

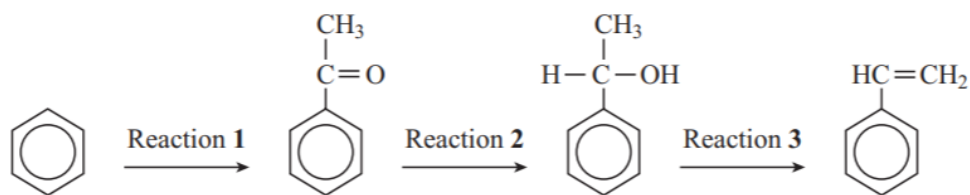
CHAPTER 27 AROMATIC CHEMISTRY

- 1** (a) Give reagents and conditions and write equations to show the formation of nitrobenzene from benzene.
Name and outline a mechanism for this reaction of benzene.

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(8 marks)

2 A possible synthesis of phenylethene (*styrene*) is outlined below.



(a) In Reaction 1, ethanoyl chloride and aluminium chloride are used to form a reactive species which then reacts with benzene.

(i) Write an equation to show the formation of the reactive species.

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(2 marks)

(ii) Name and outline the mechanism by which this reactive species reacts with benzene.

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(4 marks)

3 (a) An acylium ion has the structure $\text{R}-\overset{+}{\text{C}}=\text{O}$ where R is any alkyl group.

In the conversion of benzene into phenylethanone, $\text{C}_6\text{H}_5\text{COCH}_3$, an acylium ion $\text{CH}_3\overset{+}{\text{C}}\text{O}$ reacts with a benzene molecule.

(i) Write an equation to show the formation of this acylium ion from ethanoyl chloride and one other substance.

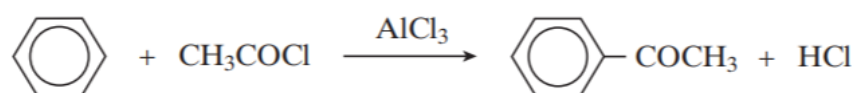
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(2 marks)

(ii) Name and outline the mechanism of the reaction of this acylium ion with benzene.

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(4 marks)

- 4 An equation for the formation of phenylethanone is shown below. In this reaction a reactive intermediate is formed from ethanoyl chloride. This intermediate then reacts with benzene.



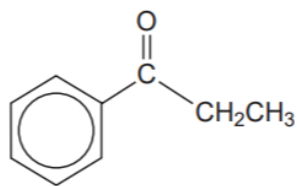
- (i) Give the formula of the reactive intermediate.

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- (ii) Outline a mechanism for the reaction of this intermediate with benzene to form phenylethanone.

(4 marks)

- 5 Consider compound **P** shown below that is formed by the reaction of benzene with an electrophile.



P

- (a) Give the **two** substances that react together to form the electrophile and write an equation to show the formation of this electrophile.

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(3 marks)

- (b) Outline a mechanism for the reaction of this electrophile with benzene to form **P**.

(3 marks)

- (c) Compound **Q** is an isomer of **P** that shows optical isomerism. **Q** forms a silver mirror when added to a suitable reagent.

Identify this reagent and suggest a structure for **Q**.

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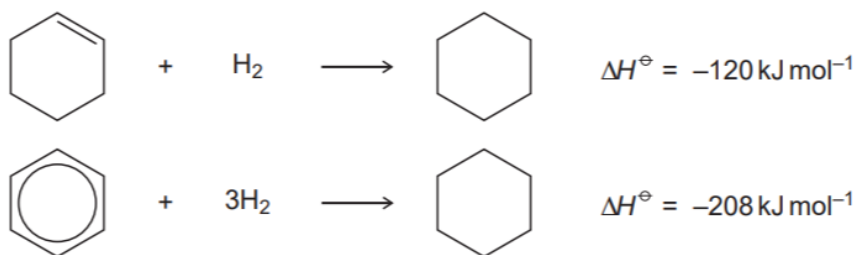
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(2 marks)

- 6 The hydrocarbons benzene and cyclohexene are both unsaturated compounds. Benzene normally undergoes substitution reactions, but cyclohexene normally undergoes addition reactions.

- (a) The molecule cyclohexatriene does not exist and is described as hypothetical. Use the following data to state and explain the stability of benzene compared with the hypothetical cyclohexatriene.



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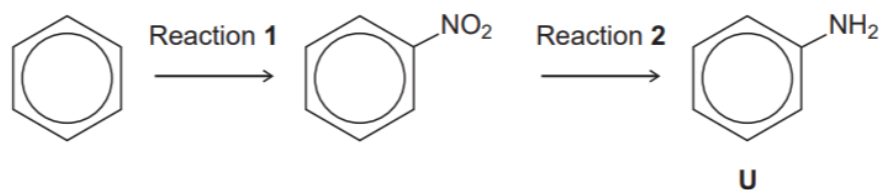
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(4 marks)

(b) Benzene can be converted into amine **U** by the two-step synthesis shown below.



The mechanism of Reaction 1 involves attack by an electrophile.

Give the reagents used to produce the electrophile needed in Reaction 1.

Write an equation showing the formation of this electrophile.

Outline a mechanism for the reaction of this electrophile with benzene.

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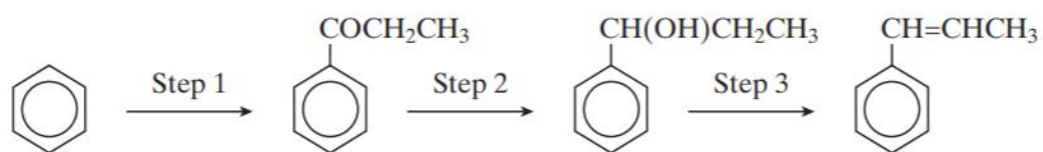
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(6 marks)

- 7 Propanoyl chloride can be used, together with a catalyst, in Step 1 of the synthesis of 1-phenylpropene from benzene via compounds **P** and **Q** as shown below.



The mechanism of Step 1 is an electrophilic substitution.

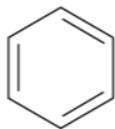
- (a) Write an equation to show the formation of the electrophile from propanoyl chloride.

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(2 marks)

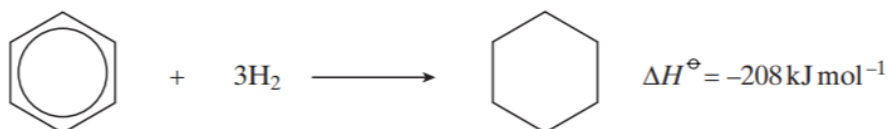
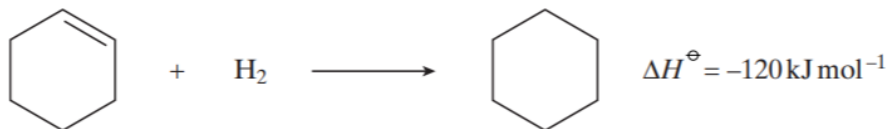
- (b) Outline the mechanism of the reaction of this electrophile with benzene in Step 1.

(3 marks)

- 8 (a) Use the following data to show the stability of benzene relative to the hypothetical cyclohexa-1,3,5-triene.



Give a reason for this difference in stability.



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(4 marks)

9 The nitration of benzene is an important industrial reaction

(a) State the reagents required for the nitration of benzene.

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(1 mark)

(b) Name an important material whose manufacture involves the nitration of benzene.

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(1 mark)

(c) (i) Write a balanced equation for the nitration of benzene.

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(2 marks)

(ii) Explain why NO_2^+ ion is described as an electrophile.

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(1 mark)

(iii) Name the type of mechanism involved in the nitration of benzene.

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(1 mark)