Centre Number	Candidate Number	

International General Certificate of Secondary Education CAMBRIDGE INTERNATIONAL EXAMINATIONS

CHEMISTRY 0620/3

PAPER 3

Candidate Name

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 EXAM	INER'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.

	$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$	forward reaction is exothermic
(i)	What are the reaction conditions fo	r 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.

<u>titration</u> using a burette and indicator

<u>precipitation</u> by mixing the solutions and filtering

<u>neutralisation</u> 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)		results of an investigation into the action of heat on copper(II) sulphate-5-water, a crystalline solid, are given below.
	The	formula is CuSO ₄ .5H ₂ O and the mass of one mole is 250 g
		.0 g sample of the blue crystals is heated to form 3.2 g of a white powder. With ner heating this decomposes into a black powder and sulphur trioxide.
	(i)	Name the white powder.
	(ii)	What is observed when water is added to the white powder?
	(iii)	Name the black powder.
		[1]
	(iv)	Calculate the mass of the black powder. Show your working.
		[3]
		1-1
	-	ese is a transition element. It has more than one valency and the metal and its nds are catalysts.
cor	-	· · · · · · · · · · · · · · · · · · ·
cor	npou	nds are catalysts.
cor	npou	nds are catalysts.
cor	npou	Predict three other properties of manganese that are typical of transition elements.
cor	npou (i)	Predict three other properties of manganese that are typical of transition elements. [3]
cor	(ii) It ha	Predict three other properties of manganese that are typical of transition elements. [3] Complete the electron distribution of manganese by inserting one number.
(a)	(ii) It ha	Predict three other properties of manganese that are typical of transition elements. [3] Complete the electron distribution of manganese by inserting one number. 2 + 8 + + 2 [1] as several oxides, three of which are shown below. Inganese(II) oxide, which is basic. Inganese(III) oxide, which is amphoteric.
(a)	(ii) It had Man Man	Predict three other properties of manganese that are typical of transition elements. [3] Complete the electron distribution of manganese by inserting one number. 2 + 8 + + 2 [1] as several oxides, three of which are shown below. Inganese(II) oxide, which is basic. Inganese(III) oxide, which is amphoteric. Inganese(IV) oxide, which is acidic.
(a)	(ii) It had Man Man	nds are catalysts. Predict three other properties of manganese that are typical of transition elements. [3] Complete the electron distribution of manganese by inserting one number. 2 + 8 + + 2 [1] as several oxides, three of which are shown below. nganese(II) oxide, which is basic. nganese(III) oxide, which is amphoteric. nganese(IV) oxide, which is acidic. Complete the word equation. manganese(II) + hydrochloric →

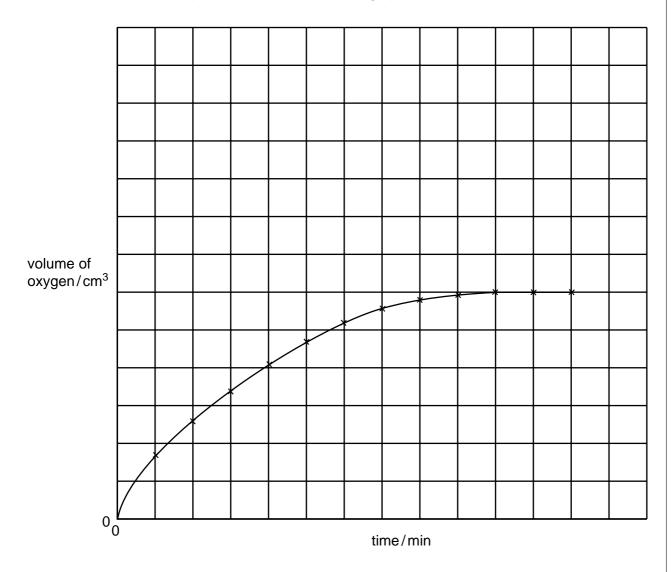
(c) Aqueous hydrogen peroxide decomposes to form water and oxygen.

$$2\mathrm{H_2O_2(aq)} \, \rightarrow \, 2\mathrm{H_2O(l)} \; + \; \mathrm{O_2(g)}$$

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 $20\,\mathrm{cm}^3$ 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.

(iii)	How would the shape of the graph differ if only half the mass of catalyst had been used in these experiments?
	[2]
The elem	nents in Period 3 and some of their common oxidation states are shown below.
Element Oxidation	G
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.
alun	ninium sulphide
silic	on phosphide[2]
(c) Cho	ose 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.
<u>-</u> .	[1]
(d) The	only oxidation state of argon is zero. Why it is used to fill light bulbs?

		6	
(e)		w a diagram that shows the arrangement of the valency electrons in the compound sodium phosphide.	
	Hea	e o to represent an electron from sodium.	
		•	[3]
(f)	Soc	lium reacts with sulphur to form sodium sulphide.	
		2Na + S \rightarrow Na ₂ S	
	An 11.5 g sample of sodium is reacted with 10 g of sulphur. All of the sodium reacted there was an excess of sulphur. Calculate the mass of sulphur left unreacted.		out
	(i)	Number of moles of sodium atoms reacted =	
	(ii)	Number of moles of sulphur atoms that reacted =	
	(iii)	Mass of sulphur reacted =g	
	(iv)	Mass of sulphur left unreacted =g	[4]
		5000 years copper has been obtained by the reduction of its ores. More recently the seen purified by electrolysis.	he
(a)	Cop	oper is used to make alloys.	
	(i)	Give two other uses of copper.	

4

.....[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)	Ele	ctrolysis and cells both involve chemical reactions and electricity.	
	Wh	at is the essential difference between them?	
		[2]	
(d)		oper is an unreactive metal. Its compounds are easily reduced to the metal or composed to simpler compounds. Complete the following equations.	
	(i)	CuO + →Cu +	
	(ii)	Copper(II) hydroxide \rightarrow +	
	(iii)	$\operatorname{Cu(NO_3)_2} \xrightarrow{\longrightarrow} \dots + \dots + \dots + \dots$	
		[4]	

5

		are unsaturated hydrocarbons. They show structural isomerism. Alkenes take part on reactions and form polymers.
(a)		uctural isomers have the same molecular formula but different structural formulae. e an example of structural isomerism.
	mol	ecular formula
	two	structural formulae
		[3]
(b)		ene reacts with each of the following. Give the name and structural formula of each duct.
	(i)	steam
		name of product
		structure of product
		[2]
	(ii)	hydrogen
	. ,	name of product
		structure of product
		[2]

		9
(c)	Alke	enes polymerise by addition.
	(i)	Explain the term <i>polymerise</i> .
		[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.
		H C = C Cl
		[2]
(d)		el may be coated with another metal, eg zinc or chromium, or with a polymer, eg (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.

BLANK PAGE

BLANK PAGE

DATA SHEET
The Periodic Table of the Elements

The Periodic Lable of the Elements	Group	0	4 He lium	20 Neon 10 Ar Argan	84 Krypton 36	131 Xe Xenon Xenon 54	Rn Radon 86		175 Lu Lutetium 71	Lr Lawrendium 103
		II/		19 Fluorine 9 35.5 C1 Chlorine	80 Br Bromine 35	127 I lodine 53	At Astatine 85		173 Yb Ytterbium 70	No Nobelium
		5		16 Oxygen 8 32 Sulphur 16	Selenium 34	128 Te Tellurium 52	Po Polonium 84		169 Tm Thulium	Md Mendelevium 101
		>		14 Nitrogen 7 31 9 Phosphorus 15	75 AS Arsenic 33	122 Sb Antimony 51	209 Bi Bismuth 83		167 Er Erbium 68	Fm Fermium
		2		Carbon 6 Silicon 14	73 Ge Germanium 32	Sn Tin 50	207 Pb Lead		165 Ho Holmium 67	Es Einsteinium 99
		=		11 Baron 5 27 AI Aluminium 13	70 Ga Gallium 31	115 In Indium 49	204 Tt Thallium		162 Dy Dysprosium 66	Californium 98
					65 Zn 2inc 30	Cadmium 48	201 Hg Mercury		159 Tb Terbium 65	BK Berkelium 97
					64 Copper 29	108 Ag Silver 47	197 Au Gold 79		157 Gd Gadolinium 64	
					59 Nickel	106 Pd Palladium 46	195 Pt Platinum 78		152 Eu Europium 63	1
					59 Cobalt	103 Rh Rhodium 45	192 Ir Iridium		Sm Samarium 62	Pu Plutonium 94
			Hydrogen		56 Fe Iron	Ruthenium 44	190 Os Osmium 76		Pm Promethium 61	Neptunium
					Manganese	Tc Technetium 43	186 Re Rhenium 75		Neodymium 60	238 U Uranium 92
					52 Cr Chromium 24	96 Mo Molybdenum 42	184 W Tungsten 74		141 Pr Praseodymium 59	Pa Protactinium 91
					51 V Vanadium 23	Niobium 41	181 Ta Tantalum 73		140 Ce Cerium 58	232 Th Thorium
					48 T Titanium	91 Zr Zirconium 40	178 Hf Hafnium 72			nic mass bol nic) number
					Scandium 21	89 ≺ Yttrium 39	139 La Lanthanum 57 *	227 Ac Actinium †	l series series	a = relative atomic mass X = atomic symbol b = proton (atomic) number
		=		Be Beryllium 4 24 Mg Magnesium 12	40 Ca Calcium	Strontium	137 Ba Barium 56	226 Ra Radium 88	anthanoic Actinoid 8	« × ₩
		_		7 Lithium 3 23 Na Sodium 11	39 R Potassium 19	85 Rb Rubidium 37	133 CS Caesium 55	Fr Francium 87	*58-71 Lanthanoid series †90-103 Actinoid series	Key
					0620/3/	O/N/02				

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).