Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6848782421

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.

This document has **20** pages. Any blank pages are indicated.

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1 **(a)** A list of symbols and formulae is shown.

Br^-
CH_4
CO_2
Cu^{2+}
H_2
K^+
Na^+
N_2
O_2
U

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]

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(c) Choose the two correct statements about carbon dioxide.
Tick (✓) **two** boxes.

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 cm^3 sample of toothpaste.

name of ion	formula of ion	mass of ion in 1000 cm^3 of toothpaste / g
ammonium	NH_4^+	0.5
calcium	Ca^{2+}	3.6
carbonate	CO_3^{2-}	2.5
chloride	Cl^-	0.9
fluoride	F^-	1.2
	Mg^{2+}	0.2
phosphate	PO_4^{3-}	28.0
sodium	Na^+	32.0
	SO_4^{2-}	10.4
tin(II)	Sn^{2+}	0.3

(a) Answer these questions using only the information in the table.

(i) State which positive ion has the lowest mass in 1000 cm^3 of toothpaste.

..... [1]

(ii) Name the compound that contains Mg^{2+} and SO_4^{2-} ions.

..... [1]

(iii) Calculate the mass of sodium ions in 200 cm^3 of toothpaste.

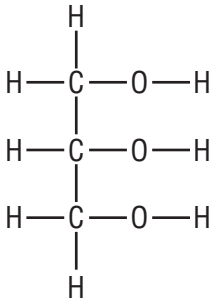
mass = ... g [1]

(b) Describe a test for chloride ions.

test .....

observations .....
[2]

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



Deduce the formula of glycerol to show the number of atoms of carbon, hydrogen and oxygen.

..... [1]

(d) Glycerol is an alcohol.
Ethanol 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 **two** products formed when ethanol undergoes complete combustion.

..... and ..... [2]

(iii) Give **one** use of ethanol.

..... [1]

[Total: 10]

3 This question is about Group I and Group VII elements.

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

$^{40}_{19}K$

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 the table by predicting:
- the melting point of sodium
- the relative hardness of potassium. [2]

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

.....

..... [2]

(d) Aqueous bromine reacts with aqueous potassium iodide.

$$Br_2 + 2KI \rightarrow 2KBr + I_2$$

(i) Explain how this equation shows that bromine is more reactive than iodine.

.....

..... [1]

(ii) State the colour of aqueous iodine.

..... [1]

(e) Bromine is a diatomic molecule.

State the meaning of the term *diatomic*.

..... [1]

(f) Bromine liquid turns into a gas very easily at room temperature.

Choose the word which best describes a substance that evaporates easily.

Draw 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 chemical reaction which occurs when an acid reacts with a base.

..... [1]

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

in acidic solution .....

in alkaline solution .....

[2]

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

nitric acid	+	calcium hydroxide	→	....	+	.....

[2]

(d) When nitric acid reacts with calcium hydroxide, the temperature of the reaction mixture increases.

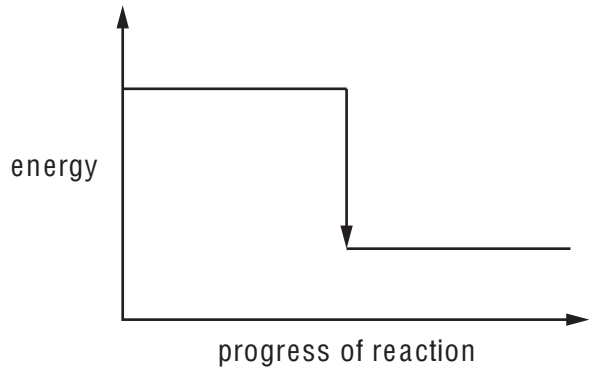
(i) Choose the word which best describes this reaction.

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.

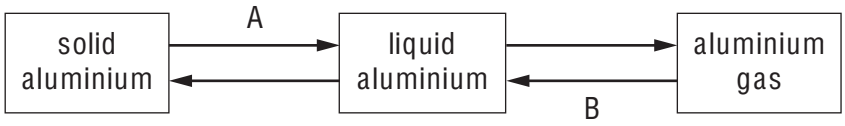
Give **one** use of slaked lime.

..... [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**.

A .....

B .....
[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.

..... [1]

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

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

.....

..... [1]

(d) 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 **other** 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.

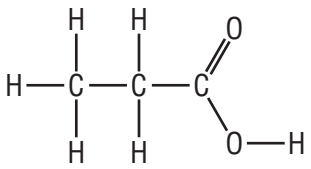
..... [1]

[Total: 12]

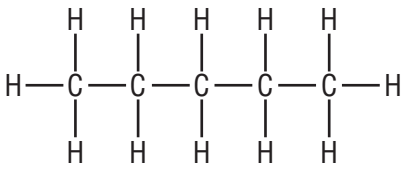
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6 **(a)** The structures of four organic compounds, **C**, **D**, **E** and **F**, are shown.

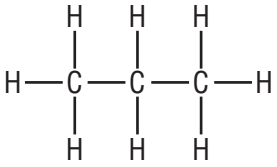
C



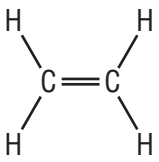
D



E



F



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

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

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

..... [1]

(iii) State which compound, **C**, **D**, **E** or **F**, is a carboxylic acid.

..... [1]

(b) Petroleum is a mixture of hydrocarbons, which can be 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.

(i) Give **two** physical properties of all metals.

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.

.....

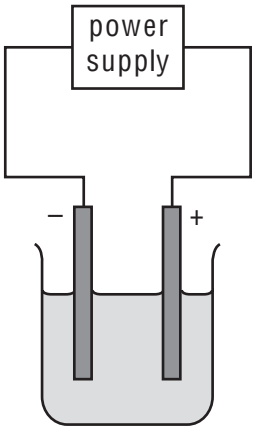
..... [1]

(b) Sodium reacts with oxygen to form sodium oxide, Na_2O.

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 $Na_2S_2O_3$.

Complete the table to calculate the relative molecular mass of $Na_2S_2O_3$.

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

relative molecular mass = ... [2]

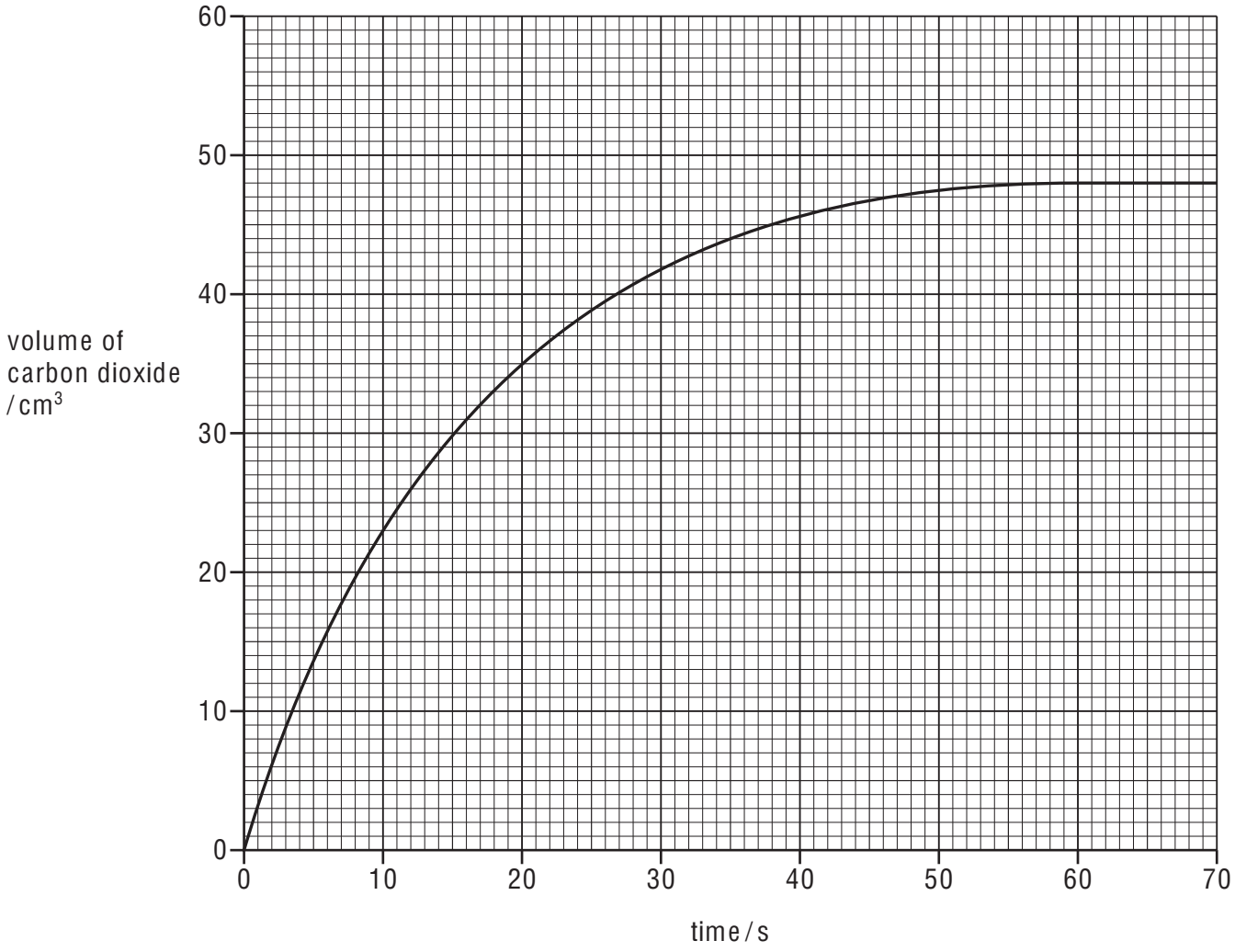
[Total: 11]

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^3 [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 cm^3 of carbon dioxide gas is produced.

Calculate the mass of calcium carbonate needed to produce 100 cm^3 of carbon dioxide gas.

mass of calcium carbonate = ... g [1]

(e) State **one** use of calcium carbonate.

..... [1]

[Total: 7]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key: atomic number / atomic symbol / name / relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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

PMT