Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	3	3	5	/	2	H	Signature	

Paper Reference(s)

4335/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Chemistry

Paper 2H

Higher Tier

Tuesday 6 November 2007 – Morning

Time: 2 hours

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
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, candidate number, your surname and initial(s) and your signature.
Answer **ALL** questions in the spaces provided in this book.
Show all stages in any calculations and state the units. Calculators may be used.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (~~☒~~) and then mark your new answer with a cross (☒).

Information for Candidates

The marks for individual questions are shown in round brackets: e.g. **(2)**.
There are 11 questions in this question paper. The total mark for this paper is 120.
There are 24 pages in this question paper. All blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.

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Turn over

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THE PERIODIC TABLE

Period	1	2					Group						3	4	5	6	7	0
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 Iridium 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

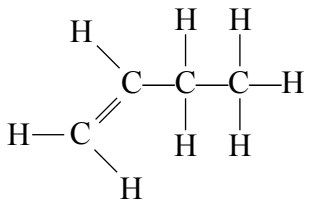
Relative atomic mass
Symbol
Name
Atomic number

Leave blank

SECTION A

1. These are the structures of six hydrocarbons.

A



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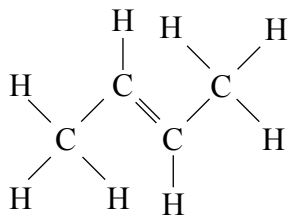

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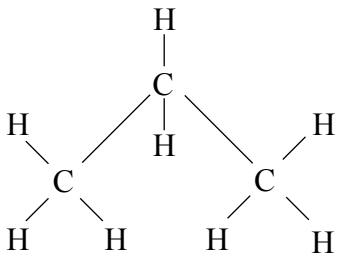

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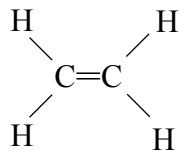

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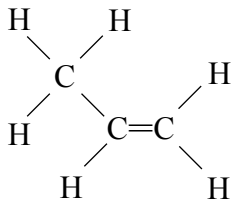

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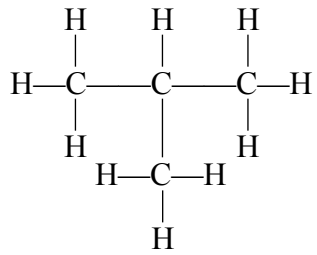


(a) Use the letters of the hydrocarbons to answer these questions.

(i) Give the letter of a hydrocarbon which is **not** an alkene. .....

(1)

(ii) Which two hydrocarbons are isomers? .....

(1)

(iii) Which structure is propene? .....

(1)

(b) Hydrocarbon **D** forms a polymer. Give the name of this polymer and draw a diagram to represent the structure of the polymer.

Name of polymer .....

Structure of polymer

(3) **Q1**

(Total 6 marks)

Leave blank

2. (a) Atoms contain smaller particles. Complete the table to show the relative mass and relative charge of each particle.

Particle	Relative mass	Relative charge
electron		
neutron	1	
proton		+1

(4)

(b) Use the Periodic Table on page 2 to name an element whose atoms

(i) contain equal numbers of protons and neutrons .....

(1)

(ii) have the electronic configuration 2.8.4 .....

(1)

(iii) have no neutrons. .....

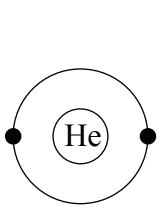
(1)

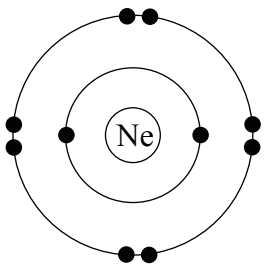
(c) Scientists think they will soon make an element that will go directly below astatine in the Periodic Table. Suggest how many electrons an atom of this element would have in its outer electron shell.

.....

(1)

(d) The diagrams show the electronic configuration of helium and of neon.





(i) What is the similarity in the outer electron shells of these two atoms?

.....

(1)

(ii) What effect does this similarity have on the chemical reactivity of helium and neon?

.....

(1)

Q2

(Total 10 marks)

Leave blank

3. Use information from the table to answer this question.

↑ increasing reactivity	**Name of metal**	**Colour of solid metal**	**Colour of a solution of the metal(II) sulphate**
	magnesium	grey	colourless
	zinc	grey	colourless
	iron	dark grey	green
	copper	pink-brown	blue

(a) When zinc is added to magnesium sulphate solution, no reaction occurs. Explain why.

.....

.....

(1)

(b) When iron filings are added to copper(II) sulphate solution, a reaction takes place.

(i) Write a chemical equation for this reaction.

.....

(2)

(ii) Describe the colour changes during this reaction.

Colour change of solid .....

.....

Colour change of solution .....

.....

(4)

(c) When copper is added to dilute sulphuric acid, no reaction occurs. When iron is added to dilute sulphuric acid, hydrogen gas and iron(II) sulphate solution are formed. What does this show about the reactivity of hydrogen compared to the reactivity of copper and the reactivity of iron?

.....

.....

.....

(2)

Q3

(Total 9 marks)

Leave blank

4. Magnesium sulphate and hydrogen are formed when magnesium reacts with dilute sulphuric acid.

(a) The ΔH value for this reaction is negative.

(i) What does ΔH represent?

.....

(2)

(ii) What happens to the temperature of the reaction mixture during this reaction?

.....

(1)

(b) Hydrogen gas burns in oxygen to produce a colourless liquid. Name this colourless liquid.

.....

(1)

(c) Magnesium sulphate can be prepared in a laboratory using the reaction between magnesium carbonate and dilute sulphuric acid.

$$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l) + CO_2(g)$$

Describe how you would make magnesium sulphate crystals using this reaction.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5)

(Total 9 marks)

Q4

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Leave blank

5. Hydrogen chloride, HCl, is a covalent compound. It is a colourless gas and is soluble in a number of solvents.

(a) (i) Draw a dot and cross diagram to show the covalent bonding in a molecule of hydrogen chloride. Show outer electrons only.

(2)

(ii) Hydrogen chloride has a low boiling point. Put a cross (☒) in the correct box to show the reason for this.

- The covalent bonds are strong ☐
- The covalent bonds are weak ☐
- There are weak forces between the ions ☐
- There are weak forces between the molecules ☐

(1)

(b) (i) Hydrochloric acid is a solution of hydrogen chloride in water. Give the **formula** of the species that makes the solution acidic.

.....

(1)

(ii) Explain why there is no colour change when universal indicator paper is added to a solution of hydrogen chloride in methylbenzene.

.....

(1)

Leave blank

(c) (i) When concentrated hydrochloric acid is added to solid potassium manganate(VII), chlorine gas is given off. Describe what is seen if a piece of damp universal indicator paper is held in the gas.

.....

.....

(2)

(ii) Chlorine exists as two isotopes. Why do these isotopes have identical chemical properties?

.....

(1)

(d) Iron forms two chlorides, iron(II) chloride and iron(III) chloride. Describe a chemical test that you could use to distinguish between these compounds.

Test .....

.....

Result with iron(II) chloride .....

Result with iron(III) chloride .....

(3)

Q5

(Total 11 marks)

TOTAL FOR SECTION A: 45 MARKS

Leave blank

SECTION B

6. A sequence of reactions involving ethanol is:

$$C_6H_{12}O_6 \xrightarrow{\text{Reaction } \mathbf{1}} C_2H_5OH \xrightarrow{\text{Reaction } \mathbf{2}} C_2H_5ONa$$

(a) (i) What type of substance is $C_6H_{12}O_6$?

.....

(1)

(ii) What is the empirical formula of $C_6H_{12}O_6$?

.....

(1)

(b) Reaction **1** is used to prepare ethanol by fermentation.

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

1 .....

2 .....

(2)

(c) Ethanol can be made industrially by the hydration of ethene.

(i) Write a chemical equation for this reaction.

.....

(1)

(ii) State **two** conditions used in this industrial process.

1 .....

2 .....

(2)

Leave blank

(d) State **two** reasons why a country such as Brazil makes large quantities of ethanol by fermentation instead of by the hydration of ethene.

1 .....

.....

2 .....

.....

(2)

(e) (i) What is added to ethanol in Reaction **2**?

.....

(1)

(ii) State the name of the product.

.....

(1)

(iii) Predict the type of bonding between O and Na in the compound C_2H_5ONa.

.....

(1)

Q6

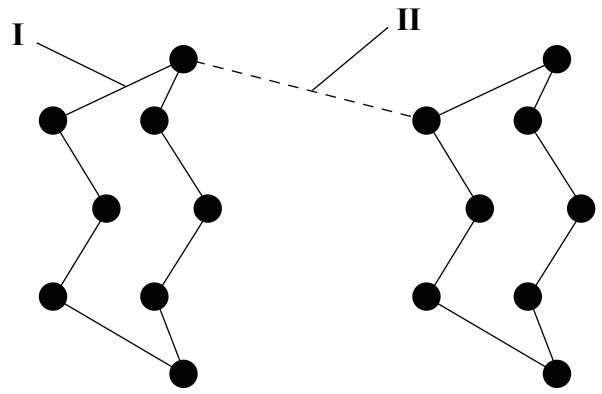
(Total 12 marks)

Leave blank

7. (a) Solid sulphur can exist in different forms called allotropes.

The most common allotrope of sulphur is rhombic sulphur.

The diagram shows how two molecules of sulphur are arranged in this allotrope.



(i) What is the formula of one molecule of sulphur?

.....

(1)

(ii) What is represented by each of the lines labelled **I** and **II**?

I .....

II .....

(2)

(b) In the Contact process, sulphur dioxide is converted to sulphur trioxide.

(i) Write a chemical equation for this conversion.

.....

(2)

(ii) State **three** conditions used in this conversion.

1 .....

2 .....

3 .....

(3)

Leave blank

(c) Sulphur trioxide in the atmosphere causes acid rain.

(i) Write a chemical equation for the formation of acid rain by sulphur trioxide.

.....

(1)

(ii) State **two** harmful effects of acid rain on the environment.

1 .....

.....

2 .....

.....

(2)

Q7

(Total 11 marks)

Leave blank

8. Magnesium and fluorine react together to form magnesium fluoride.

$$Mg(s) + F_2(g) \rightarrow MgF_2(s)$$

(a) (i) Describe the structure of a metal such as magnesium.

.....

.....

.....

(2)

(ii) What is meant by the term **malleable**?

.....

.....

(1)

(iii) Explain, in terms of its structure, why magnesium is malleable.

.....

.....

.....

(2)

(b) The atoms of fluorine in the F_2 molecule are joined by a covalent bond.

Describe how the atoms are held together by this bond.

.....

.....

.....

(2)

(c) Give the electronic configuration of

(i) a fluorine atom

.....

(ii) a fluoride ion

.....

(2)

Leave blank

(d) Draw a diagram to show the arrangement of electrons in a magnesium ion, showing its charge.

(2)

(e) Suggest why magnesium fluoride, MgF_2, has a higher melting point than sodium fluoride, NaF.

.....

.....

.....

.....

.....

(2)

Q8

(Total 13 marks)

Leave blank

9. The equation for the reaction used to manufacture ammonia in the Haber process is

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ/mol$$

A temperature of 450 °C and a pressure of 200 atmospheres are often used.

(a) Complete the table to show what happens to the rate of reaction and yield of ammonia if the conditions are changed as shown.

Change	**Effect on**	
	Rate of reaction	**Yield of ammonia**
decrease in temperature		
addition of catalyst		

(4)

(b) State and explain, using the kinetic theory, the effect on the rate of reaction of increasing the concentration of nitrogen in the Haber process.

.....

.....

.....

.....

.....

(3)

(c) Under the conditions used in the Haber process the yield of ammonia is about 15%. What happens to the unreacted nitrogen and hydrogen?

.....

.....

.....

(1)

Leave blank

(d) Ammonia is used to manufacture nitric acid. The word equations for the process are:

Reaction **1** ammonia + oxygen → nitrogen monoxide + water

Reaction **2** nitrogen monoxide + oxygen → nitrogen dioxide

Reaction **3** nitrogen dioxide + oxygen + water → nitric acid

(i) The same type of reaction occurs in Reactions **1**, **2** and **3**.

Name this type of reaction.

.....

(1)

(ii) Which metal is used as the catalyst in Reaction **1**?

.....

(1)

(iii) Write a chemical equation for Reaction **2**.

.....

(2)

(e) An important fertiliser is made by reacting ammonia with nitric acid.

Give the formula for this fertiliser.

.....

(1)

(f) Name the elements, other than nitrogen, that an NPK fertiliser must contain.

.....

.....

(2)

Q9

(Total 15 marks)

Leave blank

10. Some reactions of calcium compounds are shown in this sequence.

$$CaO \xrightarrow{\text{Reaction } \mathbf{1}} Ca(OH)_2 \xrightarrow{\text{Reaction } \mathbf{2}} Ca(NO_3)_2 \xrightarrow{\text{Reaction } \mathbf{3}} CaCO_3$$

(a) What colour do calcium compounds give in a flame test?

.....

(1)

(b) What is added to calcium oxide in Reaction **1**?

.....

(1)

(c) The chemical equation for Reaction **2** is

$$Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$$

A 14.8 g sample of calcium hydroxide is neutralised by a solution of nitric acid of concentration 1.6 mol dm^{-3}.

(i) Calculate the relative formula mass of calcium hydroxide and the amount, in moles, of calcium hydroxide in the 14.8 g sample.

(2)

Leave blank

(ii) Calculate the minimum volume, in cm^3, of this solution of nitric acid needed to neutralise the sample of calcium hydroxide.

(3)

(iii) Reaction **2** is used to prepare 0.050 moles of calcium nitrate.

Calculate the mass of this amount of calcium nitrate.

(2)

(d) Sodium carbonate solution is used as the reagent in Reaction **3**.

Write a chemical equation for the reaction and state **one** observation that can be made.

Equation .....

Observation .....

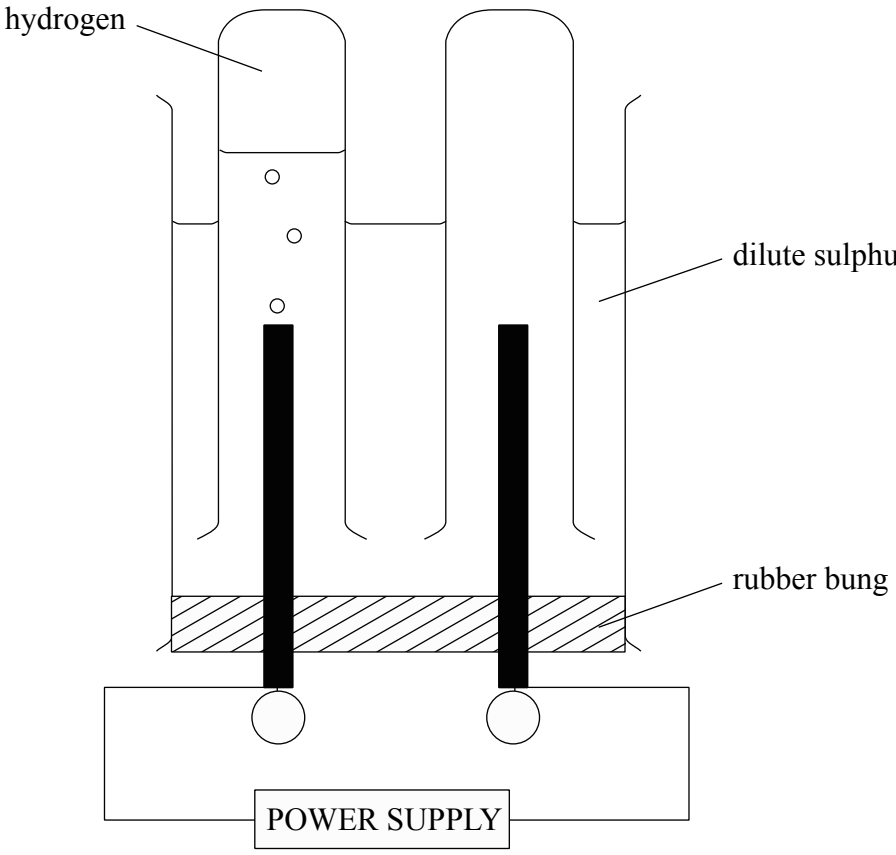
(3)

Q10

(Total 12 marks)

Leave blank

11. The diagram shows apparatus that can be used to electrolyse dilute sulphuric acid.



(a) (i) Label the electrodes in the diagram by writing the symbols + and – in the circles.

(1)

(ii) The equations for the reactions occurring at the electrodes are

Equation **1** $2H^+(aq) + 2e^- \rightarrow H_2(g)$

Equation **2** $4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$

Give the formula of the species being reduced.
Give a reason for your choice.

Species .....

Reason .....

.....

(2)

Leave blank

(iii) The volume of hydrogen gas collected after a few minutes is shown on the diagram.

Draw another line on the diagram to show the volume of oxygen gas collected after the same length of time.
Explain your choice with reference to Equations **1** and **2**.

.....

.....

.....

(3)

(b) In one experiment, the amount of charge passed was 0.40 faraday.

(i) Calculate the amount, in moles, of hydrogen gas formed.

(1)

(ii) Calculate the volume, in dm^3, of this amount of hydrogen gas at room temperature and pressure (rtp).
(Molar volume of any gas = 24 dm^3 at rtp)

(2)

(c) In a second experiment, the amount of charge passed was 0.80 faraday.

(i) Calculate the amount, in moles, of oxygen formed.

(1)

(ii) Calculate the mass, in g, of oxygen formed.

(2) **Q11**

(Total 12 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

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