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General Certificate of Education (A-level)
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Biology BIOL4

(Specification 2410)

Unit 4: Populations and Environment

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 candidates' 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 candidates' 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 candidates' 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)	(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)	Evidence (not a mark) 3 and 4 / two Rhesus positives produce Rhesus negative child/children / 7 / 9; Explanation (not a mark) Both Rhesus positives/3 and 4 carry recessive (allele)/ are heterozygous / if Rhesus positive was recessive, all children (of 3 and 4) would be Rhesus positive/recessive;	2	Do not negate mark if candidate refers to gene rather than allele. Answers including correct and incorrect evidence = zero marks evidence and explanation.

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

Question	Marking Guidance	Mark	Comments
3(a)	Complementary to / fits / binds to active site; Competitive / competes / 'prevents' enzyme-substrate complexes / 'prevents' urea attaching;	2	Max one mark if candidate suggests that active site/enzyme is damaged destroyed or useless. Allow inhibitor 'prevents' or 'stops' urea/substrate attaching unless candidate clearly indicates this is permanent. Ignore reference to inhibitor forming an enzyme/substrate complex.
3(b)(i)	Reduces loss of ammonia up to day8/9;	1	
3(b)(ii)	Increase in urease / temperature; More enzyme-substrate complexes; More bacteria;	2max	
3(c)	Less urea/ammonia lost (from soil) / less urea broken down; Urea/ammonia converted to nitrite/nitrate; Used to produce protein / amino acids / DNA / bases / nucleotides;	3	Reference to incorrect bacteria (e.g. denitrifying) producing nitrite/nitrate negates second marking point.

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)(i)	Temperature and light;	1	
5(a)(ii)	Increase in temperature causes increase in rate of photosynthesis / uptake of carbon dioxide; Increase in light/ more/medium/high light (intensity) causes increase in rate of photosynthesis / uptake of carbon dioxide;	2	
5(b)	2.75 - 2.81 (mg g^{-1} hr^{-1})	1	Accept answers in range 2.75 - 2.81;
5(c)	1. Growth will decrease (at higher temperature); 2. Rate of respiration will increase at higher temperature; 3. Photosynthesis decreases as limited by light/ as there is less light;	3	Ignore references to effect of temperature on rate of photosynthesis;

Question	Marking Guidance	Mark	Comments
6(a)(i)	1. Oxygen taken up/used (by woodlouse); 2. Carbon dioxide (given out) is absorbed by solution/potassium hydroxide; 3. Decrease/change in pressure;	3	Reference to vacuum negates last marking point; Reject reference to pressure increasing inside tube.
6(a)(ii)	1. Distance (drop moves) and time; 2. Mass of woodlouse; 3. Diameter/radius/bore of tubing/lumen / cross-sectional area;	3	If answer refers to measuring volume using the syringe allow 2 max – one mark for measuring volume; one mark for mass of woodlouse;
6(b)	1. Less/no proton/H^+ movement so less/no ATP produced; 2. Heat released from electron transport/redox reactions / / energy not used to produce ATP is released as heat; 3. Oxygen used as final electron acceptor/combines with electrons (and protons);	3	

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)	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)	Not flooded aerobic conditions/more oxygen / with flooding anaerobic conditions/less oxygen; Not flooded fewer/less active anaerobic microorganisms/respiration / not flooded more/more active aerobic microorganisms/respiration;	2	

Question	Marking Guidance	Mark	Comments
8(a)	1. (Colonisation by) pioneer (species); 2. Change in environment / example of change caused by organisms present; 3. Enables other species to colonise/survive; 4. Change in diversity/biodiversity; 5. Stability increases / less hostile environment; 6. Climax community;	5 max	Example of change e.g. formation of soil/humus/ organic matter / increase in nutrients; Do not accept genetic diversity for mark point 4.
8(b)	Advantages 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; Disadvantages 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	Max 3 for advantages or disadvantages. Ignore references to leaching, eutrophication. Ignore references to cost.

8(c)	1. Geographical isolation; 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 allele frequency; 8. Occurs over a long period of time;	5 max	In this question must refer to allele where appropriate, not gene.