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CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1886287663

BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **February/March 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 **16** pages.

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1 Blood pressure in the arteries changes during the cardiac cycle. The highest blood pressure occurs during ventricular systole when the ventricles contract and push blood out of the heart. The lowest blood pressure occurs during diastole when the atria and the ventricles are relaxed.

Blood pressure is measured as two values:

- systolic blood pressure
- diastolic blood pressure.

A blood pressure monitor, as shown in Figure 1.1, is used to measure the blood pressure in the brachial artery in the arm.

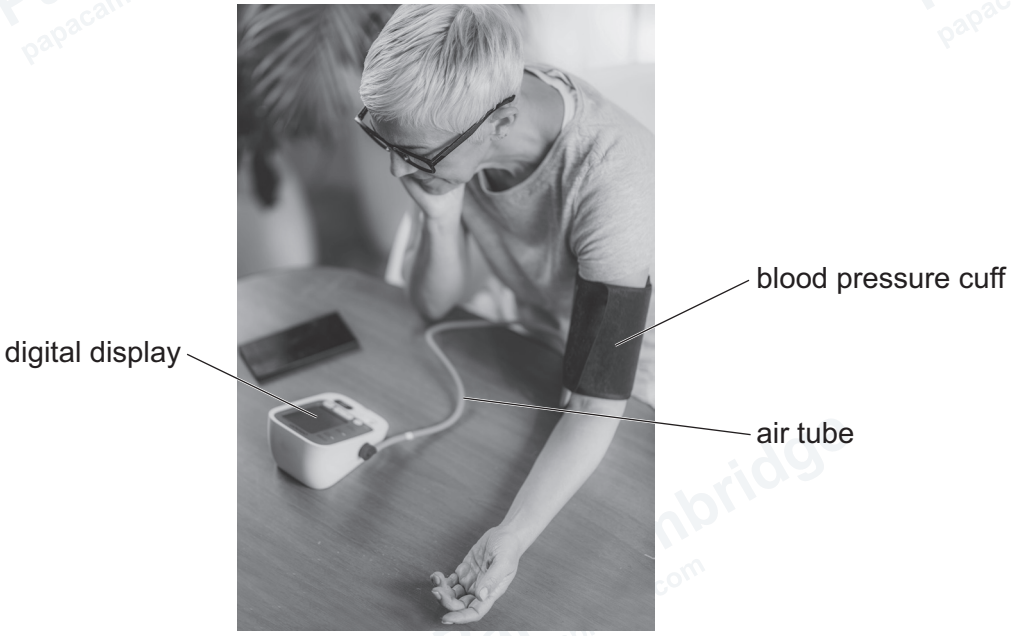


Figure 1.1

Some scientists investigated the effect of a 12-week exercise programme on the blood pressure of a group of 18 people. The people were aged from 40 years to 64 years, did **not** exercise regularly and had jobs that mainly involved sitting.

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The exercise programme consisted of a sequence of three activities, repeated three times a week for 12 weeks.

The three activities in each sequence were:

- walking for 5 minutes
- running slowly for 30 minutes
- walking for 5 minutes.

(a) The time spent walking and running, the number of repeats and the 12-week period were all standardised.

Identify **two other** variables in this exercise programme that the scientists should standardise.

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(b) On the morning **before** the start of the 12-week exercise programme, blood pressure measurements were taken for the group of 18 people, as shown in Figure 1.2. Every blood pressure measurement included a systolic and a diastolic blood pressure reading.

1 Resting blood pressure was measured while each person was sitting.

2 Each person then carried out a walking test on a treadmill for 15 minutes. The gradient of the treadmill was increased every minute.



3 After the walking test, the mean blood pressure of each person was determined from blood pressure measurements taken every 20 minutes over a period of 10 hours.

4 For each person, the scientists calculated the **difference** between the mean blood pressure after the walking test and the resting blood pressure.

$$\begin{pmatrix}\text{difference}\\ \text{in blood}\\ \text{pressure}\end{pmatrix} = \begin{pmatrix}\text{mean blood}\\ \text{pressure after}\\ \text{the walking test}\end{pmatrix} - \begin{pmatrix}\text{resting blood}\\ \text{pressure before}\\ \text{the walking test}\end{pmatrix}$$

5 The **mean** difference in blood pressure was then calculated for the 18 people in the study.

Figure 1.2

The same blood pressure measurements were taken on the morning **after** the end of the 12-week exercise programme and used to recalculate the mean difference in blood pressure for the 18 people in the study.

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Figure 1.3 shows the results of this investigation.

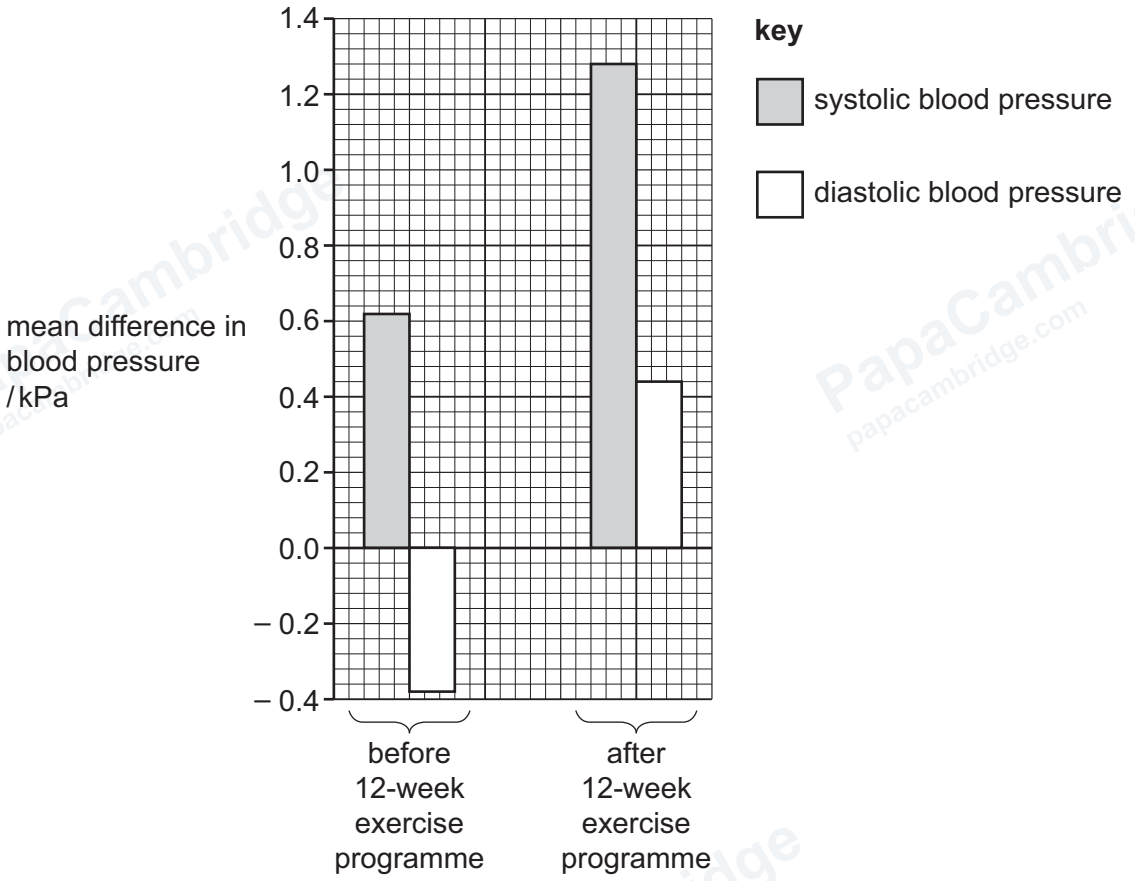


Figure 1.3

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

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(ii) Describe the results of the investigation shown in Figure 1.3.

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(c) Table 1.1 shows the mean resting systolic blood pressure data for the 18 people included in the investigation.

Table 1.1

before or after 12-week exercise programme	mean resting systolic blood pressure /kPa	sample standard deviation /kPa	standard error (SE) /kPa
before	17.71	1.33	.....
after	17.08	1.35	0.32

(i) The formula for the calculation of standard error (SE) is:

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

key to symbols

s = sample standard deviation

n = sample size (number of observations)

Complete Table 1.1 by calculating the SE for the mean resting systolic blood pressure before the 12-week exercise programme. [1]

(ii) Suggest why it is helpful to calculate the standard error for the mean resting systolic blood pressure before and after the 12-week exercise programme.

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2 *Daphnia magna* is a small invertebrate that is found in many fresh water ecosystems.

Figure 2.1 shows one *D. magna*, as seen with a light microscope. The body of *D. magna* is transparent, and the beating of the heart can be easily observed.

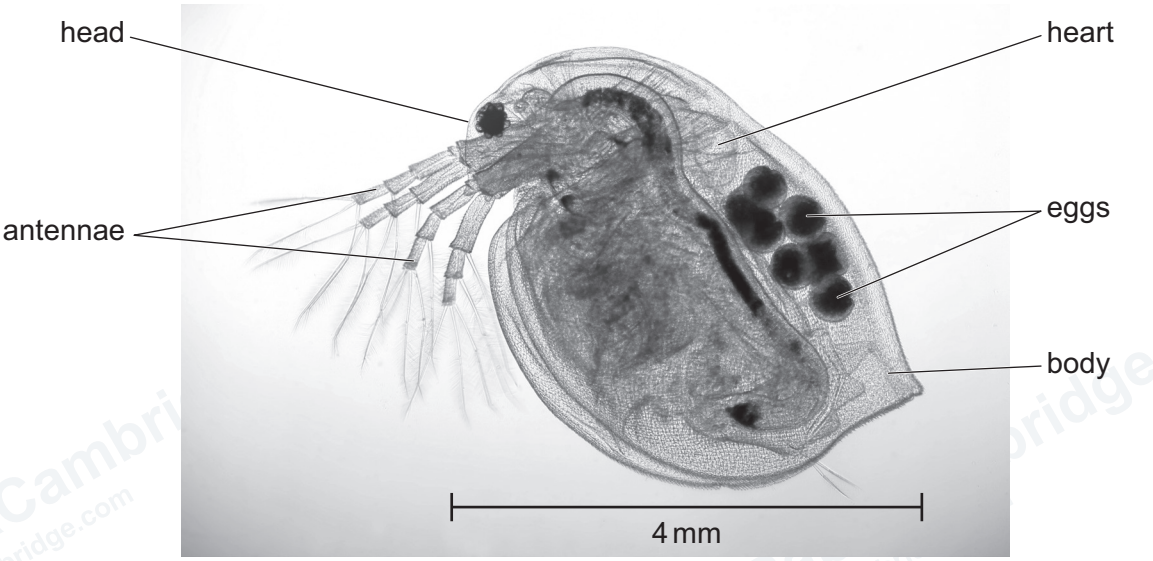


Figure 2.1

A student obtained a sample of pond water containing several *D. magna*.

To measure the time taken for one cardiac cycle in *D. magna*, the student:

- used a pipette to place one *D. magna* in the centre of a Petri dish
- added a small amount of cotton wool to reduce the movement of the *D. magna*
- added two drops of pond water to the *D. magna*
- observed the heart of the *D. magna* using a light microscope
- counted the number of cardiac cycles (heart beats) in one minute.

(a) In a trial experiment at 20 °C, the student counted 232 cardiac cycles in one minute.

Calculate the time taken for one cardiac cycle.

Give your answer in seconds and to **two** significant figures.

time for one cardiac cycle = ... s [1]

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(b) Caffeine is a drug found in tea and coffee.

The student decided to investigate the effect of caffeine concentration on the time taken for one cardiac cycle in *D. magna*.

(i) The student was given a 0.5% stock solution of caffeine from which to prepare a range of caffeine solutions of known concentrations to use in this investigation.

The student made **20 cm^3** of each solution.

Describe a method the student could use to make a **proportional** dilution of the 0.5% stock solution of caffeine to obtain a 0.3% solution of caffeine.

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(ii) Describe a method that the student could use to investigate the effect of caffeine concentration on the time taken for one cardiac cycle in *D. magna*.

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

You can assume that a detailed risk assessment has been prepared.

Details of how to carry out a proportional dilution should **not** be included.

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3 The Armand Bayou is a slow-flowing river that forms an aquatic ecosystem in Texas, North America.

Some biologists decided to study two invasive alien species of aquatic plants that are commonly found in the Armand Bayou: water hyacinth, *Eichhornia crassipes*, and malancha, *Alternanthera philoxeroides*. Water hyacinth and malancha reduce biodiversity in the Armand Bayou.

Water hyacinth is a floating plant that grows on the surface of the river. Water currents and the wind can move water hyacinth plants from one place to another.

Malancha has roots that attach the plant to the soil at the edge of the river. Malancha grows and reproduces to form dense mats on the river surface, which can trap floating water hyacinth plants.

Figure 3.1 shows water hyacinth and Figure 3.2 shows malancha.



Figure 3.1

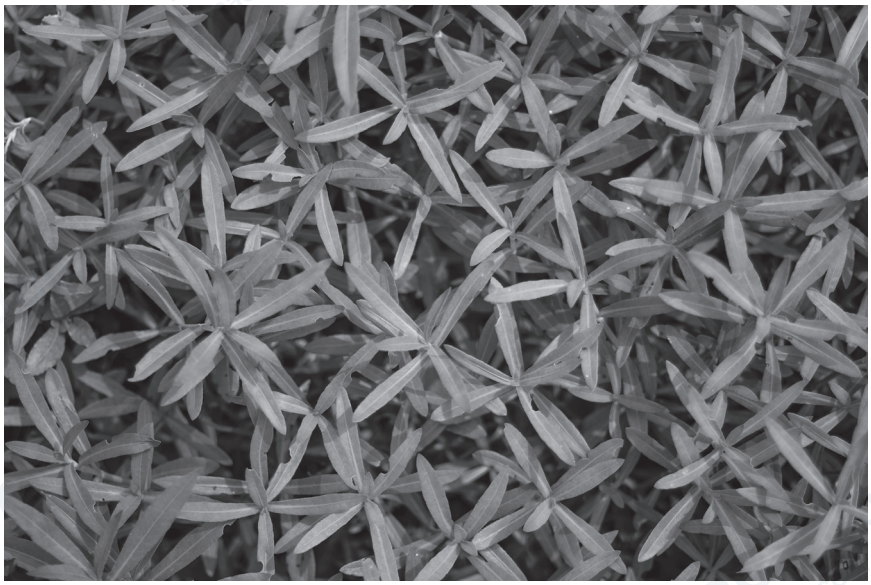


Figure 3.2

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The biologists carried out a survey at 69 locations in the Armand Bayou. At each location, both invasive alien species were present.

(a) The biologists estimated the percentage cover of water hyacinth and the percentage cover of malancha at each of the 69 locations. For these two variables, the biologists calculated Pearson's linear correlation coefficient, *r*, as +0.389, which was significant at $p < 0.001$.

Complete the sketch graph in Figure 3.3 to show the relationship between these two variables. Include axis labels in your answer.



Figure 3.3

[2]

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(b) The biologists carried out an investigation at 12 of the 69 locations in the Armand Bayou where both invasive alien species were present. The biologists wanted to test the hypothesis that:

The removal of malancha from the Armand Bayou will reduce the abundance of water hyacinth.

Figure 3.4 shows a map of the Armand Bayou and the surrounding area.

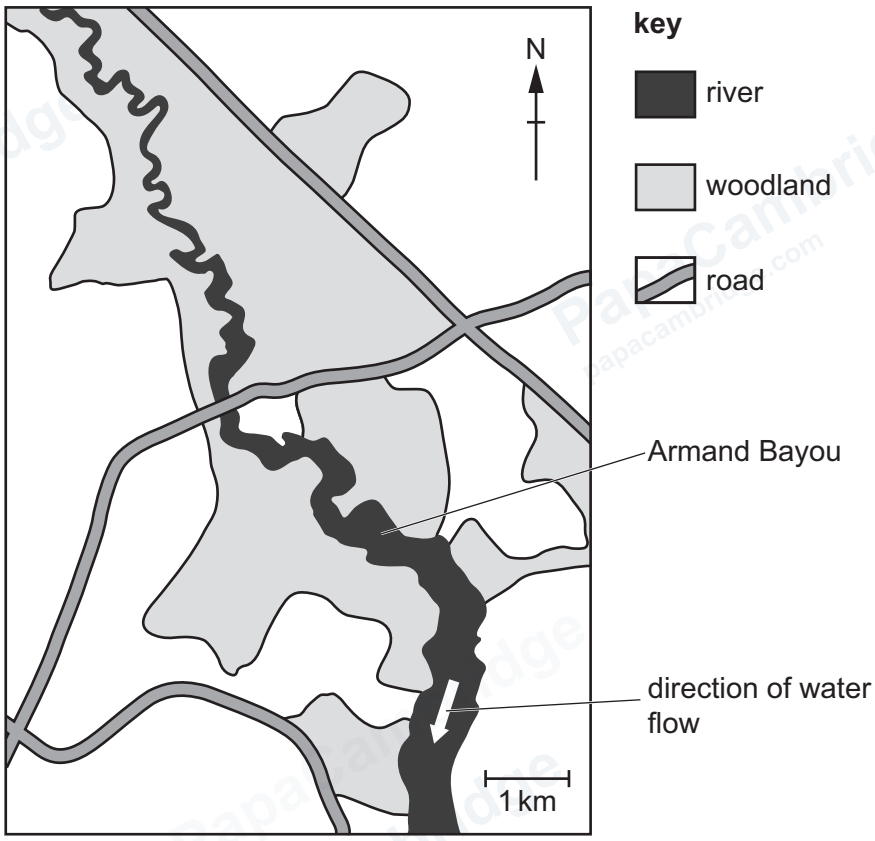


Figure 3.4

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At each of the 12 locations, a 3 m × 5 m study area was marked out as shown in Figure 3.5.

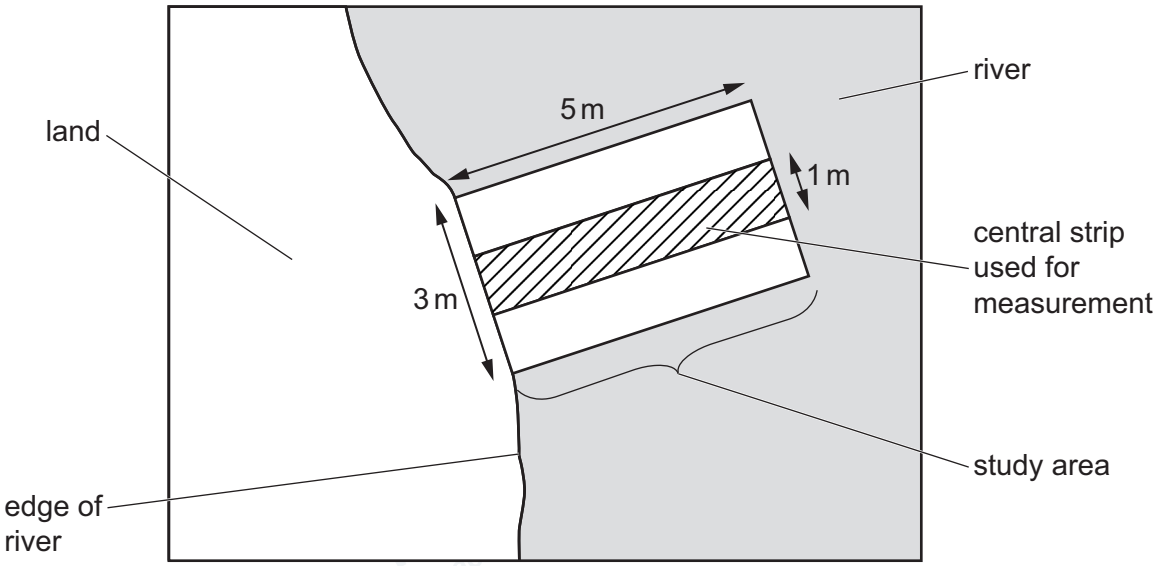


Figure 3.5

(i) Describe a method that the biologists could use to select 12 locations at random from the 69 locations used in **3(a)**.

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The 3 m × 5 m study areas at the 12 locations were divided into three groups of four. Each group of study areas was treated in a different way, as shown in Table 3.1.

Table 3.1

	treatment	details of treatment within the 3 m × 5 m study areas
1	removal of malancha **and** water hyacinth	• At the start of the investigation, the biologists removed all the malancha **and** all the water hyacinth. • Other plant species were **not** removed. • The removal of malancha was repeated every week for 7 weeks.
2	removal of malancha	• At the start of the investigation, the biologists removed all the malancha. • Water hyacinth and other plant species were **not** removed. • The removal of malancha was repeated every week for 7 weeks.
3	control	• Malancha, water hyacinth and other plant species were **not** removed.

After 8 weeks, the biologists recorded the area covered by water hyacinth within the central strip of each study area as shown in Figure 3.5. The area covered by water hyacinth was used as a measure of abundance.

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Figure 3.6 shows the results of the investigation. Error bars show 95% confidence intervals (95% CI).

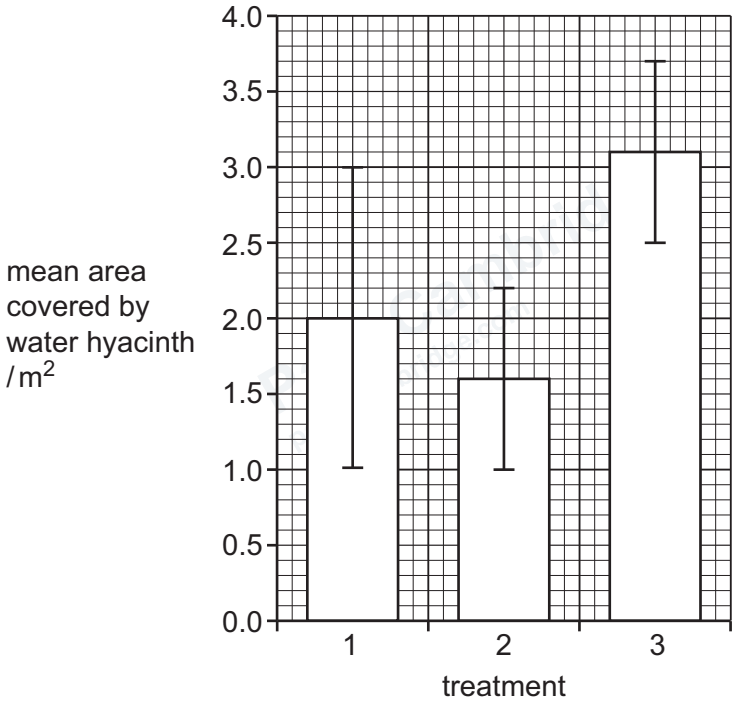


Figure 3.6

(ii) The mean area covered by water hyacinth in locations given treatment **2** is smaller than the mean area covered by water hyacinth in locations given treatment **3** (control).

Use the data in Figure 3.6 to calculate this difference as a percentage of the results for treatment **3**.

space for working

percentage difference = ... [2]

(iii) State which statistical test could be used to establish the statistical significance of this difference between locations given treatment **2** and locations given treatment **3**.

Explain why the test chosen would be suitable.

statistical test .....

explanation .....

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[1]

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(iv) The risk assessment for this investigation stated that the biologists should wear gloves to prevent an allergic reaction to the different plant species.

Suggest **one other** hazard of the investigation, the risk associated with the hazard, and the precaution that would need to be taken.

hazard .....

.....

risk .....

.....

precaution .....

.....

[1]

(v) A conservation volunteer wanted to reduce the abundance of invasive alien plant species found in the Armand Bayou.

The conservation volunteer analysed data from the investigation and concluded that removing malancha would reduce the abundance of water hyacinth in the Armand Bayou.

With reference to Figure 3.6 and other information provided about the investigation, evaluate the extent to which this conclusion can be supported.

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[Total: 11]

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