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

Paper Reference(s)

4335/2H

London Examinations IGCSE

Chemistry

Paper 2H

Higher Tier

Thursday 3 November 2005 – Morning

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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8	
9	
10	
11	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

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 120. The marks for parts of questions are shown in round brackets: e.g. (**2**).
There are 24 pages in this question paper. All blank pages are indicated.
A Periodic Table is given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Indium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

Leave blank

SECTION A

1. (a) The table gives the names of some compounds. Place ticks (✓) in the table to show the type of bonding in each compound and whether it is soluble or insoluble in water. Each row should have two ticks. Some ticks have already been done for you.

Name of compound	Ionic bonding	Covalent bonding	Insoluble in water	Soluble in water
ammonia				
methane			✓	
poly(ethene)		✓		
sodium chloride				
sodium hydroxide	✓			✓

(4)

(b) All the substances listed are very useful.

(i) Give **one** use of poly(ethene).

.....

(1)

(ii) Name **two** products that are made using sodium hydroxide.

Product 1 .....

Product 2 .....

(2)

(Total 7 marks)

Q1

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Leave blank

2. This question is about chlorine.

(a) Give the name of a substance that reacts with hydrochloric acid to produce chlorine gas.

.....

(1)

(b) Describe the test for chlorine.

Test .....

Result .....

(2)

(c) Chlorine gas reacts with iron to form a solid.

(i) Give the name of this solid.

.....

(1)

(ii) When this solid is dissolved in water a yellow solution is formed. State what you **see** when sodium hydroxide solution is added to this yellow solution.

.....

.....

(1)

(d) When chlorine gas is bubbled through colourless potassium iodide solution a brown solution is formed.

(i) Name the substance that makes the solution brown.

.....

(1)

(ii) What does this reaction show about the reactivity of chlorine compared with that of iodine?

.....

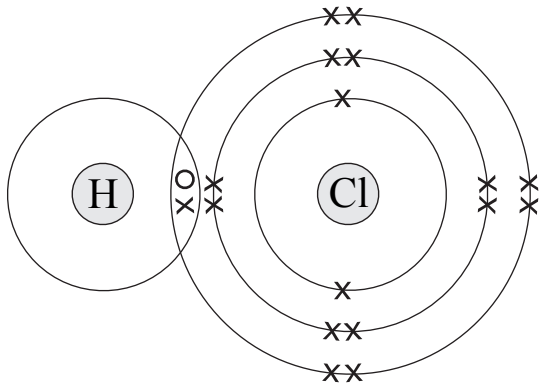
(1) **Q2**

(Total 7 marks)

Leave blank

3. This question is about two covalently bonded compounds.

(a) The dot and cross diagram shows the covalent bonding in a hydrogen chloride molecule.



What is a covalent bond?

.....

(1)

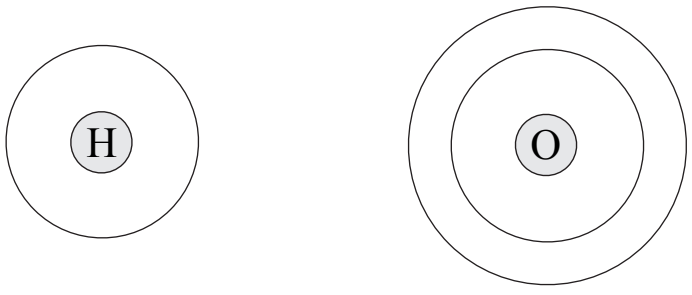
(b) Use words from the box to complete the sentences about hydrogen chloride.
Each word may be used once, more than once or not at all.

giant	**high**	**ions**	**low**
molecules	**simple**	**strong**	**weak**

Hydrogen chloride has a ..... molecular structure. There are ..... forces between the ..... Because of this, hydrogen chloride has a ..... boiling point.

(4)

(c) (i) Use the Periodic Table to help you complete the diagrams to show the electronic configuration of hydrogen and of oxygen.



(2)

Leave blank

(ii) Draw a dot and cross diagram to show the covalent bonding in a water molecule.

(2)

(iii) State the shape of a water molecule.

.....

(1)

Q3

(Total 10 marks)

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Leave blank

4. The table gives the electronic configuration of three different atoms.

Atom	Electronic configuration
fluorine	2.7
magnesium	2.8.2
sodium	2.8.1

(a) Describe the electron transfers that take place when magnesium reacts with fluorine to make the ionic compound magnesium fluoride, MgF_2. You may use diagrams to help your answer.

.....

.....

.....

.....

.....

(3)

(b) In this reaction both oxidation and reduction have occurred. State which element has been oxidised, giving a reason.

.....

.....

(2)

(c) (i) Give the symbols of the ions formed by sodium and fluorine.

.....

(1)

(ii) Give the formula of sodium fluoride.

.....

(1)

(d) A flame test is carried out on separate samples of magnesium fluoride and sodium fluoride.
The magnesium fluoride does not colour the flame.
What colour do you see when the sodium fluoride is tested?

.....

(1)

Q4

(Total 8 marks)

Leave blank

5. The table gives the colours of some indicators at different pH values.

Indicator	pH						
	1	**3**	**5**	**7**	**9**	**11**	**13**
litmus	← red →			purple	← blue →		
phenolphthalein	← colourless →					← pink →	
methyl orange	← red →		← yellow →				

(a) (i) Use the table to find the pH of a solution in which litmus is red **and** methyl orange is yellow.

.....

(1)

(ii) Litmus is purple in sodium chloride solution. What colour is phenolphthalein in sodium chloride solution?

.....

(1)

(b) A student was investigating the neutralisation of aqueous ammonia using hydrochloric acid.
She placed 25 cm^3 of aqueous ammonia in a conical flask and added a few drops of litmus.
She then slowly added hydrochloric acid to the mixture in the flask.
The indicator turned purple after she had added 15 cm^3 of hydrochloric acid.
The word equation for the reaction is

ammonia + hydrochloric acid $\rightarrow$ ammonium chloride

(i) Write a chemical equation for the reaction of ammonia with hydrochloric acid.

.....

(2)

Leave blank

(ii) Describe a chemical test to show that the solution obtained contains ammonium ions. Give the result of the test.

.....

.....

.....

(3)

(iii) The student used the same original solutions of aqueous ammonia and hydrochloric acid to make a pure sample of ammonium chloride crystals. Describe how she could do this.

.....

.....

.....

.....

.....

(3)

(c) (i) Lead(II) chloride is insoluble. Name two solutions that react together to make lead(II) chloride.

First solution .....

Second solution .....

(2)

(ii) Write a **word** equation for this reaction.

.....

.....

(1)

Q5

(Total 13 marks)

TOTAL FOR SECTION A: 45 MARKS

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SECTION B

6. In an experiment a student left some solid sodium chloride in a beaker of water for several days. The diagrams show the beaker at the start and end of the experiment.

start end

(a) Write the formulae, with state symbols, of the two substances in the beaker at the start of the experiment.

.....

(2)

(b) At the end of the experiment the student took a sample of the solution from near the top of the water.
He tested it for the presence of chloride ions. The test was positive.

(i) Name the **two** substances the student added to test for the presence of chloride ions.

.....

.....

(2)

(ii) Describe the observation made in the test.

.....

(1)

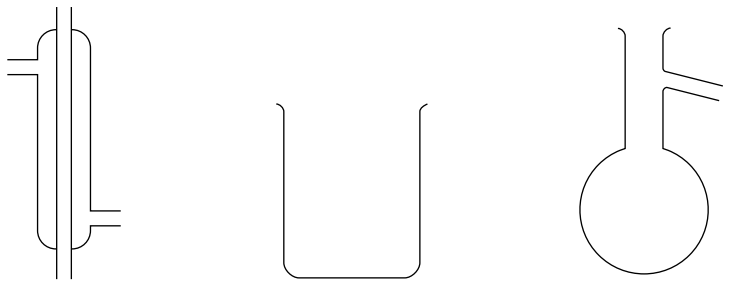
(iii) Name the process by which the chloride ions moved through the water to near the top of the water.

.....

(1)

Leave blank

(c) Sea water contains dissolved sodium chloride. The following pieces of laboratory apparatus can be used to make drinking water from sea water.



(i) Draw a labelled diagram to show how these pieces of apparatus can be assembled to do this.

(3)

(ii) Name the technique used in this process.

.....

(1)

(Total 10 marks)

Q6

Leave blank

7. This question is about the transition metal copper and some of its compounds.

(a) Describe the structure of copper metal and explain why it is a good conductor of electricity.

.....

.....

.....

.....

(3)

(b) The sequence shows reactions involving copper compounds.

$CuCO_3 \xrightarrow{\text{step 1}} CuO \xrightarrow{\text{step 2}} Cu(NO_3)_2 \xrightarrow{\text{step 3}} Cu(OH)_2 \xrightarrow{\text{step 4}}$ complex ion

(i) State the colour of:

copper(II) carbonate .....

copper(II) oxide .....

(2)

(ii) In step 1, copper(II) carbonate decomposes on heating.

Write a chemical equation for this reaction.

.....

(1)

(iii) Describe a test for the gas produced in step 1.

Test .....

Result .....

(2)

Leave blank

(iv) State the reagent used in step 2, and the type of reaction occurring.

Reagent .....

Type of reaction .....

(2)

(v) Both aqueous sodium hydroxide and aqueous ammonia can be used as reagents in step 3.

Describe **one** observation in step 3 that could be made if **either** reagent were used.

.....

(1)

(vi) Excess aqueous ammonia is used as the reagent in step 4.

What is the colour of the solution formed?

.....

(1)

(vii) Give the formula of the complex ion formed in step 4.

.....

(1)

(c) Give the name and formula of another oxide of copper that is not shown in (b).

Name .....

Formula .....

(2)

Q7

(Total 15 marks)

Leave blank

8. The conversion of ethane to ethene is an endothermic reaction.

$$C_2H_6(g) \rightarrow C_2H_4(g) + H_2(g)$$

(a) State one use of each product formed in the reaction.

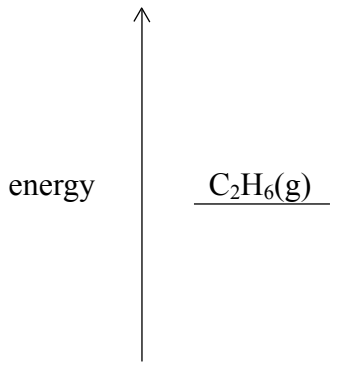
$C_2H_4(g)$ .....

$H_2(g)$ .....

(2)

(b) The reaction can be represented by an energy level diagram.

Complete the diagram by showing the products of the reaction.



(1)

(c) The table shows the values of some average bond dissociation energies.

Bond	C—C	C═C	C—H	H—H
Dissociation energy (kJ/mol)	348	612	412	436

(i) Ethane and hydrogen contain only single bonds. Ethene contains both single and double bonds.

Draw a displayed formula for each of the molecules ethane and ethene in the equation.

ethane → ethene + hydrogen

H—H

(2)

Leave blank

(ii) Use your displayed formulae and the information in the table to calculate the energy change occurring during the conversion of ethane to ethene and hydrogen.

(3)

(d) At room temperature the conversion of ethane to ethene is very slow.
State **two** changes in the conditions that would increase the rate of this reaction.

1 .....

2 .....

(2)

(e) The equation represents a reaction of ethene used in industry.

$$2C_2H_4(g) + O_2(g) \rightleftharpoons 2(CH_2)_2O(g) \qquad \Delta H = -214 \text{ kJ/mol}$$

(i) What do the symbols $\rightleftharpoons$ and ΔH represent?

$\rightleftharpoons$ .....

ΔH .....

(2)

(ii) The reaction is carried out at a pressure of 2 atm and a temperature of 300 °C.

Predict what would happen to the amount of product formed at equilibrium if these conditions were changed as follows:

Pressure increased .....

.....

Temperature increased .....

.....

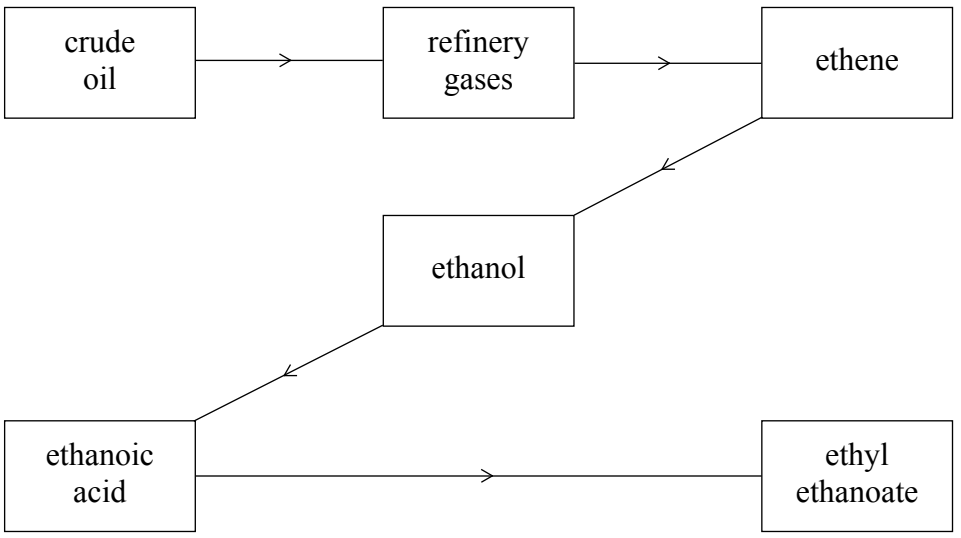
(2)

Q8

(Total 14 marks)

Leave blank

9. The flowchart shows how crude oil can be converted into some organic compounds.



(a) Name the process used to obtain refinery gases from crude oil.

.....

(1)

(b) Name **two** other fractions produced in this process.

1 .....

2 .....

(2)

Leave blank

(c) Ethene is converted to ethanol by reaction with steam.

State **two** conditions used in this conversion.

1 .....

2 .....

(2)

(d) In some countries ethanol is manufactured in a different way from the one shown in the flowchart.

(i) State the raw material used to manufacture ethanol in this way.

.....

(1)

(ii) Explain why some countries manufacture ethanol in this way.

.....

.....

.....

.....

.....

(2)

(e) The final product in the flowchart is ethyl ethanoate.

(i) Name the reagent and conditions used in the conversion of ethanoic acid to ethyl ethanoate.

Reagent .....

Conditions .....

(2)

(ii) Name the homologous series to which ethyl ethanoate belongs.

.....

(1)

Q9

(Total 11 marks)

Leave blank

10. This question is about the reactions of the metals calcium, iron and zinc.

(a) Samples of each of the powdered metals were placed in separate beakers of water. Only calcium reacted immediately.

Describe **two** observations that could be made during the reaction of calcium with water. Write a chemical equation for the reaction.

Observation 1 .....

Observation 2 .....

Equation .....

(3)

(b) A reaction occurred when powdered zinc was heated in steam.

Name the zinc compound formed. Write a chemical equation for the reaction.

Name of compound .....

Equation .....

(2)

(c) Some powdered zinc was added to a solution of iron(II) sulphate.

(i) Write an ionic equation to show the reaction that occurs.

.....

(1)

(ii) State the type of reaction occurring.

.....

(1)

(d) Iron rusts slowly in the presence of water.

Name one other substance that must be present for iron to rust.

.....

(1)

Leave blank

(e) Galvanising is one method used to prevent iron from rusting.

(i) Describe how a sheet of iron is galvanised.

.....

(1)

(ii) A sheet of galvanised iron was scratched and left in the rain. The exposed iron did not rust. Explain why.

.....

.....

.....

.....

(2)

Q10

(Total 11 marks)

Leave blank

11. One reaction that occurs in the blast furnace during the extraction of iron is the reaction between iron(III) oxide and carbon.

$$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$

(a) Calculate the relative formula mass of iron(III) oxide, using information from the Periodic Table.

.....

(1)

(b) 320 kg of iron(III) oxide were added to the blast furnace.

(i) Calculate the amount, in moles, of iron(III) oxide added.

.....

.....

(2)

(ii) Calculate the maximum amount, in moles, of iron formed from this amount of iron(III) oxide.

.....

.....

(2)

(iii) Calculate the maximum mass, in kilograms, of iron formed from this amount of iron(III) oxide.

.....

.....

(2)

Leave blank

(c) Most of the carbon monoxide formed in the reaction in (b) is converted to carbon dioxide before it leaves the blast furnace.

(i) Explain how carbon monoxide acts as a poison.

.....

.....

(1)

(ii) During one period in the operation of the blast furnace, the amount of carbon dioxide released was 5000 moles.

Calculate the volume, in dm^3, that this amount of carbon dioxide would occupy at room temperature and pressure (rtp).

(The molar volume of a gas is 24 dm^3 at rtp.)

.....

.....

(1)

(d) Write the chemical equation for the reaction in which iron(III) oxide is reduced by carbon monoxide.

.....

(2)

(e) (i) Limestone is added to the blast furnace to remove impurities. State the main impurity removed.

.....

(1)

(ii) Write **two** chemical equations to show how limestone removes this impurity.

Equation 1 .....

Equation 2 .....

(2) **Q11**

(Total 14 marks)

TOTAL FOR SECTION B: 75 MARKS

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