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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

4988245957

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2009**

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 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.

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1	
2	
3	
Total	

This document consists of **7** printed pages and **1** blank page.

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1 A definition of probiotics is: *'Live microorganisms which when administered in adequate amounts confer a health benefit to a person'*.
Lactic acid bacteria (LAB), which can be found in yoghurt, are commonly used as probiotics. The longer these bacteria survive in gastric juice (in the stomach) and intestinal juice (in the small intestine) the greater the benefit to the person.

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The effect of immobilisation and continuous culture on the probiotic characteristics of the LAB bacterium *Bifidobacterium longum* was studied.

Two continuous culture system were used:

C1: a control culture containing free bacteria,

C2: a test culture containing bacteria immobilised in beads.

The temperature of the fermenters was varied during the culture period.

Day 1–6	37 °C
Day 7–13	35 °C
Day 14 onwards	32 °C

Samples were collected from each culture system at different times. These cells were tested for their tolerance to a variety of environmental stresses.

(a) Suggest two variables in the fermenter that should be controlled. For each variable, suggest a method by which it might be controlled.

1. variable .....

   method of control .....

   .....

2. variable .....

   method of control .....

   ..... [4]

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The ability of cells to survive in the stomach and intestines was tested by mixing the cultures with artificial gastric and intestinal juices and incubating for 1 hour at 37 °C. Cell survival was estimated by counting the number of live colonies growing on culture plates after 48 hours.

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Fig. 1.1 shows the effect of immobilisation and continuous culture on cell survival of *B. longum*.

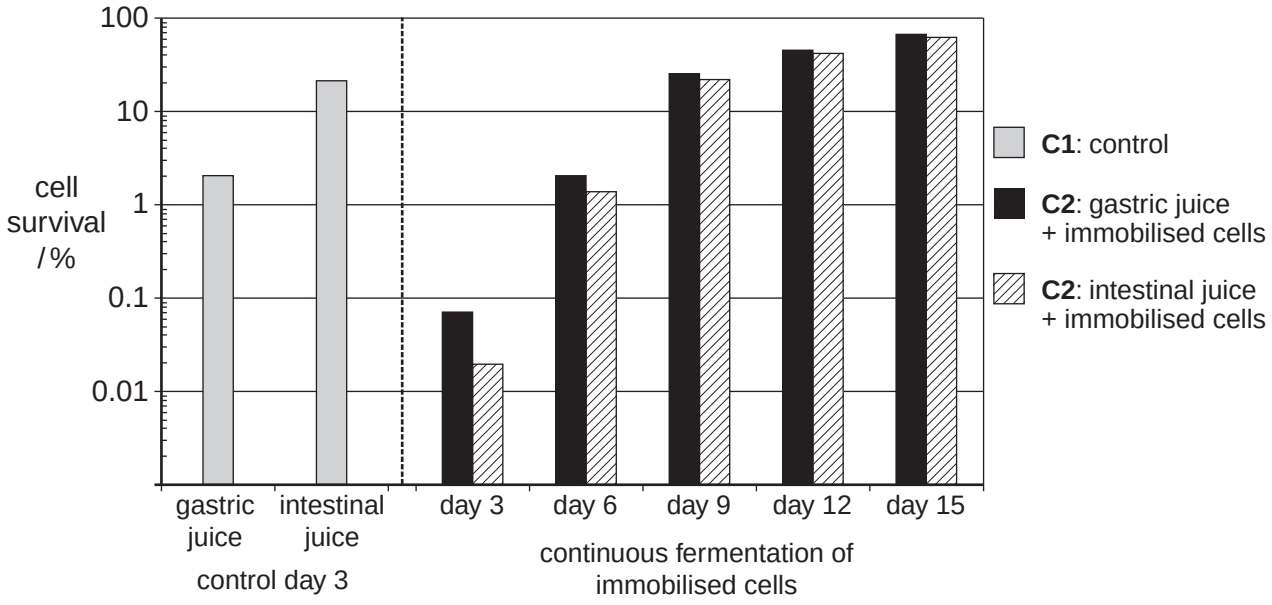


Fig. 1.1

(b) Describe what these results show about the percentage survival of *B. longum* in continuous culture.

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.....[3]

(c) The standard deviation of the survival rates for control cells after 3 days was estimated at 2±1% in gastric juice and 21±9% in intestinal juice.
State the data needed to calculate the standard deviation.

.....

.....[2]

[Total: 9]

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2 Fig. 2.1 shows a diagram of a pollen trap.

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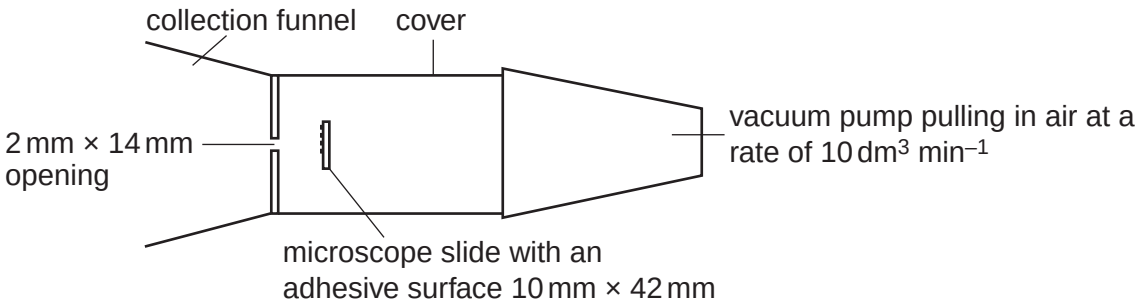


Fig. 2.1

This apparatus can be used to estimate the number of pollen grains present in the atmosphere. The apparatus is left for a period of time, the slide removed and a pollen stain added. The number of pollen grains are counted using a microscope.

A student thought that there would be more pollen in the atmosphere during the day than during the night. The hypothesis was:

As the light increases the number of pollen grains present in the atmosphere will increase and then decrease as the light decreases.

(a) Outline a procedure, using this pollen trap, that the student could use to test this hypothesis.

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.....[8]

(b) In a further investigation, the student collected pollen between 06.00h and 12.00h on a dry, hot day and estimated the number of pollen grains in 1 m^3 of air.

The mean number of pollen grains visible in the field of view = 6

The area of the field of view = 0.25 mm^2

The number of pollen grains in 1 m^3 of air = 2800

Use the data collected by the student and the information in Fig. 2.1 to show how the student obtained this number. Show all the steps in your calculation.

[3]

(c) The student then collected pollen for the same time period on a wet, hot day.

The mean number of pollen grains visible in the field of view = 2

The chi-squared test at 1 degree of freedom showed that the results were significant at 0.05 probability.

(i) State a null hypothesis for the chi-squared test.

.....

.....[1]

(ii) Explain why the student chose the chi-squared test.

.....

.....[1]

(iii) Explain why the student used 1 degree of freedom.

.....[1]

[Total: 14]

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3 Discs of a plant tissue with cells containing a red pigment were cut and washed in running water for 24 hours. These discs were used by a group of students in an investigation to test the hypothesis:

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Ethanol increases membrane permeability more than an increase in temperature.

Fig. 3.1 shows the experimental set up used.

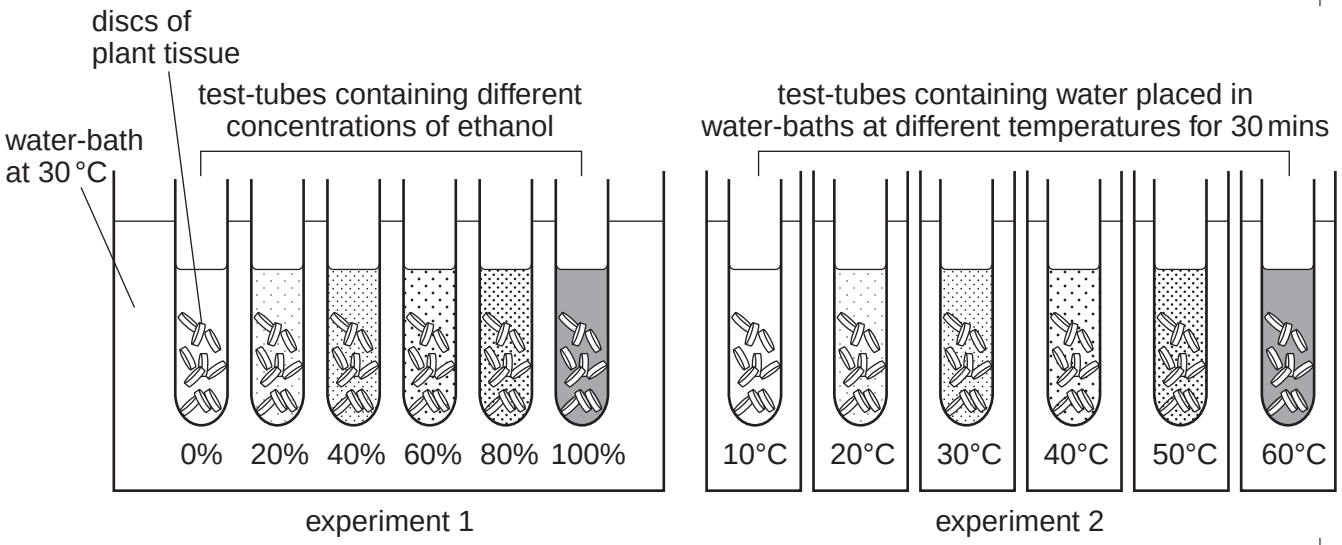


Fig. 3.1

After 30 minutes the liquid around the discs of plant tissue was poured into a colorimeter tube. A colorimeter with a blue filter was used to measure the absorbance of light. Water was used to standardise the absorbance of the colorimeter to 0.

The more red pigment in the liquid the higher the absorbance of light.

(a) (i) Identify the two independent variables in the investigation.

1. .....

2. ..... [2]

(ii) Identify the dependent variable.

..... [1]

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Table 3.1 shows the results of experiment 1.

Table 3.1

	absorbance at each ethanol concentration					
	0%	20%	40%	60%	80%	100%
student 1	0.00	0.12	0.21	0.35	0.65	0.70
student 2	0.10	0.10	0.22	0.32	0.60	0.75
student 3	0.00	0.18	0.20	0.38	0.59	0.72
student 4	0.00	0.18	0.35	0.35	0.65	0.76
student 5	0.15	0.10	0.18	0.34	0.62	0.75

Table 3.2 shows the results of experiment 2.

Table 3.2

	absorbance at each temperature					
	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C
student 1	0.00	0.00	0.00	0.09	0.65	0.79
student 2	0.15	0.20	0.05	0.15	0.70	0.85
student 3	0.10	0.05	0.00	0.18	0.62	0.81
student 4	0.00	0.00	0.04	0.30	0.75	0.88
student 5	0.10	0.00	0.02	0.25	0.60	0.85

(b) (i) **On Table 3.1**, indicate by placing a circle around the value, **two** results that may be anomalous. [2]

(ii) Suggest why the design of this investigation does not provide reliable results to allow a conclusion to be made about the hypothesis.

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.....[2]

[Total: 7]

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