Question			Expected Answers	Mark	Additional Guidance
1	(a)		spread over wider area / more widespread / bigger range / AW **;**	1	**ACCEPT** geographical description, e.g. **'**they now live in the South / Wales also' but answer must imply that they still live in previously occupied areas **IGNORE** *idea of* higher numbers **IGNORE** bigger / more without further qualification
1	(b)	(i)	impossible / difficult , to count every individual **;** sample provides an estimate **;** sample representative (of whole area) **;**	2 max	**ACCEPT** *idea that* counting every individual is too time consuming
1	(b)	(ii)	to compare (the two areas) ; (presence or absence of) roe deer is independent variable **;** *idea of* controlling variables other than roe deer **;**	1 max	**ACCEPT** one area acts as a control **ACCEPT** to see the effect of the roe deer
1	(b)	(iii)	**1** (species) richness is number of species (in a habitat) **;** **2** (species) evenness is , abundance / number of individuals of , each / every / all , species (in a habitat) **;** **3** *idea that* both (richness and evenness) are needed to reveal dominance **;** **4** *idea that* high biodiversity associated with high species richness **and** high species evenness **;**	3 max	**IGNORE** amount **ACCEPT** 'how many' as AW for 'number' **ACCEPT** evenness is relative , numbers / abundance , of (each) species **IGNORE** number of individuals of , a / the / one , species

Question			Expected Answers	Mark	Additional Guidance
1	**(b)**	**(iv)**	plants are , the basis / AW , of (all) food chains **;** shrubs / plants , are food for , insects / animals , that birds eat **;** *idea that* shrubs might provide , nesting sites / cover / protection / habitat **;**	**1 max**	 **IGNORE** birds eat , shrubs / seeds / fruit **IGNORE** 'fewer insects' without reason for fewer insects **AWARD** in the context of birds, or animals that birds eat **IGNORE** home
	(b)	**(v)**	(habitat) dominated by, one / few / AW, species **;** ecosystem / habitat , is , unstable / less likely to cope with change **;**	**2**	**ACCEPT** high number of one species **IGNORE** area / environment **ACCEPT** in the context of an example of environmental change **ACCEPT** a change in one species with have a large effect on the , ecosystem / habitat / food chain
1	**(c)**	**(i)**	*idea of* danger to , humans / local wildlife / domestic animals / deer **;** environment may no longer be suitable for lynx / AW **;**	**1**	**ACCEPT** *idea of* danger to existing food chains **IGNORE** could become a pest **IGNORE** dangerous without further qualification **IGNORE** competition

Question			Expected Answers	Mark	Additional Guidance
1	(c)	(ii)	**1** (phylogeny is) the evolutionary , relationship between / history of , organisms / species **;** **2** phylogeny is the basis of classification ; **3** example of molecular evidence used to classify **;** **4** species / organisms , within the same group have shared , phylogeny / evolutionary history / common ancestor **; ora** **5** *idea that* phylogeny of *L. lynx* and *L. pardinus* are sufficiently , different to have been placed in separate species / similar to have been placed in same genus **;**	**4 max**	**1 ACCEPT** reasonable description of evolutionary , history / relationship, e.g. changes in ancestral organisms **2** Must be a clear statement **3 ACCEPT** base sequence / amino acid sequence / DNA / cytochrome C / haemoglobin / ATPase (used to classify)
1	(c)	(iii)	modern / new / better , technology (to distinguish between closely related species) **;** more , molecular / biochemical / DNA / genetic , evidence **;**	**1**	**ACCEPT** named example, e.g. DNA sequencing

Question			Expected Answers	Mark	Additional Guidance
1	(c)	(iv)	**1** *idea of* impact on food chain(s) **;** **2** *idea of* right to exist / duty of humans to care for other species / ethical reason / preserving species for future generations **;** **3** *idea of* aesthetic reason **;** **4** economic reason / tourism / might provide useful resource **;**	**3max**	**1 ACCEPT** controlling deer population **1 ACCEPT** top carnivore / top predator / keystone species / it might compete with existing species **1 IGNORE** other species might die **2 IGNORE** 'playing God' **2 IGNORE** refs to poaching / hunting **3 ACCEPT** beautiful creatures / nice to look at / AW
			Total	**[19]**	

Question			Answer	Mark	Guidance
2	(a)		Nymphaea **;**	1	**NOTE**: the first letter must clearly be in upper case and the others in lower case and the spelling correct
2	(b)		**1** (natural) habitat / ecosystem , lost due to / destroyed by **/** under threat from , climate change / (named) human activity **;** **2** number / population , (in natural habitat) is very low **;** **3** *idea that* in the wild, (sexual) reproduction is difficult (if numbers are low) **; ora** **4** (breeding *ex situ* can) maintain , the gene pool / genetic / allelic , diversity**; ora** **5** *idea that* allows protection from **,** grazers / herbivores / plant collectors / competing species **; ora** **6** *idea of* protection from **,** pathogen / parasites / disease **; ora**	3 max	**IGNORE** can be in optimum conditions throughout **1** The essence of this marking point is habitat loss plus reason. Award tick when both these ideas have been seen. **1 ACCEPT** natural disaster / deforestation , as reason for habitat loss **2 IGNORE** reference to , extinct / endangered **3 ACCEPT** e.g. fertilization can be carried out using a paintbrush **5 ACCEPT** habitat contains organisms that are a threat **5 ACCEPT** protection from , predators / poachers / hunters **6 ACCEPT** pests

Question			Answer	Mark	Guidance
2	(c)		**1** can be collected with minimal damage to (wild) , population / habitat / ecosystem ; **2** take up little space / larger numbers can be stored **;** **ora** **3** can store great(er) , genetic / allelic , diversity **; ora** **4** low(er) maintenance / manpower costs / AW **; ora** **5** easy / cheaper, to transport / AW **; ora** **6** *idea of* remaining viable for long periods **; ora** **7** less , susceptible / vulnerable , to, disease / pests / environmental change **; ora** **8** *idea that* prevents fertilisation by undesired pollen **;**	3 max	**Mark as prose. Ignore numbered lines**. **2 ACCEPT** easier to store a large amount **4 CREDIT** 'cheaper' only if supported by an explanation **4 IGNORE** easier to keep unqualified **4 ACCEPT** less labour-intensive **4 DO NOT CREDIT** no maintenance costs **6 CREDIT** description / example – e.g. kept dry so that they do not rot / regular germination and new seed production **6 IGNORE** 'last a long time' unqualified **6 ACCEPT** 'stay , alive / fertile , for a long time' **7 ACCEPT** the adult plant might have a disease **7 IGNORE** prevents

Question			Answer	Mark	Guidance
2	(d)		**1** (use of) quadrat **;**	4 max	**1 ACCEPT** description of a quadrat / point frame **1 IGNORE** quadrant
					AWARD either a or b *for both marking points* ***2*** *and* ***3****. Do not mix a and b marks. If both a and b marks are present ignore the lower scoring letter.*
			2a random (sampling) **;**		**2a ACCEPT** bits of paper in a hat / random number generator **2a DO NOT CREDIT** throw
			3a placing measuring tapes (at right angles) / use grid **;** **OR**		**3a ACCEPT** e.g. bottom left hand corner of quadrat placed at coordinate / two students walk in a straight line from each tape measure
			2b (use of) transect **;** **3b** (quadrat / point frame) placed at regular intervals **;**		**3b ACCEPT** systematic sampling
			4 (use of identification) key **;**		
			5 example / detail , of method used to determine abundance **;**		**5 ACCEPT** percentage cover / percentage frequency / number of hits with point frame / ACFOR **5 ACCEPT** strategy for dealing with plants half in or out of quadrat **5 IGNORE** 'count' without further clarification
			6 repeat many times / *idea of* considering appropriate number of samples **;**		**6 ACCEPT** calculate running mean **6 IGNORE** several / a few **6** If number state must be at least 5
			7 sample / AW , at different , seasons / times of year **;**		**7 ACCEPT** throughout the year

Question			Answer	Mark	Guidance
2	(e)			3 max	**IGNORE** prompt lines and mark as prose
			1 reason for not having found all species ;		**1 ACCEPT** e.g. some (named) habitats inaccessible / microscopic species missed / low numbers of individuals / habitat unexplored / some habitats rare / species are nocturnal
			2 may have become extinct , recently / since recording **;**		**2 ACCEPT** organisms constantly become extinct
			3 evolution is on-going / new species are being formed / AW **;**		**3 ACCEPT** new species are being created
			4 *idea that* some (species) difficult to distinguish / some species may be reclassified / AW **;**		**4 ACCEPT** e.g. might mistake several species for one **4 ACCEPT** scientists might disagree about whether it is a species or not.
			Total	**14**	

Question			Expected Answer	Mark	Additional Guidance
3	(a)				**Award** 1 mark for each correct row **DO NOT CREDIT** if more than one letter in a box

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)	
contains thymine	**D**	
contains ribose	**R**	;
consists of 2 chains connected to each other with hydrogen bonds	**D**	;
has a sugar-phosphate backbone	**B**	;
has 4 different nitrogenous bases	**B**	;
contains a pentose sugar	**B**	;
is found in the nucleus and cytoplasm	**R**	;

6

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(i)			
		1	(information used to) decide which, group / taxon, organism / species / named example, fits in **;**		**1** answers must refer to the information provided by the study of DNA, rather than simply the job of taxonomists**,** e.g. **ACCEPT** 'it can be used to put organisms into groups' **1 IGNORE** 'for classification' unqualified – look for idea of: groups **1 CREDIT** ref to belonging to same taxonomic group, e.g. 'to see if it belongs in the genus *Homo*'
		2	compare the proportion of (different) bases **;**		**2 IGNORE** 'examine proportion of bases' **2 CREDIT** idea for looking at similarities / differences
		3	compare the DNA / genes / sequence of bases **;**		**3 IGNORE** 'examine sequence of bases' **3 CREDIT** idea for looking at similarities / differences
		4	*idea of:* the more similar the, DNA / genes, the closer the relationship / AW **;**	**2 max**	**4** Must contain reference to similarity of DNA
3	(b)	(ii)			**Mark the first <u>two</u> suggestions** **IGNORE** ref to genetics as DNA is 'biochemical'
		1	fossil record **;**		
		2	anatomy / physiology / behaviour **;**		**2 ACCEPT** AW for anatomy, e.g. observable / physical features / cell structure **2 ACCEPT** AW for physiology, e.g. method of reproduction
		3	embryology / AW **;**	**2 max**	
3	(c)		**J ;** **T ;**	**2**	**DO NOT CREDIT** names

Question			Expected Answer	Mark	Additional Guidance
3	(d)	(i)			
		1	no DNA from living specimens in Wales analysed ;		
		2	population (may have) evolved / mutations have occurred / genetic variation, (since 1948) ;		**2 ACCEPT** description of evolved **2 DO NOT CREDIT** 'evolution' unqualified by context of pine marten population
				1 max	
3	(d)	(ii)			**ACCEPT** animals as AW for pine martens throughout answer
		1	(introduced) pine martens might not be adapted to local conditions / AW ;		**1 ACCEPT** not adapted to the habitat **1 DO NOT CREDIT** 'used to'
		2	(local) habitat, might have changed / is no longer suitable (for any pine martens) / AW ;		
		3	introduced, pine martens, might outcompete native, population / pine martens ;		**3 ACCEPT** introduced pine martens might kill native / Welsh pine martens **3 IGNORE** 'compete' unqualified
		4	introduced pine martens might bring disease ;		
		5	Welsh pine marten would lose its, distinctiveness / identity, because of interbreeding ;		
				1 max	
			Total	**14**	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	1	biodiversity (of heathland) ;		
		2	rare / endangered, species / plants / animals / fungi / organisms / named organism ;		
		3	rarity of (this) habitat ;		
		4	example of current *legal* status ;		***4*** e.g. National Park / SSSI / protected species / National Nature Reserves / NNR / other *legal* example
		5	(likely) reduction in size of, habitat / ecosystem / heathland ;		***5*** **IGNORE** 'habitat destruction' alone. Must refer to extent or size of destruction.
		6	effect of reduced size on viability (of whole ecosystem) ;		
		7	effect on, movement / spread, of, species / named species / plants / animals ;		***7*** **CREDIT** effect on wildlife corridors Answers could refer to limiting species spread or introduction of species
		8	a method of minimizing impact / AW / named example ;		***8*** e.g. 'toad tunnels' / relocation of population 'build toad tunnels so that the toads can still move between the two areas of heathland' = 2 marks (mps 7 and 8)
				3 max	
4	(b)	(i)			
		1	*idea of* (collect in) different / wider, area ;		***1*** **ALLOW** several transects e.g. another path
		2	(collect at) different, times of day / times of year / weather conditions ;		
		3	use of named, collecting / identifying, technique ;		***3*** e.g. (sweep) net / photographs / feeding stations **IGNORE** pooter (as could only catch larvae) / light trap / use of key / single transect
		4	method of ensuring that individuals not counted again ;		***4*** This mark refers to an initial or the only sample – it is **not** linked to mp 5
		5	mark-release-recapture / capture-recapture, technique ;		***5*** **CREDIT** count marked individuals in 2nd sample / population = $\frac{\text{no. in 1st sample x no. in 2nd sample}}{\text{no. retrapped in 2nd sample}}$
				3 max	

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(b)</td><td>(ii)</td><td>
<table>
<tr><th>species</th><th>n</th><th>n/N</th><th>$(n/N)^2$</th></tr>
<tr><td>Grayling (Hipparchia semele)</td><td></td><td></td><td></td></tr>
<tr><td>Large Heath (Coenonympha tullia)</td><td></td><td><u>0.3548</u></td><td></td></tr>
<tr><td>Gatekeeper (Pyronia tythonus)</td><td></td><td></td><td></td></tr>
<tr><td>Green Hairstreak (Callophrys rubi)</td><td></td><td></td><td></td></tr>
<tr><td>Silver-studded Blue (Plebeius argus)</td><td></td><td></td><td></td></tr>
<tr><td>Small Heath (Coenonympha phamhylus)</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Sum (Σ)</td><td>0.31633 OR 0.31217</td></tr>
<tr><td></td><td></td><td>1 - Σ</td><td>D = 0.68367 OR 0.68783</td></tr>
</table>
;
;
;
</td><td>3</td><td>Original table on question paper had incorrect figure in $(n/N)^2$ column for Grayling row. Answers for mps 2 & 3 take this into account.

ACCEPT ecf from incorrect answer for Σ (whether decimal places or rounding)</td></tr>
<tr><td>4</td><td>(b)</td><td>(iii)

1

2</td><td>many species present / high species richness / all species evenly represented / high species evenness / high biodiversity ;

(so) should not be developed / development should be modified / development should be reconsidered / should be conserved / AW ;</td><td>2</td><td>IGNORE refs to relative robustness of habitat

1 ACCEPT ‘types of butterfly’ as AW for species
IGNORE ‘individuals’ or ‘organisms’

2 DO NOT CREDIT ref to ‘planning’ alone (as given in question)
2 IGNORE responses that imply uncertainty about the development. e.g. ‘could’ ‘might’ ‘may’</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>species</th><th>letter</th></tr>
<tr><td>Grayling
(Hipparchia semele)</td><td>A ;</td></tr>
<tr><td>Large Heath
(Coenonympha tullia)</td><td>D ;</td></tr>
<tr><td>Gatekeeper
(Pyronia tythonus)</td><td>F ;</td></tr>
<tr><td>Green Hairstreak
(Callophrys rubi)</td><td>B ;</td></tr>
<tr><td>Silver-studded Blue
(Plebeius argus)</td><td>C ;</td></tr>
<tr><td>Small Heath
(Coenonympha phamhylus)</td><td>E</td></tr>
</table>
</td><td>5</td><td>DO NOT CREDIT if more than one letter given against any individual species</td></tr>
<tr><td>4</td><td>(c)</td><td>(ii)
1

2

3</td><td>(is) same <u>genus</u> ;

have, features / characteristics / appearance / behaviour / biochemistry / physiology / anatomy / genes / genetic makeup / DNA, that are, similar / in common ;

(share a) common, ancestor / phylogeny ;</td><td>2 max</td><td>1 DO NOT CREDIT vague statements like ‘could be in the same genus’
IGNORE Coenonympha

2 IGNORE ‘similar’ on its own
DO NOT CREDIT ‘same’
IGNORE specific examples (e.g. orange wings / large spot)

3 ACCEPT closely related ;</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>18</td><td></td></tr>
</table>