

Centre No.						Surname	Initial(s)
Candidate No.						Signature	

Paper Reference(s)

4437/5H

# London Examinations IGCSE

## Science (Double Award)

### Chemistry

Examiner's use only

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Team Leader's use only

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Paper 5H

# Higher Tier

Tuesday 7 November 2006 – Morning

Time: 1 hour 30 minutes

**Materials required for examination**

Nil

**Items included with question papers**

Nil

Question Number	Leave Blank
1	
2	
3	
4	
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6	
7	
8	
9	
10	
Total	

**Instructions to Candidates**

In the boxes above, write your centre number and candidate number, your surname, initial(s) and signature.

The paper reference is shown at the top of this page. Check that you have the correct question paper.

Answer **ALL** the questions in the spaces provided in this question paper.

Show all the steps in any calculations and state the units.

Calculators may be used.

**Information for Candidates**

The total mark for this paper is 90. The marks for parts of questions are shown in round brackets: e.g. (2).

A Periodic Table is given on page 2.

This paper has 10 questions. All blank pages are indicated.

**Advice to Candidates**

Write your answers neatly and in good English.

**Turn over**

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## THE PERIODIC TABLE

	Group							0																		
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1	<table style="width: 100%; text-align: center;"> <tr> <td style="border: 1px solid black;">1 <b>H</b> Hydrogen 1</td> <td colspan="6"></td> <td style="border: 1px solid black;">4 <b>He</b> Helium 2</td> </tr> </table>							1 <b>H</b> Hydrogen 1							4 <b>He</b> Helium 2											
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**Key**

Relative atomic mass  
Symbol  
Name  
Atomic number



**SECTION A**

1. (a) In industry, chlorine and sodium hydroxide are manufactured from brine.

(i) Name the compound in brine that is the source of chlorine.

.....  
(1)

(ii) What method is used to obtain chlorine and sodium hydroxide from brine?

.....  
(1)

(iii) State **one** large-scale use of sodium hydroxide.

.....  
.....  
(1)

(b) What colour is chlorine gas?

.....  
(1)

(c) Damp red litmus paper changes colour when placed in separate samples of chlorine and sodium hydroxide.

(i) State the colour of red litmus paper in chlorine gas.

.....  
(1)

(ii) What property of chlorine is shown by this colour change?

.....  
(1)

(iii) State the colour of red litmus paper in sodium hydroxide solution.

.....  
(1)

(iv) What property of sodium hydroxide is shown by this colour change?

.....  
(1)

**(Total 8 marks)**

Q1



2. The formulae  $\text{CH}_4$  and  $\text{C}_4\text{H}_{10}$  represent two organic compounds.

(a) State why these compounds are described as

(i) saturated.....  
 .....  
 (1)

(ii) hydrocarbons .....  
 .....  
 (1)

(b)  $\text{CH}_4$  and  $\text{C}_4\text{H}_{10}$  are members of the same homologous series. All members of the same homologous series can be represented by a general formula.

(i) What is the general formula of this homologous series?  
 .....  
 (1)

(ii) To which homologous series do  $\text{CH}_4$  and  $\text{C}_4\text{H}_{10}$  belong?  
 .....  
 (1)

(iii) Give **two** other features of members of the same homologous series.  
 1 .....  
 2 .....  
 (2)

(c) The compound  $\text{C}_4\text{H}_{10}$  exists as isomers. What is meant by the term **isomers**?  
 .....  
 .....  
 (2)

(Total 8 marks)

Q2



Leave  
blank

3. The Periodic Table on page 2 may be useful in answering parts of this question.

The symbols of some atoms and ions are shown below.

Al      Cl<sup>-</sup>      Mg      Mg<sup>2+</sup>      Na<sup>+</sup>      O<sup>2-</sup>

(a) Which **one** of these is formed by the loss of one electron from an atom?

.....  
(1)

(b) Which **one** of these is formed by the gain of two electrons by an atom?

.....  
(1)

(c) Which **one** of these has the same electronic configuration as an atom of argon?

.....  
(1)

(d) Which **one** of these has an electronic configuration of 2.8.2?

.....  
(1)

(e) Which **three** of these have the same electronic configuration?

.....  
(1)

(Total 5 marks)

Q3



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4. The equation shows the formation of hydrogen chloride.



(a) (i) What does the symbol  $\Delta H$  represent?

.....  
(1)

(ii)  $\Delta H$  is negative for this reaction. What does this indicate?

.....  
(1)

(b) Draw a dot and cross diagram to show the bonding in  $\text{H}_2$ .

(1)

(c)  $\text{H}_2$  molecules contain strong bonds. Explain why the boiling point of  $\text{H}_2$  is low.

.....  
.....  
(2)

(d) A student carries out a test to show that a solution of hydrogen chloride contains chloride ions. First she adds dilute nitric acid.

(i) Name the other solution she adds.

.....  
(1)

(ii) Describe what she observes.

.....  
(1)

(iii) Complete the equation to show the reaction that occurs.

..... +  $\text{HCl}$   $\rightarrow$  ..... + .....

(2)

Q4

(Total 9 marks)

TOTAL FOR SECTION A: 30 MARKS



**SECTION B**

5. The table gives some information about the elements in Group 7 of the Periodic Table.

Element	Melting point (°C)	Boiling point (°C)
fluorine	-220	-188
chlorine	-101	-35
bromine	-7	
iodine	+114	+184
astatine		+337

(a) (i) Use the information in the table to predict the physical state of astatine at room temperature.

.....  
**(1)**

(ii) Use the information in the table to predict a value for the boiling point of bromine.

.....  
**(1)**

(b) All atoms of elements in Group 7 have seven electrons in their outer shell. When they react they can form ions.

(i) What is the charge on the ions formed?

.....  
**(1)**

(ii) Explain why the atoms form ions with this charge.

.....  
 .....  
**(2)**

(c) Which element in Group 7 is the **most** reactive?

.....  
**(1)**





Leave  
blank

(d) When chlorine gas is bubbled through potassium bromide solution a reaction takes place.

(i) Write the chemical equation for the reaction.

.....  
(2)

(ii) What is **seen** during the reaction?

.....  
(1)

(e) A compound contains 16.4% potassium, 30.0% chlorine and 53.6% iodine by mass. Calculate the empirical formula of the compound.

(3)

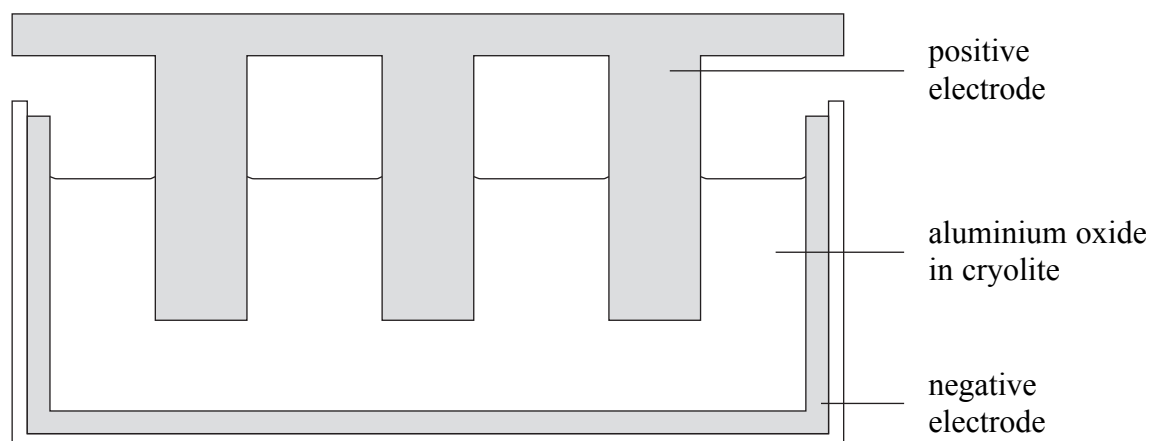
Q5

(Total 12 marks)

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6. Aluminium is extracted from aluminium oxide by electrolysis. The diagram shows a cross-section through an electrolysis cell.



- (a) Aluminium oxide has a melting point of over 2000°C.

- (i) Explain why obtaining molten aluminium oxide is difficult.

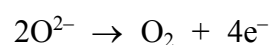
.....  
 .....  
**(1)**

- (ii) How does the use of cryolite help to overcome this difficulty?

.....  
 .....  
**(2)**

- (b) The products of the electrolysis are oxygen and aluminium.

The ionic half-equation to show the formation of oxygen at the positive electrode is



Write the ionic half-equation to show the formation of aluminium at the negative electrode.

.....  
**(2)**



Leave blank

(c) The electrolysis of aluminium oxide is a redox process. Use the equations in (b) to help you identify what has been oxidised. Explain your answer.

Oxidised .....

Explanation .....

**(2)**

(d) Explain why the positive electrodes need to be replaced regularly.

.....

.....

.....

.....

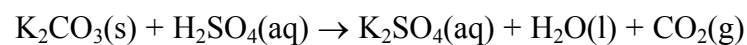
**(3)**

**Q6**

**(Total 10 marks)**



7. Potassium carbonate,  $K_2CO_3$ , reacts with sulphuric acid,  $H_2SO_4$ .



Dilute sulphuric acid is placed in a beaker. Solid potassium carbonate is added until no further reaction occurs.

(a) How can you tell that the reaction has stopped?

.....  
 .....  
 (1)

(b) (i) Calculate the relative formula mass,  $M_r$ , of potassium carbonate.

(1)

(ii) Calculate the amount, in moles, of potassium carbonate in 2.76 g.

(1)

(iii) Calculate the relative formula mass,  $M_r$ , of carbon dioxide.

(1)

(iv) Calculate the mass of carbon dioxide formed.

(1)

(v) Calculate the volume of this mass of carbon dioxide at room temperature and pressure (rtp).

The volume of one mole of any gas at rtp is  $24 \text{ dm}^3$ .

(1)



Leave  
blank

(c) Describe simple tests that can be used to show that the solution produced in the reaction contains

(i) potassium ions

Test .....

Result .....

**(2)**

(ii) sulphate ions

Test .....

.....

Result .....

**(3)**

Q7

**(Total 11 marks)**



8. Crude oil is a complex mixture of different hydrocarbons. It is separated into useful fractions by fractional distillation. Short-chain hydrocarbons are used as fuels.

(a) Name the fraction that contains methane.

.....  
(1)

(b) Long-chain hydrocarbons are cracked to produce hydrocarbons with shorter chains.

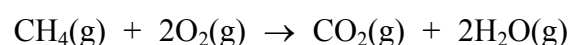
(i) State **one** condition needed for cracking to occur.

.....  
(1)

(ii) Why are long-chain hydrocarbons available for cracking?

.....  
.....  
(1)

(c) Methane is used as a fuel. The combustion of methane is shown by the equation



In this reaction the energy used to break bonds is less than the energy given out when new bonds are formed. What does this indicate about the reaction?

.....  
(1)

(d) When a hydrocarbon burns in a limited supply of oxygen, incomplete combustion occurs. One of the products is carbon monoxide.

(i) Write a chemical equation for the incomplete combustion of methane.

.....  
(2)

(ii) Why can incomplete combustion be dangerous?

.....  
.....  
.....  
(2)

(Total 8 marks)

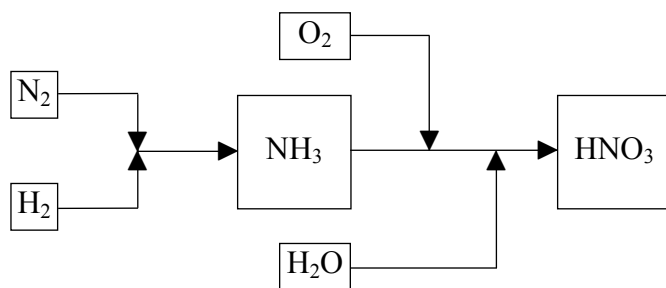
Q8



**TURN OVER FOR QUESTION 9**



9. The flow chart shows the steps in the industrial production of ammonia, NH<sub>3</sub>, and nitric acid, HNO<sub>3</sub>.



(a) (i) Name the raw material from which hydrogen is obtained.

..... (1)

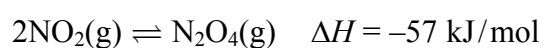
(ii) Write a chemical equation to show how hydrogen is obtained from this raw material.

..... (2)

(iii) Name the catalyst used in the production of ammonia.

..... (1)

(b) During the conversion of ammonia into nitric acid, nitrogen dioxide, NO<sub>2</sub>, is made. Nitrogen dioxide can undergo the following reaction.



This reaction is reversible. A dynamic equilibrium is established.

(i) What is meant by the term **dynamic equilibrium**?

.....  
 .....  
 ..... (2)

(ii) What happens to the amount of N<sub>2</sub>O<sub>4</sub>(g) in the mixture at equilibrium when the pressure is increased?

..... (1)





Leave  
blank

(iii) What happens to the amount of  $\text{N}_2\text{O}_4(\text{g})$  in the mixture at equilibrium when the temperature is increased?

.....  
(1)

(c) (i) Why is it important that oxides of nitrogen are not allowed to escape into the atmosphere?

.....  
(1)

(ii) Describe **two** problems that can result.

1 .....

.....

2 .....

.....

(2)

Q9

(Total 11 marks)

--	--



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**10.** Diamond and graphite are allotropes of carbon. They both have giant molecular covalent structures.

Both diamond and graphite have high sublimation points.

Diamond can be used for cutting.

Graphite can be used as a lubricant.

(a) Describe, without drawing a diagram, the structure of diamond.

Include the number of atoms to which each carbon atom is bonded and how the atoms are arranged. Explain how this structure relates to the use of diamond in cutting.

.....  
.....  
.....  
.....  
.....  
.....

**(3)**

(b) Describe, without drawing a diagram, the structure of graphite.

Include the number of atoms to which each carbon atom is bonded and how the atoms are arranged. Explain how this structure relates to the use of graphite as a lubricant.

.....  
.....  
.....  
.....  
.....  
.....

**(3)**

(c) Explain why both diamond and graphite have high sublimation points.

.....  
.....

**(2)**

**Q10**

**(Total 8 marks)**

**TOTAL FOR SECTION B: 60 MARKS**

**TOTAL FOR PAPER: 90 MARKS**

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