Mark schemes

(a) 4:

1 **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]

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

2 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] (a) 1. Kingdom, Phylum, Class, Order, Family;

3

2. *Luscinia svecica.*

1 mark for each correct column

Allow Genus and Species if both placed in box for species but not if both placed in genus box

2

(b) Number of different alleles of each gene.

Accept number of different base sequences (found) in each gene

1

(c) 1. Has greater proportion of genes / percentage of genes showing diversity;2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278

2

[5] (a) 1. Draw grid over (map of) area;

4

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) fromsame area / same population;
2. Affecting ratio of marked to unmarked.

2

[10] (a) 14;

5

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]

6 (a) 1. Vaccine/it contains antigen (from HPV);

Term 'antigen' may be first mentioned with point 2

2. Displayed on antigen-presenting cells;

Accept named example, e.g. macrophage/phagocyte/B cells

3. Specific helper T cell (detects antigen and) stimulates specific B cell;

Accept 'helper T cell with receptor on surface' for 'specific' and B cells with receptor/antibody on surface that bind to antigen for 'specific'

4. B cell divides/goes through mitosis/forms clone to give plasma cells;

5. B cell/plasma cell produces antibody;

4 max

(b) 1. Two (doses) because got more antibody;

Accept more effective in producing antibody

2. With three doses, second dose/dose at 1 month doesn't leadto production of any more antibody (than the two-dose group)/get same/similar response;

3. Three doses would be more expensive/less popular withparents/girls (and serves no purpose);

Accept 'less painful'

2 max

(c) t-test, because comparing two means;

Mark for correct test <u>and</u> explanation correct

Accept 'comparing the mean'

Reject 'to show that the results/means are significant'

1

(d) 1. Compare (base sequences of) DNA;
2. Look for mutations/named mutations (that change the basesequence);
3. Compare (base sequences of) (m)RNA;

1 and 3 accept triplet/codon sequences for comparisons

Ignore references to 'introns/non-coding DNA'

2 **max**

[9]

7 (a) (i) (Grouped according to) evolutionary

links/history/relationships / common ancestry;

Ignore: closely related, factors, characteristics

Ignore: genetically similar

1

(ii) 1. Able to reproduce;

Accept: smallest taxonomic group/groups of organisms with same genes/ chromosomes/same number of chromosomes

Accept: breed for 'reproduce'

Ignore: mate

Reject: genetically identical

Ignore: similar genes/chromosomes

2. To produce fertile offspring;

Ignore: that are 'viable'

2

(b) Phylum
Class
Family
Genus;

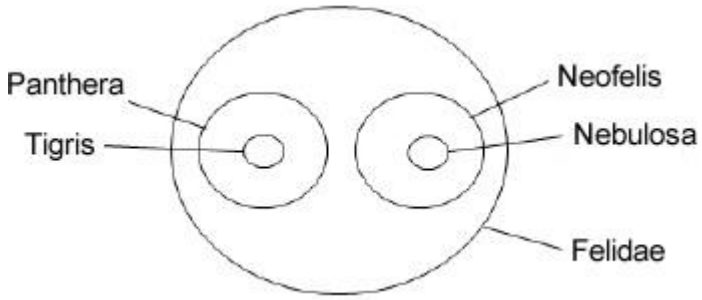
Accept: pleural answers phyla / genera / families

Accept phonetic answers phyllem/phylem/fylum/fyla/phylae/phyli /jenus/ jenera/familys

All 4 in correct order for 1 mark

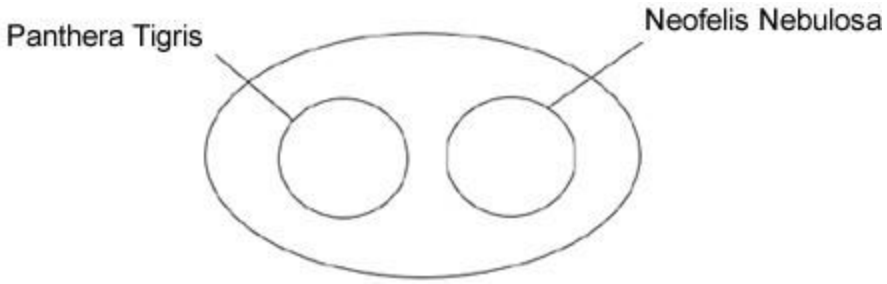
1

(c) 1. Two circles/with two inner circles with no overlap;



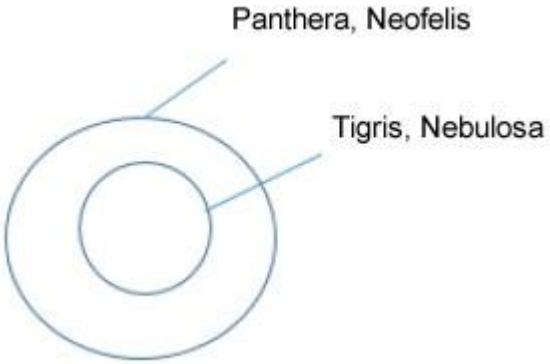
= 2 marks

OR



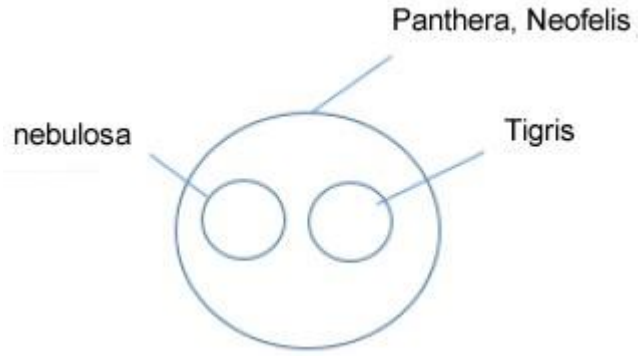
= 2 marks

OR



= 1 mark

OR



= 1 mark

2. Labels correct;

Ignore underlining / capitals

Accept: P tigris/ N nebulosa

Accept phonetic spelling

2

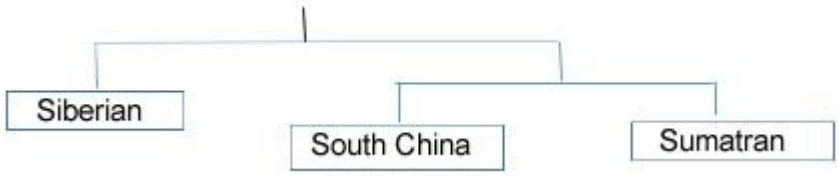
(d) 1. South China and Sumatran tigers share a more recentcommon ancestor;

Accept: more closely related (statement must be comparative)

Accept: a labelled hierarchy

2. (because) identical/same/matching (nucleotide) sequences;

Accept: converse for Siberian tiger eg Siberian is less closely related to South China AND Sumatran tigers



2

[8]

8

(a) 1. Type of feed affects (antibiotic) resistant bacteria (in animals);

Accept: null hypotheses

Accept predictions, for example

More antibiotic resistant bacteria form in animals fed with antibiotics in their food

2. (Antibiotic) resistant resistant infect /are passed on to animals/farmer / resistant resistant are passed between animals;

Accept: bird to bird/bird to human/human to human

Accept: a link (exists) between (antibiotic) resistance in animals and their keepers/farmers – as lowest level QWC

3. Incidence of (antibiotic) resistant resistant differs in chickens and turkeys;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

4. Incidence of (antibiotic) resistant resistant differs in chicken farmers and turkey farmers;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

Max 2

(b) (i) 1. Large(r) percentage of resistant bacteria in turkeys/low(er) percentage of resistant bacteria in chickens;

Accept: E coli for bacteria

Ignore: number, eg. ignore 'more'/'fewer' turkeys/chickens

2. Large(r) percentage of resistant bacteria in turkey farmers/low(er) percentage of resistant bacteria in chicken farmers;

2

(ii) 1. (More) antibiotic in turkey feed kills (more) non-resistant bacteria / resistant bacteria survive; *Accept: antibiotic creates selection pressure*

Survive must be explicit, not implied by 'reproduce'

2. (Resistant bacteria) reproduce / pass on gene for resistance;

2

(c) (Human) faeces contain pathogens;

Accept: harmful organisms

1

(d) 1. Large number of farms / farmers (surveyed) / 46;

'Reliable' is used in the question stem

2. So results are (likely to be) representative / can identify anomalousresults;

Ignore: reproducible / accurate / valid / reliable

Accept valid explanation of replicates minimising effects of chance

2

(e) 1. (DNA) hybridisation (of gene for resistance in bacteria takenfrom bird and farmer);

2. (Identical) strands separate at high(est) temperature;

OR

3. Compare base/nucleotide sequence (of gene for resistance inbacteria taken from bird and farmer);
4. (Identical strains) have identical/same base sequences*Mark in pairs, do not mix and match.*

Accept: bacteria in bird and farmer/both types of bacteria have identical base sequences = 2 marks

2

(f) 1. (Antibiotic use has) increased cases of bacterial resistance;

Accept: number

2. Transfer/horizontal transmission of (resistance) gene topathogens/harmful bacteria;

Accept: conjugation

3. (Antibiotic) resistant bacteria cause harm / medical treatments lesseffective;

Accept: superbug

4. Avoids side effects on animals;
5. Increased demand for organic food;
6. Antibiotic/resistant bacteria could be present in human food;
7. High cost of antibiotics;
8. Legislation has controlled antibiotic use;*Accept: EU/government guidelines*

4 max

[15]

9 (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 <u>species</u> 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]

10

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

Accept: reproductive isolation as an alternative to no interbreeding.

2. Mutation linked to (different) markings/colours;
3. Selection/survival linked to (different) markings/colours;
4. Adapted organisms breed / differential reproductive success;

Note: 'passed on to offspring' on its own is not sufficient for reproduction.

5. Change/increase in allele frequency/frequencies;

5

(b) 1. (Compare DNA) base sequence / base pairing / (DNA) hybridisation;

Ignore: compare chromosomes / 'genetic make-up'.

Accept: (compare) genes / introns / exons.

*Note: reference to **only** comparing alleles is 1 max.*

2. Different in six (species) /different in different species / similar in three (subspecies) /similar in same species/subspecies;

Ignore: compare chromosomes / 'genetic make-up'.

Reject: 'same alleles/ same DNA bases in three species/subspecies'.

Note: mark point 2 can be awarded without mark point 1.

2

[7]

11 (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] 1. Carbon dioxide combines with ribulose bisphosphate / RuBP;

12

2. Produces two glycerate (3-)phosphate / GP;

Accept: any answer which indicates that 2 x as much GP produced from one RuBP.

3. GP reduced to triose phosphate / TP;

Must have idea of reduction. This may be conveyed by stating m.p. 4.

4. Using reduced NADP;

Reject*: Any reference to reduced NAD for m.p.4 but allow reference to reduction for m.p. 3.*

5. Using <u>energy</u> from ATP;

Must be in context of GP to TP.

6. Triose phosphate converted to glucose / hexose / RuBP / ribulose bisphosphate /named organic substance;

[6] (a) Succession;

13

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 carbondioxide used in photosynthesis than produced in respiration;

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

1

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

Accept: lower compensation point.

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

Neutral: any references to rate of photosynthesis.

2

[8] (a) (i) 1. Groups within groups;

14

1. accept idea of larger groups at the top / smaller groups at thebottom

2. No overlap (between groups);

2

(ii) (Grouped according to) evolutionary links / history / relationships / common ancestry;

Neutral: closely related

Neutral: genetically similar

1

(b) (i) 1. (Only) one amino acid different / least differences / similar amino acid sequence / similar primary structure;

2. (So) similar DNA sequence / base sequence;

2

(ii) 1. Compared with humans / not compared with each other;

Accept: degenerate code / more than one triplet (codes) for an amino acid

2. Differences may be at different positions / different amino acids affected / does not show where the differences are (in the sequence);

1 max

(iii) 1. All organisms respire / have cytochrome c;

Accept: converse arguments for haemoglobin

1. Accept 'more' instead of 'all'

1. Accept 'animals' instead of organisms'

2. (Cytochrome c structure) is more conserved / less varied (betweenorganisms);

2. Neutral: cytochrome c is conserved

1 max

[7] (a) Push – legume

15

Pull – grass;

Both needed for mark

1

(b) 1. Set up tape measures on two sides of the plot / make grid of plot;

Allow 'Number each plant'. With this approach mp3 cannot be awarded.

2. Use random number table / calculator / generator;*Allow 'Select from a hat' idea.*

3. To generate coordinates;

3

(c) 1. To prevent competition between the maize and the grass;2. For light / nutrients / water;

OR

3. Idea of limits movement of pest (between grass and maize);

4. Only eating / damaging grass;

2 max

(d) 1. Nitrogen-fixing bacteria convert nitrogen (in the air) into ammonium compounds (in the soil) which are converted into nitrates / nitrification occurs;

Accept 'ammonia' for 'ammonium compounds'.

2. Maize uses nitrates (in soil) for amino acid / protein / ATP / nucleotideproduction;

2. Must be in the context of maize.
Ignore ionic formulae unless only these are given.

2

(e) 1. Reduced % damage to maize plants / increased maize grain yield;

2. Calculation to justify mp 1;

3. Standard deviation shows no overlap but need stats to show significance of thisdifference;

4. More profit / net income / greater income than additional cost (with push-pull);

5. $322 extra / 408% more / $401 v $79 profit;

Accept '$350 extra income compared to $28 extra spend'.
Mp5 gains credit for both mp4 and 5

3 max

[11] (a) (i) Reliable / representative / for statistical tests;

16

Accept: identify anomalies

Neutral: accurate / valid / bias

1

(ii) 1. Find coordinates (on a grid) / split area into squares / number the sites;

1. Ignore references to tape measures, metre rulers etc

2. Method of generating / finding random numbers eg calculator / computer /random number generator / random numbers table;

2. Accept: numbers out of a hat / use of dice

2

(iii) 1. Breeding (of lizards);

Neutral: weather / climate / hurricanes / hibernation / migration / emigration / immigration

2. Food source / prey;

3. Predator;

4. Variation in malarial infection;

5. Temperature variation;

6. Availability of water eg drought / 'rainy season'

2 max

(b) 1. Number in sample varies;

2. Allow a (valid) comparison;

2

(c) 1. (Overall) positive correlation (for either / both species); *Neutral: only one study / no repeats*

2. Reference to (site) 5 / 300 metres;

3. Limited results for *A. wattsi* / small sample / number / percentage infected for *A. wattsi*;.

2 max

(d) (i) 1. Fewer *A.wattsi* infected / more *A. gingivinus* infected;

2. Higher number of *A.wattsi* present when higher percentage / number of *A.gingivinus* infected / no *A.wattsi* present when *A.gingivinus* has zero infection;

2

(ii) 1. Reduced immunity / increased susceptibility to disease;

1. Accept: idea that energy / resources are used to combat malaria

2. Reduced oxygen transport / uptake / respiration / reduced activity / movement;

2

(iii) 1. There is a <u>probability</u> of less than 1% / 0.01;

1. Reject: probability is / equal to 1% / 0.01;

1. Reject 0.01% / 5% / 0.05 / 0.05%

2. That result(s) / correlation / it is due to chance;

2. Allow correct interpretation using above (incorrect) figures eg there is a probability of less than 5% that the results are due to chance =1 mark

OR

3. There is a <u>probability</u> of more than 99% / 0.99;

4. That result(s) / correlation / it is not due to chance;

Note: there is a probability of more than 5% that the results are due to chance =0 marks

3. Reject: probability is / equal to 99% / 0.99;

3. Reject 0.99% / 95% / 0.95 / 0.95%

4. Allow correct interpretation of above figures ie 0.99% / 95% / 0.95 / 0.95% but reject if less than

2

[15] (a) (i) Kingdom / phylum / class;

17

Accept Animalia / animal kingdom / Chordata / Chordates / Aves

Allow phonetic spelling

1

(ii) Family;

1

(b) 1. Shows the spread of the data / how data varies;

1. Reject range.

Accept varies from the mean

2. Overlap = no difference / due to chance / not significant;

2. Allow converse

2

(c) 1. Different species would have different amino acid sequences;*Accept more closely related = more similar sequence*

2. Amino acid sequence is the result of DNA / alleles / base sequence;

References to incorrect statements about coding negates second mark

2

[6] (a) Removes bias;

18

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 species / Beech aphid / Large white butterfly / 7-spot ladybird absent / only three species / species diversity lower / mostly one species / mostly bird-cherry aphid;

1. Allow species richness in context of few species

2. Fewer plant species;

2. Allow one type of food source if clearly plant

2

(c) For:

1. Data support the claim / evidence supports claim;

1. *Ignore reference to correlation / causation*

Against:

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

2 max

(d) 1. Greater variety of plants;

2. Another habitat / more habitats / places to live / niches / another food source /more food types;

2. Answers referring to 'more food' should not be credited. Allow reference to either animal or plant as foods

2

[9] (a) 1. Carbohydrate / sugar / named carbohydrate;

19

2. Minerals / named mineral ion;

Accept alternatives for mineral such as inorganic substances / ions. Accept symbol for ion. Accept incorrect symbols providing that answers are not ambiguous.

3. Amino acids / protein;

4. Vitamins;

2 max

(b) 1. Shake / stir / mix;

2. Even distribution of yeast / cells;

Accept other terms with a similar meaning for both points

2

(c) Two marks for correct answer of 20 / 20.2 / 20.22;;

One mark for incorrect answer in which student clearly shows increase as 8.912 – 7.413 or as 1.499;

Ignore references to 10^6

2

(d) 1. More competition;

2. Less oxygen;

3. Less glucose / sugar / carbohydrate / respiratory substrate;

4. Ethanol / alcohol becomes toxic / inhibits respiration / inhibits reproduction;

5. Fall in pH;

2 max

[8] (a) 1. Closer the (amino acid) sequence the closer the relationship;

20

2. (Protein structure) related to (DNA) base / triplet sequence;

Amino acid sequence is related to (DNA) base / triplet sequence = two marks;

2

(b) 1. Reference to base triplets / triplet code / more bases than amino acids / longer base sequence than amino acid sequence;

Different (base) triplets code for same amino acids = 2 marks;

Degeneracy of triplet code = 2 marks

2. Introns / non-coding DNA / degeneracy of code / more than one code for each amino acid;

Ignore reference to codon.

2

[4] (a) Greater variety / different foods;

21

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); Correctreference to diffusion;

Accept (Eggs) cannot move (out of water) for 1 mark

2

(ii) Concentration (of pesticide) is increased;

1

[7]

22

(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] (a) Two marks for correct answer, 41.9 / 42 ;;

23

One mark for incorrect answer of 0.42;

2

(b) Increases proportion of crop that is used / greater proportion is grain / reducesproportion of crop that is not used / is not grain;

1

(c) Quadrats from different parts of field;

Biotic / abiotic factors / named biotic / abiotic factor different;

2

(d) Water (in plants and grain);
Varies;

2

[7] (a) Greater when treated with herbicide **G**;

24

Same number but total biomass larger;

Can be shown by figures

2

(b) Fewer weeds left to produce seeds;
Less contamination of crop (by weeds); / fewer weeds to separate from crop; / less competition (between crop and weeds);

2

(c) **Advantage**
Weeds growing fast / photosynthesising fast so effect will be seen /
will have large effect;

Disadvantage
No information about winter / other seasons /
weeds not growing fast / could kill
(beneficial) insects /
crop may be harvested before effects noticeable;

One mark for advantage and
one mark for disadvantage

2

(d) **Limitations of investigation**
1. No control / untreated field;
2. Amount of herbicide may be different;
3. May be differences between fields; Eg soil Nutrients / fertiliser added Type of weedMicroclimates
4. May be different number of weeds (at start);

Limitations of results
5. No replicates / one set of data;
6. Field size may vary / not specified;

Scientific Research
7. Scientific research / example of scientific research has led to greater yield;*When marking please number the marking points*

e.g. 5✓ *means a mark award for point 5*

5 max

[11

] (a) Banding pattern changes as cheetah gets older / difficult to judge as tail is short / fluffy;

25 **1**

(b) (i) Mean not (always) a whole number;
Standard deviation not (always) zero;

2

(ii) Movement of tail / angle of sight / confused it with another band / subjective estimation;

Accept reference to ***Figure 1***

E.g. Bands 2 and 3 have same thickness but look different

1

(c) Band width not the same on both sides of tail;

1

(d) Offspring of the same family will be more similar genetically;
As have same mother (and father) / parent;
Expect to see more differences in randomly chosen cheetahs;

3

[8]