Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

5129107863

BIOLOGY **5090/41**

Paper 4 Alternative to Practical **October/November 2023**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

DC (LK/CGW) 313848/1
© UCLES 2023

1 Hydrogen peroxide is a toxic waste product found in cells. Catalase, an enzyme present in cells, breaks down hydrogen peroxide to produce water and oxygen.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

When potato tissue is added to a solution of hydrogen peroxide in a test-tube the catalase in the potato cells causes bubbles of oxygen to be produced. If some detergent is added to the hydrogen peroxide solution the oxygen bubbles are trapped to produce a layer of bubbles that rises up the test-tube. The height of this layer of bubbles indicates how much catalase activity there has been.

A student used this method to investigate the activity of the catalase in potato tissue by following these instructions:

- Label three large test-tubes **A**, **B** and **C**.
- Add 5 cm^3 of hydrogen peroxide solution to each test-tube. **Hydrogen peroxide is an irritant that may cause damage to eyes and skin.**
- Add 1 cm^3 of detergent to the hydrogen peroxide solution in each test-tube.
- Cut three pieces of potato measuring 10 mm × 10 mm × 10 mm.
- Add one of the pieces of potato to test-tube **A**. It will sink to the bottom of the hydrogen peroxide solution.
- Immediately start your timer and observe the piece of potato. Bubbles of oxygen will rise to the surface and form a layer at the top of the hydrogen peroxide solution.
- Measure the height of this layer at 2, 4 and 6 minutes from the start and record these measurements. The height of the layer of bubbles should be measured from the top of the hydrogen peroxide solution to the top of the layer of bubbles as shown in Fig. 1.1.

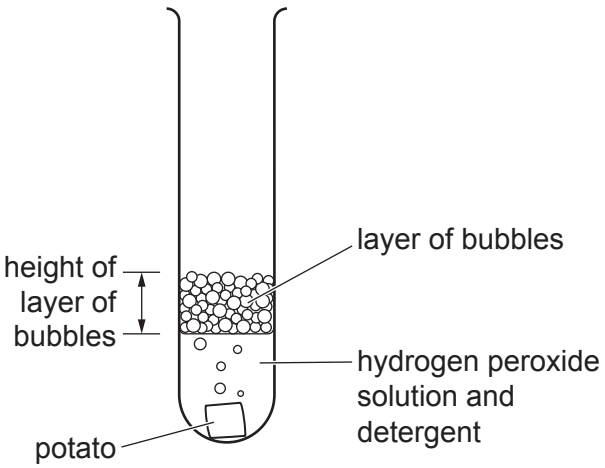


Fig. 1.1

- Cut the second piece of potato into four equal parts and add them to test-tube **B**.
- Start your timer and repeat the measurements as for test-tube **A**.
- Cut the third piece of potato into eight equal parts and add them to test-tube **C**.
- Start your timer and repeat the measurements as for test-tube **A**.

(a) **(i)** State a safety precaution that the student should take while doing the investigation with hydrogen peroxide solution.

..... [1]

The student recorded the measurements in a notebook as shown in Fig. 1.2.

Height of layer of bubbles in millimetres

Minutes	2	4	6
1cm^3 of potato	12	18	23
Potato cut into 4 parts	14	22	31
Potato cut into 8 parts	19	31	38

Fig. 1.2

(ii) Enter the headings in Table 1.1.

[2]

(iii) Complete Table 1.1 by entering the student's results.

Table 1.1

.....	.....		
	test-tube A	**test-tube B**	**test-tube C**
2			
4			
6			

[3]

Cutting the potato pieces into smaller parts increases the surface area of the potato.

(iv) Describe the effect of increasing the surface area of the potato and explain what caused this effect.

description .....

.....

explanation .....

.....

.....
[3]

The student found that the top of the layer of bubbles was not always flat when they had to measure the height of the layer.

(v) Suggest what they could do to ensure that the measurements taken every two minutes were comparable.

.....

..... [1]

(vi) The student noticed two unexpected problems during the investigation. Suggest how each may have affected the results.

1. bubbles sometimes stuck to the potato

suggestion .....

.....

2. some of the eight parts of potato in test-tube **C** stuck together

suggestion .....

.....
[2]

(vii) Suggest how the student can prove that it is the activity of the enzyme catalase that produces the bubbles.

.....

..... [1]

(b) Another student investigated the activity of catalase in potato by measuring the volume of oxygen produced. They added cubes of potato to hydrogen peroxide solution in the apparatus shown in Fig. 1.3.

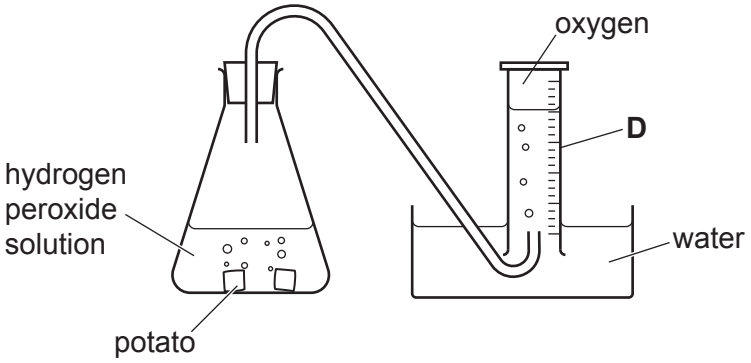


Fig. 1.3

(i) Name the piece of apparatus labelled **D**.

..... [1]

(ii) Design an investigation to determine the effect of **temperature** on the activity of catalase in potato.

Use the apparatus shown in Fig. 1.3.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 20]

2 Bacteria can be grown on agar jelly in a Petri dish. When they grow and multiply the clear agar jelly becomes cloudy.

Antibiotics can prevent the growth of bacteria. Discs of filter paper dipped in an antibiotic solution can be placed on the surface of the agar. If the area around a disc remains clear, the antibiotic has prevented the growth of the bacteria. The larger the clear area, the more effective the antibiotic is.

A student investigated the effect of distilled water (**E**) and four different antibiotics (**F**, **G**, **H** and **J**) on some bacteria using the method described.

They set up three identical Petri dishes and measured the diameter of the clear areas around the filter paper discs after a few days.

There was no clear area around disc **E** in any of the Petri dishes.

Fig. 2.1 shows the results for Petri dish 3.

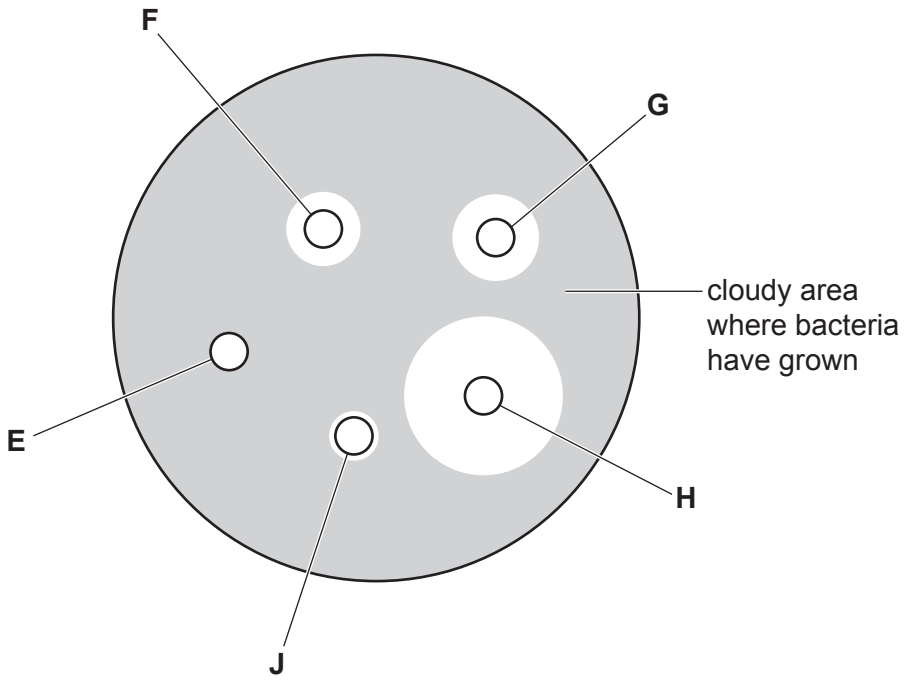


Fig. 2.1

Most of the measurements for the clear areas around the discs with antibiotics **F**, **G**, **H** and **J** are shown in Table 2.1.

Table 2.1

antibiotic	diameter of clear area / mm			
	Petri dish 1	Petri dish 2	Petri dish 3	mean
F	12	6	12	10.0
G	15	14	14	14.3
H	20	21		
J	8	8	8	8.0

(a) **(i)** Measure the diameter of the clear area around the disc with antibiotic **H** in Fig. 2.1 and record this in the table.

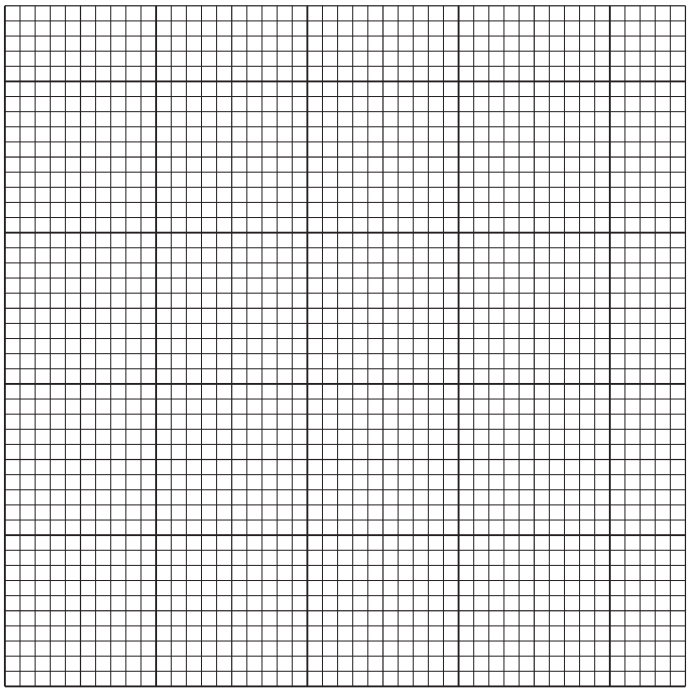
[1]

(ii) Calculate the mean diameter of the clear areas around the discs with antibiotic **H**. Enter the value in the table rounded to one decimal place.

Space for working.

..... [2]

(b) **(i)** Construct a bar chart of the four **mean diameters** in Table 2.1 on the grid.



[4]

(ii) State which antibiotic was most effective at preventing growth of the bacteria.

..... [1]

(c) The student realised that one of their results was anomalous.

State which measurement was an anomalous result and suggest what the student could have done about it.

.....

.....

.....

..... [2]

[Total: 10]

3 Fig. 3.1 is a photomicrograph of a section through a kidney showing some kidney tubules.

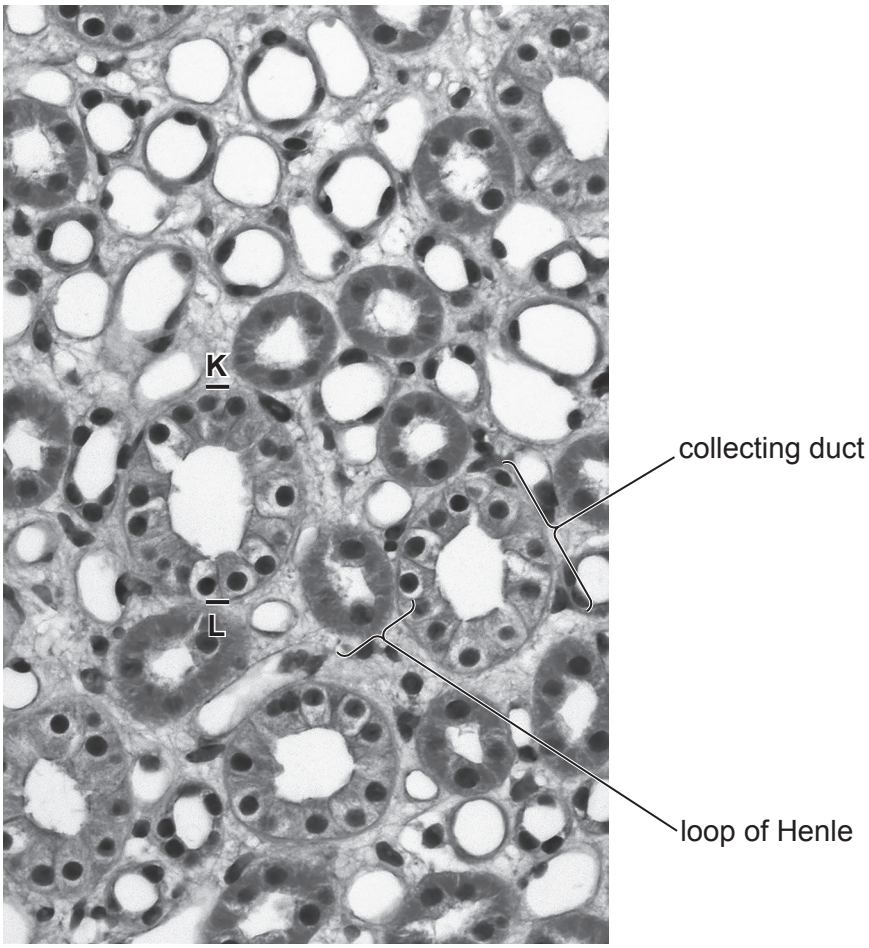


Fig. 3.1

(a) **(i)** **K** and **L** indicate the diameter of a collecting duct. Draw a straight line to join **K** and **L** on the collecting duct in the photomicrograph.

Measure the length of the line and record it.

.....

The actual distance between **K** and **L** is 0.06 mm.

Calculate the magnification of the photomicrograph and record it to the nearest whole number.

Space for working.

magnification × .....
[3]

(ii) In the space below make a large drawing of the collecting duct and loop of Henle that are labelled in Fig. 3.1. Draw them as they appear in the photomicrograph.

[5]

(b) A person suffering from Type 1 diabetes produces urine containing glucose.

Describe a test that could be carried out to detect whether glucose is present in a sample of urine.

description of test .....

.....

positive result .....

[2]

[Total: 10]

BLANK PAGE

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

© UCLES 2023