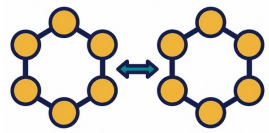
Benzene Structure Map

Edexcel International A Level Chemistry · Unit 5 · Topic 18A Benzene: Structure and Stability

1 Two models 18.1

- C_6H_6: one H on each carbon
- Kekulé: **alternating** C=C and C–C
- Cyclohexa-1,3,5-triene
- Delocalised: **six equal bonds**



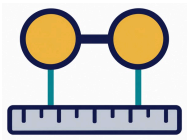
2 Bonding 18.2

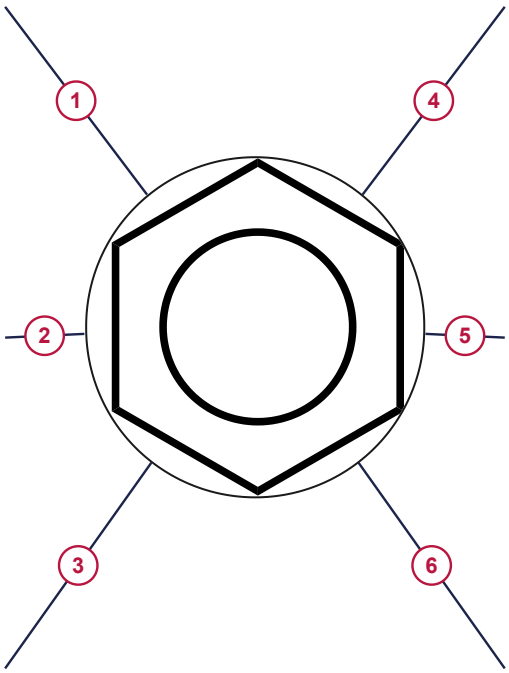
- Each C: three σ-bonds, planar, 120°
- One **p-orbital** per carbon
- p-orbitals **overlap sideways**
- π-system above and below the ring



3 Bond lengths 18.1

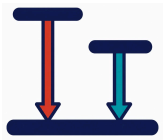
- C–C 0.154 nm; C=C 0.134 nm
- Benzene: all six **0.139 nm**
- **Between** single and double
- So not alternating





4 Hydrogenation 18.1

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



5 Bromine water 18.3

- Cyclohexene: orange to colourless
- Benzene: **no reaction**
- Alkene: localised, polarises Br_2
- Benzene: delocalised, **lower density**



6 Isomers and infrared 18.1

- Kekulé: four dibromobenzenes
- Only **three** exist
- No alkene peak near 1650 cm^{-1}
- Arene C–H 3100–3000 cm^{-1}



Kekulé against the evidence what each model predicts and what is found

Test	Kekulé predicts	Found
Ring bond lengths	Two	One, 0.139 nm
ΔH hydrogenation	−360 kJ mol^{-1}	−208 kJ mol^{-1}
Bromine water	Decolourises	No reaction
Dibromobenzenes	Four	Three
Infrared	Alkene C=C peak	Peaks near 1600, 1500 cm^{-1}

Worked examples

Formula

- 92.3% C, Mr 78
- C:H = 1:1, so CH
- **78 ÷ 13 = 6: C_6H_6**

Stability

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

Drawing

- Kekulé ring or circle
- Both accepted
- **Corners are C–H**

Electrophilic substitution and phenol follow in Topic 18B.

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