UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2236760819

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2013**

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 ink.
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.

Electronic calculators may be used.
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	
Total	

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1 A student saw an advertisement about using the plant growth regulator gibberellin (GA) to stimulate the germination and early growth of seeds.

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The student obtained some of the advertised growth regulator.

The information on the packet received from the supplier gave the following information.

1. The GA is supplied as a stable powder in pre-weighed sachets.
2. The contents of each sachet when dissolved in $1\,dm^3$ water gives a concentrated solution of $1\,g\,dm^{-3}$ ($3\,mmol\,dm^{-3}$).
3. The concentrated solution can be diluted according to the type of seed germinated.
4. Seeds should be soaked in the concentration required for the particular type of seed before planting.

The student decided to test the growth regulator on barley to find out if the advertisement was true.

Research into the germination of barley provided the following information.

- Barley needs to be soaked in water for 24 hours before germinating.
- Barley germinates best at a temperature between 15–20 °C and without light.
- Embryos will develop into young plants with visible roots in 3 days and a shoot within 7 days.
- Germinating barley dries out very quickly and dies.
- The concentration of GA in barley tissue is normally $1\ \mu mol\ dm^{-3}$.
- Food stores in the endosperm of barley are hydrolysed by enzymes stimulated by GA and translocated into the developing embryo.

Fig. 1.1 shows a germinated barley grain.

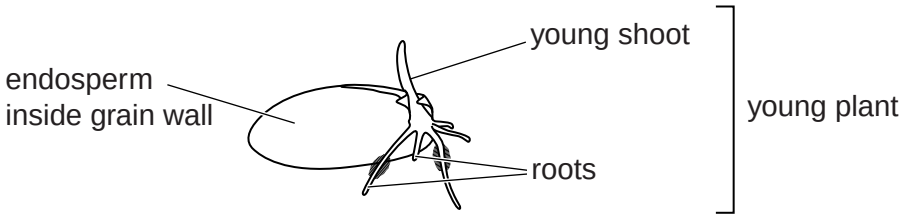


Fig. 1.1

The student tested the hypothesis:

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As the concentration of GA increases to an optimum the rate of germination of barley grains and the early growth of the young plants increases.

(a) Sketch a curve to show the expected results if the student's hypothesis is correct.



[2]

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

independent variable .....

dependent variable ..... [2]

(ii) Describe a method the student could use to test the hypothesis.

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

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(c) To find the effect of GA on the growth of the young plants, the student calculated the percentage difference in growth of young plants from barley that had been soaked in water (untreated barley) and the young plants from each of the experimental groups of barley.

(i) State how percentage difference is calculated.

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..... [2]

(ii) Explain why the student used percentage difference instead of the actual difference between young barley plants.

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.....[2]

(d) The student used separate *t*-tests to find out if the percentage difference between the young plants grown from untreated barley and any of the young plants grown from the experimental barley, was significant.

(i) State **one** reason why the *t*-test is a suitable statistical test to use for the student's data.

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.....[1]

(ii) Suggest a null hypothesis for these tests.

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.....[1]

[Total: 17]

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2 The effect of oxygen on the growth of a species of bacterium, *Aerobacter aerogenes*, was investigated. The procedure used is listed below.

- A container of sterile growth medium was inoculated with 2.5×10^6 cells per cm^3 of the bacterium.
- The growth medium was maintained at a constant temperature and pH.
- The culture was stirred constantly at a low speed.
- The bacteria were grown at first in anaerobic conditions.
- After a period of time a stream of air was passed through the culture at a constant rate.
- Samples of the culture were removed at intervals and the population of bacteria estimated in each sample.

(a) Identify the **independent** variable in this investigation.

.....[1]

(b) Three of the precautions taken in this procedure were:

- the pH was kept constant
- a sterile medium was used
- the culture was stirred constantly at a low speed.

Explain why each of these precautions was necessary.

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.....[3]

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Fig. 2.1 shows the surface view of a counting grid for a light microscope used to estimate the number of bacteria in each sample.

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The depth of the grid is 0.1 mm.

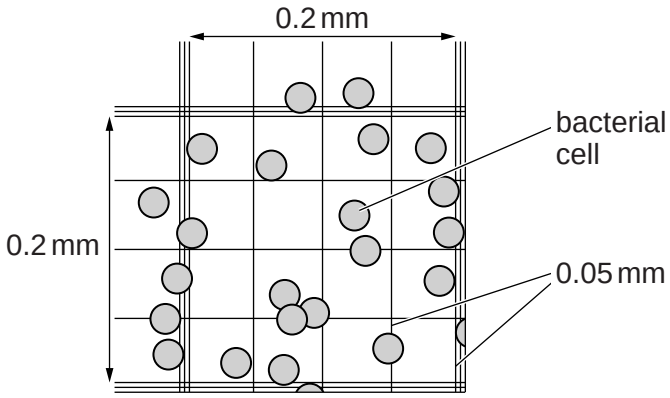


Fig. 2.1

(c) Suggest how this apparatus could be used to estimate the number of cells per cm^3 of culture.

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..... [5]

Question 2 continues on Page 8

Table 2.1 shows the results of the investigation.

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Table 2.1

time since inoculation of growth medium / min	100	130	160	190	220	250	280	310	340	370
population of bacteria / 10^6 cells cm^{-3}	14	23	40	66	78	224	463	812	1122	1148

(d) Suggest why the results in Table 2.1 may not be reliable.

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(e) Suggest an explanation for the results of the investigation into the growth of *Aerobacter aerogenes* show in Table 2.1.

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[Total: 13]

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