2.11 Chemistry: Aromatic Chemistry, Carbonyls and Amines: 10-minute Pack

AQA 7405 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Phenol reacts rapidly with bromine water at room temperature, without the need for a halogen-carrier catalyst, to give an immediate white precipitate. Benzene does not react with bromine water under these conditions.

(a) Explain, in terms of the interaction between the oxygen lone pair and the ring, why phenol is far more reactive than benzene towards electrophilic substitution. **(3)**

(b) Identify the organic product formed when phenol reacts with excess bromine water, and give its molecular formula. **(2)**

(c) State the electrophile involved in the reaction between phenol and bromine water, and explain why this electrophile does not need to be generated using a halogen-carrier catalyst (unlike the bromination of benzene). **(2)**

(Total for Question 1 is 7 marks)

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Mark scheme · 2.11 Chemistry: Aromatic Chemistry, Carbonyls and Amines: 10-minute Pack

Question 1

(a) one of the lone pairs on the oxygen atom of the -OH group overlaps with (is delocalised into) the ring π system **B1**

(a) this increases the electron density of the delocalised ring, particularly at the 2-, 4- and 6- positions **B1**

(a) so the ring more strongly polarises/attracts electrophiles such as Br_2, so no halogen-carrier catalyst is needed and reaction occurs readily at room temperature **B1**

(a) Answer: The oxygen lone pair delocalises into the ring, increasing electron density (especially at 2/4/6 positions), so phenol reacts with electrophiles such as Br_2 far more readily than benzene, without a catalyst.

(b) 2,4,6-tribromophenol **B1**

(b) $C_6H_3Br_3O$ **B1**

(b) Answer: 2,4,6-tribromophenol, $C_6H_3Br_3O$

(c) electrophile is Br+ (a bromine atom carrying a partial/full positive charge) **B1**

(c) the electron-rich ring of phenol polarises the Br-Br bond sufficiently on its own (induces a dipole in Br_2) for heterolytic fission to occur, so a catalyst (e.g. $FeBr_3$/$AlBr_3$) is not required **B1**

(c) Answer: Br+ (from polarisation of Br_2 by the electron-rich ring); phenol's ring is electron-rich enough to induce the necessary polarisation of Br-Br itself, without a halogen-carrier catalyst.

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