

Hydrocarbons

AS & A Level

Question Paper 6

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Core Organic Chemistry
Topic	Hydrocarbons
Paper	AS & A Level
Booklet	Question Paper 6

Time allowed: 78 minutes

Score: /58

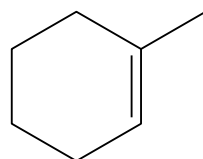
Percentage: /100

Grade Boundaries:

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

Question 1

Compound **A** is an unsaturated hydrocarbon that can be used as the starting material for the production of organic compounds.

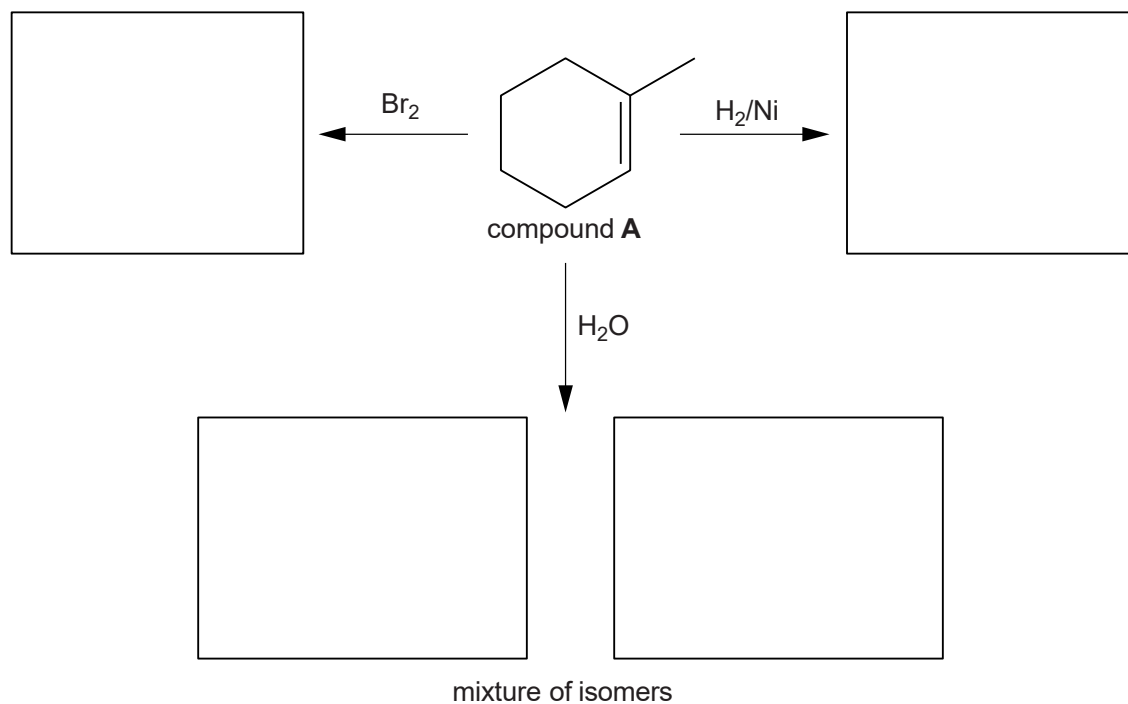


compound **A**

(a) What is the molecular formula of compound **A**? [1]

(b) The flowchart shows three **addition** reactions of compound **A**.

(i) In the boxes below, show the structures of the organic products formed in the reactions. [4]



(ii) What are the essential conditions for the reaction of compound **A** with H_2O ? [2]

(iii) Using curly arrows, outline the mechanism for the reaction of compound **A** with Br_2 . [3]

(iv) Name the mechanism in part (iii). [1]

[Total 11 Marks]

Question 2

The hydrocarbons present in crude oil are processed to obtain useful materials, including many fuels.

Alkanes with 6–10 carbon atoms are used in petrol.

(a) What is the general formula of an alkane? [1]

(b) Carbon monoxide and nitrogen monoxide are pollutants formed in internal combustion engines, using petrol as their fuel.

- Explain how carbon monoxide and nitrogen monoxide are formed in internal combustion engines.
- Describe the stages that allow a catalytic converter to reduce carbon monoxide and nitrogen monoxide emissions.
- Include equations for any reactions and use octane to represent the alkanes present in petrol. [6]

(c) Oil companies process alkanes into branched and cyclic hydrocarbons to promote efficient combustion in petrol.

- Draw the structure of one branched and one cyclic saturated hydrocarbon that contains 8 carbon atoms.
- Name each hydrocarbon. [3]

Branched	Cyclic
<i>name:</i>	<i>name:</i>

(d) The greenhouse effect of a gas in the atmosphere is dependent on two factors.

State these **two** factors.

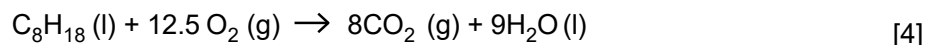
[2]

- (e) By 2020, the EU has regulated that a car must emit less CO₂ per kilometre than in 2015. A typical car will need to emit 5.6×10^5 g less CO₂ in 2020 compared with 2015.

Calculate how much less petrol would be consumed by a typical car in 2020 to meet this regulation.

Give your answer in litres of petrol (1 litre of petrol has a mass of 700 g).

Assume that petrol is liquid octane and that complete combustion takes place, as in the equation below.



[Total 16 Marks]

Question 3

Crude oil contains many hydrocarbons.

The table shows information about some of these hydrocarbons.

Hydrocarbon	Molecular formula	Boiling point/ $^{\circ}\text{C}$
Hexane	C_6H_{14}	69
3-Methylpentane	C_6H_{14}	63
2,2-Dimethylbutane	C_6H_{14}	50

(a) What is the empirical formula of hexane? [1]

(b) Explain why hexane is both *saturated* and a *hydrocarbon* [2]

(c) Draw the skeletal formula for 2,2-dimethylbutane. [1]

(d) Describe and explain the trend shown by the boiling points of the hydrocarbons in the table. [3]

- (e) Decane, $C_{10}H_{22}$, can be cracked to form hexane and **one** other product.

Write an equation for this reaction.

[1]

- (f) In the presence of ultraviolet radiation, butane, C_4H_{10} , reacts with chlorine to form a large number of organic products.

Several of these products are structural isomers of $C_4H_8Cl_2$.

- (i) Write an equation, using molecular formulae, for the formation of $C_4H_8Cl_2$ from butane.

[1]

- (ii) Complete the table below about two of the structural isomers of $C_4H_8Cl_2$.

[2]

	Isomer 1	Isomer 2
Name	1,4-Dichlorobutane	
Displayed formula		$ \begin{array}{ccccccc} & H & H & Cl & H & & \\ & & & & & & \\ Cl & -C & -C & -C & -C & -H & \\ & & & & & & \\ & H & H & H & H & & \end{array} $

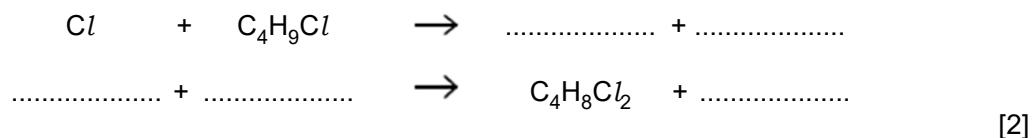
(g) The reaction between butane and chlorine is an example of radical substitution.

Initially, chlorobutane, C_4H_9Cl , is formed, which then reacts with more chlorine to form $C_4H_8Cl_2$.

(i) The first step of the reaction of C_4H_9Cl with chlorine is the homolytic fission of a chlorine molecule.

What is meant by the term *homolytic fission*? [2]

(ii) Complete the missing species in the propagation steps below.



(h) Butane, C_4H_{10} , undergoes incomplete combustion when there is a shortage of oxygen.

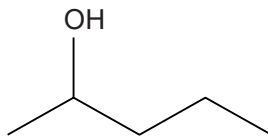
Write an equation for the incomplete combustion of butane.

[1]

[Total 16 Marks]

Question 4

Pentan-2-ol, shown below, is a secondary alcohol.



(a) Pentan-2-ol can be converted into three alkenes, **A**, **B** and **C**, by the elimination of water.

- Two of the alkenes, **A** and **B**, are stereoisomers.
- The third alkene, **C**, is a structural isomer of both **A** and **B**.

This elimination often uses a catalyst.

(i) What is a suitable catalyst for this reaction? [1]

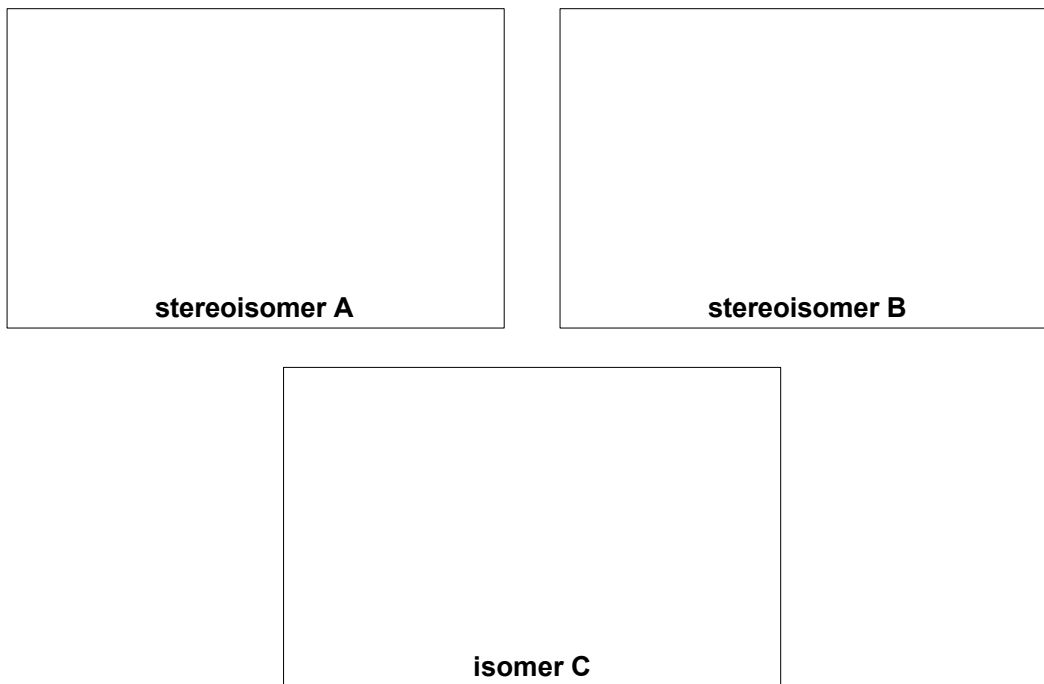
(ii) Construct an equation, using molecular formulae, for the elimination of water from pentan-2-ol. [1]

(iii) Explain what is meant by the terms *structural isomers* and *stereoisomers*. [4]

(iv) In the boxes below:

- draw the structures of stereoisomers **A** and **B**
- draw the structure of isomer **C**.

[3]



(v) Stereoisomers **A** and **B** show *E/Z* isomerism.

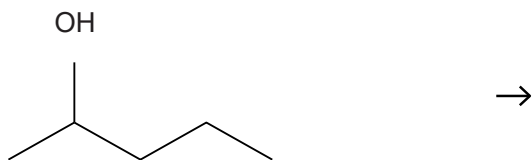
State **two** features of these molecules that enable them to show *E/Z* isomerism. [2]

(b) Pentan-2-ol can be oxidised by heating under reflux with acidified aqueous potassium dichromate(VI).

Complete the equation for this oxidation.

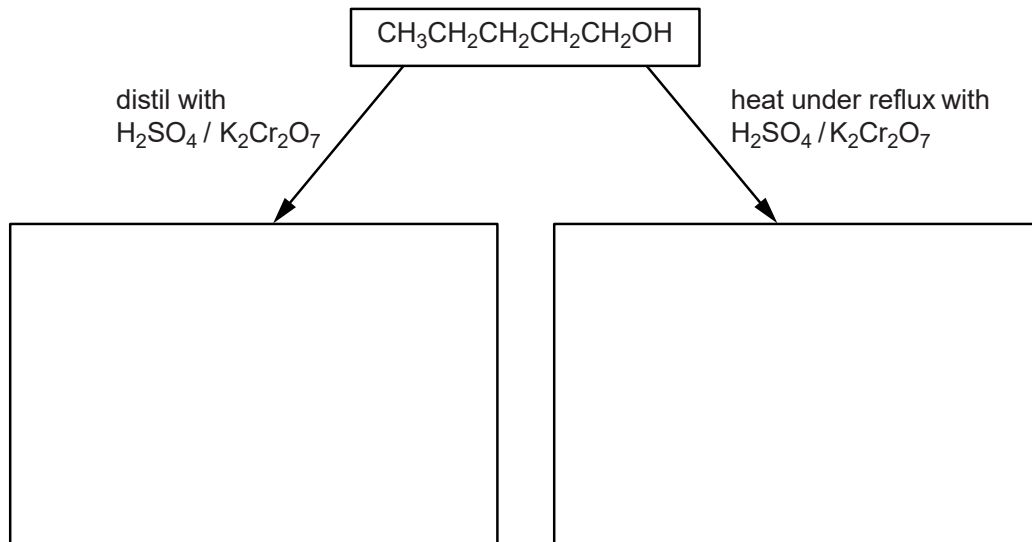
Use a skeletal formula for the organic product.

Use [O] to represent the oxidising agent. [2]



(c) Pentan-1-ol can also be oxidised but it gives two different products.

Complete the flowchart below to show the structures of the two organic products formed.



[2]

[Total 15 Marks]