

## 7.4 Genetics, populations, evolution, ecosystems (A-Level Only) - Populations in ecosystems 2 – Mark schemes

### Q1.

- (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]**

### Q2.

- (a) Fertilisers / detergents / slurry / manure / sewage / faeces; 1
- (b)  $(31 - 5) / 31 \times 100\%$  / single error in otherwise correct method;  
83.87 / 83.9 / 84%; 2
- (c) Have continuous data for phosphate but not for biomass;  
Effect of named factor explained; 2
- (d) 1. Increased phosphate causes increase in plant growth / algal bloom;  
2. Plants (cover surface and) block out light so plants (under surface) die;  
3. Increase in (aerobic) bacteria / decomposers (which break down plants);  
4. Bacteria / decomposers use up oxygen / reduce oxygen conc. in water;  
5. In respiration;  
6. Plants unable to photosynthesise so less oxygen produced; max 6
- [11]**

### Q3.

- (a) Population – organisms of one species in an ecosystem / habitat / area;  
Community – organisms of all species / all populations in an ecosystem / habitat / area; 2
- (b) (i) No immigration / migration (Ignore references to emigration);  
No reproduction (*Ignore references to death*);

Idea of mixing;  
Marking does not influence behaviour / increase vulnerability to predation;  
Sample / population large enough;

max 2

(ii)  $\frac{96 \times 77}{11}$  ; 672;

*Correct answer (however derived) scores 2 marks*  
*Incorrect answer with evidence of correct method scores 1 mark.*

2

- (c) Principle of randomly placed quadrats and method of producing random quadrats; (*Reject 'throwing'*)  
Valid method of obtaining no. dandelions in given area (mean per quadrat / total no. in many quadrats);  
Multiply to give estimate for total field area;

3

- (d) (i) Niche of A – 1;  
Niche of B – 3;  
Too small for B / too hot for A – 4;  
Too large for A / too cold for B – 2;  
*All four correct = 2 marks; any 2 correct = 1 mark*

2

- (ii) Original population living in one area / 2 species evolved in the area;  
Idea of genetic variability;  
Concept of reproductive isolation;  
Possible mechanism;  
Gene pools become increasingly different;  
Until interbreeding does not produce fertile offspring;

max 4

[15]

#### Q4.

- (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; 3
- (e) Probability greater than 95% / 0.95;  
Results are not due to chance / results are significant;  
Because bars do not overlap; 3
- (f) Plot as graph;  
Draw line of best fit;  
Read off appropriate value; 3
- [20]**

**Q5.**

- (a) 1 4 year cycles;  
2 predator / stoat peaks after prey / lemming;  
3 lemmings increase due to low numbers of stoats / available food;  
4 more food for stoats so numbers increase;  
5 increased predation reduces number of lemmings;  
6 number of stoats decreases due to lack of food / starvation; 6
- (b) smaller populations have fewer different alleles / more homozygosity / less heterozygosity / smaller gene pool / lower genetic variability;  
migrants bring in new alleles / increase gene pool; 2
- (c) geographical isolation of populations;  
variation present in population(s);  
different environmental conditions / different selection pressures / different phenotypes selected;  
change in genetic constitution of populations / gene pools / allele frequency; 4
- [12]**

**Q6.**

- (a) species present change the habitat / named change;  
other species able to colonise;  
new species better competitors; 3

- (b) D - as more species present;  
more complex food webs;
- or
- change in one species will have little effect on others;  
as alternative food sources;
- 2 max
- (c) sand drains easily / low water retention;  
(sunken stomata) reduce transpiration;  
as pocket of saturated air trapped near stomatal pore;  
this reduces diffusion / water potential gradient;
- 3 max
- (d) series of changes over a distance / gradient of environmental  
factor / named environmental factor / cline present / ensures  
sampling of each community;

1

[9]

**Q7.**

- (a) use of random numbers to place quadrats;  
number of individuals counted in large number of quadrats;  
little variation random, large variation - clustered;
- 3
- (b) less competition;  
for water / nutrients;
- 2

[5]

**Q8.**

- (a) 1 shore crab rapidly colonises / rapid growth;  
2 ability to live different environments / no natural predators / will  
have similar / overlapping niche with native species / valid  
example / shore crab may be carrier of disease;  
3 shore crab better competitor / more aggressive;  
4 decreased population of prey species;  
5 ecosystem less stable;
- 5
- (b) between A and B water potential of blood rises as water potential of  
blood rises as water potential of surrounding water rises, after B rise  
in water  
potential less rapid / at C no further change occurs;
- 1
- (c) No – as blood is isotonic with surrounding water / blood and  
surrounding  
water have same water potential;
- 1
- (d) (i) water potential of blood maintained;

so (blood) cells not destroyed (by osmosis);

OR

replaces ions / salts lost diffusion;  
ions / salts required for named metabolic process;

2

- (ii) rate of respiration decreases;  
less ATP made;  
insufficient to maintain water potential of blood when in estuary;  
isotonic in sea so no need to transport salts;

OR

sea temperature higher than river;  
higher metabolic rate / higher enzyme activity;  
advantage of this crab e.g. still able to escape from predators;

3 max

[12]

**Q9.**

- (a) (i) true indication of growth / water mass may vary;

1

- (ii) intraspecific;

1

- (iii) the denser the planting the greater the yield;  
above a planting density of approx 30 competition for  
named resource / named limiting factor / population density  
not limiting;

*(accept nutrients / space reject food)*

2

- (b) use genetically identical plants / clones / asexual reproduction /  
tissue culture; maintain identical environmental conditions / named  
condition; reference to density of planting;

2 max

[6]

**Q10.**

- (a) (i) transect line may not go through representative areas / may avoid  
certain areas;

1

- (ii) large sample;  
how random coordinates are generated / how random places  
chosen;

2

- (b) (i) spread of values around the mean height of the plant;

1

- (ii) smaller plants at higher altitude;  
greater the altitude the lower the standard deviation ;  
reference to figures to make a comparison;
- 2 max

- (iii) the plants measured were grown under uniform conditions;
- 1

[7]

**Q11.**

- (a) populations of different species;  
living in the same environment / habitat;  
(often) named after dominant plant / example;  
*(one mark for principle: all the species living in the same place)*
- 2 max

- (b) more species / diversity (in the field);  
more niches / habitats;  
more feeding opportunities (range of types available);
- 3

- (c) one method named, e.g.:  
mark, release, recapture;  
sweep netting / kick sample;  
pitfall traps;  
light trap;
- 1 max

[6]

**Q12.**

- (i) normal virus reduces area eaten by 40cm<sup>2</sup>  
genetically engineered reduces by 64 cm<sup>2</sup>  
64 – 40 = 24

$$\frac{24}{40} \times 100 = 60\% \text{ more effective}$$

1 mark for principle of calculation;  
60% more effective = 2 marks;

or

$$\frac{64}{40} = 1.6 \text{ times more effective}$$

1 mark for principle of calculation;  
1.6 times more effective = 2 marks;

*(if only difference in area eaten given, 1 mark)*

2

- (ii) toxin kills the caterpillars faster than just the virus;

so less time for leaves to be eaten / energy for eating;

2

[4]

**Q13.**

(a) there is no difference between the number of lichens growing on the walls (facing different directions);

1

(b) 36, 36, 36;

1

(c) 2;

1

(d) p less than 0.05 so reject the null hypothesis;  
the difference is not due to chance / significant difference;  
the direction the wall faces does have an effect on the population of lichens;

3 max

(e) algae photosynthesise / produce organic molecules / named;  
fungus anchors the lichen / absorbs water which is available to the algae / prevents dehydration of alga / absorbs mineral ions / phosphates / nitrates;

2

[8]

**Q14.**

(a) 1. colonisation / pioneering;  
2. microscopic plants at start;  
3. death / decomposition;  
4. named change in environment e.g. increase in organic matter / stabilisation;  
5. new species colonise once there is a change;  
6. increase in number of species / diversity / increase in total amount of living material / biomass / more niches / increase in nutrient availability / change from more extreme conditions / more stability;

6

(b) marking principles:  
one mark – direct result of removing forest cover;  
e.g. soil erosion / leaching  
one mark – specific effect on organisms in lake;  
e.g. more sediment / nutrients (for plants to grow)

2

(c) 1. named nutrient availability;  
2. numbers of producers providing energy (for a food chain) / light intensity affecting the rate of photosynthesis;  
3. disease killing (weaker) members of species / predation described;  
4. space for nest building / niches;

5. competition for a named limited resource / (intra and interspecific) competition explained;

5

[13]

**Q15.**

With hormone (third column) cadmium produces large / significant / 45% fall in enzyme production;  
without hormone (second column) no significant effect on enzyme production with cadmium;.

2 max

[2]

**Q16.**

(a) pioneers / suitable example colonise land;  
example of change in environment;  
enables change in species;  
conditions change further / example to favour trees;

4

(b) stable community / no further succession / final community;

1

(c) roots unable to respire (aerobically);  
active transport of minerals / other metabolic effect stops;

2

(d) action of bacteria / decomposers inhibited / fewer bacteria / decomposers;  
acid conditions inhibits enzymes / enzymes denatured / changes active site;  
H<sup>+</sup> ions affect active site;  
anaerobic conditions;

3 max

[10]

**Q17.**

(a) (i) the non-living / physical part (of an ecosystem / environment);

1

(ii) density-independent, with named abiotic factor and a specific effect;

1

(b) capture, count and release;  
carefully mark to avoid detection;  
recapture, count marked and unmarked;

*(information from an equation is valid)*

3

[5]

**Q18.**

(i) idea of rise and fall;



peak and trough later than those of larvae / idea of time lag;  
(allow correct line drawn on the graph)

2

- (ii) reduction in leaf area / size decreases photosynthesis;  
less food reserves available for production of new needles;  
OR  
feeding larvae damage more growing points;  
takes time for tree to recover / less growing time for needles;

2

[4]

### Q19.

- (a) (i) tips colonised by short-lived plants / short lived plants are pioneers;  
short-lived plants fast growing / spreading / distribute seeds quickly;  
short-lived plants change the environment e.g. make conditions  
more favourable for long-lived plants;  
valid reference to competition;
- (ii) long-lived plants compete with each other;  
death of some long-lived plants;  
more niches / leaving spaces / areas for growth of short-lived  
plants; short-lived plants recolonise;

6 max

- (b) control of named variable e.g. light, water-content, nutrients;  
large numbers of both species / 10+ individuals;  
range of different concentrations of zinc;  
valid measurement of growth, height / leaf area / root  
growth / numbers / mass / % germination;  
statistical analysis / correlation between the two sets of data;  
OR  
large number of samples taken (in the field);  
principle of determining zinc concentration of soil;  
valid measurement of growth, height / leaf area / root  
growth / numbers / mass / % germination;  
statistical analysis / correlation between the two sets of data;

3 max

[9]

### Q20.

- (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]

**Q21.**

- (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]

**Q22.**

- (a) Competition described / named biotic factor (that they might compete for);  
*Reject ref. to predation or abiotic factors*

1

- (b) (i) Not many animals brought home during this period;  
 Overall, detached bring in most animals;  
 Mostly mammals, (fewer birds) and fewest frogs;  
*Idea of 'preference', not just restating data*

Cats prefer mammals to birds / find mammals easier to catch;  
*Idea of 'preference'/'availability', not just restating data*

Cats do not prefer frogs / have fewer frogs to catch;  
 Cats in flats take very few birds or frogs;  
 Suitable use of standard deviations;

2 max

- (ii) Suggestion; with explanation;  
*Note that sample size is large – reject ref. to small / sample sizes.*

Examples,

Method underestimates prey;  
(Because) cats don't bring some prey home/eat it before seen;

Cats may kill other animals;  
But don't bring them home/eat them;

Don't know how many cats in each type of housing;  
So comparisons difficult;

Overlap of SDs (in some cases);  
So no significant differences between means / named examples where this is so;

Don't know details of housing;  
May have different amounts of prey / types of prey around;

Number of prey not large;  
So, possible large variability in results;

2 max

- (c) (i) Wearing a bell reduces/affects/changes a cat's probability of catching prey;

*Accept statements of – Null hypothesis that wearing a bell makes no difference to probability of catching prey*

1

- (ii) No (significant) difference for birds and frogs;  
(Significant) fall in mammals caught;  
Suitable ref. to standard deviations;

*Reject mammals and birds fall*

2 max

[8]