AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.9.2 CARBON DIOXIDE AND METHANE AS GREENHOUSE GASES (PACK 2)

SCORE	PERCENTAGE
/144	%

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Q1.

(a) condenses

1

(b) the fractions have different boiling points

1

(c) propane

*do **not** accept propene*

1

(d) C_nH_{2n+2}

1

(e) CH_4 + **2** O_2 ⟶ CO_2 + **2** H_2O

allow multiples

1

(f) bromine water

1

(g) to assess the environmental impact (of the stages in the life of a product)

allow to see the effect / harm / damage on the Earth / environment / planet

ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability

1

(h) **Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.

3–4

Level 1: Relevant features are identified and differences noted.

1–2

No relevant content

0

Indicative content

- burning 10 000 bags produces 10 kg more of carbon dioxide than landfill
- putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning
- putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning
- burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces 15 kg
- putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg
- landfill produces less carbon dioxide than burning
- landfill produces more solid residue than burning
- burning produces less sulfur dioxide than landfill

[11]

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Q2.

(a) methane

1

(b) any **two** examples from:

allow effects from the same bullet point

- rising sea levels
- melting ice
- agricultural problems
- extremes of weather
- loss of habitats

ignore global warming
ignore acid rain
ignore global dimming

*do **not** accept reference to ozone*

2

(c) $\frac{6.0}{4.1} \times 0.0235$

1

= 0.0344(kg)

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

*an answer of 0.0344(kg) scores **2** marks*

(d) use less plastic
or
use recycled plastic

allow carbon capture
ignore any reference to energy / fuels

1

(e) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.

5–6

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

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- 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

[12]

Q3.

(a) 4.6×10^9 years

1

(b) $\frac{780\,000 - 27\,000}{27\,000} \times 100$

1

$= 2788.\dot{8}$

1

= 2800 (%)

allow an answer from an incorrect calculation correctly given to 2 significant figures

1

*an answer of 2800 (%) scores **3** marks*
*allow 2788.88889 (%) or correctly rounded answer for **2** marks*

(c) incomplete combustion

1

(d) volcanoes (on early Earth) released water vapour

1

(water vapour then) condensed (to form the oceans)

1

allow steam for water vapour

(e) ice caps have melted

[8]

Q4.

(a) 0.1%

1

(b) bar correctly drawn to ±½ square

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1

(c) argon

1

(d) increased

1

data values to justify

1

(e) electricity and industry are equal

1

electricity and industry are highest

1

transport is lowest

1

electricity or industry is double transport

1

(f) use of renewable energy sources
or
specific example

1

(g) limited investment in renewable technology
or
disagreement between countries

accept specific reason which relates to response to (f), eg insufficient sunlight

1

[11]

Q5.

(a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

1

(b) toxic

accept causes death

1

acid rain
or
respiratory problems

accept respiratory problems / asthma

1

global dimming

1

(c)

Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5-6

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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 • methane is the best fuel because it gives more energy per gram than coal, and gives less carbon dioxide per kJ of energy produced • petrol is best because it being a liquid is easier to handle than gas or coal - although the energy content is lower than the others, it gives out less carbon dioxide than coal • methane has more energy per gram than coal • coal produces most carbon dioxide • coal can produce sulfur dioxide	

6

[10]

Q6.

(a) any **two** from:

- Earth's atmosphere more / mostly nitrogen
  allow converse
- Earth has more oxygen
  allow Venus has no oxygen
- Earth has (much) less carbon dioxide
  allow converse

2

(b) (carbon dioxide) respiration / combustion / volcanic eruptions / decomposition / animals
allow (carbon dioxide) breathed out

1

(oxygen) plants / algae / producers / photosynthesis

1

(c) evaporation / transpiration
allow (enters atmosphere through) exhalation

1

precipitation / rain / snow / sleet / condensation / freezing

1

(d) global warming

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1

(e) any **two** from:

- sea-level rise **or** high tides travel further inland
- melting ice caps
- flooding
- less land for farming
- changes to which plants will grow (due to climate change)
- (increased) coastal erosion
- extreme weather
- change in rainfall
- drought
- desertification
- loss of habitat
- temperature stress (for humans and wildlife)
- decreased food-producing capacity of some regions

ignore global warming

ignore temperature change unqualified

2

[9]

Q7.

(a) any **two** from:

- the area of ocean with sea ice has reduced since 1979
- the amount of ice follows the same pattern during a year

allow ice reduces in the summer and increases in the winter

- most ocean with sea ice in February / March
- least ocean with sea ice in September / October
- area of ocean with sea ice decreases from March to September each year
- area of ocean with sea ice increases from September to February / March each year
- decrease is greater between 1995 and 2016 compared with 1979 to 1995

allow other correct conclusions derived from the graph

2

(b)

Level 3: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5-6
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 • deforestation has reduced the number of trees on the planet	

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• which has reduced the amount of carbon dioxide that can be removed from the atmosphere • increased combustion releases more carbon dioxide into the atmosphere • therefore there is a build-up of carbon dioxide in the atmosphere • (build up) allows short-wavelength radiation to pass into the Earth's atmosphere • and absorbs long-wavelength • causing an increase in global temperature • the increase in temperature causes ice to melt	

6

[8]

Q8.

(a) dissolved

in this order

1

carbonates

1

(b) Photosynthesis

1

(c) water

In this order

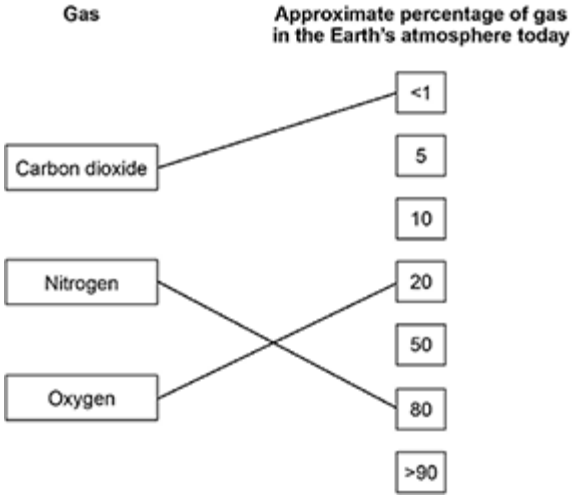
oxygen

both needed for the mark

1

(d)

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Extra lines from Gas negate the mark

3

(e) increases global temperatures

1

(f) use renewable energy supplies

1

(g) correct reason, eg:
- renewable technology underdeveloped
- disagreement between countries

1

[10]

Q9.

(a) sediment / limestone formation from carbonates

1

(b) short wavelength radiation

1

passes through atmosphere to Earth's surface

1

Earth's surface radiates different wavelengths

1

which are absorbed by greenhouse gases to produce temperature increase
allow CH_4 H_2O or CO_2

1

(c) 13.8 %
allow values in the range 13.0 to 15.0

1

(d) 15.08 (°C)
allow values in the range 15.05 – 15.10

1

(e) correlation between CO_2 levels and temperature

1

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despite short-term variations of temperature

1

supported by values from graph which show correlation

1

cannot determine causality from this data or possible causality as increasing use of fossil fuels since 1900 has caused accelerated temperature increase

1

[11]

Q10.

Level 3 (5–6 marks):
A full explanation is given that is coherent and logically structured, linking effect of increase in carbon dioxide to climate change and effects on biodiversity.

Level 2 (3–4 marks):
An attempt is made to link the effects of rising carbon dioxide levels to climate change and biodiversity. The logic may be inconsistent at times but builds towards a coherent explanation.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and attempts at reasoning may not be consistent.

0 marks:
No relevant content.

Indicative content

- rise in carbon dioxide increases atmospheric temperature / causes global warming
- global warming causes extreme weather patterns
- such as rise in sea levels
- increased or decreased rainfall
- frequency of storms / droughts
- rise in sea levels means habitats will change due to flooding
- rise in sea levels could increase salt in soil
- increased rainfall will increase water levels
- severity of storms / droughts could affect photosynthesis
- consequences of changes are loss of or damage to habitats
- which will affect animal and plant distributions
- by increasing migration or species dying off
- which decreases biodiversity

[6]

Q11.

(a) gravity (of moon and sun)

1

(b) any **two** from:

__1__ mark for statement, __1__ mark for correctly linked reason

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

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or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ

1

1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year

1

so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares)

1

*allow 1 500 000 with no working shown for **3** marks*

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]

Q43.

(a) (i) 214 (billion tonnes)

*allow **1** mark for reading 122 and 92 correctly*

*allow **1** mark for the correct addition of incorrect readings*

2

(ii) 18.35

allow 18.4

*do **not** allow 18.3*

1

(b) (i) (only) a small mass of carbon (dioxide) is released from burning fuels (compared to other processes)

allow the carbon (dioxide) released from other processes / respiration and decomposition is (much) greater

1

(ii) any **two** from:

- (more) plants would absorb (more) carbon (dioxide)

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- (due to more) photosynthesis
  an idea of more is needed at least once
- fewer animals would release less carbon (dioxide)
- (due to less) respiration (in animals).
  an idea of a reduction is needed at least once
  ignore references to oxygen

2

[6]

Q44.

(a) combustion

1

(b)

Substance	Environmental effect
Carbon dioxide	Acid rain
Oxides of nitrogen	Bioleaching
Solid particles	Global dimming
	Global warming

extra lines from substance negates mark

3

[4]

Q45.

(a) burning of fossil fuels
accept burning of a named fossil fuel

1

(b) Change:
carbon dioxide dissolves / is absorbed by oceans / water
accept ocean acts as a reservoir / store

1

Effect:
increases acidity of water
ignore references to acid rain
accept as alternative approach:
change: global warming / greenhouse gas
effect: leads to increase in ocean / water temperature

1

(c) (i) *422*
allow answers in range of 418-430

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1

(ii) from 1980 to 2010 carbon dioxide increased by 50ppm ***and*** coral decreased by 50%

allow answers in range of 48-52 ppm

1

from 2010 to 2020 carbon dioxide increased by 32 ppm,

allow answers in range of 30-40 ppm

allow ecf from part (i) with a tolerance of ± 2 ppm

1

(so) would expect coral to decrease by half again

accept increasing rate of change of carbon dioxide / coral

or

exponential rate of change of carbon dioxide / coral

1

[7]

Q46.

(a) (i) 78 %

1

(ii) A – nitrogen

allow N_2

N must be uppercase and 2 must be subscript

ignore N

1

B – oxygen

allow O_2

O must be uppercase and 2 must be subscript

ignore O

1

(b) (i) any **two** from:

- level *up* to 1900 (allow 1890 to 1910)
- increasing from 1900 to today (*allow 1890 to 1910*)

  allow increased by 90 (ppm), allow answers in the range 88 – 92
- increased more rapidly in last 50 years

  *if no other marks gained allow **1** mark for it has increased*

2

(ii) (fossil) fuels

accept coal / oil / (natural) gas / peat

allow petrol / diesel / methane

1

[6]

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Q47.

plants absorb CO_2 for photosynthesis

ignore carbon

1

all organisms / any named organism respire(s) and release(s) CO_2

ignore breathing

ignore carbon

1

any **four** from:

- carbon compounds / named compound made by plants
- plants eaten by animals
- dead organisms / faeces are decomposed / decayed

  allow broken down
- by bacteria / microorganisms
- dead plants and animals (may) form fossil fuels
- when (fossil) fuels are burnt they release CO_2 into the air

4

[6]

Q48.

(a) (i) carbon dioxide

1

(ii) because water boils at 100°C and the temperature on Venus is 460°C

1

therefore any water on the surface would boil to form steam / water vapour / gas

1

(b) any **three** from:

- by photosynthesis
- by dissolving in oceans
- by the formation of (calcium) carbonate **or** limestone
- by the formation of oil **or** coal

  accept by the formation of fossil fuels

3

(c) (i) 0.0317 (%)

1

(ii) the percentage of carbon dioxide has increased

1

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(iii) any **one** from:

- burning of fossil fuels
- deforestation
- release of 'locked up' carbon dioxide

1

[9]

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Q1.

Foundation

(a) 58% of students selected the correct response ‘condenses’. The most commonly seen incorrect answer was ‘dissolves’.

(b) 54% of students recognised that the fractions separate due to different boiling points.

(c) 15% of students gained credit, recognising the alkane to be propane. This suggests that students are not familiar with the use of models to represent alkanes.

(d) The correct answer of C_nH_{2n+2} was the most commonly chosen, by 42% of students, although C_nH_{2n} proved an effective distractor.

(e) Balancing an equation such as this combustion of methane was very demanding for the vast majority of students. 13% of students achieved this mark.

Multiples were accepted. Some students who did not gain credit had a valiant attempt at balancing, evidenced by their calculations and working alongside the question. Others had little idea, either inserting a variety of numbers and / or formulae on the answer lines, or simply not attempting it.

(f) The correct answer of bromine water was the most commonly chosen, by 44% of students, although limewater proved an effective distractor.

(g) 8% of students knew the definition from the specification, or were able to give an equivalent statement. A large number of vague responses were seen such as ‘to see how we can do things better’.

(h) The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic and using landfill. Students writing these responses made little reference to the information in the table, and many of these students missed the key command word, ‘Compare’.

13% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from the table. To access level 2, students were expected to ‘note the magnitude’ of the differences, as stated in the generic level descriptor in the mark scheme. 30% of students were awarded a level 2 mark.

Some students had difficulty interpreting the information in the table, reversing the causal relationship, and attempted to suggest that the emissions caused the disposal method. A number of students were unable to express the comparisons clearly or accurately, for example suggesting that the processes used carbon dioxide or sulfur dioxide, or writing that landfill increases the sulfur dioxide by 10%. Some students’ calculations from the table were incorrect, for example the difference the mass of sulfur dioxide produced by the two methods was sometimes given as ‘10’, and the difference between the mass of solid residue given as ‘20’.

Students did demonstrate a good understanding of environmental responsibility.

Higher

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(a) 83% of students achieved this mark. None of the other three possible answers proved to be dominant.

(b) 79% of students achieved this mark. 'The fractions have different melting points' proved to be dominant wrong answer.

(c) 49% of students gained credit, recognising the alkane to be propane. Most popular incorrect answer was butane. Some students gave a formula even though the question asked for the name of the alkane.

(d) The correct answer of C_nH_{2n+2} was the most commonly selected response by students (77%) although C_nH_{2n} proved to be the most effective distractor.

(e) 56% of students successfully balanced equation for the combustion of methane. Multiples were regularly seen, and credit accordingly given.

(f) The correct answer of bromine water was chosen by 67% of students. Anhydrous copper sulfate proved to be the most effective distractor.

(g) 28% of students knew the definition from the specification or were able to give an equivalent statement. A large number of vague incorrect responses were seen encompassing issues such as pollution, sustainability, energy and carbon footprint.

(h) In this 'extended response' question students were asked to compare the two methods for the disposal of biodegradable plastic bags using information given in the table.

26% of students gained full marks on this question and a further 38% of students achieved marks at level 2. To access level 2, students were expected to 'note the magnitude' of the differences, as stated in the generic level descriptor in the mark scheme.

17% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from the table.

The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic or the benefits of burning plastic bags to generate electricity. Students writing these responses made little reference to the information in the table and many of these students ignored the key command word, 'Compare'. However, the higher-attaining students had logically worked their way down the information in the table, comparing and calculating differences when constructing their answer.

Q2.

Foundation

(a) 63% of students recognised methane as a greenhouse gas. Nitrogen was the most commonly seen incorrect response.

(b) This question discriminated well. 29% of students were able to name two effects of climate change, with the next 33% naming one effect.

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, pollution or ozone.

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(c) Many students found this calculation challenging with 3% of students able to give the correct answer. 70% of students managed a single division or multiplication with two of the numbers given, but were unable to continue to complete the calculation required. Some of those who knew the correct method failed to convert from grams to kilograms, but were still able to access one of the two marks. Some students were able to apply the correct method, but did the calculation in two parts, and their rounding after the first part gave rise to an incorrect final answer. Students should be aware that they should not do any rounding until they reach their final answer.

(d) 13% of students suggested using less plastic or recycled plastic, or gave a reference to carbon capture. Some incorrect responses focussed on the disposal, including burning, rather than the manufacture of plastic. Planting trees to capture the carbon proved a popular idea.

(e) 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.

4% 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. The most logically sequenced of these discussed each of the three gases in turn, resulting in very readable and accessible accounts. A further 12% of students achieved a level 2 mark, and a further 32% achieved a level 1 mark.

Many of the lower-attaining students discussed modern day changes to the Earth's atmosphere, rather than addressing the changes since the Earth's early atmosphere. These students attempted to explain increases in carbon dioxide levels due to industrial or other human activity, and decreases in oxygen due to increasing population. Some students included mention of the ozone layer. Some of these accounts were less logically sequenced and suggest that lower-attaining students are more 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 Earth's early atmosphere, but were not successful at linking these changes to explanations. When students did attempt an explanation, the effects of photosynthesis on changes in the percentages of oxygen and carbon dioxide were better known than those of volcanic action on the change in percentage of nitrogen.

Higher

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

(b) 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

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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.

(c) 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.

(d) 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.

(e) 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.

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Q3.

(a) 79% of students could recall the correct age of the Earth in standard form.

(b) 79% of students were not able to calculate a percentage change. Many did not give their answer to two significant figures. Incorrect rounding was frequently seen.

(c) 80% of students recalled that carbon monoxide is released by incomplete combustion.

(d) Few students described volcanoes releasing water vapour. Misconceptions were frequent, such as volcanoes releasing carbon dioxide that changed to water vapour. More students could describe water vapour condensing, although recall of the water cycle was frequent, not always relevant, and often confused between evaporation and condensation. 295 of students achieved one or two marks for this question.

(e) 35% of students could describe melting ice caps as a result of increasing greenhouse gases. Misconceptions included that carbon dioxide dissolving in oceans increases the volume of water, and that increased rainfall is responsible for sea level rise.

Q43.

(a) (i) Just over a third of the students gained full marks for this question. 1 mark could be gained for correctly reading 122 and 92 from the graph. Incorrect readings that were correctly added together could also gain 1 mark. This highlights the importance of showing working for all calculations, no matter how simple the calculation may appear to be.

(ii) Some students attempted to write out the number in full, or in standard form, but could only gain the mark if they had deleted billion from the answer line. There were some avoidable errors made, such as writing 1.835 instead of 18.35. Others divided 5 by 3.67 instead of multiplying the numbers together.

(b) (i) Students were instructed to use information given in the graph to suggest why some scientists do not think that burning fuels is the main cause of carbon dioxide in the atmosphere. Many said that respiration and decomposition released more carbon than burning fuels to gain the mark. If figures were quoted, a comparison was needed. Some students gave confused responses about photosynthesis, which did not answer the question which was about burning and the release of carbon dioxide.

(ii) Students had to suggest how eating less food from animals and eating more food from plants could reduce the amount of carbon dioxide in the atmosphere. Credit could not be gained just for mentioning respiration or photosynthesis alone. Clear statements as to whether these processes would occur more or less were needed, and how this would affect the amount of carbon dioxide absorbed or released. Many students linked in to the idea of decomposition of dead organisms, which was ignored. Some spoke about carbon dioxide being produced by the meat production processes, or from cooking the meat, which was also ignored. Others focused their responses on oxygen, which did not answer the question.

Q44.

(a) Almost sixty percent of students knew that fossil fuels release energy by combustion, with the most common distractor being “decomposition”.

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(b) Approximately a quarter of students gained all 3 marks. The most well-known link was that carbon dioxide caused global warming, with solid particles being the cause of global dimming the least likely to be known. Many linked solid particles to bioleaching, showing a lack of knowledge of two specialist terms.

Q45.

(a) Only a third of students gained this mark. A reference to the burning or combustion of fossil fuels, or a named fossil fuel was needed. Using fossil fuels, or burning fuels, were both insufficient responses. There were many references to deforestation and increased use of cars which were ignored.

(b) Many students did not score because they gave very vague responses such as "Carbon dioxide will kill the coral". Others thought there was too little carbon dioxide around, which would also kill the coral. Some students just referred to the carbon dioxide concentration in the air, rather than in the water, which is what affects the coral. Those who realised that carbon dioxide dissolved in the water often failed to relate this to increased acidity. Some did not express dissolving well enough to gain the mark and simply said it pollutes, dilutes or contaminates the water. Some said it increased the pH of the water so increased its acidity; the reference to an increased pH negated this mark. A very common misconception was that absorption of carbon dioxide into the ocean resulted in a consequent loss of oxygen. Some students thought that coral is a plant, and so would benefit from more carbon dioxide for photosynthesis. Only a few answered in terms of the alternative route, but usually only gained the first marking point for saying global warming. Only a few went on to explain that this would increase the temperature of the oceans.

(c) (i) Answers within the range 418 – 430 were all credited, in order to allow tolerance on the student's line of best fit. Many responses were in the range 400-416, usually due to an incorrectly drawn curve or because they attempted to answer the question without extrapolating a line of best fit.

(ii) There were many responses that did not contain any reference to the data, which was explicitly asked for in the question. Other students who did use data did not follow the instruction to consider both carbon dioxide and coral, and as a consequence could not access the first marking point. Some just answered in terms of the increase from 1980 to 2010, without calculating the actual change. A small number attempted to calculate the increase in carbon dioxide from 2010 to 2020, and so missed out on the second marking point. The third mark was the one most frequently obtained, usually for responses linked to the increasing rate of change of carbon dioxide.

Q46.

(a) (ii) The names and percentages of gases in the air were not well known.

(b) (i) There were many good responses that included all three marking points. A few did not describe the change in carbon dioxide concentration in detail, but gained the compensation mark for saying it increased. Some students had not read the question properly and gave reasons for the increase, which was not asked for.

Q47.

It was encouraging to see many excellent answers gaining five or six marks. Failure to

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gain full marks was usually due to not using the technical terms photosynthesis or respiration, or giving confusing accounts of decay and fossilisation. Most students were able to gain at least one mark for this question.

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