Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Blank pages are indicated.

[Turn over

1 (a) Woodlice are small invertebrates that live in cool, damp places under wood and stones.

Some students determined the respiration rate of woodlice at different temperatures.

Fig. 1.1 shows a single woodlouse.

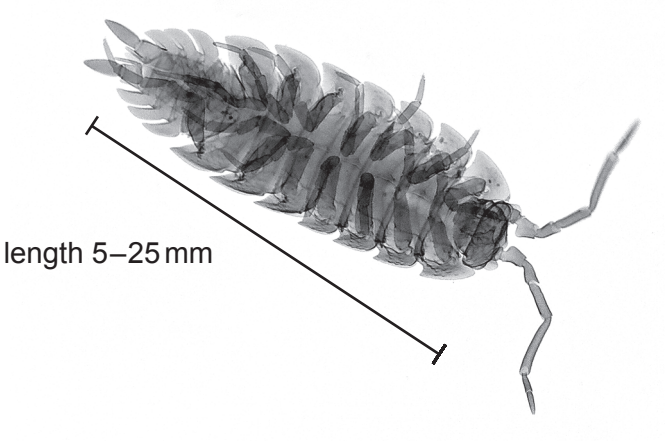

Fig. 1.1

The students tested the hypothesis:

For each 10 °C increase in temperature the volume of oxygen absorbed will double.

Fig. 1.2 shows the respirometer that the students used.

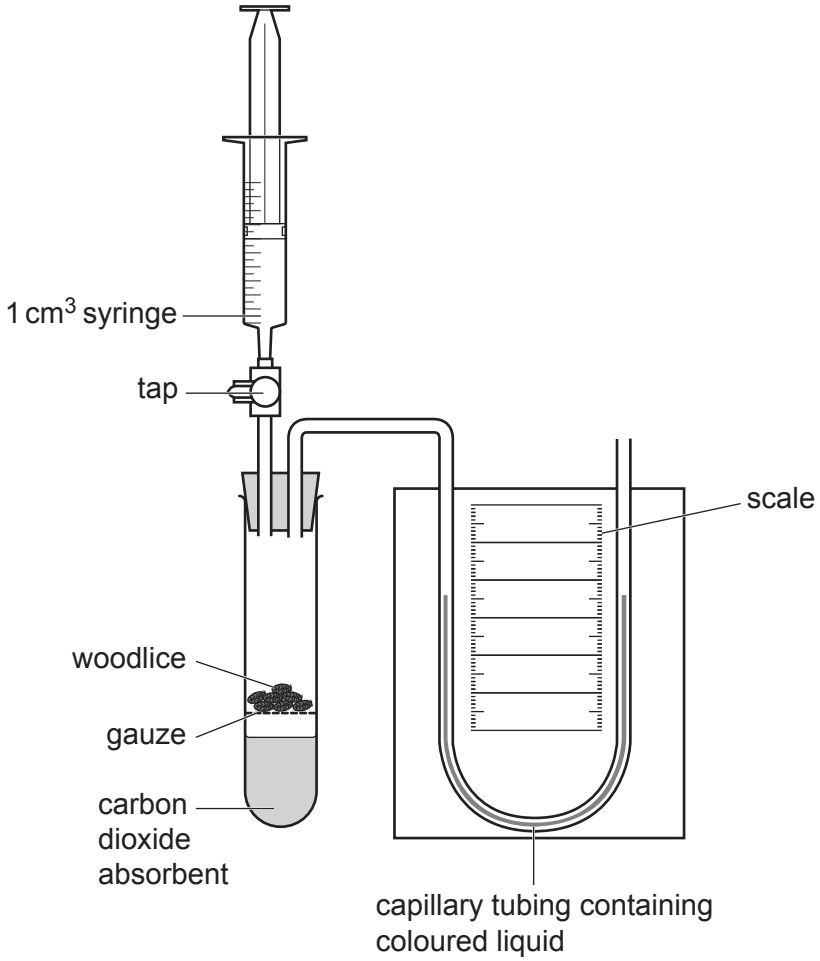

Fig. 1.2

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

independent variable .....

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dependent variable .....

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[2]

(ii) The students decided to measure oxygen uptake for 5 minutes using a range of temperatures from 5 °C to 35 °C.

Suggest why the students chose this range of temperatures **and** suggest a suitable interval that the students should use.

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..... [2]

(iii) State a suitable control for this investigation.

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..... [1]

(iv) State why the carbon dioxide absorbent solution was placed in the tube.

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..... [1]

(v) Suggest **one** variable in this investigation that **cannot** be standardised.

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..... [1]

(b) (i) Describe a method by which the students could set up the respirometer **and** use it to test their hypothesis:

For each 10°C increase in temperature the volume of oxygen absorbed will double.

Your method should be set out in a logical order and be detailed enough to let another person follow it.

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(ii) Each 1 cm length of the capillary tubing containing coloured liquid in Fig. 1.2 has a volume of 10 mm^3.

Describe how the students could use their results to calculate the rate of respiration for each temperature from their results.

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..... [3]

(iii) Use the axes in Fig. 1.3 to show the expected shape of the curve if the hypothesis is correct.

For each 10°C increase in temperature the volume of oxygen absorbed will double.

Include the labels and units for each axis.

Fig. 1.3

[3]

(c) The students used the same apparatus to determine the output of carbon dioxide by the woodlice at 35 °C. The students used this result and the result for oxygen uptake at 35 °C to calculate the respiratory quotient (RQ).

The RQ was calculated as 0.95.

State what conclusion can be made from this RQ value.

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..... [1]

[Total: 21]

2 **(a)** Cotton bollworms, *Helicoverpa* spp., are insect pests of cotton.

Adult cotton bollworms are moths. The adult female moths lay eggs on cotton plants. The eggs hatch into larvae. The larvae feed on cotton plants, causing extensive damage and reduction in yield.

Fig. 2.1 shows a mature cotton fruit (cotton boll) from an uninfested plant.

Fig. 2.2 shows a cotton bollworm larva inside a damaged cotton boll.

Fig. 2.1

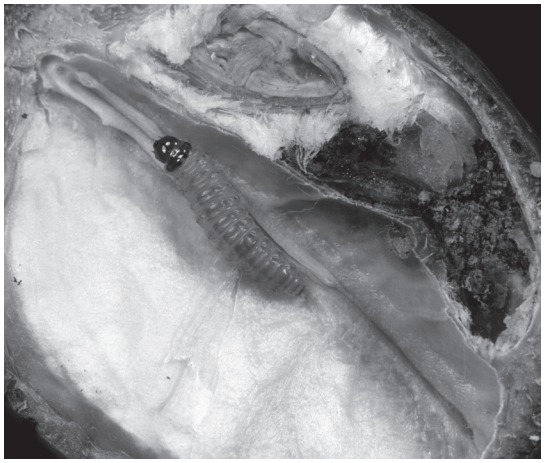

Fig. 2.2

A gene, *cry1Ac*, from the bacterium *Bacillus thuringiensis* (Bt), can be inserted into the cotton genome to produce Bt cotton.

- The protein, Cry1Ac, coded by *cry1Ac* is toxic to some species of bollworm.
- This toxicity gives cotton plants some resistance to cotton bollworm.

Studies of the effectiveness of the protein Cry1Ac showed that older plants produced less of the protein. As a result, spraying with insecticide was still needed when larval density increased.

An improved Bt cotton with two genes, *cry1Ac* and *cry2Ab*, produced two different proteins and was expected to give protection from *Helicoverpa* spp. for the whole growing season.

This improved Bt cotton was introduced into Australia in 2004. An investigation was carried out to determine whether this improved Bt cotton would also need spraying with insecticide.

Two different farms were used. In each farm, a standard-sized plot at the centre of a cotton field was marked out.

- Each plot measured 20 m^2.
- Each plot was divided into 3 sets of 8 rows of cotton.
- Each row of cotton was divided into 1 metre sections, each with 8–10 plants.

Two treatments were used in each plot in a random pattern.

- In treatment 1, the researchers removed all the larvae from the plants.
- In treatment 2, the researchers made sure that there were 3 medium-sized larvae (9–16 mm in length) per metre section.

Fig. 2.3 shows the arrangement of a 20 m^2 plot in a cotton field.

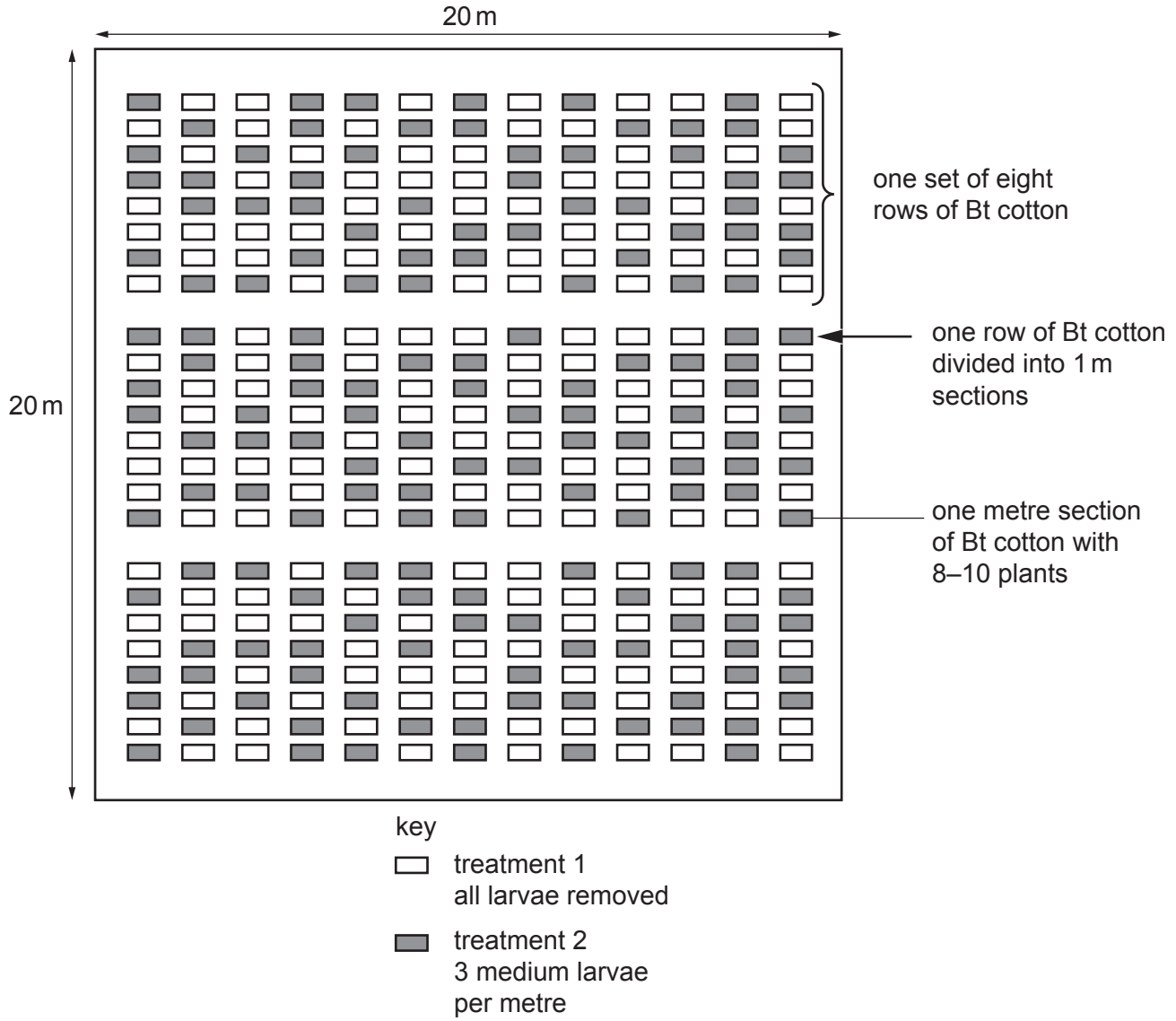

Fig. 2.3

- After three days, the plot on one farm was sprayed with an insecticide and the plot on the other farm was not sprayed with an insecticide.
- The cotton bolls were picked at the same time, when all the bolls in each plot were open.
- The cotton bolls were weighed.
- The cotton fibres were separated from the cotton bolls and weighed.

(i) Suggest how the researchers made sure that there were 3 medium-sized larvae in each section for treatment 2.

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(ii) Identify **two** variables that have been standardised in this investigation.

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2 .....

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[2]

(iii) Explain why one of the plots was **not** sprayed with insecticide.

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..... [1]

(b) Table 2.1 shows the results of this study.

Table 2.1

plot	**not sprayed with insecticide**		**sprayed with insecticide**	
treatment	1 (larvae removed)	2 (3 larvae present)	1 (larvae removed)	2 (3 larvae present)
mean mass of cotton bolls per section / g ± *s*	521.2 ± 77.6	418.6 ± 74.2	615.5 ± 92.5	605.6 ± 118.1
mean mass of cotton fibre per section / g ± *s*	223.8 ± 30.9	203.7 ± 23.5	251.3 ± 38.6	240.0 ± 56.0

A *t*-test can be used to find out if treatment 2 has any effect on the yield of cotton fibre.

(i) State **one** reason why the *t*-test is suitable for the data in Table 2.1.

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(ii) State a null hypothesis for the *t*-test to compare the effect of insecticide on yield of cotton fibre when larvae are present.

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(c) The researchers were trying to find out if farmers growing improved Bt cotton will benefit from spraying the improved Bt cotton with insecticide to control cotton bollworm infestations.

Comment on whether the results in Table 2.1 show that improved Bt cotton should be sprayed with insecticide.

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[Total: 9]

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