

Mark schemes

1

- (a)
1. Geographic(al) isolation;
 2. Separate gene pools / no interbreeding / gene flow (between populations);
Accept: reproductive isolation
This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred.
 3. Variation due to mutation;
 4. Different selection pressures / different abiotic / biotic conditions / environments / habitats;
Neutral: different conditions / climates if not qualified
Accept: named abiotic / biotic conditions
 5. Different(ial) reproductive success / selected organisms (survive and) reproduce;
Accept: pass on alleles / genes to next generation as equivalent to reproduce
 6. Leads to change / increase in allele frequency.
Accept: increase in proportion / percentage as equivalent to frequency
- (b)
1. Capture / collect sample, mark and release;
 2. Method of marking does not harm lizard / make it more visible to predators;
 3. Leave sufficient time for lizards to (randomly) distribute (on island) before collecting a second sample;
 4. (Population =) number in first sample \times number in second sample divided by number of marked lizards in second sample / number recaptured.

6

4

- (c) 1. High concentration of / increase in carbon dioxide linked with respiration at night / in darkness;
 2. No photosynthesis in dark / night / photosynthesis only in light / day;
Neutral: less photosynthesis
3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration;
 4. Decrease in carbon dioxide concentration with height;
More carbon dioxide absorbed higher up
Accept: less carbon dioxide higher up / more carbon dioxide lower down
5. (At ground level)
 less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / micro-organisms produce carbon dioxide.
Neutral: less leaves unqualified or reference to animals

5

[15]

2

- (a) 1. Cut (DNA) at same (base) sequence / (recognition) sequence;
Accept: cut DNA at same place
2. (So) get (fragments with gene) **R** / required gene.
Accept: 'allele' for 'gene' / same gene

2

- (b) 1. Each has / they have a specific base sequence;
 2. That is complementary (to allele r or R).
Accept description of 'complementary'

2

- (c) 1. Fragments L from parent rr, because all longer fragments / 195 base pair fragments;
Ignore: references to fragments that move further / less, require identification of longer / shorter or 195 / 135
Accept: (homozygous) recessive
2. Fragments N from parent RR, because all shorter fragments / 135 base pair fragments;
1 and 2 Accept: A3 for 195 and A4 for 135
2. Accept: (homozygous) dominant
3. (M from) offspring heterozygous / Rr / have both 195 and 135 base pair fragments.
Accept: have both bands / strips
Reject: primer longer / shorter

3

- (d) 1. (Cells in mitosis) chromosomes visible;
 2. (So) can see which chromosome DNA probe attached to.

2

- (e) (i) 1. For comparison with resistant flies / other (two) experiments / groups;
Ignore: compare results / data / no other factors
2. To see death rate (in non-resistant) / to see effect of insecticide in non-resistant / normal flies.
Accept: 'pesticide' as 'insecticide'
Accept to see that insecticide worked / to see effect of enzyme

2

- (ii) (PM must be involved because)
1. Few resistant flies die (without inhibitor);
 2. More inhibited flies die than resistant flies;
 3. (PM) inhibited flies die faster (than resistant flies);
- (Other factors must be involved because)
4. Some resistant flies die;
 5. But (with inhibitor) still have greater resistance / die slower than non-resistant flies.
- Accept: (with inhibitor) die slower than non-resistant flies*

4 max

[15]

3

- (a) (Recessive) allele is always expressed in females / females have one (recessive) allele / males need two recessive alleles / males need to be homozygous recessive / males could have dominant and recessive alleles / be heterozygous / carriers;
- Accept: Y chromosome does not carry a dominant allele. Other answers must be in context of allele not chromosome or gene.*

1

- (b) (i) 1. 1, (2) and 5;
Accept: for 1 mark that 1 and 2 have slow (feather production) but produce one offspring with rapid (feather production).
Neutral: any reference to 3 being offspring of 1.
2. 1 must possess / pass on the recessive allele / 1 must be a carrier / heterozygous / if slow (feather production) is recessive all offspring of (1 and 2) would be slow (feather production) / if rapid (feather production) was dominant 1 would have rapid (feather production);
Reject: both parents must be carriers / possess the recessive allele.
Reject: one of the parents (i.e. not specified) must be a carrier / heterozygous.

2

(ii) $5 = X^fY / X^fY^- / f / f^- / fY ;$

$7 = X^FX^f$ and X^FX^F (either way round) /

or X^fX^F and X^fX^F (either way round) /

or X^FX^f, X^fX^F and X^FX^F (in any order);

Note: allow $5 = X^fY, X^fY.$

Accept: for both 5 and 7 a different letter than F. However, lower case and capital letter must correspond to that shown in the answer. For example accept $7 = X^RX^r$ and $X^RX^R.$

2

(iii) X^FX^f and X^fY or X^fX^F and X^fY

or X^FX^f and X^fY^- or X^fX^F and $X^fY^- /$

or Ff and $fY /$

or Ff and $fY^- /$

or Ff and $f^- /$

or Ff and $f;$

Accept: a different letter than F. However, lower case and capital letter must correspond to that shown in the answer.

Accept: each alternative either way round.

1

(c) Correct answer of 32 (%) = 3 marks;;;

Accept: 0.32 = 2 marks

If incorrect answer, allow following points

1. $p^2 / q^2 = 4\% / 0.04 /$ or $p / q = 0.2;$

2. Shows understanding that $2pq =$ heterozygotes / carriers;

Accept: answer provided attempts to calculate $2pq.$ This can be shown mathematically i.e. 2 x two different numbers.

3

[9]

4

(a) 1. Allows (valid) comparison;

2. Number / sample size may vary;

2

- (b) 1. Increased chance of (severe malaria) with blood group A / decreased chance of (severe malaria) with sickle cell;

Accept: converse for mild malaria i.e. increased chance of mild malaria with sickle cell / decreased chance of mild malaria with blood group A.

Accept: if answer is comparative e.g. greatest risk of severe malaria with blood group A.

2. One mark for one of the following:

almost equal chance with blood group O / slightly greater chance of mild malaria with O / slightly lower chance of severe malaria with O / 2.5 x / 2.48 x / more than twice the chance of severe with blood group A / (almost) 50% / half the chance of severe malaria with sickle cell / twice the chance of mild malaria with sickle cell;

Neutral: answers which only refer to or use ratios.

2

- (c) 1. Individuals with the **Hb^C** (allele) reproduce;
2. Pass on **Hb^C** (allele) which increases in frequency;
3. **Hb^A Hb^A** individuals less likely to survive / reproduce / frequency of **Hb^A** (allele) decreases;

3

[7]

5

- (a) 1. No / few consumers / pests / pathogens;

Accept: No / few predators.

Accept: description of competition for a named resource with reference to 'other species'.

Accept: More resistance to disease.

2. Outcompetes / better competitor for resources / light / CO₂ / abiotic factor / ideal niche;

Neutral: competition for food.

2

- (b) 1. (Cost of) control / removal;
2. (Cost of) restoring habitat / conservation;
3. (Loss of income) from fishing;
4. (Loss of income) from boating / tourism / recreation;

Accept: any valid recreational activity e.g. canoeing.

2 max

- (c) (i) 1. Removes water;
2. Water content can vary in sample / plant;
Note: Reweighing / constant mass indicates all water removed = 2 marks. ; 2
- (ii) 1. 0.5 is not effective / has little effect / 1.0 is less effective (than 5.0) / concentrations below 5.0 less effective;
Accept: for first 3 mark points effect on growth / biomass as a measure of effectiveness.
Accept: references to 'this concentration' = 5.0.
Accept: 5.0 is the minimum effective concentration.
1. and 2. 5.0 is the minimum effective concentration that reduces growth = 2 marks.
2. At 5.0 biomass / growth is reduced;
3. Small difference between using 5.0 and 25.0;
4. Using 5.0 is cost effective / using 25.0 is expensive / high concentrations may affect the environment / other organisms / chemical may remain in habitat / bioaccumulation;
Accept: any impact on the habitat e.g. contaminate water supply. 4
- (d) (i) To compare / see effect with / without fungus / fluridone / control agent / s;
Neutral: for comparison on its own.
Neutral: to see effect of variables / results / treatments / factors without further qualification. 1
- (ii) 1. Is specific / grows / survives in Hydrilla / habitat;
Accept: 'known to work'
2. Can reproduce / only one application required;
3. Does not become a pest; 2
- (iii) 1. Fluridone / chemical acts quickly / quickly reduces Hydrilla;
2. Fungus / biological control keeps Hydrilla in low numbers / fungus / biological control works over a long time / can reproduce / resistance does not develop against fungus / biological control; 2

[15]

6

- (a) (i) (Organisms that) can breed together / interbreed **and** produce fertile offspring;
Need both aspects. Reject 'inbreed'
Reject viable offspring

1

- (ii) Same number (of organisms) in each region / (organisms) equally spread;
Allow other ways of expressing 'region' or 'equally spread', eg not clumped together, same number per unit area

1

(b)
$$P = \frac{AS}{R} \quad ; ;$$

2 marks for correct answer

*1 mark for having **A** on top of equation (recognises that total population related to total area)*

Note:

$P = A \times S / R$ or

$P = A / R \times S$

are also correct.

Allow 1 mark for

$$\frac{S}{P} = \frac{R}{A}$$

2

- (c) (i) *In mark–release-recapture (technique)*

Accept converse by considering assumptions of proportional sampling

1. No assumption that organisms are uniformly distributed;

2. Size of total area / size of sampled region not required;

Marking point 1 or marking point 2 do not have to start with the same technique

In this case, allow difference by implication i.e. do not penalise if the two techniques are not compared

2

- (ii) Animals are from / all part of the same population;

1

[7]

7

- (a) *Ulva lactuca*;

Reject: Ulva on its own

Accept: lactuca on its own

Accept: Incorrect spelling

1

- (b) (i) Difficult / too many / too many to count / individual organisms not identifiable / too small to identify / grows in clumps;

Neutral: easier / quicker / representative / more accurate, unless qualified

1

- (ii) Any described feature of concrete eg texture / flat / composition chemicals / nutrients etc;

Neutral: not natural / man made / are different, without further qualification

1

- (c) 1. Pioneer species / *Ulva* increases then decreases;

1 and 4. Growth / reproduces = increases. Dies = decrease

2. Principle of a species changing the conditions / a species makes the conditions less hostile;

2. Accept description of change in conditions eg soil / humus forms, nutrients increased

3. New / named species better competitor / previous / named / pioneer species outcompeted;

Pioneer species grows, dies and forms humus = 2 marks

G. coulteri / Gelidium outcompetes other / named species = 2 marks

4. *G. coulteri / Gelidium* increases and other / named species decreases;

4

[7]

8

- (a) 1. Expression / appearance / characteristic due to genetic constitution / genotype / allele(s);

1. Accept: named characteristic

1. Accept: homozygous / heterozygous / genes / DNA

1. Neutral: chromosomes

2. (Expression / appearance / characteristic) due to environment;

2

- (b) (i) 1. 3 and 4 and 9 / 11 / affected offspring;

1. Accept: 9 / 11 and their parents

1. Accept: unaffected parents have affected children

2. Both 3 and 4 are carriers / heterozygous;

2. Accept: if 3 and 4 are unaffected all their children will be unaffected

OR

If dominant at least one of 3 and 4 would be affected;

2

- (ii) 1. 11 is affected, 3 is not;
1 Accept: 3 / unaffected father / parents produce an affected daughter
1. Accept: 3 and 4 would only produce unaffected females
2. 3 / father of 11 does not have a recessive allele on his X chromosome / X^t ;
2. Answers must be in context of alleles

OR

(If on X) 11 / affected female would not receive the recessive allele on X chromosome / X^t from 3 / father;

Reject: recessive / dominant chromosomes

OR

(If on X) 3 / father (of 11) would pass on the dominant allele on his X chromosome / X^T ;

2

- (c) (i) Answer in range of 5.8 – 6.2% = 3 marks;;;
Answers in range of 0.058 - 0.062 = 2 marks

If incorrect answer, then 2 max of following points

1. $q^2 / p^2 / tt = 0.001$ or 1 divided by 1000;
2. $p / q / T = 0.968 - 0.97$;
3. Understanding that heterozygous = $2pq$;
3. This can be shown mathematically ie 2 x two different numbers
3. Accept: answer provided attempts to calculate $2pq$

3 max

- (ii) Affected individuals (usually) do not reproduce / die during childhood / do not pass on allele / genetic screening;

1

[10]

9

- 1.P Pathogens and effects on host
- 2.T Taxonomy
- 2.C Classification and evolution.
- 2.I Inheritance and evolution
- 2.Gc Genetic code, universal
- 2.B Behaviour
- 2.Ev Populations and evolution, variation between individuals within a species
- 3.BP Relationships within ecosystems – eg predator / prey
- 3.E Energy transfer in ecosystems
- 3.N Nutrient cycles, the organisms involved
- 3.S Succession, biodiversity, species and individuals in a community
- 4.H Human impacts on the environment and its effect on relationships between organisms – including farming
- 4.Gt Gene technology and GMO and selective breeding
- 4.Ar Antibiotic resistance

Examiners are free to select other letters if they wish

The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves

Breadth, one mark for use of an example from each of the following approaches – 3 max:

1. Pathogen and host
2. Evolution (related topics)
3. Ecological
4. Human intervention in relationships

[25]

10

- (a) 2.84:1;

Accept '2.84 to 1' or (just) 2.84

Do not accept 1:2.84 or 142:50

1

- (b) 1. Some embarrassed / some not willing to show tongue / cannot tell;
2. Could not decide whether thumb was straight or not / thumb bending is judgemental / subjective;

2

- (c) 1. (No) - should be 92.9% / should be calculated from 182 out of 196 / should not be calculated from 182 out of 200;
Allow either no or yes approach but no mark awarded for no or yes on its own
2. (Yes) – assumes 4 out of 200 use either hand;
Accept ambidextrous
3. (But) sample may not be representative;
This could be expressed in other ways e.g. only based on one part of the country / might not be the same in different parts of the UK / might not be representative of UK
4. Small sample size / only sampled 200;

2 max

[5]

11

- (a) (i) 1. No overall pattern / pattern (of right or left most common) is not the same for all islands;
Allow expression in other ways e.g. three islands show left on top is more common
2. For **(B) C** and **E** there is little difference;
3. Large differences on **A and D** and opposite ways (to each other);
Need both aspects but allow other expressions of 'opposite ways'
- (ii) 1. Can record all individuals on (small) islands;
2. (So) no / less sampling error;
3. (Maybe) different rates of mutation / different selection pressures / different environmental conditions;
4. Inbreeding / breeding with close relatives (more likely);
5. (Little) gene flow / (more chance of) genetic drift;
Accept reference to either of these ideas for this point
- (b) 1. If R is recessive, R × R parents cannot produce L offspring;
Accept use of genetic diagrams to illustrate points 1 and 2
2. If L is recessive, L × L parents cannot produce R offspring;
Accept right arm on top as R etc.
3. R × R **and** L × L parents produce both types of offspring;
Need reference to two parent crosses for this mark

2 max

2 max

3

(c) Both L and R in a set of twins / (some) twins show different arm-folding;

1

[8]

12

1. Use 1 in 400 to find frequency of homozygous recessive / q^2

OR

1 in 400 gives frequency of 0.0025;

Note - convention has recessive allele as q and dominant allele as p but allow reversal (since outcome is the same) as long as this is consistent throughout

2. Find square root of q^2 / find square root of 0.0025;

3. Use of $p + q = 1.0$ / determine frequency of both alleles / both p and q / find $p = 0.95$ and $q = 0.05$;

4. Use of $2pq$ to find carriers / heterozygotes;

The question requires a description but credit working where correct as alternative since this shows the stages

[3]