OCR
Oxford Cambridge and RSA

Friday 17 May 2024 – Morning

GCSE (9–1) Combined Science A (Gateway Science)

J250/03 Chemistry (Foundation Tier)

Time allowed: 1 hour 10 minutes

F

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science A (Chemistry) (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

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Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 When iron reacts with dilute hydrochloric acid, bubbles of hydrogen are produced.

Which state symbol describes these bubbles?

A aq

B g

C l

D s

Your answer ☐ **[1]**

2 Magnesium reacts with oxygen to make magnesium oxide.

magnesium + oxygen → magnesium oxide

Which type of reaction is shown by the equation?

A Displacement

B Electrolysis

C Neutralisation

D Oxidation

Your answer ☐ **[1]**

3 Which gas turns limewater cloudy?

A Carbon dioxide

B Chlorine

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

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4 Zinc chloride is an ionic compound made from Zn^{2+} and Cl^- ions.

What is made at the **negative** electrode during the electrolysis of molten zinc chloride?

A Chlorine

B Hydrogen

C Oxygen

D Zinc

Your answer ☐ **[1]**

5 The table shows the colours of an indicator at different pH values.

1	2	3	4	5	6	7	8	9	10	11	12
Pink			Orange			Purple			Green		

Which colour is this indicator in a **neutral** solution?

A Green

B Orange

C Pink

D Purple

Your answer ☐ **[1]**

6 The energy change in a reaction is 30 000 J.

What is the energy change in **kJ**?

A 3

B 30

C 300

D 3000

Your answer ☐ **[1]**

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7 Which row describes a **formulation**?

	Description	Amount of chemicals
A	compound	exact
B	mixture	exact
C	compound	random
D	mixture	random

Your answer ☐ **[1]**

8 What is the ionic equation for an aqueous neutralisation reaction?

A $H^+ + OH^+ \longrightarrow H_2O$

B $H^+ + OH^- \longrightarrow H_2O$

C $H^- + OH^+ \longrightarrow H_2O$

D $H^- + OH^- \longrightarrow H_2O$

Your answer ☐ **[1]**

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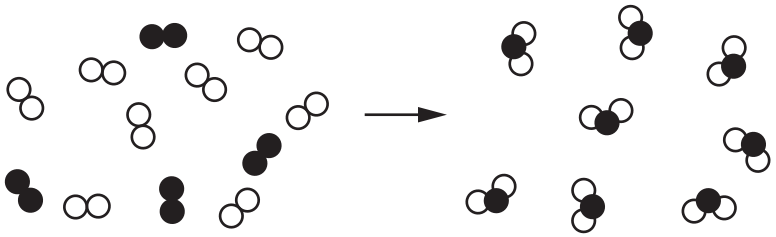
9 The diagram represents the particle model for a change in the arrangement of some particles.



Which row describes this change?

	Type of change	Explanation
A	chemical	The particles break up and then join together in a different way.
B	chemical	The particles stay the same but are arranged in a different way.
C	physical	The particles break up and then join together in a different way.
D	physical	The particles stay the same but are arranged in a different way.

Your answer ☐ **[1]**

10 Which element in the table is a **non-metal**?

	Appearance at room temperature	Melting point (°C)	Electrical conductivity
A	silver liquid	–39	high
B	orange-red solid	1083	high
C	yellow solid	113	low
D	silvery-white solid	3422	high

Your answer ☐ **[1]**

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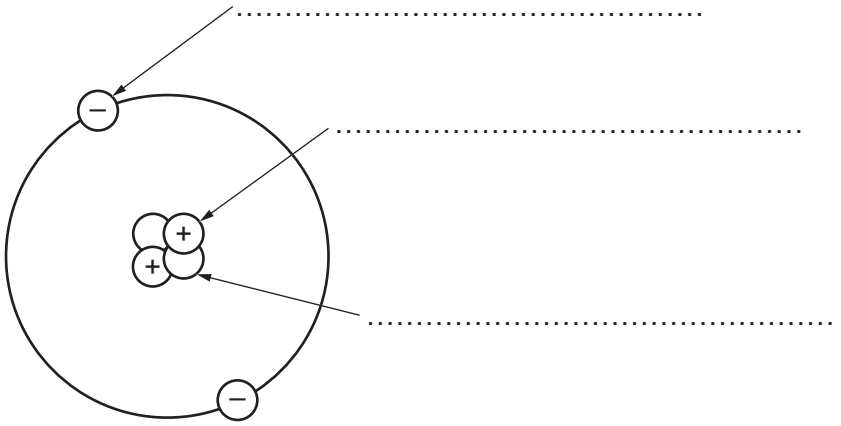
Section B

11 Elements in the Periodic Table are made from atoms.

(a) Atoms are made from three particles called **protons**, **neutrons** and **electrons**.

The diagram shows an atom.

(i) Label the names of the three particles on the diagram.



[2]

(ii) Complete the sentence about the atom.

Put a (ring) around the correct option.

The particle with the lowest relative mass is the **proton / neutron / electron**. **[1]**

(iii) The **first** of these three particles to be discovered was by J.J. Thomson.

Complete the sentence about the particles.

Put a (ring) around the correct option.

The particle that was discovered first was the **proton / neutron / electron**. **[1]**

(b) Write the **symbol** of the element made from atoms with nine protons.

Use the Periodic Table on the Data Sheet.

..... **[1]**

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(c) The table shows part of Mendeleev's Periodic Table published in 1871.

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	I	Ru Rh Pd

(i) Which property did Mendeleev use to arrange the elements in his Periodic Table?

Tick (✓) **one** box.

Atomic number ☐

Atomic size ☐

Atomic weight ☐

[1]

(ii) Give **one** reason why Mendeleev left gaps in his Periodic Table.

.....

..... **[1]**

(iii) Elements from which Group(s) are present in **both** Mendeleev's Periodic Table and the modern Periodic Table?

Use the Periodic Table on the Data Sheet.

Tick (✓) **one**, **two** or **three** boxes.

Group 1 ☐

Group 7 ☐

Group 0 ☐

[1]

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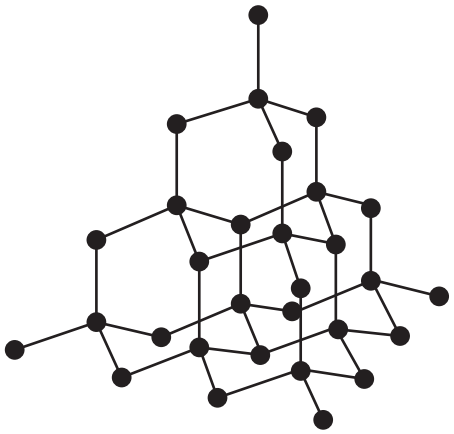
12 This question is about diamond and graphite.

(a) The diagram shows the structure of diamond.



(i) Which element is diamond made from?

..... **[1]**

(ii) What is the maximum number of covalent bonds that each atom in diamond can form?

..... **[1]**

(iii) The atoms in diamond have a diameter of 0.000000000154 m.

What is the diameter of the atoms in standard form?

Tick (✓) **one** box.

1.54×10^{-13} m ☐

1.54×10^{-10} m ☐

1.54×10^{-3} m ☐

[1]

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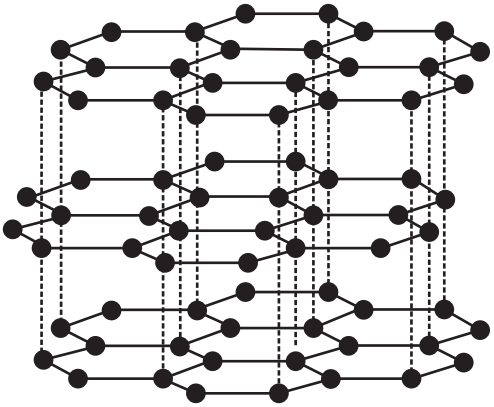
(iv) The properties of diamond can be explained in terms of its structure and bonding.

Draw lines to connect each **property** with its correct **explanation**.

Property	Explanation
	It has many strong covalent bonds.
High melting point	It has no free electrons.
Does not conduct electricity	It is a simple molecule.
	It is made from ions.

[2]

(b) This diagram shows the structure of graphite.



Which statements about the properties of graphite are **true** and which are **false**?

Tick (✓) **one** box in each row.

Properties of graphite	True	False
It conducts electricity.		
It is as hard as diamond.		
It has a high melting point.		

[2]

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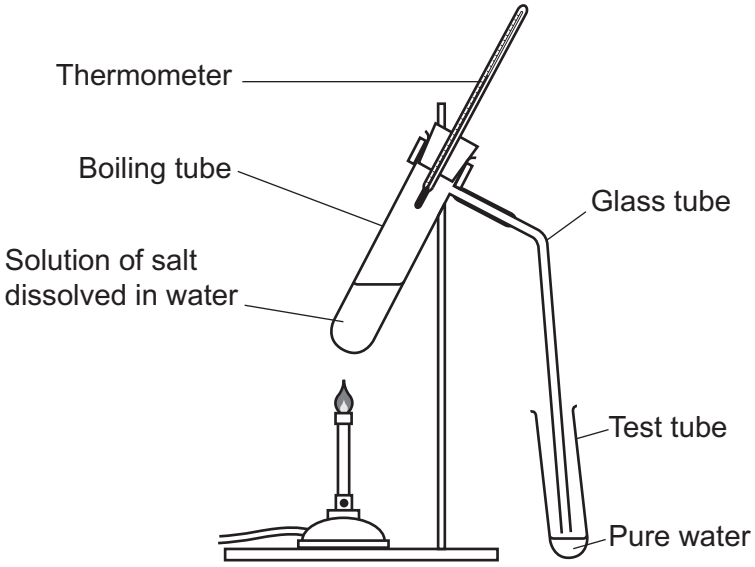
13 A student investigates mixtures of salt and water.

(a) The student has a solution of salt dissolved in water.

The diagram shows how they separate pure water from the solution.



(i) What name is given to this method of separation?

Tick (✓) **one** box.

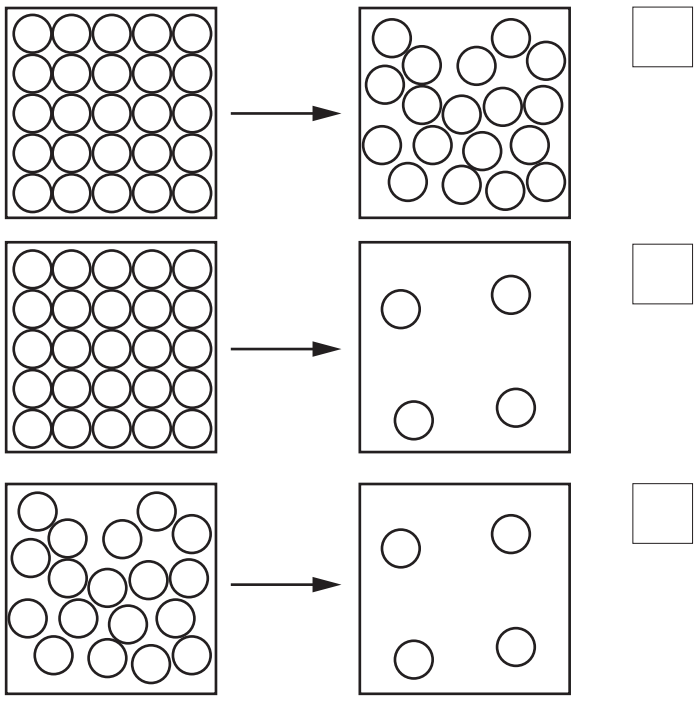
Crystallisation ☐ Distillation ☐ Filtration ☐

[1]

(ii) The particle diagrams represent changes of state.

Which diagram represents what happens in the boiling tube?

Tick (✓) **one** box.



☐

☐

☐

[1]

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(iii) After several minutes the glass tube becomes hot, and no more water is collected in the test tube.

Give **one** reason why the glass tube becomes hot.

.....

..... **[1]**

(iv) The student wants the experiment to work for longer.

What other piece of equipment can they use instead of the glass tube?

..... **[1]**

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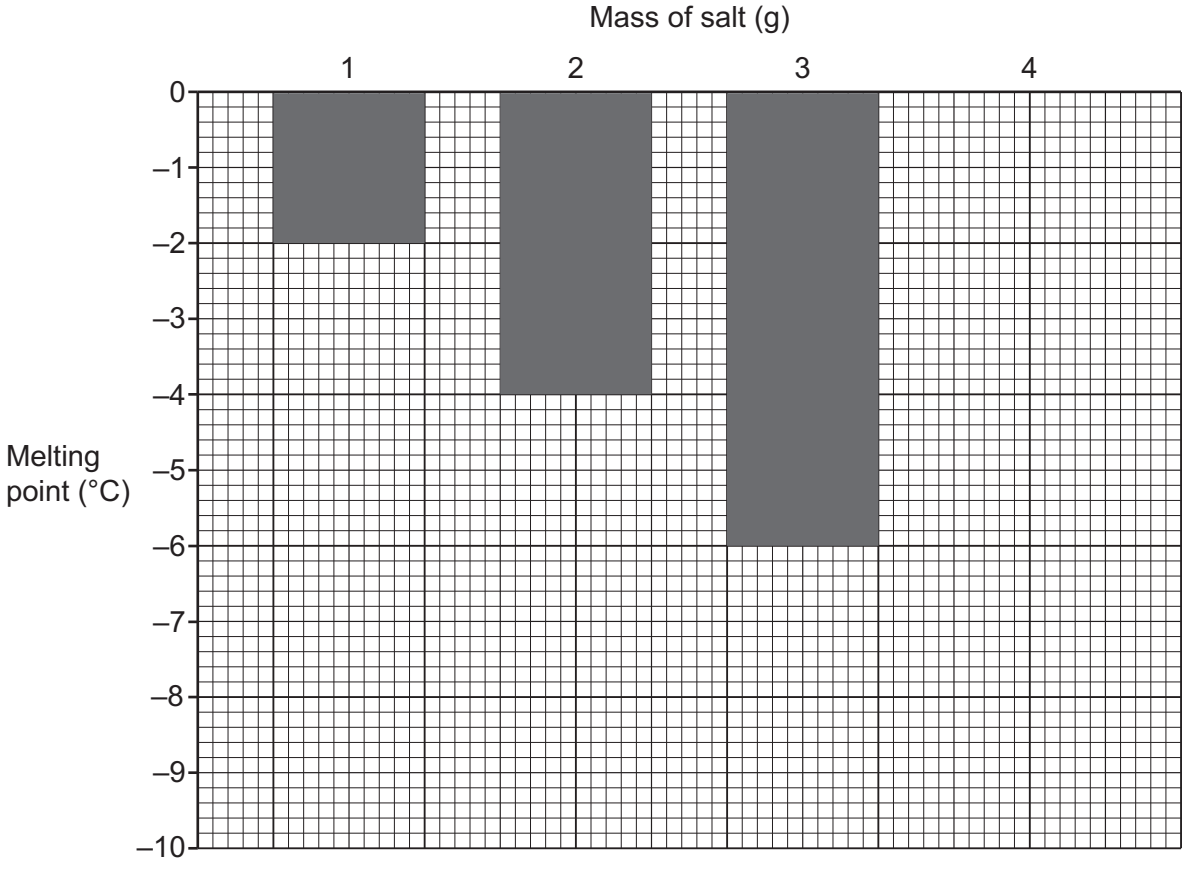
(b) The student also investigates how adding salt to ice changes the melting point of the ice.

The table shows their results.

Mass of salt (g)	Melting point (°C)
1	–2
2	–4
3	–6
4	–8

(i) The student draws a bar chart of the results.

Draw a bar on the bar chart for the results when 4 g of salt are added to the ice.



[1]

(ii) Describe how changing the mass of salt changes the melting point.

.....

..... **[1]**

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(iii) The student thinks the results show that pure ice will have a melting point of 0 °C.

Explain why the student is **correct**.

.....

..... **[1]**

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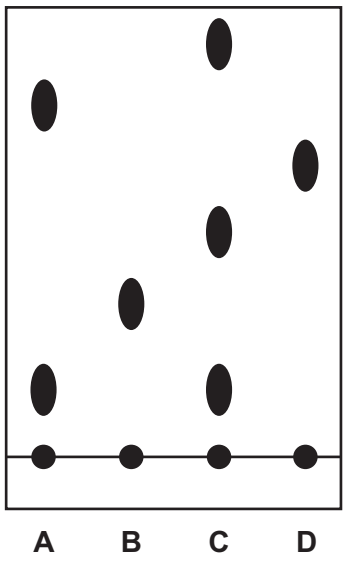
14 A teacher uses paper chromatography to show which dyes are in four different food colourings, **A**, **B**, **C** and **D**.

Fig. 14.1 shows the result of their experiment.

Fig. 14.1



(a) Which food colouring contains the most dyes?

..... **[1]**

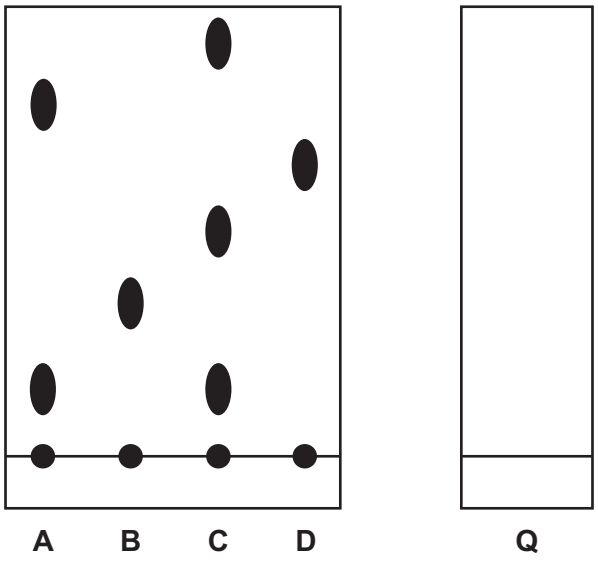
(b) Which food colourings contain the same dye?

..... **[1]**

(c) The teacher repeats the experiment with a new food colouring **Q**. They find it contains the same dyes that are also found in **B** and **D**.

Draw the results for the food colouring **Q** on **Fig. 14.2**.

Fig. 14.2



[1]

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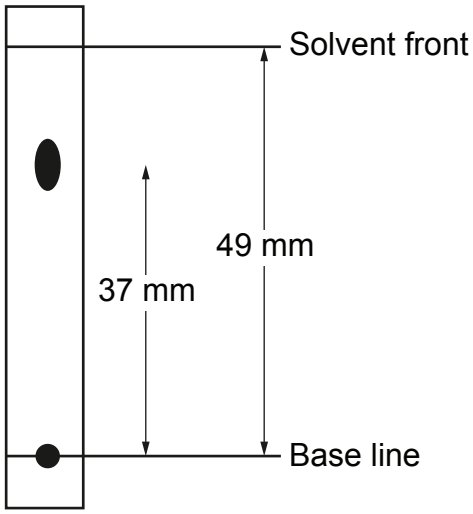
(d) **Fig. 14.3** shows the result for the food colouring **D**.

Fig. 14.3



Calculate the R_f value for the dye in the food colouring.

Give your answer to **2** significant figures.

Use the equation: $R_f = \frac{\text{distance travelled by the ink}}{\text{distance travelled by the solvent}}$

R_f value = ... **[3]**

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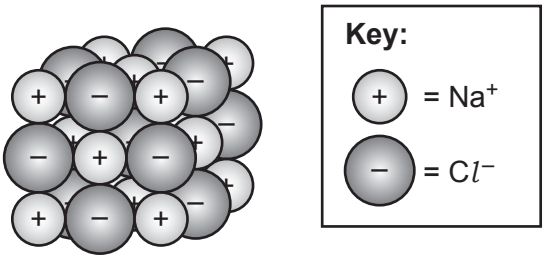
15* This question is about the ionic compound sodium chloride, NaC*l*.

It is made from sodium ions, Na^+, and chloride ions, Cl^- ions.

The diagram shows the structure of sodium chloride.



The table show information about four materials.

Material	Appearance at room temperature	Melting point (°C)	Does it dissolve in water?	Does it conduct heat?	Does it conduct electricity?
A	a flexible white solid	120	no	no	no
B	a shiny silver solid	232	no	yes	yes
C	a white solid	801	yes	no	when melted into a liquid
D	a white solid	1713	no	no	no

Material **C** is sodium chloride.

Describe properties of material **C** that shows it is sodium chloride.

Explain these properties using ideas about the structure and bonding of sodium chloride.

.....

.....

.....

.....

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.....

.....

..... **[6]**

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16 The formula of a compound is **X**$(OH)_2$. **X** is an element found in Group 2 of the Periodic Table.

The relative formula mass of **X**$(OH)_2$ is 74.1.

(a) Calculate the relative formula mass of **one** OH.

Relative atomic mass (A_r): H = 1.0 O = 16.0

Relative formula mass of **one** OH = ... **[1]**

(b) Use your answer to part **(a)** to calculate the relative atomic mass of **X**.

Relative atomic mass of **X** = ... **[2]**

(c) Use your answer to part **(b)** to identify **X**.

Use the Periodic Table on the Data Sheet.

..... **[1]**

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17 Lithium reacts with oxygen to form lithium oxide.

The symbols for lithium and oxygen on the Periodic Table are:

3
Li
6.9

8
O
16.0

(a) Explain how the positions of lithium and oxygen in the Periodic Table are used to decide that lithium is a metal and oxygen is a non-metal.

Use the Periodic Table on the Data Sheet.

.....

..... **[1]**

(b) Lithium reacts with oxygen to make lithium oxide.

Complete the **balanced symbol** equation for the reaction.

$$.....Li + O_2 \rightarrow .....Li_2O$$

[2]

(c) Write the electron arrangement for an atom of lithium.

..... **[1]**

(d) When an atom of lithium reacts with oxygen it forms a lithium ion, Li^+.

Describe how an atom of lithium forms a lithium ion.

.....

..... **[2]**

(e) A student thinks that sodium reacts in a similar way to lithium.

Explain why they are **correct**.

Use the Periodic Table on the Data Sheet.

.....

..... **[1]**

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(f) Lithium can exist as two isotopes.

3 **Li** 6	3 **Li** 7

Explain what **isotope** means.

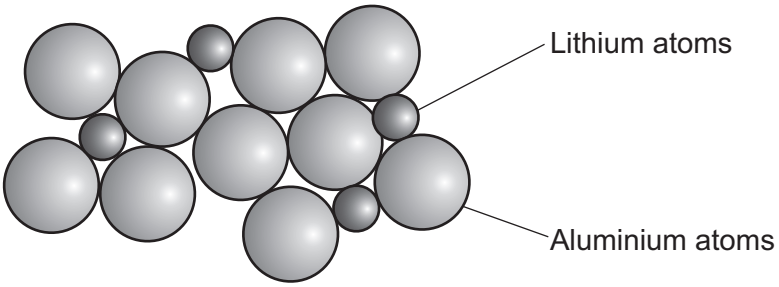
.....

.....

..... **[2]**

(g) Lithium can be added to aluminium to make an alloy. One alloy contains 2% lithium.

A student draws a diagram of the alloy.



(i) Calculate the percentage of lithium atoms in the alloy drawn by the student.

Percentage of lithium atoms in the alloy = ... % **[2]**

(ii) Suggest a reason why the student's diagram is **incorrect**.

.....

..... **[1]**

END OF QUESTION PAPER

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EXTRA ANSWER SPACE

If you need extra space use this lined page. You must write the question numbers clearly in the margin.

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