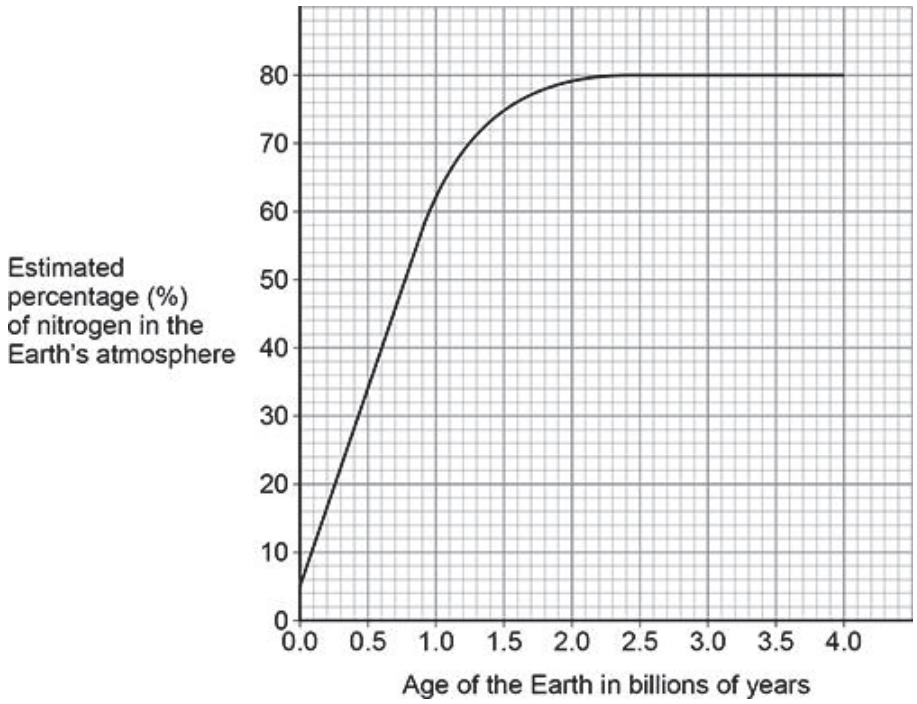
Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about the Earth's atmosphere and naturally occurring polymers.

(a) The figure below shows how the estimated percentage of nitrogen in the Earth s atmosphere has changed since the Earth was formed.



Describe the trends shown by the graph.

Use data from the figure above.

_____

_____

_____

_____

_____

_____

(3)

The percentage of oxygen in the Earth s atmosphere has increased since the Earth was formed.

This is because of photosynthesis.

The word equation for the photosynthesis reaction is:

carbon dioxide + water → glucose + oxygen

(b) What happened to the percentage of carbon dioxide in the atmosphere when photosynthesis began?

Tick (✓) **one** box.

The percentage of carbon dioxide decreased.	☐
The percentage of carbon dioxide stayed the same.	☐
The percentage of carbon dioxide increased.	☐

(1)

(c) The photosynthesis reaction takes in energy from the surroundings.

Complete the sentence.

Choose the answer from the box.

carbon dioxide	**light**	**water**

The source of the energy used in photosynthesis is _____.

(1)

(d) Which **two** produce oxygen by photosynthesis?

Tick (✓) **two** boxes.

- Algae ☐
- Animals ☐
- Plants ☐
- Viruses ☐
- Yeast ☐

(2)

(e) The glucose produced during photosynthesis can form naturally occurring polymers.

Which **two** are naturally occurring polymers that can be produced from glucose?

(chemistry only)

Tick (✓) **two** boxes.

- Cellulose ☐
- DNA ☐
- Poly(propene) ☐
- Protein ☐
- Starch ☐

(2)

DNA molecules contain two polymer chains.

A DNA molecule has a relative formula mass (M_r) of approximately 140 000 000 000

(f) What is the approximate relative formula mass (M_r) of the DNA molecule in standard form? **(chemistry only)**

Tick (✓) **one** box.

- 1.4×10^9 ☐
- 1.4×10^{10} ☐
- 1.4×10^{11} ☐
- 1.4×10^{12} ☐

(1)

(g) What is the approximate relative formula mass (M_r) of each polymer chain in the DNA molecule? **(chemistry only)**

Tick (✓) **one** box.

- 70 000 000 000 ☐
- 140 000 000 000 ☐
- 280 000 000 000 ☐
- 560 000 000 000 ☐

(1)

(h) Complete the sentence. **(chemistry only)**

The shape of a DNA molecule is a double _____ .

(1)

(i) How many different nucleotides are present in a molecule of DNA? **(chemistry only)**

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

(1)

(Total 13 marks)

Q2.

This question is about oxygen.

Scientists think that there was little or no oxygen in the Earth's early atmosphere.

(a) Which planet today has an atmosphere that is similar to the Earth's early atmosphere?

Tick (✓) **one** box.

- Jupiter ☐
- Mars ☐
- Neptune ☐
- Saturn ☐

(1)

(b) Which is the approximate percentage of oxygen in the Earth's atmosphere today?

Tick (✓) **one** box.

- 20% ☐
- 50% ☐
- 80% ☐
- 100% ☐

(1)

(c) Which **two** of the following increased the percentage of oxygen in the Earth's atmosphere?

Tick (✓) **two** boxes.

- Active volcanoes emitted gases ☐
- Algae and plants evolved ☐
- Animals evolved ☐
- Carbonate sediments formed in oceans ☐
- Photosynthesis took place ☐

(2)

(d) Some scientists think that 1100 million years ago the Earth's atmosphere contained:

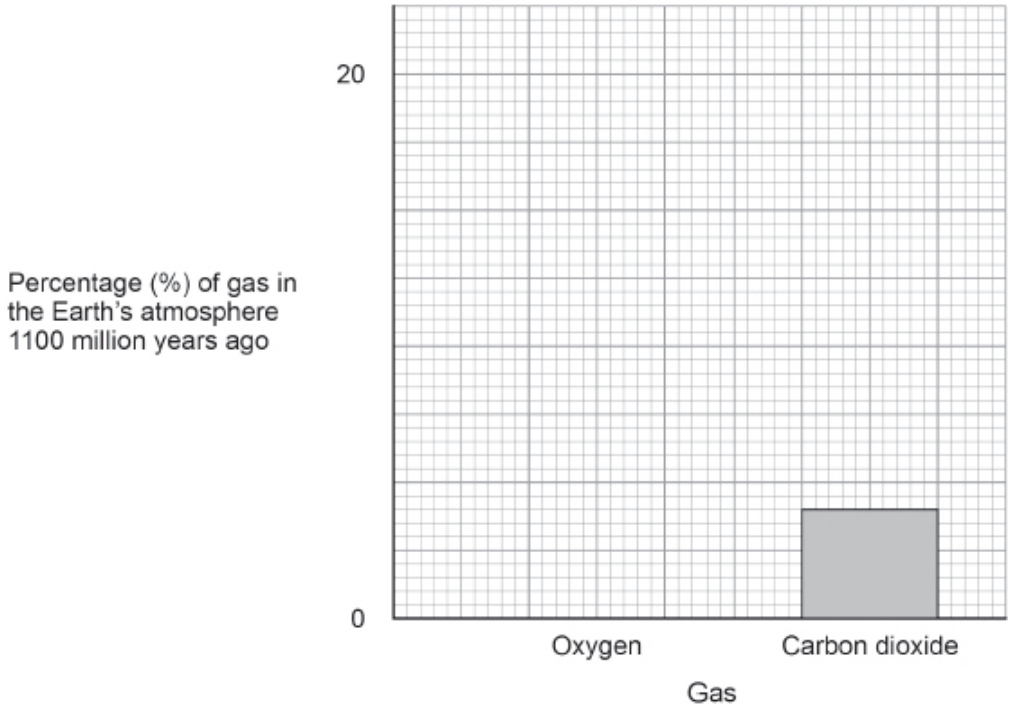
- 16% oxygen
- 4% carbon dioxide.

Complete **Figure 1**.

You should:

- complete the *y*-axis scale
- plot the percentage of oxygen in the Earth's atmosphere 1100 million years ago.

Figure 1



(2)

Oxygen is produced when manganese dioxide is added to hydrogen peroxide solution.

The equation for the reaction is:

hydrogen peroxide → water + oxygen

A student investigated the effect of changing the temperature on the decomposition of hydrogen peroxide.

This is the method used.

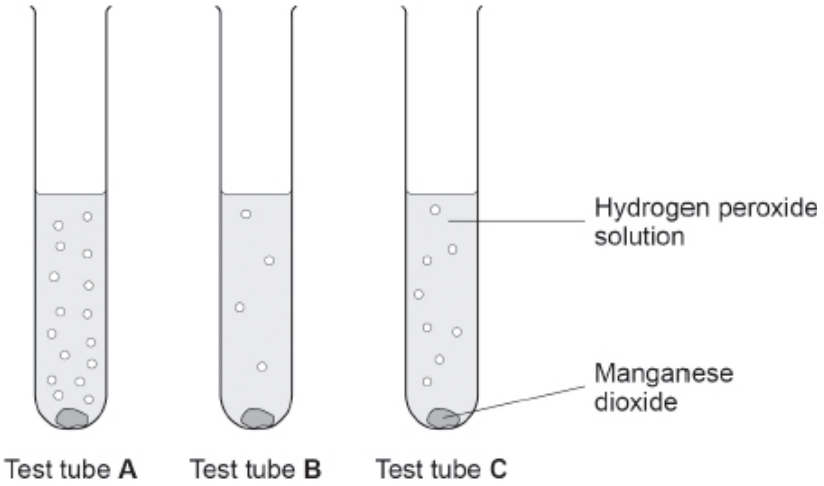
1. Add 5 cm^3 of hydrogen peroxide solution to three test tubes labelled **A**, **B** and **C**.

2. Place each test tube in a water bath at a different temperature.

3. Add 0.2 g of manganese dioxide to each test tube.

Figure 2 shows the results.

Figure 2



(e) Which test tube contained hydrogen peroxide solution at the highest temperature?

Tick (✓) **one** box.

Test tube **A** ☐

Test tube **B** ☐

Test tube **C** ☐

(1)

(f) The student tested the gas produced.

What is used to prove that the gas is oxygen?

Tick (✓) **one** box.

A glowing splint	☐
Bromine water	☐
Damp litmus paper	☐

(1)

(g) Manganese dioxide does not appear in the chemical equation for this reaction.

Which is a correct statement about manganese dioxide in this reaction?

Tick (✓) **one** box.

Manganese dioxide increases the activation energy in this reaction.	☐
Manganese dioxide is a catalyst in this reaction.	☐
Manganese dioxide is used up during this reaction.	☐
Manganese dioxide reduces the rate of this reaction.	☐

(1)

(Total 9 marks)

Q3.

This question is about the Earth's atmosphere.

The table below shows:

- the estimated percentages of gases in the Earth's early atmosphere
- the percentages of gases in the Earth's atmosphere today.

Gas	Estimated percentage (%) in the Earth's early atmosphere	Percentage (%) in the Earth's atmosphere today
Nitrogen	1.8	**X**
Oxygen	0.2	20.95
Carbon dioxide	96.0	0.04
Other gases	2.0	0.92

(a) Calculate value **X** in the table above.

_____

_____

X = _____%

(1)

(b) Which **two** other gases may have been in the Earth's early atmosphere?

Tick (✓) **two** boxes.

Ammonia ☐

Coal ☐

Limestone ☐

Methane ☐

Poly(ethene) ☐

(2)

Algae and plants increased the percentage of oxygen in the Earth's atmosphere.

The same process in algae and plants decreased the percentage of carbon dioxide in the Earth's atmosphere.

(c) Which process in algae and plants increased the percentage of oxygen in the Earth's atmosphere?

Tick (✓) **one** box.

- Fermentation ☐
- Photosynthesis ☐
- Rusting ☐
- Sedimentation ☐

(1)

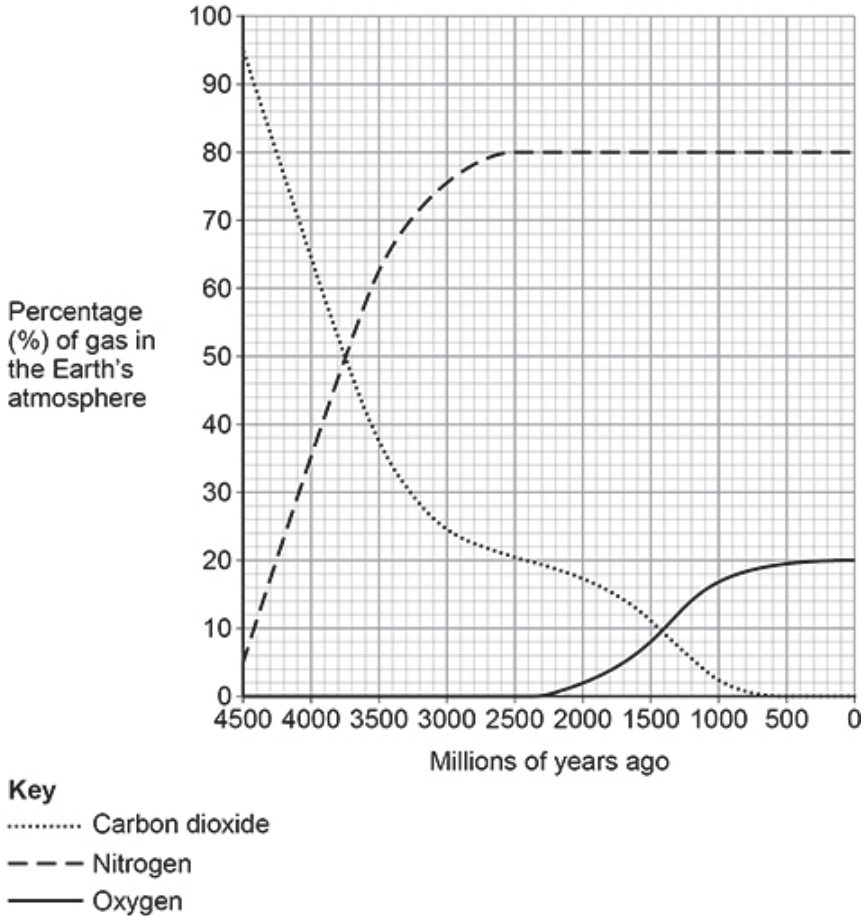
(d) Which **two** other processes decreased the percentage of carbon dioxide in the Earth's atmosphere?

Tick (✓) **two** boxes.

- Burning fossil fuels ☐
- Dissolving carbon dioxide in oceans ☐
- Eruption of volcanoes ☐
- Evolution of animals ☐
- Formation of sedimentary rocks ☐

(2)

The figure below shows how the percentages of gases in the Earth's atmosphere may have changed since the atmosphere was formed.



(e) When was the percentage of oxygen in the Earth's atmosphere 8%?

Use the figure above.

_____ millions of years ago

(1)

(f) When did the percentage of nitrogen in the Earth's atmosphere become constant?

Use the figure above.

_____ millions of years ago

(1)

(g) Crude oil was formed from an ancient biomass as the Earth's atmosphere evolved.

What did this ancient biomass mainly consist of?

Tick (✓) **one** box.

Limestone	☐
Plankton	☐
Sand	☐

(1)

(h) Most of the percentages of the gases in the figure above are estimated values.

Why have scientists used estimated values for the percentages of the gases in the figure above?

_____

_____

(1)

(Total 10 marks)