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General Certificate of Education (A-level)
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Biology BIOL5

(Specification 2410)

Unit 5: Control in Cells and in Organisms

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Question	Marking Guidance	Mark	Comments
1(a)	One/an amino acid (can be) coded for by more than one triplet;	1	Accept codon for triplet Accept description of triplet – three bases/nucleotides
1(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
1(c)(i)	To join nucleotides together to form mRNA/premRNA/RNA;	1	Reject forming base pairs Accept checking and correcting mismatched base pairs
1(c)(ii)	Reverse transcriptase;	1	If they give two enzymes, no mark
1(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 Guidance	Mark	Comments
2(a)(i)	1. Moves out of the way when calcium ions bind; 2. Allowing myosin to bind (to actin)/crossbridge formation;	2	1. Accept shape change with Ca^{2+} 1. Don't accept just "calcium" 1. Accept presence of calcium ions leads to movement instead of binds Accept references to troponin
2(a)(ii)	1. Head (of myosin) binds to actin and moves/pulls/slides actin past; 2. (Myosin) detaches from actin and re-sets/moves further along (actin) 3. This uses ATP;	2 max	**Q** 1. Accept myosin power stroke (to move actin) 1. Accept push 1. Accept crossbridges form instead of myosin head binds to actin 1. Must refer to myosin head or crossbridges
2(b)(i)	1. (Glycogen broken down) gives (lots of) glucose for glycolysis/anaerobic respiration; 2. Glycolysis/anaerobic respiration not very efficient/only yields 2 ATP per glucose;	2	1. Give if context of anaerobic respiration clear 2. Accept anaerobic respiration is a quick source of ATP for exercise 2. Accept very little ATP
2(b)(ii)	1. (Many capillaries) give high concentration/lots of oxygen/ shorter diffusion pathway for oxygen/large surface area for oxygen exchange/diffusion; 2. Good glucose supply with little glycogen present; 3. Allows high rate of/more aerobic respiration ***OR*** prevents build-up of lactic acid/(muscle) fatigue;	2 max	3. Accept idea of aerobic respiration during endurance events/long periods of exercise

Question	Marking Guidance	Mark	Comments
3(a)	Three changes described;;; Eg 1. Formation/growth of vacuole; 2. Formation of starch grains/amyloplasts; 3. Movement of grains/amyloplasts towards bottom of cell; 4. Cells get longer/wider/larger;	3 max	Neutral nucleus shrinks, since it doesn't 2. Accept starch grains get bigger Note – list rule applies
3(b)	1. Grows sideways before starch grains form; 2. Bending starts when/as grains form; 3. More bending as grains increase in number; 4. More elongation (of cells)/growth (of roots) downwards as starch grains increase/move; 5. Bending starts before grains move down; 6. Could be related to vacuole;	3 max	**Q** 3. Ignore starch grain growth references 6. Ignore references to nucleus
3(c)	1. Greater (elongation) growth on top of root/less growth on bottom of root; 2. (IAA) at bottom of root/where IAA concentration high inhibits expansion/elongation (of cells); 3. (IAA) at top of root/where IAA concentration low leads to expansion/elongation (of cells);	2 max	Ignore references to effects of IAA on cell division Reject references to cell shrinkage 2 and 3 need reference to expansion/elongation, not just growth 3. Accept less inhibition

Question	Marking Guidance	Mark	Comments
4(a)	1. Positive correlation between sucrose and dopamine concentrations/higher concentration of sucrose, more dopamine; 2. So (dopamine) makes them want to drink/eat more (sucrose); 3. Positive feedback because drinking/eating leads to wanting to drink/eat (even) more;	3	**Q** NB question is 'How <u>do</u> these ...', not 'Do these .... 1. Ignore simple statements of numbers from graph without description of trend 3. It must be a clear statement of why this example is positive feedback, not inferred from points 1 and 2
4(b)	1. (Refractory period) leads to discrete/separate nerve impulses/time when another nerve impulse can't happen; ***OR*** (Refractory period) limits number of impulses per second/frequency of nerve impulses; 2. When maximum frequency reached/exceeded, no further increase in information/all (higher) concentrations of sucrose seem the same;	2	
4(c)	1. (Negative feedback) stops desire/wish to eat/appetite; 2. (This) limits amount eaten/stops eating; 3. Prevents/reduces risk of obesity/too much energy intake;	3	1. Accept stops dopamine release (in this context) 1. Accept makes them feel full 2. Accept prevents constant eating 3. Accept prevents vomiting Accept descriptions based on what would happen in absence of the feedback mechanism – or if stomach empty for points 1 and 2

Question	Marking Guidance	Mark	Comments
5(a)	4.9/4.89;; 38.62 – 36.82; 36.82	2 max	Correct answer = 2 marks
5(b)	Suitable reason with explanation;; Eg Suit prevents loss of sweat; So heat of evaporation not lost; ***OR*** Water (initially) at higher temperature than skin/body/blood; (So) heat gained/less lost (by conduction/convection);	2 max	Accept idea of no heat gradient Ignore references to 'by radiation'
5(c)	1. Yes for temperature and oxygen consumption/no for carbon dioxide; 2. Because P value (equal to, or) less than 0.05 (other than carbon dioxide)/ P value greater than 0.05 (for carbon dioxide);	2	2. Here assume understanding that 0.001 is less than 0.05 2. Accept correct use of < and > for less than and more than 2. Accept valid responses based on greater or less than 95%
5(d)	1. Increased temperature leads to faster enzyme activity; 2. Faster rate of respiration (and oxygen consumption);	2	1. Accept faster metabolism 2. Accept more oxygen for respiration to mean more respiration

Question	Marking Guidance	Mark	Comments
6(a)	Cytosine with Guanine <u>and</u> (Adenine) with Uracil;	1	Ignore G, C and U
6(b)	Two reasons, with suitable amplification;; Only infected cells have HIV protein on surface; So carrier only attaches to/specific to these cells/siRNA can only enter these cells; ***OR*** siRNA (base sequence) complementary/specific to one mRNA; Only infected cells contain mRNA of HIV/this gene/ stops translation of this gene/only binds to this mRNA /destroys this mRNA;	4 max	**Q** Accept idea of specificity Accept could not inhibit other/non- HIV mRNA
6(c)	1. Carrier binds to (protein on) HIV; 2. Prevents HIV/it binding to (receptor on human) cell;	2	1. Accept references to HIV membrane Reject references to binding to HIV protein on human cell

Question	Marking Guidance	Mark	Comments
7(a)	1. Causes sodium ion channels to open; 2. Sodium ions enter (cell and cause depolarisation);	2	1. Reject if wrong sequence of events Reject sodium on its own only once
7(b)	1. (If not removed) keeps binding (to receptors); 2. Keeps causing action potentials/depolarisation (in post-synaptic membrane); 3. Prevents information being carried across synapse/described consequence;	2 max	Accept answers based on what happens if it is transported out – ie what should happen 2. Accept keeps Na^+ channels open(ing)
7(c)	1. Movement in all groups (about) same before MDMA; 2. MDMA increases movement in Group **L**; 3. Group **K** shows MDMA causes movement; 4. No/little increase in mice without receptor/Group **M**;	3 max	**Q** 2. Accept normal mice for **L** 3. Accept **K** is a control

Question	Marking Guidance	Mark	Comments
8(a)	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	3. Accept normal and gene 4. Accept have <u>a</u> deletion mutation
8(b)	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	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 Accept converse arguments involving – eg introns do not code for amino acids/proteins Reject references to making amino acids, once
8(c)	1. Restriction mapping/described; 2. DNA/base sequencing (of fragments)/ description/name of method;	2	

Question	Marking Guidance	Mark	Comments
9(a)	1. No effect at 25^{o}C; 2. Keeps growing at 30^{o}C and 35^{o}C/up to 35^{o}C (more than without GB); 3. Above 35^{o}C, falls but grows more than plant without GB;	2 max	The question only refers to plants <u>with</u> GB 1. Reject same mass 3. Accept at all temperatures above 25^{o}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)	(As temperature increases,) 1. Enzyme activity reduced/(some) enzymes denatured; 2. Less photosynthesis, so fewer sugars formed; 3. Less (complex) biological molecules/organic substances made (that add to mass); 4. Less respiration; 5. Less energy/ATP for growth; 6. Less energy for named function associated with growth	4 max	3. Accept named (significant) substance – eg cellulose. Do not accept glucose/simple sugars 6. Eg mitosis, uptake of mineral ions
9(c)	1. (Rubisco activase attaches to thylakoid and) this changes shape/tertiary structure (of enzyme)/blocks active site/changes active site; 2. (This) prevents substrate/RuBP entering active site/binding;	2	Note – question states enzyme stops working when it attaches to thylakoid, not before 1. Accept rubisco in this context 2. Accept prevents ES complex forming 2. Accept no longer complementary to substrate/RuBP

9(d)	1. GB prevents/reduces binding of rubiscoactivase to (thylakoid membrane); 2. (Prevents it) up to 35^{o}C; 3. (So) rubiscoactivase/enzyme remains active; 4. (So) photosynthesis/light-independent stage still happens; 5. Above 35^{o}C, some binding still occurs but less than without GB, so less reduction in growth;	4 max	1. Accept enzyme instead of rubiscoactivase. Accept rubisco 4. Accept descriptions of light-independent stage

9(e)	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;	2 max	1. "other research" is minimum accepted 1. Accept previous experiments research with temperature resistant crops Ignore simple references to looking at previous studies/other plants – need to relate to this context

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)	**1.M** Membrane function as selectively permeable barrier **1.T** Transport mechanisms across membranes **1.CT** Absorption and co-transport of sodium ions and glucose **2.P** Photosynthesis, chloroplast, thylakoids **2.R** Respiration, mitochondrion and cristae **2.Ps** Protein secretion, RER, SER and Golgi **3.A** Surface receptors/antigen and immune response **3.CD** Cell division **3.B** Vertical and horizontal transmission – membranes and bacteria **3.Pc** Pacinian corpuscle **4.Tr** Tropisms – movement of IAA **4.N** Nerve impulses/action potentials **4.S** Synaptic transmission **4.Mc** Muscle contraction, calcium ion movement/storage **4.H** Hormones - eg Blood glucose regulation – insulin and glucagon **4.O** Osmosis, including water movement in plants	25	Examiners are free to select other letters if they wish The emphasis in answers should be on the <u>involvement of membranes</u> in processes, not just the processes themselves Breadth, one mark for use of an example from each of the following approaches: 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)	**1.P** Pathogens and effects on host **1.CH** Cholera **1.TB** TB **2.T** Taxonomy **2.C** Classification and evolution **2.I** Inheritance and evolution **2.Gc** Genetic code, universal **2.B** Behaviour **2.Ev** Populations and evolution, variation between individuals within a species **3.BP** Relationships within ecosystems – eg predator/prey **3.E** Energy transfer in ecosystems **3.N** Nutrient cycles, the organisms involved **3.S** Succession, biodiversity, species and individuals in a community **4.H** Human impacts on the environment and its effect on relationships between organisms – including farming **4.Gt** Gene technology and GMO and selective breeding **4.Ar** Antibiotic resistance	25	Examiners are free to select other letters if they wish The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves Breadth, one mark for use of an example from each of the following approaches – 3 max: 1. Pathogen and host 2. Evolution (related topics) 3. Ecological 4. Human intervention in relationships