OCR
Oxford Cambridge and RSA

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Wednesday 18 November 2020 – Morning

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/04 Combined Science (Foundation Tier)

Time allowed: 1 hour 45 minutes

8271773746

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9-1) Combined Science B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

J260004

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

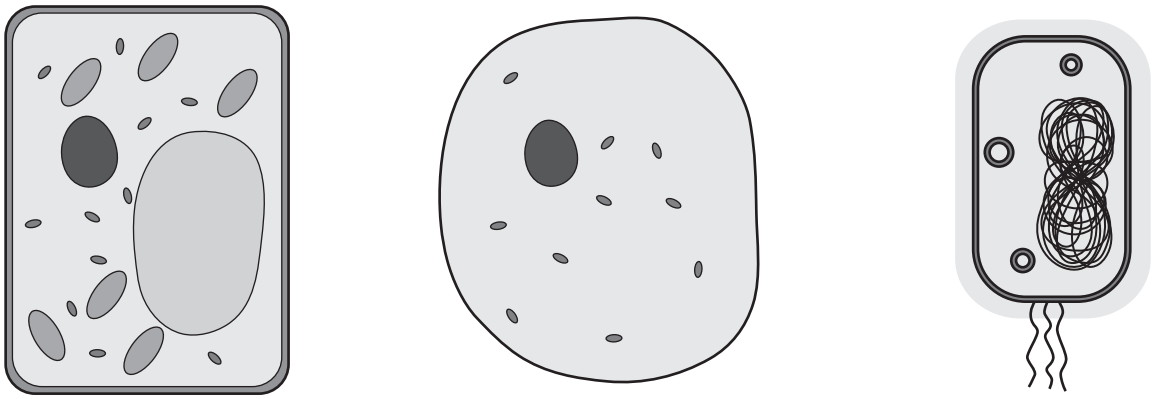
INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 **(a)** Sarah draws **three** different cells, cell A, cell B, and cell C, as shown in **Fig. 1.1.**



Cell A Cell B Cell C

Fig. 1.1

(i) What type of cell is **cell A**?

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

(ii) What is found in **all** three cells?

Tick (✓) **one** box.

Cell membrane	☐
Nucleus	☐
Mitochondria	☐
Chloroplast	☐

[1]

(iii) **Cell C** has a length of 0.0047 mm.

1 mm = 1000 μm.

Calculate the length of cell C in micrometres, μm.

Length = ... μm **[1]**

(b) Microscopes can be used to look at cells.

Complete the sentences about microscopes.

Use words from the list.

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

focus	**light**	**resolution**	**neutron**
magnify	**depth**	**electron**	**power**

A microscope can be used to ..... parts of a cell that cannot be seen with the naked eye.

..... microscopes have a higher magnification and ..... than ..... microscopes, so they can be used to look at parts of a cell in more detail. **[4]**

(c) **Fig. 1.2** shows a light microscope.

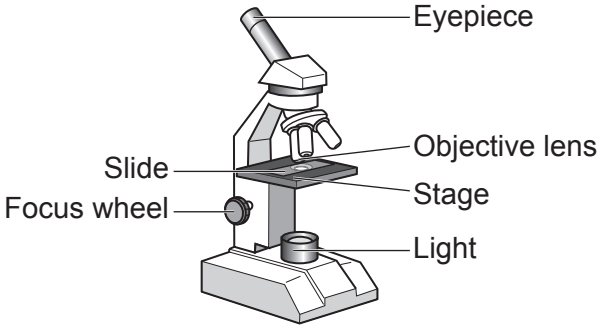


Fig. 1.2

(i) Sarah uses the microscope in **Fig. 1.2** to look at some cells.

The steps Sarah takes to look at some cells are listed below but are **not** in the correct order.

A Place the prepared slide on the microscope stage.

B Turn the focus wheel to make the image clear.

C Change the objective lens to a higher magnification.

D Prepare a microscope slide of the cells.

E Use the objective lens with the lowest magnification.

Write the **letters** in the boxes to show the correct order.

The first one has been done for you.

D				

[3]

(ii) Which combination of eyepiece and objective lens will produce a magnification of × 400?

Tick (✓) **one** box.

Eyepiece	Objective lens	
× 10	× 20	☐
× 5	× 40	☐
× 10	× 40	☐
× 5	× 20	☐

[1]

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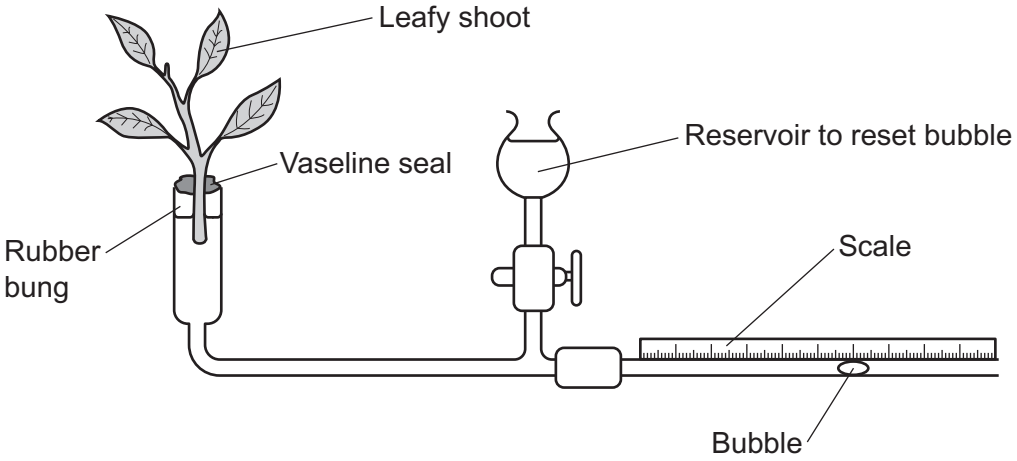
2 **(a)** Ben is investigating the movement of water in plant tissue using a potometer as shown in the diagram.



Ben measures how far the bubble moves in 15 minutes, and then calculates the rate of water uptake. He repeats the measurements 5 times, and his results can be seen in the table.

Repeat	Rate of water uptake (mm^3/min)
1	1.2
2	1.4
3	1.1
4	1.2
5	0.7

(i) Ben says the value for repeat **5** is an outlier.

Give **one** reason why Ben says this.

.....

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

(ii) Suggest what has caused the outlier.

.....

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

(iii) Calculate the mean rate of water uptake by the plant in Ben's experiment.

Use data from the table.

Mean rate of water uptake = ... mm^3/min **[1]**

(iv) Ben wants to investigate the different factors that speed up the rate of water uptake by the plant.

Suggest **three** ways he can change his experiment to speed up the rate of water uptake.

Suggestion 1

.....

Suggestion 2

.....

Suggestion 3

.....

[3]

3 (a) **Table 3.1** shows the properties of some materials.

Material	Tensile Strength (MPa)	Density (g/cm^3)	Electrical conductivity	Thermal conductivity	Flexibility	Melting Point (°C)
Aluminium	290	2.7	good	good	medium	660
Low-density polyethylene (LDPE)	17	0.9	poor	poor	high	110
Steel	1020	8.1	good	good	medium	1400

Table 3.1

(i) Which material in **Table 3.1** should be used as an **insulator** around electrical wires found in a plug, as shown in **Fig. 3.1**?

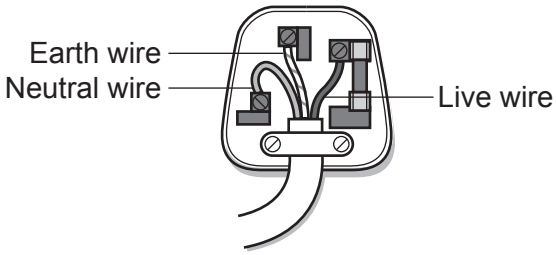


Fig. 3.1

Put a (ring) around the correct answer.

aluminium **LDPE** **steel** **[1]**

(ii) Overhead electrical cables used in the National Grid need to be flexible, and as light as possible.

Which material in **Table 3.1** should be used for overhead electrical cables in the National Grid as shown in **Fig. 3.2**?

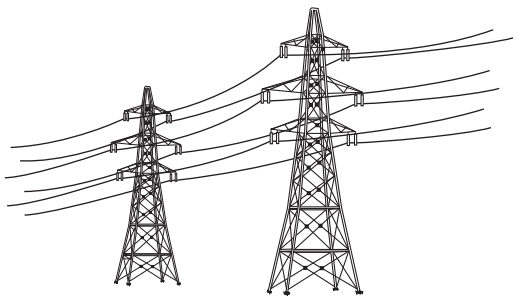


Fig. 3.2

Put a (ring) around the correct answer.

aluminium **LDPE** **steel** **[1]**

(b) Which statements about the materials in **Table 3.1** are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Aluminium is more likely to bend without breaking than LDPE.		
LDPE is nine times less dense than steel.		
Steel is the strongest material.		

[2]

(c) Suggest which material costs the least to recycle.

Use data from **Table 3.1** to explain your answer.

.....

.....

.....

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

(d)* In some professional cycling sports, competitors have to run with their bicycles.

Table 3.2 shows some materials used to make professional cycling bicycles.

Material	Density (g/cm^3)	Strength (MPa)	Brittleness	Cost of frame (£)
Steel	8.1	1020	low	350
Aluminium	2.7	290	low	500
Titanium	4.5	434	low	1000
Carbon fibre	1.8	1600	high	800

Table 3.2

Give the **advantages** and **disadvantages** of using carbon fibre for professional cycling bicycles.

Use the information in **Table 3.2** and calculations to support your answer.

.....

.....

.....

.....

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.....

.....

.....

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.....

.....

..... **[6]**

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]**

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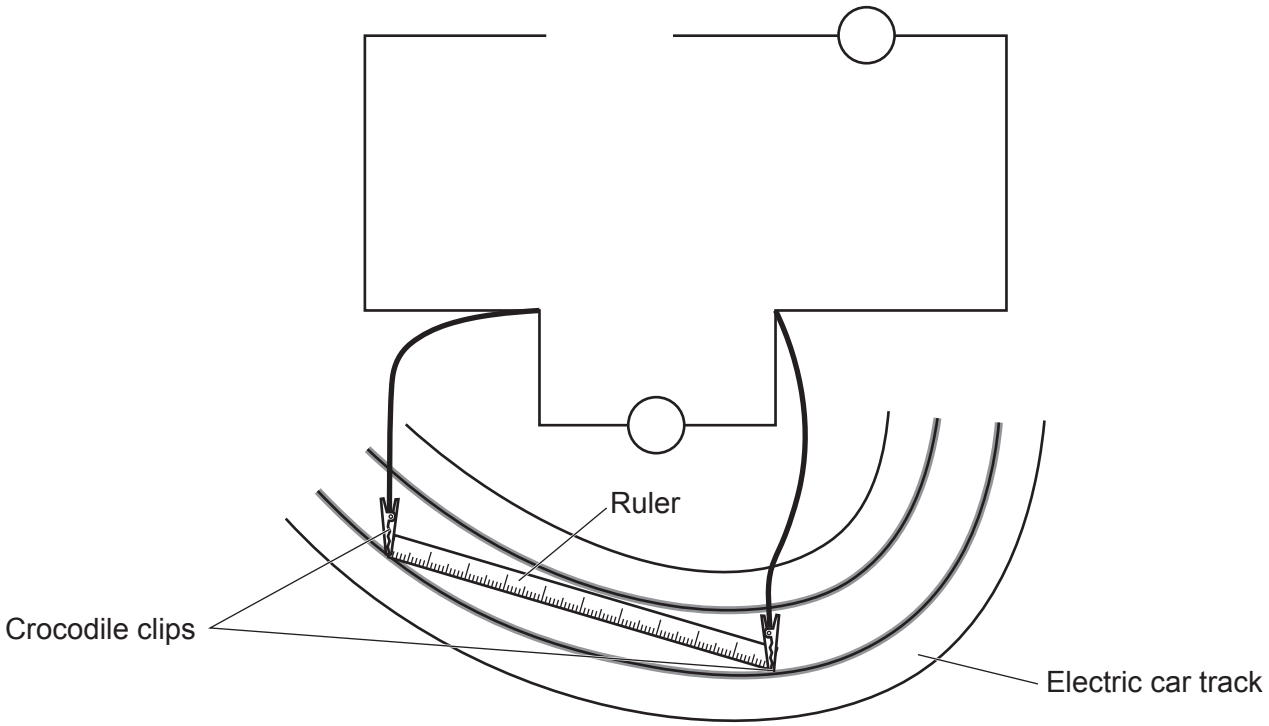
5 **(a)** Beth is investigating how changing the length of a wire affects its resistance.

(i) Complete the circuit diagram to show how Beth can investigate the resistance of a wire inside a section of an electric car track.



[3]

(ii) Beth calculates the resistance of different lengths of the section of track, and her results are shown in the table.

Length of section of track (cm)	Resistance (Ω)
10	2.5
20	5.0
30	7.5
40	10.0
50	12.5

What can be concluded from Beth's results?

Use the data in the table to support your answer.

.....

.....

.....

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

(iii) Calculate the current in the circuit when there is a potential difference of 3.0 V across 50 cm of track.

Use the equation: potential difference = current × resistance

Current = ... A **[2]**

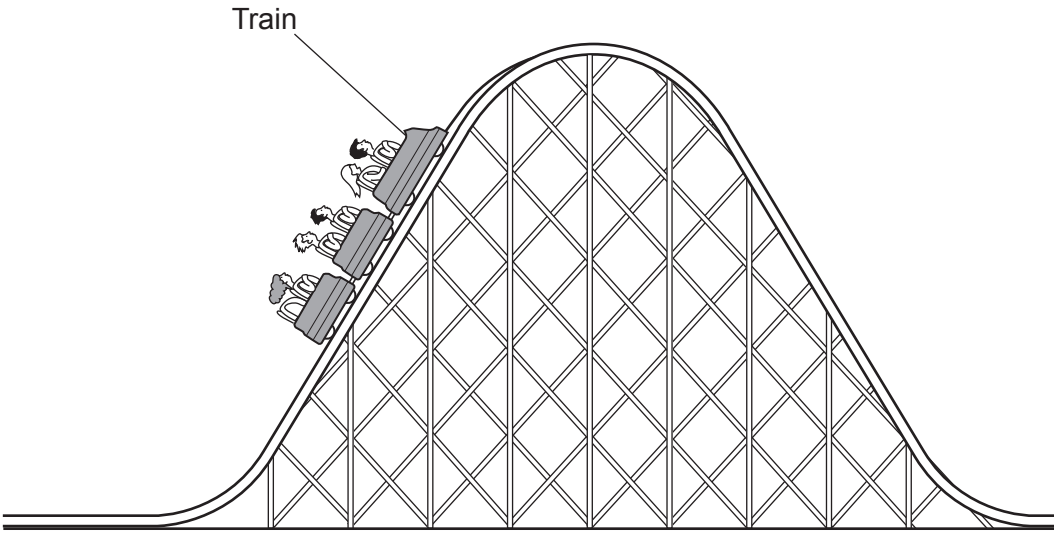
(b) Beth makes three changes to the investigation to improve it.

Draw lines to connect each change in the investigation with its correct improvement.

Change in investigation	Improvement
Adding a switch to the circuit	Greater accuracy of measurement
Only using straight sections of track	Increases the precision
Taking several readings at each track length	Reduces the risk of overheating

[2]

6 The diagram shows part of a rollercoaster ride.



(a) Complete the sentences about the energy transfers in a rollercoaster ride.

Use words from the list.

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

sound	**kinetic**	**electrical**
gravitational potential	**thermal**	**increases**
decreases	**speed**	**distance travelled**

As work is done by an electric motor to move the train to the top of the rollercoaster ride, the ..... energy store of the train increases. As the train starts moving down, this energy store ..... . The ..... of the train increases as the train starts moving down, which causes the ..... energy store of the train to increase. Some energy is dissipated into the inaccessible thermal energy store of the surroundings. **[4]**

(b) **(i)** Which equation should be used to calculate gravitational potential energy?

Tick (✓) **one** box.

(mass × gravitational field strength) ÷ height ☐

mass × gravitational field strength × height ☐

mass × gravitational field strength × $(\text{height})^2$ ☐

(mass × height) ÷ gravitational field strength ☐

[1]

(ii) At the highest point of the rollercoaster ride, the train is 40 m from the ground.

The train has a mass of 1400 kg when it is full of passengers.

Calculate the gravitational potential energy stored in the train when it is at the highest point of the rollercoaster ride.

Gravitational field strength = 10 N / kg

Gravitational potential energy = ... J **[2]**

(c) The train reaches a maximum speed of 90 **km / h**.

Calculate the maximum kinetic energy of the train when it is full of passengers.

Use the equation: kinetic energy = 0.5 × mass × speed^2

Kinetic energy = ... J **[4]**

(d) The electric motor that provides the energy to lift the train to the top of the rollercoaster ride has an efficiency of 0.40.

An empty train has 360 000 J of gravitational potential energy at the highest point of the rollercoaster ride.

Calculate the total energy transferred by the electric motor.

Use the equation: efficiency = useful energy transferred ÷ total energy transferred

Give your answer in **kJ**.

Total energy transferred = ... kJ **[3]**

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.

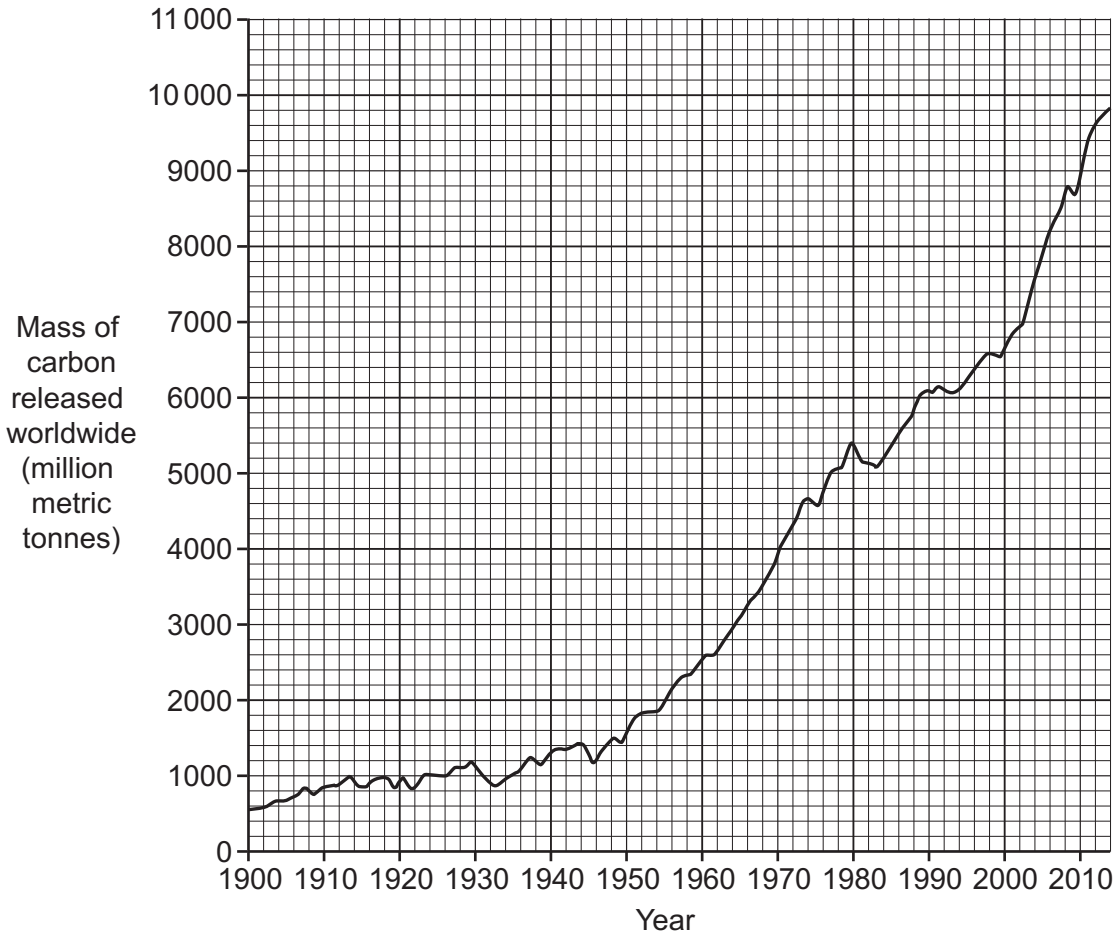


Fig. 7.1

(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]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).