



Rewarding Learning

ADVANCED

General Certificate of Education
2024

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

Biology

Assessment Unit A2 3

assessing

Practical Skills in Biology

MV18

[ABY31]

WEDNESDAY 19 JUNE, MORNING

Time

1 hour 15 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only.

Answer **all eight** questions.

Information for Candidates

The total mark for this paper is 60.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

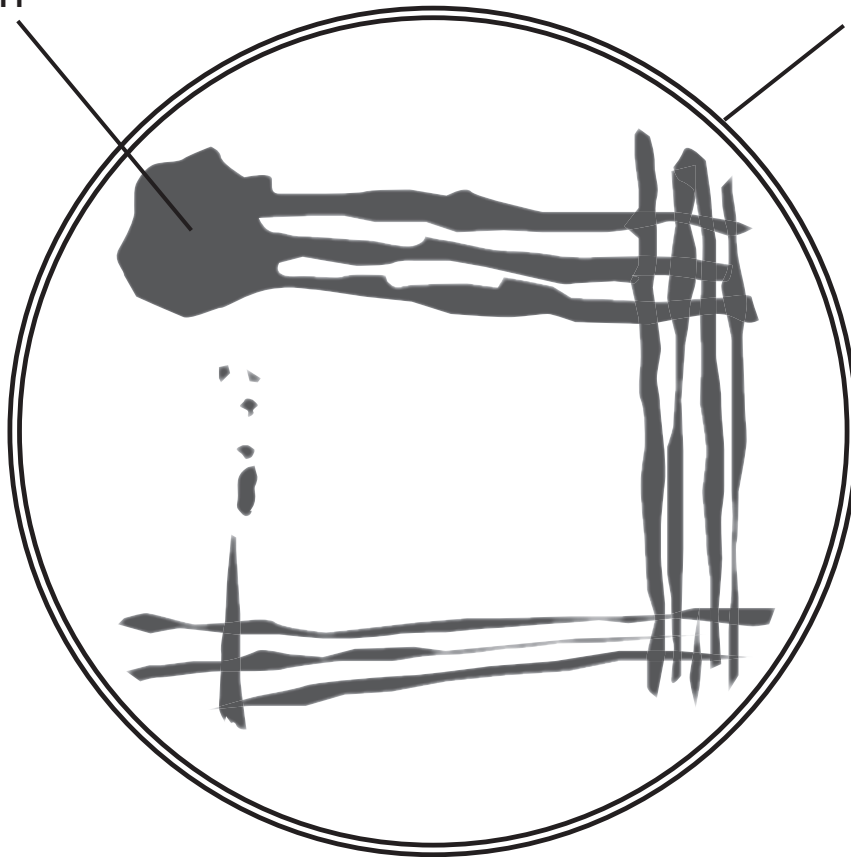
Use accurate scientific terminology in all answers.

Statistics Sheets are not required for use with this paper.

- 1 A streak plate can be prepared after inoculating an agar plate with bacteria.
The diagram below represents a streak plate after incubation at 25°C for 24 hours.

Initial inoculation

Petri dish with nutrient agar



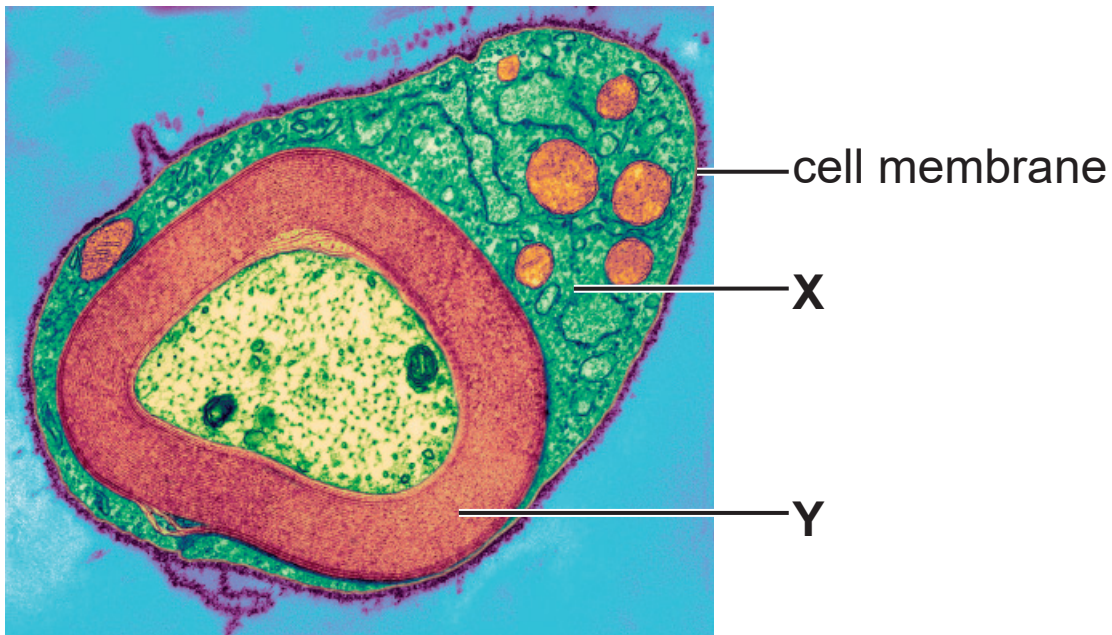
(a) After inoculation, describe the steps taken to produce the pattern shown in the diagram. (You do not need to describe how to maintain aseptic conditions.)

[3 marks]

(b) State **one** reason for producing a streak plate.

[1 mark]

- 2 The electron micrograph image below shows a transverse section (TS) through a mammalian neurone.



- (a) (i) Identify cell **X** and structure **Y**. [2 marks]

X _____

Y _____

- (ii) Using the letter **Z**, label the axon on this micrograph. [1 mark]

(b) Describe and explain the effect that structure **Y** has on nervous transmission. [2 marks]

(c) Suggest **one** way in which the appearance of the neurone would differ if the section was taken at the position of a node of Ranvier. [1 mark]

(d) State the evidence which indicates that this image was taken using a transmission electron microscope rather than a scanning electron microscope. [1 mark]

3 The table below contains descriptions of terms related to the chromatography of plant pigments.

(a) Complete the table by adding the missing terms.

[2 marks]

Term	Description
	The position where pigment is spotted onto the chromatography paper.
	The position reached by the solvent when the chromatogram is removed from the chromatography tank.

(b) The common nettle (***Urtica dioica***) can be used when preparing a leaf extract for chromatography.

(i) Describe the steps involved in preparing a nettle leaf extract for use in chromatography. [3 marks]

(ii) Describe how you would determine the R_f value of a plant pigment. [2 marks]

- (c) Three students, **A**, **B** and **C**, produced chromatograms of pigments from nettle leaves.

The students calculated R_f values and their results are shown in the table below.

Pigment	R_f		
	A	B	C
Carotene	0.96	0.94	0.94
Xanthophyll	0.68	0.66	0.69
Chlorophyll a	0.63	0.62	0.64
Chlorophyll b	0.43	0.41	0.44

- (i) Suggest **one** reason to account for the variability of the students' results. [1 mark]

- (ii) The pigments shown in the table can be identified by their R_f values.

Suggest **one other** way in which each photosynthetic pigment could be identified on a chromatogram. [1 mark]

- 4** During the light-dependent stage of photosynthesis, photolysis releases hydrogen ions and electrons. Electrons can reduce a redox indicator such as DCPIP, turning the indicator from blue to colourless.

Isolated chloroplasts can be used to demonstrate redox reactions in photosynthesis.

(a) A procedure for obtaining isolated chloroplasts is outlined below.

- 1.** Pour a suspension of lettuce leaves blended with buffer into centrifuge tubes.
- 2.** Centrifuge.
- 3.** Discard the pellet.
- 4.** Centrifuge again.
- 5.** Pour off the supernatant. The pellet contains isolated chloroplasts.

(i) The purpose of step **3** is to discard a particular cell organelle from the suspension.

Name this organelle. [1 mark]

(ii) In order to carry out steps **2** and **4**, students using this procedure would require additional information, including centrifuge speed.

Identify **one** other piece of information that should be included. [1 mark]

(iii) Name one organelle likely to be present in the **supernatant** at step **5**. [1 mark]

(b) In an experiment by a student, three test tubes were set up as outlined in the table below.

The results of the experiment are also included.

Tube	Contents and treatment	Colour	
		at start	after 30 minutes
A	water and DCPIP in bright light	blue	blue
B	chloroplast suspension and DCPIP in darkness	blue-green	blue-green
C	chloroplast suspension and DCPIP in bright light	blue-green	green

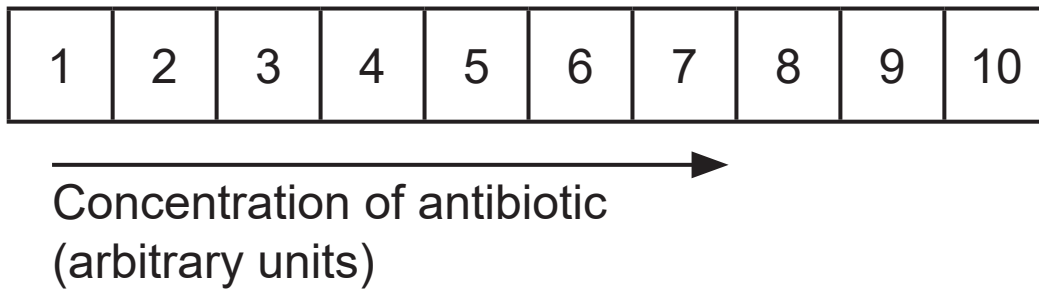
(i) Explain fully the results shown. [3 marks]

- (ii) Another student carried out the same experiment, but suspected that the chloroplast suspension was contaminated with mitochondria. Suggest how this student's results would differ from those shown, if there was mitochondrial contamination. [2 marks]

Explain your answer.

- 5 (a) E-strips are lengths of plastic, coated with antibiotic. They are a useful tool in analysing the effect of antibiotic concentration on bacterial growth.

The concentration of antibiotic increases along an E-strip as shown below.



In an investigation, an agar plate was inoculated with a strain of bacteria.

- (i) Name the piece of equipment used to create a bacterial 'lawn' over the surface of the agar.
[1 mark]

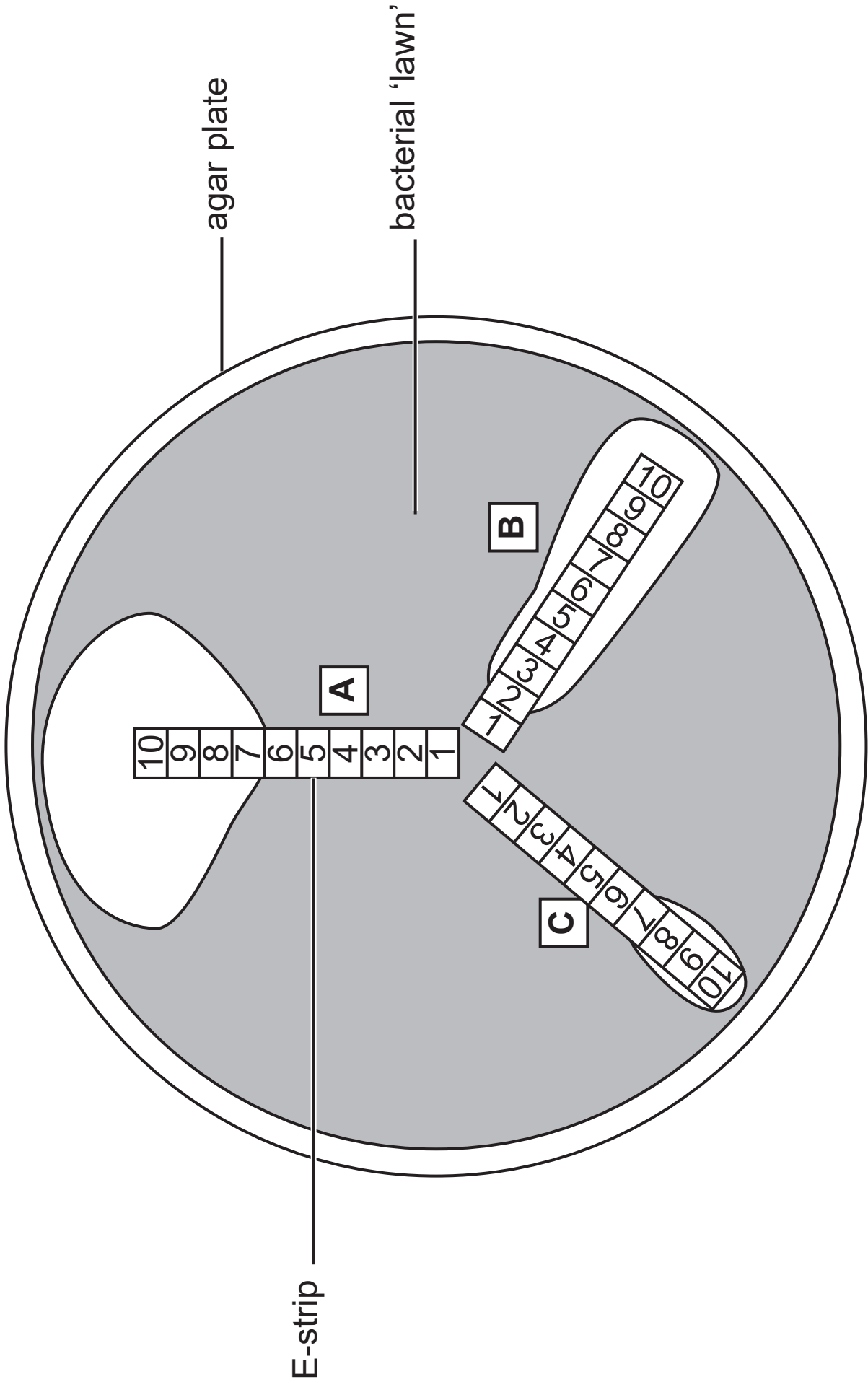
Three E-strips, each containing a different antibiotic (**A**, **B** and **C**), were then placed on the agar plate.

Following this, the agar plate was incubated at 37°C for 48 hours.

The results are shown in the diagram opposite.

(ii) Describe the results shown. [3 marks]

(iii) Following this investigation, it was concluded that antibiotic **B** was most suitable to treat infections caused by this strain of bacteria. Suggest why this conclusion was reached. [2 marks]



(iv) State **one** piece of evidence which suggests that this investigation was carried out in a scientific setting, rather than a school laboratory. [1 mark]

(b) Describe **three** aseptic techniques that should be used to prevent contamination when transferring microorganisms from a culture bottle to an agar plate. [3 marks]

1. _____

2. _____

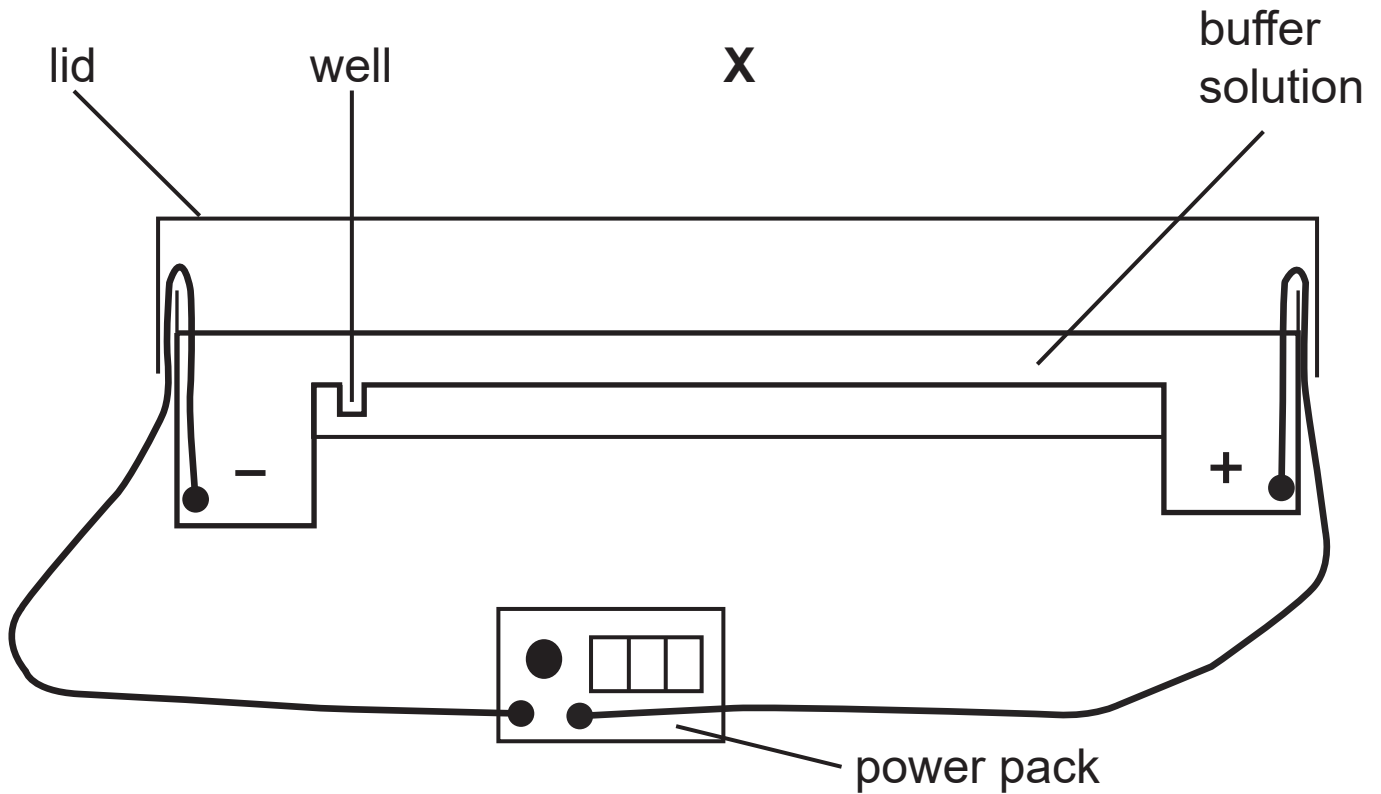
3. _____

(c) Progress in science is normally published in scientific papers, each of which includes a bibliography.

Suggest **one** function of a bibliography. [1 mark]

6 Gel electrophoresis is a process which separates DNA fragments.

The diagram below shows the key components in a gel electrophoresis system.

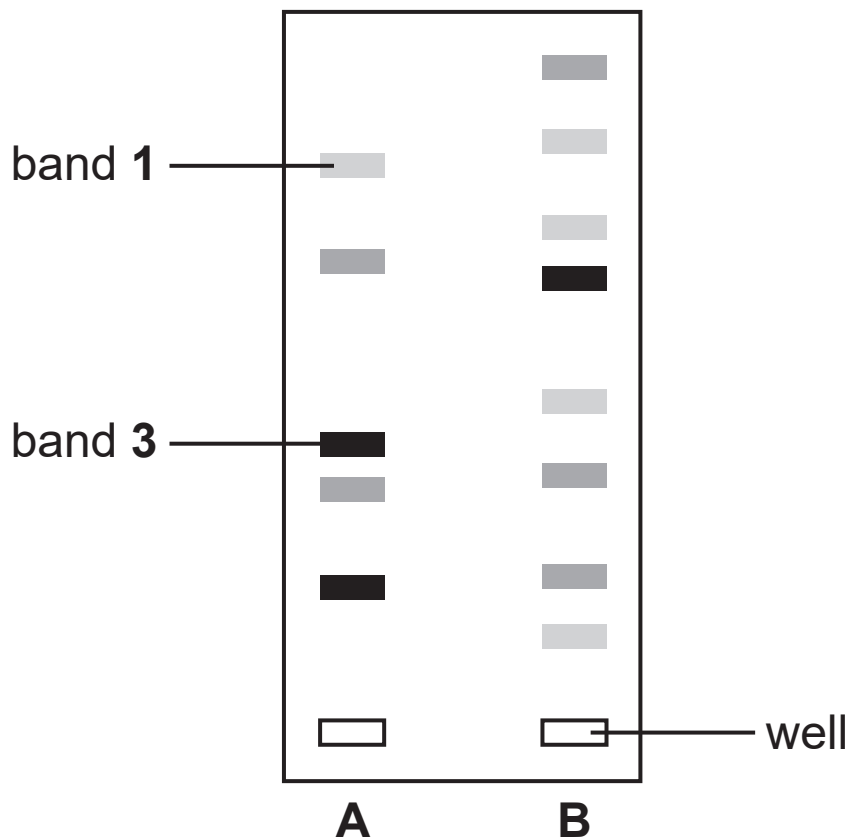


(a) (i) Draw a line from **X** to identify the gel in the apparatus. [1 mark]

(ii) Suggest **one** function of the lid in the gel electrophoresis system. [1 mark]

(b) In an investigation, two identical batches of DNA were incubated separately with **different** restriction enzymes. The resulting DNA fragments from each batch were added to two different wells (**A** and **B**) in the gel.

The diagram below represents the electrophoresis gel following the migration of the DNA fragments.



(i) Account for the differences in position, and suggest why the degree of staining between bands **1** and **3** in lane **A** is different. [2 marks]

position _____

degree of staining _____

(ii) Using the diagram, suggest **one** conclusion that can be made about the **DNA recognition sites** for the two restriction enzymes used in this investigation.
[1 mark]

7 Respiratory quotient (RQ) values for living tissue can be calculated using data obtained from a respirometer. Oxygen uptake is measured first, followed by the measurement of carbon dioxide production.

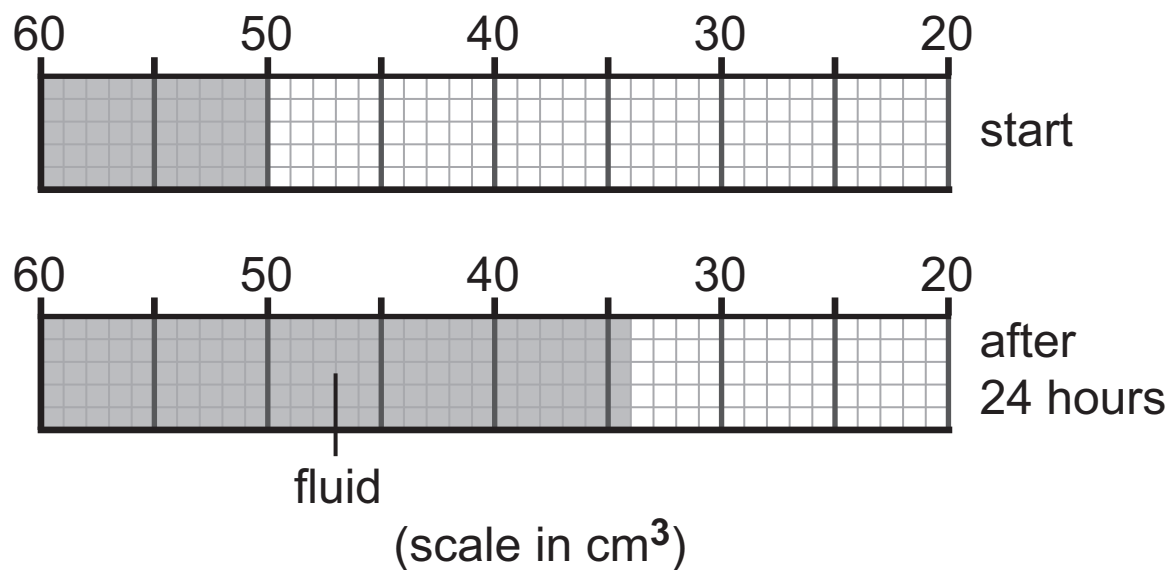
(a) Calculations of RQ in a school setting are often done using mealworms or maggots.

Suggest **one** reason why these animals are suitable for this role. [1 mark]

(b) In an investigation, a respirometer containing 10 maggots was set up and left for 24 hours. This respirometer contained potassium hydroxide solution.

The level of fluid was measured at the start and at the end of the 24-hour period. The results are represented below.

Respirometer with potassium hydroxide solution



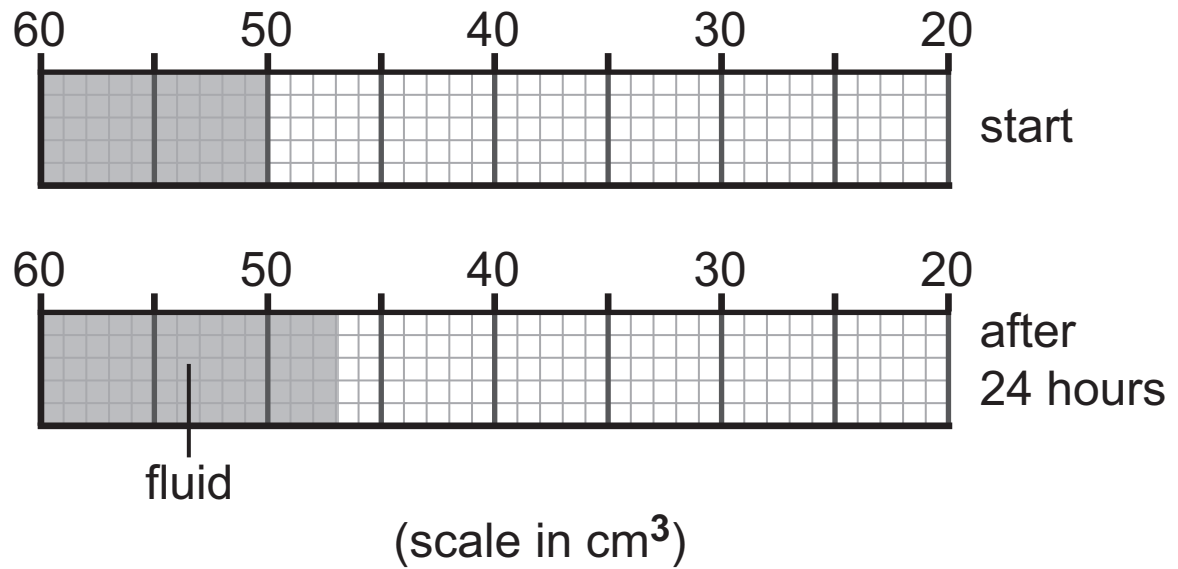
(i) Calculate the volume of oxygen consumed by the maggots during the 24-hour period. [1 mark]

_____ cm³

The potassium hydroxide solution in the respirometer was replaced with water and the investigation was repeated.

The results of this are represented below.

Respirometer with water



(ii) Calculate the RQ value for the maggots.
[2 marks]

(Show your working.)

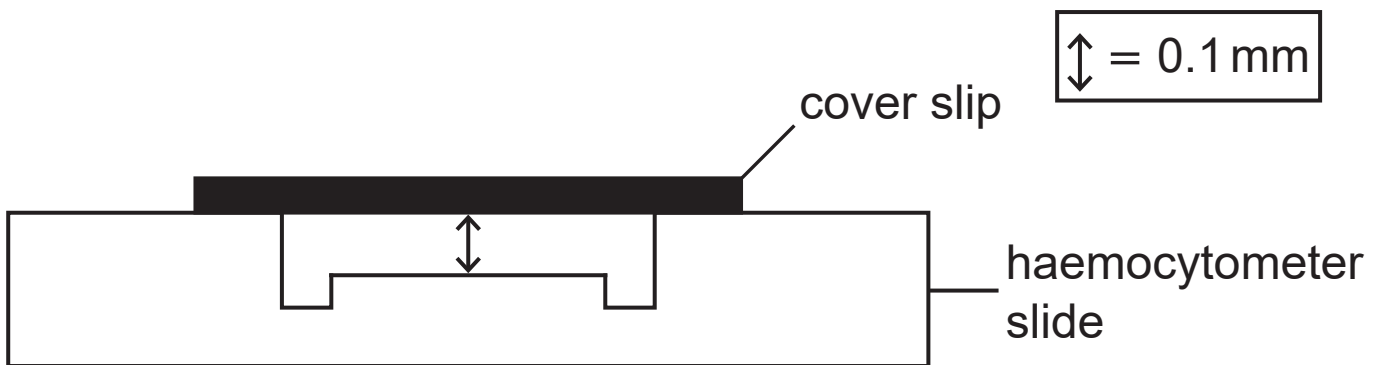
(c) This investigation could have been done using two respirometers running at the same time.

Suggest the **main advantage** in using the same respirometer, and only replacing the potassium hydroxide solution with water, to complete this investigation. [2 marks]

Explain your answer.

Blank Page
(Questions continue overleaf)

- 8 The diagram below shows a side view of a haemocytometer.



- (a) Using the letter **X**, label the diagram to show the position of the counting grid. [1 mark]
- (b) In an investigation, a student (student 1) used a haemocytometer to estimate the number of yeast cells in a population in a flask. The student removed a sample of yeast from the flask and added this to a haemocytometer.

The number of yeast cells in a type-C square was counted. This was repeated for a further 19 type-C squares for this sample. The mean number of yeast cells in a type-C square was calculated as 7.4.

Type-C squares have an area of 0.0025 mm^2 .

- (i) Calculate the number of yeast cells per mm^3 .
[2 marks]

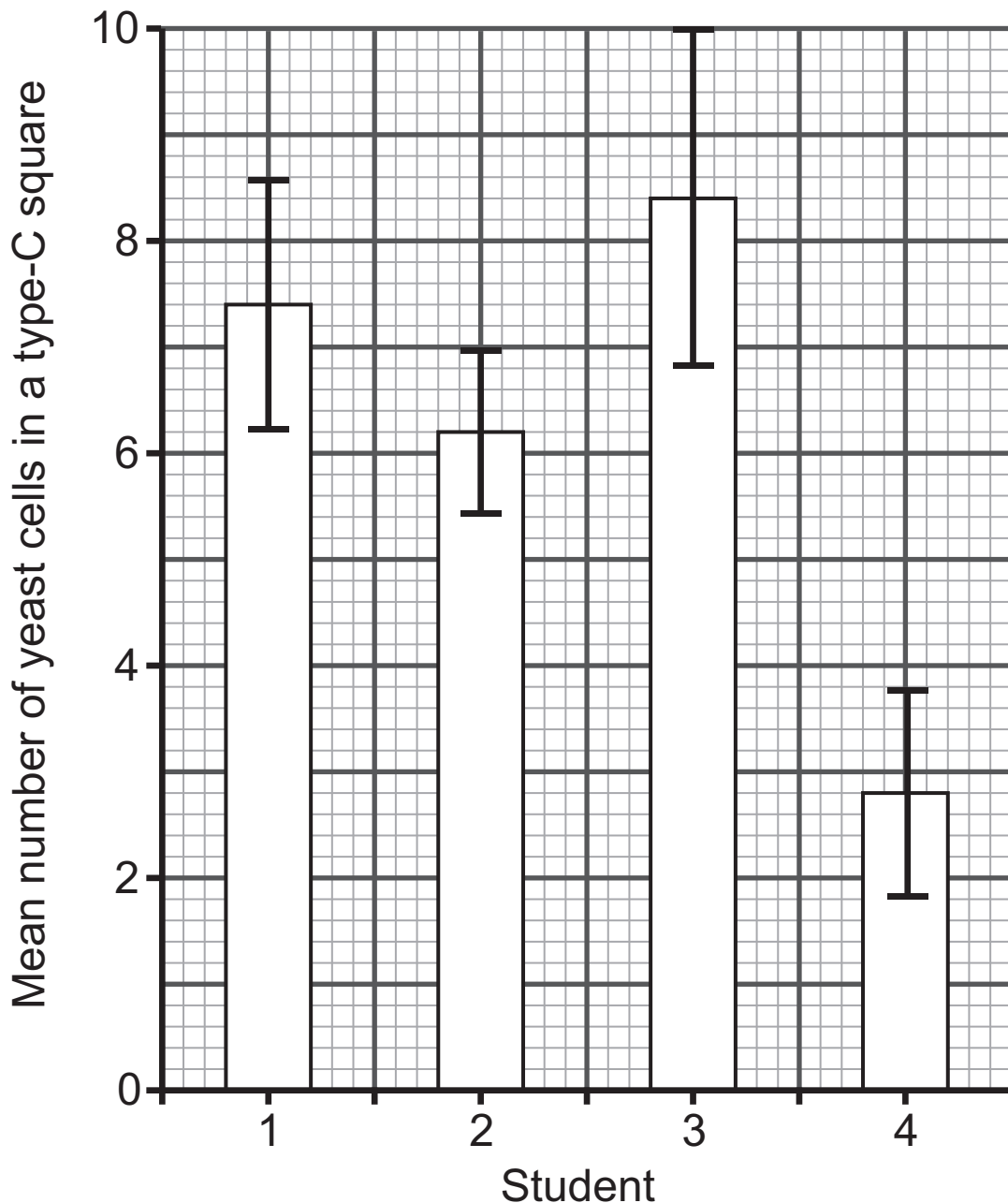
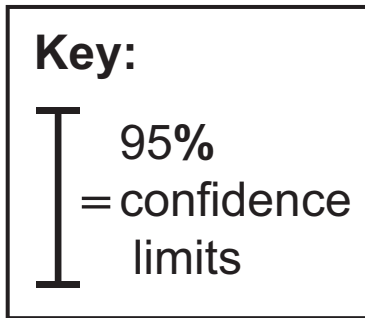
(Show your working.)

_____ mm^{-3}

- (ii) Suggest why type-C squares were used in this investigation rather than type-A or type-B squares.
[2 marks]

Explain your answer.

(c) Three other students (students 2, 3 and 4), also removed a sample from the same flask at the same time. Each of these students counted the numbers of yeast cells in 20 type-C squares. Their mean results (with 95% confidence limits) are shown in the graph below.



(i) Summarise the results. [3 marks]

(ii) Suggest an explanation for the result for student 4. [1 mark]

(d) When representing population growth of yeast in a graph, it may be appropriate to use graph paper with a logarithmic (log) scale on the y-axis.

Suggest a reason for this. [1 mark]

This is the end of the question paper

SOURCES

Q1 © Chief Examiner

Q2 © Thomas Deerinck, NCMIR / Science Photo Library

Q5(a)(i) . © Chief Examiner

Q6 © Chief Examiner

Q8 © Chief Examiner

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

Total Marks	
--------------------	--

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.