AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.1.1.6

Relative atomic mass

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**13**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.1.1.6 Relative atomic mass

Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	B		1	AO2 5.1.2.1
04.2	calcium oxide **or** CaO carbon dioxide **or** CO_2	either order	1 1	AO1 5.1.1.1 5.3.1.3
04.3	decomposition		1	AO1 5.3.1.3
04.4	endothermic		1	AO1 5.5.1.1
04.5	32 (g)	allow 31–33 (g)	1	AO2 5.3.1.3
04.6	 $\frac{32}{5.2} \times 24$ 148 (g) **or** uses graph eg 12 dm^3 gives 74 (g) (1) (then factors up so that 24 dm^3 gives) 148 (g) (1)	an answer of 148 (g) scores **2** marks allow ecf from question **04.5** allow a range 143–153 (g) allow a range 143–153 (g)	 1 1	AO3 5.3.1.3

5.1.1.6 Relative atomic mass

Answer 01 · Mark scheme

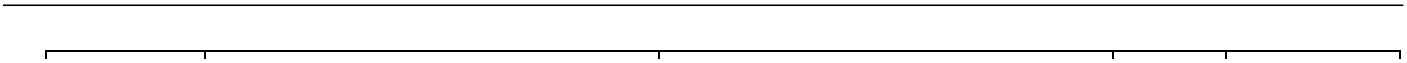
June 2018 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7		mark mistakes and calculation independently		AO3 5.3.1.3
	(mistakes) increase in mass = 3 (not 4)	allow mistakes in either order	1	
	inserted numbers inversely into formula	allow numbers wrong way round	1	
	(calculation)	an answer of 250 scores the **2** calculation marks	1	
	gradient $= \frac{750}{3}$	allow $\frac{1000}{4}$		
	250 (cm^3 per g)	if no calculation marks awarded allow $\frac{750}{3}$ **or** 187.5 **or** $\frac{3}{750}$ **or** 0.004 for **1** mark	1	
04.8		an answer of 24 scores the **3** calculation marks		AO2 5.3.1.2 5.3.1.3 5.1.1.5
	3 × 16 or 48		1	
	(48) + 12 or 60	allow their mass of oxygen + 12	1	
	84 − (60) **or** 24	allow 84 − their mass of carbonate	1	
	magnesium **or** Mg	magnesium **or** Mg without working scores this mark	1	
Total			**16**	

5.1.1.6 Relative atomic mass

Answer 01 · Mark scheme

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



5.1.1.6 Relative atomic mass

Answer 02 · Mark scheme June 2019 | 8464/C/1F | Original Q7

07.1	(aq)	allow aq ignore aqueous ignore formulae	1	AO1 5.2.2.2
07.2	HNO_3		1	AO1 5.1.1.1 5.4.2.2
07.3	red purple **or** blue	allow orange or yellow do **not** accept green allow shades of purple e.g. violet	1 1	AO1 5.4.2.4
07.4	D		1	AO3 5.4.2.4
07.5	 3 × 16 **or** 48 $\frac{48}{80}$ (×100) 60 (%)	an answer of 60 (%) scores **3** marks an answer of 20 (%) scores **2** marks for: $\frac{16}{80}$ (× 100) (1) = 20 (%) (1)	 1 1 1	AO2 5.3.1.2

5.1.1.6 Relative atomic mass

Answer 02 · Mark scheme

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

Question	Answers	Mark	AO/ Spec. Ref
07.6	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 AO2
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	5.5.1.1
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content **Steps** • use a suitable container e.g. test tube • use insulation • add water • measure the initial water temperature (with a thermometer) • add stated mass e.g. 1g **or** 1 spatula • stir (to dissolve the solid) • measure the final (allow lowest or highest) temperature of the solution • calculate the temperature difference **or** determine graphically • repeat with different masses • repeat with the same volume of water to access level 3 there must be an indication of how the temperature change is determined using different masses dissolved in the same quantity of water		
Total			**14**

5.1.1.6 Relative atomic mass

Answer 03 · Mark scheme November 2020 | 8464/C/1F | Original Q3

03.1	positively charged		1	AO2 5.1.1.3
03.2	the atom is mainly empty space.		1	AO2 5.1.1.3 5.1.1.7
03.3	the mass is concentrated at the centre of the atom.		1	AO1 5.1.1.3
03.4	halogens		1	AO1 5.1.2.6
03.5	fluorine		1	AO1 5.1.2.6
03.6	2.13 (g)		1	AO2 5.3.1.1
03.7	197 + (3 × 35.5) **or** 197 + 106.5 = 303.5		1 1	AO2 5.3.1.2
Total			**8**	

5.1.1.6 Relative atomic mass

Answer 03 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.1.1.6 Relative atomic mass

Answer 04 · Mark scheme

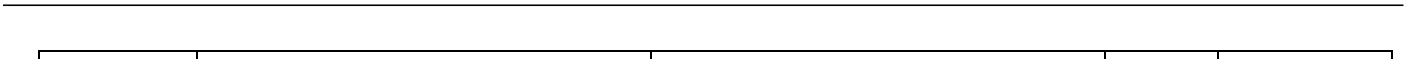
November 2021 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a metal and a non-metal		1	AO1 5.1.2.1 5.1.2.3 5.3.1.1
01.2	magnesium + chlorine → magnesium chloride	allow Mg for magnesium allow Cl_2 for chlorine allow $MgCl_2$ for magnesium chloride	1	AO2 5.1.1.1 5.1.2.6
01.3	balance		1	AO1 5.3.1.3
01.4	more than 1.0 g		1	AO3 5.3.1.3 5.4.1.1
01.5	(% =) $\frac{24}{40} \times 100$ = 60 (%)		1 1	AO2 5.3.1.2
01.6	the student heated the magnesium carbonate for less than ten minutes		1	AO3 5.3.1.3
01.7	$\frac{0.97 + 0.91 + 0.95}{3}$ **or** $\frac{2.83}{3}$ = 0.943333 (g) = 0.94 (g)	allow for **1** mark $\frac{0.97 + 0.91 + 0.50 + 0.95}{4}$ **or** $\frac{3.33}{4}$ = 0.8325 (g) allow an answer correctly rounded to 2 significant figures using values from the table	1 1 1	AO3 AO2 AO2 5.3.1.3
Total			10	

5.1.1.6 Relative atomic mass

Answer 04 · Mark scheme

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



5.1.1.6 Relative atomic mass

Answer 05 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	alkali metals		1	AO1 5.1.2.5
04.2	98 (°C)	allow a value in the range 97–99 (°C)	1	AO2 5.1.2.5
04.3	$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$	allow multiples	1	AO2 5.1.2.5 5.4.1.1
04.4	(M_r =) 23 + 16 + 1 = 40		1 1	AO2 5.1.2.5 5.3.1.2

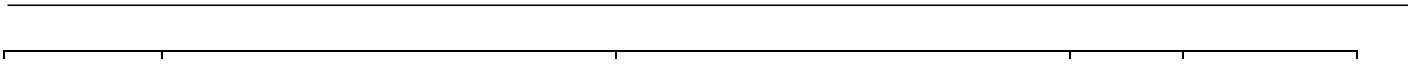
5.1.1.6 Relative atomic mass

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO1 AO2
	Level 1: Relevant features are identified and differences noted.	1–2	AO1
	No relevant content	0	
	Indicative Content: <u>Similarities – sodium and potassium both:</u> • float • move • bubble / effervesce / fizz • melt • form a ball • get smaller **or** disappear <u>Differences – potassium:</u> • moves faster • bubbles faster • reacts faster • disappears faster • catches fire • lilac flame		5.1.2.5
Total		**9**	

5.1.1.6 Relative atomic mass

Answer 05 · Mark scheme

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



5.1.1.6 Relative atomic mass

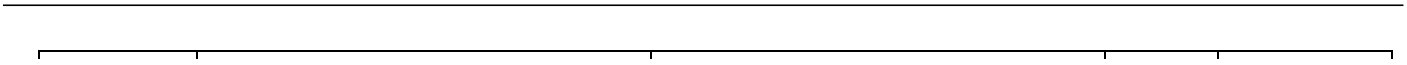
Answer 06 · Mark scheme November 2021 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(Group) 0 **or** noble gases		1	AO2 5.1.2.2
06.2	B		1	AO2 5.1.1.3
06.3	A		1	AO3 5.1.1.3
06.4	(atoms with the) same number of protons	allow atoms with the same atomic number allow atoms of the same element ignore the same number of electrons	1	AO1 5.1.1.5
	(but with) different numbers of neutrons	ignore (but with) different mass numbers do **not** accept (but with) different relative atomic mass	1	
06.5	$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$ = 39.138 = 39.1	 allow correctly rounded answer to **1** decimal place from an incorrect calculation using all the values given in the question	1 1 1	AO2 5.1.1.6
Total			**8**	

5.1.1.6 Relative atomic mass

Answer 06 · Mark scheme

November 2021 | 8464/C/1F | Original Q6



5.1.1.6 Relative atomic mass

Answer 07 · Mark scheme

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

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	**2** Mg + O_2 → 2 MgO	allow multiples	1	AO2 5.1.2.5 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	any **one** from: • wear safety glasses / goggles • do not look directly at burning magnesium • wear heat proof glove	allow look through blue glass allow use tongs allow tie hair back	1	AO3 5.4.1.1 5.4.1.2 5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(M_r =) 24 + (2 × 19) = 62		1 1	AO2 5.1.2.5 5.3.1.2

5.1.1.6 Relative atomic mass

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **one** from: • argon has a full outer shell • argon has 8 electrons in the outer shell • argon has a stable arrangement of electrons.	allow energy level for shell allow does not need to lose and / or gain electrons	1	AO2
	(so) argon is unreactive	ignore argon is a noble gas	1	AO1 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	**Metal** — **Method used to extract that metal** Metal **D** → Extracted by electrolysis of a molten ionic compound. Metal **D** → Extracted from its oxide by reduction with carbon. Metal **E** → Extracted from its oxide by reduction with hydrogen. Metal **E** → Removed from the Earth as the metal itself. do **not** accept more than one line from a box on the left		1 1	AO3 5.4.1.2 5.4.1.3 5.4.3.1 5.4.3.2 5.4.3.3

5.1.1.6 Relative atomic mass

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(because) ions (which are) free to move when molten (but are) fixed in solid	 allow reference to charged particles for MP2 and MP3	1 1 1	AO1 5.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(sodium contains) delocalised electrons (which) carry (electrical) charge (through the metal / sodium)	allow free electrons ignore throughout for through ignore current / electricity	1 1	AO1 5.2.2.8

Total Question 4		13

5.1.1.6 Relative atomic mass

Answer 08 · Mark scheme

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

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	neutralisation	allow exothermic	1	AO1 5.4.2.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(M_r =) (1 × 2) + 32 + (4 × 16) = 98		1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(A_r O × 4 =) 4 × 16 **or** 64 (percentage of oxygen =) $\frac{64}{110} \times 100$ = 58.18 = 58 (%)	 allow correct use of incorrectly determined mass of oxygen allow a correctly calculated answer to 2 significant figures from an incorrect calculation which uses the values in the question	1 1 1 1	AO2 5.3.1.2

5.1.1.6 Relative atomic mass

Answer 08 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(unit conversion) (25 cm^3 ÷ 1000) = 0.025 dm^3		1	AO2 5.3.2.5
	(conc =) $\frac{0.30}{0.025}$ (g/dm^3)	allow correct use of incorrect / no unit conversion	1	
	= 12 (g/dm^3)		1	
	alternative approach: $\frac{0.30}{25}$ (g/cm^3) (1)			
	= 0.012 (g/cm^3) (1)			
	(unit conversion) (0.012 × 1000) = 12 (g/dm^3) (1)	allow correct conversion of an incorrect concentration calculation		

Total Question 7	10

5.1.1.6 Relative atomic mass

Answer 09 · Mark scheme

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

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	alkali metals		1	AO1 5.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	0.2 nm		1	AO1 5.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	atomic number		1	AO1 5.1.1.5

Question	Answers	Mark	AO / Spec. Ref.
01.4	<table><tr><th>Name</th><th>Relative charge</th></tr><tr><td>Proton</td><td>**+(1)**</td></tr><tr><td>**Neutron**</td><td>0</td></tr><tr><td>Electron</td><td>-1</td></tr></table>	1 1	AO1 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	+1		1	AO2 5.1.1.7 5.1.2.3 5.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	63 (°C)	allow a value in the range 50–80 (°C)	1	AO3 5.1.2.5

5.1.1.6 Relative atomic mass

Answer 09 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	$A_r = \frac{(39 \times 93) + (41 \times 7)}{100}$		1	AO2 5.1.1.6

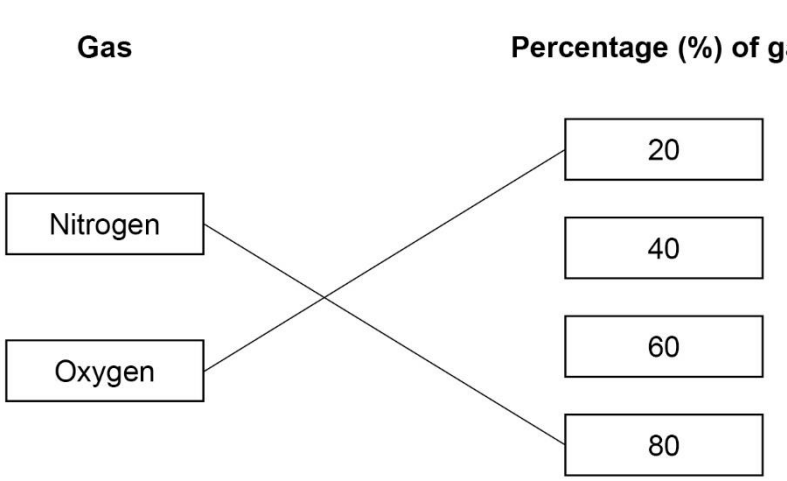
Total Question 1	**8**

5.1.1.6 Relative atomic mass

Answer 10 · Mark scheme

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

Question 1

Question	Answers	Mark	AO / Spec. Ref.
01.1	 do **not** accept more than one line from a box on the left	1 1	AO1 5.9.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	dissolving in oceans photosynthesis		1 1	AO1 5.9.1.2 5.9.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(from 1800 carbon dioxide percentage is) constant until 1850 (then) increases (to 2020)	 allow a value in the range 1850 to 1865	1 1 1	AO2 5.9.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	methane		1	AO1 5.9.2.2

5.1.1.6 Relative atomic mass

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	climate change		1	AO1 5.9.2.2 5.9.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(M_r =) 12 + (2 × 16) = 44		 1 1	AO2 5.3.1.2 5.9.2.2

Total Question 1	**11**

5.1.1.6 Relative atomic mass

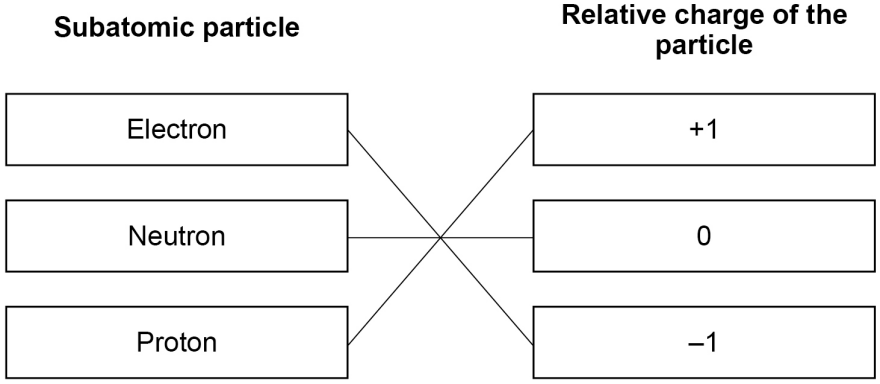
Answer 11 · Mark scheme

June 2025 | 8464/C/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	electron		1	AO1 5.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	nucleus		1	AO1 5.1.1.3

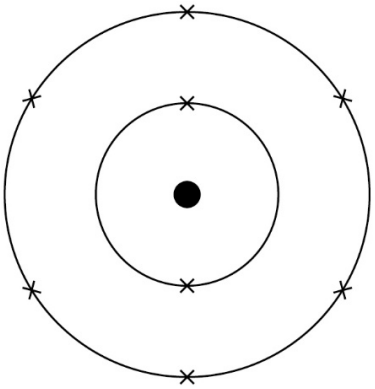
Question	Answers	Mark	AO / Spec. Ref.
01.3	 allow **1** mark for 1 or 2 correct do **not** accept more than one line from a box on the left	2	AO1 5.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the number of protons only		1	AO1 5.1.1.4

5.1.1.6 Relative atomic mass

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$(A_r =) \frac{(10 \times 19.7) + (11 \times 80.3)}{100}$	allow $(A_r =) \frac{197 + 883.3}{100}$ allow $(A_r =) \frac{1080.3}{100}$	1	AO2 5.1.1.6
	= 10.803		1	
	= 10.8		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6		allow any combination of x, O, $e^{(-)}$, ● for electrons	1	AO2 5.1.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	model **B** shows the 3D arrangement of the ions		1	AO3 5.2.1.3
	model **B** shows the relative sizes of the ions		1	

Total Question 1	11

5.1.1.6 Relative atomic mass

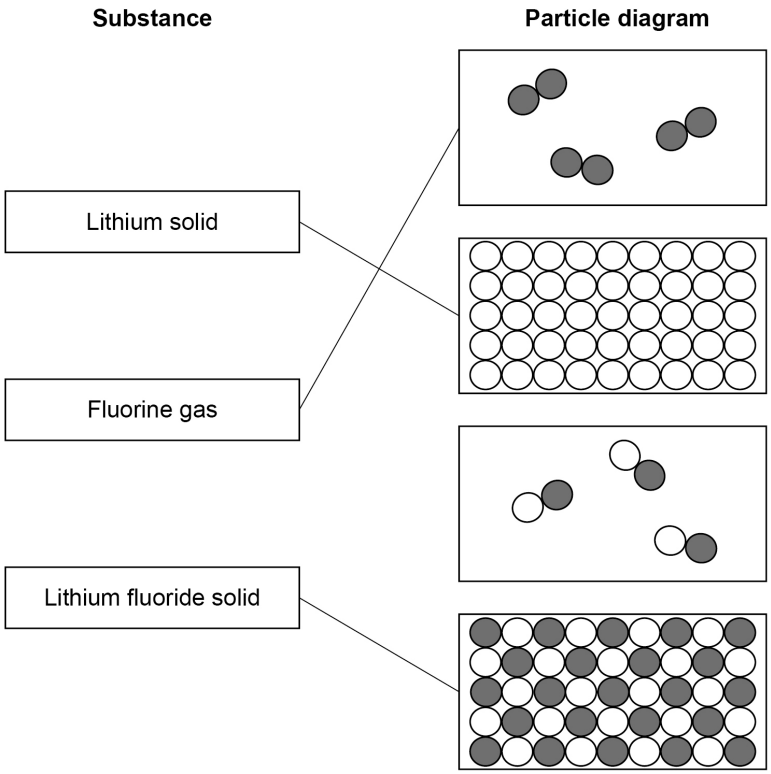
Answer 12 · Mark scheme

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

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	Li		1	AO1 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	delocalised electrons from the outer shell		1	AO1 5.2.1.5

Question	Answers	Mark	AO / Spec. Ref.
02.3	 do **not** accept more than one line from a box on the left	1 1 1	AO3 5.1.1.1 5.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	**D**		1	AO3 5.2.2.3

5.1.1.6 Relative atomic mass

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	diamond		1	AO1 5.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(relative formula mass =) 12 + (19 × 4) = 88		1 1	AO2 5.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	6	allow 3 pairs	1	AO2 5.2.1.1 5.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	nitride		1	AO2 5.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	neon has a stable arrangement of electrons		1	AO1 5.1.2.4

Total Question 2	**12**

5.1.1.6 Relative atomic mass

Answer 13 · Mark scheme

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

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(a reaction) which transfers energy to the surroundings	allow heat for energy allow (a reaction) which releases energy (to the surroundings)	1	AO1 5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(mass of oxygen = 2 × 16 =) 32		1	AO2 5.3.1.2
	(percentage =) $\frac{32}{74}$ × 100	allow correct use of an incorrectly determined mass of oxygen	1	
	= 43.2 (%)	allow 43.2432 (%) correctly rounded to at least 2 significant figures	1	

5.1.1.6 Relative atomic mass

Answer 13 · Mark scheme

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

Question	Answers	Mark	AO / Spec. Ref.
07.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 5.5.1.1 RPA10
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	

	Indicative content
	• measure volume of water
	  ○ using a measuring cylinder
	  ○ pour into a suitable container eg insulated cup
	• measure initial temperature of water
	  ○ using a thermometer
	• add known mass of calcium oxide
	  ○ measured with a balance
	  ○ stir
	• measure the highest temperature reached by the mixture
	or
	measure temperature reached after set time period
	  ○ determine the temperature change
	• repeat with different masses of calcium oxide
	or
	add successive masses to the same mixture
	• use the same volume of water
	  ○ use the same initial temperature of water
	
	for **Level 3** all key steps should be described and the control variable the same volume of water must be given		

Total Question 7	**10**

5.1.1.6 Relative atomic mass

Answer 01 · Examiner comments

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

Question 4 (low & standard demand)

04.2 Even though the stem informed students that the products were a metal oxide and a gas, very few students (6%) could name both of the products formed when calcium carbonate ($CaCO_3$) is heated.

04.3 63% of students knew that the type of reaction when a compound breaks down is called decomposition.

04.4 60% of students knew that the type of reaction that takes in energy from the surroundings is called an endothermic reaction.

Answer 01 · Examiner comments

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

04.7 This question discriminated between students well. The two mistakes made in the student's calculation were often poorly expressed or ambiguous such as, 'the calculation is wrong'; 'used the wrong numbers'; 'the volume is wrong'; and 'readings are taken from the wrong place'.

Many students correctly identified at least one of the mistakes but several of these students continued to use either the incorrect mass or the inverse formula for their calculation.

13% of students expressed the mistakes well and correctly calculated the gradient. There were 12% of students who did not attempt to answer this question.

5.1.1.6 Relative atomic mass

Answer 04 · Examiner comments — November 2021 | 8464/C/1F | Original Q1

Question 1 (low and standard demand)

01.1 Most students knew that magnesium reacting with chlorine is an example of a metal reacting with a non-metal.

01.2 Approximately two thirds of students were able to construct a word equation from the information supplied in the question.

01.3 Approximately two thirds of students knew that a balance is used to measure 1.0 g of magnesium.

01.4 Nearly half of students deduced that more than 1.0 g of magnesium chloride is formed when 1.0 g of magnesium reacts with chlorine.

01.5 Just under one third of students gained two marks for correctly calculating the percentage of magnesium in magnesium oxide.

01.6 More than half of students deduced that the anomalous result is explained when the student heated the magnesium carbonate for less than ten minutes. 'The student used a higher temperature' was a strong distractor.

01.7 Approximately one quarter of students gained three marks for correctly calculating the mean and just under one third of students incorrectly included the anomalous result in their mean. A few did not give their answer to two significant figures.

Answer 05 · Examiner comments — November 2021 | 8464/C/1F | Original Q4

Question 4 (low and standard demand)

04.1 More than two thirds of students knew that the name of the Group 1 elements is the alkali metals.

04.2 More than two thirds of students were able to determine the melting point of sodium from the bar chart recognising the *y*-axis scale of 1 small square being equal to 4 °C.

04.3 Nearly two thirds of students were able to balance the chemical equation.

04.4 More than half of students successfully calculated the relative formula mass of sodium hydroxide.

04.5 This extended response question required students to compare the observations when sodium and potassium are reacted with water. Approximately half of students either recalled or used the figure to state that with sodium fizzing occurs. Other observations seen included sodium melting, forming a ball and moving. A comparison of the similarities and differences between these metals and also the magnitude of these was required to achieve level two.

5.1.1.6 Relative atomic mass

Answer 06 · Examiner comments November 2021 | 8464/C/1F | Original Q6

Question 6 (standard demand)

06.1 Just under half of students knew that Group 0, the noble gases, had not been discovered when Mendeleev's version of the periodic table was published.

06.2 The plum pudding model was identified by nearly three fifths of students.

06.3 Chadwick discovered the neutron. Students found difficulty in making the link between this discovery and the figure which represented an atom containing neutrons. Approximately one third of students gained the mark.

06.4 The question required students to answer in terms of 'subatomic particles'; the answer was that isotopes are atoms with the same number of protons but different numbers of neutrons. Less than one fifth of students gained a mark.

06.5 Just over one fifth of students gained the first mark by showing that the weighted average had to be divided by 100. The evaluation of this gained the second mark which then needed to be correctly rounded to one decimal place.

Answer 07 · Examiner comments June 2022 | 8464/C/1F | Original Q4

Question 4 (Low and standard demand)

04.1 More than 70% of students correctly balanced the equation. Some students changed the formula, usually from MgO to MgO_2

04.2 Almost three-quarters of students stated a safety precaution that should be taken when heating magnesium and oxygen. The most common correct responses were to wear eye protection and to use tongs.

04.3 Almost one-quarter of students gave the correct answer for the relative formula mass of magnesium fluoride. These students recognised that the subscript 2 means the relative atomic mass of fluorine needed to be doubled before being added to the relative atomic

5.1.1.6 Relative atomic mass

Answer 07 · Examiner comments June 2022 | 8464/C/1F | Original Q4

mass of magnesium. Many showed clear steps in their calculation. The most common errors were to either add or multiply 24 and 19.

04.4 Magnesium does not react when heated with argon - argon is unreactive because argon atoms have eight electrons in the outer shell. Common responses referred to magnesium (and argon) both being unreactive, that metals (or solids) do not react with gases or that both elements had full outer shells. This question discriminated well.

04.5 Almost 60% of students gained at least one of the two marks for correctly deducing the method used to extract a metal. The students were given a reactivity series showing the position of these two metals compared to other known metals, carbon and hydrogen.

04.6 Students found difficulty in explaning why sodium chloride conducts electricity when molten but not when a solid. Many indicated that this was due to something being able to move but failed to link this to ions or charged particles. Most referred to moving particles, atoms or electrons.

04.7 Students also found difficulty in explaning why sodium conducts electricity when solid. Delocalised electrons were rarely seen as was the concept of these delocalised electrons carrying charge through the sodium.

5.1.1.6 Relative atomic mass

Answer 08 · Examiner comments

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

Question 7 (standard demand)

07.1 This question was answered with a wide variation of responses. Just under 20% of students knew that the reaction was either neutralisation or exothermic. Displacement was a common incorrect response as was endothermic which was given more frequently than exothermic.

07.2 Nearly a third of students correctly calculated the relative formula mass of sulfuric acid from the given formula and showed clear steps in their calculation. Students should be aware that when data is provided it is usually all required to be used to get to the correct answer. The most common responses seen that were not creditworthy were M_r = 49 from (1+32+16), M_r = 512 from (1×16×32) and M_r = 146 from (2+16+(4×32)).

07.3 Students found this question demanding but it proved to be a good discriminator. Just over a third of students gained at least 1 mark. Some students were not credited with MP1 as they had used the mass of O = 16, rather than O = 16 × 4. Some students successfully worked through the calculation logically but either forgot to follow the question instruction to give their answer to 2 significant figures or left their answer correct to 2 decimal places. Other responses showed little or no understanding of what was required in the calculation with figures added, subtracted or simply multiplied together.

07.4 Students found this question demanding but it proved to be a good discriminator. A small number of students gained all 3 marks. Many just multiplied the mass (0.30 g) by the volume (25 cm^3). Many answers calculated the concentration of the solution successfully (0.30 ÷ 25) but omitted to convert the volume of cm^3 into dm^3. Other students showed the correct conversion of the volume (0.025 dm^3) but then took the calculation no further.

5.1.1.6 Relative atomic mass

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Answer 09 · Examiner comments

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

Question 1 (low & standard demand)

01.1 Three-quarters of students could name Group 1 elements as the alkali metals. Halogens was the most common incorrect response.

01.2 Three-quarters of students could estimate the radius of a potassium atom as 0.2 nm. A fifth of students selected 0.2 mm.

01.3 The majority of students knew that the atomic number is the number of protons in an atom. Mass number was the most popular incorrect distractor.

01.4 Two-thirds of students gained both marks. Some students failed to indicate that protons are positively charged: + or +1 was needed for the answer. Phonetic spellings of neutron were credited.

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	1
Nefron	0
Electron	−1

Complete **Table 1**.

[2 marks]

This response demonstrates a common error in not giving the charge on the proton, but the spelling for neutron is acceptable phonetically so marking point 2 was awarded.

01.5 Students were given the electronic structure of a potassium atom (2,8,8,1) and a diagram showing that a potassium ion has a full outer shell (2,8,8). Nearly two-thirds of students were able to deduce that the ion is formed by losing an electron, which results in the formation of a +1 ion. A quarter of students thought that the ion had a –1 charge.

01.6 Most students were able to correctly predict the melting point of potassium from the trend shown in the bar graph.

01.7 Nearly two-thirds of students knew that relative atomic mass is calculated by multiplying the percentage abundance of each isotope by its mass number and averaging these values for all isotopes. A fifth of students selected the third option.

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Answer 10 · Examiner comments

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

Question 1 (low demand)

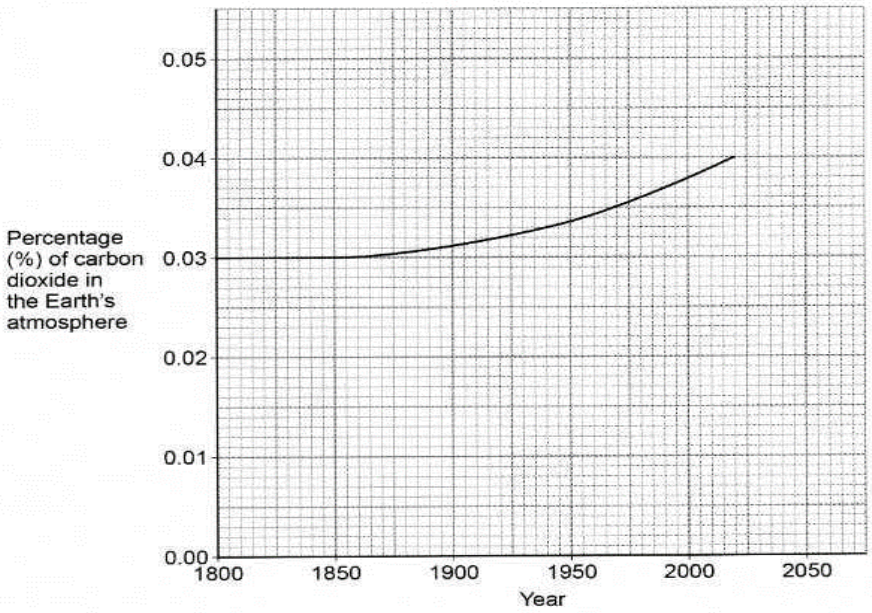
01.1 This AO1 question proved a challenging start to the paper, with just over a quarter of students gaining both marks and more than half of students not gaining any marks. Many students gave the percentage of oxygen in the air as 80%.

01.2 Two-thirds of students could identify at least one of the reasons why the percentage of carbon dioxide decreased in the Earth's early atmosphere, with photosynthesis being the most common correct answer. Deforestation and respiration were the most common incorrect responses.

01.3 About 40% of students were able to gain 1 mark on this AO2 question, often for recognising that the trend was increasing. Mention of the constant level from 1800 was less often seen, although about a third of students were able to gain all 3 marks. Some students not only described the trend but suggested reasons for it, which was not necessary for this 'describe' question; students would benefit from a clear understanding of the expectations of the command word.

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]

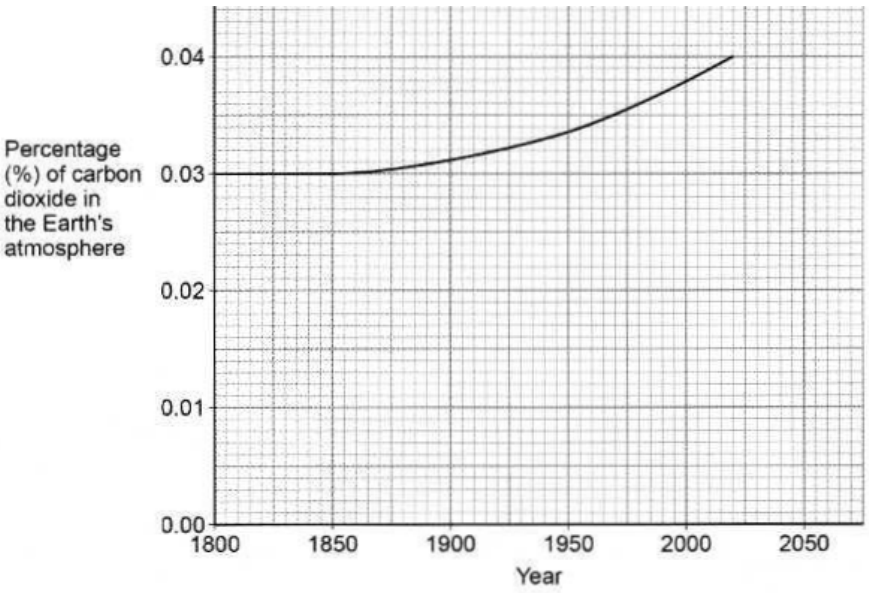
as the years go on, the percentage of carbon dioxide in the Earth's atmosphere increases slowly. from 0.03 in 1800 to 0.04 in 2020.

This is a typical response that only gained 1 of the 3 marks: the student has identified the upwards trend but has not described the constant levels nor the date at which the change happens.

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5.1.1.6 Relative atomic mass

Answer 10 · Examiner comments June 2024 | 8464/C/2F | Original Q1



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]

from 1800 to 1850 the percentage of carbon dioxide in the earths atmosphere stayed the same however from 1850 - 2000 the percentage of carbon dioxide increased in the earths atmosphere

This student has gained all 3 marks, by identifying that the percentage was constant, then increased and giving the date (1850) where the change was observed.

01.4 Methane was well known as a greenhouse gas.

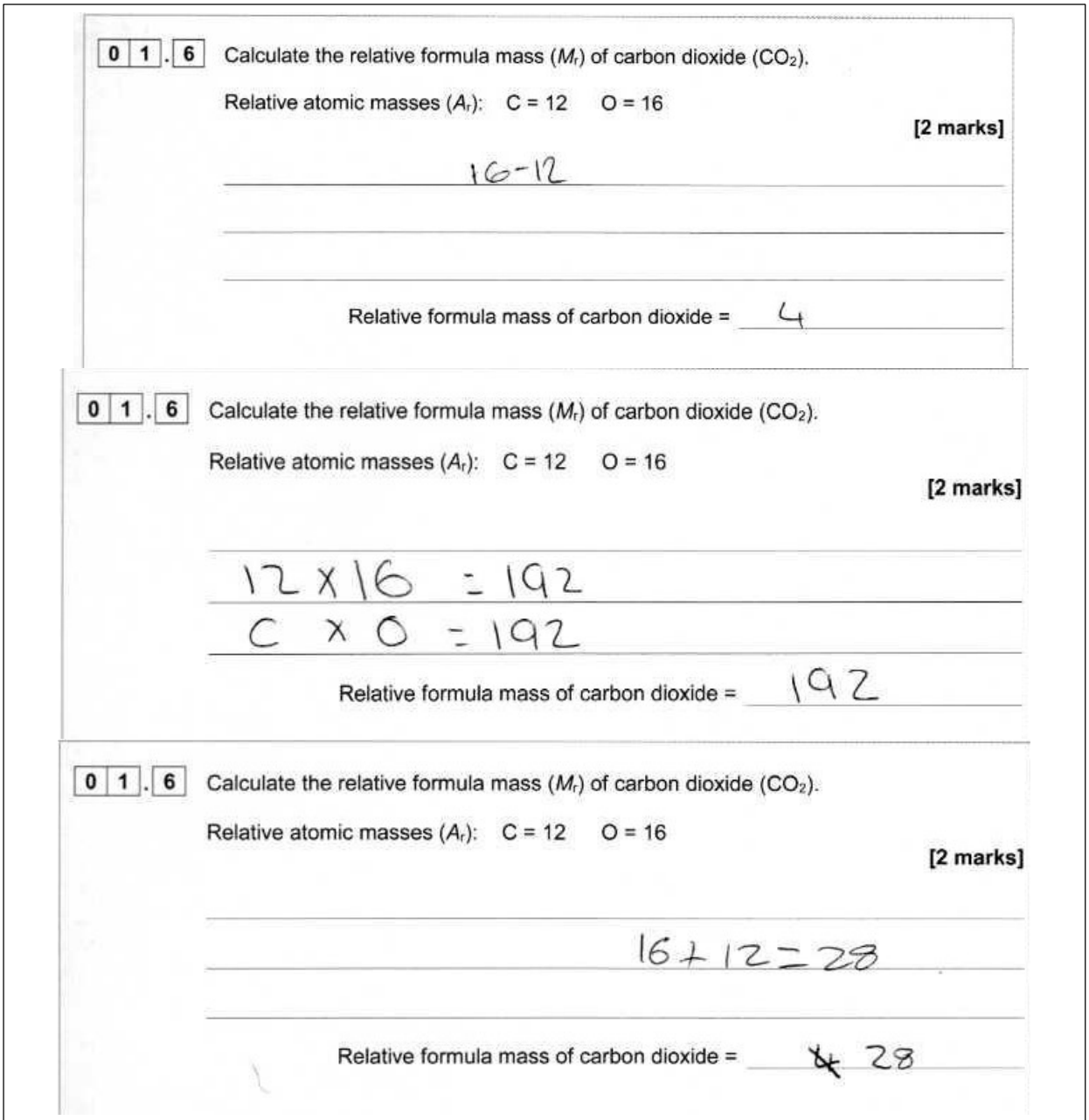
01.5 The link between climate change and greenhouse gases was also well known.

01.6 The method of calculating a relative formula mass as not well known, with fewer than a third of students correctly performing this calculation. Common mistakes were to add the two A_r values, multiply them together or subtract one from another.

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5.1.1.6 Relative atomic mass

Answer 10 · Examiner comments June 2024 | 8464/C/2F | Original Q1



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]

16-12

Relative formula mass of carbon dioxide = 4

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]

12 x 16 = 192

C x O = 192

Relative formula mass of carbon dioxide = 192

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]

16 + 12 = 28

Relative formula mass of carbon dioxide = ~~4~~ 28

These examples demonstrate common errors shown by students in answering this question.

In the first response, the student has subtracted one A_r value from another; in the second the student has multiplied the two A_r values together; in the third the student has added the two A_r values together.

None of these responses gained any marks.

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Answer 11 · Examiner comments

June 2025 | 8464/C/1F | Original Q1

Question 1 (Low and Standard demand)

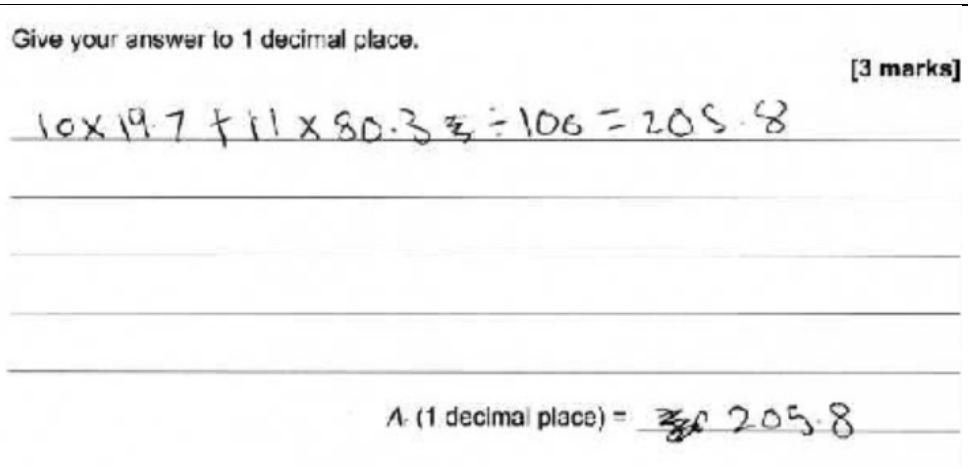
01.1 Just under half of students could name the electron as the first subatomic particle to be discovered. Proton was the most common incorrect response.

01.2 The majority of students knew that the name of the centre of an atom is the nucleus. Phonetic spellings were credited. Common incorrect answers were proton and neutron.

01.3 The majority of students correctly linked the relative charges with each subatomic particle. Many gained 1 mark for showing that the neutron has no charge.

01.4 Less than half of students knew that the atomic number is the number of protons in an atom. The number of number of neutrons + the number of protons in an atom was a more popular incorrect distractor.

01.5 The calculation of the relative atomic mass using the mass numbers and percentage abundance was correctly carried out by nearly two-third of students. The first mark was for the mathematical expression although some students did not divide 1080.3 by 100 and others used their calculator incorrectly. A small number of students who evaluated the expressions as 10.803 did not round their answer to 1 decimal place.



This student did not gain any credit. They only divided the last number (80.3) by 100 so their calculation evaluates as:
10 × 19.7 = 197 then added [11 × (80.3÷100) = 8.833] so 197 + 8.833 = 205.8

01.6 Many students correctly arranged the 8 electrons on the two levels on the figure as 2,8. A number arranged the 8 electrons as 4,4 or 0,8 and others used a different numbers of electrons.

01.7 Less than 20% of students gained 2 marks for Model B shows the 3D arrangement of the ions and the relative sizes of the ions. The most popular incorrect distractors were the charges on the ions and the electronic structures of the ions.

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5.1.1.6 Relative atomic mass

Answer 12 · Examiner comments

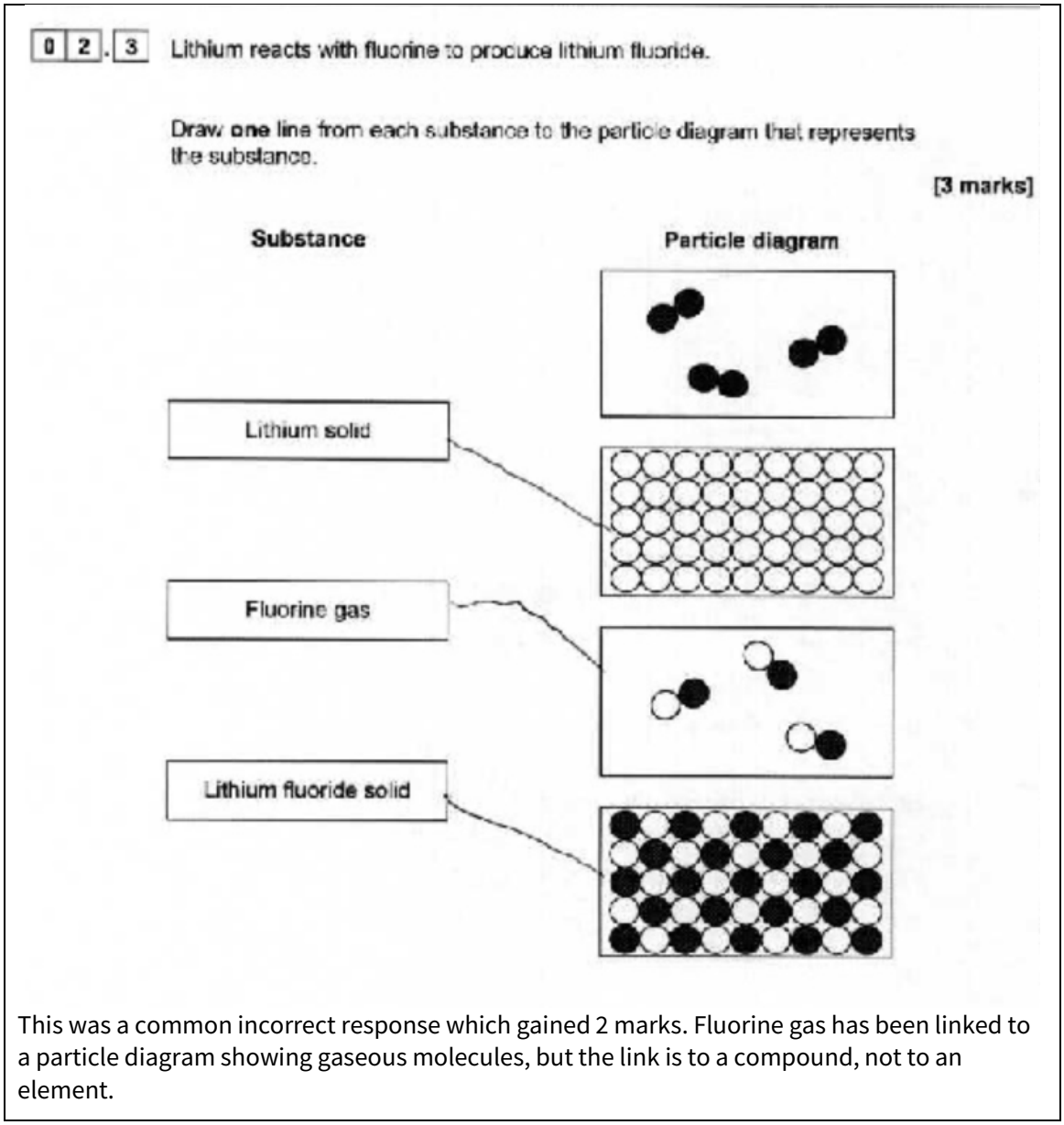
June 2025 | 8464/C/1F | Original Q2

Question 2 (Low demand)

02.1 Many students correctly wrote the chemical symbol of lithium with a capital L followed by a lower case i. When writing symbols lowercase letters must be discernibly smaller than capitals.

02.2 More than half of students knew that delocalised electrons from the outer shell are involved in metallic bonding. Fixed electrons in the outer shell was the most popular incorrect distractor.

02.3 Students should recognise particle diagrams for solid and gaseous states and for elements and compounds. Different colour circles are used to represent different atoms or ions so students should deduce that both the (diatomic) fluorine gaseous molecule and lithium solid particle diagram would only have one colour circle whereas the ionic compound lithium fluoride solid particle diagram would have two different colour circles. The majority of students correctly linked the substance to the particle diagram that represents the substance.



This was a common incorrect response which gained 2 marks. Fluorine gas has been linked to a particle diagram showing gaseous molecules, but the link is to a compound, not to an element.

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5.1.1.6 Relative atomic mass

Answer 12 · Examiner comments June 2025 | 8464/C/1F | Original Q2

02.4 Just over half the students were able to use the electrical conductivity of a substance when solid and liquid to identify the ionic compound lithium fluoride.

02.5 Just over half the students recognised the structure of diamond. Graphite was the most common incorrect response.

02.6 A third of students gained both marks for 88 with or without working. Some gained 1 mark for the correct mathematical expression or writing 12 + 76. Many students did not multiply the number of atoms by the relative atomic mass of the atom so gave either 31 or 288 by adding or multiplying the A_r values of carbon and fluorine or used the 4 (atoms of fluorine) as a power giving a M_r of several thousand.

02.7 Just over half the students identified that six shared electrons were shown in the overlap of energy levels in the diagram representing a molecule of nitrogen. Three pairs would have been an acceptable answer although 3 was a common incorrect answer.

02.8 Only 5% of students were able to select the word from the box to complete the name of the compound with the formula Li_3N. The most common answer was nitrogen. Credit was awarded if the student identified the correct answer in the box, provided this was not contradicted by what was written in the answer space.

02.9 Just under half of students knew that neon does not react with other elements because neon has a stable arrangement of electrons. The most popular incorrect distractor was neon is a non-metallic element.

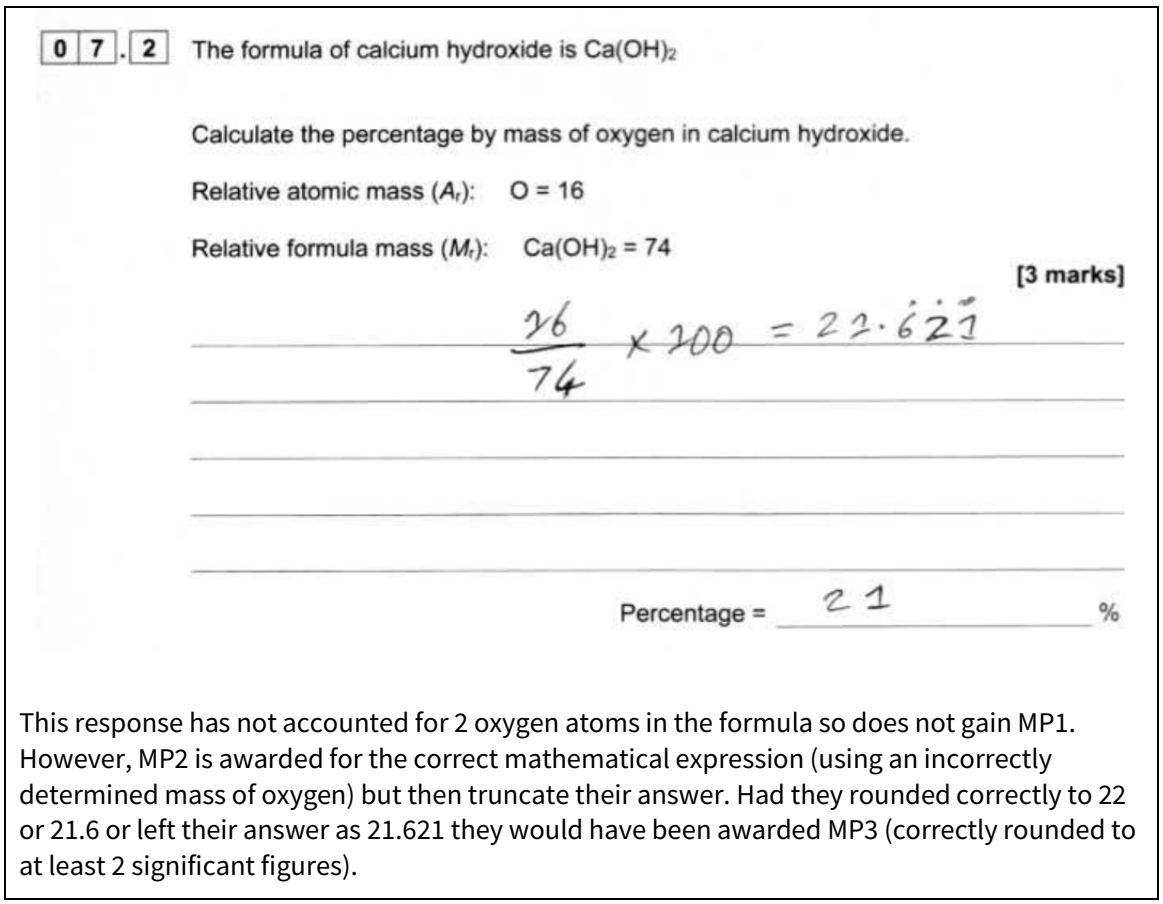
Answer 13 · Examiner comments

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

Question 7 (Standard demand)

07.1 The definition for an 'exothermic' reaction was not well known. Students rarely stated that energy or heat was released or transferred to 'the surroundings'. Answers were mostly general explanations, describing how energy or heat were 'given off' or 'released'. Common non-creditworthy responses referred to energy or heat being *produced*, the idea of heat or energy being 'lost' or references to an increase in temperature. Some answers stated that 'oxygen' or 'a gas' was given off by the reaction.

07.2 This question was poorly answered, and 20% of students did not attempt this question. The majority of students didn't understand the use of brackets in a formula as they ignored the subscript 2. Evidence of 32 in their answers was not commonly seen. Students were unclear about how to calculate a percentage. Lots of different variations on the use of 16 and 74 were often seen such as 74+16, 74-16 or 74÷16. Many students attempted to calculate the M_r when it was already given.



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]

$\frac{16}{74} \times 100 = 22.621$

Percentage = 21 %

This response has not accounted for 2 oxygen atoms in the formula so does not gain MP1. However, MP2 is awarded for the correct mathematical expression (using an incorrectly determined mass of oxygen) but then truncate their answer. Had they rounded correctly to 22 or 21.6 or left their answer as 21.621 they would have been awarded MP3 (correctly rounded to at least 2 significant figures).

07.3 This was an 'extended response' style of question. Such questions are marked holistically. There are overall generic descriptions for the three levels of response at the top of the mark scheme, giving a hierarchy of response. Within each level there are 2 marks.

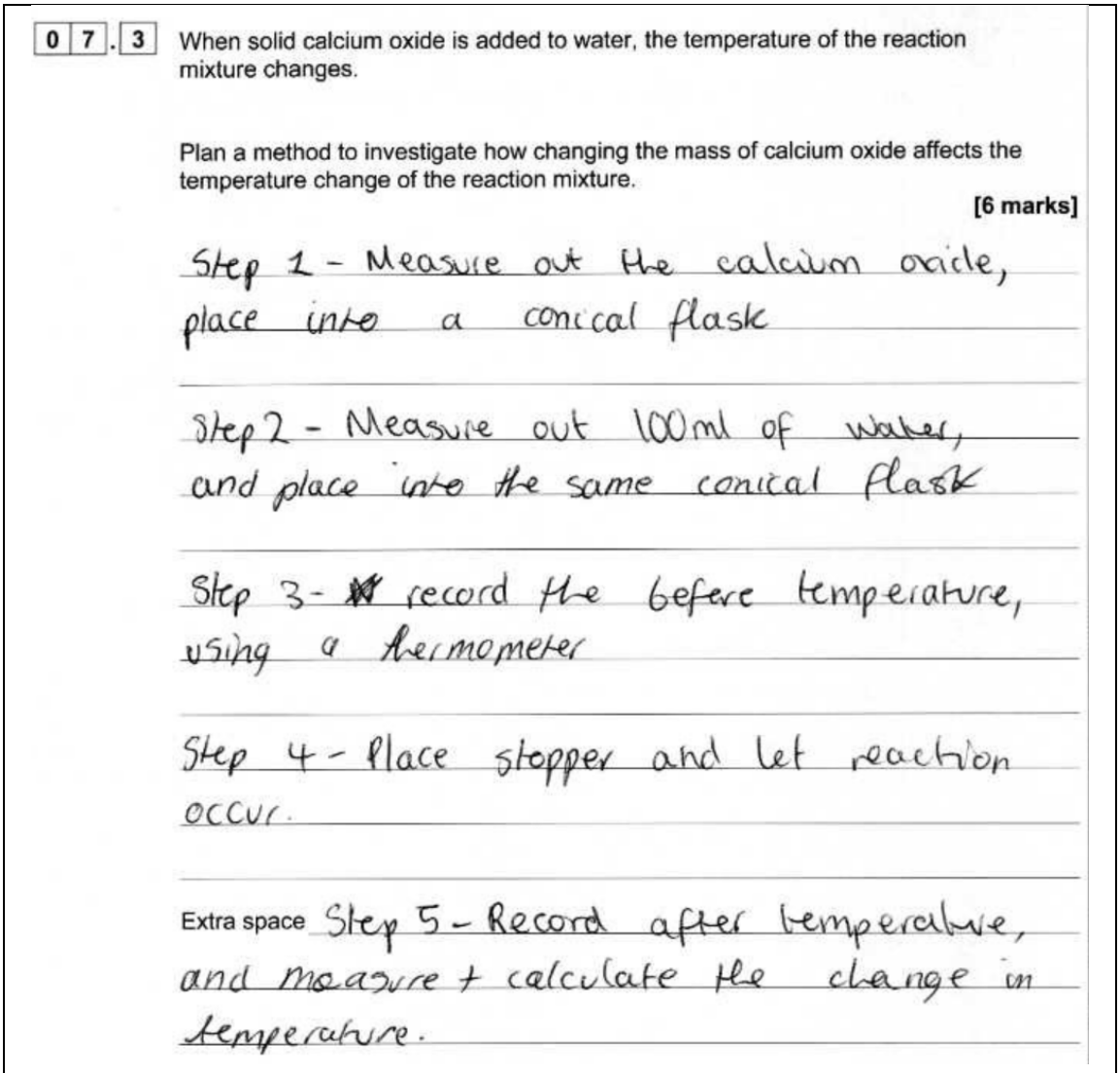
Students were asked to plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction when calcium oxide is added to water. The indicative content includes 5 key steps and the control variable, along with some additional information.

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5.1.1.6 Relative atomic mass

Answer 13 · Examiner comments June 2025 | 8464/C/1F | Original Q7

At Level 1, students needed to identify some relevant steps. To enter Level 2, three key steps, or two with the control variable, were required. To achieve marks in Level 3, all 5 key steps and the control variable were needed. Only a very small minority of students were able to obtain 6 marks.



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]

Step 1 - Measure out the calcium oxide, place into a conical flask

Step 2 - Measure out 100ml of water, and place into the same conical flask

Step 3 - record the before temperature, using a thermometer

Step 4 - Place stopper and let reaction occur.

Extra space Step 5 - Record after temperature, and measure + calculate the change in temperature.

In this response, the student has stated a valid volume of water but omitted 'mass' of calcium oxide. In step 3 they record the 'before' temperature, but this is after both reactants have been added to the conical flask so is not credited with taking the initial temperature. They have not stated when the subsequent temperature is measured nor described how the temperature change is determined. Had the student 'repeated the experiment with different masses of calcium oxide' they would have been credited with the control variable as this would imply fixing the volume stated. The students uses a thermometer which is a valid point in the mark scheme.

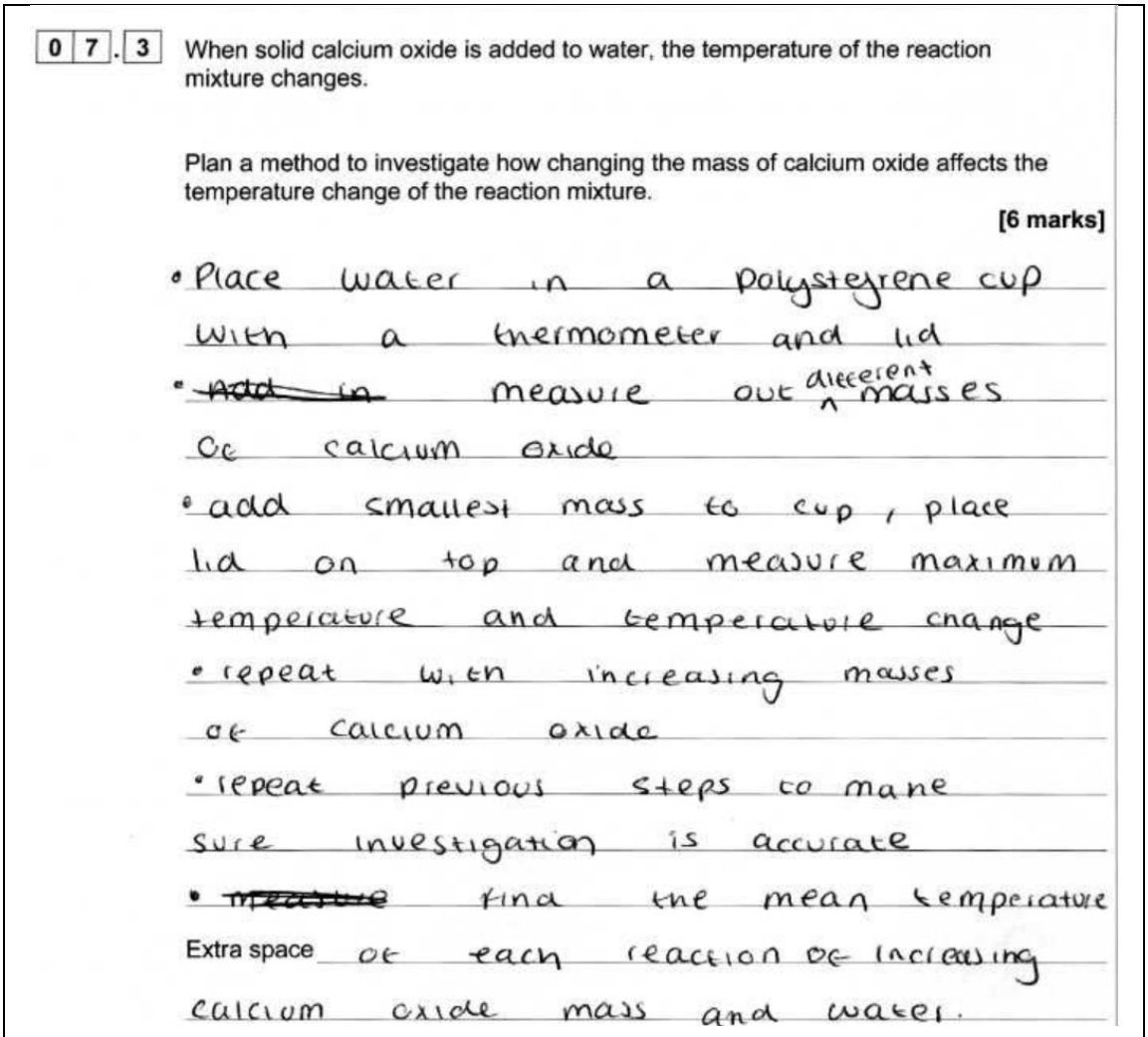
Only one key step is stated with some additional information (correct use of a thermometer) so this is a Level 1 response and is awarded 1 mark.

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5.1.1.6 Relative atomic mass

Answer 13 · Examiner comments June 2025 | 8464/C/1F | Original Q7

Most students added calcium oxide to water but many omitted either volume (of water) or mass (of solid) although 'amount' was creditworthy for both here. Students usually described taking the 'initial' temperature (but often after they had added solid to water). Many were less clear on when and how the subsequent temperature or temperatures were to be taken. Too frequently it was stated that the 'temperature change' was to be measured which is not creditworthy, as this requires a calculation. The need for a control variable, whilst rarely stated as such, was often found in a Level 2 response due to the students realising that the volume of water needed to be fixed along with the experiment being repeated in some way. An indication of how the temperature change was to be determined was rarely seen.



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]

- Place water in a polystegrene cup with a thermometer and lid
- ~~Add in~~ measure out different masses of calcium oxide
- add smallest mass to cup, place lid on top and measure maximum temperature and temperature change
- repeat with increasing masses of calcium oxide
- repeat previous steps to make sure investigation is accurate
- ~~Measure~~ find the mean temperature of each reaction of increasing calcium oxide mass and water.

Extra space

In this response, the student has omitted volume of water but stated mass of calcium oxide. The initial temperature is not recorded but the maximum temperature is. They repeat for accuracy and then repeat with different masses of calcium oxide. They have not stated how the temperature change is determined nor that they need to use the same volume of water when repeating. The student uses a suitable container (an insulated cup) and a thermometer which are valid ideas from the mark scheme.

There are three key steps with some additional information (thermometer and insulated cup) so this is a Level 2 response and is awarded 3 marks.

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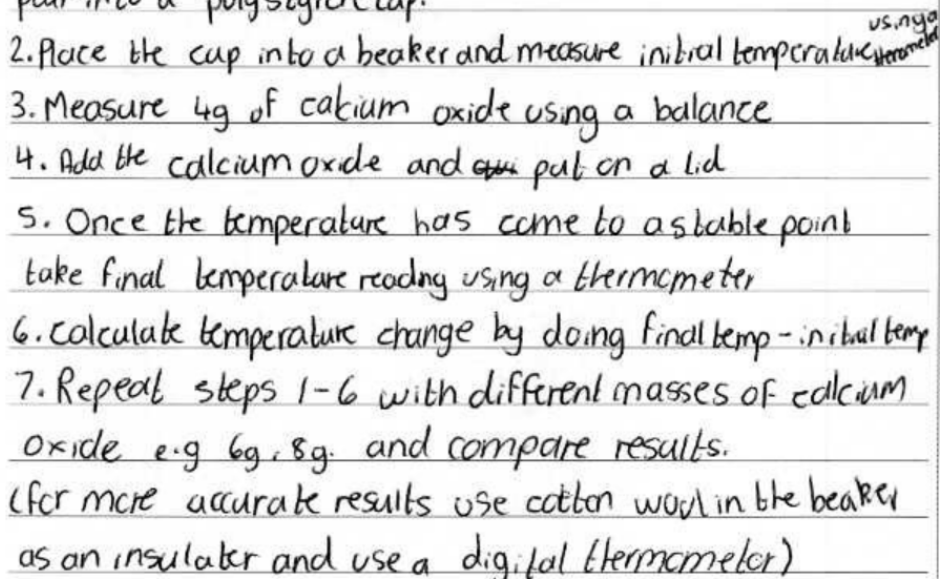
5.1.1.6 Relative atomic mass

Answer 13 · Examiner comments June 2025 | 8464/C/1F | Original Q7

0 2 . 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]



In this response (from a Higher tier paper), the student has stated a valid volume of water and mass of calcium oxide. The initial temperature (before the solid is added) and final temperature are recorded. They repeat with different masses of calcium oxide and are using the same volume of water so are credited with having a control variable. They have shown how the temperature change is determined. The student uses a measuring cylinder, suitable container (an insulated cup), balance and a thermometer which are additional valid points in the mark scheme.

There are all five key steps, a control variable, how the temperature change is determined with lots of additional information, so this is a Level 3 response and is awarded 6 marks.

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5.1.1.6 Relative atomic mass

Answer 13 · Examiner comments June 2025 | 8464/C/1F | Original Q7

Contact us

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