

Version



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

**Biology**

**BIOL4**

**(Specification 2410)**

**Unit 4: Populations and Environment**

***Report on the Examination***

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## General Comments

The paper produced a relatively good spread of marks and, in the longer recall questions, there were some very impressive answers with students displaying an excellent understanding of the unit content covered on the examination paper. As expected, questions involving interpretation of data presented graphically or in tables proved more challenging but were generally answered well. A number of questions proved to be very effective discriminators and often gave better students the opportunity to show their understanding of a topic or to demonstrate their analytical skills. There was also considerable variation in the ability of students to express their ideas clearly and logically. Weaker students often failed to gain credit because of the use of imprecise or inappropriate scientific terminology.

### Question 1

- (a) The vast majority of students correctly identified the pioneer species as being crabgrass. A small minority provided the incorrect response 'bare field' or 'grassland'.
- (b) Almost ninety percent of students obtained at least one mark, often for indicating that the species present changed the environment. Many of these students also gained a second mark by referring to the habitat becoming less hostile or by describing how new species outcompeted species already present. A misconception by weaker students was that succession involved new species developing from existing species.
- (c) Most students did not gain this mark as they suggested that no light would pass through to the forest floor. Very few students appreciated that only those plants which could photosynthesise at low light intensities would be present.

### Question 2

- (a) The vast majority of students gained the mark for explaining what is meant by a dominant allele. Unfortunately some students suggested that it is 'expressed in a gene'.
- (b) Most students were able to provide all the correct genotypes which would result in a brown-shelled snail.
- (c) This also proved to be a high-scoring question with many students gaining all three marks. Students gaining two marks often failed to link correctly the genotypes of the offspring to their phenotypes. A small minority of students misread the question and completed a genetic cross between a yellow snail and a pink snail. If this was done correctly, one mark was awarded. Very few students scored zero.
- (d) This proved far more demanding. The most common error was to have  $q^2 = 0.51$  rather 0.49 as students assumed that 51% represented the homozygous recessive snails, rather than the combination of the homozygous dominant and heterozygous snails. Another incorrect method involved taking 0.51 as the frequency of the dominant allele (i.e. p) and 0.49 as the frequency of the recessive allele (q). These errors often resulted in only a single mark being awarded.

### Question 3

- (a) Four out of five students were able to provide a suitable definition of the ecological term community. Incorrect responses were often definitions relating to a population or ecosystem.

- (b)(i) Almost two thirds of students correctly provided the range of depths, 7.2 to 8.4, at which all three species of fish may be found living together. The most common incorrect response was 6.8 to 8.4.
- (b)(ii) The vast majority of students obtained both marks for this question often by referring to competition for food. Students gaining one mark usually described competition for an unspecified 'resource'.
- (c) Most students gained one mark for a description of the decreasing temperature with increasing depth of water. Approximately half of these students then gained another mark for describing either the overlap of the ranges of the fish or the idea that another named factor could be involved. Very few students mentioned both of these ideas to obtain 3 marks. Some students merely described the depth ranges and temperatures at which each of the three species of fish were found or referred to the unknown sample size or lack of statistical tests. Although a significant number of students referred to correlation not indicating causation, this was more often than not described in an incorrect context.

#### Question 4

- (a) Four out of five students were able to name ribulose biphosphate as the substance which combines with carbon dioxide in a chloroplast.
- (b) The formation of ATP and reduced NADP in the grana was well known by many students. A significant number did not state that the NADP was reduced and some referred to reduced NAD. Others knew that the light-dependent reaction occurred in the grana but did not identify the products needed in the light-independent reaction or only identified one of the two. Others only stated that the stroma is where the light-independent reaction takes place which fixes carbon dioxide. Some thought that the grana have no effect on the uptake of carbon dioxide or that the light-dependent reaction occurs in the stroma.
- (c) This proved more demanding with only one in four students gaining both marks. Most students did appreciate that the lack of light would prevent the light-dependent reaction from taking place or named the products which could no longer be produced from this process. However, they often did not use this information to predict the uptake of radioactively labelled carbon dioxide if tube **A** were placed in the dark. A few students thought there would be 'no difference' to the uptake of carbon dioxide in the dark as the light-independent reaction does not use light. A small number of students thought that there would be more respiration in the dark leading to an increase in carbon dioxide in tube **A**.
- (d) Despite the question asking students to use their knowledge of the light-independent reaction, a significant number of students only referred to the lack of the products of the light-dependent reaction resulting in a lack of RuBP without any details of the pathway of its production. Many students did appreciate that ATP and reduced NADP were involved in reducing glycerate 3-phosphate but not all of them named triose phosphate as the product to gain a mark. Relatively few students obtained the second marking point by outlining that RuBP is formed from triose phosphate.
- (e) Less than a third of students obtained both marks in this question. However most gained at least one mark often by linking electron transfer to the production of ATP. The fact that electron transfer is required for the reduction of NADP was less well known. The reference to electron transfer in the question resulted in some weaker

students providing details about chemiosmosis in respiration or relating to reduced NAD.

### Question 5

- (a) Over half the students obtained both marks with 'specificity', 'only needs one application' and the idea that 'pests do not develop resistance' providing the main correct responses. It was pleasing to note that few students mentioned 'pests becoming immune'. The common responses which did not gain credit often related to 'cost' or involved confusion with fertilisers.
- (b) The vast majority of students gained at least one mark by providing quantitative details on one of the main changes in the percentage of leaves occupied by predatory mites. However, a significant minority of students referred to days rather than weeks and multiplied the percentage of leaves occupied by ten. Approximately half the students were able to describe the three main changes shown on the graph to obtain a second mark point. Students who did not gain this mark often failed to refer to the rapid decrease (after week 8) in the percentage of leaves occupied.
- (c) The vast majority of students clearly understood that an effective biological control decreases the numbers of pests. Less than half of these students gained the second mark point by stating that the level of infestation remained low after the decrease. The reasons predator-prey numbers fluctuated over the entire period was often included in many responses.
- (d) Most students gained at least one mark for providing a valid reason why farmers might decide not to use predatory mites to control two-spotted mites. The most common scoring mark points related to the long time for this control method to become effective. Only half the students obtained both marks and this often arose due to the same idea being repeated. Responses which suggested that the data might not be reliable or that repeat studies would be required were not credited.
- (e) Most students gained one mark either by stating that the pesticide killed predatory mites or that some of the two-spotted mites were resistant and survived. Approximately half of these students obtained the second mark by explaining that the subsequent increase in the population of two-spotted mites was a result of reproduction. Often this increase was linked to the lack of predation and less competition for food.

### Question 6

- (a) A significant number of students failed to explain adequately why both experiments were carried out at the same temperature. Their responses were often limited to having a 'fair test' or controlling a variable. Students who provided more details often gained a mark for mentioning that temperature affects enzyme-controlled reactions. Better students specifically referred to respiration and obtained the second mark point.
- (b)(i) This question provided a good spread of marks. The most common scoring point was the absorption of carbon dioxide by potassium hydroxide. Many students gained a second mark for the uptake of oxygen by the seeds. Better students obtained maximum marks by stating that a decrease in volume or pressure in the flask would cause the level of the coloured liquid to go down in the right-hand side of the manometer tube. However, a significant number of students failed to gain this mark as they only referred to a change in pressure or stated that a vacuum was produced.

Some students suggested that photosynthesis was taking place with the seeds absorbing carbon dioxide and producing oxygen.

- (b)(ii) Rather surprisingly relatively few students provided the correct answer of 4. The most common incorrect answer was 5, although a full range of numerical values from 0 to 15 was noted by examiners.
- (c) Approximately one in four students gained both marks. These students often clearly explained that no oxygen would be used by the seeds and, as any carbon dioxide produced would be absorbed by the potassium hydroxide, the level of liquid would not change. A third of students gained one mark often for stating that no oxygen uptake would occur. Some students negated this mark point by suggesting that carbon dioxide is not produced during anaerobic respiration. A minority of students suggested ethanol would affect the level of coloured liquid in the tube.

### Question 7

- (a) Most students were able to suggest one reason why petroleum is used as a comparison when evaluating NLPs of biofuels. This usually related to petroleum being the most commonly used fuel. Far fewer students provided a valid second reason but, when they did, this was often linked to the large amount of carbon dioxide produced from using petroleum. Common responses which were not credited included that petroleum 'is a control', 'is a fossil fuel' or 'is cheap'.
- (b) Most students gained at least one mark for the idea that environment agency scientists were unbiased. Relatively few students went on to make a valid second comment about their interest in the environmental effects of using biofuels or that the agency was non-profit making. Often students simply suggested that the environment agency would have unlimited funding or that their scientists would be experts.
- (c)(i) The majority of students gained at least two marks almost invariably for realising that most biofuels resulted in a reduction in carbon dioxide compared with using petroleum whereas using soy-based biodiesel increased production of carbon dioxide. However, there was a significant minority of students who stated that a negative percentage change would increase production of carbon dioxide. Many students did refer to carbon dioxide as a greenhouse gas but far fewer than expected mentioned global warming and limited their comments to climate change. Better students suggested that using biofuels could produce other named greenhouse gases.
- (c)(ii) Many students failed to gain a mark on this question. There was often considerable confusion in the answers provided by these students. Many of their explanations focused on anaerobic respiration and ethanol production rather than uptake and production of carbon dioxide. However, students who understood 'negative percentage change' had little difficulty relating this to the greater uptake of carbon dioxide during photosynthesis compared with its production when biofuels are used.
- (d) Many students had difficulty applying the biological principles from unit 2 to gain marks in this question. The most common scoring mark was that ethanol could be produced quicker or in greater amounts following pretreatment. Better students did appreciate that cellulose would be broken down to glucose which could then be used in glycolysis. The mark points relating to cellulose being a polysaccharide and being insoluble were credited less frequently.

- (e) The majority of students obtained at least one mark usually for referring to the removal of other species during changes in land use. Half these students then mentioned the removal of habitats or food sources to gain the second mark.

### Question 8

- (a) This question, as with parts (b) and (c), proved to be a very effective discriminator. The vast range of farming practices which increase productivity of agricultural crops resulted in an extended mark scheme. The most commonly awarded marks were for fertilisers and the roles of named nutrients (usually nitrates for proteins), and for pesticides reducing crop damage. Many students also appreciated the role of herbicides in destroying weeds and removing competition. A significant number of students wrote at length about optimising light, temperature and carbon dioxide to maximise photosynthesis. Only one mark was available for this idea and it had to be in the context of using glasshouses. Selective breeding and the benefits of ploughing were also mentioned by a good proportion of students. Marks were awarded for correct references to crop rotation, irrigation and other similar farming practices not specifically outlined on the specification. However, many students failed to gain marks by correctly identifying a farming practice but then failing to explain clearly how it increased productivity.
- (b) It was pleasing to note that, compared with previous years, a higher percentage of students obtained good marks on this topic. The most frequently awarded marks related to the action of nitrifying bacteria in the process of converting ammonium ions into nitrite and then into nitrate. However a significant number of students missed a mark by not clearly describing that the conversion of nitrite to nitrate is a separate process. There was some confusion relating to saprobiotic nutrition with relatively few students providing a named compound from which ammonia is formed. The action of nitrogen-fixing bacteria was outlined by better students although most simply referred to their presence in root nodules. There were inevitably some irrelevant descriptions of the role of denitrifying bacteria.
- (c) Although few students obtained maximum marks, many gained at least four out of the five marks available. There were some excellent answers with these students providing a detailed account of the processes involved in the production of resistant strains of insect pests. At the other end of the ability range there were references to insects becoming immune and considerable confusion between genes and alleles. The most frequently awarded mark points related to a mutation having initially caused resistance and for stating that resistant pests would survive and breed. Better students who mentioned the 'allele for resistance' often appreciated that the frequency of the allele would increase in future generations. Far fewer students mentioned 'variation' or 'selection'. Poor powers of expression often prevented weaker students gaining credit although it was also evident that many of these answers were based on a limited understanding of natural selection.

### Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results statistics](#) page of the AQA Website.