OCR
Oxford Cambridge and RSA

Friday 9 June 2023 – Afternoon

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

J260/04 Combined Science (Foundation Tier)
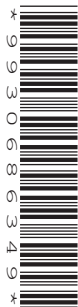
Time allowed: 1 hour 45 minutes

F

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

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

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.

OCR is an exempt Charity

Turn over

1   Pathogens can cause diseases in humans.

Draw lines to connect each defence mechanism with the explanation of how it functions.

Defence mechanism   **Explanation**

| Stomach acid |

| Clots the blood to prevent pathogens from entering cuts |

| Skin |

| Produces antibodies, or ingests and digests pathogens |

| Platelet |

| Barrier that prevents pathogens from entering the body |

| White blood cell |

| Can kill pathogens and stop them from reproducing |

[3]

2 **(a)** The plant genome is inside the nucleus of each cell.

(i) What is a genome?

....

.... **[1]**

(ii) What is the function of the nucleus in a plant cell?

Tick (✓) **one** box.

It controls what goes into and out of the cell. ☐

It controls how organisms develop and function. ☐

It maintains the shape of the cell. ☐

[1]

(b) Plants make small organic molecules including sugars, fatty acids, glycerol and amino acids.

Why is it important for plants to be able to make their own amino acids?

....

.... **[1]**

(c) Scientists can genetically engineer crop plants.

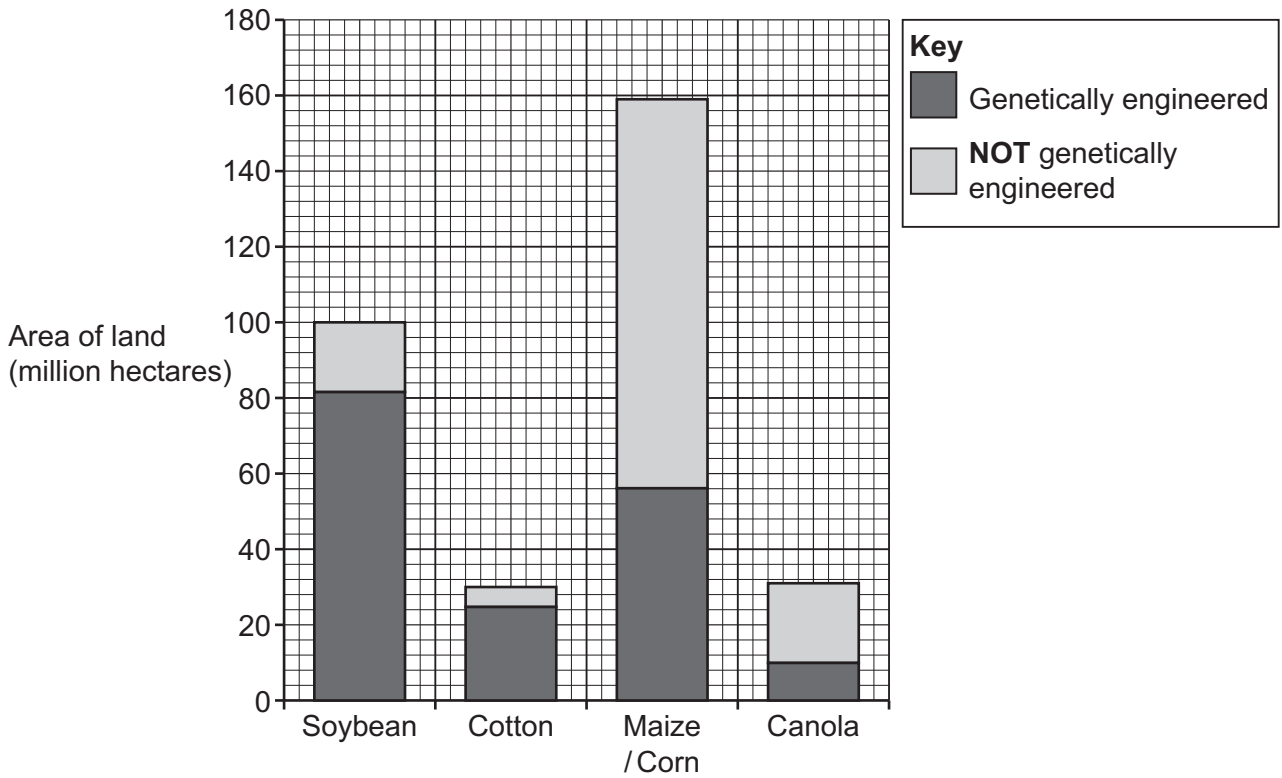Complete the description of genetic engineering.

Use words from the list.

copied	DNA	modified	protein	removed	desirable

Genetic engineering is a process in which the genome is .... so the crop

plant has .... characteristics.

[2]

Turn over

(d) The bar chart shows the area of land used to grow four different crop plants.
Some of each crop plant grown is genetically engineered.

(i) Give **three** conclusions that can be made from the data.

1 ....

....

2 ....

....

3 ....

....

[3]

(ii) There are 31 million hectares of canola grown.

30% of the canola grown is genetically engineered.

Calculate the number of hectares used to grow genetically engineered canola.

Number of hectares = ... million hectares **[2]**

5

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3   A student is investigating how light intensity affects the rate of photosynthesis.

They predict that "the greater the light intensity the greater the rate of photosynthesis".

They set up an experiment as shown in **Fig. 3.1**.

Fig. 3.1
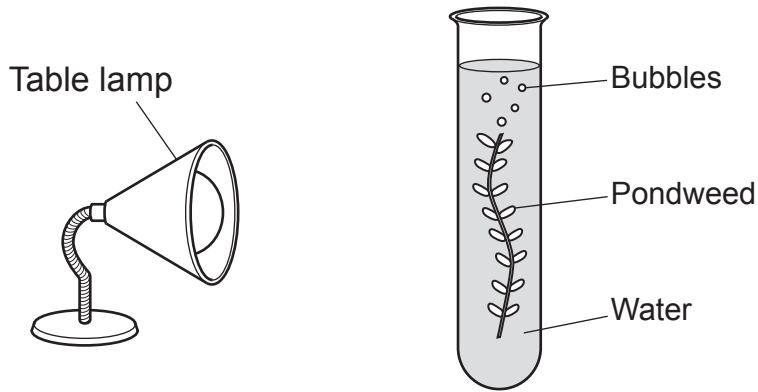
To measure the rate of photosynthesis they count how many bubbles are produced in 10 minutes.

(a) Which **two** factors will the student need to control to make the student's investigation valid?

Tick (✓) **two** boxes.

Number of bubbles produced ☐

Temperature of the water ☐

The size of the pondweed ☐

Volume of the bubbles ☐

[2]

(b) The student sets up a second experiment using the equipment in **Fig. 3.2**.

Fig. 3.2
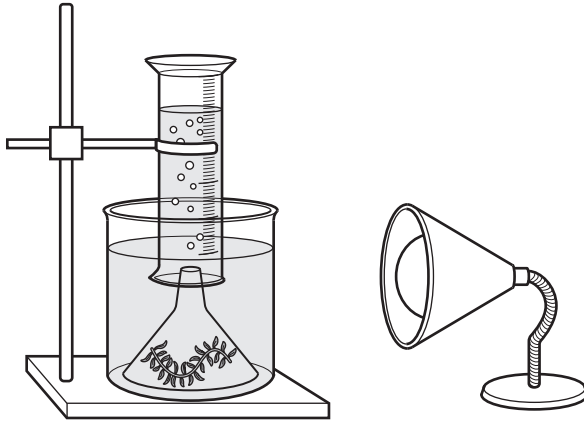
Explain how this second experiment will improve the quality of the data collected to measure the rate of photosynthesis.

....

....

....

.... **[2]**

(c) The table shows the results of the second experiment.

Time (minutes)	Volume of gas produced (cm³)
0	0.0
5	1.5
10	3.9
15	5.2
20	6.7

(i) Plot the results from the table on the graph.

Include a line of best fit.

Volume of
gas produced
(cm³)
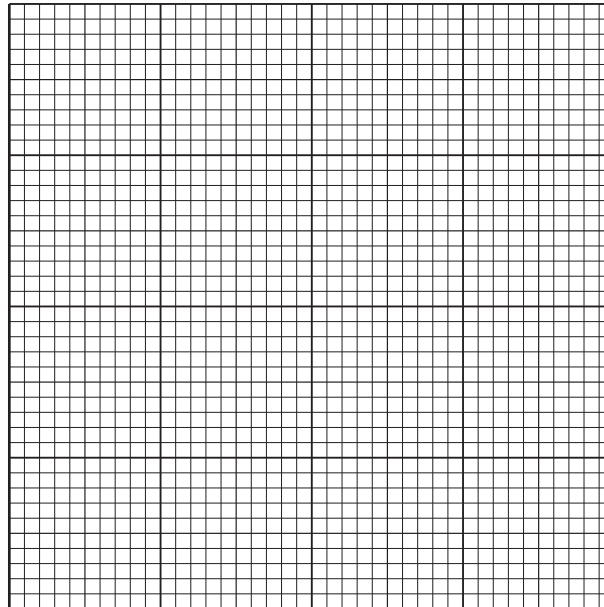
Time (minutes)

[3]

(ii) Calculate the rate of photosynthesis.

Give your answer to **1** decimal place.

Rate of photosynthesis = ... cm³/minute **[3]**

(iii) The temperature of the water used in this experiment was 20 °C.

The student repeats the experiment at 30 °C.

What would you expect the gradient of the graph to look like at 30 °C?
You may draw a labelled line on the graph.

Explain your answer.

....

....

....

.... **[2]**

4   **Fig. 4.1** shows the relationship between the percentage of population with access to potable water and the number of deaths per 1000 people in the population.

Each point on **Fig. 4.1** represents a country.

Fig. 4.1
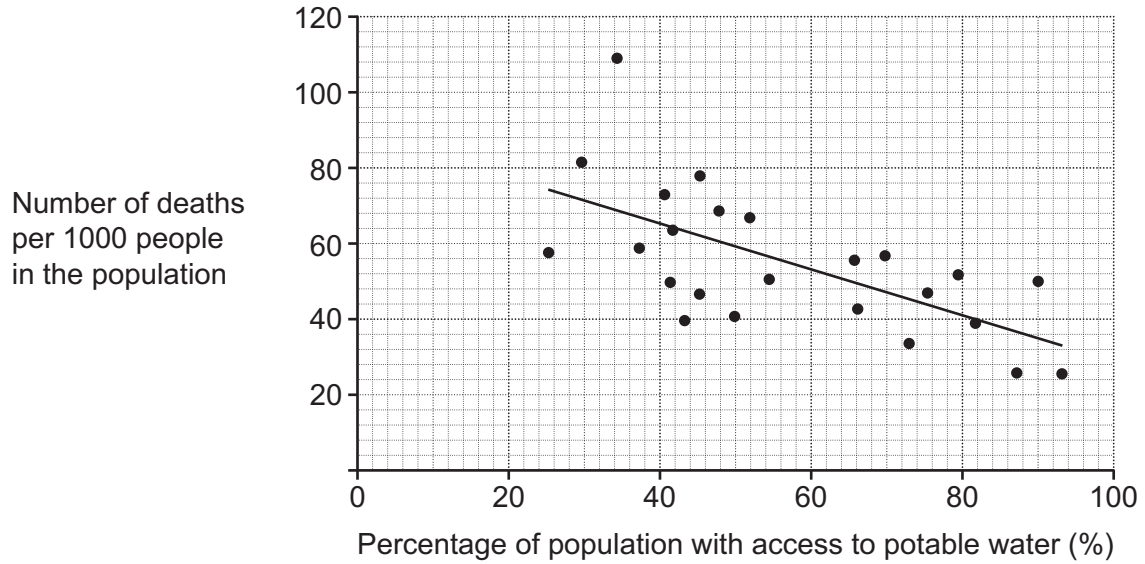
(a) (i)   Put a (ring) around the data point that could be considered an outlier on **Fig. 4.1**.   **[1]**

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

     ....

     .... **[1]**

(b)* **Fig. 4.2** shows the number of deaths per 100 000 people due to typhoid fever from 1900 to 1960 in the USA.

Typhoid fever is a bacterial infection. It can be spread by drinking water that has not been treated.

Fig. 4.2

Give arguments **for** and **against** chlorine being added to drinking water all over the world.

Use information from **Fig. 4.1** and **Fig. 4.2**.

....

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.... **[6]**

5 Dev reacts calcium carbonate with dilute hydrochloric acid.

(a) The diagram shows the experiment he sets up.
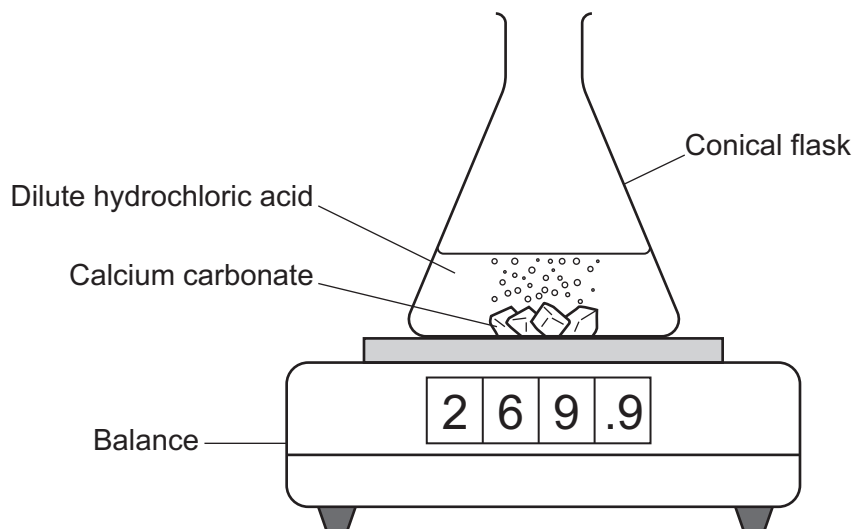
(i) Which gas is produced in this reaction?

Tick (✓) **one** box.

Carbon dioxide ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

[1]

(ii) When calcium carbonate reacts with hydrochloric acid, calcium chloride is formed.

Calculate the relative formula mass of calcium chloride ($CaCl_2$).

Use the Data and Equation Sheet.

Relative formula mass = ... **[3]**

(b) The graph shows how the mass of the conical flask changes during the reaction.
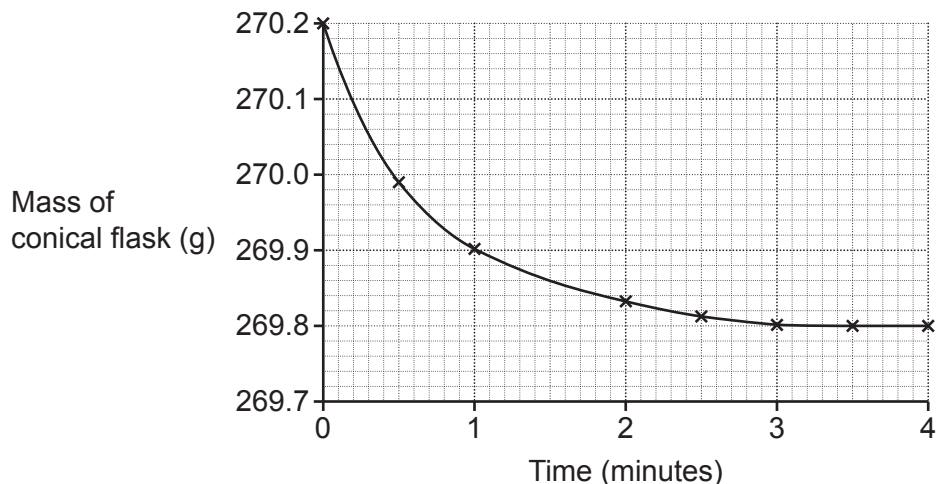

(i) Explain why the mass of the conical flask decreases during the reaction.

....

.... **[1]**

(ii) Estimate when all of the calcium carbonate has reacted.

Explain your answer.

Time = ... minutes

Explanation ....

....

....

....

....
[3]

(c) Explain how Dev can develop his experiment to show that mass is conserved during the reaction.

....

....

....

.... **[2]**
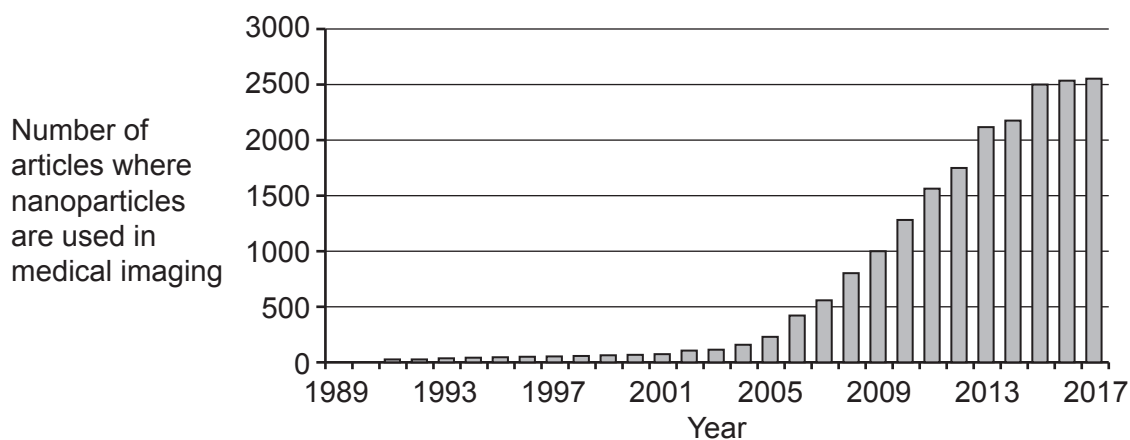
6 Pubmed is a search engine that can be used to search for scientific articles.

The graph shows some data about the number of articles where nanoparticles were used in medical imaging.

(a) What can you conclude from the data in the graph?

....

....

....

.... **[2]**

(b) A group of scientists studied one person who worked for a nanotechnology company. The person worked with nanochemicals and became ill.

The group of scientists concluded that "nanochemicals are bad for people's health because they can make you ill".

(i) Suggest **two** reasons why scientists in the nanotechnology **company** might disagree with this conclusion.

1 ....

....

2 ....

....

[2]

(ii) Describe what the group of scientists should have done to improve their study.

....

....

....

.... **[2]**

(c) Nanoparticles have been used in medicine alongside MRI scans to help detect cancer in patients.

Why are health professionals and patients happy to be part of nanoparticle trials?

....

.... **[1]**

7 (a) Complete the table by describing the attraction and repulsion between unlike and like poles for permanent steel magnets.

Arrangement of two steel magnets	Attract or repel?
N S N S	....
N S S N	....
S N N S	....
S N S N	....

[2]

(b) Complete the sentence to explain how the behaviour of a magnetic compass provides evidence that the core of the Earth is magnetic.

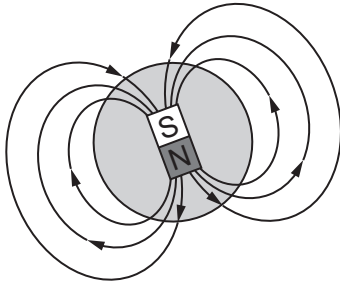Put a ⬭ring around the correct options.

The north pole of a magnetic compass will point **towards / away from** the

magnetic / geographic north pole. **[1]**

(c) **Fig. 7.1** shows the Earth's magnetic field.

Fig. 7.1

How does **Fig. 7.1** show that the magnetic field is strongest at the Earth's north and south poles?

Tick (✓) **one** box.

The field lines at the poles are closer together. ☐

The field lines at the poles are further apart. ☐

The field lines cross each other at the poles. ☐

There are more field lines at the poles. ☐

[1]

(d) **Fig. 7.2** shows the poles of a permanent steel magnet and an induced iron magnet interacting with another, stronger magnet.

Fig. 7.2
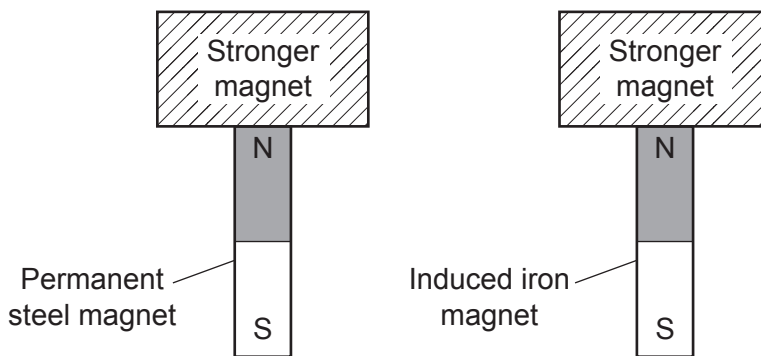
Explain what happens to the iron and steel magnets after the stronger magnet is removed.

....

....

....

.... **[2]**

Turn over

(e) When there is an electric current in a wire there is a magnetic field around the wire.

A solenoid is a coil of wire.

The table describes 4 magnets.

Magnet	Current in the solenoid	Number of turns in solenoid	Iron core present or absent?
A	Low	2	Present
B	Low	60	Absent
C	Medium	50	Absent
D	High	50	Present

Explain which magnet will have the strongest magnetic field.

....

....

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....

.... **[4]**
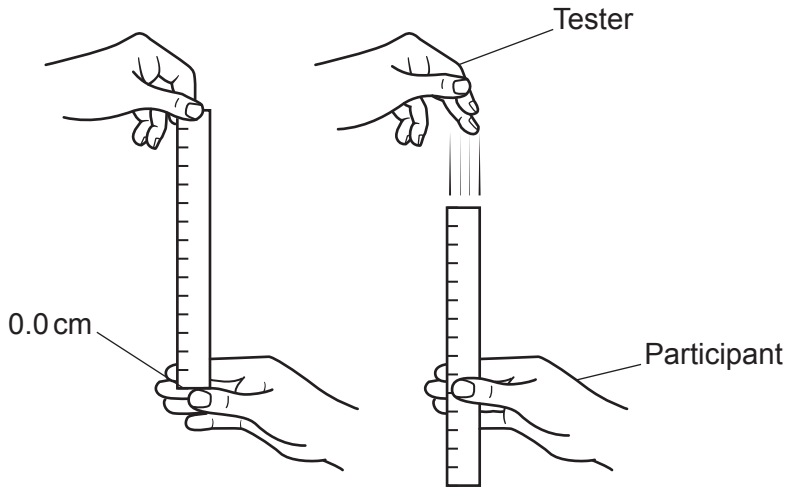
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8 Two students are doing an experiment to investigate reaction times. The diagram shows their experiment.

(a) The statements outline the method used. They are **not** in the correct order.

A	The tester lets go of the ruler.

B	The participant catches the ruler as soon as they realise the tester has let go of the ruler.

C	The distance the ruler has dropped is measured.

D	The participant has their fingers and thumb near, but not touching, the ruler.

E	The tester holds a ruler above the participant's hand.

(i) Write the letters in the boxes to show the correct order of the statements.

The first one has been done for you.

E				

[2]

(ii) Suggest **two** improvements to the method that would ensure that the measurements taken were valid.

Improvement 1 ....

....

Improvement 2 ....

....

[2]

(b) The experiment is repeated three times. **Table 8.1** shows the results.

Table 8.1

Repeat	Distance ruler falls (cm)
1	8.4
2	7.9
3	7.7

The students conduct a fourth repeat. The distance recorded is 12.7 cm.

Suggest **one** reason why this value of 12.7 cm is greater than the first three repeats.

....

.... **[1]**

(c) The students find some data they can use to convert the distance fallen by the ruler into a reaction time. This information is in **Table 8.2**.

Table 8.2

Ruler reading (mm)	Reaction time (s)
10	0.05
20	0.06
30	0.08
40	0.09
50	0.10
60	0.11
70	0.12
80	0.13
90	0.14
100	0.14
110	0.15

A second participant repeats the experiment. The mean distance the ruler falls is 6.7 cm.

Use **Table 8.2** to estimate their reaction time.

Reaction time = ... s **[2]**

(d) Another way of determining the reaction time is to use a formula.

Calculate the reaction time when the ruler falls 0.0670 m.

Use the formula:

$t = \sqrt{\dfrac{2d}{g}}$

t = reaction time (s)
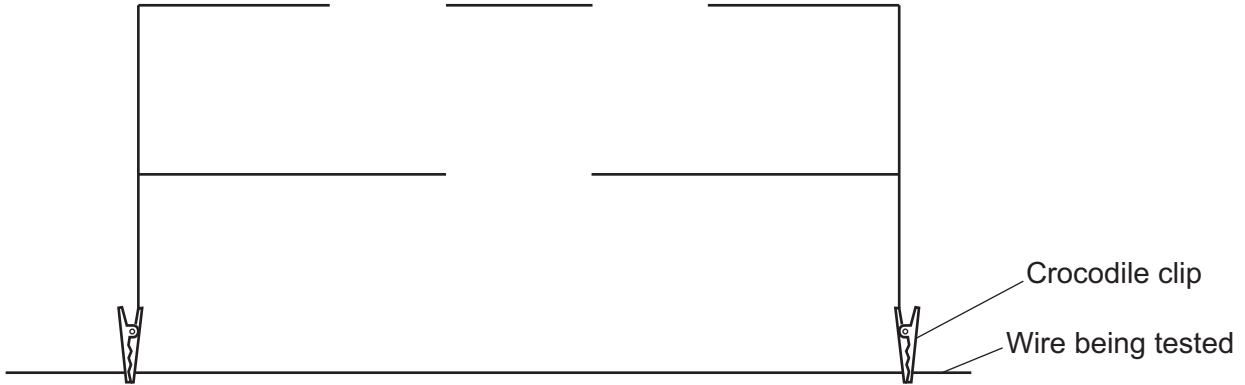d = distance travelled by ruler (m)
g = 10 N/kg.

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

Reaction time = ... s **[3]**

9 A student sets up a circuit to determine the resistance of a wire.

(a) Complete the circuit diagram by:
  • adding a cell
  • adding the equipment needed to measure the potential difference and current.

Crocodile clip
Wire being tested

[1]

(b) The length of the wire used in the experiment is 90 cm. The current is 0.16 A and the potential difference is 1.5 V.

Calculate the resistance of the wire.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[2]**

(c) The student predicts that the longer the wire is the greater the resistance will be.

Describe how the student can extend their investigation to test their prediction.

....

....

....

.... **[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).

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