

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

Forename(s)

Candidate signature

INTERNATIONAL AS CHEMISTRY (9620)

Unit 2: Organic 1 and Physical 1

Wednesday 22 May 2019 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do **not** write outside the box around each page or on blank pages.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.

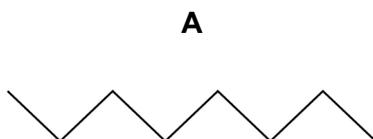
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	



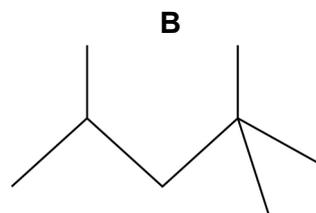
Answer **all** questions in the spaces provided.

0 1

The skeletal formulas and boiling points of two structural isomers, **A** and **B**, are shown below.



boiling point = 125 °C



boiling point = 99 °C

0 1 . 1

Use molecular formulas to write an equation for the complete combustion of **A**.

[1 mark]

0 1 . 2

Use IUPAC rules to name **B**.

[1 mark]

0 1 . 3

Explain why **A** has a higher boiling point than **B**.

[2 marks]

0 1 . 4

A mixture of **A** and **B** can be separated in the laboratory.

Name the technique that can be used to separate **A** and **B**.

[1 mark]



0 1 . 5 One molecule of an alkane with molecular formula $C_{20}H_{42}$ is cracked.
The products are tetramethylbutane, propene and ethene.

Use molecular formulas to deduce an equation for this reaction.

[1 mark]

0 1 . 6 The cracking reaction in Question **01.5** is carried out at a high temperature.

State **one** other condition needed.

[1 mark]

0 1 . 7 Explain why the atom economy for the reaction in Question **01.5** is 100 %

[1 mark]

Question 1 continues on the next page

Turn over ►



0 1 . 8 Isomer **B** reacts with chlorine to produce a compound with $M_r = 252.0$

This compound contains 38.10% carbon and 5.55% hydrogen by mass.

Calculate the empirical formula and the molecular formula of this compound.
Show your working.

[4 marks]

Empirical formula _____

Molecular formula _____

12



0 2 . 1 Van der Waals' forces exist between all molecules.

Explain how these forces arise.

[3 marks]

0 2 . 2 Draw a diagram to show the strongest intermolecular force between one ammonia molecule and one water molecule.

Include all partial charges and all lone pairs of electrons.

[3 marks]

6

Turn over for the next question

Turn over ►



0 3

An alcohol reacts with hot concentrated sulfuric acid to form a mixture of alkenes.

This alcohol also reacts with acidified potassium dichromate(VI) to form an organic compound that does **not** react with Tollens' reagent.

0 3 . 1

Explain how this information shows that this alcohol must be a secondary alcohol.

[2 marks]

0 3 . 2

Pentan-2-ol can be dehydrated by reaction with hot concentrated sulfuric acid to form pent-2-ene and water.

Outline a mechanism for this reaction.

[3 marks]

- 0 3 . 3** Describe a test-tube reaction that can be used to show that pentan-2-ol has been dehydrated.
Give the result.

[2 marks]

- 0 3 . 4** Draw the skeletal formula of the product formed when pentan-2-ol reacts with acidified potassium dichromate(VI).

[1 mark]

- 0 3 . 5** Draw the displayed formula of the tertiary alcohol with molecular formula $C_5H_{12}O$

[1 mark]



0 4 . 3 Nitrogen monoxide (NO) is formed in internal combustion engines.

State **one** essential condition for the formation of NO in an engine.
Write an equation to show the formation of NO in an engine.

[2 marks]

Condition _____

Equation

6

Turn over for the next question

Turn over ►



0 5

F, G and H are isomers of C₅H₁₀

$\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$	$\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$	$\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$
F	G	H

0 5 . 1

Use IUPAC rules to name F.

[1 mark]

0 5 . 2

F reacts with hydrogen bromide.

Name and outline the mechanism for the reaction that forms the major product, J.

Explain why J is the major product in this reaction.

[7 marks]

Name of mechanism _____

Mechanism

Explanation _____



0 5 . 3 **G** exists as *E* and *Z* isomers.

Draw the structure of the *E* isomer.

[1 mark]

0 5 . 4 Explain why **F** does **not** show *E–Z* isomerism.

[1 mark]

0 5 . 5 Draw the structure of an isomer of C_5H_{10} that is **not** an alkene.

[1 mark]

Question 5 continues on the next page

Turn over ►

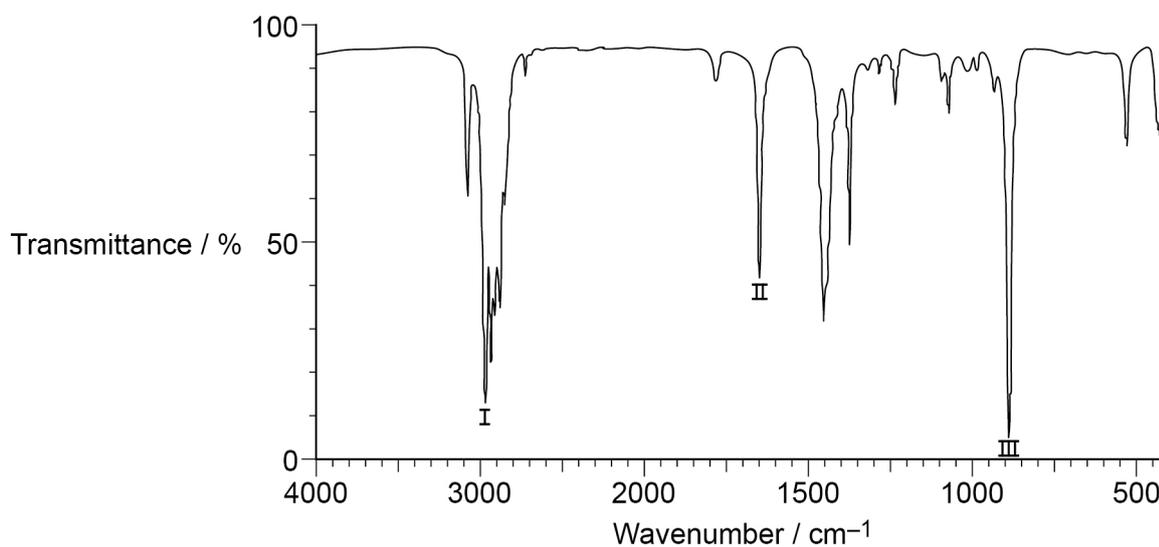


0 5 . 6 Draw one repeating unit of the polymer that can be formed from **H**, $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$

[1 mark]

0 5 . 7 Figure 1 shows the infrared spectrum of **H**.

Figure 1



Use **Table A** on the Data Sheet to identify the absorption that would **not** be present in the polymer.

Tick (✓) **one** box.

[1 mark]

I

II

III



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0 6 Hydrogen peroxide (H_2O_2) decomposes, in the presence of a catalyst, to form water and oxygen.

0 6 . 1 Write the equation for the decomposition of hydrogen peroxide.

[1 mark]

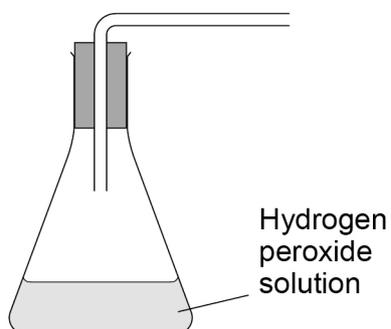
0 6 . 2 Explain why the decomposition of hydrogen peroxide is a redox reaction.

Use oxidation states to justify your answer.

[3 marks]

0 6 . 3 Complete the diagram to show the apparatus a student could use to collect the oxygen formed in this decomposition and measure its volume.

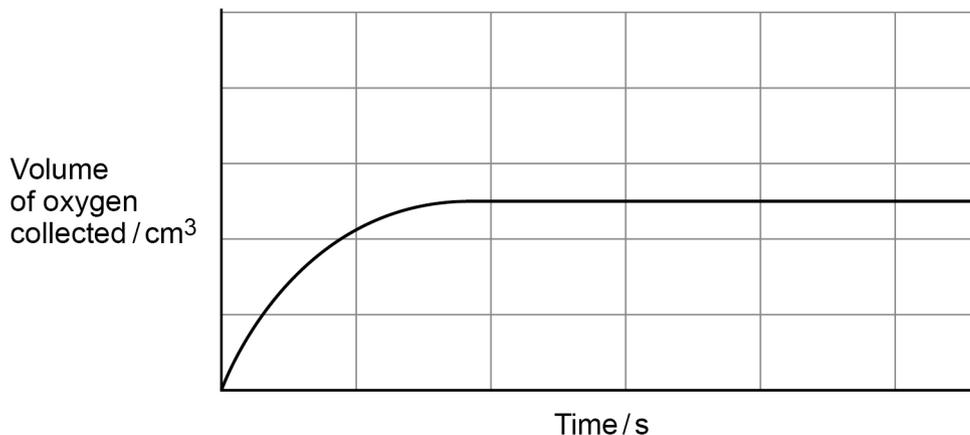
[1 mark]



5 cm³ of a 1.0 mol dm⁻³ solution of hydrogen peroxide decomposes, in the presence of a copper(II) oxide catalyst, at 298 K

Figure 2 shows how the volume of oxygen collected changes with time.

Figure 2



0 6 . 4 Explain why the curve is steepest at the start of the reaction.

[2 marks]

0 6 . 5 The experiment is repeated using 5 cm³ of a 2.0 mol dm⁻³ solution of hydrogen peroxide under the same conditions as in Question **06.4**

Draw a curve on **Figure 2** to show how the volume of oxygen collected changes with time in this experiment.

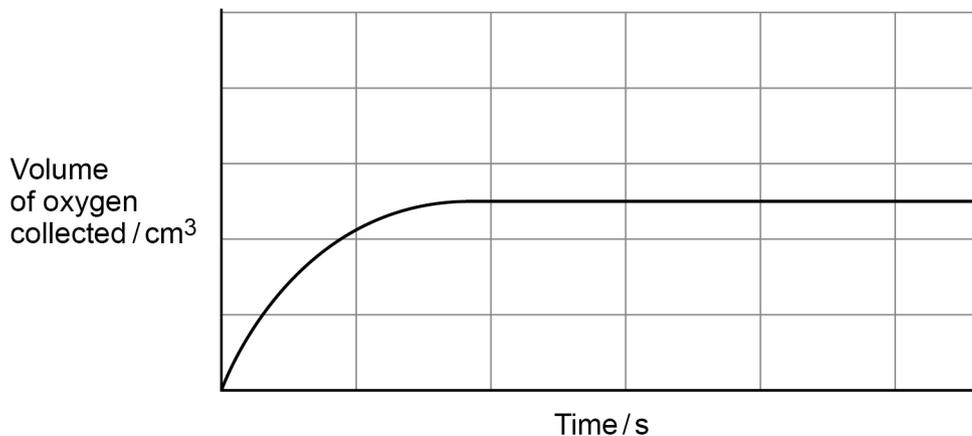
[2 marks]

Turn over ►



0 6 . 6

Figure 3 shows the volume of oxygen collected using 5 cm^3 of a 1.0 mol dm^{-3} solution of hydrogen peroxide, in the presence of a copper(II) oxide catalyst, at 298 K

Figure 3

Potassium iodide is a more effective catalyst than copper(II) oxide.

The experiment is repeated using potassium iodide instead of copper(II) oxide.

Draw a curve on **Figure 3** to show how the volume of oxygen collected changes with time in this experiment.

[2 marks]

06.7

Calculate the maximum volume, in cm^3 , of oxygen formed at 298 K and 100 kPa, in the reaction in Question **06.6**

The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

[3 marks]

Volume _____ cm^3

14

Turn over for the next question

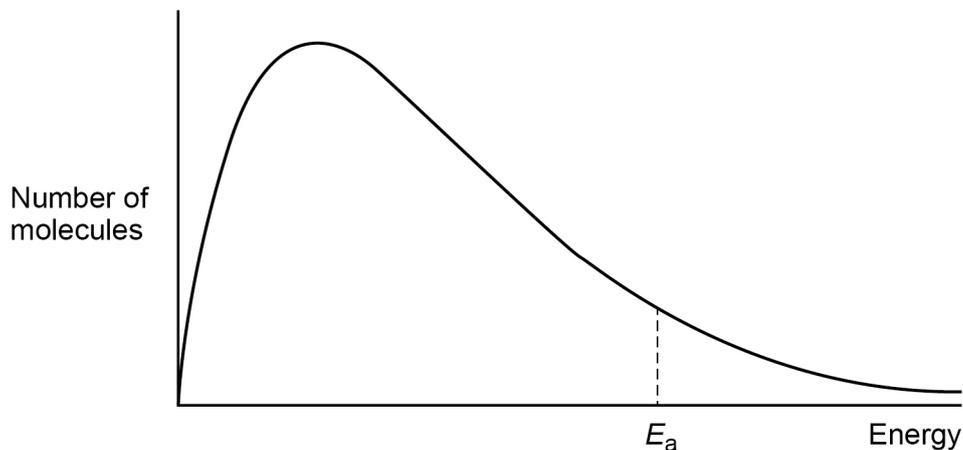
Turn over ►

0 7

Figure 4 shows the Maxwell–Boltzmann distribution for the molecules of a gas in a container of volume V and at temperature T

The activation energy (E_a) for its decomposition is shown.

Figure 4



0 7 . 1

Write the letter **M** on the appropriate axis of **Figure 4** to show the value of the most probable energy of the molecules of the gas at temperature T

[1 mark]

0 7 . 2

The sample of gas at temperature T is placed in a container that has a volume of $2V$

Explain why the Maxwell–Boltzmann distribution does **not** change for the gas in the new container.

[1 mark]

0 7 . 3

State the effect, if any, of an increase in temperature on the value of E_a for this decomposition.

[1 mark]



0 8

This question is about the reactions of halogenoalkanes.

0 8 . 1Halogenoalkanes react with reagent **Z** to form alcohols or alkenes depending on the conditions.Identify reagent **Z**.

State the condition(s) that favour the formation of each product.

Name the type of reaction in each case.

[5 marks]Reagent **Z** _____

Condition(s) to form alcohols _____

Type of reaction to form alcohols _____

Condition(s) to form alkenes _____

Type of reaction to form alkenes _____

0 8 . 2

Write an equation to show the reaction between chloroethane and an excess of ammonia.

Explain why this reaction is slower than the reaction between iodoethane and an excess of ammonia.

[2 marks]

Equation

Explanation _____

7**END OF QUESTIONS**

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Copyright information

For confidentiality purposes, acknowledgements of third-party copyright material are published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from www.oxfordaqaexams.org.uk after the live examination series.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and Oxford International AQA Examinations will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2019 Oxford International AQA Examinations and its licensors. All rights reserved.



2 4



1 9 6 X C H O 2

IB/M/Jun19/CH02