Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						7	0	8	1	/	0	2	Signature	

Paper Reference(s)

7081/02

Examiner's use only

Team Leader's use only

London Examinations GCE

Chemistry

Ordinary Level

Paper 2

Friday 22 May 2009 – Morning

Time: 2 hours

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
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, initial(s) and signature.
The paper is arranged in TWO sections, A and B.
In Section A, answer ALL the questions in the spaces provided in this question paper.
In Section B, answer TWO questions in the spaces provided in this question paper.
Indicate which question you are answering by marking the box (☒). If you change your mind, put a line through the box (~~☒~~) and then indicate your new question with a cross (☒).

Information for Candidates

A Periodic Table is printed on the back cover of this question paper.
Calculators may be used.
The total mark for this paper is 100. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper. All blank pages are indicated.

DATA

One mole of any gas occupies 24 000 cm^3 at room temperature and atmospheric pressure.
One mole of electrons carries a charge of 96 500 coulombs or 1 faraday.

Advice to Candidates

Write your answers neatly and in good English.
In calculations, show **all** the steps in your working.

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SECTION A

Answer ALL the questions in this section.

There is useful data on the front cover and a Periodic Table is printed on the back cover of this question paper.

1. (a) Complete the following table for salt preparations.

Name of salt	Names of reactants	Other product(s)
copper(II) nitrate	copper(II) carbonate and	
barium sulphate	barium nitrate and	
anhydrous iron(II) chloride	iron and	

(6)

(b) In a displacement reaction, 1.30 g of a metal, **M**, was reacted with excess aqueous silver nitrate. After removing, washing and drying, the silver produced was found to weigh 4.32 g.

The equation for the reaction is

$$M(s) + 2AgNO_3(aq) \rightarrow M(NO_3)_2(aq) + 2Ag(s)$$

(i) Explain why the silver must be washed.

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(1)

(ii) Calculate the relative atomic mass of M.

Moles of silver produced: .....

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Moles of M reacting: .....

Relative atomic mass of M: .....

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(3)

Q1

(Total 10 marks)

Leave blank

2. A student was asked to analyse an aqueous mixture of copper(II) sulphate and ammonium bromide.

(a) The student added aqueous sodium hydroxide to the aqueous mixture, warmed it and held a piece of red litmus to the mouth of the test tube.

Give TWO observations that would be made and identify the product responsible for each observation.

First observation: .....

Product: .....

Second observation: .....

Product: .....

(4)

(b) Give a test that the student could use, and the result, to confirm the presence of the sulphate ion in the mixture.

Test: .....

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Result: .....

(3)

(c) Give a test that the student could use, and the result, to confirm the presence of the bromide ion in the mixture.

Test: .....

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Result: .....

(3)

(Total 10 marks)

Q2

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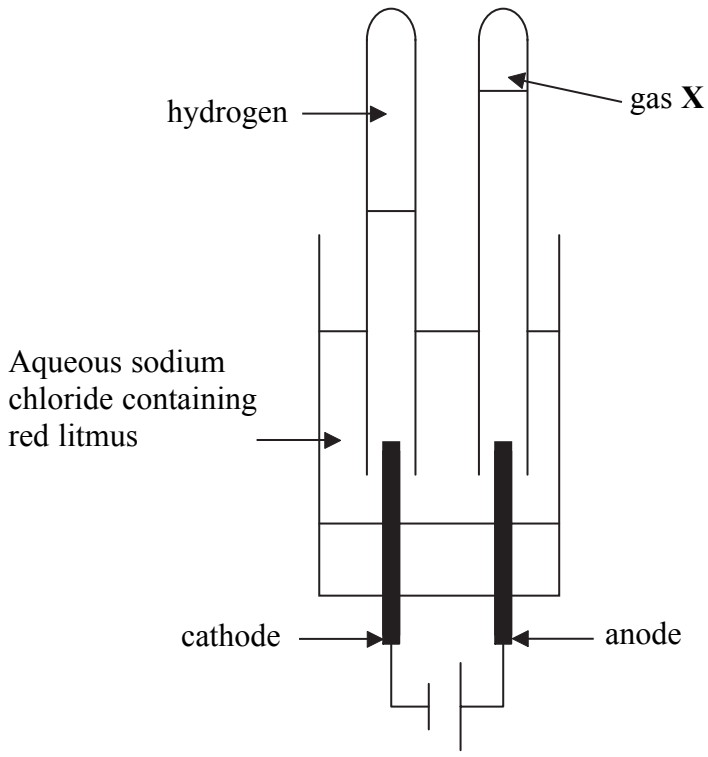
3. (a) Aqueous sodium chloride can be electrolysed using carbon electrodes in the cell shown below.



(i) Hydrogen was evolved at the cathode and the red litmus around the electrode turned blue.

Write an ionic equation for the formation of hydrogen and explain why the litmus turned blue. Give a test to show that the gas is hydrogen.

Equation: .....

Explanation: .....

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Test for hydrogen: .....

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(4)

(ii) The red litmus around the anode turned colourless. Identify gas **X** and write an ionic equation for its formation.

Gas: .....

Equation: .....

(2)

Leave blank

(b) An article to be copper plated is made the cathode in an electrolytic cell consisting of aqueous copper(II) sulphate and a copper anode.

(i) Complete the equations for the reactions at the cathode and anode; include state symbols.

Cathode: $Cu^{2+}(aq)$ + ... → .....

Anode: $Cu(s)$ → ..... + ...

(2)

(ii) Calculate the mass of copper produced by the passage of a charge of 20 faradays.

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(2)

Q3

(Total 10 marks)

Leave blank

4. (a) An organic compound **P** has the following percentage composition by mass:

C = 17.83% H = 2.97% Br = 79.20%

(i) Use the figures to show that the empirical formula of **P** is $C_3H_6Br_2$.

(2)

(ii) What extra information is needed to obtain the molecular formula of **P**?

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(1)

(iii) **P** is obtained when propene reacts with bromine.

Write the equation for the reaction, clearly showing the structures of propene and **P**.

State the type of reaction taking place: .....

Give the observation made during the reaction:

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(4)

Leave blank

(b) When the alkane $C_{10}H_{22}$ is heated to high temperature, it can break down into smaller molecules.

$$C_{10}H_{22} \rightarrow C_7H_{14} + \mathbf{Q} + \mathbf{R}$$

Q is an alkane and **R** is an alkene. Give the formulae of **Q** and **R** and state the type of reaction occurring.

Formula of **Q** .....

Formula of **R** .....

Type of reaction .....

(3)

(Total 10 marks)

Q4

Leave blank

5. (a) (i) Draw a dot and cross diagram to show the outer shell electron arrangement in a molecule of water.

(2)

(ii) Draw a diagram to show the shape of a water molecule, using a line to represent a covalent bond.

(1)

(iii) Give a reason why ice has a low melting point.

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(1)

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(b) Give the particles present in a metal structure and state how a metal conducts electricity.

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(3)

(c) Give the particles present in the structure of sodium chloride and explain why sodium chloride can conduct electricity when molten but not when solid.

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(3)

Q5

(Total 10 marks)

TOTAL FOR SECTION A: 50 MARKS

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SECTION B

Answer TWO questions in this section.

Where appropriate, equations and diagrams should be given to clarify your answer.

If you answer Question 6, put a cross in this box ☒ .

6. (a) Metals are extracted from their ores by reduction processes. The method used depends on the position of the metal in the reactivity series.

(i) Aluminium is extracted by electrolysis from purified bauxite dissolved in a solvent.

Identify the solvent. Write an equation for the formation of aluminium at the cathode. Give **two** reasons why this process is expensive.

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(4)

(ii) Aluminium metal can be used to extract chromium from chromium(III) oxide.

What condition is required to start this reaction? Write an equation and explain why this reaction involves both oxidation and reduction.

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(4)

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(iii) Lead is a metal below iron in the reactivity series and is found as its ore galena, PbS.

Galena can be heated in air to form lead(II) oxide and sulphur dioxide; write an equation for this reaction.

The lead(II) oxide is then reduced to the metal; suggest how this is likely to be done and write an equation for the reaction.

The overall process forms gases that are harmful to the environment. Identify two of the gases and state why each one is considered to be harmful.

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(6)

(b) Iron is a typical transition element. Describe two chemical characteristics of a transition metal, using iron as an example.

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(c) Write an equation for the reaction of iron with each of the following.

(i) Dry chlorine gas.

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(2)

(ii) Steam.

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(2)

(d) Describe a chemical test to distinguish between aqueous solutions containing an iron(II) salt and an iron(III) salt. Give the reagent and the observations made.

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(3)

Q6

(Total 25 marks)

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If you answer Question 7, put a cross in this box ☒ .

7. (a) Hydrogen can be made industrially from steam and methane by the following reactions.

Reaction 1: $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ $\Delta H = +210 \text{ kJ mol}^{-1}$

Reaction 2: $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ $\Delta H = -42 \text{ kJ mol}^{-1}$

(i) Explain the significance of the plus and minus signs before the values of ΔH.

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(2)

(ii) State, with a reason, which reaction would give a higher yield of product at a low temperature. Give **one** disadvantage of using a low temperature in this reaction.

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(2)

(iii) State, with a reason, the effect of an increase in pressure on the yield of product in each reaction.

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(b) Hydrogen and nitrogen can be used to make ammonia. Give **three** conditions that are used in this industrial process.

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(3)

(c) Ammonia is used to make fertilisers such as ammonium nitrate. Write the equation for the reaction of ammonia and nitric acid, HNO_3. Calculate the percentage by mass of nitrogen in ammonium nitrate.

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(4)

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(d) (i) Describe how you would perform a titration to find the concentration, in mol dm^{-3}, of a solution of nitric acid. Give essential practical details including the apparatus used. You are provided with aqueous sodium hydroxide of known concentration and methyl orange indicator.

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(7)

(ii) The equation for the reaction is

$$NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_2O(l)$$

In a titration, 25.0 cm^3 of nitric acid required 22.50 cm^3 of 0.200 mol dm^{-3} sodium hydroxide for neutralisation. Calculate the concentration of the nitric acid in mol dm^{-3}.

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(3)

Q7

(Total 25 marks)

Leave blank

If you answer Question 8, put a cross in this box ☒ .

8. (a) (i) Describe the manufacture of ethanol by the hydrolysis of ethene and write an equation for the reaction.

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(ii) Describe how a pure sample of aqueous ethanol can be obtained by fermentation starting from **glucose**. Write an equation for the reaction.

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(iii) Give **one** advantage and **one** disadvantage of the fermentation method over the hydrolysis method.

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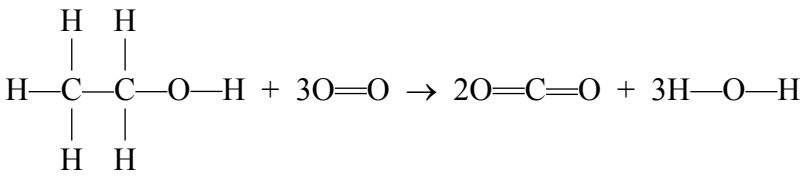
(2)

(b) When ethanol is burnt in oxygen, the reaction represented by the following equation occurs.



Some average bond dissociation energies are given in the table below.

Type of bond	Average bond dissociation energy / kJ mol^{-1}
C—C	350
C—H	410
C—O	360
O—H	460
O=O	495
C=O	745

(i) Calculate the total energy needed to break all the bonds in the reactant molecules.

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(ii) Calculate the total energy released when the bonds are formed in the product molecules.

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(2)

(iii) Hence calculate the enthalpy change ΔH for the combustion of 1 mole of ethanol.

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(2)

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(c) Name and draw the displayed formula of the organic product formed when ethanol reacts with each of the following under suitable conditions.

(i) Phosphorus pentachloride, PCl_5.

(2)

(ii) Ethanoic acid.

(2)

(iii) Concentrated sulphuric acid.

(2) **Q8**

(Total 25 marks)

Leave blank

If you answer Question 9, put a cross in this box ☒ .

9. (a) Use the kinetic theory to explain the following observations. Write equations for any reactions that occur.

(i) Little reaction occurs when an iron bar is heated to 1000 °C whereas iron filings immediately ignite when placed in a Bunsen flame.

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(ii) When hydrogen and oxygen are mixed at room temperature there is no reaction, but if a flame is applied there is a violent explosion.

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(b) Chlorine, bromine and iodine are members of the group of elements called the halogens.

(i) State why these elements have similar chemical properties and explain why the reactivity decreases as the group is descended.

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(ii) State what is observed during the reaction between chlorine and aqueous sodium iodide. Write an ionic equation for the reaction.

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(2)

(iii) State how one physical property of the halogens changes as the group is descended.

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(1)

(iv) Chlorine is prepared in the laboratory by the oxidation of concentrated hydrochloric acid. The chlorine gas is passed through a wash-bottle containing water before being dried and collected.

Identify a suitable oxidising agent and give a reason why the chlorine is passed through water. Give a suitable drying agent and state how the chlorine can then be collected.

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(c) Write equations for the reaction between magnesium and steam and for the reaction between calcium and cold water.

Give **two** observations made when calcium is added to water.

Identify a metal which reacts more vigorously with water than calcium and write an equation for the reaction.

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(8) Q9

(Total 25 marks)

TOTAL FOR SECTION B: 50 MARKS

TOTAL FOR PAPER: 100 MARKS

END

THE PERIODIC TABLE

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

Key

Atomic number
Symbol
Name
Relative atomic mass