Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6490842500

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2024**

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. Any blank pages are indicated.

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1 Blood vessels must be able to withstand and maintain varying blood pressures.

There are several methods that could be used to determine the strength of a blood vessel. One method is called the circumferential tensile strength (CTS) test, as shown in Fig. 1.1.

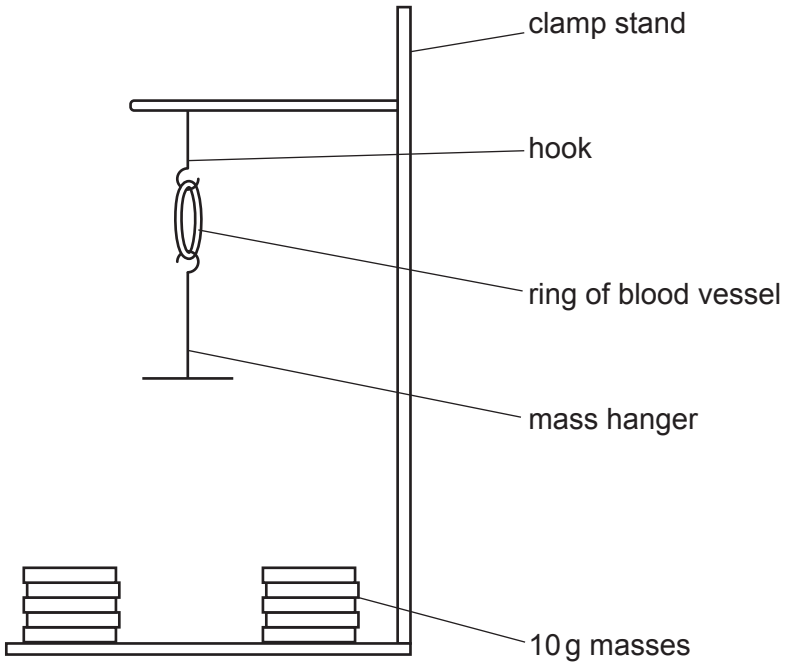


Fig. 1.1

The ring of blood vessel, shown in Fig. 1.1, was cut from a length of artery or vein that was prepared by removing surrounding tissues.

A student wanted to use the apparatus in Fig. 1.1 to determine the mass needed to break an artery and the mass needed to break a vein.

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

independent variable .....

.....

dependent variable .....

.....

[1]

(ii) The student was provided with lengths of a large artery, lengths of a large vein and standard laboratory apparatus.

Describe how the student could use the CTS test to determine the mass needed to break an artery and the mass needed to break a vein.

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

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.... [6]

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Another student investigated how the length of a ring of vein and the length of a ring of artery increases as more mass is added.

The student used the apparatus shown in Fig. 1.2 with the ring of vein.

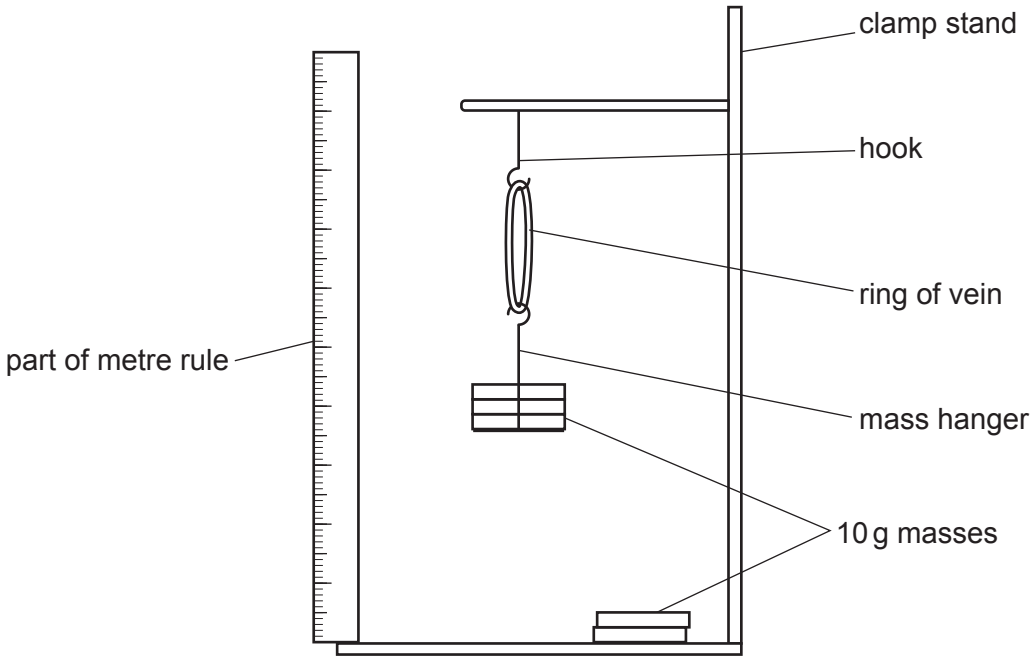


Fig. 1.2

The results for the ring of vein are shown in Table 1.1.

Table 1.1

mass added / g	length of ring of vein / mm	percentage increase in length of ring of vein
0	21	0
10	36	……..
20	38	81
30	40	90
40	41	……..
50	41	……..

(b) (i) Complete Table 1.1 by calculating the percentage increase in length of the ring of vein for 10 g, 40 g and 50 g. [2]

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(ii) Explain why the student calculated the percentage increase in length of the ring of vein.

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..... [1]

(iii) On the grid in Fig. 1.3, plot a graph of the data shown in Table 1.1.

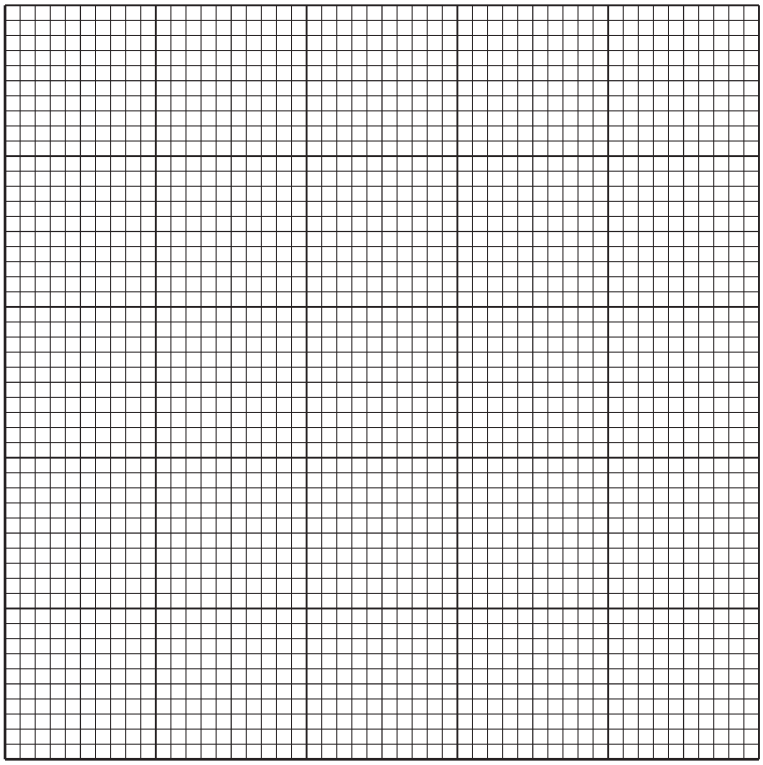


Fig. 1.3

[3]

(iv) The student carried out the same investigation using a muscular artery instead of a vein.

Predict the shape of the curve you would expect for the muscular artery.

On Fig. 1.3:

- sketch the curve you predicted for the muscular artery
- label this curve with the word **artery**.

[2]

(v) Explain the shape of the curve you sketched for the muscular artery in Fig. 1.3.

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..... [2]

(vi) Another student suggested that the experiment should be repeated with more rings from the same blood vessels.

Suggest **two other** ways the student could modify the method to improve the quality of the results.

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..... [2]

[Total: 19]

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2 Gibberellins are a group of plant hormones that are involved in the elongation of plant stems.

A student investigated the effect of two different concentrations of a gibberellin, known as GA_3, on stem elongation of 10-day old pea seedlings.

The student was given a stock solution of GA_3 with a concentration of 2.85×10^{-4} mol dm^{-3}.

(a) Describe a method the student could use to make a solution of GA_3 with a concentration of 1.90×10^{-6} mol dm^{-3} **and** state the dilution factor used.

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..... [2]

(b) In the investigation, the student:

- used the two concentrations of GA_3: 2.85×10^{-4} mol dm^{-3} (high concentration GA_3) and 1.90×10^{-6} mol dm^{-3} (low concentration GA_3)
- applied the high concentration GA_3 to one batch of 10-day-old pea seedlings
- applied the low concentration GA_3 to another batch of 10-day-old pea seedlings
- applied distilled water to a third batch of 10-day-old pea seedlings, as a control
- standardised all other variables
- measured the length of the stem of each seedling every two days until the seedlings were 20 days old
- calculated the rate of stem elongation in cm day^{-1}.

State **one** way in which the student could standardise the measuring of stem length.

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..... [1]

(c) The results of the investigation are shown in Table 2.1.

Table 2.1

age of seedling / days	mean stem length with high concentration GA_3 added / cm	mean stem length with low concentration GA_3 added / cm	mean stem length with distilled water added / cm
10	2	2	2
12	4	2	3
14	7	5	4
16	6	12	7
18	20	15	8
20	25	21	8
rate of stem elongation / cm day^{-1}	2.3	.....	0.6

(i) Complete Table 2.1 by calculating the rate of stem elongation in cm day^{-1} for the seedlings with low concentration GA_3 added.

[1]

(ii) A scientist stated that they did not have enough confidence in the results in Table 2.1 to make any conclusions.

State **one** reason to support the statement made by the scientist.

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..... [1]

(iii) Describe how the student could modify the investigation to increase confidence in the results.

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..... [1]

(d) The student found a study on the internet that considered the effect of different wavelengths of light on the concentration of two types of gibberellins, GA_1 and GA_8, in pea plants.

In the study, 60 pea seeds were germinated and kept in the dark (no light) for seven days.

The pea seedlings were divided into four batches of 15:

- batch 1 remained in the dark
- batch 2 was exposed to blue light (470 nm)
- batch 3 was exposed to red light (680 nm)
- batch 4 was exposed to far-red light (750 nm).

After 4 hours the concentrations of GA_1 and GA_8 in the seedlings were measured.

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Table 2.2 shows the results.

Table 2.2

batch	wavelength of light / nm	colour of light	mean GA_1 concentration ± standard deviation / ng g^{-1} fresh mass	mean GA_8 concentration ± standard deviation / ng g^{-1} fresh mass
1	–	dark	2.87 ± 0.72	3.07 ± 0.10
2	470	blue light	0.21 ± 0.05	3.90 ± 0.13
3	680	red light	0.31 ± 0.10	5.03 ± 0.21
4	750	far-red light	1.38 ± 0.26	4.00 ± 0.72

The student calculated the standard error (SE) and 95% confidence intervals (95% CI) for the data shown in Table 2.2. The formulae that the student used were:

$$SE = \frac{s}{\sqrt{n}}$$

95% CI = $\bar{x}$ ± (2 × SE)

key to symbols

s = standard deviation

n = sample size (number of observations)

$\bar{x}$ = mean

Table 2.3 shows the calculated values for SE and 95% CI for the data from Table 2.2.

Table 2.3

batch	SE for GA_1 / ng g^{-1} fresh mass	mean ± 95% CI for GA_1 / ng g^{-1} fresh mass	SE for GA_8 / ng g^{-1} fresh mass	mean ± 95% CI for GA_8 / ng g^{-1} fresh mass
1	0.186	2.87 ± 0.37	0.026	3.07 ± 0.05
2	0.013	0.21 ± 0.03	0.034	3.90 ± 0.07
3	0.026	0.31 ± 0.05	0.054	5.03 ± 0.11
4	……..	……..	0.186	4.00 ± 0.37

Complete Table 2.3 to show the calculated values for SE **and** mean ± 95% CI for the data from far-red light for GA_1 (batch 4). [2]

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(e) Fig. 2.1 shows the bar chart of the results from the study.

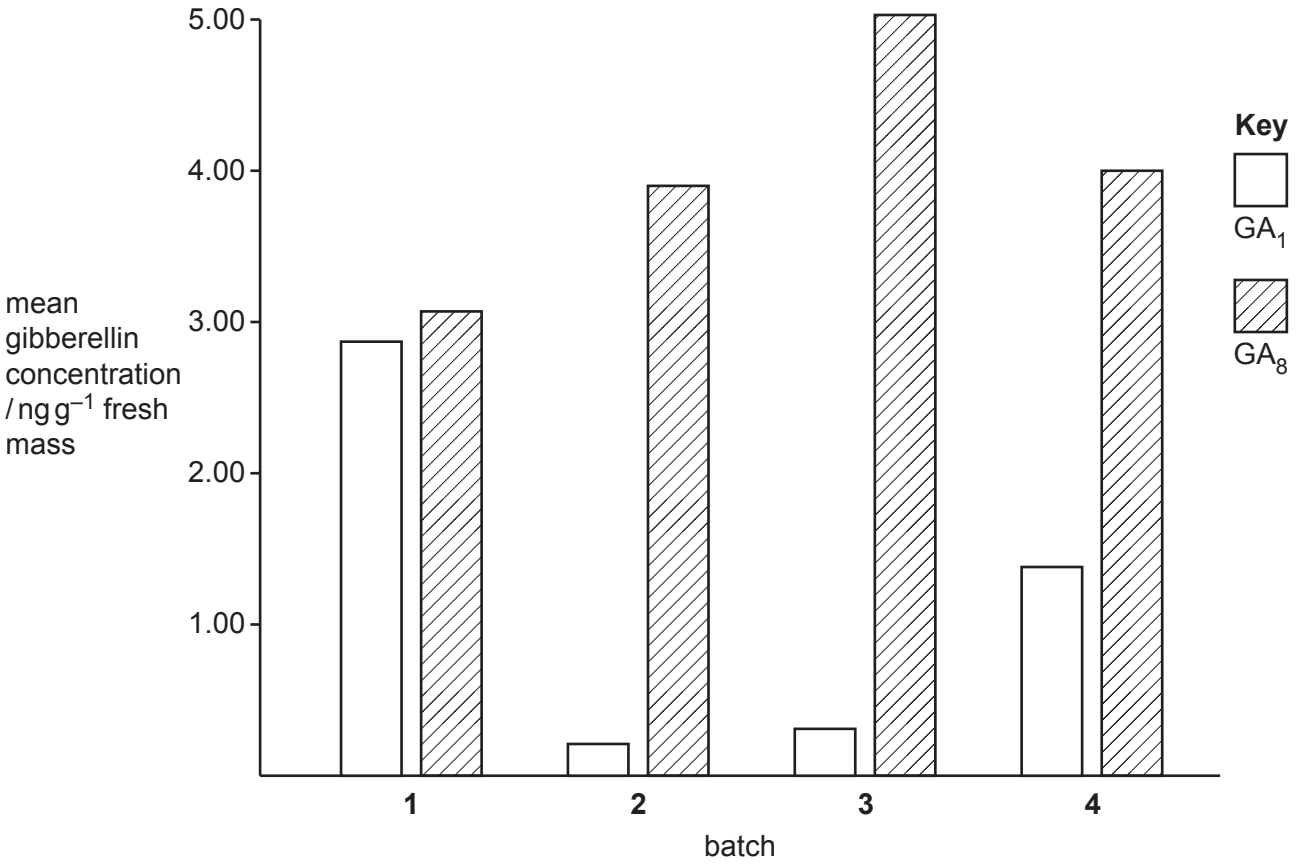


Fig. 2.1

Use Fig. 2.1, Table 2.2 **and** Table 2.3 to state **three** conclusions about the effect of different wavelengths of light on the concentrations of GA_1 and GA_8 in plants.

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..... [3]

[Total: 11]

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