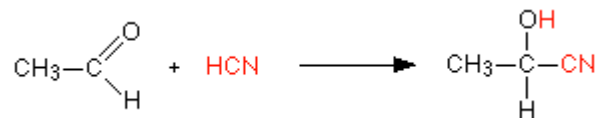


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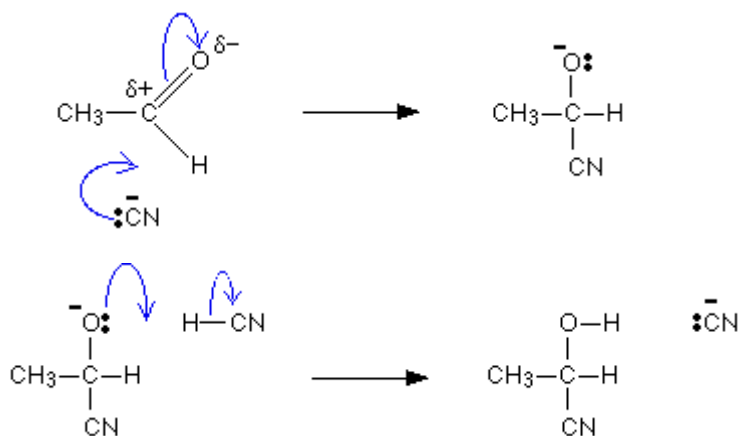
NUCLEOPHILIC ADDITION: C=O and HCN

1. Under the right conditions, HCN adds across the carbon-oxygen double bond in ethanal in the following way:



The product is 2-hydroxypropanenitrile.

The mechanism for the reaction is:



- a) Describe and explain in words what is happening during this reaction.
- b) In the second stage of this mechanism, the hydrogen that becomes attached to the oxygen doesn't necessarily have to come from an HCN molecule. Suggest two other possible sources of the hydrogen atom.
- c) The reaction is perhaps most commonly done using sodium or potassium cyanide solution acidified with some dilute sulphuric acid to give a pH of about 4 - 5.
- (i) Explain why a slightly acidic pH helps the first stage of the mechanism to work.
- (ii) Explain why a more acidic reaction mixture would result in a very slow reaction.
- d) Write the mechanism for the addition of HCN to propanone: $\text{CH}_3\text{-C}\begin{array}{l} \text{CH}_3 \\ \text{=O} \end{array}$
2. *Ignore this question if you don't know about optical isomerism. On the other hand, if you should know about optical isomerism, but have forgotten about it, use this opportunity to revise it properly, and then do the question.*
- a) 2-hydroxypropanenitrile (see the top of the page) exhibits optical isomerism. Explain briefly why this molecule has optical isomers.

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- b) When HCN adds across the carbon-oxygen double bond of ethanal, a racemic mixture is formed. What is a racemic mixture?
- c) Explain with the help of diagrams why a racemic mixture is formed.