

Question	Marking Guidelines	Mark	Comments
1(a)	Crabgrass;	1	Reject: grass or grassland Reject: crabgrass if another organism is also included
1(b)	<ol style="list-style-type: none"> 1. Species/plants/animals change the environment/conditions/add humus/nutrients etc.; 2. Less hostile (habitat); 3. Species/plants better competitors; 	2 max	<p>Accept 'they' for species/plants in mark points 1 and 3</p> <p>Allow 'more hospitable' or equivalent for mark point 2</p>
1(c)	(Only) plants which can photosynthesise with less light (remain);	1	<p>Accept converse but do not award mark for idea that plants cannot photosynthesise and die because there is no light</p> <p>Answers must be in context of being or not being able to photosynthesise with less light</p>

Question	Marking Guidelines	Mark	Comments
2(a)	Is always expressed/shown (in the phenotype);	1	Reject 'is always present' without further qualification
2(b)	$C^B C^B$, $C^B C^P$ and $C^B C^Y$; <u>Or</u> $C^B C^B$, $C^P C^B$ and $C^Y C^B$;	1	All three are required for the mark Accept $C^B C^B$, $C^B C^P$, $C^B C^Y$, $C^Y C^B$ and $C^P C^B$ Accept BB, BP and BY <u>or</u> BB, BP, BY, YB and PB
2(c)	1. Two genotypes (as parents) shown as $C^P C^Y$ <u>Or</u> Two sets of gametes shown as C^P and C^Y ; 2. Genotypes of offspring shown as $C^P C^Y$, $C^P C^P$ and $C^Y C^Y$; 3. Above genotypes of offspring correctly linked to phenotypes i.e. pink and yellow;	3	Award one mark maximum for candidates who have misread the question and complete a correct genetic cross between a pink snail, $C^P C^Y$ and a yellow snail, $C^Y C^Y$ to give pink and yellow offspring Accept ratio (or equivalent) of 3 pink: 1 yellow for mark point 3
2(d)	1. Correct answer of 42%;;; = 3 marks 2. $q^2 = 0.49/49\%$ OR $q = 0.7/70\%$; 3. Shows understanding that $2pq$ = heterozygotes / carriers / shows answer is derived from $2pq$;	3	Answer of 0.42 = 2 marks Award one mark maximum for answer of 49.9/49.98/50% or 0.49/0.5 Award one mark maximum for answer of 40.8/41% or 0.41 Accept: $b^2 = 0.49/49\%$ or $b = 0.7/70\%$ for mark point 2

Question	Marking Guidelines	Mark	Comments
3(a)	All/group of species / all/group of populations / all the organisms;	1	<p>Accept equivalent terms for group.</p> <p>Answers which only refer to organisms must have idea of all the organisms not just a group of organisms</p> <p>Reject answers which include 'environment' or abiotic factors as part of the definition</p>
3(b)(i)	7.2 – 8.4 (metres);	1	Accept answer of 1.2
3(b)(ii)	<ol style="list-style-type: none"> 1. Food / prey / oxygen; 2. Less/no competition; 	2	<p>Do not accept 'resource' for mark point 1 unless this is qualified as food/prey/oxygen</p> <p>Reference to light and CO₂ as a resource negates mark point 2</p> <p>Ignore intraspecific/interspecific for mark point 2</p>
3(c)	<ol style="list-style-type: none"> 1. Increase in depth linked to decrease in temperature / decrease in depth linked to increase in temperature; 2. Correlation/relationship between temperature and fish distribution does not indicate a causal effect; 3. Overlap in ranges / different fish/species occupy same depth; 4. Other abiotic/biotic/named factor involved; 	3 max	<p>Accept increase or decrease in temperature is related to 'higher depth' or 'lower depth' due to ambiguity of these terms</p> <p>Ignore any reference to correlation unless it is clearly in context of temperature and fish distribution</p> <p>Temperature does not determine fish distribution is not sufficient for idea of causal effect</p> <p>Reject: 'casual' for mark point 2</p> <p>Reject 'other factors' for mark point 4 unless further qualified</p>

Question	Marking Guidance	Mark	Comments
4(a)	One/an amino acid (can be) coded for by more than one triplet;	1	Accept codon for triplet Accept description of triplet – <u>three</u> bases/nucleotides
4(b)	1. Triplet/three bases on mRNA; 2. That code for an amino acid;	2	1. Accept nucleotide for base 1. Accept DNA for mRNA 1. Ignore references to RNA unqualified 2. Accept code for stop/start
4(c)(i)	To join <u>nucleotides</u> together to form mRNA/premRNA/RNA;	1	Reject forming base pairs Accept checking and correcting mismatched base pairs
4(c)(ii)	Reverse transcriptase;	1	If they give two enzymes, no mark
4(d)	GGATCC same as CCTAGG in opposite direction;	1	Accept reads same both ways/same forward and back Neutral bases are the opposite of each other/reference to base pairs

Question	Marking Guidelines	Mark	Comments
5(a)	<ol style="list-style-type: none"> 1. Specific (to one pest); 2. Only needs one application/ reproduces; 3. Keeps population low; 4. Pests do not develop resistance; 5. Does not leave chemical in environment/on crop / no bioaccumulation; 6. Can be used in organic farming; 	2 max	<p>Ignore reference to leaching or eutrophication</p> <p>Reference to immunity disqualifies mark point 4</p>
5(b)	<ol style="list-style-type: none"> 1. Increases, rapid decrease, constant/level/fluctuates; 2. Accept any one of increases at 3/4 weeks / increases to 8 weeks / peaks at 8 weeks / levels at 10 weeks; 	2	<p>Allow equivalent terms for description of the three main changes described in mark point 1</p> <p>Ignore any reference to initial decrease</p> <p>Allow steep decrease as equivalent to rapid decrease in mark point 1 but reject large/significant decrease unless further qualified</p> <p>Accept any one of following for mark point 2</p> <p>Increases to any value between 8 and 9% / peaks at any value between 8 and 9% / decreases to any % below 2%</p>
5(c)	<ol style="list-style-type: none"> 1. Decrease number of pests / (two-spotted) mite / decrease in % (of leaves occupied); 2. Remains at low numbers / remains below 2%; 	2	<p>Accept any % below 2% for mark point 2</p>

<p>5(d)</p>	<ol style="list-style-type: none"> 1. Cost of treatment/biological control; 2. Takes (a long) time to act; 3. Pest/two-spotted mite is not completely removed; 4. May become a pest/damage/eat crop; 	<p>2 max</p>	
<p>5(e)</p>	<ol style="list-style-type: none"> 1. Pesticide kills predatory mites / other predators / two-spotted mites are <u>resistant</u>; 2. Two-spotted mite reproduces; 	<p>2</p>	<p>Accept breed/multiply for mark point 2</p>

Question	Marking Guidance	Mark	Comments
6(a)	Cytosine with Guanine <u>and</u> (Adenine) with Uracil;	1	Ignore G, C and U
6(b)	<p>Two reasons, with suitable amplification;;</p> <p>Only infected cells have HIV protein on surface;</p> <p>So carrier only attaches to/specific to these cells/siRNA can only enter these cells;</p> <p>OR</p> <p>siRNA (base sequence) complementary/specific to one mRNA;</p> <p>Only infected cells contain mRNA of HIV/this gene/ stops translation of this gene/only binds to this mRNA /destroys this mRNA;</p>	4 max	<p>Q</p> <p>Accept idea of specificity</p> <p>Accept could not inhibit other/non- HIV mRNA</p>
6(c)	<ol style="list-style-type: none"> 1. Carrier binds to (protein on) HIV; 2. Prevents HIV/it binding to (receptor on human) cell; 	2	<ol style="list-style-type: none"> 1. Accept references to HIV membrane <p>Reject references to binding to HIV protein on human cell</p>

Question	Marking Guidelines	Mark	Comments
7(a)	<ol style="list-style-type: none"> 1. Is widely/commonly used; 2. Provides a standard/benchmark/reference; 3. Produces large amount of carbon dioxide; 4. Is a decreasing resource / could be replaced by biofuel; 	2 max	<p>Allow a variety of descriptors for marking point 2 e.g. 'provides a base line', 'produces known amount of carbon dioxide'</p> <p>Mark point 2, do not accept 'for comparison' on its own as 'comparison' is in stem of question</p> <p>Ignore reference to a control</p>
7(b)	<ol style="list-style-type: none"> 1. Independent / no bias / trustworthy; 2. Non-profit making; 3. (Focused on) effect on environment/climate; 	2 max	
7(c)(i)	<ol style="list-style-type: none"> 1. Most/3 biofuels show reduction in CO₂/negative % change in CO₂; 2. (But) soy-based biodiesel is positive/ shows an increase in CO₂; 3. CO₂ is a greenhouse gas; 4. Global warming (affected); 5. Other 'greenhouse gases'/ methane/nitrous oxide/water vapour etc. (affect climate); 	4 max	<p>Allow reference to figures for mark points 1 and 2</p> <p>Must show that so-based biodiesel is positive or increases rather than simply 'it doesn't decrease'</p>
7(c)(ii)	<ol style="list-style-type: none"> 1. CO₂ taken up in <u>photosynthesis</u>; 2. More taken up than produced (when it is used); 3. Less CO₂ produced than petrol; 	2 max	

<p>7(d)</p>	<ol style="list-style-type: none"> 1. (These microorganisms) don't have (cellulose-digesting) enzymes; 2. (Cellulose) is a polysaccharide/polymer/long (molecule/chain); 3. (Cellulose) is insoluble / glucose/product of digestion is soluble; 4. Broken down into glucose/monomers /monosaccharides; 5. Sugars/glucose used in glycolysis / glucose can be converted to pyruvate; 6. Produces more ethanol/fuel produces ethanol/fuel quicker; 	<p>3 max</p>	<p>Accept 'don't make enough of these enzymes' for mark point 1</p> <p>Accept 'large' for mark point 2</p> <p>Ignore (alpha) glucose for mark point 4. Do not accept sugars for mark point 4</p> <p>Accept 'speeds up process' for mark point 6</p>
<p>7(e)</p>	<ol style="list-style-type: none"> 1. Removes species / fewer species / growth of single crop / single plant species / monoculture; 2. Removes habitats / fewer habitats/niches /only one habitat; 3. Removes variety of food sources / fewer food sources / only one food source; 	<p>2 max</p>	<p>Deforestation or removal of hedges on its own should not be credited</p>

Question	Marking Guidance	Mark	Comments
8(a)	<ol style="list-style-type: none"> 1. Carriers are heterozygous/have one normal copy and one mutant copy of gene/have one recessive allele/don't have the condition; 2. Both have DNA that binds (about) half/50% amount of probe (that non-carrier does); 3. Probe binds to dominant/healthy allele; 4. So only one copy of exon in their DNA/ have one copy of gene without exon/base sequence for probe to bind to; 	3 max	<ol style="list-style-type: none"> 3. Accept normal and gene 4. Accept have <u>a</u> deletion mutation
8(b)	<ol style="list-style-type: none"> 1. Introns not translated/not in mRNA; 2. (Exons) code for amino acids/introns do not code for amino acids; 3. Mutations of these (exons) affect amino acid sequences; 4. (That produce) faulty protein/change tertiary structure of protein; 5. So important to know if parents' exons affected, rather than any other part of DNA/introns; 	3 max	<ol style="list-style-type: none"> 1. Accept not expressed 2. Accept polypeptide/protein for amino acids 3. Accept deletion leads to frameshift 4. In this context, accept affects protein made <p>Accept converse arguments involving – eg introns do not code for amino acids/proteins</p> <p>Reject references to making amino acids, once</p>
8(c)	<ol style="list-style-type: none"> 1. Restriction mapping/described; 2. DNA/base sequencing (of fragments)/ description/name of method; 	2	

Question	Marking Guidance	Mark	Comments
9(a)	<ol style="list-style-type: none"> No effect at 25°C; Keeps growing at 30°C and 35°C/up to 35°C (more than without GB); Above 35°C, falls but grows more than plant without GB; 	2 max	<p>The question only refers to plants <u>with</u> GB</p> <ol style="list-style-type: none"> Reject same mass Accept at all temperatures above 25°C more growth than without GB
9(b)(i)	<u>Significantly</u> different /SEs do not overlap ;	1	Accept converse without GB
9(b)(ii)	<p>(As temperature increases,)</p> <ol style="list-style-type: none"> Enzyme activity reduced/(some) enzymes denatured; Less photosynthesis, so fewer sugars formed; Less (complex) biological molecules/organic substances made (that add to mass); Less respiration; Less energy/ATP for growth; Less energy for named function associated with growth 	4 max	<ol style="list-style-type: none"> Accept named (significant) substance – eg cellulose. Do not accept glucose/simple sugars Eg mitosis, uptake of mineral ions
9(c)	<ol style="list-style-type: none"> (Rubisco activase attaches to thylakoid and) this changes shape/tertiary structure (of enzyme)/blocks active site/changes active site; (This) prevents substrate/RuBP entering active site/binding; 	2	<p>Note – question states enzyme stops working when it attaches to thylakoid, not before</p> <ol style="list-style-type: none"> Accept rubisco in this context Accept prevents ES complex forming Accept no longer complementary to substrate/RuBP

<p>9(d)</p>	<ol style="list-style-type: none"> 1. GB prevents/reduces binding of rubiscoactivase to (thylakoid membrane); 2. (Prevents it) up to 35°C; 3. (So) rubiscoactivase/enzyme remains active; 4. (So) photosynthesis/light-independent stage still happens; 5. Above 35°C, some binding still occurs but less than without GB, so less reduction in growth; 	<p>4 max</p>	<ol style="list-style-type: none"> 1. Accept enzyme instead of rubiscoactivase. Accept rubisco 4. Accept descriptions of light-independent stage
<p>9(e)</p>	<ol style="list-style-type: none"> 1. Looked for information/journals, on crop plants that grow at high temperatures; 2. (Crop plants cited in this research) contain/make GB; 3. So assumed making plants produce GB makes them resistant to high temperatures; 	<p>2 max</p>	<ol style="list-style-type: none"> 1. "other research" is minimum accepted 1. Accept previous experiments research with temperature resistant crops <p>Ignore simple references to looking at previous studies/other plants – need to relate to this context</p>

Additional notes on marking Question 10

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will be. In fact, extra credit is given for those who show evidence of a greater breadth of study. These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally come from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

Question	Marking Guidance	Mark	Comments
10(a)	<p>1.M Membrane function as selectively permeable barrier</p> <p>1.T Transport mechanisms across membranes</p> <p>1.CT Absorption and co-transport of sodium ions and glucose</p> <p>2.P Photosynthesis, chloroplast, thylakoids</p> <p>2.R Respiration, mitochondrion and cristae</p> <p>2.Ps Protein secretion, RER, SER and Golgi</p> <p>3.A Surface receptors/antigen and immune response</p> <p>3.CD Cell division</p> <p>3.B Vertical and horizontal transmission – membranes and bacteria</p> <p>3.Pc Pacinian corpuscle</p> <p>4.Tr Tropisms – movement of IAA</p> <p>4.N Nerve impulses/action potentials</p> <p>4.S Synaptic transmission</p> <p>4.Mc Muscle contraction, calcium ion movement/storage</p> <p>4.H Hormones - eg Blood glucose regulation – insulin and glucagon</p> <p>4.O Osmosis, including water movement in plants</p>	25	<p>Examiners are free to select other letters if they wish</p> <p>The emphasis in answers should be on the <u>involvement of membranes</u> in processes, not just the processes themselves</p> <p>Breadth, one mark for use of an example from each of the following approaches:</p> <ol style="list-style-type: none"> 1. Membranes – basic functions 2. Organelle membranes 3. Cell surface membranes 4. Processes – eg protein secretion, synaptic transmission, cell division

Question	Marking Guidance	Mark	Comments
10(b)	<p>1.P Pathogens and effects on host</p> <p>1.CH Cholera</p> <p>1.TB TB</p> <p>2.T Taxonomy</p> <p>2.C Classification and evolution</p> <p>2.I Inheritance and evolution</p> <p>2.Gc Genetic code, universal</p> <p>2.B Behaviour</p> <p>2.Ev Populations and evolution, variation between individuals within a species</p> <p>3.BP Relationships within ecosystems – eg predator/prey</p> <p>3.E Energy transfer in ecosystems</p> <p>3.N Nutrient cycles, the organisms involved</p> <p>3.S Succession, biodiversity, species and individuals in a community</p> <p>4.H Human impacts on the environment and its effect on relationships between organisms – including farming</p> <p>4.Gt Gene technology and GMO and selective breeding</p> <p>4.Ar Antibiotic resistance</p>	25	<p>Examiners are free to select other letters if they wish</p> <p>The emphasis in answers should be on the <u>relationships and interactions between organisms</u> not just the topics themselves</p> <p>Breadth, one mark for use of an example from each of the following approaches – <u>3 max</u>:</p> <ol style="list-style-type: none"> 1. Pathogen and host 2. Evolution (related topics) 3. Ecological 4. Human intervention in relationships