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	

<table>
<tr><th colspan="3">Question</th><th colspan="2">Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td></td><td>climate - tropical versus temperate
tropical has …

1 higher temperature / hotter ;
2 more (sun)light / days longer ;
3 photosynthesis faster ;

4 idea that
more storage of , organic molecules / biomass / energy
or
more formation of , organic molecules / biomass ;

5 AVP ;

vegetation - woodland or rainforest versus grassland(s)
woodland or forest has …

6 idea of greater complexity / greater biodiversity / more niches ;
7 competition for space less limiting ;

8 AVP ;</td><td>4 max</td><td>CREDIT reverse arguments for temperate

<table><tr><th></th><th>tropical</th><th>temperate</th></tr><tr><td>temperature</td><td>higher</td><td>lower</td></tr><tr><td>light intensity</td><td>more</td><td>less</td></tr><tr><td>photosynthesis</td><td>more</td><td>less</td></tr><tr><td>biomass made</td><td>more</td><td>less</td></tr></table>
eg ● less seasonal change
● faster , mineral cycling / decomposition

CREDIT reverse arguments for grassland

<table><tr><th></th><th>wood</th><th>grassland</th></tr><tr><td>complexity</td><td>more</td><td>less</td></tr><tr><td>competition</td><td>less</td><td>more</td></tr></table>
eg ● greater , humidity / shelter</td></tr>
<tr><td>2</td><td>(b)</td><td></td><td colspan="2">(bomb) calorimeter ;

detail of technique ;

detail of , measurement / analysis ;</td><td>2 max</td><td>

eg ● known / dry , mass of (organic material)
● (material) burnt in oxygen

eg ● temperature rise of water measured
● known volume of water
● calculation described / converted to kJ</td></tr>
</table>

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

Question			Expected Answer	Mark	Additional Guidance
3	(a)				**Note: All mark points are comparative**
			1 pioneers arrive **,** ***before*** climax / ***earlier*** **;** **ora**		**1** **CREDIT** pioneers arrive first / climax arrive last
			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 **;**		**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)
				2 max	

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 **;** **2** meiosis **;** **3** cross(ing)-over **;** **4** between non-sister chromatids **;** **5** (in) prophase I **;** **6** independent / random , assortment / segregation **;** **7** (in) metaphase **;** **8** *idea of* random **,** fertilisation / fusion of gametes **;** **9** AVP **;**	5	**1** **CREDI** in context of gene or chromosome mutation **ACCEPT** a suitable description e.g. change in DNA base sequence / non-disjunction **2** **DO NOT CREDIT** incorrect spelling of meiosis **3** **ACC PT** formation of chiasmata **4** **DO NOT CREDI** sister here (CON) but **IGNORE** sister for mp 3 and mp 5 **5** needs to be in context of 3 or 4 **6** **ACC PT** description e.g. random alignment of bivalents **7** needs to be in context of 6 metaphase I (chromosomes) or I I (chromatids) **IGNORE** anaphase **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** 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**	