YISHUN INNOVA JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	
CG	
INDEX NO.	

H2 BIOLOGY

9744/04

22 Aug 2024

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name and class in the spaces at the top of this page.

Write in dark blue or black pen only.
You may use a soft pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer **all** questions in the spaces provided on 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	/22
2	/16
3	/17
Total	/55

This document consists of **20** printed pages.

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 activity.

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 1moldm^{-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 1moldm^{-3} ascorbic acid solution, **A**.

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

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

Table 1.2 shows the first two beakers you will use to make your serial dilution. You will need to complete **three** additional beakers.

For each beaker, state:

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

Table 1.2

Concentration of ascorbic acid / $moldm^{-3}$	Concentration of the ascorbic acid transferred / $moldm^{-3}$	volume of ascorbic acid solution transferred / cm^3	volume of distilled water, **W**, added / cm^3
1.0	1.0	10.0	0.0
0.1	1.0	1.0	9.0

[3]

Carry out step **1** to step **13**.

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

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

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

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

You will need to cut at least 70 discs.

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

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

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

8 Set up the apparatus as shown in Fig. 1.1 using the test-tube labelled **0**. The syringe barrel should be fully submerged in the beaker of water, **B**.

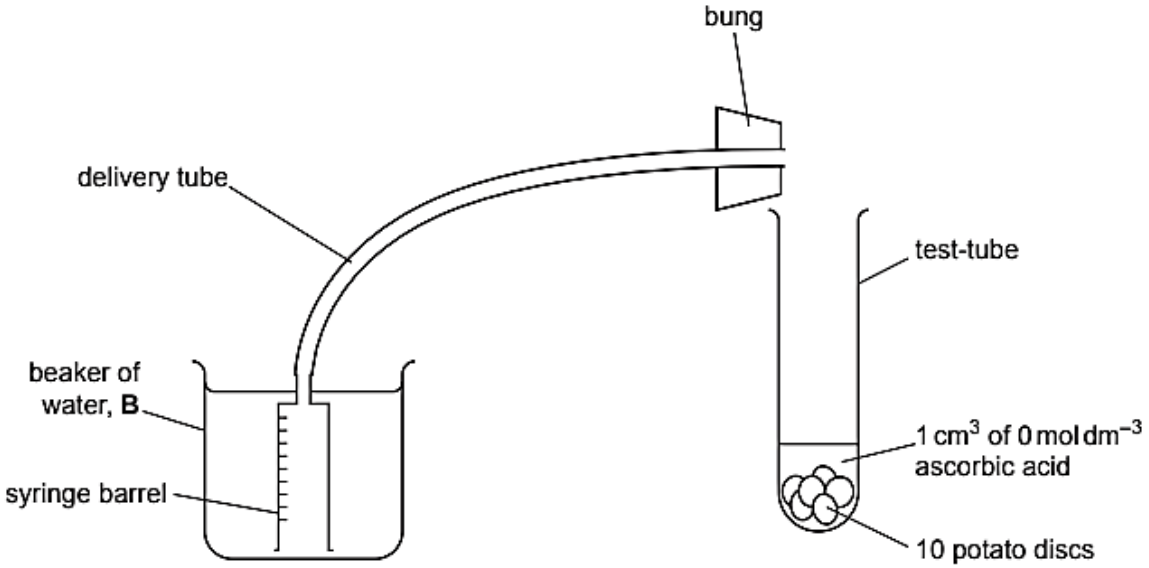


Fig 1.1

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.

10 Record in **(a)(ii)** the initial volume of gas in the syringe barrel, then start the stopwatch.

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.

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

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.

[6]

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

greatest volume of gas produced = ...

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

rate of gas production = ... cm^3min^{-1}

[2]

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

.....

.....

.....

.....

..... [2]

Carry out step **14** to step **18**.

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

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

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)**.

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

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**).

..... °C

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

..... °C

Calculate the **change** in temperature after 2 minutes.

..... °C

[2]

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

Explain your answer.

.....

..... [1]

(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.

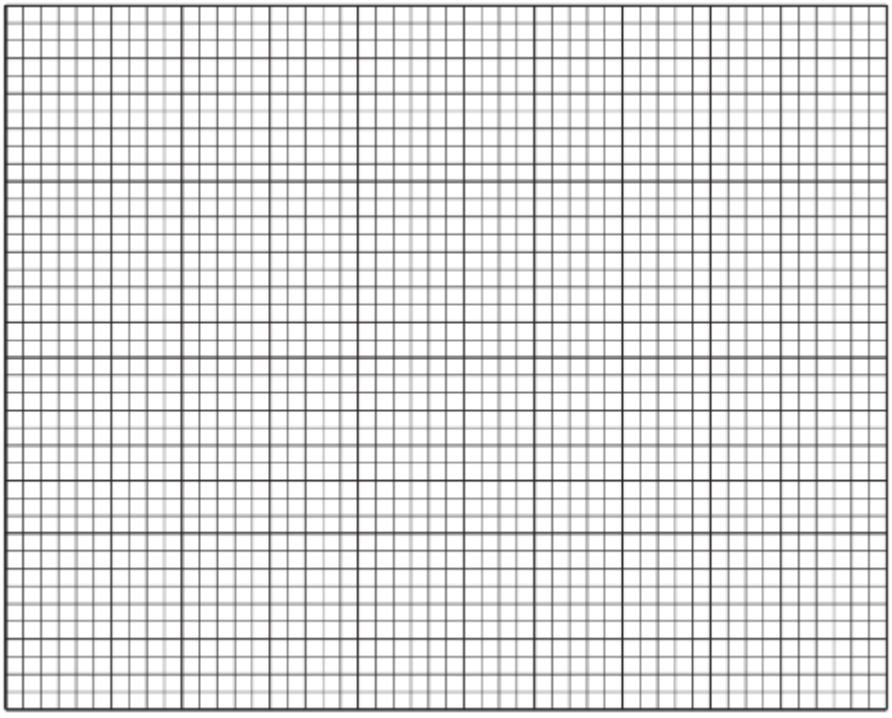
The results are shown in Table 1.3.

Table 1.3

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 1.3 on the grid shown below.

Use a sharp pencil.



[4]

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

[2]

[Total: 22]

2 A group of students investigated two habitats: dense woodland and open grassland.

- Trees are the dominant plants in woodland. The trees form a canopy under which flowering herbs, small shrubs and grasses grow.
- Grasses are the dominant plants in grassland. The grasses and small flowering plants form a continuous ground cover with only a few small shrubs present.

Fig. 2.1 shows photographs of the two areas.

Fig. 2.1

The students decided to compare the adaptations for reducing water loss in the plants growing in each area.

The students suggested the following hypothesis:

The density of stomata will be higher in plants found in the woodland habitat than in the grassland habitat.

(a) (i) State the independent and dependent variables in this investigation.

Independent variable: .....

Dependent variable: ..... [2]

The students collected leaves from a number of different plant species in each area. To study the density of stomata on leaves, impressions of the epidermis can be made using clear varnish.

- One surface of each leaf is painted with a thin layer of varnish.
- The varnish is left to dry.
- Clear sticky tape is applied to the leaf over the varnished area, to make a leaf impression.
- The tape and varnish are removed and stuck to a microscope slide.
- The leaf impression on the slide is viewed using a microscope.

Fig. 2.2 shows the microscope image of one leaf impression prepared in this way.

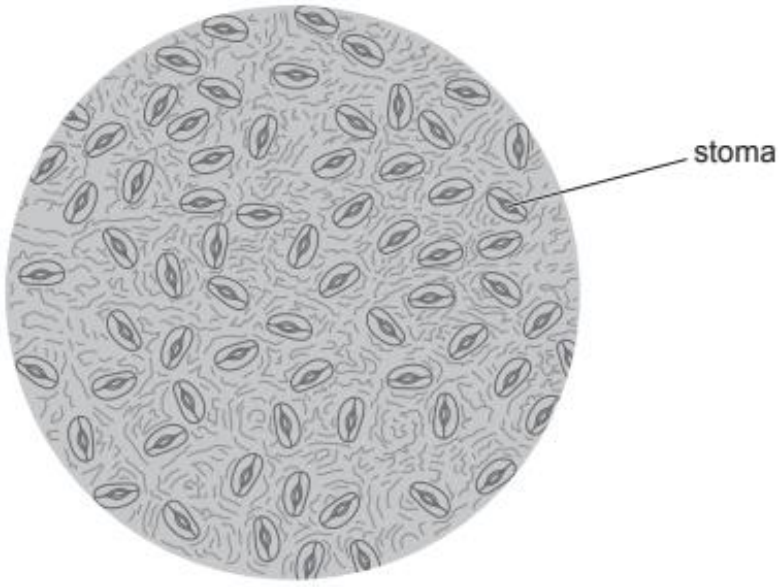


Fig. 2.2

(ii) State the measurements that the students need to make to determine the stomatal density in Fig. 2.2.

.....

.....

.....

.....

..... [2]

(iii) Calculate the stomatal density in Fig. 2.2.

Space for working.

stomatal density = ... mm^{-2}

[2]

(iv) Describe how the students could gather data to compare the stomatal density of plants growing in the woodland and the grassland habitat.

Your method should be set out in a logical order and be detailed enough to allow another person to follow it.

You should not repeat details of the method for making the leaf impressions.

[6]

(b) The students found a published investigation on the effect of light intensity on stomatal density in the species *Lycopersicon esculentum*.

Two plants of *Lycopersicon esculentum* were selected. One was grown in high light intensity and the other was grown in low light intensity.

The results are shown in Table 2.1.

Table 2.1

leaf number	**high light intensity**			**low light intensity**		
	number of stomata $\times 10^3$		leaf area / cm^2	number of stomata $\times 10^3$		leaf area / cm^2
	upper surface	lower surface		upper surface	lower surface	
1	1634	3131	496	18	1277	160
2	1482	5072	509	10	906	115
3	1865	6365	637	14	1398	171
mean	1660	4856	547	14	1194	149

(i) Calculate the percentage decrease in mean leaf area for leaves grown in low light intensity compared with those grown in high light intensity.

Your answer should be expressed as a whole number.

..... % [1]

(ii) The scientists who carried out the published investigation concluded that:

*plants grown in higher light intensity have higher stomatal density **only** on the upper surface of the leaves compared to plants grown in lower light intensity.*

Evaluate whether or not the data in Table 2.1 supports this conclusion.

[3]

[Total: 16]

3 **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. 3.1. Use a sharp pencil.

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

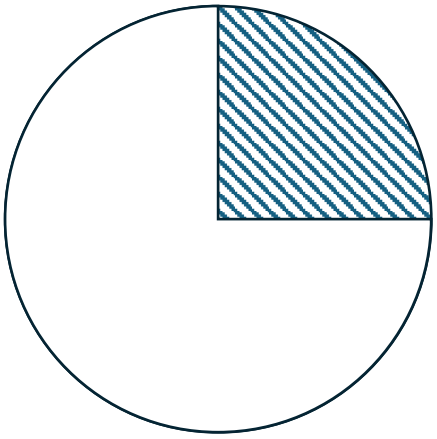


Fig 3.1

[4]

(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]

(b) Fig. 3.2 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 1mm.

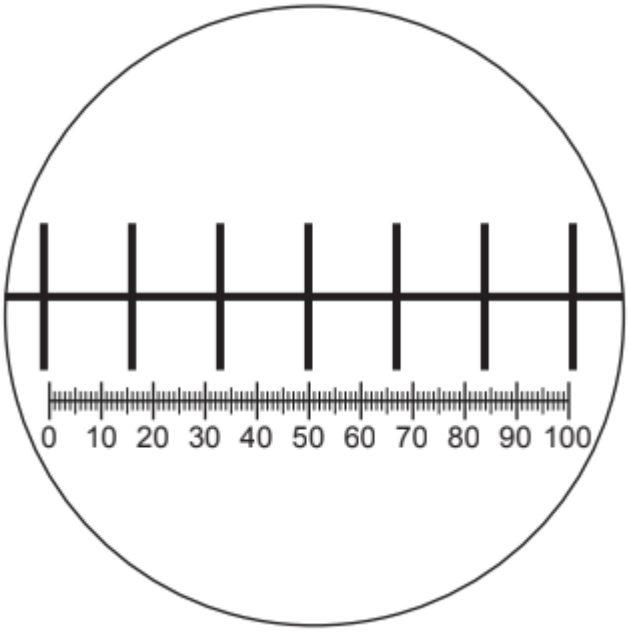


Fig. 3.2

(i) Use Fig. 3.2 to calculate the actual length of one eyepiece graticule unit.

Show your working.

actual length = ...

[3]

Fig. 3.3 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. 3.2.

The eyepiece graticule has been placed across the diameter of the section.

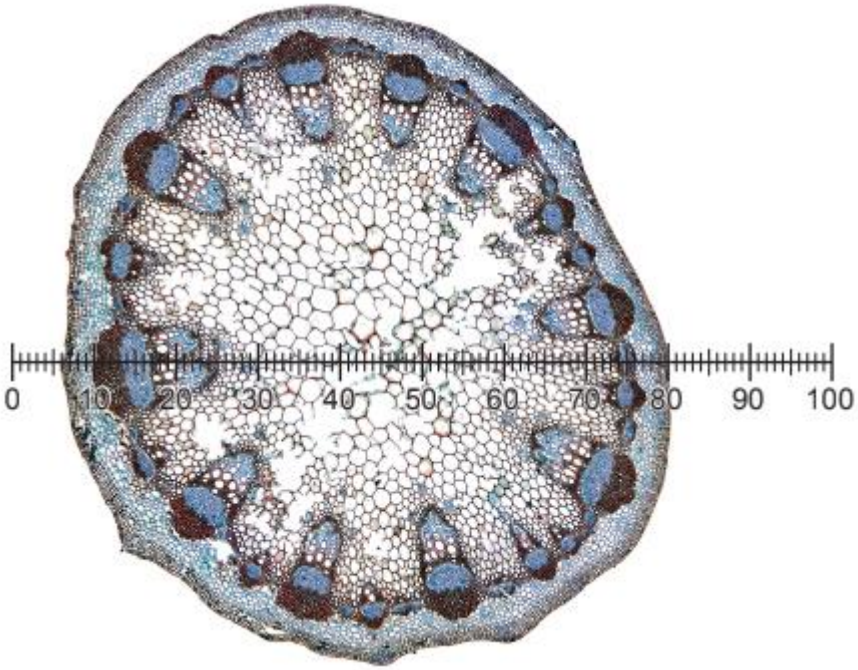


Fig. 3.3

(ii) Use the calibration of the eyepiece graticule from **(b)(i)** to calculate the actual diameter of the section in Fig. 3.3.

Show your working.

actual diameter = ...

[2]

(iii) Identify **three** observable differences, other than size and colour, between the stem section on **K1** and the stem section on Fig. 3.3.

Record **three** observable differences in Table 3.1.

Table 3.1

feature	K1	Fig 3.3

[3]

[Total:17]