

18.2 Biodiversity

Question Paper

Course	CIEA Level Biology
Section	18. Classification, Biodiversity & Conservation
Topic	18.2 Biodiversity
Difficulty	Medium

Time allowed: 50
Score: /35
Percentage: /100

Question 1a

Compare species diversity with species richness.

[2 marks]

Question 1b

Fertilisers are commonly used today by most farmers as they help to increase crop yield and profit. If it rains shortly after fertilisers are applied to a field then some of the fertiliser can enter nearby water sources as runoff. A conservationist investigated the effect that fertiliser runoff from a nearby farm had on the distribution of organisms living in a stream. At the point where fertiliser had entered the stream, she found a high density of specific organisms but a low index of diversity. Suggest how fertiliser contaminating the stream could result in these findings and provide an explanation for your answer.

[2 marks]

Question 1c

Predict how the index of diversity will change as the conservationist moves further away from the farm to take her sample.

Justify your answer.

[2 marks]

Question 1d

The conservationist wanted to use their findings to take action against the local farm. However, the farmer's lawyer argued that the scientific methods of the conservationist were not rigorous enough to conclude that fertilizer runoff was affecting species richness in the nearby stream. The lawyer demanded that more samples at random locations are to be taken. Explain the importance of taking a large number of samples at random sites.

[2 marks]

Question 2a

Distinguish between the biological terms *niche* and *ecosystem*.

[2 marks]

Question 2b

A Biology teacher investigated the different species of insects found in a grassy meadow and in a nearby farmed field. The insects were collected using traps at randomly chosen sites both in the grassy meadow and in the farmed field. Table 2.1 below shows the data collected.

Table 1

Insect species	Total number of individuals collected from farmed field	Total number of individuals collected from grassy meadow
Black aphid	230	0
Green aphid	0	569
Dingy Skipper butterfly	0	21
Green lacewing	7	9
Brown lacewing	0	37
Total number of individuals of all species	237	646

Use the formula below to calculate Simpson's index of diversity (D) for the insects collected in the farmed field.

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

Key to symbols:

n = number of individuals of each type present in the sample
(types may be species and/or higher taxa such as genera, families, etc.)

N = the total number of all individuals of all types present in the sample

Show your working.

[2 marks]

Question 2c

Without doing any further calculations and using the data in Table 2.1, predict whether the index of diversity for insects from the grassy meadow will be higher or lower than the index of diversity for insects from the farmed field.

Explain your answer.

[3 marks]

Question 2d

A student stated that the results of this investigation suggested that farming caused a reduction in species diversity.

Evaluate this by providing arguments in support of and against this statement.

[2 marks]

Question 3a

The Frégate Island giant tenebrionid beetle or Frégate beetle (*Polposipus herculeanus*), is a flightless species of beetle of the family Tenebrionidae. It is endemic to Frégate Island in the Seychelles. A PhD student wanted to estimate the number of Frégate beetles on the island.

Explain how they could use the mark-release-recapture method to do this.

[3 marks]

Question 3b

The PhD student in part (a) used the mark-release-recapture technique to estimate the size of the population of Frégate beetles on the island. They collected 176 beetles and marked them before releasing them back into the same area. Later, they collected 198 beetles, 22 of which were marked.

Calculate an estimate of the number of beetles on the island. Use the formula below and show your working.

Lincoln index

$$N = \frac{n_1 \times n_2}{m_2}$$

Key to symbols:

N = estimate of population size

n_1 = number of individuals captured in first sample

n_2 = number of individuals (both marked and unmarked) captured in second sample

m_2 = number of marked individuals recaptured in second sample

[2 marks]

Question 3c

The PhD student made sure that their study met the conditions required for the results from the mark-release-recapture method to be valid.

State **three** of these conditions.

[3 marks]

Question 3d

Explain the difference between the biological terms *population* and *community*.

[1 mark]

Question 4a

The diversity of dung beetle species was investigated at two grassland sites in North America.

Dung beetles feed on animal faeces (dung).

The first grassland site was grazed by cattle and the second grassland site was **not** grazed by cattle. The areas of the two grassland sites were the same.

At each grassland site, dung beetles were collected, identified and counted.

The results are shown in Table 1.

Table 1

dung beetle species	number of dung beetles on grassland grazed by cattle	number of dung beetles on grassland not grazed by cattle
A	4267	6641
B	2005	774
C	353	108
D	218	85
total	6843	7608

(i)

Simpson's index of diversity (D) for the dung beetles on the grassland site grazed by cattle was calculated as 0.522, using the formula:

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

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

Calculate Simpson's index of diversity (D) for the dung beetles on the grassland site that was **not** grazed by cattle.

Complete Table 2 to show your working.

Write your final answer to **three** decimal places.

Table 2

dung beetle species	number of dung beetles on grassland not grazed by cattle	$\frac{n}{N}$	$\left(\frac{n}{N} \right)^2$
A	6641		
B	774		
C	108		
D	85		
total	7608		

[3]

(ii)

Describe what the results in Table 1 and both figures for Simpson's index of diversity show about the effect of grazing by cattle on the diversity of dung beetles.

[2]

[5 marks]

Question 4b

Other species of beetle that do not feed on animal dung are found on the grassland sites.

Name **and** describe **one** method for estimating the population size of a species of beetle that does **not** feed on dung in each of the two areas of grassland.

[4 marks]