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.

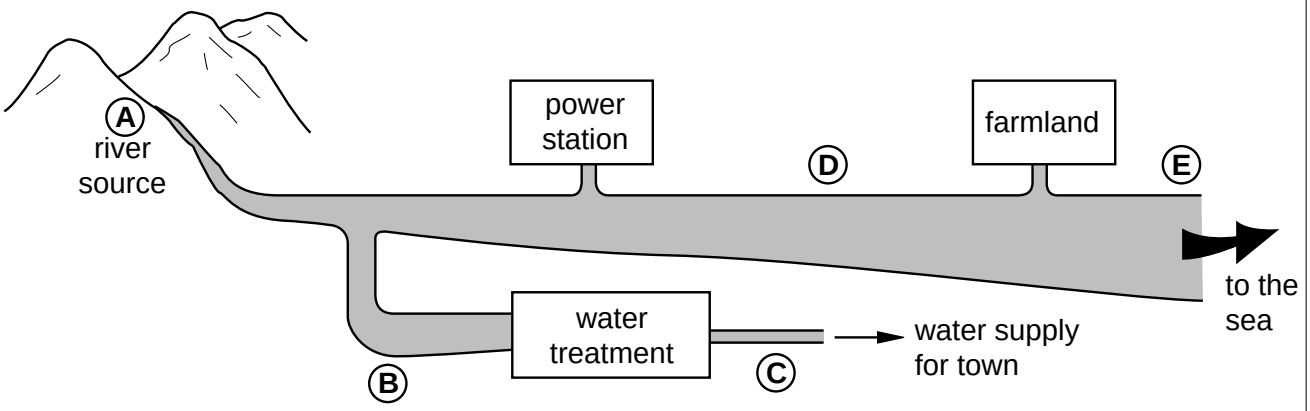
Stick your personal label here, if provided.

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]

(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]

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.

.....

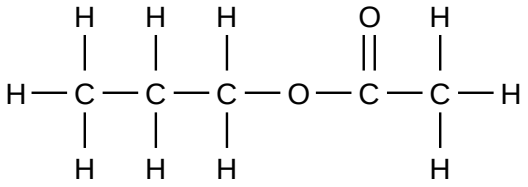
..... [2]

(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]

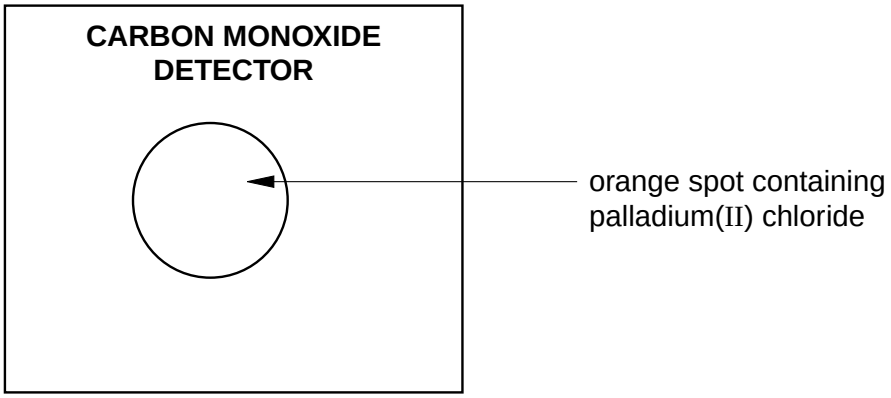
(ii) Name a solid substance that will react with both acids. Describe what you will **see** during the reaction.

substance .....

observations .....

..... [2]

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]

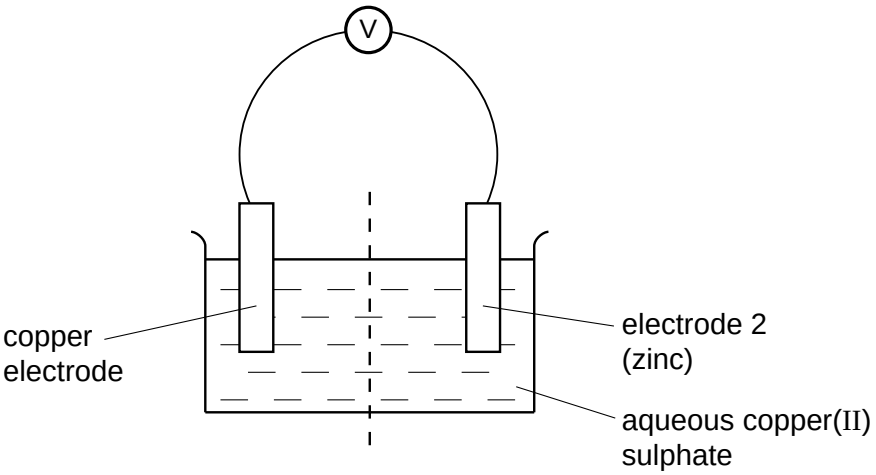
(c) Name **one** industrial process that uses carbon monoxide as a reducing agent.

..... [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]

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.

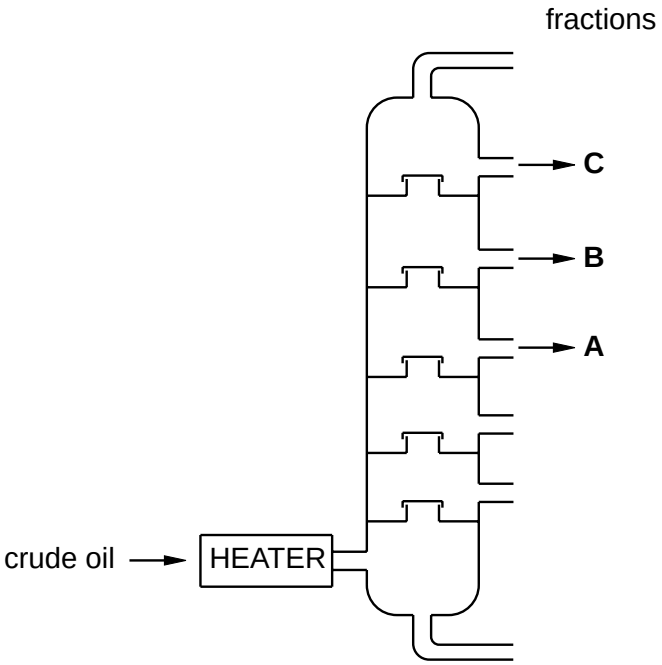
(i) Describe how the rates of the reactions would be different. Explain your answer.

(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.

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

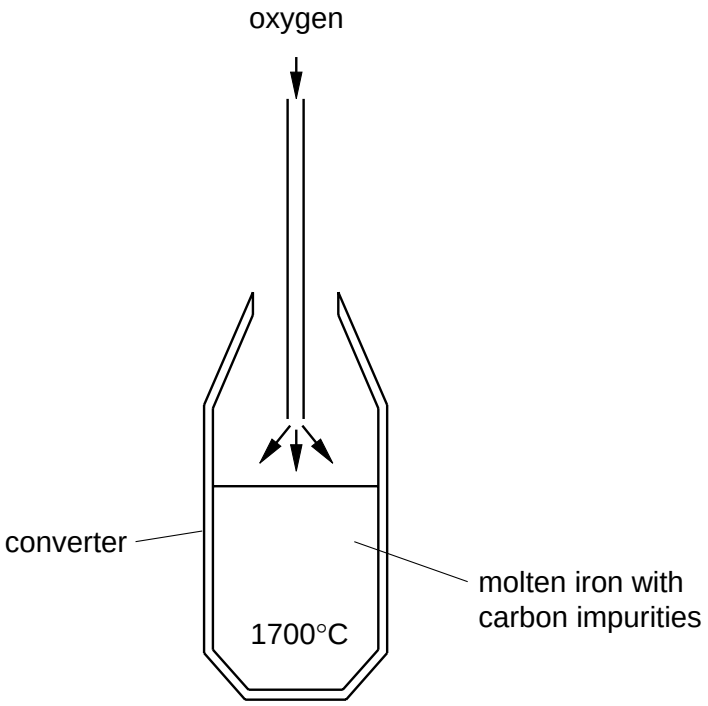
(ii) Write an equation for the complete combustion of hexadecane.

(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.

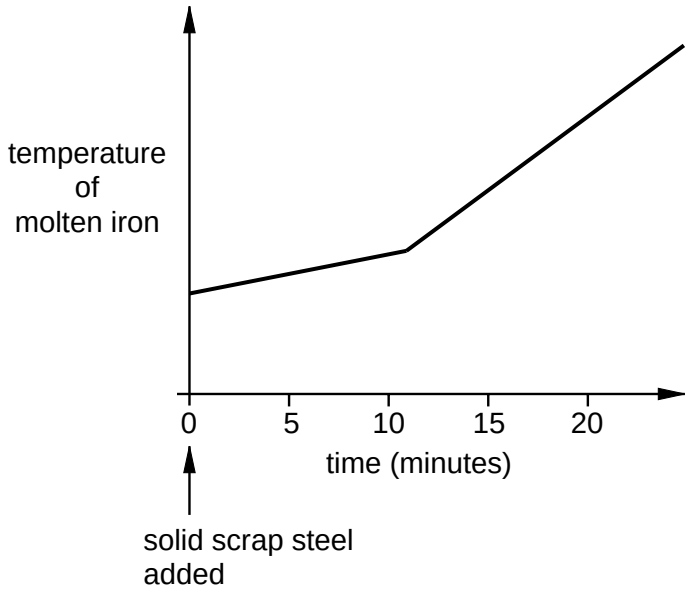


(a) The temperature of the molten iron increases as the oxygen is blown onto it. Explain why. [1]

(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.

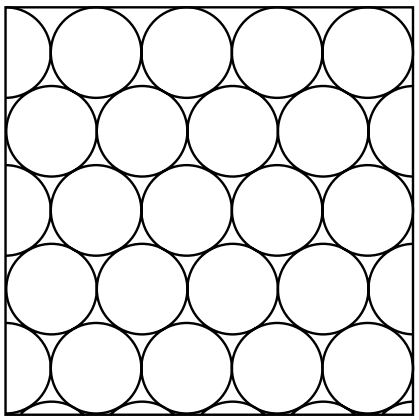
(c) Scrap steel is recycled by being added, as a solid, to the molten iron, before the oxygen blow. The graph below shows how the temperature of the molten iron changes during the oxygen blow.



(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]

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 = 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.).