

Exercise walk-through

5.3.1

Use benzene evidence and select substitution conditions

Pearson Edexcel · International A-Level · Chemistry

Choose a cell voltage

Your turn

Reduction potentials are $+0.80\text{ V}$ and $+0.34\text{ V}$. What is spontaneous E°_{cell} ?

- A. $+1.14\text{ V}$
- B. $+0.46\text{ V}$
- C. -0.46 V

Find oxidation state and coordination

Your turn

$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$ has which chromium state and coordination number?

- A. +1 and 4
- B. +3 and 6
- C. +3 and 2

Aspirin transfer calculation

Your turn

2.76 g salicylic acid, $M=138$, gives aspirin $M=180$ in 1:1 ratio. Dry mass is 2.52 g. What is yield?

- A. 50.0%
- B. 70.0%
- C. 91.3%

Exercises 2.1·2.3

2.1 Give two pieces of evidence against three separate ordinary C=C bonds in benzene. [2]

2.2 Calculate stabilisation relative to the hypothetical model if one C=C hydrogenation is -118 kJ mol^{-1} and benzene is -206 kJ mol^{-1} . [3]

2.3 State benzene bromination conditions and compare phenol with bromine water. [3]

Exercises 2.1·2.3

2.1 Give two pieces of evidence against three separate ordinary C=C bonds in benzene. [2]

2.1 Equal intermediate C–C bond lengths; hydrogenation less exothermic than three isolated double bonds predict. Accept appropriate IR evidence in place of either.

2.2 Calculate stabilisation relative to the hypothetical model if one C=C hydrogenation is -118 kJ mol^{-1} and benzene is -206 kJ mol^{-1} . [3]

2.2 Three-bond prediction = $3(-118) = -354 \text{ kJ mol}^{-1}$. Difference = 148 kJ mol^{-1} , benzene lower in starting enthalpy/more stable.

2.3 State benzene bromination conditions and compare phenol with bromine water. [3]

2.3 Benzene needs a halogen carrier such as FeBr_3 . Phenol reacts without that catalyst, making white 2,4,6-tribromophenol and decolourising bromine water.

Exercises 3.1·3.3

3.1 Write the nitrating-electrophile generation equation and name the electrophile. Explain how substitution retains the aromatic system overall. [4]

3.2 Give reagents for making ethylbenzene and phenylethanone from benzene. Identify which is Friedel–Crafts acylation. [3]

3.3 A student predicts benzene will rapidly decolourise bromine water because it has six π electrons. Explain the error, and state sulfonation conditions. [3]

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3.1 $\text{HNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{NO}_2^+ + \text{HSO}_4^- + \text{H}_2\text{O}$. NO_2^+ is nitronium. Ring attack tem-

3.2 Give reagents for making ethylbenzene and phenylethanone from benzene. Identify which is Friedel–Crafts acylation. [3]

3.2 Ethylbenzene: chloroethane/anhydrous AlCl_3 . Phenylethanone: ethanoyl chloride/anhydrous AlCl_3 , the acylation reaction.

3.3 A student predicts benzene will rapidly decolourise bromine water because it has six π electrons. Explain the error, and state sulfonation conditions. [3]

3.3 Its electrons are delocalised and addition would lose stabilisation, so it resists the usual bromine-water addition test. Sulfonation uses fuming sulfuric acid.