HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.4.5 Species and taxonomy

Mark scheme

Version 1 · 9 October 2026

TOTAL MARKS	QUESTIONS
47	8

How to use this mark scheme

;	Separates marking points. Each semicolon marks the end of one creditable point, and each point is worth one mark.
;;	Two marks for this answer (used for calculations).
/	Alternative words or phrases that are credited for the same point.
OR	An alternative answer for the same mark.
( )	Words in brackets are not needed to gain the mark.
max	More marking points are listed than marks available. Award up to the number of marks shown.
Accept	An alternative answer that gains credit.
Reject	A wrong answer. It does not gain credit and cancels a correct point it contradicts.
Ignore	Neither credited nor penalised. Mark the rest of the answer.
ECF	Error carried forward: credit correct working that uses an earlier wrong answer.
AO	Assessment objective: AO1 knowledge and understanding; AO2 applying knowledge; AO3 analysing, interpreting and evaluating.

Where an answer is correct but not listed, credit it if it is biologically accurate and answers the question at the depth the marks require. Right + wrong = wrong: a contradiction cancels a correct point.

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Species and courtship 3.4.5

Question	Marking guidance	Mark	Comments
01	They can interbreed to produce fertile offspring;	**1** (1 × AO1)	

Question	Marking guidance	Mark	Comments
02.1	Correct answer for 2 marks: 78.6 (%);; Accept for 1 mark: 42 − 9 = 33 **OR** (42 − 9) ÷ 42	**2** (2 × AO2)	**Accept** 79 or 78.57 (%) for 2 marks **Accept** (70 − 15) ÷ 70 for 1 mark **Reject** 55 (%) (difference in percentage points); no credit **Reject** 21.4 (%) for 2 marks

Question	Marking guidance	Mark	Comments
02.2	1. Only the pattern of flashes is different OR live males differ in other ways, eg size, scent, movement, brightness of flash; 2. So any difference in replies is due to the pattern (of flashes) only; 3. The (same) pattern can be repeated exactly for every female OR the pattern can be altered, eg the time between flashes doubled, which live males would not do;	**2 max** (2 × AO3)	1. **Accept** 'to control other variables' only with a named variable **Ignore** 'to make it a fair test' unqualified **Ignore** ethical reasons

Question	Marking guidance	Mark	Comments
02.3	1. Many more females replied to the species A pattern than to the species B pattern (42 compared with 3 OR 70% compared with 5%); 2. So females recognise (the courtship signal of) males of their own species; 3. Fewer females replied when the time between flashes was doubled (9 OR 15%), so the timing of flashes is (part of) what is recognised OR the signal is specific to the species; 4. No females replied with the LED off, so the replies are a response to the flashes (and not to other conditions in the container); 5. The male only finds/approaches a female that replies, so (courtship is a precursor to mating and) mating is (mostly) with a member of the same species; 6. Members of the same species can produce fertile offspring, so mating is successful;	**5 max** (2 × AO2) (3 × AO3)	**Max 3** if no data from Table 1 are used 1. **Accept** '14 times as many' 5. **Accept** prevents/reduces mating with species B 6. **Accept** avoids wasting time/energy/gametes on mating with another species, as an alternative for point 6 **Accept**, as an AO3 alternative for point 4, that a few females (3) replied to species B, so recognition is not perfect **Ignore** 'to attract a mate' unqualified

Classification and binomial naming 3.4.5

Question	Marking guidance	Mark	Comments
03.1	X = phylum, Y = order, Z = genus;;	**2** (2 × AO1)	All three correct = 2 marks; two correct = 1 mark **Accept** phyla and genera **Accept** phonetic spelling; ignore upper or lower case

Question	Marking guidance	Mark	Comments
03.2	Canidae;	**1** (1 × AO2)	**Accept** 'family' **Accept** phonetic spelling; ignore case **Reject** Carnivora, Mammalia, *Vulpes*, *Canis*

Question	Marking guidance	Mark	Comments
03.3	1. *Vulpes* is the genus (name), so they are (only) in the same genus; 2. The second part of the binomial/the species name is different (*vulpes* and *zerda*) OR each species has its own binomial; 3. Being the same species depends on being able to (interbreed and) produce fertile offspring (not on the name);	**2 max** (2 × AO2)	**Ignore** case and italics in any names written 2. **Accept** 'the binomials are different'

Question	Marking guidance	Mark	Comments
04.1	Taxon;	**1** (1 × AO1)	**Accept** taxa **Reject** taxonomy, hierarchy, classification

Question	Marking guidance	Mark	Comments
04.2	Each family contains one or more genera;	**1** (1 × AO1)	

Question	Marking guidance	Mark	Comments
04.3	1. Smaller groups are placed within larger groups OR (groups are arranged in) a hierarchy, with no overlap (between groups); 2. (Grouped) by evolutionary origins/relationships/history;	**2** (2 × AO1)	1. Both the idea of groups within groups (or hierarchy) **and** no overlap are needed 2. **Accept** common ancestry 2. **Ignore** grouping by similar features/characteristics unqualified

Question	Marking guidance	Mark	Comments
04.4	1. Genus G overlaps family 1 and family 2 OR one species of genus G is in family 1 and the other is in family 2; 2. In a phylogenetic classification there is no overlap (between groups) OR each genus must be entirely within one family; 3. Species in a genus share one evolutionary origin/a (recent) common ancestor, so they cannot be in two families;	**2 max** (2 × AO2)	1. **Accept** 'genus G is in two families' **Ignore** references to the number of species in each genus

Clarifying evolutionary relationships 3.4.5

Question	Marking guidance	Mark	Comments
05.1	1. Antibodies are specific OR (each) antibody binds to an antigen/albumin with a complementary shape; 2. Albumin of more closely related species has a more similar amino acid sequence OR tertiary structure/shape (to brown bear albumin); 3. So more antibodies bind (forming more antigen–antibody complexes), giving more precipitate/higher turbidity; 4. More similar proteins show more similar DNA base sequences/genes, so the species are more closely related OR have a more recent common ancestor;	**3 max** (2 × AO1) (1 × AO2)	2. **Accept** primary structure for amino acid sequence 4. **Accept** 'more recent common ancestor' for more closely related 4. **Ignore** 'similar DNA' without reference to base sequence or genes

Question	Marking guidance	Mark	Comments
05.2	67 (arbitrary units);	**1** (1 × AO2)	**Accept** 67.0 or 67.00

Question	Marking guidance	Mark	Comments
05.3	Correct answer for 2 marks: 35 (%);; Accept for 1 mark: 30 ÷ 86 (× 100) **OR** 34.9 OR 34.88 (%) (not to two significant figures)	**2** (2 × AO2)	**Reject** 65 (%) for 2 marks (percentage difference)

Question	Marking guidance	Mark	Comments
05.4	1. (Supports:) mean turbidity for polar bear (81) is closest to brown bear (86) / higher than Asian black bear (67) and giant panda (30); 2. (Supports:) ranges of readings do not overlap (polar bear 79–83, Asian black bear 65–70), so the difference is likely to be real/not due to chance; 3. Only one protein/albumin compared OR only a small part of the genome compared; 4. Only one animal of each species OR variation within each species not considered; 5. Turbidity may be affected by other factors, eg different concentrations of albumin in the serum of each species; 6. Should be confirmed with comparison of DNA base sequences OR genome sequencing;	**4 max** (4 × AO3)	**Max 3** if only supporting **or** only limiting points are given 1. **Accept** a correct reference to the mean for the Asian black bear calculated in 05.2 4. **Accept** antibodies from only one rabbit 6. **Reject** 'compare the DNA' without reference to base sequence or genome sequencing **Ignore** 'only three readings' or 'sample size too small' unqualified

Question	Marking guidance	Mark	Comments
06.1	1. Species inherit DNA/base sequences from a common ancestor; 2. Differences in base sequence arise (by mutation) after species separate/diverge; 3. More similar base sequences (show) a more recent common ancestor OR (show) the species diverged/separated more recently OR there has been less time for mutations/differences to accumulate;	**2 max** (2 × AO1)	**Max 1** if point 3 is not given **Ignore** 'more closely related' (given in the question) **Reject** 'similar DNA' without reference to base sequence

Question	Marking guidance	Mark	Comments
06.2	Tree C;	**1** (1 × AO2)	P and Q are most similar (97.1%); R is more similar to both (92.4%, 92.6%) than S is (88.0%, 88.2%)

Question	Marking guidance	Mark	Comments
06.3	1. Species S is a present-day/living species (like P, Q and R) OR no present-day species evolved from another present-day species; 2. All four species (evolved from) share a common ancestor OR S and the ancestor of P, Q and R evolved from a common ancestor; 3. The lineage leading to S separated/diverged earliest (but S has continued to evolve);	**2 max** (1 × AO2) (1 × AO3)	2. **Accept** the common ancestor is extinct 3. **Accept** 'S is the least recently evolved/oldest species' as part of this point **Ignore** other statements about whether S is the oldest/least recently evolved species

Question	Marking guidance	Mark	Comments
06.4	Correct answer for 2 marks: 5.51×10^{7};; Accept for 1 mark: 2.9% (of positions differ) OR $0.029 \times 1.9 \times 10^{9}$ **OR** 55 100 000 (not in standard form)	**2** (2 × AO2)	**Accept** 5.5×10^{7} for 2 marks **Reject** 1.84×10^{9} (identical positions) for 2 marks

Question	Marking guidance	Mark	Comments
07	1. K and L share visible features/beak shape and food, which explains the earlier classification; 2. (Supports:) K's genome is more similar to M (98.6%) than to L (94.1%), so K is more closely related to M OR shares a more recent common ancestor with M; 3. Similar beak shape may be due to a similar diet/way of feeding rather than close relationship OR only a few visible features were compared; 4. The genome compares (a very large number of) inherited base sequences/all of the DNA; 5. No data for L compared with M OR only one individual of each species OR other species in each genus not considered;	**3 max** (3 × AO3)	**Max 2** if no data from Table 5 are used 2. **Accept** 'more recent common ancestor' for more closely related 3. Do not require the term convergent evolution; ignore it if used

Extended response: identifying a species 3.4.5

Question	Marking guidance	Mark	Comments
08	1. They are the same species if they can (interbreed to) produce fertile offspring; 2. Put males and females from different populations together (in captivity) and see whether they mate/produce offspring; 3. Breed the offspring (with each other) to see whether they are fertile; 4. Courtship is a (necessary) precursor to mating, so observe whether females respond to the courtship display of males from the other population; 5. Courtship allows species recognition, so if females do not respond to the other display, this suggests different species; 6. Control: also pair males and females from the same population (to show they mate in these conditions) OR use many individuals from each population; 7. Compare DNA base sequences OR use genome sequencing (of the two populations); 8. Compare proteins using antibodies (immunological comparison); 9. More similar base sequences/proteins (show) more closely related OR a more recent common ancestor;	**6 max** (4 × AO1) (2 × AO2)	**Max 4** if only breeding and courtship evidence (points 1–6) **or** only molecular evidence (points 7–9) is given 4. **Accept** 'see whether the courtship leads to mating' 7. **Reject** 'compare DNA' without reference to base sequence or genome sequencing 8. **Accept** a described immunological test, eg antibodies against the proteins of one population mixed with proteins of the other **Credit** other correct functions of courtship as extra detail, but they are not required **Ignore** references to speciation or isolation; they are not required

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