UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1001250705

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2010**

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 a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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.

For Examiner's Use	
1	
2	
Total	

This document consists of **7** printed pages and **1** blank page.

1 A student noticed that the leaves on a plant growing close to a wall had two sorts of leaves. The leaves next to the wall were in the shade and looked different from the leaves on the side away from the wall that were exposed to the sun. The length of the internodes on the stem also looked different.

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The student decided to investigate the differences by measuring some features of 30 leaves and internodes from each side of the plant.

Fig. 1.1 shows the leaf shape

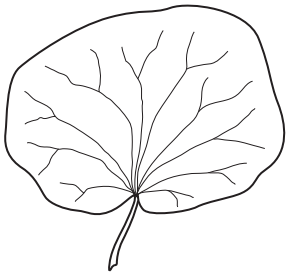

Fig. 1.1

Fig. 1.2 shows an internode

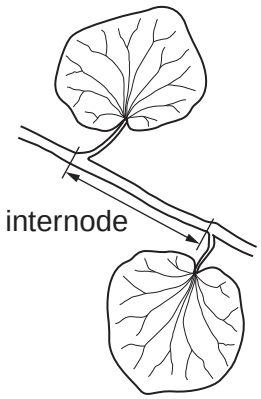

Fig. 1.2

Table 1.1 shows the student's results.

Table 1.1

	shaded leaves	**exposed leaves**
mean internode length / mm	23 ± 4	15 ± 3
mean surface area of leaves / mm^2	2750 ± 12	1800 ± 15
mean mass of leaves / mg	50 ± 8	60 ± 10
mean leaf surface area : leaf mass ratio	55 ± 9	30 ± 6
rate of water loss / mg mm^{-2} h^{-1}	50 ± 11	65 ± 12

(a) (i) State the independent variable being investigated.

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(ii) Outline the procedures the student could use to obtain these results.

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The student carried out *t*-tests for leaf surface area : leaf mass ratio and for internode length.

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The leaf surface area : leaf mass ratio gave the value ***t* = 12.6**

The formula for *t*-test is

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

(b) (i) Complete the calculation to find the value of *t* for the internode length. Show your working.

$t =$ $\quad\quad$ $\frac{\quad -}{\sqrt{\frac{4^2}{30} + \quad -}}$

$=$ $\quad\quad$ $\frac{}{0.9}$

t = ...[3]

Table 1.2 shows the critical values at p < 0.05 for the *t*-test.

Table 1.2

degrees of freedom	18	20	21	22	23	24	25	26	27	28	29	30	40	60	∞
critical value	2.10	2.09	2.08	2.07	2.06	2.06	2.06	2.06	2.05	2.05	2.04	2.04	2.02	2.00	1.96

The number of degrees of freedom is 58.

(ii) State how the number of degrees of freedom was calculated.

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(iii) State and explain the meaning of these results.

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In a further investigation, the student cut sections of the leaves from the shaded side and from the exposed side of the plant. The following procedures were carried out:

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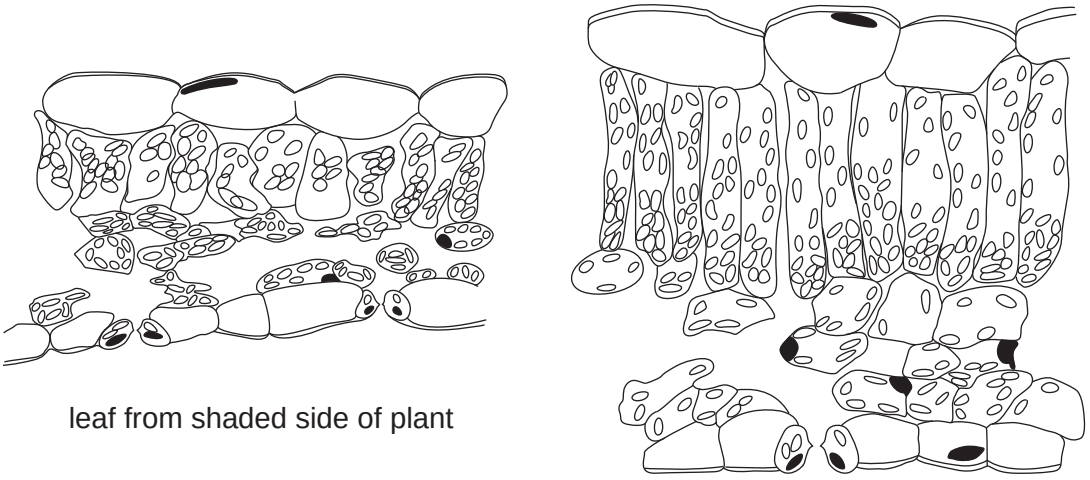
Transverse sections were made of each leaf and high-power drawings were made from these sections. The relative thickness of both the leaf and the cuticle were measured using an eyepiece graticule and the difference in the distribution of chloroplasts was observed.

Fig. 1.3 shows drawings made from transverse sections of these leaves.



leaf from shaded side of plant

leaf from exposed side of plant

Fig. 1.3

(c) (i) Explain how the actual thickness of the leaf could be measured.

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(ii) With reference to the student's results, state what conclusions can be drawn about the differences in adaptations shown by shaded leaves and exposed leaves of the plant.

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.....[3]

[Total: 20]

2 Fig. 2.1 shows a freshwater crustacean. This animal has a two-chambered heart that can be seen through the exoskeleton.

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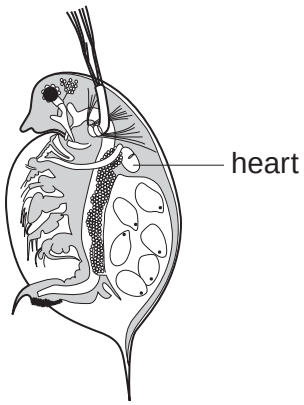

Fig. 2.1

An investigation into the effect of temperature on heart rate was carried out using this organism to test the hypothesis:

Heart rate doubles for every 10 °C increase in temperature.

Five crustaceans, each measuring 5 mm in length, were placed in water of different temperatures and left for five minutes. The heart beat was counted for 20 seconds using a tally counter and stop watch. Table 2.1 shows the results of the investigation.

Table 2.1

	heart rate / beats per minute						
	temperature / °C						
	5	10	15	20	25	30	35
specimen 1	30	45	63	96	132	165	84
specimen 2	33	51	69	105	150	171	87
specimen 3	33	48	66	93	130	174	69
specimen 4	45	57	87	111	168	183	78
specimen 5	24	36	51	78	120	135	75

(a) (i) Identify two variables that have been controlled during this investigation.

1. .....

2. .....[2]

(ii) Suggest **one** other variable that should be controlled.

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(iii) Suggest **one** feature of the procedure which may cause the results to be inaccurate.

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(iv) Suggest a reason why the student used five specimens at each temperature.

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The student calculated the percentage change in heart rate for each specimen.
Table 2.2 shows these results.

Table 2.2

	percentage change in heart rate					
	temperature / °C					
	5–10	10–15	15–20	20–25	25–30	30–35
specimen 1	50	40	52	38	25	-49
specimen 2	55	35	52	42	14	-49
specimen 3	45	38	40	39	34	-60
specimen 4	27	52	28	51	9	-57
specimen 5	50	41	53	54	12	-44

(b) (i) Suggest why the student converted the raw data to percentage change.

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(ii) Describe how the percentage change between 25 °C and 30 °C was calculated.

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(iii) Predict the effect on the heart rate of an increase in temperature to 40 °C.

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(c) Assess how far the results of the investigation support the hypothesis.

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.....[2]

[Total: 10]

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