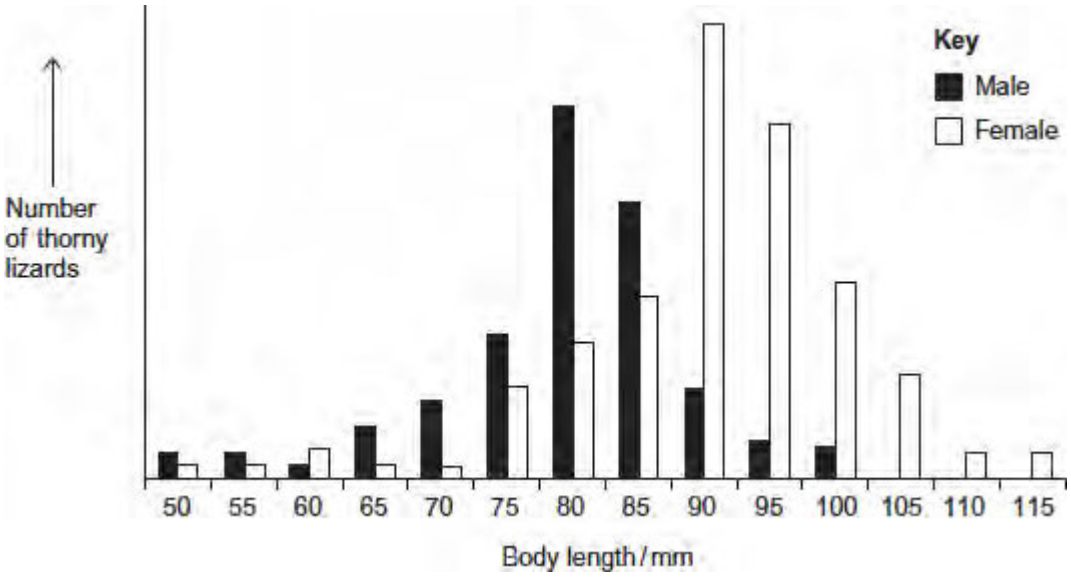
Q1.(a) Ecologists measured the body lengths of male and female thorny lizards living in the same habitat. The ecologists measured the body lengths to the nearest 5 mm. The graph shows how they presented their results.



Give **two** differences in the variation in body length of male and female thorny lizards.

1 .....

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2 .....

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(2)

(b) Another group of ecologists investigated biodiversity of lizards in a woodland area.

Their results are shown in the table.

Lizard species	**Number of individuals**
Dominican giant anole	5
Hispaniolan green anole	11

Hispaniolan stout anole	22
Bark anole	91
Hispaniolan grass anole	13
Cope's galliwasp	5
Cochran's least gecko	8
Peninsula least gecko	1

The index of diversity can be calculated using the formula

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

where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

(i) Use the formula to calculate the index of diversity of lizards in the woodland area.
Show your working.

Answer = ...

(2)

(ii) The ecologists also determined the index of diversity of lizards in an oil palm plantation next to the woodland area. They found fewer species of plant in the oil palm plantation. Lizards feed on plants and insects.

Explain why fewer species of plant would lead to fewer species of lizard in the oil palm plantation.

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[Extra space].....

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(3)
(Total 7 marks)

Q2.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)

Q3. 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)

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?

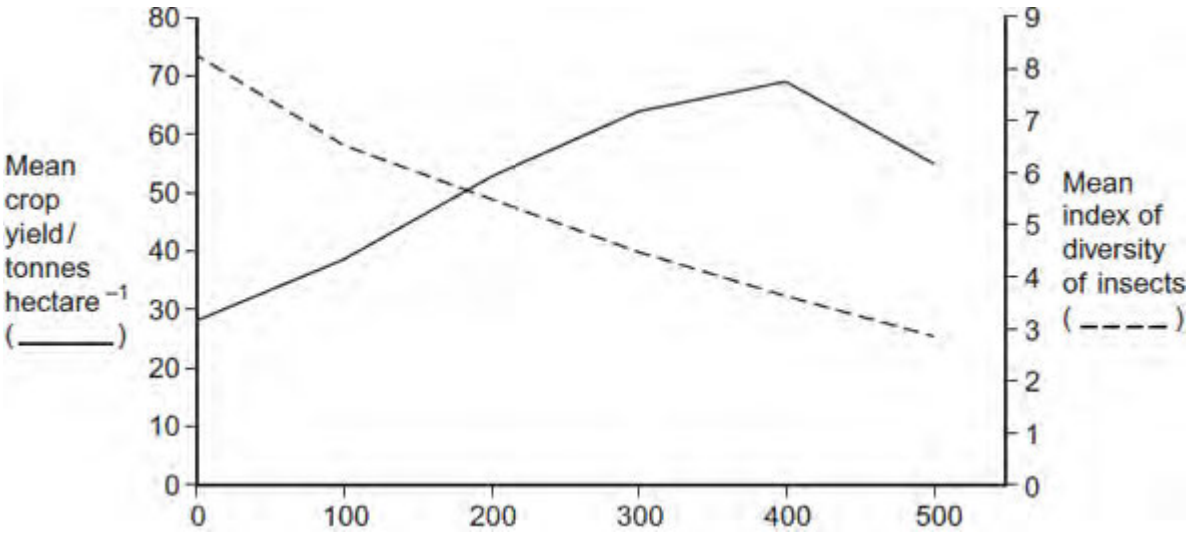
1 .....

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.



Concentration of herbicide sprayed on field / mg dm^{-3}

(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. The Amazonian forest today contains a very high diversity of bird species.

- Over the last 2 000 000 years, long periods of dry climate caused this forest to separate into a number of smaller forests.
- Different plant communities developed in each of these smaller forests.
- Each time the climate became wetter again, the smaller forests grew in size and merged to reform the Amazonian forest.

(a) Use the information provided to explain how a very high diversity of bird species has developed in the Amazonian forest.

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(Extra space).....

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(5)

(b) Speciation is far less frequent in the reformed Amazonian forest. Suggest one reason for this.

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(1)
(Total 6 marks)