



A-Level Biology

Classification and Taxonomy

Question Paper

Time available: 65 minutes

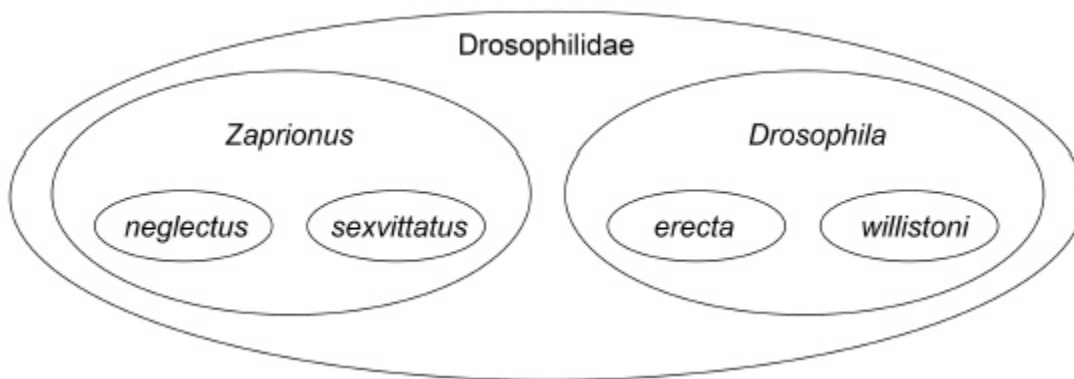
Marks available: 53 marks

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1.

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

Figure 1



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

(2)

(b) Name the taxon to which Drosophilidae belongs.

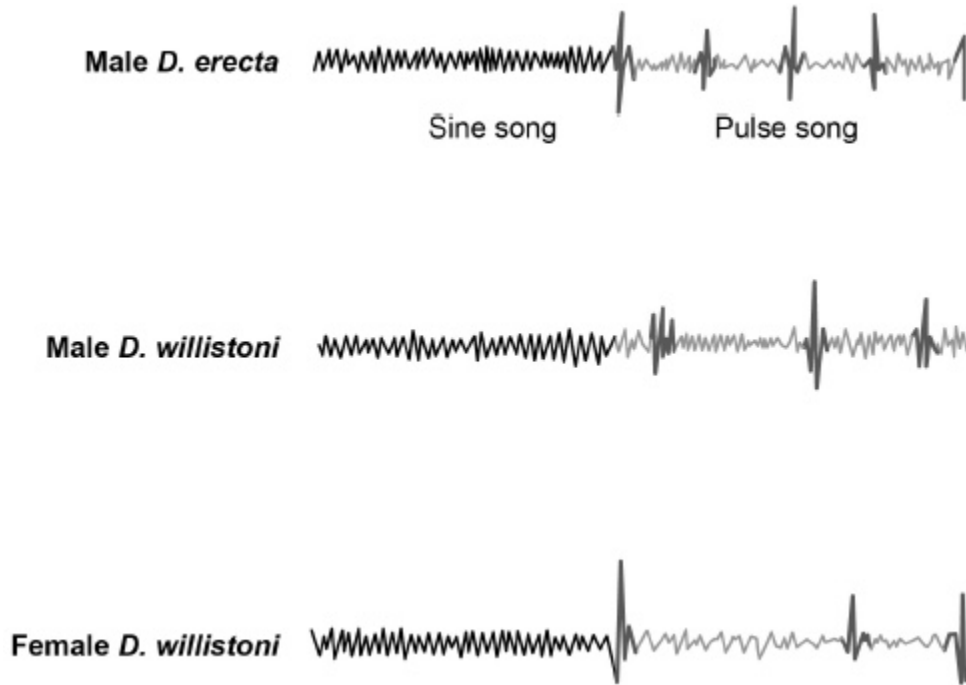
(1)

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.

(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.

(2)

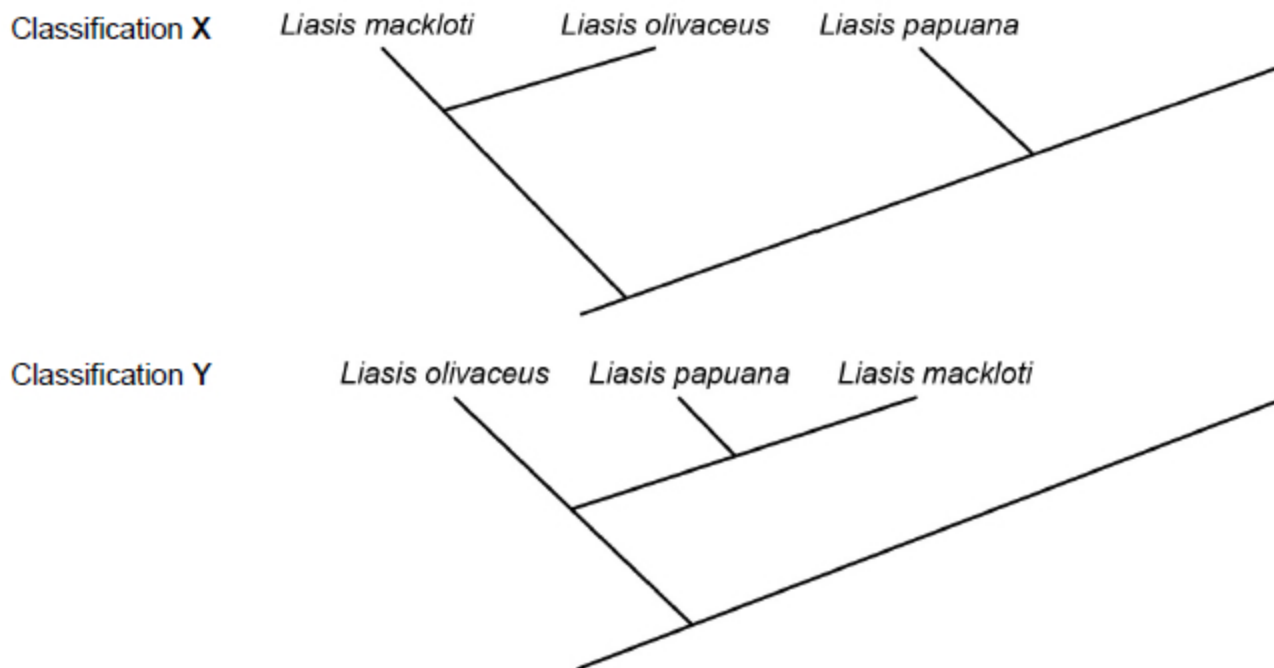
(Total 7 marks)

2.

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.



- (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. _____

2. _____

3. _____

(3)

(Total 7 marks)

3.

(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 (\pm SD) / mm | |
|--------------------------------|------------------------------|--------------------|
| | Head and body | Tail |
| St. Kilda field mouse | 112.3 (\pm 9.3) | 105.5 (\pm 8.4) |
| Long-tailed field mouse | 95.2 (\pm 8.2) | 90.2 (\pm 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.

(2)

(Total 9 marks)

4.

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.

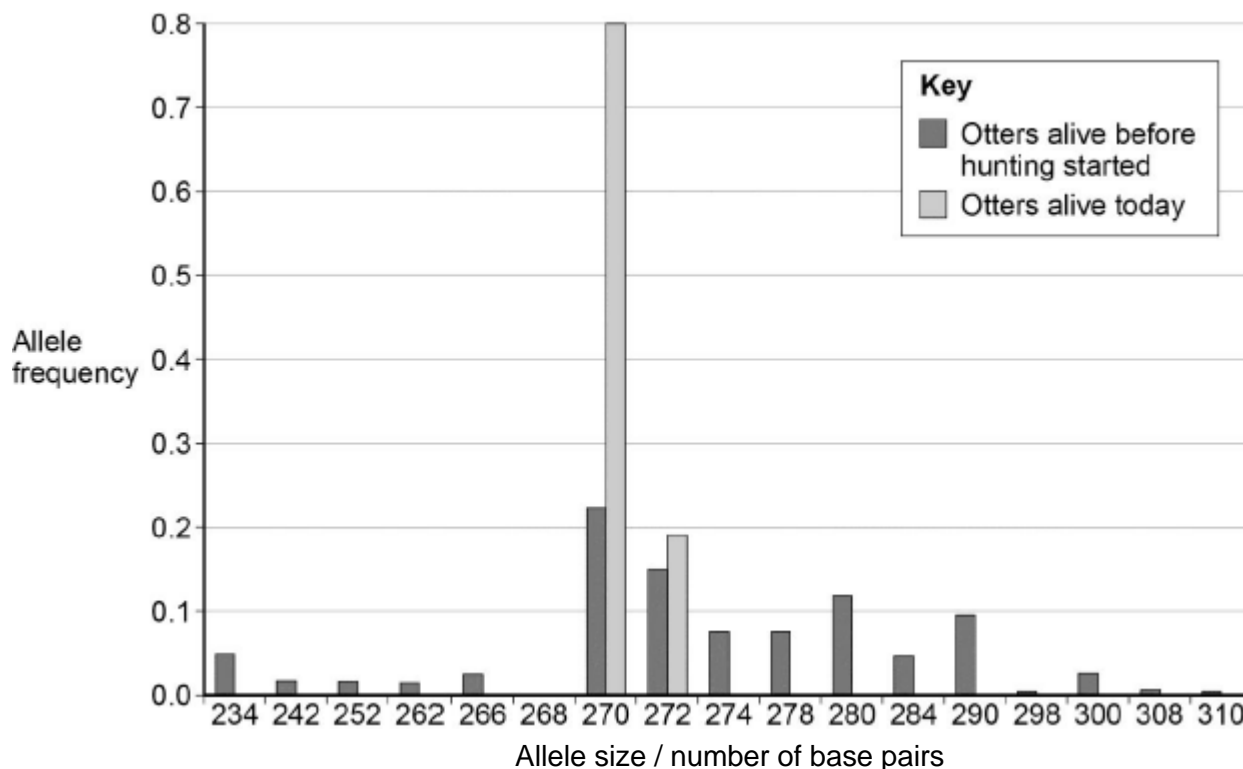
(1)

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)

5.

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.

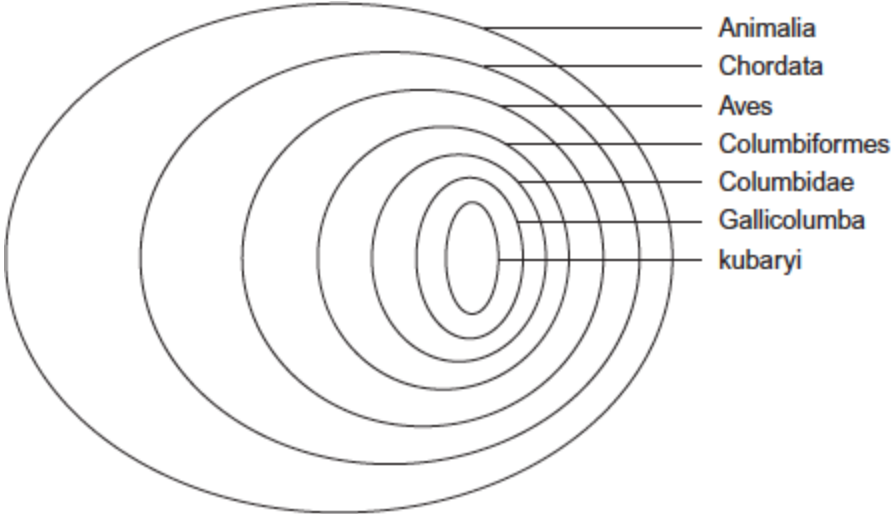
(2)

(Total 5 marks)

6.

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.

(1)

(Total 3 marks)

7.

(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.

(4)

(Total 9 marks)

8.

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 (\pm standard deviation) | 13.6 (\pm 1.9) | 10.8 (\pm 1.3) | 14.2 (\pm 1.6) | 11.6 (\pm 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)