Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	57 / 57.3 **;** **;**	**2**	**Award 2 marks for a correct answer** **ACCEPT** 57.25 for 2 marks If answer is incorrect then allow 1 working mark for 655 – 280 or for seeing 375 anywhere in the working
	(a)	(ii)	*description (D)* **D1** number of **,** waders / birds **,** decrease (in area 2) **;** **D2** (numbers decrease) in **,** all / four **,** species **;** **D3** unlike / different to **,** area 1 / where hedgehogs absent **;** **D4** (area 1) two species increase / only two species decrease **;** **D5** quote any two % change figures **;** *explanation (E)* **E1** hedgehogs are **,** secondary consumers / 'predators' **;** **E2** hedgehogs **,** stop birds breeding / reduce offspring (one year) **;** **E3** *idea of* fewer **,** new adults / breeders (next year) **;** **E4** *idea of* more deaths than 'births' **;**	**6 max**	**D1** **CREDIT** 'it' as number **ACCEPT** 'amount' **D2** **CREDIT** the four names if all said to decrease **D4** **CREDIT** lapwing and redshank increase / only dunlin and snipe decrease **D5** Percentage change figures: area 1 area 2 lapwing +24 -31 redshank +51 -41 dunlin -31 -56 snipe -10 -57 Look for ecf from 4(a)(i) if snipe in area 2 incorrect **E1** **IGNORE** hedgehogs eat eggs as given in question **E3** Look for idea of future / knock-on effect

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(iii)	**1** plenty of / enough **,** food / birds' eggs / space **;** **2** breed rapidly / breed successfully / young survive **;** **3** no / few **,** predators **;** **4** few die (young / before breeding) **;** **5** *idea that* hedgehogs are introduced species **;** **6** invasive / fill vacant niche / not reached carrying capacity **;** **7** these hedgehogs restricted to island **;** **8** cannot **,** emigrate / leave island (so numbers build up) **;**	**4 max**	**Mark the first suggestion on each numbered line. Award 1 mark for a factor and a further mark for a related explanation** **1 CREDIT** little competition for food
1	(b)		*idea that the following may be ethically wrong* **1** killing hedgehogs **;** **2** letting hedgehogs **,** kill / decrease number of **,** waders **;** **3** introducing hedgehogs to island (upset the ecosystem) **;** **4** catching / moving **,** hedgehogs might cause suffering **;** **5** doing nothing **;**	**3 max**	**CREDIT ORA** *idea preventing these is ethically right* **IGNORE** 'right to life' and 'playing God' **2 CREDIT ORA** need to conserve waders **4** *'the other methods are cruel'* = 1 mark (mp 4) *'moving hedgehogs elsewhere causes problem somewhere else'* = 1 mark (mp 4) **5 CREDIT ORA** idea of human responsibility
				15	

Question			Expected Answers	Marks	Additional Guidance
2	**(a)**		ecosystem **;** producers / autotrophs **;** primary **;** trophic level(s) **;** biotic / living **;** minerals / elements **;**	**6**	**DO NOT CREDIT** plants **DO NOT CREDIT** tropic **CREDIT** named, element / ion, e.g. nitrogen, nitrate **ACCEPT** symbol e.g. N / NO_3^- **ACCEPT** nutrient **DO NOT CREDIT** energy / waste products
2	**(b)**	**(i)** **1** **2** **3** **4** **5** **6** *larger squirrel populations* **7** **8**	limiting / density-dependent, factors **;** carrying capacity **;** intraspecific competition **;** for, food / nesting sites **;** interspecific competition **;** with, deer / tree shrew / giant squirrel **;** attract more predators **;** parasites / diseases, spread more easily **;**	**max 4**	***3*** **ACCEPT** description e.g. ● “competition with other members of the same species” ● “competition with other (small) squirrels” ***4*** **ACCEPT** they run out of food ***5*** **ACCEPT** description e.g. “competition with other species” ***7*** **DO NOT CREDIT** predation alone, must be linked to larger squirrel population ***8*** **DO NOT CREDIT** disease alone, must be linked to larger squirrel population

Question			Expected Answers	Marks	Additional Guidance
2	(b)	(ii)	species richness & evenness decrease **; ora** (richness) 29 → 26 (species) **;** (evenness) large numbers of, 2 / some, species, but, low numbers / none, of other species **;**	**max 2**	**ACCEPT** they both, decrease / decline / fall **or** they were higher at start **ACCEPT** 6 → 4 **or** 2 fewer (from table) **or** 3 fewer (from text) **CREDIT** suitable named e.g.s from table
2	(c)	(i)	rare initially / AW **;** prey, numbers have reduced / have become extinct / have left the area **;** idea of slower reproductive rate / AW **;**	**max 1**	**ACCEPT** that there weren't very many at start **DO NOT CREDIT** 'lack of food' unless has indicated that food is an animal **ACCEPT** don't breed as fast / don't have as many offspring
2	(c)	(ii) **1** **2** **3** **4** **5** **6** **7** **8**	aesthetic / amenity / recreational, value **;** (eco)tourism **;** to, preserve biodiversity / preserve genetic diversity / stop extinction **;** ref. interactions between species / need to preserve whole habitat **;** (rainforest species / preserve gene pool as) could be useful, in future / as potential, for, medicine / genetic engineering / AW **;** to support indigenous peoples / AW **;** to stop effect of deforestation on, atmosphere / climate / soil **;** AVP **;**	**max 3**	**Mark the FIRST suggestion on each numbered line** ***1*** **ACCEPT** description, e.g. beautiful / so people will visit / so people will use it for leisure ***2*** **ACCEPT** description, e.g. raise money from visitors ***3*** **ACCEPT** description, e.g. keep more species ***4*** **ACCEPT** description, e.g. if habitat destroyed there will be a knock-on effect on many species ***5*** **ACCEPT** for drugs, pharmaceuticals, GM or GM e.g. (like crop improvement) ***6*** **ACCEPT** let native people continue to live in forest income for indigenous people ***7*** **ACCEPT** to stop, CO_2 % rising / global warming / erosion **or** forest acts as C, sink / store ***8*** e.g. ● habitat for pollinators ● habitat for predators of pests **DO NOT CREDIT** 'right to life'

Question			Expected Answers	Marks	Additional Guidance
2	(d)				**LOOK FOR** key ideas expressed in different ways
			management practices		
		M1	coppicing / pollarding / description **;**		***M1*** **CREDIT** coppicing with standards / rotational coppicing
		M2	selective felling / description **;**		***M2*** **ACCEPT** only some trees cut down
		M3	rotational felling / description **;**		***M3*** **ACCEPT** cycle of felling different areas
		M4	strip felling **;**		
		M5	replant after felling **;** **(max 2)**		
			explanation of benefits re. sustainability		
		B1	preserves / prevents disruption to, habitat / ecosystems / nesting sites **;**		
		B2	maintains / increases, species diversity / biodiversity **;**		
		B3	prevents, soil erosion / leaching **;**		
		B4	less disturbance by machinery **;**		
		B5	AVP **;** **(max 2)**		***B5*** **CREDIT** specific benefits linked to a practice e.g. ● faster recovery due to seeding from untouched areas nearby (M3) ● pollarding so deer can't eat shoots (M1)
				max 4	
			Total	**20**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	DNA / gene / genetic **,** fingerprinting / profiling / analysis **;** DNA / protein / gene **,** sequencing **;** electrophoresis **;**	**1 max**	**IGNORE** gene testing / gene probing / gene mapping / genome sequencing
3	(a)	(ii)	rarely / do not **,** produce seed / cross-pollinate / interbreed **;** only reproduce asexually **;**	**1 max**	
3	(a)	(iii)	vegetative propagation **;**	**1**	**IGNORE** asexual reproduction (as given in the question)
3	(b)		**1** genetically identical / little genetic variation **;** **2** all susceptible / none resistant **,** to this disease **;** **3** beetles **,** move / fly **,** from tree to tree **or** beetles are vector **;** **4** trees grow **,** in clonal patch / close together **or** disease spreads through **,** suckers / roots **or** connected by **,** suckers / roots **;** **5** the beetles only **,** live on / target **,** elm trees **;** **6** attempts at control contributed to spread **;** **7** as **more** trees became diseased then **more** tree surgery was necessary (contributing to spread of problem) **;** **8** as **more** trees became infected then **more ,** saws / equipment **,** were contaminated **;**	**4 max**	**1 IGNORE** clone **2 IGNORE** all susceptible to 'disease' in general. Only credit if **one particular** disease is implied e.g. the / new / fungus / same **,** disease **DO NOT CREDIT** immune instead of resistant **3 IGNORE** simple repetition of text 'beetles spread disease'

Question			Expected Answers	Marks	Additional Guidance
3	(c)	(i)	**1** less / no **,** movement of water **or** less / no **,** water reaches leaves **;** **2** less / no **,** minerals / nitrate / phosphate / magnesium / iron **;** **3** less / no **,** chlorophyll formation **;** **4** chlorophyll breakdown / leaf senescence **;**	**2 max**	**2** **CREDIT** correct symbols NO_3^-, PO_4^{2-}, Mg^{2+}, Fe^{2+}, Fe^{3+} **IGNORE** nutrients **IGNORE** reference to other substances such as sugars
3	(c)	(ii)	**1** less / no **,** photosynthesis **;** **2** less / no **,** sugar(s) / amino acid(s) / assimilates / organic molecules **;** **3** <u>roots</u> cannot **,** respire / do active transport / metabolise **;** **4** the falling leaves carry the fungus **;**	**2 max**	**2** **CREDIT** named sugars, e.g. sucrose **,** glucose **,** hexose **IGNORE** nutrients / food

Question			Expected Answers	Marks	Additional Guidance
3	(d)	1	cut plant material into **,** explants / small pieces **;**		1 **DO NOT CREDIT** a single cutting
		2	example of part of plant used e.g. leaf / stem / root / bud / meristem / dividing region at tip of plant **;**		
		3	sterilise explant **;**		
		4	(with) bleach / sodium hypochlorite / alcohol **;**		
		5	place on **,** agar / growth medium **;**		5 **CREDIT** place in aerated solution
		6	containing **,** glucose / amino acids / nitrates / phosphates **;**		6 **IGNORE** polymers / carbohydrates
		7	callus **or** mass of **,** undifferentiated / totipotent **,** cells **;**		7 **DO NOT CREDIT** description of single cell
		8	high auxin **and** cytokinin (for callus formation) **;**		
		9	subdivide callus / sub-culturing **;**		9 **IGNORE** ref. single cells
		10	treat to induce **,** roots / shoots **;**		
		11	change plant hormone ratio **;**		11 **CREDIT** description **,** e.g. high auxin to give roots or (relatively) high cytokinin to give shoots (auxin : cytokinin ratio = 100 : 1 for roots, 4 : 1 for shoots, or similar figures)
		12	transfer to **,** greenhouse / soil / less controlled environment / non-sterile environment **;**		
		13	ref. aseptic conditions (anywhere within stages 5-11) **;**	**6 max**	13 Do not award for sterilising explant (which is mp3)
			QWC – described in logical sequence of steps ;	**1**	**Award QWC for sequence of marks as follows:** either mp 1 or 2 **then** 1 mark from mps 5 – 8 **then** 1 mark from mp 9 - 12

Question			Expected Answers	Marks	Additional Guidance
3	(e)		*advantages* **1** quick **;** **2** disease-free / virus-free **,** stock created **;** **3** plants have same feature / uniform plants created **;** **4** can reproduce infertile plants **;** **5** can reproduce plants that are hard to grow from seed **;** **6** create whole plants from GM cells **;** **7** production **,** not determined by seasons / at any time / anywhere in the world **;** **8** (plantlets small) can be transported easily / grown in small space **;** **9** can save rare species from extinction **;** *disadvantages* **10** expensive / labour intensive **,** process **;** **11** process can fail due to microbial contamination **;** **12** all offspring susceptible to *same* **,** pest / disease / named environmental factor (e.g. drought) **;** **13** no / low / little **,** genetic variation **;**	**4**	**CREDIT** the first answer on each prompt line **1** **IGNORE** ref. large numbers alone **3** refers to plant phenotype e.g. plants **,** grow at same rate / grow to same height **12** **IGNORE** all are susceptible to disease in general (as in 3b) **13** **IGNORE** loss of alleles
				22	