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Cambridge International AS & A Level

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9558564265

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.
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- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
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[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.

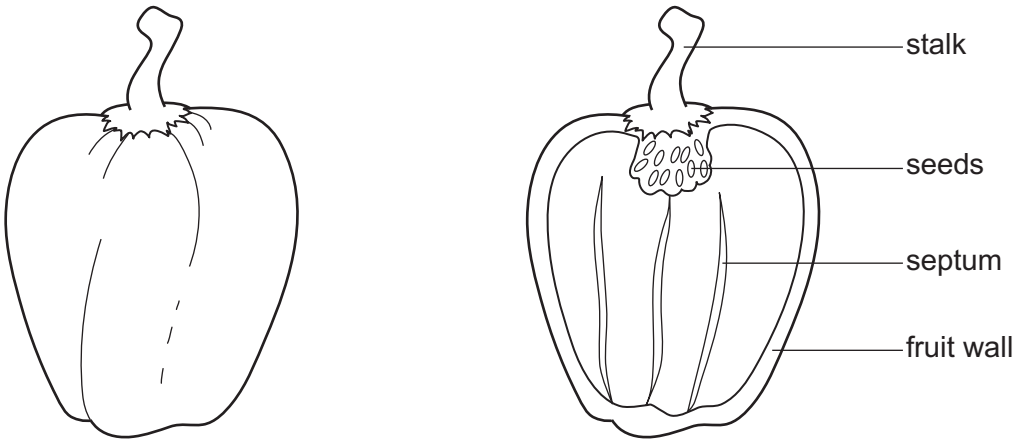


Fig. 1.1

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.

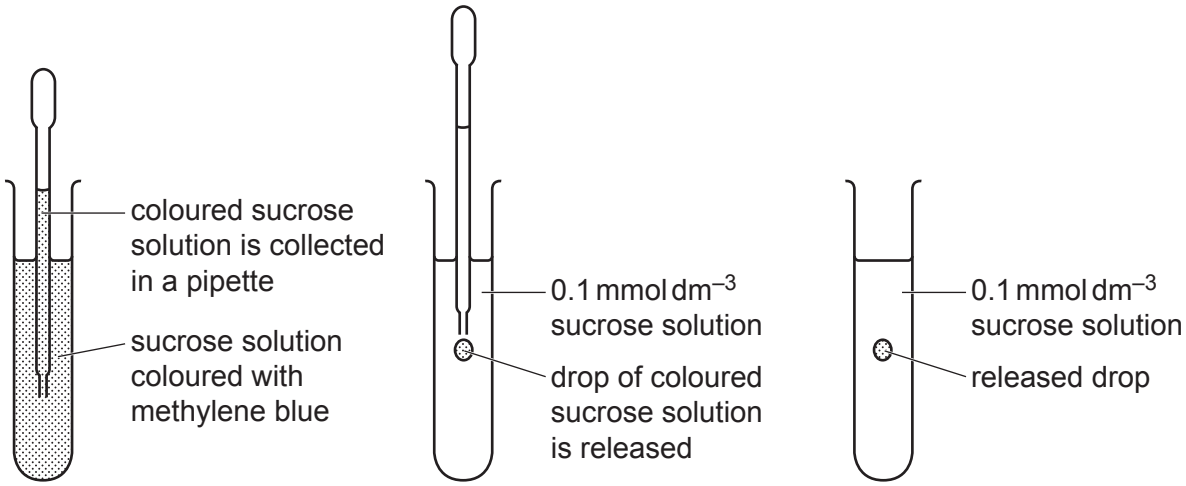


Fig 1.3

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.

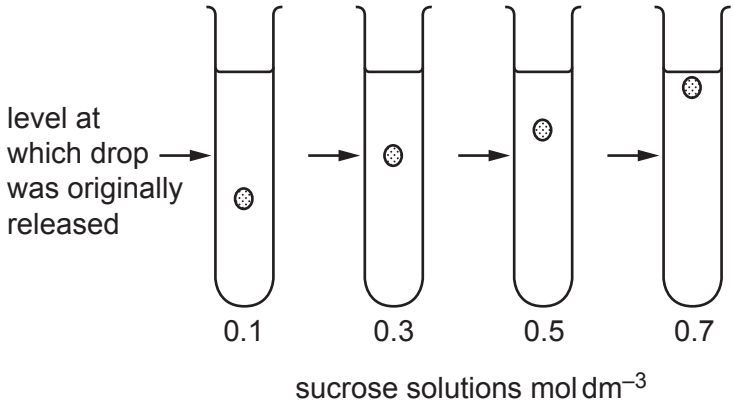


Fig. 1.4

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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.

..... [1]

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

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..... [3]

[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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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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..... [1]

(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.

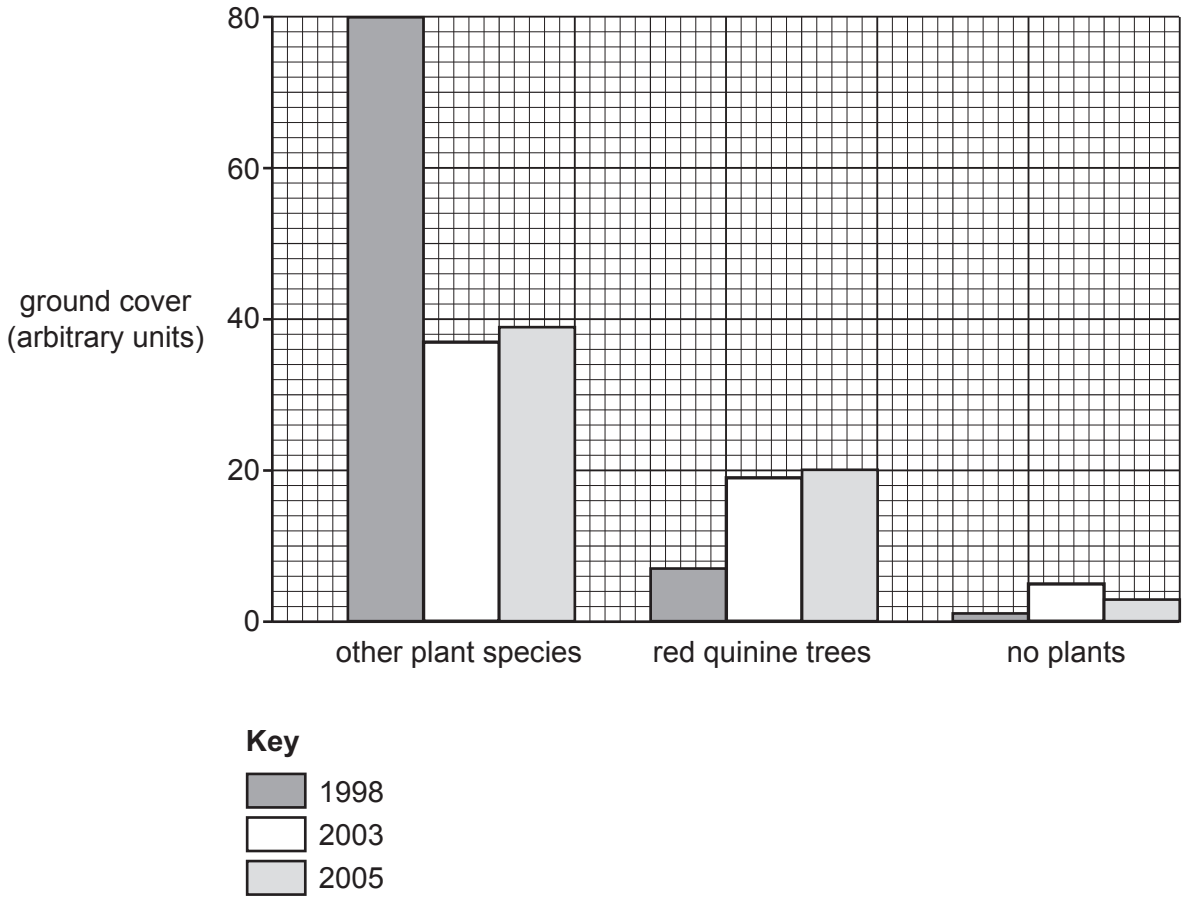


Fig. 2.1

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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Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1579622618

BIOLOGY **9700/52**

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

1 hour 15 minutes

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[Turn over

1 Some students observed a flowering plant and noticed that the flower was supported by a long stalk.

To investigate how the stalk supported the flower, the students first cut transverse sections of the stalk. The students then used a light microscope to observe the transverse sections of the stalk.

Fig. 1.1 shows a plan diagram of a transverse section of the stalk.

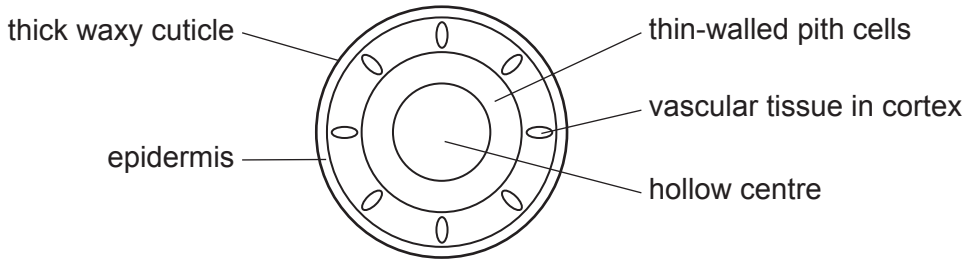


Fig. 1.1

Fig. 1.2 shows the appearance of two cells from each of the layers.

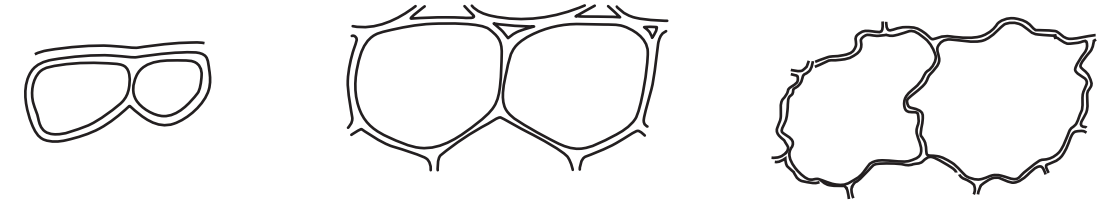


Fig. 1.2

The students cut out a piece of stalk that was 40 mm long and then split this lengthways into 4 strips, as shown in Fig. 1.3.

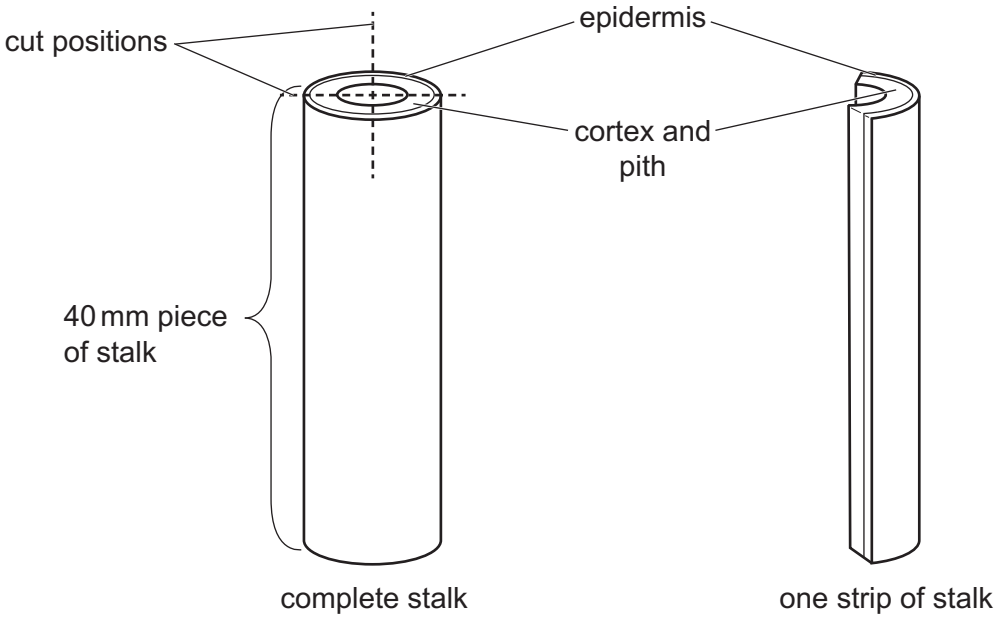


Fig. 1.3

The students observed that the strips immediately curved lengthways so that the epidermis was on the **inside** of the curve.

All the strips were put into a Petri dish containing water and left for a period of time.

After soaking in water, the strips curved even further.

Fig. 1.4 shows the appearance of a strip after being soaked in water, viewed from one end.

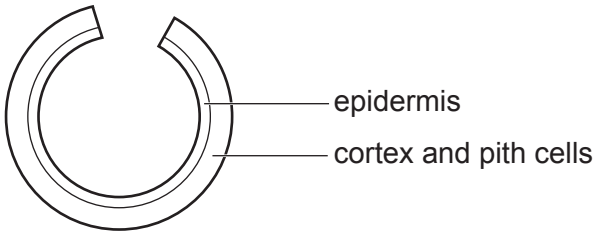


Fig. 1.4

(a) State what conclusions can be made about the role of the stalk cells in supporting the flower.

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(b) In another investigation to find the **water potential** of the tissues in the flower stalk the students decided to:

- put strips in different concentrations of sucrose solution
- observe the direction and degree of curvature of the strips
- calculate the angle of curvature of the strips from photographs, using a mathematical procedure that they found on the internet.

The students were provided with a 1.0 mol dm^{-3} sucrose solution. They decided to use this to make a range of sucrose solutions. They made 50 cm^3 of each solution.

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

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..... [3]

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

independent variable .....

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dependent variable .....

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[2]

(iii) Using the different sucrose solutions from **(b)(i)**, describe a method the students could use to collect the data needed to estimate the water potential of the tissues in the flower stalk.

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

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

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(c) Fig. 1.5 shows the appearance of some strips of flower stalk after being immersed in high concentrations of sucrose solution and in low concentrations of sucrose solution.

The students measured the curvature of the epidermis of the strips.

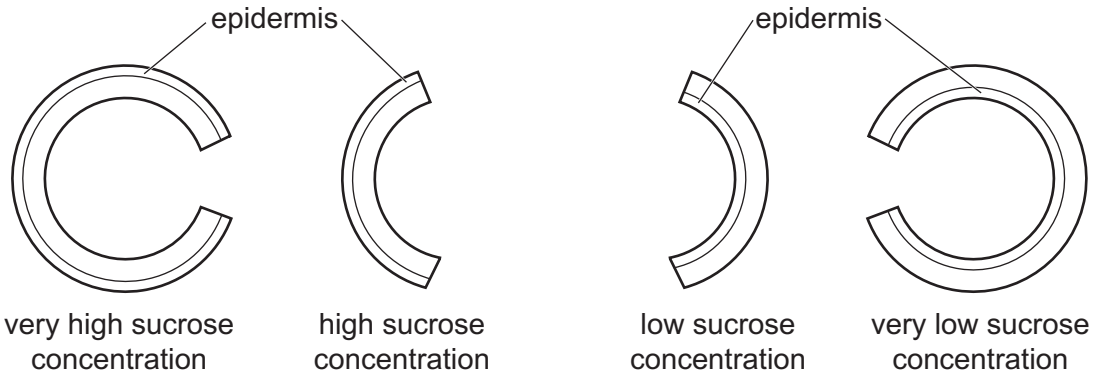


Fig. 1.5

(i) Sketch a graph on Fig. 1.6 of the expected results of immersing strips of the flower stalks in sucrose solutions of different concentration.

Include axes labels and units.

Indicate how this graph could be used to estimate the sucrose concentration equivalent to the water potential of the tissues in the flower stalk.



[4]

Fig. 1.6

(ii) Predict the appearance of the strip in a sucrose solution that has the **same** water potential as the cells of the strip.

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[Total: 19]

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2 Water hyacinth, *Eichhornia crassipes*, is a plant that grows on the surface of waterways such as rivers and lakes and is an alien species in many parts of the world. The plant grows and reproduces to form dense mats. As a result, water hyacinth outcompetes local species and reduces biodiversity.

Weevils are a group of insects that feed on water hyacinth. Certain species of weevil are used in South Africa as part of a programme to control the spread of water hyacinth.

Researchers carried out a two-stage investigation to assess the effect of weevils on water hyacinth.

Stage 1 was a pilot experiment in the laboratory. Stage 2 was a field experiment.

Stage 1: Pilot experiment

- Water hyacinth plants were collected from the river and kept in a laboratory.
- Each plant was kept in a separate bucket of river water for 6 weeks.
- During the 6 weeks, the plants were inspected twice a day and any insects, including weevils, were removed.
- Feeding scars (damage caused by insect feeding) were counted.

- At the end of the 6 weeks, the buckets containing the plants were divided into 6 groups.
- The length of the longest leaf stalk (petiole) of each plant was measured.
- The number of feeding scars on the second youngest leaf (leaf 2) of each plant was counted.

Each group was then given a different treatment, as shown in Table 2.1.

Table 2.1

group	treatment	
1	not sprayed with insecticide	no weevils added
2	not sprayed with insecticide	1 mating pair of weevils added after 1 week
3	sprayed with insecticide	no weevils added
4	sprayed with insecticide	1 mating pair of weevils added 1 week after spraying with insecticide
5	sprayed with insecticide	1 mating pair of weevils added 2 weeks after spraying with insecticide
6	sprayed with insecticide	1 mating pair of weevils added 3 weeks after spraying with insecticide

After 4 weeks, the effects of the treatments on water hyacinth were assessed.

The results are shown in Table 2.2.

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Table 2.2

group	mean length of longest petiole / cm ± *s*		mean number of feeding scars on leaf 2 ± *s*	
	before treatment	after treatment	before treatment	after treatment
1	41 ± 2.0	38 ± 3.0	23 ± 4.0	0
2	32 ± 3.5	29 ± 3.3	16 ± 3.0	22 ± 5.0
3	36 ± 2.0	35 ± 3.8	18 ± 4.0	0.5 ± 0.2
4	38 ± 2.0	36 ± 3.0	30 ± 9.0	0.5 ± 0.2
5	34 ± 2.5	31 ± 3.5	25 ± 5.0	0.5 ± 0.2
6	37 ± 3.8	35 ± 4.3	13 ± 3.5	1.0 ± 0.5

(a) (i) Explain the reason for spraying the water hyacinth plants with insecticide in treatment 3.

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(ii) Explain why treatment 2 and treatments 4, 5 and 6 were included in the experiment.

treatment 2 .....

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treatments 4, 5 and 6 .....

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[2]

(iii) Explain what the standard deviation (*s*) shows about the results in Table 2.2.

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..... [2]

(iv) State **one** conclusion that can be made from the results in Table 2.2.

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..... [1]

Stage 2: Field experiment

- 10 plots, each of 20 m^2, were marked out in a river.
- The plots were filled with water hyacinth plants.
- The plants were sampled at the start and the mean petiole length and number of feeding scars were recorded, as in the pilot experiment.
- 5 of the plots were sprayed with insecticide every three weeks.
- 5 of the plots were not sprayed, to allow weevils from the environment to feed on the plants.
- The plants were sampled after 33 weeks and the mean petiole length and number of feeding scars were recorded, as in the pilot experiment.

The results of the field experiment are shown in Fig. 2.1 and Fig. 2.2.

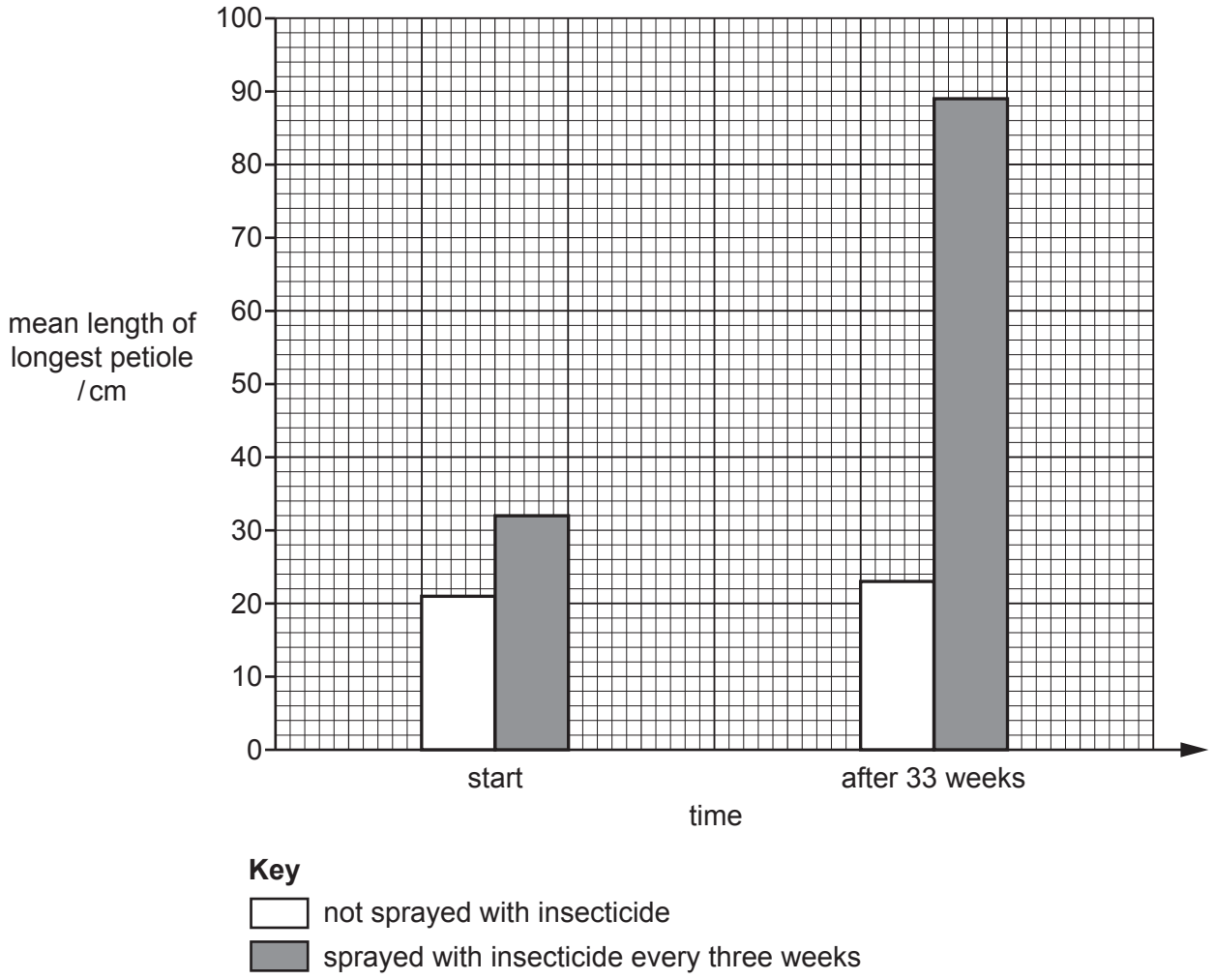


Fig. 2.1

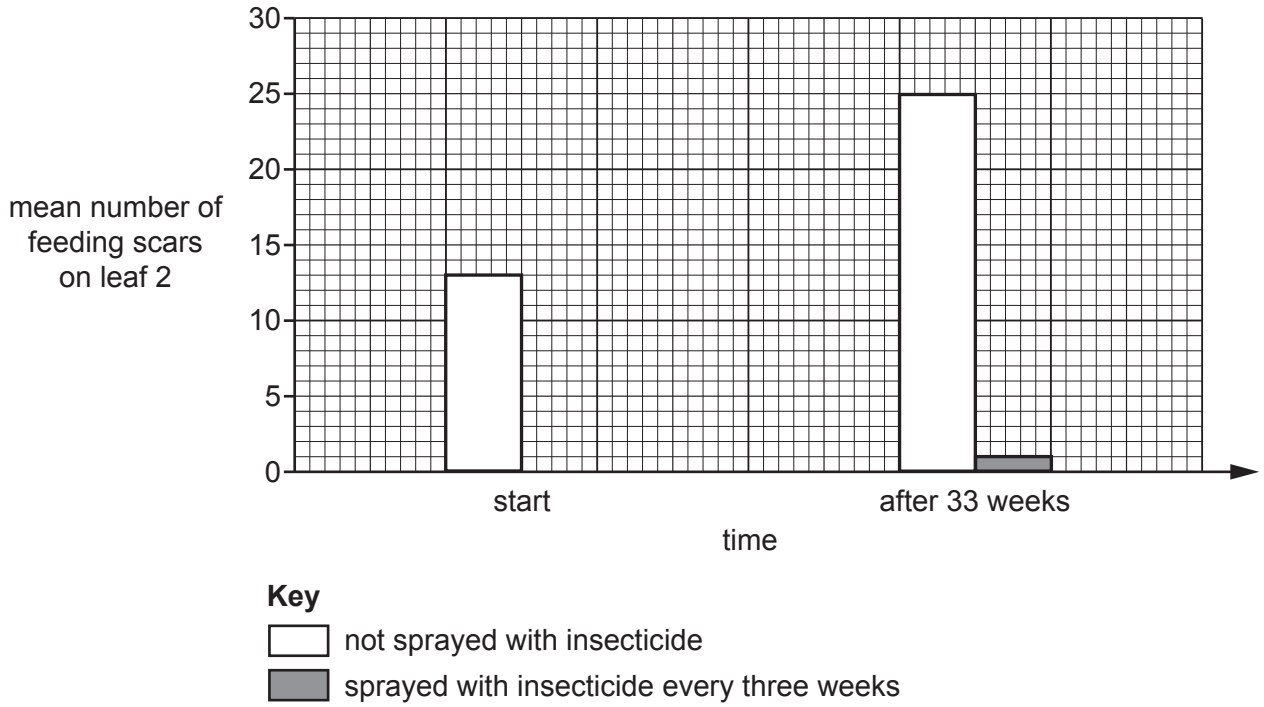


Fig. 2.2

(b) (i) Calculate the percentage change in the mean length of the longest petiole for leaves sprayed with insecticide.

Show your working and give your answer to the nearest whole number.

.....% [2]

(ii) State **one** reason why the *t*-test can be used to analyse the data in Fig. 2.2.

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(iii) State what information is needed to calculate the degrees of freedom used to determine if the calculated *t*-value is significant.

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..... [1]

[Total: 11]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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BIOLOGY **9700/53**

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1 hour 15 minutes

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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.

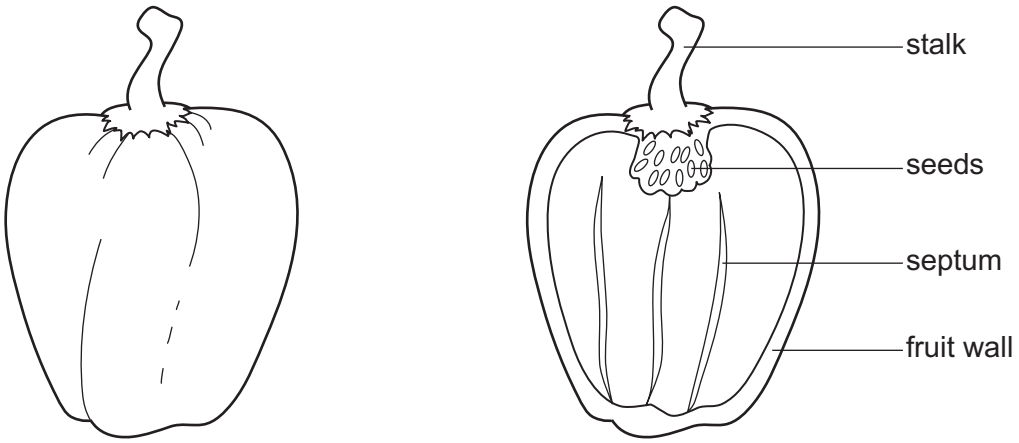


Fig. 1.1

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.

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..... [6]

(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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(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.

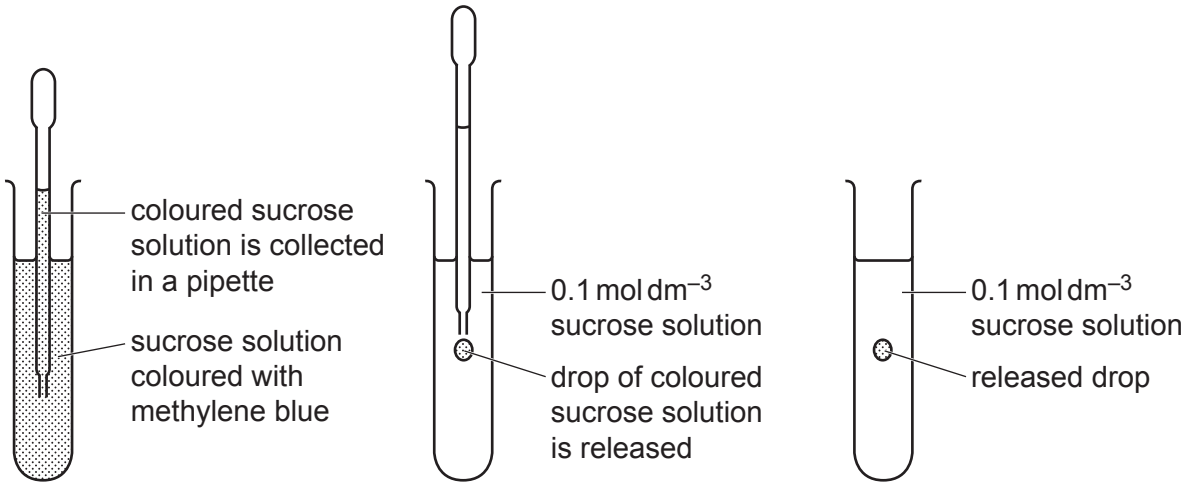


Fig 1.3

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.
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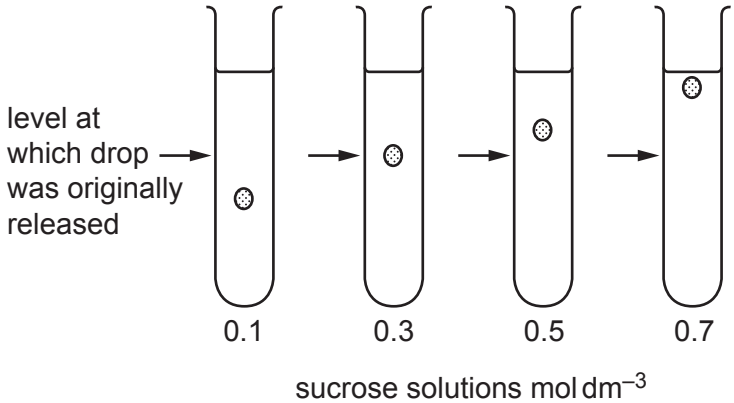


Fig. 1.4

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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
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(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.

..... [1]

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

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..... [3]

[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.

1 .....

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2 .....

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3 .....

.....

[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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..... [1]

(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.

.....

.....

..... [1]

(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.

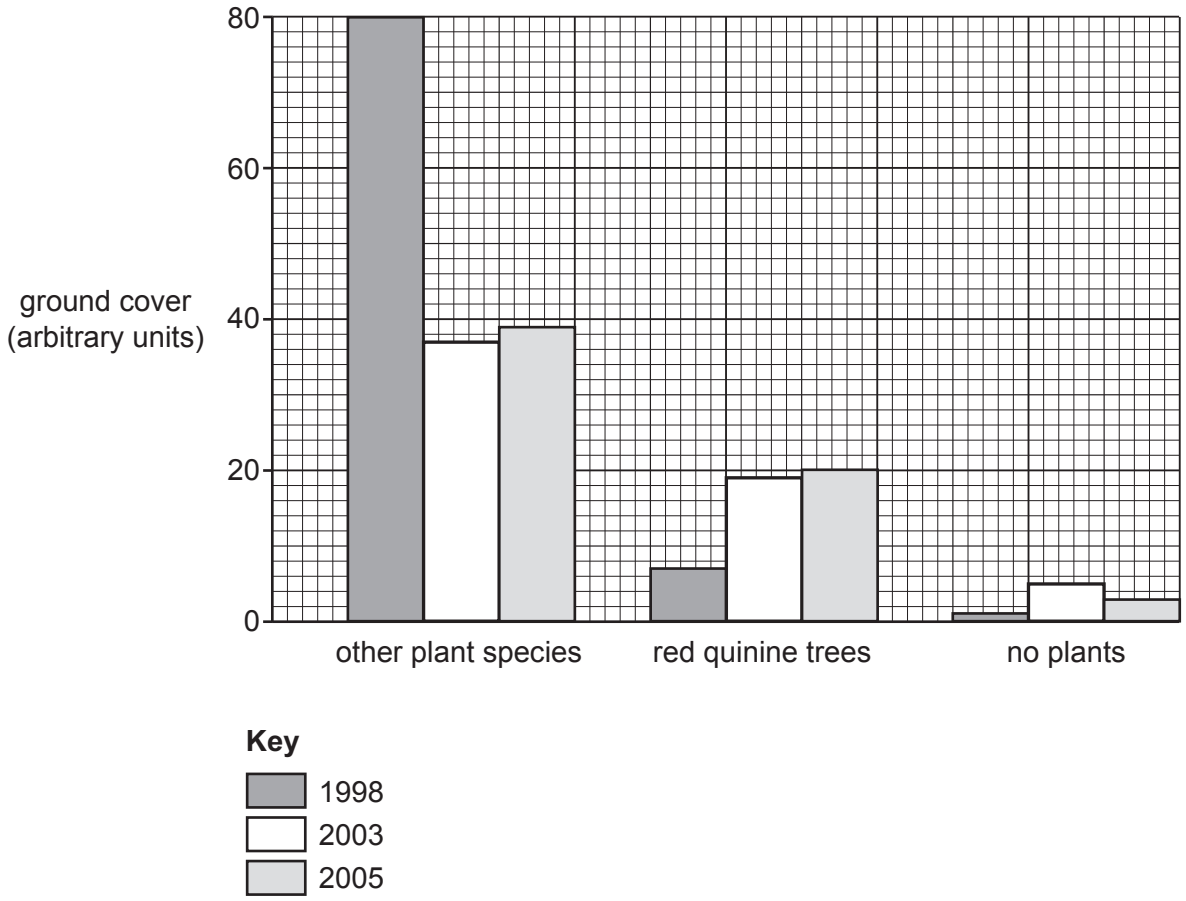


Fig. 2.1

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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..... [4]

[Total:10]

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