



**General Certificate of Education (A-level)  
January 2012**

**Biology**

**BIOL4**

**(Specification 2410)**

**Unit 4: Populations and Environment**

**Final**

***Mark Scheme***

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## Mark Scheme – General Certificate of Education (A-level) Biology – BIOL4 – January 2012

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"> <li>Capture sample, mark and release;</li> <li>Appropriate method of marking suggested / method of marking does not harm fish;</li> <li>Take second sample and count marked organisms;</li> <li> <math display="block">\text{Population} = \frac{\text{No in sample}_1}{\text{Number marked in sample}_2} \times \text{No in sample}_2</math> </li> </ol>	3 max	<ol style="list-style-type: none"> <li>E.g. Cutting a fin/attaching a tag/paint/marker.</li> <li>May be awarded from equation if not given here.</li> <li>Accept any valid alternative to equation or answer expressed as a ratio.</li> </ol>
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"> <li>With different mouth eats different food / has different way of feeding / specific mouth shape for specific food;</li> <li>Competition between species/interspecific competition is reduced;</li> </ol>	2	<ol style="list-style-type: none"> <li>Catches more food and gas exchange are neutral</li> <li>Reject intraspecific</li> </ol>

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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"> <li>(With fewer fish) reduced predation / not being eaten results in more freshwater shrimps;</li> <li>Increased competition for food/resources / more producers eaten by shrimps / more shrimps eating producers;</li> <li>Less food/resources for mayfly;</li> </ol>	2 max	Principles <ol style="list-style-type: none"> <li><u>Effect of</u> fish on shrimps</li> <li><u>Effect of</u> shrimps on producer</li> <li><u>Effect of</u> food on mayfly</li> </ol>
2(b)(i)	<ol style="list-style-type: none"> <li>Two marks for correct answer in range 16.8 to 18.9;;</li> <li>One mark for incorrect answer in which candidate divides 19 to 21 by 111 to 113;</li> </ol>	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"> <li>Single-celled producers are more digestible / contain less cellulose (than plants) / less energy lost in faeces;</li> <li>All of producer eaten/parts of plant not eaten;</li> <li>Less heat/energy lost / less respiration;</li> </ol>	2 max	<ol style="list-style-type: none"> <li>May refer to either trophic level</li> </ol>
2(c)	<ol style="list-style-type: none"> <li>Photosynthesis/light dependent reaction/light independent reaction;</li> <li>Carbon-containing substances;</li> </ol>	2	Allow organic substance or named organic substance

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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) <b>OR</b> 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

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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)	1. Correct explanation for differences between day and night e.g. photosynthesis only during the daytime / no photosynthesis/only respiration at night; 2. Net carbon dioxide uptake during the day/in light <b>OR</b> No carbon dioxide taken up at night/in dark / carbon dioxide released at night/in dark; 3. At ground level <u>more</u> respiration / in leaves <u>more</u> photosynthesis; 4. Carbon dioxide produced at ground level/carbon dioxide taken up in leaves;	4	Principles <b>Comparing day and night/light and dark</b> 1. Explanation in terms of photosynthesis/respiration 2. Effect on carbon dioxide production/uptake  <b>Comparing leaves with ground level</b> 3. Explanation in terms of photosynthesis/respiration 4. Effect on carbon dioxide production/uptake  2 and 4 must relate to why the change occurs
4(c)	1. Variation in original colonisers / mutations took place; 2. Some better (adapted for) survival (in mountains); 3. Greater reproductive success; 4. <u>Allele</u> frequencies change;	3 max	2. Allow “advantage so able to survive”  4. Reject gene/genotype

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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; <b>OR</b> 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

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



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

<p>7(d)</p>	<p><b>In support</b></p> <p>1. Food <b>B</b> produces greater mass than control/greater than 100%;</p> <p><b>But</b></p> <p>2. Error bars for <b>B</b> mean <b>B</b> could be no better / not different from control;</p> <p>3. Overlap of error bars for <b>B</b> and <b>A</b>;</p> <p>4. <b>A</b> no better than/not different from <b>B</b>;</p> <p><b>Experimental limitations</b></p> <p>5. Experiment only ran for 10 days;</p> <p>6. Experimental conditions /breed of pig may not be the same as on the farm;</p> <p>7. No information about cost;</p>	<p>4 max</p>	<p>Read standard deviation as standard error</p> <p>1. Must refer to control</p> <p>4. Neutral: "Results not significant". Mark must compare <b>A</b> to <b>B</b></p>
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Question	Marking guidelines	Mark	Comments
8(a)	<ol style="list-style-type: none"> <li>1. Releases energy in small / manageable amounts;</li> <li>2. (Broken down) in a one step / single bond broken;</li> <li>3. Immediate energy compound/makes energy available rapidly;</li> <li>4. Phosphorylates/adds phosphate;</li> <li>5. Makes (phosphorylated substances) more reactive / lowers activation energy;</li> <li>6. Reformed/made again;</li> </ol>	4 max	<ol style="list-style-type: none"> <li>1. Accept less than glucose</li> <li>2. Accept easily broken down</li> <li>4. Do not accept phosphorus or P on its own</li> <li>6. Must relate to regeneration</li> </ol>
8(b)	<ol style="list-style-type: none"> <li>1. Substrate level phosphorylation / ATP produced in Krebs cycle;</li> <li>2. Krebs cycle/link reaction produces reduced coenzyme/reduced NAD/reduced FAD;</li> <li>3. Electrons released from reduced /coenzymes/ NAD/FAD;</li> <li>4. (Electrons) pass along carriers/through electron transport chain/through series of redox reactions;</li> <li>5. Energy released;</li> <li>6. ADP/ADP + Pi;</li> <li>7. Protons move into intermembrane space;</li> <li>8. ATP synthase;</li> </ol>	6 max	<ol style="list-style-type: none"> <li>Accept alternatives for reduced NAD</li> <li>2. Accept description of either Krebs cycle or link reaction</li> <li>5. Allow this mark in context of electron transport or chemiosmosis</li> <li>6. Accept H<sup>+</sup> or hydrogen ions and cristae</li> <li>7. Allow description of movement through membrane</li> <li>8. Accept ATPase. Reject stalked particles</li> </ol>

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