

Mark schemes

1

(a) Community;

1

(b) (Less) competition for food/resource;

Ignore: competition for niche/habitat.

Accept: space/named resource.

Reject: intraspecific competition.

1

(c) 1. Correlation **but** does not mean a causal effect;

Ignore: positive/ negative (correlation).

2. Other abiotic/biotic/named factor involved;

Accept: due to presence/absence of fish.

Reject: 'other factors' unless further qualified.

3. Variation in numbers of beetles species at same/similar particular pH;

Accept: same number of beetles at different pHs.

Accept: 'scattered results' / 'anomalies' / 'spread of results'.

4. Large sample;

Max 3

(d) Fish feed on predator/consumer of water beetle;

Accept: beetles feed on fish/faeces.

1

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2

- (a) 1. (Expression/appearance/characteristic due to) genetic constitution/genotype/allele(s);
Accept: named characteristic.
Accept: homozygous/ heterozygous/genes/DNA.
Ignore: chromosomes.
2. (Expression/appearance/characteristic due to) environment; 2
- (b) (i) 1. (Individual) 2 has colour vision but 4 is colour blind / 10 has colour vision but 12 is colour blind
OR
4/12 is colour blind but parents have colour vision;
2. So 2/10 must be heterozygous/carriers;
Accept: (1), 2 and 4 or 10, (11) and 12.
Accept: any suitable description and explanation equivalent to points 1 and 2.
Reject: (both) parents heterozygous/carriers.
Accept: correct genotypes for 2 and 10.
Accept: for 2 marks, if it was dominant the daughters (8 and 10) of individual 4 would be colour blind. 2
- (ii) $X^B X^b$ or $X^b X^B$;
Reject: Bb / bB
Accept: XB Xb or Xb XB;
Accept: use of other letter than B
e.g. $X^R X^r$, $X^H X^h$. 1
- (c) (i) 2 marks for the correct answer of 0.0625 / 6.25% / $\frac{1}{16}$::;
1 mark for incorrect answer but shows 0.03125 / 3.125% / $\frac{1}{32}$;
Accept: 0.063 / 0.06 / 6.3% / 6% for 2 marks.
Accept: incorrect answer but shows / 0.0313 / 0.031 / 0.03 / 3.13% / 3.1% / 3% / $\frac{1}{4} \times \frac{1}{4}$ / 0.25×0.25 for 1 mark.
Note: if probability is calculated as a percentage but no % shown in the answer then deduct one mark. For example 6.25 = one mark, 3.125 = zero. 2
- (ii) 2 marks for the correct answer of 48(%);;
1 mark for an incorrect answer but shows understanding that $2pq =$ heterozygous or attempts to calculate $2pq$;
1 mark maximum for the answer of 0.48. 2

[9]

3

- (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

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4

- (a) 1. Respiration/metabolism/ammonification;
2. (Releases/produces) heat;

Reject: 'produces energy'.

2

- (b) 1. SD is spread of data around the mean;
Accept: variation around the mean.
Accept: range is difference between highest and lowest values/extremes or range includes anomalies/outliers.
2. (SD) reduces effect of anomalies/ outliers;
Reject: (SD) removes anomalies/outliers.
3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance;
Ignore: reliability/accuracy/validity.

2 max

- (c) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;
Accept: increases nitrification/ammonification or 'breaks down waste faster'.
5. Aeration/provides oxygen;

2 max

- (d) 1. Microorganisms change the abiotic conditions/temperature /organic waste /provide nutrients;
Must refer to microorganisms or bacteria/named bacteria causing the change.
Ignore: change the environment.
2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;
Accept: 'decrease in cocci, others are going up'.
Accept: decrease in cocci and increase in either rod type or increase in both types.
4. Gram positive outcompete / better competitors;
Accept: rods outcompete (cocci) / better competitors.

3 max

[9]

5

- (a) 1. (Use) coordinates / number the rocks/sites/squares;
Ignore: references to grid, tape measures, metre rulers etc.
2. Method of generating/finding random numbers e.g. calculator/computer/random number generator/random numbers table;
Accept: numbers out of a hat / use of dice.
- 2
- (b) Difficult/too many to count / individual organisms not identifiable / too small to identify/count / grows in clumps;
Ignore: easier/quicker/representative/ more accurate, unless qualified.
- 1
- (c) Any suitable factor with valid explanation = 1 mark
1. Wave action - firmer grip on rock is necessary (at either site);
2. Wind/air movement/less humid - more evaporation at site A / more (physical) damage;
3. Light – (linked to) photosynthesis (at either site);
4. Temperature – (linked to) photosynthesis/respiration/enzymes/ evaporation (at either site);
5. pH – (linked to) enzymes/proteins;
- Note: other common factors include salt (salinity) linked to water potential / named nutrient e.g. nitrate linked to protein/DNA.*
Ignore: carbon dioxide/oxygen/pollution/rainfall/food/nutrients.
Reject: biotic factors e.g. predation.
- 2 max
- (d) 1. Greater variety of food / more food sources;
Ignore: more food.
2. More/variety of habitats/niches;
Ignore: homes/shelters.
Accept: different habitats.
- 2
- (e) (i) 1. (So they were) hungry/not full;
Accept: description of hunger e.g. appetite / 'empty stomach'/'so they eat'.
2. (Allows) comparison;
- 2
- (ii) 1. Alga without consumer/named consumer/animal;
Accept: repeat experiment without consumer.
Accept: in separate tank / in tank where not eaten.
2. (Find change in mass) in dark;
3. For 50 hours;
Accept: 'same time as in experiment'.
Accept: For lower time period then scaled up to 50.
- 3
- (iii) 1. For *Laurencia pacifica* **and** *Cystoseira osmondacea*

(difference in results) significant /reject null hypothesis / not due to chance / less than 5%/0.05 probability due to chance;

Accept: for Laurencia pacifica 'less than 1%/0.01 probability'.

2. For *Egregia leavigata* **and** *Microcystis pyrifera* no significant (difference in results)/accept null hypothesis / is due to chance/more than 5%/0.05 probability due to chance;

Accept: 'insignificant' for 'no significant difference'.

3. (Difference in results) for *Laurencia pacifica* is the most significant;

Note: reference to probabilities on their own is not sufficient.

1, 2 and 3. Accept: abbreviations for all species.

3

[15]

6

- (a) 9 (hours);;

If multiply 75 by 0.11 and 0.23 but wrong answer, then 1 mark

*Accept for **one** mark if multiply 75 by two wrong proportions near to 0.11 ± 0.01 and 0.23 ± 0.01 or multiply by the difference between the two (wrong) proportions*

2

- (b) (Yes because)

1. Both/Each species (mean) time spent looking around greater where many predators;
2. Differences (appear to be) significant because SDs do not overlap;

(No because)

3. Wildebeest spend same (mean) time looking around where many predators as impalas where few predators;
4. Don't know what they are looking for (when heads up);
5. Habitats might be different in different areas (which could affect the behaviour);

Accept 'mean proportion' means 'time'

1. Require idea of both, not just quoting numbers

2. This point must be in the context of point 1

2. Do not accept results significant

2. Accept 'because bars do not overlap'

2. Do not accept SE for SD

3. Accept overlap in SD as equivalent to same time

5. Ignore 'other factors' unqualified and discussions of experimental variables

4 max

- (c) 1. Less time spent feeding
OR
 More energy lifting head/looking round;
 2. (So) less food/biomass for respiration
OR
 less energy for growth/reproduction/care of young;
OR
 3. Raising head makes them more visible to predators;
 4. So more likely to be attacked/eaten/killed;
- 2. Accept any appropriate suggestion of less energy for something to do with life of the herbivore*
- 2. Allow less food/biomass for growth/reproduction*
- 2. Ignore references to energy for respiration*

2

[8]

7

- (a) 1. (Reaction with ATP) breaks/allows binding of myosin to actin/ actinomyosin bridge;
 2. Provides energy to move myosin head;
- 1. Credit 'breaks' or 'allows' binding to actin (because cyclical)*
- 2. Allow in context of 'power stroke' or 're-cocking' (because cyclical)*
- 2. Ignore contraction on its own*

2

- (b) (i) Any value between 68.5 and 69.49 (%);;
- If get difference of 0.9 but calculation of percentage incorrect, then award 1 mark;

2

- (ii) (Mutant mice)

1. Unable to make phosphocreatine/ less phosphate available to make/recycle ATP;
2. So less energy/so less ATP available for contraction/fast muscle fibres;
- 1 and 2. Reject production/creation of energy once*
- 2. Accept less energy for grip*
- 2. Accept no energy/no ATP for contraction/fast muscle fibres*

2

- (c) 1. (Heterozygous) have one dominant/normal allele (for creatine production);
 2. (This) leads to production of enough/normal amount of creatine;
- 1. Accept has one allele/one copy of the gene for/that is making creatine*

2

[8]

8	(a) (No – no mark) Graph / bar chart only shows number of species, not the name of the species.	1	
	(b) (No – no mark) 1. Mutations are spontaneous / random; 2. Only the rate of mutation is affected by environment; 3. Different species do not interbreed / do not produce fertile offspring; 4. So mutation / gene / allele cannot be passed from one species to another. <i>Ignore references to correlation does not prove causation</i>	4	
	(c) 1. Initially one / few insects with favourable mutation / allele; 2. Individuals with (favourable) mutation / allele will have more offspring; 3. Takes many generations for (favourable) mutation / allele to become the most common allele (of this gene).	3	[8]
9	(a) (Genes / loci) on same chromosome.	1	
	(b) 1. GN and gn linked; 2. GgNn individual produces mainly GN and gn gametes; 3. Crossing over produces some / few Gn and gN gametes; 4. So few(er) Ggnn and ggNn individuals.	4	
	(c) (Grey long:grey short:black long:black short) =1:1:1:1	1	
	(d) 1. Chi squared test; 2. Categorical data.	2	[8]
10	(a) 0.32. <i>Correct answer = 2 marks</i> <i>Accept 32% for 1 mark max</i> <i>Incorrect answer but identifying 2pq as heterozygous = 1 mark</i>	2	
	(b) 1. Mutation produced <i>KDR minus</i> / resistance allele; 2. DDT use provides selection pressure; 3. Mosquitoes with <i>KDR minus</i> allele more likely (to survive) to reproduce; 4. Leading to increase in <i>KDR minus</i> allele in population.	4	
	(c) 1. Neurones remain depolarised; 2. So no action potentials / no impulse transmission.	2	

- (d) 1. (Mutation) changes shape of sodium ion channel (protein) / of receptor (protein);
 2. DDT no longer complementary / no longer able to bind.

2

[10]

11

- (a) 1. Reduction in ATP production by aerobic respiration;
 2. Less force generated because fewer actin and myosin interactions in muscle;
 3. Fatigue caused by lactate from anaerobic respiration.

3

(b) Couple **A**,

1. Mutation in mitochondrial DNA / DNA of mitochondrion affected;
 2. All children got affected mitochondria from mother;
 3. (Probably mutation) during formation of mother's ovary / eggs;

Couple **B**,

4. Mutation in nuclear gene / DNA in nucleus affected;
 5. Parents heterozygous;
 6. Expect 1 in 4 homozygous affected.

4 max

- (c) 1. Change to tRNA leads to wrong amino acid being incorporated into protein;
 2. Tertiary structure (of protein) changed;
 3. Protein required for oxidative phosphorylation / the Krebs cycle, so less / no ATP made.

3

- (d) 1. Mitochondria / aerobic respiration not producing much / any ATP;
 2. (With MD) increased use of ATP supplied by increase in anaerobic respiration;
 3. More lactate produced and leaves muscle by (facilitated) diffusion.

3

- (e) 1. Enough DNA using PCR;
 2. Compare DNA sequence with 'normal' DNA.

2

[15]

12

- (a) (i) Unit of energy / mass, per area, per year.

1

- (ii) 1. Less light / more shading / more competition for light;
Neutral: references to animals

2. Reduced photosynthesis.
Accept: no photosynthesis

2

- (b) 1. Pioneer species;
 2. Change in abiotic conditions / less hostile / more habitats / niches;
Accept: named abiotic change or example of change e.g. formation of soil / humus / organic matter / increase in nutrients
Neutral: reference to change in environment unqualified
Neutral: more hospitable / habitable / homes / shelters
 3. Increase in number / amount / diversity of species / plants / animals.
Accept: other / new species (colonise)

3

- (c) 1. Net productivity = gross productivity minus respiratory loss;
 2. Decrease in gross productivity / photosynthesis / increase in respiration.

2

- (d) 1. Conserving / protecting habitats / niches;
 2. Conserving / protecting (endangered) species / maintains / increases (bio) diversity;
 3. Reduces global warming / greenhouse effect / climate change / remove / take up carbon dioxide;
 4. Source of medicines / chemicals / wood;
 5. Reduces erosion / eutrophication.
Accept: tourism / aesthetics / named recreational activity

1 max

[9]

13

- (a) Both alleles are expressed / shown (in the phenotype).
Accept: both alleles contribute (to the phenotype)
Neutral: both alleles are dominant

1

- (b) Only possess one allele / Y chromosome does not carry allele / gene / can't be heterozygous.
Accept: only possess one gene (for condition)
Neutral: only 1 X chromosome (unqualified)

1

- (c) 1. X^GX^B , X^BX^B , X^GY , X^BY ;

Accept: equivalent genotypes where the Y chromosome is shown as a dash e.g. X^{G-} , or is omitted e.g. X^G

Reject: GB, BB, GY, BY as this contravenes the rubric

2. Tortoiseshell female, black female, ginger male, black male;

3. (Ratio) 1:1:1:1

2 and 3. Award one mark for following phenotypes tortoiseshell, black, (black) ginger in any order with ratio of 1:2:1 in any order.

*Allow one mark for answers in which mark points 1, 2 and 3 are not awarded but show parents with correct genotypes i.e. X^GX^B and X^BY **or gametes as** X^G , X^B and X^B , Y*

3. Neutral: percentages and fractions

3. Accept: equivalent ratios e.g. for 1:1:1:1 allow 0.25 : 0.25 : 0.25 : 0.25

3

- (d) (i) Correct answer of 0.9 = 2 marks;

Incorrect answer but shows $q^2 = 0.81 =$ one mark.

Note: 0.9% = one mark

2

- (ii) Homozygous dominant increases and homozygous recessive decreases.

1

[8]