AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.2

Relative formula mass

Past-paper questions

Tier	**Foundation**
Question groups	**18**
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.

5.3.1.2 Relative formula mass

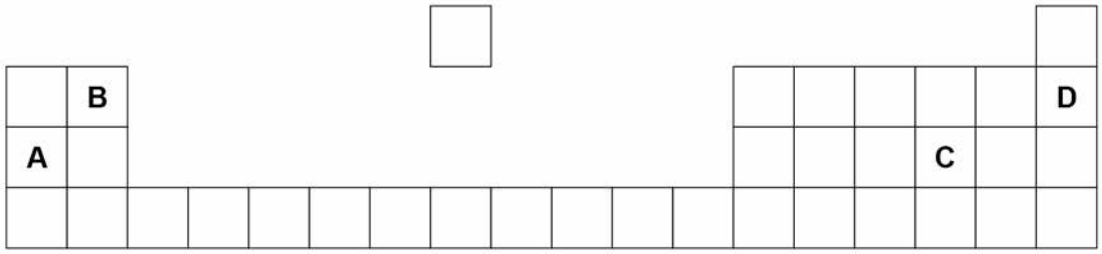
Question 01

June 2018 | 8464/C/1F | Original Q4

0 4 This question is about the elements in Group 2 of the periodic table.

0 4 . 1 **Figure 9** shows the positions of four elements, **A**, **B**, **C**, and **D**, in the periodic table.

Figure 9



Which element is in Group 2?

[1 mark]

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 4 continues on the next page

5.3.1.2 Relative formula mass

Question 01 · continued June 2018 | 8464/C/1F | Original Q4

Group 2 metal carbonates break down when heated to produce a metal oxide and a gas.

metal carbonate → metal oxide + gas

0 4 . 2 Name the two products when calcium carbonate ($CaCO_3$) is heated.

[2 marks]

_____ and _____

0 4 . 3 What type of reaction happens when a compound breaks down?

[1 mark]

Tick **one** box.

- burning ☐
- decomposition ☐
- neutralisation ☐
- reduction ☐

0 4 . 4 The metal carbonate takes in energy from the surroundings to break down.

What type of reaction takes in energy from the surroundings?

[1 mark]

Tick **one** box.

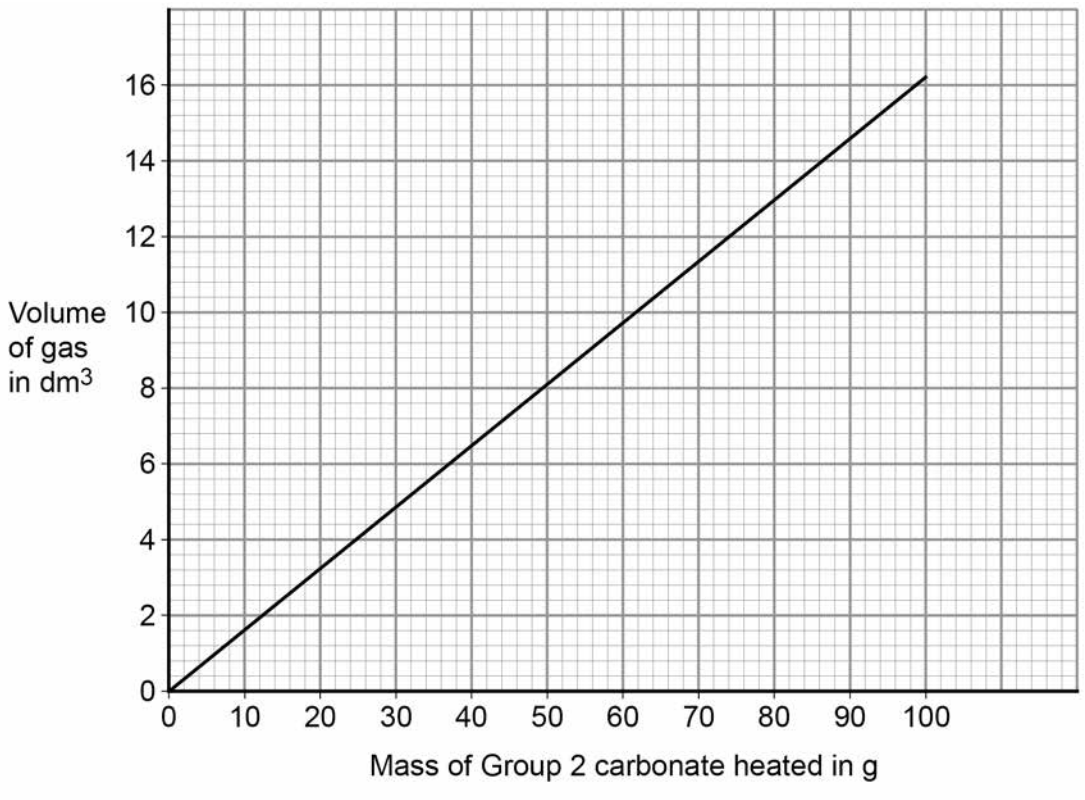
- combustion ☐
- electrolysis ☐
- endothermic ☐
- exothermic ☐

5.3.1.2 Relative formula mass

Question 01 · continued

0 4 . 5 **Figure 10** shows the volume of gas produced when a Group 2 metal carbonate is heated.

Figure 10



The student collected 5.2 dm^3 of gas.

What mass of the Group 2 metal carbonate is heated?

[1 mark]

Mass = _____ g

0 4 . 6 Calculate the mass of the Group 2 carbonate needed to produce 24 dm^3 of gas.

Use your answer from question **04.5** to help you.

[2 marks]

_____

_____

_____

_____

Mass = _____ g

Question 01 · continued

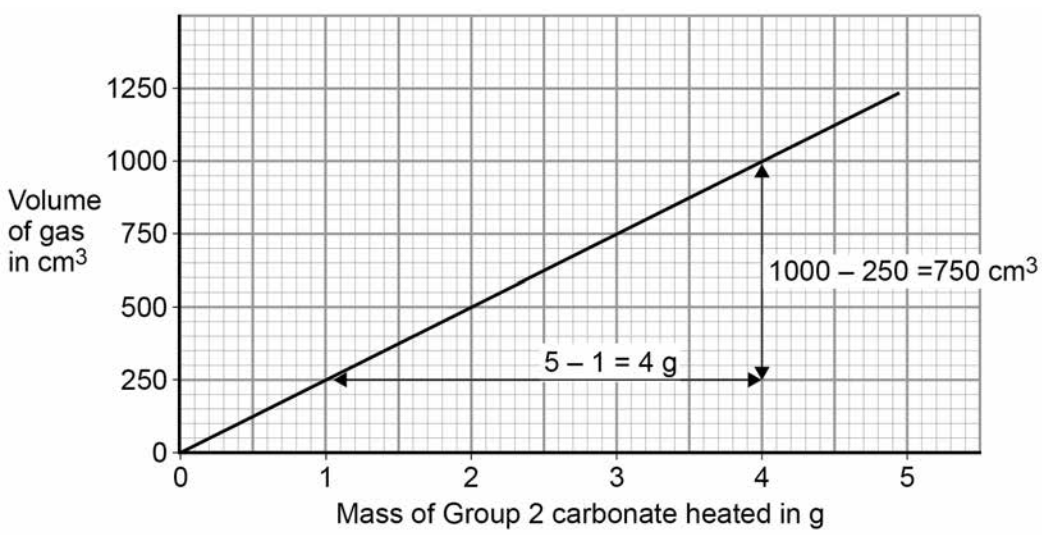
0 4 . 7 A student heated different masses of a Group 2 carbonate. The student measured the volume of gas produced.

Figure 11 shows a graph of the student's results.

The student calculates the gradient of the line in **Figure 11**

The student makes **two** mistakes.

Figure 11



Correct formula for gradient = $\frac{\text{Increase in volume of gas}}{\text{Increase in mass of Group 2 metal carbonate heated}}$

Student's calculation = $\frac{4}{750}$ = 0.00533 cm^3 per g

Identify the **two** mistakes the student makes.

Calculate the correct gradient of the line.

[4 marks]

Mistake 1 _____

_____

Mistake 2 _____

_____

Calculation _____

_____

Gradient = _____ cm^3 per g

5.3.1.2 Relative formula mass

Question 01 · continued

0 4 . 8 A student repeated the experiment with a different Group 2 metal carbonate (**X**CO_3).

The relative formula mass (M_r) of **X**CO_3 is 84

Relative atomic masses (A_r): C = 12 O = 16

Calculate the relative atomic mass (A_r) of **X**.

Name metal **X**.

Use the periodic table.

[4 marks]

Relative atomic mass (A_r) = _____

Metal **X** is _____

16

5.3.1.2 Relative formula mass

Question 02

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

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

Figure 1

$^{32}_{16}S$

0 1 . 1 Complete **Table 1**

[1 mark]

Table 1

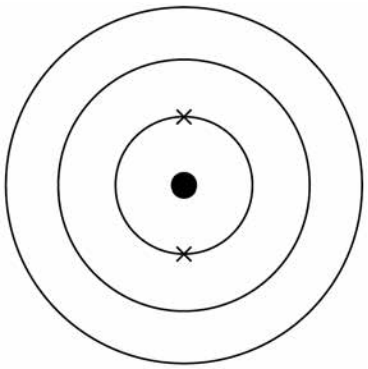
Particle	Number of particles in a sulfur atom
Electron	16
Neutron	
Proton	16

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



5.3.1.2 Relative formula mass

Question 02 · 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 ☐

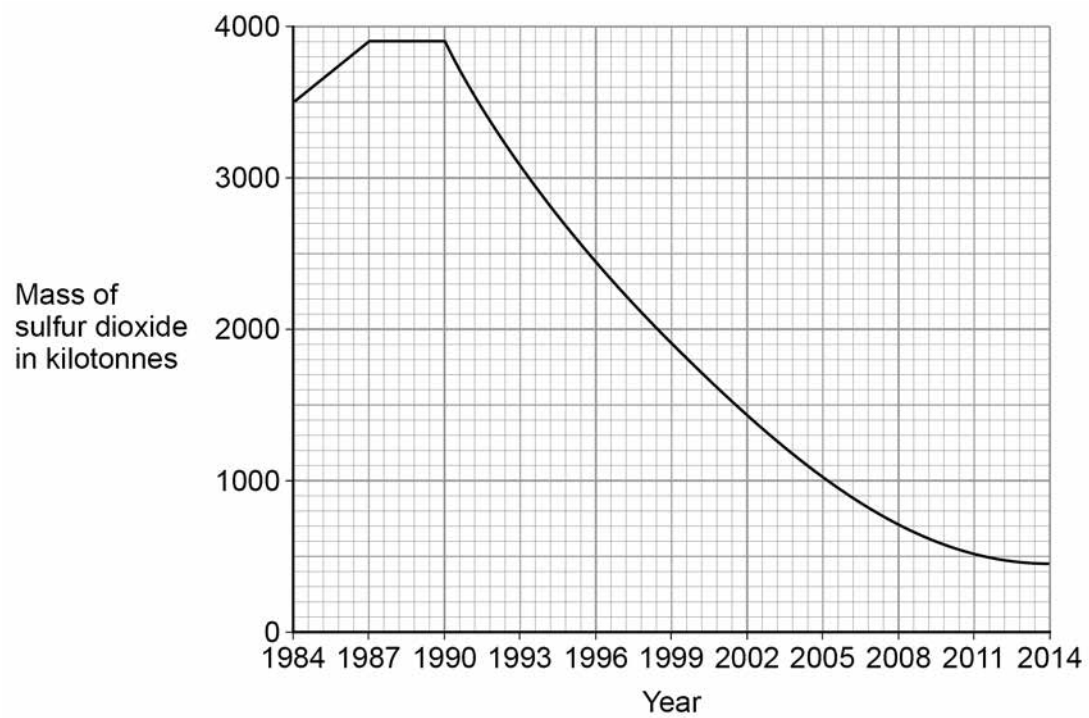
Question 1 continues on the next page

5.3.1.2 Relative formula mass

Question 02 · 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.

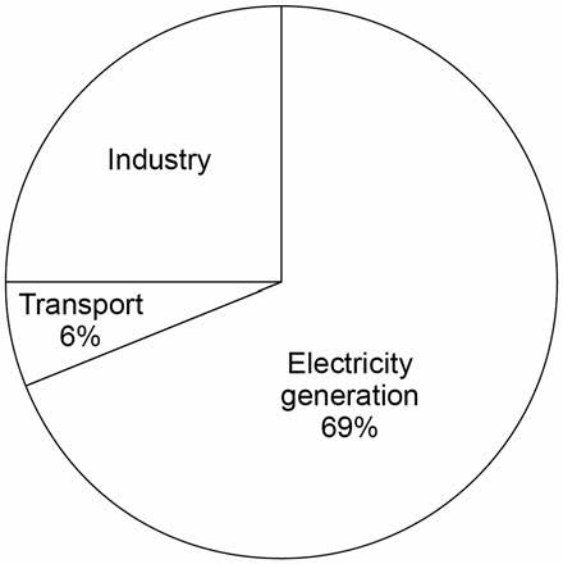
[3 marks]

5.3.1.2 Relative formula mass

Question 02 · 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

5.3.1.2 Relative formula mass

Question 03

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

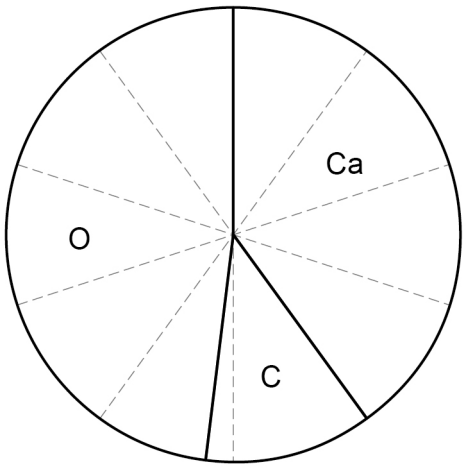
0 5 This question is about oxygen and compounds of oxygen.

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 = _____ %

5.3.1.2 Relative formula mass

Question 03 · continued

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

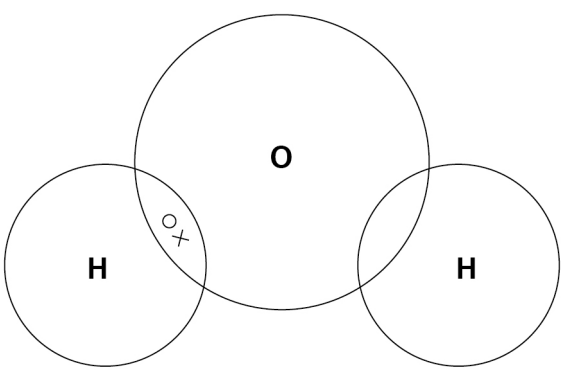
Figure 5 shows part of a dot and cross diagram of a molecule of water (H_2O).

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**

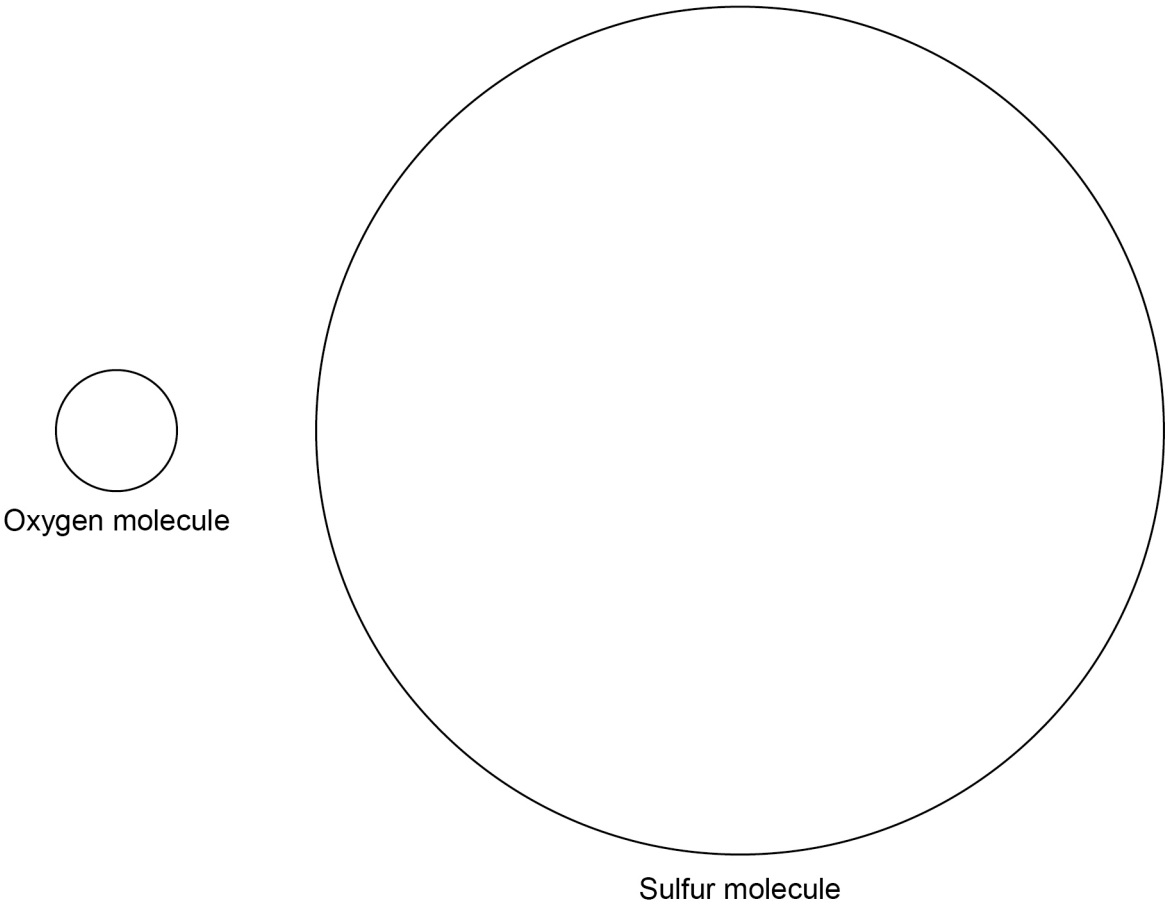
There are _____ bonds between the atoms of oxygen in an oxygen molecule.

5.3.1.2 Relative formula mass

Question 03 · 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

5.3.1.2 Relative formula mass

Question 04

June 2019 | 8464/C/1F | Original Q7

0 7 This question is about salts.

Ammonium nitrate solution is produced when ammonia gas reacts with nitric acid.

0 7 . 1 Give the state symbol for ammonium nitrate solution.

[1 mark]

_____

0 7 . 2 What is the formula of nitric acid?

[1 mark]

Tick (✓) **one** box.

HCl ☐

HNO_3 ☐

H_2SO_4 ☐

NH_4OH ☐

0 7 . 3 Ammonia gas dissolves in water to produce ammonia solution.

Ammonia solution contains hydroxide ions, OH^-

A student adds universal indicator to solutions of nitric acid and ammonia.

What colour is observed in each solution?

[2 marks]

Colour in nitric acid _____

Colour in ammonia solution _____

5.3.1.2 Relative formula mass

Question 04 · continued

0 7 . 4 The student gradually added nitric acid to ammonia solution.

Which row, **A**, **B**, **C** or **D**, shows the change in pH as the nitric acid is added until in excess?

[1 mark]

Tick (✓) **one** box.

	pH of ammonia solution at start	pH after addition of excess nitric acid	
A	10	7	☐
B	2	10	☐
C	7	1	☐
D	10	2	☐

0 7 . 5 Calculate the percentage by mass of oxygen in ammonium nitrate (NH_4NO_3).

Relative atomic masses (A_r): H = 1 N = 14 O = 16

Relative formula mass (M_r): NH_4NO_3 = 80

[3 marks]

Percentage by mass of oxygen = _____ %

Question 7 continues on the next page

5.3.1.2 Relative formula mass

Question 04 · continued

0 7 . 6 Describe a method to investigate how the temperature changes when different masses of ammonium nitrate are dissolved in water.

You do **not** need to write about safety precautions.

[6 marks]

14

5.3.1.2 Relative formula mass

Question 05

0 1 . 1 This question is about gases.

Draw **one** line from each substance to the description of the substance.

[3 marks]

Substance	Description of substance
	Compound
Air	Element
Carbon dioxide	Hydrocarbon
Oxygen	Metal
	Mixture

5.3.1.2 Relative formula mass

Question 05 · continued

0 1 . 2 What is used to test for each of the gases?

Draw **one** line from each gas to the test for the gas.

[2 marks]

Gas	Test
Carbon dioxide	A glowing splint
	A lighted splint
Oxygen	Limewater
	Litmus paper

0 1 . 3 Give **two** reasons why the percentage of carbon dioxide in the air has decreased in the last 2.7 billion years.

[2 marks]

Tick (✓) **two** boxes.

- Combustion ☐
- Dissolved in oceans ☐
- Intense volcanic activity ☐
- Photosynthesis ☐
- Respiration ☐

5.3.1.2 Relative formula mass

Question 05 · continued

Oxygen reacts with sulfur dioxide.

The reaction is reversible.

0 1 . 4 What is the symbol for a reversible reaction?

[1 mark]

_____

0 1 . 5 Complete the sentence.

[1 mark]

In a reversible reaction the forward reaction is exothermic, so the

reverse reaction is _____ .

0 1 . 6 A reversible reaction happens in apparatus which stops the escape of reactants and products.

Complete the sentence.

[1 mark]

Equilibrium is reached when the forward and reverse reactions happen at

exactly the same _____ .

10

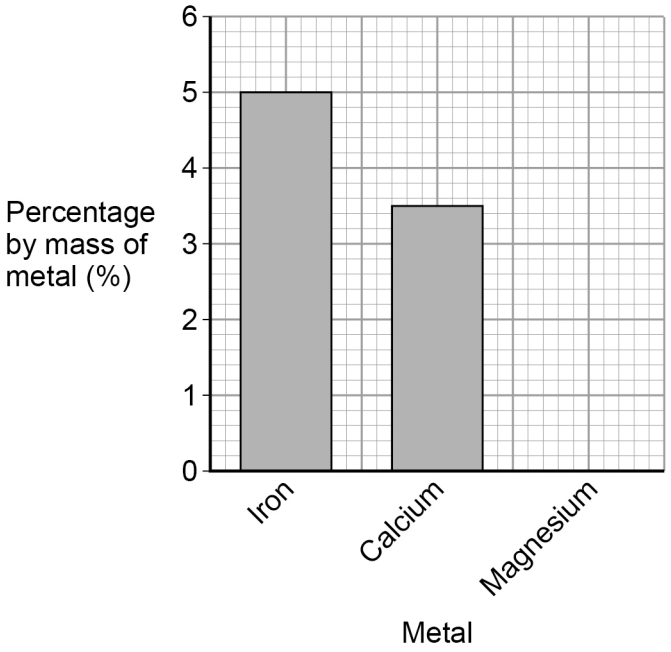
5.3.1.2 Relative formula mass

Question 06

June 2019 | 8464/C/2F | Original Q5

0 5 **Figure 6** shows the percentage by mass of some metals in the Earth's crust.

Figure 6



0 5 . 1 What is the percentage by mass of calcium in the Earth's crust?

[1 mark]

Tick (✓) **one** box.

3.25% ☐ 3.50% ☐ 4.50% ☐ 5.00% ☐

0 5 . 2 The percentage by mass of magnesium in the Earth's crust is 2.1%

Draw the bar for magnesium on **Figure 6**.

[1 mark]

Question 5 continues on the next page

5.3.1.2 Relative formula mass

Question 06 · continued

0 5 . 3 Copper sulfate is produced during the extraction of copper from the Earth's crust.

Copper is produced from copper sulfate solution using iron.

The word equation for the reaction is:

copper sulfate + iron → iron sulfate + copper

From the equation a company calculated that 648 kg of copper sulfate are needed to produce 617 kg of iron sulfate and 258 kg of copper.

Calculate the mass of iron needed to make 258 kg of copper.

[2 marks]

Mass = _____ kg

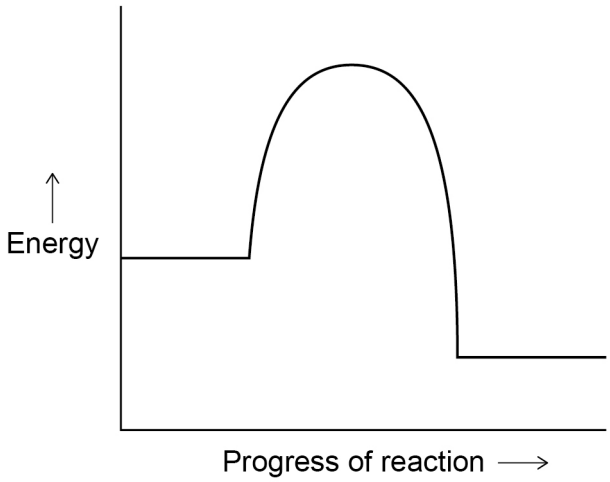
5.3.1.2 Relative formula mass

Question 06 · continued

Copper is used as a catalyst.

0 5 . 4 **Figure 7** shows the reaction profile for a reaction without a catalyst.

Figure 7

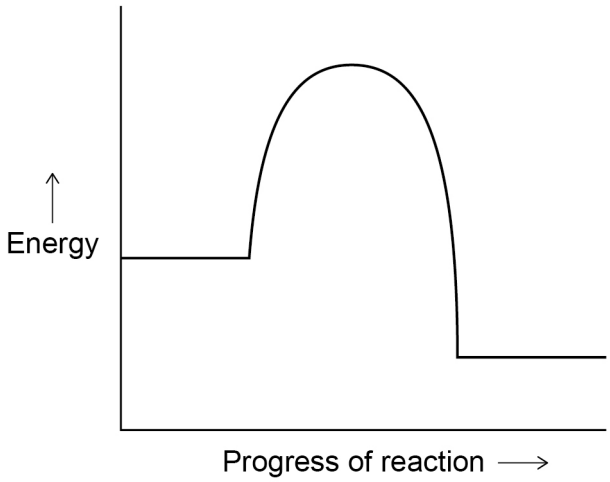


Draw an arrow on **Figure 7** to show the activation energy.

[1 mark]

0 5 . 5 The reaction profile for the reaction without a catalyst is shown again in **Figure 8.**

Figure 8



Draw a reaction profile on **Figure 8** for the same reaction with a catalyst.

[2 marks]

5.3.1.2 Relative formula mass

Question 06 · continued

0 5 . 6 What are catalysts in biological systems called?

[1 mark]

Tick (✓) **one** box.

- Detergents ☐
- Enzymes ☐
- Polymers ☐
- Solvents ☐

8

5.3.1.2 Relative formula mass

Question 07

November 2020 | 8464/C/1F | Original Q3

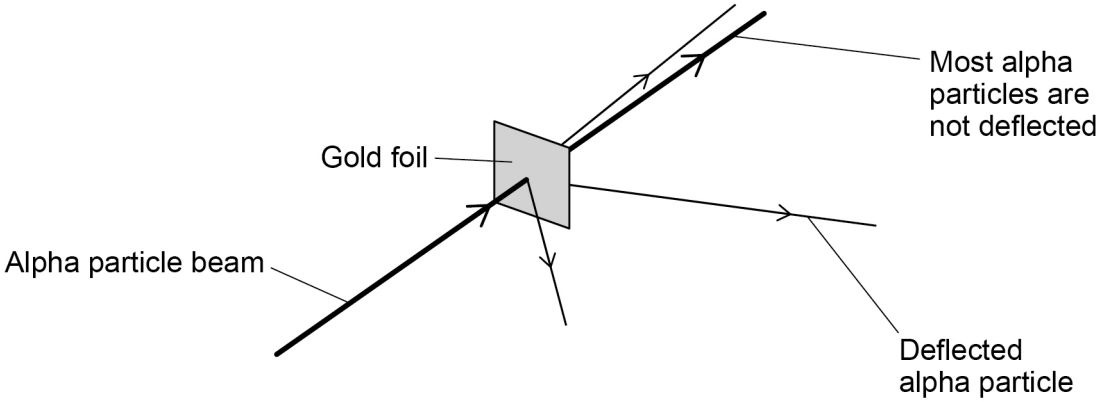
0 3 This question is about gold and compounds of gold.

In the alpha particle scattering experiment alpha particles are fired at gold foil.

Alpha particles are positively charged.

Figure 4 shows the results.

Figure 4



0 3 . 1 Some alpha particles are deflected.

Complete the sentence.

Choose the answer from the box.

[1 mark]

negatively charged	**not charged**	**positively charged**

Some alpha particles are deflected because

the nucleus of the atom is _____.

5.3.1.2 Relative formula mass

Question 07 · continued

0 3 . 2 Why are most alpha particles **not** deflected?

[1 mark]

Tick (✓) **one** box.

- The atom is a tiny sphere that cannot be divided. ☐
- The atom is mainly empty space. ☐
- The electrons orbit the nucleus at specific distances. ☐

0 3 . 3 What was **one** conclusion from the alpha particle scattering experiment?

[1 mark]

Tick (✓) **one** box.

- The mass is concentrated at the centre of the atom. ☐
- The mass is concentrated at the edge of the atom. ☐
- The mass is spread evenly throughout the atom. ☐

Gold reacts with the elements in Group 7 of the periodic table.

0 3 . 4 What are Group 7 elements known as?

[1 mark]

Tick (✓) **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

Question 07 · continued

0 3 . 5 Fluorine, chlorine and bromine react with gold.

Which element will be the most reactive with gold?

[1 mark]

Tick (✓) **one** box.

Fluorine ☐ Chlorine ☐ Bromine ☐

0 3 . 6 3.94 g of gold reacts with chlorine to produce 6.07 g of gold chloride.

The word equation for the reaction is:

gold + chlorine → gold chloride

Calculate the mass of chlorine that reacts with 3.94 g of gold.

[1 mark]

Mass = _____ g

0 3 . 7 Calculate the relative formula mass (M_r) of gold chloride ($AuCl_3$).

Relative atomic masses (A_r): Cl = 35.5 Au = 197

[2 marks]

Relative formula mass (M_r) = _____

8

5.3.1.2 Relative formula mass

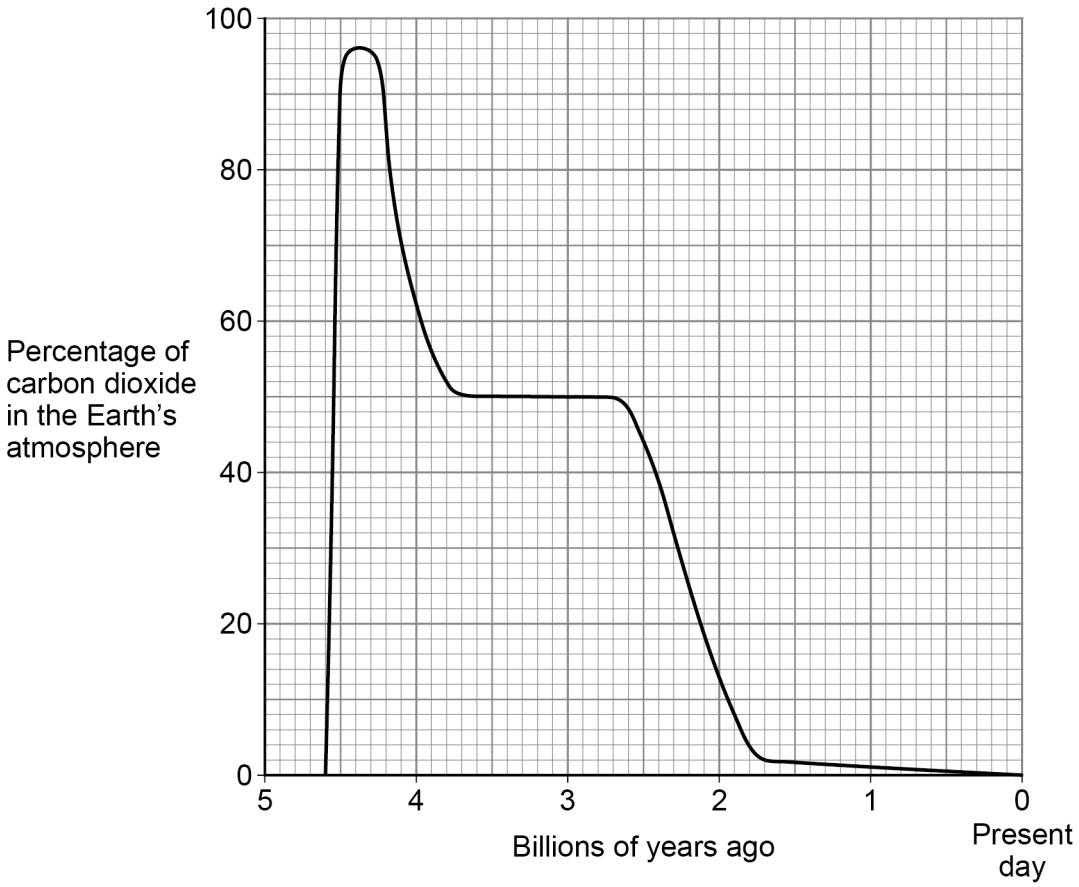
Question 08

November 2020 | 8464/C/2F | Original Q2

0 2 This question is about carbon dioxide in the Earth's atmosphere.

Figure 2 shows how the percentage of carbon dioxide in the Earth's atmosphere has changed over 4.6 billion years.

Figure 2



0 2 . 1 What was the highest percentage of carbon dioxide in the Earth's atmosphere?

Use **Figure 2**.

[1 mark]

Highest percentage = _____ %

5.3.1.2 Relative formula mass

Question 08 · continued

0 2 . 2 The percentage of carbon dioxide in the atmosphere has decreased since Earth's early atmosphere.

Which **two** processes have decreased the percentage of carbon dioxide in the Earth's atmosphere?

[2 marks]

Tick (✓) **two** boxes.

- Combustion of fuels ☐
- Formation of sedimentary rocks ☐
- Photosynthesis ☐
- Volcanic activity ☐

0 2 . 3 The total amount of carbon dioxide emitted over the life cycle of a product can be measured.

What name is given to the total amount of carbon dioxide emitted during the life cycle of a product?

[1 mark]

Tick (✓) **one** box.

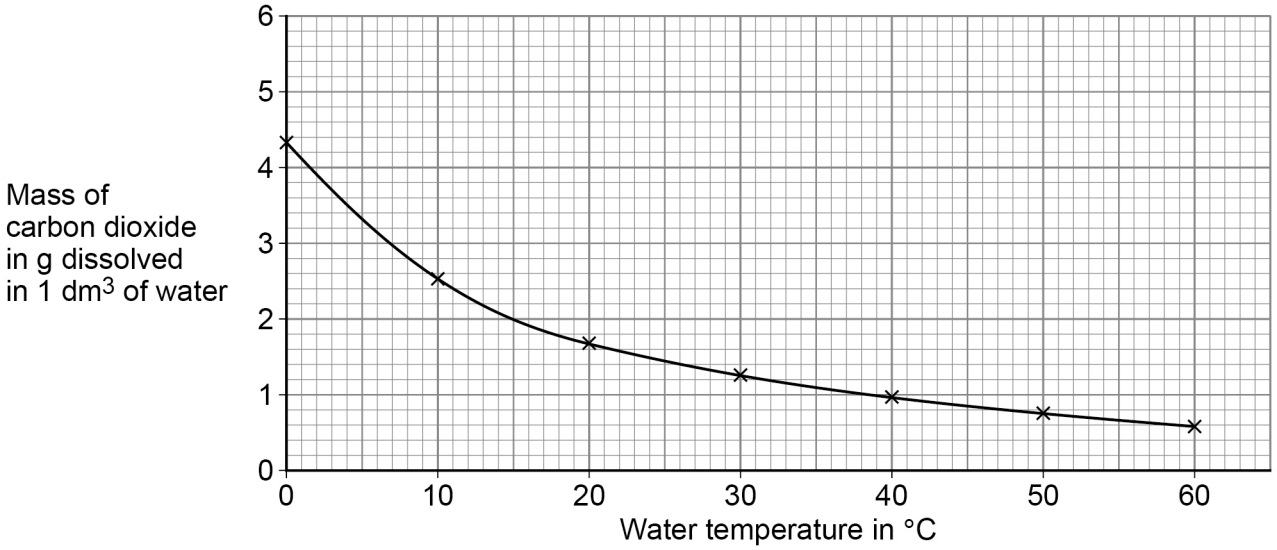
- Carbon footprint ☐
- Global dimming ☐
- Greenhouse effect ☐

Question 08 · continued

Carbon dioxide dissolves in water.

Figure 3 shows the mass of carbon dioxide dissolved in water at different temperatures.

Figure 3



0 2 . 4 Complete **Table 1**.

Use **Figure 3**.

[2 marks]

Table 1

Water temperature in °C	**Mass of carbon dioxide in g dissolved in 1 dm^3 of water**
5	
15	

0 2 . 5 Calculate the difference in the mass of carbon dioxide dissolved in 1 dm^3 of water at 5 °C and at 15 °C

Use **Table 1**.

[1 mark]

Mass = _____ g

Question 08 · continued

0 2 . 6 Carbon dioxide is a greenhouse gas.

The greenhouse effect happens in four stages.

The four stages are:

Stage **A** Carbon dioxide stops longer wavelength radiation escaping

Stage **B** Radiation is absorbed by the Earth

Stage **C** Longer wavelength radiation is emitted

Stage **D** Shorter wavelength radiation enters the atmosphere.

What is the correct order of stages **A**, **B**, **C** and **D**?

[1 mark]

Tick (✓) **one** box.

C, **A**, **B**, **D** ☐

C, **D**, **B**, **A** ☐

D, **B**, **C**, **A** ☐

D, **C**, **B**, **A** ☐

0 2 . 7 Changes in the percentage of carbon dioxide in the Earth's atmosphere cause climate change.

Give **two** effects of climate change.

[2 marks]

1 _____

_____

2 _____

_____

10

5.3.1.2 Relative formula mass

Question 09

November 2021 | 8464/C/1F | Original Q1

0 1 Magnesium is in Group 2 of the periodic table.

1.0 g of magnesium reacted with chlorine to produce magnesium chloride.

0 1 . 1 Which types of element react when magnesium reacted with chlorine?

[1 mark]

Tick (✓) **one** box.

- A metal and a metal ☐
- A metal and a non-metal ☐
- A non-metal and a non-metal ☐

0 1 . 2 Write the word equation for the reaction when magnesium reacts with chlorine.

[1 mark]

_____ + _____ → _____

0 1 . 3 What apparatus was used to measure the mass of 1.0 g of magnesium?

[1 mark]

Tick (✓) **one** box.

- Balance ☐
- Beaker ☐
- Ruler ☐

5.3.1.2 Relative formula mass

Question 09 · continued

0 1 . 4 What mass of magnesium chloride was produced?

[1 mark]

Tick (✓) **one** box.

Less than 1.0 g ☐

1.0 g ☐

More than 1.0 g ☐

0 1 . 5 Magnesium reacts with oxygen to produce magnesium oxide.

Calculate the percentage mass of magnesium in magnesium oxide (MgO).

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgO = 40

[2 marks]

Percentage mass of magnesium = _____ %

Question 1 continues on the next page

5.3.1.2 Relative formula mass

Question 09 · continued

Magnesium carbonate decomposes to produce magnesium oxide and carbon dioxide.

The word equation for the reaction is:

magnesium carbonate → magnesium oxide + carbon dioxide

Four students heated 2.00 g of magnesium carbonate for 10 minutes.

Table 1 shows the results.

Table 1

Mass of carbon dioxide produced in g				
Student 1	**Student 2**	**Student 3**	**Student 4**	**Mean**
0.97	0.91	0.50	0.95	**X**

0 1 . 6 What is the most likely reason for **Student 3**'s anomalous result?

[1 mark]

Tick (✓) **one** box.

The student heated more than 2.00 g of magnesium carbonate. ☐

The student heated the magnesium carbonate for less than 10 minutes. ☐

The student used a higher temperature. ☐

0 1 . 7 Calculate value **X** in **Table 1**.

Do **not** use the anomalous result.

Give your answer to 2 significant figures.

[3 marks]

X (2 significant figures) = _____ g

10

5.3.1.2 Relative formula mass

Question 10

November 2021 | 8464/C/1F | Original Q4

0 4 Sodium and potassium are Group 1 elements.

0 4 . 1 What is the name of Group 1 elements?

[1 mark]

Tick (✓) **one** box.

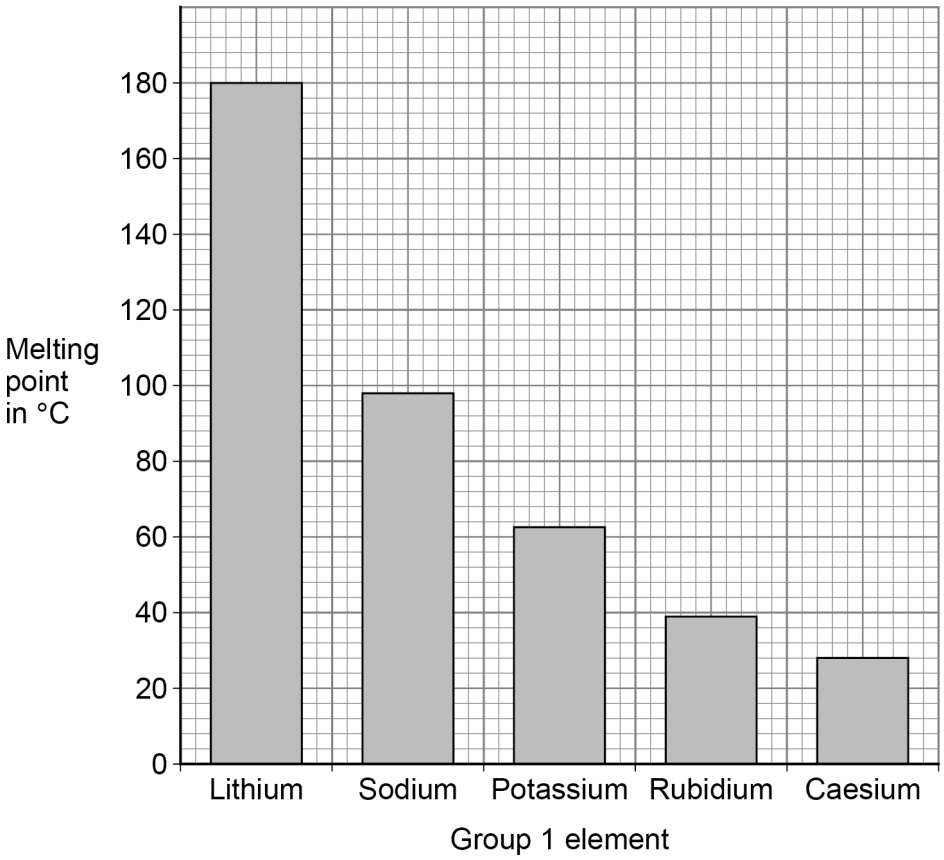
- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

5.3.1.2 Relative formula mass

Question 10 · continued

0 4 . 2 **Figure 5** represents the melting points of Group 1 elements.

Figure 5



What is the melting point of sodium?

[1 mark]

Melting point of sodium = _____ °C

0 4 . 3 Sodium reacts with water to produce sodium hydroxide and hydrogen.

Balance the equation for the reaction.

[1 mark]

$$____ Na + 2H_2O \rightarrow 2NaOH + H_2$$

5.3.1.2 Relative formula mass

Question 10 · continued

0 4 . 4 Calculate the relative formula mass (M_r) of sodium hydroxide (NaOH).

Relative atomic masses (A_r): H = 1 O = 16 Na = 23

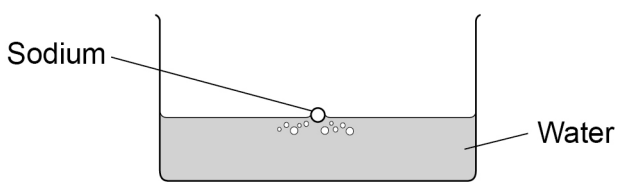
[2 marks]

Relative formula mass (M_r) = _____

0 4 . 5 Sodium and potassium both react with water.

Figure 6 shows sodium reacting with water.

Figure 6



Compare what is seen when sodium reacts with water and when potassium reacts with water.

[4 marks]

9

5.3.1.2 Relative formula mass

Question 11

November 2021 | 8464/C/2F | Original Q3

0 3 An increase in greenhouse gases in the Earth's atmosphere causes an increase in global temperature.

0 3 . 1 An increase in global temperature is a major cause of climate change.

Give **two** effects of global climate change.

[2 marks]

1 _____

_____

2 _____

_____

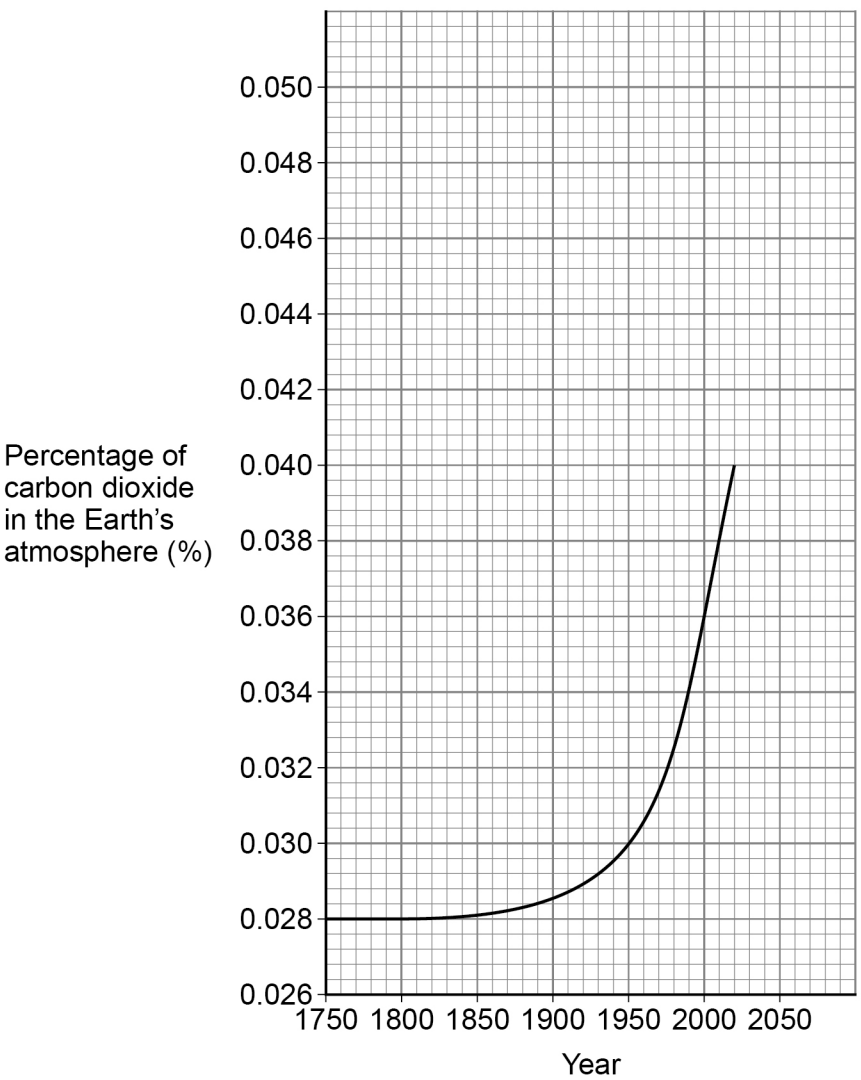
Question 3 continues on the next page

Question 11 · continued

Carbon dioxide is a greenhouse gas.

Figure 3 shows the percentage of carbon dioxide in the Earth's atmosphere from 1750.

Figure 3



5.3.1.2 Relative formula mass

Question 11 · continued

0 3 . 2 Describe the trend in the percentage of carbon dioxide in the Earth's atmosphere from 1750 to 2000.

Use **Figure 3**.

[2 marks]

0 3 . 3 Determine the change in the percentage of carbon dioxide in the Earth's atmosphere from 1950 to 2000.

Use **Figure 3**.

[2 marks]

Percentage of carbon dioxide in 1950 _____

Percentage of carbon dioxide in 2000 _____

Change in percentage of carbon dioxide = _____ %

0 3 . 4 Give **one** reason why the percentage of carbon dioxide in the atmosphere is changing.

[1 mark]

0 3 . 5 Predict the percentage of carbon dioxide in the Earth's atmosphere in 2050.

You should extend the graph line on **Figure 3**.

[2 marks]

Percentage of carbon dioxide in 2050 = _____ %

9

5.3.1.2 Relative formula mass

Question 12

June 2022 | 8464/C/1F | Original Q4

0 4 This question is about elements and compounds.

0 4 . 1 Magnesium and oxygen react to produce magnesium oxide.

Balance the equation for the reaction.

[1 mark]

$$_____ Mg + O_2 \rightarrow 2\,MgO$$

0 4 . 2 Suggest **one** safety precaution that should be taken when heating magnesium and oxygen.

[1 mark]

0 4 . 3 Calculate the relative formula mass (M_r) of magnesium fluoride (MgF_2).

Relative atomic masses (A_r): F = 19 Mg = 24

[2 marks]

Relative formula mass (M_r) = _____

0 4 . 4 Argon is a noble gas.

Explain why **no** product is formed when magnesium and argon are heated together.

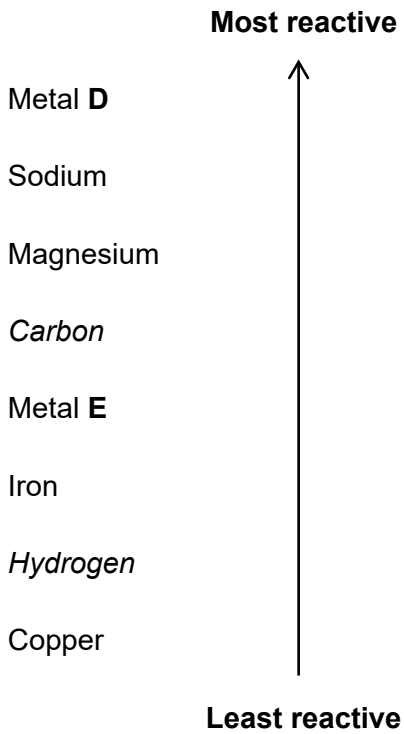
[2 marks]

5.3.1.2 Relative formula mass

Question 12 · continued

0 4 . 5 **Figure 10** shows a reactivity series.

Figure 10



5.3.1.2 Relative formula mass

Question 12 · continued

Draw **one** line from each metal to the method used to extract that metal.

Use **Figure 10**.

[2 marks]

Metal	Method used to extract that metal
	Extracted by electrolysis of a molten ionic compound.
Metal **D**	Extracted from its oxide by reduction with carbon.
	Extracted from its oxide by reduction with hydrogen.
Metal **E**	
	Removed from the Earth as the metal itself.

Question 4 continues on the next page

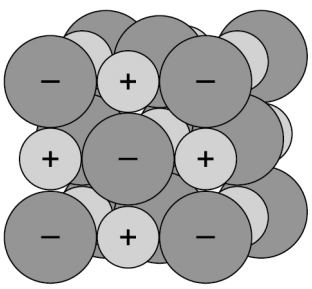
5.3.1.2 Relative formula mass

Question 12 · continued

A substance conducts electricity when it has charged particles that are free to move.

0 4 . 6 **Figure 11** represents the structure of sodium chloride.

Figure 11



Sodium chloride

Explain why sodium chloride conducts electricity when molten but **not** when solid.

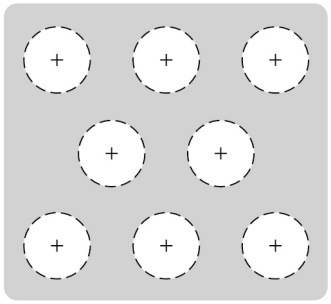
[3 marks]

5.3.1.2 Relative formula mass

Question 12 · continued

0 4 . 7 **Figure 12** represents the structure of sodium metal.

Figure 12



Sodium metal

Explain why sodium metal conducts electricity when solid.

[2 marks]

13

5.3.1.2 Relative formula mass

Question 13

June 2022 | 8464/C/2F | Original Q1

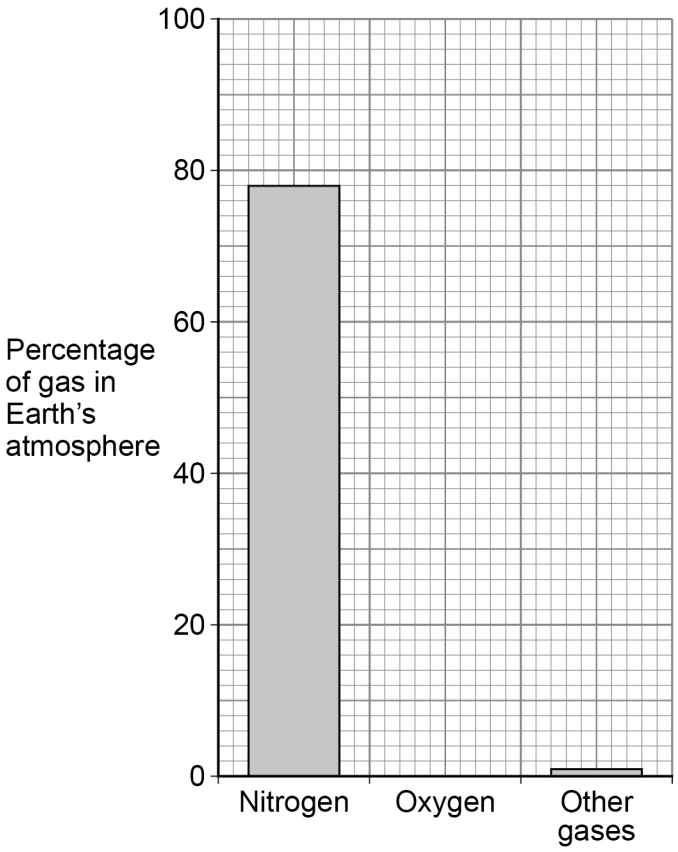
0 1 This question is about the Earth's atmosphere.

0 1 . 1 The Earth's atmosphere contains 21% oxygen.

Draw the bar for oxygen on **Figure 1**.

[1 mark]

Figure 1



0 1 . 2 What is used to test for oxygen gas?

[1 mark]

Tick (✓) **one** box.

- A burning splint ☐
- A glowing splint ☐
- Damp litmus paper ☐
- Limewater ☐

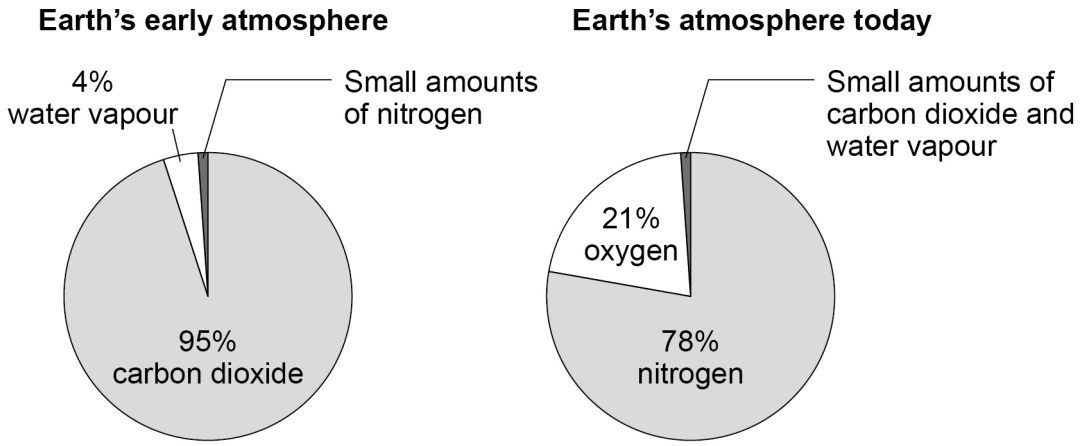
5.3.1.2 Relative formula mass

Question 13 · continued

The Earth's early atmosphere was very different from the Earth's atmosphere today.

Figure 2 shows the composition of the Earth's early atmosphere and of the Earth's atmosphere today.

Figure 2



0 1 . 3 The percentages of nitrogen and oxygen in the Earth's atmosphere today are different from the Earth's early atmosphere.

Complete the sentences.

Choose answers from the box.

Use **Figure 2**.

Each answer can be used once, more than once or not at all.

[2 marks]

decreased	**increased**	**stayed the same**

Since the Earth's early atmosphere, the percentage of nitrogen in the Earth's atmosphere has _____ .

Since the Earth's early atmosphere, the percentage of oxygen in the Earth's atmosphere has _____ .

5.3.1.2 Relative formula mass

Question 13 · continued

0 1 . 4 The Earth's atmosphere today contains a small amount of carbon dioxide.

Why has the percentage of carbon dioxide decreased since the Earth's early atmosphere?

[2 marks]

Tick (✓) **two** boxes.

- Dissolved in oceans ☐
- Formation of sedimentary rocks ☐
- Industrialisation ☐
- Respiration ☐
- Volcanic activity ☐

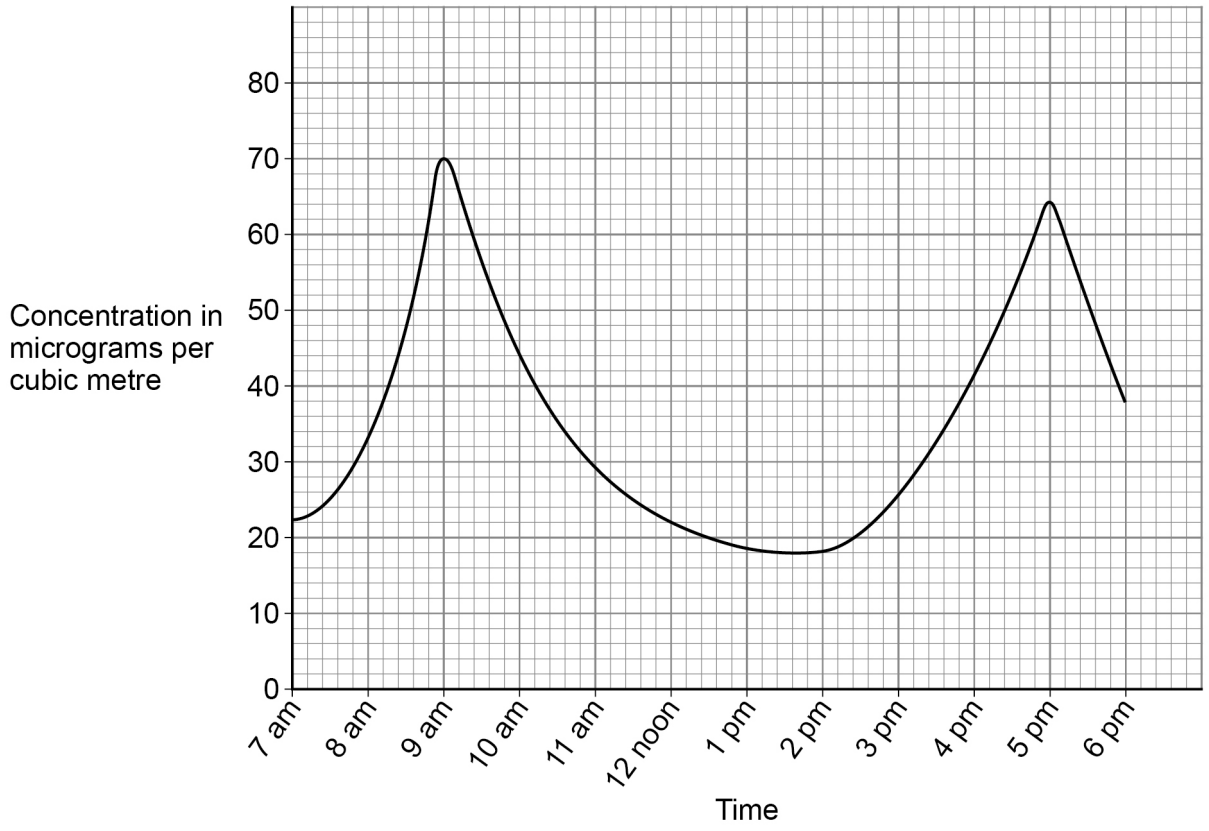
5.3.1.2 Relative formula mass

Question 13 · continued

Oxides of nitrogen are produced when nitrogen reacts with oxygen in car engines.

Figure 3 shows the concentration of oxides of nitrogen in the atmosphere during one day in a city.

Figure 3



0 1 . 5 Which **two times** have the highest concentrations of oxides of nitrogen in the atmosphere?

[2 marks]

1 _____

2 _____

0 1 . 6 Suggest why there are the highest concentrations of oxides of nitrogen at these times.

[1 mark]

_____

_____

9

5.3.1.2 Relative formula mass

Question 14

June 2023 | 8464/C/1F | Original Q7

0 7 Lithium hydroxide reacts with sulfuric acid to produce lithium sulfate.

The equation for the reaction is:

$$2\,LiOH + H_2SO_4 \longrightarrow Li_2SO_4 + 2\,H_2O$$

0 7 . 1 What type of reaction is this?

[1 mark]

0 7 . 2 Calculate the relative formula mass (M_r) of sulfuric acid (H_2SO_4).

Relative atomic masses (A_r): H = 1 O = 16 S = 32

[2 marks]

Relative formula mass (M_r) = _____

5.3.1.2 Relative formula mass

Question 14 · continued

0 7 . 3 Calculate the percentage by mass of oxygen in lithium sulfate (Li_2SO_4).

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): Li_2SO_4 = 110

Give your answer to 2 significant figures.

[4 marks]

Percentage by mass of oxygen (2 significant figures) = _____ %

0 7 . 4 A solution of lithium sulfate contains 0.30 g of lithium sulfate in 25 cm^3.

Calculate the concentration of lithium sulfate in g/dm^3.

[3 marks]

Concentration = _____ g/dm^3

10

5.3.1.2 Relative formula mass

Question 15

June 2024 | 8464/C/2F | Original Q1

0 1 The Earth's atmosphere has changed during the last 4.6 billion years.

0 1 . 1 What is the approximate percentage of nitrogen and of oxygen in the Earth's atmosphere today?

Draw **one** line from each gas to the percentage of that gas.

[2 marks]

Gas	Percentage (%) of gas
Nitrogen	20
	40
Oxygen	60
	80

0 1 . 2 The approximate percentage of carbon dioxide in the Earth's early atmosphere was 95%.

Which are **two** reasons why the percentage of carbon dioxide has **decreased** since the Earth's early atmosphere?

[2 marks]

Tick (✓) **two** boxes.

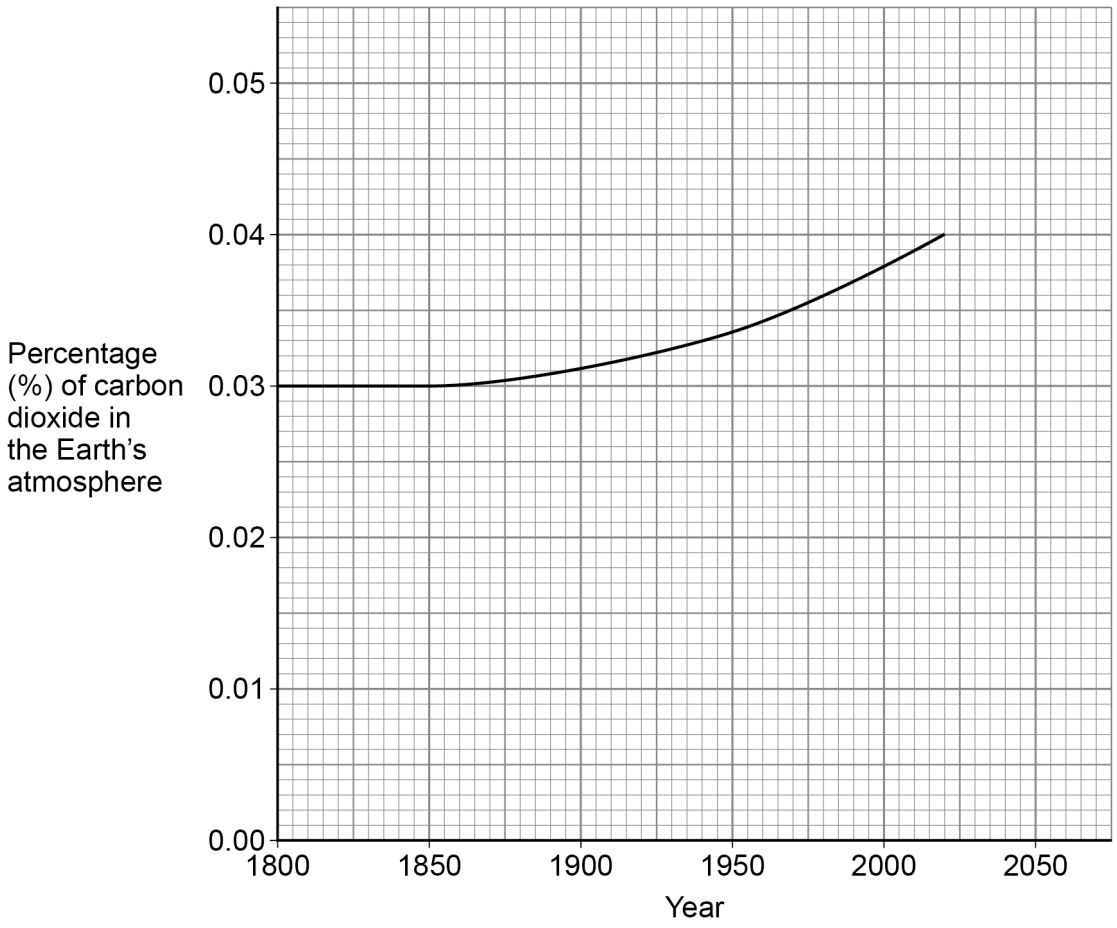
- Combustion of fuels ☐
- Deforestation ☐
- Dissolving in oceans ☐
- Photosynthesis ☐
- Respiration ☐

5.3.1.2 Relative formula mass

Question 15 · continued

0 1 . 3 **Figure 1** shows the change in the percentage of carbon dioxide in the Earth's atmosphere from 1800 to 2020.

Figure 1



Describe the trend in the percentage of carbon dioxide in the Earth's atmosphere from 1800 to 2020.

Use data from **Figure 1**.

[3 marks]

5.3.1.2 Relative formula mass

Question 15 · continued

Carbon dioxide is a greenhouse gas.

0 1 . 4 Which of the following is also a greenhouse gas?

[1 mark]

Tick (✓) **one** box.

- Argon ☐
- Methane ☐
- Nitrogen ☐
- Oxygen ☐

0 1 . 5 Which of the following is an environmental problem caused by greenhouse gases?

[1 mark]

Tick (✓) **one** box.

- Acid rain ☐
- Climate change ☐
- Global dimming ☐

5.3.1.2 Relative formula mass

Question 15 · continued

0 1 . 6 Calculate the relative formula mass (M_r) of carbon dioxide (CO_2).

Relative atomic masses (A_r): C = 12 O = 16

[2 marks]

Relative formula mass of carbon dioxide = _____

11

Turn over for the next question

5.3.1.2 Relative formula mass

Question 16

June 2025 | 8464/C/1F | Original Q2

0 2 Lithium, carbon, nitrogen, fluorine and neon are elements in the same row of the periodic table.

0 2 . 1 What is the chemical symbol of lithium?

Use the periodic table.

[1 mark]

_____

0 2 . 2 Lithium has metallic bonding.

Which electrons are involved in metallic bonding?

[1 mark]

Tick (✓) **one** box.

- Delocalised electrons from the inner shell ☐
- Delocalised electrons from the outer shell ☐
- Fixed electrons in the inner shell ☐
- Fixed electrons in the outer shell ☐

Question 2 continues on the next page

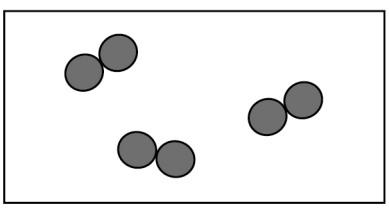
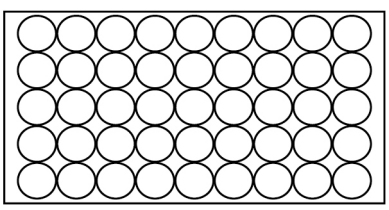
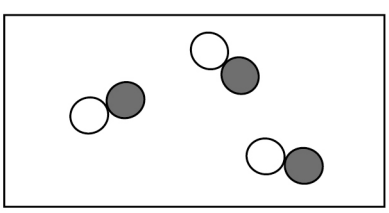
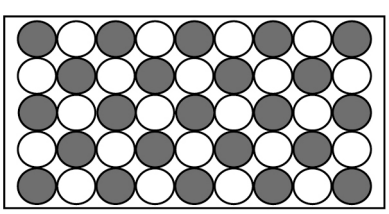
5.3.1.2 Relative formula mass

Question 16 · continued

0 2 . 3 Lithium reacts with fluorine to produce lithium fluoride.

Draw **one** line from each substance to the particle diagram that represents the substance.

[3 marks]

Substance	Particle diagram
Lithium solid	
Fluorine gas	
Lithium fluoride solid	
	

5.3.1.2 Relative formula mass

Question 16 · continued

0 2 . 4 **Table 2** shows the electrical conductivity of three substances.

Table 2

Substance	Electrical conductivity when solid	Electrical conductivity when liquid
C	Poor	Poor
D	Poor	Good
E	Good	Good

Lithium fluoride is an ionic compound.

Which substance is lithium fluoride?

[1 mark]

Tick (✓) **one** box.

C ☐ **D** ☐ **E** ☐

Question 2 continues on the next page

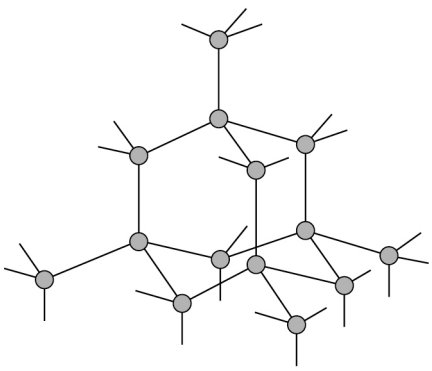
5.3.1.2 Relative formula mass

Question 16 · continued

0 2 . 5 Carbon can exist in different forms.

Figure 4 represents one form of carbon.

Figure 4



What is the name of the form of carbon in **Figure 4**?

[1 mark]

Tick (✓) **one** box.

Buckminsterfullerene ☐

Diamond ☐

Graphite ☐

0 2 . 6 Carbon and fluorine form a compound with the formula CF_4

Calculate the relative formula mass (M_r) of CF_4

Relative atomic masses (A_r): C = 12 F = 19

[2 marks]

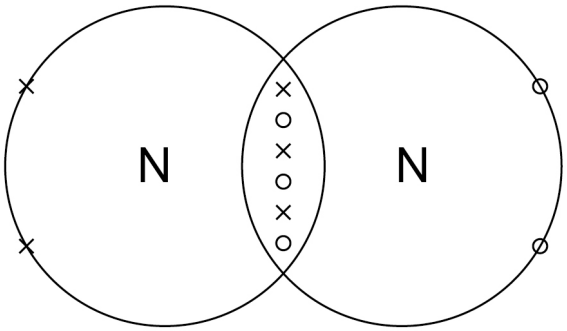
Relative formula mass (M_r) = _____

5.3.1.2 Relative formula mass

Question 16 · continued

0 2 . 7 **Figure 5** represents a molecule of nitrogen.

Figure 5



What is the total number of shared electrons in the covalent bond shown in **Figure 5**?

[1 mark]

_____

0 2 . 8 Lithium and nitrogen form a compound with the formula Li_3N

Complete the sentence.

Choose the answer from the box.

[1 mark]

nitrate	**nitride**	**nitrogen**

The name of the compound with the formula Li_3N is lithium _____.

Question 2 continues on the next page

5.3.1.2 Relative formula mass

Question 16 · continued

0 2 . 9 Neon does **not** react with other elements to form compounds.

Why is neon unreactive?

[1 mark]

Tick (✓) **one** box.

Neon has a stable arrangement of electrons. ☐

Neon is a gas at room temperature. ☐

Neon is a non-metallic element. ☐

12

5.3.1.2 Relative formula mass

Question 17

June 2025 | 8464/C/1F | Original Q7

0 7 A student investigated an exothermic reaction.

The student reacted solid calcium oxide with water to produce calcium hydroxide.

0 7 . 1 What is meant by an 'exothermic' reaction?

[1 mark]

0 7 . 2 The formula of calcium hydroxide is $Ca(OH)_2$

Calculate the percentage by mass of oxygen in calcium hydroxide.

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): $Ca(OH)_2$ = 74

[3 marks]

Percentage = _____ %

Question 7 continues on the next page

5.3.1.2 Relative formula mass

Question 17 · continued

0 7 . 3 When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

Extra space

10

5.3.1.2 Relative formula mass

Question 18

June 2025 | 8464/C/2F | Original Q6

0 6 The proportions of most gases in the Earth's atmosphere have not changed much for the past 200 million years.

0 6 . 1 About one-fifth of the atmosphere is oxygen.

Describe the test for oxygen gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 6 . 2 **Table 5** shows the percentages of some gases in the Earth's early atmosphere and in the Earth's atmosphere today.

Table 5

	Percentage (%) of gas in the atmosphere	
Gas	**Earth's early atmosphere**	**Earth's atmosphere today**
Carbon dioxide	95	0.04
Nitrogen	3	78.0
Oxygen	Less than 1	21.0

5.3.1.2 Relative formula mass

Question 18 · continued

Explain how the percentages of gases have changed from Earth's early atmosphere to Earth's atmosphere today.

You should refer to all three gases in **Table 5**.

[6 marks]

Extra space

0 6 . 3 Methane is a greenhouse gas.

Give **two** ways to reduce methane emissions into the atmosphere.

[2 marks]

1

2

5.3.1.2 Relative formula mass

Question 18 · continued

The percentage of sulfur dioxide in the Earth's atmosphere increased between 1850 and 1980.

0 6 . 4 Describe how sulfur dioxide emissions are produced.

[2 marks]

0 6 . 5 Give **one** harmful effect of sulfur dioxide emissions.

[1 mark]

0 6 . 6 Suggest **one** reason why the percentage of sulfur dioxide in the Earth's atmosphere has decreased since 1980.

[1 mark]

14