Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2020**

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. Blank pages are indicated.

[Turn over

1 Two methods of estimating the water potential of plant tissue are described.

Method 1: Pieces of tissue are left in sucrose solutions of different concentrations. The percentage change in mass of the tissue is determined.

Method 2: Pieces of tissue are left in sucrose solutions of different concentrations. The change in the density of the solutions in which the pieces of tissue have been left is estimated.

A student compared the use of method 1 with method 2 to estimate the water potential of tissue in the fruit wall of red pepper, *Capsicum annum*.

Fig. 1.1 shows a red pepper fruit and a labelled longitudinal section of the same fruit.

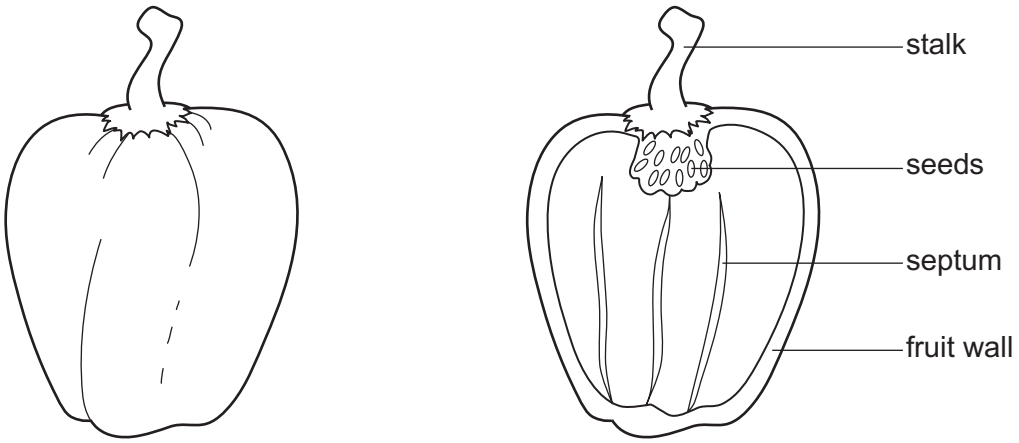

Fig. 1.1

The student first used method 1.

- Pieces of the red pepper fruit wall tissue of known mass were prepared.
- These pieces of tissue were placed in solutions of different sucrose concentration.
- The change in mass of the tissue after a period of time was calculated.

(a) (i) State the independent variable **and** the dependent variable in this investigation.

independent .....

dependent .....

[2]

(ii) The student was given a 1.0 mol dm^{-3} stock solution of sucrose. The student decided to use the stock solution to make a range of sucrose solutions. The student made 50 cm^3 of each solution.

Suggest a suitable range of solutions the student could use **and** describe how these solutions could be made by **proportional** dilution of the 1.0 mol dm^{-3} stock solution of sucrose.

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(b) Using the different sucrose solutions from **(a)(ii)**, describe a method the student could use to collect the data needed to estimate the water potential of the tissue in the fruit wall of the red pepper.

Do **not** include details of how to make the different sucrose solutions.

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

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(c) (i) The student calculated the percentage change in mass of the tissue.

Describe how the student could have calculated the percentage change in mass of the tissue **and** explain why the percentage change should be used.

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..... [2]

(ii) Sketch a graph of the expected results on Fig. 1.2.

Include axes labels and units.

Indicate how this graph could be used to estimate the sucrose concentration equivalent to the water potential of the tissue in the red pepper fruit wall.

[3]

Fig. 1.2

(d) The student then used method 2.

- Large test-tubes were set up in pairs.
- Each pair of test-tubes contained the same volume of a concentration of sucrose solution.
- The concentrations ranged from 0.1 mol dm^{-3} to 0.7 mol dm^{-3}.

1. Red pepper tissue was placed in one of the test-tubes containing 0.1 mol dm^{-3} sucrose solution.
2. After the tissue had been soaking in the solution for a period of time, the tissue was removed.
3. The solution from which the red pepper tissue had been removed was coloured by adding methylene blue solution.
4. One drop of this coloured solution was then placed in the other large test-tube containing 0.1 mol dm^{-3} sucrose solution as shown in Fig. 1.3.

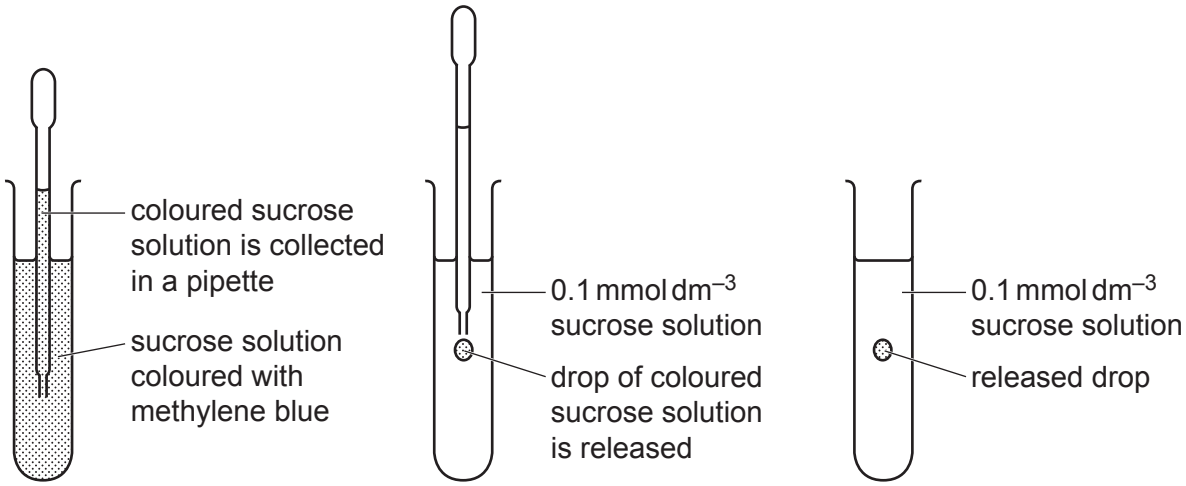

Fig 1.3

5. Step 1 to step 4 were repeated with the other concentrations of sucrose.

- If the plant tissue has gained water from the sucrose solution in which it has been soaking, the released drop will move down in the tube.
- If the plant tissue has lost water to the solution in which it has been soaking, the drop of coloured solution will be less dense and the released drop will move up in the tube.

The results are shown in Fig. 1.4.

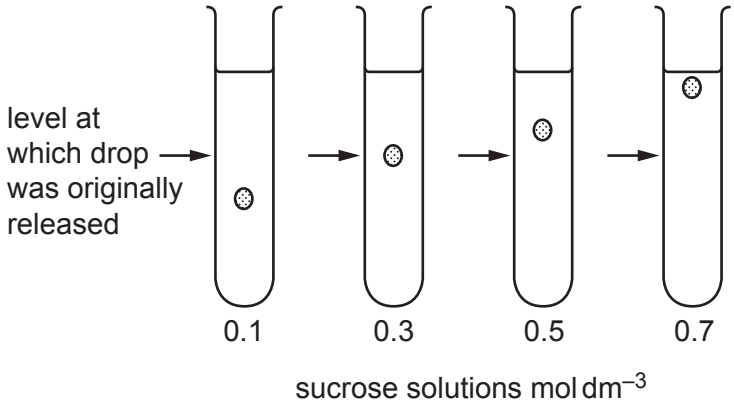

Fig. 1.4

Table 1.1 shows the water potentials of the sucrose solutions used by the student in method 1 and method 2.

Table 1.1

sucrose concentration / mol dm^{-3}	water potential / kPa
0.10	−260
0.20	−540
0.30	−860
0.40	−1120
0.50	−1450
0.60	−1800
0.70	−2180

(i) Using the results of the experiment in Fig. 1.4 and the data in Table 1.1, state the water potential of the red pepper tissue.

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(ii) Suggest why the student thought that method 1 would give a better estimate of water potential than method 2.

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[Total: 20]

2 Biodiversity is important in maintaining the stability of an ecosystem. Biodiversity can be reduced by the introduction of new species to an ecosystem.

The red quinine tree, *Cinchona pubescens*, was introduced to the Galapagos Islands in the 1940s. By 2010, it had covered 110 000 hectares of Santa Cruz, one of the larger Galapagos islands.

(a) A group of scientists studied the impact of the red quinine tree on the plant biodiversity of Santa Cruz.

Line transects were used to study an area of 32 hectares in the hills of Santa Cruz.

(i) Suggest **three** variables that the scientists needed to standardise in this study.

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[3]

In addition to the line transects, the scientists set up 14 sample plots in the study area.

(ii) Suggest a method that could be used for randomly selecting the position of the plots.

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(b) The scientists decided to use Simpson's Index of Diversity to calculate the plant biodiversity of the study plots.

State what data they needed to collect to calculate Simpson's Index of Diversity.

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(c) Over a 7-year period the scientists measured the:

- ground covered by red quinine trees
- ground covered by other plant species
- ground **not** covered by plants.

Fig. 2.1 shows the results.

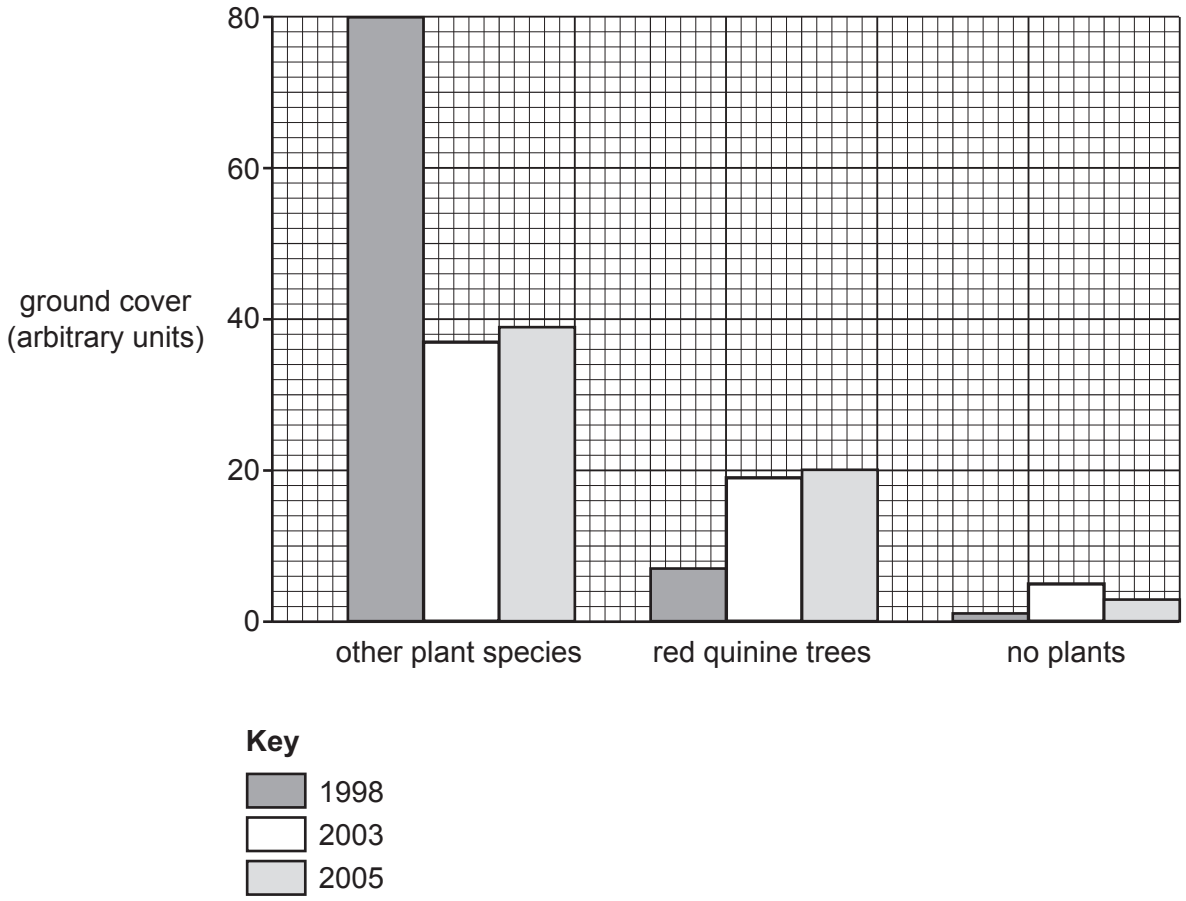

Fig. 2.1

Calculate the percentage change in the ground covered by red quinine trees in the plots from 1998 to 2005.

..... % [1]

(d) The scientists suggested the hypothesis:

The presence of red quinine trees in the hills of Santa Cruz causes a decrease in biodiversity.

The scientists carried out statistical tests on their studies of species diversity.

The probability values (*p*) from the results of the statistical tests are shown in Table 2.1.

Table 2.1

	value of *p*
decrease in species diversity 1998–2003	< 0.001
decrease in species diversity 2003–2005	> 0.05

Evaluate the data in Fig. 2.1 and Table 2.1 and discuss the extent to which the data supports or does **not** support this hypothesis.

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[Total:10]

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