AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.4.5 SPECIES AND TAXONOMY

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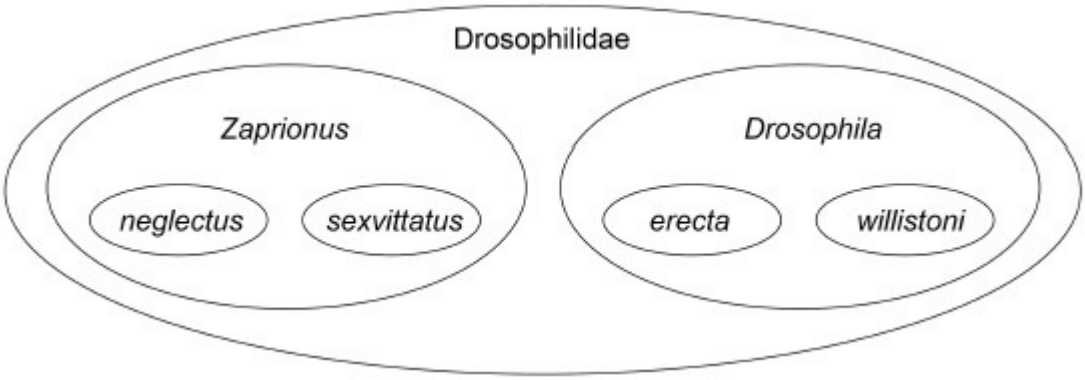
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Q1.

Figure 1 represents the phylogenetic classification of **four** different species of fruit fly.

Figure 1



(a) **Figure 1** shows a hierarchy. Explain how.

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(2)

(b) Name the taxon to which Drosophilidae belongs.

_____

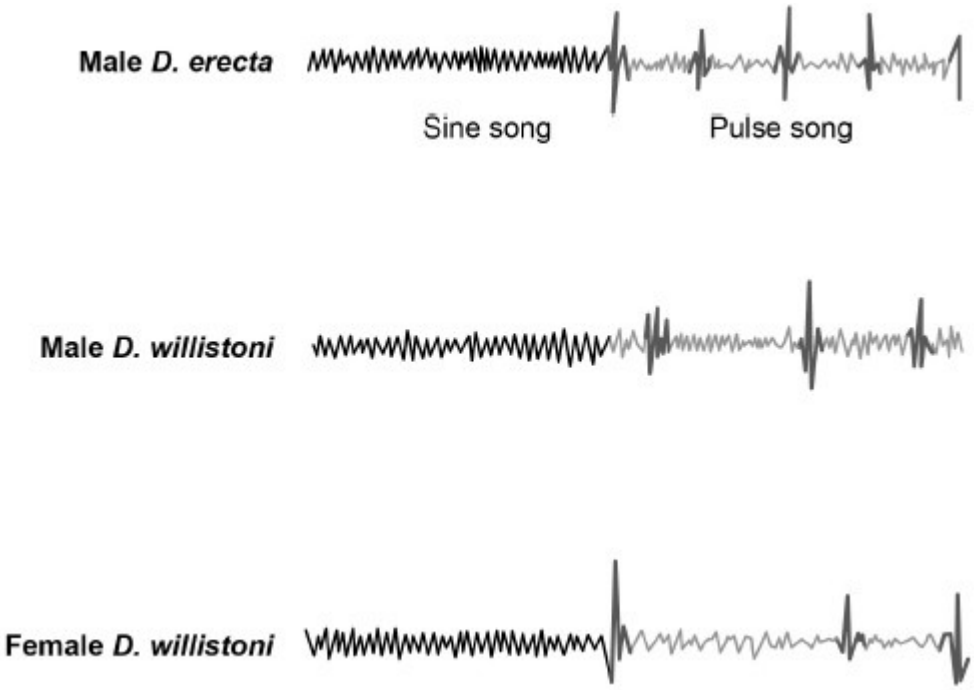
(1)

Drosophila fruit flies display courtship behaviour. One of the stages of courtship is singing by males. Normally a male will produce a ‘sine song’, in which continual noise is made, and a ‘pulse song’, in which there is continual noise with some louder peaks.

Scientists showed fruit flies a visual stimulus that made them sing. They made recordings of these songs.

Figure 2 shows the recordings of the songs of three flies over the same time period.

Figure 2



(c) D. erecta and *D. willistoni* are closely related species but different species.

Describe evidence from **Figure 2** that supports this statement.

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(2)

(d) The scientists repeated their experiments, using female fruit flies as the visual stimulus. When a male and female *D. willistoni* were together, their songs led to mating.

When two female *D. willistoni* were together, their songs did **not** lead to any attempt to mate.

Use information from **Figure 2** to suggest why the two females did not attempt to mate.

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(2)

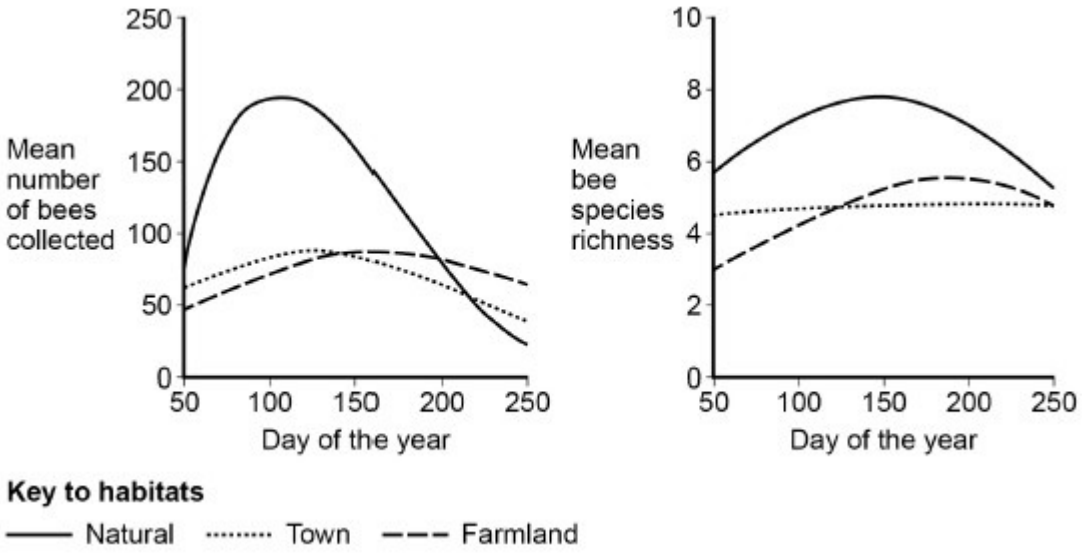
(Total 7 marks)

Q2.

Bees are flying insects that feed on nectar made in flowers. There are many different species of bee.

Scientists investigated how biodiversity of bees varied in three different habitats during a year. They collected bees from eight sites of each habitat four times per year for three years.

The scientists' results are shown below in the graphs in the form they presented them.



(a) What is meant by 'species richness'?

_____

(1)

(b) From the data in the graphs, a student made the following conclusions.

1. The natural habitat is most favourable for bees.
2. The town is the least favourable for bees.

Do the data in the graphs support these conclusions? Explain your answer.

1. The natural habitat is most favourable for bees.

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2. The town is the least favourable for bees.

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(4)

(c) The scientists collected bees using a method that was ethical and allowed them to identify accurately the species to which each belonged.

In each case, suggest **one** consideration the scientists had taken into account to make sure their method

1. was ethical.

_____

_____

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_____

2. allowed them to identify accurately the species to which each belonged.

_____

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(2)

(d) Suggest and explain **two** ways in which the scientists could have improved the method used for data collection in this investigation.

1. _____

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2. _____

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(2)

(e) Three of the bee species collected in the farmland areas were *Peponapis pruinosa*, *Andrena chlorogaster* and *Andrena piperi*.

What do these names suggest about the evolutionary relationships between these bee species? Explain your answer.

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(2)

(Total 11 marks)

Q3.

(a) Define each of the following terms.

Species _____

_____

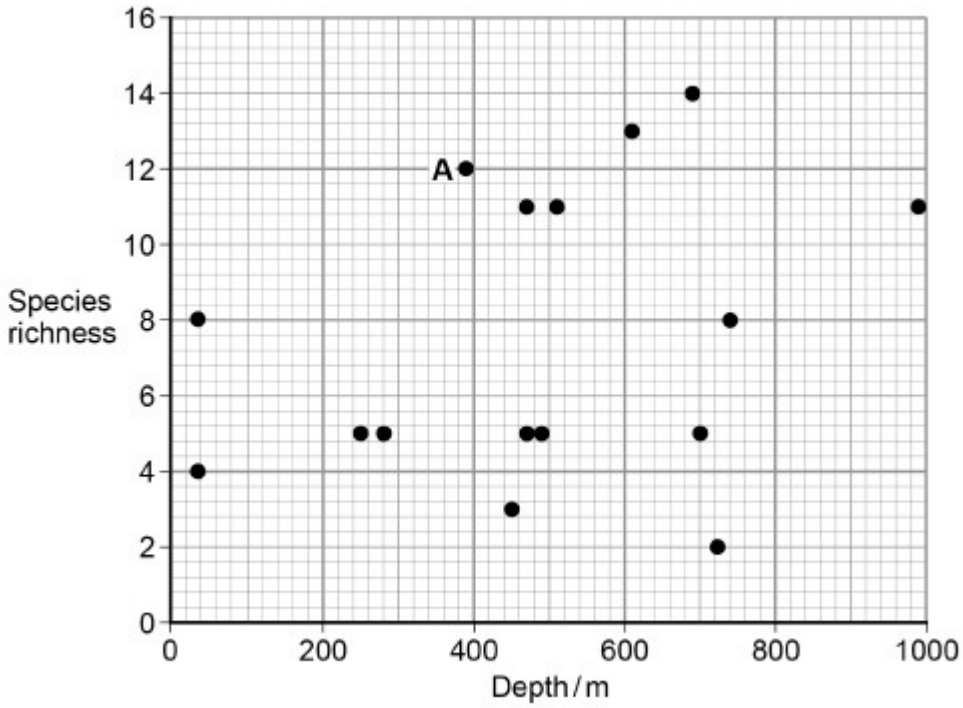
Species richness _____

_____

(2)

Scientists investigated the species richness of fish caught at various depths in the Pacific Ocean close to the western coast of Chile.

The graph shows the scientists' results. 68% of all the fish caught in this investigation came from sample **A**.



(b) What is the modal value of species richness?

_____

(1)

(c) 68% of all the fish caught in this investigation came from sample **A**.
A student thought this showed that sample **A** had a greater index of diversity than any of the other samples.

It is **not** possible to draw this conclusion from the given data. Give reasons why.

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(3)

(Total 6 marks)

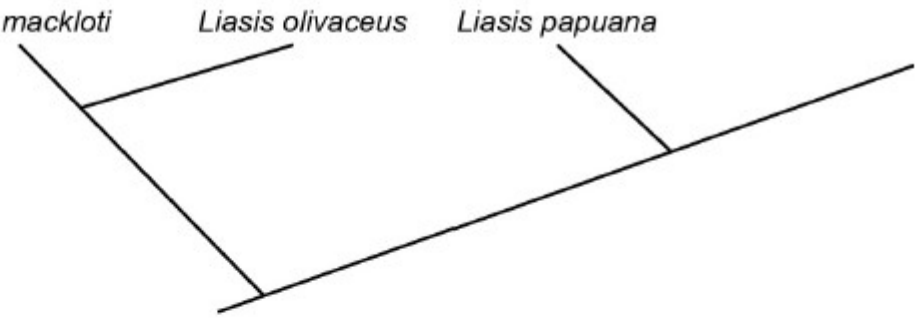
Q4.

The diagram shows two different ways of classifying the same three species of snake.

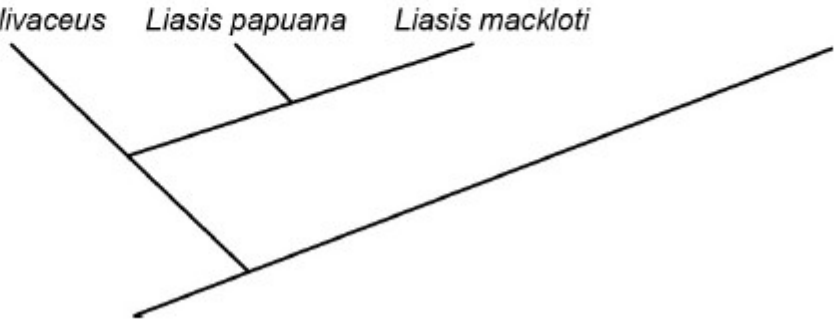
- Classification **X** is based on the frequency of observable characteristics
- Classification **Y** is based on other comparisons of genetic characteristics.

All three species of snake belong to the Python family.

Classification **X**



Classification **Y**



(a) What do these classifications suggest about the evolutionary relationships between these species of snake?

Classification **X** _____

_____

_____

_____

Classification **Y** _____

_____

_____

_____

(2)

(b) Complete the table below to show the missing names of the taxa when classifying these snakes.

Taxon (hierarchical order)	**Name**
	Eukaryote
	Animal
	Chordata
	Reptilia

	Squamata
Family	Python

(1)

(c) There is a debate about the name of one of these species of snake. Some scientists name it *Liasis papuana* and other scientists name it *Apodora papuana*.

Give the name of the taxon about which the scientists disagree.

_____

_____

(1)

(d) State **three** comparisons of genetic diversity that the scientists used in order to generate Classification **Y**.

1. _____

_____

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2. _____

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3. _____

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(3)

(Total 7 marks)

Q5.

(a) There are many different species of field mouse in Europe. Using a phylogenetic classification, all of these species have names that start with *Apodemus*.

What information does this give about field mice?

_____

_____

_____

_____

(2)

The long-tailed field mouse, *Apodemus sylvaticus*, is a small mammal common in mainland Britain.

(b) Complete **Table 1** to show the classification of the long-tailed field mouse.

Table 1

Taxon	Name of Taxon
	Eukarya
Kingdom	Animalia
	Chordata
	Mammalia
Order	Rodentia
Family	Muridae

(2)

The St. Kilda field mouse lives only on one island off the coast of Scotland. It is very similar in appearance to the long-tailed field mouse but is larger and has lighter coloured fur.

Biologists wanted to find out if the St. Kilda field mouse and the long-tailed field mouse populations belonged to different species. They measured the length of the same features of a large number of individuals from the two populations.

The results are shown in **Table 2**.

Table 2

Population	**Mean length (±SD) / mm**	
	Head and body	Tail
St. Kilda field mouse	112.3 (±9.3)	105.5 (±8.4)
Long-tailed field mouse	95.2 (±8.2)	90.2 (±7.3)

(c) Do the data in **Table 2** provide evidence that the two populations belong to different species? Use calculations of ratios to support your answer.

_____

(3)

(d) Describe how breeding experiments could determine whether the two populations are from the same species.

_____

_____

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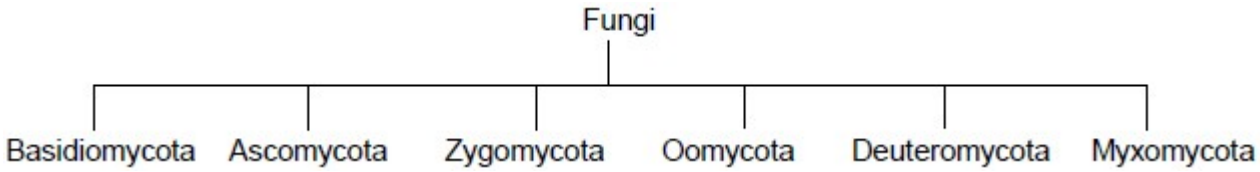
(2)

(Total 9 marks)

Q6.

Figure 1 shows one way in which the kingdom Fungi can be classified.

Figure 1



(a) Name the taxon represented by Zygomycota.

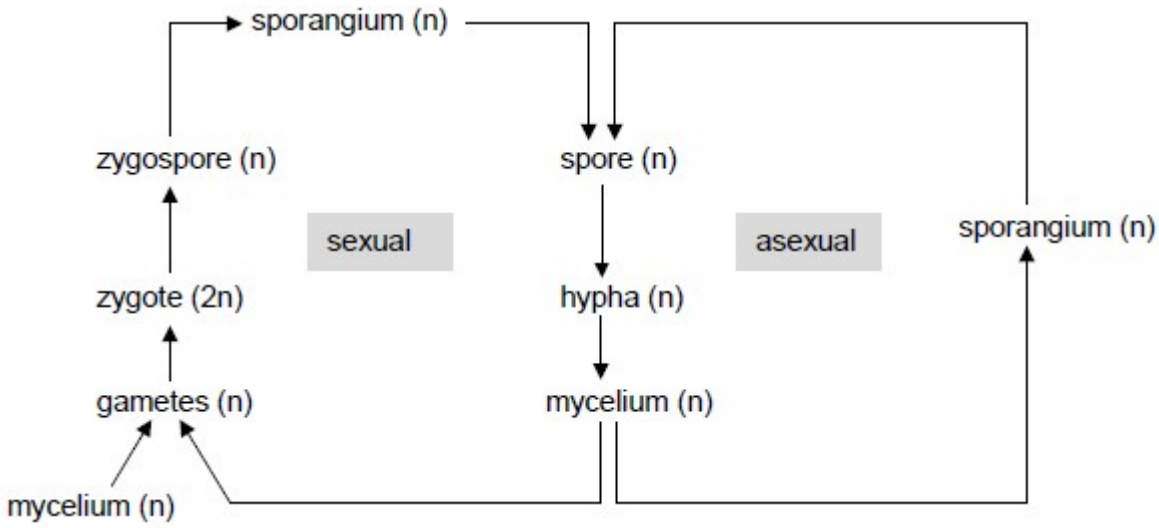
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(1)

Rhizopus is a member of the Zygomycota. It has thread-like hyphae that form a mass, called a mycelium, across its food source. Vertical hyphae form spore-carrying sporangia. A new hypha grows from each spore.

Figure 2 shows the life cycle of *Rhizopus*.

Figure 2



(b) Write the letter **M** on **Figure 2** to show where meiosis occurs.

(1)

(c) **Figure 2** shows that *Rhizopus* is able to reproduce both asexually and sexually.
Suggest and explain **one** advantage of asexual reproduction and **one** advantage of sexual reproduction in this life cycle.

Asexual _____

_____

_____

Sexual _____

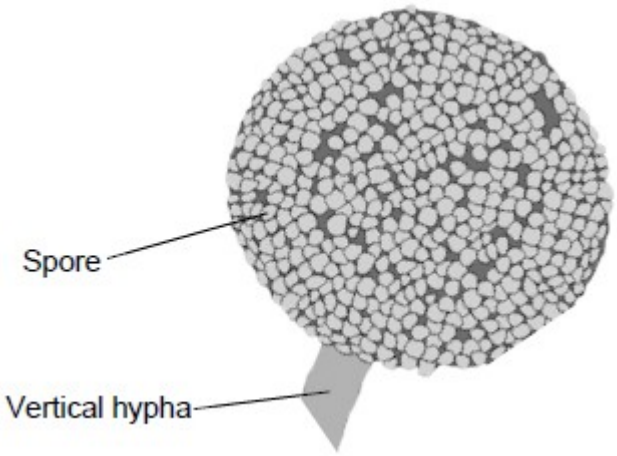
_____

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(2)

Figure 3 shows one spore-carrying sporangium from *Rhizopus*. The magnification of **Figure 3** is × 700.

Figure 3



(d) The hypha supporting the spore-carrying sporangium is vertical.
Suggest **one** advantage of the hypha being vertical.

_____

_____

(1)

(e) A scientist wanted to calculate the mean volume of *Rhizopus* spores.
Describe how she could use **Figure 3** do this.
You may assume the spores are perfectly spherical.

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(3)

(Total 8 marks)

Q7.

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.

_____

(1)

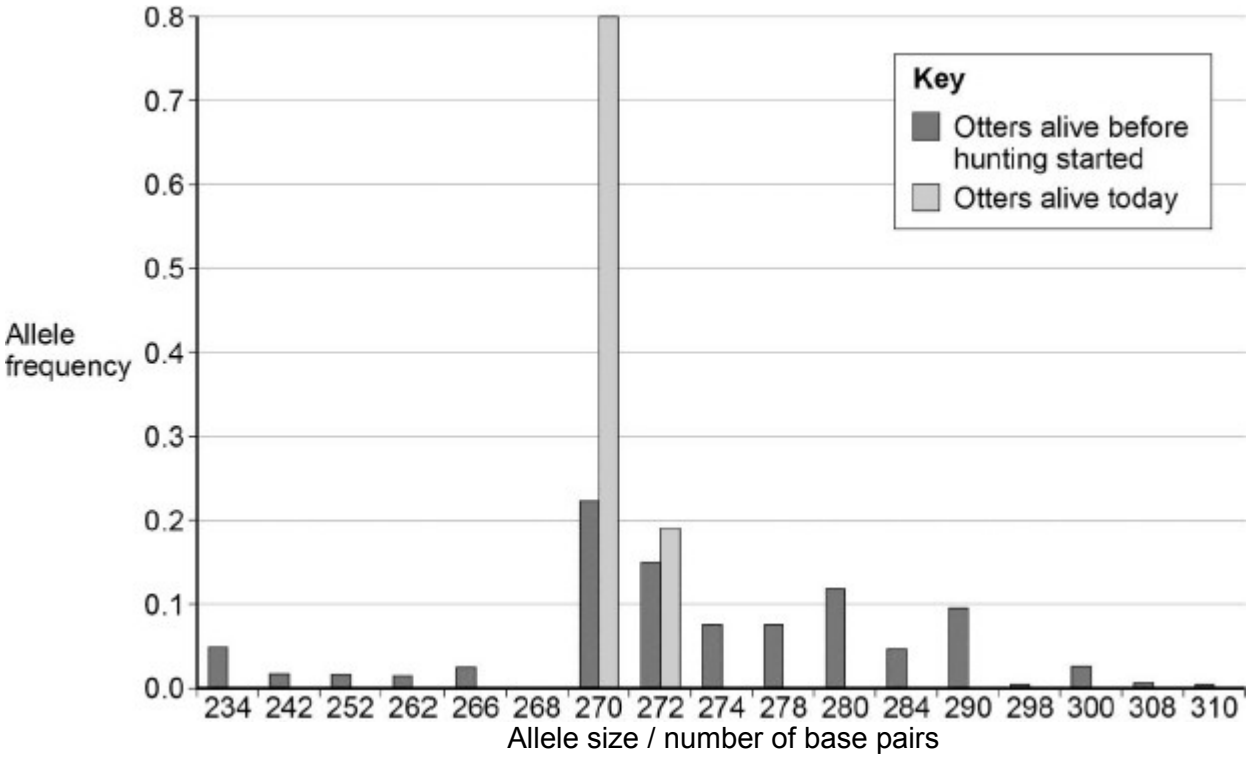
Scientists investigated the effect of hunting on the genetic diversity of otters. Otters are animals that were killed in very large numbers for their fur in the past.

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.

_____

_____

(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.

_____

_____

_____

_____

(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. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q8.

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?**

_____

_____

(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)

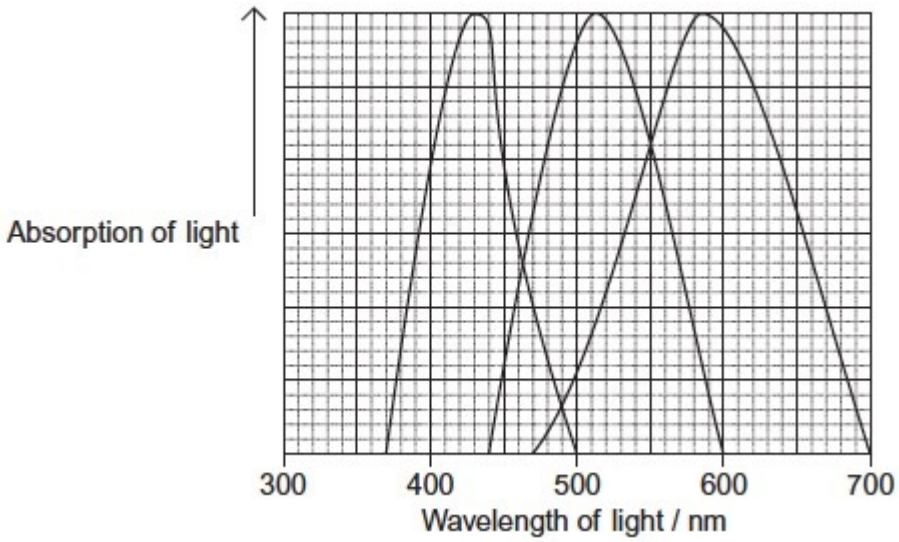
Q9.

The retinas in the eyes of humans and birds have cone cells that absorb light of different wavelengths.

Resource A

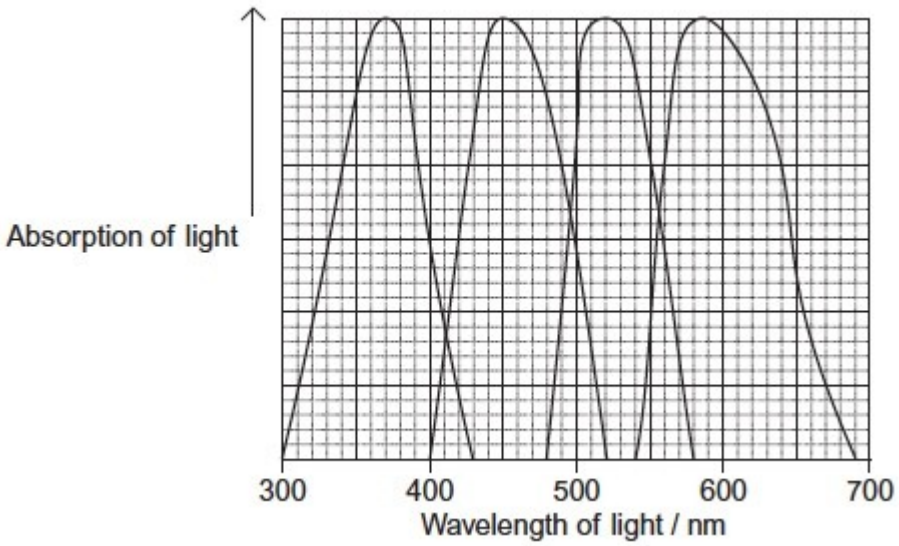
A scientist recorded the absorption of light of different wavelengths by different types of human cone cells. Her results are shown in **Figure 1**. Each curve shows the absorption of light by one type of cone cell.

Figure 1



She also recorded the absorption of light of different wavelengths by different types of bird cone cells. These results are shown in **Figure 2**. Each curve shows the absorption of light by one type of cone cell.

Figure 2



Resource B

Bluethroats are a species of small brightly coloured bird. The feathers on the throats of male birds reflect UV light (370 nm). Scientists investigated the response of female bluethroats to this reflected UV light.

The scientists used 40 male birds selected because they were very similar to each other. The scientists treated the throat feathers of male birds as follows:

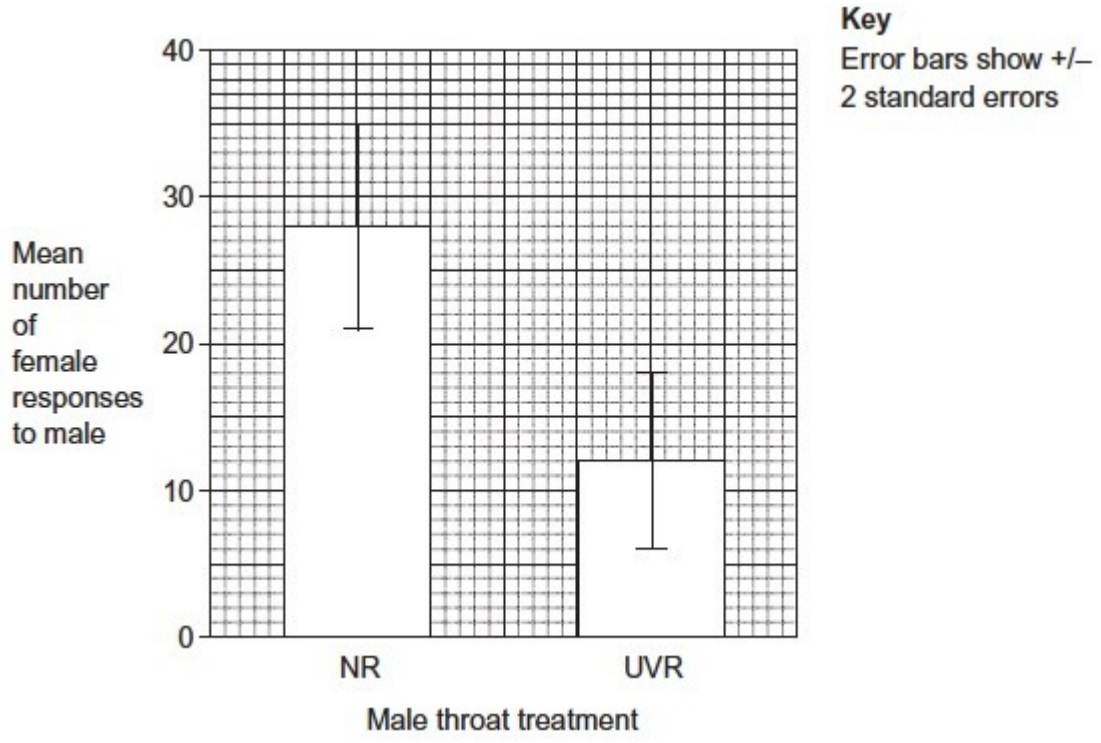
- they put a clear oil on the throat feathers of 20 males. They described these males as no UV reduction (NR).

- they put the same oil on the throat feathers of another 20 males but the oil contained a substance that absorbs UV light. They described these males as UV reduced (UVR).

In each experiment, the scientists placed two males where a female could see them. One male was NR and the other was UVR. During the next 5 minutes, they recorded how many times the female responded by moving towards each male.

Their results are shown in **Figure 3**.

Figure 3



Use **Resource B** to answer Questions (a) to (d).

(a) The male birds were selected because they were very similar to each other. Suggest **two** reasons why it was important that they were of similar age.

1

_____

_____

_____

2

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(2)

(b) Of the 40 male birds the scientists selected 20 to receive the NR treatment. They selected these birds at random.
Suggest how.

_____

_____

_____

(1)

(c) The scientists recorded how many times each female moved towards a male.

In designing the experiment, suggest **two** assumptions the scientists made when they decided to record this movement.

1

2

(2)

(d) The pigment in the throat feathers of the male birds that reflects UV light is a protein.
This protein arose by a gene mutation.
Explain how a gene mutation could result in a new protein.

(3)

Use **Resources A and B** to answer Question (e).

(e) A student who read both resources concluded that female bluethroats are attracted to the blue throat feathers of males when selecting a mate.
Do these data support this conclusion? Give reasons for your answer.

_____

(4)

(Total 12 marks)

Q10.

(a) Explain what is meant by a

(i) phylogenetic group

_____

_____

(1)

(ii) species.

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(2)

The classification of tigers and clouded leopards is shown in **Table 1**.

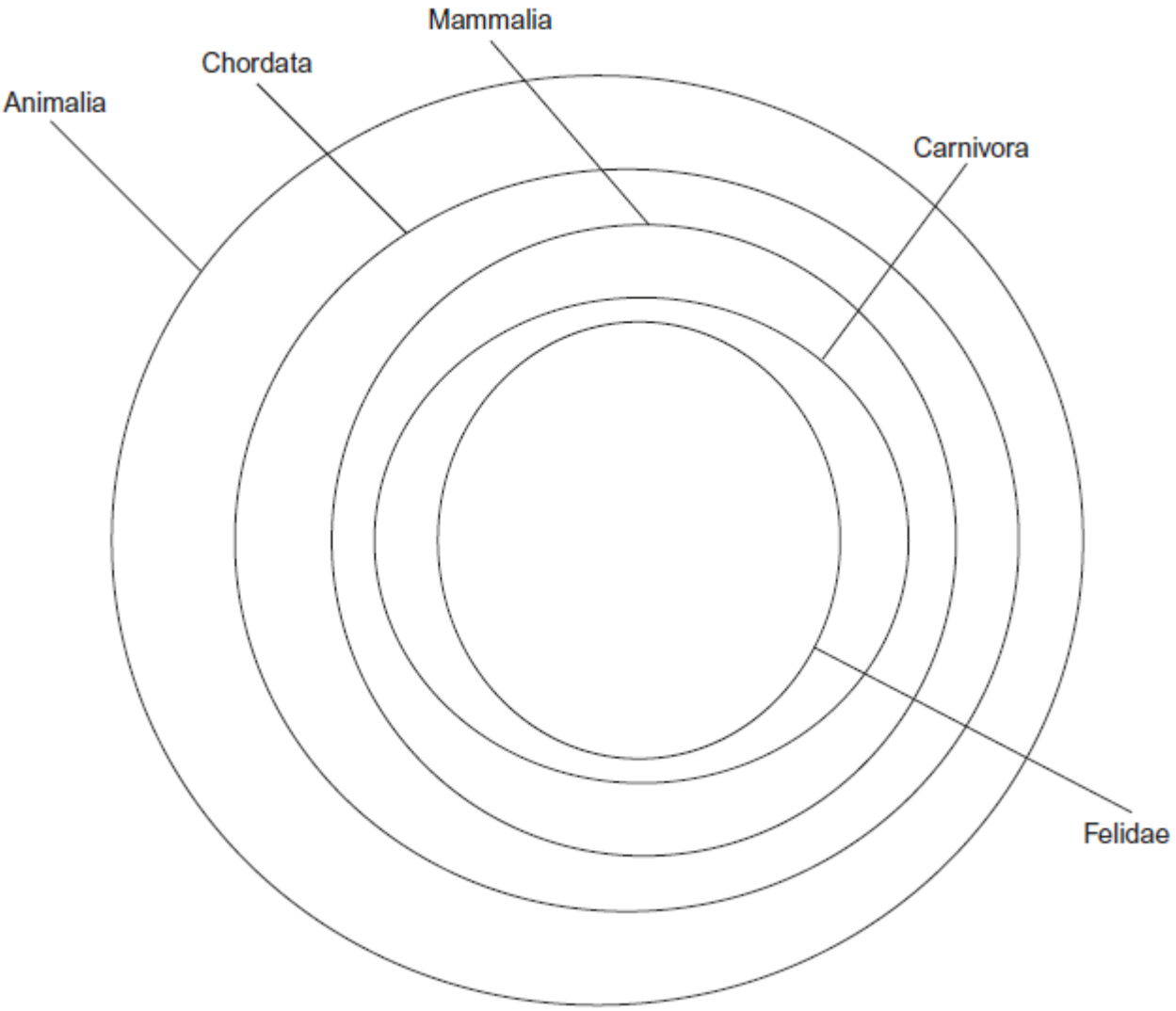
Table 1

Taxonomic group	**Tiger**	**Clouded Leopard**
Kingdom	Animalia	Animalia
	Chordata	Chordata
	Mammalia	Mammalia
Order	Carnivora	Carnivora
	Felidae	Felidae
	Panthera	Neofelis
Species	Tigris	Nebulosa

(b) Complete **Table 1** by adding the **four** other taxonomic groups to which the tiger and clouded leopard belong.

(1)

The circles in the diagram represent the hierarchy of taxonomic groups for the classification shown in **Table 1**.



(c) Draw additional circles on the diagram and label them to include all the information about the tiger and clouded leopard shown in **Table 1**.

(2)

Table 2 shows part of the nucleotide sequence in a gene in populations of tigers living in different parts of the world.

Table 2

Siberian tiger	G C A C C G T
South China tiger	A C G C C G C
Sumatran tiger	A C G C C G C

(d) Explain what the information in **Table 2** suggests about the phylogenetic relationships between these tigers.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q11.

(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.

_____

_____

_____

_____

_____

(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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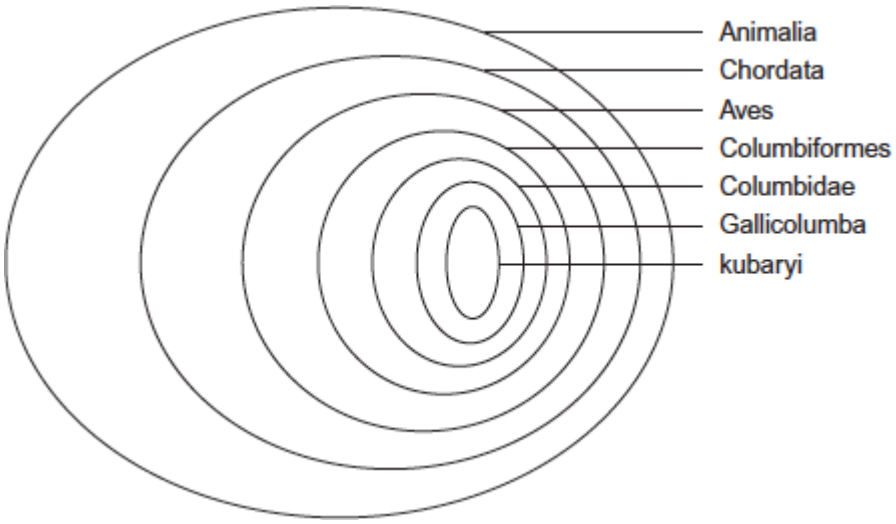
(4)

(Total 9 marks)

Q12.

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?

_____

(1)

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

_____

(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.

_____

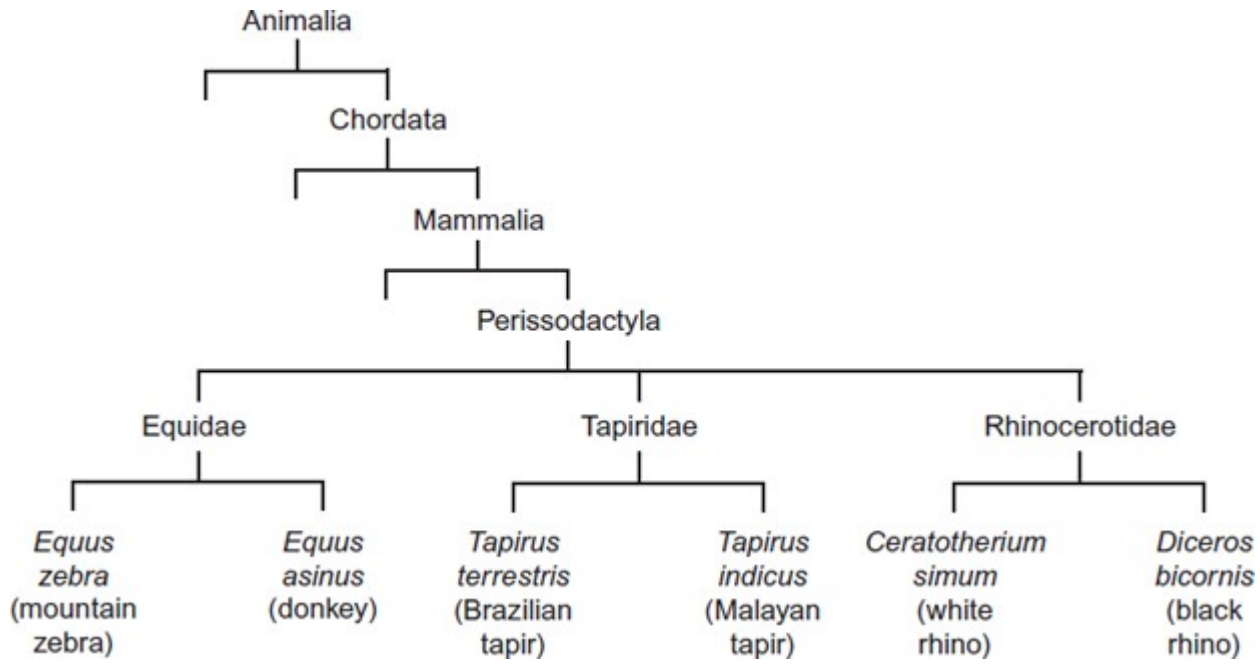
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(1)

(Total 3 marks)

Q13.

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**?

_____

_____

_____

_____

(2)

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

(1)

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

_____

(1)

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

_____

_____

_____

_____

(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.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q14.

(a) What is a *species?*

_____

_____

_____

(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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_____

_____

_____

(3)

(Total 7 marks)

Q15.

Organisms can be classified using a hierarchy of phylogenetic groups.

(a) Explain what is meant by:

(i) a hierarchy

_____

_____

_____

_____

_____

(2)

(ii) a phylogenetic group.

_____

_____

_____

(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.

_____

_____

_____

_____

_____

(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.

_____

_____

_____

(1)

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

_____

_____

_____

(1)

(Total 7 marks)

Q16.

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.

_____

_____

_____

_____

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_____

_____

_____

(5)

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

_____

_____

_____

(1)

(Total 6 marks)

Q17.

Hummingbirds belong to the order Apodiformes. One genus in this order is *Topaza*.

(a) (i) Name **one** other taxonomic group to which all members of the Apodiformes belong.

_____

(1)

(ii) Name the taxonomic group between order and genus.

_____

(1)

The crimson topaz and the fiery topaz are hummingbirds.

Biologists investigated whether the crimson topaz and the fiery topaz are different species of hummingbird, or different forms of the same species.

They caught large numbers of each type of hummingbird. For each bird they

- recorded its sex

- recorded its mass
- recorded the colour of its throat feathers
- took a sample of a blood protein.

The table shows some of their results.

	Crimson topaz		Fiery topaz	
	Male	**Female**	**Male**	**Female**
Mean mass / g (± standard deviation)	13.6 (±1.9)	10.8 (±1.3)	14.2 (±1.6)	11.6 (±0.63)
Colour of throat feathers	Green	Grey edges	Yellowish green	No grey edges

(b) Explain how the standard deviation helps in the interpretation of these data.

_____

_____

_____

_____

_____

(2)

(c) The biologists analysed the amino acid sequences of the blood protein samples from these hummingbirds.

Explain how these sequences could provide evidence as to whether the crimson topaz and the fiery topaz are different species.

_____

_____

_____

_____

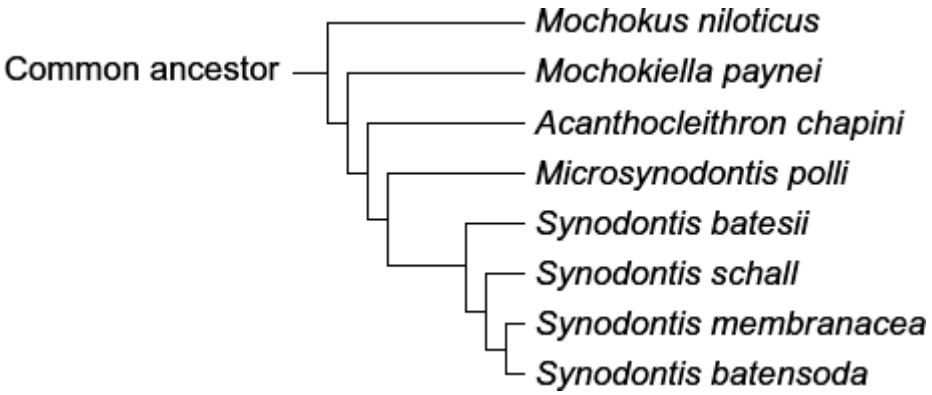
_____

(2)

(Total 6 marks)

Q18.

There are over 200 species of catfish. All catfish evolved from a common ancestor.
The diagram shows how some species of catfish are classified. This diagram is based on the evolutionary links between these species.



(a) (i) Which species of catfish is most closely related to *Synodontis membranacea*?

_____

(1)

(ii) Which species of catfish is most distantly related to *Synodontis membranacea*?

_____

(1)

(b) How many different genera are shown in this diagram?

☐

(1)

(c) (i) A scientist carried out breeding experiments with catfish from different populations.
Describe how the results could show that the catfish belong to the same species.

_____

_____

_____

(1)

(ii) The variety of colours displayed by catfish is important in courtship. Give **two** ways in which courtship increases the probability of successful mating.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Q19.

The body markings of cheetahs vary, in particular the pattern of bands on their tails. Cheetahs are solitary animals but the young stay with their mother until they are between 14 and 18 months old.

Scientists investigated the banding pattern on the tails of cheetahs living in the wild.

- They drove a car alongside a walking cheetah and used binoculars to study the tail pattern.
- They gave each cheetah a banding pattern score based on the width of the dark and light bands on the end of the tail.
- They scored the width of the bands on the right and left side of the tail using a 5 point scale of width.

A typical pattern on the right side of one cheetah's tail is shown in **Figure 1**.

Figure 1

Band number 1 2 3 4 5 6 7



Band width score 3 1 1 4 3 3 3

The scientists collected data from each cheetah on four separate occasions. **Figure 2** shows the data for one of the cheetahs.

Figure 2

Side of tail	**Mean band width score (± standard deviation)**						
	Band 1	**Band 2**	**Band 3**	**Band 4**	**Band 5**	**Band 6**	**Band 7**
Right	3.00 (± 0.82)	1.00 (± 0.00)	1.00 (± 0.00)	3.75 (± 0.50)	2.75 (± 0.50)	3.00 (± 0.00)	3.00 (± 0.00)
Left	3.75 (± 0.50)	3.25 (± 0.50)	2.00 (± 0.50)	3.00 (± 0.00)	2.00 (± 0.00)	2.50 (± 0.50)	3.00 (± 0.50)

(a) The scientists only used data from cheetahs which were fully grown. Suggest why.

_____

_____

(1)

(b) The scientists estimated the width of the bands on the same cheetah on four separate occasions. They did not always get the same score.

(i) Give **two** pieces of evidence from **Figure 2** which show that the scientists sometimes obtained different scores for the same band.

1. _____

_____

2. _____

_____

(2)

(ii) The method the scientists used resulted in them getting different scores for the same band. Suggest why.

_____

_____

(1)

(c) What is the evidence from **Figure 2** that the dark and light bands do **not** form rings of equal width around the tail?

_____

_____

(1)

(d) The scientists found the difference in banding pattern between

- offspring in the same family
- cheetahs chosen randomly.

Explain how scientists could use this information to show that some variation in tail banding was genetic.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q20.

In 2002, biologists identified a new group of insects. They called these insects gladiators.

(a) (i) *Mantophasma zephyra* is one species of gladiator. Complete the table to show how this species is classified.

Kingdom	Animalia
	Arthropoda

	Insecta
	Notoptera
Family	Mantophasmatodae
Species	

(2)

(ii) This system of classification consists of a hierarchy. Explain what is meant by a hierarchy.

_____

_____

_____

_____

(2)

(b) In 2002, very few gladiators were available for identification. Scientists around the world used photographs to establish the relationship of gladiators to other insects.

Explain how.

_____

_____

(1)

(Total 5 marks)

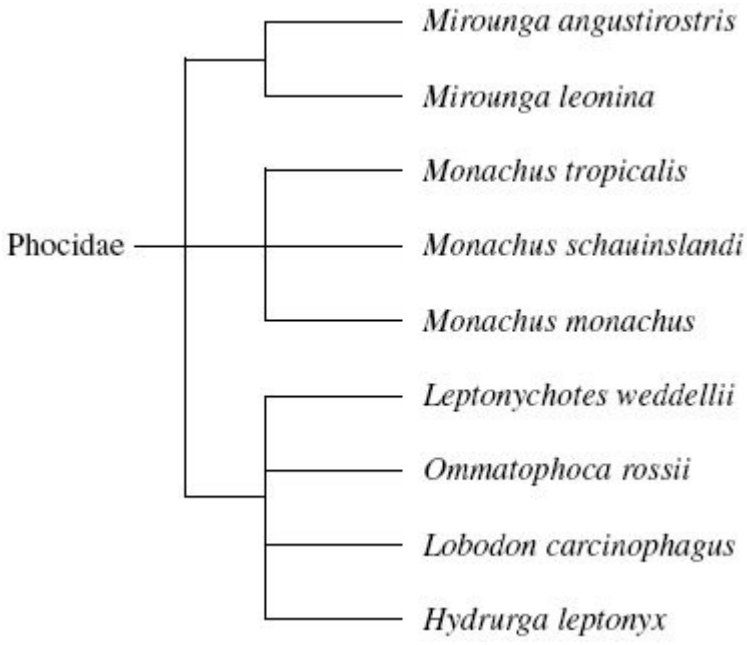
Q21.

(a) An order is a taxonomic group. All seals belong to the same order. Name **one** other taxonomic group to which all seals belong.

_____

(1)

(b) The diagram shows how some species of seal are classified.



(i) How many different genera are shown in this diagram?

(1)

(ii) All the seals shown in the diagram are members of the Phocidae. Phocidae is an example of a taxonomic group. Of which taxonomic group is it an example?

_____

(1)

(iii) The diagram is based on the evolutionary history of the seals. What does the information in the diagram suggest about the common ancestors of *Mirounga angustirostris*, *Mirounga leonina* and *Monachus tropicalis*?

_____

_____

_____

(1)

(c) A species of seal shows genetic diversity. Explain what is meant by genetic diversity.

_____

_____

(1)

(Total 5 marks)

Q22.

(a) The guinea pig, *Cavia porcellus*, is a small mammal. Complete the table to show the classification of the guinea pig.

Kingdom	
	Chordata
	Mammalia
	Rodentia
Family	Caviidae
Genus	
Species	

(2)

(b) In South America, there are several species of guinea pig. They are thought to have arisen by sympatric speciation.
Explain how sympatric speciation may have occurred.

_____

_____

_____

_____

_____

_____

(3)

(c) In guinea pigs, hair length and hair colour are controlled by two genes on different chromosomes. The hair may be either long or short and its colour either black or brown.

A male guinea pig and a female guinea pig both had short, black hair. The male was homozygous for hair length, and the female was homozygous for hair colour. Repeated crossings of these two guinea pigs resulted in offspring of four different genotypes, all of which had short, black hair.

Complete the genetic diagram to explain these results. Write in the box the symbols you will use to represent the alleles.

Allele for short hair = _____	Allele for long hair = _____
Allele for black hair = _____	Allele for brown hair = _____

	Male	Female
Parental phenotypes	Short, black hair	Short, black hair
Parental genotypes	_____	_____

Gamete genotypes _____ _____

Offspring genotypes _____

Offspring phenotypes Short, black hair

(4)

(d) In another investigation, the same female guinea pig was twice mated with another male which had long, brown hair. Of the 14 offspring, 10 had short, black hair and 4 had long, black hair. The investigators expected equal numbers of offspring with these two phenotypes. They used a χ^2 test to determine whether the observed results fitted the expected 1:1 ratio.

Give a suitable null hypothesis for the investigation.

_____

_____

(1)

(Total 10 marks)

Q23.

Finches are small birds. Fourteen species of finch are found on the Galapagos Islands.

(a) What is a species?

_____

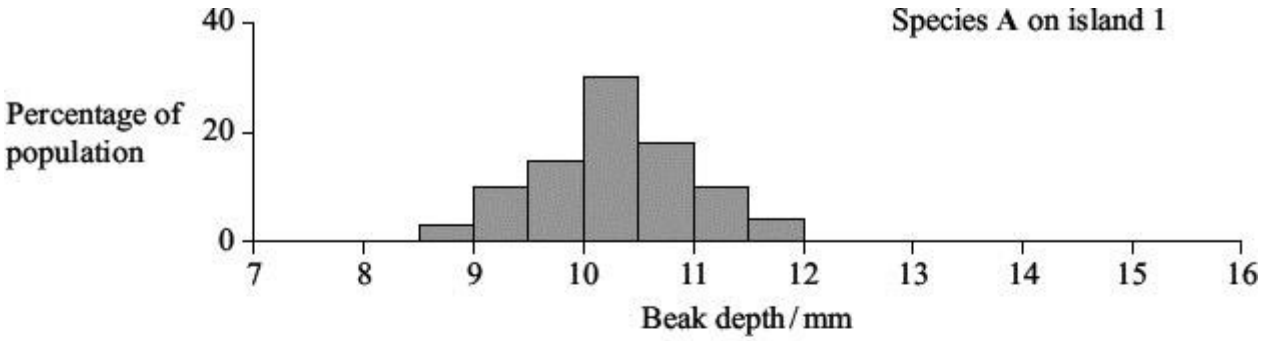
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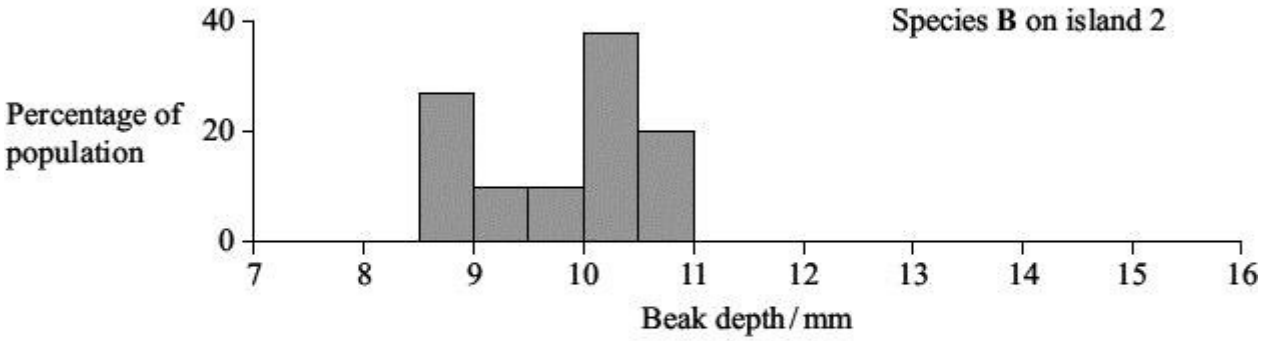
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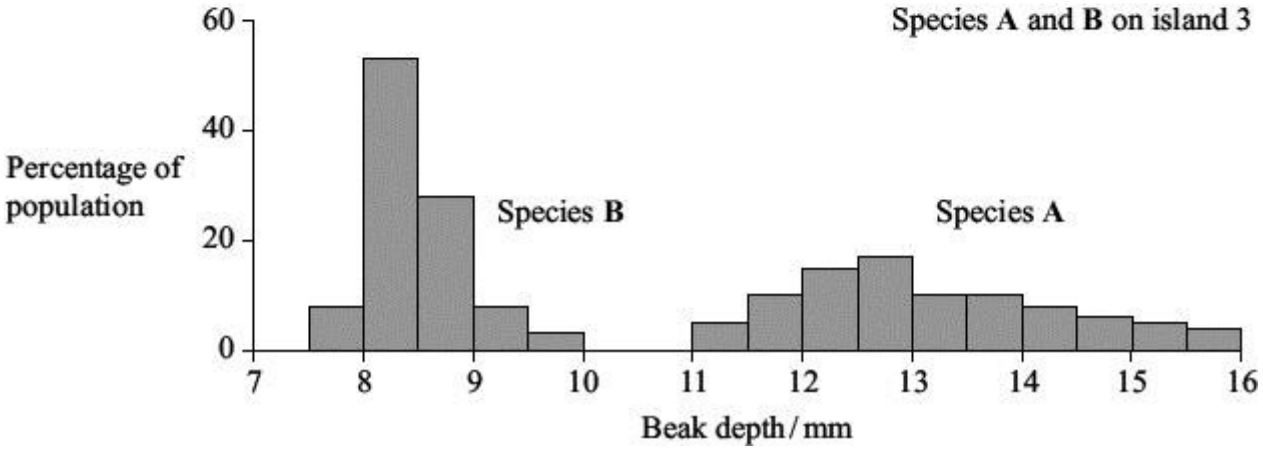
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(2)

(b) Measurements were made of the beak depth of two species of finch (species **A** and species **B**) on different islands. Species **A** is found on island 1, species **B** is found on island 2. Both species are found on island 3. They are thought to have colonised island 3 from islands 1 and 2 respectively. The graphs show the ranges of beak depths of the two species on the different islands.







What type of natural selection took place in the populations of both species after they had colonised island 3? Explain your answer.

_____

_____

_____

_____

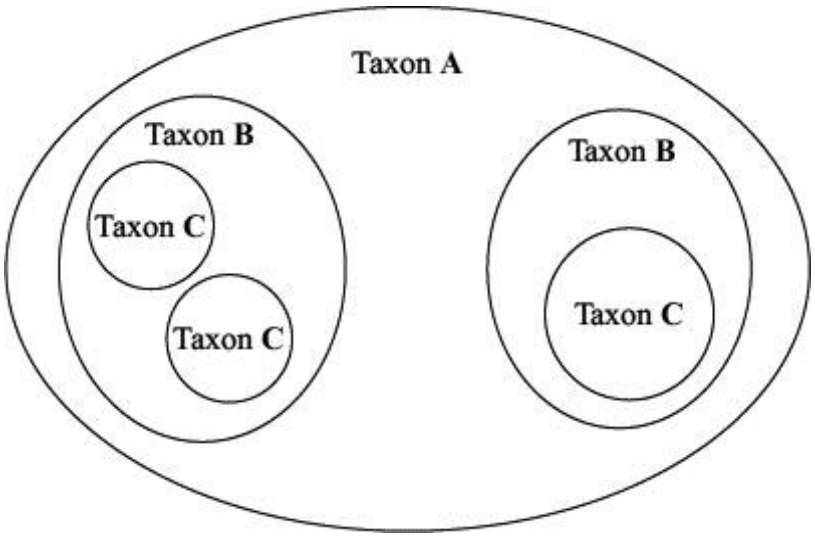
_____

(3)

(Total 5 marks)

Q24.

In taxonomy, each of the levels of classification (class, family, genus, kingdom, order, phylum and species) is called a taxon. The diagram represents just three of these levels of classification.



Explain which of these levels of classification could **not** be

(i) a genus;_____

_____

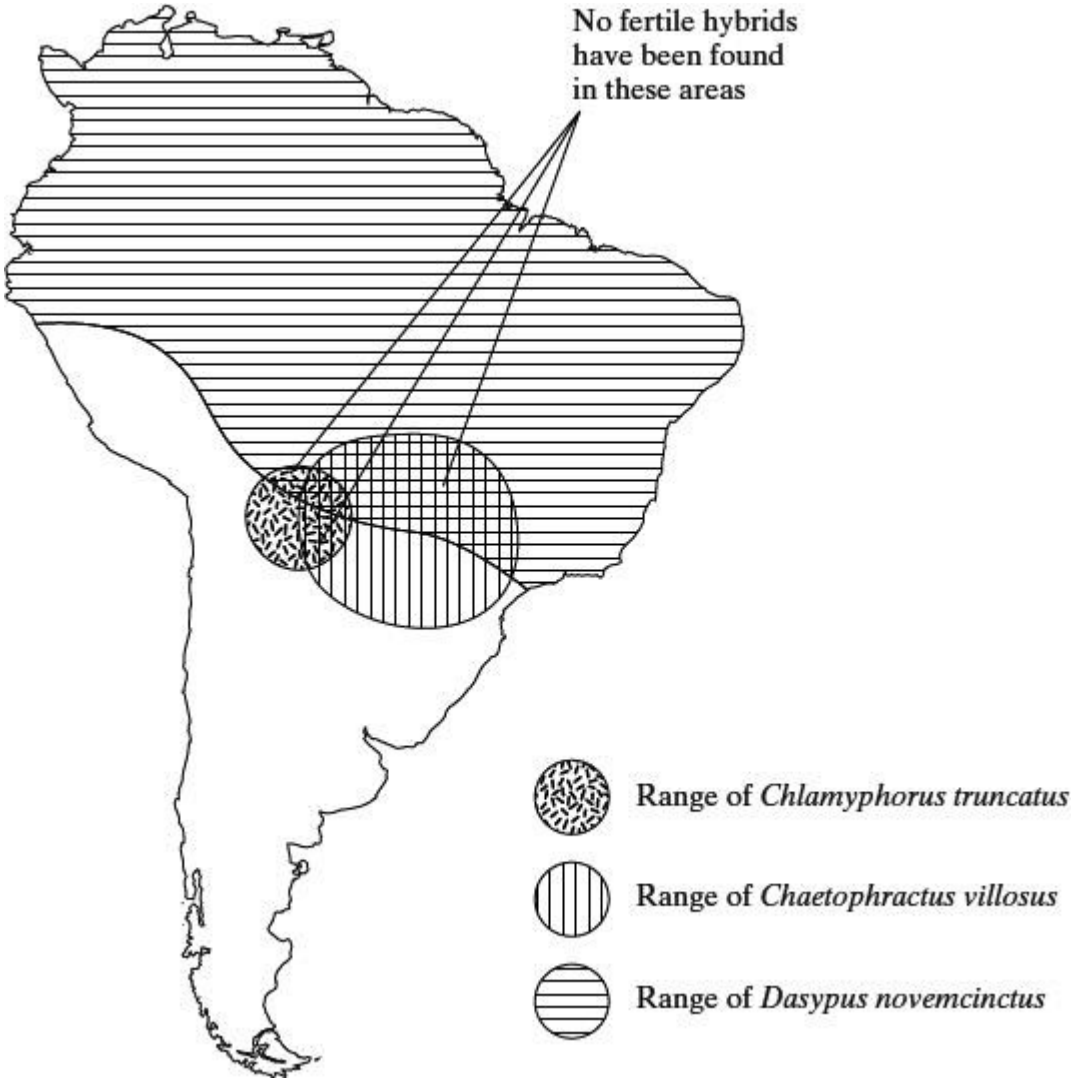
(ii) a phylum _____

_____

(Total 2 marks)

Q25.

Armadillos are mammals. The map shows the ranges of three species of armadillo in South America.



(a) (i) What evidence in their ranges suggests that the three armadillos belong to different species?

_____

_____

(1)

(ii) What further evidence would confirm that the three armadillos belong to different species?

_____

_____

(1)

(b) (i) Complete the table to show the classification of *Dasypus novemcinctus*.

Kingdom	
Phylum	Chordata
	Mammalia

	Xenarthra
	Dasypodidae
Genus	
Species	

(2)

(ii) What is the lowest taxonomic grouping that the three species of armadillos can share? Explain your answer.

_____

_____

_____

_____

(1)

(Total 5 marks)

Q26.

(a) The cheetah, *Acinonyx jubatus*, and other cat species belong to the family Felidae. Complete the table to show the classification of the cheetah.

Kingdom	Animalia
	Chordata
	Mammalia
	Carnivora
Family	Felidae
Genus	

(2)

(b) This system of classification is described as hierarchical. Explain what is meant by a hierarchical classification.

_____

_____

(1)

(c) Despite differences in form, leopards, tigers and lions are classified as different species of the same genus. Cheetahs, although similar in form to leopards, are

classified in a different genus.

(i) Describe **one** way by which different species may be distinguished.

_____

_____

(1)

(ii) Suggest **two** other sources of evidence which scientists may have used to classify cheetahs and leopards in different genera.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Q27.

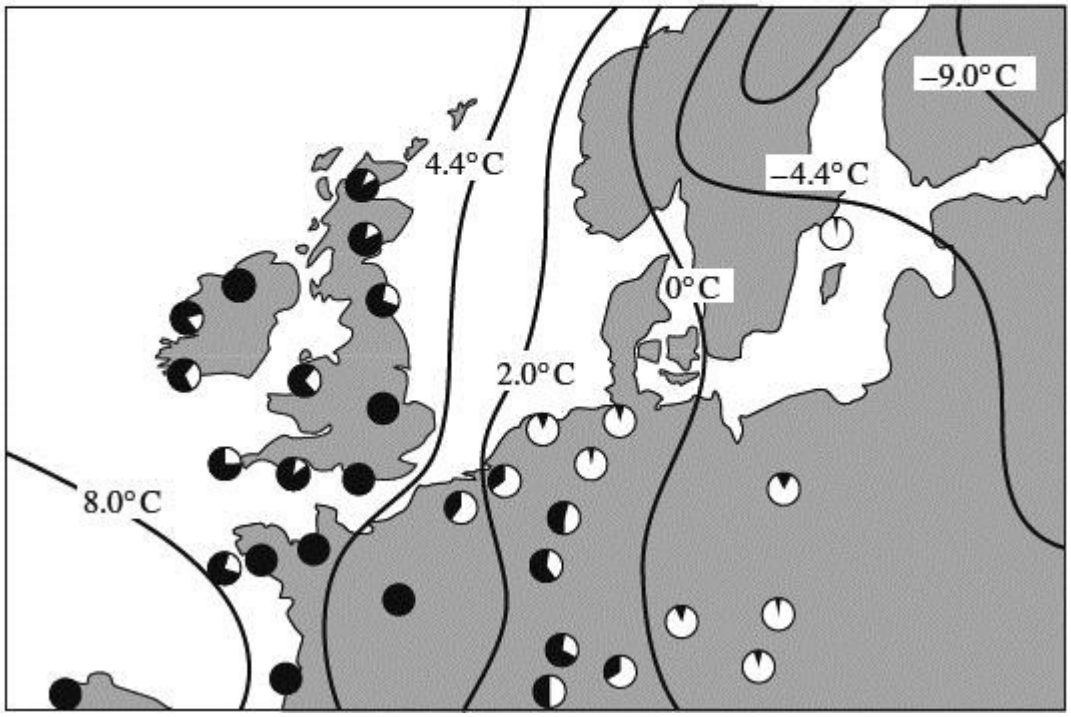
Clover plants have leaves all through the year. Some clover plants have leaves that produce poisonous hydrogen cyanide gas when damaged. These cyanogenic plants are less likely to be eaten by snails. However, the leaves of these plants can be damaged by frost, resulting in the production of enough hydrogen 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 in different 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)

Q28.

Lake Malawi in East Africa contains around 400 different species of cichlids which are small, brightly coloured fish. All these species have evolved from a common ancestor.

(a) Describe **one** way in which scientists could find out whether cichlids from two different populations belong to the same species.

_____

_____

_____

_____

(2)

(b) During the last 700 000 years there have been long periods when the water level was much lower and Lake Malawi split up into many smaller lakes. Explain how speciation of the cichlids may have occurred following the formation of separate, smaller lakes.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Many species of cichlids are similar in size and, apart from their colour, in appearance. Suggest how the variety of colour patterns displayed by these cichlids may help to maintain the fish as separate species.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q29.

(a) Explain the principles which biologists use to classify organisms into groups.

_____

_____

_____

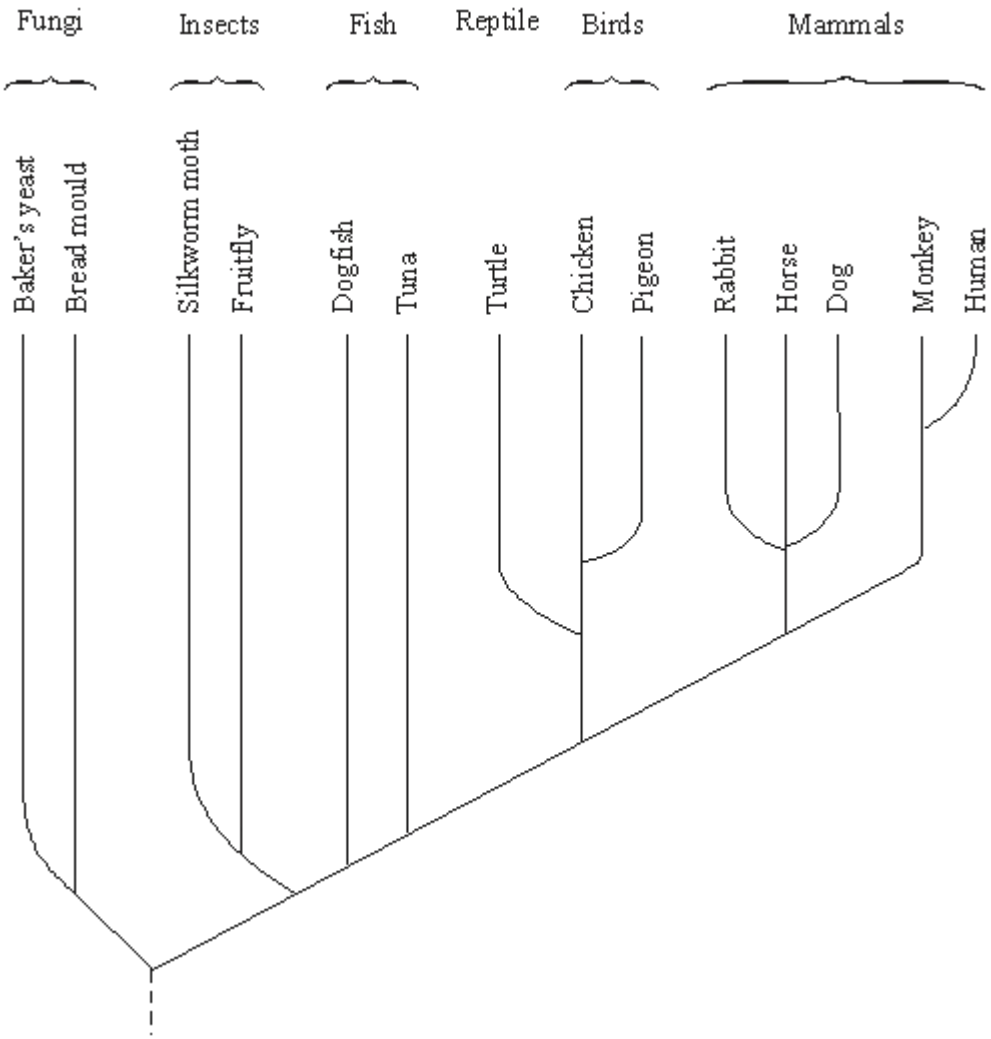
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_____

_____

(3)

Cytochrome c is a protein with about 100 amino acids and is present in all eukaryotic organisms. It has the same three-dimensional shape in all species, but only 30 of the amino acids are the same in all species. The amino acid sequence of cytochrome c has been used to construct the phylogenetic tree shown below.



(b) Name the kingdoms represented in this phylogenetic tree.

_____

(1)

(c) What does the phylogenetic tree show about the evolutionary relationship between fungi and insects?

_____

_____

_____

_____

(2)

(d) Suggest how information on amino acid sequences is used to construct a phylogenetic tree.

_____

_____

_____

_____

(2)

(e) Suggest **one** advantage and **one** disadvantage of using cytochrome c to construct a phylogenetic tree.

Advantage

_____

_____

Disadvantage

_____

_____

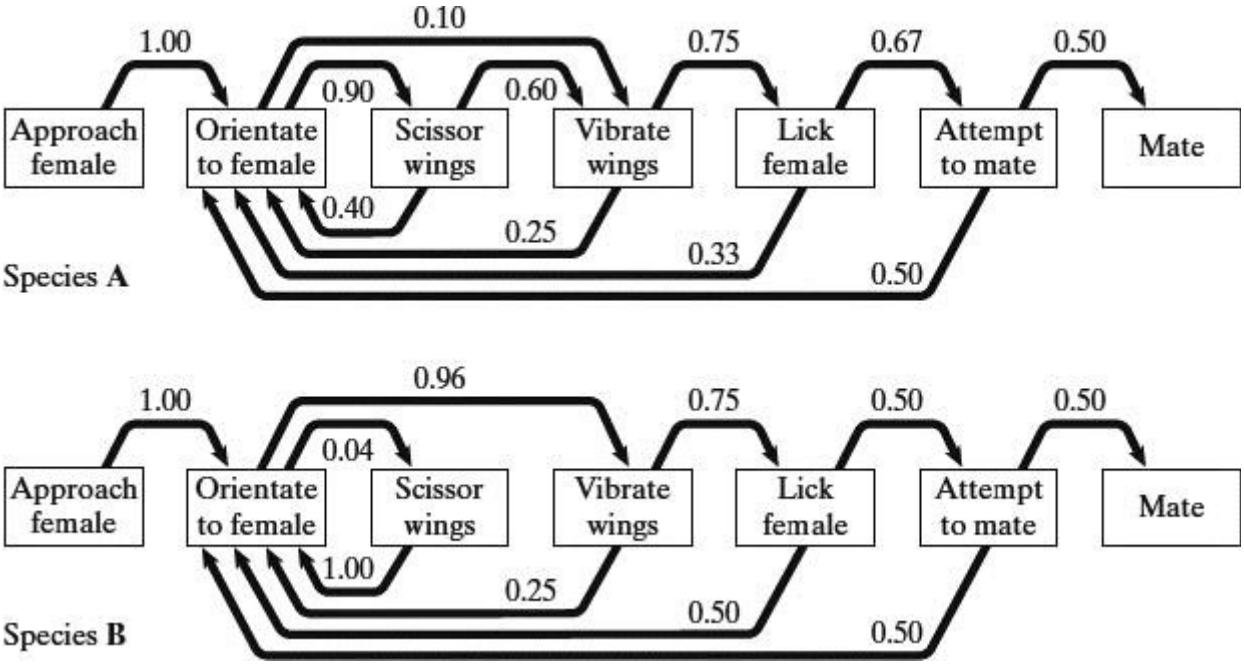
(2)

(Total 10 marks)

Q30.

Courtship and mating in fruitflies can occur equally well in the light or dark.

The diagrams show the courtship sequence of males from two closely related species of fruitfly (species **A** and species **B**). The numbers show the probability of one courtship element following from another.



(a) Once a male of species **A** has orientated to the female, what is the probability that he will perform each courtship element once only and then attempt to mate? Show your working.

Probability _____

(2)

(b) Suggest how the courtship sequences provide evidence to support the claim that the two species are

(i) closely related;

_____

_____

(1)

(ii) separate species.

_____

_____

(1)

(c) During courtship, vibration of the wings creates a sound. The sound is different in the two species of fruitfly. Explain how this prevents mating between members of different species.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q31.

(a) The mammals form a class called the Mammalia within the animal kingdom. The grey wolf is a species of mammal. **Figure 1** shows the groups within the Mammalia to which the wolf (labelled **W**) belongs.

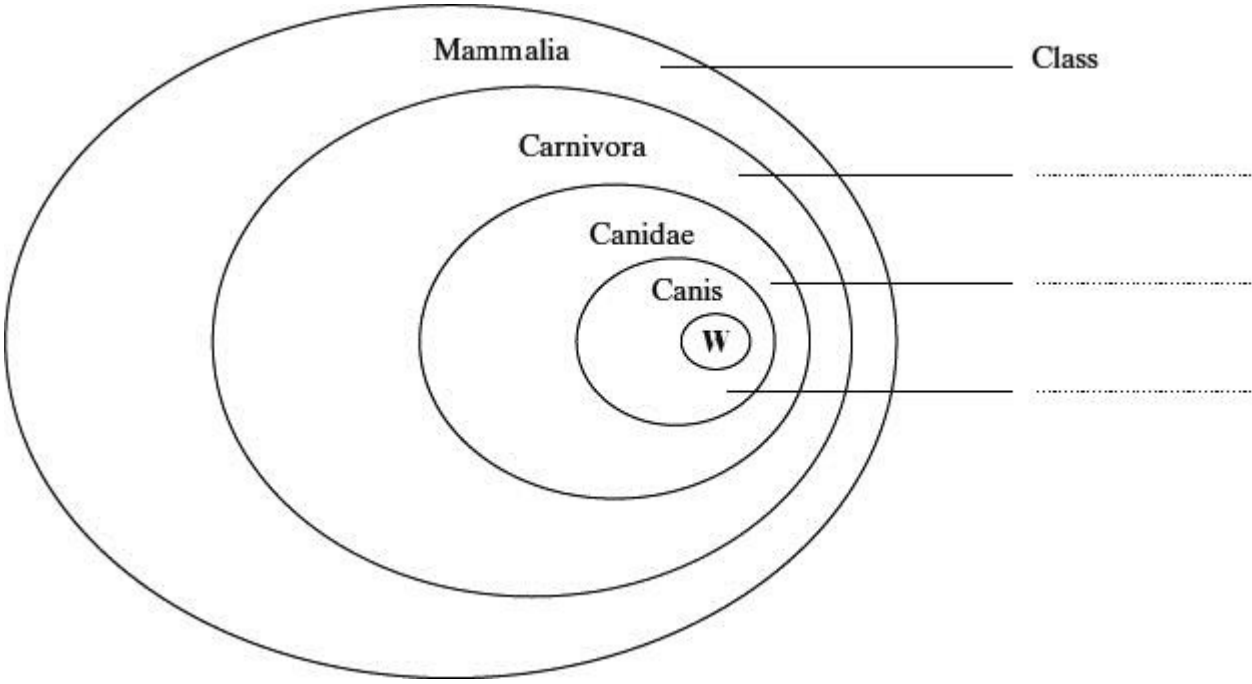


Figure 1

(i) Label **Figure 1** to show the names of the groups.

(2)

(ii) The lion, *Panthera leo*, belongs to another group in the Carnivora, called the Felidae. Add this information to **Figure 1**, using the letter L to represent the lion species.

(1)

(b) The diagrams show two systems of classification of mammals. **Figure 2** shows a simple hierarchy. **Figure 3** shows a phylogenetic system.

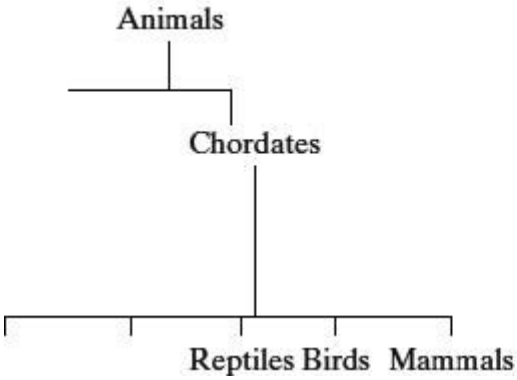


Figure 2

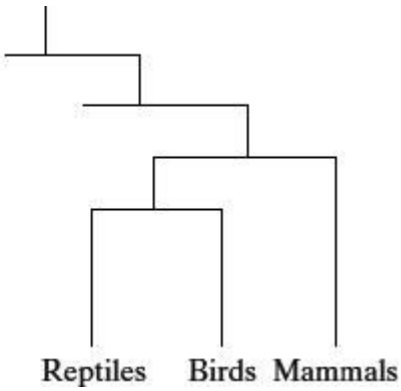


Figure 3

(i) What is meant by a hierarchy?

_____

_____

(1)

(ii) By reference to **Figures 2** and **3**, explain how a phylogenetic system differs

from a simple hierarchy.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q32.

This question should be written in continuous prose, where appropriate.

Quality of Written Communication will be assessed in these answers.

(a) Use your knowledge of classification to arrange *class*, *phylum*, *genus* and *family* in order of decreasing number of species.

largest number of species → smallest number of species

_____ _____ _____ _____

(1)

(b) Cytochrome c is a protein involved in one of the reactions of aerobic respiration in a mitochondrion. The molecular structure of cytochrome c from different species has been analysed. More similarities are present in the structure of cytochrome c in closely related species than in distantly related species.

(i) Explain what is meant when two species are described as being *closely related*.

_____

_____

(1)

(ii) A difference in the molecular structure of cytochrome c may arise in a small population that becomes geographically isolated. Explain how the difference may arise and how it may spread in the population.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 6 marks)