19.1 Primary amines

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS amine • primary amines • halogenoalkane • nucleophilic substitution • nitrile

Objective

Build the skills to answer exam questions on **primary amines** – making them from a **halogenoalkane** and ammonia.

You must be able to:

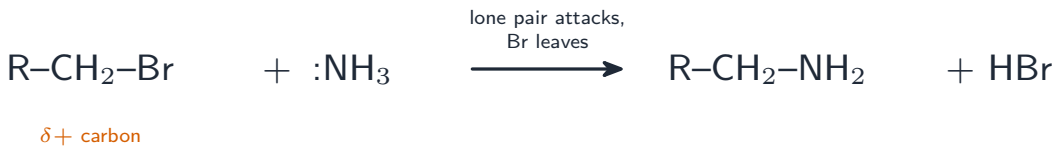
- recall the reaction of a halogenoalkane with ammonia to make a primary amine
- describe it as a nucleophilic substitution

1 Key knowledge and worked examples

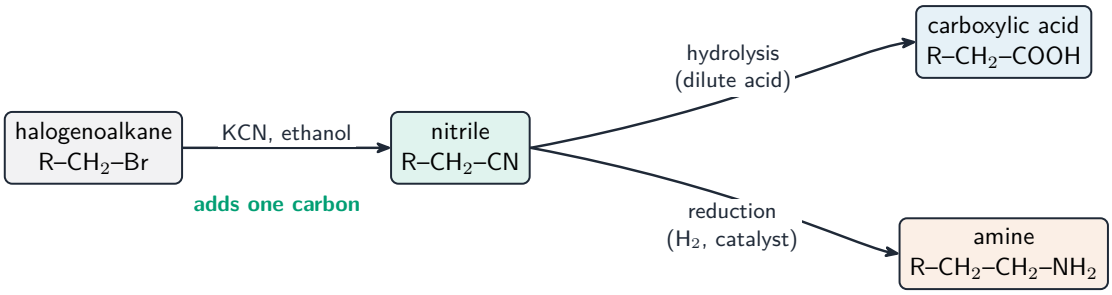
Making a primary amine

An **amine** has an $–NH_2$ group. Heat a halogenoalkane with **ammonia** in ethanol, under pressure:

$$C_2H_5Br + NH_3 \rightarrow C_2H_5NH_2 + HBr$$



A nucleophilic substitution: ammonia's lone pair attacks the δ+ carbon, displacing the halogen



Amines via the nitrile route

Use an **excess** of ammonia, or the amine made reacts again with more halogenoalkane.

2 Practice

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 Exam-style questions

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

3.2 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

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]

Solutions

Each answer shows the steps, then the **result**.

2.1

- ammonia (NH_3) in ethanol; heated under pressure

2.2

- nucleophilic substitution

3.1 B

- Excess ammonia stops the amine reacting further with the halogenoalkane

3.2 A

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

3.3

(a)

- $C_2H_5Br + NH_3 \rightarrow C_2H_5NH_2 + HBr$

(b)

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