

Question number	Answer	Marks	Guidance
1 (a)	Weight has reduced; figures quote; length has reduced; figures quote;	4	
1 (b) (i)	Smallest fish removed mean weight increased; largest fish removed mean weight decreased; fish randomly removed mean weight, fluctuated / stayed about the same; figures quote;	4	
1 (b) (ii)	Smallest / largest, fish removed changed allele frequency; larger frequency of, small / large, alleles in next generation; directional selection; random removal did not change allele frequency; selection not directional;	5	
1 (c)	Artificial selection; scientists are selection pressure;	2	
2 (a)	<i>Genome</i> complete set of DNA; of an organism; <i>operon</i> more than one gene; switched, on / off, together; <i>expression</i> switching on of a gene; transcription initiated;	6	
2 (b)	Regulatory genes products control the expression of other genes; code for, repressor / enhancer, proteins; products used elsewhere in the, cell / organism; e.g. enzymes;	4	
2 (c) (i)	<i>Both</i> one regulatory gene; have operator and promoter; repressor protein binds to operator; and blocks promoter; lac has three structural genes and trp has five structural genes;	5	
2 (c) (ii)	Tryptophan binds to repressor protein; repressor protein then binds to operator; transcription halted; binding of, lactose / tryptophan, changes 3D shape of repressor protein;	4	
3	Eukaryotes have nucleus; ORA DNA free in cytoplasm in Prokaryotes; <i>idea that</i> transcription and translation occur in different areas in Eukaryotes; ORA mRNA has to leave nucleus to attach to ribosome in Eukaryotes; proteins contained in vesicles in Eukaryotes; Eukaryotes have Golgi body; modification of proteins occurs in Golgi body;	7	
4 (a)	Species evenness is a measure of the number of individuals in each species; species richness is the number of different species;	2	
4 (b)	Species richness is the same; species evenness is higher at site 2; figures quote;	3	
4 (c) (i)	Foredune = 0.55; mature dune = 0.88;	2	
4 (c) (ii)	More succession has occurred in mature dune; closer to climax community; greater number of species present/more individuals in each species present;	3	
5	<i>Economical</i> discovery of new drugs; local communities may depend on forest; ecotourism; <i>ecological</i> maintenance of biodiversity; <i>ethical idea</i> of human responsibility; effect on local communities; <i>aesthetic</i> ecotourism;	7	

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6 (a)	Require different conditions / AW; control agents might work / feed on each other and not pest / AW; idea of competition; idea of limited resources; further detail; e.g. <i>M. calliginosus</i> eats larvae and so other two would not be able to survive AVP; e.g. ref. to cost and management of releasing all three at same time	4 max	
6 (b)	Parasitic wasps might be slower to work / AW; parasitic wasp eggs might take a while to hatch; parasitic wasps must fly and locate prey so therefore slower to act / AW; AVP;	2 max	
6 (c)	Environmental benefits / AW; (idea of) bioaccumulation; pesticides might kill biological control agent; pesticides might kill beneficial insects / non target species; pesticides (might kill pest) and remove food for biological control agent / disrupt food chains; idea of pest resistance (over time); immunity health benefits; AVP; e.g. to demonstrate good practice	4 max	
6 (d)	(weeks 1 and 2) no difference in aphid population size; presence of natural predators reduces growth of aphid population; ora presence of natural predators aphid population reaches plateau; relevant data quote; absence of natural predators aphid population peaks (and declines); relevant data quote;	3 max	
6 (e)	ref. to cost; pressure from agricultural companies; pressure from supermarkets / no aphids allowed on food / AW; biocontrol needs to be reintroduced / labour intensive; ease of application biocontrol slow to act; lack of knowledge for biocontrol of all pests; biocontrol cannot be used in large fields; AVP;	3 max	
7 (a)	(composition of ecosystem) changes; over time;	2	
7 (b)	Greater number of individuals within each species; greater number of different species; more species per unit area; <i>idea of</i> increased mass of living material; increased number of heterotrophs; e.g. predators;	6	
7 (c) (i)	instability of, mud / soil; waterlogged / low oxygen levels in soil / low nitrate; varying salinity / high salt concentration / low water potential; idea of periodic, desiccation / submergence; ref to wave action on plants;	2 max	

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7(c) (ii)	<p><i>Similarity</i> – same, sequence / zonation / pattern, as move up shore; Salicornia always at lowest elevation / first in succession; Juncus always at highest elevation / final plant in succession; all plants found between 4 and 34 cm above sea level / ora; species have similar spread on both marshes (23/24 cm); elevation range of Salicornia does not overlap with any other species /ora; Salicornia only species with non-overlapping ranges on A and B; max 1 <i>Difference</i> – plants found at higher elevations in salt marsh B / ora; Limonium found at higher elevation than Sarcocornia in A / ora; species mean soil elevations greater range in A than B (19/15); max 1</p>	2 max	
7 (c) (iii)	Salicornia;	1	
7 (c) (iv)	stabilise soil / develop soil structure; increase humus content; raise soil levels; aerate soil; decrease salinity / change pH; provide food; shelter / form microhabitat; nitrogen fixation / increase nitrates / increase minerals;	2 max	
7 (d) (i)	two from <i>Spartina</i> , <i>Limonium</i> and <i>Sarcocornia</i> ; <i>mark first two answers</i>	1	
7 (d) (ii)	light / minerals / named mineral / carbon dioxide / pollinators / space; R water, nutrients. <i>mark first answer in list</i>		
7 (e)	transect; continuous / belt / interrupted / line; random placement of transect / AW; use quadrats / point quadrat; R quadrant measurement of elevation for each quadrat; percentage cover within quadrat / number of hits with point quadrat; use ACFOR scale; reliability – large number of quadrats / repeat transect; AVP; e.g. use of keys, reference to safety, calculate mean percentage cover.	4 max	max 3 if no transect
8 (a) (i)	sprayed / added to crops (to kill insect pests); idea of persisting, in / on, plant crop or passed onto animals (food chain); ref. to leaching / run off, into water courses / AW; water to water treatment plant / used as drinking water / used as water	2 max	

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	source;		
8 (a) (ii)	ref. to affecting nervous system / nerve agents; ACh not broken down / synaptic transmission impaired / AW; continuous stimulation of post-synaptic membranes; AVP; e.g. detail of inhibition	2 max	
8 (a) (iii)	partially permeable membrane; allows organophosphate to diffuse through; biological recognition layer; (contains) immobilised acetylcholinesterase; organophosphate binds to acetylcholinesterase; (because of) complementary shape to active site / binds elsewhere on enzyme; A ref. to action of competitive / non-competitive inhibitor ref. to adding acetylcholine (to obtain product / acetate / choline and acetate); (organophosphate binding) product formation inhibited; ref. to higher concentration of organophosphate linked to greater inhibition / less product; acetate / H ⁺ / choline, detected by transducer / electrode; converted to electric signal / impulse / current;	5 max	allow mps from suitable labelled / annotated diagram max 4 if principle of inhibition not noted (e.g. organophosphate in river water sample and acetylcholine added as substrate)
8 (a) (iv)	any three valid, e.g. sensitive / detection of small concentrations; accurate; quantitative; rapid results; portable / can test in the field; continuous monitoring; (very) specific; reusable; ease of use; small sample only required;	3 max	
8 (b) (i)	ref. to specificity (of immobilised, molecule / enzyme); glyphosate, wrong shape / not complementary shape / doesn't fit (e.g. at active site) / different enzyme needed / AW; binding does not occur; require enzyme(s) that are, inhibited by / complementary to, glyphosate;	2 max	
8 (b) (ii)	<i>Advantages</i> increased yield; reduces competition / AW; makes glyphosate selective / AW; can use weed killer when crops are growing (for maximum effect); AVP; e.g. only killing weeds, not crop plants / crop plants do not die 1 max <i>Disadvantages</i> ref. to unknown harmful effects to humans;	2 max	

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	idea of 'superweeds' / gene transfer; may encourage overuse of glyphosate; ref. to effects of above e.g. bioaccumulation, pollution; reduction of biodiversity; AVP; e.g. may affect crop quality		
8 (c)	(both) catalyse / speed up, reactions; <i>restriction endonuclease enzyme</i> to cleave / cut out / desired gene / AW; ref. to recognition of specific sequences; ref. to 'sticky ends' / staggered cuts; to cleave / cut plasmid; for gene insertion; 3 max <i>DNA ligase</i> seal sugar-phosphate backbone; formation of phosphodiester bonds; (desired) gene spliced / sealed / AW, into vector / plasmid; forms recombinant DNA	4 max	