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BIOLOGY

GENETICS, BIODIVERSITY & CLASSIFICATION

Level & Board	AQA (A-LEVEL)
TOPIC:	BIODIVERSITY, WITHIN A COMMUNITY
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	5
TOTAL MARKS	39

Biodiversity within a community - 2

1.

A student looked into the species richness and diversity index of insects in three distinct environments: a hedge, a wheat field, and a barley field.

Her results are displayed in the following table.

	Number of individuals of each insect species in each habitat		
Insect species	**Barley field**	**Wheat field**	**Hedge**
a	32	4	34
b	78	0	12
c	0	126	22
d	0	5	12
e	0	0	8
f	0	0	42
g	0	25	13
h	0	10	12
i	0	0	12
j	42	41	0
Species richness			
Total number of insects (N)			

(a) Fill in the species richness and total number of insects for each environment in the table. **(2)**

(b) Determine the wheat field diversity index.

Apply the subsequent formula: **(2)**

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where N = total number of organisms

and n = total number of organisms of each species.

(c) Compared to the barley field, the hedge had a higher insect variety index.

Explain why. **(3)**

2.

Farmers are paid by the UK government to maintain grassy borders surrounding crop fields. Numerous plant species can be found in these verdant areas. The goal of leaving the strips in place is to promote animal biodiversity.

(a) Describe the two ways that the grassy strips contribute to the greater animal diversification. **(2)**

Scientists looked into how soil animal biodiversity was impacted by grassy strips.

• A field was divided into 25 m × 5 m plots, with a grassy strip of land 5 m wide between each plot.

• They sowed wheat in every plot every year.

• In the fifth year, they took soil samples from the grassy areas surrounding each wheat plot as well as from the plots themselves.

• To gather the soil creatures in each sample, they spent forty minutes manually sorting each soil sample.

(b) For forty minutes, the scientists made the decision to gather creatures from the soil samples.

Explain how the scientists arrived at the decision that 40 minutes was a suitable duration. **(2)**

(c) The scientists' publication of their findings is displayed in the table below. They computed mean values as well as the mean's two-fold standard deviation (SD).

95.4% of the data are within two standard deviations above and below the mean.

Group of animals	Mean number of animals per m^2 (± 2 × SD)		Mean number of species per m^2 (± 2 × SD)	
	Soil under wheat crop	Soil under grassy strips	Soil under wheat crop	Soil under grassy strips
Beetles	41.2 (± 6.4)	80.1 (± 10.1)	10.0 (± 1.6)	17.3 (± 1.0)
Centipedes	18.4 (± 3.6)	13.5 (± 1.0)	1.8 (± 0.3)	2.1 (± 0.2)
Earthworms	244.5 (± 27.1)	281.2 (± 39.4)	3.8 (± 0.3)	5.1 (± 0.2)
Millipedes	38.4 (± 12.2)	36.2 (± 2.9)	3.5 (± 0.3)	3.2 (± 0.2)
Woodlice	0.0	73.9 (± 8.5)	0.0	2.8 (± 0.2)

The results in the table could not be used to calculate an index of diversity.

Describe your reasoning. **(1)**

(d) A farming publication published a summary of this study. The writer came to the conclusion that the variety of soil creatures was not significantly impacted by the creation of grassy strips surrounding farms.

Do you think this conclusion is correct?

Make use of the table's evidence to support your response. **(4)**

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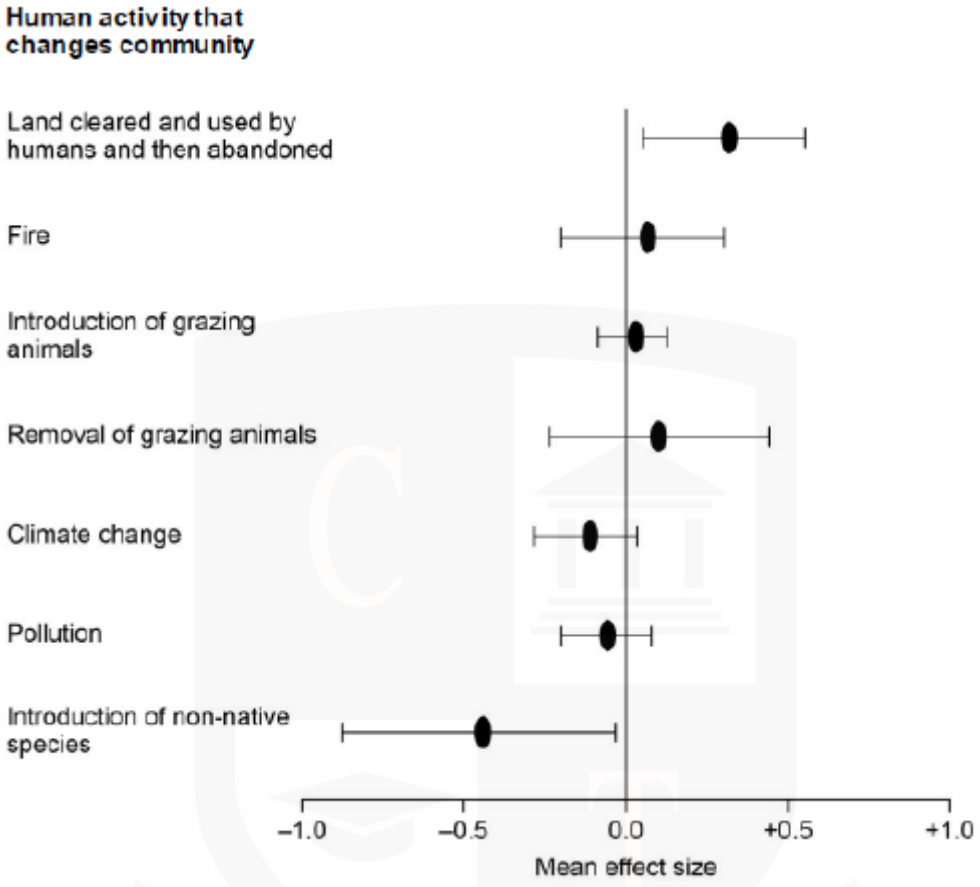
3.

Scientists looked into how human-caused changes affected the biodiversity of plants in various communities. They gathered information from numerous published studies that documented shifts in the species richness of plants over an extended period of time.

The effect size was determined by the scientists using information from each experiment.

A measure of how species diversity changes over time is the effect size. A positive score indicates that species richness is increasing over time.

The results of the scientists are displayed in the graph below in the format in which they were published. 95.4% of the data is represented by the horizontal bars, which show ±2 standard deviations.



(c) Based on these statistics, what conclusions can you draw about how human activity affects biodiversity? **(3)**

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(b) Provide a rationale for the impact size observed upon the introduction of non-native species into populations. **(2)**

(c) Explain how you would look into how the abundance of a native plant species in a community might be affected over a long period of time by an invasion by a non-native plant species (a biotic environmental factor). **(3)**

(d) Effect size is computed in the following way.

1. Split the species richness in the final year of the study (SR2) by the species richness in the initial year of the study (SR1).

2. Determine the outcome's natural log (loge).

3. Calculate the period (T) in decades that elapsed between the first and last year (1 decade = 10 years).

The species richness in one community was 15.3 in year 2 (SR2), 18.2 in year 1 (SR1), and the experiment ran for 29 years.

For this inquiry, create an equation for "effect size" and determine its value using loge, SR2, SR1, and T. The loge key on a calculator is represented by ln, or loge. **(2)**

4.

A student looked into the heathland's plant distribution.

The number of plants he discovered in a 1 m^2 sample area is displayed in the table below.

Species of plant	Number counted in 1 m^2
Common heather	2
Red fescue	14
Vetch	2
White clover	8

(a) How diverse is the sample species composition? **(1)**

(b) Calculate the index of diversity of this sample. Display your work.

Use the following formula to compute the index of diversity. **(2)**

$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

where N is the total number of organisms of all species

and n is the total number of organisms of each species

(c) Make recommendations about how the student may gather information to provide a more accurate value for this habitat diversity index. **(2)**

5.

A community's biodiversity can be measured using species richness and an index of diversity.

(a) How do these two biodiversity metrics differ from one another? **(1)**

Researchers looked into the variety of butterflies seen in a jungle. Their study took several months to complete.

At five locations, the scientists installed one understorey trap and one canopy trap.

The canopy traps were positioned 16–27 meters above ground among the tree leaves, and the understorey traps were positioned 1.0–1.5 meters below the ground beneath the trees.

The quantity of each species of butterfly that was captured in the traps was noted by the scientists. Their findings are summarized in the table below.

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Species of butterfly	Mean number of butterflies		P value
	In canopy	In understorey	
Prepona laertes	15	0	< 0.001
Archaeoprepona demophon	14	37	< 0.001
Zaretis itys	25	11	> 0.05
Memphis arachne	89	23	< 0.001
Memphis offa	21	3	< 0.001
Memphis xenocles	32	8	< 0.001

(b) The canopy traps were positioned 16–27 meters above the ground. Explain the wide range of differences in the traps heights. **(1)**

(c) The species diversity in the canopy is higher than that of the understorey by what multiple? Display your work. **(3)**

The formula for calculating species diversity is as follows.

$$d = \frac{N(N-1)}{\sum n\,(n-1)}$$

where n represents the total number of creatures in each species and N represents the total number of organisms in all species.

(d) To determine if the variation in each species distribution between the canopy and understorey was the result of chance, the researchers performed a statistical test. The table displays the P values that were found.

Describe the findings of these statistical tests. **(3)**

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