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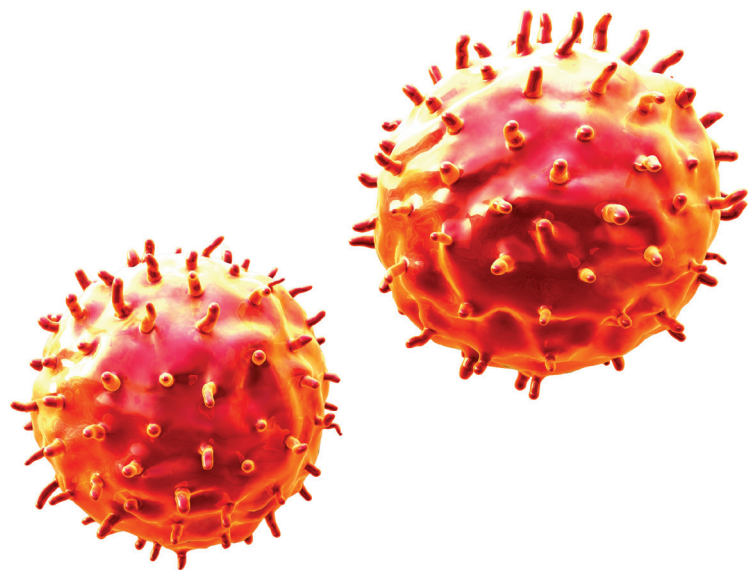
Example Candidate Responses

Paper 6

Cambridge IGCSE[®]

Biology 0610

For examination from 2016



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Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE Biology (0610), 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 a range of candidate responses has been chosen as far as possible to exemplify high, middle and low responses. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, the response is annotated with 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. At the end of the booklet, there is 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 additional comment.

The questions, mark schemes and pre-release material used here are available to download as a zip file from the School Support Hub as the Example Candidate Responses Files. The papers used in this booklet are:

Question Paper 6, June 2016	
Question paper	June 2016 Question Paper 61 (0610_s16_qp_61.pdf)
Mark scheme	June 2016 Paper 61 Mark Scheme (0610_s16_ms_61.pdf)

Other past papers, Examiner Reports and other teacher support materials 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 – Question 1, High	Examiner comments
<p>(ii) Compare the activity of catalase in the potato pieces A, B and C.</p> <p>THE ACTIVITY IS MORE EFFICIENT IN PIECE B (14.5 bubbles) WHILE IT DECREASES IN C (12) AND THE LEAST EFFICIENT WAS IN A (4 bubbles) [1]</p> <div data-bbox="199 638 742 929" style="border: 1px solid orange; border-radius: 15px; padding: 10px; margin-top: 10px;"> <p>Answers are by real candidates in exam conditions. These show you the types of answers for each level.</p> <p>Discuss and analyse the answers with your learners in the classroom to improve their skills.</p> </div>	<p>The mark is awarded as the candidate gives the relative activities of all three samples.</p> <div data-bbox="1061 593 1444 963" style="border: 1px solid orange; border-radius: 15px; padding: 10px; margin-top: 10px;"> <p>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.</p> </div>

How the candidate could have improved the answer

- (a)(ii) The candidate was awarded full marks but could have improved the column headings by expanding them to '**Number of bubbles / 3 min**' and '**Mean number of bubbles / 3 min**' to make them more precise.

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

- (a)(i) *The examiner was expecting candidates to use a ruler to determine the dimensions of the potato pieces. The dimensions should be entered into the table in millimetres (as that unit is given in the column heading).*

The most common error that candidates made was to state their measurements in centimetres and not in millimetres (as stated in the table heading.)

Often candidates lose marks because they misread or misinterpret 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.

Assessment at a glance

All candidates take three papers. Candidates who have studied the Core subject content, or who are expected to achieve a grade D or below, should be entered for Paper 1, Paper 3 and either Paper 5 or Paper 6. These candidates will be eligible for grades C to G. Candidates who have studied the Extended subject content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, Paper 4 and either Paper 5 or Paper 6. These candidates will be eligible for grades A* to G.

Core candidates take:

Paper 1 45 minutes
Multiple Choice 30%
40 marks
40 four-choice multiple-choice questions
Questions will be based on the Core subject content

Assessing grades C–G
Externally assessed

Extended candidates take:

Paper 2 45 minutes
Multiple Choice 30%
40 marks
40 four-choice multiple-choice questions
Questions will be based on the Extended subject content (Core and Supplement)

Assessing grades A*–G
Externally assessed

and Core candidates take:

Paper 3 1 hour 15 minutes
Theory 50%
80 marks
Short-answer and structured questions
Questions will be based on the Core subject content

Assessing grades C–G
Externally assessed

and Extended candidates take:

Paper 4 1 hour 15 minutes
Theory 50%
80 marks
Short-answer and structured questions
Questions will be based on the Extended subject content (Core and Supplement)

Assessing grades A*–G
Externally assessed

All candidates take either:

Paper 5 1 hour 15 minutes
Practical Test 20%
40 marks
Questions will be based on the experimental skills in Section 4
Assessing grades A*–G
Externally assessed

or:

Paper 6 1 hour
Alternative to Practical 20%
40 marks
Questions will be based on the experimental skills in Section 4
Assessing grades A*–G
Externally assessed

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Paper 6 – Alternative to Practical

Question 1

Example Candidate Response – Question 1, High

Examiner comments

1 Metabolic reactions in cells produce toxic chemicals which can be converted to harmless or less toxic chemicals.

Hydrogen peroxide is broken down using the enzyme catalase which is found in most cells.

Fig. 1.1 shows this reaction.

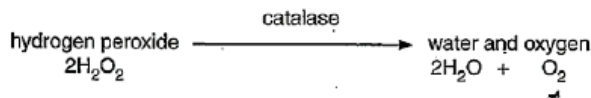


Fig. 1.1

A student investigated the effect of alcohol (ethanol) on the activity of catalase found in potato, using three pieces of potato cut to the same size.

Fig. 1.2 shows these pieces of potato.

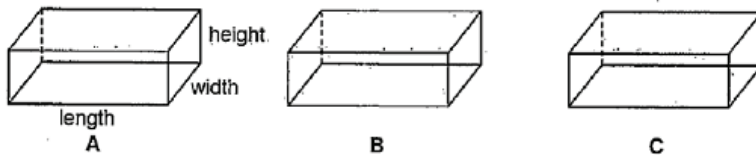


Fig. 1.2

(a) (i). Measure the length, width and height of one of these pieces of potato.

Record your results in Table 1.1.

Table 1.1

length of potato piece /mm	width of potato piece /mm	height of potato piece /mm
30 30	10 10	10 10

1 Note how the candidate has crossed out the answers they did not want to be marked. Doing this makes it very clear to the Examiner which text is the intended answer.

The candidate gives three accurate measurements, so gains the mark.

[1] Mark awarded for 1(a)(i) = 1 out of 1

Step 1 The student labelled six test-tubes, 1, 2, 3, 4, 5, and 6 and used a syringe to add 10 cm³ of hydrogen peroxide solution to each of the test-tubes.

Step 2 They cut potato piece A to obtain two slices of similar size.

Step 3 The student placed the free end of a delivery tube into a large test-tube containing water.

Step 4 They placed one of the slices of potato piece A into the hydrogen peroxide solution in test-tube 1.

Step 5 The student immediately placed the rubber bung attached to the delivery tube into test-tube 1 and pushed it in as tightly as possible, as shown in Fig. 1.3.

Example Candidate Response – Question 1, High

Examiner comments

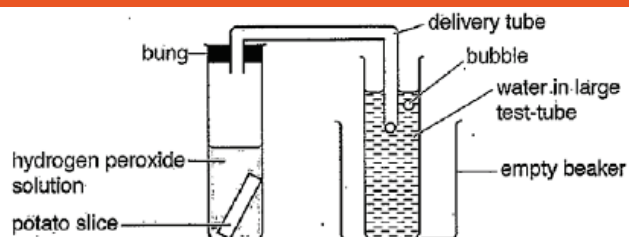


Fig. 1.3

Step 6 They counted the number of bubbles released from the delivery tube in 3 minutes.

Step 7 The student repeated steps 4–6 for the second slice of potato piece A using test-tube 2.

Step 8 They repeated steps 2–7 for potato piece B using test-tubes 3 and 4.

Step 9 They repeated steps 2–7 for potato piece C using test-tubes 5 and 6.

The student used a tally to count the number of bubbles.

Fig. 1.4 shows their tally count.

A1		A2	
B1		B2	
C1		C2	

Fig. 1.4

MEAN CALCULATIONS

$$A = \frac{5 + 3}{2} = 4$$

$$B = \frac{18 + 11}{2} = 14,5$$

$$C = \frac{12 + 10}{2} = 11$$

(ii) Prepare a table to record the student's results. Your table should show:

- the numbers of bubbles produced by each slice of potato in 3 minutes
- the mean number of bubbles produced by each of potato piece A, B and C.

Complete your table using the results from Fig. 1.4.

POTATO PIECES	BUBBLES PRODUCED in 3min	MEAN of bubbles
A ₁	5	4
A ₂	3	
B ₁	18	14,5
B ₂	11	
C ₁	12	11
C ₂	10	

[5]

The table is drawn neatly with an appropriate number of cells; all column headings are adequate and the unit is given; data is entered correctly.

Mark awarded for 1(a)(ii) = 5 out of 5

Example Candidate Response – Question 1, High

Examiner comments

- (b) (i) Suggest why the free end of the delivery tube was placed in the water before adding the potato slice to the hydrogen peroxide solution and connecting the test-tube to the bung of the delivery tube.

TO MAKE SURE THAT THE TEST TUBE WAS COVERED AS FAST AS POSSIBLE.

[1]

The candidate essentially re-states the information given in the stem, and does not answer the question.

Mark awarded for 1(b)(i) = 0 out of 1

- (ii) Explain why the bung of the delivery tube must fit tightly into the test-tube.

BECAUSE THERE WILL NO LOSS OF O₂ IN THE AIR OUTSIDE AND ALL THE O₂ PRODUCED WILL GO PASS THROUGH THE DELIVERY TUBE.

[2]

The candidate is awarded one mark for 'prevents leakage of oxygen / all oxygen collected' (with benefit of doubt as the answer is not expressed clearly.) The candidate does not refer to the validity / consistency of the results, so they do not gain the second mark.

Mark awarded for 1(b)(ii) = 1 out of 2

- (c) The pieces of potato that the student used in their investigation were soaked in different concentrations of alcohol for 24 hours.

- Potato piece A was soaked in 20% alcohol.
- Potato piece B was soaked in 2% alcohol.
- Potato piece C was soaked in 10% alcohol.

- (i) Suggest the relationship between the number of bubbles and the activity of catalase.

AS THE ACTIVITY OF THE CATALASE IS RELATED TO THE AMOUNT OF ALCOHOL IN WHICH THE PIECES WERE SOAKED, THE AS THE ALCOHOL INCREASES IT STOPS THE ACTIVITY OF THE CATALASE AND SO LESS BUBBLES ARE PRODUCED.

[1]

The response is not ideal as the candidate refers to the *amount* of alcohol instead of the alcohol *concentration* but the mark is awarded for the final statement about reduced activity of the catalase resulting in fewer bubbles.

Mark awarded for 1(c)(i) = 1 out of 1

- (ii) Compare the activity of catalase in the potato pieces A, B and C.

THE ACTIVITY IS MORE EFFICIENT IN PIECE B (19.5 bubbles) WHILE IT DECREASES IN C (1 bubble) AND THE LEAST EFFICIENT WAS IN A (4 bubbles).

[1]

The mark is awarded as the candidate gives the relative activities of all three samples.

Mark awarded for 1(c)(ii) = 1 out of 1

- (iii) Predict the number of bubbles that would be produced in 3 minutes if a piece of potato was soaked in 50% alcohol before being placed in hydrogen peroxide solution.

IT WILL BE LESS THAN 4, maybe 2 or 1 or none.

[1]

The candidate reasons correctly that the increased alcohol concentration would result in a bubble number less than 4.

Example Candidate Response – Question 1, High	Examiner comments
<p>(d) (i) State one variable that has been controlled in the student's investigation.</p> <p>Describe how this variable was controlled.</p> <p>variable <u>the sizes of the potatoes the amount of H_2O_2</u></p> <p>how it was controlled <u>IT WAS CONTROLLED BY CUTTING PIECES OF THE SAME SIZE USING A SYRINGE. IT WAS ADDED 10 cm^3 IN EACH TEST TUBE</u></p> <p style="text-align: right;">[2]</p>	<p>Mark awarded for 1(c)(iii) = 1 out of 1</p> <p>A valid variable was selected. It would be preferable to state <i>volume</i> or <i>concentration</i> of hydrogen peroxide rather than <i>amount</i>. A correct method of control is given.</p>
<p>(ii) The method of measuring the oxygen gas produced is a source of error.</p> <p>State one reason why this method is a source of error.</p> <p><u>COUNTING THE BUBBLES DELIVERED ISN'T RELIABLE.</u></p> <p>Suggest how to improve the method to minimise this error.</p> <p><u>REPEAT THE EXPERIMENT MORE TIMES AND TO TAKE A MORE ACCURATE MEAN.</u></p> <p style="text-align: right;">[2]</p>	<p>Mark awarded for 1(d)(i) = 2 out of 2</p> <p>The reason given needs to be more specific by explaining <i>why</i> counting bubbles is unreliable. For example, bubbles will vary in size. The improvement is acceptable.</p>
<p>(iii) Identify the source of error in step 2. State why this is a source of error.</p> <p>source of error <u>THE SIZES ARE SIMILAR, NOT IDENTICAL</u></p> <p>reason <u>AS THE SIZES ARE NOT THE SAME THE NUMBER OF BUBBLES WILL BE DIFFERENT FOR SURE.</u></p> <p style="text-align: right;">[2]</p>	<p>Mark awarded for 1(d)(ii) = 1 out of 2</p> <p>A correct source of error but an inadequate reason. The candidate needs to refer to surface area or the number of catalase molecules available.</p>
<p>(iv) Describe a control experiment that the student could carry out for this investigation.</p> <p><u>INSTEAD OF PUTTING THE PIECES OF POTATO IN HYDROGEN PEROXIDE SOLUTION, PUT THEM IN DISTILLED WATER AND DO ALL THE STEPS OF THE REAL EXPERIMENT.</u></p> <p style="text-align: right;">[2]</p>	<p>Mark awarded for 1(d)(iii) = 1 out of 2</p> <p>The candidate gains a mark for saying that the same experimental procedure would be used. Using water instead of hydrogen peroxide would not be a control for this experiment.</p>
<p>(v) Predict the result expected from the control experiment described in (iv).</p> <p><u>THERE WILL BE NO BUBBLES PRODUCED.</u></p> <p style="text-align: right;">[1]</p>	<p>Mark awarded for 1(d)(iv) = 1 out of 2</p> <p>Although the control in (iv) was incorrect, this prediction was awarded a mark on the basis of error-carried-forward.</p>

Example Candidate Response – Question 1, High

Examiner comments

(e) State one safety precaution required when ethanol is used in an investigation.

Use protected safety glasses and gloves

[1]

**Mark awarded for 1(d)(v)
 = 1 out of 1**

A correct safety precaution stated.

(f) In an investigation into the effects of alcohol on the nervous system, people were asked to carry out a test on their reaction time.

The person being tested looked at a coloured block on a computer screen.
 As soon as the colour changed they pressed a button.
 The time taken to press the button was recorded by the computer.
 This was their reaction time.

**Mark awarded for 1(e)
 = 1 out of 1**

Twenty people were tested before and after consuming a drink containing the same concentration of alcohol.

Table 1.2 shows the results of this investigation.

Table 1.2

test person	reaction time before consuming alcohol /milliseconds	reaction time after consuming alcohol /milliseconds
1	272	322
2	310	350
3	225	270
4	243	290
5	240	308
6	264	315
7	201	238
8	262	300
9	225	252
10	235	278
11	225	253
12	247	271
13	226	266
14	194	220
15	206	239
16	309	340
17	223	261
18	243	286
19	270	316
20	180	225
mean	240	280

(i) Calculate the mean for the reaction time after consuming alcohol.

Write your answer in Table 1.2.

[1]

The mean is calculated accurately.

**Mark awarded for 1(f)(i)
 = 1 out of 1**

Example Candidate Response – Question 1, High	Examiner comments
<p>(ii) Plot a bar chart to show the mean reaction time of the people tested before and after consuming alcohol.</p> <p>(iii) The range of reaction times recorded before consuming alcohol is 180–310 milliseconds. Use Table 1.2 to identify the range of reaction times recorded after consuming alcohol.</p> <p style="text-align: center;">225 250 - 350 milliseconds [1]</p> <p style="text-align: right;">[Total: 27]</p>	<p>The axes are labelled correctly and the scale on the y-axis is even. Both plots are accurate. Columns are of equal width, not touching and occupy more than half the grid on the y-axis.</p> <p>Mark awarded for 1(f)(ii) = 3 out of 3</p> <p>Incorrect range given.</p> <p>Mark awarded for 1(f)(iii) = 0 out of 1</p> <p>Total mark awarded = 21 out of 27</p>

How the candidate could have improved the answer

- (a)(ii) The candidate was awarded full marks but could have improved the column headings by expanding them to 'number of bubbles / 3 min' and 'Mean number of bubbles / 3 min' to make them more precise.
- (b)(i) The candidate could have improved by reading the question more carefully and thinking about their response, as they did not answer the question posed. It was necessary to give a response along the lines of preventing leakage of oxygen, or that bubbles could be counted as soon as the reaction starts.
- (b)(ii) The instruction in the question was to 'explain' and the question carries two marks, which usually indicates that two distinct points are needed. The candidate provided one point only. The candidate would have gained full marks if there was reference to the validity / consistency of the results. The candidate could also have stated their answer more clearly.
- (c)(i) Although the candidate was given the benefit of the doubt and awarded the mark, candidates should be encouraged to use the correct scientific vocabulary and refer to 'volume' or 'concentration' and not 'amount'.

- (d)(i) All the material required for full marks is present, but it could have been expressed more clearly. The candidate could improve by deciding what to write before putting pen to paper. On a minor point, it is preferred that chemical names are written, rather than the symbols given. In this instance, $2\text{H}_2\text{O}_2$ indicates 'two molecules of hydrogen peroxide'.
- (d)(ii) The candidate could improve by explaining why counting bubbles is an unreliable method. This could be that bubbles vary in size, or that small bubbles might not be counted.
- (d)(iii) The candidate gains one mark from what is written in total. Ideally, the source of error needs to say that the imprecise method of cutting leads to different sized pieces of potato. The candidate then needs to give a reason for it being a source of error, i.e. it would mean different surface areas of potato / different numbers of catalase molecules exposed to hydrogen peroxide solution, thus the volume of oxygen released would vary.
- (d)(iv) The response could have been improved by having a control that eliminated the effect of alcohol. For example, soaking the potato in water and not in alcohol.
- (d)(v) The candidate was awarded a mark for stating the result that would have been obtained if their control suggestion had been carried out; the follow-through reasoning was appropriate.
- (f)(ii) A minor improvement would be to label the y-axis '**mean** reaction time / ms'.
- (f)(iii) The candidate got the lower end of the range incorrect: the correct range was **220** – 350.

Example Candidate Response – Question 1, Middle

Examiner comments

1 Metabolic reactions in cells produce toxic chemicals which can be converted to harmless or less toxic chemicals.

Hydrogen peroxide is broken down using the enzyme catalase which is found in most cells.

Fig. 1.1 shows this reaction.

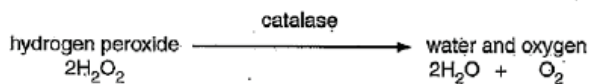


Fig. 1.1

A student investigated the effect of alcohol (ethanol) on the activity of catalase found in potato, using three pieces of potato cut to the same size.

Fig. 1.2 shows these pieces of potato.

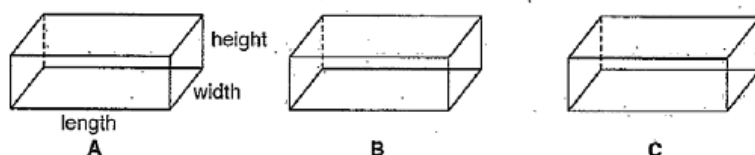


Fig. 1.2

(a) (i) Measure the length, width and height of one of these pieces of potato.

Record your results in Table 1.1.

Table 1.1

length of potato piece /mm	width of potato piece /mm	height of potato piece /mm
30 mm ①	10	10

[1]

① An incorrect answer has been crossed out and replaced with the correct answer. It is important that incorrect answers are clearly crossed out. If two conflicting answers are given, no marks are awarded.

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

Step 1 The student labelled six test-tubes, 1, 2, 3, 4, 5, and 6 and used a syringe to add 10 cm³ of hydrogen peroxide solution to each of the test-tubes.

Step 2 They cut potato piece A to obtain two slices of similar size.

Step 3 The student placed the free end of a delivery tube into a large test-tube containing water.

Step 4 They placed one of the slices of potato piece A into the hydrogen peroxide solution in test-tube 1.

Step 5 The student immediately placed the rubber bung attached to the delivery tube into test-tube 1 and pushed it in as tightly as possible, as shown in Fig. 1.3.

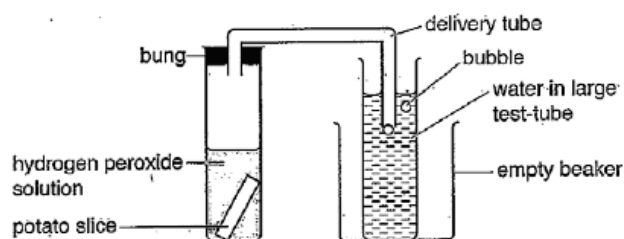


Fig. 1.3

Example Candidate Response – Question 1, Middle

Examiner comments

Step 6 They counted the number of bubbles released from the delivery tube in 3 minutes.
 Step 7 The student repeated steps 4–6 for the second slice of potato piece A using test-tube 2.
 Step 8 They repeated steps 2–7 for potato piece B using test-tubes 3 and 4.
 Step 9 They repeated steps 2–7 for potato piece C using test-tubes 5 and 6.
 The student used a tally to count the number of bubbles.
 Fig. 1.4 shows their tally count.

A1	5	A2	3
B1	18	B2	11
C1	12	C2	10

Fig. 1.4

- (ii) Prepare a table to record the student's results.
 Your table should show:
- the numbers of bubbles produced by each slice of potato in 3 minutes
 - the mean number of bubbles produced by each of potato piece A, B and C.

Complete your table using the results from Fig. 1.4.

number of bubbles	potato pieces					
	A		B		C	
	1	2	1	2	1	2
number of bubbles produced	5	3	18	11	12	10
mean	4		14.5		11	

[5]

The candidate produces a table with the correct number of columns and rows. The data entered is correctly. However, the units are missing from both the number of bubbles and the mean (number of bubbles), so a mark is lost.

Mark awarded for 1(a)(ii) = 4 out of 5

- (b) (i) Suggest why the free end of the delivery tube was placed in the water before adding the potato slice to the hydrogen peroxide solution and connecting the test-tube to the bung of the delivery tube.

To prevent the escape of oxygen gas, as the potato slice contains the catalase enzyme.

[1]

The candidate gives a correct response.

Mark awarded for 1(b)(i) = 1 out of 1

Example Candidate Response – Question 1, Middle	Examiner comments
<p>(ii) Explain why the bung of the delivery tube must fit tightly into the test-tube.</p> <p>To prevent the gas pressure inside from blocking the tube.</p> <p>[2]</p>	<p>The answer does not make sense, no marks are awarded.</p> <p>Mark awarded for 1(b)(ii) = 0 out of 2</p>
<p>(c) The pieces of potato that the student used in their investigation were soaked in different concentrations of alcohol for 24 hours.</p> <ul style="list-style-type: none"> Potato piece A was soaked in 20% alcohol. Potato piece B was soaked in 2% alcohol. Potato piece C was soaked in 10% alcohol. <p>(i) Suggest the relationship between the number of bubbles and the activity of catalase.</p> <p>As the activity of catalase enzyme increases, the more hydrogen peroxide breaks water and oxygen bubbles are produced.</p> <p>[1]</p>	<p>The candidate states the correct relationship.</p> <p>Mark awarded for 1(c)(i) = 1 out of 1</p>
<p>(ii) Compare the activity of catalase in the potato pieces A, B and C.</p> <p>The activity in potato piece B was more, as the mean number of bubbles was 14.5, while the mean number of bubbles in A was 4 and in C, it was 11.</p> <p>[1]</p>	<p>The candidate starts correctly by stating that B had more (catalase) activity, but does not complete the answer by relating this to the activity of A and C. Quoting the number of bubbles produced is not explicit enough.</p> <p>Mark awarded for 1(c)(ii) = 0 out of 1</p>
<p>(iii) Predict the number of bubbles that would be produced in 3 minutes if a piece of potato was soaked in 50% alcohol before being placed in hydrogen peroxide solution.</p> <p>10 bubbles. $4 \rightarrow 0.3$</p> <p>[1]</p>	<p>The prediction is incorrect.</p> <p>Mark awarded for 1(c)(iii) = 0 out of 1</p>
<p>(d) (i) State one variable that has been controlled in the student's investigation.</p> <p>Describe how this variable was controlled.</p> <p>variable temperature</p> <p>how it was controlled by using a water bath, which can regulate the temperature.</p> <p>[2]</p>	<p>Temperature was not a variable that was controlled in this investigation, so both parts of the answer are incorrect.</p> <p>Mark awarded for 1(d)(i) = 0 out of 2</p>

Example Candidate Response – Question 1, Middle	Examiner comments
<p>(ii) The method of measuring the oxygen gas produced is a source of error.</p> <p>State one reason why this method is a source of error.</p> <p>As the student can miscount the number of bubbles produced.</p> <p>Suggest how to improve the method to minimise this error.</p> <p>By measuring the volume of oxygen produced by attaching a gas type syringe to the apparatus.</p> <p style="text-align: right;">[2]</p>	<p>The candidate correctly identifies a source of error and has suggests an improvement that would increase the accuracy of the result.</p> <p>Mark awarded for 1(d)(ii) = 2 out of 2</p>
<p>(iii) Identify the source of error in step 2. State why this is a source of error.</p> <p>source of error ^{parallel} error error may have occurred, while measuring the sides.</p> <p>reason as the ruler wasn't on the potato, while measuring its length, width and height.</p> <p style="text-align: right;">[2]</p>	<p>This answer does not relate to step 2 (where no ruler was used in cutting the original slice into two pieces).</p> <p>Mark awarded for 1(d)(iii) = 0 out of 2</p>
<p>(iv) Describe a control experiment that the student could carry out for this investigation.</p> <p>By By doing the same experiment, but using the a boiled piece of potato to denature the catalase enzyme.</p> <p style="text-align: right;">[2]</p>	<p>The candidate is awarded a mark for stating that the same experiment is repeated. Using boiled potato does not test the effect of alcohol, so the second mark is not awarded.</p> <p>Mark awarded for 1(d)(iv) = 1 out of 2</p>
<p>(v) Predict the result expected from the control experiment described in (iv).</p> <p>no oxygen bubbles will be produced.</p> <p style="text-align: right;">[1]</p>	<p>This is awarded one mark on the basis of error-carried-forward. The candidate's reasoning that boiled potato would not produce any oxygen is correct.</p> <p>Mark awarded for 1(d)(v) = 1 out of 1</p>
<p>(e) State one safety precaution required when ethanol is used in an investigation.</p> <p>using a water-bath, when heating to prevent the ethanol ethanol from splashing.</p> <p style="text-align: right;">[1]</p>	<p>The safety precaution is accepted as valid.</p> <p>Mark awarded for 1(e) = 1 out of 1</p>

Example Candidate Response – Question 1, Middle

Examiner comments

- (f) In an investigation into the effects of alcohol on the nervous system, people were asked to carry out a test on their reaction time.

The person being tested looked at a coloured block on a computer screen.
As soon as the colour changed they pressed a button.
The time taken to press the button was recorded by the computer.
This was their reaction time.

Twenty people were tested before and after consuming a drink containing the same concentration of alcohol.

Table 1.2 shows the results of this investigation.

Table 1.2

test person	reaction time before consuming alcohol /milliseconds	reaction time after consuming alcohol /milliseconds
1	272	322
2	310	350
3	225	270
4	243	290
5	240	308
6	264	315
7	201	238
8	262	300
9	225	252
10	235	278
11	225	253
12	247	271
13	226	266
14	194	220
15	206	239
16	309	340
17	223	261
18	243	286
19	270	316
20	180	225
mean	240	280

- (i) Calculate the mean for the reaction time after consuming alcohol.

Write your answer in Table 1.2.

[1]

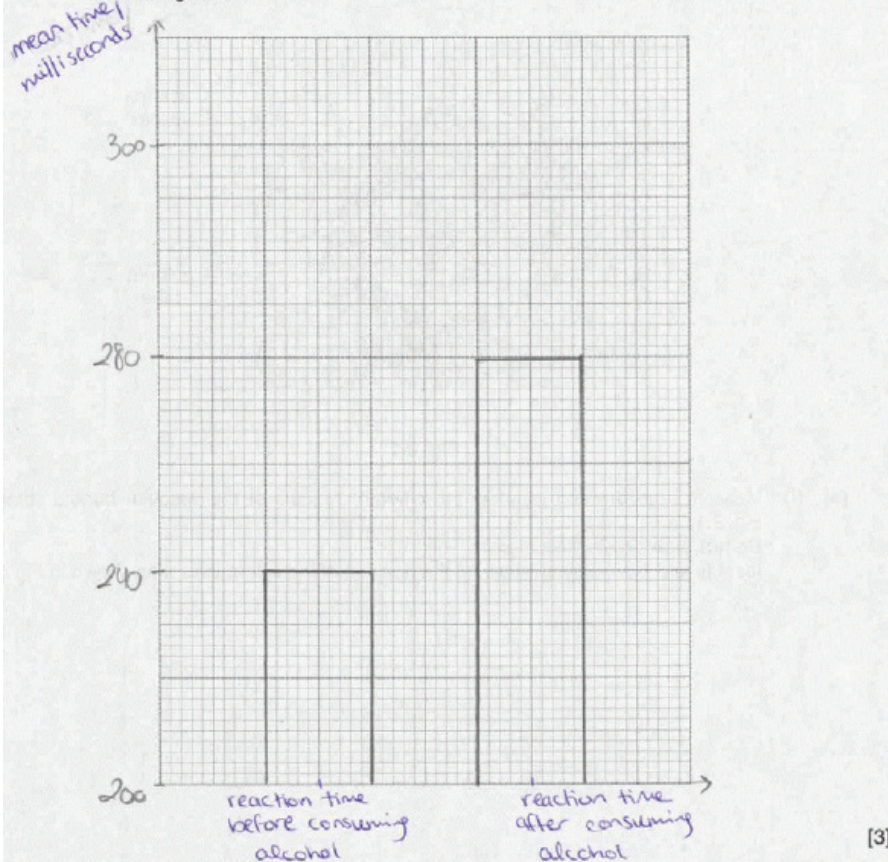
The mean is calculated correctly.

**Mark awarded for 1(f)(i)
= 1 out of 1**

Example Candidate Response – Question 1, Middle

Examiner comments

(ii) Plot a bar chart to show the **mean** reaction time of the people tested before and after consuming alcohol.



(iii) The range of reaction times recorded before consuming alcohol is 180–310 milliseconds.

Use Table 1.2 to identify the range of reaction times recorded after consuming alcohol.

...220–350... milliseconds [1]

[Total: 27]

Marks are awarded as columns are plotted accurately, they are equal width and not touching. The y-axis is not fully labelled and the scale on the y-axis is uneven so one mark is not awarded.

Mark awarded for 1(f)(ii) = 2 out of 3

The range is accurate.

Mark awarded for 1(f)(iii) = 1 out of 1

Total mark awarded = 16 out of 27

How the candidate could have improved the answer

- 1(a)(ii) The candidate would have gained another mark by giving the headings as 'number of bubbles / 3 min' and 'mean number of bubbles / 3 min.'
- 1(b)(ii) The candidate could have improved by stating that if the bung does not fit tightly, oxygen will escape from the apparatus. This will mean that the number of bubbles will be reduced and so results will not be valid.
- 1(c)(ii) The candidate needed to take their answer further by stating that potato piece B had the greatest catalase activity and A had the least (and therefore, C was in between).
- 1(c)(iii) The candidate needed to base their prediction on the fact that A (soaked in 20% alcohol) produced the smallest number of bubbles: mean of 4 bubbles / 3 min. Thus, soaking the potato piece in 50% alcohol would not produce more bubbles than A. Any answer between 0 – 4 (bubbles / 3 min) was acceptable.
- 1(d)(i) The candidate could have improved by reading the description of the investigation with more care and then selecting a variable that was controlled. The method of controlling the variable would depend on which one was selected. For example, the surface areas of the potato pieces were controlled by cutting each piece to the same dimensions.

Example Candidate Responses: Paper 6

- 1(d)(iii) The candidate could have improved by reading step 2 carefully. No ruler was used. This resulted in the two pieces having different dimensions. This would mean that the number of enzyme molecules available would be different and so different volumes of gas would be produced.
- 1(d)(iv) The candidate could have improved by considering the information given about the treatment of the pieces that resulted in the differing oxygen volumes. This treatment involved soaking in alcohol, so the control must test whether this treatment was actually responsible for the differing volumes of gas produced.
- 1(d)(v) The candidate could have improved this answer if the correct response to (d)(iv) had been given.
- 1 (f)(ii) An improvement would have been to label the *y*-axis correctly as “mean reaction time / ms.” Also the scale on the *y*-axis between 280 and 300 should be made even.

Example Candidate Response – Question 1, Low

Examiner comments

1 Metabolic reactions in cells produce toxic chemicals which can be converted to harmless or less toxic chemicals.

Hydrogen peroxide is broken down using the enzyme catalase which is found in most cells.

Fig. 1.1 shows this reaction.

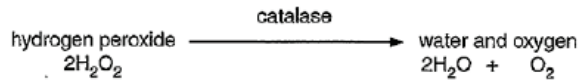


Fig. 1.1

A student investigated the effect of alcohol (ethanol) on the activity of catalase found in potato, using three pieces of potato cut to the same size.

Fig. 1.2 shows these pieces of potato.

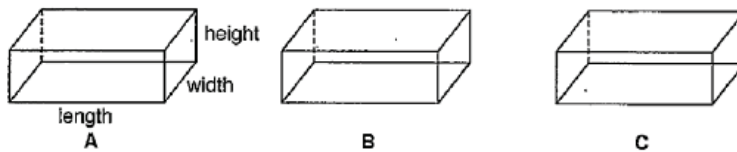


Fig. 1.2

(a) (i) Measure the length, width and height of one of these pieces of potato.

Record your results in Table 1.1.

Table 1.1

length of potato piece /mm	width of potato piece /mm	height of potato piece /mm
3mm	1mm	1mm

The mark is not awarded as the measurements are incorrect. It looks as if candidate has given them in cm, not mm.

[1] **Mark awarded for 1(a)(i) = 0 out of 1**

Step 1 The student labelled six test-tubes, 1, 2, 3, 4, 5, and 6 and used a syringe to add 10cm³ of hydrogen peroxide solution to each of the test-tubes.

Step 2 They cut potato piece A to obtain two slices of similar size.

Step 3 The student placed the free end of a delivery tube into a large test-tube containing water.

Step 4 They placed one of the slices of potato piece A into the hydrogen peroxide solution in test-tube 1.

Step 5 The student immediately placed the rubber bung attached to the delivery tube into test-tube 1 and pushed it in as tightly as possible, as shown in Fig. 1.3.

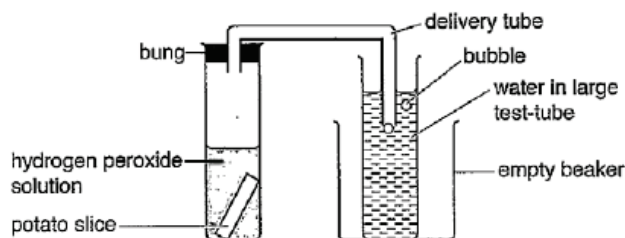


Fig. 1.3

Example Candidate Response – Question 1, Low

Examiner comments

- Step 6 They counted the number of bubbles released from the delivery tube in 3 minutes.
- Step 7 The student repeated steps 4–6 for the second slice of potato piece A using test-tube 2.
- Step 8 They repeated steps 2–7 for potato piece B using test-tubes 3 and 4.
- Step 9 They repeated steps 2–7 for potato piece C using test-tubes 5 and 6.

The student used a tally to count the number of bubbles.

Fig. 1.4 shows their tally count.

A1		A2	
B1		B2	
C1		C2	

Fig. 1.4

- (ii) Prepare a table to record the student's results. Your table should show:
- the numbers of bubbles produced by each slice of potato in 3 minutes
 - the mean number of bubbles produced by each of potato piece A, B and C.

Complete your table using the results from Fig. 1.4.

	Number of bubbles Produced by each slice of potato in 3mins	the mean # of bubbles produced by each of potato piece
A ₁	6	3 4
B ₁	18	10 14.5
C ₁	12	10 11
A ₂	3	
B ₂	11	
C ₂	10	

The candidate is awarded marks for drawing a table, including an appropriate number of cells, and correctly calculating all three means.

The candidate is not awarded the other two marks because there is no heading for the 'potato piece' column and the number of bubbles for A₁ is incorrect.

Mark awarded for 1(a)(ii) = 3 out of 5

Example Candidate Response – Question 1, Low	Examiner comments
<p>(b) (i) Suggest why the free end of the delivery tube was placed in the water before adding the potato slice to the hydrogen peroxide solution and connecting the test-tube to the bung of the delivery tube.</p> <p>So no reaction happens without the delivery tube and connecting the test-tube to the bung being there.....[1]</p>	<p>The candidate recognises that it is important to have the apparatus set up before the start of the reaction but is not awarded a mark because no reference is made to oxygen / gas produced (either that it is prevented from escaping or that all the gas will be collected).</p> <p>Mark awarded for 1(b)(i) = 0 out of 1</p>
<p>(ii) Explain why the bung of the delivery tube must fit tightly into the test-tube.</p> <p>① So nothing can escape ② So results are accurate.....[2]</p>	<p>The candidate gains a mark for stating that the results would be accurate. '... nothing can escape' is too vague and so does not gain a mark. It is essential to say that oxygen / gas cannot escape.</p> <p>Mark awarded for 1(b)(ii) = 1 out of 2</p>
<p>(c) The pieces of potato that the student used in their investigation were soaked in different concentrations of alcohol for 24 hours.</p> <ul style="list-style-type: none"> Potato piece A was soaked in 20% alcohol. Potato piece B was soaked in 2% alcohol. Potato piece C was soaked in 10% alcohol. 	<p>The candidate is not awarded a mark as the answer is too vague and no relationship is given.</p>
<p>(i) Suggest the relationship between the number of bubbles and the activity of catalase.</p> <p>they aren't the same.....[1]</p>	<p>Mark awarded for 1(c)(i) = 0 out of 1</p>
<p>(ii) Compare the activity of catalase in the potato pieces A, B and C.</p> <p>they are all different.....[1]</p>	<p>The answer is not sufficiently detailed to be awarded a mark.</p> <p>Mark awarded for 1(c)(ii) = 0 out of 1</p>
<p>(iii) Predict the number of bubbles that would be produced in 3 minutes if a piece of potato was soaked in 50% alcohol before being placed in hydrogen peroxide solution.</p> <p>35.....[1]</p>	<p>The candidate gives a figure that is too high, suggesting that they do not understand the experiment or the results.</p> <p>Mark awarded for 1(c)(iii) = 0 out of 1</p>

Example Candidate Response – Question 1, Low	Examiner comments
<p>(d) (i) State one variable that has been controlled in the student's investigation.</p> <p>Describe how this variable was controlled.</p> <p>variable <u>potato slice</u></p> <p>how it was controlled <u>in each test tube the same size of potato slice</u></p> <p style="text-align: right;">[2]</p>	<p>'Potato slice' is not awarded a mark as it is unclear which aspect of the potato is being controlled. The mark for the variable is actually awarded in the second part of the answer where it becomes clear that it is the size that is being controlled. The second mark is awarded for use of the same size of potato in each test.</p> <p>Mark awarded for 1(d)(i) = 2 out of 2</p>
<p>(ii) The method of measuring the oxygen gas produced is a source of error.</p> <p>State one reason why this method is a source of error.</p> <p><u>Because it can be more or less ^{oxygen} in each test tube</u></p> <p>Suggest how to improve the method to minimise this error.</p> <p><u>Use the same tube</u></p> <p style="text-align: right;">[2]</p>	<p>The candidate does not identify a source of error in the method, and so cannot suggest an improvement. No marks are awarded.</p> <p>Mark awarded for 1(d)(ii) = 0 out of 2</p>
<p>(iii) Identify the source of error in step 2. State why this is a source of error.</p> <p>source of error <u>Cutting potato ^{into} to two slices</u></p> <p>reason <u>the slices to might not be equally the same</u></p> <p style="text-align: right;">[2]</p>	<p>One mark is awarded for stating that the two pieces of potato may not be identical in size (taking what is written in total.) The second mark cannot be awarded as the candidate does not explain why differently sized pieces would result in an error.</p> <p>Mark awarded for 1(d)(iii) = 1 out of 2</p>
<p>(iv) Describe a control experiment that the student could carry out for this investigation.</p> <p><u>Boiled enzymes</u></p> <p style="text-align: right;">[2]</p>	<p>No marks are awarded as the candidate does not describe a suitable control for this experiment.</p> <p>Mark awarded for 1(d)(iv) = 0 out of 2</p>

Example Candidate Response – Question 1, Low

Examiner comments

(v) Predict the result expected from the control experiment described in (iv).

faster results

[1]

Error-carried-forward is acceptable here. However, no marks are awarded because if a boiled enzyme had been used, no gas would have been produced.

Mark awarded for 1(d)(v) = 0 out of 1

(e) State one safety precaution required when ethanol is used in an investigation.

Safety goggles

[1]

One mark is awarded for an acceptable safety precaution.

Mark awarded for 1(e) = 1 out of 1

(f) In an investigation into the effects of alcohol on the nervous system, people were asked to carry out a test on their reaction time.

The person being tested looked at a coloured block on a computer screen.
 As soon as the colour changed they pressed a button.
 The time taken to press the button was recorded by the computer.
 This was their reaction time.

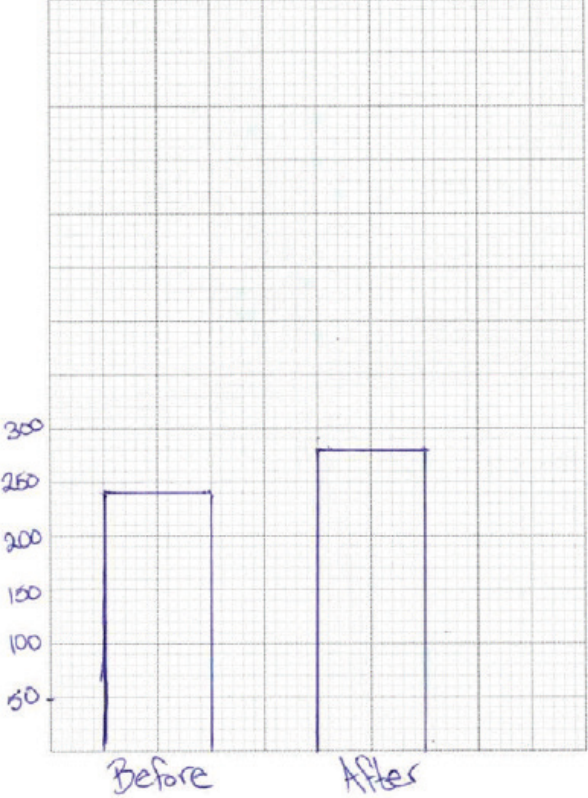
Twenty people were tested before and after consuming a drink containing the same concentration of alcohol.

Table 1.2 shows the results of this investigation.

Table 1.2

test person	reaction time <u>before</u> consuming alcohol /milliseconds	reaction time after consuming alcohol /milliseconds
1	272	322
2	310	350
3	225	270
4	243	290
5	240	308
6	264	315
7	201	238
8	262	300
9	225	252
10	235	278
11	225	253
12	247	271
13	226	266
14	194	220
15	206	239
16	309	340
17	223	261
18	243	286
19	270	316
20	180	225
mean	240	<i>280</i>

8/10

Example Candidate Response – Question 1, Low	Examiner comments
<p>(i) Calculate the mean for the reaction time after consuming alcohol. Write your answer in Table 1.2. [1]</p> <p>(ii) Plot a bar chart to show the <u>mean</u> reaction time of the people tested before and after consuming alcohol.</p>  <p>[3]</p>	<p>The mean is calculated accurately.</p> <p>Mark awarded for 1(f)(i) = 1 out of 1</p> <p>One mark is awarded for accurately plotting both bars. The other two marks are not awarded as there is no label on the y-axis and the bars occupy less than half the grid on the y-axis.</p> <p>Mark awarded for 1(f)(ii) = 1 out of 3</p>
<p>(iii) The range of reaction times recorded before consuming alcohol is 180–310 milliseconds. Use Table 1.2 to identify the range of reaction times recorded after consuming alcohol. 404.5 milliseconds [1]</p> <p>[Total: 27]</p>	<p>It is unclear how the candidate arrives at the answer given, which is incorrect.</p> <p>Mark awarded for 1(f)(iii) = 0 out of 1</p> <p>Total mark awarded = 10 out of 27</p>

How the candidate could have improved the answer

1(a)(i) The candidate could have improved their answer by using the correct units. It is also worth noting that if units are given in the column / row header, then units should not be repeated in the data cell.

If the candidate had measured the potatoes in cm and also changed the units in the table headings to cm, the mark would have been awarded, since the units in the table and the data would have matched.

- 1(a)(ii) The candidate could have improved the answer by:
- drawing lines with a ruler
 - inserting outer borders to the table
 - pre-planning the table (A2, B2 and C2 are obviously a late addition and squashed into the available space)
 - arranging the pairs of test-tubes in two parallel columns
 - counting the tally marks more carefully
 - giving a heading for the potato piece column
 - putting units in the “mean” column heading.
- (b)(i) The candidate could have improved the response by answering the question more fully.
- (b)(ii) The candidate could have improved the answer by being specific in the response. In this case, they were not awarded a mark because they did not state specifically what was prevented from escaping (gas/oxygen). Although they were awarded the mark for saying the experiment would be accurate, an improved response would have been to say it would be **more** accurate.
- (c)(i) This answer could have been improved by stating the relationship: the lower the concentration of alcohol, the more bubbles were produced.
- (c)(ii) The candidate could have improved by being more detailed. They needed to state that sample B had the highest catalase activity, followed by C, with A having the least activity.
- (c)(iii) The candidate needed to base the prediction on the fact that A (soaked in 20% alcohol) produced the smallest number of bubbles: mean of 4 bubbles / 3 min. Thus, soaking the potato piece in 50% alcohol would not produce more bubbles than A. Any answer between 0 – 4 (bubbles / 3 min) was acceptable.
- (d)(i) Although the candidate was awarded full marks for this question, they could have improved the answer by stating the variable (size of potato piece) in the correct answer space.
- (d)(ii) The candidate could have improved by stating clearly a source of error in the measurement of the oxygen, and then suggest a way of rectifying this. The most obvious error is that bubbles vary in size, so counting them would not be a reliable method of estimating the total gas volume produced. Any reasonable improvement would have gained the second mark.
- (d)(iii) The candidate could have improved on this answer by explaining that different sized pieces would have different surface areas. This would mean that the number of enzyme molecules available would be different and so different volumes of gas would be produced.
- (d)(iv) The candidate could have improved by considering the information given about the treatment of the pieces that resulted in the differing oxygen volumes. This treatment involved soaking in alcohol, so the control must test whether this treatment was actually responsible for the differing volumes of gas produced. The candidate would have been awarded a second mark for saying that exactly the same procedure would be followed with the control as in the investigation described.
- (d)(v) The correct response for an error-carried-through mark to be awarded (i.e. the response to match the incorrect control suggested) would be that no gas would be produced (as boiling would denature the catalase).
- (e) An improvement would be to say that safety goggles should be worn.
- (f)(ii) The candidate could have improved the answer by labelling the *y*-axis (*'mean reaction time / ms'*) and using the height of the available graph paper more efficiently. The *x*-axis label could also have been improved to *'before drinking alcohol'* and *'after drinking alcohol'*.
- (f)(iii) The improvement would be to quote a range (as given in the example provided in the question). The correct answer was 220 – 350 (milliseconds).

Common mistakes candidates made in Question 1

- (a)(i) *The examiner was expecting candidates to use a ruler to determine the dimensions of the potato pieces. The dimensions should be entered into the table in millimetres (as that unit is given in the column heading).*

The most common error that candidates made was to state their measurements in centimetres and not in millimetres (as stated in the table heading.)

- (a)(ii) *The examiner was expecting candidates to construct a table with the correct number of cells and with column headings, and to correctly record their data into the table.*

A commonly mistake made by candidates was to omit the units (/ 3 min) from the column headings. Some candidates could not count the tally signs correctly; it appeared that the sloping line denoting '5' was not understood. Some candidates drew tables without using a ruler.

- (b)(i) *The use of 'suggest' in the question indicated that the candidate is not expected to have met this scenario previously. They are expected to provide a sensible reason for the action described, using previous experimental experience.*

A number of candidates incorrectly thought that the procedure described would prevent air (from the atmosphere) entering the delivery tube.

- (b)(ii) *The examiner was expecting the candidate to give a reason why the bung has to have a tight fit in the test tube.*

Some candidates incorrectly thought that a tightly fitting bung was there to prevent substances entering the test-tube. It was common for candidates to refer to 'fair tests' rather than using a precise term such as 'accuracy' or 'validity'.

- (c)(i) *The examiner was expecting the candidate to apply general knowledge to a novel situation and state the relationship between bubble numbers produced and catalase activity.*

The most common error was to refer to the amount of alcohol rather than the percentage or concentration of alcohol.

- (c)(ii) *The examiner was expecting the catalase activity of all three potato pieces to be placed in order.*

The most common errors were:

- restating the number of bubbles with no interpretation
- saying that sample B was more active than sample A, with no reference to the activity of sample C.

- (c)(iii) *The use of the word 'predict' in the question indicated that candidates were required to make a logical connection between the pieces of information, in order to arrive at a certain number of bubbles for the answer.*

Many candidates stated a number of bubbles that was not based on the experimental results given. It appeared that they were guessing.

- (d)(i) *The examiner was expecting a concise answer to 'state one variable.' The candidate was then expected to state in words how the variable selected was kept constant.*

The most common errors were:

- stating a variable that was not controlled in the experiment (such as temperature)
- stating 'potato' as the variable, and then in answer to the second part of the question saying, 'the size was controlled'.

These candidates were giving insufficient detail.

- (d)(ii) *The examiner was expecting a concise reason for the oxygen measurement method to be a source of error. The candidate was expected to apply general knowledge of the subject to this novel situation and provide a possible modification to the method. There was no unique answer.*

A fairly common error was to say that the gas collected may not be oxygen and thus the gas must be tested with a glowing match (or similar).

- (d)(iii) *The examiner was expecting the candidate to refer to step 2 in the description of the investigation. The single source of error had to be stated. Following on from this, the candidate was expected to explain why it constituted a source of error.*

Many candidates did not appreciate what 'step 2' involved (which was dividing a piece of potato without using a ruler). Many assumed a ruler had been used and so gave inappropriate sources of error. Even those who gave a correct source of error could not explain the reason.

- (d)(iv) *The examiner was expecting the candidate to devise a control experiment and say what it would entail. As there were two marks for the answer, the examiner was expecting two distinct points to be made.*

Many candidates appeared to be using controls that they were accustomed to use in class experiments, but that were not applicable here, such as: boiled potato, no potato, boiled catalase, or glass beads.

- (d)(v) *The candidate was expected to use logic to say what the results of the control experiment would be.*

The most common error here was to quote a number of bubbles that bore no relationship to the control suggested.

- (e) *The examiner was expecting a concise description of a safety precaution that would be necessary when using ethanol in a laboratory.*

A significant number of candidates gave safety precautions that were unrelated to the use of ethanol.

- (f)(i) *The examiner was expecting a numerical response.*

Very occasionally, the candidates calculated the mean incorrectly. A few candidates appeared not to have calculators as they were manually adding up in the margins and then performing the division.

- (f)(ii) *The candidate was expected to construct a bar chart on the grid provided.*

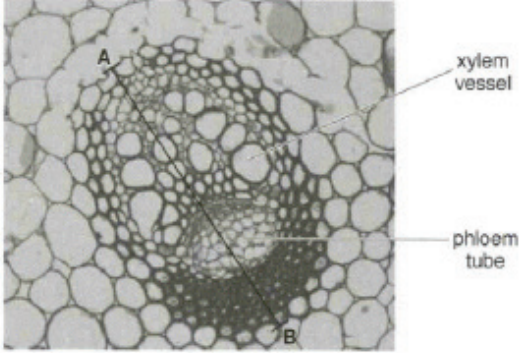
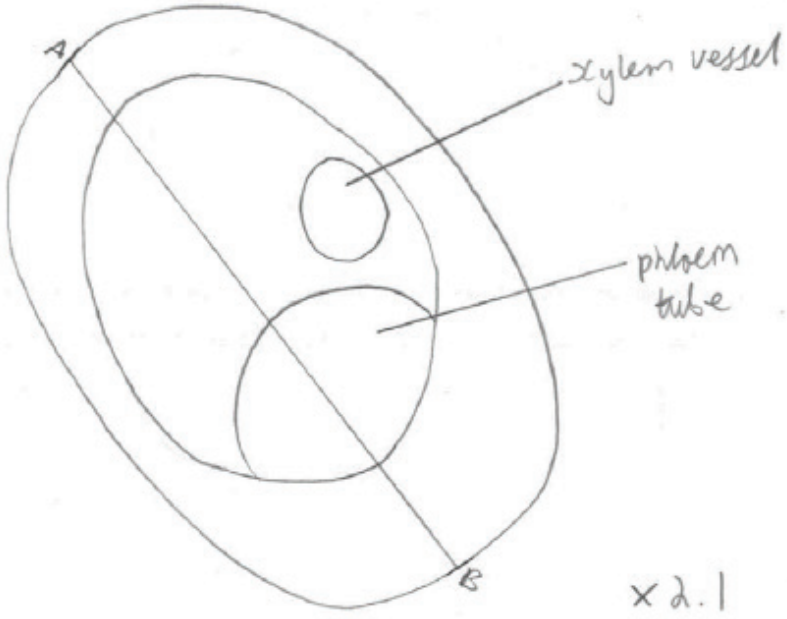
The most common errors were:

- not labelling the y-axis
- omitting the units from the y-axis label
- drawing touching bars

- (f)(iii) *The examiner was expecting a lower and an upper limit to be given for the range.*

It was fairly common for the range to be selected incorrectly.

Question 2

Example Candidate Response – Question 2, High	Examiner comments
<p>2 Fig. 2.1 is a photograph of a cross-section of a vascular bundle in a leaf. Line AB shows the length of the vascular bundle.</p>  <p>Fig. 2.1</p> <p>(a) (i) Make a large drawing to show the different regions of the vascular bundle shown in Fig. 2.1. Do not draw any individual cells. Identify and label on your drawing the position of the xylem vessel as shown in Fig. 2.1.</p>  <p style="text-align: right;">x 2.1</p> <p style="text-align: right;">[5]</p>	<p>The candidate is awarded marks: for all lines being clear, single and unbroken; the drawing is larger than the photograph; the vascular bundle is oval in shape, and the areas of phloem and xylem are shown; the correct position of the required label.</p> <p>One mark is not awarded because two other areas (visible in the photograph) are not drawn.</p> <p>Mark awarded for 2(a)(i) = 4 out of 5</p>

Example Candidate Response – Question 2, High

Examiner comments

(ii) Measure the length of line AB as shown on Fig. 2.1. Include the unit.

Length of AB 5.8 mm

Mark on your drawing a line in the same position as AB.

Measure the line you have drawn.

Length of line on drawing 12 mm

$$\text{magnification} = \frac{\text{length of line on drawing}}{\text{length of AB}}$$

Calculate the magnification of your drawing using the information above and your answers.

Show your working. $\text{magnification} = \frac{\text{length line on drawing}}{\text{length of AB}}$

$$M = \frac{12}{5.8}$$

$$M = 2.086 \text{ magnification } \times 2.1$$

[3]

Both measurements are accurate and the appropriate units are given. The magnification is calculated correctly, rounded to a sensible number and expressed with a × sign.

Mark awarded for 2(a)(ii) = 3 out of 3

(iii) State one way visible in Fig. 2.1 in which the xylem vessel is different from the phloem tube.

The phloem tube is made up of lots of cells whereas the xylem vessel is hollow.

[1]

The photograph has a phloem tube and a xylem vessel labelled, so that a direct comparison can be made. The candidate has taken the entire area of phloem as one tube, and so the answer is not correct.

Mark awarded for 2(a)(iii) = 0 out of 1

(b) The walls of xylem vessels are supported by a chemical called lignin, which can be stained by a red dye. This makes the xylem vessel walls easily seen when using a microscope.

Use this information to plan how you could find the position of the vascular bundles in a stem.

you could cut a cross-section of a stem and place it on a white tile so the ~~back~~ ^{out} ~~lower~~ ^{plane} can easily be seen. you could take 5 pieces of samples (cross sections) of the stem and cut them all the same size depth of 10 mm. you could then add 5 drops of the dye to each cross section of the stem, which would highlight the xylem vessel.

Then you could measure the distance ~~of~~ ^{from} the xylem vessel on a microscope and compare it with the actual pieces, to locate the outline of the vascular bundle in each sample. ^{using different}

[Total: 13]

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Sample allows for errors in the measuring of the vascular bundle may be in a different plane in each case.

The candidate gains full marks for cutting sections of a suitable plant material, adding the dye (to stain the lignin) and then identifying the vascular bundle by the presence of the dyed structures. The candidate states that the cross sections had a depth of 10 mm, which is impractical, but this did not detract from the marks.

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

Total marks awarded = 11 out of 13

How the candidate could have improved the answer

- (a)(i) The candidate could have improved their answer by examining the photograph more carefully and indicating other areas on the diagram. It is not expected that candidates have knowledge of vascular bundle structure (other than xylem and phloem), but it is expected that they can examine a specimen and distinguish different areas.
- (a)(iii) The candidate could have improved by examining the specimen more carefully.
- (b) No major improvement required. It was not necessary (from the instructions) to carry out the staining on five pieces of stem, but it was not incorrect to do so. The scientific principle behind the repetition is sound. An improvement would have been to state an appropriate thickness for the sections, but saying they were thin would have been sufficient.

Example Candidate Response – Question 2, Middle

Examiner comments

2 Fig. 2.1 is a photograph of a cross-section of a vascular bundle in a leaf. Line AB shows the length of the vascular bundle.

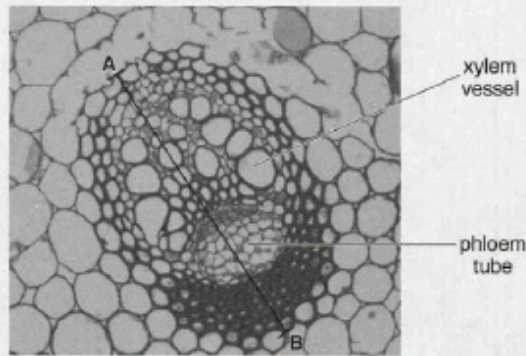
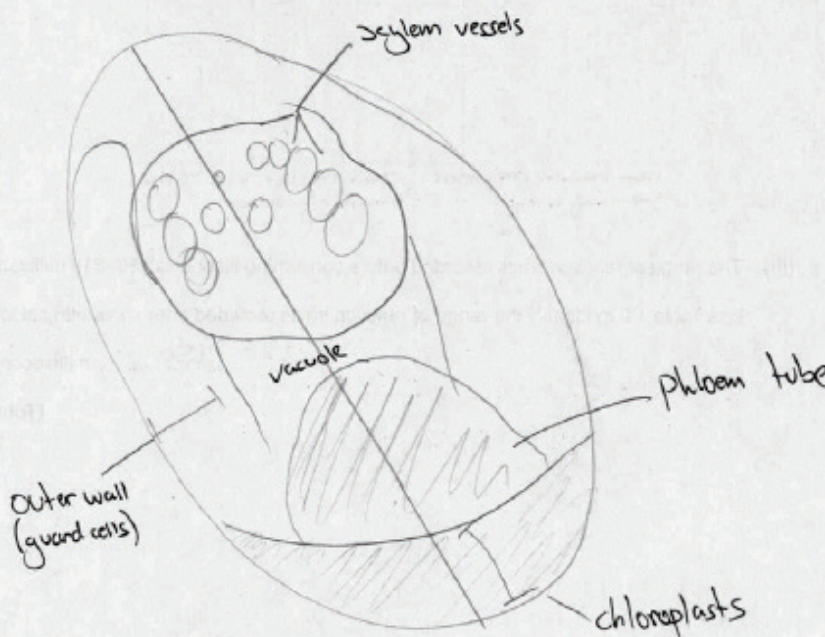


Fig. 2.1

(a) (i) Make a large drawing to show the different regions of the vascular bundle shown in Fig. 2.1. Do not draw any individual cells. Identify and label on your drawing the position of the xylem vessel as shown in Fig. 2.1.



[5]

Two marks are awarded since: the diagram is sufficiently large; and the overall shape is oval, the phloem area is shown and there are three contiguous xylem vessels.

Marks were not awarded because: the lines are not continuous, there are some overlaps and the phloem is shaded; only one other area (the sclerenchyma) is shown; and although there is a label stating 'xylem vessels' the lines do not end on the structures.

Note that strange labels 'vacuole', 'guard cells' and 'chloroplasts', appear.

Mark awarded for (a)(i) = 2 out of 5

Example Candidate Response – Question 2, Middle	Examiner comments
<p>(ii) Measure the length of line AB as shown on Fig. 2.1. Include the unit.</p> <p>Length of AB 5 mm</p> <p>Mark on your drawing a line in the same position as AB.</p> <p>Measure the line you have drawn.</p> <p>Length of line on drawing 140 mm</p> $\text{magnification} = \frac{\text{length of line on drawing}}{\text{length of AB}}$ <p>Calculate the magnification of your drawing using the information above and your answers.</p> <p>Show your working.</p> $\frac{140}{59} = 2.37$ <p>magnification x 2.37 [3]</p>	<p>The first measurement is accurate, the second one is not. The magnification calculation is carried out correctly.</p> <p>Mark awarded for (a)(ii) 2 out of 3</p>
<p>(iii) State one way visible in Fig. 2.1 in which the xylem vessel is different from the phloem tube.</p> <p>..... The xylem vessels are much wider. [1]</p>	<p>The correct comparison is stated.</p> <p>Mark awarded for (a)(iii) = 1 out of 1</p>
<p>(b) The walls of xylem vessels are supported by a chemical called lignin, which can be stained by a red dye. This makes the xylem vessel walls easily seen when using a microscope.</p> <p>Use this information to plan how you could find the position of the vascular bundles in a stem.</p> <p>..... Use the dye to enter the xylem vessels. Dye the stem. In order to find the vascular bundle look for a large area that is dyed red. This is your bundle. [4]</p> <p>[Total: 13]</p>	<p>The dye is added to stain the xylem vessels and the latter, is used to locate the vascular bundle.</p> <p>Mark awarded for (b) = 2 out of 4</p> <p>Total marks awarded = 7 out of 13</p>

How the candidate could have improved the answer

- (a)(i) The candidate could have improved by:
- drawing clear continuous lines and not shading parts of the diagram
 - examining the photograph in more detail and drawing all the areas visible
 - ensuring that label lines end on the intended structures.
- (a)(ii) An improvement would have been to measure the length of the line drawn on the diagram more accurately.
- (b) The candidate could have improved by giving more detail of the planning, such as cutting a thin section and giving the dye sufficient time to stain the xylem vessels. Dissecting the stem is not appropriate.

Example Candidate Response, Question 2, Low

Examiner comments

2 Fig. 2.1 is a photograph of a cross-section of a vascular bundle in a leaf. Line AB shows the length of the vascular bundle.

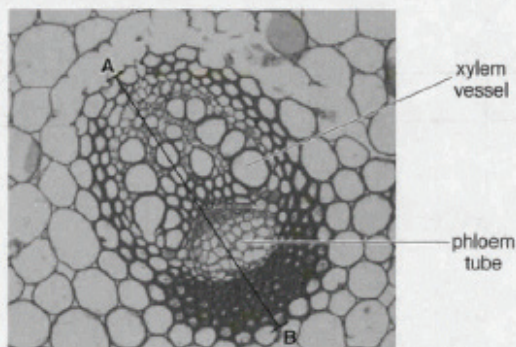
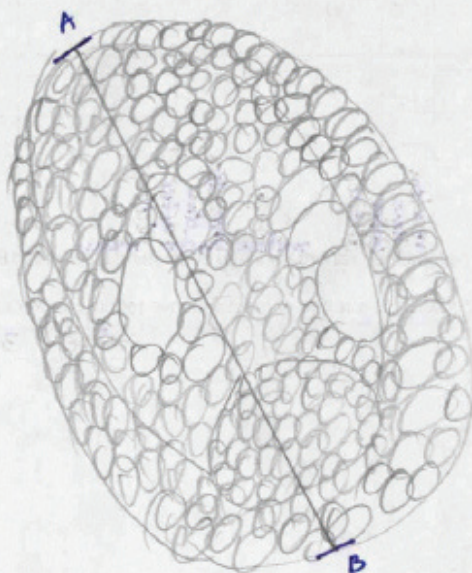


Fig. 2.1

(a) (i) Make a large drawing to show the different regions of the vascular bundle shown in Fig. 2.1. Do not draw any individual cells. Identify and label on your drawing the position of the xylem vessel as shown in Fig. 2.1.



Two marks are awarded since: the drawing is much larger than the original photograph; and the drawing shows the area of phloem plus three contiguous xylem vessels (which is allowed as representing the area of xylem).

Marks were not awarded since: the lines are not single, clear and unbroken; the candidate has ignored the instruction given and has drawn numerous cells with many errors in line quality; no other areas are defined on the drawing; and the candidate has not shown the position of the xylem vessel.

Mark awarded for 2(a)(i) = 2 out of 5

Example Candidate Response, Question 2, Low

Examiner comments

(ii) Measure the length of line AB as shown on Fig. 2.1. Include the unit.

Length of AB 59 mm

1cm = 10mm
5.9 =

Mark on your drawing a line in the same position as AB.

Measure the line you have drawn.

Length of line on drawing 109 mm

$$\text{magnification} = \frac{\text{length of line on drawing}}{\text{length of AB}}$$

Calculate the magnification of your drawing using the information above and your answers.

Show your working.

$$\frac{109}{59}$$

magnification x $\frac{109}{59}$ mm ¹ [3]

(iii) State one way visible in Fig. 2.1 in which the xylem vessel is different from the phloem tube.

Xylem vessel are bigger and wider than phloem tube

..... [1]

(b) The walls of xylem vessels are supported by a chemical called lignin, which can be stained by a red dye. This makes the xylem vessel walls easily seen when using a microscope.

Use this information to plan how you could find the position of the vascular bundles in a stem.

→ Put few drops of lignin in the steam

→ if the colour wait till it diffuse

→ the part where you can put it under the microscope

→ the part which will be red in colour → vascular bundles

..... [4]

[Total: 13]

The candidate is awarded marks for the accurate measurement and units of the line AB on the photo, and for the correct measurement of the line on their drawing.

The magnification calculation is incomplete, so a mark is not awarded here.

1 Note that the candidate has included 'mm' in the magnification, which would invalidate the answer even if it were calculated correctly.

Mark awarded for 2(a)(ii) = 2 out of 3

The candidate is awarded one mark for correctly identifying a difference.

Mark awarded for 2(a)(iii) = 1 out of 1

The candidate appears to have misunderstood the information given, as the dye is referred to as lignin. The only mark awarded is for the waiting period to give the dye time to be absorbed. The location of the vascular bundle is insufficiently explained.

Mark awarded for 2(b) = 1 out of 4

Total mark awarded = 6 out of 13

How the candidate could have improved the answer

- (a)(i) The candidate could have improved by:
- drawing areas (not individual cells)
 - representing all the different areas visible in the photograph
 - improving line quality and ensuring lines do not overlap
 - following all instructions, particularly the instruction to label the xylem vessel.
- (a)(ii) The answer could be improved by the candidate completing the calculation and remembering that a magnification is not followed by units of length.
- (a)(iii) The sole improvement would be to use the correct tense (but this is a minor matter and does not impact on the mark as the biology is perfectly clear).
- (b) The candidate could have improved the answer by having a better understanding of the question. Reading the information given more carefully would have helped. The candidate needs to say that a thin section of the stem is cut (otherwise any cell detail would not be visible under the microscope).

Common mistakes candidates made in Question 2

- (a)(i) *The examiner was expecting a drawing, in pencil, showing the different regions of the vascular bundle from the photograph provided. The candidate was expected to label a xylem vessel on the drawing produced.*

The majority of candidates drew cells and not areas of different cell types. Where cells were drawn the line quality almost inevitably fell below the standard required as lines were numerous. Many of those who drew areas of different cells used shading. The majority differentiated xylem and phloem only. Many neglected to label an xylem vessel.

- (a)(ii) *The examiner was expecting the candidate to make two linear measurements, using a ruler, and to state these, giving appropriate units. These measurements should then be used to calculate the magnification of the candidate's drawing.*

The most common error was not drawing the line AB on the diagram.

- (a)(iii) *The examiner was expecting a brief description of a visible difference between a xylem vessel and a phloem tube shown in the photograph.*

Some candidates mistook the whole area of phloem tissue for one phloem tube.

- (b) *The examiner was expecting a precise sequence of actions that would be carried out in order to locate a vascular bundle. There were four marks available so the candidate was expected to give at least four steps in the process they planned.*

Many candidates had not planned the sequence of procedures before starting to write and so produced rather muddled accounts. Common stages omitted were cutting a section and leaving time for the dye to be absorbed by the lignin.

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