TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

CANDIDATE NAME	
CIVICS GROUP	

H2 BIOLOGY 9744/04

Paper 4 Practical **24 August 2023**

2 hours 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, civics group and index 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 and graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

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

The use of 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.

At the end of the examination, fasten all your work securely together.

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

Shift
Laboratory

For examiner's Use	
1	/ 17
2	/ 16
3	/ 22
Total	**/ 55**

Question 1

You should read through the whole of this question carefully and then plan your use of time to make sure that you finish all that you would like to do.

Yeast cells are able to respire both aerobically and anaerobically using glucose as a substrate.

You are required to investigate the effect of temperature on the rate of respiration of yeast using a respirometer.

A simple respirometer can be made by attaching a length of plastic tubing to a 10 cm^3 syringe, using a short section of rubber tubing. The respirometer may be supported with a retort stand and clamp.

Fig. 1.1 shows a simple respirometer containing a yeast suspension.

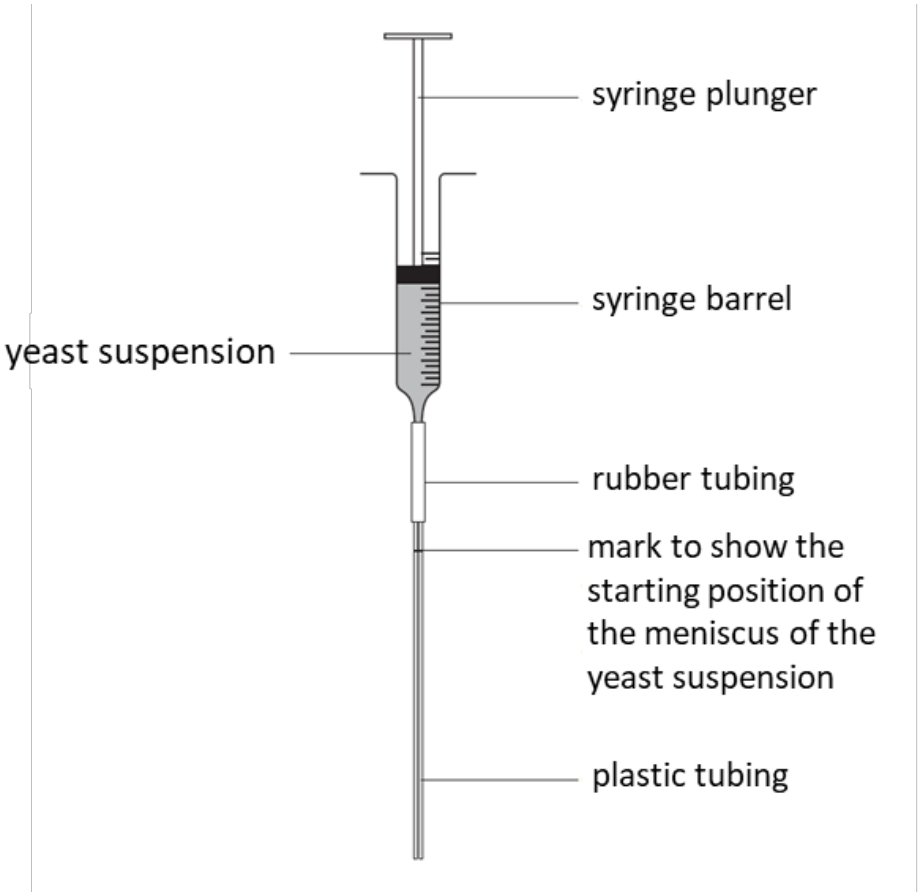

Fig. 1.1

In order to introduce the yeast suspension into the simple respirometers, the following steps are used:

- Remove a sample of the yeast suspension in 20% glucose solution and place it into a boiling tube.
- Make sure that the plunger is pushed fully into the barrel of the syringe.
- Insert the plastic tubing into the yeast suspension in a boiling tube.
- Withdraw the plunger until the yeast suspension reaches the 5 cm^3 mark on the syringe.
- Lift the respirometer so that the glass tubing comes out of the yeast suspension.
- Keep the apparatus vertical. Slowly withdraw the plunger so that the yeast suspension rises up the plastic tubing until the suspension is near to the top of the plastic tubing (See Fig. 1.1).
- Mark the start position of the meniscus of the yeast suspension.

Consider a strategy to allow you **to investigate the effect of temperature on the rate of respiration of yeast**, making use of the apparatus provided.

You will need to decide on a suitable range of temperature for this investigation.

You are provided with:

- simple respirometers
- a suspension of yeast cells in a 20% glucose solution that has been maintained at 35°C for at least 15 minutes before the start of the examination
- water at 30°C
- water at 40°C
- crushed ice
- hot water at 70°C
- a thermometer
- a stopwatch
- a retort stand.

Determine the rate of respiration of yeast by measuring the movement of the meniscus down the plastic tubing.

(a) Describe how you will use the apparatus and materials provided to determine the effect of temperature on the rate of respiration. [10]

Your plan should:

- identify the independent and dependent variables.

  Identify the variables you will need to control.

- include a control.

- have a clear and helpful structure such that the method you use is able to be repeated by anyone reading it, including scientific reasoning behind procedure.

- use the correct technical and scientific terms.

- include reference to safety measures to minimise any risks associated with proposed experiment.

There is no need to describe how to set up respirometer in your methods (It has been described on page 3).

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(b) Carry out the method you proposed in **(a)** to determine the rate of respiration of yeast at **30°C**. There is no need to carry out replicates for this question.

Present your result and workings clearly. [2]

(c) Explain why the meniscus of the yeast suspension moved down the plastic tubing. [3]

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(d) Using your theoretical knowledge, sketch a curve on Fig. 1.2 to show how you would expect the rate of respiration of yeast to change as temperature changes.

Label the axes. [2]

Fig. 1.2

[Total: 17]

Question 2

Enzyme **E** catalyses the hydrolysis of starch. Starch can be found on the surface of some types of paper. When dipped in iodine, these papers turned dark blue / black.

The end-point of this hydrolysis catalysed by Enzyme **E** is the change in colour of stained paper from blue/black to light blue or white.

You are required to:

- make different concentrations of the enzyme solution, **E,** by simple dilution.
- investigate the effect of different concentrations of **E**, by finding the time taken for the dark blue / black colour of a square paper to change to light blue or white.

You are provided with:

Solutions	Contents	Hazard	Concentration /%	Volume / cm^3
E	*Enzyme solution*	Irritant Harmful	1.0	50
W	Distilled water	None	-	50
0.01% iodine (for Question 2)	Iodine in potassium iodide solution	Irritant Harmful	0.01	-

(a) (i) Decide on the concentrations of **E** you will use in your investigation.

You will need to make up to 10 cm^3 of each concentration of **E**.

Complete the table below to show:

- the concentrations of **E**
- the volumes of **E**
- the volumes of **W**. [2]

Concentration of **E** /%	Volume of **E** /cm^3	Volume of **W** /cm^3

You are advised to read steps **1** to **11** before proceeding.

Proceed as follows:

1. Prepare the concentrations of enzyme solution as stated in **(a)(i)** with the beakers provided.

2. Label 5 test tubes and add the concentrations of **E** into the respective test-tubes, to a depth of 2 cm.

3. Using a scalpel, make a single cut, 1 cm long, in the end of a wooden splint as shown in Fig. 2.1.

4. Fit a piece of 1 cm x 1 cm paper into the cut as shown in Fig. 2.2.

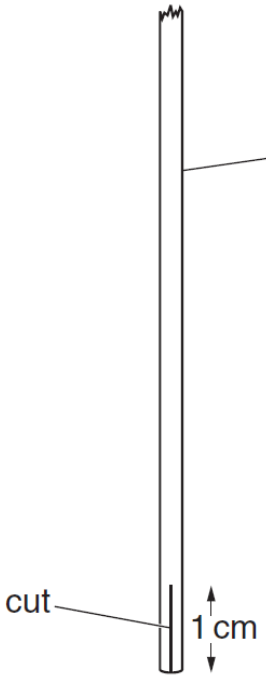

Fig. 2.1

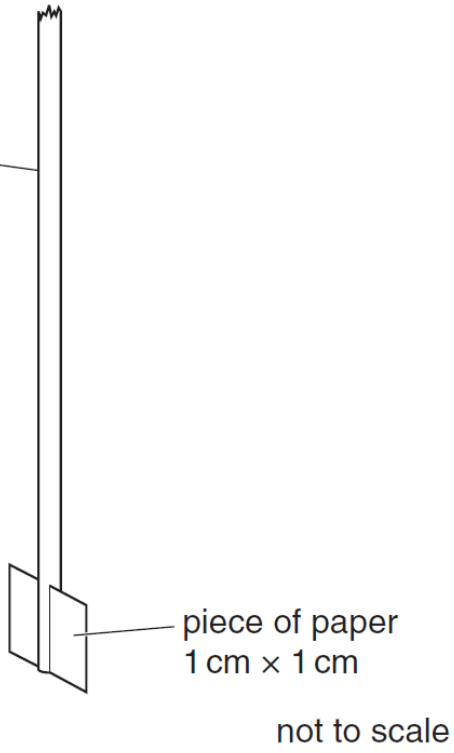

Fig. 2.2

5. Put the piece of paper into the iodine solution, labelled **0.01% iodine (for Question 2)**, as shown in Fig. 2.3, for at least 30 seconds so that the paper is evenly stained.

   This should be used as the colour standard.

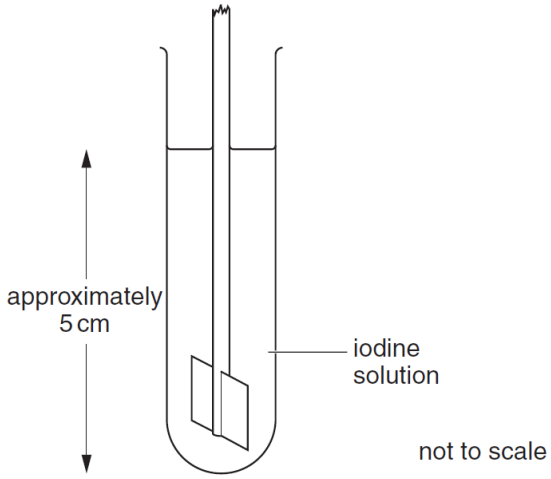

Fig. 2.3

6. Repeat steps **4** to **5** with another wooden splint.

7. Put this splint and its piece of stained paper into the test-tube containing **E**, as shown in Fig. 2.4.

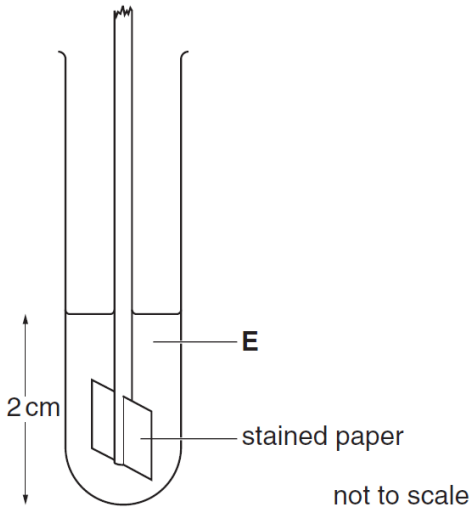

Fig. 2.4

8. Start timing.

9. Occasionally mix the contents by moving the test-tube.

10. Record the time taken for the stained paper to reach the end-point.

    If the end-point is not reached at three minutes, stop timing. Record this as 'more than 180'.

11. Repeat steps **4** to **10** with each of the other concentrations of **E**.

(ii) Record your results in an appropriate format in the space below. [3]

(iii) Explain the result that you have obtained. [3]

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(b) You are also provided with an unknown concentration of the enzyme, labelled **U**.

(i) Carry out the same experiment to find out the time taken for the stained paper to reach end-point with **U**.

State the time taken in seconds for the time taken to reach end-point with **U**. [1]

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(ii) Complete Fig. 2.5 by:

- labelling the position on the line for each of the prepared percentage concentrations of enzyme, **E**. [1]
- putting the label **U** on Fig. 2.5 to show an estimate of the concentration of enzyme in **U**. [1]

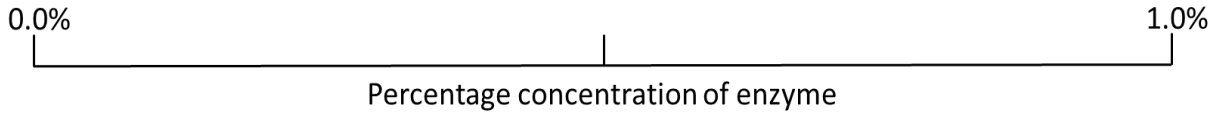

Fig. 2.5

(c) Fig. 2.6 shows the ruler used by a student in step **7** to measure the depth of **E**.

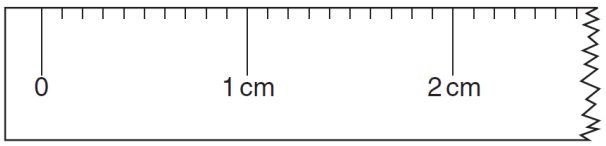

Fig. 2.6

The uncertainty or the precision of an instrument is given as half the smallest division of that instrument.

State the uncertainty of measurement using this ruler. [1]

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(d) Identify **two** significant sources of error in your investigation. [2]

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(e) Suggest how you would make **two** improvements to this investigation. [2]

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[Total: 16]

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Question 3

(a) **Iodine** solution and **methylene blue** solution are used as stains for biological material.

You are required to:

- observe the effect of using different stains, **iodine** solution and **methylene blue** solution, on thin sections of plant material, **S**
- record observations of the cells and their cell contents.

Iodine solution and **methylene blue** solution will stain your skin. Handle the stained plant material with forceps.

If any methylene blue comes into contact with your skin, wash it off immediately with water.

1. Label two microscope slides, **S1** and **S2**.
2. Put **one or two drops** of **iodine** solution onto slide **S1** and **one or two drops** of **methylene blue** solution onto slide **S2**.
3. You are given plant material, **S**. Cut one end of **S** to expose fresh layer of the plant material using a knife, as shown in Fig. 3.1.

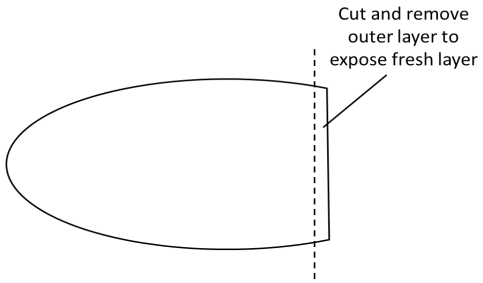


Fig. 3.1

4. Using a scalpel, cut **two very thin** sections of the plant material, **S**, from the newly exposed end.
5. Put each of the thin sections onto the drops of stain on slides **S1** and **S2** respectively, as shown in Fig. 3.2.

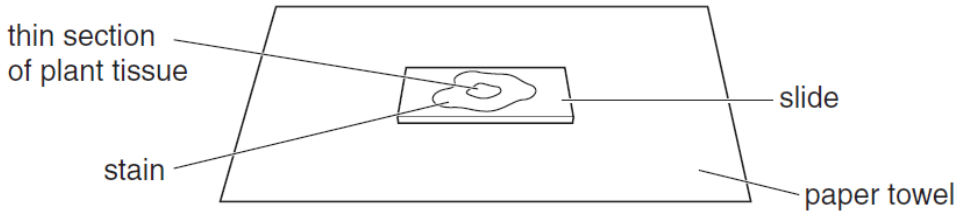


Fig. 3.2

6. Put a few more drops of **iodine** solution onto the plant section on **S1** and put a few more drops of **methylene blue** solution onto the plant section on **S2**. Make sure the **iodine** solution and **methylene blue** solution cover each of the sections.

7. Place a coverslip onto each slide. The coverslip may not lie flat.

8. Use the paper towel to dry off any excess liquid around the coverslip,

9. View the slides using the microscope. Look for the thinnest part of the section, which may be at the edge, so that the cells and their contents can be observed.

   (i) From each slide **S1** and **S2**, make large, labelled drawings of two adjacent touching cells and their cell contents.

   (ii) On your drawing, label one starch grain.

   (iii) Annotate your drawings to describe one observable difference between **S1** and **S2**.

[7]

S1:

S2:

(b) **M1** is a slide of a stained transverse section through a plant stem.

(i) Draw a large plan diagram of the region of the stem of **M1** indicated by the box region in Fig. 3.3. Use a sharp pencil.

Use a ruled label line and label to identify the epidermis. [5]

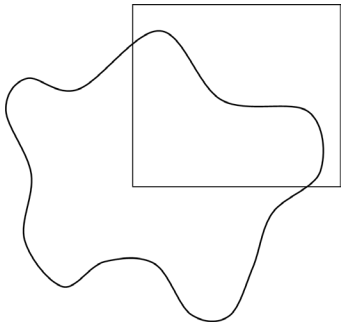


Fig. 3.3

(ii) Fig. 3.4 shows a photomicrograph of a transverse section of a different stem from **M1**.

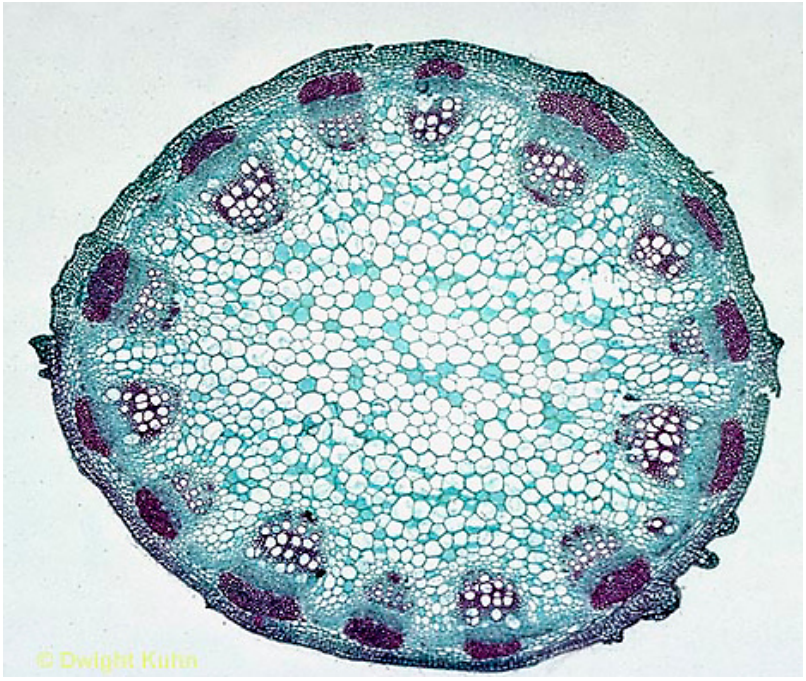


Fig. 3.4

Identify **two** observable differences, other than size and colour, between the stem section on **M1** and the stem section on Fig. 3.4.

Record the observable differences in Table 3.1. [2]

Table 3.1

feature	M1	Fig. 3.4

(c) In an investigation, the concentration of sugars in a plant were measured over 24 hours. For the first eight hours, the plant was in the dark, then it was placed in the light for the remaining 16 hours.

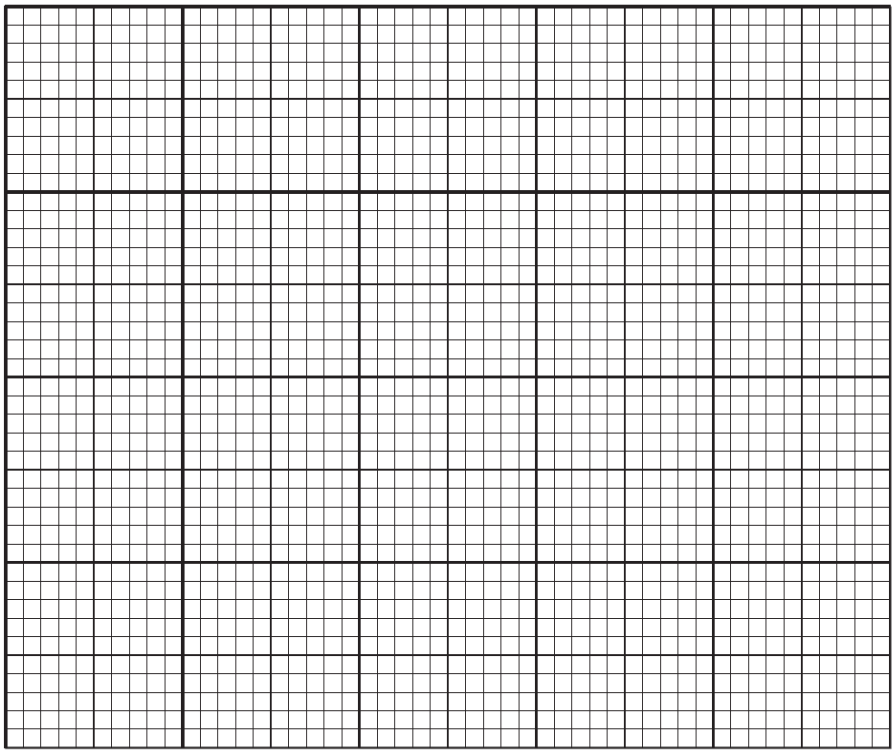
The concentrations of sugars were measured in samples taken from leaves and from phloem sieve tubes. Phloem functions to transport sugar from the leaves to the rest of the plant.

Table 3.2 shows the results of this investigation.

Table 3.2

time / hours	concentration of sugars / μmol	
	in leaves	in phloem sieve tubes
0	0.38	0.22
5	0.21	0.17
8	0.12	0.12
15	0.24	0.16
24	0.39	0.22

(i) Use the grid provided to show the changes in concentration of sugars with time. [4]



(ii) Describe the trend for the concentration of sugars **in the leaves**. Suggest an explanation for the trend. [4]

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End of Paper 4

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