

**Q1.** 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.

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(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.

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(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.

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

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(1)

**(Total 7 marks)**

**Q2.** (a) What information is required to calculate an index of diversity for a particular community?

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

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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 a smooth 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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- (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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(Total 9 marks)

- Q3.** (a) Heath is a community of plants and animals. A student investigated the species diversity of plants in this community. The table shows her results.

Plant species	Number of plants per m <sup>2</sup>
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 record only the number of species present.

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(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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(ii) the species diversity of animals.

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(2)

(Total 8 marks)

**Q4.** (a) Give **two** aims of biological conservation.

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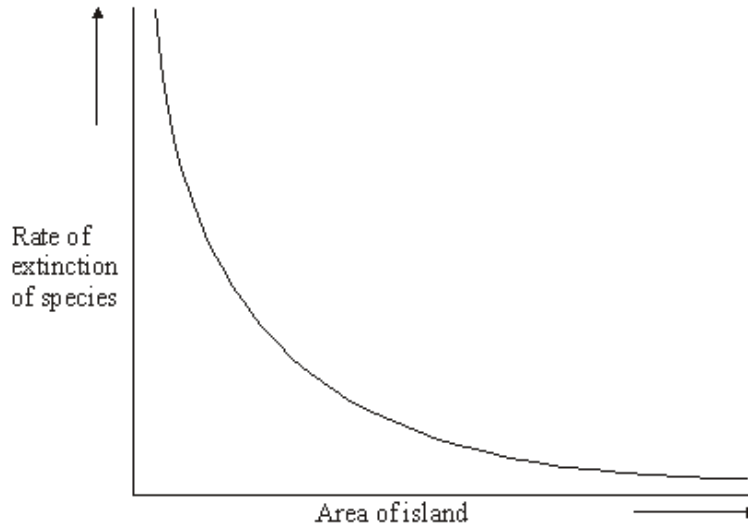
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(2)

(b) The graph shows the rate of extinction of species of birds on islands of different size.



(i) Describe the relationship between the rate of extinction of species and the areas of the islands.

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(2)

(ii) Suggest **one** cause of this relationship.

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(1)

(Total 5 marks)

**Q5.** 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

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

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

- (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 two crops.

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(1)

(Total 3 marks)

**Q6.** The table shows the numbers of adult butterflies in two areas of the same tropical forest. In the logged area some trees had been cut down for timber. In the virgin forest no trees had been cut down. The two areas were the same size.

Butterfly species	Logged forest		Virgin forest	
	Number	$n(n-1)$	Number	$n(n-1)$
<i>Eurema tiluba</i>	72	5112	19	342
<i>Cirrochroa emalea</i>	43	1806	132	17292
<i>Partenos sylvia</i>	58	3306	14	182
<i>Neopithecops zalmora</i>	6	30	719	6162
<i>Jamides para</i>	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.

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(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?

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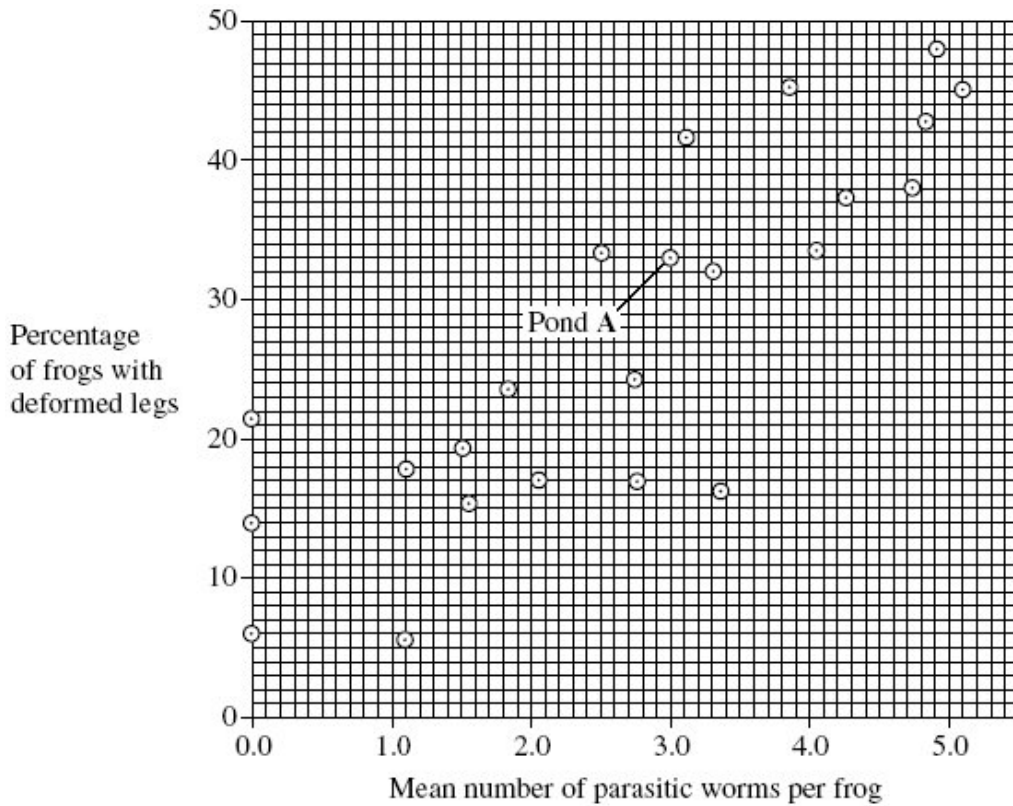
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(Total 6 marks)

**Q7.** (a) In the USA, members of the public found many frogs with deformed legs. Scientists investigated this. They collected samples of the frogs. They wanted to get reliable data. Give **one** feature of the sample, other than a large sample size, that would help to make sure that their data were reliable.

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(1)

The team of scientists then investigated frogs in ponds. The team measured many different factors and then analysed their results. The graph shows the relationship between the percentage of frogs with deformed legs and the mean number of parasitic worms found in the frogs.



- (b) The scientists collected a sample of three frogs from pond A. What was the total number of parasitic worms found in these three frogs?

(1)

- (c) One scientist suggested that the parasites caused the deformed legs found in frogs. Does the graph support this suggestion? Explain your answer.

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- (d) The scientists wrote a paper. In their discussion they wrote that they found very few ponds that were free from human influence. The few that they did find were only in mountainous areas.

The scientists could not draw any reliable conclusions about whether human influence contributed to the frogs' deformed legs. Explain why each of the following meant that they could not draw reliable conclusions.

- (i) There were very few ponds free from human influence.

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(1)

- (ii) The ponds free from human influence were found only in mountainous areas.

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(2)

In a second investigation, another research team investigated deformed legs in frogs in a different way.

- They chose six ponds, all of which contained parasitic worms. Three of the ponds were close to fields and received agricultural run-off from these fields. The other three ponds did not receive agricultural run-off.
- They built two cages in each of the six ponds. One cage in each pond allowed parasitic worms to enter and one cage did not.
- They put frogs that were not infected with parasitic worms into all twelve cages.

The table shows the results of this second investigation.

	Percentage of frogs with deformed limbs					
	Ponds with agricultural run-off			Ponds with no agricultural run-off		
Pond number	1	2	3	4	5	6
Cage with mean mesh diameter of 500 $\mu\text{m}$	22	27	24	3	4	7
Cage with mean mesh diameter of 75 $\mu\text{m}$	0	0	0	0	0	0

- (e) One of the boxes in the table has been shaded. Describe the information given in the shaded box.

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- (f) What conclusions can you draw from the data in the table about the factors causing deformed leg in frogs? Explain your answer.

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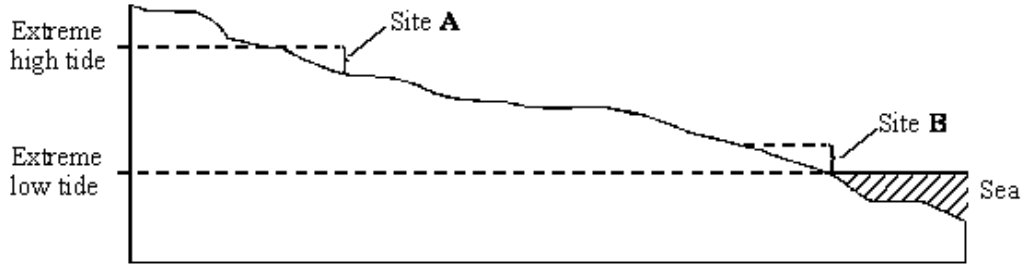
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(Total 15 marks)

**Q8.** 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 <sup>2</sup>	Site B: lower shore	Mean number per m <sup>2</sup>
<i>Ascophyllum nodosum</i>	2	<i>Corallina officinalis</i>	31
<i>Fucus spiralis</i>	10	<i>Fucus serratus</i>	8
<i>Fucus vesiculosus</i>	4	<i>Laminaria digitata</i>	15
<i>Pelvetia canaliculata</i>	6	<i>Laminaria hyperborea</i>	3
		<i>Laminaria saccharina</i>	6
		<i>Laurencia pinnatifida</i>	18
		<i>Palmaria palmata</i>	6
Index of diversity		Index of diversity	4.77

(a) (i) Use 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 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** = .....

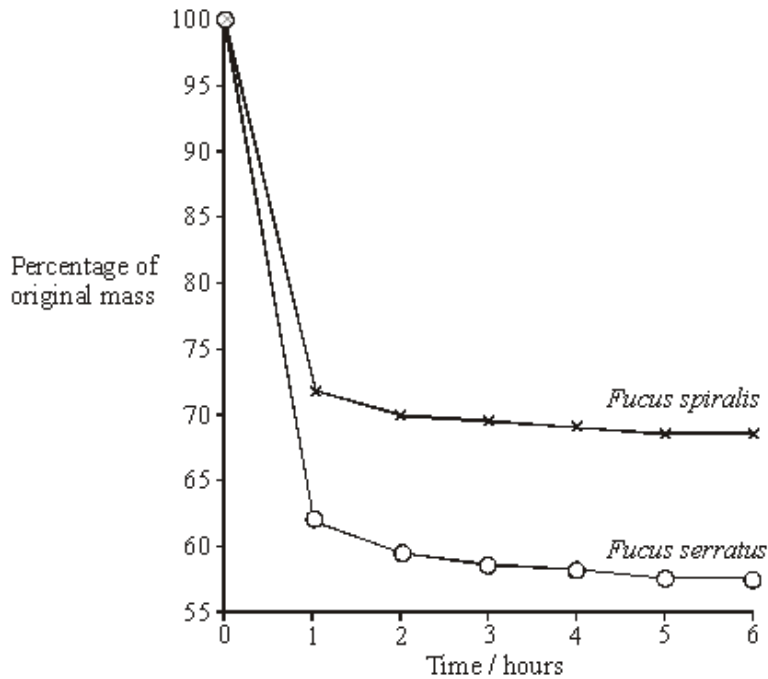
(2)

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

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(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 shore and 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.

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(3)  
(Total 6 marks)

- Q9.** (a) Explain what is meant by monoculture.

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- (b) (i) Where monoculture takes place on a large scale, farmers often remove hedges. Explain **two** benefits to the farmer of removing hedges.

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(2)

- (ii) Usually, the older a hedge the more species of shrub it contains. Explain why removal of hedges that are several hundred years old affects more animal species than the removal of young hedges.

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(2)

- (c) Monoculture often involves the use of large amounts of pesticides. Some of these pesticides are toxic to species that are not pests. These animals may be killed immediately when the pesticide is applied. Explain **one** other way by which the use of pesticides can lead to the death of animals that are not pests.

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(2)

(Total 7 marks)

**Q10.** Students investigated the effect of modern farming on the diversity of birds. The table shows some results from one farm.

Species	Number of birds
Greenfinch	12
Goldfinch	7
Partridge	3
Lapwing	2

- (a) (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 a particular species

Use this formula to calculate the index of diversity for the results shown in the table. Show your working.

Answer.....

(2)

- (ii) It is useful in an investigation like this to calculate the index of diversity. Explain why it is more useful to calculate the index of diversity than to record just the number of species present.

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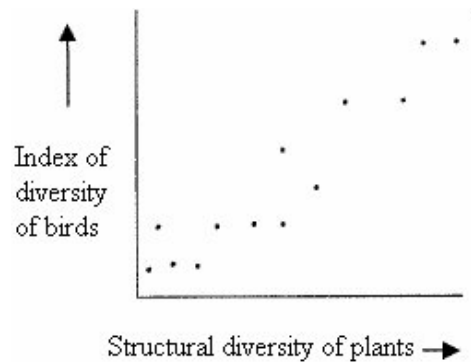
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(2)

Structural diversity refers to the different forms of plants such as herbs, shrubs and trees present in a particular area. The graph shows the relationship between the index diversity of birds and structural diversity of the plants on farmland.



- (b) (i) Describe the relationship between the index of diversity for birds and structural diversity for plants.

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(1)



(ii) Suggest an explanation for this relationship.

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(2)

(c) The European Union gives grants to farmers to re-plant hedges previously removed.  
Explain how re-planting hedges might affect the index diversity for birds found on farms.

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(1)

**(Total 8 marks)**

