Hydrocarbons
AS & A Level

Question Paper 4

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Hydrocarbons
Paper	AS & A Level
Booklet	Question Paper 4

Time allowed: **69 minutes**

Score: **/51**

Percentage: **/100**

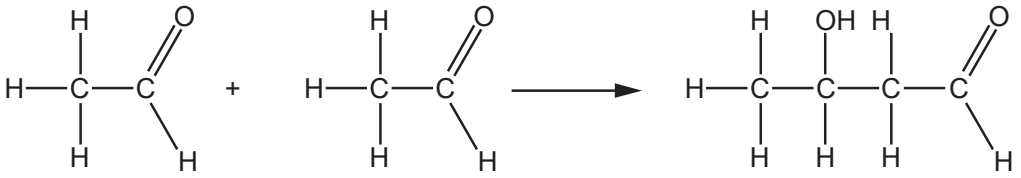
Grade Boundaries:

A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

This question is about organic reactions.

(a) Compound **A** is formed when ethanal is mixed with OH^-(aq) ions, which act as a catalyst.

The balanced equation is shown in **reaction 6.1** below.



Reaction 6.1

Compound **A**

(i) Give the systematic name for compound **A**.

[1]

(ii) What type of reaction has taken place?

[1]

(iii) **Reaction 6.1** takes place in two steps. OH^- ions act as a catalyst.

In **step 1**, ethanal reacts with OH^- ions to set up an acid–base equilibrium.
In **step 2**, compound **A** is formed.

- Complete the equilibrium for **step 1** and label the conjugate acid–base pairs as: **A1**, **B1** and **A2**, **B2**.

CH_3CHO + OH^- $\rightleftharpoons$ ..... + ...

....

- Suggest the equation for **step 2**.

[3]

(iv) A similar reaction takes place when propanone, $(CH_3)_2CO$, is mixed with OH^-(aq) ions.

Draw the structure of the organic product of this reaction.

[1]

(b)* Many organic reactions use electrophiles as reagents.

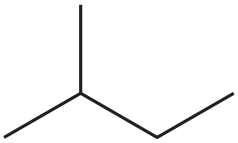
Explain the role of electrophiles in organic chemistry.

Your answer should include **one** reaction of an aliphatic compound and **one** reaction of an aromatic compound, including relevant mechanisms. **[6]**

(Total 12 marks)

This question is about saturated hydrocarbons.

(a) Compounds **A**, **B** and **C** are saturated hydrocarbons.
The structures and boiling points of **A**, **B** and **C** are shown below.

	Isomer	Boiling point /°C
A		36
B		28
C		9

- Use the structures to explain what is meant by the term structural isomer.
- Explain the trend in boiling points shown by **A**, **B** and **C** in the table.

[5]

(b) Compounds **A**, **B** and **C** all react with chlorine in the presence of ultraviolet radiation to form organic compounds with the formula $C_5H_{11}Cl$.

(i) Name the mechanism for this reaction.

[1]

(ii) Complete the table to show the number of structural isomers of $C_5H_{11}Cl$ that could be formed from the reaction of chlorine with **A** and **B**.

	A	**B**
Number of structural isomers	.....	.....

[2]

(iii) The reaction of compound **A** with excess chlorine forms a compound **D**, which has a molar mass of 175.5 g mol^{-1}.

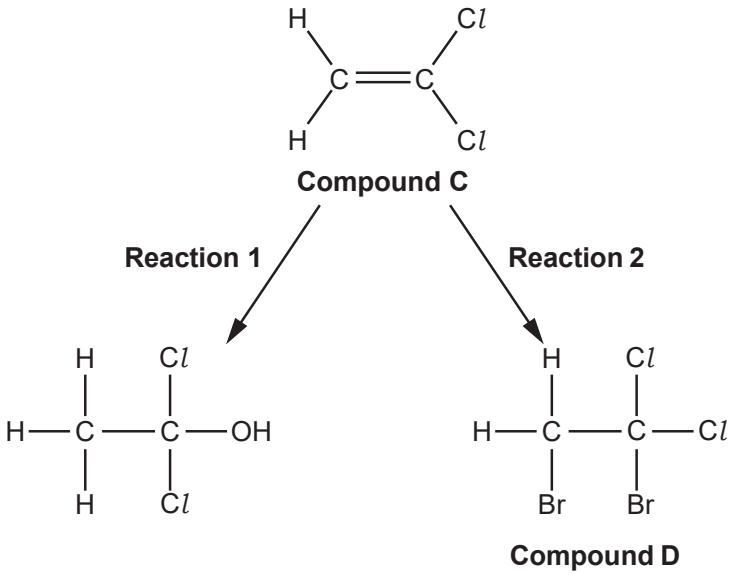
Draw a possible structure for compound **D** and write the equation for its formation from compound **A**. Use molecular formulae in the equation.

Compound D

[2]

(Total 10 marks)

Two reactions of compound **C** are shown in the flowchart below.



(a) State the reagents and conditions for **reaction 1**. **[1]**

(b) In **reaction 2**, compound **C** reacts with bromine to form compound **D**.

(i) Give the systematic name of compound **D**.

[1]

(ii) Outline the mechanism for **reaction 2**.

Include curly arrows, charges and relevant dipoles.

[3]

(c) Compound **C** forms an addition polymer **E**.

(i) Write a balanced equation for this reaction.

Show displayed formulae. **[2]**

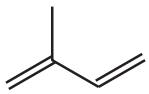
(ii) State **one** advantage and **one** disadvantage of using combustion as a method for the disposal of waste polymer **E**.

[2]

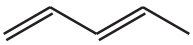
(Total 9 marks)

This question is about unsaturated hydrocarbons.

(a) Compound **A** and compound **B** are isomers.



compound A



compound B

Compound **A** has a lower melting point than compound **B**.

Suggest why. **[2]**

(b) Compound **C**, $CH_3CH_2CH=CHCH_2CH_2OH$, exists as *cis* and *trans* stereoisomers.

(i) Name compound **C**. **[1]**

(ii) Define the term *stereoisomers*. **[1]**

(iii) Draw the structures of the *cis* and *trans* stereoisomers of compound **C**.

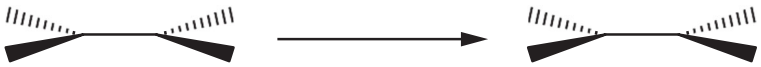
[2]

cis	*trans*

(c) The C=C group in an alkene contains a π-bond.

Complete the diagram below to show how p-orbitals are involved in the formation of a π-bond.

[1]



(d) Compound **D**, shown below, reacts with hydrogen bromide by electrophilic addition. A mixture of two organic compounds, **E** and **F**, is formed.

compound D

(i) Suggest how an HBr molecule can act as an electrophile. **[1]**

(ii) Draw the structures of the two organic compounds **E** and **F**. **[2]**

E	**F**

(iii) Outline the mechanism of the reaction between compound **D** and hydrogen bromide to form **either** compound **E or** compound **F**.

Include curly arrows and relevant dipoles.

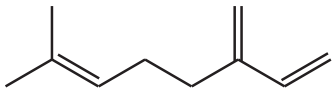
[3]

(iv) Which of **E** or **F** is the major organic product?

Explain your answer.

[1]

(e) Myrcene, $C_{10}H_{16}$, is a naturally occurring hydrocarbon containing more than one carbon-carbon double bond.



myrcene

(i) Reaction of 204 mg of myrcene with hydrogen gas produces a saturated alkane.

Calculate the volume of hydrogen gas, in cm^3 and measured at RTP, needed for this reaction.

Show your working.

[2]

(ii) β-Carotene is a naturally occurring unsaturated hydrocarbon found in carrots.
A β-carotene molecule contains 40 carbon atoms, has two rings, and a branched chain.

0.0200 mol of β-carotene reacts with 5.28 dm^3 of hydrogen gas to form a saturated hydrocarbon.

Using molecular formulae, construct a balanced equation for this reaction.

Include relevant calculations and reasoning.

[4]

(Total 20 marks)