



Cambridge International Examinations

Cambridge International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

CHEMISTRY 0620/31

Paper 3 (Extended) May/June 2015

1 hour 15 minutes

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 an HB pencil for any diagrams or graphs.

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

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

Electronic calculators may be used.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.



1

Coal is a solid fossil fuel.			
Name two other fossil fuels.			
[2	2]		
Two of the elements present in a sample of coal are carbon and sulfur.			
A sample of coal was heated in the absence of air and the products included water, ammoniand hydrocarbons.	а		
Name three other elements present in this sample of coal.			
[2	2]		
Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide whic reacts with rain water to form sulfuric acid.	h		
(i) Describe how the high temperatures in vehicle engines are another cause of acid rain.			
	••		
[3	3]		
(ii) Give two harmful effects of acid rain.			
[2	2]		
In 2010, a large coal-burning power station in the UK was converted to burn both coal an wood.	d		
Explain why the combustion of wood rather than coal can reduce the effect of the emission from this power station on the level of carbon dioxide in the atmosphere.	IS		
[Total: 12	-		
	Two of the elements present in a sample of coal are carbon and sulfur. A sample of coal was heated in the absence of air and the products included water, ammoniand hydrocarbons. Name three other elements present in this sample of coal. [2] Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide whice reacts with rain water to form sulfuric acid. (i) Describe how the high temperatures in vehicle engines are another cause of acid rain. [3] [4] [6] In 2010, a large coal-burning power station in the UK was converted to burn both coal and wood. Explain why the combustion of wood rather than coal can reduce the effect of the emission from this power station on the level of carbon dioxide in the atmosphere.		

2

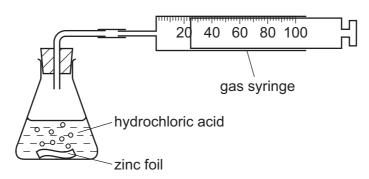
		m the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, and phosphorus, which have to be removed when this iron is converted into steel.
(a)	equ	plain how the addition of oxygen and calcium oxide removes these impurities. Include an lation for a reaction of oxygen and a word equation for a reaction of calcium oxide in this cess.
		[5]
(b)	Milo	d steel is the most common form of steel. Mild steel contains a maximum of 0.3% of carbon.
	Hig	h carbon steel contains 2% of carbon. It is less malleable and much harder than mild steel.
	(i)	Give a use of mild steel.
	(ii)	Suggest a use of high carbon steel.
((iii)	Explain why metals are malleable.
		[3]
((iv)	Suggest an explanation why high carbon steel is less malleable and harder than mild steel.
		[2]
		[Total: 12]

3 (a) The reactions between metals and acids are redox reactions.

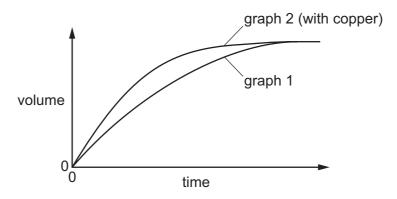
$$Zn + 2H^+ \rightarrow Zn^{2+} + H_2$$

(i) Which change in the above reaction is oxidation, Zn to Zn^{2+} or $2H^+$ to H_2 ? Give a reason for your choice.

- (ii) Which reactant in the above reaction is the oxidising agent? Give a reason for your choice.
- **(b)** The rate of reaction between a metal and an acid can be investigated using the apparatus shown below.



A piece of zinc foil was added to 50 cm³ of hydrochloric acid, of concentration 2.0 mol/dm³. The acid was in excess. The hydrogen evolved was collected in the gas syringe and its volume measured every minute. The results were plotted and labelled as graph 1.



The experiment was repeated to show that the reaction between zinc metal and hydrochloric acid is catalysed by copper. A small volume of aqueous copper(II) chloride was added to the acid before the zinc was added. The results of this experiment were plotted on the same grid and labelled as graph 2.

[2]
[3]
rochloric
[4]
acid, of
[3]
ری [otal: 16]

[Turn over

4	The alcohols	form	а	homo	logous	series

(a) (i)	Give three characteristics which all members of a homologous series share.			
(ii)	Give the name of the third member of this series.			
	name	[1]		
(iii)	Deduce the molecular formula of the alcohol whose $M_{\rm r}$ = 158. Show your working.			
		. [2]		
(b) Exp	plain why the following two alcohols are isomers.			
	CH_3 CH_3 CH_3 CH_3 CH_2 CH_2 CH_2 CH_2 CH_3 CH_3			

(c)	Thi	s question is based on typical reactions of butan-1-ol.	
	(i)	When butan-1-ol, $\mathrm{CH_3-CH_2-CH_2-OH}$, is passed over the catalyst silicon(IV) ox water is lost.	ide,
		Deduce the name and the structural formula of the organic product in this reaction.	
		name	
		structural formula	
			[2]
	(ii)	Suggest the name of the ester formed from butanol and ethanoic acid.	,
	,		[1]
	(iii)	Butan-1-ol is oxidised by acidified potassium manganate(VII).	
		Deduce the name and the structural formula of the organic product in this reaction.	
		name	
		structural formula	
			[0]
		FT-1-1.	[2]
		[Total:	13]

- 5 The halogens are a group of non-metals in Group VII of the Periodic Table.
 - (a) The reactivity of the halogens decreases down the group.

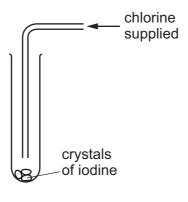
(b)

Describe an experiment which shows that chlorine is more reactive than iodine. Include an equation in your answer.
[3
The halogens form interhalogen compounds. These are compounds which contain two different halogens.
Deduce the formula of the compound which has the composition 0.013 moles of jodine atoms

and 0.065 moles of fluorine atoms.

[2

(c) Iodine reacts with chlorine to form a dark brown liquid, iodine monochloride.



$$I_2(s) + Cl_2(g) \rightarrow 2ICl(I)$$

When more chlorine is added and the tube is sealed, a reversible reaction occurs and the reaction comes to equilibrium.

$$ICl(I) + Cl_2(g) \rightleftharpoons ICl_3(s)$$
 dark brown yellow

(i) Give another example of a reversible reactio	n.
--	----

.....[1]

(ii) Explain the term equilibrium.

......[2]

(d)	Chlorine is removed from the tube and a new equilibrium is formed.
	Explain why there is less of the yellow solid and more dark brown liquid in the new equilibrium mixture.
	[2]
(e)	A sealed tube containing the equilibrium mixture is placed in ice-cold water. There is an increase in the amount of yellow solid in the equilibrium mixture.
	What can you deduce about the forward reaction in this equilibrium?
	$ICl(I) + Cl_2(g) \rightleftharpoons ICl_3(s)$
	Explain your deduction.
	[3]
	[Total: 13]

6

Acid-base reactions are examples of proton transfer.					
(a) Eth	hylamine is a weak base and sodium hydroxide is a strong base.				
(i)	In terms of proton transfer, explain what is meant by the term weak base.				
	[2]				
(ii)	Given aqueous solutions of both bases, describe how you could show that sodium hydroxide is the stronger base. How could you ensure a 'fair' comparison between the two solutions?				
	[3]				
(b) Eth	nylamine reacts with acids to form salts.				
	$\label{eq:charge_state} $				
(i)	Complete the equation for the reaction between sulfuric acid and ethylamine. Name the salt formed.				
	\dots CH ₃ CH ₂ NH ₂ + \dots \rightarrow \dots				
	name of salt[3]				
(ii)	Amines and their salts have similar chemical properties to ammonia and ammonium salts.				
	Suggest a reagent that could be used to displace the weak base, ethylamine, from its salt ethylammonium chloride.				
	[1]				

[Total: 14]

		•••	
(c)	Ga	ases diffuse, which means that they move to oc	cupy the total available volume.
	(i)	Explain, using kinetic particle theory, why gas	ses diffuse.
			[2]
	(ii)	When the colourless gases hydrogen bromid solid is formed.	e and ethylamine come into contact, a white
		$CH_3CH_2NH_2(g) + HBr(g) \rightarrow 0$	CH ₃ CH ₂ NH ₃ Br(s) white solid
		The following apparatus can be used to comethylamine and hydrogen bromide.	pare the rates of diffusion of the two gases
		gives off	gives off
		CH ₃ CH ₂ NH ₂ (g)	HBr(g)
		A B	C 383
	CC	otton wool soaked in	cotton wool soaked in
		ethylamine(aq)	conc. hydrobromic acid
		Predict at which position, A , B or C , the white	e solid will form. Explain your choice.

[3]

DATA SHEET
The Periodic Table of the Elements

Group	0	4 He Helium	20 Neon 10 Argon	18	8 7	Krypton 36	131	Xe Xenon 54	R	Radon 86		175 Lu Lutetium		L	Lawrengum 103
	IIA		19 Fluorine 9 35.5 C1		∞ ਯ	Bromine 35	127	L lodine 53	Ą	m		173 Yb Ytterbium 70			Nobelium 102
	>		Oxygen 32 Suffer Suffer	16	Se 79		128	Te Tellurium 52	Ъ	_		169 Tm Thulium 69			Mendelevium 101
			Nitrogen 7 31 31 Phosphorus	\rightarrow	75 As		122	Sb Antimony 51	209 B			167 Er Erbium 68			100
	<u>\</u>		Carbon 6 28 Silicon	14	д е	E	119	Sn Tin	207 Pb			165 Ho Holmium 67			einsteinium 99
	=		B Boron 5 27 A1 Aluminium	13	° 20		115	Indium	204 T 1			162 Dy Dysprosium 66	_		Californium 98
					Se Zn	Zinc 30	112	Cadmium 48	201 Ha	Mercury 80		159 Tb Terbium 65		Berkellin	
					⁸ O	Copper 29	108	Ag Silver 47	197 Au	Plo9 79		157 Gd Gadolinium 64		Ca Culling	96
					²⁹	Nickel 28	106	Pd Palladium 46	195 T	Platinum 78		152 Eu Europium 63		Americium	Amencium 95
					္ဖ ၀	Cobalt 27	103	Rhodium	192 I r	Iridium 77		Sm Samarium 62		Pu	
		T Hydrogen			ъ В В	Iron 26	101	Ru Ruthenium 44	190 O S	Osmium 76		Pm Promethium 61		V	Neptunium 93
					55 Mn	Manganese 25		Tc Technetium 43	786 Re	Rhenium 75		Neodymium 60	238		Uranium 92
					ن وو	Chromium 24	96	Molybdenum	184	Tungsten 74		Pr Praseodymium 59		Profestinium	Protactinium 91
					51	Vanadium 23	93	Niobium	181 a	Tantalum 73		140 Ce Cerium	232	Th mind	06
					8 F	Titanium 22	91	Zr Zirconium 40	178 ‡	72			nic mass	loq	nic) number
					Sc Sc	Scandium 21	68	Yttrium 39	139 La	Lanthanum 57 *	Actinium teges	l series eries	a = relative atomic mass	X = atomic symbol	b = proton (atomic) number
	=		Beryllium 4 24 Mg Magnesium	12	9 Q	Calcium 20	88	Strontium 38	137 Ba	Barium 56	226 Ra Radium 88	*58-71 Lanthanoid series 190-103 Actinoid series		× ×	ё П
	_		Lithium 3 Lithium 3 23 Na Sodium	7	® ×	Potassium 19	82	Rb Rubidium 37	133 CS	Caesium 55	Francium 87	*58-71 L:		Key	٩

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

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.