

# Organic synthesis (A Level)

A-Level Chemistry 9701 · Topic 36 revision notes

Everything from the 1 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

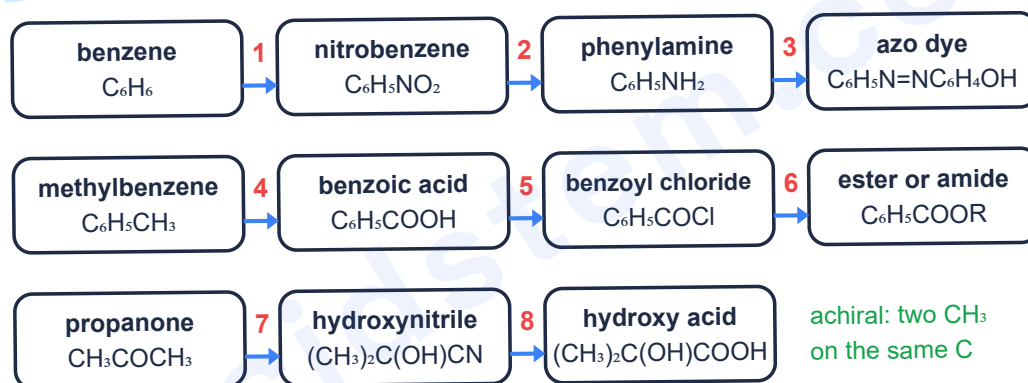
1. Multi-step organic synthesis

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# 1 Multi-step organic synthesis

## Syllabus 36.1

Organic synthesis means getting from a **starting material** to a **target** using reactions you know. First **identify every functional group** in each molecule (arene, phenol, alcohol, halogenoalkane, alkene, aldehyde or ketone, carboxylic acid, ester, acyl chloride, amine, amide, nitrile) and predict how each reacts with the reagent given. Then work **backwards from the target**: what group must the previous compound have had? Each step needs a **reagent, conditions and a reaction type** (electrophilic substitution, nucleophilic addition, reduction, oxidation, hydrolysis, condensation). Nucleophilic addition to a planar  $C=O$ , such as  $HCN$  with ethanal, can create a **chiral centre as a racemic mixture**, but drugs are often needed as a **single enantiomer**. Yields multiply: the **overall yield** is the product of the step yields, so short routes are better.



1 conc.  $HNO_3$  + conc.  $H_2SO_4$ , 25–60 °C

2 Sn + conc. HCl, reflux; then NaOH(aq)

3  $HNO_2$  below 10 °C; then phenol,  $OH^-$

4 hot alkaline  $KMnO_4$ ; then dilute  $H^+$

5  $SOCl_2$  or  $PCl_5$

6 ROH (ester),  $RNH_2$  (amide)

7 HCN with KCN catalyst

8 dilute HCl(aq), heat under reflux

numbers on the arrows match the reagent key

achiral: two  $CH_3$   
on the same C

Fig. 1: three A Level routes on one reaction map, with reagents for each numbered step

### Groups, reagents, types, yield.

- ✓ **Label every group** before choosing a reagent.
- ✓ **Work backwards** from the target, one group at a time.
- ✓ **Each step:** reagent, conditions, reaction type.
- ✓ **Overall yield:** multiply the step yields.

### Watch out!

Do not **add** or **average** step yields: multiply them. Give **conditions** as well as reagents (reflux, temperature, catalyst) and say **dilute** or **concentrated**.

Diazotisation must be kept **below 10 °C** or the diazonium salt decomposes.  $\text{Sn/HCl}$  reduction needs  $\text{NaOH(aq)}$  afterwards to free the amine from its salt.

Check whether a carbonyl product is chiral before claiming a racemic mixture, and remember that one reagent attacks **every** group that responds to it.