Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	**1** (sheep / animals) ingest / consume / eat / feed on (grass / plants) **;** **2** digest / hydrolyse **,** (protein) to amino acids **;** **3** amino acids move **into ,** blood / cells **;** **4** synthesis of <u>proteins</u> / <u>translation</u> **;**	**3 max**	**2** **ACCEPT** break down **IGNORE** enzymes **3** **ACCEPT** amino acids are absorbed into **,** blood / cells **CREDIT** AW description of movement e.g. diffusion / active transport but **DO NOT CREDIT** movement by osmosis
1	(a)	(ii)	**1** death / leaf loss **;** **2** decomposition / decay **;** **3** excretion / urination / described **;** **4** egestion / defaecation / described **;**	**2 max**	**3** **IGNORE** faeces in the context of mp3 but do not then credit mp4 as a description therefore *'excretion of faeces'* scores mp3 only **IGNORE** waste matter **4** **IGNORE** waste matter

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(iii)	**1 C** is *Nitrosomonas* **;** **2 D** is *Nitrobacter* **;** **3 C and D** are nitrifying bacteria **;** *for mps 1 , 2 and 3* **internal max 2** **4** plants need nitrates to make **,** amino acids / protein(s) / enzymes / DNA / RNA / nucleic acids / chlorophyll / cytoplasm / new cells **;**	**3**	**Full marks can only be awarded if mp 4 awarded** **1 & 2 ACCEPT** "*they are 'Nitrosomonas and Nitrobacter'* = **2 marks** (correct order) *'they are Nitrobacter and Nitrosomonas'* = **1 mark** (wrong order) **4 IGNORE** plants need nitrates to grow (as given in Q) .
1	(a)	(iv)	**1 E** continues / plants use nitrate **;** **2** less / no **, B** / decay **;** **3** less / no **, C** / **D** / recycling of nitrogen / nitrification **;** **4** (cabbages) harvested / removed **;**	**3 max**	**IGNORE** references to other letters throughout **2 ACCEPT** cabbages do not rot down

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(v)	**1** legume / any named leguminous plant **;** **2** *Rhizobium* / nitrogen-fixing bacteria (in root nodules) **;** **3** *idea of converting* nitrogen gas / N_2 **,** into **,** compounds / ammonium / ammonia / amino acids / protein (in plants) **;** **4** plants ploughed in / plants left to decay / ref **B** / ref **C** / ref **D** **;**	**3 max**	**1** **CREDIT** English or Latin name. Examples include but are not limited to: pea (*Pisum*) / bean (*Phaseolus* or *Vicia*) / vetch (*Vicia*) / soya (*Glycine*) / chickpea (*Cicer*) / peanut (*Arachis*) / alfalfa, lucerne or medick (*Medicago*) / clover or trefoil (*Trifolium*) / lupin (*Lupinus*) / *Leucaena / Cyamopsis / Sesbania* **IGNORE** names of non-leguminous plants, therefore *'plant legumes such as cucumbers'* scores mp 1 **3** the nitrogen must be clearly gaseous **IGNORE** nitrite / nitrate (because not made in plant)
1	(b)		**1** genetic resource / gene bank / have (different) alleles **;** **2** for **,** genetic engineering / genetic modification / artificial selection / selective breeding / described **;** **3** if conditions change / in the future **;** **4** example of useful trait **;** **5** to maintain **,** biodiversity / genetic diversity / (large) gene pool **;**	**2 max**	**IGNORE** biotourism **1** **IGNORE** source of genes **3** **IGNORE** unless context is genetic **4** e.g. disease resistance (**not immunity**) / hardiness / more or better quality wool or meat An animal need **not** be named but if it is it should be a **farm animal** e.g. sheep / cows / goats / pigs / poultry **5** **CREDIT ORA** to prevent loss of genetic diversity **IGNORE** to prevent extinction / to increase biodiversity

Question			Expected Answers	Marks	Additional Guidance
1	(c)	(i)	mutation / described **;** selection / selection pressure / selective advantage **;**	**2**	**1** **ACC** **PT** new or different allele formed / DNA changed **2** **IGNOR** type of selection
1	(c)	(ii)	**1** small **,** population / gene pool **;** **2** ref. inbreeding / genetic drift **;** **3** unusual diet / cannot eat grass / poisoned by grass / must eat seaweed **;** **4** may not be commercially viable / expensive to keep **;**	**2 max**	**1** **CREDIT** lack of genetic **,** variability / variety **2** **CREDI** founder effect **3** Mark point must relate to diet
				20	

Question			Expected Answer		Mark	Additional Guidance
2	(a)			*climate - tropical versus temperate* *tropical has …*		**CREDIT** reverse arguments for temperate
			1 **2** **3**	high**er** temperature / hott**er ;** **more** (sun)light / days long**er ;** photosynthesis fast**er ;**		
			4	*idea that* **more** storage of **,** organic molecules / biomass / energy **or** **more** formation of **,** organic molecules / biomass **;**		
			5	AVP **;**		eg ● **less** seasonal change ● fast**er ,** mineral cycling / decomposition
				*vegetation - woodland **or** rainforest versus grassland(s)* *woodland **or** forest has …*		**CREDIT** reverse arguments for grassland
			6 **7**	*idea of* great**er** complexity / great**er** biodiversity / **more** niches **;** competition for space **less** limiting **;**		
			8	AVP **;**	**4 max**	eg ● great**er ,** humidity / shelter
2	**(b)**		(bomb) calorimeter **;**			
			detail of technique **;**			eg ● known / dry **,** mass of (organic material) ● (material) burnt in oxygen
			detail of **,** measurement / analysis **;**		**2 max**	eg ● temperature rise of water measured ● known volume of water ● calculation described / converted to kJ

	tropical	*temperate*
temperature	higher	lower
light intensity	more	less
photosynthesis	more	less
biomass made	more	less

	wood	*grassland*
complexity	more	less
competition	less	more

Question			Expected Answer		Mark	Additional Guidance	
2	(c)	(i)	(perch) 22 ; (cow) 1 ;		2		
2	(c)	(ii)	1 *for bobcat* 2 3 4 5 6 7	higher in bobcat / lower in cow ; more (energy) absorbed ; **ora** less (energy / waste) egested ; **ora** correct comparative figs. quoted from table ; meat more digestible ; **ora** mainly protein and fat ; contains no <u>cellulose</u> ; **ora**	3 max	*1* *2* *3* *4* *5* *6* *7*	**DO NOT CREDIT** figs alone **IGNORE** refs to grasshopper and perch **ALLOW** ecf if cow calculated as > 6 in **(i)** bobcat 83(%) <u>and</u> cow 40(%) (absorbed) **or** bobcat 17(%) <u>and</u> cow 60(%) (egested)
2	(c)	(iii)	1 2 3 4 5	<u>grasshopper</u> ; *idea of* high conversion to biomass figure ; *idea of* herbivore / primary consumer / low(er) trophic level than perch ; *idea of* more food available ; *idea of* one stage of energy loss in food chain not two / more energy passes through food chain (to humans) ;	3 max	*1* *2* *3* *4* *5*	If perch is suggested, candidate can only access mp 2 **= max 1** If bobcat or cow suggested, then **= 0** **ACCEPT** ref to more energy accumulated in body **ACCEPT** mp2 in context of perch for max 1
				Total	14		

Question			Expected Answer	Mark	Additional Guidance
3	(a)		**1** pioneers arrive **,** ***before*** climax / ***earlier*** **;** **ora** **2** pioneer communities subject to **,** ***greater*** / ***more*** **,** change / succession / replacement **;** **ora** **3** pioneer community (usually) has **,** ***less*** / ***lower*** **,** biodiversity **;** **ora** **4** *idea that* pioneer community is (often) ***less*** **,** stable / self-sustaining **;** **ora** **5** pioneer community has ***lower*** biomass **;** **ora** **6** AVP **;**	**2 max**	**Note: All mark points are comparative** **1** **CREDIT** pioneers arrive first / climax arrive last **6** e.g. species in pioneer community better adapted to (named) abiotic factor(s) **and** those in climax community better adapted to (named) biotic factor(s)

Question			Expected Answer	Mark	Additional Guidance
3	(b)		**1** decomposition is break down **,** dead matter / waste **or** decomposition is conversion of organic matter to inorganic **;** **2** denitrification is conversion of nitrates to nitrogen (gas) **;** **3** decomposition increases **,** mineral / nitrate **,** supply **and** denitrification reduces **,** mineral / nitrate **,** supply **;**	**2 max**	**1 IGNORE** putrefication **1 CREDIT** for **inorganic:** carbon dioxide / CO_2 / water / H_2O / ammonium compounds / ammonium ions / NH_4^+ **IGNORE** ammonia / NH_3 **2 CREDIT** correct formulae (NO_3^- and N_2) **DO NOT CREDIT** nitrogen oxides **3 CREDIT** decomposition returns , mineral / nitrate, to soil **and** denitrification removes mineral / nitrate, to soil
3	(c)		**1** conservation maintains **,** ecosystem / biodiversity / species / habitats **or** conservation involves **,** active / sustainable **,** management of **,** ecosystem / resource / habitat **;** **2** preservation leaves **,** ecosystems / habitats **,** undisturbed **;**	**2**	**IGNORE environment for MP1 and 2** **ACCEPT** named resource **ACCEPT** unchanged/ not disrupted / no physical intervention **IGNORE** ref to preservation in any context other than that of conservation/preservation

Question			Expected Answer	Mark	Additional Guidance
3	(d)		**1** nitrogen fixation is the conversion of (atmospheric) nitrogen into **,** ammonia / ammonium compounds / ammonium ions **;** **2** nitrification is the conversion of **,** ammonia / ammonium compounds /ammonium ions **,** into nitrite / nitrate **;** **3** correct ref to microorganisms involvement in both processes **;**	**2 max**	**1** **CREDIT** N_2 / NH_3 / NH_4^+ **2** **CREDIT** NH_3 / NH_4^+ **CREDIT** NO_2^- / NO_3^- **DO NOT CREDIT** nitrate to nitrite **3** e.g. nitrogen fixation involves **,** *Rhizobium* / *Azotobacter* / *Nostoc* **and** nitrification involves **,** *Nitrosomonas* / *Nitrobacter*
			Total	**8**	

Question			Answer	Marks	Guidance
4	(a)		**1** mutation **;**	5	**1** **CREDI** in context of gene or chromosome mutation **ACCEPT** a suitable description e.g. change in DNA base sequence / non-disjunction
			2 meiosis **;**		**2** **DO NOT CREDIT** incorrect spelling of meiosis
			3 cross(ing)-over **;** **4** between non-sister chromatids **;**		**3** **ACC PT** formation of chiasmata **4** **DO NOT CREDI** sister here (CON) but **IGNORE** sister for mp 3 and mp 5
			5 (in) prophase I **;**		**5** needs to be in context of 3 or 4
			6 independent / random , assortment / segregation **;**		**6** **ACC PT** description e.g. random alignment of bivalents
			7 (in) metaphase **;**		**7** needs to be in context of 6 metaphase I (chromosomes) or I I (chromatids) **IGNORE** anaphase
			8 *idea of* random **,** fertilisation / fusion of gametes **;**		**8** **CREDI** description relating to plant (as Q states rhubarb) e.g. any pollen grain could land on any stigma / any pollen grain could reach any ovule
			9 AVP **;**		**9** ref. epigenetics

Question			Answer	Marks	Guidance
4	(b)	(	reproductive **;** cloning **;**	2	**ACCEPT** 'whole organism'
4	(b	(ii)	(callus / plant) tissue culture / micropropagation **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** tissue culturing / micropropagating **IGNORE** cloning
4	(b)	(iii)	*they have different (qualitatively or quantitatively)* **1** genes / DNA / alleles / genotypes **;** **2** repressor proteins **;** **3** enzymes **;** **4** protein folding / tertiary structure / thermostability **;** **5** (plant) growth regulators / hormones **;**	2	**Mark the first 2 suggestions.** Must have 'different' idea at least ONCE e.g. higher / only one of them has x **3** **CREDIT** different enzymes or different amounts **4** **CREDIT** enzyme activity at different temperatures **5** **ACCEPT** PGRs / named hormones eg gibberellins
4	(c)	(	**1** (test) different varieties **;** **2** several plants or leaves (of each) / repeat readings **;** **3** same age **;** **4** same soil **,** type / mineral content / pH **;** **5** same light **,** exposure / conditions **;** **6** same **,** watering regime / temperature / CO_2 concentration **;**	5	**1** **ACCEPT** 'Timperley Early' and 'Victoria' **IGNORE** species **2** **ACCEPT** three or more **CREDIT** 'control / controlled' for 'same' in mps **3,4,5,6 & 7** **4** **IGNORE** soil nutrient level or content **5** **CREDIT** light intensity / wavelength / duration **IGNORE** amount of light *If none of mps 4-6 awarded*

Question			Answer	Marks	Guidance
					ACCEPT *'grown under same conditions' for 1 mark and dot for QWC if stated as controlled*
			7 same, preparation or testing procedure detail **;** (e.g. leaf mass / volume of solvent / soaking time / temperature)		**7** **IGNORE** amount (of solvent / water / ethanol / alcohol) or size (of leaf). Procedure can be liquidising/pestle and mortar, stated same for each.
			8 test / measure**,** (oxalic) acid concentration / acidity / pH / H^+ ion concentration **;**		**8** **IGNORE** amount / content / how much (of acid or H^+ ions) except for QWC
			9 detail of measuring method **;**		**9** e.g. pH probe universal indicator (not litmus) titration **IGNORE** colorimetry
			QWC ;	1	**Award if** variables correctly identified as independent (**1** only) **and** controlled (any of **3/4/5/6/7**) **and** dependent (**8** only).

Question			Answer	Marks	Guidance
4	(c)	(ii)	**1** bacteria / fungi **;** **2** *idea of* external digestion **;** **3** by **,** enzymes / named enzymes **;** **4** absorption of breakdown products **;** **5** release of carbon dioxide and water **;** **6** (breakdown of protein) makes **,** ammonium **,** ions / compounds **or** NH_4^+ **;**	3	**1** **DO NOT CREDI** wrong bacteria eg nitrogen fixing, nitrifying, denitrifying, *Rhizobium, Nitrosomonas, Nitrobacter* **2** **CREDIT** saprotrophic / saprophytic / saprobiotic **ACCEPT** **'**breaking down' for digestion **3** e.g. cellulase / lignase **6** **CREDIT** ammonification **IGNORE** ammonia / nitrates
4	(d)		auxin / IAA **;** not destroyed by light / more present in dark **;** moves down from shoot tip / uniformly distributed **;** (causes) <u>cell</u> elongation **;**	2	**IGNORE** gibberellins and references to phototropism and more light on one side
			Total	**21**	