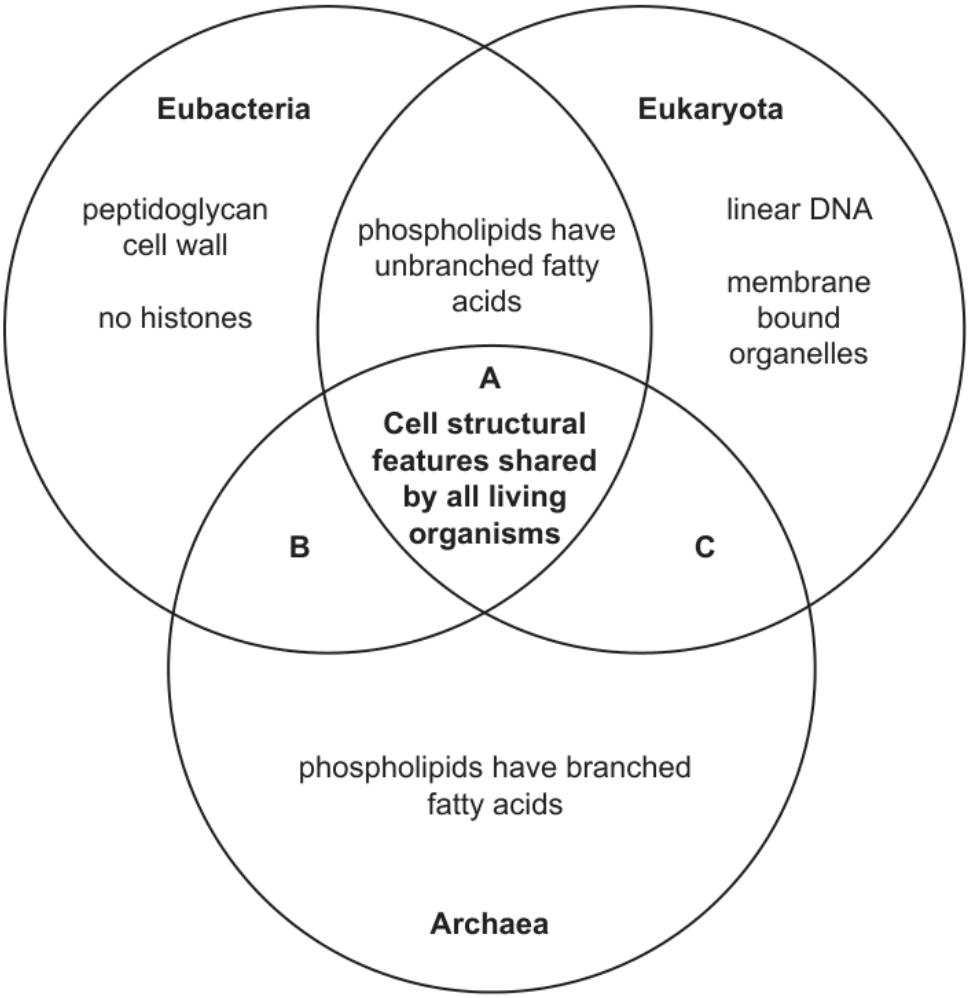
Classification and Biodiversity (2.1): Eduqas A Level Biology Exam Questions by Topic

19 questions · 42 marks · about 50 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Component 2 · June 2023 · Q1(a)(i) · 1 mark

1. (a) All living organisms are classified into one of three taxonomic groups called Domains. **Image 1.1** represents the main structural features of cells of the organisms belonging to each of the three Domains.

Image 1.1



(i) State **two** structural features of cells shared by **all** living organisms, as shown by region **A** in **Image 1.1**. [1]

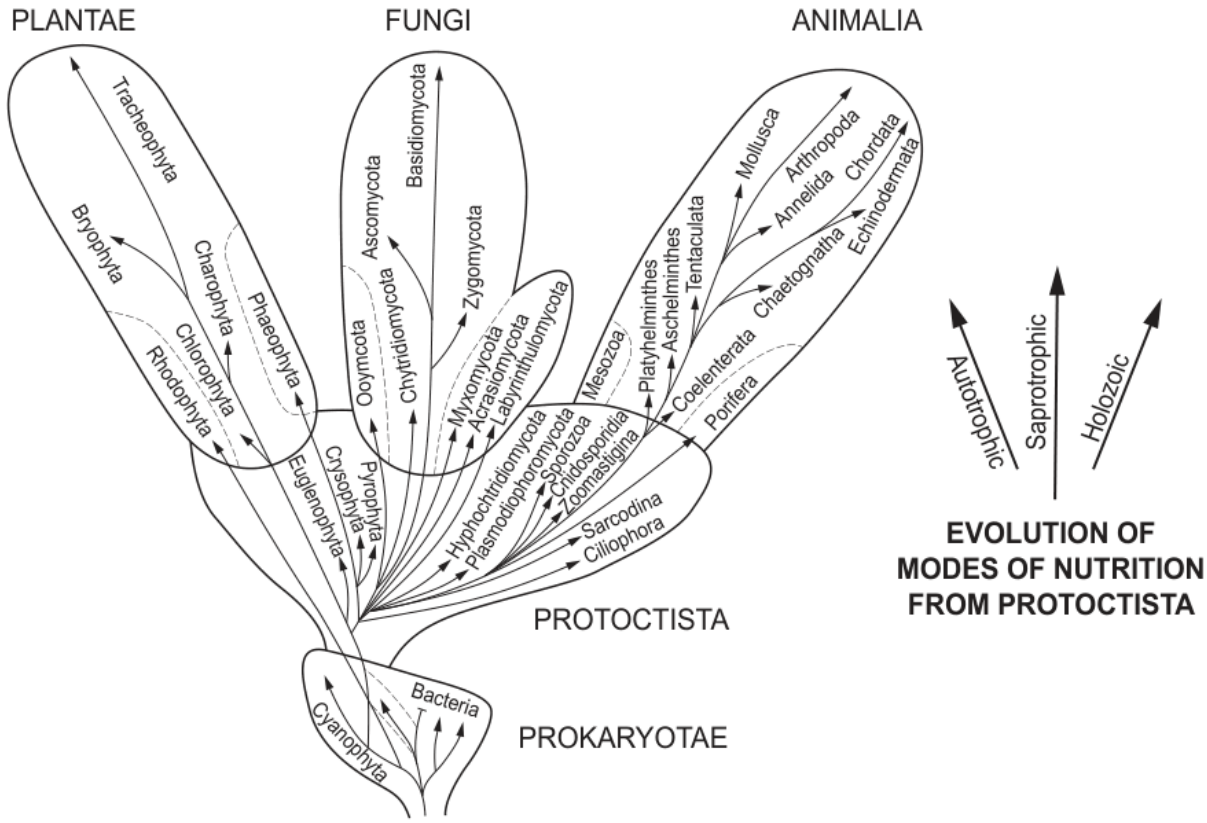
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1. Classifying organisms is important because it allows scientists to better understand evolutionary relationships. In 1969, RH Whittaker proposed a five Kingdom system including evolutionary relationships based on modes of nutrition.

Figure 1.1



(a) (i) Explain how the three arrows indicating mode of nutrition on Figure 1.1 illustrate the evolution of the three higher Kingdoms from the Protoctista. [3]

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Question 3 · A level Component 2 · June 2022 · Q1(a)(ii) · 2 marks

(ii) Complete the table below to show the current classification of this snail. [2]

Domain	.....
Kingdom	.....
Phylum	Mollusca
Class	Gastropoda
Order	Pulmonata
Family	Hygromiidae
Genus	.....
Species	.....

Question 4 · A level Component 2 · Autumn 2021 · Q2(c)(ii) · 2 marks

(ii) Explain why the reclassification of *Scilla italica* as *Hyacinthoides italica* demonstrates the tentative nature of classification. Suggest why its scientific name may change again in the future. [2]

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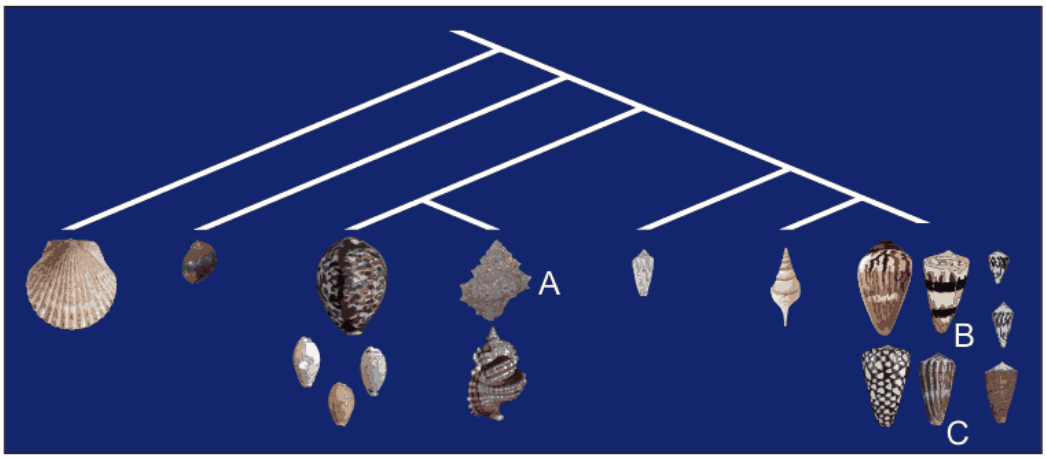
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Question 5 · information from earlier in the question

2. Cone snails are venomous, predatory marine snails. There are approximately 10 000 species of cone snails identified mainly by the shape, colour and banding patterns of the shell. **Image 2.1** shows some of these organisms.

Image 2.1



Organism	Binomial name	Common name
A	*Bursa nobilis*	The Noble Frog Shell
B	*Conus capitaneus*	The Captain's Cone
C	*Conus omaria*	Omaria Cone

Question 5 · AS Component 2 · June 2022 · Q2(b) · 3 marks

(b) **Image 2.1** also shows the binomial names and common names of some of the snails. With reference to organism **A**, explain what is meant by the binomial system and the reasons for scientists using this rather than the common names. [3]

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Question 6 · AS Component 2 · June 2024 · Q1(a)(ii) · 1 mark

(ii) Many related species of damselfish live close together within the same reef. Explain why they are classified as separate species. [1]

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(d) The amino acid sequence of the protein cytochrome C has been used to investigate the evolutionary relationship between organisms. The table below shows the amino acid sequences of parts of the protein from three sources, wheat, barley and maize. The amino acids are represented by using a single letter code, e.g. G = glycine.

SOURCE	Position of amino acid in polypeptide chain																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15-60	61	62	63	64	65	66	67	68	69	70	71	72-112
1	M	D	S	F	A	E	A	P	A	G	N	P	T	T		V	I	W	E	E	N	T	L	Y	D	Y	
2	M	A	P	F	D	E	A	P	P	G	K	S	K	A		V	E	W	E	E	K	T	L	T	D	Y	
3	M	A	S	F	D	E	A	P	P	G	K	P	K	A		V	E	W	E	E	K	T	L	Y	E	Y	

(i) Explain why determining the amino acid sequence of proteins from different organisms can be used to show evolutionary relationships. [1]

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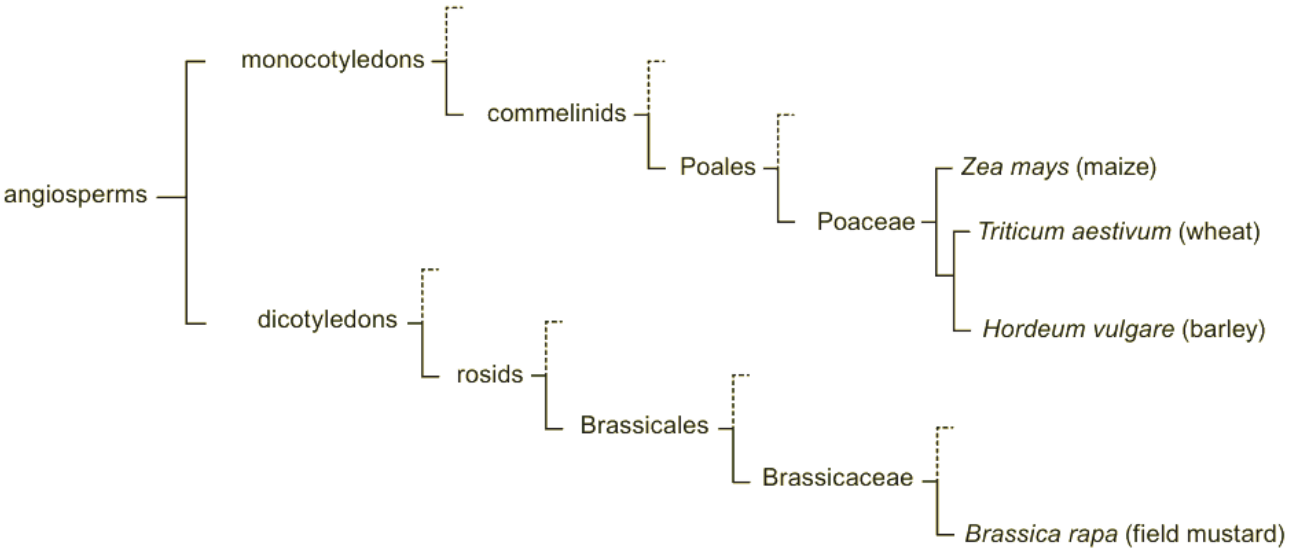
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(c) The photograph below shows a flower of the field mustard plant, *Brassica rapa*.



Diagram **1** below shows the classification of wheat and field mustard and their evolutionary relationship.

Diagram 1



Each branch on the diagram represents a clade, i.e. an ancestor together with all its descendants.

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Question 8 · A level Component 2 · June 2018 · Q3(d)(iii) · 2 marks

(iii) Use the table above and diagram **1** on page **12** to conclude which source came from which species. [2]

Species	Source
Maize (*Zea mays)*	.....
Wheat *(Triticum aestivum)*	.....
Barley *(Hordeum vulgare)*	.....

Question 9 · AS Component 2 · June 2018 · Q2(c) · 3 marks

(c) There has been some debate as to whether the pseudo-thumb in red pandas and giant pandas are examples of analogous or homologous structures. Distinguish between analogous and homologous structures. Explain why analogous features are not considered evidence of common ancestry. [3]

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Question 10 · information from earlier in the question

(d) Double-stranded DNA can be taken from different species. The molecules are heated to make the DNA single-stranded.

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Question 10 · A level Component 2 · June 2024 · Q2(d)(ii) · 3 marks

Single-stranded DNA from one species is then mixed with single-stranded DNA from another species. These are allowed to bond together and form hybrid DNA molecules. The temperatures at which the hybrid DNA can be separated again into single strands (separation temperature) can give an indication of evolutionary relatedness.

(ii) Biologists formed hybrid DNA from a human and a chimpanzee and from a human and an orangutan.
Suggest why hybrid human / chimpanzee DNA separated at higher temperatures than hybrid human / orangutan DNA. [3]

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Question 11 · A level Component 2 · June 2025 · Q6(a)(ii) · 1 mark

The results for the two sites are shown in **Table 6.1**.

Table 6.1

	Mean number of plants per quadrat	
Plant species	Site **1**	Site **2**
A	22	17
B	16	12
C	4	7
D	7	10
E	3	8
F	0	3
G	4	13
H	7	12
I	2	0

(ii) State a numerical value for the species **richness** of: [1]

Site **1** = ...

Site **2** = ...

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Question 12 · information from earlier in the question

The data collected were used to calculate a Simpson's Diversity Index for both sites. The data for Site **2** is given in **Table 6.2**.

Table 6.2

Plant Species	n	(n − 1)	n(n − 1)
A	17	16	272
B	12	11	132
C	7	6	42
D	10	9	90
E	8	7	56
F	3	2	6
G	13	12	156
H	12	11	132
I	0	0	0
(N)	.....	$\sum n(n-1) =$	.....
$N(N-1) =$	.....		

Site **1** had a Simpson's Diversity Index of 0.80.

Question 12 · A level Component 2 · June 2025 · Q6(a)(iv) · 2 marks

(iv) Use the answers to (ii) and (iii) to suggest why using species richness alone is not a valid measure of biodiversity in this study. [2]

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Question 13 · information from earlier in the question

4. An investigation was carried out to determine the effect of sheep grazing on the plant biodiversity of an upland heath. An area of previously grazed land was fenced off to exclude the sheep and the plant biodiversity was immediately calculated and then recalculated after 5 years. Each calculation of plant biodiversity involved taking a large number of random samples at the site.

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Question 13 · AS Component 2 · June 2019 · Q4(a)(ii) · 4 marks

(ii) Describe a suitable method which could be used to collect the data needed to estimate plant biodiversity in this investigation. [4]

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Question 14 · AS Component 2 · June 2019 · Q4(b)(i) · 3 marks

The table below shows the results of the investigation.

Species	Number of individuals	
	Immediately after fencing	Five years after fencing
Erica cinerea (height: 20 cm – 60cm)	34	18
Calluna vulgaris (height: 20 cm – 60 cm)	26	10
Carex binervis (height: 15 cm – 120 cm)	24	53
Galium saxatile (height: 5 cm – 20 cm)	43	0
Potentilla erecta (height: 10 cm – 30 cm)	53	12
Sorbus aucuparia (height: up to 10 m)	0	2
Diversity (Simpson's index)	0.79	

(b) (i) Use the formula given below to calculate the Diversity index for the experimental site after grazing was excluded for 5 years. **Give your answer to 2 decimal places.** [3]

$$\text{Diversity} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

N = total number of individual plants
n = number of individuals per species
$\sum$ = sum of

Species	n	$(n-1)$	$n(n-1)$
Erica cinerea			
Calluna vulgaris			
Carex binervis			
Galium saxatile			
Potentilla erecta			
Sorbus aucuparia			
	N =		$\sum n(n-1)$ =
	$(N-1)$ =		

$N(N-1)$ = ...

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Question 15 · AS Component 2 · June 2019 · Q4(c) · 3 marks

(c) After grazing had been excluded for 5 years the percentage ground cover by *Erica cinerea* had increased from 33 % to 67 %.

Use this information and the information given in the table on page 12 to suggest how this change could have affected the overall biodiversity at the site. [3]

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Question 16 · information from earlier in the question

(c) Today, all Northern Elephant Seals are descended from the 50 or so Guadalupe seals.

In order to assess the impact of the population bottleneck on the genetic diversity of northern elephant seals a group of scientists compared nucleotide sequences of DNA. Samples were taken from 185 present day northern elephant seals and compared with 22 museum samples of northern elephant seals collected in the nineteenth century.

Five different base sequences have been identified at the same point in the same gene locus. The results table below shows the number of specimens showing each of these alternative base sequences.

Base sequence at a particular point in the gene locus.	Number of specimens showing this sequence	
	present day	nineteenth century
GTA	50	8
GAA	0	8
GAG	0	4
AAG	135	1
AAA	0	1

[A. Rus Hoelzel *et al*; J. Evol. Biol. **15** (2002) 567-575)]

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Question 16 · A level Component 2 · June 2018 · Q5(c)(iii) · 2 marks

(iii) With reference to the data, draw a conclusion about the impact of population bottlenecks on genetic diversity of northern elephant seals. [2]

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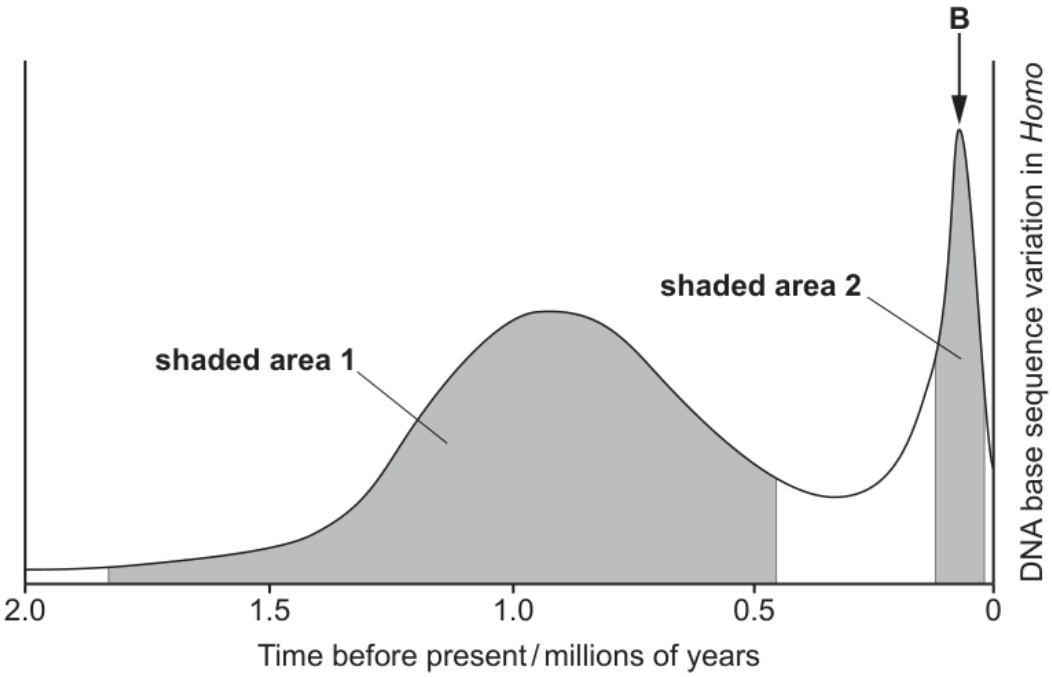
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Question 17 · information from earlier in the question

(c) DNA from ancient bones and teeth can be extracted and sequenced. **Image 3.3** shows the variation in the base sequences of DNA from bones of members of the genus *Homo* who lived up to two million years ago.

Image 3.3



Shaded area 1 in **Image 3.3** shows the time when early species of the genus *Homo* were diverging from each other. **Shaded area 2** shows the time when *H. sapiens* and *H. neanderthalensis* both lived.

Question 17 · AS Component 2 · June 2025 · Q3(c)(ii) · 1 mark

(ii) Explain why the position of Arrow **B** on **Image 3.3** indicates the time when the genus *Homo* had the highest genetic diversity. [1]

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(c) Many damselfish species live between the branches of coral, where they feed on algae and obtain protection from predatory fish. They also feed on suspended plankton away from the coral but never swim far beyond it.

Image 1.4 shows a population of *Chromis viridis* around a colony of coral.

Image 1.4



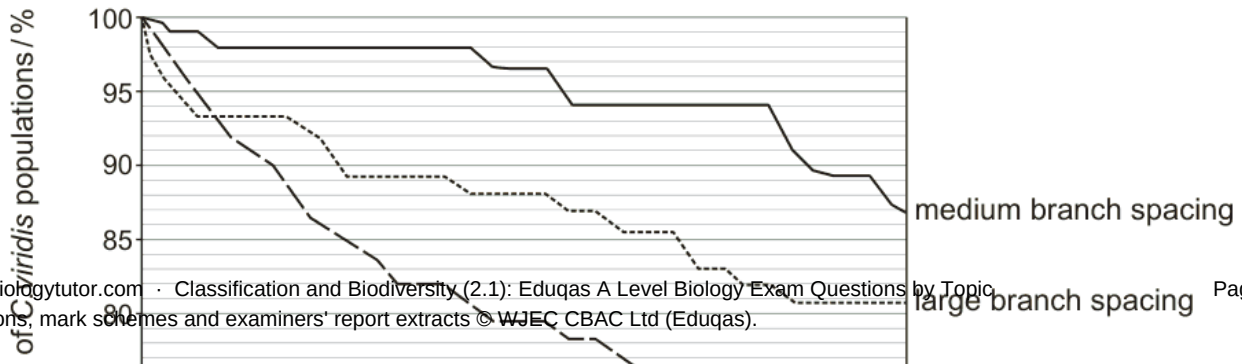
The spacing size between branches of host coral affects damselfish survival.

In an investigation:

- *S. hystrix* corals with the same diameter were monitored from the time of initial colonisation by a population of young *C. viridis*.
- Each coral was identified as having either large, medium or small branch spacing.
- The number of fish within each coral was counted every day for 30 days.
- The percentage of the initial population surviving after each day was calculated.

Graph 1.5 shows percentage survival for *C. viridis* populations within three sizes of coral branch spacing.

Graph 1.5



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Question 18 · AS Component 2 · June 2024 · Q1(c)(iii) · 3 marks

(iii) Some alleles that cause increased growth were present at lower frequencies in populations of *C. viridis* living within corals with small branch spacing.

Use the information given in part (c) to suggest how the biodiversity of these populations has been affected by natural selection and explain your answer. [3]

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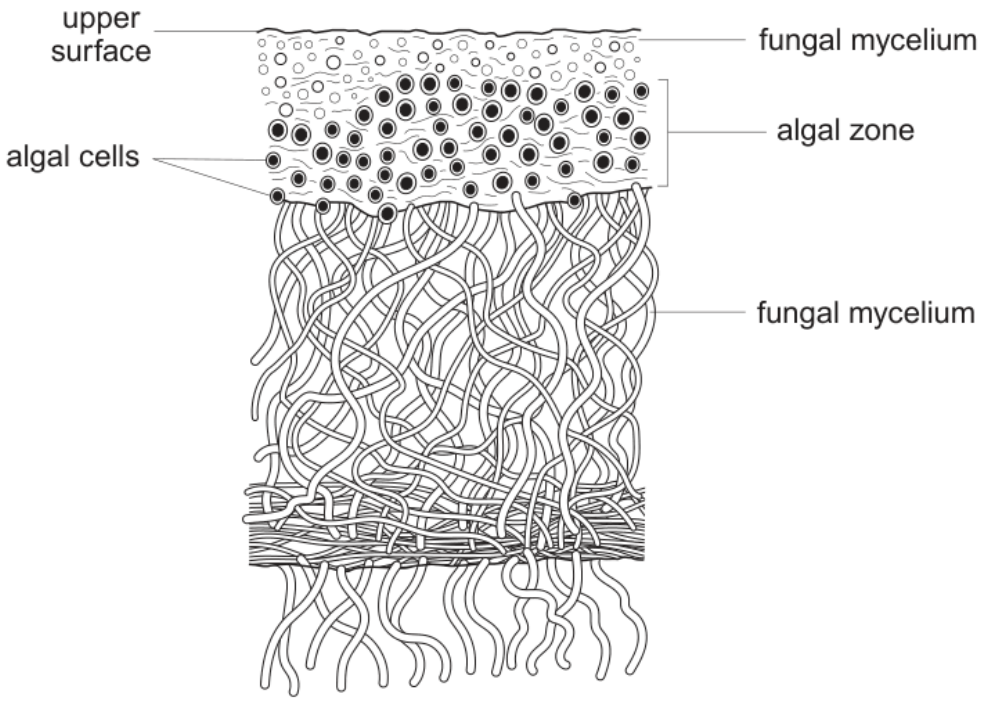
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Question 19 · information from earlier in the question

2. Lichens are found growing on many surfaces such as buildings, rocks and tree trunks. They are composed of two organisms, a fungus and a single-celled, photosynthetic alga. The two organisms co-exist in a relationship where both benefit. The main part of the lichen is known as a thallus. The diagram below shows a cross section through a lichen thallus.



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Question 19 · AS Component 2 · June 2019 · Q2(c) · 2 marks

(c) Explain the position and distribution of the algae within the lichen thallus. [2]

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Mark schemes

Question 1 · AS Component 2 · June 2023 · Q1(a)(i) · 1 mark

1	(a)	(i)	**Any two for one mark** DNA/RNA/nucleic acid plasma membrane ribosomes cytoplasm	1	1		

Question 2 · A level Component 2 · June 2019 · Q1(a)(i) · 3 marks

1	*(a)*	(i)		Plants are Autotrophs/ or description of (1) Fungi are saprotrophs/ or description of (1) Animals are holozoic/ or description of (1)	3	3	

Question 3 · A level Component 2 · June 2022 · Q1(a)(ii) · 2 marks

(ii)

Domain	**Eukaryote / Eukarya/ Eukaryota**
Kingdom	**Animalia / Animals**
Phylum	Mollusca
Class	Gastropoda
Order	Pulmonata
Family	Hygromiidae
Genus	***Candidula must have Capital C***
Species	***intersecta must have lower case i***

4 correct = 2 marks
3/2 correct = 1 mark
0/1 = 0 marks
Correct spellings of genus and species

2 2

Question 4 · A level Component 2 · Autumn 2021 · Q2(c)(ii) · 2 marks

(ii)				(tentative) classification based on evidence available / not fixed may not accurately reflect evolutionary relatedness (1) changes as new evidence found/ or given example (1)	2		2

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Question 5 · AS Component 2 · June 2022 · Q2(b) · 3 marks

(b)	binomial name {made of two parts/genus then species} (1) *Bursa* = genus and *nobilis* = species (1) spelling + letter cases must be correct Common name could vary regionally/ different languages/ Could cause confusion when identifying species (1)	2	1	3

Question 6 · AS Component 2 · June 2024 · Q1(a)(ii) · 1 mark

(ii)	(different species) are unable to <u>inter</u>breed to produce fertile {hybrids / offspring} / only individuals of the same species are able to <u>inter</u>breed and produce fertile {hybrids / offspring} (1)	1		1

Question 7 · A level Component 2 · June 2018 · Q3(d)(i) · 1 mark

(d)	(i)	The (more) closely related the fewer differences there will be/the fewer differences the more recent common ancestor/ORA	1	1	

Question 8 · A level Component 2 · June 2018 · Q3(d)(iii) · 2 marks

	(iii)	1 3 2/1 2 3 = 2 marks		2	2	2

Question 9 · AS Component 2 · June 2018 · Q2(c) · 3 marks

(c)	Analogous structures (evolve separately) are different structures to perform a similar function/or example (1) Homologous structures (evolve from a common ancestor) similar structure performing different functions/or example (1) Analogous structures arise through convergent evolution/OWTTE (1)	3	3	

Question 10 · A level Component 2 · June 2024 · Q2(d)(ii) · 3 marks

(ii)	more closely related (to chimps than orangutans) / share more recent common ancestor / ORA (1) More similar DNA (base sequences) / more complementary bases / ORA (1) So more hydrogen bonds {form / need to be broken} / ORA (1)	2	1	3

Question 11 · A level Component 2 · June 2025 · Q6(a)(ii) · 1 mark

	(ii)	Both 8 (1)	1	1	1

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Question 12 · A level Component 2 · June 2025 · Q6(a)(iv) · 2 marks

(iv)	**Any two (x1) from** (Biodiversity also includes) species evenness (1) Richness same for both sites (BUT index of diversity is different) (1) Richness does not describe {how dominant species are / spread of species number / the abundance of species / owtte} / ORA for species evenness (1)	1	1	2	2

Question 13 · AS Component 2 · June 2019 · Q4(a)(ii) · 4 marks

(ii)	Any **four** (×1) from: A. Place two tape measures at right angles to form the axes of a grid (1) B. (Use a calculator/ computer to) generate random coordinates (1) C. Place (the corner of) the quadrat at the point indicated on the grid(1) D. {Identify/ record/ count} each plant species and the number within the quadrat (1) Accept count the number of each species E. Repeat and calculate a mean	4	4	4	

Question 14 · AS Component 2 · June 2019 · Q4(b)(i) · 3 marks

(b)	(i)	Calculation diversity index = 0.63= 3 marks If incorrect award 2 marks for not rounding = 0.63202688 If incorrect award 1 mark for each of Calculation of N(N-1) =8 930 Calculation ∑n(n-1) =3 286	3	3	3

Question 15 · AS Component 2 · June 2019 · Q4(c) · 3 marks

(c)	Reference to data from table with regard to height of plants e.g. *E. cinerea* grows up to 60cm in height / *G. saxatile* only grows up to 20cm (1) Preventing light reaching the smaller plants / Fewer small plants grow due to competition by heather (1) Causing {a reduction in the numbers of some species / species richness}/ elimination of *Galium saxatile* (1)	3	3	

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Question 16 · A level Component 2 · June 2018 · Q5(c)(iii) · 2 marks

(iii)		(Population bottleneck) has caused decrease in genetic diversity (1) only 2 different sequences in modern but all 5 found in 19th C/GAA GAG AAA are missing in present day/ there is a wider range of different sequences in nineteenth C(1)	2 2	2

Question 17 · AS Component 2 · June 2025 · Q3(c)(ii) · 1 mark

	(ii)	The greatest variation in the base sequence (1)	1	1 0

Question 18 · AS Component 2 · June 2024 · Q1(c)(iii) · 3 marks

	(iii)	Reduces biodiversity (of population) (1) MP2 **Any two (×1) from** selection against larger fish / larger fish at a disadvantage (1) larger fish cannot hide so more likely to be predated (1) Insufficient space for larger fish / competition for space / spaces too small for larger fish to survive (1)	3 3

Question 19 · AS Component 2 · June 2019 · Q2(c) · 2 marks

	(c)		Any **two** (×1) from Near upper surface to {capture sunlight for photosynthesis / to absorb enough CO_2} (1) Fungal mycelium prevents dehydration of algae (1) Arranged in thin layer because light will not penetrate deeper into thallus (1)	1 1 2	

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