Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

8932538116

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2014**

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 **8** printed pages.

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1 **(a)** Many people are intolerant to the disaccharide lactose, which is found in milk.
The enzyme lactase is used commercially to catalyse the breakdown of lactose to the monosaccharides glucose and galactose. These sugars taste sweeter and are easier to digest than lactose.

Enzymes can be immobilised in a number of different ways, using different materials.

Fig. 1.1 shows three ways of immobilisation of enzymes.

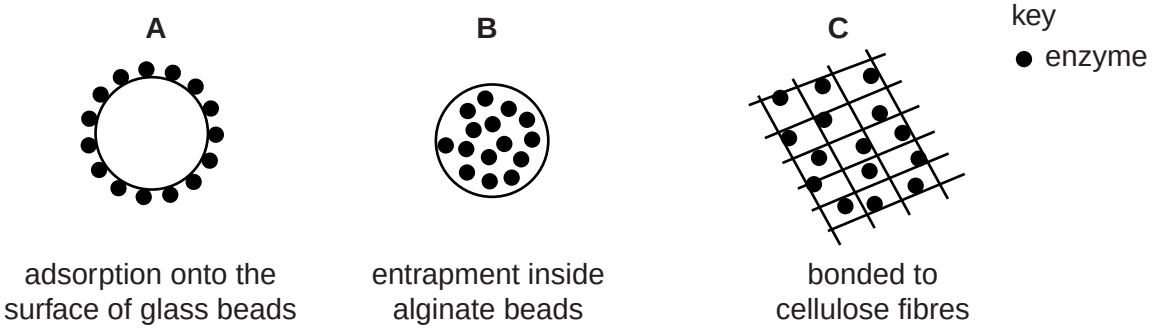


Fig. 1.1

A student carried out an investigation to compare the activity of the enzyme lactase that had been immobilised in the three different ways shown in Fig. 1.1.

- A solution containing 20 mg cm^{-3} of lactose was poured through a column containing the immobilised enzyme.
- The solution containing the products was collected and the concentration of glucose measured.

(i) State a null hypothesis that the student could make for this investigation.

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.....[1]

(ii) State the independent variable in this investigation.

.....[1]

(iii) Suggest how the dependent variable might be measured.

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.....[1]

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(b) Outline a procedure the student could use to compare the activity of lactase that has been immobilised in different ways.
Your method should be detailed enough for another person to use.

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(c) Table 1.1 shows the student's results.

Table 1.1

	way of immobilisation		
	A: adsorption onto the surface of glass beads	**B**: entrapment inside alginate beads	**C**: bonded to cellulose fibres
mean volume of solution containing product / cm^3	21	25	20
mean glucose concentration / $mg\,cm^{-3}$	15	10	12
mean total glucose collected / mg		250	

(i) Complete Table 1.1 by calculating the mean total glucose collected for **A** and **C**. [1]

(ii) State the other two pieces of information that are required to calculate the rate of hydrolysis of lactose by these immobilised enzymes.

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.....[2]

(d) Table 1. 2 shows the results of a number of statistical tests to find out if the differences in the rates of reaction were significant.

Table 1.2

statistical tests carried out between different ways of immobilisation		
A and **B**	**A** and **C**	**B** and **C**
significant at P < 0.05	significant at P < 0.05	not significant at P < 0.05

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(i) State what is meant by 'significant at $P < 0.05$'.

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.....[2]

(ii) The student concluded that immobilising lactase by adsorption onto the surface of glass beads (**A**) has a greater activity than either of the other ways of immobilising the enzyme.

With reference to Table 1.1 and Table 1.2, state the evidence that supports this conclusion.

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.....[2]

[Total: 17]

2 Fig. 2.1 shows the apparatus used to supply nutrient solution to the roots of young plants.

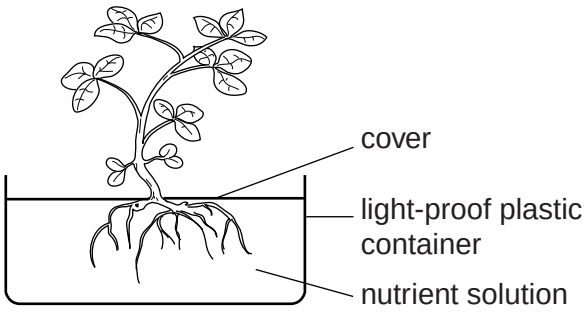


Fig. 2.1

- Twelve young plants of the same species were grown with their roots in a nutrient solution as shown in Fig. 2. 1.
- Phosphate ions labelled with radioactive phosphorus (^{32}P) were added to the nutrient solution and the plants left for 24 hours.
- After 24 hours the nutrient solution was replaced by another nutrient solution containing unlabelled phosphate ions.
- The leaves of six of the plants were covered by light-proof material; the leaves of the other six plants were not covered.
- Each day five leaves from each plant were selected. A Geiger counter was used to measure the radioactivity of individual leaves in counts per minute (cpm).
- These measurements were converted into cpm per unit area of leaf and the means were calculated.

Fig. 2.2 shows the results of these measurements.

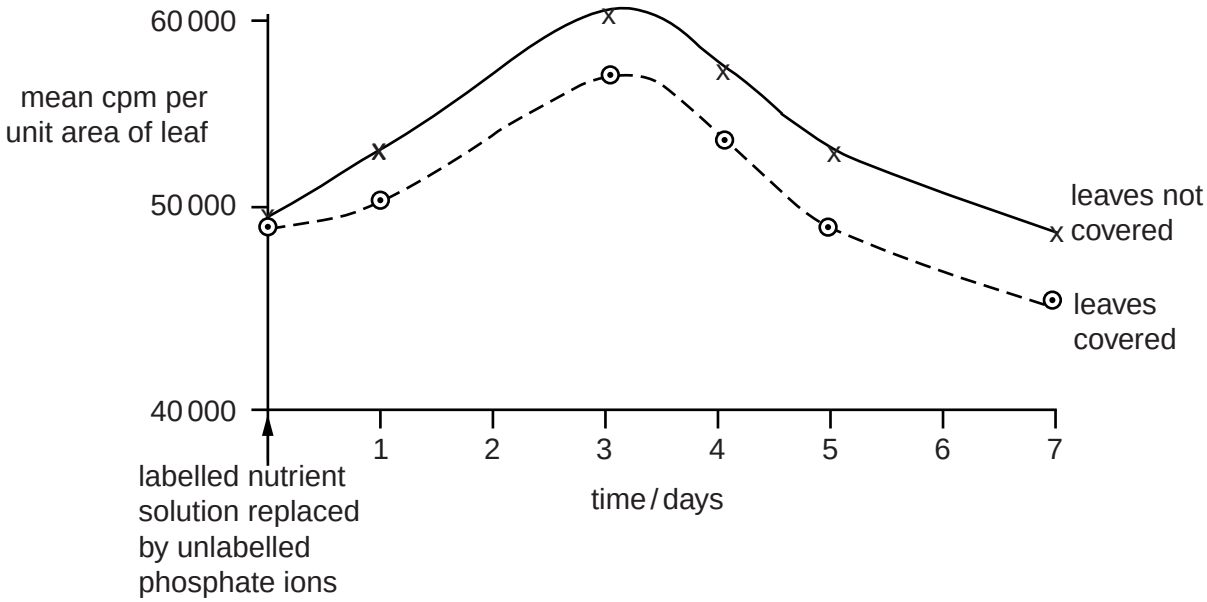


Fig. 2.2

(a) (i) Explain why the results were converted to cpm **per unit area of leaf**.

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(ii) State how the mean cpm per unit area of leaf was calculated.

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(b) (i) Fig. 2.2 shows that:

- radioactivity in leaves that were covered is always lower than in the leaves that were not covered
- in both leaves that were covered and leaves that were not covered, radioactivity increased to day 3 and then decreased.

Suggest reasons for these observations.

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(ii) Identify **two** ways in which the reliability of the results could be improved.

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(c) Radioactivity causes dark spots to appear on X-ray film.

The radioactive phosphate is transported to the leaves in a tissue.
Outline a method, using X-ray film, to locate and identify this tissue.

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.....[3]

(d) Another set of plants were exposed to moving air after they were transferred to unlabelled nutrient.
Predict, **with reasons**, the effect on the measurements of radioactivity in leaves that were covered **and** in leaves that were not covered.

covered leaves .....

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leaves not covered .....

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.....[2]

[Total: 13]

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