

CHEMISTRY



KS3 SCIENCE EXAM PREPARATION STUDENT BOOK

CHEMISTRY OF THE ATMOSPHERE

Please complete all of these questions in this book and store this work in your student revision files.

This will provide a useful resource for revision.

Name	
Class	
Teacher	

Revision Question Book
KS3 Science

This book is suitable for
students carrying out the KS3
Science course



In the following book there are several questions based on KS3 Science. These questions are additional to the work which you do on in your lessons.

To gain the highest grade possible in KS Science it is recommended that you complete these questions at home or in revision sessions outside of lessons.

This will both familiarise yourself with both the concepts found in the syllabus and the examination technique found in examinations.

The mark scheme to the questions is integrated in the book for you to use independently.

To improve competency in answering questions on KS3 Science and achieve mastery in this module, answer all of these questions independently.

When you have completed your work in this book, please store this work in your student files.

Many thanks for all of your hard work in Science.

Mr. Turnbull

**HIGHER TIER**

1. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

1.1 Millions of years ago the Earth's atmosphere was probably just like that of Mars today.

The table shows data about the atmosphere of Mars and Earth today.

Mars today		Earth today	
nitrogen	3%	nitrogen	78%
oxygen	trace	oxygen	21%
water	trace	water	trace
Carbon dioxide	95%	Carbon dioxide	trace
Average surface temperature -23°C		Average surface temperature 15°C	

The percentages of some gases in the Earth's atmosphere of millions of years ago have changed to the percentages in the Earth's atmosphere today.

For **two** of these gases describe how the percentages have changed **and** suggest what caused this change.

[2 Marks]

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1.2 Titan is the largest moon of the planet Saturn.
Titan has an atmosphere that contains mainly nitrogen.
Methane is the other main gas.

Main gases in Titan's atmosphere	Percentage (%)	Boiling point in °C
Nitrogen	95	-196
Methane	5	-164
Average surface temperature -178°C		

When it rains on Titan, it rains methane!

Use the information above and your knowledge and understanding to explain why.

[2 Marks]

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1.3 Ultraviolet radiation from the Sun produces simple alkenes, such as ethene (C_2H_4) and propene (C_3H_6) from methane in Titan's atmosphere.

State the general formula for alkenes.

[1 Mark]

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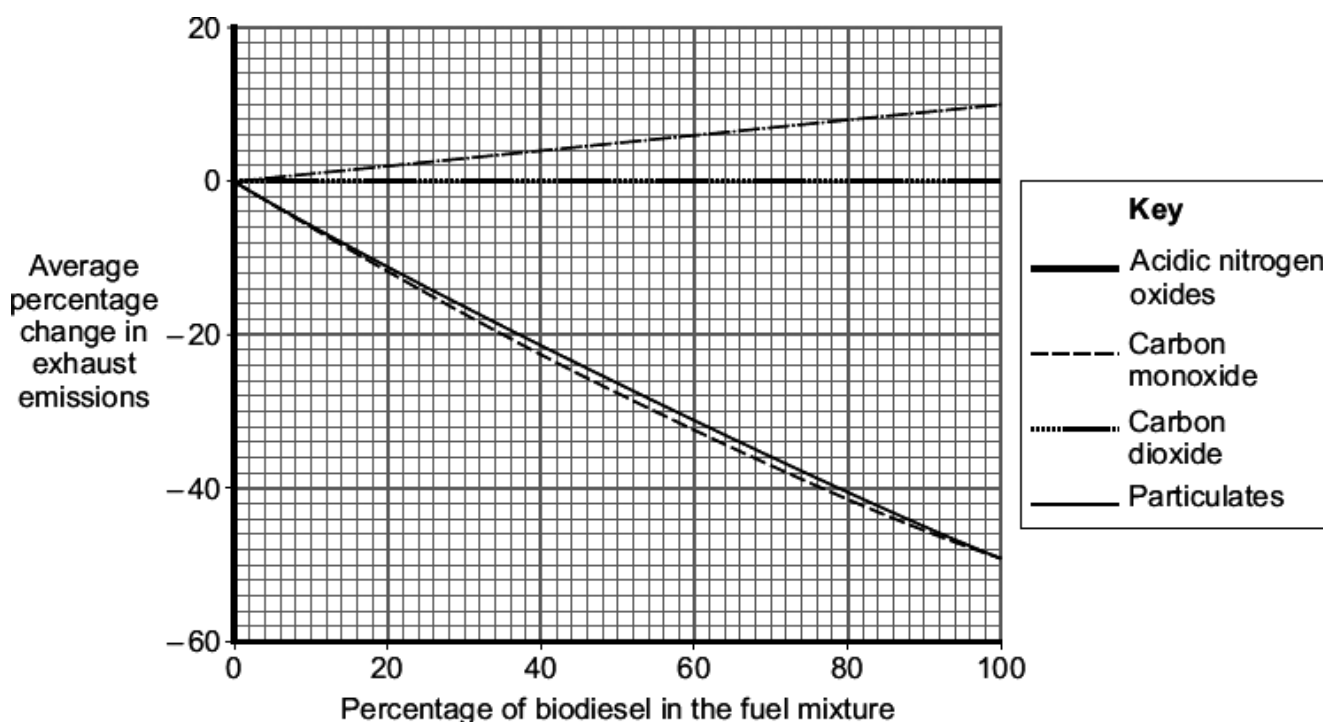
**Q2.**

Petroleum diesel is produced from crude oil.

Most vehicles that use petroleum diesel as fuel can also use biodiesel or a mixture of these two fuels. In the UK (in 2010) there must be 5 % biodiesel in all petroleum diesel fuel.

Biodiesel is produced from plant oils such as soya. The crops used to produce biodiesel can also be used to feed humans. The benefit that biodiesel is 'carbon neutral' is outweighed by the increasing demand for crops. This increasing demand is causing forests to be burnt to provide land for crops to produce biodiesel. Only a huge fall in the price of petroleum diesel would halt the increasing use of biodiesel.

The graph shows the average percentage change in exhaust emissions from vehicles using different mixtures of petroleum diesel and biodiesel.



There is no difference in carbon dioxide emissions for all mixtures of petroleum diesel and biodiesel.

Use the information and your knowledge and understanding to evaluate the use of plant oils to produce biodiesel.

Remember to give a conclusion to your evaluation.

[5 Marks]

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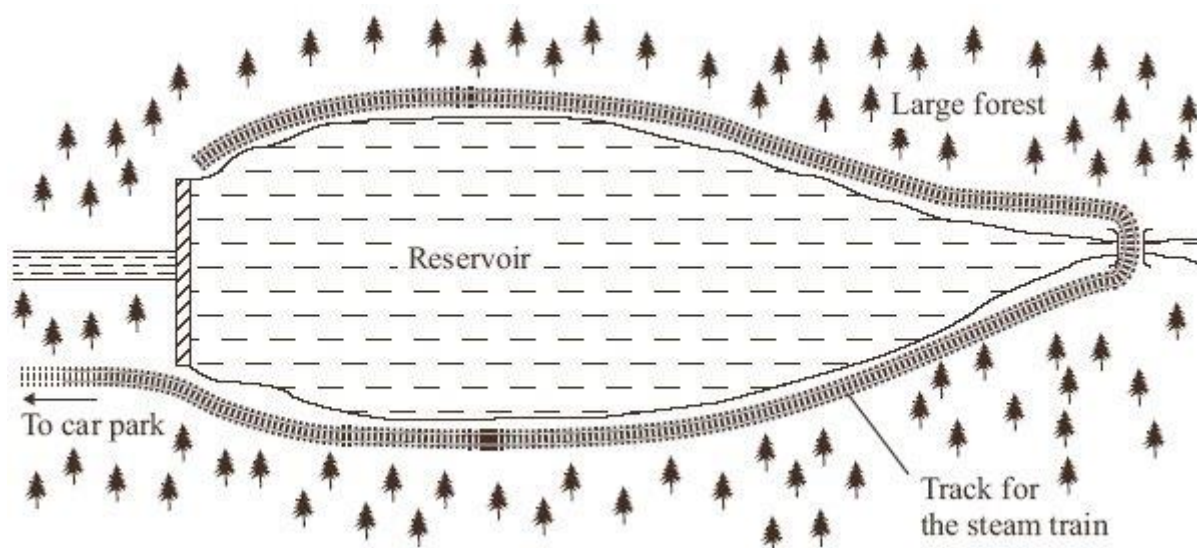
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Q3. A large reservoir is surrounded by trees. Planners need to protect the environment. The distance around the reservoir is many kilometres. There will be only one road access to a car park a few kilometres from the reservoir. From the car park people would be transported to accommodation, activities or places of interest by steam train.



3.1 Coal contains carbon and small amounts of sulfur. The steam train would cause environmental problems if coal were used as the fuel.

Explain why.

[4 Marks]

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3.2 The planners have stated that, as a result of using the steam train, there must be no overall increase of carbon dioxide added to the atmosphere. The steam train would be considered as 'carbon neutral' if wood, from the surrounding forest, were used as the fuel.

Suggest why.

[3 Marks]

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Q4. The amount of carbon dioxide in the Earth's atmosphere has changed since the Earth was formed. The amount of carbon dioxide continues to change because of human activities.

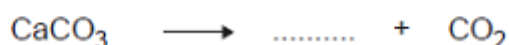
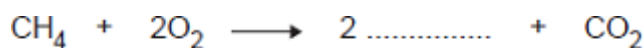
4.1 Cement is produced when a mixture of calcium carbonate and clay is heated in a rotary kiln. The fuel mixture is a hydrocarbon and air.

Hydrocarbons react with oxygen to produce carbon dioxide.

Calcium carbonate decomposes to produce carbon dioxide.

Complete each chemical equation by writing the formula of the other product.

[2 Marks]



4.2 Hydrocarbons and calcium carbonate contain **locked up** carbon dioxide.

What is *locked up* carbon dioxide?

[2 Marks]

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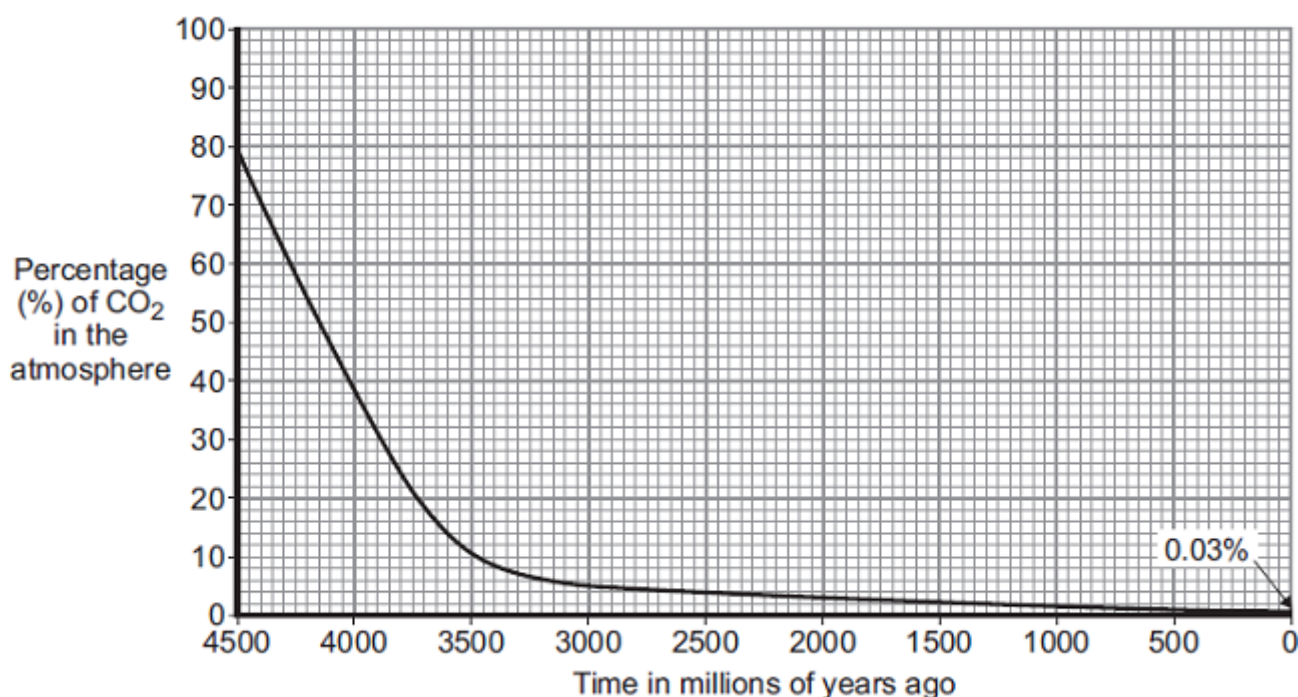
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4.3 Graph 1 shows how the percentage of carbon dioxide in the atmosphere changed in the last 4500 million years.

Graph 1





Use information from **Graph 1** to answer these questions.

4.4 Describe how the percentage of carbon dioxide has changed in the last 4500 million years.

[2 Marks]

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4.5 Give **two** reasons why the percentage of carbon dioxide has changed.

[2 Marks]

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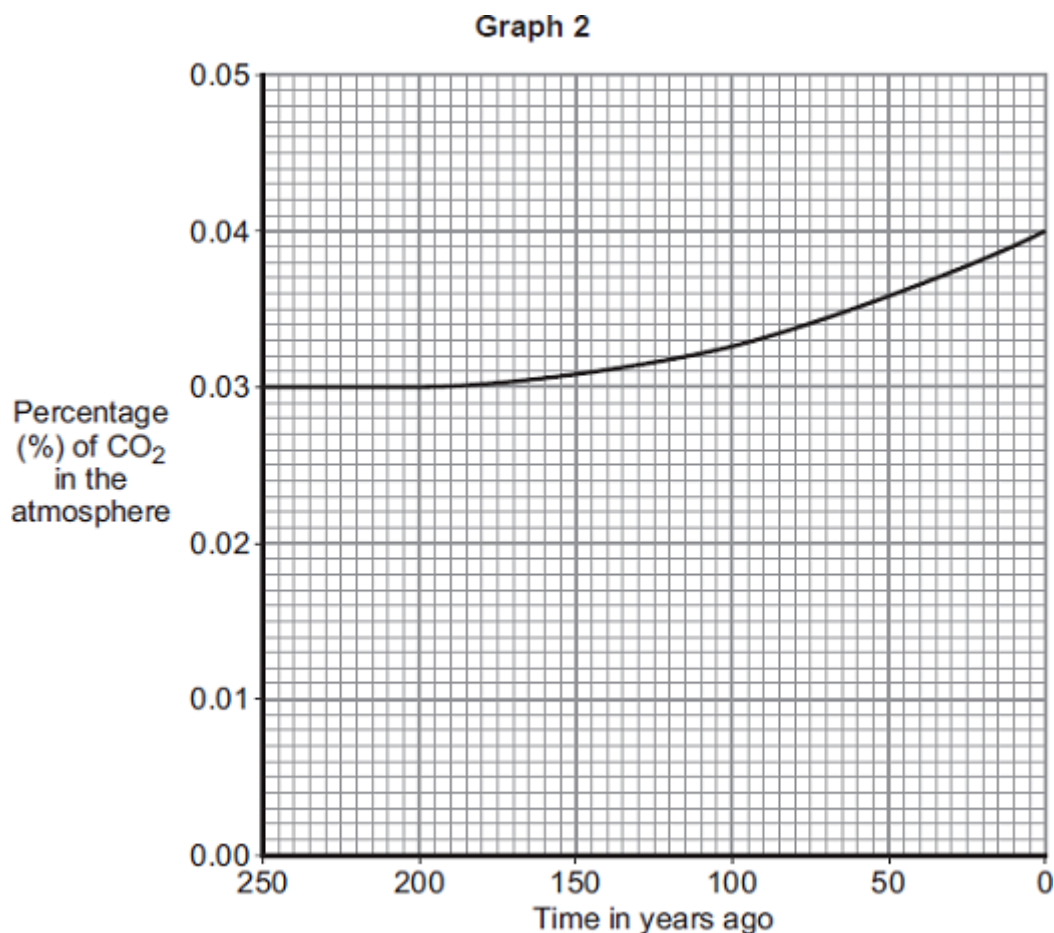
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4.6 Graph 2 shows how the percentage of carbon dioxide in the atmosphere changed in the last 250 years.



Should we be concerned about this change in the percentage of carbon dioxide?

Explain your answer.

[2 Marks]

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Q5. For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same.

5.1 Describe the natural processes which remove carbon dioxide from the atmosphere.

[4 Marks]

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5.2 The amount of carbon dioxide in the atmosphere has increased over the last one hundred years. Suggest **two** reasons why this has happened.

[2 Marks]

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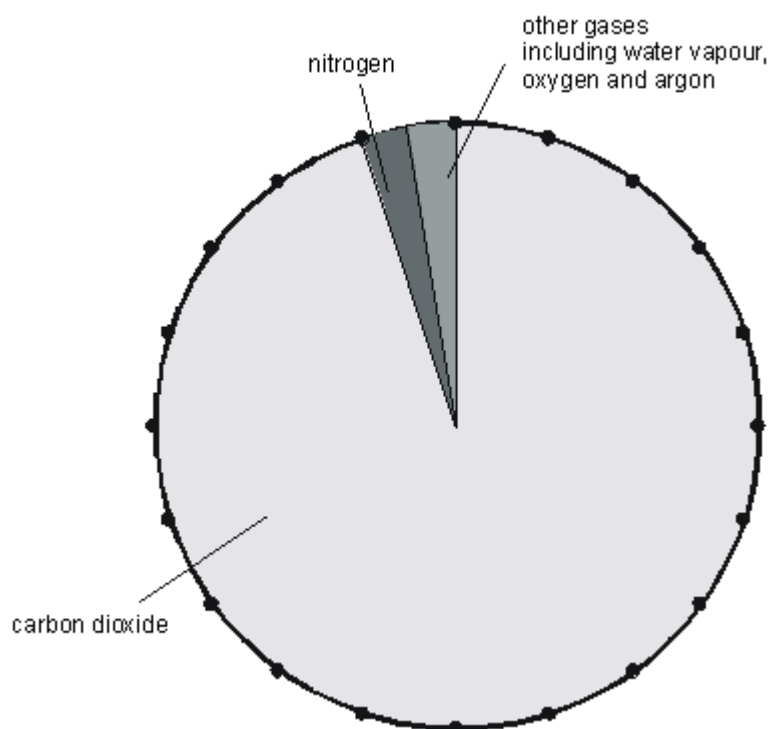
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Q6. The pie chart below shows the composition of the atmosphere on the planet Mars.



6.1 Use the pie chart above to calculate the percentage of carbon dioxide in the atmosphere on Mars.

[2 Marks]

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6.2 The atmosphere on Earth is very different from that on Mars. One important difference is that the Earth's atmosphere contains a large amount of oxygen.

Give **two** other ways in which the Earth's atmosphere is different from the atmosphere on Mars.

[2 Marks]

1.

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2.

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6.3 When the Earth was formed its atmosphere is thought to have been similar to the atmosphere on Mars. Explain how green plants and other organisms have changed the composition of the Earth's atmosphere.

[4 Marks]

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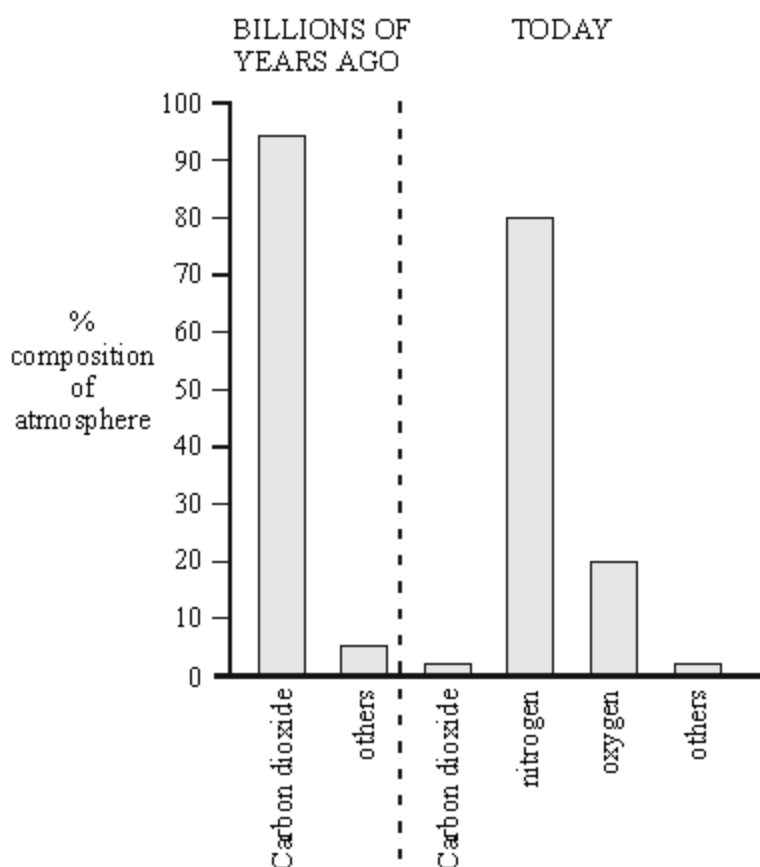
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Q7. The bar chart shows the composition of the Earth's atmosphere today, and as it was billions of years ago.



7.1 Use information from the bar chart to describe how the atmosphere today is different from the atmosphere of billions of years ago.

[2 Marks]

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7.2 Describe the processes which have brought about the changes in the proportions of these gases in the air over billions of years.

[4 Marks]

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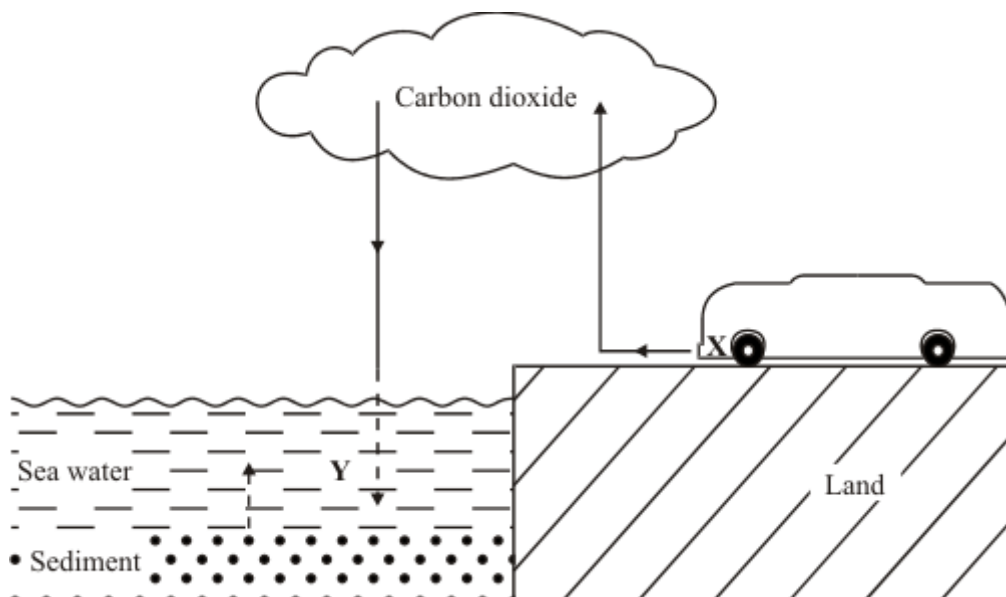
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Q8.
The amount of carbon dioxide in the atmosphere is increased by reactions that occur in internal combustion engines (**X**) and is decreased by reactions in sea water (**Y**).



Describe, in as much detail as you can, the reactions which take place at **X** and **Y**.

8.1 X

[2 Marks]

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8.2 Y

[3 Marks]

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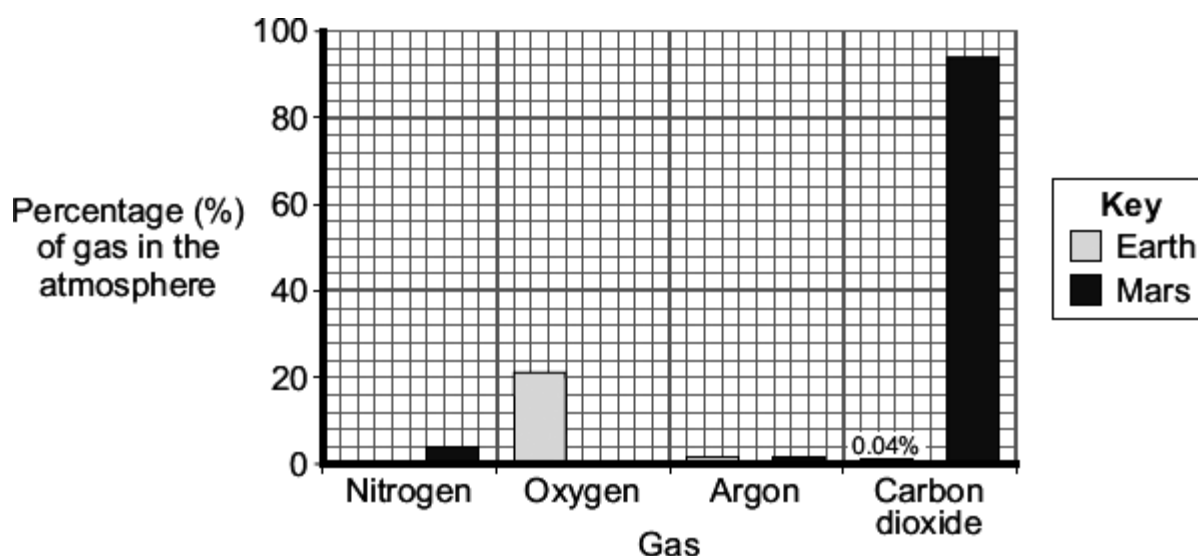
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**FOUNDATION TIER**

1. The bar chart shows some of the gases in the atmospheres of Earth today and Mars today.



1.1 Complete the bar chart to show the percentage of nitrogen in the Earth's atmosphere today.

[1 Mark]

Some scientists suggest that the Earth's early atmosphere was like the atmosphere of Mars today.

1.2 There is **not** much oxygen in the atmosphere of Mars.

Suggest why.

[1 Mark]

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.....

1.3 The percentage of argon in the Earth's atmosphere today is the same as it was in the Earth's early atmosphere.

Suggest why.

[1 Mark]

.....

.....



1.4 Compared with the percentage of carbon dioxide in the Earth's early atmosphere there is **not** much carbon dioxide in the Earth's atmosphere today.

Give **one** reason for this change.

[1 Mark]

.....

.....

1.5 Draw a ring around the correct answer to complete the sentence.

Some theories suggest that the Earth's early atmosphere was

[1 Mark]

made by

- burning fossil fuels.
- the formation of oceans.
- the eruption of volcanoes.



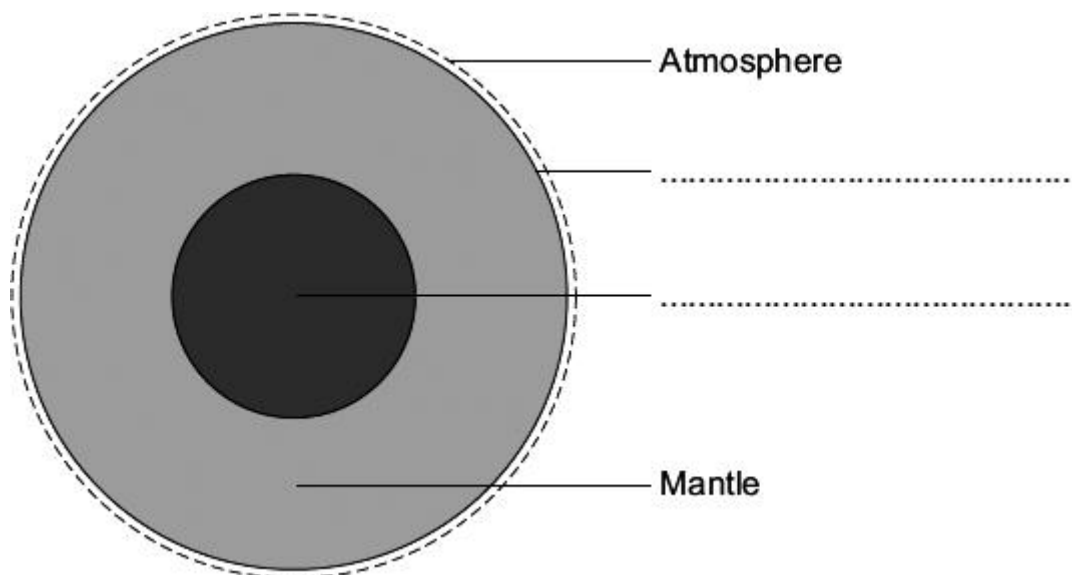
Q2.

The Earth has a layered structure and is surrounded by an atmosphere.

2.1 The diagram shows the layers of the Earth.

Complete the labels on the diagram.

[2 Marks]



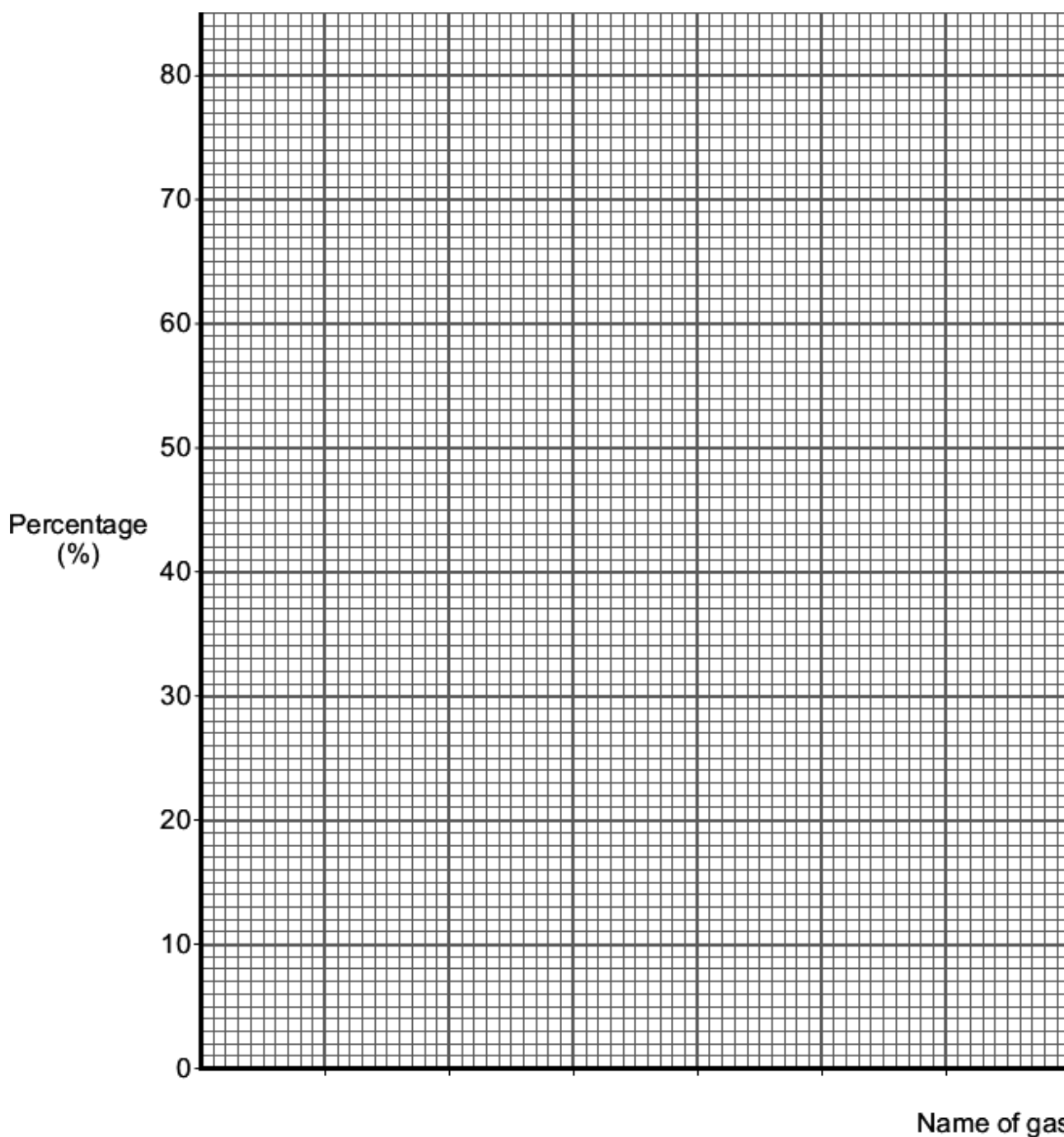


2.2 The data in the table shows the percentages of the gases in the Earth's atmosphere.

Name of gas	Percentage (%) of gas
Nitrogen	78
Oxygen	21
Other gases	1

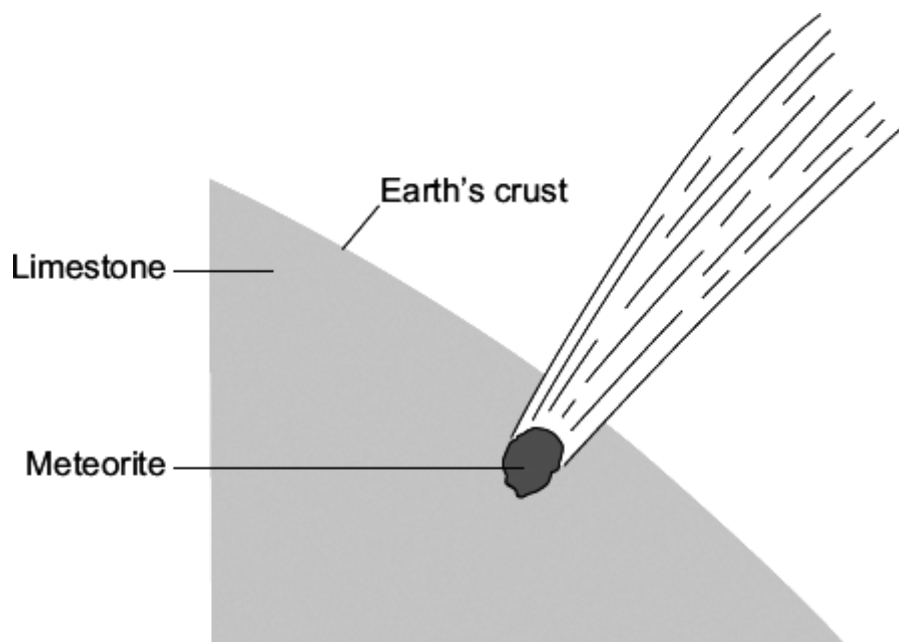
Present the data in the table on the grid below.

[3 Marks]





2.3 Millions of years ago a large meteorite hit the Earth.
The meteorite heated limestone in the Earth's crust to a very high temperature.
The heat caused calcium carbonate in the limestone to release large amounts of carbon dioxide.



Draw a ring round the correct answer to complete each sentence.

[2 Marks]

- (i) Carbon dioxide was released because the calcium carbonate was

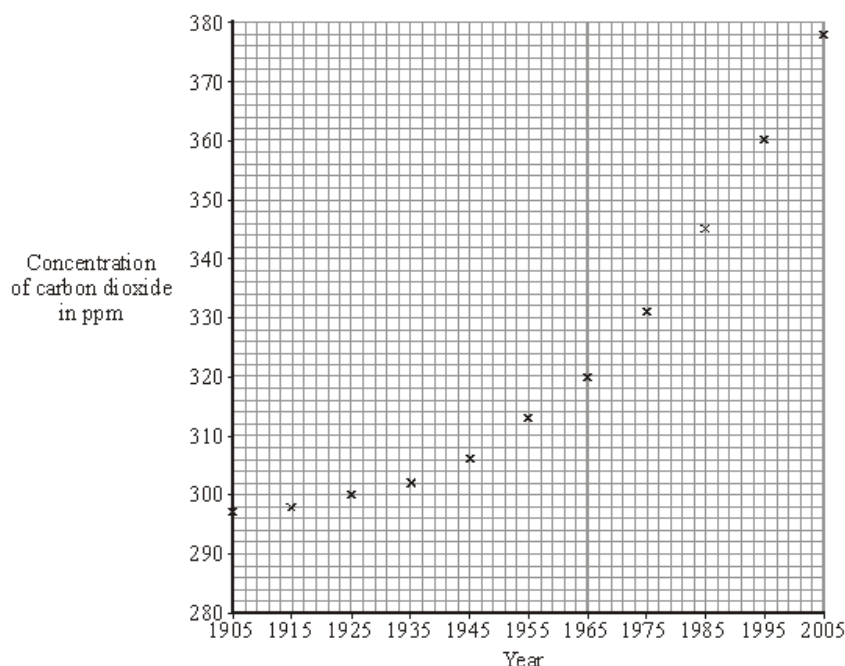
decomposed.
evaporated.
reduced.

- (ii) More carbon dioxide in the Earth's atmosphere causes

acid rain.
global dimming.
global warming.

**Q3.**

Global warming is thought to be happening because of the increased burning of fossil fuels. The concentration of carbon dioxide in the air from 1905 to 2005 has been calculated.



3.1 Draw a line of best fit for these points.

[1 Mark]

3.2 What was the concentration of carbon dioxide in 1955?

[1 Mark]

_____ ppm

3.3 In what year did the concentration of carbon dioxide reach 350 ppm?

[1 Mark]

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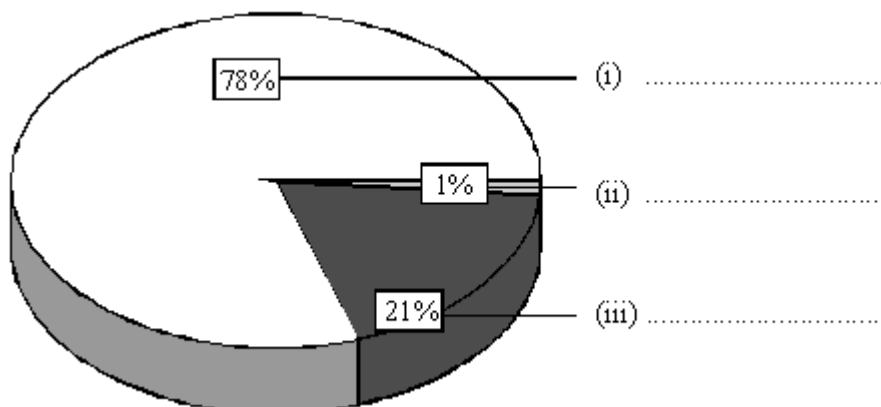
3.4 Use the graph to describe, in as much detail as you can, what happened to the concentration of carbon dioxide from 1905 to 2005.

[2 Marks]

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**Q4.**

4.1 Air is a mixture of gases. The pie chart shows the percentages, by volume, of the main gases in dry air. Complete the chart by adding the names of these **three** gases.

[3 Marks]

4.2 Complete each of the **four** spaces in the sentences by choosing the best word from the box.

[4 Marks]

condenses	condensing	evaporates	evaporating
melts	sea	trees	vapour

The air in the atmosphere above this country always contains _____ .

Most of this is the result of water _____ from the surface of the _____ .

Some of it _____ to form millions of tiny drops of water in clouds.

4.3 Thousands of millions of years ago the Earth's early atmosphere was formed. Complete the following sentence.

[1 Mark]

The carbon dioxide in this early atmosphere probably came from _____

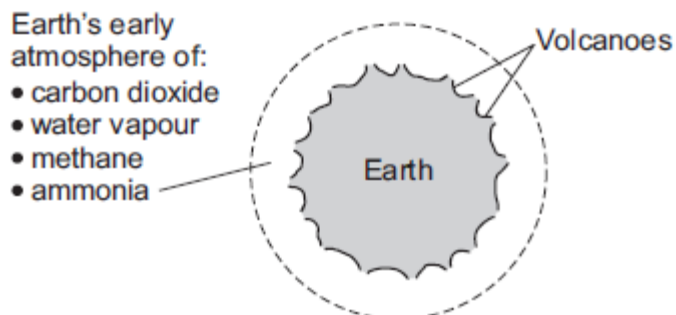
_____ .

**Q5.**

This question is about the Earth and its atmosphere.

5.1 Figure 1 shows the Earth and its atmosphere billions of years ago.

Figure 1



The boiling point of water is 100 °C.

Suggest **one** reason why there was no liquid water on the Earth's surface billions of years ago.

[1 Mark]

.....

.....

The Earth's atmosphere today contains nitrogen, oxygen, argon, carbon dioxide and other gases.

5.2 Draw **one** line from each substance to a description of the substance.

[3 Marks]

Substance	Description of the substance
air	compound
carbon dioxide	element
argon	hydrocarbon
	metal
	mixture



5.3 Which gas in the Earth's atmosphere is used when hydrocarbons burn?

[1 Mark]

Tick (✓) **one** box.

carbon dioxide

☐

nitrogen

☐

oxygen

☐

5.3 What percentage of the Earth's atmosphere is nitrogen?

[1 Mark]

Tick (✓) **one** box.

about 40%

☐

about 60%

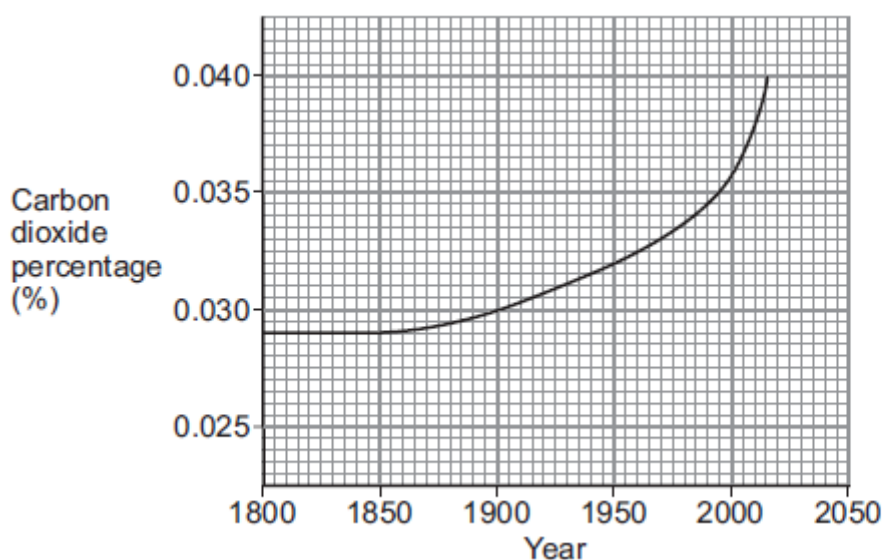
☐

about 80%

☐

Figure 2 shows the carbon dioxide percentage (%) in the Earth's atmosphere since the year 1800.

Figure 2



5.4 What was the carbon dioxide percentage in 1900?

[1 Mark]

_____ %



5.5 Describe, in detail, how the carbon dioxide percentage changed from 1900 to 2015.

[2 Marks]

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5.6 Suggest **two** reasons for the change in the carbon dioxide percentage from 1900 to 2015.

[2 Marks]

1.

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2.

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.....



MARK SCHEME

HIGHER

1.1 any **two** from:

*asks for cause therefore no marks for just describing the change
must link reason to a correct change in a gas*

carbon dioxide has decreased due to:

accept idea of 'used' to indicate a decrease

- plants / microorganisms / bacteria / vegetation / trees
- photosynthesis
ignore respiration
- 'locked up' in (sedimentary) rocks / carbonates / fossil fuels
- dissolved in oceans
ignore volcanoes

oxygen has increased due to:

accept idea of 'given out / produced'

- plants / bacteria / microorganisms / vegetation / trees
- photosynthesis
ignore respiration

nitrogen increased due to:

accept idea of 'given out / produced'

- ammonia reacted with oxygen
- bacteria / micro organisms
ignore (increase in) use of fossil fuels / deforestation

2

1.2 (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

1.3 C_nH_{2n}

1

[5]



2. any **four** from:

to gain 4 marks both pros and cons should be given

Arguments for biodiesel

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO₂ when growing / during photosynthesis
allow burning biodiesel produces little / low amount of global dimming
ignore sulfur dioxide
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process
accept produced by a low tech process
- biodegrades (easily)
ignore engine effects

Arguments against biodiesel

max **three** from:

- creates food shortages
accept price of food increases
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO₂
allow burning trees increases CO₂
allow deforestation increases global warming
- burning biodiesel produces high amounts of nitrogen oxides
allow increases acid rain
- crops takes time to grow
allow crops can fail
- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]



3.1 any **two** environmental problems with linked explanations

- global warming (1)

accept effects of global warming

caused by (formation of) carbon dioxide / greenhouse gas (1)

ignore greenhouse effect

- acid rain (1)

accept effects of acid rain

ignore respiratory problems

caused by (formation of) sulfur dioxide (1)

accept sulfur oxide

ignore sulfuric acid

- global dimming (1)

ignore respiratory problems

caused by (formation of) particles / particulates / fires / smoke / carbon / pm 10 (1)

- scarring of landscape (1)

caused by mining / quarrying of coal (1)

ignore ozone layer

max 4

3.2 any **three** from:

- replant the trees / renewable / sustainable

ignore reusable

- carbon dioxide is used by the trees / photosynthesis

accept trees absorb carbon dioxide as they grow

*do **not** allow respiration*

- it's a (continuous carbon) cycle

accept 'carbon dioxide goes back into the air'

accept trees use CO₂ which is released when trees are burnt

- no 'new' carbon (dioxide) is produced **or**

no locked up carbon (dioxide) is released

accept no carbon (dioxide) from fossil fuels is produced

3
[7]



4.1 H₂O

must be formula

1

CaO

must be formula

1

4.2 carbon dioxide from the air / (Earth's early) atmosphere

it = carbon (dioxide)

accept carbon dioxide from millions of years ago

1

formed (sedimentary) rocks **or** fossil fuels

ignore trapped / stored

1

4.3 decreases rapidly at first

it = carbon (dioxide)

1

then slowly **or** levels off

*allow both marks if the description is correct using either 'rapidly' **or** 'slowly'*

allow correct use of figures for either marking point

*if no other mark awarded, allow CO₂ decreased for **1** mark*

1

4.4 any **two** from:

it = carbon (dioxide)

accept photosynthesis

- used by plants
- dissolved in oceans
- 'locked up' in fossil fuels **or** formed fossil fuels
- 'locked up' in rocks **or** formed rocks

2

4.5 (yes)

it = percentage of carbon (dioxide)

ignore yes or no

because the percentage of carbon dioxide is increasing

1

which causes global warming (to increase)

allow (carbon dioxide) causes greenhouse effect/climate change

1

or

(no)



because the percentage of carbon dioxide is low (1)

compared to millions of years ago (1)

allow global warming can be caused by other factors (e.g. Sun / water vapour / methane)

[10]



5.1 Quality of written communication

for any two ideas sensibly stated

1

any **three** from:

- plants take in (CO_2)

accept photosynthesis uses (CO_2)

- converted to glucose / starch / carbohydrates

ignore carbon compounds by itself

- CO_2 locked up in fossil fuels

accept coal / oil / natural gas / methane for fossil fuels

- CO_2 reacts with / dissolves (sea)water

accept ocean removes CO_2

- producing hydrogencarbonates

accept carbonic acid

- producing carbonates

accept named carbonates

- marine animals use carbonates to make shells

*do **not** accept bones*

- forms sedimentary rocks

accept limestone / chalk

accept marble

*do **not** accept sediments alone*

3

5.2 any **two** from:

- burning of fossil fuels **or** cars / industry / air travel / power stations

ignore increase in population

ignore more use of electricity

- natural processes cannot absorb all the extra CO_2

- deforestation

accept less photosynthesis

ignore volcanic activity

accept burn trees

2

[6]



6.1 95% (1 mark for working)

2

6.2 Much less carbon dioxide
Much more nitrogen

2

6.3 Plants take up CO₂
plants give out oxygen
when they die trap CO₂ in rocks and fossil fuels
methane and ammonia reacted with oxygen
nitrogen gas produced
by reaction of oxygen and ammonia
and by denitrifying bacteria
formation of ozone layer
any 4 for 1 mark each

4

[8]



7.1 amount of CO_2 (much) lower
amount of O_2 (much) higher
amount of N_2 (much) higher (owtte.)
less other gases/less NH_3 /less CH_4

any 2 for 2 marks

2

7.2 4 points from:

plants (evolved)/photosynthesis/algae

take in CO_2

give out O_2

water vapour condensed

ozone formed from oxygen

less CO_2 is produced now from volcanic activity

CO_2 from air trapped in sedimentary rocks or fossil fuels

nitrogen produced by bacteria/living organisms/microbes/decay of dead organisms (**not** nitrifying bacteria, nitrogen fixing 4 bacteria)

nitrogen produced by reaction of NH_3 with O_2 /decomposition of NH_3

nitrogen builds up because it is unreactive

(Assume answer refers to today's atmosphere)

any 4 for 1 mark each

4

[6]



8.1 any **two** 1 mark each

burning / combustion

fossil fuels **or** (locked up) carbon
accept fuel / named fuel

oxygen used

2

8.2 any **three** from

produces (calcium) carbonate

which is insoluble

produces (calcium) hydrogencarbonate

which is soluble

photosynthesis

releases oxygen

3

[5]



FOUNDATION

Q1.

- 1.1** bar drawn correctly 78 – 80 (%) **1**
- 1.2** (Mars has) no (green / living) plants / trees **1**
- 1.3** (argon) is unreactive / inert
accept argon is a noble gas
ignore it is in Group 0 **1**
- 1.4** (the amount of carbon dioxide has decreased because it has been) absorbed /
used by (green / living) plants / trees **or** used for photosynthesis
accept dissolved / absorbed by oceans or locked up in fossil fuels / carbonate rocks **1**
- 1.5** the eruption of volcanoes **1**
- [5]**



Q2.

2.1 crust

ignore Earth's

1

core

ignore inner and/or outer

1

2.2 bar chart

1

all heights are correct

accept correctly plotted points

1

all labels are correct for nitrogen, oxygen and other / argon

1

2.3 (i) decomposed

1

(ii) global warming

1

[7]



Q3.	
3.1 curve of best fit drawn through or close to all of the points	1
3.2 313	1
3.3 1989 +/- 1	1
3.4 concentration / amount of carbon dioxide has <u>increased</u> recently the rate of increase is <u>increasing</u>	1
	[5]

**Q4.****4.1** nitrogen (gas) **or** N_2 *if only the formula is given it must be correct in every detail***1****4.2** argon (gas) **or** Ar**1****4.3** oxygen (gas) **or** O_2 **1****4.4** vapour**1**

evaporating

1

sea(s)

1

condenses

1**4.5** volcanoes **or** volcanic activity **or** the sea(s)*allow carbonates(s) (rocks)**do not credit inside***1****[8]**

**Q5.**

5.1 the Earth's (surface) temperature was high **or** at/above 100 °C

*allow the Earth's (surface) temperature was too / very hot **or** water evaporated / boiled **or** turned to steam / gas*

allow because of heat from volcanoes

ignore the Earth's (surface) was covered by volcanoes

ignore water turned to water vapour

1

5.2 air ————— mixture

1

carbon dioxide ————— compound

1

argon ————— element

1

allow only one line from each substance

5.3 oxygen

1

5.4 about 80 %

1

5.5 0.03(0) (%)

1

5.6 increased

1

slowly then rapidly

1

allow figures from graph to indicate increase

5.7 any **two** from:

use of fossil fuels

deforestation

allow less trees / plants

cars/transport

industry/factories

ignore more people

2**[11]**



Acknowledgements

This document has been produced by Mr J Turnbull.

All relevant information has been credited in the document.

This document has been produced for educational purposes only.

This document has been produced for the KS3 Science Specification.

