YISHUN INNOVA JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME			
CG		INDEX NO.	

H2 BIOLOGY

9744/04

29 Aug 2023

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	/25
2	/12
3	/18
Total	/55

This document consists of **16** printed pages and **2** blank pages.

Answer **all** questions.

1 The enzyme amylase breaks down starch to form reducing sugars.

It has been found that tea affects the activity of amylase.

You will investigate the effect of different concentrations of tea extract on the breakdown of starch by amylase.

You are provided with the materials shown in Table 1.1.

Table 1.1

label	contents	hazard	volume / cm^3
E	amylase solution	harmful irritant	30
T1	100% tea extract	none	20
S	starch solution	none	50
W	distilled water	none	150
iodine	iodine solution	irritant	20

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

It is recommended that you wear suitable eye protection.

You will need to carry out a serial dilution of the 100% tea extract, **T1**, to reduce the concentration by half between each successive dilution.

You are required to make up a sufficient volume of each tea extract so that, once the serial dilution has been completed, there is a volume of at least 5.0cm^3 for each concentration prepared.

(a) (i) Complete Table 1.2 to show you will make the concentration of the tea extract **T1, T2, T3, T4** and **T5**.

Table 1.2

	Tea extract				
	T1	**T2**	**T3**	**T4**	**T5**
percentage concentration of tea extract	100				
percentage concentration of tea extract to be diluted					
volume of the tea extract to be diluted / cm^3					
volume of distilled water **W** / cm^3					

[3]

Read steps **1 – 12**.

Proceed as follows.

1 Prepare the concentrations of tea extract as shown in Table 1.2.

2 Label the test-tubes with the concentrations you have prepared in step **1**.

3 Put 1 cm^3 of each concentration of tea extract into the appropriately labelled test-tube.

4 Put 1 cm^3 of **E** into each of the labelled test-tubes. Shake gently to mix.

5 Using the beakers labelled **hot water** and **cold water**, set up and maintain a water-bath with water between 30°C and 40°C.

6 Put the test-tubes from step **4** into the water-bath.

7 Label the **two** spotting plates, as shown in Fig. 1.1, with:

- the times 2, 4, 6, and 8 (minutes)
- the percentage concentrations of tea extract you have prepared in step **1**.

8 Put drops of iodine solution onto the spotting tile as shown in Fig. 1.1.

You will need one row of drops of iodine solution for each of the concentrations of tea extract you prepared in step **1**.

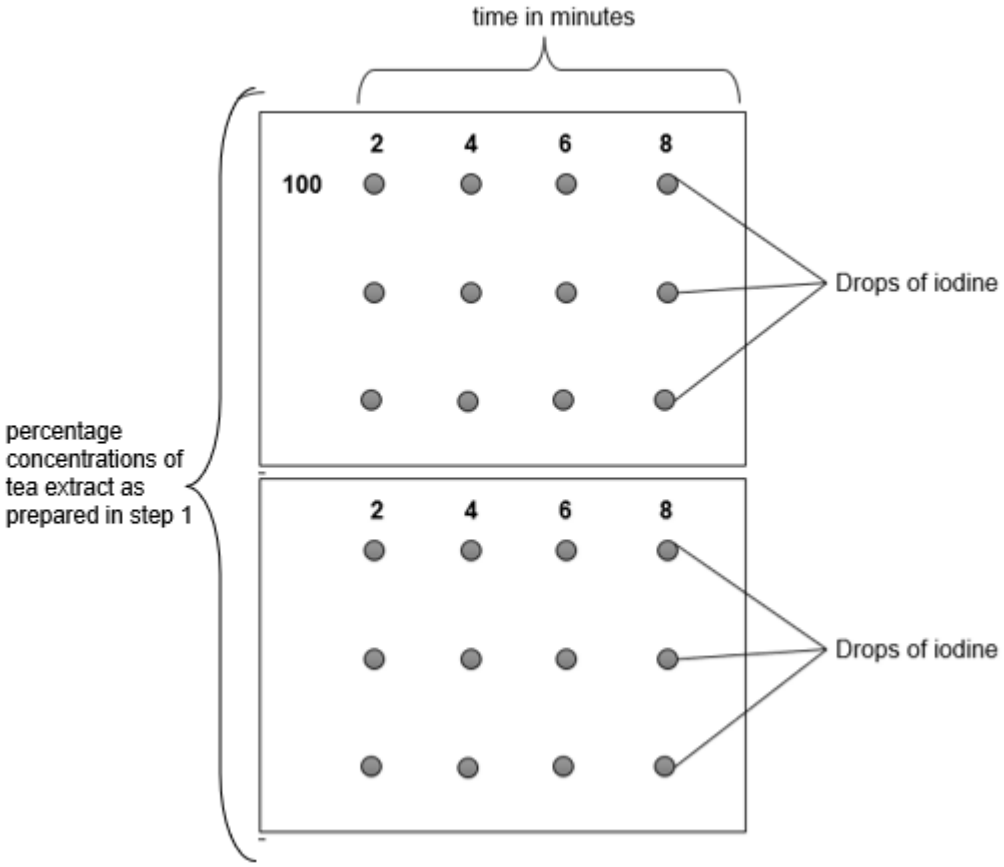


Fig. 1.1

9 Put 2 cm^3 of starch solution **S** into each test-tube (in the water-bath). Shake gently to mix. Start timing.

10 After 2 minutes:

- use a pipette to remove a sample of the solution from the test-tube labelled 100%,
- put 1 drop of the solution onto the spot of iodine solution labelled 2 (minutes) on the row labelled 100 (%),
- put 1 drop of the next solution onto the spot of iodine solution labelled 2 (minutes) on the row labelled with your next concentration of tea extract,
- repeat for the other concentrations of tea extract you prepared in step **1**, so that all of the drops of iodine solution in the 2-minute column have been used.

11 Repeat step 10 at intervals of 2 minutes until there is no blue-black colour. This is the endpoint.

Note: you will not see the original colour of the iodine due to the colour of the tea extract.

If the iodine continues to turn blue-black at 8 minutes, stop sampling and record this as 'more than 8'.

12 Record in **(a)(ii)** the time taken to reach the endpoint.

(ii) Record your results in an appropriate table.

[4]

(iii) State the trend for your results.

.....

..... [1]

(iv) Tea is a competitive inhibitor of amylase.

Explain how tea can act as a competitive inhibitor of amylase.

[3]

(v) The volume of the drops of iodine solution in step **8** was not standardised.

Suggest one improvement to step **8**.

[1]

(vi) Identify **two** possible sources of error in step 9 and suggest improvements to reduce the effect of these errors.

[4]

(b) Caffeine is a chemical found in tea and many other drinks.

A student investigated the concentration of caffeine in different types of drink.

Table 1.3 shows the student's raw data and processed data.

Table 1.3

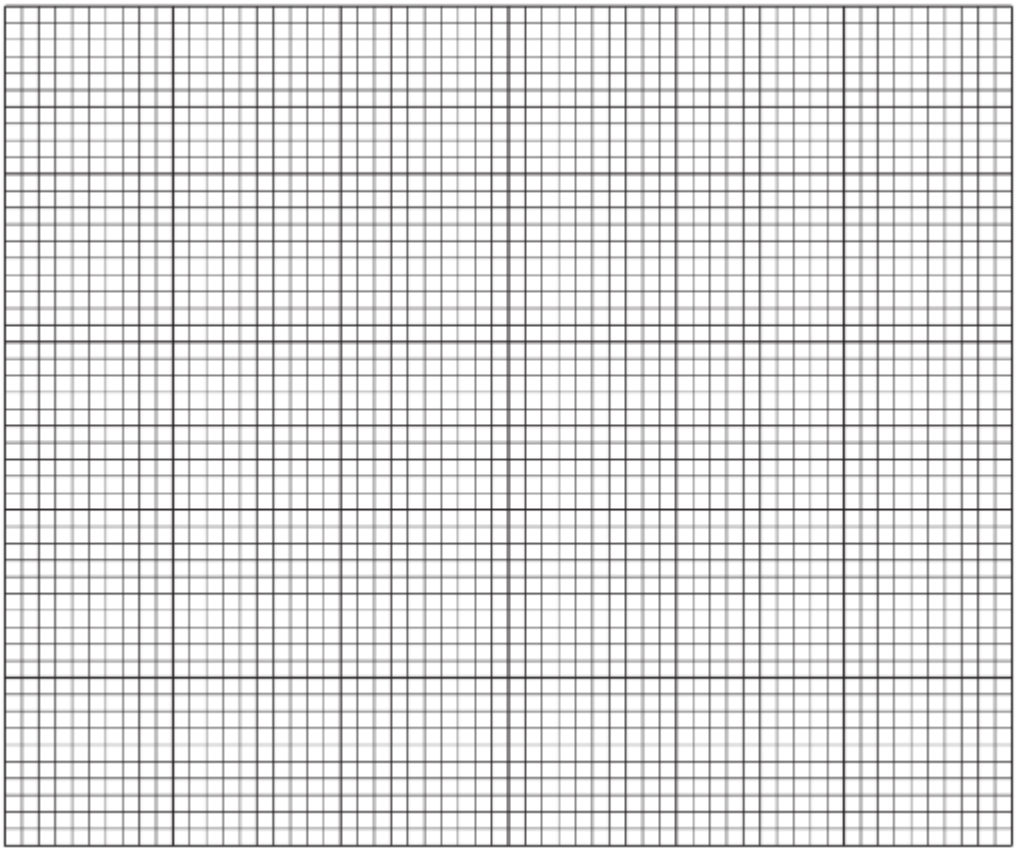
type of drink	**raw data**		**processed data**
	volume of one serving /cm^3	**mass of caffeine per serving /mg**	**concentration of caffeine / mg cm^{-3}**
black tea (BT)	220	40	0.18
filter coffee (FC)	350	195	
decaffeinated tea (DT)	220	5	0.02
cola light (CL)	330	33	0.10
espresso coffee (EC)	30	48	1.60
green tea (GT)	220	18	0.08

(i) Complete Table 1.3 by calculating the concentration of caffeine in filter coffee.

Show your working.

[2]

(ii) Plot a suitable graph on the grid to show the concentration of caffeine (processed results) in the different types of drink shown in Table 1.3.



[4]

(c) **(i)** An energy drink contains a mixture of caffeine and reducing sugars.

State the reagent you would use to determine the concentration of reducing sugar in the energy drink.

.....[1]

(ii) Describe how you would use the reagent in **(c)(i)** to determine the concentration of reducing sugar in the energy drink.

.....

.....

.....

.....[2]

[Total: 25]

2 The rate of photosynthesis can either be measured by the rate at which carbon dioxide is taken in or the amount of oxygen that is given out. During photosynthesis in leaves, carbon dioxide enters through the stomata and diffuses through intercellular air spaces to the mesophyll cells.

Leaf discs submerged in sodium hydrogencarbonate solution can be used to investigate the effect of light intensity on photosynthesis. The rate of photosynthesis is measured by the time taken for the submerged discs to reach the surface when oxygen builds up in the air spaces.

Using this information, design an experiment to investigate the effect of light intensity on photosynthesis in *Camellia sinesis* (tea) plant leaves.

In your plan you must use:

- bench lamp with 60 W bulb
- 1% sodium hydrogencarbonate solution
- *C. sinesis* (tea) leaves

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

- normal laboratory glassware, e.g. a variety of different sized beakers, measuring cylinders, and syringes
- forceps
- plastic straw
- plastic ruler
- retort stand
- timer, e.g. stopwatch

Your plan should:

- have a clear and helpful structure such that the method you use is repeatable by anyone reading it
- be illustrated by relevant diagram(s), if necessary
- identify the independent and dependent variables
- describe with scientific reasoning, the method used so that the results can be replicated and is as accurate as possible
- indicate how the results could be recorded
- use the correct technical and scientific terms
- include reference to safety measures to minimise any risks associated with the proposed experiment.

[12]

3 During this question you will require access to the microscope and slide **K1**.

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

You are not expected to be familiar with this specimen.

(a) Use the microscope to observe the different tissues in the stem on **K1**.

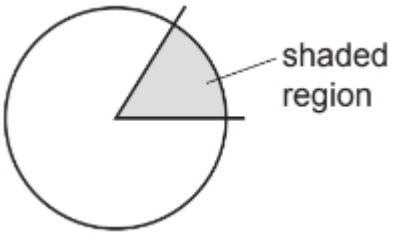


Fig. 3.1

(i) Draw a large plan diagram of the area of the stem on **K1** shown in Fig. 3.1.

A plan diagram shows the arrangement of different tissues. Your drawing should show the correct shapes and proportions of the different tissues.

No cells should be drawn.

Your drawing should include **two** large vascular bundles.

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

[4]

(ii) Observe the epidermis of the section on **K1**.

Select **four** adjacent epidermal cells that are arranged end to end in a line. Each cell in the line must touch at least one other cell.

Make a large drawing of this line of four cells.

Use one ruled label line and label your drawing, to identify the cell wall of one cell.

[4]

(iii) Measure **and** record the length of the radius of **K1** in eyepiece graticule units.

Length = …… eyepiece graticule units

Record the magnification of the objective lens you used when measuring the radius of **K1**.

magnification = x ……..

Using the measurement of radius in eyepiece graticule units recorded, calculate the actual area of the stem, in micrometres (μm).

Area of the stem = πr^2

You can assume that calibration of the eyepiece graticule using a stage micrometer gives the results shown in Table 3.1.

Table 3.1

Objective lens used	Number of eyepiece graticule units in a 0.1 mm division of a stage micrometer
x 10	11
x 40	39

Show your working.

1 eyepiece graticule unit = ……..μm

actual area = …….. μm^2 [3]

(b) Fig. 3.2 is a photomicrograph of a stained transverse section through a stem of a different type of plant.

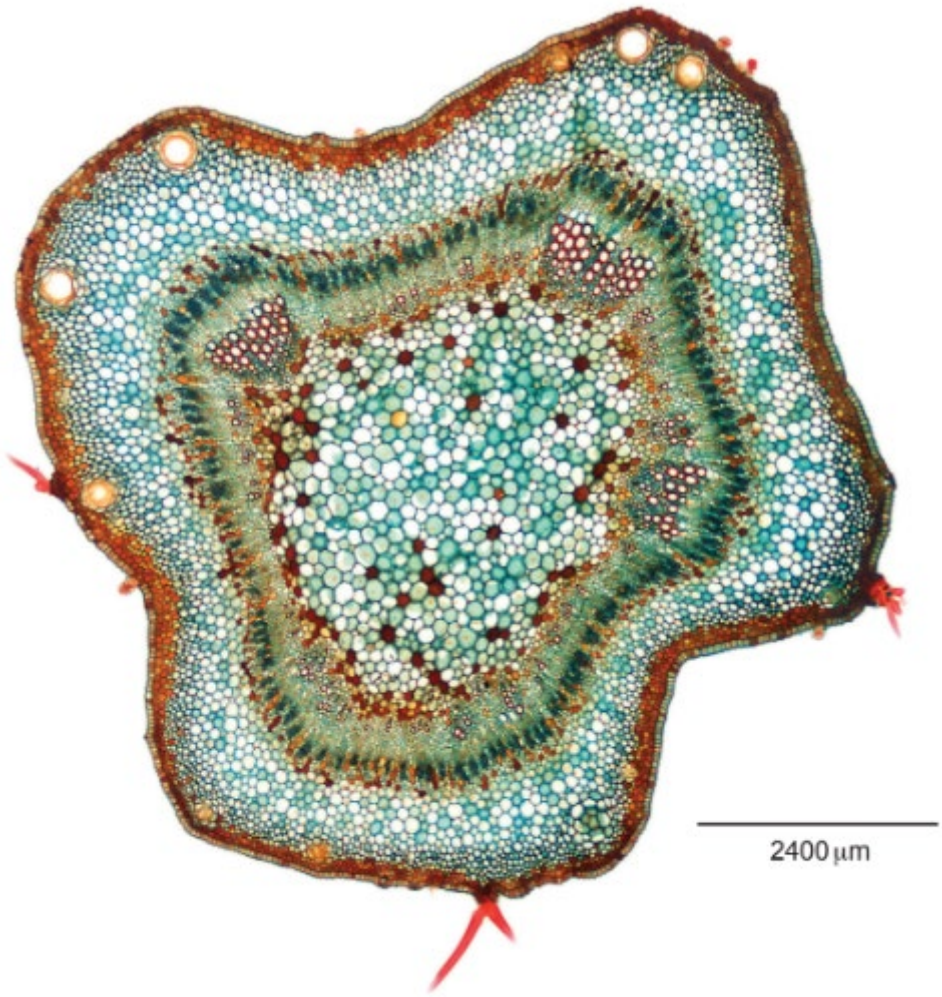


Fig. 3.2

(i) Use the scale bar on Fig. 3.2 to calculate the magnification of Fig. 3.2.

Show your working.

magnification = ... [3]

(ii) Identify the observable differences between the stem on **K1** and the stem in Fig. 3.2.

Record these observable differences in Table 3.2.

Table 3.2

Feature	K1	Fig. 3.2

[4]

[Total: 18]

[BLANK PAGE]

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