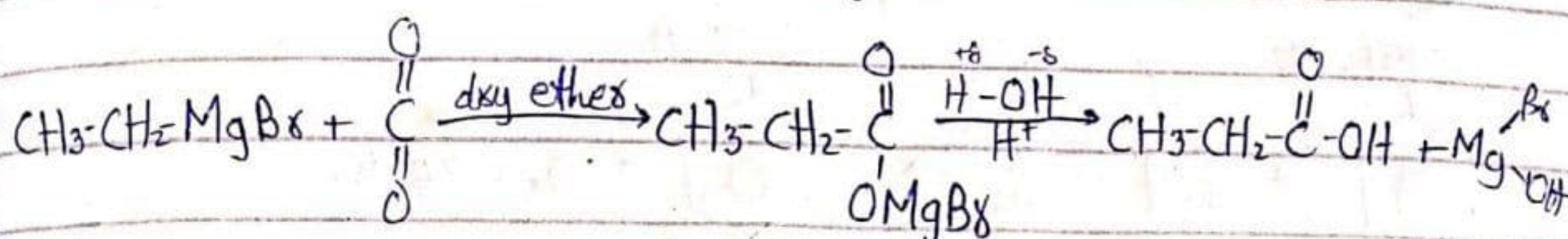
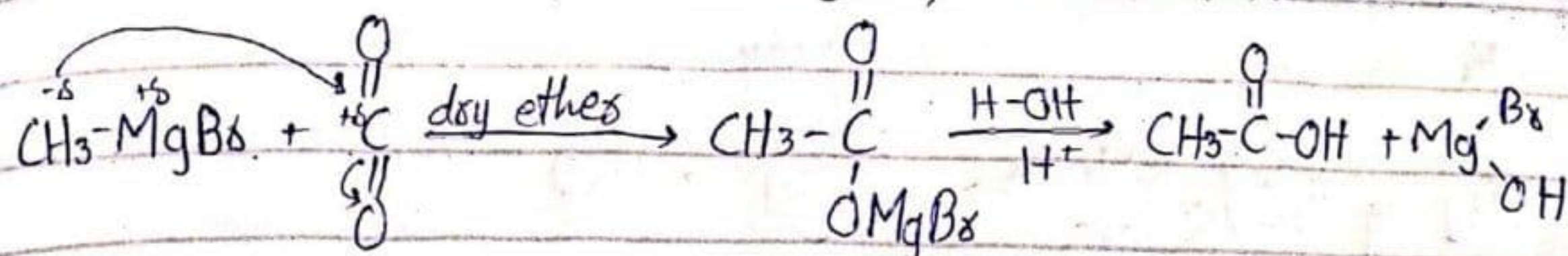


Carboxylic Acid and its derivative

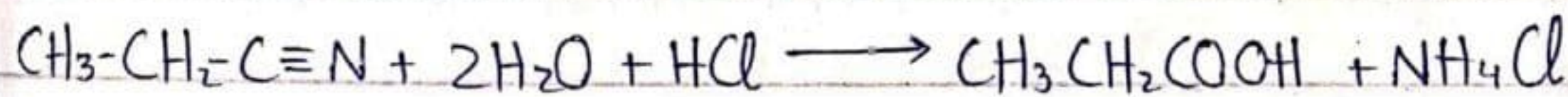
Preparation of Carboxylic acid

1- Rxn of CO_2 with Grignard's reagent (Carbonylation of Grignard reagent)

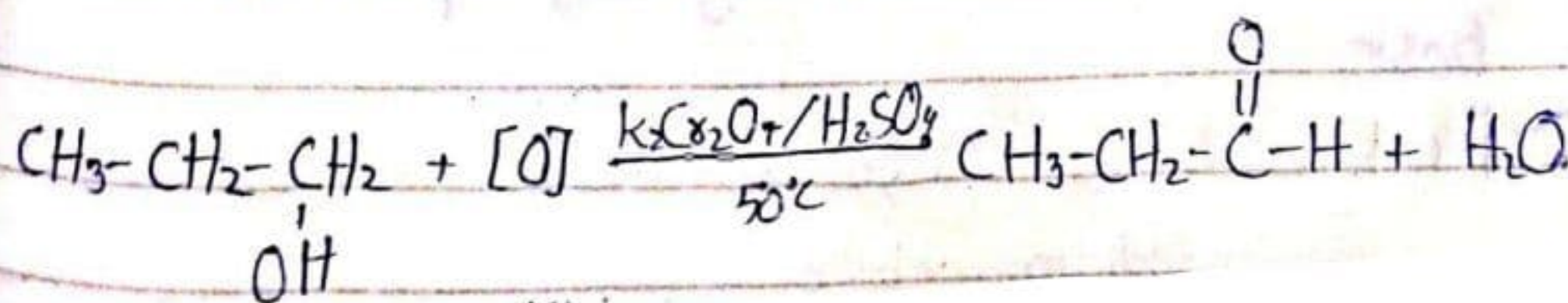
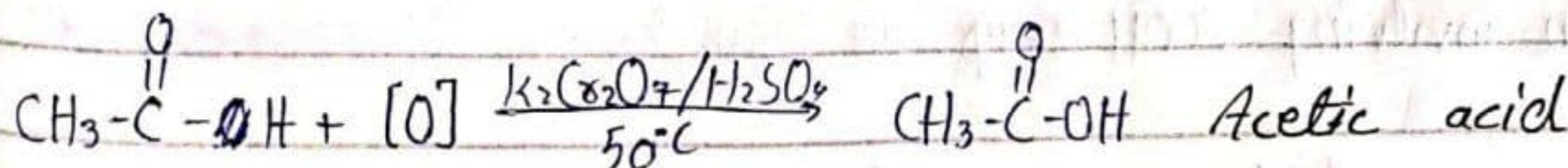
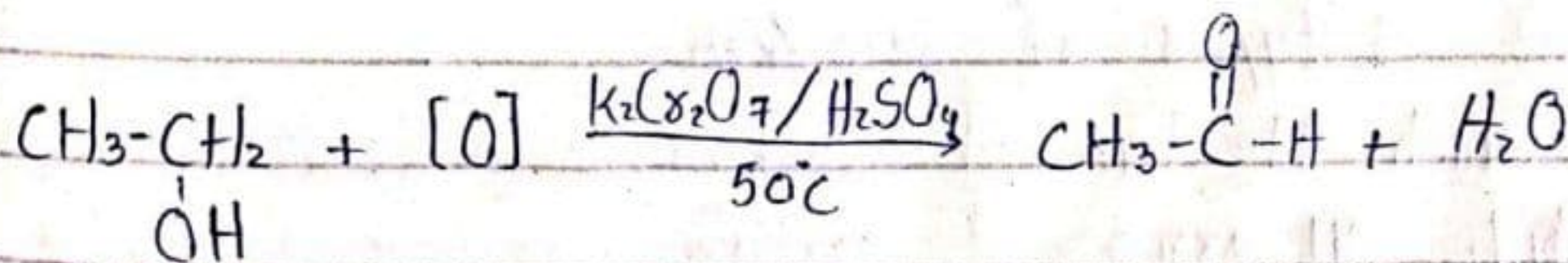


2- Hydrolysis of nitrile

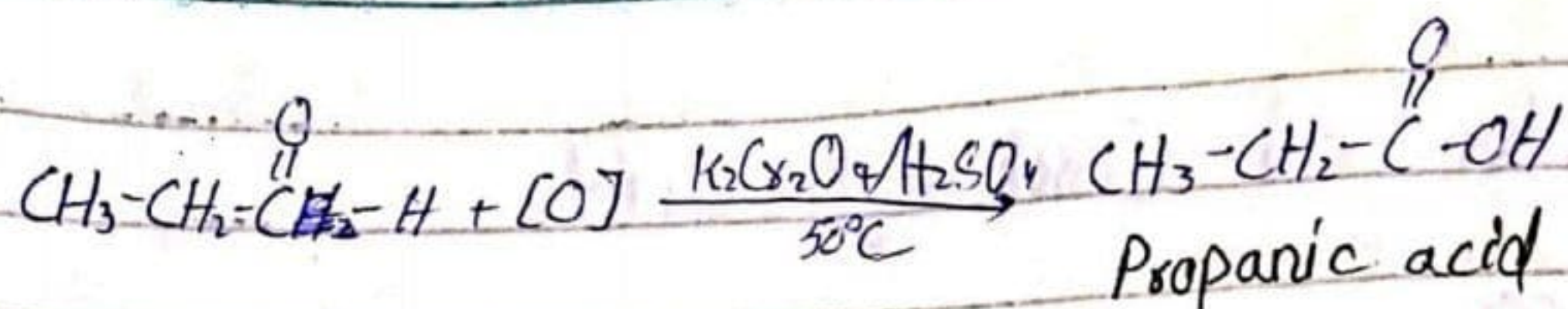
Organic compound containing cyanide group are called nitrile.



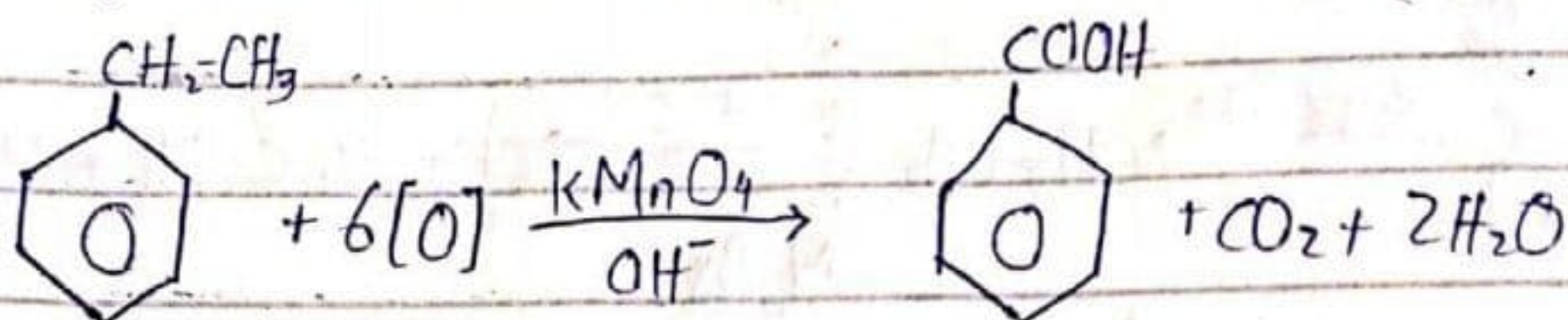
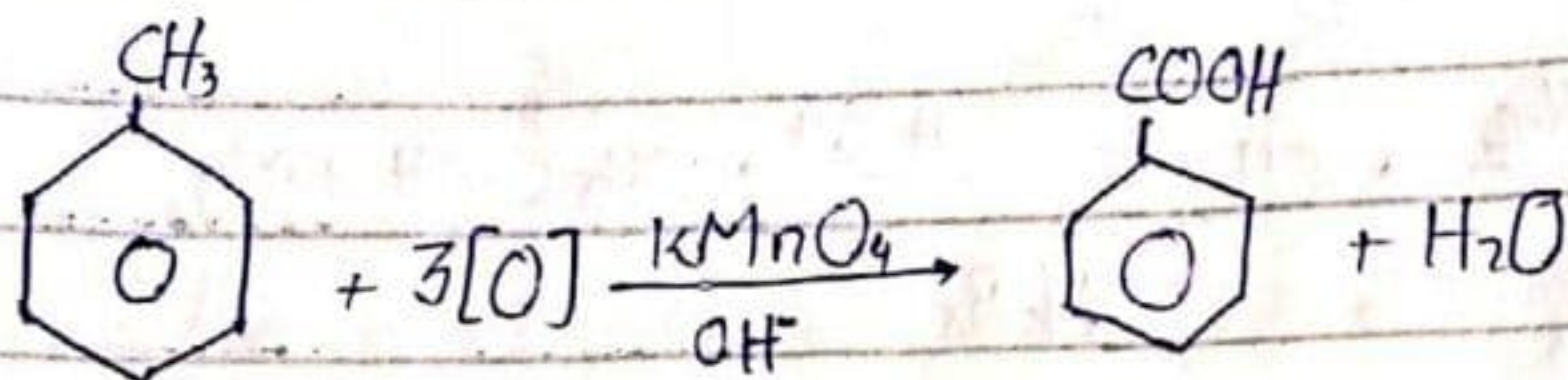
3- Oxidation of alcohol



4 $\Rightarrow$ Benzene to benzoic acid $\xrightarrow{\text{oxidation}}$ Benzoic acid
 Benzene $\xrightarrow{\text{acylation}}$ Methyl benzene



4- oxidation of side chain



Reactivity

Carboxylic group contain chemistry of carbonyl group and hydroxyl group, carboxylic group is reactive due to presence of carbonyl group which increase the polarity of OH-group.

- 1- Meta directing group make them highly reactive
- 2- Bigger the alkyl group attached to the carboxylic group it is less reactive
- 3- Ortho para group make them more reactive than simple carboxylic acid but less than meta group

Reactions

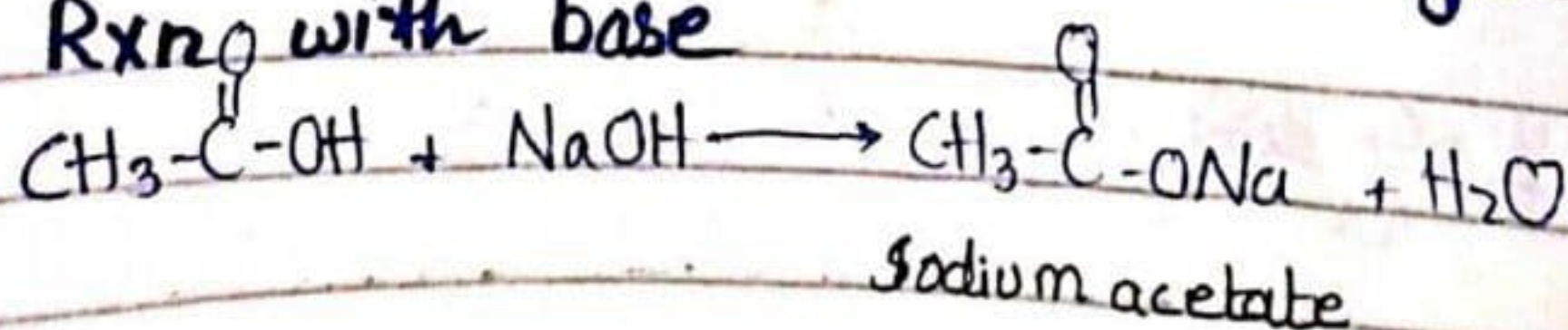


These are 3 types of reaction-

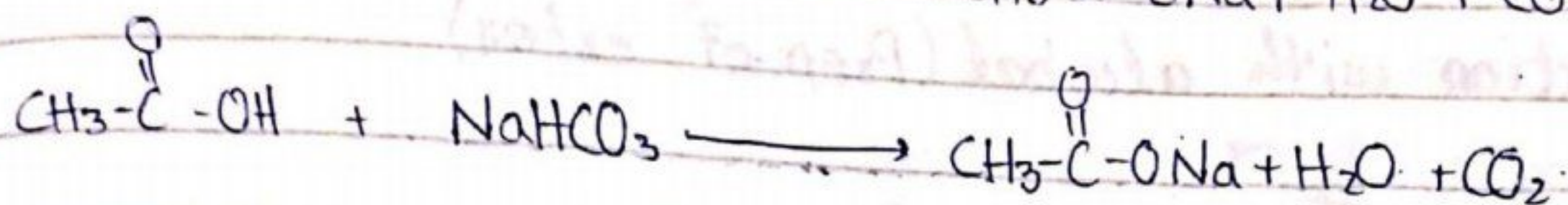
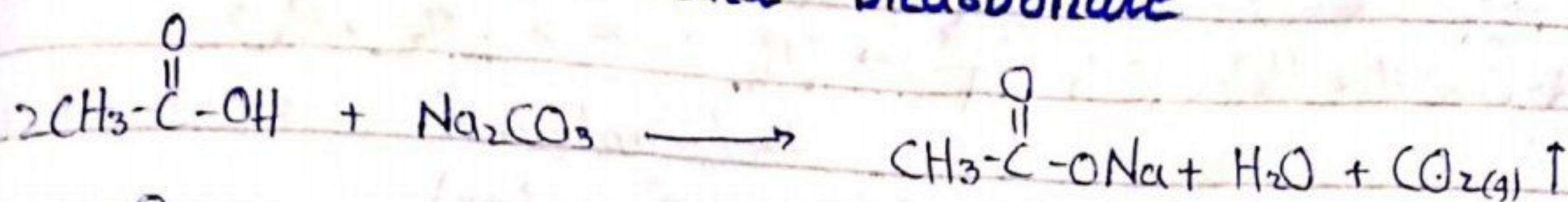
- 1- Rxn in which H-atom of carboxylic group is involve
- 2- Rxn in which OH-group of carboxylic group is involve
- 3- Rxn involving COOH group as whole

2- Rxn in which H-atom of Carboxylic group is involve

i) Rxn with base

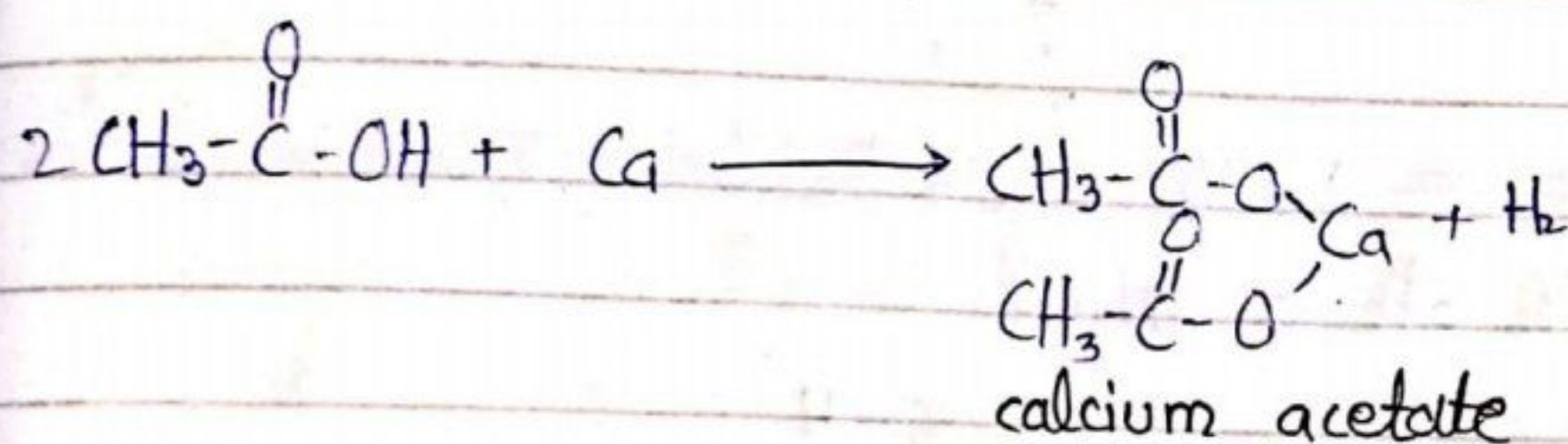
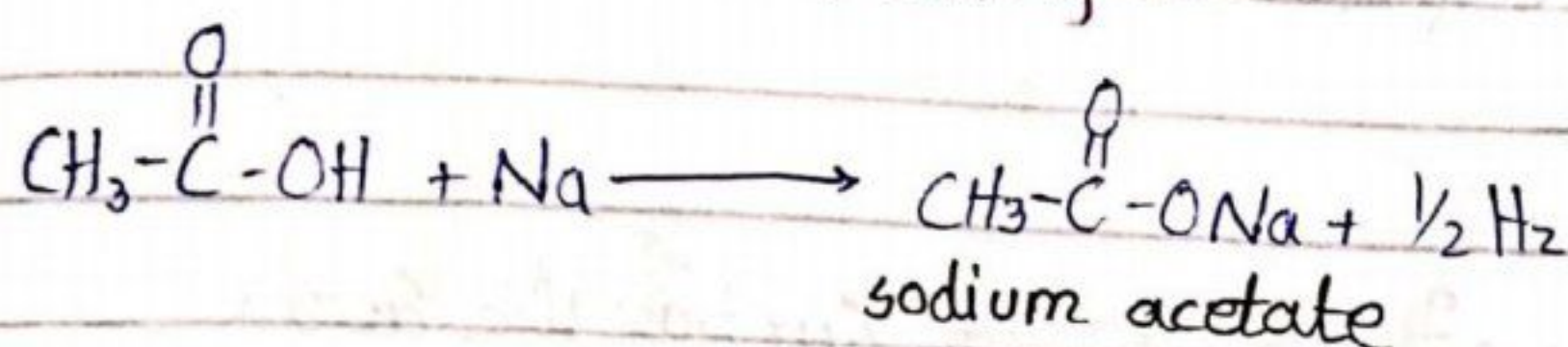


ii) Rxn with carbonate and bicarbonate



iii) Rxn with metals

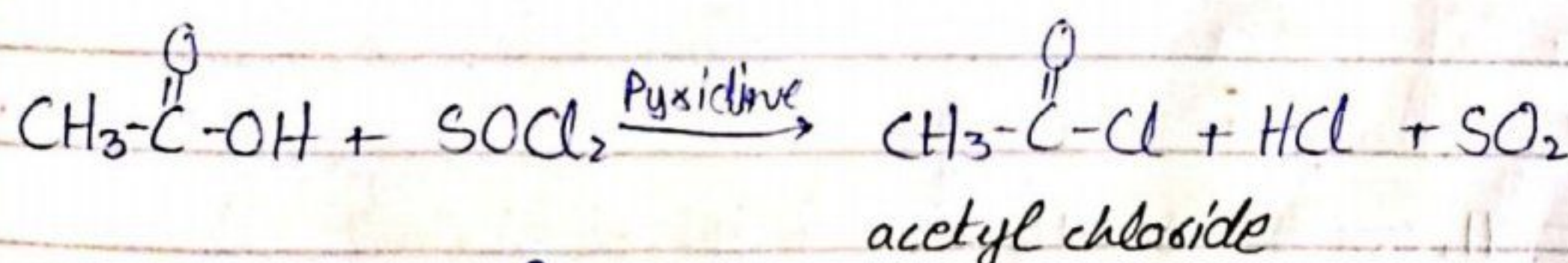
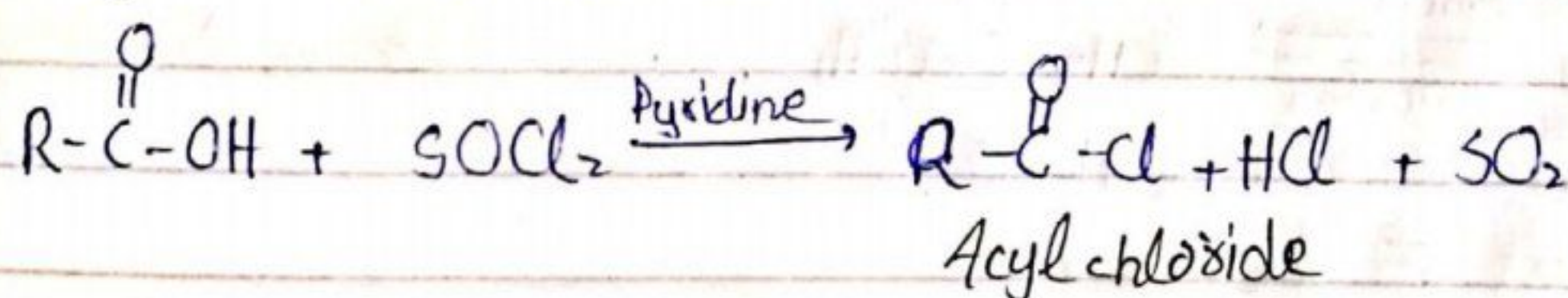
Active metals $\Rightarrow$ Na, K, Ca, Mg



2- Rxn in which OH group of COOH is involved

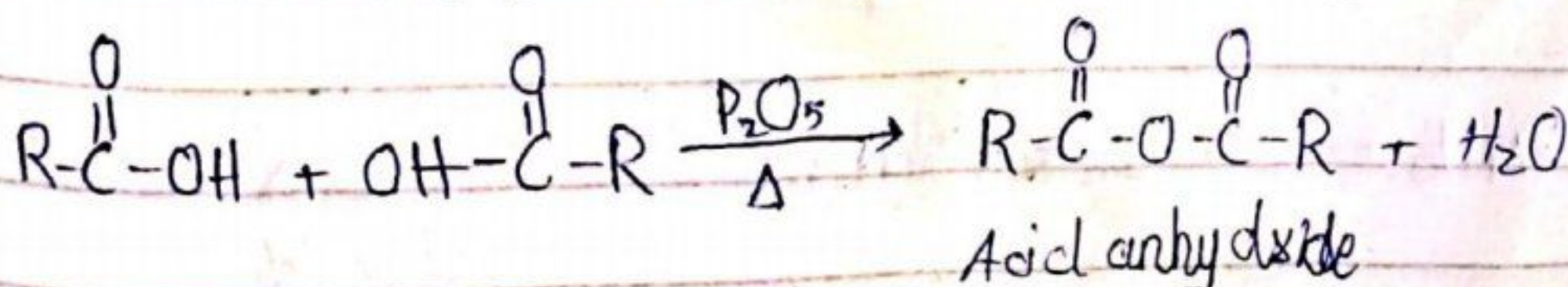
i) Reaction with thionyl chloride (SOCl_2)
or

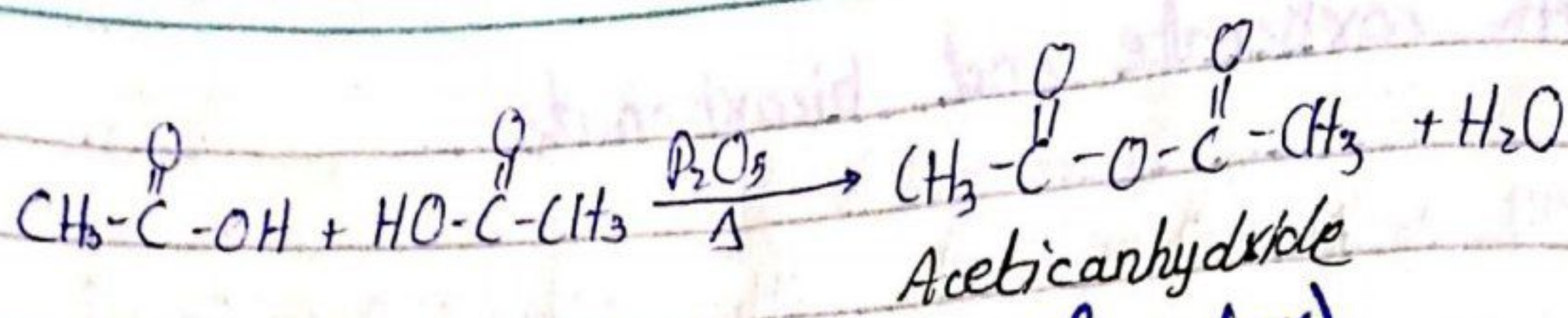
Prep. of Acid halide



2) Dehydration of carboxylic acid
or

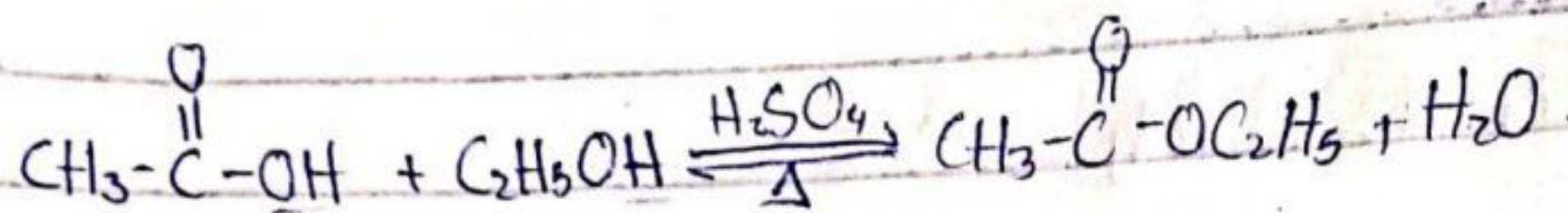
Rxn with P_2O_5 or Prep. of Acid anhydride





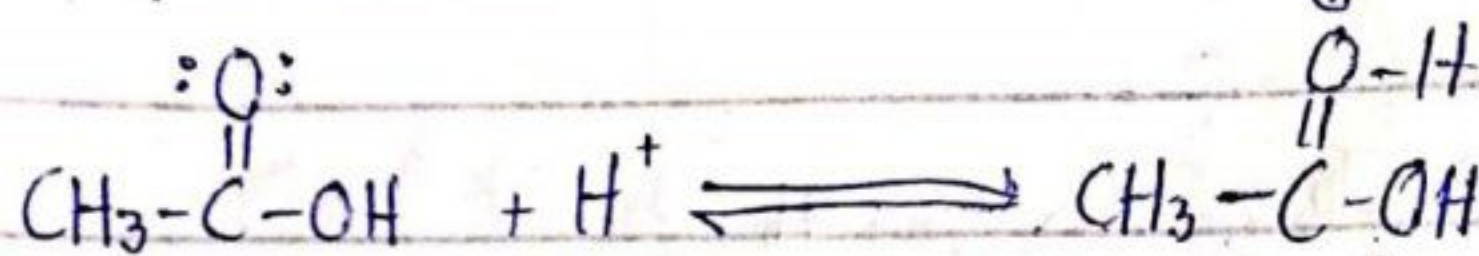
iii) Reaction with alcohol (Prep. of ester)

Identification ^{or} test of carboxylic group

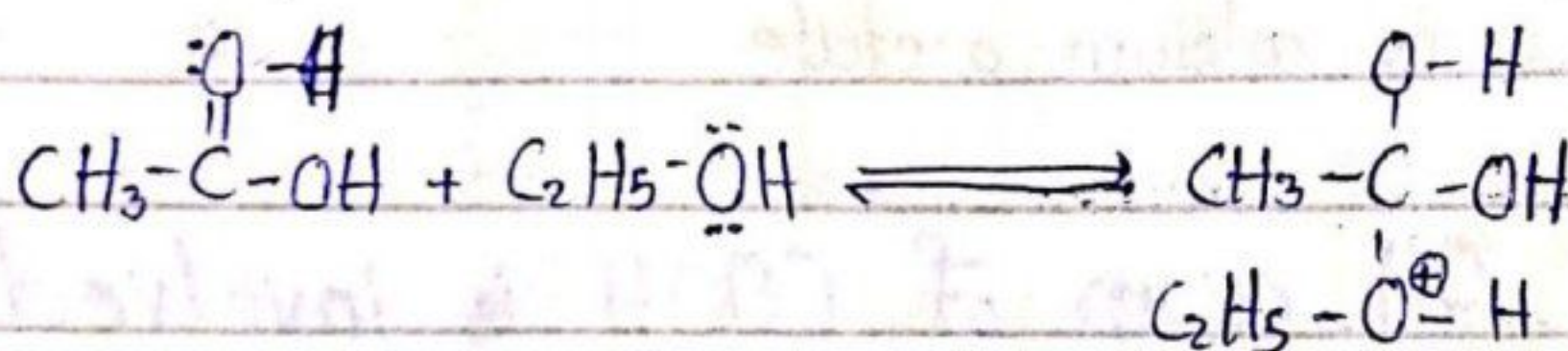


Mechanism

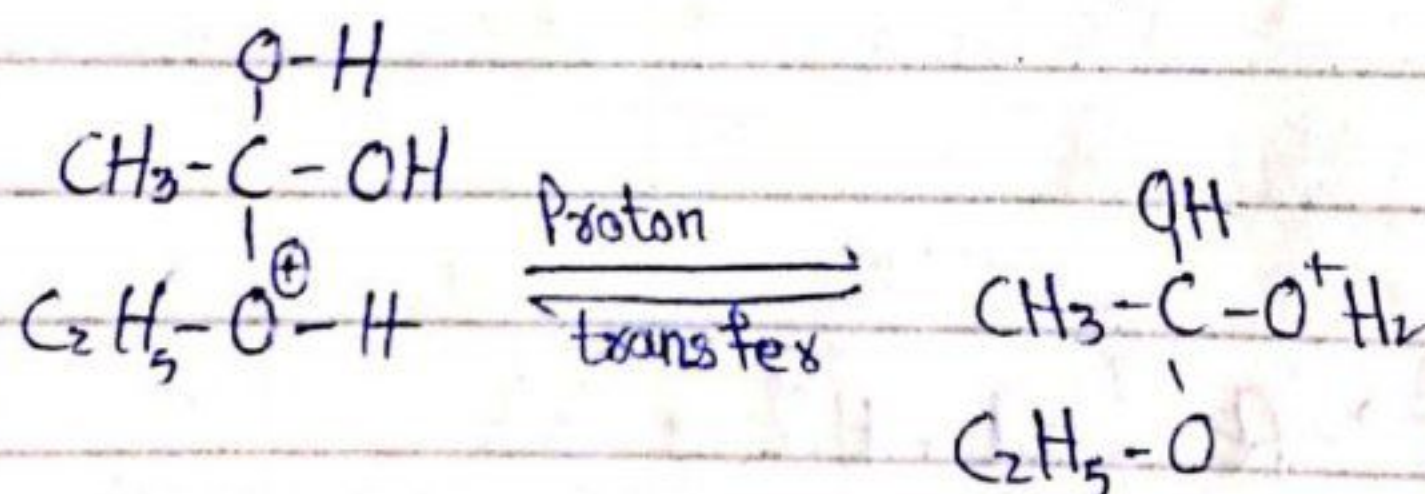
Step-1 (Protonation of Oxygen of Carboxylic acid)



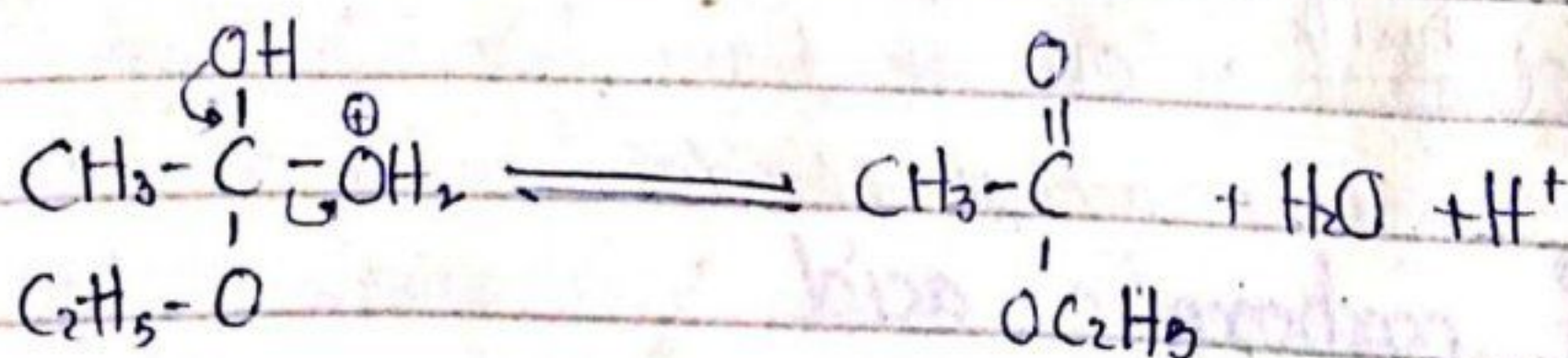
Nucleophilic attack of alcohol



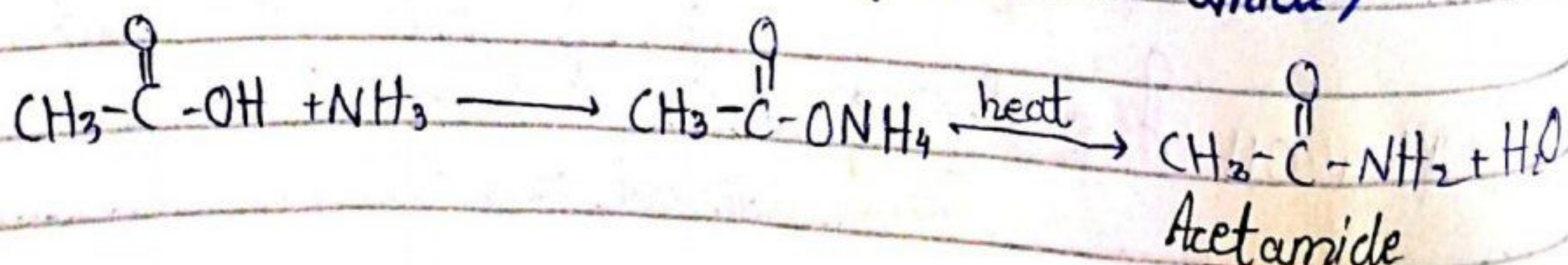
3- Transfer of proton



4- Elimination of H₂O and H⁺



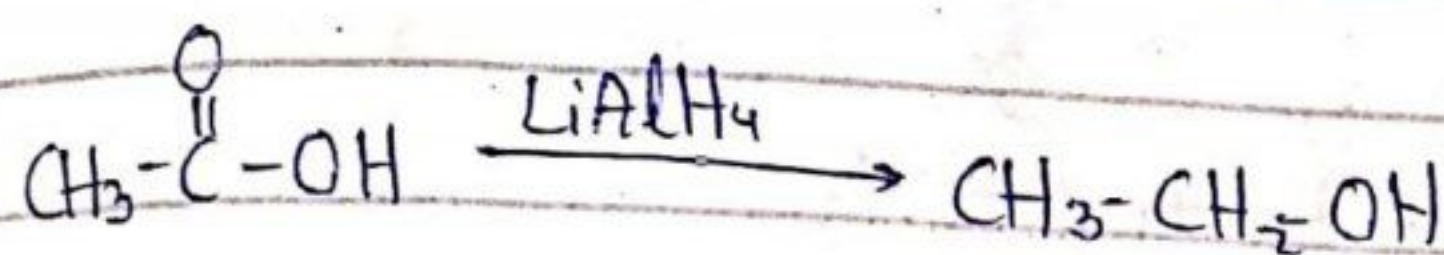
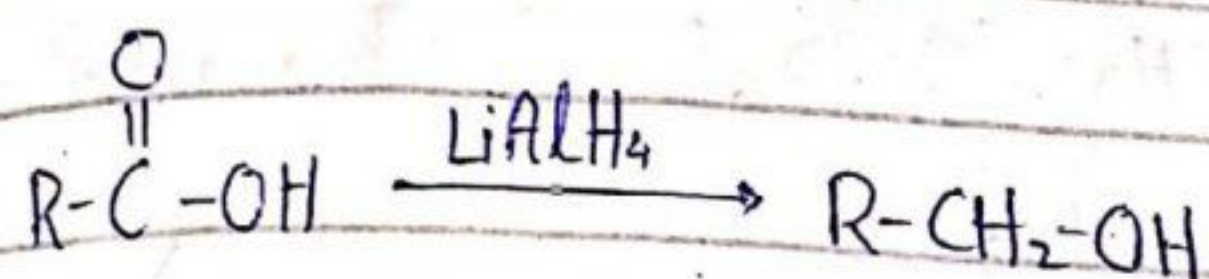
iv) Reaction with ammonia (Preparation of amide)



3. Reaction involving -COOH as Whole

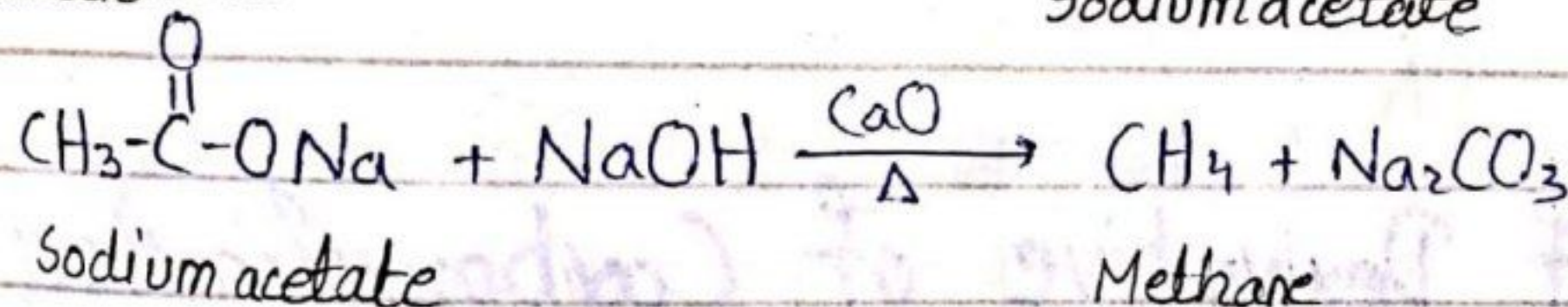
1. Reduction to alcohol

Carboxylic acid are reduce into primary alcohol. Carboxylic acid are less reactive than aldehyde, ketone, or ester for reduction. Therefore they are reduce with LiAlH_4 .

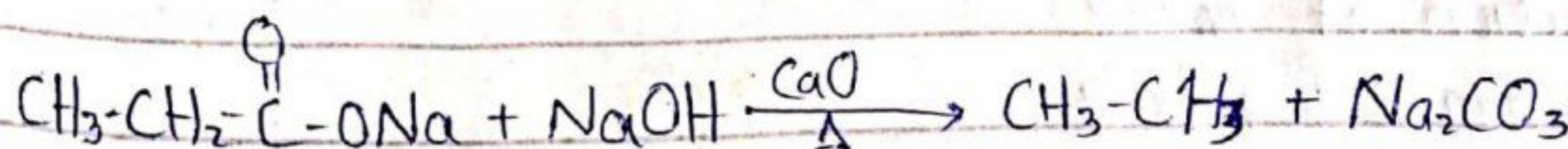
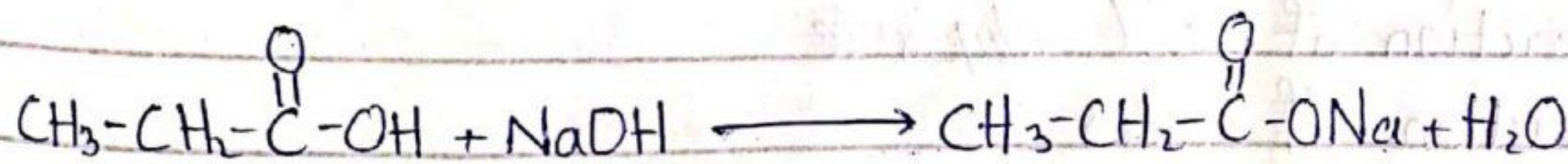


2. ^{V.V.V-4} Decarboxylation

Removal of CO_2 from molecule is called decarboxylation. For decarboxylation soda lime ($\text{NaOH} + \text{CaO}$) is used.



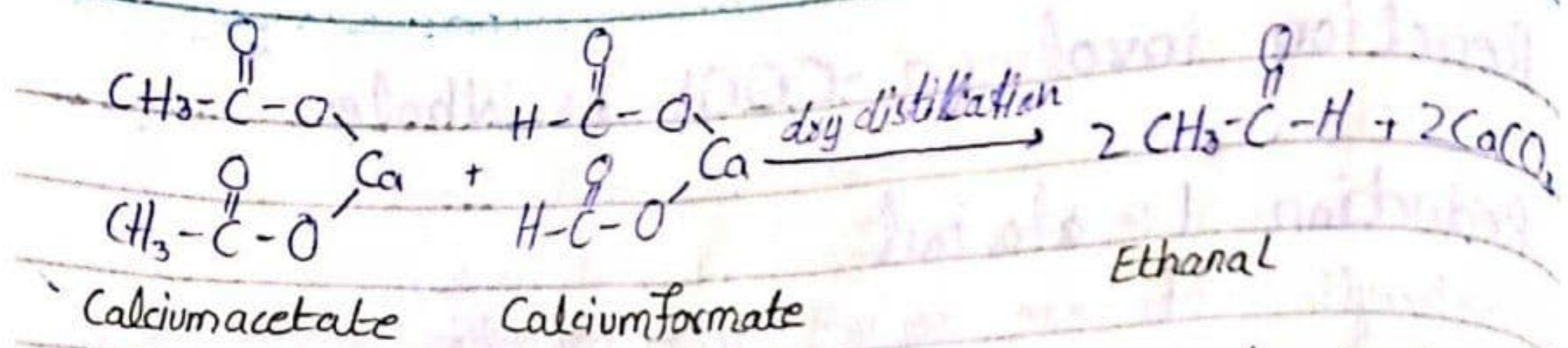
Q:- Convert Propanoic acid $\longrightarrow$ Ethane



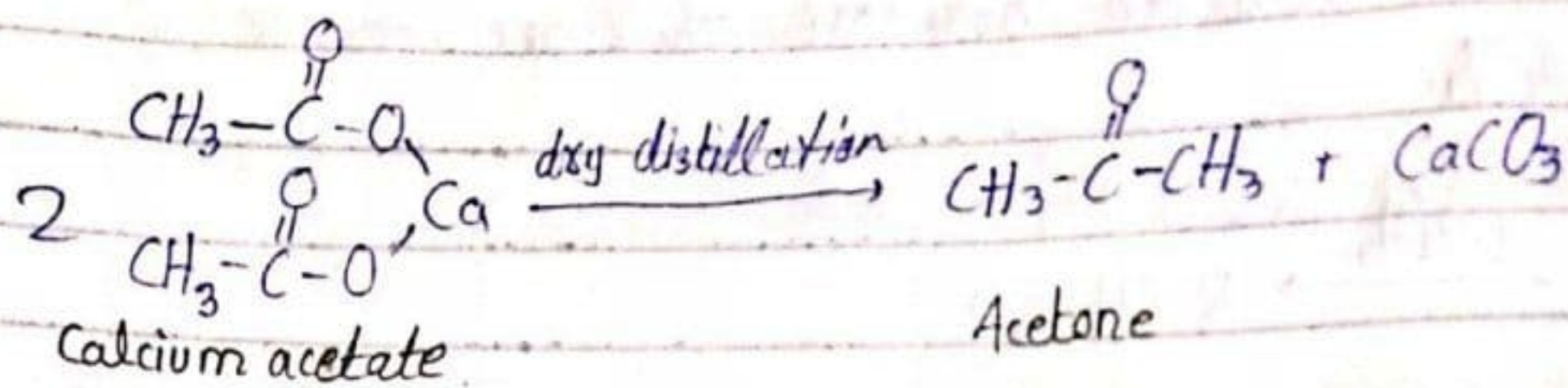
3. Dry distillation

Q: What happen when Calcium acetate & Calcium formate is heated

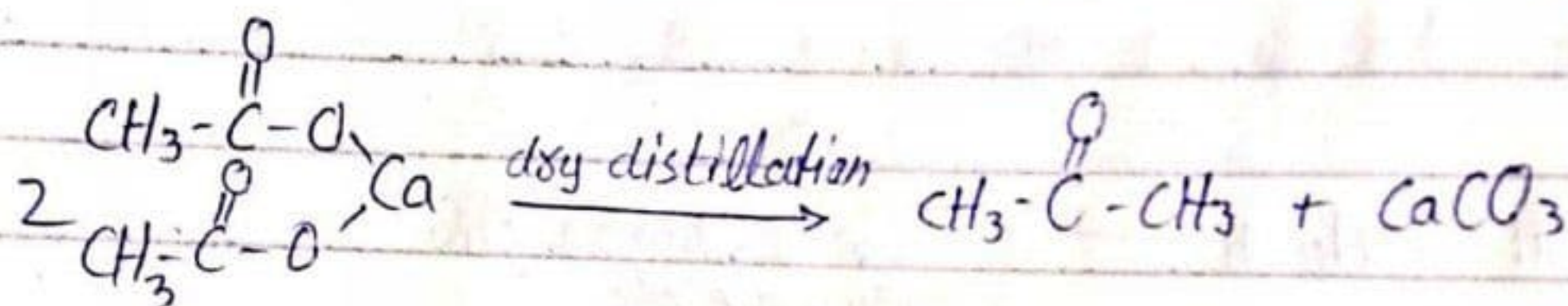
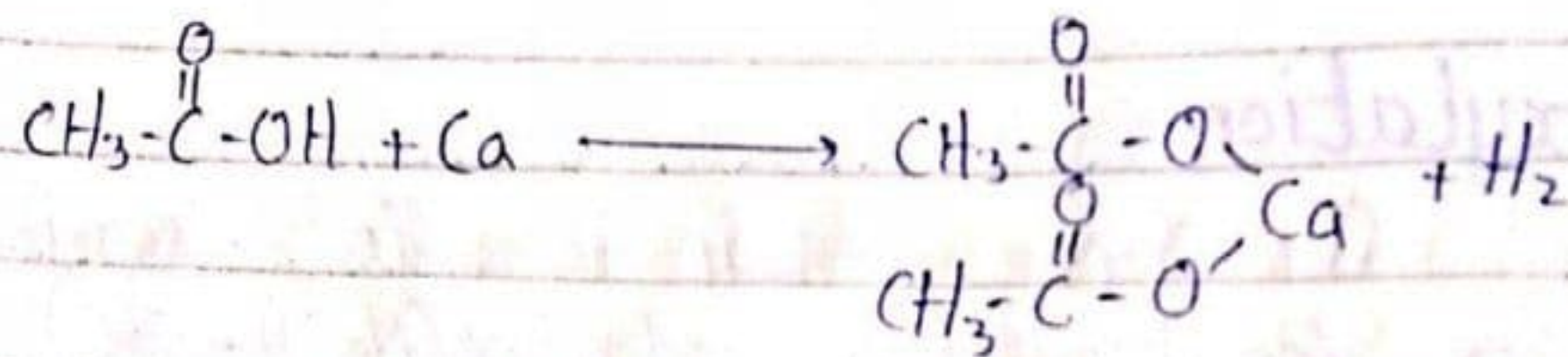
"When solid salt is directly heated this process is called dry distillation"



Q: What happen when calcium acetate is heated



Q: Convert $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH} \longrightarrow \text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$



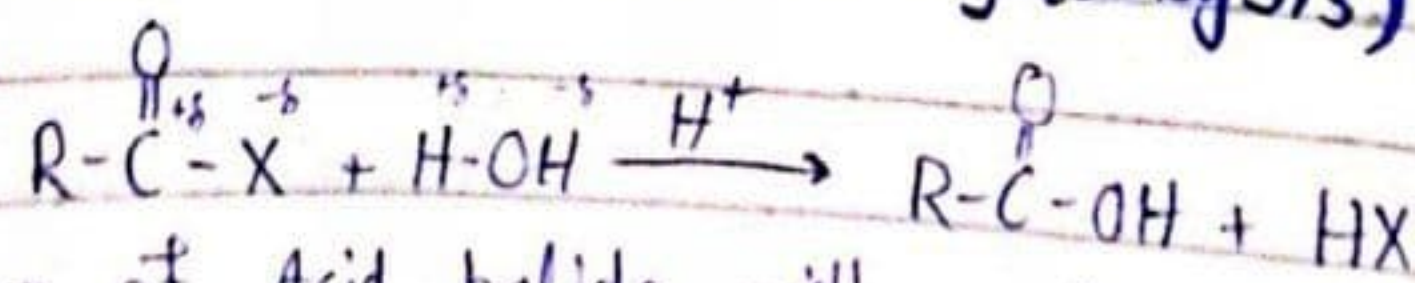
Reaction of Derivative of Carboxylic Acid

- 1- Reaction of Acid halide
- 2- Reaction of acid anhydride
- 3- Reaction of ester
- 4- Reaction of amide
- 5- Reaction of nitrile



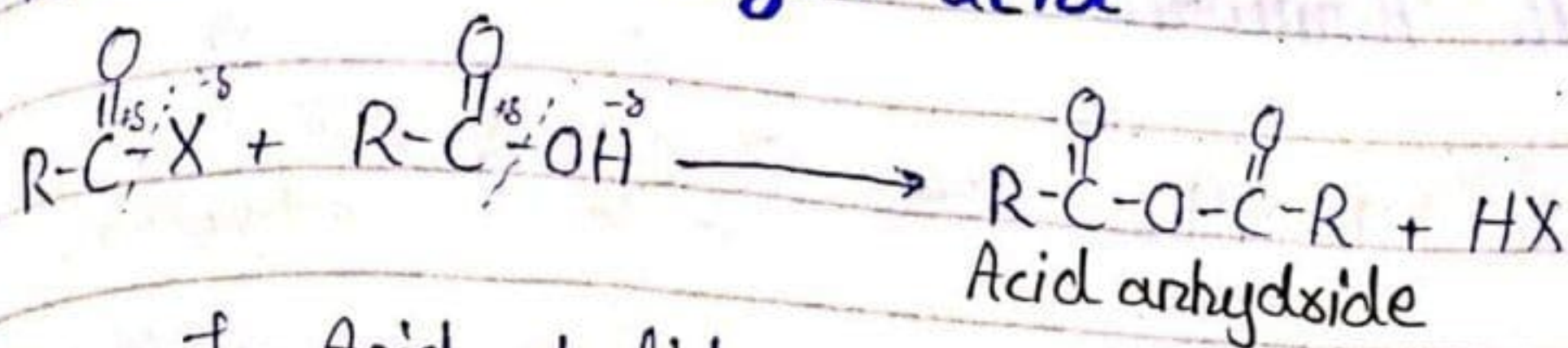
1- Reaction of Acid halide

1) Rxn with water (Hydrolysis)



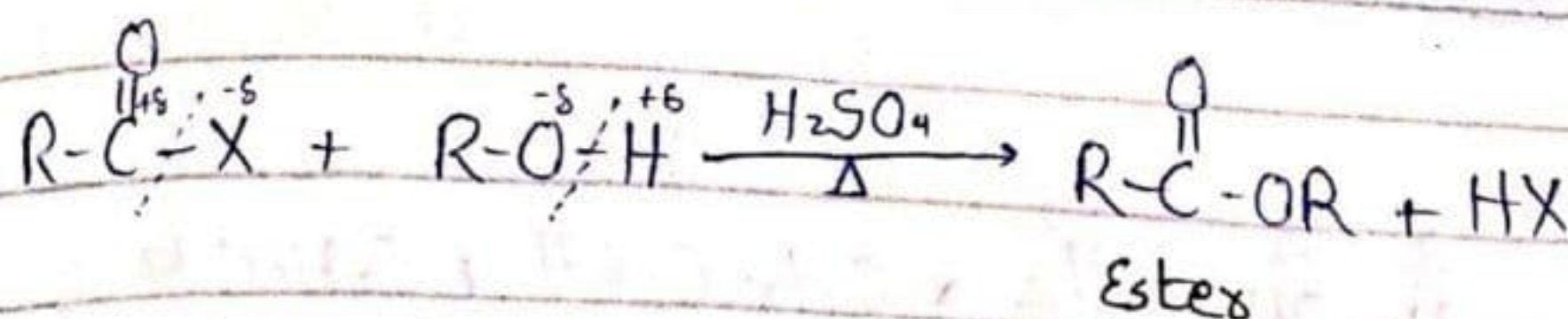
Rxn of Acid halide with water produce carboxylic Acid

ii) Rxn with carboxylic acid



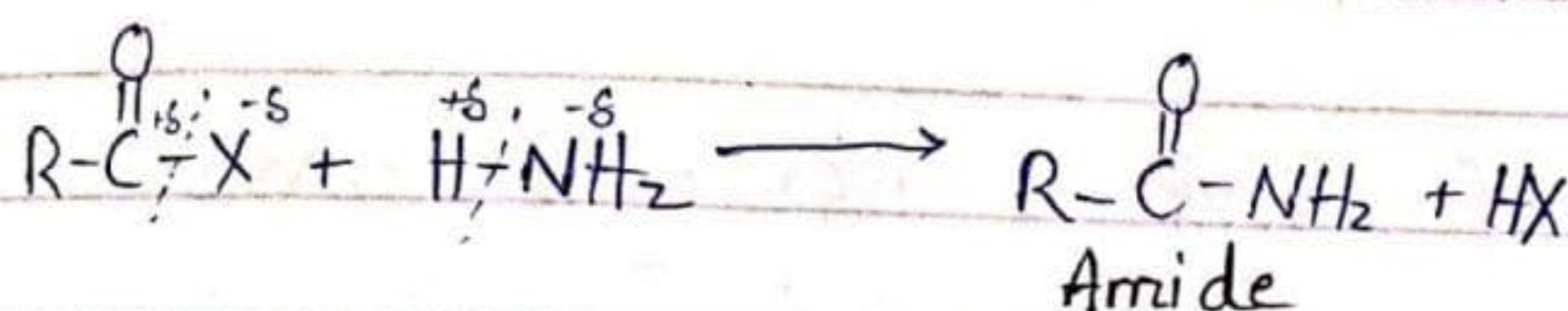
Rxn of Acid halide with carboxylic acid produce Acid anhydride.

iii) Rxn with alcohol



Rxn of Acid halide with alcohol produce ester.

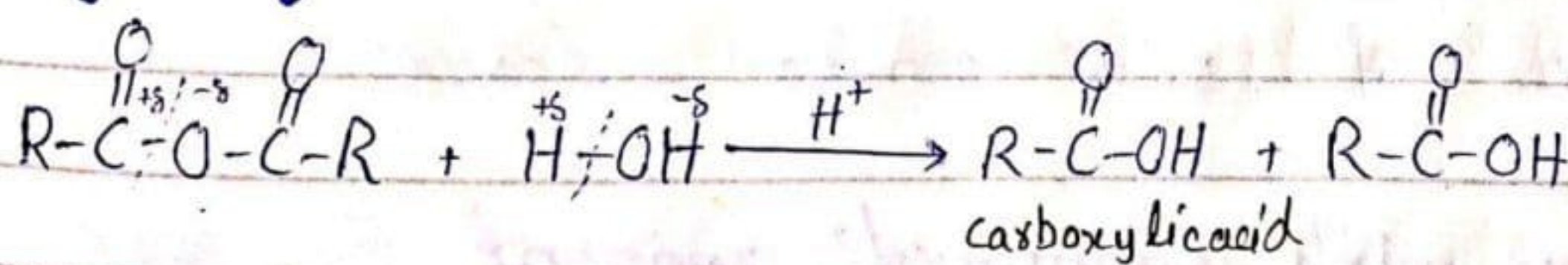
iv) Rxn with Ammonia



Rxn of Acid halide with ammonia produce amide.

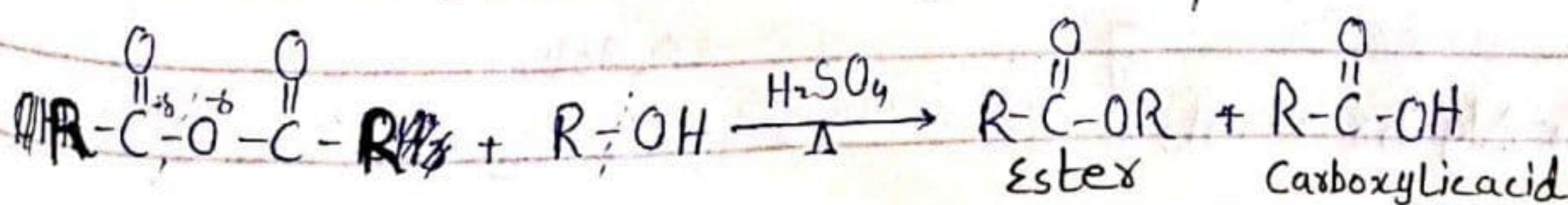
2- Reaction of Acid anhydride

i) Hydrolysis



Hydrolysis of Acid anhydride produce carboxylic acid.

ii) Rxn with alcohol (Alcoholysis)

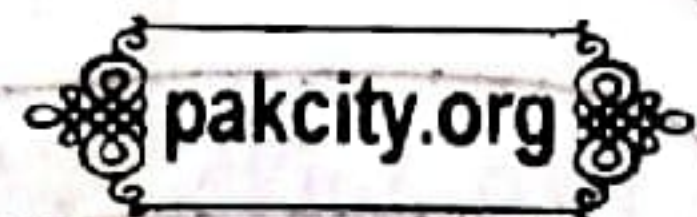


Rxn of Acid anhydride with alcohol produce ester & carboxylic acid.

ii) Rxn with Ammonia

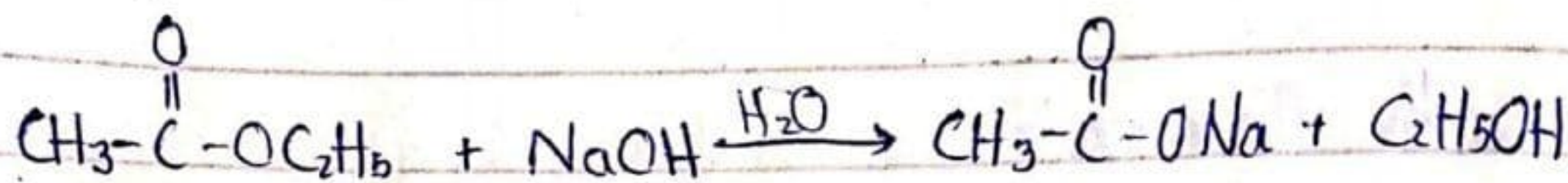
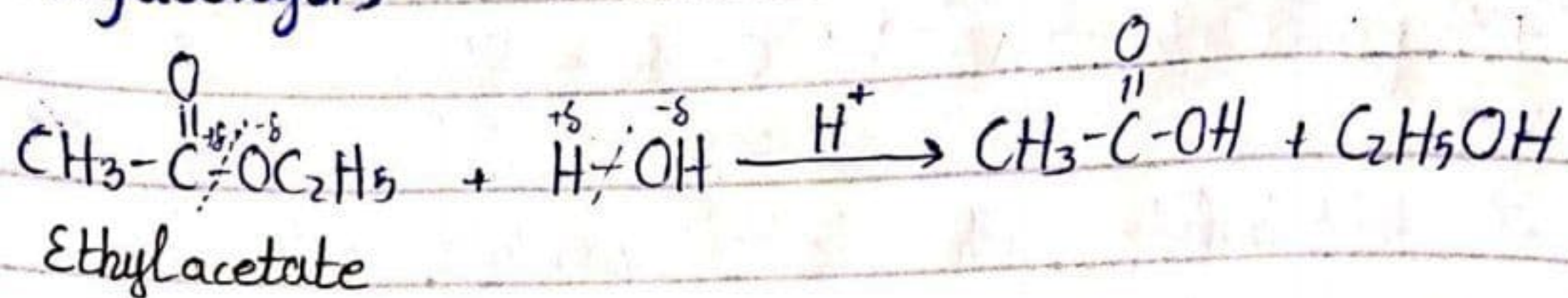


Rxn of acid anhydride with ammonia produce amide & carboxylic acid.



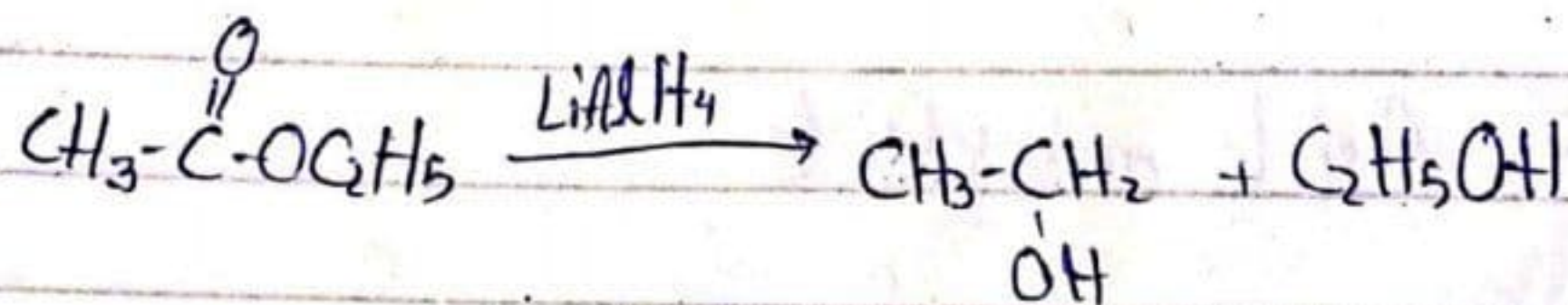
3- Rxn of Ester

i) Hydrolysis



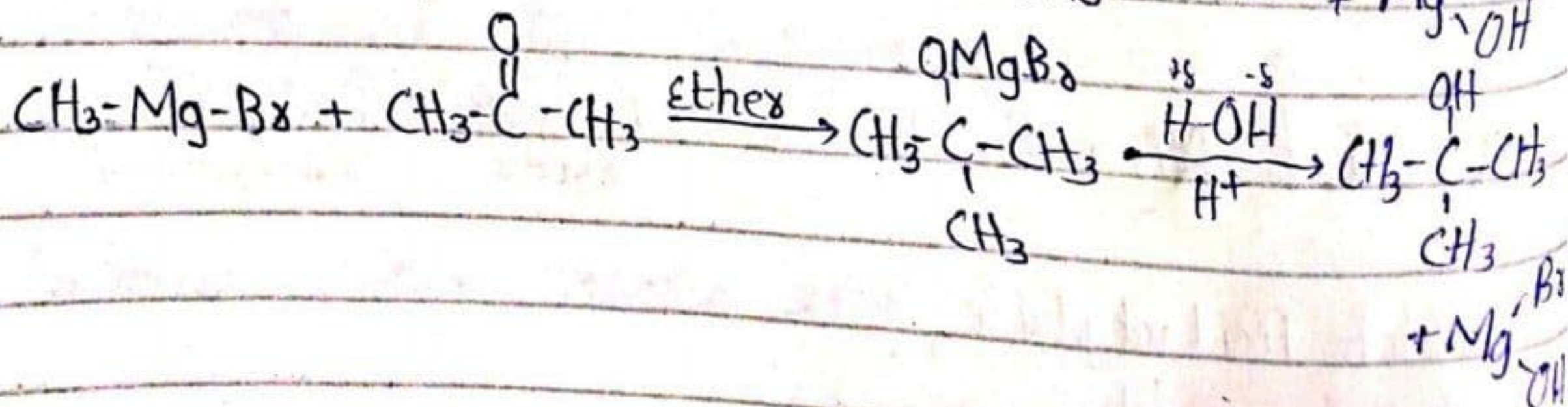
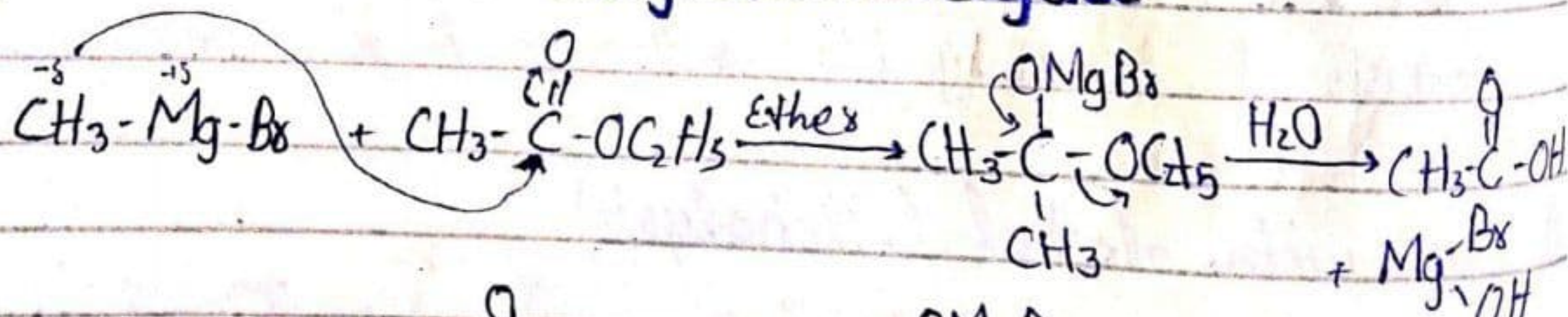
Basic hydrolysis of ester is also called saponification.

ii) Reduction of ester



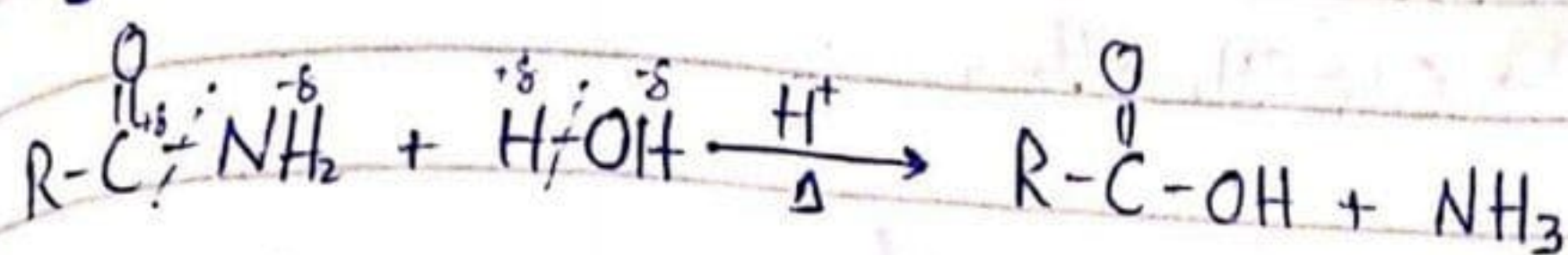
Reduction of ester produce alcohol

iii) Reaction with Grignard's reagent

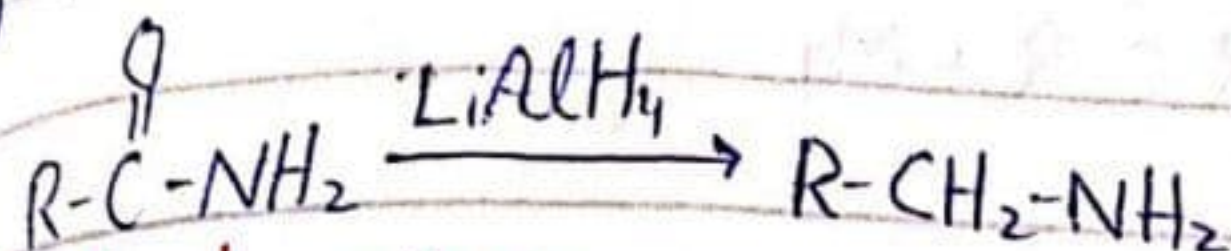


4- Rxn with of Amide

i) Hydrolysis



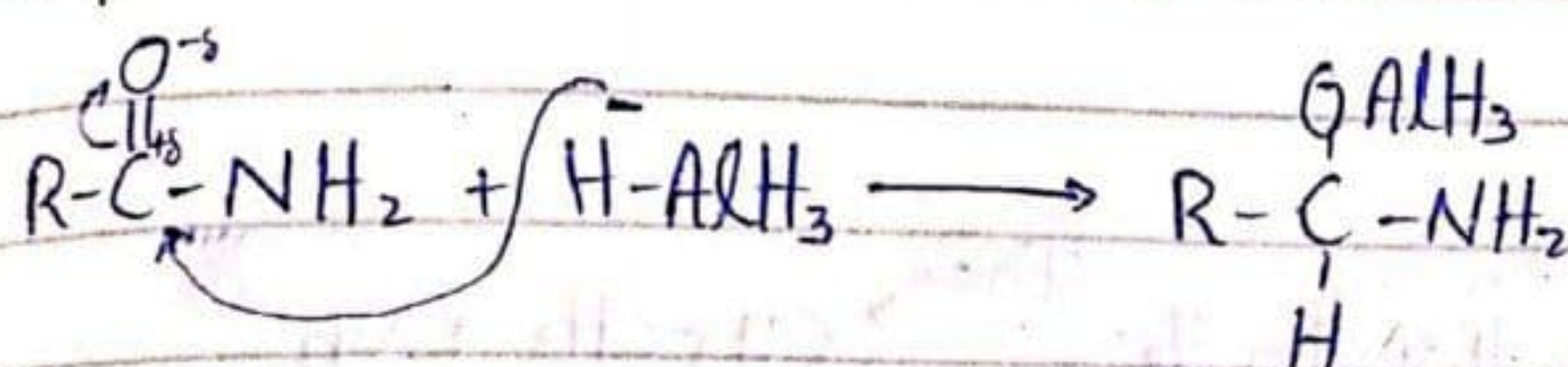
ii) Reduction of Amide



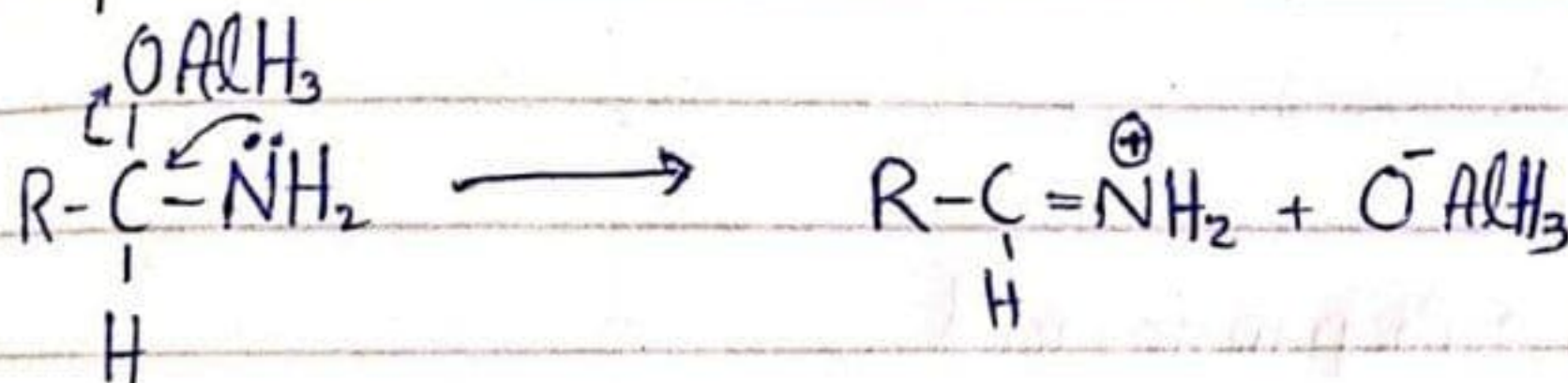
Mechanism



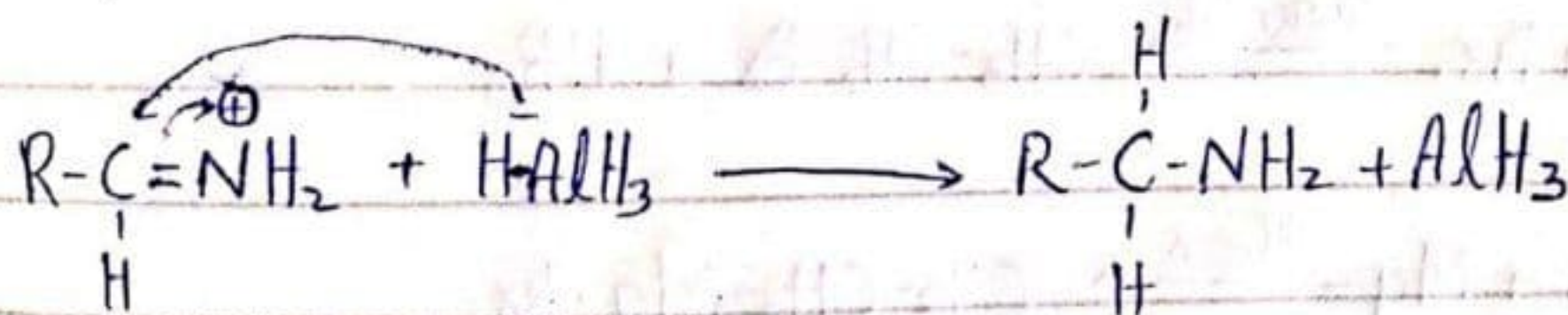
Step-1



Step-2

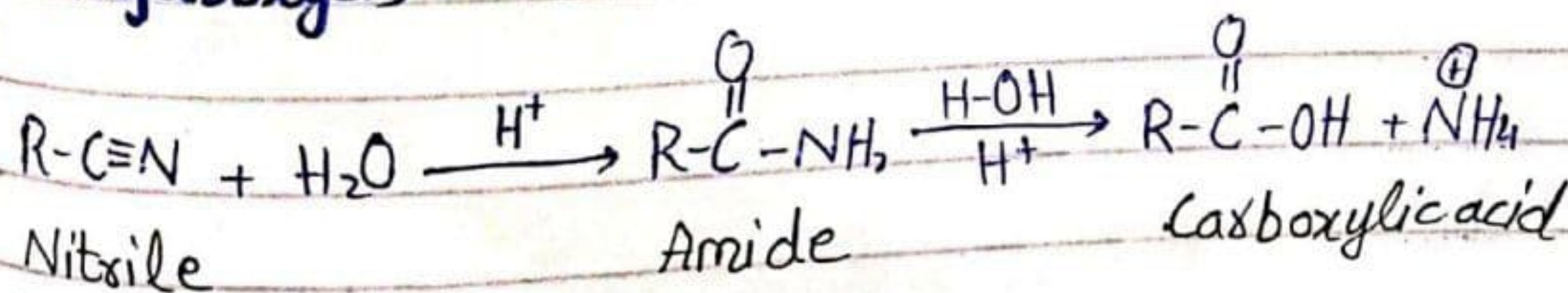


Step-3

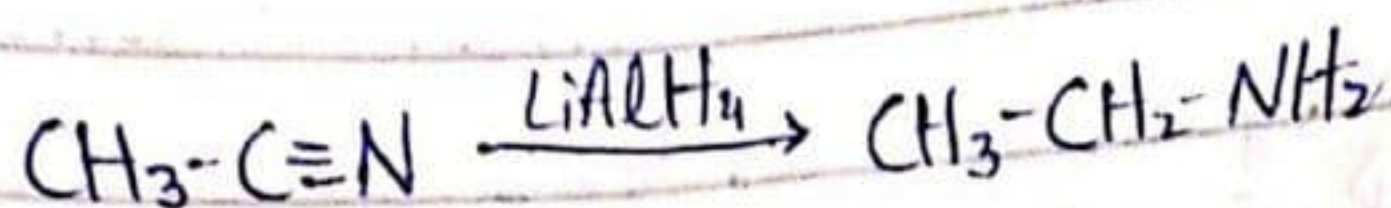
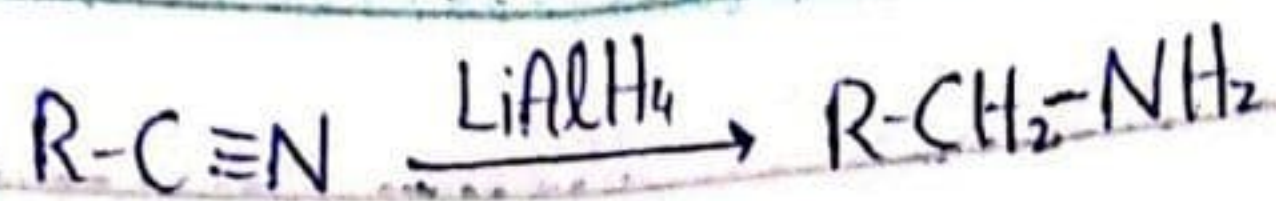


5- Rxn of nitrile

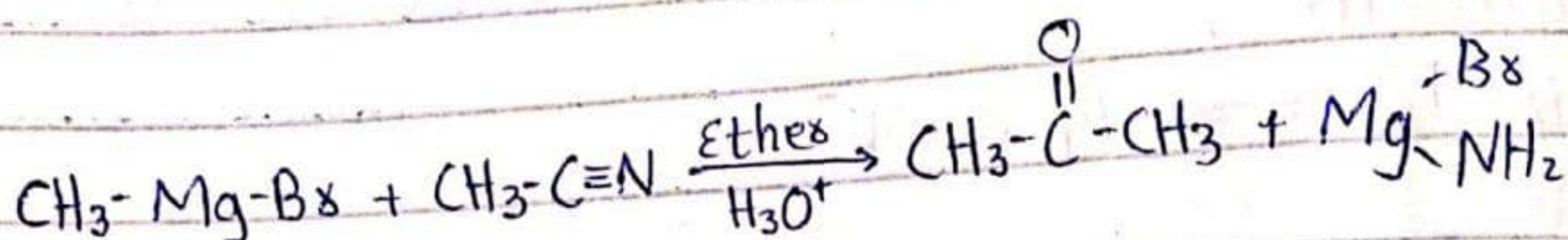
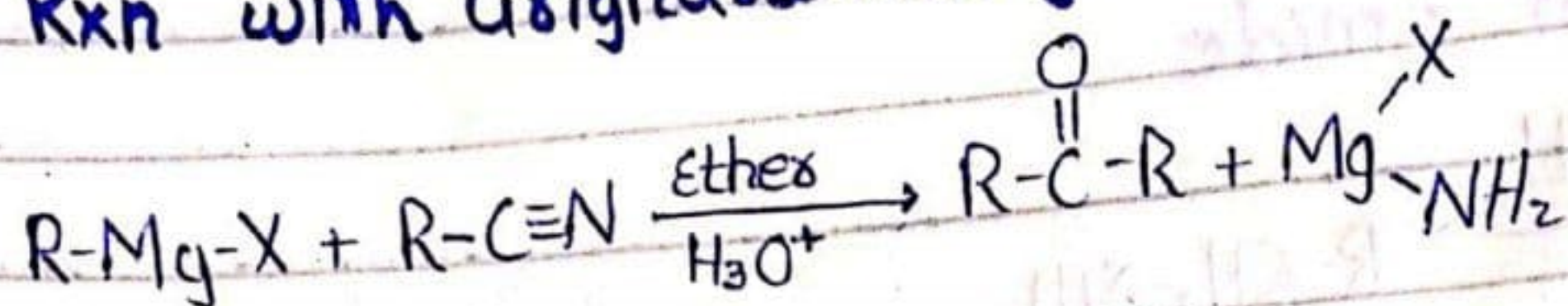
i) Hydrolysis



ii) Reduction of Nitrile

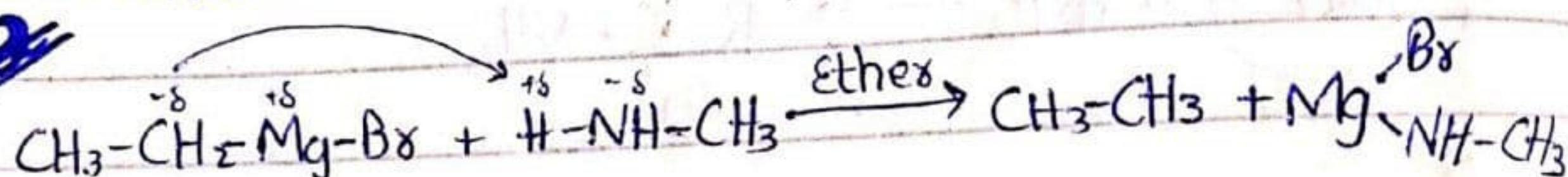


iii) Rxn with Grignard's reagent



Exercise

Q2



Q5

Convert
Ethane $\longrightarrow$ Propanoic acid

