Quadrant II – Notes

Programme: B.Sc.

Subject: Chemistry

Paper Code: CHC 103

Paper Title: Physical and Organic Chemistry

Unit: I (Carboxylic acids and their derivatives)

Module Name: Preparation of acid esters from acids

Module No: 06

Name of the Presenter: Ms. Divya R. Sawant

Transcript

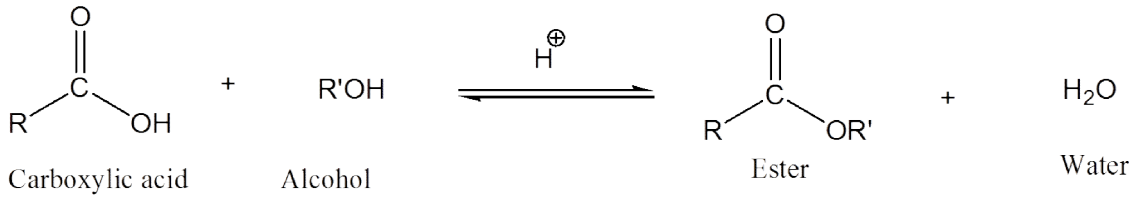
Preparation of acid esters from acids

Esterification reactions

It was first described by Emil- Fischer and Arthur Speier in 1895 hence it is also called as Fischer esterification or Fischer-Speier esterification reaction.

Carboxylic acids on heating with an alcohol in presence of strong mineral acid form esters, this reaction is called esterification reactions.

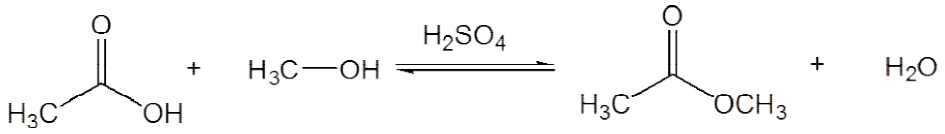
General equation for reaction between an acid RCOOH and an alcohol R'OH to form Ester is given below. (R and R' can be same or different)



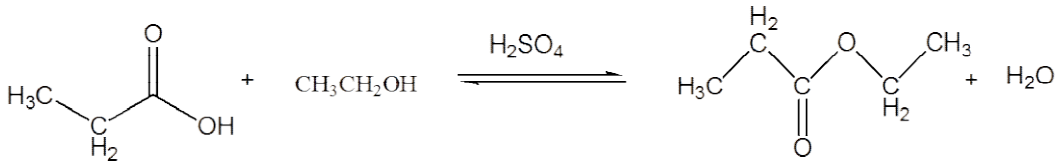
Carboxylic acid Alcohol Ester Water

Esterification reaction is reversible in nature and the reaction type is Nucleophilic acyl substitution reaction.

Examples of esterification reaction



Acetic Acid Methanol Methyl ethanoate



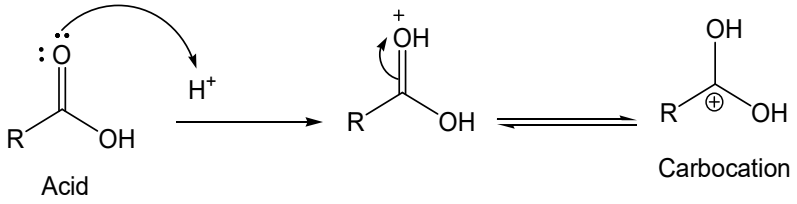
Propanoic acid Ethanol Ethyl propanoate

Order of reactivity of alcohol : primary > secondary > tertiary

The above trend is because of steric hindrance (or bulkiness), as bulkiness increases from primary to tertiary alcohol the rate of esterification reaction decreases.

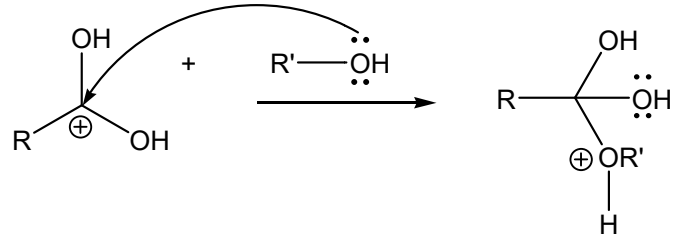
Mechanism of esterification reaction

Step 1: Protonation by acid catalyst.



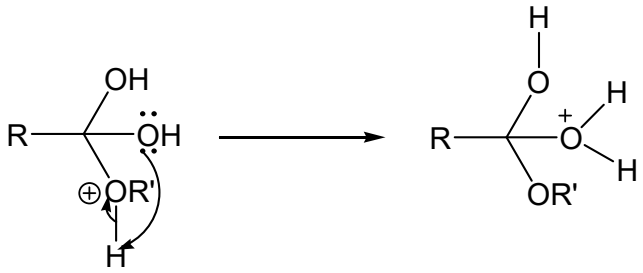
Acid Carbocation

Step 2: Addition of alcohol to the carbocation



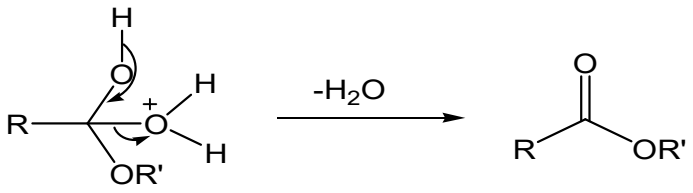
Carbocation Tetrahedral intermediate

Step 3: Proton transfer



Tetrahedral intermediate

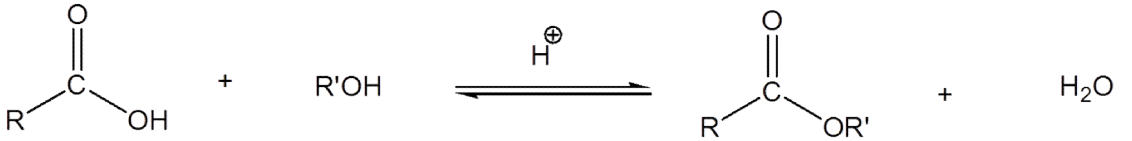
Step 4: Elimination of water



Ester

Optimizing the yield of the esterification reaction

Since the esterification reaction is reversible an 1:1 mixture of alcohol andacid will reach equilibrium with about 70% yield of ester. But as with many other equilibrium process the reaction can be taken in one direction either by changing concentration, pressure, temperature or volume of reagent. This new change will led the reaction to adjust new equilibrium to counteract the new change which is basic of LeChatelier's principle.



Carboxylic acid Alcohol Ester Water

Yield can be optimized either by:

- Increasing the concentration of one of the reactant to produces more ester.
- Removal of side product water will also shift the equilibrium towards forward direction.