

34.1 Primary and secondary amines

Name: _____ Class: _____ Date: _____

Total: 23 marks

KEY WORDS amine 胺 • amide 酰胺 • basicity 碱性 • ammonia 氨 • reduction 还原

Objective

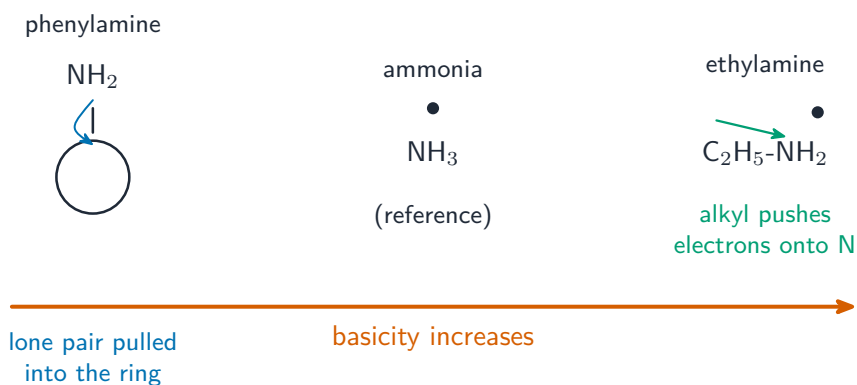
Build the skills to answer exam questions on **primary and secondary amines** 胺 — how they are made, and the trends in **basicity** 碱性.

You must be able to:

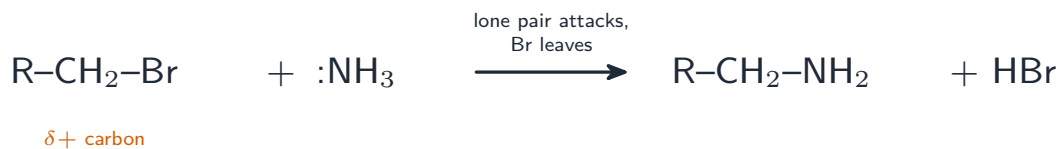
- give the reagents to make amines (from halogenoalkanes, amides, nitriles)
- explain why amines are basic
- explain and compare the basicity of ammonia, an aliphatic amine and phenylamine

1 Worked examples

■ Basicity



Basicity depends on the N lone pair: an alkyl group makes it more available (ethylamine strongest); a ring pulls it away (phenylamine weakest)



Routes to primary and secondary amines

- amines are basic because the **N lone pair** can accept an H^+ .
- basicity:** phenylamine < ammonia < ethylamine.
 - ethylamine: alkyl group pushes electrons onto N $\rightarrow$ lone pair more available $\rightarrow$ strongest.
 - phenylamine: lone pair delocalised into the ring $\rightarrow$ less available $\rightarrow$ weakest.
- make a primary amine:** halogenoalkane + excess NH_3 in ethanol, heat under pressure; or reduce a nitrile/amide with LiAlH_4 .

2 Practice

2.1 State why an amine is able to act as a base. [1]

2.2 Give the reagents to convert bromoethane into ethylamine. [2]

3 Exam-style questions

3.1 Which is the **strongest** base? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A phenylamine
 - B ammonia
 - C ethylamine
 - D they are equal

3.2 Reduction of a nitrile, CH_3CN , with LiAlH_4 gives: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A ethylamine
 - B ethanamide
 - C ethanoic acid
 - D ethanenitrile

3.3 Explain why ethylamine is a stronger base than ammonia. [2]

3.4 Explain why phenylamine is a much weaker base than ethylamine. [3]

3.5 Three bases are compared: ammonia, ethylamine and phenylamine.

(a) Place the three in order of increasing basicity and explain the order in terms of the availability of the nitrogen lone pair. [4]

(b) Ethylamine can be made from bromoethane and excess ethanolic ammonia. Write the equation, name the mechanism, and explain why an **excess** of ammonia is used. [4]

(c) Phenylamine is made from nitrobenzene. Give the reagents and conditions, and write the equation using [H] for the reducing agent. [3]

(d) Write the equation for ethylamine reacting with dilute hydrochloric acid, and name the salt. [2]
