Variation and Evolution (2.6): Eduqas A Level Biology Exam Questions by Topic

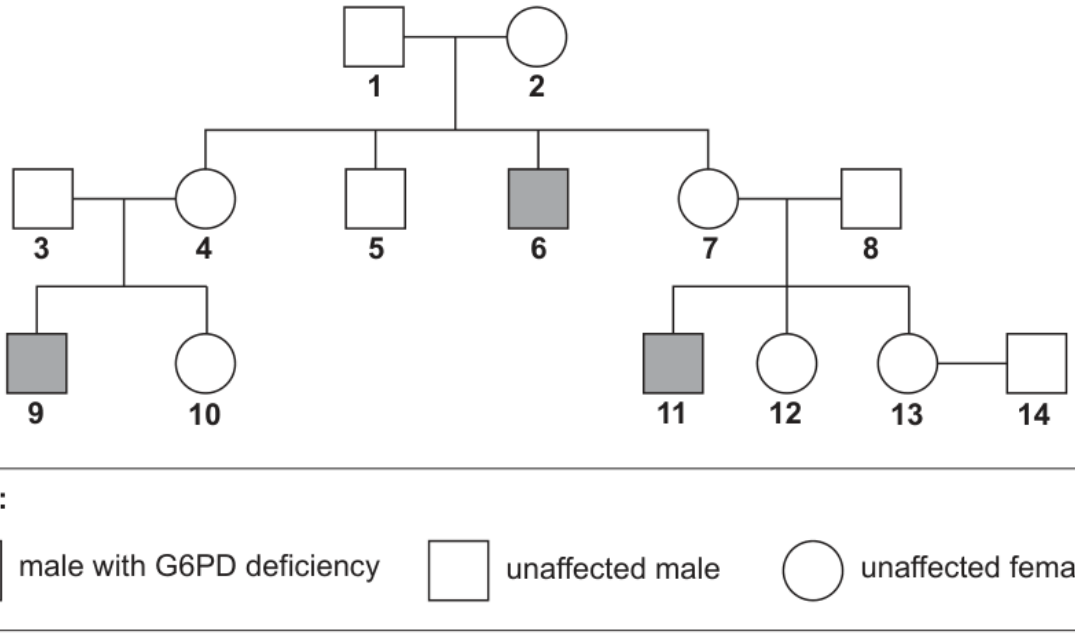
24 questions · 58 marks · about 70 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 2 · June 2024 · Q3(b)(i) · 2 marks

(b) G6PD deficiency is a hereditary condition in which red blood cells break down when the body is exposed to certain foods, drugs, infections or stress. The gene coding for G6PD is found on the X chromosome.

Image 3 shows the inheritance of G6PD deficiency in one family.

Image 3



(i) State **two** factors that affect an organism's phenotype. [2]

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4. Wheat grain size is determined by the plants' genetics (i.e. variety), and the length of the grain filling period (time between fertilisation and harvesting). Plant breeders cross varieties of wheat in order to increase grain size. The photograph below shows the results of one such cross.



(a) Distinguish between **continuous** and **discontinuous** variation. You should give an example, which is visible in the photograph, for each one. [3]

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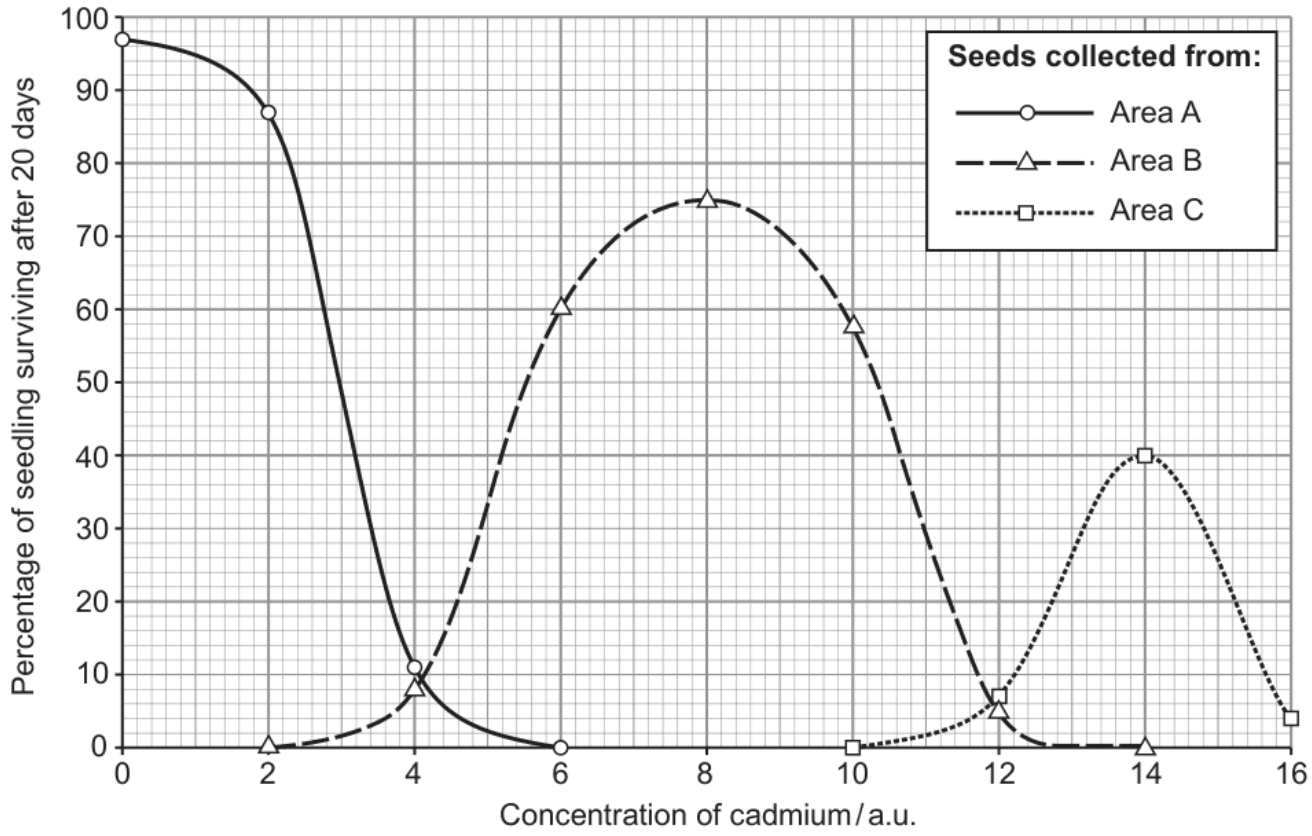
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Question 3 · information from earlier in the question

Seeds were collected from three areas of a habitat contaminated with cadmium and then grown at different cadmium concentrations. The percentage of seedlings surviving after 20 days was recorded. **Image 4.1** shows the results of the investigation.

Image 4.1



Question 3 · A level Component 2 · June 2022 · Q4(b)(ii) · 1 mark

(ii) State the **type** of variation shown in all three populations. [1]

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Question 4 · information from earlier in the question

The scientists wanted to investigate the effect of prey size on jaw development in snakes.

- They used newly hatched snakes from both locations; 123 snakes were measured from the island and 129 from the mainland.
- The snakes were fed either large or small mice over several months until they reached maturity.
- The jaw length of each snake was measured from the tip of the nose to the point of articulation of the upper jaw using digital callipers with a precision of 0.01 mm.

The results are shown in **Table 7.2**.

Table 7.2

	Experiment 1		Experiment 2	
	Mainland snakes		Island snakes	
	Group A – fed small mice	Group B – fed large mice	Group C – fed small mice	Group D – fed large mice
Mean length of snakes' jaws at hatching / mm	13.26	13.28	13.85	13.79
Mean length of snakes' jaws at maturity / mm	26.37	26.64	29.20	33.83

Question 4 · A level Component 2 · June 2023 · Q7(a)(vii)I · 1 mark

(vii) The scientists concluded that the island snakes:

- may carry genes that determine a larger relative jaw size
- jaw sizes increase if fed larger prey.

Use the results shown in **Table 7.2** to explain the evidence that suggests the size of the tiger snakes' jaws at maturity is:

I. a genetically inherited trait; [1]

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Question 5 · A level Component 2 · June 2023 · Q7(a)(vii)II · 1 mark

II. affected by environmental factors. [1]

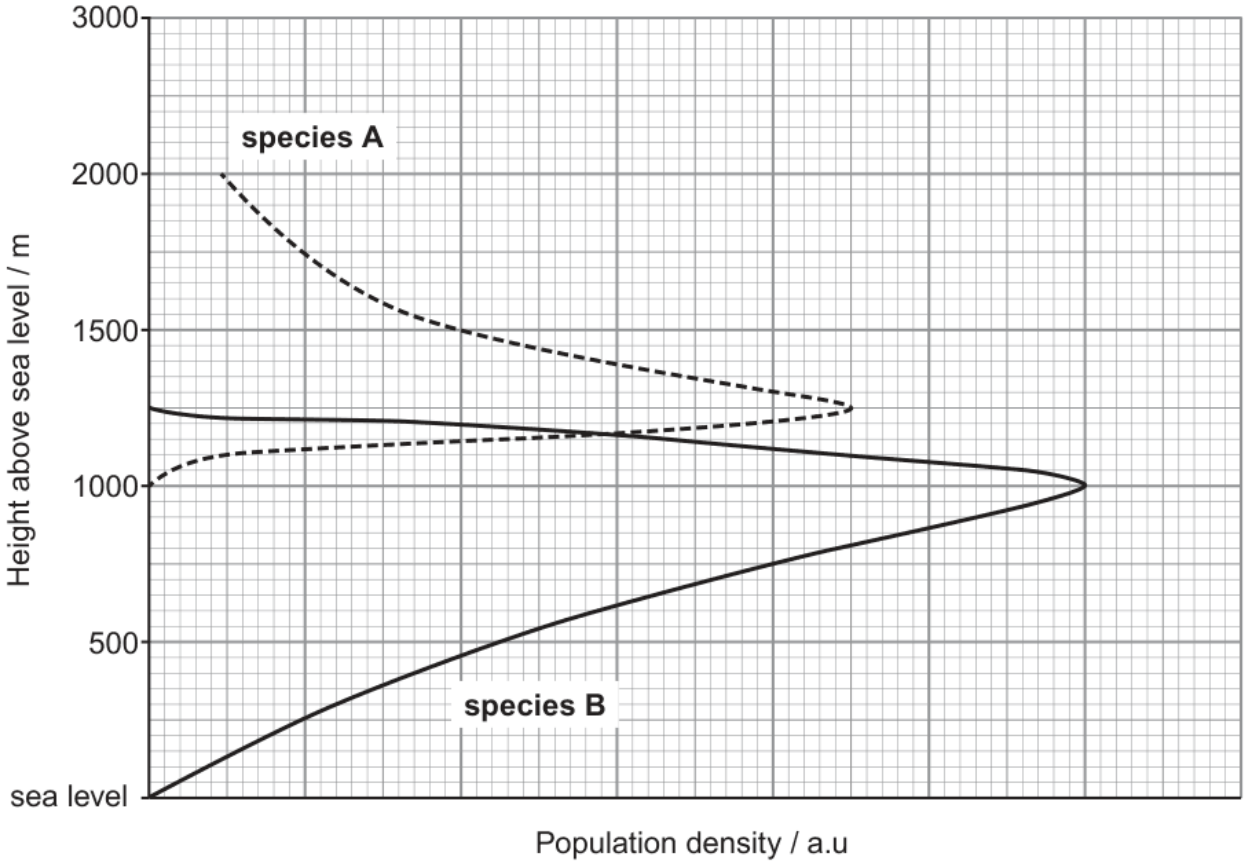
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7. **Image 7.1** shows the population densities of two species of closely related birds at different heights above sea level in a mountain range in the USA.

Image 7.1



(a) (i) State the main type of competition present: [1]

I. at 800 m .....

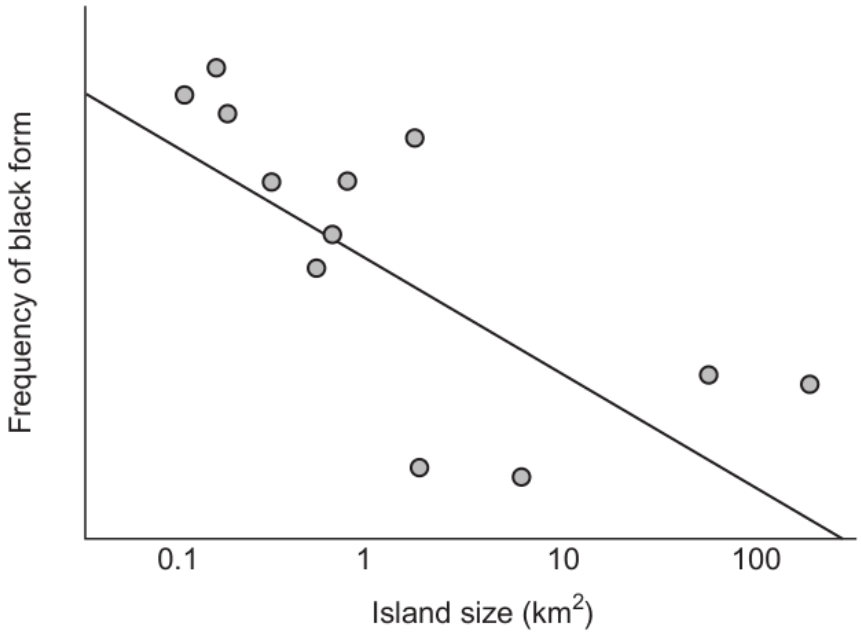
II. between 1 000 m and 1 250 m .....

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A group of scientists studied the frequency of the black forms on the Russell Islands within the Solomon group.

Their results are shown in Figure 4.2. The island size is shown as a log scale.

Figure 4.2



Monarch flycatchers are known to be territorial and behaviour studies have shown increased aggression in black forms.

(c) State the trend shown on the graph and use the information about the birds' behaviour to suggest a possible mechanism to account for the trend. [3]

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Question 8 · A level Component 2 · June 2024 · Q5(b) · 2 marks

(b) The elaiosome attracts ants. The seeds are taken into the ants' underground nest and the elaiosomes are fed to the ants' larvae while the seeds are discarded.

Explain how the presence of the elaiosome is an advantage to the black wattle plant. [2]

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Question 9 · A level Component 1 · June 2017 · Q3(d) · 3 marks

(d) Using your knowledge of natural selection, explain why more species have become extinct recently, compared to pre-industrial times. [3]

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Question 10 · A level Component 2 · June 2018 · Q1(f)(i) · 3 marks

The Hardy-Weinberg Principle states that the frequency of alleles for a given gene remains constant from generation to generation, providing the population is large and no selection takes place.

The frequency of Tay-Sachs disease is 1 in 360 000 births in the general population of the USA. However, the frequency is 1 in 40 000 in certain populations, which isolate themselves culturally. One such population is the Old Order Amish of the Kishacoquillas Valley, Pennsylvania, USA. Recent estimates put the size of this population at 40 000.

(f) (i) Use the Hardy Weinberg equations, given below, to calculate the number of people in the Amish community in the Kishacoquillas Valley that carry the Tay-Sachs allele without suffering the disease. [3]

$p + q = 1.0$ $p^2 + 2pq + q^2 = 1.0$

Number of people who are carriers of Tay-Sachs allele = ...

Question 11 · A level Component 2 · June 2018 · Q1(f)(ii) · 2 marks

(ii) Explain why the frequency of Tay-Sachs is higher in isolated populations and predict, with a reason, what is likely to happen to the frequency of the Tay-Sachs allele in the general population. [2]

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Question 12 · information from earlier in the question

(c) In the UK some people regularly donate blood. The proportions of the different blood groups donated are recorded. The results are shown in **Table 5.3**.

Table 5.3

ABO Blood group	% of blood donors
A	37
B	11
O	49
AB	3

Question 12 · A level Component 2 · June 2025 · Q5(c)(ii) · 4 marks

(ii) Using the values in **Table 5.3** and the equations below, calculate the % frequency of people carrying a dominant and recessive allele for blood group. [4]

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

where p = frequency of dominant alleles ($I^A + I^B$)

q = frequency of recessive allele (I^O)

Frequency of the recessive I^O allele in the UK = ...

Frequency of dominant alleles in the UK = ...

Frequency of people carrying a dominant and recessive allele for blood group = ...

% frequency of people carrying a dominant and recessive allele for blood group = ...

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Question 13 · A level Component 2 · June 2025 · Q5(c)(iii) · 1 mark

Four years before this data was published the percentage of the donors with blood group O was found to be 46%.

(iii) Assuming the figures given are reliable estimates, give **one** reason this population is not at Hardy-Weinberg equilibrium for blood groups. [1]

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Question 14 · A level Component 2 · June 2017 · Q3(b) · 4 marks

Breeding experiments in the lab have revealed that dewlap colour-pattern is inherited as a Mendelian trait, in which orange (**D**) is dominant to white (**d**).

The gene pool of the *A.brevirostris* population contains no **D** alleles.

The Hardy-Weinberg equations may be used to calculate the frequencies of the alleles **D** and **d** in the gene pool of the population of *A.websteri*

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

(b) In the north zone population of 400 lizards, four were found to have white dewlaps.

Calculate the frequencies of the two alleles in this population, and calculate how many of the lizards with orange dewlaps were heterozygous. [4]

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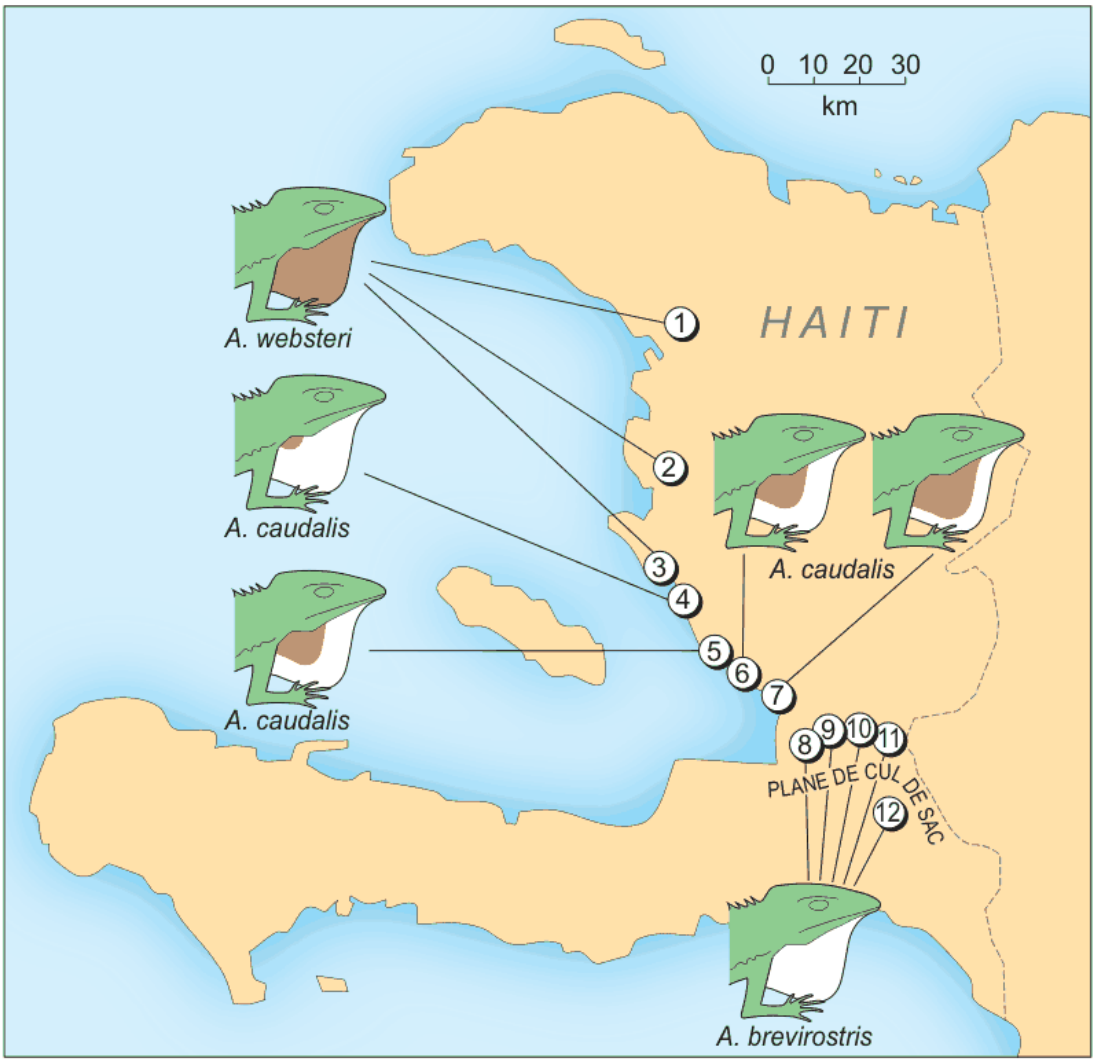
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3. In the Caribbean there is a group of lizards called Anoles. The males possess a retractable flap of skin under the throat, termed a dewlap, which is used in courtship, aggressive interactions and even encounters with predators. The patterns of orange colouration on the dewlaps of three species of Anole lizard and their distribution in Haiti are shown below.



Zone	Sites	Habitat
North	1,2,3	Beach
Central	4,5,6,7	Beach
South	8,9,10,11,12	Forest

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 15 · A level Component 2 · June 2017 · Q3(c)(i) · 4 marks

The evolution of the three species is believed to be an example of sympatric speciation, resulting from differences in the habitats.

(c) (i) Explain how the habitat in the south zone could bring about the dewlap colouration found in *A.brevirostris*. [4]

Question 16 · information from earlier in the question

Breeding experiments in the lab have revealed that dewlap colour-pattern is inherited as a Mendelian trait, in which orange (**D**) is dominant to white (**d**).

The gene pool of the *A.brevirostris* population contains no **D** alleles.

The Hardy-Weinberg equations may be used to calculate the frequencies of the alleles **D** and **d** in the gene pool of the population of *A.websteri*

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 16 · A level Component 2 · June 2017 · Q3(c)(ii) · 2 marks

(ii) Explain why after many generations the frequency of allele **D** is zero in the *A.brevirostris* population but the frequency of allele **d** in *A.websteri* will never be zero. [2]

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Question 17 · information from earlier in the question

An investigation was carried out into the number of snails with different numbers of bands at two sites on either side of an estuary. **Image 1.2** shows the position of the sample sites and information about the vegetation and soil at each site.

Image 1.2

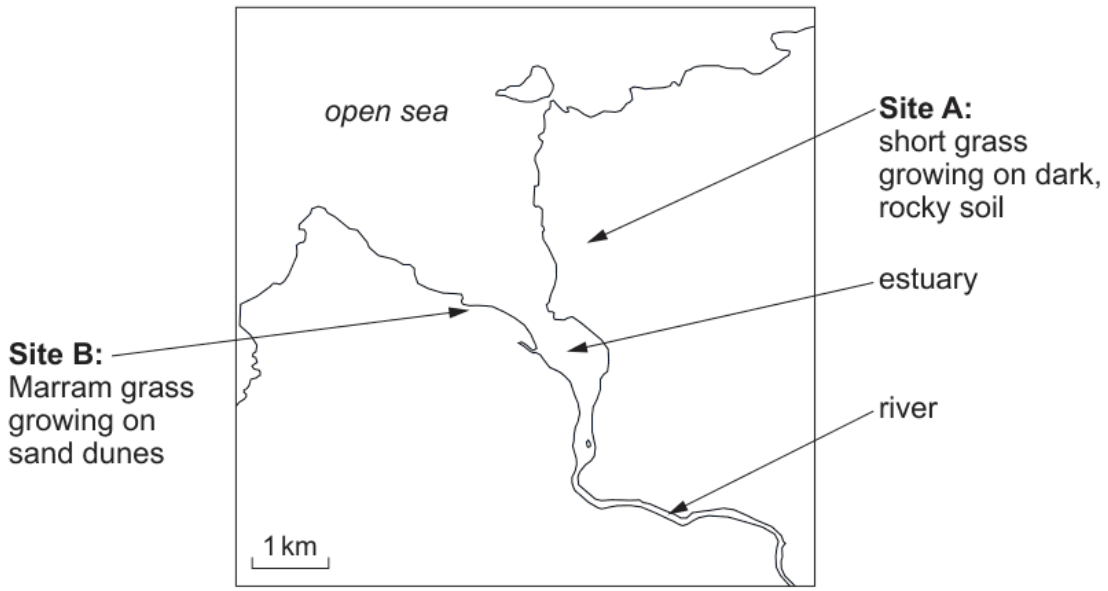
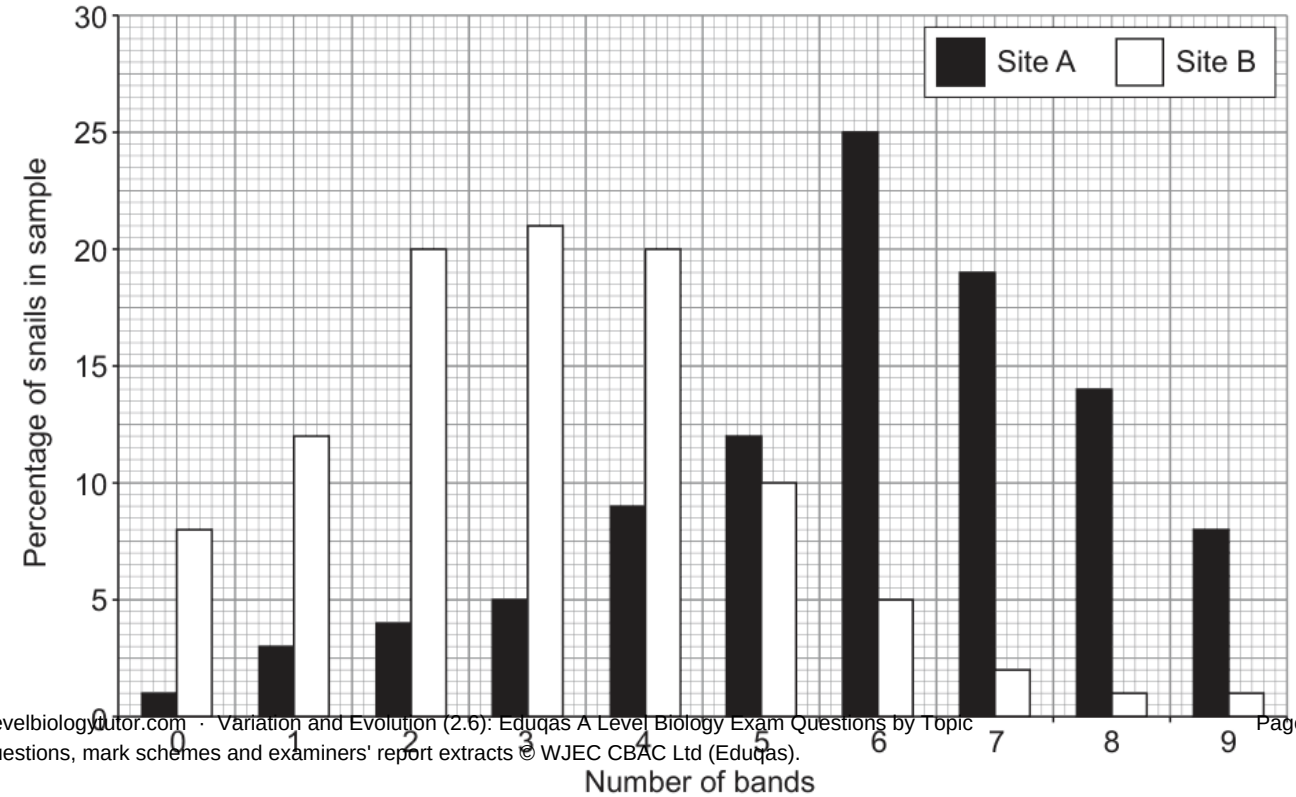


Image 1.3 shows the percentage of snails in each sample with different numbers of bands.

Image 1.3



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Statistical analysis of the data showed that there was a highly significant difference in the distribution of snails with different numbers of bands between Sites **A** and **B**.

Question 17 · A level Component 2 · June 2022 · Q1(b)(iv) · 3 marks

(iv) Explain how the vegetation and soil type at sites **A** and **B** shown in **Image 1.2** could have caused the difference in banding of the snails at the two sites. [3]

Question 18 · A level Component 2 · June 2022 · Q1(b)(v) · 3 marks

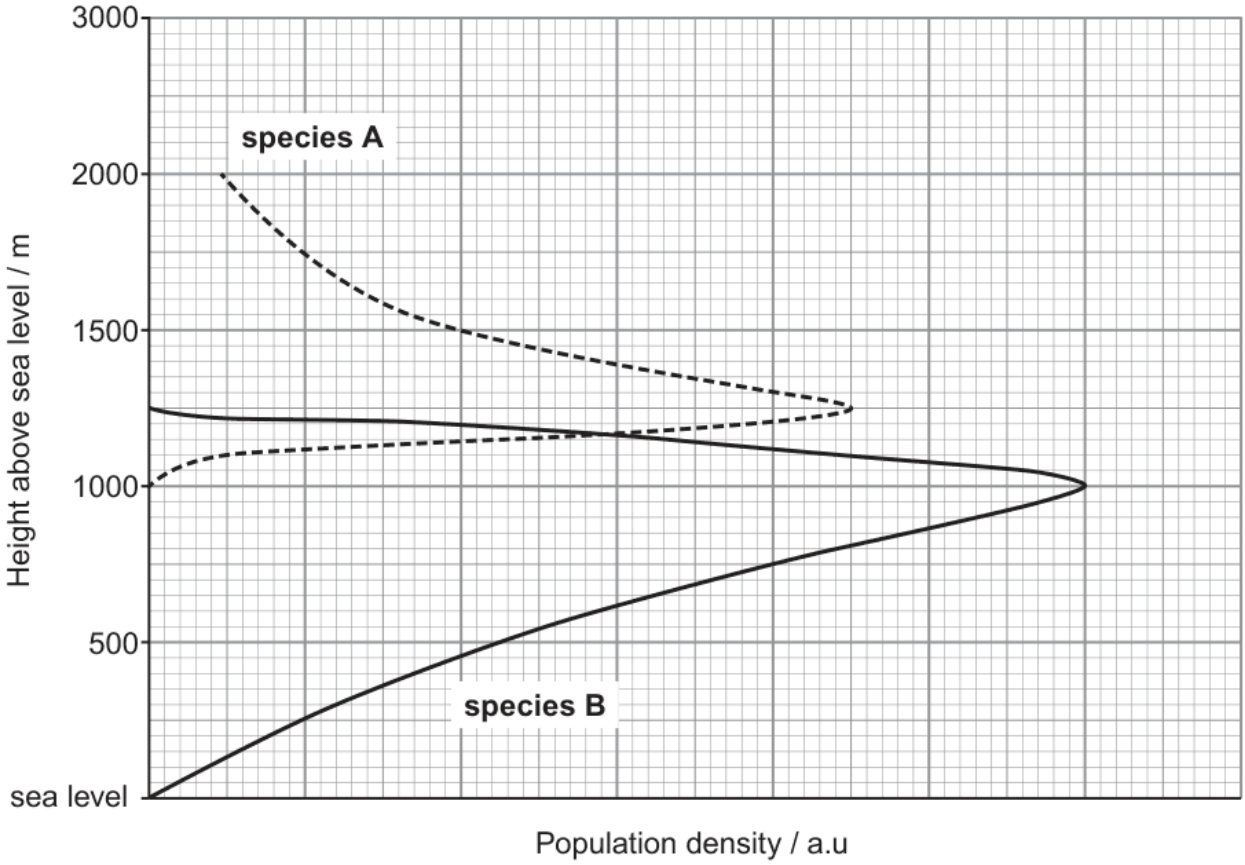
(v) Suggest how the location and habitat of the sites has led to a significant change in the frequency of the alleles between the two populations of this species of snail. [3]

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Question 19 · information from earlier in the question

7. **Image 7.1** shows the population densities of two species of closely related birds at different heights above sea level in a mountain range in the USA.

Image 7.1



Question 19 · A level Component 2 · Autumn 2021 · Q7(b)(i) · 3 marks

(b) DNA analysis of the genes which code for haemoglobin has shown that the birds evolved into different species less than 10 000 years ago.

(i) Use the information given and your own knowledge to explain how **natural selection** could account for the evolution of these two species from their common ancestor. [3]

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Question 20 · A level Component 2 · Autumn 2021 · Q7(b)(ii) · 2 marks

(ii) Explain why the evolution of these two species from the same common ancestor is an example of sympatric speciation. [2]

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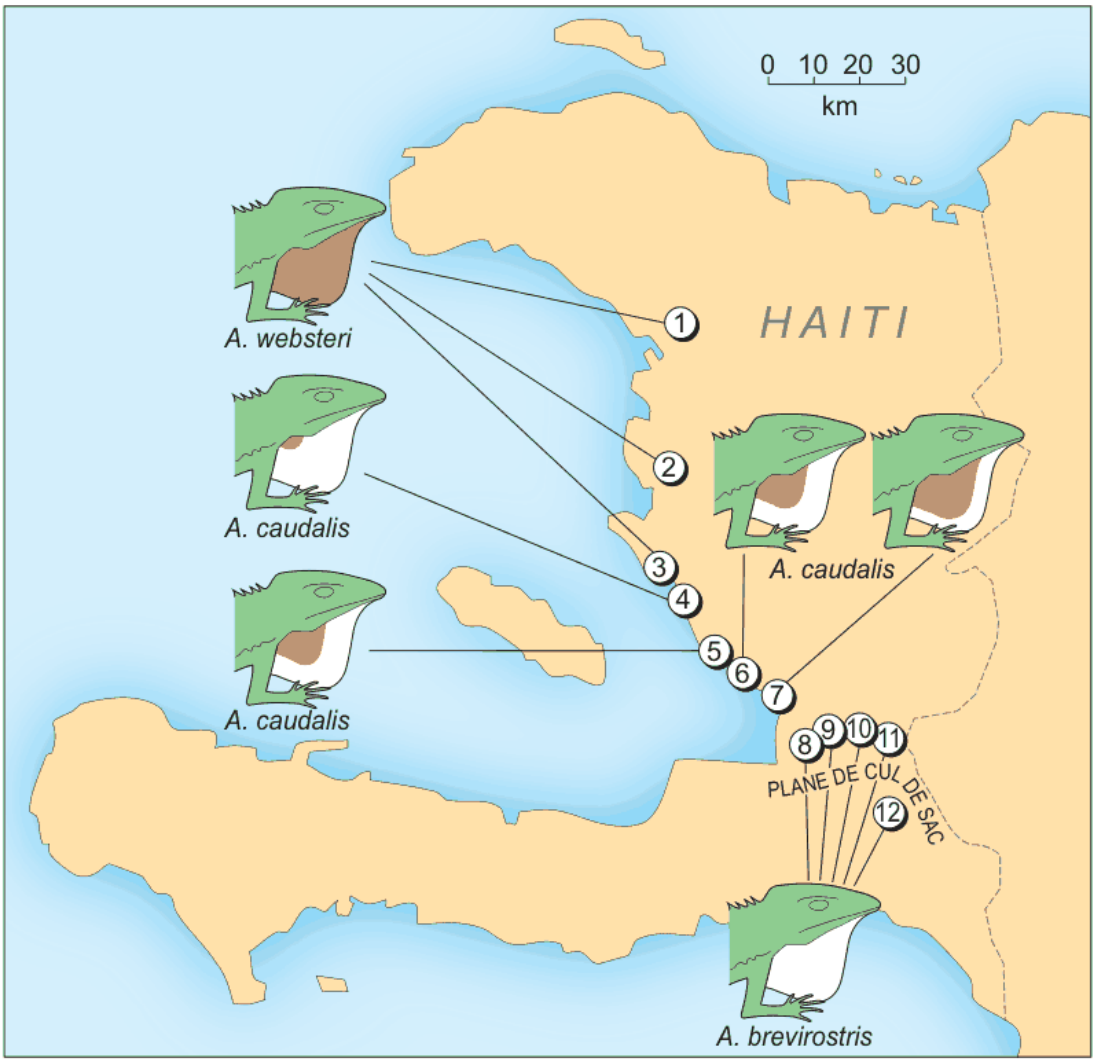
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3. In the Caribbean there is a group of lizards called Anoles. The males possess a retractable flap of skin under the throat, termed a dewlap, which is used in courtship, aggressive interactions and even encounters with predators. The patterns of orange colouration on the dewlaps of three species of Anole lizard and their distribution in Haiti are shown below.



Zone	Sites	Habitat
North	1,2,3	Beach
Central	4,5,6,7	Beach
South	8,9,10,11,12	Forest

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 21 · A level Component 2 · June 2017 · Q3(d) · 3 marks

(d) The Anole lizards found at sites **3** and **4** are different species. Explain how their dewlap colouration may have resulted in this speciation. [3]

Question 22 · A level Component 2 · June 2024 · Q4(b)(iv) · 2 marks

It has been suggested that the two forms of fish will eventually become separate species due to allopatric speciation.

(iv) Explain what is meant by allopatric speciation. [2]

Question 23 · A level Component 2 · June 2024 · Q4(b)(v) · 2 marks

It had been suggested that the **cave form** may have developed due to a small population undergoing genetic drift.

(v) Explain why genetic drift has a bigger impact on small populations. [2]

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7. Scientists studied the diet and length of jaws of tiger snakes (*Notechi scutatus*) on the mainland of Australia and an island 5 km off its coast.

When captured and handled, some of the snakes regurgitated their prey. This allowed the scientists to identify the diet of the snakes. The results are shown in **Table 7.1**.

Table 7.1

Area snake found	Prey	Mass of prey / g	Circumference of prey / mm	Number of snakes in which prey item found
Island	Seagull chick	133.10	155.00	1
Island	Silver gull chick	39.70	121.80	10
Island	Skink (lizard)	26.43	58.42	21
Island and mainland	Mouse	19.28	55.82	28
Mainland	Tree frog (type 1)	18.64	58.85	21
Mainland	*Ctenotus* (lizard)	9.85	33.45	40
Mainland	Tree frog (type 2)	1.00	21.55	20
Mainland	Tree frog (type 3)	0.88	21.76	33
				TOTAL 174

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The scientists wanted to investigate the effect of prey size on jaw development in snakes.

- They used newly hatched snakes from both locations; 123 snakes were measured from the island and 129 from the mainland.
- The snakes were fed either large or small mice over several months until they reached maturity.
- The jaw length of each snake was measured from the tip of the nose to the point of articulation of the upper jaw using digital callipers with a precision of 0.01 mm.

The results are shown in **Table 7.2**.

Table 7.2

	Experiment 1		Experiment 2	
	Mainland snakes		Island snakes	
	Group A – fed small mice	Group B – fed large mice	Group C – fed small mice	Group D – fed large mice
Mean length of snakes' jaws at hatching / mm	13.26	13.28	13.85	13.79
Mean length of snakes' jaws at maturity / mm	26.37	26.64	29.20	33.83

Question 24 · A level Component 2 · June 2023 · Q7(b)(i) · 3 marks

(b) It has been proposed that the two populations of snakes may eventually evolve into two separate species.

(i) With reference to all the information about the snakes in the two populations, outline how the two separate species may evolve. [3]

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Mark schemes

Question 1 · A level Component 2 · June 2024 · Q3(b)(i) · 2 marks

	(b)	(i)		(Expression /appearance /characteristic due to) genes / genotype / allele(s) (1) environment / epigenetics (1)	2		2	

Question 2 · A level Component 2 · June 2018 · Q4(a) · 3 marks

4	(a)	Discontinuous -Colour/hairs/smooth/wrinkled coat/shape **+** Continuous – length/width/size (1) **1 mark FOR BOTH** Continuous - shows a gradation from one extreme to another/controlled by more than one gene (1) Discontinuous-. When characters are clear-cut/controlled by a single gene (1)		3	3

Question 3 · A level Component 2 · June 2022 · Q4(b)(ii) · 1 mark

		(ii)	Continuous 1		1	

Question 4 · A level Component 2 · June 2023 · Q7(a)(vii)I · 1 mark

(vii)	I	Mainland groups (A and B) had {no/ small/ only 0.27mm} difference in mean jaw length (at maturity) / group C are larger than group A (1)	1	1

Question 5 · A level Component 2 · June 2023 · Q7(a)(vii)II · 1 mark

II	jaw length increased when large {prey/ mice} was given/ group D jaw length was larger than group C/ group B jaw length was larger than group A (1)	1	1

Question 6 · A level Component 2 · Autumn 2021 · Q7(a)(i) · 1 mark

7	(a)	(i)	(800m =) intra-specific **+** (1000 to 1250m =) interspecific	1	1

Question 7 · A level Component 2 · June 2019 · Q4(c) · 3 marks

(c)	The larger the island the less black forms/ ORA (1) Competition is greater on small islands for {territories / food/ nesting sites/ ORA} (1) Aggression (linked to black gene) {gives a selective advantage/ is selected for/ allows them to outcompete} other forms/ ORA (1)	1	2	3

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Question 8 · A level Component 2 · June 2024 · Q5(b) · 2 marks

(b)	**Any two (×1) from** • (Results in) dispersal / owtte (1) • Reduces competition / more chance of new plant growing / owtte (1) • (Seed underground) so escapes fire / has better conditions for growth / owtte} (1) • Prevents seed being eaten (by other animals) (1)	2	2

Question 9 · A level Component 1 · June 2017 · Q3(d) · 3 marks

(d)	A. In a changing environment, some species' adaptation {became unsuitable/ they were selected against} (1) B. Cannot {adapt/ evolve} in a relatively short period of time/ {Animals cannot move fast enough/ seeds cannot disperse quickly enough} to another habitat where they were suitably adapted/ Correct reference to slow mutation rates(1) C. Increased {human population/ industry/ pollution} is causing environmental change (1)	3	3

Question 10 · A level Component 2 · June 2018 · Q1(f)(i) · 3 marks

(f)	(i)		398 = 3 marks If incorrect award 2 marks for: 2pq = 2 X 0.995 X 0.005 = 2 marks 2pq = 0.00995 = 2 marks accept 9.95 x 10^{-3} If incorrect award 1 mark for one of: p =0.995 q=0.005 accept 5 x 10^{-3}		3	3	2

Question 11 · A level Component 2 · June 2018 · Q1(f)(ii) · 2 marks

(ii)		(Hardy Weinberg principle does not apply because) {population is small/genetic drift/founder effect/small gene pool/no migration/no immigration}/higher probability of two carriers having children (1) Decrease because h alleles will be lost from gene pool when sufferers die in childhood/selective abortion/selected against/selective disadvantage/less likely to reproduce (1)		2	2

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Question 12 · A level Component 2 · June 2025 · Q5(c)(ii) · 4 marks

(ii)	frequency of I^O= 0.7 (1) frequency of dominant alleles= 0.3 (1) frequency of heterozygotes = 0.42 (1) % frequency of heterozygotes = 42% (1) If first two frequencies are 70% and 30% award 1 Mark If line 4 is a % of the frequency on line 3 allow 1 mark.	4	4	4

Question 13 · A level Component 2 · June 2025 · Q5(c)(iii) · 1 mark

(iii)	Immigration/ emigration / migration / or description of	1	1

Question 14 · A level Component 2 · June 2017 · Q3(b) · 4 marks

(b)	q/d = 0.1/ $^1/_{10}$ (1) p/D = 0.9/ $^9/_{10}$ (1) 72 = 2 marks If 72 incorrect allow the following for 1 mark 2pq = 2 x 0.1 x 0.9 x 400 0.18 x 400	4	4	4

Question 15 · A level Component 2 · June 2017 · Q3(c)(i) · 4 marks

(c)	(i)	Any four (x1) from: A. White (dewlaps) more visible in forest habitat (1) B. Selective advantage (1) C. Males will {attract more/ mate with} females/ {scare/ warn} off {rivals/predators} (1) D. More (males) will pass on {advantageous/ white dewlap} alleles (1) E. Alleles for white dewlaps become more frequent in (gene pool) (1)	1 3		4

Question 16 · A level Component 2 · June 2017 · Q3(c)(ii) · 2 marks

	(ii)	In A.brevirostris allele **D** is selected against and so removed from the gene pool (1) (Although d is a disadvantage in) A.websteri, it is{not expressed/ masked/ passed on} in heterozygotes and therefore remains in the gene pool(1)	2		2

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Question 17 · A level Component 2 · June 2022 · Q1(b)(iv) · 3 marks

(iv)	**Any three (x1) from** A. (Vegetation and soil type / environment) act as selection pressures / different selection pressures at each site (1) B. Site A (short grass + dark soil) more bands + Site B (Marram grass + sandy soil) fewer bands provide better camouflage (1) C. (Better camouflaged) increased chance of survival/ selective advantage/ less chance of predation/ owtte (1) D. So can reproduce + pass on (advantageous) allele(s) (to offspring) (1)	3	3	

Question 18 · A level Component 2 · June 2022 · Q1(b)(v) · 3 marks

(v)	**Any three (x1) from** A. (Estuary / sea / seawater/ river) acts a {physical/ geographical} barrier between the populations / description of geographical isolation/ allopatric speciation (1) B. Different selection pressures (on the populations at each site) (1) C. Different alleles {selected for / provide competitive advantage} in different sites / ORA / random mutations will be different in each population/ snails with advantageous alleles are more likely to survive (1) D. {Genetic drift/ no gene flow/ no exchange of alleles} due to no interbreeding (1)	3	3

Question 19 · A level Component 2 · Autumn 2021 · Q7(b)(i) · 3 marks

(b)	(i)	**Any three (x1) from:** A. mutation (in gene for haemoglobin) (1) B. gave birds with mutation (for higher O_2 affinity) an advantage (at higher altitudes due to lower oxygen levels) / oxygen availability becomes a selection pressure (1) C. more likely to survive and reproduce (1) D. and pass on <u>allele</u> for high oxygen affinity to offspring (1) **Max 2 if answers are not in context**	2	1	3

Question 20 · A level Component 2 · Autumn 2021 · Q7(b)(ii) · 2 marks

	(ii)	both species live in same {habitat / area} (1) no {physical barrier / geographical} / {only reproductive / behavioural barrier}} to interbreeding (1)	2	2	

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Question 21 · A level Component 2 · June 2017 · Q3(d) · 3 marks

(d)	They have the {opposite/ different} dewlap colour/ wtte (1) Males will not attract females/ courtship rituals (1) There is a reproductive barrier /behavioural isolation/ genetic drift/ do not interbreed (1)	3		3

Question 22 · A level Component 2 · June 2024 · Q4(b)(iv) · 2 marks

(iv)	In different areas / geographical isolation / there is a physical barrier (1) Which prevents interbreeding / gene flow (1)	2		2

Question 23 · A level Component 2 · June 2024 · Q4(b)(v) · 2 marks

(v)	**Any two (x1) from** • {Changes in allele frequencies / loss of an allele} are due to chance (1) • (a small population / gene pool) is more susceptible to {small / random} changes / Small change in gene pool can result in large changes in allele frequency / owtte (1) • easier for alleles to be lost from the gene pool (in small populations) (1)	2		2

Question 24 · A level Component 2 · June 2023 · Q7(b)(i) · 3 marks

(b)	(i)	A. (Island groups) geographically isolated (from mainland)/ allopatric speciation/ physical barrier (1) B. Each group had (different) selection pressures/ ref to different {mass/ circumference} prey (1) C. {Those with selective advantage/ survivors} {breed/ reproduce} and pass on allele (for characteristic) (1)	1	2	3

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