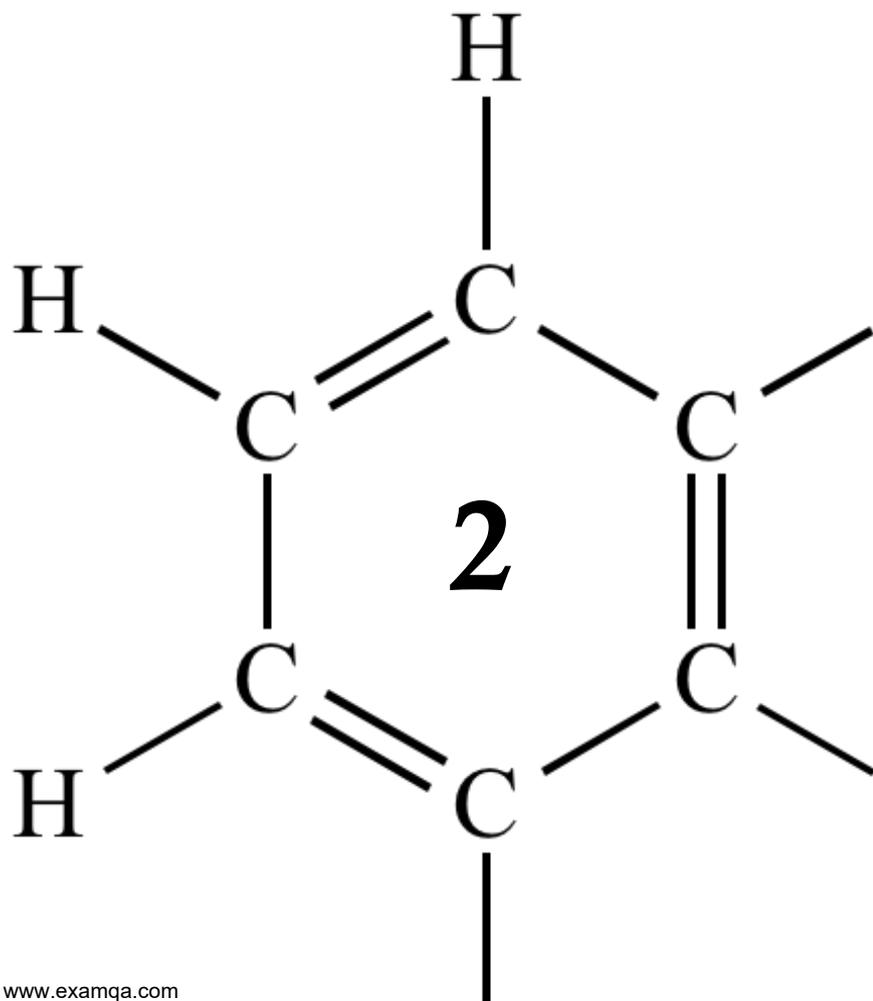


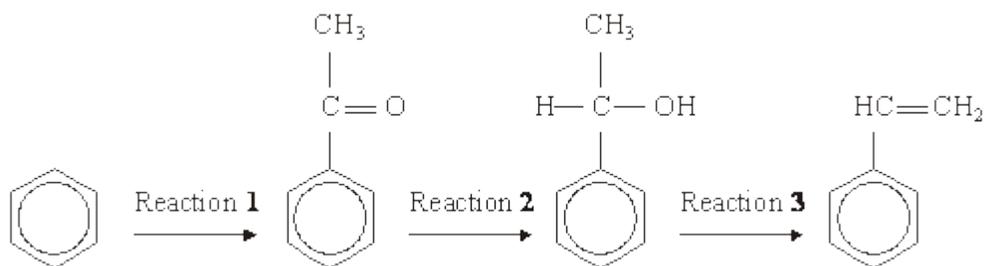
AQA A2 CHEMISTRY
SYNTHESIS ~ ANALYSIS

ORGANIC SYNTHESIS



1

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.

Write an equation to show the formation of the reactive species.

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

(6)

- (b) NaBH_4 is a possible reagent for Reaction 2.

Name and outline the mechanism for the reaction with NaBH_4 in Reaction 2.

Name the product of Reaction 2.

(6)

- (c) Name the type of reaction involved in Reaction 3 and give a reagent for the reaction.

(2)**(Total 14 marks)****2**

Which one of the following pairs of reagents reacts to form an organic product that shows only 2 peaks in its proton n.m.r. spectrum?

- A** butan-2-ol and acidified potassium dichromate(VI)
B ethanoyl chloride and methanol
C propanoic acid and ethanol in the presence of concentrated sulphuric acid
D ethene and hydrogen in the presence of nickel

(Total 1 mark)**3**

Which one of the following pairs reacts to form an organic product with only 2 singlets in its proton n.m.r. spectrum?

- A** ethene and bromine
B propan-2-ol and acidified potassium dichromate(VI)
C ethanol and concentrated sulphuric acid
D epoxyethane and water in the presence of dilute sulphuric acid

(Total 1 mark)

8

Use the data given on the back of the Periodic Table (PT) to help you answer this question. Compounds **A** to **G** are all isomers with the molecular formula $C_6H_{12}O_2$

- (a) Isomer **A**, $C_6H_{12}O_2$, is a neutral compound and is formed by the reaction between compounds **X** and **Y** in the presence of a small amount of concentrated sulphuric acid. **X** and **Y** can both be formed from propanal by different redox reactions.

X has an absorption in its infra-red spectrum at 1750 cm^{-1} .

Deduce the structural formulae of **A**, **X** and **Y**. Give suitable reagents, in each case, for the formation of **X** and **Y** from propanal and state the role of concentrated sulphuric acid in the formation of **A**.

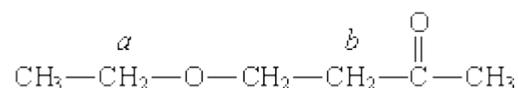
(7)

- (b) Isomers **B**, **C**, **D** and **E** all react with aqueous sodium carbonate to produce carbon dioxide. Deduce the structural formulae of the three isomers that contain an asymmetric carbon atom.

The fourth isomer has only three singlet peaks in its proton n.m.r. spectrum. Deduce the structural formula of this isomer and label it **E**.

(4)

- (c) Isomer **F**, $C_6H_{12}O_2$, has the structural formula shown below, on which some of the protons have been labelled.



A proton n.m.r. spectrum is obtained for **F**. Using Table 1 at the back of the Periodic Table (PT), predict a value of δ for the protons labelled *a* and also for those labelled *b*. State and account for the splitting patterns of the peaks assigned to the protons *a* and *b*.

(6)

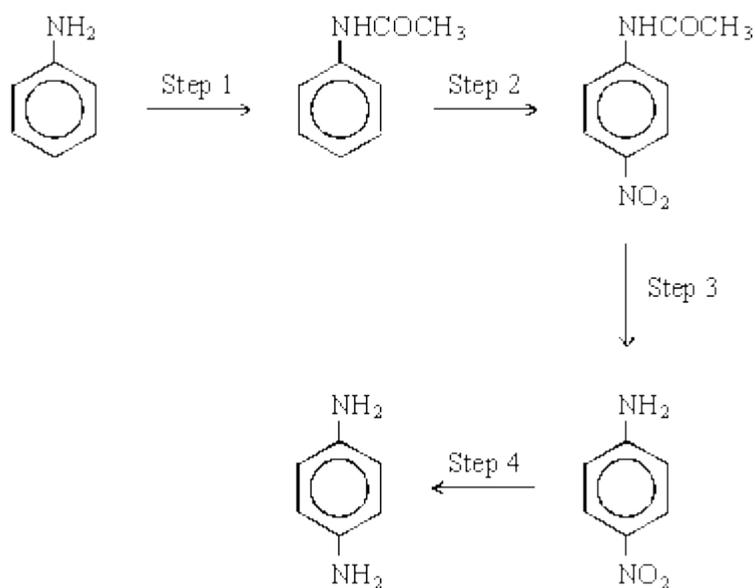
- (d) Isomer **G**, $C_6H_{12}O_2$, contains six carbon atoms in a ring. It has an absorption in its infra-red spectrum at 3270 cm^{-1} and shows only three different proton environments in its proton n.m.r. spectrum. Deduce a structural formula for **G**.

(2)

(Total 19 marks)

9

A possible synthesis of 1,4-diaminobenzene is shown below.



- (a) Identify a suitable reagent or combination of reagents for Step 1. Name and outline a mechanism for the reaction. (6)
- (b) Identify a suitable reagent or combination of reagents for Step 2. Name and outline a mechanism for the reaction. (6)
- (c) Identify a suitable reagent or combination of reagents for Step 4. Draw the repeating unit of the polymer formed by reaction of 1,4-diaminobenzene with pentanedioic acid. (3)

(Total 15 marks)