1 ***(a)** Ethanol can be oxidized successively to ethanal and to ethanoic acid.

The boiling temperatures of these substances are:
ethanol 78 °C, ethanal 21 °C, ethanoic acid 118 °C.

Explain in terms of the intermolecular forces in the liquids why the order of the boiling temperature is

ethanal < ethanol < ethanoic acid

(3)

(b) State what tests you would perform in each case, and the result you would expect, to show that

(i) ethanal contains a carbonyl group.

(2)

(ii) ethanal is an aldehyde.

(2)

(c) Ethanal reacts with HCN, in the presence of a catalyst of cyanide ions from KCN, to give a cyanohydrin, $CH_3CH(OH)CN$.

(i) Give the mechanism for this reacti

(3)

(ii) Explain why it is necessary to use HCN and KCN in this reaction, rather than HCN on its own.

(1)

*(iii) Explain why the product mixture from this reaction is **not** optically active.

(2)

(Total for Question = 13 marks)