AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.7

Electronic structure

Past-paper questions

Tier	**Foundation**
Question groups	**12**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

5.1.1.7 Electronic structure

Question 01

June 2018 | 8464/C/1F | Original Q2

0 2 This question is about the halogens.

0 2 . 1 Which group in the periodic table is known as the halogens?

[1 mark]

Tick **one** box.

Group 1 ☐

Group 2 ☐

Group 7 ☐

Group 0 ☐

0 2 . 2 A fluorine atom has 7 electrons in the outer shell.

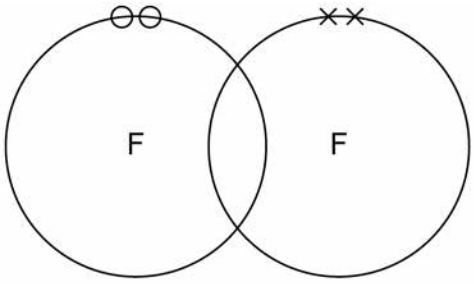
Figure 8 shows part of a dot and cross diagram to represent a molecule of fluorine (F_2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.

[2 marks]

Figure 8



0 2 . 3 Chlorine reacts with potassium bromide solution.

Complete the word equation.

[2 marks]

chlorine + potassium bromide → _____ + _____

Question 01 · continued

0 2 . 4 What type of reaction happens when chlorine reacts with potassium bromide solution?

[1 mark]

Tick **one** box.

- decomposition ☐
- displacement ☐
- neutralisation ☐
- precipitation ☐

0 2 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

an atom	**an electron**	**a neutron**	**a proton**

Chlorine is more reactive than bromine.

This is because chlorine gains _____ more easily.

0 2 . 6 How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

[1 mark]

bigger than	**the same size as**	**smaller than**

A chlorine atom is _____ a bromine atom.

5.1.1.7 Electronic structure

Question 01 · continued

0 2 . 7 Give a reason for your answer to question **02.6**

[1 mark]

Reason _____

_____

0 2 . 8 Fluorine reacts with chlorine to produce ClF_3

Balance the chemical equation for the reaction.

[1 mark]

$Cl_2 +$ _____ $F_2 \rightarrow 2\ ClF_3$

0 2 . 9 Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

energy **forces** **molecules** **weak**

[3 marks]

13

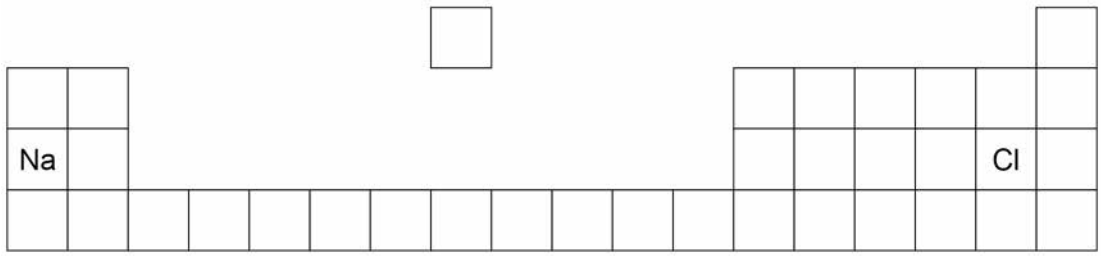
5.1.1.7 Electronic structure

Question 02

0 6 This question is about sodium and chlorine.

Figure 13 shows the positions of sodium and chlorine in the periodic table.

Figure 13



0 6 . 1 State **one** difference and **one** similarity in the electronic structure of sodium and of chlorine.

[2 marks]

Difference _____

_____

Similarity _____

_____

0 6 . 2 Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

5.1.1.7 Electronic structure

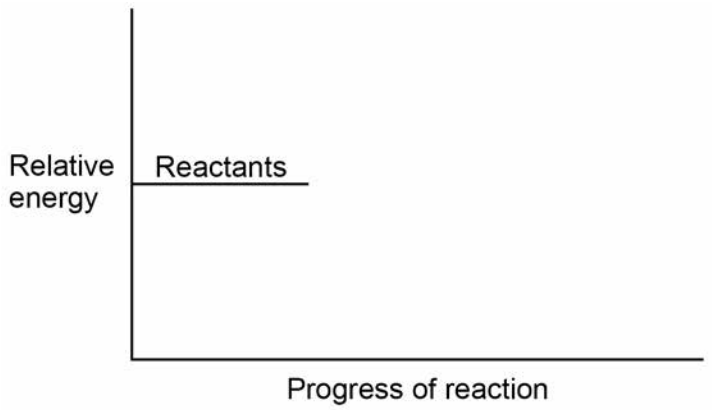
Question 02 · continued

0 6 . 3 The reaction between sodium and chlorine is an exothermic reaction.

Complete the reaction profile for the reaction between sodium and chlorine.

[2 marks]

Figure 14



8

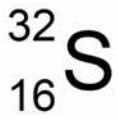
5.1.1.7 Electronic structure

Question 03

June 2018 | 8464/C/2F | Original Q1

0 1 **Figure 1** represents an atom of sulfur.

Figure 1



0 1 . 1 Complete **Table 1**

[1 mark]

Table 1

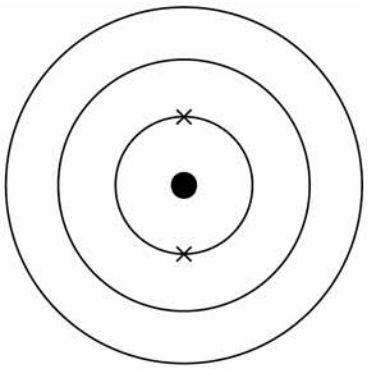
Particle	Number of particles in a sulfur atom
Electron	16
Neutron	
Proton	16

0 1 . 2 Sulfur is in Group 6 of the periodic table.

Complete the electronic structure of the sulfur atom represented in **Figure 2**

[1 mark]

Figure 2



5.1.1.7 Electronic structure

Question 03 · continued

0 1 . 3 Sulfur reacts with oxygen to produce sulfur dioxide.

Complete the word equation for this reaction.

[1 mark]

sulfur + _____

0 1 . 4 What effect is caused by sulfur dioxide?

[1 mark]

Tick **one** box.

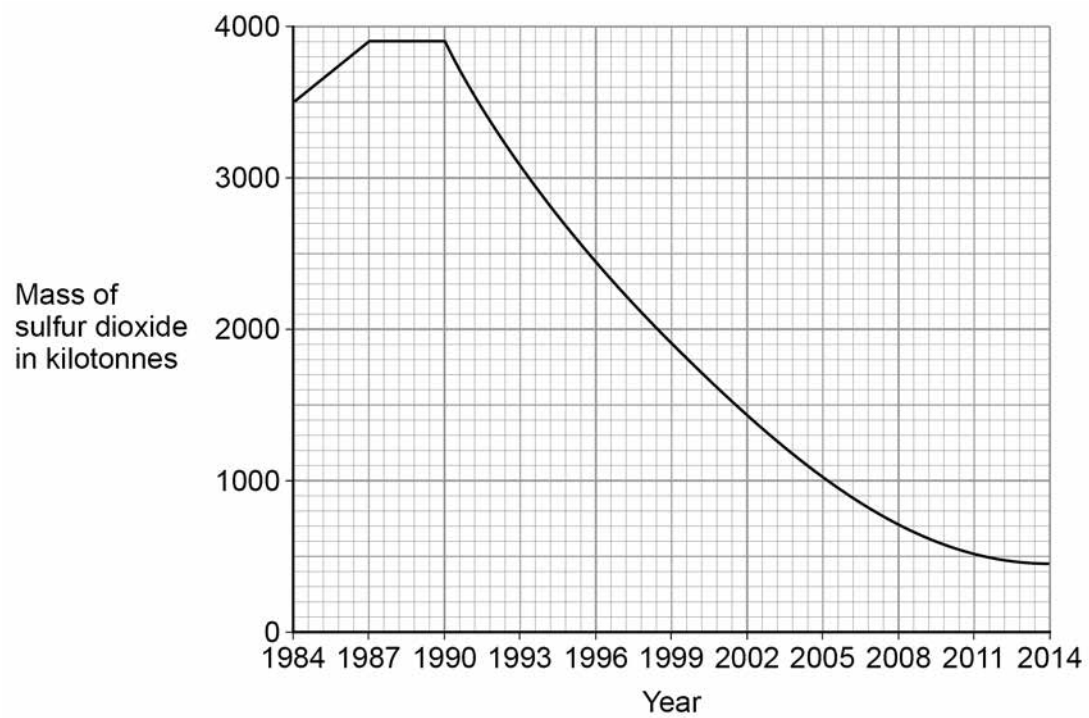
- Acid rain ☐
- Global dimming ☐
- Global warming ☐
- Sea levels rising ☐

Question 1 continues on the next page

Question 03 · continued

0 1 . 5 **Figure 3** shows the mass of sulfur dioxide in the Earth's atmosphere between 1984 and 2014

Figure 3



A student said:

'the mass of sulfur dioxide in the atmosphere decreased every year between 1984 and 2014'

Is the student correct?

Use data from **Figure 3** to justify your answer.

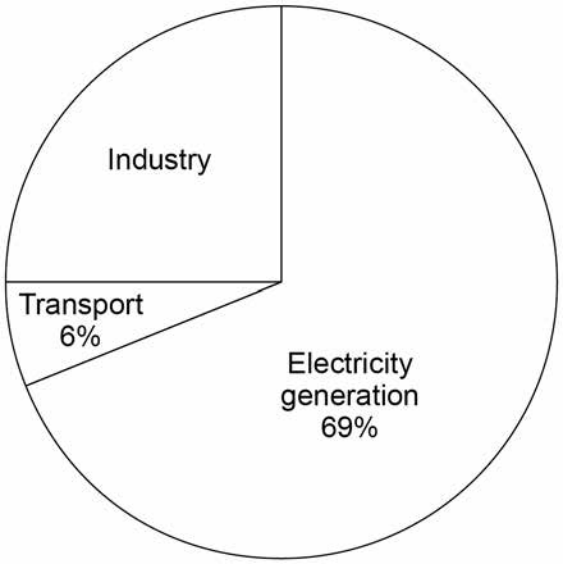
[3 marks]

5.1.1.7 Electronic structure

Question 03 · continued

0 1 . 6 **Figure 4** shows the percentage of sulfur dioxide released by human activities.

Figure 4



Calculate the percentage of sulfur dioxide released by industry.

[2 marks]

Percentage = _____ %

9

5.1.1.7 Electronic structure

Question 04

June 2019 | 8464/C/1F | Original Q3

0 3 This question is about the periodic table and argon.

0 3 . 1 What order did scientists use to arrange elements in early periodic tables?

[1 mark]

Tick (✓) **one** box.

- Atomic weight of element ☐
- Number of neutrons in an atom of element ☐
- Size of atoms of element ☐
- Year element was discovered ☐

0 3 . 2 In early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame some of these problems in his periodic table.

Complete the sentence.

[1 mark]

Mendeleev did this by leaving _____ for elements that had not been discovered.

Question 3 continues on the next page

5.1.1.7 Electronic structure

Question 04 · continued

0 3 . 3 What is the name of the group that contains argon?

[1 mark]

Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

0 3 . 4 An atom of argon is represented as $^{40}_{18}Ar$

Determine the number of protons and the number of neutrons in one atom of argon.

[2 marks]

Number of protons _____

Number of neutrons _____

0 3 . 5 Different atoms of argon are, $^{39}_{18}Ar$ and $^{38}_{18}Ar$

What is the name given to these different atoms of argon?

[1 mark]

Tick (✓) **one** box.

- Fullerenes ☐
- Ions ☐
- Isotopes ☐
- Molecules ☐

5.1.1.7 Electronic structure

Question 04 · continued

0 3 . 6 What is the electronic structure of an argon atom, $^{40}_{18}Ar$?

[1 mark]

Tick (✓) **one** box.

2 ☐ 2, 8 ☐ 2, 8, 2 ☐ 2, 8, 8 ☐

0 3 . 7 Why is argon unreactive?

[1 mark]

_____

_____

8

Turn over for the next question

5.1.1.7 Electronic structure

Question 05

June 2019 | 8464/C/1F | Original Q5

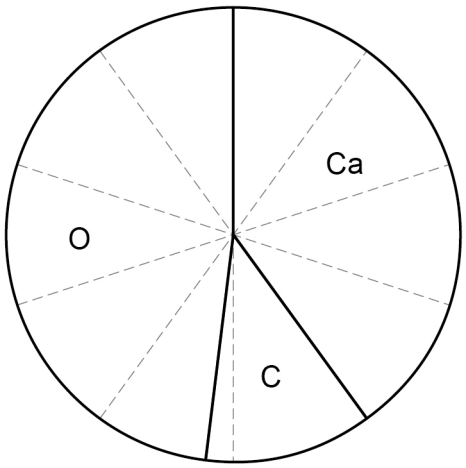
0 5 This question is about oxygen and compounds of oxygen.

0 5 . 1 What is the state symbol of oxygen at room temperature?

[1 mark]

0 5 . 2 **Figure 4** shows the percentage by mass of the elements calcium, carbon and oxygen in calcium carbonate.

Figure 4



What is the percentage by mass of calcium in calcium carbonate?

[1 mark]

Percentage = _____ %

0 5 . 3 At high temperature, sodium nitrate decomposes into sodium nitrite and oxygen.

A student heats three samples of sodium nitrate.

The mass of each sample was 4.50 g

The mass of solid after heating was recorded.

Table 2 shows the mass of solid after heating in each experiment.

Table 2

Experiment	Mass of solid after heating in g
1	3.76
2	3.98
3	4.09

Calculate the mean mass of solid after heating.

Give your answer to 3 significant figures.

[3 marks]

Mean mass of solid after heating = _____ g

Question 5 continues on the next page

0 5 . 4 **Table 3** shows the electronic structure of hydrogen and oxygen.

Table 3

Element	Electronic structure
Hydrogen	1
Oxygen	2,6

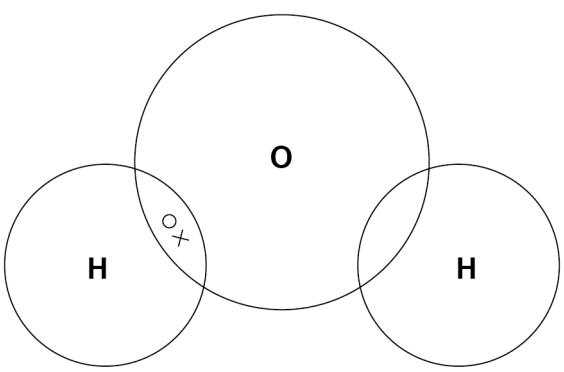
Figure 5 shows part of a dot and cross diagram of a molecule of water (H_2O).

Complete the dot and cross diagram.

You should show only the electrons in the outer energy levels.

[2 marks]

Figure 5



Oxygen and sulfur are examples of simple molecules.

0 5 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

covalent	ionic	metallic

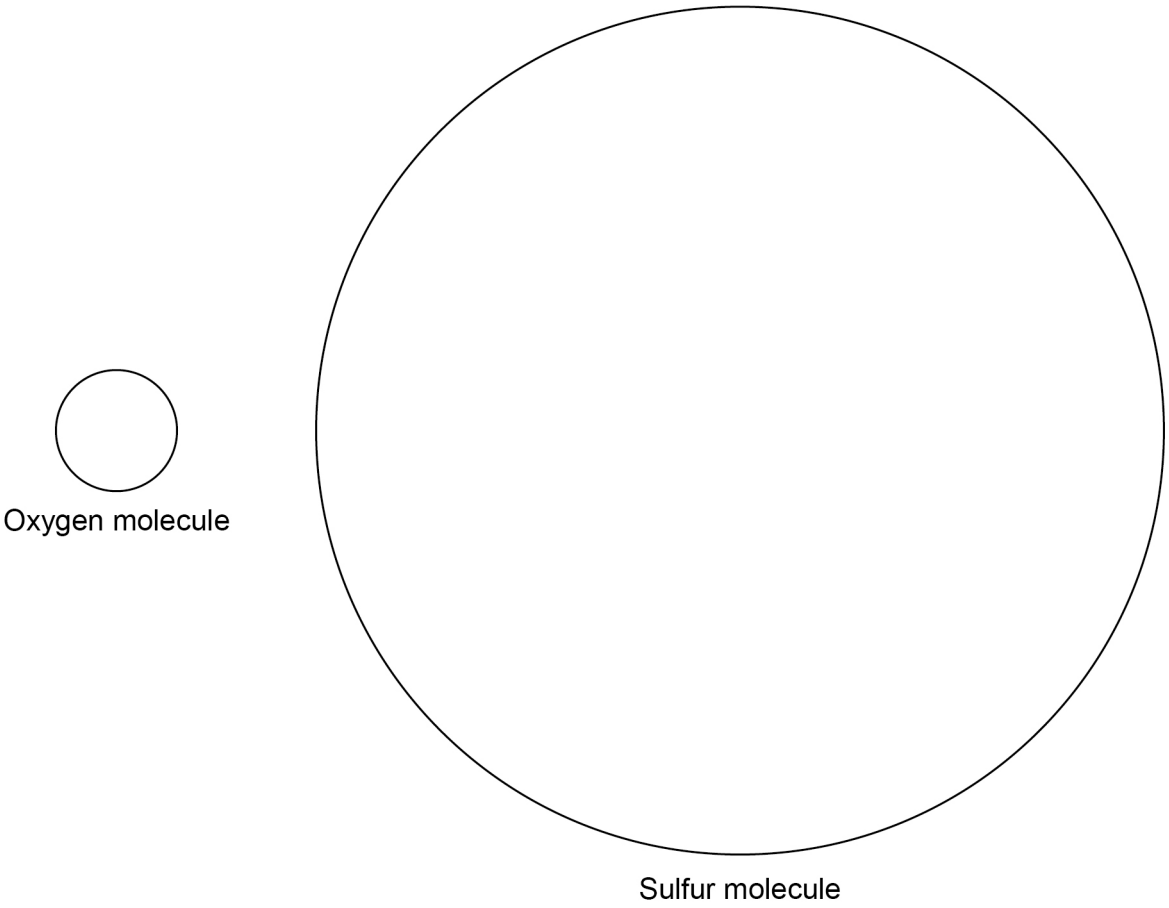
There are _____ bonds between the atoms of oxygen in an oxygen molecule.

5.1.1.7 Electronic structure

Question 05 · continued

0 5 . 6 **Figure 6** shows the relative sizes of an oxygen molecule and a sulfur molecule.

Figure 6



How does the boiling point of sulfur compare with the boiling point of oxygen?

Complete the sentences.

[2 marks]

The boiling point of sulfur is _____ the boiling point of oxygen.

This is because in sulfur the intermolecular forces are _____ than the intermolecular forces in oxygen.

10

5.1.1.7 Electronic structure

Question 06

November 2020 | 8464/C/1F | Original Q5

0 5 This question is about elements in the periodic table.

0 5 . 1 What property was used to arrange elements in early periodic tables?

[1 mark]

Tick (✓) **one** box.

Atomic number ☐

Atomic weight ☐

Mass number ☐

0 5 . 2 In early periodic tables, iodine (I) was placed before tellurium (Te).

Mendeleev placed iodine after tellurium.

Figure 7 shows part of Mendeleev's periodic table.

Figure 7

16 **O**	19 **F**
32 **S**	35.5 **Cl**
79 **Se**	80 **Br**
128 **Te**	127 **I**

Suggest **one** reason why Mendeleev placed iodine in the column shown in **Figure 7**.

[1 mark]

5.1.1.7 Electronic structure

Question 06 · continued

Table 3 shows the melting points of three Group 1 metals.

Table 3

Metal	Melting point in °C
Lithium	180
Sodium	98
Potassium	63

0 5 . 3 What state is lithium at 100 °C?

Use **Table 3**.

[1 mark]

Tick (✓) **one** box.

Gas ☐ Liquid ☐ Solid ☐

0 5 . 4 Complete the graph in **Figure 8**.

Use **Table 3**.

You should:

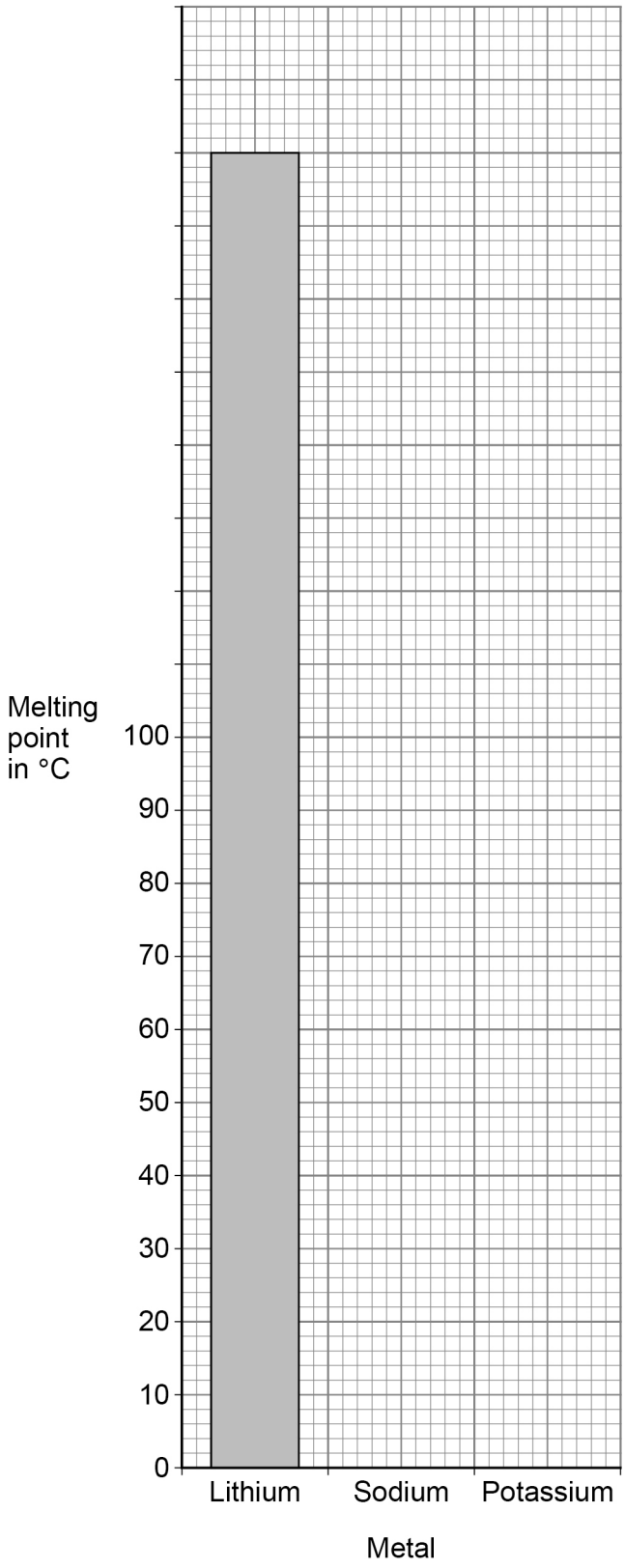
- complete the scale on the y-axis
- draw bars to show the melting points of sodium and potassium.

[3 marks]

5.1.1.7 Electronic structure

Question 06 · continued

Figure 8

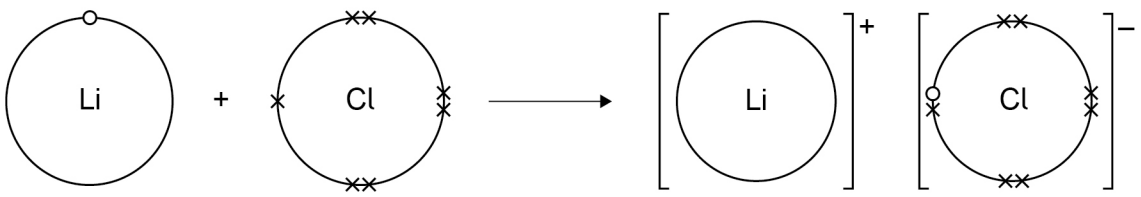


0 5 . 5 Lithium reacts with chlorine to produce lithium chloride.

Figure 9 shows what happens to the electrons in the outer shells when a lithium atom reacts with a chlorine atom.

The dots (o) and crosses (x) represent electrons.

Figure 9



Describe what happens to a lithium atom and to a chlorine atom when they react.

Use **Figure 9** to answer in terms of electrons.

[3 marks]

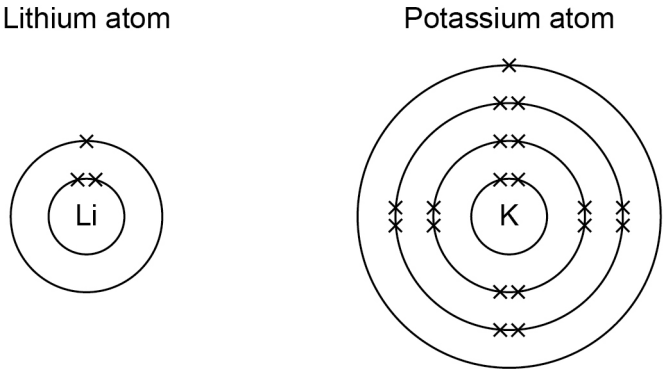
5.1.1.7 Electronic structure

Question 06 · continued

0 5 . 6 Lithium and potassium are in the same group of the periodic table.

Figure 10 represents the electronic structures of a lithium atom and of a potassium atom.

Figure 10



Give **two** reasons why potassium is more reactive than lithium.

[2 marks]

1 _____

_____

2 _____

_____

11

5.1.1.7 Electronic structure

Question 07

June 2022 | 8464/C/1F | Original Q1

0 1 This question is about Group 1 elements.

0 1 . 1 What are the Group 1 elements known as?

[1 mark]

Tick (✓) **one** box.

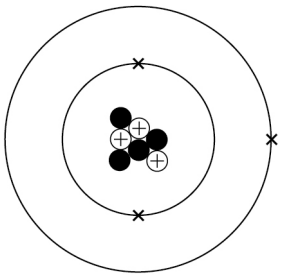
Alkali metals ☐

Halogens ☐

Noble gases ☐

0 1 . 2 **Figure 1** shows a lithium atom.

Figure 1



What is the number of electrons and neutrons in the atom of lithium?

[2 marks]

Number of electrons _____

Number of neutrons _____

0 1 . 3 What is the relative charge on a lithium ion?

[1 mark]

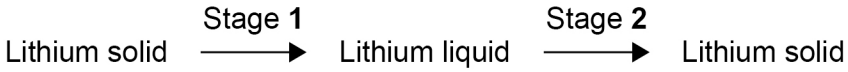
Tick (✓) **one** box.

+1 ☐ 0 ☐ –1 ☐

5.1.1.7 Electronic structure

Question 07 · continued

0 1 . 4 Lithium is heated and then cooled in an experiment.



Two physical changes happen in the experiment.

Draw **one** line from each stage to the physical change that happens in that stage.

[2 marks]

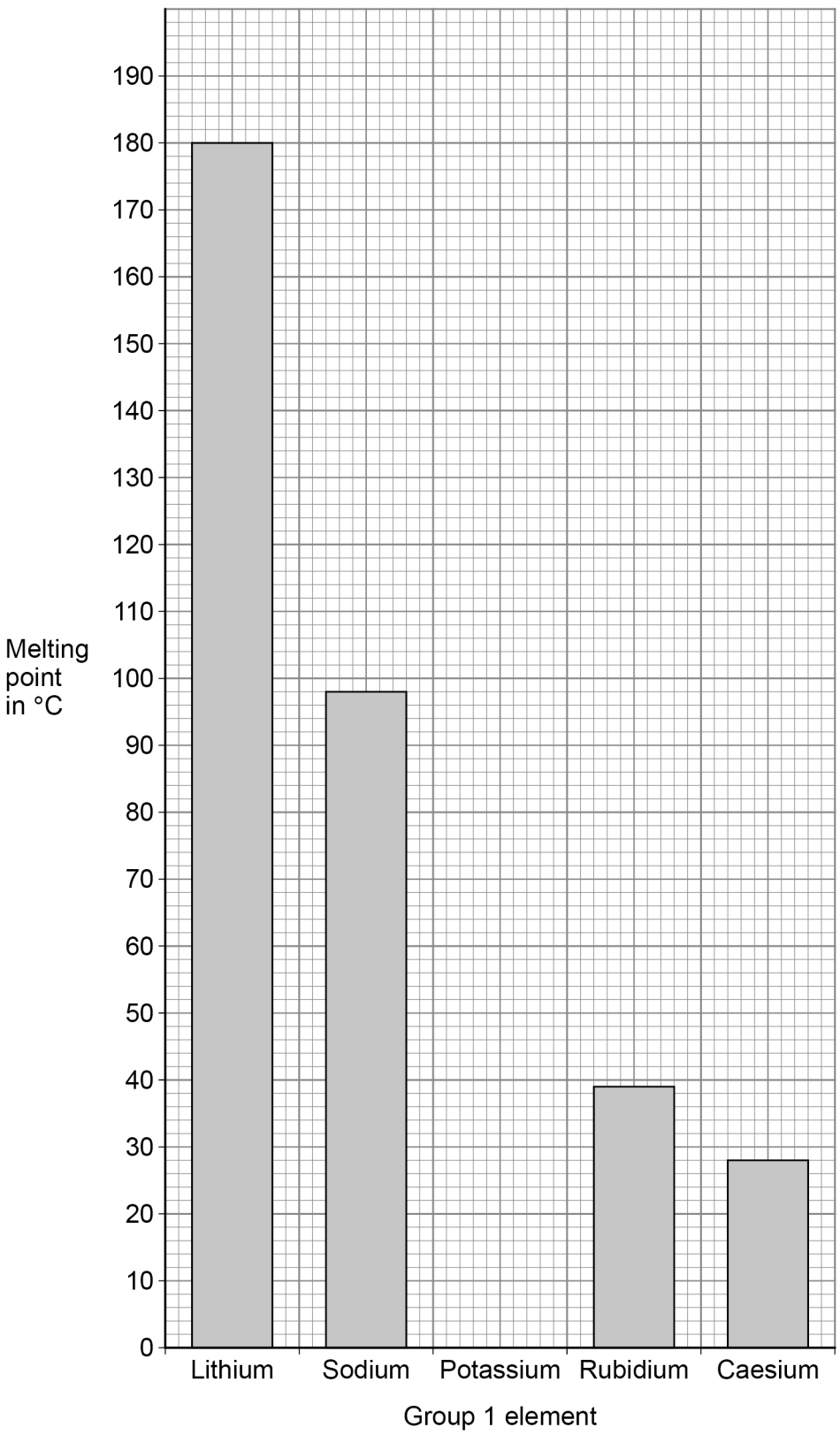
Stage	Physical change
	Boiling
	Condensing
Stage **1**	
	Dissolving
Stage **2**	
	Freezing
	Melting

Question 1 continues on the next page

Question 07 · continued

Figure 2 represents the melting points of some Group 1 elements.

Figure 2



5.1.1.7 Electronic structure

Question 07 · continued

0 1 . 5 What is the melting point of caesium?

Use **Figure 2**.

[1 mark]

Melting point = _____ °C

0 1 . 6 The melting point of potassium is 63 °C

Draw a bar for the melting point of potassium on **Figure 2**.

[1 mark]

0 1 . 7 Describe the trend of the melting points of the Group 1 elements in **Figure 2**.

[3 marks]

_____

_____

_____

_____

_____

_____

0 1 . 8 The boiling point of sodium is 883 °C

What is the state of sodium at 150 °C?

Use **Figure 2**.

[1 mark]

Tick (✓) **one** box.

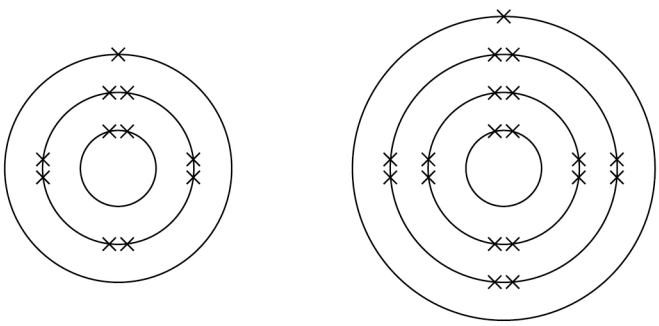
Gas ☐

Liquid ☐

Solid ☐

0 1 . 9 **Figure 3** represents the electronic structure of a sodium atom and of a potassium atom.

Figure 3



Sodium atom

Potassium atom

Complete the sentence.

Choose the answer from the box.

[1 mark]

gains an electron	**loses an electron**	**shares an electron**

Potassium is more reactive than sodium because potassium more

easily _____ .

13

5.1.1.7 Electronic structure

Question 08

June 2022 | 8464/C/1F | Original Q2

0 2 This question is about hydrogen chloride and sodium hydroxide.

0 2 . 1 A chlorine atom has 7 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

Figure 4 represents part of a dot and cross diagram for a molecule of hydrogen chloride.

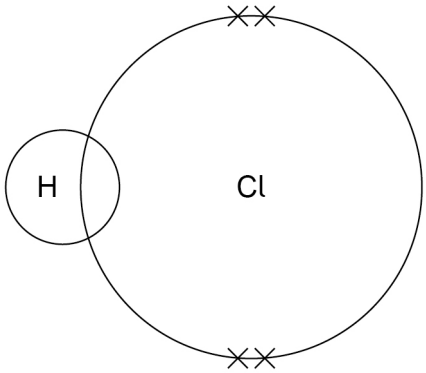
Complete the dot and cross diagram.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells.

[2 marks]

Figure 4



0 2 . 2 Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid reacts with sodium hydroxide solution.

Complete the word equation for the reaction between hydrochloric acid and sodium hydroxide.

[1 mark]

hydrochloric acid + sodium hydroxide → _____ + water

Question 2 continues on the next page

Question 08 · continued

Solutions of hydrochloric acid and sodium hydroxide are reacted and the temperature change is recorded.

0 2 . 3 In the reaction, 3.65 g of hydrogen chloride reacts with 4.00 g of sodium hydroxide.

1.80 g of water is produced.

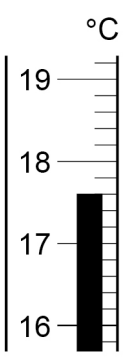
Calculate the mass of the other product.

[1 mark]

Mass = _____ g

0 2 . 4 **Figure 5** shows part of the thermometer used to measure the temperature.

Figure 5



What is the temperature reading on the thermometer?

[1 mark]

Temperature = _____ °C

0 2 . 5 In the reaction, the temperature increases.

What type of reaction is happening when the temperature increases?

[1 mark]

0 2 . 6 Sodium hydroxide is an alkali.

Which **two** ions are in sodium hydroxide solution?

[2 marks]

Tick (✓) **two** boxes.

Cl^- ☐ H^+ ☐ Na^+ ☐ O^{2-} ☐ OH^- ☐

8

5.1.1.7 Electronic structure

Question 09

June 2023 | 8464/C/1F | Original Q3

0 3 Structure and bonding is used to explain properties of compounds.

Metal atoms react with non-metal atoms to form ions.

0 3 . 1 Which group of elements does **not** form ions?

[1 mark]

Tick (✓) **one** box.

Alkali metals ☐

Halogens ☐

Noble gases ☐

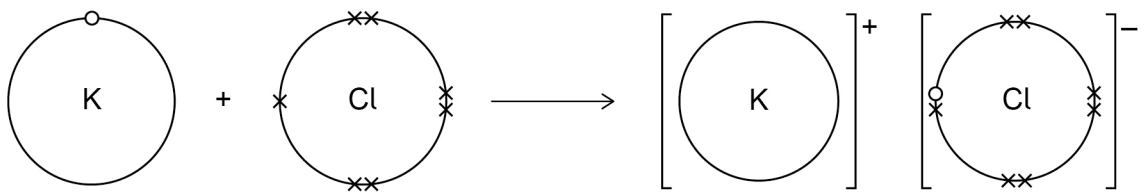
Question 3 continues on the next page

0 3 . 2 Potassium reacts with chlorine to produce potassium chloride (KCl).

Figure 6 shows what happens to the electrons in the outer shells when a potassium atom reacts with a chlorine atom.

The dots (o) and crosses (×) represent electrons.

Figure 6



Describe what happens when a potassium atom reacts with a chlorine atom to produce potassium chloride.

Answer in terms of electrons.

[4 marks]

5.1.1.7 Electronic structure

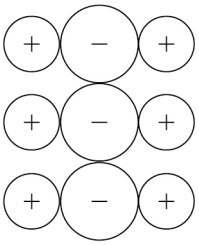
Question 09 · continued

0 3 . 3 In solid ionic compounds, oppositely charged ions attract to form a giant structure.

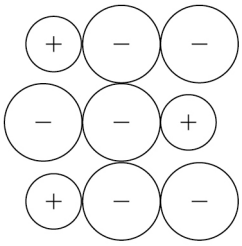
Which structure represents the arrangement of ions in solid potassium chloride?

[1 mark]

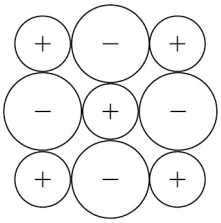
Tick (✓) **one** box.



☐



☐



☐

Question 3 continues on the next page

Non-metal atoms share electrons to form covalent bonds.

0 3 . 4 Water (H_2O) is a covalent molecule.

Table 2 shows the number of electrons in the outer shells of hydrogen atoms and of oxygen atoms.

Table 2

Element	Number of electrons in the outer shell of an atom
Hydrogen	1
Oxygen	6

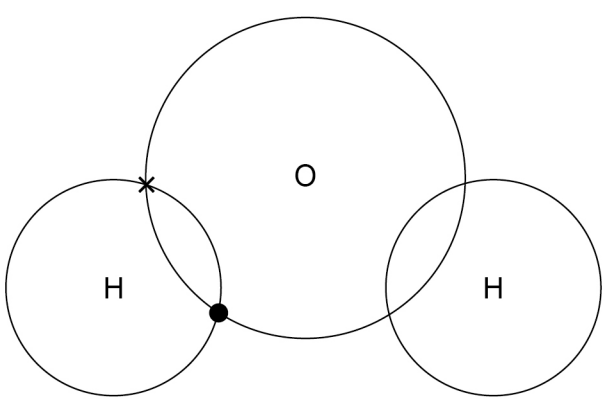
Figure 7 shows part of a dot and cross diagram for a molecule of water.

Complete the dot and cross diagram.

You should only show electrons in the outer shells.

[2 marks]

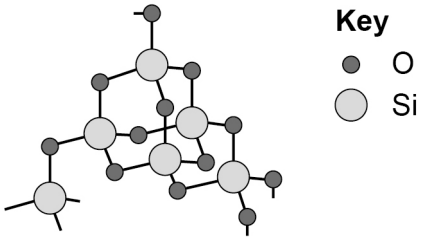
Figure 7



0 3 . 5 Silica has a giant covalent structure.

Figure 8 represents the structure of silica.

Figure 8



Determine the ratio of silicon (Si) atoms to oxygen (O) atoms in silica.

Use **Figure 8**.

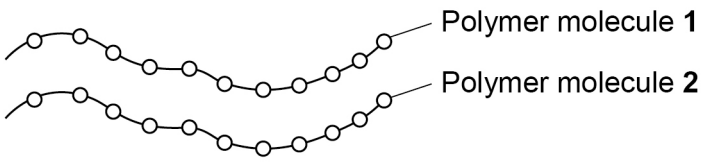
[1 mark]

_____ Si : _____ O

0 3 . 6 Polymers have very large molecules.

Figure 9 represents part of the structure of a polymer.

Figure 9



What holds polymer molecule **1** and polymer molecule **2** together in a polymer?

[1 mark]

Tick (✓) **one** box.

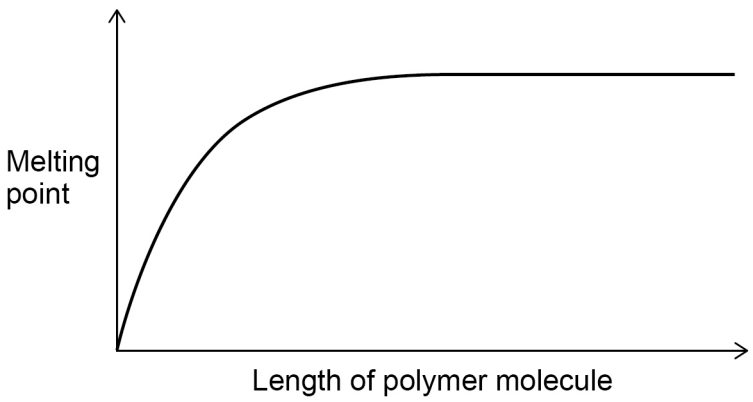
Covalent bonds ☐

Electrostatic attraction between ions ☐

Weak intermolecular forces ☐

0 3 . 7 **Figure 10** shows the melting point of a polymer as the length of the polymer molecule increases.

Figure 10



Describe the trend shown in **Figure 10**.

[3 marks]

13

5.1.1.7 Electronic structure

Question 10

June 2024 | 8464/C/1F | Original Q1

0 1 Potassium is in Group 1 of the periodic table.

0 1 . 1 What name is given to Group 1 elements?

[1 mark]

Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

0 1 . 2 A potassium atom is very small.

What is the radius of a potassium atom?

[1 mark]

Tick (✓) **one** box.

- 0.2 cm ☐
- 0.2 mm ☐
- 0.2 nm ☐

0 1 . 3 What name is given to the number of protons in an atom?

[1 mark]

Tick (✓) **one** box.

- Atomic number ☐
- Group number ☐
- Mass number ☐

Question 10 · continued

0 1 . 4 **Table 1** shows the name and the relative charge of the particles in a potassium atom.

Table 1

Name of particle	Relative charge
Proton	
	0
Electron	–1

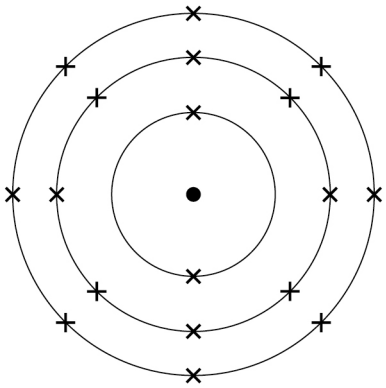
Complete **Table 1**.

[2 marks]

0 1 . 5 The electronic structure of a potassium atom is 2,8,8,1

Figure 1 represents the electronic structure of a potassium **ion**.

Figure 1



What is the charge on a potassium **ion**?

[1 mark]

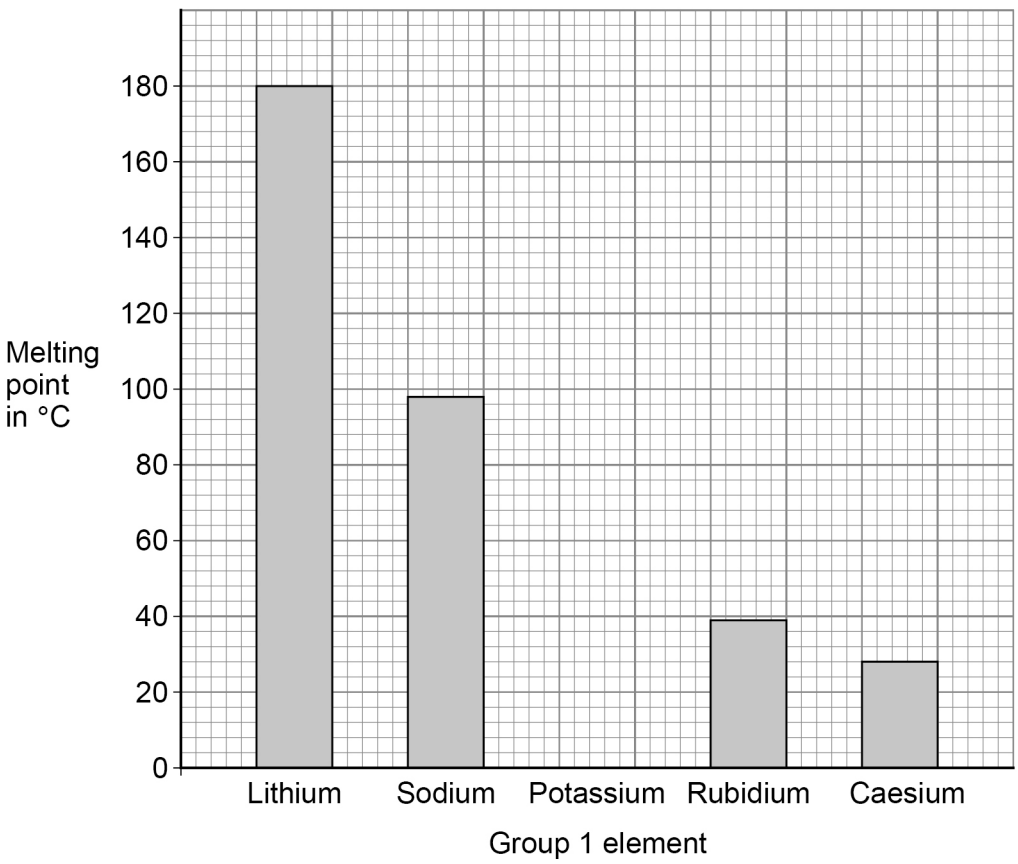
Tick (✓) **one** box.

–1 ☐ 0 ☐ +1 ☐

Question 10 · continued

0 1 . 6 **Figure 2** shows the melting points of some Group 1 elements.

Figure 2



Predict the melting point of potassium.

[1 mark]

Melting point = _____ °C

5.1.1.7 Electronic structure

Question 10 · continued

0 1 . 7 Potassium has two isotopes.

Table 2 shows the percentage (%) abundance of the two isotopes.

Table 2

Isotope	Percentage (%) abundance
$^{39}_{19}K$	93
$^{41}_{19}K$	7

How is the relative atomic mass (A_r) of potassium calculated?

[1 mark]

Tick (✓) **one** box.

$A_r = \dfrac{(39 \times 7) + (41 \times 93)}{100}$ ☐

$A_r = \dfrac{(39 \times 93) + (41 \times 7)}{100}$ ☐

$A_r = \dfrac{(39 \times 41) + (93 \times 7)}{100}$ ☐

8

5.1.1.7 Electronic structure

Question 11

June 2024 | 8464/C/1F | Original Q2

0 2 Carbon is in Group 4 of the periodic table.

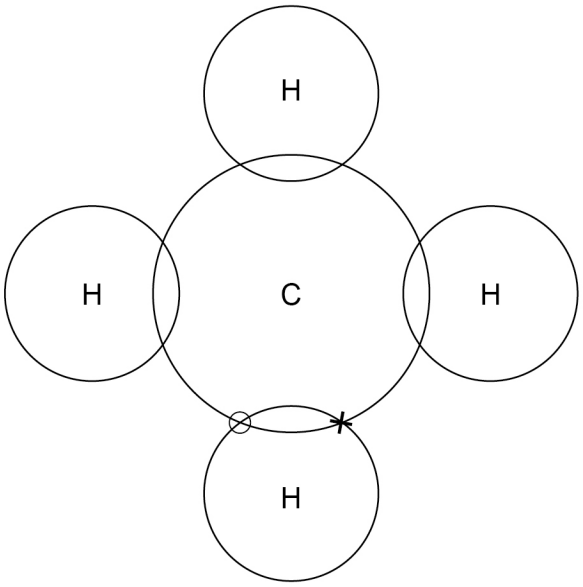
0 2 . 1 Methane contains carbon and hydrogen atoms.

A carbon atom has 4 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

Complete the dot and cross diagram for a methane molecule.

[2 marks]



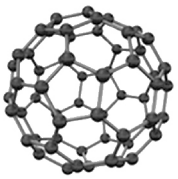
5.1.1.7 Electronic structure

Question 11 · continued

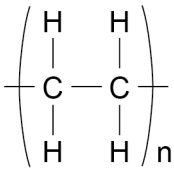
0 2 . 2 Which diagram represents the structure of diamond?

[1 mark]

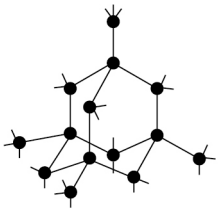
Tick (✓) **one** box.



☐



☐



☐

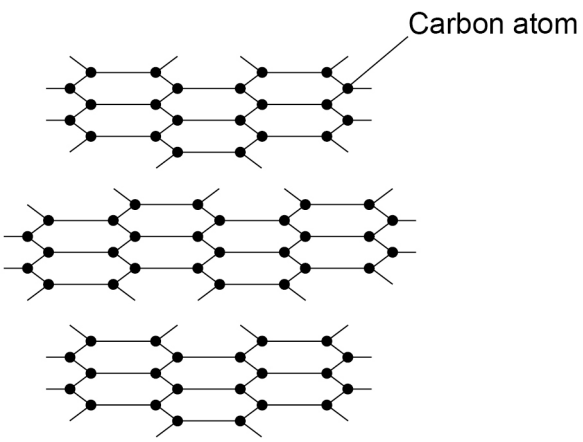
Question 2 continues on the next page

5.1.1.7 Electronic structure

Question 11 · continued

Figure 3 represents part of the structure of graphite.

Figure 3



0 2 . 3 In graphite each carbon atom forms covalent bonds.

How many covalent bonds does each carbon atom form in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

0 2 . 4 Graphite conducts electricity.

Which particles carry electrical charge through graphite?

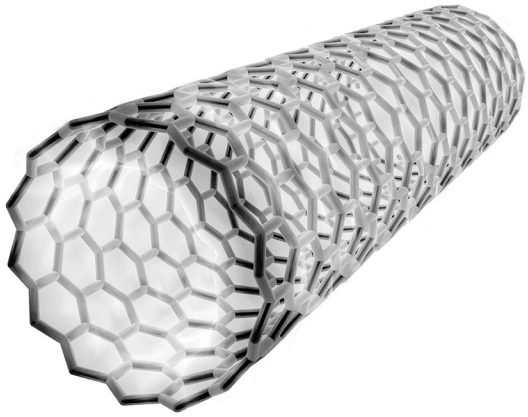
[1 mark]

5.1.1.7 Electronic structure

Question 11 · continued

Figure 4 represents the structure of a fullerene.

Figure 4



0 2 . 5 Where are fullerenes used?

[1 mark]

Tick (✓) **one** box.

- In electronic components ☐
- In self-heating cans ☐
- In sports injury packs ☐

0 2 . 6 Describe the structure of the fullerene shown in **Figure 4**.

[2 marks]

8

5.1.1.7 Electronic structure

Question 12

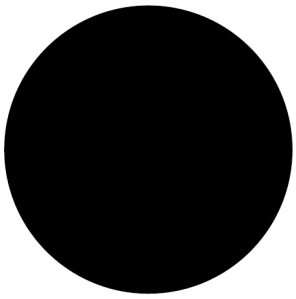
0 1 This question is about atoms and ions.

The model of the atom has changed over time.

0 1 . 1 In an early model, scientists thought the atom was a tiny sphere that could **not** be divided.

Figure 1 represents this early model of the atom.

Figure 1



The discovery of a subatomic particle led to a change in the model in **Figure 1**.

Which was the first subatomic particle to be discovered?

[1 mark]

Tick (✓) **one** box.

Electron ☐

Neutron ☐

Proton ☐

Question 12 · continued

0 1 . 2 In a later model of the atom, most of the mass was concentrated in the centre of the atom.

What is the name of the centre of an atom?

[1 mark]

0 1 . 3 Atoms contain three types of subatomic particle.

Draw **one** line from each subatomic particle to the relative charge of the particle.

[2 marks]

Subatomic particle	Relative charge of the particle
Electron	+1
Neutron	0
Proton	–1

0 1 . 4 What is meant by the 'atomic number of an atom'?

[1 mark]

Tick (✓) **one** box.

- The number of neutrons only ☐
- The number of protons only ☐
- The number of neutrons + the number of protons ☐

Question 1 continues on the next page

Question 12 · continued

0 1 . 5 **Table 1** shows information about two isotopes of an element.

Table 1

	Mass number	Percentage (%) abundance
Isotope **A**	10	19.7
Isotope **B**	11	80.3

Calculate the relative atomic mass (A_r) of the element.

Use the equation:

$$A_r = \frac{\text{(mass number} \times \text{percentage) of isotope A + (mass number} \times \text{percentage) of isotope B}}{100}$$

Give your answer to 1 decimal place.

[3 marks]

A_r (1 decimal place) = _____

5.1.1.7 Electronic structure

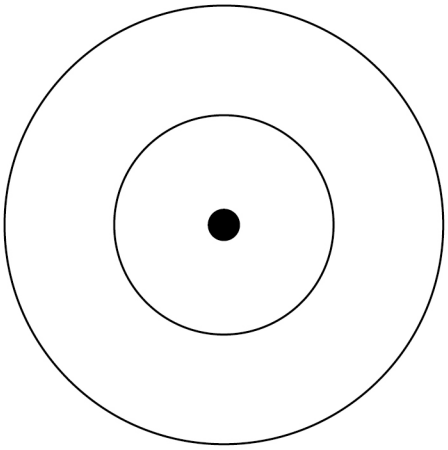
Question 12 · continued

0 1 . 6 An oxygen atom has eight electrons.

Complete **Figure 2** to show the electronic structure of an oxygen atom.

[1 mark]

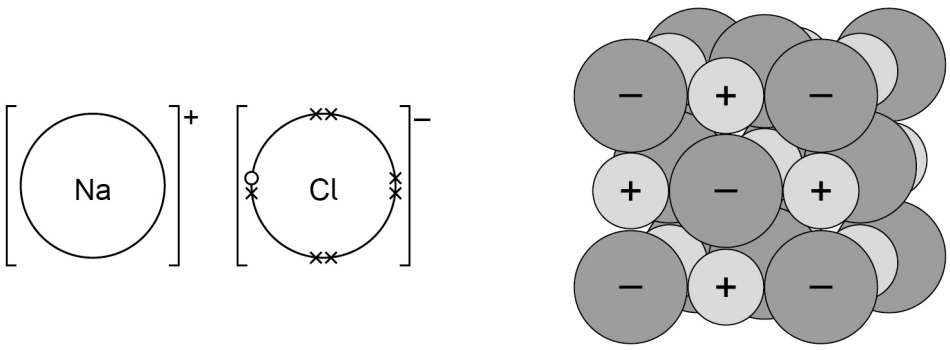
Figure 2



Question 1 continues on the next page

0 1 . 7 **Figure 3** represents two models of sodium chloride.

Figure 3



Model **A**

Model **B**

What are **two** advantages of model **B** compared with model **A**?

[2 marks]

Tick (✓) **two** boxes.

Model **B** shows the 3D arrangement of the ions. ☐

Model **B** shows the charges on the ions. ☐

Model **B** shows the electronic structures of the ions. ☐

Model **B** shows the relative sizes of the ions. ☐

Model **B** shows which elements are present. ☐

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