

Candidate Name _____

Centre Number

Candidate
Number

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**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.

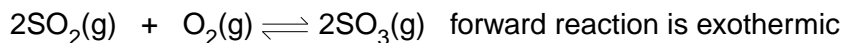
A copy of the Periodic Table is printed on page 12.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
TOTAL	

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.

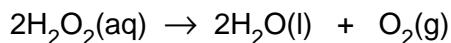
- (i) Complete the word equation.

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

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

.....[1]

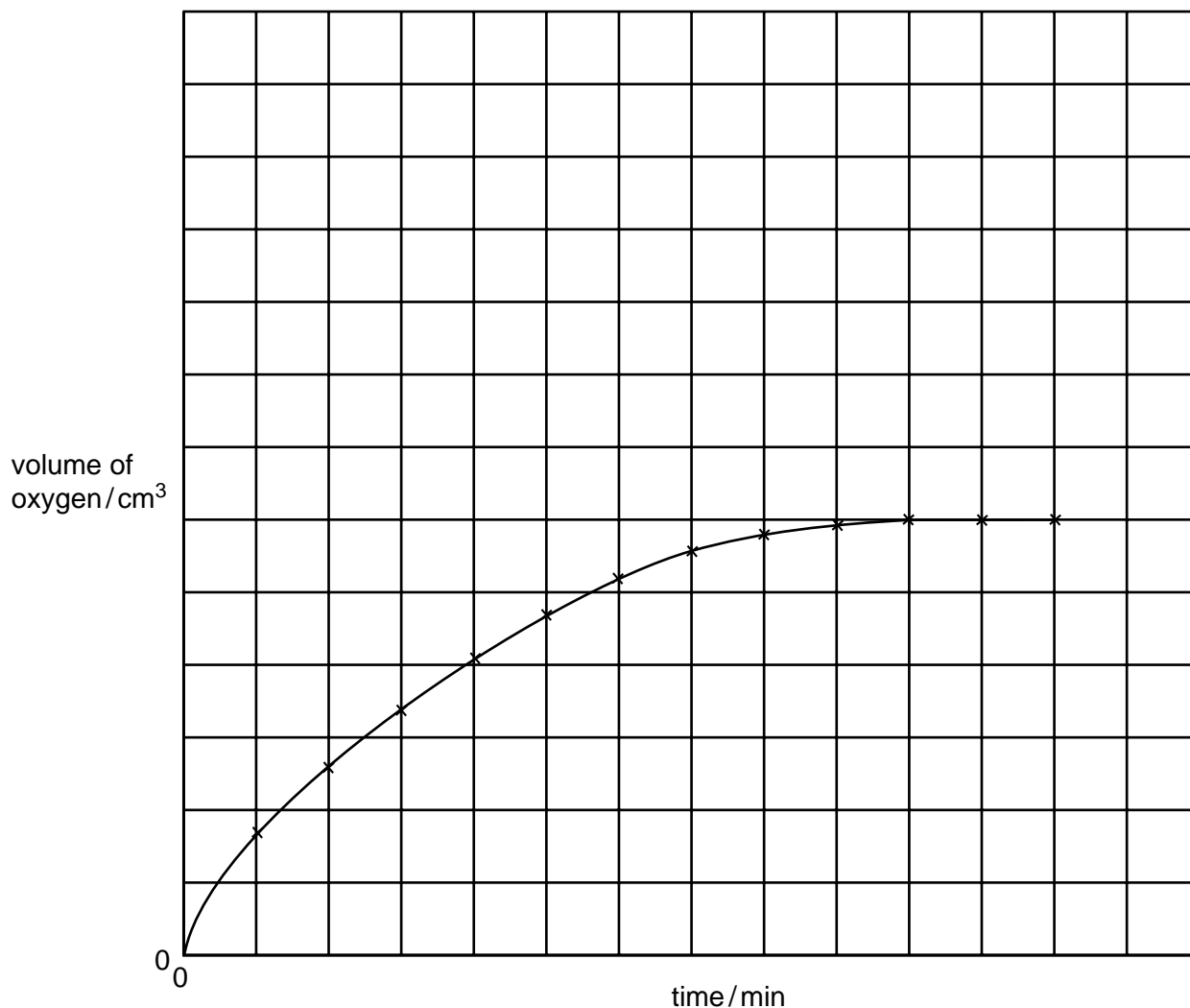
- (c) Aqueous hydrogen peroxide decomposes to form water and oxygen.



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 cm³ 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 cm³ 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]

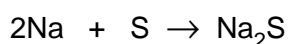
- (e) Draw a diagram that shows the arrangement of the valency electrons in the ionic compound sodium phosphide.

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.

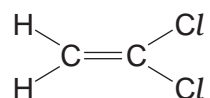
(i) Explain the term *polymerise*.

.....
[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					0		
		1 H Hydrogen 1										4 He Helium 2		
7 Li Lithium 3	9 Be Beryllium 4											20 Ne Neon 10		
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9					36 Kr Krypton 36			
39 K Potassium 19	40 Ca Calcium 20	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17					84 Ar Argon 18			
85 Rb Rubidium 37	88 Sr Strontium 38	45 Sc Scandium 21	48 Ti Titanium 22	59 Co Cobalt 27	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		
133 Cs Caesium 55	137 Ba Barium 56	89 Y Yttrium 39	91 Zr Zirconium 40	101 Ru Ruthenium 44	106 Pd Palladium 46	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		
226 Ra Radium 88	227 Ac Actinium 89	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	152 Eu Europium 63	157 Gd Gadolinium 64	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	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103
		150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71				

*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 dm³ at room temperature and pressure (r.t.p.).