Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

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|---|---|
| CANDIDATE NAME | |
| CENTRE NUMBER | |
| CANDIDATE NUMBER | |

*2437208772*

**BIOLOGY** **9700/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2017**

**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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CAMBRIDGE International Examinations

**1** A student used the internet to find information about caffeine and the possible effects it has on the body.

The student decided to test the hypothesis that:

Caffeine decreases the reaction time and increases the heart rate.

Table 1.1 shows the results of the student's research into the caffeine content of drinks.

**Table 1.1**

| drink | cup of coffee | cup of tea | 100 $cm^3$ energy drink | 350 $cm^3$ cola |
|---|---|---|---|---|
| caffeine content / mg | 80 | 40 | 30 | 45 |

The student also found that it takes about 45 minutes before caffeine from a drink is fully absorbed into the blood and about 4 to 5 hours for the effect to wear off.

After further research, the student decided:

- test subjects should not know whether they are having a drink with caffeine or without caffeine
- drinks with caffeine and without caffeine should look identical
- to measure the subject's reaction time using a computer programme that flashes a coloured light at random intervals. The subject presses a switch as soon as they see the light
- to measure the heart rate using a pulse meter attached to the first finger.

**(a)** Suggest why it is important that the test subjects should not know whether they are having a drink with caffeine or without caffeine.

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..... [1]

**(b) (i)** State the independent variable and the **two** dependent variables in this investigation.

*independent variable* .....

.....

*dependent variables* .....

.....[2]

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**(ii)** Use the information given to describe a method by which the student could test their hypothesis using **one** of the drinks.

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

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**(c)** In another experiment 10 subjects were each given a different concentration of caffeine. The reaction time was measured 5 times for each subject and a mean calculated.

Table 1.2 shows the results.

**Table 1.2**

| subject | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| concentration of caffeine / mg dm$^{-3}$ | 0 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
| mean reaction time / ms | 355 | 343 | 340 | 321 | 300 | 305 | 288 | 252 | 242 | 204 |

Fig. 1.1 shows the graph produced by a computer programme for the data.

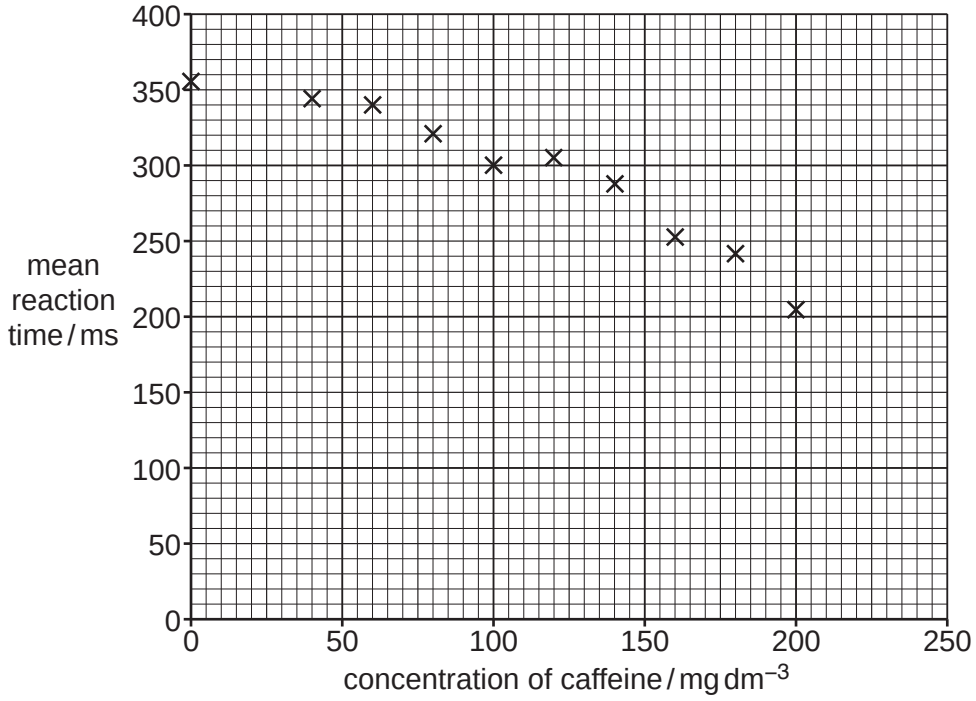



**Fig. 1.1**

Based on this graph the student decided to use a statistical test to find the strength of the correlation between the concentration of caffeine and the mean reaction time.

**(i)** State why Pearson's linear correlation test is suitable for the data.

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..... [1]

**(ii)** The results of the statistical test gave Pearson's linear correlation, ***r*** = –0.722.

State what this value indicates about the relationship between the concentration of caffeine and the mean reaction time.

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.....[1]

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Table 1.3 shows part of a table of critical values for Pearson's linear correlation test (***r***).

**Table 1.3**

| number of pairs of data ($n$) | probability level ($p$) | | | |
|---|---|---|---|---|
| | **0.10** | **0.05** | **0.02** | **0.01** |
| 1 | 0.988 | 0.997 | 0.9995 | 0.9999 |
| 2 | 0.900 | 0.950 | 0.980 | 0.990 |
| 3 | 0.805 | 0.878 | 0.934 | 0.959 |
| 4 | 0.729 | 0.811 | 0.882 | 0.917 |
| 5 | 0.669 | 0.754 | 0.833 | 0.874 |
| 6 | 0.622 | 0.707 | 0.789 | 0.834 |
| 7 | 0.582 | 0.666 | 0.750 | 0.798 |
| 8 | 0.549 | 0.632 | 0.716 | 0.765 |
| 9 | 0.521 | 0.602 | 0.685 | 0.735 |
| 10 | 0.497 | 0.576 | 0.658 | 0.708 |

**(iii)** Describe how the student calculated the degrees of freedom.

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**(iv)** Describe how the student used the probability table to find out if the value for $r = 0.722$ is significant.

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**(d)** Suggest **two** reasons why the method used for the investigation into the effect of caffeine concentration may have given results that are **not** reliable.

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..... [2]

**(e)** Effects of caffeine in the body include the promotion of acetylcholine release and the inhibition of acetylcholinesterase.

Suggest how this could account for the results in Table 1.2.

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..... [1]

[Total: 20]

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**Question 2 starts on page 8**

**2** An investigation was carried out into the size of individuals in a species of ground beetle common in Europe. Five different sites, **A** to **E**, were sampled during the three warmest months of the year.

Table 2.1 shows information about the temperature at these sites.

**Table 2.1**

| site | **A** | **B** | **C** | **D** | **E** |
|---|---|---|---|---|---|
| average yearly temperature / °C | 10.6 | 9.0 | 15.3 | 16.5 | 22.4 |
| lowest average temperature / °C | –2.1 | –1.3 | 8.1 | 1.5 | 16.1 |
| highest average temperature / °C | 23.6 | 21.5 | 23.4 | 28.5 | 29.6 |

- The population at each site was sampled a total of 10 times during the three month period.
- The beetles were sampled at 20 different locations within each site, on the same day.
- The length of each captured beetle was measured to the nearest mm as a measurement of body size.
- The beetles were divided into two groups according to body size, large and small.
- The results from the different locations in each site were added together.
- The population size and the percentages of large and small beetles in the population were estimated.

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

1 .....

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2 .....

.....[2]

**(ii)** Outline how the population size of the beetles can be estimated.

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..... [2]

**(b)** Table 2.2 shows the results of the investigation.

**Table 2.2**

| site | **A** | **B** | **C** | **D** | **E** |
|---|---|---|---|---|---|
| population of beetles | 10 792 | 11 314 | 18 426 | 15 224 | 17 650 |
| number of large beetles | 6520 | 6276 | 10 687 | 6432 | 6523 |
| number of small beetles | 4272 | 5038 | | 8792 | 11 127 |
| percentage of large beetles | 60 | | 58 | 42 | 37 |

**(i)** Complete Table 2.2 by filling in the missing values for sites **B** and **C**. [2]

**(ii)** State, with a reason, whether these results support the hypothesis:

The body size of individuals in populations of ground beetles increases as the environmental temperature decreases.

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..... [1]

**(c)** State two **other** conclusions that can be made about the effect of temperature on body size of the beetles.

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2 .....

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**(d)** Predict **one** way in which climate change may influence the populations of these ground beetles.

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..... [1]

[Total: 10]

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