Q1. (a) Apart from water vapour, two gases account for about 99% of the present atmosphere of our planet.

What are the names of these gases?

..... and .....

(1)

(b) Scientists now have evidence that, over three billion years ago, our planet's atmosphere was mostly a mixture of water vapour, carbon dioxide, methane and ammonia. Since then the mixture has gradually changed.

(i) Suggest why there is now less water vapour in the atmosphere.

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(2)

(ii) Suggest why there is now less carbon dioxide in the atmosphere.

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(2)

(c) The following information suggests that the continents of Africa and South America were once joined together but then began to move apart.

Fossilised remains of a large fern-like plant called Glossopteris have been found in the rocks of the Carboniferous period in both Africa and South America.

Fossilised remains of a freshwater reptile called Mesosaurus have been found in the rocks of the Permian period in both Africa and South America.

No fossils of identical organisms have been found in the rocks of the Jurassic or the Cretaceous period in Africa or South America.

The following table gives the names of some of the periods in our planet's geological history.

Start of the period millions of years ago	Name of the period
2	Quaternary
65	Tertiary
136	Cretaceous
190	Jurassic
225	Triassic
280	Permian
345	Carboniferous
395	Devonian
435	Silurian
500	Ordovician
570	Cambrian

(i) Use this information to suggest when Africa and South America began to move apart.

About ..... million years ago.

(1)

(ii) What conditions were necessary for Africa and South America to move apart?

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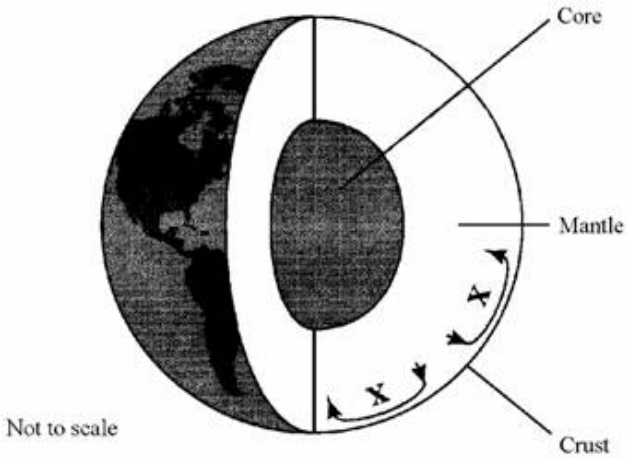
(3)

(Total 9 marks)

Q2. The diagram shows a view of the inside of the Earth.



Adapted from Physics for You (1996) by Keith Johnson, Nelson Thornes

(a) The curved lines marked **X** show two of the slow currents in the mantle.

(i) What sort of currents are these?

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(1)

(ii) How do these currents occur and what is their energy source?

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(3)

(b) Movements of the plates of the Earth's crust can result in earthquakes.

Give **two** other geological results of these movements.

1 .....

2 .....

(2)

(Total 6 marks)

Q3. Read the passage, which is from the start of a magazine article. It will help you to answer the questions.

Third rock from the Sun

Geologists now have evidence that the Earth's crust began to form about four and a half billion years ago. The surface of the Earth was then at temperatures well above 100 °C and the atmosphere was mostly carbon dioxide with some ammonia, methane and water vapour. About a quarter of a billion years after it had first formed, the crust had become thicker and had cooled down to below 100 °C.

Slowly, over a period of about three billion years, oxygen became established in the atmosphere. Some was released from the Earth's interior by volcanoes and some was produced, by the process of photosynthesis, by algae which had evolved in the seas.

(a) Explain how the first seas formed.

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(2)

(b) Briefly describe **two** processes which reduced the proportion of carbon dioxide in the Earth's atmosphere over the period of three billion years.

1. .....

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2. .....

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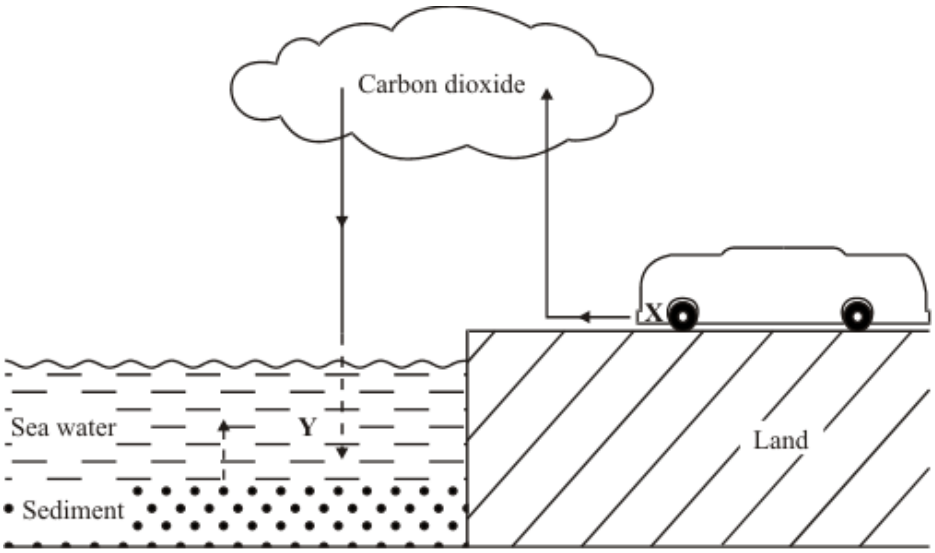
(2)

(Total 4 marks)

Q4. 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**.

(a) **X** .....

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(2)

(b) **Y** .....

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(3)

(Total 5 marks)

Q5. For 200 million years the proportions of the different gases in the atmosphere have been much the same as today. Over the past 150 years the amount of carbon dioxide in the atmosphere has increased from 0.03% to 0.04%.

(a) Describe how carbon dioxide is released into the atmosphere:

(i) by human and industrial activity;

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(2)

(ii) from carbonate rocks by geological activity.

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(2)

(b) Explain how the seas and oceans can decrease the amount of carbon dioxide in the atmosphere.

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(3)

(c) (i) Give **one** reason why the amount of carbon dioxide in the atmosphere is increasing gradually.

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(1)

(ii) Give **one** effect that increasing levels of carbon dioxide in the atmosphere may have on the environment.

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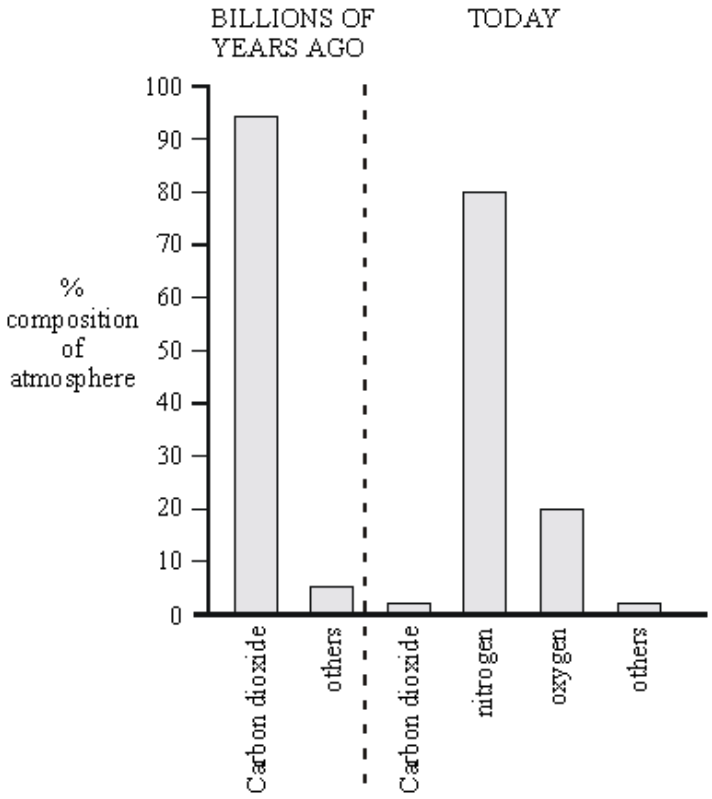
(1)

(Total 9 marks)

Q6. The bar chart shows the composition of the Earth's atmosphere today, and as it was billions of years ago.



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

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(2)

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

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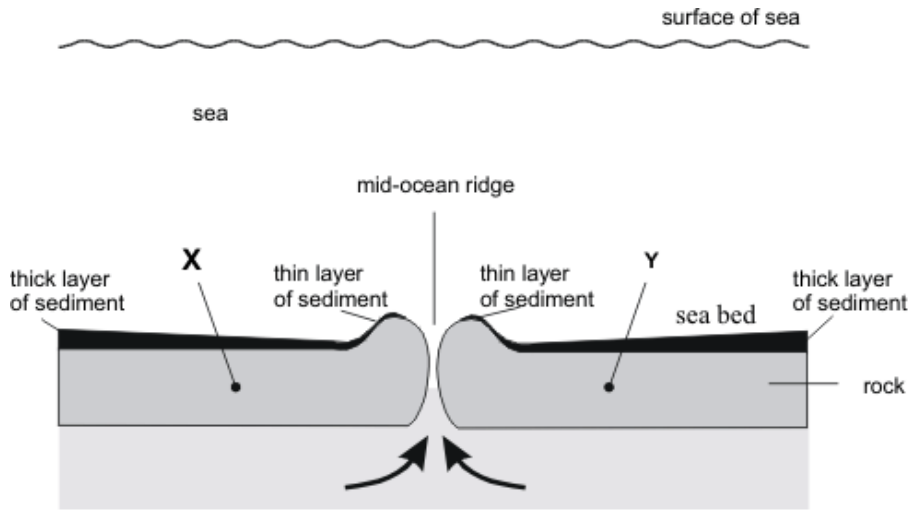
(4)
(Total 6 marks)

Q7. The diagram below shows a cross-section of a mid-ocean ridge.



(a) X and Y are two separate tectonic plates.

(i) The two plates are both moving. Explain, as fully as you can, what causes tectonic plates to move.

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(3)

(ii) New ocean floor is created at the mid-ocean ridge. Explain, as fully as you can, how this happens.

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(3)

(b) The layer of sediment that has collected on the ocean floor increases in depth the further it is from the mid-oceanic ridge. Suggest a reason for this.

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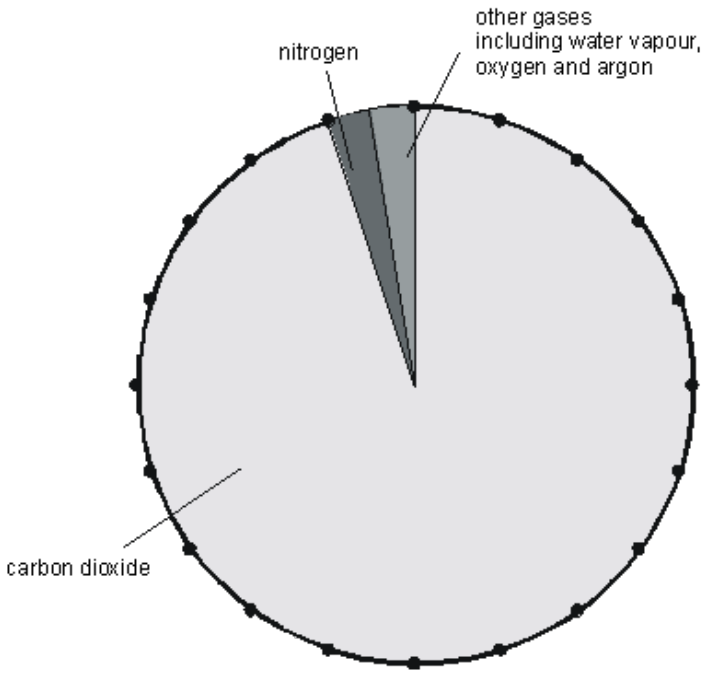
(2)
(Total 8 marks)

Q8. The pie chart below shows the composition of the atmosphere on the planet Mars.



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

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..... %

(2)

(b) 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.

1. .....

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2. .....

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(2)

(c) 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.

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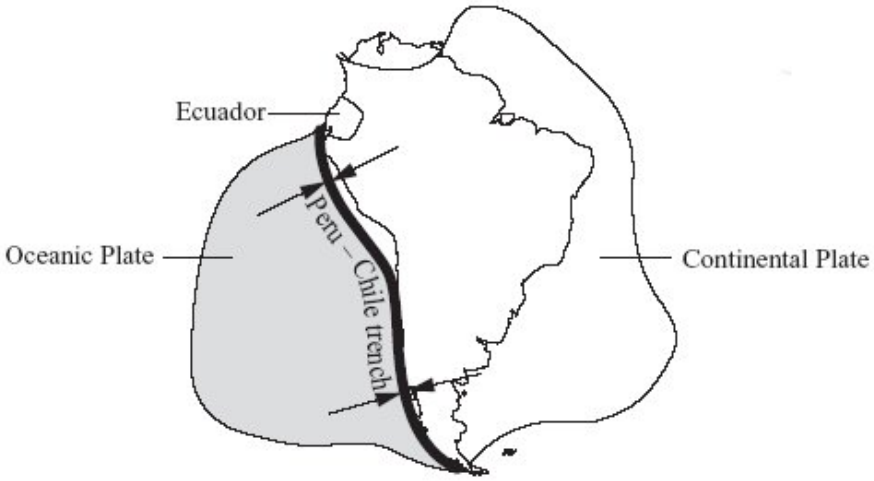
(4)

(Total 8 marks)

Q9. The Peru-Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: Witney, Drozdowska and Maile, *AQA GCSE Physics* (Hodder & Stoughton) 2002.
Adapted and reproduced by permission of Hodder & Stoughton.

Explain what causes the tectonic plates to move.

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(Total 2 marks)

Q10. (a) For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same.

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

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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(4)

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

1 .....

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2 .....

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(2)

(Total 6 marks)

Q11. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

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

The table shows data about the atmospheres of Mars and Earth as they are now.

Mars		**Earth**	
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	

Suggest what has caused the main gases in the Earth's atmosphere of millions of years ago to change to the present-day atmosphere.

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(2)

(b) Titan is the largest moon of the planet Saturn. It has an atmosphere that, like the Earth's, 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! Explain why.

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(2)

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

(i) Draw the structure of propene, C_3H_6, to show the covalent bonds.

(1)

(ii) Explain how propene molecules form a polymer. You should name the polymer formed.

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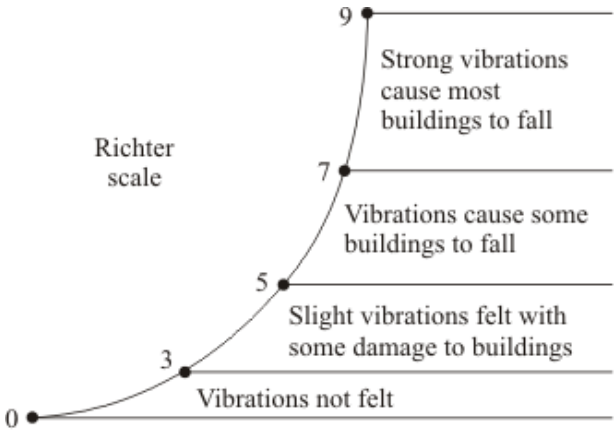
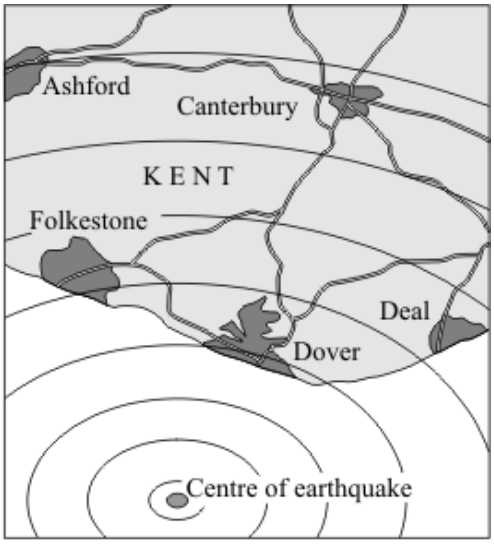
(3)
(Total 8 marks)

Q12. In 1935 C.F. Richter designed a scale for comparing the size of earthquakes.



A newspaper reported that an earthquake off the coast of Kent had caused plaster to come down from ceilings, house tiles to loosen and church bells to ring.



The epicentre is the place on the surface of the Earth directly above where the earthquake occurs.

(a) Suggest why the earthquake in Kent was reported and why most earthquakes in the UK are **not** reported.

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(2)

(b) Explain how earthquakes are caused.

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(3)

(c) People living in Kent were not warned about this earthquake.

In terms of what is happening within the Earth, explain the problems of trying to predict earthquakes.

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(2)
(Total 7 marks)

Q13. Air is a mixture of gases and contains various pollutants. The gases are useful and can be separated by fractional distillation of liquid air. The table gives information about some of the gases in air.

Name of gas	Formula	Melting point in °C	Boiling point in °C
Helium	He	–272.2	–269.0
Oxygen	O_2	–219.0	–183.0
Nitrogen	N_2	–210.0	–195.9
Argon	Ar	–189.0	–185.9
Carbon dioxide	CO_2	–78.5	–78.5
Water vapour	H_2O	0.0	100.0

To separate these gases:

- the air is filtered
- water is removed first
- carbon dioxide is then removed by absorption
- the gases remaining are compressed and cooled to –200 °C.

(a) The air is filtered before the gases are separated.

Suggest why.

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(1)

(b) Water vapour and carbon dioxide are removed before the gases are compressed and cooled.

Use the information in the table to suggest why.

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(2)

(c) After the water and carbon dioxide have been removed, which gas stays liquid over the greatest temperature range?

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(1)

(d) After the water and carbon dioxide have been removed, the four gases that are left are compressed and cooled to –200 °C.

(i) Which gas does **not** liquefy?

.....

(1)

(ii) The three liquefied gases are then allowed to warm up.

Give the order in which the three liquefied gases would vaporise.

1st .....

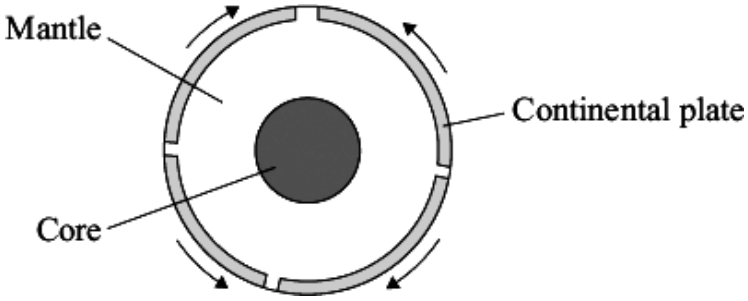
2nd .....

3rd .....

(1)

(Total 6 marks)

Q14. In 1915 Wegener proposed his idea of continental drift. About 50 years later the theory of plate tectonics was developed and this confirmed his idea.



(a) Give **one** reason why Wegener's idea was not accepted in 1915.

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(1)

(b) The theory of plate tectonics is used to explain why earthquakes occur.

Explain how earthquakes occur.

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(2)

(c) Suggest why it is difficult to predict when an earthquake will occur.

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(1)
(Total 4 marks)

Q15. There are different theories about how mountain ranges formed on the surface of the Earth.

(a) (i) Suggest **one** reason why there are different theories.

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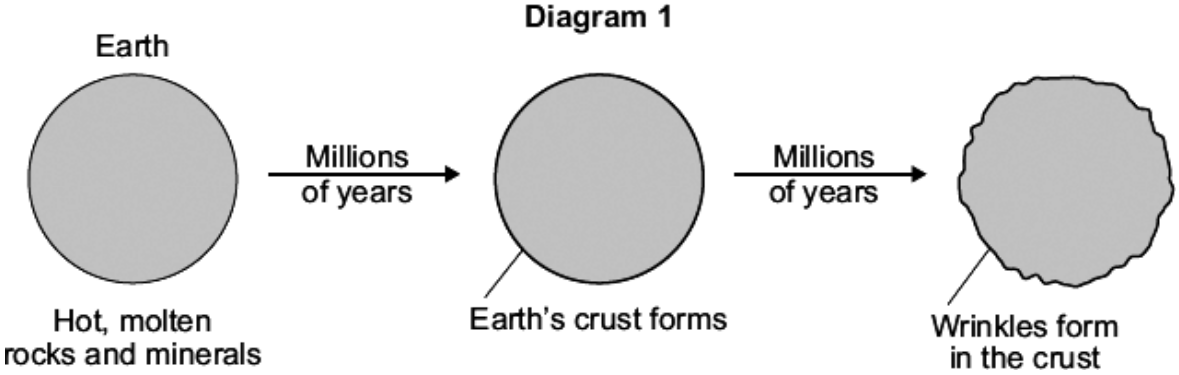
(1)

(ii) **Diagram 1** represents an early theory of how mountain ranges may have formed.

Diagram 1



Use **Diagram 1** to suggest how mountain ranges may have formed.

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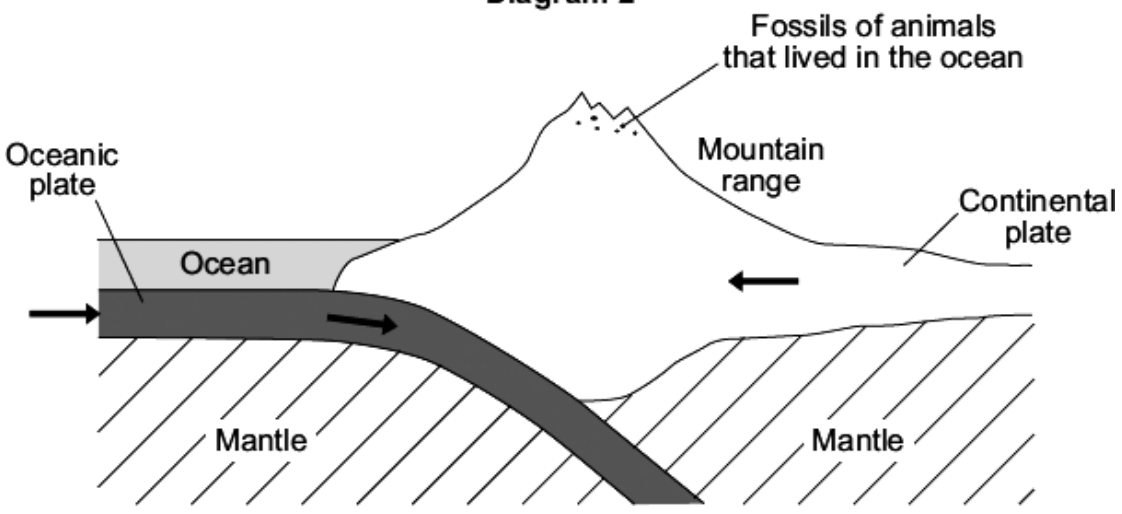
(2)

(b) **Diagram 2** represents a more recent theory of how mountain ranges may have formed.

Diagram 2



(i) The Earth's crust and the upper part of the mantle are cracked into a number of very large pieces called tectonic plates.

Explain how these tectonic plates are able to move.

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(3)

(ii) Use **Diagram 2** to suggest how mountain ranges may have formed.

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(2)
(Total 8 marks)

Q16. The table shows some properties of gases in dry air

Gas in dry air	Density in kg/m^3	Melting point in °C	Boiling point in °C	Percentage (%) in air
Nitrogen	1.2506	–210	–196	78.08
Oxygen	1.4290	–219	–183	20.95
Carbon dioxide	1.977	–57	–57	0.033
Helium	0.1785	–272	–269	0.00052
Neon	0.8999	–249	–246	0.0019
Argon	1.7837	–189	–186	0.934
Krypton	3.74	–157	–153	0.00011
Xenon	5.86	–112	–108	0.0000087

(a) In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

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(2)

(b) Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

Step 1: Filter to remove solid particles

Step 2: Remove carbon dioxide

Step 3: Cool the remaining air to –200 °C

Step 4: Separate by allowing the liquefied gases to warm up.

(i) Carbon dioxide is removed before the air is cooled to –200 °C.

Suggest **one** reason why.

.....

.....

(1)

(ii) Which two gases do **not** condense when the remaining air is cooled to –200 °C?

.....and .....

(1)

(iii) Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name these **two** gases and give a reason for your answer.

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(2)

(Total 6 marks)

Q17. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere has changed.

(a) 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.

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(2)

(b) 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.

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(2)

(c) 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)
(Total 5 marks)

Q18. Scientists study the atmosphere on planets and moons in the Solar System to understand how the Earth's atmosphere may have evolved.

Titan is the largest moon of Saturn.

The table shows data about some substances in the atmosphere of Titan.

Substance	Melting point in °C	Boiling point in °C
Nitrogen	–210	–196
Methane	–183	–164
Argon	–189	–186
Hydrogen	–259	–253
Carbon monoxide	–205	–192

(a) There is no water on Titan. The average surface temperature on Titan is –179 °C.

Which of the substances in the table would form oceans on Titan?

Explain your answer.

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(2)

(b) Amino acids are essential to life.

In the 1950s the Miller-Urey experiment showed that simple amino acids, such as glycine (NH_2CH_2COOH), could have been produced from the Earth's early atmosphere.

The Miller-Urey experiment showed that simple amino acids could be produced by reactions between hydrocarbons, ammonia and water.

Explain how the Miller-Urey experiment suggests that reactions between the substances in Titan's atmosphere could also produce simple amino acids.

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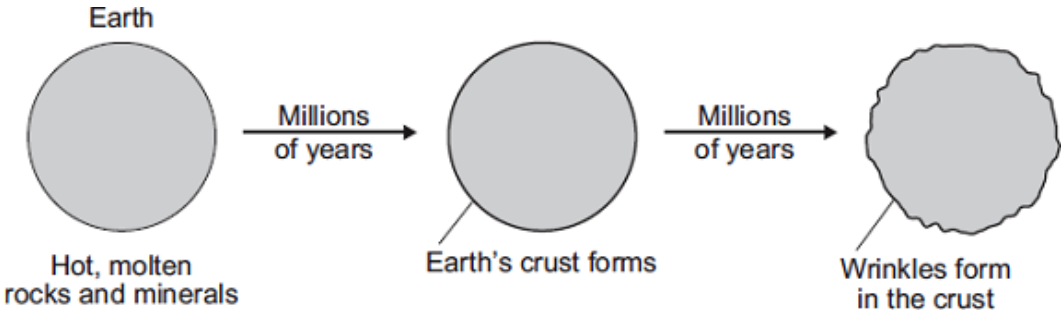
(4)
(Total 6 marks)

Q19. There were many ideas about how the Earth was formed from a molten ball of rock and minerals.

At one time scientists thought the features of the Earth were caused when the molten ball of rock and minerals cooled and wrinkled.



(a) Scientists now have evidence that the Earth has a layered structure.

Describe the layered structure of the Earth. You should indicate the relative sizes of the layers.

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(3)

(b) At one time scientists thought the Earth's continents were formed in fixed positions when the molten ball of rock and minerals cooled and wrinkled.

In 1912, the scientist Alfred Wegener suggested his idea about how Earth's continents formed.

Describe Wegener's idea of how Earth's continents formed.

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(2)

(Total 5 marks)

Q20. 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.

(a) 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.

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

$$CH_4 + 2O_2 \longrightarrow 2 \text{ .....} + CO_2$$

$$CaCO_3 \longrightarrow \text{.....} + CO_2$$

(2)

(ii) Hydrocarbons and calcium carbonate contain *locked up* carbon dioxide.

What is *locked up* carbon dioxide?

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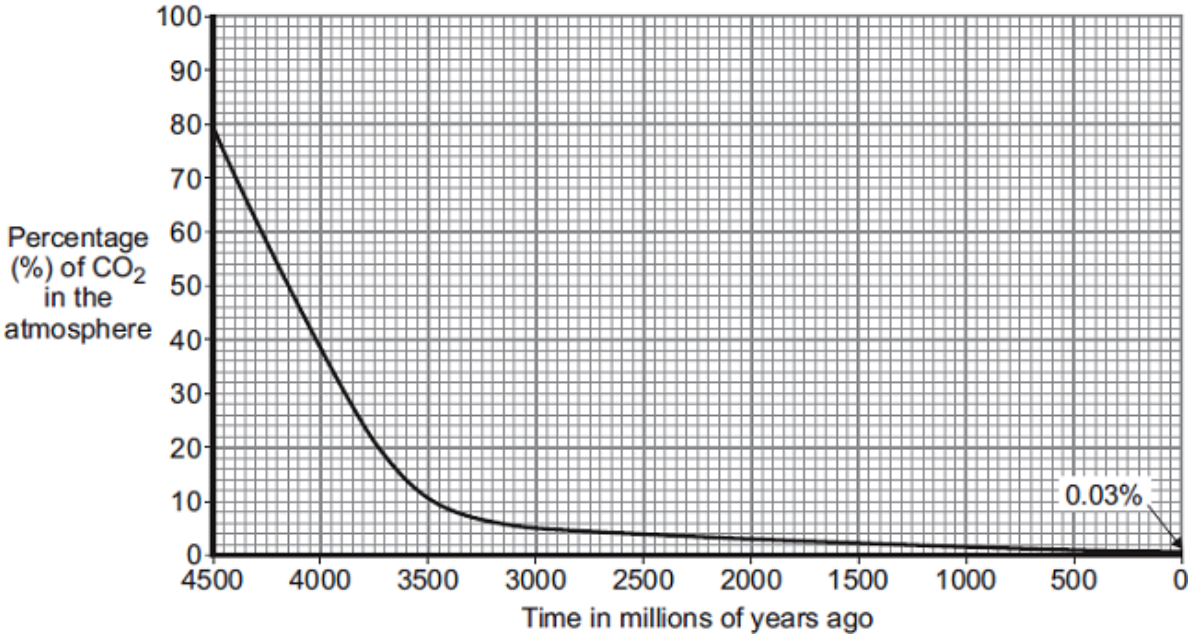
(2)

(b) **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.

(i) Describe how the percentage of carbon dioxide has changed in the last 4500 million years.

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(2)

(ii) Give **two** reasons why the percentage of carbon dioxide has changed.

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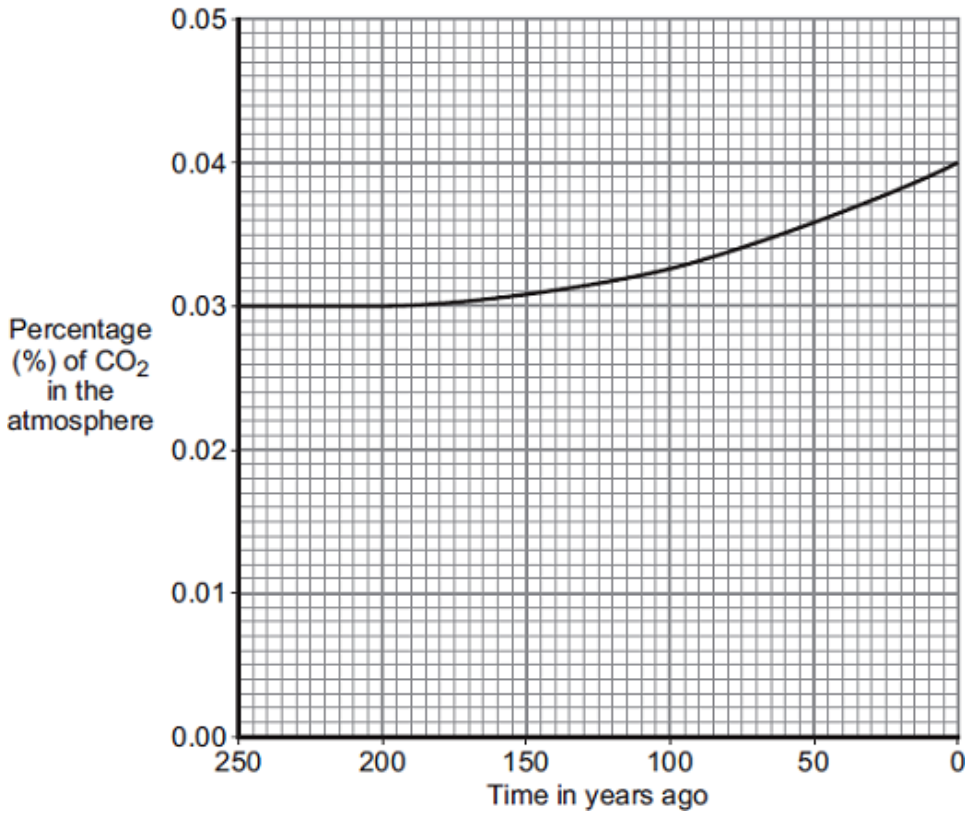
(2)

(c) **Graph 2** shows how the percentage of carbon dioxide in the atmosphere changed in the last 250 years.

Graph 2



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

Explain your answer.

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(2)
(Tota 10 marks)