



6: The diversity of life – Topic questions

The questions in this document have been compiled from past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
8	2017	May/June	41
8	2017	May/June	42
5	2016	May/June	41

The mark scheme for each question is provided at the end of the document.

- 8 There is considerable variation in the ecosystems that occur in the continent of North America. These include coniferous forest, prairie grassland, scrub and desert. Large areas of land that once contained natural ecosystems are now used for agriculture.

(a) Explain how the variation in ecosystems in North America contributes to biodiversity.

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- (b) The diversity of some beetle species that feed on animal dung (faeces) was investigated at two types of grassland site in North America. The first type of grassland site was grazed by cattle and the second type of site was not grazed.

Dung beetles were collected, identified and counted from two areas of the same total size. Some of the results are shown in Table 8.1.

Table 8.1

beetle species	number of dung beetles on grassland grazed by cattle	number of dung beetles on grassland not grazed
<i>Onthophagus pennsylvanicus</i>	4267	6641
<i>Canthon ebenus</i>	2005	774
<i>Canthon pilularius</i>	353	108
<i>Onthophagus hecate</i>	218	85
total	6843	7608

- (i) State the null hypothesis for a statistical test comparing the data from the two types of site.

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 [1]

- (ii) State how many genera and how many species of beetle are shown in Table 8.1.

genera species [1]

- (iii) Simpson's Index of Diversity for the beetles on the grassland grazed by cattle was calculated as 0.521 using the formula:

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

n = number of individuals of each species present in the sample
 N = the total number of all individuals of all species

Calculate Simpson's Index of Diversity for the beetles on the grassland that was not grazed. Complete Table 8.2 to show your working. Show all working to **three** decimal places. Write your final answer on the dotted line.

Table 8.2

species	number on grassland not grazed	$\frac{n}{N}$	$\left(\frac{n}{N} \right)^2$
<i>Onthophagus pennsylvanicus</i>	6641		
<i>Canthon ebenus</i>	774		
<i>Canthon pilularius</i>	108		
<i>Onthophagus hecate</i>	85		
total	7608		

Simpson's Index of Diversity = [3]

- (iv) Describe what the results in Table 8.1 **and** both figures for Simpson's Index of Diversity show about the effect of grazing on the diversity of dung beetles.

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 [2]

[Total: 11]

8 An investigation was carried out in a temperate woodland that contained a number of areas with two different types of ground cover vegetation.

- On higher ground where the soil was drier, the dominant ground cover plant was bracken, *Pteridium aquilinum*.
- On lower ground where the soil was wetter, the dominant ground cover plant was bramble, *Rubus fruticosus*.

(a) Describe how the abundance of the two plant species at higher and lower ground sites could be measured.

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[Turn over

- (b) Soil from under bracken and under brambles was collected and placed in two funnels. A bright light was placed over each funnel so that small invertebrate animals moved down the funnels and were collected in two collecting vessels.

The main groups of invertebrates present were identified and counted. Some of the results are shown in Table 8.1.

Table 8.1

invertebrate group	number present in soil under bracken	number present in soil under brambles
pseudoscorpion	49	21
wireworm	22	12
gamasid mite	18	7
springtail	10	1
total	99	41

- (i) It was not possible to identify the invertebrates as far as genus or species level, and only the wireworm group could be classified as far as the taxonomic level **above** genus.

Name the taxonomic level represented by the wireworm group.

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- (ii) State the null hypothesis for a statistical test comparing the data from the two types of site.

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 [1]

- (iii) Simpson's Index of Diversity for invertebrates from the soil under bracken was calculated as 0.663 using the formula:

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

n = number of individuals of each species present in the sample

N = the total number of all individuals of all species.

Calculate Simpson's Index of Diversity for the invertebrates from the soil under brambles. Complete Table 8.2 and use the space provided to show your working. Show all working to **three** decimal places. Write your final answer on the dotted line.

Table 8.2

animal taxon	number present in soil under brambles	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$
pseudoscorpion	21		
wireworm	12		
gamasid mite	7		
springtail	1		
total	41		

Simpson's Index of Diversity = [3]

- (iv) Describe what Table 8.1 and the calculated figures for Simpson's Index of Diversity show about the effect of bracken and bramble vegetation cover on the diversity and abundance of soil invertebrates in the woodland.

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[Turn over]

..... [2]

[Total: 11]

- 5 Fig. 5.1 shows a water vole, *Arvicola amphibius*. This species is native to Great Britain.



Fig. 5.1

The numbers of water voles are estimated to have fallen by 94% in the last century.

This is thought to be due to habitat fragmentation and also to extensive predation by mink, *Neovison vison*, shown in Fig. 5.2. Mink originated in North America but were brought to Great Britain for fur farming. Some escaped or were released into the wild, where their numbers rapidly increased.



Fig. 5.2

- (a) Name **and** describe a method for estimating the abundance of water voles in a local area.

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- (b) Both water voles and mink are classified as class Mammalia, phylum Chordata, kingdom Animalia.

Outline two features of the **cells** of members of the kingdom Animalia that distinguish them from the cells of other multicellular eukaryotes.

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- 2
- [2]

- (c) (i) Discuss the reasons why alien species should be controlled.

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- (ii) Suggest **one** way of controlling mink numbers in Great Britain.

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[Total: 10]

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
<u>underline</u>	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	alternative valid point

Paper 41

Question	Answer	Marks
8(a)	<p><i>max 4 of:</i></p> <p>1 different <u>habitats</u> ;</p> <p>2 different <u>niches</u> ;</p> <p>3 many (different) <u>species</u> / large variety of <u>species</u> ;</p> <p>4 <i>ref. to</i> (much) genetic diversity within a species ;</p> <p>5 different <u>selection</u> pressures ;</p> <p>6 <i>ref. to</i> <u>adaptation</u> ;</p> <p>7 different, climate / rainfall / temperature / soil / topography / conditions ;</p>	4
8(b)(i)	both sites are the same / no (significant) difference between two sites ;	1
8(b)(ii)	<i>genera</i> 2 and <i>species</i> 4 ;	1

Question	Answer	Marks																								
8(b)(iii)	<p><i>all figures to 3 d.p. to score but only penalise extra d.p. or rounding error associated with extra d.p. once</i></p> <table><tr><th>species</th><th>number on grassland not grazed</th><th>n / N</th><th>$(n / N)^2$</th></tr><tr><td><i>Onthophagus pennsylvanicus</i></td><td>6641</td><td><u>0.873</u></td><td>0.762</td></tr><tr><td><i>Canthon ebenus</i></td><td>774</td><td><u>0.102</u></td><td>0.010</td></tr><tr><td><i>Canthon pilularius</i></td><td>108</td><td><u>0.014</u></td><td>0.000</td></tr><tr><td><i>Onthophagus hecate</i></td><td>85</td><td><u>0.011</u></td><td>0.000</td></tr><tr><td>total</td><td>7608</td><td></td><td>0.772</td></tr></table> <p>n / N figures correct / numbers of each species divided by total ;</p> <p>$(n / N)^2$ calculated and added up ; ecf from incorrect column 1 including figures with fewer / more than 3 d.p.</p> <p>0.228 ; ecf total figure subtracted from 1</p>	species	number on grassland not grazed	n / N	$(n / N)^2$	<i>Onthophagus pennsylvanicus</i>	6641	<u>0.873</u>	0.762	<i>Canthon ebenus</i>	774	<u>0.102</u>	0.010	<i>Canthon pilularius</i>	108	<u>0.014</u>	0.000	<i>Onthophagus hecate</i>	85	<u>0.011</u>	0.000	total	7608		0.772	3
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8(b)(iv)	<p>greater species <u>evenness</u> on grazed grassland ; ora A mostly, one species / <i>O. pennsylvanicus</i>, on not grazed</p> <p>grazing increases (dung beetle species) (bio)<u>diversity</u> ; ora</p> <p><i>if opposite conclusion reached check answer for (iii) and apply ecf for mp2 if $D > 0.521$</i></p>	2																								
		Total: 11																								

Question	Answer	Marks																								
8(a)	<div>1. <u>random sampling</u> ;</div> <div>2. (using) random number generator for coordinates ;</div> <div>3. in both sites ;</div> <div>4. measure, percentage cover / (Braun-Blanquet / ACFOR) scale cover ;</div> <div>5. using (square frame) quadrats ;</div> <div>6. repeat sampling ;</div>	max 4																								
8(b)(i)	family / sub-family ;	1																								
8(b)(ii)	that there is no significant difference (between the two sites) ;	1																								
8(b)(iii)	<table><tr><th>animal taxon</th><th>number present in soil under brambles</th><th>$\frac{n}{N}$</th><th>$(n/N)^2$</th></tr><tr><td>pseudoscorpion</td><td>21</td><td>0.512</td><td>0.262</td></tr><tr><td>wireworm</td><td>12</td><td>0.293</td><td>0.086</td></tr><tr><td>gamasid mite</td><td>7</td><td>0.171</td><td>0.029</td></tr><tr><td>springtail</td><td>1</td><td>0.024</td><td>0.001</td></tr><tr><td>total</td><td>41</td><td></td><td>0.378</td></tr></table> <div>n / N figures correct or numbers of each species divided by total ;</div> <div>$(n / N)^2$ calculated and added up ;</div> <div>total figure subtracted from 1 / 1 – 0.378 = 0.622 ; ecf</div>	animal taxon	number present in soil under brambles	$\frac{n}{N}$	$(n/N)^2$	pseudoscorpion	21	0.512	0.262	wireworm	12	0.293	0.086	gamasid mite	7	0.171	0.029	springtail	1	0.024	0.001	total	41		0.378	3
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Question	Answer	Marks
8(b)(iv)	<p>apply ecf from (iii) if <i>D</i> is very different to 0.663/ 0.622</p> <ol style="list-style-type: none"> bracken and bramble / both sites, have similar Simpson's Index of Diversity (<i>D</i>) numbers ; or bracken and bramble / type of vegetation, has little effect on soil organism diversity ; soil organisms more abundant under bracken ; ora 	2
		Total: 11

Question	Answer	Marks
5(a)	<ol style="list-style-type: none"> mark-release-recapture / AW ; A catch, mark, return, catch A mark-and-recapture <i>description (max 3)</i> <ol style="list-style-type: none"> detail of trapping ; e.g. Longworth / Sherman / live / small mammal detail of marking ; e.g. felt tip pen / clipping fur / not to have adverse effects detail of timing of second trapping ; e.g. not too soon or mixing will not occur / not too long after as migration may occur / after 24 hours / 1 day (any number of days up to two weeks) detail of calculation ; e.g. Lincoln Index / Petersen index or <u>number marked time 1</u> \times <u>no. captured time 2</u> / number of marked individuals recaptured time 2 A symbols in equation if key is given 	[max 4]
5 (b)	<p>glycogen ; centrioles / centrosomes ; (may have) cilia / flagella / microvilli ; no cell wall ; no, large / central / permanent, vacuole ; A no tonoplast</p>	[max 2]

Question	Answer	Marks
5(c)(i)	1 reduce, other organisms' abundance/biodiversity ; A endanger, rare species/water voles A causes extinction 2 alter food, chains/webs ; 3 due to predation ; 4 due to competition ; 5 due to spreading disease ; 6 may change habitat ; e.g. create shade, change soil pH 7 may be toxic/threaten human health ;	[max 3]
5(c)(ii)	culling/hunting/trapping ; contraceptive measures ; biological control disease agent ; I introduce new mink-eating predator I biological control alone	[max 1]
		Total: 10