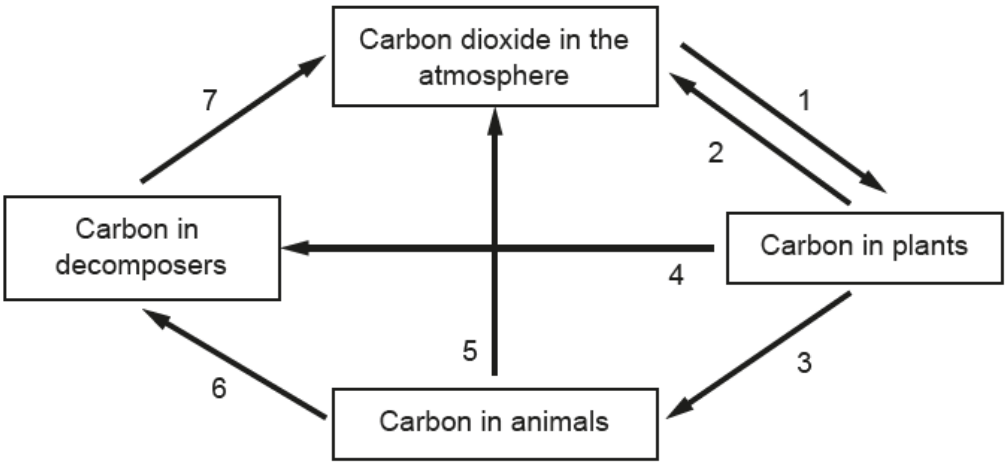
Living together – food and ecosystems – 2021/20 GCSE 21st Biology Combined Science B

1. Nov 2021/Paper_J260/01/No.3

The diagram shows a model of the carbon cycle.

The numbered arrows show the movement of carbon in the carbon cycle.



(a) **(i)** Write down the number which represents photosynthesis.

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

(ii) Write down a number which represents respiration.

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

(b) Fungi are decomposers which secrete enzymes.

How do **enzymes** help fungi to absorb food molecules?

.....

.....

.....

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

(c) One estimate for the total global biomass is 550.0 billion tonnes.

Some scientists estimate that 25% of the total global biomass is fungi.

Calculate how many billion tonnes of fungi there are globally, using these estimates.

Fungi = ... billion tonnes **[2]**

2. Nov 2020/Paper_J260/01/No.7

(a) **Fig. 7.1** shows a labelled cross section of a leaf.

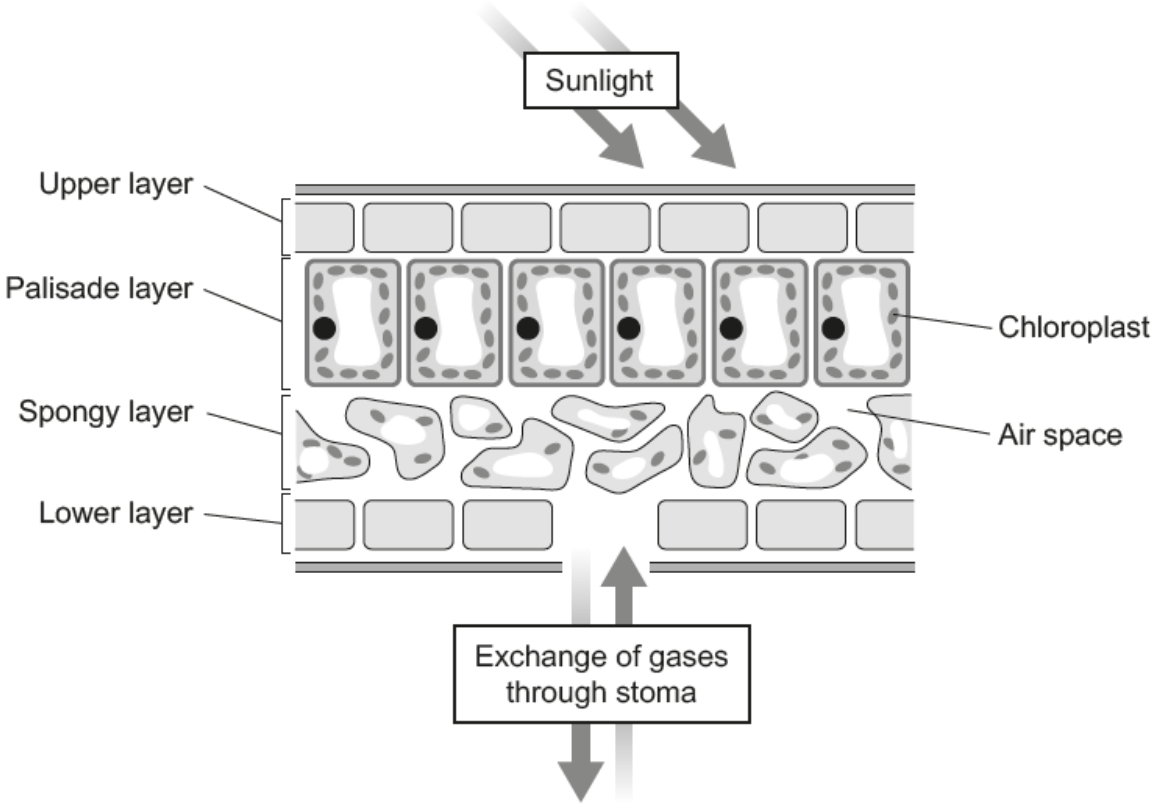


Fig. 7.1

Explain why more photosynthesis takes place in the palisade layer than the spongy layer.

Use **Fig. 7.1** to support your answer.

.....

.....

.....

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

(b) Two transport tissues are found in plants.

(i) Name the transport tissue that transports water and minerals.

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

(ii) Name the transport tissue that transports sugars.

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

(iii) The sugars that are made by photosynthesis move into a transport tissue to go to the rest of the plant.

Which process moves sugars into the transport tissue?

Put a (ring) around the correct answer.

Active transport **Respiration** **Osmosis** **Transpiration** **[1]**

(iv) A student uses a microscope to count the number of stomata in a field of view.

The student counts the number of stomata in three other fields of view, and his results are shown in the table.

Number of stomata per field of view				Mean
9	11	14	10	

Calculate the mean number of stomata per field of view.

Use the data in the table.

Mean number of stomata = ... **[1]**

(c) Some of the sugars that are made by photosynthesis are joined together to make a large storage molecule.

What is the name of this large storage molecule?

Tick (✓) **one** box.

Fatty acid ☐

Lipid ☐

Protein ☐

Starch ☐

[1]

3. Nov 2020/Paper_J260/01/No.8

Amaya feeds birds in her garden.

She wants to see if there is a relationship between the body mass of the bird and how often they are feeding.

(a) Amaya records how often she sees each bird species feeding and produces a dominance rank, as shown in the table.

The highest ranked species, the house sparrow, is seen feeding the most.

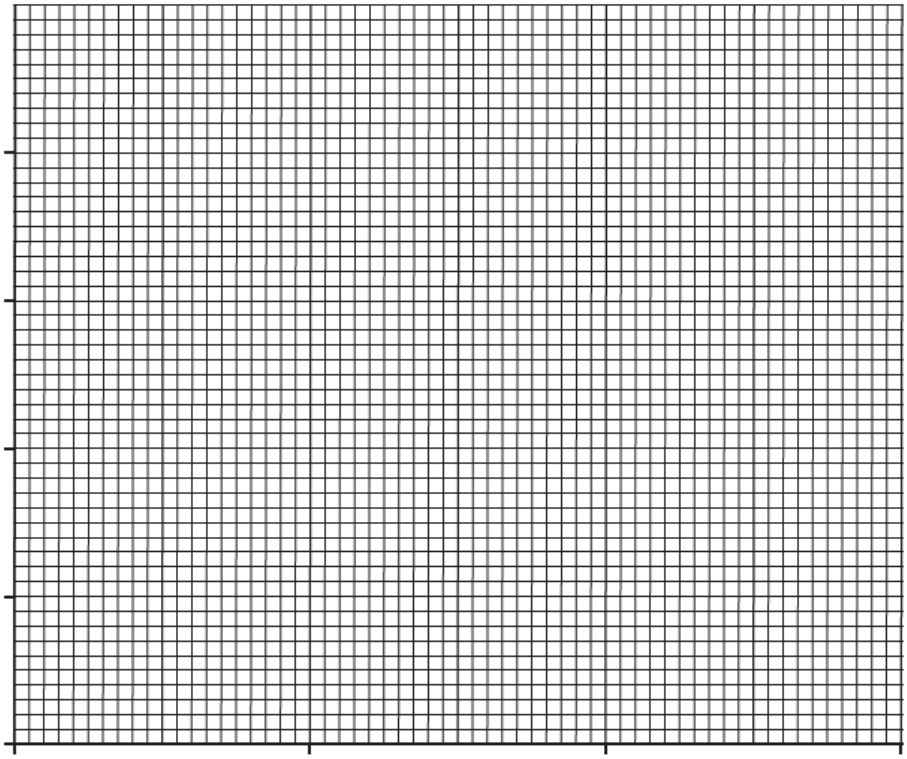
She finds out the mean body mass for each bird species from doing some research.

Bird species	Mean body mass (g)	Rounded body mass (g)	Dominance rank
House sparrow	27.3		1
Nuthatch	21.6		2
Goldfinch	15.5		3
Chaffinch	21.8		4
Coal tit	9.4		5

Complete the table by rounding the mean body mass of each bird species to the **nearest whole number**. **[2]**

(b) **(i)** Plot a graph of dominance rank against rounded body mass, using the data in the table. **[2]**

(ii) Draw a line of best fit. **[1]**



(c) Before Amaya collected the data, she wrote the following hypothesis:

The greater the mass of the species of bird, the more often the species will feed.

(i) Do Amaya's findings **support** her hypothesis?

Use the graph to explain your answer.

.....

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

(ii) Explain why Amaya's findings do **not** prove her hypothesis.

.....

.....

.....

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

(d) The birds in Amaya's garden are part of a community that includes plants and other animal species.

The species in this community are interdependent.

Give **two** reasons why this interdependence is important for the species in the community.

1 .....

.....

2 .....

.....

[2]

4. Nov 2020/Paper_J260/01/No.9

(a) Complete the sentences to describe the process of photosynthesis.

Use words from the list.

You may use the words once, more than once or not at all.

carbon dioxide	**chlorophyll**	**energy**	**glucose**
light	**oxygen**	**protein**	**respiration**
starch	**transpiration**	**water**	

Photosynthesis has two main stages. The first stage requires light and ..... to split water molecules into hydrogen and the waste product ..... . Some of the waste product is used for ..... by the plant, and the excess is released from the leaves. The hydrogen is transferred to the second stage.

In the second stage carbon dioxide and hydrogen combine to make ..... . The process of photosynthesis is endothermic, and endothermic processes require transfer of..... from the surroundings.

[3]

(b) A student is investigating the requirements of photosynthesis.

The student sets up **three** tubes, **Tube A**, **Tube B**, and **Tube C** as shown in **Fig. 9.1**, and leaves them for 24 hours in a room with windows.

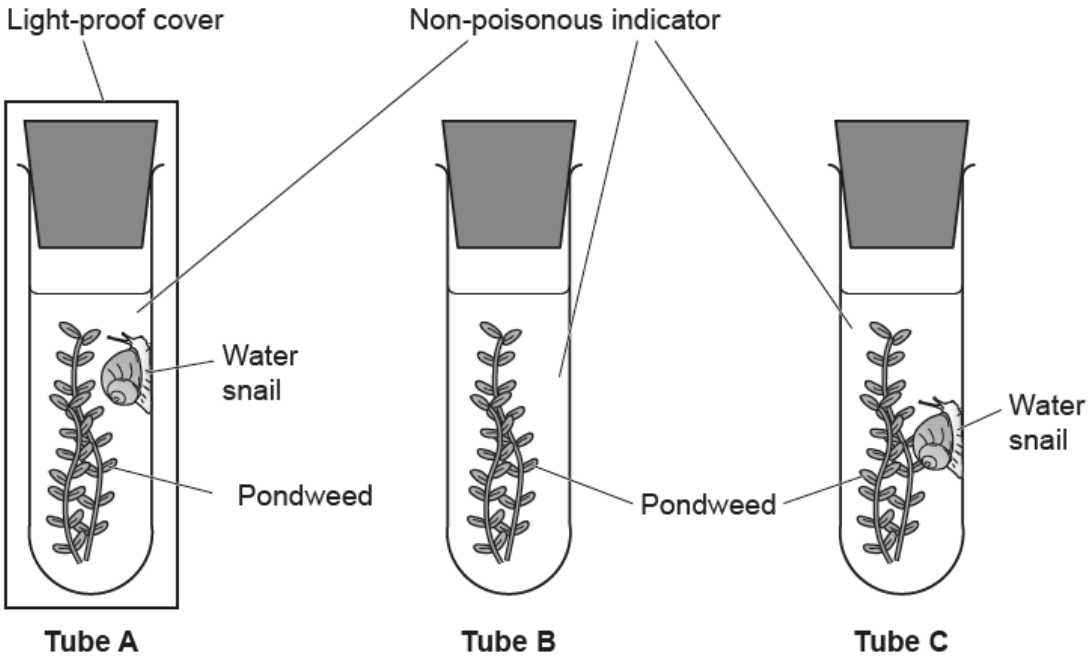


Fig. 9.1

Table 9.1 shows the indicator colour changes when the carbon dioxide level changes.

Carbon dioxide level	Indicator colour change
Decreases	Red to purple
Increases	Red to yellow

Table 9.1

Table 9.2 shows the colour of the indicator at the start, and at the end after 24 hours, for each tube.

Tube	Colour of indicator at the start	Colour of indicator at the end after 24 hours
A	Red	Yellow
B	Red	Purple
C	Red	Red

Table 9.2

(i) Which tube, **A**, **B** or **C**, shows that carbon dioxide is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

(ii) Which tube, **A**, **B** or **C**, shows that light is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

(iii) Explain why the indicator in **Tube C** does **not** change colour.

.....

.....

.....

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

(iv) Identify **one** variable that should be kept the same in the student's investigation.

.....

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

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

(a) Some students are talking about the movement of molecules in plant cells.

Nina
Water molecules move across a partially permeable membrane from regions of higher concentration to lower concentration.

Kareem
Gas and water molecules move across a partially permeable membrane.

Sarah
Molecules move randomly from regions of higher concentration to lower concentration.

Jack
Plants use energy from ATP to transport molecules across a cell membrane.

(i) Which student is correctly talking about osmosis?

Tick (✓) **one** box.

Nina ☐

Kareem ☐

Sarah ☐

Jack ☐

[1]

(ii) Which student is correctly talking about active transport?

Tick (✓) **one** box.

Nina ☐

Kareem ☐

Sarah ☐

Jack ☐

[1]

(b) (i) Mia is investigating osmosis in potato cells. She writes a six-step plan.

Step 1. Cut 5 pieces of potato.

Step 2. Weigh them and record the masses.

Step 3. Put them into different salt solutions.

Step 4. Leave them for a few minutes.

Step 5. Take them out and weigh them again.

Step 6. Calculate the percentage change in mass.

Suggest how Mia can improve **Steps 1**, **3** and **4** of her plan to ensure her investigation is valid.

Step 1 .....

.....

Step 3 .....

.....

Step 4 .....

.....

[3]

(ii) Mia's measurements for one piece of potato are shown in the table.

Starting mass (g)	20.4
Final mass (g)	18.2

Calculate the percentage decrease in mass for this piece of potato.

Use the equation: percentage decrease = $\frac{\text{change}}{\text{original}} \times 100$

Give your answer to **3** significant figures.

Percentage decrease = ... % **[3]**

6. 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.

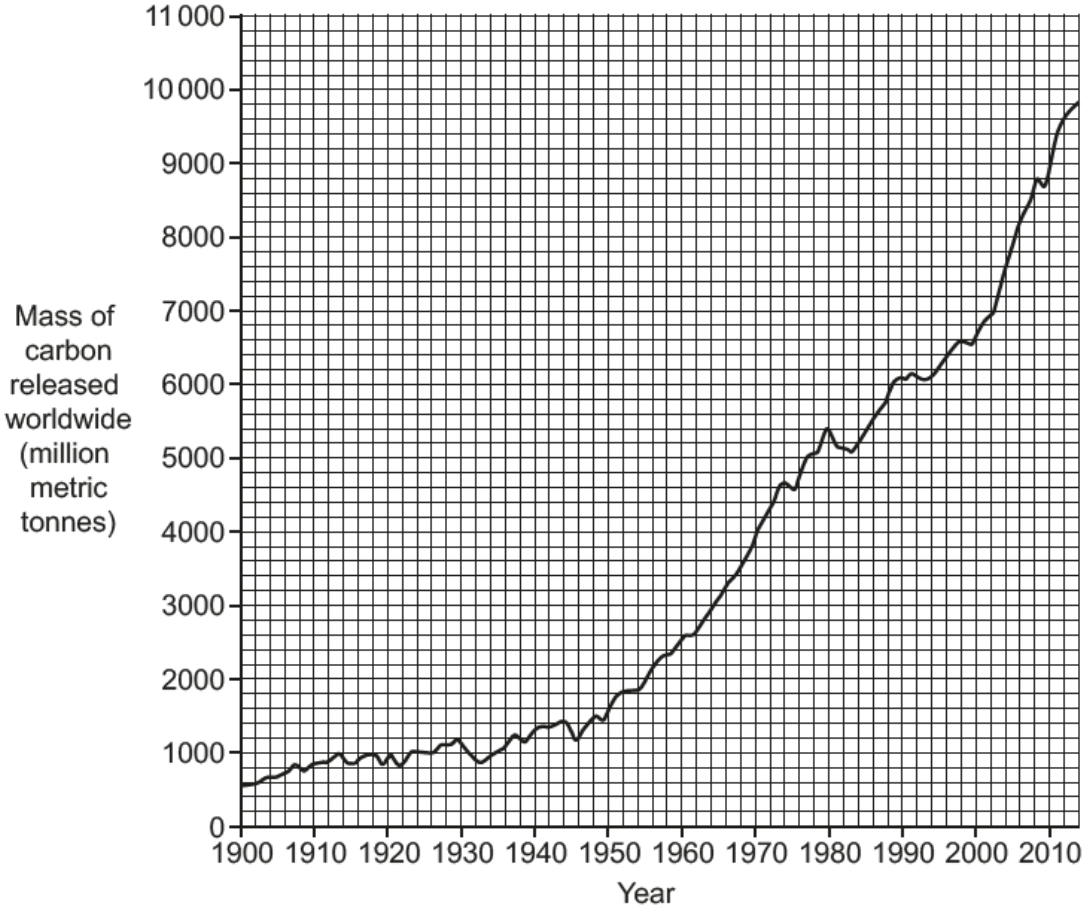

Mass of carbon released worldwide (million metric tonnes)
11 000
10 000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
Year

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]

7. Nov 2021/Paper_J260/05/No.8

The Amazon rainforest covers 670 000 000 hectares. In 2019, 906 000 hectares of rainforest were lost in fires.

(a) Calculate the percentage of the total rainforest area that was lost to fires in 2019.

Give your answer to **2** significant figures.

Percentage of rainforest area lost = ... % **[3]**

(b) Some fires are started in the Amazon rainforest to clear land for agriculture. This affects local and global biodiversity.

Suggest an ecological, moral, economic, and political issue which could affect the decisions made about starting fires in the Amazon rainforest.

Ecological .....

.....

Moral .....

.....

Economic .....

.....

Political .....

.....

[4]

(c) (i) The Amazon rainforest is a major carbon sink. This means it removes carbon dioxide from the atmosphere and stores it.

Describe the process of photosynthesis to explain how forests store carbon.

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..... **[4]**

(ii) Photosynthesis is part of the carbon cycle.

Give **two** reasons why the carbon cycle is important to living things.

1 .....

.....

2 .....

.....

[2]

(iii) Complete each sentence about the role of microorganisms in the carbon cycle.

Use the words.

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

enzymes photosynthesise hormones respire lipids transpire

Microorganisms are involved in decomposition. They secrete ..... which break down dead, organic matter. The products of digestion are absorbed into their cells and the microorganisms ..... , producing carbon dioxide.

[2]

8. Nov 2021/Paper_J260/05/No.9

(a) **Fig. 9.1** is a diagram of a plant cell. It is not to scale.

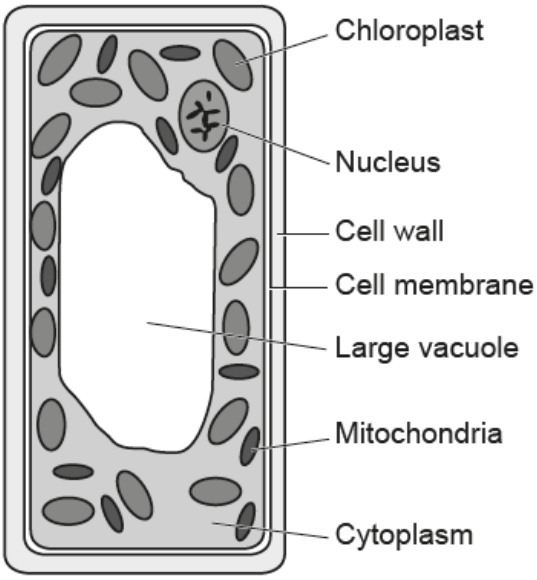


Fig. 9.1

Write down **one** structure in the plant cell used in cellular respiration.

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

(b) Starch is a large, insoluble, long-chain carbohydrate made from glucose molecules.

Explain the importance of synthesising and storing starch inside plant cells.

Use ideas about cellular respiration and osmosis in your answer.

.....

.....

.....

.....

.....

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

(c) The table shows the approximate lengths of **three** plant cell components.

Complete the table by converting the approximate length of each component into metres.

$1\,\mu m = 1 \times 10^{-6}\,m$

$1\,nm = 1 \times 10^{-9}\,m$

Component	Approximate length	Approximate length (m)
Chloroplast	5.0 μm	
Nucleus	0.007 mm	
Starch grain	500 nm	

[3]

(d) **Fig. 9.2** shows some apparatus that can be used to measure aerobic respiration by germinating seeds.

Tube A contains potassium hydroxide solution.
Tube B contains potassium hydroxide solution and germinating seeds.
Potassium hydroxide absorbs carbon dioxide.

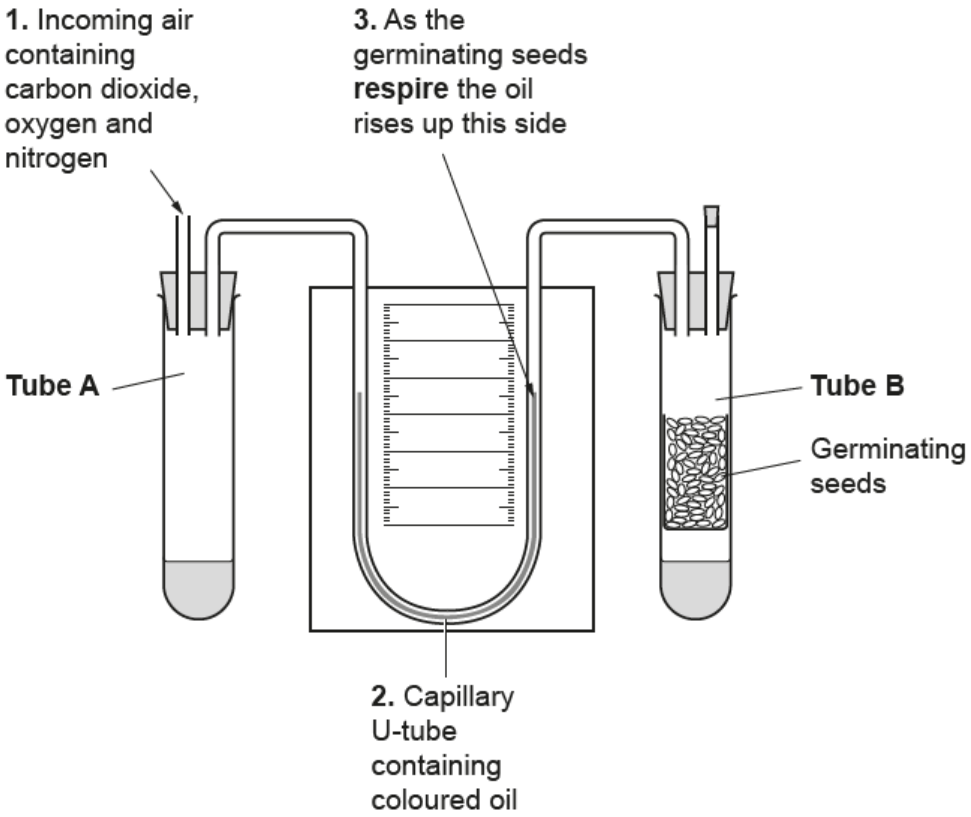


Fig. 9.2

(i) Explain why the oil rises up the right-hand side of the U-tube, as shown with **label 3** in **Fig. 9.2**.

.....

.....

.....

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

(ii) Changes in temperature will affect the **volume** of the gases in the tubes.

Why is this a problem when investigating respiration reactions?

.....

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

(iii) Suggest **one** way the experiment could be developed to maintain the temperature.

.....

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

(e) **Fig. 9.3** shows results from an investigation into the effect of temperature on oxygen uptake by germinating corn seeds.

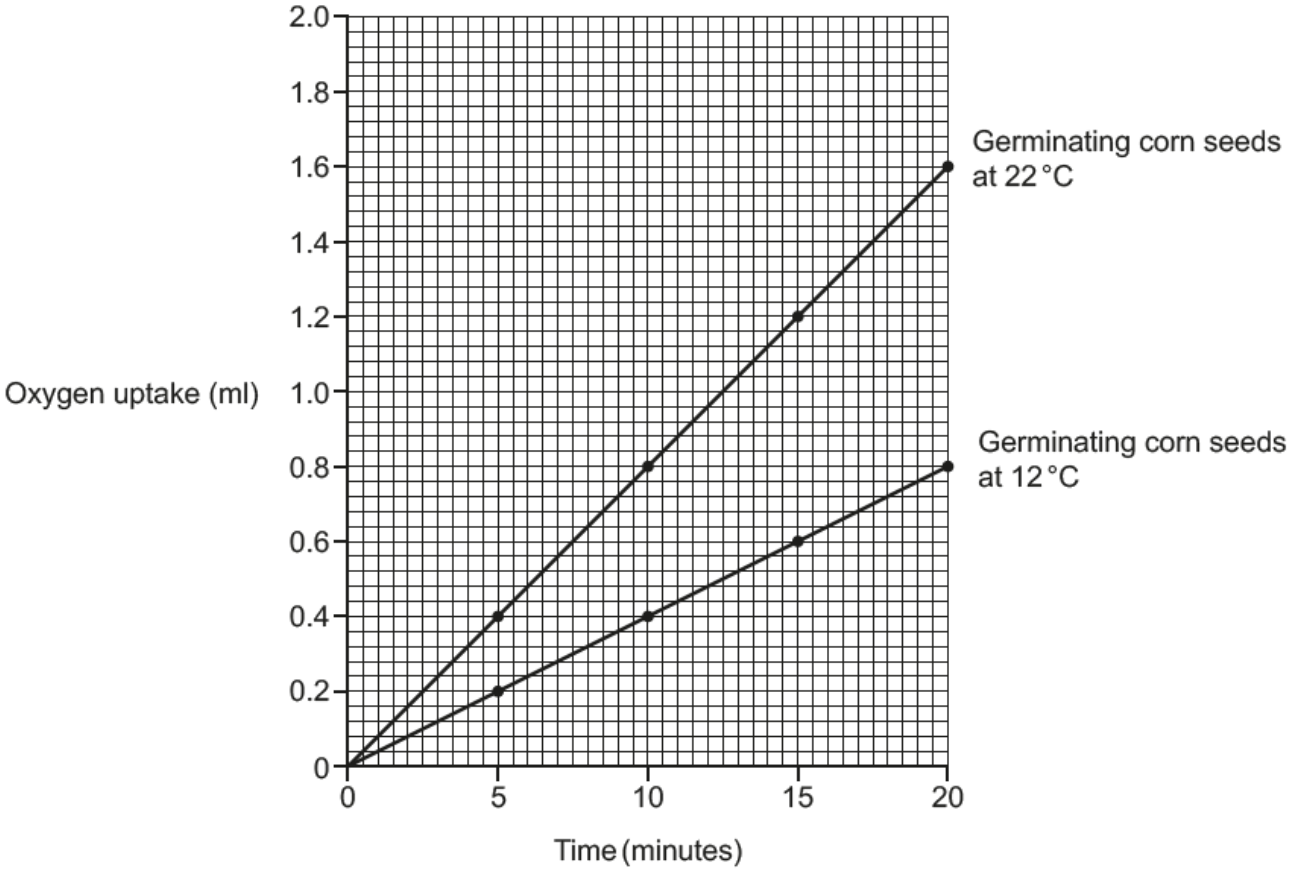


Fig. 9.3

Calculate the increase in the rate of oxygen uptake per °C.

Give your answer in **standard form**.

Rate of oxygen uptake per °C = ... ml/min/°C

[4]

9. Nov 2021/Paper_J260/06/No.8

(a) Amaya is investigating the effect of light intensity on the rate of photosynthesis in pondweed.

She uses the equipment in **Fig. 8.1**.

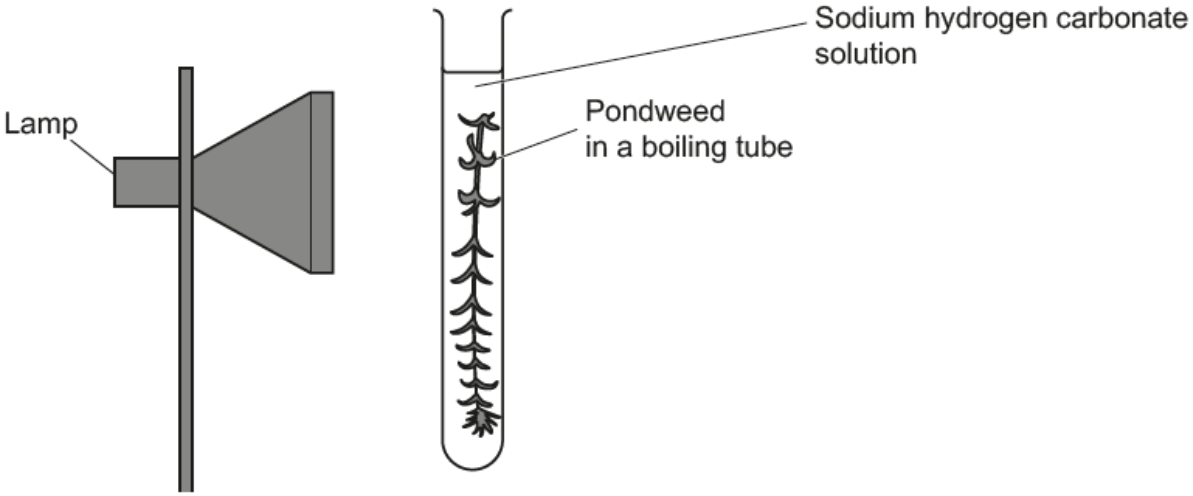


Fig. 8.1

(i) Identify **two** control variables that are needed to ensure Amaya collects valid data.

1 .....

2 .....

[2]

(ii) Describe how to change the independent variable in Amaya's investigation.

.....

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

(b) Complete the sentence to explain why the rate of photosynthesis changes when the distance from the light source changes.

Use the words.

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

directly **distance** **speed** **inversely** **root** **square** **sum**

Light intensity is ..... proportional to the ..... of the

..... from the light source. **[2]**

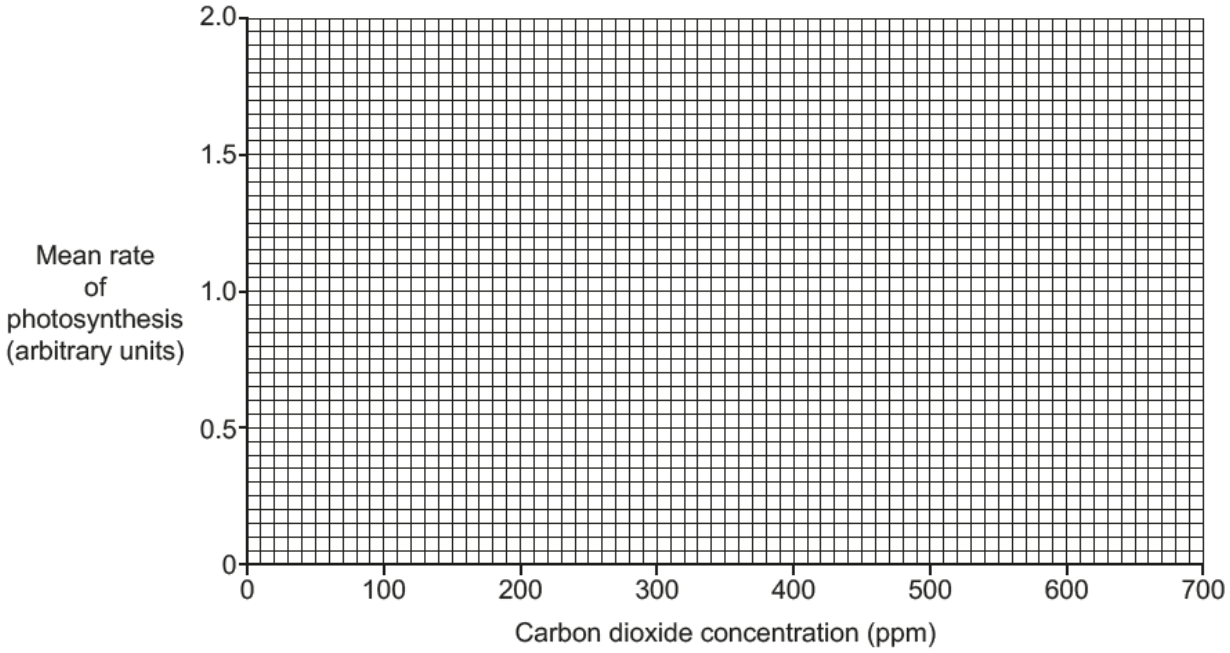
(c) In a second experiment Amaya investigates the effect of carbon dioxide concentration on the rate of photosynthesis.

Amaya's results are shown in the table.

PPM = parts per million

Carbon dioxide concentration (ppm)	Mean rate of photosynthesis (arbitrary units)
200	0.5
300	1.0
400	1.2
500	1.4
600	1.6
700	1.6

(i) Plot Amaya's results on the graph, **and** draw a line of best fit. **[2]**



(ii) Explain the pattern shown in the data for a carbon dioxide concentration of **over** 600 ppm.

.....

.....

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.....

.....

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

(d) **Fig. 8.2** shows observations that scientists have made of global temperature change over time.

The natural factors band in **Fig. 8.2** shows the estimated contribution of natural factors to global temperature change over time. The size of the band represents uncertainty in the scientists' estimates.

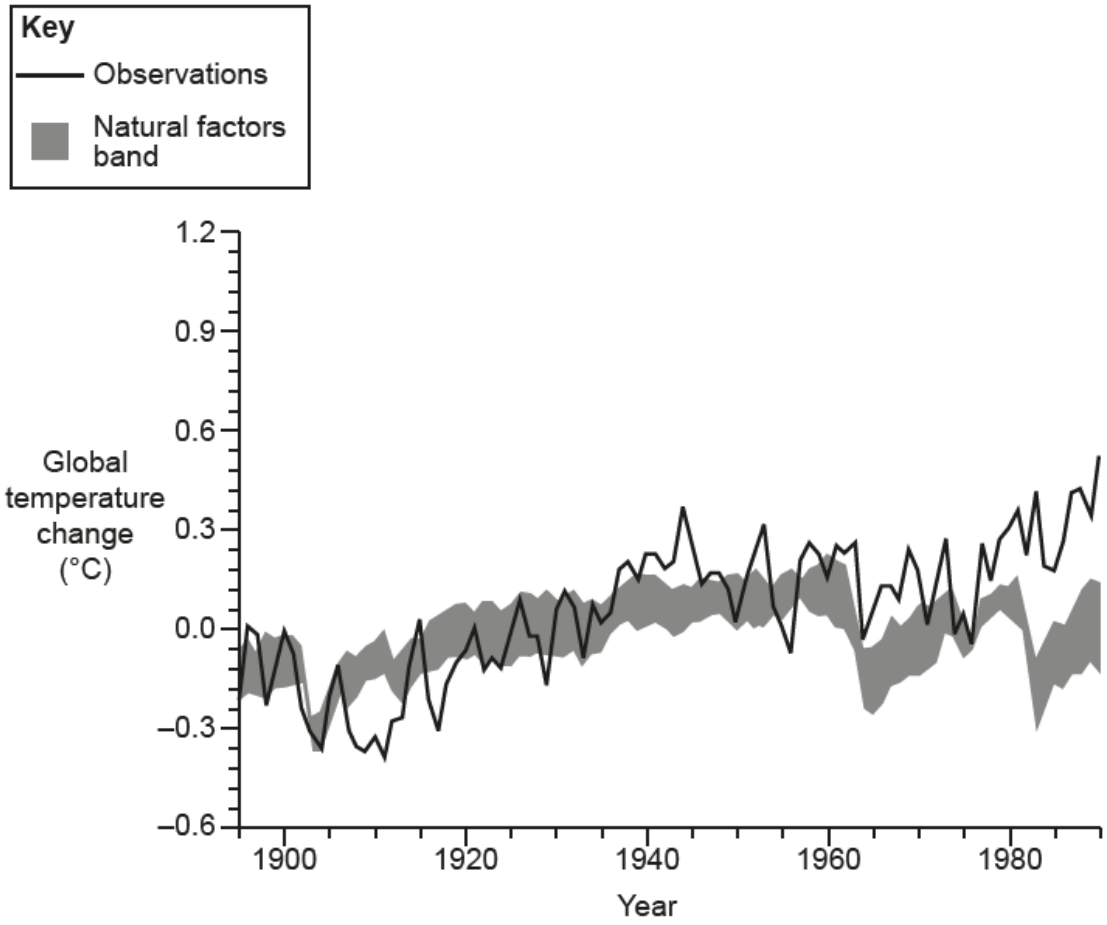


Fig. 8.2

(i) Give **two** conclusions that can be made about global temperature change over time.

1. .....

.....

2. .....

.....

[2]

(ii) Suggest what **Fig. 8.2** shows about the role of humans in global temperature change over time.

.....

.....

.....

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

10. Nov 2020/Paper_J260/05/No.1

Amaya feeds birds in her garden.

She wants to see if there is a relationship between the body mass of the bird and how often they are feeding.

(a) Amaya records how often she sees each bird species feeding and produces a dominance rank, as shown in the table.

The highest ranked species, the house sparrow, is seen feeding the most.

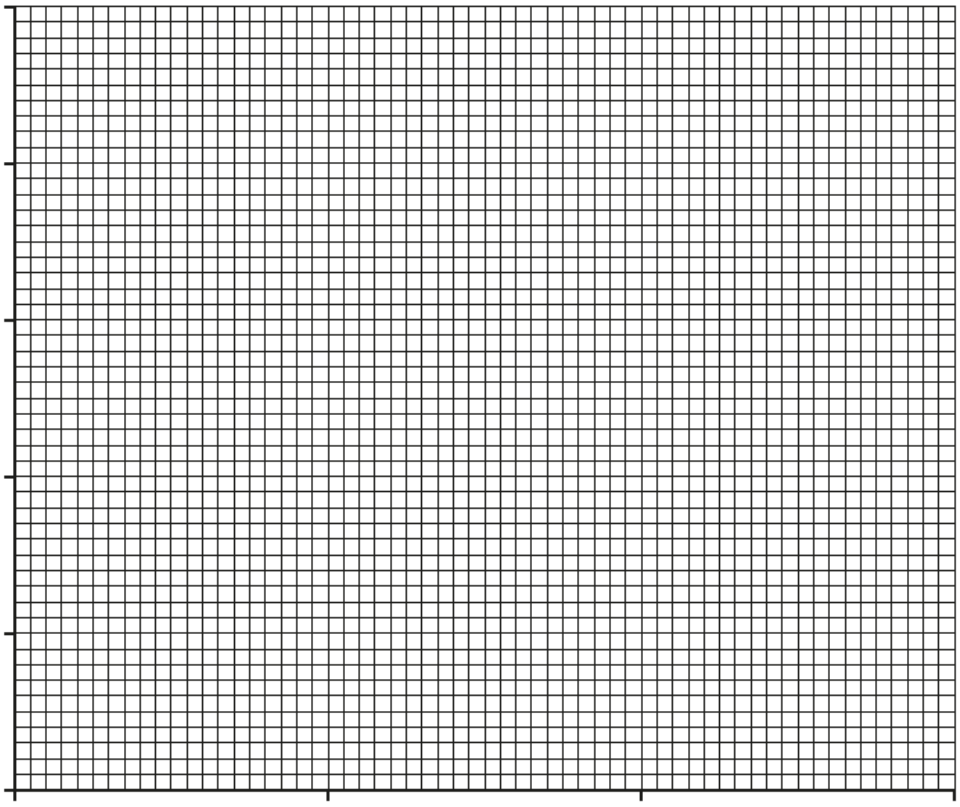
She finds out the mean body mass for each bird species from doing some research.

Bird species	Mean body mass (g)	Rounded body mass (g)	Dominance rank
House sparrow	27.3		1
Nuthatch	21.6		2
Goldfinch	15.5		3
Chaffinch	21.8		4
Coal tit	9.4		5

Complete the table by rounding the mean body mass of each bird species to the **nearest whole number.** **[2]**

(b) **(i)** Plot a graph of dominance rank against rounded body mass, using the data in the table. **[2]**

(ii) Draw a line of best fit. **[1]**



(c) Before Amaya collected her data, she wrote the following hypothesis:

The greater the mass of the species of bird, the more often the species will feed.

(i) Do Amaya's findings **support** her hypothesis?

Use the graph to explain your answer.

.....

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

(ii) Explain why Amaya's findings do **not** prove her hypothesis.

.....

.....

.....

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

(d) The birds in Amaya's garden are part of a community that includes plants and other animal species.

The species in a community are interdependent.

Give **two** reasons why this interdependence is important for the species in the community.

1 .....

.....

2 .....

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

11. Nov 2020/Paper_J260/05/No.2

(a) Complete the sentences to describe the process of photosynthesis.

Use words from the list.

You may use the words once, more than once or not at all.

chlorophyll	**carbon dioxide**	**energy**	**glucose**
light	**oxygen**	**protein**	**respiration**
starch	**transpiration**	**water**	

Photosynthesis has two main stages. The first stage requires light and ..... to split water molecules into hydrogen and the waste product ..... . Some of the waste product is used for ..... by the plant, and the excess is released from the leaves. The hydrogen is transferred to the second stage.

In the second stage carbon dioxide and hydrogen combine to make ..... . The process of photosynthesis is endothermic, and endothermic processes require transfer of ..... from the surroundings.

[3]

(b) A student is investigating the requirements of photosynthesis.

The student sets up three test tubes, **Tube A**, **Tube B**, and **Tube C**, as shown in **Fig. 2**.1, and leaves them for 24 hours in a room with windows.

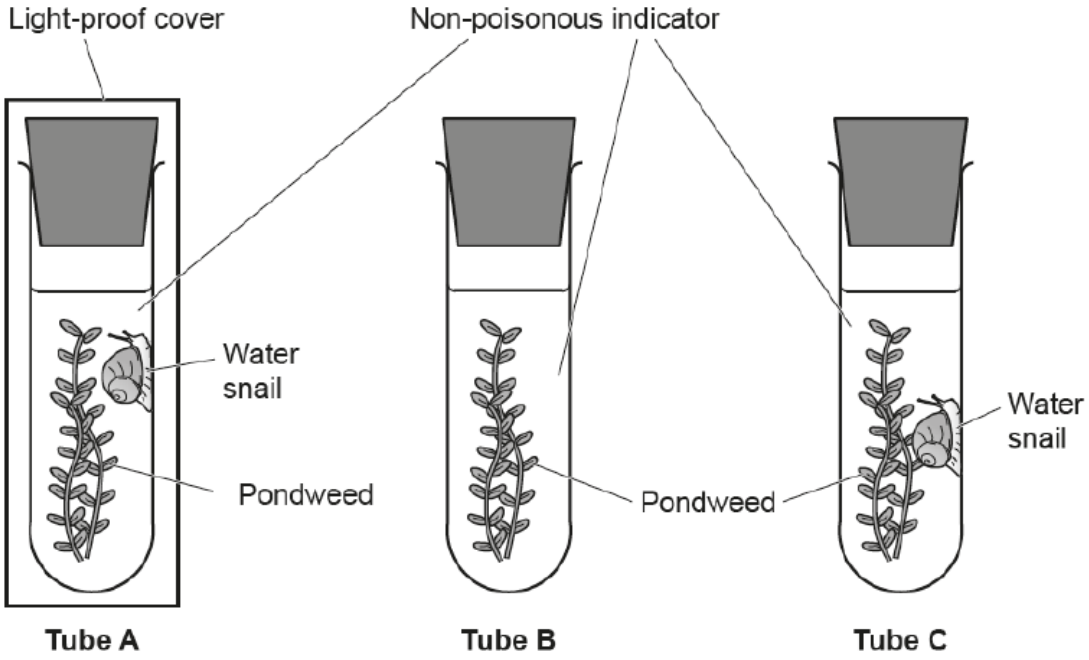


Fig. 2.1

Table 2.1 shows how the indicator colour changes when the carbon dioxide level changes.

Carbon dioxide level	Indicator colour change
Decreases	Red to purple
Increases	Red to yellow

Table 2.1

Table 2.2 shows the colour of the indicator at the start, and at the end after 24 hours, for each tube.

Tube	Colour of indicator at the start	Colour of indicator at the end after 24 hours
A	Red	Yellow
B	Red	Purple
C	Red	Red

Table 2.2

(i) Which tube, **A**, **B** or **C**, shows that carbon dioxide is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

(ii) Which tube, **A**, **B** or **C**, shows that light is needed for photosynthesis to occur?

Explain your answer.

Tube .....

Explanation

.....

.....

.....

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

(iii) Explain why the indicator in **Tube C** does **not** change colour.

.....

.....

.....

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

(iv) Identify **one** variable that should be kept the same in the student's investigation.

.....

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

12. Nov 2020/Paper_J260/06/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.

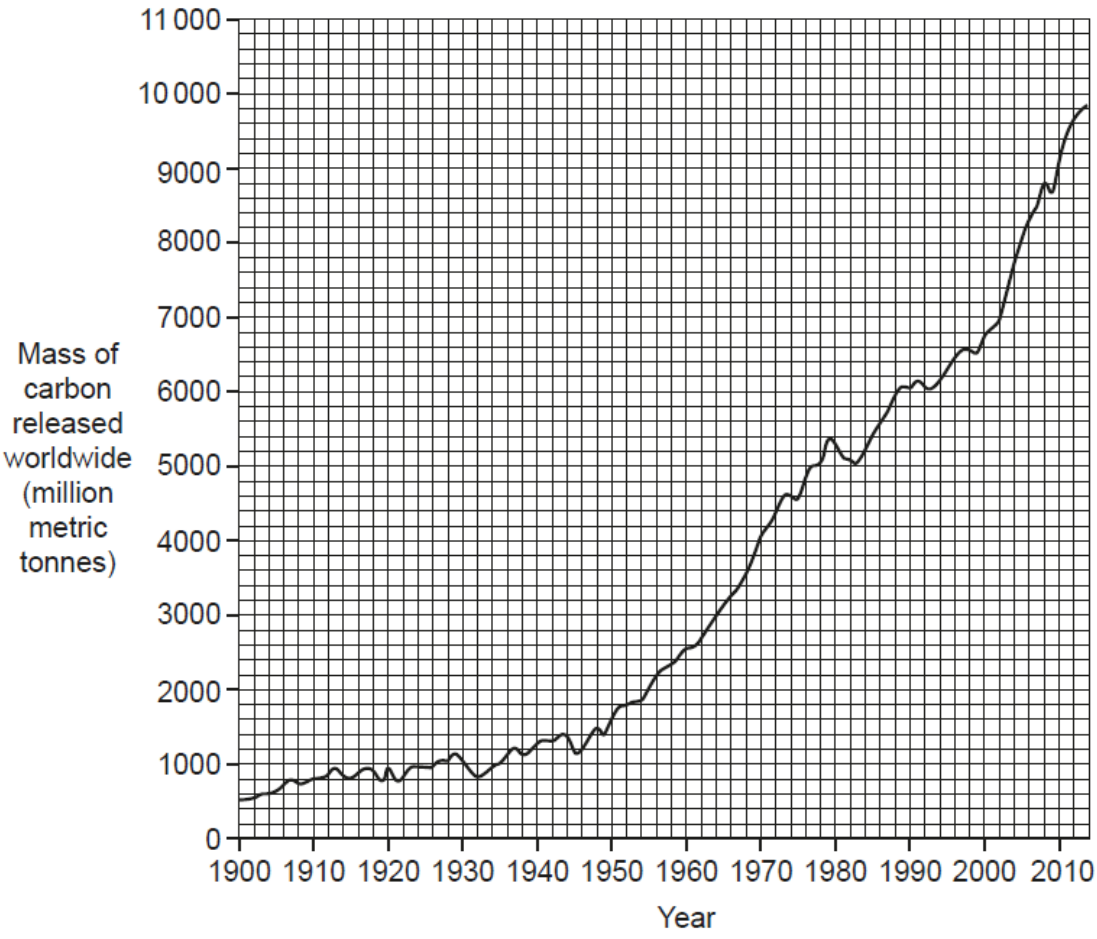


Fig. 1.1

(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** .....

.....

[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?

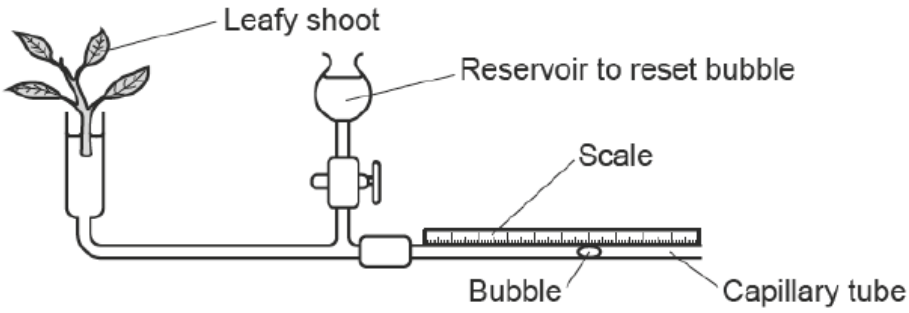
Tick (✓) **two** boxes.

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]

13. Nov 2020/Paper_J260/06/No.2

Ben is investigating the rate of water uptake by a plant, using a potometer as shown in the diagram.



(a) (i) Suggest **one** addition to the diagram before Ben starts his investigation.

.....

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

(ii) Explain your answer to **(a)(i)**.

.....

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

(b) Ben makes the improvement to the apparatus, and then conducts his experiment five times, under different **environmental** conditions each time.

He records how far the bubble moves in 20 minutes, as shown in the table.

Experiment	Distance of bubble along capillary tube (mm)		Distance moved by bubble (mm)
	Start position	End position	
1	15	18	3
2	18	27	9
3	27	38	11
4	12	21	9
5	21	38	17

(i) The result in Experiment 5 is significantly higher than the other results, and could be due to a higher temperature.

Explain the effect of a higher temperature on the rate of water uptake.

.....

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

(ii) Suggest **two** other environmental conditions which Ben could have changed to significantly increase the rate of water uptake by the plant in Experiment 5.

1 .....

2 .....

[2]

(c) Ben conducts one of the experiments at a much higher temperature. In these **conditions** many of the **stomata will close**.

Which experiment shows the expected data for this environmental condition?

Explain your answer.

Experiment .....

Explanation .....

.....

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

(d) The internal cross-section of the capillary tube has an area of $0.8\,mm^2$.

Calculate the rate of water uptake in Experiment **2**.

Rate of water uptake = ... mm^3/min **[3]**

(e) What steps does Ben need to follow to make a **valid comparison** of the rate of transpiration for two different species of plant?

Include the control variables and dependent variable in your answer.

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..... **[4]**