

# Organic synthesis

## A-Level Chemistry

## Organic synthesis

Like the AS synthesis topic, this asks you to **join up** known reactions to build a target molecule. Now you also have the A Level reactions of arenes, phenol, amines, amides and acyl chlorides.

### Identifying functional groups

A molecule may carry several **functional group** 官能团 types. Use the test reactions to spot each one, then predict its behaviour. For example:

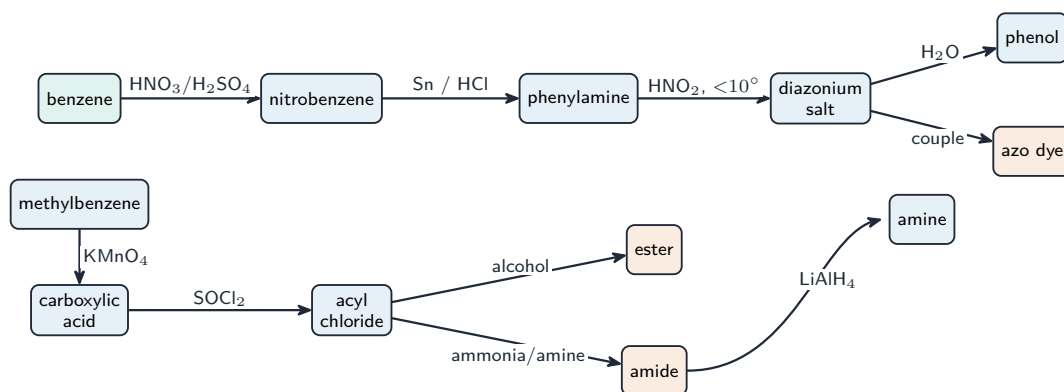
- decolourises bromine water with **no** catalyst, giving a white precipitate → a phenol or a phenylamine (the ring is activated).
- reacts violently with cold water, giving fumes of HCl → an **acyl chloride** 酰氯.
- gives a purple colour with neutral FeCl<sub>3</sub> → a **phenol** 苯酚.

add this	you see	functional group
bromine water (no catalyst)	white precipitate	phenol or phenylamine
cold water	violent, HCl fumes	acyl chloride
neutral FeCl <sub>3</sub>	purple colour	phenol

*Identification tests added at A Level: each reagent gives a characteristic result that points to a functional group*

### A map of the A Level reactions

Start	Reagent and conditions	Product
benzene (an <b>arene</b> 芳烃)	HNO <sub>3</sub> / H <sub>2</sub> SO <sub>4</sub> ( <b>electrophilic substitution</b> 亲电取代)	nitrobenzene
nitrobenzene	Sn / conc HCl, then NaOH ( <b>reduction</b> 还原)	phenylamine
phenylamine	HNO <sub>2</sub> , below 10 °C	a diazonium salt
diazonium salt	warm water	phenol; or couple with phenol → azo dye
methylbenzene	hot KMnO <sub>4</sub> ( <b>oxidation</b> 氧化)	benzoic acid
<b>carboxylic acid</b> 羧酸	SOCl <sub>2</sub> or PCl <sub>5</sub>	acyl chloride
acyl chloride	alcohol / phenol	an <b>ester</b> 酯
acyl chloride	ammonia / <b>amine</b> 胺	an <b>amide</b> 酰胺
amide or <b>nitrile</b> 腈	LiAlH <sub>4</sub>	an amine
halogenoalkane	KCN	a nitrile (adds one carbon)



*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 and analysing a route

To devise a **synthetic route** 合成路线, work **backwards** from the target: which single reaction makes it, and from what? Repeat until you reach the starting material, then write each step with its **reagent** 试剂 and conditions.

When you **analyse** a route, state the type of reaction for each step (for example electrophilic substitution, **addition-elimination** 加成消去, oxidation or reduction) and watch for likely **by-products** 副产物—for example, making an amine from a halogenoalkane also gives over-substituted amines, lowering the yield.