



EUNOIA JUNIOR COLLEGE
JC2 Preliminary Examinations 2025
General Certificate of Education Advanced Level
Higher 2

CANDIDATE
NAME

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CIVICS
GROUP

2

4

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REGISTRATION
NUMBER

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BIOLOGY

9744/04

Paper 4 Practical

26 August 2025

2 hours 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number on all the work you hand in.

Give details of the practical shift and laboratory, where appropriate, in the boxes provided.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use stapler, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** questions in the spaces provided in the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

The number of marks is given in brackets [] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
1	
2	
3	
Total	55

This document consists of **19** printed pages and **1** blank page.

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Answer **all** questions.

- 1 The enzyme amylase catalyses the hydrolysis (breakdown) of starch to reducing sugars, as shown in Fig. 1.1.

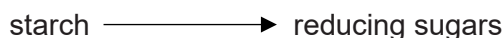


Fig. 1.1

A student investigated the effect of temperature on the hydrolysis of starch by the enzyme amylase, which has an optimal temperature close to 40°C.

The student carried out the following steps:

- step 1: put 2 cm³ of amylase into a test-tube
- step 2: put 18 cm³ of starch solution into a different test-tube
- step 3: put the test-tubes into a water-bath at 10°C
- step 4: leave the test-tubes for 3 minutes
- step 5: put the starch solution into the test-tube containing the amylase
- step 6: leave the test-tube for 2 minutes
- step 7: immediately determine the relative amount of reducing sugars in the test-tube
- repeat steps 1 to 7 at 40°C and at 100°C.

You are provided with three beakers, **S1**, **S2** and **S3**. These three beakers contain the same products of the reaction involving starch and amylase as the test-tubes prepared by the student in step 6. Each beaker contains the products of the reaction produced at one of the three temperatures tested.

You will determine:

- the relative amount of reducing sugar present in each beaker
- the presence or absence of starch in each beaker
- which of the beakers **S1**, **S2** and **S3** contain products of the amylase-catalysed reaction carried out at 10°C, 40°C and 100°C respectively.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm ³
S1	products of the reaction involving starch and amylase carried out at a particular temperature	none	20
S2	products of the reaction involving starch and amylase carried out at a particular temperature	none	20
S3	products of the reaction involving starch and amylase carried out at a particular temperature	none	20
U	products of the reaction involving starch and amylase at an unknown temperature	none	20
B	Benedict's solution	irritant	30
iodine	iodine solution	irritant	15

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

It is recommended that you wear suitable eye protection.

To investigate the effect of temperature on the hydrolysis of starch by the enzyme amylase you will need to:

- carry out the test for reducing sugars on **S1**, **S2** and **S3**
- determine the relative amount of reducing sugar in each solution
- carry out the test for starch on **S1**, **S2**, and **S3**
- determine the presence or absence of starch in each solution.

- (a) (i) Explain why the student left the test-tubes in the water bath for 3 minutes before adding the starch solution.

.....
[1]

To determine the relative amount of reducing sugar in each solution, the time to the first colour change will be measured using 5 cm³ of each solution.

- (ii) Describe how you will carry out the test for reducing sugars.

.....
[1]

- (iii) State how you will determine which solution has the **highest amount** of reducing sugar present.

.....
[1]

- (iv) State the independent variable in this investigation.

.....
[1]

Carry out step 1 to step 5.

step 1 Label one test-tube, **S1**.

step 2 Put 5 cm³ of **S1** into the test-tube.

step 3 Repeat step 1 and step 2 for **S2** and **S3**.

step 4 Carry out the test for reducing sugars as you described in **(a)(ii)**.

If the time taken to the first colour change is longer than 120 seconds then record as 'more than 120'.

step 5 Record in **(a)(v)** the time taken to the first colour change for each solution.

Carry out step 6 to step 11 to test for the presence of starch.

step 6 Label a clean test-tube, **S1**.

step 7 Put 5 cm³ of **S1** into the test-tube.

step 8 Repeat step 6 and step 7 for **S2** and **S3**.

step 9 Put 2 drops of iodine solution into each test-tube. Shake gently to mix.

If any starch is present the solution will change to a blue-black colour.

step 10 Observe the colour in each test-tube.

step 11 Record in **(a)(v)** the colour for each solution.

(v) Record your results in an appropriate table.

(vi) Complete Table 1.2 using your results in (a)(v).

For reducing sugar content use only the words: **none**, **low**, **medium** or **high**.

For presence of starch use only the words: **present** or **absent**.

You may use each word once, more than once or not at all.

Table 1.2

	reducing sugar content	presence of starch
S1		
S2		
S3		

[2]

(vii) Explain which of the beakers **S1**, **S2** and **S3** contain products of the amylase-catalysed reaction carried out at 100°C.

.....

.....

.....

.....

.....

.....[3]

U contains the products of the reaction involving starch and amylase solution in a water-bath at an unknown temperature.

You will need to:

- carry out the test for reducing sugars and the test for starch on **U**
- compare the results for **U** with the results for **S1**, **S2** and **S3**
- estimate the temperature of the water-bath used for **U**.

Carry out step 12 and step 13.

step 12 Repeat the test for reducing sugars and the test for starch on **U**.

step 13 Record your results in (a)(viii).

- (viii) Record the result of the test for reducing sugars for **U**.

time taken to first colour change s

Record the result of the test for starch for **U**.

colour [1]

- (ix) Use your results in (a)(v) and (a)(viii) to estimate the temperature of the water-bath used for **U**.

temperature of water-bath °C [1]

- (x) Describe how the student could obtain a **quantitative** estimate of the concentration of reducing sugar in a solution.

.....

 [4]

[Total: 19]

2 There are a variety of methods used to estimate the water potential of plant tissue.

A student decided to estimate the water potential of potato tissue using the method described.

- 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. The concentration of sucrose solution that would result in no change in mass of the potato pieces indicates the water potential of the potato tissue.

Table 2.1 shows the results of this investigation.

Table 2.1

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	

- (a) (i) Use the data in Table 2.1 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 clearly.

percentage change in mass = [1]

- (ii) Use the data in Table 2.1 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 clearly.

mean percentage change in mass = [1]

- (iii) Plot a graph of the **mean** data in Table 2.1 on the grid in Fig. 2.1.

Use a sharp pencil.

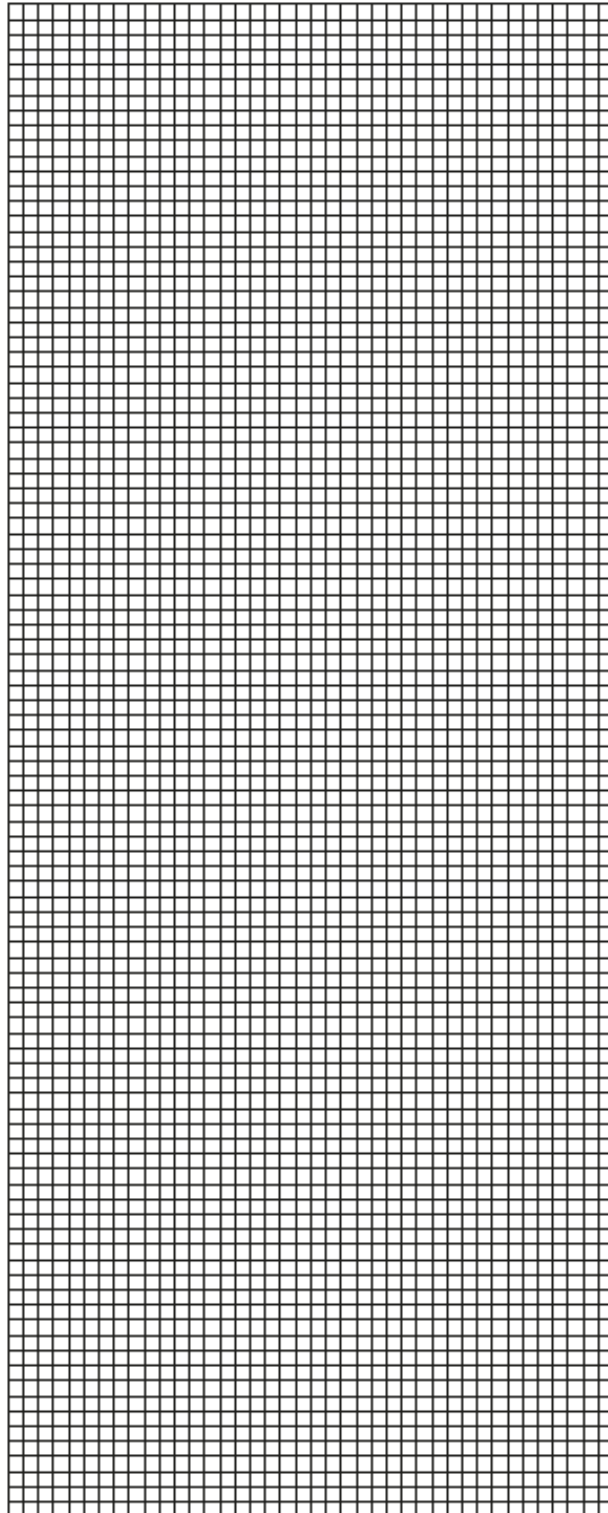


Fig. 2.1

- (iv) Use your graph in Fig. 2.1 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]

The student decided to use another method to estimate the water potential of potato tissue. This method involved soaking potato tissue in different concentrations of sucrose solution, and then measuring the change in density of the sucrose solution for each concentration of sucrose solution that the potato tissue was soaked in. The more water present in a sucrose solution, the less dense it is.

For each concentration of sucrose solution, some of it was removed prior to soaking the potato tissue and coloured with a dye. To test if there is a change in density of a sucrose solution after the potato tissue has been soaked in it, a drop of the respective coloured sucrose solution will be used as shown in Fig. 2.2.

Fig. 2.2. also shows the three possible outcomes that the student would see for each concentration of sucrose tested.

- 1 The coloured sucrose drop will rise if the drop is less dense than the sucrose solution in the test-tube.
- 2 The coloured sucrose drop will remain where it is released if the drop is similar in density to the sucrose solution in the test-tube.
- 3 The coloured sucrose drop will sink if the drop is more dense than the sucrose solution in the test-tube.

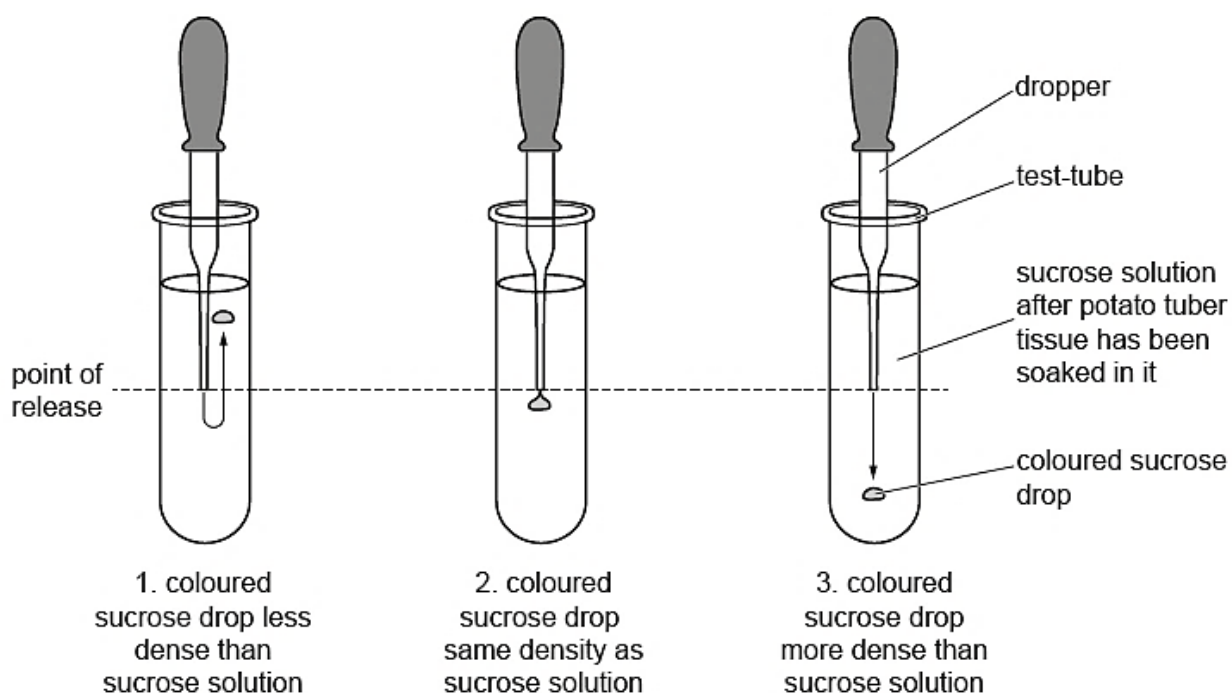


Fig. 2.2

- (b)** Plan an investigation to estimate the water potential of potato tissue by measuring the change in density of sucrose solution.

You must plan to use:

- 1 mol dm⁻³ sucrose solution
- potato tissue
- methylene blue

You may select from the following apparatus and plan to use appropriate additional apparatus:

- normal laboratory glassware, e.g. test-tubes, beakers, dropper, glass rods etc.
- syringes
- scalpel, cork borer, white tile

Your plan should:

- have a clear and helpful structure such that the method you use is able to be repeated by anyone reading it
- be illustrated by relevant diagrams, if necessary
- identify the variable that you will need to control
- use the correct technical and scientific terms
- include reference to safety measures to minimise any risks associated with the proposed experiment

This image shows a full page of white paper with horizontal dashed lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

[Total: 16]

- 3 Starch grains are present in plant cells. The starch grains have different sizes and shapes depending on the type of plant.

As the starch grains get larger, patterns form on the surface of the starch grains. These patterns can be observed using a microscope.

You are provided with a sample from plant **C**.

You will need to:

- prepare a microscope slide of starch grains from **C**.
- observe the starch grains present on the microscope slide.
- draw **two** starch grains.

Carry out step 1 to 10.

step 1 Label one clean and dry microscope slide, **C**. Put the slide onto a paper towel.

step 2 Put sample **C** onto a white tile.

Note:

Do not use the seed coat of sample **C** in the preparation of the microscope slide.

step 3 Cut a thin slice (approximately 1 mm) from the end of sample **C**.

step 4 Cut this slice into smaller pieces.

step 5 Put two drops of distilled water onto these small pieces.

step 6 Use a Pasteur pipette to transfer drops of the liquid from around the small pieces prepared in step 5 onto the slide labelled **C**.

step 7 Put a coverslip over the liquid on slide **C**.

step 8 Use the microscope to observe the starch grains on slide **C**.

You may need to reduce the amount of light entering the microscope and will need to adjust the fine focus to observe the surface of the starch grains clearly.

step 9 Select **two** starch grains on slide **C** that show distinct circular patterns on their surface.

step 10 Make a large drawing of these **two** starch grains in **(a)(i)**.

- (a) (i) Make a large drawing of **two** starch grains from slide **C**.

Use a sharp pencil.

[4]

- (ii) Suggest why the starch grains get smaller as plants germinate.

.....

.....[1]

- (b) Fig. 3.1 is a photomicrograph showing the epidermis of a plant.

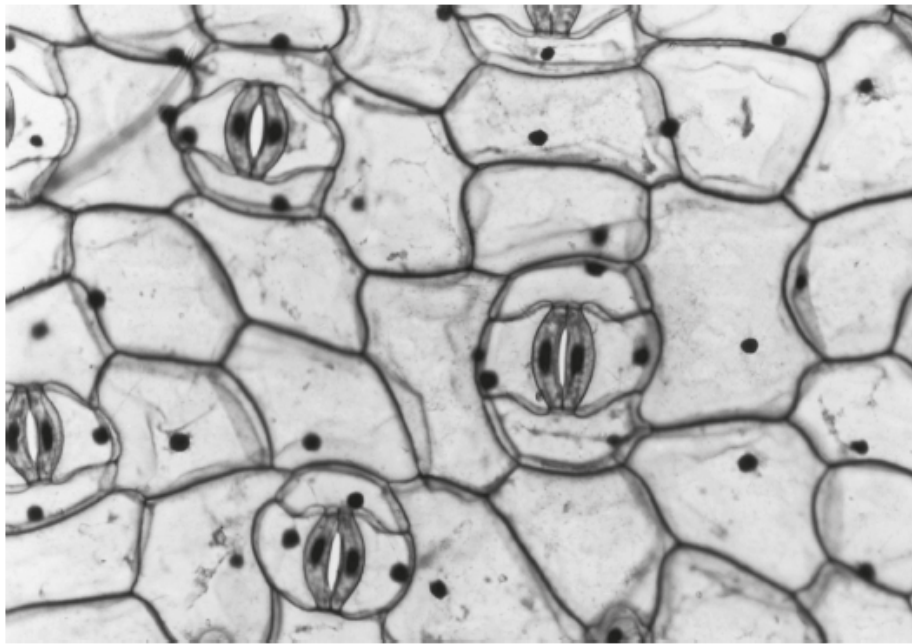


Fig. 3.1

The actual area of the epidermis visible in the photomicrograph in Fig. 3.1 is 0.04 mm^2 .

The leaf from which Fig. 3.1 is taken has a total surface area of 2000 mm^2 .

- (i) Use Fig. 3.1 to estimate the total number of stomata on the leaf.

Show your working.

Total number of stomata =
[2]

- (ii) One way to improve the accuracy of the estimate of the total number of stomata on a leaf is to use a photomicrograph with a larger area.

State one other way to improve the accuracy of the estimate of the total number of stomata on a leaf.

.....
.....[1]

(c) **K1** is a slide of a stained transverse section through a plant root.

- (i) Draw a large plan diagram of the vascular tissue region of the root on **K1**, as indicated by the shaded area in Fig. 3.2.

Use a sharp pencil.

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

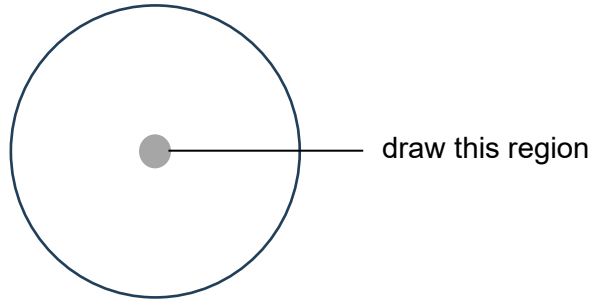


Fig. 3.2

Fig. 3.3 is a photomicrograph of a stained transverse section of a stem from a different plant.

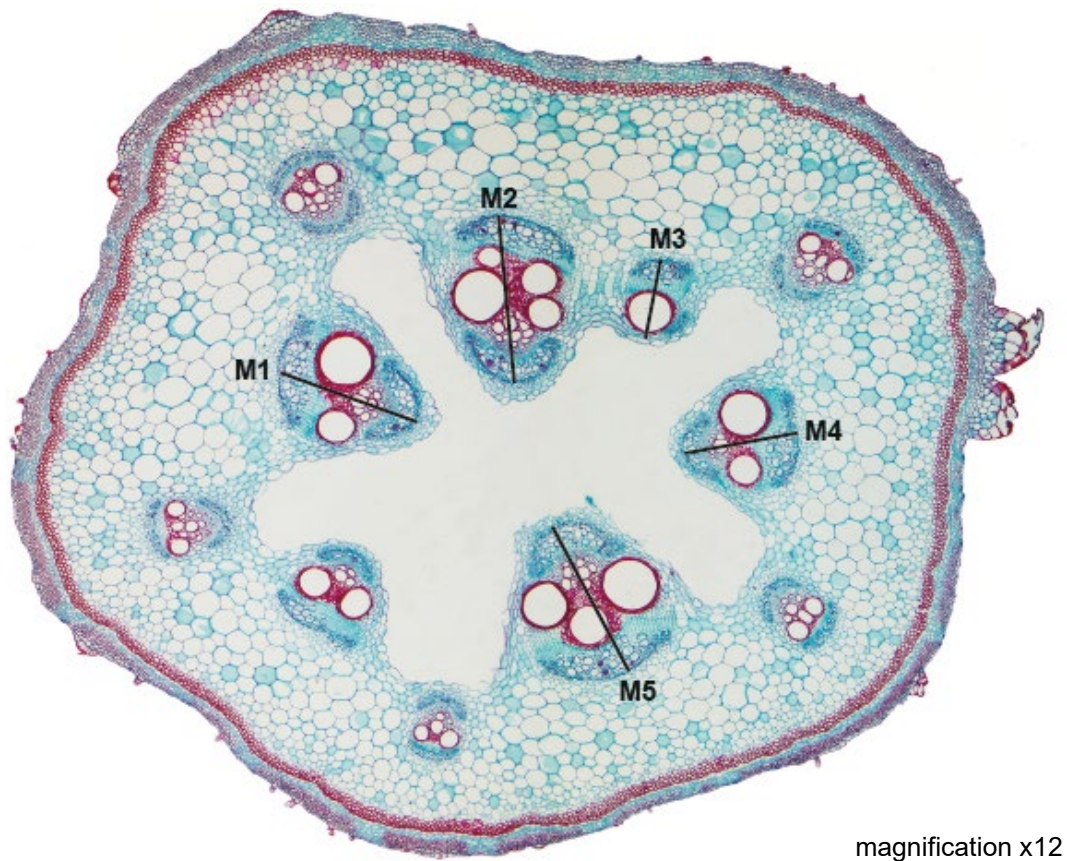


Fig. 3.3

- (ii) Measure the length of the vascular bundles using the lines **M1**, **M2**, **M3**, **M4** and **M5** in Fig. 3.3 **and** calculate the mean actual length of the vascular bundles.

Show your working.

M1 = **M2 =** **M3 =** **M4 =** **M5 =**

Mean actual length
[4]

- (iii) A student suggested that the mean actual length of the vascular bundles calculated in (c)(ii) was not accurate for the whole plant.

Describe **two** modifications to the method used in (c)(ii) that would allow a more accurate mean length of the vascular bundles for the whole plant to be calculated.

1

.....

.....

2

.....

.....

[2]

- (iv) State one observable difference between the vascular tissue seen in **K1** and the stem shown in Fig. 3.3.

.....

.....[1]

[Total: 20]