

MINISTRY OF EDUCATION
SECONDARY ENGAGEMENT PROGRAMME
GRADE 11
CHEMISTRY

WEEK 9

LESSON 1

Topic: Esters

Sub-topic: Formation and hydrolysis of esters

Objectives: Given equations students will:

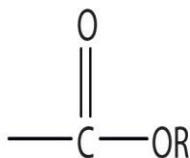
- (iii) correctly explain the formation of esters.
- (iv) accurately describe the hydrolysis of esters.

Content

Esters are liquids with pleasant, fruity scents. Esters and water are formed when alcohols react with carboxylic acids. This reaction is called esterification, which is a reversible reaction. This type of reaction is called a condensation reaction, which means that water molecules are eliminated during the reaction. The conditions for esterification are:

- concentrated sulfuric acid as a catalyst
- reflux at 180°C

Functional group: -COOR

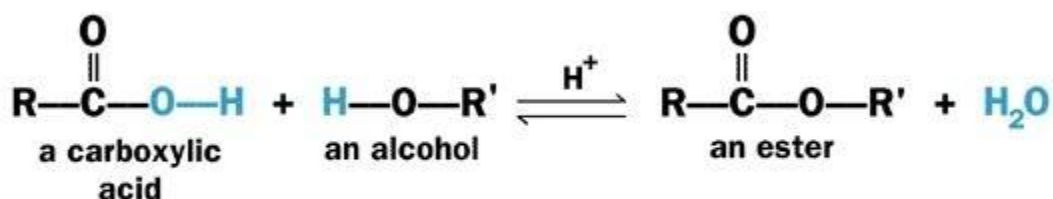
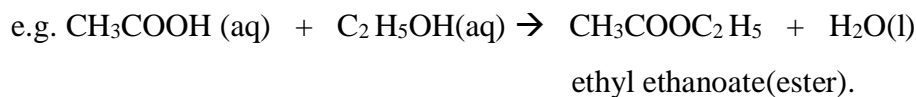


Where R represents an alkyl group

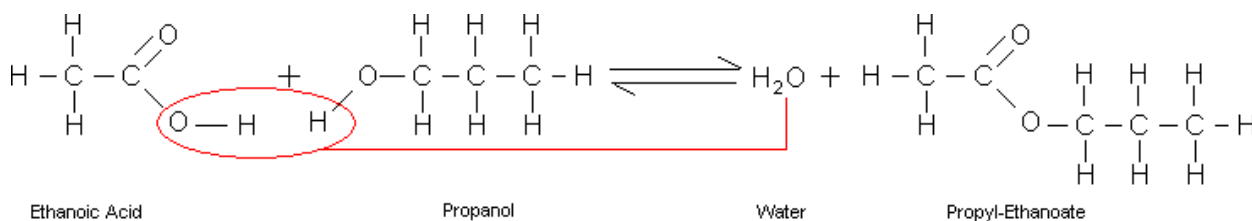
Esterification

Ethanoic acid reacts with ethanol to form the ester ethyl ethanoate

This reaction takes place in the presence of concentrated sulphuric acid which acts as a catalyst and dehydrating agent.



(Where R and R' are general hydrocarbon groups)

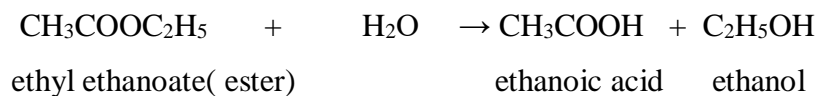


Hydrolysis of Esters

Hydrolysis refers to the breaking up of a compound using water. This process can be accelerated using either dilute acid or dilute alkali. Esters can be hydrolyzed when heated with dilute acid or dilute alkali

1. Acid Hydrolysis Of Ester

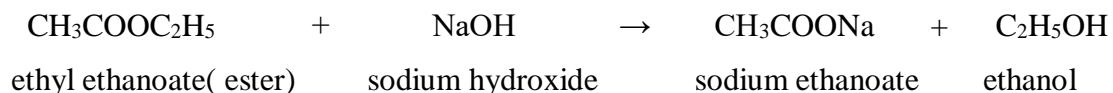
The ester is heated with a strong acid such as sulphuric acid to produce the carboxylic acid and alcohol.



The reaction in this instance is reversible and the ester is only partially ionized.

2. Alkali Hydrolysis of Ester (Saponification)

In the alkali catalyzed reaction, the ester is heated with a strong alkali such as sodium hydroxide. The reaction is irreversible and the completely hydrolyzed ester forms alcohol and a salt of the carboxylic acid.



Uses of Esters

1. Esters known as parabens are used as food and drug preservatives as a result of which they'll resist the growth of microorganisms like molds and yeast.
2. Esters have good odours as they are used as an ingredient of perfumes, food flavourings to spice up the flavour and smell of processed foods, in essential oils, cosmetics, etc.
3. Natural esters are found in pheromones.
4. Phosphoesters form the backbone of DNA molecules.
5. Esters are utilized in the assembly of polyester.
6. Nitrate esters, like glyceryl trinitrate, are acknowledged for its explosive properties.
7. Esters are used in the making of surfactants E.g. soap, detergents.

References

1. <https://sites.google.com/site/chemistryolp/formation-of-esters>
2. <https://www.bbc.co.uk/bitesize/guides/z3v4xfr/revision/5>
3. <http://www.chemguide.co.uk/organicprops/alcohols/background.html>
4. http://en.wikipedia.org/wiki/Alcohol#Physical_and_chemical_properties
5. <http://en.wikipedia.org/wiki/Alcohol>
6. <http://www.cerlabs.com/experiments/10534977545.pdf>
7. http://www.thenakedscientists.com/forum/index.php?topic=18296.0;prev_next=prev