HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.4.6 Biodiversity within a community

Mark scheme

Version 1 · 9 October 2026

TOTAL MARKS	QUESTIONS
36	5

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 richness and index of diversity 3.4.6

Question	Marking guidance	Mark	Comments
01.1	The number of different plant species and the number of individual plants of each species;	**1** (1 × AO1)	The index of diversity uses the number of individuals of each species (*n*) and their total (*N*), so the number of species must also be known.

Question	Marking guidance	Mark	Comments
01.2	1. (Species richness:) the number of (different) species in a community; 2. (Index of diversity:) the relationship between the number of species in a community and the number of individuals in each species;	**2** (2 × AO1)	1. **Accept** habitat/ecosystem/area for community 1. **Reject** number of species in a population 1. **Reject** number of individuals/organisms in a community 2. **Accept** 'takes into account the number of species **and** the number of individuals of each species' 2. **Accept** the formula $d = N(N - 1) / \Sigma n(n - 1)$ only if *N* and *n* are both correctly explained 2. **Reject** 'variety of alleles'

Question	Marking guidance	Mark	Comments
02.1	Correct answer of 2.1 for 2 marks;; Accept for 1 mark: $N(N - 1) = 3540$ **OR** $\Sigma n(n - 1) = 1702$ **OR** a correct answer not given to 2 significant figures, eg 2.08 / 2.080	**2** (2 × AO1)	Working: 60 × 59 = 3540; 41(40) + 3(2) + 6(5) + 2(1) + 4(3) + 4(3) = 1640 + 6 + 30 + 2 + 12 + 12 = 1702; 3540 ÷ 1702 = 2.0799 **Reject** 6.0 (Wood 1) for 2 marks

Question	Marking guidance	Mark	Comments
02.2	1. Wood 2 is dominated by one species (A) (41 of 60 individuals / about 68%) OR in Wood 2 the other species are present in small numbers (2–6 each); 2. In Wood 1, the individuals are spread more evenly between the species (6–15 per species);	**2** (2 × AO2)	1 and 2. Each point needs a reference to Table 1, eg a named species or numbers **Ignore** a general statement that the index of diversity takes into account the number of individuals of each species, unless applied to the data **Ignore** 'each/all species in Wood 2 have small numbers' (one species is abundant) **Ignore** 'Wood 2 has fewer species' / 'lower species richness' (the stem says they are the same) **Ignore** 'Wood 2 has fewer individuals' (both totals are 60)

Question	Marking guidance	Mark	Comments
02.3	1. Only one sample/one 0.25 m^2 square from each wood, so it may not be representative of the whole wood; 2. Only one day/afternoon OR only one time of year (October), so numbers/species present may differ at other times/in other weather; 3. Only leaf-litter invertebrates were recorded, not all of the species in the woods/community, eg plants/birds/mammals; 4. Small invertebrates may have been missed/not seen OR invertebrates may have escaped/been missed while sorting;	**3 max** (3 × AO3)	1. **Accept** no repeat samples, so it is not known whether the difference is due to chance/significant 1. **Accept** the square may not have been placed at random 3. **Accept** 'invertebrates are not the whole community' 1. **Accept** the single square may not be typical of the wood, eg deeper/wetter leaf litter at that spot **Ignore** differences between the woods (eg tree species, light) unless linked to the sample not being representative **Ignore** unqualified references to sample size **Ignore** 'no statistical test' unqualified

Question	Marking guidance	Mark	Comments
02.4	490;	**1** (1 × AO2)	Working: 50 × 49 = 2450; 2450 ÷ 5.0 = 490

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Question	Marking guidance	Mark	Comments
02.5	Number of species: 3 Number of individuals of each species: 14, 13, 13;	**1** (1 × AO2)	Values of *d*: 4 species, 2.36; 3 species, 3.16; 5 species, 1.56; 2 species, 2.05 The community with the most species does not have the highest index of diversity, because most of its individuals belong to one species.

Comparing the biodiversity of communities 3.4.6

Question	Marking guidance	Mark	Comments
03.1	Correct answer of 0.69 for 2 marks;; Accept for 1 mark: $\Sigma(n/N)^2$ = 0.309 / 0.31 (not subtracted from 1) **OR** a correct answer not given to 2 significant figures, eg 0.691 **OR** the correct total number of moths, N = 40	**2** (2 × AO2)	Working: N = 40; (18/40)² + (11/40)² + (6/40)² + (3/40)² + (2/40)² = 0.2025 + 0.075625 + 0.0225 + 0.005625 + 0.0025 = 0.30875; 1 − 0.30875 = 0.69125 **Reject** an answer calculated with the formula for *d* for 2 marks (the question gives Simpson's index)

Question	Marking guidance	Mark	Comments
03.2	1. (Does not support) the error bars/±2 standard deviations for species richness overlap, so there is no significant difference in species richness OR the difference is (likely) due to chance; 2. (Supports) the error bars/±2 standard deviations for Simpson's index do not overlap, so there is a significant difference in the index of diversity OR the (higher) index in the suburbs is (probably) not due to chance; 3. Simpson's index takes into account the number of individuals of each species as well as the number of species, so it is a better measure of biodiversity (than species richness alone); 4. Only one night/one month (July), so results may differ at other times of year/in other weather; 5. Light traps catch only moths attracted to light/flying at night OR lights in the city centre (eg street lights) may compete with the traps; 6. One trap in each of 10 gardens may not be representative/typical of all city-centre/suburban gardens;	**4 max** (1 × AO2) (3 × AO3)	**Max 2** from points 4–6 1. **Accept** use of ranges: 12–24 and 14–26 2. **Accept** use of ranges: 0.56–0.68 and 0.72–0.86 3. **Accept**, as an alternative, that city-centre catches may be dominated by one or a few species / moths in the suburbs are spread more evenly between species 1 and 2. **Accept** SD for standard deviation 1 and 2. **Reject** 'overlap shows a significant difference' **Ignore** 'no statistical test' or 'sample size too small' unqualified **Ignore** other differences between the gardens (eg plants, garden size, pesticides) unless linked to the sample not being representative **Ignore** 'only moths were sampled' (the conclusion is about moth biodiversity)

Farming techniques and conservation 3.4.6

Question	Marking guidance	Mark	Comments
04.1	1. More plant species OR higher plant species richness in system B (23 compared with 4); 2. (So) more (different) habitats/niches (for invertebrates), eg in the hedgerows/strips; 3. (So) more food sources OR greater variety/types of food (for invertebrates), eg from the hedgerows/strips; 4. No herbicide is sprayed on the strips, so wild plant species survive (there);	**3 max** (1 × AO1) (2 × AO2)	1. **Accept** larger plant diversity 2. **Ignore** shelter/homes/environments 3. **Ignore** 'more food' unqualified; accept 'more food sources' 3. **Accept** named food, eg nectar/pollen/seeds/leaves of different plants **Ignore** 'more plants' unqualified

Question	Marking guidance	Mark	Comments
04.2	So that differences in biodiversity/yield are due to the farming system (only) OR because soil type/weather affect which (plant) species grow/yield;	**1** (1 × AO2)	**Accept** 'they are control(led) variables' only if what they control is explained **Ignore** 'to make it a fair test' unqualified

Question	Marking guidance	Mark	Comments
04.3	7.2 (%);	**1** (1 × AO2)	**Accept** 7.25 or any correct rounding, eg 7 **Reject** 7.8% (decrease divided by the yield in system B)

Question	Marking guidance	Mark	Comments
04.4	1. System B has higher plant species richness **and** a higher invertebrate index of diversity, so it is better for conservation; 2. More plant and invertebrate species provide more food sources/habitats for other organisms, eg birds OR more organisms/species in food webs; 3. Barley yield is lower in system B, so less food is produced OR the farmer makes less profit/income; 4. The decrease in yield is small (about 7%) compared with the increase in biodiversity (index of diversity about 2.6 times / plant species about 6 times higher); 5. Payments could make up for the farmer's lost income/profit; 6. Only one year of data OR only plants and ground-dwelling invertebrates were measured (so the effect on the whole community/other groups is not known); 7. No standard deviations/measure of spread given, so it is not known whether the differences are significant;	**5 max** (1 × AO2) (4 × AO3)	**Max 3** unless the answer includes at least one of points 1 or 2 **and** at least one of points 3 or 5 (point 4 may count for either side, not both) 1. Needs both measures 3. **Ignore** 'lower yield' unless linked to less food or less profit/income 4. **Accept** use of the student's answer to 04.3 **Credit** extra correct detail, eg the strips/hedgerows may support pollinators or predators of crop pests, which could benefit the crop, as an alternative to point 2 7. **Accept** SD for standard deviation. Ignore 'no statistical test' unqualified

Question	Marking guidance	Mark	Comments
05.1	1. Ethical reasons, eg species/organisms have a right to exist OR responsibility to future generations; 2. Maintains food webs/food chains OR ecosystem stability, because species depend on each other (for food/habitats); 3. Stores carbon/takes up carbon dioxide, so reduces climate change/global warming; 4. Source of medicines/drugs/wood/new foods; 5. Gene pools/genetic resources for breeding (new) crops/livestock; 6. Useful to farming, eg pollinators/natural predators of crop pests/soil fertility; 7. Reduces (soil) erosion OR reduces eutrophication; 8. Tourism OR recreation/enjoyment OR aesthetic reasons;	**2 max** (2 × AO1)	**Ignore** 'to conserve species/prevent extinction' or 'to conserve habitats' unqualified (restates the question) 4. **Accept** named example, eg a drug from a plant **Ignore** 'it is good for the environment' unqualified

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Question	Marking guidance	Mark	Comments
05.2	1. Removing hedgerows removes habitats/niches/nesting sites (eg for birds/insects/small mammals); 2. Removing hedgerows/the meadow removes food sources (eg seeds/berries/nectar/leaves); 3. Growing only maize and spraying herbicide leave only one plant species OR kill other plant species (eg wild flowers/weeds/grasses), so plant species richness falls; 4. Fewer plant species means fewer habitats/niches and fewer food sources, so fewer animal species can live there; 5. Insecticide also kills other insect species (not only those that feed on maize) OR is not specific; 6. So less food for animals that eat insects, eg birds/spiders OR effects pass along food chains/webs; 7. Ploughing destroys the habitats of/kills soil organisms (eg earthworms/insect larvae); 8. Species richness falls because (many) species are lost/fewer species are present; 9. Index of diversity falls because there are fewer species **and**/OR one species (maize) makes up most of the individuals/dominates;	**6 max** (3 × AO1) (3 × AO2)	**Max 4** unless at least one explanation point (1, 2, 4, 6 or 7 (habitat version)) is given: naming techniques and the species lost, without explaining the loss of habitats/niches/food sources, cannot gain full marks **Max 5** unless both point 8 and point 9 are given 8. Must refer to animal species, species other than maize, or the whole community; not awarded for the same statement that gains point 3 2 and 4. **Ignore** 'less food' unqualified; accept 'fewer food sources' 1 and 4. **Ignore** shelter/homes/environments 5. **Accept** named beneficial insects, eg pollinators/bees/ladybirds 7. **Ignore** 'disturbs the soil' unless linked to habitats/organisms 7. Only the habitat version ('destroys the habitats of soil organisms') lifts the Max 4 cap; 'kills soil organisms' gains point 7 but does not 9. **Reject** 'every species has fewer individuals' as the reason **Credit** extra correct detail, eg hedgerows linking habitats

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