OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL AS

CHEMISTRY (9620)

Unit 2: Organic 1 and Physical 1

Monday 20 January 2020 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.
- 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).
- All working must be shown.
- 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.

Do not write outside the box

0 1 Hydrocarbon **A** is obtained by the cracking of an alkane.

0 1 . 1 State what is meant by the term cracking.

Give **one** reason why some alkanes are cracked.

[2 marks]

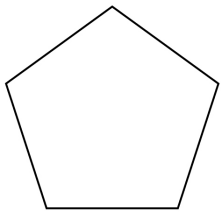
Meaning of the term cracking _____

_____

Reason for cracking _____

_____

The skeletal formula of **A** is shown.



0 1 . 2 Draw the skeletal formula of an isomer of **A** that is **not** a cyclic alkane.

[1 mark]

Do not write outside the box

0 1 . 3 Identify a reagent that can be used in a simple test-tube reaction to distinguish between **A** and an isomer of **A** that is **not** a cyclic alkane.

State what is observed.

[3 marks]

Reagent _____

Observation with **A** _____

_____

Observation with an isomer of **A** that is **not** a cyclic alkane _____

_____

0 1 . 4 A cracking reaction forms **A**, ethane and ethene in a 1:1:2 ratio.

Write an equation for this reaction.

[1 mark]

_____

7

Turn over for the next question

Do not write outside the box

0 2 This question is about some reactions of propene.

Propene reacts with hydrogen bromide to form two different products.

0 2 . 1 Name the mechanism for this reaction.

[1 mark]

0 2 . 2 Draw the skeletal formula of the major product formed in the reaction of propene with hydrogen bromide.

Explain why this is the major product.

[3 marks]

Skeletal formula

Explanation

0 2 . 3 Propene can form poly(propene).

Explain why propene is reactive and poly(propene) is **not** reactive.

[2 marks]

6

Do not write outside the box

0 3 In **acidic** conditions, epoxyethane reacts with water to form ethane-1,2-diol.

$$C_2H_4O + H_2O \rightarrow HOCH_2CH_2OH$$

0 3 . 1 Outline the mechanism for this reaction.

Give **one** use of ethane-1,2-diol.

[4 marks]

Mechanism

Use _____

0 3 . 2 A sample of 4.3 g of epoxyethane reacts with an excess of water to form 4.6 cm^3 of ethane-1,2-diol.

Calculate the percentage yield for the formation of ethane-1,2-diol.

The density of ethane-1,2-diol is 1.11 g cm^{-3}

[4 marks]

Percentage yield _____

8

Do not write outside the box

0 4 This question is about halogenoalkanes.

The first step in the mechanism of the reaction between chlorine and methane to form chloromethane is shown.

$$Cl_2 \rightarrow 2\,Cl^{\bullet}$$

0 4 . 1 Name the mechanism of the reaction to form chloromethane from methane.

[1 mark]

0 4 . 2 Give equations for two steps in this reaction that involve $Cl^{\bullet}$ as a reactant.

[2 marks]

1 _____

2 _____

0 4 . 3 Chloromethane reacts with an excess of ammonia.

Outline a mechanism for this reaction.

[4 marks]

0 4 . 4 Cyanide acts as a nucleophile in the reaction between potassium cyanide and chloromethane.

State why cyanide is able to act as a nucleophile in this reaction.

[1 mark]

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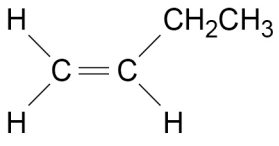
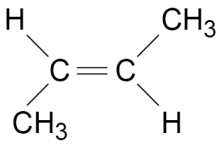
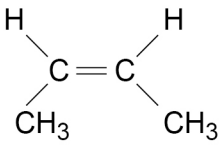
Hydroxide ions react with 2-chlorobutane to form the three isomers shown.



P



Q



R

0 4 . 5 State the role of hydroxide ions in this reaction.

[1 mark]

0 4 . 6 **P** and **Q** are isomers.

Name this type of isomerism.

[1 mark]

0 4 . 7 **Q** and **R** are stereoisomers.

Define the term stereoisomers.

[2 marks]

0 4 . 8 **R** is *Z*-but-2-ene.

State why **R** is the *Z* isomer.

[1 mark]

13

Do not write outside the box

0 5 This question is about alcohols and their oxidation products.

0 5 . 1 Some alcohols can be oxidised.

Identify a suitable oxidising agent.

State the colour change observed in the oxidation.

[2 marks]

Oxidising agent _____

Colour change _____

0 5 . 2 Butan-1-ol is oxidised to form an aldehyde.

Write an equation for this reaction.
You should use [O] to represent the oxidising agent.

State how the aldehyde is obtained from the reaction mixture.

[2 marks]

Equation

_____

How aldehyde is obtained

_____

0 5 . 3 Draw the structure of the carboxylic acid formed by the oxidation of butan-1-ol.

[1 mark]

Do not write outside the box

0 5 . 4 Use IUPAC rules to name the organic compound formed when butan-2-ol is oxidised.

[1 mark]

0 5 . 5 Compounds **S** and **T** are isomers with M_r = 58.0
When heated with Tollens' reagent, **S** forms a silver mirror but **T** does not.

Draw the structures of **S** and **T**.

[2 marks]

S **T**

0 5 . 6 Draw the structure of the alcohol with molecular formula $C_5H_{12}O$ that is **not** easily oxidised.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 7 Compound **U** has M_r = 60.0
The infrared spectrum of **U** has absorptions in the ranges 2500–3000 cm^{-1} and 1680–1750 cm^{-1}

Name compound **U**.

Identify a reagent that can be used in a simple test-tube reaction to confirm the presence of the functional group in **U**.

State what is observed.

[3 marks]

Name of **U** _____

Reagent _____

Observation _____

0 5 . 8 Which compound is a secondary alcohol?

Tick (✓) **one** box.

[1 mark]

2,2-dimethylpropan-1-ol ☐

2,3-dimethylbutan-2-ol ☐

3,3-dimethylpentan-2-ol ☐

13

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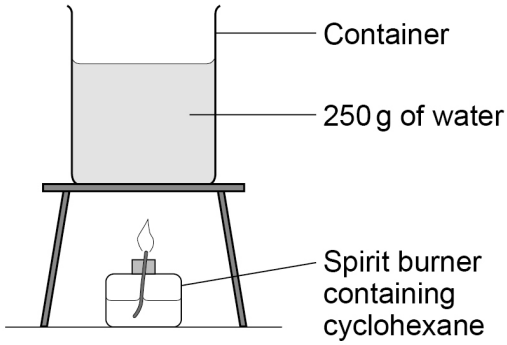
0 6 This question is about cyclohexane, C_6H_{12}

0 6 . 1 A student collects data to calculate the enthalpy of combustion of liquid cyclohexane.



Method

- Weigh the spirit burner containing the cyclohexane and place it under the container of water.
- Measure the initial temperature of the water.
- Allow the cyclohexane to burn for five minutes.
- Measure the maximum temperature of the water.
- Reweigh the spirit burner containing the cyclohexane.

Results

Initial temperature of water	18.5 °C
Maximum temperature of water	49.0 °C
Mass of cyclohexane burned	1.51 g

Calculate a value for the enthalpy of combustion, in kJ mol^{-1}, of cyclohexane.

The specific heat capacity of water, c = 4.18 J K^{-1} g^{-1}
You should ignore the heat capacity of the container.

[4 marks]

Enthalpy of combustion _____ kJ mol^{-1}

Turn over ►

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A value for the enthalpy of combustion of cyclohexane can be calculated from mean bond enthalpy data.

0 6 . 2 Define the term mean bond enthalpy.

[1 mark]

0 6 . 3 Cyclohexane (C_6H_{12}) burns in oxygen as shown.

$$C_6H_{12}(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$$

Table 1 shows some mean bond enthalpy data.

Table 1

	C—C	C—H	O=O	C=O	O—H
Mean bond enthalpy / kJ mol^{-1}	348	412	496	743	463

Use the equation and the data in **Table 1** to calculate a value for the enthalpy of combustion, in kJ mol^{-1}, of cyclohexane.

[3 marks]

Enthalpy of combustion _____ kJ mol^{-1}

Do not write outside the box

0 6 . 4 The enthalpy of combustion value calculated using bond enthalpy data in **Question 06.3** is different from the value calculated in the experiment in **Question 06.1**.

Give **two** reasons why these values are different.

[2 marks]

Reason 1 _____

_____

Reason 2 _____

_____

10

Turn over for the next question

Do not write outside the box

0 7 Compound **Y** was analysed in a combustion experiment.

0 7 . 1 Complete combustion of 0.220 g of **Y** formed 0.524 g of carbon dioxide and 0.267 g of water.

Calculate the percentage by mass of carbon and of hydrogen in **Y**.

[3 marks]

C _____ %

H _____ %

0 7 . 2 Compound **Y** contains carbon, hydrogen and oxygen only.

Use your answers to **Question 07.1** to calculate the empirical formula of **Y**.

(If you were unable to answer **Question 07.1** you should use the values 68.1% carbon and 13.7% hydrogen. These are **not** the correct values.)

[3 marks]

Empirical formula _____

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0 7 . 3 Compound **Y** and compound **Z** both have an absorption at 3330 cm^{-1} in their infrared spectra.

Z is a symmetrical molecule with molecular formula C_3H_8O

Draw the displayed formula of **Z**

[1 mark]

7

Turn over for the next question

Do not write outside the box

0 8 The polymer poly(tetrafluoroethene) is made from the monomer C_2F_4

0 8 . 1 Draw the repeating unit of poly(tetrafluoroethene).

[1 mark]

0 8 . 2 Define the term standard enthalpy of formation.

[2 marks]

Do not write outside the box

0 8 . 3 The monomer C_2F_4 can be made as shown in the equation.

$$2\,CHClF_2(g) \rightarrow C_2F_4(g) + 2\,HCl(g) \quad \Delta H = +127\ kJ\ mol^{-1}$$

Some standard enthalpies of formation are shown.

Substance	$C_2F_4(g)$	$HCl(g)$
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	–658	–92.3

Calculate the standard enthalpy of formation, in kJ mol^{-1}, of $CHClF_2$

Give your answer to 3 significant figures.

[3 marks]

Enthalpy of formation _____ kJ mol^{-1}

6

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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