



Candidate Name \_\_\_\_\_

**International General Certificate of Secondary Education  
CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**CHEMISTRY  
PAPER 3**

**0620/3****OCTOBER/NOVEMBER SESSION 2002**

1 hour 15 minutes

Candidates answer on the question paper.  
No additional materials are required.

**TIME** 1 hour 15 minutes**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

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

A copy of the Periodic Table is printed on page 12.

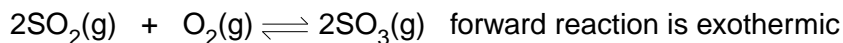
FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
<b>TOTAL</b>	

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**This question paper consists of 10 printed pages and 2 blank pages.**



- 1 (a) Sulphuric acid is made by the Contact Process.



- (i) What are the reaction conditions for the Contact Process?

.....  
 .....[3]

- (ii) Would the yield of sulphur trioxide increase, decrease or stay the same when the temperature is increased? Explain your answer.

.....  
 .....  
 .....[2]

- (iii) Describe how sulphur trioxide is changed into concentrated sulphuric acid.

.....  
 .....[2]

- (b) There are three ways of making salts from sulphuric acid.

titration using a burette and indicator

precipitation by mixing the solutions and filtering

neutralisation of sulphuric acid using an excess of an insoluble base

Complete the following table of salt preparations.

method	reactant 1	reactant 2	salt
titration	sulphuric acid		sodium sulphate
neutralisation	sulphuric acid		zinc sulphate
precipitation	sulphuric acid		barium sulphate
	sulphuric acid	copper(II) oxide	copper(II) sulphate

[4]

- (c) The results of an investigation into the action of heat on copper(II) sulphate-5-water, a blue crystalline solid, are given below.

The formula is  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  and the mass of one mole is 250 g

A 5.0 g sample of the blue crystals is heated to form 3.2 g of a white powder. With further heating this decomposes into a black powder and sulphur trioxide.

- (i) Name the white powder.

.....[1]

- (ii) What is observed when water is added to the white powder?

.....[1]

- (iii) Name the black powder.

.....[1]

- (iv) Calculate the mass of the black powder. Show your working.

.....  
 .....  
 .....[3]

- 2 Manganese is a transition element. It has more than one valency and the metal and its compounds are catalysts.

- (a) (i) Predict **three** other properties of manganese that are typical of transition elements.

.....  
 .....[3]

- (ii) Complete the electron distribution of manganese by inserting one number.

2 + 8 + ..... + 2 [1]

- (b) It has several oxides, three of which are shown below.

Manganese(II) oxide, which is basic.

Manganese(III) oxide, which is amphoteric.

Manganese(IV) oxide, which is acidic.

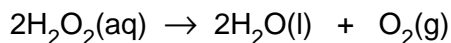
- (i) Complete the word equation.

manganese(II) oxide + hydrochloric acid  $\rightarrow$  ..... + .....  
 ..... [2]

- (ii) Which, if any, of these oxides will react with sodium hydroxide?

.....[1]

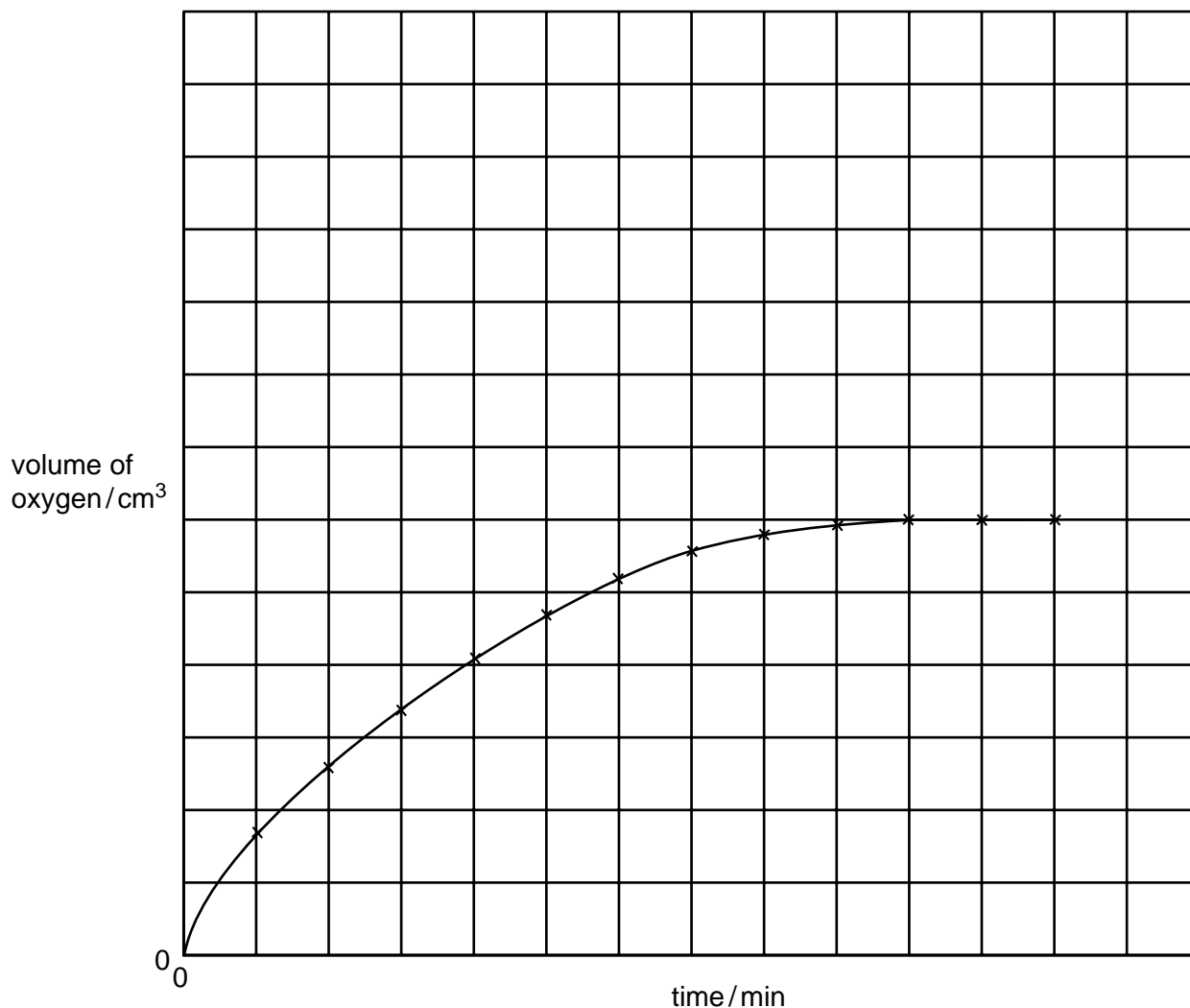
- (c) Aqueous hydrogen peroxide decomposes to form water and oxygen.



This reaction is catalysed by manganese(IV) oxide

The following experiments were carried out to investigate the rate of this reaction.

A 0.1 g sample of manganese(IV) oxide was added to 20 cm<sup>3</sup> of 0.2 M hydrogen peroxide solution. The volume of oxygen produced was measured every minute. The results of this experiment are shown on the graph.



- (i) How does the rate of reaction vary with time? Explain why the rate varies.

.....  
 ..... [3]

- (ii) The following experiment was carried out at the same temperature.

0.1 g of manganese(IV) oxide and 20 cm<sup>3</sup> of 0.4 M hydrogen peroxide

Sketch the curve for this experiment on the same grid.

[2]

- (iii) How would the shape of the graph differ if only half the mass of catalyst had been used in these experiments?

.....  
 .....  
 .....[2]

- 3 The elements in Period 3 and some of their common oxidation states are shown below.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Oxidation State	+1	+2	+3	+4	-3	-2	-1	0

- (a) (i) Why do the oxidation states increase from sodium to silicon?

.....[1]

- (ii) After Group(IV) the oxidation states are negative and decrease across the period. Explain why.

.....  
 .....[2]

- (b) The following compounds contain two elements. Predict their formulae.

aluminium sulphide .....

silicon phosphide ..... [2]

- (c) Choose a different element from Period 3 that matches each description.

- (i) It has a similar structure to diamond.

.....[1]

- (ii) It reacts violently with cold water to form a solution pH = 14.

.....[1]

- (iii) It has a gaseous oxide of the type  $XO_2$ , which is acidic.

.....[1]

- (d) The only oxidation state of argon is zero. Why it is used to fill light bulbs?

.....  
 .....[1]

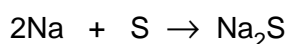
- (e) Draw a diagram that shows the arrangement of the valency electrons in the ionic compound sodium phosphide.

Use o to represent an electron from sodium.

Use x to represent an electron from phosphorus.

[3]

- (f) Sodium reacts with sulphur to form sodium sulphide.



An 11.5 g sample of sodium is reacted with 10 g of sulphur. All of the sodium reacted but there was an excess of sulphur.

Calculate the mass of sulphur left unreacted.

- (i) Number of moles of sodium atoms reacted = .....  
[2 moles of Na react with 1 mole of S]

- (ii) Number of moles of sulphur atoms that reacted = .....

- (iii) Mass of sulphur reacted = .....g

- (iv) Mass of sulphur left unreacted = .....g [4]

- 4 For over 5000 years copper has been obtained by the reduction of its ores. More recently the metal has been purified by electrolysis.

- (a) Copper is used to make alloys.

- (i) Give **two** other uses of copper.

.....[2]

- (ii) Alloys have similar structures to pure metals. Give a labelled diagram that shows the structure of a typical alloy, such as brass.

[3]

**(b)** Copper is refined by the electrolysis of aqueous copper(II) sulphate using copper electrodes. Describe the change that occurs at the electrodes.

**(i)** cathode (pure copper) .....  
.....[1]

**(ii)** anode (impure copper) .....  
.....[1]

**(iii)** Write an ionic equation for the reaction at the cathode.  
.....[1]

**(iv)** If carbon electrodes are used, a colourless gas is given off at the anode and the electrolyte changes from a blue to a colourless solution.

The colourless gas is .....

The solution changes into ..... [2]

**(c)** Electrolysis and cells both involve chemical reactions and electricity.

What is the essential difference between them?

.....  
.....[2]

**(d)** Copper is an unreactive metal. Its compounds are easily reduced to the metal or decomposed to simpler compounds. Complete the following equations.

**(i)** ...CuO + .....  $\rightarrow$  ...Cu + .....

**(ii)** Copper(II) hydroxide  $\xrightarrow{\text{(heat)}}$  ..... + .....  
.....

**(iii)**  $\text{Cu}(\text{NO}_3)_2 \xrightarrow{\text{(heat)}}$  ..... + ..... + .....  
[4]

**5** Alkenes are unsaturated hydrocarbons. They show structural isomerism. Alkenes take part in addition reactions and form polymers.

**(a)** Structural isomers have the same molecular formula but different structural formulae. Give an example of structural isomerism.

molecular formula .....

two structural formulae

[3]

**(b)** Ethene reacts with each of the following. Give the name and structural formula of each product.

**(i)** steam

name of product .....

structure of product

[2]

**(ii)** hydrogen

name of product .....

structure of product

[2]



(c) Alkenes polymerise by addition.

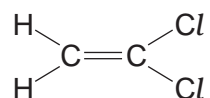
(i) Explain the term *polymerise*.

.....  
 .....[2]

(ii) What is the difference between addition polymerisation and condensation polymerisation?

.....  
 .....[2]

(iii) Poly(dichloroethene) is used extensively to package food. Draw its structure. The structural formula of dichloroethene is drawn below.



[2]

(d) Steel may be coated with another metal, eg zinc or chromium, or with a polymer, eg poly(chloroethene), to prevent rusting.

(i) Suggest a property of poly(chloroethene) that makes it suitable for this purpose.

.....[1]

(ii) Explain why the steel will rust when the protective coating of chromium or polymer is broken.

.....[1]

(iii) When the protective layer of zinc is broken, the steel still does not rust. Suggest an explanation.

.....  
 .....  
 .....[2]





**DATA SHEET**  
**The Periodic Table of the Elements**

		Group										
I	II	III	IV	V	VI	VII	0					
		1 <b>H</b> Hydrogen 1										4 <b>He</b> Helium 2
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4											20 <b>Ne</b> Neon 10
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	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					35.5 <b>Cl</b> Chlorine 17	
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16					40 <b>Ar</b> Argon 18		
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	56 <b>Fe</b> Iron 26	55 <b>Mn</b> Manganese 25	59 <b>Co</b> Cobalt 27	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
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	101 <b>Ru</b> Ruthenium 44	100 <b>Rh</b> Rhodium 45	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	190 <b>Os</b> Osmium 76	186 <b>Re</b> Rhenium 75	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	209 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86
		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	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	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103

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

**Key**

a	<b>X</b>
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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.).