

4.7 Genetic Information, Variation and Relationship – Investigating Biodiversity Mark schemes

Q1.

- (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 $2 \times \text{SD}$ 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

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Q2.

- (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]

Q3.

- (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]

Q4.

- (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

[10]

Q5.

- (a) 1. 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]

Q6.

- (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

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Q7.

- (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]

Q8.

- (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

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Q9.

- (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]

Q10.

- (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]

Q11.

- (a) 1. Large surface area provided by lamellae / filaments increases diffusion / makes diffusion efficient;;
*Q Candidates are required to refer to lamellae or filaments.
Do not penalise for confusion between two*
2. Thin epithelium / distance between water and blood;
3. Water and blood flow in opposite directions / countercurrent;
4. (Point 4) maintains concentration gradient (along gill) / equilibrium not reached / as water always next to blood with lower concentration of oxygen;
5. Circulation replaces blood saturated with oxygen;
6. Ventilation replaces water (as oxygen removed);

6

- (b) Mixing of air and water (at surface);

Air has higher concentration of oxygen than water;

Diffusion into water;

Plants / seaweeds near surface / in light;

Produce oxygen by photosynthesis;

2 max

- (c) Not much oxygen near sea bed;

Toadfish haemoglobin (nearly) saturated / loads readily at / has higher affinity for oxygen at low partial pressure (of oxygen);

2

- (d) The chimpanzee and the bonobo are more closely related (than to the gorilla);

They have identical amino acids / one of the amino acids is different in the gorilla;

2

[12]

Q12.

- (a) (i) Will work in all weather conditions / hairs will stick to it even if shrew / animal is wet / withstand rain; 1
- (ii) So shrews come into contact with glue; 1
- (b) Avoids bias / allows statistical tests to be carried out;
Allow description 1
- (c) (i) Increases the reliability of the measurements;

If measurements are repeatable, differences less likely to be due to measurement / personal error / anomalies unlikely;

Accept advantages of repeatable results. E.g. identifying anomalies / remove errors

2

- (ii) Plot graph / scatter diagram of one set of results against the other;
Q To gain first marking point, candidates must say what has been plotted.

Expect to see points lying close to line / Line should slope upwards / show positive correlation;

If what is being plotted is not clear, second point cannot be awarded.

OR

Plot measurement against hair number;

Look for overlying / corresponding points;

2

- (d) (i) One mark for a valid explanation based on individual shrews entering more than one hair tube / many hairs from same shrew / shrews enter without leaving hair;

1

- (ii) Rules out differences due to changes in population / changes in environmental conditions;

That could be produced by births / deaths / migration / specific example of environmental conditions affects results;

2

- (e) (A statistical test) determines the probability of results being due to chance;

Enables null hypothesis / description of null hypothesis to be accepted / rejected / determines whether correlation / result is significant;

2

- (f) (i) (Curve / line of best fit shows) positive correlation / description of positive correlation;

1

- (ii) Curve / line of best fit (almost) parallel to x-axis / horizontal / level / no correlation / index is independent of number of shrews;

Hair tubes with positive results when no shrews trapped;

Small size of shrews means shrews may not trigger traps;

2 max

[15]

Q13.

- (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);

- (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]

Q14.

- (a) phylum, class, order;
species, *Acinonyx jubatus*;

2

- (b) larger groups containing smaller groups;

1

- (c) (i) do not interbreed to produce fertile offspring / different DNA / different niches;

1

- (ii) fossil record;
evolutionary history / phylogeny;
biochemical differences e.g. DNA / proteins / cytochromes;
homologous features / named feature;
karyotype / number and form of chromosomes;
(discount any example credited in (i))

2

[6]

Q15.

- (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]