Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

1189327790

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2022**

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 **16** pages. Any blank pages are indicated.

DC (CE/SG) 302258/3

1 A group of students investigated two habitats: dense woodland and open grassland.

- Trees are the dominant plants in woodland. The trees form a canopy under which flowering herbs, small shrubs and grasses grow.
- Grasses are the dominant plants in grassland. The grasses and small flowering plants form a continuous ground cover with only a few small shrubs present.

Fig. 1.1 shows photographs of the two areas.

Fig. 1.1

The students decided to compare the adaptations for reducing water loss in the plants growing in each area.

The students suggested the following hypothesis:

The density of stomata will be higher in plants found in the woodland habitat than in the grassland habitat.

(a) (i) State the independent **and** dependent variables in this investigation.

independent variable .....

dependent variable ..... [2]

The students collected leaves from a number of different plant species in each area. To study the density of stomata on leaves, impressions of the epidermis can be made using clear varnish.

- One surface of each leaf is painted with a thin layer of varnish.
- The varnish is left to dry.
- Clear sticky tape is applied to the leaf over the varnished area, to make a leaf impression.
- The tape and varnish are removed and stuck to a microscope slide.
- The leaf impression on the slide is viewed using a microscope.

Fig. 1.2 shows the microscope image of one leaf impression prepared in this way.

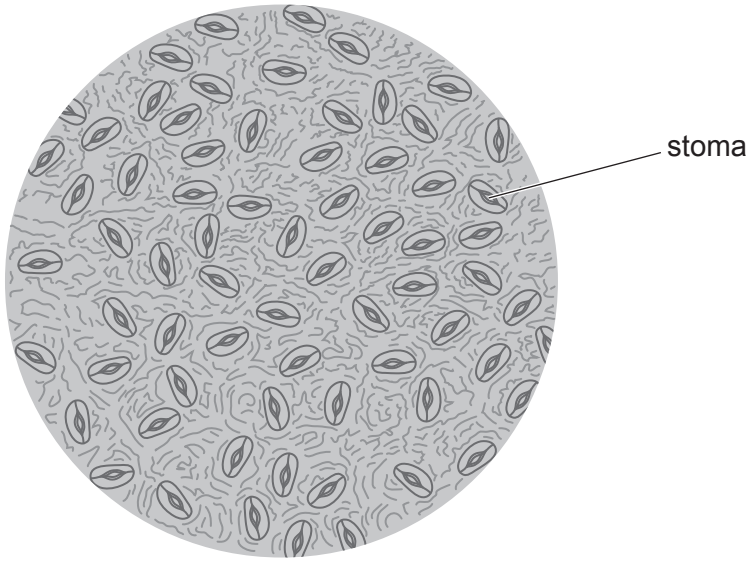

Fig. 1.2

(ii) State the measurements that the students need to make to determine the stomatal density in Fig. 1.2.

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..... [2]

(iii) Calculate the stomatal density in Fig. 1.2.

Space for working.

stomatal density = ... mm^{-2} [2]

(iv) Describe how the students could gather data to compare the stomatal density of plants growing in the woodland and the grassland habitat.

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

You should **not** repeat details of the method for making the leaf impressions.

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Question 1 continues on page 6.

(b) The students found a published investigation on the effect of light intensity on stomatal density in the species *Lycopersicon esculentum*.

Two plants of *Lycopersicon esculentum* were selected. One was grown in high light intensity and the other was grown in low light intensity.

The results are shown in Table 1.1.

Table 1.1

leaf number	**high light intensity**			**low light intensity**		
	number of stomata $\times 10^3$		leaf area / cm^2	number of stomata $\times 10^3$		leaf area / cm^2
	upper surface	lower surface		upper surface	lower surface	
1	1634	3131	496	18	1277	160
2	1482	5072	509	10	906	115
3	1865	6365	637	14	1398	171
mean	1660	4856	547	14	1194	149

(i) Calculate the percentage decrease in mean leaf area for leaves grown in low light intensity compared with those grown in high light intensity.

Your answer should be expressed as a whole number.

..... % [1]

(ii) The scientists who carried out the published investigation concluded that:

plants grown in higher light intensity have higher stomatal density **only** on the upper surface of the leaves compared to plants grown in lower light intensity.

Evaluate whether or not the data in Table 1.1 supports this conclusion.

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..... [3]

[Total: 16]

2 Human immunodeficiency virus (HIV) is an example of a virus that spreads from other animals to humans where it causes disease.

Fig. 2.1 shows a chimpanzee, *Pan troglodytes troglodytes*. Chimpanzees can carry the simian immunodeficiency virus (SIV) which is similar to HIV.

It is thought that chimpanzees who carry antibodies for SIV do not become ill if infected with HIV.

This has been investigated by scientists developing potential vaccines for HIV.

Fig. 2.1

Tests were carried out to see if antibodies against SIV present in chimpanzees bind to HIV antigens.

Test strips were prepared which contained several different HIV antigens.

When samples are applied to the test strip a line will appear in the control region. If the sample contains antibodies to the HIV antigens present on the strip, additional lines will also appear.

Samples of chimpanzee faeces were collected from a number of sites in Gabon in central Africa.

The faecal samples were prepared and then applied to the test strips.

(a) (i) Suggest why the investigators collected faecal samples from chimpanzees rather than plasma samples.

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..... [1]

(ii) Suggest a method for preparing the faecal samples before applying them to the test strips.

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..... [2]

(iii) The scientists collected 608 faecal samples from 224 individual chimpanzees.

Suggest a laboratory method that could be used to identify whether two faecal samples belong to the same individual or not.

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..... [1]

Samples from humans and chimpanzees were applied to the test strips.

1. Plasma samples from humans who are infected with HIV (HIV+)
2. Plasma samples from humans who are not infected with HIV (HIV–)
3. Faecal samples from chimpanzees who are infected with SIV (SIV+)
4. Faecal samples from chimpanzees who are not infected with SIV (SIV–)

The results are shown in Fig. 2.2.

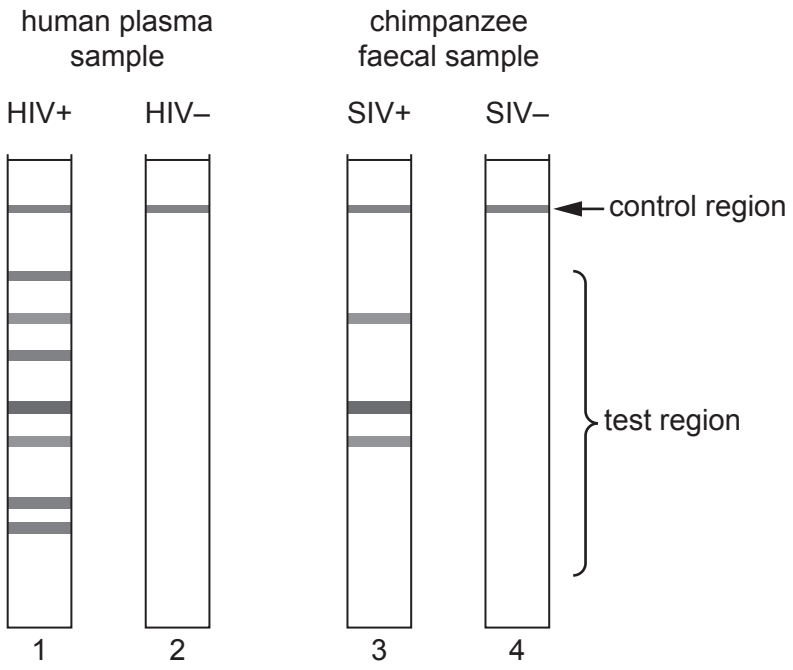

Fig. 2.2

(b) Suggest conclusions that can be drawn from the results shown in Fig. 2.2.

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..... [3]

Question 2 continues on page 12.

(c) HIV infection may lead to HIV/AIDS which, if left untreated, may cause death. The effects of SIV infection in chimpanzees are usually less severe.

A group of scientists investigated the effect of SIV infection on the life expectancy of a population of chimpanzees living in the wild.

- The population of 94 chimpanzees was observed for a nine-year period.
- The ages of all the chimpanzees in the population were estimated.
- The chimpanzees were observed each day.
- The numbers of dead and absent chimpanzees were recorded each day.
- Faecal samples of all the chimpanzees in the population were tested for SIV antibodies.

The results of the investigation are summarised in Table 2.1 and Fig. 2.3.

Table 2.1

SIV status	original number of chimpanzees in population	number of chimpanzees who died or disappeared during the study
SIV–	77	11
SIV+	17	7

The percentage of chimpanzees of each age remaining in the population are represented in Fig. 2.3.

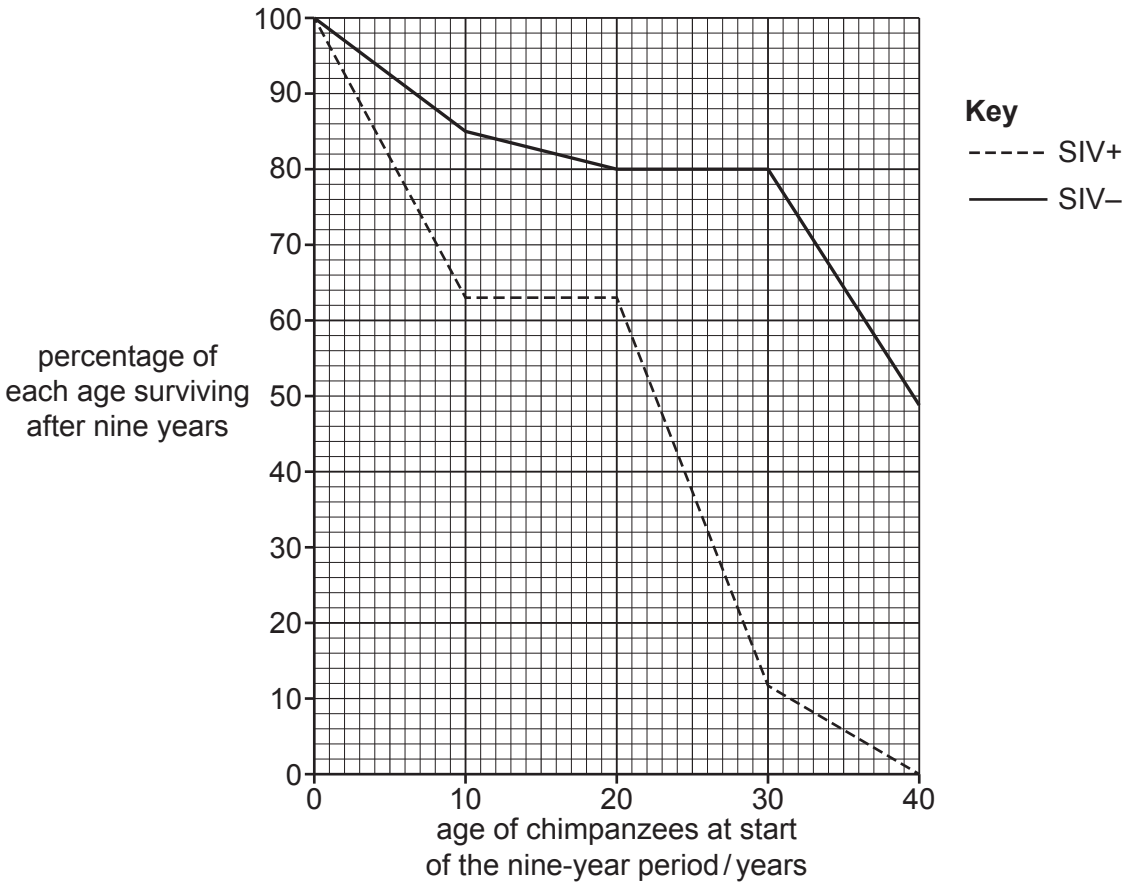

Fig. 2.3

(i) Fig. 2.3 presents the results of the investigation as the percentage of chimpanzees surviving at each age.

Explain the advantages of presenting the results of this study as percentages.

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..... [2]

The investigators concluded that chimpanzees infected with SIV die at an earlier age than uninfected chimpanzees.

The investigators decided to test their conclusion statistically.

(ii) State a null hypothesis the scientists could make before carrying out their statistical test.

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..... [1]

(iii) The investigators carried out their statistical analysis and found that they could reject the null hypothesis at $p < 0.05$.

Explain what is meant by the term $\boldsymbol{p < 0.05}$.

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..... [2]

(iv) Suggest why the data presented in Fig. 2.3 may not be an accurate representation of the effect of SIV infection on the life expectancy of the chimpanzees.

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..... [2]

[Total: 14]

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