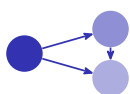


Organic Synthesis

A-Level Chemistry • Topic 36

A-Level Chemistry



Organic Synthesis

What we will cover

- 1 Identifying functional groups
- 2 The A Level reaction map
- 3 Planning a route

1

Tests and routes

Organic Synthesis

↳ Tests and routes

Identifying functional groups

A Level identification tests:

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

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

Organic Synthesis

↳ Tests and routes

The A Level reaction map

The new chains link up:

- aromatic: benzene → nitrobenzene → phenylamine → diazonium → phenol / azo dye
- acyl: acid → acyl chloride → ester / amide

Organic Synthesis

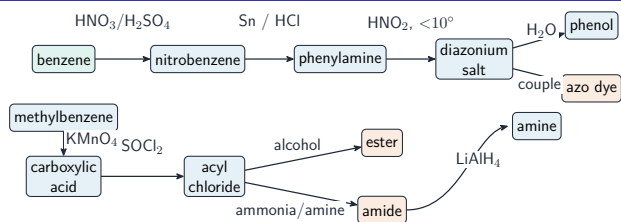
↳ Tests and routes

The A Level reactions the map adds

halogenoalkane + KCN	gives a nitrile 腈 – adds one carbon
nitrile, hydrolysed	gives a carboxylic acid 羧酸 with that extra carbon
nitrile, reduced	gives a primary amine, also one carbon longer
arene 芳烃 reactions	electrophilic substitution 亲电取代 – nitration, halogenation, Friedel-Crafts
carbonyl + HCN	nucleophilic addition, giving a hydroxynitrile – again one carbon added
acyl chloride + amine	addition-elimination 加成-消除, giving an amide

A molecule may carry **several functional groups** 官能团. Use the test reactions to identify each one, then plan the route that changes only the group you need.

The A Level reaction map, in detail



A map of the A Level reactions: the aromatic chain (top) and the acyl-chloride chain (bottom), with their feed-ins. Work backwards from your target

Planning a route

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

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

plan backwards from the target



Exam tips

- Combine AS and A-level steps and watch for **benzene-ring reactions** and **carbon-count changes**.
- State every **reagent and condition**, and note when a step produces a **racemic mixture**.
- Choose the shortest route that reaches the target functional group.

2

Recap

Worked example – benzene to phenylamine

Suggest a route from benzene to phenylamine, with reagents and conditions for each step.

- There is **no way to put NH_2 straight onto the ring** – it takes two steps.
- Step 1 **nitrate**: concentrated HNO_3 + concentrated H_2SO_4 , $55^\circ\text{C} \Rightarrow$ nitrobenzene.
- Step 2 **reduce**: Sn + concentrated HCl , reflux; then add **excess NaOH** .
- The reduction gives the salt $\text{C}_6\text{H}_5\text{NH}_3^+$ first; the NaOH frees **phenylamine**.

Benzene $\rightarrow \text{NH}_2$ is *always* nitrate-then-reduce. Then phenylamine + HNO_2 at 5°C gives the diazonium ion for azo dyes.

Topic 36 – key takeaways

1 Tests

each reagent identifies a group

2 Aromatic chain

benzene to phenylamine to phenol/azo dye

3 Acyl chain

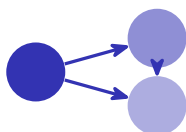
acid to acyl chloride to ester/amide

4 Plan backwards

from the target; state reagent & type

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