Air and water – 2021/20 GCSE 21st Chemistry Combined Science B

1. Nov/2021/Paper_J260/02/No.9

The table shows data about the composition of the Earth's atmosphere 4 billion years ago and today.

	Composition of gases in Earth's atmosphere (%)	
	4 billion years ago	**Today**
Carbon dioxide	20	0.04
Water	50	small
Nitrogen	3	78
Oxygen	0	21
Other gases	.....	small

(a) (i) Complete the table to show the approximate percentage of other gases in the atmosphere 4 billion years ago. **[1]**

(ii) Four billion years ago the Earth was extremely hot.

When the temperature of the Earth cooled to below 100 °C there was a large decrease in the amount of water vapour in the atmosphere.

Describe what happens when hot water vapour cools to below 100 °C.

Use ideas about arrangement and speed of particles in your answer.

.....

.....

.....

..... **[3]**

(b) How and why have the percentages of **carbon dioxide** and **oxygen** in the atmosphere changed over time?

Use data from the table to support your answer.

.....

.....

.....

.....

.....

..... **[3]**

(c) Some rocks are red because they contain iron oxide.

Iron oxide was formed when iron in the rocks reacted with oxygen in the atmosphere.

(i) Complete the **balanced symbol** equation for the reaction which produces iron oxide.

..... Fe + ... O_2 $\rightarrow$ $2Fe_2O_3$

[1]

(ii) Scientists think these red rocks formed 2.3 million years ago.

Suggest why these rocks could **not** form 4 billion years ago.

Use data from the table to support your answer.

.....

..... **[1]**

2. Nov/2020/Paper_J260/02/No.2

The demand for drinking water in the world is increasing and we need new ways of supplying drinking water.

Waste water from drains and sewers can be treated, and then returned to rivers so that it can be used again.

(a) The diagram shows the stages in the treatment of waste water.

Draw lines to connect each **stage** with its **function**.

One has been done for you.

Stage	Function
Aeration	Breaks down organic material
Bacteria added	Provides oxygen
Filtration	Removes large objects
Settlement	Solid falls to bottom of tank

[2]

(b) Chlorine can also be added to water to make it safe to drink.

Describe the test and result to identify chlorine.

Test .....

.....

Result .....

.....

[2]

(c) Typhoid is a disease which can be spread by drinking unsafe water.

Fig. 2.1 shows the number of people who had typhoid per 100 000, in a city, every 5 years, from 1890 to 1930.

Table 2.1 shows data for this city, for two years, 1890 and 1930.

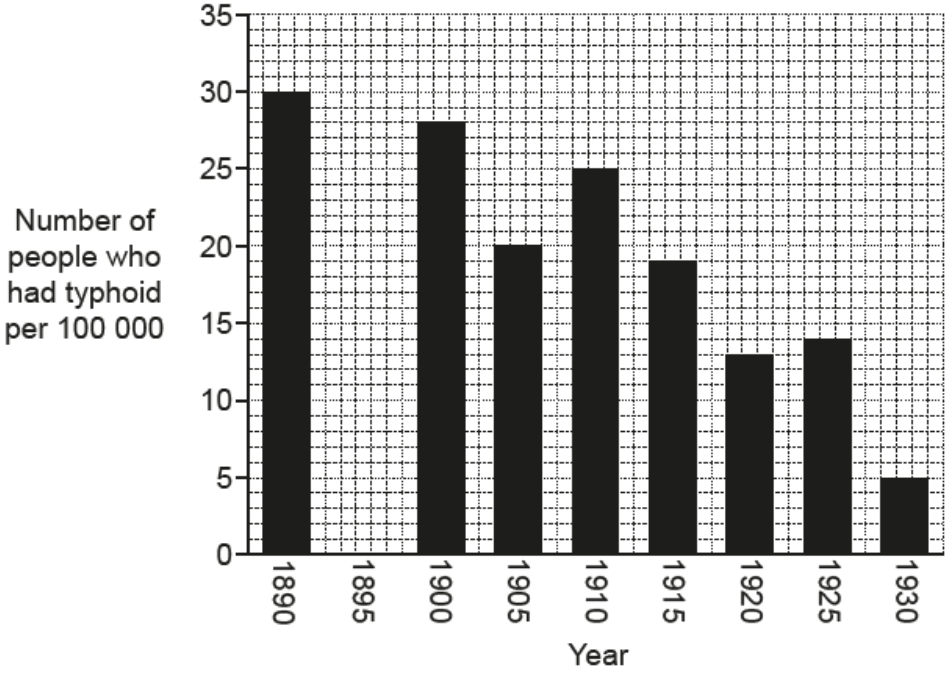


Fig. 2.1

Year	Total population of the city	Number of people who had typhoid per 100 000	Total number of people who had typhoid
1890	60 000	.....	18
1930	200 000	5	.....

Table 2.1

(i) Complete **Table 2.1**. **[2]**

(ii) In 1895, the number of people who had typhoid per 100 000 was 25.

Plot this data on **Fig. 2.1**. **[1]**

3. Nov/2020/Paper_J260/02/No.6

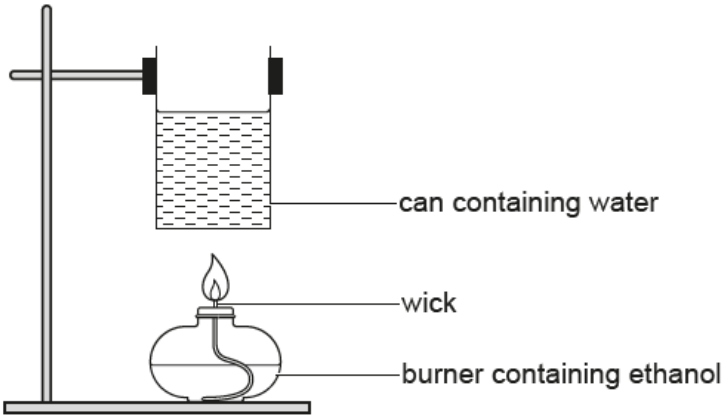
Nina investigates the combustion of ethanol.

(a) Complete the **balanced symbol** equation for the combustion of ethanol in air.

C_2H_5OH + ... O_2 → ..... CO_2 + ... H_2O

[2]

(b) Nina uses this apparatus for her experiment.



Nina measures the mass of the burner containing ethanol, and the temperature of the water at the start of the experiment. She also measures the mass of water in the can.

She burns some ethanol, and then measures the temperature of the water and the mass of the burner containing ethanol at the end of the experiment.

(i) What apparatus does Nina need to make her measurements?

Put a (ring) around the **two** correct answers.

balance **beaker** **condenser** **funnel** **pH meter** **thermometer**

[2]

(ii) Nina uses a lighted splint to light the wick which starts the ethanol burning.

The flame from the lighted splint provides the activation energy needed to start the ethanol burning.

What is the activation energy in this experiment?

Tick (✓) **two** boxes.

- The energy given out when ethanol burns. ☐
- The energy needed to boil the ethanol. ☐
- The energy needed to break bonds in the ethanol molecules. ☐
- The energy supplied by a catalyst. ☐
- The minimum energy needed for the reaction to start. ☐

[2]

(c) Here are the results of Nina's experiment.

Mass of water in the can (g)	200
Mass of burner containing ethanol at the start (g)	242.1
Mass of burner containing ethanol at the end (g)	241.7
Temperature of water at the start (°C)	19
Temperature of water at the end (°C)	27

(i) Is the reaction endothermic or exothermic?

Use Nina's results to explain your answer.

.....

..... **[1]**

(ii) What is the mass of ethanol burned in Nina's experiment?

Mass of ethanol burned = ... g **[1]**

(iii) What is the temperature change of the water in Nina's experiment?

Temperature change of the water = ... °C **[1]**

(iv) Calculate the energy that was needed to change the temperature of the water in Nina's experiment.

Use the equation:
Energy change (J) = 4200 × mass of water (kg) × change in temperature (°C)

Give your answer in **kJ**.

Energy change = ... kJ **[3]**

4. Nov/2020/Paper_J260/04/No.7

(a) Complete the sentences about the greenhouse effect.

Use words from the list.

You can use each word once, more than once or not at all.

absorbed	**microwave**	**reflected**	**methane**
ultraviolet	**scattered**	**nitrogen**	**infrared**

The Earth receives electromagnetic radiation from the Sun. Some of this radiation is ..... by the Earth's surface, causing it to warm up. ..... radiation is then emitted from the Earth's surface. Some of this radiation is then ..... by greenhouse gases in the atmosphere such as carbon dioxide and ..... , which is then re-emitted in all directions. **[4]**

(b) Carbon dioxide is a greenhouse gas.

Fig. 7.1 shows the mass of carbon released worldwide every year from 1900 to 2014.

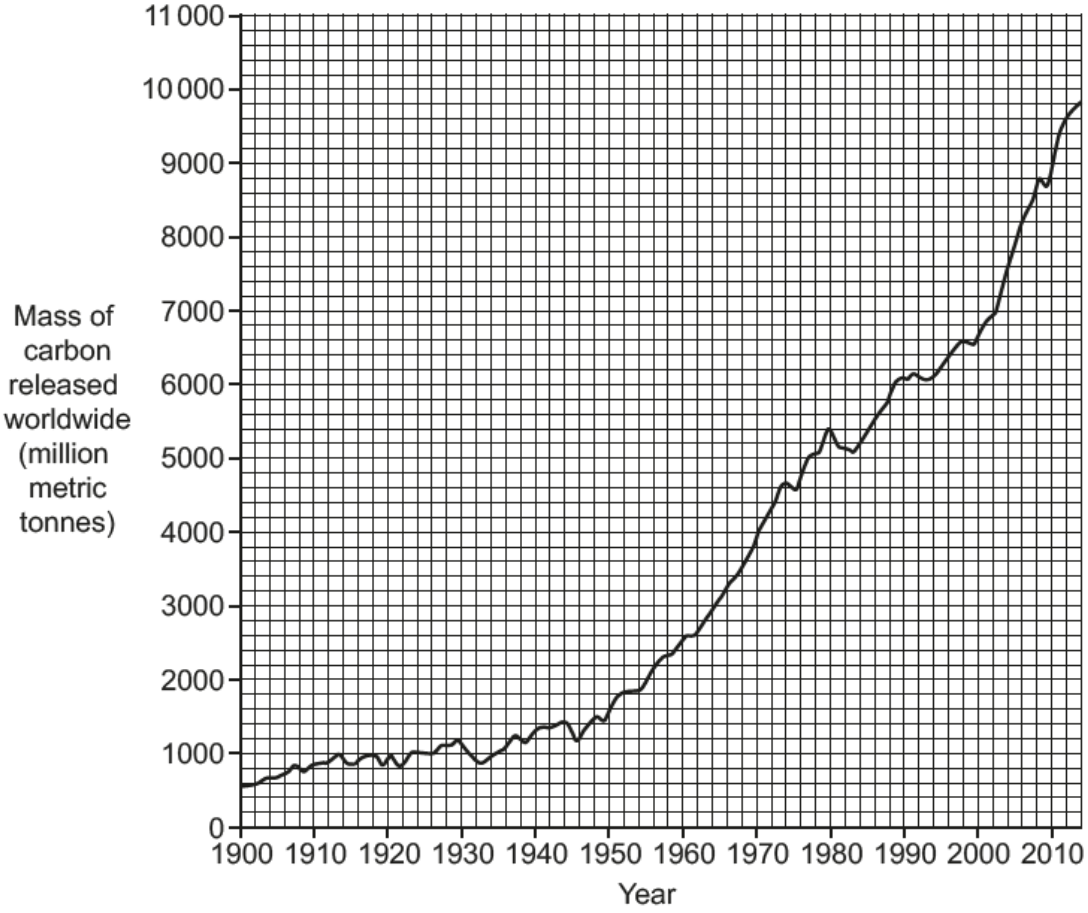


Fig. 7.1

(i) Describe the trend shown in **Fig. 7.1** and suggest **two** possible explanations for this trend.

Trend .....

.....

Explanation **1** .....

.....

Explanation **2** .....

.....

[3]

(ii) Give **one** reason why the data in **Fig. 7.1** may be inaccurate.

.....

..... **[1]**

(iii) Describe **two** effects of the trend seen in **Fig. 7.1**.

Effect **1** .....

.....

Effect **2** .....

.....

[2]

(c) Carbon capture and storage is a process where carbon dioxide is collected and stored underground.

Suggest **two** negative effects of carbon capture and storage on the environment.

1 .....

.....

2 .....

.....

[2]

(d) **(i)** Coal and oil are **non-renewable** sources of energy.

Biofuels such as wood or straw pellets are **renewable** sources of energy.

How are non-renewable sources of energy different from renewable sources of energy?

.....

..... **[1]**

(ii) Biofuels are carbon neutral. This means that their use does **not** increase carbon dioxide levels in the atmosphere. Coal is not carbon neutral.

Which **two** statements explain why biofuels are carbon neutral?

Tick (✓) **two** boxes.

Biofuels release water when they burn.	☐
Plants take in carbon dioxide when they photosynthesise.	☐
Biofuels release less sulfur dioxide when burnt.	☐
Plants give out carbon dioxide when they respire.	☐
Burning plants releases the same mass of carbon dioxide they absorb.	☐

[2]

5. Nov/2021/Paper_J260/06/No.1

The table shows data about the composition of the Earth's atmosphere 4 billion years ago and today.

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.....

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..... **[3]**

(b) How and why have the percentages of **carbon dioxide** and **oxygen** in the atmosphere changed over time?

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Iron oxide was formed when iron in the rocks reacted with oxygen in the atmosphere.

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..... Fe + ... O_2 $\rightarrow$ $2Fe_2O_3$

[1]

(ii) Scientists think these red rocks formed 2.3 million years ago.

Suggest why these rocks could **not** form 4 billion years ago.

Use data from the table to support your answer.

.....

..... **[1]**

6. Nov/2021/Paper_J260/06/No.5

Carbon dioxide gas in the atmosphere is one cause of the greenhouse effect.

(a) Explain how carbon dioxide causes the greenhouse effect.

Include ideas about radiation from the Sun.

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.....

.....

..... **[3]**

(b) Carbon dioxide gas, $CO_2(g)$ dissolves in seawater to form dissolved carbon dioxide, $CO_2(aq)$.

Dissolved carbon dioxide reacts with seawater to form two new ions. The two new ions are soluble.

Equation 1 shows what happens when dissolved carbon dioxide reacts with water.

Equation 1 $CO_2(aq) + H_2O(.....) \rightleftharpoons HCO_3^-(.....) + H^+(.....)$

(i) Complete **equation 1** by adding the missing state symbols. **[2]**

(ii) **Equation 1** shows an equilibrium reaction.

What does the $\rightleftharpoons$ symbol mean?

..... **[1]**

(iii) The pH of seawater is 7.5.

The reaction in **equation 1** causes the pH of seawater to change.

Explain how **and** why the pH changes.

.....

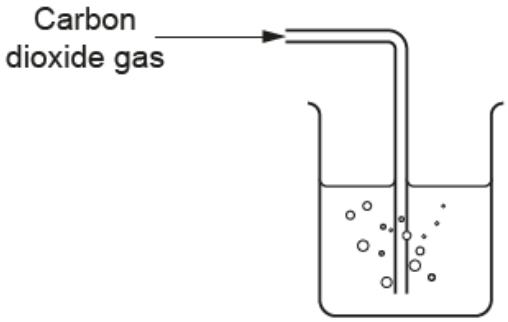
.....

.....

..... **[2]**

(iv) Ling does an experiment. She bubbles carbon dioxide through water.

She uses this apparatus.



Suggest **two** methods for showing that the pH of the water changes.

1 .....

2 .....

[2]

7. Nov/2020/Paper_J260/06/No.7

Fig. 7.1 shows the change in concentration of carbon dioxide in the atmosphere from 1500 to 2000.

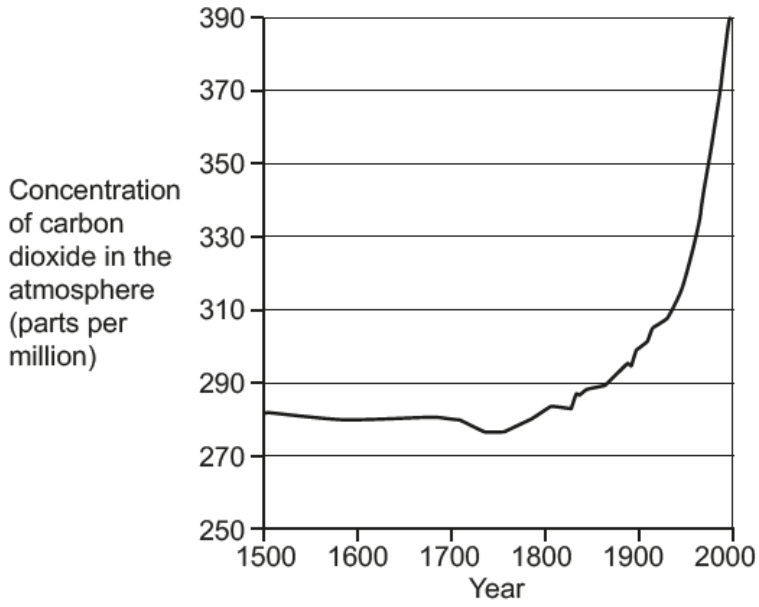


Fig. 7.1

Fig. 7.2 shows the total world carbon emissions from fossil fuels from 1700 to 2014.

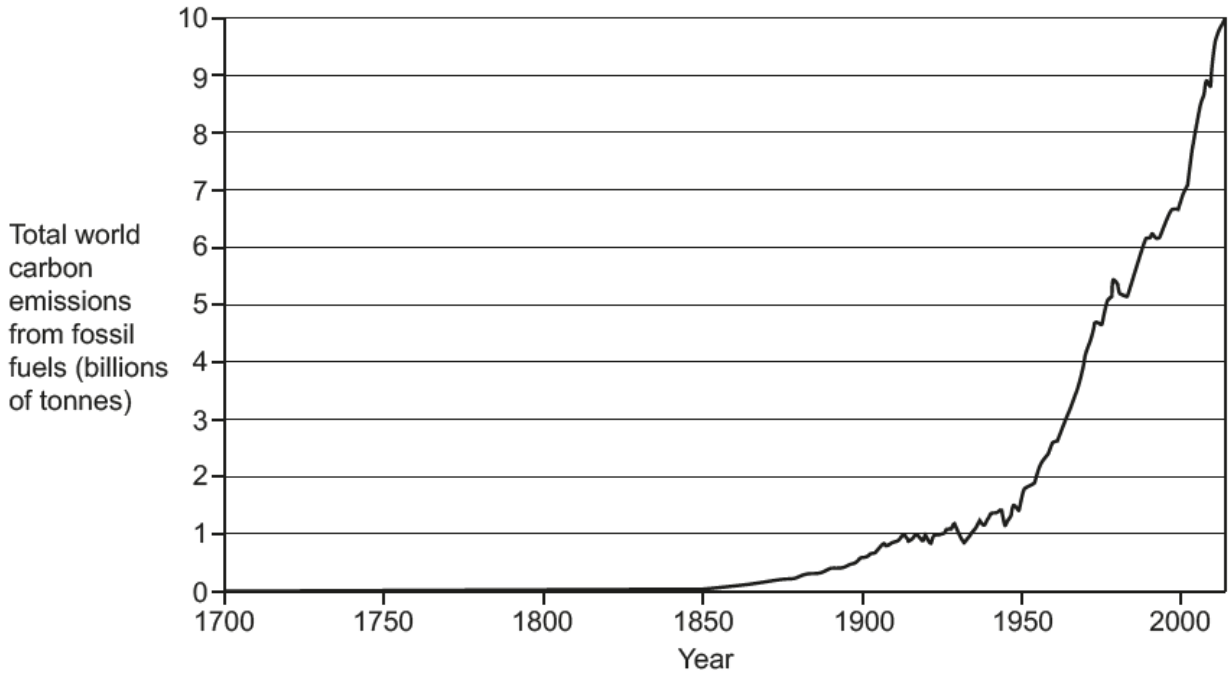


Fig. 7.2

(a) Describe the relationship between the concentration of carbon dioxide in the atmosphere and the total world carbon emissions from fossil fuels, shown by **Fig. 7.1** and **Fig. 7.2**.

.....

..... **[1]**

(b) Scientists are developing ways of reducing the concentration of carbon dioxide in the atmosphere, because of the link between increased greenhouse gas emissions and recent climate change.

One way of reducing the concentration of carbon dioxide in the atmosphere is by using alternative sources of energy instead of fossil fuels.

Suggest **two** other ways that the concentration of carbon dioxide in the atmosphere can be reduced.

1 .....

2 .....

[2]

(c) Electric cars are being developed to reduce the dependency on fossil-fuel powered cars.

An electric car has a battery which is recharged by mains electricity.

(i) Discuss the use of electric cars as a way of reducing the concentration of carbon dioxide in the atmosphere.

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.....

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.....

.....

..... **[3]**

(ii) Mia drives 15 000 km in her car each year.

She used to drive a car which burned 1200 kg of petrol each year. Each kilogram of petrol produced 2.1 kg of carbon dioxide.

Mia now drives a new car which produces 90 g of carbon dioxide per km.

Calculate the decrease in the mass of carbon dioxide produced in one year in Mia's new car compared to her old one.

Decrease in mass of carbon dioxide = ... kg **[4]**

8. Nov/2020/Paper_J260/08/No.1

(a) Complete the sentences about the greenhouse effect.

Use words from the list.

You can use each word once, more than once or not at all.

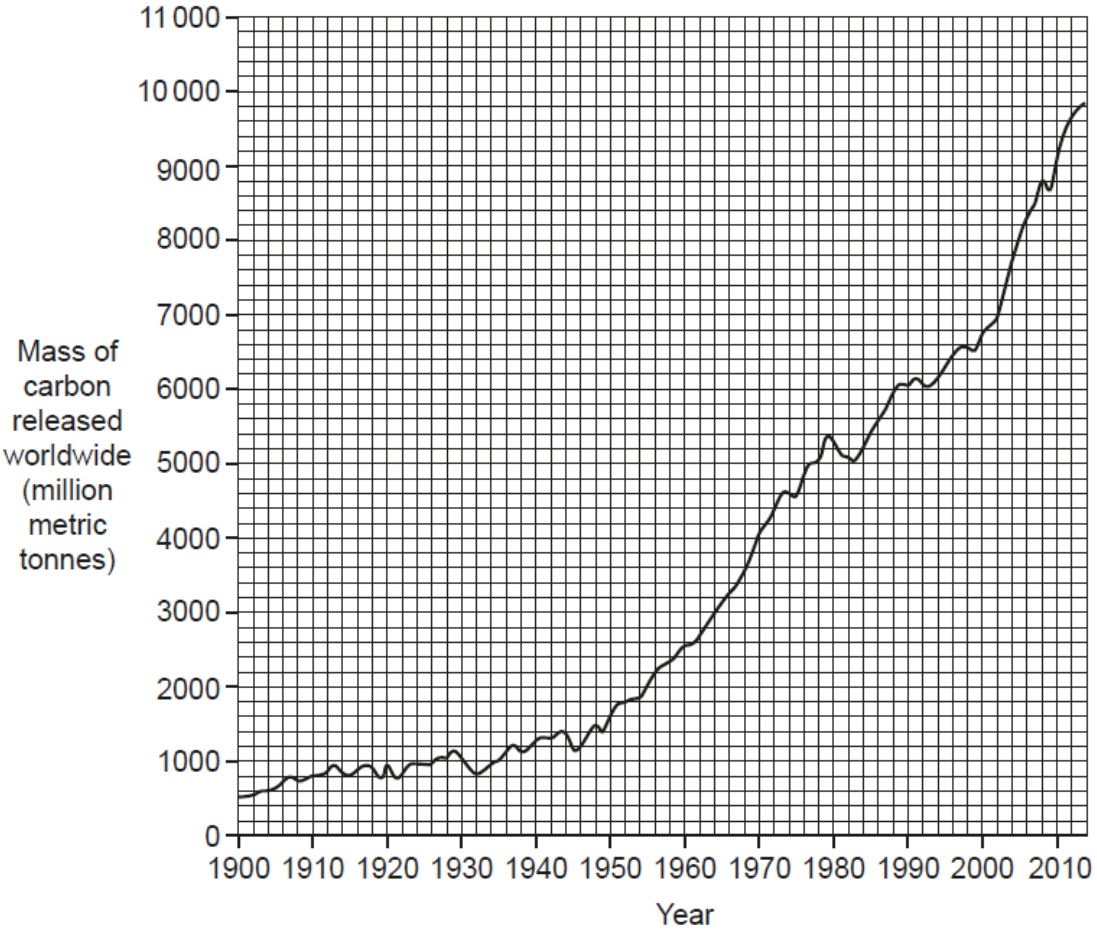
absorbed	**microwave**	**reflected**	**methane**
ultraviolet	**scattered**	**nitrogen**	**infrared**

The Earth receives electromagnetic radiation from the Sun. Some of this radiation is ..... by the Earth's surface, causing it to warm up. ..... radiation is then emitted from the Earth's surface. Some of this radiation is then ..... by greenhouse gases in the atmosphere such as carbon dioxide and ....., which is then re-emitted in all directions.

[4]

(b) Carbon dioxide is a greenhouse gas.

Fig. 1.1 shows the mass of carbon released worldwide every year from 1900 to 2014.



(i) Describe the trend shown in **Fig. 1.1** and suggest **two** possible explanations for this trend.

Trend .....

.....

Explanation **1** .....

.....

Explanation **2** .....

.....

[3]

(ii) Give **one** reason why the data in **Fig. 1.1** may be inaccurate.

.....

..... **[1]**

(iii) Describe **two** effects of the trend seen in **Fig. 1.1**.

Effect **1** .....

.....

Effect **2** .....

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[2]

(c) Carbon capture and storage is a process where carbon dioxide is collected and stored underground.

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[2]

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Plants give out carbon dioxide when they respire.	☐
Burning plants releases the same mass of carbon dioxide they absorb.	☐

[2]