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	**Higher**
Question groups	**4**
Available paper years	**2020–2025**

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 November 2020 | 8464/C/2H | Original Q3

03.1	microbes chemicals	allow bacteria / pathogens	1 1	AO1 5.10.1.3
03.2	anaerobic digestion		1	AO1 5.10.1.3
03.3	(decrease =) 6.7 (billion) (% decrease =) $\frac{6.7}{8.0}$ × 100 = 84 (%) **alternative approach:** (% now used =) $\frac{1.3}{8.0}$ × 100 (1) = 16.25 (1) (% decrease =) 84 (%) (1)	 allow correct use of an incorrect value for decrease in plastic bag use allow 83.75 / 83.8 (%) allow 83.75 / 83.8 (%)	1 1 1	AO2 5.10.2.2

5.3.1.3 Mass changes when a reactant or product is a gas

03.4	respiratory problems **or** acid rain	allow named respiratory conditions eg asthma allow breathing problems allow consequences of acid rain eg kills aquatic life **or** damages limestone buildings allow smog	1	AO1 5.9.3.2

03.5	(increased) more traffic (decreased) improved efficiency of car engines	allow more cars allow use of catalytic converters allow more electric / hybrid cars allow lower temperature of car engines allow more use of public transport allow more people walk / cycle ignore better designed engines	1 1	AO3 5.9.3.1

Total			**9**

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 01 · Mark scheme

November 2020 | 8464/C/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Mark scheme

November 2020 | 8464/C/2H | Original Q6

06.1	**D B C A**		1	AO1 5.9.2.1

06.2	(maximum % =) 96 (%)	allow a value in the range 95 to 97 (%)	1	AO2 5.9.1.1 5.9.1.2 5.9.1.4 5.9.2.2
	(maximum mass =) $\frac{96}{100} \times 5.15 \times 10^{18}$	allow correct use of incorrectly determined percentage	1	
	$= 4.94 \times 10^{18}$ (kg)	allow 4.944×10^{18} (kg)	1	

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Mark scheme

November 2020 | 8464/C/2H | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO1 5.9.1.1 5.9.1.2 5.9.1.3 5.9.1.4 5.9.2.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–3	
	No relevant content	0	
	Indicative content: during the first billion years of the Earth's existence carbon dioxide levels increased due to • intense volcanic activity from 4.4 to 2.7 billion years ago carbon dioxide levels decreased as • water vapour condensed to form oceans • carbon dioxide dissolved in the oceans • carbonates precipitated • sedimentary rocks formed from 2.7 to 1.7 billion years ago carbon dioxide levels decreased as • algae appeared • plants evolved • algae and plants photosynthesised • sedimentary rocks formed • fossil fuels formed over the past 100-200 years carbon dioxide levels increased due to • the industrial revolution • human activity • the burning of fossil fuels		

Total			**10**

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 02 · Mark scheme

November 2020 | 8464/C/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(mass of oxygen = 0.20 – 0.12) = 0.08 (g)		1	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1 5.4.1.1
	(moles of oxygen) = $\frac{0.08}{32}$	allow **1** mark for 0.005 if derived from $\frac{0.08}{16}$	1	
	= 0.0025		1	
06.2	(without a lid the) mass of magnesium oxide was less		1	AO3 5.4.1.1
	(because) products escaped	allow magnesium oxide escaped	1	
06.3	(mass of copper oxide =) $\frac{79.5}{63.5} \times 0.5$		1	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1 5.3.2.2 5.3.2.3 5.4.1.1
	= 0.62598 (g)		1	
	= 0.626 (g)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the values in the question	1	

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Mark scheme

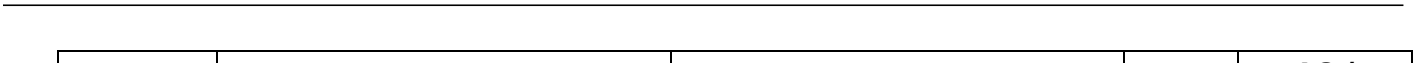
November 2021 | 8464/C/1H | Original Q6

06.4	3:2 ratio Fe : O_2 (molecules) **or** 3:4 ratio Fe : O (atoms)		1	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1
	(formula) Fe_3O_4	allow **1** mark for Fe_3O_2 from 3:2 ratio Fe : O (atoms) (MP2 but not MP1)	1	5.3.2.2 5.3.2.3 5.4.1.1
	$3\,Fe + 2\,O_2 \rightarrow Fe_3O_4$	allow multiples allow correct use of incorrectly determined formula allow **1** mark for Fe, O_2 and Fe_3O_4 **or** allow **1** mark for Fe, O_2 and incorrectly determined formula	2	
Total			**12**	

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Mark scheme

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



5.3.1.3 Mass changes when a reactant or product is a gas

Answer 04 · Mark scheme

June 2025 | 8464/C/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	a Bunsen burner reaches a higher temperature	allow a water bath will not reach a high enough temperature	1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(magnesium) (contents of crucible) increase in mass (from 0.24 to 0.38 g)	allow a value in the range 0.38 to 0.39 for 0.38	1	AO2
	(because magnesium) gains oxygen		1	AO3
	(magnesium carbonate) (contents of crucible) decrease in mass (from 0.84 to 0.44 g)	allow a value in the range 0.44 to 0.45 for 0.44	1	AO2
	(because) carbon dioxide is released	allow (because) carbon dioxide gas is produced	1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	both reactions produce 0.01 mol of magnesium oxide		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(if solid escaped) the final mass would be lower for the actual results than for the predicted results	allow (solid cannot have escaped because) same mass of solid product formed allow (solid cannot have escaped because) both form 0.4 g of solid allow (solid cannot have escaped because) the final mass of the contents (of the crucible) are the same	1	AO3 5.3.1.3

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(ratio Fe : H_2O) 3:4		1	AO2 5.1.1.1 5.3.1.1
	(formula) Fe_3O_4	allow formula correctly determined from incorrect ratio	1	5.3.2.1 5.3.2.2 5.3.2.3
	3 Fe + 4 H_2O → Fe_3O_4 + 4 H_2	allow multiples allow correct use of an incorrectly determined formula for iron oxide allow **1** mark for Fe, H_2O, Fe_3O_4 and H_2 **or** allow **1** mark for Fe, H_2O, H_2 and an incorrectly determined formula for iron oxide	2	5.4.1.2

Total Question 6	**11**

5.3.1.3 Mass changes when a reactant or product is a gas

Answer 03 · Examiner comments November 2021 | 8464/C/1H | Original Q6

Question 6 (standard, standard / high and high demand)

06.1 Just over one-tenth of students gained full marks in this calculation. Having correctly calculated the mass of oxygen the most common error was to incorrectly calculate the number of moles by dividing by the relative atomic mass of oxygen (16) rather than the relative formula mass of oxygen molecules (32).

06.2 Few students realised that without a lid the mass of products would decrease as magnesium oxide would escape during the reaction.

06.3 This calculation was answered correctly by approximately one fifth of students. A small number were not able to round their answer correctly to three significant figures.

06.4 Students found this question challenging. Very few students were able to make the link between the moles of reagents that reacted and the formula of the product. Just under one sixth of students were able to correctly write a balanced chemical equation using their iron oxide product from the earlier part of the question.

Answer 04 · Examiner comments

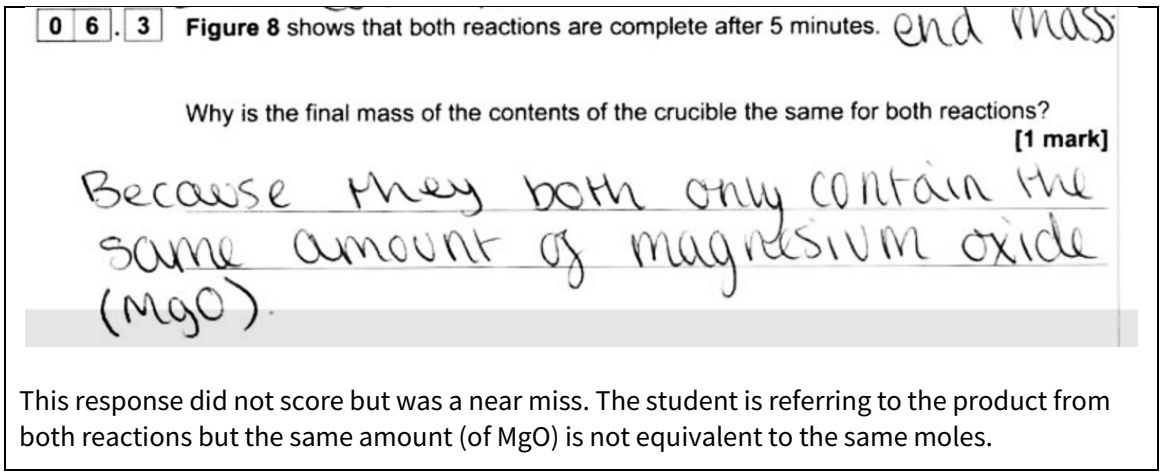
June 2025 | 8464/C/1H | Original Q6

Question 6 (Standard, Standard/High and High demand)

06.1 The reason why the student used a Bunsen burner instead of a water bath is that the Bunsen burner reaches a higher temperature. Common responses which were not creditworthy made no reference to a temperature comparison or stated that a Bunsen burner gives more heat.

06.2 The question asked students to explain the trends in the graph for the first 3 minutes. The trends of magnesium increasing in mass or magnesium carbonate decreasing in mass were described well. Many students who attempted to support their trends with data misread the graph scale so did not gain MP1 and/or MP2; 0.82 g and 0.22 g were common incorrect starting masses, similar errors were made at 3 minutes and others referred to the common mass of 0.4 g at 4 minutes. Reasons for these changes namely magnesium gaining oxygen and carbon dioxide being released from magnesium carbonate were frequently omitted.

06.3 Making the link with the equations and graphs made this a demanding question. When students wrote about moles they usually referred to the moles of the reactants being the same rather than the moles of the product.



0 6 . 3 **Figure 8** shows that both reactions are complete after 5 minutes. end mass

Why is the final mass of the contents of the crucible the same for both reactions?

[1 mark]

Because they both only contain the same amount of magnesium oxide (MgO).

This response did not score but was a near miss. The student is referring to the product from both reactions but the same amount (of MgO) is not equivalent to the same moles.

06.4 This high-demand AO3 question proved challenging. Students could have either described what happened if the conclusion was correct which would result in a final mass lower than predicted or use the graph to conclude that both lines have the same final mass (0.4 g) so solid cannot have escaped. Responses often failed to include mass.

06.5 Many students were able to calculate the ratio of iron to water but only those who gave the simplest ratio were credited with MP1. Most were unable to make the link between the moles of reagents that reacted and the formula of the product so MP2 was rarely awarded. When writing symbols lowercase letters must be discernibly smaller than upper case letters. Many students gave a balanced equation using their formula for iron oxide; FeO and FeO_2 were common incorrect responses which were then used correctly to access MP3 and MP4. Those students who gave the formula of hydrogen as H were unable to access the final 2 marks.

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5.3.1.3 Mass changes when a reactant or product is a gas

Answer 04 · Examiner comments June 2025 | 8464/C/1H | Original Q6

0 6 . 5 Iron reacts with steam (H_2O) to produce an oxide of iron and hydrogen gas.

0.120 moles of iron reacts with 0.160 moles of steam.

Determine the balanced equation for the reaction.

You should determine:

- the simplest whole number mole ratio of Fe : H_2O
- the formula of the iron oxide produced.

[4 marks]

0.12 mol : 0.16 mol

12 : 16 mol

Simplest mole ratio of Fe : H_2O = 12 : 16

Formula of the iron oxide = FeO_2

Balanced equation for the reaction:

$Fe + 2H_2O \rightarrow FeO_2 + 2H_2$

This response was awarded 2 marks. The student has not evaluated the simplest ratio and the formula is incorrect. However, they gave a balanced equation using their formula for iron oxide (FeO_2) so gain MP3 and MP4.

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