YISHUN INNOVA JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME

CG

INDEX NO.

H2 BIOLOGY

9744/04

30 Aug 2022

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 **14** 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 drinking 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

labelled	contents	hazard	volume/cm^3
E	amylase solution	harmful irritant	50
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	***50***	***25***	***12.5***	***6.25***
percentage concentration of tea extract to be diluted		***100***	***50***	***25***	***12.5***
volume of the tea extract to be diluted / cm^3		***5.0***	***5.0***	***5.0***	***5.0***
volume of distilled water **W** / cm^3		***5.0***	***5.0***	***5.0***	***5.0***

1 100, 50, 25, 12.5, 6.25 (% concentration of tea extract) and 100, 50, 25, 12.5 (% concentration of tea extract to be diluted);

2 At least 5.0 cm^3 for volume of the tea extract to be diluted ;

3 Equal volume of distilled water W added to the volume of tea extract to be diluted and precision to be kept to 1 decimal point ;

Penalised only once for incorrect precision for MP2 and MP3

[3]

Read steps **1 – 12**.

Proceeds as follows.

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

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

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

4 Put 1cm^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 a white tile, as shown in Fig. 1.2, with:

- the times 2, 4, 6, 8 and 10 (minutes)
- the percentage concentrations of tea extract you prepared in step **1**.

8 Put drops of iodine solution onto the white 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**.

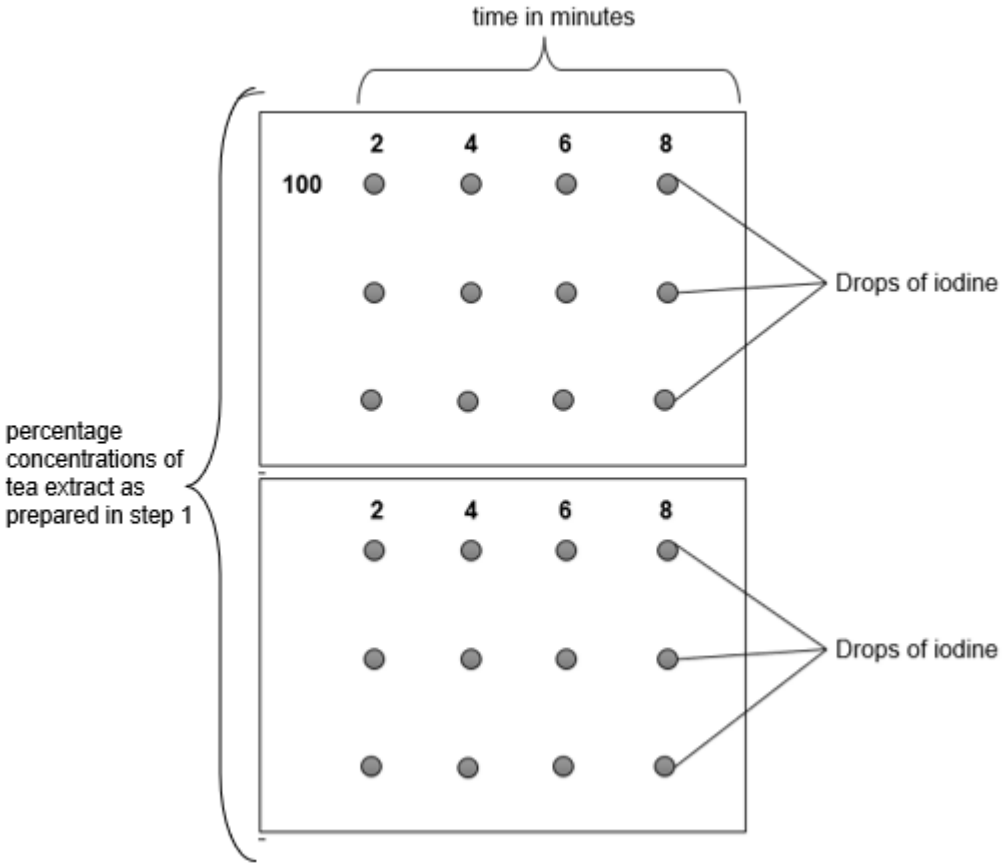


Fig. 1.1

9 Put 2cm^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 end-point.

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

If the iodine continues to turn blue-black at 10 minutes, stop sampling and record this as 'more than 10'.

12 Record in (a)(ii) the time taken to reach the end-point.

(ii) Record your results in an appropriate table.

1 heading for independent variable:
percentage concentration of tea, and before heading for dependent variable and no units in body of table ;

2 heading for dependent variable:
time taken to reach end-point and min (unit) and no units in body of table ;

3 readings for all samples and time for the highest concentration of tea more than for the lowest concentration of tea ;

4 results recorded in whole minutes ;

Percentage concentration of tea extract	*Time taken to reach end-point / min*
100	
50	
25	
12.5	
6.25	

[4]

(iii) State the trend for your results.

As the percentage conc. of tea extract decreases from 100% to 6.25%,

the time taken to reach end-point decreases from … to … ; [1]

(iv) Tea is a competitive inhibitor of amylase.

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

1 inhibitor competes with the starch for the active site

because (compound in) tea extract has a similar shape to starch ;

2 (compound in) tea extract tea is complementary to the active site

and binds to active site to form enzyme-inhibitor complex ;

3 fewer enzyme-substrate complexes formed

hence rate of starch hydrolysis is reduced ; [3]

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

Suggest one improvement to step **8**.

1 use a syringe

to place a fixed volume of iodine on the spotting tile ; [1]

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

1 starch solution not at same temperature as T and E ;

2 incubate reagents at 40 °C for equilibration ; OR

OR 3 starch is added at different times to each of the test tube ;

4 carry out each test separately so that time taken for starch hydrolysis is fixed ;

OR 5 uneven mixing of reagents results in uneven rate of hydrolysis ;

6 mix for a stated time;

Either MP1, 2 OR MP3, 4, OR MP5, 6

[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 1.2 shows the student's raw data and processed data.

Table 1.2

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 1.2 by calculating the concentration of caffeine in filter coffee.

Show your working.

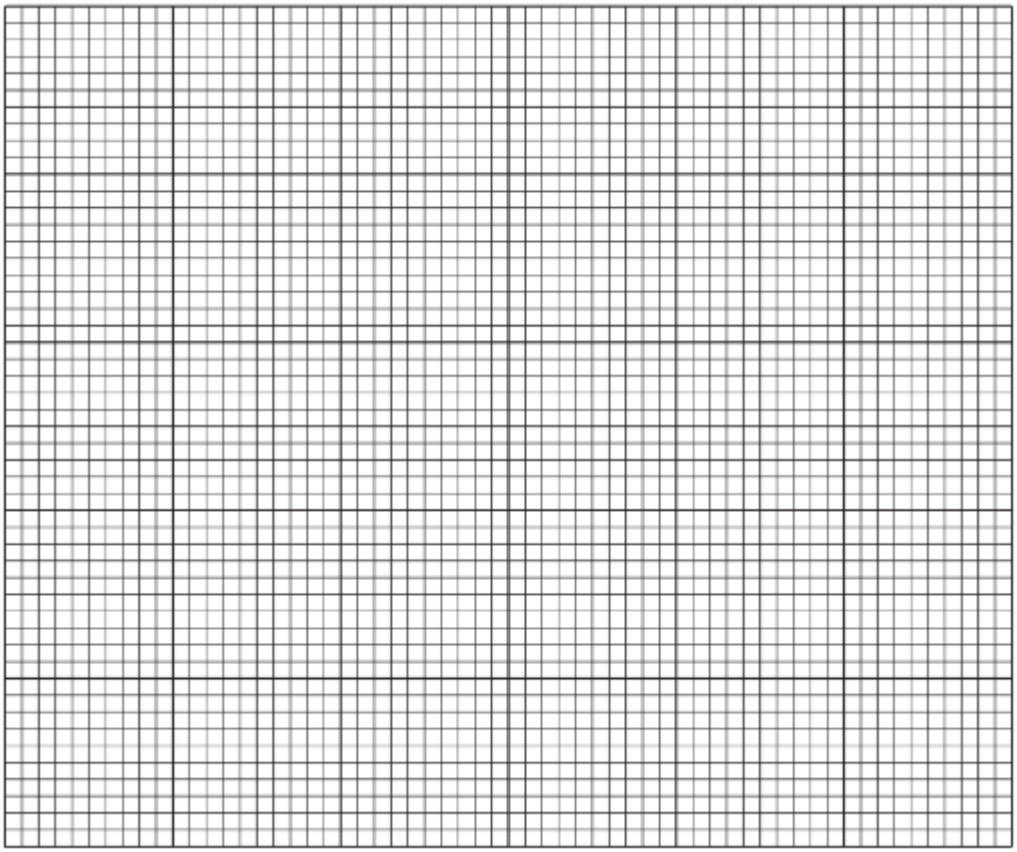
Concentration of caffeine in filtered coffee
= 195 / 350
= 0.56 ;

1 working (195 / 350)
2 correct answer and precision (2 d.p.) ;

[2]

(ii) Plot a bar chart on the grid to show the concentration of caffeine (processed results) in the different types of drink shown in Table 1.2.

Use a sharp pencil for drawing bar charts.



1 x-axis: type of drink and bars labelled appropriately and y-axis: concentration of caffeine / mg cm^{-3} ;

2 scale on x-axis: even width of all six bars and scale on y-axis: 0.4 mgcm^{-3} to 2 cm, labelled at least every 2 cm ;

3 correct plotting of all six bars ;

4 six separate bars drawn and with horizontal and vertical lines joined precisely ; [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.

Benedict's (solution) ; [1]

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

1 Add 2cm^3 of energy drink to a test-tube and add an equal volume of Benedict's solution

2 Place the test tube in a boiling water bath for 2 minutes;

3 Filter the (brick red) precipitate

and weigh the precipitate to determine the concentration of reducing sugar; [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, to show, for example, the arrangement of the apparatus used
- identify the independent and dependent variables
- describe the method with the scientific reasoning used to decide the method so that the results are as accurate and repeatable as possible
- include layout of results tables and graphs with clear headings and labels
- use the correct technical and scientific terms
- include reference to safety measures to minimize any risks associated with the proposed experiment.

[12]

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

(a) Set up the microscope so that you can observe the section on **K1**.

Observe the different tissues in the area on **K1** shown by the shaded region in Fig. 2.1.

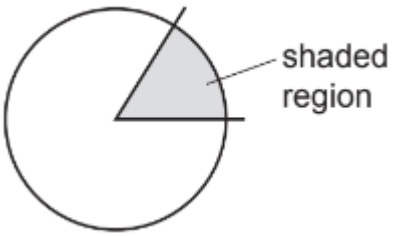


Fig. 3.1

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the area of the section on **K1** shown by the shaded region in Fig. 2.1, to include **two** large vascular bundles.

Your drawing should show the correct shapes and proportions of the different tissues.

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

1 uses most of the available space size and no shading and no cells drawn ;
2 correct proportions of vascular bundle compared to the diameter of the stem ;
3 draws vascular bundles connected to each other ;
4 label line and label to epidermis ;

[4]

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

Select a line of **four** adjacent epidermal cells. 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 to identify the cell wall of one cell.

1 uses most of the available space and all lines sharp and continuous and draws correct shape of cells ;
2 draws only four whole cells and each cell touches at least one other cell ;
3 two lines around each cell and three lines where cells touch ;
4 label line and label to one cell wall ;

[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

Objective lens used number of eyepiece graticule units in a 0.1 mm division of a stage micrometer.

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]

1 stating appropriate number of eyepiece graticule for length of radius and appropriate magnification ;

2 correct working and answer ;

for x10 magnification,
1 eyepiece graticule unit = 0.1 x 1000 / 11 = 9.09

for x40 magnification,
1 eyepiece graticule unit = 0.1 x 1000 / 39 = 2.56

3 correct working and answer ;

actual area = πr^2

where r = no. of eyepiece graticule x actual length of eyepiece graticule;

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through a stem of a different type of plant.

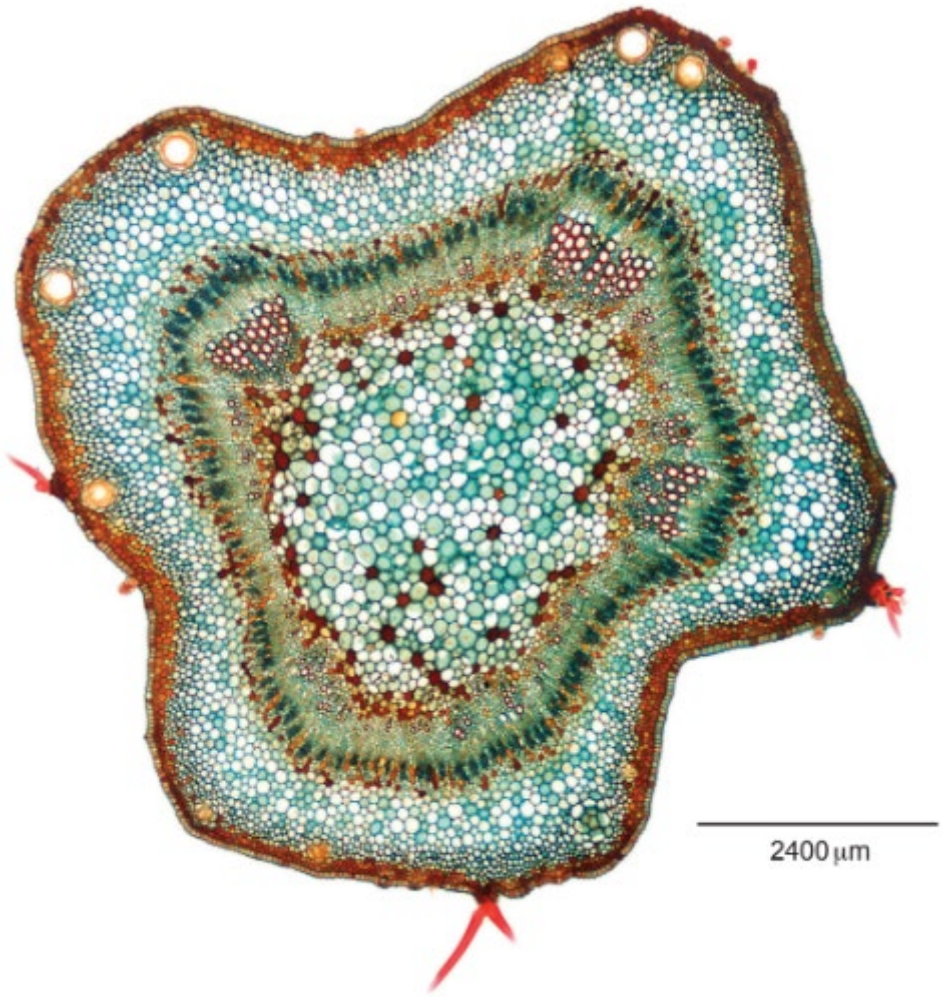


Fig. 2.2

(i) Use the scale bar on Fig. 2.2 to calculate the magnification of Fig. 2.2.

Show your working.

1 records the length of the scale bar ;
2 shows conversion of the measurement of the scale bar to the same units as the actual length of the scale bar ;
3 shows division of the length of the scale bar by the actual length of the scale bar ;

magnification = ... [3]

(ii) Identify the observable differences between the section on K1 and the section in Fig. 2.2.

Record the observable differences in Table 2.1.

Table 2.1

Feature	K1	Fig. 2.1
number of vascular bundles	*many*	*fewer ;*
trichomes / hair-like structures	*absent*	*present ;*
shape of stem	*circular*	*curved ;*
epidermis	*thick*	*thin ;*
AVP;		

[4]

[Total: 18]

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