AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.3

Mass changes when a reactant or product is a gas

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**3**
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.

5.3.1.3 Mass changes when a reactant or product is a gas

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

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 01 · Mark scheme

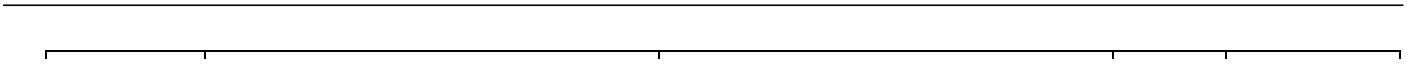
June 2018 | 8464/C/1F | Original Q4

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**	

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5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Mark scheme

June 2023 | 8464/C/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	energy / electricity		1	AO1 5.4.3.1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	carbon dioxide		1	AO1 5.4.3.1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	sodium reacts with air / oxygen **or** sodium is highly reactive	allow titanium (chloride) reacts with air / oxygen	1	AO3 5.1.2.5 5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	argon		1	AO3 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$TiCl_4 + 4\,Na \longrightarrow Ti + \mathbf{4}\,NaCl$	allow multiples	1	AO2 5.1.1.1 5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	4.4 (g)		1	AO2 5.3.1.1 5.3.1.3

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(the) mass decreased (because) carbon dioxide escapes (into the atmosphere)	 allow (because) carbon dioxide is a gas allow (because) a gas is produced	1 1	AO2 5.3.1.1 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	the copper oxide is reduced (reason) (copper oxide) loses oxygen		1 1	AO2 5.4.1.3

Total Question 5	10

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Mark scheme

June 2025 | 8464/C/1F | Original Q3

Question 3

Question	Answers	Mark	AO / Spec. Ref.
03.1	magnesium + oxygen → magnesium oxide allow MgO for magnesium oxide	1	AO2 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	oxidised		1	AO1 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	0.30 (g)	allow 0.3 (g)	1	AO2 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	a solid reacts with a gas to produce a solid		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	ring around point 0.25, 0.35		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(mean =) $\frac{0.96 + 0.93 + 0.92 + 0.95}{4}$ = 0.94 (g)	allow (mean =) $\frac{3.76}{4}$	1 1	AO2 5.3.1.3

5.3.1.3 Mass changes when a reactant or product is a gas

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	a water bath is not hot enough		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	some of the magnesium did not react	allow the reaction was incomplete allow none of the magnesium reacted allow there was no reaction	1	AO3 5.3.1.3

Total Question 3	**9**

5.3.1.3 Mass changes when a reactant or product is a gas

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.

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Examiner comments June 2023 | 8464/C/1F | Original Q5

Question 5 (low/standard demand)

05.1 More than a third of students knew that the extraction of aluminium is expensive because the process uses large amounts of energy. Heat was a very common response that was insufficient to gain credit.

05.2 More than 50% of students knew that carbon dioxide is produced when oxygen reacts with the positive carbon electrodes when aluminium is extracted by electrolysis from a molten mixture of aluminium oxide and cryolite.

05.3 Only a very small number of students were able to suggest that when titanium was extracted from a mixture of titanium chloride and sodium an inert atmosphere was essential to prevent the sodium reacting with air.

05.4 A third of students knew that argon is used for the inert atmosphere when titanium is extracted from a mixture of titanium chloride and sodium.

05.5 Just over half of the students correctly balanced the equation for the reaction of sodium with titanium chloride. Students should be aware that they should not change the formula of the compounds in the equation.

05.6 Students should know that the law of conservation of mass states that the mass of reactants equals to the mass of products. In this experiment the mass of carbon dioxide produced equals the difference between the sum of the mass of copper oxide and carbon (reactants) minus the mass of copper produced (other product). Only 20% of students calculated this correctly.

05.7 Students were asked to explain why the mass of a mixture of copper oxide and carbon in a crucible changed when the mixture was heated. Few students recognised that the mass would decrease because the carbon dioxide produced is a gas that escapes into the atmosphere. The term evaporation was incorrectly used by a large number of students. Only a small number of students gained two marks.

05.8 This question asked what happens to copper oxide in the reaction between copper oxide and carbon. Students should be careful with their use of technical terms as many incorrectly stated that ‘copper’ loses oxygen. Approximately 30% of students knew that copper oxide was reduced but very few students were then able to give a reason why.

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Examiner comments

June 2025 | 8464/C/1F | Original Q3

Question 3 (Low and Standard demand)

03.1 Three quarter of students added magnesium oxide to complete the word equation. Phonetic spellings were credited. Those students who wrote a correct formula were awarded the mark. Water was a common additional product.

03.2 The majority of students were able to select the word from the box to describe the process of magnesium reacting with oxygen as oxidised. Credit was awarded if the student identified the correct answer in the box.

03.3 More than half of students were able to use the data to determine the mass of magnesium in the crucible before heating by subtracting the mass of the empty crucible from the mass of the crucible and magnesium before heating. 0.2 g was the mass of oxygen that reacted, a common answer obtained by subtracting the wrong data.

03.4 Less than a third of students knew that when magnesium is heated with oxygen in a crucible the reaction results in an increase in the mass of the contents of the crucible because a solid reacts with a gas to produce a solid. Just over half the students selected the incorrect response that the reactants have a greater mass than the product.

03.5 The graph had 8 points. A straight line (of best fit) could be drawn through 7 of these with the point at (0.25, 0.35) being anomalous which required a ring to be drawn around it. Students were not expected to draw a line when answering this question although many did. Those who drew a line without a positive identification of the anomalous point were not credited.

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5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Examiner comments June 2025 | 8464/C/1F | Original Q3

03.6 The calculation of the mean mass was correctly carried out by nearly three-quarters of students. Most students achieved either 2 or 0 marks.

0 3 . 6 The student did the experiment using 0.60 g of magnesium four times.

Table 4 shows the results.

Table 4

	Test 1	Test 2	Test 3	Test 4	Mean
Mass of the contents of the crucible after heating in grams	0.96	0.93	0.92	0.95	X

Calculate mean value **X**. **[2 marks]**

0·96 + 0·93 + 0·92 + 0·95 ÷ 4 = 3·0475

Mean value **X** = 3·0475 g

This was a common incorrect response. The student has only divided the 4th number by 4 (rather than the total of all four)
i.e. 0.95÷4 (= 0.2375) and adding this to the first 3 numbers (0.96+0.93+0.92 = 2.81)

03.7 Just over half the students knew that a water bath is not hot enough to allow magnesium to react with oxygen. The crucible would dissolve in a water bath was the most popular incorrect distractor.

03.8 Few students were able to give a correct reason for why a student who heated the crucible for 1 minute instead of for 5 minutes obtained different results. The answer was that a reaction has not taken place or that the reaction was incomplete. Common incorrect responses focussed on time (not long enough) or temperature (not high enough).

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