

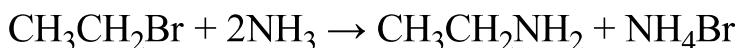
# 19 Nitrogen compounds

The material covered in this chapter is for AS Level but will be revisited in [Chapter 34](#) for A Level. Classification of amines will not be tested at AS Level.

## Primary amines

### Formation of primary amines

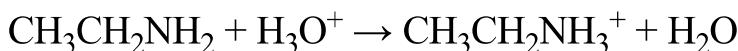
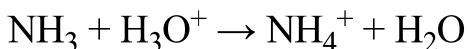
The simplest reaction for producing a primary amine is to heat a halogenoalkane in ethanol with ammonia under pressure:



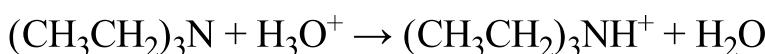
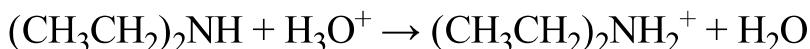
As long as excess ammonia is used, the reaction does not produce unwanted by-products.

### Basicity of primary amines

When considering the basic properties of alkyl amines, it is easiest to think of them as substituted ammonia molecules. If you remember that bases are proton acceptors it is not too difficult to make the comparison. Compare the two equations:



The same rule applies to secondary and tertiary amines, with alkyl groups substituting hydrogen atoms on the nitrogen atom:



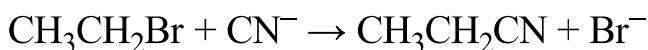
Amines are generally *stronger* bases than ammonia. This is because alkyl groups are electron-donating, pushing negative charge onto the nitrogen atom

and strengthening the attraction to the proton. The more alkyl groups there are attached to the nitrogen, the stronger the base formed.

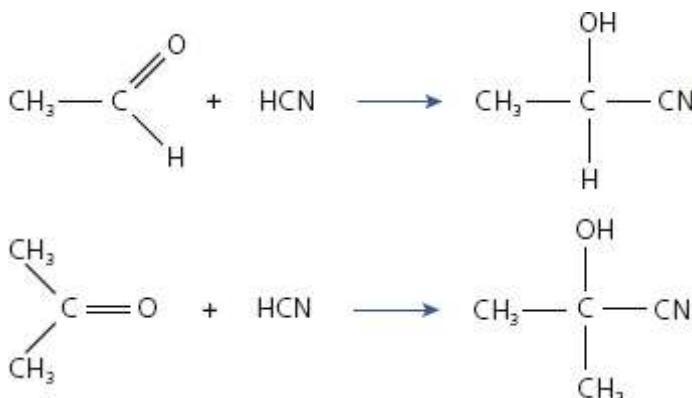
# Nitriles and hydroxynitriles

## Formation of nitriles and hydroxynitriles

In [Chapter 15](#) we saw that halogenoalkanes react by heating with  $\text{KCN}$  in ethanolic solution to form nitriles by nucleophilic substitution:



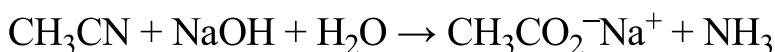
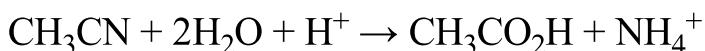
Hydroxynitriles can be produced by heating aldehydes and ketones with  $\text{HCN}$  using  $\text{KCN}$  as a catalyst ([Figure 19.1](#)), by nucleophilic addition as we saw in [Chapter 17](#).



**Figure 19.1**

## Reaction of nitriles

The key reaction of nitriles is their hydrolysis using dilute acid or dilute alkali followed by acidification. This reaction results in the formation of the relevant carboxylic acid. These reactions were covered in [Chapter 18](#).



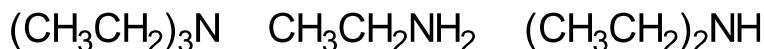
## NOW TEST YOURSELF

1 Suggest why the formation of nitriles and hydroxynitriles are important reactions in organic chemistry.

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## REVISION ACTIVITY

a What is it that makes amines stronger bases than ammonia?  
b Put these amines in order of increasing base strength, weakest first:



## END OF CHAPTER CHECK

By now you should be able to:

- recall the reactants and conditions by which amines can be produced
- recall the reactants and conditions by which nitriles and hydroxynitriles can be produced
- describe the hydrolysis of nitriles with dilute acid or dilute alkali