Aromatic and Multi-Step Synthesis Map

Cambridge International AS & A Level Chemistry · Topic 36 Organic synthesis

1 Several groups

36.1.1(a)

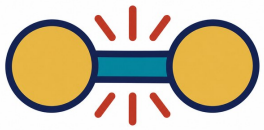
- Phenol, amine, amide
- Acyl chloride, ester
- **Ring** each one
- One test per group



2 What a reagent reaches

36.1.1(b)

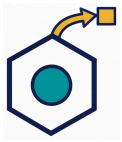
- NaOH: phenol and COOH
- Na_2CO_3: COOH only
- Dilute HCl: amines
- Excess: two groups

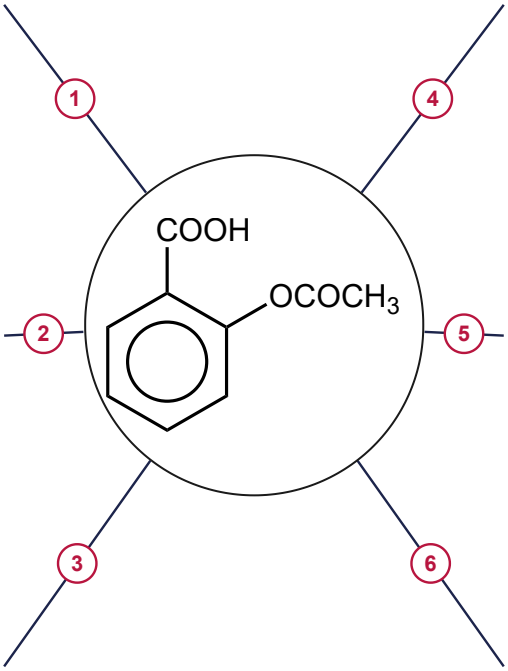


3 Aromatic routes

36.1.2

- Nitrate, then reduce
- Acylate with $AlCl_3$
- Diazonium: below 10 °C
- Side chain to COOH

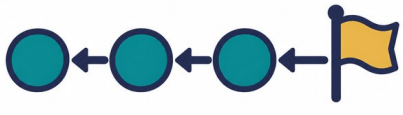




4 Working backwards

36.1.2

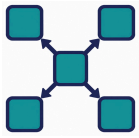
- Start at the **target**
- Which bond was last?
- Conditions at each step
- Yields **multiply**



5 Reading a step

36.1.3-a

- Ring: electrophilic substitution
- NO_2 to NH_2: reduction
- RCOCl: addition-elimination
- Name the reagents



6 By-products

36.1.3-b

- Ring **isomers**
- A second NO_2 if hot
- Activated rings react again
- HCl and SO_2



Key aromatic reagents

reagent and conditions

Change	Reagent	Conditions
Benzene to nitrobenzene	Conc HNO_3, conc H_2SO_4	25–60 °C
Nitrobenzene to phenylamine	Sn, conc HCl	Hot, then NaOH(aq)
Benzene to phenylethanone	CH_3COCl, $AlCl_3$	Heat
Methylbenzene to benzoic acid	Alkaline $KMnO_4$	Hot, then dilute acid
Phenylamine to diazonium salt	$NaNO_2$, dilute acid	Below 10 °C

Worked examples

Overall yield

- 60%, 90% and 80%
- 0.60 × 0.90 × 0.80
- **43.2%**

Name the by-products

- Nitrating methylbenzene
- 2- and 4-nitro isomers
- **Each is the other's by-product**

Two bases

- HOC_6H_4COOH
- NaOH: both lose H^+
- Na_2CO_3: **COOH only**

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