UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7975299313

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills **May/June 2007**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Instructions to Supervisors.

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 **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.
You are advised to spend one hour on each question.

For Examiner's Use	
1	
2	
Total	

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You are reminded that you have only one hour for each question in the practical examination.
You should read carefully through the whole of each question and then plan your use of the time to make sure that you finish all of the work that you would like to do.

1 You are required to investigate the effect of lead nitrate on the activity of the enzyme amylase.
You are provided with a 1% solution of lead nitrate, labelled **S1**, a solution of starch, labelled **S2** and a solution of amylase, labelled **S3**. You are also provided with a solution of iodine in potassium iodide, labelled **iodine** and a supply of distilled water.

(a) Investigate the effect of amylase on starch in the absence of lead nitrate.

- place 2 cm^3 of distilled water in a test-tube.
- add 2 cm^3 of starch solution.
- add 0.5 cm^3 of amylase and start timing.
- after five minutes add four drops of iodine solution and shake gently.

Describe and explain your results.

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.....[2]

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(b) You are now going to add a range of different concentrations of lead nitrate solutions that you will prepare yourself to samples of starch and test for the activity of the enzyme amylase.
Carefully follow the instructions below.
You should present and record your observations and data in the space provided.
You will need to:

- read through the instructions **below** carefully
- prepare the space below so that it is ready for you to record the readings
- decide how many different concentrations of lead nitrate solutions you will need and prepare them by serial dilution.
- modify the method you used in **(a)** to test the effect of each of the concentrations of lead nitrate on the activity of amylase on starch.

(i) Record the data in the space below.

[6]

(ii) Draw a conclusion from your results.

.....

.....[1]

(c) pH has a large effect on the rate of enzyme-catalysed reactions.

(i) Suggest how pH could have been controlled in this experiment.

.....

.....[1]

(ii) Identify two **other** significant sources of error in this experiment.

1 .....

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2 .....

.....[1]

(d) A student carried out a similar investigation but used a colorimeter to determine the mean transmission of light through the solutions.
This was used to show the activity of the enzyme.
The data in Table 1.1 were obtained.

Table 1.1

percentage concentration of lead nitrate solution	transmission of light / arbitrary units			mean transmission of light / arbitrary units
	first run	second run	third run	
0	84	87	82	84.3
0.2	55	53	52	53.3
0.4	36	37	36	36.3
0.6	27	24	27	26.0
0.8	22	20	21	21.0
1.0	20	21	18	

(i) When the student first performed this investigation, the transmission for a 1.0 % solution of lead nitrate was 74 arbitrary units.
Explain why the student discarded this result and repeated the experiment with a freshly made solution.

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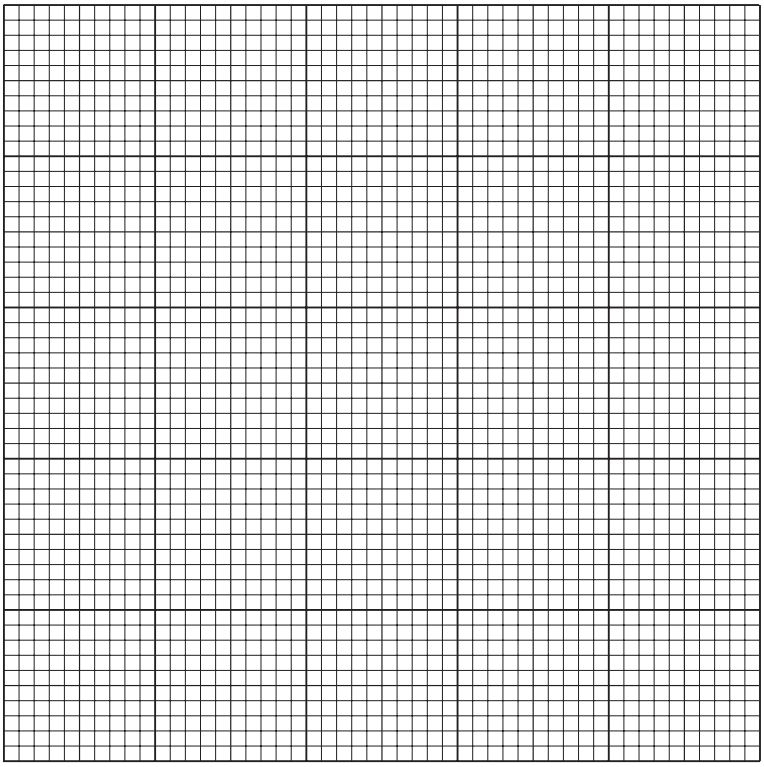
.....[1]

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(ii) Complete Table 1.1 by calculating the missing mean transmission for a 1.0% solution of lead nitrate.
You may use the space below to show your working.

Put your answer in the space on Table 1.1. [1]

(iii) Plot a graph to show the effect of lead nitrate concentration on the mean transmission of light.



[3]

(e) State the relationship between lead nitrate concentration and the activity of amylase.

.....

.....

.....[1]

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(f) The student's hypothesis was;

- lead nitrate is so toxic that any concentration will inhibit the enzyme amylase.

Discuss the student's hypothesis in relation to the results obtained.

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.....[2]

(g) Suggest how your experiment in **1 (b)** could be improved other than using a colorimeter.

.....

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.....[3]

[Total : 22]

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2 Slide **T1** is a transverse section of a leaf.

(a) (i) Draw a low-power plan diagram of **T1** to show the distribution of the tissues in the area of the section indicated in Fig. 2.1.
No labels are required.

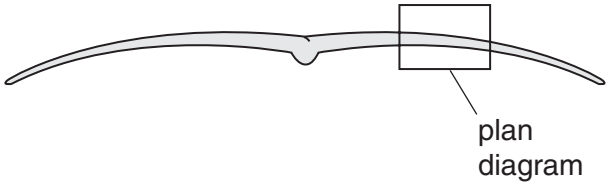


Fig. 2.1

[2]

(ii) Use the transparent ruler to measure the actual thickness of the leaf lamina, under low power. Put the slide on the microscope and lay the ruler on top of it, re-focussing the microscope if needed.
Measure the size of your drawing across the same point.
Draw a line on your drawing to show where you made the measurement.
Calculate the magnification of your drawing.
Show your working.

magnification ..... [2]

(iii) Estimate the uncertainty in the measurement of the actual thickness of the leaf lamina.

uncertainty = ... [1]

(iv) Suggest how an error in measuring the lengths could occur.

.....

.....

.....[1]

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[Turn over

(b) Stomata are found on the lower surface of the leaf in the specimen on slide **T1**. The pores are likely to be closed and you may have to search to find a clear example.

(i) In the space below, make a high-power, labelled drawing of two guard cells and their adjacent epidermal cells.

[4]

(ii) Draw two cells from the upper epidermis, to same scale as your drawing in **(b) (i)**.

[2]

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(c) Fig. 2.2 is a photomicrograph of a transverse section of a different leaf.

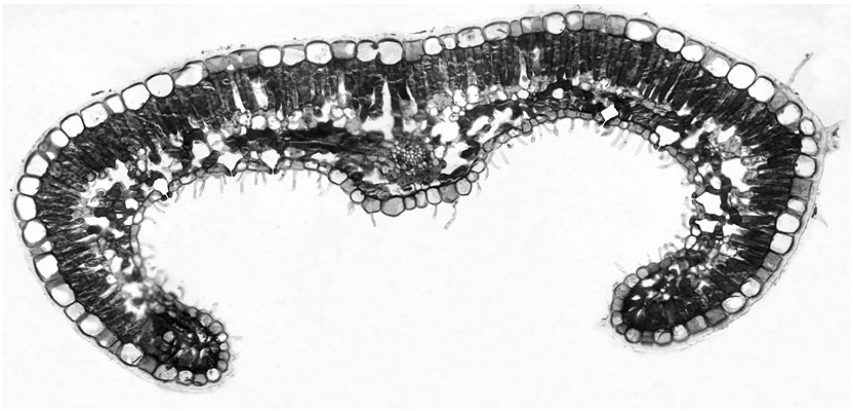


Fig. 2.2

(i) Prepare the space below so that it is suitable for you to compare and contrast the location of stomata observed in specimen **T1** with Fig. 2.2.
Record your observations in the space that you have prepared.

[4]

(ii) State **two** key features of the leaf shown in Fig. 2.2 which indicate that it is adapted to reduce transpiration.

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.....[2]

[Total : 18]

[Paper total : 40]

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* 6 1 2 3 4 4 7 4 0 8 *

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1 You are required to estimate the concentration of reducing sugar in a fruit juice, labelled **F1,** by comparison with that in a range of glucose solutions.
You are provided with a 0.8% solution of glucose, labelled **F2**, Benedict's solution, distilled water and five test-tubes.

(a) Carry out the Benedict's test on fruit juice **F1**.
Describe and explain your results.

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.....[3]

(b) You are now going to test a range of glucose solutions that you will prepare yourself using **F2** and distilled water.
Carefully follow the instructions below.
You should present and record your observations and data in the space provided.
You will need to:

- read through the instructions carefully
- prepare the space on the next page so that it is ready for you to record the readings
- decide how many different strength glucose solutions you will need and prepare these by serial dilution
- carry out the tests so that you can compare your results with the result for the fruit juice.

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(i) Record the data in the space below.

[6]

(ii) Estimate the concentration of reducing sugar in the fruit juice **F1**.

..... [1]

(c) The volume of reactants can affect the results that you obtain.

(i) State how you controlled this variable in your investigation.

.....

.....[1]

(ii) Identify two **other** significant sources of error in this experiment.

1 .....

.....

2 .....

.....[1]

(d) Suggest how the student could improve this experiment.

.....

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.....[3]

(e) A student used another carbohydrate, starch, to investigate the effect of pH on the activity of the enzyme amylase.

The data in Table 1.1 were obtained.

Table 1.1

pH	time taken for complete hydrolysis /min			mean time / min
	first run	second run	third run	
5	11	10	8	9.6
6	7	6	7	6.6
7	3	4	3	3.3
8	4	5	6	5.0
9	10	9	10	

(i) When the student first performed this investigation, the time taken for complete hydrolysis at pH 7 was 17 minutes.
Explain why the student discarded this result and repeated the experiment with freshly made solutions.

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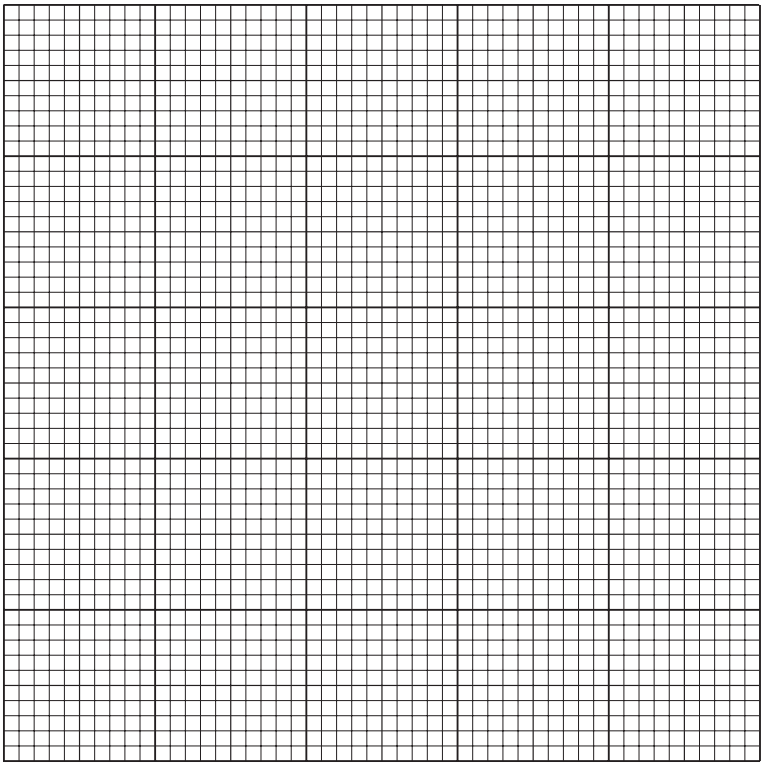
.....[1]

(ii) Complete Table 1.1 by calculating the missing mean time value for pH 9.
You may use the space below to show your working.

Put your answer in the space on Table 1.1. [1]

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(iii) Plot a graph to show the effect of pH on the complete hydrolysis of starch by amylase.



[3]

(f) State the relationship between pH and the hydrolysis of starch by amylase.

.....

.....[1]

(g) The student's hypothesis was:

- the activity of the enzyme would increase with increasing pH.

Discuss the student's hypothesis in relation to the results obtained.

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.....[2]

[Total : 23]

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2 **R1** is a slide of a stained longitudinal section through a root tip.
You are also provided with an eyepiece graticule that has been fitted to the eyepiece of your microscope and a stage scale (stage micrometer) printed on acetate sheet.
The 1 cm stage scale is divided into 100 divisions.
Each division is 0.1 mm

(a) **(i)** Draw a low-power plan diagram of **R1** and show the area in which you can see cells undergoing mitosis.

[2]

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(ii) Carefully examine this area using the high-power of your microscope. Identify a cell that has a clear nucleus but is not undergoing mitosis.

Count the number of divisions of the eyepiece graticule across the cell.

number of divisions .....

Remove the slide **R1** and replace it with the stage scale.
Using the same magnification, adjust the focus until you can see the eyepiece graticule on top of the stage scale.
Count the number of eyepiece graticule divisions that match an exact number of stage scale divisions.

number of eyepiece graticule divisions .....

number of stage scale divisions .....

Use this information to calculate the actual width of the cell.
Show your working.

actual width of cell ..... [2]

(iii) Estimate the uncertainty in the measurement of the actual width of the cell.

uncertainty = ... [1]

(iv) Suggest how an error in measuring the lengths could occur.

.....

.....

.....[1]

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(b) Fig. 2.1 is a photomicrograph showing cells from further up the root.

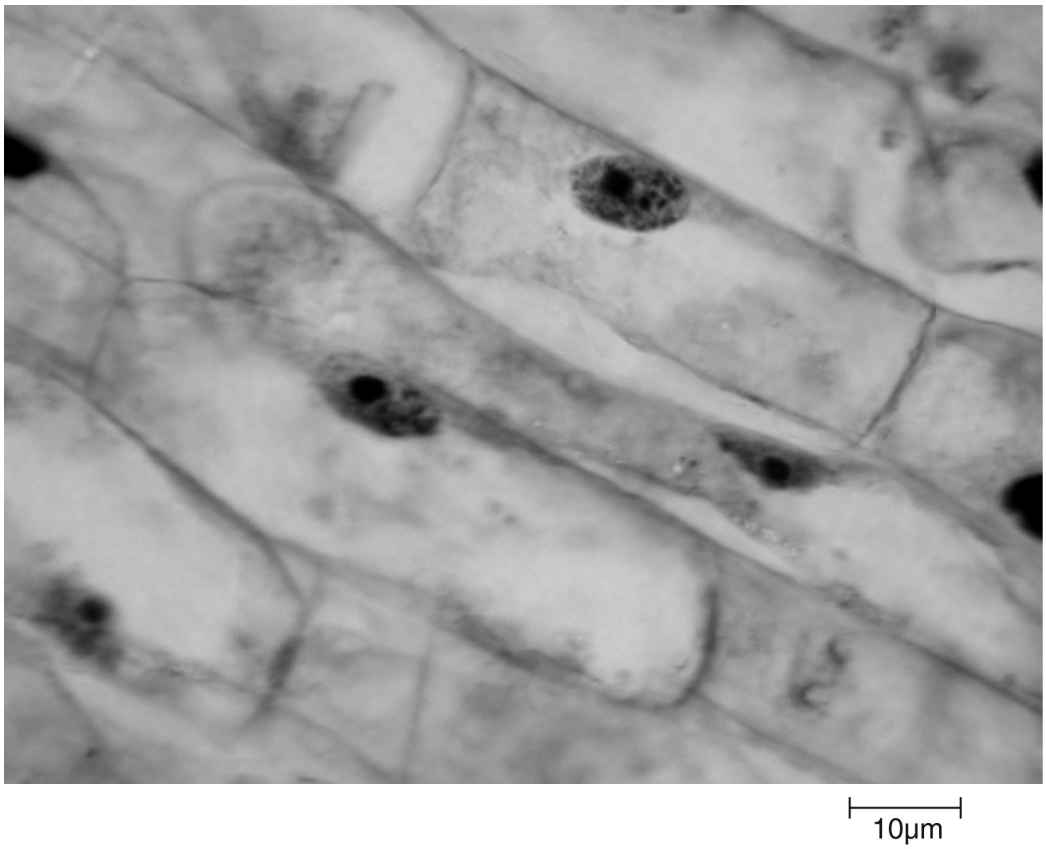


Fig. 2.1

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(i) Prepare the space below so that it is suitable for you to compare and contrast a cell like the one you measured in **(a) (ii)** with the cells in Fig. 2.1.
Record your observations in the space below.

[4]

(ii) Roots grow in length.
State **one** observation from the materials provided that confirms this and suggest how such growth occurs.

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.....[2]

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(c) Cells undergoing mitosis can be seen in the specimen on slide **R1**.
In the space below, make a high-power labelled, drawing of **two** cells showing chromosomes, undergoing different stages of mitosis.

[5]

[Total : 17]

[Paper total : 40]

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