Aromatic Chemistry Map

AQA A-level Chemistry · 3.3.10 Aromatic chemistry

1 Bonding

3.3.10.1

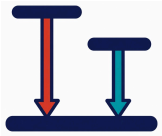
- Planar ring, 120°
- p-orbitals **overlap sideways**
- Six **delocalised** electrons
- All bonds 0.139 nm



2 Stability

3.3.10.1

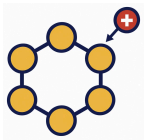
- Cyclohexene −120 kJ mol^{-1}
- Predicted triene **−360**
- Benzene measured **−208**
- **152 kJ mol^{-1} more stable**

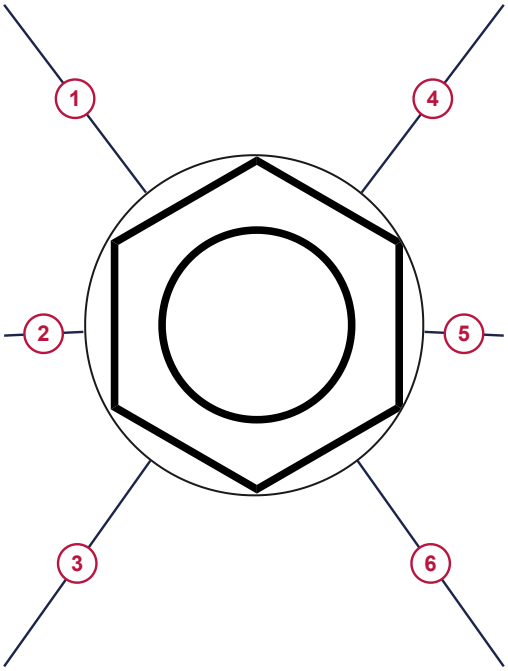


3 Substitution

3.3.10.1, 3.3.10.2

- Addition **loses delocalisation**
- π-electrons attack E^+
- Horseshoe, + inside
- **H^+ lost**: ring restored





4 Nitration

3.3.10.2

- Conc HNO_3 + conc H_2SO_4
- **Below 55 °C**
- Nitronium ion **NO_2^+**
- H_2SO_4 is regenerated



5 Uses of nitration

3.3.10.2

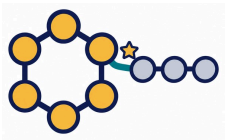
- Key step to **explosives**
- Reduction gives **amines**
- Nitrobenzene → phenylamine
- Limited to monosubstitution



6 Acylation

3.3.10.2

- RCOCl + **anhydrous $AlCl_3$**
- Acylium ion RCO^+
- Attack on carbonyl C: a ketone
- **New C–C bond** in synthesis



Electrophiles

how each one forms, and the catalyst that returns

Reaction	Electrophile	Forming it	Catalyst back
Nitration	NO_2^+	$HNO_3 + 2H_2SO_4 \rightarrow NO_2^+ + H_3O^+ + 2HSO_4^-$	$H^+ + HSO_4^- \rightarrow H_2SO_4$
Acylation	CH_3CO^+	$CH_3COCl + AlCl_3 \rightarrow CH_3CO^+ + AlCl_4^-$	$H^+ + AlCl_4^- \rightarrow AlCl_3 + HCl$

Worked examples

Stability

- 3 × −120 = −360
- −360 against −208
- **152 kJ mol^{-1}**

Yield

- 7.8 g C_6H_6: 0.100 mol
- 8.61 g product: 0.0700 mol
- **70%**

Adding H_2

- Benzene −208, diene −232
- −208 − (−232)
- **+24 kJ mol^{-1}**

Nitrobenzene is reduced to phenylamine in 3.3.11 Amines.

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