Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY **5070/02**

Paper 2

October/November 2004

1 hour 30 minutes

Candidates answer on the Question Paper.
Additional Materials: Answer Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces provided at the top of this page and on any separate answer paper used.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, or rough working.
You may use a calculator.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
A copy of the Periodic Table is printed on page 16.

Section B
Answer **three** questions.
Write your answers on any line pages provided and/or a separate answer paper.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

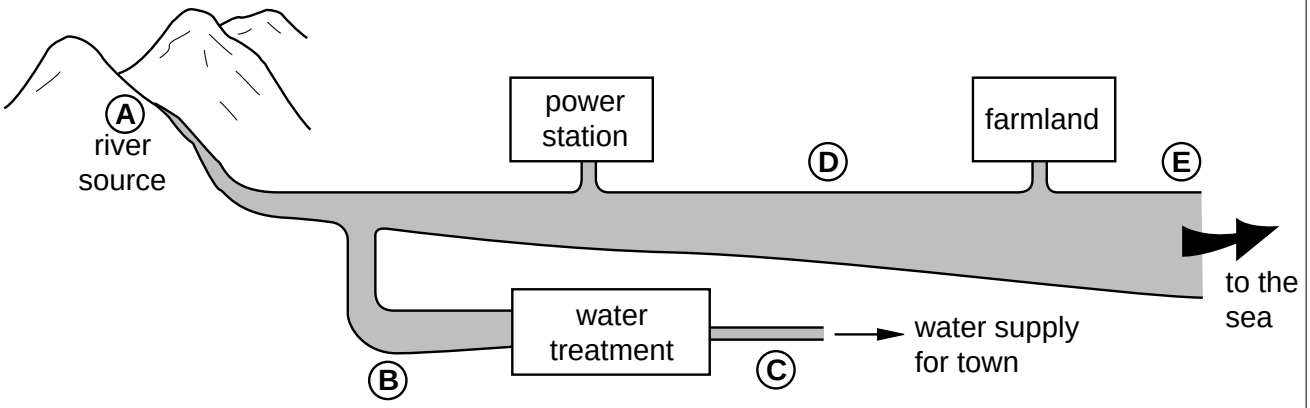
Stick your personal label here, if provided.

For Examiner's Use	
Section A	
B7	
B8	
B9	
B10	
TOTAL	

This document consists of **14** printed pages and **2** lined pages.

Section A

A1 The diagram shows where five water samples, **A** to **E**, were taken from a river.



The table shows information about the water samples.

sample	*temperature* / °C	*dissolved oxygen* / *ppm*
A	6	15
B	5	13
C	6	13
D	13	12
E	8	

(a) Describe how the temperature of the river water changes as it flows from the source of the river to the sea.

..... [1]

(b) Fertiliser enters the river as it flows past the farmland.

(i) Suggest the oxygen content of water sample **E**.

.....

(ii) Explain your reasoning.

.....

..... [3]

For Examiner's Use

(c) Samples **B** was taken before and sample **C** was taken after the water was treated for use as the water supply for the town. Complete the table to show how the contents change when the water is treated.

contents	*change (increases / decreases / stays the same)*
dissolved minerals	stays the same
suspended particles	
dissolved oxygen	stays the same
living microbes (e.g. bacteria)	
chlorine	

[3]

[Turn over

A2

substance	*type of bonding*	*melting point* / °C	*boiling point* / °C
iodine	covalent	114	184
lead(II) bromide	ionic	370	914
methane	covalent	–182	–161
bromine	covalent	–7	59
silicon dioxide	covalent	1610	2230
lithium	metallic	180	1360

Use the substances named in the table to answer the following questions.

(a) Name the substances that are **not** solids at room temperature and pressure.

..... [1]

(b) Which substance is a liquid over the largest temperature range?

..... [1]

(c) Name the substances that are non-metallic elements.

..... [1]

(d) Which **two** substances conduct electricity when molten?

..... [1]

(e) Explain, using ideas about structure, why methane and silicon dioxide have different melting points.

.....

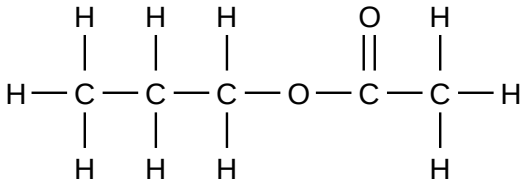
..... [2]

(f) Describe a method for making lead from lead(II) bromide.

.....

..... [2]

A3 This is the structure of an ester made in a reversible reaction between a carboxylic acid and an alcohol.



(a) **(i)** State the conditions for this reaction.

.....

..... [2]

(ii) Draw the structure of the carboxylic acid used in the reaction.

[1]

(iii) Write an equation for this reaction.

..... [2]

(b) A student carried out some experiments to compare the relative strengths of dilute ethanoic acid with dilute hydrochloric acid.

(i) Describe a test that can be used to distinguish between dilute ethanoic acid and dilute hydrochloric acid.

.....

..... [2]

(ii) Name a solid substance that will react with both acids. Describe what you will **see** during the reaction.

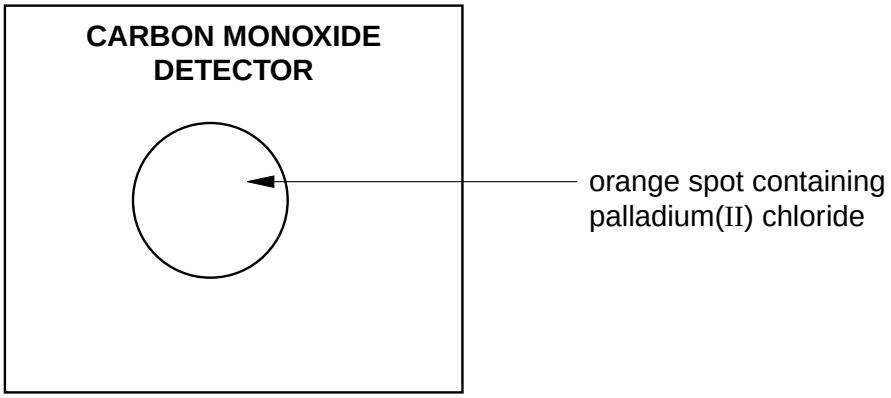
substance .....

observations .....

..... [2]

[Turn over

A4 Carbon monoxide detectors can be used in the home.



The orange spot turns black if there is a high concentration of carbon monoxide in the air.

(a) Why is carbon monoxide hazardous?

..... [1]

(b) The spot turns black when palladium(II) chloride reacts with carbon monoxide to form palladium metal.

$$PdCl_2(s) + \boxed{} + CO(g) \rightarrow Pd(s) + 2HCl(g) + CO_2(g)$$

(i) Complete the equation by writing the formula of the missing reactant in the box.

(ii) Complete the table to show the oxidation states of palladium and carbon before and after the reaction takes place.

element	*oxidation state before reaction*	*oxidation state after the reaction*
palladium		
carbon		

(iii) Use information from the table to explain why this is a redox reaction.

.....

..... [5]

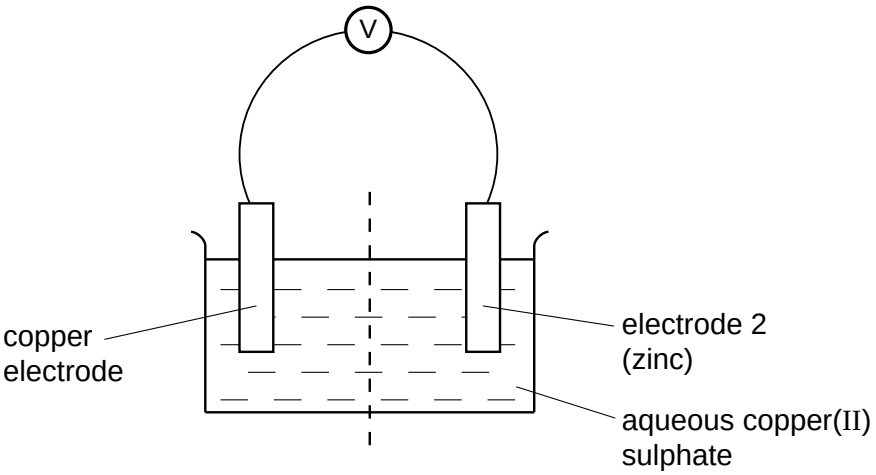
(c) Name **one** industrial process that uses carbon monoxide as a reducing agent.

..... [1]

A5 **(a)** Write an ionic equation for the reaction between zinc and aqueous copper(II) sulphate.

..... [1]

This reaction can be used to generate electricity in a cell.



(b) Drawn an arrow on the diagram to show the direction of the flow of electrons in the wire. [1]

(c) The voltage of the cell was measured when the following metals were used as electrode 2.

copper **iron** **lead** **zinc**

Complete the table by entering the metals in the correct order.

meter reading / V	*metal*
1.10	
0.78	
0.21	
0.00	

[2]

(d) When **metal M** was used as electrode 2, it produced a higher voltage than zinc. Suggest a name for **metal M**.

..... [1]

[Turn over

A6 This question is about making salts.

(a) For each salt, suggest the name of the missing reagent and briefly describe how to obtain the solid product from the reaction mixture.

(i) Salt to be made: lithium chloride.

reagent 1: dilute hydrochloric acid

reagent 2: .....

I could obtain solid lithium chloride by: .....

.....

(ii) Salt to be made: barium sulphate.

reagent 1: aqueous potassium sulphate

reagent 2: .....

I could obtain solid barium sulphate by: .....

.....

(iii) Salt to be made: blue copper(II) sulphate crystals.

reagent 1: dilute sulphuric acid

reagent 2: .....

I could obtain blue copper(II) sulphate crystals by:

.....

..... [6]

(b) Ammonium sulphate can be made by reacting aqueous ammonia with dilute sulphuric acid.

$$2NH_3(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$$

Calculate the mass of ammonium sulphate that can be made from 51 g ammonia.

.....

.....

..... [3]

Section B

Answer **three** questions from this section.
Tie the extra sheets used loosely to this booklet.

B7 Magnesium carbonate decomposes when it is heated.

$$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$$

In an experiment, 10.5 g of magnesium carbonate was heated to a constant mass.

(a) Sketch a graph to show how the volume of carbon dioxide collected changes with time. Explain your answer. [3]

(b) Calculate the maximum volume of carbon dioxide, at room temperature and pressure, that can be formed from 10.5 g of magnesium carbonate. [3]

(c) The experiment was repeated under the same conditions using zinc carbonate instead of magnesium carbonate.

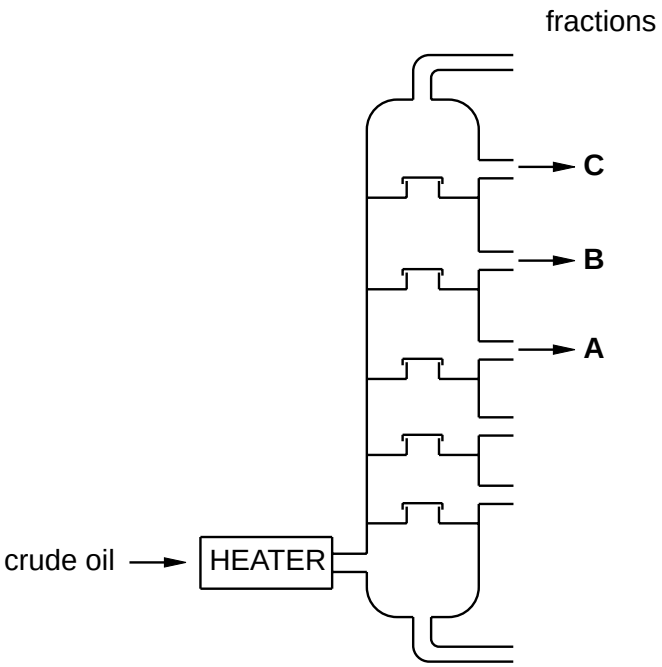
(i) Describe how the rates of the reactions would be different. Explain your answer.

(ii) The same mass (10.5 g) of zinc carbonate was used. Would the total volume of carbon dioxide formed be the same? Explain your answer. [4]

[Total: 10 marks]

[Turn over

B8 This diagram shows a fractionating column for the separation of crude oil.



The following fractions leave the column.

fraction	*number of carbon atoms*	*boiling range* / °C
naptha	7 – 14	90 – 150
paraffin	9 – 16	150 – 240
diesel oil	15 – 25	220 – 250

(a) Which fractions leave the column at each of the points **A**, **B** and **C**? [1]

(b) Explain how the fractionating column separates the crude oil mixture. [3]

(c) Octane, C_8H_{18}, is a hydrocarbon in petrol. Hexadecane, $C_{16}H_{34}$, is one of the hydrocarbons in ship fuel.

(i) Show by calculation that hexadecane contains a higher percentage of carbon by mass than octane.

This is the equation for the complete combustion of octane.

$$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$$

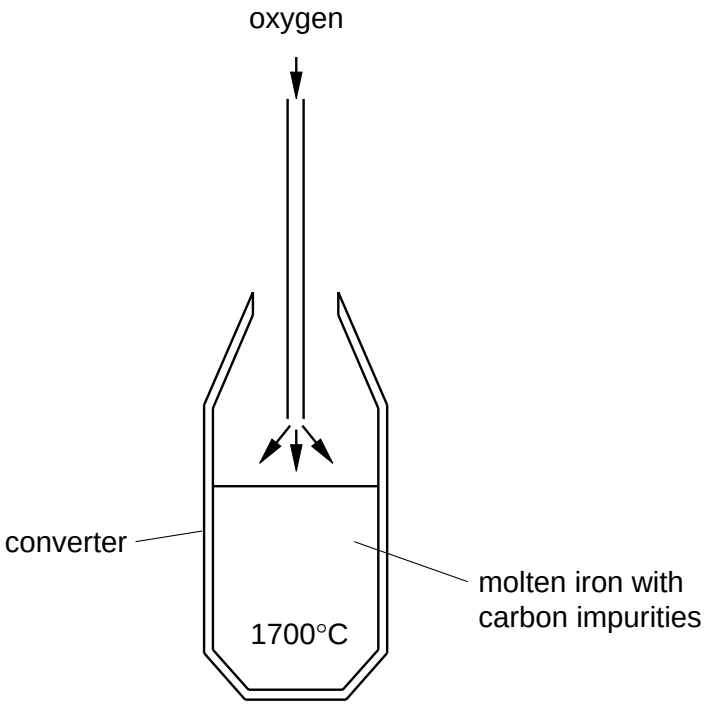
(ii) Write an equation for the complete combustion of hexadecane.

(iii) Use the equations to explain why hexadecane burns with a smokier flame than octane. [5]

(d) Name **two** fuels, suitable for cars, which do not come from crude oil. [1]

[Total: 10 marks]

B9 Iron from the Blast Furnace contains carbon as an impurity. To remove the carbon, oxygen is blown on the molten iron in a large vessel known as a converter. The carbon is oxidised to carbon dioxide.



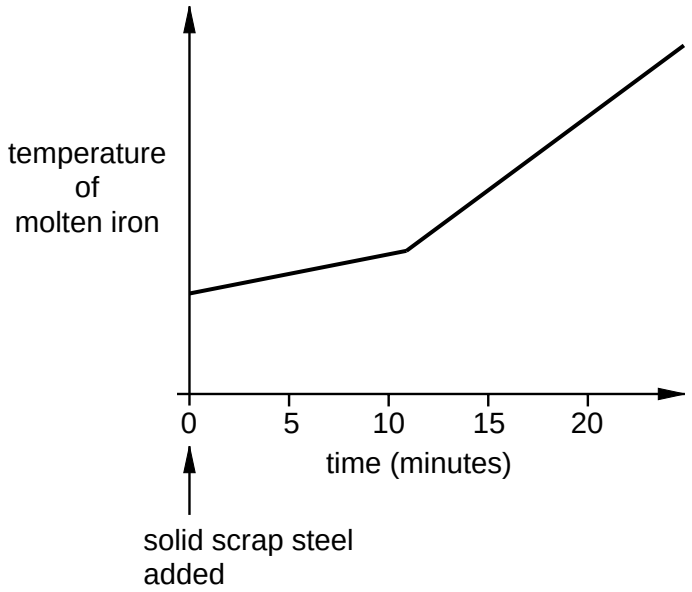
(a) The temperature of the molten iron increases as the oxygen is blown onto it. Explain why. [1]

(b) During the oxygen blow, some of the molten iron is oxidised to iron(III) oxide. Write an equation for this reaction. State symbols are not required. [2]

B9 CONTINUES OVERLEAF.

[Turn over

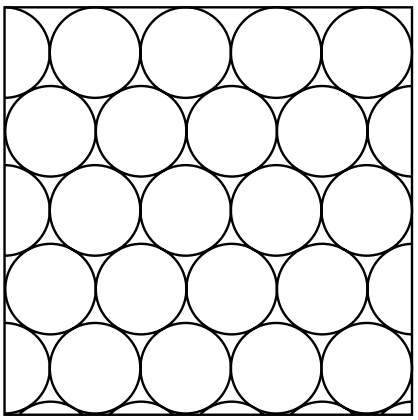
(c) Scrap steel is recycled by being added, as a solid, to the molten iron, before the oxygen blow. The graph below shows how the temperature of the molten iron changes during the oxygen blow.



(i) Describe how the temperature of the molten iron changes during the oxygen blow. Explain why the solid scrap steel affects the temperature change during the oxygen blow.

(ii) Give a reason why it is important to recycle steel. [3]

(d) The diagram shows the arrangement of atoms in pure iron.



Draw similar diagrams to show the arrangement of atoms in

(i) low carbon steel alloy,

(ii) high carbon steel alloy.

(iii) How do the properties of the two types of steel differ? Use your diagrams to explain why the properties are different. [4]

[Total: 10 marks]

B10 Electroplating can be used to coat nickel with a thin coating of silver.

(a) Draw a labelled diagram of an apparatus that can be used to electroplate silver onto nickel. [3]

(b) Write equations, with state symbols, for the reactions at the anode and cathode. [2]

(c) Solutions of two salts, **A** and **B**, were electrolysed using carbon electrodes. The following products were collected.

salt	*products*
A	oxygen and hydrogen
B	chlorine and hydrogen

(i) Suggest the names of the two salts, **A** and **B**.

(ii) Describe tests to confirm the identifies of the three gases collected. [5]

[Total: 10 marks]

[Turn over

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DATA SHEET
The Periodic Table of the Elements

Group

I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 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
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
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	64 **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
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**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
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															
				140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
				232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a **X** b	a = relative atomic mass **X** = atomic symbol b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).