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Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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3445964092

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

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

INFORMATION

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[Turn over

1 Juglone is a chemical produced by plants in the genus *Juglans*, which includes different species of walnut tree.

Fig. 1.1 shows a black walnut tree.

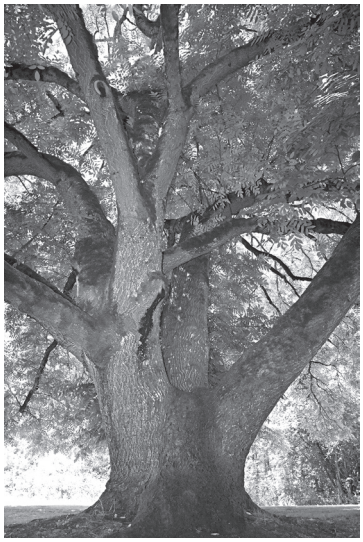


Fig. 1.1

Juglone produced by a black walnut tree can diffuse into the soil surrounding the tree.

Groups of scientists have observed that juglone affects different species of plant growing close to black walnut trees.

Juglone can reduce the percentage of seeds that germinate, delay the start of germination or reduce growth. In some studies, juglone has no effect on germination or growth.

A student planned to investigate the effect of juglone on the cucumber plant, *Cucumis sativus*.

In the investigation, the student:

- placed some damp soil containing juglone in a tray
- added some cucumber seeds to the soil
- placed the container in a suitable environment for germination and growth.

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Fig. 1.2 shows cucumber seedlings (young plants) a few days after germination.



Fig. 1.2

The student planned to compare the effect of exposing cucumber seeds to:

- juglone solution with a concentration of 1.0×10^{-3} mol dm^{-3}, which is a concentration that has been measured in soils surrounding black walnut trees
- a control treatment.

The student planned to determine:

- the percentage of cucumber seeds that germinated in soil
- the growth of each cucumber seedling 10 days after the appearance of the seedling above the soil.

(a) Identify the independent variable in this investigation.

..... [1]

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(b) Juglone solutions are prepared using a mixture of solvents.

The student was provided with:

- a juglone solution with a concentration of $0.1\,\text{mol}\,\text{dm}^{-3}$
- the mixture of solvents.

Using the solution provided, the student prepared a juglone solution with a volume of $500\,\text{cm}^3$ and a concentration of $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$.

The student carried out 1 dilution to prepare the $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$ solution using measuring cylinders.

(i) State the volumes that the student used to carry out the dilution to produce $500\,\text{cm}^3$ of $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$ juglone solution.

.....

..... [2]

(ii) Outline **one** improvement the student could make to reduce the percentage error while carrying out the dilution.

.....

.....

..... [1]

(c) **(i)** State a suitable control that the student could use, **and** explain why the student decided to include a control in the investigation.

control .....

.....

explanation .....

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[2]

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(ii) Describe a method the student could use to investigate the effect of juglone on:

- the percentage of cucumber seeds that germinate
- the growth of each cucumber seedling 10 days after the appearance of the seedling above the soil.

The description of your method should be set out in a logical way and be detailed enough for another person to follow.

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(d) Another student investigated the effect of juglone on a different species of plant called crimson clover, *Trifolium incarnatum*.

The student recorded the number of days required for germination of:

- 10 seeds treated with a juglone solution with a concentration of 1.0×10^{-3} mol dm^{-3}
- 10 seeds not treated with a juglone solution.

(i) The student used the *t*-test to analyse the results. The *t*-test is appropriate for the number of seeds that were used.

Suggest **two other** reasons why the *t*-test is an appropriate statistical test to use for this investigation.

.....

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.....

..... [2]

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(ii) The null hypothesis for this *t*-test was:

There is no difference between the time taken for seeds to germinate when treated with juglone and the time taken for seeds to germinate when not treated with juglone.

The calculated value of *t* was **2.090**.

The student compared **2.090** to the values in Table 1.1.

Table 1.1

degrees of freedom	probability level (*p*)			
	0.10	**0.05**	**0.01**	**0.001**
17	1.740	2.110	2.898	3.965
18	1.734	2.101	2.878	3.922
19	1.729	2.093	2.861	3.883
20	1.725	2.086	2.845	3.850
21	1.721	2.080	2.831	3.819

Using Table 1.1 and the calculated value of *t* of **2.090**, state **and** explain what the student can conclude about the results.

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..... [3]

[Total: 18]

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2 Compounds containing nitrite ions (NO_2^-) are present in many foods eaten by humans.

Scientists tested the effect of different concentrations of nitrite ions on the population growth of 5 species of bacterium. All 5 species are pathogenic and can infect the human digestive system.

For each species of bacterium, the scientists placed suspensions of the bacteria in a microwell plate. A microwell plate is a plastic plate containing 96 wells, which are similar to small test-tubes.

In each well, the scientists added:

- a suspension of the bacterial species
- a solution containing nitrite ions
- nutrient broth.

The scientists incubated the microwell plate at 37 °C for 24 hours. After 24 hours, the scientists estimated the number of bacteria in each well by measuring optical density, using a microwell plate reader.

For each species of bacterium, the scientists repeated the experiment with several different concentrations of solution containing nitrite ions.

The scientists determined the lowest nitrite concentration at which no bacterial population growth had occurred after 24 hours.

(a) The scientists standardised temperature, pH (pH 4.8) and time in the investigation.

State **two other** variables that the scientists should standardise in this investigation.

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2 .....

[2]

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(b) The results of the investigation are shown in Fig. 2.1.

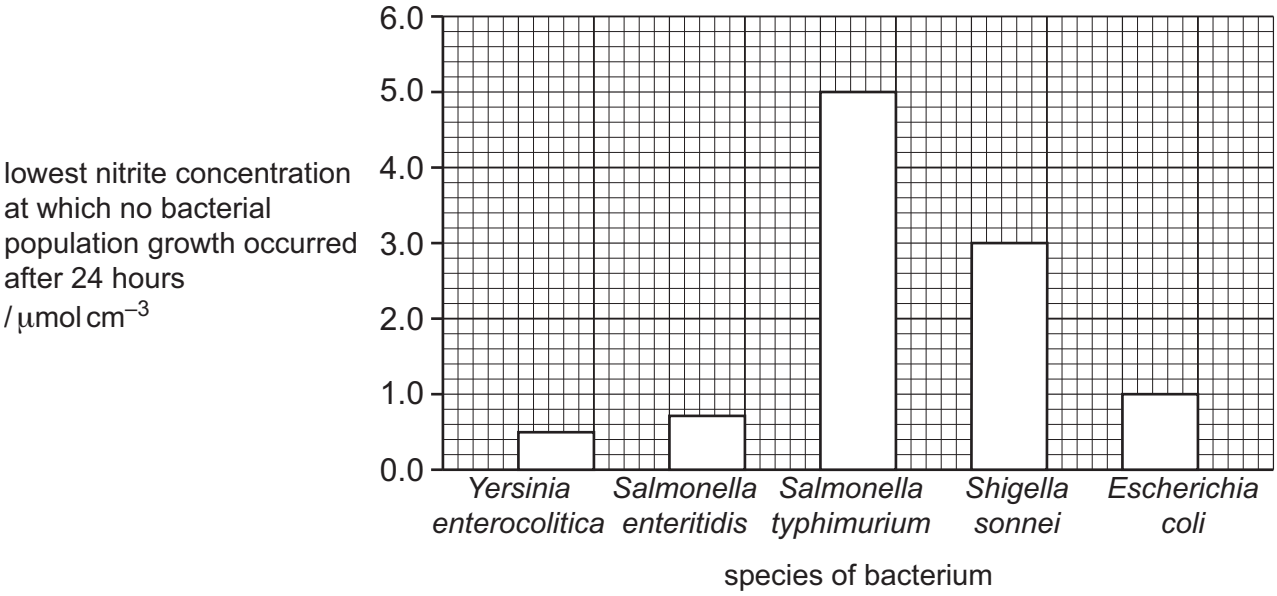


Fig. 2.1

(i) State the type of **data** represented by the species of bacterium and the lowest nitrite concentration in Fig. 2.1.

species of bacterium .....

lowest nitrite concentration .....

[2]

(ii) The 2 species of *Salmonella* shown in Fig. 2.1 are closely related.

Calculate the percentage difference between the results shown in Fig. 2.1 for the 2 species of *Salmonella*.

Show your working.

.....%

[3]

(iii) Use Fig. 2.1 to state:

- the species of bacterium that is most affected by nitrite ions
- the species of bacterium that is least affected by nitrite ions.

most affected .....

least affected .....

[1]

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(c) A student looked at the results and stated:

Consuming a lot of nitrites would improve the health of people because it would help to prevent diseases in the digestive system caused by pathogenic bacteria.

Suggest **four** reasons why this conclusion might **not** be valid.

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[4]

[Total: 12]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3707265692

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

1 hour 15 minutes

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No additional materials are needed.

INSTRUCTIONS

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[Turn over

1 The plantain lily, *Hosta plantaginea,* as shown in Fig. 1.1, is a flowering plant found in Asia.



Fig. 1.1

The hydrostatic pressure increases inside guard cells when water enters the guard cells down a water potential gradient. This affects the width of the stomata.

Fig. 1.2 shows 1 open stoma from the plantain lily surrounded by 2 guard cells.

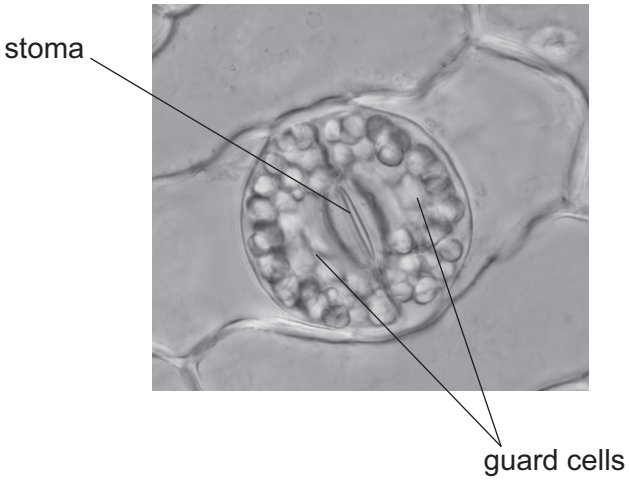


Fig. 1.2

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A student investigated the effect of different sucrose solutions on the width of stomata in the leaves of plantain lily.

The student:

- prepared 5 microscope slides as shown in Table 1.1

Table 1.1

microscope slide number	liquid added to microscope slide
1	large drop of distilled water
2	large drop of 2.5% sucrose solution
3	large drop of 5.0% sucrose solution
4	large drop of 10.0% sucrose solution
5	large drop of 20.0% sucrose solution

- removed the lower epidermis from a leaf of plantain lily
- immersed 1 small piece of lower epidermis in the drop on microscope slide 1
- placed a cover slip over the piece of lower epidermis
- observed the stomata using a light microscope fitted with an eyepiece graticule
- repeated the steps for microscope slides 2, 3, 4 and 5.

(a) (i) State the independent and dependent variables in the investigation.

independent .....

.....

dependent .....

.....

[2]

(ii) The student prepared 20 cm^3 of 2.5%, 5.0% and 10.0% sucrose solutions from a 20.0% w/v stock solution.

Complete the description of the student's dilution method for the 2.5% and 5.0% sucrose solutions by writing the correct volumes in the following sentences.

The student mixed ..... cm^3 of 20.0% sucrose stock solution with ..... cm^3 of distilled water to produce a 2.5% sucrose solution.

The student mixed ..... cm^3 of 20.0% sucrose stock solution with ..... cm^3 of distilled water to produce a 5.0% sucrose solution.

[2]

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(iii) The student observed stomata on the microscope slides using the high-power objective lens.

Outline a method the student could use to investigate the effect of the sucrose solutions in Table 1.1 on the width of stomata in the leaves of plantain lily.

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

Details of how to prepare the microscope slides should **not** be included.

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(iv) Predict the effect of increasing the sucrose concentration from 0.0% to 20.0% on the width of stomata in the leaves of plantain lily.

Explain your prediction.

prediction .....

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explanation .....

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[2]

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(b) Another piece of lower epidermis from a leaf of plantain lily was immersed in a large drop of distilled water on a microscope slide.

Fig. 1.3 shows the lower epidermis viewed using the low-power objective lens.

The student determined the stomatal density on the lower epidermis using Fig. 1.3 only.

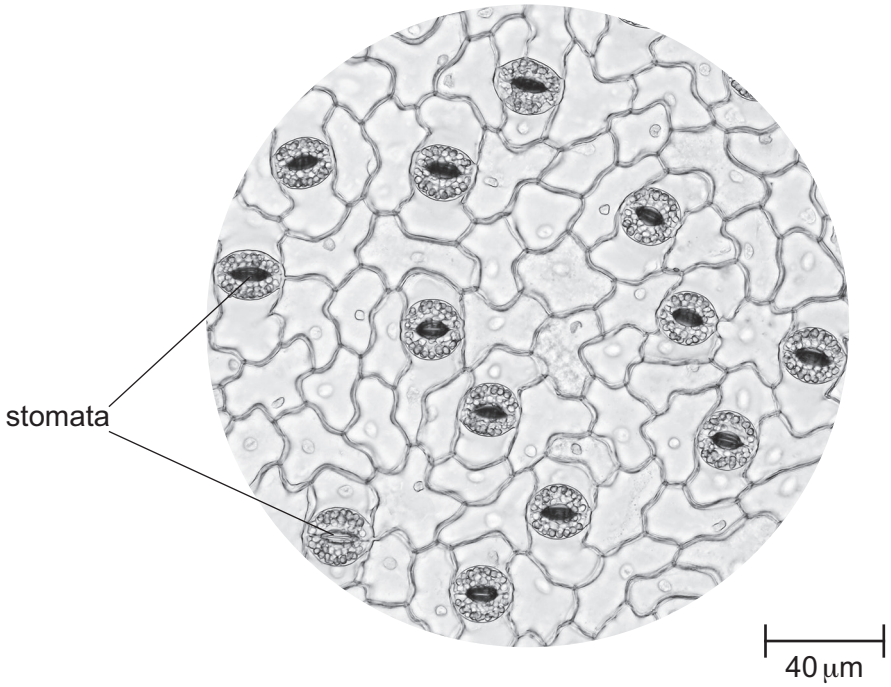


Fig. 1.3

(i) Use Fig. 1.3 to calculate the stomatal density on the lower epidermis.

Use the equation:

area = πr^2 and π = 3.14

Give your answer to the nearest whole number and show your working.

stomatal density = ... mm^{-2}

[4]

(ii) Suggest how this investigation could be improved to increase confidence in your answer in **(b)(i)**.

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(iii) A different plant species had a lower stomatal density than the value calculated for plantain lily in **(b)(i)**.

Suggest how the environmental conditions of the different plant species may vary from those of the plantain lily.

Explain your answer.

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[Total: 18]

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2 Scientists investigated the effect of abscisic acid (ABA) on reducing water loss in plants. The scientists predicted that ABA, as well as stimulating stomatal closure, also reduces water loss in plants in other ways.

The scientists used a mutant variety of thale cress, *Arabidopsis thaliana*, that has stomata that do **not** respond to ABA. When ABA is present, the stomata of the mutant variety remain open.

The scientists sprayed different concentrations of ABA on the leaves of the mutant variety and measured the transpiration rates of the plants.

The results are shown in Fig. 2.1.

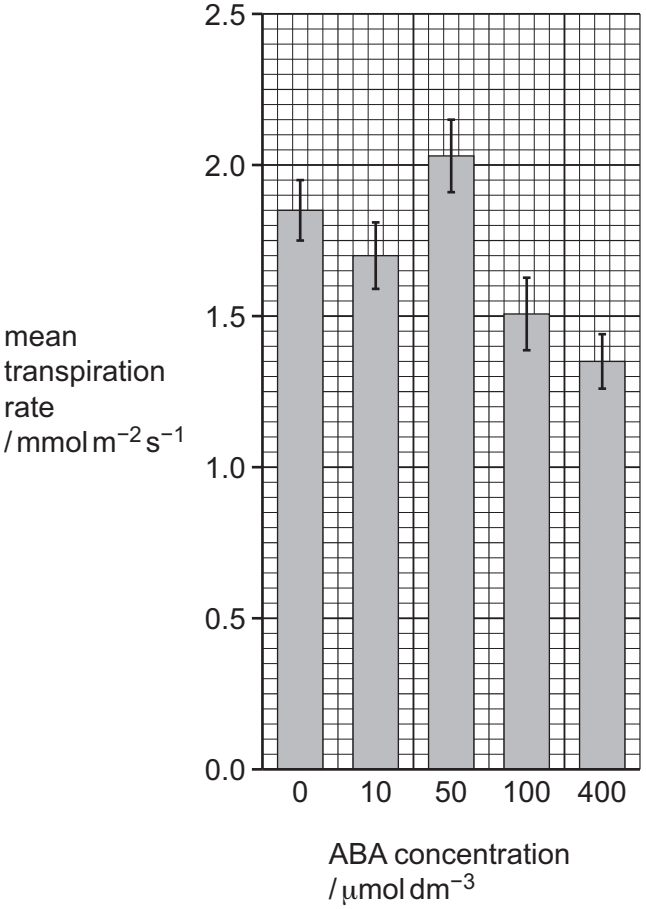


Fig. 2.1

(a) Calculate the percentage decrease in transpiration rate from 0 to 400 μmol dm^{-3} of ABA for the mutant variety.

Show your working.

percentage decrease = ...

[2]

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(b) With reference to Fig. 2.1, suggest conclusions that can be made about the effect of different concentrations of ABA on the transpiration rates of the mutant variety.

State the evidence that supports your conclusions.

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(c) The scientists used a mutant variety of thale cress that has stomata that do **not** respond to ABA.

The scientists concluded that ABA reduces water loss in thale cress by ways other than stomatal closure.

Suggest additional information that is required to increase the confidence in this conclusion.

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[Total: 7]

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3 Seeds of the common stork's-bill, *Erodium cicutarium*, are shown in Fig. 3.1.

The awn is an extension on the *E. cicutarium* seed. The seed uses the awn to push the seed head into the soil to allow the seed to germinate. The awn changes shape when the humidity changes.

Humidity is the concentration of water vapour in the air. The higher the humidity, the higher the concentration of water vapour in the air.



Fig. 3.1

A student investigated the effect of humidity on the appearance of the awn.

The student set up the apparatus as shown in Fig. 3.2.

Water can be added to the filter paper to change the humidity in the beaker surrounding the seed. Increasing the volume of water added to the filter paper increases the humidity.

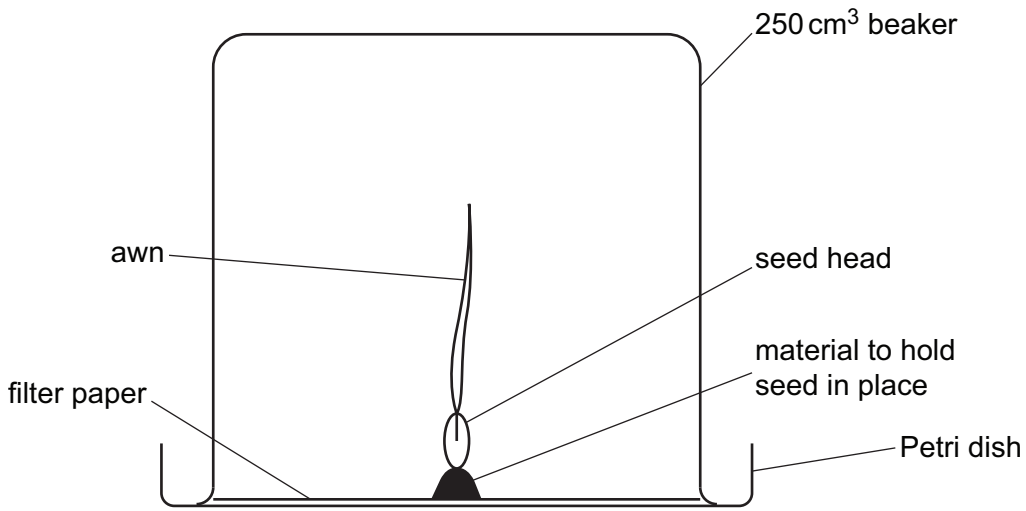


Fig. 3.2

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(a) State **two** variables the student would need to standardise for the investigation using the apparatus shown in Fig. 3.2.

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(b) Outline a method the student could use to measure the effect of different levels of humidity on the appearance of the awn, using the apparatus in Fig. 3.2.

Do **not** include standardised variables from **(a)** or a risk assessment.

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[Total: 5]

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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

T6986964 86

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

1 hour 15 minutes

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Fig. 1.1 shows a black walnut tree.

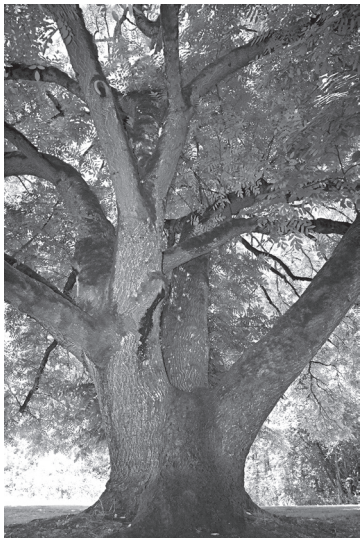


Fig. 1.1

Juglone produced by a black walnut tree can diffuse into the soil surrounding the tree.

Groups of scientists have observed that juglone affects different species of plant growing close to black walnut trees.

Juglone can reduce the percentage of seeds that germinate, delay the start of germination or reduce growth. In some studies, juglone has no effect on germination or growth.

A student planned to investigate the effect of juglone on the cucumber plant, *Cucumis sativus*.

In the investigation, the student:

- placed some damp soil containing juglone in a tray
- added some cucumber seeds to the soil
- placed the container in a suitable environment for germination and growth.

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Fig. 1.2 shows cucumber seedlings (young plants) a few days after germination.



Fig. 1.2

The student planned to compare the effect of exposing cucumber seeds to:

- juglone solution with a concentration of 1.0×10^{-3} mol dm^{-3}, which is a concentration that has been measured in soils surrounding black walnut trees
- a control treatment.

The student planned to determine:

- the percentage of cucumber seeds that germinated in soil
- the growth of each cucumber seedling 10 days after the appearance of the seedling above the soil.

(a) Identify the independent variable in this investigation.

..... [1]

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(b) Juglone solutions are prepared using a mixture of solvents.

The student was provided with:

- a juglone solution with a concentration of $0.1\,\text{mol}\,\text{dm}^{-3}$
- the mixture of solvents.

Using the solution provided, the student prepared a juglone solution with a volume of $500\,\text{cm}^3$ and a concentration of $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$.

The student carried out 1 dilution to prepare the $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$ solution using measuring cylinders.

(i) State the volumes that the student used to carry out the dilution to produce $500\,\text{cm}^3$ of $1.0 \times 10^{-3}\,\text{mol}\,\text{dm}^{-3}$ juglone solution.

.....

..... [2]

(ii) Outline **one** improvement the student could make to reduce the percentage error while carrying out the dilution.

.....

.....

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(c) **(i)** State a suitable control that the student could use, **and** explain why the student decided to include a control in the investigation.

control .....

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explanation .....

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[2]

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(ii) Describe a method the student could use to investigate the effect of juglone on:

- the percentage of cucumber seeds that germinate
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The student recorded the number of days required for germination of:

- 10 seeds treated with a juglone solution with a concentration of 1.0×10^{-3} mol dm^{-3}
- 10 seeds not treated with a juglone solution.

(i) The student used the *t*-test to analyse the results. The *t*-test is appropriate for the number of seeds that were used.

Suggest **two other** reasons why the *t*-test is an appropriate statistical test to use for this investigation.

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(ii) The null hypothesis for this *t*-test was:

There is no difference between the time taken for seeds to germinate when treated with juglone and the time taken for seeds to germinate when not treated with juglone.

The calculated value of *t* was **2.090**.

The student compared **2.090** to the values in Table 1.1.

Table 1.1

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..... [3]

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2 Compounds containing nitrite ions (NO_2^-) are present in many foods eaten by humans.

Scientists tested the effect of different concentrations of nitrite ions on the population growth of 5 species of bacterium. All 5 species are pathogenic and can infect the human digestive system.

For each species of bacterium, the scientists placed suspensions of the bacteria in a microwell plate. A microwell plate is a plastic plate containing 96 wells, which are similar to small test-tubes.

In each well, the scientists added:

- a suspension of the bacterial species
- a solution containing nitrite ions
- nutrient broth.

The scientists incubated the microwell plate at 37 °C for 24 hours. After 24 hours, the scientists estimated the number of bacteria in each well by measuring optical density, using a microwell plate reader.

For each species of bacterium, the scientists repeated the experiment with several different concentrations of solution containing nitrite ions.

The scientists determined the lowest nitrite concentration at which no bacterial population growth had occurred after 24 hours.

(a) The scientists standardised temperature, pH (pH 4.8) and time in the investigation.

State **two other** variables that the scientists should standardise in this investigation.

1 .....

2 .....

[2]

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(b) The results of the investigation are shown in Fig. 2.1.

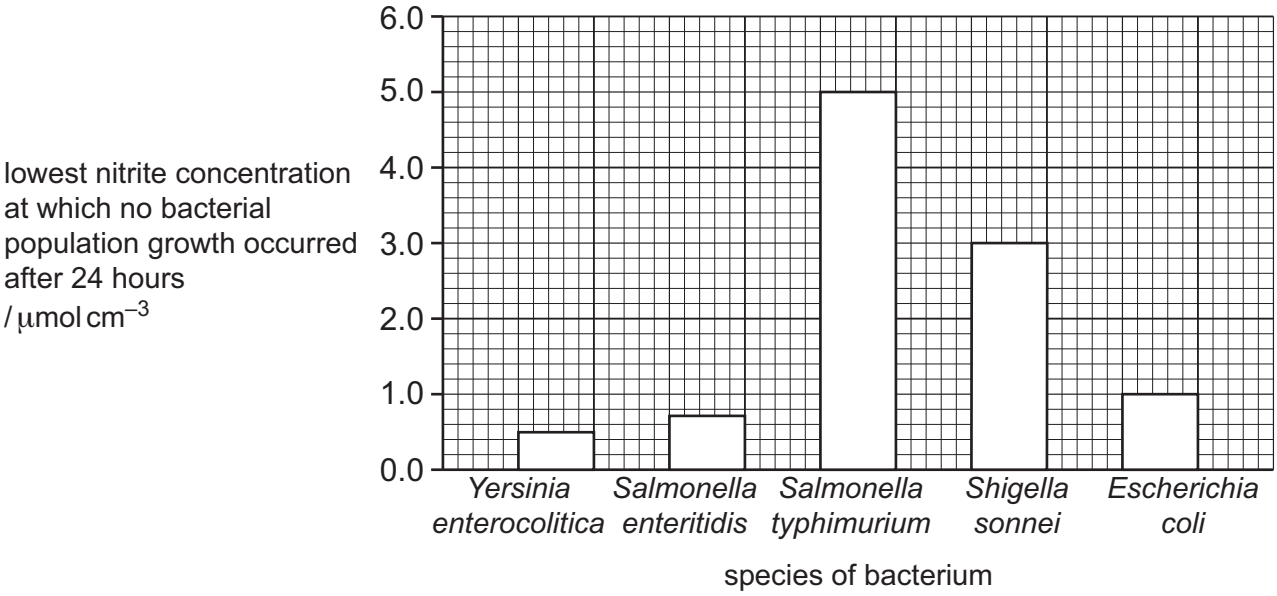


Fig. 2.1

(i) State the type of **data** represented by the species of bacterium and the lowest nitrite concentration in Fig. 2.1.

species of bacterium .....

lowest nitrite concentration .....

[2]

(ii) The 2 species of *Salmonella* shown in Fig. 2.1 are closely related.

Calculate the percentage difference between the results shown in Fig. 2.1 for the 2 species of *Salmonella*.

Show your working.

.....%

[3]

(iii) Use Fig. 2.1 to state:

- the species of bacterium that is most affected by nitrite ions
- the species of bacterium that is least affected by nitrite ions.

most affected .....

least affected .....

[1]

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(c) A student looked at the results and stated:

Consuming a lot of nitrites would improve the health of people because it would help to prevent diseases in the digestive system caused by pathogenic bacteria.

Suggest **four** reasons why this conclusion might **not** be valid.

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[4]

[Total: 12]

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3307575406

BIOLOGY **9700/54**

Paper 5 Planning, Analysis and Evaluation **October/November 2025**

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.

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[Turn over

1 *Beta vulgaris vulgaris*, as shown in Fig. 1.1, is a food crop with a swollen, edible root known as beetroot.

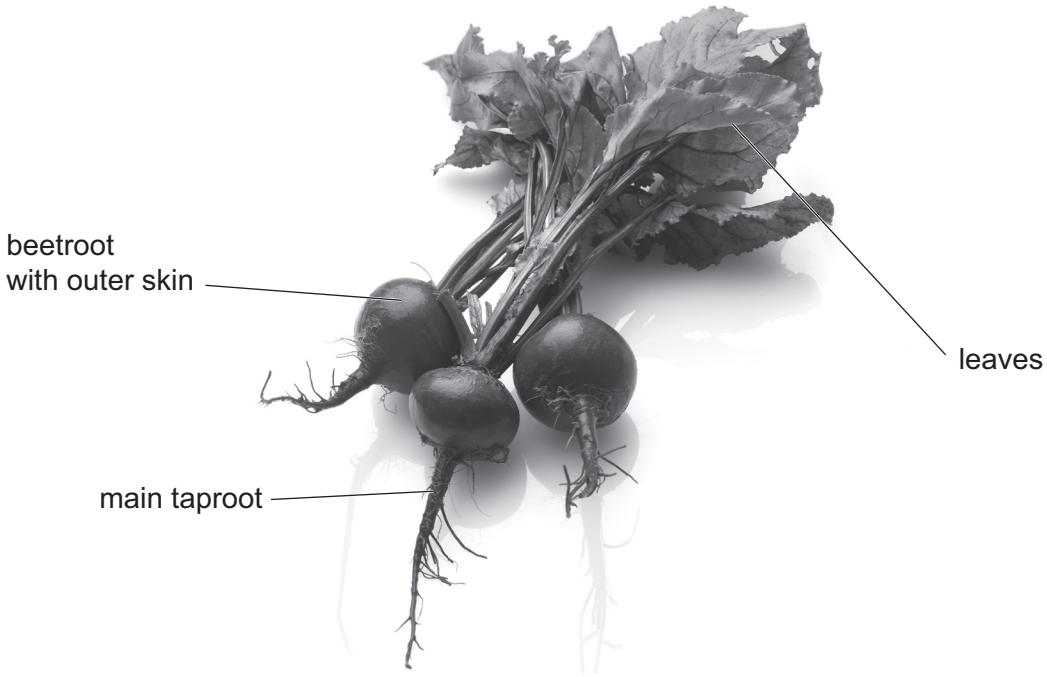


Fig. 1.1

A student determined the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

The student used distilled water and a stock solution of 2.0 mol dm^{-3} sucrose to prepare a range of sucrose solutions.

Each sucrose solution was prepared using proportional dilution and had a final volume of 30 cm^3.

(a) Complete Table 1.1 to show how the concentrations were made.

Table 1.1

final concentration of sucrose solution / mol dm^{-3}	volume of distilled water / cm^3	volume of 2.0 mol dm^{-3} stock sucrose solution / cm^3
2.0	0.0	30.0
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
0.0	30.0	0.0

[2]

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(b) Describe a method the student could use to collect the data needed to determine the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

The student was supplied with the sucrose solutions prepared in **1(a)** and standard laboratory equipment.

Do **not** include details of how the student:

- prepared the sucrose solutions in **1(a)**
- would use the data collected to determine the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

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

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(c) The student calculated the mean percentage change in mass of the beetroot for each concentration of sucrose solution.

(i) The student plotted these calculated values to obtain a line graph.

Complete Fig. 1.2 by:

- labelling the axes
- sketching the line that the student obtained.



Fig. 1.2

[2]

(ii) Explain how the student used the completed line graph in Fig. 1.2 to estimate the concentration of sucrose solution that has the same water potential as the cells of the beetroot.

.....

.....

..... [1]

(iii) The cells of the beetroot contain a red pigment which can leak out into the solution when the tissue is cut. The student noticed that each sucrose solution was coloured red at the end of the investigation.

Suggest **one** improvement the student could make to the method to reduce the amount of red pigment in each sucrose solution.

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..... [1]

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Question 2 starts on page 6.

2 The buff-tailed bumblebee, *Bombus terrestris*, is an insect that uses its tongue to feed on the nectar and pollen of flowers.

Buff-tailed bumblebees can feed on the nectar and pollen of flowers by either gripping (holding) onto flower petals or by hovering (flying) in front of the flowers.

Fig. 2.1 shows the buff-tailed bumblebee.

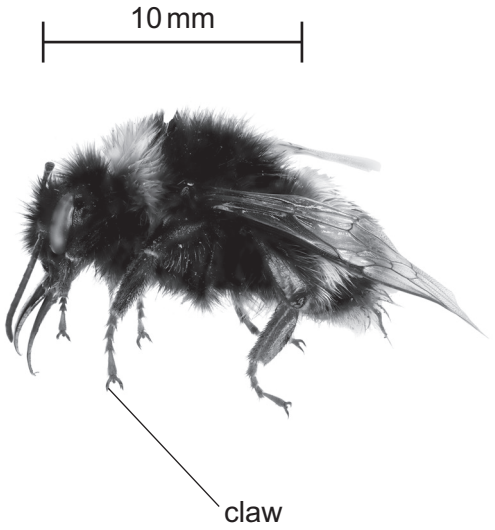


Fig. 2.1

The buff-tailed bumblebee has adaptations, such as claws, to help it to grip on to flower petals to obtain nectar and pollen.

Fig. 2.2 shows the buff-tailed bumblebee using its claws to grip on to the flower petals as the bee feeds.



Fig. 2.2

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Fig. 2.3 is a magnified image of the claw of a bee.

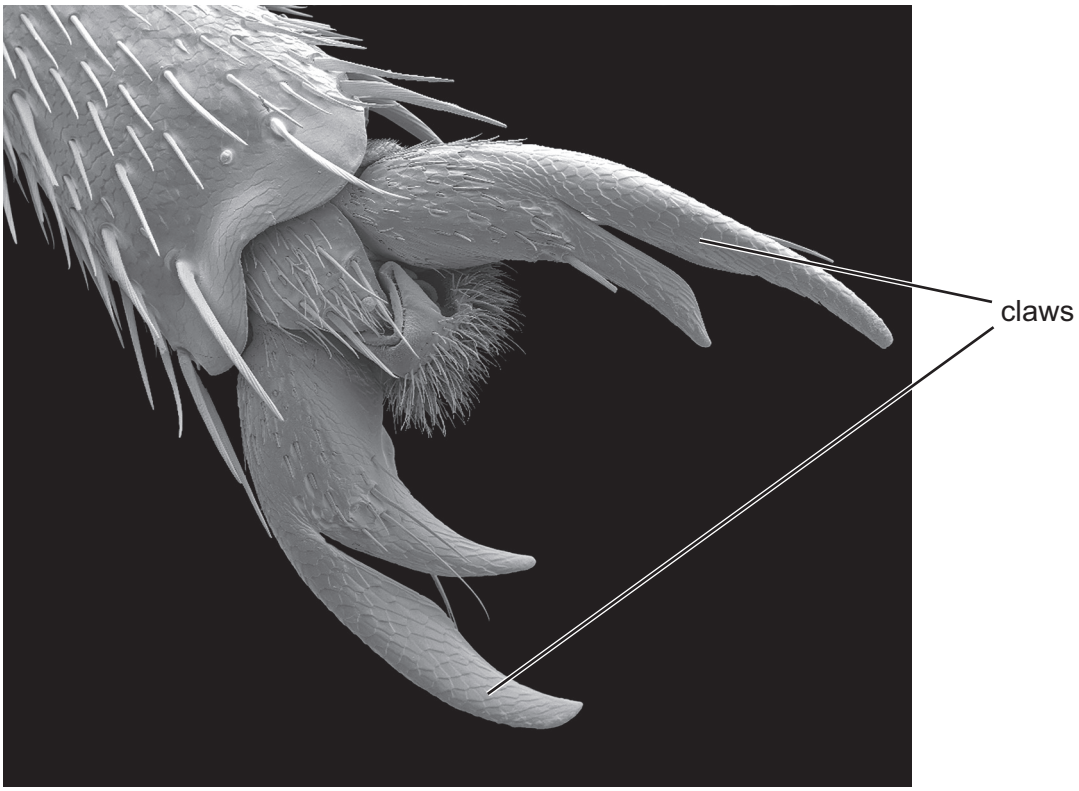


Fig. 2.3

(a) Suggest a method that can be used to measure the image length of the longest part of the curved claw in Fig. 2.3.

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..... [1]

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(b) The surfaces of flower petals of different plant species have different textures.

Fig. 2.4 shows a scanning electron micrograph of a rough surface of a flower petal.

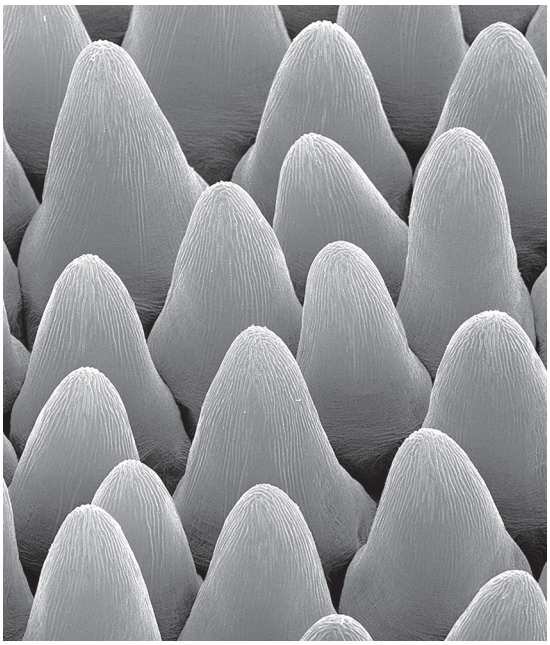


Fig. 2.4

Fig. 2.5 shows a scanning electron micrograph of a smoother surface of a flower petal.

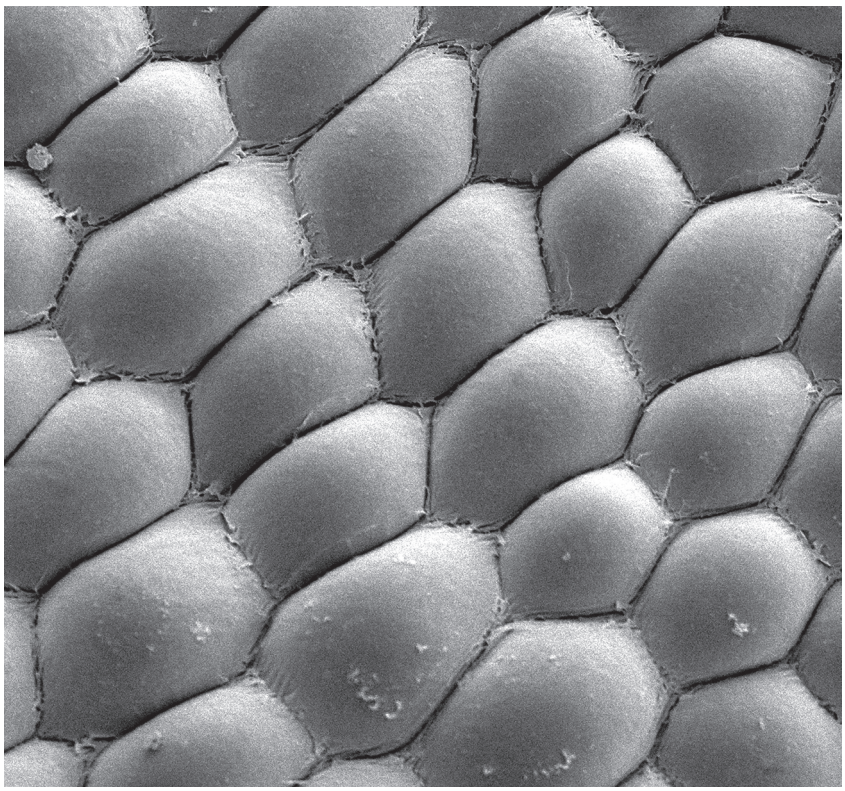


Fig. 2.5

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A scientist made an artificial flower apparatus, as shown in Fig. 2.6.

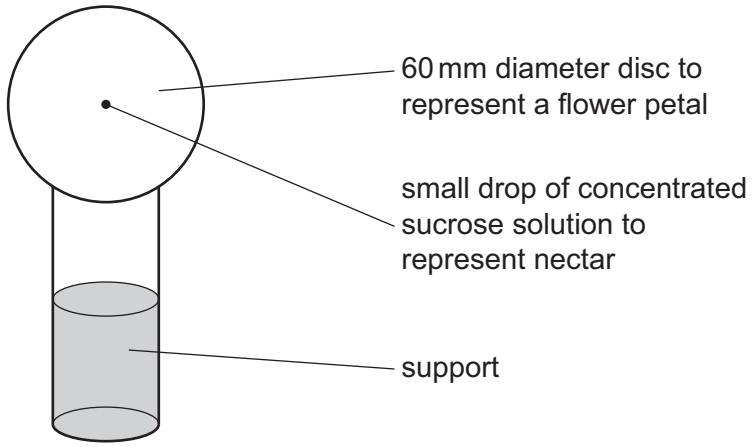


Fig. 2.6

To model flower petals with different levels of roughness, the scientist used different discs.

Each disc was made using particles of different diameters attached to the surface of the disc, as shown in Table 2.1.

Table 2.1

mean particle diameter on the disc / μm	level of roughness
5	smooth ↓
9	
12	
16	
30	
53	rough

(i) The diameter of each disc was standardised as 60 mm.

Identify **one** other variable the scientist should standardise when making the discs.

.....

.....

..... [1]

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(ii) The scientist investigated if the level of roughness of the discs affects whether buff-tailed bumblebees grip on to the disc or hover when they feed (feeding visit) from the small drop of concentrated sucrose solution.

For each disc, the scientist:

- recorded the number of feeding visits when the buff-tailed bumblebees gripped on to the disc
- recorded the number of feeding visits when the buff-tailed bumblebees hovered in front of the disc
- calculated the percentage of feeding visits when the buff-tailed bumblebees gripped on to the disc.

State the **independent** variable in this investigation.

.....

..... [1]

(iii) For the disc with a mean particle diameter of 16 μm, the scientist calculated that the buff-tailed bumblebees gripped on to the disc for 79% of their feeding visits.

The total number of feeding visits was 117.

Calculate the number of feeding visits when the buff-tailed bumblebees hovered in front of the disc.

Give your answer to the nearest whole number.

number of feeding visits when the buff-tailed bumblebees hovered = ... [1]

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(iv) Fig. 2.7 shows the results of the investigation.

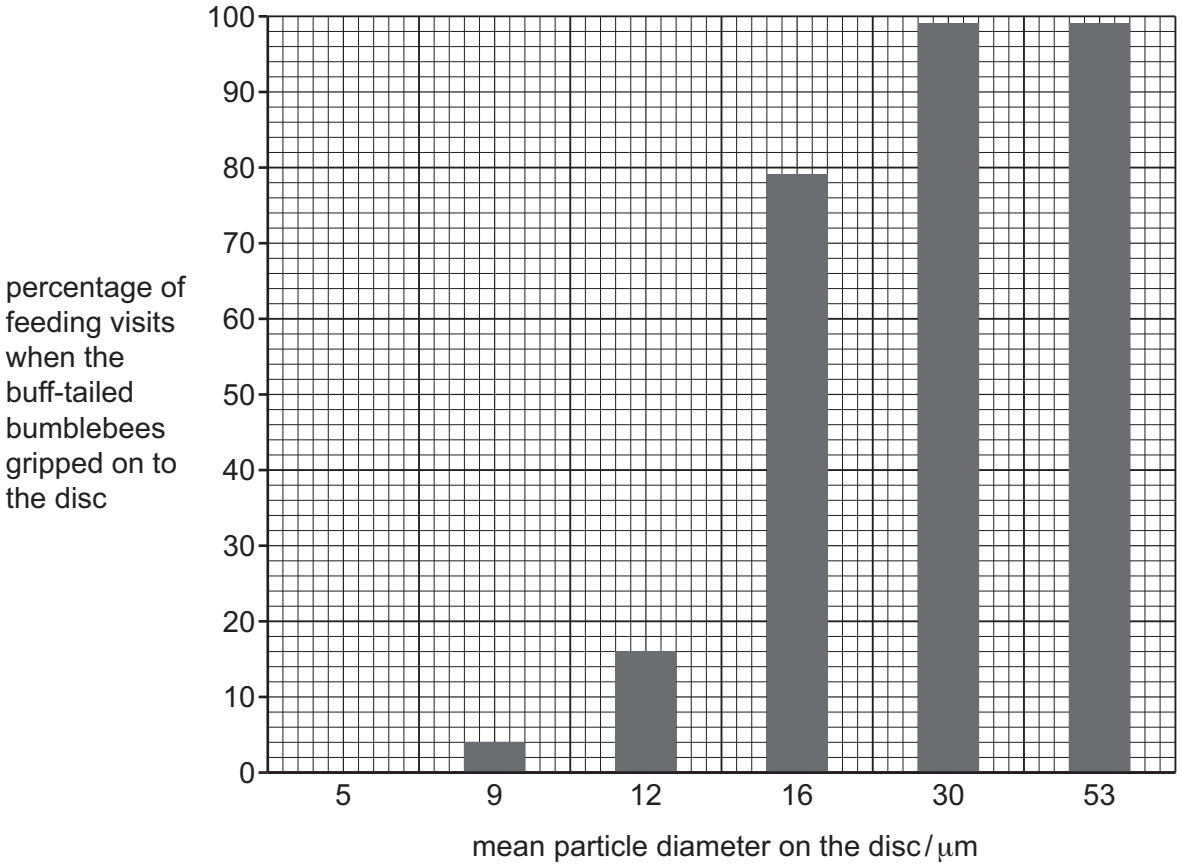


Fig. 2.7

State **two** conclusions that can be made from the results in Fig. 2.7.

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..... [2]

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(c) A student used the Spearman's rank correlation to analyse the data in Fig. 2.7.

The student stated the null hypothesis as:

There is no correlation between the mean particle diameter on the disc and the percentage of feeding visits when the buff-tailed bumblebees gripped on to the disc.

The formula for Spearman's rank correlation (r_s) is:

$$r_s = 1 - \left(\frac{6 \times \Sigma D^2}{n^3 - n} \right)$$

key to symbols:
D = difference in rank between each pair of measurements

n = number of pairs of items in the sample

(i) Complete Table 2.2 to calculate ΣD^2.

Table 2.2

mean particle diameter on the disc / μm	rank of mean particle diameter on the disc	percentage of feeding visits when the buff-tailed bumblebees gripped on to the disc	rank of percentage of feeding visits when the buff-tailed bumblebees gripped on to the disc	Difference in rank, D	D^2
5	1	0			
9	2	4			
12	3	16			
16	4	79			
30	5	99			
53	6	99			
				$\Sigma D^2 =$	

[2]

(ii) Use the calculated value for ΣD^2 from Table 2.2 to calculate r_s.

$r_s =$ ..... [1]

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(iii) Table 2.3 shows the critical values of r_s at the 0.05 probability level.

Table 2.3

n	5	6	7	8	9	10	11	12
critical value of r_s	0.90	0.83	0.71	0.64	0.60	0.56	0.54	0.50

Use the data from Table 2.3 to explain why the student rejected the null hypothesis.

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..... [1]

[Total: 10]

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3 **(a)** Pectin is a polysaccharide found in plant cell walls. Pectinase is an enzyme that hydrolyses pectin.

A student investigated the use of pectinase to extract more juice from different types of fruit.

The student:

- removed the outer skin and cut each type of fruit into small pieces
- placed each type of fruit into a separate beaker with 5 cm^3 of 1% pectinase solution
- incubated the mixture at 60 °C for 10 minutes
- passed the contents of the beaker through a filter funnel into a measuring cylinder
- measured the volume of juice extracted from each type of fruit.

Table 3.1 shows the results.

Table 3.1

type of fruit	volume of juice extracted / cm^3			
	sample 1	sample 2	sample 3	mean of samples
apple	16	17	17	.....
orange	30	37	33	.....
pineapple	41	44	45	.....
grapes	17	15	11	.....

(i) Complete Table 3.1 by calculating the means. [1]

(ii) The independent variable is the type of fruit and the dependent variable is the volume of juice extracted.

Complete Table 3.2 to show the type of variable and the type of data.

Table 3.2

	type of variable	type of data
type of fruit		
volume of juice extracted		

[2]

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(iii) State **two** changes the student should make to their method to improve the quality of their results.

.....

.....

.....

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..... [2]

(b) The student wanted to determine the quantity of pectin in the cell walls of different types of fruit.

Suggest why the student could **not** use the experiment in **3(a)** to determine the quantity of pectin in the cell walls of different types of fruit.

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..... [2]

[Total: 7]

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