Rewarding Learning

ADVANCED
General Certificate of Education
2022

Centre Number

Candidate Number

Biology

Assessment Unit A2 3
assessing
Practical Skills in Biology

[ABY31]

ABY31

FRIDAY 24 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.

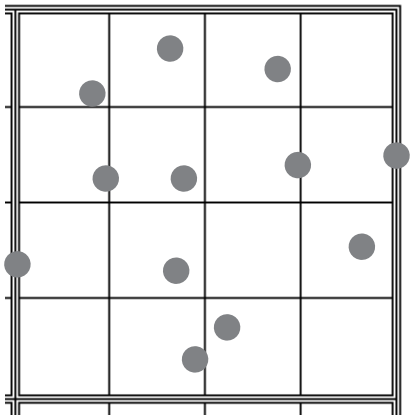
13143

28ABY3101

1 **(a)** The size of a yeast population in a culture can be influenced by numerous factors, including temperature. Several cultures of yeast were set up, each at a different temperature. The numbers of yeast cells were estimated using a haemocytometer, and one sample is represented by the diagram below.

The distance between the surface of the haemocytometer and the overlying coverslip was 0.1 mm.

Type-B square (side 0.2 mm)



(i) Using the type-B square shown above, calculate the number of yeast cells per mm^3.

(Show your working.)

_____ cells mm^{-3} [3]

(ii) Some yeast cells may be found at slightly different depths within a sample.

Suggest how a student could ensure that all the yeast cells within a sample on a haemocytometer would be visible for counting when viewed at high power.

_____

_____ [1]

(b) Identify **two** factors, other than temperature, which could influence the size of the yeast population in this investigation.

1. _____

2. _____ [2]

2 The pigments present in the leaves of the Common Nettle (*Urtica dioica*) were investigated using chromatography, as outlined in the procedure below:

1. Several fresh nettle leaves were finely cut and placed in a mortar with a pinch of sand and 1 cm^3 of solvent.

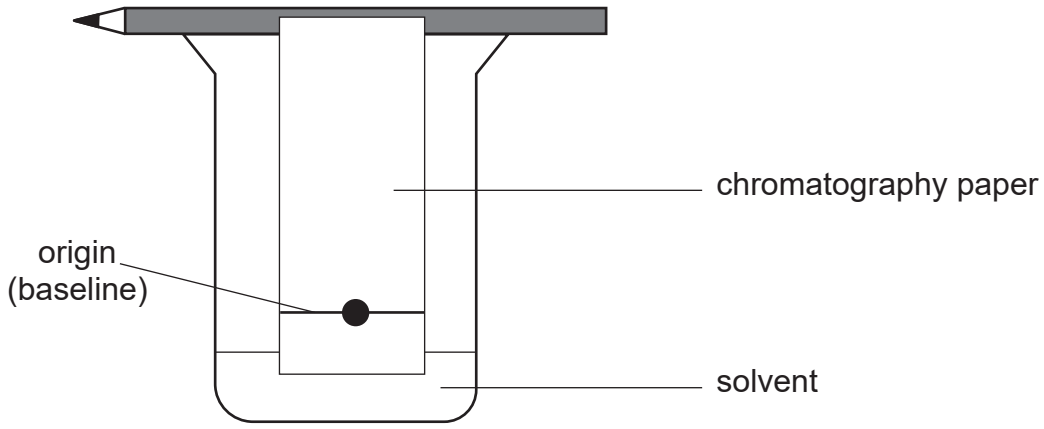
2. The mixture was ground with a pestle for three minutes.

3. An origin line was drawn, in pencil, 3 cm from the base of a strip of chromatography paper.

4. A fine glass tube was used to form a spot of the leaf extract on the centre of the line.

5. The spot was dried, and five further spots were added on top of it; each spot being dried before the next spot was added.

6. The top of the paper was taped to a pencil and lowered into a beaker containing solvent, making sure that the origin was above the solvent level as shown below.



7. The paper was left in place for several hours, until the solvent had almost reached the top.

8. The paper was removed from the beaker and the position of the solvent front was marked immediately.

(a) Explain the following:

- in step 3, the origin line was drawn with pencil

_____

_____

- in step 5, the spot was dried between each successive additional spot

_____

_____

- in step 6, the origin was above the level of the solvent

_____

_____

- in step 8, the solvent front was marked as soon as the paper had been removed.

_____

_____ [4]

(b) Chromatography is often carried out in a sealed container, so that the solvent vapours saturate the container causing the solvent to rise further up the paper.

Suggest **one** other reason for carrying out chromatography in a sealed container.

_____

_____ [1]

(c) Three distinct coloured spots were evident in the chromatogram produced from the nettle leaves. These are recorded in the table below, along with the R_f values which were calculated for each spot.

Colour	**R_f value**
Blue-green	0.28
Green	0.21
Yellow	0.09

(i) In addition to measuring the distance from the origin to the solvent front, state the other measurement required to calculate an R_f value.

_____

_____ [1]

(ii) Determine the colour of the spot which was closest to the origin.

_____ [1]

(iii) State what can be concluded about the pigment which is found closest to the origin.

_____

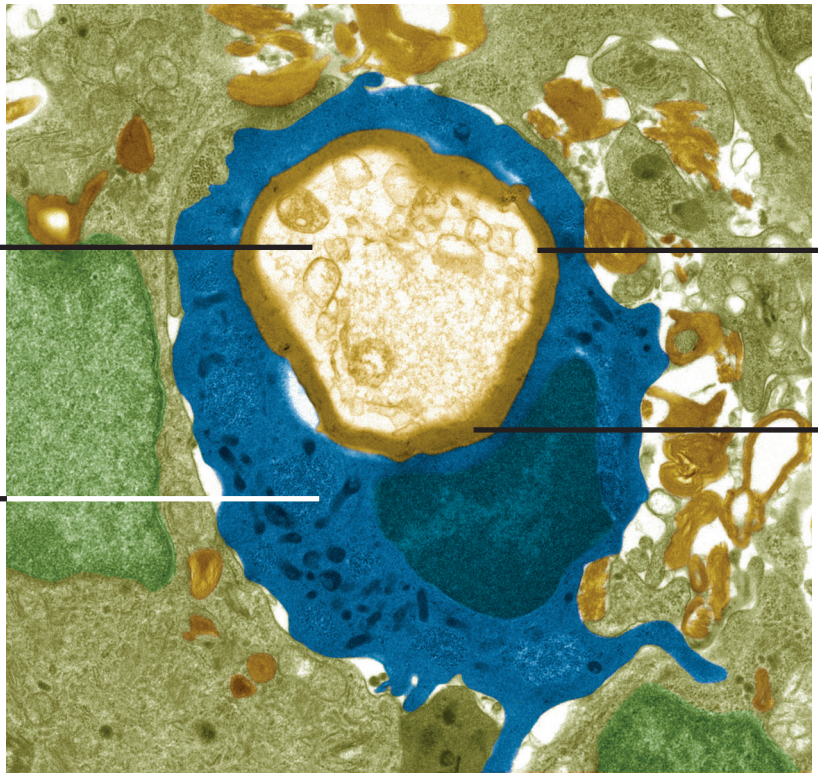
_____ [1]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

3 **(a)** Some types of white blood cell can engulf body cells by phagocytosis. The micrograph below shows a phagocyte which has engulfed a damaged neurone in the human body. The image has been artificially colour-enhanced to show the phagocyte in blue.



Magnification ×6000

© Steve Gschmeissner / Science Photo Library

Structure **X** is found on the outside of the neurone cell membrane as shown.

(i) Identify structure **X**.

_____ [1]

(ii) Identify precisely the type of microscope which was used to obtain this image.

_____ [1]

(b) Structure **X** in the micrograph is much thinner on damaged neurones than on undamaged neurones. One way in which such damage can occur is as a result of the medical condition multiple sclerosis (MS).

The speed of nerve impulses in five undamaged neurones and five neurones damaged by MS was recorded as shown in the table below.

Neurone number	**Speed of nerve impulse / ms^{-1}**	
	Undamaged neurones	**Damaged neurones**
1	38	12
2	20	2
3	42	15
4	42	14
5	38	3
Median	**38**	

(i) Complete the table by determining the **median** speed of the nerve impulse in damaged neurones. [1]

(ii) Suggest why the median was used to compare the effect of the damage, rather than the mean.

_____

_____ [1]

(iii) The values in the table were obtained at 20°C. Suggest and explain how the speed of nerve impulses in the **undamaged** neurones would be affected if a temperature of 30°C was maintained during the investigation.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

4 **(a)** With reference to aseptic techniques, outline a procedure which could be used to produce a 'lawn' of the bacterium *Staphylococcus aureus*, given a culture of *S. aureus* in nutrient broth, a Petri dish containing sterile nutrient agar and access to normal laboratory apparatus.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

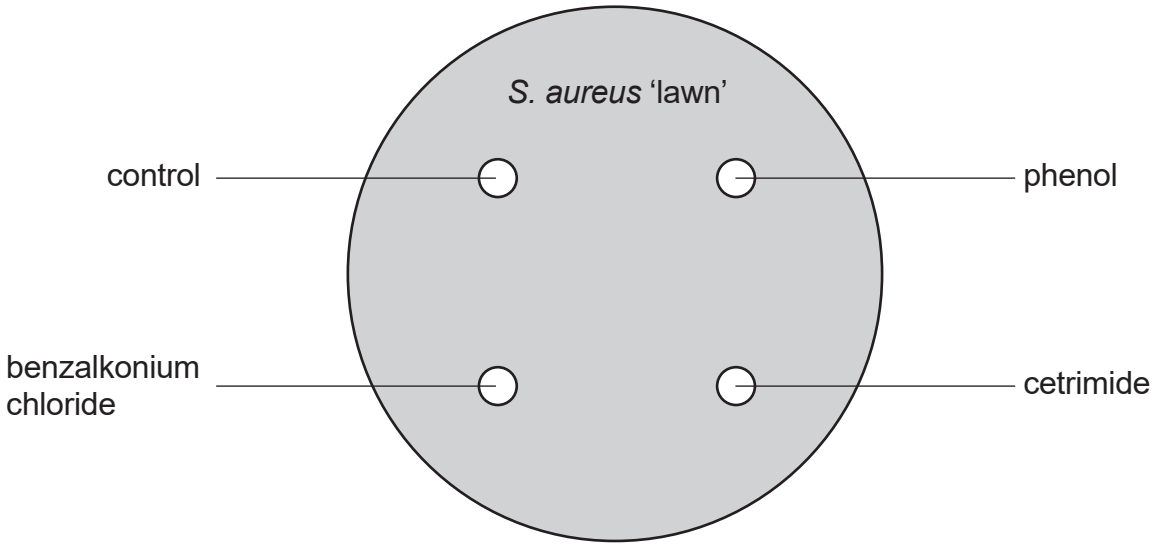
_____

_____ [5]

In order to clean minor skin wounds, creams can be used to kill microbes which could potentially enter the body and cause an infection. There are several types of antimicrobial ingredients in such creams, including benzalkonium chloride, phenol and cetrimide.

Discs of filter paper of diameter 5 mm were soaked in 1% solutions of each of these substances and placed on a 'lawn' culture of *S. aureus* growing on nutrient agar. A control disc was also included in the investigation.

Ten Petri dishes were set up. An example is shown below.



(b) Suggest a suitable substance in which the control disc could be soaked.

_____ [1]

(c) This investigation was carried out in a specialised microbiology laboratory. The Petri dishes were incubated at 37°C for 48 hours.

(i) Explain why this incubation temperature is not normally used in a school laboratory.

_____

_____ [1]

(ii) Explain why the microbiologists considered this temperature suitable for this investigation.

_____

_____ [1]

(iii) Describe **one** method of preventing accidental release of *S. aureus*:

- during the incubation

_____

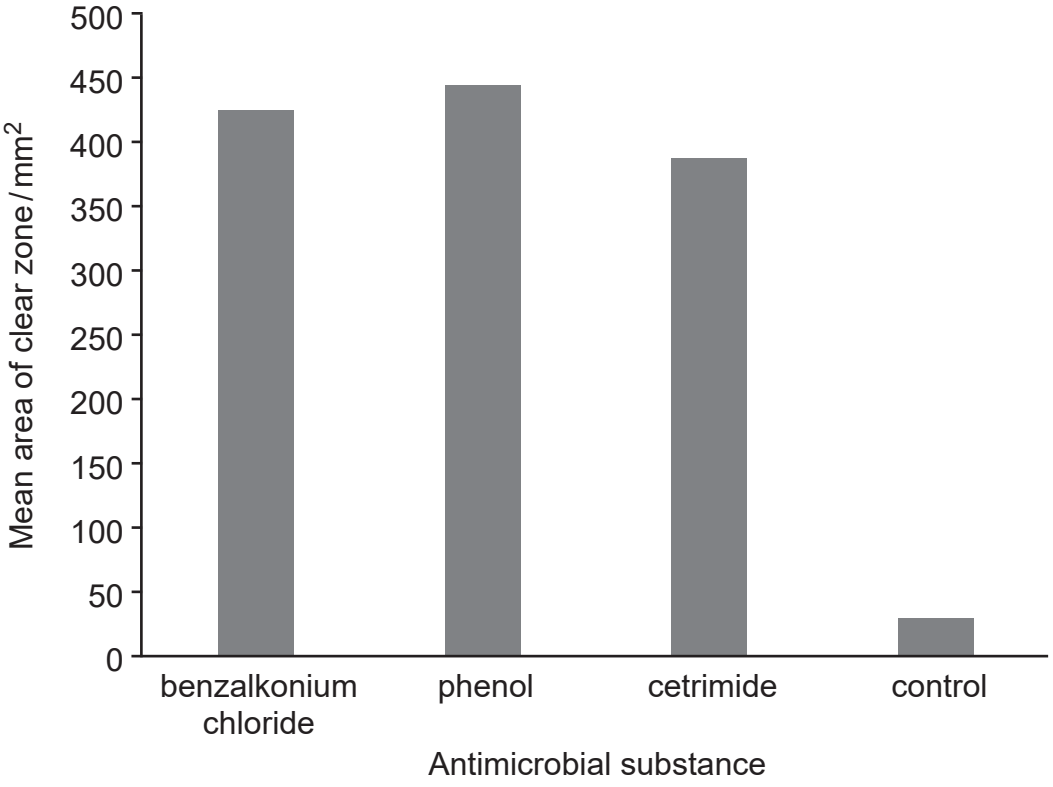
_____ [1]

- after the investigation.

_____

_____ [1]

(d) Following incubation, the clear area around each disc was measured and the mean values were plotted, as shown below.



(i) Suggest a suitable caption for the graph.

_____

_____

_____ [2]

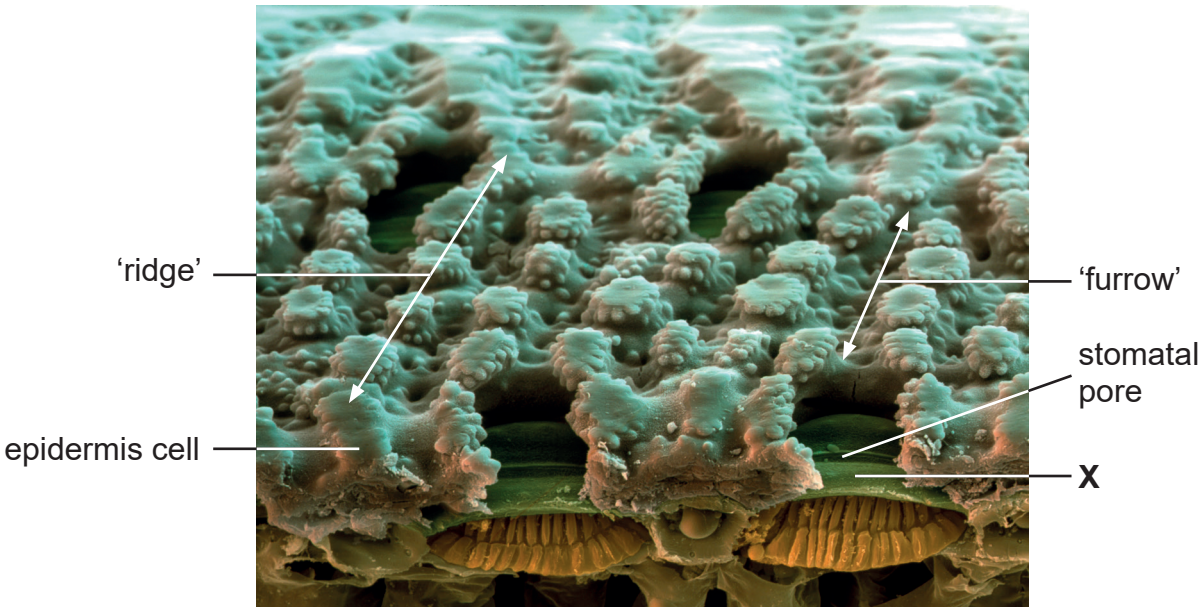
(ii) From the graph it appears that phenol is the most effective substance in preventing growth of *S. aureus*.

Identify **one** statistical analysis which could be undertaken to determine if the mean value for phenol is significantly different from the means of the other two antimicrobial substances.

_____ [1]

[Turn over

5 **(a)** The micrograph below shows tissue layers in part of the stem of Southern Giant Horsetail (*Equisetum giganteum*). This plant shares many features with ferns and is therefore classified in the same taxonomic group.



Magnification × 600

© Eye of Science / Science Photo Library

(i) Identify the type of cell labelled **X** which surrounds a stomatal pore.

_____ [1]

(ii) As can be seen in the micrograph, the epidermal cells of *E. giganteum* are highly specialised and organised into a series of 'ridges' and 'furrows' on the external surface of the stem. Comment on the position of the stomata in relation to the epidermis and suggest an explanation for this positioning.

_____

_____

_____

_____

_____

_____

_____

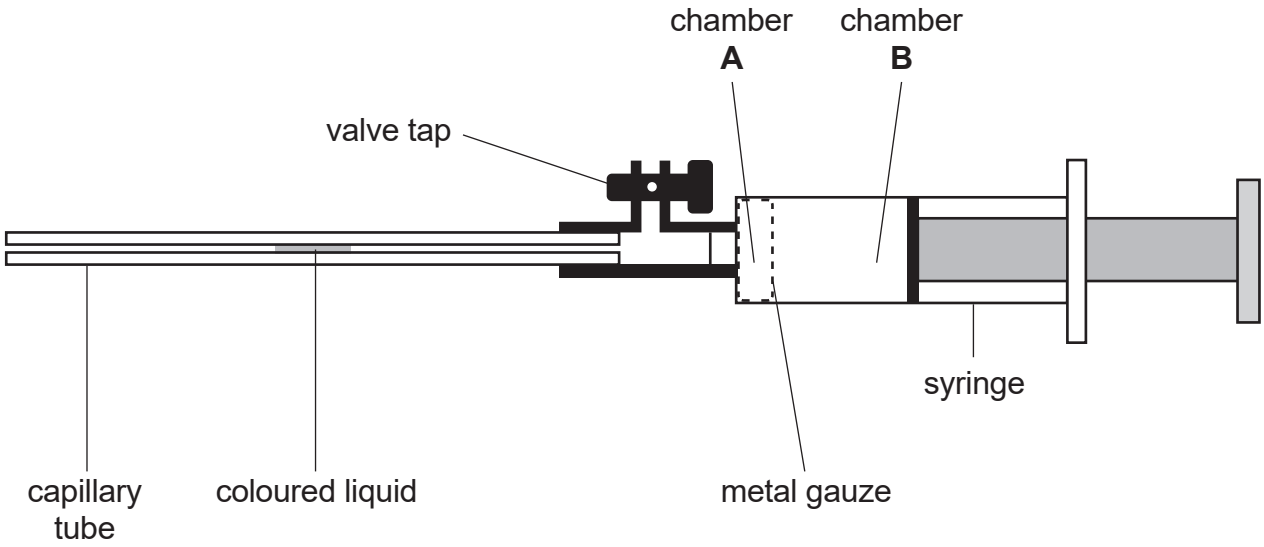
_____ [3]

(b) Identify the organ on which these cells (**X**) would usually be found.

_____ [1]

6 A respirometer can be used to determine the respiratory quotient (RQ) value for small invertebrates such as mealworms.

The apparatus below shows a simple respirometer.



Ten mealworms were placed in chamber **B**. In order to measure the consumption of oxygen by the mealworms, solid soda lime was added to chamber **A**. The coloured liquid was drawn into the capillary tube, by pulling back the syringe.

(a) Explain why soda lime was added to chamber **A**.

_____

_____ [1]

(b) **(i)** After placing the mealworms in chamber **B**, it is recommended that there is a 10-minute interval before readings are recorded. Explain the reason for this.

_____

_____

_____ [1]

(ii) Describe the change which needs to be made to the apparatus before obtaining the results necessary to calculate carbon dioxide production.

_____

_____

_____ [1]

(c) With the soda lime in chamber **A**, the coloured liquid moved 8 mm to the right during the measuring period.

The calculated RQ value for the mealworms was 0.875. Determine the direction and distance moved by the coloured liquid when carbon dioxide production was being measured.

(Show your working.)

Distance moved _____ mm

Direction of movement _____ [3]

(d) Identify **two** variables which should have been controlled in this experiment.

1. _____

2. _____ [2]

7 **(a)** When carrying out a dissection, some principles are similar regardless of the specimen being dissected.

For a dissection procedure with which you are familiar, describe:

- how the specimen is supported or placed in position
- the apparatus used
- how to observe the structures clearly.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(b) Computers can be used to carry out 'virtual dissections'. In this, students perform the steps of the dissection using software which uses images of the biological material.

In a study in the USA, it was found that students who carried out a virtual dissection scored higher in a subsequent test than those who had carried out a traditional dissection.

Suggest **two** other advantages of a virtual dissection compared to a traditional dissection.

1. _____

_____

_____

2. _____

_____

_____ [2]

8 The following extract is adapted from a government document providing advice for landowners concerning algal blooms.

Algae occur naturally in inland waters such as rivers, streams and lakes. When conditions are ideal for growth, an algal bloom can occur. During a bloom, the water becomes less clear and may look green or blue-green. Scums can form during calm weather when several bloom-forming species rise to the surface.

Algae can produce toxins. These toxins can kill wild animals, livestock and pets. They can also harm people, producing rashes after skin contact and illnesses if swallowed.

Algal blooms block sunlight from reaching plants in the water and they use up oxygen in the water at night. Oxygen is also used up when the bloom decays, leading to a decrease in oxygen which can suffocate fish and other animals.

Algal blooms are natural features of some waters. Increasing shade and reducing nutrients in the water can control algae. Your local Environment Agency Officer can advise you on prevention, control and long-term management.

Source: Guidance: Algal blooms: advice for the public and landowners Published by Environment Agency 31 January 2017 © Crown Copyright Contains public sector information licensed under the Open Government Licence v3.0.

(a) Using the information provided, identify **one** way in which algal blooms may be controlled and use your knowledge to explain why this control method is effective.

_____

_____

_____

_____ [2]

(b) The effects of algae in a lake can be analysed by monitoring abiotic factors. Using the information in the passage, identify **one** such factor and describe precisely how an algal bloom would affect this factor.

Abiotic factor _____

Effect of algal bloom _____

_____

_____ [2]

(c) The abundance of algae in a freshwater lake can be monitored by taking a water sample and using a colorimeter to measure transmission of light through the sample.

(i) Explain why a red filter would be used in the colorimeter.

_____

_____ [1]

An Environment Agency Officer monitored a lake which was prone to experiencing algal blooms. Water samples were taken over several months, and % transmission through the sample for each date is shown in the table below.

Sample date	% transmission
13th March	94
24th April	89
10th July	65
14th August	62
11th September	57
23rd October	79

(ii) Assuming that % transmission values reflect the abundance of algae, describe how the abundance of algae changed over the sample period and suggest which sample date may indicate the most severe algal bloom that year.

_____

_____

_____

_____ [2]

(iii) Suggest **one** precaution which must be taken during the sampling procedure to ensure that the results are valid.

_____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

BLANK PAGE

DO NOT WRITE ON THIS PAGE

BLANK PAGE

DO NOT WRITE ON THIS PAGE

BLANK PAGE

DO NOT WRITE ON THIS PAGE

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

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.