OXFORD

INTERNATIONAL AQA EXAMINATIONS

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

OXFORD AQA INTERNATIONAL AS

CHEMISTRY (9620)

Unit 2 Organic 1 and Physical 1

Monday 22 January 2018 06:00 GMT Time allowed: 1 hour 30 minutes

A

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.

Do not write outside the box

0 1 Alkenes react with electrophiles.

0 1 . 1 State what is meant by the term **electrophile**.

[1 mark]

0 1 . 2 Bromine is a non-polar molecule.

Explain why alkenes undergo electrophilic addition reactions with bromine.

[2 marks]

Do not write outside the box

0 1 . 3 Outline a mechanism for the reaction of propene with concentrated sulfuric acid to show the formation of the major product.

[4 marks]

0 1 . 4 Explain why the product of the reaction in Question **01.3** is the major product in the reaction of propene with concentrated sulfuric acid.

[2 marks]

9

Turn over for the next question

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0 2 Alkanes undergo combustion reactions and substitution reactions.

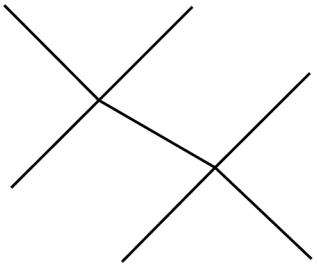
0 2 . 1 Write an equation for the complete combustion of octane.

[1 mark]

0 2 . 2 State why the complete combustion of octane may contribute to environmental problems.

[1 mark]

0 2 . 3 The skeletal formula of an isomer of octane is shown.



Give the IUPAC name for this isomer.

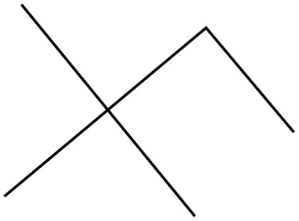
[1 mark]

0 2 . 4 Explain why the isomer of octane shown in Question **02.3** has a lower boiling point than octane.

[2 marks]

Do not write outside the box

The skeletal formula of compound **Y** is shown.



Y reacts with chlorine in a free radical substitution reaction.

0 2 . 5 State what is meant by the term **free radical**.

[1 mark]

0 2 . 6 Give an equation for each of the propagation steps in the free radical reaction of **Y** (C_6H_{14}) with chlorine to form $C_6H_{13}Cl$

You should use molecular formulae in your equations.

[2 marks]

Propagation step 1

Propagation step 2

Question 2 continues on the next page

Do not write outside the box

0 2 . 7 Deduce the number of position isomers that can be formed when **Y** reacts with chlorine to form $C_6H_{12}Cl_2$

Tick (✓) **one** box.

[1 mark]

4	5	6	7
☐	☐	☐	☐

9

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 3 This question is about elimination reactions.

0 3 . 1 But-2-ene can be produced from 2-bromobutane in an elimination reaction.

Give the reagent and state a suitable condition for this reaction.

Outline the mechanism.

[5 marks]

Reagent _____

Condition _____

Mechanism

0 3 . 2 Identify a structural isomer of but-2-ene that is also formed in the reaction in Question **03.1**

Explain your answer.

[2 marks]

Structural isomer formed _____

Explanation _____

_____

_____

Do not write outside the box

0 3 . 3 An alkene can also be formed when an alcohol undergoes an elimination reaction.

Identify a reagent for this reaction.

[1 mark]

---

0 3 . 4 Give the displayed formula of an alcohol with molecular formula $C_5H_{12}O$ that does **not** undergo an elimination reaction to form an alkene.

[1 mark]

9

Turn over for the next question

Do not write outside the box

0 4 The following pairs of compounds can be distinguished by simple test-tube reactions.

Give a reagent, or combination of reagents, that can be added to the compounds in each pair to distinguish between them.
State what is observed in each case.

0 4 . 1 Hexane and hex-2-ene.

[3 marks]

Reagent _____

Observation with hexane _____

Observation with hex-2-ene _____

0 4 . 2 Propanone and propanal

[3 marks]

Reagent _____

Observation with propanone _____

Observation with propanal _____

0 4 . 3 Propan-2-ol and 2-methylpropan-2-ol

[3 marks]

Reagent _____

Observation with propan-2-ol _____

Observation with 2-methylpropan-2-ol _____

0 4 . 4 Iodoethane and ethanoic acid

[3 marks]

Reagent _____

Observation with iodoethane _____

Observation with ethanoic acid _____

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0 4 . 5 A mass spectrometer can be used to determine the molecular formulae of compounds.

Table 1 shows some relative atomic mass values to four decimal places.

Table 1

Element	Relative atomic mass
Carbon	12.0096
Hydrogen	1.0078
Oxygen	15.9994

Show, by calculation, how these relative atomic masses can be used to distinguish between pentane and butanal.

[2 marks]

14

Turn over for the next question

Do not write outside the box

0 5 Epoxyethane is an important compound used in synthesis.

0 5 . 1 Write an equation to show the formation of epoxyethane from ethene.

State the type of reaction occurring.

[2 marks]

Equation

Type of reaction _____

0 5 . 2 Ethane-1,2-diol is formed when epoxyethane reacts with water.

Write an equation for this reaction.

Give a use for ethane-1,2-diol.

[2 marks]

Equation

Use for ethane-1,2-diol _____

0 5 . 3 Ethane-1,2-diol can also be formed from 1,2-dibromoethane.

Identify a reagent for this reaction.

State the type of reaction occurring.

[2 marks]

Reagent _____

Type of reaction _____

6

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0 6 When anhydrous calcium chloride dissolves in water, an exothermic process occurs.

A student carried out an experiment to measure the enthalpy change when a sample of anhydrous calcium chloride was added to water.

- The temperature of 50.0 cm^3 of water was measured every minute for three minutes. Before recording the temperature, the water was stirred with the thermometer.
- At the fourth minute, 2.00 g of anhydrous calcium chloride were added to the water. The mixture was stirred but the temperature was not recorded.
- At the fifth minute, the temperature was recorded.
- Stirring and recording the temperature at one-minute intervals continued for seven more minutes.

0 6 . 1 State the meaning of the term **enthalpy change**.

[1 mark]

0 6 . 2 The student used a balance, a thermometer and a stopclock in the experiment. Identify **one** other piece of apparatus essential to achieve an accurate result.

[1 mark]

0 6 . 3 Explain why it is important that the reaction mixture is stirred before recording each temperature.

[1 mark]

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0 6 . 4 A graph of temperature versus time was plotted for the data collected.
The lines before and after the addition of calcium chloride were extrapolated to the fourth minute.
Using these lines, the temperature rise at the fourth minute was found to be 7.0°C.

Calculate the heat released, in kJ, in this experiment.

Assume that:

- the density of the solution is 1.00 g cm^{-3}
- the specific heat capacity of the solution is 4.18 J $K^{-1}g^{-1}$
- all heat released is used to heat the solution.

[2 marks]

Heat released _____ kJ

0 6 . 5 Calculate the amount, in moles, of calcium chloride in 2.00 g of anhydrous calcium chloride.

[1 mark]

Amount _____ mol

0 6 . 6 Calculate a value for the enthalpy change, in kJ mol^{-1}, in this experiment.
Use your answers from Questions **06.4** and **06.5**

(If you were unable to answer Questions **06.4** and **06.5**, you should use the values 2.0 kJ and 0.024 mol. These are **not** the correct answers.)

[2 marks]

Enthalpy change _____ kJ mol^{-1}

Do not write outside the box

0 6 . 7 Calcium chloride can be made by reacting limestone with sodium chloride in a multi-stage reaction which can be represented by the following overall equation.

$$2NaCl + CaCO_3 \rightarrow Na_2CO_3 + CaCl_2$$

The standard enthalpy change for this reaction can be calculated using standard enthalpies of formation, and by applying Hess's law.

Give the meaning of the term **standard enthalpy of formation**.
State Hess's law.

[3 marks]

Standard enthalpy of formation _____

_____

_____

_____

_____

Hess's law _____

_____

_____

Do not write outside the box

0 6 . 8 Calculate the standard enthalpy change for the reaction between sodium chloride and calcium carbonate.
Use Hess's law and the standard enthalpies of formation given below in **Table 2**.

$$2NaCl + CaCO_3 \rightarrow Na_2CO_3 + CaCl_2$$

Table 2

	$CaCl_2$	$CaCO_3$	$NaCl$	Na_2CO_3
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	– 795	– 1207	– 411	– 1131

[3 marks]

Enthalpy change _____ kJ mol^{-1}

14

Turn over ►

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0 7 This question is about the equilibrium:

$$A(g) + 2B(g) \rightleftharpoons C(g) + D(g) \qquad \Delta H = +253 \text{ kJ mol}^{-1}$$

0 7 . 1 Write an expression for K_c for the equilibrium.

Deduce the units of K_c for this equilibrium.

[2 marks]

Units: _____

0 7 . 2 Predict the effect, if any, on the value of K_c for this equilibrium of:

- increasing the temperature
- increasing the volume of the flask
- adding a catalyst.

[3 marks]

Increasing the temperature _____

Increasing the volume of the flask _____

Adding a catalyst _____

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0 7 . 3 Nitrogen reacts with hydrogen to form ammonia as shown in the equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Samples of ammonia, nitrogen and hydrogen were placed in a reaction flask of volume 1.50 dm^3 and allowed to reach equilibrium.

The equilibrium mixture was found to contain 0.975 mol of hydrogen and 0.060 mol of nitrogen. The value of K_c at this temperature is 9.60 mol^{-2} dm^6

Calculate the concentration of ammonia in the equilibrium mixture.

[4 marks]

Concentration of ammonia _____ mol dm^{-3}

9

END OF QUESTIONS

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There are no questions printed on this page

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