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CAMBRIDGE
International Education

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CANDIDATE NAME

CENTRE NUMBER

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BIOLOGY **9700/33**

Paper 3 Advanced Practical Skills 1 **February/March 2026**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
Total	

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1 Urease is an enzyme that hydrolyses urea into ammonia and carbon dioxide, as shown in Figure 1.1.

$$\text{urea} + \text{water} \xrightarrow{\text{urease}} \text{ammonia} + \text{carbon dioxide}$$

Figure 1.1

Ammonia forms an alkaline solution that causes red litmus paper to change colour to blue.

The change in colour of the red litmus paper to blue can be used to determine the end-point of the reaction.

You will investigate the effect of changing the concentration of urea on the time taken to reach the end-point.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
E	urease solution	harmful irritant	10
S	5.0% urea solution	none	30
W	distilled water	none	60
U	unknown concentration of urea	none	10
R	red litmus paper	none	–

If any urease solution comes into contact with your skin, wash it off immediately.

It is recommended that you wear suitable eye protection.

You will need to:

- prepare different concentrations of urea
- mix the different concentrations of urea with urease
- measure the time taken for red litmus paper to turn blue
- use your results to estimate the concentration of urea in a urea solution of unknown concentration.

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(a) You will need to carry out a serial dilution of the 5.0% urea solution, **S**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of urea in addition to the 5.0% urea solution, **S**.

After the serial dilution is completed, you will need to have 10 cm^3 of each concentration available to use.

(i) Complete Figure 1.2 to show how you will prepare your serial dilution.

Each beaker should have labelled arrows to show:

- the volume of urea solution transferred from one beaker to the next
- the volume of distilled water, **W**, added.

Include a label under each beaker to show the concentration of the urea solution.

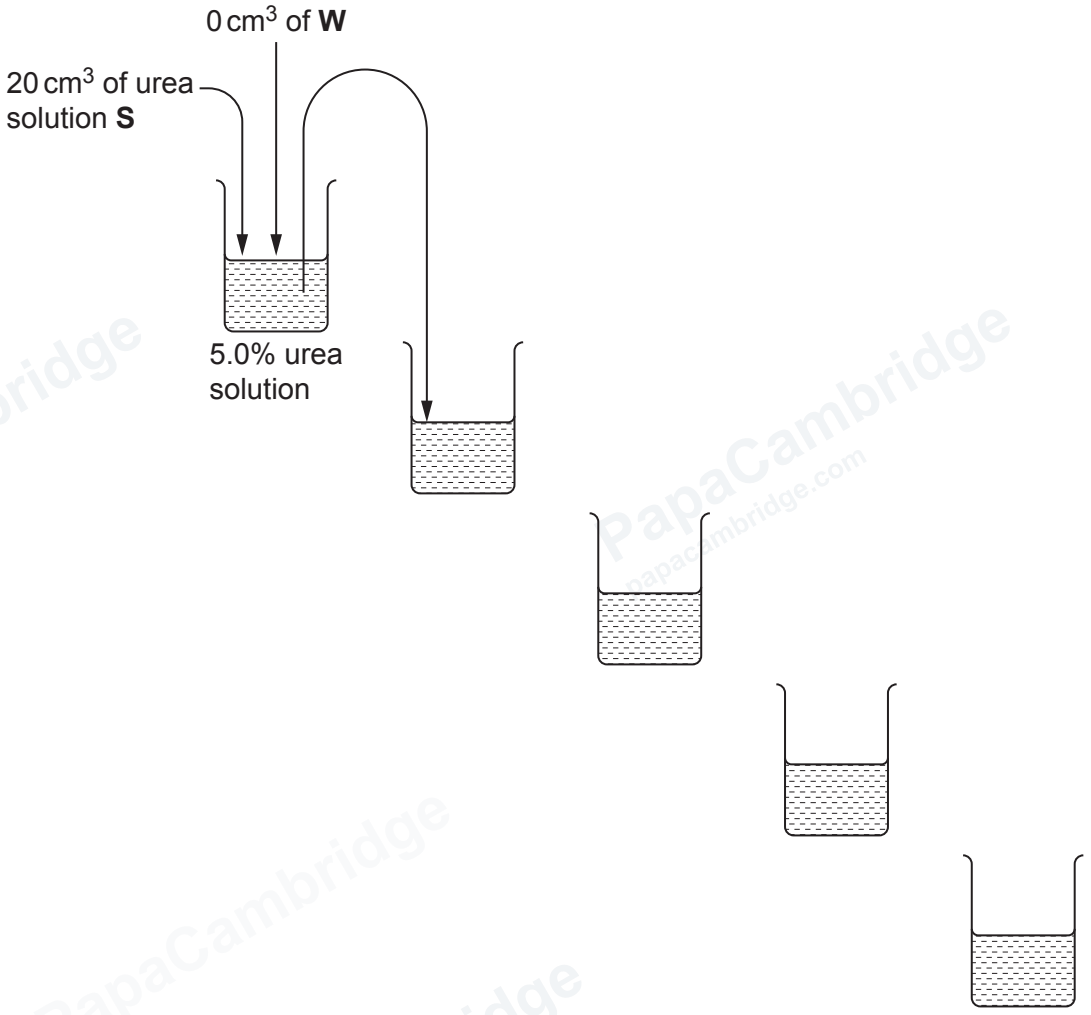


Figure 1.2

[3]

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Carry out step 1 to step 8.

step 1 Label beakers with the concentrations of urea that you have stated in Figure 1.2.

step 2 Prepare the concentrations of urea, as shown in Figure 1.2, in the appropriately labelled beakers.

step 3 Prepare a clean, dry spotting tile by labelling the wells with the concentrations of urea that you have stated in Figure 1.2.

step 4 Cut the red litmus paper to obtain five pieces, each approximately 0.5 cm in length. Put one piece of litmus paper into each labelled well on the spotting tile.

step 5 Put 3 drops of urease solution, **E**, into each labelled well.

The reaction will start when the urea solution is added in step 6.

step 6 Put 5 drops of 5.0% urea solution into the appropriately labelled well. Mix gently and immediately start timing.

step 7 Record in **1(a)(ii)** the time taken for the **whole surface** of the litmus paper to change colour from red to blue. This is the end-point of the reaction.

If the whole surface has **not** changed colour after 180 seconds, record the result as 'more than 180'.

step 8 Repeat step 6 and step 7 with the other concentrations of urea you prepared in step 2.

(ii) Record your results in an appropriate table.

[5]

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(iii) Describe the trend in your results.

.....

.....

..... [1]

Carry out step 9 to step 13.

step 9 Label a clean, dry well on the spotting tile with the letter **U**.

step 10 Cut the red litmus paper to obtain one piece that is approximately 0.5 cm in length. Put the piece of litmus paper into the well.

step 11 Put 3 drops of urease solution, **E**, into the well.

step 12 Put 5 drops of the urea solution of unknown concentration, **U**, into the well. Mix gently and immediately start timing.

step 13 Record in **1(a)(iv)** the time taken for the **whole surface** of the litmus paper to change colour from red to blue.

If the whole surface has **not** changed colour after 180 seconds, record the result as 'more than 180'.

(iv) Record your result for **U**.

time = ... s [1]

(v) Use your results from **1(a)(ii)** and **1(a)(iv)** to estimate the concentration of urea in **U**.

percentage concentration = ... [1]

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(vi) Identify **two** sources of error in step 4 to step 7.

For each error, suggest an improvement to the method that will reduce the effect of the error.

error 1 .....

.....

improvement .....

.....

.....

error 2 .....

.....

improvement .....

.....

.....

[2]

(vii) If all sources of error were removed, suggest a modification to the method that would enable the concentration of **U** that you recorded in **1(a)(v)** to be estimated more accurately.

.....

.....

..... [1]

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(b) Scientists investigated the effect of temperature on urease activity.

The results are shown in Table 1.2.

Table 1.2

temperature / °C	urease activity / arbitrary units
10	38
20	65
35	98
40	90
50	10

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

Use a sharp pencil.

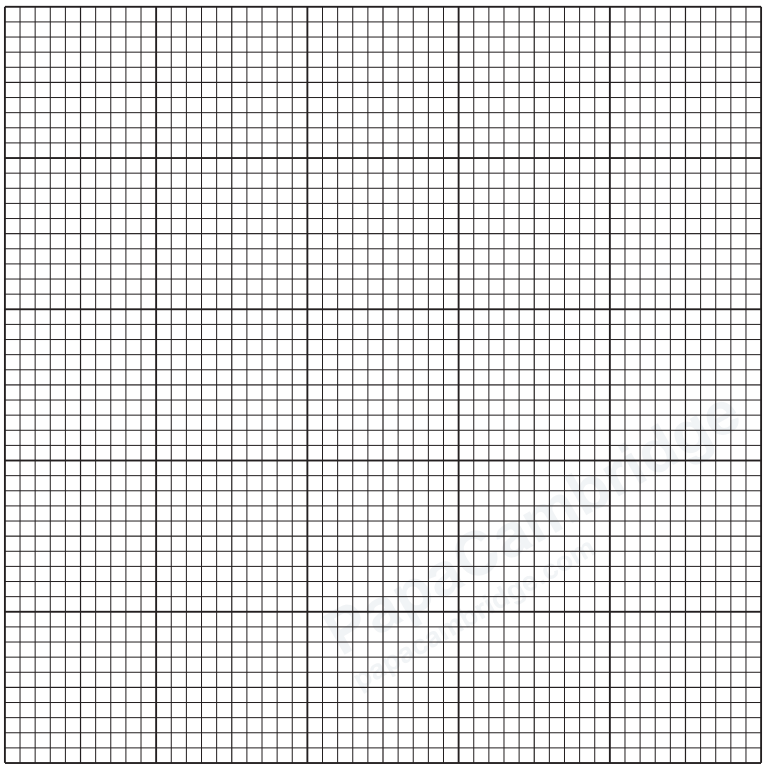


Figure 1.3

[4]

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(ii) Use your graph in Figure 1.3 to estimate urease activity at 25 °C.

Show on your graph how you obtained your answer.

urease activity = ... arbitrary units
[2]

(iii) Use the data in Table 1.2 and your graph in Figure 1.3 to suggest an explanation for the change in urease activity from 35 °C to 50 °C.

.....

.....

.....

.....

..... [2]

[Total: 22]

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2 **P1** is a slide of a stained transverse section through a leaf.

(a) **(i)** Draw a large plan diagram of the region on **P1** indicated by the shaded area in Figure 2.1.

Use a sharp pencil.

Use **one** ruled label line and a label to identify the xylem.

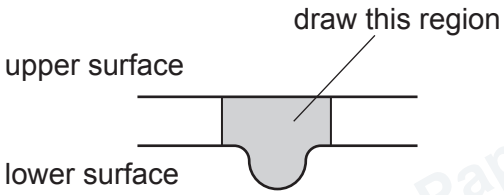


Figure 2.1

[5]

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(ii) Observe the cells in the upper epidermis of the section of the leaf on **P1**.

Select a group of **four** adjacent upper epidermal cells. Each cell must touch at least **one** other cell.

- Make a large drawing of this group of **four** epidermal cells.
- Use **one** ruled label line and label to identify the cell wall.

[5]

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(b) Figure 2.2 is a photomicrograph of a stained transverse section of a leaf from a different species of plant.

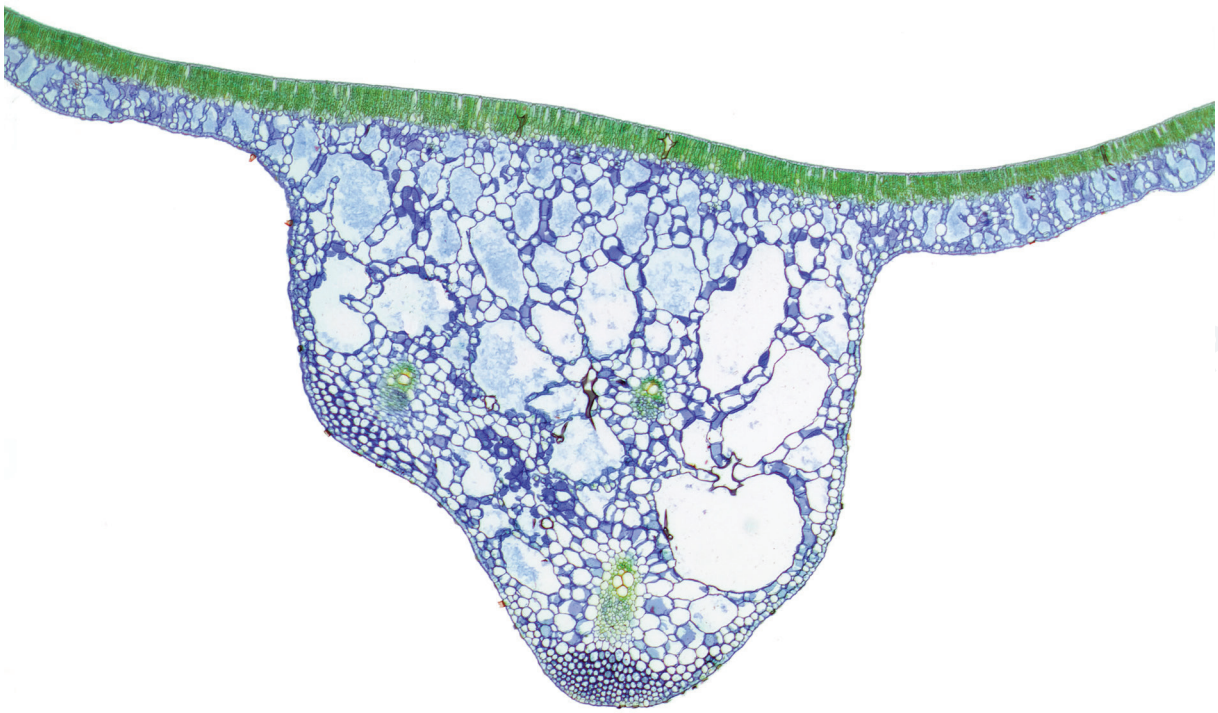


Figure 2.2

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Identify **three** observable differences, **other** than colour, between the section on **P1** and the section in Figure 2.2.

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

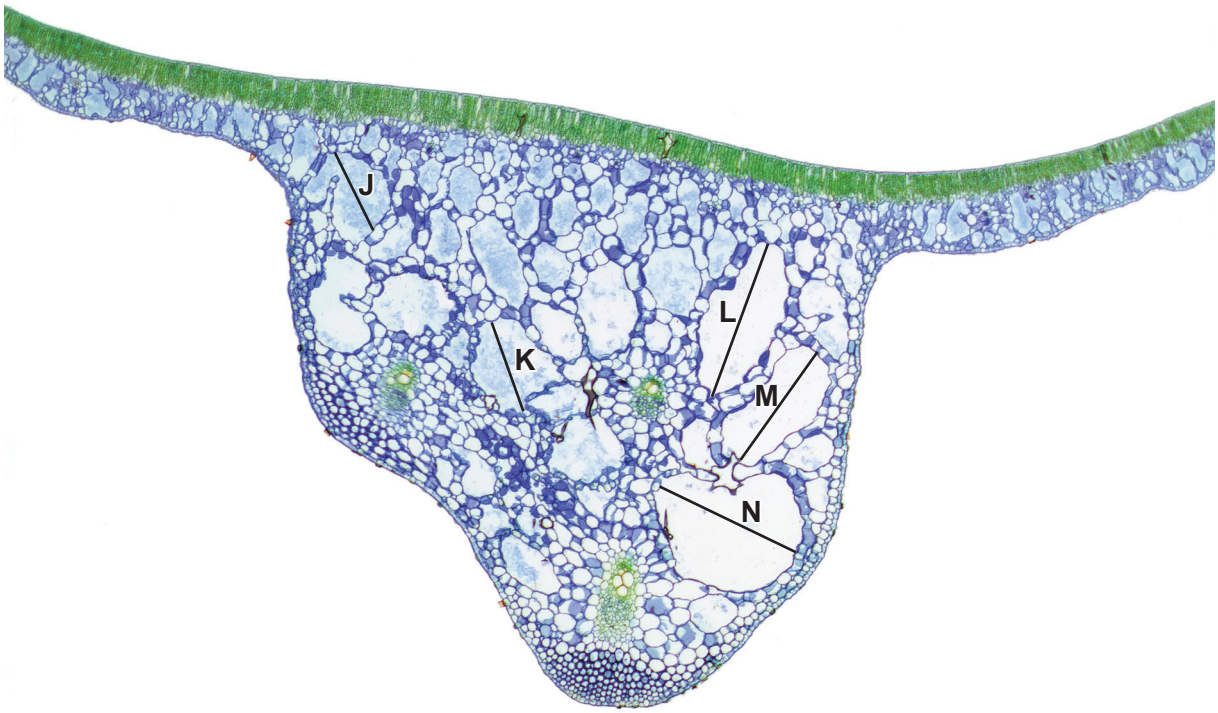
Table 2.1

feature	P1	Figure 2.2
1		
2		
3		

[4]

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(c) Figure 2.3 is the same photomicrograph as that shown in Figure 2.2.



magnification ×24

Figure 2.3

(i) In Figure 2.3, the lines **J**, **K**, **L**, **M** and **N** are drawn across the lengths of five air spaces.

Measure the lengths in the photomicrograph of these five air spaces, along the lines **J**, **K**, **L**, **M** and **N**.

length of **J** = ...

length of **K** = ...

length of **L** = ...

length of **M** = ...

length of **N** = ...

[1]

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(ii) Calculate the mean length in the photomicrograph of the five air spaces measured in **2(c)(i)**.

Show your working.

mean length = ...
[1]

(iii) Calculate the **actual** mean length of these five air spaces in micrometres (μm), using your answer to **2(c)(ii)** and the magnification shown in Figure 2.3.

Give your answer to **two** significant figures.

Show your working.

actual mean length = ... μm
[2]

[Total: 18]

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