Question			Expected Answers	Mark	Additional Guidance
1	(a)		**1** different species **;** **2** different genus **;** **3** genetically incompatible **;** **4** (may have) different number of chromosomes **;** **5** physical / behavioural **,** reason for reproductive incompatibility **;**	**2 max**	**3 ACCEPT** 'DNA sufficiently different' **IGNORE** refs to meiosis **4 IGNORE** refs to meiosis **5** e.g. eggs remain unfertilised / different incubation patterns **IGNORE** refs to fertility of offspring
1	(b)	(i)	Convention (on) International Trade (in) Endangered Species **;**	**1**	**ACCEPT** Commission / Conference / Congress **ACCEPT** Trading **DO NOT CREDIT** Conservation / Countries
1	(b)	(ii)	**1** regulate / monitor **,** trade in selected **,** species / animals / plants / animal products **;** **2** *idea of* ensuring trade does not put wild populations at risk **;** **3** *idea of* prohibiting commercial trade in wild plants **;** **4** *idea of* allowing trade in artificially propagated plants **;** **5** *idea of* allowing trade in less endangered species subject to permit **;**	**2 max**	**Mark the first two answers only.** **IGNORE** trafficking throughout (as in stem) **1 ACCEPT** idea of species being on a list **ACCEPT** endangered **ACCEPT** prevent **IGNORE** illegal **IGNORE** animals / plants unqualified **3 ACCEPT** endangered plants

Question			Expected Answers		Mark	Additional Guidance
1	(c)		unrelated / AW, individuals ; health ; of reproductive age ; selecting individuals of opposite sex (for breeding) ; select higher proportion of females ;		2 max	**ACCEPT** idea of individuals with sufficiently different genes **ACCEPT** 'whether they are healthy (or not)' **ACCEPT** fertility of individuals
1	(d)		**1** bird(s) healthy / quarantine before release ; **2** adequate (natural) food supply / provide food (if necessary) ; **3** protected reserve / no hunting / no poaching / legal protection ; **4** method to monitor population ; **5** raise public awareness / educate local population / educate collectors ; **6** method to prepare animals for survival in wild ; **7** *idea of* gradual introduction, e.g via semi-wild habitat ;		3 max	**1** **IGNORE** refs to ongoing health monitoring **3** **ACCEPT** ref to controlling predators **4** e.g. tag birds **5** **ACCEPT** involve local population **6** e.g. raise with minimal human contact, predat awareness training **ACCEPT** teaching it to find food
				Total	**[10]**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)			**ACCEPT** reference to numbers rather than breeding success throughout
		1	(all), sub-arctic / all 4 named sub-arctic, species / birds, show decrease **;**		**1** sub-arctic species = snow bunting + Lapland bunting + ptarmigan + dottere
		2	(all / most), other / non sub-arctic / all 4 named non sub-arctic, species / birds, show, increase / no change **;**		**2** non sub-arctic species = red grouse + wheatear + meadow pipit + ring ouzel
		3	greater change / AW (in breeding success), in sub-arctic than in non sub-arctic species **;**		
		4	comparative figs (in 1970 **AND** 2000) **;**		**4** number of young for one sub-arctic and one non sub-arctic species in 1970 and 2000 (or calculated subtraction between the two years) **4 DO NOT CREDIT** if figures are not from 1970 and 2000
				3	

species	number of young raised per year		
	1970	**2000**	**difference in number of young raised between 1970 and 2000**
Snow bunting*	78	2	Down 76
Lapland bunting*	7	0	Down 7
Ptarmigan*	1280	876	Down 404
Red grouse	890	962	Up 72
Wheatear	209	231	Up 22
Meadow pipit	23	82	Up 59
Ring ouzel	23	26	Up 3
Dotterel*	45	35	Down 10

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(ii)			
		1	climate change / global warming **;**		**1 IGNORE** greenhouse effect **1 DO NOT CREDIT** 'it is too warm' or 'it is not cold enough' without reference since 1970
		2	(environmental) change too rapid for adaptation **;**		
		3	change in, flora / plants / food supply / insects / prey / predators / human activity **;**		**3 ACCEPT** camouflage no longer appropriate / reduction in size of habitats
		4	disease (that affects sub-arctic species more than others) **;**		
		5	sub-arctic species, less well-adapted than / have been outcompeted by, non sub-arctic species / AW **;**	**2 max**	**5 ACCEPT** ora
2	(b)	(i)	the number of species present (in a habitat) **;**	**1**	**DO NOT CREDIT** range / amount

Question			Expected Answer	Mark	Additional Guidance
2	(b)	(ii)			**Mark the first <u>three</u> suggestions**
		1	*idea of:* unbiased method to selecting sampling area **;**		**1 ACCEPT** e.g. random selection of, areas / coordinates OR use of transect **1 IGNORE** 'random sampling' unqualified
		2	sample many times / AW, and calculate mean / average **;**		
		3	standardised sweeping procedure **;**		**3** e.g. same type of movement / same length of time same number of sweeps **3 ACCEPT** sample at same time of day **3 IGNORE** same collector **3 IGNORE** refs to using alternative collecting techniques in order to collect more insect species
		4	ensure insects do not escape (before being identified) **;**		**4 ACCEPT** use of pooter
		5	method to prevent recounting **;**		**5** if ref to mark-release-recapture, **IGNORE** 'release and recapture' and look for idea for preventing recounting
		6	sample at different times of, day / month / year / weather conditions **;**	**3 max**	

Question			Expected Answer	Mark	Additional Guidance
2	(b)	(iii)			
		1	(measures), abundance / numbers, of individuals in each species ;		
		2	species evenness is more quantitative than species richness ; **ora**		
		3	high(er) species evenness indicates high(er) biodiversity ; **ora**		
		4	low species evenness indicates, dominance by / high abundance of, one / few, species ; **ora**		
		5	used to calculate (Simpson's) Index of Diversity ;		
		6	example used to illustrate explanation of mp 3 or 4 ;		**6** e.g. "Two areas have the same number of species. One with 90% of 1 species has less biodiversity than one where all species have an abundance of 5-20%"
				3 max	
			Total	**12**	

Question			Expected Answer	Mark	Additional Guidance
3	(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	
3	(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	

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(ii)	<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> ; ; ;	3	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)
3	(b)	(iii)	**1** many species present / high species richness / all species evenly represented / high species evenness / high biodiversity **;** **2** (so) should not be developed / development should be modified / development should be reconsidered / should be conserved / AW **;**	2	**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'

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>3</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>3</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>

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	likely to become extinct / on the verge of extinction / numbers are not sustainable / numbers too low for survival of species / numbers drop below 10% of (original) population ;	1	**DO NOT CREDIT** 'may' / 'might' / 'could' become extinct **CREDIT** 'die out' or 'wiped out' instead of extinct
4	(a)	(ii)	133 333 ; ;	2	Award 2 marks for a correct answer, even if no working shown. **ALLOW** 1 mark for seeing 133 333.3333... if answer is incorrectly rounded or not rounded to a whole number. If the answer is incorrect **ALLOW** 1 mark for $\frac{4000 \times 100}{3}$
4	(b)	(i)	painkiller still being used ; *in captivity – allow reverse argument for in the wild* fed uncontaminated food / keep away from painkiller ; health of individuals monitored / treated for disease ; eggs (artificially) incubated / young hand reared ; reduced mortality of young ; provision of mate / females breeding can be manipulated ; protection , from hunting / predation ; competition reduced (between , individuals / species) ;	4 max	**IGNORE** ref to controlling diet or nutrition e.g. hormones / artificial insemination / artificial selection 'safer environment' is not quite enough

Question			Expected Answers	Marks	Additional Guidance
4	(b)	(ii)	maintain / increase **,** genetic variation / gene pool **;** reduce risk of **,** inbreeding / breeding between related birds **;** different 'races' of vulture in different areas / geographical variation / different subspecies **;** less likely **all** contaminated with painkiller **;** less risk of losing all individuals due to **,** disease / natural disaster / human action **;**	**3 max**	In the context of the vultures**,** rather than 'biodiversity' **CREDIT** different alleles **DO NOT CREDIT** different genes **CREDIT ora** for idea of promoting outbreeding **ALLOW** ref to types of (white-backed) vulture
4	(c)		reason **or** explanation **; ; ;** *Suitable examples include but are **not** limited to:* • maintains biodiversity • part of food chain / part of ecosystem / part of food web / scavengers • have a right to existence / moral reason • specific religious reason • give pleasure / beautiful creatures • ecotourism • useful product / source of medicine / medical research • genetic resource • saves clearing up / remove carcasses • prevents disease • keeps **,** rat / dog **,** population down	**3**	**CREDIT any three valid suggestions**. *Ignore the numbers on the answer lines.* *Mark as prose and award points as they arise.* The idea of research must be qualified

Question			Expected Answers	Marks	Additional Guidance
4	(d)		ban / make illegal , use of **this** painkiller ; provide alternative painkillers (that do not have the same ecological impact) ; no hunting / no killing / legal protection , of white-backed vultures ; protected areas / sanctuary / reserves ; provide breeding sites ; prevent habitat destruction ; monitoring (of vultures) / tagging ; feeding programme (for released birds) / provide uncontaminated carcasses ; qualified ref. to education ; promotion of ecotourism ; in case the population falls again , sperm and egg banks / frozen embryos ;	**3 max**	e.g. to farmers / local people (on importance of vultures)
			Total	**16**	

Question			Answer		Marks	Guidance
5	(a)	(i)	*idea of* if one susceptible to, this / the disease, all likely to be **;**		1	**DO NOT CREDIT** if the response is referring to diseases in general
5	(a)	(ii)	**1**	environment / environmental factor **;**	2	
			2	(variation in) weather conditions / temperature **;**		**2 ACCEPT** climate
			3	rainfall / soil water content **;**		**3 IGNORE** 'availability of water' unqualified
			4	soil , (named) mineral / nitrate , content / AW **;**		**4 IGNORE** nutrient **4 ACCEPT** mineral availability / amount of fertiliser added
			5	(named) biotic factor (might vary) **;**		**5** e.g. number of pests / competition from other plants / disease
5	(a)	(iii)	mutation **;**		1	**ACCEPT** deletion etc. **IGNORE** (named) mutagenic agent

Question			Answer		Marks	Guidance
5	(b)				6	If a candidate describes resistance as immunity **DO NOT CREDIT** the first time it is seen but apply **ECF** thereafter
			1	cross / breed, with disease resistant variety ;		**1 ACCEPT** make two disease resistant individuals reproduce **1 IGNORE** crossbreed two best individuals
			2	method to test offspring for disease resistance ;		**2 ACCEPT** general statement **or** example e.g: 'germinate seeds, expose to disease, see if die'
			3	select , best offspring / offspring with resistance ;		**3 ACCEPT** seeds / tubers / potatoes **3 IGNORE** children / babies
			4	(inter)breed, offspring with resistance / best offspring ;		
			5	(continue process) for (many) generations ;		**5 IGNORE** many years
			6	*idea of* avoid breeding, closely related / AW , individuals to preserve genetic diversity ; **ora**		**6 ACCEPT** avoid , inbreeding / inline breeding **6 ACCEPT** 'maintain genetic diversity by breeding with plants from different field / area' **6 ACCEPT** breed with different varieties to widen the gene pool
			7	(regularly back) cross with, wild variety ;		
			8	*idea of* preserving rare varieties in case they are needed in the future ;		**8 ACCEPT** use of seed bank to preserve range of alleles
			9	AVP ;		**9** e.g, ref. to marker assisted selection / detail of pollination method / prevention of self-pollination / asexual reproduction of desired variety
			QWC ;		1	**Award** if the answer has been given **one** mark from marking points **1–5 and one** mark from marking points **6–8**
				Total	**11**	