Cambridge Assessment International Education

Example Candidate Responses – Paper 5

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 53

0610 June 2021 Mark Scheme 53

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
(vi) Identify **two** variables that were kept constant in this investigation. 7 1 Same starting volume of 1cm³ in each tube before DCPIP added 2 Same DCPIP used Same vitamin C used. [2] (vii) Explain why it was important to swirl the contents of the test-tube after adding each drop of DCPIP in step 9. To make sure reacted fully to see results, DCPIP some may be stuck to edge of tube - make sure all reacts with DCPIP. 8 [1] (b) Repeating the investigation would improve the method used. rate estimation instead of 9	7 The candidate needs to state that the 'volume of vitamin C solution' would be kept constant, rather than just stating 'starting volume'. However, in this case, the starting volume is 1cm³ and so this is accepted. Mark for (a)(vi) = 2 out of 2 8 The candidate writes a clear and comprehensive answer that

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)(i)** The candidate could have shown all the steps in working out their answer. This is always advisable whenever a calculation is required.
- **(a)(iii)** When stating a conclusion or describing a trend, both variables needed be stated in full. The candidate only mentioned 'more DCPIP' when they were actually counting the number of drops. In this case, the two were equivalent, but this would not always be true.

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

- Conclusions often lacked detail or consisted of simple descriptions of the results. Candidates needed to mention both variables in a suitable way, such as: 'As **A** increases, **B** decreases.' Some candidates stated individual data points which was not sufficient. For example, 'when **A** = x, **B** = y' was a description of the results and did not describe the trend.
- Many candidates confused the tests for biological molecules. Candidates needed be able to recall the reagent and colour of a positive test result for each of 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.

You are going to estimate 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.

Read all the instructions but DO NOT CARRY THEM OUT until you have drawn a table for your results in the space provided in 1(a)(ii).

You should use the safety equipment provided while you are carrying out the practical work.

Step 1 Label four small beakers **A**, **B**, **C** and **D**.

Step 2 Use the large syringe and 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	1	3	0.25
B	2	2	0.50
C	3	1	0.75
D	4	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 3 Label four test-tubes **A**, **B**, **C** and **D** and place them in a test-tube rack.

Step 4 Use the small syringe to transfer 0.5 cm^3 of vitamin C solution from beaker **A** to test-tube **A**.

Step 5 Repeat step 4 using beaker **B** and test-tube **B**.

Step 6 Repeat step 4 using beaker **C** and test-tube **C**.

Step 7 Repeat step 4 using beaker **D** and test-tube **D**.

Step 8 Fill the dropping pipette with the **DCPIP** solution.

Examiner comments

1 The candidate gives the correct value. The question asks candidates to complete the table and in this case a correct answer either on the answer line or in the table itself, would be awarded the mark.

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

Example Candidate Response – high, continued

Step 9 Put one drop of DCPIP into test-tube **A** and swirl gently to mix.

The blue colour should disappear as the vitamin C reacts with the DCPIP. You will be counting the number of drops of DCPIP you put into the test-tube.

Step 10 Repeat step 9 until the blue colour does **not** disappear and the solution remains blue.

Step 11 Record, in your table in **1(a)(ii)**, the total number of drops of DCPIP you have put into test-tube **A**.

Step 12 Repeat step 8 to step 11 with test-tubes **B**, **C** and **D**.

(ii) Prepare a table to record your results.

A - 3 dunes orange

Test Tube	Total number of drops of DCPIP put in solution	Final Percentage concentration of Vitamin C
A	10	0.25
B	20	0.50
C	25	0.75
D	37	1.00

2 3

[4]

(iii) State a conclusion for your results.

The higher the final percentage concentration of Vitamin C, the more DCPIP it takes to make it turn blue. 4 [1]

Step 13 Label a clean test-tube **H**.

Step 14 Use the small syringe to put 0.5 cm^3 of health drink **H** into test-tube **H**.

Step 15 Add drops of DCPIP and swirl gently until the colour in the test-tube remains blue.

(iv) Record the number of drops of DCPIP you added to test-tube **H**.

18 5 drops [1]

(v) Estimate the percentage concentration of vitamin C in health drink **H** using your results from **1(a)(ii)** and **1(a)(iv)**.

0.45 6 % [1]

Examiner comments

2 The candidate draws a neat table with a suitable number of rows and columns. They show the final concentration of vitamin C. This column is an alternative to the column headed 'test-tube'. Either of these columns, together with the number of drops of DCPIP, is sufficient to be awarded the mark.

3 The candidate includes all four values and the value for test-tube D is larger than the value for test-tube A, which shows the correct trend.

Mark for (a)(ii) = 4 out of 4

4 The conclusion is consistent with the results shown in (a)(ii). The candidate mentions the concentration of both vitamin C and DCPIP.

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

5 The number of drops the candidate gives is well within the range expected for this experiment.

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

6 The candidate correctly determines the estimated value of 0.45 % using the results recorded in (a)(iv) and (a)(ii).

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

Example Candidate Response – high, continued

(vi) Identify **two** variables that were kept constant in this investigation. 7

1 Same starting volume of 1 cm³ in each tube before DCPIP added

2 Same DCPIP used & same vitamin C used.

[2]

(vii) Explain why it was important to swirl the contents of the test-tube after adding each drop of DCPIP in step 9.

To make sure reacted fully to see results, some DCPIP may be stuck to edge of tube - make sure all reacts with DCPIP. 8 [1]

(b) Repeating the investigation would improve the method used.

Suggest **two** other improvements to the method that would allow a more accurate estimation of the concentration of vitamin C in health drink **H**.

1 Use a burett to put in DCPIP instead of pipette - more accurate and reliable. 9

2 (Use more samples to know more where concentration lies - make more accurate)

Use a different syringe or wash when using different beakers for DCPIP in tubes so don't change concentration. [2] 10

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

Human error - may miscount, lose track or with putting with pipette may put more drops than was meant to (2 drops going in at once. [1] 11

Examiner comments

7 The candidate needs to state that the 'volume of vitamin C solution' would be kept constant, rather than just stating 'starting volume'. However, in this case, the starting volume is 1 cm^3 and so this is accepted.

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

8 The candidate writes a clear and comprehensive answer that covers two aspects of the mark scheme: the need to mix all of the DCPIP and also to make sure that the DCPIP and vitamin C react fully.

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

9 In this case, using a burette is insufficient to be awarded the first mark. The candidate needs to include that a burette allows the volume of DCPIP to be measured. Using more samples, either in terms of repeats or increased intermediate concentrations, is acceptable and the candidate is awarded the second mark.

10 Sufficient syringes and pipettes are provided so contamination should not be an issue.

Mark for (b) = 1 out of 2

11 Usually, human error is not an acceptable answer as it is too vague. However, due to the nature of this practical procedure, the merging of two drops into one is difficult to avoid and would change the volume of the drop.

Mark for (c) = 1 out of 1

Example Candidate Response – high, continued	Examiner comments
(d) 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 Add buriets solution to the drink and shake. If there was protein it would turn from light blue to purple if protein present. Otherwise wouldn't go purple. 12 glucose Use benedicts test for reducing sugars. Add the benedicts solution to a sample of the drink (H) and shake. Then heat it up. If glucose is present it should change color to like red or green. Use a color scale to work out the concentration of the glucose in H. [5]	12 The reagents, procedures and results of the positive tests are all correct and the candidate is awarded full marks. The phonetic spelling of biuret is acceptable, as long as it cannot be mistaken for any other reagent, such as Benedict's. Mark for (d) = 5 out of 5 **Total mark awarded = 18 out of 19**

How the candidate could have improved their answer

- **(a)(i)** The candidate could have shown all the steps in working out their answer. This is always advisable whenever a calculation is required.
- **(a)(iii)** When stating a conclusion or describing a trend, both variables needed be stated in full. The candidate only mentioned 'more DCPIP' when they were actually counting the number of drops. In this case, the two were equivalent, but this would not always be true.
- **(a)(vi)** The candidate needed to be more specific in their answer. They referred to 'volume' but needed to give details that this was the starting volume of the vitamin C solution.
- **(d)** The candidate stated that the Benedict's solution should be heated, but they could have specified that it was heated to 70-80 °C.
- The candidate needed to take care over their spelling of scientific terminology. They misspelt several terms, including 'biuret' and 'burette'.

Example Candidate Response – middle

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

You are going to estimate 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.

Read all the instructions but DO NOT CARRY THEM OUT until you have drawn a table for your results in the space provided in 1(a)(ii).

You should use the safety equipment provided while you are carrying out the practical work.

Step 1 Label four small beakers **A**, **B**, **C** and **D**.

Step 2 Use the large syringe and 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	1	3	0.25
B	2	2	0.50
C	3	1	
D	4	0	1.00

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

0.75 1 % [1]

Step 3 Label four test-tubes **A**, **B**, **C** and **D** and place them in a test-tube rack.

Step 4 Use the small syringe to transfer 0.5 cm^3 of vitamin C solution from beaker **A** to test-tube **A**.

Step 5 Repeat step 4 using beaker **B** and test-tube **B**.

Step 6 Repeat step 4 using beaker **C** and test-tube **C**.

Step 7 Repeat step 4 using beaker **D** and test-tube **D**.

Step 8 Fill the dropping pipette with the **DCPIP** solution.

Examiner comments

1 The candidate is awarded the mark for stating the correct concentration on the answer line. When asked to complete the table, candidates are expected to write their value in the body of the table. However, an answer on the answer line is acceptable.

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

Example Candidate Response – middle, continued

Step 9 Put one drop of DCPIP into test-tube **A** and swirl gently to mix.

The blue colour should disappear as the vitamin C reacts with the DCPIP. You will be counting the number of drops of DCPIP you put into the test-tube.

Step 10 Repeat step 9 until the blue colour does **not** disappear and the solution remains blue.

Step 11 Record, in your table in **1(a)(ii)**, the total number of drops of DCPIP you have put into test-tube **A**.

Step 12 Repeat step 8 to step 11 with test-tubes **B**, **C** and **D**.

(ii) Prepare a table to record your results.

	test tube			
	A	B	C	D
number of drops	8	11	16	22

2

3

[4]

(iii) State a conclusion for your results.

The less water, and more vitamin C, the more drops of dcpip I had to use to make the solution turn blue. 4 [1]

Step 13 Label a clean test-tube **H**.

Step 14 Use the small syringe to put 0.5 cm^3 of health drink **H** into test-tube **H**.

Step 15 Add drops of DCPIP and swirl gently until the colour in the test-tube remains blue.

(iv) Record the number of drops of DCPIP you added to test-tube **H**.

11 5 drops [1]

(v) Estimate the percentage concentration of vitamin C in health drink **H** using your results from **1(a)(ii)** and **1(a)(iv)**.

0.50 6 % [1]

Examiner comments

2 The table is uneven, but it does conform to the accepted format in terms of rows and columns. In this case, it is effectively a horizontal table with a heading to the left. The candidate records all four values and the result for test-tube D is higher than A, showing that the experiment was performed correctly.

3 In this table, the heading of 'test tube' should be to the left of the data that it is relevant to (A, B, C and D). Here, 'test tube' refers to the data below it, which includes the number of drops so the candidate cannot be awarded a mark for suitable headings.

Mark for (a)(ii) = 3 out of 4

4 The candidate includes both the independent variable (vitamin C) and the dependent variable (number of drops of DCPIP) in their conclusion and links these together correctly.

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

5 The number of drops the candidate records is very close to the value we would expect for the unknown solution.

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

6 The candidate's estimate for the vitamin C concentration is exactly as expected and consistent with the number of drops recorded in (a)(iv).

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

Example Candidate Response – middle, continued

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

7 1 amount of solution in the test tubes at the beginning

2 amount of solution in the beakers

[2]

(vii) Explain why it was important to swirl the contents of the test-tube after adding each drop of DCPIP in step 9.

So you could get the exact number of drops added to make it turn blue. If you had 5 drops already added and you add 2 mix and mix and it turns blue, you dont know if the exact amount was 6or7 drops. [1]

8

(b) Repeating the investigation would improve the method used.

Suggest **two** other improvements to the method that would allow a more accurate estimation of the concentration of vitamin C in health drink **H**.

1 use good lab equipment.

9

2 use a calculator

[2]

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

drop ~~s~~ sizes could be bigger than one another.

10

[1]

Examiner comments

7 'Amount' is a term that could mean a range of variables, such as concentration, mass or volume. Here, the answer has to refer to volume, as concentration varies from one test-tube to the next. The volume of solution in the beakers does not affect the reaction taking place in the test-tubes.

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

8 The candidate has an idea of why swirling is necessary, but they need to give a clearer explanation. Swirling ensures that all of the DCPIP has reacted with the vitamin C.

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

9 The candidate's response is too general to be awarded a mark. If the candidate suggests a different piece of equipment, they need to be specific and explain how changing the equipment would be an improvement.

Mark for (b) = 0 out of 2

10 The candidate is awarded a mark for realising that drop sizes are not consistent.

Mark for (c) = 1 out of 1

Example Candidate Response – middle, continued	Examiner comments
(d) 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 You would use Iodine Solution and it would turn blue if protein was present. 11 glucose ~~You could also use iodine~~ testing for glucose, you could use Benedicts 12 solution & it would turn brown if gluose was present. [5]	11 The candidate incorrectly identifies the test reagent for protein as iodine solution. The colour they suggest for a positive result is incorrect for both biuret reagent and iodine solution. 12 The candidate gives the correct test reagent, but their answer does not mention the need for heating or give a correct colour change for the Benedict's test. Mark for (d) = 2 out of 5 **Total mark awarded = 10 out of 19**

How the candidate could have improved their answer

- **(a)(v)** The candidate needed to make sure the figures they wrote were clear, for example, the zero could nearly have been mistaken for a six.
- **(a)(ii)** The candidate needed to place table headings above the data or to the left of the data, such that the heading related to either the data below them or the data to the right of them. The candidate mixed these up and placed headings both to the side and above the data. They could also have improved the table if they had added the concentration of vitamin C. Although just 'test-tube' was acceptable in this case, it would always be good practice to include both the independent variable and the dependant variable shown in the table.
- **(a)(vii)** The candidate needed to be more specific and refer to 'volume of vitamin C solution' rather than just 'amount of solution'.

Example Candidate Response – low

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

You are going to estimate 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.

Read all the instructions but DO NOT CARRY THEM OUT until you have drawn a table for your results in the space provided in 1(a)(ii).

You should use the safety equipment provided while you are carrying out the practical work.

Step 1 Label four small beakers **A**, **B**, **C** and **D**.

Step 2 Use the large syringe and 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	1	3	0.25
B	2	2	0.50
C	3	1	
D	4	0	1.00

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

0.75 1 % [1]

Step 3 Label four test-tubes **A**, **B**, **C** and **D** and place them in a test-tube rack.

Step 4 Use the small syringe to transfer 0.5 cm^3 of vitamin C solution from beaker **A** to test-tube **A**.

Step 5 Repeat step 4 using beaker **B** and test-tube **B**.

Step 6 Repeat step 4 using beaker **C** and test-tube **C**.

Step 7 Repeat step 4 using beaker **D** and test-tube **D**.

Step 8 Fill the dropping pipette with the **DCPIP** solution.

Examiner comments

1 The candidate states the correct value on the answer line so is awarded the mark.

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

Example Candidate Response – low, continued

Step 9 Put one drop of DCPIP into test-tube **A** and swirl gently to mix.

The blue colour should disappear as the vitamin C reacts with the DCPIP. You will be counting the number of drops of DCPIP you put into the test-tube.

Step 10 Repeat step 9 until the blue colour does **not** disappear and the solution remains blue.

Step 11 Record, in your table in **1(a)(ii)**, the total number of drops of DCPIP you have put into test-tube **A**.

Step 12 Repeat step 8 to step 11 with test-tubes **B**, **C** and **D**.

(ii) Prepare a table to record your results.

Tube A	Tube A	Tube C	Tube D
Number of drops	1		
Number of drops	4		
Number of drops			

[4]

(iii) State a conclusion for your results.

It went up each time.

.....

.....

[1]

Step 13 Label a clean test-tube **H**.

Step 14 Use the small syringe to put 0.5 cm^3 of health drink **H** into test-tube **H**.

Step 15 Add drops of DCPIP and swirl gently until the colour in the test-tube remains blue.

(iv) Record the number of drops of DCPIP you added to test-tube **H**.

5 drops [1]

(v) Estimate the percentage concentration of vitamin C in health drink **H** using your results from **1(a)(ii)** and **1(a)(iv)**.

10 % [1]

Examiner comments

2 The table is generally acceptable in terms of structure and the candidate is awarded one mark for having a minimum of two columns and a header row. However, the candidate does not include headings on the first column and they only record test-tube A in the table. This means that some of the results are missing and it is not possible to identify a correct trend.

Mark for (a)(ii) = 1 out of 4

3 The candidate includes insufficient detail to be able to form a valid conclusion. Conclusions should always refer to both the independent variable, the dependent variable and how they relate to each other.

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

4 The number of drops the candidate adds to H is reasonable for the investigation, but their estimation of the concentration cannot be awarded a mark based on the candidate's own results.

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

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

Example Candidate Response – low, continued

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

1 the DCPIP 5

2 the test tube

[2]

(vii) Explain why it was important to swirl the contents of the test-tube after adding each drop of DCPIP in step 9.

So you know when to stop putting DCPIP. 6

[1]

(b) Repeating the investigation would improve the method used.

Suggest **two** other improvements to the method that would allow a more accurate estimation of the concentration of vitamin C in health drink **H**.

1 The DCPIP made the solution in the test tube turn blue really quickly. 7

2 The things to mix the DCPIP into the solution

[2]

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

It's not accurate because you dont know how much each drop is. 8

[1]

Examiner comments

5 The type of indicator used is the same in each case so the candidate is awarded a mark for stating 'DCPIP'. Simply stating 'the test-tube' does not describe a constant variable so the candidate cannot be awarded any marks for this.

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

6 The candidate needs to include more information to explain the idea of mixing the DCPIP with the vitamin C or allowing them to fully react.

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

7 The candidate's first answer is an observation, but it is not an improvement that would allow a more accurate estimate of the vitamin C concentration. The candidate's second answer is not detailed enough to be awarded any marks.

Mark for (b) = 0 out of 2

8 The candidate's answer needs more detail, but does convey the idea that each drop could be a different size or volume.

Mark for (c) = 1 out of 1

Example Candidate Response – low, continued	Examiner comments
(d) 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 You would test protein in health drink H by putting iodine in a solution in a test tube. 9 glucose You can test glucose in a health drink H by putting clean water and dirty water in a tube. [5]	9 The candidate gives an incorrect reagent for the protein test and does not state the colour of a positive test. They need to describe a suitable test for glucose. Mark for (d) = 0 out of 5 **Total mark awarded = 5 out of 19**

How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to ensure that each column of data had a heading that was clear. All of the results obtained needed to be recorded in the table, so that any trend could be identified. Here, four test-tubes were used but the candidate only recorded one in the table.
- **(a)(iii)** The candidate needed to write a more precise and descriptive conclusion. 'It' could refer to any variable and was too vague to awarded any marks. A good conclusion should state the independent and dependent variables and how they relate to each other.
- The candidate needed to ensure they only considered controlled or constant variables that were significant in the practical procedure. The candidate identified that different test-tubes were used for each vitamin C solution, but they were also not critical in terms of the final outcome.

Common mistakes candidates made in this question

- Conclusions often lacked detail or consisted of simple descriptions of the results. Candidates needed to mention both variables in a suitable way, such as: 'As **A** increases, **B** decreases.' Some candidates stated individual data points which was not sufficient. For example, 'when **A** = x, **B** = y' was a description of the results and did not describe the trend.
- Many candidates confused the tests for biological molecules. Candidates needed be able to recall the reagent and colour of a positive test result for each of the substances stated in the syllabus.

Question 2

Example Candidate Response – high	Examiner comments

(a) You are provided with the leaf of a plant, **L1**.

(i) Make a large drawing of leaf **L1**.

1

[4]

(ii) Measure the length of your drawing in **2(a)(i)**. Include the unit.

Indicate on your drawing where you measured this length.

length of the leaf in your drawing ..... 109 mm .....

Measure the actual length of the leaf **L1**. Include the unit.

2

actual length of leaf **L1** ..... 64 mm .....

Calculate the magnification of your drawing using the equation:

$$\text{magnification} = \frac{\text{length of the leaf in your drawing}}{\text{actual length of leaf L1}}$$

$m = \frac{109}{64}$

$= 1.703$

$\times 1.70$

[3]

1 The candidate's drawing is neat with smooth unbroken lines and uses the majority of the available space. The leaf has far fewer veins than the leaf that is provided, but the candidate accurately records the staggered arrangement of the veins.

Mark for (a)(i) = 3 out of 4

2 The candidate clearly shows on their diagram where the length of the leaf is measured and they correctly record the length using appropriate units. The candidate's calculation of magnification is correct for the values given so the candidate is awarded full marks.

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. 2.1. 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.

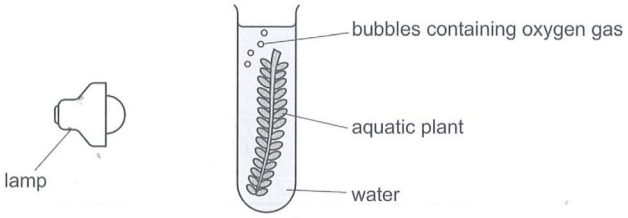
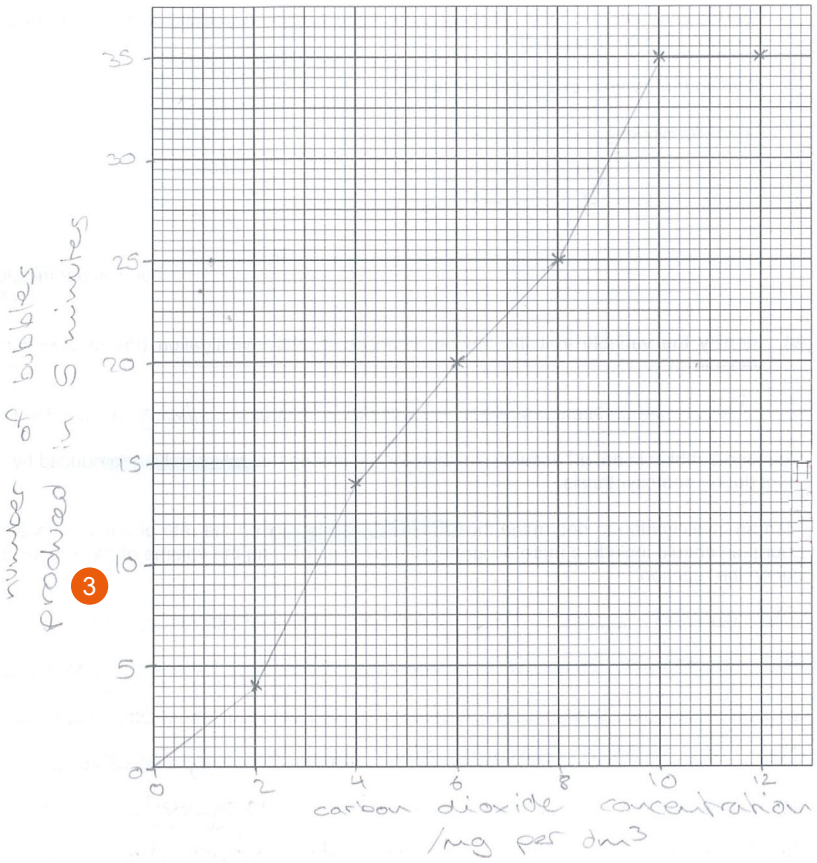


Fig. 2.1

The student's results are shown in Table 2.1.

In Table 2.1 De

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.  3 [4] (ii) Describe the trend shown on your graph in **2(b)(i)**. As the carbon dioxide concentration /mg per dm3 increases so does the number of bubbles produced in 5 minutes 4 [1]	3 The candidate correctly labels both axes with full descriptions of the variables and suitable units. They plot the data points correctly and the points are neatly joined with straight lines. Extrapolation to zero would not normally be accepted, but in this case zero bubbles could be expected when no carbon dioxide is present. Mark for (b)(i) = 4 out of 4 4 The candidate's description of the trend correctly includes both variables and states the relationship between them. 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.

4 / 14

Space for working.

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

$= 3$

3 5 ..... bubbles per minute [2]

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

6 the carbon dioxide concentration /mg per dm^3 [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.

I would use the same volume of carbon dioxide and same concentration in each test tube 7 of carbon dioxide /mg per dm^3 for the experiment. To accurately collect the gas being produced I would use a gas syringe 8 attached to the test tube containing a plant and water and CO_2. Use the same 9 species of plant for each experiment. I would use a meter ruler to measure how far away 10 each light source will be ie. 10cm, 20cm, 30cm, 40cm and 50cm. This will give a different light intensity at each point on the ruler. I would time using a stopwatch the volume of gas produced in 5 minuets. Don't touch the lamp as it will be hot. Repeat each experiment a minimum of 3 times to be able to calculate an average of volume of gas being produced for each distance. 11 [6]

[Total: 21]

Examiner comments

5 The candidate shows all their working and they correctly give the calculated value of 2.8 to one significant figure.

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

6 The candidate correctly identifies the independent variable. Although units are not required, the candidate includes the correct ones for the variable stated.

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

7 The volume of carbon dioxide is ignored, but the candidate states the correct concentration of carbon dioxide as a variable that needs to be kept constant. The candidate is awarded one of the two marks for controlled variables.

8 The candidate correctly identifies a gas syringe as a piece of apparatus that would allow the volume of gas to be collected.

9 The candidate identifies that 'species of plant' is a variable that needs to be kept constant, so they are awarded the second marking point for controlled variables.

10 The candidate recommends another correct piece of apparatus, this time a metre ruler, to be used to measure the distance of the plant from the lamp.

11 The candidate states a suitable range of distances of the lamp from the plant, thereby changing the light intensity.

Mark for (c) = 6 out of 6

Total mark awarded = 20 out of 21

How the candidate could have improved their answer

- **(a)(i)** The candidate needed to take care over their drawing of the specimen, take careful observations and transfer as much detail as possible to the image produced on the page. They needed to include more detail of the leaf venation, although all other aspects of the drawing were good.
- **(b)(i)** The candidate extrapolated the line to the origin. Extrapolation to zero would not normally be accepted, but in this case zero bubbles could theoretically have been possible when no carbon dioxide was present. As a general rule, lines should not be extrapolated past the data points unless asked to do so in the question.

Example Candidate Response – middle	Examiner comments
(a) You are provided with the leaf of a plant, **L1**. (i) Make a large drawing of leaf **L1**.  1 [4] (ii) Measure the length of your drawing in **2(a)(i)**. Include the unit. Indicate on your drawing where you measured this length. length of the leaf in your drawing ..... 10cm ..... Measure the actual length of the leaf **L1**. Include the unit. actual length of leaf **L1** ..... 10cm ..... Calculate the magnification of your drawing using the equation: $\text{magnification} = \frac{\text{length of the leaf in your drawing}}{\text{actual length of leaf L1}}$ 1 2 ..... [3]	1 The candidate draws the leaf to an acceptable size and it shows a serrated pattern around that edge that is a good representation of the detail seen on the actual leaf provided. The candidate draws the line that forms the mid-vein with a ruler and so they are not awarded the second marking point. The random arrangement of the veins in the diagram is not representative of the leaf provided. Mark for (a)(i) = 2 out of 4 2 The candidate clearly shows the measured distance on the drawing and the measurement of this is correct with suitable units. The candidate gives the correct calculation of magnification for the values given. Mark for (a)(ii) = 3 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. 2.1. 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.

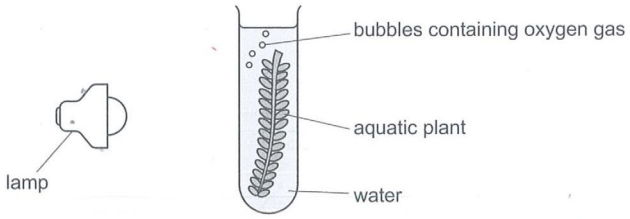
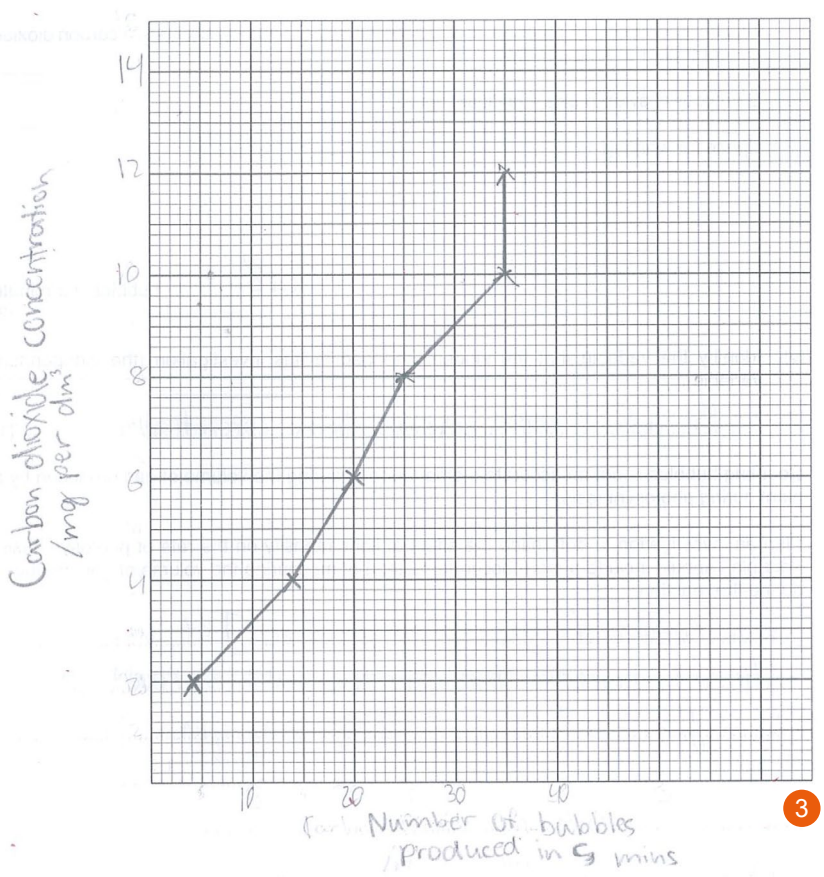


Fig. 2.1

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.  3 [4] (ii) Describe the trend shown on your graph in **2(b)(i)**. The more you add the more it rises 4 [1]	3 The candidate draws the graph with the independent variable on the *y*-axis, but this is acceptable as long as the axis is clearly labelled. They plot all values correctly and join the data points with straight lines. Mark for (b)(i) = 4 out of 4 4 The candidate needs to refer to the variables in their answer. Mark for (b)(ii) = 0 out of 1

Example Candidate Response – middle, 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.

2.8 5 bubbles per minute [2]

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

He added more 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.

You could do the same method. Just use a different / brighter light. So the bubble could show up brighter and have a magnifying glass to zoom it in. 7

Examiner comments

5 The candidate calculates the correct value but gives it to two significant figures instead of one.

Mark for (b)(iii) = 1 out of 2

6 The candidate gives a correct answer of 'carbon dioxide concentration'.

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

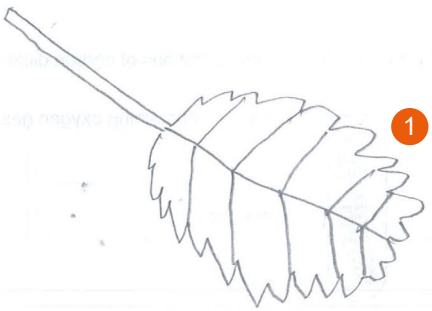
7 The candidate gives very little detail in their plan. Simply stating that the same method is used or the same things are kept constant is not enough to be awarded a mark, the answer must specify the detail. By using a brighter light it suggests two different light intensities are being used so the candidate is awarded the mark for the independent variable.

Mark for (c) = 1 out of 6

Total mark awarded = 12 out of 21

How the candidate could have improved their answer

- **(a)(i)** The candidate needed to draw the leaf free-hand with clear, unbroken lines. They could not be awarded any marks for using a ruler or compass for any part of the drawing. The candidate also needed to observe the specimen carefully in order to assess the level of detail required.
- **(a)(iii)** The candidate needed to understand the difference between decimal places and significant figures. They also needed to show all the working involved in their calculations.
- **(b)(i)** The candidate started both axes at zero but they needed to put values at the start of the *x* and *y*-axes.
- **(c)** The candidate needed to add more detail to their answer. They stated that the 'same method' as before was carried out this was not enough so could not be awarded any marks for the method or control of variables. They could have split the plan up and identified the independent variable, the dependent variable and how the other variable would be controlled. They could then describe a simple method that covered repeats and any suitable safety measures.

Example Candidate Response – low	Examiner comments
2 (a) You are provided with the leaf of a plant, **L1**. (i) Make a large drawing of leaf **L1**.  1 [4]	1 Although the candidate's drawing is of a reasonable size, the actual leaf (excluding the stalk) is too small compared to the size of the space provided. The outline is just sufficient to be awarded the mark, with no major errors shown. Venation is shown and the serrated edge of the original specimen leaf has been reproduced. Therefore, the candidate is awarded three marks. Mark for (a)(i) = 3 out of 4
(ii) Measure the length of your drawing in **2(a)(i)**. Include the unit. Indicate on your drawing where you measured this length. length of the leaf in your drawing ..... 3.7 mm ..... Measure the actual length of the leaf **L1**. Include the unit. 2 actual length of leaf **L1** ..... 11 mm ..... Calculate the magnification of your drawing using the equation: magnification = length of the leaf in your drawing / actual length of leaf **L1** 3.7 / 11 = 3 0.336363636 [3]	2 The candidate needs to include an indication on the drawing of the measurement that they take. 3.7 mm is not a suitable distance for the leaf length based on their drawing. 3 Despite the values being incorrect, the calculation of the magnification based on those values is correct so the candidate is awarded one mark. Mark for (a)(ii) = 1 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. 2.1. 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.

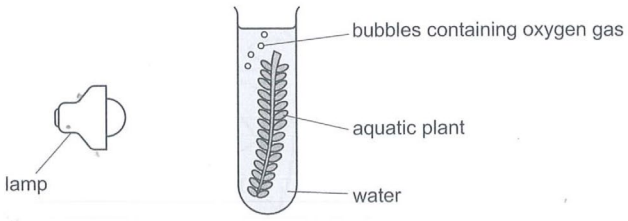
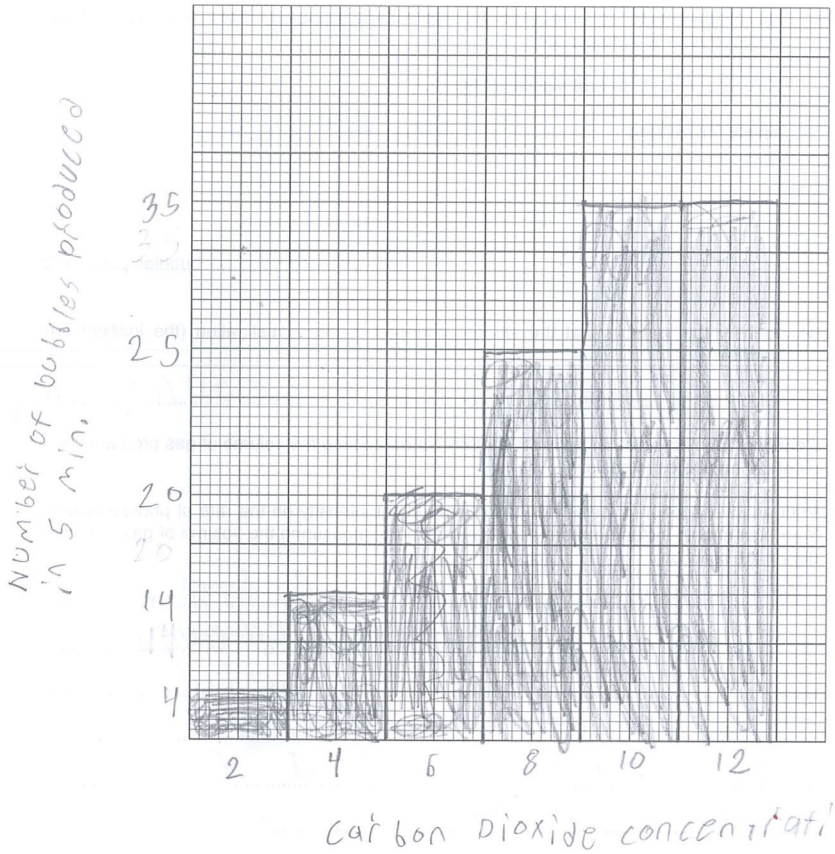


Fig. 2.1

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 – low, continued	Examiner comments
(i) Plot a line graph on the grid of the data in Table 2.1.  4 [4] (ii) Describe the trend shown on your graph in **2(b)(i)**. It went up until it stayed the same. 5 [1]	4 The *x*-axis label is missing its units and the *y*-axis is not scaled at regular intervals. The candidate plots the bars close together but they introduce errors by drawing the bars freehand so they cannot be awarded the mark. The question asks for a line graph rather than a bar chart. Mark for (b)(i) = 0 out of 4 5 The candidate does not state the dependent and independent variables and stating 'it' is too vague to be awarded a mark. Mark for (b)(ii) = 0 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.

6

10 ..... bubbles per minute [2]

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

He changed the amount of carbon dioxide. 7 [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.

You will do the same ~~this~~ thing but you will put a beaker over the plant to fully trap the bubbles 8 then you can count them a whole lot easier. This is how you can make it better.

6 It is unclear how the candidate obtains a value of 10 so the candidate cannot be awarded the marks for the calculation and the significant figures.

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

7 'Amount' can mean the concentration or volume of carbon dioxide. Either would work in theory and so amount is accepted in this case, although the candidate could have given 'concentration' instead.

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

8 The candidate is awarded a mark for suggesting a piece of apparatus that could be used to measure the volume of gas collected. They need to give details of the method and variables.

Mark for (c) = 1 out of 6

Total mark awarded = 6 out of 21

How the candidate could have improved their answer

- **(a)(ii)** The candidate needed to read the question carefully and follow all instructions given. In question they needed to include an indication of measurement to the drawing.
- **(b)(i)** The candidate should have drawn a line graph rather than a bar chart.
- **(a)(i)** The candidate needed to allow sufficient time for drawing the specimen. This question was worth 4 marks, yet some candidates appeared to rush the drawing and did not observe the detail in sufficient depth.
- **(a)(ii)** The candidate should have included more detail in their description of the graph. Using terms such as 'it went up' did not convey enough information to be awarded a mark. The candidates needed to state the variables labelled on the *x* and *y*-axes when they described the trend shown by the graph.
- **(b)(iii)** The candidate needed to show all the stages of the calculations. For the calculation of the rate of photosynthesis, if the candidate had shown the steps they took in the calculation, then an incorrect answer rounded to one significant figure could still have been awarded the mark.

Common mistakes candidates made in this question

- Many candidates did not show their working when performing a calculation. No matter how simple a question seems, all working should be shown so if a mistake was made some marks could still be awarded if working was indicated.
- Candidates needed to take care when producing their diagrams and use clear unbroken lines. They needed to take care to include the detail of the original specimen.
- Some candidates did not read or fully understand the questions before attempting an answer. They needed to ensure that they read the questions fully and clearly understood them before attempting an answer. Simple instructions, such as the type of graph to draw or the number of significant figures to display, would always be stated in the question.

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