UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0790342953

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 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 soft 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 **both** 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	

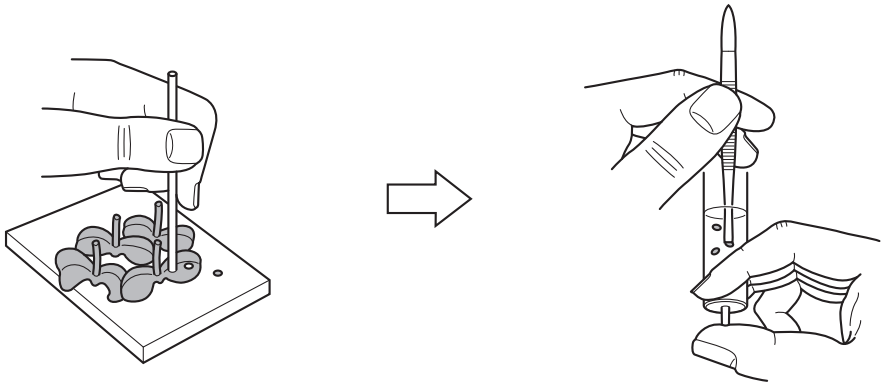
This document consists of **10** printed pages and **2** blank pages.

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1 Many plants produce two types of leaves. One type is produced where the leaves develop in full sunlight and are called 'sun leaves'. The other type is produced where the leaves develop in the shade and are called 'shade leaves'.

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A student investigated photosynthesis in both types of leaves using leaf discs. Fig. 1.1 shows the method used by the student to obtain the leaf discs.



1. leaf discs cut using a plastic straw

2. forceps used to place six leaf discs into 0.2 mol dm^{-3} sodium hydrogen carbonate solution in a syringe barrel

Fig. 1.1

The student then carried out the following actions:

3. replaced the plunger into the syringe, turned the syringe upside down and pushed in the plunger to force out all the air
4. placed a finger over the open end of the syringe and pulled down the plunger to create a vacuum
5. tapped the side of the syringe to remove air bubbles
6. repeated actions 3–5 until the leaf discs sank to the bottom of the syringe.

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The student measured the rate of photosynthesis of discs from both types of leaves to test the hypothesis

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Leaf discs from shade leaves will photosynthesise at a higher rate in low light intensity than leaf discs from sun leaves.

Fig. 1.2 shows the appearance of the leaf discs in the syringe as they photosynthesise.

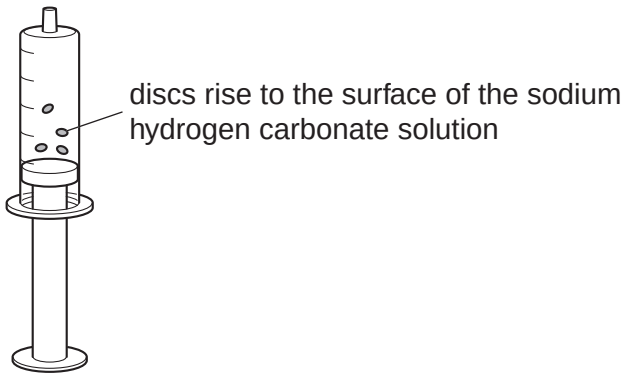


Fig. 1.2

(a) (i) Explain why the leaf discs rise to the surface in the light.

.....

..... [1]

(ii) Using this method, outline how the student could test the hypothesis.

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[7]

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Fig. 1.3 shows the results that the student plotted from the investigation.

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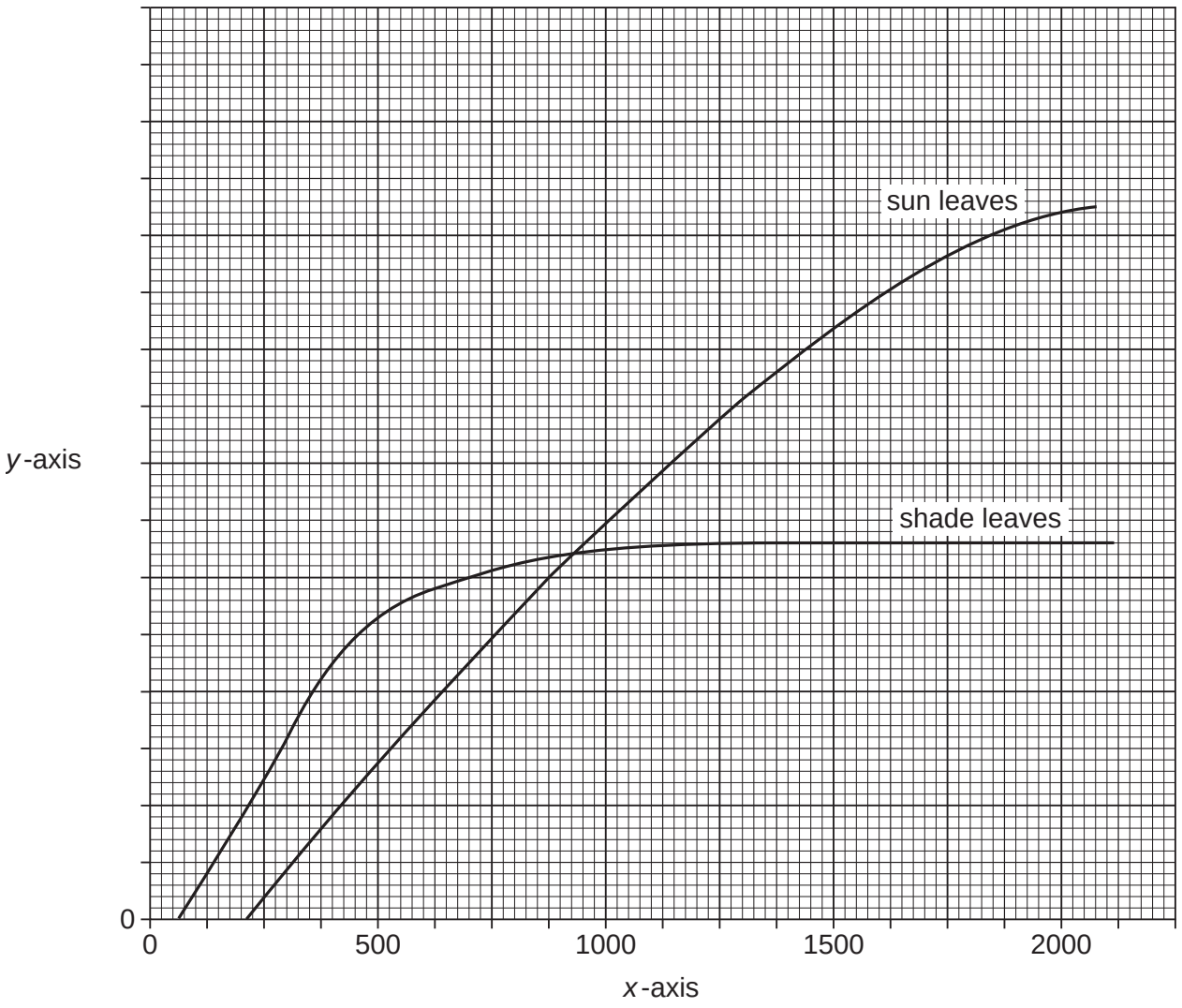


Fig. 1.3

(b) (i) Suggest labels for the axes of this graph.

x-axis .....

.....

y-axis .....

..... [2]

(ii) State two ways in which the student's data support the hypothesis.

1. .....

.....

2. .....

..... [2]

In a further investigation using these two types of leaves, the student estimated the number of stomata per unit area. Epidermal strips from the lower surface of the leaf were mounted in water and observed under a microscope.

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The diameter of the field of view was measured using an eyepiece graticule. The actual field of view was calculated using a calibration value from a slide micrometer scale.

Diameter of field of view at ×100 magnification = 0.5 mm

(c) (i) Calculate the area of the field of view. Use the formula $\pi \mathbf{r}^2$. ($\pi = \frac{22}{7}$ or $\pi = 3.14$)

Give your answer to one significant figure.

..... [1]

(ii) Table 1.1 shows the results of the stomatal count investigation.

Table 1.1

	number of stomata visible at ×100 magnification										mean number of stomata	number of stomata per mm^2
sun leaves	21	24	36	24	15	18	27	33	18	24	24±6	120
shade leaves	36	39	35	42	28	36	34	40	48	32	37±6	

Calculate the mean number of stomata per mm^2 for the shade leaves.
Show your working below and write your answer in Table 1.1.

[2]

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(iii) State the null hypothesis for a statistical test to find out whether the difference in the number of stomata is significant.

.....

..... [1]

(iv) Name a statistical test that could be used and give the reason for your answer.

.....

..... [2]

(d) The results of the statistical test showed that the difference was significant.

Suggest **one** reason why there is a difference in the number of stomata of shade leaves and sun leaves.

.....

..... [1]

[Total: 19]

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[Turn over

2 One technique used for studying antigen-antibody reactions is immunodiffusion.

For Examiner's Use

Wells are cut into an agar support medium to contain antigens and antibodies. Antibodies and antigens diffuse out of the wells into the agar. If an antigen meets a complementary antibody a reaction occurs causing a band of precipitate to appear.

Fig. 2.1 shows the results of an immunodiffusion test with known antigens **P** and **Q** and the antibodies to these antigens.

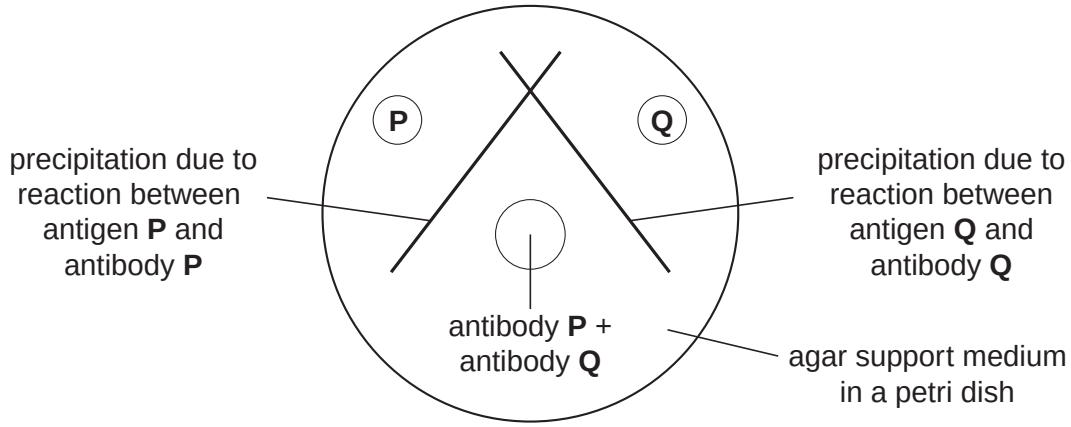


Fig. 2.1

In an investigation, the serum from two test organisms was tested for the presence of antibodies to specific antigens. Both organisms had been previously exposed to both antigens. The serum was placed in wells at the edge of the petri dish and the antigens in a central well.

Fig. 2.2 shows the test set-up.

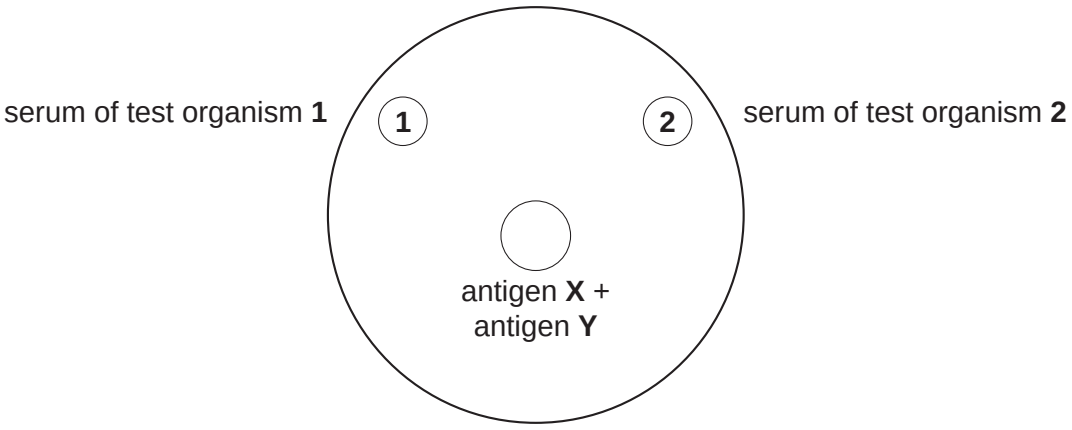


Fig. 2.2

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(a) (i) Suggest **one** variable that must be controlled in this procedure.

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..... [1]

(ii) State the independent variable in this investigation.

..... [1]

(iii) Both test organisms had antibodies against antigen **X**, but only organism **2** had antibodies against antigen **Y**.

On Fig. 2.2 draw lines to represent where precipitation might have occurred for both organisms. [2]

(b) Suggest two disadvantages of immunodiffusion for detecting antigens.

1. .....

.....

2. .....

..... [2]

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(c) A naturally occurring mutant of *Plasmodium* sp. has been tested for use as a 'whole organism' vaccination against malaria. The mutant organism develops normally in mosquito vectors and infects the salivary glands in the same way as non-mutant wild type *Plasmodium* sp. In mice, the mutant infects liver cells but does not multiply and cannot enter red blood cells.

Trials using mice were carried out and the effectiveness of the mutant organism as a vaccine tested by injecting non-mutant wild type *Plasmodium* sp. into vaccinated and non-vaccinated mice.

Table 2.1 shows the results of investigations in mice using the mutant *Plasmodium* sp.

Table 2.1

	number of mutant *Plasmodium* cells given to the mice			percentage of mice not infected by wild type *Plasmodium* sp.
test group	first inoculation	first booster inoculation	second booster inoculation	
1	0	0	0	0
2	50 000	25 000	25 000	100
3	10 000	10 000	10 000	100
4	10 000	10 000	0	70

(i) Suggest the purpose of including each of the following test groups.

group 1 .....

.....

groups 2 and 3 .....

.....

group 4 .....

..... [3]

(ii) Using the information in the question, outline a procedure that might be used to obtain mutant *Plasmodium* sp. to use in the vaccination trials.

.....

.....

.....

..... [2]

[Total: 11]

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Copyright Acknowledgements:

Figure 1.2 © Appearance of leaf discs in a syringe; http://www-saps.plantsci.cam.ac.uk/worksheets/scotland/sunshade.htm
Figure 2.1 © W R Clark; *The Experimental Foundations of Modern Immunology*; 4th Ed; Wiley & Sons Inc; 1991.

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