AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.9.1 THE COMPOSITION AND EVOLUTION OF THE EARTH'S ATMOSPHERE (PACK 1)

SCORE	PERCENTAGE
/163	%

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Q1.

(a) What percentage of the Earth's atmosphere is nitrogen?

Tick **one** box.

5% ☐ 20% ☐ 50% ☐ 80% ☐

(1)

(b) During the first billion years of the Earth's existence the amount of nitrogen in the atmosphere increased.

Give **one** source of this nitrogen.

_____

(1)

(c) Nitrogen is used to make ammonia.

The word equation for the reaction is:

nitrogen + hydrogen _____ ammonia

Write the correct symbol in the equation to show that it is a reversible reaction.

(1)

(d) A reversible reaction can reach equilibrium.

Complete the sentence.

Equilibrium is reached when the forward reaction and the reverse reaction happen at the same _____ .

(1)

(e) Fertilisers are formulations containing nitrogen.

What is a formulation?

_____

_____

(1)

(f) The table below shows percentages of chemical elements in a fertiliser.

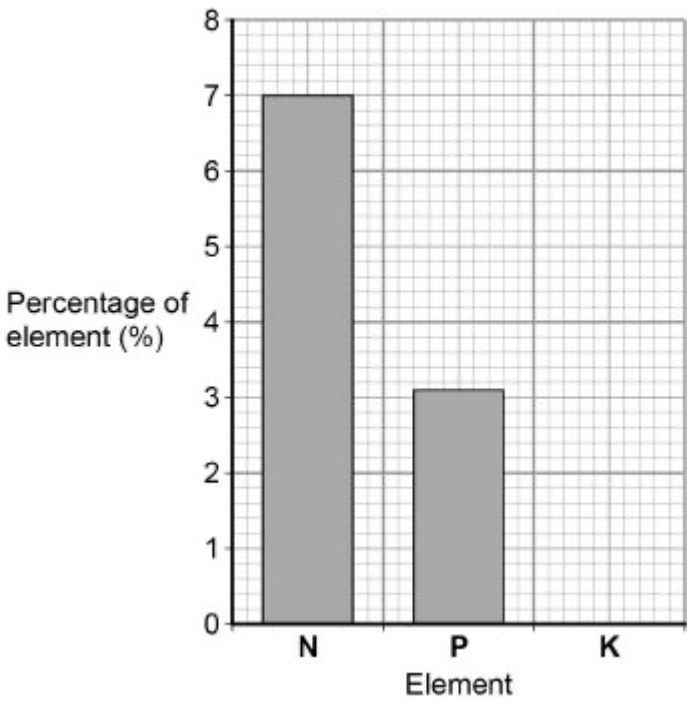
Element	**Percentage (%)**
Nitrogen (N)	7.0
Phosphorus (P)	3.1
Potassium (K)	5.8

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Draw the bar for potassium on **Figure 1**

Use the information in the table above.

Figure 1



(1)

(g) A fertiliser contains 0.225 g of iron per 3.0 g of fertiliser.

Which calculation gives the percentage of iron in the fertiliser?

Tick **one** box.

$\frac{0.225}{3.0 \times 100}$ ☐

$\frac{3.0 \times 100}{0.225}$ ☐

$\frac{0.225 \times 3.0}{100}$ ☐

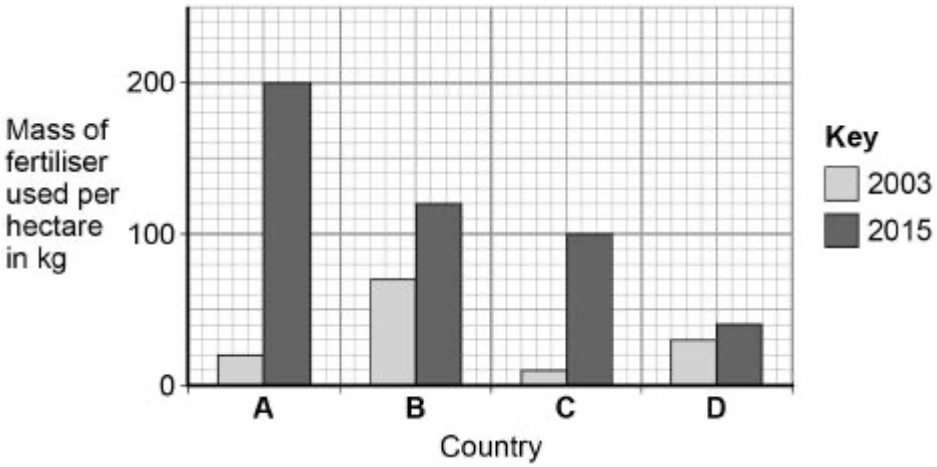
$\frac{0.225 \times 100}{3.0}$ ☐

(1)

(h) **Figure 2** shows the use of fertiliser in four different countries, **A**, **B**, **C** and **D**, in 2003 and 2015

Figure 2

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A student said:

'**much** more fertiliser was used in 2015 than in 2003'

Is the student correct?

Use data from **Figure 2** to justify your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q2.

This question is about the Earth's atmosphere.

(a) Carbon dioxide is a greenhouse gas.

What is another greenhouse gas?

Tick **one** box.

Argon ☐

Methane ☐

Nitrogen ☐

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Oxygen ☐

(1)

(b) Greenhouse gases cause global climate change.

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

1. _____

_____

2. _____

_____

(2)

(c) 4.1 kg of a plastic, used to make plastic bottles, has a carbon footprint of 6.0 kg of carbon dioxide.

Calculate the carbon footprint of **one** plastic bottle of mass 23.5 g

_____

_____

_____

_____

Carbon footprint = _____ kg of carbon dioxide

(2)

(d) Give **one** way that carbon dioxide emissions can be reduced when a plastic bottle is manufactured.

_____

_____

(1)

(e) Explain how the percentages of nitrogen, oxygen and carbon dioxide in the Earth's atmosphere today have changed from the Earth's early atmosphere.

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____

_____

_____

(6)

(Total 12 marks)

Q3.

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

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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.

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_____

_____

(1)

(Total 8 marks)

Q4.

The table shows the gases in the Earth's atmosphere today.

Gas	**Percentage (%)**
N_2	78.0
O_2	21.0
Ar	0.9
Other gases	**X**

(a) What is the percentage of **X**?

Tick **one** box.

0.01% ☐ 0.1% ☐ 1% ☐ 10% ☐

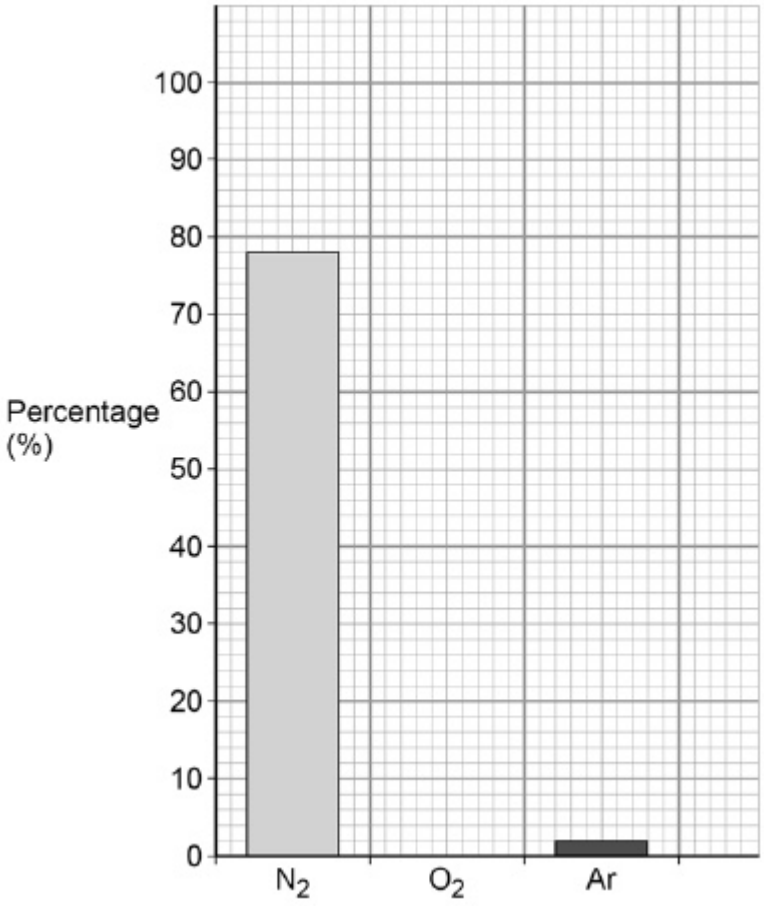
(1)

(b) Complete **Figure 1**.

Plot the data from the table on **Figure 1**.

Figure 1

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(1)

(c) What is the name of the gas with symbol Ar?

Tick **one** box.

Aluminium ☐

Argon ☐

Arsenic ☐

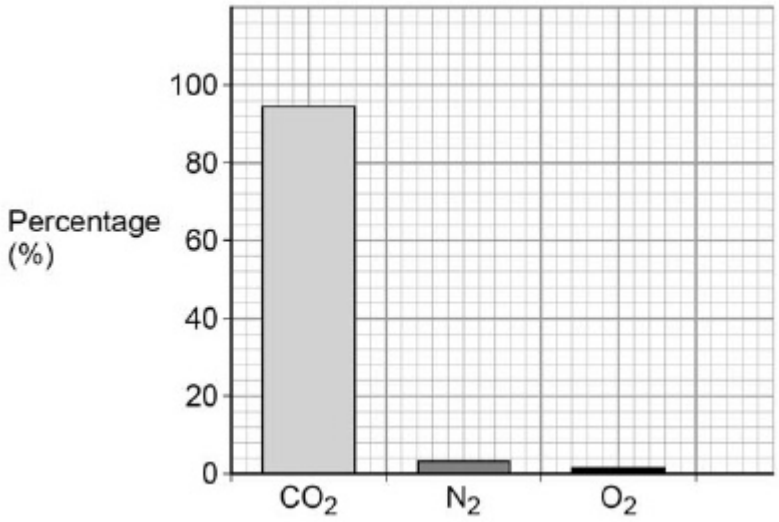
Astatine ☐

(1)

(d) **Figure 2** shows the gases in the atmosphere of Mars today.

Figure 2

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Some theories suggest that the Earth's early atmosphere was the same as the atmosphere of Mars today.

Describe the change in the percentage of oxygen from the Earth's early atmosphere to the Earth's atmosphere today.

Use values from the table and **Figure 2**.

_____

_____

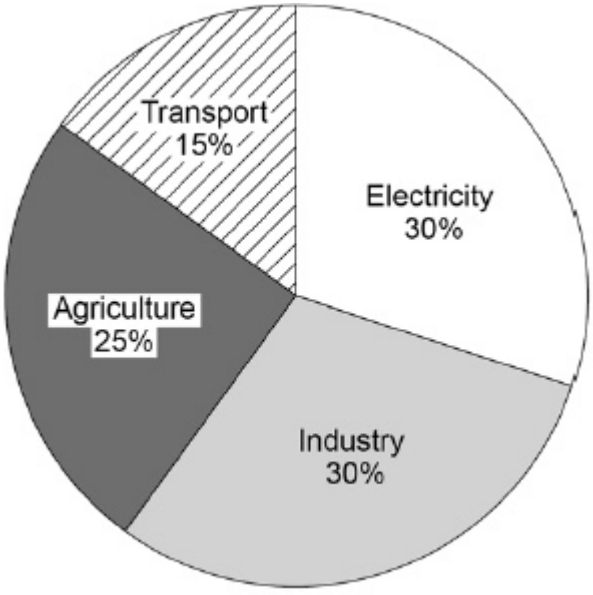
_____

_____

(2)

(e) **Figure 3** shows the percentage of greenhouse gases from human activities.

Figure 3



Compare the contribution of each activity to the total amount of greenhouse gases.

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Use data from **Figure 3**.

(4)

(f) Suggest **one** way greenhouse gas emissions could be reduced.

(1)

(g) Give **one** reason why it is difficult for some countries to reduce emissions of greenhouse gases.

(1)

(Total 11 marks)

Q5.

The table shows the percentage of some gases in the atmosphere on Earth and on Venus.

Gas	Percentage of gas in atmosphere	
	Earth	**Venus**
Nitrogen	78.08	3.50
Oxygen	20.95	0.00
Carbon dioxide	0.04	96.50

(a) Give **two** differences in the atmosphere on Earth compared with the atmosphere on Venus.

1.

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2. _____

_____

(2)

(b) Give a source of each of the gases below that are found in the Earth's atmosphere.

Carbon dioxide _____

_____

Oxygen _____

_____

(2)

(c) Water moves between the Earth and its atmosphere.

Describe how water enters and leaves the atmosphere.

How water enters the atmosphere _____

_____

How water leaves the atmosphere _____

_____

(2)

(d) The percentage of carbon dioxide in the Earth's atmosphere is increasing.

What environmental problem is caused by the increased percentage of carbon dioxide in the atmosphere?

Tick **one** box.

Deforestation	☐
Destruction of peat bogs	☐
Global warming	☐
Pollution of streams	☐

(1)

(e) Suggest **two** negative impacts of climate change.

_____

_____

_____

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_____

(2)

(Total 9 marks)

Q6.

Two isotopes of carbon are $^{12}_{6}C$ and $^{14}_{6}C$.

(a) Describe **two** similarities and **one** difference in the atomic structure of the two isotopes.

You should refer to the **number** and **type** of sub-atomic particles in each isotope.

Similarity 1 _____

_____

Similarity 2 _____

_____

Difference _____

_____

(3)

$^{14}_{6}C$ is a radioactive isotope with a half-life of 5730 years.

(b) A sample of $^{14}_{6}C$ from a fossilised tree gives a count rate of 20 decays per second.

The tree died 17 190 years ago.

Determine what the count rate of the $^{14}_{6}C$ isotope was when the tree died.

_____

_____

_____

_____

_____

Count rate = _____ decays per second

(2)

(c) Some molecules in air contain $^{14}_{6}C$.

Explain how $^{14}_{6}C$ atoms from the air can become part of human cells.

_____

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_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 10 marks)

Q7.

This question is about gases in the Earth's atmosphere.

(a) The amount of carbon dioxide in the Earth's atmosphere decreased during the first billion years of the Earth's existence.

Complete the sentences. Use words from the box.

carbonates	**dissolved**	**evaporated**	**melted**	**nitrates**	**sulfates**

The amount of carbon dioxide in the Earth's atmosphere decreased because

the carbon dioxide_____ in the oceans.

Sediments were formed when _____ were produced.

Algae and plants use carbon dioxide and water to produce oxygen.

(2)

(b) What is the name of this process?

Tick **one** box.

Carbon capture ☐

Combustion ☐

Photosynthesis ☐

Polymerisation ☐

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(1)

(c) Complete the word equation for this process.

carbon dioxide + _____ → glucose + _____

(1)

(d) Draw **one** line from each gas to the approximate percentage of the gas in the Earth's atmosphere today.

Gas	Approximate percentage of gas in the Earth's atmosphere today
	<1
	5
Carbon dioxide	
	10
Nitrogen	20
	50
Oxygen	
	80
	>90

(3)

(e) Carbon dioxide is a greenhouse gas.

Why does increasing the amount of carbon dioxide change the global climate?

_____

(1)

(f) How can countries reduce carbon dioxide emissions?

Tick **one** box.

only burn methane ☐

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use renewable energy supplies ☐

use waste plastic bags as fuel ☐

(1)

(g) Give **one** reason why it is difficult for countries to reduce emissions of carbon dioxide.

_____

_____

(1)

(Total 10 marks)

Q8.

There is less carbon dioxide in the Earth's atmosphere now than there was in the Earth's early atmosphere.

(a) The amount of carbon dioxide in the Earth's early atmosphere decreased because it was used by plants and algae for photosynthesis, dissolved in the oceans and formed fossil fuels.

Give **one** other way that the amount of carbon dioxide in the Earth's early atmosphere decreased.

_____

_____

(1)

(b) Carbon dioxide is a greenhouse gas.

Describe the greenhouse effect.

_____

_____

_____

_____

_____

_____

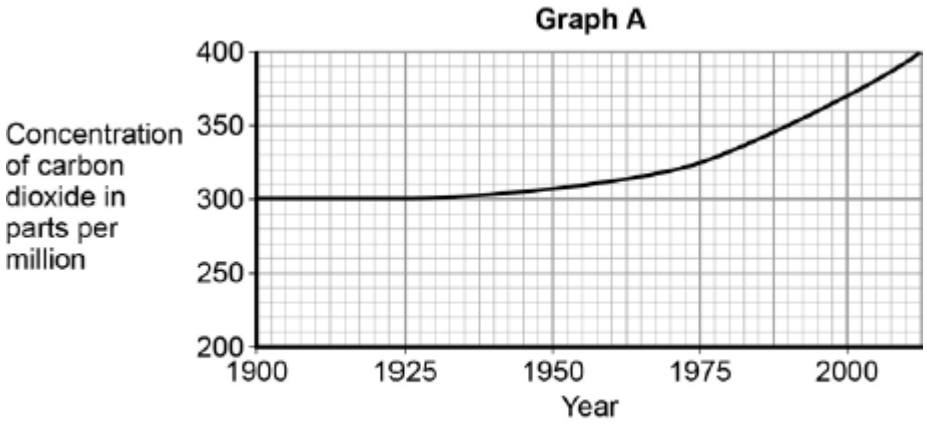
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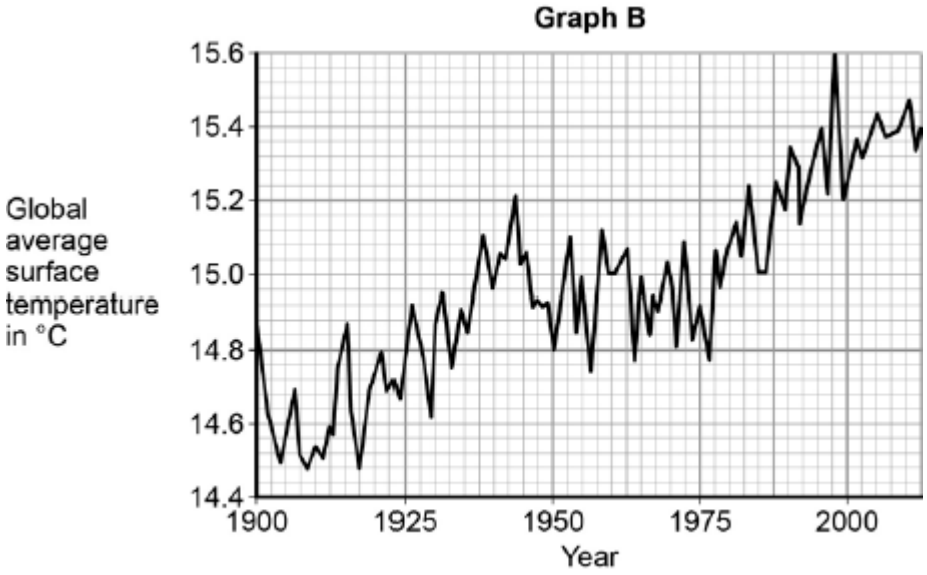
(4)

(c) The graphs in **Figure 1** show the concentration of carbon dioxide in the atmosphere and global average surface temperature since 1900.

Figure 1

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Calculate the percentage increase in the concentration of carbon dioxide from 1975 to 2000.

_____ %

(1)

(d) What was the global average surface temperature in 1980?

Global average surface temperature = _____ °C

(1)

(e) A student stated: 'The graphs show that increasing the concentration of carbon dioxide in the atmosphere causes global temperature increases.'

Discuss why this statement is only partially true.

_____

_____

_____

_____

_____

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_____

_____

_____

(4)

(Total 11 marks)

Q9.

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

(a) The table below shows percentages of the main gases in the atmospheres of Earth and Mars today.

Gas	Percentage in atmosphere of Mars today	Percentage in atmosphere of Earth today
Carbon dioxide	95.00	0.04
Nitrogen	3.50	78.00
Oxygen	0.50	21.00

For each gas in the table, suggest a reason for the change in the percentage of the gas in Earth's atmosphere.

Carbon dioxide _____

_____

Nitrogen _____

_____

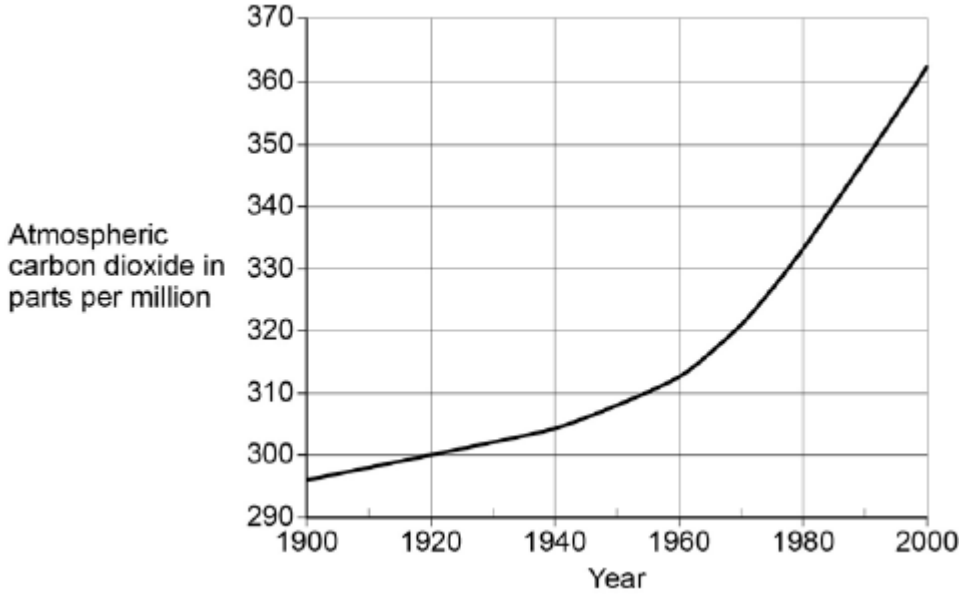
Oxygen _____

_____

(3)

(b) The figure below shows how the concentration of carbon dioxide in the Earth's atmosphere changed between 1900 and 2000.

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One of the causes of the increase in carbon dioxide between 1900 and 2000 is increased use of fossil fuels.

Suggest when use of fossil fuels began to increase.

Use data from the figure above to explain your answer.

(2)

(c) What is the percentage increase in carbon dioxide levels between 1970 and 2000?

Increase = _____ %

(3)

(d) Explain how the changes shown in the figure above can have harmful effects on the environment.

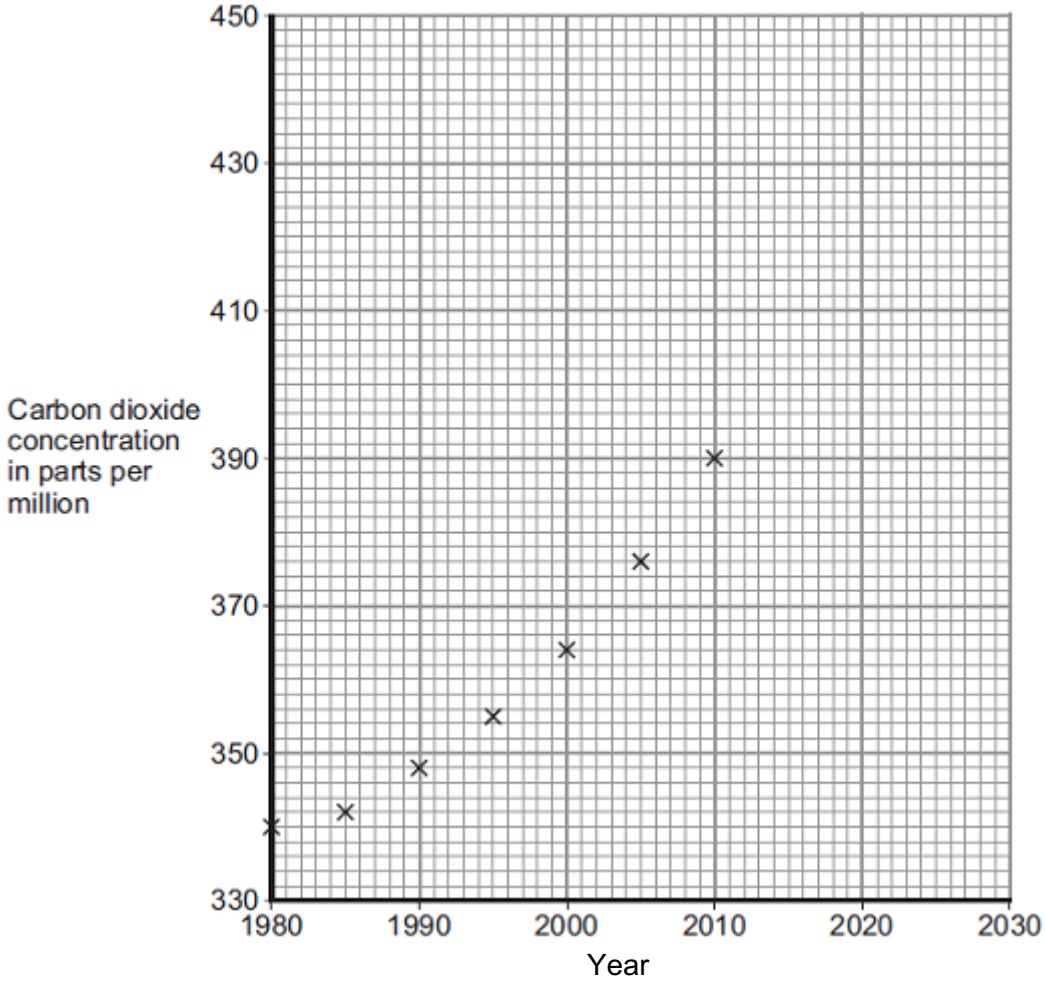
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(4)
(Total 12 marks)

Q40.

Figure 1 shows the concentration of carbon dioxide in the air from 1980 to 2010.

Figure 1



(a) Use the correct answer from the box to complete the sentence.

burning fossil fuels	**earthquakes**	**photosynthesis**

The main reason for the change in carbon dioxide concentration is

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_____ .

(1)

(b) Scientists estimate that in 2020, the carbon dioxide concentration in parts per million will be 430.

Plot this point on the graph.

Draw a line of best fit to complete the graph.

(2)

(c) **Figure 2** shows part of the Great Barrier Reef. The Great Barrier Reef is in an ocean.
The Great Barrier Reef is made of coral. Coral is made by tiny living organisms.

Figure 2



© pniesen/iStock/Thinkstock

Scientists measured the amount of coral on the reef from 1980 to 2010.
The scientists used the data to predict the amount of coral on the reef in 2020.

The results are shown in the table below.

Year	Relative amount of coral
1980	100
2010	50
2020	25

Use information from **Figure 1** and the table.

What conclusion can you make about the change in carbon dioxide concentration in the air and the amount of coral on the reef from 1980 to 2020?

_____

_____

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_____

_____

(2)

(Total 5 marks)

Q41.

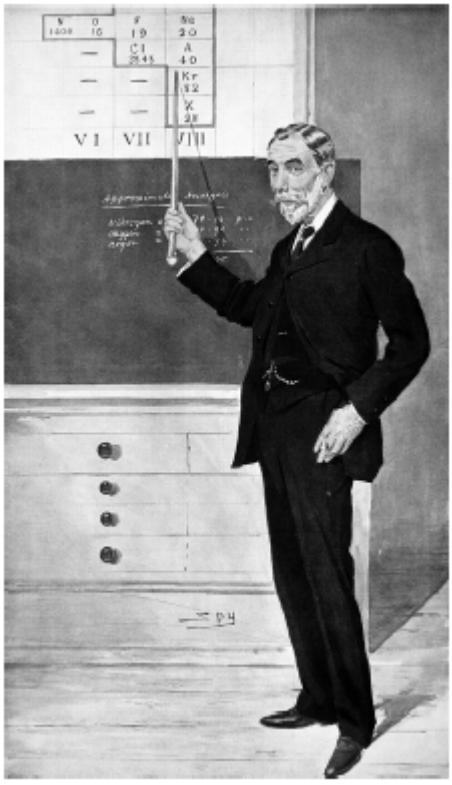
In 1785, Henry Cavendish investigated gases in the air. Cavendish found a very small amount of an unknown gas. Cavendish predicted that the unknown gas was a new element.

The figure below shows William Ramsay.

In 1894, William Ramsay:

- removed oxygen and carbon dioxide from dry air
- passed the remaining gases over hot magnesium.

The nitrogen reacted with magnesium to produce magnesium nitride. A very small amount of unreactive gas was left, which Ramsay named as a new element.



© Photos.com/Thinkstock

(a) Write a word equation for the chemical reaction that Ramsay used to remove nitrogen from the remaining gases.

_____

(2)

(b) Name the type of gas that Ramsay discovered in the air.

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_____

(1)

(c) Suggest why Cavendish did not publish the discovery of a new element.

_____

_____

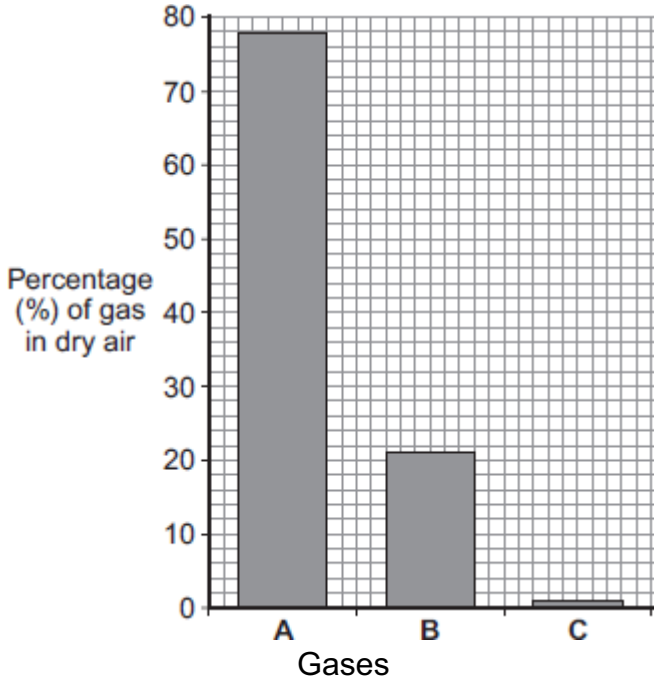
(1)

(Total 4 marks)

Q42.

This question is about the Earth's atmosphere today.

(a) The bar chart shows the percentage by mass of the gases in dry air from the atmosphere.



(i) What percentage of the atmosphere is gas **A**? _____ %

(1)

(ii) Use gases from the box to answer this question.

bromine	**hydrogen**	**nitrogen**	**oxygen**

Name gas **A** and gas **B** shown on the bar chart.

Gas **A**: _____

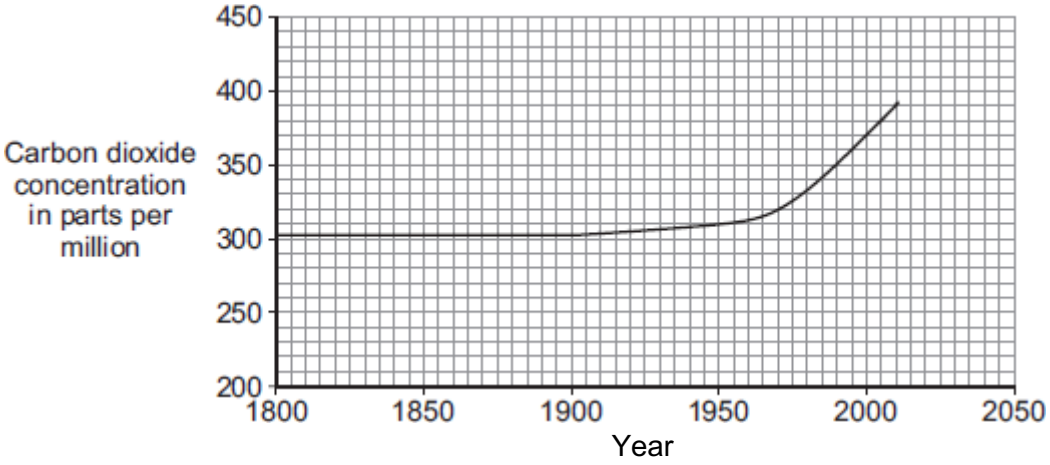
Gas **B**: _____

(2)

(b) The concentration of carbon dioxide in the atmosphere has changed.

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The graph shows how the concentration of carbon dioxide has changed since 1800.



(i) Describe how the concentration of carbon dioxide has changed since 1800.

_____

_____

_____

_____

(2)

(ii) Complete the following sentence.

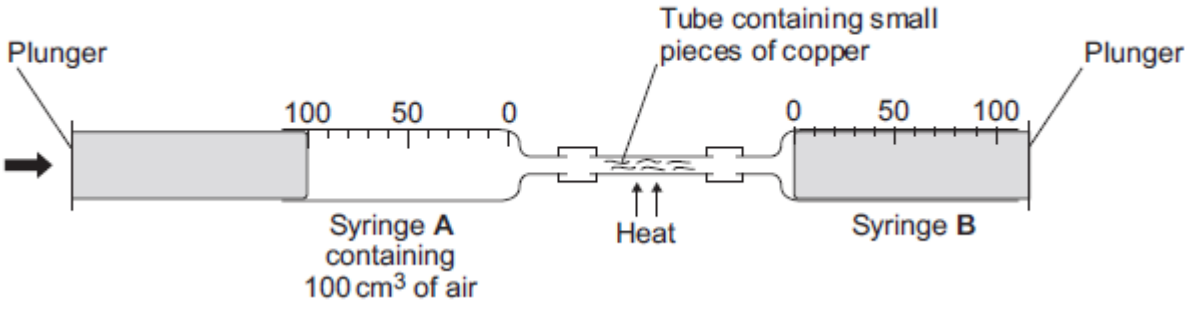
The main process that has caused the change in carbon dioxide is the burning of _____ .

(1)

(Total 6 marks)

Q43.

The diagram shows the apparatus used to investigate the percentages of gases in the air.



100 cm^3 of air was measured using Syringe **A**.

The air was passed over the heated copper by pushing the plungers backwards and forwards. The air was passed over the heated copper until the volume of air did not change.

A black solid formed on the copper when the air was passed over the copper.

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(a) (i) Which gas in the air reacted with the copper?

_____

(1)

(ii) What volume of this gas would you expect to react with copper in the investigation?

_____ cm^3

(1)

(iii) Write a word equation for the reaction occurring between copper and the gas.

_____ + _____ → _____

(1)

(b) (i) What is the main gas remaining in the apparatus at the end of the investigation?

_____

(1)

(ii) Name **one** other gas which will also be present at the end of the investigation.

_____

(1)

(Total 5 marks)

Q44.

(a) **Table 1** shows the percentages of gases in the atmospheres of Earth and Mars.

Table 1

Gas	Percentage of gas (%)	
	Earth	**Mars**
Carbon dioxide	0.04	95
Nitrogen	78	3
Oxygen	21	0.13

Using **Table 1**, describe how the atmosphere of the Earth is different from the atmosphere of Mars.

_____

_____

_____

_____

(2)

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(b) **Table 2** shows the mean surface temperature of three planets.

Table 2

	Earth	Mars	Venus
Mean surface temperature in °C	20	-23	460

Oceans cover 71% of the Earth's surface.

Mars and Venus have water vapour in their atmospheres.

Why does the water vapour **not** form oceans on their surfaces?

Mars: _____

_____

Venus: _____

_____

(2)

(Total 4 marks)

Q45.

The atmosphere of Mars is different from the atmosphere of Earth.

(a) (i) What is the percentage of nitrogen in the Earth's atmosphere today?

_____

(1)

(ii) **Table 1** shows the percentages of gases in the atmosphere of Mars.

Table 1

Gas	Percentage of gases in the atmosphere of Mars (%)
Carbon dioxide	95
Nitrogen	3
Oxygen	0.13

Earth's early atmosphere may have been like the atmosphere on Mars.

Describe how and why the percentages of carbon dioxide and oxygen in the Earth's atmosphere have changed.

_____

_____

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_____

_____

_____

_____

_____

_____

_____

(5)

(b) **Table 2** shows the mean surface temperature and percentage of water vapour in the atmosphere of three planets.

Table 2

	Earth	**Mars**	**Venus**
Mean surface temperature in °C	20	-23	460
Percentage (%) of water vapour in atmosphere	0.4	0.002	0.0002

Suggest why Venus and Mars do **not** have oceans.

_____

_____

_____

_____

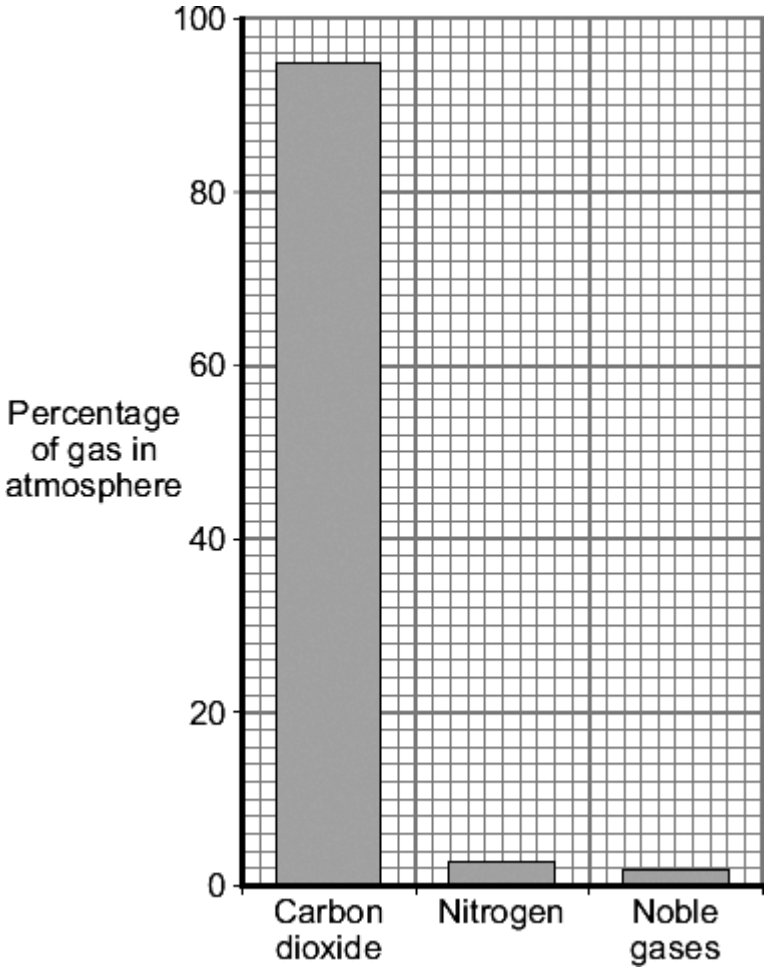
(2)

(Total 8 marks)

Q46.

The bar chart shows the composition of the atmosphere on Mars.

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Complete each sentence to give **three** differences between the composition of the atmospheres on Mars and on Earth.

The atmosphere on Mars has a much higher percentage of _____ .

The atmosphere on Mars has a much lower percentage of _____ .

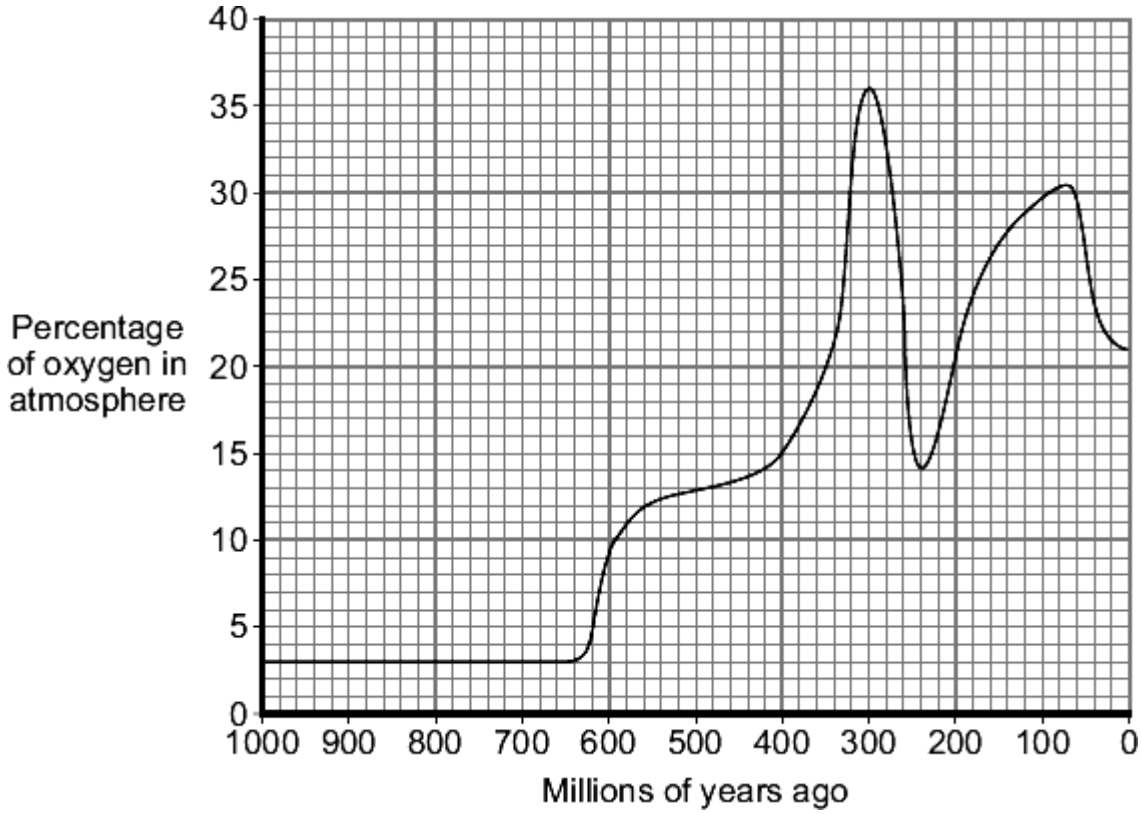
The atmosphere on Mars has no _____ .

(Total 3 marks)

Q47.

The graph shows changes in the percentage of oxygen in the Earth's atmosphere over the last thousand million years.

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(i) The percentage of oxygen in the atmosphere changed between 700 million years ago and 300 million years ago.

How many more times greater was the percentage of oxygen in the atmosphere 300 million years ago compared with 700 million years ago?

_____

_____

Answer = _____ times greater

(1)

(ii) The percentage of oxygen in the atmosphere changed between 700 million years ago and 300 million years ago.

Explain why.

_____

_____

_____

_____

(2)

(Total 3 marks)

Q48.

Active volcanoes give off gases.

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Koryaksky volcano, Russia.
Photo by Jack Lockwood of the USGS, public domain via wikimedia commons

The table shows the percentages of gases a volcano gives off.

Name of gas	Percentage (%) of gas
Carbon dioxide	49
Water vapour	37
Sulfur dioxide	12
Carbon monoxide	2

(a) Scientists use this data to predict what the Earth's early atmosphere was like and how the oceans were formed.

Use information from the table to help you answer the following questions.

(i) Describe how a gas released from volcanoes caused the oceans to be formed.

_____

_____

_____

_____

(2)

(ii) Gases from volcanoes formed the Earth's early atmosphere.

Which was the main gas in the Earth's atmosphere billions of years ago?

_____

(1)

(iii) Which **two** other gases were also present in the Earth's early atmosphere?

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Tick (✓) **two** boxes.

Gas	Tick (✓)
Ammonia	
Chlorine	
Fluorine	
Methane	

(2)

(b) What are the **two** main gases in the Earth's atmosphere today?

Tick (✓) **two** boxes.

Gas	Tick (✓)
Chlorine	
Hydrogen	
Nitrogen	
Oxygen	

(2)

(c) (i) Draw a ring around the correct answer in the box to complete the sentence.

The amount of carbon dioxide in the atmosphere is increasing.

The main process causing this is

combustion.

condensation.

photosynthesis.

(1)

(ii) How is carbon from carbon dioxide locked up in sedimentary rocks?

Tick (✓) **two** boxes.

	Tick (✓)
In calcium carbonate	
In the mantle	
In fossil fuels	

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In the Earth's core	

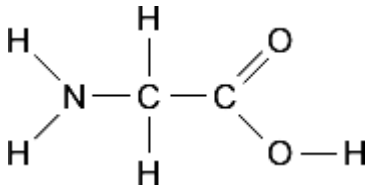
(2)

(Total 10 marks)

Q49.

Two scientists, Miller and Urey, investigated how simple gases that may have been present in the Earth's early atmosphere led to the formation of chemicals such as glycine. Glycine is found in living organisms.

The displayed (structural) formula of glycine is:



(a) Name **three** simple gases that could have been present in the Earth's early atmosphere that might combine to form glycine.

1. _____

2. _____

3. _____

(3)

(b) Describe the main differences between the Earth's early atmosphere and the atmosphere today.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Air is a source of some gases used in industrial processes.

Name the process used to separate the gases in air.

Give the reason why this process can be used to separate the gases.

_____

_____

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_____

_____

(2)

(Total 9 marks)

Q50.

Billions of years ago, the Earth's early atmosphere was probably like the atmosphere of Venus today.

The table shows the temperature and the percentage composition of the atmospheres of the Earth and Venus today.

	Percentage (%) composition of atmosphere	
Name of gas	**Earth today**	**Venus today**
Nitrogen	78	3.5
Oxygen	20.6	a trace
Argon	0.97	a trace
Carbon dioxide	0.03	96.5
Water vapour	0.4	a trace
Average surface temperature	20 °C	460 °C

(a) Use information from the table to help you to answer each part.

(i) In the Earth's atmosphere billions of years ago

the main gas was _____ .

(1)

(ii) The Earth's surface is mainly covered with water.

There is no water on the surface of Venus.

Suggest why.

_____

_____

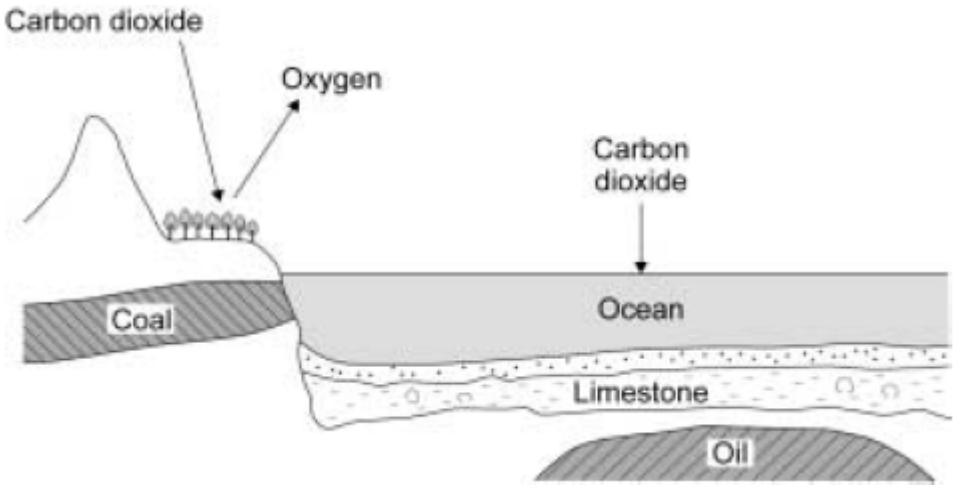
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_____

(2)

(b) The diagram shows part of the Earth and ways that carbon dioxide can be removed from the Earth's atmosphere.

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Give **three** ways that carbon dioxide can be removed from the Earth's atmosphere.

_____

_____

_____

_____

_____

_____

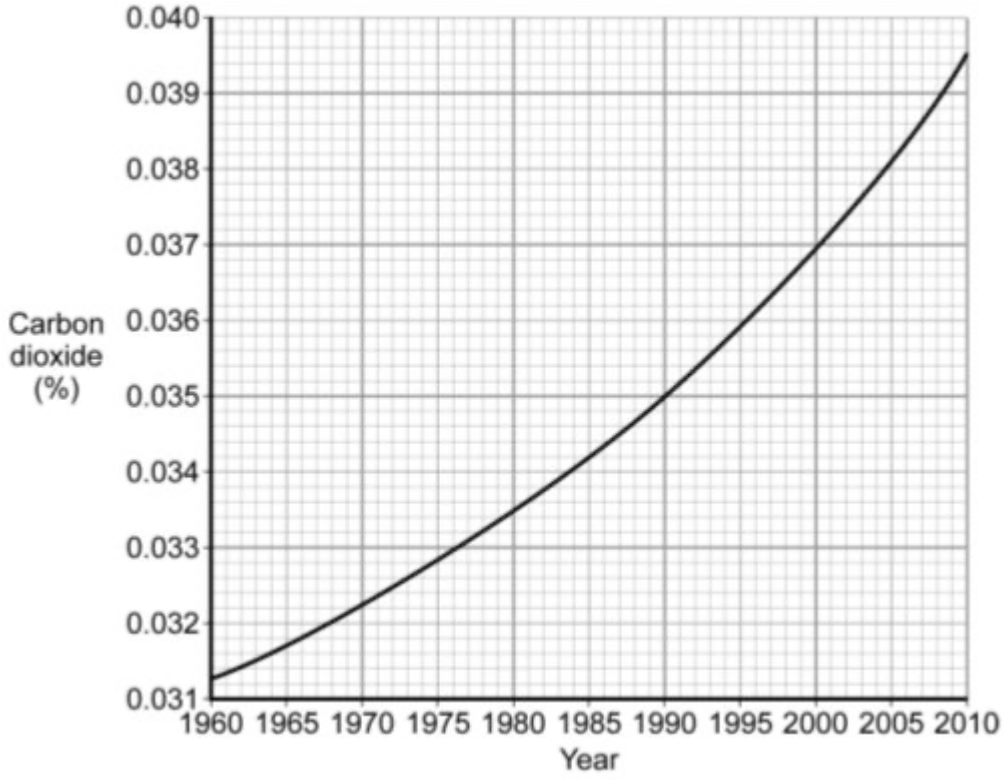
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(3)

(c) In the Earth's atmosphere the percentage of carbon dioxide has remained at about 0.03% for many thousands of years.

The graph shows the percentage of carbon dioxide in the Earth's atmosphere over the last 50 years.

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(i) What was the percentage of carbon dioxide in the Earth's atmosphere in 1965?

_____ %

(1)

(ii) What change has happened to the percentage of carbon dioxide in the Earth's atmosphere over the last 50 years?

_____

(1)

(iii) Suggest **one** reason for this change.

_____

_____

(1)

(Total 9 marks)

Q51.

There was little or no nitrogen in Earth's early atmosphere, but a gaseous compound of nitrogen was present in small amounts.

(a) Name this gaseous compound.

_____

(1)

(b) In 1892, Lord Rayleigh compared nitrogen from the air with very pure nitrogen obtained from nitrogen compounds. The density of the nitrogen was:

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nitrogen from the air = 1.2572 grams per litre

nitrogen from nitrogen compounds = 1.2511 grams per litre.

Rayleigh and Sir William Ramsay proved that atmospheric nitrogen was not pure but contained five other gases, which together made up about 1 % of the Earth's atmosphere.

The gases were argon (0.94 %) and traces of helium, neon, krypton and xenon. The five gases are similar in that they show no chemical reactions but have different physical properties, eg density, melting point, boiling point.

(i) Suggest **one** reason why scientists did **not** find these five gases in the atmosphere at an earlier date.

_____

_____

(1)

(ii) Give **one** way of separating the five gases from each other.

_____

_____

(1)

(iii) From the information given in the question, which prediction can be safely made?

Tick (✓) **one** box.

Nitrogen makes up about 78 % of the atmosphere.	☐
Argon has a density greater than the density of nitrogen.	☐
Neon, krypton and xenon have a density lower than the density of nitrogen.	☐
Nitrogen from nitrogen compounds must contain a very light gas such as hydrogen.	☐

(1)

(Total 4 marks)

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