A Level AQA Biology

22 Populations and evolution – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	$q^2 = 0.004$ $q = 0.063245553$; $p = 0.936754447$ (= 1 – q); ($2pq$ =) 0.11849; (×100 =) 11.849% = 12%;	**The correct final answer of 12% scores 4 marks.** If the final answer is incorrect, award one mark for each of the following (up to a maximum of 3 marks), applying ECF at each stage.	4	AO2 3.7.2 MS 2.4
01.2	$p^2 = 0.992$ $p = 0.99599$; $q = 0.00401$ (= 1 – p); ($2pq$ =) 0.007987; (×100 =) 0.798% = 0.80%;	**The correct final answer of 0.80% scores 4 marks.** If the final answer is incorrect, award one mark for each of the following (up to a maximum of 3 marks), applying ECF at each stage.	4	AO2 3.7.2 MS 2.4
01.3	$p = 0.99599$ $q = 0.00401$ (= 1 – p); (q^2 =) 0.00001608; (×100 =) 0.001608% = 0.0016%;	**The correct final answer of 0.0016% scores 3 marks.** If the final answer is incorrect, award one mark for each of the following (up to a maximum of 2 marks), applying ECF at each stage.	3	AO2 3.7.2 MS 2.4
01.4	founder effect / genetic bottleneck genetic drift / random change in allele frequencies , when new population was established; inter-marriage within their population;		2 max	AO2 3.7.2

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Question	Answers	Extra information	Mark	AO Spec reference
02.1	$q^2 = 0.28 \left(\frac{7}{25}\right)$ $q = 0.52915$; $p = 0.47085$ (1 – 0.52915); $2pq = 0.4983$ ($2 \times 0.47085 \times 0.52915$); $0.4983 \times 25 = 12.4575$ 12;	***The correct final answer of 12 scores 4 marks.*** If the final answer is incorrect, award one mark for each of the following (up to a maximum of 3 marks), applying ECF at each stage.	4	AO2 3.7.2 MS 2.4
02.2	*in a pet shop*: mating will (probably) not be random; small population size; migration/rabbits will be sold and leave artificial selection;	**Allow** reverse arguments (stating the assumptions of the Hardy–Weinberg equations)	3 max	AO3 3.7.2
03.1	mutation(s) selection pressure allele		3	AO1 3.7.3
03.2	curve to the right or left of the original curve curve (approximately) the same height and width as the original curve		2	AO2 3.7.3
03.3	curve that has a higher peak and that is narrower than the original curve curve with (approximately) the same mean as the original curve		2	AO2 3.7.3

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>04.1</td><td>
<table>
<tr><th>Allopatric</th><th>Sympatric</th></tr>
<tr><td>✓</td><td></td></tr>
<tr><td></td><td>✓</td></tr>
<tr><td></td><td>✓</td></tr>
</table>
<table>
<tr><th>Geographical</th><th>Mechanical</th><th>Behavioural</th><th>Temporal</th></tr>
<tr><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>✓</td></tr>
<tr><td></td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>One mark per correct type of speciation

One mark for geographical AND mechanical
One mark for temporal
One mark for behavioural</td><td>3

3</td><td>AO2
3.7.3</td></tr>
<tr><td>04.2</td><td>random (changes)
(effects are more obvious) in small populations
ref. to genetic bottleneck
ref. to founder effect</td><td></td><td>3 max</td><td>AO1
3.7.3</td></tr>
<tr><td>05.1</td><td>all populations of different species (living in the same area)</td><td></td><td>1</td><td>AO1
3.7.4</td></tr>
<tr><td>05.2</td><td>random sampling
(use of) quadrats
(use of) percentage cover / frequency
large sample size
ref. to identification key / method for identifying species
ref. to scaling up observed numbers to estimate population size</td><td></td><td>5 max</td><td>AO1
3.7.4
AT k</td></tr>
</table>

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Question	Answers	Extra information	Mark	AO Spec reference
05.3	mass of carbon/ dry mass of tissue per given area dry plant material in an oven ref. to scaling up values to estimate for the field		2 max	AO1 3.5.3
05.4	$\frac{(26 \times 32)}{2}$; = 416;	If the final answer is incorrect, award one mark for 26×32 or division by 2 (seen anywhere)	2	AO2 3.7.4 AT h MS 0.4
06.1	**D A F B E C** ;;;	If the order is incorrect, award one mark for: • **D** first and **C** last • **A** before **E**	3	AO2 3.7.4
06.2	*anatomical adaptation* low-lying or short (to reduce wind exposure) / long roots *physiological adaptation* resistant to high light intensity / ability to photosynthesis / ability to fix nitrogen from the atmosphere (due to the lack of soil) / rapid germination of seeds		2	AO2 3.4.4 3.7.4
06.3	(use of) belt transect repeat measurements / several transect sites random selection of transect sites regular placement of quadrats (along transect) ref. identification key ref. biodiversity calculation (e.g., Index of Diversity);		4 max	AO2 3.4.6 3.7.4 AT k

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>07</td><td>The following are suitable topic areas from the specification that could be used to describe the techniques that can be used to measure genetic diversity and biodiversity in ecosystems.

In order to fully address the question and reach the highest mark bands, students must also include at least five topics in their answer, to demonstrate a synoptic approach to the essay.

<table>
<tr><th>Specification reference</th><th>Topic area</th></tr>
<tr><td>3.2.1.3</td><td>Methods of studying cells</td></tr>
<tr><td>3.4.3</td><td>Genetic diversity</td></tr>
<tr><td>3.4.4</td><td>Genetic diversity</td></tr>
<tr><td>3.4.6</td><td>Biodiversity</td></tr>
<tr><td>3.4.7</td><td>Investigating diversity</td></tr>
<tr><td>3.7.4</td><td>Populations in ecosystems</td></tr>
<tr><td>3.8.3</td><td>Using genome projects</td></tr>
<tr><td>3.8.4.2</td><td>… differences in DNA between individuals of the same species can be exploited for identification and diagnosis of heritable conditions (A-level only)</td></tr>
<tr><td>3.8.4.3</td><td>Genetic fingerprinting (A-level only)</td></tr>
</table>

Students may be able to show the relevance of other topics from the specification.

Note: other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.</td><td></td><td>25</td><td>AO1
3.2.1.3
3.4.3
3.4.4
3.4.6
3.4.7
3.7.4
3.8.3</td></tr>
</table>

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Skills box answers

Question	Answer
1	87 $q^2 = \frac{1}{2000} = 0.000\,5$, therefore $q = 0.022\,4$, and $p = (1 - 0.022\,4) = 0.977\,6$ $2pq = 1 - (0.022\,4)^2 - (0.977\,6)^2 = 0.043\,5$ In a population of 2000, $2pq = 0.043\,5 \times 2000 = 87$. Therefore, if there is one sufferer of cystic fibrosis in a population of 2000, there will be 87 carriers
2	10.9%. $p + q = 1$, therefore $q = 1 - 0.942 = 0.058$ $p^2 + 2pq + q^2 = 1$ Therefore $2pq = 1 - q^2 - p^2 = 1 - (0.058)^2 - (0.942)^2$ $= 0.109\,4$ So the frequency of the heterozygous genotype ($2pq$) = 0.109 To calculate the frequency of $2pq$ as a percentage of the population = $0.109 \times 100 = 10.9\%$