Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

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7750682372

BIOLOGY **9700/51**

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

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Do not use staples, paper clips, glue or correction fluid.
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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 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.

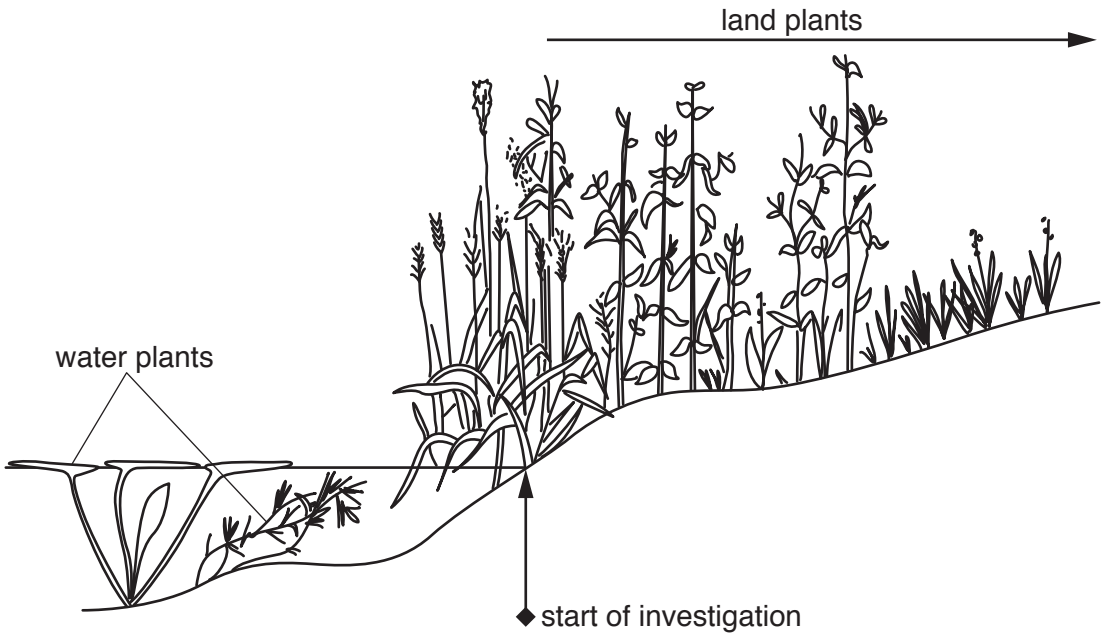


Fig. 1.1

(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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[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.

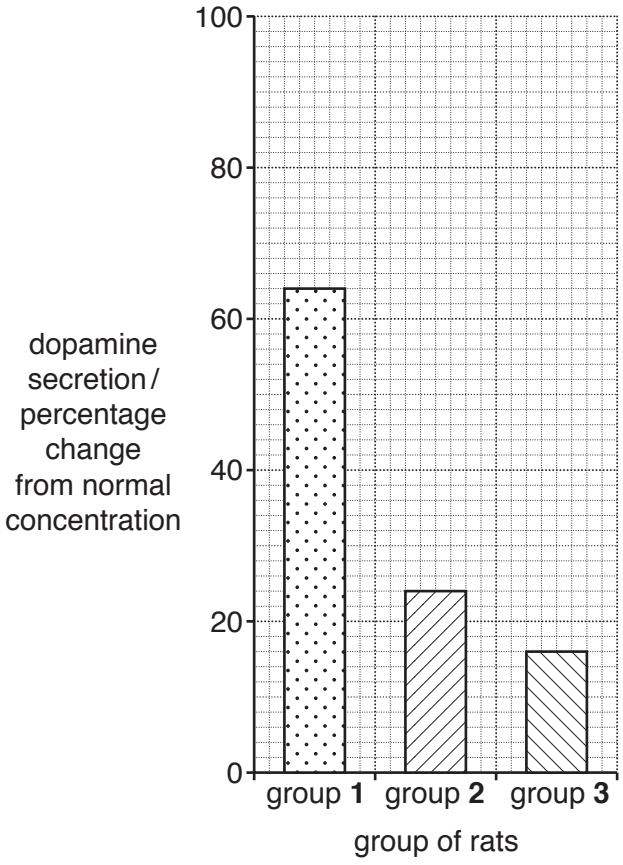


Fig. 2.1

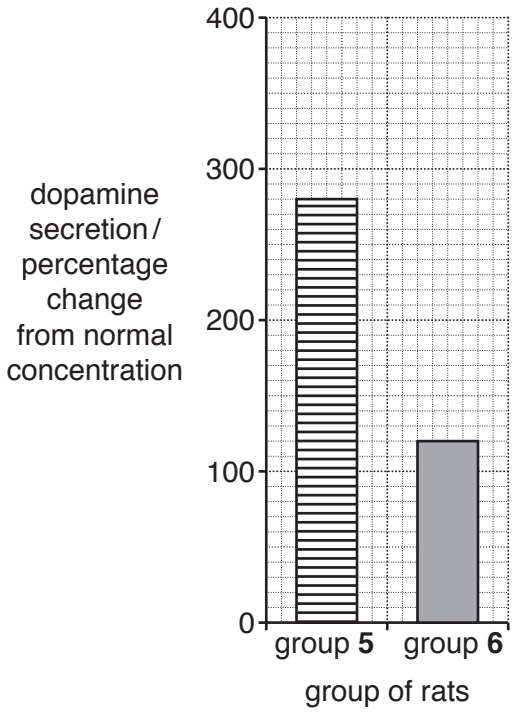


Fig. 2.2

(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 .....

.....

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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.....[2]

[Total: 12]

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CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

0674730717

BIOLOGY **9700/52**

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

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

(a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

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..... [2]

(b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

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The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

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

independent variable .....

dependent variable ..... [1]

(d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	height of plant/mm	
	grazed area	ungrazed area
1	586	858
2	549	873
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	
median	561	

(i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

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(ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$S_M = \frac{s}{\sqrt{n}}$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

standard error, grazed area = ...

standard error, ungrazed area = ... [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3 mm to 585.7 mm.

(iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

$$95\%\ \text{CI} = \text{mean} \pm 2\ S_M$$

Show your working.

ungrazed area .....mm to .....mm [2]

(iv) State what information is gained by calculating the confidence intervals.

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..... [2]

(e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. .....

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2. .....

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..... [2]

(f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice .....

reason ..... [1]

[Total: 21]

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Question 2 starts on page 8

2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.



Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm^3 per minute ($dm^3\,min^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	**1**	**2**	**3**	**4**	**5**
number of packets of cigarettes smoked per year	0	1–50	51–100	101–150	151–230
mean number of packets smoked per group ± *s*	0	30.61 ± 10.47	73.80 ± 16.52	127.27 ± 9.66	189.22 ± 27.51
mean age of volunteers ± *s* /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	28.90 ± 4.20	36.22 ± 3.21
mean PEFR ± *s* /$dm^3\,min^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8

s = standard deviation

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

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(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.

2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

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do not support

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(c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

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..... [1]

(ii) State **two** ways in which the data for **group 5** is less trustworthy compared with the data for the other groups.

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[Total: 9]

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CANDIDATE NAME

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0499271381

BIOLOGY **9700/53**

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

1 hour 15 minutes

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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.

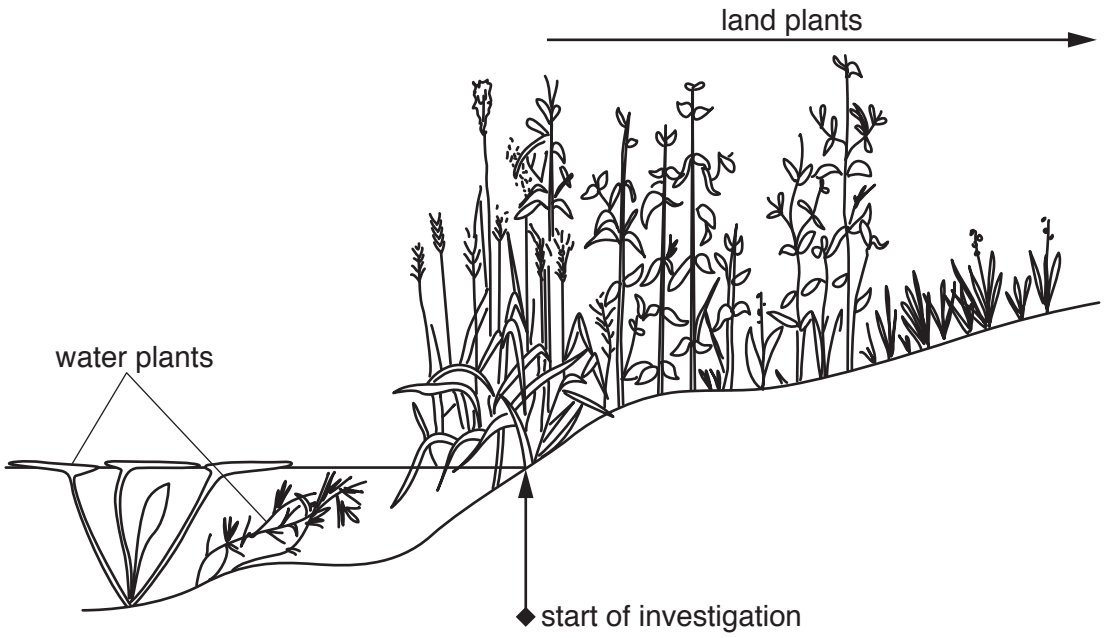


Fig. 1.1

(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
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3	21	3	5	8	–5	25.00
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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 .....

.....

2 .....

.....

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.

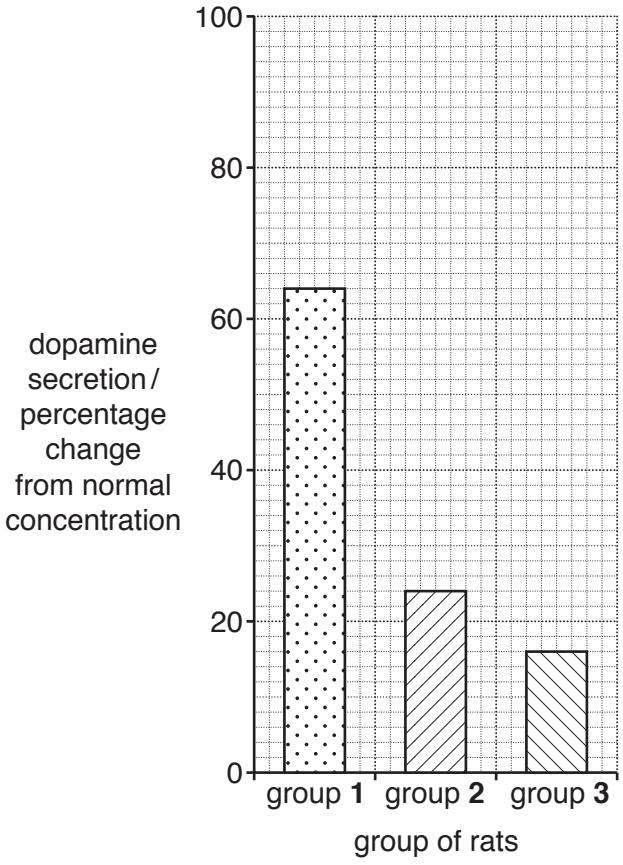


Fig. 2.1

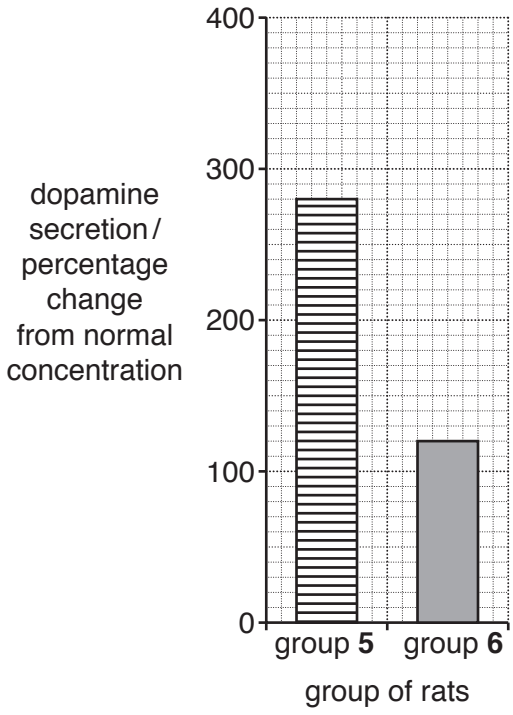


Fig. 2.2

(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 .....

.....

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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.....[2]

[Total: 12]

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