Cambridge Assessment International Education

Example Candidate Responses – Paper 6

Cambridge IGCSE™ / IGCSE (9–1)

Biology 0610 / 0970

For examination from 2021

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9–1) Biology 0610 / 0970, and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen from the June 2021 exam series to exemplify a range of answers.

For each question, the response is annotated with a clear explanation of where and why marks were awarded or omitted. This is followed by examiner comments on how the answer could have been improved. In this way, it is possible for you to understand what candidates have done to gain their marks and what they could do to improve their answers. There is also a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work with examiner commentary. These help teachers to assess the standard required to achieve marks beyond the guidance of the mark scheme. Therefore, in some circumstances, such as where exact answers are required, there will not be much comment.

The questions, mark schemes and inserts used here are available to download from the School Support Hub. These files are:

0610 June 2021 Question Paper 63

0610 June 2021 Mark Scheme 63

Past exam resources and other teaching and learning resources are available on the School Support Hub:

www.cambridgeinternational.org/support

How to use this booklet

This booklet goes through the paper one question at a time, showing you the high-, middle- and low-level response for each question. The candidate answers are set in a table. In the left-hand column are the candidate answers, and in the right-hand column are the Examiner comments.

Example Candidate Response – high, continued	Examiner comments
(iii) State a conclusion for the student's results. In Conclusion, the higher the percentage of concentration vitamin C the more drops we of DCPIP needed until the solution turns blue. 3 [1] (iv) Suggest why the student repeated the investigation. The reason why is it minimize error in the investigation. To make sure it was an accurate results drawn up. 4 [1] Step 7 The student put 0.5 cm^3 of health drink **H** into a clean test-tube. They then added drops of 1% DCPIP to the test-tube until the solution in the test-tube remained blue. ... using the ... % [1]	3 The candidate's conclusion includes both the percentage concentration of vitamin C and the number of drops of DCPIP and describes how they relate to each other. Mark for (a)(iii) = 1 out of 1 4 The candidate is awarded the mark, however they could include the fact that repeating the ... us

Answers are by real candidates in exam conditions. These show you the types of answers for each level. Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner comments are alongside the answers. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams so you can help your learners to refine their exam technique.

How the candidate could have improved their answer

- **(a)(iv)** The candidate stated that repeating a procedure 'makes it more accurate' or 'minimises errors'. They could have explained how repeating would make it more accurate. This could have included the identification and removal of anomalous results, or the identification of a need to take more measurements.

This section explains how the candidate could have improved each answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

Common mistakes candidates made in this question

- Some candidates' conclusions lacked detail or consisted of simple descriptions of the results. Both variables needed to be mentioned. A suitable format could be: 'As A increases, B decreases.' Stating individual data points was not sufficient, for example, 'when A = x, B = y' would be a description of the results and would not describe the trend.
- Candidates often confused the tests for biological molecules. Candidates needed to be able to recall the reagents and colour of a positive test result for the substances stated in the syllabus.

Often candidates were not awarded marks because they misread or misinterpreted the questions.

Lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes and give them the best chance of achieving the available marks.

Question 1

Example Candidate Response – high

1 Vitamin C is an important component of a balanced diet. Many health drinks contain vitamin C.

A student estimated the concentration of vitamin C in a health drink by comparing it to solutions with known concentrations of vitamin C.

DCPIP is an indicator for vitamin C. When added to a vitamin C solution, the blue DCPIP reacts with vitamin C and becomes colourless. Drops of DCPIP are added to the vitamin C solution until the solution remains blue.

Step 1 The student labelled four beakers **A**, **B**, **C** and **D** and used the information in Table 1.1 to make the vitamin C solutions in the four labelled beakers.

Table 1.1

beaker	volume of 1.00% vitamin C solution / cm^3	volume of water / cm^3	final percentage concentration of vitamin C
A	10	30	0.25
B	20	20	0.50
C	30	10	0.75
D	40	0	1.00

(a) (i) Complete Table 1.1 by calculating the final percentage concentration of vitamin C in beaker **C**.

1

0.50 + 0.25 = 0.75

0.75 % [1]

Step 2 A syringe was used to transfer 0.5 cm^3 of the vitamin C solution from beaker **A** into a test-tube labelled **A**.

Step 3 The student filled a dropping pipette with a **1% DCPIP** solution and added one drop at a time to test-tube **A**. The blue colour disappeared as vitamin C reacted with the DCPIP.

The number of drops was counted as they were added to the test-tube.

Step 4 The student stopped adding drops of DCPIP to test-tube **A** when the solution remained blue in colour when a drop was added. The total number of drops of DCPIP added was recorded.

Step 5 The student then repeated steps 2 to 4 using the solutions from beakers **B**, **C** and **D** and test-tubes labelled **B**, **C** and **D**.

Step 6 The student then repeated steps 2 to 5 to obtain a second set of results.

Examiner comments

1 The candidate gives the correct concentration and is awarded the mark.

Mark for (a)(i) = 1 out of 1

Example Candidate Response – high, continued

The student's results are shown in Fig. 1.1.

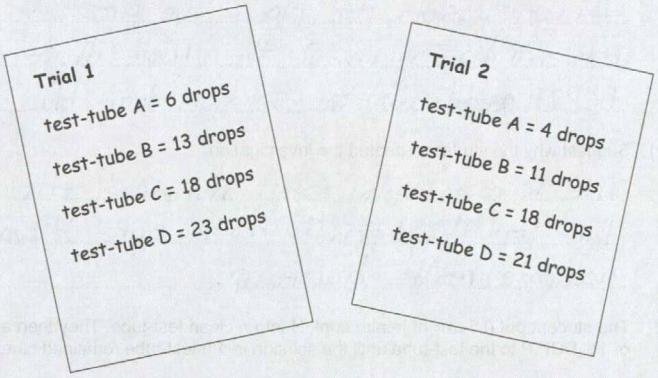


Fig. 1.1

(ii) Prepare a table to record the results shown in Fig. 1.1.

Your table should include the average of the two trials.

beaker	percentage concentration of vitamin C	Total Number of drops of DCPIP added until blue		
		Trial 1	Trial 2	Average
A	0.25	6	4	5
B	0.50	13	11	12
C	0.75	18	18	18
D	1.00	23	21	22

[5]

2

Examiner comments

2 The candidate draws a well-constructed table and includes both the beaker label and the concentration of vitamin C, although either one would have been sufficient for the mark. They show both trials for each concentration and calculate an average and are awarded full marks.

Mark for (a)(ii) = 5 out of 5

Example Candidate Response – high, continued

(iii) State a conclusion for the student's results.

In Conclusion, the higher the percentage of concentration vitamin C the more drops ~~he~~ of DCPIP needed until the solution turns blue. 3 [1]

(iv) Suggest why the student repeated the investigation.

The reason why is it minimize error in the investigation. To make sure it was an accurate results drawn up. 4 [1]

Step 7 The student put 0.5 cm^3 of health drink **H** into a clean test-tube. They then added drops of 1% DCPIP to the test-tube until the solution in the test-tube remained blue.

A total of **10 drops** of DCPIP were added to the sample of health drink **H**.

(v) Estimate the percentage concentration of vitamin C in health drink **H**, using the information in Table 1.1, your table in **1(a)(ii)** and step 7.

0.5 5 % [1]

(vi) Suggest **two** improvements to the method that would allow a more precise estimation of the vitamin C concentration in health drink **H**.

1 The syring was not exchanged after every use, so they could change the syring for each beaker to not mix the solutions

2 They should ensure that the drops are of the same size. 6 They could have a control variable with only distilled water or Vitamin C, solution. [2]

(vii) Identify **two** variables that were kept constant in this investigation.

1 Same volume of vitamin C solution transfured to each test tube

2 Same percentage concentration of DCPIP 7 [2]

Examiner comments

3 The candidate's conclusion includes both the percentage concentration of vitamin C and the number of drops of DCPIP and describes how they relate to each other.

Mark for (a)(iii) = 1 out of 1

4 The candidate is awarded the mark, however they could include the fact that repeating the investigation would allow anomalous results to be identified.

Mark for (a)(iv) = 1 out of 1

5 The candidate states an acceptable concentration and is awarded the mark. However a value between 0.25% and 0.5%, rather than exactly 0.5%, would have been better.

Mark for (a)(v) = 1 out of 1

6 The candidate identifies that drop size affects precision, and is awarded a mark. They could mention a method for controlling drop size or refer to measuring volume too.

Mark for (a)(vi) = 1 out of 2

7 The candidate correctly identifies both the volume of vitamin C solution and the concentration of DCPIP as controlled variables.

Mark for (a)(vii) = 2 out of 2

Example Candidate Response – high, continued	Examiner comments
(b) Explain why counting the number of drops of DCPIP is not accurate. This could not be accurate because the drops may not have been the same size 8 / Amounts No one was measuring how large or small the drops were. [1] **(c)** The manufacturers of health drink **H** claim that it also contains protein and glucose. Describe how you would test health drink **H** for protein and glucose. Include the results for a positive test. protein To test for protein you would put the drink H into a testtube and add a few drops of biuret solution. If the color changes from blue – purple protein is present. 9 glucose To test for glucose you would put the drink H into a testtube and add a few drops of benedicts reagents to it. Right after you'd would put the testtube into a hotwater bath for a few sec to a minute. If it changes from blue to brick-red glucose is present.	8 The candidate recognises that drop size may vary and therefore counting the number of drops is an inaccurate method. Mark for (b) = 1 out of 1 9 The candidate describes the correct test reagents, methods and colours so is awarded full marks. Mark for (c) = 5 out of 5 **Total mark awarded = 18 out of 19**

How the candidate could have improved their answer

- **(a)(iv)** The candidate stated that repeating a procedure 'makes it more accurate' or 'minimises errors'. They could have explained how repeating would make it more accurate. This could have included the identification and removal of anomalous results, or taking more measurements.
- **(a)(vi)** When improvements are asked for, human error or avoidable errors such as contamination are not accepted. The procedure needed to be carried out in such a way as to make such errors avoidable.
- **(a)(vi)** The candidate referred to a 'control variable'. This indicated confusion between an experimental control (used to justify the validity of the hypothesis) and controlled variables (the variables that need to be kept constant). The candidate needed to use the appropriate scientific terminology carefully and in the correct context.
- **(c)** The candidate described a colour change as 'from blue – purple', but they needed to write this out in full 'from blue to purple' rather than use a symbol. The candidate was awarded the mark but a fuller description would have been clearer.

Example Candidate Response – middle

1 Vitamin C is an important component of a balanced diet. Many health drinks contain vitamin C.

A student estimated the concentration of vitamin C in a health drink by comparing it to solutions with known concentrations of vitamin C.

DCPIP is an indicator for vitamin C. When added to a vitamin C solution, the blue DCPIP reacts with vitamin C and becomes colourless. Drops of DCPIP are added to the vitamin C solution until the solution remains blue.

Step 1 The student labelled four beakers **A**, **B**, **C** and **D** and used the information in Table 1.1 to make the vitamin C solutions in the four labelled beakers.

Table 1.1

beaker	volume of 1.00% vitamin C solution / cm^3	volume of water / cm^3	final percentage concentration of vitamin C
A	10	30	0.25
B	20	20	0.50
C	30	10	0.75
D	40	0	1.00

(a) (i) Complete Table 1.1 by calculating the final percentage concentration of vitamin C in beaker **C**.

1

0.75 % [1]

Step 2 A syringe was used to transfer 0.5 cm^3 of the vitamin C solution from beaker **A** into a test-tube labelled **A**.

Step 3 The student filled a dropping pipette with a **1% DCPIP** solution and added one drop at a time to test-tube **A**. The blue colour disappeared as vitamin C reacted with the DCPIP.

The number of drops was counted as they were added to the test-tube.

Step 4 The student stopped adding drops of DCPIP to test-tube **A** when the solution remained blue in colour when a drop was added. The total number of drops of DCPIP added was recorded.

Step 5 The student then repeated steps 2 to 4 using the solutions from beakers **B**, **C** and **D** and test-tubes labelled **B**, **C** and **D**.

Step 6 The student then repeated steps 2 to 5 to obtain a second set of results.

Examiner comments

1 The candidate calculates the correct concentration and records it in the table.

Mark for (a)(i) = 1 out of 1

Example Candidate Response – middle, continued

The student's results are shown in Fig. 1.1.

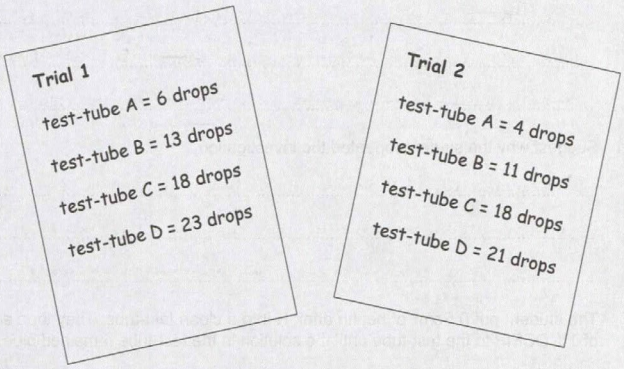


Fig. 1.1

(ii) Prepare a table to record the results shown in Fig. 1.1.

Your table should include the average of the two trials.

2

Test tubes	Results for Trial 1 ~~Trial 1 Results for Trial 1 Volume of water cm³~~	~~Results for Trial 2~~ Results for Trial 2	final percentage concentration of vitamin C
Test tube A	6 drops	4 drops	0.25
Test tube B	13 drops	11 drops	0.50
Test Tube C	18 drops	18 drops	0.75
Test tube D	23 drops	21 drops	1.00

Examiner comments

2 The table is constructed appropriately and the candidate records eight measurements so they are awarded two marks. They do not include a column for averages and they place the units in the body of the table. They show the final concentrations but do not calculate any averages for the two trials.

Mark for (a)(ii) = 2 out of 5

Example Candidate Response – middle, continued

(iii) State a conclusion for the student's results.

~~That~~ ~~For~~ Based on this experiment, we can conclude, that the ~~more drops of DCPIP~~ higher the percentage of vitamin C ~~to the solution, the higher the percentage~~ the more DCPIP drops would have to be added to it; ~~the increase for~~ [1]

3

(iv) Suggest why the student repeated the investigation.

The student repeated the results so that they would have a replica of the ~~ex~~ variables, this way they can be sure to arrive at accurate results; This decreases the chances of flaws in the experiment changing the results. [1]

4

Step 7 The student put 0.5 cm^3 of health drink **H** into a clean test-tube. They then added drops of 1% DCPIP to the test-tube until the solution in the test-tube remained blue.

A total of **10 drops** of DCPIP were added to the sample of health drink **H**.

(v) Estimate the percentage concentration of vitamin C in health drink **H**, using the information in Table 1.1, your table in **1(a)(ii)** and step 7.

1.25 % [1]

5

(vi) Suggest **two** improvements to the method that would allow a more precise estimation of the vitamin C concentration in health drink **H**.

1 Rather than estimating based on comparison to known health drinks, maybe the student should've measured for themself using

2 They could have created their own ~~and not use each~~ values all together and not use any known drinks at all. [2]

6

(vii) Identify **two** variables that were kept constant in this investigation.

1 Volume of vitamin C solution

2 Volume of water [2]

7

Examiner comments

3 The candidate's conclusion correctly links the concentration of vitamin C with the number of drops of DCPIP.

Mark for (a)(iii) = 1 out of 1

4 The candidate is awarded a mark for their idea of achieving more accurate results. They could suggest that anomalies could be identified.

Mark for (a)(iv) = 1 out of 1

5 The candidate's stated value of 1.25% is outside the acceptable range (0.26–0.50%) so they cannot be awarded any marks.

Mark for (a)(v) = 0 out of 1

6 The candidate's answers do not relate to the precision of the estimate so they cannot be awarded any marks.

Mark for (a)(vi) = 0 out of 2

7 The candidate states that the volume of vitamin C solution was kept constant and is awarded a mark. The volume of water is not controlled because different volumes are used to produce the different dilutions of vitamin C from the stock solution.

Mark for (a)(vii) = 1 out of 2

Example Candidate Response – middle, continued

(b) Explain why counting the number of drops of DCPIP is not accurate.

The drops of DCPIP are not accurate, as they were not measured, they are just an estimate. 8

[1]

(c) The manufacturers of health drink **H** claim that it also contains protein and glucose.

Describe how you would test health drink **H** for protein and glucose.

Include the results for a positive test.

protein The health drink H could be poured into a test tube, ~~2cm³~~ 5cm³ of it, and a few drops of ~~biuret~~ Biuret's solution ~~add~~ would be added. Then test 9 tube would be shaken up. If solution turns from blue to pink or purple in colour the sugar is present.

glucose ~~It~~ The health drink H could be poured into a test tube, 2cm³ of it, and then a water bath would need to be made, set at 75°C. Then ~~test tube +~~ Benedict's solution would be added to test tube, then test tube would sit in water bath for 5 minutes. Then if the colour changes from blue to green/yellow or brick red, then glucose is present.

[5]

Examiner comments

8 The candidate does not clarify what is estimated / not measured. The measure the number of drops but the volume of each drop is not. The idea that the volume of each drop is not consistent needs to be included for the mark to be awarded.

Mark for (b) = 0 out of 1

9 The candidate correctly identifies Biuret and Benedict's reagents and they state the correct colour change for each. They also refer to heating the Benedict's reagent so are awarded full marks.

Mark for (c) = 5 out of 5

Total mark awarded = 11 out of 19

How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to read the question carefully and follow all the instructions. In this question, they missed the instruction to include averages.
- **(b)** The candidate needed to include more detail in their answer, for example they needed to state the volume to prevent their answer from being ambiguous.

Example Candidate Response – low

Examiner comments

1 Vitamin C is an important component of a balanced diet. Many health drinks contain vitamin C.

A student estimated the concentration of vitamin C in a health drink by comparing it to solutions with known concentrations of vitamin C.

DCPIP is an indicator for vitamin C. When added to a vitamin C solution, the blue DCPIP reacts with vitamin C and becomes colourless. Drops of DCPIP are added to the vitamin C solution until the solution remains blue.

Step 1 The student labelled four beakers **A**, **B**, **C** and **D** and used the information in Table 1.1 to make the vitamin C solutions in the four labelled beakers.

Table 1.1

beaker	volume of 1.00% vitamin C solution / cm^3	volume of water / cm^3	final percentage concentration of vitamin C
A	10	30	0.25
B	20	20	0.50
C	30	10	0.75
D	40	0	1.00

(a) (i) Complete Table 1.1 by calculating the final percentage concentration of vitamin C in beaker **C**.

1

0.75 % [1]

Step 2 A syringe was used to transfer 0.5 cm^3 of the vitamin C solution from beaker **A** into a test-tube labelled **A**.

Step 3 The student filled a dropping pipette with a **1% DCPIP** solution and added one drop at a time to test-tube **A**. The blue colour disappeared as vitamin C reacted with the DCPIP.

The number of drops was counted as they were added to the test-tube.

Step 4 The student stopped adding drops of DCPIP to test-tube **A** when the solution remained blue in colour when a drop was added. The total number of drops of DCPIP added was recorded.

Step 5 The student then repeated steps 2 to 4 using the solutions from beakers **B**, **C** and **D** and test-tubes labelled **B**, **C** and **D**.

Step 6 The student then repeated steps 2 to 5 to obtain a second set of results.

1 The candidate calculcates the correct concentration and records this on the answer line and in the table.

Mark for (a)(i) = 1 out of 1

Example Candidate Response – low, continued

The student's results are shown in Fig. 1.1.

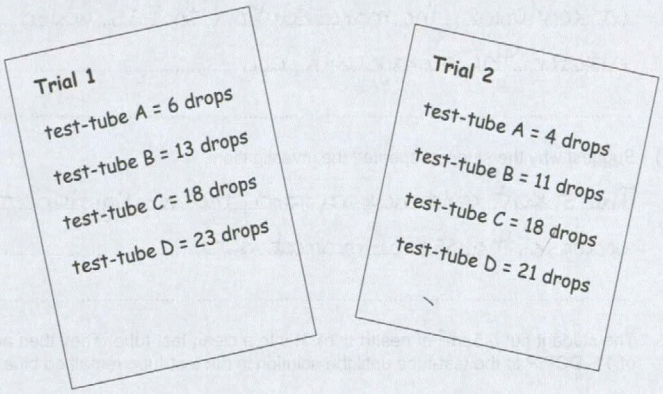


Fig. 1.1

(ii) Prepare a table to record the results shown in Fig. 1.1.

Your table should include the average of the two trials.

Test-tube	Trial 1	Average	Test-tube	Trial 2	Average
A	6	7	A	4	7
B	13	15.75	B	11	15.75
C	18	22.5	C	18	22.5
D	23	28.25	D	21	28.25

2

3

Examiner comments

2 The candidate draws a suitable table but the heading of 'Trial 1' is not sufficient to describe the dependent variable. The value being recorded is the number of drops of DCPIP so this should form part of the table heading.

3 The candidate includes a column to show averages and all eight data values for the two trials are recorded, however, the candidate does not calculate the averages correctly.

Mark for (a)(ii) = 3 out of 5

Example Candidate Response – low, continued

(iii) State a conclusion for the student's results.

In conclusion, the more solution that is added, the greater the average will be. 4

..... [1]

(iv) Suggest why the student repeated the investigation.

The student could have repeated the investigation to decrease the risk of incorrect data. 5

..... [1]

Step 7 The student put 0.5 cm^3 of health drink **H** into a clean test-tube. They then added drops of 1% DCPIP to the test-tube until the solution in the test-tube remained blue.

A total of **10 drops** of DCPIP were added to the sample of health drink **H**.

(v) Estimate the percentage concentration of vitamin C in health drink **H**, using the information in Table 1.1, your table in **1(a)(ii)** and step 7.

11 6 % [1]

(vi) Suggest **two** improvements to the method that would allow a more precise estimation of the vitamin C concentration in health drink **H**.

1 Measure the amount of DCPIP instead of counting the drops. 7

2 Use an non contaminated health drink H solution for the second investigation.

[2]

(vii) Identify **two** variables that were kept constant in this investigation.

1 The amount of DCPIP. 8

2 Amount of health drink H.

[2]

Examiner comments

4 The candidate's answer is unclear because 'more solution' could refer to vitamin C or DCPIP and they do not define what they mean by 'average'.

Mark for (a)(iii) = 0 out of 1

5 The candidate is awarded the mark as they address the idea of spotting anomalous or incorrect data points. They could add that repeated investigations would allow anomalous results to be identified.

Mark for (a)(iv) = 1 out of 1

6 The value of 11 is outside the acceptable range, 0.26% – 0.50%, so the candidate cannot be awarded the mark.

Mark for (a)(v) = 0 out of 1

7 The term 'amount' could refer to the volume or the concentration of DCPIP so the candidate cannot be awarded any marks. It is unclear how a 'non-contaminated health drink' could affect the precision of the estimate so they are not awarded any marks for this part.

Mark for (a)(vi) = 0 out of 2

8 The candidate's reference to the 'amount' is too vague and they cannot be awarded any marks for this. They need to specify either the volume of vitamin C solution or the concentration of DCPIP.

Mark for (a)(vii) = 0 out of 2

Example Candidate Response – low, continued	Examiner comments
(b) Explain why counting the number of drops of DCPIP is not accurate. This is not accurate because a larger amount of the drops could have been added without the student realizing. 9 [1] **(c)** The manufacturers of health drink **H** claim that it also contains protein and glucose. Describe how you would test health drink **H** for protein and glucose. Include the results for a positive test. protein A solution could be used to determine whether or not protein is present in the drink. If protein is present, the liquid could turn a white cloudy color. 10 glucose There is a solution that can be added to the drink to test whether or not glucose is present in the drink.	9 The candidate shows some understanding, but doesn't describe their idea clearly enough to be awarded the mark. Mark for (b) = 0 out of 1 10 The candidate seems to mix up the test for proteins with the test for lipids. They do not name either biuret reagent or Benedict's reagent. Mark for (c) = 0 out of 5 **Total mark awarded = 5 out of 19**

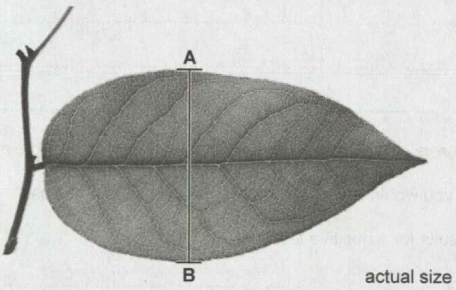
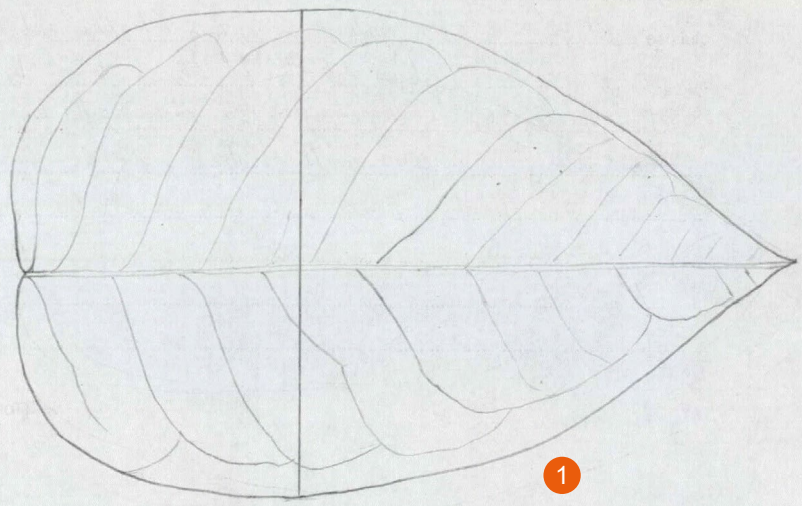
How the candidate could have improved their answer

- **(a)(iii)**, **(a)(v)** and **(b)** The candidate gave answers that didn't fully express their ideas and they couldn't be awarded marks for these. When the volume of a solution remains constant but the concentration varies, using the word 'amount' was not precise enough to be awarded any marks.
- **(c)** The candidate needed to understand the tests for biological molecules. They also needed know the names of the different reagents together with the starting and final colours for a positive test and any associated methods.

Common mistakes candidates made in this question

- Some candidates' conclusions lacked detail or consisted of simple descriptions of the results. Both variables needed to be mentioned. A suitable format could be: 'As A increases, B decreases.' Stating individual data points was not sufficient, for example, 'when A = x, B = y' would be a description of the results and would not describe the trend.
- Candidates often confused the tests for biological molecules. Candidates needed to be able to recall the reagents and colour of a positive test result for the substances stated in the syllabus.
- Some candidates missed instructions that they needed to follow if they were to be awarded full marks.

Question 2

Example Candidate Response – high	Examiner comments
2 (a) Fig. 2.1 is a leaf from a plant.  Fig. 2.1 (i) Make a large drawing of the leaf in Fig. 2.1.  1	1 The candidate draws a very good representation of the leaf. The diagram has an unbroken outline, suitable large size and a pattern of venation that is close to that of the original. Mark for (a)(i) = 4 out of 4

Example Candidate Response – high, continued	Examiner comments
(ii) Measure the length of line **AB** in **Fig. 2.1**. Include the unit. length of line **AB** ..... 40 mm ..... Draw a line on your drawing in **2(a)(i)** to show the position of line **AB**. Measure this line on your drawing. Include the unit. length of the line on your drawing ..... 102 mm ..... Calculate the magnification of your drawing using your measurements and the equation: magnification = length of the line on your drawing / length of line **AB** in **Fig. 2.1** 2 $\frac{102}{40} = 2.55$ × 2.55 ..... [3]	2 The candidate correctly measures the line as 40 mm and draws a line on their drawing which they measure correctly. They calculate the magnification correctly and show their working. Mark for (a)(ii) = 3 out of 3

Example Candidate Response – high, continued

Examiner comments

(b) A student used an aquatic plant to investigate the effect of carbon dioxide concentration on the rate of photosynthesis. The production of oxygen gas can be used as an estimate of the rate of photosynthesis.

The student set up the apparatus shown in Fig. 2.2. He counted the number of bubbles produced in 5 minutes. The carbon dioxide concentration in the water around the aquatic plant was 2 mg per dm^3.

He repeated the experiment with five different concentrations of carbon dioxide.

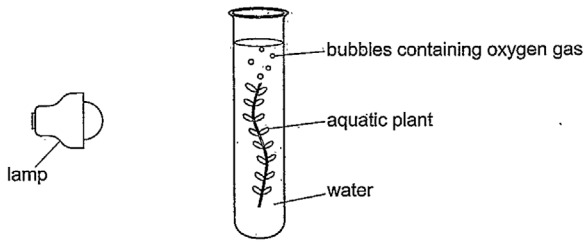
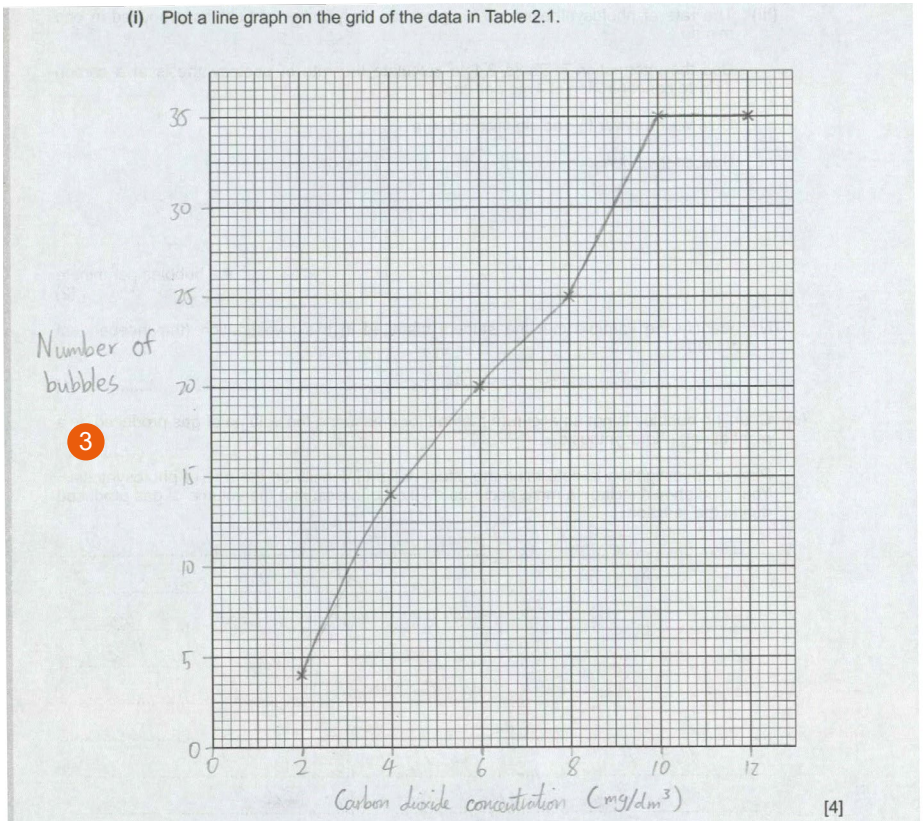


Fig. 2.2

The student's results are shown in Table 2.1.

Table 2.1

carbon dioxide concentration / mg per dm^3	number of bubbles produced in 5 minutes
2	4
4	14
6	20
8	25
10	35
12	35

Example Candidate Response – high, continued	Examiner comments
(i) Plot a line graph on the grid of the data in Table 2.1.  [4] (ii) Describe the trend shown on your graph in **2(b)(i)**. the number of bubbles increases and then stays as the carbon dioxide concentration increases 4 [1]	3 The candidate includes an appropriate scale on their graph, plots all points correctly and draws a reasonable line of best fit. It would be better to label the y-axis as 'number of bubbles in 5 minutes' rather than just 'number of bubbles'. Mark for (b)(i) = 3 out of 4 4 The candidate's conclusion correctly links the dependent and independent variables. Mark for (b)(ii) = 1 out of 1

Example Candidate Response – high, continued

(iii) The rate of photosynthesis can be given as the number of bubbles produced in one minute.

Use the information in Table 2.1 to calculate the rate of photosynthesis at a carbon dioxide concentration of 4 mg per dm^3.

Give your answer to **one** significant figure.

Space for working.

$\frac{14}{5} = 2.8 = 3$ 5

3 bubbles per minute [2]

(iv) Identify the variable that the student changed in this investigation (the independent variable).

carbon dioxide concentration 6 [1]

(c) Counting bubbles is not an accurate method for measuring the volume of gas produced by a plant during photosynthesis.

Plan an investigation to determine the effect of light intensity on the rate of photosynthesis. Your plan should include a more accurate method of measuring the volume of gas produced during the reaction.

5

~~st~~ put water into a testtube with ~~6~~ mg per dm^3 of carbon dioxide concentration in the water ~~and~~ then put the aquatic plant into it. Use different number of lamps ~~for each~~, first time use one lamp, the second time use two lamps and third time use three lamps. Each time the volume of water and carbon dioxide concentration does not change. Use a gas syringe to collect the gas been produced for each time. The ~~temp~~ room temperature ~~was~~ should be constant ~~all~~.

7 8 9 10

Examiner comments

5 The candidate shows the correct workings for their calculation of rate of photosynthesis and they round their answer to one significant figure.

Mark for (b)(iii) = 2 out of 2

6 The candidate correctly identifies the independent variable.

Mark for (b)(iv) = 1 out of 1

7 This is a concise answer, but it covers the main points and the candidate is awarded full marks. The candidate describes a simple investigation based on the method from the question stem, with an aquatic plant and a light source.

8 The candidate chooses three different light intensities and they describe their method to achieve these (increasing the number of lamps).

9 The candidate names a suitable piece of apparatus for collecting the volume of gas.

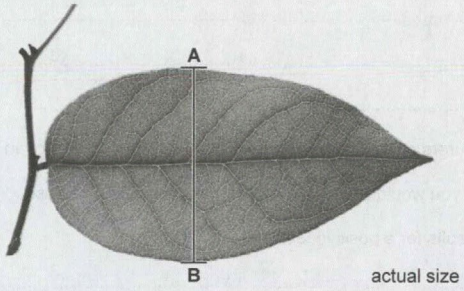
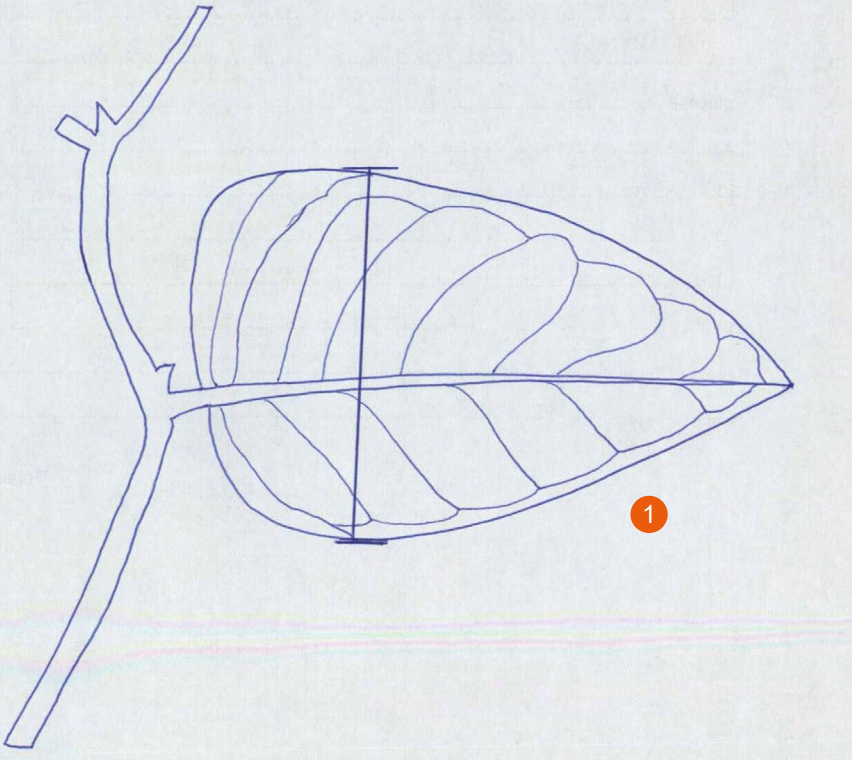
10 The candidate states that the carbon dioxide concentration and the temperature stated are being kept constant so the candidate is awarded two marks for the controlled variables.

Mark for (c) = 6 out of 6

Total mark awarded = 20 out of 21

How the candidate could have improved their answer

The candidate could have described a method that included at least two repeats and some reference to safety that was relevant to the investigation. Their description of the method needed to be as specific as possible, for example, by describing the volume of gas collected instead of just the 'gas collected'.

Example Candidate Response – middle	Examiner comments
2 (a) Fig. 2.1 is a leaf from a plant.  Fig. 2.1 (i) Make a large drawing of the leaf in Fig. 2.1.  1	1 The candidate draws a diagram of a good size with neat and unbroken lines. The detail of venation is good and shows with sufficient alternating. They are awarded full marks. Mark for (a)(i) = 4 out of 4

Example Candidate Response – middle, continued	Examiner comments
(ii) Measure the length of line **AB** in **Fig. 2.1**. Include the unit. length of line **AB** ..... 1.5 in. ..... Draw a line on your drawing in **2(a)(i)** to show the position of line **AB**. Measure this line on your drawing. Include the unit. length of the line on your drawing ..... 3 in. 2 ..... Calculate the magnification of your drawing using your measurements and the equation: $\text{magnification} = \frac{\text{length of the line on your drawing}}{\text{length of line AB in Fig. 2.1}}$ 2 [3]	2 Inches are not an acceptable unit so they cannot be awarded a mark for this. The candidate includes a measurement line on their drawing they measure it correctly. Their calculation for magnification is correct for the values given and the candidate is awarded two marks. Mark for (a)(ii) = 2 out of 3

Example Candidate Response – middle, continued

Examiner comments

(b) A student used an aquatic plant to investigate the effect of carbon dioxide concentration on the rate of photosynthesis. The production of oxygen gas can be used as an estimate of the rate of photosynthesis.

The student set up the apparatus shown in Fig. 2.2. He counted the number of bubbles produced in 5 minutes. The carbon dioxide concentration in the water around the aquatic plant was 2 mg per dm^3.

He repeated the experiment with five different concentrations of carbon dioxide.

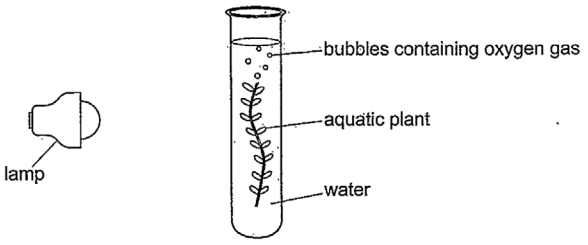


Fig. 2.2

The student's results are shown in Table 2.1.

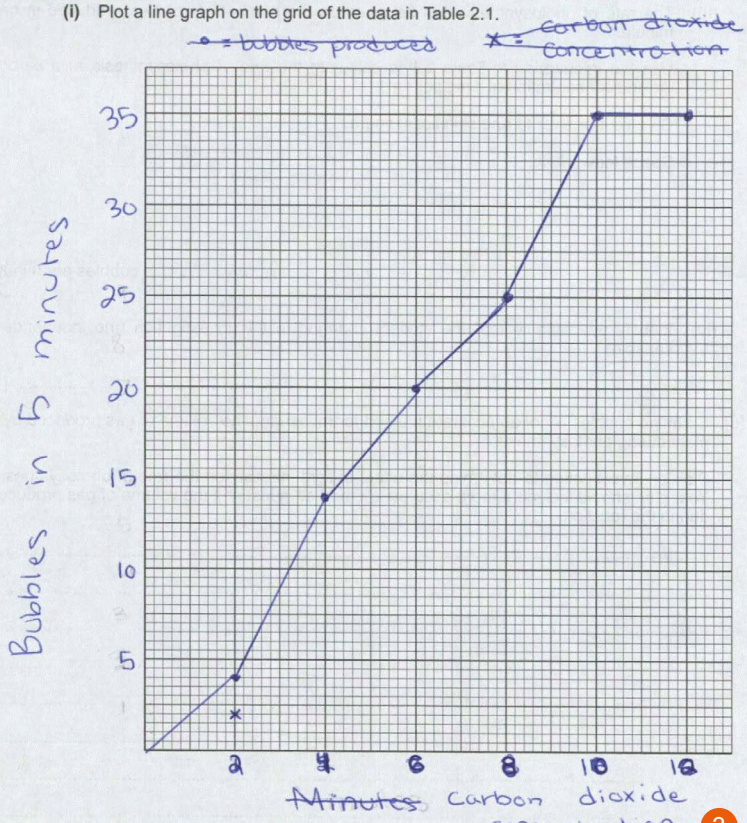
Table 2.1

carbon dioxide concentration / mg per dm^3	number of bubbles produced in 5 minutes
2	4
4	14
6	20
8	25
10	35
12	35

Example Candidate Response – middle, continued

Examiner comments

(i) Plot a line graph on the grid of the data in Table 2.1.



[4]

(ii) Describe the trend shown on your graph in **2(b)(i)**.

As carbon dioxide As the amount of bubbles produced increases so does the concentration of carbon dioxide. They have a positive correlation.

[1]

3 The x-axis of the graph does not include appropriate units and the line joining the points is disjointed in places. The scale the candidate includes on both axes is acceptable and they plot all the points accurately. The candidate is awarded two marks.

Mark for (b)(i) = 2 out of 4

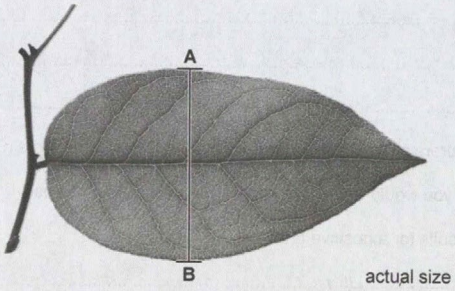
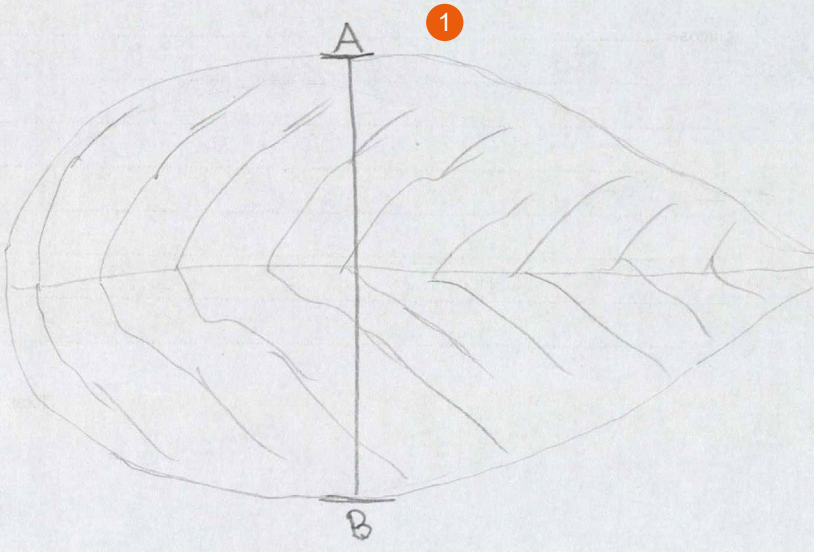
4 The candidate correctly links the independent and dependent variables to describe the trend shown on the graph.

Mark for (b)(ii) = 1 out of 1

Example Candidate Response – middle, continued	Examiner comments
(iii) The rate of photosynthesis can be given as the number of bubbles produced in one minute. Use the information in Table 2.1 to calculate the rate of photosynthesis at a carbon dioxide concentration of 4 mg per dm^3. Give your answer to **one** significant figure. Space for working. 3.5 (5) bubbles per minute [2] **(iv)** Identify the variable that the student changed in this investigation (the independent variable). Carbon Dioxide Concentration (6) [1] **(c)** Counting bubbles is not an accurate method for measuring the volume of gas produced by a plant during photosynthesis. Plan an investigation to determine the effect of light intensity on the rate of photosynthesis. Your plan should include a more accurate method of measuring the volume of gas produced during the reaction. Set up an apparatus of an aquatic plant in a test tube in 4 different lightings. Measure each tube at (7) regular intervals checking the carbon dioxide concentration of the water. The one with the most carbon dioxide has the fastest rate of photosynthesis.	(5) The value the candidate gives is incorrect and they give it to two significant figures rather than one, as specified in the question. Mark for (b)(iii) = 0 out of 2 (6) The candidate correctly identifies the independent variable. Mark for (b)(iv) = 1 out of 1 (7) The candidate describes a simple experiment that uses an aquatic plant lit with four different light intensities and they are awarded two marks. The question asks for a more accurate method of measuring the volume of carbon dioxide but the candidate does not give a method. Mark for (c) = 2 out of 6 **Total mark awarded = 12 out of 21**

How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to use SI units. For measuring length in this question, suitable SI units were millimetres (mm) or centimetres (cm).
- The candidate needed to show all their working when they carried out calculations. Marks could be awarded for evidence that the correct steps had been carried out even if the final answer was incorrect.
- **(b)(i)** The x-axis values on the graph were only just legible. The candidate needed to cross out and rewrite any incorrect numbers rather than attempting to correct them by writing over the top. The graph lines should not be extrapolated beyond the plotted points unless specifically required by the question.
- The candidate needed to include controlled variables, repeats and safety information in their plan, but a conclusion was not required.

Example Candidate Response – low	Examiner comments
2 (a) Fig. 2.1 is a leaf from a plant.  Fig. 2.1 (i) Make a large drawing of the leaf in Fig. 2.1.  	1 The candidate's drawing is a good size and they include a sufficient number of veins so they are awarded two marks. However, the outline is feathery and the position of the veins does not reflect the venation seen on the image of the leaf. Mark for (a)(i) = 2 out of 4

Example Candidate Response – low, continued	Examiner comments
(ii) Measure the length of line **AB** in **Fig. 2.1**. Include the unit. length of line **AB** 4 cm Draw a line on your drawing in **2(a)(i)** to show the position of line **AB**. Measure this line on your drawing. Include the unit. length of the line on your drawing 9.5 cm 2 Calculate the magnification of your drawing using your measurements and the equation: $\text{magnification} = \frac{\text{length of the line on your drawing}}{\text{length of line AB in Fig. 2.1}}$ 2.37 cm [3]	2 The candidate correctly measures and records both lengths of line AB with suitable units. Although the calculation is correct for the magnification, they write 'cm' after the magnification answer, so cannot be awarded the mark for this part. Magnification does not have a unit. Mark for (a)(ii) = 2 out of 3

Example Candidate Response – low, continued

Examiner comments

(b) A student used an aquatic plant to investigate the effect of carbon dioxide concentration on the rate of photosynthesis. The production of oxygen gas can be used as an estimate of the rate of photosynthesis.

The student set up the apparatus shown in Fig. 2.2. He counted the number of bubbles produced in 5 minutes. The carbon dioxide concentration in the water around the aquatic plant was 2 mg per dm^3.

He repeated the experiment with five different concentrations of carbon dioxide.

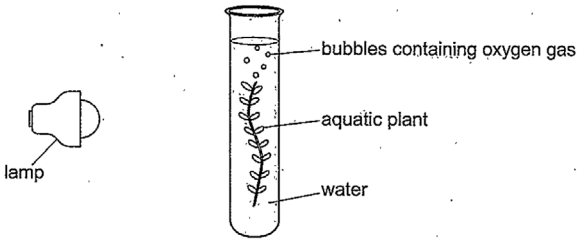


Fig. 2.2

The student's results are shown in Table 2.1.

Table 2.1

carbon dioxide concentration / mg per dm^3	number of bubbles produced in 5 minutes
2	4
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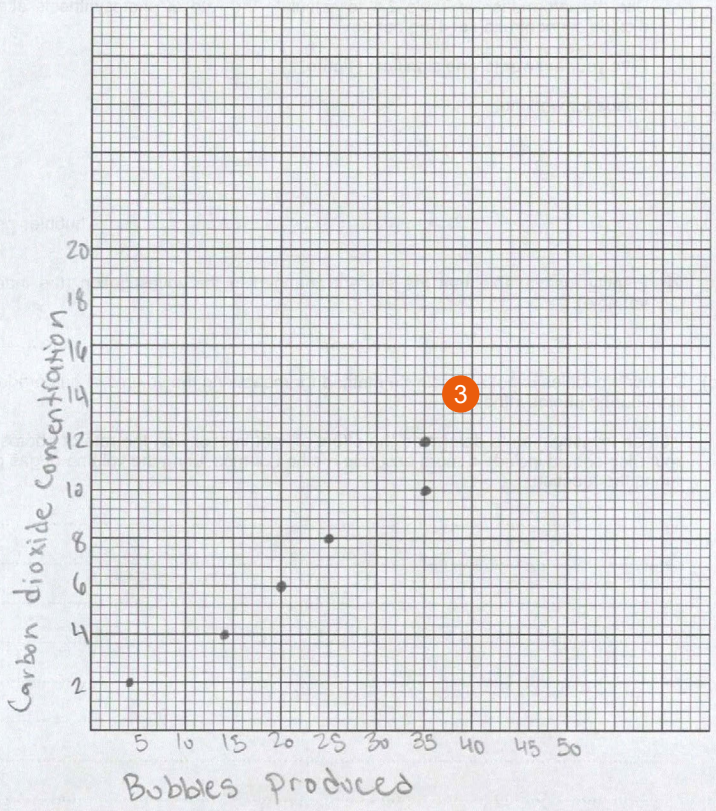
8	25
10	35
12	35

Example Candidate Response – low, continued	Examiner comments
(i) Plot a line graph on the grid of the data in Table 2.1.  [4] (ii) Describe the trend shown on your graph in **2(b)(i)**. The bigger amount of CO_2 Concentration, the more bubbles produced 4 [1]	3 The candidate does not include suitable units on the two axes and the scale on the y-axis that is used to plot data takes up less than half of the grid. Although the plotted points are very large, they are just acceptable, smaller points would have been better. The candidate does not draw a line to connect the points. Mark for (b)(i) = 1 out of 4 4 The candidate adequately describes the trend shown on the graph and refers to both carbon dioxide concentration and the number of bubbles. Mark for (b)(ii) = 1 out of 1

Example Candidate Response – low, continued	Examiner comments

(iii) The rate of photosynthesis can be given as the number of bubbles produced in one minute.

Use the information in Table 2.1 to calculate the rate of photosynthesis at a carbon dioxide concentration of 4 mg per dm^3.

Give your answer to **one** significant figure.

Space for working.

5

3.5 ..... bubbles per minute [2]

(iv) Identify the variable that the student changed in this investigation (the independent variable).

The mg per dm^3 6 ..... [1]

(c) Counting bubbles is not an accurate method for measuring the volume of gas produced by a plant during photosynthesis.

Plan an investigation to determine the effect of light intensity on the rate of photosynthesis. Your plan should include a more accurate method of measuring the volume of gas produced during the reaction.

Put one in a dark room and one out in the sun. Measure the volume of gas by 7

5 The candidate does not include a calculation and gives an incorrect value. They give their answer to two significant figures rather than one.

Mark for (b)(iii) = 0 out of 2

6 Although the units may be correct for concentration of carbon dioxide, the candidate does not identify an independent variable.

Mark for (b)(iv) = 0 out of 1

7 The candidate's plan indicates that they would investigate at least two different light intensities so they are awarded one mark.

Mark for (c) = 1 out of 6

Total mark awarded = 7 out of 21

How the candidate could have improved their answer

- **(a)(i)** The candidate needed to take sufficient care when they drew the outline of the leaf and when observing the detail of the image.
- **(b)(i)** The candidate needed to make sure that their data points in their graph were small and neat. They needed to label both axes and include a suitable scale with at least half of the grid taken up by the plotted points. The candidate needed to draw a suitable line for their line graph and it would have been appropriate to join the points with straight lines here.
- **(c)** The candidate needed to state the dependent and independent variables and explain how the controlled variables would be kept constant. They could have included a brief description of how the method should be repeated and a suitable safety precaution too.

Common mistakes candidates made in this question

- Some candidates did not show their working when performing a calculation. When performing a calculation, no matter how simple it seems, all working should be shown. If a mistake was made, some marks could still be awarded if their working was indicated.
- Drawings should be done with care and produced using smooth unbroken lines. Care should be taken to include the detail of the original image.
- Some candidates did not read the questions fully so did not clearly understand them before attempting an answer. Simple instructions, such as the type of graph to draw or the number of significant figures to display, were stated in the questions.
- **(c)** Some candidates only stated that the method should be repeated or that one repeat should be performed, but this was insufficient. At least two repeats, giving three trials, were needed in order to identify anomalous results.

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