UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY

Paper 3

0620/03

October/November 2004

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

Candidate Name

Centre Number

Candidate Number

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

WRITE IN THE BOXES PROVIDED ON THE QUESTION PAPER

DO **NOT** WRITE IN THE BARCODE.

DO **NOT** WRITE IN THE GREY AREAS BETWEEN THE PAGES.

Do not use staples, paper clips, highlighters, glue or correction fluid.

You may use a calculator.

Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part questions.

A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **15** printed pages and **1** blank page.

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UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

For Examiner's Use

1 **(a)** Two of the gases in air are nitrogen and oxygen. Name **two** other gases present in unpolluted air.

[2]

(b) Two common pollutants present in air are sulphur dioxide and lead compounds. State the source and harmful effect of each.

sulphur dioxide

source	
harmful effect	[3]

lead compounds

source	
harmful effect	[2]

(c) Respiration and photosynthesis are two of the processes that determine the percentage of oxygen and of carbon dioxide in the air.

(i) Name another process that changes the percentages of these two gases in air.

[1]

(ii) The equation for photosynthesis is given below.

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

This is an endothermic reaction.

Complete the reaction for respiration.

$C_6H_{12}O_6 + 6O_2 \longrightarrow$ [ ] + [ ]

This is an [ ] reaction.

[2]

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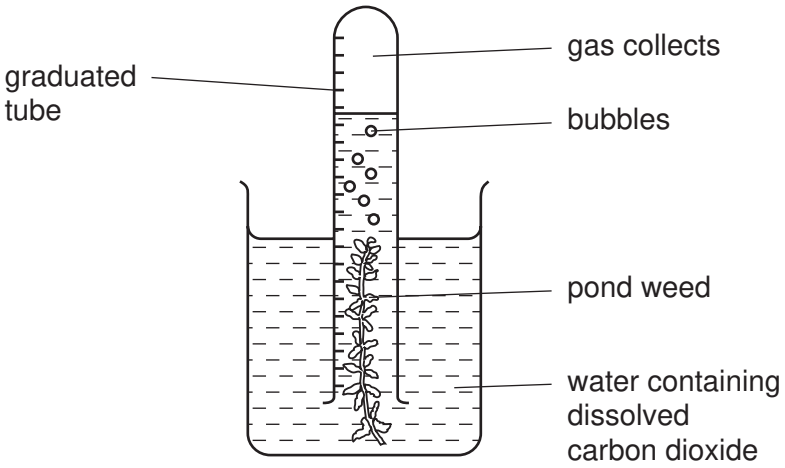
(d) The rate of photosynthesis of pond weed can be measured using the following experiment.



(i) Describe how you could show that the gas collected in this experiment is oxygen.

[1]

(ii) What measurements are needed to calculate the rate of this reaction?

[2]

(iii) What would be the effect, and why, of moving the apparatus further away from the light?

.....

[2]

For Examiner's Use

2 The salt copper(II) sulphate can be prepared by reacting copper(II) oxide with sulphuric acid.

Complete the list of instructions for making copper(II) sulphate using **six** of the words below.

blue cool dilute filter

saturated sulphate white oxide

Instructions

1 Add excess copper(II) oxide to [ ] sulphuric acid in a beaker and boil it.

2 [ ] to remove the unreacted copper(II) oxide.

3 Heat the solution until it is [ ].

4 [ ] the solution to form [ ]

coloured crystals of copper (II) [ ]. [6]

For Examiner's Use

3 The simplest alcohol is methanol.

(a) It is manufactured by the following reversible reaction.

$$CO\ (g) + 2H_2\ (g) \underset{\substack{300\,^{\circ}C \\ 30atm}}{\rightleftharpoons} CH_3OH\ (g)$$

(i) Reversible reactions can come to equilibrium. Explain the term *equilibrium*.

.....

[1]

(ii) At 400 °C, the percentage of methanol in the equilibrium mixture is lower than at 300 °C. Suggest an explanation.

.....

[2]

(iii) Suggest two advantages of using high pressure for this reaction.
Give a reason for each advantage.

advantage	.....
reason	.....
	.....

advantage	.....
reason	.....
	[5]

For Examiner's Use

(b) **(i)** Complete the equation for the combustion of methanol in an excess of oxygen.

$\boxed{}\ CH_3OH + \boxed{}\ O_2 \longrightarrow \boxed{} + \boxed{}$ [2]

(ii) Complete the word equation.

methanol + ethanoic acid ⟶ ..... + ... [2]

(iii) Methanol can be oxidised to an acid. Name this acid.

..... [1]

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4 In the following list of ionic equations, the metals are in order of reactivity.

$$\square \rightarrow \square + \square$$

$$Zn \rightarrow Zn^{2+} + 2e^-$$

$$Sn \rightarrow Sn^{2+} + 2e^-$$

$$Hg \rightarrow Hg^{2+} + 2e^-$$

$$Ag \rightarrow Ag^{+} + e^-$$

↑ reactivity of metals increases

(a) **(i)** In the space at the top of the series, write an ionic equation that includes a more reactive metal. [1]

(ii) Define *oxidation* in terms of electron transfer.

.....

[1]

(iii) Explain why the positive ions are likely to be oxidising agents.

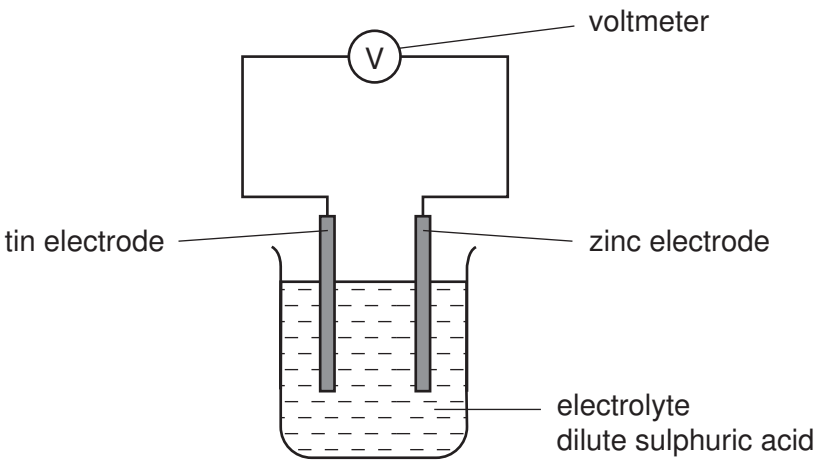
[1]

(iv) Which positive ion(s) can oxidise mercury metal (Hg)?

[1]

For Examiner's Use

(b) The following diagram shows a simple cell.



(i) Predict how the voltage of the cell would change if the tin electrode was replaced with a silver one.

[1]

(ii) Which electrode would go into the solution as positive ions? Give a reason for your choice.

[1]

(iii) State how you can predict the direction of the electron flow in cells of this type.

[1]

For Examiner's Use

5 Strontium and sulphur chlorides both have a formula of the type XCl_2 but they have different properties.

property	strontium chloride	sulphur chloride
appearance	white crystalline solid	red liquid
melting point / °C	873	-80
particles present	ions	molecules
electrical conductivity of solid	poor	poor
electrical conductivity of liquid	good	poor

(a) The formulae of the chlorides are similar because both elements have a valency of 2. Explain why Group II and Group VI elements both have a valency of 2.

.....

[2]

(b) Draw a diagram showing the arrangement of the valency electrons in one covalent molecule of sulphur chloride.
Use x to represent an electron from a sulphur atom.
Use o to represent an electron from a chlorine atom.

[3]

(c) Explain the difference in electrical conductivity between the following.

(i) solid and liquid strontium chloride

[1]

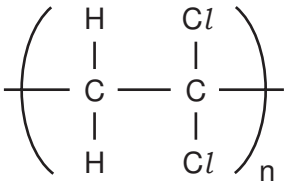
(ii) liquid strontium chloride and liquid sulphur chloride

[1]

For Examiner's Use

6 Polymers are extensively used in food packaging. Poly(dichloroethene) is used because gases can only diffuse through it very slowly. Polyesters have a high thermal stability and food can be cooked in a polyester bag.

(a) **(i)** The structure of poly(dichloroethene) is given below.



Draw the structural formula of the monomer.

[1]

(ii) Explain why oxygen can diffuse faster through the polymer bag than carbon dioxide can.

.....

[2]

(b) **(i)** A polyester can be formed from the monomers $HO\text{-}CH_2CH_2\text{-}OH$ and $HOOC\text{-}C_6H_4\text{-}COOH$. Draw the structure of this polyester.

[2]

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(Ii) Name a naturally occurring class of compounds that contains the ester linkage.

[1]

(iii) Suggest what is meant by the term *thermal stability.*

[1]

(c) (i) Describe **two** environmental problems caused by the disposal of plastic (polymer) waste.

[2]

(ii) The best way of disposing of plastic waste is recycling to form new plastics. What is another advantage of recycling plastics made from petroleum?

[1]

For Examiner's Use

7 **(a)** **(i)** Write a symbol equation for the action of heat on zinc hydroxide.

[2]

(ii) Describe what happens when solid **sodium** hydroxide is heated strongly.

[1]

(b) What would be **observed** when copper(II) nitrate is heated?

.....

[3]

(c) Iron(III) sulphate decomposes when heated. Calculate the mass of iron(III) oxide formed and the volume of sulphur trioxide produced when 10.0 g of iron(III) sulphate was heated.
Mass of one mole of $Fe_2(SO_4)_3$ is 400 g.

$$Fe_2(SO_4)_3\ (s) \longrightarrow Fe_2O_3\ (s) + 3SO_3\ (g)$$

Number of moles of $Fe_2(SO_4)_3$ =	
Number of moles of Fe_2O_3 formed =	
Mass of iron(III) oxide formed =	g
Number of moles of SO_3 produced =	
Volume of sulphur trioxide at r.t.p. =	dm^3

[5]

For Examiner's Use

8 The alkenes are a homologous series of unsaturated hydrocarbons.

(a) The table below gives the names, formulae and boiling points of the first members of the series.

name	formula	boiling point / °C
ethene	C_2H_4	-102
propene	C_3H_6	-48
butene	C_4H_8	-7
pentene	C_5H_{10}	30
hexene		

(i) Complete the table by giving the formula of hexene and by predicting its boiling point.

[2]

(ii) Deduce the formula of the alkene which has a relative molecular mass of 168. Show your working.

[2]

(b) Describe a test that will distinguish between the two isomers, but-2-ene and cyclobutane.

test

result with but-2-ene

result with cyclobutane [3]

For Examiner's Use

(c) Alkenes undergo addition reactions.

(i) What class of organic compound is formed when an alkene reacts with water?

[1]

(ii) Predict the structural formula of the compound formed when hydrogen chloride reacts with but-2-ene.

[1]

(iii) Draw the structure of the polymer formed from but-2-ene.

[2]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).

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