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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/04 Summer 2023 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Paper 4 series overview

Paper 4 is the final Foundation tier paper sat by candidates for the GCSE (9-1) Combined Science B qualification.

It contains questions drawn from all areas of the specification and from all three of the science subjects.

In this year's paper, Questions 8 and 9 were the questions that were common to the Higher tier paper.

Most candidates made an attempt at answering all the questions.

Marks were given where candidates followed the instructions in the question, (e.g. tick **one** box) where they demonstrated and applied their scientific knowledge and where candidates structured their answers using bullet points or sentences rather than writing longer, wordy answers that missed the point.

Candidates did well on Question 4 about water, but did not do as well on Question 6a about nanoparticles.

Two questions had a statistically significantly higher rate of omission (were left blank) than others on the paper and these were 3cii and 5aii.. This could indicate that candidates are not confident with calculating a rate from data in a table and relative formula mass

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read the questions carefully and followed the instructions. For example, 'tick one box' or 'draw one line' • showed full working out in calculations • structured their answers effectively • used correct scientific language in their answers • used a calculator when answering calculation questions.	• only wrote the answer on the answer line in calculation questions, without showing any working out • wrote short answers in 2 and 3 mark questions that did not contain enough detail to score more than 1 mark • did not read the questions carefully and so gave extra details about things that were not asked • did not attempt some questions – including tick the box and draw a line style questions • used vague terminology such as 'electricity' rather than 'current' • tried to rely on answers that were generic, such as those related to 'accuracy', 'fair test' and 'repeating and finding a mean'.

Question 1

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]

Most candidates did well on this question.

Misconception

The most common misconception was confusion between the role of platelets and white blood cells.

Question 2 (a) (i)

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

(i) What is a genome?

.....

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

It was rare to see a correct answer to this question. Examiners needed to get the idea that the candidate understood that the genome is all of the genetic material.

Common wrong answers included vague ideas about DNA, descriptions of structures or organelles within the cell, an attempt at defining gene or descriptions of the nucleus.

Question 2 (a) (ii)

(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]

The vast majority of candidates correctly chose the second option.

Question 2 (b)

(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]**

Very few candidates made the connection between amino acids and proteins, so it was rare for examiners to award this mark.

It was common to see answers that related to photosynthesis, such as plants producing their own food, or answers about growth and repair that did not include the word protein.

Misconception

? A small number of candidates thought that amino acids were the first line of defence against infection, similar to stomach acid in a human.

Question 2 (c)

(c) Scientists can genetically engineer crop plants.

Complete the description of genetic engineering.

Use words from the list.

copied	**DNA**	**modified**	**protein**	**removed**	**desirable**

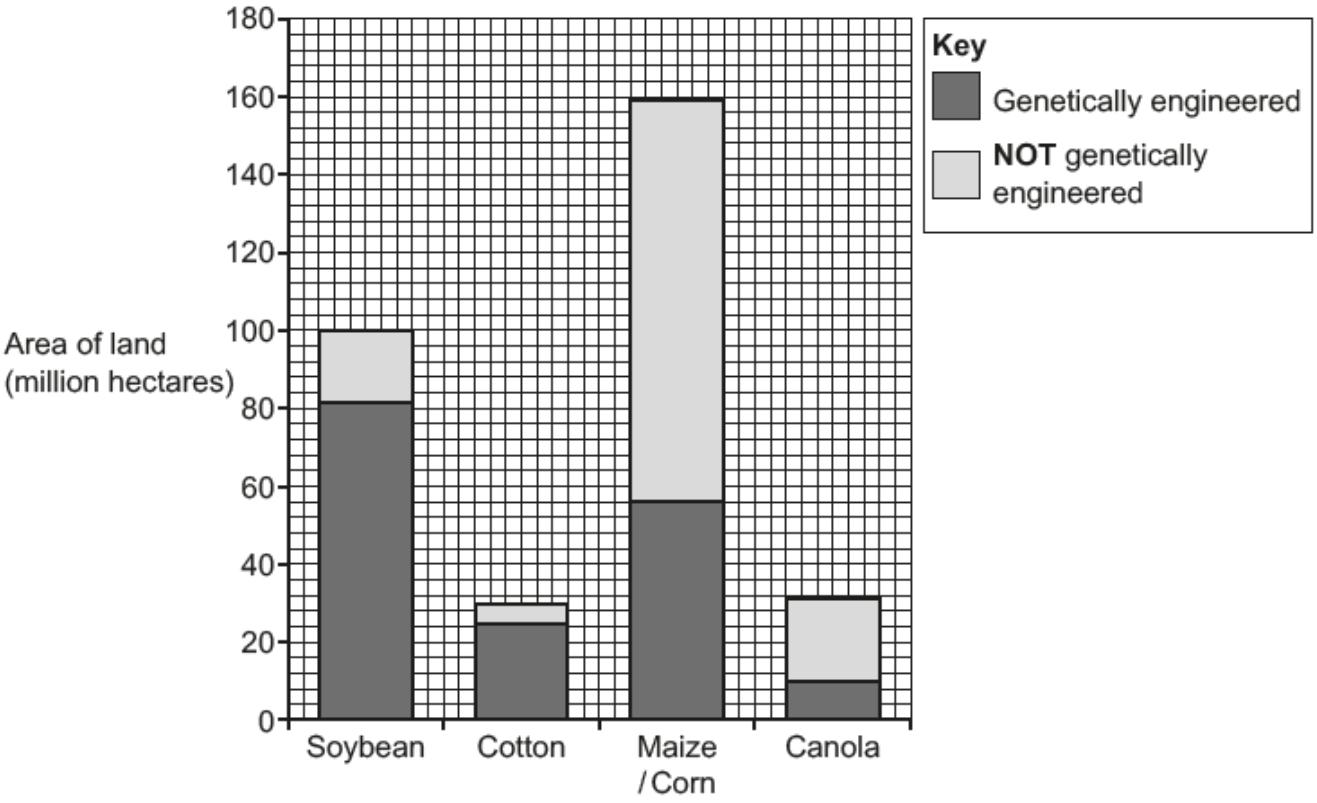
Genetic engineering is a process in which the genome is ..... so the crop plant has ..... characteristics.

[2]

Around half of the candidates were given both marks on this question, and a further quarter were given 1 mark.

Question 2 (d) (i)

(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]

Just over half of candidates made two or three correct conclusions using the data from the bar chart. Wrong answers included the idea that soybean was somehow 'better' when it was genetically engineered or that non-genetically engineered cotton was somehow less 'popular' than its genetically engineered counterpart.

Assessment for learning

Candidates should be trained to stick to comparative descriptions when interpreting graphs like this.

Exemplar 1

1 Maize / corn grows better when it's not genetically engineered

2 Cotton grows better when it's genetically engineered

3 Soybean grows better when it's genetically engineered

[3]

This response is a good example of the candidate not expressing their conclusions in a clear enough way.

The graph does not give us any information about how well the crops grow, only the area of land used to grow genetically engineered and not genetically engineered plants.

Candidates should look at the information provided carefully and phrase their answers in a way that matches the data.

Question 2 (d) (ii)

(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]**

Many candidates wrote the full answer of 9 300 000 rather than 9.3 and so were given only 1 mark rather than 2 marks.

Candidates should look carefully at the answer space and present their answer in the format asked for in the question.

In the working out, examiners needed to see the mathematical operation that the candidates were doing (in other words multiplication). Many candidates who got the wrong answer showed their working out as 30% of 31 million rather than 30% x 31 million and so were not given credit.

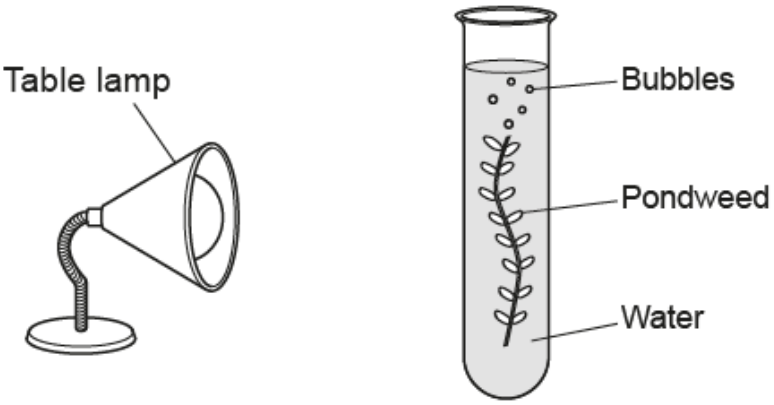
Question 3 (a)

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 ☐

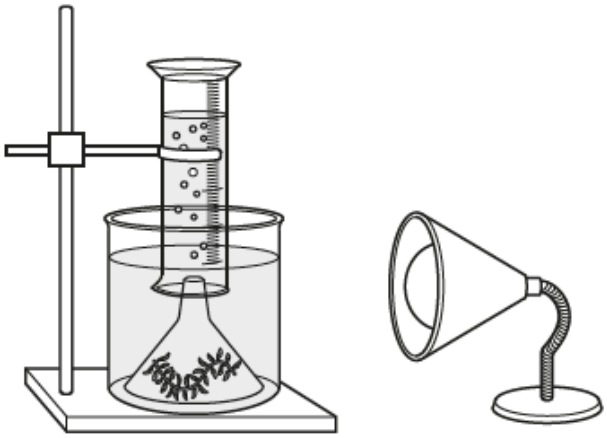
[2]

Nearly all candidates were given marks in this question.

Question 3 (b)

(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]**

This question seemed to cause problems even for candidates at the top of the mark distribution. Examiners needed to see that a **volume** of gas was measured, or that the gas could not escape, or the bubbles could have been different sizes.

Many responses indicated that it would still be necessary to count the bubbles, or that it would be easier to count the bubbles because it will take them longer to work their way up the measuring cylinder, or that the bubbles would be easier to see, because they were not hidden behind the pondweed.

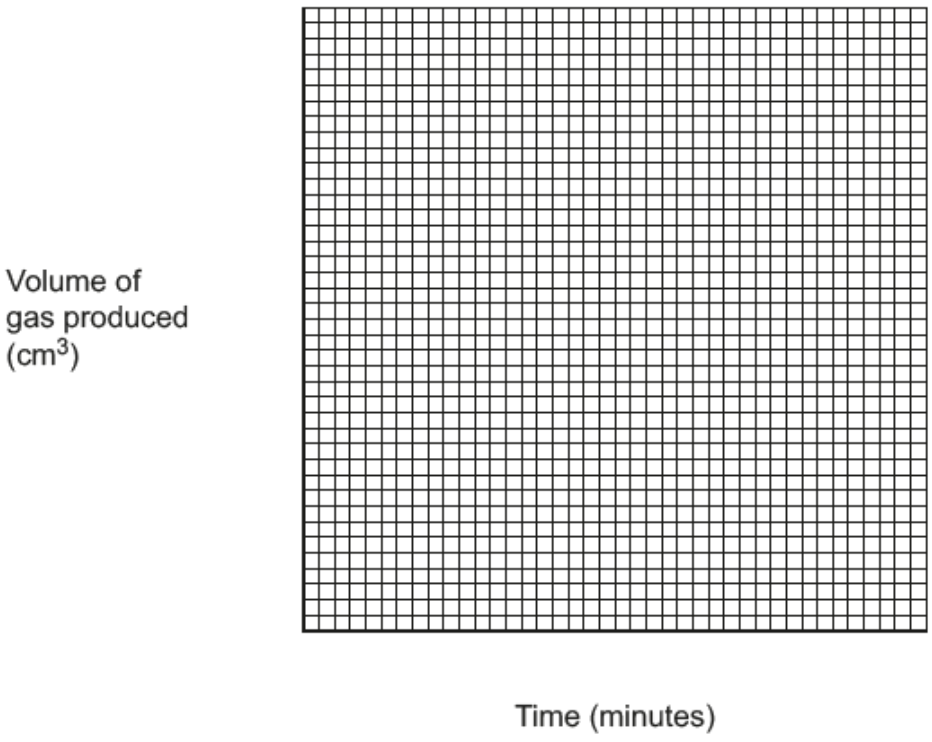
Question 3 (c) (i)

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

Time (minutes)	Volume of gas produced (cm^3)
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.



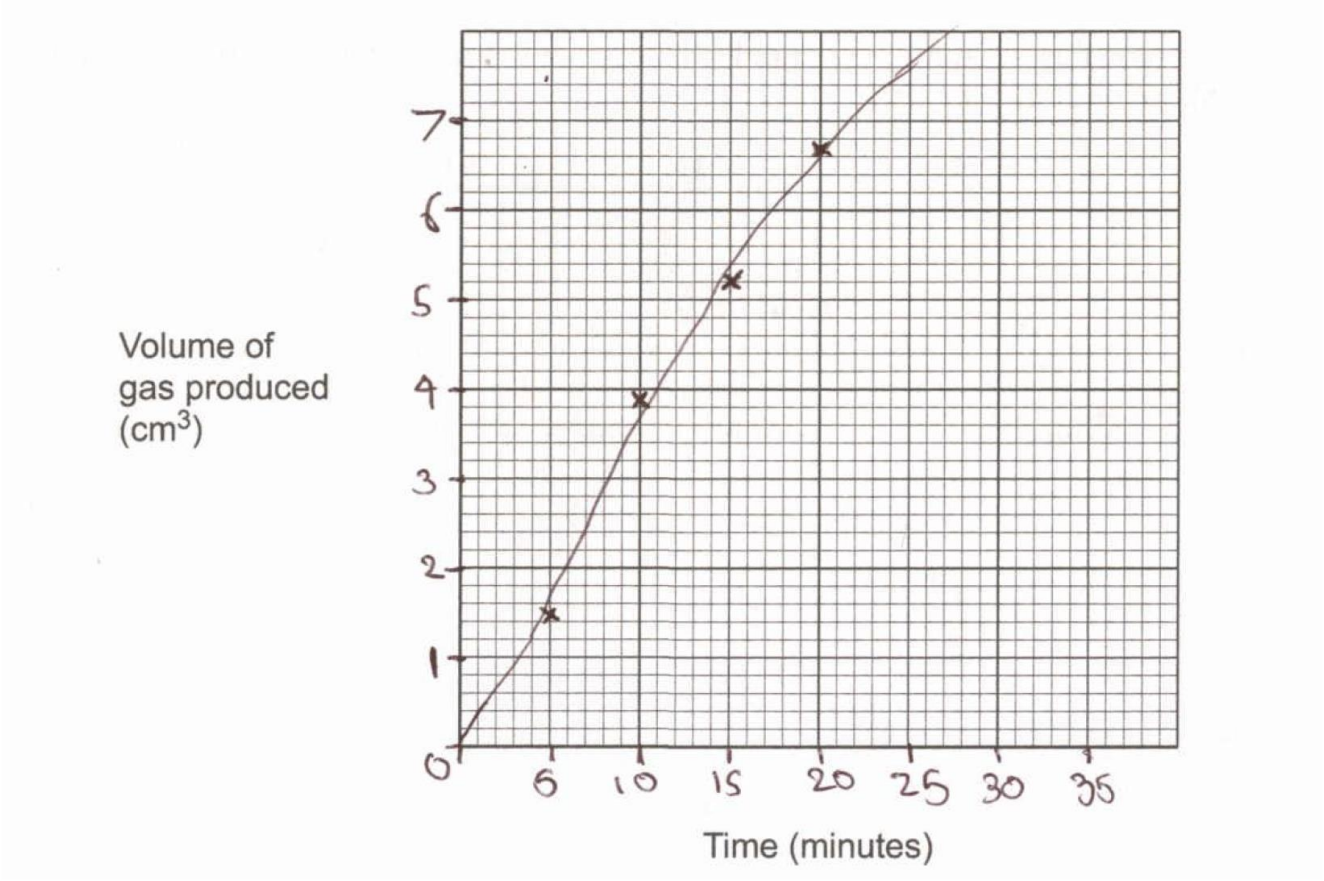
[3]

The usual errors about plotting graphs were seen in this question.

Examiners needed to see a linear scale with appropriate intervals, all five points correctly plotted and a single straight line of best fit. Bar charts were a common incorrect type of graph.

Many candidates used the numbers from the table as their numbers for the scale and had these equally spaced up the vertical axis, the point at the origin was often not plotted and examiners saw many dot to dot lines.

Exemplar 2



In this response, the candidate has made three mistakes.

The scale that they have used for the vertical axis is fine but the scale that they have chosen for the horizontal axis only uses half of the graph paper.

While the candidate has correctly plotted four of the points, the point at the origin is missing.

The candidate's line of best fit is not straight and is not drawn with a ruler.

Question 3 (c) (ii)

(ii) Calculate the rate of photosynthesis.

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

Rate of photosynthesis = ... cm^3/minute **[3]**

Candidates found this question very demanding. Many candidates attempted to divide the numbers upside down (i.e. times divided by volumes), or randomly chose two numbers that were not provided and then divided those.

Question 3 (c) (iii)

(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]**

Most candidates stated that the line would be steeper or added a steeper line to the graph.

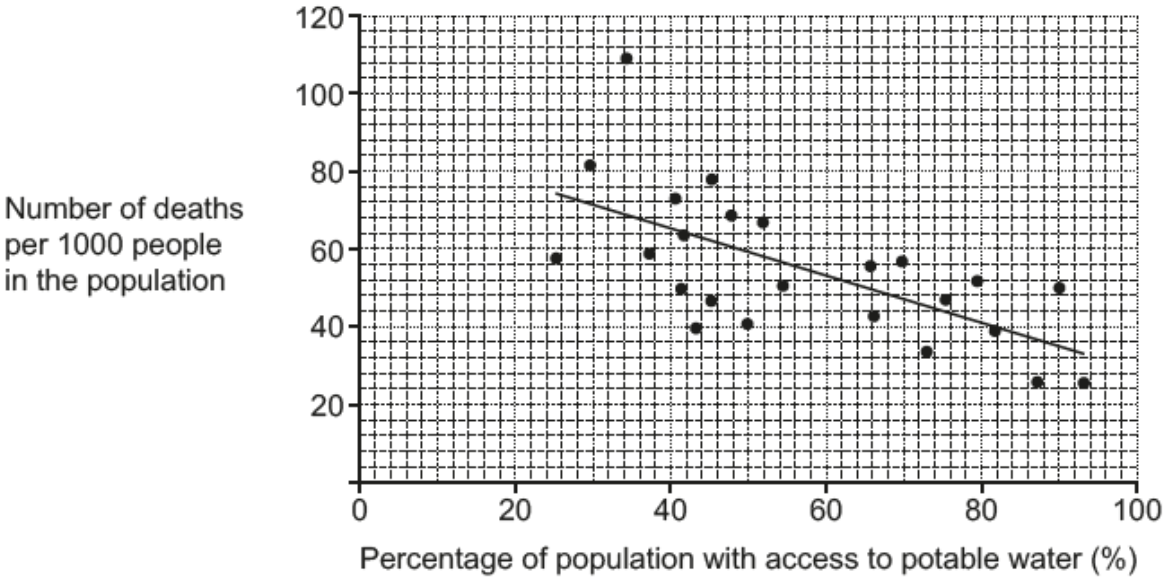
Few candidates were able to explain why this would be the case. The idea of rate was most commonly missing and candidates wrote statements like 'there would be more gas' but did not link this to a time thereby missing the idea of rate.

Question 4 (a) (i)

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]**

A very large majority of candidates correctly identified the outlier.

Question 4 (a) (ii)

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

.....

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

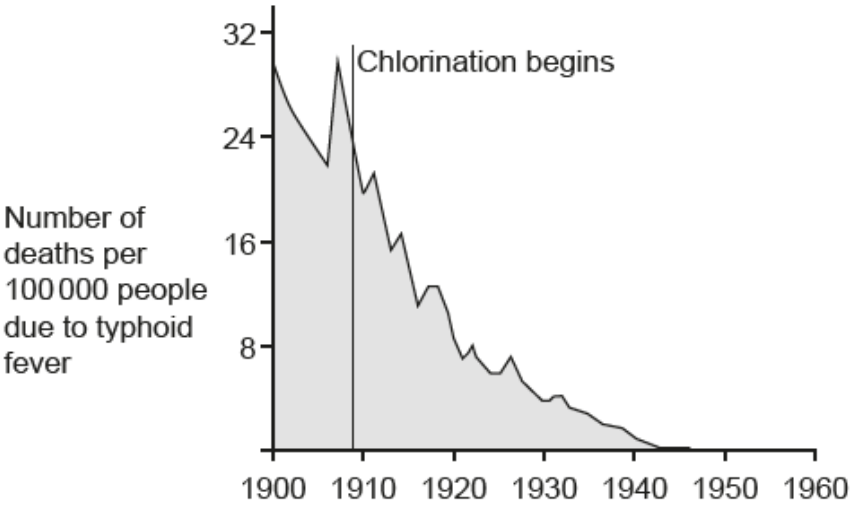
Most candidates were able to explain why their chosen point was an outlier.

Question 4 (b)*

(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**.

.....

.....

.....

.....

.....

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

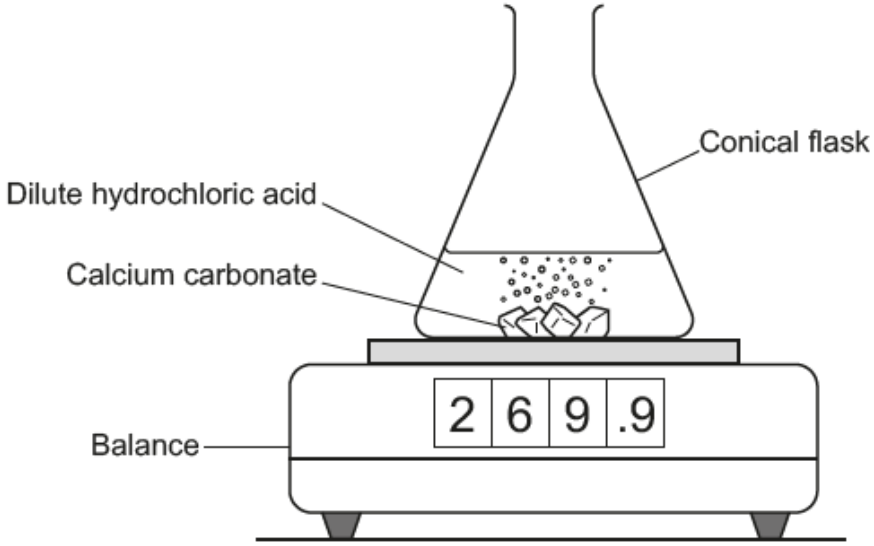
This question required candidates to use the information provided in the graphs.

Most candidates used Fig 4.2 and correctly stated that, after chlorination, the number of deaths had a dramatic fall, and therefore covered the 'for' part of the question. Less common were any graph related comments that were against chlorination, such as it is taking around 40 years to reduce the death rate to 0.

Question 5 (a) (i)

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]

Popular incorrect answers were hydrogen and oxygen.

Question 5 (a) (ii)

(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.

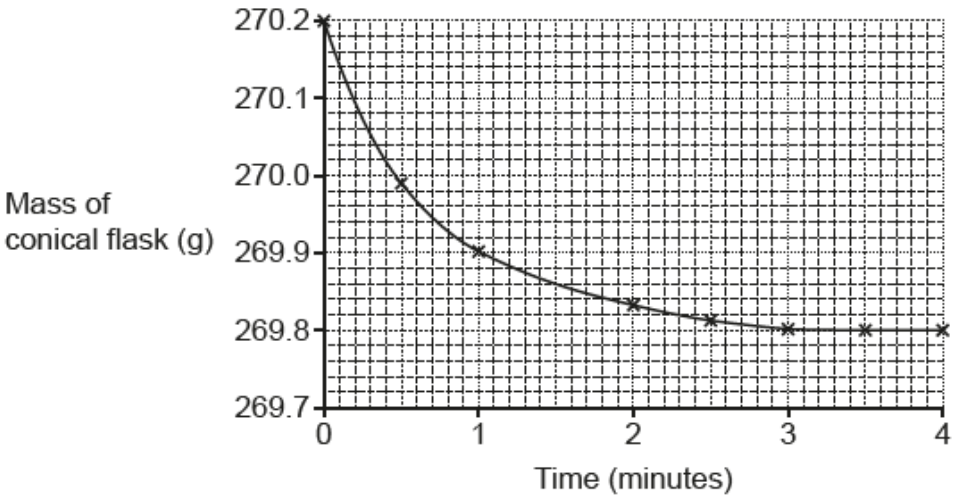
Relative formula mass = ... **[3]**

It appeared that a lot of candidates were not familiar with the data and equation sheet and attempted to recall numbers from memory. It was common to see the numbers 40 and 35 (the atomic masses of the most abundant isotopes of these elements) rather than the relative atomic masses, 40.1 and 35.5, that were given in the Periodic Table.

Many candidates made creative use of arithmetic to incorrectly find the relative formula mass, for example, squaring 35.5 or multiplying the numbers together rather than adding.

Question 5 (b) (i)

(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]**

Most candidates understood the idea of a gas being formed but very few realised the gas would leave the flask, and it is this that causes the reduction in mass, rather than just the idea that the gas is generated. Some candidates thought that the glass gets corroded by the acid or that the solid somehow disappears.

Question 5 (b) (ii)

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

Explain your answer.

Time = ... minutes

Explanation .....

.....

.....

.....

.....

[3]

Most candidates correctly identified 3 minutes as being the time at which all the calcium carbonate had reacted, and many went on to explain this by making reference to the graph. Around 1 in 5 candidates went further to describe the idea that the reaction must have stopped by this point.

Question 5 (c)

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

.....

.....

.....

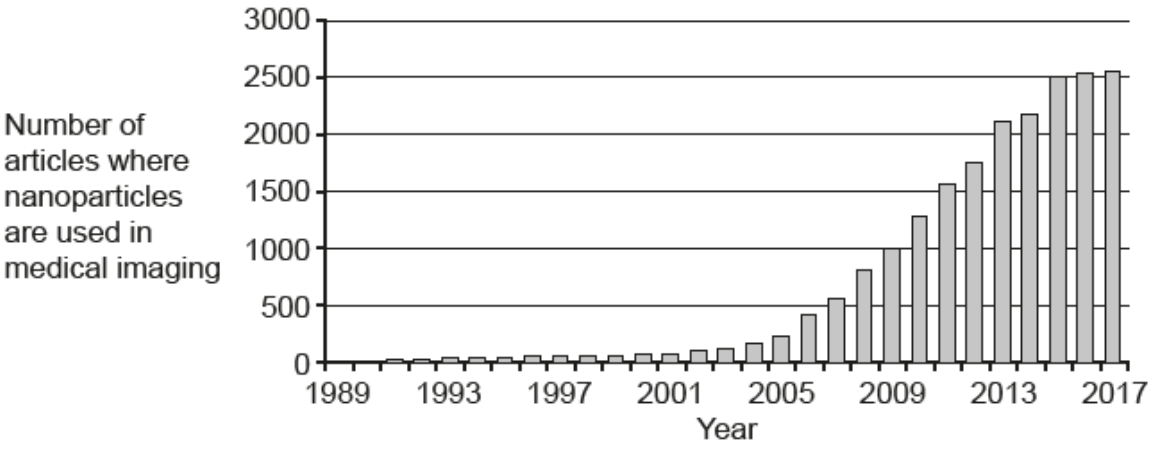
..... **[2]**

Some candidates suggested that Dev would need to stop the gas from leaving the flask and some suggested a method of doing this. Other candidates suggested weighing the flask before and after the experiment, thereby not realising that the gas would have escaped, and not proving that mass was conserved.

Question 6 (a)

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]**

Most candidates correctly identified the increasing pattern in the graph, and around about a quarter of candidates made some developed statement to give more detail about this, such as the levelling off from 2015 or the rapid increase from 2005.

Question 6 (b) (i)

(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]

Most candidates realised that it is not good scientific practice to have a sample size of one, and a large minority communicated the idea that something else might have caused the illness, for example a cold or food poisoning.

Question 6 (b) (ii)

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

.....

.....

.....

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

A large number of candidates realise that you would need to test more people or rule out common causes of illness. A significant minority of candidates suggested generic answers such as repeating the experiment.

Question 6 (c)

(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]**

Where candidates were given this mark, it was generally because they understood the idea of the greater good. The most common reason for candidates not being given the mark was for the idea of detecting cancer which was stated in the question.

Question 7 (a)

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?
	.....
	.....
	.....
	.....

[2]

A very large majority of candidates were given 2 marks in this question.

Question 7 (b)

(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

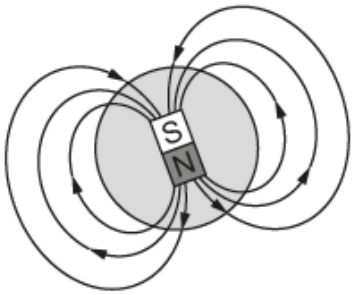
magnetic / geographic north pole. **[1]**

Approximately half of candidates chose both of the right options.

Question 7 (c)

(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. ☐

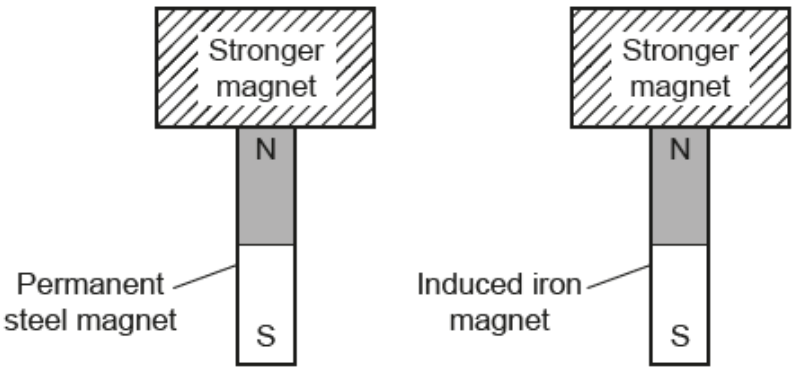
[1]

Most candidates correctly chose the first option.

Question 7 (d)

(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]**

This question was not well answered and has revealed a very misunderstood part of the specification.

Candidates' answers were mostly based around the (incorrect) idea that the magnets could fall off and attract or repel each other rather than about the idea of permanent and temporary magnets.

Question 7 (e)

(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.

.....

.....

.....

.....

.....

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

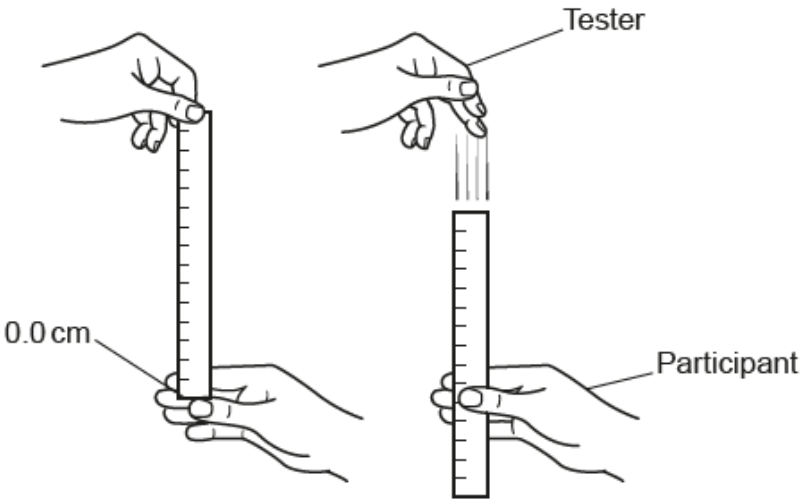
The majority of candidates were given 3 or 4 marks on this question.

Where full marks were not given, it was usually because the candidate had written that D had fifty turns rather than a high number of turns and had not recognised that C also has fifty turns. Examiners were looking for a descriptive answer here rather than just quoting numbers from the table.

Correct references to high current and the presence of the iron core were very commonly awarded marks.

Question 8 (a) (i)

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]

The majority of candidates were given 2 marks for correctly arranging all the stages in the right order.

Question 8 (a) (ii)

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

Improvement 1 .....

.....

Improvement 2 .....

.....

[2]

A lot of candidates wrote down generic answers about repeating and finding an average rather than relating their experiences to the situation given in the question.

The most common correct answers were about placement of the ruler or ensuring that the hand was kept stable.

Question 8 (b)

(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]**

Many candidates found it hard to explain why the fourth result would be significantly different from the others. Many correctly stated that the reaction time was longer but did not go further and explain a factor that might have caused this.

Question 8 (c)

(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]**

Examiners saw lots of creative use of the numbers from the table with a large number of candidates adding all the numbers from the reaction time column and then dividing by 11 to find an average rather than interpolating from the table. Answers of 0.11 and 0.12 were commonly given 1 mark.

Question 8 (d)

(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:

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

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]**

Many candidates were given all 3 marks for correctly calculating and rounding their answer to the three significant figures required by the question.

Some candidates wrote down the full number from their calculator display without rounding it and were given 2 marks.

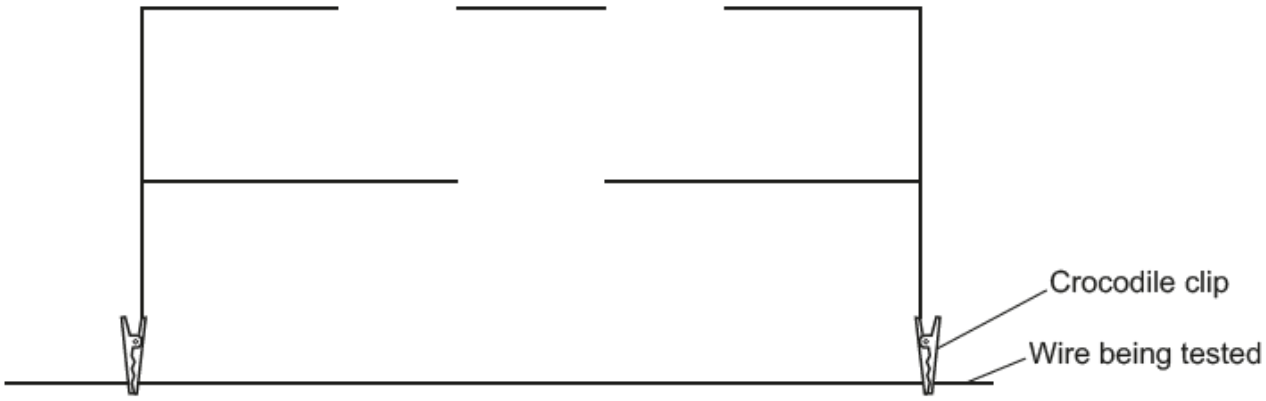
Others didn't seem familiar with the square root and tried to square root only one of the numbers, rather than all of the numbers inside it.

Question 9 (a)

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.

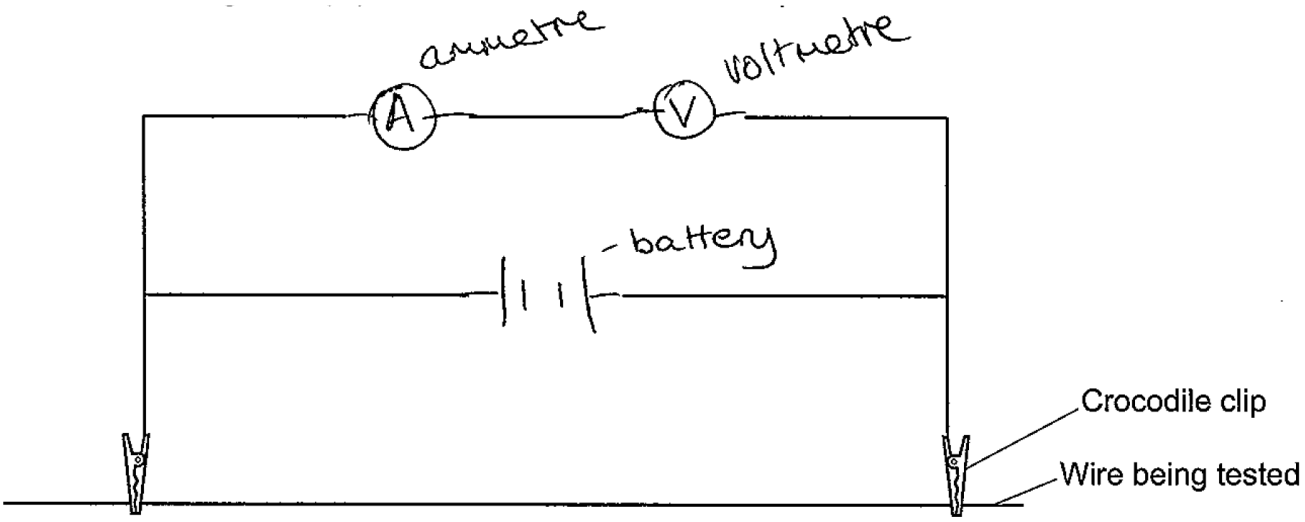


[1]

Misconception

Common incorrect answers here involved not using the correct symbol for a cell and putting the ammeter and voltmeter in the wrong places.

Exemplar 3



This exemplar illustrates a very common incorrect response.

The candidate has attempted to use the three gaps in the circuit but has not thought through carefully how the meters should be arranged.

While the voltmeter is connected in parallel with the battery, the placement of the ammeter is wrong.

The question specifically asked for a cell and the candidate here has drawn a battery. In this particular question it was necessary to draw a cell.

Question 9 (b)

(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 x resistance

Resistance = ... Ω **[2]**

Roughly half of candidates got the final correct answer. The other half either multiplied the numbers together or did the division upside down.

Question 9 (c)

(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]**

Many candidates said that they would change the length of the wire and see the effect that this had on resistance. Other candidates gave answers that were a little bit too vague such as adding more wire(s) which could have meant using more than one rather than one longer wire.

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