Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3410U10-1

Z22-3410U10-1

FRIDAY, 17 JUNE 2022 – AFTERNOON

CHEMISTRY – Unit 1:
Chemical Substances, Reactions and Essential Resources

FOUNDATION TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**3**	
3.	**6**	
4.	**8**	
5.	**12**	
6.	**8**	
7.	**10**	
8.	**6**	
9.	**5**	
10.	**9**	
11.	**6**	
Total	**80**	

3410U101
01

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

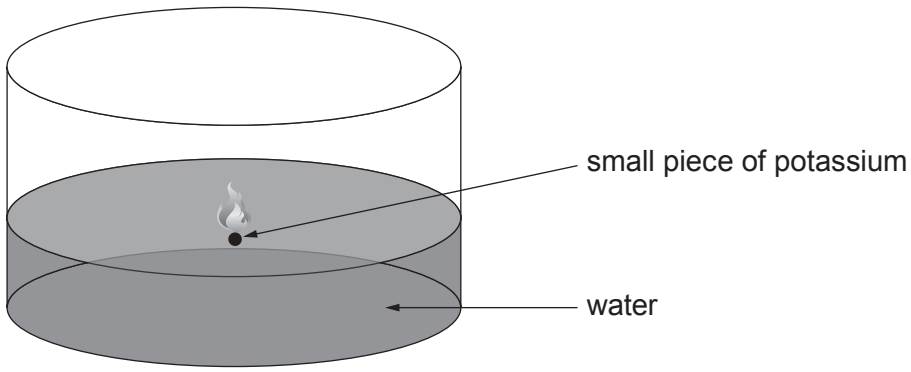
Question **8** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

Answer **all** questions.

1. (a) Potassium reacts with water to produce potassium hydroxide and hydrogen gas.

$$2K + 2H_2O \longrightarrow 2KOH + H_2$$



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(i) Complete the table. Tick (✓) **one** box in **each** of the last two rows. [2]

Substance	Formula	Element	Compound
potassium	K	✓	
water	H_2O		✓
potassium hydroxide	KOH		
hydrogen	H_2		

(ii) During the reaction, potassium burns with a **lilac** flame.

Give **two** other observations that you would expect to make.

Choose your answers from the box. [2]

orange crystals form	**fizzing**	**potassium sinks**
potassium floats	**white precipitate forms**	

Observation 1 .....

Observation 2 .....

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(b) Potassium also reacts with oxygen to produce potassium oxide.

$$\square\ K + O_2 \longrightarrow 2K_2O$$

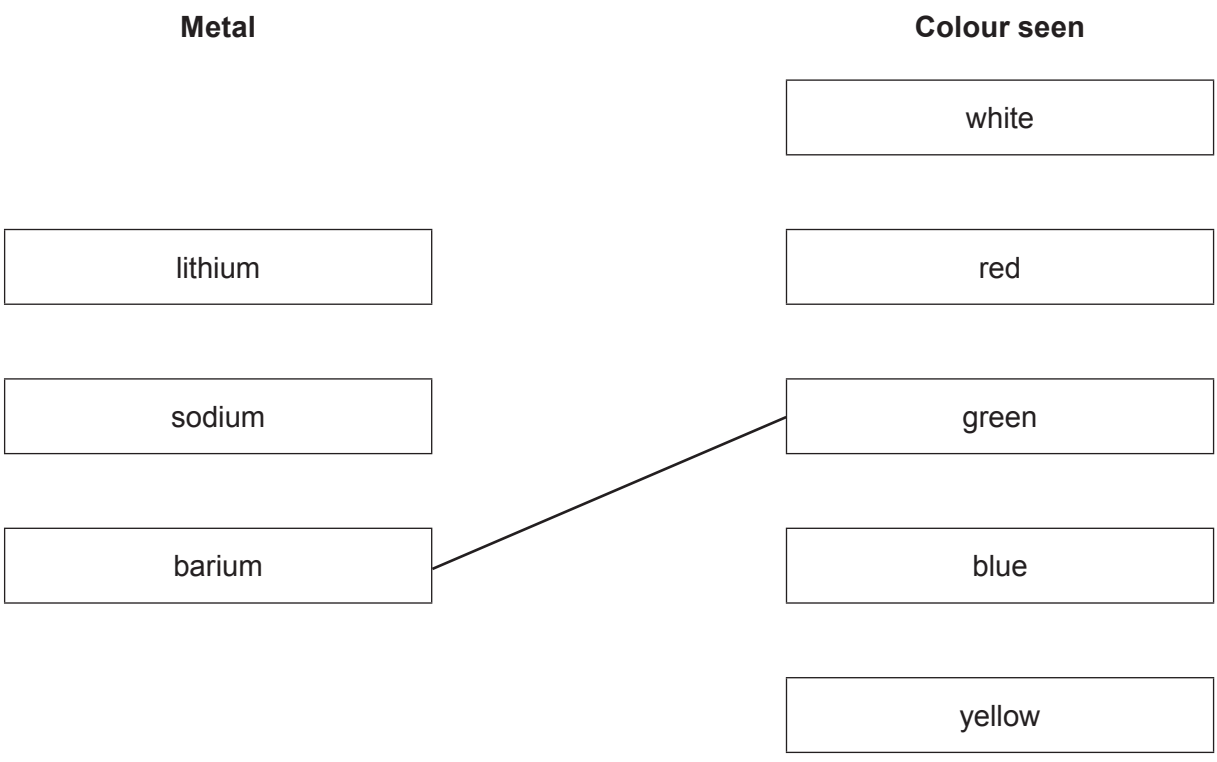
Choose a number from the box to balance the equation for this reaction. [1]

2	4	6

(c) Most Group 1 and Group 2 metals can be identified by the colour seen in a flame test.

Draw **one** line from each metal to the colour seen.

One line has been drawn for you. [2]



7

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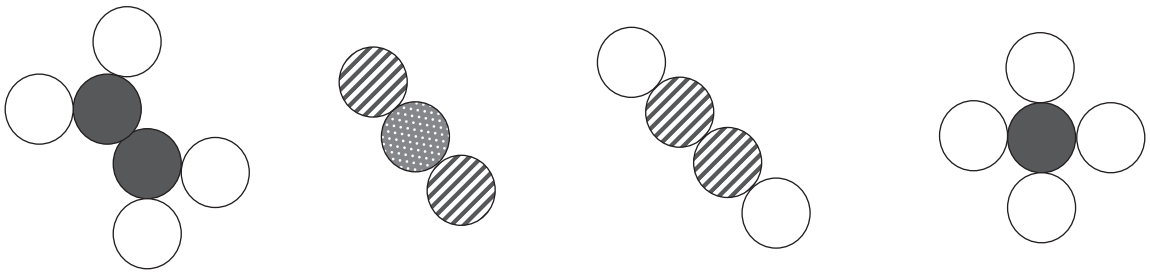
2. (a) The following diagrams represent molecules of some gases.



A **B** **C** **D**

Give the **letter** of the diagram which represents each of the following molecules. [2]

sulfur dioxide, SO_2 .....

ethene, C_2H_4 .....

(b) This chemical equation shows the burning of ethene, C_2H_4.

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$

Complete the **word** equation for this reaction. [1]

ethene + oxygen ⟶ ..... + water

3410U101
05

3

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3. Chlorine, bromine and iodine are elements in Group 7 of the Periodic Table.

(a) State the number of electrons in the outer shell of a chlorine atom. [1]

.....

(b) Underline the correct formula of chlorine gas. [1]

Cl_2 Cl^2 Cl 2Cl

(c) A teacher demonstrated the reactivity of Group 7 elements by placing heated iron wool in gas jars containing vapours of the elements.

The class recorded the results shown in the table.

Group 7 element	Observation with heated iron wool
chlorine	glowed very brightly
bromine	
iodine	glowed faintly

(i) Put a tick (✓) in the box to show the observation when heated iron wool was placed in bromine vapour. [1]

glowed less brightly than iodine ☐

glowed less brightly than chlorine ☐

glowed more brightly than chlorine ☐

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(ii) The compound produced in the reaction between iron wool and bromine contains the ions Fe^{3+} and Br^{-}.

I. Give the formula of this compound. [1]

.....

II. State the name of this compound. [1]

.....

(d) Tick (✓) the box next to a common use of iodine. [1]

to disinfect skin before surgery	☐
to make coloured fireworks	☐
to sterilise swimming pools	☐
to fill party balloons	☐

3410U101
07

6

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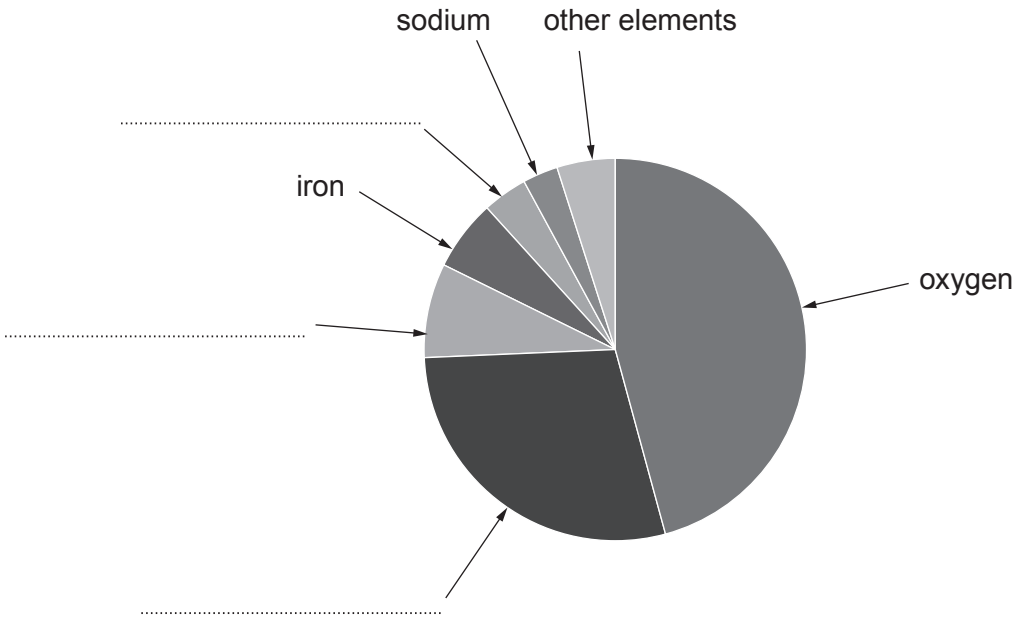
4. (a) The Earth's crust contains more than 80 elements, including many metals. Some of the metals, such as gold, are found 'native' or uncombined, but most are bonded with other elements to form compounds.

The crust can be thicker than 80 kilometres in some spots and less than one kilometre thick in others.

Just six elements make up almost all of the Earth's crust. These are aluminium, calcium, iron, oxygen, silicon and sodium.

Silicon is the second most abundant element. The amount of aluminium is approximately double the amount of calcium.

The chart shows the percentages of elements contained in the crust.



(i) Use the information given to **label** the remaining sections of the chart. [2]

(ii) Underline the approximate fraction of elements in the crust which are metals. [1]

$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{3}{4}$

Examiner only

(iii) Tick (✓) the statement which best explains why most metals are **not** found native in the crust. [1]

most metals have higher melting points than gold ☐

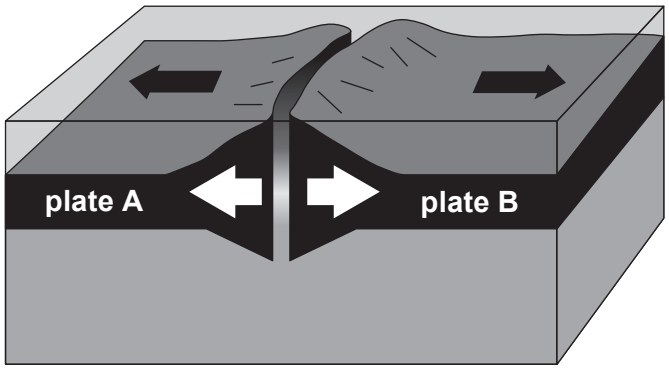
most metals are magnetic ☐

most metals are more reactive than gold ☐

most metals are radioactive ☐

(b) Tectonic plates are huge sections of the crust that move very slowly above the mantle. The places where plates meet are called plate boundaries.

The diagram shows one type of plate boundary.



(i) Describe how new rock is formed at this plate boundary. [3]

.....

.....

.....

.....

(ii) Underline the name of this type of plate boundary. [1]

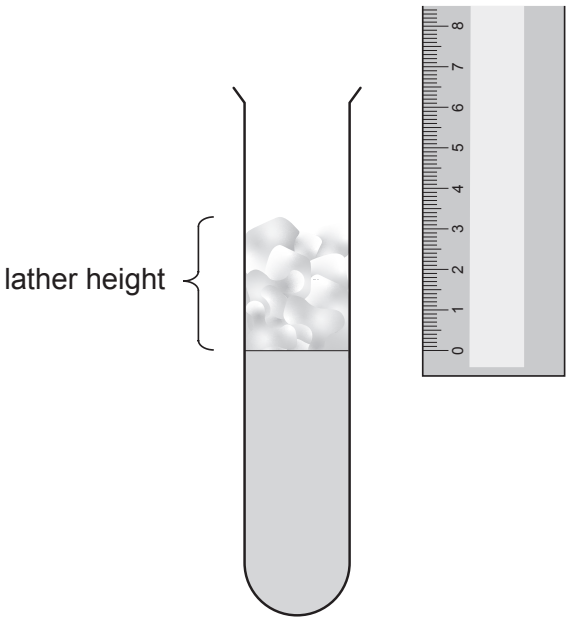
conservative **destructive** **constructive**

3410U101
09

8

5. (a) A class measured the hardness of five different samples of water, **A**, **B**, **C**, **D** and **E**.

They added soap solution to each water sample and measured the height of the lather produced on shaking.



Their results are shown in the table.

Water sample	Lather height (cm)
A	1.5
B	3.0
C	0.5
D	5.0
E	2.0

Examiner only

(i) Complete the order of hardness of the water samples, from softest to hardest. [1]

softest ⟶ hardest

D				**C**

(ii) Calcium is one of two metal ions which cause hardness in water.

Underline the name of the other metal ion which causes hardness in water. [1]

potassium **sodium** **nickel** **magnesium** **tin**

(iii) Tick (✓) **all** of the variables which must be controlled in this experiment. [2]

volume of soap solution ☐

type of water ☐

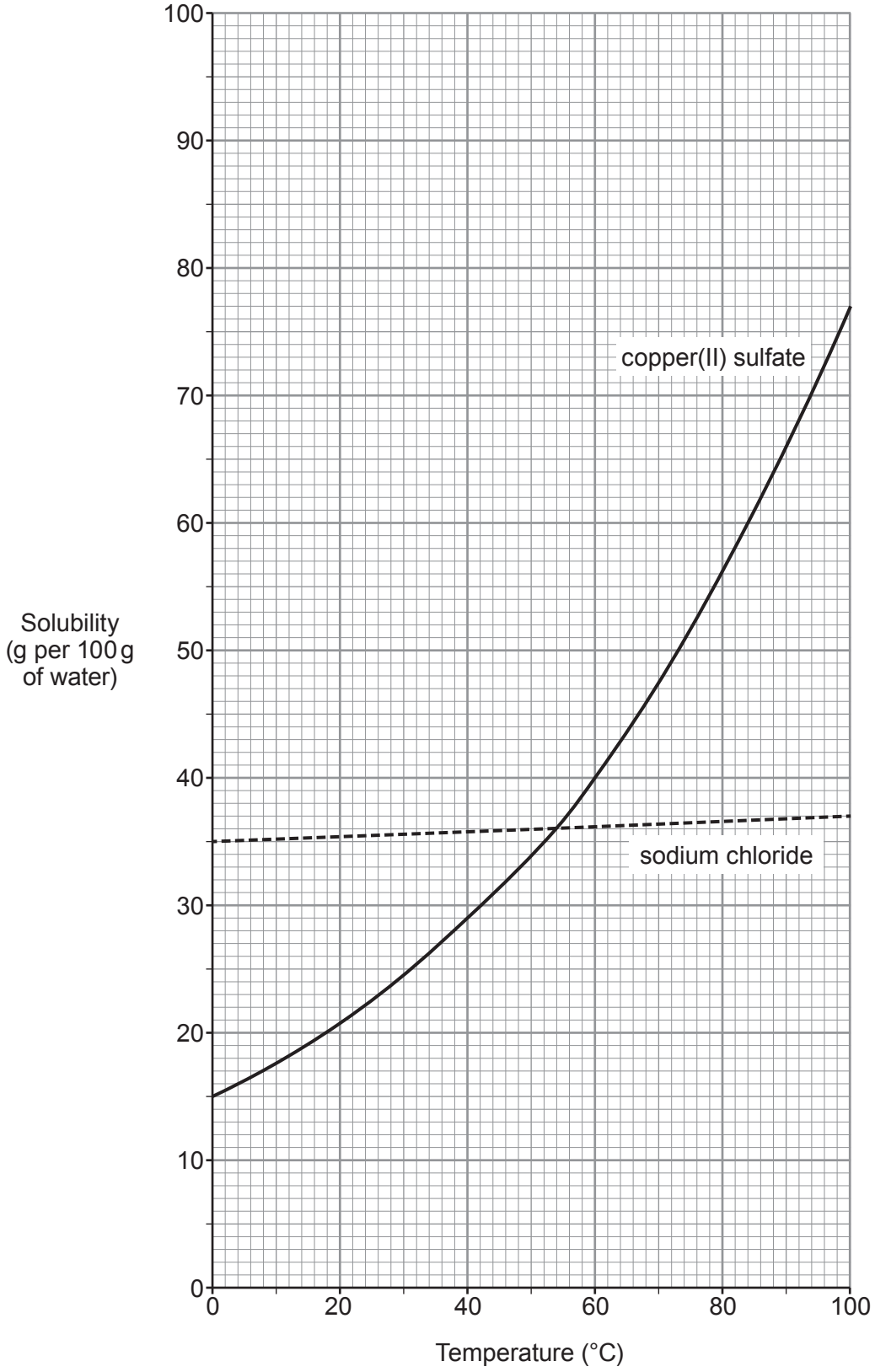
type of soap solution ☐

volume of water ☐

height of lather ☐

width of test tube ☐

(b) The graph shows the solubilities of sodium chloride and copper(II) sulfate at different temperatures.



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(i) State the temperature at which the two compounds have the same solubility. [1]

..... °C

(ii) Compare the changes in solubility of the two compounds. [2]

.....

.....

.....

(iii) Calculate the mass of copper(II) sulfate that would dissolve in **1000 g** of water at 40 °C. [2]

Mass = ... g

3410U101
13

(c) Potassium sulfate, K_2SO_4, is soluble in water.

(i) State the number of sulfur atoms in the formula K_2SO_4. [1]

.....

(ii) Calculate the relative formula mass (M_r) of K_2SO_4. [2]

A_r(K) = 39 A_r(S) = 32 A_r(O) = 16

M_r = ...

12

Examiner only

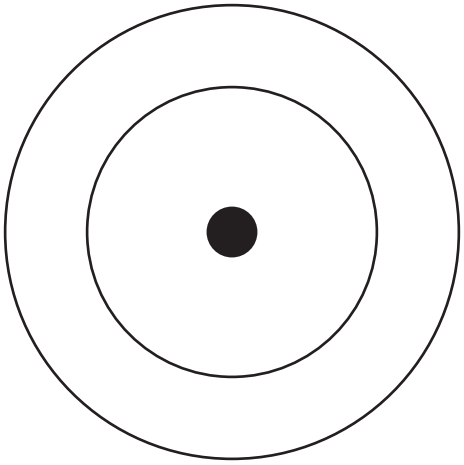
6. (a) An atom of an element has 5 protons, 5 electrons and 6 neutrons.

(i) State the atomic number and the mass number of this atom. [2]

Atomic number .....

Mass number .....

(ii) Complete the diagram of the electronic structure of the element. [1]



(iii) Explain why the atom has no overall charge. [2]

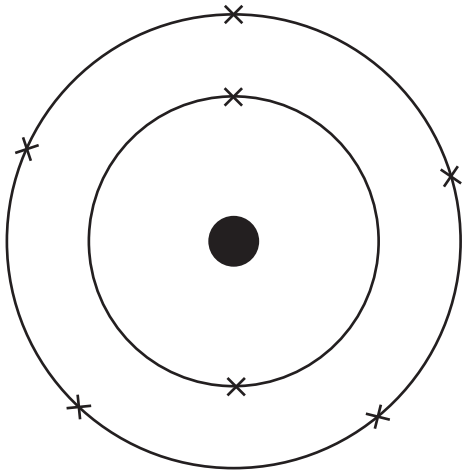
.....

.....

.....

Examiner only

(b) The diagram shows the electronic structure of another element.



This element is in Group 5 and Period 2 of the Periodic Table.

(i) State the name of the element. [1]

.....

(ii) Use the electronic structure to explain why this element is in Group 5. [1]

.....

.....

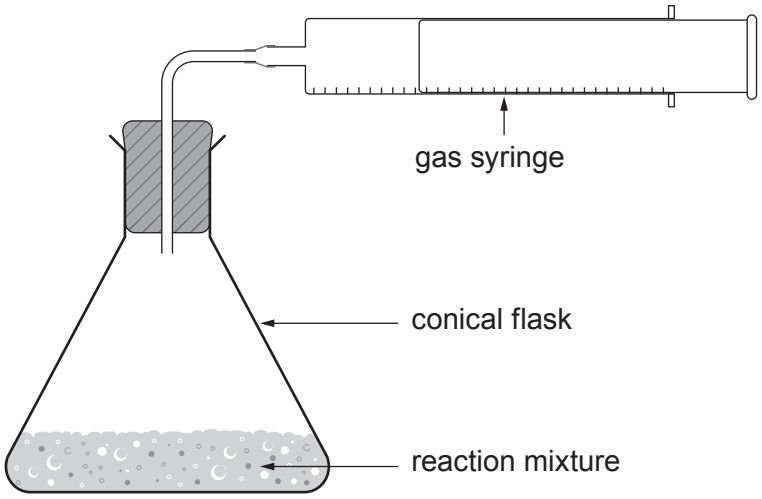
(iii) Use the electronic structure to explain why this element is in Period 2. [1]

.....

.....

8

7. A student decided to investigate the rate of reaction of different concentrations of hydrochloric acid with pieces of chalk, using the equipment shown.



Chalk contains calcium carbonate and the reaction produces carbon dioxide gas.

The table shows the student's results.

Concentration of hydrochloric acid (M)	Volume of gas produced in 1 minute (cm^3)
0.2	8
0.4	16
0.6	24
0.8	32
1.0	40
1.2	48

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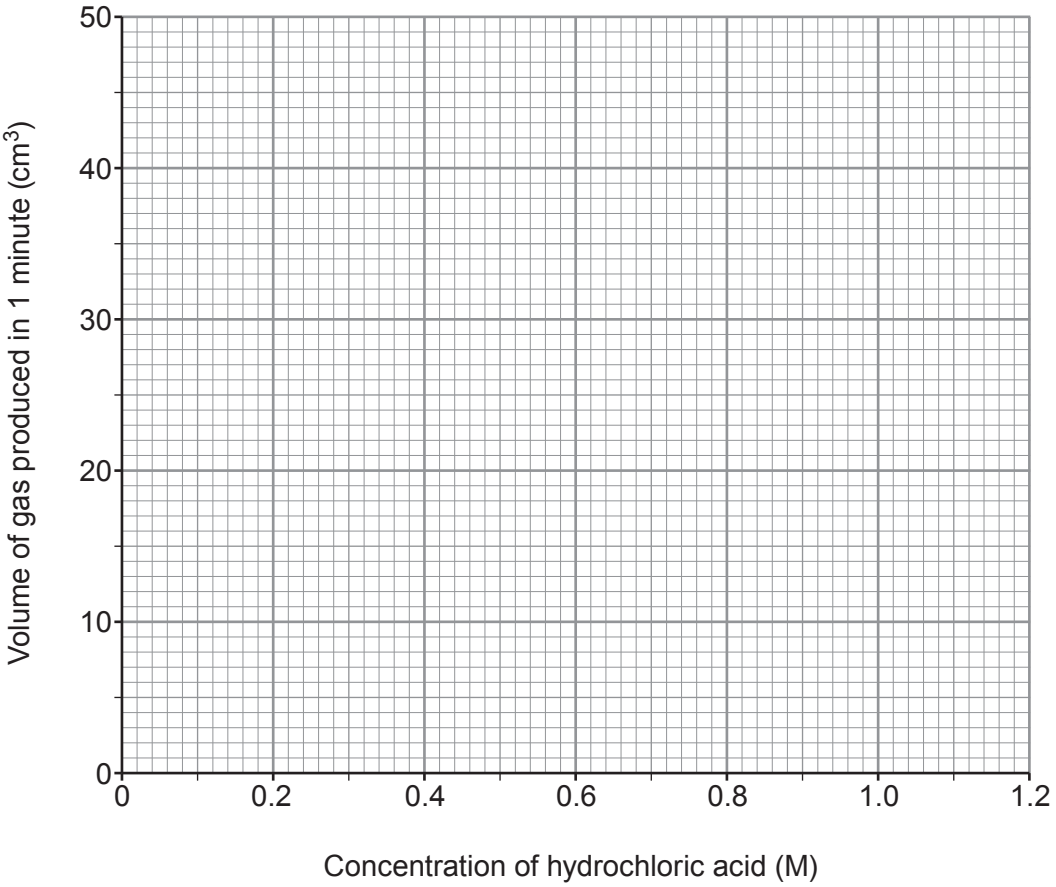
(a) Plot the results from the table on the grid. Draw a suitable line. [3]



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(b) Describe how the volume of gas produced in 1 minute changes as the concentration of the acid changes. [2]

.....

.....

.....

(c) Underline the correct word(s) in each bracket to explain the results. [3]

When the acid concentration is higher, there are

(more / less / the same number of) particles in the same volume.

Acid particles **(dissolve / mix / collide)** with the chalk more frequently.

The **(chalk / acid / gas)** is produced at a higher rate.

(d) Other than changing the concentration of the acid or the mass of the chalk added, state **two** ways in which the rate of this reaction could be increased. [2]

.....

.....

.....

10

Examiner only

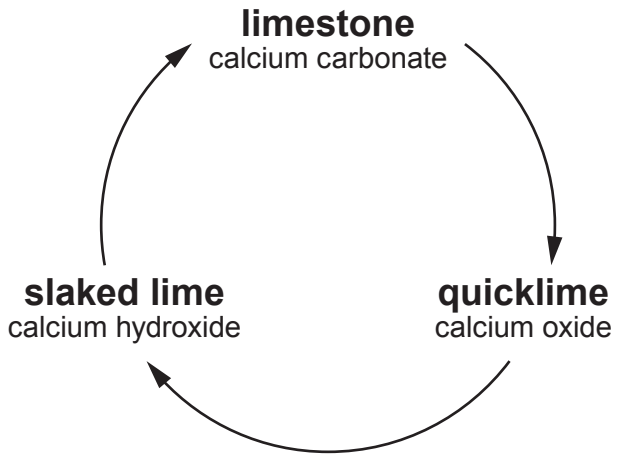
8. Burning fossil fuels leads to global warming.

Explain how global warming arises and describe the problems caused. [6 QER]

6

Examiner only

9. Limestone is a rock which consists mostly of calcium carbonate. The diagram shows a cycle of reactions involving limestone.



(a) (i) When limestone is heated, calcium carbonate is converted to calcium oxide and carbon dioxide.

I. State the name for this type of reaction. [1]

.....

II. Write a balanced symbol equation for the reaction. [2]

..... ⟶ ..... + ...

(ii) State what must be added to calcium oxide to form calcium hydroxide. [1]

.....

(b) Give **one** use of limestone in the construction industry. [1]

.....

5

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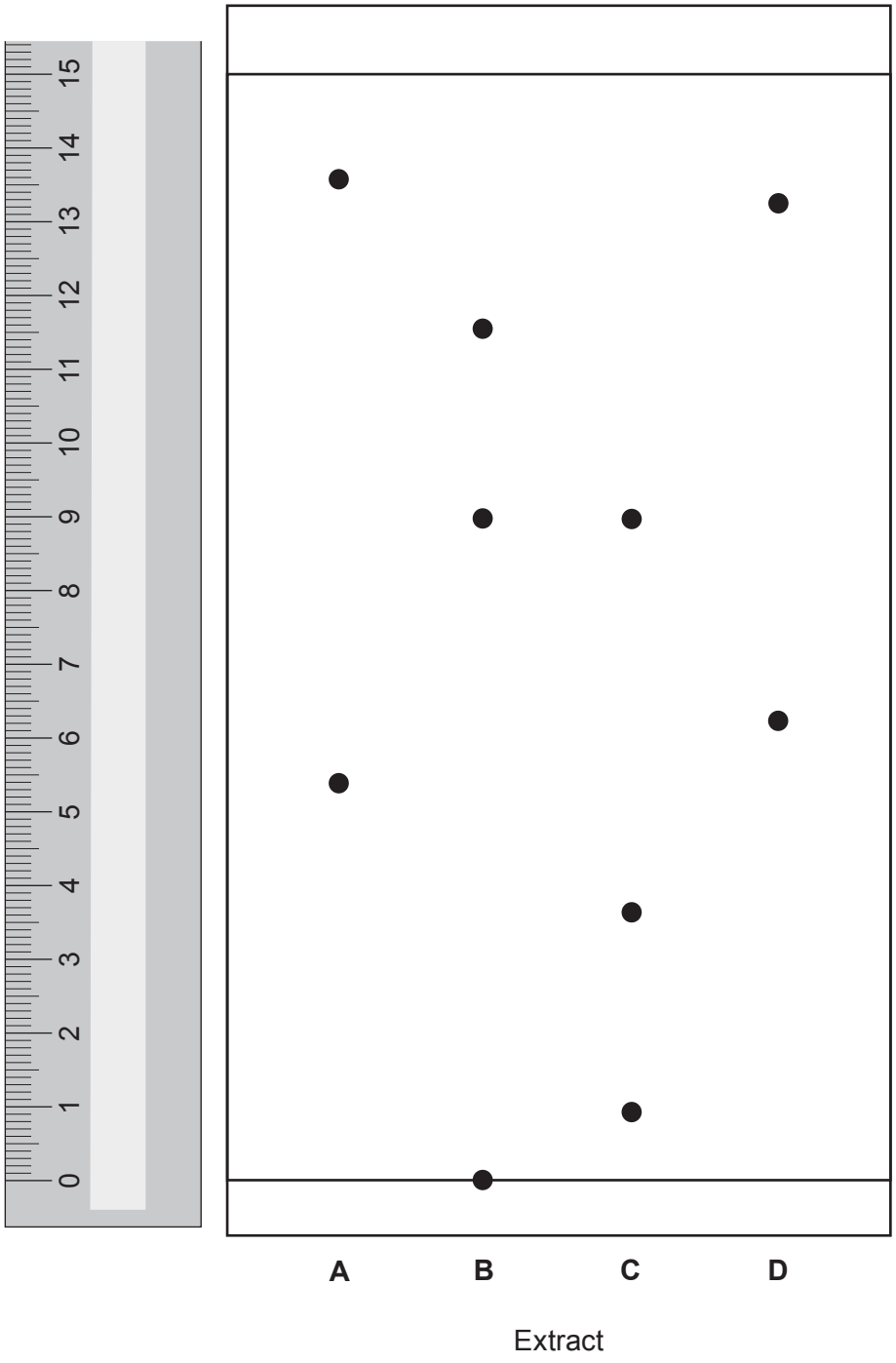
10. Paper chromatography can be used to identify plant leaf pigments. This process uses a chemical called acetone as the solvent instead of water.

The diagram shows the chromatogram of plant leaf extracts **A**, **B**, **C** and **D** in acetone.



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(a) All of the extracts contain a mixture of pigments with different R_f values.

For which plant leaf extract, **A**, **B**, **C** or **D**, is the **highest** R_f value 0.60?

Give your reasoning. [3]

Extract .....

Reasoning .....

.....

.....

(b) Explain why the pigments travel different distances on the chromatogram. [2]

.....

.....

.....

(c) One of the extracts contains a pigment which is insoluble in acetone.

State the **letter** of this extract. Explain your choice. [2]

Extract .....

Explanation .....

.....

(d) The chemical formula of the solvent acetone is C_3H_6O. Calculate the percentage by mass of carbon in acetone.

The relative formula mass (M_r) of acetone is 58. [2]

$A_r(C) = 12$

Percentage = ... %

9

Examiner only

11. (a) The Earth's early atmosphere contained large amounts of water vapour and carbon dioxide. Explain why the amounts of water vapour and carbon dioxide decreased over geological time. [4]

Water vapour .....

.....

.....

.....

Carbon dioxide .....

.....

.....

.....

(b) State the percentages of nitrogen and oxygen in the present atmosphere. [2]

Nitrogen ..... %

Oxygen ..... %

6

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
aluminium	Al^{3+}	bromide	Br^{-}
ammonium	NH_4^{+}	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^{-}
calcium	Ca^{2+}	fluoride	F^{-}
copper(II)	Cu^{2+}	hydroxide	OH^{-}
hydrogen	H^{+}	iodide	I^{-}
iron(II)	Fe^{2+}	nitrate	NO_3^{-}
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^{+}	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^{+}		
silver	Ag^{+}		
sodium	Na^{+}		
zinc	Zn^{2+}		

THE PERIODIC TABLE

Group	1	2										3	4	5	6	7	0
																	4 He Helium 2
						1 H Hydrogen 1											
	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	63.5 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
	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	179 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															

Key