AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.4.6 BIODIVERSITY WITHIN A COMMUNITY

SCORE	PERCENTAGE
/252	%

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Q1.

(a) (A measure of) the number of (different) species in a community;

For 'community' accept 'habitat/ecosystem/one area/environment'

Reject 'in a population'.

1

(b) **Yes, natural best, because**

1. Peak of (mean) bee numbers in natural habitat is highest;

For accept description for 'peak'.

2. The (mean) number of bees was higher in the natural habitat until day 200;

2. For 'day 200' accept any day between 190 and 210.

2. For 'until day 200' accept 'for 200 days'.

3. (Mean) species richness in natural habitat higher at all times;

No, natural not best, because

4. Lowest (mean) number of bees after day 220;

4. For 'day 220' accept any day between 210 and 230.

Yes, town worst, because

5. Peak of species richness higher in <u>both</u> natural and farmland

OR

Species richness lowest in town from day 125;

For 'day 125' accept any day between 115 and 135.

No, town not worst, because

(Mean) species richness is lower in farmland until day 125;

For 'day 125' accept any day between 115 and 135.

For 'until day 125' accept 'for 125 days'.

7. Similar (mean) number of bees to farmland;

OR

(Mean) number of bees lower in farmland until day 140;

For 'day 140' accept any day between day 130 and 150.

For 'until day 140' accept 'for 140 days'

General, no, because

8. Index of diversity of bees not measured

OR

The number of bees of each species is not known;

4 max

(c) 1. Must not harm the bees
OR
Must allow the bee to be released unchanged;

2. Must allow close examination
OR
Use a key (to identify the species);

Accept method that allows close examination

Ignore references to DNA sequencing

Accept 'use photographs/specimens (to identify species)'

2

(d) 1. Collect at more times of the year **so** more points on graph/better line (of best fit) on graph;

Both suggestion and explanation is required for each mark point.

The explanation must relate to the graph.

2. Counted number of individuals in each species **so** that they could calculate index of diversity;

3. Collected from more sites/more years **to** increase accuracy of (mean) data;

For 'accuracy' accept 'representative'.

2 max

(e) 1. *A. chlorogaster* and *A. piperi* are more closely related (to each other than to *P. pruinosa*);

Must be a comparative statement.

Accept A. chlorogaster and A. piperi share a more recent/closer common ancestor (than they do with P. pruinosa);

Ignore references to A. chlorogaster and A. piperi not being related to P. pruinosa or not having a common ancestor with P. pruinosa.

2. Because they are in the same genus;

2

[11]

Q2.

(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]

Q3.

(a) Correct answer of 4.92, 2 marks;
If N(N-1) = 3540, **OR** ∑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]

Q4.

(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]

Q5.

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

e.g.

1. Increase in plant diversity leads to more <u>types</u> 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

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 m^2)

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]

Q6.

(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]

Q7.

(a) 4:

1

(b) 2.68(6).

If answer incorrect:
Σn(n-1) = 242 = 1 mark
N(N-1) = 650 = 1 mark

2

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

Allow larger area = 1 mark

2

[5]

Q8.

(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]

Q9.

(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 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]

Q10.

(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]

Q11.

(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/<u>species</u>;
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 repeat<u>s</u> 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]

Q12.

(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 <u>and</u> 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 <u>and</u> of females is 50 to 115 / the spread is 50 for males <u>and</u> 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** <u>or</u> 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]

Q13.

(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]

Q14.

(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 CO_2 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]

Q15.

(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]

Q16.

(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]

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

2

(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. Σ = 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 <u>species</u> / Beech aphid / Large white butterfly / 7-spot ladybird absent / only three <u>species</u> / <u>species</u> 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 <u>plants</u>;

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 <u>not</u> 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) 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 <u>with</u> 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 <u>number</u> 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]

Q22.

(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 ∑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]

Q23.

(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]

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 / O_2 ;
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) (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 / CO_2;

ACCEPT converse argument re. F. serratus

3

[6]

Q27.

(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]

Q28.

(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]

Q29.

(a) colder / below 0°C (January) areas, cyanogenic plants die in this cold / acyanogenic survive;
non-cyanogenic allele / gene passed on more often / its frequency increases;
warmer (January) areas cyanogenic plants at advantage,
because of less herbivore selection pressure / feeding;
so cyanogenic survive more often to pass on cyanogenic allele / gene.

4 max

(b) large (and equal) number of quadrats in each area;
(reject several)
random sampling method, described;
(accept described 'systematic' method)
percentage cover / point hits per quadrat / count plants;
mean / average value for each area;
statistics test to see if differences significant.

4 max

[8]

Q30.

(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]

Q31.

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

2

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]

Q32.

(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]

Q33.

(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]

Q1.

67.1% of students could answer question (a), a test of recall from section 3.4.6 of the specification. Once again, many students confused the terms population and community, and the terms species richness and an index of diversity.

Question (b) was the first opportunity on the paper for students to interpret scientific evidence and demonstrate Assessment Objective 3 skills. The question, 'Do the data in the figure support these conclusions?', should have demonstrated that careful use of these data would be required in the answer. Both conclusions were comparative statements, natural habitat being the *most* favourable and town habitat being the *least* favourable, and so the marking points were linked to comparative statements between the habitats. A description of one habitat alone was, thus, not sufficient to gain credit. Numbers were provided on the axes and so quoting days of the year was expected in the answers. This question provides a good example to demonstrate the importance of using and quoting the correct evidence from the data when trying to support the conclusions. It is also a good example of how times from the x-axis of the graph should be used to illustrate where observed trends begin and end. Some 76.6% of students were able to gain at least one mark; only 7.9% scored four marks.

In part (c), the majority of students appreciated that the bees should not be harmed and so gained the first mark. Many students got confused with mark-release-recapture techniques but, since no population estimate was being made in this investigation, this was not relevant.

Question (d) was designed to test practical skills with the command 'suggest and explain', so an improvement with a specific explanation of how that change would improve the data was required. It was hoped that A-level students could be specific about why collecting more data would be beneficial. For example, they were told that these graphs were drawn following collection from four data points – students should be aware from their graphical work that this would not result in an accurate line of best fit, or that intermediate points could not be determined from these few data points. Similarly, statements related to the improved *accuracy* of the (mean) data were few and far between; simple statements referring to collecting from more sites, or for more years, are not sufficient to gain marks when asked to give an explanation. Students should be encouraged to use an appropriate term from the published glossary – "to make the results reliable" was not sufficient to gain credit. Very, very few students could use their knowledge of section 3.4.6 to point out that these data would have been more meaningful if numbers of each species had been counted so that an index of diversity could be calculated. Worryingly, 71% of students failed to score here; less than 2% gained both available marks.

Question (e) was answered well, with most students (62.1%) understanding the binomial system for naming of species and linking it to their evolutionary relationship. Some students suggested that the two *Andrena* species were unrelated to *Peponapis pruinosa* and that they did not share a common ancestor – this was not creditworthy.

Q2.

In answering question (a), the majority of students were able to define a species, but simpler answers just stated "can make offspring", rather than **fertile** offspring. Far fewer were able to define species richness. Some gave the definition of the index of diversity, and many stated the number of species in a population.

Two-thirds of students answered question (b) correctly; those who failed to score did not

understand what the mode is.

Question (c) was far more challenging for students, with 62% failing to score any marks. Students failed to understand what had been asked and what the data showed, for example stating “68% from one sample is not fair; all sample sizes should be the same”. Many students also stated that sample A could have been **all** of the same species, which was not possible. Once again students were trying to apply generic ideas about experimental design without comprehending what had been asked. Commonly seen answers included “only one area”, “no repeats”, “no statistical tests”, “not representative”, “not a fair test”, “correlation does not mean causation”. Students failed to understand what species richness is, stating that “the number of different species is not given”. Only 0.2% of students scored all three marks.

Q3.

(a) Students had more success with this calculation than with the previous two in the paper; possibly this was because they had practised inserting numbers into this equation. It was pleasing to see that 58% of students knew what N and n represent, and could insert their values into the equation and get a correct answer. Another 20% obtained one mark for correctly calculating either the top or bottom number in the equation (but getting the wrong final answer). The commonest error was thinking that N = number of species.

(b) This question discriminated quite well, even though it involved a well-known method. The commonest error was to count the number (or percentage cover) of each species, when only the number of species is required. If a student wrote about counting the number of species and the number of individuals, they did not get the mark because the examiner had no way of knowing whether or not they understood the difference between the data required to calculate species richness and index of diversity.

(c) This question discriminated very well, even though 46% of students scored zero. Answers suggested that few students really understand P values, or the nature and purpose of statistical tests. They showed how many think statistical tests demonstrate whether or not results, i.e. the data collected, are significant, or accurate, or reliable. Quite a few followed statements, about the data being due to chance, with observations that this showed the method was incorrect, that the scientists made errors, or that not enough data were collected. The data in Table 2 came from a study published in a peer-reviewed scientific journal. Unless given specific information in a question that indicates otherwise, students should assume that data have been collected, processed and presented correctly. The results of the statistical test in this example indicate whether or not the **difference between** two means is significant or not. It was heartening to find a few students who noted that a t-test might have been used to obtain P; though this was not required to answer the question. Some students got the meanings of ≤ and ≥ the wrong way around. This might explain why quite a few thought that only the change in diversity for Islay was significant. Some students tried to compare 0.001 with 0.05. Many noted that there was a significant change in species richness on all three, but failed to note that there were increases on two islands and a reduction on the other.

Q10.

(a) 70% of students correctly gave 14 as the answer. Some students used **Figure 2** rather than **Figure 1** or provided a definition of species richness.

(b) Surprisingly, less than 50% of students obtained this mark. Many students suggested that the additional information required was the total number of all dung

beetles rather than the number of individuals in each species.

(c) Almost two thirds of students failed to obtain a mark on this question. It was evident that many students did not fully understand what was meant by standard deviations. Also a large number of students used the results in **Figure 1** rather than **Figure 2**. Most students who did refer to no overlap in standard deviations were able to relate this to there being a significant difference in mean total to obtain both mark points.

(d) Three out of every four students correctly explained that choosing sites at random would prevent bias. Responses failing to gain credit often referred to 'controlling variables' or 'a fair test'.

(e) Most students obtained at least one mark usually by referring to the removal of a habitat for the birds. A significant number of these students then gained a second mark by referring to a decrease in food sources. Very few students obtained maximum marks as they did not relate the removal of hedges to the loss of plant/insect species. Often students showed understanding but did not gain credit due to the use of imprecise terminology and/or poor quality of communication. Common examples of this included, 'less food', 'less homes' and 'less shelters'. A small minority of students misinterpreted this question and discussed reduction in genetic diversity.

Q11.

(a) Almost as many achieved this mark as did not, so the definition of species diversity is not well known. Some confusion exists between species diversity and genetic diversity. Many students referred incorrectly to diversity within a 'population' so missed completely the point that the definition focussed on a collection of species. Instead of using 'number' in their definition, some students mentioned 'range' to suggest that they regarded diversity as a measure between two extremes.

(b) Most students achieved a mark for demonstrating they knew that the number of each species is relevant in the calculation, but, for many, their poor quality of written communication prevented the award of a second mark. For example, a common error was to refer to 'number of species' rather than make clear the importance of a 'grand total of organisms'.

(c) Many students showed a good appreciation of the principles of diversity and density and achieved both marks. The imprecise use of terms prevented some from achieving any marks, eg, 'organism' rather than 'species'; 'thrive' rather than 'reproduce' and 'hostile' rather than a precisely described effect of sewage.

(d) (i) The principle that repeatable results are a requirement in order to be able to draw conclusions was well understood. Unfortunately, some students only offered a comment about the observed difference in results and did not go further to state that it prevented the scientist from coming to a conclusion. Others gave an imprecise comment about the scientist being less able to draw a conclusion or they gave reasons why the two investigations might have produced differing results or they offered suggestions on how to improve the quality of findings.

(ii) Very few students gained the mark here either because they referred only to making a 'single repeat', or they repeated the investigation by changing the independent variable, and hardly any went further to confirm what the repeats would need to show before conclusions could be made.

Q12.

(a) About a third obtained both marks and half one mark. The commonest correct observation was that female lizards are longer. Fewer students noted that there is a greater range of lengths amongst females. Many students had trouble expressing themselves clearly. Some said that most females were 90 mm long and most males 80 mm. This is not correct, these are modal values. Others stated that males were mainly shorter than females below 100 mm.

(b) (i) 75% obtained both marks for the calculation.

(ii) The problem for many students in this part was that they wrote about factors affecting the number of lizards, not the number of species as required in the stem of the question. This meant that large numbers wrote about less food in the plantation, rather than fewer food sources, and failed to gain credit. The question required students to think about fewer food sources for both lizards and the insects they feed on. Only just over a tenth of students noted that there would be a lower diversity of insects in the plantation. This, together with fewer species of plants, would limit the range of food sources available and thus the number of species of lizard that could live there. It was pleasing to see that many students obtained a mark for stating there were fewer habitats or niches in the plantation.

Q13.

Parts (a), (b)(ii) and (b)(iii) proved to be good discriminators.

(a) 70% of students scored full marks. Those who scored one mark often gave both alternatives of the second mark point. Weaker responses often lacked clarity; for example, ‘number of individuals’ and ‘different species within a population’. Students who failed to score often thought that the ‘size of the area’ and ‘standard deviation values’ are needed to calculate an index of diversity. It should be noted that although the specification requires students to be able to calculate one specific index of diversity, the mark scheme was amended so that other types of index of diversity could be credited.

(b) (i) Most students were aware that the purpose of the control fields was to ensure that the results are due to the herbicide, or not due to another factor. Those who failed to score typically gave stock How Science Works responses, which could apply to any investigation. These usually referred to comparing groups or results, ensuring that the results were due to the independent variable, or simply that these fields acted as controls. Students should be reminded of the need to relate their answers to the specific investigation or context outlined.

(ii) Half of students scored one mark and this was usually for appreciating that the herbicide killed more weeds, which led to less competition. However, the ability to explain the effect of high concentrations of herbicide, in terms of damage to the crop, proved to be a good discriminator. Unfortunately, many students did not read information in the introduction carefully enough. They thought that the herbicide killed insects, which meant that fewer crops were eaten. The weakest responses usually went no further than to describe the graph.

(iii) Just under half of students scored at least two marks. This was usually for ‘fewer habitats’ and ‘fewer food sources’. It was only the best responses that referred to ‘fewer plant species’ being present. Similarly, the ability to express these ideas discriminated well. Weaker responses often referred to ‘less food’ and ‘less plants’, which were not credited. As mentioned in part (i), some

students wrongly thought that the herbicide killed insects, which directly led to a decrease in their index of diversity.

Q14.

(a) Over 95% of students correctly named the process as succession. Speciation was the most common incorrect response.

(b) Most students obtained at least one mark, usually for stating that more habitats would be available. Many of these students also referred to a greater variety of food sources although a significant minority simply stated there would be more food, which was not credited. Approximately a third of students gained all three marks by also indicating that as the woodland developed there would be an increase in the variety of plants.

(c) (i) 50% of students correctly gave temperature and carbon dioxide as the two limiting factors. Most who did not referred to water rather than temperature. However, humidity, mineral ions / nutrients, oxygen, pH, light intensity and chlorophyll were also given as limiting factors. Only rarely were two incorrect factors selected.

(ii) Most students referred to the uptake of carbon dioxide in photosynthesis and its release during respiration but did not fully explain net productivity. Some students got the use / production of carbon dioxide in photosynthesis / respiration the wrong way round. Almost a third of students did gain this mark, almost invariably by stating that net productivity = gross productivity minus respiration.

(iii) This question was not answered well. Very few students were able to use the information in **Figure 2** to explain how the shade plant is better adapted to gain both marks. The lower rate of respiration was recognised but the lower release of carbon dioxide was usually described at low light intensities rather than at 0 or in the dark. The idea of greater productivity in the shade plant was less frequently described. Most answers related to photosynthesis and many students gained no marks. As in part (ii), the uptake and release of carbon dioxide was sometimes wrongly assigned to respiration and / or photosynthesis. The surface area of the leaves, amount of chlorophyll and number of stomata were also incorrectly used as part of some students' explanations.

Q15.

This question was targeted at grade E. It is again surprising that all parts proved to be good discriminators.

(a) Two-thirds of students gained full marks. This was usually for mentioning that organisms of the same species can produce fertile offspring. However, some students failed to gain the mark for replacing the word 'fertile' with 'viable'.

(b) (i) Seventy percent of students correctly calculated the index of diversity within the range of 6.97 to 7. Of the other thirty percent, most gained one mark for calculating a correct numerator or denominator.

(ii) Nearly all students gained at least one mark, typically for 'fewer habitats'. Similarly, reference to pesticides or machinery decreasing species diversity was common. Compared with the previous series, it was pleasing to see a greater percentage of students refer to 'less food sources' or 'less variety of

food', rather than simply 'less food'. Relatively few students linked clearing the forest to a reduction in the number of plant species.

Q16.

(a) This question was the most effective discriminator on the entire paper. The best answers used all the information provided to describe how geographic isolation could cause a very high diversity of bird species. At the other extreme, speciation was ignored and a description of succession was given. Most answers did attempt to explain speciation but often did not make sufficient use of the information provided to gain high marks. Usually these accounts only gained the marks for geographic isolation and for describing differential reproductive success. Poor use of terminology was also clearly evident in these weaker responses. References to different selection pressures and changes in allele frequency were often only mentioned in better responses.

(b) Surprisingly, almost fifty percent of students failed to gain this mark. Common incorrect response referred to a climax community being formed, or mutations not occurring. Students gaining this mark often mentioned no 'isolation☐ or 'a similar environment☐.

Q17.

(a) (i) 40% of students gave one ethical argument for maintaining biodiversity that was of A-level standard. This was the idea of preventing extinction or loss of habitats. References to animal rights, or 'playing God' were classed as neutral.

(ii) Just under half of students gave one economic argument for maintaining biodiversity. The most common responses that gained credit referred to medicine, tourism or agriculture.

(b) This proved to be a good discriminator. Nearly two-thirds of students gained at least one mark usually for the answer 'fewer habitats'. Very few students mentioned that a lower percentage of the original forest meant that fewer plant species would be present. The ability to express the idea of 'fewer food sources' discriminated well. This was often conveyed in weaker responses as 'less food', which was not credited.

(c) 85% of students scored at least one mark. This was usually for 'number of each species'. It should be noted that the specification requires students to be able to calculate one specific index of diversity. The 'number of species' is not required to calculate this index of diversity. Consequently, this response was classed as neutral

(d) 70% of students scored full marks. Students who did not typically referred to surface area only, a *larger* SA:VOL, a *smaller* VOL:SA, fat or feathers.

Q18.

(a) This question was generally answered well, with the better students able to explain the importance of random collection in the context of the investigation rather than simply turning out the phrase 'avoiding bias'.

(b) (i) Most students understood the summation process even though they made mistakes in another part of the calculation. A significant number of answers went up to 5 or 6 decimal places which, although not penalised, should be avoided. The mathematical requirements of the specification do state the 'use

of an appropriate number of significant figures'. A significant number of students use the space available as rough working rather than for setting out the logic by which they arrived at the answer. A tangled mass of numbers did not always allow the examiners to credit incorrect responses for an understanding of underlying principles.

(ii) Most students made reasonable attempts at this section. Most correct references were to the reduction in species number and to the predominance of the bird-cherry aphid. Incorrect references were made to totals of all organisms and totals of all species. Weaker students assumed that the fewer organisms in total, the lower the biodiversity. Some wrote, incorrectly, about genetic diversity.

(c) Instead of evaluating the conclusion given, a significant number of students wrote their own conclusions about the effects of farming on the environment and the mechanisms by which these were brought about. Answers were often vague and did not refer to the data provided.

(d) Generally answered well; almost all students offered responses, often with good explanations relating to increasing variety of habitats and food sources.

Q19.

(a) (i) Slightly more than half the students obtained this mark, often for mentioning the idea of identifying anomalies or that the sample would be representative of the population. Answers failing to gain credit often lacked sufficient detail with responses such as 'to make the results reliable' or 'to calculate an average' being commonplace.

(ii) Almost 95% of students gained this mark by mentioning the removal of bias.

(b) Two thirds of students correctly carried out the calculation and obtained both marks. Approximately 5% of students obtained a principle method mark having calculated an incorrect answer.

(c) This question proved to be a fairly effective discriminator. Surprisingly, a significant minority of students suggested that there would be a decrease in the variety of insects on the golf course despite the stem of the question indicating that diversity would be higher. However, most students did mention an increase in habitats for one mark. Many also appreciated there would be an increase in the variety of food sources although references to 'more food' were not credited. Only the very best students mentioned an increase in the variety of plants.

Q20.

(a) This proved to be a very effective discriminator with almost equal numbers of candidates scoring two, one or zero marks. A significant number of candidates referred to 'more food' rather than a greater variety of foods. Vague terms such as 'more shelter' were not accepted as an alternative to more habitats.

(b) Very few candidates obtained both marks in this question. However, almost half the candidates gained one mark for indicating that the index of diversity measures the number of species and the number of individuals. Better candidates used this information to explain that an index of diversity would be more useful where some species were only present in low or high numbers.

(c) (i) This proved a very demanding question with two thirds of candidates scoring

zero. Despite the cue that 'these eggs are small' relatively few candidates correctly linked this to a large surface area to volume ratio. Only a small percentage of these candidates then referred to diffusion. It was very disappointing to see responses describing pesticides moving by osmosis.

(ii) The majority of candidates appreciated that evaporation of water would increase the concentration of the pesticide.

Q21.

(a) Those candidates who could explain with sufficient clarity that it was necessary to determine the number of each species present were able to gain credit. A surprising number of candidates knew that an equation was involved and could quote it with some degree of accuracy. Many revealed, however, little knowledge of what the various terms represented.

(b) Part (a) should have indicated to candidates that the thrust of this question was species diversity. Unfortunately the term diversity triggered many candidates to respond in terms of selection, genetic bottlenecks or the founder effect. The approach to this question was further influenced by a poor understanding of the concept of a species with many candidates apparently of the impression that all insects are members of the same species. Better candidates however approached the question in an appropriate way, and although they did not always appear to appreciate that clearing forest and planting crops would lower the plant diversity and hence the variety of available food, they were able to make worthwhile comments.

(c) In part (i), many candidates showed an unfamiliarity with the idea that joining points on a graph with straight lines indicated uncertainty over the reliability of intermediate points. Answers to part (ii) were rather better with most candidates clearly understanding the nature of controls even if they enjoyed less success in explaining why a control would be necessary in the investigation described.

(d) The best candidates understood the requirements of a question requiring evaluation and were able to link the changes in breeding birds shown on the graph with species diversity. They also indicated that the data referred to total number of birds and not diversity and point out the shortcomings at arriving at conclusions based on limited data. Those who did not gain significant credit, not infrequently failed to read the axes with sufficient care or did not appreciate why the points had been joined with straight lines. Evaluate was occasionally regarded as having the same meaning as Explain. Explanations gained little if any credit.

Q22.

(a) (i) Most candidates correctly carried out the calculation and obtained both marks. Approximately 10% of candidates obtained a principle method mark but calculated an incorrect answer.

(ii) Very few candidates obtained both marks in this question. Approximately a third of candidates gained one mark for indicating that the index of diversity measures the number of species and the number of individuals. However, only the very best candidates used this information that an index of diversity would be more useful when some species were only present in small numbers.

(b) (i) Most candidates gained one mark for explaining that removing other plant species or growing a single crop would reduce the species diversity of plants. However, very few candidates gained a second mark for explaining how these plant species would be decreased e.g. by the use of chemicals or by

competition from the crop plant.

(ii) A majority of candidates gained one mark for appreciating that a decrease in plant species would provide fewer habitats for animals. Better candidates gained a second mark for referring to a decrease in the variety of food sources available. However, many candidates simply stated there would be 'less food' which was not credited.

Q23.

Candidates were not always selective in choosing the material to answer this question. They sometimes wrote at length about succession in part (a) (which concerned diversity), and then found they had nothing new to say in part (b), which did concern succession.

(a) Good candidates were able to state, clearly and unequivocally, that an increase in the index of diversity means that the number of species has increased, as has the number of individuals within each species. Weaker candidates sometimes wrote all they knew about succession here or sometimes just wrote about "an increase in the organisms", failing to distinguish between new species and existing species.

(b) Most candidates were able to describe the role of pioneer species in colonising a harsh environment and the ways in which they might change this environment. Better candidates then went on to say that these changes allowed new species to become established with the creation of new habitats for still other species. However, too many could not resist following the development right through to the climax and describing the nature of this condition. Clearly, given the question, this was not necessary and could have wasted valuable time for some candidates.

Q24.

(a) Nearly all candidates knew that habitats would be lost, and a good number also knew that this would reduce the number of species in the area.

(b) Better candidates realised that both potassium nitrate and ammonium nitrate would release nitrate ions into the soil immediately, and that the ammonium ions in ammonium nitrate could be nitrified by nitrifying bacteria to provide a secondary release of nitrates. Many candidates, however, just did not apply their knowledge to the problem and merely recited chunks of the nitrogen cycle, with some confusion between nitrifying and nitrogen-fixing bacteria.

Q25.

(a) In this section, candidates often concentrated on either the method of achieving randomness in the sampling or on how other variables might have been controlled: both aspects were required for a complete answer.

(b) Most realised that mayfly nymphs belonging to the family Caenidae and living in the deep water showed the greatest variation as this sample had the highest standard deviation. Some were less specific.

(c) A simple definition in terms of an organism's role in the ecosystem or community was required to explain the meaning of the term *ecological niche*. Some candidates' answers could equally well have been applied to the term 'habitat'. However, there were few problems in recognising that one family of mayfly nymphs living mainly in deep water and the other in shallow water indicated that they occupied different ecological niches. Also, most candidates appreciated that the occupancy of different niches would result in reduced competition for some environmental resource (food

being the most common correct suggestion), although some should have thought more carefully about the given situation before suggesting competition for 'light' of for 'mates' (the two groups of mayflies were from different families). Some confused *intraspecific* and *interspecific* competition – only the latter being applicable here.

Q26.

(a) Most candidates were able to substitute the data in the formula and calculate the index of diversity correctly. There were occasional arithmetical errors. Many appreciated that the numbers of individuals had been used in the calculation of the index of diversity, or pointed out that the influence of rare species would be minimised. Weaker candidates frequently thought the index of diversity was good for comparing two areas (although why this should be an advance on just comparing the numbers of species present was not made apparent).

(b) Some candidates were confused and seemed to regard the results as having been derived *in situ* on the shore rather than being produced using a balance in a laboratory. Many confused cause and effect and ignored information provided earlier in the question, insisting that *Fucus spiralis* must have been located on the lower shore as it lost less water due to having been exposed for a shorter time. Those who did realise that *Fucus spiralis* in fact lost less water because it was better adapted to life on the upper shore, very rarely went on to suggest that living in this location (seemingly rather hostile) would result in reduced competition between it and the other species.

Q27.

(a) Most candidates clearly appreciated that the samples would best be obtained by using random numbers to determine co-ordinates, although they were not always specific as to how these numbers would be generated. There were, however, frequent references to "throwing" a quadrat, a technique which does not give rise to a genuinely random distribution.

(b) In part (i), candidates revealed considerable difficulty in recognising the trend of a decrease followed by stabilisation from a depth of around 200 cm. The most frequent response was to ignore the change in gradient and refer simply to the population falling. Where a genuine attempt was made to offer an explanation for the difference in numbers in part (ii), answers were usually correctly related to the decreasing concentration of oxygen available for respiration.

(c) There was obvious confusion in the minds of some between the concepts of ecological succession and natural selection. While some of those who made this distinction produced excellent answers, others lost their way in rambling anthropomorphic accounts of bacteria "not finding conditions to their liking" or being "happier" with conditions at other depths. There were also many general references to "bacteria". These lacked the necessary precision to gain significant credit.

(d) Part (i) was generally well answered and there were many accounts based on correct references to the surface layers being the only ones where numbers of aerobic bacteria increased. Part (ii) also produced some sound responses although candidates were inclined to embellish their answers with irrelevant detail relating to the anticipated change with time. Once again, a failure to gain marks most commonly stemmed from imprecise use of the word "bacteria". In both parts (c) and (d) there was a need to refer them as being either aerobic or anaerobic.

(e) There was encouraging evidence of a good understanding of standard error and many candidates were able to show some appreciation of this demanding concept.

However, answers were seldom targeted at explaining what the error bars revealed about the difference in activity at the times given. In spite of the wording of the last sentence of the question, the terms probability and chance were seldom incorporated into the explanation.

(f) The most frequent approach to this part of the question was to produce a mass of figures supporting a complex but inappropriate calculation. With these data the best approach was to construct a graph and draw a line of best fit. The likely number of bacteria could then have been established by reading off the appropriate value from the curve.

Q28.

(a) Surprisingly few candidates suggested a suitable method of trapping butterflies, but many could suggest mark, release and recapture as a method of estimating the population and gained one mark. Few candidates could then go on to explain how the data collected would be used to estimate a population.

(b) This calculation was done well by many candidates, although some did a lot of extra work and did not use the information given. A minority of candidates could not even begin to attempt the calculation.

(c) This question discriminated well. Better candidates calculated the index of diversity and correctly stated that diversity increased with logging. Weaker candidates could explain the effects on one or more species of butterfly, but they often missed the mark for stating that the number of butterflies decreased because they incorrectly used the term species (fewer species of butterflies) or population (the butterfly population decreases).

Q29.

Many good answers were seen to both parts of this question. The topics covered were obviously familiar to many candidates. Where marks were not gained, it was usually because of omissions rather than errors. The full range of marks was seen and the question discriminated well.

(a) Almost all of the candidates obtained a mark for noting that cyanogenic plants might die in areas with very low mean January temperatures. Many went on to obtain a second mark for identifying the positive advantage that cyanogenic plants have in warmer areas, because they deter herbivores. Only the better candidates wrote about the impact of these different selection pressures on allele frequencies in different clover populations. It was encouraging to note that ‘rote answers’, unrelated to this example were absent. Some weaker candidates did fail to score marks because they wrote in general terms about factors affecting natural selection and evolution but with no reference to the specific factors given in this example.

(b) The vast majority of candidates were familiar with the use of quadrats. Many were also able to describe a suitable method for placing these at random locations in the study areas. Some candidates suggested the use of transects and this suggestion was rejected; unless they suggested the use of very large numbers of transects along randomly chosen lines. Many candidates scored one mark for suggesting the use of large numbers of quadrats. A surprising number failed to get this mark, either because they made no reference to sample size, or because they wrote vaguely

about ‘several’ quadrats being used. The majority of candidates obtained a mark for what a quadrat might be used to measure. A large number of candidates made reference to the use of statistics but often that was all they said. The examiners were looking for the use of a statistical test to determine whether or not there was a significant difference in the number of clover plants in the two areas.

Q30.

(a) Many candidates failed to explain the advantages of removing hedgerows in sufficient detail, many just stating that this leaves ‘more space’ with no further qualification. Good candidates included detail about the effect on the crop, or the cost of labour in maintaining hedgerows.

(b) Although most candidates scored at least one mark, many did not refer back to the stem of the question. Some suggested that it might be easier for the farmer to destroy the beetles if they were all in one place, or that the strip of grass might become a source of humus. Relatively few candidates explained that the strip of grass would allow the beetles easier access to pests throughout the crop.

(c) Most candidates scored well on this question, with the most popular responses describing the effect of hedgerows in preventing erosion, or promoting biodiversity.

Q31.

(i) Most candidates calculated the diversity index correctly and obtained both marks. A significant few understood how to use the equation but failed to apply the right mathematical approach; multiplying a number by the value zero was often performed incorrectly.

(ii) Only rarely was a valid reason given for the difference in diversity index. Many candidates incorrectly believe that the quantity of available food, rather than the type of food, determines species diversity.

Q32.

(a) The majority of candidates showed that they were aware of what is meant by an abiotic factor and many correctly identified all three.

(b) Candidates showed little evidence of having actually carried out fieldwork. Several misread the question and simply gave the standard answer relating to the random positioning of quadrats. Few could give a reasonable description of how to obtain a measure of the percentage cover. Better answers suggested subdividing the large quadrat into smaller squares, or counting whether vegetation was present at a large number of points. Several candidates merely subdivided the quadrat into 10 small squares, and candidates then recorded presence or absence of vegetation, which clearly could only at best give a value to the nearest 10%.

(c) Most candidates were aware that the correlation was unlikely to be due to chance, and several expanded their answer to point out there was only a 1 in 20 probability of its being a chance result. Some, however, stated that the result showed that moisture in the soil caused the increase in vegetation, or vice versa.

(d) Most could suggest some factor that might change, such as increase in humus, but

few gave a clear explanation of how the physical environment would be changed as a consequence.

Q33.

(a) A surprisingly high proportion of candidates failed to calculate the percentage correctly, and those who did often did not round off their answer, thus suggesting that a fraction of a species existed.

(b) Few candidates showed appreciation of the role of isolation in the production of new species that would be unique to the Solomon Islands. Most focused on one aspect only. For example, some described adaptation to the range of habitats without discussing speciation. Others pointed out the problems of interbreeding without considering how the endemic species might have arisen in the first place.