

Questions

Q1.

The concentration of carbon dioxide in the atmosphere can be measured in parts per million (ppm).

Figure 1 shows the measurements in January 2018 and January 2019.

	concentration of carbon dioxide in ppm
January 2018	407.96
January 2019	410.83

Figure 1

(i) Calculate the increase in the concentration, in ppm, of carbon dioxide from January 2018 to January 2019.

Give your answer to the nearest whole number.

(2)

.....

.....

.....

increase in concentration of carbon dioxide = ppm

(ii) Give a possible cause for this increase in the concentration of carbon dioxide.

(1)

.....

.....

.....

(Total for question = 3 marks)

Q2.

Figure 8 shows one molecule of each of four different substances, A, B, C and D.

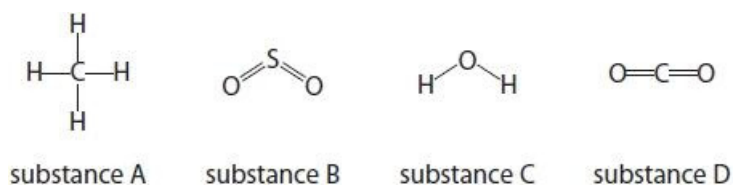


Figure 8

Carbon dioxide is present in the Earth's atmosphere.

Some processes increase the amount of carbon dioxide in the atmosphere, other processes decrease it.

Draw one straight line from each change in the amount of carbon dioxide in the atmosphere to the process causing the change.

(2)

**change in the amount of
carbon dioxide in the atmosphere**

increase

decrease

process causing the change

carbon dioxide absorbing
the Sun's energy

carbon dioxide dissolving
in oceans

volcanic emissions

using argon in light bulbs

burning hydrogen

(Total for question = 2 marks)

Q3.

The atmosphere contains 21% of oxygen.

(i) Figure 1 shows an incomplete bar chart of the main gases in the atmosphere.

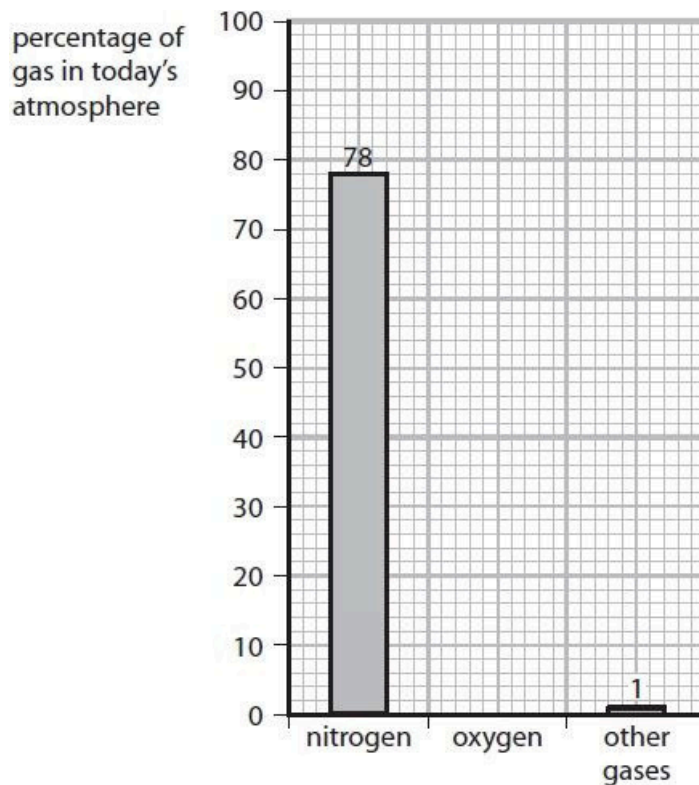


Figure 1

Complete the bar chart by showing the percentage of oxygen in the atmosphere.

(1)

(ii) Calculate the volume of oxygen present in 300 cm³ of air.

(volumes are measured under the same conditions of temperature and pressure)

(2)

.....
.....

volume of oxygen = cm³

(Total for question = 3 marks)

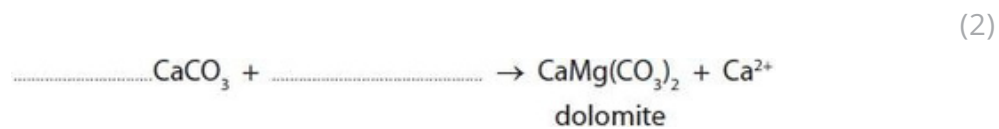
Q4.

Much of the carbon dioxide present in the Earth's early atmosphere dissolved into the oceans.

This led to the formation of compounds including calcium carbonate, CaCO_3 .

Some of the calcium carbonate reacted with magnesium ions to form dolomite, $\text{CaMg}(\text{CO}_3)_2$.

Complete the ionic equation for the reaction of calcium carbonate with magnesium ions.



(Total for question = 2 marks)

Q5.

Potassium reacts with oxygen to form potassium oxide.

(i) Describe the test to show that a gas is oxygen.

(2)

.....
.....
.....
.....

(ii) Potassium oxide is ionic.

Write the electronic configurations for the ions in potassium oxide, K_2O .

(2)

potassium ion:

oxide ion:

(Total for question = 4 marks)

Q6.

Figure 9 shows a sample of hydrogen peroxide solution decomposing to form water and oxygen gas.

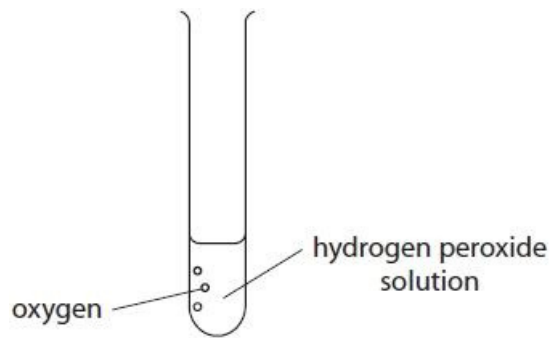


Figure 9

Describe the test to show the gas produced is oxygen.

(2)

.....

.....

.....

(Total for question = 2 marks)

Q7.

This question is about oxygen.

A student uses the apparatus shown in Figure 10 to investigate the percentage of oxygen in the atmosphere.

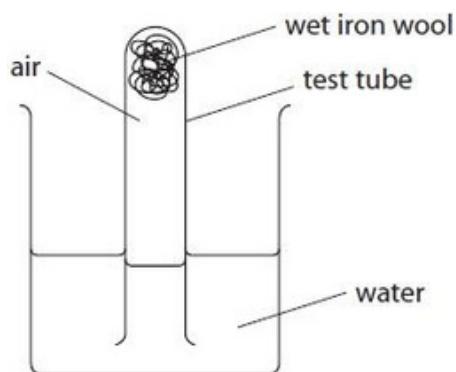


Figure 10

The apparatus was left for a few days.

(i) Explain one change the student would see after a few days.

(2)

.....
.....

(ii) Explain one change that can be made to the apparatus in Figure 10 to allow the student to calculate the percentage of oxygen in the atmosphere.

(2)

.....
.....
.....
.....

(Total for question = 4 marks)

Q8.

This question is about gases.

* Figure 16 shows the relative amounts of three gases in the early atmosphere compared to the composition of today's atmosphere.

gas	relative amount in early atmosphere	composition of today's atmosphere
water vapour	large amount	0% to 4%
carbon dioxide	large amount	less than 0.5%
oxygen	little or none	21%

Figure 16

Natural processes and human activities have altered the relative amounts of these gases in the atmosphere.

Explain how the relative amount of each of the gases in Figure 16 has increased or decreased over time.

(6)

(Total for question = 6 marks)

Q9.

This early atmosphere was hot and contained water vapour.
The atmosphere today contains less water vapour.

Explain what caused the amount of water vapour in the atmosphere to decrease.

(2)

.....
.....
.....
.....

(Total for question = 2 marks)

Q10.

This question is about oxygen.

The percentage of oxygen in today's atmosphere is greater than the percentage of oxygen in the Earth's early atmosphere.

Explain what caused this change to happen.

(2)

.....
.....
.....
.....

(Total for question = 2 marks)

Q11.

and Q are both mixtures of gases.

One has the same composition as the early atmosphere and the other has the same composition as the current atmosphere.

Tests are carried out on gas mixtures P and Q.

The test for carbon dioxide is to bubble the gas into limewater; if carbon dioxide is present calcium carbonate is formed.

The results of the tests are shown in Figure 6.

test	result with gas mixture P	result with gas mixture Q
bubble gas into limewater	white precipitate forms after 4 minutes	white precipitate forms after 10 seconds
place burning splint into gas mixture	splint continues to burn	splint immediately goes out

Figure 6

Explain, using the data in Figure 6, which gas mixture represents the early atmosphere.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q12.

Give the name of the most common gas in the Earth's early atmosphere.

(1)

.....

(Total for question = 1 mark)

Q13.

The Earth's atmosphere contains several gases.

The apparatus shown in Figure 2 is used to find the percentage of oxygen in dry air.

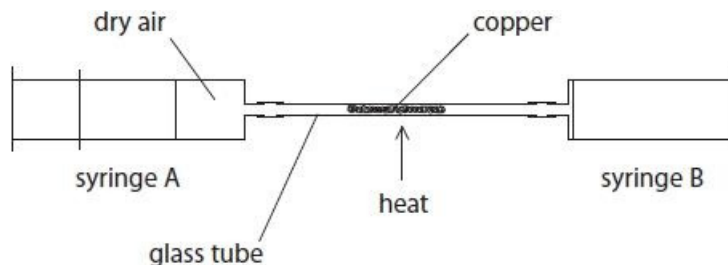


Figure 2

Syringe A contains 50 cm³ of dry air and syringe B contains no air.

The copper in the glass tube is heated strongly.

The air in the apparatus is passed backwards and forwards over the copper until all the oxygen has been removed.

(i) The following results were obtained

initial volume of air in apparatus = 50 cm³

final volume of gas in apparatus = 40 cm³

Calculate the percentage of oxygen in this sample of dry air.

(2)

.....

.....

.....

percentage oxygen in the air =

(ii) At the end of the experiment, the apparatus and its contents are allowed to cool before the final volume of gas is measured.

(1)

The apparatus and its contents must be allowed to cool because

- A reading the volume while the apparatus is hot is dangerous
- B the glass tube may crack when it is hot and allow air into the apparatus
- C the gas has expanded when it is hot
- D the copper reacts with other gases in the air when it is hot

(Total for question = 3 marks)

Q14.

Figure 8 shows one molecule of each of four different substances, A, B, C and D.

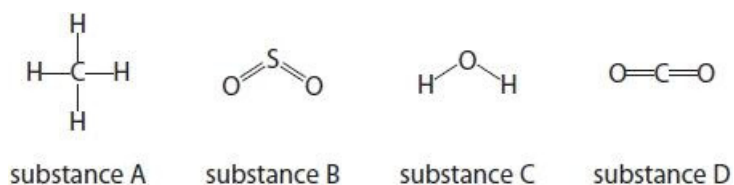


Figure 8

The amount of oxygen in the atmosphere has increased since the Earth's early atmosphere was formed.

Explain what has caused this change.

(2)

.....

.....

.....

(Total for question = 2 marks)

Q15.

The Earth's atmosphere contains several gases.

The Earth's earliest rocks contained iron sulfide and no iron oxide.

Later the rocks contained iron oxide as well as iron sulfide.

Explain what happened to allow this change to occur.

(2)

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q16.

The Earth's atmosphere contains several gases.

Figure 1 shows the relative amounts of gases thought to be in the Earth's early atmosphere.

gas	relative amount in Earth's early atmosphere
oxygen	small
carbon dioxide	large
nitrogen	small
water vapour	large

Figure 1

The amount of water vapour in today's atmosphere is much less than the amount in the Earth's early atmosphere.

Explain why the amount of water vapour in the atmosphere has decreased.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q17.

Figure 8 shows one molecule of each of four different substances, A, B, C and D.

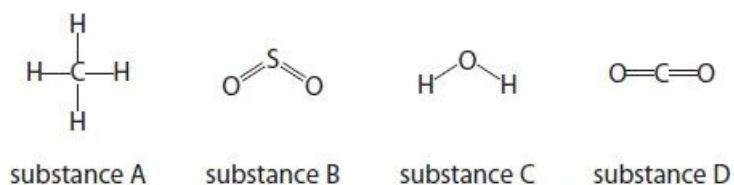


Figure 8

Figure 9 shows a graph of the amount of carbon dioxide in the Earth's atmosphere from 1985 to 2005.

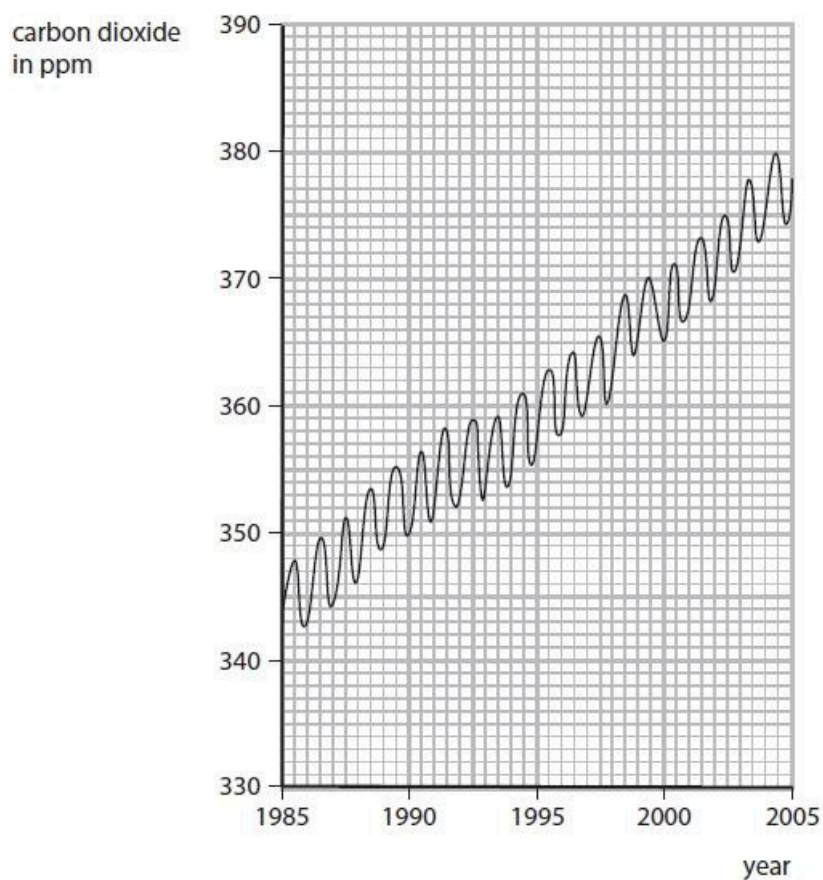


Figure 9

(i) Describe how the amount of carbon dioxide in the Earth's atmosphere varies within each year.

(1)

.....

.....

.....

(ii) Describe the overall trend in the amount of carbon dioxide in the Earth's atmosphere from 1985 to 2005.

(1)

.....
.....
.....

(iii) Calculate the change in the amount of carbon dioxide in the Earth's atmosphere from the beginning of 1990 to the beginning of 2000.

(2)

.....
.....
.....

change in amount = ppm

(Total for question = 4 marks)

Q18.

Carbon dioxide is one of the gases in the Earth's atmosphere.
 The percentage of carbon dioxide in the Earth's atmosphere has changed over time.

(i) Which row of the table shows the approximate percentage of carbon dioxide thought to be in the Earth's early atmosphere and how this percentage changed to form the Earth's atmosphere today?

(1)

	approximate percentage of carbon dioxide in the Earth's early atmosphere	change in percentage carbon dioxide to form the Earth's atmosphere today.
<input type="checkbox"/> A	5	increased
<input type="checkbox"/> B	5	decreased
<input type="checkbox"/> C	95	increased
<input type="checkbox"/> D	95	decreased

(ii) The actual percentage of carbon dioxide in the Earth's atmosphere today varies.

Explain two factors that cause the percentage of carbon dioxide in today's atmosphere to vary.

(4)

factor 1

.....

.....

.....

.....

factor 2

.....

.....

.....

.....

(Total for question = 5 marks)

Mark Scheme

Q1.

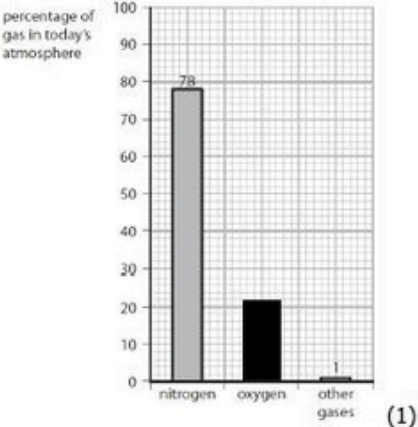
Question number	Answer	Mark	
(i)	allow 2 for correct answer with or without working change in concentration = $410.83 - 407.96$ (= 2.87) (1) = 3 (1)	(2)	
Question number	Answer	Additional guidance	Mark
(ii)	volcanic activity / burning of fossil fuels / deforestation / respiration	allow more vehicles on road ignore global warming / ice-caps melting / farming	(1)

Q2.

Question Number	Answer	Mark
	<p>change in the amount of carbon dioxide in the atmosphere</p> <p>process causing the change</p> <p>reject multiple lines from a box</p>	(2) AO 1 1

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Q3.

Question number	Answer	Additional guidance	Mark
(i)	Vertical bar for oxygen to just over 20% as shown in the bar chart (ignore width): 	ignore bars touching each other ignore 21 above bar	(1)
(ii)	MP1 : $\frac{21}{100}$ (1) (=0.21) MP2 : 0.21×300 (1) (= 63) (cm ³)	63 (cm ³) with no working scores 2 marks 300/4.76 = 63 (2) 300/4.8 = 62.5 (2) allow 21 x 300 (1) (= 6300) allow $\frac{300}{100}$ (1) (= 3)	(2)

Q4.

Question number	Indicative content	Mark
	$2 \text{CaCO}_3 + \text{Mg}^{2+} \rightarrow \text{CaMg}(\text{CO}_3)_2 + \text{Ca}^{2+}$ 2 (1) Mg^{2+} (1)	(2)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	A description to include <ul style="list-style-type: none"> • use of glowing splint (1) • (glowing splint) relights (1) 	2 nd mark dependent on correct test	(2) AO1

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Question number	Answer	Additional guidance	Mark
(ii)	potassium ion: 2.8.8 (1) oxide ion: 2.8 (1)	Allow other separators between the numbers including spaces	(2) AO1

Q6.

Question number	Answer	Additional guidance	Mark
	A description to include glowing splint (1) relights (1)	MP2 is dependent on MP1	(2) AO1

Q7.

Question number	Answer	Additional guidance	Mark
(i)	iron wool {turns orange-brown / rusts} (1) (because) it has {oxidised/ reacted with oxygen} (1) OR water level in test tube rises (1) (because) oxygen (in the air) has reacted (with the iron) / volume of oxygen (in test tube) has decreased (1)	allow any suitable colour to describe rust ignore changes colour ignore air allow volume of air decreases the iron turns orange-brown because it has rusted = 2 marks allow 1 mark for volume of water (in beaker) decreases due to evaporation	(2) AO2 2

Question number	Answer	Additional guidance	Mark
(ii)	<p>replace test tube with a measuring cylinder (1)</p> <p>to measure the {volume / amount} of oxygen used up / to measure the change in {volume / amount} of gas in the tube (1)</p>	<p>graduated test tube allow (upturned) burette ignore gas syringe</p> <p>allow air in place of gas</p> <p>allow gas syringe (0) to measure volume of oxygen used (1) allow use of ruler (1) to measure water heights (1)</p>	(2) AO3 3

Q8.

Question number	Indicative content	Mark
	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>AO1 (6 marks)</p> <p>Natural: Origins:</p> <ul style="list-style-type: none"> • {carbon dioxide / water / gases} from volcanoes • the Earth cooled • so water vapour condensed (to form oceans/seas) reducing amount of water vapour • carbon dioxide {dissolves in/absorbed by} the oceans reducing amount of carbon dioxide • some carbon dioxide incorporated into sea animals' shells <p>Natural: Evolution</p> <ul style="list-style-type: none"> • plants evolved • photosynthesis • photosynthesis releases oxygen increasing amount of oxygen • photosynthesis absorbs carbon dioxide reducing amount of carbon dioxide <p>Human effects</p> <ul style="list-style-type: none"> • amounts of carbon dioxide in recent time increasing due to burning fossil fuels • amounts of carbon dioxide in recent time increasing due to agriculture • deforestation means less carbon dioxide absorbed • reforestation means more oxygen produced 	(6) AO1

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Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> • Demonstrates elements of chemical knowledge, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	<ul style="list-style-type: none"> • Demonstrates chemical knowledge, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	<ul style="list-style-type: none"> • Demonstrates accurate and relevant chemical knowledge throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then: Information directly copied from the table is not credited e.g water vapour goes down Water vapour has gone down (0) Humans respire giving carbon dioxide (0)
Level 1	1-2	<u>Additional Guidance</u> Candidate gives basic ideas only, these may or may not be linked	<u>Possible candidate response</u> Carbon dioxide is produced by volcanoes (1) Water vapour decreased because the earth cooled (1) Water vapour in the atmosphere condensed to form oceans (2) Trees photosynthesise and absorb carbon dioxide (2) Trees take in carbon dioxide and produce oxygen (2) Plants release oxygen, burning fossil fuels release carbon dioxide (2)
Level 2	3-4	<u>Additional Guidance</u> candidate gives basic idea about two areas. OR candidate gives a detailed explanation about one process	<u>Possible candidate response</u> Carbon dioxide is absorbed during photosynthesis by plants and burning fossils produces carbon dioxide (3) Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide (4) Trees photosynthesise which absorb carbon dioxide and release oxygen (3) Primitive plants evolved in oceans and started to photosynthesise which decreased the amount of carbon dioxide and increase the amount oxygen in the atmosphere. (4)

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Level 3	5-6	<u>Additional Guidance</u> candidate explains ideas about all three areas	<u>Possible candidate response</u> Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide. Cars produce carbon dioxide (5) Trees photosynthesise which absorb carbon dioxide and release oxygen. The Earth cooled and water condensed to produce oceans, these oceans absorbed carbon dioxide. Burning fossil fuels produces carbon dioxide and deforestation has led to fewer trees and therefore less carbon dioxide being absorbed (6)
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Q9.

Question number	Answer	Additional guidance	Mark
	An explanation linking any two <ul style="list-style-type: none"> • Earth cooled (1) • water (vapour) condensed (1) • oceans formed / seas formed/ rainfall (1) 	allow temperature decreased	(2)

Q10.

Question number	Answer	Additional guidance	Mark
	an explanation linking <ul style="list-style-type: none"> • plants (1) • (produces oxygen by) photosynthesis (1) 	allow cyanobacteria / stromatolites allow 'photosynthetic organisms' = 2 marks	(2) AO1 1

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Q11.

Question number	Indicative content	Additional guidance	Mark
	<p>An explanation to include</p> <p>Q is early atmosphere (0) because</p> <ul style="list-style-type: none"> limewater ppt faster so contains {more/large amount of} carbon dioxide (1) splint goes out so {little/no oxygen} (1) 	<p>If P given then (0)</p> <p>If neither P nor Q stated they must be clearly referring to Q to score.</p>	(2)

Q12.

Question number	Answer	Additional guidance	Mark
	carbon dioxide	allow CO ₂	(1)

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	<p>final answer of 20 (%) with or without working (2)</p> <p>volume gas used = 50-40 (1) (= 10 (cm³))</p> <p>percentage = (50-40)/50 x 100 (1) = 20 (%)</p>	<p>allow ecf throughout</p> <p>allow 40-50 (1) (= -10cm³)</p> <p>allow 40/50 x 100 = 80% (1) then 100 - 80 = 20% (1)</p> <p>if no other marks awarded allow 10/50 = 0.2 (1)</p>	(2) AO 2 2

Question Number	Answer	Mark
(ii)	<p>C the gas has expanded when it is hot</p> <p>The only correct answer is C</p> <p><i>A is not correct because this is not true</i></p> <p><i>B is not correct because this is not relevant</i></p> <p><i>D is not correct because this is not true</i></p>	(2) AO 2 2

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Q14.

Question Number	Answer	Additional guidance	Mark
	An explanation including <ul style="list-style-type: none"> plants (grow/ evolve etc.) (1) photosynthesis occurs (1) 	allow trees or any other reference to plants reject respiration/breathing for MP2 ignore all other information	(2) AO 1 1

Q15.

Question Number	Answer	Additional guidance	Mark
	An explanation linking <ul style="list-style-type: none"> oxygen increased (in atmosphere) (1) (oxygen) {reacts / combines} with iron (sulphide) / iron is oxidised (1) 	allow oxygen appears (1) photosynthesis produces oxygen (1) ignore oxygen reacts with <u>rocks</u> / sulfur <u>in rocks</u> replaced by oxygen / oxygen enters <u>rocks</u> / iron ore	(2) AO 2 1

Q16.

Question Number	Answer	Additional guidance	Mark
	An explanation linking <ul style="list-style-type: none"> (Earth) cooled / temperature decreased (1) (water vapour / steam) condensed / oceans formed (1) 	allow temperature of atmosphere/ Earth decreased allow it rained (and formed oceans) allow lakes/seas	(2) AO 1 1

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Q17.

Question Number	Answer	Additional guidance	Mark
(i)	suitable description of variation (within a year) (1)	allow increases and decreases / goes up and down [or vice-versa] allow fluctuates reject a pattern described for a timescale other than a year e.g. goes up one year and down the next	(1) AO 3 2a

Question Number	Answer	Additional guidance	Mark
(ii)	increases (over time) (1)	ignore from (number) to (number) allow positive correlation, trend etc.	(1) AO 3 2a

Question Number	Answer	Additional guidance	Mark
(iii)	15 with no working or correct working scores 2 figures read from graph 364-366 and 349-351 (1) subtraction of numbers from above (1)	negative answer does not score 2 nd mark	(2) AO 2 1

Q18.

Question number	Answer	Mark
(i)	D 95 decreased is the only correct answer A is incorrect as the percentage of carbon dioxide was thought to be 95% B is incorrect as the percentage of carbon dioxide was thought to be 95% C is incorrect as the amount of carbon dioxide has decreased	(1)

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Question number	Answer	Additional guidance	Mark
(ii)	<p>An explanation to include any two linked pairs</p> <p>combustion/ burning of fossil fuels (1) {increases/ gives out} carbon dioxide (1)</p> <p>respiration (1) increases carbon dioxide (1)</p> <p>increases in sea temperature (1) release of (dissolved) carbon dioxide (1)</p> <p>photosynthesis (1) {absorbs/ takes in/ reduces} carbon dioxide (1)</p> <p>carbon dioxide (dissolves) into the sea (1) carbon dioxide decreases (1)</p> <p>volcanic emissions (1) releases carbon dioxide (1)</p> <p>deforestation means less photosynthesis (1) carbon dioxide increases (1)</p> <p>use of alternative energy/ electric cars (1) less carbon dioxide release (1)</p>	<p>each pair to be separately marked; MP2 dependent on MP1</p> <p>allow named fossil fuel / carbon compound that is burnt e.g. wood ignore 'use of fossil fuels' / 'use of cars' but allow MP2</p> <p>ignore 'breathing' / 'population increase' but allow MP2</p> <p>ignore 'plants/ trees' etc but allow MP2</p> <p>ignore 'deforestation' alone but allow MP2</p>	(4)