



Dr. Blossa Science

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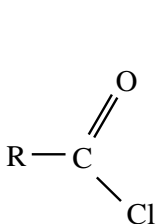
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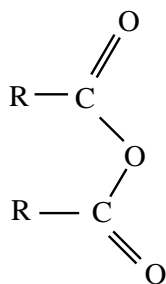
Nurture your dreams

Functional derivatives of carboxylic acids

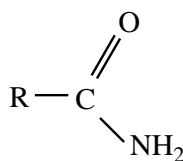
Closely related to carboxylic acids and to each other are a number of chemical families known as functional derivatives of carboxylic acids: Acid halide, anhydride, amide and esters. These derivatives are compounds in which the OH of the carboxylic acid has been replaced by X(Cl, Br, I), OOCR, NH₂ or OR.



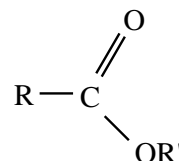
Acid chloride



Acid anhydride

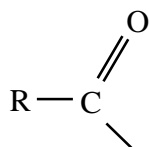


Acid amide



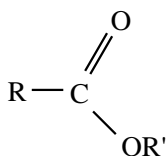
Ester

They all contain the group

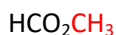


1. Esters

They have a general formula



Examples



Methylmethanoate



Ethylethanoate



Ethylpropanoate

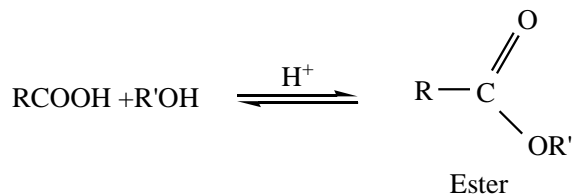
Physical properties

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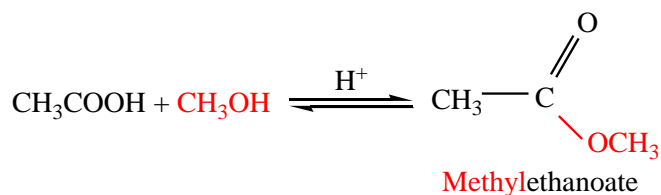
- (i) Insoluble in water but soluble in organic solvent
- (ii) They are neutral liquids with pleasant smell
- (iii) They have low boiling points compared to carboxylic acids of comparable molecular mass.

Preparation

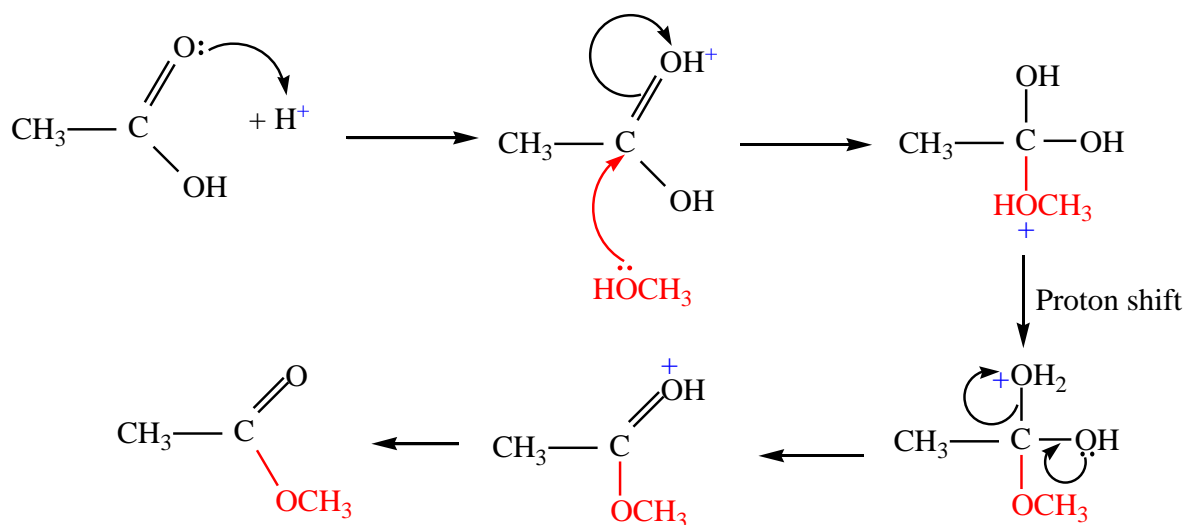
- (a) By reacting carboxylic acids with alcohol in the presence of mineral acids



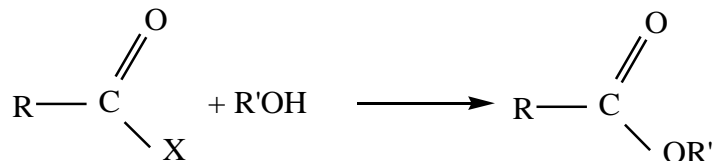
Example



Mechanism

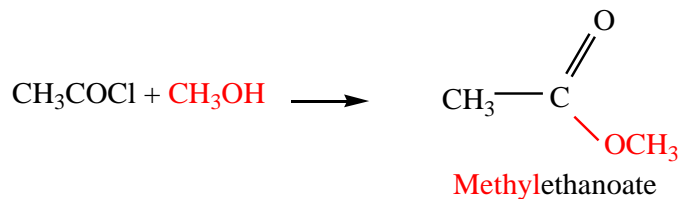


- (b) reaction of alcohols with acid halides

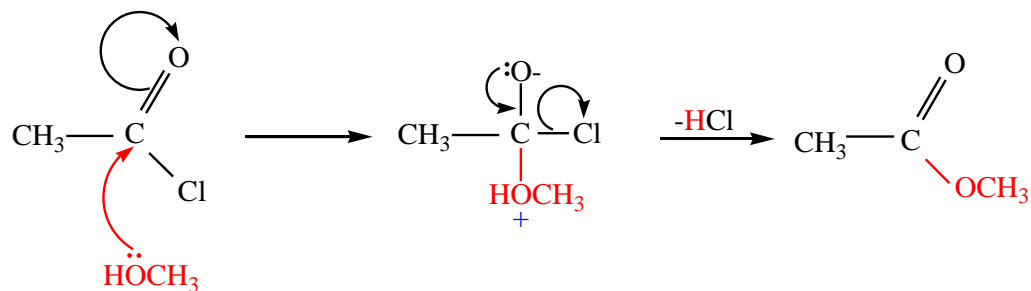


where X = Cl, Br, or I

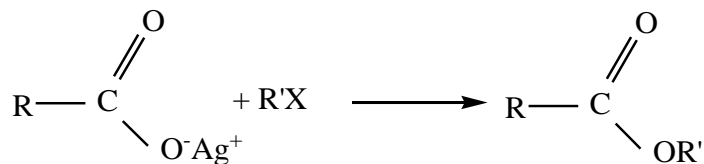
Example



Mechanism



(c) By reacting silver salts of carboxylic acid with alkyl halide

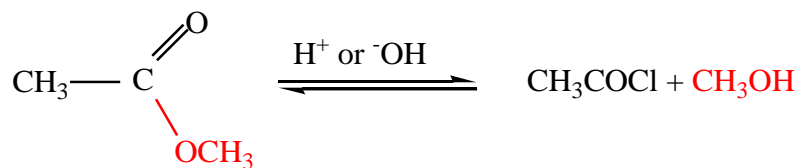


Chemical properties

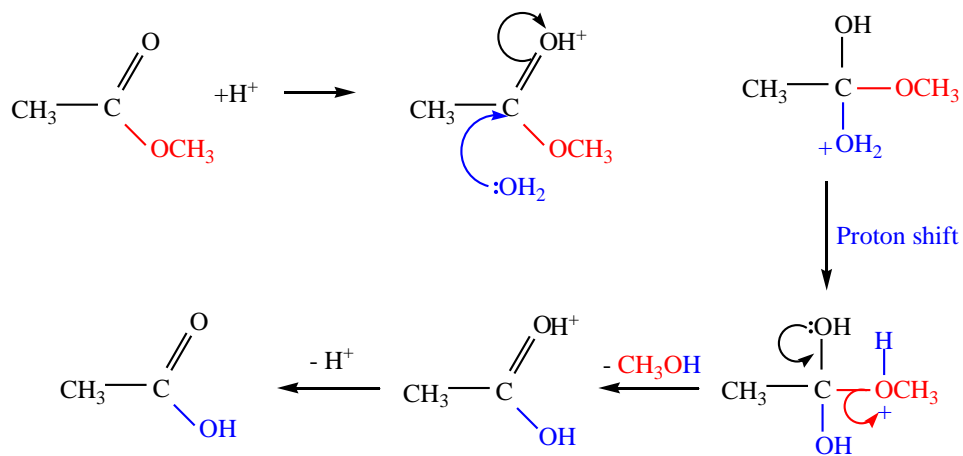
1. Hydrolysis

Esters are hydrolyzed by mineral acids or alkalis

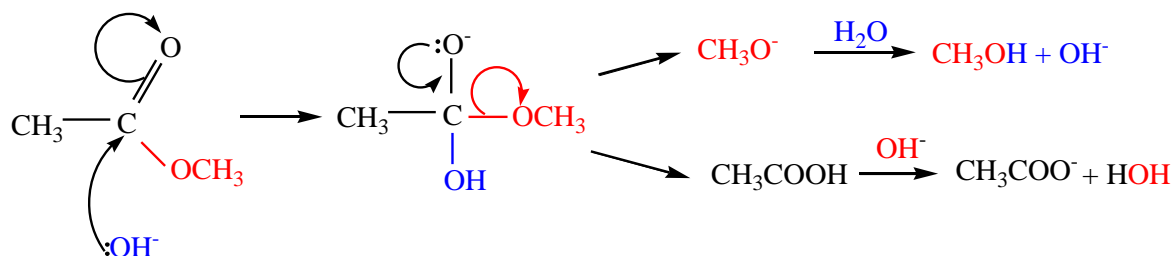
Example



Mechanism (acid catalyzed)

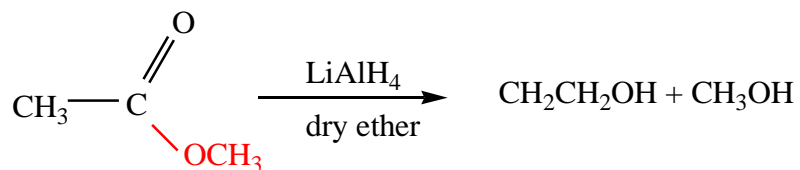


(ii) base catalyzed

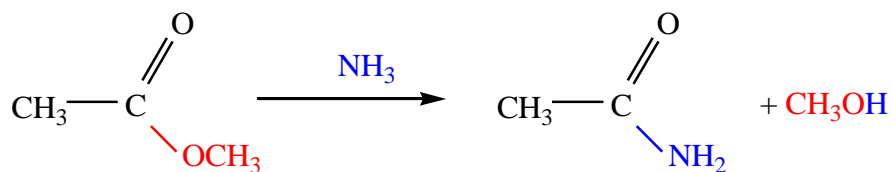


2. Esters are reduced by LiAlH₄ in presence of dry ether to alcohols

Examples



3. Esters react with ammonia to form acid amide

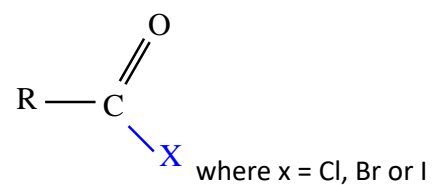


Uses of esters

In formation of perfumes

Acid halides

These have a general formula



Examples

$\text{C}_6\text{H}_5\text{COCl}$ Benzoylchloride

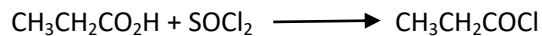
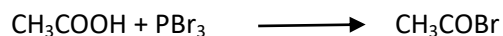
CH_3COBr Ethanoylbromide

$\text{CH}_3\text{CH}_2\text{COI}$ Propanoyliodide

Preparation

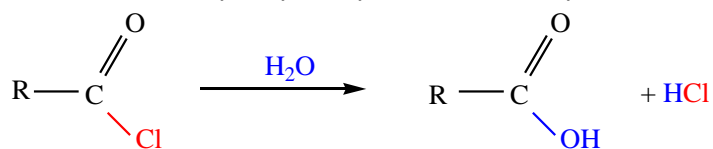
By reacting carboxylic acid with phosphorus halide or thionylchloride

Examples

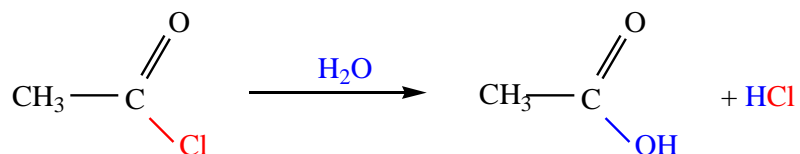


Chemical properties

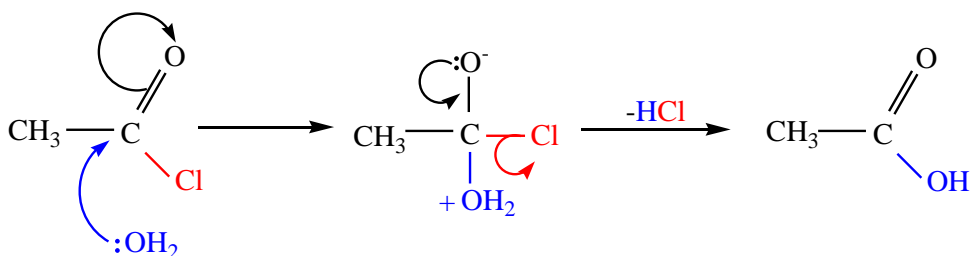
1. Acid halides are hydrolyzed by water to carboxylic acids



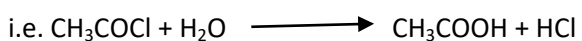
Example



Mechanism

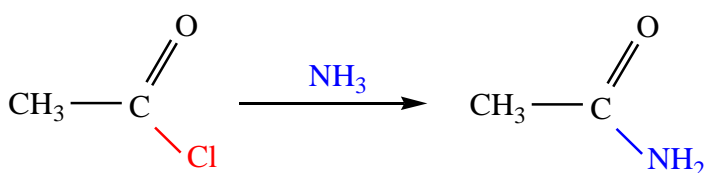


When ethanoyl chloride is exposed to moist air white fumes are seen due to the production of HCl.

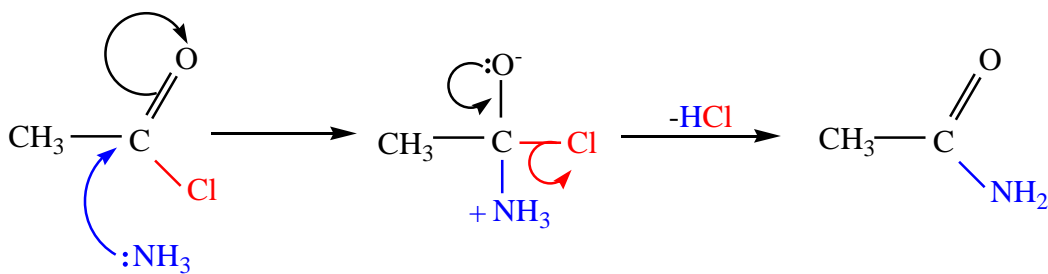


2. Acid halides react with ammonia and amines to produce amides

Example

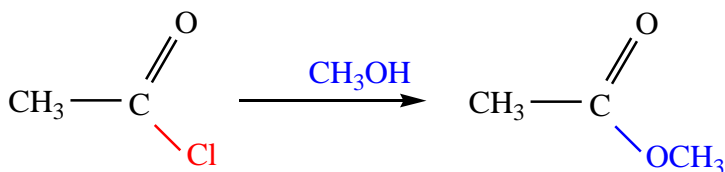


Mechanism

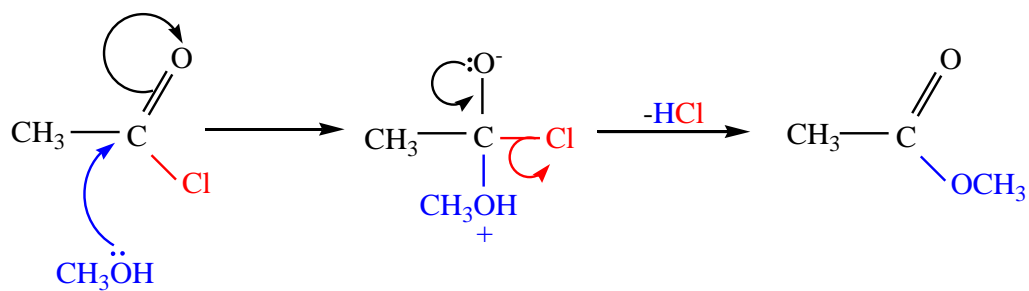


3. Acid halide react with alcohols to form esters

Example

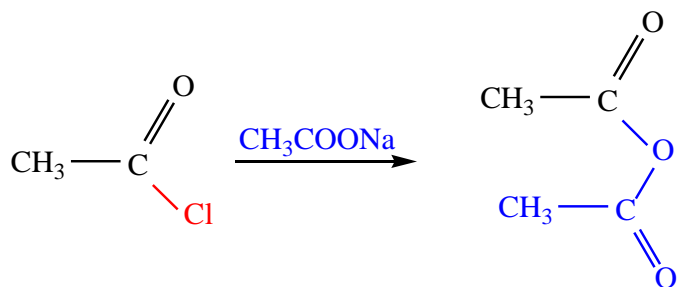


Mechanism

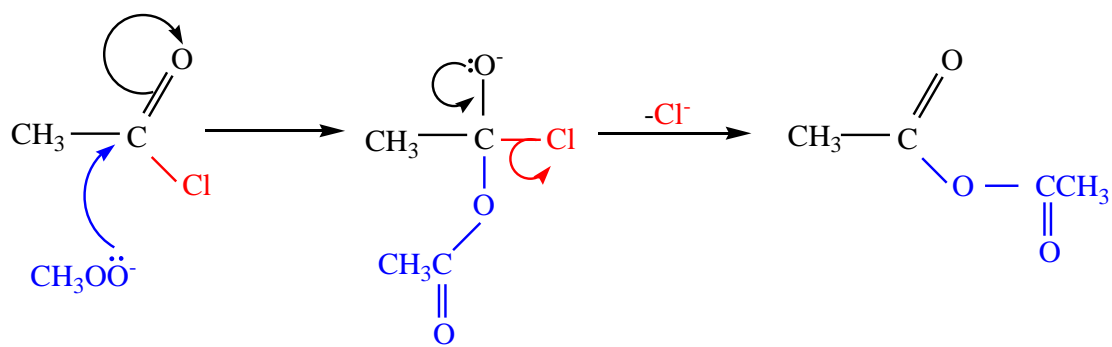


4. Acid halides react with anhydrous sodium salt of carboxylic acid to form acid anhydride

Example

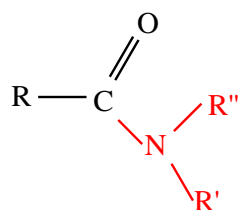


Mechanism



Acid amide

These have a general formula



where R, R' and R'' are hydrogen atoms or alkyl groups

Examples

CH₃CONH₂ Ethanamide

CH₃CH₂CONH₂ Propanamide

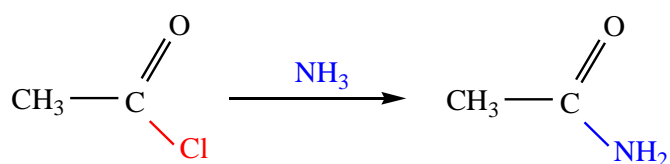
Physical properties

- They are white crystalline salts except methanamide
- Lower members are soluble in water but the solubility decreases with increasing molecular mass.
- They have relatively high boiling points due to formation of intermolecular hydrogen bonds

Preparation

1. By reaction of ammonia with ester, acid anhydride or acid halides

Examples

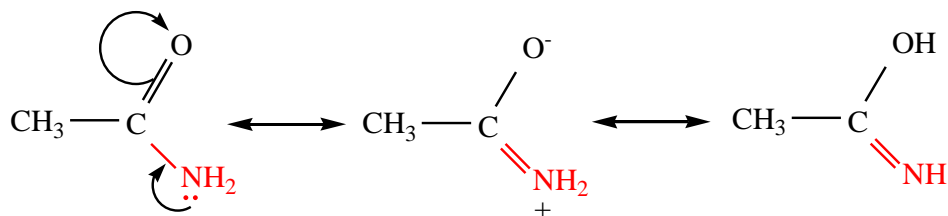


2. Dehydration of carboxylic acids with ammonium carbonate

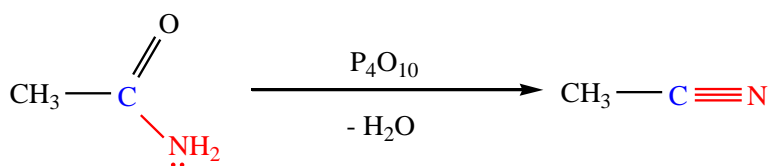


Chemical properties

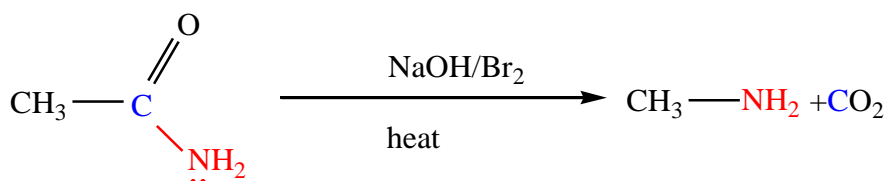
1. They are weaker bases compared to amines and are neutral to litmus. They do not form salts with acids as amines do because their lone pair of electron on the nitrogen atom is delocalized.



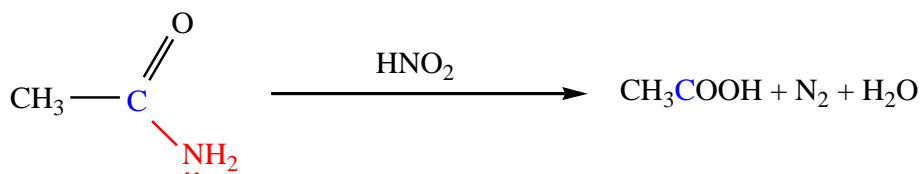
2. Amides form nitriles when distilled over phosphorus pentoxide, P₄O₁₀.



3. Amides react with hot alkaline bromine solution to give amines

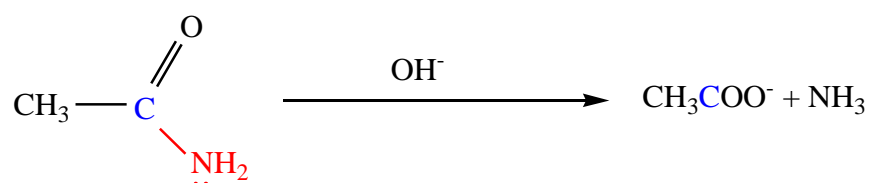
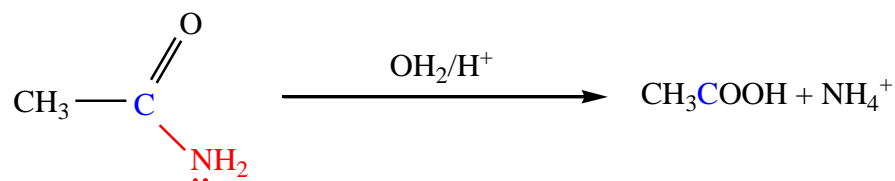


4. Like amines, amides react with nitrous acid liberating nitrogen



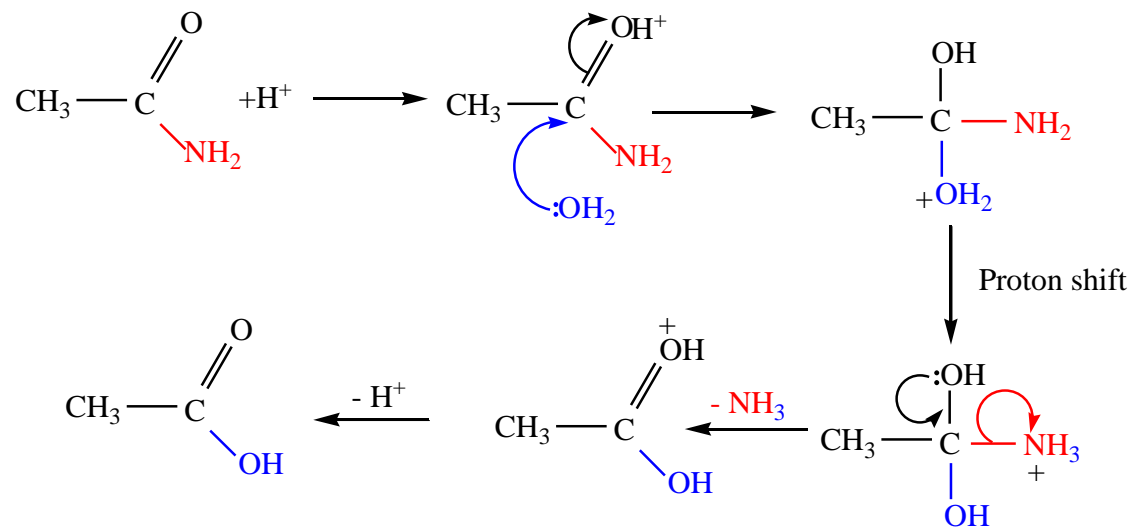
5. Amides are hydrolyzed with mineral acid or alkalis

Example



Mechanism

(a) Acid catalyzed



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