Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/08 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 8 series overview

Paper 8 is the final Higher tier paper for 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.

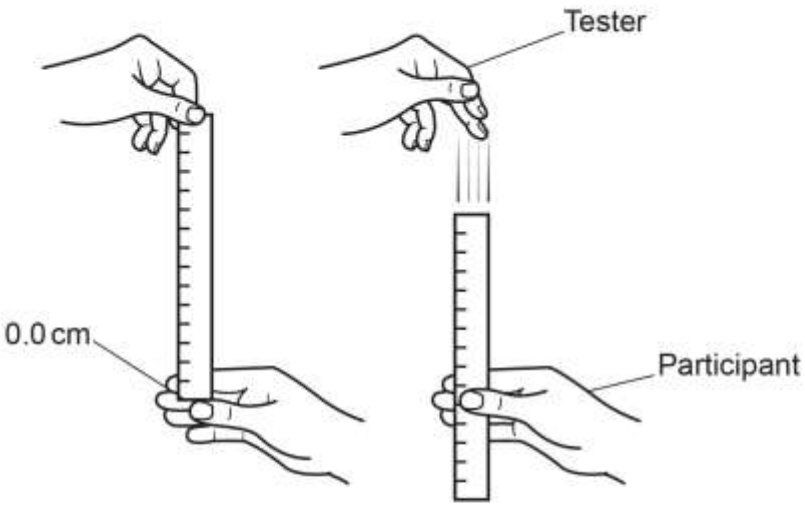
In this year's paper, Questions 1 and 2 were the questions that were common to the Foundation tier paper.

Candidates find this paper more challenging due to the synoptic nature. The ability of a candidate to articulate their responses and the use of technical language is regularly tested. Candidates performed well in the calculations. Candidates found ideas of 'How Science Works' the most challenging. While many seemed to have carried out practical work, there wasn't an understanding of the disciplinary knowledge one might expect from Higher tier candidates. However, it was particularly pleasing to see most candidates engaging well with the extended writing question. Many candidates gave excellent reasoning for their choice of bag the supermarket should buy. Describing the trends in data and relating that to the context of the question is perhaps an area of development. Many candidates gave superficial responses that did not consider the spread of the data, or outliers, and what this meant to the trends of the data. Centres could perhaps use the graphs in Question 4 to teach ideas of fluctuation in data versus overall trends, and the general patterns of scatter, including what data might be classed as an outlier, to allow candidates the opportunity to develop a better understanding in future series.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• calculations of a variety of quantities including resistance, energy and percentage • evaluation of scientific ideas to make judgements • describing trends in data.	• drawing graphs • drawing diagrams, e.g. circuit diagrams and magnetic field line representations • the use of some technical language • explaining trends of data in graphs including spread of data, outliers and fluctuation and linking these to the context of the question.

Question 1 (a) (i)

1 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]

Almost all candidates could give the correct order of statements for the method to work.

Question 1 (a) (ii)

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

Improvement 1 .....

.....

Improvement 2 .....

.....

[2]

Approximately half the candidates scored at least one mark. From a variety of responses that could score the mark, the most common discussed the stability of the hand or dropping the ruler from the same height.

Question 1 (b)

(b) The experiment is repeated three times. **Table 1.1** shows the results.

Table 1.1

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]**

Just over half the candidates could identify a reason why the value was greater than the others. There was confusion over the ruler being higher or lower in the hand leading to the value being greater. Some candidates found it difficult to articulate their ideas, perhaps suggesting they had not carried out or seen the practical during lessons.

Question 1 (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 1.2**.

Table 1.2

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 1.2** to estimate their reaction time.

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

This question required a conversion of 6.7 cm into 67 mm, then for candidates to look to the table to estimate the value between 0.11 and 0.12. A number of candidates gave a response of exactly 0.11 or 0.12 suggesting they had not fully engaged with the data.

Question 1 (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]**

The majority of candidates scored all 3 marks here. They could correctly put the data into the equation and process it to give a response to 3 significant figures. Where candidates did not score full marks, they often omitted the ×2 in the calculation or omitted the square root.

Question 2 (a)

2 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]

This is an area for development. Very few candidates drew the voltmeter appropriately (in parallel with the wire being tested, and not in series with the cell or ammeter) , and circuit symbols for a cell were often drawn as a battery or even a resistor.

Question 2 (b)

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

Calculate the resistance of the wire.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[2]**

Almost all candidates could correctly process the data using the equation given.

Question 2 (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.

.....

.....

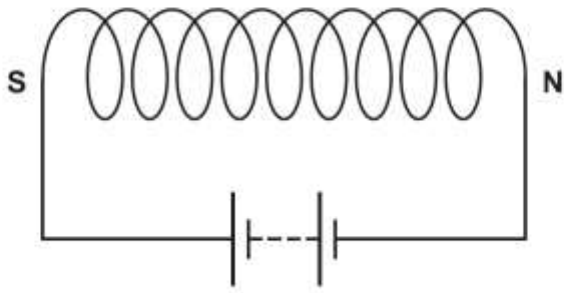
.....

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

Most candidates could identify the need to increase the length of the wire, but fewer could articulate the need to take new readings of current and potential difference to calculate a new value for resistance and then compare this to the previous reading.

Question 3 (a)

3 Kofi is investigating a solenoid, using the circuit shown. The north and south poles of the solenoid are labelled **N** and **S**.



(a) Kofi places a plotting compass near the solenoid.

How will the plotting compass show that there is a magnetic field around the solenoid?

.....

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

Candidates generally scored this mark.

Question 3 (b)

(b) Draw the magnetic field around the solenoid. **[2]**

There was an expectation that candidates could draw at least one line above and below the solenoid to represent the magnetic field. Where candidates did not score, they drew lines around the whole circuit rather than just the solenoid or did not show lines converging at the poles. Candidates generally could represent the direction of the magnetic field with arrows pointing from North to South, however several candidates had contradictory arrows meaning this mark could not be given.

Question 3 (c)

(c) Kofi places some paperclips near the solenoid. The paperclips experience a magnetic force, which is caused by the magnetic field around the solenoid.

Give **three** ways in which Kofi can increase the effect of the magnetic field on the paperclips.

1 .....

2 .....

3 .....

[3]

Most candidates could give at least one correct response. The most common being for adding an iron core, moving paper clips closer or increasing the current.

Technical language

Candidates talked about adding more 'coils' of wire rather than adding more 'turns' of wire. There is a big difference between adding more turns to the existing wire to increase the strength of the solenoid and adding coils, which might imply the addition of more solenoids. Centres should help candidates to develop their technical language so they can express their ideas clearly.

Question 3 (d)

(d) 57 C of charge flows through the solenoid in 30 seconds.

Calculate the current flowing through the solenoid.

Use the equation: charge = current × time

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

Almost all candidates could calculate the current correctly using the equation given.

Question 3 (e)

(e) The potential difference across the solenoid is 0.95 V.

Calculate the work done when 57 C of charge flows through the solenoid.

Use the equation: potential difference = $\frac{\text{work done}}{\text{charge}}$

Work done = ... J **[2]**

Almost all candidates could correctly calculate the work done by using the equation given.

Question 4 (a)

4 Nina is studying potable (clean drinking) water.

(a) Two sources of potable water are waste water and sea water.

Identify one **other** source of potable water.

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

A wide variety of responses were seen here, depicting different sections of the water cycle where potable water might be found such as mountains, streams, rivers, lakes, aquifers, etc.

Question 4 (b) (i)

(b) The diagram shows the stages in the treatment of waste water.

(i) Describe the function of the 'aeration' and 'bacteria added' stages.

.....

.....

.....

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

Very few candidates scored marks in this question. There was little to no acknowledgement that 'aeration' is the addition of oxygen. Even fewer candidates could explain that bacteria are added to break down organic matter. Most incorrect responses focused on the bacteria being added to kill other harmful bacteria in the water supply.

Question 4 (b) (ii)

(ii) What is the function of the filtration and settlement stages?

.....

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

Approximately half the responses were given a mark for explaining that solid insoluble waste could be removed by these two processes. Incorrect responses were often vague and discussed removing salts or impurities without the idea of these being solids.

Question 4 (c)

(c) Describe **one** way in which potable water can be obtained from sea water.

.....

.....

.....

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

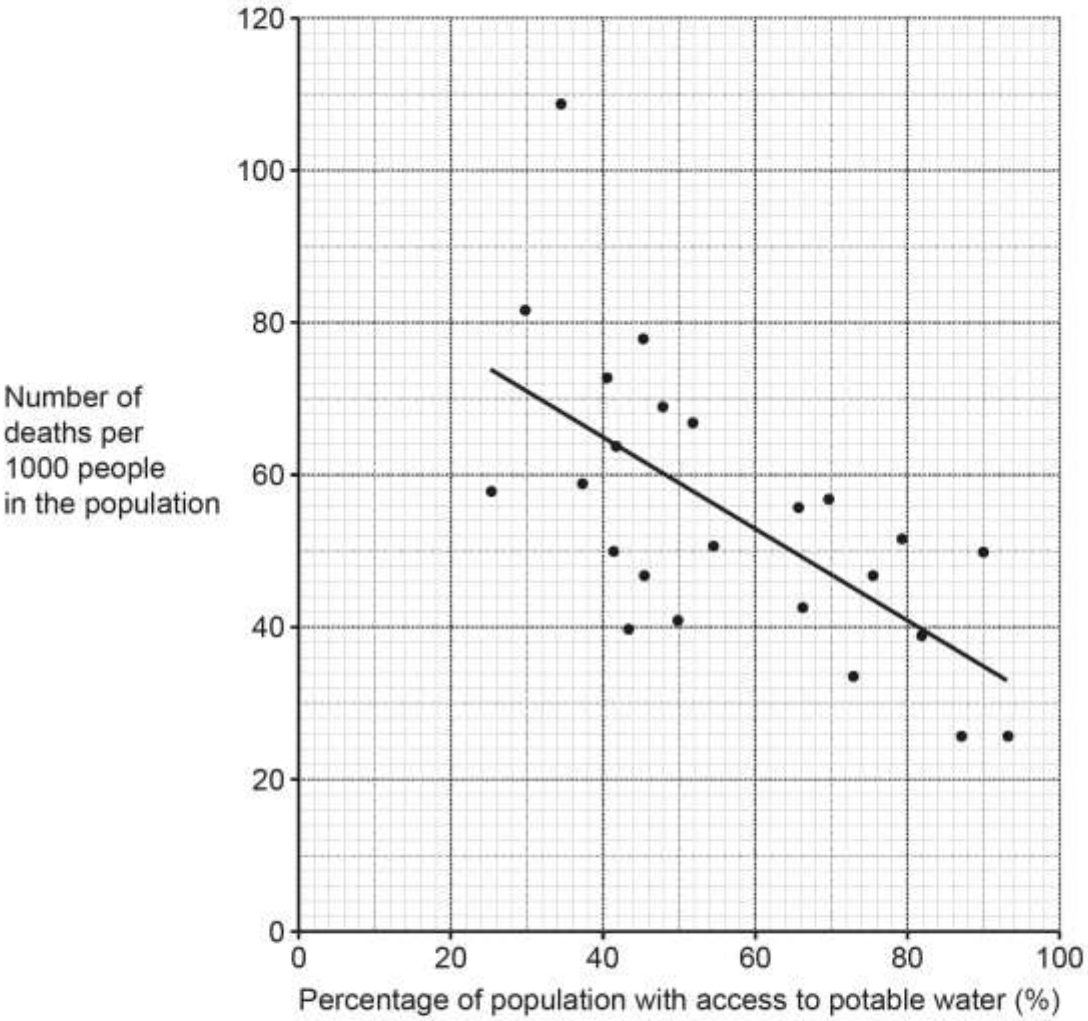
The first concept here was that sea water contains salt. Those candidates who realised this could then discuss how that salt was removed from the water. The second concept was how the water and the salt could be separated. Many candidates discussed filtration rather than membrane filtration, osmosis rather than reverse osmosis or boiling, without condensing to retrieve the water. Some candidates discussed collecting the salt, rather than collecting the water.

Question 4 (d)

(d) Nina finds a graph (**Fig. 4.1**) that 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



Nina forms a hypothesis about **Fig. 4.1**:

"The higher the percentage of the population that drink potable water, the lower the death rate."

Evaluate the quality of Nina's hypothesis.

.....

.....

.....

.....

.....

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

The majority of candidates scored 1 mark for identifying the trend in the data. Fewer candidates could accurately describe the scatter of the data or identify the outlier at 109 deaths per 1000 people in the population. Only a small number of candidates discussed a causal mechanism or link between the potable water being available to drink and the number of deaths. Even fewer candidates addressed the command word 'evaluate' and discussed the validity of the study through the sample size, accuracy of reporting of the data from each country, or other factors that might affect the death rate in a particular country.

The number of marks available in this question should point the candidates to the amount of clear points to be made. A significant number of candidates simply made one or two clear points and so limited the marks available to them.

Centres could use this question to model how to discuss the wider implications of the data. There is a need for candidates to demonstrate greater depth of understanding of how the data is collected, processed, and presented when articulating their responses. Candidates need to dig deep into the data, rather than give superficial responses with simple trends in the data in future series.

Question 4 (e)

(e) Chlorine is added to water in some parts of the world because it kills microorganisms in the water.

Suggest why scientists in a developing country may have different opinions **for** and **against** using chlorinated water.

For .....

.....

.....

.....

Against .....

.....

.....

.....

[4]

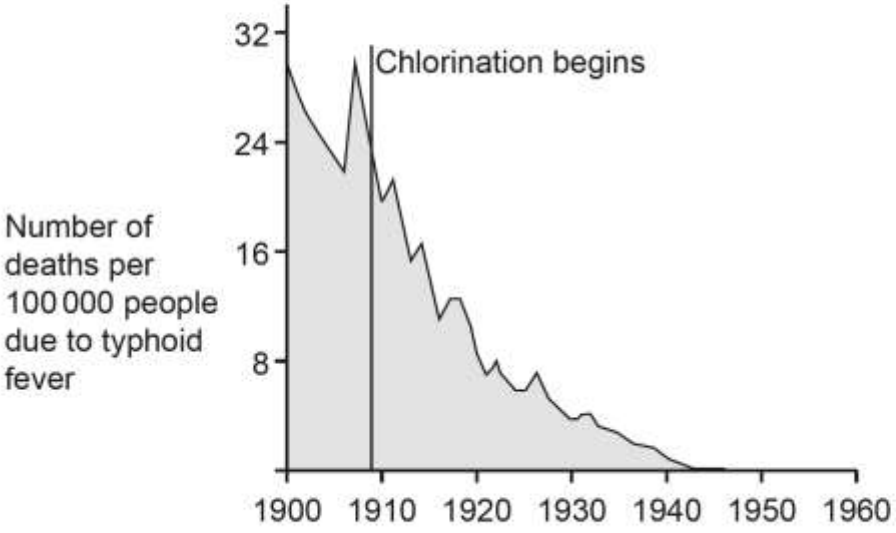
Many candidates repeated the stem of the question, quoting chlorine kills microorganisms in water, without adding anything new. Candidates most commonly scored 2 of the 4 marks available for identifying that chlorine makes water safer to drink but can be expensive or difficult to distribute in some countries. Very few candidates actually gave four clear points to be considered for marking.

Question 4 (f)

(f) **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



Explain what conclusions you can make from **Fig. 4.2** about the effectiveness of chlorination of water.

.....

.....

.....

.....

.....

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

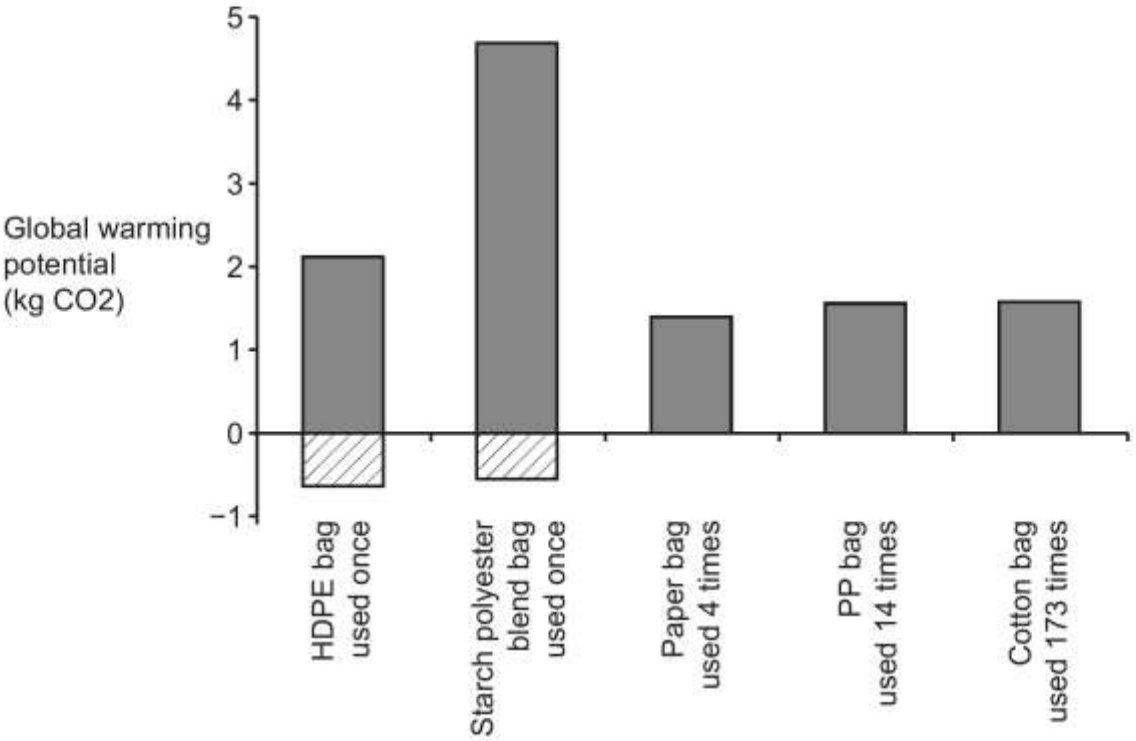
The majority of candidates scored 2 marks for describing the trend in the data after chlorination began. Very few candidates could add the depth of understanding needed to score 3 marks. Discussion of the fluctuation in the data or other reasons for the reductions in deaths, such as vaccinations or developments of treatments were very rarely seen.

Question 5 (a)*

5 (a)* A supermarket wants to buy new shopping bags for their customers. They look at some data comparing the global warming potential (GWP) of different bags.

GWP is a measure that tells us the amount of greenhouse gas emissions that each bag produces over its lifetime.

The striped bar indicates that materials are recycled or reused during that bag's production, which reduces the overall GWP of that bag.



The table shows the cost of each type of bag to the customer.

Bag Type	HDPE plastic bag	Starch polyester blend bag	Paper bag	Polypropylene plastic (PP) bag	Cotton bag
Cost of bag to consumer	10p	10p	30p	55p	£1.50

Explain which bag the supermarket should buy.

In your answer you should explain why you have **not** chosen the other bags.

.....

.....

.....

.....

.....

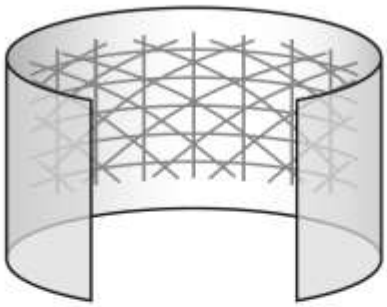
..... **[6]**

Most candidates gave well-reasoned arguments and evaluated their ideas of global warming potential, number of uses and cost of the bag very well, being credited with Level 2 or Level 3. A significant number of candidates scored 5 or 6 marks. This was pleasing to see, as candidates had clearly engaged with the data and the context of the question.

Question 5 (b)

(b) Some plastic bottles are made from polyester. The polyester bottles are strong, hard and flexible.

The polymer chains in the polyester bottles are shown in the diagram.



Polymer chains
in three directions

Draw lines to connect each **feature of polyester** with the **property** it results in.

Feature of polyester	Property
Polymer chains are held by many intermolecular forces.	Hardness
Polymer chains are long and can move past each other.	Strength
Polymer chains crossing in 3 directions gives resistance to scratching.	Flexibility

[2]

Almost all candidates scored 2 marks here. Where only one mark was scored, the candidates could identify why polymer chains are flexible.

Question 6 (a)

6 Some students are investigating osmosis in pieces of potato. The table shows their results.

Concentration of sugar solution (mol/dm^3)	Initial mass of the potato (g)	Final mass of the potato (g)	Percentage change in mass (%)
0.0	1.08	1.25	15.7
0.2	1.09	1.13	3.5
0.4	1.17	1.03	–12.0
0.6	1.12	0.85	–24.1
0.8	1.08	0.75	–30.1

(a) Describe the method the students use to obtain these results.

.....

.....

.....

.....

.....

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

Very few candidates were given full marks for this question. Most candidates scored only 1 or 2 marks of the 4 marks available.

In this question, candidates were asked to recall the practical procedure that would have been used to obtain the data provided. Very few candidates were able to describe the method that would be used in the appropriate amount of detail. The most common mark point given was for identifying that the students would need to find the initial mass of the piece of potato before putting it into the solution. Candidates often described cutting potato into slices but did not qualify this by indicating the importance of the shape. Those who did do this well referred to the use of a cork borer, indicating that they had indeed conducted this investigation.

Many candidates did explain that pieces of potato would need to be put into the different solutions, but they did not explain that the potato pieces would need to be left in the solution for the same amount of time, nor that (ideally) they would be removed when equilibrium had been reached. Many candidates could explain that the potato would then be removed from the solution, and the final mass found. However, few candidates mentioned the need to remove the excess solution before finding the mass.

Some candidates thought the question was asking how percentage change could be calculated and focused their answer on this.

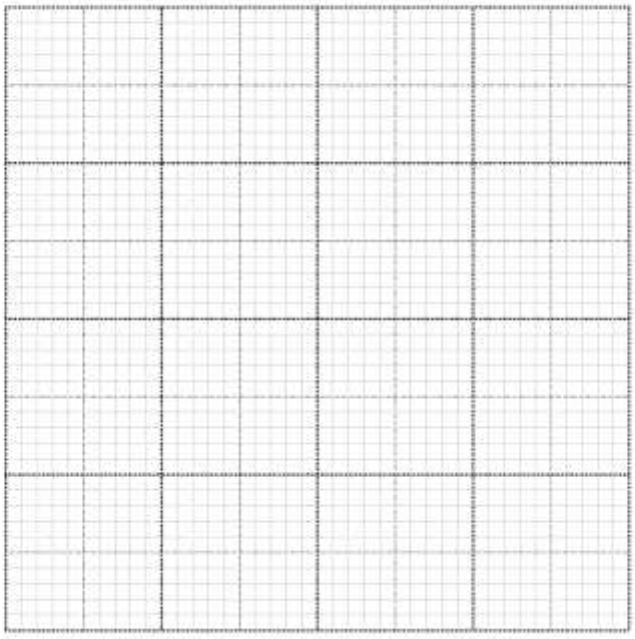
Assessment for learning

Centres could help candidates by highlighting disciplinary knowledge when doing practical work. For example, teachers can ask why a step in the procedure is important, perhaps considering the impact on the final value/result if that step were missed out. Questions like this can help in the development of a more thorough understanding of the method.

Question 6 (b) (i)

(b) (i) Plot the students' results on the grid **and** draw a line of best fit.

Use the concentration of sugar solution and percentage change in mass data.



[4]

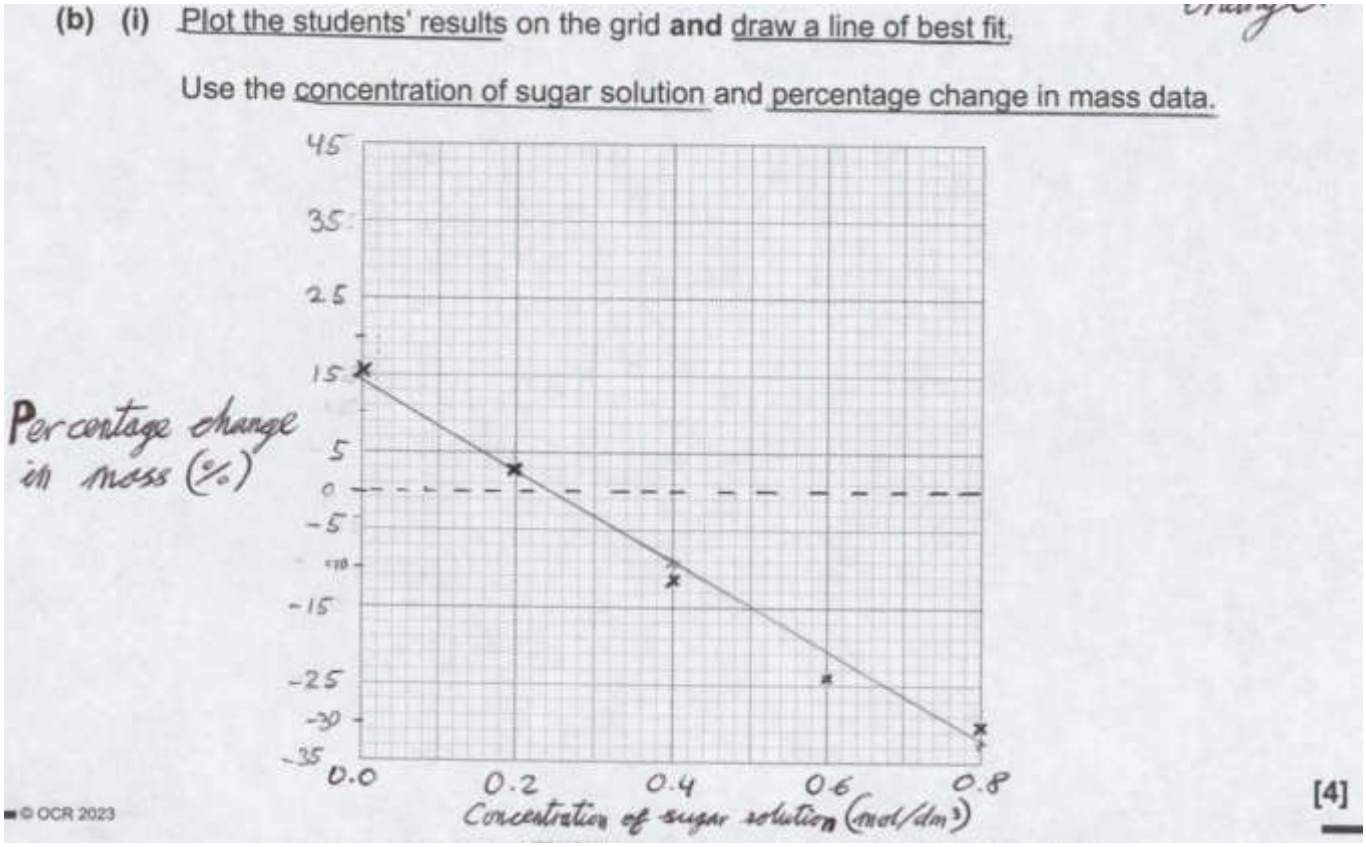
Most candidates scored only 1 or 2 marks in this question.

This was a challenging graph for candidates to construct, one which tested their understanding of linear scales. Many candidates did not appreciate that the x axis should intersect the y axis at 0.00.

The most common errors included incorrect positioning of the x-axis, nonlinear or inaccurate scales and a failure to accurately label the axes (including a lack of units). The correct plotting of points and correct lines of best fit were the most commonly credited marks.

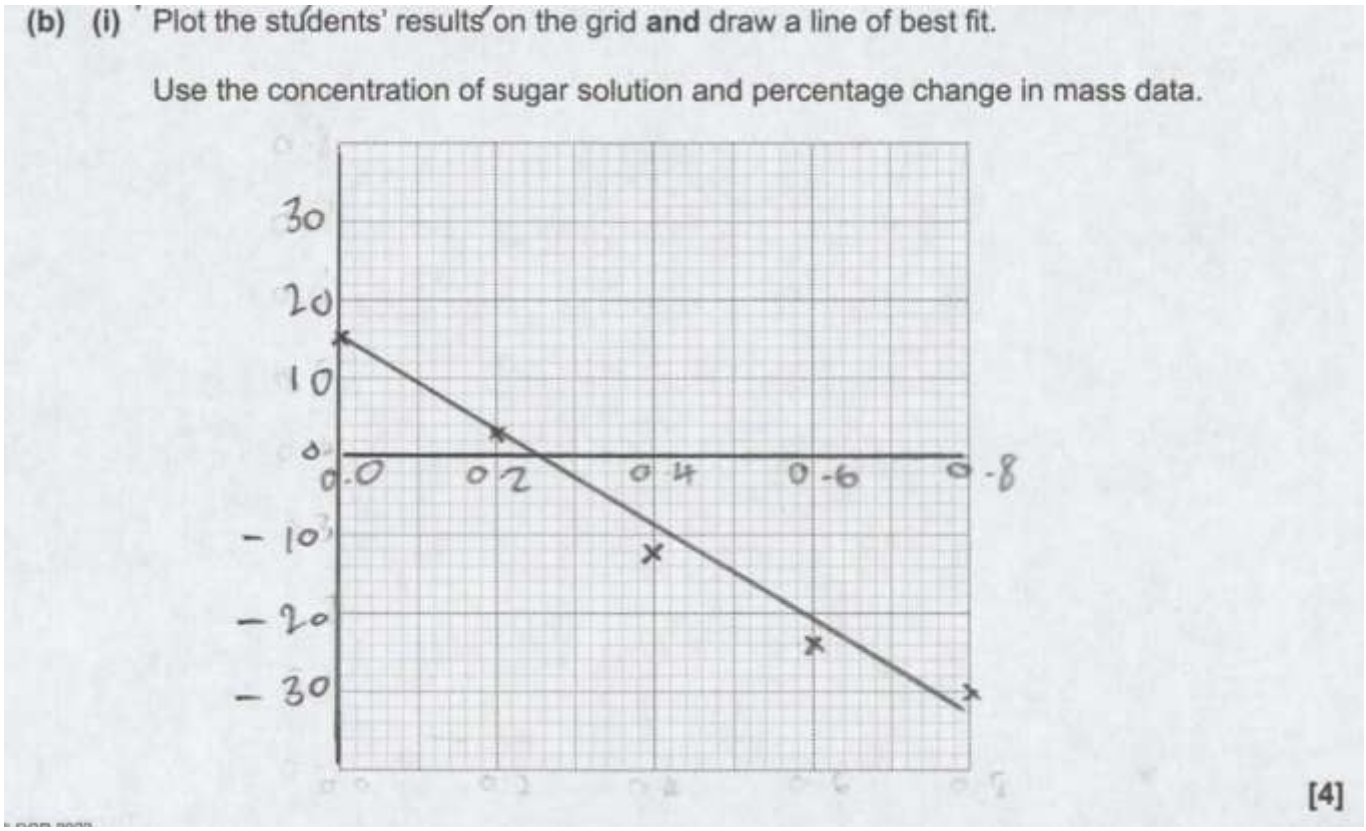
Centres should be reminded that candidates should only draw lines of best fits through the points plotted, rather than extrapolating their lines beyond the final point, unless they are asked to do so.

Exemplar 1



This is a fully correct response with the x-axis drawn at 0 on the y-axis (even though it is a dotted line, this is acceptable). Both the x-axis and y-axis are linear scales, and they are correctly labelled. The points are plotted correctly, and a suitable line of best fit has been drawn. This scores all 4 marks.

Exemplar 2

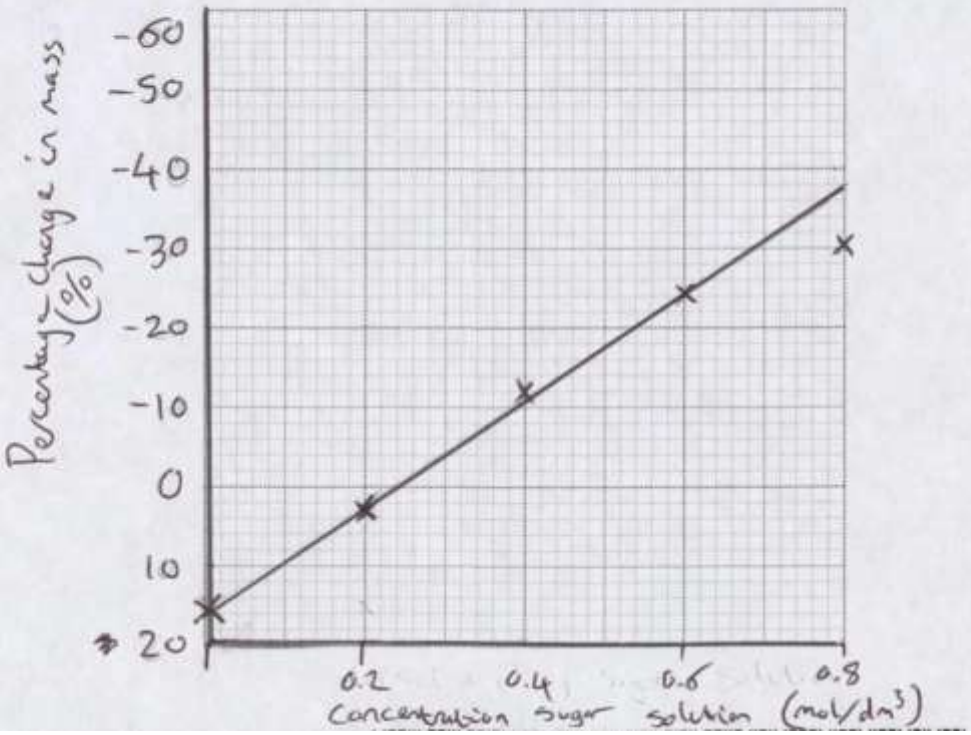


This exemplar shows a clearly positioned x-axis, but neither axis is labelled. Points are plotted correctly, and a suitable line of best fit has been drawn. This scores 3 marks.

Exemplar 3

(b) (i) Plot the students' results on the grid **and** draw a line of best fit.

Use the concentration of sugar solution and percentage change in mass data.



OCR 2023

[4]

This graph has the y-axis inverted with positive values at the bottom and negative values at the top, showing a lack of understanding of how axes are used to display data. The x-axis is drawn at the bottom rather than at 0 on the y axis. Despite the errors with the axes, the points were accurately plotted, and a suitable line of best fit was drawn so 2 marks were given.

Question 6 (b) (ii)

(ii) The student concludes that the concentration of the potato cells is $0.2\,mol/dm^3$.

Explain why the student is **wrong**.

Use ideas about osmosis in your answer.

.....

.....

.....

.....

.....

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

Very few candidates scored a mark in this question.

Very few candidates appeared to have completed an osmosis practical with the intention of estimating the concentration of the sugar in the potato cells, and they found this part very difficult.

Many candidates simply discussed the principles of osmosis, correctly indicating that water moves from an area of high water potential to low water potential. They had not appreciated that, when the solution and the cell were at the same concentration, there would be no net movement of water, and that this would be reflected in the percentage change in mass, which would be 0. Candidates who did score here often correctly stated that if the two were the same concentration, the potato piece should not gain mass.

Question 6 (b) (iii)

(iii) Describe **two** ways in which the student can determine a more accurate value for the concentration of the potato cells.

1 .....

.....

2 .....

.....

[2]

Very few candidates scored here. Candidates mainly focused their answers on conducting repeats or on ways in which they could control variables. Very few had an appreciation of how to find a more accurate estimation of the concentration of the cells. Centres should be encouraged to use this type of data and investigation to develop a deeper understanding of candidate's knowledge of scientific methods.

Question 6 (c)

(c) The student puts another piece of potato into a sugar solution of 0.4 mol / dm^3.

The initial mass of the potato is 1.04 g.
The final mass of the potato is 0.90 g.

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

Give your answer to **2** decimal places.

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

Most candidates scored all 3 marks for correctly calculating the percentage change. Where candidates scored only 1 or 2 marks, they often missed the subtraction of 0.9 from 1.04 or missed the division by 1.04.

There were some errors in quoting a value to 2 decimal places. Some candidates interpreted the question as needing 2 significant figures rather than 2 decimal places and quoted 13 rather than 13.46. Some candidates incorrectly rounded to 14 despite being very successful in rounding earlier in the paper.

Question 6 (d)

(d) Plants take in carbon dioxide and water for photosynthesis.

Describe how the carbon dioxide needed for photosynthesis enters the plant.

.....

.....

.....

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

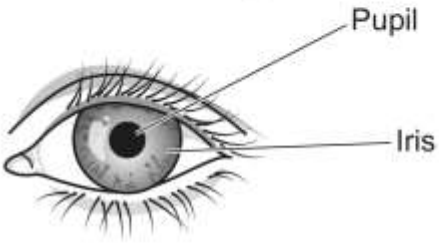
Most candidates scored 1 or 2 marks for this question. Where only 1 mark was scored it was generally for identifying the stomata. The lack of technical language was evident when candidates referred to holes and pores, rather than using the correct keyword. Very few candidates discussed diffusion as the process by which the carbon dioxide entered the leaf.

Question 7 (a)

7 Some students are studying the pupil reflex. The amount of light entering the eye is controlled by this reflex.

The size of the pupil changes in response to light conditions. When it is dark, the pupil gets bigger, and when it's light, the pupil gets smaller.

The diagram shows the pupil and the iris of the eye. The iris controls the diameter of the pupil. When the iris is large, the pupil is small.



(a) Suggest a method the students can use to measure how long it takes for the pupil reflex response to take place.

.....

.....

.....

.....

.....

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

Most candidates scored at least 2 marks in this question. Candidates did not gain credit for the first marking point where they had not recognised the need for changing the light conditions. Very few candidates identified the need to measure the reflex when it had finished (when the pupil was at its smallest or largest). A pleasing number of candidates suggested using videos and slow motion to capture the image of the reflex and slow down the video to make it easier to take measurements; other good responses referred to using a simple timer or stopwatch.

Question 7 (b)

(b) **Fig. 7.1** and **Fig. 7.2** shows the diameter of the iris and the pupil before and after the reflex response.

Fig. 7.1 – Before reflex response

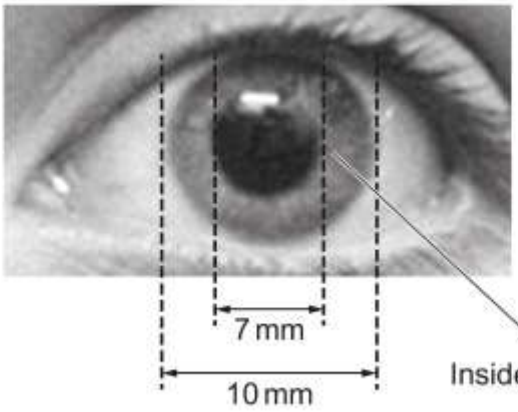
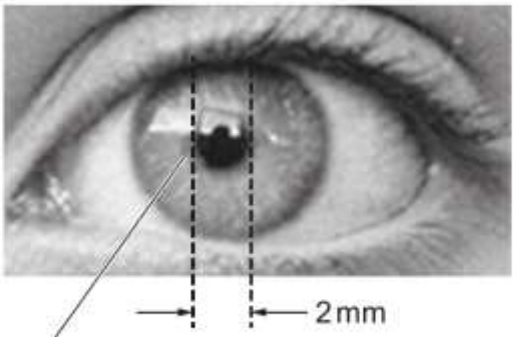


Fig. 7.2 – After reflex response



Calculate the average speed, in **m/s**. of the inside edge of the iris during the reflex response.

Use the equation: average speed = $\frac{\text{distance travelled}}{\text{time taken}}$

The time recorded for the reflex response was 0.25 s.

Average speed = ...m/s **[4]**

Most candidates scored 2 marks in this question. There were a number of power of ten errors; common conversion errors included dividing by 100 rather than by 1000.

Other common errors included missing the division by 2. The diagram shows the diameter of the iris rather than the radius, so the total distance travelled needed to be halved. This led to a number of candidates giving a final answer of 0.02 rather than 0.01.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

For the June 2023 series, Exams Officers will be able to download copies of your candidates' completed papers or 'scripts' for all of our General Qualifications including Entry Level, GCSE and AS/A Level. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals.

Find out more.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
ocr.org.uk/qualifications/resource-finder
ocr.org.uk
facebook.com/ocrexams
twitter.com/ocrexams
instagram.com/ocrexaminations
linkedin.com/company/ocr
youtube.com/ocrexams

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT