OXFORD

INTERNATIONAL AQA EXAMINATIONS

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 23 May 2018 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.
- 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	
TOTAL	

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

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0 1 Isomers of octane are hydrocarbons used in motor fuels.

0 1 . 1 Name the process used to obtain kerosene from crude oil.

[1 mark]

0 1 . 2 Octane can be produced by catalytic cracking of kerosene.

Identify the catalyst and state the temperature used in this process.

Write an equation to show the cracking of one molecule of pentadecane ($C_{15}H_{32}$) to form octane and one other product.

Use molecular formulas in your equation.

[3 marks]

Catalyst

Temperature

Equation

0 1 . 3 2,2,4-trimethylpentane is an isomer of octane used in motor fuels.

Draw the skeletal formula of 2,2,4-trimethylpentane.

[1 mark]

Do not write outside the box

0 1 . 4 Write an equation to show the incomplete combustion of 2,2,4-trimethylpentane to form carbon monoxide and water only.

Use molecular formulas in your equation.

[1 mark]

0 1 . 5 Carbon monoxide is removed using a catalytic converter.

Write an equation to show how the carbon monoxide reacts to form less harmful products in the catalytic converter.

[1 mark]

0 1 . 6 Explain how a catalyst works.

[2 marks]

9

Turn over for the next question

Do not write outside the box

0 2 Difluoromethane (CH_2F_2) and trifluoromethane (CHF_3) are used as refrigerants.

0 2 . 1 Fluorine can react with difluoromethane to form trifluoromethane.

Give **one** essential condition for this reaction and name the mechanism.

[2 marks]

Condition _____

Name of mechanism _____

0 2 . 2 Write an equation for each of the following steps in the mechanism for this reaction.

[4 marks]

Initiation step

_____

First propagation step

_____

Second propagation step

_____

A termination step

_____

6

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ANSWER IN THE SPACES PROVIDED

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0 3 This question is about reactions of halogenoalkanes.

0 3 . 1 2-Bromopentane reacts with aqueous sodium hydroxide to form pentan-2-ol.

Name and outline the mechanism for this reaction.

[3 marks]

Name of mechanism _____

Mechanism

0 3 . 2 Other halogenoalkanes also react with aqueous sodium hydroxide to form pentan-2-ol.

Identify a halogenoalkane that reacts at a faster rate than 2-bromopentane to form pentan-2-ol.

Explain your answer.

[2 marks]

Halogenoalkane _____

Explanation _____

_____

_____

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0 3 . 3 A mixture of three alkenes can be formed when 2-bromopentane reacts with hot, ethanolic sodium hydroxide. Two of these alkenes are a pair of stereoisomers.

State what is meant by the term stereoisomers.

Draw the skeletal formulas of the two stereoisomers formed in this reaction.

[3 marks]

Isomer 1 **Isomer 2**

0 3 . 4 Identify an isomer of 2-bromopentane that does **not** react with hot, ethanolic sodium hydroxide to produce an alkene.

[1 mark]

9

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0 4 Hydrated ethanedioic acid has the formula $H_2C_2O_4.xH_2O$

A student completed an experiment to determine the value of *x* in the formula.

0 4 . 1 The student made up a solution of ethanedioic acid in a volumetric flask as follows

- 2.00 g of solid hydrated ethanedioic acid were placed in a weighing bottle.
- The solid acid was transferred to a beaker and dissolved in some distilled water.
- The solution formed was then transferred to a clean 250 cm^3 volumetric flask through a funnel.
- The beaker and funnel were washed and the washings were transferred to the volumetric flask.
- Distilled water was added up to the 250 cm^3 mark.

Give **two** improvements to the student's method.

[2 marks]

Improvement 1 _____

_____

_____

Improvement 2 _____

_____

_____

Do not write outside the box

0 4 . 2 25.0 cm^3 of the solution of ethanedioic acid were titrated with a 0.115 mol dm^{-3} sodium hydroxide solution.

Aqueous sodium hydroxide solution was added from a burette and 27.35 cm^3 were needed for neutralisation.

Ethanedioic acid reacts with sodium hydroxide as follows

$$H_2C_2O_4(aq) + 2NaOH(aq) \rightarrow Na_2C_2O_4(aq) + 2H_2O(l)$$

Calculate the value of x in $H_2C_2O_4.xH_2O$

You **must** show your working.

[5 marks]

x _____

Question 4 continues on the next page

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0 4 . 3 State why it is important to fill the space below the tap in the burette before beginning an accurate titration.

[1 mark]

0 4 . 4 State why the funnel used to fill the burette should be removed before starting the titration.

[1 mark]

0 4 . 5 State why rinsing the inside of the conical flask with distilled water during a titration can improve the accuracy of the end point.

[1 mark]

0 4 . 6 The total percentage uncertainty in the titre is ±0.15 cm^3

Calculate the total percentage uncertainty in the titre value in this experiment.

[1 mark]

Percentage _____ %

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0 5 Compounds with carbon–carbon double bonds are useful as they take part in a wide variety of reactions.

0 5 . 1 2-Methylpropene reacts with hydrogen bromide to form 2-bromo-2-methylpropane.

Name and outline the mechanism to show the formation of 2-bromo-2-methylpropane from 2-methylpropene.

[5 marks]

Name of mechanism _____

Mechanism

0 5 . 2 In the reaction in Question **05.1**, small amounts of 1-bromo-2-methylpropane are also formed.

Explain why 2-bromo-2-methylpropane is the major product.

[2 marks]

_____

_____

_____

_____

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0 5 . 3 Draw the displayed formula of a functional group isomer of 2-methylpropene.

[1 mark]

0 5 . 4 2-Methylpropene forms a polymer that is used in chewing gum.

Give the repeating unit of the polymer formed from 2-methylpropene.

State the IUPAC name of the polymer.

[2 marks]

Repeating unit

Name of polymer _____

0 5 . 5 Explain why the polymer in chewing gum is unreactive.

[2 marks]

_____

_____

_____

_____

12

Turn over ►

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0 6 Four tests were used to identify the unknown organic compounds **A**, **B**, **C** and **D**. The observations from these tests are shown in **Table 1**.

Table 1

	Test 1	Test 2	Test 3	Test 4
	Addition of bromine water	**Addition of acidified potassium dichromate(VI)**	**Addition of Tollens' reagent**	**Addition of sodium carbonate**
A	remains orange	turns green	silver mirror formed	no visible change
B	remains orange	turns green	no visible change	no visible change
C	remains orange	remains orange	no visible change	effervescence
D	turns colourless	turns green	no visible change	no visible change

0 6 . 1 Use the observations from **Table 1** to identify the unknown organic compound that **must** contain two different functional groups.

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

0 6 . 2 Identify the gas formed in the reaction of compound **C** with sodium carbonate in **Test 4**.

[1 mark]

0 6 . 3 In the reaction of acidified potassium dichromate(VI) in **Test 2**, green Cr^{3+} ions are formed.

Write a half-equation to show the conversion of $Cr_2O_7^{2-}$ ions into Cr^{3+} ions.

[1 mark]

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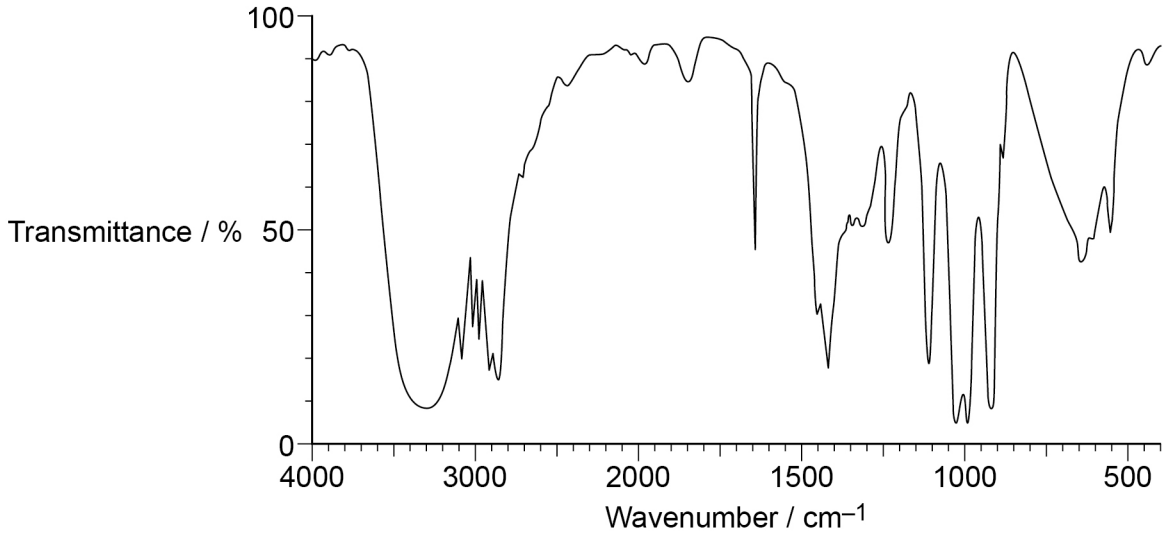
The infrared spectrum of compound **B** is shown in **Figure 1**.

Figure 1



0 6 . 4 Use the infrared spectrum to deduce which one of the tests for compound **B** shown in **Table 1** is incorrect.

Explain your answer.

[3 marks]

Test _____

Explanation _____

_____

_____

_____

_____

6

Turn over for the next question

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0 7 Alcohols undergo combustion, oxidation and elimination reactions.

0 7 . 1 An unknown alcohol is analysed by complete combustion.

When 0.250 g of the alcohol is burned, 0.625 g of carbon dioxide and 0.307 g of water are produced.

Calculate the empirical formula of the alcohol.

[5 marks]

Empirical formula _____

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0 7 . 2 Butan-1-ol can be oxidised to butanoic acid in a two-step process.

butan-1-ol → butanal → butanoic acid

The reaction mixture is heated under reflux to make sure that the oxidation to butanoic acid is complete.

Write an overall equation for the oxidation of butan-1-ol to form butanoic acid.

Use [O] in your equation to represent the oxidising agent.

[1 mark]

0 7 . 3 Explain how heating under reflux ensures the complete oxidation of butan-1-ol to butanoic acid.

[2 marks]

0 7 . 4 Explain why butanal has a lower boiling point than both butan-1-ol and butanoic acid.

[3 marks]

Question 7 continues on the next page

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0 7 . 5 Identify the isomer of butan-1-ol that is **not** easily oxidised.

[1 mark]

_____

0 7 . 6 Butan-1-ol can be converted into but-1-ene in an elimination reaction.

Give the reagent used and outline the mechanism for this reaction.

[5 marks]

Reagent _____

Mechanism

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END OF QUESTIONS

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