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 28 May 2010 – 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) When manganese(IV) oxide is added to concentrated hydrochloric acid, chlorine is formed.

When manganese(IV) oxide is added to aqueous hydrogen peroxide, oxygen is formed.

State the role of manganese(IV) oxide

(i) in the formation of chlorine,

.....

(ii) in the formation of oxygen.

.....

(2)

(b) Give a test to identify

(i) chlorine,

.....

(ii) oxygen.

.....

(2)

(c) A different oxide of manganese has the following composition by mass:

Mn = 69.6% O = 30.4%

Calculate the empirical formula of the oxide of manganese.

(3)

Leave blank

(d) Manganese is a transition metal. Give three chemical characteristics of a typical transition metal that would distinguish it from a non-transition metal.

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(3)

Q1

(Total 10 marks)

Leave blank

2. (a) Methane is the first member of the homologous series of alkanes.

(i) Write the general formula for an alkane.

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(1)

(ii) Draw a diagram to show the shape of a methane molecule, using lines to represent covalent bonds. Name the shape that a methane molecule adopts.

Diagram:

Name of shape: .....

(3)

(iii) State how the chemical properties and a named physical property of members of a homologous series change, if at all, as the molecular mass increases.

Chemical properties: .....

.....

Named physical property: .....

.....

(2)

Leave blank

(b) The formula $C_2H_4Cl_2$ can represent two isomers.

(i) Explain what is meant by **isomers**.

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(1)

(ii) Draw the displayed formulae for the two isomers of $C_2H_4Cl_2$

(2)

(iii) Write the empirical formula for $C_2H_4Cl_2$

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(1)

Q2

(Total 10 marks)

Leave blank

3. A student performed a series of titrations using aqueous sulphuric acid of concentration 0.0500 mol dm^{-3} and a solution of sodium hydroxide of unknown concentration. In each titration, 25.00 cm^3 of sodium hydroxide solution was placed in a conical flask and the volumes of sulphuric acid used are shown in the table.

Titration	**1**	**2**	**3**	**4**
Volume of sulphuric acid used / cm^3	26.80	25.70	25.60	25.65

The equation for the reaction is

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

(a) Name the piece of apparatus that would be used to add the sulphuric acid.

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(1)

(b) Name a suitable indicator for the titration and state the colour change during the neutralisation process.

Indicator:.....

Colour change:.....

(2)

(c) State two precautions that should be taken during the addition of sulphuric acid in order to achieve an accurate result.

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(2)

Leave blank

(d) (i) Suggest a reason why the first titration value is higher than the other values.

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(1)

(ii) Calculate the mean volume of 0.0500 mol dm^{-3} sulphuric acid used in titrations 2, 3 and 4.

(1)

(iii) Use the mean value to calculate the concentration in mol dm^{-3} of the sodium hydroxide solution.

(3)

Q3

(Total 10 marks)

Leave blank

4. (a) The first stage in the manufacture of nitric acid is the catalytic oxidation of ammonia to form nitrogen oxide, NO.

(i) Complete the equation for the reaction.

$4NH_3 + 5O_2 \rightarrow$ ..... + ...

(1)

(ii) Identify the catalyst used.

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(1)

(iii) State the temperature used for the reaction.

.....

(1)

(iv) Explain why no further heating is required once the correct temperature has been reached.

.....

(1)

(b) 0.150 g of nitrogen oxide gas, NO, has a volume of 112 cm^3 at 0 °C and 1 atmosphere pressure. Calculate the volume of one mole of the gas under these conditions.

(3)

(c) The reaction between nitrogen oxide and oxygen is represented by the equation

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

If 200 cm^3 of nitrogen oxide is reacted with excess oxygen, what volume of nitrogen dioxide will be formed, all measurements being taken at the same temperature and pressure?

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(1)

Leave blank

(d) (i) State what is meant by the **Avogadro constant**.

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(1)

(ii) The Avogadro constant is represented as L. Calculate, in terms of L, the number of molecules in 480 cm^3 of nitrogen oxide at room temperature and pressure.

(1)

Q4

(Total 10 marks)

Leave blank

5. (a) The following is a description of the preparation of a pure sample of hydrated cobalt(II) chloride crystals, starting from cobalt(II) oxide and dilute hydrochloric acid.

Some dilute hydrochloric acid was placed in a beaker and heated. Spatula measures of cobalt(II) oxide were added and stirred until there was a small excess of cobalt(II) oxide remaining at the bottom of the beaker. The mixture was filtered and the filtrate was placed in an evaporating basin. The basin was heated until about half the solution had evaporated. The solution was allowed to cool slowly and crystals appeared.

(i) Write the equation for the reaction of cobalt(II) oxide, CoO, and dilute hydrochloric acid.

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(1)

(ii) Why was the mixture warmed?

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(1)

(iii) Why was cobalt(II) oxide added until in excess?

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(1)

(iv) Why was the mixture filtered?

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(1)

(v) Why was the solution evaporated until only half remained?

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(1)

(vi) What was the effect of cooling slowly on the size of the crystals?

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(1)

Leave blank

(vii) What would have happened if the solution had been evaporated until no more water was evolved?

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(1)

(b) The M_r of $CoCl_2.xH_2O$ is 238. Calculate the value of x.

(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) The boiling points and melting points for some gases present in the air are given in the table. This information can be used to separate the components of air in industry.

Gases	Melting point / °C	Boiling point / °C
water vapour	0	100
oxygen	–218	–183
nitrogen	–210	–196
neon	–248	–246

Use the values in the table to answer the following questions.

(i) State what happens to water vapour when the temperature is lowered from room temperature to –10 °C.

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(1)

(ii) In the industrial process, the gases are passed through a series of pipes until the temperature reaches –200 °C.

Why must water vapour be removed before this takes place?

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(1)

Leave blank

(iii) State what happens to the remaining gases when the temperature is lowered to –200 °C. Describe how the gases can then be separated so as to obtain a pure sample of each one.

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(5)

(b) You are given two 100 cm^3 gas syringes that can be connected by a piece of glass tubing, some small pieces of copper and a Bunsen burner.

Describe an experiment to find the percentage by volume of oxygen in the air. State and explain what you would see during the experiment and write an equation for the reaction that occurs.

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(10)

Leave blank

(c) The carbon dioxide content of the atmosphere is increasing as more fossil fuels are burnt.

(i) State what is meant by the term **fuel**.

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(1)

(ii) Write an equation for the complete combustion of octane, C_8H_{18}, in air. Give the name of another gas that would be produced when the burning takes place in a limited supply of air.

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(3)

(iii) A higher amount of carbon dioxide in the atmosphere results in a decrease in the pH of the oceans. Explain how this can happen and write an equation for any reaction that occurs.

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(3)

(iv) Give one other environmental problem caused by an increase in the carbon dioxide content of the atmosphere.

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(1)

Q6

(Total 25 marks)

Leave blank

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

7. (a) Electrolysis is used in industry to obtain many important elements and compounds.

(i) When brine is electrolysed, the products are hydrogen, chlorine and sodium hydroxide. Write equations for the reactions that occur at the electrodes and state why sodium hydroxide is a product of the electrolysis process.

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(3)

(ii) Magnesium is extracted from molten magnesium chloride by electrolysis. Write an equation for the reaction at the cathode and explain why this is a reduction process. Give a reason why magnesium chloride is electrolysed when molten rather than in aqueous solution.

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(3)

Leave blank

(iii) After extraction from its ore, impure copper requires further refining by electrolysis. Describe how this is carried out and write equations for the reactions that occur. Do **not** draw a diagram.

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(5)

(b) Name the gaseous product, give a condition and write an equation for the reaction of hydrogen with chlorine. State the conditions under which the product has acidic properties; explain your answer.

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(5)

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(c) (i) Describe how sodium hydroxide is used in the manufacture of soap from a naturally-occurring ester.

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(4)

(ii) The ester methyl ethanoate has the molecular formula $C_3H_6O_2$. Give the displayed formula of the ester and identify by name the two organic compounds used in the preparation of the ester.

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(3)

(d) Pure copper is used in electrical cables. Explain how copper conducts electricity.

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(2)

Q7

(Total 25 marks)

Leave blank

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

8. Elements can be broadly classified as 'metals' and 'non-metals'.

(a) (i) Give **two** typical **physical** properties of zinc and **two** typical **physical** properties of sulphur to illustrate the difference between a metal and a non-metal.

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(4)

(ii) Describe the reaction, if any, of zinc and of sulphur with aqueous hydrochloric acid. Write an equation for any reaction that occurs.

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(3)

(b) (i) Magnesium has an electron configuration of 2,8,2 and oxygen has an electron configuration of 2,6. Explain in terms of electron transfer how magnesium oxide is formed.

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(7)

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(ii) Explain how two atoms of oxygen can combine to form a molecule. Draw a diagram to show the electron arrangement in the outer shell of the molecule.

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(5)

(iii) Explain why two metals do not combine to form a compound.

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(1)

(c) Explain why the reactivity of metals increases as a group is descended.

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(3)

(d) State which group of non-metals in the Periodic Table is unreactive and explain why this is so.

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(2)

Q8

(Total 25 marks)

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

9. (a) (i) Describe how you would test for the presence of iron(II) ions and sulphate ions in a solution suspected to contain iron(II) sulphate. Write **ionic** equations for the reactions.

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(6)

(ii) Describe how you would test for the presence of ammonium ions and carbonate ions in a solution suspected to contain ammonium carbonate. Write **ionic** equations for the reactions.

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(8)

Leave blank

(b) (i) Compound **P** gave a brick-red colour in a Bunsen flame. Addition of dilute nitric acid followed by aqueous silver nitrate to a solution of **P** gave a yellow precipitate. Give the formulae of the ions present in **P**.

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(2)

(ii) Compound **R** gave a lilac colour in a Bunsen flame. Addition of dilute hydrochloric acid to **R** gave a gas which turned acidified potassium dichromate(VI) from orange to green. Give the formulae of the ions present in **R**.

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(2)

(iii) Compound **T** reacted with magnesium to form a gas which exploded when ignited. Addition of dilute nitric acid followed by aqueous silver nitrate to **T** gave a white precipitate. Give the formulae of the ions present in **T** and write an equation for the reaction between **T** and magnesium.

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(3)

Leave blank

(c) An alkane **X** containing eight carbon atoms was cracked at high temperature to form a compound **Y** containing three carbon atoms and one other compound **Z**.

Compound **Y** decolourised bromine water. Identify **X**, **Y** and **Z** and write an equation for the reaction between **Y** and bromine water.

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(4) 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