Alcohols, Acids, Esters

$R - OH$

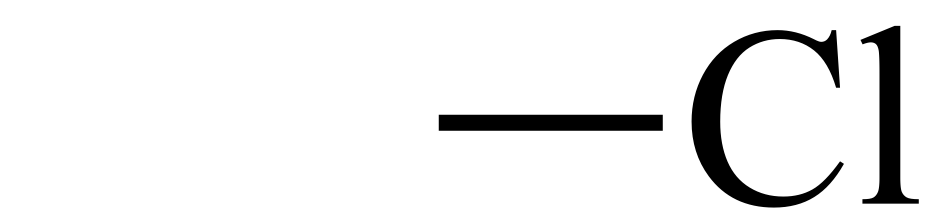
$R - COOH$

$R - COOR_1$

Functional Groups

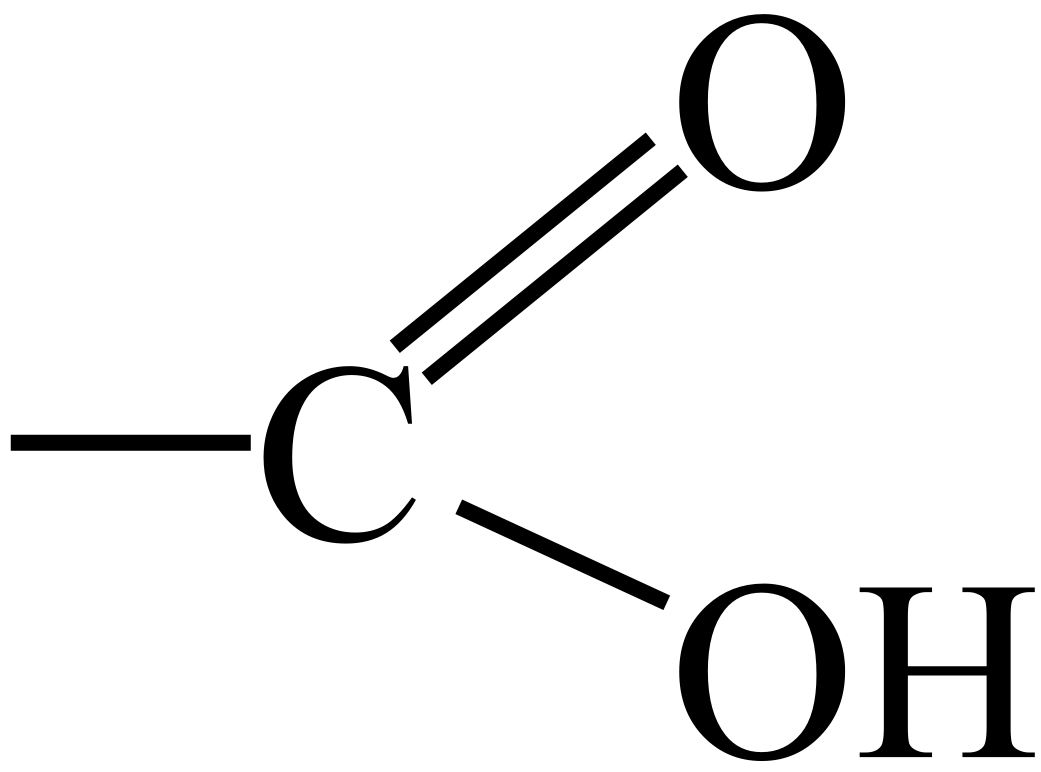
- A group of atoms that give a characteristic set of properties to a molecule containing that group

Chloro Functional Group



Hydroxy Functional Group

Carboxy Functional Group



Alkyl Groups

- A fragment of an alkane that substitutes for a removed hydrogen atom

First 10 Alkyl Groups (R)

$-CH_3$	methyl	$-(CH_2)_5CH_3$	hexyl
$-CH_2CH_3$	ethyl	$-(CH_2)_6CH_3$	heptyl
$-(CH_2)_2CH_3$	propyl	$-(CH_2)_7CH_3$	octyl
$-(CH_2)_3CH_3$	butyl	$-(CH_2)_8CH_3$	nonyl
$-(CH_2)_4CH_3$	pentyl	$-(CH_2)_9CH_3$	decyl

First Four Chloroalkanes,

- CH_3Cl chloromethane
- CH_3CH_2Cl chloroethane
- $CH_{3(}CH_2)_2Cl$ 1–chloropropane
- $CH_{3(}CH_2)_3Cl$ 1– chlorobutane

First Four Alcohols

- CH_3OH methanol
- CH_3CH_2OH ethanol
- $CH_{3(}CH_2)_2OH$ 1–propanol
- $CH_{3(}CH_2)_3OH$ 1–butanol

First Four Carboxylic Ccids

- $HCOOH$ methanoic acid
- CH_3COOH ethanoic acid
- CH_3CH_2COOH propanoic acid
- $CH_{3(}CH_2)_2COOH$ butanoic acid

The Need for Systematic Names

- To keep track of the many natural and synthetic organic chemicals
- Helps international communications of chemists
- Often “common” names do not relate to structure of the compound

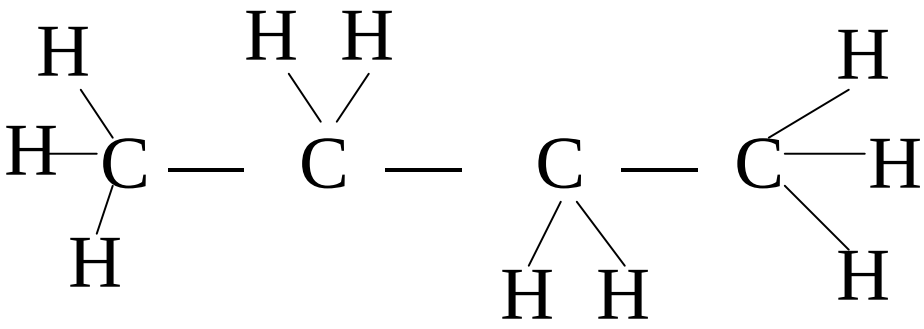
Construction of Systematic Names

- The alkane or alkene chain
- Name and number of functional groups
- Position of functional groups on the carbon chain

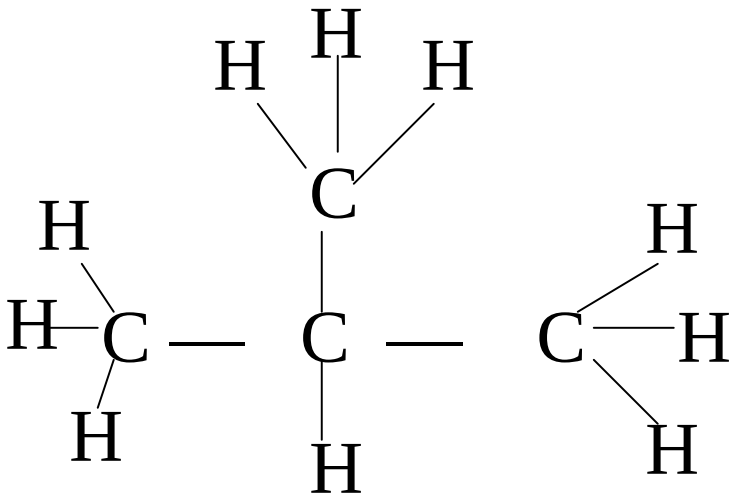
Isomers

- Molecules of the same molecular formula but have their atoms arranged in a different way
- Butane above and Butene and above have isomers
- Chloroalkanes for example have isomers above chloropropane – called structural isomers

Isomers of C_4H_{10}



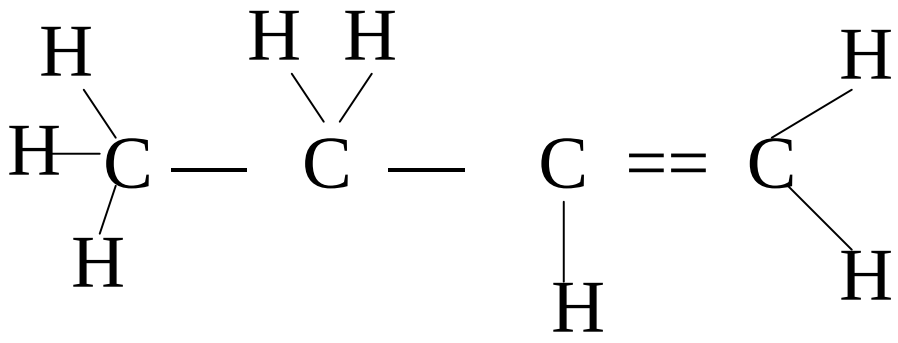
butane



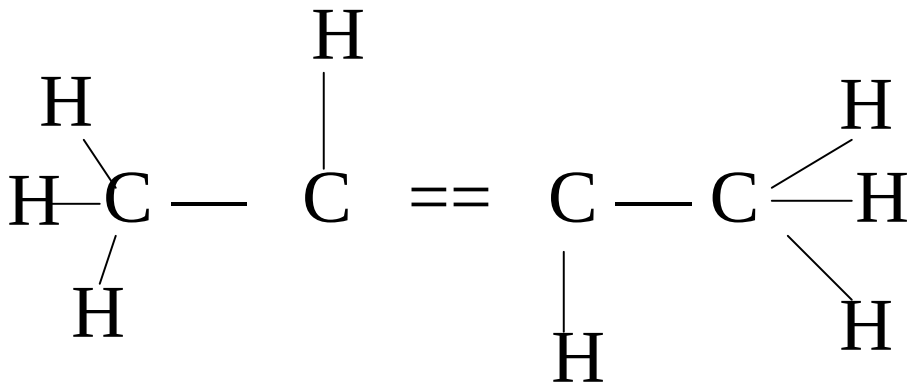
2 – methyl – propane

or methyl propane

Isomers of Butene C_4H_8

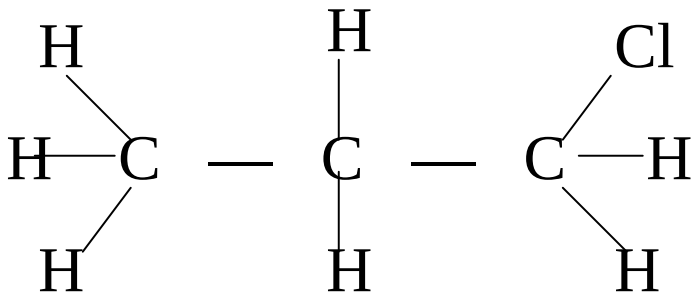


1 – butene

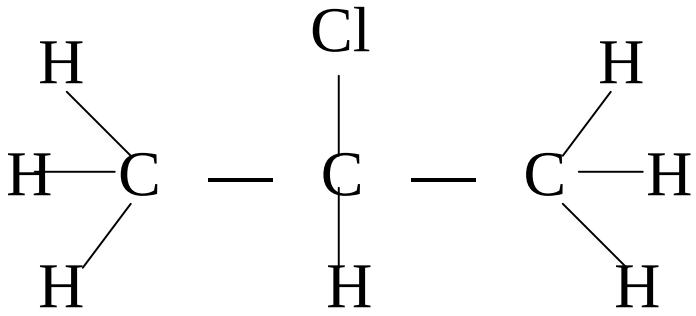


2 – butene

Isomers of Chloropropane

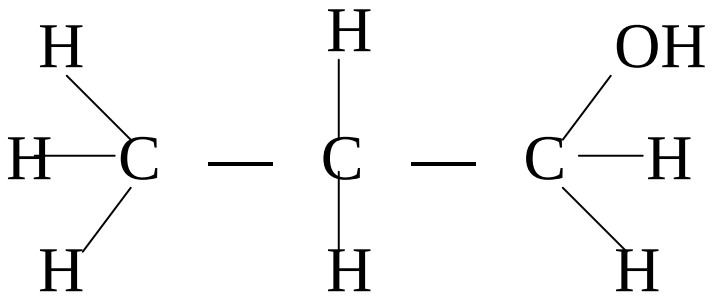


1 – chloropropane

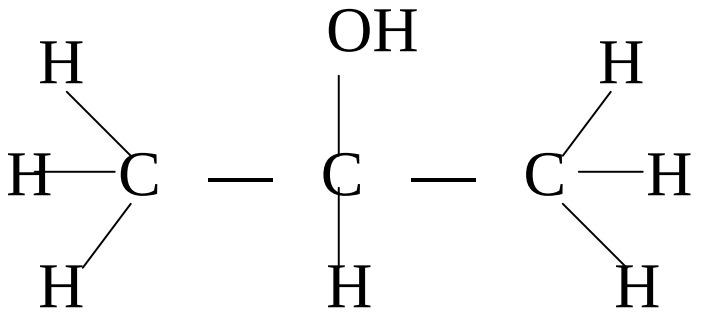


2 - chloropropane

Isomers of Propanol



1 – propanol



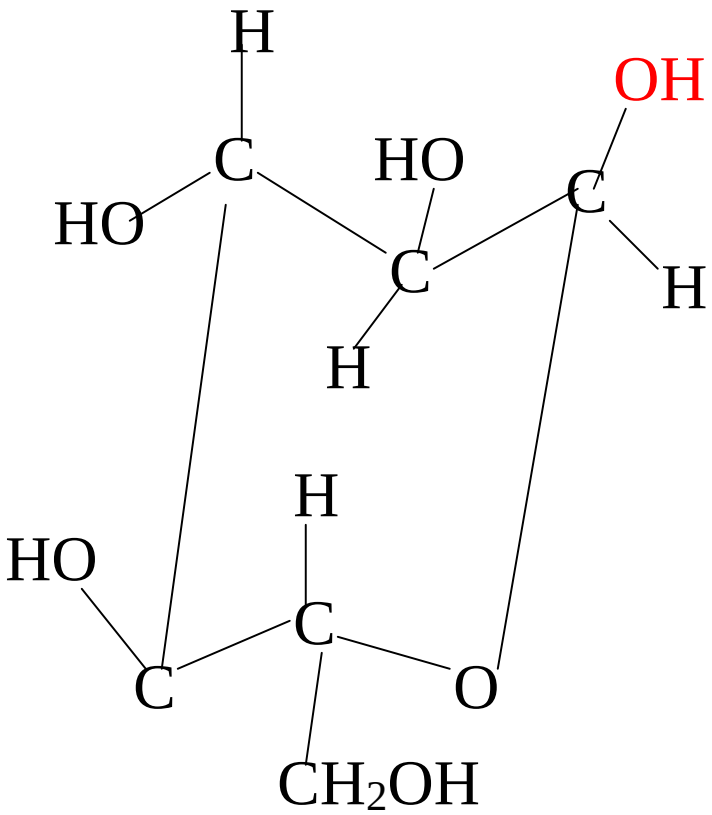
2 – propanol

The Role of Shape in Chemical Reactions

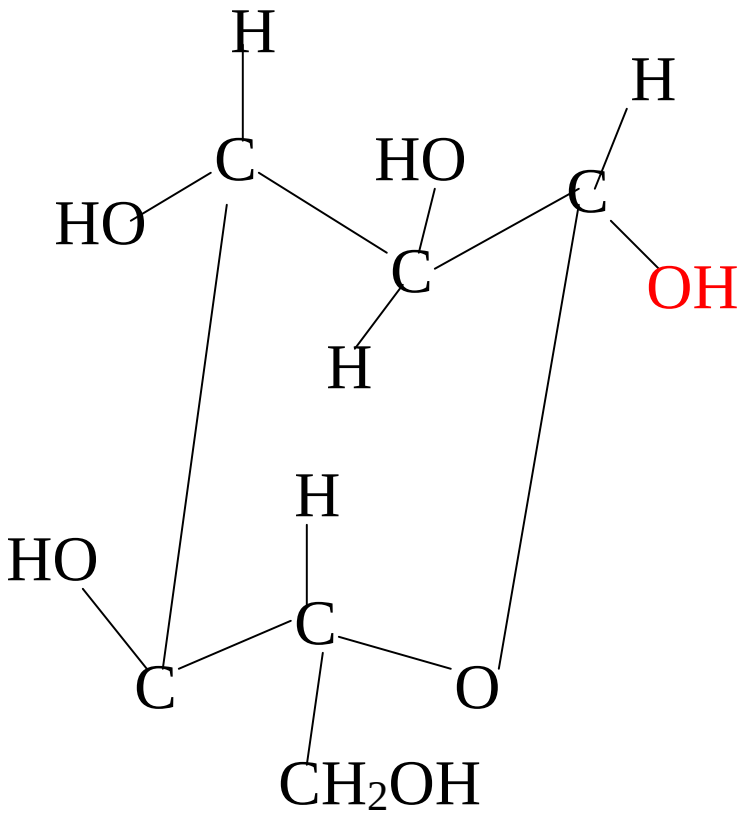
- Different structures of isomers can result in different properties and reactions
- eg. Starch and Glucose which are made up of long chains of glucose molecules
- Starch - we can digest uses a – glucose
- Cellulose we cant cellulose ß – glucose

Glucose

a – glucose



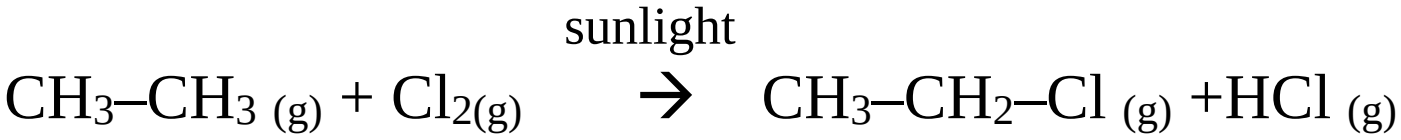
ß – glucose



Substitution Reactions

- When one of the hydrogen atoms attached to a carbon atom is replaced by another atom or group of atoms
- Some examples follow

Production of Chloroethane



One Cl atom replaces, (or substitutes) an H atom in the ethane molecule

An example of a substitution reaction

Production of Ethanol

$$CH_3–CH_2–Cl_{(g)} + OH^-_{(aq)} \rightarrow CH_3–CH_2–OH_{(aq)} + Cl^-_{(g)}$$

One OH group replaces, (or substitutes) an Cl atom in the chloroethane molecule.
Sodium Hydroxide solution is used

Another example of a substitution reaction

Production of Ethanoic Acid (Vinegar)

- Reaction with oxygen
  - Natural reaction in air

$$CH_3CH_2OH_{(aq)} \xrightarrow{O_{2(aq)}} CH_3COOH_{(aq)}$$

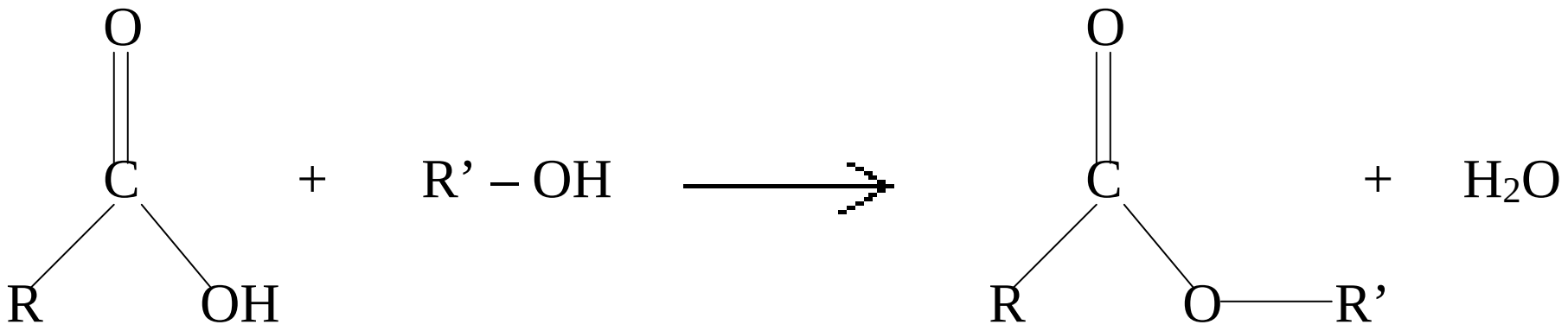
- Reaction with an acidified catalyst
  - Used in industrial applications

$$CH_3CH_2OH_{(aq)} \xrightarrow[H^+_{(aq)}]{MnO_4^-{}_{(aq)} \text{ or } Cr_2O_7^{2-}{}_{(aq)}} CH_3COOH_{(aq)}$$

Esters

- A group of organic compounds responsible for some of the natural and synthetic flavours ./ smells.
- Produced by adding an alcohol and a carboxylic acid
- Example of a condensation reaction – a reaction where water is produced

Preparation of Esters (Esterfication)

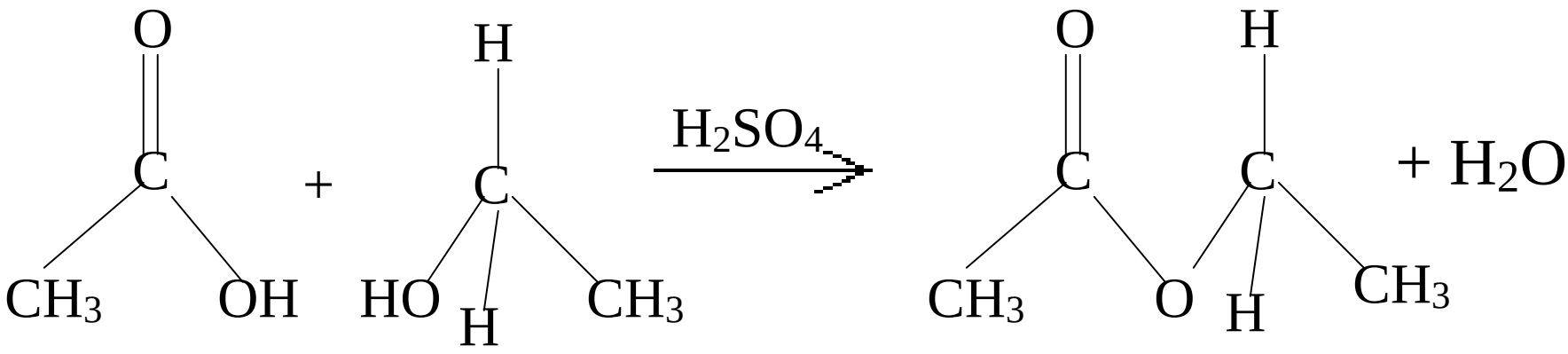


R & R' are hydrocarbon groups

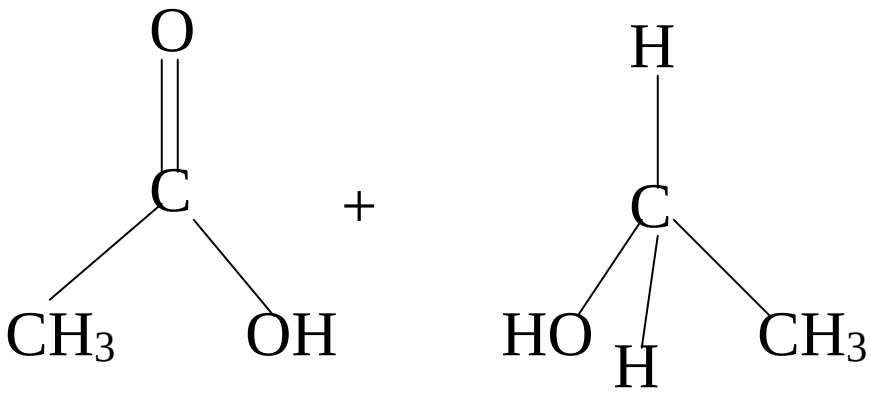
Preparation of Ethyl ethanoate

- Commonly called Ethyl acetate
- Gently heat a mixture of ethanol and ethanoic acid with a trace of sulfuric acid

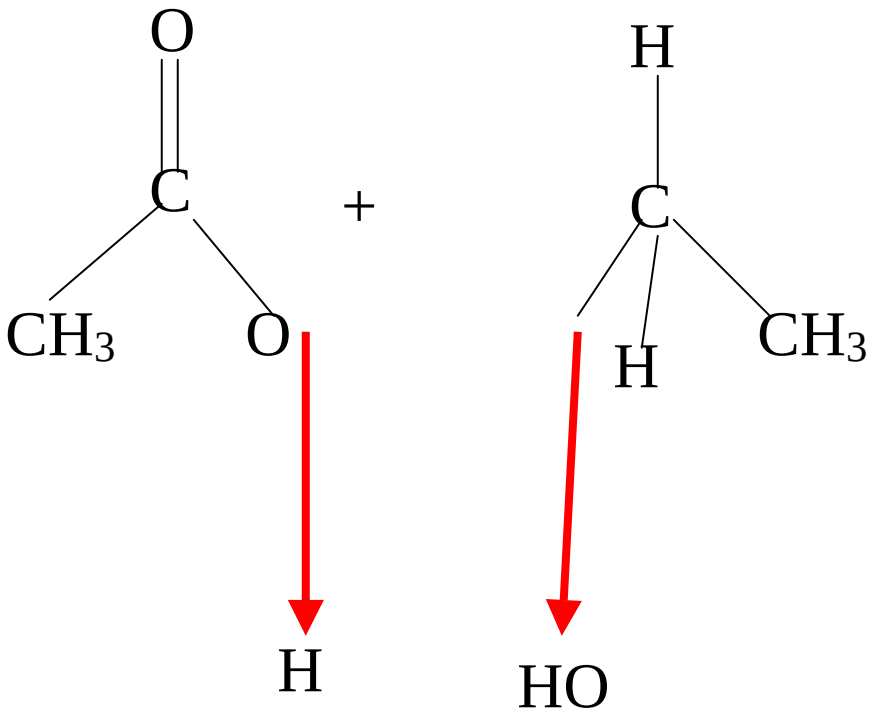
$$CH_3COOH_{(l)} + CH_3CH_2OH_{(l)} \xrightarrow{H_2SO_{4(l)}} CH_3COOCH_2CH_{3\,(l)} + H_2O_{(l)}$$



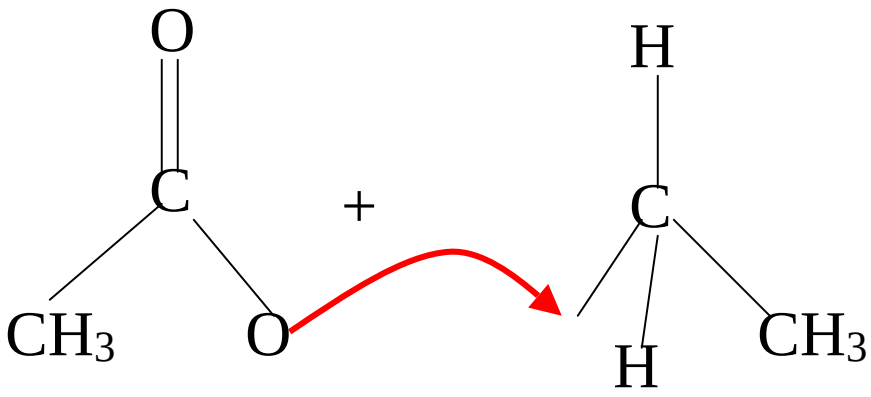
Preparation of Ethyl ethanoate



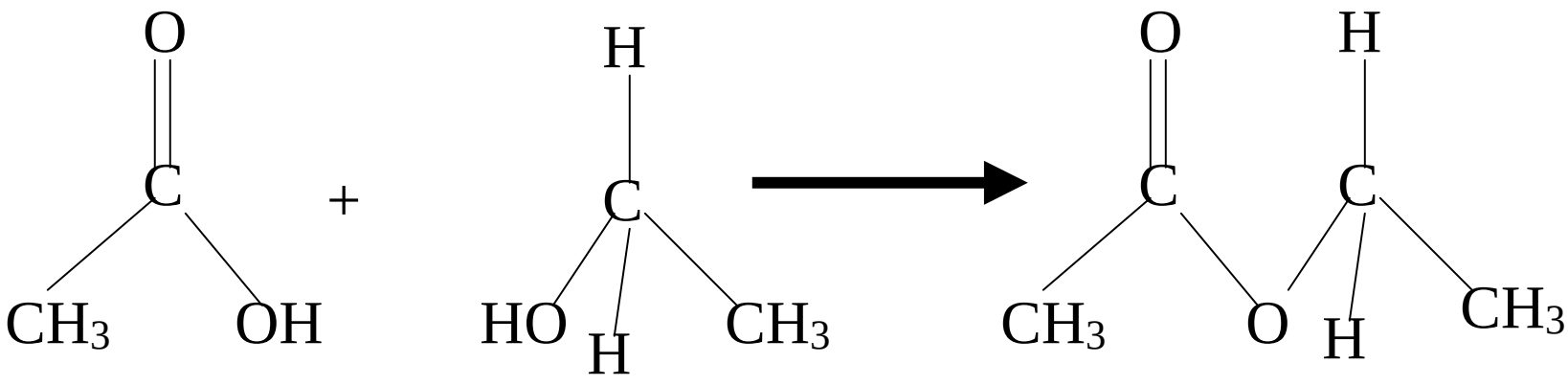
Preparation of Ethyl ethanoate



Preparation of Ethyl ethanoate



Preparation of Ethyl ethanoate



H_2O

Naming Esters

- First part of the name comes from the alcohol
- Second part comes from the carboxylic acid
- Example
- Propanol added to Butanoic acid
- Gives Propyl Butanonoate

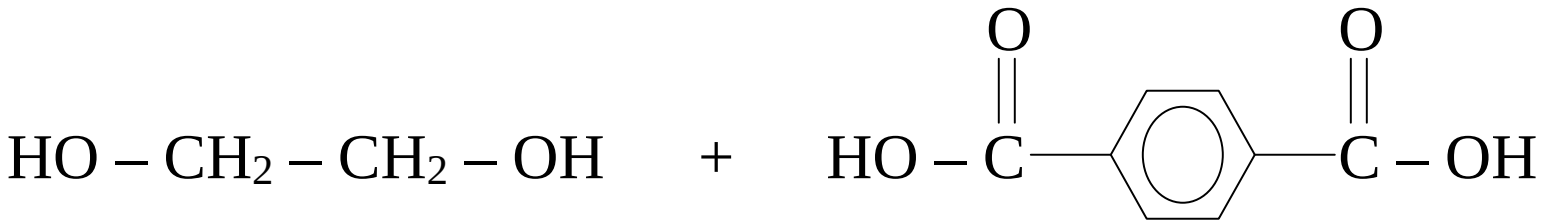
Polyester

- A copolymer made from alcohol and carboxylic monomers
  - The alcohol has two hydroxy groups
  - The acid has two carboxy groups
- The monomers join in a condensation reaction to form polyester chains
- Molecules held together with dispersion forces between molecules

Production of PET (PolyEthylene Terephthalate

- The most common polyester
- Made from
- Terephthalic acid
- Ethylene glycol

Production of PET (PolyEthylene Terephthalate



Ethylene glycol

Terephthalic acid

Production of PET (PolyEthylene Terephthalate