

34.2 Phenylamine and azo compounds

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS azo compound 偶氮化合物 • phenylamine 苯胺 • phenylamine and azo compounds 苯胺与偶氮化合物
• diazonium salt 重氮盐 • dye 染料

Objective

Build the skills to answer exam questions on **phenylamine and azo compounds** 苯胺与偶氮化合物 — making phenylamine, diazonium salts, and azo dye coupling.

You must be able to:

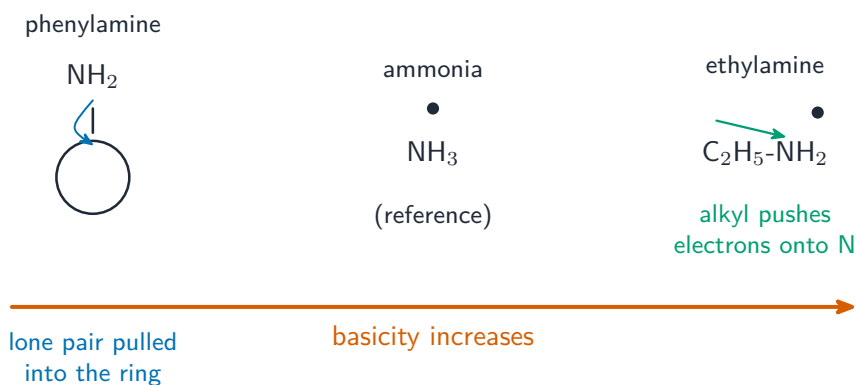
- give the two-step route from benzene to phenylamine
- describe the formation of a diazonium salt and its conditions
- describe azo coupling and why azo compounds are coloured dyes

1 Worked examples

■ Diazonium salts and azo dyes



The strong colour of an azo dye comes from the $-N=N-$ azo group joining two aromatic rings



Phenylamine is a weaker base than aliphatic amines

- **make phenylamine:** benzene $\rightarrow$ (nitrate) $\rightarrow$ nitrobenzene $\rightarrow$ (Sn / conc. HCl, then NaOH) $\rightarrow$ phenylamine.
- **diazonium salt:** phenylamine + NaNO_2 + dilute acid, **below 10 °C** $\rightarrow$ benzenediazonium chloride.
- **azo coupling:** diazonium salt + phenol in NaOH(aq) $\rightarrow$ a coloured **azo compound** (a dye); the -N=N- group links two rings.

2 Practice

2.1 Give the reagents to reduce nitrobenzene to phenylamine. [2]

2.2 State the temperature needed to make a stable diazonium salt. [1]

3 Exam-style questions

3.1 A diazonium salt is made from phenylamine using: [1]

- A NaNO_2 + dilute acid, below 10 °C
- B conc. HNO_3 + conc. H_2SO_4
- C Br_2 water
- D LiAlH_4

3.2 The colour of an azo dye is due to the: [1]

- A -OH group

- **B** -NH_2 group
 - **C** -N=N- group
 - **D** benzene ring alone
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3.3 Outline the two-step synthesis of phenylamine from benzene, giving the reagents for each step. [3]

3.4 A benzenediazonium salt is coupled with phenol in alkaline solution.

(a) State the type of compound formed. [1]

(b) State **one** common use of such compounds. [1]

Solutions

2.1 tin (Sn) and concentrated hydrochloric acid; then NaOH(aq).

2.2 below 10 °C (kept cold in an ice bath).

3.1 A. NaNO_2 + dilute acid below 10 °C makes the diazonium salt.

3.2 C. The $-\text{N}=\text{N}-$ azo group is responsible for the colour.

3.3 nitrate benzene with conc. HNO_3 + conc. H_2SO_4 to give nitrobenzene; reduce with Sn and conc. HCl; then add NaOH(aq) to free the phenylamine.

3.4 (a) an azo compound / azo dye.

(b) used as a dye (colouring).