1 Wading birds (waders) are birds that feed in shallow water. Table 4.1 shows changes in the population size of four species of wader in two areas of the Western Isles off the coast of Scotland.

- Area 1 is an area that has remained free of hedgehogs.
- Area 2 is an area where four hedgehogs were introduced from the mainland in 1974. Since then, they have established a large population.

Hedgehogs eat the eggs of ground-nesting birds like waders.

Table 4.1

	number of breeding pairs of wader birds			
	area 1 (hedgehogs absent)		area 2 (hedgehogs present)	
year / species of wader	1983	2000	1983	2000
lapwing	1104	1364	1869	1287
redshank	486	733	1288	760
dunlin	803	558	2016	884
snipe	172	154	655	280

(a) (i) Calculate the percentage decrease in the number of breeding pairs of **snipe** in **area 2** between 1983 and 2000.

Show your working.

Answer = ... % **[2]**

(ii) Use the data in Table 4.1 to describe **and** explain the effect of the introduction of hedgehogs on the number of breeding pairs of waders in **area 2**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

(iii) Suggest **two** factors that might have allowed a large population of hedgehogs to increase from just four individuals in **area 2**.

Explain how each factor has led to an increase in the hedgehog population.

1 .....

.....

.....

.....

2 .....

.....

.....

..... **[4]**

(b) Three suggested methods to reduce the effect of hedgehogs on the numbers of waders in area 2 were considered. These were:

- trapping and moving hedgehogs to the mainland
- trapping hedgehogs and keeping them in captivity indefinitely
- trapping of hedgehogs followed by humane killing.

The third method was judged to be the most effective and likely to succeed in reducing hedgehog numbers.

Comment on the ethical issues involved in making this decision.

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

[Total: 15]

2 Sarawak is an area of tropical rainforest in south-east Asia. Logging has been allowed in 60% of the forest.

A study was carried out into the effects of logging on the diversity of mammal species living in the forest. An area of rainforest was sampled before logging, immediately after logging and then again two years and four years after logging.

Before logging began, there were 29 mammal species and four years after logging there were 26 mammal species.

Table 5.1 shows the population densities of six groups of mammals before and after logging. Where numbers were too small to measure the density, the species was recorded as "present".

Table 5.1

mammal	mean number of animals per km^2			
	before logging	immediately after logging	two years after logging	four years after logging
marbled cat	present	0	0	0
oriental small-clawed otter	present	0	0	0
giant squirrel	5	1	4	1
small squirrel	16	24	104	19
tree shrew	10	5	10	38
barking deer	3	1	10	present

(a) Marbled cats and otters are carnivores, while squirrels, shrews and deer are herbivores.

Use the information provided to choose the best word(s) or terms to complete the following passage.

The rainforest ..... is a dynamic set of interactions between populations of organisms and the abiotic environment. Energy flows from ..... , such as trees, to ..... consumers, such as squirrels, and on to consumers such as cats and otters at higher ..... . The activities of decomposers contribute to the energy lost from the ..... component of the rainforest but decomposers allow ..... to be recycled. **[6]**

(b) (i) Table 5.1 shows that the number of small squirrels increases initially, but then decreases.

Explain, using your knowledge of factors affecting population growth, why the small squirrel population in this rainforest does **not** increase in size indefinitely.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(ii) Describe, using the information provided, how species richness **and** species evenness change in the rainforest by comparing the situation before logging and four years after logging.

.....

.....

.....

.....

..... **[2]**

(c) (i) Suggest why marbled cats and oriental small-clawed otters became extinct in this area but other mammals did not.

.....

..... **[1]**

(ii) Outline **three** reasons for conserving biological resources, such as the rainforest in Sarawak.

1 .....

.....

2 .....

.....

3 .....

..... **[3]**

(d) Timber is produced sustainably in the United Kingdom.

Describe **and** explain the benefits of **two** management practices used in sustainable timber production in a temperate country.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

[Total: 20]

3 Molecular evidence has shown that all specimens of the English Elm tree, *Ulmus procera*, form a genetically isolated clone. English Elms developed from a variety of elm brought to Britain from Rome in the first century A.D.

Although English Elm trees make pollen, they rarely produce seeds. Instead they spread by developing structures known as suckers from their roots. Each sucker can grow into a new tree.

This tendency of elms to create suckers has been exploited by humans, who have separated the suckers, with roots attached, and used them to plant hedges and establish new woodlands.

(a) (i) Suggest a technique that could be used to provide **molecular** evidence that all English Elm trees form a clone.

..... **[1]**

(ii) State why the English Elm clone is genetically isolated from other varieties of elm.

.....

..... **[1]**

(iii) State the name given to the process in which plants reproduce asexually by means such as suckers.

..... **[1]**

(b) In 1967, a new, virulent strain of an elm disease fungus arrived in Great Britain on imported timber. Beetles that lived under the bark of elm trees spread the fungus.

The saws used to cut down dead branches were not sterilised after use. When the saws were used to prune healthy trees, these trees became infected. Approximately 25 million elm trees, most of the English Elm population, died within a few years of the arrival of this fungus.

Explain why there was such a rapid loss of elm trees in Britain as a result of this elm disease.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(c) Elm trees respond to fungal infection by plugging their xylem vessels. The leaves on the upper branches of the tree then turn yellow and die. When most of the branches have lost their leaves and died, the roots are weakened and may also die.

(i) Explain why the plugging of xylem vessels will result in the leaves of the upper branches turning yellow.

.....

.....

.....

.....

.....

..... **[2]**

(ii) Explain why the loss of leaves from the tree may result in the death of the tree's roots.

.....

.....

.....

.....

.....

..... **[2]**

(d) Many ornamental plants for gardens can be cloned by tissue culture.

Describe the process of cloning plants by tissue culture.

In your answer you should make clear the order in which the steps of the process occur.

.... **[7]**

(e) List **two** advantages and **two** disadvantages of cloning plants by tissue culture.

advantage 1 .....

.....

advantage 2 .....

.....

disadvantage 1 .....

.....

disadvantage 2 .....

..... **[4]**

[Total: 22]