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

Wednesday 17 June 2009 – Morning

Time: 2 hours

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.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer ALL the questions. Writer your answers in the spaces provided in this question paper.
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 total mark for this paper is 120. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 10 questions in this question paper.
There are 24 pages in this question paper. Any 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					Group						3	4	5	6	7	0
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. The pictures show some uses of metals.

a coating to prevent rusting	aircraft bodies	electrical wiring	railway tracks
			

Complete the table.

Use	Name of metal with this use	Property on which the use depends
a coating to prevent rusting		
aircraft bodies		
electrical wiring		
railway tracks		

(Total 8 marks)

Q1

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2. Use the Periodic Table on page 2 to help you answer this question.

(a) Identify the most reactive metallic element in the Periodic Table.

.....

(1)

(b) Give the formula of the compound formed between sodium and the most reactive element in Group 7.

.....

(1)

(c) All of the metals in Group 1 react with water. There are similarities between the reactions. Put a cross (☒) in **three** boxes to show which statements apply to the reactions of **all** Group 1 metals with water.

a flame is seen	☒
a solution of the metal hydroxide is formed	☒
a solution of the metal oxide is formed	☒
carbon dioxide is formed	☒
hydrogen is formed	☒
the metal sinks	☒
the solution formed is acidic	☒
the solution formed is alkaline	☒

(3)

(d) The elements in Group 0 were originally thought to be totally unreactive. However, in 1962 the first compound of xenon was made but it was not until 2000 that the first compound of argon was made.

What does this order of discovery suggest about the trend in reactivity of the elements in Group 0?

.....

.....

.....

(1)

(Total 6 marks)

Q2

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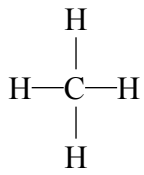
3. Methane, CH_4, is an organic compound. It is the first member of an homologous series of **saturated hydrocarbons**.
The displayed formula of methane is



(a) What is meant by the term **hydrocarbon**?

.....

.....

.....

(2)

(b) What is meant by the term **saturated**?

.....

.....

(1)

(c) Name the homologous series of which methane is the first member.

.....

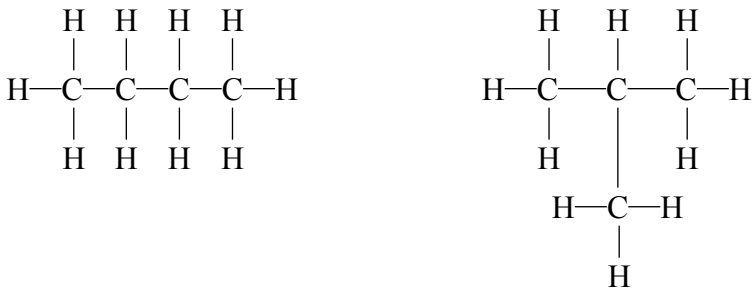
(1)

(d) Draw the displayed formula of the second member of this homologous series.

(2)

Leave blank

(e) The displayed formulae of two other organic compounds are



(i) What is the molecular formula of these two compounds?

.....

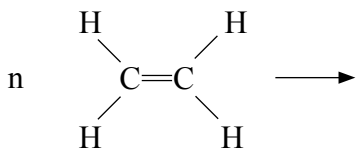
(1)

(ii) What name is given to compounds that have the same molecular formula but different displayed formulae?

.....

(1)

(f) Some other organic compounds are used to make polymers.
Poly(ethene) is an addition polymer made from many identical monomer molecules.
Complete the following equation to show the formation of poly(ethene).



(2)

(g) Nylon is another example of a polymer.

(i) What type of polymer is nylon?

.....

(1)

(ii) Put a cross (☒) in the **two** boxes to show the types of monomers used in the manufacture of nylon.

alcohol ☒

alkene ☒

diamine ☒

dicarboxylic acid ☒

(2)

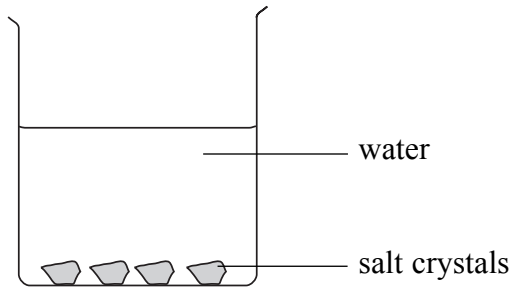
(Total 13 marks)

Q3

Turn over

Leave blank

4. A few crystals of a green salt are placed in a beaker of cold water. The crystals start to dissolve.



(a) Describe how the appearance of the contents of the beaker change over a period of time.

.....

.....

.....

.....

(2)

(b) Name the process that occurs after the crystals dissolve.

.....

(1)

(c) How will the results of the experiment differ if hot water is used in place of cold water? Explain your answer.

Difference .....

.....

Explanation .....

.....

(2)

(d) A sample of the solution is removed from the beaker. Describe a test, and its result, that would show the sample contains ammonium ions.

Test .....

.....

Result .....

.....

(3)

Q4

(Total 8 marks)

Leave blank

5. One way of obtaining the metal copper is by heating copper(I) sulphide in air. The equation for the reaction is

$$Cu_2S + O_2 \rightarrow 2Cu + SO_2$$

(a) Explain why this reaction could be described as the oxidation of sulphur.

.....

.....

(1)

(b) The sulphur dioxide produced reacts with water to form a single product. This product is an acid.

(i) Write a chemical equation for the reaction of sulphur dioxide with water.

.....

(1)

(ii) Identify the ion in the product which causes it to be acidic.

.....

(1)

(iii) Name a substance that could be added to confirm the presence of this ion. What would be seen if this ion were present?

Substance added .....

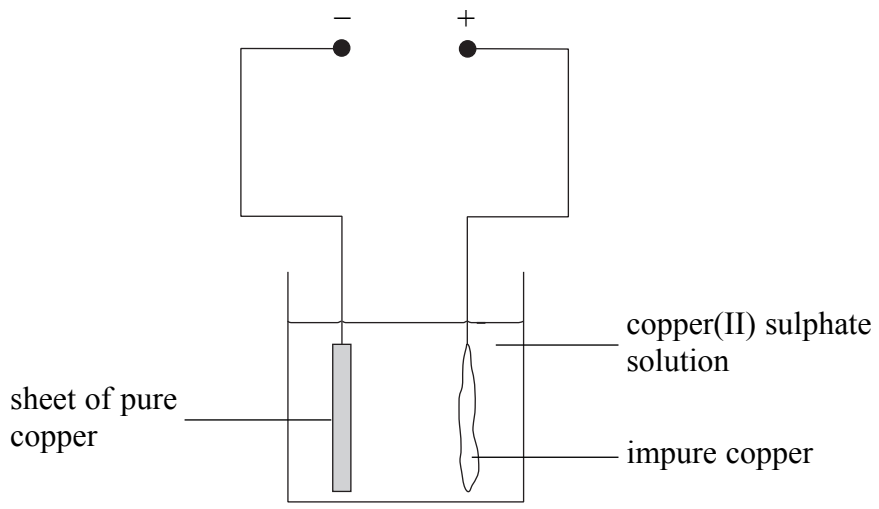
What would be seen .....

.....

(2)

Leave blank

(c) Impure copper can be purified using the circuit shown:



The equation for the reaction at the positive electrode is

$$Cu \rightarrow Cu^{2+} + 2e^{-}$$

The equation for the reaction at the negative electrode is

$$Cu^{2+} + 2e^{-} \rightarrow Cu$$

What happens to the mass of the sheet of pure copper as the reactions occur? Explain your answer.

.....

.....

.....

(2)

Leave blank

(d) Copper forms when magnesium reacts with copper(II) nitrate solution. The ionic equation for the reaction is

$$Cu^{2+}(aq) + Mg(s) \rightarrow Cu(s) + Mg^{2+}(aq)$$

(i) What does this reaction indicate about the reactivity of copper?

.....

(1)

(ii) Describe the colour change of the solution if an excess of magnesium is added.

Colour at start .....

Colour at finish .....

(2)

Q5

(Total 10 marks)

TOTAL FOR SECTION A: 45 MARKS

Leave blank

SECTION B

6. Alkenes are unsaturated hydrocarbons.

(a) State the general formula of all alkenes.

.....

(1)

(b) Draw the displayed formula of ethene.

(1)

(c) Alkenes can be shown to be unsaturated using bromine water. Describe the colour change that occurs when an alkene reacts with bromine water.

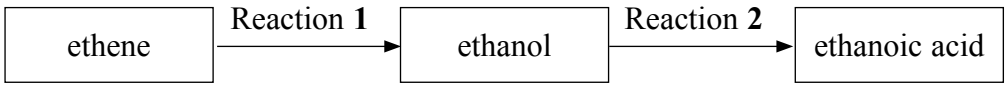
.....

.....

(2)

Leave blank

(d) Ethene is the starting material in the following sequence of reactions.



(i) State the other reagent, the catalyst, and one other condition used in Reaction **1**.

Reagent .....

Catalyst .....

Condition .....

(3)

(ii) The reagents used in Reaction **2** are potassium dichromate(VI) and dilute sulphuric acid. State the type of reaction that occurs.

.....

(1)

(iii) Ethanoic acid, CH_3COOH, and ethanol, CH_3CH_2OH, react together to form ethyl ethanoate.
Give the structural formula of ethyl ethanoate and name the homologous series to which it belongs.

Structural formula

Name of homologous series .....

(2)

(Total 10 marks)

Q6

Turn over

Leave blank

7. Ammonia is manufactured by the Haber process, in which nitrogen and hydrogen react together in a reversible reaction.

(a) (i) State the raw material from which each element is obtained.

Nitrogen .....

Hydrogen .....

(2)

(ii) Write a chemical equation for the reaction between nitrogen and hydrogen.

.....

(2)

(b) Typical conditions used in the Haber process are a temperature of 450 °C and a pressure of 200 atm.

Complete the table to show what would happen to the rate of reaction and the yield of ammonia if the conditions were changed as shown. Choose from these responses:

decreased	**increased**	**no change**

	Temperature changed to 600 °C	**Pressure changed to 100 atm**	**Iron catalyst added**
Rate of reaction			
Yield of ammonia			no change

(5)

(c) (i) Describe how the ammonia is separated from the unreacted nitrogen and hydrogen gases.

.....

.....

.....

.....

(2)

(ii) State what happens to the unreacted nitrogen and hydrogen gases.

.....

.....

(1)

Leave blank

(d) Ammonia and sulphuric acid react together to make a compound used in fertilisers.

(i) Name the compound formed when ammonia and sulphuric acid react together, and write a chemical equation for the reaction that occurs.

Name .....

Equation .....

.....

(3)

(ii) State the type of reaction occurring.

.....

(1)

Q7

(Total 16 marks)

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8. (a) The combustion of hydrogen gives out a lot of heat. What term is used to describe reactions that give out heat?

.....

(1)

(b) The atoms in a molecule of hydrogen are joined by a strong covalent bond.

What is a covalent bond?

.....

.....

.....

(2)

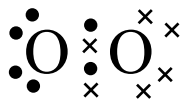
(c) Explain why hydrogen is a gas at room temperature.

.....

.....

(2)

(d) A molecule of oxygen can be represented by a dot and cross diagram:



Draw a dot and cross diagram, showing only the outer electrons, to represent a molecule of water.

(2)

Leave blank

(e) The equation for the combustion of hydrogen is

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

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

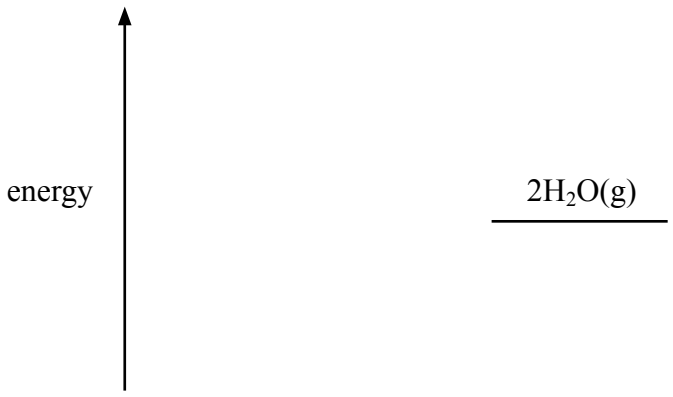
Bond	H—H	O═O	O—H
Dissociation energy (kJ/mol)	436	496	463

Use the values in the table to calculate the energy change for the combustion of hydrogen.

(3)

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

Complete the diagram by inserting the reactants.



(1)

Leave blank

(g) On cooling, the $H_2O(g)$ produced in the combustion of hydrogen is converted into $H_2O(l)$.

Describe how the speed of, and the distance between, the particles change during this conversion.

Speed of particles .....

.....

Distance between particles .....

.....

(2)

(h) When water is added to white anhydrous copper(II) sulphate, blue hydrated copper(II) sulphate is formed.

Write a chemical equation for the reaction that occurs. Include state symbols in the equation.

.....

.....

(3)

Q8

(Total 16 marks)

Leave blank

9. A sample of copper contains two isotopes.

(a) What are isotopes?

.....

.....

(2)

(b) (i) Complete the table for these isotopes of copper.

Atomic number	Mass number	Number of protons	Number of neutrons	Percentage of each isotope in sample
29	63			69
		29	36	31

(3)

(ii) Use information from the table to calculate the relative atomic mass of this sample of copper. Give your answer to one decimal place.

(2)

(c) Identify the element, and its mass number, which is used in the definition of relative atomic mass.

.....

(2)

(d) Why do the two isotopes of copper have the same chemical properties?

.....

.....

.....

(1)

Leave blank

(e) Copper is a transition metal. State two properties of copper or its compounds that are typical of transition metals but not of other metals.

1 .....

2 .....

(2)

(f) Two reactions involving copper compounds are shown in this sequence:

copper(II) carbonate $\xrightarrow{\text{Reaction } \mathbf{1}}$ copper(II) oxide $\xrightarrow{\text{Reaction } \mathbf{2}}$ copper(II) chloride

(i) Reaction **1** occurs when copper(II) carbonate is heated. Carbon dioxide is the other product of this reaction.

Describe the colour change seen and write a chemical equation for the reaction. Include state symbols in the equation.

Colour change .....

Chemical equation .....

.....

(4)

(ii) The other substance needed for Reaction **2** is dilute hydrochloric acid. Write the chemical equation for Reaction **2**.

.....

.....

(3)

(g) Give the formula of another oxide of copper.

.....

(1)

Q9

(Total 20 marks)

Leave blank

10. Calcium sulphate can be prepared using a precipitation reaction between calcium chloride solution and dilute sulphuric acid.

$$CaCl_2(aq) + H_2SO_4(aq) \rightarrow CaSO_4(s) + 2HCl(aq)$$

(a) State three steps needed to produce a pure dry sample of calcium sulphate from the mixture formed in this reaction.

Step 1 .....

Step 2 .....

Step 3 .....

(3)

(b) A 5.55 g sample of calcium chloride ($M_r = 111$) is dissolved in water to make a solution.

(i) Calculate the amount, in moles, in the sample of calcium chloride.

.....

.....

.....

(2)

(ii) What amount, in moles, of sulphuric acid is needed to react completely with the calcium chloride solution?

.....

.....

(1)

(iii) Calculate the relative formula mass of calcium sulphate. Use data from the Periodic Table on page 2.

.....

.....

(1)

(iv) Calculate the mass, in grams, of calcium sulphate formed.

.....

.....

.....

(2)

Leave blank

(c) The following equation represents a reaction used to prepare the salt lead(II) nitrate.

$$PbCO_3(s) + 2HNO_3(aq) \rightarrow Pb(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$

In this experiment the amount of nitric acid used was 0.0400 mol.

(i) The concentration of the dilute nitric acid used was 0.500 mol dm^{-3}. Calculate the volume, in cm^3, of dilute nitric acid used.

(3)

(ii) In this experiment, 0.0200 mol of carbon dioxide gas was produced. Calculate the volume, in cm^3, that this amount of carbon dioxide occupies at room temperature and pressure (rtp).
(molar volume of any gas = 24 000 cm^3 at rtp)

(1) **Q10**

(Total 13 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

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