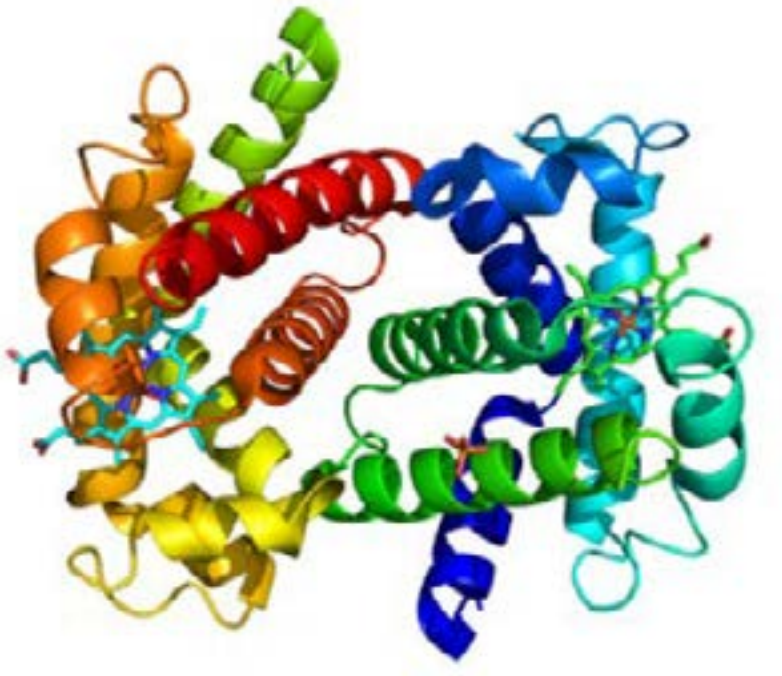
Cambridge Assessment International Education

Example Responses – Paper 3

Cambridge International AS & A Level Biology 9700

For examination from 2022



Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS & A Level Biology 9700.

This booklet contains responses to all questions from June 2022 Paper 32, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub.

9700 June 2022 Question Paper 32

9700 June 2022 Mark Scheme 32

9700 June 2022 Confidential Instructions Paper 32

Past exam resources and other teaching and learning resources are available from the School Support Hub.

Question 1

1 Plant tissues contain the enzyme catalase which catalyses the breakdown of hydrogen peroxide into oxygen gas and water.

Ascorbic acid acts as an inhibitor of catalase.

You will investigate the effect of changing ascorbic acid concentration on catalase inhibition.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
H	hydrogen peroxide solution	harmful irritant	50
W	distilled water	none	50
A	1 mol dm^{-3} ascorbic acid solution	irritant	10

If **H** or **A** comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

You are also provided with five cylinders of potato tissue, labelled **P**.

(a) You will need to carry out a serial dilution of the 1 mol dm^{-3} ascorbic acid, **A**, to reduce the concentration by a **factor of ten** between each successive dilution.

You will need to prepare four concentrations of ascorbic acid in addition to the 1 mol dm^{-3} ascorbic acid solution, **A**.

After the serial dilution is completed, you will need to have 9 cm^3 of each concentration available to use.

(i) Complete Fig. 1.1 to show how you will prepare your serial dilution.

Fig. 1.1 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker, add labelled arrows to show:

- the volume of ascorbic acid solution transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of ascorbic acid solution.

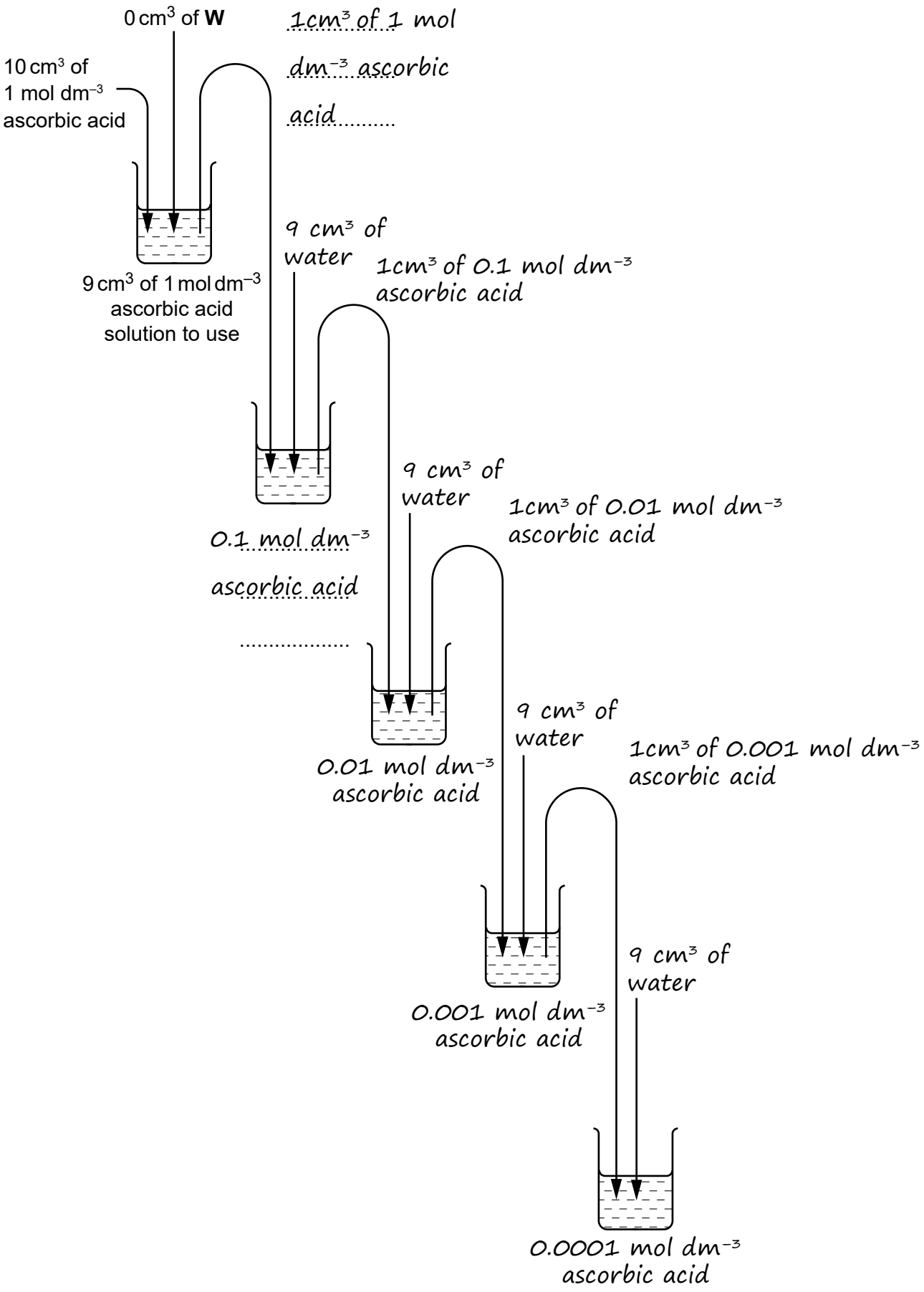

0 cm3 of W
10 cm3 of 1 mol dm–3 ascorbic acid
9 cm3 of 1 mol dm–3 ascorbic acid solution to use
1cm3 of 1 mol dm–3 ascorbic acid
9 cm3 of water
1cm3 of 0.1 mol dm–3 ascorbic acid
0.1 mol dm–3 ascorbic acid
9 cm3 of water
1cm3 of 0.01 mol dm–3 ascorbic acid
0.01 mol dm–3 ascorbic acid
9 cm3 of water
1cm3 of 0.001 mol dm–3 ascorbic acid
0.001 mol dm–3 ascorbic acid
9 cm3 of water
0.0001 mol dm–3 ascorbic acid

Fig. 1.1

[3]

Examiner comment

The stem of the question tells candidates to draw three additional beakers, so that there are five beakers in total. In the example, the labelled arrows show the volume of ascorbic acid solution transferred, the volume of water added each time and the concentration of ascorbic acid under each beaker. The diagram clearly shows 1 cm^3 of each concentration of ascorbic acid being transferred to the next beaker and 9 cm^3 of distilled water being added each time to make the dilution. Then, each time the 1 cm^3 of ascorbic acid is transferred, this leaves 9 cm^3 of each concentration ready to use, as stated in the question, and the concentration of ascorbic acid solution is reduced by a factor of 10 between each successive dilution.

Carry out step 1 to step 13.

step 1 Prepare the concentrations of ascorbic acid solution, as decided in **(a)(i)**, in the beakers provided.

step 2 Label test-tubes with the ascorbic acid concentrations prepared in step 1.

step 3 Label another test-tube **0**.

step 4 On a white tile carefully cut the cylinders of potato tissue into thin discs that are approximately 1–2 mm thick.

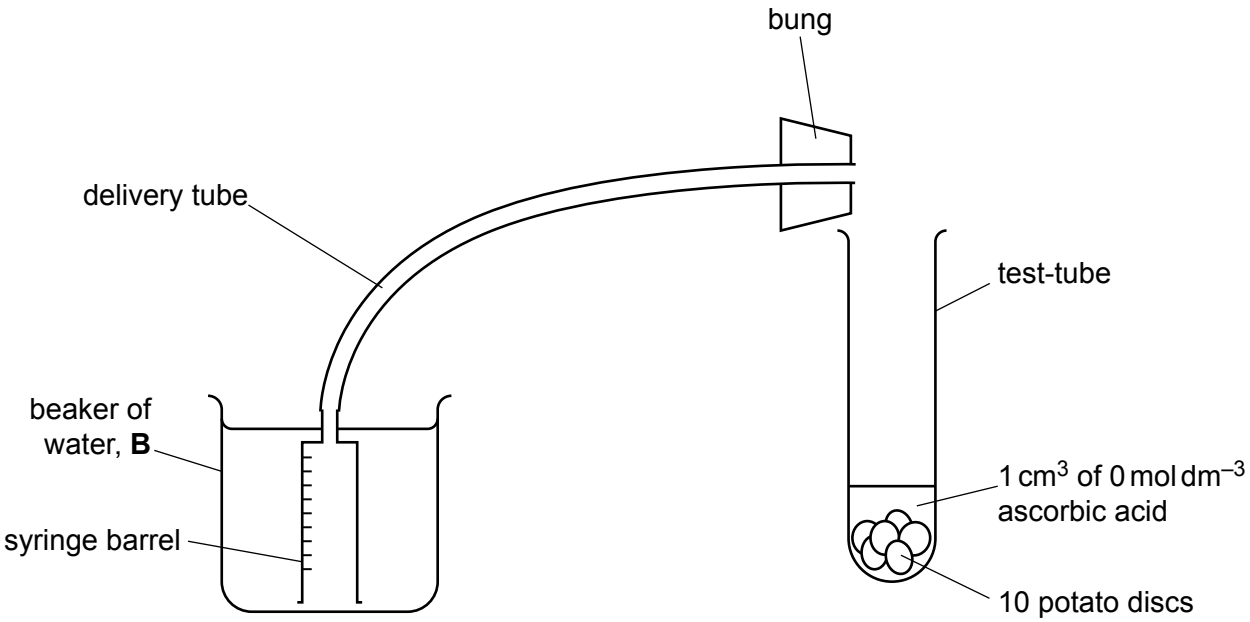
You will need to cut at least 70 discs.

step 5 Place 10 potato discs into each labelled test-tube.

step 6 Add 1 cm^3 distilled water, **W**, to the test-tube labelled **0**.

step 7 Add 1 cm^3 of each concentration of ascorbic acid to the appropriately labelled test-tubes.

step 8 Set up the apparatus as shown in Fig. 1.2 using the test-tube labelled **0**. The syringe barrel should be fully submerged in the beaker of water, **B**.



step 9 Add 5 cm^3 of hydrogen peroxide solution **H** to the test-tube labelled **0**. Place the bung into the top of the test-tube, making sure that the syringe barrel stays fully submerged.

step 10 Record in **(a)(ii)** the **initial volume** of gas in the syringe barrel then start the stop-clock.

step 11 After 2 minutes record in **(a)(ii)** the **final volume** of gas in the syringe barrel. If the syringe barrel is full of gas, record as 10.

step 12 Repeat step 9 to step 11 with each of the test-tubes labelled in step 2.

step 13 Calculate the **total** volume of gas produced at each concentration of ascorbic acid. Record these processed results in **(a)(ii)**.

(ii) Record your results in an appropriate table, including raw results **and** processed results.

concentration of ascorbic acid / mol dm^{-3}	initial volume of gas / cm^3	final volume of gas / cm^3	total volume of gas / cm^3
1.0	1.3	2.0	0.7
0.1	1.0	3.2	2.2
0.01	2.4	6.4	4.0
0.001	1.3	6.6	5.3
0.0001	1.1	7.2	6.1
0	1.2	8.0	6.8

[6]

Examiner comment

Candidates were told to make a serial dilution to produce 5 different concentrations of ascorbic acid and to follow the steps to carry out the investigation. 1 cm^3 of ascorbic acid was added to 5 cm^3 hydrogen peroxide and 10 potato discs. The volume of gas produced after 2 minutes was measured. The procedure was carried out for each concentration of ascorbic acid and for 0 mol dm^{-3} (distilled water).

- Marks were awarded for constructing a table with appropriate headings and for recording raw and processed results appropriately.
- Candidates needed to follow the procedure carefully when carrying out the investigation to collect data and record all of their results as instructed.
- The table needed to be constructed with the independent variable, concentration of ascorbic acid / mol dm^{-3}, to the left of the dependent variable, volume of gas / cm^3. The headings should include the appropriate units.
- All of the ascorbic acid concentrations made in **1(a)(i)** and 0 mol dm^{-3} should be listed under the independent variable heading.
- The concentrations should not have the unit (mol dm^{-3}) next to the value in the table as it was included in the heading.
- In the procedure, candidates were told to record the initial volume of gas in the syringe barrel at 0 minutes, the final volume of gas in the syringe barrel at 2 minutes and then calculate the total volume of gas produced for each concentration of ascorbic acid (processed results). The table therefore should have 3 columns to the right of the independent variable to record the volume of gas / cm^3.

concentration of ascorbic acid / mol dm^{-3}	initial volume of gas / cm^3	final volume of gas / cm^3	total volume of gas / cm^3

or

concentration of ascorbic acid / mol dm^{-3}	volume of gas / cm^3		
	initial	final	total

- Each heading for the dependent variable needed to include the unit (cm^3).
- The volumes recorded should not have the unit (cm^3) next to them in the table as it was included in the heading.
- When placing the bung into the top of the test-tube, some gas was being produced as the reaction had already started and so there was a small volume of gas in the syringe barrel at the start of each investigation (initial volume). The volume present would have been different for each concentration. Candidates needed to record the value for each concentration as instructed, rather than assume that the initial volume for each concentration was meant to be 0 cm^3. These volumes should be recorded in the first column, initial volume of gas / cm^3.
- After 2 minutes the volume of gas present in the syringe barrel for each concentration of ascorbic acid needed to be recorded under final volume / cm^3.
- The total volume of gas is calculated by subtracting the initial volume from the final volume for each concentration of ascorbic acid and should be recorded under the heading, total volume of gas / cm^3. A common error was adding the initial and final volumes together to find the total volume of gas produced.
- Candidates that recorded initial volumes of 0 cm^3 for each concentration tended to only record 2 columns instead of 3 for the volume of gas / cm^3 in the syringe barrel, initial and final, as the final volume was assumed to be the total volume of gas produced.
- The graduations on a 10 cm^3 syringe were 0.2 cm^3 and so volumes may be recorded to an accuracy of 0.1 cm^3 for both the initial and final volumes of gas. Candidates should take care to take accurate readings using the apparatus provided.
- Candidates were told to record the result as 'more than 10' if the syringe barrel was full of gas after 2 minutes. Some candidates estimated a value greater than 10 when this happened.
- The expected trend was observed if the procedure was followed correctly. Ascorbic acid is an inhibitor of the catalase enzyme so as the concentration of ascorbic acid decreased the volume of gas produced increased. Candidates should be encouraged to write down the actual results from their investigation and not reorder them if they have followed the procedure correctly.

(iii) Use your results in **(a)(ii)** to identify the **greatest** volume of gas produced in the reaction.

greatest volume of gas produced = 6.8

Use your answer to calculate the **rate** of gas production.
Show your working.

6.8 ÷ 2

rate of gas production = 3.4 $cm^3\,min^{-1}$

[2]

Examiner comment

In the results table in **1(a)(ii)**, 6.8 is the greatest volume of gas produced. Since this was collected in 2 minutes and the answer needs to be in $cm^3\ min^{-1}$, the candidate needs to divide 6.8 by two to obtain the rate of gas production.

(iv) Describe **two** improvements to the procedure that would make the measurements more accurate.

1 Repeat to identify anomalous results or calculate a mean.

2 Use a gas syringe.

[2]

Examiner comment

- Candidates should be encouraged to only describe 2 improvements as in the stem of the question.
- Other valid suggestions were stating a specific tool, e.g. vernier caliper, to standardise the thickness of the potato cylinders and using a thermostatically controlled water-bath to standardise the temperature.
- Using another experimenter is not a valid improvement to the actual procedure carried out.

Carry out step 14 to step 18.

step 14 Label a test-tube **T**.

step 15 Put 5 cm^3 of **H** into test-tube **T**.

step 16 Use a thermometer to measure the temperature of **H** in test-tube **T**. Record this value, to the nearest 0.5 °C, in **(b)(i)**.

step 17 Add 10 discs of potato tissue to test-tube **T** and start timing.

step 18 After 2 minutes measure the temperature of the mixture in test-tube **T**. Record this value, to the nearest 0.5 °C, in **(b)(i)**.

(b) (i) State the temperature of **H before** adding potato discs (step 16). 21.5 °C

State the temperature of **H** 2 minutes **after** adding potato discs (step 18).

23.5 °C

Calculate the **change** in temperature after 2 minutes. 2.0 °C

[2]

Examiner comment

This is a straightforward measurement and recording of the temperature. Most candidates calculate the change in temperature correctly.

(ii) State whether temperature is a significant source of error in this investigation.

Explain your answer.

Yes. When the hydrogen peroxide was broken down it released heat energy. An increase in temperature would cause an increase in the rate of reaction. [1]

Examiner comment

- For very small increases in temperature in **1(b)(i)**, e.g. 0.5 °C, an acceptable answer was: 'no' or 'not significant'. The temperature increase was too small to have an effect on the rate of reaction.
- Many candidates stated that temperature was or was not a significant source of error, but did not explain the effect that temperature would have had on the investigation.

(c) A study was carried out in which volunteers were given different daily doses of ascorbic acid (vitamin C) in addition to their normal diet. The maximum ascorbic acid concentration in the blood plasma of each volunteer was measured.

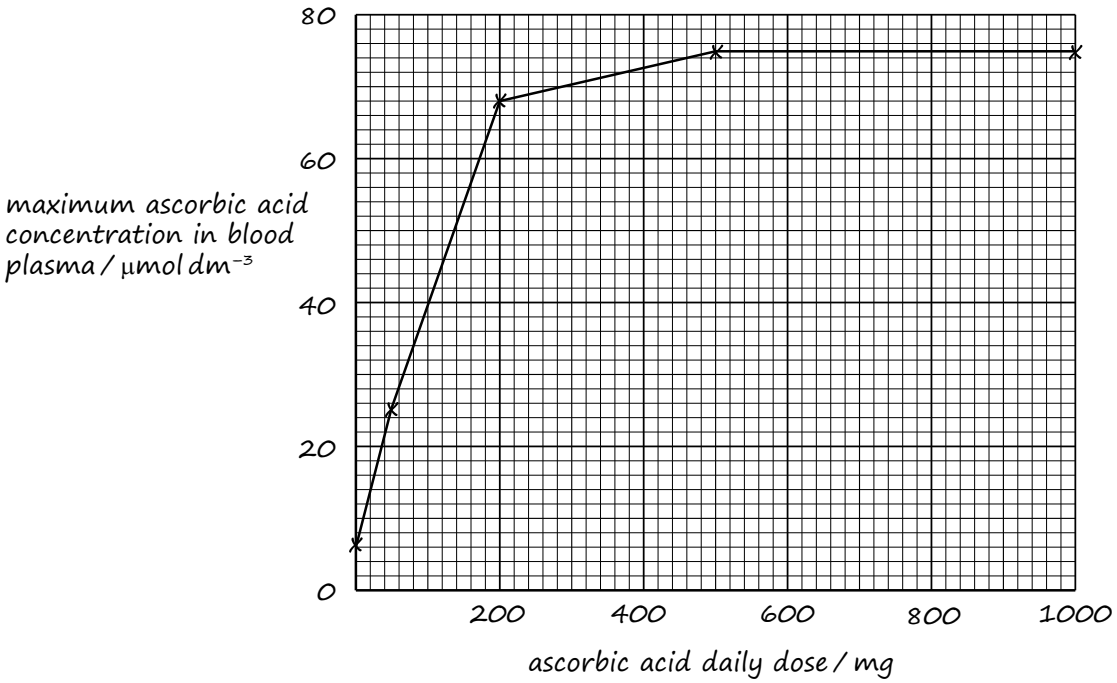
The results are shown in Table 1.2.

Table 1.2

ascorbic acid daily dose / mg	**maximum ascorbic acid concentration in blood plasma / μmol dm^{-3}**
0	6
50	25
200	68
500	75
1000	75

(i) Plot a graph of the data in Table 1.2 on the grid in Fig. 1.3.

Use a sharp pencil.



[4]

Fig. 1.3

Examiner comment

- The x-axis needed to be labelled with the independent variable, ascorbic acid daily dose / mg, as stated in Table 1.2.
- The y-axis needed to be labelled with the dependent variable, maximum ascorbic acid concentration in blood plasma / μmol dm^{-3}, as stated in Table 1.2.
- Candidates needed to carefully choose the scale on each axis, so that both axes used most, or all, of the grid provided and the data could be plotted accurately to within half a square. The scale on each axis should be labelled at least every 2 cm. The most common error was using a non-linear scale on the x-axis: 0, 50, 200, 500 and 1000 mg, the values for the independent variable given in Table 1.2.
- The graph points needed to be plotted accurately using a sharp pencil to within half a square, as a dot within a circle or a small cross.
- The plotted points of the graph needed to be connected with a clear, sharp and unbroken line with ruled straight lines joining the points or a smooth curve. The line should not be extrapolated at either end.

(ii) Suggest an explanation for the results for a daily dose of 0 mg and the results for daily doses of between 500–1000 mg.

0 mg the concentration of ascorbic acid in blood plasma was obtained from the volunteer's normal diet.

500–1000 mg ascorbic acid concentration does not increase after a daily dose of 500 mg as the maximum absorption of ascorbic acid occurs at 500 mg.

[2]

Examiner comment

- Candidates should be encouraged to read the information given about the study that was carried out when answering questions following the graph.
- At 0 mg some candidates just quoted the value of 6 μmol dm^{-3} ascorbic acid which did not explain why it was present in the blood plasma. The information states that doses of ascorbic acid were given in addition to their normal diet.
- At 500–1000 mg many candidates used their knowledge of enzymes to explain the shape of the graph rather than explaining the effect of increasing the daily dose of ascorbic acid on the concentration of ascorbic acid in the blood plasma.
- Common errors were stating that the blood plasma was saturated with ascorbic acid and confusing the term absorbance with the process of absorption.

Question 2

2 **K1** is a slide of a stained transverse section through a plant stem.

(a) **(i)** Draw a large plan diagram of the region of the stem on **K1** indicated by the shaded region in Fig. 2.1. Use a sharp pencil.

Use **one** ruled label line and label to identify the epidermis.

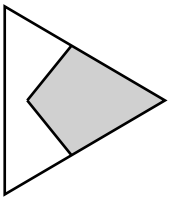
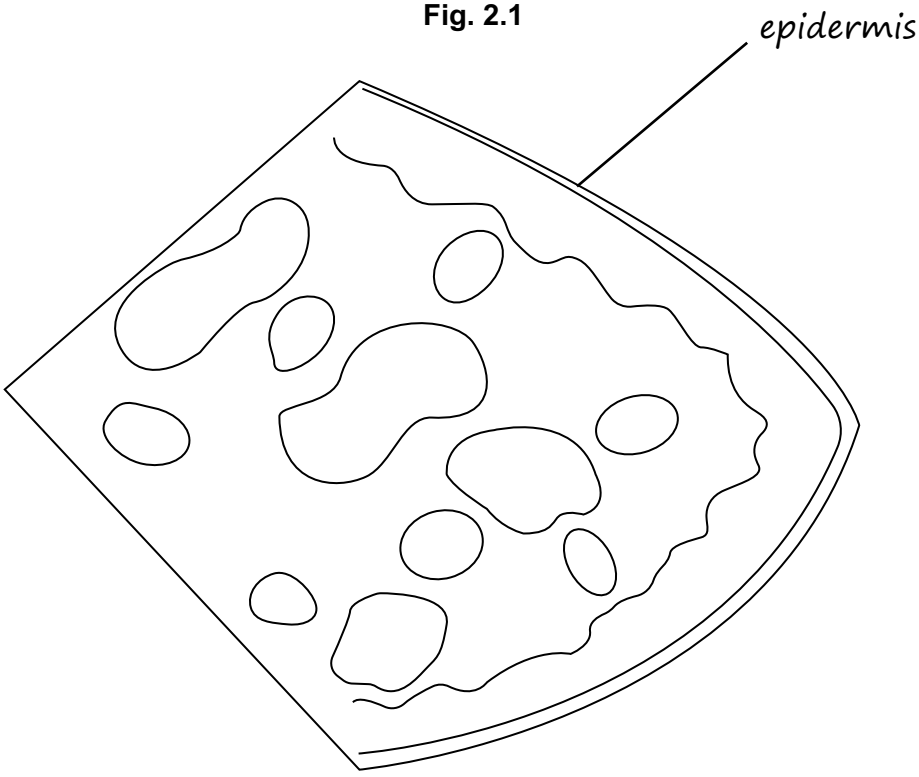


Fig. 2.1



[5]

Examiner comment

The stem on **K1** was not a circular shape, so Fig. 2.1 was included to indicate that one of the angular sections of the stem was the region to be drawn.

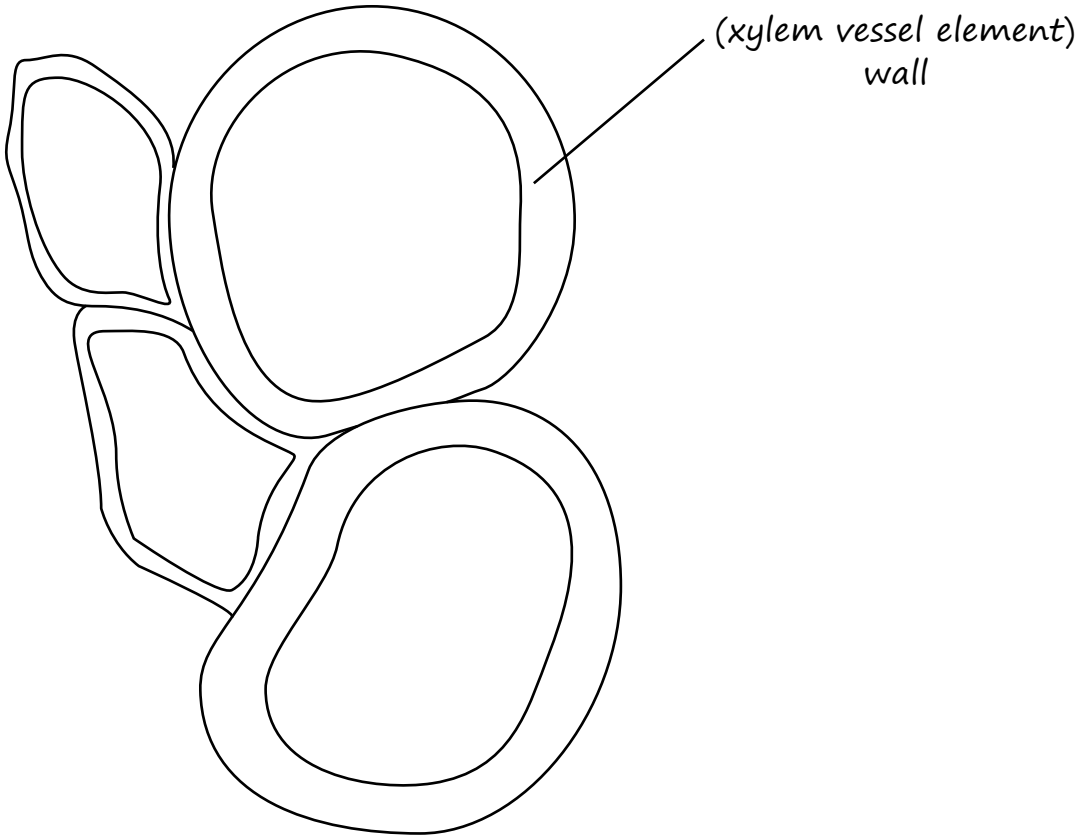
- The plan diagram needed to use most of the available space and clearly show the features observed in the region drawn, with no shading.
- The correct region, as indicated in Fig. 2.1, needed to be drawn. Individual cells should not be included as part of a plan diagram. Many candidates included xylem vessel elements in the vascular bundles.
- Observation of specific detail in the specimen was awarded marks:
  - a layer of vascular bundles beneath the epidermis could be indicated by a wavy line or a layer of oval shapes.
  - detail of the pattern of vascular bundles and air spaces scattered in the cortex of the stem.
- Candidates needed to label the epidermis using a label line that touched the outer line of the drawing or ends between the two lines representing the epidermis. Some candidates forgot to label the drawing.

(ii) Observe one of the larger vascular bundles of the section on **K1**.

Select a group of **four** adjacent xylem vessel elements.

Each xylem vessel element must touch at least **two** other xylem vessel elements.

- Make a large drawing of this group of four xylem vessel elements.
- Use **one** ruled label line and label to identify the wall of **one** xylem vessel element.



[5]

Examiner comment

The drawing shows four xylem vessel elements that have been selected according to the criteria stated in the question. The best responses used a sharp pencil to draw single, clear lines that joined precisely and showed a different shape for each xylem vessel element, since that is what was seen in the specimen. Candidates were not awarded full marks for drawing lines that did not meet up precisely and/or drawing the same shape for each xylem vessel element.

(b) Fig. 2.2 shows a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

The length of one division on this stage micrometer is 1 mm.

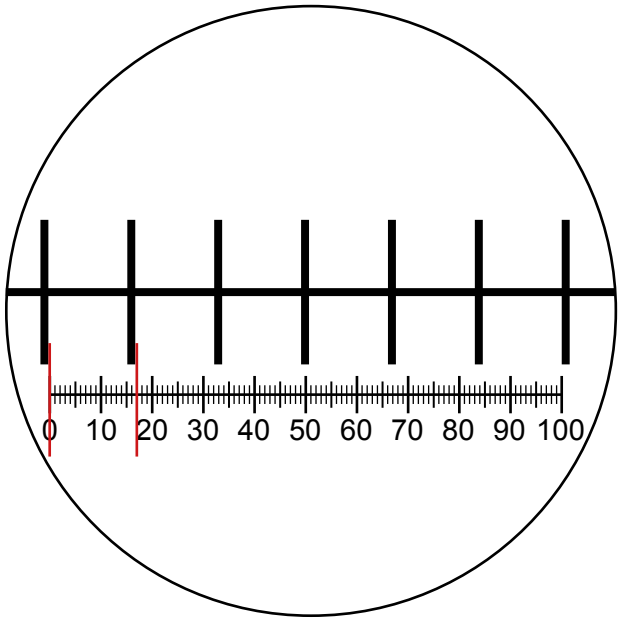


Fig. 2.2

(i) Use Fig. 2.2 to calculate the actual length of one eyepiece graticule unit.

Show your working.

1 mm = 17 eyepiece graticule units

$\frac{1}{17}$

actual length = 59 µm [3]

Examiner comment

- An instruction to 'Show your working' was included in the exam paper which indicates that the candidate needs to show how the actual length of 1 eyepiece graticule unit was determined rather than just writing the answer on the answer line.
- The number of eyepiece graticule units in 1 mm of the stage micrometer scale needed to be measured from the same position relative to each division on the stage micrometer, as shown on the diagram above.
- In the diagram, 0 on the eyepiece graticule scale is level with the right side of the first thick line of the stage micrometer, as indicated above. A line is drawn from the right side of the second thick line (1 mm) on the stage micrometer. This crosses the eyepiece graticule unit scale at 17 units. Therefore 1 mm = 17 eyepiece graticule units.
- If a line was drawn from the right of the third thick line (2 mm) it would cross the eyepiece graticule scale at 34, 17 eyepiece graticule units from the second thick line (1 mm).
- Many candidates measured from different positions. A common error was drawing lines from the inside of both thick lines (0 mm and 1 mm) on the stage micrometer and stated 1 mm = 15 eyepiece graticule units.
- Another common error was counting the number of divisions on the stage micrometer as 6 or 7 (the number of thick lines on the stage micrometer) and dividing it by the total number of eyepiece graticule units, 100.
- The answer needed to be given to the correct number of significant figures with the appropriate units.

Fig. 2.3 shows a photomicrograph of a transverse section through a different stem to **K1**. This was taken with the same microscope and lenses used to take Fig. 2.2. The eyepiece graticule has been placed across the diameter of the section.

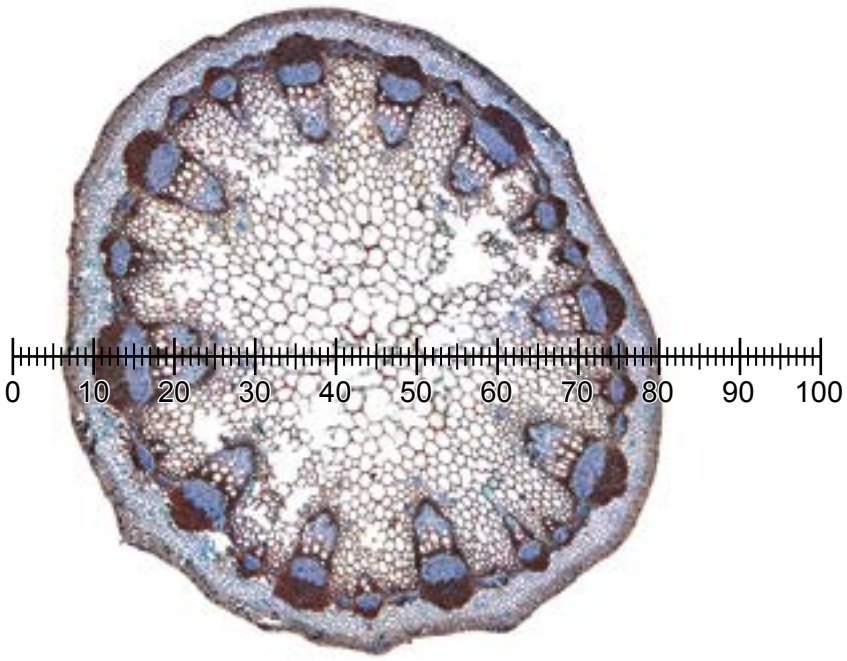


Fig. 2.3

(ii) Use the calibration of the eyepiece graticule from **(b)(i)** to calculate the actual diameter of the section in Fig. 2.3.

Show your working.

74 eyepiece graticule units

74 x 59 μm

actual diameter = 4366 μm ..... [2]

Examiner comment

Most candidates found this straightforward. After measuring the diameter of the stem using the eyepiece graticule placed across Fig. 2.3, candidates needed to use the actual length of one eyepiece graticule unit shown in **(b)(i)** to calculate the actual diameter of the stem.

(iii) Identify **three** observable differences, other than size and colour, between the stem section on **K1** and the stem section on Fig. 2.3.

Record **three** observable differences in Table 2.1.

Table 2.1

feature	K1	Fig. 2.3
number of vascular bundles	more	fewer
air spaces	more	fewer
shape	triangular	round

[3]

[Total: 18]

Examiner comment

- Candidates should provide only three observations, as stated in the question. Many candidates did not follow the rubric of the question and stated more than three observations. Additional examples were not awarded marks and candidates risked losing marks as there was a higher chance of them providing a wrong or contradictory answer. Candidates are advised to think carefully about which three responses are the best ones and state only three.
- Candidates should be reminded that it is not possible to observe 3D shapes, e.g.' Fig. 2.3 is a sphere'. Stating the colour of the different stains on **K1** and Fig. 2.3 would also not be awarded any marks.
- In this example, there is not a magnification stated for Fig. 2.3 so a comparison of the size of the stems or vascular bundles was not possible.
- Possible comparisons were: the presence of stomata, the thickness of the epidermis, the shape and distribution of the vascular bundles and the presence of a vascular cap on the vascular bundles.
- A common error that was not awarded marks was to refer to the stem section as a cell, e.g. '**K1** – there were more vascular bundles in the cell'.

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