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

Paper Reference(s)

**7081/02**

# London Examinations GCE

## Chemistry

## Ordinary Level

Paper 2

Monday 19 January 2009 – Morning

Time: 2 hours

Examiner's use only

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Team Leader's use only

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| Question Number | Leave Blank |
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**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 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. Marks for parts of questions are shown in round brackets: e.g. **(2)**.
This paper has 9 questions. 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 questions in this section.**

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

**1.** (a) For the laboratory preparation of dry hydrogen, state the reactants, drying agent and method of collection.

Reactants .....

Drying agent .....

Method of collection .....

**(3)**

(b) (i) Write an equation for the combustion of hydrogen in oxygen to form water.

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**(1)**

(ii) Give a **chemical** test and the result to show that water is the product.

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**(2)**

(iii) Give a **physical** test and the result to show that the water is pure.

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**(2)**

(c) Write the equation for the reaction between hydrogen and chlorine and name the gaseous product.

Equation .....

Name of product .....

**(2)**

**(Total 10 marks)**

**Q1**

Leave blank

**2.** You are provided with solutions of hydrochloric acid, sodium hydroxide, barium chloride and limewater **only**. In addition, you have a Bunsen burner, test tubes and dropping pipettes but no other apparatus.

Describe how you would distinguish between each of the following pairs of substances. Write an equation for any **one** of the reactions.

(a) Aqueous sodium chloride and aqueous sodium sulphate.

Test .....

Observation for sodium chloride .....

Observation for sodium sulphate .....

**(3)**

(b) Aqueous iron(II) chloride and aqueous iron(III) chloride.

Test .....

Observation for iron(II) chloride .....

Observation for iron(III) chloride .....

**(3)**

(c) Solid sodium carbonate and solid magnesium carbonate.

Test .....

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Observation for sodium carbonate .....

Observation for magnesium carbonate .....

**(3)**

(d) Equation for one of the reactions.

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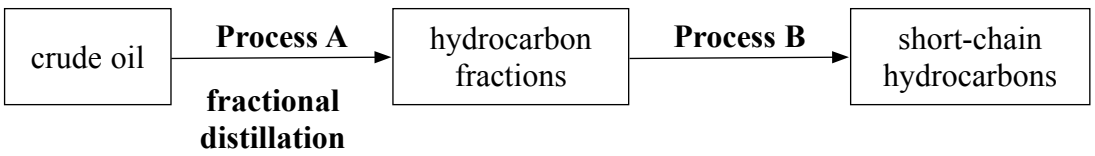
**(1)**

**Q2**

**(Total 10 marks)**

Leave blank

**3.** (a) Crude oil is a raw material in the petrochemicals industry. Short-chain hydrocarbons can be obtained from crude oil as shown below.




(i) Name **two** hydrocarbon fractions produced by Process A and give a use for one of them.

Fraction 1 name .....

Use .....

Fraction 2 name .....

**(3)**

(ii) Name Process B and state why it is important in the petrochemical industry.

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**(2)**

(iii) Short-chain hydrocarbons are used to make polymers. Draw the structure for poly(ethene).

**(1)**

Leave blank

(b) (i) Draw the structures of **two** isomers of the alkane $C_5H_{12}$ and name **one** of them.

**(3)**

(ii) Draw the structure of **one** isomer of the alkene $C_4H_8$.

**(1)**

**Q3**

**(Total 10 marks)**

Leave blank

**4.** For each of the following reactions involving the halogens or their compounds

- describe what you would see
- name the halogen-containing product(s)
- complete and balance the equation for the reaction.

(a) Chlorine gas is bubbled through aqueous sodium iodide.

Observation .....

.....

Names of products .....

Equation: $Cl_2$ + NaI $\longrightarrow$

**(4)**

(b) Chlorine gas is passed over heated iron in a hard glass tube.

Observation .....

.....

Name of product .....

Equation: Fe + $Cl_2$ $\longrightarrow$

**(3)**

(c) Aqueous silver nitrate is added to aqueous sodium bromide.

Observation .....

.....

Name of product .....

Equation: $AgNO_3$ + NaBr $\longrightarrow$

**(3)**

**Q4**

**(Total 10 marks)**

Leave blank

**5.** An experiment was performed to investigate the enthalpy change when iron filings are added to copper(II) sulphate solution. 5.0 g of iron was added to 50.0 $cm^3$ of copper(II) sulphate solution of concentration 0.50 mol $dm^{-3}$ in a polystyrene cup and the mixture was stirred. The rise in temperature was 24.0 °C.

(a) If it is assumed that the mass of the copper(II) sulphate solution is 50.0 g, it is possible to calculate the energy change by using the formula

Energy change (kJ) = mass of solution (kg) × 4.2 × rise in temperature (°C)

(i) Calculate the energy change for the amounts of reactants in the cup.

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**(2)**

(ii) Calculate the number of moles of copper(II) sulphate in 50.0 $cm^3$ of the solution and hence calculate the energy change per mole of copper(II) sulphate.

Moles of copper(II) sulphate

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Energy change per mole

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**(3)**

(iii) Enthalpy change for the reaction ($\Delta H$) = ..... kJ $mol^{-1}$

**(1)**

(b) (i) Write the ionic equation for the reaction, including state symbols.

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**(2)**

(ii) Explain, in terms of electron transfer, why this is a redox reaction.

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**(2)**

**Q5**

**(Total 10 marks)**

**TOTAL FOR SECTION A: 50 MARKS**

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## SECTION B

**Answer TWO questions in this section. If you change your mind, put a line through the box (☒) and then indicate your new question with a cross (☒).**

**Where appropriate, give equations and diagrams to clarify your answers.**

**If you answer question 6 put a cross in this box ☒ .**

**6.** (a) (i) Explain briefly how the difference in a physical property of oxygen and nitrogen enables the two gases to be obtained from air on an industrial scale. Details of the equipment used are not required.

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**(4)**

(ii) State how a lighted spill can be used to distinguish between samples of oxygen and nitrogen.

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**(2)**

(iii) Give the names of **two** noble gases present in the air and state a use for each of them.

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**(2)**

(iv) Give the name of a gas that is a cause of global warming and write the equation to show how this gas is formed when methane burns in air.

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**(3)**

Leave blank

(b) (i) A nitrogen molecule contains a triple covalent bond. Draw a diagram to show the electron arrangement of the outer shells in a molecule of nitrogen and suggest why the gas is inert at room temperature.

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**(3)**

(ii) Nitrogen reacts with hydrogen to form ammonia in a reversible exothermic reaction.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92 \text{ kJ mol}^{-1}$$

State the temperature and pressure used in the industrial process and name the catalyst.
Use the information in the equation to deduce whether the temperature and the pressure should be high or low in order to obtain a high yield of ammonia. Compare your answer with the conditions used in practice and explain why these conditions are chosen.

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**(8)**

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(iii) Ammonia can be prepared in the laboratory using the reaction between calcium hydroxide and ammonium chloride.

$$Ca(OH)_2 + 2NH_4Cl \longrightarrow CaCl_2 + 2NH_3 + 2H_2O$$

Calculate the volume of ammonia formed at room temperature and atmospheric pressure from 0.535 g of ammonium chloride.

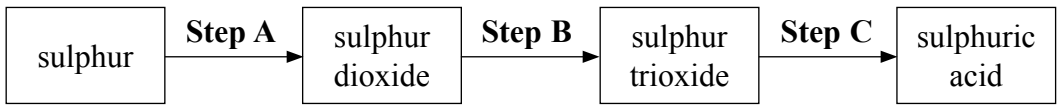
**(3)** **Q6**

**(Total 25 marks)**

Leave blank

**If you answer question 7 put a cross in this box ☒ .**

**7.** (a) Sulphur can be converted into sulphuric acid using the following steps.




(i) Sulphur can exist as two allotropes. Explain what this means and name the allotropes.

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**(3)**

(ii) Which two of the above steps involve oxidation? Explain your answer.

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**(2)**

(iii) Write the equation and give the conditions for the reaction in Step **B**.

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**(4)**

(iv) How is reaction **C** carried out on an industrial scale? Why is sulphur trioxide not added directly to water?

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**(3)**

Leave blank

(b) (i) Describe a test for sulphur dioxide and give the expected result.

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**(2)**

(ii) Write an equation for the reaction of sulphur dioxide with an excess of aqueous sodium hydroxide. Name the products.

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**(3)**

(c) Concentrated sulphuric acid is used in

- the conversion of ethanol to ethene
- the formation of an ester when ethanol reacts with ethanoic acid.

For each reaction, give the conditions, write an equation and state the role of the concentrated sulphuric acid. Draw the structure of the ester formed and name it.

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**(8)**

**Q7**

**(Total 25 marks)**

Leave blank

**If you answer question 8 put a cross in this box ☒ .**

**8.** (a) Explain each of the following.

(i) Sodium metal conducts electricity in both the solid and molten states whereas sodium chloride only conducts when molten.

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**(5)**

(ii) Many covalent compounds are gases or liquids whereas ionic compounds are solids at room temperature.

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**(5)**

Leave blank

(iii) A solution of hydrogen chloride in water reacts with magnesium to form a colourless gas whereas a solution of hydrogen chloride in methylbenzene does not react with magnesium.

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**(4)**

(iv) Lumps of calcium carbonate react at a different rate to powdered calcium carbonate when added to hydrochloric acid.

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**(3)**

Leave blank

(b) Manganese(IV) oxide acts as a catalyst in the decomposition of hydrogen peroxide.

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

Given a sample of manganese(IV) oxide and 100 $cm^3$ of aqueous hydrogen peroxide, describe experiments you could do to show that manganese(IV) oxide

(i) speeds up the reaction

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**(3)**

(ii) is not used up during the reaction.

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**(5)**

**Q8**

**(Total 25 marks)**

Leave blank

**If you answer question 9 put a cross in this box ☒.**

**9.** (a) Copper can be obtained from the ore, copper pyrites, $CuFeS_2$. The ore is heated in a limited amount of air.

$$4CuFeS_2 + 11O_2 \longrightarrow 4Cu + 2Fe_2O_3 + 8SO_2$$

(i) Calculate the maximum mass of copper that can be obtained from 367 kg of copper pyrites.

**(3)**

(ii) State why the gaseous product from this reaction must not be allowed to escape into the atmosphere.

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**(1)**

(b) The copper obtained from copper pyrites is too impure for electrical wiring and has to be purified by electrolysis.

(i) Name the electrolyte and the materials used for the cathode and anode. Write equations for the reactions at the electrodes. Give one observation that can be made during the electrolysis.

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**(6)**

(ii) Explain which of the electrode reactions is a reduction.

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**(2)**

Leave blank

(iii) Calculate the mass of copper formed by the passage of a charge of 200 faradays.

**(2)**

(c) State two chemical characteristics of transition metals that apply to copper or its compounds. Give an example to illustrate each characteristic.

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**(4)**

(d) Describe what you would observe in each of the following experiments. Write equations for the reactions that occur.

(i) Aqueous sodium hydroxide is added to aqueous copper(II) sulphate.

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**(3)**

(ii) Copper(II) nitrate crystals are heated strongly.

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**(4)**

**Q9**

**(Total 25 marks)**

**TOTAL FOR SECTION B: 50 MARKS**

**TOTAL FOR PAPER: 100 MARKS**

**END**

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# THE PERIODIC TABLE

| Period | 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group | | | | | | | | | | | | | | | | | |
| 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