Q1.(a) Give **three** ways in which courtship behaviour increases the probability of successful mating.

1 .....

2 .....

3 .....

(3)

Male field crickets produce a courtship song by vibrating their wings. The natural song contains seven low-pitched ‘chirps’ followed by two high-pitched ‘ticks’.

Scientists recorded this song and used a computer program to change the number of chirps and ticks. Different versions of the song were then played back continuously to females in the presence of a male. This male had previously had one wing removed so he could not produce a courtship song. The scientists determined the percentage of females that showed courtship behaviour within 5 minutes of hearing each recorded song.

The results of the scientists’ playback experiments are shown in the table below.

Version of recorded song played	Number of chirps	Number of ticks	Percentage of females that showed courtship behaviour within 5 minutes
K	No song played		30
L (natural)	7	2	83
M	7	0	70
N	0	2	65
O	7	1	83
P	7	4	82

(b) The scientists wanted to know if the recorded natural song was less effective than the natural song in stimulating courtship behaviour.

Suggest how the scientists could determine if the recorded natural song (**L**) was less effective than the natural song.

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(2)

(c) A student concluded from the data in the table above that the number of chirps and ticks is essential for successfully stimulating courtship behaviour.

Do these data support this conclusion? Explain your answer.

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[Extra space] .....

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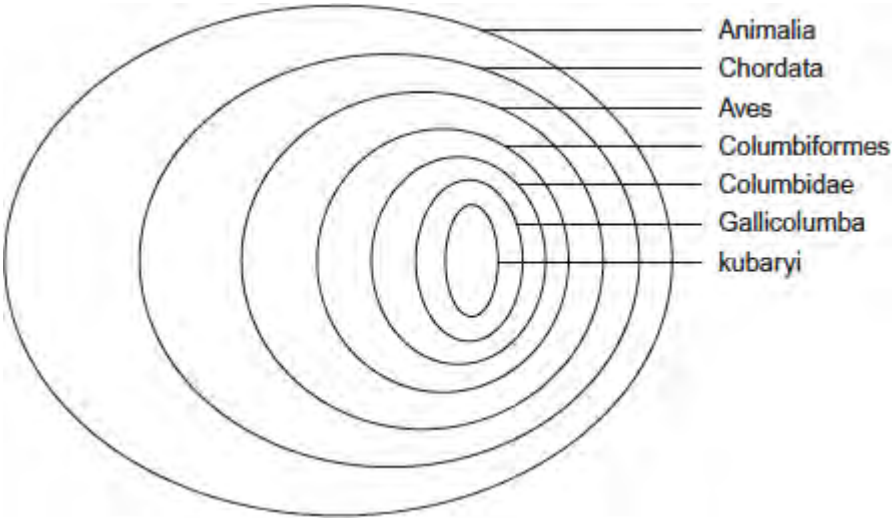
(4)
(Total 9 marks)

Q2. Micronesia is a group of islands in the Pacific Ocean. The white-fronted ground dove is a bird found on these islands.

The diagram below shows how the white-fronted ground dove is classified.



(a) To which class does the white-fronted ground dove belong?

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(1)

(b) Give the scientific name for the white-fronted ground dove.

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(1)

(c) This classification system consists of a hierarchy as there are small groups within larger groups.

Give **one** other feature of a hierarchy that is shown in the diagram.

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(1)

(Total 3 marks)

Q3. The table shows the taxons and the names of the taxons used to classify one species of otter. They are **not** in the correct order.

	Taxon	**Name of taxon**
J	Family	Mustelidae

K	Kingdom	Animalia
L	Genus	Lutra
M	Class	Mammalia
N	Order	Carnivora
O	Phylum	Chordata
P	Domain	Eukarya
Q	Species	lutra

(a) Put letters from the table above into the boxes in the correct order. Some boxes have been completed for you.

		O	**M**			**L**	**Q**

(1)

(b) Give the scientific name of this otter.

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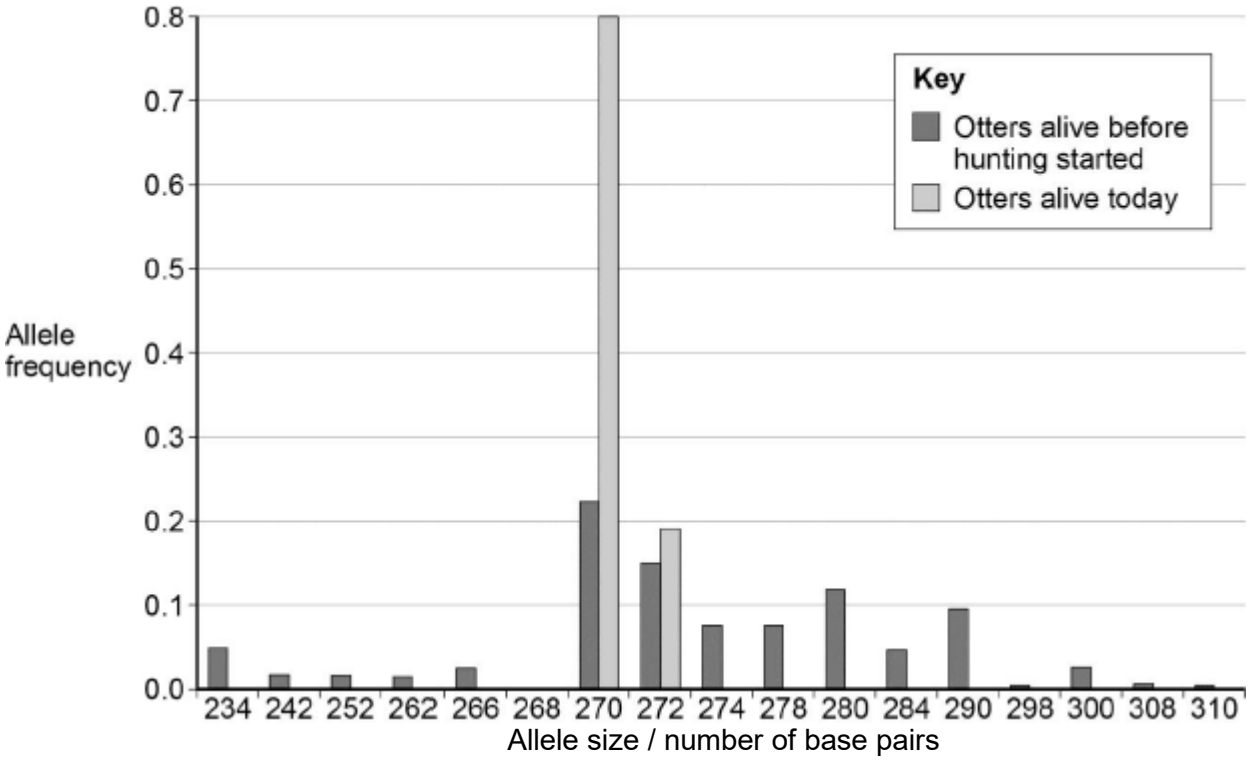
(1)

Scientists investigated the effect of hunting on the genetic diversity of otters. Otters are animals that were killed in very large numbers for their fur in the past.

The scientists obtained DNA from otters alive today and otters that were alive before hunting started.

For each sample of DNA, they recorded the number of base pairs in alleles of the same gene. Mutations change the numbers of base pairs over time.

The figure below shows the scientists' results.



(c) The scientists obtained DNA from otters that were alive before hunting started.

Suggest **one** source of this DNA.

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(1)

(d) What can you conclude about the effect of hunting on genetic diversity in otters? Use data from the figure above to support your answer.

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(2)

(e) Some populations of animals that have never been hunted show very low levels of genetic diversity.

Other than hunting, suggest **two** reasons why populations might show very low levels of genetic diversity.

1 .....

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2 .....

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(2)
(Total 7 marks)

Q4.Table 1 shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists.

Table 1

Taxon	Name of taxon
Domain	Eukaryota
	Animalia
	Chordata
	Aves
	Passeriformes
	Muscicapidae
Genus	
Species	

(a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

(2)

A group of scientists investigated genetic diversity in different species of bird. For each species, the scientists:

- collected feathers from a large number of birds
- extracted DNA from cells attached to each feather
- analysed the samples of DNA to find genetic diversity.

Table 2 summarises their results.

Table 2

Species of bird	Number of genes examined	Number of genes examined that showed genetic diversity
Willow flycatcher	708	197
House finch	269	80
Bluethroat	232	81

(b) In this investigation, what is meant by **genetic diversity?**

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(1)

(c) The scientists concluded that the bluethroat showed greater genetic diversity than the willow flycatcher. Explain why they reached this conclusion. Use calculations to support your answer.

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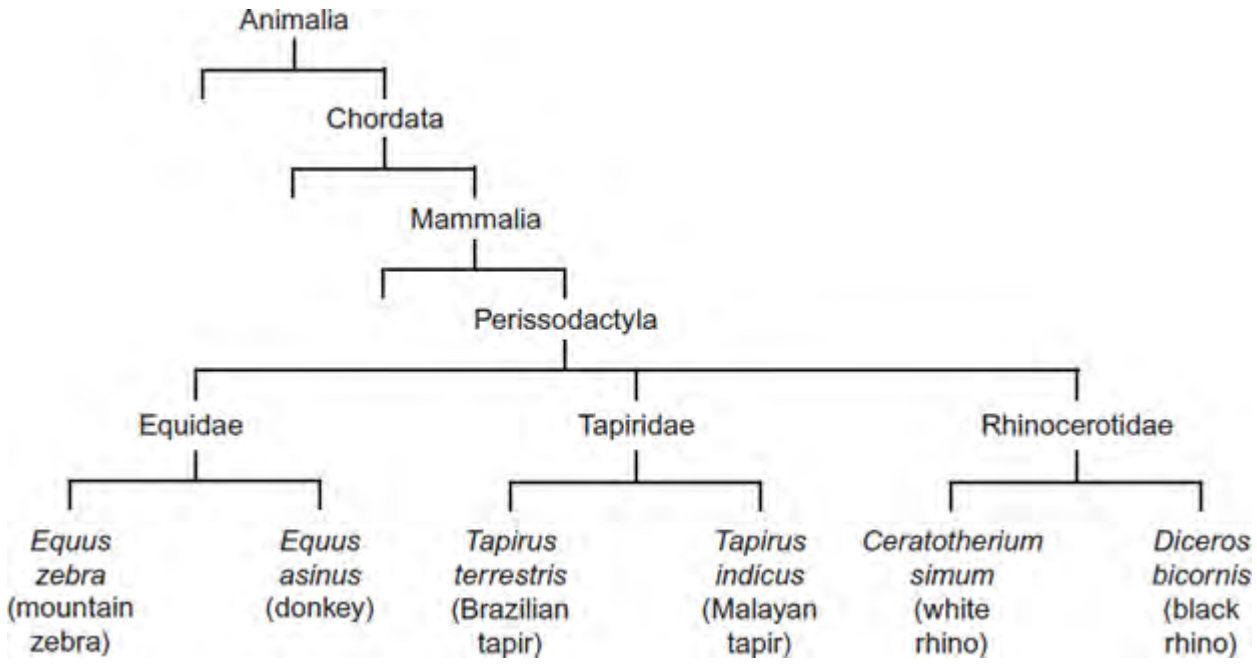
(2)
(Total 5 marks)

Q5. The following figure shows how some animals with hooves are classified.



(a) This type of classification can be described as a phylogenetic hierarchy.

(i) What is meant by a **hierarchy**?

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(Extra space) .....

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(2)

(ii) How many different families are shown in the figure?

(1)

(iii) To which phylum does the white rhino belong?

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(1)

(b) (i) Explain the role of independent segregation in meiosis.

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(2)

(ii) A zedonk is the offspring produced from breeding a mountain zebra with a donkey.

- The body cells of a mountain zebra contain 32 chromosomes.
- The body cells of a donkey contain 62 chromosomes.

Use this information to suggest why zedonks are usually infertile.

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(2)
(Total 8 marks)

Q6.(a) What is a *species?*

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(2)

(b) Scientists investigated the diversity of plants in a small area within a forest. The table shows 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.

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(Extra space).....

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(3)
(Total 7 marks)

Q7. Organisms can be classified using a hierarchy of phylogenetic groups.

(a) Explain what is meant by:

(i) a hierarchy

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(2)

(ii) a phylogenetic group.

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(1)

(b) Cytochrome c is a protein involved in respiration. Scientists determined the amino acid sequence of human cytochrome c. They then:

- determined the amino acid sequences in cytochrome c from five other animals
- compared these amino acid sequences with that of human cytochrome c
- recorded the number of differences in the amino acid sequence compared with human cytochrome c.

The table shows their results.

Animal	Number of differences in the amino acid sequence compared with human cytochrome c
A	1
B	12
C	12
D	15
E	21

(i) Explain how these results suggest that animal **A** is the most closely related to humans.

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(2)

(ii) A student who looked at these results concluded that animals **B** and **C** are more closely related to each other than to any of the other animals.

Suggest **one** reason why this might **not** be a valid conclusion.

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(1)

(iii) Cytochrome c is more useful than haemoglobin for studying how closely related different organisms are. Suggest **one** reason why.

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(1)

(Total 7 marks)