

4.6 Genetic information, Variation and relationship – Biodiversity within a community – Mark schemes

Q1.

- (a) 1. Species = (A group of) organisms that are able to produce fertile offspring;
2. Species richness = the number of (different) species in a community;
2. *Accept in a habitat / ecosystem / area*
2. *Reject in a population*
2. *Ignore 'types' unqualified* 2
- (b) 5; 1
- (c) 1. Number of individuals of each species not known;
2. **Almost** all (of sample A / the 68%) could be of the same species;
3. Two / other samples have a higher number of species / higher species richness but a lower number of individuals / fish;
4. Other samples may have more individuals of each species;
2. *If not stated otherwise, assume MP2 relates to sample A / 68%* 3 max

[6]

Q2.

- (a) Correct answer of 4.92, 2 marks;
If $N(N-1) = 3540$, **OR** $\sum n(n-1) = 720$, then award 1 mark
Accept 4.916 / 4.917 / 4.9 2
- (b) 1. A method of selecting sampling sites at random;
2. Use of quadrat;
3. Identify (plant) species (at site / in each quadrat)
OR
Count number of (different plant) species (at site / in each quadrat);
1. *E.g. grid with coordinates selected using random number table*
2. *Frame or point*
3. *Reject refs to % cover, or counting individuals* 3
- (c) 1. Significant increase in species richness on Islay and Colonsay **and** (significant) fall on Harris;
2. Change in diversity on Islay not significant;
3. Greater than 0.05 / 5% probability of getting this change / difference by chance (on Islay)
OR
(For other differences) less than 0.001 / 0.1% probability of getting this change / difference by chance (for species richness on Colonsay, Harris, Islay)
OR
Less than 0.01/1% probability of getting this change/difference by chance (for diversity index on Colonsay, Harris);
2. *Accept converse about significance of differences in other cases*

3. *Reject **results** are due / not due to chance*
3. *Ignore refs to P unqualified*

3

[8]

Q3.

(a)

3	6	9
152	211	167

2

(b) 2.45

Use of the correct denominator = 1 mark

2

- (c)
1. More plant species;
 2. More food sources / variety of food;
 3. More habitats / niches;
Allow converse for barley field
More food = neutral

3

[7]

Q4.

(a) Any **two** valid reasons;

e.g.

1. Increase in plant diversity leads to more types of food for animals;
2. Increase in variety of animals leads to increase in predator species;
3. Increase in niche / habitat

2 max

- (b)
1. Repeat soil sorting for different times and record number of species collected;
 2. Find optimum time / time beyond which further sorting does not lead to increase in animal species found

2

(c) 1. No data on number of individuals in each

$$\text{species / diversity index} = \frac{N(N-1)}{\sum n(n-1)}$$

1

(d) Principle:

1. Overlap of 2 × SD shows probability of differences (in means) being due to chance is greater than 0.95;
Allow converse of MP1

Credit MP1 wherever it appears

Agree:

2. No difference in number of earthworms and millipedes (per m²)
3. No difference in number of species of centipedes or millipedes.

Disagree:

4. More beetles and woodlice in grassy strips;
5. More species of beetles, earthworms, woodlice in grassy strips.

4 max

[9]

Q5.

- (a)
1. Only cleared and abandoned and introduction of non-native species make (significant) difference;
 2. Because only (means of) these ± 2 SDs from zero / no change;
 3. About same number / 4 to 3 increase or decrease (species) richness / biodiversity;
Accept converse for others

3

- (b)
1. Non-native species out-competes / kills / eats / is a disease of native plants;
 2. Some (populations of) native species become extinct (in the community);

2

- (c)
1. Set up grid system with coordinates;
 2. Place large number of quadrats (at coordinates) selected at random;
 3. Count number of / estimate percentage cover of native plant in quadrats;
 3. Repeat at same time each year (for many years);

3 max

- (d)
1. Correct answer two marks – 0.0599;

1 mark for writing $\frac{\log_e(SR2/SR1)}{\text{Time in decades}}$
Award 1 mark for answer of – 5.985 or 0.290

2

[10]

Q6.

- (a) 4:

1

- (b) 2.68(6).

If answer incorrect:
 $\sum n(n-1) = 242 = 1 \text{ mark}$
 $N(N-1) = 650 = 1 \text{ mark}$

2

- (c) 1. Take more samples and find mean;
2. Method for randomised samples described.

Allow larger area = 1 mark

2

[5]

Q7.

- (a) Species richness measures only number of (different) species / does not measure number of individuals.

1

- (b) Trees vary in height.

1

- (c) 1. Index for canopy is 3.73;
2. Index for understorey is 3.30;
3. Index in canopy is 1.13 times bigger;

If either or both indices incorrect, allow correct calculation from student's values.

3

- (d) 1. For *Zaretis itys*, difference in distribution is probably due to chance / probability of being due to chance is more than 5%;
2. For all species other than *Zaretis itys*, difference in distribution is (highly) unlikely to be due to chance;
3. Because $P < 0.001$ which is highly significant / is much lower than 5%.

3

[8]

Q8.

- (a) 1. Draw grid over (map of) area;
2. Select squares / coordinates at random.

2

- (b) 1. No emigration / immigration;
2. No losses to predation;
3. Marking does not affect survival;
4. Birth rate and death rate equal;
5. (In this case) all belong to one population.

2 max

- (c) 1. Only glows brightly with UV, so doesn't make insects more visible;
2. So doesn't affect / increase predation;

OR

1. Glows brightly with UV marking visible;
2. So makes it easy to pick out labelled insects.

2

- (d) 10 130.
Tolerance of ± 1

$$N = \frac{M \times C}{R} = 1 \text{ marks}$$

2

- (e) 1. Scientists removed large numbers of insects (which were not returned) from same area / same population;
2. Affecting ratio of marked to unmarked.

2

Q9.

- (a) 14; 1
- (b) Number (of individuals) in each species (of dung beetle);
Accept: population of each species. 1
- (c) 1. No overlap in standard deviations;
Accept: no overlap in error bars.
2. (Difference in mean total) significant/is not due to chance/is real; 2
- (d) No bias;
Ignore: 'representative sample'. 1
- (e) 1. Removes species/types of plant/insect;
Accept: decrease in plant/insect diversity.
2. Fewer food sources;
Ignore: less food.
Accept: less variety of food.
Accept: removes a food source.
3. Fewer habitats/niches;
Accept: loss/removal/destruction/ of a habitat.
Accept: no habitat.
Ignore: homes/shelters. 3

[8]

Q10.

- (a) Number of species in a community;
Accept: number of species in a habitat/area/ecosystem
Accept: species richness
Accept: all the species for number of species
Ignore: variation/diversity
Reject: in a population 1
- (b) 1. Number of (organisms of) each species;
Accept: 'population' for number and accept individual for organism.
Accept: 'species richness'
2. Total number of organisms (of all species) / Total number of species;
Idea of grand total of all organisms, not just number of different species 2
- (c) 1. Described effect of sewage (eg oxygen depletion/is toxic/kills);
Accept: increase in BOD

- Accept: eutrophication/description of eutrophication*
2. Prevents some/many species colonising/ reproducing/remaining;
Accept: only a few species survive
 3. Sewage is food source for (individuals of) some/a few/species;
 4. (So) increase only in their numbers;

Max 2

- (d) (i) 1. Results are not repeatable / are not representative / unreliable / conflict / contradict;
Accept: different / don't agree
Ignore: not valid/not reproducible/inaccurate
2. Can't make any conclusions;

2

- (ii) Do repeats to find a pattern/distribution/mean (of index of diversity);
Accept: use a different technique to obtain more reliable evidence;
Need idea of more than one repeat
Accept: calculate an average
Accept: at different times
Accept: statistical test to see if results differ significantly

1

[8]

Q11.

- (a) 1. Females are (generally) longer / larger / bigger / up to 115(mm) / males are (generally) shorter / smaller / up to 100(mm);
Ignore: tall
Accept: females have a larger / 90 modal / peak / most common value and males have a smaller / 80 modal / peak / most common value
Accept mean length of females greater / mean length of males shorter
Reject: use of mean in relation to 80 mm or 90 mm
Reject: Most of the females are 90 mm long / most of the males are 80 mm long

2. Females show a greater range / variation / males show a narrower range / variation.
Accept: correct use of figures from the graph: the range of males is 50 to 100 and of females is 50 to 115 / the spread is 50 for males and 65 for females

2

- (b) (i) **2.6 to 2.7** = 2 marks;
Incorrect answer but evidence of a numerator of **24180 OR 156 × 155** or denominator of **9014** = 1 mark;

2

- (ii) (Fewer plant species) – no mark
1. (So) few(er) habitats / niches;
Ignore habitat size

Q Neutral: fewer homes

2. (So) lower diversity of insects / fewer insect species / fewer insect types;

Q Neutral: fewer insects

Accept less variety of insects

3. (So) fewer food sources / less variety of food.

Q Neutral: less food

Ignore references to pesticides, farmers' actions, competition between lizards and evolution

3

[7]

Q12.

- (a) 1. Number of (individuals of) each species;

Accept: 'population' for 'number'

2. Total number of individuals / number of species;

Accept: 'species richness'

MP2 allows for other types of diversity index

2

- (b) (i) (Shows) results are due to the herbicide / are not due to another factor / (to) compare the effect of using and not using the herbicide / shows the effect of adding the herbicide;

Neutral: allows a comparison

Neutral: ensures results are due to the independent variable

Reject: 'insecticide'

Accept: 'pesticide'

1

- (ii) 1. (More) weeds killed **so** more crops / plants survive / higher yield / less competition;

2. High concentrations (of herbicide) harm / damage / kill / are toxic to crops / plants;

Accept: 'pesticide'

Neutral: 'insecticide'

Accept: use of figures (eg 400+)

2

- (iii) 1. Reduced plant diversity / fewer plant species / fewer varieties of plant;

Accept: 'weed' for 'plant'

Neutral: fewer plants

Accept: only one crop species remains

2. Fewer habitats / niches;

Q Neutral: fewer homes / shelters

3. Fewer food sources / varieties of food;

Neutral: less food

3

[8]

Q13.

(a) Succession;

Ignore any word in front of succession e.g. secondary / ecological succession.

Neutral 'forestation'.

1

(b) 1. Greater variety / diversity of plants / insects / more plant / insect species;

Neutral: more plants.

2. More food sources / more varieties of food;

Neutral: more food / more / greater food source (singular).

3. Greater variety / more habitats / niches;

Accept: more nesting sites.

Q Neutral: more homes / shelters.

3

(c) (i) Temperature and carbon dioxide;

Neutral: water, chlorophyll.

1

(ii) Shows (gross) photosynthesis / productivity minus respiration / more carbon dioxide used in photosynthesis than produced in respiration;

Correct answers are often shown as: net productivity = (gross) photosynthesis – (minus) respiration.

1

(iii) 1. (Shade plant) has lower (rate of) respiration / respiratory losses / less CO₂ released at 0 light intensity / in dark;

Accept use of figures.

Accept: lower compensation point.

2. Greater (net) productivity / less sugars / glucose used / more sugars / glucose available;

Neutral: any references to rate of photosynthesis.

2

[8]

Q14.

(a) 1. No interbreeding / gene pools are separate / geographic(al) isolation;

Accept: all marks if answer written in context of producing increased diversity of plants

1 Do not award this mark in context of new species being formed and then not interbreeding

1 Accept reproductive isolation as an alternative to no interbreeding

2. Mutation;

2 Accept: genetic variation

3. Different selection pressures / different foods / niches / habitats;

3 Accept: different environment / biotic / abiotic conditions or named condition

3 Neutral: different climates

4. Adapted organisms survive and breed / differential reproductive success;
5. Change / increase in allele frequency / frequencies;

5

- (b) Similar / same environmental / abiotic / biotic factors / similar / same selection pressures / no isolation / gene flow can occur (within a species);

Accept: same environment

1

[6]

Q15.

- (a) (i) Two marks for correct answer of 4.3;
Q An answer of 4 scores 1 mark

One mark for incorrect answer that clearly shows understanding of $\sum n(n-1) / 188$ as denominator;

2

- (ii) Measures number of individuals (of each species) and number of species;

Q First marking point can only be awarded if there is a reference to species.

Some species only present in small numbers;

2

- (b) (i) Reduced as one crop / species grown / other species removed;

Use of herbicides / weeding / ploughing / wheat (better) competitor for named factor e.g. light / nutrients;

2

- (ii) (Reduced) as less variety of food sources;

(Reduced) as fewer habitats / niches;

Q Answers only referring to 'less food' should not be credited

2

[8]

Q16.

- (a) 1. Group of similar organisms / organisms with similar features / organisms with same genes / chromosomes;

1. Accept: same number of chromosomes

1. Accept: smallest taxonomic group

1. Reject: genetically identical. Only allow 1 max if mentioned

1. Q Neutral: similar genes / chromosomes

2. Reproduce / produce offspring;

2. Accept: breed / mate

3. That are fertile;

3. Neutral: that are 'viable'

'Produce fertile offspring' = 2 marks

2 max

- (b) (i) Correct answer of 6.97 to 7 = 2 marks;
One mark for 6320 as numerator or 906 as denominator;

2

- (ii) 1. Decrease in variety of plants / fewer plant species;
1. Accept: reference to monoculture or description
1. Neutral: fewer plants
2. Fewer habitats / niches;
2. Neutral: fewer homes / less shelter
3. Decrease in variety of food / fewer food sources;
3. Neutral: less food
3. Accept: less variety of prey

3

[7]

Q17.

- (a) (i) (We should maintain biodiversity to)
Prevent extinction / loss of populations / reduction in populations / loss of habitats / save organisms for future generations (idea of);
Neutral: references to 'playing God' / animal rights

1

- (ii) A suitable example of how some species may be important financially e.g.
1. medical / pharmaceutical uses;
 2. commercial products / example given;
 3. tourism;
 4. agriculture;
 5. saving local forest communities;

1 max

- (b) 1. Fewer plant species / decrease in plant diversity;
Accept: converse arguments for islands with a high percentage of forest remaining
1. Neutral: fewer plants
2. Fewer habitats nesting sites / niches / food sources / varieties / less protection from predators / hunters / environment;
2. Neutral: fewer homes
2. Neutral: less food

2

- (c) 1. Number of (individuals / birds of) each species;
1. Neutral: number of species
2. Total number of individuals / birds of all species;
2. Accept: 'total number of birds' as given context for 'all species' in the investigation

- (d) 1. (Larger birds have) a low(er) SA:VOL;
Neutral: reference to fat / feathers
2. (So) less heat loss / more heat retained;
MP2 is independent of MP1

2

[8]**Q18.**

- (a) Removes bias;

1

- (b) (i) 1. 1.28 / 1.29 / 1.285 / 1.3
1. Ignore more than 3dp
2. Answer incorrect but shows clear understanding of Σ
*2. $\Sigma = 318250$. Allow mark if denominator written out.
Incorrect denominator but evidence of understanding gains mark*

2

- (ii) Diversity index would be lower (NO MARK)
Assume wheat field if site unspecified

1. Fewer species / Beech aphid / Large white butterfly / 7-spot ladybird absent / only three species / species diversity lower / mostly one species / mostly bird-cherry aphid;
1. Allow species richness in context of few species
2. Fewer plant species;
2. Allow one type of food source if clearly plant

2

- (c) For:

1. Data support the claim / evidence supports claim;
1. Ignore reference to correlation / causation

Against:

2. Only wheat field / only comparing with wood / one type of habitat / only insects considered;

2 max

- (d) 1. Greater variety of plants;
2. Another habitat / more habitats / places to live / niches / another food source / more food types;
*2. Answers referring to 'more food' should not be credited.
Allow reference to either animal or plant as foods*

2

[9]**Q19.**

- (a) (i) Produces a more reliable mean / average / makes sure sample was representative / reduce effect of extreme values / identify anomalies;
Ignore references to chance 1
- (ii) Removes bias; 1
- (b) Two marks for correct answer of 5.8;
One mark for incorrect answer that clearly shows denominator as 216; 2
- (c) 1. Increase in variety of plants / shrubs / grass;
2. More habitats / niches;
3. Greater variety of food sources / more food sources;
Answers only referring to 'more food' should not be credited 3

[7]

Q20.

- (a) Greater variety / different foods;
More habitats / niches;
Answers only referring to 'more food' should not be credited but allow 'more food sources'. 2
- (b) Also measures number of individuals in a species / different proportions of species;
Some species may be present in low / high numbers;
First marking point can only be awarded if there is a reference to species. 2
- (c) (i) Large surface area to volume (ratio) / permeable / thin (outer layer);
Correct reference to diffusion;
Accept (Eggs) cannot move (out of water) for 1 mark 2
- (ii) Concentration (of pesticide) is increased; 1

[7]

Q21.

- (a) (i) EITHER: Correct answer: 3.45 / 3.44 / 3.4 = 2 marks
OR: Understanding of $\sum n(n-1)$ / use of
134 / (2 + 90 + 12 + 30)
+ wrong answer = 1 mark
max 2
- (ii) Takes account of number of individuals / abundance / population size (as well as number of species); 1

- (b) The species at A / *F. spiralis* loses less water / loses water less rapidly / loses less mass;

The species at A / *F. spiralis* better adapted to / can survive where exposed for longer / to drier conditions;

The species at A / *F. spiralis* avoids competition For named aspect – e.g. light / substratum / space / CO₂;

ACCEPT converse argument re. F. serratus

3

[6]

Q22.

- (a) Increase in number of species;

Increase in numbers of some species;

2

- (b) Initial environment hostile / few organisms adapted;

These organisms change the environment / suitable example;

More niches / more habitats;

Allowing other organisms to become established;

max. 3

[5]

Q23.

- (a) 10

(reject: 9.76)

1

- (b) isolation (on islands);
variety of habitats / conditions different from origin / other islands;
differing pathways of natural selection;
leading to organisms too different to interbreed.

3 max

[4]

Q24.

- (a) deforestation removes many habitats / niches fewer species / fewer types of organisms;

(do not credit just fewer organisms);

2

- (b) 1. nitrate ions in fertiliser available / absorbed immediately;
2. ammonium converted to nitrate by nitrifying bacteria
3. fertiliser would provide only the initial release of nitrate / potassium nitrate;

3

[5]

Q25.

- (a) Samples collected at random;
Method for choosing random sites – random

coordinates / position from tables / calculator / other suitable means;

Other named factor constant e.g.:

Same size of net / same width of opening of net / use of one quadrat / Quadrats of same size / of stated size / same area disturbed / collect each Sample for same time;

3

- (b) *Caenidae* in deep water – because highest standard deviation / 'S.D.= 7.92'

1

- (c) (i) An organism's role / in the ecosystem / community;
[ALLOW refs. To trophic levels / named]
(IGNORE refs. To habitat)

1

- (ii) *Caenidae* found mainly in deep water AND *Baetidae* in shallow water / one family mainly in deep water AND the other in shallow water;

1

- (iii) Reduces competition for named factor – e.g. food / shelter / O₂ ;
To ensure both types survive / otherwise better adapted type displaces other type;
OR
Ref. to 'Competitive exclusion principle' = 2 marks

max 2

[8]

Q26.

- (a) Tapes / string / axes laid out at right angles / grid area;
Method of obtaining random co-ordinates;
Do not allow "Use random number generator"

2

- (b) (i) Decrease then remain constant;
From 200 cm / over 150 cm;

2

- (ii) Oxygen decreasing because soil becomes more compacted / not replaced;
Decrease in oxygen leads to fewer aerobes surviving;

2

- (c) Anaerobic bacteria replace aerobic as oxygen decreased by aerobic bacteria;
Remove competition;
Aerobic bacteria no longer able to survive in these conditions;

3

- (d) (i) Near the surface / in top 50 cm;
Table shows decrease with time at greater depths;

2

- (ii) Decrease;
Fewer aerobic bacteria with depth;
Oxygen concentration decreases / less oxygen at depth;

- (e) Probability greater than 95% / 0.95;
Results are not due to chance / results are significant;
Because bars do not overlap;

3

3

- (f) Plot as graph;
Draw line of best fit;
Read off appropriate value;

3

[20]

Q27.

- (a) suitable method of capture;
mark individuals and release;
count percentage recaptured / use Lincoln index / equation;

2 max

- (b)
$$\frac{282 \times 281}{25384} = 3.12$$

(accept 3.1 / 3.122)

2

- (c) decrease in total numbers of butterflies;
(*reject population*)
change in proportion of species / example(s);
increase in diversity in logged forest / calculation(4.01);

2 max

[6]

Q28.

- (a) source of pests / animals, and effect on crop;
source of weeds / no longer taking nutrients, hence competition /
reduced yield; creation of larger fields / leaving room,
hence more efficient use of machinery / grow more crops;
hedgerows have to be maintained, so removal saves time / money;

2 max

- (b) allows beetles to remain / survive / over winter in the middle of the
field / strip of grass;
effect on distribution, e.g. do not normally reach the centre of the field
/ can reach all parts;

2

- (c) increases biodiversity;
source of food for animals;
habitat / nest for animals;
reduce need for insecticides / attracts insects away from crop;
windbreaks / prevent erosion / run-off / leaching;
migratory corridors;

2 max

[6]

Q29.

- (i) for correct use of sigma;
numerator = 380 and denominator = 132;

2.87 to 2.9 gains 2 marks
(do not allow 2.8 or denominator = 135)

- (ii) more types of prey found on strawberries;

1

[3]

Q30.

- (a) Number of a / each (species);

Accept answers expressed differently providing they convey this information.

Ignore extra information if it does not contradict answer.

1

- (b) 1. Lower diversity of plants / few species of plants / less variety of plants / few plant layers;

2. Few sources / types of food / feeding sites; / few habitats / niches;

3. Fewer (species of) herbivore so few (species of) carnivores;

3

- (c) (i) Cannot predict / do not know intermediate values;

1

- (ii) To see what would happen / compare with no management work / to see if numbers fell anyway / To show that it was not a factor;

Management as a term not required. Allow explanations.

1

- (d) 1. Total number of birds along ditch B / ditch with one side cleared greater than along ditch A / ditch with both sides cleared;

2. But only gives data for all birds / does not give data for species / data not about diversity;

3. Single ditch / single occasion / not repeated / no control;

Principles:

Correct from evidence

Total number not diversity

Flaws in technique

3

[9]

Q31.

- (a) angle, moisture and pH

(all required)

1

- (b) system for subdividing quadrat into, e.g. many squares;
method of estimating cover in small squares, e.g. counting those where cover over 50%, or cover at points (of intersection);

(not just 'count squares with vegetation' unless very small)

2

- (c) increasing vegetation cover is related to increasing moisture content
(allow 'affects' moisture content or vice versa, not 'causes');

correlation is significant / not due to chance / can reject null hypothesis
/ only 1 in 20 / 5% probability that the correlation is due to chance;

2

- (d) factor; and linked effect e.g.
wind-blown particles trapped;
accumulation of soil;
OR
accumulation of organic / dead / decomposed matter / humus;
increase in mineral ions / improved water retention / improved
soil structure;
OR
nitrogen fixation;
increased nitrate concentration / improved soil fertility;

2 max

[7]