Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/54**

Paper 5 Planning, Analysis and Evaluation **May/June 2025**

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 **8** pages.

[Turn over

1 A student investigated the effect of gibberellin (GA) and abscisic acid (ABA) on the germination of wheat grains.

The student found out the following information.

- The molecular mass of GA is 346 g.
- The molecular mass of ABA is 264 g.
- The range of concentrations at which GA is active in plant tissues is from 1×10^{-6} to 1×10^{-5} mol dm^{-3}.
- The range of concentrations at which ABA is active in plant tissues is from 1×10^{-6} to 1×10^{-4} mol dm^{-3}.
- Newly formed wheat grains contain a high concentration of ABA which decreases over time.
- When the concentration of ABA falls low enough the GA is able to promote germination.
- Wheat germinates best at temperatures from 10 °C to 25 °C and without light.

Fig. 1.1 shows the germination and early growth of wheat.

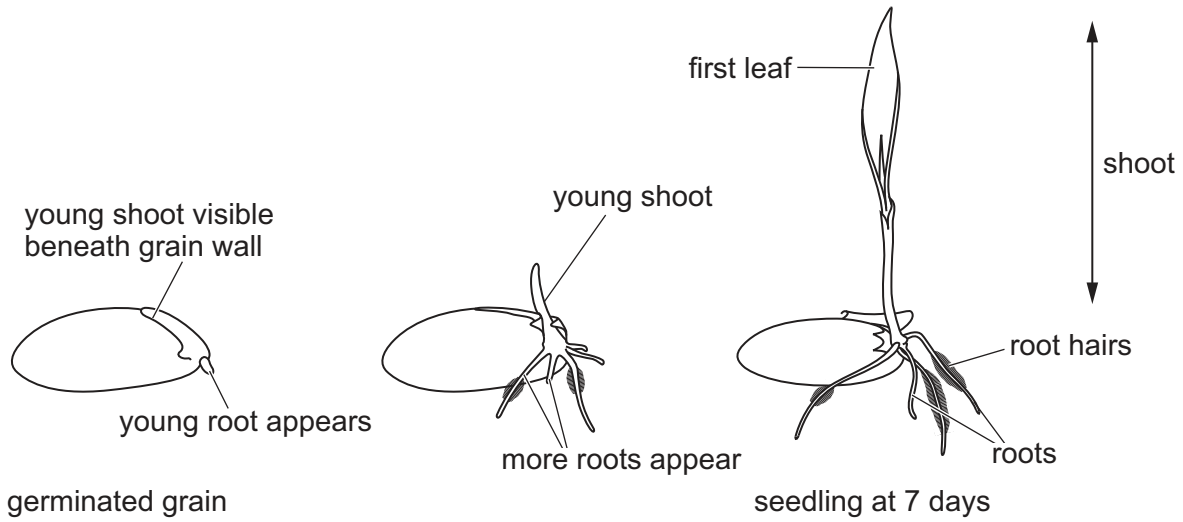

Fig. 1.1

To test the effects on germination of adding ABA, the student started by soaking wheat grains for 24 hours in a solution of 1×10^{-6} mol dm^{-3} GA. These were then split into several groups of 50 grains and a different concentration of ABA was added to each group.

The student made a stock solution of ABA with a concentration of 1×10^{-3} mol dm^{-3} which was then diluted to make the solutions needed for the investigation.

(a) (i) Using the information about ABA above, describe how the student made a stock solution of 1×10^{-3} mol dm^{-3} ABA.

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..... [2]

(ii) The student used the stock solution of 1×10^{-3} mol dm^{-3} ABA to prepare a range of dilutions from 1×10^{-4} mol dm^{-3} to 1×10^{-7} mol dm^{-3} to use in their investigation.

Each dilution had a volume of 100 cm^3.

Describe how the student prepared these dilutions.

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..... [2]

(b) (i) Identify the independent and the dependent variables in this investigation.

independent variable.....

dependent variable..... [2]

(ii) Describe a procedure that the student could use to complete the investigation to find the effect of different concentrations of ABA on the germination of wheat grains.

Your method should be detailed enough for another person to use and should **not** repeat any details from **(a)(ii)** of how to dilute the stock solution.

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(c) The student calculated the percentage germination of the grains in the different concentrations of ABA.

(i) Explain how the percentage germination was calculated.

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(ii) Complete Fig. 1.2 by sketching a graph to predict the results the student might expect. On the axes, show the range of values and the units that might be used to plot the graph.

Fig. 1.2

[3]

(d) In another investigation the student tested the effect of gibberellin (GA) on the elongation of shoots. Five groups of 20 wheat grains were soaked in GA solution. Each group was treated with a different concentration of GA and then left to germinate and grow for 10 days. The length of each shoot was measured and a mean shoot length was calculated for each GA concentration.

Table 1.1 shows the results of this investigation.

Table 1.1

concentration of GA / mol dm^{-3}				
0	1×10^{-7}	1×10^{-6}	1×10^{-5}	1×10^{-4}
mean shoot length / mm ± SE				
120 ± 10	150 ± 5	175 ± 15	210 ± 12	180 ± 8

(i) Explain what standard error (SE) shows about the reliability of the results in Table 1.1.

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The student carried out a number of *t*-tests.

In each *t*-test, the student compared the mean shoot length of the seedlings grown from grains that were **not** treated with GA with those that were treated with GA.

(ii) Suggest a null hypothesis for the *t*-test between **no** GA treatment and those treated with 1×10^{-5} mol dm^{-3} GA.

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(iii) Explain how the student should use the values for *t* to determine if there is a significant difference between the mean shoot length of wheat grown with **no** GA treatment and the mean shoot length of wheat grown with GA treatment.

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..... [3]

[Total: 21]

2 A student investigated the oxygen consumption of isolated mitochondria under different conditions.

Mitochondria were isolated by crushing liver cells in ice cold buffer and filtering to remove cell debris. The filtrate was centrifuged to separate the mitochondria. The mitochondria were suspended in ice cold buffer.

(a) State **one** reason for keeping the mitochondria in cold buffer solution during isolation.

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..... [1]

Fig. 2.1 shows the apparatus used to measure the oxygen consumption of the isolated mitochondria.

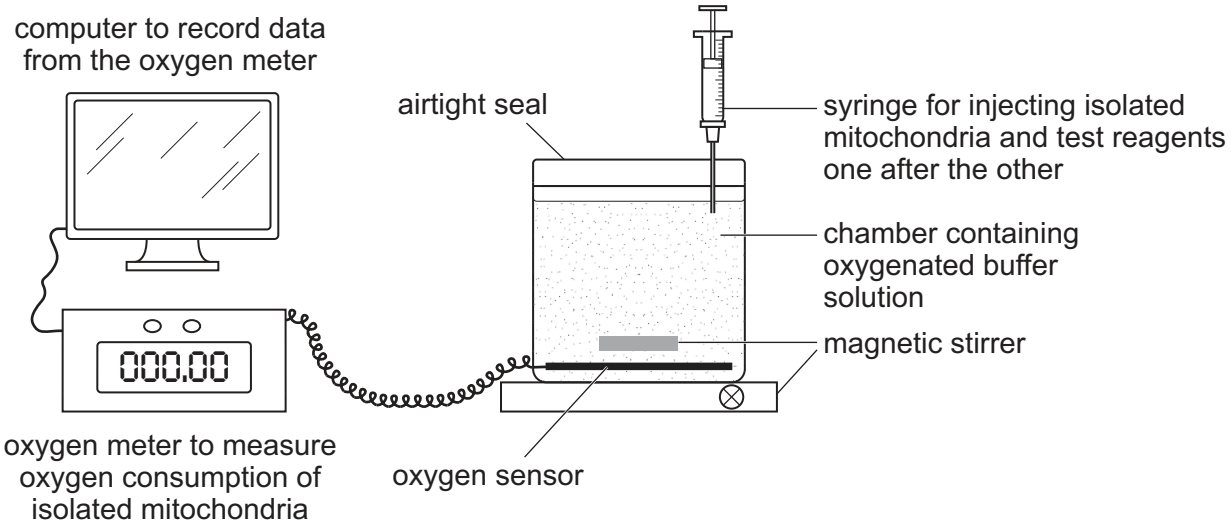

Fig. 2.1

The apparatus was used as follows.

- The apparatus was set up as shown in Fig. 2.1 and left for 1 minute to equilibrate.
- At 1 minute, a standard volume of mitochondria in buffer solution was injected through the seal.
- At 2 minutes, a solution of succinate, a Krebs cycle intermediate, was injected through the seal.
- At 5 minutes, a solution of ADP was injected through the seal.
- At 6 minutes, a solution of cyanide was injected through the seal.

During this procedure the oxygen concentration in the chamber was measured continuously and displayed as a trace on the computer screen as shown in Fig. 2.2.

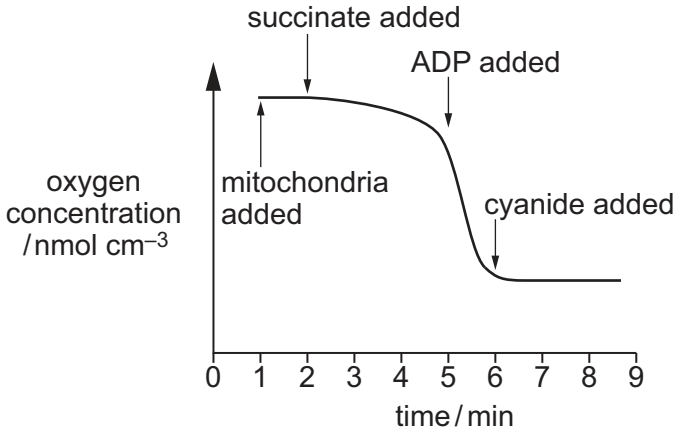

Fig. 2.2

Using the figures from the trace, the computer calculated the rate of oxygen consumption following each addition. This procedure was repeated three more times using fresh samples of mitochondria.

Table 2.1 shows the rates of oxygen consumption for each of the four trials.

Table 2.1

	rate of oxygen consumption / nmol min^{-1}				
	trial 1	**trial 2**	**trial 3**	**trial 4**	**mean**
mitochondria alone	0.03	0.02	0.03	0.01	0.02
mitochondria with succinate	50.22	49.10	48.53	50.15	
mitochondria with ADP and succinate	139.23	170.10	142.67	138.10	147.53
mitochondria with cyanide, ADP and succinate	0.00	0.10	0.00	0.01	0.03

(b) (i) Calculate the mean rate of oxygen consumption for mitochondria with succinate.

Write your answer in Table 2.1. [1]

(ii) On Table 2.1 indicate, by placing a circle around each value, **two** results that may be anomalous. [2]

(iii) State **two** ways that the student could have processed the results to allow for these possible anomalies.

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(c) Explain the results shown in Fig. 2.2 and Table 2.1.

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[Total: 9]