Rewarding Learning

ADVANCED
General Certificate of Education
2024

Centre Number

Candidate Number

Biology

Assessment Unit A2 3
assessing
Practical Skills in Biology

[ABY31]

ABY31

WEDNESDAY 19 JUNE, MORNING

TIME

1 hour 15 minutes.

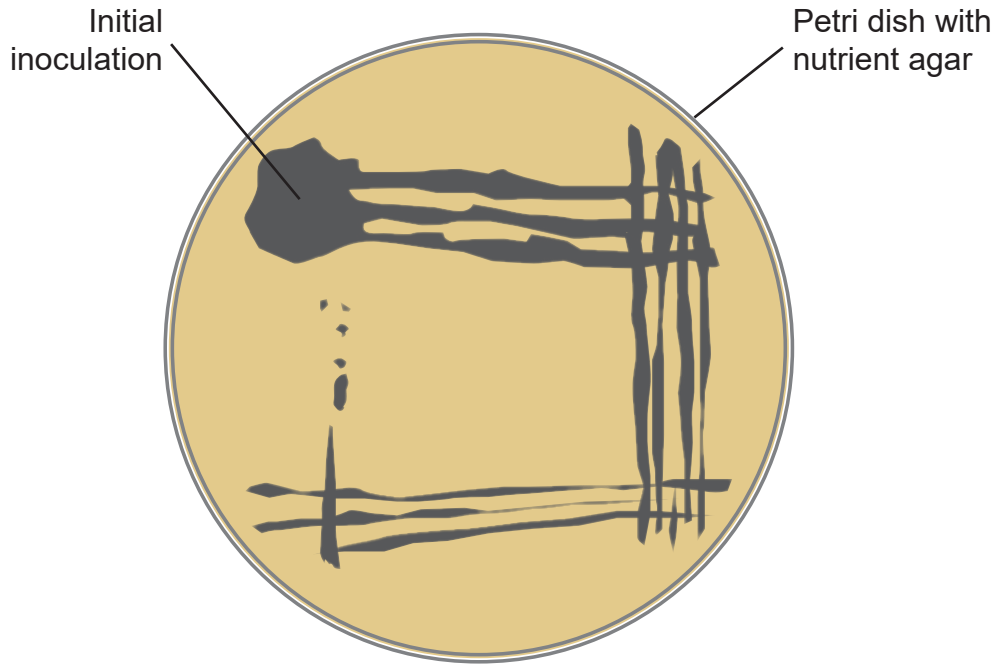
INSTRUCTIONS TO CANDIDATES

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 outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.
Figures in brackets printed down the right-hand side of pages 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.



Source: Chief Examiner

(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]

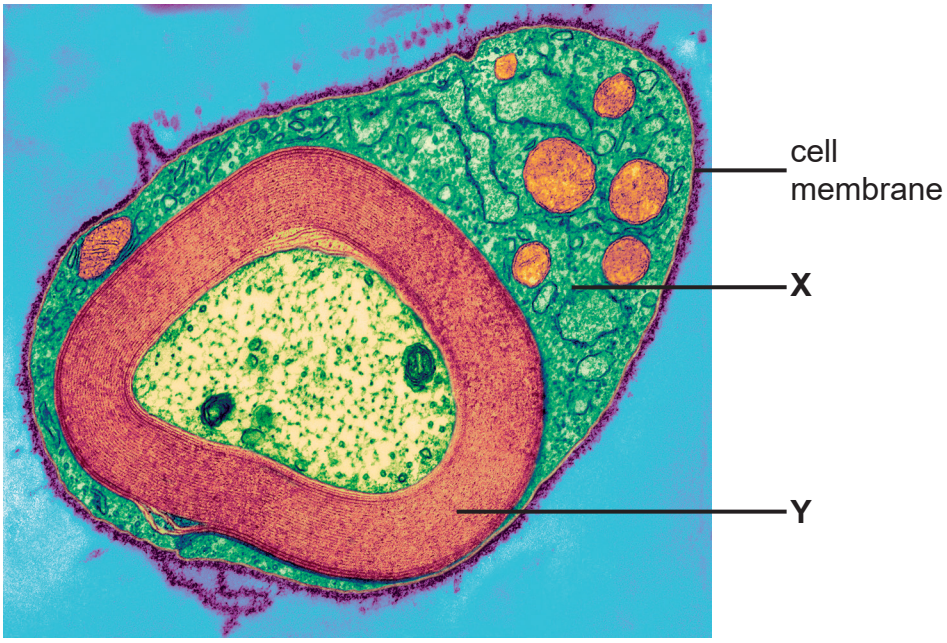
(b) State **one** reason for producing a streak plate.

_____

_____ [1]

[Turn over

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



Source: © Thomas Deerinck, NCMIR / Science Photo Library

(a) (i) Identify cell **X** and structure **Y**.

X _____

Y _____ [2]

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

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

_____

_____

_____ [2]

(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]

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

_____

_____

_____ [1]

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

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

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.

[2]

(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]

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

_____

_____

_____

_____

_____ [2]

(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]

(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]

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]

(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]

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

_____ [1]

[Turn over

(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]

(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.

Explain your answer.

_____

_____

_____

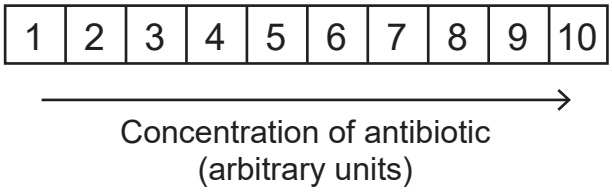
_____

_____ [2]

[Turn over

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.

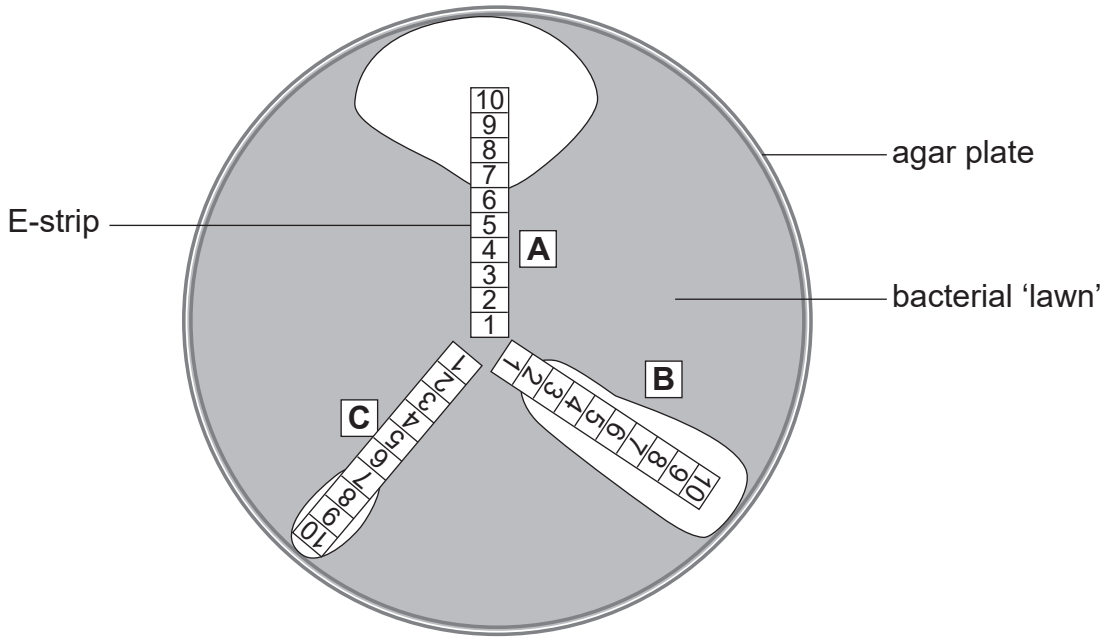
(i) Name the piece of equipment used to create a bacterial 'lawn' over the surface of the agar.

_____ [1]

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 below.



Source: Chief Examiner

(ii) Describe the results shown.

[3]

(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]

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

[1]

[Turn over

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

1. _____

_____

2. _____

_____

3. _____

_____ [3]

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

Suggest **one** function of a bibliography.

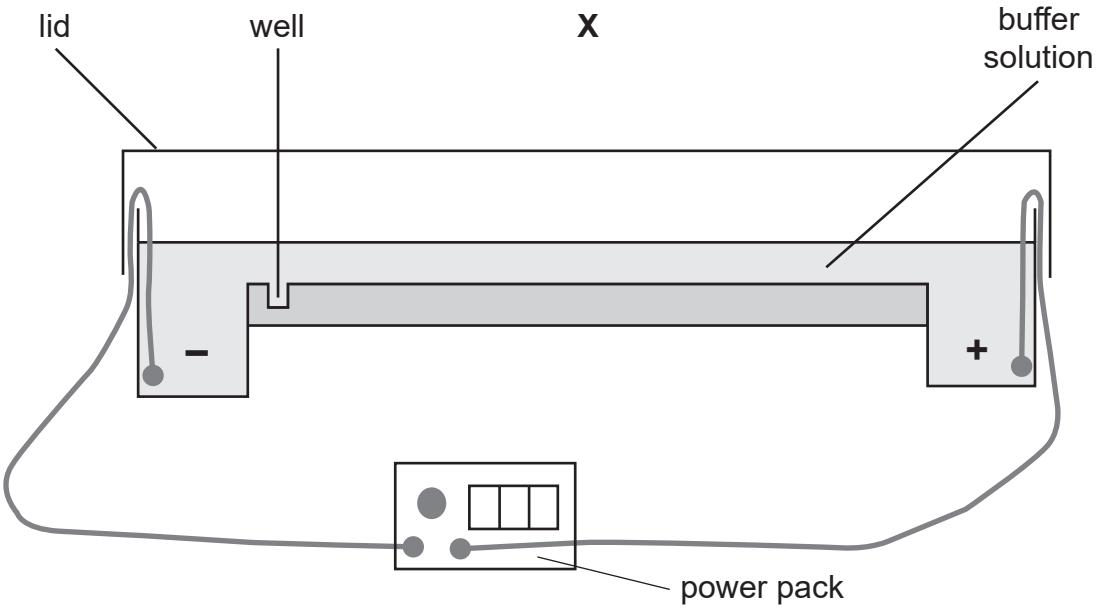
_____

_____

_____ [1]

6 Gel electrophoresis is a process which separates DNA fragments.

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



Source: Chief Examiner

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

(ii) Suggest **one** function of the lid in the gel electrophoresis system.

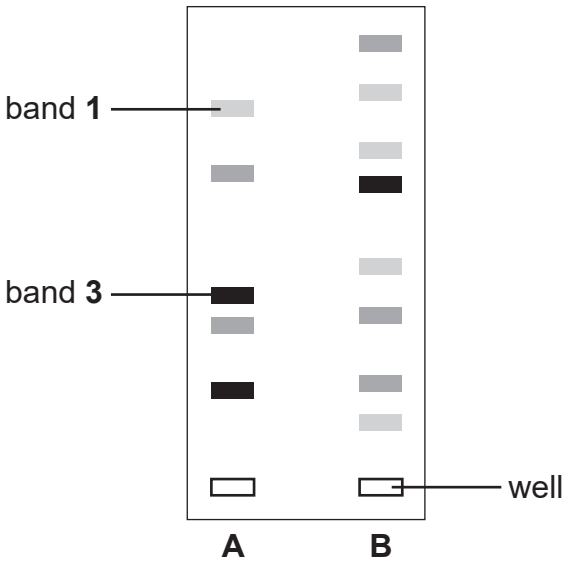
_____

_____ [1]

[Turn over

(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.

position _____

_____

degree of staining _____

_____ [2]

(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]

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.

_____

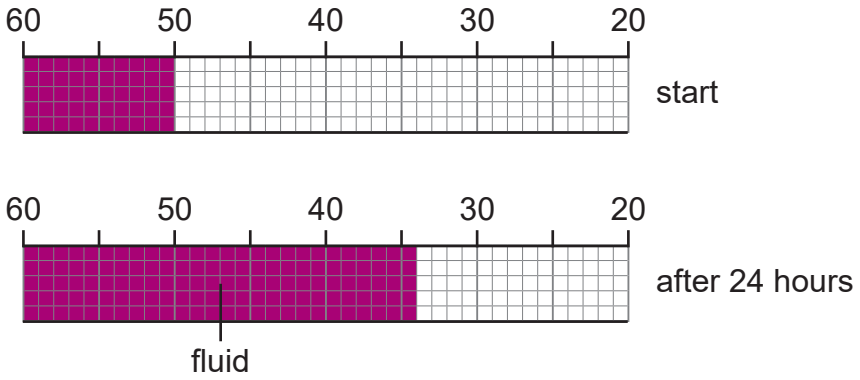
_____

_____ [1]

(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



(scale in cm^3)

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

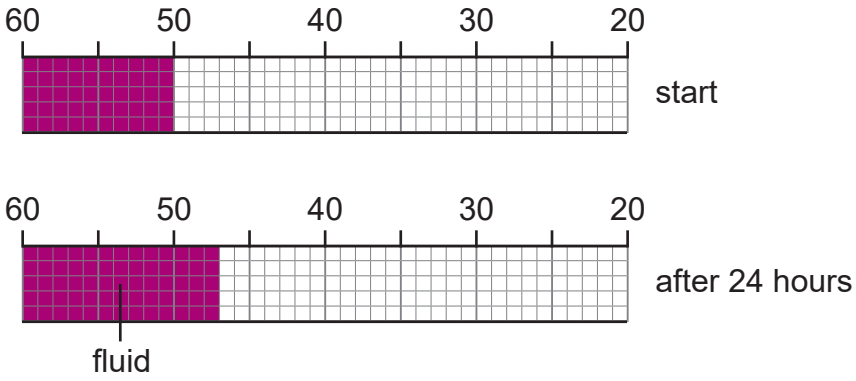
_____ cm^3 [1]

[Turn over

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



(scale in cm^3)

(ii) Calculate the RQ value for the maggots.

(Show your working.)

_____ [2]

(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.

Explain your answer.

_____

_____

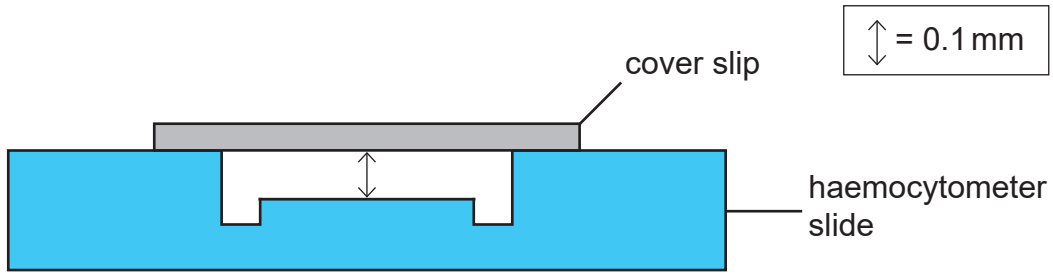
_____

_____

_____ [2]

[Turn over

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



Source: Chief Examiner

(a) Using the letter **X**, label the diagram to show the position of the counting grid. [1]

(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.

(Show your working.)

_____ mm^{-3} [2]

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

Explain your answer.

_____

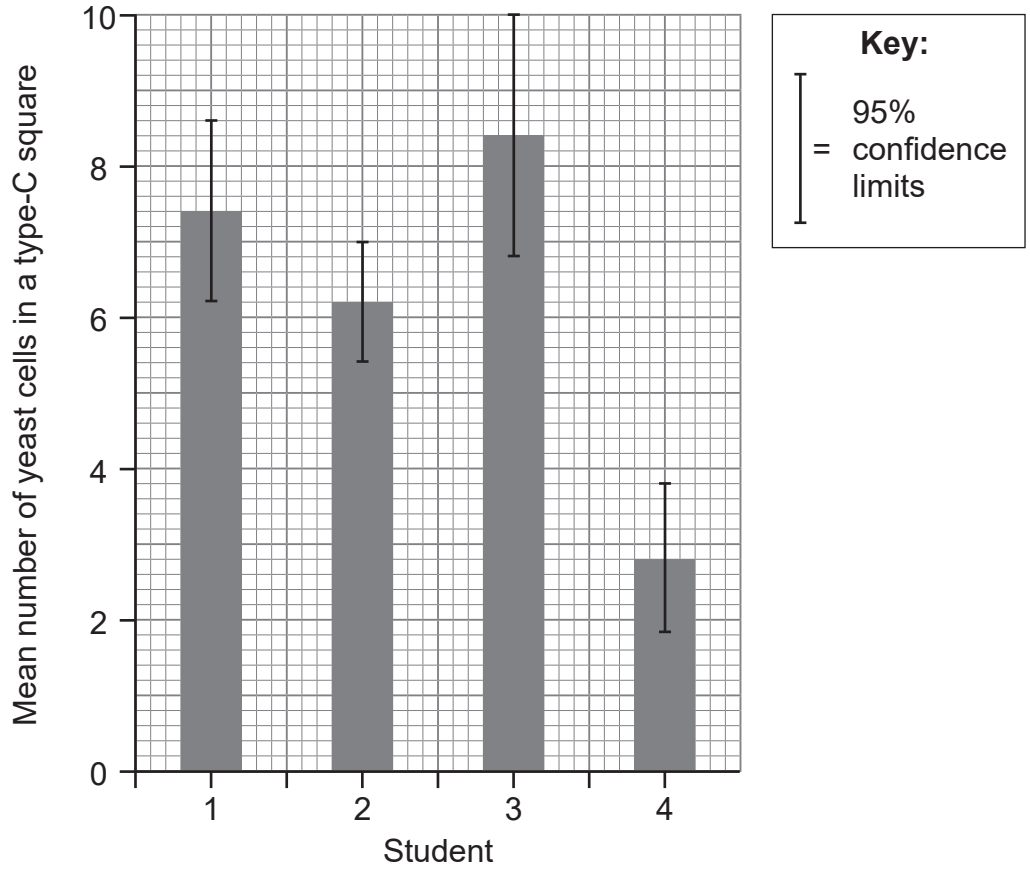
_____

_____

_____ [2]

[Turn over

(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]

(ii) Suggest an explanation for the result for student **4**.

_____

_____

_____ [1]

(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]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

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

Examiner Number