Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

9766553958 59

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2021**

1 hour 15 minutes

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 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.

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1 **(a)** Students at a college often took a shortcut between the library and the tennis courts across an area of open land. The area of open land was covered by a large number of plants of a variety of different species. Walking over this area many times damaged the plants by trampling. As a result, a shortcut path formed across the area of open land between the library and tennis courts. This path was approximately one metre wide.

Fig. 1.1 shows a map of the area.

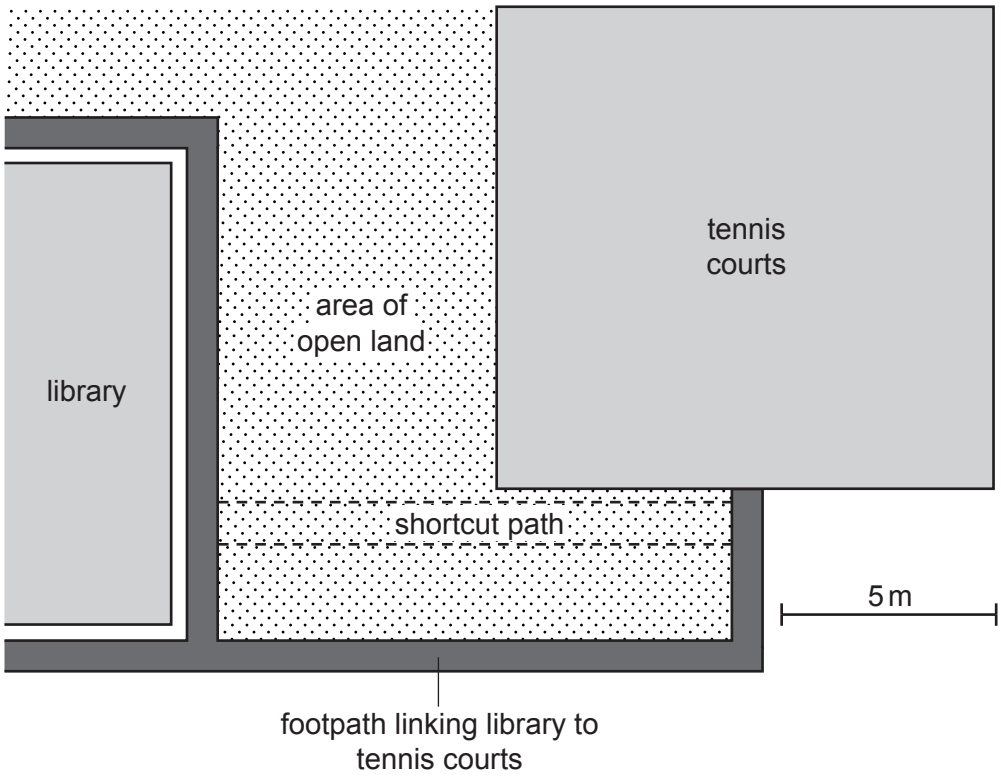


Fig. 1.1

Some students decided to investigate the effect of trampling on the biodiversity of plant species growing in the area of open land.

(i) State the data the students need to collect to assess the biodiversity of plant species.

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..... [2]

(ii) State the independent variable in this investigation.

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..... [1]

(b) Describe a method the students could use to compare the biodiversity of plant species growing in the area of untrampled open land with the biodiversity of plant species growing on the shortcut path.

Your method should be set out in a logical order and be detailed enough to let another person follow it.

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..... [8]

Question 1 continues on page 5

(c) The students compared the drainage of water through soil from the shortcut path with the drainage of water through soil from the untrampled area of open land.

The students obtained soil samples by pushing tube-shaped cutters vertically down into the soil to a depth of 10 cm. Each tube-shaped cutter had a diameter of 10 cm. When removed, a cylinder of soil 10 cm in length remained in each cutter.

Fig. 1.2 shows one of the tube-shaped cutters.

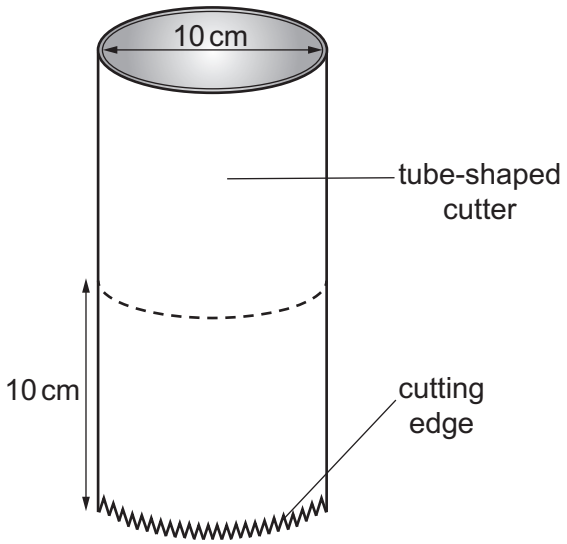


Fig. 1.2

Soil samples were collected at random from the shortcut path and from the untrampled area of open land.

The students collected ten soil samples from each of the two areas.

Drainage was measured by pouring the same volume of water into the top of each of the tubes containing soil. The time taken for 10 cm^3 of water to drain through each tube was recorded.

Table 1.1 shows the results that the students recorded.

Table 1.1

sample number	time for 10 cm^3 of water to drain through the soil / s	
	shortcut path	untrampled area
1	125	75
2	148	82
3	192	69
4	130	70
5	185	80
6	177	90
7	202	72
8	120	58
9	132	76
10	152	66
mean ± standard deviation	156.3 ± 30.3	73.8 ± 9.0

From the results shown in Table 1.1, the students concluded that:

Trampling compresses the soil, reducing the size of air spaces. This means that water drains through the soil more slowly.

(i) State **one** way that the results in Table 1.1 support the conclusion and **one** way that the results in Table 1.1 do **not** support the conclusion.

support .....

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do **not** support .....

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[2]

The students calculated the standard error (S_M) and 95% confidence intervals (95% CI) for the drainage data shown in Table 1.1. The formulae that the students used were:

$S_M = \frac{s}{\sqrt{n}}$ 95% CI = mean ± (2 × S_M)

s = standard deviation

n = sample size (number of observations)

Table 1.2 shows the calculated values for S_M and 95% CI for the data from the shortcut path.

Table 1.2

	shortcut path	untrampled area
standard error (S_M) /s	9.6	
95% confidence intervals (95% CI) /s	137.1 to 175.5	

(ii) Complete Table 1.2 to show the calculated values for S_M and 95% CI for the data from the untrampled area of open land.

[2]

(iii) Calculating 95% confidence intervals (95% CI) provides additional information for interpreting the results of investigations.

State the additional information about the data shown in Table 1.1 that can be gained from the calculated values of 95% CI.

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..... [2]

(d) In a further investigation, the students studied one species of plant growing in the area of open land. They noticed that some plants of this species had larger leaves than other plants of this species. They thought that the surface area of the leaves might be affected by the drainage of the soil.

The students collected 20 plants of this species at random. At each place where a plant had been collected, the students collected a 10 cm deep soil sample using a tube-shaped cutter, as shown in Fig. 1.2.

For each plant, the students determined the surface area of the largest leaf.

(i) Outline how the surface area of a leaf can be determined.

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..... [2]

For each soil sample, the students measured the time taken for 10 cm^3 of water to drain through the soil sample, as described in **(c)**.

The students calculated the Spearman's rank correlation coefficient (r_s) for their data on leaf surface area and the time taken for 10 cm^3 of water to drain through the soil sample.

(ii) The students calculated the r_s value as **−0.455**.

State the relationship between leaf surface area and the time taken for 10 cm^3 of water to drain through the soil sample that is suggested by an r_s value that is less than zero.

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..... [1]

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Table 1.3 shows part of a table showing critical values of r_s at different probabilities (p). These critical values are used for testing the null hypothesis that there is **no** correlation between two sets of data.

Table 1.3

number of pairs of items in the sample (n)	probability (p)					
	0.5	0.1	0.05	0.01	0.005	0.001
8	0.310	0.643	0.738	0.881	0.905	0.976
9	0.267	0.600	0.700	0.833	0.867	0.933
10	0.248	0.564	0.648	0.794	0.830	0.903
11	0.236	0.536	0.618	0.755	0.800	0.873
12	0.217	0.503	0.587	0.727	0.769	0.846
18	0.170	0.401	0.472	0.600	0.643	0.728
19	0.165	0.391	0.460	0.584	0.628	0.712
20	0.161	0.380	0.447	0.570	0.612	0.696
21	0.156	0.370	0.435	0.556	0.599	0.681
22	0.152	0.361	0.425	0.544	0.586	0.667

(iii) To use Table 1.3, negative r_s values must first be converted to positive values.

Using the positive r_s value of **0.455**, state **and** explain what can be concluded from Table 1.3 about the relationship between leaf surface area and the time taken for 10 cm^3 of water to drain through the soil sample.

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..... [2]

[Total: 22]

2 **(a)** Indigo carmine is a water-soluble indicator. When oxygen is bubbled through a solution of this indicator, the colour changes from colourless to blue.

A student used indigo carmine solution to investigate some of the factors that may limit the rate of photosynthesis.

Fig. 2.1 shows the apparatus used by the student.

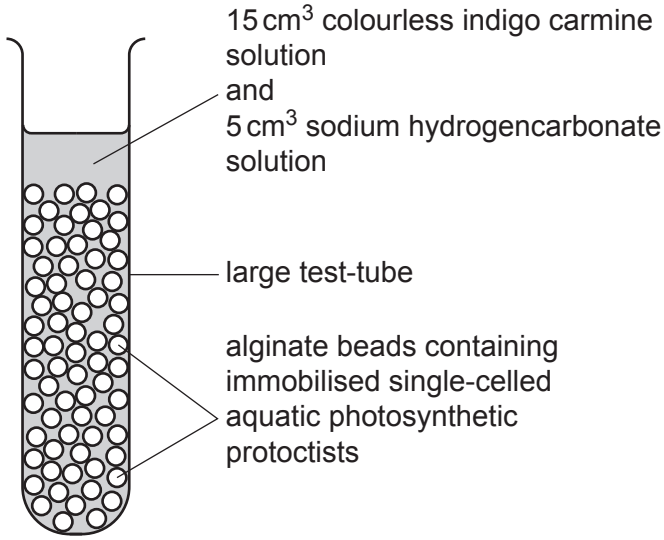


Fig. 2.1

The student prepared four sets of this apparatus. For each set of apparatus, the student used a different concentration of 5 cm^3 sodium hydrogencarbonate solution: 0.25%, 0.50%, 0.75% and 1.00%. Sodium hydrogencarbonate solution is a source of carbon dioxide for photosynthesis.

After adding indigo carmine solution and sodium hydrogencarbonate solution to the alginate beads, the apparatus was illuminated with a bench lamp from a distance of 20 cm. To minimise heating effects, the bench lamp used an LED bulb.

For each concentration of sodium hydrogencarbonate solution, the time for the indigo carmine solution to turn from colourless to blue was recorded.

The investigation was repeated with four new sets of apparatus illuminated with the same bench lamp at a distance of 10 cm, instead of 20 cm. The same concentrations of sodium hydrogencarbonate solution were used as previously.

All other variables in this investigation were standardised.

(i) State the dependent variable in this investigation.

..... [1]

(ii) State **one** variable that needed to be standardised in this investigation, **other** than temperature or those variables clearly standardised in Fig. 2.1.

..... [1]

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(b) The time taken for each indigo carmine solution to turn blue was converted to a rate of photosynthesis in arbitrary units. This was done in such a way that the slowest rate of photosynthesis in this investigation was given a value of 1.00 arbitrary units. All other rates of photosynthesis were therefore greater than 1.00 arbitrary units.

Table 2.1 shows the results of this investigation and some of the student's calculated values.

Table 2.1

distance of apparatus from bench lamp / cm	20				10			
percentage concentration of sodium hydrogencarbonate solution	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00
time taken for indicator to turn blue / s	600	310	250	250	600	310	235	195
rate of photosynthesis / arbitrary units	1.00	1.94	2.40	2.40	1.00	1.94		3.08

(i) Complete Table 2.1 by calculating the missing rate of photosynthesis in arbitrary units. [1]

(ii) State **three** conclusions that can be made from the results shown in Table 2.1 about factors that affect the rate of photosynthesis **and** when these factors become limiting.

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..... [3]

(iii) Confidence in conclusions that are made from the results shown in Table 2.1 is reduced by a lack of repeats and a lack of statistical analysis.

Suggest **two other** reasons that reduce confidence in conclusions that are made from the results shown in Table 2.1.

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..... [2]

[Total: 8]

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