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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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0120013753

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2012**

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 pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **both** 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	
Total	

This document consists of **8** printed pages.

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1 The single- celled alga *Chlorella* is common in polluted waters and is used in sewage lagoons to reduce the nitrate content of the water.

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Fig. 1.1 shows cells of *Chlorella* viewed with a light microscope using high power.

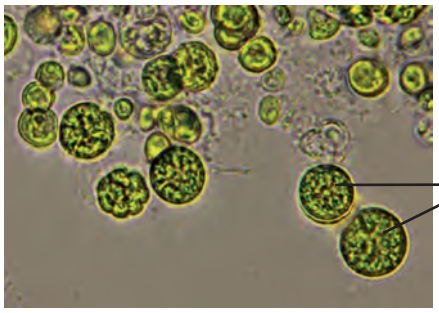


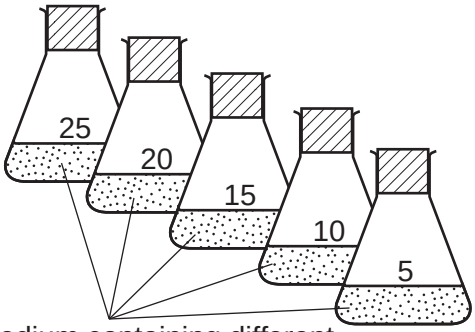
Fig. 1.1

A student investigated the effect of different concentrations of nitrate on the population growth of a species of *Chlorella*. The student used sodium nitrate in the investigation.

Fig. 1.2 shows the main steps in the procedure.

Step 1

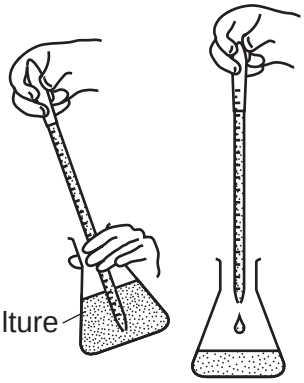
- 250 cm^3 of a growth medium was added to each of five flasks
- a different concentration of sodium nitrate solution from 5 mmol dm^{-3} – 25 mmol dm^{-3} was added to the flasks



growth medium containing different concentrations of sodium nitrate

Step 2

- 1 cm^3 sample removed from a *Chlorella* culture using a graduated pipette
- the 1 cm^3 sample transferred to a flask

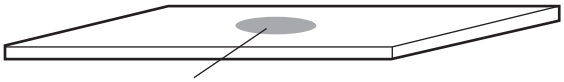


Step 3

- Step 2 repeated for the rest of the flasks
- the flasks were left in sunlight at room temperature.

Step 4

- immediately the number of cells of *Chlorella* in 5 samples taken from each flask was counted.
- 5 samples were removed from each flask at intervals of 2 days for a period of 10 days and the number of cells counted.



haemocytometer used by the student for counting the cells

Fig. 1.2

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

independent .....

dependent .....[1]

(ii) Identify **two** variables that the student has controlled in this investigation as shown in Fig. 1.2.

.....

.....[1]

(iii) There are other variables that the student could have controlled in this investigation.

Describe how **two** other variables could have been controlled.

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.....[4]

(b) (i) The student used solid sodium nitrate to prepare the highest concentration of sodium nitrate solution shown in Fig. 1.2 (25 mmol dm^{-3}). This concentration was then used to prepare all the other concentrations.
Describe the procedure that the student used to prepare the concentrations shown in Fig. 1.2. Your description should be sufficiently detailed so that another person can easily follow your procedure.
The molar mass of sodium nitrate is 85 g mol^{-1}.

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.....[4]

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(ii) The student also prepared another flask to use as a control.

Suggest a suitable solution to use as a control for this investigation.

.....

.....[1]

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

Table 1.1

concentration of sodium nitrate / mmol dm^{-3}	mean number of cells in 1 cm^3 at the start	mean percentage increase in number of cells of *Chlorella*				
		day 2	day 4	day 6	day 8	day 10
control	10035	1	2	2	2	2
5	10630	40	75	140	175	220
10	10128	50	105	160	230	285
15	10743	75	135	210	292	360
20	10108	65	125	195	280	330
25	10900	55	110	170	250	300

(i) State how the mean percentage increase in number of cells was calculated.

.....

.....

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.....

.....[3]

(ii) Suggest why the student calculated the mean percentage increase in numbers of *Chlorella*.

.....

.....[1]

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(d) State what conclusions can be drawn from the results in Table 1.1 about the effect of different concentrations of nitrate on the growth of *Chlorella*.

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..... [3]

(e) Suggest how the student's investigation should be modified to find the optimum nitrate concentration for the growth of this *Chlorella*.

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..... [1]

(f) Sewage lagoons also contain high concentrations of phosphate. In another investigation, the student used sodium phosphate instead of sodium nitrate to find out the effect of different phosphate concentrations on the growth of *Chlorella*.

Suggest a prediction that the student could make about the effect of the different concentrations of phosphate on the growth of *Chlorella*.

Show your answer as a sketch graph on the axes below.

[2]

[Total: 21]

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2 Dialysis is used to treat kidney failure. One type of dialysis, called CAPD, allows patients to move around during treatment. During this type of dialysis a fluid containing the sugar dextrose, a form of glucose, is passed into the abdominal cavity and left for a few hours. Wastes and excess water pass into the dialysis fluid, which is then removed and thrown away.

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Fig. 2.1 shows dialysis fluid being added to the abdominal cavity.

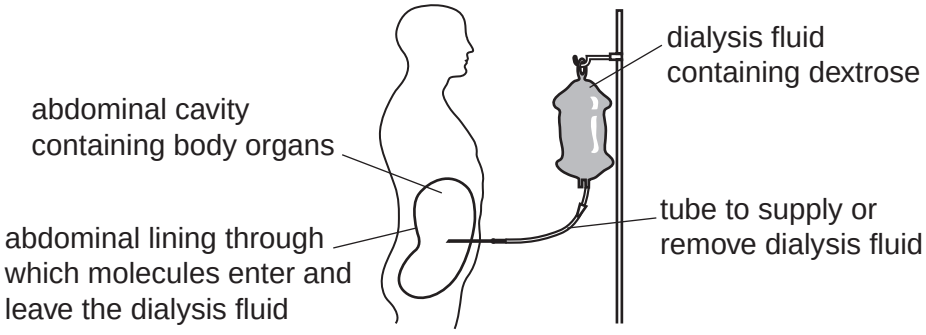

Fig. 2.1

(a) Tests are carried out on each patient receiving CAPD to find out if the treatment is effective. One of these tests uses strips that change colour to indicate the urea concentration.

Outline how test strips could be used to find the effectiveness of CAPD in removing urea.

.....

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..... [2]

One effect of kidney failure is anaemia which can be treated by injecting a hormone that stimulates red blood cell production. This treatment can cause a lack of iron used for the synthesis of haemoglobin. Iron supplements are usually taken by mouth.

Ten male and four female patients with a mean age of 63, all using dialysis and being treated for anaemia, took part in a study into a different way of giving iron supplements.

Test **A** was carried out on samples of blood from the patients at the start.
Measurements were made of :

- haemoglobin content
- iron content
- ferritin, a plasma protein for transporting iron.

The patients were supplied with an iron supplement which they took by mouth for three months. At the end of this time test **B** was carried out on samples of blood from the patients by measuring the same three substances as before.

In the next part of the study the patients' iron supplements were replaced by an iron-dextran complex that was injected into their muscles once a week for three months. Test **C** was carried out on samples of blood from the patients in the same way as in tests **A** and **B**.

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Table 2.1 shows the results of this study.

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Table 2.1

substance tested	mean concentration ± S_M			range of concentrations in people without anaemia
	test **A** (before treatment with iron supplements)	test **B** (after injection with hormone and iron taken by mouth)	test **C** (after injection with hormone and iron given by injection)	
haemoglobin / g dm^{-3}	90 ± 1	100 ± 1	130 ± 3	120 – 130
iron / μg dm^{-3}	740 ± 15	540 ± 11	940 ± 21	500 – 1760
ferritin / μg dm^{-3}	2.81 ± 0. 69	2.67 ± 1.04	6.60 ± 1.04	11 – 300

(b) (i) State what S_M shows about the data.

.....

.....[2]

(ii) A number of *t*-tests were carried out to determine if the treatments with iron supplements had a significant effect on the concentrations of the substances tested. The results of test **A** were used as a comparison for both test **B** and test **C**. State why the *t*-test is a suitable statistical test to use for the data.

.....[1]

(iii) State evidence in Table 2.1 that suggests the results of these *t*-tests might be significant.

.....

.....[1]

Question 2 continues on page 8

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(c) The researchers who carried out this study concluded that providing iron supplement by injection was more effective than providing iron by mouth.

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(i) State the evidence from Table 2.1 for this conclusion.

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(ii) Suggest limitations of this study.

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.....[3]

[Total: 9]

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