



Cambridge International Examinations

Cambridge International General Certificate of Secondary Education (9-1)

CANDIDATE NAME				
CENTRE NUMBER		CANDIDATE NUMBER		

CHEMISTRY
Paper 3 The

0971/03

Paper 3 Theory (Core)

For Examination from 2018

SPECIMEN PAPER

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, graphs or rough working.

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

DO **NOT** WRITE IN ANY BARCODES.

Answer all questions.

Electronic calculators may be used.

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

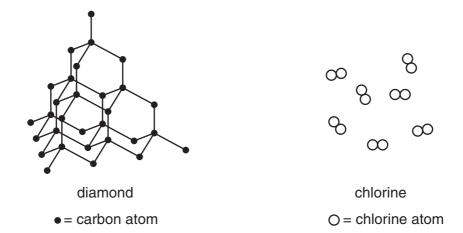
A copy of the Periodic Table is printed on page 16.

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.



1 The structures of diamond and chlorine are shown below.



(a) Describe the structure of these two substances. Use the list of words to help you.

CO	valent	diatomic	giant	macromolecule	molecule	structure	
diamon	d						
							•••••
chlorine))						
							[4]

(b) The structure of a compound containing carbon and chlorine is shown below.

$$\begin{array}{c|cccc}
Cl & Cl \\
Cl & Cl \\
Cl & C \\
Cl & Cl \\
Cl &$$

What is the molecular	tormula of	this c	ompound?
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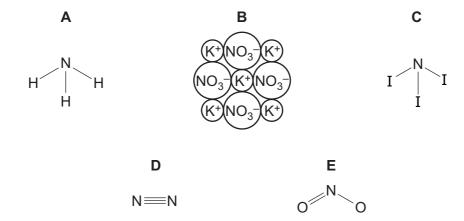
[1]

					3			
(c)	Chl	orine is	a halogen.					
	(i)	State	the colour o	f chlorine.				
	[
	The	table s	shows some	e properties of the h	nalogens.			
				T				
			element	boiling point/°C	density in liquid state/g per cm ³	colour		
			fluorine	-188	1.51	yellow		
			chlorine	-35	1.56			
			bromine	-7		red-brown		
			iodine	+114	4.93	grey-black		
	Use	e the int	formation in	the table to answe	r the following ques	stions.		
	(ii)	Predic	t the density	y of liquid bromine.				
	` ,			,				[1]
	(iii)	Doscri	iho tho trong	t in boiling point of	the halogens down	the group		Γ.1
,	(111)	Descri	ibe the trent	a in boiling point of	the halogens down	tile group.		[4]
								[1]
(d)	(i)	Comp	lete the wor	d equation for the r	eaction of bromine	with aqueous	potassium iodid	e.
		bromir	ne + potassi	ium iodide \rightarrow	+			
								[2]
	(ii)	Sugge	est why bron	nine does not react	t with aqueous pota	ssium chloride	e.	
								[1]
(e)				an ionic substance d molecular substa	but iodine is a mole	ecular substar	ice.	
	5010	ability II	ı waltı:		********************************			
								••••
	ele	ctrical c	conductivity?	,				••••
		[2]						

2	Bro	omine is an ele	ment in Group VII	of the Periodic Table	2 .	
	(a)	State the form	nula for a molecule	of bromine.		
					[1]
	(b)	After two mir	nutes red-brown fui		in the bottom of a sealed gas jar of a above the liquid surface. After one ho nout the gas jar.	
			air liquid bromine			
		st	tart	after 2 minutes	after 1 hour	
		Use the kinet	ic particle model of	matter to explain th	ese observations.	
		******************			[3]

[Total: 4]

3 The structures of some substances containing nitrogen are shown below.

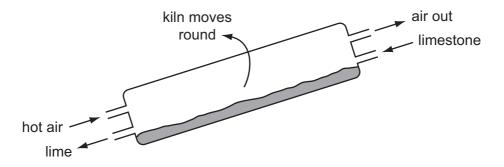


Answer the following questions by choosing from the structures $\bf A$, $\bf B$, $\bf C$, $\bf D$ or $\bf E$. You can use each structure once, more than once or not at all.

Which structure represents

(a)	an acidic oxide,	[1]
(b)	an ionic structure,	[1]
(c)	a gas which turns damp red litmus paper blue,	[1]
(d)	a compound which is formed under conditions of high temperature and pressure in car engines	[1]
(e)	a molecule containing halogen atoms,	[1]
(f)	a salt?	[1]
		[Total: 6]

The diagram shows a rotary lime kiln used to make lime from limestone. Limestone is fed in at the top of the kiln and lime comes out at the bottom.

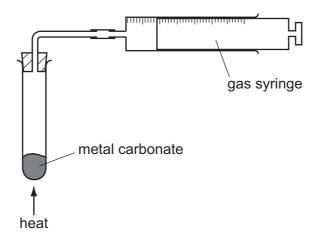


(a)	State the	chemical	name	for	lime
-----	-----------	----------	------	-----	------

		[1]
(b)	State the name of the type of chemical reaction that takes place in the kiln.	
		[1]
(c)	Suggest why the air coming out of the kiln has a greater percentage of carbon dioxide t the air entering the kiln.	har
		[1]
(d)	State one use for lime.	

[1]

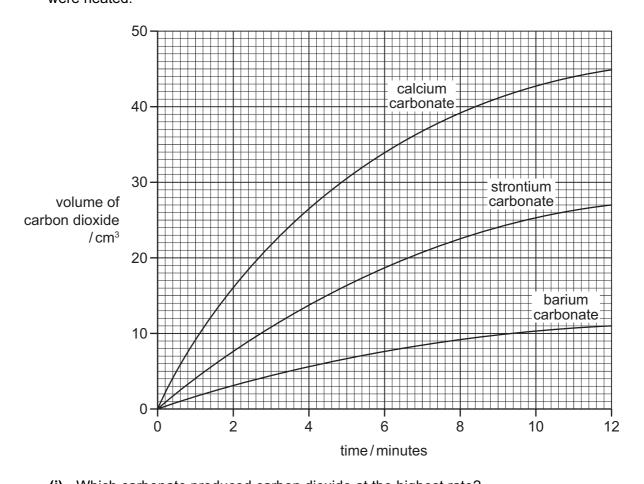
(e) A student compared the rates of reaction of three metal carbonates. She measured the volume of gas released using the apparatus shown.



State **one** thing that must be kept constant if the rates of the three reactions are to be compared in a fair way.

[1]

(f) The graph shows the volume of carbon dioxide released when the three metal carbonates were heated.



y which carbonate produced carbon dioxide at the highest rate?
[1]
) What volume of carbon dioxide was produced by strontium carbonate in twelve minutes?
[1]
) How do the rates of the reactions of these three metal carbonates relate to the position of calcium, strontium and barium in the Periodic Table?
[2]

9)	present in calcium carbonate.	אוג
		[3]

Iron	ı is a	transition element.	
(a)	Stat	te three properties of transition elements which are not shown by the Group I elements	S.
	1.		
	2.		
	3.		[3]
(b)	Tho	e symbols for two isotopes of iron are shown below.	
(10)	1110		
		⁵⁴ ₂₆ Fe ⁵⁷ ₂₆ Fe	
	(i)	How do these two isotopes differ in their atomic structure?	
			[1]
	(ii)	Determine the number of neutrons present in one atom of the isotope $\frac{57}{26}$ Fe.	
		20	[4]
	/:::\	Determine the number of electrons in one Fe ³⁺ ion.	[1]
	(iii)		[4]
			[1]
(c)	Pur	e iron rusts very easily.	
	Des	scribe and explain one method of preventing rusting.	
	met	thod	
	ехр	lain why this method works	
			[2]
(1.)	سمسا		
(a)		can be recycled.	
	⊏xp	plain two advantages of recycling metals.	
			•••••
			•••••
			[2]

(e) In the blast furnace, iron(III) oxide reacts with carbon monoxide.

(f)

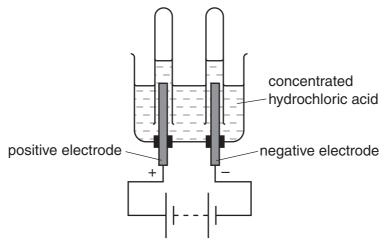
$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

Which substance gets reduced in this reaction?
Explain your answer.

sub	stance	
exp	lanation	
		[2]
(i)	Carbon monoxide is a pollutant gas produced in motor car engines. State why carbon monoxide is formed.	
(ii)	State one harmful effect of carbon monoxide.	[1]
		[1]

[Total: 14]

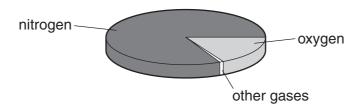
Concentrated hydrochloric acid can be electrolysed using the apparatus shown.



(a)	Define the term electr	rolysis?					
							[1]
(b)	What is the name given Put a ring around the	•					
	anion	anode c	athode	cation	electrolyte		ra t
							[1]
(c)	State the name of the	gas given off a	at the negative	electrode.			
							[1]
(d)	Complete the following	g sentence abo	out electrolysis	s using word	s from the list.		
	inert r	nagnesium	platinum	reactiv	e solid		
	Electrodes made of	graphite or		are g	enerally used	in electroly	/sis
	because they are						[2]

(e)	Wh	en concentrated hydrochloric acid is electrolysed, chlorine is released.	
	(i)	Draw the shells and the electronic structure in an atom of chlorine.	
	(ii)	Draw the electronic structure of a chlorine molecule. Show only the outer electron shells.	[1]
			[2]
	(iii)	Describe a test for chlorine.	
		test	
		result	[2]
(f)	Нус	drochloric acid reacts with the base calcium hydroxide.	
	(i)	Complete the word equation for this reaction.	
		hydrochloric acid + calcium hydroxide \rightarrow +	
			[2]
	(ii)	Hydrochloric acid also reacts with zinc. Complete the symbol equation for this reaction.	
		$Zn + \dots HCl \rightarrow ZnCl_2 + \dots$	[2]
		[Total:	14]

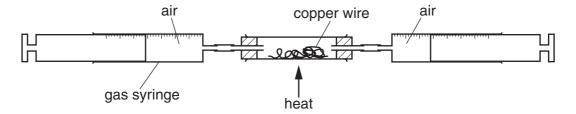
7 The pie chart shows the composition of air.



	(a)	(i)	What is the	percentage	of nitrogen	in the air?
--	-----	-----	-------------	------------	-------------	-------------

		[1]
(ii)	Apart from nitrogen and oxygen, state the names of two gases present in unpollute	d air.
	and	[2]

(b) The percentage of oxygen in air can be found using the apparatus shown below.



Air is passed backwards and forwards over the heated copper using the syringes. The copper reacts with oxygen in the air.

copper + oxygen → copper(II) oxide

As the experiment proceeds, suggest what happens to

1	1)	the tota	LVOLUMA	of air	in the	asp	syringes,	
١	•,	tile tota	i voidinc	Oi aii	111 1110	gas	Syringes,	,

[1]

(ii) the mass of the wire in the tube.

 [1	•
11	
 	٠

(c) State one use of copper.



[Total: 6]

8

Eth	iene,	, C ₂ H ₄ , is manufactured by cracking petroleum fractions.	
(a)	(i)	What do you understand by the term fraction?	
			. [1]
	(ii)	Complete the symbol equation for the manufacture of ethene from dodecane, $C_{12}H_{26}$.	
		$C_{12}H_{26} \rightarrow C_2H_4 + \dots$	[1]
(b)		o fractions obtained from the distillation of petroleum are refinery gas and gasoline. Ite one use of each of these fractions.	
		nery gas	
	gas	soline [[2]
(c)	Wh	nene is an unsaturated hydrocarbon. Inat do you understand by the following terms? Saturated	
	hyc		[2]
(d)	Eth	nene is used to make ethanol.	
	(i)	Which of these reactions is used to make ethanol from ethene? Tick one box.	
		catalytic addition of steam	
		fermentation	
		oxidation using oxygen	
		reduction using hydrogen	[1]

	(ii)	Draw th	e struct	ure of eth	nanol, sh	owing all	atoms ai	nd bonds.			
											[2]
(e)	Cor	nplete th	e follow	nake poly ving sente list belov	ences ab	out this re	action.				
	ado	ditions	са	rbohydra	ates	catalys	ts	monome	ers	polymers	•
	The	ethene	molecu	les which	join to fo	orm poly(e	ethene) a	are the			
	The	poly(eth	nene) m	olecules	formed a	ire					[2]
										I	Total: 11]

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	=	2	He	halium	4	10	Š	1030	50	18	Ā	argon 40	36	호	uophia	\$	\$	Xe	xarcm	131	96	瀀	redon	ì												
					1	ф	ш	Produce	19	17	õ	dilorine 35.5	35	ä	bounine	80	53	I	poline	127	98	¥	astatee	1					E.	3	A.75	0/1	8	۲	Investor	
	5					00	0	uaddan.	16	16	S	32 32	8	Se	ederium	7.9	25	<u>a</u>	Solbutum	128	84	Ьо	polonium	1	116	^	Pvermor/um	1	20	ç	yterbium	27	102	ŝ	nobelum	
	>					~	z	nitropan	14	16	۵	phosphons 31	33	As	amenic	75	51	Sp	artimony	122	83	B	biamuth	509					69	Ę	tribun.	601	101	PΜ	теговочит	
	2					9	O	carbon	12	14	Ö	28	32	Ge	permanium	73	90	Sn	Æ	119	82	ЬЬ	bead	207	114	FZ	Serovium	í	89	ш	erbium 467	701	90	E	Semium	
	≡				-	ω	Ф	barran	11	13	ΑŽ	aluminum 27	31	Ga	gallum	2	49	Ę	mojou	116	81	ř	frallum	204					67	운	holmáun	8	66	s	oirsteirium	
													90	Zu	2002	99	48	S	cadmium	112	90	Β̈́	meteury	201	112	ວົ	operion		99	à	dysprosium	201	86	Ö	calfornium	
													59	O	saddro	8	47	Ag	allyne	108	79	Au	pod	197	111	Rg	noengerium	1	65	2	retham 450	601	26	ă	berkellum	
dni													$\overline{}$	ž		\neg				\neg				\neg			E	1	4	В	gadolinism	200	96	Š	onfum	
Group													27	ပိ	cobst	20	45	문	фофия	103	77	'n	Hickory	192	109	¥	megnerium)	63	ѿ	europium	70.	36	Am	americkum	
		,	I	нуфорин ,	-								88	Ьe	iron	8	‡	R	nuthantun	101	92	ŝ	cominm	190	108	Ε	hassium)	62	ES.	samanum	200	đ	P	phronium	
													25	Mn	manganese	55	43	J _C	technolom	1	75	Se Se	hanium	186	107	B	pohrlum	1	61	F	promothum	1	83	ď	nephrism	
						'n	poq		uass				24	ပ်	dromism	25	42	Wo	тоффонти	96	74	3	ungsten	184	106	Sg	seaborgium	1	8	P	neodymium	total	92	>	uranium 238	and a
				2	Ng.	atomic number	atomic symbol	rames	relative atomic mass				23	>	vanadum	51	14	£	riobium	93	73	Тa	tartakım	181	105	9	dubnium	1	20	ď	prancipaline 1.4.1		5	Ра	protectinium 23:1	200
						app.	ato		relati				22	F	Stankum	48	40	Zr	zhonism	91	7.2	Ξ	hafrium	178	104	꾿	ntherfordum	1	58	ථ	meno	140	90	£	Porlum 232	gA4
													2	Sc	96andkm	45	30	>	ytrum	88	57-71	larthanoids			89-103	actinoide			24	æ	lanthanum	200	88	Ac	acthium	
	=					4	Be	buryllium	6	12	δ	magnessen 24	20	Sa	calcium	40	38	ഗ്	strongem	88	99	Ва	berium	137	88	Ra	radkım)		8						-
	-					m	=	Hihum	7	11	Na	andum 23	19	¥	polassium	39	37	8	nubidum	98	99	క	cansium	133	87	正	frandum	1		lanthanoids				actinoids		

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

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