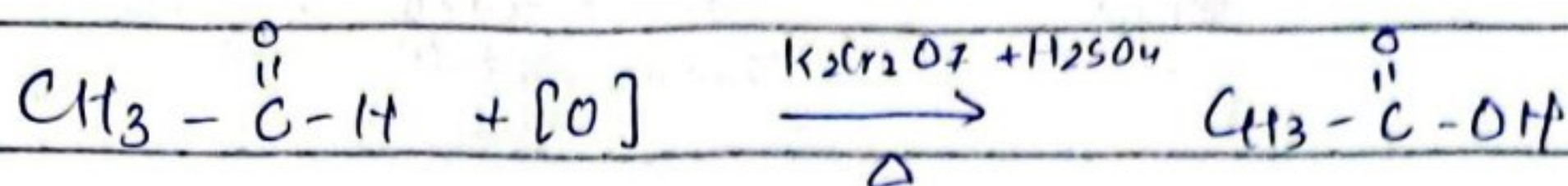
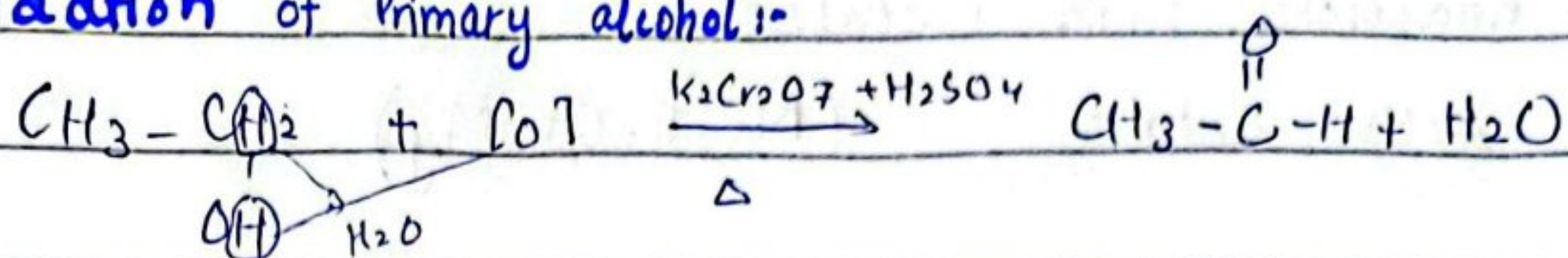
Acid hydrolysis



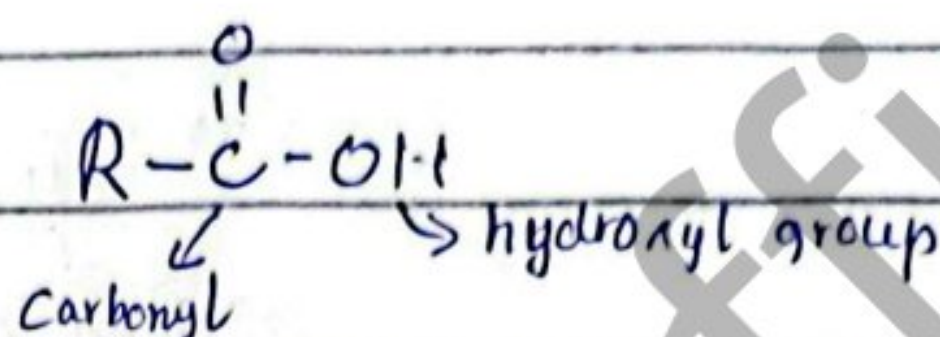
Basic hydrolysis



3) Oxidation of primary alcohol:-



Reactivity:-



Carboxylic acid are reactive due to presence of carbonyl group which increase the polarity of OH group

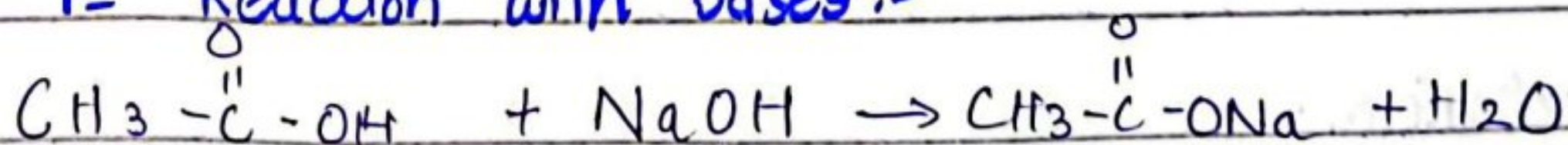
Reactions:- (A) Reactions in which hydrogen atom of carboxylic gp is involved:-

(B) Reaction in which OH group of carboxylic gp is involved

(C) Reaction involving -COOH as whole:-

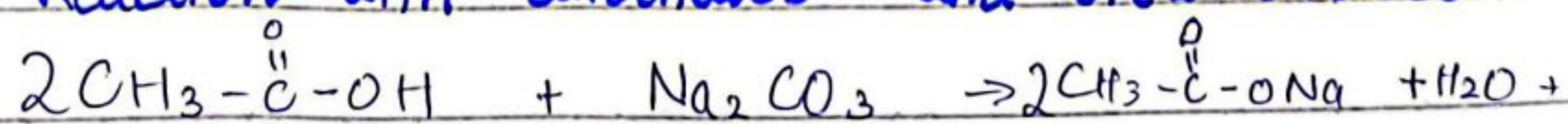
(A) Reaction in which hydrogen atom of carboxylic gp is involved:-

i- Reaction with bases:-

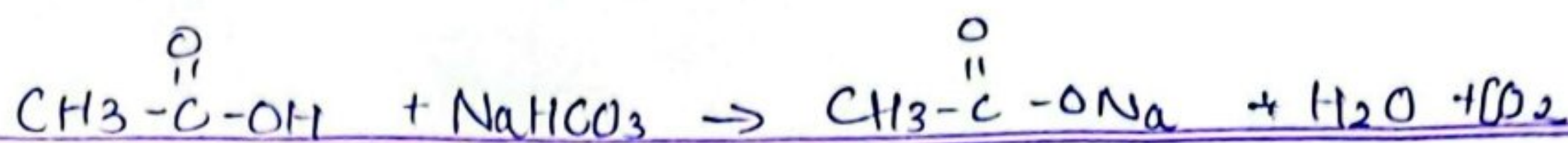


Sodium acetate

ii- Reaction with carbonates and bicarbonates:-

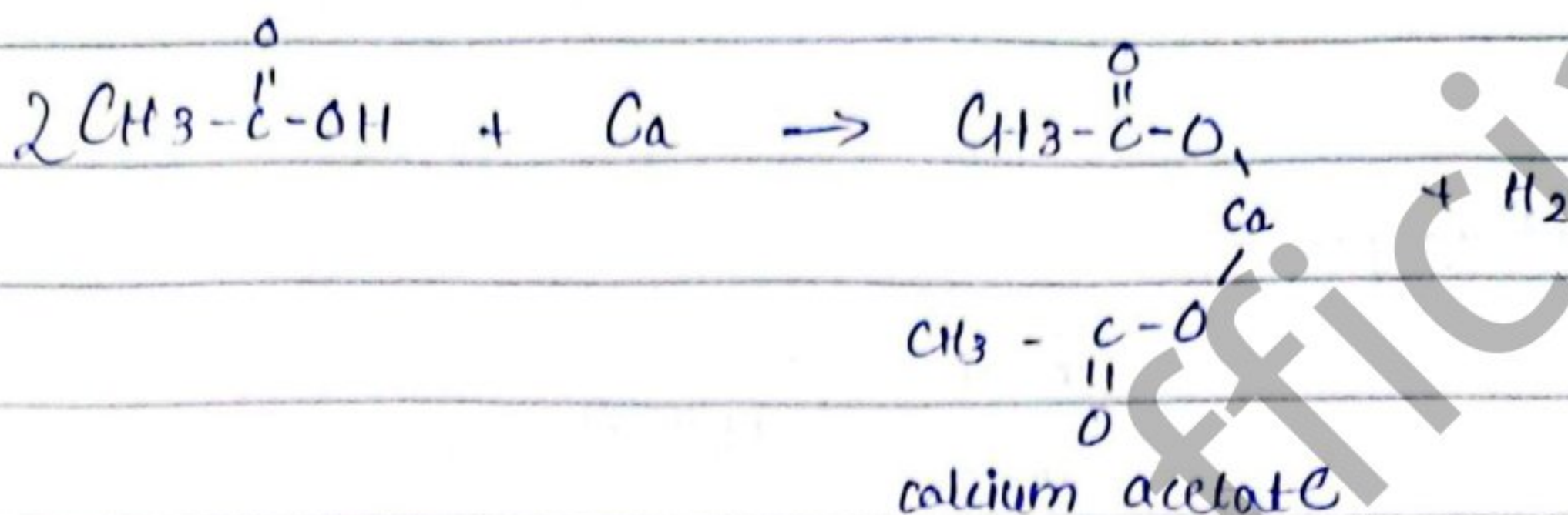
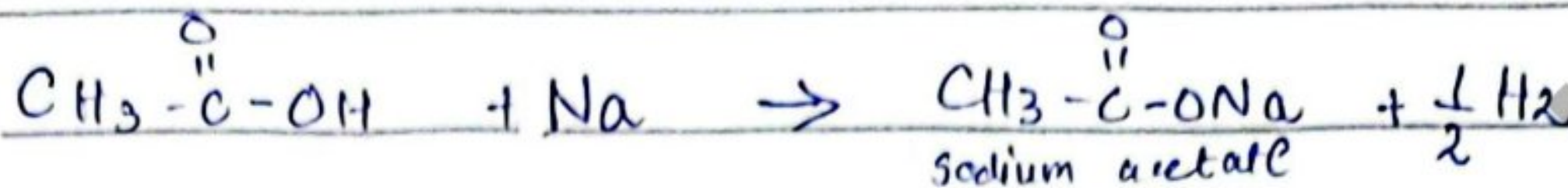


sodium carbonate



iii. Reaction with metals:-

active metals (controllable reactions) (Na, K, Ca, Mg)



Most imp

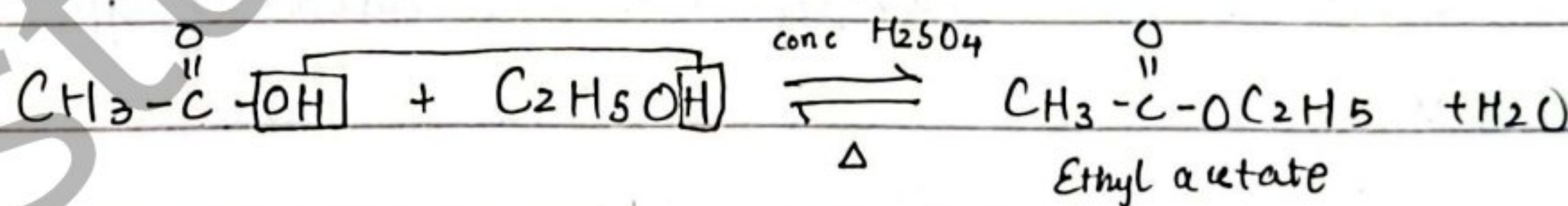
Ⓑ Reaction in which OH group of carboxylic gp is involved

① Reaction with alcohol (Preparation of Ester)

Esterefication^{or} (Fischer Esterefication)

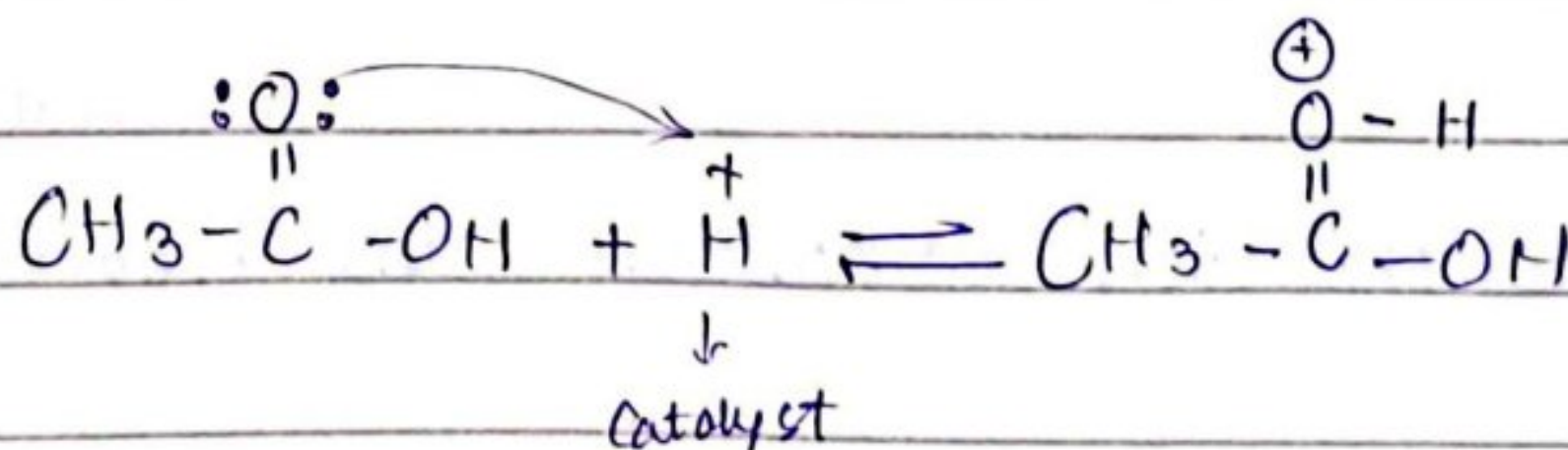
Identification test^{or} of carboxylic acid:-

Def:- When carboxylic acid is reacted with alcohol in the presence of H_2SO_4 as a catalyst ester is formed. This process is called esterefication.



Mechanism:-

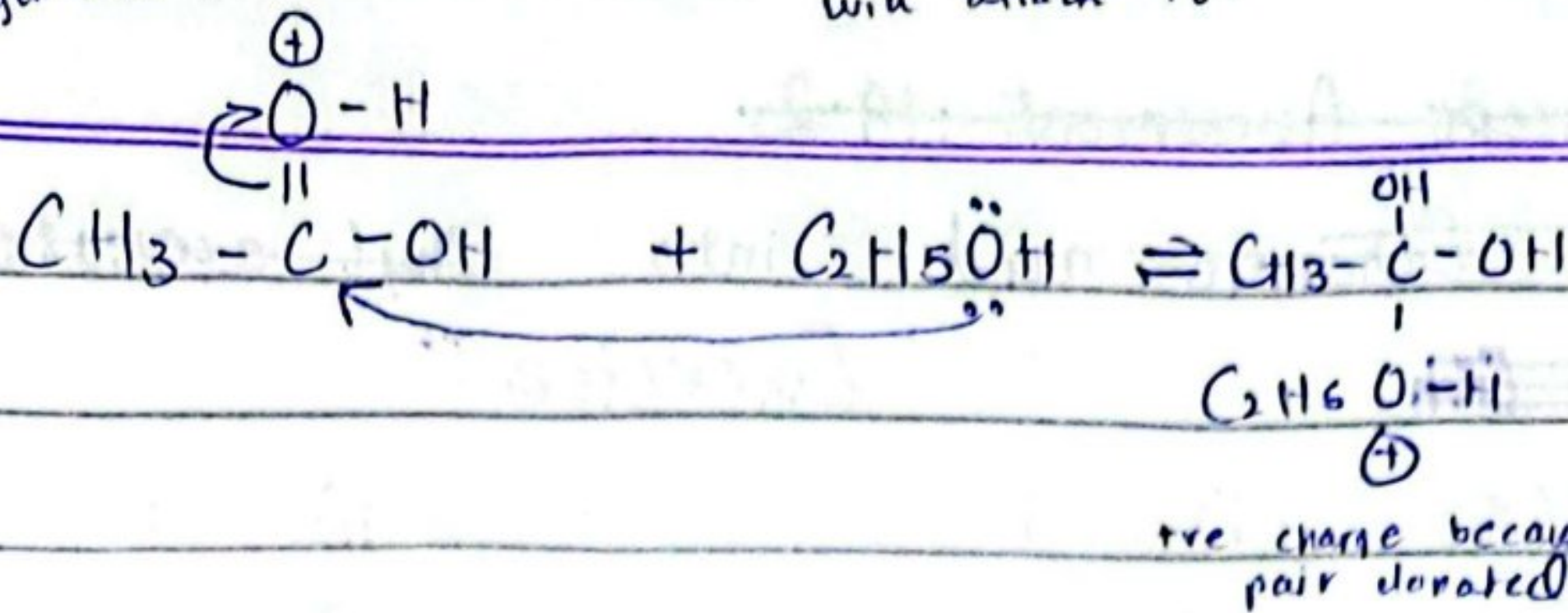
Step: 1



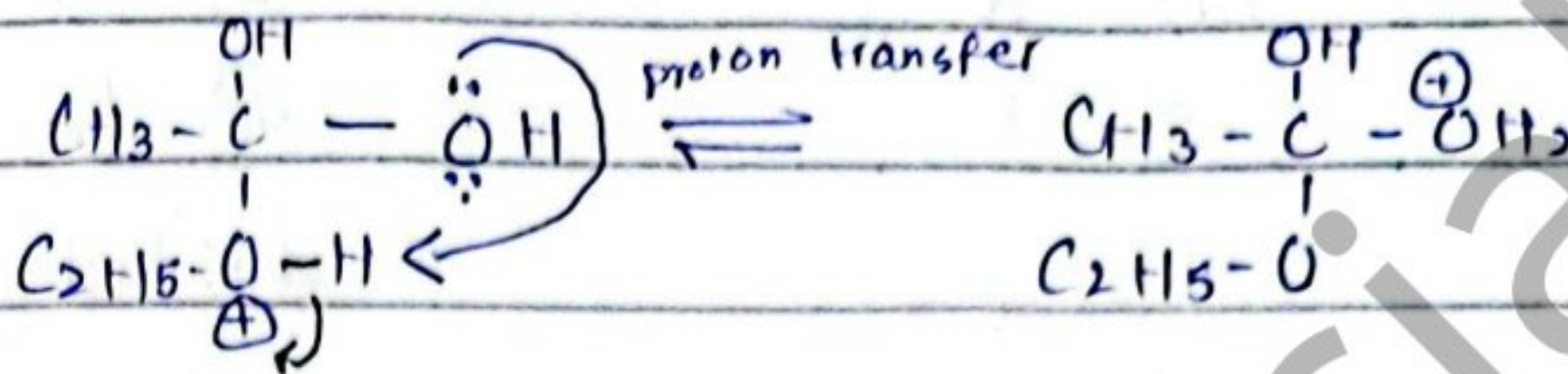
also called protonation

oxygen will pull this electron to stabilize and then C will have a charge so, $C_2H_5\ddot{O}H$ (lone pair) of this will attack it.

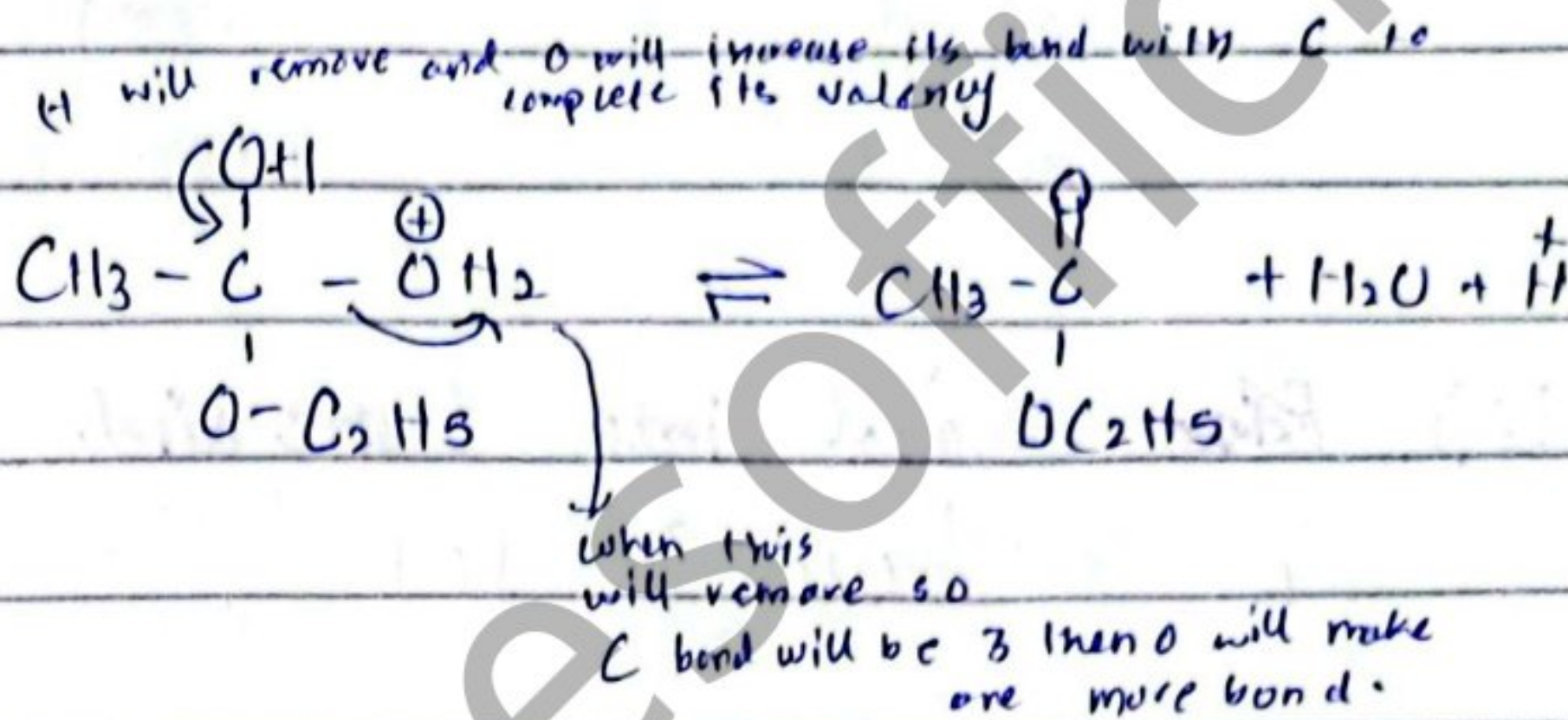
Step: 2



Step: 3

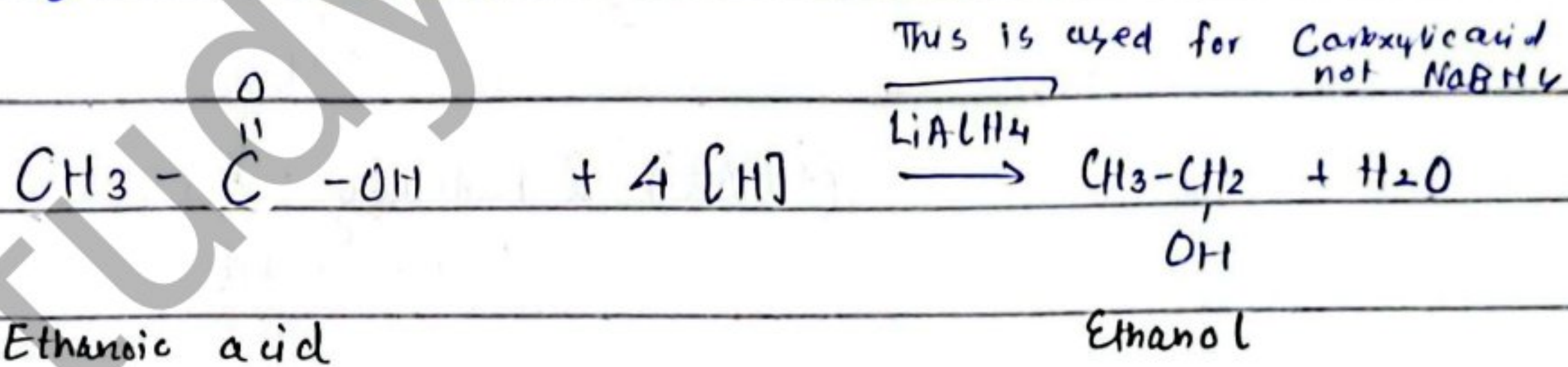


Step: 4



© Reaction involving $COOH$ as a whole:-

i) Reduction to alcohol:-



"Exercise"

MCQs:-

i) b

ii) a

iii) a

iv) (d) 3-pentanone

v) b

vi) b

vii) d

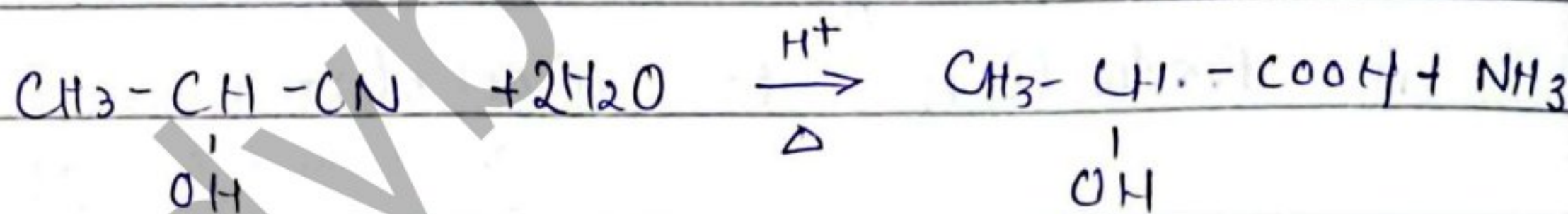
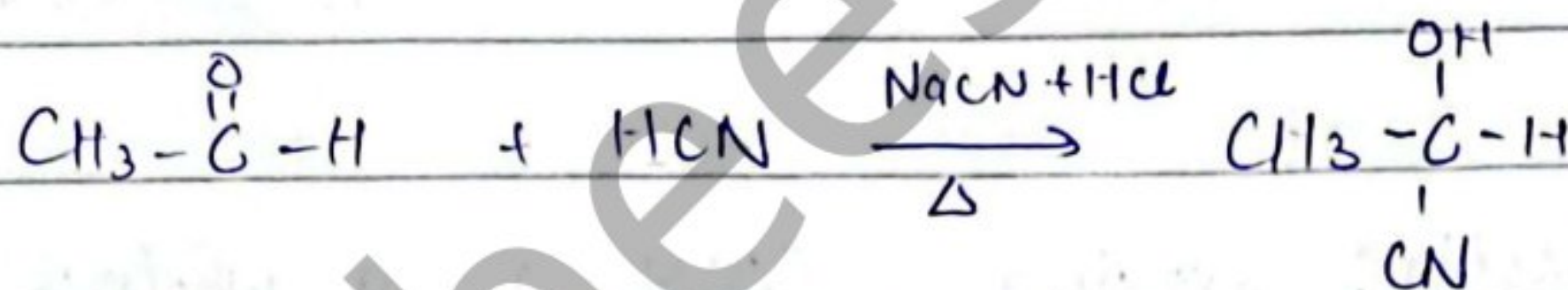
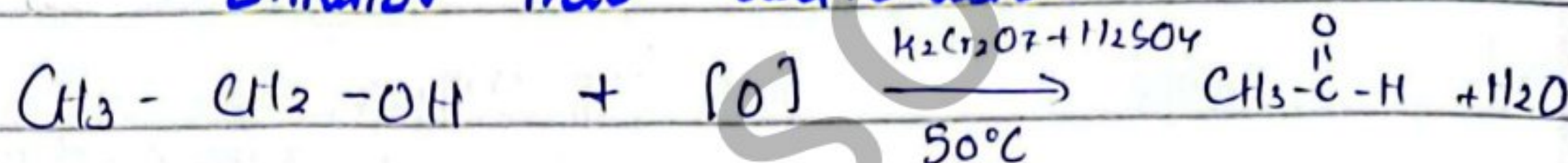
viii) b

ix) a

x) b

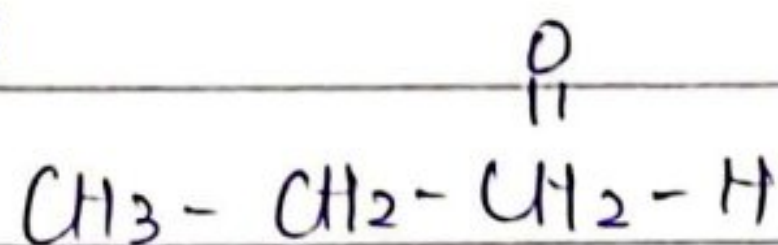
xi) c

iv) Ethanol into Lactic acid

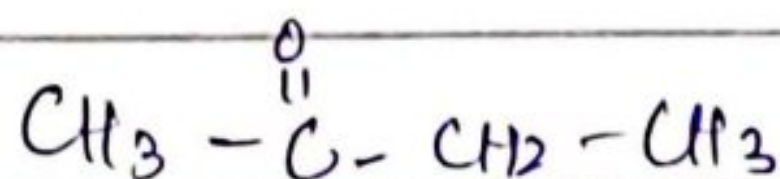


(IUPAC) 2-hydroxy propanoic acid
Lactic acid

10- $\text{C}_4\text{H}_8\text{O}$



Butanal



2-Butanone

(i) Tollen's / Fehling's

(ii) Iodoform 2-Butanone will give