Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

5699843206

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2016**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **10** printed pages and **2** blank pages.

DC (AL) 135524/1

CAMBRIDGE International Examinations

[Turn over

1 (a) The opening and closing of stomata involves the movement of potassium ions into and out of guard cells. Opening and closing of stomata is influenced by a number of environmental factors, for example light and temperature.

A student investigated the effect of potassium chloride (KC*l*) on the opening of stomata.

The student was provided with:

- $500\,cm^3$ of $250\,mmol\,dm^{-3}$ KC*l* solution
- freshly picked leaves from a plant that had been kept in the dark and a high concentration of carbon dioxide for an hour. This ensured that all the stomata were closed.

Strips of leaf tissue were obtained by cutting a leaf into sections as shown in Fig. 1.1.

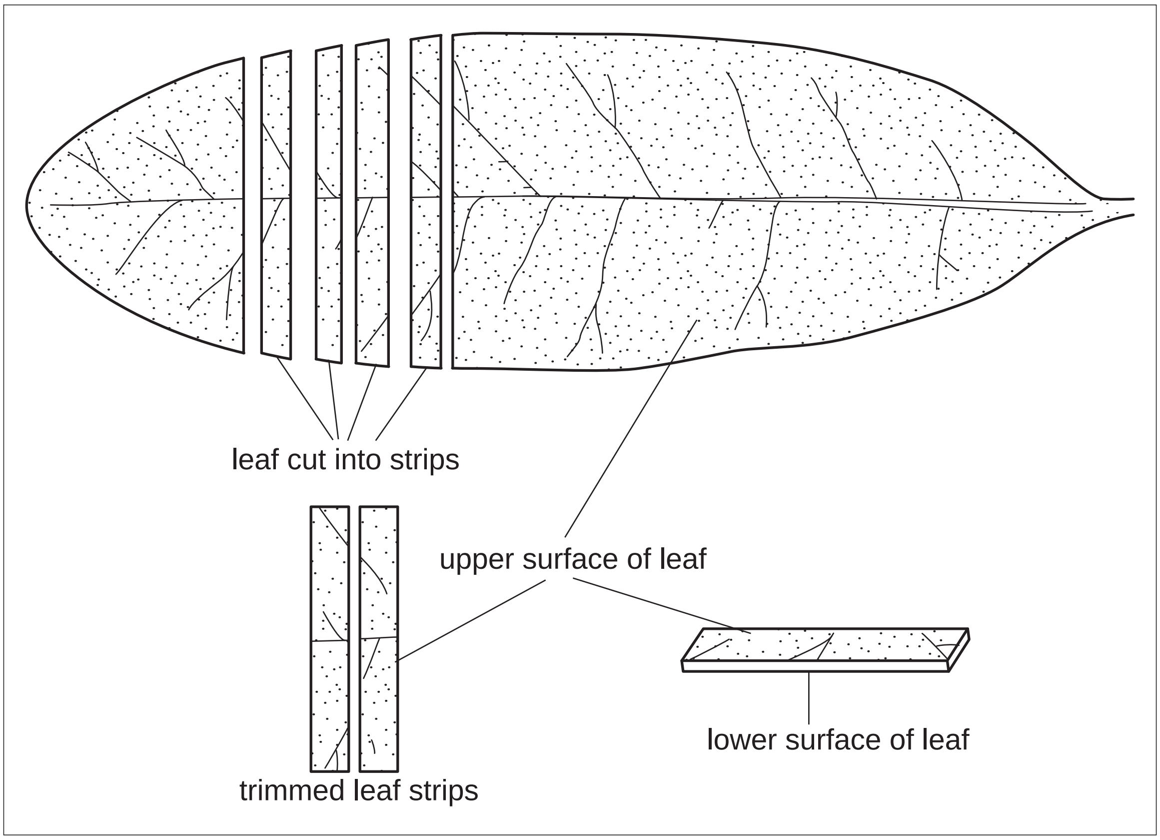

Fig. 1.1

The student floated three strips of leaf tissue in each of a range of buffered potassium chloride solutions for 2 hours and then recorded the number of open stomata.

(i) Identify the independent and dependent variables in this investigation.

independent variable ....

....

dependent variable ....

....[2]

(ii) The student used the 250 mmol dm^{-3} KC*l* solution to make 100 cm^3 of four other concentrations by reducing the concentration by 50 mmol dm^{-3} each time.

Describe a procedure that the student could use to prepare these four concentrations.

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....[3]

(b) **(i)** Suggest a hypothesis that the student could test about the effect of KC*l* on the opening and closing of stomata.

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....[1]

(ii) Describe a method that the student could use to investigate the effect of different concentrations of KC*l* on the opening of stomata.

The description of your method should be detailed enough for another person to follow and should **not** repeat the details from **(a)(ii)** of how to dilute the 250 mmol dm^{-3} solution of KC*l*.

....[5]

(c) The student also tested the hypothesis:

The more light the wider the stomata open.

- Eight leaves from young plants that had been kept in the dark for 24 hours were covered by metal foil.
- A fluorescent lamp of fixed intensity was placed 10 cm from the plant. The metal foil was removed from the leaves.
- Two leaves were removed at the start of the experiment and three epidermal strips were made from each leaf. An epidermal strip is made by peeling the epidermis from a leaf as a single layer.
- The diameter of the stomatal aperture of five of the stomata with the widest aperture on each strip was measured.
- At one hour intervals two more leaves were removed and the same procedure repeated.

Fig. 1.2 shows stomata at different stages of opening.

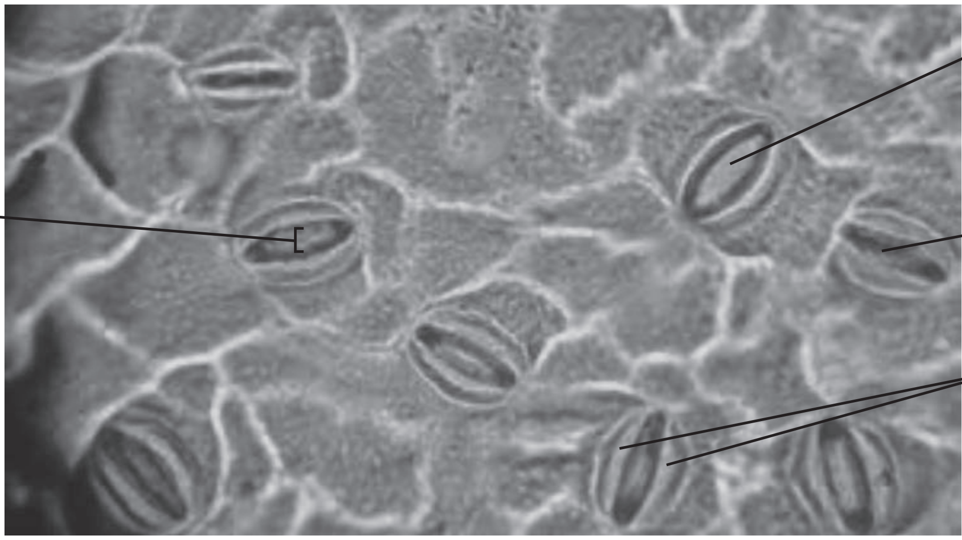

Fig. 1.2

(i) Outline how the student could find the actual diameter of a stomatal aperture.

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....[2]

Table 1.1 shows the results of the student's experiment.

Table 1.1

time / min	diameter of stomatal aperture / µm														
0 (control)	0.5	0.1	0.2	0.3	0.4	0.1	0.5	0.2	0.3	0.3	0.1	0.2	0.2	0.2	0.4
60	0.9	1.1	1.0	1.3	1.2	1.8	1.5	0.8	0.2	1.3	1.1	0.8	1.0	1.9	0.9
120	1.9	2.4	2.6	2.6	2.5	2.2	2.8	2.4	2.4	3.9	2.6	2.3	2.5	2.2	2.7
180	4.1	4.8	4.2	4.0	5.7	4.7	3.9	4.1	5.5	4.5	4.3	4.0	3.1	4.1	4.3

(ii) **On Table 1.1**, draw circles around **two** values that are anomalous. [1]

(iii) The student calculated the mean diameter of the stomatal apertures and the rate at which the diameter of the stomatal apertures increased.
Table 1.2 shows some of these calculations.

Table 1.2

time / min	mean diameter of stomatal apertures / µm	rate of increase of diameter of the stomatal apertures / µm min^{-1}
0	0.3	
60	1.2	0.015
120	2.5	0.022
180	4.6	

Complete Table 1.2 by calculating the rate of increase of the diameter of the stomatal apertures between 120 minutes and 180 minutes.

Space for working

[1]

(iv) The experimental procedure described in **(c)** could be criticised for poor technique in obtaining results.

Suggest how the procedure could be modified to improve the quality of these results.

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....[3]

(d) The experimental procedure used in **(c)** is not completely valid for the stated hypothesis:

The more light the wider the stomata open.

Suggest how this hypothesis could be modified to match the procedure described in **(c)**.

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....[1]

[Total: 19]

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2 Cereal crops are often sprayed with selective herbicides which can reduce the population of the local wildlife. One method of helping to conserve wildlife is to leave a 6 m strip, called a headland, around fields where cereal crops are grown. The headland is not sprayed with any herbicides.

An investigation was carried out into the effect on the butterfly populations of leaving headlands unsprayed.

- Two groups of 20 fields growing the same cereal crop were studied.
- The headlands of one group of 20 fields were left unsprayed by herbicide.
- The headlands of the other group of 20 fields were sprayed with herbicide.
- The total number of each species of butterfly was counted in each group of 20 fields.
- A chi-squared (χ^2) test was used to find out if the differences in the butterfly populations were significant.

(a) State two variables that were standardised in this investigation.

1 ....

2 ....[1]

(b) **(i)** State a reason why the chi-squared (χ^2) test is suitable to use for comparing the butterfly populations.

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....[1]

(ii) State a null hypothesis for the chi-squared test for this investigation.

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....[1]

(iii) Table 2.1 shows the results for one of the species of butterfly, species **Q**.

Complete Table 2.1 to calculate the value of χ^2 using the equation below.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$$v = c - 1$$

O = observed result
E = expected result
v = degrees of freedom
c = number of classes

Table 2.1

species **Q**	O	E	$(O - E)^2$	$\frac{(O - E)^2}{E}$
number on headland sprayed with herbicide	3			
number on headland not sprayed with herbicide	37			

χ^2 = ...[3]

Table 2.2 shows some chi-squared (χ^2) values.

Table 2.2

degrees of freedom	p <			
	0.10	0.05	0.01	0.001
1	2.71	3.84	6.64	10.83
2	4.61	5.99	9.21	13.82
3	6.25	7.82	11.34	16.27

(iv) State the critical value at $p < 0.05$ for this chi-squared test. ....[1]

(v) State what you conclude from the result of the chi-squared test for species **Q**.

....[1]

Table 2.3 shows the results of the investigation and the significance of the results from chi-squared tests for the other species of butterflies counted.

Table 2.3

butterfly species	number of each species on headland sprayed with herbicide	number of each species on headland not sprayed with herbicide	significance of chi-squared test
R	1	17	p< 0.001
S	38	56	not significant
T	13	29	p< 0.05
U	59	93	p< 0.05
V	0	11	p< 0.01
W	23	52	p< 0.01

(c) With reference to Table 2.3 **and** your calculation for species **Q**, state **three** conclusions that can be drawn from these results about the effect of herbicides on the species of butterfly studied.

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....[3]

[Total: 11]

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