Cambridge International **A Level**

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0931292726

BIOLOGY **9700/51**

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

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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Write in dark blue or black pen.
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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.

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1 **(a)** The enzyme ethanol dehydrogenase occurs in a wide variety of organisms. It is able to catalyse a reversible reaction that converts ethanol to ethanal or ethanal to ethanol.

Ethanol is toxic and in some tissues the ethanol can be converted to ethanal and then to ethanoate (acetate) which is used as an energy source.

Fig. 1.1 shows these reactions.

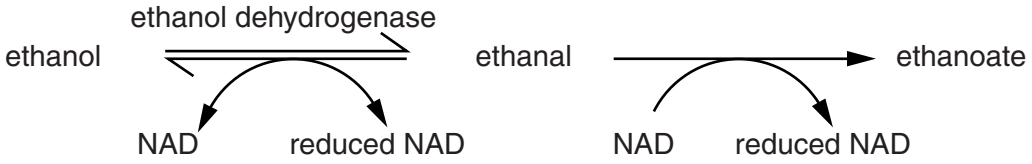


Fig. 1.1

In industry ethanol is converted to ethanal, which is used to make a variety of compounds, such as dyes, flavourings and perfumes.

A student carried out an investigation to find out if the activity of immobilised ethanol dehydrogenase differed from that of non-immobilised (free) ethanol dehydrogenase.

The student:

- immobilised a 1 mg dm^{-3} ethanol dehydrogenase solution
- used both the NAD and the ethanol at concentrations of 10^{-3} mol dm^{-3}
- used methylene blue as an indicator of enzyme activity. Methylene blue becomes colourless when oxidised
- measured the time for methylene blue to become colourless.

(i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....[2]

(ii) Outline how the student could immobilise the enzyme ethanol dehydrogenase.

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(iii) Suggest a suitable control for this investigation.

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.....[1]

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(b) Describe a method the student could use to find the activity of the immobilised and free ethanol dehydrogenase.

Assume that the immobilisation traps all of the available enzyme from the solution.

Your method should be detailed enough for another person to use.

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(c) The results of the student's investigation are shown in Table 1.1.

Table 1.1

rate of reaction / arbitrary units ±*s*			
experimental		control	
free enzyme	immobilised enzyme	free enzyme	immobilised enzyme
0.0333 ± 0.0024	0.0222 ± 0.0022	0.00012 ± 0.0001	0.00010 ± 0.0002

(i) Describe how the student could calculate the rate of reaction, taking into account the results of the control experiments.

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(ii) State what standard deviation (*s*) shows about the results of this investigation.

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(d) The student carried out a statistical test to find out if the difference in the rate of reaction between the immobilised and free enzyme was significant.

The results were significant at $P < 0.05$. Explain what this means.

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[Total: 19]

2 An investigation into feeding relationships in a community was carried out using radioactively labelled phosphorus (^{32}P). A solution containing ^{32}P labelled phosphate ions can be supplied to a plant using a stem well.

Fig. 2.1 shows a vertical section through a stem well.

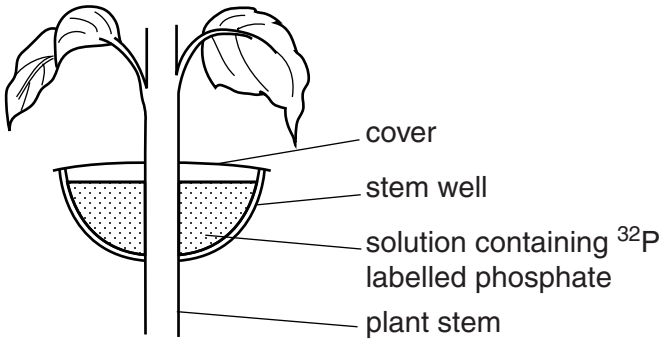


Fig. 2.1

- Stem wells were used to supply 200 individual plants of the dominant herbaceous species in the community with a solution containing ^{32}P phosphate ions.
- The stem wells were left in place for one week and then removed.
- At intervals during the first week and for a further 11 weeks after the wells were removed, tissue samples were taken from the plants and from other members of the community.
- The activity of ^{32}P phosphate ions per unit biomass was measured in each sample.

Fig. 2.2 shows the results of this investigation.

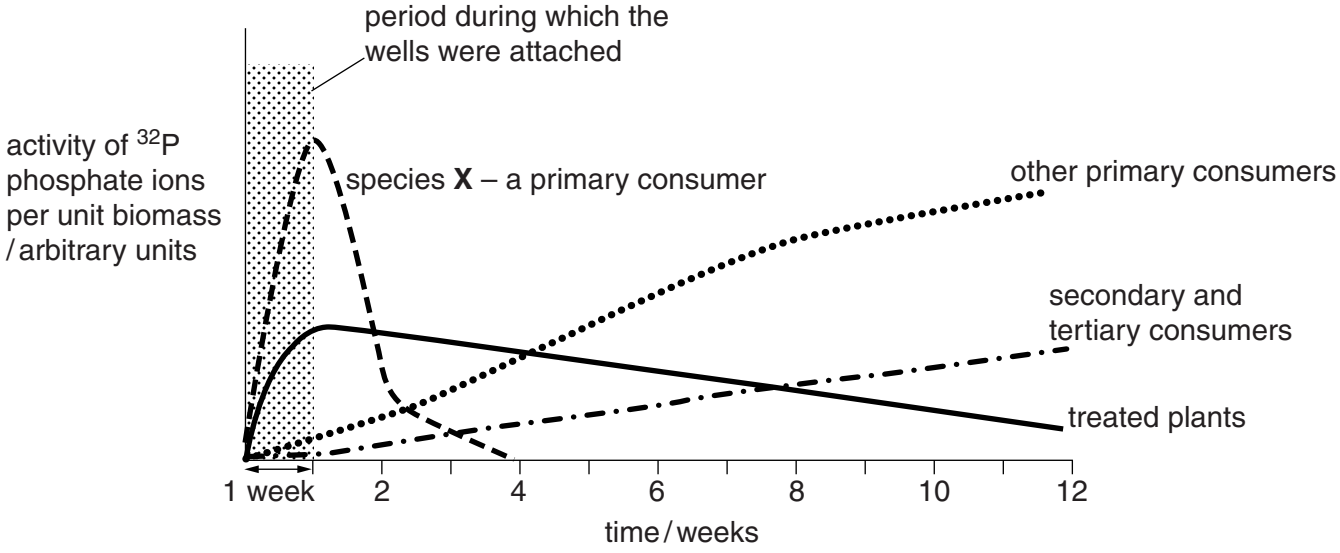


Fig. 2.2

(a) (i) Identify **one** variable that has been standardised in this investigation.

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.....[1]

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

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.....[1]

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(b) (i) The mass of the samples taken from different members of the community varied. The radioactivity of each sample was measured using a Geiger counter.

Suggest how the activity of ^{32}P phosphate ions **per unit biomass** was calculated.

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.....[1]

(ii) State why the activity of ^{32}P phosphate ions per unit biomass was calculated.

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.....[1]

(c) (i) A student made the following conclusions from information in Fig. 2.1 and Fig. 2.2.

1. Radioactive ^{32}P passes into secondary and tertiary consumers from primary consumers.
2. Radioactivity in species **X** increases as ^{32}P labelled phosphate is used to synthesise DNA and ATP.
3. Other primary consumers do not obtain food from the treated plants.
4. Radioactivity in the treated plants increases because the ^{32}P labelled phosphate is absorbed into the stem and transported in the phloem.

State, with a reason, whether the evidence in Fig. 2.1 and Fig. 2.2 supports or does not support **each** of these conclusions.

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(ii) Suggest **one** other conclusion, supported by the evidence in Fig. 2.2, that the student could draw from this investigation.

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(d) The aim of this investigation was to study feeding relationships in a community.

Suggest how this investigation could be improved to find all the feeding relationships in the community.

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[Total: 11]

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Cambridge International **A Level**

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6797562548

BIOLOGY **9700/52**

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

1 hour 15 minutes

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[Turn over

PAPA CAMBRIDGE

1 **(a)** The enzyme ethanol dehydrogenase occurs in a wide variety of organisms. It is able to catalyse a reversible reaction that converts ethanol to ethanal or ethanal to ethanol.

Ethanol is toxic and in some tissues the ethanol can be converted to ethanal and then to ethanoate (acetate) which is used as an energy source.

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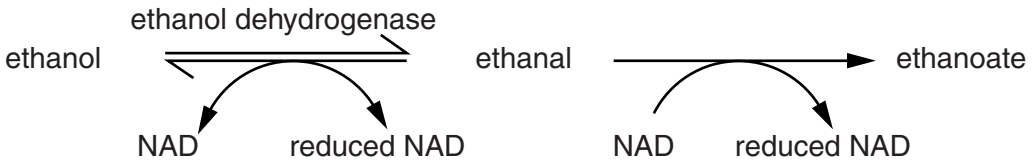


Fig. 1.1

In industry ethanol is converted to ethanal, which is used to make a variety of compounds, such as dyes, flavourings and perfumes.

A student carried out an investigation to find out if the activity of immobilised ethanol dehydrogenase differed from that of non-immobilised (free) ethanol dehydrogenase.

The student:

- immobilised a 1 mg dm^{-3} ethanol dehydrogenase solution
- used both the NAD and the ethanol at concentrations of 10^{-3} mol dm^{-3}
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- measured the time for methylene blue to become colourless.

(i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....[2]

(ii) Outline how the student could immobilise the enzyme ethanol dehydrogenase.

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(iii) Suggest a suitable control for this investigation.

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PAPA CAMBRIDGE

(b) Describe a method the student could use to find the activity of the immobilised and free ethanol dehydrogenase.

Assume that the immobilisation traps all of the available enzyme from the solution.

Your method should be detailed enough for another person to use.

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PAPA CAMBRIDGE

(c) The results of the student's investigation are shown in Table 1.1.

Table 1.1

rate of reaction / arbitrary units ±*s*			
experimental		control	
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(ii) State what standard deviation (*s*) shows about the results of this investigation.

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PAPA CAMBRIDGE

(d) The student carried out a statistical test to find out if the difference in the rate of reaction between the immobilised and free enzyme was significant.

The results were significant at $P < 0.05$. Explain what this means.

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.....[2]

[Total: 19]

PAPA CAMBRIDGE

2 An investigation into feeding relationships in a community was carried out using radioactively labelled phosphorus (^{32}P). A solution containing ^{32}P labelled phosphate ions can be supplied to a plant using a stem well.

Fig. 2.1 shows a vertical section through a stem well.

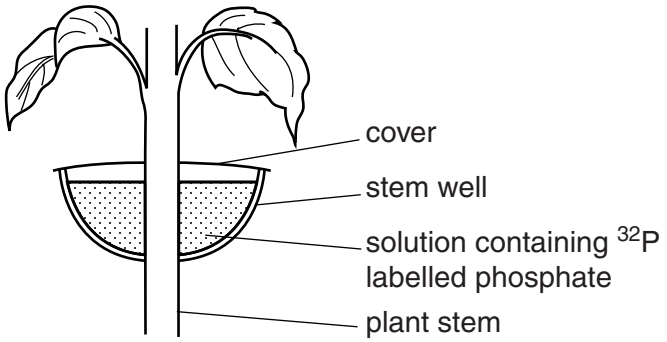


Fig. 2.1

- Stem wells were used to supply 200 individual plants of the dominant herbaceous species in the community with a solution containing ^{32}P phosphate ions.
- The stem wells were left in place for one week and then removed.
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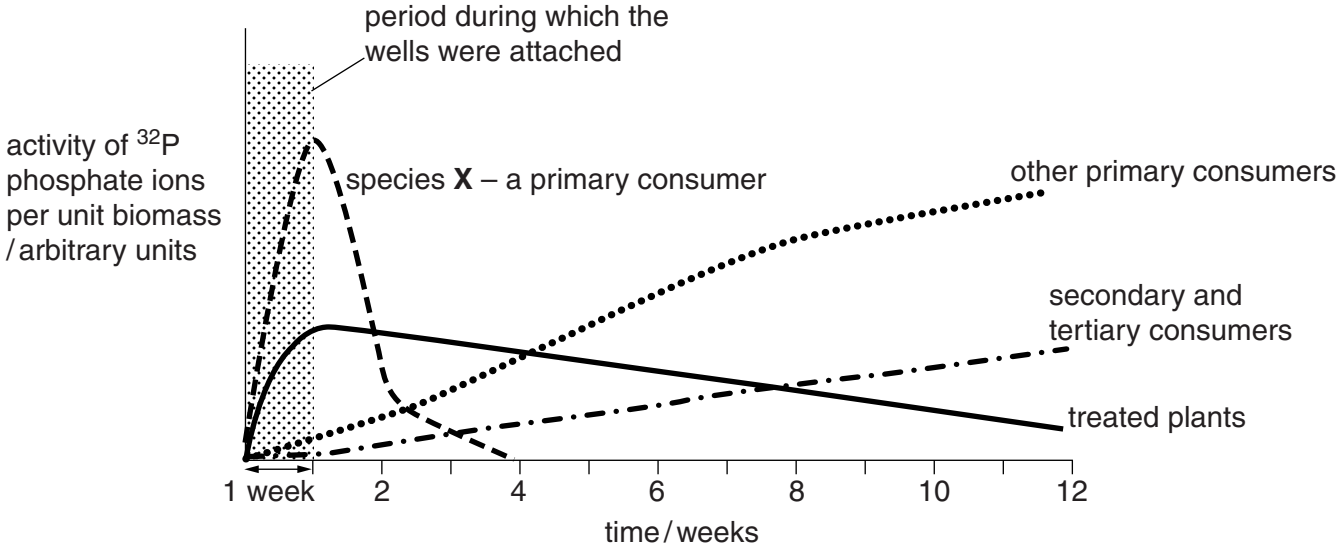


Fig. 2.2

(a) (i) Identify **one** variable that has been standardised in this investigation.

.....

.....[1]

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

.....

.....[1]

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(b) (i) The mass of the samples taken from different members of the community varied. The radioactivity of each sample was measured using a Geiger counter.

Suggest how the activity of ^{32}P phosphate ions **per unit biomass** was calculated.

.....

.....[1]

(ii) State why the activity of ^{32}P phosphate ions per unit biomass was calculated.

.....

.....[1]

(c) (i) A student made the following conclusions from information in Fig. 2.1 and Fig. 2.2.

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3. Other primary consumers do not obtain food from the treated plants.
4. Radioactivity in the treated plants increases because the ^{32}P labelled phosphate is absorbed into the stem and transported in the phloem.

State, with a reason, whether the evidence in Fig. 2.1 and Fig. 2.2 supports or does not support **each** of these conclusions.

1. .....

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2. .....

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3. .....

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4. .....

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PAPA CAMBRIDGE

(ii) Suggest **one** other conclusion, supported by the evidence in Fig. 2.2, that the student could draw from this investigation.

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.....[1]

(d) The aim of this investigation was to study feeding relationships in a community.

Suggest how this investigation could be improved to find all the feeding relationships in the community.

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[Total: 11]

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PAPA CAMBRIDGE

Cambridge International **A Level**

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8932538116

BIOLOGY **9700/53**

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

1 hour 15 minutes

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PAPA CAMBRIDGE

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.

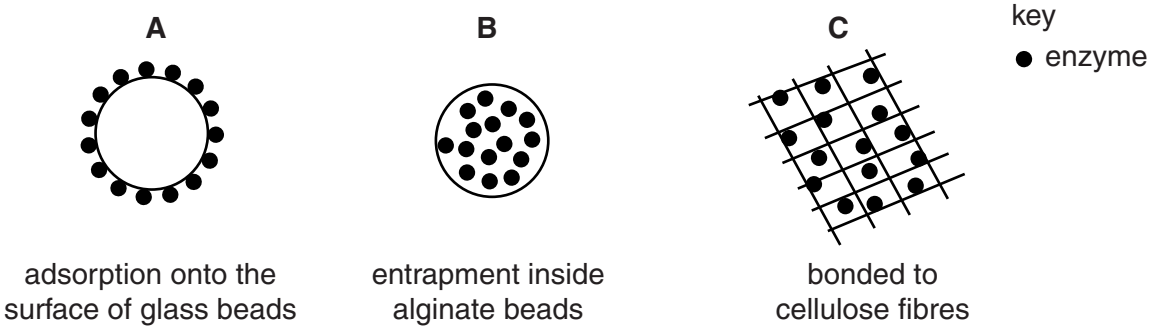


Fig. 1.1

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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(ii) State the independent variable in this investigation.

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

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PAPA CAMBRIDGE

(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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PAPA CAMBRIDGE

(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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PAPA CAMBRIDGE

(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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[Total: 17]

PAPA CAMBRIDGE

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

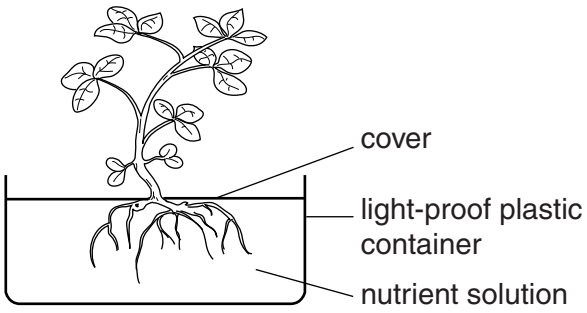


Fig. 2.1

- 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.

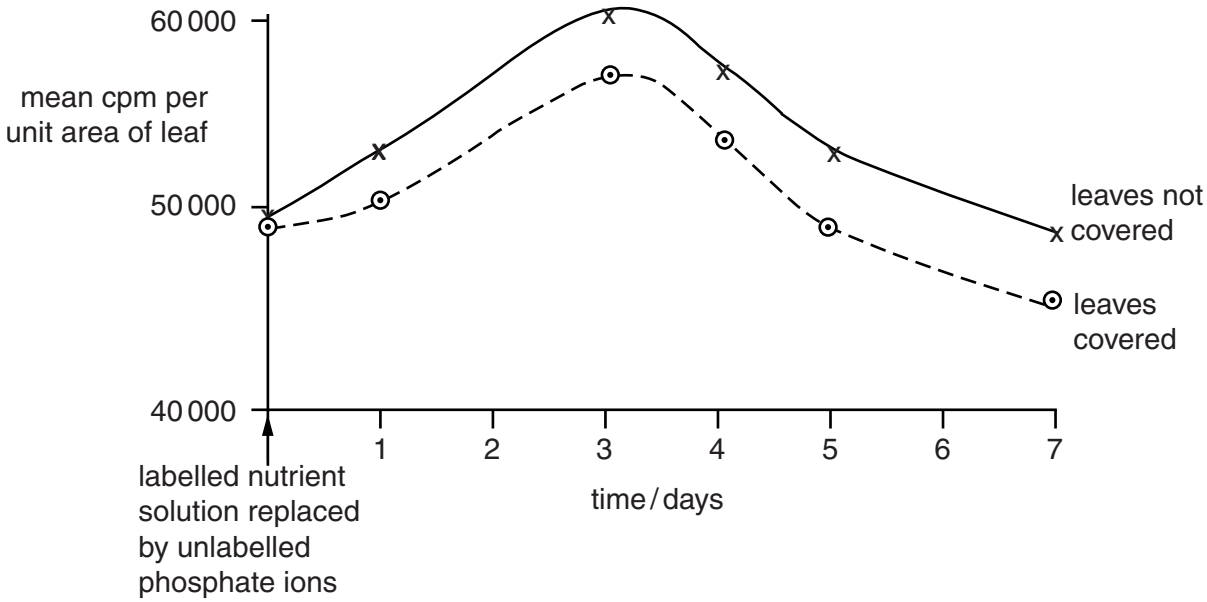


Fig. 2.2

PAPA CAMBRIDGE

(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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.....[1]

(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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PAPA CAMBRIDGE

(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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(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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