Helicate

HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.4.5 Species and taxonomy

Topic question bank

Version 1 · 9 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
8	47	No time limit	/ 47

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Total		**47**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA AS and A-level Biology (7401/7402), specification section 3.4.5. Not affiliated with or endorsed by AQA.

Do not write outside the box

Species and courtship 3.4.5

0 1 Which of the following shows that two organisms belong to the same species?
Tick (✓) one box.

[1 mark]

They look the same and have the same visible features. ☐

They live in the same habitat at the same time. ☐

They can interbreed to produce fertile offspring. ☐

They belong to the same genus. ☐

1

Turn over for the next question

Do not write outside the box

Fireflies are beetles that produce flashes of light. In one species of firefly, species **A**, courtship takes place at night:

- a flying male produces a pattern of flashes
- a female resting on a plant replies with a single flash
- the male flies towards the female's flash, and the pair then mate.

A second species of firefly, species **B**, lives in the same meadows. Males of species **B** produce a different pattern of flashes.

Scientists placed females of species **A**, one at a time, in a dark container. A small electric light (LED) controlled by a computer produced a pattern of flashes, and the scientists recorded whether the female replied. Each female was tested with only one pattern. Table 1 shows their results.

Table 1

Pattern of flashes produced by the LED	Number of females tested	Number of females that replied
Pattern of a species **A** male	60	42
Pattern of a species **B** male	60	3
Species **A** pattern with the time between flashes doubled	60	9
No flashes (LED switched off)	60	0

0 2 . 1 Calculate the percentage decrease in the number of females that replied when the time between flashes in the species **A** pattern was doubled.

[2 marks]

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.....

Answer ..... **%**

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Suggest why the scientists used an LED controlled by a computer, rather than live males, to produce the flashes.

[2 marks]

0 2 . 3 Use Table 1 to explain the role of courtship in species recognition in species **A**, and why this role is important for successful mating.

[5 marks]

9

Turn over for the next question

Do not write outside the box

Classification and binomial naming 3.4.5

Table 2 shows the phylogenetic classification of three species of mammal. Three of the taxon ranks have been replaced by the letters **X**, **Y** and **Z**.

Table 2

Taxon rank	Red fox	Fennec fox	Grey wolf
Domain	Eukarya	Eukarya	Eukarya
Kingdom	Animalia	Animalia	Animalia
X	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia
Y	Carnivora	Carnivora	Carnivora
Family	Canidae	Canidae	Canidae
Z	*Vulpes*	*Vulpes*	*Canis*
Species	*vulpes*	*zerda*	*lupus*

0 3 . 1 Give the taxon ranks represented by **X**, **Y** and **Z**.

[2 marks]

X .....

Y .....

Z .....

0 3 . 2 Give the name of the smallest taxon that includes both the red fox and the grey wolf.

[1 mark]

.....

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.....

Question 3 continues on the next page

Do not write outside the box

A student said: *"The red fox and the fennec fox are the same species, because both of their scientific names start with* Vulpes*."*

0 3 . 3 Explain why the student is wrong.

[2 marks]

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.....

5

0 4 . 1 In a classification hierarchy, what is the term for any one of the groups, such as a family or a genus?

[1 mark]

.....

0 4 . 2 Which statement about a phylogenetic classification hierarchy is correct?
Tick (✓) one box.

[1 mark]

All species in the same class belong to the same order. ☐

Each family contains one or more genera. ☐

A phylum is a smaller group than a class. ☐

Species in the same kingdom share a more recent common ancestor than species in the same family. ☐

Question 4 continues on the next page

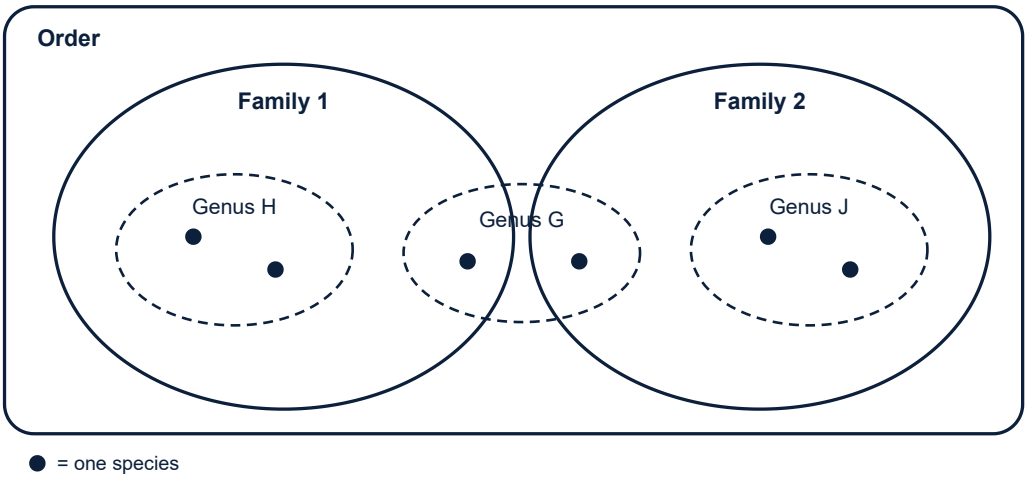
Do not write outside the box

0 4 . 3 A phylogenetic classification places each species in a series of taxa, as in Table 2.
Explain how these taxa are arranged in relation to one another, **and** give what the arrangement is based on.

[2 marks]

A student drew Figure 1 to represent part of a phylogenetic classification.

Figure 1



0 4 . 4 Explain why Figure 1 cannot represent a phylogenetic classification.

[2 marks]

6

Turn over for the next question

Do not write outside the box

Clarifying evolutionary relationships 3.4.5

Scientists investigated the relationships between the brown bear and four other species of mammal.

- They injected albumin, a protein found in blood serum, from a brown bear into a rabbit. The rabbit produced antibodies against brown bear albumin.
- They collected serum containing these antibodies from the rabbit.
- They mixed a sample of this serum with serum from one animal of each of the five species. When the antibodies bind to albumin, a precipitate forms that makes the mixture cloudy (turbid).
- They measured the turbidity of each mixture with a colorimeter. They took three readings for each species.

Table 3 shows their results. The mean for the Asian black bear has not been given.

Table 3

Species that provided the serum	Turbidity / arbitrary units			
	Reading 1	Reading 2	Reading 3	Mean
Brown bear	84	88	86	86
Polar bear	81	79	83	81
Asian black bear	66	70	65	
Giant panda	30	33	27	30
Grey wolf	10	12	11	11

Question 5 continues on the next page

Do not write outside the box

0 5 . 1 Explain why the turbidity of each mixture gives information about how closely related each species is to the brown bear.

[3 marks]

0 5 . 2 Calculate the mean turbidity for the Asian black bear.

[1 mark]

Answer _____ **arbitrary units**

0 5 . 3 The scientists expressed the mean turbidity for each species as a percentage of the mean turbidity for the brown bear.
Calculate this percentage for the giant panda.
Give your answer to **two** significant figures.

[2 marks]

Answer _____ **%**

Question 5 continues on the next page

Do not write outside the box

The scientists concluded that the polar bear is more closely related to the brown bear than the Asian black bear and the giant panda are.

0 5 . 4 Evaluate this conclusion.

[4 marks]

10

Turn over for the next question

Do not write outside the box

Scientists sequenced the genomes of four species of lizard, **P**, **Q**, **R** and **S**. For each pair of species, they lined up (aligned) the two genomes and calculated the percentage of base positions at which the bases were identical.

Table 4 shows their results.

Table 4

Pair of species	Percentage of aligned base positions with identical bases
P and **Q**	97.1
P and **R**	92.4
P and **S**	88.0
Q and **R**	92.6
Q and **S**	88.2
R and **S**	88.5

0 6 . 1 Explain why a higher percentage of identical bases suggests that two species are more closely related.

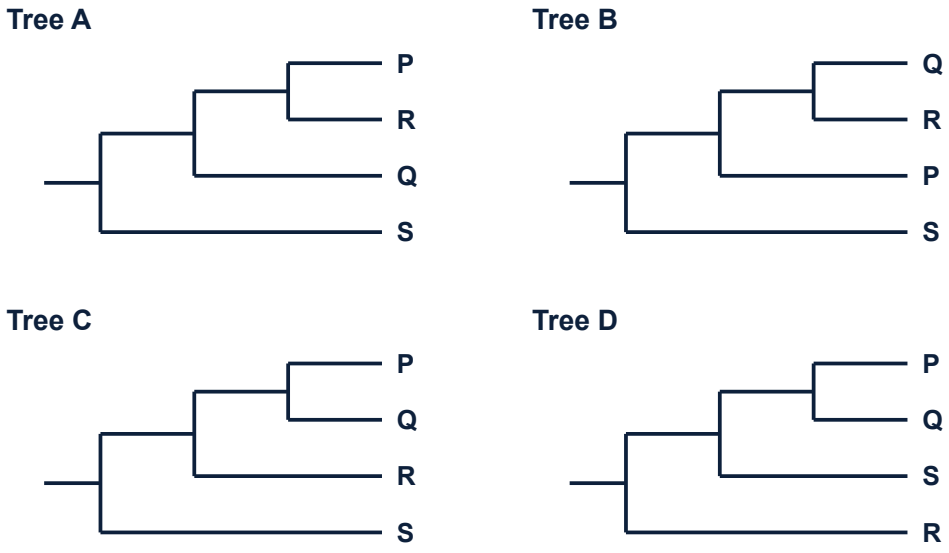
[2 marks]

Question 6 continues on the next page

Do not write outside the box

Figure 2 shows four possible phylogenetic trees for these species.

Figure 2



Each tree runs from a common ancestor (left) to present-day species (right).

0 6 . 2 Which tree in Figure 2 is supported by the data in Table 4?
Tick (✓) one box.

[1 mark]

Tree A ☐

Tree B ☐

Tree C ☐

Tree D ☐

Question 6 continues on the next page

Do not write outside the box

A student said: *"Species **P**, **Q** and **R** all evolved from species **S**."*

0 6 . 3 Use the supported tree to explain why the student is wrong.

[2 marks]

0 6 . 4 When the genomes of species **P** and **Q** were aligned, 1.9×10^9 base positions were compared.
Use Table 4 to calculate the number of base positions at which the bases of **P** and **Q** were different.
Give your answer in standard form.

[2 marks]

Answer .....

7

Turn over for the next question

Do not write outside the box

In the 19th century, songbird species **K** and **L** were placed in the same genus because of their visible features. Species **M** was placed in a different genus.

Recently, scientists sequenced the genomes of all three species. Table 5 shows some of their data.

Table 5

Feature	Species **K**	Species **L**	Species **M**
Beak shape	Short and thick	Short and thick	Long and thin
Main food	Seeds	Seeds	Insects
Percentage of aligned base positions with bases identical to species **K**	–	94.1	98.6

0 7 The scientists have suggested that species **K** should be moved into the same genus as species **M**.
Use Table 5 to evaluate this suggestion.

[3 marks]

3

Turn over for the next question

Do not write outside the box

Extended response: identifying a species 3.4.5

Two populations of salamander live in neighbouring valleys. Salamanders from the two populations look almost identical. Before mating, the males in each population perform a courtship display, and the displays of the two populations are different.

0 8 Describe how scientists could use breeding experiments, courtship and molecular evidence to find out whether the two populations belong to the same species, and how closely related they are.

[6 marks]

6

END OF QUESTIONS

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