OXFORD

INTERNATIONAL AQA EXAMINATIONS

Please write clearly in block capitals.

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INTERNATIONAL AS

CHEMISTRY (9620)

Unit 2: Organic 1 and Physical 1

Tuesday 22 January 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.
- 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	
9	
TOTAL	

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

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0 1 This question is about alkanes with the molecular formulas shown.

C_6H_{12}	C_6H_{14}	$C_{22}H_{46}$	C_3H_8
A	**B**	**C**	**D**

0 1 . 1 Give the IUPAC name of an alkane that could be **A**.

[1 mark]

0 1 . 2 Draw skeletal formulas for **two** branched-chain isomers of **B**.

State the type of isomerism shown.

[3 marks]

Isomer 1

Isomer 2

Type of isomerism

Do not write outside the box

0 1 . 3 Thermal cracking of one molecule of **C** can form one molecule of **B** and two molecules of another organic compound.

The reaction occurs at a high temperature.

Write an equation for this reaction.

State **one other** reaction condition needed.

[2 marks]

Equation

Reaction condition

0 1 . 4 Under different conditions, catalytic cracking of **C** can occur as shown.

$$\underset{\textbf{C}}{C_{22}H_{46}} \rightarrow 2C_5H_{10} + \underset{\textbf{A}}{C_6H_{12}} + \underset{\textbf{B}}{C_6H_{14}}$$

Name the catalyst used.

[1 mark]

D reacts with bromine gas in UV light or bright sunlight in the same way as methane reacts with chlorine. The reaction is a free-radical substitution.

0 1 . 5 Write an equation for the initiation step of this reaction.

[1 mark]

0 1 . 6 Write an equation to show the formation of a hydrocarbon in a termination step for the reaction of **D** with bromine gas in UV light.

[1 mark]

9

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0 2 Compound **E** contains carbon, hydrogen and oxygen only.
E contains 54.51% carbon and 9.15% hydrogen by mass.

0 2 . 1 Calculate the empirical formula of **E**.

[3 marks]

Empirical formula _____

0 2 . 2 The mass spectrum of **E** showed a molecular ion peak with m/z = 88

Use this information and your answer to question **02.1** to determine the molecular formula of **E**.

[2 marks]

Molecular formula _____

0 2 . 3 The infrared spectrum of **E** shows

- a broad absorption in the region 3230–3550 cm^{-1}
- **no** absorption in the region 1680–1750 cm^{-1}

Use **Table A** in the Data Sheet to deduce what information the infrared spectrum provides about the structure of **E**.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

0 2 . 4 Outline a chemical test that would confirm that **E** contains a C=C double bond.

[2 marks]

Test _____

Observation _____

_____

9

Turn over for the next question

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0 3 Alcohols can be classified as primary, secondary or tertiary.

0 3 . 1 Draw the structure of a primary alcohol and a tertiary alcohol with the same molecular formula $C_4H_{10}O$

[2 marks]

Primary alcohol

Tertiary alcohol

0 3 . 2 Describe how a student could distinguish between a secondary alcohol and a tertiary alcohol.

[3 marks]

Reagent(s) _____

Observation with secondary alcohol _____

_____

Observation with tertiary alcohol _____

_____

Do not write outside the box

0 3 . 3 A primary alcohol is partially oxidised to form compound **F**.

Identify the functional group in **F**.

Outline a chemical test that could be used to confirm the presence of this functional group.

[3 marks]

Functional group _____

_____

Test _____

_____

Observation _____

_____

0 3 . 4 Write an equation to show the complete oxidation of 2-methylpropan-1-ol.

In your equation write a displayed formula for 2-methylpropan-1-ol.

Use [O] to represent the oxidising agent.

[2 marks]

10

Turn over for the next question

Do not write outside the box

0 4 Many fuels belong to the homologous series of alkanes.

0 4 . 1 Compounds in a homologous series can be represented by the same general formula.

Give **two other** characteristics of a homologous series.

[2 marks]

0 4 . 2 Write an equation to show the incomplete combustion of the alkane pentane, forming carbon monoxide and water only.

[1 mark]

0 4 . 3 Catalytic converters are used to remove the NO and CO formed in petrol engines.

Write an equation to show the reaction that occurs in a catalytic converter to remove these gases.

[1 mark]

0 4 . 4 When fossil fuels are burned in power stations sulfur dioxide is formed.

- Give **one** reason why sulfur dioxide is removed.
- Identify a compound that could be used to remove sulfur dioxide.
- State the type of reaction that occurs when sulfur dioxide is removed.

[3 marks]

Reason

Compound

Type of reaction

7

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0 5 The alkene but-1-ene reacts with HBr to form a mixture of 1-bromobutane and 2-bromobutane.

0 5 . 1 Name and outline the mechanism to form 2-bromobutane in this reaction.

[5 marks]

Name of mechanism _____

Mechanism

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0 5 . 2 15.96 g of but-1-ene reacted to form a mixture of 1-bromobutane and 2-bromobutane. The mixture formed contained 6.88 g of 1-bromobutane.

Calculate the maximum amount, in moles, of 2-bromobutane that could be formed.

[3 marks]

Amount _____ mol

0 5 . 3 Explain why 2-bromobutane is the major product of this reaction.

[2 marks]

_____

_____

_____

_____

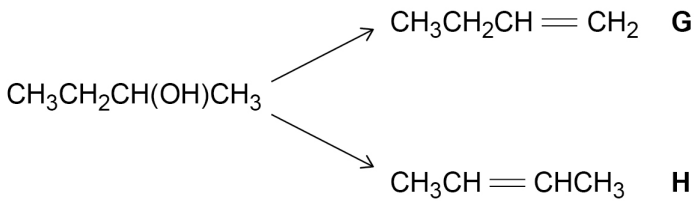
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Turn over for the next question

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0 6 **Figure 1** shows butan-2-ol can be dehydrated to form a mixture of alkenes.

Figure 1



0 6 . 1 Give the reagent and conditions needed for this reaction.

[2 marks]

Reagent _____

Conditions _____

0 6 . 2 Outline the mechanism for the dehydration of butan-2-ol to produce **H**.

[3 marks]

Mechanism

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0 6 . 3 **H** exists as two stereoisomers.
Draw the structure of each isomer and give their **full** IUPAC names.

[2 marks]

Isomer 1 Isomer 2

Name _____ Name _____

0 6 . 4 **G** undergoes addition polymerisation.
Draw a section of the polymer formed showing one repeating unit.

[1 mark]

0 6 . 5 Addition polymers are made from alkenes.
Suggest **one** advantage of using alcohols rather than crude oil as the source of alkenes.

[1 mark]

_____

_____

9

Turn over ►

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0 7 This question is about epoxyethane, C_2H_4O

0 7 . 1 Draw the displayed formula of epoxyethane.

[1 mark]

0 7 . 2 Epoxyethane is manufactured from ethene.

Write an equation and identify the catalyst for this reaction.

[2 marks]

Equation

Catalyst

0 7 . 3 Identify the product when one mole of epoxyethane reacts with one mole of water.

[1 mark]

4

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0 8 Halogenoalkanes react with hydroxide ions in two different ways.
The hydroxide ion acts either as a nucleophile or as a base.

0 8 . 1 Give the meaning of the term nucleophile.

[1 mark]

0 8 . 2 The hydroxide ion acts as a nucleophile in the reaction with 2-bromopropane to form propan-2-ol.
State the conditions needed for this reaction.

[1 mark]

0 8 . 3 2-Chloropropane also reacts with hydroxide ions to form propan-2-ol.

Explain why the reaction of 2-chloropropane is slower than the reaction of 2-bromopropane.

[1 mark]

0 8 . 4 Hydroxide ions act as a base in elimination reactions with halogenoalkanes.
State the conditions needed for these reactions.

Draw the structure of the organic product formed when 2-iodo-2-methylpropane reacts with hydroxide ions in an elimination reaction.

[2 marks]

Conditions

Structure of organic product

5

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0 9 Ethanol and propanoic acid react together in the presence of an acid catalyst to form ethyl propanoate ($CH_3CH_2COOCH_2CH_3$) and water as shown.

$CH_3CH_2OH + CH_3CH_2COOH \rightleftharpoons CH_3CH_2COOCH_2CH_3 + H_2O \qquad \Delta H^{\ominus} = -22 \text{ kJ mol}^{-1}$

A mixture was prepared using 2.45 mol of ethanol, 1.20 mol of propanoic acid and 0.87 mol of water.

At a given temperature, the mixture was left to reach equilibrium.

The equilibrium mixture contained 55.08 g of $CH_3CH_2COOCH_2CH_3$ (M_r = 102.0)

0 9 . 1 Calculate the amount, in moles, of $CH_3CH_2COOCH_2CH_3$ at equilibrium.

Use your answer to calculate the amount of ethanol and of water in the equilibrium mixture.

[3 marks]

Amount of $CH_3CH_2COOCH_2CH_3$ _____ mol

Amount of ethanol _____ mol

Amount of water _____ mol

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0 9 . 2 Write an expression for the equilibrium constant (K_c) for this equilibrium.

State why K_c does not have units.

[2 marks]

K_c

Reason why K_c does not have units _____

_____

0 9 . 3 Under different conditions, the equilibrium mixture contains 0.067 mol of $CH_3CH_2COOCH_2CH_3$, 0.033 mol of propanoic acid, 0.033 mol of ethanol and 0.567 mol of water.

Calculate a value for K_c for this equilibrium under these conditions.

[1 mark]

K_c _____

0 9 . 4 For this equilibrium, predict the effect of an increase in temperature on the value of K_c

Tick (✓) **one** box.

[1 mark]

Decreases ☐

Stays the same ☐

Increases ☐

7

END OF QUESTIONS

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