Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	4	3	7	/	5	H	Signature	

Paper Reference(s)

4437/5H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Science (Double Award)

Chemistry

Paper 5H

Higher Tier

Tuesday 6 November 2007 – Morning

Time: 1 hour 30 minutes

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
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 10 questions in this question paper. The total mark for this paper is 90.
There are 16 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

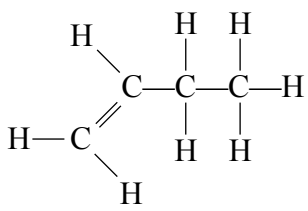
Relative atomic mass
Symbol
Name
Atomic number

Leave blank

SECTION A

1. These are the structures of six hydrocarbons.

A



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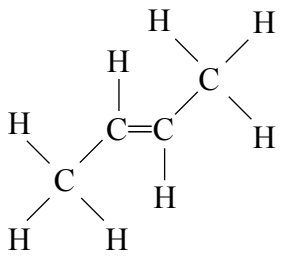

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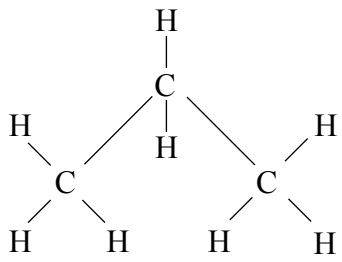

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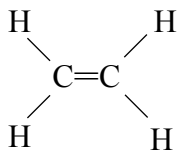

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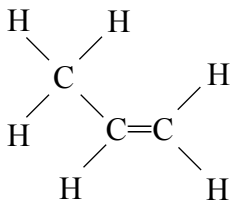

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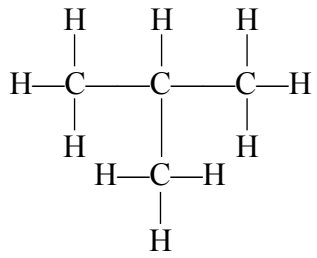


(a) Use the letters of the hydrocarbons to answer these questions.

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

(1)

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

(1)

(b) Hydrocarbon **D** forms a polymer. Draw a diagram to represent the structure of the polymer.

Structure of polymer

(2) **Q1**

(Total 4 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. .....

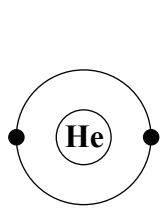
(1)

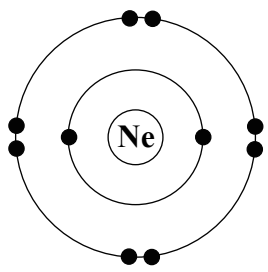
(c) Scientists think they will soon make an element that will go directly below astatine in the Periodic Table. Suggest how many electrons an atom of this element would have in its outer electron shell.

.....

(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.

	Name of metal	Colour of solid metal	Colour of a solution of the metal(II) sulphate
increasing reactivity ↑	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. 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 shell 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) Chlorine exists as two isotopes. Why do these isotopes have identical chemical properties?

.....

(1)

(c) 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) Q4

(Total 7 marks)

TOTAL FOR SECTION A: 30 MARKS

Leave blank

SECTION B

5. This question is about three elements, **X**, **Y** and **Z**, in Period 3 of the Periodic Table.

X bleaches damp red litmus paper.
Y reacts vigorously with water to form hydrogen gas and an alkaline solution.
The oxide of **Z** reacts with both acids and alkalis to form a solution of a salt.

(a) Using the information above, identify elements **X**, **Y** and **Z**.

X is .....

Y is .....

Z is .....

(3)

(b) Which **two** of the elements **X**, **Y** and **Z** form positive ions in their reactions?

.....

(1)

(c) The solution formed when **Y** reacts with water is alkaline.
State the colour of methyl orange in this solution.

.....

(1)

(d) Describe a test to show that the gas formed in the reaction of **Y** with water is hydrogen.

.....

.....

(1)

(e) Complete the chemical equation for the reaction of the oxide of **Z** with sulphuric acid.

.....Z_2O_3 + ...H_2SO_4 ⟶

(2)

Q5

(Total 8 marks)

Leave blank

6. The alkanes are a homologous series of saturated hydrocarbons.

These are the displayed formulae of two alkanes:

(a) What is the general formula of the alkanes?

.....

(1)

(b) State **two** features of the members of a homologous series, other than having the same general formula.

1 .....

.....

2 .....

.....

(2)

(c) Why are alkanes described as **saturated**?

.....

.....

(1)

(d) Ethanol has the molecular formula C_2H_6O.
Why is it not a hydrocarbon?

.....

.....

(1)

Leave blank

(e) Draw the displayed formulae of two isomers which have the molecular formula C_5H_{12}. Give the name of each.

Isomer 1	
Name	

Isomer 2	
Name	

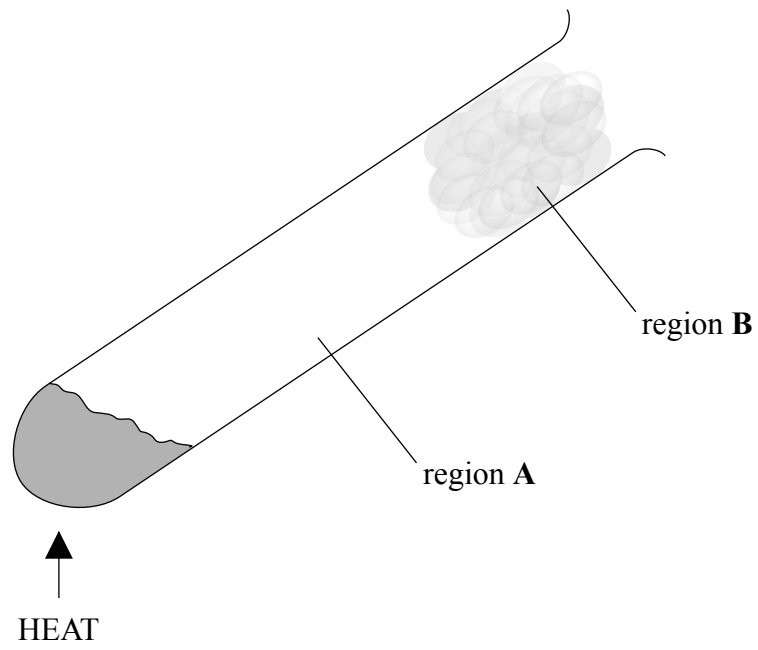
(4) **Q6**

(Total 9 marks)

Leave blank

7. A student carries out some experiments on ammonium chloride, NH_4Cl.

(a) A sample of ammonium chloride is heated gently in a test tube as shown in the diagram.
A reversible reaction occurs.



What are the names of the **two** substances present in the test tube in region **A**?

1 .....

2 .....

(2)

(b) The student removes the white solid from region **B** in the test tube.
She heats some of this solid with aqueous sodium hydroxide and tests the gas given off with damp red litmus paper. The litmus paper turns blue.

(i) Which gas is given off in this reaction?

.....

(1)

(ii) What is the formula of the positive ion present in the white solid?

.....

(1)

(iii) Write the chemical equation for the reaction that occurs when the white solid is heated with aqueous sodium hydroxide.

.....

(2)

Leave blank

(c) The student dissolves some of the white solid in water.
She adds silver nitrate solution and dilute nitric acid. A white precipitate forms.

(i) What is the name of the white precipitate?

.....

(1)

(ii) What is the formula of the negative ion present in the white solid?

.....

(1)

(iii) Complete the chemical equation for the reaction that occurs. Include state symbols.

NH_4Cl(.....) + $AgNO_3$(.....) ⟶

(2)

Q7

(Total 10 marks)

Leave blank

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

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

(a) Give the electronic configuration of

a fluorine atom .....

a fluoride ion.....

(2)

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

(2)

(c) The reaction between magnesium and fluorine is described as a redox reaction because both reduction and oxidation occur.

Identify the substance in the reaction that undergoes reduction and give a reason for your choice.

Substance .....

Reason .....

(2)

(d) Magnesium fluoride is an ionic compound.

Why are the magnesium ions attracted to the fluoride ions?

.....

.....

(1)

Leave blank

(e) Explain why the melting point of fluorine is much lower than that of magnesium fluoride.

.....

.....

.....

(2)

(f) A sample of magnesium contains three isotopes. The percentages of two isotopes are shown in the table.

Isotope	^{24}Mg	^{25}Mg	^{26}Mg
Percentage	78.6	10.1	

(i) Calculate the percentage of ^{26}Mg in the sample.

(1)

(ii) Calculate the relative atomic mass of this sample of magnesium. Give your answer to one decimal place.

(2) **Q8**

(Total 12 marks)

Leave blank

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

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

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) 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 14 marks)

PLEASE TURN OVER FOR QUESTION 10

Leave blank

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

$$K_2O \xrightarrow{\text{Reaction } \mathbf{1}} KOH \xrightarrow{\text{Reaction } \mathbf{2}} KNO_3$$

The chemical equation for Reaction **1** is

$$K_2O + H_2O \rightarrow 2KOH$$

(a) Give the name of a reagent that can be added to potassium hydroxide in Reaction **2** and write a chemical equation for the reaction.

Name .....

Equation .....

(2)

(b) An 18.8 g sample of potassium oxide, K_2O, is used in Reaction **1**.

(i) Calculate the relative formula mass of

K_2O .....

KOH .....

(2)

(ii) Calculate the maximum mass, in g, of potassium hydroxide, KOH, that can be formed from 18.8 g of potassium oxide, K_2O.

(2)

(c) A student carries out similar reactions involving rubidium compounds.
When rubidium hydroxide reacts with hydrochloric acid the products are rubidium chloride and water. Write a chemical equation for this reaction.

.....

(1)

Q10

(Total 7 marks)

TOTAL FOR SECTION B: 60 MARKS

TOTAL FOR PAPER: 90 MARKS

END