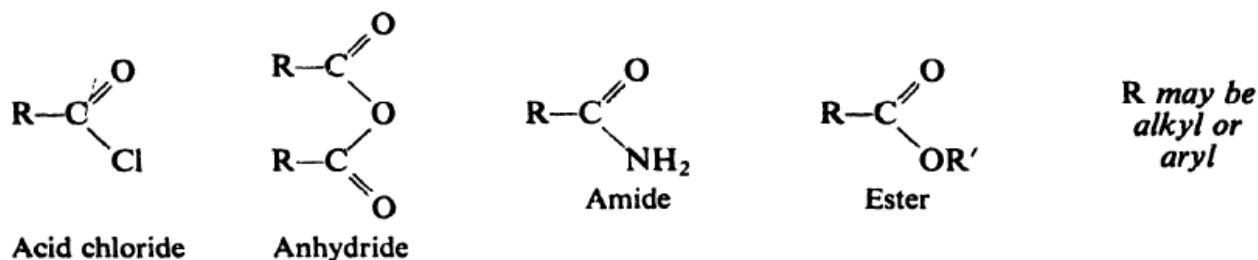


## Functional derivatives of carboxylic acids

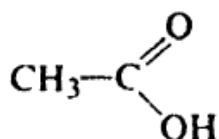
Closely related to the carboxylic acids and to each other are a number of chemical families known as **functional derivatives of carboxylic acids**: *acid chlorides*, *anhydrides*, *amides*, and *esters*. These derivatives are compounds in which the  $\text{—OH}$  of a carboxyl group has been replaced by  $\text{—Cl}$ ,  $\text{—OOCR}$ ,  $\text{—NH}_2$ , or  $\text{—OR}'$ .



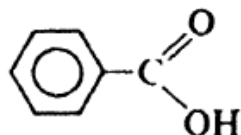
They all contain acyl group ( $\text{RCO-}$ )

### Nomenclature

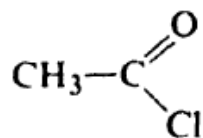
The names of acid derivatives are taken in simple ways from either the common name or the IUPAC name of the corresponding carboxylic acid. For example:



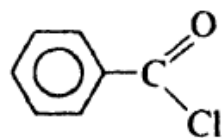
Acetic acid  
Ethanoic acid



Benzoic acid



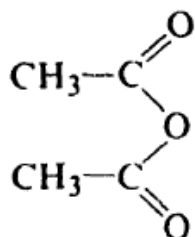
Acetyl chloride  
Ethanoyl chloride



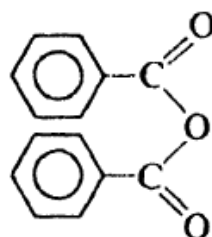
Benzoyl chloride

**Change:**

*-ic acid to -yl chloride*

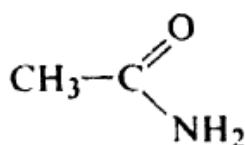


Acetic anhydride  
Ethanoic anhydride

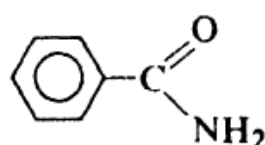


Benzoic anhydride

*acid to anhydride*

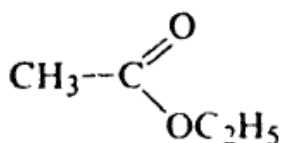


Acetamide  
Ethanamide

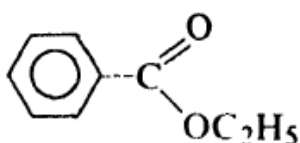


Benzamide

*-ic acid of common name  
(or -oic acid of IUPAC name)  
to -amide*



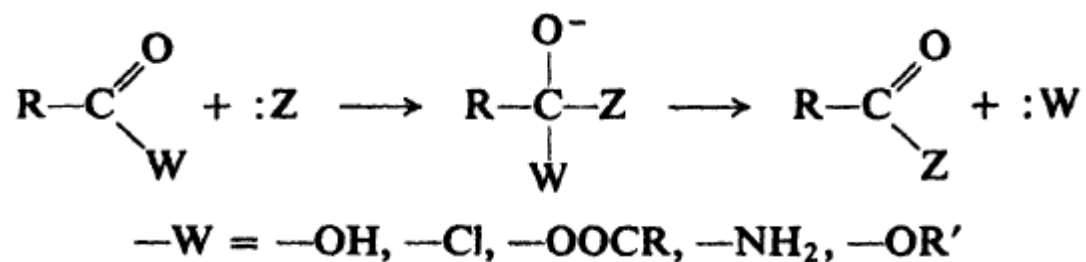
Ethyl acetate  
Ethyl ethanoate



Ethyl benzoate

*-ic acid to -ate,  
preceded by name of  
alcohol or phenol group*

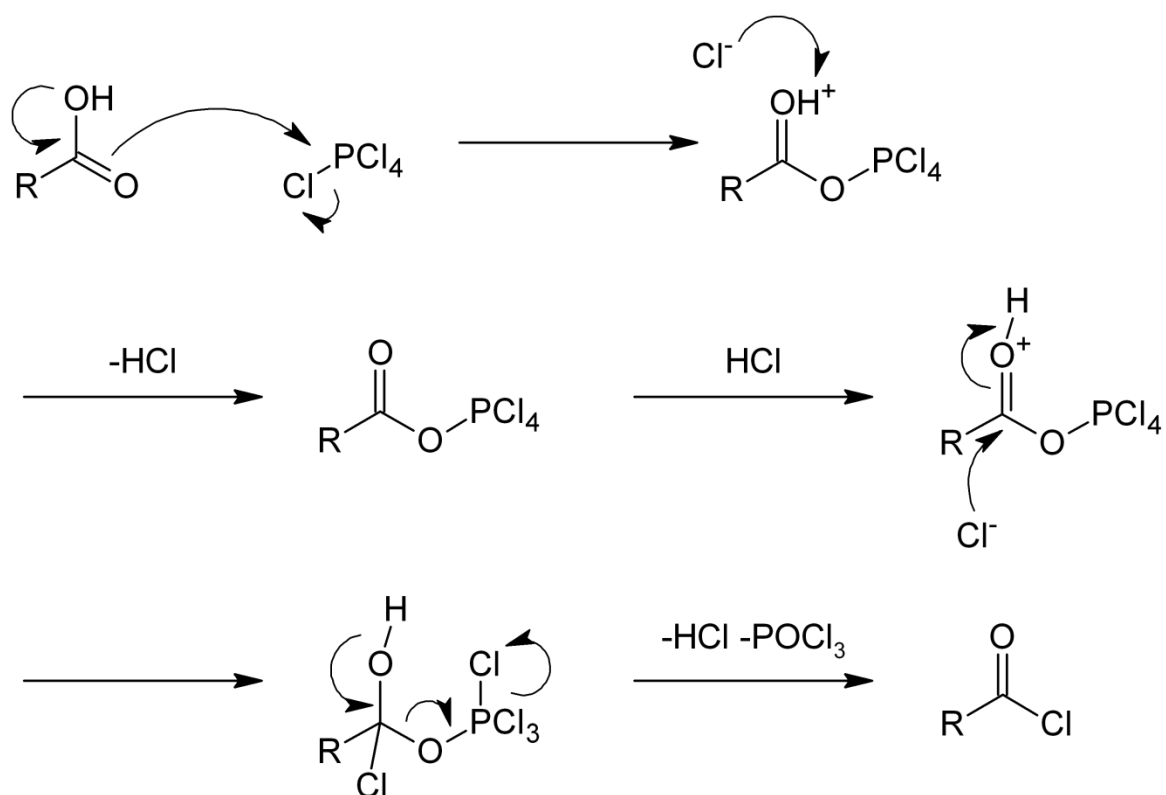
**Acyl compounds**—carboxylic acids and their derivatives—typically undergo **nucleophilic substitution** in which  $-\text{OH}$ ,  $-\text{Cl}$ ,  $-\text{OOCR}$ ,  $-\text{NH}_2$ , or  $-\text{OR}'$  is replaced by some other basic group(Z)



## ACID CHLORIDES

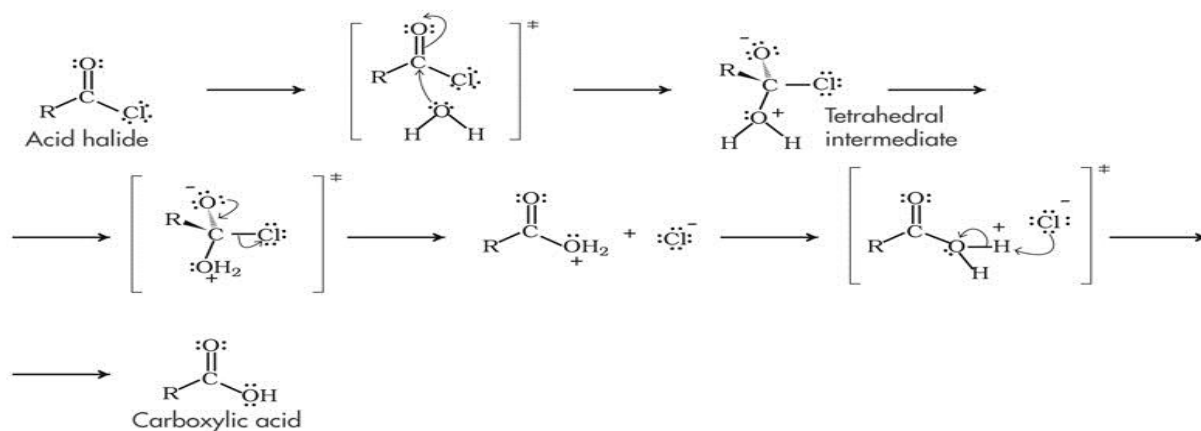
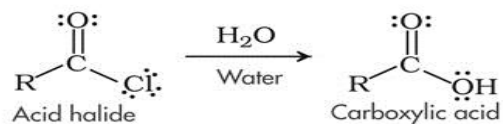
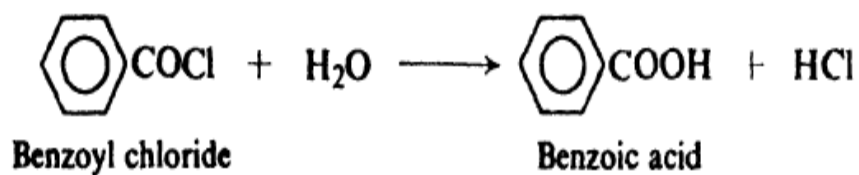
Acid chlorides are prepared from the corresponding acids by reaction with thionyl chloride,  $\text{PCl}_3$ ,  $\text{PCl}_5$ .

Mechanism with  $\text{PCl}_5$

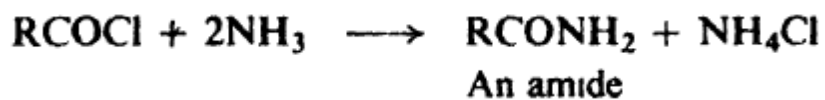


1- Conversion into acids  
Hydrolysis

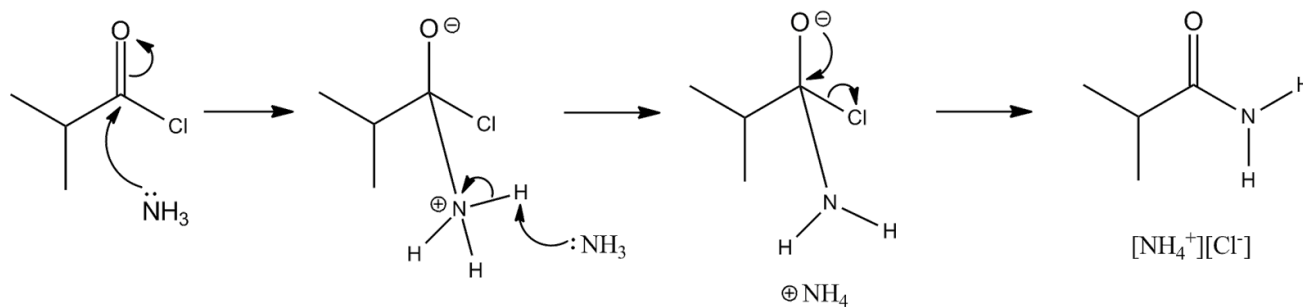
**Example:**



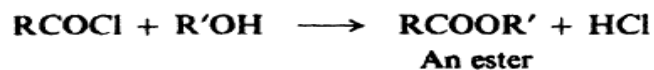
2- Conversion into amides



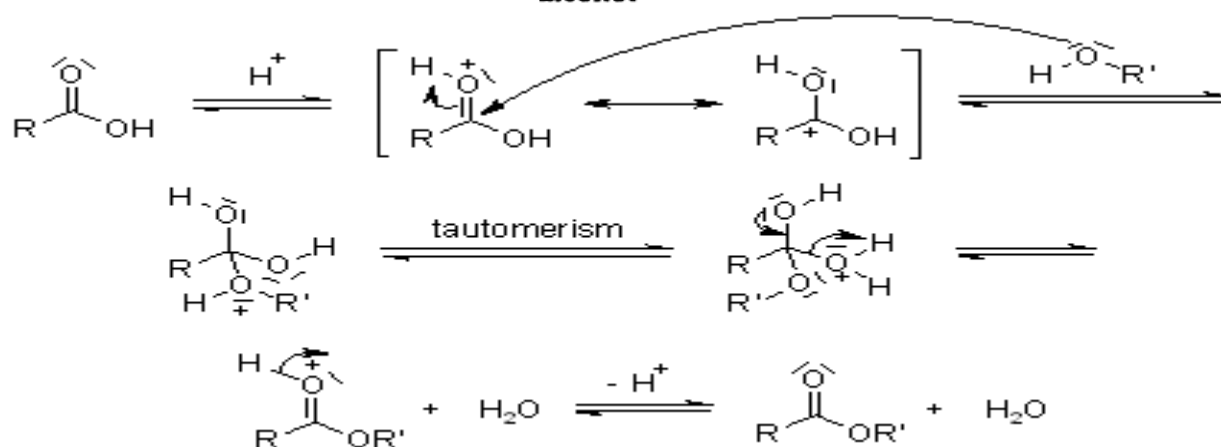
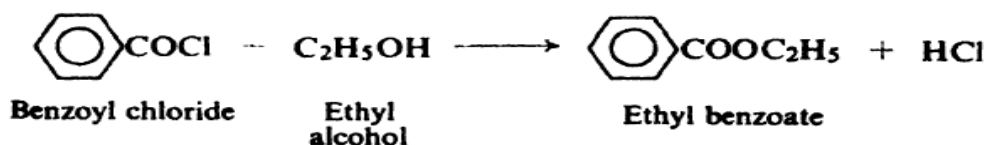
Mechanism



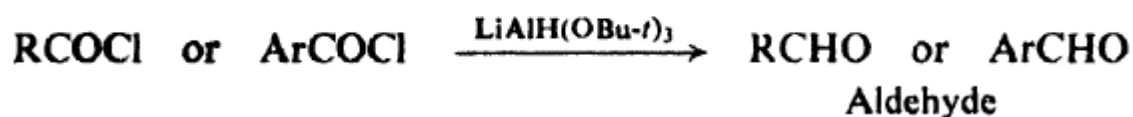
3- Conversion into esters



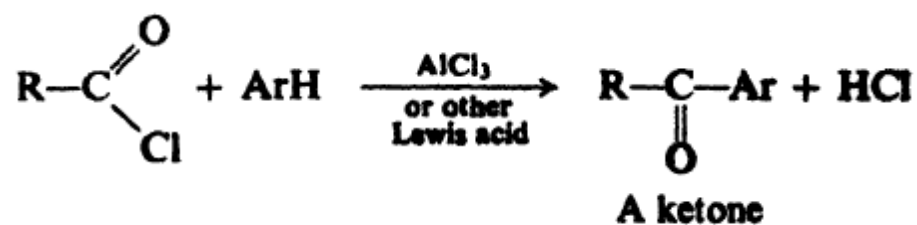
*Example:*



#### 4. Formation of aldehydes by reduction.

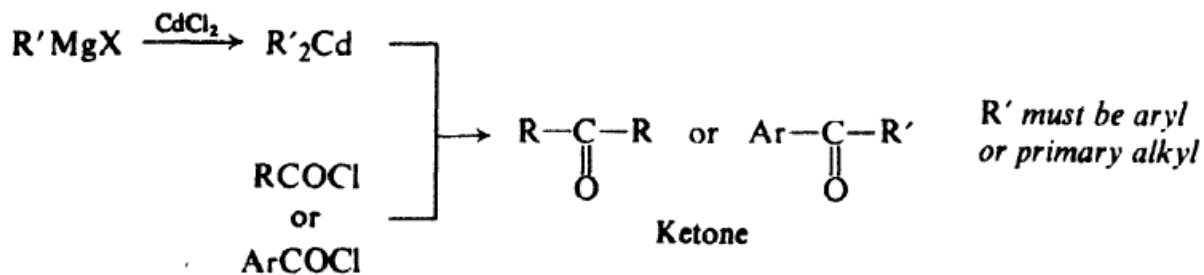


#### 5-formation of ketones, friedl-crafts acylation

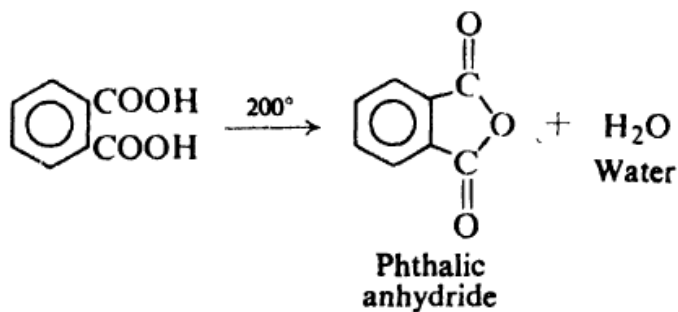
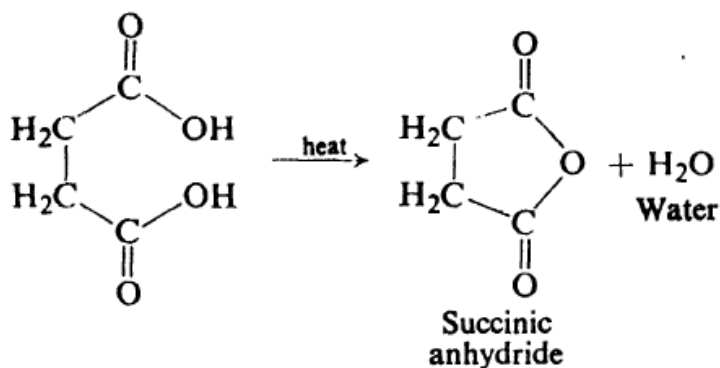
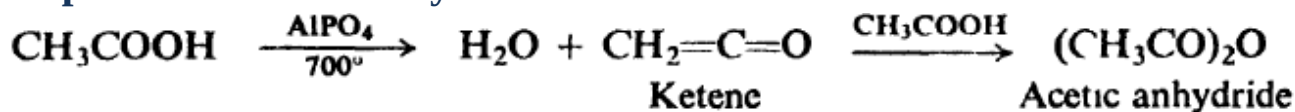


Give the mechanism of the title reaction

#### 6-formation of ketone with organocadmium compounds

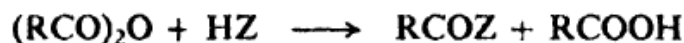


### Preparation of acid anhydrides



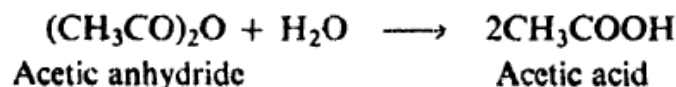
### Reactions of acid anhydrides

1-conversion into acid and acid derivatives



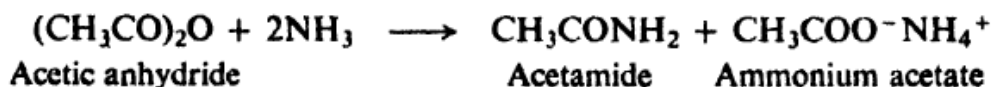
**(a) Conversion into acids. Hydrolysis**

*Example:*



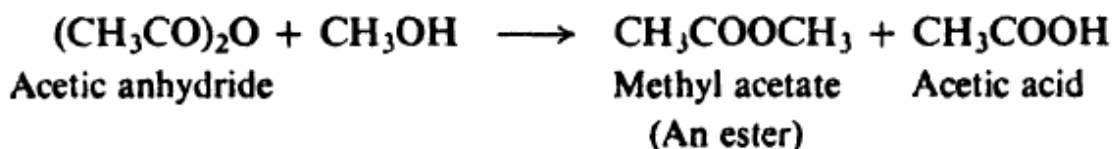
**(b) Conversion into amides. Ammonolysis**

*Examples:*

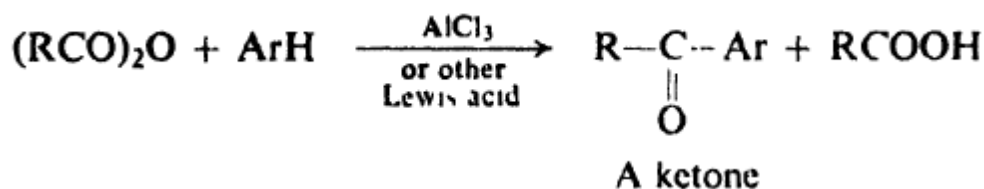


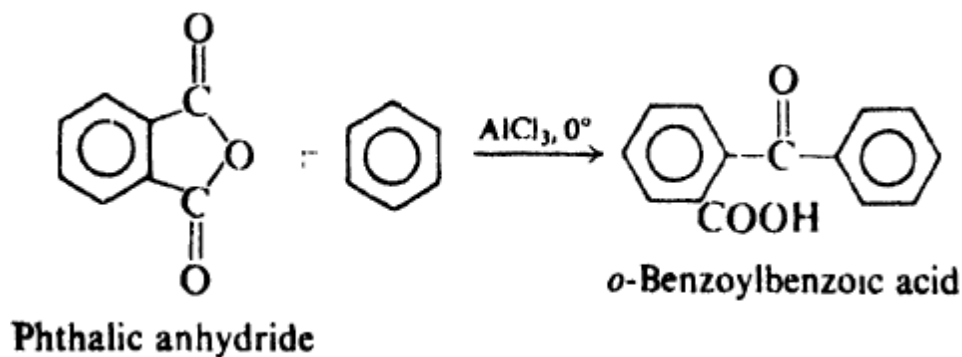
**(c) Conversion into esters. Alcoholysis**

*Examples:*



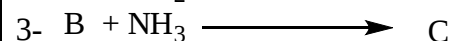
**Formation of ketones. Friedel-Crafts acylation.**





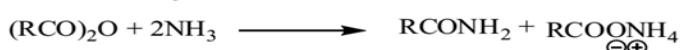
### Problem

give the structural formulas for compounds A through C



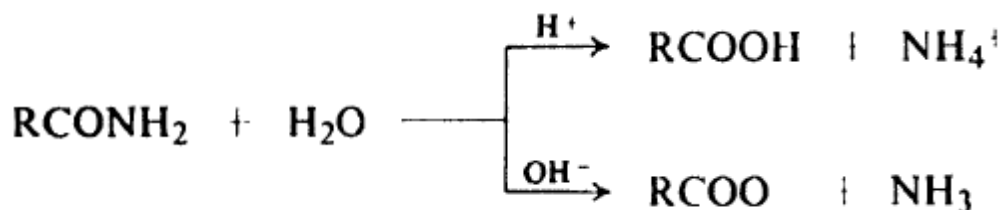
## Preparation of amides

In the laboratory amides are prepared by the reaction of ammonia with acid chlorides or, when available, acid anhydrides. In industry they are often made by heating the ammonium salts of carboxylic acids.

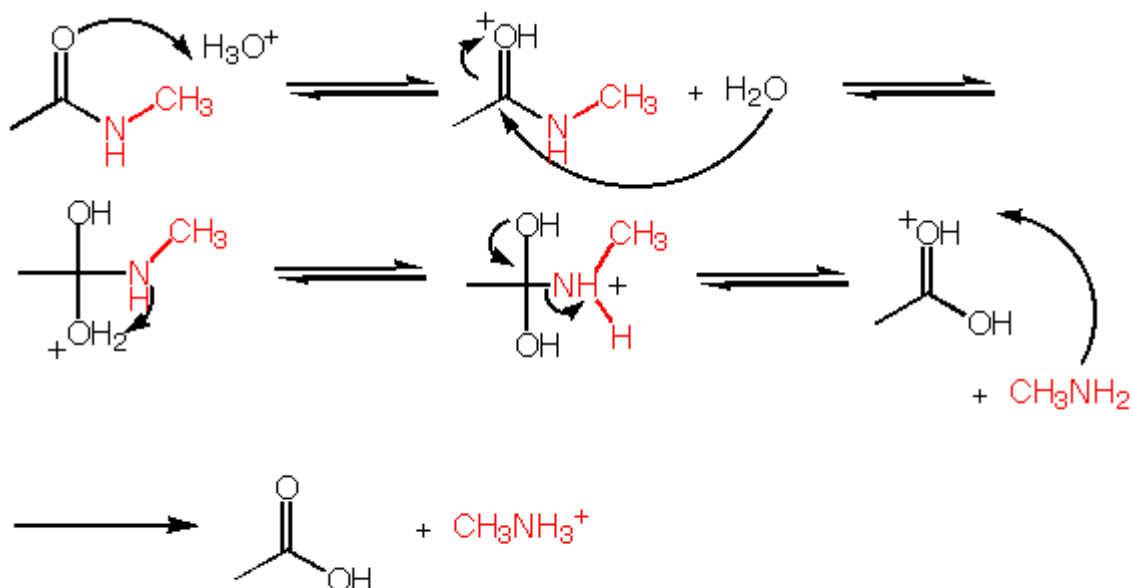


Reactions of amides

Hydrolysis of amides

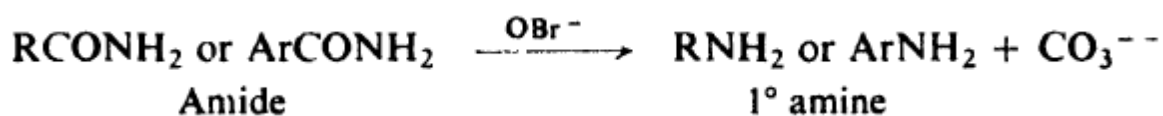


Mechanism

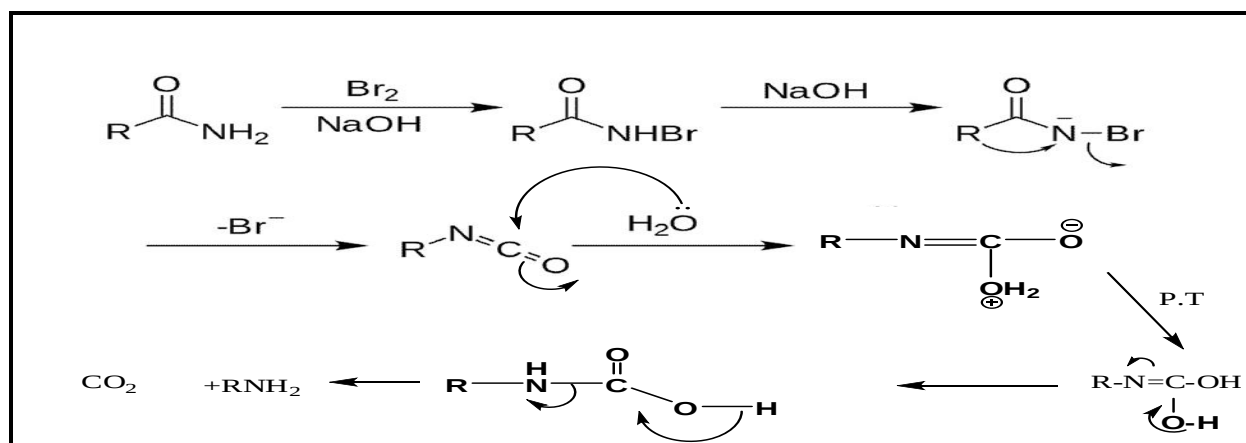


Give the mechanism in alkaline medium

### Hofmann degradation of amides

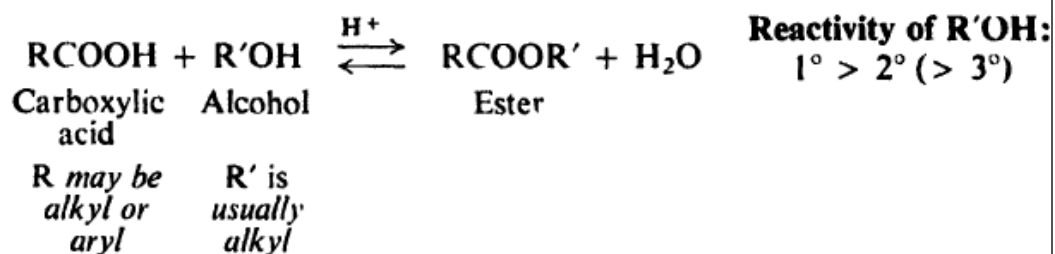


### Mechanism

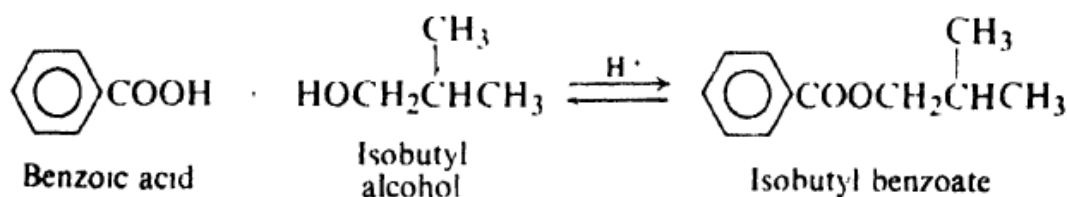
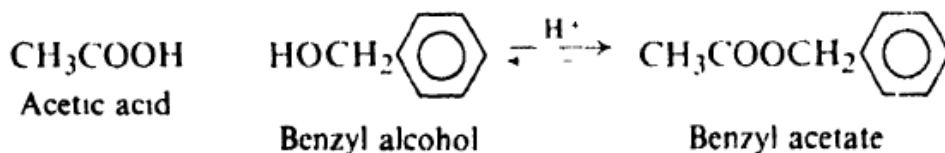


### Preparation of esters

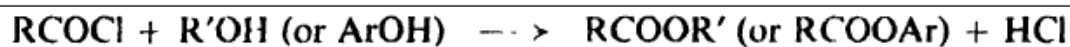
Esters are usually prepared by the reaction of alcohols or phenols with acids or acid derivatives.



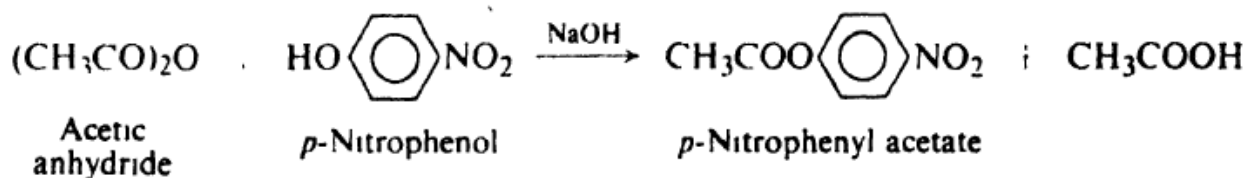
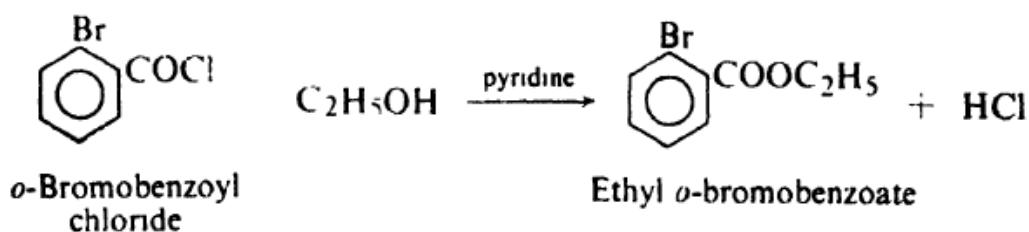
**Examples:**



**From acid chlorides or anhydrides.**



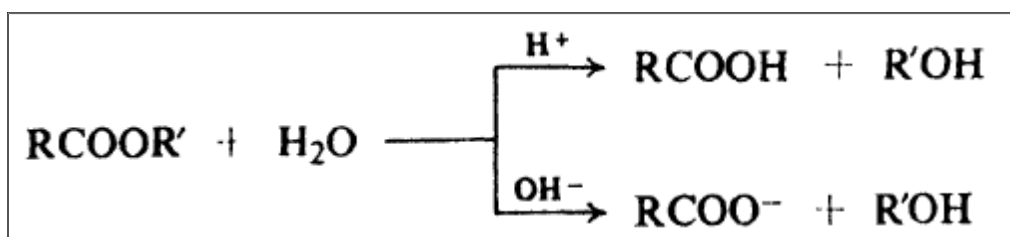
**Examples:**



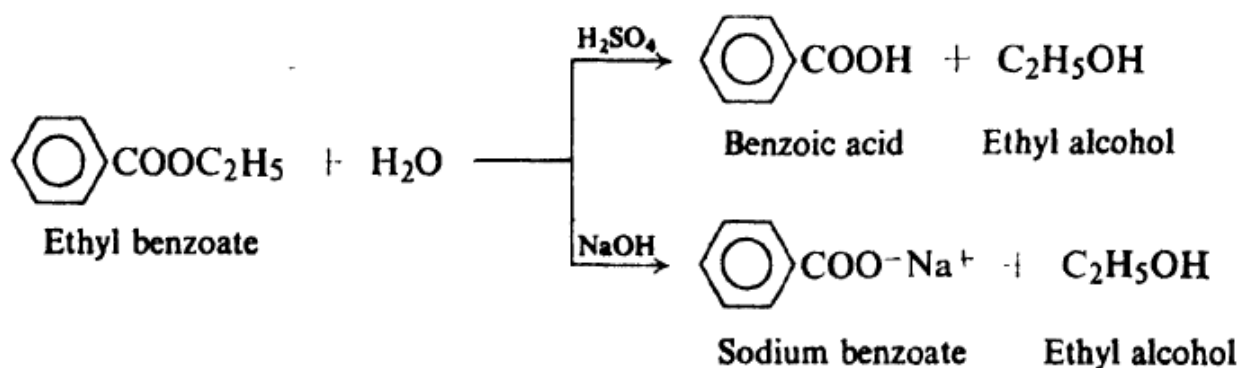
Write these mechanism

-reactions of esters

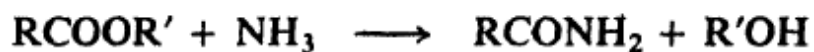
Conversion into acids and acid derivatives



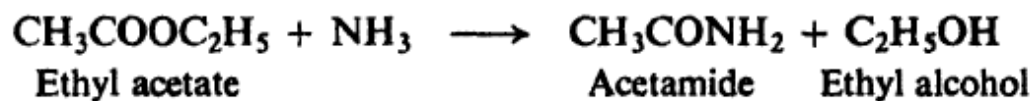
*Example:*



Conversion into amides



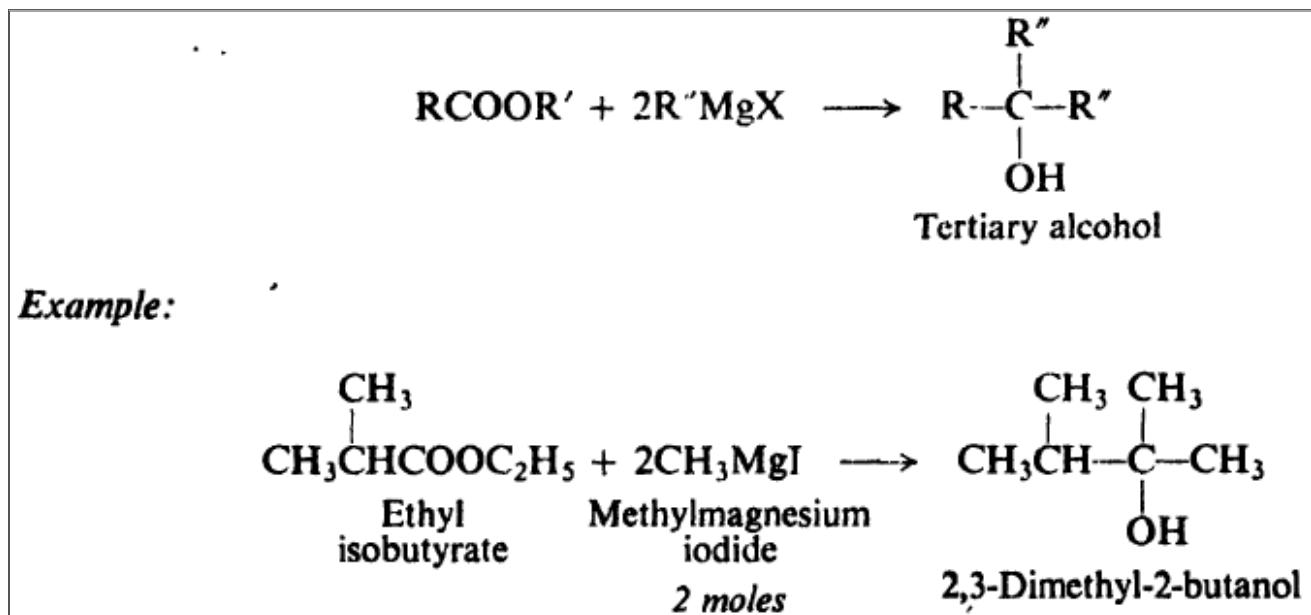
*Example:*



Mechanism

**Reaction with Grignard reagents.**

mechanism



mechanism

