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

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

BIOLOGY **9700/31**

Advanced Practical Skills 1 **May/June 2011**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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

Answer **all** questions.

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.

For Examiner's Use	
1	
2	
Total	

This document consists of **11** printed pages and **1** blank page.

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.
- Plan your use of **the time** to make sure that you finish all the work that you would like to do.

You will **gain marks** for recording your results according to the instructions.

1 Enzyme **E** catalyses the hydrolysis of starch to glucose.
The end-point of the reaction can be found by measuring the time taken for all the starch to be hydrolysed.

You are required to investigate the effect of the independent variable, copper sulfate concentration, on enzyme **E**.

You are provided with:

labelled	**contents**	**hazard**	**concentration / %**	**volume / cm^3**
E	amylase solution	irritant	1	10
S	starch solution	none	1	50
C	copper sulfate solution	harmful irritant	0.03	20
W	distilled water	none	–	100
iodine	iodine in potassium iodide solution	irritant	–	50

Copper sulfate can inhibit enzyme **E**.
The extent of inhibition depends on the concentration of the copper sulfate solution. A student investigated the inhibition of enzyme **E** at concentrations of copper sulfate solution greater than 0.03% and found that the enzyme was completely inhibited.

The student suggested the hypothesis:

concentrations of copper sulfate solution below 0.03% will continue to inhibit the enzyme.

You are required to investigate this hypothesis by carrying out a serial dilution of copper sulfate solution which reduces the concentration by ten-fold between each successive dilution.

Fig. 1.1 shows how to make the first concentration of 0.003% copper sulfate solution.

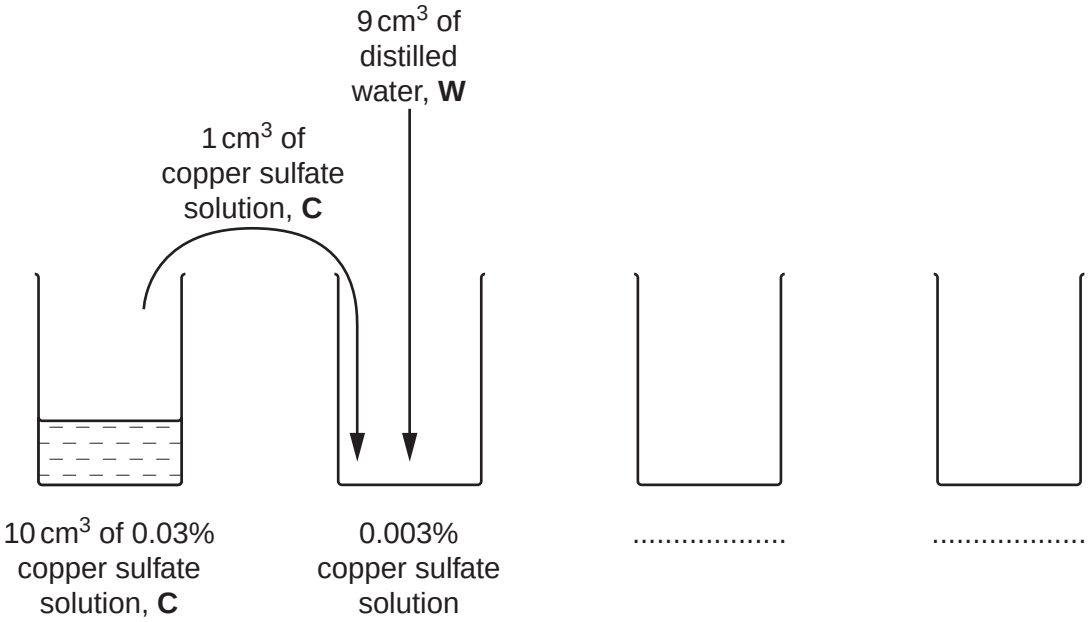

Fig. 1.1

(a) (i) Complete Fig. 1.1 to show how you will make **two** further concentrations of copper sulfate solution. [3]

Proceed as follows:

1. Prepare the concentrations of copper sulfate solution as shown in Fig. 1.1 in the containers provided. Use the syringe labelled **'For copper sulfate'**.

2. Label test-tubes with the concentrations of copper sulfate solutions and label another test-tube **W**.

3. Wipe the tile clean with a damp paper towel and then dry the tile. Label the tile, as shown in Fig. 1.2. The numbers indicate the sampling times in seconds.

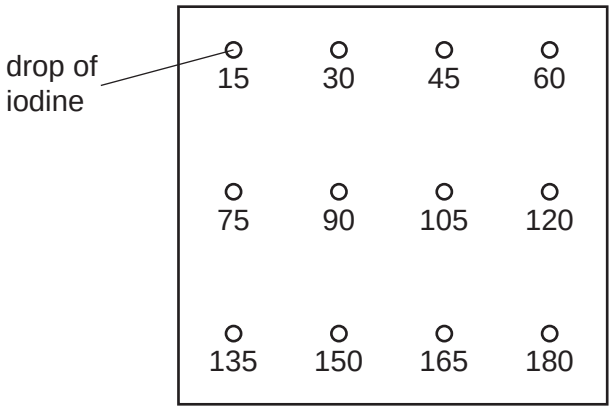

Fig. 1.2

4. Put one drop of **iodine** on the tile at each sampling time, as shown in Fig. 1.2.

5. Put 1 cm^3 of **W** into the labelled test-tube.

6. Put 3 cm^3 of **S** into the same test-tube. Mix well.

7. Put 0.5 cm^3 of **E** into the same test-tube. Mix and start timing.

8. Use a glass rod to stir the mixture.

9. After 15 seconds use the glass rod to transfer a drop of the mixture to the **iodine** drop, labelled 15, on the tile.

10. Immediately clean the glass rod with a paper towel.

11. Repeat steps **8** to **10** at 15 second intervals until the **iodine** drop does not change colour. If the **iodine** drop changes colour at 180 seconds, record 'more than 180' as your result (for step 12).

12. Record the time taken to reach the end-point.

13. Repeat steps **3** to **12** replacing the 1 cm^3 of **W** with 1 cm^3 of the **lowest** concentration of copper sulfate solution.

14. Repeat step **13** with the other concentrations of copper sulfate solution.

(ii) Prepare the space below and record your results.

[5]

(iii) The student's hypothesis stated that "concentrations of copper sulfate solution below 0.03% will continue to inhibit the enzyme".

Explain how your results provide evidence for the support or the rejection of this hypothesis.

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(iv) Identify **one** significant source of error in your investigation.

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..... [1]

(v) A colorimeter could have been used to determine the end-point.
Describe **three** other modifications to this investigation which would improve the confidence in your results.

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..... [3]

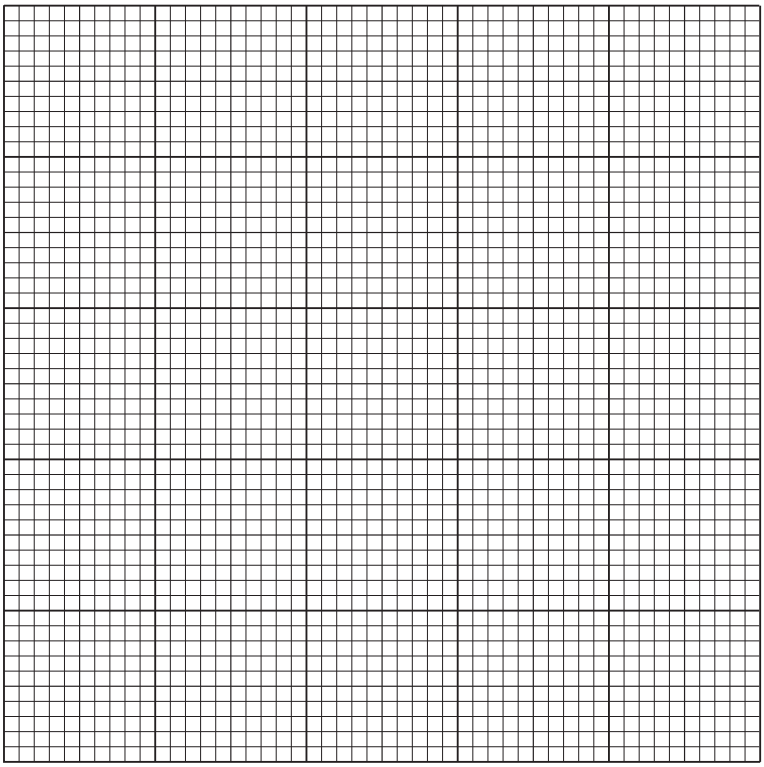
Table 1.1 shows the results of an investigation into the effect of the concentration of copper sulfate solution on a protein suspension. A protein suspension was mixed with different concentrations of copper sulfate solution.
After a set time, the percentage absorbance of light was measured using a colorimeter.

Table 1.1

copper sulfate concentration / mol dm^{-3} × 10^{-3}	absorbance of light by protein suspension / %					
	trial 1	trial 2	trial 3	trial 4	trial 5	mean
25.0	100	99	100	99	100	100
12.5	97	95	80	97	94	96
5.5	78	81	79	82	80	80
3.5	84	59	58	58	62	
1.5	9	11	10	9	8	9

(b) **(i)** Draw a circle around each of the anomalous results **and** complete the table. [2]

(ii) Plot a graph of the data shown in Table 1.1.



[4]

(iii) Explain the effect of copper sulfate solution on the protein suspension.

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..... [2]

[Total: 22]

2 **J1** is a slide of a stained transverse section through a leaf.

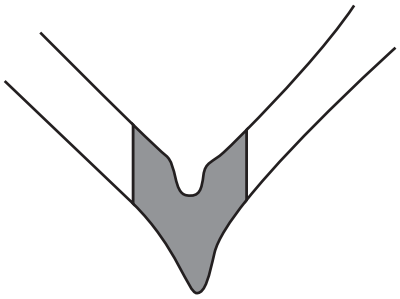

Fig. 2.1

(a) Draw a large plan diagram of the part of the leaf indicated by the shaded area in Fig. 2.1.

Label the xylem and an air space.

[5]

(b) Make a large drawing of six cells from the part of the leaf indicated by the shade in Fig. 2.2.

The cells should be two adjacent (touching) cells from the epidermis and two adjacent cells from each of the next two layers.

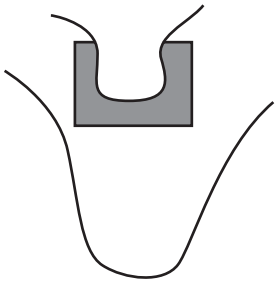

Fig. 2.2

Label one epidermal cell.

[5]

Fig. 2.3 is a photomicrograph of a transverse section through a leaf of a different species.

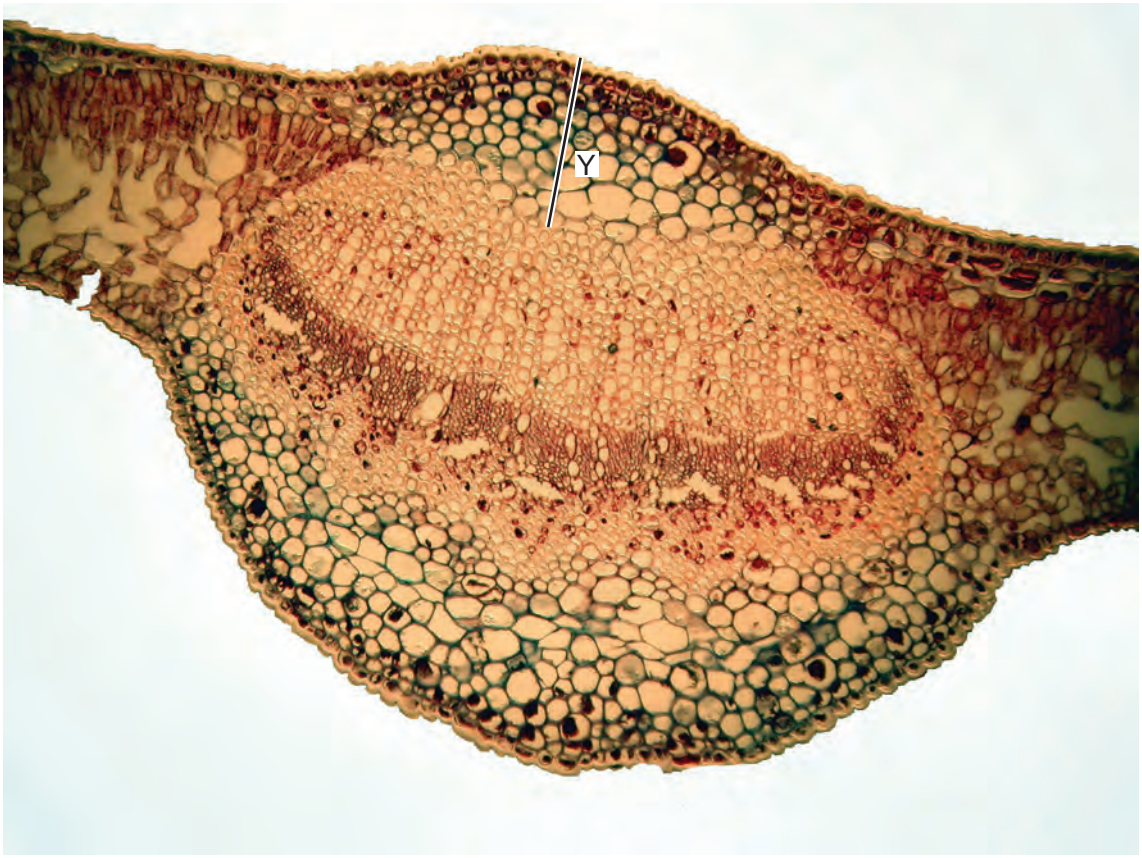

Fig. 2.3

(c) The actual length of line **Y** is 785 μm.
Use this measurement to calculate the magnification of Fig. 2.3.

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

magnification × ..... [3]

(d) Prepare the space below so that it is suitable for you to record the observable diffe between the specimens on **J1** and in Fig. 2.3.

Record your observations in the space you have prepared.

[5]

[Total: 18]

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