

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
CHEMISTRY			0620/33
Paper 3 (Extended)		Octo	ober/November 2010

Candidates answer on the Question Paper.

No Additional Materials are required.

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.

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

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

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

At the end of the examination, fasten all your work securely together.

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

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1		
2		
3		
4		
5		
6		
7		
Total		

1 hour 15 minutes

This document consists of 14 printed pages and 2 blank pages.



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[Turn over

1 The diagrams below show the electron arrangement in two compounds.

00 +	×× _	××
8 K 8 '	${}^{ imes}_{\circ}Cl_{ imes}^{ imes}$	$H_{\circ}^{\times}O_{\circ}^{\times}H$
$\overline{}$	_ × ×	××

(a)	In a water molecule, each hydrogen atom is bonded to the oxygen atom by sharing a pair of electrons.
	Why does an oxygen atom share two pairs of electrons rather than just one pair?
	[1]
(b)	Describe how a potassium atom becomes a potassium ion.
	[1]
(c)	Why is there a bond between the ions in potassium chloride?
	[1]
(d)	Solid potassium chloride is a poor conductor of electricity. When dissolved in water it is a good conductor. Explain.
	[2]
	[Total: 5]

- 2 Vanadium is a transition element.
 - (a) An atom of the most common isotope of vanadium can be represented as $^{51}_{23}\mathrm{V}\,.$

Complete the following table to show the number of protons, electrons and neutrons in each particle.

particle	number of protons	number of electrons	number of neutrons
⁵¹ ₂₃ V			
⁵¹ ₂₃ V ³⁺			
⁵⁰ ₂₃ V			

[3]

(b)	The	e major use of vanadium is to make vanadium steel alloys.
	(i)	Explain the phrase steel alloys.
		[2]
	(ii)	State the name and use of another steel alloy.
		name
		use[2]
(c)	Two	o of the oxidation states of vanadium are +3 and +4.
	(i)	Write the formula of vanadium(III) oxide and of vanadium(IV) oxide.
		vanadium(III) oxide
		vanadium(IV) oxide[2]
	(ii)	Vanadium(III) oxide is basic and vandium(IV) oxide is amphoteric. Describe how you would obtain a sample of vanadium(III) oxide from a mixture of these two oxides.
		[3]
		[Total: 12]

3 The reactions of a metal and the thermal stability of some of its compounds are determined by the position of the metal in the reactivity series.

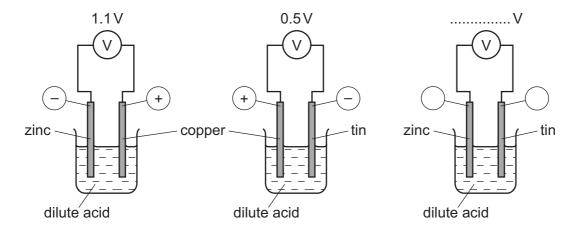
(a) To find the order of reactivity of the metals, cobalt, magnesium, silver and tin, the following experiments were carried out.

experiment	result
tin plus silver(I) nitrate solution	silvery layer on tin
magnesium plus tin(II) nitrate solution	grey deposit on magnesium
tin plus cobalt nitrate solution	no reaction

		tin plus copait nitrate solution	no reaction	I
	(i)	Give as far as possible the order of react Write the least reactive first.	civity of these metals.	
				[2]
	(ii)	What additional experiment needs to b reactivity?	e done to put all four metals	s in order of
				[1]
	(iii)	Write an ionic equation for the reaction be on the equation the change which is oxic		ons. Indicate
				[3]
(b)		dium is a more reactive metal than magne in magnesium compounds.	sium. Sodium compounds are	more stable
		an experiment, their hydroxides were heate reaction' otherwise complete the equation		ompose write
	Na	OH →		
	Mg	J(OH)₂ →		[2]

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(c) A cell consists of two different metal electrodes in an electrolyte. Three possible cells are shown below.



(i)	Why is the more reactive metal the negative electrode?	
(ii)	How can you deduce that zinc is more reactive than tin?	[2]
		[1]
(iii)	How could you change the zinc/copper cell to have a voltage greater than 1.1	V?
		[1]
(iv)	Complete the labelling of the zinc/tin cell.	[2]
	[Tota	al: 14]

The electrolysis of concentrated aqueous sodium chloride, between inert electrodes, is used to make four important chemicals.

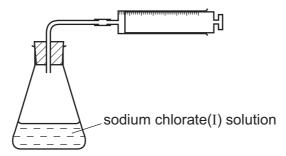
hydrogen ch SO SO

chlo sodi	chlorine sodium hydroxide sodium chlorate(I)				
(a)	The	ions present in the electrolyte are Na ⁺ , H ⁺ , C <i>l</i> ⁻ and OH ⁻ .			
	(i)	Hydrogen ions are discharged at the negative electrode (cathode). Write an equation for this reaction.			
			[2]		
	(ii)	The hydrogen ions are from the water.			
		$H_2O \rightleftharpoons H^+ + OH^-$			
		Suggest an explanation why the concentration of hydroxide ions increases.			
			[2]		
(iii)	When a dilute solution of sodium chloride is used, chlorine is not formed at t positive electrode (anode), a different gas is produced. Name this gas.	:he		
			[1]		
(iv)	State an example of an inert electrode.			
			[1]		
(b)	(i)	State a use of hydrogen.			
			[1]		
((ii)	Why is chlorine used to treat the water supply?			

© UCLES 2010 0620/33/O/N/10 (c) Sodium chlorate(I) is made by the reaction between chlorine and sodium hydroxide. It is used as bleach but over time it decomposes.

$$2NaClO(aq) \rightarrow 2NaCl(aq) + O_2(g)$$

The rate of decomposition can be studied using the apparatus shown below.



(i)	How could you measure the rate of decomposition of sodium chlorate(I)?
	[1]
(ii)	Describe how you could show that the rate of decomposition of sodium chlorate(I) is a photochemical reaction.
	[2]

[Total: 11]

$$-C$$
 or $-COOH$.

- (a) Ethanoic acid is a typical carboxylic acid. It forms ethanoates.
 - (i) Complete the following equations.

5

$Mg + \dots + \dots + \dots + \dots$	
	[2
sodium + ethanoic → +	

(ii) Ethanoic acid reacts with ethanol to form an ester. Give the name of the ester and draw its structural formula. Show all of the bonds.

name	 	 	 	

structural formula

[2]

[1]

- **(b)** Maleic acid is an unsaturated acid. 5.8 g of this acid contained 2.4 g of carbon, 0.2 g of hydrogen and 3.2 g of oxygen.
 - (i) How do you know that the acid contained only carbon, hydrogen and oxygen?
 - (ii) Calculate the empirical formula of maleic acid.

Number of moles of carbon atoms =

Number of moles of hydrogen atoms =

Number of moles of oxygen atoms =

The empirical formula is[3]

(iii)	The mass of one mole of maleic acid is 116 g. What is its molecular formula?
	[2]
(iv)	Maleic acid is dibasic. One mole of acid produces two moles of H ⁺ . Deduce its structural formula.
	[2]
	[Total: 13]

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[2]

6 The Kinetic Theory explains the properties of matter in terms of the arrangement and movement of particles.

- (a) Nitrogen is a gas at room temperature. Nitrogen molecules, N_2 , which are spread far apart move in a random manner at high speed.
 - (i) Draw a diagram showing the arrangement of the valency electrons in a nitrogen molecule.

Use \times to represent an electron from a nitrogen atom.

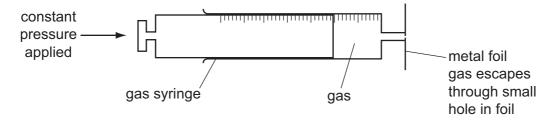
(ii)	How does the movement and arrangement of the molecules in a crystal of nitrogen differ from those in gaseous nitrogen?
	[3]
Use	e the ideas of the Kinetic Theory to explain the following.
(i)	A sealed container contains nitrogen gas. The pressure of a gas is due to the molecules of the gas hitting the walls of the container. Explain why the pressure inside the container increases when the temperature is increased.

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(b)

(ii) The following apparatus can be used to measure the rate of diffusion of a gas.

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The following results were obtained.

gas	temperature /°C	rate of diffusion in cm³/min
nitrogen	25	1.00
chlorine	25	0.63
nitrogen	50	1.05

Explain why nitrogen diffuses faster than chlorine.	
Explain why the nitrogen diffuses faster at the higher temperature.	
	[1]
	[Total: 10

- 7 Synthetic polymers are widely used in the modern world.
 - (a) Their use has brought considerable advantages to modern life as well as some disadvantages.
 - (i) Suggest **two** advantages of a plastic bucket compared to a steel bucket.

[2]

(ii) Name two uses of man-made fibres, such as nylon and Terylene.

(iii) Describe the pollution caused by synthetic polymers.

- **(b)** One type of polymer is formed by addition polymerisation.
 - (i) The structural formula of an addition polymer is given below.

Give the name and structural formula of the monomer.

name of monomer[1]

structural formula of monomer

[1]

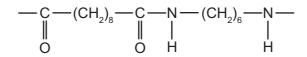
(ii) Draw the structural formula of the addition polymer formed by the polymerisation of phenylethene. The structural formula of phenylethene is given below.

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$$C_6H_5$$
 $C=C$

[2]

(c) Nylon is made by condensation polymerisation. It has the structural formula shown below.



(i)	Name th	he linkage	in this	polymer.
-----	---------	------------	---------	----------

[4]
 [1]

(ii) Name the natural macromolecules which have the same linkage.

[4	
	[1]

(iii) Deduce the formulae of the two monomers which reacted to form the nylon and water.

monomer	
HIGHORIC	

monomer

[2]

[Total: 15]

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DATA SHEET
The Periodic Table of the Elements

								Gro	Group							-	
-	=											≡	≥	>	>	\	0
		I					T Hydrogen										4 He Helium
7 Li Lithium	9 Be Beryllium											11 Boron 5	12 C Carbon 6	14 N itrogen 7	16 Oxygen	19 T Fluorine	20 Ne Neon
23 Na Sodium	Magnesium	-										27 A1 Aluminium 13	28 Si Silicon	31 P Phosphorus 15	32 S Sulfur 16	35.5 C1 Chlorine	40 Ar Argon
39 K Potassium	Ca Calcium 20	Scandium	48 Ti Titanium	51 V Vanadium 23		Manganese	56 Fe Iron	59 Cobalt	59 Nickel	64 Cu Copper	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	AS AS Arsenic	Selenium	80 Br Bromine 35	84 Kr Krypton 36
Rb Rbidium 37	Strontium 38	89 ×	91 Zr Zirconium 40	93 Nb Nobium 41	96 Mo Molybdenum 42	Tc Technetium 43	Ru Ruthenium 44	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 lodine 53	131 Xe Xenon
133 Cs Caesium 55	137 Ba n Barium 56	139 La Lanthanum *	178 Hf Hafnium 72	181 Ta Tantanum 73	184 W Tungsten 74		190 Os Osmium 76		195 Pt Platinum 78	197 Au Gold	1	204 T 1 Thallium	207 Pb Lead	209 Bi Bismuth 83	Po Polonium 84	At	Radon 86
Francium 87	226 Ra	Actinium terminal Actinium ter															
*58-71 190-10	*58-71 Lanthanoid series	id series series		140 Ce Cerium	Pr Praseodymium 59	Neodymium	Pm Promethium 61	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
Key	e ×	 a = relative atomic mass X = atomic symbol b = proton (atomic) number 	1	232 Th Thorium	Pa Protactinium 91	238 U Uranium 92	Neptunium	Pu Plutonium 94			BK Berkelium 97			Fm Fermium		Nobelium 102	Lr Lawrendu 103

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

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