Mark schemes

(a) (i) Method of positioning quadrats,

1

E.g. Find direction and distance from specified point / find coordinates on a grid / split area into squares;

Method of generating random numbers;

E.g. From calculator / telephone directory / numbers drawn from a hat;

Last point represents minimum answer

Q *Do not credit any method that relies on throwing a quadrat*

2

(ii) Calculate running mean / description of running mean;

When enough quadrats, this shows little change / levels out (if plotted as a graph);

Enough to carry out a statistical test;

A large number to make sure results are reliable;

Ignore terms that are not incorrect
Regards large numbers as 10 / 10% +

Need to make sure work can be carried out in the time available;

2 max

(b) Coppice different parts of the wood at different times;

As data show many daffodils flowering 4 / 5 years after coppicing;

Q *Second point needs specific reference to the graph, numbers and time after coppicing. Accept any correct answer that does this.*

2

(c) Positive correlation between rainfall and flowering / the higher the rainfall, the more daffodil flowers;

Negative correlation / the higher the temperature the fewer daffodils in flower;

All statistically significant so not likely to be / not due to chance;

2 max

[8] (a) Vegetation consists mainly of low growing species / herbs / annuals / no / few trees;

2

Species **X** has high rate of photosynthesis at high light intensity;

*Do not credit Species **X** is first tree*

Species **X** grow fastest at high rate of photosynthesis / at high light intensities and will outcompete other species **Y** / **Z**;

3

(b) Produces shade / reduces light intensity;

Species **Z** grows best / photosynthesis best / in low light intensity /
Species **Z** does not grow well / low rate of photosynthesis in high light intensity;

Accept answers in terms of CO_2 absorption

2

[5

] (a) (i) Will work in all weather conditions / hairs will stick to it even if shrew / animal is wet /

3 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 morethan 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 environmentalconditions;

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 positivecorrelation;

1

(ii) Curve / line of best fit (almost) parallel to x-axis / horizontal / level / nocorrelation / 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]

(a) (i) decomposers convert (nitrogen in organic compounds) into ammonia / ammonium;

4 suitable example of "organic nitrogen" - protein / urea / amino acid etc. (e.g. linked to process); nitrifying bacteria / correctly named convert ammonium to nitrate; via nitrite;

3

(ii) convert nitrogen (gas) into ammonium / ammonia / amino acids;
add usable / available nitrogen to an ecosystem / eq.;

2

(b) (i) 1. numbers of dispersed bacteria increase as they feed on organic matter;

2. numbers of free-swimming protoctistans increase because number ofbacteria increase;

3. dispersed bacteria decrease as amount of dispersed organic matterdecreases / due to lack of food / as organic matter is converted to flocs / are preyed on by free-swimming protoctistans;

3

(ii) 1. (in a succession) organisms (enter an area and) change the environment /conditions creating new niches / habitats;

2. allows different species / different types of organisms to enter / besuccessful;

3. dispersed bacteria change dispersed organic matter to flocs;

4. presence of flocs allows crawling protoctistans to enter / to increase / tobe successful;

4

[12]

5 (a) (i) ecosystem is (self-supporting) system in which all organisms / community interact with physical environment / community + environment / biotic + abiotic;

1

(ii) A + B + E + F + G + I;

1

(b) pygmy weed competes for CO_2 / light / nutrients; reduction in numbers of original plants; some of original plant <u>species</u> lost; loss of habitats / niches / shelter / food sources; consumers die / some migrate;

3 max

[5]

6 (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]

7 (i) Population is the total number of organisms / individuals of a species / tigers in an area (at a given time);

1

(ii) (Deforestation involves) habitat destruction / destruction of niches;

Some prey animals move out or die / fewer suitable prey for tiger / less food for tiger; Reduces tiger population if prey biomass falls below 600 (tonnes per km^2);

3 [4]

8 (a) (i) *Selecting the nettle plant*:

Random number table avoids bias in placing of quadrat;
'Nearest centre' avoids bias in choosing plant to measure;

1 mark for "method avoids bias"

2

(ii) *Measuring the sixth leaf:*

To allow valid comparison / so as not to introduce another variable;
Reduces / avoids influence of growth / age / light / shading;

2

(b) Definition of range + SD / effect of outliers on range + SD;
Ranges are similar in both areas;
Suggests that variation within populations is similar;
SD smaller in area of high light intensity;
Shows that area of high light intensity is a more uniform population;

4

(c) 1.164 / 1.16 / 1.2 , however derived = 2 marks
0.83 – 0.86 / 1.1, however derived = 1 mark
Evidence of correct use of both sets of figures, but inappropriate answer = 1 mark

2

[10]

9 (a) collect a sample (of insects in each area) and mark unobtrusively / in a way not harmful to insects; release and allow time <u>to re-integrate</u> with rest of population / eq.; collect second sample and count number marked; number in population estimated by:

$$\frac{S1 \times S2}{\text{Number marked in } 2^{nd} \text{ sample}} \;/\;/$$

$$\frac{\text{Total marked}}{\text{Number marked in } 2^{nd} \text{ sample}} = \frac{\text{Population}}{\text{second sample}};$$

4

(b) (i) 1;

1

(ii) (p =) 0.05 / 5%;
(ignore 95%)

1

(iii) value for χ^2 <u>exceeds</u> critical value / 125.8 > 10.8 ;
Results unlikely to be due to chance / have a biological cause;
P < 0.1% / < 5% ;

2 max

(c) (i) biomass respired / GPP – respiration = NPP;
biomass lost as CO_2;

2

(ii) more food for insects;

1

[11] (a) Fertilisers / detergents / slurry / manure / sewage / faeces;

10 **1**

(b) (31 – 5) / 31 x 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] (a) Population – organisms of one species in an ecosystem / habitat / area;

11

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 randomquadrats;
(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] (a) 1. Occurs in an unchanging environment;

12

1

+

2. Selection against extremes / selection for the mean / mean / median / modeunaltered
3. Range / S.D is reduced
4. Increasing proportion of populations becomes well adapted to environment;

4

(b) 1. All plants are acyanogenic below –4 °C and (most) cyanogenic above +10 °C;
2. Cyanogenic plants' cells freeze below –4°;
3. Releasing cyanide (into their own tissues) / damaging / killing plants / disruptingmetabolism;
4. Selective advantage not to produce cyanide at –4 °C;
5. Slugs present at higher temperatures / not usually present / inactive at lowertemperatures and cyanide production kills / deters slugs;

5

[10] (a) Tapes / string / axes laid out at right angles / grid area;

13

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 / notreplaced;
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] (a) 1 4 year cycles;

14

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 / lessheterozygosity / 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] (a) (i) change in community over time;

15

either due to change environmental / abiotic factors / change is due to species present;

2

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

1

(b) (increased) <u>interspecific</u> competition; for light / nutrients / named nutrient / water;

2

(c) fewer leaves / lower surface area / shading of leaves so less photosynthesis to producenew biomass / glucose / growth;
competition with other species for nitrates / named nutrients so

reduced synthesis of protein or named compound; ratio of leaves to woody parts and roots decreases so higher respiration relative to photosynthesis;

3

[8] (a) species present change the habitat / named change;

16

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 pf saturated air trapped near stomatal pore; this reduces diffusion / water potential gradient;

3 max

(d) series of changes over a distance / gradient of environmentalfactor / named environmental factor / cline present / ensures sampling of each community;

1

[9] (a) use of random numbers to place quadrats;

17

number of individuals counted in large number of quadrats;
little variation random, large variation - clustered;

3

(b) less competition;
for water /
nutrients;

2

[5] (a) (i) true indication of growth / water mass may vary;

18

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

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

19

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] (a) 1 shore crab rapidly colonises / rapid growth;

20

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 aswater 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 surroundingwater 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] (a) Gg / suitable equivalent;

21

Grey : black about 3: 1;

[Note: Can be in table / diagram]

2

(b) To determine the probability;

[Accept: Likelihood]

Of the results being due to chance;

[Accept: Coincidence]

2

(c) (i) both alleles will be expressed (in the phenotype);

1

(ii) 0.25 / 25%; = 2 marks
C^N = 250 / 1000; = 1 mark

2

(iii) P^2 = $(0.25)^2$ / 0.0625 / square of calculated figure for C^N; = 2 marks $p^2 + 2pq +$ q^2 = 1.0; = 1 mark
= 31.25 / 31;

[Accept: Derived from either p^2 or q^2]

3

[10] (a) populations of different species;

22

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]

23 (i) normal virus reduces area eaten by 40cm^2

genetically engineered reduces by 64 cm^2

64 – 40 = 24

$\frac{24}{40} \times 100$

= 60% more effective

1 mark for principle of calculation;

60% more effective = 2 marks; or

$\frac{64}{40}$

= 1.6 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]

24 (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]

25

(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 livingmaterial / 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) competitionexplained;

5

[13]

26

(a) very long / deep roots, to reach water deep in the soil / nitrogen-fixing bacteria, to provide a source of nitrogen for growth in poor soil;

1

interspecific;

1

(b) (mesquite) proteins / amino acids (ploughed) into soil / nodules ploughed in and
(decomposers) bacteria / fungi feed on these;
excrete ammonia;
nitrifying bacteria convert these to nitrites / nitrates; absorbed by roots of grasses and increase their growth; *accept increases recycling of other ions / phosphate / potassium;*

3

(c) control organism a parasite / predator;specific to pest; population varies with population of pest; controls size of pest population but does not kill all;

keeps pest population low enough to prevent significant (economic) damage;

3 max

[8]

27

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]

28

(a) (i) (collect and) dry all above ground plant material; *(reject collect one / small sample / whole plants)* in an oven at or just below 100 °C; weigh and repeat until constant mass; other precaution, e.g. cooling in desiccator;

3 max

(ii) large number of sample areas / repeats;randomly selected;

2

(iii) drying destroys plants, so different samples needed;large area, so difficult to get representative samples; difficult to measure biomass of trees; variability in growing conditions; variability of abiotic conditions in different areas of forest;

2 max

(b) (i) 1:25

1

(ii) most of the plants are trees / large with high proportion of dead / non-photosynthesising biomass; herbs grow rapidly / small so large percentage increase / herbs have higher productivity, so ratio lower at 10 years;

2

[10]

29

(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]

(i) idea of rise and fall;

30

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]

(a) pioneers / suitable example colonise land;

31

example of change in environment;
enables change in species;
<u>conditions change further / example</u> to favour trees;

4

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

1

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

2

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

3 max

[10] (a) (i) tips colonised by short-lived plants / short lived plants are pioneers;

32

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] (a) 10

33

(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] (a) Competition described / named biotic factor (that they might compete for);

34

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]

35

(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]