Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5282330416

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **February/March 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.

CAMBRIDGE International Examinations

1 **(a)** A group of students investigated the effects of glucose and ATP on the contraction of muscle fibres.

Muscle tissue was cut into pieces along the length of the muscle. These pieces were pulled apart to obtain thin strips containing muscle fibres.

Fig. 1.1 shows the preparation of these thin muscle strips.

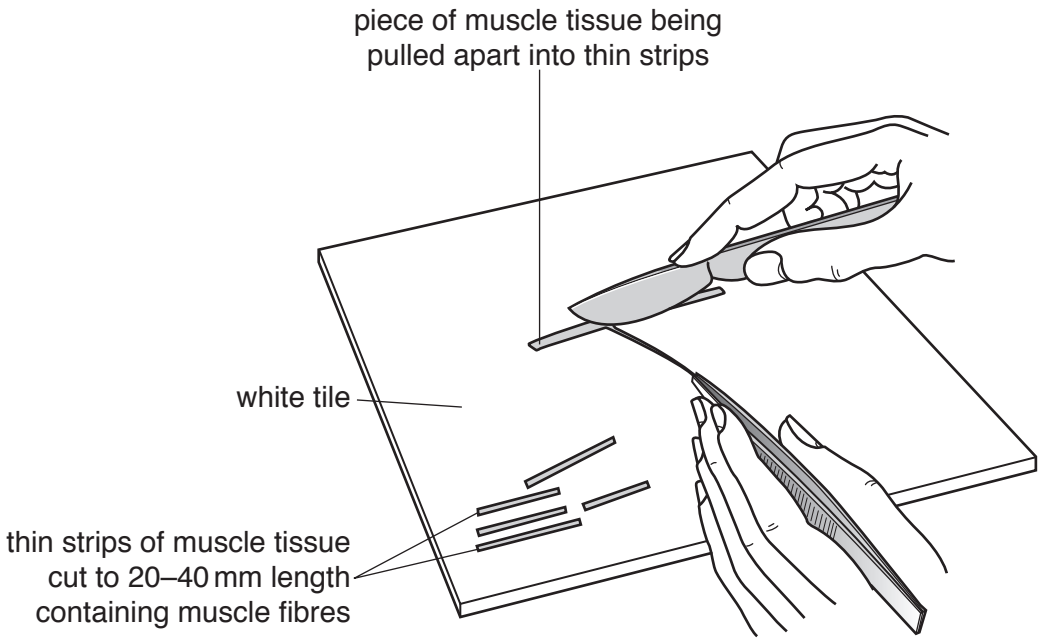

Fig. 1.1

- The prepared thin muscle strips were placed in a Petri dish containing Ringer's solution. Ringer's solution contains the correct balance of ions for animal tissues to function in the Petri dish.
- Some of these thin muscle strips were then placed on a microscope slide and their lengths were measured in mm.
- Ringer's solution was added to these thin muscle strips on the microscope slide and left for a few minutes.
- The length of each of the thin muscle strips was remeasured.

This procedure was repeated with two new sets of thin muscle strips. A different solution was added to each set of thin muscle strips on a microscope slide, instead of Ringer's solution, as follows:

- Ringer's solution containing glucose
- Ringer's solution containing ATP.

The percentage decrease in length was calculated for each of the thin muscle strips.

The results showed that the Ringer's solution containing ATP caused the thin muscle strips to decrease in length. Ringer's solution on its own and Ringer's solution containing glucose did not cause any change in the length of the thin muscle strips.

(i) Identify the independent and dependent variables in the students' investigation.

independent variable .....

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dependent variable .....

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[2]

(ii) State why the students calculated the decrease in length of the muscle fibres as a percentage.

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.....[1]

(iii) State the purpose of testing the muscle strips in Ringer's solution without glucose or ATP.

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.....[2]

(b) The students decided to adapt their method to test the hypothesis:

the greater the concentration of ATP added to the thin muscle strips, the greater the percentage decrease in length.

The students were additionally provided with a stock solution of Ringer's solution containing 0.5% ATP.

Describe how the students could adapt their method to test this hypothesis.

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

You should not include details of preparing the thin muscle strips containing muscle fibres.

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(c) The students' hypothesis was:

the greater the concentration of ATP added to the thin muscle strips, the greater the percentage decrease in length.

Complete Fig. 1.2 to show the graph predicted by this hypothesis. Add labels for the axes, including units, and draw the expected shape of the curve.

Fig. 1.2

[3]

(d) The students carried out their planned method and plotted a graph of their results.

Suggest two reasons why the results obtained by the students may not be valid for the contraction of muscle fibres in a living organism.

1 .....

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2 .....

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[2]

(e) The students thought that adding glucose as well as ATP to muscle fibres might increase the effect of ATP.

Suggest how the students could find out if glucose has this effect.

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.....[2]

[Total: 18]

2 Melanism (dark-coloured wings) in a species of moth is controlled by a gene with two alleles. The dominant allele codes for the melanic form and the recessive allele codes for the non-melanic form (pale, speckled wings). Birds are a predator of this species.

The melanic form is better camouflaged in areas polluted by carbon deposits from smoke. The non-melanic form is better camouflaged in areas unpolluted by smoke.

The frequencies of these two forms of moth were investigated in two populations living in different areas, **X** and **Y**, by using moth traps and counting the numbers of each type of moth. The investigation was carried out over a period of time corresponding to twenty-four generations of this species.

(a) Suggest **two** variables in this investigation that should be standardised.

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.....[2]

During this time period, human activity increased in both areas **X** and **Y** as towns and roads were developed. During generation 1, a large factory started releasing lots of smoke in area **X**.

Fig. 2.1 shows the results of the investigation.

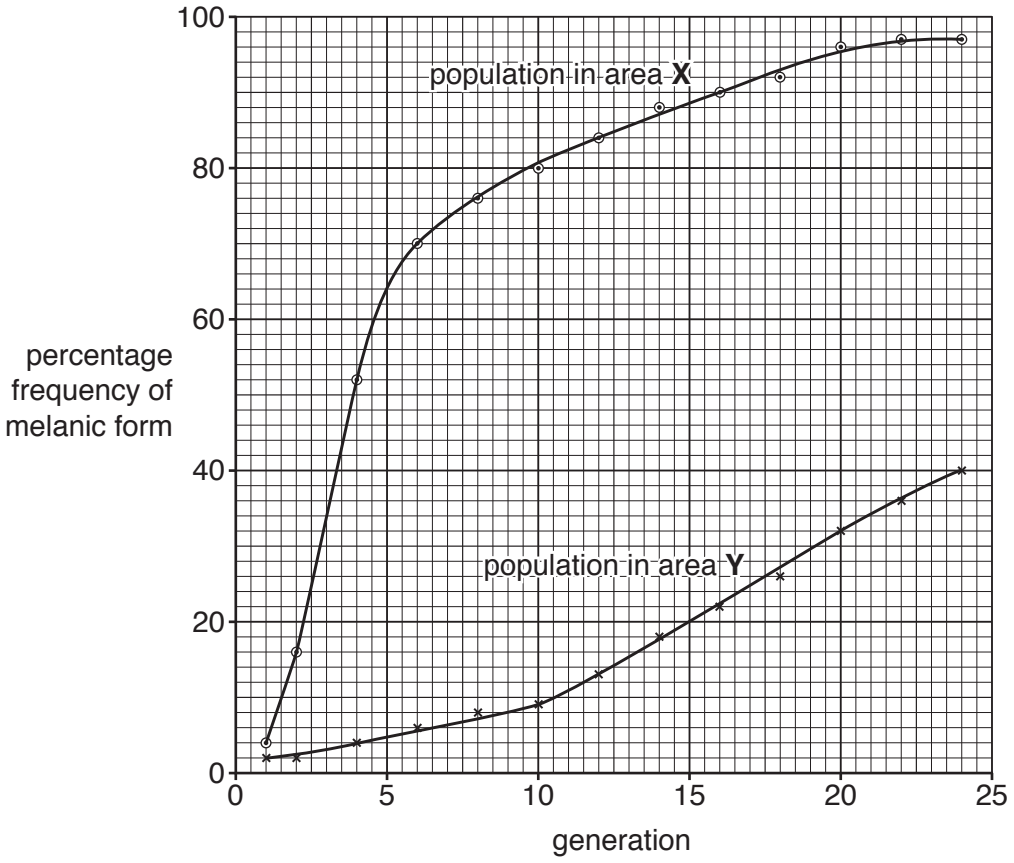

Fig. 2.1

(b) Describe **and** explain the changes in the **two** populations, as shown in Fig. 2.1.

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(c) If the factory in area **X** closed during generation 10, sketch a line on Fig. 2.1 to predict the likely effect on the frequency of the melanic form of the moth in area **X** for the next 14 generations. [1]

(d) The investigators assumed that the changes in the frequencies of the different types of moth in both areas **X** and **Y** were the result of predation by birds.

Suggest two other possible reasons for the increase in frequency of the melanic form.

1 .....

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2 .....

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[2]

(e) The investigators carried out test crosses by breeding a heterozygous male melanic moth with several female non-melanic moths. The number of moths of each form in the next generation was recorded.

melanic	56
non-melanic	48

(i) Complete Table 2.1 to calculate the chi-squared (χ^2) value for determining whether or not these results were significantly different from those expected for crosses of this type.

The formula for calculating χ^2 is:

$$\chi^2 = \Sigma \frac{(O-E)^2}{E} \qquad v = c - 1$$

v = degrees of freedom c = number of classes

Table 2.1

category	O	E	$\frac{(O-E)^2}{E}$
melanic	56		
non-melanic	48		
		χ^2 =	

[3]

(ii) Table 2.2 shows some critical values for χ^2 at different probabilities.

Table 2.2

degrees of freedom	probability						
	0.99	0.95	0.90	0.10	0.05	0.01	0.001
1	0.0002	0.0039	0.0158	2.706	3.841	6.635	10.827
2	0.0201	0.1026	0.2107	4.605	5.991	9.210	13.815

Use Table 2.2 to explain whether or not the χ^2 value calculated in Table 2.1 is significant.

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[Total: 12]