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Wednesday 18 November 2020 – Afternoon

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

J260/08 Combined Science (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ru er (cm/mm)
- the Data Sheet for GCSE (9-1) Comb ned Sc ence B (ns de th s document)

You can use:
- an HB penc
- a sc ent f c or graph ca ca cu ator

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 **16** pages.

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

Turn over

Answer **all** the questions.

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.
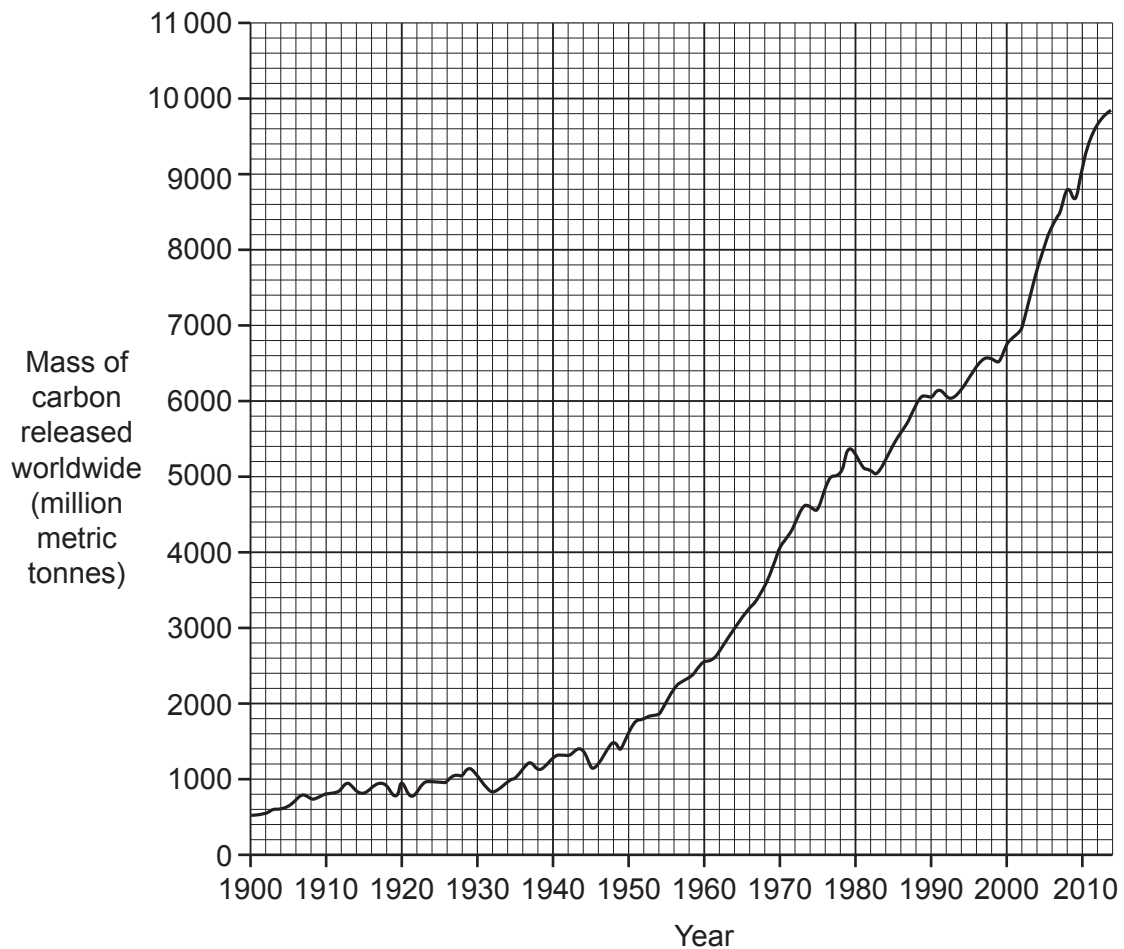
Fig. 1.1

(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. ☐
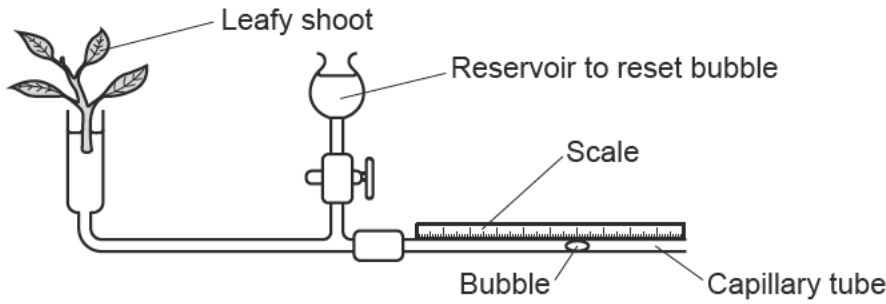
Plants give out carbon dioxide when they respire. ☐

Burning plants releases the same mass of carbon dioxide they absorb. ☐

[2]

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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]**

Turn over

3 **(a)** Layla is investigating **two** fixed resistors.

She sets up an electrical circuit with a 9 V battery to calculate the resistance of each resistor **separately**.

Draw a circuit diagram of this electrical circuit in the box.

[3]

(b) Layla says that placing the two resistors in parallel should give the same total resistance in the circuit as placing them in series.

Is Layla correct?

Yes ☐   No ☐

Explain your answer.

....

....

....

.... **[2]**

(c) Layla calculates that the resistance of each resistor is 100 Ω.

(i) Calculate the total resistance in Layla's circuit when the two resistors are connected in series.

Total resistance in series = ...Ω **[1]**

(ii) Estimate the total resistance in Layla's circuit when the two resistors are connected in parallel.

Estimated total resistance in parallel = ...Ω **[1]**

(d) Layla replaces the old motor in a 12V electric toy car with a new motor, as shown in the diagram.

She also has access to four different resistors, 10Ω, 12Ω, 16Ω, and 20Ω.

What is the minimum size resistor that Layla needs to put into the series circuit of the electric toy car to avoid the new motor overheating and breaking?

Resistor = ... Ω **[3]**

4 (a) Sodium is an element in Group 1 of the Periodic Table.

Write the **balanced symbol** equation for the reaction of sodium with chlorine.

Include state symbols.

.... **[3]**

(b) **Table 4.1** shows some Group 2 elements and their reaction with water.

Element	Reaction with water
Beryllium	No reaction
Magnesium	Reacts with steam
Calcium	Reacts slowly with cold water
Strontium	

Table 4.1

(i) Predict the reaction of strontium with water.

....

.... **[1]**

(ii)* **Table 4.2** shows the melting point of some Group 2 oxides.

Oxide	Melting point (°C)
Magnesium oxide	2852
Calcium oxide	2572
Strontium oxide	2531
Barium oxide	1923

Table 4.2

Table 4.3 shows the ionic radius of Group 2 ions, and the oxide ion.

Element	Ion	Ionic radius (nm)
Magnesium	Mg^{2+}	0.072
Calcium	Ca^{2+}	0.100
Strontium	Sr^{2+}	0.118
Barium	Ba^{2+}	0.135
Oxygen	O^{2}	0.140

Table 4.3

Explain the trend in melting points for the Group 2 oxides shown in **Table 4.2**.

Use data from **Table 4.2** and **Table 4.3**, and your knowledge of ionic bonding, to support your answer.

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.... **[6]**

5 (a) Explain how electron microscopy has increased our understanding of cells.

....

....

....

.... **[2]**

(b) **Fig. 5.1** shows an electron microscope image of a leaf cell.

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Fig. 5.1

(i) Which part of the leaf cell contains chlorophyll?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

[1]

(ii) The actual distance between lines **P** and **Q** is 5.83 μm.

Calculate the magnification used to create the image in **Fig. 5.1**.

Use the equation: measured size = actual size × magnification

1 mm = 1000 μm

Give your answer in **standard form**.

Magnification of image = ... **[4]**

(c) Cellular respiration takes place in both the mitochondria and cytoplasm of animal cells.

Which statements about cellular respiration in animal cells are **true**, and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Cellular respiration is exothermic.		
Cellular respiration releases water in both the mitochondria and cytoplasm.		
Lactic acid is only made by cellular respiration that takes place in the cytoplasm.		
Oxygen is used for cellular respiration in the cytoplasm.		

[3]

(d) The number of mitochondria in different body cells of a healthy human is shown in the graph.
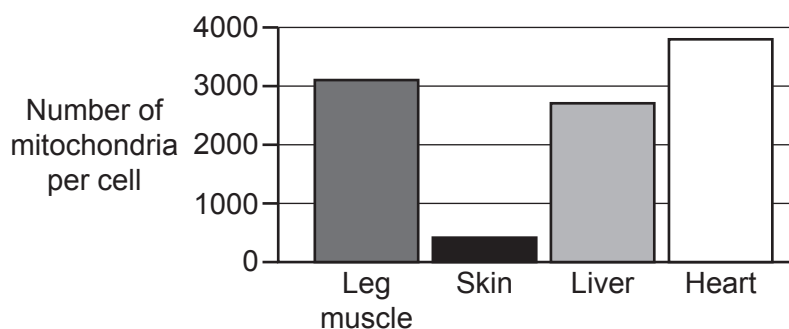
Explain the trend shown in the graph.

....

....

....

.... **[2]**

6 Mia has a bottle of white vinegar which states that it contains 6.0% ethanoic acid by volume. White vinegar is a colourless solution of ethanoic acid in water.

Mia checks the percentage of ethanoic acid by volume in white vinegar by titrating the white vinegar with an alkali solution.

Some of Mia's procedure is shown below:

Stage 1. Transfer $25\,cm^3$ of white vinegar from a measuring cylinder to a conical flask.
Stage 2. Add a few drops of universal indicator to the conical flask.

Burette filled
with alkali —
solution

Conical flask with
white vinegar
and indicator
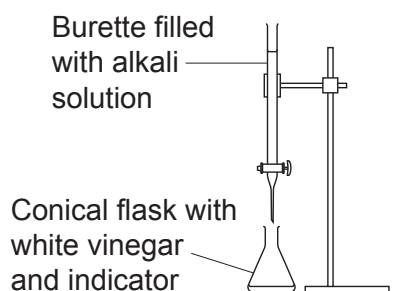
(a) Mia's teacher says that she can improve the procedure for both **stage 1** and **stage 2** of this experiment.

State **one** improvement for each stage of this experiment, and explain how this improves the procedure.

Stage 1

Improvement ....

....

Explanation ....

....

Stage 2

Improvement ....

....

Explanation ....

....

[4]

(b) Outline the rest of the procedure to titrate the white vinegar with an alkali solution to obtain **accurate** and **precise** results.

....

....

....

....

.... **[3]**

(c) Mia does the titration six times, and her results are shown in the table.

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5	Titration 6
Burette reading at end (cm^3)	22.0	43.0	64.2	86.1	21.1	42.3
Burette reading at start (cm^3)	0.0	22.0	43.0	64.2	0.0	21.1
Volume added (cm^3)	22.0	21.0	21.2	21.9	21.1	21.2

Mia uses her results to calculate a mean titration value.

Evaluate Mia's results to suggest which values should be used to calculate the mean.

....

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.... **[3]**

(d) Mia calculates that $25.0\,cm^3$ of the white vinegar contains 0.026 moles of ethanoic acid. The relative formula mass of ethanoic acid is 60.0.

The density of ethanoic acid is $1.05\,g/cm^3$.

Show that the white vinegar contains 6.0% ethanoic acid by volume.

Use the equation: density = mass ÷ volume

Use the equation: number of moles = mass of substance ÷ relative formula mass

[4]

END OF QUESTION PAPER

16

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).

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