1. Antibiotic resistance in bacteria is becoming an increasing problem.

Describe how a sulfonamide-resistant population of bacteria could develop.

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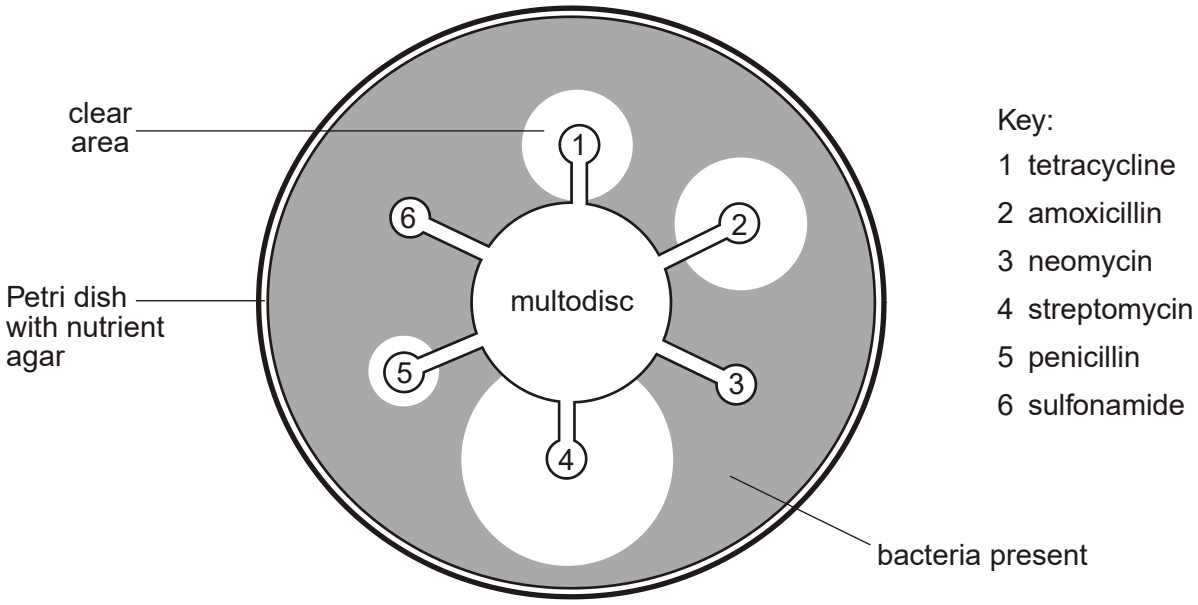
[Total 4 marks]

2. Hospitals can check to see if a strain of bacteria causing an infection is resistant to a range of antibiotics by using a **multodisc**. A multodisc contains different antibiotics.

- The bacteria are isolated from a patient.
- The bacteria are spread on nutrient agar in a Petri dish.
- The multodisc is placed on the agar.

The figure below shows a Petri dish with the bacteria, in which is placed a multodisc containing six different antibiotics.



(i) Explain why there are clear areas of agar in the Petri dish.

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[1]

(ii) Using the figure above, name the antibiotic that is most effective against the bacteria causing the infection.

.....

[1]

(iii) Suggest **three** reasons why a hospital might use a multodisc to select the most suitable antibiotic for treating a patient.

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[3]

[Total 5 marks]

3. Drugs, such as antibiotics, are often first discovered in the natural environment.

Explain why it may become increasingly difficult to discover new drugs in the future.

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[Total 2 marks]

4. Fig. 1 below shows a photograph of a part of a heathland habitat. A study was carried out on the biodiversity of this habitat.

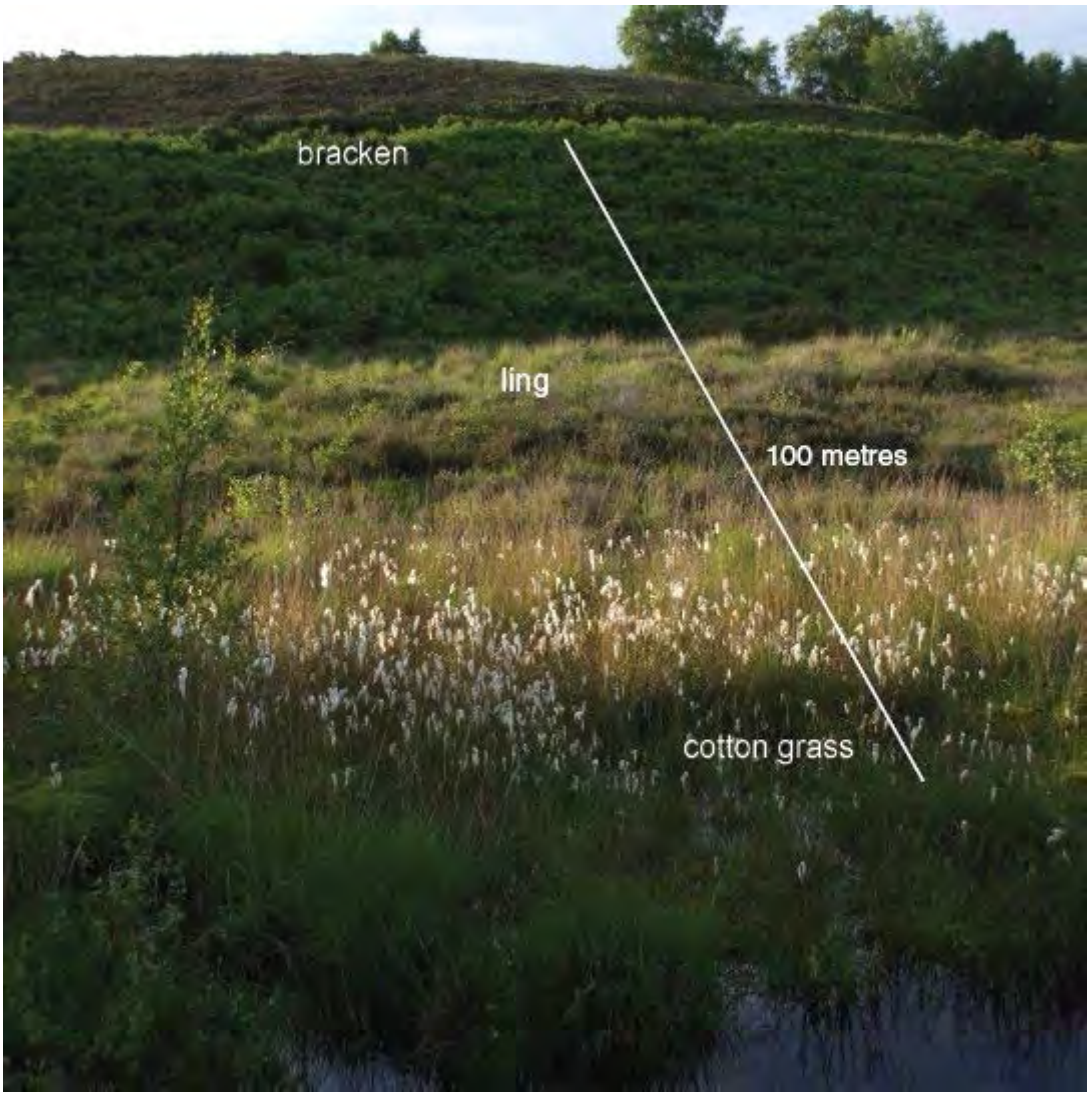

Fig. 1

(a) Define the terms:

habitat .....

.....

.....

biodiversity .....

.....

.....

[3]

(b) In this study, a student placed his quadrat on areas he considered to have the most biodiversity.

Explain what is wrong with this technique.

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[2]

(c) The student looked at the abundance of three plants at different distances from the bottom of the slope.

The results table drawn by the student is shown below.

distance from bottom of slope	percentage cover of each plant species		
	cotton grass	ling	bracken
0 m	76	0	0
10 m	68	0	0
20 m	0	2	0
30 m	0	35	0
40 m	0	50	0
50 m	0	60	7
60 m	0	40	17
70 m	0	10	42
80 m	0	0	68
90 m	0	0	71
100 m	0	0	74

(i) The format of the student's table is incorrect.

Suggest **one** way in which the student could correct the table.

.....

.....

[1]

Fig. 2 is a graph showing the distribution of cotton grass and bracken at different distances from the bottom of the slope.

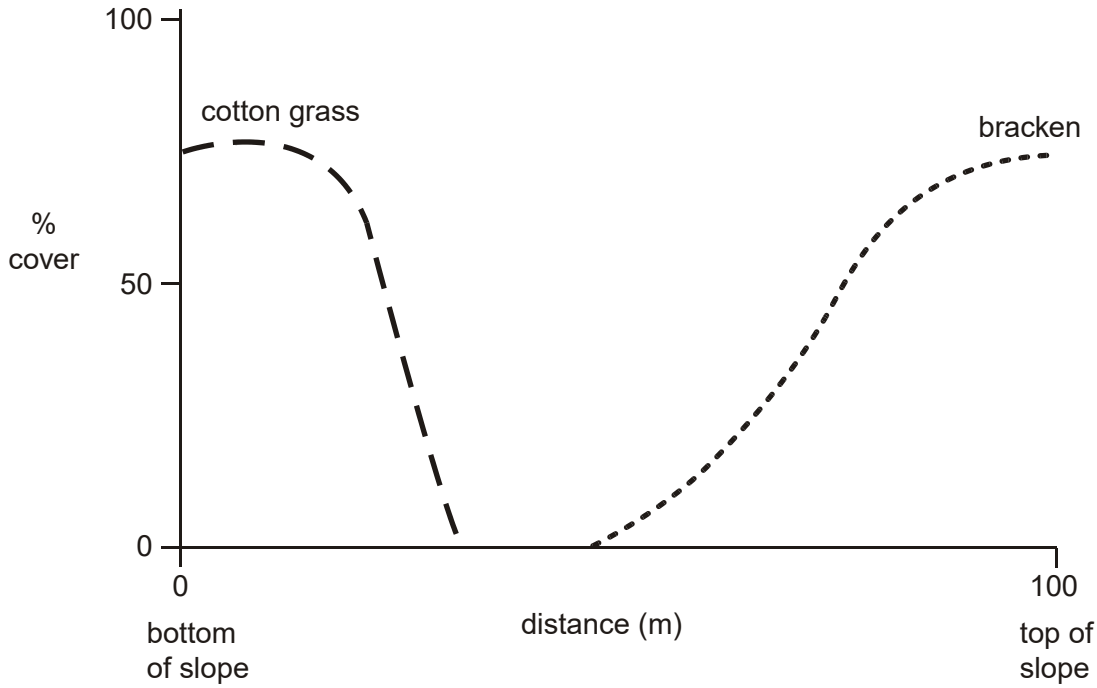

Fig. 2

(ii) Using the information given in the table above, **sketch on Fig. 2** a curve to show the distribution of **ling**.

[3]

(iii) Describe the distribution of **bracken**.

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[2]

(d) (i) The student was asked to calculate the biodiversity using Simpson's Index of Diversity.

Suggest what additional data he would need to **collect** in order to calculate Simpson's Index of Diversity in this habitat.

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[2]

(ii) The student calculated Simpson's Index as 0.2. This is a low value.

State the **significance** of this low value for this habitat.

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[1]

[Total 14 marks]

5. In India, the population of the white-backed vulture, *Gyps bengalensis*, has fallen by 97% to an estimated 4 000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- hese farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

(i) Suggest what is meant by *critically endangered*.

.....

.....

[1]

(ii) Calculate the **original** population of the white-backed vulture.

Show your working.

Answer = ...

[2]

[Total 3 marks]

6. In India, the population of the white-backed vulture, *Gyps bengalensis*, has fallen by 97% to an estimated 4 000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- hese farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

In an effort to save the white-backed vulture, a captive breeding programme has been set up.

Three centres in India have been built, each housing up to 40 individuals. These vultures have been collected from different areas of the Indian subcontinent.

(i) Explain why the decision was made to conserve the species in captivity (*ex situ*) rather than in the wild (*in situ*).

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[4]

(ii) Explain why the white-backed vultures in the captive breeding programme were,

- collected from several different areas
- housed in three separate centres.

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[3]

[Total 7 marks]

7. In India, the population of the white-backed vulture, *Gyps bengalensis*, has fallen by 97% to an estimated 4000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- hese farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

In an effort to save the white-backed vulture, a captive breeding programme has been set up.

Three centres in India have been built, each housing up to 40 individuals. These vultures have been collected from different areas of the Indian subcontinent.

Outline **three** reasons why the conservation of the white-backed vulture is important.

1 .....

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2 .....

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3 .....

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[Total 3 marks]

8. In India, the population of the white-backed vulture, *Gyps bengalensis*, has fallen by 97% to an estimated 4 000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- hese farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

In an effort to save the white-backed vulture, a captive breeding programme has been set up.

Three centres in India have been built, each housing up to 40 individuals. These vultures have been collected from different areas of the Indian subcontinent.

Suggest **three** measures that could be taken **in the long term** to preserve the numbers of white-backed vultures, once the captive bred individuals have been released into the wild.

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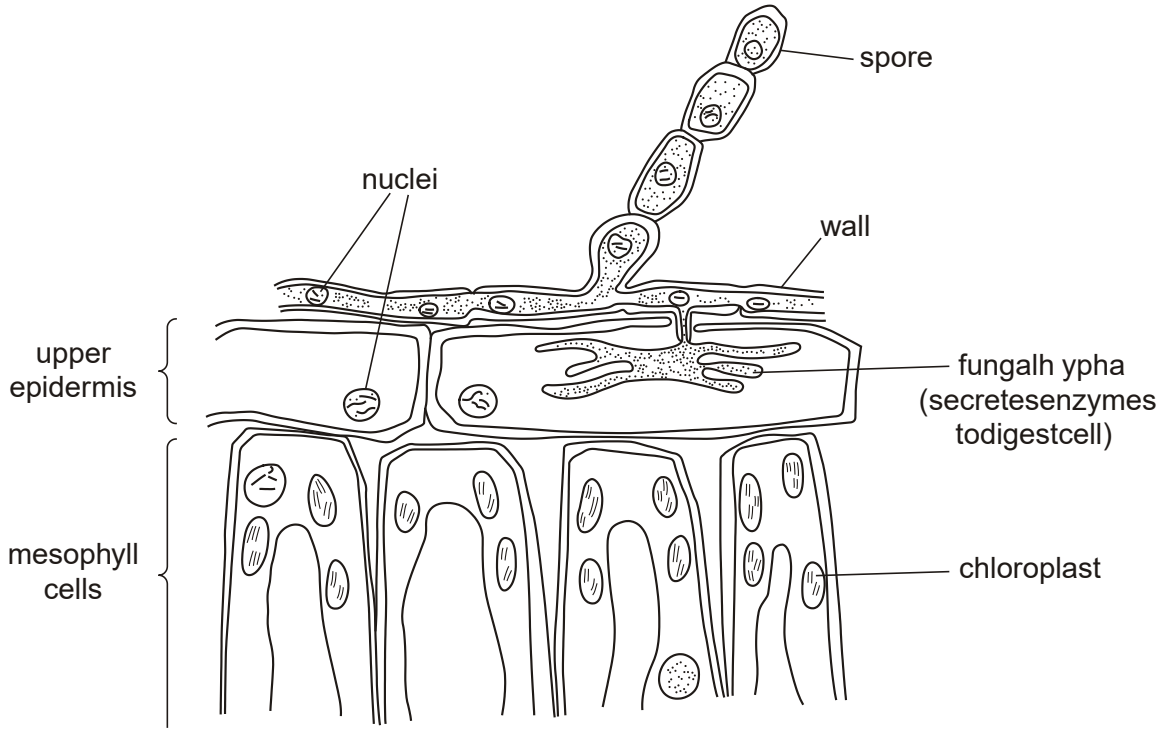
[Total 3 marks]

9. The figure below shows a section of a leaf from a pear tree that is infected by the mildew fungus.



(i) State **one** feature, **shown in the figure above**, that excludes **both** the pear tree and mildew from the kingdom Prokaryotae.

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[1]

(ii) State **two** reasons why mildew should be placed in the kingdom Fungi.

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[2]

(iii) State **two** reasons why the pear tree should be placed in the kingdom Plantae.

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[2]

(iv) Name **two** kingdoms other than Prokaryotae, Fungi and Plantae.

1 .....

2 .....

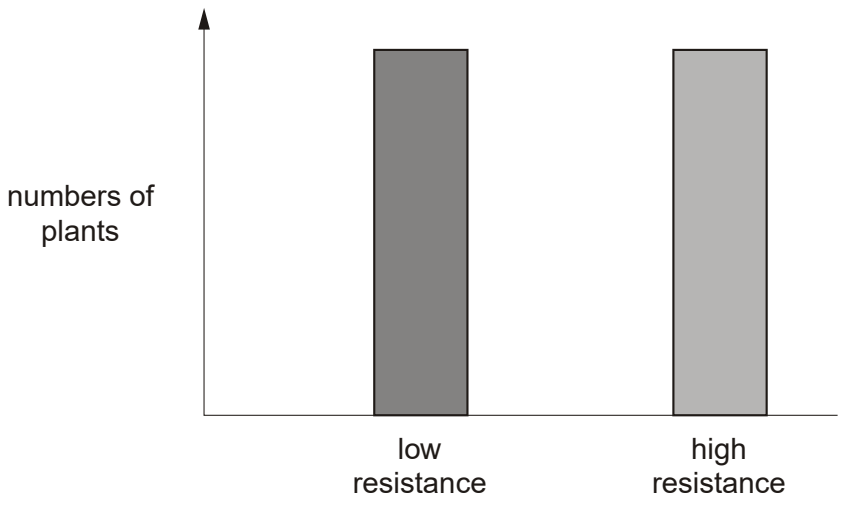
[2]

[Total 7 marks]

10. The mildew fungus also infects wheat plants, causing disease.

- Most wheat plants in the UK show little resistance to this disease.
- Some Iranian wheat plants are resistant.
- The yield from these resistant wheat plants is very low.

(i) An investigation into the resistance of the Iranian wheat plants to mildew produced the results shown in the figure below.



State the type of variation that is shown in the figure above **and** describe its characteristics.

type of variation .....

characteristic of this type of variation

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[3]

(ii) Outline how a breeding programme could be carried out to produce wheat plants which have both high yield **and** resistance to mildew.

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[3]

[Total 6 marks]

11. Over a period of time, mildew can overcome the resistance bred into the wheat.

Use the theory of natural selection to explain how the mildew fungus adapts to overcome this resistance.

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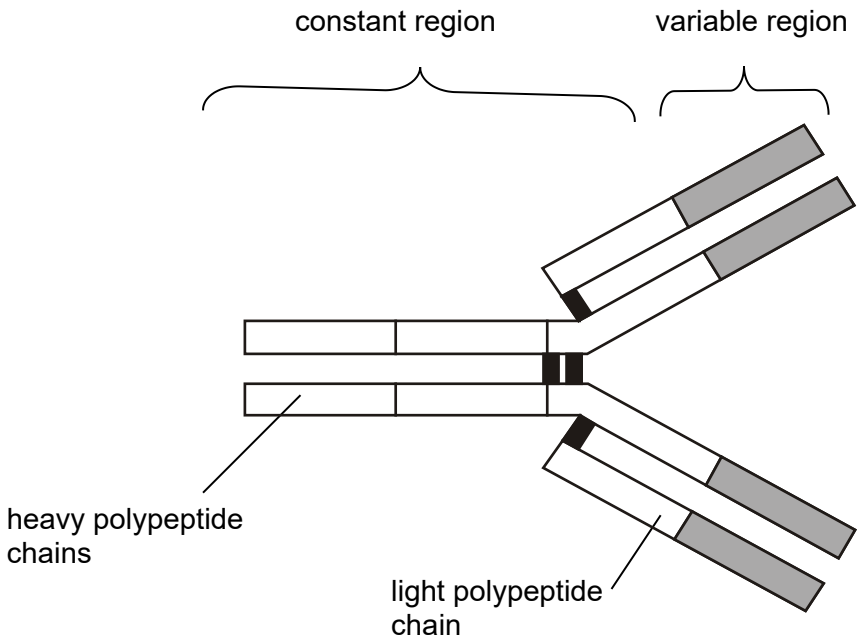
[Total 4 marks]

12. An antibody is an example of a protein molecule**,** which has a specific 3-dimensional shape.

The diagram below shows the structure of an antibody molecule.



(i) Outline how the structure of an antibody molecule is related to its function.

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[3]

(ii) Suggest why the base sequence in the genes for human antibodies is more similar to that found in a chimp than to that found in a mouse.

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[2]

[Total 5 marks]

13. A group of students carried out some fieldwork to investigate the diversity of insects in three habitats:

- a field of barley
- a field of wheat
- the vegetation under a hedge.

Their results are shown in the table below. The table also shows how they used their data to calculate Simpson's Index of Diversity (D) for each habitat.

$$D = 1 - (\Sigma(n/N)^2)$$

where N = the total number of insects found, and n is the number of individuals of a particular species.

	number of individuals of each species in each habitat		
species	barley field	wheat field	under hedge
a	32	4	0
b	78	0	1
c	0	126	2
d	0	5	12
e	0	0	8
f	0	0	9
g	0	25	3
h	0	10	3
i	0	0	2
j	0	0	5
k	86	56	0
l	0	0	7
species richness	3	6	10
total number of insects (N)	196	226	52
Simpson's Index of Diversity (D)		0.61	0.86

(a) State what is meant by the term *species richness*.

.....

.....

[1]

(b) (i) Calculate the value for Simpson's Index of Diversity (D) for the barley field.

Show your working and write your answer **in the shaded box in the table**.

[2]

(ii) Using the data in the table, suggest why the value of Simpson's Index of Diversity (D) for the vegetation under the hedge is so much higher than that for the wheat field.

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[3]

(c) Describe how the students may have determined the numbers of individuals of each species in each habitat.

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[5]

[Total 11 marks]

14. Studies of biodiversity are an integral part of an environmental impact assessment (EIA).

(i) Discuss the role of an EIA as part of a local planning decision.

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[3]

(ii) Suggest why some conservationists might object to these studies.

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[2]

[Total 5 marks]

15. The leopard, *Panthera pardus*, is a large member of the cat family.

Complete the following table to show the full classification of the leopard.

Kingdom	……
……	Chordata
Class	Mammalia
……..	Carnivora
Family	Felidae
Genus	……
……	*pardus*

[Total 5 marks]

16. The leopard belongs to a kingdom in which all members are eukaryotic. Plants are also eukaryotic.

Name **two** other kingdoms that contain eukaryotic organisms.

1 .....

2 .....

[Total 2 marks]

17. Historically, all organisms were classified into just two kingdoms. In 1988 a five-kingdom system of classification was accepted. In 1990 a three domain system was proposed.

Discuss, with reference to the **Prokaryotes**, the reasons why classification systems are not universally accepted and why they change over time.

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[Total 4 marks]

18. (a) *Staphylococcus aureus* is a species of bacterium that is found on the skin.

(i) Describe how variation may arise within a species of bacterium such as *S. aureus.*

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[1]

(ii) Suggest why such variation alters the characteristics of the individual organism.

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[2]

(b) Discuss the difficulties that variations arising in *S. aureus* may cause to the medical profession.

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[4]

[Total 7 marks]

19. The black rhinoceros, *Diceros bicornis*, is an endangered species whose numbers have fallen to approximately 3000 in the past thirty years. For this reason, the species was placed on Appendix I of the Convention on International Trade in Endangered Species (CITES) agreement. Since the black rhinoceros has been placed on the appendix, numbers have stabilised, or even increased, in several countries.

(a) (i) Explain the term endangered species.

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[2]

(ii) Suggest **two** reasons why the black rhinoceros is endangered.

1 .....

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2 .....

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[2]

(b) State two ways in which the CITES agreement is helping to save endangered species, such as the black rhinoceros.

1 .....

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2 .....

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[2]

[Total 6 marks]

20. Outline the potential benefits to agriculture of maintaining the biodiversity of wild animals and plants.

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[Total 4 marks]

21. Antibiotics can be used to artificially prevent bacterial infections. However, resistance to antibiotics is common among bacteria. For example, the so-called 'superbug' MRSA (methicillin-resistant *Staphylococcus aureus*) is resistant to many antibiotics.

(i) State the way in which a bacterium develops resistance to an antibiotic.

.....

[1]

(ii) Suggest **two** measures, **apart from use of antibiotics**, that could be taken in a hospital to combat possible infection with MRSA.

1 .....

.....

2 .....

.....

[2]

[Total 3 marks]

22. The figure below shows some deadwood that has been colonised by fungi.

(i) List **three** features of organisms belonging to the Kingdom Fungi.

1 .....

2 .....

3 .....

[3]

(ii) State **two** features that fungi have in common with plants.

1 .....

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2 .....

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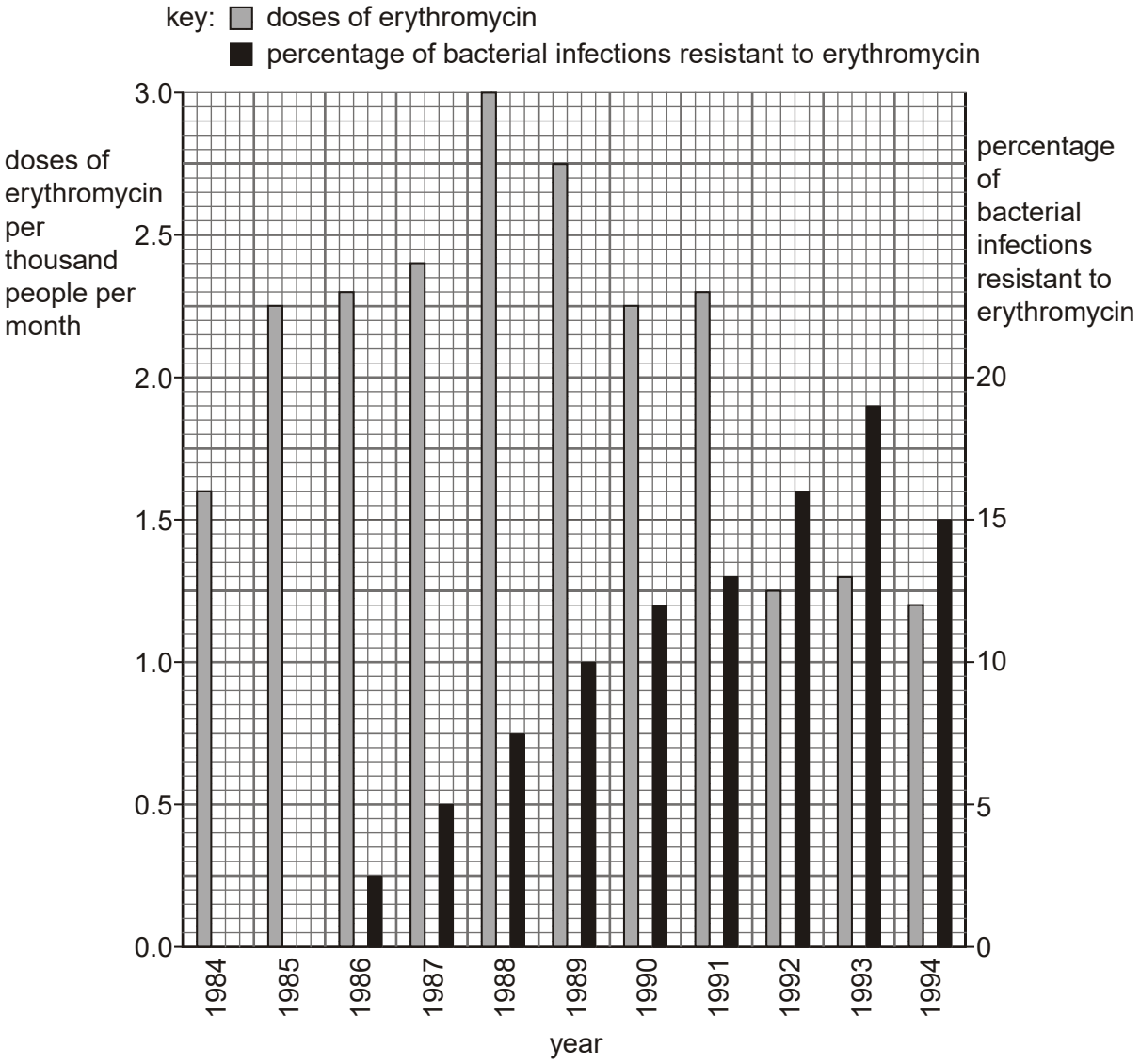
[2]

[Total 5 marks]

23. In Finland, a national campaign in 1988 led to a reduction in the use of the antibiotic erythromycin.

The figure below shows the number of doses of erythromycin used per thousand people per month over the eleven year period 1984–94.

The percentage of infections each year caused by the bacterium *Streptococcus pyogenes* that were resistant to erythromycin is also shown.



(i) With reference to the information in the figure, explain the changes in the percentage of infections of *S. pyogenes* that are resistant to erythromycin.

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[4]

(ii) Describe **two** ways in which resistance to erythromycin may arise in a population of *S. pyogenes*.

1 .....

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2 .....

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[4]

[Total 8 marks]

24. The Millennium Seed Bank Project (MSBP) is a global conservation programme conceived, developed and managed by the Seed Conservation Department at the Royal Botanic Gardens, Kew. The aims of the project are to collect and conserve 10% of the world's seed-bearing plants by 2010.

The project aims to make seeds available for research and species re-introduction into the wild. Scientists working in seed banks have to maintain the viability and genetic variability of the seeds they store. Samples of seeds stored are germinated to assess their variability.

Describe **how** scientists working in seed banks maintain the viability and genetic variability of seeds.

viability .....

.....

.....

genetic variability .....

.....

.....

[Total 3 marks]

25. In this question, one mark is available for the quality of spelling, punctuation and grammar.

Zoos and botanic gardens, such as Kew Gardens, are involved in many conservation projects throughout the world.

Outline the problems experienced by zoos and botanic gardens in managing such projects **and** explain why it is important for such projects to be successful.

[7]

Quality of Written Communication [1]

[Total 8 marks]

26. Musk deer occur throughout forested mountain habitats in Asia and eastern Russia. They live in small groups, normally three individuals in a group, and are primarily active at night.

The deer are hunted illegally for traditional medicine and also threatened by habitat destruction. Populations of musk deer in China and Mongolia are listed in Appendix II of the Convention for International Trade in Endangered Species (CITES).

Explain what is meant by the term *endangered species*.

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[Total 2 marks]

27. In this question, one mark is available for the quality of the use and organisation of scientific terms.

Musk deer populations in isolated habitats could be conserved by a programme of captive breeding. Zoos, such as London Zoo and Jersey Zoo, are involved in captive breeding of many endangered species.

Describe how a captive breeding programme for musk deer would be set up **and** discuss the problems associated with the reintroduction of the captively bred deer back into the wild.

[7]

Quality of Written Communication [1]

[Total 8 marks]

[Total 8 marks]

28. Hedgerows are important in farming as they act as sites of refuge for beneficial insects, provide protection for the crop from adverse weather conditions and act as wildlife corridors.

Farmers are advised to leave strips of land between hedgerows and the crops in the fields to encourage biodiversity.

Describe how you would investigate whether leaving strips of land around fields encourages **plant** biodiversity.

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[Total 5 marks]

29. When hedgerows are destroyed there is a loss of biodiversity.

Suggest why this loss of biodiversity is of concern.

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[Total: 3 marks]

30. The tiger, *Panthera tigris,* is the largest and most distinctive cat in the world.

Complete the following table to show the classification of the tiger.

kingdom	.....
.....	chordata
.....	mammalia
order	carnivora
family	felidae
genus	.....
.....	*Panthera tigris*

[Total 5 marks]

31. Seed banks maintain the genetic diversity of plant populations.

State **two** methods used to preserve seeds in seed banks.

1 .....

2 .....

[Total 2 marks]

32. When Darwin first came to the Galapagos there were some 3000 tortoises which had been reduced to 14 by 1965. Since then each type of tortoise has been kept on its own island as part of a captive breeding programme. The Espanola Tortoise was successfully bred so that there are now about 1000 of them on Santa Cruz Island. Conservationists are now planning to release them into the wild on another island to increase the population there.

(a) Suggest **two** reasons why the population decreased before 1965.

1 .....

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2 .....

.....

[2]

Captive breeding programmes are not always as successful as the one described above.

(b) Explain why many species **do not** breed successfully in captivity.

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[3]

(c) State **two** problems encountered when releasing captive bred individuals into the wild.

1 .....

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2 .....

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[2]

(d) A further study of 134 individuals was carried out on the tortoise population. It was found that the population had a very low genetic diversity. This was caused by an introduced male tortoise from the San Diego Zoo who fathered nearly 80 of the individuals sampled.

Suggest how a low genetic diversity may be damaging to the population.

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[3]

[Total 10 marks]

33. The Millennium Seed Bank Project is an international plant conservation project. Its aim is to prevent the extinction of about 24 000 plant species.

Suggest **two** benefits of preventing extinction of plant species.

1 .....

.....

2 .....

.....

[Total 2 marks]

34. Papaya fruit are an important commercial crop in many tropical countries. The wild relatives of *C. papaya* are found in tropical South America.

(i) Explain the **importance** of keeping seeds of the wild relatives of commercial crop plants, such as papaya, in a seed bank.

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[3]

(ii) Outline the main steps by which disease resistance could be selectively bred into commercially grown papaya.

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[3]

[Total 6 marks]

35. The black rhinoceros, *Diceros bicornis*, is an endangered species whose numbers have fallen to approximately 3000 in the past thirty years. For this reason, the species was placed on Appendix I of the Convention on International Trade in Endangered Species (CITES) agreement. Since the black rhinoceros has been placed on the appendix, numbers have stabilised, or even increased, in several countries.

(i) Explain the term *endangered species*.

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[2]

(ii) Suggest **two** reasons why the black rhinoceros is endangered.

1 .....

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2 .....

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[2]

[Total 4 marks]

36. The clearing of tropical forests across the Earth has been occurring on a large scale basis for many centuries. This process, known as deforestation, involves the cutting down, burning and damaging of forests. The loss of tropical rain forest is more profound than merely destruction of beautiful areas. If the current rate of deforestation continues, the world's rain forests will vanish within 100 years, causing unknown effects on global climate and eliminating the majority of plant and animal species on the planet.

State **three** reasons for the decline in rain forest.

1 .....

2 .....

3 .....

[Total 3 marks]

37. Over half of the species of plants and animals comprising the biodiversity of the Earth are thought to exist in tropical rain forests.

What are the economic and ethical reasons for maintaining biodiversity?

economic reasons

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ethical reasons

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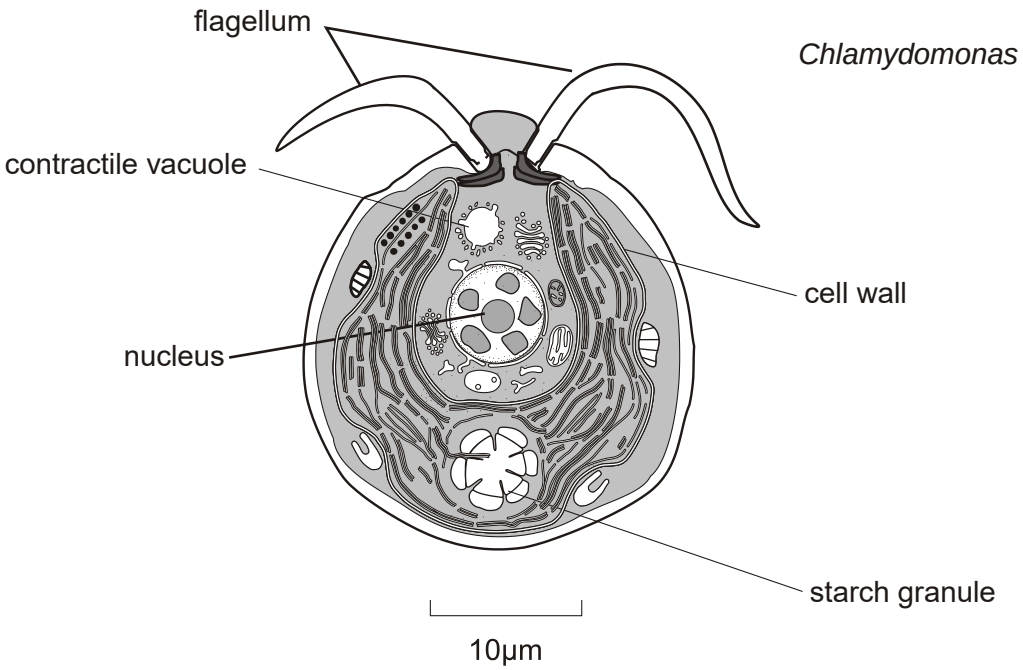
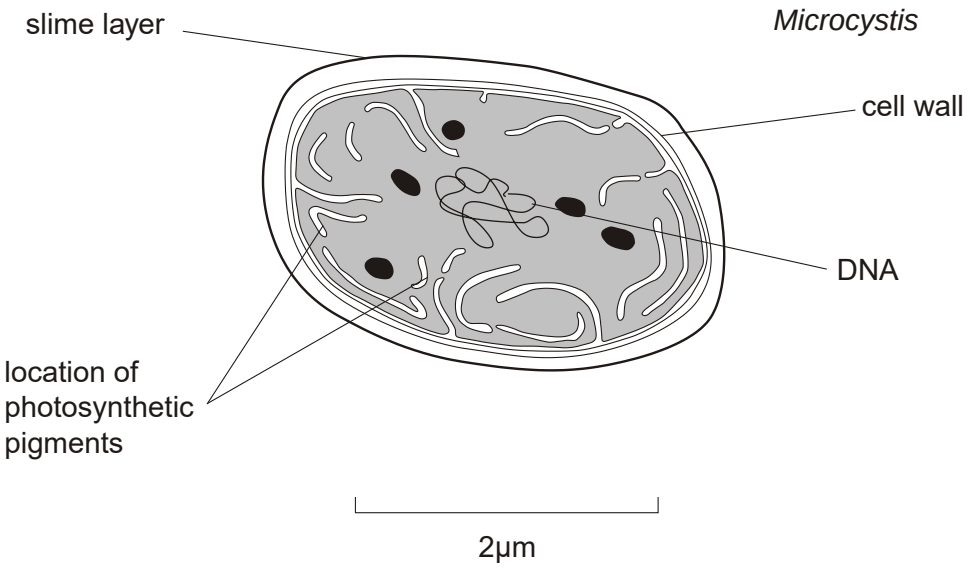
[Total 5 marks]

38. In this question, one mark is available for the quality of spelling, punctuation and grammar.

The figure below shows a green alga, *Chlamydomonas*, and a cyanobacterium, *Microcystis*.





Green algae and cyanobacteria (blue-green bacteria) were once classified in the Kingdom Plantae. As more information became available, taxonomists re-classified these organisms into separate kingdoms. The green algae are now in the Kingdom Protoctista. Although cyanobacteria and green algae share certain structural and functional features, they are placed in different kingdoms.

Suggest why the green algae and cyanobacteria were originally considered to be plants **and** explain why taxonomists decided to re-classify them into **separate** kingdoms.

Use the information given in the figure above and the box to help you. You may annotate the figure if you wish.

[7]

Quality of Written Communication [1]

[Total 8 marks]

39. Preserving the diversity of life on Earth has come to be an accepted goal for many people.

However, this goal can sometimes come into conflict with other goals, such as economic development.

In 1980, the International Union for the Conservation of Nature and Natural Resources (IUCN) proposed a statement to form the basis for conserving biodiversity. One of the points included in the statement is:

"All species have an inherent right to exist. The ecological processes that support the integrity of the biosphere and its diverse species and habitats are to be maintained."

Within the UK, many initiatives have been set up to help maintain biodiversity. One is the Dartmoor Biodiversity Project, part of which is the Habitat Action Plan for moorland, which covers almost 50% of the National Park.

This Action Plan specifies many objectives, all of which aim to maintain the range of habitats on Dartmoor and ensure that all native plants and animals continue to breed successfully and maintain healthy populations.

(a) State what is meant by the term *biodiversity.*

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.....

[2]

(b) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Outline the **ecological**, **economic** and **ethical** reasons behind initiatives such as the Dartmoor Biodiversity Project and other similar projects around the world.

(*Allow one line page*)

[8]

Quality of Written Communication [1]

(c) State **four** activities of conservation organisations, such as the Royal Society for the Protection of Birds, which contribute to the maintenance of biodiversity.

1 .....

2 .....

3 .....

4 .....

[4]

[Total 15 marks]