Name: _____

Atmosphere part 3 AQA Triple Chemistry

Date: _____

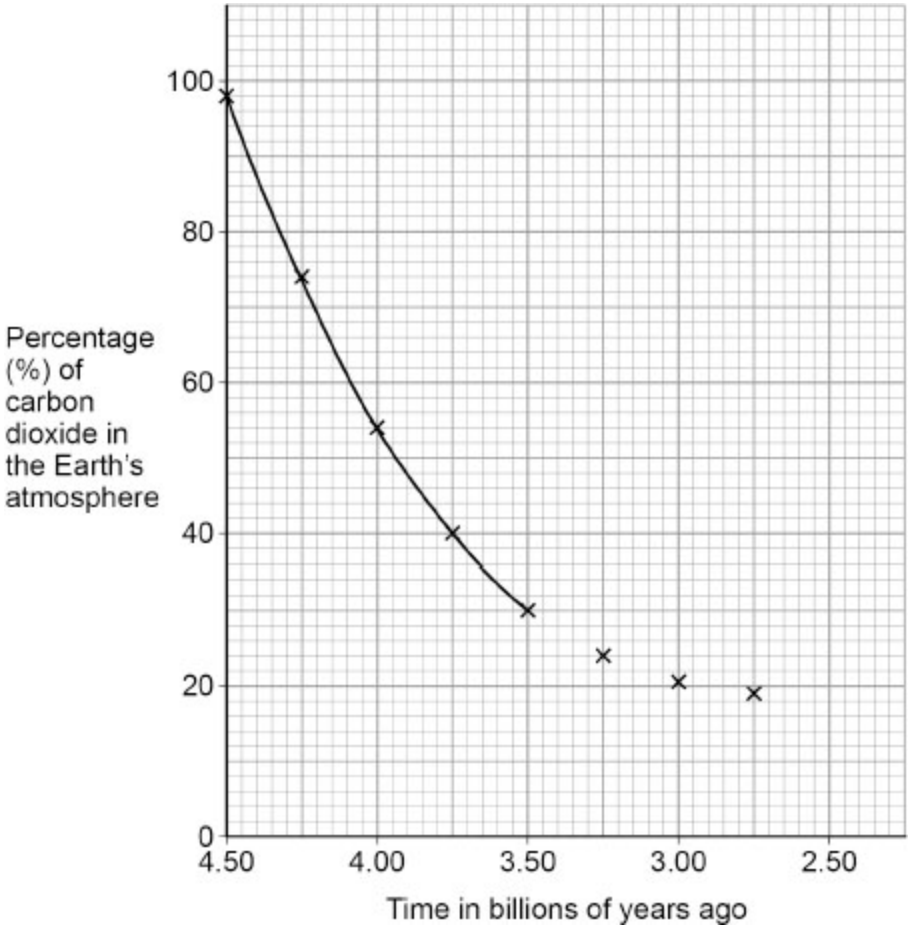
Time: **71 minutes**

Marks: **69 marks**

Comments:

1. The Earth's atmosphere has changed over time.

The figure below shows the percentage of carbon dioxide in the Earth's atmosphere between 4.5 billion and 2.75 billion years ago.



(a) Complete the figure above.

You should extend the line of best fit to the plotted point at 2.75 billions of years ago.

(1)

(b) What was the percentage (%) of carbon dioxide in the Earth's atmosphere 3.75 billions of years ago?

Use the figure above.

_____ %

(1)

(c) The percentage of carbon dioxide changed between 4.5 and 3.0 billion years ago.

Which was a cause of this change?

Use the figure above.

Tick (✓) **one** box.

Carbon dioxide was dissolved in oceans. ☐

Carbon dioxide was produced during combustion of fossil fuels. ☐

Carbon dioxide was released during volcanic activity. ☐

(1)

The table below shows information about the percentage of nitrogen present in the Earth's atmosphere.

Time in billions of years ago	Percentage (%) of nitrogen
4.5	4
4.0	34
3.5	62
3.0	75
2.5	78

(d) The percentage of nitrogen changed between 4.5 and 2.5 billion years ago.

Which was a cause of this change?

Use the table above.

Tick (✓) **one** box.

Nitrogen was dissolved in oceans. ☐

Nitrogen was produced during combustion of fossil fuels. ☐

Nitrogen was released during volcanic activity. ☐

(1)

(e) When did the percentage of nitrogen in the Earth's atmosphere become similar to the percentage of nitrogen in the Earth's atmosphere today?

Use the table above.

Tick (✓) **one** box.

2.5 billion years ago ☐

3.0 billion years ago ☐

3.5 billion years ago ☐

4.0 billion years ago ☐

4.5 billion years ago ☐

(1)

(f) Which **two** gases may also have been present in the Earth's early atmosphere?

Tick (✓) **two** boxes.

Ammonia ☐

Chlorine ☐

Helium ☐

Hydrogen ☐

Methane ☐

(2)

(g) Name the process that started to produce oxygen in the Earth's atmosphere 2.7 billion years ago.

_____

(1)

(Total 8 marks)

2. The Earth's atmosphere has changed over time.

(a) Explain how the percentage of nitrogen changed in the Earth's early atmosphere.

_____

_____

_____

_____

(2)

(b) **Table 1** shows the percentage (%) of carbon dioxide present in the Earth's early atmosphere.

Table 1

Time in billions of years ago	Percentage (%) of carbon dioxide in the Earth's early atmosphere
4.5	98
4.0	54
3.5	30
3.0	21

The percentage of carbon dioxide in the Earth's **early** atmosphere changed between 4.5 billion and 3.0 billion years ago.

Give **two** reasons why.

1 _____

_____

2 _____

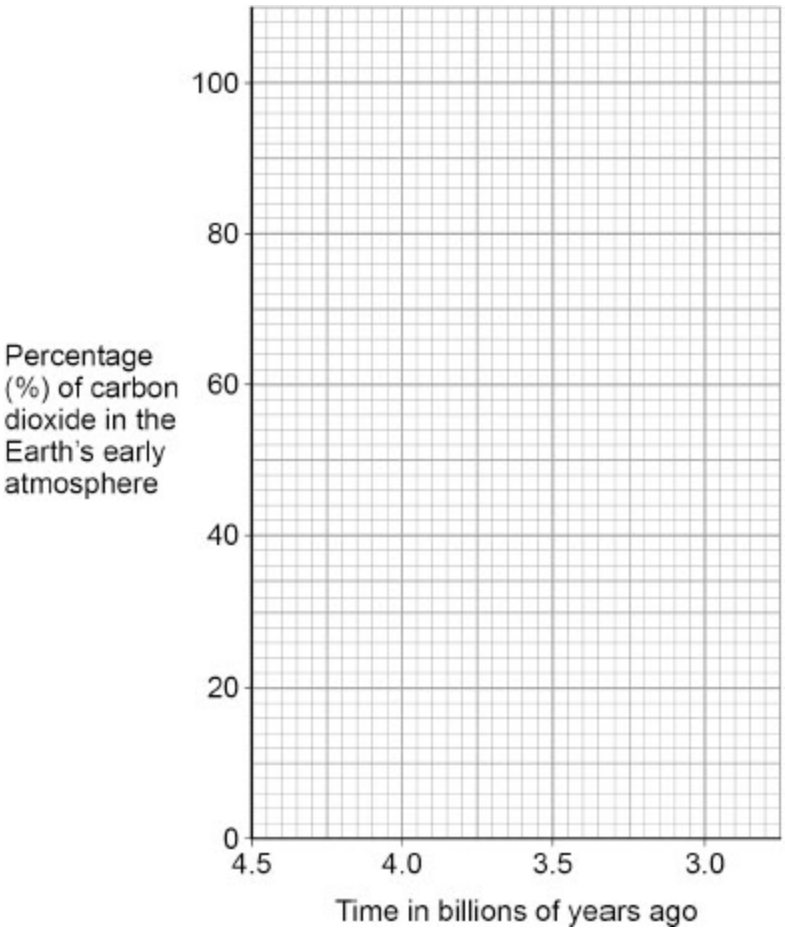
_____

(2)

(c) Complete the figure below.

You should:

- plot the data in **Table 1**
- draw a line of best fit.



(2)

(d) **Table 2** shows information about the percentage (%) of carbon dioxide and of oxygen present in the Earth's atmosphere over time.

Table 2

Time in billions of years ago	Percentage (%) of gas in the Earth's atmosphere	
	Carbon dioxide	Oxygen
2.5	18	1
2.0	15	2
1.5	10	8
1.0	3	17
0.5	1	19

The percentages of carbon dioxide and of oxygen in the Earth's atmosphere changed between 2.5 billion and 0.5 billion years ago.

Explain how.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

3. This question is about burning coal.

A power station has four coal-burning furnaces.

Each furnace burns 3000 kg of coal per minute.

The table below shows some information about this coal burning power station

Number of furnaces in use	Mass of coal burned per minute in kilograms	Mass of sulfur dioxide produced per minute in kilograms	Mass of carbon dioxide produced per minute in kilograms
0	0	0	0
1	3000	100	7000
2	6000	200	14 000
3	9000	300	21 000
4	12 000	400	28 000

(a) Carbon dioxide is a greenhouse gas.

What is the effect on the rate of global climate change of using more furnaces in this power station?

Complete the sentence.

Choose the answer from the box.

decreases	stays the same	increases

Use the table above.

The rate of global climate change _____ .

(1)

(b) 7000 kg of carbon dioxide are produced when 3000 kg of coal are burned.

Calculate the mass of carbon dioxide produced when 1 kilogram of coal is burned.

_____

_____

_____

Mass of carbon dioxide = _____ kg

(2)

(c) Complete the sentence.

Sulfur dioxide causes an environmental effect called acid _____ .

(1)

The table is repeated below.

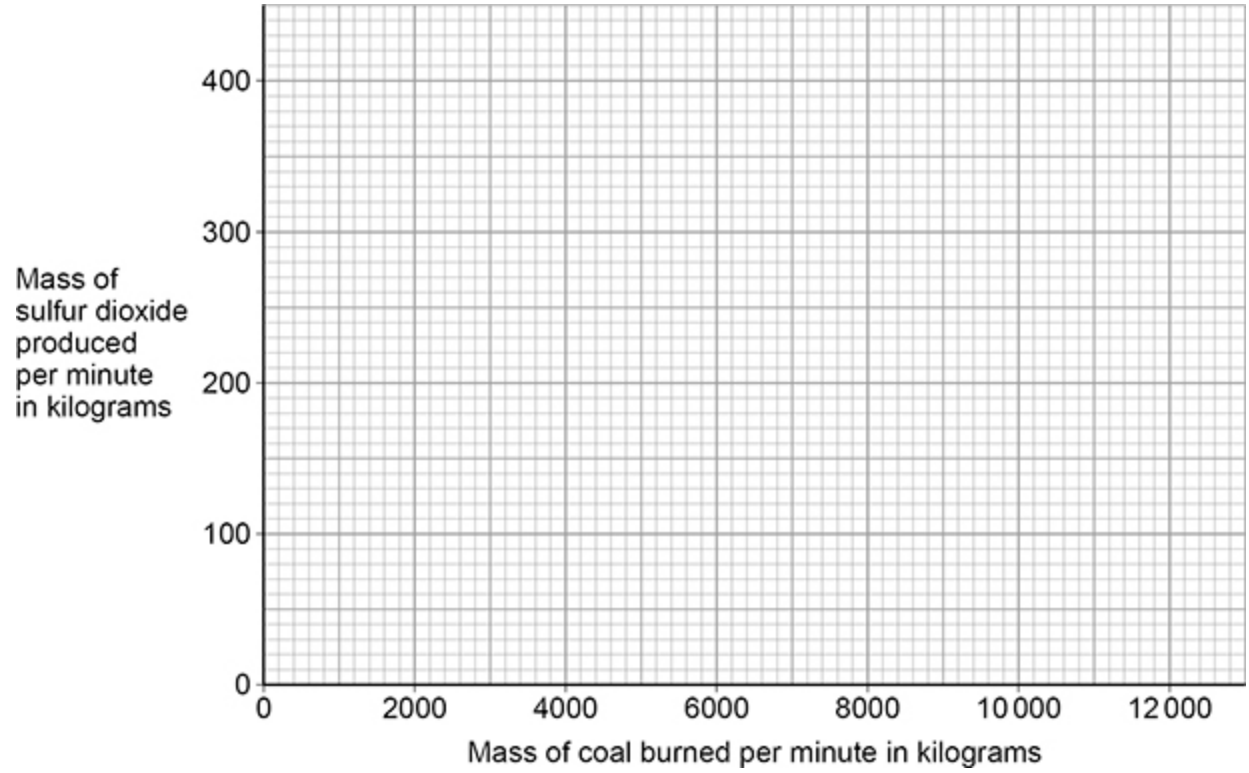
Number of furnaces in use	**Mass of coal burned per minute in kilograms**	**Mass of sulfur dioxide produced per minute in kilograms**	**Mass of carbon dioxide produced per minute in kilograms**
0	0	0	0
1	3000	100	7000
2	6000	200	14 000
3	9000	300	21 000
4	12 000	400	28 000

(d) The figure below shows how the mass of sulfur dioxide produced per minute varies with the mass of coal burned per minute.

Complete the figure below.

You should:

- plot data the table above on the figure below
- draw a line of best fit.



(3)

(e) Complete the sentence.

Use the table and figure above.

As the mass of coal burned per minute increases, the mass of sulfur dioxide produced per minute _____.

(1)

(f) This power station also releases particulates into the air.

Complete the sentence.

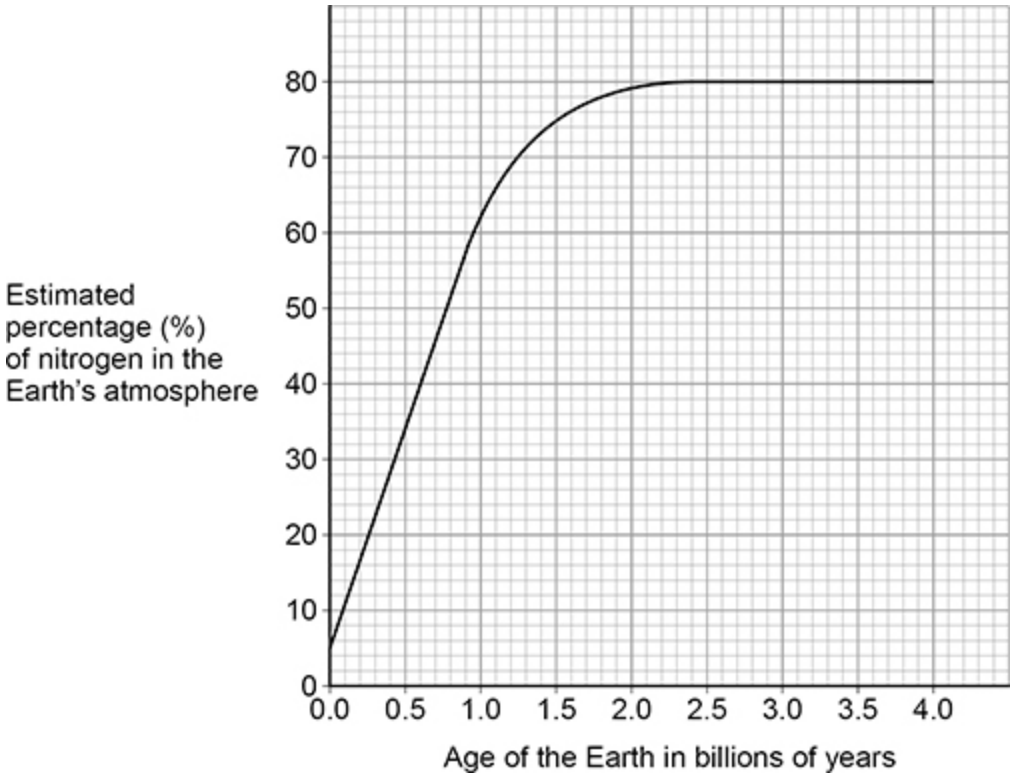
The release of particulates into the air causes global _____.

(1)

(Total 9 marks)

4. 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?

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?

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?

Tick (✓) **one** box.

70 000 000 000 ☐

140 000 000 000 ☐

280 000 000 000 ☐

560 000 000 000 ☐

(1)

(h) Complete the sentence.

The shape of a DNA molecule is a double _____ .

(1)

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

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

(1)

(Total 13 marks)

5. This question is about burning fuels in central heating boilers.

In the future, gas central heating boilers may burn hydrogen rather than natural gas.

The table below shows information about these fuels when 1 dm^3 of the fuel is burned in a central heating boiler.

	Fuel	
	Hydrogen	**Natural gas**
Energy released in kJ	11.9	37.1
Mass of carbon dioxide produced in grams	0.00	1.83
Mass of water vapour produced in grams	0.75	1.50
Mass of oxides of nitrogen produced in grams	6.6×10^{-4}	4.9×10^{-4}

(a) Explain how oxides of nitrogen are produced when burning fuels.

_____

_____

_____

_____

(2)

(b) Explain **one** positive impact on the environment of burning hydrogen rather than natural gas as a fuel.

Use the table above.

_____

_____

_____

_____

(2)

(c) Explain **one** negative impact on the environment of burning hydrogen rather than natural gas as a fuel.

Use the table above.

_____

_____

_____

_____

(2)

(d) Air is 20% oxygen.

Calculate the volume of air needed to provide enough oxygen to react with 3.50 dm^3 of hydrogen gas.

The equation for the reaction is

$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

_____

_____

_____

_____

_____

Volume of air = _____ dm^3

(3)

(e) Central heating boilers can also burn kerosene.

Kerosene is produced from crude oil in a fractionating column using fractional distillation.

In the first step, crude oil is heated and hydrocarbon vapours are formed.

Explain how kerosene is produced from these hydrocarbon vapours.

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

6. This question is about greenhouse gases and climate change.

(a) Which **two** gases are greenhouse gases?

Tick (✓) **two** boxes.

Argon	☐
Carbon dioxide	☐
Nitrogen	☐
Methane	☐
Oxygen	☐

(2)

(b) Why are greenhouse gases essential for supporting life on Earth?

_____

_____

(1)

The percentage of greenhouse gases in the Earth's atmosphere today is increasing.

Many scientists think that this increase is causing global climate change.

(c) What is a cause of the greenhouse effect?

Complete the sentence.

Greenhouse gases absorb long wavelength _____.

(1)

(d) Which **two** are potential effects of global climate change?

Tick ✓ **two** boxes.

- Fewer droughts ☐
- Fewer storms ☐
- Higher sea levels ☐
- Less coastal flooding ☐
- Melting polar ice ☐

(2)

(e) Water vapour is a greenhouse gas.

The percentage by mass of water vapour in the Earth's atmosphere is 0.25%.

Calculate the mass of water vapour in 350 kg of the Earth's atmosphere.

Give your answer in grams.

_____

_____

_____

_____

_____

Mass = _____ g

(3)

(Total 9 marks)

7. 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:

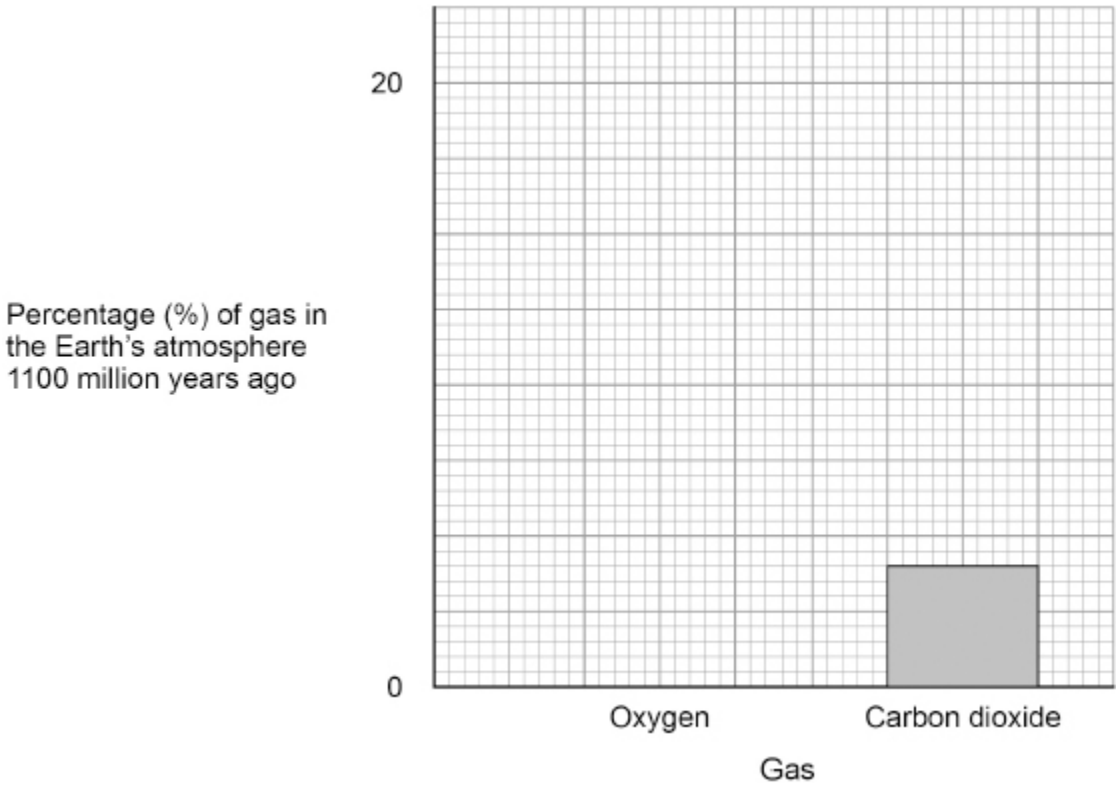
- 16% oxygen
- 4% carbon dioxide.

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.

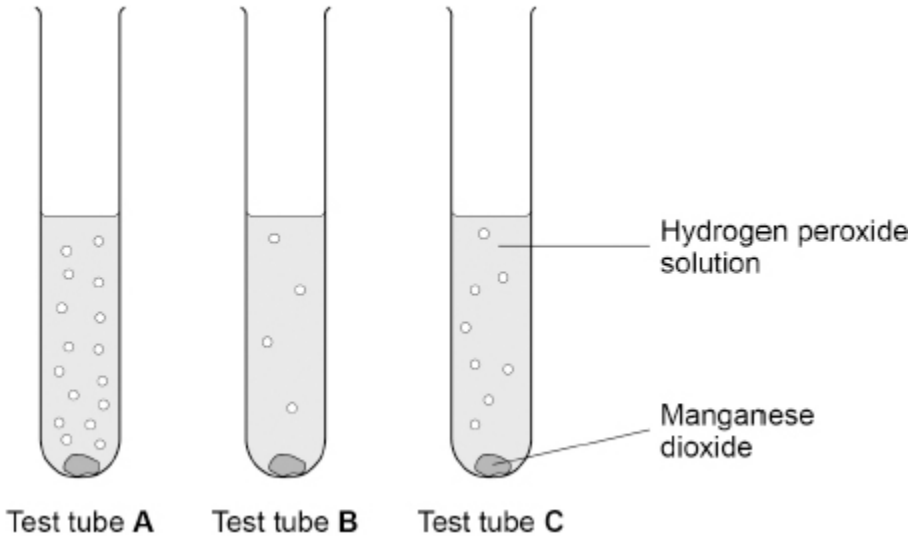
1. Add 5 cm^3 of hydrogen peroxide solution to three test tubes labelled **A**, **B** and **C**.

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)

1.

(a) line of best fit

1

(b) 40 (%)

1

(c) carbon dioxide was dissolved in oceans

1

(d) nitrogen was released during volcanic activity

1

(e) 2.5 billion years ago

1

(f) ammonia

1

methane

1

(g) photosynthesis

1

[8]

2.

(a) (the percentage of) nitrogen increased

1

(because of intense) volcanic activity

1

(b) (carbon dioxide) dissolved in water / oceans

1

(carbonate) forming sediments / precipitates

*do **not** accept formed shells of sea creatures*

*do **not** accept photosynthesis*

*do **not** accept formed fossil fuels*

1

(c) all four points plotted correctly

allow a tolerance of ± ½ a small square

1

line of best fit

1

(d) carbon dioxide decreased
and
oxygen increased

ignore dissolving in oceans
ignore sedimentation

1

(because of) photosynthesis

*do **not** accept respiration*

1

(by) algae / plants

allow (by) cyanobacteria

1

[9]

3. (a) increases

1

(b)

$$(\text{mass} =) \frac{7000}{3000}$$

1

= 2.33 (kg)

allow 2.333333 correctly rounded to at least 2 significant figures

1

(c) rain

1

(d) five points plotted correctly

allow a tolerance of ± ½ a small square
*allow three or four points plotted correctly for **1** mark*

2

line of best fit

1

(e) increases

1

(f) dimming

1

[9]

4. (a) percentage of nitrogen increases

1

until 2.3 billion years

allow a value in the range 2.1 to 2.4 billion years

allow until 80%

1

then remains constant

1

(b) the percentage of carbon dioxide decreased

1

(c) light

1

(d) algae

1

plants

1

(e) cellulose

1

starch

1

(f) 1.4×10^{11}

1

(g) 70 000 000 000

1

(h) helix

1

(i) 4

1

[13]

5. (a) high temperatures

ignore pressure

1

(cause) nitrogen (from air) and oxygen (from air) to react

1

(b) less climate change

ignore references to water vapour

allow less global warming

allow an effect of climate change for climate change

1

(because) no carbon dioxide (produced)

1

(c) more oxides of nitrogen (produced)

1

(so) more acid rain

or

(so) more respiratory problems

allow an effect of acid rain for acid rain

allow a named respiratory problem for respiratory problems

MP2 cannot be linked to an incorrect gas from MP1 1

1

(d) (volume of oxygen = $3.50 \times \frac{1}{2} =$

1.75 (dm^3)

1

(volume of air =) $1.75 \times \frac{100}{20}$

allow correct use of an incorrectly determined volume of oxygen

1

= 8.75 (dm^3)

1

(e) there is a temperature gradient in the (fractionating) column

allow the (fractionating) column gets cooler going up

1

(so) kerosene condenses

allow (so) the hydrocarbons / vapours condense

1

at the level (in the column) corresponding to kerosene's boiling point (range)

allow at the level (in the column) corresponding to the boiling point of the hydrocarbons / vapours

for the award of 2 marks for MP2 and MP3, a reference to kerosene must be made

1

[12]

6. (a) carbon dioxide

1

methane

1

(b) (greenhouse gases) maintain temperatures on Earth (high enough to support life)

1

(c) (greenhouse gases absorb long wavelength) radiation

(greenhouse gases absorb long wavelength) infra-red (radiation)

1

(d) higher sea levels

1

melting polar ice

1

(e) (mass =)

$\frac{0.25}{100} \times 350$

1

= 0.875 (kg)

1

= 875 (g)

allow a correct conversion of an incorrectly determined mass

1

alternative approach:

350 kg = 350 000 g (1)

(mass =)

$\frac{0.25}{100} \times 350\,000$ (1)

allow correct use of incorrect / no conversion of mass

= 875 (g) (1)

[9]

7. (a) Mars

1

(b) 20%

1

(c) algae and plants evolved

1

photosynthesis took place

1

(d) (*y*-axis labelled) 5, 10, 15, (20)

allow (y-axis labelled) 4, 8, 12, 16, (20)

ignore correct intermediate values

1

oxygen bar drawn to 16%

allow a tolerance of ± ½ a small square

1

(e) test tube **A**

1

(f) a glowing splint

1

(g) manganese dioxide is a catalyst in this reaction

1

[9]