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 9 June 2010 – Afternoon

Time: 2 hours

Question Number	Leave Blank
1	
2	
3	
4	
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8	
9	
10	
11	
12	
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. Write 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 12 questions in this question paper.
There are 28 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							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

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SECTION A

1. Calcium and sodium are both reactive metals.
A small piece of each metal is added to separate troughs of water.
The metals react with water as shown in these equations:

calcium + water → compound **A** + gas **X**

sodium + water → compound **B** + gas **X**

(a) (i) State one observation that would be the same during both reactions.

.....

.....

(1)

(ii) State one observation that could be made during the reaction between sodium and water, but not during the reaction between calcium and water.

.....

.....

(1)

(b) (i) What is the **name** of compound **A**?

.....

(1)

(ii) What is the **formula** of compound **B**?

.....

(1)

(c) Identify gas **X** and describe a test, and the result, for this gas.

Identity of **X** .....

Test .....

.....

(2)

Leave blank

(d) (i) State the colour of universal indicator in a solution of compound **B**.
Which ion causes universal indicator to turn this colour?

Colour of universal indicator .....

Ion .....

(2)

(ii) What colour does compound **B** give in a flame test?

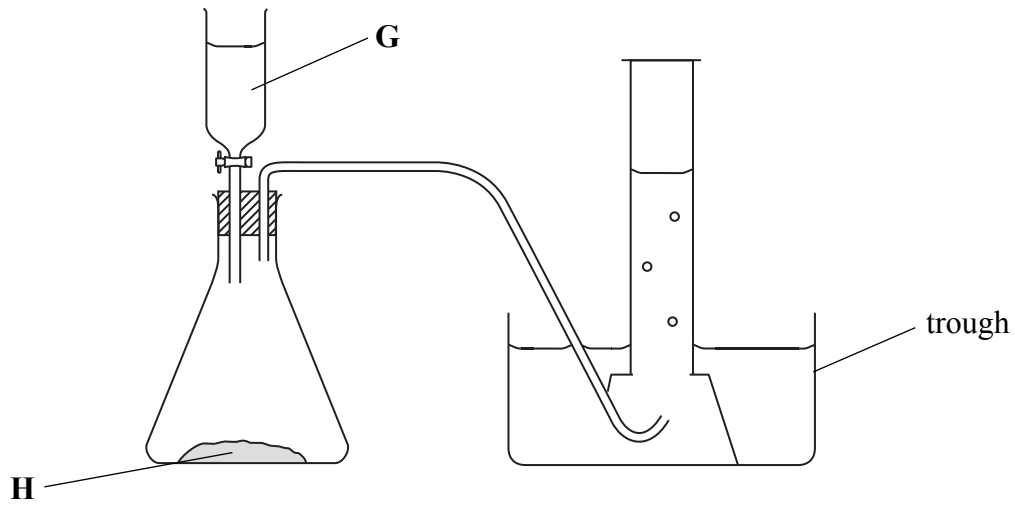
.....

(1) **Q1**

(Total 9 marks)

Leave blank

2. The diagram shows apparatus for preparing oxygen gas in the laboratory using a colourless solution **G** and a black powder **H**.



(a) **Name** the substances **G** and **H**.

G .....

H .....

(2)

(b) The diagram shows oxygen gas being collected over water.
Suggest one other way to collect the gas.

.....

.....

(1)

(c) Substance **H** is unchanged at the end of the reaction.
What is the role of **H** in the reaction?

.....

(1)

Leave blank

(d) Solution **G** is used in the restoration of old paintings. It makes them lighter by converting black lead(II) sulphide in the paints into white lead(II) sulphate. The chemical equation for this reaction is

$$PbS(.....) + 4H_2O_2(.....) \rightarrow PbSO_4(.....) + 4H_2O(.....)$$

(i) Complete the equation by writing a state symbol after each formula.

(2)

(ii) The reaction is a redox reaction because both reduction and oxidation occur. Identify the substance that is oxidised in the reaction, giving a reason for your choice.

Substance oxidised .....

Reason .....

(2)

(e) Some sulphur is burned in a gas jar of oxygen. The gas formed is sulphur dioxide. The sulphur dioxide is tested with damp blue litmus paper and with filter paper soaked in potassium dichromate(VI) solution.

(i) Write a chemical equation for the reaction between sulphur and oxygen.

.....

(1)

(ii) The damp litmus paper turns red when placed in the sulphur dioxide.
What does this indicate about sulphur dioxide?

.....

(1)

(iii) The potassium dichromate(VI) paper changes colour when placed in the sulphur dioxide.
State the colour change observed.

Starting colour .....

Final colour .....

(2)

(Total 12 marks)

Q2

Leave blank

3. The reaction between magnesium and chlorine forms the ionic compound magnesium chloride, $MgCl_2$.

(a) By reference to electrons, describe how magnesium and chlorine atoms form magnesium chloride.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Oxidation occurs in this reaction.

Identify the substance that is oxidised in the reaction, giving a reason for your choice.

Substance oxidised .....

Reason.....

.....

(2)

(c) Explain why magnesium chloride has a high melting point.

.....

.....

.....

.....

.....

.....

.....

(3) **Q3**

(Total 8 marks)

BLANK PAGE

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4. Crude oil is a mixture of many different compounds.

(a) During industrial refining, crude oil is first separated into fractions.

(i) What is the name of the process used to obtain fractions from crude oil?

.....

(1)

(ii) Describe how the fractions are obtained.

.....

.....

.....

.....

.....

.....

(4)

(b) Four of the fractions obtained from crude oil are:

bitumen
diesel
gasoline
kerosene

(i) Which of these four fractions is the most viscous?

.....

(1)

(ii) Which of these four fractions is the most volatile?

.....

(1)

(iii) Which of these four fractions is used in making roads?

.....

(1)

(iv) Name two other fractions obtained from crude oil.

1 .....

2 .....

(2)

Leave blank

(c) Octane is a hydrocarbon in the gasoline fraction.

Write the names of the substances in the word equation for the complete combustion of octane.

octane + ... → ..... + ...

(3)

(d) Octane belongs to a homologous series called the alkanes.
One characteristic of a homologous series is that each member of the series has the same general formula.

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

.....

(1)

(ii) State two other characteristics of a homologous series.

1 .....

.....

2 .....

.....

(2)

Q4

(Total 16 marks)

TOTAL FOR SECTION A: 45 MARKS

Leave blank

SECTION B

5. (a) What is meant by the term **atomic number**?

.....

.....

(1)

(b) (i) What name is given to two atoms of the same element that contain different numbers of neutrons?

.....

(1)

(ii) Complete the table about two atoms of argon.

Number of protons in an atom	Number of electrons in an atom	Number of neutrons in an atom	Mass number
18	18	20	
			40

(4)

(iii) Explain why argon is chemically unreactive.

.....

.....

.....

(1)

Leave blank

(c) (i) In a sample of copper, 69.1% of the atoms have a mass number of 63 and the remainder have a mass number of 65.
Use this information to calculate the relative atomic mass of copper. Give your answer to 3 significant figures.

(3)

(ii) Explain why copper atoms with different numbers of neutrons have identical chemical properties.

.....

.....

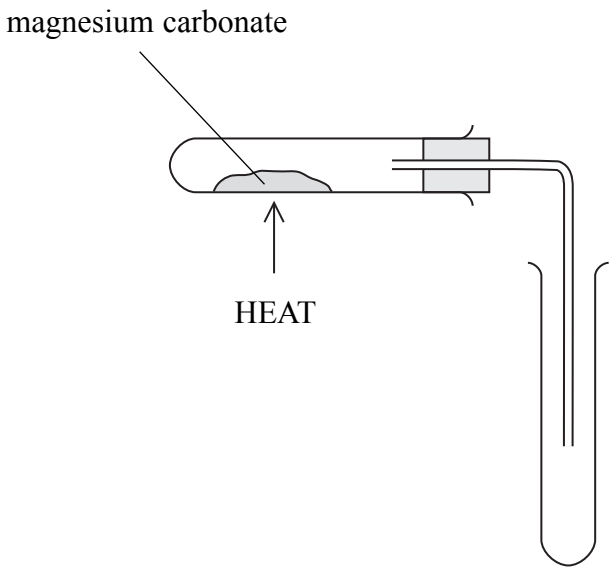
(1)

Q5

(Total 11 marks)

Leave blank

6. Magnesium carbonate undergoes thermal decomposition in a similar way to calcium carbonate.



(a) Write a chemical equation for the thermal decomposition of magnesium carbonate.

.....

(2)

(b) Magnesium carbonate can be made as a precipitate by reacting together solutions of two soluble salts.

(i) **Name** two suitable soluble salts.

.....

.....

(2)

(ii) Write a chemical equation for the reaction.

.....

.....

.....

(2)

Leave blank

(iii) Describe how you would obtain a pure, dry, sample of the magnesium carbonate formed in this reaction.

.....

.....

.....

.....

.....

.....

.....

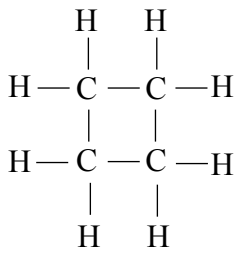
(3)

Q6

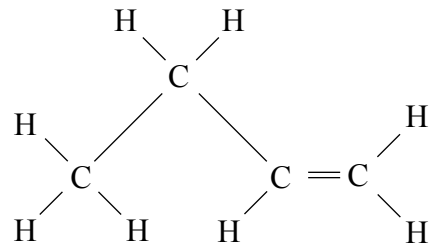
(Total 9 marks)

Leave blank

7. **A** and **B** are two hydrocarbons with the molecular formula C_4H_8.
Their structures are:



A



B

(a) Describe a chemical test to distinguish between hydrocarbons **A** and **B**.
Give the result you would expect for each hydrocarbon.

Test .....

Result with **A** .....

Result with **B** .....

(3)

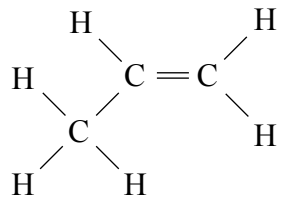
(b) To which homologous series does **B** belong?

.....

(1)

Leave blank

(c) Hydrocarbon **C** belongs to the same homologous series as **B**. It has the structure:



C

C forms an addition polymer. Draw the repeat unit of this polymer.

(2)

(d) Give the name of the addition polymer formed by **C**.

.....

(1)

Q7

(Total 7 marks)

Leave blank

8. The table gives some information about two metals and their compounds.

Substance	Colour of solid	Solubility in water	Colour of solution
copper	brown	insoluble	not applicable
copper(II) sulphate	blue	soluble	blue
zinc	grey	insoluble	not applicable
zinc sulphate	white	soluble	colourless

(a) When zinc is added to copper(II) sulphate solution a displacement reaction takes place.

(i) Write a chemical equation for the displacement reaction.

.....

.....

(2)

(ii) What does this reaction suggest about the reactivity of copper compared to zinc?

.....

.....

(1)

(iii) Use the information in the table to describe what you would expect to see during the reaction.

.....

.....

.....

.....

(2)

Leave blank

(b) Iron rusts when exposed to air and water.

Ships are often prevented from rusting by attaching zinc blocks to their hulls.

(i) Give the name of this method of preventing rusting.

.....

(1)

(ii) Explain how the zinc blocks prevent rusting.

.....

.....

.....

(2)

(iii) Suggest why attaching copper blocks to the hulls of ships would not prevent them from rusting.

.....

.....

(1)

Q8

(Total 9 marks)

Leave blank

9. Phosphorus(V) chloride, PCl_5, reacts with water to form hydrogen chloride gas and phosphoric acid, H_3PO_4.

(a) Write the chemical equation for this reaction.

.....

.....

(2)

(b) State and explain the colour change seen when hydrogen chloride gas is bubbled into water containing universal indicator.

.....

.....

.....

.....

(3)

(c) (i) A hydrogen chloride molecule contains a covalent bond.

Draw a dot and cross diagram to show the electrons in this molecule.
Show only the outer electrons of each atom.

(2)

(ii) How does the covalent bond hold the hydrogen and chlorine atoms together?

.....

.....

.....

(2)

Leave blank

(d) Hydrogen chloride is a gas at room temperature.

Explain why hydrogen chloride has a low boiling point.

.....

.....

.....

(2)

(e) The reaction between dilute phosphoric acid and sodium hydroxide solution is represented by the equation

$$H_3PO_4 + 3NaOH \rightarrow Na_3PO_4 + 3H_2O$$

A sample of sodium hydroxide solution was titrated against dilute phosphoric acid. It was found that 25.0 cm^3 of sodium hydroxide solution was neutralised by 12.30 cm^3 of phosphoric acid of concentration 0.150 mol dm^{-3}.

(i) Calculate the amount, in moles, of phosphoric acid used in the titration.

(2)

(ii) Calculate the amount, in moles, of sodium hydroxide that would react with this amount of phosphoric acid.

(1)

(iii) Calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution.

(2) **Q9**

(Total 16 marks)

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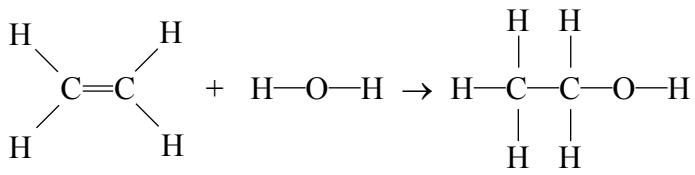
10. One industrial process for making ethanol involves reacting ethene with steam.



(a) Identify the catalyst and one other condition used for this reaction.

.....

.....

.....

(2)

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

Bond	C—C	C═C	C—H	C—O	O—H
Dissociation energy (kJ/mol)	348	612	412	360	463

Use these values to calculate:

(i) The energy required, in kJ/mol, to break the bonds in the reactants.

(1)

(ii) The energy given out, in kJ/mol, when the bonds in the product are formed.

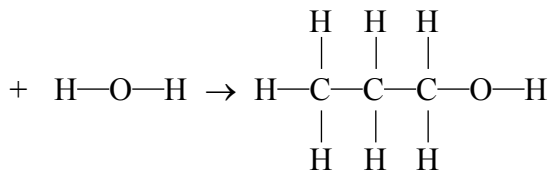
(1)

Leave blank

(iii) The enthalpy change, in kJ/mol, for this reaction.

(1)

(c) Other alkenes react with steam in a similar way to ethene.
Complete the following equation by drawing the structure of the missing reactant.



(1) **Q10**

(Total 6 marks)

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11. (a) Copper(II) carbonate reacts with dilute hydrochloric acid.
The equation for the reaction is

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$

An excess of copper(II) carbonate was added to a solution containing 0.200 mol of hydrochloric acid.

(i) Calculate the amount, in moles, of copper(II) carbonate that will react with 0.200 mol of hydrochloric acid.

(1)

(ii) Calculate the mass, in grams, of this amount of copper(II) carbonate.

(2)

(iii) Calculate the volume of carbon dioxide gas at room temperature and atmospheric pressure that will be formed in this reaction.
(The volume of 1 mol of any gas at room temperature and atmospheric pressure is 24 dm^3).

(2)

(b) Describe what is seen when excess ammonia solution is added gradually to copper(II) chloride solution. Give the formula of the complex ion formed.

.....

.....

.....

.....

(3)

Q11

(Total 8 marks)

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12. Chlorine is manufactured industrially by the electrolysis of concentrated sodium chloride solution in a diaphragm cell.
Hydrogen is formed at the negative electrode (cathode).
Chlorine is formed at the positive electrode (anode).

(a) Both electrodes are made from metal.
Describe the structure of a metal and explain why metals are able to conduct electricity.

.....

.....

.....

.....

.....

(3)

(b) (i) The negative electrode is made of steel (iron).

Suggest why steel is not suitable for making the positive electrode.

.....

.....

(1)

(ii) Identify the metal from which the positive electrode is made.

.....

(1)

Leave blank

(c) The equation for the reaction at the positive electrode is

$$2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$$

A diaphragm cell was operated using a current of 100 000 A.

(i) Calculate the charge, in coulombs, passing in 2 minutes.

(2)

(ii) Calculate the amount, in moles, of chlorine molecules produced in 2 minutes. (One faraday is 96 000 coulombs).

(2) **Q12**

(Total 9 marks)

TOTAL FOR SECTION B: 75 MARKS

TOTAL FOR PAPER: 120 MARKS

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