Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

0499271381

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2016**

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 **9** printed pages and **3** blank pages.

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[Turn over

1 Fig. 1.1 shows some of the plants growing in a pond and on the land around the pond.
Some students decided to investigate the changes in the distribution and abundance of species of land plants at different distances from the edge of the pond.

They started their investigation at the plants growing next to the water, as shown in Fig. 1.1.

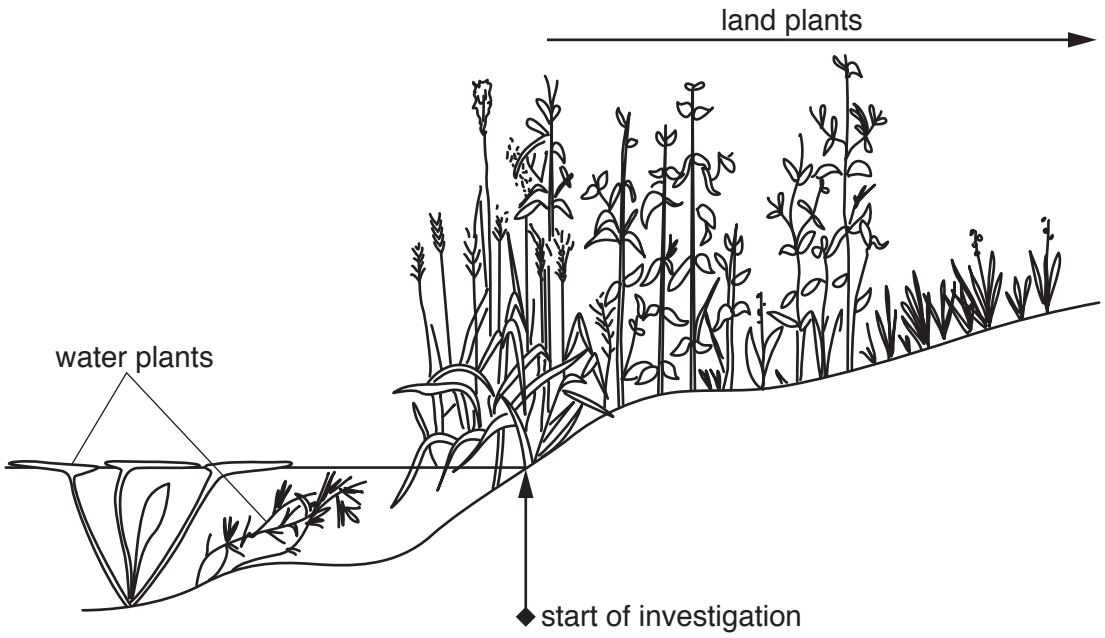


Fig. 1.1

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

independent variable .....

.....

dependent variable .....

.....[2]

(ii) Describe a systematic sampling method the students could use to find out how the distribution and abundance of the plant species changed as the distance from the edge of the pond increased.

Your description of the sampling method should be detailed enough for another person to use.

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(b) The students also collected samples of soil at different distances from the pond edge and estimated the water content.

The students wanted to find out if the water content of the soil at the different distances sampled was related to the number of different plant species found at the same distances. To do this, a Spearman's rank correlation (r_s) was carried out using the data in Table 1.1.

Table 1.1

sample	water content / arbitrary units	rank	number of species	rank	rank difference (D)	D^2
1	28	1	3	10	–9	81.00
2	26	2	4	9	–7	49.00
3	21	3	5	8	–5	25.00
4	18	4	6	7	–3	9.00
5	15	5.5	8	6	–0.5	0.25
6	14	7.5	9	4.5	3	9.00
7	15	5.5	10	3	2.5	6.25
8	14	7.5	9	4.5	3	9.00
9	13	9.5	11	2	7.5	56.25
10	13	9.5	12	1	8.5	72.25
					$\sum D^2$ =	

The formula for Spearman's rank correlation is:

$$r_s = 1 - \left(\frac{6 \times \sum D^2}{n^3 - n} \right)$$

r_s = Spearman's rank correlation
n = number of pairs of observations
D = difference between each pair of ranked measurements
$\sum$ = sum of

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(i) Complete Table 1.1 to show $\sum D^2$. [1]

(ii) Use the information in Table 1.1 to calculate the value for r_s.
Show the values for:

- $6 \times \sum D^2$
- $n^3 - n$

r_s = ...[2]

(iii) State what the value for r_s shows about the relationship between soil water content and the number of species present.

.....

.....[1]

(c) (i) The group of students then investigated the relationship between soil air content and the number of different plant species at the same sampling points.

The students calculated the r_s value as +0.86.

Table 1.2 shows part of a Spearman's rank probability table.

Table 1.2

n (number of pairs)	8	9	10	11	12
significance level 5%	0.738	0.700	0.648	0.618	0.618
significance level 1%	0.881	0.883	0.794	0.755	0.727

The students concluded that their r_s value of +0.86 for the relationship between soil air content and the number of species present was significant at both the 5% level and 1% level.

Explain how the students reached this conclusion.

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.....[2]

(ii) Based on the result of their Spearman's rank test and the significance of the r_s value, the students concluded that:

Soil air content caused the difference in the number of plant species that could grow at different distances from the edge of the pond.

Suggest why this conclusion may not be valid.

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.....[2]

[Total: 18]

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2 There are chemicals in the brain which give feelings of pleasure and reward.

Nicotine in cigarette smoke is believed to cause addiction by increasing the secretion of these chemicals in the brain.

Research into the treatment of nicotine addiction was carried out using rats to test the effect of a drug, topiramate, which blocks the secretion of these chemicals.

Topiramate was administered to the rats in a saline solution.

Table 2.1 shows the treatment given to six groups of healthy laboratory rats.

Table 2.1

group of rats	treatment with topiramate	treatment with a standard concentration of nicotine
1	none (saline solution only)	given
2	low concentration	given
3	high concentration	given
4	high concentration	not given (water given instead)
Groups **5** and **6** were pre-treated with nicotine for 14 days to simulate nicotine addiction		
5	none (saline solution only)	given
6	high concentration	given

One of the chemicals in the brain associated with pleasure and reward is dopamine. The concentration of dopamine was measured in all six groups.

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[Turn over

(a) (i) State three variables which **should have been** standardised in this investigation.

1 .....

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2 .....

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3 .....

.....[3]

(ii) Groups **1**, **4** and **5** are all controls. Explain why these were included.

*control groups **1** and **5*** .....

.....

*control group **4*** .....

.....[2]

Fig. 2.1 and Fig. 2.2 show the results of using topiramate on the dopamine secretion in the brain.

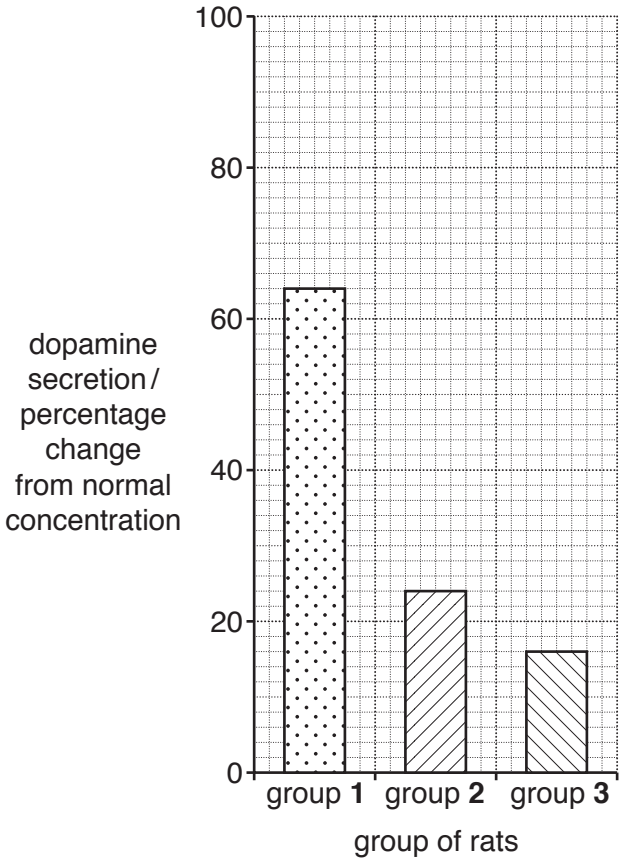


Fig. 2.1

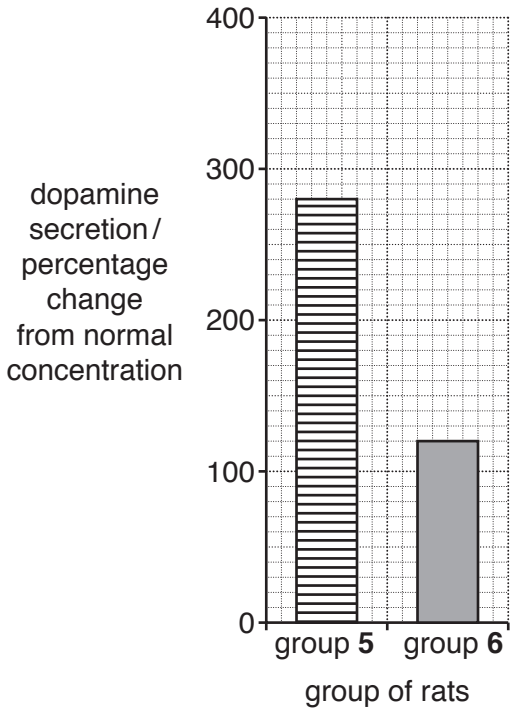


Fig. 2.2

(b) Rats pre-treated with nicotine were used as a model for humans addicted to nicotine.

In rats that have not been treated with topiramate (groups **1** and **5**), the secretion of dopamine in response to nicotine is greater in rats that have been pre-treated with nicotine (group **5**), than in rats that have not been pre-treated with nicotine (group **1**).

Calculate the ratio of the increase in dopamine secretion caused by pre-treatment with nicotine (group **5**) compared to no pre-treatment with nicotine (group **1**).

.....[2]

(c) State three conclusions that can be drawn about the effect of topiramate on the secretion of dopamine by the brain in response to nicotine.

1 .....

.....

2 .....

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3 .....

.....[3]

(d) The researchers also studied the effect of topiramate on two other brain chemicals, noradrenaline and serotonin.

They found that topiramate:

- completely inhibits the release of noradrenaline, which is associated with pleasure and reward
- stimulates the secretion of serotonin, which has been shown in human trials to reduce smoking and inhibit the secretion of dopamine.

Suggest why the researchers concluded that topiramate could be successful in treating nicotine addiction.

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