Example Candidate Responses

Cambridge International AS & A Level

Cambridge International AS and A Level Biology

9700

Paper 3 – Advanced Practical Skills

Cambridge Advanced

CAMBRIDGE International Examinations

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Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS and A Level Biology (9700), 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 to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For each question, each response is annotated with a clear explanation of where and why marks were awarded or omitted. This, in turn, 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 will have to do to improve their answers. At the end there is a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work. These help teachers to assess the standard required to achieve marks, beyond the guidance of the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

The questions, mark schemes and pre-release material used here are available to download as a zip file from Teacher Support as the Example Candidate Responses Files. These files are:

Question Paper 22, June 2016	
Question paper	9700_s16_qp_22.pdf
Mark scheme	9700_s16_ms_22.pdf
Question Paper 33, June 2016	
Question paper	9700_s16_qp_33.pdf
Mark scheme	9700_s16_ms_33.pdf
Question Paper 41, June 2016	
Question paper	9700_s16_qp_41.pdf
Mark scheme	9700_s16_ms_41.pdf
Question Paper 52, June 2016	
Question paper	9700_s16_qp_52.pdf
Mark scheme	9700_s16_ms_52.pdf

Past papers, Examiner Reports and other teacher support materials are available on Teacher Support at **https://teachers.cie.org.uk**

How to use this booklet

Example candidate response – high	Examiner comments
Answer **all** the questions. 1 Statements **A** to **E** are about the structure and functioning of enzymes. State the correct term to match each of the statements **A** to **E**. 1 …that needs to be overcome by reactants in order … …es on the active site being partially flexible and …e. …n… …n enzyme, with a tertiary or quaternary structure that results in an approximately spherical shape. Globular **D** The term for enzymes that function outside cells. Extracellular **E** The concentration of substrate that enables an enzyme to achieve half the maximum rate of reaction. Km value [5] [Total: 5]	1 This candidate has responded as requested and given answers that are concise and are **Total mark awarded = 5 out of 5**

Answers 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, linked to specific part of the answer. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

How the candidate could have improved their answer

Stating for **E** the 'Michaelis-Menten constant' wou…
However, knowledge that this is also referred to a…
was able to gain full marks.

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

Common mistakes candidates made in this question

A. Some candidates only gave the term 'activation' … strictly correct it was allowed.

B. Some candidates gave a mixture of terms, such … 'induced substrate', 'lock and key fit'. The examiner …

C. Named globular proteins were incorrectly given as a response. Of these, 'haemoglobin' was most commonly seen. The spellings of 'globular' were not always correct.

This lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes at the exam and give them the best chance of achieving a high mark.

Assessment at a glance

Candidates for Advanced Subsidiary (AS) certification take Papers 1, 2 and 3 (either Advanced Practical Skills 1 or Advanced Practical Skills 2) in a single examination series.

Candidates who, having received AS certification, wish to continue their studies to the full Advanced Level qualification may carry their AS marks forward and take Papers 4 and 5 in the examination series in which they require certification.

Candidates taking the full Advanced Level qualification at the end of the course take all five papers in a single examination series.

Candidates may only enter for the papers in the combinations indicated above.

Candidates may not enter for single papers either on the first occasion or for resit purposes.

All components will be externally assessed.

Component	Weighting	
	AS Level	A Level
Paper 1 Multiple Choice **1 hour** This paper consists of 40 multiple choice questions, all with four options. All questions will be based on the AS Level syllabus content. Candidates will answer all questions. Candidates will answer on an answer sheet. [40 marks]	31%	15.5%
Paper 2 AS Level Structured Questions **1 hour 15 minutes** This paper consists of a variable number of questions, of variable mark value. All questions will be based on the AS Level syllabus content. Candidates will answer all questions. Candidates will answer on the question paper. [60 marks]	46%	23%
Paper 3 Advanced Practical Skills **2 hours** This paper requires candidates to carry out practical work in timed conditions. This paper will consist of two or three experiments drawn from different areas of the AS Level syllabus. Candidates will answer all questions. Candidates will answer on the question paper. [40 marks]	23%	11.5%
Paper 4 A Level Structured Questions **2 hours** This paper consists of a variable number of structured questions each with a variable mark value (Section A) and a choice of one free response style question worth 15 marks (Section B). All questions will be based on the A Level syllabus but may require knowledge of material first encountered in the AS Level syllabus. Candidates will answer on the question paper. [100 marks]	–	38.5%
Paper 5 Planning, Analysis and Evaluation **1 hour 15 minutes** This paper consists of a variable number of questions of variable mark value based on the practical skills of planning, analysis and evaluation. Candidates will answer on the question paper. [30 marks]	–	11.5%

Teachers are reminded that the latest syllabus is available on our public website at **www.cie.org.uk** and Teacher Support at **https://teachers.cie.org.uk**

Paper 3 – Advanced practical skills

Question 1

Example candidate response – high	Examiner comments

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

You are provided with:

labelled	contents	hazard	volume/cm^3
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard ~~irritant~~ harmful irritant 1

level of risk medium [1]

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room.

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room. 2

temperature 22.5 °C [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

30, 40, 50, 60 in degrees Celsius. 3

[2]

1 The hazard and the level of risk are identified.

Mark for (a) = 1/1

2 The temperature of the room is stated with the appropriate units.

Mark for (b) (i) = 1/1

3 The interval between each temperature is appropriate and the correct units (°C) are included.

Mark for (b) (ii) = 2/2

Example candidate response – high, continued	Examiner comments

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

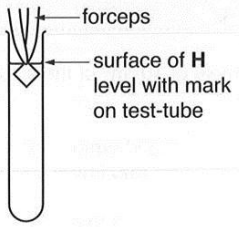


Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Example candidate response – high, continued	Examiner comments

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

temperature /°C	time taken for square to return to surface /s		
	1	2	
20.5	~~30~~ 10	13	
30.0	~~120~~ 16	12	
40.0	~~16~~ 19	16	
50.0	21	21	
60.0	35	35	
70.0	more than 120	more than 120	

[6]

(iv) Identify **two** significant sources of error in this investigation.

cutting
temperature

Difficulty to cut the filter paper in ~~exact~~ exactly 1cm x 1cm.
Concentration of ~~substrat~~ H will decrease ~~in~~ after carring
out the several experiment. Hence, the concentration of H might not
be the same for every ~~experiment~~ repeated experiment.

.....[2]

4 A table has been drawn to record the results with the appropriate headings; it includes data for five temperatures to the appropriate degree of accuracy.

5 Although the results for the trials are included, the mean is not shown in the table.

Mark for (b) (iii) = 5/6

6 Two sources of error are identified, with the reasons why they are errors.

Mark for (b) (iv) = 2/2

Example candidate response – high, continued	Examiner comments

(v) Explain how the enzyme catalase was affected by the change in temperature.

as temperature increases, the time taken for square to return to surface increased, as temperature increases, more less enzyme substrate complex is formed and so, less oxygen produce, so time taken to return to surface increases, the enzyme (catalase) is no longer active at 70°C. This shows at this temperature it is denatured and does not bind to hydrogen peroxide. [2]

7

7 The candidate states that the enzyme is denatured and gives a reason why the activity of the enzyme is decreasing.

Mark for (b) (v) = 2/2

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use a thermostatically controlled water bath.

8

8 The candidate correctly suggests the use of a thermostatically-controlled water bath but not the reason for its use.

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Prepare 5 different concentration ↑ solutions of catalase by simple or serial dilution. E.g. of concentrations 1.0, 0.8, 0.4, 0.2. Setup also a control with water so concentration 0. Add equal volume of catalase to individual test tubes. Drop the filter paper soaked into P and measure time taken. Repeat for accuracy. [3]

9

9 The candidate correctly states the number of catalase concentrations to use but not how to prepare them. Reference to simple and serial dilution is awarded a mark.

Mark for (b) (vi) = 2/3

Example candidate response – high, continued	Examiner comments

(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

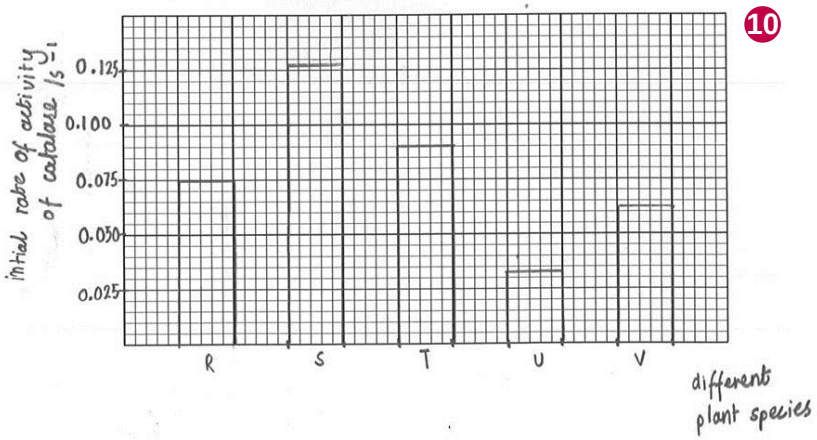
Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.



[4]

10 The axes are labelled accurately, the correct scale is used and the plotting of the points is accurate. However, the horizontal line of the bar for S is too thick.

Mark for (c) = 3/4

Total marks awarded = 18 out of 21

How the candidate could have improved their answer

(b) (iii) The candidate understood that it was necessary to carry out two trials to improve the reliability of the investigation. However, they needed to calculate the mean value to gain full marks.

(b) (vi) The candidate correctly stated that a thermostatically-controlled water bath could be used to standardise the temperature. To improve this answer the candidate needed to state its purpose, which is to achieve a constant temperature.

(c) The candidate correctly labelled the axes and accurately plotted the five points. To improve this answer the horizontal lines needed to be drawn with a *thin* straight line. 3/4

Mark awarded = **(a) 1/1**
Mark awarded = **(b) (i) 1/1, (ii) 2/2, (iii) 5/6, (iv) 2/2, (v) 2/2, (vi) 2/3**
Mark awarded = **(c) 3/4**

Total marks awarded = 18 out of 21

Example candidate response – middle

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

You are provided with:

labelled	contents	hazard	volume/cm^3
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high.

hazard Harmful irritant (hydrogen peroxide solution) 1

level of risk Medium .....[1]

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room.

Solution P

Solution P

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

(i) Use the thermometer to measure the temperature of the room. 2

temperature 26 °C .....[1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample. 3

30 °C, 40 °C, 50 °C, 60 °C and 70 °C (Maximum)

.....[2]

Examiner comments

1 The hazard and the level of risk are identified.

Mark for (a) = 1/1

2 The temperature of the room is stated with the appropriate units.

Mark for (b) (i) = 1/1

3 The interval between each temperature is appropriate and the correct units (°C) are included.

Mark for (b) (ii) = 2/2

Example candidate response – middle, continued	Examiner comments

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top. ✓
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

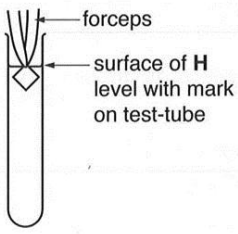


Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Example candidate response – middle, continued

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

Temperature of solution in petri dish. / °C	Time taken for the square to return to the surface / s
24.0	53.97
30.0	55.09
40.0	57.19
50.0	More than 120
60.0	More than 120
70.0	More than More than 120

4

5

[6]

(iv) Identify **two** significant sources of error in this investigation.

Error in measuring the temperature of plant extract during heating. 6

Unequal size of filter paper (may vary with each squares) 7

.....[2]

(v) Explain how the enzyme catalase was affected by the change in temperature.

The enzyme catalase has the optimum temperature of 40 °C. Higher than 40 °C such as 50 °C and above, may make the enzyme to denature. 8 The lower the temperature, the less energy it receive but as it goes higher (up to 40 °C), the more energy it receives. So, temperature affects the rate of reaction of the enzyme [2]

Examiner comments

4 An appropriate table has been drawn to record the results with the appropriate headings.

5 Although the candidate includes data for five temperatures, the values are not recorded to the appropriate degree of accuracy and the results of the trials are not recorded.

Mark for (b) (iii) = 4/6

6 Identifying 'measuring the temperature' as a source of error is incorrect.

7 Identifying a source of error due to the unequal size of the filter paper is correct.

Mark for (b) (iv) = 1/2

8 The candidate states that the enzyme is denatured but does not give a reason why the activity of the enzyme is slowing down.

Mark for (b) (v) = 1/2

Example candidate response – middle, continued

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

use thermostatically controlled water bath 9

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

use titration to measure the ~~con~~ different concentration of catalase. Take at least ~~six~~ 6 different concentration of 10 catalase of same volume. Use the squares to investigate the reaction with hydrogen peroxide. Higher concentration will ~~be~~ form more enzyme-substrate complex hence more and faster reaction. [3]

(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

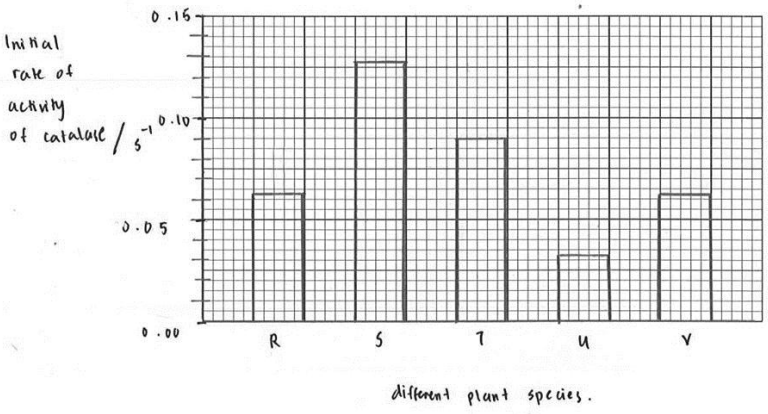
Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1.



11

[4]

9 The candidate correctly suggests the use of a thermostatically-controlled water bath but not the reason for its use.

10 The candidate correctly states the number of catalase concentrations to use but not how to prepare them.

Mark for (b) (vi) = 1/3

11 The axes are labelled accurately and the correct scale is used, but the plotting point for the data for R is incorrect and the horizontal line for V is too thick.

Mark for (c) = 2/4

Total marks awarded = 13 out of 21

How the candidate could have improved their answer

(b) (iii) The times for the first three temperatures should have been recorded as whole numbers as the times taken for the pieces of filter paper to return to the surface were not precise. The candidate should have also carried out trials and calculated the mean values.

(b) (iv) The candidate needed to identify the fact that the concentration of the hydrogen peroxide solution was affected each time a piece of filter paper containing P was put into it.

(b) (v) The candidate stated that an increase in temperature affected the enzyme catalase by making it denatured. The answer could have been improved by referring to how temperature affects the binding of the substrate to the active sites of the enzyme and the formation of enzyme-substrate-complexes.

(b) (vi) The candidate correctly stated that a thermostatically-controlled water bath could be used to standardise the temperature. To improve this answer the candidate needed to state its purpose, which is to achieve a constant temperature. The candidate correctly stated that at least six concentrations of catalase should be prepared. To improve this answer, the candidate needed to describe how these different concentrations would be prepared.

(c) The candidate correctly labelled the axes. To improve this answer, the points needed to be accurately plotted and the horizontal lines needed to be drawn with a *thin* straight line.

Mark awarded = **(a) 1/1**
Mark awarded = **(b) (i) 1/1, (ii) 2/2, (iii) 4/6, (iv) 1/2, (v) 1/2, (vi) 1/3**
Mark awarded = **(c) 2/4**

Total marks awarded = 13 out of 21

Example candidate response – low

1 Plant cells contain an enzyme, catalase, which catalyses the hydrolysis (breakdown) of hydrogen peroxide into oxygen and water. An extract of plant tissue contains catalase.

You are required to investigate the effect of temperature (independent variable) on catalase in a plant extract solution.

$H \longrightarrow O_2 + H_2O$ (enzyme (catalase))

You are provided with:

labelled	contents	hazard	volume/cm^3
P	plant extract solution	none	100
H	hydrogen peroxide solution	harmful irritant	100

100cm^3 = P
H = 100cm^3

You are advised to wear suitable eye protection, especially when using the hydrogen peroxide solution, **H**. If **H** comes into contact with your skin, wash off with cold water.

(a) When carrying out a practical procedure the hazards of using the solutions need to be considered. Then the level of risk needs to be assessed as low or medium or high.

State the hazard with the greatest level of risk when using the solutions then state the **level** of risk of the procedure: low or medium or high. 1

hazard Harmful irritant

level of risk low level [1]

(1) keep P = 10cm^3 room temp

(b) You are required to keep a sample of 10 cm^3 of the solution in **P** to test at the temperature of the room.

Then heat the remaining solution in **P** and remove 10 cm^3 samples of the solution at different temperatures including a sample at the **maximum** temperature of 70 °C.

Remaining 90 heat, 10 cm^3 each, 70°C → MAX

(i) Use the thermometer to measure the temperature of the room.

temperature 20.3 2 [1]

(ii) You will need to test a sample of the solution in **P** which has been heated to 70 °C.

State the other temperatures at which you will remove each sample.

50°C, 55°C, 60°C, ~~70~~ 65°, 70°. 3

[2]

Examiner comments

1 The candidate correctly identifies the hazard as 'harmful irritant' but incorrectly assesses the level of risk as low.

Mark for (a) = 0/1

2 Although the candidate has read the value of the temperature correctly, the units are omitted.

Mark for (b) (i) = 0/1

3 The interval between each temperature is appropriate and the correct units (°C) are included.

Mark for (b) (ii) = 2/2

Example candidate response – low, continued	Examiner comments

Proceed as follows:

1. Put 10 cm^3 of the solution in **P** into a petri dish labelled with the temperature of the room you recorded in **(b)(i)**.
2. Gently heat the beaker labelled **P**, containing the remaining solution.
3. When the temperature of the solution in **P** reaches the lowest temperature stated in **(b)(ii)**, remove the Bunsen burner.
4. Remove 10 cm^3 of the solution in **P** and put it into a labelled petri dish.
5. Replace the Bunsen burner.
6. Repeat step 2 to step 5 for each of the temperatures stated in **(b)(ii)**.
7. When the solution reaches 70 °C, remove the last sample and put it into a labelled petri dish.
8. Turn off the Bunsen burner.
9. Leave the solutions to cool while you cut squares of filter paper, 1 cm × 1 cm. You will need to decide how many squares to cut to give you confidence in your results.
10. Put a mark on the test-tube 2 cm from the top.
11. Put **H** into the test-tube up to this mark.
12. Use forceps to pick up one square of filter paper and dip the whole square into the solution in the petri dish that is labelled with the temperature of the room.
13. Wipe the square against the petri dish to remove excess solution from both sides of the square.
14. Hold the square just below the surface of **H** so that the top of the square is level with the surface of **H** as shown in Fig. 1.1.

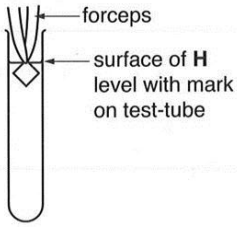


Fig. 1.1

15. Immediately release the square (you may need to shake the forceps) and start timing.
16. Measure the time taken for the square to return to the surface. Record the time in **(b)(iii)**.

    If the time is more than 120 seconds, stop timing and record 'more than 120'.

Example candidate response – low, continued

17. Remove the square from the test-tube.

*Note: if the square remains at the bottom of the test-tube, pour off **H** into the container labelled **H**. Use water in the beaker labelled 'for washing' to rinse out the square from the test-tube. Then repeat step 11.*

18. Repeat step 12 to step 17 with each of the samples removed at the different temperatures.

(iii) Prepare the space below and record your results.

	29°C	40°C	50°C	60°C	70°C
Time taken	14.28	42.35	50.32	113.20	more than 120
Time taken	13.12s	50.10	49.23	115.56	more than 120
Time taken	14.56	49.81	51.06	110.23	more than 120
Avg.	14.	47	150.61	113.	more than 120

[6]

(iv) Identify **two** significant sources of error in this investigation.

1. Reaction time is might be high in the investigation.
2. Impurities of the catalase solution might be mixed when new filter paper is introduced after each temperature

.....[2]

(v) Explain how the enzyme catalase was affected by the change in temperature.

when the temperature is increasing the time taken for the catalase enzyme to react also increases and at 60°c the enzyme denatures since the results shows a big difference between the results of 50°c - 60°c .

.....[2]

Examiner comments

4 A table has been drawn to record the results but the heading for temperature is incomplete and the heading for time lacks units.

5 Although the candidate has included data for five temperatures, the values are not recorded to the appropriate degree of accuracy.

Mark for (b) (iii) = 3/6

6 'Reaction time' is not a source of error.

7 While the candidate understands that the catalase solution on each square of paper might affect the hydrogen peroxide solution, they give 'impurities' which is incorrect here.

Mark for (b) (iv) = 0/2

8 The response indicates that the activity of the enzyme slows as the temperature increases but no reason is given for why this is happening.

Mark for (b) (v) = 0/2

Example candidate response – low, continued

(vi) This procedure investigated the effect of temperature on the activity of catalase in the plant extract.

To modify this procedure for investigating another variable, the independent variable (temperature) would need to be standardised.

Describe how the temperature could be standardised.

Use thermostatic temperature 9

Now consider how you could modify this procedure to investigate the effect of the **concentration of catalase** in the plant extract on the breakdown of hydrogen peroxide.

Describe how this independent variable, **concentration of catalase**, could be investigated.

Use different concentration of enzyme, for example 5% to 10% and same temperature and concentration of plant extract solution. Cut filter paper by 1cm x 1cm, dip it on the plant concentration into different concentration of enzyme catalase then ~~take~~ record the time. [3]

(c) A student investigated the activity of catalase in plant extracts from different species of plants, **R**, **S**, **T**, **U** and **V**, by measuring the initial rate of activity.

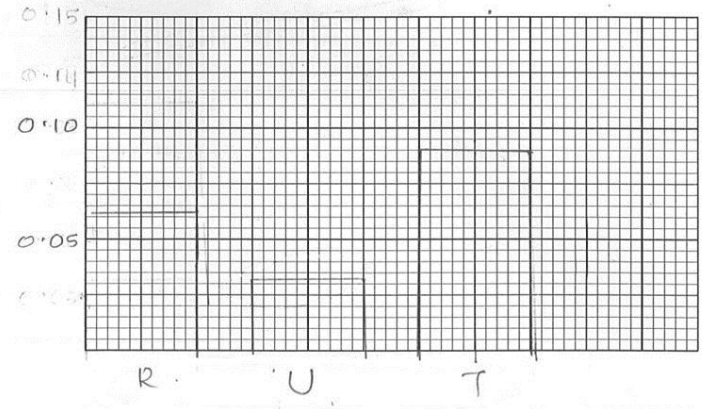
Table 1.1 shows the results for this investigation.

Table 1.1

different plant species	initial rate of activity of catalase /s^{-1}
R	0.0750
S	0.1275
T	0.0900
U	0.0325
V	0.0625

You are required to use a sharp pencil for charts.

Plot a chart of the data shown in Table 1.1. 10



Examiner comments

9 There is no description of how the temperature could be standardised.

Mark for (b) (vi) = 0/3

10 Although the scale selected is appropriate, the labels for the axes are not given and the data for S and V have been omitted.

Mark for (c) = 0/4

Total marks awarded = 5 out of 21

How the candidate could have improved their answer

(a) As the hazard was identified as a 'harmful irritant', the candidate should have assessed the level of risk of the procedure as 'medium'.

(b) (i) The candidate omitted to write the appropriate units, °C, after the value for the temperature of the room.

(b) (ii) The candidate could have inserted °C after each temperature.

(b) (iii) The table of results should have included headings for temperature and time with the appropriate units. The times for the first four temperatures should have been recorded as whole numbers, as the times for the pieces of filter paper to return to the surface were not precise.

(b) (iv) The candidate needed to identify the fact that the concentration of the hydrogen peroxide solution was affected each time a piece of filter paper containing P was put into it.
The candidate could also have mentioned the fact that the pieces of filter paper sometimes touch the side of the test-tube, thus affecting the time they take to reach the surface.

(b) (v) The candidate described how increasing the temperature affects the time taken for the piece of paper to rise to the surface. The answer could have been improved by giving reasons for the reduced activity of the enzyme such as the reduced number of enzyme-substrate-complexes being formed.

(b) (vi) The candidate needed to describe the correct apparatus to use in order to achieve a constant temperature. The candidate stated that different concentrations of enzyme should be used but did not specify the exact number or how to prepare them.

(c) The candidate needed to label the axes and include all the data given in the table. The five points needed to be accurately plotted and the horizontal lines needed to be drawn with a *thin* straight line.

Mark awarded = **(a) 0/1**
Mark awarded = **(b) (i) 0/1, (ii) 2/2, (iii) 3/6, (iv) 0/2, (v) 0/2, (vi) 0/3**
Mark awarded = **(c) 0/4**

Total marks awarded = 5 out of 21

Common mistakes candidates made in this question

(a) Some candidates did not refer to the table provided on the question paper, which detailed the solutions provided and the hazard associated with each solution.

(b) (i) Some candidates omitted the appropriate units, °C, when recording the temperature of the room.

(b) (ii) Some candidates omitted the appropriate units, °C, when stating the temperature. The interval between each temperature should be at least 5 °C as it is difficult to control the temperature of solution P.

(b) (iii) Some candidates included units, °C or seconds, in the body of the table rather than in the headings.

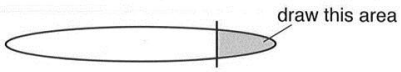
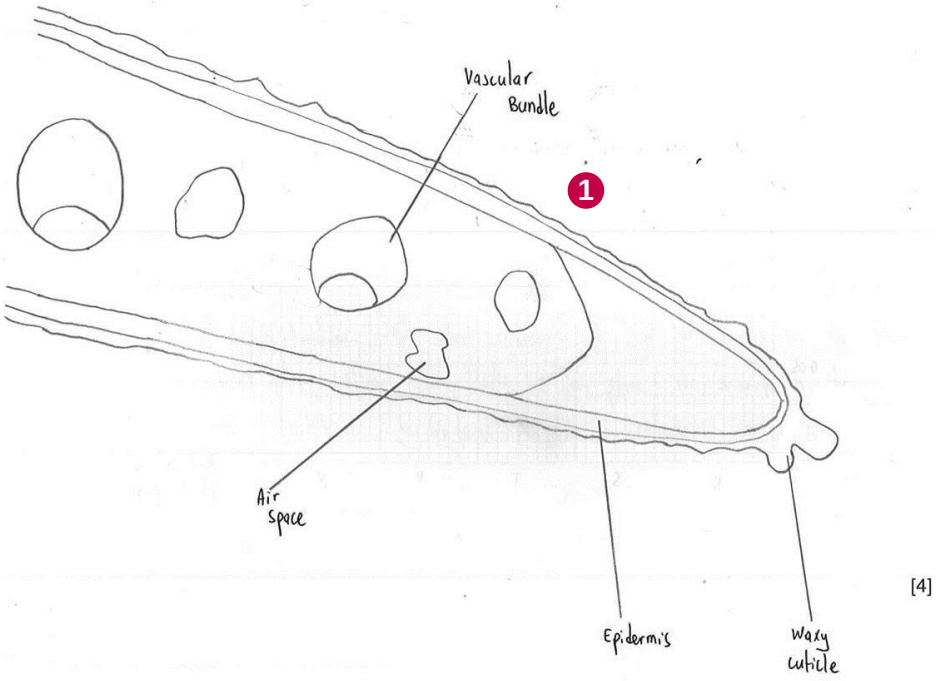
(b) (iv) Some candidates identified sources of error unrelated to the investigation that they had carried out, such as parallax errors when reading the thermometer.

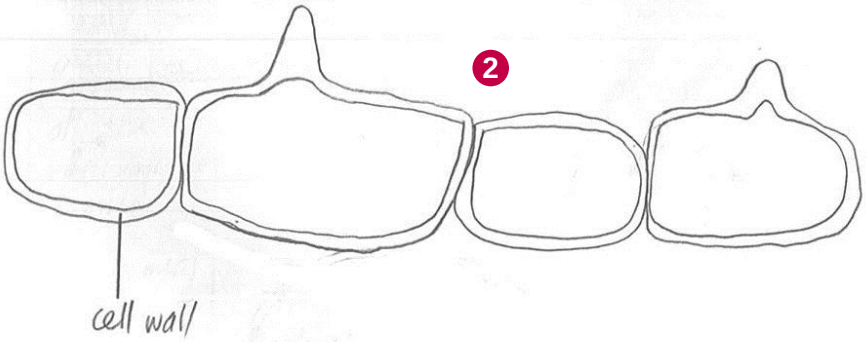
(b) (v) Many candidates described their results rather than explaining how the enzyme was binding to the substrate causing breakdown of the hydrogen peroxide.

(b) (vi) Some candidates repeated the whole method when they only needed to state the modifications to the procedure which had already been described.

(c) Many candidates didn't label the axes fully and accurately using the headings provided in Table 1.1. Some candidates didn't plot all the data in the order given in the table or to draw the bars using thin, straight lines.

Question 2

Example candidate response – high	Examiner comments
2 **K1** is a slide of a stained transverse section through a plant leaf. You are not expected to be familiar with this specimen. *You are required to use a sharp pencil for drawings.* **(a)** **(i)** Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.  **Fig. 2.1** *You are expected to draw the correct shape and proportions of the different tissues.*  [4]	1 The drawing is an acceptable size, the required number of vascular bundles has been drawn and the area of cells near the tip is shown. However, the lines representing the epidermis are too far apart. Mark for (a) (i) = 3/4

Example candidate response – high, continued	Examiner comments
(ii) Observe the epidermis in **K1**. These cells are not identical. Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells. Make a large drawing of this group of **four** cells. Each cell of the group must touch at least one other cell. Use **one** ruled label line and label to identify the cell wall of **one** cell.  [5]	2 The four cells are touching, with two lines representing the correctly labelled cell wall. The drawing also includes cells that are not identical. However, the quality of the drawing is not creditworthy. Mark for (a) (ii) = 4/5

Example candidate response – high, continued

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant.

You are not expected to be familiar with this specimen.

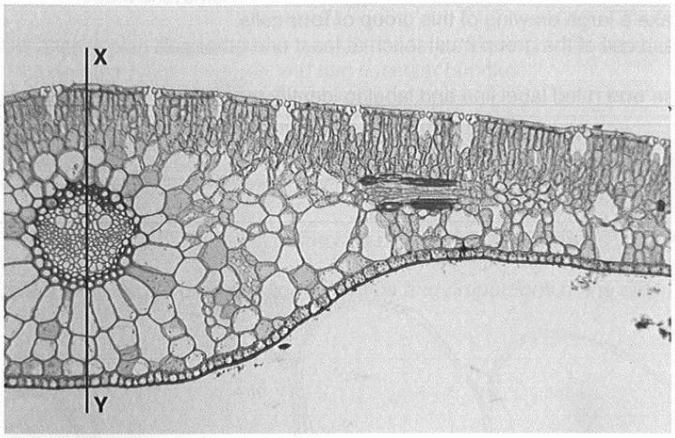


Fig. 2.2

(i) Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle.

You may lose marks if you do not show your working.

X-Y diameter of vascular bundle

54mm : 18mm

27 : 9

9 : 3

3 : 1

simplest ratio 3:1 [5]

(ii) Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat.

habitat ~~Under a river~~ ~~In~~ In the river ~~water~~

feature Has many air spaces in the leaf [1]

Examiner comments

3 The measurement of the depth of the midrib is attributed to X–Y, which is not creditworthy. As this error is carried forward, credit is given for all the other marking points.

Mark for (b) (i) = 4/5

4 The candidate is aware that the leaf is from a water habitat and states a feature which adapts the leaf to this habitat.

Mark for (b) (ii) = 1/1

Example candidate response – high, continued	Examiner comments
(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2. Record your observations in the space you have prepared. Differences 5 K1 / Fig. 2.2 Palisade mesophyll cells are less packed / Palisade mesophyll cells are more packed More air spaces between the cells / Less air spaces between the cells ~~Smaller vascular bundle~~ Doesn't have sunken stomata / ~~Larger vascular bundle~~ Has sunken stomata [4]	5 The table does not have three columns and is therefore not creditworthy. The three observable differences are correct. Mark for (c) = 3/4 **Total marks awarded = 15 out of 19**

How the candidate could have improved their answer

(a) (i) The candidate correctly represented the epidermis as two lines. However, these needed to be shown closer together so that the proportions of the different tissues were correct.

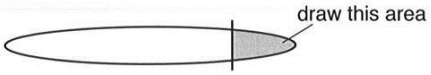
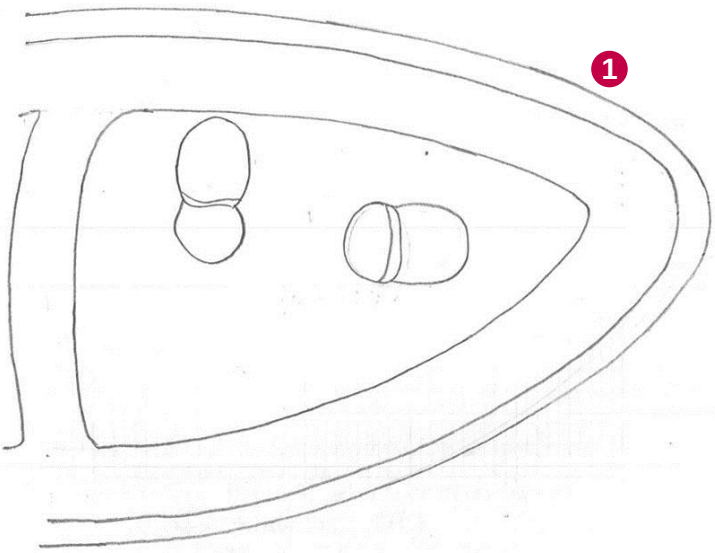
(a) (ii) The candidate correctly drew four cells with the cell walls shown by double lines. To improve this answer, the lines should have been drawn more carefully so that each line was thin and continuous.

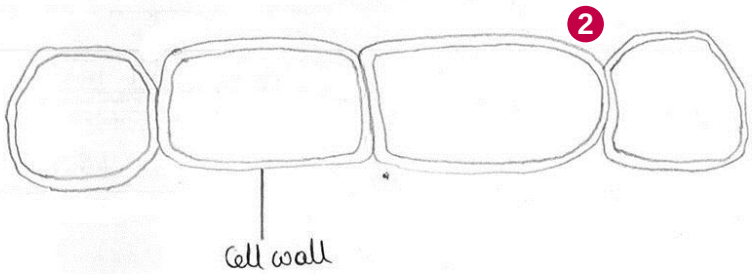
(b) (i) The candidate correctly measured the depth of the midrib and the diameter of the vascular bundle. To improve this answer, the units of both the measurements needed to be shown.

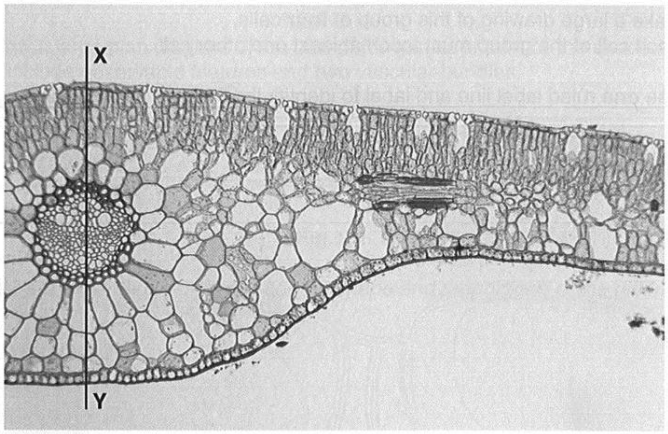
(c) The candidate drew a table to show the features observed and the differences between K1 and Fig.2.2, but the inclusion of a third column to identify each observed feature would have been clearer. The answer could have been improved by the inclusion of another observable difference.

Mark awarded = **(a) (i) 3/4, (ii) 4/5**
Mark awarded = **(b) (i) 4/5, (ii) 1/1**
Mark awarded = **(c) 3/4**

Total marks awarded = 15 out of 19

Example candidate response – middle	Examiner comments
2 **K1** is a slide of a stained transverse section through a plant leaf. You are not expected to be familiar with this specimen. *You are required to use a sharp pencil for drawings.* **(a)** **(i)** Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.  **Fig. 2.1** *You are expected to draw the correct shape and proportions of the different tissues.*  [4]	1 The drawing is an acceptable size and the required number of vascular bundles is shown. However, the lines representing the epidermis are too far apart and the area of cells near the tip has not been drawn. Mark for (a) (i) = 2/4

Example candidate response – middle, continued	Examiner comments
(ii) Observe the epidermis in **K1**. These cells are not identical. Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells. Make a large drawing of this group of **four** cells. Each cell of the group must touch at least one other cell. Use **one** ruled label line and label to identify the cell wall of **one** cell.  [5]	2 The candidate earns marks for showing cells that are not identical and for labelling the cell wall. However, the lines representing the epidermis are too far apart. The quality of the drawing overall is not creditworthy. Mark for (a) (ii) = 3/5

Example candidate response – middle, continued	Examiner comments
(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant. You are not expected to be familiar with this specimen.  **Fig. 2.2** **(i)** Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle. You may lose marks if you do not show your working. From Fig. 2.2, Depth of midrib = 50.5 mm Diameter of vascular bundle = ~~19.0 mm~~ 20.0 mm Ratio of depth of midrib : diameter of vascular bundle $\frac{50.5\text{ mm}}{20.0\text{ mm}}$: ~~19.0~~ $\frac{20.0\text{ mm}}{20.0\text{ mm}}$ 2 (2.525) : 2 (1) 5.05 : 2 5 : 2 ~~5.05 : 1~~ 5 : 2 *simplest ratio* .....[5] **(ii)** Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat. *habitat* .....Desert..... *feature* ....Vascular bundles far away from the epidermis.....[1]	**3** The measurement of the depth of the midrib is incorrect. Mark for (b) (i) = 2/5 **4** There is no awareness that the leaf is from a water habitat. Mark for (b) (ii) = 0/1

Example candidate response – middle, continued

(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2.

Record your observations in the space you have prepared. **5**

Feature	slide K1	Fig 2.2
Vascular bundle	Vascular bundles are close to the epidermis	Vascular bundle present in the central part of the leaf
Air spaces	the air spaces are larger in size	the air spaces are smaller in size.
Epidermis	upper epidermis thinner	upper epidermis thicker
Palisade cells	Palisade cells are less closely packed	palisade cells are more closely packed
Collenchyma cells	less number of collenchyma cells close to the lower epidermis	more number of collenchyma cells close to the lower epidermis

[4]

Examiner comments

5 This is an appropriate table with three columns and two observable differences that are correct.

Mark for (c) = 3/4

Total marks awarded = 10 out of 19

How the candidate could have improved their answer

(a) (i) This candidate's drawing was large enough to show the different tissues clearly and it included two vascular bundles. To improve the drawing, the two lines representing the epidermis needed to be drawn closer together so that the proportions of the different tissues were correct. It also needed to include an area of cells close to the tip of the leaf.

(a) (ii) To improve this answer, the candidate should have drawn the lines more carefully so that each was thin and continuous. They should also have selected cells which showed clear differences between them.

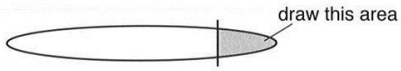
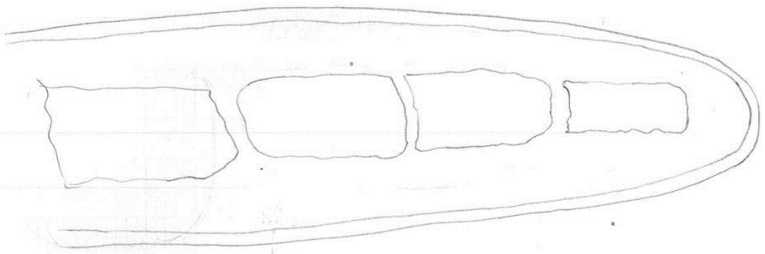
(b) (i) To improve this answer, the measurement of the midrib needed to be within the range allowed by the examiner and to the correct degree of accuracy. When measuring in millimetres, the value should be in whole numbers.

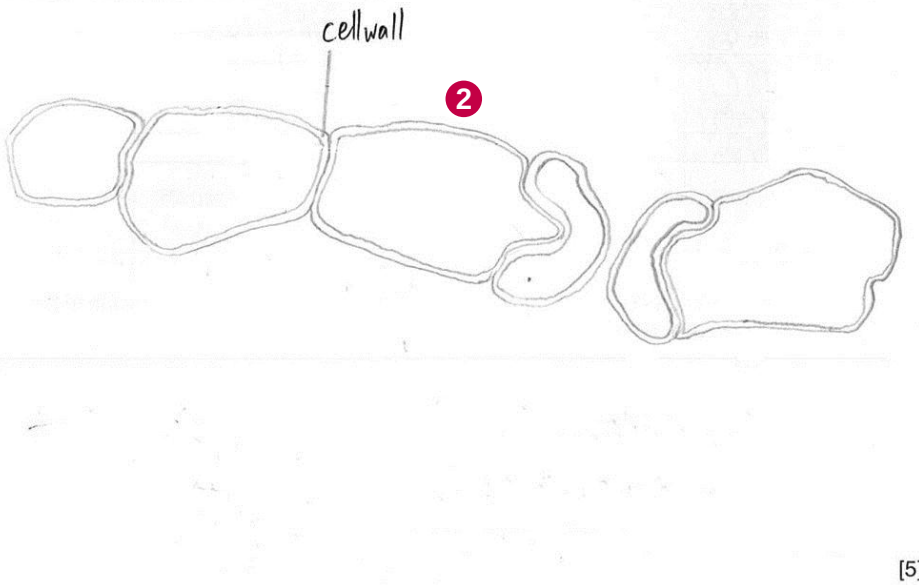
(b) (ii) To improve their answer, the candidate needed to recognise that the features of the leaf are observed in a plant living in a wet habitat.

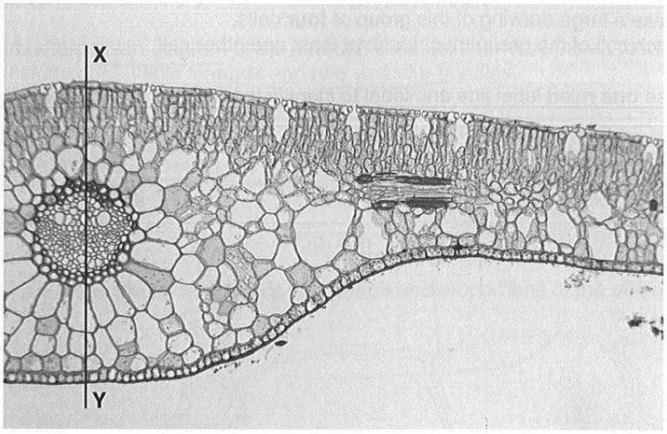
(c) To improve this answer, the candidate should have observed more tissues and features such as the stomata and the air spaces.

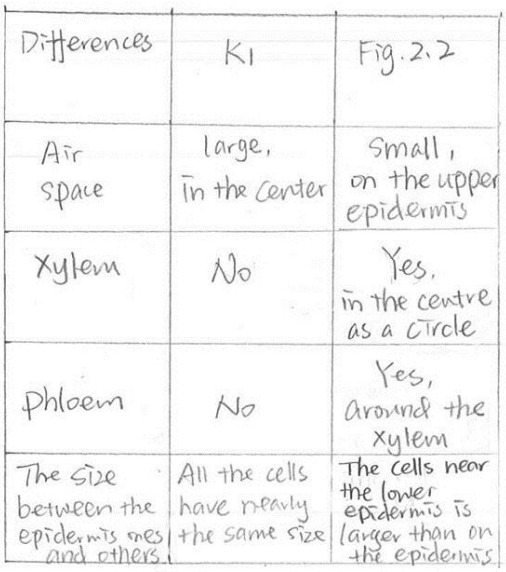
Mark awarded = **(a) (i) 2/4, (ii) 3/5**
Mark awarded = **(b) (i) 2/5, (ii) 0/1**
Mark awarded = **(c) 3/4**

Total marks awarded = 10 out of 19

Example candidate response – low	Examiner comments
2 **K1** is a slide of a stained transverse section through a plant leaf. You are not expected to be familiar with this specimen. *You are required to use a sharp pencil for drawings.* **(a) (i)** Draw a large plan diagram of the part of the leaf as shown by the shaded area in Fig. 2.1, to include observable features and **two** vascular bundles.  **Fig. 2.1** *You are expected to draw the correct shape and proportions of the different tissues.* 1  [4]	1 The drawing is below the minimum size acceptable and no vascular bundles are shown. The epidermis is drawn as two lines but the area of cells near the tip has not been included. Mark for (a) (i) = 1/4

Example candidate response – low	Examiner comments
(ii) Observe the epidermis in **K1**. These cells are not identical. Select **one** group of **four** adjacent (touching) cells which show some of the differences between these cells. Make a large drawing of this group of **four** cells. Each cell of the group must touch at least one other cell. Use **one** ruled label line and label to identify the cell wall of **one** cell.  [5]	2 The quality of the drawing is not creditworthy and it includes too many cells. One mark is awarded for including cells that are not identical and one for labelling the cell wall. Mark for (a) (ii) = 2/5

Example candidate response – low	Examiner comments
(b) Fig. 2.2 is a photomicrograph of a stained transverse section through part of a leaf from a different type of plant. You are not expected to be familiar with this specimen.  **Fig. 2.2** **(i)** Use the line **X–Y** to determine the simplest ratio of the depth of the midrib to the diameter of the vascular bundle. You may lose marks if you do not show your working. Depth of midrib = 2.8 cm Diameter of vasc. bundle = 1.9 cm 3 1.9 : 2.8 ×10 ( ) ×10 19 : 28 *simplest ratio* ~~19:28~~ 19 : 28 [5] **(ii)** Suggest a habitat where this plant might grow and **one** observable feature, shown in Fig. 2.2, which adapts it to this habitat. *habitat* ~~cold habitat hot h~~ hot climate. 4 *feature* ~~Thick cuticle~~ Thick cuticle [1]	3 The measurement of the depth of the midrib is incorrect and the final answer does not show the ratio of the depth of the midrib to the diameter of the vascular bundle. Mark for (b) (i) = 0/5 4 There is no awareness that the leaf is from a water habitat. Mark for (b) (ii) = 0/1

Example candidate response – low	Examiner comments
(c) Prepare the space below so that it is suitable for you to record observable differences between the leaf on **K1** and the leaf in Fig. 2.2. Record your observations in the space you have prepared.  5 [4]	5 The candidate has drawn a table with three columns and states an observable difference that is creditworthy. Mark for (c) = 2/4 **Total marks awarded = 5 out of 19**

How the candidate could have improved their answer

(a) (i) The size of the drawing needed to be large enough to show the different tissues clearly. The candidate drew the air cavities present in the leaf but did not include the vascular bundles. To improve their answer, the candidate needed to observe the leaf and include as many different tissues as possible.

(a) (ii) The candidate needed to draw only four cells, as instructed.

(b) (i) To improve this answer, the measurement of the midrib needed to be within the range allowed by the examiner. The candidate needed to show the simplest ratio of the depth of the midrib to the diameter of the vascular bundle, but instead they reversed the ratio and therefore did not gain the mark.

(b) (ii) To improve this answer, the candidate needed to recognise that the features of the leaf are observed in a plant living in a wet habitat.

(c) To improve this answer the candidate should have observed more tissues and features such as the stomata and the mesophyll cells. The examiner required a description of the features for both K1 and Fig. 2.2 so stating 'no' or 'yes' was not sufficient.

Mark awarded = **(a) (i) 1/4, (ii) 2/5**
Mark awarded = **(b) (i) 0/5, (ii) 0/1**
Mark awarded = **(c) 2/4**

Total marks awarded = 5 out of 19

Common mistakes candidates made in this question

(a) (i) Some candidates didn't make their drawings big enough to show all the different tissues they could observe clearly and in the correct proportions. A common mistake was to omit features that could clearly be seen.

(a) (ii) Some candidates didn't make their drawings large enough to show the different tissues clearly. Candidates needed to select cells which fulfilled the requirements of the question, then observe and draw what they observed. A common mistake was to omit features of the epidermal cells that could clearly be seen.

(b) (i) Many candidates didn't show all the steps in their working or include units with the measurements they had taken.

(b) (ii) Many candidates didn't recognise the features that indicate that the leaf is adapted to a wet habitat, for example the features of a leaf that floats and lies flat on the water allowing the palisade cells to gain access to the sun; stomata on the upper surface for gas exchange; air chambers which provide buoyancy.

(c) Many candidates didn't draw a table which included a column listing the features observed and some candidates didn't make comparative statements, such as 'fewer stomata' or 'more stomata'.

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Version 1.0

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