Bacterial Oxidation

A dilute solution of ethanol is oxidised by bacteria (Acetobacter) in the presence of atmospheric oxygen into a dilute solution of ethanoic Acid (Vinegar is prepared using this technique from poor quality wine)

$$C_2H_5OH + O_2 \xrightarrow{\text{bacteria}} CH_3COOH + H_2O$$

ethanol — O_2: atmospheric oxygen — ethanoic Acid.

This also explains why beer and wine that contains about 4% ethanol turns sour on standing. This is because bacterial oxidation of dilute solution occurs converting a dilute solution of ethanol into a dilute solution of ethanoic acid (Vinegar)

3) Esterification

- It is a process in which an alcohol reacts with an acid to form ester and water.

$$\text{Alcohol} + \text{Acid} \rightleftharpoons \text{Ester} + \text{water}$$

Functional Group of Ester: $-C(=O)-O-$

R: Can be alkyl or hydrogen

R: This R can only be alkyl and never H in Esters

Characteristics of Esterification

- Reversible reaction
- Very slow reaction at r.t.p

How would you speed up the process of esterification

- Heating the reaction mixture (Could use a reflux condenser)
- By adding a catalyst (Conc Sulfuric Acid) (Fehling's solution)

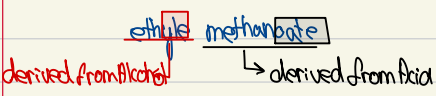
What is the function of conc. Sulfuric Acid?

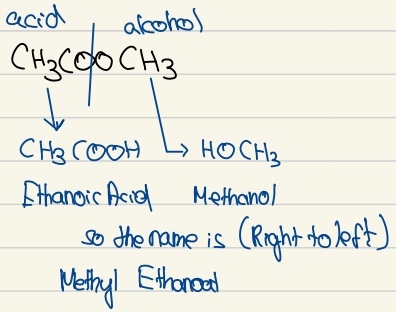
- It acts as a catalyst
- So that the Sulfuric Acid which is a dehydrating agent can remove water by absorbing thereby decreasing the rate of backward reaction therefore favouring the forward reaction

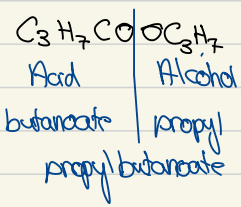
Naming of Esters

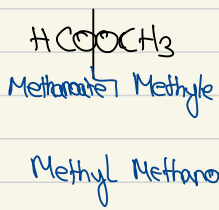
Formula of ester has two parts:

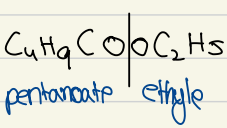
1) Acid part of ester → (noate) ending
2) Alcohol part of ester → (yl) ending.





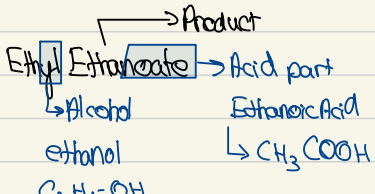




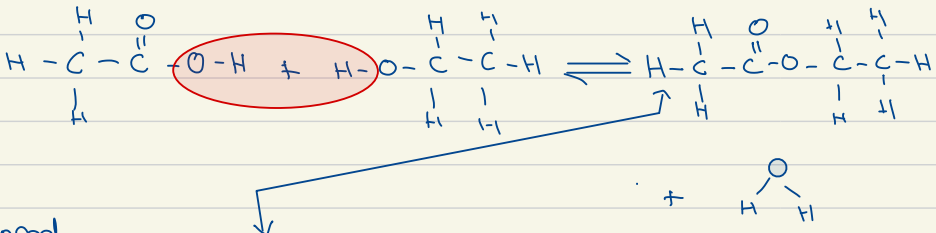


Ethyle pentanoate.

In esterfication Acid looses OH and Acid loses H. And this H and OH makes water. In writting the ester write the acid part first, followed by the alcohol part but from the oxygen end.



displayed formula

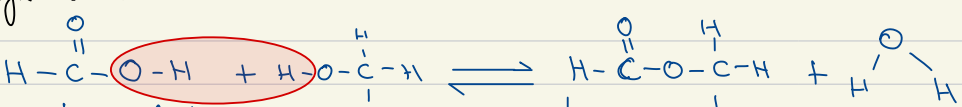


Condensed

$CH_3 . CO_2 . CH_2 CH_3$.

$C_n H_{2n+2}$

Methyle Methanoate

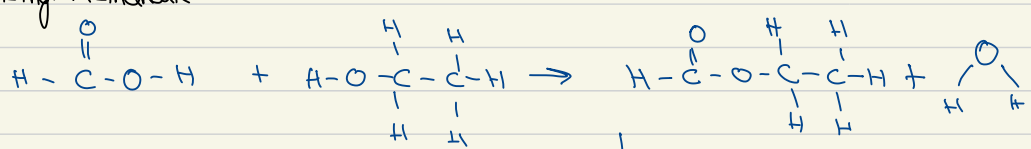


Methyle Methanoate.

Condensed

$H . CO_2 . CH_3$

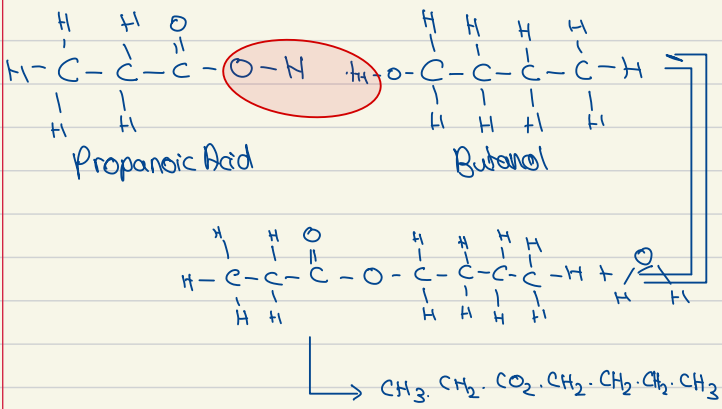
Ethyl Methanoate



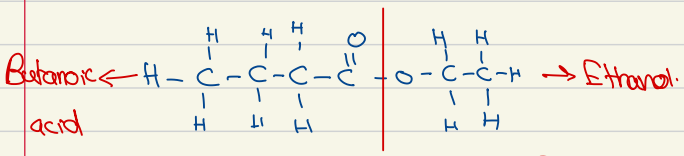
condensed

$H . CO_2 . CH_2 . CH_3$

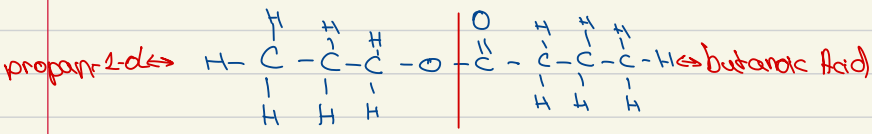
Butyl Propanoate

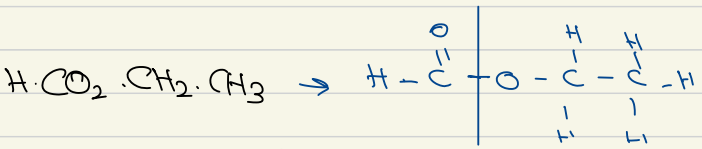


Name the Alcohol and Acid required to prepare the following ester

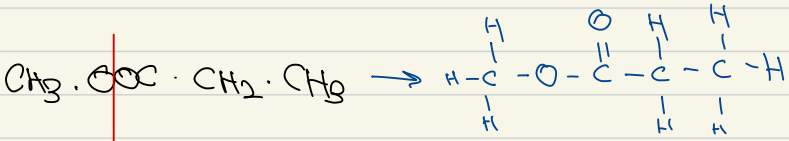


The part of the ester after breaking has $-\overset{O}{\overset{\|}{C}}-$ is the Carboxylic Acid
The other will be the alcohol





Methanoic Acid & Ethanol



methanol propanoic acid

Properties of Ethyl Ethanoate

1→ It's a colorless liquid
2→ It's insoluble in water
3→ Neutral to litmus
4→ Sweet/fruity smell

Uses of Esters

→ Manufacture perfumes
→ Artifical flavours and essence
→ Used as solvent in medicine

Characteristics of Esterification

1) Reversible REACTION
2) Very slow reaction @ r.t.p

How would you speed up the process of Esterification?

- By heating the reaction mixture - use reflux condenser if necessary
- By adding a catalyst

Q Name the catalyst used in the process of Esterification

Few drops of concentrated Sulfuric Acid.

Q What is the function of concentrated sulfuric acid in Esterification?

- It acts as a catalyst
- It acts as a dehydrating agent, removing water, favouring the forward reaction
- It absorbs water thereby decreasing rate of the backward reaction and thus increasing the yield of the Ester.

Naming of Esters:

Formula of Ester has 2 parts

1) Acid Part of Ester (-noate ending)
2) Alcohol Part of Ester (-yl ending)

alcohol → ethyl
acid → Methanoate

Ethyl Methanoate

Acid ; alcohol

CH_3COOCH_3 → Methyl Ethanoate.

Ethanoate ; methyl

Ester naming is right to left

$C_3H_7COOC_3H_7$

Butanoate | Propyl → Propyl Butanoate

$HCOOCH_3$

Methanoate | methyl → Methyl Methanoate

$C_4H_9COOC_2H_5$

Pentanoate | ethyl → Ethyl Pentanoate

In Esterification,

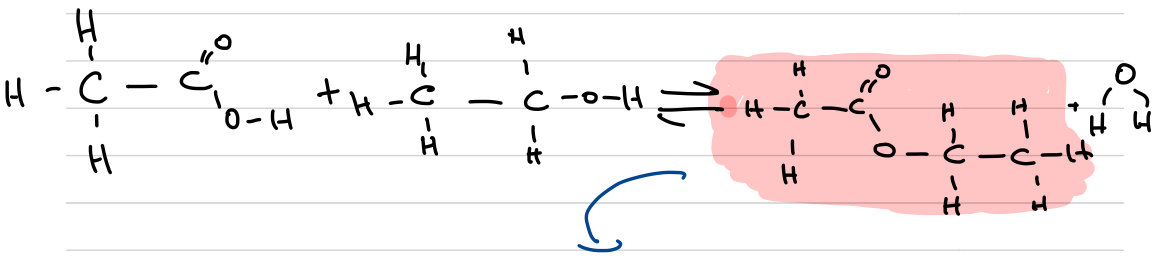
- Acid loses OH
- Alcohol loses H
- Then H and OH makes water.
- In writing the formula of the Ester, write the acid part first followed by the alcohol part but from the oxygen end.

ethyl Ethanoate

ethanol C_2H_5OH

↳ Ethanoic Acid: CH_3COOH

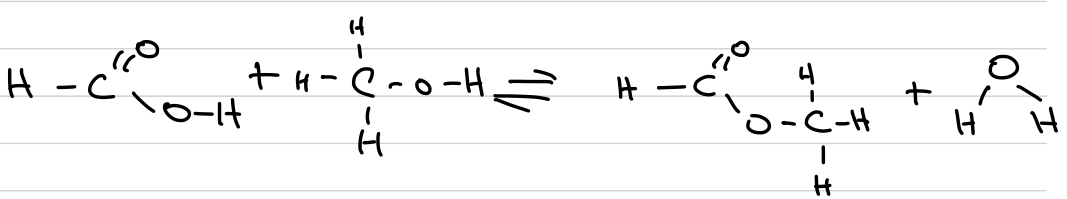
$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$



$CH_3 \cdot CO_2 \cdot CH_2 \cdot CH_3$

methyl methanoate

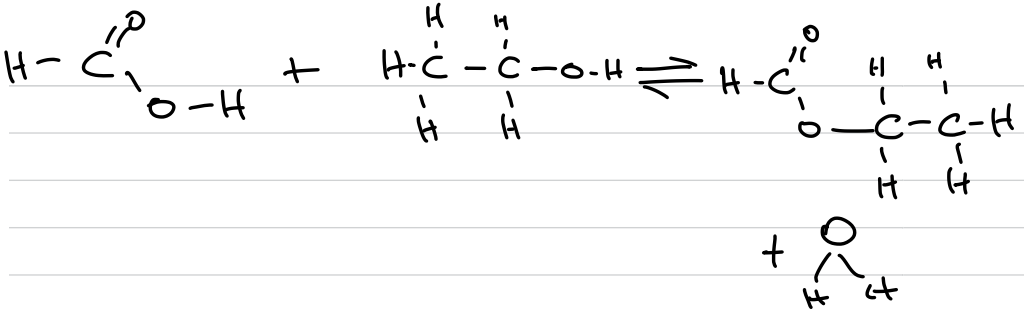
$$HCOOH + CH_3OH \rightleftharpoons HCOOCH_3 + H_2O$$



$$H \cdot CO_2 \cdot H + CH_3 \cdot OH \rightleftharpoons H \cdot CO_2 \cdot CH_3 + H_2O$$

ethyl methanoate

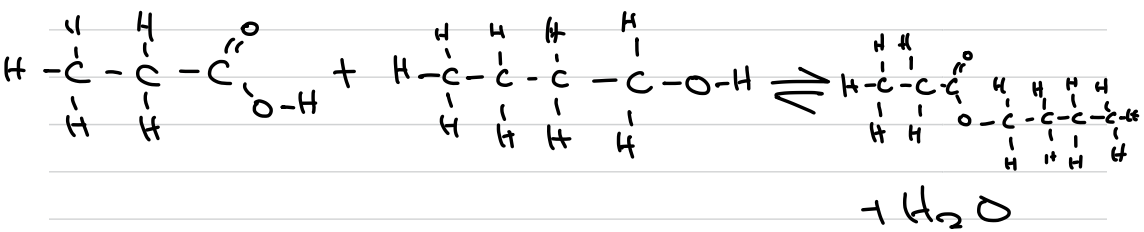
$$HCOOH + C_2H_5OH \rightleftharpoons HCOOC_2H_5 + H_2O$$



$$H{-}CO_2{-}H + CH_3{-}CH_2{-}OH \rightleftharpoons H{-}CO_2{-}CH_2{-}CH_3$$

Butyl Propanoate

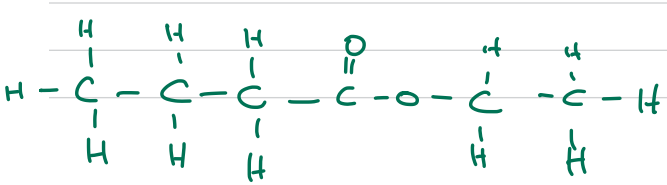
$$C_2H_5COOH + C_4H_9OH \rightleftharpoons C_2H_5COOC_4H_9 + H_2O$$



$$CH_3{-}CH_2{-}CO_2{-}H + CH_3{-}CH_2{-}CH_2{-}CH{-}OH \rightleftharpoons$$

$$CH_3{-}CH_2{-}CO_2{-}CH_2{-}CH_2{-}CH_2{-}CH_3$$

Q Name the alcohol and acid required to prepare the following Ester

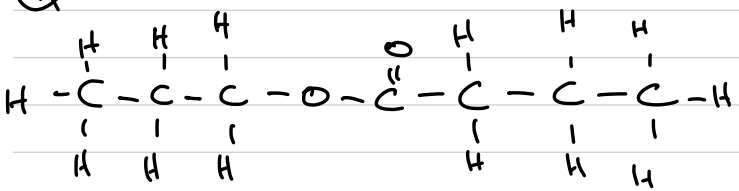


Butanoic Acid and Ethanol

Ethyl Butanoate

$-\overset{\overset{O}{\|}}{C}-$ Part after division having $-\overset{\overset{O}{\|}}{C}-$ is going to be the acid part.

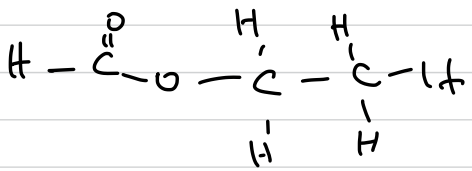
Q



Butanoic Acid and Propan-1-ol

$H \cdot CO_2 \cdot CH_2 \cdot CH_3$

Methanoic Acid and Ethanol a



Q $CH_3 \cdot OOC \cdot CH_2 \cdot CH_3$

Propanoic Acid and Methanol

LAB Preparation of the Esters
Ethyl Ethanoate

USES OF ALCOHOLS