AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.9.1.4

How carbon dioxide decreased

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
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.

5.9.1.4 How carbon dioxide decreased

Answer 01 · Mark scheme June 2018 | 8464/C/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	methane		1	AO1 5.9.2.2
02.2	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
02.3	$\frac{6.0}{4.1} \times 0.0235$ = 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
02.4	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

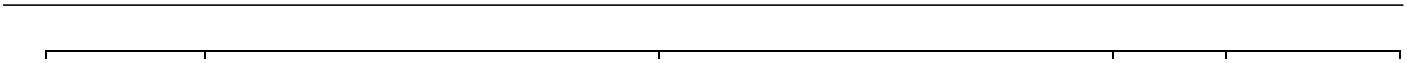
5.9.1.4 How carbon dioxide decreased

Question	Answers	Mark	AO / Spec. Ref.
02.5	**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**

5.9.1.4 How carbon dioxide decreased

Answer 01 · Mark scheme

June 2018 | 8464/C/2H | Original Q2



5.9.1.4 How carbon dioxide decreased

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	

5.9.1.4 How carbon dioxide decreased

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

5.9.1.4 How carbon dioxide decreased

Answer 02 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.9.1.4 How carbon dioxide decreased

Answer 03 · Mark scheme

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	nitrogen increased		1	AO1 5.9.1.2
	(because of) emission from volcanoes	allow (because of) denitrifying bacteria	1	5.9.1.3
	oxygen increased		1	
	(because of) photosynthesis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	carbon dioxide is used during photosynthesis		1	AO1 5.9.1.4
	in trees		1	
	(which) die and are compressed		1	
	over millions of years		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	coal has a higher proportion / percentage of carbon		1	AO2 5.9.3.1

5.9.1.4 How carbon dioxide decreased

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	uses bacteria to produce solutions containing copper compounds from which copper is obtained by displacement / electrolysis	 allow to produce leachate solutions 	1 1 1	AO1 5.10.1.4

5.9.1.4 How carbon dioxide decreased

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	1000 (kg of plants) gives 7.92 (kg of nickel)		1	AO2 5.10.1.4
	(mass = $\frac{7.92}{4.8}$ × 100 =) 165 (kg)		1	
	(conversion 165 kg =) 165 000 (g)	allow correct conversion of an incorrectly determined mass in kg	1	
	= 1.65 × 10^5 (g)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams	1	
	OR			
	(mass =) $\frac{0.792}{4.8}$ × 1000 (1)			
	= 165 (kg) (1)			
	(conversion 165 kg =) 165 000 (g) (1)	allow correct conversion of an incorrectly determined mass in kg		
	= 1.65 × 10^5 (g) (1)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams		

Total Question 5		**16**

5.9.1.4 How carbon dioxide decreased

Answer 04 · Mark scheme June 2025 | 8464/C/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(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

5.9.1.4 How carbon dioxide decreased

Question	Answers	Mark	AO / Spec. Ref.
02.2	**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		

5.9.1.4 How carbon dioxide decreased

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	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.
02.4	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.
02.5	any **one** from: • respiratory problems • acid rain	 allow immediate consequence of acid rain	1	AO1 5.9.3.2

5.9.1.4 How carbon dioxide decreased

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	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 2	**14**

5.9.1.4 How carbon dioxide decreased

Answer 01 · Examiner comments June 2018 | 8464/C/2H | Original Q2

Question 2 (standard demand)

02.1 Methane was recognised by 85% of students as a greenhouse gas. Nitrogen was the most commonly seen incorrect response.

02.2 60% of students were able to name two effects of climate change, with a further 29% of students able to name one effect. Students give a wide range of creditworthy responses; melting polar ice caps, named extremes of weather and / or desertification.

Students who did not gain credit were sometimes too vague, for example giving responses such as unspecified changes in the weather, or unspecified effects on people. Others gave causes rather than effects of climate change or referred to acid rain.

02.3 51% of students achieved some credit on this question. Many of those who knew the correct method failed to convert from grams to kilograms and consequently achieved only one mark for the calculation. The remainder of students attempted a single division or multiplication with two of the numbers given but were unable to continue to complete the calculation required.

Some students were able to apply the correct method, but did the calculation in two parts, and their rounding after the initial calculation gave rise to an incorrect final answer. Students should be aware that they should not undertake any rounding until they reach their final answer.

5.9.1.4 How carbon dioxide decreased

Answer 01 · Examiner comments June 2018 | 8464/C/2H | Original Q2

02.4 27% of students suggested using less plastic or recycled plastic in the manufacture of plastic bottles or gave a reference to carbon capture. Some incorrect responses focussed on the disposal, including burning plastic, rather than the manufacture of plastic or transportation of the plastic bottles, releasing carbon dioxide in to the air. Planting trees to capture the carbon or using renewable energy sources to provide energy for manufacturing the bottles proved popular ideas.

02.5 This 'extended response' question discriminated well. It asked for an explanation of how the levels of three gases have changed since the Earth's early atmosphere. To achieve marks in level 1, statements of change for the three main gases in the Earth's atmosphere was required. When explanations were linked to the changes, marks in levels 2 or 3 were awarded. The clearer, more logical and more detailed accounts achieved level 3 marks.

19% of students achieved a level 3 mark on this standard demand question. Some accurate and well-expressed responses were seen, succinctly explaining the changes to all three gases. Many students gave detailed responses that showed a greater depth and understanding, giving numerous linked explanations for the changes in composition of the gases in the Earth's atmosphere. The most logically sequenced of these discussed each of the three gases in turn, resulting in very readable and accessible accounts. 33% of students achieved a level 2 mark, and a further 27% achieved a level 1 mark.

However, many of the lower-attaining students discussed post Industrial Revolution changes to the Earth's atmosphere, rather than addressing the changes since the formation of the Earth's early atmosphere. These students attempted to explain increases in carbon dioxide levels due to industrial manufacturing or other human activity; decreases in oxygen due to increasing population or deforestation. Some of these accounts were less logically sequenced and suggest that lower-attaining students are challenged by the concept of evolutionary timescales or are failing to read the question carefully.

As mentioned in the general comments for this paper, students should note the command word for an extended response question carefully. In this question students were asked to 'Explain'. Many students qualitatively described the changes in amounts of nitrogen, oxygen or carbon dioxide since the formation of the Earth's early atmosphere but were not successful at linking these changes to explanations. The most popular explanation was the effects of photosynthesis on changes in the percentages of both oxygen and carbon dioxide. The dissolving of carbon dioxide into the newly formed oceans was better known than those of the volcanic action on the change in percentage of nitrogen.

5.9.1.4 How carbon dioxide decreased

Answer 03 · Examiner comments June 2022 | 8464/C/2H | Original Q5

Question 5

Students were able to demonstrate knowledge of the changes to the Earth's atmosphere, but knowledge of some of the other areas of the specification assessed in this question were a lot less familiar to students.

05.1 Over 90% of students achieved at least 1 mark on this question. This was predominantly for identifying that the concentration of oxygen increased. This was linked to photosynthesis as the next most common mark, followed by an increase

Answer 03 · Examiner comments June 2022 | 8464/C/2H | Original Q5

in nitrogen. The source of nitrogen from volcanoes was known by about 10% of students.

05.2 The formation of coal was not well known by students. About a quarter of students gained at least one mark, usually for knowing the timescale was over millions of years. 2 or more marks were achieved by fewer than 10% of students. The question asked how carbon dioxide was turned into coal. The most common misconceptions were around the idea that carbon dioxide is compressed.

05.3 Fewer than 2% of students gained the mark here. A comparison of the **proportion** of carbon in each fuel source was required for the mark. The most common responses were around the idea that coal was made from carbon dioxide, so released more back into the atmosphere.

05.4 Just over one third of students achieved at least one mark, usually for identifying bacteria. The least likely mark to be awarded was for the production of a solution containing copper compounds.

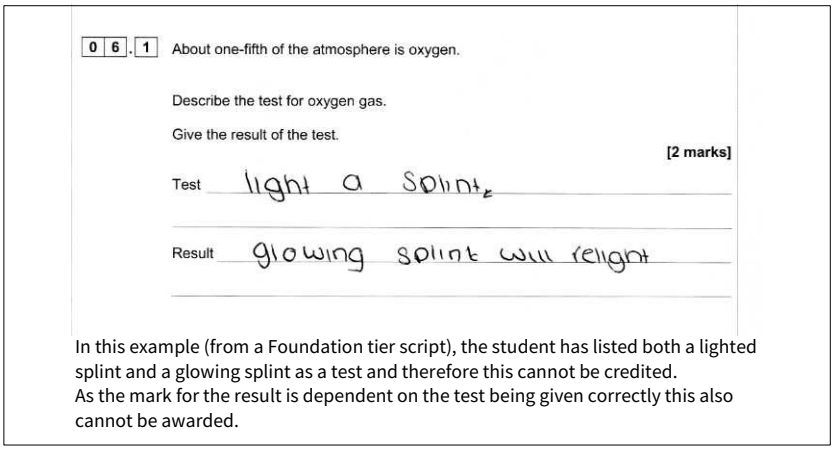
05.5 This was a high demand question where just over half of students scored at least one mark, often for a conversion from kg to g. Beyond that, students did not appear to be confident in interpreting the data given and only around 5% scored full marks.

5.9.1.4 How carbon dioxide decreased

Answer 04 · Examiner comments June 2025 | 8464/C/2H | Original Q2

Question 2 (Standard demand)

02.1 There were many responses referring 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. Students who were awarded marking point 1 were nearly always awarded marking point 2 as well. The most common incorrect response was using the test for hydrogen, with students referencing a lighted splint and a squeaky pop.



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

Describe the test for oxygen gas.

Give the result of the test.

[2 marks]

Test light a splint

Result glowing splint will relight

In this example (from a Foundation tier script), the student has listed both a lighted splint and a glowing splint as a test and therefore this cannot be credited.
As the mark for the result is dependent on the test being given correctly this also cannot be awarded.

02.2 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. A third of all students gained marks at this level.

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 offer an explanation for at least two of them. Just over a quarter of all students gained 5 or 6 marks.

A decrease in carbon dioxide and an increase in oxygen could both be linked to 'algae / plants' and 'photosynthesis'. For nitrogen, whilst many students recognised that the percentage had increased, very few stated that it was due to volcanic activity or denitrifying bacteria. This was the main reason for a number of students working at Level 3, not being awarded the upper mark.

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5.9.1.4 How carbon dioxide decreased

Answer 04 · Examiner comments

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]

- The earth's early atmosphere had 95% carbon dioxide but now here is only 0.04%.
- In the Earth's early atmosphere there was 3% Nitrogen gas but now here is 78%.
- In the earth's early atmosphere here was less than 1% of oxygen whereas now here is 21%.

This is a weak response. The student has basically just written figures from the table. The only weak comparison is carbon dioxide now being 'only' 0.04%. Two relevant statements are needed to access lower Level 1 so 0 marks were awarded.

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%!

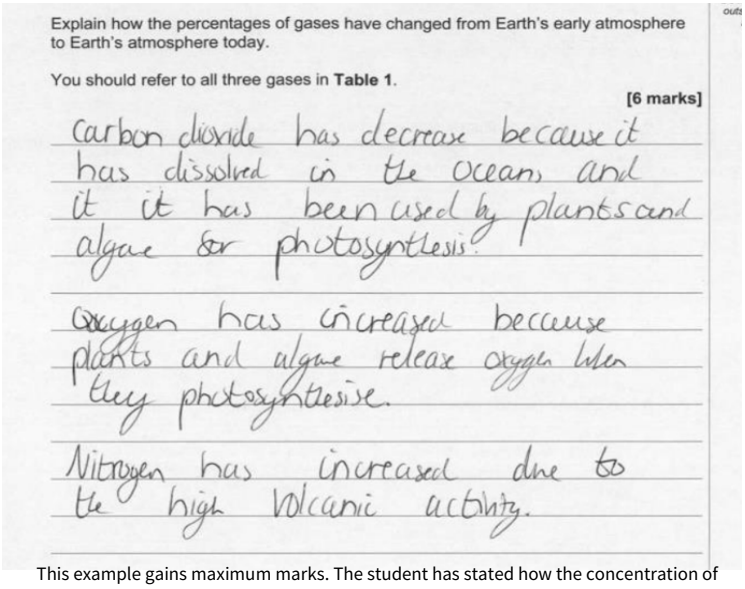
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This was a common response. The student has identified how the concentrations of all 3 gases have changed but has failed to offer any explanation as to why these changes have occurred. 2 marks in Level 1 are awarded.

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5.9.1.4 How carbon dioxide decreased

Answer 04 · Examiner comments


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]

carbon dioxide has decrease because it has dissolved in the ocean, and it it has been used by plants and algae for photosynthesis.

Oxygen has increased because plants and algae release oxygen when they photosynthesise.

Nitrogen has increased due to the high volcanic activity.

This example gains maximum marks. The student has stated how the concentration of each gas has changed and offered an explanation for each one.

02.3 All of the ideas on the mark scheme were accessed by the students, although the most common responses referred to livestock farming and fossil fuels. However, 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. This resulted in a third of students who answered the question not gaining credit.

02.4 The most common insufficient response was that 'fuels' were being burnt rather than 'fossil fuels'. Students also often used the incorrect terminology for sulfur reacting with oxygen, with many referring to 'binding' or 'joining'. If bonding was used, it had to be *chemical* bonding for the mark to be awarded. A number of students referred to the sulfur reacting with carbon dioxide. Consequently, over half the students failed to score any marks.

02.5 This question was well answered by the majority of students with over two thirds being able to correctly name a harmful effect of sulfur dioxide. The most common insufficient response was a simple reference to lung damage or breathing issues rather than the correct terminology of respiratory problems.

02.6 Students found this question difficult. From all the acceptable responses, the most common by far referred to the use of fossil fuels, with a significant minority listing new laws/legislation. A few students used statements referring to the increased use of renewable energy/resources as an alternative to using less fossil fuels. Students could also link the increased use of electric vehicles to less use of fossil fuels. The common error here was that students had to clearly imply

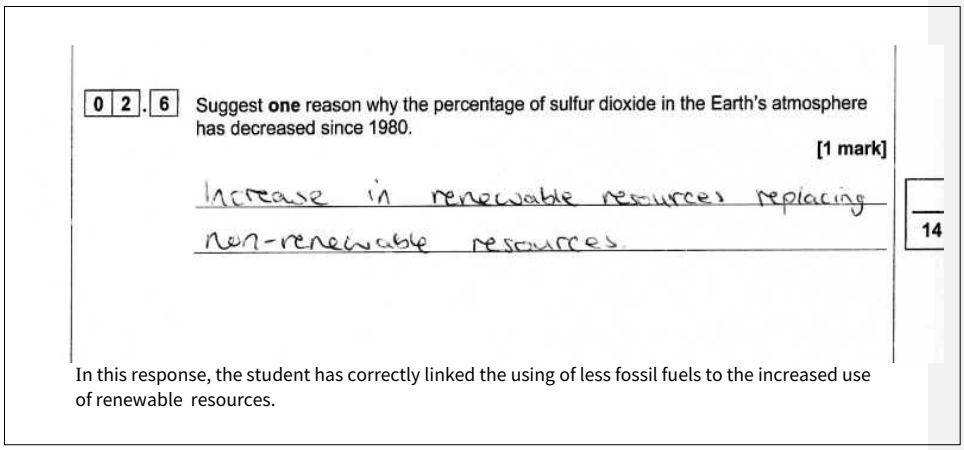
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5.9.1.4 How carbon dioxide decreased

Answer 04 · Examiner comments

June 2025 | 8464/C/2H | Original Q2

'increased' use and many did not. A common misconception appeared to be that sulfur dioxide itself is used as a fuel and we now do not use it as much. Less than a third of students gained any credit in this question.



0 2 . 6 Suggest **one** reason why the percentage of sulfur dioxide in the Earth's atmosphere has decreased since 1980.

[1 mark]

Increase in renewable resources replacing non-renewable resources.

14

In this response, the student has correctly linked the using of less fossil fuels to the increased use of renewable resources.