

# **Cambridge IGCSE**<sup>™</sup>

CANDIDATE NAME				
CENTRE NUMBER		CANDIDATE NUMBER		

CHEMISTRY 0620/32

Paper 3 Theory (Core)

May/June 2022

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)	A list of symbols and formulae is shown.

 $\begin{array}{c} Br^- \\ CH_4 \\ CO_2 \\ Cu^{2+} \\ H_2 \\ K^+ \\ Na^+ \\ N_2 \\ O_2 \\ \end{array}$ 

Answer the following questions using these symbols or formulae. Each symbol or formula may be used once, more than once or not at all.

State which symbol or formula represents:

(i)	a compound that is a product of respiration	
		[1]
(ii)	an ion that gives a lilac colour in a flame test	
		[1]
iii)	a gas which is 21% of clean, dry air	
		[1]
iv)	an element that has a radioactive isotope used as a source of energy	
		[1]
(v)	an ion formed when an atom gains an electron.	
		[1]

**(b)** Complete the table to show the relative masses of a proton, a neutron and an electron.

type of particle	relative mass
proton	1
neutron	
electron	

[2]

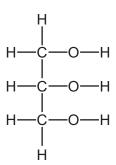
<ul><li>(c) Choose the two correct statements about carbon dioxide.</li><li>Tick (✓) two boxes.</li></ul>	
Carbon dioxide is a mixture of two elements.	
Carbon dioxide is an acidic oxide.	
Carbon dioxide has ionic bonding.	
Carbon dioxide has a giant covalent structure.	
There are three atoms in a molecule of carbon dioxide.	[2]
	[Total: 9]

2 The table shows the masses of some ions in a 1000 cm³ sample of toothpaste.

name of ion	formula of ion	mass of ion in 1000 cm <sup>3</sup> of toothpaste/g	
ammonium	NH <sub>4</sub> <sup>+</sup>	0.5	
calcium	Ca <sup>2+</sup>	3.6	
carbonate	CO <sub>3</sub> <sup>2-</sup>	2.5	
chloride	Ct-	0.9	
fluoride	F-	1.2	
	Mg <sup>2+</sup>	0.2	
phosphate	PO <sub>4</sub> <sup>3-</sup>	28.0	
sodium	Na⁺	32.0	
	SO <sub>4</sub> <sup>2-</sup>	10.4	
tin(II)	Sn <sup>2+</sup>	0.3	

(a)	Ans	swer these questions using only the information in the table.	
	(i)	State which positive ion has the lowest mass in 1000 cm³ of toothpaste.	
			[1]
	(ii)	Name the compound that contains $\mathrm{Mg^{2+}}$ and $\mathrm{SO_4^{2-}}$ ions.	
			[1]
	(iii)	Calculate the mass of sodium ions in 200 cm³ of toothpaste.	
		mass = g	[1]
(b)	Des	scribe a test for chloride ions.	
	test	·	
	obs	ervations	
			[2]

(c) Toothpaste also contains glycerol. The structure of glycerol is shown.



	Dec	duce the formula of glycerol to show the number of atoms of carbon, hydrogen and oxyg	en.
			[1]
(d)	•	cerol is an alcohol. anol is also an alcohol.	
	(i)	Draw the structure of ethanol to show all of the atoms and all of the bonds.	
			[1]
	(ii)	Name the <b>two</b> products formed when ethanol undergoes complete combustion.	
		and	[2]
	(iii)	Give <b>one</b> use of ethanol.	
			[1]
		[Total:	10]

3	This o	nuestion	is	about	Group	Т	and	Groui	o VII	element	ts
•	11113	Jucation	10	about	Oloup		ana	Olou	V 11	CICITICIT	w

(a)	Deduce the number of electrons, neutrons and protons in one atom of the isotope of potassium
	shown.

<sup>40</sup><sub>19</sub>K

number of electrons .	
number of neutrons	
number of protons	
	[3]

**(b)** Complete the chemical equation for the reaction of potassium with water to form potassium hydroxide and a gas which pops with a lighted splint.

$$2K + ....H_2O \rightarrow 2KOH + ....$$
 [2]

(c) The table shows some properties of four Group I elements.

element	melting point /°C	boiling point /°C	relative hardness
lithium	181	1342	5.0
sodium		883	0.7
potassium	63	760	
rubidium	39	686	0.2

(i)	Complete t	the t	able	by	predicting:
-----	------------	-------	------	----	-------------

the melting point of sodium

•	the	relative	hardness	of not	assium
•	นเธ	ICIALIVE	Halulicss	OI DOL	assiuiii.

[2]

(ii)	Predict the physical state of potassium at 100 °C.
	Give a reason for your answer.


.....[2]

$$\mathrm{Br_2}$$
 + 2KI  $ightarrow$  2KBr +  $\mathrm{I_2}$ 

	(i)	Explain how this equa	tion shows that br	omine is more re	active than iodi	ne.
						[1
	(ii)	State the colour of aqu	ueous iodine.			
						[1
(e)	Broi	mine is a diatomic mole	ecule.			
	Stat	e the meaning of the te	erm <i>diatomic</i> .			
						[1
(f)	Broi	mine liquid turns into a	gas very easily a	t room temperatu	re.	
	Cho	ose the word which be	st describes a sul	bstance that evap	oorates easily.	
	Dra	w a circle around your	chosen answer.			
		conductor	flammable	malleable	volatile	[1
						[Total: 13

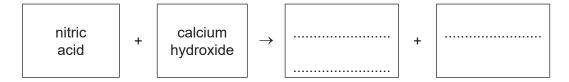
4	This	question	is	about	acids	and	bases.
---	------	----------	----	-------	-------	-----	--------

(a)	Name the type of	of chemical	reaction	which o	ccurs whe	n an acid	d reacts	with a	base.
-----	------------------	-------------	----------	---------	-----------	-----------	----------	--------	-------

(b) Describe the colour of litmus in acidic and alkaline solutions.

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in acidic solution ......in alkaline solution ......
```

(c) Complete the word equation for the reaction of nitric acid with calcium hydroxide.



[2]

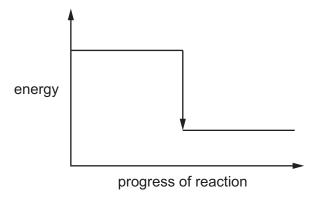
[2]

- (d) When nitric acid reacts with calcium hydroxide, the temperature of the reaction mixture increases.
  - (i) Choose the word which best describes this reaction.

Draw a circle around your chosen answer.

decomposition endothermic exothermic oxidation [1]

- (ii) Complete the energy level diagram for the reaction of nitric acid with calcium hydroxide by writing the words:
  - reactants
  - products.



[1]

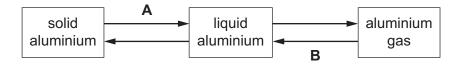
(e) Calcium hydroxide is slaked lime.

Give one use of slaked lime.

\_\_\_\_\_\_[1

[Total: 8]

- **5** This question is about aluminium.
  - (a) The changes of state of aluminium are shown.



Name the changes of state represented by A and B.

Α	
В	
_	[2

- **(b)** Use the kinetic particle model to describe the differences between solid aluminium and liquid aluminium in terms of:
  - the arrangement of the particles
  - the separation of the particles.

[4]

- (c) Aluminium ore contains aluminium oxide.
  - (i) Name the main ore of aluminium.

[4]

(ii) Aluminium is extracted from aluminium oxide by electrolysis.

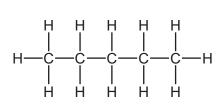
Explain why aluminium is extracted by electrolysis and not by reduction with carbon.

.....

(a)	Aluminium can be used to reduce iron(III) oxide to iron.	
	$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$	
	Describe how this equation shows that iron(III) oxide is reduced.	
		[1]
(e)	Aluminium is used for electric cables.	
	State one <b>other</b> use of aluminium.  Give a reason for this use in terms of the properties of aluminium.	
	use of aluminium	
	reason for this use	
		 [2]
(f)	Deduce the electronic structure of aluminium.	
	Use the Periodic Table to help you.	
		[1]
	[Total:	12]

6 (a) The structures of four organic compounds, C, D, E and F, are shown.

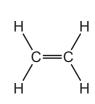
C H H O H-C-C-C



D

H H H | | | H—C—C—C—F | | |

Ε



F

(i)	State which <b>two</b> of the compounds, <b>C</b> , <b>D</b> , <b>E</b> and <b>F</b> , are in the same homologous	series.

...... and ....... [1]

(ii)	State which compound, <b>C</b> , <b>D</b> , <b>E</b> or <b>F</b> , is the monomer used to make poly(ethene).	

111)	State which compound, C, D, E or F, is a carboxylic acid.	
		[1]

(b)	Petroleum is a mixture	of hydrocarbons,	which can b	e separated	into fractions.

Describe how petroleum is separated into fractions to include:

•	the name of the process used to separate the fractions


•	how this process separates the different fractions.				


[4]

(c) Complete the table to show the name and uses of some petroleum fractions.

name of fraction	use of fraction
naphtha	
diesel oil (gas oil)	
	making roads

[3]

[Total: 10]

- 7 This question is about sodium and compounds of sodium.
  - (a) Sodium is a metal in Group I of the Periodic Table.

1	
2	
	[2]

(ii) Give **one** physical property of Group I metals that is different from most other metals and state how it is different.

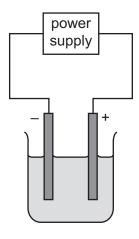
		[41

(b) Sodium reacts with oxygen to form sodium oxide, Na<sub>2</sub>O.

Complete the chemical equation for this reaction.

....Na + 
$$O_2 \rightarrow ....Na_2O$$
 [2]

(c) The diagram shows the apparatus used to electrolyse molten sodium iodide.



- (i) Complete the diagram by labelling:
  - the electrolyte
  - the cathode.

[2	

(ii) Name the products formed at each electrode.

positive electrode	

negative electrode .....

[2]

(d) A compound of sodium has the formula  $\mathrm{Na_2S_2O_3}$ .

Complete the table to calculate the relative molecular mass of  $\mathrm{Na_2S_2O_3}$ .

atom	number of atoms	relative atomic mass	
sodium	2	23	2 × 23 = 46
sulfur		32	
oxygen		16	

relative molecular mass = ..... [2]

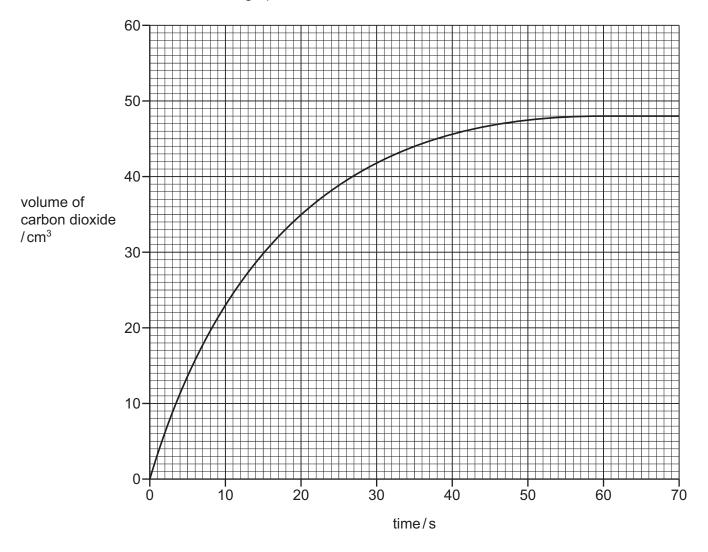
[Total: 11]

**8** A student investigates the reaction of small pieces of calcium carbonate with dilute hydrochloric acid. The hydrochloric acid is in excess.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

The rate of reaction is found by measuring the volume of carbon dioxide gas produced as time increases.

The results are shown on the graph.



(a) Deduce the volume of carbon dioxide gas at 35 s.

volume = ..... cm<sup>3</sup> [1]

**(b)** The experiment is repeated at a higher temperature.

All other conditions stay the same.

Draw a line **on the grid** to show how the volume of carbon dioxide gas produced changes as time increases. [2]

(c)	Describe the effect each of the following has on the rate of reaction of calcium carbonate with dilute hydrochloric acid.
	All other conditions stay the same.
	The reaction is carried out using a higher concentration of hydrochloric acid.
	The reaction is carried out using powdered calcium carbonate.
	[2]
(d)	When 0.11 g of calcium carbonate is used, 25 cm³ of carbon dioxide gas is produced.
	Calculate the mass of calcium carbonate needed to produce 100 cm³ of carbon dioxide gas.
	mass of calcium carbonate = g [1]
(e)	State <b>one</b> use of calcium carbonate.
	[1]
	[Total: 7]

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The Periodic Table of Elements

	$\equiv$	<sup>2</sup> He	helium 4	10	Ne	neon 20	18	Ar	argon 40	36	궃	krypton 84	54	Xe	xenon 131	98	Ru	radon			
	<b>=</b>			6	ш	fluorine 19	17	Cl	chlorine 35.5	35	ğ	bromine 80	53	П	iodine 127	85	¥	astatine			
	>			80	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	<u>a</u>	tellurium 128	84	Ъо	molod –	116	^	livermorium -
	>			7	Z	nitrogen 14	15	ட	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	Bi	bismuth 209			
	≥			9	ပ	carbon 12	14	S	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Pb	lead 207	114	Fl	flerovium -
	≡			2	Ω	boron 11	13	Αl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	11	thallium 204			
										30	Zn	zinc 65	48	g	cadmium 112	80	Рg	mercury 201	112	S	copernicium -
										59	D C	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 -
ָ ס				1						27	ပိ	cobalt 59	45	몬	rhodium 103	77	٦	iridium 192	109	Ĭ	meitnerium -
		- I	hydrogen 1							26	Fe	iron 56	44	Ru	ruthenium 101	92	Os	osmium 190	108	Hs	hassium
							1			25	Mn	manganese 55	43	ပ	technetium -	75	Re	rhenium 186			bohrium –
				_	loq	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	⊐	tantalum 181	105		dubnium -
					atc	rel				22	F	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104	꿆	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
	_			က	<u>'</u>	lithium 7	1	Na	sodium 23	19	<b>×</b>	potassium 39	37	Rb	rubidium 85	55	S	caesium 133	87	ъ	francium

Lu Lu	lutetium 175	103	۲	lawrencium	1
° A	ytterbium 173	102	8 N	nobelium	1
e9 Tm	thulium 169	101	Md	mendelevium	1
<sub>88</sub> <u>п</u>	erbium 167	100	Fm	ferminm	I
67 Ho	holmium 165	66	Es	einsteinium	Ι
© Dy	dysprosium 163	86	ర్	californium	-
e5 Tb	terbium 159	97	BK	berkelium	_
<sup>2</sup> PO	gadolinium 157	96	Cm	curium	I
es Eu	europium 152	92	Am	americium	_
62 Sm	samarium 150	94	Pu	plutonium	_
Pm	promethium -	93	d d	neptunium	_
°° P	neodymium 144	l			
59 <b>Pr</b>	praseodymium 141	91	Ра	protactinium	231
Se Se					
57 <b>La</b>	lanthanum 139	89	Ac	actinium	ı

lanthanoids

actinoids

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