

A level Chemistry A

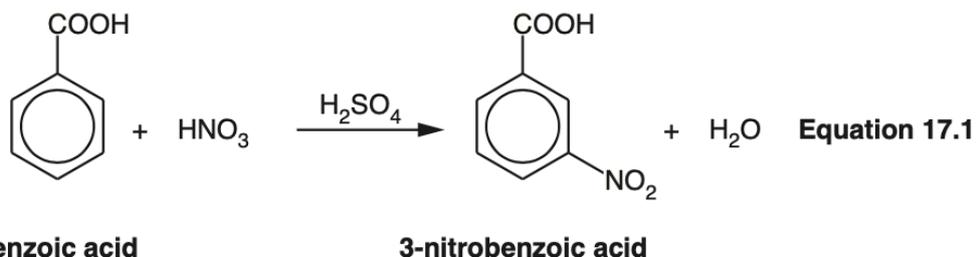
H432/02 Synthesis and analytical techniques

Question Set 9

1. This question is about the chemistry of aromatic compounds.

(a) Benzoic acid can be nitrated by concentrated nitric acid in the presence of concentrated sulfuric acid as a catalyst, as shown in **Equation 17.1**.

The organic product of this reaction is 3-nitrobenzoic acid.



(i) Outline the mechanism for this nitration of benzoic acid.

Show how H_2SO_4 behaves as a catalyst.

[5]

(ii)* A chemist carries out the reaction in **Equation 17.1** using 4.97 g of benzoic acid.

The chemist obtains 3-nitrobenzoic acid as an impure solid.

The chemist purifies the solid to obtain 4.85 g of 3-nitrobenzoic acid.

Describe a method to obtain a pure sample of 3-nitrobenzoic acid from the impure solid, determine the percentage yield and check its purity.

[6]

(b) A student investigates the relative ease of nitration of phenol, benzene, and benzoic acid.

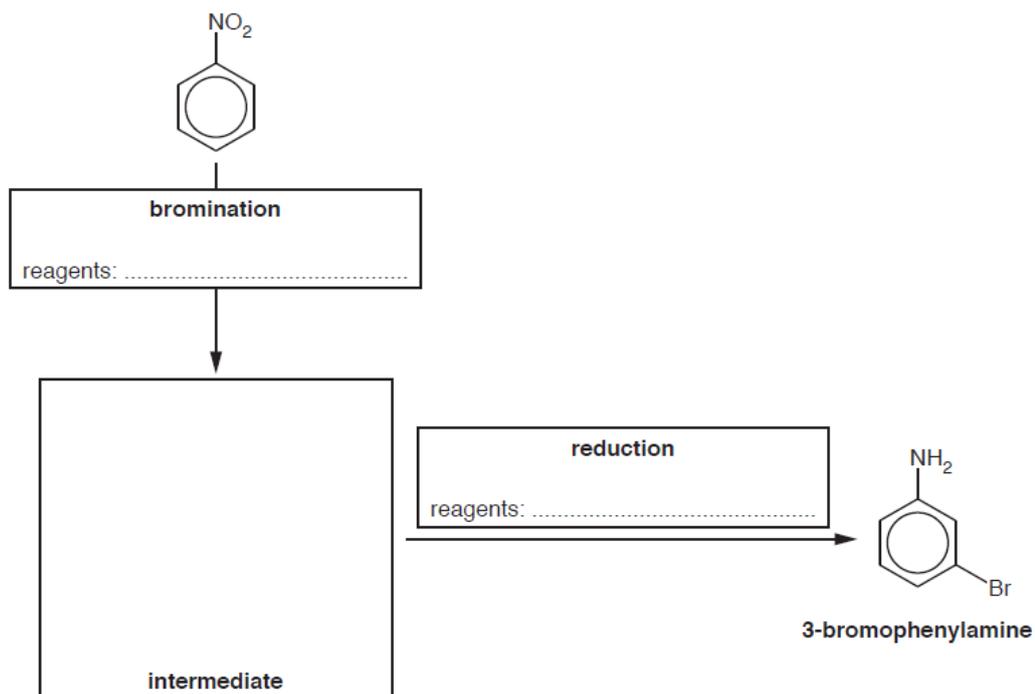


The student finds that the conditions required for the nitration of each compound are different, as shown in **Table 17.1**.

| Compound | phenol | benzene | benzoic acid |
|-----------------------------------|----------------|----------------------|----------------------|
| Conditions required for nitration | Dilute HNO_3 | Concentrated HNO_3 | Concentrated HNO_3 |
| | 20 °C | 55 °C | 100 °C |
| | No catalyst | H_2SO_4 catalyst | H_2SO_4 catalyst |

Table 17.1

- (i) State the trend in the relative ease of nitration of phenol, benzene, and benzoic acid. [1]
- (ii) Apply your knowledge of the bonding in arenes to explain the trend in part (b)(i). [3]
- (c) A student synthesises 3-bromophenylamine, shown below, starting from nitrobenzene.
- (i) Complete the flowchart showing the structure of the intermediate and the **formulae** of the reagents for each stage.



- (ii) Another student attempts the same synthesis but carries out reduction **before** bromination. The student was surprised to find that two structural isomers of 3-bromophenylamine had been formed instead of the desired organic product.

Explain this result and suggest the structures of the two isomers that formed.

Total Marks for Question Set 9: 21

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