

NAME : _____

CLASS : _____



JURONG PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination 2023

BIOLOGY
Higher 2

9744/04
17 August 2023

Paper 4 Practical

2 hours 30 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name 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 staples, paper clips, 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.

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	
2	
3	
Total	

This document consists of **16** printed pages.

Answer **all** questions.

- 1 There are molecules on the surface of yeast cells which cause the cells to stick together. When a yeast suspension is placed in a test-tube some of the cells sink slowly to the bottom.

(a) (i) Show clearly on Fig. 1.1 what you would expect the contents of the test-tube to look like after 10 minutes. You will gain marks for clear annotations.

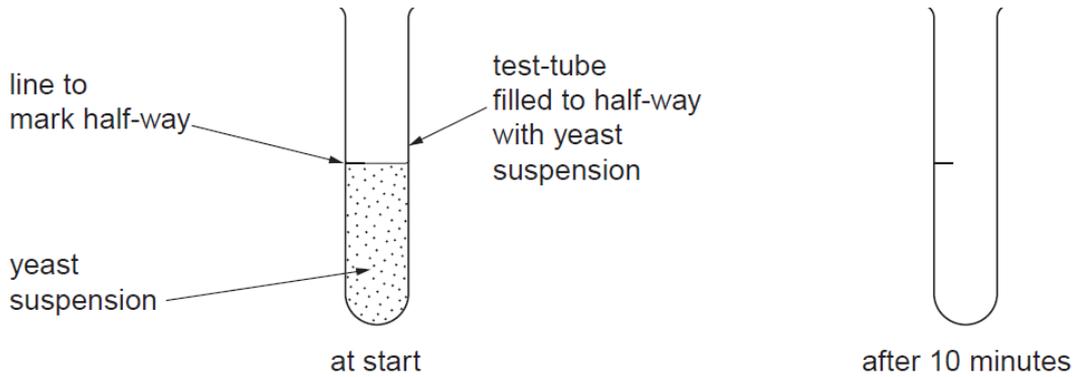


Fig. 1.1

[2]

You are required to investigate the effect of the independent variable, pH, on the sedimentation of a yeast cell suspension over a period of 10 minutes.

(ii) State the time intervals you will use and what you will use the graph paper scale to measure.

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..... [2]

You are provided with:

- a suspension of yeast cells, **Y**, in a beaker labelled **Y**
- calcium chloride solution, **C**, in a container labelled **C**
- buffer **pH 3**, **pH 4**, **pH 5** and **pH 6** in containers labelled **pH 3**, **pH 4**, **pH 5** and **pH 6**.

Proceed as follows.

- 1 Label one test-tube for each pH.
- 2 Use the marker provided to mark a line half-way along the length of each test-tube as shown in Fig. 1.1.

You will need to put 1 cm³ of **C** in each test-tube, and then an equal volume of **Y** and each buffer solution so that the mixture will fill the test-tube to the half-way mark as shown in Fig. 1.2.

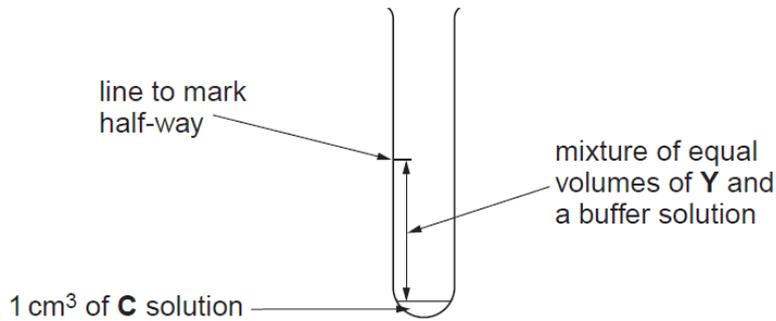


Fig. 1.2

- (iii) Use the test-tube labelled **T** and the other apparatus provided and decide on the volume of **Y** and the volume of each buffer solution to use.

Describe all the steps you used to work out the volumes.

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..... [1]

State the volume of **Y** and the volume of each buffer solution to use.

volume of **Y**

volume of each buffer solution

[1]

- 3 Put the volume of buffer solution labelled **pH 3**, stated in **(iii)**, into the test-tube labelled **pH 3**.
 - 4 Put 1 cm³ of **C** to the same test-tube.
 - 5 Repeat steps 3 and 4 with each of the other buffer solutions **pH 4**, **pH 5** and **pH 6**.
 - 6 Stir the yeast suspension **Y** with a glass rod.
 - 7 Put the volume of **Y**, stated in **(iii)**, into each test-tube to make the total volume up to the half-way mark.
 - 8 Put a bung or cork into the test-tube and invert the test-tube twice to mix well. Repeat with each test-tube.
 - 9 Immediately start timing. At your selected times, record your observations. You may need to lift each test-tube to eye level to take each reading. Take care not to disturb the contents of the test-tube.
- (iv)** Prepare the space below and record your observations.

(v) Use your results to state the effect of pH on the yeast suspension.

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..... [1]

(vi) Identify **two** significant sources of error in this experiment.

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..... [2]

(vii) Suggest how you could make **three** improvements to this investigation.

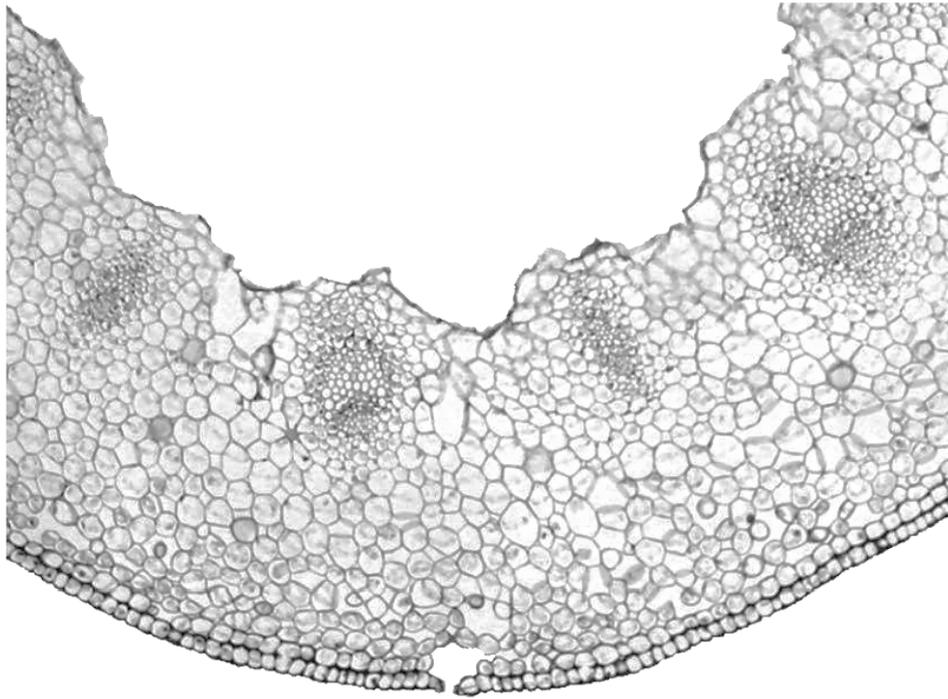
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..... [3]

(viii) Suggest a suitable control that could have been set up for this investigation.

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..... [1]

[Total: 17]

2 Fig. 2.1 is a photomicrograph of a transverse section through part of a stem.



magnification $\times 100$

Fig. 2.1

(a) Draw a large plan diagram of the specimen shown in Fig. 2.1.

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

No cells should be drawn.

Label the epidermis.

[5]

Fig. 2.2 is a photomicrograph of a transverse section through part of a different plant organ from a different plant species.

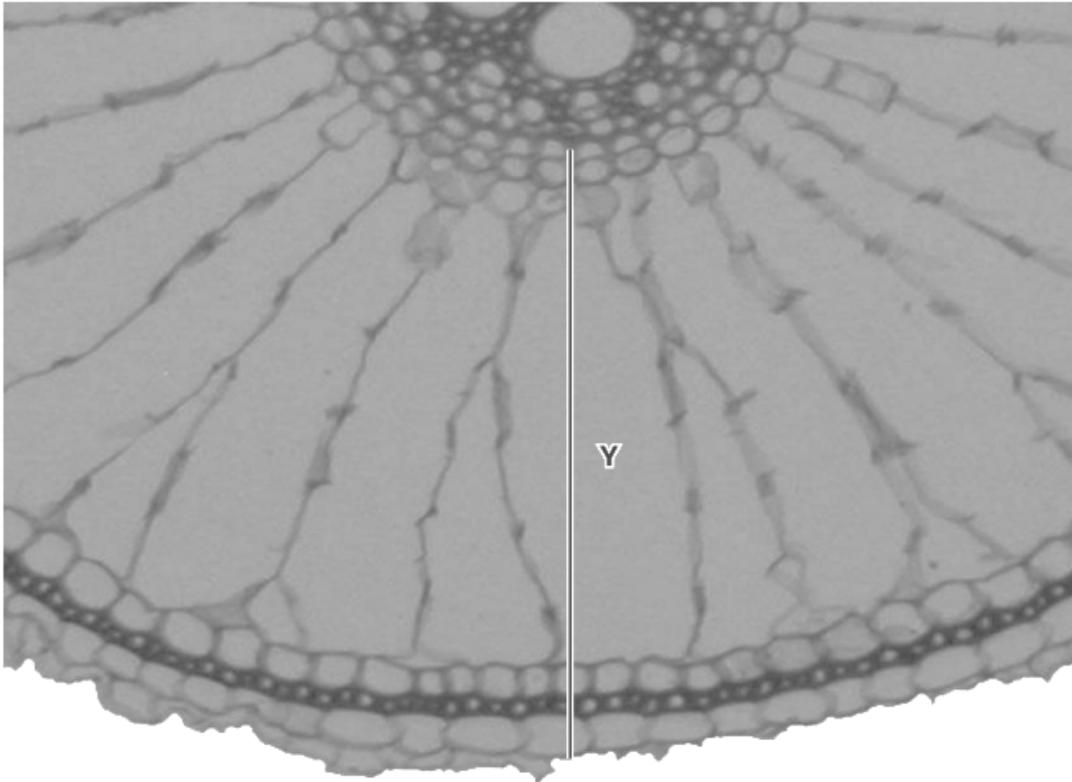


Fig. 2.2

(b) (i) Prepare the space below so that it is suitable for you to record **two** observable differences between the specimens in Fig. 2.1 and in Fig. 2.2.

Record your observations in the space you have prepared.

[3]

- (ii) The actual length of line Y is 495 μm . Use this measurement to calculate the magnification of Fig. 2.2.

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

magnification \times [4]

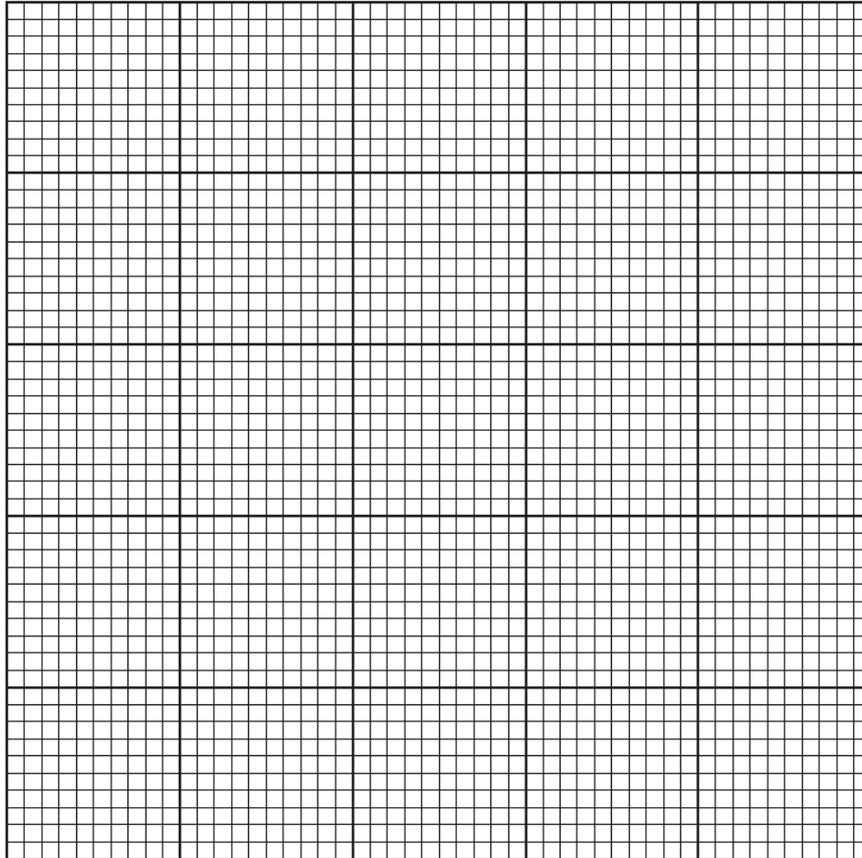
- (c) Rice is often grown with its roots submerged in water. Barley is a crop that is quickly killed by such conditions. Respiration rate of root cells can be measured as rate of production of carbon dioxide.

In an investigation into the rate of respiration in rice and barley root cells, the data shown in Table 2.1 were obtained.

Table 2.1

conditions	rate of production of carbon dioxide / mmol g^{-1}
rice root cells with oxygen (RO)	4.5
rice root cells without oxygen (RW)	5.6
barley root cells with oxygen (BO)	9.2
barley root cells without oxygen (BW)	3.0

(i) Use the grid provided to display the results shown in Table 2.1 in an appropriate form.



[4]

(ii) Explain the difference in the rates of respiration in the sets of seeds used in this investigation.

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..... [3]

[Total: 19]

- 3 Methylene blue stains dead cells blue.
Living cells are not stained blue so they will appear white or clear.

You are provided with:

- methylene blue solution, **M**, (handle carefully as it will stain your skin)
- suspensions of yeast cells, labelled **S1**, **S2** and **S3**.

Each suspension, **S1**, **S2** and **S3** has been heated for ten minutes at 45 °C or 80 °C or 100 °C.

You are required to:

- use the microscope to observe the colour of the yeast cells from **S1**, **S2** and **S3**, after **M** has been added
- record your observations by using annotated drawings of three yeast cells from each of **S1**, **S2** and **S3**
- identify the temperature at which each of **S1**, **S2** and **S3** was heated.

1 Label three microscope slides **S1**, **S2** and **S3**.

2 Place **one drop** of **S1** onto slide **S1** and add **one drop** of **M**. Mix carefully using a glass rod. (If **M** comes into contact with your skin rinse with cold water.)

3 Repeat step 2 with **S2** and **S3**.

4 Leave for five minutes.

5 Add a coverslip to each slide.

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

7 Use the microscope to observe the yeast cells on each slide, then select cells which you can draw and annotate to describe the effect of the methylene blue, **M**.

(a) (i) Prepare the space below and record your observations by:

- making drawings of **three** cells from **each** of the slides in the boxes provided
- annotating your drawings to describe the effect of methylene blue, **M** on the cells.

S1

S2



S3



[4]

- (ii) Use your observations to identify the temperature that was used to heat each of the suspensions **S1**, **S2** and **S3**.

Complete the table.

suspension	temperature / °C
S1	
S2	
S3	

[1]

- (iii) Explain how you identified the yeast cells that had been heated at 100 °C.

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..... [1]

(iv) A student was provided with a suspension of yeast cells which had been heated at a temperature between 45 °C and 80 °C.

Describe how you could modify this investigation to provide **quantitative** measurements that can be used to estimate this temperature.

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- (b) Baker's yeast was dissolved in water and provided with glucose to give active yeast suspension **BA**.

Brewer's yeast was dissolved in water and provided with glucose to give active yeast suspension **BR**.

A student suggested the hypothesis that:

'brewer's yeast has a lower rate of respiration than baker's yeast'.

Methylene blue solution acts as an electron acceptor and becomes colourless when reduced in the process of respiration, making it suitable to be used to test out his hypothesis. As the blue solution may float to the top of the yeast suspension, the mixture needs to be stirred constantly to observe the colour change.

The student carried out some preliminary trials to find the volumes of suspension and methylene blue solution to use. The student found that the best volumes of suspension and methylene blue solution to use were in the ratio of 20 : 1. He also realised that rate of respiration was at its optimum when the mixture was incubated in a water bath at a temperature of between 40 °C and 45 °C.

- (i) Use the results of the preliminary trials to plan and carry out an investigation to provide results that will enable you to support or reject this hypothesis.

You are provided with:

- 15 cm³ of baker's yeast suspension, in a specimen tube labelled **BA**
- 15 cm³ of brewer's yeast suspension, in a specimen tube labelled **BR**
- 5 cm³ of methylene blue solution, in a specimen tube labelled **G**.

Using the test tubes and the other apparatus provided, plan **and** carry out a method to obtain results to support or reject the student's hypothesis. Do **not** plan to carry out repeats. The results are to be recorded in a suitable format in **(b)(ii)**.

Your planned method should:

- have a clear and helpful structure so that the method described could be repeated by anyone reading it
- identify the independent and dependent variables
- include details to ensure that results are as accurate and repeatable as possible
- use the correct technical and scientific terms
- include reference to safety measures to minimise any risks associated with the proposed experiment.
- only make use of the apparatus and materials provided.

[5]

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Before proceeding further, use the beaker labelled **hot water** to collect approximately 400 cm³ of hot water from where it is provided in the laboratory.

The beaker labelled **tap water** can be filled as necessary from the tap.

Carry out your method described in **(b)(i)** to collect results. You should not spend more than 5 minutes on the experiment. If there are no changes after 300 seconds, record 'more than 300'.

(ii) Record your results in a suitable format in the space provided.

[4]

(iii) State whether or not your results in **(b)(ii)** support the student's hypothesis. Give a reason for your decision.

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..... [1]

[Total: 19]