Rewarding Learning

General Certificate of Secondary Education

2020–2021

Centre Number

Candidate Number

Single Award Science: Chemistry

Unit 2

Higher Tier

MV18

[GSA22]

TUESDAY 24 NOVEMBER 2020, MORNING

Time

1 hour, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write on blank pages.
Complete in black ink only.
Answer all **eight** questions.

Information for Candidates

The total mark for this paper is 60.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

1 **(a)** The table below gives some properties of the first five Group 1 elements.

Group 1 element	Melting point/°C	Boiling point/°C	Density/g/cm³
lithium	180	1347	0.5
sodium	98	883	0.9
potassium	64	774	0.8
rubidium	39	688	1.5
caesium	28		1.8

(i) Give **one** trend shown in the melting points of Group 1 elements. [1 mark]

_____

_____

(ii) Predict the boiling point of caesium. [1 mark]

_____ °C

(iii) Mary looked at the information in the table and concluded that:

"As you go down Group 1 the density of the elements increases."

Give **one** piece of evidence from the table that shows this conclusion is incorrect. [1 mark]

_____

_____

(b) (i) Give **two** observations you would expect when potassium reacts with water. [2 marks]

1. _____

_____

2. _____

_____

(ii) Using your knowledge of Group 1 metals suggest **one** difference in the reactions of potassium with water and rubidium with water. [1 mark]

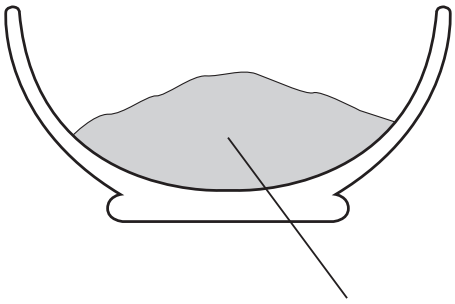
_____

_____

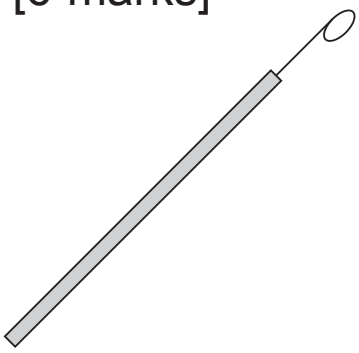
(iii) Write a word equation for the reaction of potassium with water. [2 marks]

potassium + water → ☐ + ☐

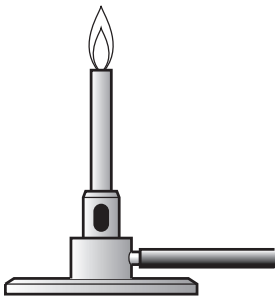
2 Describe how you would carry out a flame test to compare samples of copper chloride and sodium chloride using the apparatus shown below. [6 marks]



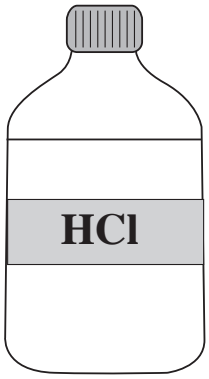
sample



nichrome wire



Bunsen burner



concentrated hydrochloric acid

Your answer should include:

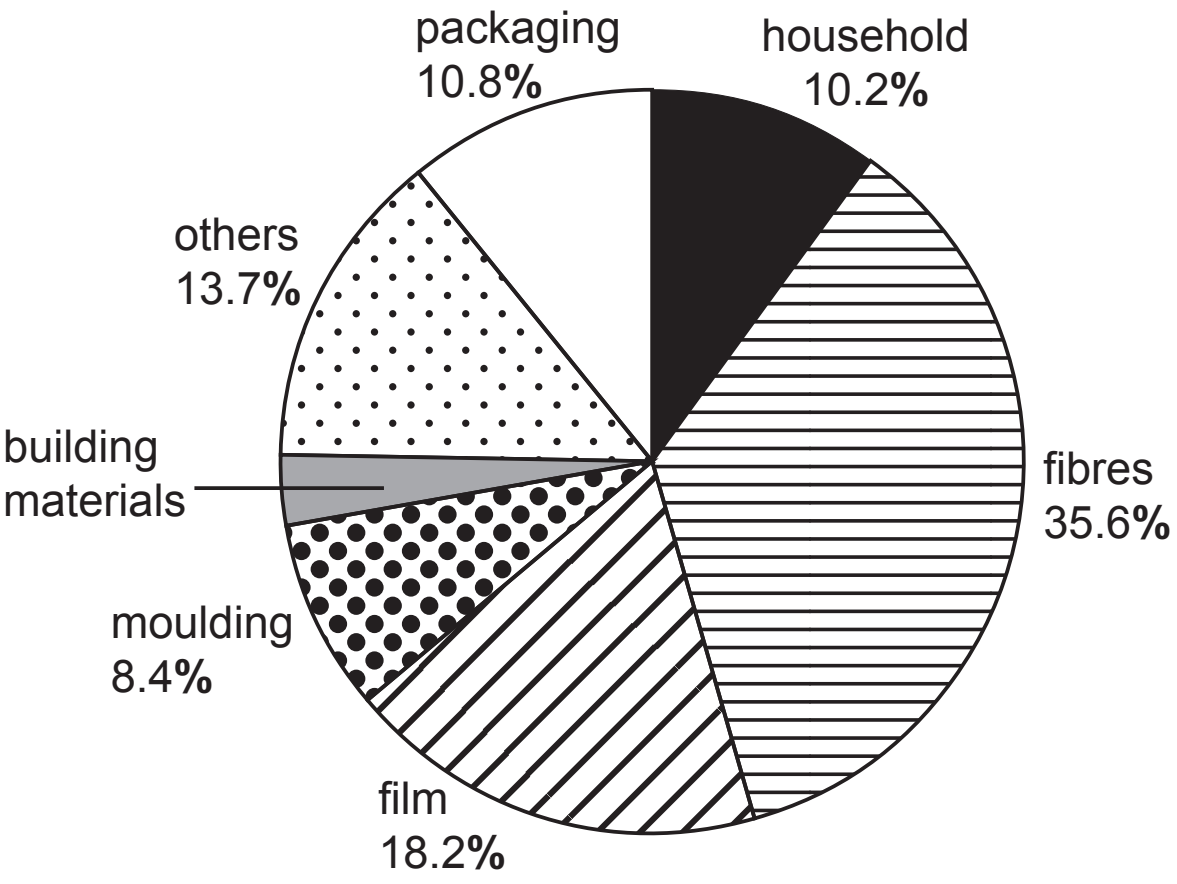
- a detailed description of the method;
- **one** safety precaution apart from wearing safety glasses;
- the results you would expect to see for copper chloride and sodium chloride.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

3 **(a)** The formula of propene is C_3H_6.
Name the two elements present in propene. [1 mark]

_____ and _____

(b) Polypropene is a plastic made from propene.
Polypropene is brittle at temperatures below 5 °C, but it gets more flexible as it warms up, melting at temperatures of 127 °C or higher.
The pie chart below shows uses of polypropene.



Use this information to answer the following questions:

(i) Calculate the percentage of polypropene used in building materials. [2 marks]
(Show your working out.)

_____ **%**

(ii) Explain why packaging made from polypropene should **not** be used in very cold conditions.
[1 mark]

_____

_____

(iii) Suggest **one** reason why polypropene is not suitable to make a container to hold boiling water. [1 mark]

_____

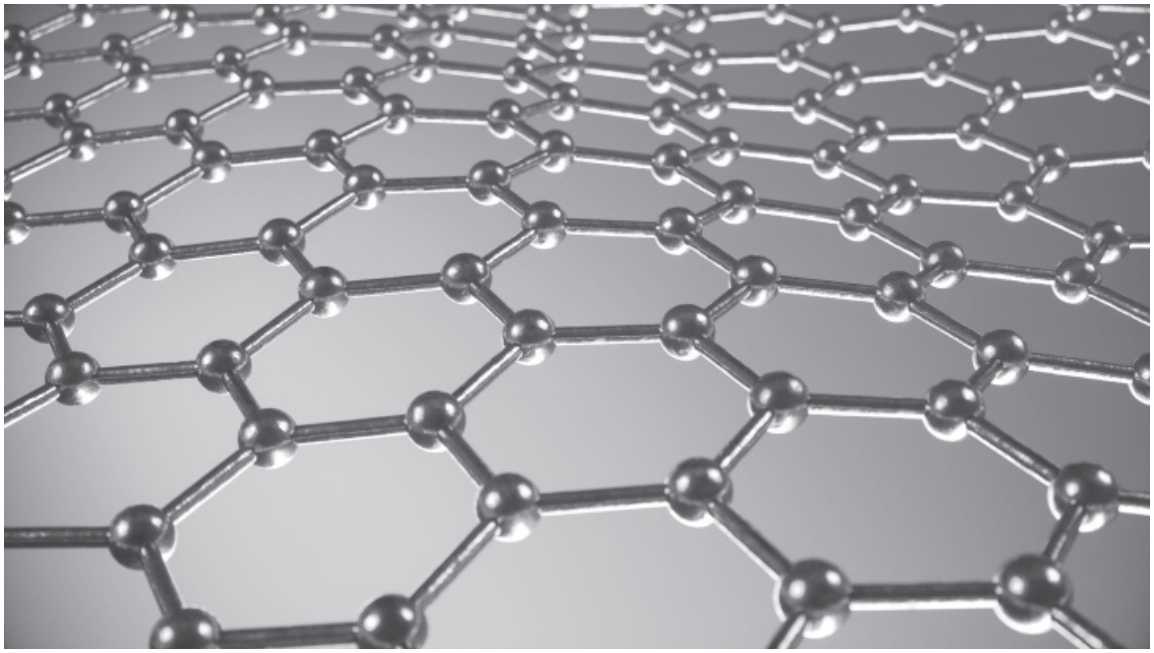
_____

(c) Polypropene is non-biodegradable. What is meant by the term **non-biodegradable?** [2 marks]

_____

_____

4 Graphene is a carbon-based material, discovered by scientists in 2004. It is a one-atom thick layer of carbon as shown below.



(a) Give **two** properties of graphene that make it suitable for use in solar cells. [2 marks]

1. _____

2. _____

(b) Nanotechnology involves the design and use of nanomaterials to replace traditional products. For example, some modern sun creams contain nanoparticles of zinc oxide.

(i) What size is a nanoparticle? [1 mark]

_____ m

(ii) Give **one** benefit of using nanoparticles of zinc oxide in sun cream. [1 mark]

_____

_____

(iii) Explain why some people are concerned about the use of nanoparticles in sun cream. [1 mark]

_____

_____

5 **(a)** Aluminium is an element which has 13 electrons.

(i) In the space below draw a diagram to show the electronic configuration of aluminium.
[1 mark]

(ii) Using your understanding of atomic structure, explain why an atom of aluminium has no electrical charge (is neutral). [1 mark]

_____

_____

(iii) Aluminium's mass number is 27. What is meant by the term **mass number**? [1 mark]

_____

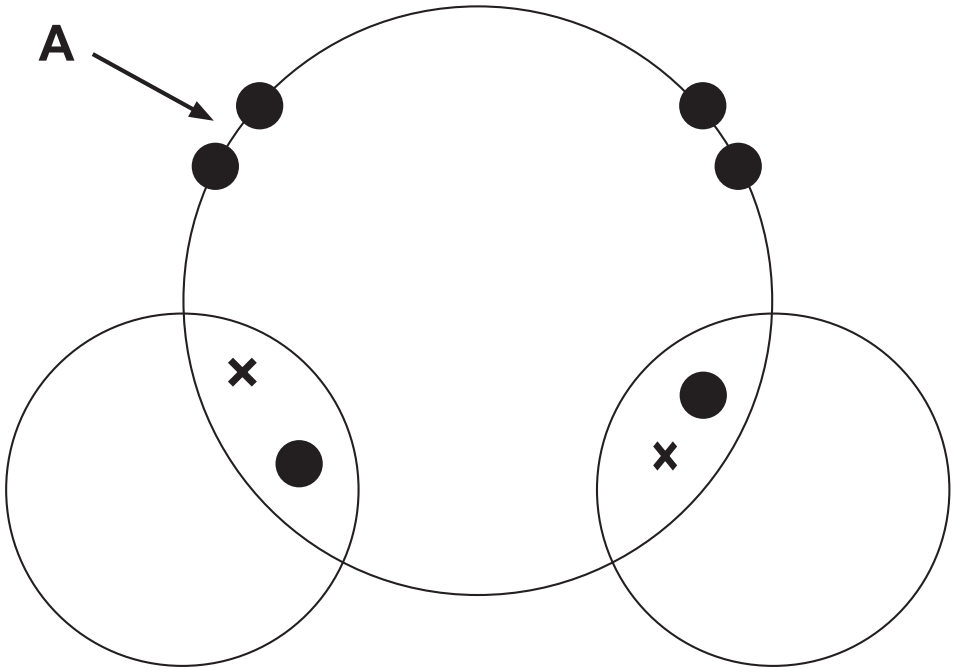
_____

(iv) Explain why aluminium is found in Group 3 of the Periodic Table. [1 mark]

_____

_____

(b) The covalent bonding in a molecule of water (H_2O) is shown below.



(i) What name is given to the pair of electrons labelled A in the diagram above? [1 mark]

_____

_____

(ii) How many covalent bonds are shown in the diagram above? [1 mark]

_____

(iii) What is meant by the term **covalent bond**? [1 mark]

_____

_____

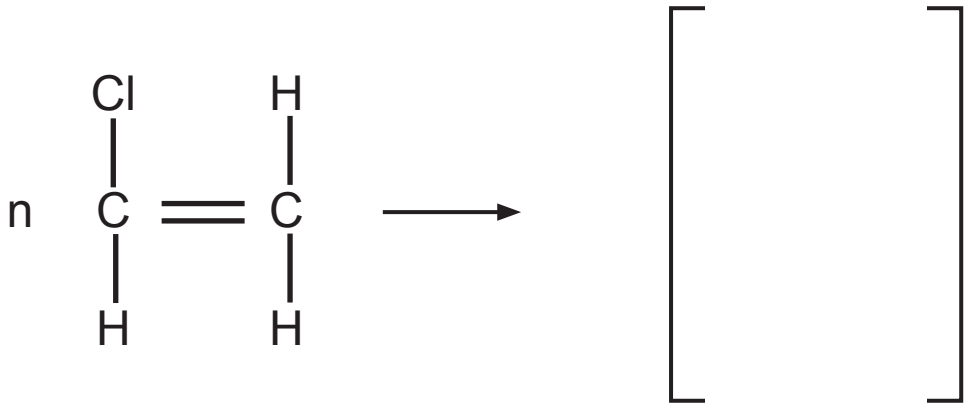
(iv) Name **one** molecule, apart from water, that has covalent bonding. [1 mark]

_____

6 Most modern houses have doors made from polyvinyl chloride (PVC).

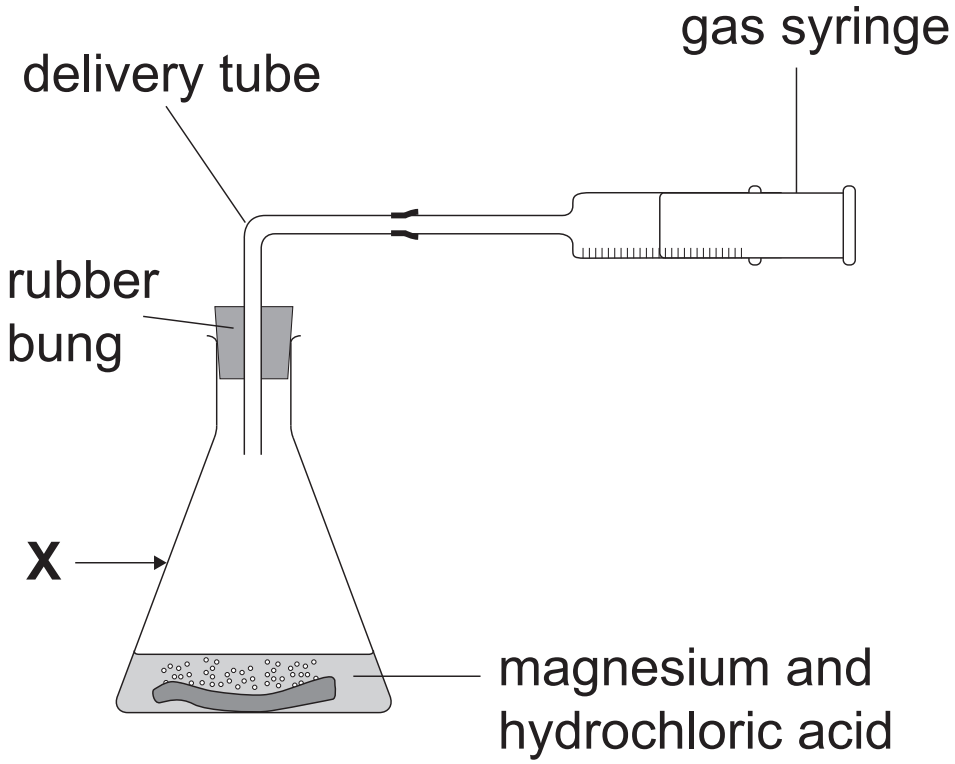
(a) Polyvinyl chloride (PVC) is made by the polymerisation of chloroethene.
What is meant by the term **polymerisation**?
[2 marks]

(b) (i) Complete the balanced symbol equation for the polymerisation of chloroethene. [2 marks]



(ii) Explain why chloroethene is **not** a hydrocarbon. [1 mark]

7 **(a)** The rate of the reaction between magnesium and dilute hydrochloric acid was investigated using the apparatus shown below.



(i) What name is given to the piece of apparatus labelled **X** in the diagram above? [1 mark]

_____

(ii) The gas collected during this investigation is hydrogen.
Describe the test for hydrogen. [1 mark]

_____

_____

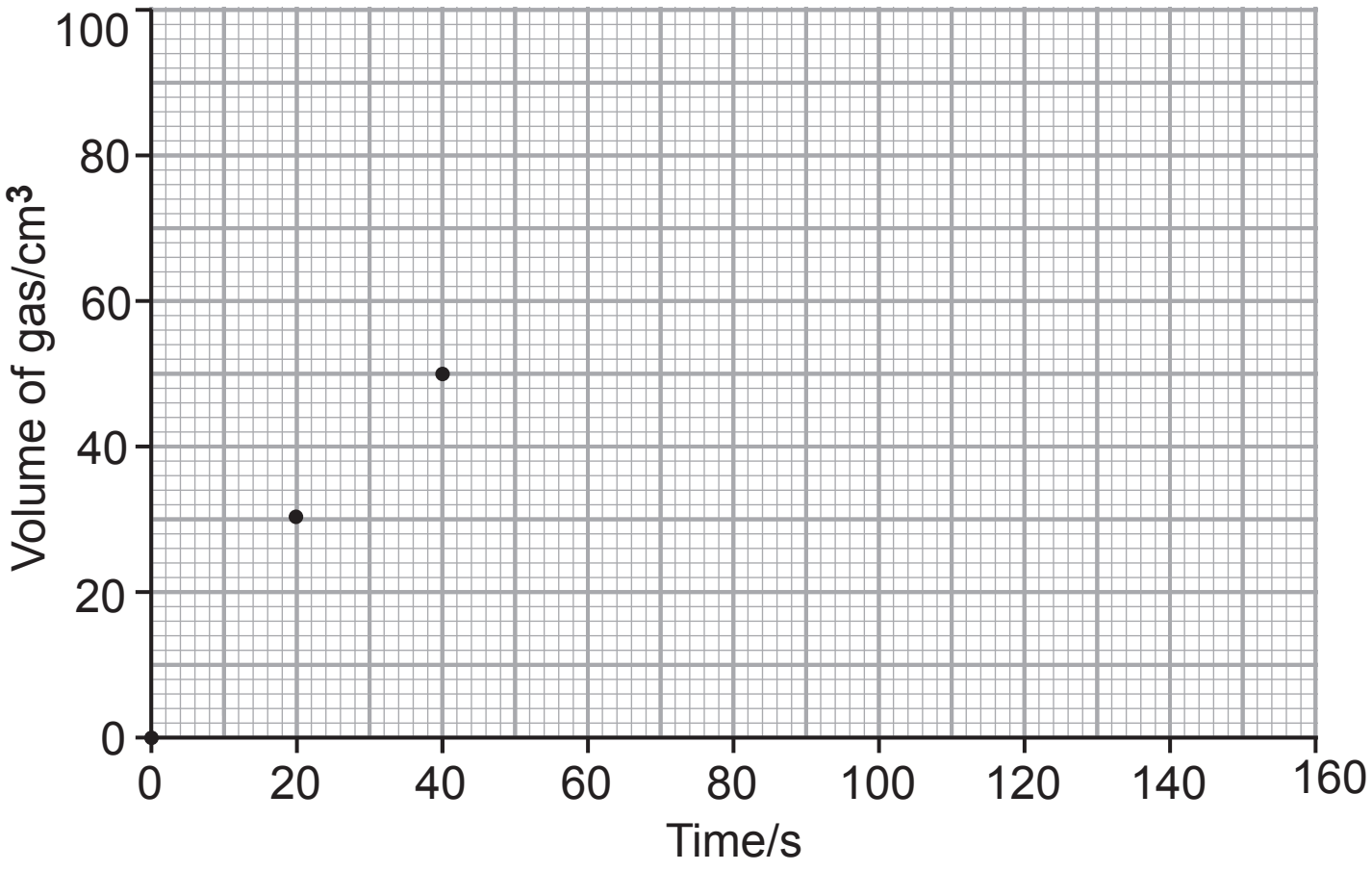
(iii) Complete the symbol equation below for the reaction of magnesium with hydrochloric acid by adding the state symbols. [2 marks]

$$Mg_{(\quad)} + 2HCl_{(\quad)} \longrightarrow MgCl_{2\,(aq)} + H_{2\,(\quad)}$$

(b) In the investigation magnesium was added to dilute hydrochloric acid at room temperature (20 °C). The volume of gas produced was measured every 20 seconds.
The results are shown below.

Time/s	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**
Volume of gas/cm^3	**0**	**30**	**50**	**65**	**74**	**83**	**87**	**90**	**90**

(i) Complete the line graph below. [3 marks]

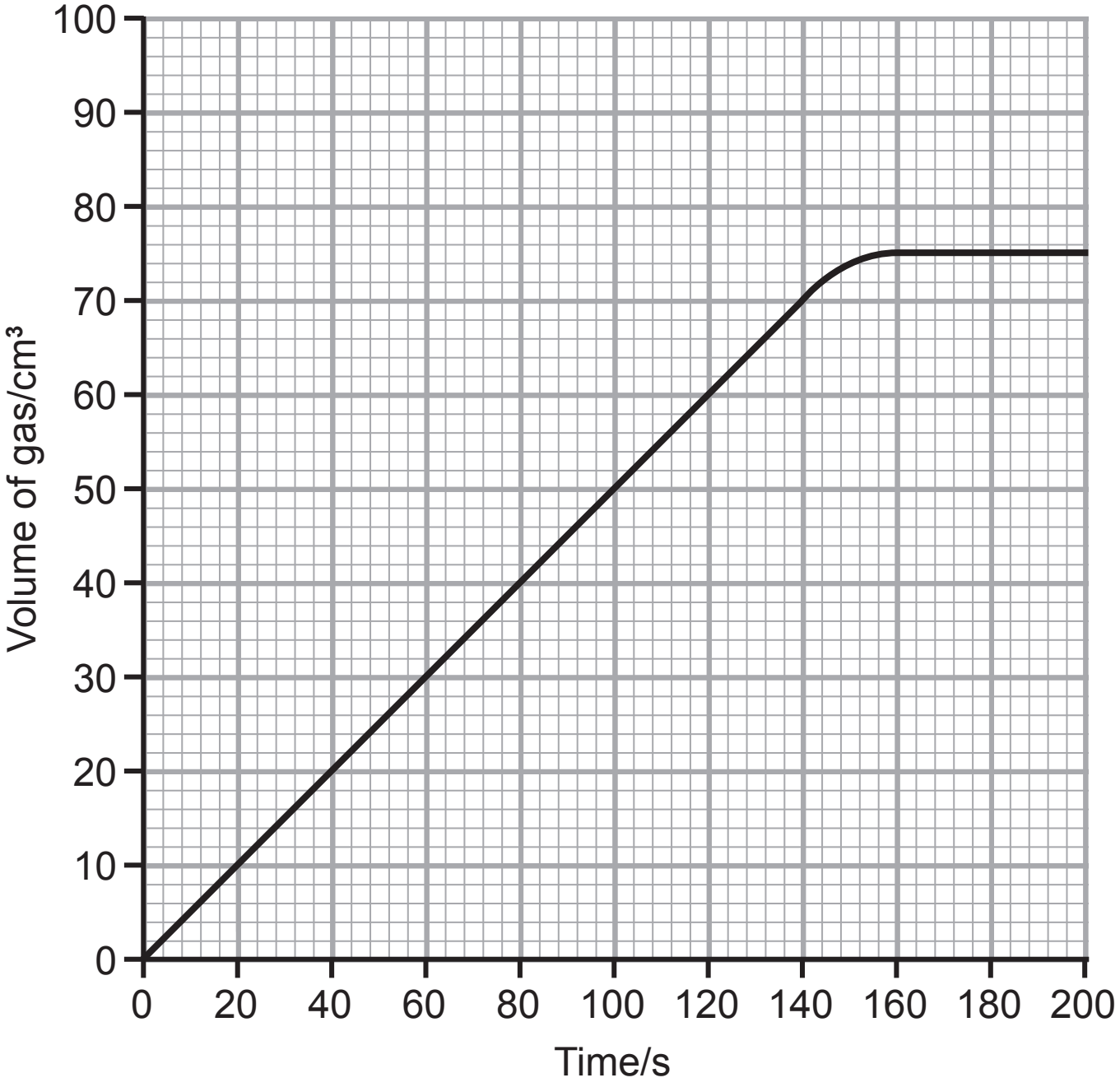


(ii) Use your graph to find out how long it took to produce the first 40 cm^3 of gas. [1 mark]

_____ s

(c) The investigation was repeated using zinc instead of magnesium at room temperature (20 °C).

The results are shown on the graph below.



(i) Describe **fully** the trend shown in the graph.
[2 marks]

_____

_____

(ii) This investigation was repeated at a temperature of 40 °C. On the graph above draw a line to show the results you would expect at 40 °C. [2 marks]

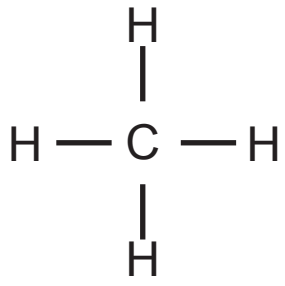
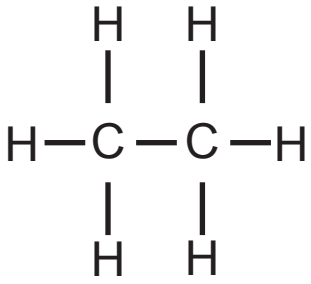
(iii) Describe what happens to the particles when the temperature is increased and explain why this affects the rate of reaction. [3 marks]

8 Methane is an alkane and is used as a fuel in gas cookers.

(a) Complete the balanced symbol equation below to show the combustion of methane (CH_4). [3 marks]

CH_4 + → +

(b) Complete the table on page 20 about some alkanes. [3 marks]

Alkane	Molecular formula	Structure
methane	CH_4	
ethane		
	C_4H_{10}	

This is the end of the question paper

SOURCES

Q2.....Principal Examiner

Q4..... © Getty Images

Q6..... Principal Examiner

Q7..... Principal Examiner

Q8..... Principal Examiner

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Butanoate	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

COUNCIL FOR THE **CURRICULUM, EXAMINATIONS** AND **ASSESSMENT**
29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
Tel: +44 (0)28 9026 1200 Fax: +44 (0)28 9026 1234
Email: info@ccea.org.uk Web: www.ccea.org.uk

Rewarding Learning

New Specification

Rewarding Learning

Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

gcse examinations

chemistry

For first teaching from September 2017

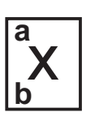
THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
1 **H** Hydrogen 1																	4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	98 **Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La*** Lanthanum 57	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	210 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac†** Actinium 89	261 **Rf** Rutherfordium 104	262 **Db** Dubnium 105	266 **Sg** Seaborgium 106	264 **Bh** Bohrium 107	277 **Hs** Hassium 108	268 **Mt** Meitnerium 109	271 **Ds** Darmstadtium 110	272 **Rg** Roentgenium 111	285 **Cn** Copernicium 112						

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	145 **Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	242 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	245 **Bk** Berkelium 97	251 **Cf** Californium 98	254 **Es** Einsteinium 99	253 **Fm** Fermium 100	256 **Md** Mendelevium 101	254 **No** Nobelium 102	257 **Lr** Lawrencium 103



a = relative atomic mass (approx)
x = atomic symbol
b = atomic number