

34.1 Primary and secondary amines

Name: _____ Class: _____ Date: _____

Total: 10 marks

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

phenylamine

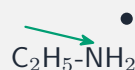


ammonia



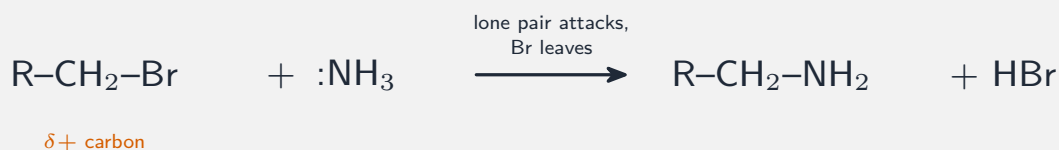
(reference)

ethylamine

alkyl pushes
electrons onto Nlone pair pulled
into the ring

basicity increases

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 → lone pair more available → strongest.
 - phenylamine: lone pair delocalised into the ring → less available → 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** phenylamine
 - **B** ammonia
 - **C** ethylamine
 - **D** they are equal
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3.2 Reduction of a nitrile, CH_3CN , with LiAlH_4 gives: [1]

- **A** ethylamine
 - **B** ethanamide
 - **C** ethanoic acid
 - **D** ethanenitrile
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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]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **34.1 Primary and secondary amines** past-paper sheet in the Library, or try these in **Practice mode**:

- 9701/41 N25 —Q9 (primary and secondary amines)

Solutions

2.1 the nitrogen lone pair can accept (donate to) an H^+ .

2.2 excess ammonia, NH_3 , in ethanol; heat under pressure.

3.1 C. Ethylamine —the alkyl group makes the lone pair most available.

3.2 A. LiAlH_4 reduces the nitrile to a primary amine, ethylamine.

3.3 the ethyl group pushes electron density onto the nitrogen (positive inductive effect); this makes the lone pair more available to accept an H^+ , so ethylamine is a stronger base than ammonia.

3.4 in phenylamine the nitrogen lone pair overlaps with / is delocalised into the benzene ring; so it is less available to accept an H^+ ; whereas in ethylamine the lone pair is fully available (and the alkyl group pushes electrons onto N), so phenylamine is much weaker.