CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2026**

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. Do **not** use correction fluid or tape.
- 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.

1 **(a)** The common woodlouse, *Oniscus asellus*, is a small invertebrate animal that is found in many areas of western and northern Europe.

Figure 1.1 shows some *O. asellus*.

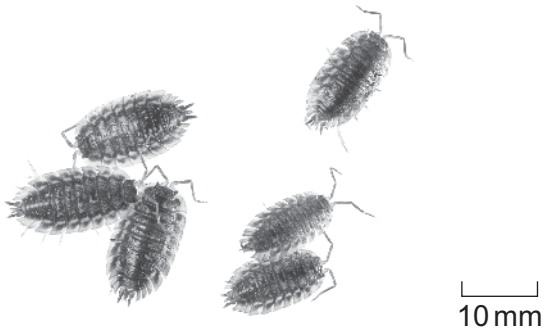

Figure 1.1

A student wanted to investigate the effect of temperature on the rate of respiration in *O. asellus*.

The student set up a respirometer as shown in Figure 1.2. A stand and clamp were used to hold the respirometer in position.

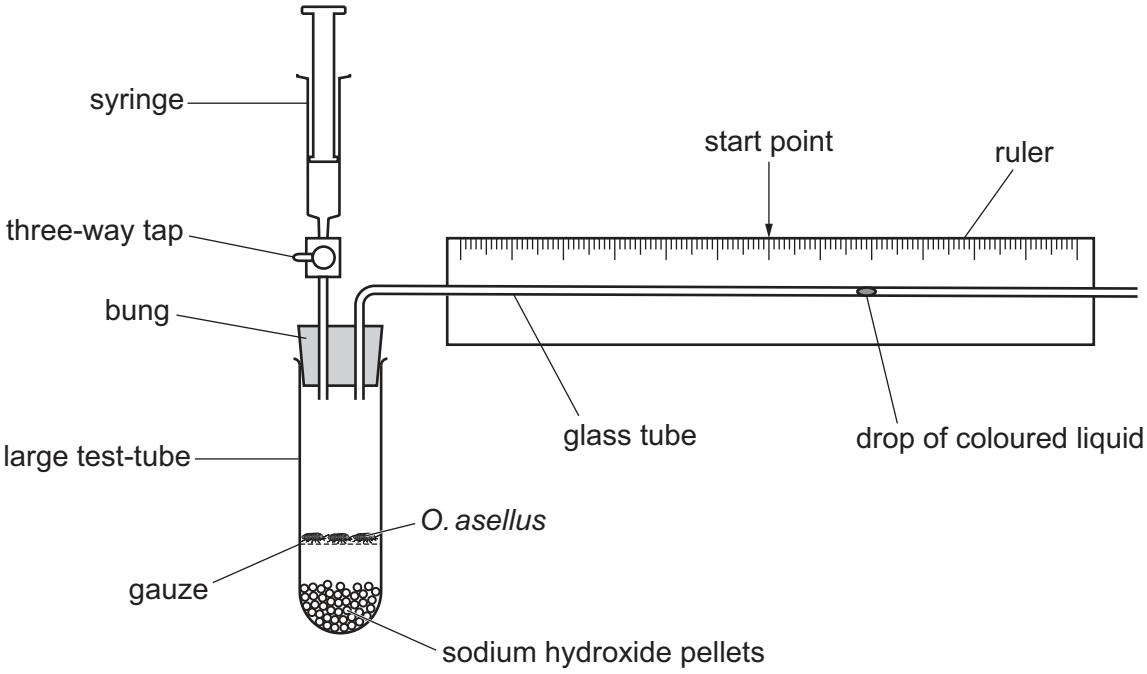

Figure 1.2

To determine the rate of respiration in *O. asellus*, the student:

- opened the three-way tap and used the syringe to move the drop of coloured liquid to the start point
- closed the three-way tap
- measured the distance moved by the drop of coloured liquid in a known time period.

(i) Predict the direction of movement of the drop of coloured liquid during the investigation. Explain your answer.

direction .....

explanation .....

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[1]

(ii) Suggest a suitable control for this investigation.

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(iii) Describe a method, using the respirometer shown in Figure 1.2, that the student could use to investigate the effect of temperature on the rate of respiration in *O. asellus*.

You should use temperatures from 5 °C to 35 °C, so that the *O. asellus* are not harmed in the investigation.

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

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(iv) The student used the data, collected in the investigation, to calculate the rate of respiration in *O. asellus* at each temperature as a volume per unit time ($mm^3\,min^{-1}$).

Describe how the student calculated the rate of respiration in units of **$mm^3\,min^{-1}$**.

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..... [1]

(b) The student then investigated the effect of different respiratory substrates on the rate of fermentation in yeast cells. The solutions of respiratory substrates were boiled to remove oxygen. The solutions were then cooled before mixing with the suspension of yeast cells.

A small test-tube was filled with $3\,cm^3$ of a yeast suspension and $2\,cm^3$ of a 20% glucose solution. The small test-tube was placed inside a large test-tube, as shown in Figure 1.3.

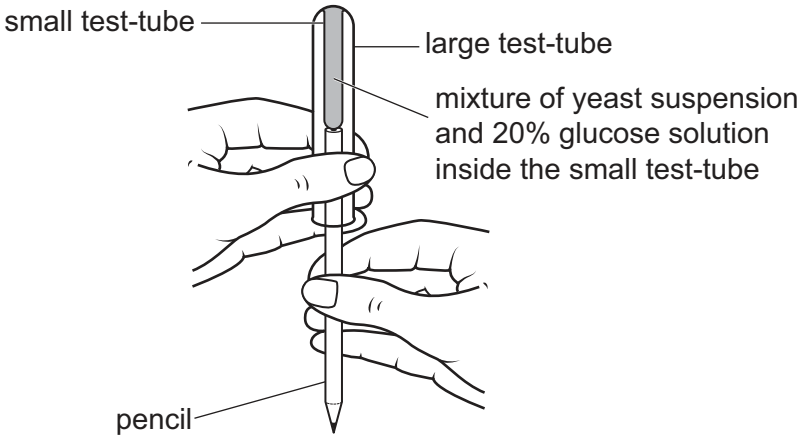

Figure 1.3

The test-tube was turned through 180° and placed in a test-tube rack for 30 minutes. During this time, gas was produced and collected as shown in Figure 1.4.

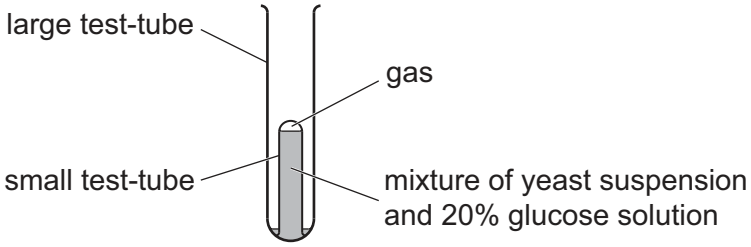

Figure 1.4

The student determined the volume of gas collected in the small test-tube after 30 minutes. This was used as a measure of the rate of fermentation.

The student repeated the experiment using a 20% maltose solution.

The student obtained data from five replicates using a 20% glucose solution and from five replicates using a 20% maltose solution.

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

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..... [1]

(ii) The student was provided with a 50% stock solution of glucose.

Describe how the student could use the stock solution to make **10 cm^3** of a 20% glucose solution.

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(iii) The student standardised the volume of the yeast suspension and the volume of the respiratory substrate solutions.

State **two other** variables that should be standardised in this investigation.

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(c) The results of the investigation are shown in Figure 1.5.

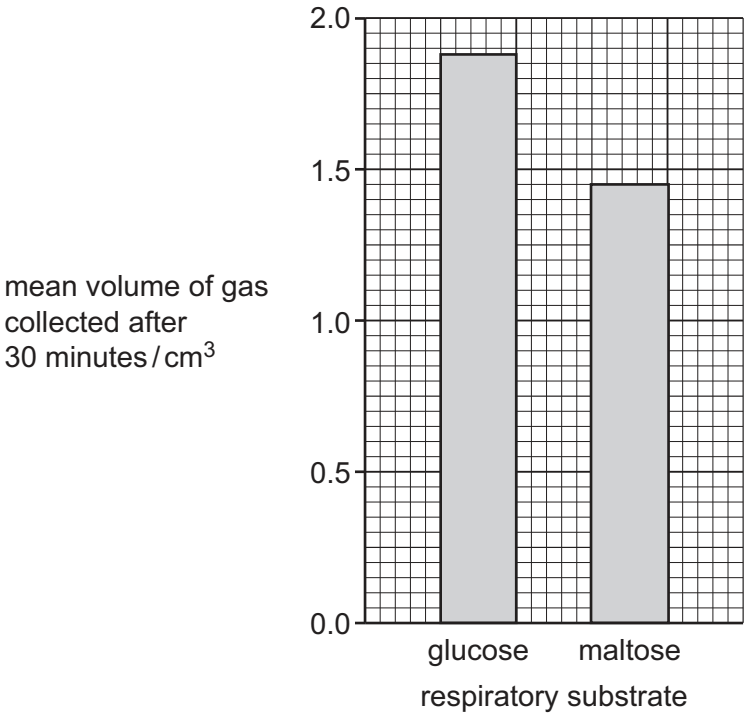

Figure 1.5

(i) Identify the type of data shown by the respiratory substrate in Figure 1.5.

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(ii) State a conclusion for the investigation, using evidence from Figure 1.5 to support your conclusion.

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(iii) Suggest why the rate of fermentation in yeast cells is different with glucose as a respiratory substrate compared with maltose as a respiratory substrate.

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[Total: 17]

2 The Galápagos Islands are a group of islands in the Pacific Ocean that are approximately 900 km from Ecuador in South America. Charles Darwin developed his theory of evolution by natural selection after visiting the Galápagos Islands in the 1830s.

Finches are small birds that are commonly found on the Galápagos Islands.

Some biologists studied one species of finch, *Geospiza conirostris*, living on Genovesa Island in the Galápagos. Genovesa Island is a small island with no mountains.

Figure 2.1 shows *G. conirostris*.

Figure 2.1

The biologists studied several breeding pairs of *G. conirostris*. Adult male *G. conirostris* sing a song to attract females for mating. Female *G. conirostris* do **not** sing.

The biologists noticed that adult male *G. conirostris* could be separated into two groups based on their song type. Adult male *G. conirostris* sing either song type **A** or song type **B**.

At the start of the investigation, the biologists caught the birds in a mist net.

Figure 2.2 shows a bird caught in a mist net. The mist net does not harm the bird.

Figure 2.2

For each male *G. conirostris* caught in the mist net, the biologists:

- attached a coloured ring to the leg of the bird so that it could be easily identified in the future
- measured the mass of the bird
- measured the depth, width and length of the bill of the bird
- released the bird back into the ecosystem
- observed the song type and other behaviours of the bird over a period of four months.

(a) Table 2.1 shows the data from the investigation.

Table 2.1

song type of male *G. conirostris*	**number of birds**	**mean mass / g**	**mean bill depth / mm**	**mean bill width / mm**	**mean bill length / mm**
song type **A**	11	25.85	10.79	9.99	15.47
song type **B**	13	24.96	11.02	10.23	14.55

Statistical analysis showed that there was no significant difference between the mean mass, the mean bill depth and mean bill width of male *G. conirostris* with song type **A** and male *G. conirostris* with song type **B**.

The biologists then carried out a *t*-test to compare the mean bill lengths of male *G. conirostris* with song type **A** and male *G. conirostris* with song type **B**.

(i) State **two** conditions of the data that allowed the biologists to carry out a *t*-test.

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(ii) State the null hypothesis for the *t*-test that the biologists carried out.

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(iii) Calculate the number of degrees of freedom (v) for the *t*-test that the biologists carried out.

number of degrees of freedom = ... [1]

(iv) The biologists calculated the value of t as **3.768**.

Table 2.2 shows the probability table for the t-test.

Table 2.2

degrees of freedom (v)	critical values		
	p = 0.50	p = 0.10	p = 0.05
20	0.687	1.725	2.086
21	0.686	1.721	2.080
22	0.686	1.717	2.074
23	0.685	1.714	2.069
24	0.685	1.711	2.064
25	0.684	1.708	2.060
26	0.684	1.706	2.056

Use the calculated value of t **and** Table 2.2 to explain what can be concluded about the mean bill lengths of male *G. conirostris* with song type **A** and male *G. conirostris* with song type **B**.

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(b) *G. conirostris* feed on a range of food sources, including:

- the leaves, flowers and fruits of the prickly pear cactus
- the seeds of the palo santo tree.

Initial observations suggested that male *G. conirostris* with song type **A** feed on different food sources than male *G. conirostris* with song type **B**.

Suggest a method that the biologists could use to measure the proportion of time spent feeding on each food source by male *G. conirostris* with song type **A** and male *G. conirostris* with song type **B**.

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(c) The biologists concluded that *G. conirostris* on Genovesa Island may be in the early stages of sympatric speciation.

Outline how this investigation:

- supports the conclusion that *G. conirostris* may be in the early stages of sympatric speciation
- could be extended to increase confidence in the conclusion.

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[Total: 13]

