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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **February/March 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 **16** pages. Any blank pages are indicated.

DC (CJ/CT) 345321/2

1 Sand dunes are important ecosystems that are found in many regions of the world. Sand dune ecosystems can be damaged by natural events, such as extreme weather conditions, and by human activities including farming and tourism.

Fig. 1.1 is a map of part of a national park in a coastal area of northern Europe. The map shows the range of ecosystems present, including two types of sand dune ecosystem: yellow dune and grey dune.

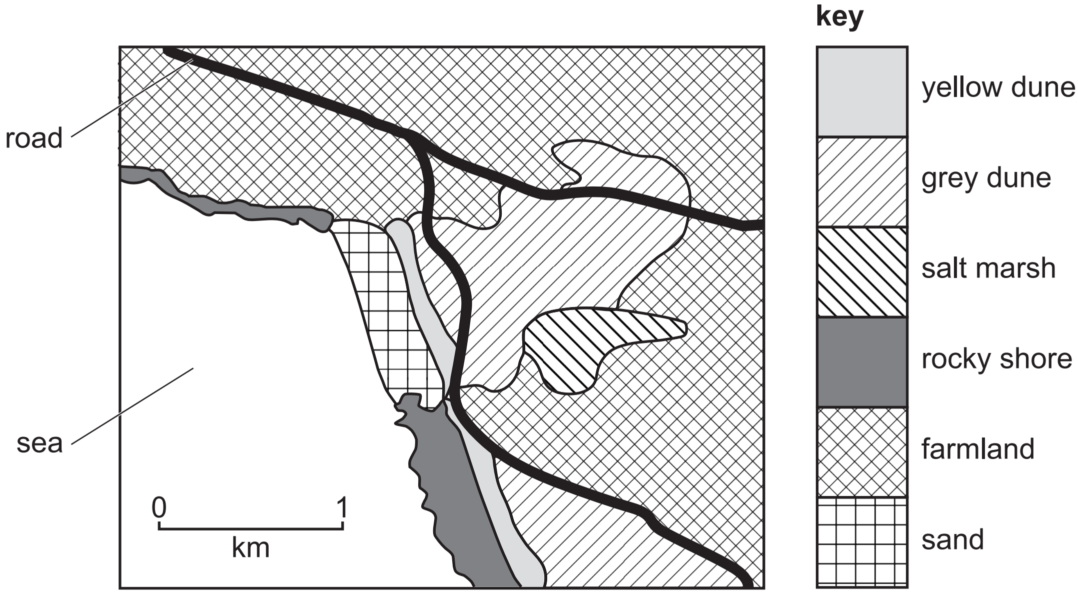

Fig. 1.1

A biologist decided to study the grey dune ecosystem. The biologist visited the ecosystem in the summer, in the month of June.

(a) The grey dune ecosystem is a habitat for the grey bush cricket, *Platycleis albopunctata*.

Fig. 1.2 shows a grey bush cricket.

Fig. 1.2

The biologist wanted to estimate the population size of the grey bush cricket in the grey dune ecosystem.

The biologist used a sweep net to catch grey bush crickets. The biologist moved the sweep net through the plants growing in the grey dune ecosystem. Any grey bush crickets on the plants were caught in the net.

Fig. 1.3 shows a biologist using a sweep net.

Fig. 1.3

Describe the mark-release-recapture method that the biologist could use to estimate the population size of the grey bush cricket.

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(b) The biologist also estimated the species diversity of the plants in the grey dune ecosystem.

The biologist counted the number of individual plants of each species in a small area and calculated Simpson's index of diversity (D).

The formula for Simpson's index of diversity (D) is:

$$D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$$

key to symbols:

n = number of individuals of each species present in the sample
N = the total number of all individuals of all species present in the sample

Table 1.1 shows the results.

Complete Table 1.1 to calculate Simpson's index of diversity (D) to **three** significant figures.

Table 1.1

species	**number of individuals (n)**	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$
marram grass	8		
red fescue	38		
creeping buttercup	3		
red clover	2		
heath dog violet	3		
lady's bedstraw	9		
restharrow	20		
ribwort plantain	1		
salad burnet	12		
spiked speedwell	4		
	N = 100		$\Sigma\left(\frac{n}{N}\right)^2$ = ...
			Simpson's index of diversity (D) = ...

[3]

(c) The national park managers introduced some conservation practices to protect the grey sand dune ecosystem and maintain biodiversity.

The biologist decided to investigate changes to the ecosystem during the ten-year period after the conservation practices were introduced.

(i) The biologist monitored the light intensity and temperature in the grey dune ecosystem.

Suggest **two other** abiotic factors the biologist could monitor during the ten-year period.

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.... [2]

(ii) Describe a method the biologist could use to investigate changes in the species diversity of the plants in the grey dune ecosystem during the ten-year period after the conservation practices were introduced.

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

Details of how to calculate Simpson's index of diversity should **not** be included.

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.... [7]

[Total: 15]

2 Nagarahole National Park in southern India is a forest ecosystem that is important for the conservation of large mammals such as the Asian elephant, *Elephas maximus*. Conflicts between people and elephants in the area surrounding the national park can threaten conservation work.

Fig. 2.1 shows a group of Asian elephants.

Fig. 2.1

Several coffee farms (farms where coffee is the crop) are found close to Nagarahole National Park. Asian elephants sometimes leave the national park and enter the coffee farms. Elephants damage crops and trees, and sometimes injure people who work on the farms.

December trees, *Erythrina subumbrans*, are planted on coffee farms to provide shade and are often damaged when elephants enter the farms.

Some scientists wanted to investigate the reasons why elephants enter coffee farms close to Nagarahole National Park.

20 coffee farms in an area to the south of Nagarahole National Park were chosen at random.

In March 2008, the scientists measured four variables at each coffee farm, as shown in Table 2.1.

Table 2.1

variable	how the variable was determined for each coffee farm
water availability	counting the number of ponds, lakes and water holes visible in satellite images
density of December trees	counting the number of December trees in ten circular areas, each with a radius of 10 m
grass biomass	drying and measuring the dry mass of all the grass leaves collected in 50 randomly selected areas of 0.25 m^2
distance from Nagarahole National Park	using GPS to measure the distance between the boundary of Nagarahole National Park and the boundary of the farm

Farmers from each coffee farm completed a questionnaire to record when elephants entered the farm.

The scientists decided to use Spearman's rank correlation to investigate the relationship between each of the four variables in Table 2.1 and the number of months that elephants entered each coffee farm per year.

(a) State **two** conditions that allow Spearman's rank correlation to be used in this investigation.

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(b) State a null hypothesis for testing whether there is a correlation between water availability and the number of months that elephants entered each coffee farm per year.

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(c) Table 2.2 shows the results of using Spearman's rank correlation (r_s) to investigate the relationship between each of the four variables in Table 2.1 **and** the number of months that elephants entered each coffee farm per year. The table is **not** complete.

Table 2.2

variable	**r_s value**	**significance**
water availability	0.63	
density of December trees	– 0.30	
grass biomass	0.02	
distance to Nagarahole National Park	0.38	

Table 2.3 shows some critical values for the Spearman's rank correlation at different probabilities. When comparing critical values in Table 2.3 with values of Spearman's rank correlation that are negative, the minus sign should be ignored.

Table 2.3

number of paired observations	**probability**			
	0.50	**0.10**	**0.05**	**0.01**
18	0.170	0.401	0.472	0.600
19	0.165	0.391	0.460	0.584
20	0.161	0.380	0.447	0.570
21	0.156	0.370	0.435	0.556

(i) For each variable in Table 2.2, decide whether the r_s value is **significant** or **not significant**. Record your decision in the third column of Table 2.2, headed **significance**. Write **yes** if the value is significant or **no** if the value is **not** significant. [1]

(ii) Describe what can be concluded from Table 2.2 about the relationship between the density of December trees and the number of months that elephants entered each coffee farm per year.

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(d) A coffee farmer living close to a different national park in India wanted to reduce the number of times that elephants entered the farm.

The farmer analysed data from the investigation and concluded that reducing the number of ponds, lakes and water holes on the farm would reduce the number of times that elephants entered the farm.

Explain how the information provided **and** the data in Table 2.2 support and do **not** support this conclusion.

support ....

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do **not** support ....

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[Total: 8]

3 Type 1 diabetes is a disease that occurs when the pancreas stops producing insulin. Type 1 diabetes occurs most commonly in children and is often the result of the immune system destroying beta cells in the pancreas. Beta cells are the cells in the pancreas that make insulin.

Rotavirus is a genus of RNA viruses that can cause infections in people throughout most of the world. Infection by *Rotavirus* causes sickness and diarrhoea in babies and young children, and may damage the pancreas. *Rotavirus* infections are also associated with the development of type 1 diabetes in children.

In May 2007, a vaccination against *Rotavirus* was introduced in Australia. All babies aged from 2 months to 4 months were offered the *Rotavirus* vaccine.

Some scientists decided to investigate whether vaccination against *Rotavirus* had reduced the number of children with type 1 diabetes in Australia.

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

independent variable ....

dependent variable ....
[2]

(b) The scientists used data that had been collected from 2000 to 2015. For each year from 2000 to 2015, the scientists used the data to:

- find the number of children aged from 0 years to 4 years
- find the number of children aged from 0 years to 4 years with type 1 diabetes
- calculate the number of children aged from 0 years to 4 years with type 1 diabetes per 100 000 children that were aged from 0 to 4 years.

The scientists repeated this analysis for children aged from 10 years to 14 years.

(i) Fig. 3.1 shows the number of children aged from 0 years to 4 years with type 1 diabetes per 100 000 for each year from 2000 to 2015.

The predicted number of children aged from 0 years to 4 years with type 1 diabetes per 100 000, if the *Rotavirus* vaccine had **not** been introduced, is also shown from 2008 to 2015.

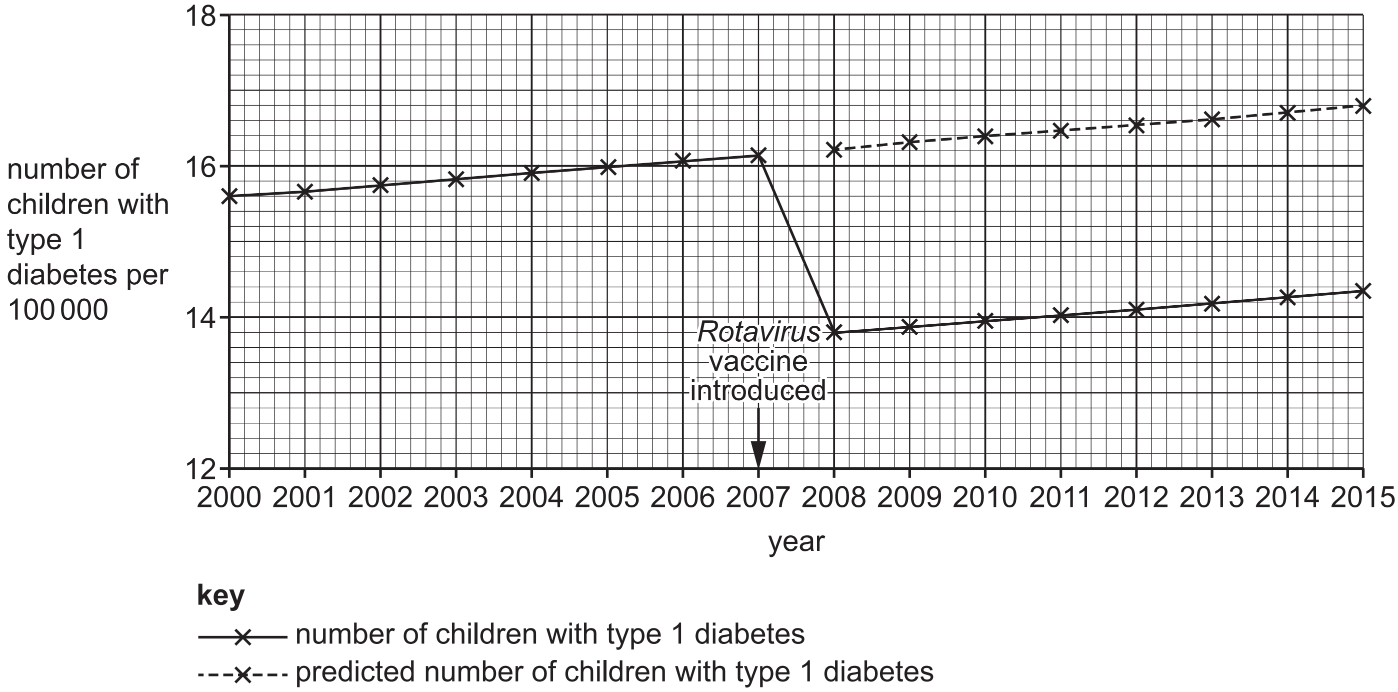

Fig. 3.1

State **two** conclusions that can be made from the data shown in Fig. 3.1.

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(ii) Fig. 3.2 shows the mean number of children with type 1 diabetes in Australia, in each of the two different age groups analysed, before and after the introduction of the *Rotavirus* vaccine in 2007. Error bars show 95% confidence intervals (95% CI).

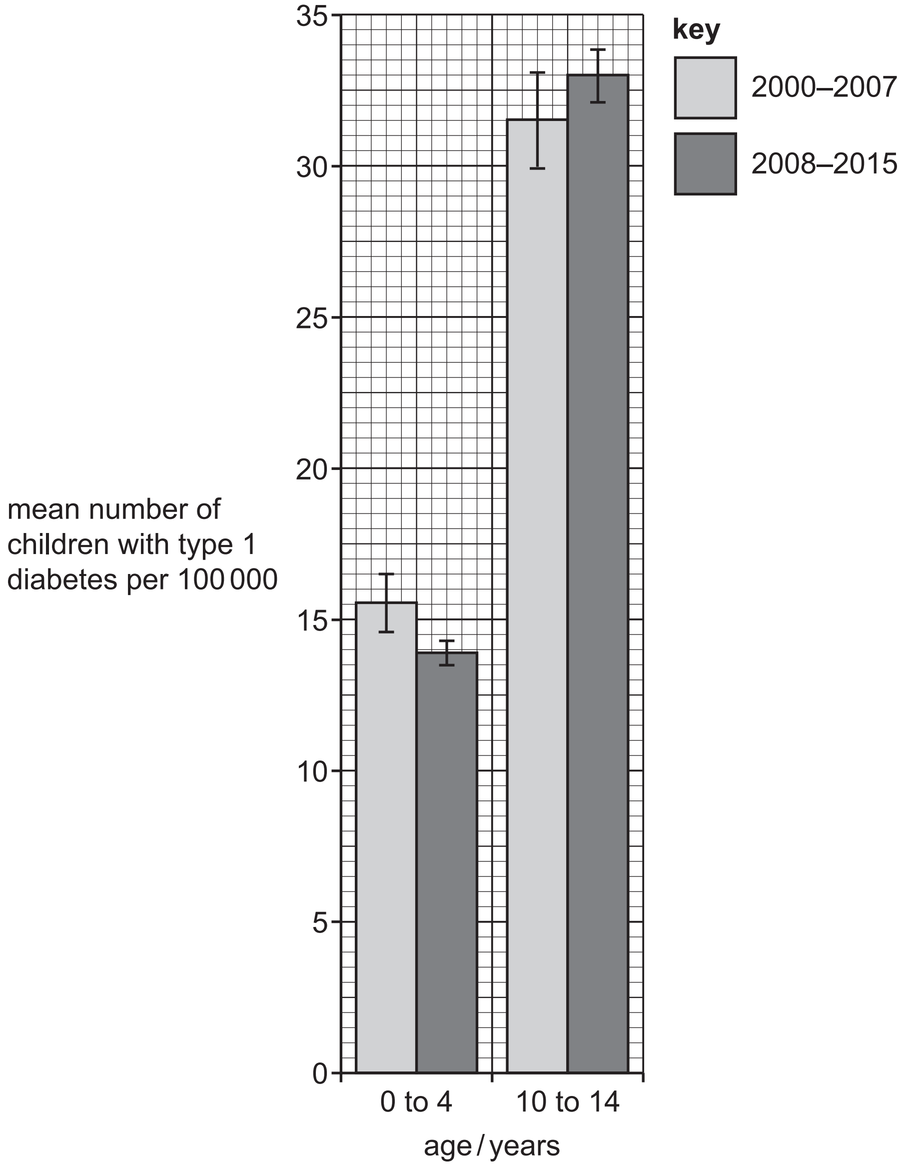

Fig. 3.2

Some students concluded that vaccination against *Rotavirus* decreased the number of children with type 1 diabetes per 100 000.

Discuss whether the information shown in Fig. 3.2 supports this conclusion.

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[Total: 7]

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