Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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 or correction fluid.
- 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	

This document has **20** pages. Any blank pages are indicated.

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1 Plasmolysis may be seen in onion cells that have been put into a sodium chloride solution. Plasmolysis occurs when water moves out of the cells and the cell surface membrane pulls away from the cell wall.

You will observe the effect of different concentrations of sodium chloride solution on onion cells in samples of onion tissue. You will use your observations to determine the concentration of sodium chloride in three solutions, **U1**, **U2** and **U3**.

You are provided with onion tissue in approximately 50 cm^3 of each of the three different concentrations of sodium chloride solution.

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

You will need to:

- prepare microscope slides of the three samples of onion tissue in **U1**, **U2** and **U3**
- observe 15 cells on each microscope slide and record how many of these cells show any sign of plasmolysis.

Carry out step 1 to step 11.

step 1 Label **one** clean and dry microscope slide **U1**. Put the slide on a paper towel.

step 2 Put a few drops of the solution in the beaker labelled **U1** onto the microscope slide.

step 3 Remove **one** piece of onion tissue from the beaker labelled **U1**. Cut the piece of onion tissue so that it is between approximately 0.5 cm × 0.5 cm and 1 cm × 1 cm. Put the remaining onion tissue back into the beaker labelled **U1**.

step 4 Peel off the inner epidermis from the piece of onion tissue.

step 5 Put the inner epidermis on the microscope slide, as shown in Fig. 1.1. If the piece of epidermis is folded, you may need to add more drops of solution. The inner epidermis will float and can then be unfolded.

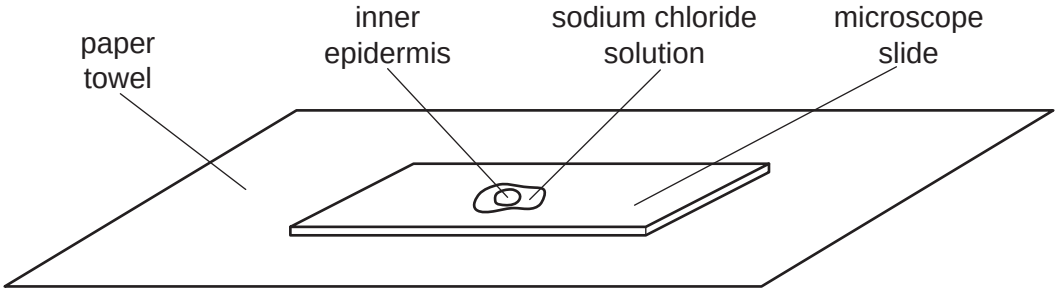

Fig. 1.1

step 6 Put a coverslip over the piece of inner epidermis on the microscope slide. Use a paper towel to remove any excess solution that is outside the coverslip.

step 7 Observe the cells of the epidermis using the microscope. You may need to reduce the amount of light entering the microscope to observe the cells clearly.

step 8 Using the ×10 objective lens, observe 15 cells. You may need to move the slide to change the field of view.

step 9 Count how many of these 15 cells are undergoing plasmolysis. Record your results in **(a)(i)**.

step 10 Repeat step 1 to step 9 using the onion tissue in **U2**.

step 11 Repeat step 1 to step 9 using the onion tissue in **U3**.

You will need to use slide **U1** again for **(a)(iii)**.

(a) (i) Record your results in an appropriate table.

[4]

(ii) The concentrations of sodium chloride solutions are: 0.10 mol dm^{-3}, 0.50 mol dm^{-3} and 1.00 mol dm^{-3}.

Using your results from **(a)(i)**, identify which solution is **U1**, **U2** or **U3**.

0.10 mol dm^{-3} .....

0.50 mol dm^{-3} .....

1.00 mol dm^{-3} .....

[1]

(iii) Observe the cells on slide **U1**.

Select a group of **four** adjacent touching cells. Each cell needs to touch at least **two** other cells.

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

[5]

(iv) Explain, in terms of water potential, your observations for slide **U1**.

.....

.....

.....

.....

.....

..... [3]

(b) A student investigated the effect of different concentrations of sucrose solution on the mass of potato pieces.

- Five different concentrations of sucrose solution were used.
- The masses of five potato pieces were measured before and after soaking in these different sucrose solutions.
- The percentage change in mass was then calculated for each potato piece.
- The procedure was repeated three times.
- The mean percentage change in mass as a result of soaking was then calculated for each concentration of sucrose.

Table 1.1 shows the results of this investigation.

Table 1.1

sucrose concentration / mol dm^{-3}	trial	initial mass / g	final mass / g	change in mass / g	percentage change in mass	mean percentage change in mass
0.0	**1**	2.4	2.5	0.1	+4.2	+8.2
	2	2.5	2.8	0.3	+12.0	
	3	2.4	2.6	0.2	+8.3	
0.2	**1**	2.4	2.5	0.1	+4.2	
	2	2.4	2.5	0.1	+4.2	
	3	2.3	2.4	0.1		
0.4	**1**	2.5	2.5	0.0	+0.0	+1.3
	2	2.5	2.6	0.1	+4.0	
	3	2.5	2.5	0.0	+0.0	
0.6	**1**	2.6	2.5	–0.1	–3.8	–6.7
	2	2.5	2.3	–0.2	–8.0	
	3	2.4	2.2	–0.2	–8.3	
0.8	**1**	2.4	2.2	–0.2	–8.3	–9.9
	2	2.4	2.2	–0.2	–8.3	
	3	2.3	2.0	–0.3	–13.0	

(i) Use the data in Table 1.1 to calculate the percentage change in mass of the potato piece soaked in 0.2 mol dm^{-3} sucrose solution in trial 3.

Show your working.

percentage change in mass = ...
[1]

(ii) Use the data in Table 1.1 to calculate the **mean** percentage change in mass of the potato pieces soaked in the 0.2 mol dm^{-3} sucrose solution.

Show your working.

mean percentage change in mass = ...
[1]

(iii) Plot a graph of the **mean** data in Table 1.1 on the grid in Fig. 1.2.

Draw the line of best fit.

Use a sharp pencil.

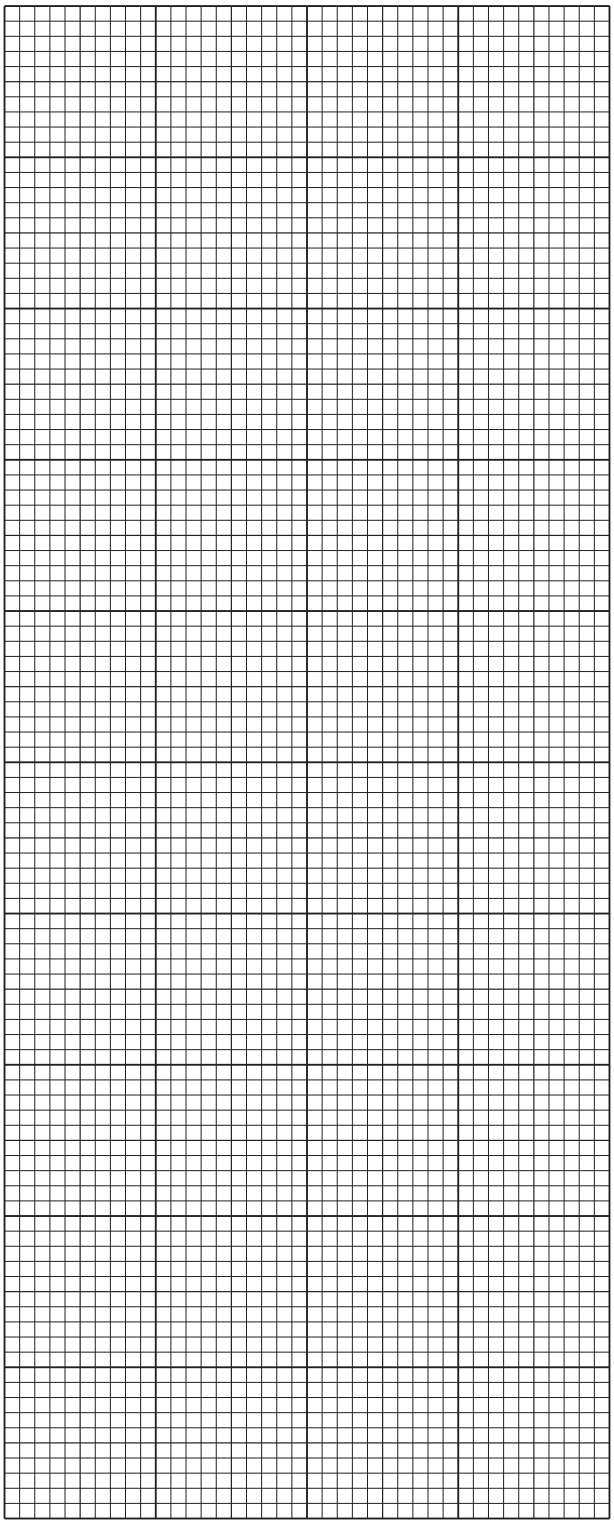

Fig. 1.2

[4]

(iv) Use your graph in Fig. 1.2 to estimate the concentration of sucrose solution that would result in **no** change in mass of the potato pieces.

concentration of sucrose solution = ...mol dm^{-3} [1]

[Total: 20]

2 Many plants store starch in their roots. The amount of starch present in roots can vary with the seasons.

In the summer months, when plants are actively growing, the starch present in roots is lower than during the winter months.

In the winter months, many of the cells are storing starch in starch grains.

Fig. 2.1 is a photomicrograph of a stained transverse section through a root in winter.

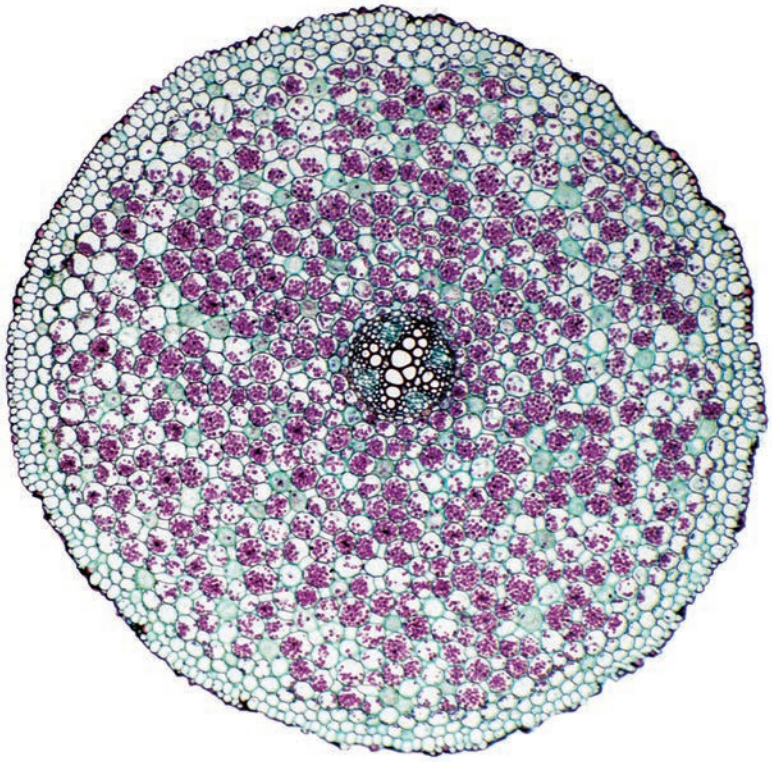

Fig. 2.1

(a) Draw a large plan diagram of the whole section shown in Fig. 2.1. Use a sharp pencil.

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

[5]

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(b) Iodine solution can be used to test for the presence of starch in root extracts. The concentration of starch in a root extract can be determined by the colour observed when iodine solution is added.

You will need to:

- prepare different concentrations of starch suspension
- estimate the concentration of starch in two root extracts
- identify the season in which each root extract was taken.

You are provided with the materials shown in Table 2.1.

Table 2.1

labelled	contents	hazard	volume / cm^3
S	1.0% starch suspension	none	50
iodine	iodine solution	none	20
W	distilled water	none	150
R1	root extract	none	20
R2	root extract	none	20

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

You need to carry out a **serial** dilution of the 1.0% starch suspension, **S**, to reduce the concentration by a **factor of 10** between each successive dilution.

You will need to prepare **four** concentrations of starch suspension in addition to the 1.0% starch suspension, **S**.

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

(i) Complete Fig. 2.2 to show how you will prepare your serial dilution.
Fig. 2.2 shows the beakers you will use.

For each beaker, add labelled arrows to show:

- the volume of starch suspension transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of the starch suspension.

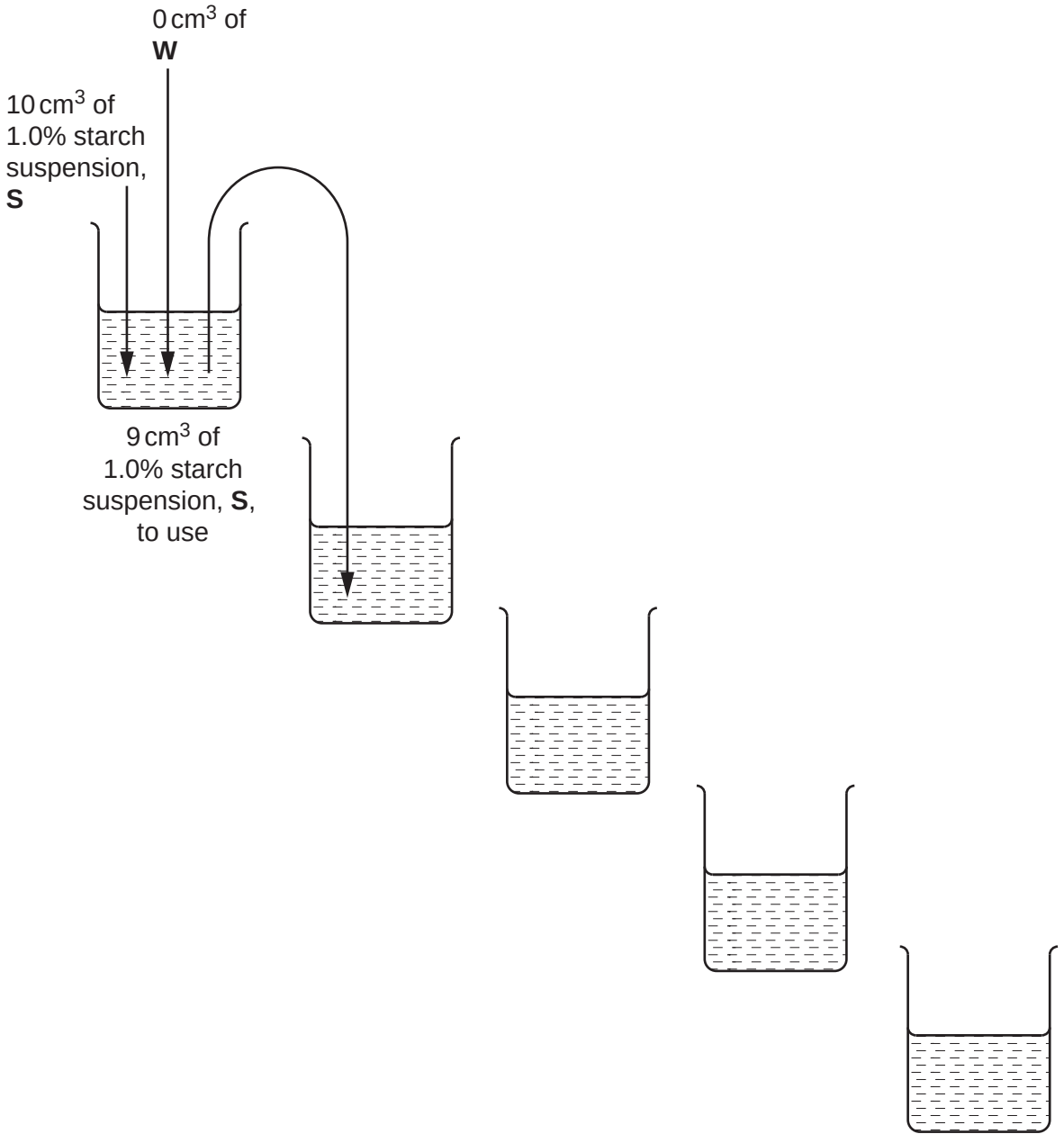

Fig. 2.2

[3]

Carry out step 1 to step 6.

step 1 Prepare the concentrations of starch suspension as decided in **(b)(i)** and shown in Fig. 2.2. Mix well.

step 2 Label test-tubes with the concentrations of starch suspension prepared in step 1.

step 3 Put 5 cm^3 of each concentration of starch solution into the appropriately labelled test-tube.

step 4 Put 3 drops of **iodine** into each of the test-tubes. Shake gently to mix.

step 5 Place the white card behind the test-tubes and observe the colour of the liquid in each test-tube. You may see the same colour in more than one test-tube.

step 6 Compare the colour of the liquid in each test-tube with the key in Fig. 2.3. Record your observations in **(b)(ii)** using only the symbols shown in the key in Fig. 2.3.

Key

colour	**symbol**
blue-black	++++++
dark blue	+++++
purple	++++
dark brown	+++
brown	++
yellow-orange	+

Fig. 2.3

(ii) Record your results in an appropriate table.

[3]

(iii) Identify the dependent variable in this investigation.

..... [1]

Carry out step 7 to step 12.

step 7 Label a test-tube **R1**.

step 8 Put 5 cm^3 of **R1** into the test-tube you have labelled **R1**.

step 9 Put 3 drops of **iodine** into the same test-tube. Shake gently to mix.

step 10 Place the white card behind the test-tube and observe the colour of the liquid in the test-tube.

step 11 Compare the colour of the liquid in the test-tube with the key in Fig. 2.3. Record your observation in **(b)(iv)** using only the symbols shown in the key in Fig. 2.3.

step 12 Repeat step 7 to step 11, using **R2** instead of **R1**.

(iv) Record your observations for **R1** and **R2**, using the symbols shown in the key in Fig. 2.3.

R1 .....

R2 .....

[1]

(v) Using your results in **(b)(ii)** and **(b)(iv)**, estimate the concentration of starch in **R1** and **R2**.

R1 .....

R2 .....

[1]

(vi) Suggest how you could make improvements to the procedure so that a more accurate estimate of the concentration of starch in **R1** and **R2** could be obtained.

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.....

..... [2]

(vii) Using the information given **and** the estimates in **(b)(v)**, identify which root extract was taken in the summer. Explain your answer.

root extract .....

explanation .....

.....

.....

[1]

(c) Fig. 2.4 is the same photomicrograph as that shown in Fig. 2.1.

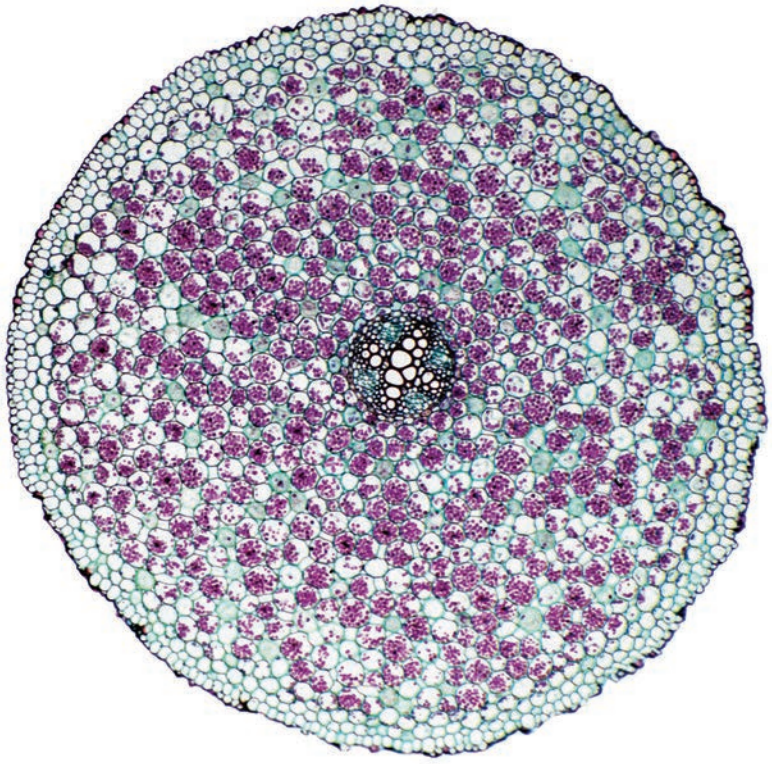

Fig. 2.4

Fig. 2.5 is a photomicrograph of a stained transverse section through a different root.

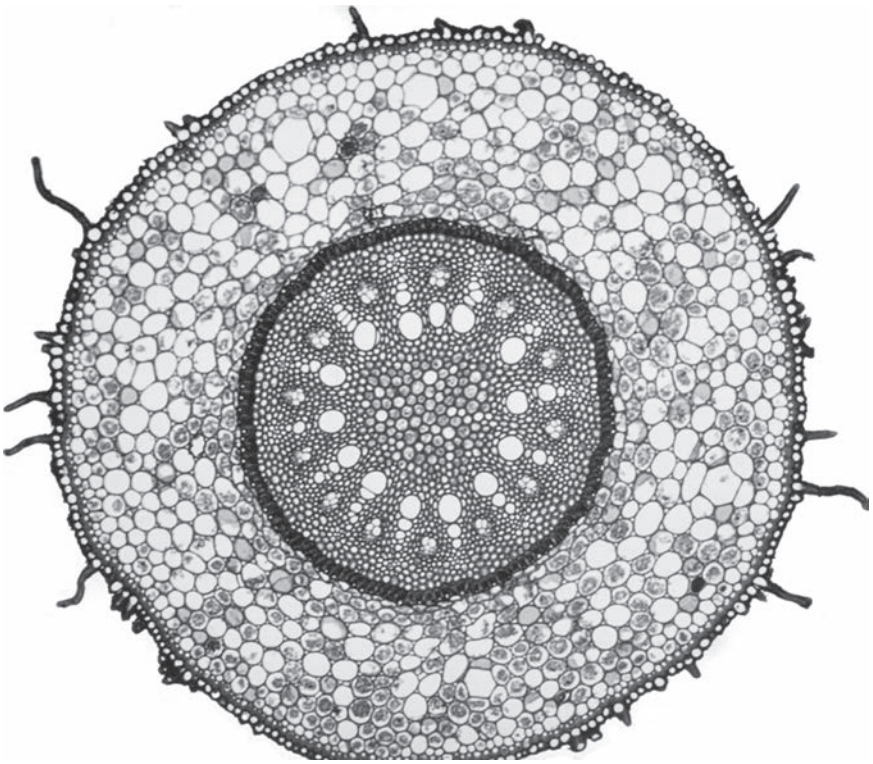

Fig. 2.5

Identify **three** observable features, other than colour and presence of starch grains, that are different in the section in Fig. 2.4 compared with the section in Fig. 2.5.

Record the differences between these three observable features in Table 2.2.

Table 2.2

feature	Fig. 2.4	Fig. 2.5

[3]

[Total: 20]

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