PAG 3 Sampling Techniques: OCR A Level Biology Exam Questions by T

16 questions · 34 marks · about 41 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · information from earlier in the question

6 (a) A group of students were studying a local field, Upper End Meadow. The students sampled plants from this field.

The students' results are given in Table 6.

Species	*n*
Meadow buttercup	6
Common daisy	7
Red clover	3
Ribwort plantain	8

Table 6

(i) Calculate the Simpson's Index of Diversity for Upper End Meadow.

Use the information in Table 6 and the formula:

$$D = 1 - \left(\sum\left(\frac{n}{N}\right)^2\right)$$

n = number of organisms of this species
N = total number of organisms

Show your working. Give your answer to **two significant figures**.

Answer ..... **[3]**

Question 1 · AS Paper 2 · June 2018 · Q6(a)(ii) · 1 mark

(ii) Name a piece of equipment that you could use for the random sampling of the plants shown in Table 6.

..... **[1]**

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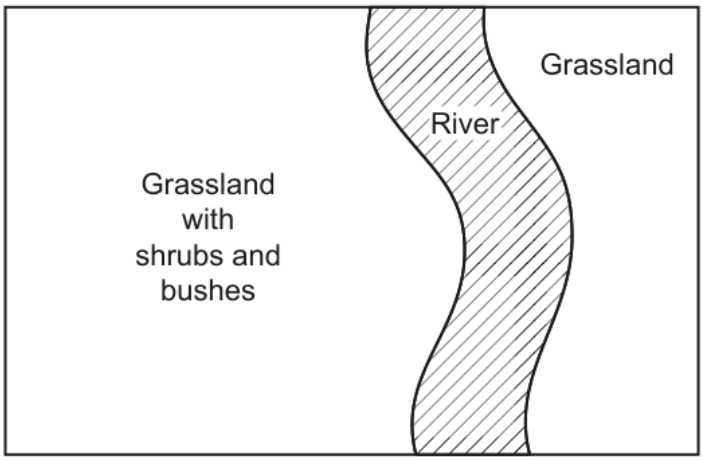
2 Species biodiversity is affected by many factors.

(a) A student plans to sample the plant species in the area shown below to assess the area's species biodiversity.



The student plans to:

- use a random number generator to generate 10 coordinates
- sample at each of the 10 coordinates
- use a point quadrat and an identification key to estimate the percentage cover of each species at each coordinate.

Describe **two** improvements to the student's plan **and** explain why they would be improvements.

Improvement .....

.....

Explanation .....

.....

Improvement .....

.....

Explanation .....

.....

[4]

Turn over

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Question 3 · A level Paper 2 · June 2022 · Q20(a)(i) · 1 mark

20 The abundance and distribution of plants can be surveyed in different ways.

Some students wanted to survey abundance and distribution of plants on a small area of grass outside the school. The area was roughly 20 m × 20 m in size.

They used the following method:

1 Lay two 20 m tape measures at right angles starting in the south east corner of the grass area.
2 Use a random number generator to select *x* and *y* coordinates.
3 While facing north, place the left-hand corner of a quadrat on the point where the coordinates meet.
4 Identify the species present in the quadrat using a key.
5 Count the number of each species present.
6 Record the information in a table.
7 Generate a new set of coordinates and repeat steps 2 to 6 until 10 quadrats have been sampled.

(a) The teacher said that this method would not allow the students to measure the distribution of plant species.

(i) Suggest an improvement to the method that would allow the distribution of plants to be measured.

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..... **[1]**

Question 4 · A level Paper 2 · June 2022 · Q20(a)(ii) · 2 marks

(ii) Identify a limitation with step 3 of the students' method and explain why this limitation might affect the data collected.

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.....

.....

..... **[2]**

Question 5 · AS Paper 2 · June 2024 · Q1(a)(i) · 1 mark

1

(a) Students used a transect line to sample species of wildflowers in a field.

(i) Name the type of sampling method used in a transect line.

..... **[1]**

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Question 6 · information from earlier in the question

(c) Habitat B was situated beside a lake and showed evidence of ecological succession.

The scientist planned to investigate how the biodiversity changed from the edge of the lake to the other side of habitat B.

(i) State the collective name of the animal and plant populations that are present at the end of primary succession.

..... **[1]**

Question 6 · A level Paper 3 · June 2018 · Q5(c)(ii) · 3 marks

(ii) Suggest how the scientist could achieve the following during their investigation:

Sample all stages of succession in the habitat .....

.....

Minimise sampling bias .....

.....

Sample insect biodiversity .....

.....

[3]

Question 7 · AS Paper 2 · November 2021 · Q5(a)(i) · 3 marks

5 **(a)** A group of students were studying invertebrate biodiversity in **two** areas of local woodland, **Area A** and **Area B**. They used pitfall traps to sample the two areas.

(i) Explain how a pitfall trap can be set up and used to sample invertebrate biodiversity.

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..... **[3]**

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Question 8 · AS Paper 2 · June 2024 · Q1(b) · 1 mark

(b) The students then used a sweep net to sample animals in two different parts of a river.

They did this by holding the sweep net in the water and at the same time kicking the riverbed downstream.

Suggest how they could improve their sampling method to obtain more valid results.

.....

..... **[1]**

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(c) Some students investigate the biodiversity of flying insect species in different parts of their school grounds.

The school has an area of wildflower meadow and some planted flower beds.

This is the method they use:

1. Select an area of wildflower meadow.
2. Pass a sweep net back and forward 5 times.
3. Shake the net into a tray and close with a transparent lid.
4. Use a key to identify the types of insect.
5. Release insects.
6. Repeat the procedure 9 times in different areas of the wildflower meadow.
7. On the same day, repeat steps 1 to 6 for the planted flower beds.

Their results for the wildflower meadow are shown in the table below.

Category	**Number of individuals**		
Bumblebees	15		
Other bees	32		
Ladybirds	2		
Other beetles	5		
Painted lady butterfly	2		
Red admiral butterfly	3		
Other butterflies	5		
Wasps	25		
Flies	11		
Total			

(i) Calculate the Simpson's Index of Diversity for the wildflower meadow.

Use the formula: $D = 1 - \left(\sum\left(\frac{n}{N}\right)^2\right)$

You may use the table above for working out.

Give your answer to **2** significant figures.

D = ... **[3]**

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Question 9 · A level Paper 2 · June 2025 · Q18(c)(iii) · 2 marks

(iii) Describe how the students should select their sampling areas for steps **1** and **6**.

.....

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.....

.....

..... **[2]**

Question 10 · A level Paper 2 · June 2025 · Q18(c)(iv) · 4 marks

(iv) Suggest **two** improvements that the students could make to step **2** of their method. For each improvement explain how that would increase the validity of the results.

Improvement 1 .....

.....

Explanation 1 .....

.....

Improvement 2 .....

.....

Explanation 2 .....

.....

[4]

Turn over

Question 11 · A level Paper 2 · June 2025 · Q18(c)(v) · 2 marks

(v) Suggest and explain **one** limitation with step **7** of the students' method.

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.....

.....

..... **[2]**

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Question 12 · A level Paper 2 · June 2022 · Q20(c)(i) · 1 mark

(c) On a biology field trip, the same students surveyed a large area of heather moorland.

On this occasion they did not use quadrats.

Pairs of students were each assigned a large area of moorland. They rated the abundance of plant species using the following scale:

A = Abundant

C = Common

F = Frequent

O = Occasional

R = Rare

One reason the use of quadrats was inappropriate was that many moorland plants are too large to fit in the quadrat.

(i) Suggest **one** other advantage of using an ACFOR rating scale for the students' survey.

.....

..... **[1]**

Question 13 · A level Paper 2 · June 2022 · Q20(c)(ii) · 1 mark

(ii) Suggest **one** limitation of using an ACFOR rating scale, instead of quadrat sampling, to rate the abundance of plant species.

.....

..... **[1]**

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Question 14 · AS Paper 1 · June 2018 · Q25(d)(ii) · 3 marks

(ii) For this investigation, the students randomly selected leaves from ten downy birch trees at varying distances from the river.

Suggest **three** ways in which the students could improve the validity of their sampling method.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

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Question 15 · information from earlier in the question

20 On a biology field trip, some students are studying an area of mixed woodland.

(a) Three tree species dominate the woodland: oak, ash and sycamore.

There are many small herbaceous plants in the woodland, but the students choose to collect data on only one: wood sorrel.

The students choose an oak tree, an ash tree and a sycamore tree and count every individual wood sorrel plant within a 3 m radius of each tree.

The results are shown in the table.

Species	**Wood sorrel population (total within 3 m radius)**					
Ash	44					
Oak	56					
Sycamore	20					

The null hypothesis of the students' investigation is that the species of tree would not affect the number of wood sorrel growing near it.

The students conclude that the conditions under oak trees are the most favourable of the three trees studied and that conditions under sycamore trees are the least favourable.

(i) Calculate the χ^2 value for the students' data.

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

You may use the empty columns in the table to help with your calculation.

χ^2 = ... **[3]**

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Question 15 · A level Paper 2 · June 2024 · Q20(a)(iii) · 2 marks

(iii) The teacher suggested that, in order to have confidence in their results, the students should include data from more than one tree for each species.

The students collect all their results on the same day.

Identify **two** other variables the students should attempt to control when carrying out an investigation such as this.

1 .....

.....

2 .....

.....

[2]

Turn over

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(c) Many schools visit the Lake District to undertake Biology fieldwork.

A group of students investigated the biodiversity of five herb plants they found in adjacent coppiced and mature areas of woodland in the spring of 2016.

Their results are shown in Table 18.

	Number of individuals (n)	
Species	**Coppiced**	**Mature**
Bluebell	35	46
Dog's mercury	2	12
Foxglove	5	1
Herb robert	20	4
Wood sorrel	8	4
Total	70	67

Table 18

(i) The students calculated the Simpson's Index of Diversity (D) for the mature area to be 0.489.

Use the information in Table 18 to work out the Simpson's Index of Diversity (D) for the area of coppiced woodland.

Use the formula: $D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$

D = ... **[3]**

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Mark schemes

Question 1 · AS Paper 2 · June 2018 · Q6(a)(ii) · 1 mark

6(a)(ii)	(point / frame) quadrat(s) ✓	1

Additional incorrect answer = 0 marks
IGNORE random number, generator / calculator

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Question 2 · A level Paper 3 · June 2024 · Q2(a) · 4 marks

2	(a)	I: large(r) sample size / AW ✓ E: more representative / better representation (of populations / area) / AW ✓ I: stratified sampling / described ✓ E: avoids missing, species / populations (in different areas / in river / on one side of river) ✓
	Question	**Answer**
		I: use frame quadrat (rather than point quadrat) / described ✓ E: less likely to miss (rare) species **or** easier to measure, tall plants / shrubs / bushes **or** less likely to harm small animals **or** more representative / better representation (of population / area) / AW ✓ I: use (a number of) transects (from bank into grassland) E: more representative of population / AW **or** less likely to miss (rare) species ✓ I: ref to sampling at different times of the year E: more representative of population / AW **or** less likely to miss species (growing at different times of the year) ✓
	Question	**Answer**
4 max	***Only award Explanation mark if linked to correct Improvement*** e.g. 'generate more (than 10) coordinates' e.g. 'carry out study twice (in grassland/shrubs/bushes and grassland)'	

Question 3 · A level Paper 2 · June 2022 · Q20(a)(i) · 1 mark

20	(a)	(i)	(description of) systematic sampling / transect ✓	1	1.2	**IGNORE** stratified

Question 4 · A level Paper 2 · June 2022 · Q20(a)(ii) · 2 marks

(ii)	(placement could be) not accurate / biased ✓ position of coordinates difficult to judge ✓ method does not specify top (left) or bottom (left) ✓	**2 max**	3.4

Question 5 · AS Paper 2 · June 2024 · Q1(a)(i) · 1 mark

1	(a)	(i)	non-random / systematic ✓	1

Question 6 · A level Paper 3 · June 2018 · Q5(c)(ii) · 3 marks

ii	belt / line, transect / described **or** stratified sampling / described ✓ random selection of transect sites	3
	or systematic sampling / place quadrats at, set / pre-determined, intervals along the transect **or** random sampling using quadrats in, selected areas / strata ✓ pooter / sweep nets / pitfall traps / light traps / tree-beating ✓	

e.g. ' lay tape from edge of lake and sample along it'

(N.B. only allow random sampling in context of stratified sampling)

ALLOW any suitable method of trapping insects

IGNORE capture mark recapture

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Question 7 · AS Paper 2 · November 2021 · Q5(a)(i) · 3 marks

5	(a)	(i)	*any three from:* dig hole and place container in soil ✓ make top of container level with soil level ✓ cover to protect from, rain / scavengers ✓ leave overnight ✓ identify / count, (named) invertebrates ✓ sample both areas, randomly / at 5(+) sites ✓	**3 max**	AO1.1

Question 8 · AS Paper 2 · June 2024 · Q1(b) · 1 mark

(b)	**1** (in both areas kick for) same number of times ✓ **2** same, kicking method used / depth of sweep net ✓ **3** sweep net is, downstream of student kicking / facing upstream ✓

max 1	**e.g**. kick sampling for 5 minutes in each part of river **e.g.** heel of foot kicking (in the direction of the net) / kick with same force / same person does the kicking

Question 9 · A level Paper 2 · June 2025 · Q18(c)(iii) · 2 marks

Question			Answer
18	(c)	(iii)	set up grid / lay out two tape measures at right angles to each other / AW ✓ use random coordinates ✓

Mark	AO	Guidance
2	3.4	**DO NOT ALLOW** systematic sampling / transects / stratified sampling **ALLOW** lines / string as AW for tape measures **ALLOW** annotated diagram **IGNORE** throwing quadrats

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Question 10 · A level Paper 2 · June 2025 · Q18(c)(iv) · 4 marks

18	**(c)**	**(iv)**	***AWARD** marks for each improvement and its matching explanation* *Improvements* **A** control height (of sweep / net) ✓ **B** control / increase , breadth (of sweep) ✓ **C** control / increase , speed (of sweep) ✓ **D** more sweeps ✓ *Explanations (much match an intended limitation)* **A** different insects could be found at different heights (above ground / vegetation) / AW ✓ **B** wider / different (breadth), sweep likely to capture more / different , insects / ora ✓ **C** more / different, insects caught by, fast / different speed, sweep ✓ **D** some / more / different, insects caught ✓	**4 max**	**3.4**	*Mark as prose (ignore prompt lines)* If controlling height (**A**) / breadth (**B**) / speed (**C**) , **also** allow **1 mark max.** for explanation of a standardised approach, e.g. results , are comparable / representative / standardised / repeatable (between areas) **IGNORE** reproducible **ALLOW** intensity / power / AW **ALLOW** fast sweep *e.g.* *people that sweep nets should be of same height (NBOD for improvement A) ; but can still be awarded explanation A* **ALLOW** insects less likely to escape

Question 11 · A level Paper 2 · June 2025 · Q18(c)(v) · 2 marks

18	**(c)**	**(v)**	**1** time of day not specified ✓ **2** (named) conditions vary at different times of the day ✓ **3** different insects are , more active / present , at certain times of the day / in different conditions ✓ **4** sampling **only** carried out on one day (in a year) ✓ **5** different insects are , more active / present , at certain times of the year / AW ✓	**2 max**	**3.3**	**ALLOW** sampling might be in morning and / or evening **ALLOW** *idea of* no fixed range of times for each site **ALLOW** readings should be taken at the same time (of the day) **ALLOW** named factor, e.g. light intensity, wind speed, temperature, rainfall, weather, availability of nectar **ALLOW** more / fewer AW for different **ALLOW** should be carried out on different days **ALLOW** more / fewer AW for different

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Question 12 · A level Paper 2 · June 2022 · Q20(c)(i) · 1 mark

(c)	**(i)**	quick(er) ✓ wide(r) area can be surveyed ✓	**1 max**

3.4	**IGNORE** easier **ALLOW** description of why it might be quicker

Question 13 · A level Paper 2 · June 2022 · Q20(c)(ii) · 1 mark

(ii)	subjective / uses judgement ✓ misses , small(er) / non-flowering , plants ✓	**1 max**

3.4	**ALLOW** opinion **IGNORE** qualitative / (not) quantitative / inaccurate / imprecise / not random / biased **ALLOW** overestimates abundance of large plants

Question 14 · AS Paper 1 · June 2018 · Q25(d)(ii) · 3 marks

	(ii)	same / similar, size / age, trees ✓ same / similar, size / age, leaves ✓ repeated leaves from each tree **and** calculate mean ✓ record results at same, time of year / day ✓ ensure leaves selected are from, same side / same height / evenly distributed around tree ✓ systematic sampling / sample at set distances (from river) / described ✓	3 max

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Question 15 · A level Paper 2 · June 2024 · Q20(a)(iii) · 2 marks

20	**(a)**	**(iii)**	age / size / height , of tree ✓ gradient (of ground) ✓ density / AW , of surrounding trees ✓ *idea of* direction of sunlight ✓	**2 max**

3.3 **Element**	**ALLOW** shading from adjacent trees **IGNORE** light intensity unqualified **ALLOW** e.g., whether they are all on the same side of a hill **IGNORE** presence of other species **IGNORE** all other variables

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Question 16 · A level Paper 2 · June 2019 · Q18(c)(i) · 3 marks

(c)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.648 or 0.649 award 3 marks** ✓✓✓ *If answer is incorrect* **ALLOW** *2 marks max for…* (some) correct values for n/N and $(n/N)^2$ ✓ $\Sigma(n/N)^2 = 0.350$ or 0.351 ✓✓ 1 - calculated $\Sigma(n/N)^2$ to 3 s.f. ✓	3
		0.65 ✓✓	

IGNORE s.f. in working

ALLOW 3 correct in each column

n/N	$(n/N)^2$
0.500	0.250
0.029	0.001
0.071	0.005
0.286	0.082
0.114	0.013

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