EXAM PAPERS PRACTICE

Biodiversity within a Community

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Biodiversity within a Community

1 A student investigated the species richness and index of diversity of insects in three differenthabitats, a barley field, a wheat field and a hedge.

Her results are shown in the table below.

	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) Complete the table for species richness and the total number of insects of each habitat.

(2)

(b) Calculate the index of diversity of the wheat field.

Use the following formula:

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

where N = total number of organisms

and n = total number of organisms of each species.

(2)

(c) The index of diversity of the insects was higher in the hedge than in the barley field. Suggest why.

(3)

(Total 7 marks)

2 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 ofdiversity of this habitat.

_____

_____

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(2)

(Total 5 marks)

3 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?

_____

_____

(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. Thetable 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.

_____

_____

(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 eachspecies 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.

(Extra space)

(3)

(Total 8 marks)

4 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.

(2)

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

1.

2.

(2)

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

_____

_____

_____

_____

(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 ofinsects 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)

5 Scientists investigated the effect of different types of animal farming on the diversity and number of dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 1 and **Figure 2** show some of their results.

Figure 1

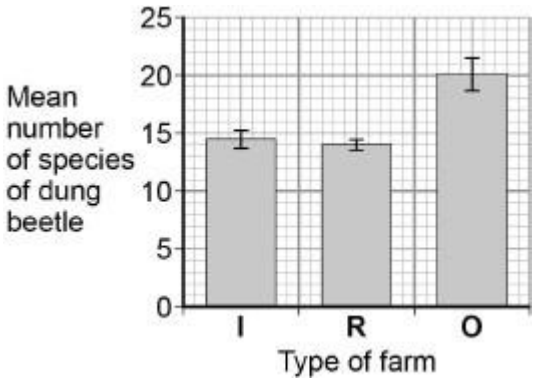
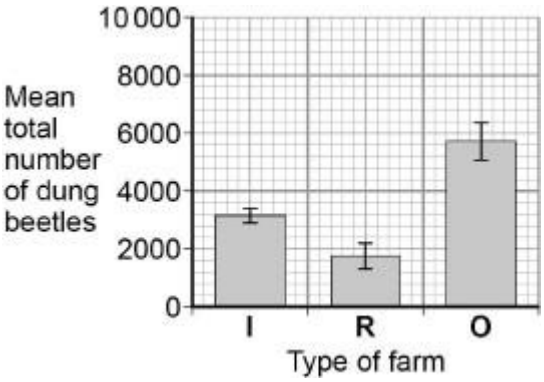


Figure 2



Key: I Standard deviation

(a) What is the mean species richness for dung beetles on the rough grazing farms?

_____

(1)

(b) In addition to the information provided in **Figures 1** and **2**, what other measurement isrequired to calculate an index of diversity for dung beetles?

_____

_____

(1)

(c) Explain what the standard deviations suggest about the difference in mean total number of dung beetles between the different types of farm.

_____

_____

_____

_____

_____

(2)

(d) The scientists placed traps to collect the dung beetles at sites chosen at random.

Explain the importance of the sites being chosen at random.

_____

_____

(1)

(e) On the intensive farms, the farmers had removed hedges to increase land for grazing. Thisresulted in a decrease in the diversity of birds on these farms.

Explain why the removal of hedges caused a decrease in the diversity of birds.

(3)

(Total 8 marks)

6 (a) What is meant by species diversity?

(1)

(b) Give **two** pieces of information needed to calculate an index of diversity for a community.

1. _____

2. _____

(2)

(c) A scientist investigated the effect sewage entering a river had on the distribution of organisms living in the river. Where sewage entered the river, he found a high density oforganisms but a low index of diversity.

Suggest how sewage entering the river could explain the scientist's findings.

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(2)

(d) A second scientist repeated the investigation of the first scientist at the same place. The second scientist obtained a high index of diversity.

(i) Explain how the second set of results affects the ability of the scientists to make any conclusions about the effect of sewage on the index of diversity.

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(2)

(ii) Suggest the additional steps that should be taken by the scientists before they are able to make any conclusions about the effect of sewage entering this river.

_____

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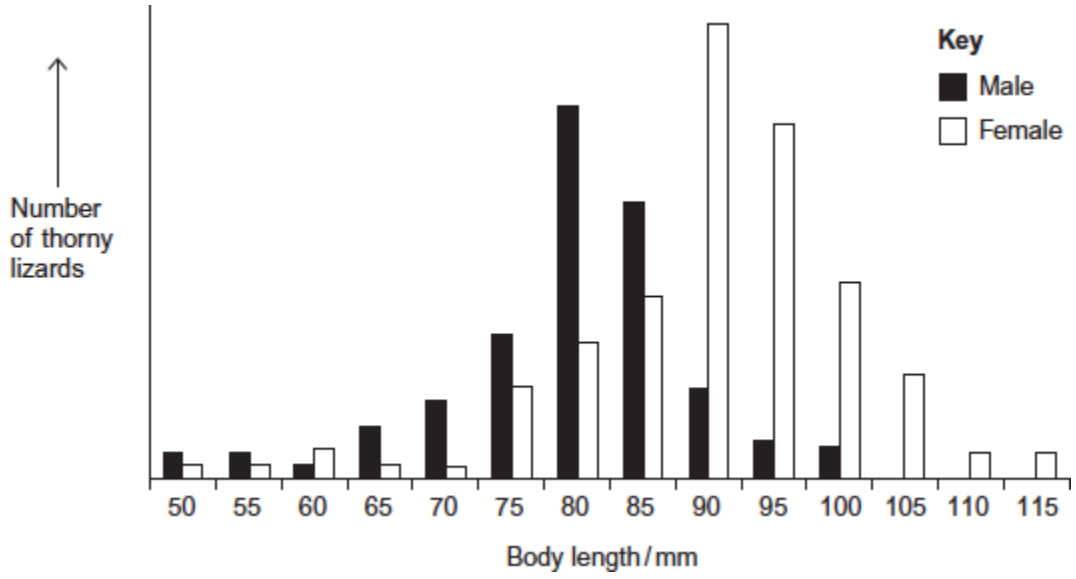
(1)

(Total 8 marks)

7 (a) Ecologists measured the body lengths of male and female thorny lizards living in the samehabitat. 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. _____

_____

2. _____

_____

(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 oilpalm 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.

[Extra space]

(3)

(Total 7 marks)

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

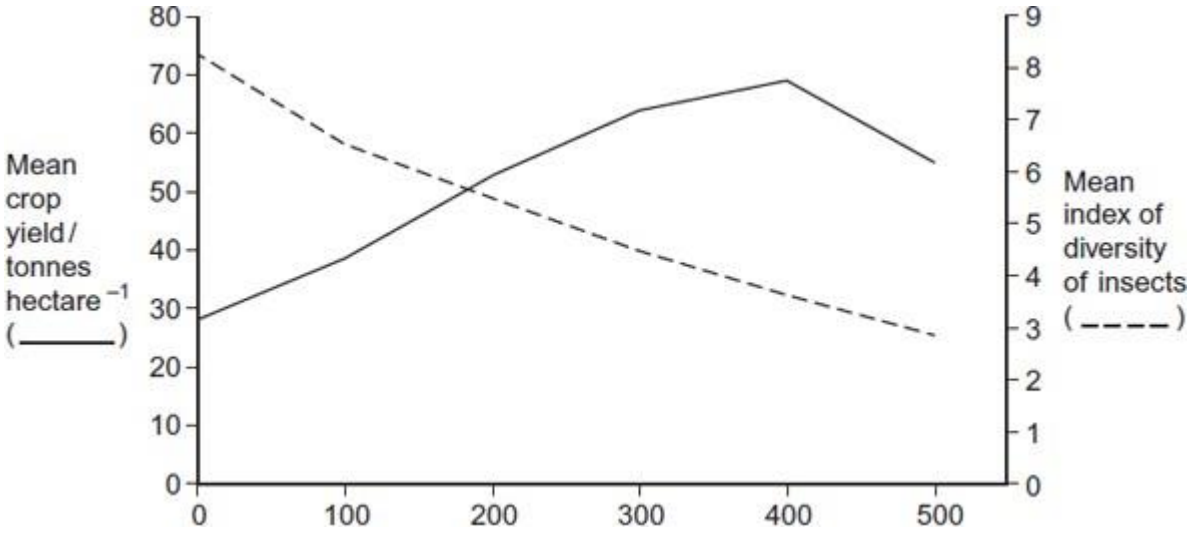
1. _____

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.

_____

_____

_____

(2)

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

_____

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(Extra space) _____

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_____

(3)

(Total 8 marks)

9 *(a)* What is a *species?*

_____

_____

_____

(2)

(b) Scientists investigated the diversity of plants in a small area within a forest. The tableshows their results.

Plant species	Number of individuals
Himalayan raspberry	20
Heartwing sorrel	15
Shala tree	9
Tussock grass	10
Red cedar	4
Asan tree	6
Spanish needle	8
Feverfew	8

The index of diversity can be calculated by the formula

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

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 plants in the forest. Show your working.

Answer = _____

(2)

(ii) The forest was cleared to make more land available for agriculture.

After the forest was cleared the species diversity of insects in the area decreased. Explain why.

(Extra space)

(3)

(Total 7 marks)

10 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.

(Extra space)

(5)

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

(1)

(Total 6 marks)

11 (a) There are ethical and economic arguments for maintaining biodiversity.

(i) Suggest **one** ethical argument for maintaining biodiversity.

_____

_____

_____

(1)

(ii) Suggest **one** economic argument for maintaining biodiversity.

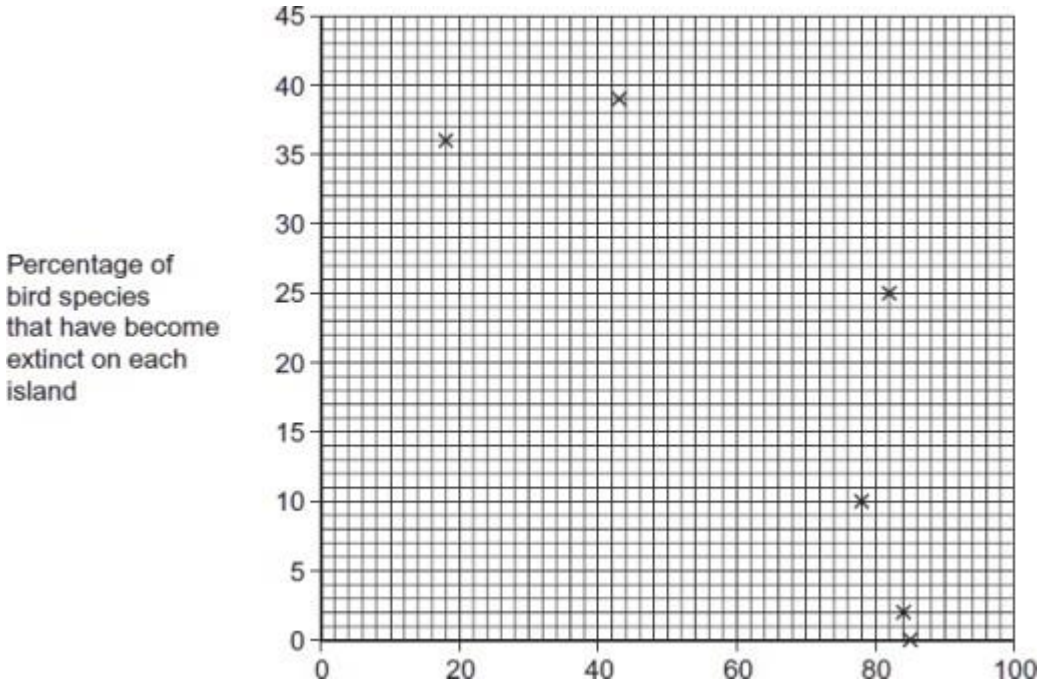
_____

_____

_____

(1)

Ecologists calculated the percentage of bird species that have become extinct on six islands in the last one hundred years. They also calculated the percentage of original forest area remaining on each island after the same time period. The graph shows their results.



(b) Explain the relationship between the percentage of original forest area remaining and the percentage of bird species that have become extinct.

_____

(2)

(c) What **two** measurements would the ecologists have needed to obtain to calculate the index of diversity of birds on each island?

1. _____

2. _____

(2)

(d) The ecologists noted that the species of birds surviving on the coldest islands had a largerbody size than those surviving on warmer islands.

Explain how a larger body size is an adaptation to a colder climate

(2)

(Total 8 marks)

12 Farmland previously used for growing crops was left for 30 years and developed into woodland. During this period, ecologists recorded an increase in the diversity of birds in the area.

(a) Name the process that resulted in the development of woodland from farmland.

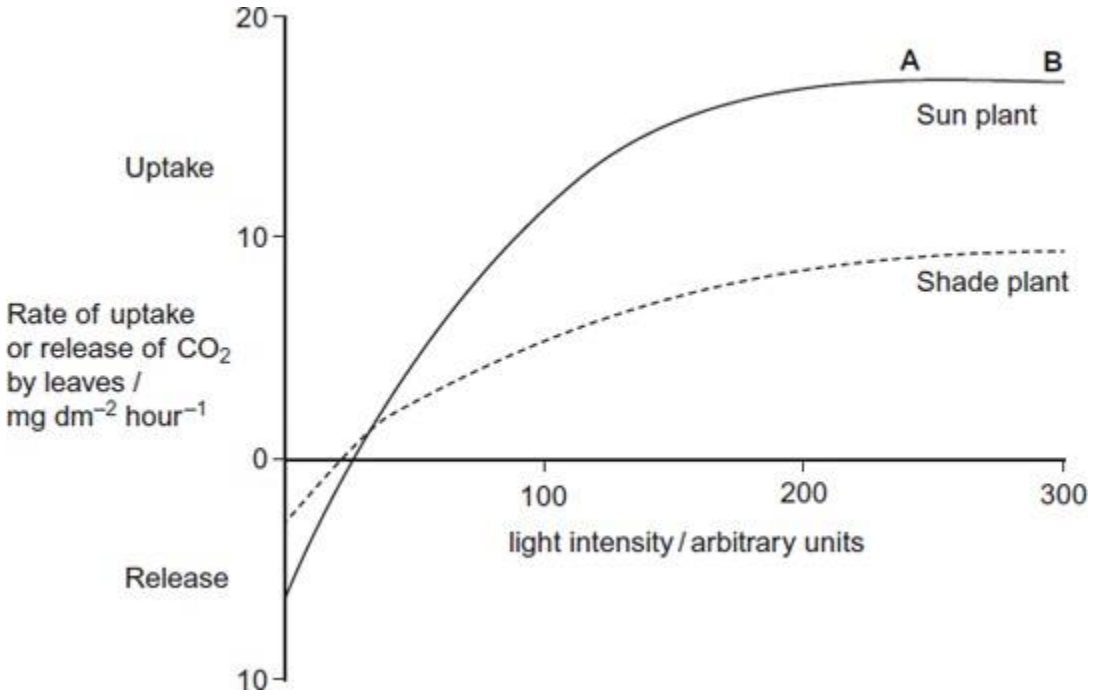
(1)

(b) Explain the increase in the diversity of birds as the woodland developed.

(Extra space)

(3)

(c) The ecologists also investigated photosynthesis in two species of plant found in the woodland. One of the species was adapted to growing in bright sunlight (sun plant) and theother was adapted to growing in the shade (shade plant). The ecologists' results are shownin the figure below.



(i) Give **two** factors which could be limiting the rate of photosynthesis in the sun plant between points **A** and **B** on the figure.

1. _____

2. _____

(1)

(ii) Explain why CO_2 uptake is a measure of net productivity.

_____

_____

(Extra space) _____

_____

(1)

(iii) Use the information in the figure to explain how the shade plant is better adapted thanthe sun plant to growing at low light intensities.

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_____

(Extra space) _____

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(2)

(Total 8 marks)

13 Scientists investigated the species of insects found in a wood and in a nearby wheat field. The scientists collected insects by placing traps at sites chosen at random both in the wood and in the wheat field.

The table shows the data collected in the wood and in the wheat field.

Species of insect	Number of organisms of each species	
	Wood	**Wheat field**
Bird-cherry oat aphid	0	216
Beech aphid	563	0
Large white butterfly	20	0
Lacewing	12	3
7-spot ladybird	36	0
2-spot ladybird	9	1
Total number of organisms of all species	640	220

(a) The scientists collected insects at sites chosen at random. Explain the importance of the sites being chosen at random.

_____

_____

_____

(1)

(b) (i) Use the formula

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

to calculate the index of diversity for the insects caught in the wood, where

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

Show your working.

Answer _____

(2)

(ii) Without carrying out any further calculations, estimate whether the index of diversity for the wheat field would be higher or lower than the index of diversity for the wood.

Explain how you arrived at your answer.

_____

_____

_____

_____

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(2)

(c) A journalist concluded that this investigation showed that farming reduces species diversity. Evaluate this conclusion.

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_____

_____

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(2)

(d) Farmers were offered grants by the government to plant hedges around their fields.Explain the effect planting hedges could have on the index of diversity for animals.

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(2)

(Total 9 marks)

14 (a) A student investigated the diversity of plants at several sites on a golf course. At each site she took a large number of random samples.

(i) Explain the importance of taking a large number of samples at each site.

_____

_____

_____

(1)

(ii) Explain the importance of taking samples at random.

_____

_____

_____

(1)

The student collected data from one part of the golf course and calculated an index ofdiversity.

The table shows her data.

Species	Number of plants per m^2
Sheep's fescue	11
Creeping buttercup	6
Clover	5
Dandelion	2
Sheep's sorrel	1
Lady's bedstraw	7
Stemless thistle	4

The index of diversity can be calculated from the formula

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

where

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

(b) Use the formula to calculate the index of diversity for the plants on this part of the golf course. Show your working.

Answer _____

(2)

(c) The golf course was surrounded by undeveloped grassland from which it had beenproduced.
The golf course had

- some areas of very short grass which was cut frequently
- some areas of longer grass which was cut less frequently
- some areas of long grass and shrubs which were never cut.

The index of diversity for the insects on the golf course was higher than that for the surrounding undeveloped grassland.

Explain the effect of developing this golf course on the index of diversity of insects.

(Extra space)

(3)

(Total 7 marks)

15 Costa Rica is a Central American country. It has a high level of species diversity.

(a) There are over 12 000 species of plants in Costa Rica. Explain how this has resulted in a high species diversity of animals.

(2)

(b) The number of species present is one way to measure biodiversity. Explain why an index of diversity may be a more useful measure of biodiversity.

(2)

(c) Crops grown in Costa Rica are sprayed with pesticides. Pesticides are substances that kill pests. Scientists think that pollution of water by pesticides has reduced the number of species of frog.

(i) Frogs lay their eggs in pools of water. These eggs are small. Use this information to explain why frogs' eggs are very likely to be affected by pesticides in the water.

(2)

(ii) An increase in temperature leads to evaporation of water. Suggest how evaporation may increase the effect of pesticides on frogs' eggs.

(1)

(Total 7 marks)

16 (a) What information is required to calculate an index of diversity for a particular community?

(1)

(b) Farmers clear tropical forest and grow crops instead.
Explain how this causes the diversityof insects in the area to decrease.

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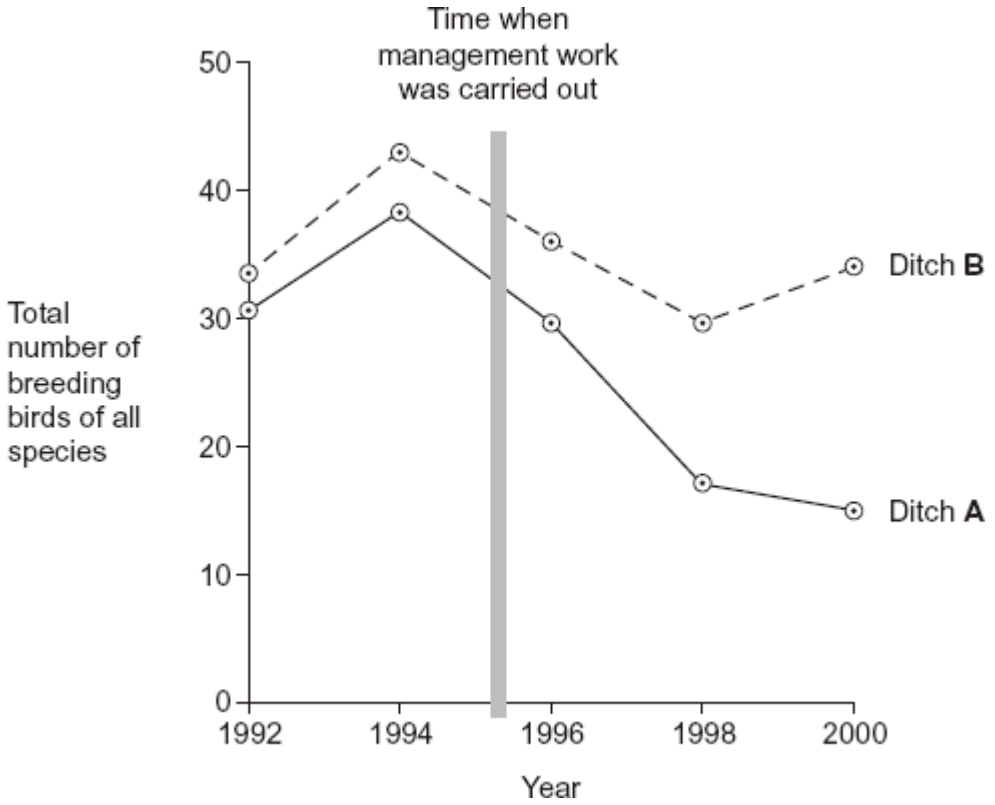
(3)

Farmers manage the ditches that drain water from their fields. If they do not, the ditches will become blocked by plants. Biologists investigated the effects of two different ways of managing ditches on farmland birds.

- Ditch **A** was cleared of plants on both banks
- Ditch **B** was cleared of plants on one bank.

The graph shows the number of breeding birds of all species along the two ditches, before and after management.



(c) (i) The points on the graph have been joined with straight lines rather than with asmooth curve. Explain why they have been joined with straight lines.

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(1)

(ii) It would have been useful to have had a control ditch in this investigation. Explain why.

_____

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(1)

(d) A farmer who wanted to increase the diversity of birds on his land read about this investigation.

He concluded that clearing the plants from one bank would not decrease diversity as much as clearing the plants from both banks. Evaluate this conclusion.

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(3)

(Total 9 marks)

17 (a) Heath is a community of plants and animals. A student investigated the species diversity ofplants in this community. The table shows her results.

Plant species	Number of plants per m^2
Heath rush	1
Bilberry	1
Sheep's sorrel	5
Ling	2
Bell heather	1
Heath bedstraw	8
Mat-grass	11

(i) The index of diversity can be calculated from the formula

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

where

d = index of diversity

N = total number of organisms of all species

n = total number of organisms of each species.

Use this formula to calculate the index of diversity for the plants on the heath.

Show your working.

Answer _____

(2)

(ii) Explain why it may be more useful to calculate the index of diversity than to recordonly the number of species present.

_____

_____

_____

_____

(2)

(b) The demand for increased food production has led to areas of heath being used to grow wheat. Explain the effect of this on

(i) the species diversity of plants

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(2)

(ii) the species diversity of animals.

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(2)

(Total 8 marks)

18 Biologists studied the process of succession in an area of wasteland over a period of ten years. They calculated the index of diversity of the area every year. After three years, the index of diversity was 1.6. After ten years, it had risen to 4.3.

(a) What information concerning the organisms present in the area is suggested by the increase in the index of diversity?

_____

_____

_____

_____

(2)

(b) The increase in the index of diversity is one indication that a biological succession is taking place in the area. Describe those features of a succession that would bring about an increase in the index of diversity.

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_____

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_____

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(3)

(Total 5 marks)

19 Mayflies are insects which lay their eggs in streams and rivers. The nymphs which hatch from theeggs live in the water for several years.

Mayfly nymphs were collected by disturbing the gravel of a stream bed. A net placed immediately downstream caught any animals which were washed out of the gravel. Eight samples were collected from shallow, fast-flowing parts of the stream and eight from deeper, slow-flowing parts. Nymphs from two different families of mayfly were found. The results are given in the table.

	Family Caenidae		**Family Baetidae**	
	Shallow water	**Deep water**	**Shallow water**	**Deep water**
Mean number of nymphs	2.38	12.88	24.50	6.00
Standard deviation	1.51	7.92	6.72	1.51

(a) Describe how you would have collected the samples in order to ensure they were representative of the habitats being investigated and could be compared with each other.

(3)

(b) Which **one** of the four samples showed the greatest variation within the sample? Give evidence from the table for your answer.

(1)

(c) The two families of mayfly nymph occupy different ecological niches.

(i) What is meant by the term *ecological niche*?

(1)

(ii) Describe the evidence in the table which suggests that the two families of mayfliesoccupy different ecological niches.

_____

_____

(1)

(iii) Explain the advantage to these two families of mayflies of occupying different ecological niches.

_____

_____

_____

_____

(2)

(Total 8 marks)

20 Deforestation often involves clearing large areas of forest for use as agricultural land.

(a) Deforestation reduces the diversity index of an area cleared in this way. Explain why.

_____

_____

_____

_____

(2)

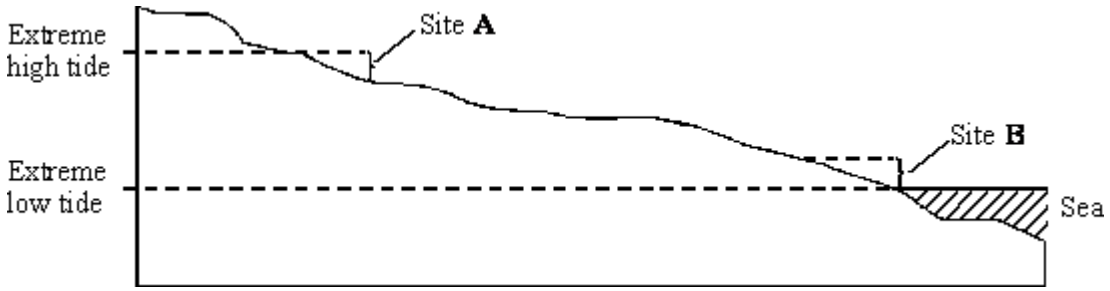
(b) Because the forest soil is often nutrient-poor, nitrogen-containing fertilisers may be appliedto ensure good crop yields. Use your knowledge of the nitrogen cycle to explain the potential benefit of applying a fertiliser containing ammonium nitrate rather than one containing potassium nitrate.

(3)

(Total 5 marks)

21 Parts of the sea shore form a very hostile environment for living organisms. Twice each day the incoming and outgoing tides alternately cover the organisms on the sea shore with water and then leave them exposed. The force of the waves could also dislodge any organisms that were not firmly attached.

The diagram shows a section through a rocky shore. Two sites were studied: site **A** was on the upper shore and site **B** on the lower shore.



The table shows the seaweeds that were found growing at sites **A** and **B**.

Site A: upper shore	Mean number per m^2	Site B: lower shore	Mean number per m^2
Ascophyllum nodosum	2	*Corallina officinalis*	31
Fucus spiralis	10	*Fucus serratus*	8
Fucus vesiculosus	4	*Laminaria digitata*	15
Pelvetia canaliculata	6	*Laminaria hyperborea*	3
		Laminaria saccharina	6
		Laurencia pinnatifida	18
		Palmaria palmata	6
Index of diversity		Index of diversity	4.77

(a) (i) Use 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 a particular species

to calculate the index of diversity for the seaweeds growing at site **A**.
Show your working.

Index of diversity at site **A** = _____

(2)

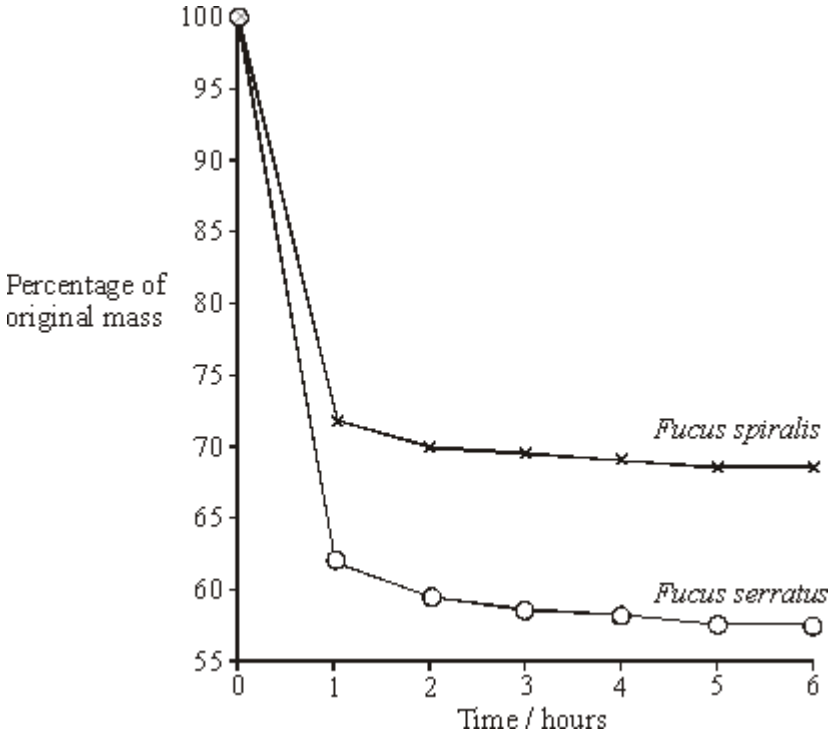
(ii) Give **one** advantage of calculating the index of diversity rather than just recording the number of species present.

_____

_____

(1)

(b) Availability of water is one abiotic factor which determines the distribution of seaweeds. The graph shows loss in mass due to water evaporation for two of the seaweed species. The two seaweeds belong to the same genus but one was found only on the upper shoreand the other only on the lower shore.



Explain how the results shown in the graph relate to the distribution of these two seaweeds on the sea shore.

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

22 When coal is mined by open-cast mining, the top layer of soil is first scraped off and stored in a large heap. Once mining has finished, the area can be reclaimed. Soil from this store is then spread back over the surface.

Some of the bacteria living in the soil store respire aerobically and some respire anaerobically. **Table 1** shows the numbers of aerobic and anaerobic bacteria found at different depths in a soil store.

Depth / cm	Mean number of bacteria per gram of soil ($\times 10^7$)			
	Aerobic bacteria		Anaerobic bacteria	
	after 1 month	after 6 months	after 1 month	after 6 months
0	12.0	12.1	0.6	0.8
50	10.4	8.6	0.8	1.3
100	10.1	6.1	0.7	4.1
150	10.0	3.2	0.7	7.9
200	11.6	0.8	0.7	8.4
250	11.9	0.7	0.8	8.8
300	11.0	0.8	0.6	9.1

Table 1

(a) Some of the soil used to determine bacterial numbers was collected from the surface of the soil store. Describe how you would ensure that this soil was collected at random.

_____

_____

_____

_____

(2)

(b) (i) Describe how the numbers of aerobic bacteria after 6 months change with depth.

_____

_____

_____

_____

(2)

(ii) Explain the difference in the numbers of aerobic bacteria at a depth of 300 cmbetween 1 and 6 months.

_____

_____

_____

_____

(2)

(c) Explain how the changes in bacterial numbers which take place at 150 cm illustrate the process of succession.

_____

_____

_____

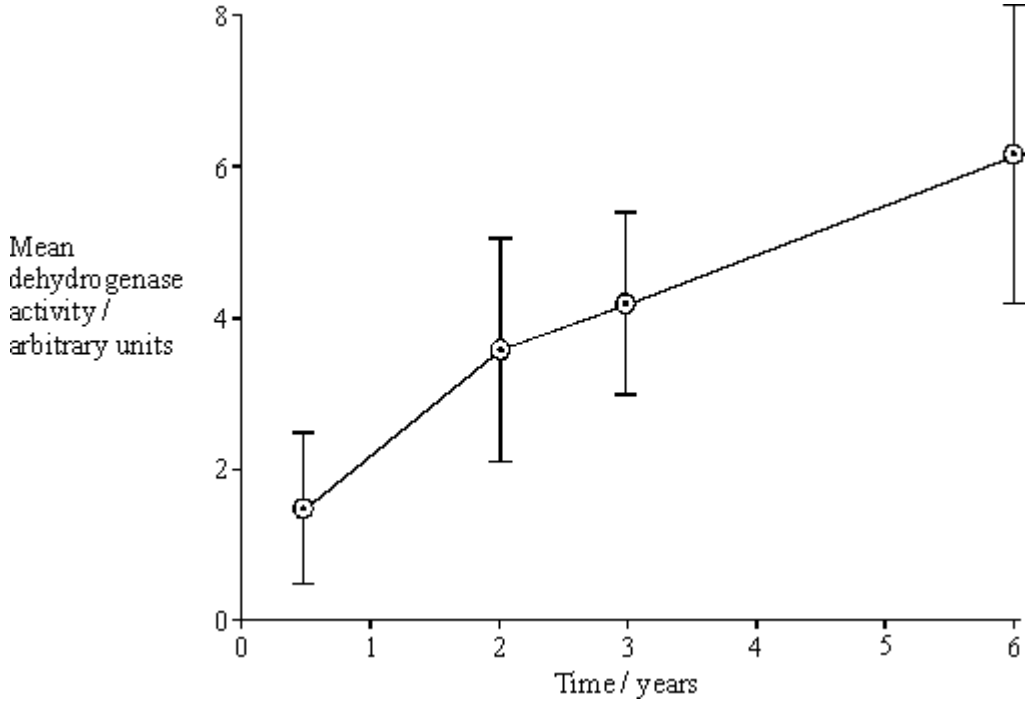
_____

_____

_____

(3)

Dehydrogenase is an enzyme involved in aerobic respiration. Dehydrogenase activity in a soil sample can be used as a measure of the activity of aerobic bacteria. The graph shows the mean dehydrogenase activity of soil samples taken from the same depth in a soil store at different times. The bars on the graph represent two standard errors above and below the mean.



(d) (i) From what depth in the soil store would you expect these soil samples to have been taken? Use information from **Table 1** to explain your answer.

_____

_____

_____

_____

(2)

(ii) How would you expect dehydrogenase activity to vary with depth after 6 months?

Use information from **Table 1** to explain your answer.

_____

_____

_____

_____

_____

(3)

(e) What do the error bars tell you about the difference between the mean dehydrogenase activity at 6 months and 3 years? Explain your answer in terms of probability and chance.

(3)

(f) **Table 2** shows the dehydrogenase activity and the number of aerobic bacteria present in some soil samples.

Dehydrogenase activity / arbitrary units	Number of aerobic bacteria per gram of soil ($\times 10^7$)
13.1	12.0
9.2	8.7
5.5	6.5
3.0	4.6
2.2	2.7
0.4	0.6

Table 2

A sample of soil was found to have dehydrogenase activity of 8.7 arbitrary units. Explain how you would use the data in **Table 2** to predict the likely number of aerobic bacteria in 1 g of this soil sample.

(3)

(Total 20 marks)

23 The Solomon Islands are situated in the Pacific Ocean. The nearest large land mass is Australia,which is about 1500 km away. The biggest islands are mountainous, with large areas of tropical forest and a wide range of habitats. Some islands have a very high species diversity, and many species are endemic, that is they occur only in the Solomon Islands.

The table shows the total number of species on the islands in four vertebrate classes and the percentage which are endemic.

Vertebrate class	Total number of species	Endemic species / %
Mammals	53	36
Birds	223	20
Reptiles	61	16
Amphibians	17	53

(a) How many reptile species are endemic?

_____

(1)

S (b) Suggest an explanation for the high proportion of endemic species on the Solomon Islands.

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

24 The vegetation on a large heap of waste from an old mine was investigated. The table shows theresults of the measurements of certain factors in 1m^2 frame quadrats placed on the south-facing slope.

Quadrat	Angle of slope / °	Vegetation cover / %	Moisture content of soil / %	pH of soil
1	45	60	17.2	5.6
2	30	70	14.6	4.2
3	25	68	20.3	5.2
4	12	100	23.5	7.1
5	7	85	21.0	5.4
6	1	100	21.2	6.8

(a) Which of the factors measured are abiotic?

_____

(1)

(b) Describe how the investigators could obtain the value for vegetation cover in each quadrat.

_____

_____

_____

_____

(2)

(c) The correlation between vegetation cover and soil moisture content was tested statistically. These two factors were found to be positively correlated, and $p < 0.05$. Explain what this result means.

_____

_____

_____

_____

(2)

S (d) At first the waste heap had no plants growing on it.
Some of the first plants to colonise itwere small herbaceous plants. Explain **one** way in which colonisation by herbaceous plants could change the physical environment.

_____

_____

_____

_____

(2)

(Total 7 marks)

25 Lacewings are insects that feed on aphids and mites, which are crop pests. The numbers of six species of lacewings, **A** to **F**, were counted on samples of apple and strawberry crops. The results are shown in the table.

Crop	Number of adults of each species of lacewing						Diversity index
	A	B	C	D	E	F	
Strawberry	31	0	3	29	17	1	3.2
Apple	10	1	1	7	0	1	

The diversity index (d) is calculated from the formula

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

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

(i) Calculate the diversity index for lacewing species in the apple crop and write the figure in the table. Show your working.

(2)

(ii) Suggest a reason why the diversity index for the lacewings is different between the twocrops.

_____

_____

(1)

(Total 3 marks)

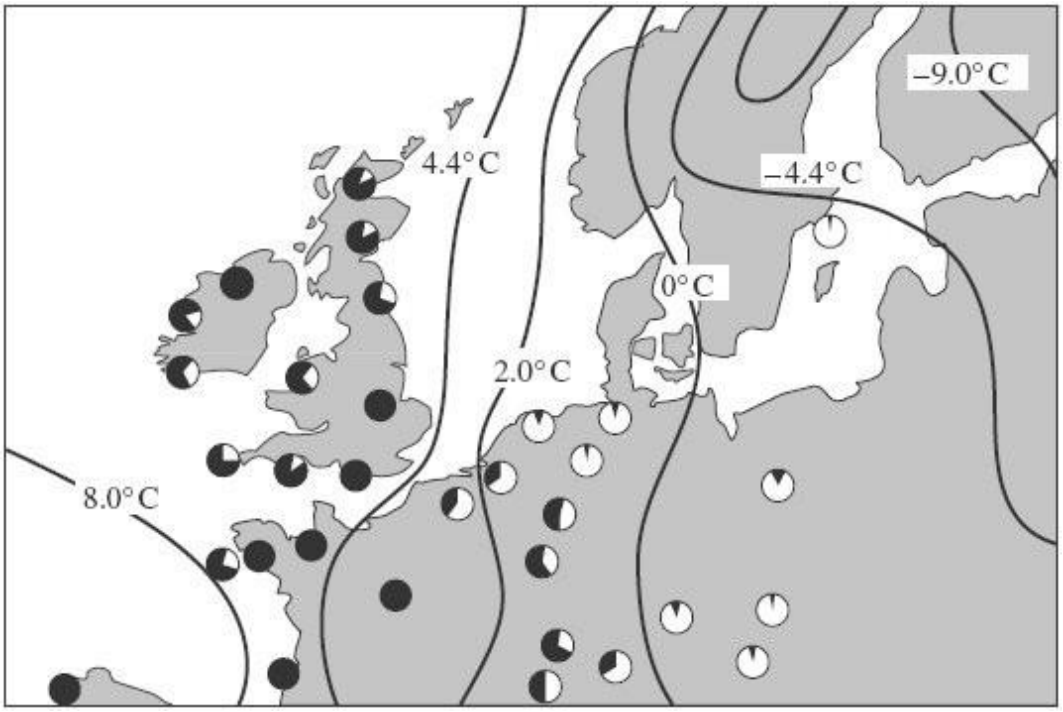
26 **S** Clover plants have leaves all through the year. Some clover plants have leaves that produce poisonous hydrogen cyanide gas when damaged. These cyanogenic plants are less likely to be eaten by snails. However, the leaves of these plants can be damaged by frost, resulting in the production of enough hydrogen cyanide to kill the plants. Acyanogenic plants do not produce hydrogen cyanide. This characteristic is genetically controlled.

The map shows the proportions of the two types of plant in populations of clover from different areas in Europe. It also shows isotherms, lines joining places with the same mean January temperature.

Key

Black area represents proportion of plants able to produce cyanide (cyanogenic)

White area represents proportion of plants not able to produce cyanide (acyanogenic)



(a) Explain how different proportions of cyanogenic plants may have evolved in populations indifferent parts of Europe.

(4)

(b) Differences in cyanide production may affect the total number of clover plants growing in different areas. Describe how you would use quadrats in an investigation to determine whether or not there is a difference in the number of clover plants in two large areas of equal size.

(4)

(Total 8 marks)

27 The table shows the numbers of adult butterflies in two areas of the same tropical forest. In thelogged area some trees had been cut down for timber. In the virgin forest no trees had been cutdown. The two areas were the same size.

	Logged forest		Virgin forest	
Butterfly species	**Number**	$n(n-1)$	**Number**	$n(n-1)$
Eurema tiluba	72	5112	19	342
Cirrochroa emalea	43	1806	132	17292
Partenos sylvia	58	3306	14	182
Neopithecops zalmora	6	30	79	6162
Jamides para	37	1332	38	1406
Total	216	11586	282	25384

(a) Describe a method for finding the number of one of the species of butterfly in the virgin forest.

_____

_____

_____

_____

(2)

(b) The index of diversity of a forest can be calculated using the equation

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

Calculate the index of diversity for the virgin forest. Show your working.

Answer _____

(2)

(c) What does the table show about the effects of logging on the butterfly populations?

_____

_____

_____

(2)

(Total 6 marks)

28 A hedgerow is a line of shrubs and trees bordering a field, together with the herbaceous plants at their base. In the last 50 years farmers have removed many hedgerows.

(a) Explain **two** advantages for a farmer of removing hedgerows.

1. _____

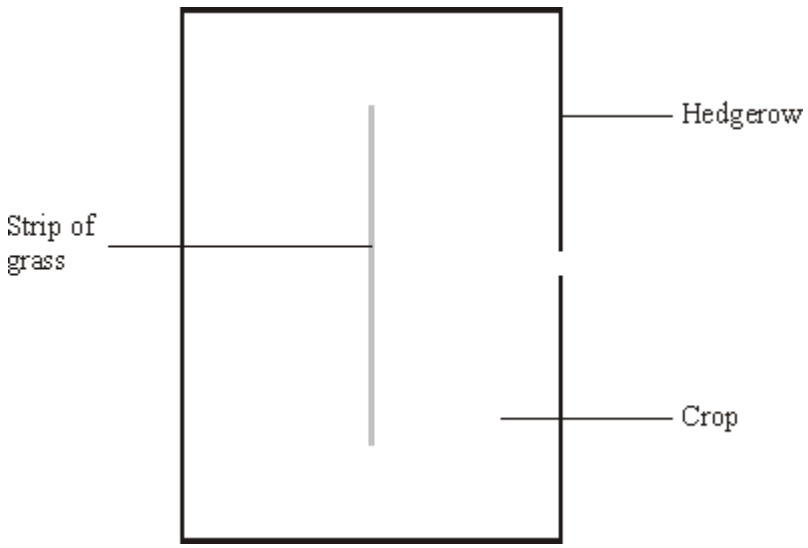
_____

2. _____

_____

(2)

(b) In recent years some hedgerows have been replanted. Ground beetles, which are unableto fly, are predators of crop pests. The beetles overwinter in the shelter of grasses at the base of the hedgerow. In some large fields, a permanent strip of grass is left as shown inthe diagram.



Suggest and explain the advantage of leaving the strip of grass in the middle of the field.

_____

_____

_____

_____

(2)

(c) Apart from providing a habitat for predators of crop pests, give **two** biological benefits of replanting hedgerows.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Mark schemes

1 (a)

3	6	9
152	211	167

2

(b) 2.45

Use of the correct denominator = 1 mark

2

(c) 1. More plant species;

2. More food sources / variety of food;

3. More habitats / niches;

Allow converse for barley field

More food = neutral

3

[7]

2 (a) 4:

1

(b) 2.68(6).

If answer incorrect:
Σn(n-1) = 242 = 1 mark
N(N-1) = 650 = 1 mark

2

(c) 1. Take more samples and find mean;
2. Method for randomised samples described.

Allow larger area = 1 mark

2

[5]

3 (a) Species richness measures only number of (different) species / does not measure number of individuals.

1

(b) Trees vary in height.

1

(c) 1. Index for canopy is 3.73;
2. Index for understorey is 3.30;
3. Index in canopy is 1.13 times bigger;

If either or both indices incorrect, allow correct calculation from student's values.

3

(d) 1. For *Zaretis itys*, difference in distribution is probably due to chance / probabilityof being due to chance is more than 5%; **1**
2. For all species other than *Zaretis itys*, difference in distribution is (highly) unlikely to be due to chance;
3. Because P < 0.001 which is highly significant / is much lower than 5%.

3

4

(a) 1. Draw grid over (map of) area;
2. Select squares / coordinates at random.

2

(b) 1. No emigration / immigration;
2. No losses to predation;
3. Marking does not affect survival;
4. Birth rate and death rate equal;
5. (In this case) all belong to one population.

2 max

(c) 1. Only glows brightly with UV, so doesn't make insects more visible;
2. So doesn't affect / increase predation;

OR

1. Glows brightly with UV marking visible;
2. So makes it easy to pick out labelled insects.

2

(d) 10 130.
Tolerance of ±1

$$N = \frac{M \times C}{R} = 1 \text{ marks}$$

2

(e) 1. Scientists removed large numbers of insects (which were not returned) from same area / same population;
2. Affecting ratio of marked to unmarked.

2

5

(a) 14;

1

(b) Number (of individuals) in each <u>species</u> (of dung beetle);

Accept: population of each <u>species</u>.

1

(c) 1. No overlap in standard deviations;

Accept: no overlap in <u>error</u> bars.

2. (Difference in mean total) significant/is not due to chance/is real;

2

(d) No bias;

Ignore: 'representative sample'.

[8]

[10]

(e) 1. Removes species/types of plant/insect;

Accept: decrease in plant/insect diversity.

2. Fewer food sources;

Ignore: less food.

Accept: less variety of food.

Accept: removes a food source.

3. Fewer habitats/niches;

Accept: loss/removal/destruction/ of a habitat.

Accept: no habitat.

Ignore: homes/shelters.

3

[8]

6

(a) Number of species in a community;

Accept: number of species in a habitat/area/ecosystem

Accept: species richness

Accept: all the species for number of species

Ignore: variation/diversity

Reject: in a population

1

(b) 1. Number of (organisms of) each species;

Accept: 'population' for number and accept individual for organism.

Accept: 'species richness'

2. Total number of organisms (of all species) / Total number of species;

Idea of grand total of all organisms, not just number of different species

2

(c) 1. Described effect of sewage (eg oxygen depletion/is toxic/kills);

Accept: increase in BOD

Accept: eutrophication/description of eutrophication

2. Prevents some/many species colonising/ reproducing/remaining;

Accept: only a few species survive

3. Sewage is food source for (individuals of) some/a few/species;

4. (So) increase only in their numbers;

Max 2

(d) (i) 1. Results are not repeatable / are not representative / unreliable / conflict / contradict;

Accept: different / don't agree

Ignore: not valid/not reproducible/inaccurate

2. Can't make any conclusions;

2

(ii) Do repeats to find a pattern/distribution/mean (of index of diversity);

Accept: use a different technique to obtain more reliable evidence;

Need idea of more than one repeat

Accept: calculate an average

Accept: at different times

Accept: statistical test to see if results differ significantly

1

[8]

7 (a) 1. Females are (generally) longer / larger / bigger / up to 115(mm) / males are(generally) shorter / smaller / up to 100(mm);

Ignore: tall

Accept: females have a larger / 90 modal / peak / most common value and males have a smaller / 80 modal / peak / most common value

Accept mean length of females greater / mean length of males shorter

Reject: use of mean in relation to 80 mm or 90 mm

Reject: Most of the females are 90 mm long / most of the males are 80 mm long

2. Females show a greater range / variation / males show a narrower range / variation.

Accept: correct use of figures from the graph: the range of males is 50 to 100 and of females is 50 to 115 / the spread is 50 for males and 65 for females

2

(b) (i) **2.6** to **2.7** = 2 marks;
Incorrect answer but evidence of a numerator of **24180 OR 156 × 155** or denominator of **9014** = 1 mark;

2

(ii) (Fewer plant species) − no mark

1. (So) few(er) habitats / niches;

Ignore habitat size

Q *Neutral: fewer homes*

2. (So) lower diversity of insects / fewer insect species / fewer insect types;

Q *Neutral: fewer insects*

Accept less variety of insects

3. (So) fewer food sources / less variety of food.

Q *Neutral: less food*

Ignore references to pesticides, farmers' actions, competition between lizards and evolution

3

[7]

8 (a) 1. Number of (individuals of) each species;

Accept: 'population' for 'number'

2. Total number of individuals / number of species;

Accept: 'species richness'

MP2 allows for other types of diversity index

2

(b) (i) (Shows) results are due to the herbicide / are not due to another factor / (to)compare the effect of using and not using the herbicide / shows the effect ofadding the herbicide;

Neutral: allows a comparison

Neutral: ensures results are due to the independent variable

Reject: 'insecticide'

Accept: 'pesticide'

1

(ii) 1. (More) weeds killed **so** more crops / plants survive / higher yield / less competition;

2. High concentrations (of herbicide) harm / damage / kill / are toxic to crops / plants;

Accept: 'pesticide'

Neutral: 'insecticide'

Accept: use of figures (eg 400+)

2

(iii) 1. Reduced plant diversity / fewer plant species / fewer varieties of plant;

Accept: 'weed' for 'plant'

Neutral: fewer plants

Accept: only one crop species remains

2. Fewer habitats / niches;

***Q** Neutral: fewer homes / shelters*

3. Fewer food sources / varieties of food;

Neutral: less food

3

[8]

9 (a) 1. Group of similar organisms / organisms with similar features / organisms with same genes / chromosomes;

1. Accept: same number of chromosomes

1. Accept: smallest taxonomic group

1. Reject: genetically identical. Only allow 1 max if mentioned

*1. **Q** Neutral: similar genes / chromosomes*

2. Reproduce / produce offspring;

2. Accept: breed / mate

3. That are fertile;

3. Neutral: that are 'viable'

'Produce fertile offspring' = 2 marks

2 max

(b) (i) Correct answer of 6.97 to 7 = 2 marks;

One mark for 6320 as numerator or 906 as denominator;

2

(ii) 1. Decrease in variety of plants / fewer plant species;

1. Accept: reference to monoculture or description

1. Neutral: fewer plants

2. Fewer habitats / niches;

2. Neutral: fewer homes / less shelter

3. Decrease in variety of food / fewer food sources;

3. Neutral: less food

3. Accept: less variety of prey

3

[7]

10 (a) 1. No interbreeding / gene pools are separate / <u>geographic(al)</u> isolation;

Accept: all marks if answer written in context of producing increased diversity of plants

1 Do not award this mark in context of new species being formed and then not interbreeding

1 Accept reproductive isolation as an alternative to no interbreeding

2. Mutation;

2 Accept: genetic variation

3. Different selection pressures / different foods / niches / habitats;

3 Accept: different environment / biotic / abiotic conditions or <u>named</u> condition

3 Neutral: different climates

4. Adapted organisms survive and breed / differential reproductive success;

5. Change / increase in allele frequency / frequencies;

5

(b) Similar / same environmental / abiotic / biotic factors / similar / same selection pressures / no isolation / gene flow can occur (within a species);

Accept: same environment

1

[6]

11 (a) (i) (We should maintain biodiversity to)

Prevent extinction / loss of populations / reduction in populations / loss of habitats / save organisms for future generations (idea of);

Neutral: references to 'playing God' / animal rights

1

(ii) A suitable example of how some species may be important financially e.g.

1. medical / pharmaceutical uses;
2. commercial products / example given;
3. tourism;
4. agriculture;
5. saving local forest communities;

1 max

(b) 1. Fewer plant species / decrease in plant diversity;

Accept: converse arguments for islands with a high percentage of forest remaining

1. Neutral: fewer plants

2. Fewer habitats nesting sites / niches / food sources / varieties / less protection from predators / hunters / environment;

2. Neutral: fewer homes

2. Neutral: less food

2

(c) 1. Number of (individuals / birds of) each species;

1. Neutral: number of species

2. Total number of individuals / birds of all species;

2. Accept: 'total number of birds' as given context for 'all species' in the investigation

2

(d) 1. (Larger birds have) a low(er) SA:VOL;

Neutral: reference to fat / feathers

2. (So) less heat loss / more heat retained;

MP2 is independent of MP1

2

[8]

12 (a) Succession;

Ignore any word in front of succession e.g. secondary / ecological succession.

Neutral 'forestation'.

1

(b) 1. Greater variety / diversity of plants / insects / more plant / insect species;

Neutral: more plants.

2. More food sources / more varieties of food;

Neutral: more food / more / greater food source (singular).

3. Greater variety / more habitats / niches;

Accept: more nesting sites.

Q *Neutral: more homes / shelters.*

3

(c) (i) Temperature and carbon dioxide;

Neutral: water, chlorophyll.

1

(ii) Shows (gross) photosynthesis / productivity minus respiration / more carbon dioxide used in photosynthesis than produced in respiration;

Correct answers are often shown as: net productivity = (gross) photosynthesis – (minus) respiration.

1

(iii) 1. (Shade plant) has lower (rate of) respiration / respiratory losses / less CO_2 released at 0 light intensity / in dark;

Accept use of figures.

Accept: lower compensation point.

2. Greater (net) productivity / less sugars / glucose used / more sugars / glucose available;

Neutral: any references to rate of photosynthesis.

2

[8]

13 (a) Removes bias;

1

(b) (i) 1. 1.28 / 1.29 / 1.285 / 1.3

1. Ignore more than 3dp

2. Answer incorrect but shows clear understanding of Σ

2. Σ = 318250. Allow mark if denominator written out. Incorrect denominator but evidence of understanding gains mark

2

(ii) Diversity index would be lower (NO MARK)

Assume wheat field if site unspecified

1. Fewer species / Beech aphid / Large white butterfly / 7-spot ladybird absent / only three species / species diversity lower / mostly one species / mostly bird-cherry aphid;

1. Allow species richness in context of few species

2. Fewer plant species;

2. Allow one type of food source if clearly plant

2

(c) For:

1. Data support the claim / evidence supports claim;

1. Ignore reference to correlation / causation

Against:

2. Only wheat field / only comparing with wood / one type of habitat / only insects considered;

2 max

(d) 1. Greater variety of plants;

2. Another habitat / more habitats / places to live / niches / another food source / more food types;

2. Answers referring to 'more food' should not be credited. Allow reference to either animal or plant as foods

2

[9]

14 (a) (i) Produces a more reliable mean / average / makes sure sample was representative / reduce effect of extreme values / identify anomalies;

Ignore references to chance

1

(ii) Removes bias;

1

(b) Two marks for correct answer of 5.8;

One mark for incorrect answer that clearly shows denominator as 216;

2

(c) 1. Increase in variety of plants / shrubs / grass;

2. More habitats / niches;

3. Greater variety of food sources / more food sources;

Answers only referring to 'more food' should not be credited

3

[7]

15 (a) Greater variety / different foods;

More habitats / niches;

Answers only referring to 'more food' should not be credited but allow 'more food sources'.

2

(b) Also measures number of individuals in a species / different proportions of species;

Some species may be present in low / high numbers;

First marking point can only be awarded if there is a reference to species.

2

(c) (i) Large surface area to volume (ratio) / permeable / thin (outer layer); Correct reference to diffusion;

Accept (Eggs) cannot move (out of water) for 1 mark

2

(ii) Concentration (of pesticide) is increased;

1

[7]

16 (a) Number of a / each (species);

Accept answers expressed differently providing they convey this information.

Ignore extra information if it does not contradict answer.

1

(b) 1. Lower diversity of plants / few species of plants / less variety of plants / few plant layers;

2. Few sources / types of food / feeding sites; / few habitats / niches;

3. Fewer (species of) herbivore so few (species of) carnivores;

3

(c) (i) Cannot predict / do not know intermediate values;

1

(ii) To see what would happen / compare with no management work / to see if numbers fell anyway / To show that it was not a factor;

Management as a term not required. Allow explanations.

1

(d) 1. Total number of birds along ditch B / ditch with one side cleared greater thanalong ditch A / ditch with both sides cleared;

2. But only gives data for all birds / does not give data for species / data not about diversity;

3. Single ditch / single occasion / not repeated / no control;

Principles:

Correct from evidence

Total number not diversity

Flaws in technique

3

[9]

17 (a) (i) Two marks for correct answer of 4.3;

Q *An answer of 4 scores 1 mark*

One mark for incorrect answer that clearly shows understanding of ∑n(n – 1) / 188 as denominator;

2

(ii) Measures number of individuals (of each species) and number of species;

Q *First marking point can only be awarded if there is a reference to species.*

Some species only present in small numbers;

2

(b) (i) Reduced as one crop / species grown / other species removed;

Use of herbicides / weeding / ploughing / wheat (better) competitor for named factor e.g. light / nutrients;

2

(ii) (Reduced) as less variety of food sources;

(Reduced) as fewer habitats / niches;

Q *Answers only referring to 'less food' should not be credited*

2

[8]

18 (a) Increase in number of species;

Increase in numbers of some species;

2

(b) Initial environment hostile / few organisms adapted;

These organisms change the environment / suitable example;

More niches / more habitats;

Allowing other organisms to become established;

max. 3

[5]

19

(a) Samples collected at random;
Method for choosing random sites – random coordinates / position from tables / calculator / other suitable means;

Other named factor constant e.g.:

Same size of net / same width of opening of net / use of one quadrat / Quadrats of same size / of stated size / same area disturbed / collect each
Sample for same time;

3

(b) *Caenidae* in deep water – because highest standard deviation / 'S.D.= 7.92'

1

(c) (i) An organism's role / in the ecosystem / community;
[ALLOW refs. To trophic levels / named]
(IGNORE refs. To habitat)

1

(ii) *Caenidae* found mainly in deep water AND *Baetidae* in shallow water / one family mainly in deep water AND the other in shallow water;

1

(iii) Reduces competition for named factor – e.g. food / shelter / O_2 ;
To ensure both types survive / otherwise better adapted type displaces other type;
OR
Ref. to 'Competitive exclusion principle' = 2 marks

max 2

[8]

20

(a) deforestation removes many habitats / niches fewer species / fewer types of organisms;
(do not credit just fewer organisms);

2

(b) 1. nitrate ions in fertiliser available / absorbed immediately;
2. ammonium converted to nitrate by nitrifying bacteria
3. fertiliser would provide only the initial release of nitrate / potassium nitrate;

3

[5]

21 (a) (i) EITHER: Correct answer: 3.45 / 3.44 / 3.4 = 2 marks OR:
Understanding of ∑n(n-1) / use of 134 / (2 + 90 + 12 + 30)
+ wrong answer = 1 mark **max 2**

(ii) Takes account of number of individuals / abundance / population size (as well as number of species); **1**

(b) The species at A / *F.spiralis* loses less water / loses water less rapidly / loses less mass;

The species at A / *F.spiralis* better adapted to / can survive where exposed for longer / to drier conditions;

The species at A / *F.spiralis* avoids competition For named aspect – e.g. light / substratum / space / CO_2;

ACCEPT converse argument re. F. serratus **3**

[6]

22 (a) Tapes / string / axes laid out at right angles / grid area;
Method of obtaining random co-ordinates;
Do not allow "Use random number generator" **2**

(b) (i) Decrease then remain constant;
From 200 cm / over 150 cm; **2**

(ii) Oxygen decreasing because soil becomes more compacted / not replaced;
Decrease in oxygen leads to fewer aerobes surviving; **2**

(c) Anaerobic bacteria replace aerobic as oxygen decreased by aerobic bacteria;
Remove competition;
Aerobic bacteria no longer able to survive in these conditions; **3**

(d) (i) Near the surface / in top 50 cm;
Table shows decrease with time at greater depths; **2**

(ii) Decrease;
Fewer aerobic bacteria with depth;
Oxygen concentration decreases / less oxygen at depth; **3**

(e) Probability greater than 95% / 0.95;
Results are not due to chance / results are significant;
Because bars do not overlap;

3

(f) Plot as graph;
Draw line of best fit;
Read off appropriate value;

3

[20]

23 (a) 10

(reject: 9.76)

1

(b) isolation (on islands);
variety of habitats / conditions different from origin / other islands;
differing pathways of natural selection;
leading to organisms too different to interbreed.

3 max

[4]

24 (a) angle, moisture and pH

(all required)

1

(b) system for subdividing quadrat into, e.g. many squares;
method of estimating cover in small squares, e.g. counting those where cover over 50%, or cover at points (of intersection);

(not just 'count squares with vegetation' unless very small)

2

(c) increasing vegetation cover is related to increasing moisture content

(allow 'affects' moisture content or vice versa, not 'causes);

correlation is significant / not due to chance / can reject null hypothesis / only 1 in 20 / 5% probability that the correlation is due to chance;

2

(d) factor; and linked effect e.g.
wind-blown particles trapped;
accumulation of soil;
OR
accumulation of organic / dead / decomposed matter / humus;
increase in mineral ions / improved water retention / improved soil structure;
OR
nitrogen fixation;
increased nitrate concentration / improved soil fertility;

2 max

[7]

25 (i) for correct use of sigma;
numerator = 380 and denominator = 132;

2

2.87 to 2.9 gains 2 marks

(do not allow 2.8 or denominator = 135)

(ii) more types of prey found on strawberries;

1

[3]

26 (a) colder / below 0°C (January) areas, cyanogenic plants die in this cold / acyanogenic survive;
non-cyanogenic allele / gene passed on more often / its frequency increases;
warmer (January) areas cyanogenic plants at advantage,
because of less herbivore selection pressure / feeding;
so cyanogenic survive more often to pass on cyanogenic allele / gene.

4 max

(b) large (and equal) number of quadrats in each area;
(reject several)
random sampling method, described;
(accept described 'systematic' method)
percentage cover / point hits per quadrat / count plants;
mean / average value for each area;
statistics test to see if differences significant.

4 max

[8]

27 (a) suitable method of capture;
mark individuals and release;
count percentage recaptured / use Lincoln index / equation;

2 max

(b) $\frac{282 \times 281}{25384} = 3.12$

(accept 3.1 / 3.122)

2 max

2

(c) decrease in total numbers of butterflies;
(reject population)
change in proportion of species / example(s);
increase in diversity in logged forest / calculation(4.01);

2 max

28 (a) source of pests / animals, and effect on crop;
source of weeds / no longer taking nutrients, hence competition / reduced yield; creation of larger fields / leaving room,
hence more efficient use of machinery / grow more crops;
hedgerows have to be maintained, so removal saves time / money;

[6]

(b) allows beetles to remain / survive /
over winter in the middle of thefield / strip of grass;
effect on distribution, e.g. do not normally reach the centre of the field / can reach all parts;

2

(c) increases biodiversity;
source of food for animals;
habitat / nest for animals;
reduce need for insecticides / attracts insects away from crop;
windbreaks / prevent erosion / run-off / leaching;
migratory corridors;

2 max

[6]