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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

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Question	Marking guidelines	Mark	Comments
1(a)	All the fish/all the species/all the populations/all the organisms;	1	Must indicate all/every species. Reject answers that suggest other fish/organisms might be present.
1(b)(i)	<ol style="list-style-type: none"> Capture sample, mark and release; Appropriate method of marking suggested / method of marking does not harm fish; Take second sample and count marked organisms; $\text{Population} = \frac{\text{No in sample}_1}{\text{Number marked in sample}_2} \times \text{No in sample}_2$ 	3 max	<ol style="list-style-type: none"> E.g. Cutting a fin/attaching a tag/paint/marker. May be awarded from equation if not given here. Accept any valid alternative to equation or answer expressed as a ratio.
1(b)(ii)	<p>One suitable reason;</p> <p>E.g. population increases/changes (between first and second sample)</p>	1	Accept other valid answers, which must, however, relate to breeding/only works if population constant.
1(c)	<ol style="list-style-type: none"> With different mouth eats different food / has different way of feeding / specific mouth shape for specific food; Competition between species/interspecific competition is reduced; 	2	<ol style="list-style-type: none"> Catches more food and gas exchange are neutral Reject intraspecific

Question	Marking guidelines	Mark	Comments
2(a)(i)	Stickleback + caddis fly (larva) + stonefly (larva);	1	All three required for mark. In any order.
2(a)(ii)	<ol style="list-style-type: none"> (With fewer fish) reduced predation / not being eaten results in more freshwater shrimps; Increased competition for food/resources / more producers eaten by shrimps / more shrimps eating producers; Less food/resources for mayfly; 	2 max	Principles <ol style="list-style-type: none"> <u>Effect of</u> fish on shrimps <u>Effect of</u> shrimps on producer <u>Effect of</u> food on mayfly
2(b)(i)	<ol style="list-style-type: none"> Two marks for correct answer in range 16.8 to 18.9;; One mark for incorrect answer in which candidate divides 19 to 21 by 111 to 113; 	2	Ignore additional decimal places. Working shown in mm. Accept working in cm/2mm squares (10/56) for 1 mark.
2(b)(ii)	<ol style="list-style-type: none"> Single-celled producers are more digestible / contain less cellulose (than plants) / less energy lost in faeces; All of producer eaten/parts of plant not eaten; Less heat/energy lost / less respiration; 	2 max	<ol style="list-style-type: none"> May refer to either trophic level
2(c)	<ol style="list-style-type: none"> Photosynthesis/light dependent reaction/light independent reaction; Carbon-containing substances; 	2	Allow organic substance or named organic substance

Question	Marking guidelines	Mark	Comments
3(a)	1. Transect/lay line/tape measure (from one side of the dune to the other); 2. Place quadrats at regular intervals along the line; 3. Count plants/percentage cover/abundance scale (in quadrats) OR Count plants and record where they touch line/transect;	3 max	1&2. Reject random in context of placing transect/quadrats 2. Accept references to stratified sampling/different seral stages 3. Accept abundance scale
3(b)	1. Stabilises sand / stops sand shifting; 2. Forms/improves soil / makes conditions less hostile;	2	2. Allow credit for example of making conditions less hostile such as: Adds nutrients Improves water retention

Question	Marking guidelines	Mark	Comments
4(a)(i)	Non-living/physical/chemical factor/non biological;	1	Do not accept named factor unless general answer given.
4(a)(ii)	Accept an abiotic factor that may limit photosynthesis/growth; E.g. Water Named soil factor Light Carbon dioxide Incline/aspect Wind/wind speed	1	Reject altitude/height Not “soil” / “weather” Accept Oxygen
4(b)	<ol style="list-style-type: none"> Correct explanation for differences between day and night e.g. photosynthesis only during the daytime / no photosynthesis/only respiration at night; Net carbon dioxide uptake during the day/in light OR No carbon dioxide taken up at night/in dark / carbon dioxide released at night/in dark; At ground level <u>more</u> respiration / in leaves <u>more</u> photosynthesis; Carbon dioxide produced at ground level/carbon dioxide taken up in leaves; 	4	<p>Principles</p> <p>Comparing day and night/light and dark</p> <ol style="list-style-type: none"> Explanation in terms of photosynthesis/respiration Effect on carbon dioxide production/uptake <p>Comparing leaves with ground level</p> <ol style="list-style-type: none"> Explanation in terms of photosynthesis/respiration Effect on carbon dioxide production/uptake <p>2 and 4 must relate to why the change occurs</p>
4(c)	<ol style="list-style-type: none"> Variation in original colonisers / mutations took place; Some better (adapted for) survival (in mountains); Greater reproductive success; <u>Allele</u> frequencies change; 	3 max	<ol style="list-style-type: none"> Allow “advantage so able to survive” Reject gene/genotype

Question	Marking guidelines	Mark	Comments
5(a)(i)	1. Animal 2 / 5 has hair but offspring do not; 2. So 2 / 5 parents must be heterozygous/carriers; OR 3. 4/7/8 are hairless but parents have hair; 4. So 2 / 5 must be heterozygous/carriers;	2	Accept parents as alternative to animals 2 and 5 1 + 3: Allow reference to children/offspring for animals 7 + 8 Ignore reference to individuals 1 and 6
5(a)(ii)	Hairless males have fathers with hair / 4 is hairless but 1 is hairy / 7 and/or 8 are hairless but 6 is hairy / only males are hairless;	1	Ignore references to other individuals Ignore reference to genotypes Allow credit for candidate who states that evidence is not conclusive/pedigree possible with autosomal character;
5(b)	1. Parental genotypes $X^H X^h$ and $X^H Y$ Gametes $X^H X^h X^H Y$; 2. Genotypes of offspring $X^H X^H, X^H Y, X^H X^h, X^h Y$; 3. Phenotypes of offspring female with hair male with hair male hairless; 4. 0.25 / $\frac{1}{4}$ / 1 in 4 / 25%;	4	Accept any letter for gene but capital letter must represent dominant allele. 1. Both parental genotypes and gametes must be correct 2. Allow for offspring genotypes correctly derived from <u>gametes</u> given by candidate; 3. Allow phenotypes correctly derived from offspring genotype Allow $H \equiv X^H, h \equiv X^h$ 4. Ignore 1:3 in context of correct probability Reject 1:4

Question	Marking guidelines	Mark	Comments
6(a)	Nitrification;	1	Accept nitrifying. Do not accept nitrogen fixing.
6(b)	<ol style="list-style-type: none"> 1. Uptake (by roots) involves active transport; 2. Requires ATP/ aerobic respiration; 	2	Reject all references to bacteria
6(c)(i)	<ol style="list-style-type: none"> 1. Not enough time / fast flow washes bacteria away; 2. (Not all/less) ammonia converted to nitrate/less nitrification; 	2	“Not enough time for bacteria to convert all the ammonia to nitrate” gains 2 marks
6(c)(ii)	<ol style="list-style-type: none"> 1. Algal bloom / increase in algae; 2. Algae block light / plants/algae die; 3. Decomposers/saprobionts/bacteria break down dead plant materials; 4. Bacteria/decomposers/saprobionts use up oxygen in respiration / increase BOD; 5. Fish die due to lack of oxygen; 	3 max	<ol style="list-style-type: none"> 4. Accept alternatives such as microbes/ saprophytes.

Question	Marking guidelines	Mark	Comments
7(a)(i)	<ol style="list-style-type: none"> 1. Same breed so similar alleles; 2. Controls/removes variable/so genes not a factor / only temperature affects results / rate of growth affected by genes; 	2	<ol style="list-style-type: none"> 1. Allow different alleles have different effects 2. Accept idea worded in such terms as inherited.
7(a)(ii)	<ol style="list-style-type: none"> 1. Different growth rates / gained different biomass / grew different amount; 2. Not due to temperature / the independent variable; 	2	<p>Allow “more food for growth”</p> <p>Ignore references to efficiency of conversion.</p>
7(b)(i)	Rise then fall with peak at 20°C;	1	Do not accept 0.85 as alternative to 20.
7(b)(ii)	<ol style="list-style-type: none"> 1. Temperature may be between 10 and 30/10 and 20/20 and 30; 2. Intervals are 10°C/large/not small/should be smaller/should be intermediates; 	2	No mark for yes or no.
7(c)(i)	<ol style="list-style-type: none"> 1. Growth rate decreasing / conversion staying same/ decreasing; 2. (Scientists would be) looking for high growth rate/ conversion / data shows unlikely to improve growth/yield; 3. Wastes time/resources/would not relate to farming conditions; 	2 max	<ol style="list-style-type: none"> 3. Ignore cruelty to pigs
7(c)(ii)	<ol style="list-style-type: none"> 1. Will lose more heat / not as much energy used to maintain body temperature; 2. Heat resulting from respiration/more respiration; 3. More food used in respiration; 	2 max	<ol style="list-style-type: none"> 1. Must be a comparative statement <p>Accept energy as equivalent to heat in the context of this question</p> <ol style="list-style-type: none"> 2. Do not credit answers relating to energy made in respiration

Question	Marking guidelines	Mark	Comments
8(a)	<ol style="list-style-type: none"> 1. Releases energy in small / manageable amounts; 2. (Broken down) in a one step / single bond broken; 3. Immediate energy compound/makes energy available rapidly; 4. Phosphorylates/adds phosphate; 5. Makes (phosphorylated substances) more reactive / lowers activation energy; 6. Reformed/made again; 	4 max	<ol style="list-style-type: none"> 1. Accept less than glucose 2. Accept easily broken down 4. Do not accept phosphorus or P on its own 6. Must relate to regeneration
8(b)	<ol style="list-style-type: none"> 1. Substrate level phosphorylation / ATP produced in Krebs cycle; 2. Krebs cycle/link reaction produces reduced coenzyme/reduced NAD/reduced FAD; 3. Electrons released from reduced /coenzymes/ NAD/FAD; 4. (Electrons) pass along carriers/through electron transport chain/through series of redox reactions; 5. Energy released; 6. ADP/ADP + Pi; 7. Protons move into intermembrane space; 8. ATP synthase; 	6 max	<ol style="list-style-type: none"> Accept alternatives for reduced NAD 2. Accept description of either Krebs cycle or link reaction 5. Allow this mark in context of electron transport or chemiosmosis 6. Accept H⁺ or hydrogen ions and cristae 7. Allow description of movement through membrane 8. Accept ATPase. Reject stalked particles

8(c)	<ol style="list-style-type: none">1. In the dark no ATP production in photosynthesis;2. Some tissues unable to photosynthesise/produce ATP;3. ATP cannot be moved from cell to cell/stored;4. Plant uses more ATP than produced in photosynthesis;5. ATP for active transport;6. ATP for synthesis (of named substance);	5 max	1. In context of in photosynthetic tissue/leaves
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