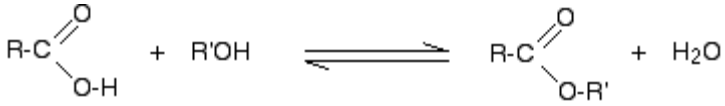
ESTERS: PREPARATION

1. a) A common way of making esters involves this equation, taken from the Chemguide page:



Explain what this equation means.

b) Name the catalyst that is normally used for this reaction.

c) If you were doing this reaction on a test tube scale, you would heat the mixture of carboxylic acid and alcohol with a few drops of the catalyst in a test tube stood in a hot water bath for a few minutes. Then if you want to smell the ester produced, you can pour the mixture into some water in a beaker.

(i) Why is it preferable to heat this in a hot water bath rather than directly with a bunsen?

(ii) Why do you get a better idea of the smell of the product by pouring the mixture into some water?

d) If you want to prepare some ethyl ethanoate on a larger scale, you would heat the reaction mixture in a flask and distil off and collect the ester as it is formed. Why does this work effectively for the small esters?

2. a) You can also make esters by reacting an acyl chloride with an alcohol. Write the general equation for this using a form similar to the one in Q1(a).

b) Describe the reaction between ethanoyl chloride and ethanol.

c) Write the formula for the ester formed by reacting

(i) propanoyl chloride with methanol,

(ii) ethanoyl chloride with propan-1-ol,

(iii) ethanoyl chloride and phenol, C_6H_5OH.

d) The ester phenyl benzoate can be made from a reaction starting from benzoyl chloride, C_6H_5COCl. However, in this case, the phenol is first converted into sodium phenoxide, $C_6H_5O^-\ Na^+$.

(i) Why is it necessary to use sodium phenoxide rather than phenol itself?

(ii) How do you convert phenol into sodium phenoxide?

(iii) Write the equation for the reaction between benzoyl chloride and sodium phenoxide.

3. Esters can also be made from alcohols or phenols using acid anhydrides such as ethanoic anhydride instead of acyl chlorides.

   a) Give two differences between a reaction involving an acid anhydride and one involving an acyl chloride.

   b) Write the equation for the reaction between ethanoic anhydride and ethanol.