AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.9.2.4

The carbon footprint and its reduction

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
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.

5.9.2.4 The carbon footprint and its reduction

Answer 01 · Mark scheme June 2018 | 8464/C/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	methane		1	AO1 5.9.2.2
07.2	any **two** examples from: • rising sea levels • melting ice • agricultural problems • extremes of weather • loss of habitats	allow effects from the same bullet point ignore global warming ignore acid rain ignore global dimming do **not** accept reference to ozone	2	AO1 5.9.2.3
07.3	$\frac{6.0}{4.1} \times 0.0235$ = 0.0344(kg)	an answer of 0.0344(kg) scores **2** marks allow correct rounding allow calculator reading if no mark awarded: allow **1** mark for 34.4 or 0.344 allow **2** marks for 34.4 g	1 1	AO2 5.9.2.4
07.4	use less plastic **or** use recycled plastic	allow carbon capture ignore any reference to energy / fuels	1	AO1 5.9.2.4 5.10.2.2

5.9.2.4 The carbon footprint and its reduction

Answer 01 · Mark scheme

June 2018 | 8464/C/2F | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.	5–6	AO1 5.9.1.2 5.9.1.3 5.9.1.4
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content nitrogen increased • because volcanoes produced nitrogen • because (denitrifying) bacteria produced nitrogen • because ammonia was converted to nitrogen oxygen increased • because algae and plants produced oxygen • by photosynthesis carbon dioxide decreased • because algae and plants used carbon dioxide • by photosynthesis • because oceans formed and carbon dioxide dissolved in the water • because carbon dioxide formed carbonates, which precipitate as sediments or formed sedimentary limestone rocks • because algae / plants and animals formed fossil fuels / coal / crude oil / natural gas		
Total			**12**

5.9.2.4 The carbon footprint and its reduction

Answer 02 · Mark scheme June 2019 | 8464/C/2F | Original Q7

07.1	high temperatures (in the engine) enable oxygen and nitrogen (from air) to react	 allow combine / bond for react	1 1	AO1 5.9.3.1

07.2	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content Examples of relevant points might include: • car **C** produces the most CO_2 during manufacture • car **A** produces the most CO_2 per km when driving • car **C** produces the most CO_2 from manufacture and 40,000km when driving • car **B** produces the most CO_2 from manufacture and 100,000km when driving Examples of linked statements might include: • car **A** produces least CO_2 during manufacture, but most CO_2 per km • car **C** produces most CO_2 during manufacture, but least CO_2 per km • car **A** produces least CO_2 during manufacture, but car **C** produces the least CO_2 per km Examples of judgements might include: • overall car **A** has the smallest carbon footprint as it has the smallest CO_2 production during manufacture, the smallest mass of CO_2 after 40,000km of driving and the smallest mass of CO_2 produced after 100,000km of driving. • car **A** eventually (after 157,895km) will have the largest carbon footprint because the mass of carbon dioxide produced per km is highest.		AO3 5.9.2.2 5.9.2.45.10.2.1

5.9.2.4 The carbon footprint and its reduction

Answer 02 · Mark scheme

June 2019 | 8464/C/2F | Original Q7

Total			**8**

5.9.2.4 The carbon footprint and its reduction

Answer 03 · Mark scheme November 2020 | 8464/C/2F | Original Q2

02.1	96 (%)	allow a value in the range 95–97 (%)	1	AO2 5.9.1.1 5.9.1.2 5.9.1.4
02.2	formation of sedimentary rocks photosynthesis		1 1	AO1 5.9.1.1 5.9.1.2 5.9.1.3 5.9.1.4 5.9.2.2
02.3	carbon footprint		1	AO1 5.9.2.4
02.4	3.3 (g) 2 (g)	allow a value in the range 3.2 – 3.4 (g) allow a value in the range 1.9 – 2.1 (g)	1 1	AO2 5.9.1.2
02.5	(3.3 – 2 =) 1.3 (g)	allow ecf from question **02.4**	1	AO2 5.9.1.2
02.6	**D B C A**		1	AO1 5.9.2.1

02.7	any **two** from: • rising sea levels • melting ice (caps) / glaciers • agricultural problems • extremes of weather • (coastal) flooding / erosion • drought • forest fires • animal habitats change / lost	allow extinction of species allow global warming	2	AO1 5.9.2.3

Total			**10**

5.9.2.4 The carbon footprint and its reduction

Answer 03 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.9.2.4 The carbon footprint and its reduction

Answer 04 · Mark scheme

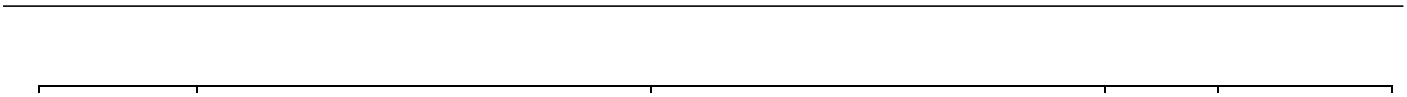
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **two** from: • global warming • melting polar ice caps • rising sea levels • flooding • crop failure **or** famine • extremes of weather • loss of habitats	do **not** accept acid rain do **not** accept global dimming do **not** accept references to ozone ignore temperature rise	2	AO1 5.9.2.3
03.2	constant (then) increases	allow no change allow stays same ignore values if given	1 1	AO2 5.9.2.2
03.3	(1950) 0.030 **and** (2000) 0.036 (0.036 – 0.030) = 0.006 (%)	 allow correct use of incorrectly determined percentage reading(s) ignore + or –	1 1	AO2 5.9.2.2
03.4	any **one** from: • combustion of fuel • deforestation • population increase	allow any named activity which burns fuel	1	AO1 5.9.2.2

03.5	extrapolation on graph determine value from extrapolation at 2050	 allow a value in the range 0.044 to 0.050 allow a tolerance of ± ½ a small square	1 1	AO3 5.9.2.2
Total			**9**	

5.9.2.4 The carbon footprint and its reduction

Answer 04 · Mark scheme

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

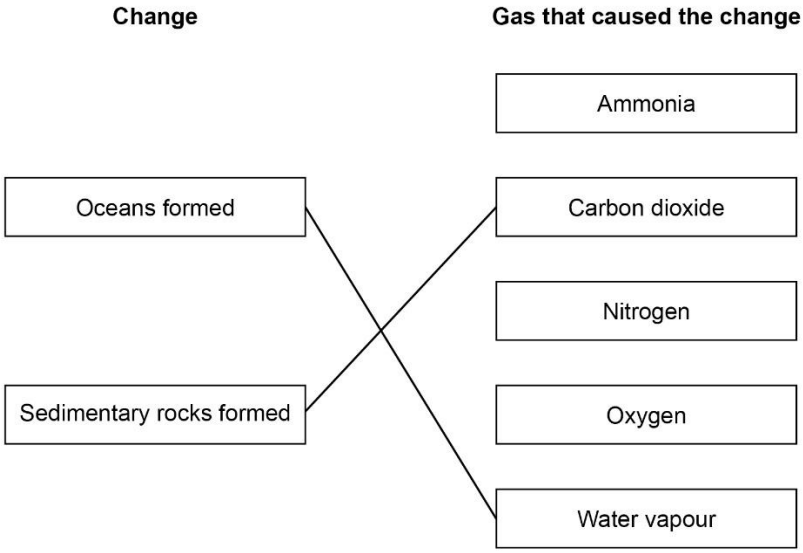


5.9.2.4 The carbon footprint and its reduction

Answer 05 · Mark scheme

June 2023 | 8464/C/2F | Original Q2

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	 do **not** accept more than one line from a box on the left	1 1	AO1 5.9.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	nitrogen		1	AO2 5.9.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(number of times more =) $\frac{95}{0.04}$ = 2375 = 2.375×10^3	 allow a correctly calculated answer in standard form from an incorrect calculation which uses values given in **Table 1**	1 1 1	AO2 5.9.1.1

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	increased		1	AO2 5.9.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(mass CO_2 =) $\frac{17.2}{4}$ = 4.3 (kg)		1 1	AO2 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	photosynthesis		1	AO1 5.9.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	any **two** from: (forest area) • increases in Africa • increases in Europe • decreases in South America • decreases in Asia		2	AO2 5.9.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	6 (%)		1	AO2 5.9.2.1 5.9.2.2

5.9.2.4 The carbon footprint and its reduction

Answer 05 · Mark scheme

June 2023 | 8464/C/2F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.9	(**A**) reuse (**B**) recycle		1 1	AO2 5.10.2.2

Total Question 2	**15**

5.9.2.4 The carbon footprint and its reduction

Answer 06 · Mark scheme

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

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(test) glowing splint (result) relights	do **not** accept burning / lit splint allow glows more brightly MP2 is dependent upon MP1 being awarded	1 1	AO1 5.8.2.2

Answer 06 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
06.2	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO3
	No relevant content	0	5.9.1.1 5.9.1.2 5.9.1.3 5.9.1.4
	Indicative content • **the percentage of carbon dioxide has decreased** ○ (because) carbon dioxide dissolved in the oceans ○ forming sediments ○ (because) algae / plants ○ photosynthesised ○ by the formation of sedimentary rocks ○ by the formation of fossil fuels • **the percentage of nitrogen has increased** ○ (because) volcanic activity produced nitrogen ○ denitrifying bacteria released nitrogen • **the percentage of oxygen has increased** ○ (because) algae / plants ○ photosynthesised for **Level 3** answers must include each of the gases with an explanation for different gases		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any **two** from: • reduce livestock farming • reduce the number of rice / paddy fields • reduce the amount of rubbish going to landfill • use methane from landfill as an energy source • reduce fossil fuel use • reduce the destruction of peat bogs	 allow reduction of specific animals / product allow reduce area of wetlands allow recycle more (so less rubbish to landfill)	2	AO1 5.9.2.2 5.9.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	fossil fuels (containing sulfur) are burnt sulfur reacts with oxygen (to produce sulfur dioxide)	allow fuels containing sulfur are burnt	1 1	AO1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **one** from: • respiratory problems • acid rain	 allow immediate consequence of acid rain	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	any **one** from: • less use of fossil fuels (containing sulfur) • sulfur is removed from fossil fuels (before burning) • sulfur dioxide is removed from waste gases (after burning) • new legislation / regulations (since 1980)	allow any named fossil fuel allow less use of fuels containing sulfur allow increased use of renewable energy allow increased use of electric vehicles	1	AO3 5.9.3.1

Total Question 6	14

5.9.2.4 The carbon footprint and its reduction

Answer 04 · Examiner comments — November 2021 | 8464/C/2F | Original Q3

Question 3 (low and standard demand)

Students generally answered this question well. The topic of climate change and its effects were well understood. The impact of increased temperature was well known. No credit was given for the

Answer 04 · Examiner comments — November 2021 | 8464/C/2F | Original Q3

common answer of “The Earth gets hotter” as the response needed to be a for consequence of this.

Many students were able to correctly describe the trend in the graph for 2 marks. However, a significant number ignored the initial section of the graph where the percentage was constant. The use of the data from the graph was good overall. Credit was not given for predictions made from the graph if the instruction to extend the graph line had not been followed, as the reading could not be checked and verified.

5.9.2.4 The carbon footprint and its reduction

Answer 05 · Examiner comments

June 2023 | 8464/C/2F | Original Q2

Question 2

02.1 Around a quarter of students gained both marks on this question. Half of all students gained one mark, most frequently for the idea that the oceans were formed from water. Far fewer were able to make the link between rock formation and carbon dioxide.

02.2 Nine in ten students were able to identify nitrogen as having the highest percentage.

02.3 One in five students gained all three marks here. A quarter completed the calculation correctly without then expressing it in standard form. Of the remaining students, very few were able to make progress, with one in twenty achieving one mark, usually for expressing an incorrect calculation in standard form. There were all combinations of calculations seen by examiners using the numbers 95 and 0.04.

02.4 This question proved to be the easiest on this year's examination, with over 97% achieving the correct answer.

02.5 Three quarters of students correctly calculated the mass of carbon dioxide. The most common incorrect response saw students multiply rather than divide the two numbers.

02.6 Around half of students correctly identified photosynthesis as the correct answer. The most common incorrect responses were respiration, distillation and deforestation.

02.7 Approximately one third of students gained two marks for this question, with one in ten gaining one mark. Many students did not identify the direction of change, suggesting Africa or South America changed the most, which was not creditworthy. Also, students often responded with ideas about developing areas and industrialised areas, without talking about the continents on the bar chart.

02.8 Students were able to calculate the percentage of landfill methane emissions from the pie chart with over 85% of students completing the question correctly.

02.9 Around half of students achieved both marks for interpreting the graphic. Only one in ten gained one mark. The most common response that gained no credit was for reuse and recycle the wrong way round. However, all of the other responses were commonly seen.

5.9.2.4 The carbon footprint and its reduction

Answer 06 · Examiner comments

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

Question 6 (Standard demand)

06.1 The test for oxygen was not well known, there were a lot of blank scripts. Those who did attempt the question often referred to lit or burning splints, or sometimes both glowing and lit together. Also, a significant number of students referred to smouldering splints, or splints that had been previously lit as opposed to a glowing splint. This standard test needs to reference 'glowing'. A splint that has been previously lit and then blown out is not equivalent.
The most common incorrect response was students attempting to describe the test for hydrogen, with students referencing the squeaky pop test.

06.2 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.

Simply quoting the data from the table was not creditworthy. Students who did not use comparative language, such as higher, lower, only or just, to compare percentages failed to gain credit. Quoted figures needed to be correct.

Simple comparative statements limited the student to Level 1.

To access Level 2, the student had to offer at least two comparisons of percentage composition along with some correctly linked explanations, although all three gases did not have to be addressed.

To access Level 3 students had to correctly identify the change in percentage composition for all three gases from the early atmosphere to the current day and explain at least two of them.

Many students simply copied out the given information and therefore failed to gain any marks. The majority of the responses were in Level 1, as students failed to explain how the changes that they had described, came about. Where they did, contradictions were made, and the credit was disqualified. Where credit was given, it was mainly as a result of a description of plants photosynthesising.

A significant number of students attempted to explain the changes in terms of climate change and the burning of fossil fuels, increased transport and pollution.

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5.9.2.4 The carbon footprint and its reduction

Answer 06 · Examiner comments

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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]

while carbon dioxide gases have decreased in percentage oxygen has increased, this can be due to photosynthesis because of the increased population of plants. However Nitrogen has increased rapidly since earth early atmosphere.

This student has correctly stated the changes in composition for the three gases.
They have also correctly identified two reasons for the decrease in carbon dioxide and two reasons for the increase in oxygen (photosynthesis/plants).
This achieves the lower mark in Level 3.

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 1**.

[6 marks]

- in early earth carbon dioxide was 95% where as no it has decreased to 0.04%.
- in early earth Nitrogen had a total of 3% in the atmosphere, whereas now it is 78% of Nitrogen gases this has increased by 75% percent!
- in the early earth oxygen levels were less than 1% of the earths atmosphere. it is now 21% of the earths atmosphere it has increased by just over 20%!

This student has correctly stated the changes in percentages for the three gases, but has not explained any reasons for this. This puts these responses at the upper mark in Level 1.

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5.9.2.4 The carbon footprint and its reduction

Answer 06 · Examiner comments June 2025 | 8464/C/2F | Original Q6

06.3 Many students appreciated that cattle farming leads to methane emissions but did not always refer to a reduction in this type of farming being required. There were many responses that answered as an absolute rather than a comparison which was insufficient for the mark. The question was looking for the idea that 'less' farming of livestock or 'less' use of fossil fuels would reduce methane for example, not stopping farming or stopping the use of fossil fuels altogether.

As they were told that methane is a greenhouse gas, some students confused the reduction of methane emissions with that of carbon dioxide and made suggestions such as planting more trees or burying methane underground.

06.4 How sulfur dioxide is released into the atmosphere was not well known, resulting in many blank scripts.
The most common insufficient response for marking point 1 was that 'fuels', rather than 'fossil fuels', were being burnt. Many students referred to the use of cars but did not link this to the burning of fossil fuels.
Students trying to explain the formation of sulfur dioxide often referred to the sulfur reacting with carbon dioxide rather than with oxygen. Very few students gained 2 marks.

06.5 Less than 20% of students could recall any problem associated with sulfur dioxide. There were many vague answers such as its toxic, causing difficulty in breathing, causing cancer, climate change, global warming, harms the environment and burns the skin. None of which gained any credit.
Acid rain was rarely mentioned and the correct terminology of 'respiratory' problems even less so.

0 6 . 5 Give **one** harmful effect of sulfur dioxide emissions. **[1 mark]**

Struggle to breathe properly.

The student has tried to offer a creditworthy response but has used incorrect terminology.
The question is looking for 'respiratory issues/problems' as opposed to breathing.
This is a higher demand question and correct terminology is required.

06.6 Students found this question difficult.
A common misconception appeared to be that sulfur itself is used as a fuel and we now do not use it as much.
Some students did attempt to link the reduction in sulfur dioxide to the use of electric vehicles. The common error here however was that they had to clearly imply 'increased' use of electric vehicles, and most did not.

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5.9.2.4 The carbon footprint and its reduction

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

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