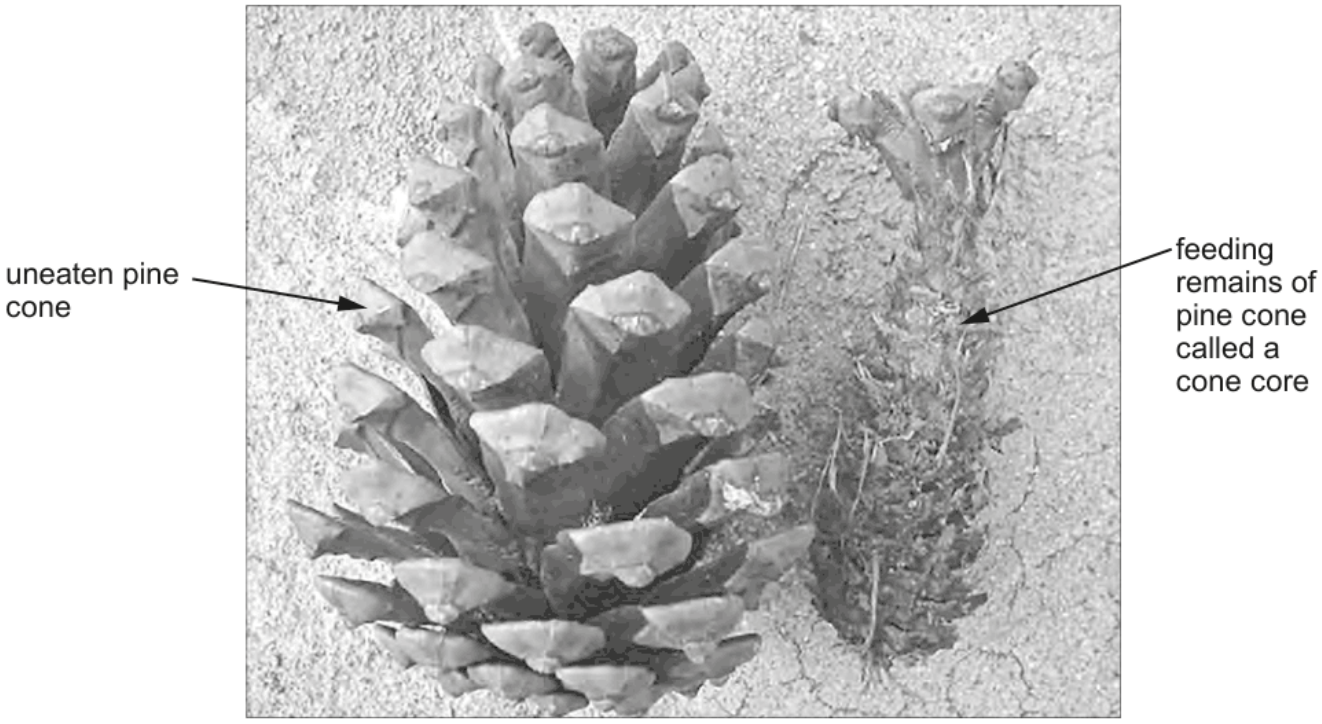
Ecology, Genetics and Statistics (Specified Practicals): Eduqas A Level Biology Exam Questions

22 questions · 53 marks · about 64 minutes. Answer in the spaces, then check the mark schemes at the end.

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

Another type of survey involves the systematic assessment of the remains of pine cones, called cone cores, the seeds of which are eaten by squirrels. This provides information on squirrel numbers, habitat use and the timing and spatial distribution of seed availability.

The photograph below shows an uneaten pine cone compared with the feeding remains of a Scots pine cone eaten by a red squirrel.



(b) Describe how you would set up a transect so that the distribution of cone cores could be easily assessed. [3]

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

Question 2 · A level Component 1 · June 2019 · Q1(e) · 2 marks

(e) A knowledge of population numbers is very important in ecology so that changes can be detected quickly. To estimate the populations of mobile animals, a method of mark and recapture is commonly used. The photograph below shows a marked Chittenango snail *(Novisuccinea chittenangoensis)*, which is classified as an endangered species.



The table below shows the method used to estimate the population and the results obtained.

Method	Result
1. Capture and count animals.	430 snails
2. Mark/tag them.	
3. Release them back into the community.	
4. Capture a second sample and count them.	410 snails
5. Record the number of marked/tagged individuals re-captured.	100 snails

The population can be estimated using the following equation.

$$\frac{M}{P} = \frac{R}{n}$$

P is the population size to be estimated.
M is the number of members of the population that are captured initially and tagged.
n is the number of members of the population that are captured subsequently.
R is the number of members of this re-captured population that are tagged.

Use the equation to calculate the population of snails. [2]

Population = ... snails

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

(c) Moths are insects. They are pollinators for many plant species and a source of food for some predatory birds.
Image 1.3 shows a lime hawk moth, *Mimas tiliae*, a species common to Southern England with numbers increasing further north.
Due to natural selection, lime hawk moth life cycles have aligned with the seasonal cycles of lime trees. Climate change can affect the timing of the growth of leaves, which their larvae (caterpillars) feed on.

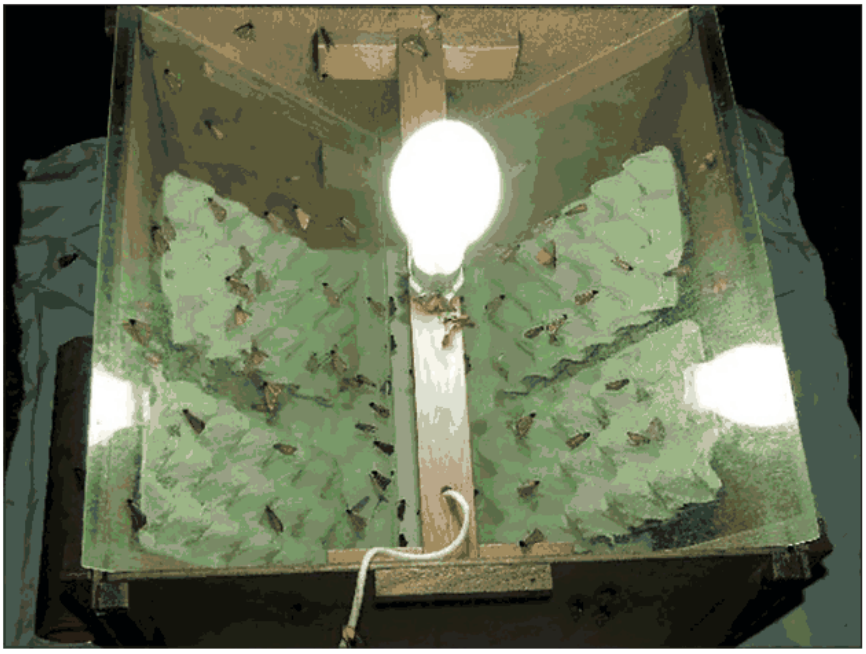
Image 1.3



Scientists monitoring the size of populations of lime hawk moths use light traps to capture moths during warm nights when they are most active.

Image 1.4

A light trap



Moths can fly in through gaps under the glass.

The glass prevents them flying back upwards.

An investigation was carried out in a southern and northern region of England using the following method.

- Five light traps, 10 metres apart, were left with the light on for four hours at night.
- After this time, captured moths were counted and marked with a small dot placed on the abdomen before releasing them.
- The procedure was repeated the following night without marking the moths after

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

Question 4 · AS Component 2 · June 2023 · Q1(c)(iii) · 2 marks

(iii) The light in the trap was on for four hours each night. State **two** other variables that should have been controlled when setting the moth traps in each region. [2]

.....

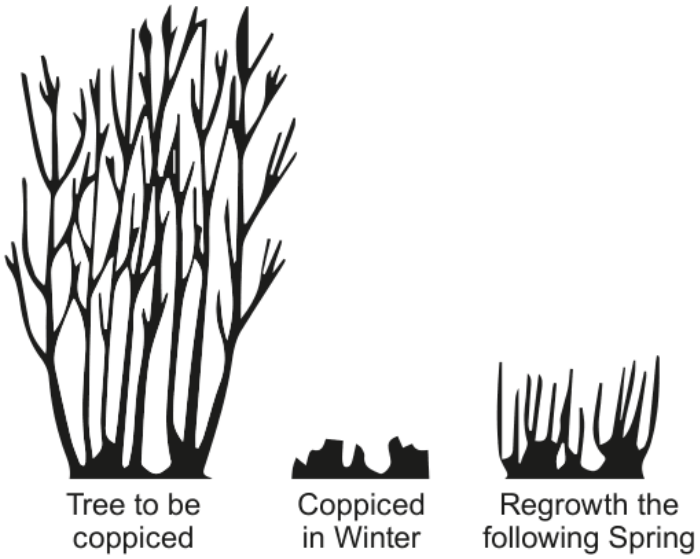
.....

.....

.....

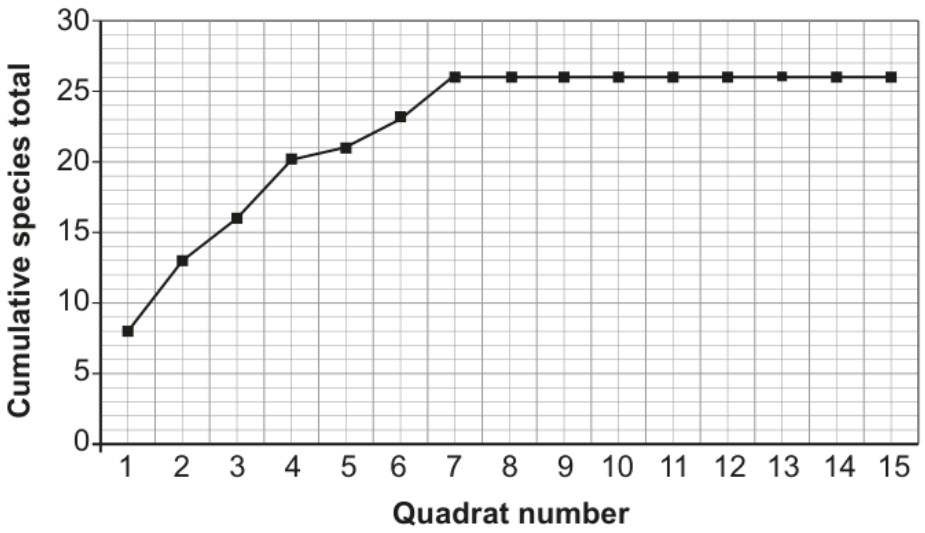
Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

4. Coppicing is a method of woodland management in which trees are cut close to the ground and allowed to regrow from the cut stumps, as shown in the diagram below.



A conservation group used Simpson's Diversity Index (D) to monitor the impact of coppicing on their local wood.

They used a 1 m^2 quadrat to identify and count plant species on the floor of the wood. Preliminary work to decide how many times to use the quadrat produced the following results.



(a) (i) With reference to these results suggest the number of quadrats the group **should use** in their actual investigation, giving reasons for your choice of sample size. [3]

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

Question 6 · AS Component 2 · June 2016 · Q4(a)(ii) · 2 marks

(ii) Describe a method the group could use to randomise the positions of the quadrats. [2]

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

(b) The group surveyed an un-coppiced area and an area where all the Hazel trees had been coppiced three years earlier. They calculated Simpson's Diversity Index using the formula:

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

where;
n = the number of individuals of each species
N = the total number of individuals of all species
$\sum$ = sum of.

The results for the un-coppiced area are shown below:

Species	n	(n – 1)	n(n – 1)
Bramble	2	1	2
Yellow Archangel	0	–1	0
Wood Sorrel	2	1	2
Foxglove	0	–1	0
Wood Anemone	0	–1	0
Dog's Mercury	6	5	30
TOTAL	N = 10		$\sum n(n-1) = 34$
	$N(N-1) = 90$		

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

= 0.62

The results for the coppiced area are given below.

(i) Using the table and the formula, calculate Simpson's Diversity Index, to two decimal places, for the coppiced area. [3]

Species	n	(n – 1)	n(n – 1)
Bramble	2		
Yellow Archangel	3		

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

Question 8 · A level Component 2 · June 2019 · Q3(a) · 3 marks

3. In order to investigate the effects of mowing on biodiversity, a group of students carried out surveys on two different sites on their school fields.

- A playing field that was mown regularly throughout the growing season.
- A meadow set aside for conservation that was mown once a year.

The students used quadrats to estimate the numbers of plants of the species found on the two sites.

The results were analysed using the Simpson's Diversity Index.

(a) Explain the steps the students should have taken to ensure their sampling methods produced representative totals. [3]

Question 9 · information from earlier in the question

To investigate whether the introduction of yellow rattle into grassland might restore biodiversity, grassland containing a single species of fast-growing grass was divided into two equal areas, area **A** and area **B**

Area **A** was seeded using a mixture of flowering plants and yellow rattle seeds

Area **B** was seeded using the same mixture of flowering plants but with no yellow rattle seeds.

The abundance and distribution of plant species in areas **A** and **B** were determined before seeding and one year after seeding.

(c) Explain why the following steps were taken when collecting data on the abundance and distribution of plant species in both areas:

Question 9 · A level Component 1 · June 2022 · Q5(c)(iii) · 2 marks

(iii) The experiment was conducted **several times** on grassland with the same species of fast-growing grass. [2]

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

(d) The data collected from areas **A** and **B** were used to calculate a Simpson's biodiversity index. **Table 5.3** shows the mean values of the Simpson's Diversity Index of areas **A** and **B** before and one year after seeding.

Table 5.3

	Value of Simpson's Diversity Index	
	Area **A**	Area **B**
Before seeding	0.45	0.46
One year after seeding	0.51	0.47

Based on these data only, it was concluded that seeding grassland with yellow rattle did result in an increase in biodiversity. However, it was decided that more data would be needed to improve confidence in this conclusion.

The following modifications to the method were suggested. Explain how each change to the method can be justified. [3]

Change	Justification
Calculate the biodiversity index again five years after seeding	....
Calculate the biodiversity index a number of different times in the same year	....
Carry out the investigation in different areas with different fast-growing grass species	....

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

Question 11 · A level Component 1 · June 2024 · Q5(b)(iii) · 4 marks

(iii) Outline a method that could be used to estimate and compare the plant biodiversity of the original forest and the avocado plantation. [4]

Question 12 · A level Component 2 · June 2025 · Q6(a)(i) · 1 mark

6. (a) A local council were approving planning permission for a car park measuring 60 m by 30 m. They had identified two possible sites. The council commissioned a biodiversity study of the two sites to help them decide which to use. The study was carried out on one day in March.

The method used to collect data from both sites was as follows:

1. Place tape measures at right angles to each other to form a pair of axes 20 m × 20 m.
2. Generate random numbers to produce the figures for the x and y co-ordinates to identify a sampling position.
3. Place a 50 cm × 50 cm quadrat at the generated sampling position.
4. Identify all the plant species present and record the numbers of each species in the quadrat.
5. Repeat steps 2–4 for a total of 10 quadrats.

(i) Explain why **random** numbers were generated in **Step 2**. [1]

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

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.

(iii) Use **Table 6.2** and the formula below to calculate the Simpson's Diversity Index for Site **2**. [3]

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

where N = number of organisms present and n = number in each species.

D = ...

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

Question 14 · information from earlier in the question

6. (a) A local council were approving planning permission for a car park measuring 60 m by 30 m. They had identified two possible sites. The council commissioned a biodiversity study of the two sites to help them decide which to use. The study was carried out on one day in March.

The method used to collect data from both sites was as follows:

1. Place tape measures at right angles to each other to form a pair of axes 20 m × 20 m.
2. Generate random numbers to produce the figures for the x and y co-ordinates to identify a sampling position.
3. Place a 50 cm × 50 cm quadrat at the generated sampling position.
4. Identify all the plant species present and record the numbers of each species in the quadrat.
5. Repeat steps 2–4 for a total of 10 quadrats.

Question 14 · A level Component 2 · June 2025 · Q6(b) · 4 marks

(b) To preserve biodiversity the local council decided to use Site **1**. However, environmentalists queried the validity of the method used to gain the results. Identify **four** limitations in the method used to collect the data. [4]

I. .....

.....

II. .....

.....

III. .....

.....

IV. .....

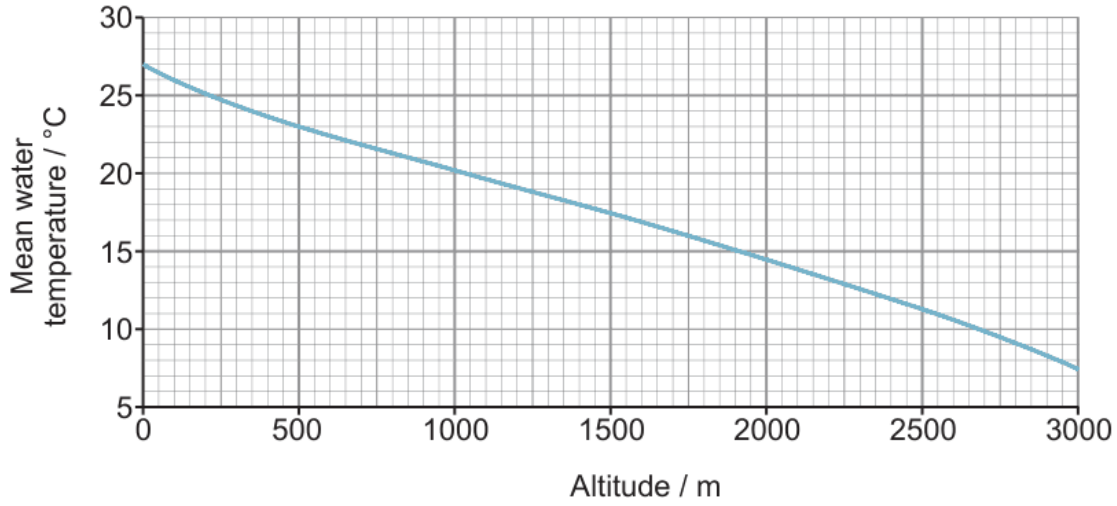
.....

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

The larvae shown in **image 1.1** are aquatic and their distribution is affected by a range of environmental factors including the temperature of the water.

To investigate the effect of temperature on the biodiversity of insects with aquatic larvae, a study was carried out at three different altitudes in a mountainous region of South America. **Image 1.2** shows how mean water temperature changes with altitude.

Image 1.2



Data were collected from shallow streams at 350 m, 2 100 m and 3 000 m above sea level, that flowed over similar rocks and had a similar pH.

Five streams were sampled at each altitude. Areas of each stream were sampled using the following kick-sampling method:

- Place a 0.5 m^2 quadrat on the stream bed in the middle of the stream.
- Place a 0.5 m wide flat-bottomed net downstream of the quadrat.
- Disturb the area of the stream bed inside the quadrat for two minutes by kicking strongly.
- Transfer the organisms caught in the net to a container.
- Group the insect larvae into Orders and record the number of Families in each Order recorded.
- Working upstream, sample a further nine areas in each stream.

(b) (i) Explain why the ecologists worked upstream from the first sample. [2]

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

Table 1.3 below shows the mean number of Families in the different Orders of insects per m^2 identified at each altitude tested.

Table 1.3

Order of insects	Number of Families identified at each altitude		
	350 m	2100 m	3000 m
Collembola	1	1	1
Plecoptera	1	1	1
Ephemeroptera	4	4	2
Odonata	4	1	0
Megaloptera	1	0	0
Hemiptera	4	0	0
Coleoptera	6	6	2
Trichoptera	8	9	6
Lepidoptera	1	1	0
Diptera	8	9	10

Table 1.4 shows the number of individuals of each Family found in the streams sampled at 3000 m.

Table 1.4

Altitude = 3000 m			
Insect Family	n	$(n–1)$	$n(n–1)$
Collembola	1	0	0
Plecoptera	1	0	0
Ephemeroptera	2	1	2
Odonata	0	–1	0
Megaloptera	0	–1	0
Hemiptera	0	–1	0
Coleoptera	2	1	2
Trichoptera	6	5	30
Lepidoptera	0	–1	0
Diptera	10	9	90
N	.....	$\Sigma n(n–1)$	.....
$(N–1)$	.....		
$N(N–1)$	.....		

(iii) Use **table 1.4** and the formula below to calculate a Diversity Index *(D)* for the streams sampled at 3000 m. [3]

$$D = 1 - \frac{\sum n(n-1)}{N(N-1)}$$ where N = total number of insect families
n = number of families per order of insect

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

Damselfish diversity on a coral reef was investigated using the following method.

In daylight hours during one day:

- Capture the damselfish within a measured sample area using nets.
- Count all the individuals of each species.
- Release them in the same place they were captured.

The number of each species (n) is shown in **Table 1.2**.

Table 1.2

Damselfish species	n	n–1	$n(n–1)$
Chromis viridis	63	62	3906
Dascyllus aruanus	38	37	1406
Pomacentrus amboinensis	34	33	1122
Amblyglyphidodon curacao	47	46	2162
Dascyllus reticulatus	23	22	506
N =	.....	$\sum n(n–1)$ =	.....
$N(N–1)$ =	.....		

(iii) Calculate the diversity index of damselfish in this area of reef using **Table 1.2** and Simpson's Diversity Index equation. [3]

$$D = 1 - \frac{\sum n(n–1)}{N(N–1)}$$

Key:

N = total number of organisms present
n = number of each species
$\sum$ = sum of

D = ...

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

Question 18 · AS Component 2 · June 2024 · Q1(a)(iv) · 2 marks

(iv) Suggest **two** possible sources of error in this method which may reduce confidence in the diversity value calculated for the whole reef. [2]

.....

.....

.....

.....

Question 19 · AS Component 2 · June 2024 · Q1(b)(i) · 1 mark

(b) The diversity of corals living within the reef was also investigated.

- A 250 m^2 area was sampled using 1 m^2 quadrats.
- 10 quadrats were placed at points selected randomly within the area.
- The percentage cover of five dominant species of coral within each quadrat was estimated and a mean calculated.

(i) The same scuba diver estimated the percentage cover in each quadrat. Give a reason why this was important for the accuracy of the method. [1]

.....

.....

Question 20 · A level Component 2 · Autumn 2021 · Q5(c)(i) · 1 mark

(c) The phenotypes of a sample of 400 seeds were recorded as shown in **table 5.2**.

Table 5.2

phenotype	number in sample
purple; smooth	201
purple; wrinkled	84
yellow; smooth	81
yellow; wrinkled	34

A Chi^2 test was carried out to determine whether the results of this cross followed Mendel's law of independent assortment.

(i) State the null hypothesis for this test. [1]

.....

.....

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

Question 21 · information from earlier in the question

(b) Pollen from the F1 generation was transferred to the stigma of pure-bred plants with rough striped leaves. The expected ratio of the phenotypes of the offspring from this cross is 1:1:1:1.

Seeds from this cross were grown and the following phenotypes were seen.

Glossy green leaves	64
Glossy striped leaves	12
Rough green leaves	11
Rough striped leaves	73

A null hypothesis was proposed that there was 'no significant difference between the observed and expected numbers of each phenotype in the offspring'.

A χ^2 (chi-squared) test can be carried out to find the probability of the results being significantly different from the expected ratio.

The χ^2 calculation is shown below.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where O = observed results
E = expected results
$\sum$ = sum of

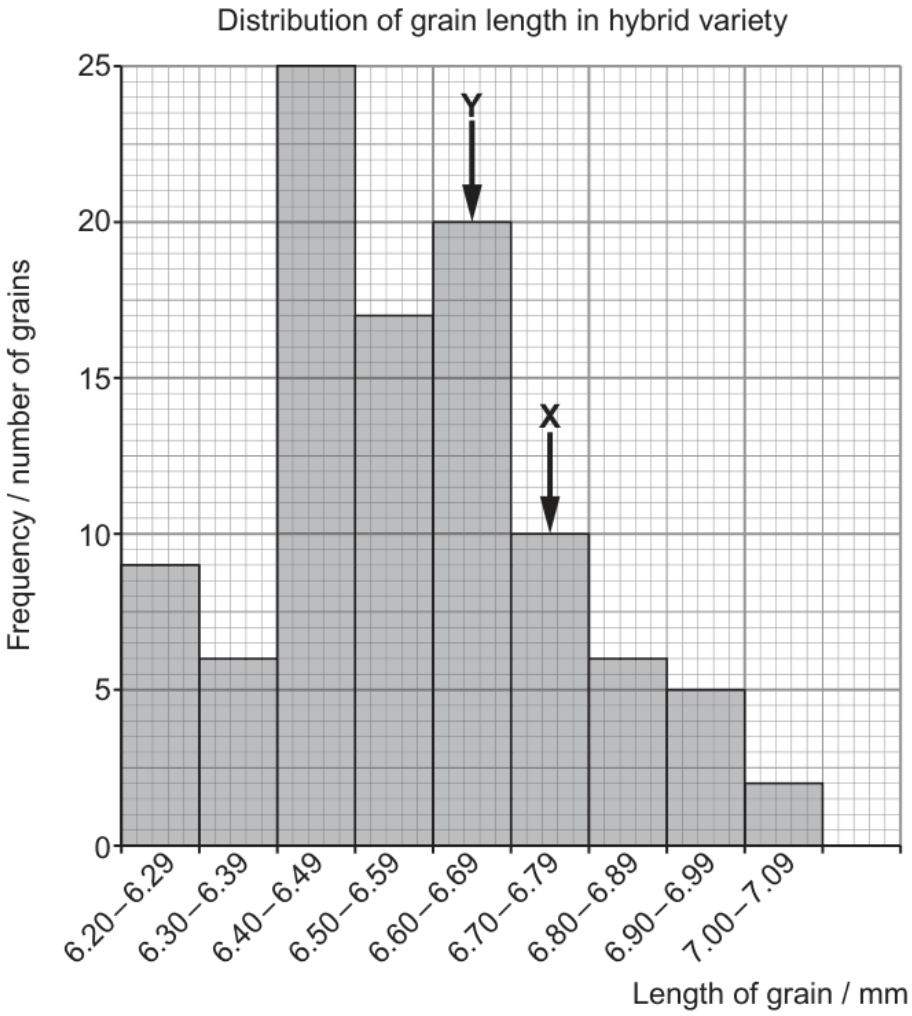
Question 21 · A level Component 2 · June 2023 · Q6(b)(ii) · 1 mark

(ii) State the number of degrees of freedom for these results. [1]

.....

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

For each parental variety the mode and median were the same. Arrow **X** shows the mode and median for parental variety A and Arrow **Y** shows the mode and median for parental variety B.



(iv) Consider the following statement:

'There is no significant difference in the length of the hybrid grains and the length of the grains of parental type B.'

Describe any evidence from the graph above to support the statement and name the terms used to describe; the type of hypothesis represented by the statement and the statistical test that could be used to test the hypothesis. [3]

Evidence .....

.....

Type of hypothesis .....

Statistical test .....

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

Mark schemes

Question 1 · A level Component 1 · June 2017 · Q7(b) · 3 marks

(b)	**Any 3 (x1) from:** A. At regular intervals place a quadrat/ description of belt transect (1) B. Count the number of cone <u>cores</u> in each quadrat/ along belt transect C. Visit each transect/ quadrat at regular intervals (around every 2–3 weeks) (1) D. Repeat in different areas (1) Max 2 marks for using block sampling	3	3	3	

Question 2 · A level Component 1 · June 2019 · Q1(e) · 2 marks

	(e)		1763 = 2 marks Award 1 mark for $\frac{430 \times 410}{100}$ $\frac{430}{P} = \frac{100}{410}$	2	2	2	2

Question 3 · AS Component 2 · June 2023 · Q1(c)(i) · 2 marks

(c)	(i)	52 = 2 marks award one mark for 51.78/51.8 $\frac{25}{14} \times \frac{29}{}$	2	2	2	

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

Question 4 · AS Component 2 · June 2023 · Q1(c)(iii) · 2 marks

(iii)	**Any two (×1) from** Type of habitat/type of surrounding vegetation (1) Light intensity of the light source (1) Time of night the light was on (1) Same weather conditions/season/time of year (1) Same size/type of trap (1) Height above ground (1)	2	2	2			

Question 5 · AS Component 2 · June 2016 · Q4(a)(i) · 3 marks

4	(a)	(i)	7 (1) A smaller number would mean missing species (1) A larger number will { not improve results/not provide more meaningful results/ take longer} (1)	2	1	3	1	1

Question 6 · AS Component 2 · June 2016 · Q4(a)(ii) · 2 marks

(ii)	**Any 2(x1) from:** Mark out a grid in the wood/use tape measures at right angles/ or description of (1) Use random number {generator/dice/ table} (1) to pick coordinates/ or description (1)	2	2	2			

Question 7 · AS Component 2 · June 2016 · Q4(b)(i) · 3 marks

(b)	(i)	Calculation of N(N-1) =14X13=182 (1) Calculation of ∑n(n-1) = 28 (1) Calculation of Diversity Index = 0.85 to 2 places of decimal (1) Correct answer = 3 marks	3	3	3	3			

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

Question 8 · A level Component 2 · June 2019 · Q3(a) · 3 marks

3	*(a)*		• Use of {random number tables/ random number generator/ 20 sided die or equivalent} / use random coordinates for sampling (1) • Use {many/ a large enough number of} quadrats (to ensure a consistent number of species)/ owtte (1) • Carry out both sites at same time of year/ Repeat investigation at different times of the year (1)	3	3	3

Question 9 · A level Component 1 · June 2022 · Q5(c)(iii) · 2 marks

	(iii)		{Increase/ test} repeatability/ reliability (1) reject accuracy/ ensure it is reliable Allows a {mean/ average} to be calculated (1)	2	2	2

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

	(d)	**Changes**:
		Calculate the biodiversity index again five years after seeding
		Calculate the biodiversity index a number of different times in the same year
		Carry out the investigation in different areas with different grass species

Yellow rattle may not have an effect in 1 growing season/ to ensure it is still there/ it may take time to grow / to see if it is still having an effect (1)	3	3	3
Plants {grow / flower} at different times of the year (so may not be present in a single sampling period) (1) ignore season/ weather			
To determine if yellow rattle has the same effects on different grass species (1)			

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

Question 11 · A level Component 1 · June 2024 · Q5(b)(iii) · 4 marks

(iii)	A. Description of setting up a grid (1) reject reference to transect B. Quadrat {locations / co-ordinates} selected randomly (1) C. Count the numbers of (individuals of) each <u>species</u> present (1) must be in context of species not just plants D. Calculate (and compare) a (Simpson's) biodiversity index for each area studied (1)	

2	2	4	4

Question 12 · A level Component 2 · June 2025 · Q6(a)(i) · 1 mark

6	(a)	(i)	{Reduce / prevent} bias	1	1

Question 13 · A level Component 2 · June 2025 · Q6(a)(iii) · 3 marks

		iii	D = 0.87 = 3 marks Allow 0.866667 correctly rounded If incorrect award 2 marks for 0.13 (not taken away from 1) 0.866667 incorrectly rounded If incorrect award one mark for either of: $\sum n(n-1) = 886$ (1) $N(N-1) = 6642$ (1)	3	3	3	3

Question 14 · A level Component 2 · June 2025 · Q6(b) · 4 marks

(b)	**Any four (x1) from** A. only vegetation / {invertebrates / animals} not taken into account (1) B. Only carried out in March / may change during the year / Only carried out once (1) C. Only 20x20m used / only 400m^2 used / may change over the {whole area / different habitats / owtte} (1) D. Does not take into account rarity of organisms (1) E. 10 quadrats not {enough / representative} / quadrats too small / owtte (1)	4	4	4

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

Question 15 · A level Component 2 · Autumn 2021 · Q1(b)(i) · 2 marks

(b)	(i)	Uncaught organisms (dislodged from stream bed) would flow downstream (1) (working upstream) would prevent more organisms being caught than would be actually present in the sample area (1) OWTTE Reject: ensures reliable samples	2	2	2

Question 16 · A level Component 2 · Autumn 2021 · Q1(b)(iii) · 3 marks

(iii)	D = 0.73 (3 marks) Accept 0.732 / 0.731601. Reject 0.731 If incorrect award 2 marks for 0.27 (has not taken result away from 1) If incorrect award 1 mark for each of **Σn(n-1)** = 124 (1 mark) **N(N-1)** = 462 (1 mark)	3	3	3

Question 17 · AS Component 2 · June 2024 · Q1(a)(iii) · 3 marks

(iii)	0.782 / 0.78 / 0.8 (3 marks) If incorrect award 2 marks 0.215 / 0.22 / 0.2 If incorrect award 1 mark each for 9102 41820	3	3	3

Question 18 · AS Component 2 · June 2024 · Q1(a)(iv) · 2 marks

(iv)	**Any two (x1) from:** Unable to capture all individuals (1) Inaccurate identification (1) Measured area may not be representative of whole reef (1) Population may not be the same at different times of the year / breeding season / times of the day / owtte etc. (1) Method has not been repeated / only one area reef was observed (1)	2	2	2

Question 19 · AS Component 2 · June 2024 · Q1(b)(i) · 1 mark

(b)	(i)	Estimate is subjective therefore {reduces variability / improves reliability} (if carried out by same person) / owtte (1)	1	1	1

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

Question 20 · A level Component 2 · Autumn 2021 · Q5(c)(i) · 1 mark

	(c)	(i)		no <u>significant</u> difference between the observed and expected numbers of each phenotype / any difference between the observed and expected numbers of each phenotype is due to chance (1)	1	1	1

Question 21 · A level Component 2 · June 2023 · Q6(b)(ii) · 1 mark

(ii)	3	1	1	1	1

Question 22 · A level Component 2 · June 2018 · Q4(b)(iv) · 3 marks

	(iv)	{Samples/hybrids} have more similar {mean/median/mode} to parent B (than parent A) (1) Null (hypothesis)(1) (students) t test(1) Accept Spearmans rank/Mann Whitney	2	1	3	3

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