

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

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Candidate  
Number

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**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	
<b>Total</b>	

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



- 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.

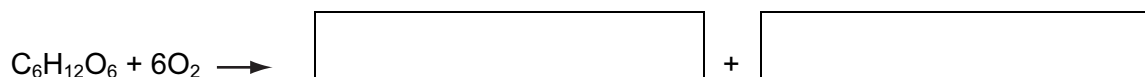
[1]
-----

- (ii) The equation for photosynthesis is given below.



This is an endothermic reaction.

Complete the reaction for respiration.

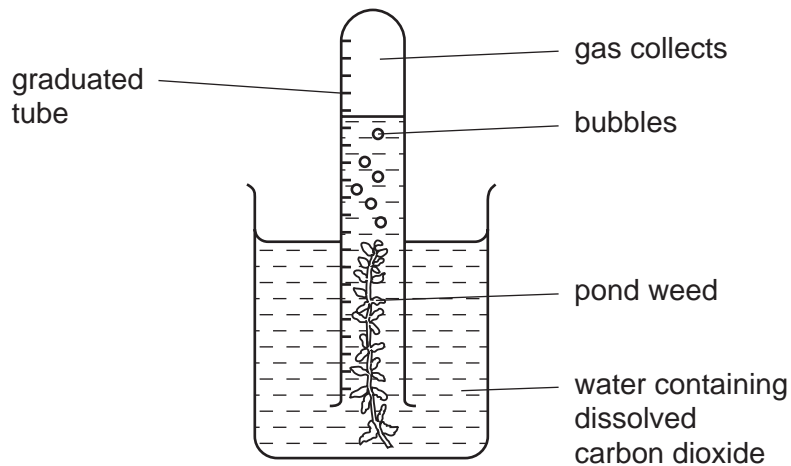


This is an  reaction.

[2]

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

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- (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?

<hr style="border-top: 1px dashed black;"/>	[2]
---	-----

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

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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

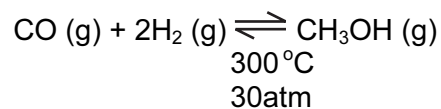
coloured crystals of copper (II)

.

[6]

3 The simplest alcohol is methanol.

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



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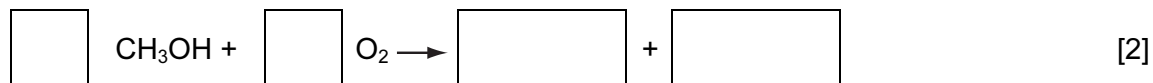
(iii) Suggest two advantages of using high pressure for this reaction.  
Give a reason for each advantage.

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

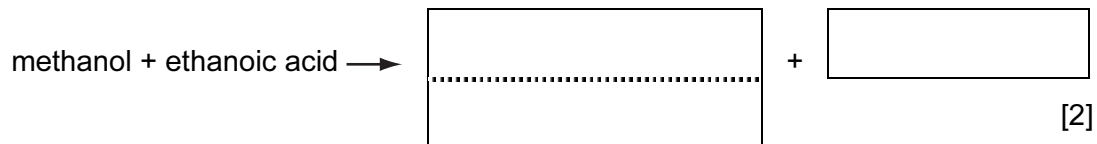
advantage	.....
reason	.....
	[5]

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



(ii) Complete the word equation.

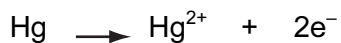
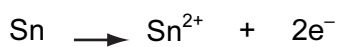
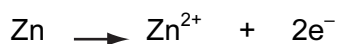
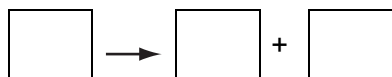


(iii) Methanol can be oxidised to an acid. Name this acid.

	[1]
--	-----

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



↑ 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]
--	-----

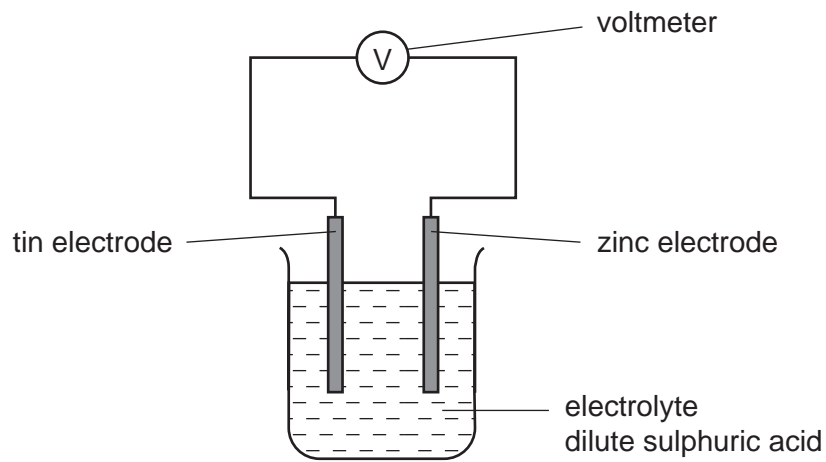
- (iii) Explain why the positive ions are likely to be oxidising agents.

[1]
-----

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

[1]
-----

(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]
--	-----



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

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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]

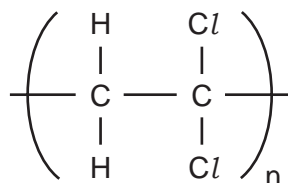
- (ii) liquid strontium chloride and liquid sulphur chloride

[1]

- 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.

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- (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-CH<sub>2</sub>CH<sub>2</sub>-OH and HOOC-C<sub>6</sub>H<sub>4</sub>-COOH. Draw the structure of this polyester.

[2]

- (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]
--	-----

- 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  $\text{Fe}_2(\text{SO}_4)_3$  is 400 g.



Number of moles of $\text{Fe}_2(\text{SO}_4)_3$ =	
Number of moles of $\text{Fe}_2\text{O}_3$ formed =	
Mass of iron(III) oxide formed =	g
Number of moles of $\text{SO}_3$ produced =	
Volume of sulphur trioxide at r.t.p. =	$\text{dm}^3$

[5]

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8 The alkenes are a homologous series of unsaturated hydrocarbons.

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(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 <sub>2</sub> H <sub>4</sub>	-102
propene	C <sub>3</sub> H <sub>6</sub>	-48
butene	C <sub>4</sub> H <sub>8</sub>	-7
pentene	C <sub>5</sub> H <sub>10</sub>	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]

(c) Alkenes undergo addition reactions.

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(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	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII																																																												
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18	39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	210 <b>Rn</b> Radon 86	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	87 <b>Fr</b> Francium
												140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103																																		

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

**Key**

a	<b>X</b>
b	

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

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