Name:		Centre/Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 BIOLOGY

9744/04

Paper 4 Practical

29 August 2023
2 hours 30 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number, name and class at the top of this page.
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.

Shift
Laboratory

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.

For Examiner's Use	
1	/23
2	/13
3	/19
Total	/55

This document consists of **15** printed pages and **1** blank page.

1 Enzyme **E** catalyses the hydrolysis of starch to maltose.

The progress of this enzyme-catalysed reaction can be followed by measuring the time taken for the substrate, starch, to disappear.

You will investigate the effect of compound C, **C1**, on the hydrolysis of starch.

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

You will need to dilute the 2.0% compound C solution, **C1**, which reduces the concentration by a **factor of ten** between four successive dilutions, to give **C2**, **C3**, **C4** and **C5**. Once the dilution has been completed, there is a volume of 10.0 cm^3 for each solution in each vial.

(a) (i) Complete Table 1 to show how you will make the concentrations of the compound C solutions, **C2**, **C3**, **C4** and **C5**.

Table 1

Label of compound C solution	Percentage concentration of compound C solution	Label of compound C solution to be diluted	Volume of compound C solution to be diluted / cm^3	Volume of distilled water to make up the dilution / cm^3	Total volume / cm^3
C1					10.0
C2		**C1**			10.0
C3					10.0
C4					10.0
C5					10.0

[3]

(ii) Describe a suitable control for the experiment and explain its purpose.

….....

….....

….....

…..... ..[2]

(b) A student suggested the hypothesis that:

'the higher the concentration of compound C, the slower the breakdown of starch.'

The student carried out some preliminary tests to find the volumes of amylase and starch solutions to use when testing this hypothesis. The student found that the best volumes of compound C, amylase and starch solutions to use were in a ratio of 1 : 2 : 6.

Use the results of the tests to plan and carry out an investigation to provide results that will enable you to support or reject this hypothesis. If the complete breakdown of starch takes more than 180 seconds, record as 'more than 180'.

In addition to the 10 cm^3 of compound C solutions prepared according to Table 1 (without the control), you are provided with:

- **only** 20 cm^3 of amylase in a container, labelled **E**
- **only** 60 cm^3 of starch in a container, labelled **S**

Using the specimen tubes and the other apparatus provided, plan **and** carry out a method to obtain results to support or reject the student's hypothesis.

You may use the space below to make any notes. Read through **(b)(i)**, **(b)(ii)** and **(b)(iii)** before proceeding.

(i) State the dependent variable.

….....

. ...[1]

(ii) Other than the volumes of the solutions, state another variable to be controlled and explain how this variable can be controlled.

….....

….....

….....

. ...[2]

(iii) Outline the steps in your method to collect the results.

….....

….....

….....

….....

….....

. ...[3]

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

[3]

(v) State whether or not your results in **(b)(iv)** support the student's hypothesis.

Give a reason for your decision.

….....

. ...[1]

(vi) Vial **U** contains compound C of an unknown concentration.

Using your steps in **(b)(iii)** and results in **(b)(iv)**, estimate the concentration of compound C in **U**.

concentration of compound C in **U**..... ..[1]

(vii) State **one** significant source of error in this investigation.

Explain why this is a source of error.

source of error .....

explanation .....

....[2]

(viii) Suggest how you could make **one** improvement to the **independent** variable so that a more accurate estimate of the concentration of compound C in **U** can be obtained.

….....

. ...[1]

(ix) Suggest how you could make **two** improvements to the measuring of the **dependent** variable so that a more accurate estimate of the concentration of compound C in **U** can be obtained.

….....

….....

….....

. ...[2]

(x) Other than washing off any solution that comes into contact with your skin with cold water, describe another safety precaution you would take and explain how it minimises any risks associated with the experiment.

….....

….....

….....

. ...[2]

[Total: 23]

2 Plant extracts contain molecules which have many uses in industry and as medicines.

It is important for scientists to be able to estimate the concentration of these molecules in plant extracts.

A student investigated the concentration of molecule **R** in extracts from different plants.

The student mixed a fixed volume of each plant extract with acidified potassium manganate(VII), a purple solution. When molecule **R** was present in the extract, it reacted with the potassium manganate(VII), causing the solution's colour to change from purple to colorless. The student took the time for this colour change to occur which was used as an indicator of the reaction's end-point. By comparing the reaction times of different plant extracts using a stopwatch, the student could determine the relative concentration of molecule **R** in each sample of plant extract.

The results are shown in Fig 2.1.

plant extract **B**

plant extract **C**

plant extract **D**

plant extract **E**

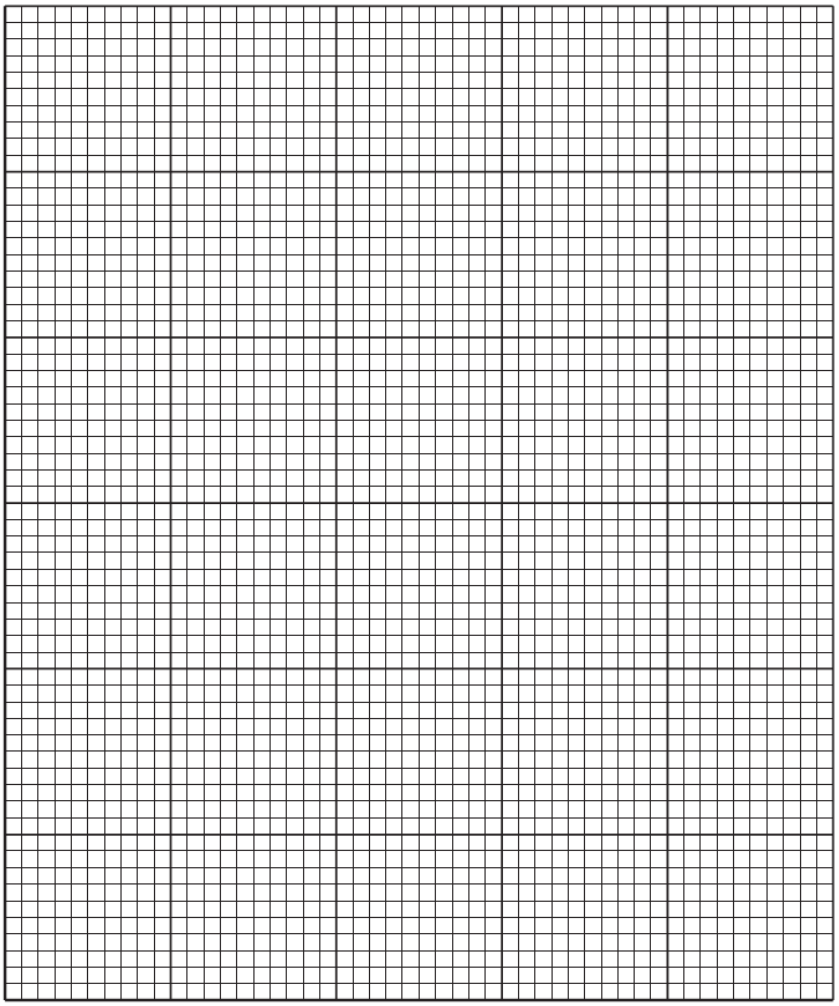
plant extract **F**

Fig 2.1

(a) (i) Record the data in Fig 2.1 in the space provided in an appropriate format.

[2]

(ii) Plot the data shown in **(a)(i)** on the grid provided in an appropriate format.



[5]

(iii) Suggest which plant extract would contain the highest concentration of **R**.

.....[1]

(b) Scientists have suggested that a different molecule in the plant extract might act as an antibiotic.

The scientists tested this by:

- spreading bacteria over the surface of agar gel containing nutrients
- putting small drops ($3\,\mu m^3$) of different concentrations of the plant extract into separate wells in the agar gel
- incubating the agar gel for 20 hours
- measuring the inhibition area (where the bacteria were not observed) for each concentration of plant extract.

The results are shown in Fig 2.2.

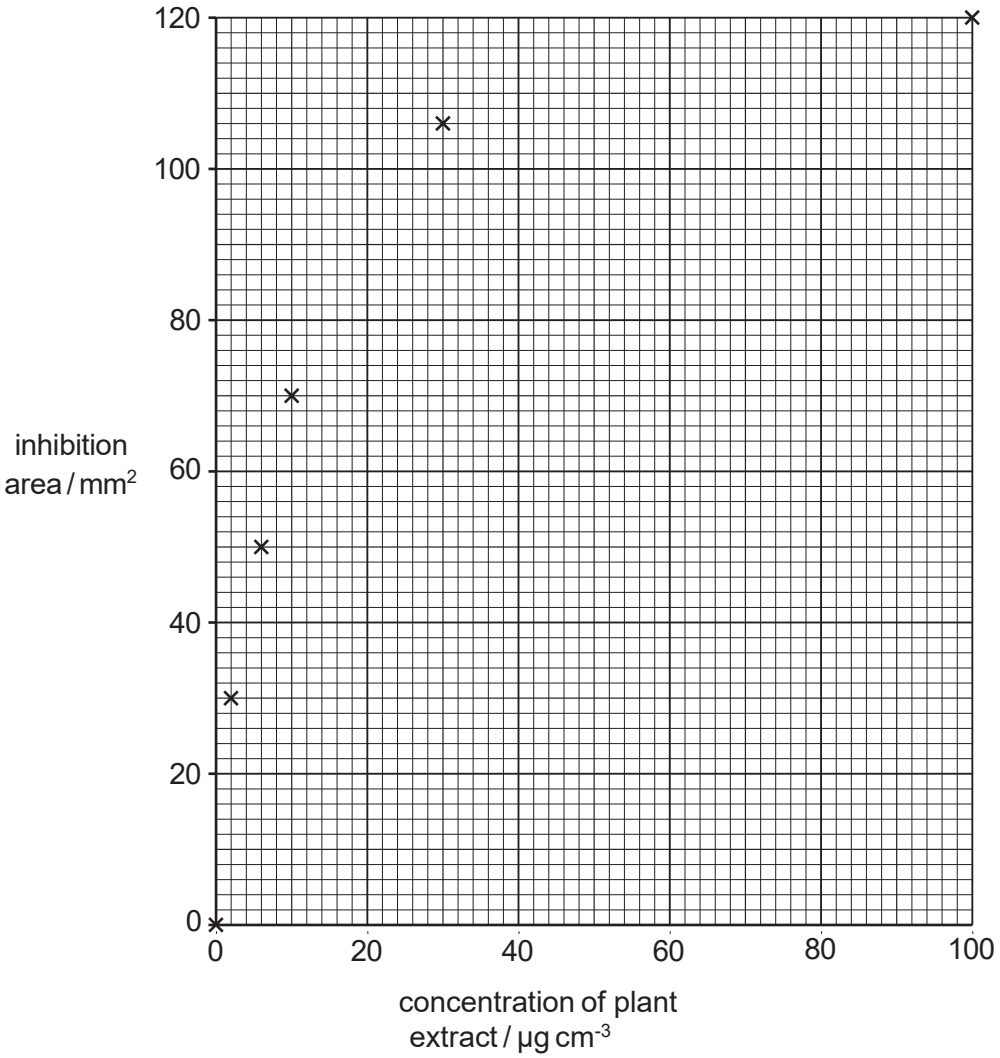


Fig 2.2

(i) Draw a line of best fit in the grid provided in Fig 2.2. [1]

(ii) Use the graph in Fig 2.2 to estimate the concentration of plant extract that results in an inhibition area of 92 mm^2. Show on Fig 2.2 how you obtained your answer.

concentration of plant extract =..... [2]

(iii) Suggest **two** ways the molecule in the plant extract may inhibit the growth of the bacteria.

….....

….....

….....

. ...[2]

[Total: 13]

3 *During this question you will require access to a microscope and slide **S1**.*

Fig 3.1 is a photomicrograph of a stained transverse section through the stem of a plant species.

This plant grows in waterlogged conditions.

You are not expected to be familiar with this specimen.

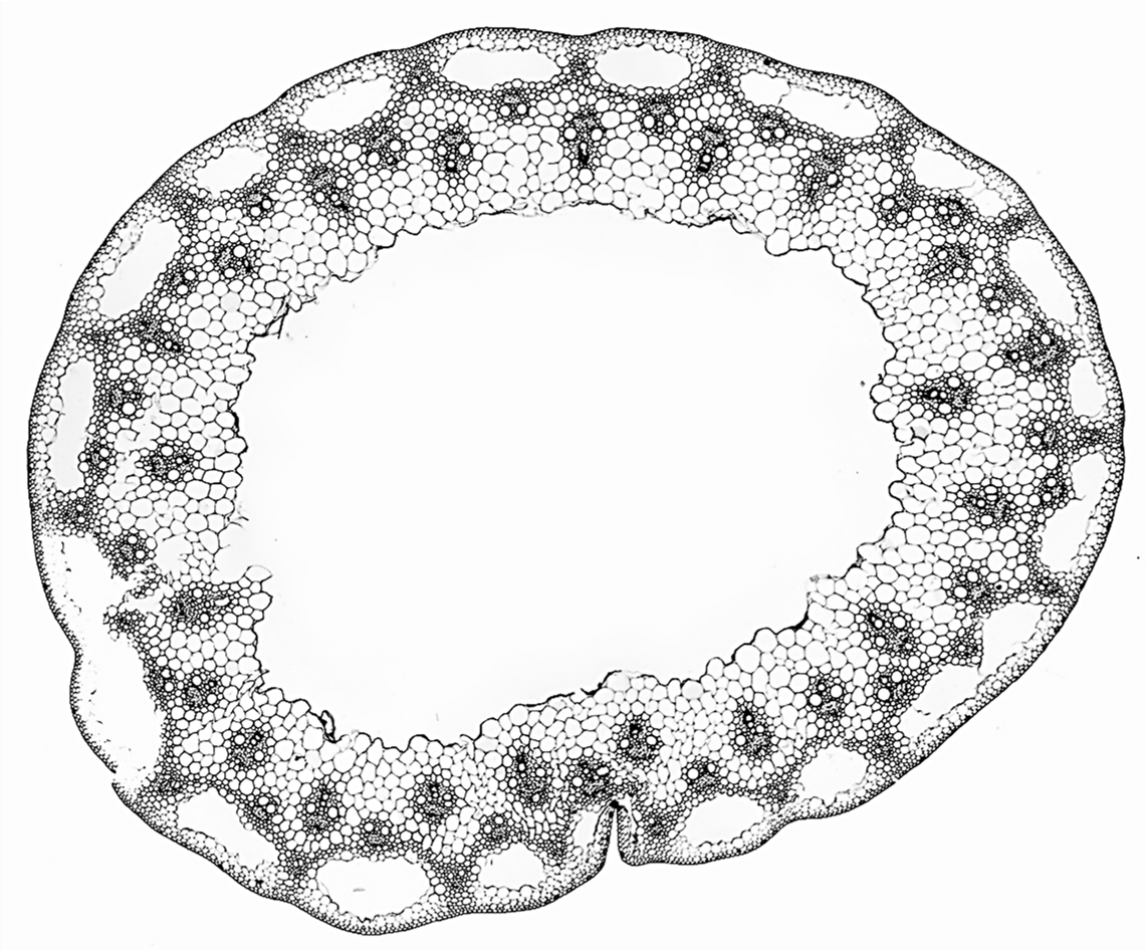


Fig 3.1

(a) (i) Use the space provided to draw a large plan diagram of the shaded area of the stem shown in **Fig 3.2**.

A plan diagram shows the arrangement of the different tissues. No cells should be drawn.

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

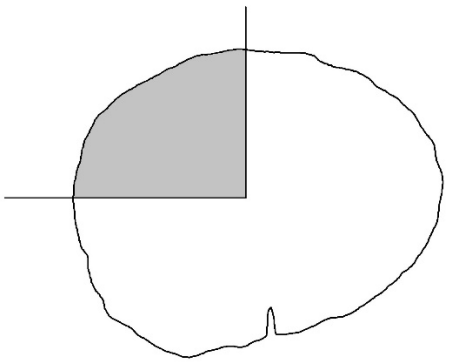


Fig 3.2

[5]

(ii) Suggest one observable feature of the stem in Fig 3.1 and explain how it supports the fact the plant grows in waterlogged conditions.

feature .....

explanation .....

....[2]

(b) Slide S1 is a microscope slide of a stained transverse section through a stem from a different species of plant. The stem of this plant does not grow in waterlogged conditions.

(i) Use a suitable table to record observable differences between the specimen in Fig 3.1 and the specimen on slide **S1**.

[3]

(ii) Observe the epidermal cells of the stem on S1.

Select **three** adjacent epidermal cells that are arranged end to end in a line.

Each cell must touch at least one other cell.

Make a large drawing of this line of **three** cells.

[4]

(c) Fig 3.3 shows a diagram of a stage micrometer scale that is being used to calibrate an eyepiece graticule.

One division, on either the stage micrometer scale or the eyepiece graticule, is the distance between two adjacent lines.

The length of one division on this stage micrometer is **0.1 mm**.

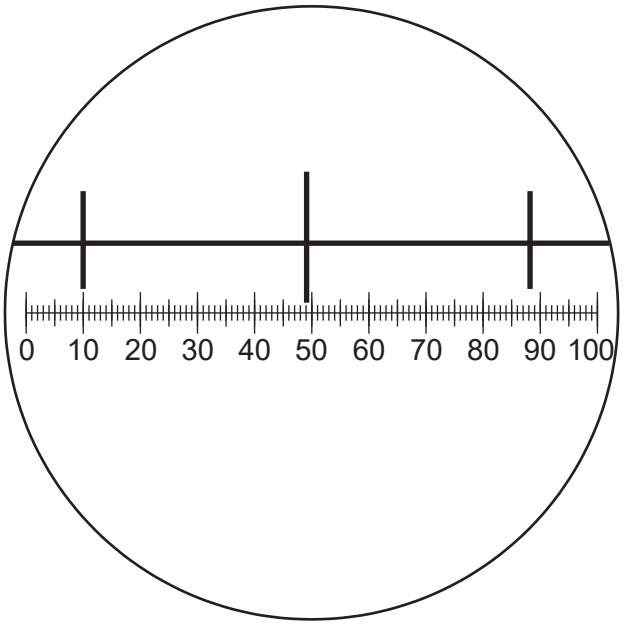


Fig 3.3

(i) Calculate the actual length of one eyepiece graticule unit in μm.

Show all your workings clearly.

..... [3]

Fig 3.4 shows a photomicrograph of a transverse section through a leaf, taken using the same microscope with the same lenses as Fig 3.3.

You are not expected to be familiar with this specimen.

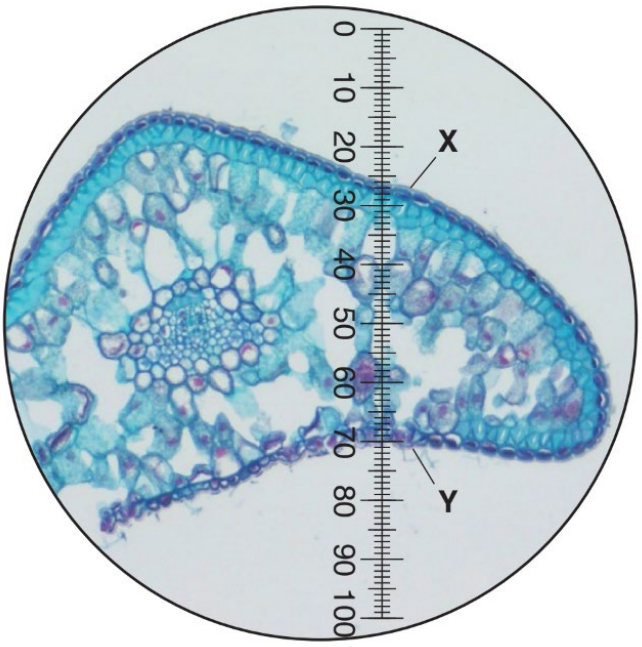


Fig 3.4

(ii) Use the calibration of the eyepiece graticule unit from **(c)(i)** and Fig 3.3 to calculate the actual length of the plant leaf from **X** to **Y**.

Show all the steps in your calculation and use appropriate units.

.....[2]

[Total: 19]

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