Q1.A student investigated the distribution of plants in a heathland.

The table below shows the number of plants he found in a sample area of 1 m^2.

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

(a) What is the species richness of this sample?

(1)

(b) Calculate the index of diversity of this sample. Show your working.

Use the following formula to calculate the index of diversity.

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

where N is the total number of organisms of all species
and n is the total number of organisms of each species

Index of diversity = ...

(2)

(c) Suggest how this student would obtain data to give a more precise value for the index of diversity of this habitat.

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(2)
(Total 5 marks)

Q2. Species richness and an index of diversity can be used to measure biodiversity within a community.

(a) What is the difference between these two measures of biodiversity?

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(1)

Scientists investigated the biodiversity of butterflies in a rainforest. Their investigation lasted several months.

The scientists set one canopy trap and one understorey trap at five sites.

- The canopy traps were set among the leaves of the trees 16–27 m above ground level.
- The understorey traps were set under trees at 1.0–1.5 m above ground level.

The scientists recorded the number of each species of butterfly caught in the traps. The table below summarises their results.

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 traps in the canopy were set at 16–27 m above ground level. Suggest why there was such great variation in the height of the traps.

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(1)

(c) By how many times is the species diversity in the canopy greater than in the understorey? Show your working.

Use the following formula to calculate species diversity.

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

where N is the total number of organisms of all species and n is the total number of organisms of each species.

Answer = ...

(3)

(d) The scientists carried out a statistical test to see if the difference in the distribution of each species between the canopy and understorey was due to chance. The P values obtained are shown in the table.

Explain what the results of these statistical tests show.

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(Extra space) .....

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(3)
(Total 8 marks)

Q3.Table 1 shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists.

Table 1

Taxon	Name of taxon
Domain	Eukaryota
	Animalia
	Chordata
	Aves
	Passeriformes
	Muscicapidae
Genus	
Species	

(a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

(2)

A group of scientists investigated genetic diversity in different species of bird. For each species, the scientists:

- collected feathers from a large number of birds
- extracted DNA from cells attached to each feather
- analysed the samples of DNA to find genetic diversity.

Table 2 summarises their results.

Table 2

Species of bird	Number of genes examined	Number of genes examined that showed genetic diversity
Willow flycatcher	708	197
House finch	269	80
Bluethroat	232	81

(b) In this investigation, what is meant by **genetic diversity?**

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(1)

(c) The scientists concluded that the bluethroat showed greater genetic diversity than the willow flycatcher. Explain why they reached this conclusion. Use calculations to support your answer.

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(2)
(Total 5 marks)

Q4. Ecologists investigated the size of an insect population on a small island. They used a mark-release-recapture method. To mark the insects they used a fluorescent powder. This powder glows bright red when exposed to ultraviolet (UV) light.

(a) The ecologists captured insects from a number of sites on the island. Suggest how they decided where to take their samples.

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(2)

(b) Give **two** assumptions made when using the mark-release-recapture method.

1 .....

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2 .....

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(2)

(c) Suggest the advantage of using the fluorescent powder in this experiment.

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(2)

The ecologists did **not** release any of the insects they captured 1–5 days after release of the marked insects.

The table below shows the ecologists' results.

Days after release	Number of marked insects remaining in population	Number of insects captured	Number of captured insects that were marked
1	1508	524	78
2	1430	421	30
3	1400	418	18
4	1382	284	2
5	1380	232	9

(d) Calculate the number of insects on this island 1 day after release of the marked insects.

Show your working.

Answer = ...

(2)

(e) The ecologists expected to obtain the same result from their calculations of the number of insects on this island on each day during the period 1–5 days after release. In fact, their estimated number increased after day 1.

During the same period, the number of insects they caught decreased.

The method used by the ecologists might have caused these changes.

Use the information provided to suggest **one** way in which the method used by the ecologists might have caused the increase in their estimates of the size of the insect population.

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(2)
(Total 10 marks)

Q5.(a) What **two** measurements are needed to calculate an index of diversity?

1 .....

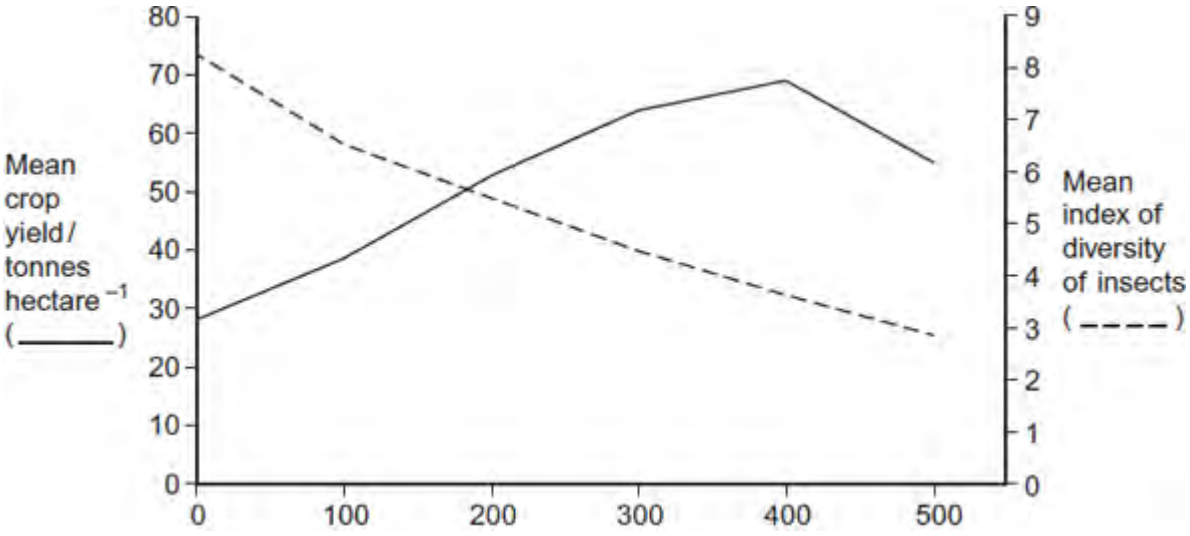
2 .....

(2)

(b) A herbicide is a chemical used to kill weeds. Ecologists investigated the effect of a herbicide on crop yield and the diversity of insects. They sprayed different fields with

the same volume of different concentrations of the herbicide. At harvest, the ecologists determined the mean crop yield and the mean index of diversity of insects for fields that had received the same concentration of the herbicide.

The figure below shows their results.



(i) Some fields acted as controls. They were sprayed with a solution that did not contain the herbicide. Explain the purpose of these control fields.

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(1)

(ii) Suggest an explanation for the relationship between the concentration of herbicide and the mean crop yield.

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(2)

(iii) Explain the relationship between the concentration of herbicide and the mean index of diversity of insects.

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(Extra space) .....

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(3)
(Total 8 marks)

Q6. During the light-independent reaction of photosynthesis, carbon dioxide is converted into organic substances. Describe how.

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(Extra space) .....

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(Total 6 marks)