

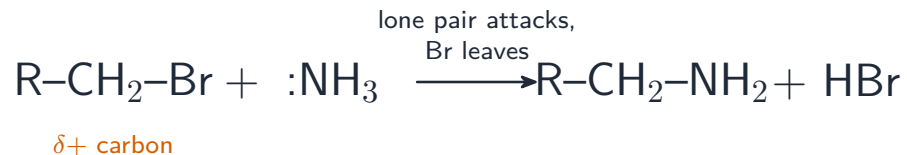
Exercise walk-through

19.1

Primary amines

A-Level Chemistry

Making a primary amine



An **amine** has an —NH_2 group.
Heat a **halogenoalkane**
with NH_3 in ethanol.

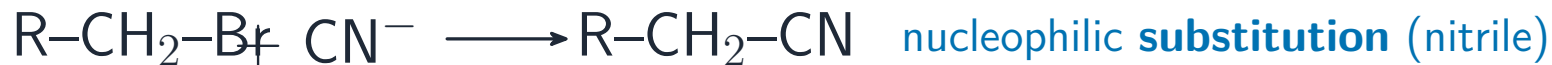
The lone pair on N attacks the $\delta+$ carbon and pushes out the halogen – a **nucleophilic substitution**. Use **excess** NH_3 .

Two ways cyanide adds a carbon

■ $\text{KCN} + \text{halogenoalkane} \rightarrow \text{a nitrile}$ (substitution)

■ $\text{HCN} + \text{carbonyl} \rightarrow \text{a hydroxynitrile}$ (addition)

Both **add one carbon** to the chain.

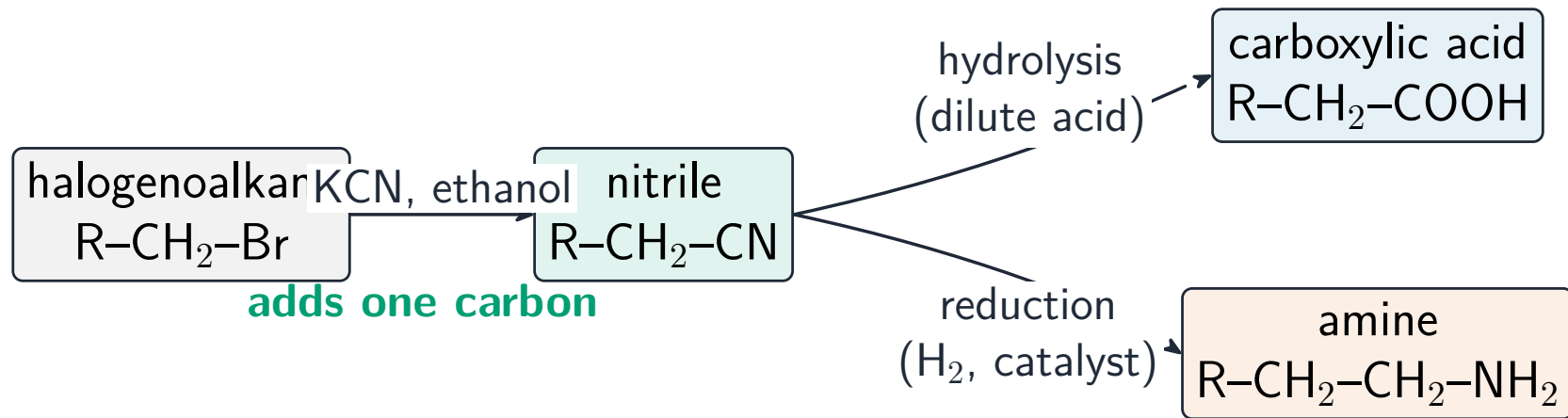


Nitrile routes

A **nitrile** is a useful hub:

- **hydrolysis** → a **carboxylic acid**
- **reduction** → an amine (a longer chain)

Nitrile routes, in detail



A **nitrile** is a useful hub – it leads two ways:

hydrolysis → a **carboxylic acid** .

reduction → an amine, one carbon longer than you started.

The two things a nitrile can become

hydrolysis

with dilute acid and heat, $\text{RCN} \rightarrow \text{RCOOH}$ – a **carboxylic acid** with the same number of carbons

reduction

with hydrogen and a catalyst (or LiAlH_4), $\text{RCN} \rightarrow \text{RCH}_2\text{NH}_2$ – an **amine**

why it matters

both routes **keep** the extra carbon the cyanide added

nucleophilic addition

how the cyanide got there: CN^- adds to an **aldehyde** or **ketone** to give a hydroxynitrile

hydrogen cyanide

the source of CN^- , used with KCN in ethanol

Count the carbons first. Bromoethane has 2 and propanoic acid has 3, so the route must add one – which is exactly what the cyanide step does.

Exercises 2.1-3.1

2.1 State the reagents and conditions to make ethylamine from bromoethane. [2]

2.2 Name the type of mechanism of this reaction. [1]

3.1 Why is an excess of ammonia used when making a primary amine? [1]

☐

A to speed up the reaction

B to stop the amine reacting further with the halogenoalkane

C to lower the temperature

D to act as a catalyst

Exercises 2.1·3.1

2.1 State the reagents and conditions to make ethylamine from bromoethane. [2]

2.1

- ammonia (NH_3) in ethanol; heated under pressure
-

2.2 Name the type of mechanism of this reaction. [1]

2.2

- nucleophilic substitution
-

3.1 Why is an excess of ammonia used when making a primary amine? [1]

☐

A to speed up the reaction

B to stop the amine reacting further with the halogenoalkane

C to lower the temperature

D to act as a catalyst

3.1 B

- Excess ammonia stops the amine reacting further with the halogenoalkane

Exercise 3.2

3.2 The species that attacks the halogenoalkane is:

[1]

☐

A the lone pair on nitrogen of ammonia

B the H^+ ion

C a free radical

D the bromide ion

Exercise 3.2

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[1]

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A the lone pair on nitrogen of ammonia

B the H^+ ion

C a free radical

D the bromide ion

3.2 A

- The lone pair on the nitrogen of ammonia is the nucleophile

Exercise 3.3

3.3 (a) Write the equation for the reaction of bromoethane with ammonia. [1]

(b) Explain why this reaction is classed as nucleophilic substitution. [2]

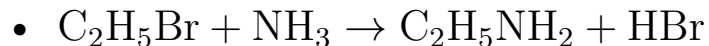
Exercise 3.3

3.3 (a) Write the equation for the reaction of bromoethane with ammonia. [1]

(b) Explain why this reaction is classed as nucleophilic substitution. [2]

3.3

(a)



(b)

- ammonia (a nucleophile) uses its lone pair to attack the $\delta+$ carbon and replaces the halogen – a substitution