

Question	Marking Guidance	Mark	Comments
1(a)	(Number of) organisms of one species in a habitat / same place;	1	
1(b)(i)	$B + I = D + E$ / $(B + I) - (D + E) = 0$ // $(B - D) + (I - E) = 0$;	1	Allow word equations.
1(b)(ii)	$B + I > D + E$ / $(B - D) + (I - E) > 0$ // $(B + I) - (D + E) > 0$;	1	
1(c)(i)	Improved medical care / improved nutrition / improved sanitation/water treatment / lower infection rates / less disease;	1	Allow any specific examples of improved health or medical care e.g. vaccinations, health education
1(c)(ii)	Correct answer of 108 605 000 = 2 marks;; 107 000 x 15 / 107 million x 0.015 / 1605 000 / (deaths) 535 000 and (births) 2140 000;	2	

Question	Marking Guidance	Mark	Comments
2(a)(i)	Only expressed/shown (in the phenotype) when homozygous / two (alleles) are present / when no dominant allele / is not expressed when heterozygous;	1	
2(a)(ii)	Both alleles are expressed/shown (in the phenotype);	1	Allow both alleles contribute (to the phenotype).
2(b)(i)	<p><u>Evidence</u> (not a mark) 3 and 4 / two Rhesus positives produce Rhesus negative child/children / 7 / 9;</p> <p><u>Explanation</u> (not a mark) <u>Both</u> Rhesus positives/3 <u>and</u> 4 carry recessive (allele)/ are heterozygous / if Rhesus positive was recessive, all children (of 3 and 4) would be Rhesus positive/recessive;</p>	2	<p>Do not negate mark if candidate refers to gene rather than allele.</p> <p>Answers including correct and incorrect evidence = zero marks evidence and explanation.</p>

2(b)(ii)	<p><u>Evidence</u> (not a mark)</p> <p>3 would not be/is Rhesus positive / would be Rhesus negative;</p> <p><u>Explanation</u> (not a mark)</p> <p>3 would receive Rhesus negative (allele) on X (chromosome) from mother / 3 could <u>not</u> receive Rhesus positive (allele) from mother / 3 would not receive Rhesus positive (allele)/X (chromosome) from father/1 / 3 will receive Y (chromosome) from father/1;</p> <p>OR</p> <p><u>Evidence</u> (not a mark)</p> <p>9 would be Rhesus positive / would not be/is Rhesus negative / 8 and 9/all daughters of 3 and 4 would be Rhesus positive;</p> <p><u>Explanation</u> (not a mark)</p> <p>As 9 would receive X chromosome/dominant allele from father/3;</p>	2	<p>Do not negate mark if candidate refers to gene rather than allele.</p> <p>One mark for evidence and one mark for explanation linked to this evidence.</p> <p>Any reference to allele being on Y chromosome negates mark for explanation.</p>
2(c)	<p>Correct answer of 48(%) = 3 marks;;;</p> <p>$q^2/p^2 = 16\%/0.16$ / $p/q = 0.4$;</p> <p>Shows that $2pq$ = heterozygotes / carriers;</p>	3	<p>Final answer of 0.48 = 2 marks</p> <p>Allow mark for identifying heterozygotes if candidate multiplies incorrect p and q values by 2.</p>

Question 3: N/A

Question	Marking Guidance	Mark	Comments
4(a)(i)	Decrease in spadefoot toad; Decrease in southern toad up to 4 newts per pond, then increase (at 8 newts per pond);	2	Allow one mark for answers stating decrease in both toad species;
4(a)(ii)	Predators/newts eat/feed/prey on toad (tadpoles); Less competition more food/resources / fewer toads feeding on frogs;	2	Allow first mark if reference is made to either toad species being eaten. For first mark candidate must clearly indicate that the newts are feeding on the toads. Answers simply stating that newts are increasing and toads are decreasing are not sufficient.
4(b)	Fewer toads/tadpoles (as number of predators increases in Figure 1); More food, so are larger / grow more / increase in mass;	2	If candidate clearly indicates fewer frog tadpoles survive, negate the first marking point. However, accept decrease in overall number of tadpoles which may include frog tadpoles.

Question	Marking Guidance	Mark	Comments
5(a)	Restriction / endonuclease;	1	Ignore specific names of restriction enzymes e.g. EcoR1
5(b)(i)	1. (Acts as a) marker gene; 2. Shows that the (human) gene has been taken up/expressed; 3. (Only) implant cells/embryos that show fluorescence / contain the jellyfish gene;	2 max	1. Accept: gene marker
5(b)(ii)	1. Factor IX present in / extracted from milk; 2. Gene only expressed in mammary glands/udder / gene not expressed elsewhere; 3. Do not need to kill sheep (to obtain Factor IX);	2 max	2. Ignore references to milk The 'only' aspect is important here.
5(c)(i)	1. Mutation / nucleus/ chromosomes/DNA may be damaged / disrupts genes; 2. May interfere with proteins (produced)/gene expression/ translation; OR 3. Embryo/antigens foreign; 4. Embryo is rejected/attacked by immune system;	2 max	1. Neutral: cell may be damaged Ignore references to hormone levels or time of implantation 3. Neutral: antigens change 4. Need idea that the immune system is involved if mark point 3 has not been given 'Embryo foreign so rejected' = 2 marks 'Embryo rejected by immune system' = 1 mark 'Embryo is rejected' = 0 marks
5(c)(ii)	1. Saves time/money for others; 2. Same work is not repeated / methods can be compared/improved/ amended/ same errors are not made;	2	
Question 6: N/A			

Question	Marking Guidance	Mark	Comments
7(a)(i)	Reduced cost; Less feed / less land use / more growth rate with same amount of food;	2	Allow is 'cost effective'
7(a)(ii)	Amount of food taken in less than expected.	1	Allow 'expected food intake is higher, Allow 'food intake is lower than it should be'
7(b)	<u>Type of food</u> (not a mark) 1. May vary in protein/fat/carbohydrate/fibre/roughage/ vitamins/minerals; 2. May affect absorption / digestibility / energy value / tastiness / growth / overall food intake; <u>Temperature</u> (not a mark) 3. Will affect <u>heat</u> loss/gain/respiration/metabolism; 4. (Need) to maintain/regulate body temperature; 5. More food/energy can be used for growth;	4 max	For mark point 1 allow appropriately named food compound e.g. cellulose, glucose For mark point 2 it must be clear that these factors are affected by the type of food. Note: two maximum marks for effect of temperature.
7(c)(i)	RFI does not affect methane production / There is no difference in the rate of methane production for low and high RFI values / The difference between the rates of methane production is due to chance / No correlation/relationship/link between RFI and methane production;	1	Any clear statement that there is no link between RFI and methane production should be credited.

7(c)(ii)	(Cattle with low RFI) produce less methane; Methane linked to greenhouse effect;	2	
7(d)(i)	Sulfate without straw;	1	
7(d)(ii)	<ol style="list-style-type: none"> 1. May affect yield / damages rice crop; 2. Substance/treatment may affect other organisms/ environment; 3. Cost of substance/application/labour; 4. Method/frequency/timing of application / amount of substance required; 	2 max	
7(d)(iii)	<p>Not flooded aerobic conditions/more oxygen / with flooding anaerobic conditions/less oxygen;</p> <p>Not flooded fewer/less active anaerobic microorganisms/respiration / not flooded more/more active aerobic microorganisms/respiration;</p>	2	

Question	Marking Guidance	Mark	Comments
8(a)	<ol style="list-style-type: none"> 1. (Colonisation by) <u>pioneer</u> (species); 2. Change in environment / example of change caused by organisms present; 3. Enables other <u>species</u> to colonise/survive; 4. Change in <u>diversity/biodiversity</u>; 5. Stability increases / less hostile environment; 6. Climax community; 	5 max	<p>Example of change e.g. formation of soil/humus/ organic matter / increase in nutrients;</p> <p>Do not accept genetic diversity for mark point 4.</p>
8(b)	<p><u>Advantages</u></p> <ol style="list-style-type: none"> 1. Specific (to one pest); 2. Only needs one application/ reproduces; 3. Keeps/maintains low population; 4. Pests do not develop resistance; 5. Does not leave chemical in environment/on crop / no bioaccumulation; 6. Can be used in organic farming; <p><u>Disadvantages</u></p> <ol style="list-style-type: none"> 7. Does not get rid of pest completely; 8. May become a pest itself; 9. Slow acting/ lag phase/ takes time to reduce pest population; 	5 max	<p>Max 3 for advantages or disadvantages.</p> <p>Ignore references to leaching, eutrophication.</p> <p>Ignore references to cost.</p>

8(c)	<ol style="list-style-type: none">1. <u>Geographical isolation</u>;2. Separate gene pools / no interbreeding (between populations);3. Variation due to mutation;4. Different environmental/abiotic/biotic conditions / selection pressures;5. Selection for different/advantageous, features/characteristics/mutation/ /allele;6. Differential reproductive success / (selected) organisms survive and reproduce;7. Leads to change in <u>allele</u> frequency;8. Occurs over a long period of time;	5 max	In this question must refer to allele where appropriate, not gene.
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Question	Marking Guidance	Mark	Comments
9(a)(i)	1. Negative correlation; 2. Wide range; 3. Overlap; 4. (Graph suggests that) other factors may be involved (in age of onset);	3 max	1. Accept: description for 'negative correlation' Neutral: 'correlation' Reject: positive correlation 2/3 Accept the use of figures from the graph 2/3 Can refer to age of onset or number of CAG repeats Ignore references to methodology
9(a)(ii)	1. Age of onset can be high / symptoms appear later in life; 2. (So) individuals have already had children / allele has been passed on; OR 3. Individuals have passed on the allele / already had children; 4. Before symptoms occur;	2 max	Accept: 'gene' for 'allele'
9(b)(i)	1. Person K ; 2. (As has) high(est) band/band that travelled a short(est) distance/slow(er) <u>so</u> has large(st) fragment/number of CAG repeats;	2	2. Must correctly link distance moved and fragment size
9(b)(ii)	Run fragments of known length / CAG repeats (at the same time);	1	Accept: references to a DNA ladder / DNA markers Do not accept DNA sequencing
9(b)(iii)	Homozygous / (CAG) fragments are the same length/size/mass;	1	Accept: small fragment has run off gel / travelled further

Question	Marking Guidance	Mark	Comments
10(a)	1. 21 or 21.4; 2. One mark for the principle of difference/initial;	2	Correct answer = 2 marks outright Ignore number of decimal places
10(b)(i)	Water intake linked to sweating / panting;	1	Neutral: ref. to urine Neutral: dehydration
10(b)(ii)	1. Food intake linked to (increased) <u>respiration</u> ; 2. Food intake linked to heat/energy release / maintaining body temperature;	2	1. Not 'increased metabolism' Reject: decreases respiration Neutral: references to environmental temperature increasing 2. This mark is independent of 1
10(c)	1. Increased sweating so less water available (for milk production); 2. Less food so less energy/nutrients available (for milk production); 3. Enzymes not working at optimum temperature;	1 max	2. Not just 'less energy available (for milk production)' 3. Reject: references to enzyme denaturation
10(d)	(Skin temperature) 1. Varies/fluctuates more / more heat lost/gained / (can be) further from core; 2. (As) more affected by environment / sweating / conduction / convection / radiation;	2	Accept: converse arguments for rectal temperature 2. Accept: 'not affected by' in relation to rectal temperature Accept: named environmental factors Accept: idea that skin is more exposed to the environment Accept refs. to vasoconstriction / vasodilation
10(e)	Select a bull whose mother/offspring produced a high milk yield;	1	

10(f)	<ol style="list-style-type: none"> 1. Allows comparison; 2. (As) different countries have different population/ sample sizes; 	2	
10(g)	<ol style="list-style-type: none"> 1. (Selective) advantage producing lactase/ being lactose tolerant/able to digest milk/able to eat dairy foods; 2. People (producing lactase) reproduce; 3. (And) pass on gene/allele; 4. <u>Allele</u> frequency increases; 	4	<p>Accept: converse arguments for people who are lactose intolerant</p> <p>If mark point 2 has not already been given, then mark point 3 automatically gains 2 marks as reproduction must have occurred</p> <p>4. Neutral: gene frequency increases / allele frequency changes</p> <p>Must be clearly stated and not implied</p>

Additional notes on marking Question 11

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 11**Essay A - The importance of shapes fitting together in cells and organisms**

Section	Topic
	Proteins & Enzymes
3.1.2	Enzyme properties and digestion
3.1.2	Protein structure
3.1.3	Plasma membrane structure and cell transport
3.1.6	Antigens, antibodies, B cells & T cells
3.1.6	Vaccines
	Nucleic Acids
3.2.2	Structure of DNA
3.2.5	DNA Replication (not PCR)
3.5.7	Transcription & translation
3.5.8	Transcriptional factors, oestrogen, siRNA
3.5.8	Restriction enzymes
	Physiology
3.2.4	Haemoglobin
3.5.2	Action potentials & synaptic transmission
3.5.3	Muscle contraction
3.5.4	Control of blood glucose concentration
3.5.5	Control of mammalian oestrous cycle

Question 10**Essay B - How bacteria can affect the lives of humans and other organisms**

Section	Topic
	Bacteria & Disease
3.1.1	Pathogens
3.1.2	Lactose intolerance
3.1.3	Cholera
3.1.4	Tuberculosis
3.2.10	Resistance to antibiotics
	Ecological Importance
3.4.6	Carbon cycle
3.4.6	Nitrogen cycle
3.4.6	Eutrophication
	Making Use of Bacteria
3.5.8	Use of bacterial enzymes e.g. restriction endonuclease, DNA polymerase for PCR
3.5.8	Use of bacterial plasmids e.g. <i>in vivo</i> gene cloning, genetically-modified crops, gene therapy
3.5.8	Use of bacteria to produce useful chemicals