Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2022**

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 **16** pages. Any blank pages are indicated.

DC (CE/JG) 302259/3

[Turn over

1 Fig. 1.1 **A** shows the root vegetable beetroot, *Beta vulgaris*.

Fig. 1.1 **B** shows a single cell from the beetroot tissue. The vacuole contains the red pigment, betalain.

The pigment molecules are too large to diffuse out of the vacuole.

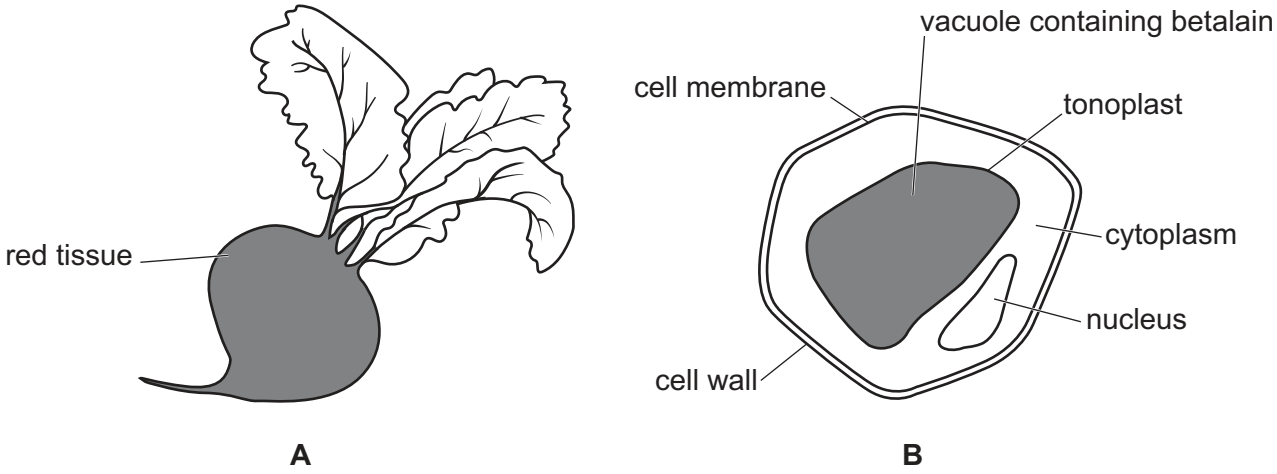

Fig. 1.1

When pieces of beetroot are soaked in a solution of calcium hypochlorite, $Ca(ClO)_2$, the beetroot tissue changes from red to white. This is caused by the calcium hypochlorite diffusing into the beetroot cell vacuoles and decolourising the betalain pigment.

Fig. 1.2 shows a cube of beetroot before soaking in the solution of calcium hypochlorite and the halved cube of beetroot after soaking in the solution of calcium hypochlorite.

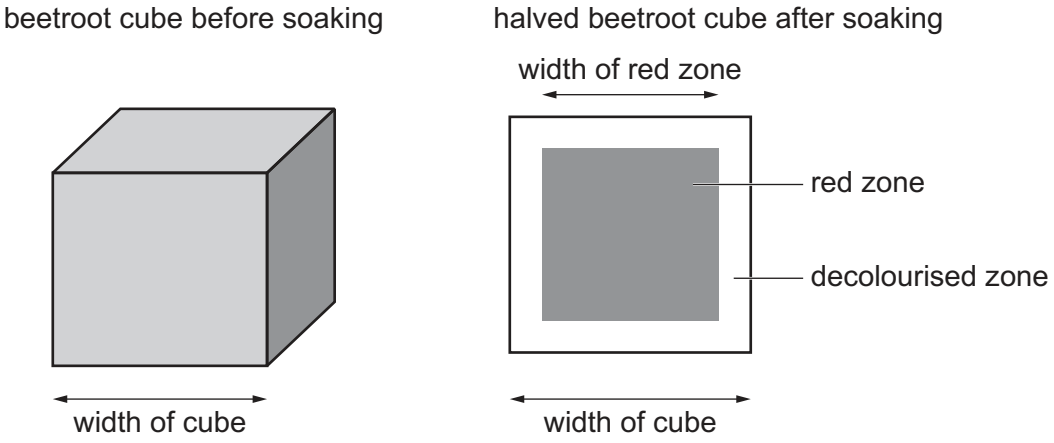

Fig. 1.2

In a class experiment:

- Cubes of beetroot of different dimensions were placed in a beaker containing a 10% solution of calcium hypochlorite.
- The cubes were left for 30 minutes.
- The cubes were then cut in half, and the width of the tissue remaining red (the red zone) was measured.

A group of students investigated the effect of changing the surface area:volume ratio on the diffusion of calcium hypochlorite into beetroot cubes. The students used cubes of different sizes and measured the width of the red zone after soaking the beetroot in calcium hypochlorite.

The students suggested the hypothesis:

The width of red tissue remaining in the beetroot after soaking in calcium hypochlorite is inversely proportional to the surface area:volume ratio of the beetroot cubes.

(a) (i) Identify the **dependent** variable in this investigation.

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(ii) Sketch a curve on Fig. 1.3 to show how you expect the width of red tissue to change as the surface area:volume ratio changes if the hypothesis is correct.

Label the axes.

Fig. 1.3

[2]

(b) (i) Describe a method the students could use to collect the data needed to test their hypothesis.

The students were provided with beetroot tissue, a 10% calcium hypochlorite solution and standard laboratory equipment.

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

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(ii) The students decided to calculate the **percentage change in volume** of the red tissue in each cube.

State how the students could calculate the percentage change in volume of the red tissue in each cube.

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(c) In a further experiment the students investigated the effect of temperature on the release of betalain pigments from beetroot tissue.

- Cubes of beetroot were cut.
- Beakers containing water were prepared.
- The beakers were placed in water-baths at temperatures between 0 °C and 85 °C.
- The beakers were allowed to equilibrate for 5 minutes.
- The beetroot cubes were added to the beakers.
- After 30 minutes the beetroot cubes were removed.
- Colorimeters, each with a blue-green filter, were used to measure the percentage transmission of light through the fluid remaining in each beaker.

The results of this experiment are shown in Table 1.1.

Table 1.1

temperature / °C	percentage transmission of light				
	student 1	student 2	student 3	student 4	mean
5	100	97	98	96	97.8
25	83	92	96	86	
45	82	73	68	71	70.7
65	26	31	29	17	28.7
85	1	2	1	1	1.3

(i) The students decided that two of their results are anomalous. One of the results that they considered anomalous is circled in Table 1.1.

Circle the **other** anomalous result **and** complete Table 1.1 by calculating the mean percentage transmission of light at 25 °C.

[2]

(ii) Describe **two** ways in which the method described in **(c)** could have been improved to give better repeatability between the results of the different students.

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(iii) With reference to the data in Table 1.1, state **and** explain the effect that increasing temperature has on the release of betalain from beetroot tissue.

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[Total: 18]

2 The European badger, *Meles meles*, pictured in Fig. 2.1, is a mammal found in England.

Badgers can contract bovine tuberculosis (bTB) caused by the pathogen, *Mycobacterium bovis*.

- Researchers estimated that 5% of the badger population in England are infected with bTB.
- bTB can be spread between badger populations and other populations of wild animals and farmed animals.
- Herds of dairy cows produce milk for human consumption. If a dairy herd becomes infected with bTB, the pathogen can be transmitted to human populations in milk.
- A variety of measures have been introduced in an attempt to reduce the bTB rate in badgers and so prevent infection of dairy cows.
- These measures include vaccination and the removal of badger populations (culling).

Fig. 2.1

(a) Suggest how researchers estimated the percentage of the badger population that was infected with bTB.

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(b) It is possible that wild badgers infect dairy cows with bTB.

A group of scientists investigated the correlation between bTB infections in badgers and bTB infections in dairy cows.

- 30 study areas in England were identified.
- Each of the areas was approximately 100 km^2.
- 10 of the 30 study areas were randomly selected and given the codes **A**–**J**.
- The number of infected cows **and** the number of infected badgers were counted in each area.
- The number of infected badgers was determined by testing for the presence of *Mycobacterium bovis* in tissue samples taken from the badgers.
- The number of infected cows was determined by testing for a response (inflammation) to the introduction of antigenic material into the skin.

Data was collected as shown in Table 2.1.

Table 2.1

data set	areas where counts were made	year when counts were made
1	**A**, **B**, **C**, **E**, **F**, **G**, **H**	1999
2	**D**, **I**, **J**	2001

The scientists expressed their data on the numbers of infected cows and infected badgers as the population **density** of infected cows and infected badgers.

(i) Explain what is meant by the term population density **and** suggest why the data was expressed in this way.

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(ii) State **three** variables that were **not** standardised in this investigation.

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(c) The scientists decided to analyse their data on the occurrence of bTB in cows and badgers statistically.

(i) State a null hypothesis for this investigation.

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(ii) The scientists plotted a scatter graph of the population density of infected badgers and infected cows as shown in Fig. 2.2.

The scientists drew a line of best fit on the scatter graph.

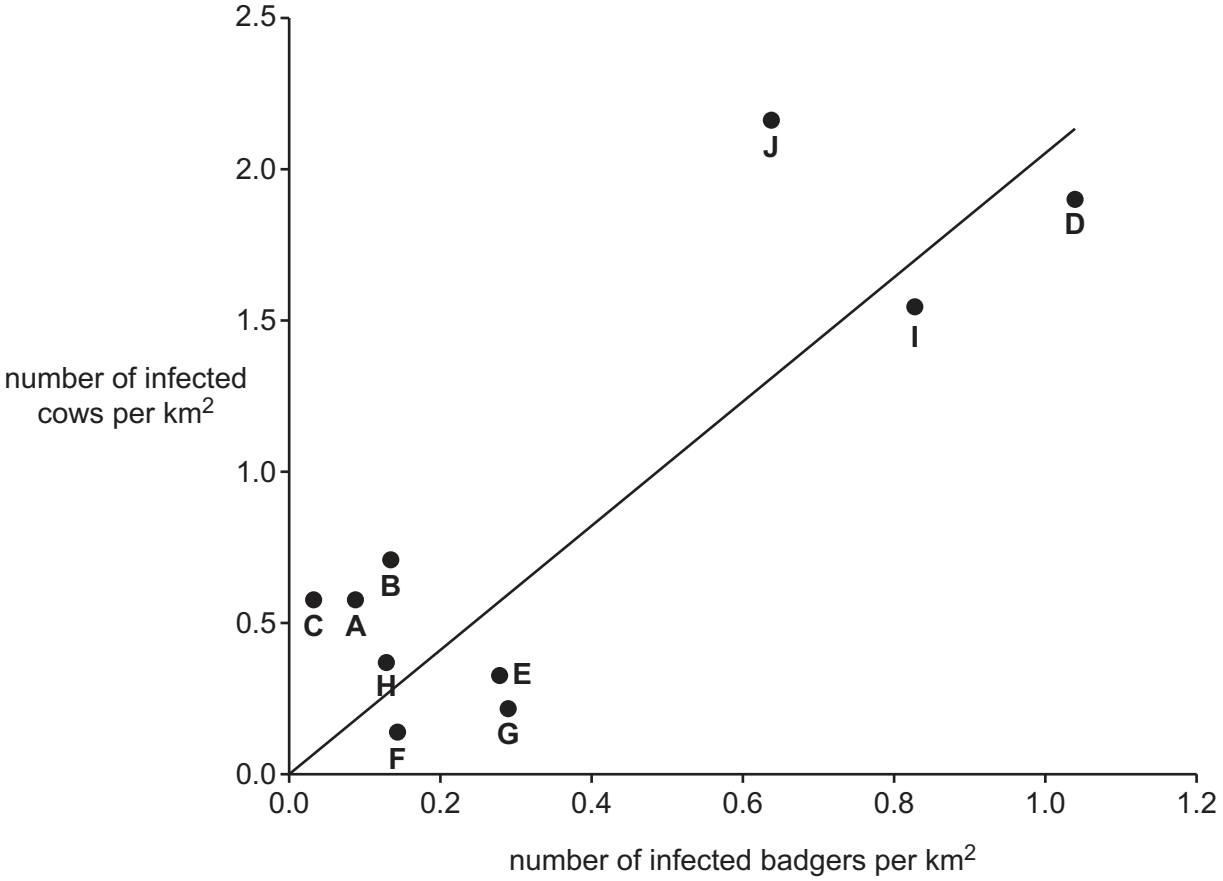

Fig. 2.2

The scientists carried out statistical tests on the two data sets combined and on each set separately.

The results of these tests are shown in Table 2.2.

Table 2.2

data set	sampling areas	correlation	significance at p=0.05
1 & 2	**A**, **B**, **C**, **D**, **E**, **F**, **G**, **H**, **I**, **J**	positive	significant
1	**A**, **B**, **C**, **E**, **F**, **G**, **H**	negative	not significant
2	**D**, **I**, **J**	negative	not significant

Some scientists suggested this information showed a strong positive relationship between the number of infected badgers in an area and the number of infected cows in the same area.

These scientists also suggested that bTB in herds of cows could be reduced by removing badgers through culling.

Evaluate whether or not the data in Fig. 2.2 and Table 2.2 support the suggestions these scientists made.

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[Total: 12]

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