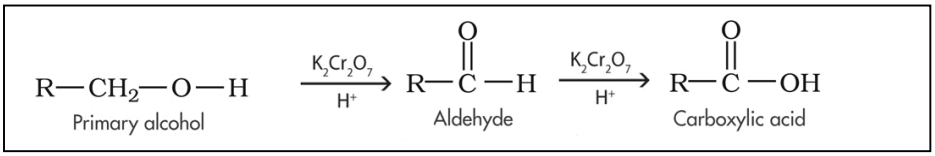
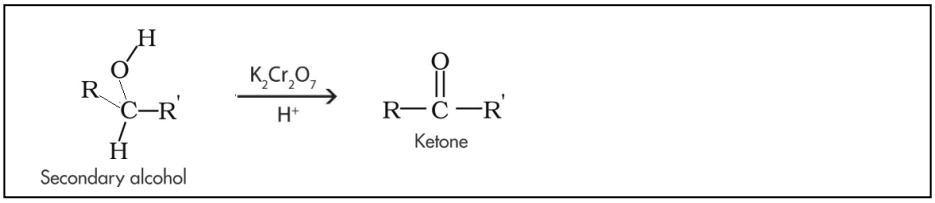
Lesson 10 Chemical reactions with alcohols carboxylic acids and esters.

Click to revise reaction pathways for the oxidation of alcohols
Click to revise the naming of esters
Below is a summary of the oxidation pathways of primary and secondary alcohols.

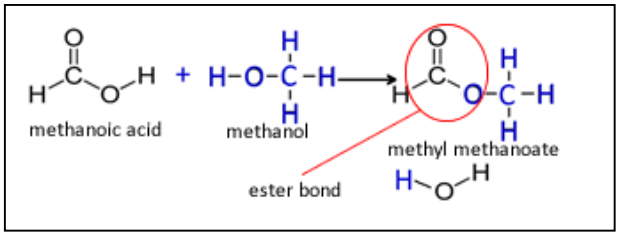




Keep in mind :
- tertiary alcohols do not undergo oxidation.
- $KMnO_4$ /H^+ can also be used as an oxidant in place of $K_2Cr_2O_7$ / H^+

Esters

An ester is synthesised from a carboxylic acid and an alcohol using an acid catalyst (H_2SO_4). The reaction that forms an ester is referred to as an ***esterification reaction***. This type of reaction is generally called a ***condensation reaction***.
A condensation reaction is one where a small molecule is given off when two molecules form a covalent bond between each other.



To name an ester follow the steps below

i. Place the alcohol that formed the ester first in the name followed by the acid.
ethanol propanoic acid

ii. Replace the ***anol*** of the alcohol with ***yl*** and the ***ic*** of the acid with ***ate*.**
ethyl propanoate

1) Name the esters formed from the following

a) Propanoic acid + ethanol $\xrightarrow[\text{catalyst}]{H_2SO_4}$

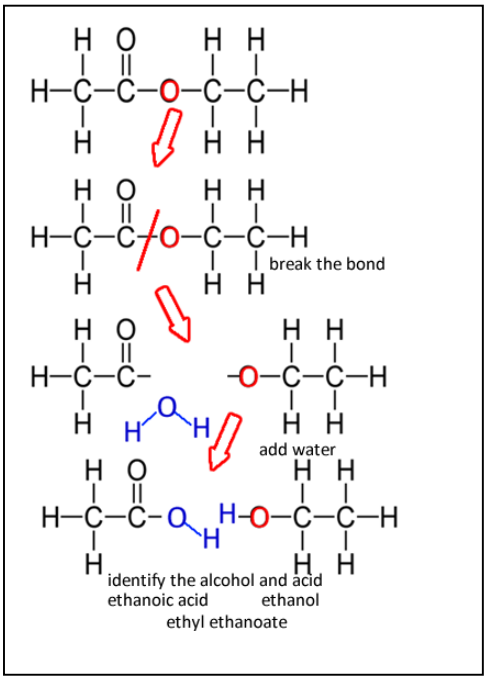
b) methanol + ethanoic acid $\xrightarrow[\text{catalyst}]{H_2SO_4}$

c) propanol + methanoic acid $\xrightarrow[\text{catalyst}]{H_2SO_4}$

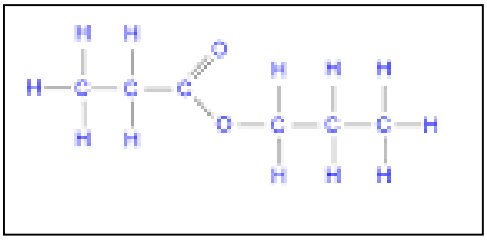
d) methanoic acid + pentanol $\xrightarrow[\text{catalyst}]{H_2SO_4}$

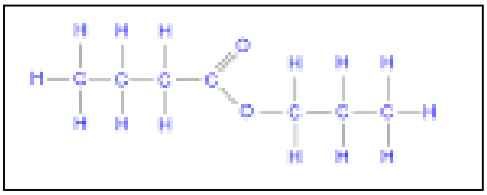
2) When faced with a structural formula of an ester and asked to name it, it is important you can identify the alcohol and acid that formed it. Take the ester shown on the right.
The C=O bonded carbon belongs to the acid while the C-O bonded carbon belongs to the alcohol.

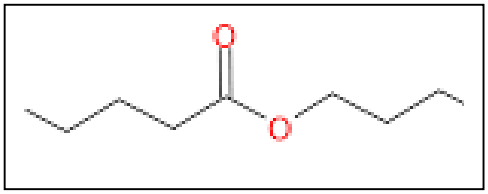
In this case the alcohol is ethanol and the acid is ethanoic acid
The ester is therefore named ethyl ethanoate.
Hydrolysis reactions involve the breaking of bonds by the addition of water. Esters undergo hydrolysis to yield an alcohol and a carboxylic acid, as shown on the right.

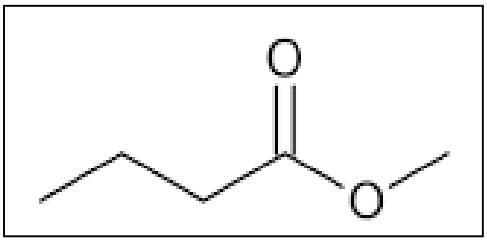


Identify the acid and alcohol that formed the esters shown on the right and name each ester.



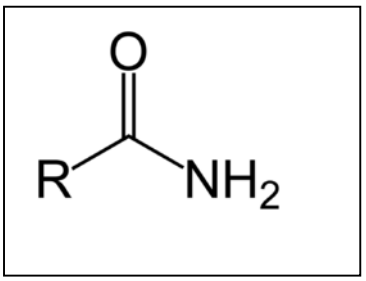






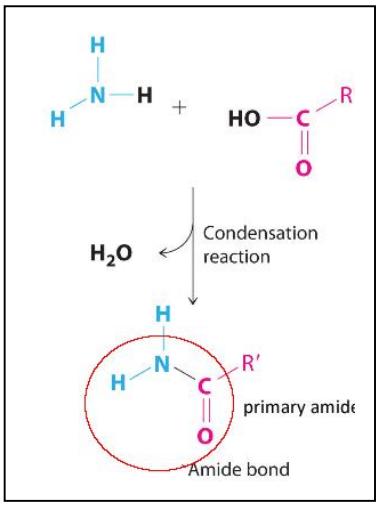
2) Explain why ethyl ethanoate has a boiling temperature of 77 °C while butanoic acid, which has the same formula mass as ethyl ethanoate, boils at 164 °C.

Amides - Reactions between carboxylic acids and amines.
A primary amide has a characteristic $CONH_2$ ending, as shown on the right.

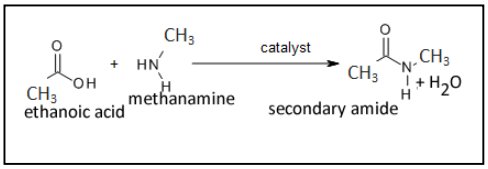


It comes about when a carboxylic acid reacts with ammonia in a condensation reaction , as shown on the right. Note how the OH from the acid combines with a H from the ammonia to produce a water molecule.

A secondary amide is produced by a carboxylic acid and an alkylamine and has the general formula RCONHR', where R and R' represent alkyl groups.
*** Note Secondary amides are not part of this course.*



Example 1 Consider the condesation reaction between ethanoic acid and methanamine, shown on the right. A secondary amide is formed and water is given off.



3) What type of functional group is produced when:
   a) Propanamine reacts with ethanoic acid
   b) Propanoic acid and pentanol

4) Complete the following word equations
   i. propanol + butanoic acid $\xrightarrow{H_2SO_4}$ +
   ii. ammonia + butanoic acid $\xrightarrow{\text{catalyst}}$ + Butanamide

5) Draw the structural formulae of the products formed in each reaction in 4) above.

i.	ii.

6) Complete the following word equations and identify the type of reaction taking place.
   i. _____ + H_2O → ethanoic acid + ethanol
   ii. Propanol + methanoic acid → _____ + H_2O
   iii. Propanoic acid + ammonia → propanamide + ____