

1.

An increase in greenhouse gases in the Earth's atmosphere causes an increase in global temperature.

(a) An increase in global temperature is a major cause of climate change.

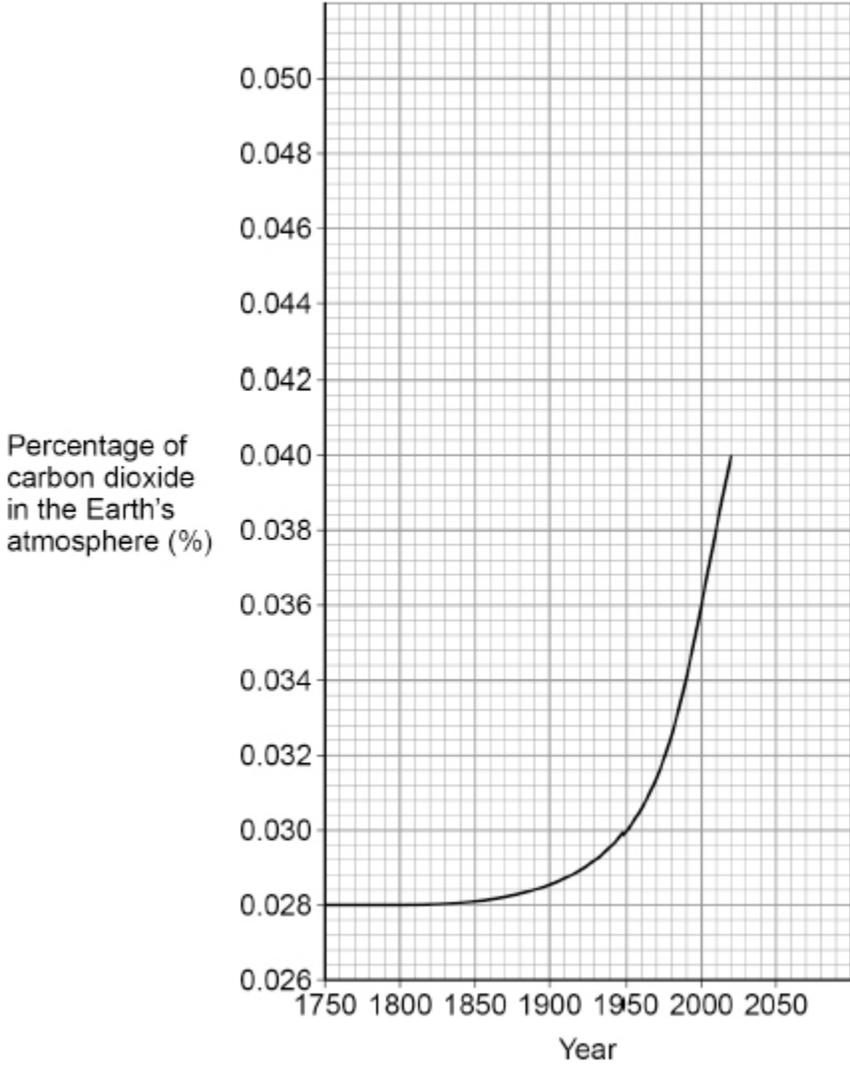
Give **two** effects of global climate change.

- 1 _____
- _____
- 2 _____
- _____

(2)

Carbon dioxide is a greenhouse gas.

The graph below shows the percentage of carbon dioxide in the Earth's atmosphere from 1750.



- (b) Describe the trend in the percentage of carbon dioxide in the Earth's atmosphere from 1750 to 2000.

Use the graph above.

(2)

- (c) Determine the change in the percentage of carbon dioxide in the Earth's atmosphere from 1950 to 2000.

Use the graph above.

Percentage of carbon dioxide in 1950 _____

Percentage of carbon dioxide in 2000 _____

Change in percentage of carbon dioxide = _____ %

(2)

- (d) Give **one** reason why the percentage of carbon dioxide in the atmosphere is changing.

(1)

- (e) Predict the percentage of carbon dioxide in the Earth's atmosphere in 2050.

You should extend the graph line on the graph above.

Percentage of carbon dioxide in 2050 = _____ %

(2)

(Total 9 marks)

2.

This question is about the atmospheres of Earth and Mars.

- (a) Earth's early atmosphere may have been like the atmosphere of Mars today.

Why are scientists **not** certain about the percentage of gases in the Earth's early atmosphere?

(1)

(b) What was formed from the water vapour in the Earth's early atmosphere?

Tick (✓) **one** box.

Crude oil

Limestone

Natural gas

Oceans

(1)

(c) The Earth's atmosphere today consists mainly of nitrogen and oxygen.

Draw **one** line from each gas to what produced the gas.

Gas	What produced the gas
	Algae
Nitrogen	Animals
	Fossils
Oxygen	Oceans
	Volcanoes

(2)

The table below shows the percentage of some gases in the atmospheres of Earth and Mars.

Gas	Percentage of gas in atmosphere (%)	
	Earth	Mars
Argon	0.9	1.9
Carbon dioxide	0.04	95
Nitrogen	78	2.6
Oxygen	21	0.2

(d) Why are animals **not** able to live on Mars?

Tick (✓) **one** box.

The atmosphere of Mars does not contain enough argon.

The atmosphere of Mars does not contain enough nitrogen.

The atmosphere of Mars does not contain enough oxygen.

(1)

(e) There is more carbon dioxide on Mars than on Earth.

Which **other** gas is found in larger quantities on Mars than on Earth?

(1)

(f) Calculate how many times more nitrogen than oxygen there is in the atmosphere of Earth.

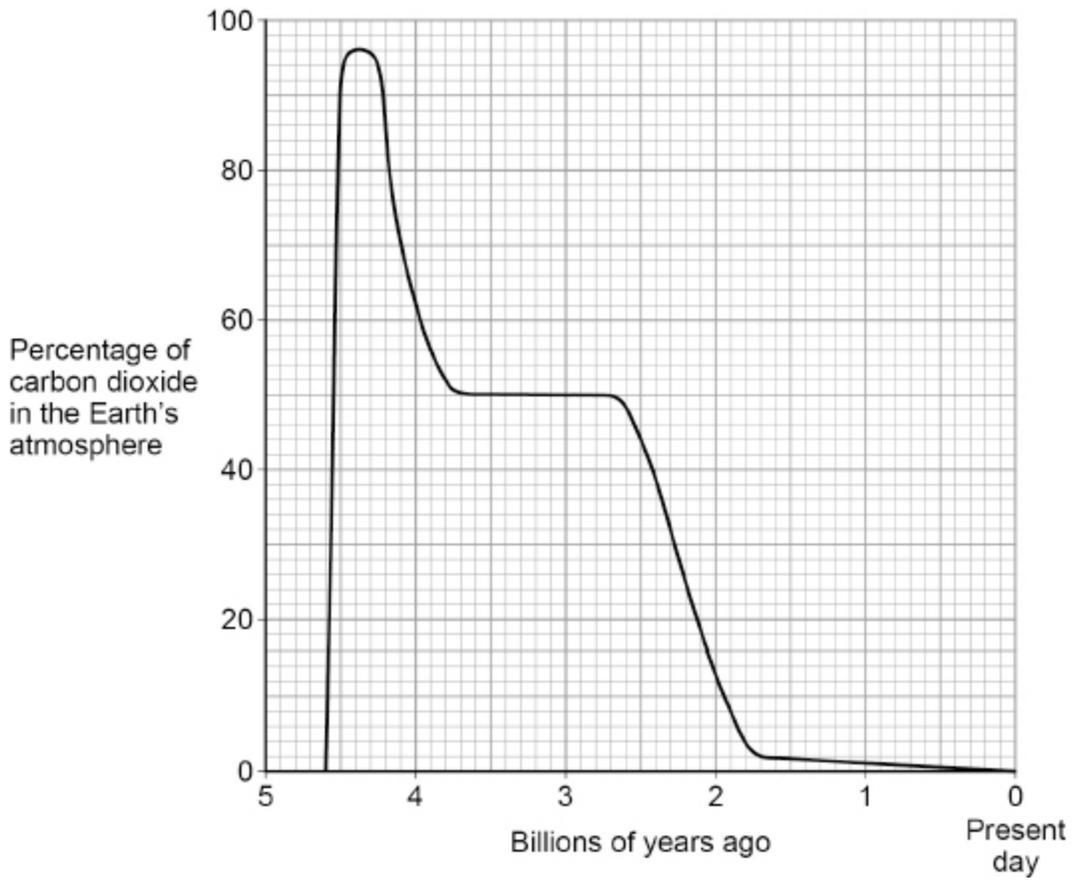
Use the table above.

Give your answer to 2 significant figures.

Number of times more nitrogen than oxygen (2 significant figures) = _____

(3)

(Total 9 marks)



(b) The mass of gas in Earth's atmosphere remains constant at 5.15×10^{18} kg
 Determine the maximum mass of carbon dioxide that was in the Earth's atmosphere.
 Use the graph above.

Mass of carbon dioxide = _____ kg

(3)

5.

There is limited evidence about the Earth's early atmosphere because of the age of the Earth.

(a) The Earth is 4.6 billion years old.

Which is the correct age of the Earth?

Tick **one** box.

4.6×10^3 years

4.6×10^6 years

4.6×10^9 years

4.6×10^{12} years

(1)

Scientists think that the Earth's early atmosphere may have been similar to the atmosphere on Mars today.

Look at the table below.

Gas	Concentration of gas in the atmosphere today in parts per million	
	Mars	Earth
Nitrogen	27 000	780 000
Oxygen	1 300	210 000
Argon	16 000	9 300
Carbon dioxide	950 000	400
Carbon monoxide	800	trace

- (b) Calculate the percentage increase in nitrogen from the Earth's early atmosphere to the atmosphere today.

Assume the Earth's early atmosphere was the same as the atmosphere today on Mars.

Give your answer to 2 significant figures.

Percentage increase in nitrogen = _____ %

(3)

- (c) Which process releases carbon monoxide into the Earth's atmosphere?

Tick **one** box.

Aerobic respiration

Bacterial decomposition

Incomplete combustion

Photosynthesis

(1)

- (d) Explain how the oceans were formed in the first billion years of the Earth's existence.

(2)

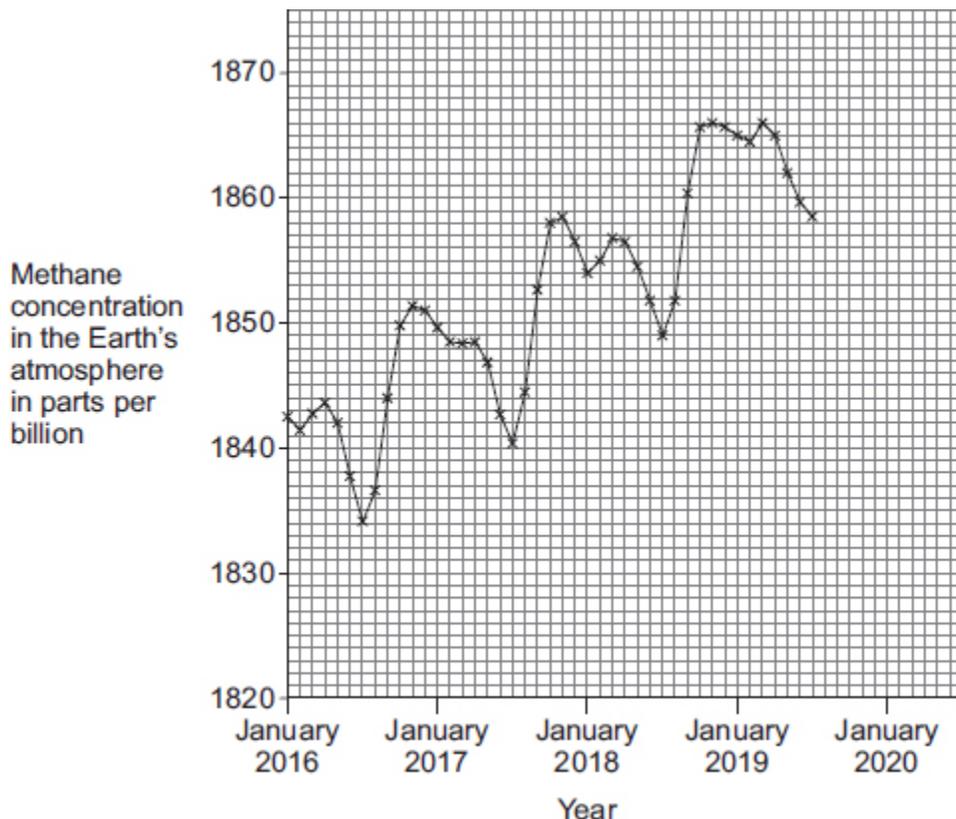
- (e) Describe how the increase in greenhouse gases has increased the mass of liquid water in the oceans.

(1)

(Total 8 marks)

6.

The graph below shows recent changes in the methane concentration in the Earth's atmosphere.



- (a) Determine the percentage increase in methane concentration in the Earth's atmosphere from January 2018 to January 2019.

Percentage increase = _____ %

(3)

(b) Methane is a greenhouse gas.

Scientists **cannot** make accurate predictions about the concentration of methane in the Earth's atmosphere in the future.

Give **one** reason why.

Use the graph above.

(1)

(c) Explain why protecting peat bogs may reduce global warming.

(2)

(d) Greenhouse gases maintain temperatures on Earth high enough to support life.

Describe the greenhouse effect in terms of the interaction of short-wavelength and long-wavelength radiation with matter.

(4)

(a) Which gas has the largest percentage in Earth's atmosphere today?

Tick (✓) **one** box.

Carbon dioxide	<input type="checkbox"/>
Nitrogen	<input type="checkbox"/>
Oxygen	<input type="checkbox"/>

(1)

(b) What is value **X** in the table above?

Tick (✓) **one** box.

0.5%	<input type="checkbox"/>	1.0%	<input type="checkbox"/>	1.5%	<input type="checkbox"/>	4.5%	<input type="checkbox"/>
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(1)

(c) Describe **three** differences between Earth's early atmosphere and Earth's atmosphere today.

Use the table above.

1. _____

2. _____

3. _____

(3)

(d) What released the gases into Earth's early atmosphere?

Tick (✓) **one** box.

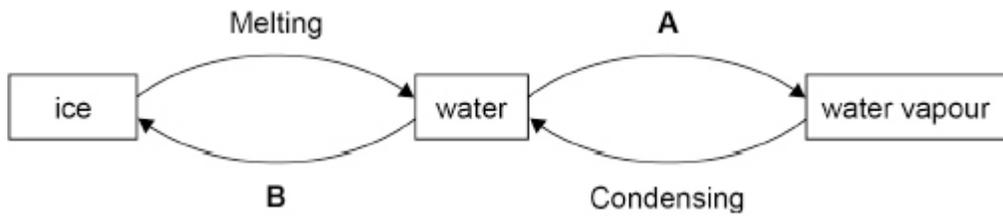
- Fossil fuels
- Sedimentary rocks
- Volcanoes

(1)

One of the other gases in Earth's atmosphere today is water vapour.

(e) Water can exist in three different states of matter.

The diagram below shows the different states of water.



Name processes **A** and **B**.

A _____

B _____

(2)

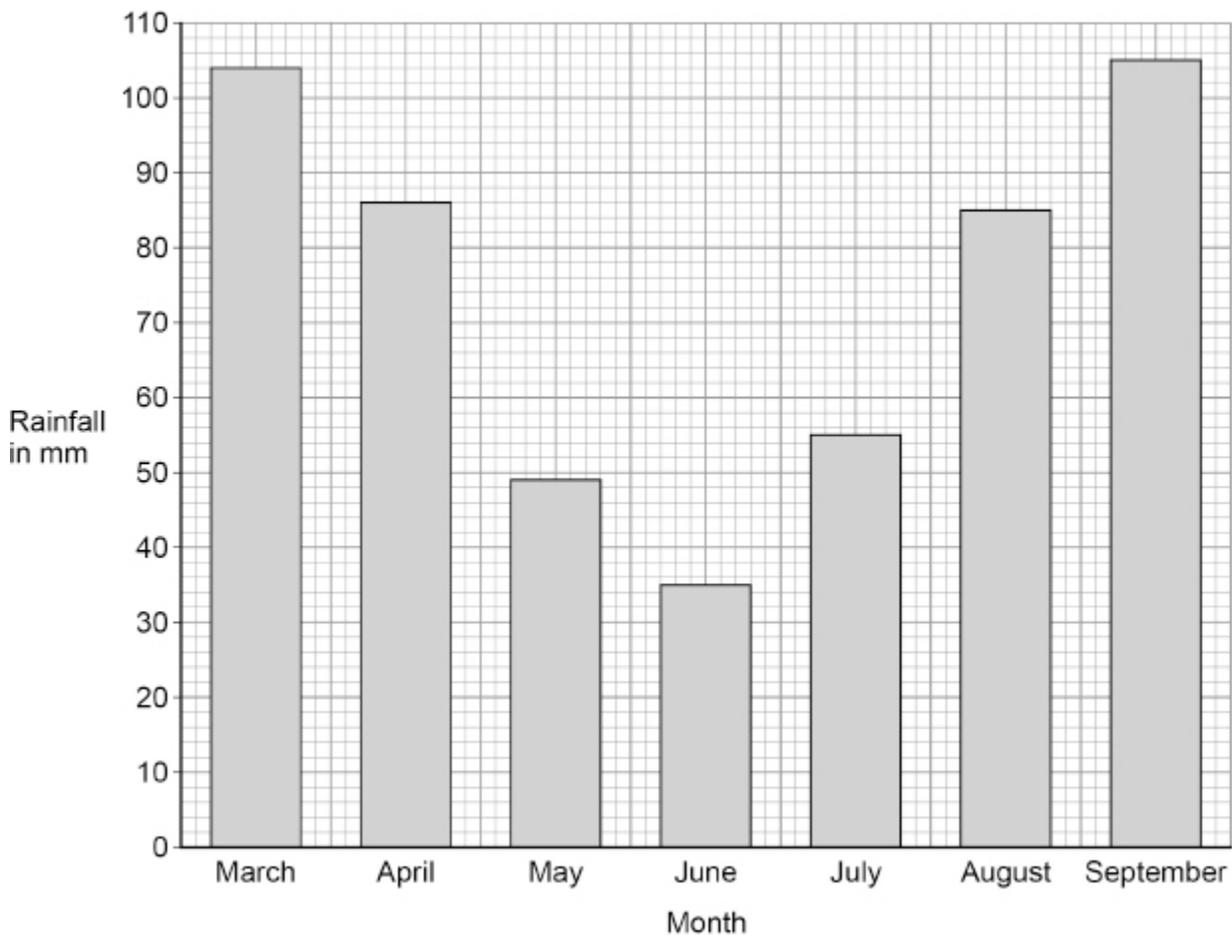
Water vapour precipitates as rain.

(f) Name **one** other form of precipitation of water from the atmosphere.

Do **not** refer to rain in your answer.

(1)

The graph below shows the rainfall from March to September in the UK.



(g) What was the rainfall in the month of April?

Rainfall = _____ mm

(1)

(h) Describe the pattern in rainfall between March and September.

Include data from the graph above in your answer.

(2)

(Total 12 marks)

Mark schemes

1.

(a) 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

(b) constant

allow no change

allow stays same

1

(then) increases

ignore values if given

1

(c) (1950) 0.030

and

(2000) 0.036

1

$(0.036 - 0.030) = 0.006$ (%)

allow correct use of incorrectly determined percentage reading(s)

ignore + or -

1

(d) any **one** from:

- combustion of fuel

allow any named activity which burns fuel

- deforestation
- population increase

1

(e) extrapolation on graph

1

determine value from extrapolation at 2050

allow a value in the range 0.044 to 0.050

allow a tolerance of $\pm \frac{1}{2}$ a small square

1

[9]

2.

(a) any **one** from:

- occurred (4.6) billion years ago
- limited evidence

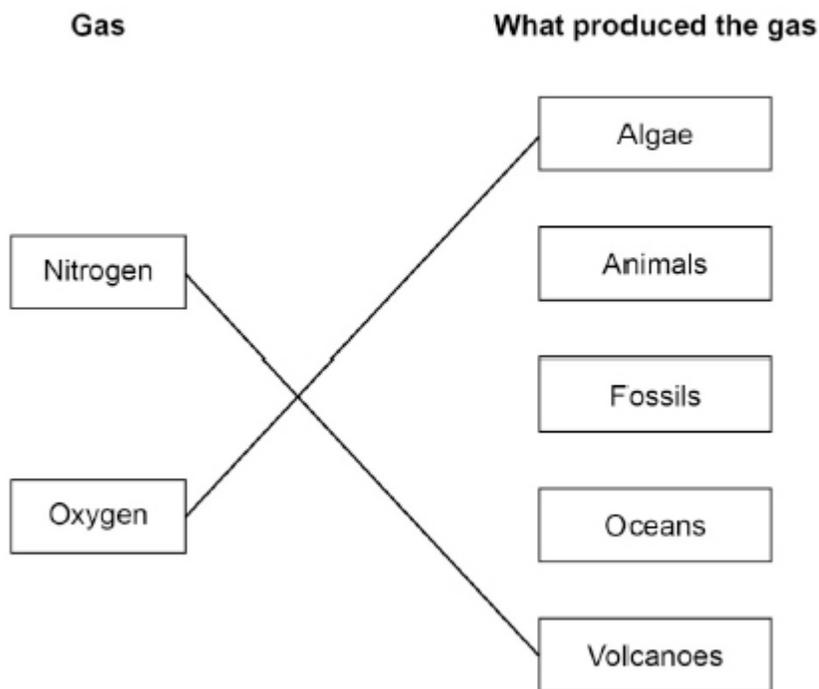
ignore nobody was there ignore no proof

1

(b) oceans

1

(c)



do **not** accept more than one line from a box on the left

1

1

(d) the atmosphere of Mars does not contain enough oxygen

1

(e) argon

allow Ar

1

(f) $\frac{78}{21}$

1

= 3.714

do **not** accept a subsequent step in the calculation

1

= 3.7

allow an answer correctly calculated to 2 significant figures which uses the values in the question

1

[9]

3.

(a) **D B C A**

1

(b) (maximum % =) 96 (%)

allow a value in the range 95 to 97 (%)

1

(maximum mass =)

$\frac{96}{100} \times 5.15 \times 10^{18}$

allow correct use of incorrectly determined percentage

1

= 4.94×10^{18} (kg)

allow 4.944×10^{18} (kg)

1

(c) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4–6

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

[10]

4.

(a) methane

allow CH₄ or water (vapour) or H₂O

allow correct example such as CFCs, nitrous oxide, ozone

1

(b)

ignore references to increased temperature and greenhouse gas / effect

any **two** from:

- ice caps melting
- rise in sea levels
- desertification
- extreme weather

allow storms or droughts or flooding

- change in species distribution
- change in migration patterns
- loss of biodiversity

allow some species become extinct / endangered

- coral bleaching
- crop failure **or** food insecurity
- loss of habitat qualified

allow correct examples such as polar bears losing ice

ignore forest fires

2

(c) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4–6

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

Photosynthesis

- (carbon dioxide is) taken in through stomata / leaves
- (carbon dioxide is) used in photosynthesis
- to make glucose / carbohydrate
- (glucose used) to make other carbon compounds or named example such as proteins, lipids
- (glucose) stored as starch

Feeding

- plants are eaten / consumed by animals
- which use the carbon compounds to make other carbon compounds

Decay

- when plants / animals die they are decomposed / decayed
- by microorganisms
- which use the carbon compounds to make other carbon compounds

Respiration

- plants / animals / microorganisms respire
- (respiration) releases carbon dioxide back into the atmosphere

Level 2 answers must consider photosynthesis and at least one other process in the carbon cycle.

Level 2 answers must include some accurate detail.

[9]

- 5.** (a) 4.6×10^9 years 1
- (b) $\frac{780\,000 - 27\,000}{27\,000} \times 100$ 1
- $= 2788.8$ 1
- $= 2800$ (%) 1
- 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]

6.

- (a) (2018) 1854 (ppb)
and
(2019) 1865 (ppb)

1

$$\frac{1865 - 1854}{1854} \times 100$$

allow $\frac{11}{1854} \times 100$

allow correct use of incorrectly determined concentration values

1

0.593 (%)

allow any answer that rounds to 0.593 (%)

1

- (b) any **one** from:

- variation month to month (within a year)
ignore variation unqualified
- variations in changes between years
- variation about the trend line

allow increasing awareness of climate change may

cause reduced (increase in) methane emissions

allow cannot predict if more livestock will be farmed

allow may eat / produce less meat

allow may eat / plant less rice

allow methane (production) from landfill is unpredictable

1

- (c) less carbon dioxide released

ignore peat bogs release methane

*do **not** accept methane released when burnt*

1

(because) less decomposition of peat (as compost)

or

(because) less burning of peat

allow peat absorbs carbon dioxide when

photosynthesising (1)

so more carbon dioxide would be removed from the

atmosphere (1)

1

(d)	short(er) wavelength radiation which enters the atmosphere (from the Sun) <i>allow UV / ultraviolet / gamma radiation which enters the atmosphere (from the Sun)</i>	1
	(short(er) wavelength radiation) is absorbed by matter / materials / Earth and re-emitted	1
	as a longer wavelength radiation <i>allow as IR / infrared radiation</i>	1
	(the longer wavelength radiation) is absorbed by a greenhouse gas which reduces radiation escaping (to space) or (the longer wavelength radiation) is absorbed by a greenhouse gas so temperature increases <i>allow a named greenhouse gas or atmosphere for greenhouse gas(es)</i>	1
(e)	Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4-6
	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

Evidence from volcanoes

- (current) volcanic emissions
- release of carbon dioxide
- water vapour (from volcanoes) condensed (forming oceans) therefore decreased in atmosphere
- nitrogen (from volcanoes) (mostly) remained due to low reactivity of nitrogen
- methane / ammonia (from volcanoes) entered atmosphere

Evidence from plants / algae / photosynthesis

- (eventually) photosynthesis by algae / plants decreased carbon dioxide
- photosynthesis by algae / plants increased oxygen

Evidence from oceans / rocks

- carbon dioxide decreased in the atmosphere as it dissolved in the oceans
- carbon dioxide also decreased in formation of sedimentary rocks

Evidence from other planets

- the current atmospheres of Mars and Venus are mainly carbon dioxide which adds evidence for this theory

For **Level 2** responses must refer to detail of volcanoes and one other source of evidence (photosynthesis / oceans / rocks / planets)

[16]

- | | | |
|-----------|---|---|
| 7. | (a) nitrogen | 1 |
| | (b) 1.0% | 1 |
| | (c) (Earth's early atmosphere had) any three from: <ul style="list-style-type: none">• more carbon dioxide• less nitrogen• less oxygen• more other gases <p style="margin-left: 40px;"><i>allow similar values for other gases</i></p> <p style="margin-left: 40px;"><i>allow converse for Earth's atmosphere today</i></p> <p style="margin-left: 40px;"><i>if clearly stated</i></p> <p style="margin-left: 40px;"><i>ignore references to values</i></p> | 3 |
| | (d) volcanoes | 1 |
| | (e) A boiling | |
| | <i>allow evaporating</i> | 1 |
| | B freezing | |
| | <i>allow solidifying</i> | 1 |

(f) any **one** from:

- sleet
- snow

allow hail(stones)

ignore ice

1

(g) 86 (mm)

allow a value in the range 85 to 87 (mm)

1

(h) rainfall decreases from 104 (mm) to 35 (mm)

allow rainfall decreases (from March) to June

1

(then) increases to 105 (mm)

allow rainfall (then) increases from June / July (to September)

if no other mark awarded allow rainfall decreases then increases for 1 mark

1

[12]