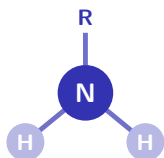


Nitrogen Compounds

A-Level Chemistry ■ Topic 19

A-Level Chemistry



Nitrogen Compounds

What we will cover

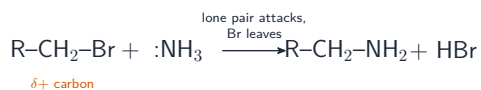
- 1 Making a primary amine
- 2 Two ways cyanide adds a carbon
- 3 Nitrile routes



amines build nylon

1 Amines and nitriles

Making a primary amine



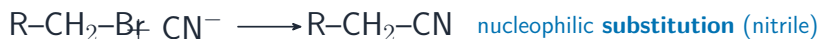
An **amine** 胺 has an -NH_2 group. Heat a **halogenoalkane** 卤代烷 with NH_3 in ethanol.

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

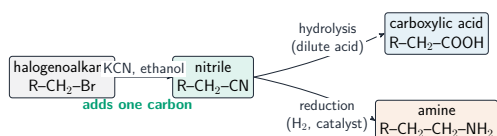
Two ways cyanide adds a carbon

- $\text{KCN} + \text{halogenoalkane} \rightarrow$ a **nitrile** 腈 (substitution)
- $\text{HCN} + \text{carbonyl} \rightarrow$ a **hydroxynitrile** 羟基腈 (addition)

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



Nitrile routes



A **nitrile** 腈 is a useful hub:

- **hydrolysis** 水解 $\rightarrow$ a **carboxylic acid** 羧酸
- **reduction** 还原 $\rightarrow$ an **amine** (a longer chain)

2

Recap

Worked example – why is an amine basic?

Explain why ethylamine is a stronger base than ammonia.

- A base **donates its lone pair** to H^+ , so the more available the pair, the stronger the base.
- In $\text{CH}_3\text{CH}_2\text{NH}_2$ the ethyl group is **electron-releasing** 推电子的 (positive inductive effect).
- It pushes electron density **onto** N, making the lone pair more available.
- $\Rightarrow$ **ethylamine** > **ammonia**.

Anything pushing electrons **onto** N strengthens the base; anything pulling them **away** (a benzene ring) weakens it.

Topic 19 – key takeaways

1 Amines

halogenoalkane + NH_3 ;
nucleophilic substitution

2 Nitriles

KCN substitutes; HCN adds –
both add a carbon

3 Hydrolysis

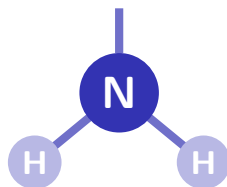
nitrile $\rightarrow$ carboxylic acid

4 Reduction

nitrile $\rightarrow$ amine; amines build
nylon

Check yourself

- 1 What attacks the carbon when NH_3 makes an amine?
- 2 Which reagent turns a halogenoalkane into a nitrile?
- 3 Hydrolysing a nitrile gives which functional group?
- 4 What does reducing a nitrile give?



Answers 1. the lone pair on nitrogen 2. KCN 3. a carboxylic acid ($-\text{COOH}$) 4. an amine