Rewarding Learning

ADVANCED
General Certificate of Education
2019

Centre Number

Candidate Number

Biology

Assessment Unit A2 3
assessing
Practical Skills in Biology

[ABY31]

ABY31

TUESDAY 7 MAY, MORNING

TIME

1 hour 15 minutes.

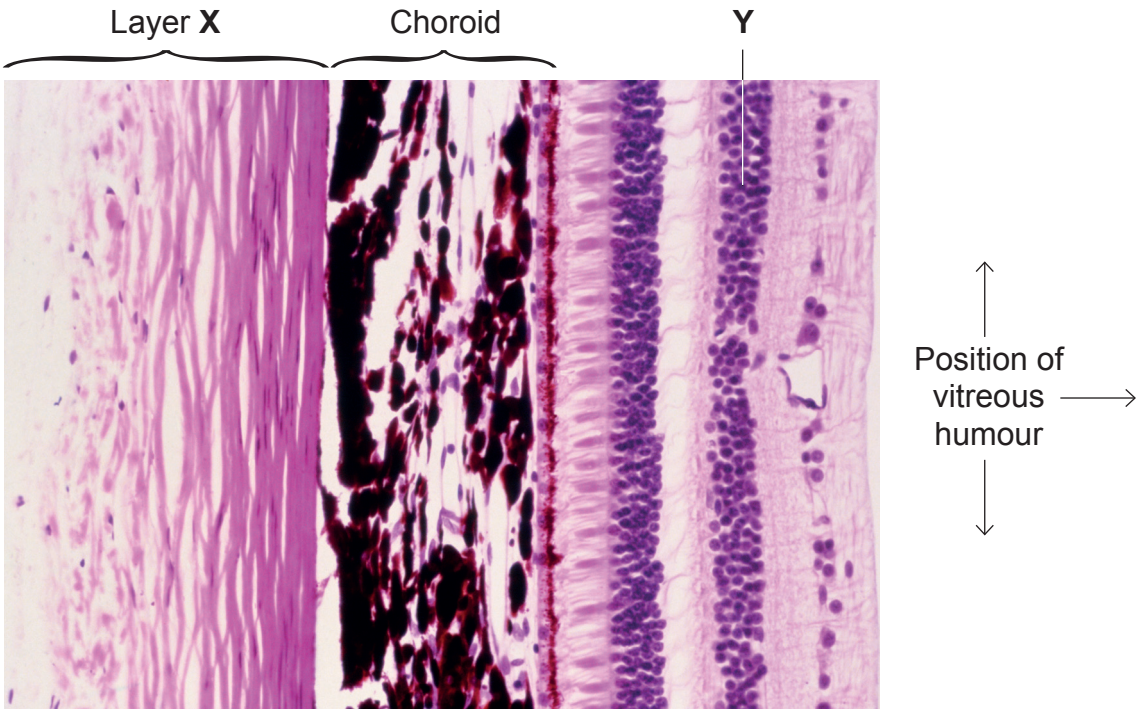
INSTRUCTIONS TO CANDIDATES

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.
Statistics Sheets are provided for use with this paper.
You are reminded of the need for good English and clear presentation in your answers.
Use accurate scientific terminology in all answers.

1 The micrograph below shows a section through the wall of the mammalian eye.



Magnification × 100

(a) Identify the layer labelled **X**.

_____ [1]

(b) Describe a function of the choroid. Suggest the importance of this function.

_____

_____

_____

_____ [2]

(c) Identify precisely the darkly-stained, round structures labelled **Y**.

_____

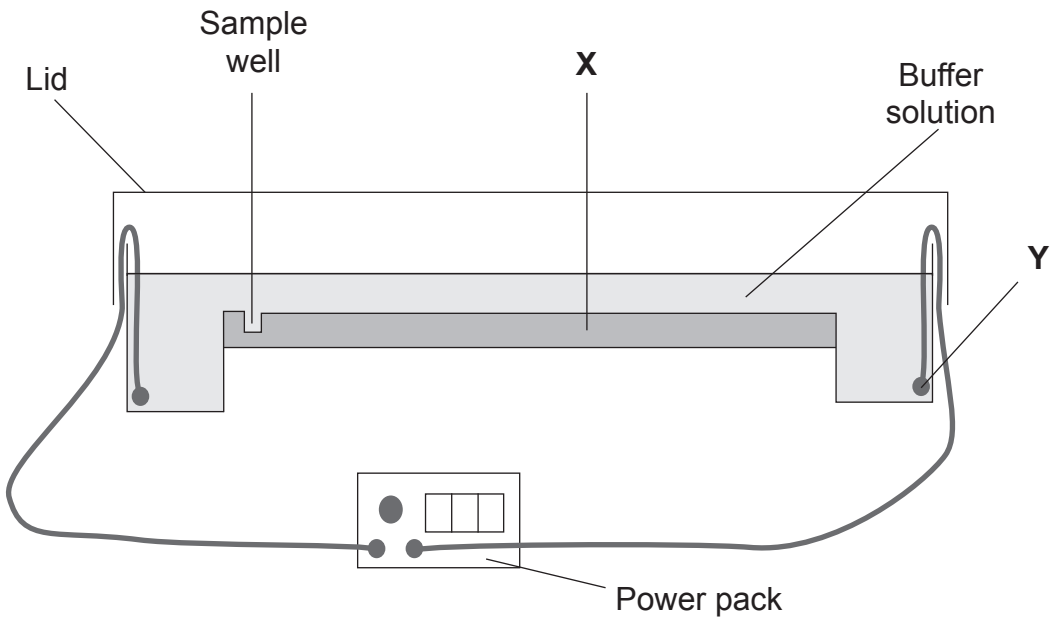
_____ [1]

(d) On the micrograph, label with the letter **Z** the region where light-sensitive **pigments** (rhodopsin/iodopsin) would be found. [1]

(e) Using the information provided, identify the type of microscope used to produce this image.

_____ [1]

2 The diagram below represents the side view of a gel electrophoresis tank. This can be used to separate fragments of DNA.



(a) Identify **X** and **Y** in the diagram.

X _____

Y _____ [2]

(b) Describe the role of the electrical current in gel electrophoresis.

_____

_____

_____ [1]

(c) Due to the addition of a dye, fragments of DNA can be seen as bands in the gel.

(i) Explain why bands originating from the same well can occupy different positions along the 'lane' following electrophoresis.

_____

_____

_____ [1]

(ii) Some bands stain more densely than others. Suggest an explanation for this.

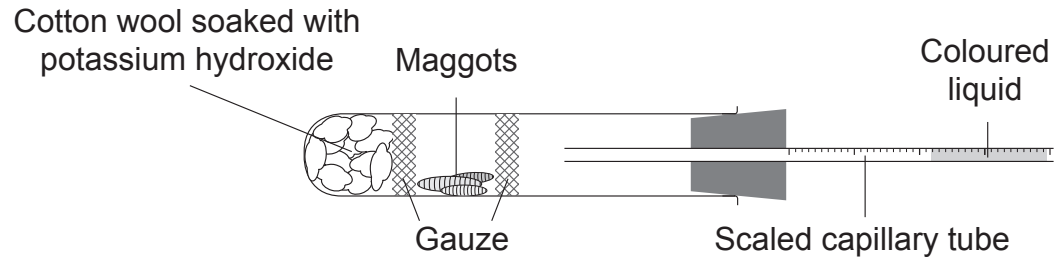
_____

_____

_____ [1]

[Turn over

3 The apparatus shown below is a simple respirometer. Potassium hydroxide absorbs carbon dioxide.



(a) Describe how this apparatus could be used to calculate the RQ value of these maggots.

[5]

(b) Maggots are often used in this type of investigation due to their high rate of respiration. Suggest **one** advantage of using several maggots, rather than a single maggot, in this type of investigation.

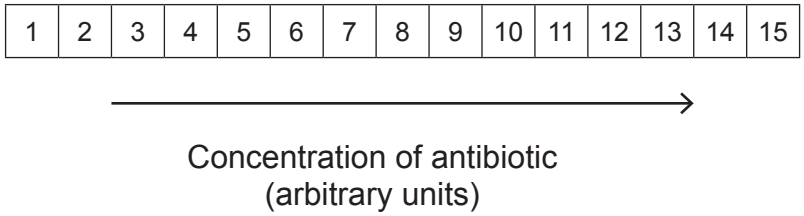
_____

_____

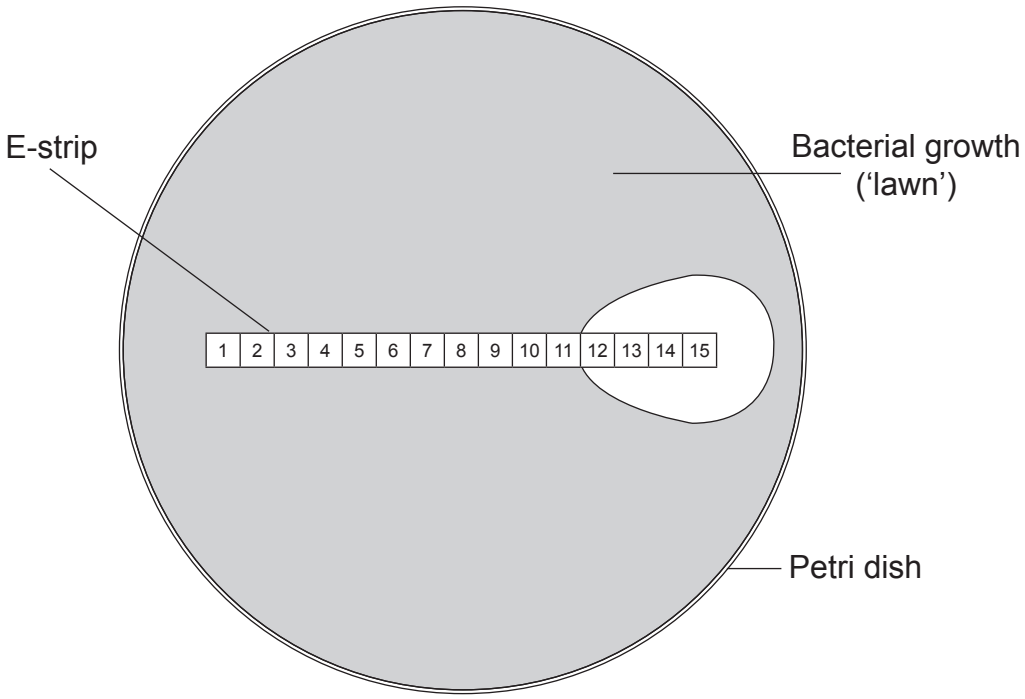
_____ [1]

[Turn over

4 The effect of antibiotic concentration on bacterial growth can be investigated using an E-strip. This is an inert strip of plastic, coated with antibiotic. The concentration of the antibiotic increases along the E-strip, as shown below.



The diagram below shows the result of an E-strip on bacterial growth.



(a) Describe and explain the results shown.

[3]

(b) A more traditional technique involves using paper discs soaked in different concentrations of antibiotic. Suggest **one** advantage of using E-strips rather than the disc technique to determine the minimum antibiotic concentration required to be effective against a particular species of bacteria.

[1]

[Turn over

5 Paper chromatography can be used to separate and identify the main photosynthetic pigments present in leaves. The process can be divided into three main stages:

1 preparing the chromatogram
2 running the chromatogram
3 calculating R_f values

(a) Identify the stage during which photosynthetic pigments separate.

_____ [1]

(b) Describe how stages **2** and **3** are carried out.

_____

_____

_____

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_____

_____

_____

_____

_____ [5]

(c) Sycamore (*Acer pseudoplatanus*) is a common tree which loses its leaves in late autumn. A student wished to investigate if the chromatogram produced from sycamore leaves in autumn would be the same as that produced in summer.

(i) State **one** variable that ought to be controlled in this investigation.

_____

_____ [1]

(ii) Suggest how the two chromatograms might differ in appearance.

Suggest a reason for this difference.

_____

_____

_____

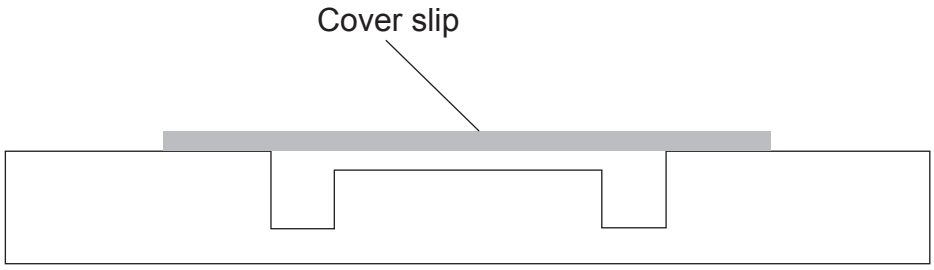
_____

_____

_____ [2]

[Turn over

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



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

(ii) When using a haemocytometer, a student noticed that some cells were lying across the grid lines. Explain how the student would ensure that these cells were not counted twice.

_____

_____ [1]

(b) A haemocytometer can be used to estimate population size in phytoplankton. These are small photosynthetic protoctistans found in the surface waters of lakes and oceans. Before counting phytoplankton, it may be necessary to dilute the sample.

(i) Explain fully why it may be necessary to dilute the sample.

_____

_____

_____

_____

_____ [2]

(ii) When diluting a sample containing phytoplankton from the ocean, a dilute saline (salt) solution is used rather than water. Explain why.

_____

_____

_____ [1]

(iii) Explain how you would dilute a sample by a factor of 100.

_____

_____

_____

_____ [1]

(c) The effect of temperature on the rate of growth of phytoplankton populations was investigated. In the laboratory, several populations were grown at different temperatures for 24 hours, and then estimates of population size were made using a haemocytometer. For a phytoplankton population grown at 20°C, a sample mean of 6.3 was obtained using type-C squares.

Type-C squares have an area of 0.0025 mm^2 and the distance between the surface of a type-C square and the overlying coverslip is 0.1 mm.

(i) Using the information provided, calculate the number of phytoplankton per mm^3 (mm^{-3}).

(Show your working.)

Answer _____ mm^{-3} [2]

[Turn over

Statistical parameters for populations grown at 25°C and 30°C are shown below.

	Temperature/°C	
	25	**30**
Number of type-C squares sampled (n)	40	40
Mean number of phytoplankton ($\bar{x}$) per type-C square	8.1	9.1
Standard deviation (error) of the mean ($\hat{\sigma}_{\bar{x}}$)	0.32	0.26

The *t*-test can be used to compare phytoplankton numbers at the two temperatures (25°C and 30°C).

(ii) State an appropriate null hypothesis for this test.

_____

_____

_____ [1]

(d) Calculate the value of *t* using data from the table above.

(Show your working.)

Answer _____ [2]

(e) Using the Statistics Sheets provided, state the probability for the calculated *t* value.

_____ [1]

(f) State your decision regarding the null hypothesis and give an appropriate conclusion for this investigation.

_____

_____

_____

_____

_____

_____ [2]

7 **(a)** During cellular respiration, molecules are oxidised during a number of stages as a consequence of hydrogen atoms being removed. NAD and FAD act as hydrogen acceptors. In experiments, methylene blue can also be used as a hydrogen acceptor, changing from blue to colourless as it becomes reduced.

In an investigation into the effect of temperature on the rate of redox reactions, three boiling tubes were set up containing ground-up soaked peas and dilute methylene blue. One boiling tube is shown below.

Each boiling tube was placed in a water bath at a different temperature: 20°C, 40°C and 60°C.

(i) Describe the dependent variable for this investigation.

_____

_____

_____ [2]

(ii) This investigation was carried out in a school laboratory during a one-hour practical lesson. Using the information provided, identify **two** aspects of the experimental design which helped to ensure results are obtained in this short time period.

1. _____

2. _____ [2]

[Turn over

(iii) Describe and explain the results you would expect in this investigation.

[4]

(b) Redox reactions can also be investigated during the process of photosynthesis. In one method, leaf material is homogenised and then centrifuged to obtain isolated chloroplasts.

(i) Describe how the leaf material could be homogenised.

_____

_____

_____ [1]

(ii) Explain why it is important to obtain isolated chloroplasts rather than using homogenised leaf tissue in this investigation.

_____

_____

_____

_____

_____

_____ [2]

[Turn over

8 In A-level Biology practical investigations, it is possible to show that many plants produce antimicrobial substances that can destroy or limit the growth of bacteria and fungi.

A possible role of these substances in plants can be summarised by the following quotation: "The function of these antibacterial substances may be to prevent or limit entry into the plant tissues where bacteria may find conditions suitable for growth." This is taken from page 23 in Malcolm Knowles' book entitled *Projects in Biology*, published in 1988 by Basil Blackwell.

However, antimicrobial substances can also be produced by microbes themselves. *The Microbes Fight Back* was published by The Royal Society of Chemistry in 2017 and written by Laura Bowater. Page 184 states that "The *Streptomyces* create a chemical weapon that can destroy this fungal microbe", when referring to *Streptomyces* bacteria being able to inhibit growth of a fungus from the *Escovopsis* genus.

Indeed, bacteria can even produce substances that destroy other bacteria, as well as fungi. *Streptomyces* (the source of the antibiotic streptomycin) is very effective in destroying other bacteria. "*Streptomyces*, that live in the soil and are amazingly prolific when it comes to producing antibiotics...", is taken from page 73, *Understanding Microbes – An Introduction to a Small World* by Jeremy W Dale, published by Wiley-Blackwell in 2013.

(a) Based on the information provided, suggest and explain where high concentrations of antimicrobial substances would be found in a plant.

_____

_____

_____

_____

_____

_____ [2]

(b) Write a bibliography for the three books referenced in the passage.

[3]

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For Examiner's use only	
Question Number	Marks
1	
2	
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8	
Total Marks	

Examiner Number