Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about the Earth's atmosphere.

(a) How long ago was the Earth formed?

Tick (✓) **one** box.

4.6 billion years ago ☐

4.6 million years ago ☐

4.6 thousand years ago ☐

(1)

The table below shows the percentages of gases in the atmospheres of Mars and Earth today.

Gas	Percentage of gas in atmosphere (%)	
	Mars	**Earth**
Carbon dioxide	95.97	0.04
Nitrogen	1.89	78.09
Oxygen	0.15	20.95
Other gases	1.99	**X**

(b) Calculate the percentage **X** of other gases in the Earth's atmosphere.

Use the table above.

_____

X = _____ %

(1)

The atmosphere of the early Earth is thought to have been similar to the atmosphere of Mars today.

The percentages of nitrogen and of oxygen in the Earth's atmosphere today have changed from the percentages in the Earth's early atmosphere.

(c) Draw **one** line from each gas to the change in the percentage of that gas.

Use the table above.

Gas	Change in percentage of gas
	Increased by about 4 times
Nitrogen	Increased by about 21%
Oxygen	Increased by about 40 times
	Increased by about 96%

(2)

(d) The percentage of carbon dioxide in the Earth's early atmosphere decreased.

Which **two** processes caused this decrease?

Tick (✓) **two** boxes.

- Carbon dioxide dissolving in sea water ☐
- Combustion of fossil fuels ☐
- Farming of animals ☐
- Formation of sedimentary rocks ☐
- Volcanoes releasing carbon dioxide ☐

(2)

(e) Photosynthesis also decreased the percentage of carbon dioxide in the Earth's early atmosphere.

Photosynthesis increased the percentage of another gas.

Complete the word equation for photosynthesis.

_____ + water → glucose + _____

(2)

(f) Complete the sentence.

Scientists are not certain about the percentages of gases in the Earth's early atmosphere because there is a lack of _____.

(1)

(Total 9 marks)

Q2.

This question is about algae.

A student:

- placed algae in water containing dissolved carbon dioxide
- shone bright light on the algae.

Gas bubbles were collected as the algae photosynthesised.

(a) Describe a test that would identify the gas collected.

Give the result of the test.

Test _____

Result _____

_____

(2)

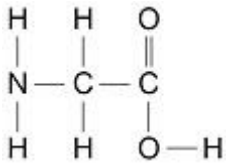
(b) Glucose is produced when algae photosynthesise.

Name **two** naturally occurring polymers produced from glucose. **(separate only)**

_____ and _____

(2)

The diagram below shows the displayed structural formula of an amino acid called glycine.



(c) How many functional groups are there in the molecule in the diagram above ?

Tick (✓) **one** box. **(separate only)**

1 ☐ 2 ☐ 3 ☐ 4 ☐

(1)

(d) Glycine reacts by condensation polymerisation to produce a polypeptide and one other substance.

Name the other substance produced. **(separate only)**

_____

(1)

(e) Scientists think that algae may have used gases in Earth's early atmosphere.

Algae need an element to produce the molecule in the diagram above which is **not** present in water or carbon dioxide.

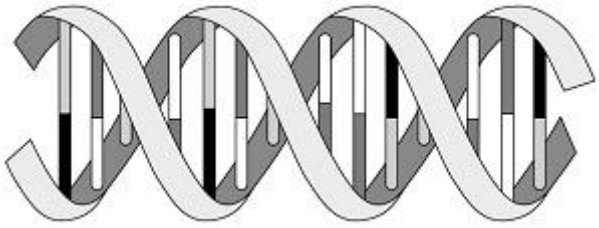
Which **two** gases from Earth's early atmosphere could have provided this element?

_____ and _____

(2)

(f) The development and function of algae are controlled by a naturally occurring polymer.

The image below represents the shape and structure of this polymer.



Describe the shape and structure of this polymer. **(separate only)**

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q3.

Titan is a moon of the planet Saturn.

The table below shows the percentages of some gases in the atmosphere of Titan and in the atmosphere of the Earth.

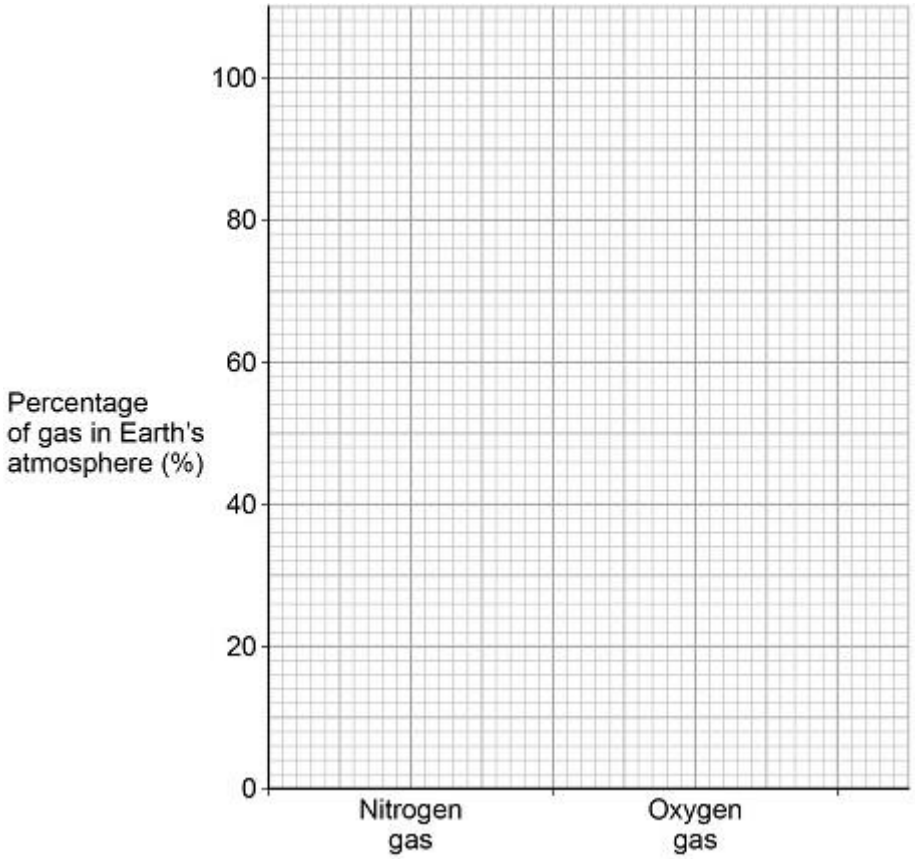
Gas	Percentage of gas in atmosphere (%)	
	Titan	Earth
Nitrogen	98	78
Oxygen	Zero	21
Methane	1.4	0.0002
Argon	0.14	0.9
Carbon dioxide	0.0001	0.04

(a) Which **two** gases are present in smaller percentages on the Earth than on Titan?

_____ and _____

(1)

(b) Complete the bar chart in the figure below to show the percentages of nitrogen gas and oxygen gas in the Earth's atmosphere.



(2)

(c) Why are algae less likely to photosynthesise on Titan than Earth?

Use the table above.

Tick (✓) **one** box.

Titan's atmosphere contains too little argon.	☐
Titan's atmosphere contains too little carbon dioxide.	☐
Titan's atmosphere contains too little methane.	☐
Titan's atmosphere contains too little nitrogen.	☐

(1)

(d) Titan is warmer than the other moons of Saturn because of the greenhouse effect.

How do greenhouse gases trap energy from the sun?

Tick (✓) **one** box.

All wavelengths of radiation are reflected back to the surface of Titan.	☐
Long wavelength radiation is reflected back to the surface of Titan.	☐
Short wavelength radiation is reflected back to the surface of Titan.	☐

(1)

As well as methane, the atmosphere of Titan contains small amounts of propene gas. Methane is an alkane and propene is an alkene.

(e) Bromine water is an orange solution used to identify alkenes.

Draw **one** line from each gas to its effect on bromine water.

Gas	Effect on bromine water
	Forms a blue solution
Methane	Forms a colourless solution
	Forms a green solution
Propene	Forms a white precipitate
	No effect

(2)

(f) Propene reacts with water (steam) to make propanol.

The ratio of the masses of propene and water that react is:

Propene : water

7 : 3

Calculate the mass of propene that reacts with 21 g water.

_____

_____

_____

_____

Mass = _____ g

(2)

(Total 9 marks)

Q4.

Titan is a moon of the planet Saturn.

The following table shows the percentages of the gases in the atmosphere of Titan.

Gas	Percentage of gas in

	atmosphere (%)
Nitrogen	98.4
Methane	1.4
Other gases	0.2

(a) Some scientists think that living organisms could have evolved on Titan.

Explain why these organisms could **not** have evolved in the same way that life is thought to have evolved on Earth.

Use the table.

(3)

(b) Saturn has other moons.

The other moons of Saturn have no atmosphere.

Titan is warmer than the other moons of Saturn because its atmosphere contains the greenhouse gas methane.

Explain how this greenhouse gas keeps Titan warmer than the other moons of Saturn.

(3)

(c) The atmosphere of Titan contains small amounts of propene.

Describe a test to show that propene is an unsaturated hydrocarbon.

Give the result of the test.

Test _____

_____

Result _____

_____

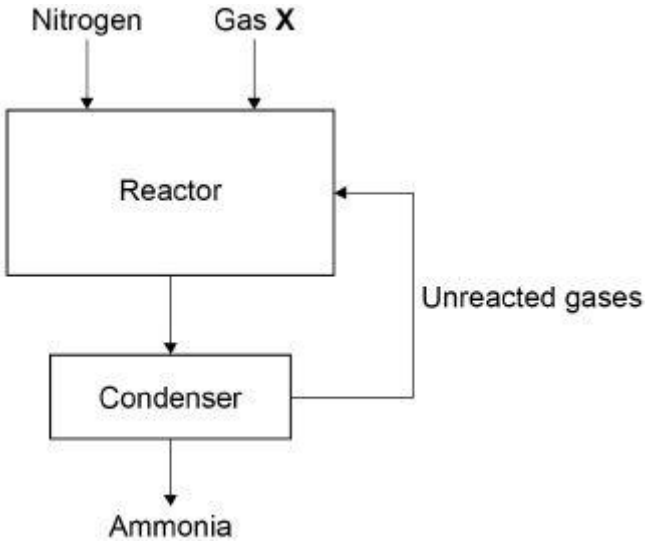
(2)

(Total 8 marks)

Q5.

This question is about gases.

The diagram below shows how nitrogen is used in the Haber Process to produce ammonia.



(a) Gas **X** in the diagram above is obtained from methane.

Name gas **X**. **(separate only)**

_____

(1)

(b) Give the approximate temperature and pressure used in the reactor. **(separate only)**

Temperature _____

Pressure _____

(2)

(c) The mixture of gases from the reactor cools in the condenser.

Suggest why ammonia condenses but the other gases do not. **(separate only)**

(1)

The Earth's early atmosphere was different to Earth's atmosphere today.

Scientists think that the Earth's early atmosphere was like the atmosphere found on Venus today.

The table below shows the amounts of carbon dioxide and oxygen in the atmospheres of Venus and Earth today.

Gas	**Percentage (%) in Venus' atmosphere today**	**Percentage (%) in Earth's atmosphere today**
Carbon dioxide	96.50	0.04
Oxygen	0.00	20.95

(d) The percentages of carbon dioxide and oxygen have changed from Earth's early atmosphere to Earth's atmosphere today.

Explain the processes that led to these changes.

(6)

(e) Why are scientists **not** certain about the percentage of each gas in the Earth's early atmosphere?

_____

_____

(1)

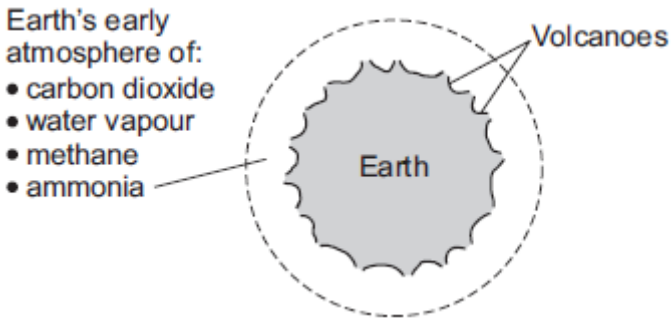
(Total 11 marks)

Q6.

This question is about the Earth and its atmosphere.

(a) **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)

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

(i) Draw **one** line from each substance to a description of the substance.

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

(3)

(ii) Which gas in the Earth's atmosphere is used when hydrocarbons burn?

Tick (✓) **one** box.

- carbon dioxide ☐
- nitrogen ☐
- oxygen ☐

(1)

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

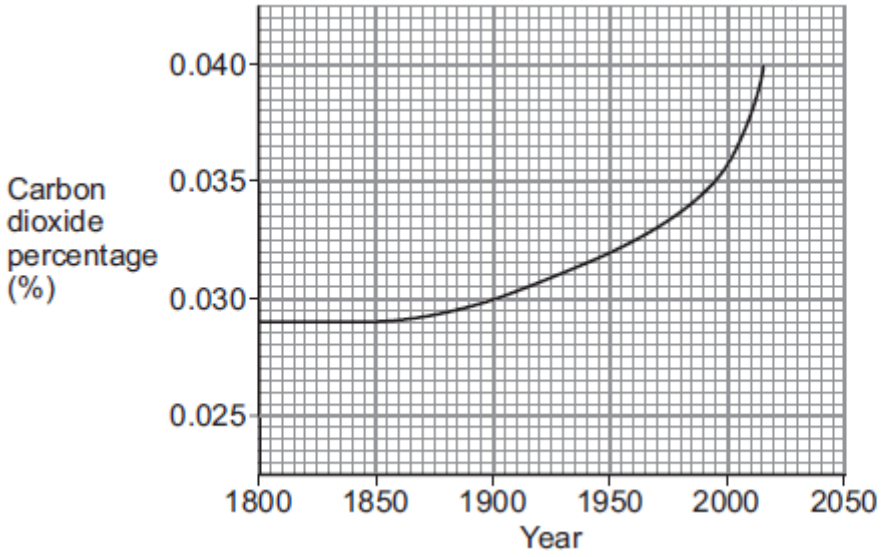
Tick (✓) **one** box.

- about 40% ☐
- about 60% ☐
- about 80% ☐

(1)

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

Figure 2



(i) What was the carbon dioxide percentage in 1900?

_____ %

(1)

(ii) Describe, in detail, how the carbon dioxide percentage changed from 1900 to 2015.

_____

_____

_____

_____

(2)

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

1. _____

_____

2. _____

_____

(2)

(Total 11 marks)