

Cambridge IGCSE[™]

CANDIDATE NAME				
CENTRE NUMBER		CANDIDATE NUMBER		

CHEMISTRY 0620/32

Paper 3 Theory (Core)

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer all questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- Do not write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

1 (a) The diagram shows part of the Periodic Table.

-	Ш						Ш	IV	V	VI	VII	VIII
								С		0	F	
							Αl				Cl	Ar
K	Ca			Fe		Zn					Br	
											Ι	
					Pt							

Answer the following questions using only the symbols of the elements in the diagram. Each symbol may be used once, more than once or not at all.

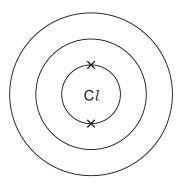
State the symbol of the element that:

(i)	provides an inert atmosphere in lamps	
		[1]
(ii)	forms an oxide which is used to neutralise acidic industrial waste	
		[1]
iii)	has an atom which forms a stable ion by the loss of one electron	
		[1]
iv)	is a metal used as an inert electrode	
		[1]
(v)	forms an ion whose aqueous solution gives a green precipitate on addition of aqueosodium hydroxide.	ous
		[1]

	/ B 1				
1	n) Chlorine	19	an	element
٨			10	an	CICITICITE

(i)	State the meaning of the term <i>element</i> .	
	[[1]
(ii)	An isotope of chlorine is shown.	
	³⁵ C <i>l</i>	
	Deduce the number of protons and neutrons in this isotope.	
	number of protons	
	number of neutrons	
		2]

(c) Complete the electronic structure of a chlorine atom.



[1]

[Total: 9]

2 The table shows the mass of air pollutants, in nanograms, in 1000 cm³ samples of air taken over a four month period.

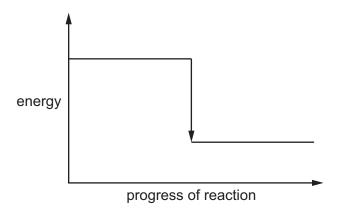
	mass of pollutant in 1000 cm³ of air/nanograms									
month	oxides of nitrogen	sulfur dioxide	carbon monoxide	ozone	particulates					
April	144.3	5.9	2.5	33.9	21.9					
May	114.2	2.0	2.1	39.6	21.7					
June	110.2	6.1	1.8	31.5	21.3					
July	115.4	2.5	2.6	24.2	19.0					

(a)	Ans	swer these questions using only the information in the table.	
	(i)	Name the pollutant that shows a continual decrease in concentration between April a July.	and
			[1]
((ii)	Name the pollutant present in the lowest concentration in May.	
			[1]
(i	iii)	Calculate the mass of carbon monoxide in 200 cm³ of the sample of air taken in April.	
		nanograms	[1]
(b)	Sulf	fur dioxide contributes to acid rain.	
	(i)	State one source of the sulfur dioxide in the air.	
			[1]
((ii)	Give one adverse effect of acid rain on buildings.	
			[1]
(i	iii)	State one use of sulfur dioxide.	

- (c) Sulfur dioxide is oxidised to sulfur trioxide, SO₃.
 - (i) Complete the chemical equation for this reaction.

$$.....SO2 + O2 \rightarrowSO3$$
 [2]

- (ii) Complete the energy level diagram for the oxidation of sulfur dioxide to sulfur trioxide by writing these words on the diagram:
 - reactants
 - products.



[1]

(iii) Explain, using information on the energy level diagram, how you know that this reaction is exothermic.

......[1]

(d) Nitrogen monoxide is a catalyst in the oxidation of sulfur dioxide to sulfur trioxide.

State the meaning of the term catalyst.

......[1]

(e) Sulfur trioxide reacts with water to form dilute sulfuric acid.

Identify which one of these pH values represents the pH of dilute sulfuric acid.

Draw a circle around the correct answer.

pH 2 pH 7 pH 9 pH 13 [1]

(f)	Particulates are tiny solid particles in the air.	
	They show Brownian motion.	
	Identify one statement that best describes Brownian motion	
	Tick one box.	
	The particles move from a higher concentration to a lower concentration.	
	The particles are smaller than oxygen molecules	S
	Brownian motion is an example of diffusion.	
	The particles move in a random zig-zag motion.	
		[1]

[Total: 13]

3 Some properties of four substances, **E**, **F**, **G** and **H**, are shown in the table.

substance	strength	ductility (how easy it is to pull into a wire)	electrical conductivity when solid	resistance to corrosion
E	very strong	good	good	very good
F	weak	good	good	poor
G strong		strong not ductile		poor
Н	strong	very good	very good	good

Answer these questions using only the information in the table.

(a)	State which substance, E , F , G or H , is best used to make electricity cables.	
	Explain your answer.	
	substance	
	explanation	
		 [3
		ျ
(b)	State which substance, E , F , G or H , is best used for making cutlery.	
	Explain your answer.	
	substance	
	explanation	
		 [3
		ုဒ
	[Total	al: 6

4 The structure of compound **J** is shown.

- (a) (i) On the structure, draw a circle around the carboxylic acid functional group. [1]
- (ii) Deduce the formula of compound **J** to show the number of carbon, hydrogen and oxygen atoms.

.....[1]

(iii) Complete the table to calculate the relative molecular mass of compound **J**. Use your Periodic Table to help you.

type of atom	number of atoms	relative atomic mass	
carbon		12	
hydrogen	10	1	10 × 1 = 10
oxygen		16	

relative molecular mass = [2]

(b) Acids react with bases such as calcium oxide.

Complete the word equation for the reaction of hydrochloric acid with calcium oxide.

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[2]

(c)	The	e chemical equ	uation for the	reaction of I	ime (calciu	um oxide	e) with a	mmoniun	n sulfate	is shown.
			CaO + (N	$IH_4)_2SO_4 \rightarrow$	CaSO ₄ +	- 2NH ₃	+ H ₂ O			
	(i)	Name the co	mpound wit	h the formul	a CaSO ₄ .					
										[1]
	(ii)	Complete the	ese phrases	about amm	onia, NH ₃ ,	using w	ords fro	om the lis	t.	
		acid	blue	gase	ous	green		liquid		
			pink	solid	solutio	n	white			
		The state of	ammonia at	room tempe	erature is .					
		Aqueous am	monia turns	damp red li	tmus pape	er				101
										[2]
										[Total: 9]

_			
5	Lthana	ic an	alkane.
J	Luianc	ıə aii	ainaiic.

(a)	Draw the structure	of ethane to	show all of the	e atoms and	all of the bonds.
-----	--------------------	--------------	-----------------	-------------	-------------------

			[1]
(b)	Cor	mplete the chemical equation for the complete combustion of propane.	
		$C_3H_8 + 5O_2 \rightarrow \dots CO_2 + \dots H_2O$	[2]
(c)	Met	hane is an alkane which is produced by the fractional distillation of petroleum.	
	(i)	State one other process which puts methane into the atmosphere.	
			[1]
	(ii)	Give one major use of methane.	
			[1]
(d)		anes and alkenes are hydrocarbons.	
	Sta	te the meaning of the term <i>hydrocarbon</i> .	
			[2]
(e)	Alka	anes and alkenes can be distinguished by a chemical test.	
	Nar	ne the reagent that can be used to distinguish between alkanes and alkenes.	
			[1]
(f)	Alke	enes are manufactured by cracking alkanes.	
	(i)	Name an element that is also produced by cracking alkanes.	
			[1]
	(ii)	State one condition required for cracking alkanes.	
			[1]
		[Tota	l: 10]

		11
6	Ele	ctrolysis is used to extract reactive metals from metal compounds.
	(a)	Describe the electrolysis of molten sodium chloride. In your answer include:
		 a labelled diagram of the apparatus used the observations made at the positive and the negative electrode.
		observation at positive electrode
		observation at negative electrode
		[5]
	(b)	Use the kinetic particle model to describe the arrangement and separation of the particles in solid sodium.
		arrangement
		separation[2]

(c) Sodium is a metal in Group I of the Periodic Table.

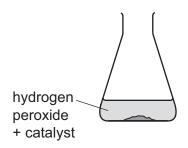
	Iron is a transition element.
	Give two ways in which the physical properties of iron differ from the physical properties of sodium.
	1
	2
	[2]
(d)	The chemical equation for the reaction between iron(III) oxide and carbon monoxide is shown.
	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
	Explain how this equation shows that carbon monoxide has been oxidised.
	[1]
	[Total: 10]

7 A student investigated the rate of decomposition of hydrogen peroxide, H₂O₂, in the presence of a catalyst by measuring the volume of oxygen released at 10 second intervals.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

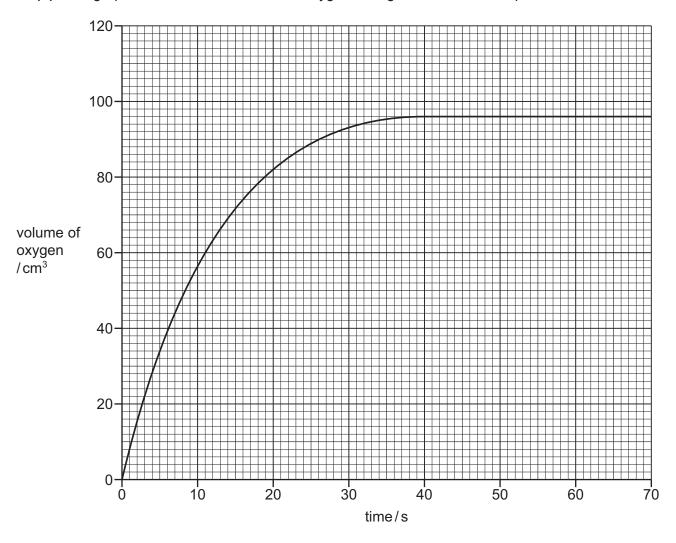
(a) Complete the diagram to show a suitable method for collecting and measuring the volume of the oxygen.

Label your diagram.



[3]

(b) The graph shows how the volume of oxygen changes as the reaction proceeds.



Answer these questions using information from the graph.

(i) Describe how the rate of this reaction changes with time.

.....[1]

(ii) Deduce the time taken to collect 60 cm³ of oxygen.

(iii) The experiment is repeated without using a catalyst.

Draw a line **on the grid** to show how the volume of oxygen changes with time when no catalyst is used.

All other conditions stay the same.

[1]

(iv) Describe what effect an increase in temperature has on the rate of this reaction.

All other conditions stay the same.

......[1]

(c)	Identify which one of	f these el	ements is l	ikely to act	as a cata	alyst in chemical reactio	ns.
	Draw a circle around	the corre	ect answer.				
		С	Mg	Na	Ni	S	[1]
(d)	Describe a test for o	xygen.					
	test						
	result						
							[2]
							[Total: 10]

8	This	question is	s about	metals	and	compo	ounds	of	metals
•	11113	question i	o about	. IIICtaio	and	COLLID	Julius	O.	III Claid

(a)	Iron reacts with	dilute	hydrochloric	acid	to form	an iror	n(II) s	alt and	a gas	which	pops	with	а
	lighted splint.												

Complete the word equation for this reaction.



(b) Identify two correct statements about iron.

Tick **two** boxes.

Iron forms an alloy called steel.	
The commonest ore of iron is called bauxite.	
Iron is usually extracted from its ore by electrolysis.	
Iron is oxidised by carbon in the blast furnace.	
Both oxygen and water are needed for iron to rust.	

[2]

[2]

(c) The table compares the reactions of four metals with warm water and with steam.

metal	reaction with warm water	reaction with steam
chromium	no reaction	slow reaction
copper	no reaction	no reaction
iron	very slow reaction	slow reaction
magnesium	very slow reaction	rapid reaction

Put the four metals in order of their reactivity. Put the least reactive metal first.

least reactive —		-	most reactive

[2]

(d) Crystals of cobalt(II) chloride, $CoCl_2$ •6H₂O, can be prepared by reacting excess cobalt(II) carbonate powder with dilute hydrochloric acid.

Describe how to prepare a sample of pure dry $cobalt(\Pi)$ chloride crystals after the reaction is complete.

In your answer describe how to:

(e)

•	remove the excess $cobalt(II)$ carbonate from the reaction mixture crystallise the $cobalt(II)$ chloride dry the crystals.
	[4]
	ew drops of water were added to a sample of solid anhydrous cobalt(II) chloride, ${\sf CoC} l_2$. e equation for the reaction is shown.
	$CoCl_2 + 6H_2O \rightleftharpoons CoCl_2 \cdot 6H_2O$
(i)	State the meaning of the symbol ← .
	[1]
(ii)	State the colour change observed when water is added to anhydrous cobalt(Π) chloride.
	from to

[Total: 13]

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The Periodic Table of Elements

	 	2	He	helium 4	10	Ne	neon 20	18	Ar	argon 40	36	궃	krypton 84	54	Xe	xenon 131	98	R	radon _			
	=				6	ш	fluorine 19	17	Cl	chlorine 35.5	35	ğ	bromine 80	53	н	iodine 127	85	Ą	astatine -			
	5				80	0	oxygen 16	16	S	sulfur 32	34	Se	selenium 79	52	<u>a</u>	tellurium 128	84	Ъ	polonium –	116		livemorium
	>				7	z	nitrogen 14	15	₾	phosphorus 31	33	As	arsenic 75	51	Sp	antimony 122	83	Ξ	bismuth 209			
	≥				9	ပ	carbon 12	14	SS	silicon 28	32	Ge	germanium 73	20	Sn	tin 119	82	Pb	lead 207	114	Fl	flerovium -
	≡				2	В	boron 11	13	Αl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	1L	thallium 204			
											30	Zu	zinc 65	48	B	cadmium 112	80	Ρ̈́	mercury 201	112	ပ်	copernicium
											29	Cn	copper 64	47	Ag	silver 108	62	Αn	gold 197	111	Rg	roentgenium
Group											28	z	nickel 59	46	Pd	palladium 106	78	చ	platinum 195	110	Ds	darmstadtium -
Gre											27	ပိ	cobalt 59	45	格	rhodium 103	77	'n	indium 192	109	₩	meitnerium -
		-	I	hydrogen 1							26	Ьe	iron 56	44		_		Os	osmium 190	108	Hs	hassium -
											25	Mn	manganese 55	43	ပ	technetium -	75	Re	rhenium 186	107	Bh	bohrium –
					_	pol	ass				24	ပ်	chromium 52	42	Mo	molybdenum 96	74	≥	tungsten 184	106	Sg	seaborgium -
				Key	atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	41	g	niobium 93	73	д	tantalum 181	105	g O	dubnium –
						atc	- Le				22	i=	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104	쪼	rutherfordium -
											21	Sc	scandium 45	39	>	yttrium 89	57–71	lanthanoids		89–103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	ഗ്	strontium 88	56	Ba	barium 137	88	Ra	radium I
	_				က	:=	lithium 7	#	Na	sodium 23	19	¥	potassium 39	37	ВВ	rubidium 85	22	S	caesium 133	87	ᇁ	francium -

Lu Lu	lutetium 175	103	۲	lawrencium	I
o X	ytterbium 173	102	8	nobelium	ı
e9 Tm	thulium 169	101	Md	mendelevium	I
68 Fr	erbium 167	100	Fm	ferminm	I
67 Ho	holmium 165	66	Es	einsteinium	I
99 O	dysprosium 163	86	ŭ	californium	I
es Tb	terbium 159	26	BK	berkelium	I
² Gd	gadolinium 157	96	Cm	curium	I
63 Eu	europium 152	92	Am	americium	I
62 Sm	samarium 150	94	Pu	plutonium	I
e1 Pm	promethium —	93	ď	neptunium	ı
9 P	neodymium 144	95	\supset	uranium	238
59 Pr	praseodymium 141	91	Ра	protactinium	231
Se O					
57 La	lanthanum 139	89	Ac	actinium	I

lanthanoids

actinoids

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