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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1001250705

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2010**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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1 A student noticed that the leaves on a plant growing close to a wall had two sorts of leaves. The leaves next to the wall were in the shade and looked different from the leaves on the side away from the wall that were exposed to the sun. The length of the internodes on the stem also looked different.

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The student decided to investigate the differences by measuring some features of 30 leaves and internodes from each side of the plant.

Fig. 1.1 shows the leaf shape

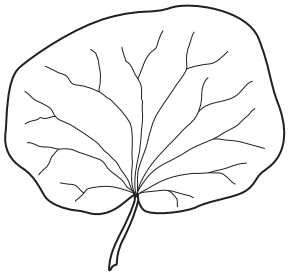


Fig. 1.1

Fig. 1.2 shows an internode

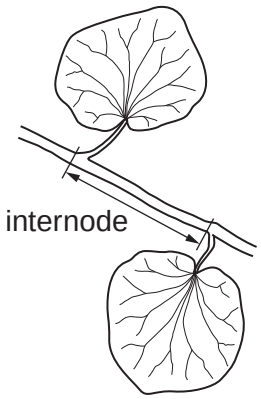


Fig. 1.2

Table 1.1 shows the student's results.

Table 1.1

	shaded leaves	**exposed leaves**
mean internode length / mm	23 ± 4	15 ± 3
mean surface area of leaves / mm^2	2750 ± 12	1800 ± 15
mean mass of leaves / mg	50 ± 8	60 ± 10
mean leaf surface area : leaf mass ratio	55 ± 9	30 ± 6
rate of water loss / mg mm^{-2} h^{-1}	50 ± 11	65 ± 12

(a) (i) State the independent variable being investigated.

.....[1]

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(ii) Outline the procedures the student could use to obtain these results.

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.....[8]

The student carried out *t*-tests for leaf surface area : leaf mass ratio and for internode length.

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The leaf surface area : leaf mass ratio gave the value ***t* = 12.6**

The formula for *t*-test is

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

(b) (i) Complete the calculation to find the value of *t* for the internode length.
Show your working.

$t =$ $\quad \frac{-}{\sqrt{\frac{4^2}{30} + -}}$

$= \quad \frac{}{0.9}$

t = ...[3]

Table 1.2 shows the critical values at p < 0.05 for the *t*-test.

Table 1.2

degrees of freedom	18	20	21	22	23	24	25	26	27	28	29	30	40	60	∞
critical value	2.10	2.09	2.08	2.07	2.06	2.06	2.06	2.06	2.05	2.05	2.04	2.04	2.02	2.00	1.96

The number of degrees of freedom is 58.

(ii) State how the number of degrees of freedom was calculated.

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(iii) State and explain the meaning of these results.

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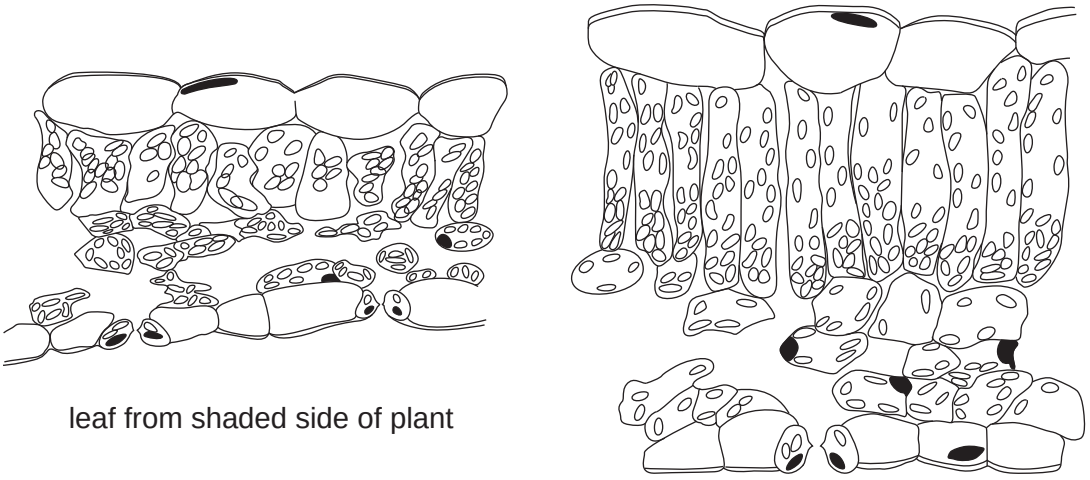
.....[2]

In a further investigation, the student cut sections of the leaves from the shaded side and from the exposed side of the plant. The following procedures were carried out:

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Transverse sections were made of each leaf and high-power drawings were made from these sections. The relative thickness of both the leaf and the cuticle were measured using an eyepiece graticule and the difference in the distribution of chloroplasts was observed.

Fig. 1.3 shows drawings made from transverse sections of these leaves.



leaf from shaded side of plant

leaf from exposed side of plant

Fig. 1.3

(c) (i) Explain how the actual thickness of the leaf could be measured.

.....

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.....[2]

(ii) With reference to the student's results, state what conclusions can be drawn about the differences in adaptations shown by shaded leaves and exposed leaves of the plant.

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.....[3]

[Total: 20]

2 Fig. 2.1 shows a freshwater crustacean. This animal has a two-chambered heart that can be seen through the exoskeleton.

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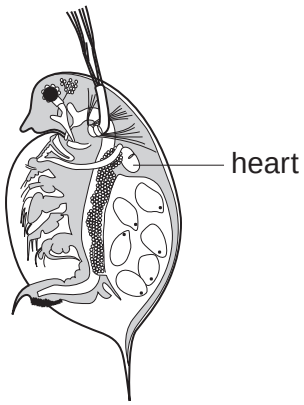


Fig. 2.1

An investigation into the effect of temperature on heart rate was carried out using this organism to test the hypothesis:

Heart rate doubles for every 10 °C increase in temperature.

Five crustaceans, each measuring 5 mm in length, were placed in water of different temperatures and left for five minutes. The heart beat was counted for 20 seconds using a tally counter and stop watch. Table 2.1 shows the results of the investigation.

Table 2.1

	heart rate / beats per minute						
	temperature / °C						
	5	10	15	20	25	30	35
specimen 1	30	45	63	96	132	165	84
specimen 2	33	51	69	105	150	171	87
specimen 3	33	48	66	93	130	174	69
specimen 4	45	57	87	111	168	183	78
specimen 5	24	36	51	78	120	135	75

(a) (i) Identify two variables that have been controlled during this investigation.

1. .....

2. .....[2]

(ii) Suggest **one** other variable that should be controlled.

.....

.....[1]

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(iii) Suggest **one** feature of the procedure which may cause the results to be inaccurate.

.....

.....[1]

(iv) Suggest a reason why the student used five specimens at each temperature.

.....

.....[1]

The student calculated the percentage change in heart rate for each specimen.
Table 2.2 shows these results.

Table 2.2

	percentage change in heart rate					
	temperature / °C					
	5–10	10–15	15–20	20–25	25–30	30–35
specimen 1	50	40	52	38	25	-49
specimen 2	55	35	52	42	14	-49
specimen 3	45	38	40	39	34	-60
specimen 4	27	52	28	51	9	-57
specimen 5	50	41	53	54	12	-44

(b) (i) Suggest why the student converted the raw data to percentage change.

.....

.....[1]

(ii) Describe how the percentage change between 25 °C and 30 °C was calculated.

.....

.....[1]

(iii) Predict the effect on the heart rate of an increase in temperature to 40 °C.

.....

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(c) Assess how far the results of the investigation support the hypothesis.

.....

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[Total: 10]

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General Certificate of Education Advanced Level

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0948406200

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2010**

1 hour 15 minutes

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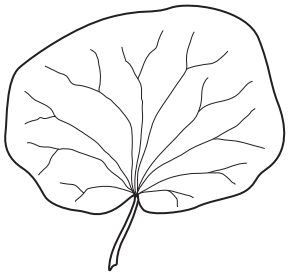


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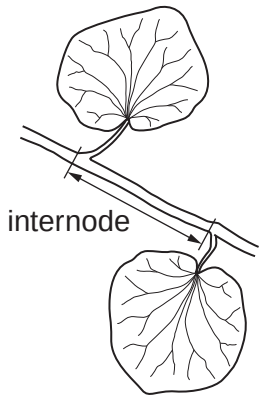


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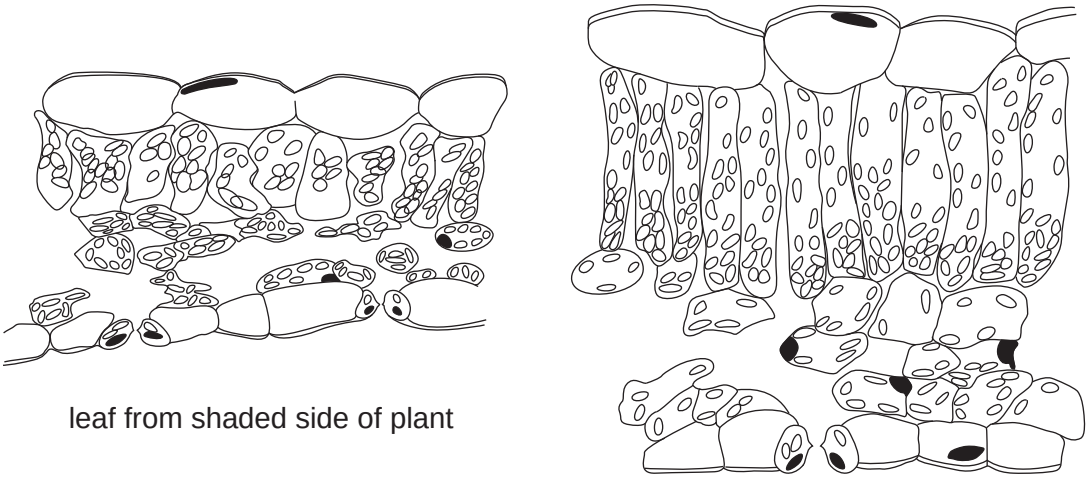
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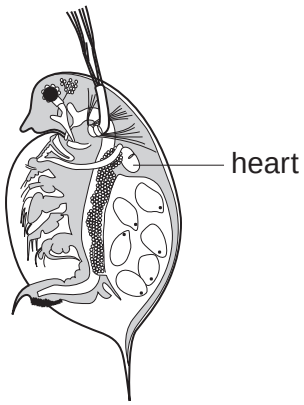


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BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2010**

1 hour 15 minutes

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[Turn over

1 Fig. 1.1 shows a simple apparatus used by a student to measure the rate of respiration in the yeast *Saccharomyces cerevisiae*.

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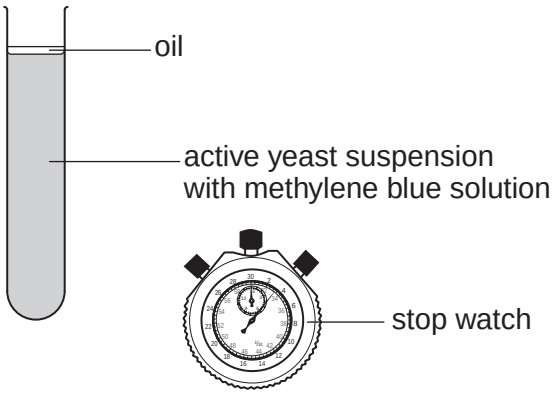


Fig. 1.1

Active yeast suspension is a pale cream colour. It is prepared by mixing dry yeast, glucose and water and leaving for 1 hour at 30 °C. The methylene blue solution acts as an electron acceptor and becomes colourless when reduced.

(a) (i) State how the dependent variable is measured in this experiment.

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(ii) Explain why the layer of oil is needed.

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(iii) Outline how the student could use this apparatus to find the optimum temperature for the respiration of yeast.

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In a further investigation, the student tested the ability of yeast to use different sugars. Active yeast suspensions were mixed with 2% solutions of six different sugars. The yeast was allowed to metabolise the sugars at its optimum temperature and the carbon dioxide released was collected for a 10 minute period.

Table 1.1 shows the student's results.

Table 1.1

volume of carbon dioxide in 10 mins / cm^3											
monosaccharides						disaccharides					
glucose (glu)		fructose (fru)		galactose (gal)		sucrose (glu + fru)		maltose (glu + glu)		lactose (glu + gal)	
1	2.0	1	5.0	1	0.1	1	3.0	1	1.4	1	0.3
2	2.2	2	3.8	2	0.3	2	2.6	2	1.7	2	0.4
3	2.4	3	4.6	3	0.2	3	3.6	3	1.3	3	0.6
mean	2.2	mean	4.5	mean	0.2	mean	3.1	mean	1.5	mean	0.4

(b) Suggest an explanation for these results.

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.....[3]

Based on these observations, the student made a hypothesis:

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The yeast will form more cells when provided with fructose than with glucose.

Table 1.2 shows the results of counting cell samples from the active yeast suspension that had been supplied with fructose or glucose and left at the optimum temperature for 30 minutes. Three samples were taken from each suspension and the cells counted using a microscope slide with a grid. Four counts were made from each sample and the number of cells per mm^3 calculated.

Table 1.2

	fructose number of cells per mm^3					glucose number of cells per mm^3				
	count 1	count 2	count 3	count 4	mean	count 1	count 2	count 3	count 4	mean
sample 1	52	75	62	56	62	53	55	48	54	51
sample 2	58	66	71	46		45	52	51	52	
sample 3	65	61	68	64		53	53	42	54	

The student then calculated the standard error for these results.

The standard deviation for fructose = 8.11 = 8 cells

The standard error for fructose = 2.30 = 2 cells

The formula for standard error is: $S_M = \frac{s}{\sqrt{n}}$ s = standard deviation, n = number of samples

(c) (i) Complete the calculation to find the value of S_M for glucose.

Show your working. State your answer to the nearest whole cell.

$$S_M = \frac{4}{\sqrt{\quad}}$$

S_M = ...[3]

(ii) State what standard deviation shows.

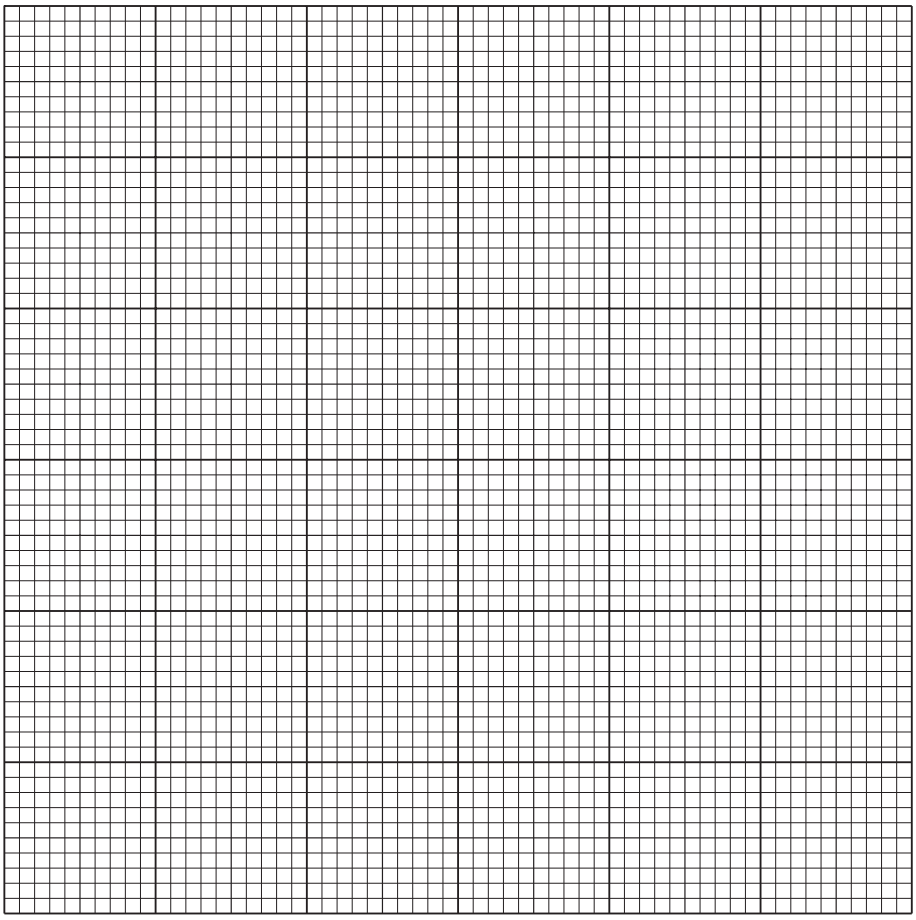
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.....[2]

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(iii) Use the grid to plot the data in Table 1.2 to show the difference in the mean population size of yeast supplied with fructose and yeast supplied with glucose. Include error bars.

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[3]

(iv) State whether the data support the hypothesis. Give a reason for your answer.

.....

.....[1]

[Total: 21]

2 In an investigation on the effects of nicotine, 20 regular smokers completed a memory test. Their reaction time after smoking various amounts of nicotine was measured.
The following procedure was used:

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- the participants did not smoke for 12 hours before the test
- the participants took a memory test
- the participants smoked a cigarette containing 0.05 mg of nicotine
- the participants took a memory test
- the participants smoked a cigarette containing 1.1 mg of nicotine
- the participants took a memory test.

The memory test consisted of:

- a random set of two, three or four letters was shown on a computer screen for 250 ms
- after 1000 ms a single letter was shown for 250 ms
- the participant pressed a 'yes button' if the letter was present in the original set or a 'no button' if it was not present
- the time taken to respond was recorded as the reaction time.

Fig. 2.1 shows the results of these investigations.

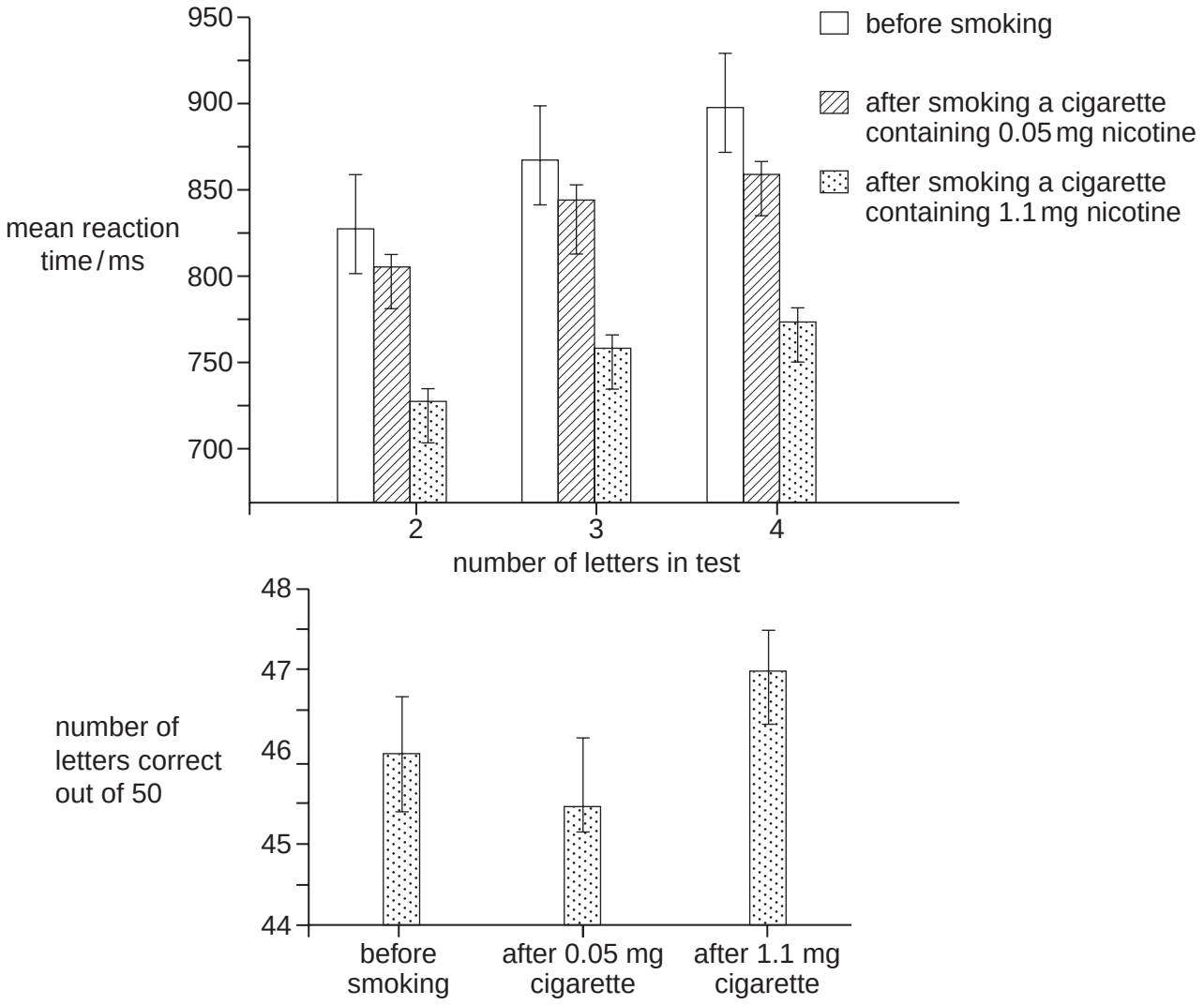


Fig. 2.1

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

independent variable .....

.....

dependent variable .....

.....[2]

(ii) State two variables that are controlled in this investigation. For each, state how it is controlled.

variable 1 .....

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.....

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variable 2 .....

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.....[4]

(b) The investigators concluded

An increase in nicotine decreases reaction time and improves accuracy of the memory test.

State how the results

(i) support this conclusion

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(ii) do not support this conclusion.

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.....[3]

[Total: 9]

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