

Exercise walk-through

36.1

Organic synthesis

A-Level Chemistry

Identifying functional groups

A Level identification tests:

- bromine water, no catalyst, white ppt → phenol or phenylamine
- violent with cold water, HCl fumes → **acyl chloride**
- purple with neutral FeCl_3 → **phenol**

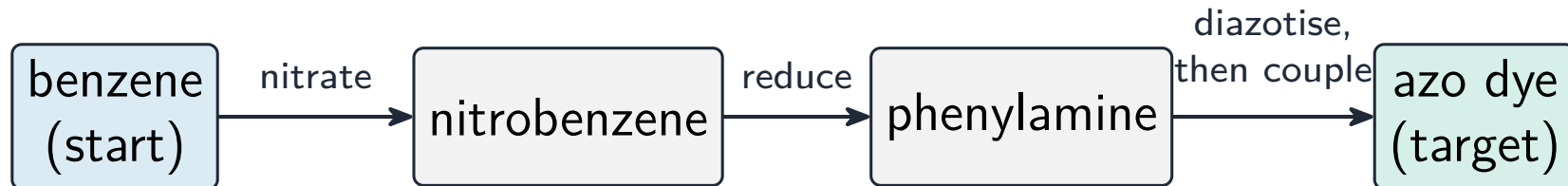
add this	you see	functional group
bromine water (no catalyst)	white precipitate	phenol or phenylamine
cold water	violent, HCl fumes	acyl chloride
neutral FeCl_3	purple colour	phenol

Planning a route

To devise a **synthetic route**, work **backwards** from the target.

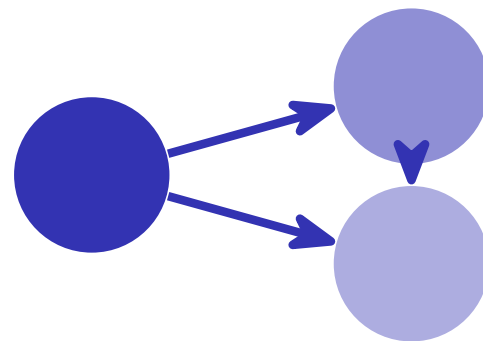
State the **reaction type** for each step (substitution, addition-elimination, oxidation...) and watch for **by-products**.

plan backwards from the target



Check yourself

- 1 What gives a purple colour with neutral FeCl_3 ?
- 2 Benzene to phenylamine takes how many steps?
- 3 Which way should you plan a synthesis?
- 4 What converts an acid to an acyl chloride?



Answers 1. a phenol 2. two 3. backwards from the target 4. SOCl_2 or PCl_5

Exercises 2.1·2.2

2.1 Give the reagents to convert benzene into nitrobenzene. [2]

2.2 State the reagent that reduces a nitrile to an amine. [1]

Exercises 2.1·2.2

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2.1

- concentrated HNO_3 and concentrated H_2SO_4 ; warm, 25–60 °C
-

2.2 State the reagent that reduces a nitrile to an amine. [1]

2.2

- LiAlH_4 (or H_2/Ni)

Exercises 3.1·3.2

3.1 To lengthen a carbon chain by one carbon, a halogenoalkane is reacted with: [1]

☐

- A** NH_3
- B** KCN
- C** LiAlH_4
- D** H_2O

3.2 In planning a synthesis, the best strategy is to: [1]

☐

- A** work forwards from any reagent
- B** work backwards from the target molecule
- C** guess reagents at random
- D** use only one reaction

Exercises 3.1·3.2

3.1 To lengthen a carbon chain by one carbon, a halogenoalkane is reacted with: [1]

☐

- A NH_3
- B KCN
- C LiAlH_4
- D H_2O

3.1 B

- KCN adds a $-\text{CN}$ group, lengthening the chain by one carbon

3.2 In planning a synthesis, the best strategy is to: [1]

☐

- A work forwards from any reagent
- B work backwards from the target molecule
- C guess reagents at random
- D use only one reaction

3.2 B

- Work backwards from the target molecule

Exercise 3.3

3.3 Devise a synthesis of **phenylamine** from benzene, giving the reagents and conditions for each step. [3]

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3.3

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

Exercise 3.4 (a)

3.4 A two-step synthesis converts bromoethane into propylamine via a nitrile.

(a) Give the reagents for each step.

[2]

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(a) Give the reagents for each step.

[2]

(a)

- KCN (in ethanol) to give propanenitrile; then LiAlH_4 (or H_2/Ni) to reduce it to propylamine

Exercise 3.4 (b)

3.4 A two-step synthesis converts bromoethane into propylamine via a nitrile.

(b) State **one** by-product/limitation of making an amine directly from a halogenoalkane and ammonia. [1]

Exercise 3.4 (b)

3.4 A two-step synthesis converts bromoethane into propylamine via a nitrile.

(b) State **one** by-product/limitation of making an amine directly from a halogenoalkane and ammonia. [1]

(b)

- the direct halogenoalkane + ammonia route also makes secondary/tertiary amines (over-substitution), lowering the yield of the primary amine