Version 1.0

General Certificate of Education (A-level)
January 2012

Biology BIOL4

(Specification 2410)

Unit 4: Populations and Environment

Report on the Examination

Further copies of this Report on the Examination are available from: aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

General Comments

The ability of students to write legibly was sometimes a real issue, as was their ability to explain their ideas concisely. The available space for writing responses should give students a clear indication of how much they are expected to write in order to gain full marks for the question. Many candiates went on to use additional sheets, having filled the space given with irrelevant information. Better organisation and planning of answers will help candiates avoid wasting time by giving irrelevant information. It was evident in several instances that students were confident when responding to questions that had appeared in a similar form in earlier or in legacy papers but found dealing with new situations very challenging.

Question 1

(a) Many students gave a full definition, including location and time. A surprising number of students gave vague responses relating to a group of organisms, a collection of organisms or a number of organisms. Some only referred to animals or just several different species or all the organisms of one species, without the important idea of the community including all the organisms in the location.

(b) In their answers to part (i), there were many very clear accounts that scored all four marking points. Quite a few students forgot to mention releasing the fish or failed to describe either a way of marking the fish or that the method should not harm the fish or make them more visible to predators. References to the percentage of marked fish in the second sample were often seen. The equation was sometimes incorrect with the total number caught as the denominator.

The vast majority of students gained the mark for part (ii), clearly understanding that the population would be increasing. Other correct answers related to behaviour during the breeding season that would result in an unrepresentative number of fish being caught. Some responses failed to gain credit because they did not clearly relate to behaviour associated with breeding.

(c) Many students correctly linked the shape of the mouth to the different food types exploited. However, while competition was sometimes mentioned, only the better students were able to link this to reducing competition between species**,** thereby showing an understanding of the significance of the niche. A significant number tried to explain how different mouth shapes arise by natural selection.

Question 2

(a) Most responses gave the correct three secondary consumers. A small number of incorrect responses seemed to be based on a failure to understand the significance of the arrows in a food web.

(b) In part (i), most students carried out this calculation correctly. A very small number failed to attempt it. Incorrect responses usually resulted from inaccurate measurement or counting of the length of the bars or getting the fraction upside-down.

Most students gained at least one mark in part (ii), with many scoring maximum credit. Some students had obviously learned about energy transfer using farming examples and repeated these examples in their answer – the question clearly asked them to use the aquatic food web shown.

(c) Many students gained two marks with very clear and detailed accounts of how energy from the sun ends up in dead organic matter. The organic compounds named were

usually suitable but only rarely were specific substances named. Some students omitted to mention photosynthesis or to name a suitable molecule. Other incorrect responses focused on the sunlight energy that missed the chlorophyll or the fact that dead plants were unable to use sunlight energy. Some answers related the transfer of energy along a food chain and/or losses in indigestible matter, parts of the plant not eaten, underground etc. The energy was sometimes said to be in the dead plant matter in the form of ATP.

Question 3

(a) Many students knew exactly how to investigate the distribution of marram grass across a sand dune and gained three marks. If one point was missing, it tended to be marking point 2, because the quadrats were not placed regularly. Many answers referred to random sampling and using two tapes at right angles and co-ordinates generated from a calculator's random number generator. These answers were not appropriate.

(b) Some excellent answers were seen which explained both points and gave several of the options for the second marking point. Many students gained the second marking point only, often giving two aspects of that point, usually less hostile and adding nutrients. Improved water retention was less commonly stated. Uncredited responses often described succession and the entry of new species to reach a climax community without explaining the role of marram grass in this process. A few students merely described what a pioneer species is or described the way the features of marram grass enable it to survive in harsh conditions.

Question 4

(a) Part (i) was correctly answered by many as a non-living factor, and most students gave a suitable example for part (ii).

(b) Answers to this question were frequently very disorganised, with students wasting many lines describing the data before attempting an explanation. The first marking point was often gained, usually for no photosynthesis at night, but students did not then develop the idea and explain that this resulted in no carbon dioxide being taken up at night. The production of carbon dioxide in respiration, and therefore that the uptake in the light was a net movement, was also very rarely mentioned. A few students tried to include the detail of the Calvin cycle to explain the reduction in carbon dioxide levels. Marking point 4 was often awarded for carbon dioxide taken in by leaves. The higher concentration of carbon dioxide at ground level was sometimes explained as being because it is denser than oxygen.

(c) There were many excellent answers where all four marking points were clearly understood and explained using the correct terminology. Many students could clearly explain that advantageous characteristics allowed trees to survive and reproduce successfully. They gained two marks. The change in allele frequency was also often correctly explained with fewer incorrect references to genes. There was some apparent misunderstanding of germination which seemed to be taken by some students to mean reproduction. There was the occasional account of succession or descriptions of features advantageous to survival in the mountains. Weaker students could say little more than that the trees with an advantage were more likely to survive. There were frequent references to directional and stabilising selection.

Question 5

(a) The answer to part (i) was very clearly and concisely expressed by the more able students, especially if they only considered the dominant/recessive nature of the alleles. Those who also tried to include the sex-linked aspect were more likely to produce confused responses. Many students gained the first marking point. Without indicating the number of the individuals referred to, it was difficult to show use of evidence from pedigree. Students who tried to explain the converse, of why hairiness was not dominant, were not able to do so unambiguously. A few students stated that it must be recessive as not many of the cattle were hairless.

The mark for part (ii) was most frequently gained by stating that only males are hairless or no females are hairless.

(b) The best students gained all four marks. Many gained three when they fully understood and had the correct genotypes and gametes but, unfortunately, omitted to include the sex of the offspring. A significant number of students managed to gain three marks by carrying out an autosomal heterozygous cross. Quite a few gave up after trying to complete the parental genotypes. In some cases, the X and Y chromosomes were included in the parental genotypes, then missed out in the gametes, only to return again in the offspring genotypes. The fourth marking point was sometimes gained in isolation. The Y chromosome was sometimes shown carrying an allele. Many students made errors because they were unable to read their own writing, mistaking a tiny superscript H for h.

Question 6

(a) Nitrogen-fixing was the commonest wrong answer in this question. The majority of responses were correct.

(b) This question was answered poorly because students did not think through the processes that were taking place in the reed bed. There were many incorrect responses referring to processes in the reeds that result in the formation of nitrates from ammonia/nitrite. Some then went on to gain one mark for active transport of these nitrates into the plant roots. Better students correctly linked the use of ATP from aerobic respiration in the active transport of nitrates, and wrote clearly and concisely. There was a surprising amount of confusion between diffusion and active transport, with active transport being said to be needed to diffuse nitrogen-containing substances from areas of high to low concentration. The oxygen was also thought to create a concentration gradient to allow the roots to take up the nitrogen-containing substances by diffusion.

(c) There were some very clear answers to part (i) from students who understood that too fast a flow would not allow time for the nitrification to occur, hence the decrease in concentration of nitrates. There was also not enough time for the saprophytes to decompose the sewage to release ammonium compounds. Some failed to mention the ammonia being converted. Other answers suggested that the soil would become waterlogged, preventing the action of the nitrifying bacteria, or that the reeds would take up more of the nitrates or that numbers of denitrifying bacteria would increase, converting the nitrate to nitrogen gas. A number thought that if the flow was too fast, the reeds would be unable to take up the nitrates, so they would end up in the lake. The fast flow was also thought to reduce the oxygen concentration in the water, thus preventing the action of the nitrifying bacteria. There was also confusion with leaching and eutrophication. There were only very occasional references to the bacteria being washed away by the fast flow. The fast flow was also said to maintain a steep diffusion gradient and increase uptake by the plant roots.

In part (ii), it was clear that many students had learnt this topic thoroughly and included all marking points. Weaker students could not explain the increase in decomposers breaking down the dead plants and using up the oxygen in the water in their respiration. The algae were often described as 'feeding' on the nitrates. A common incorrect reason for the death of the fish was a lack of food once the plants in the lake died. A minority of students had no understanding of the process of eutrophication and thought that dehydration and osmosis caused the fish to die or that high nitrate concentrations were toxic to both fish and algae. Increasing concentrations of carbon dioxide were also thought to be responsible for the death of the fish.

Question 7

(a) In part (i), most students gained the second marking point. Very few mentioned alleles and so the first marking point was rarely awarded.

In part (ii), most students gained the first marking point and around half gained the second. There were a lot of references to efficiency of conversion and to variables not being controlled.

(b) Most students gained this mark for part (i), although a surprising number thought the peak was at 30°C. Some only described either an increase or a decrease with temperature. Others described the increase up to 20°C and then a decrease from 30-35°C. A few thought that as temperature increases, growth rate decreases.

Marking point 1 for part (ii) was given by a majority of students, around half of whom gained credit for the second point, with answers being expressed in a variety of ways.

(c) In part (i), most students gained the first mark; relatively few gained either the second or third mark, usually by stating that growth was unlikely to increase beyond 35°C or that it would have been a waste of time to investigate higher temperatures. A large number of students were under the apparent impression that as soon as environmental temperature exceeded 35°C all of the pigs' enzymes would immediately denature.

A significant minority of students did not gain marks in part (ii) because they failed to make comparative statements. However, most gained the first marking point. Around a quarter gained the second. The third was rarely seen. A significant minority of students wrote about the effect of the external temperature on the pigs' enzymes in terms of collisions and enzyme-substrate complex formation.

(d) The label on the y-axis gave many students the reference to the control that they needed for the first marking point and most used the error bars in their discussion, but many failed to gain marks by referring to the smaller error bar on food **B** rather than identifying the overlap between **A** and **B**. All of the marking points were seen, but it was very rare for any one candiate to have looked beyond the first idea that caught their attention and develop enough points to gain all four marks. A significant minority of answers gave generic 'How Science Works' responses involving repeats, validity, correlation not proving casuation and reliability, failing to contextualise their answers.

Question 8

(a) Some good answers were given to this question, with candiates being confident in their understanding of the way in which ATP rapidly releases small, manageable amounts of energy in a single hydrolytic reaction. Marking points 5 and 6 were the least often seen, and the use of ATP to lower activation energy was very rarely seen, although answers frequently referred to activation of glucose in glycolysis.

(b) Many excellent answers were given in this section that included six or more of the marking points and showed excellent understanding of the processes involved in ATP formation, including chemiosmosis. A significant number gave an account of the whole process of respiration, including glycolysis, using up the space provided and indicating that the answer continued on a separate sheet. One or two included the digestion and absorption of carbohydrates. Weaker students often gained marking points 1, 2 and 6. There was confusion over protons and electrons and hydrogen ions/atoms and molecules. Some students confused the processes of respiration and the light-independent reaction of photosynthesis. Glycerate 3-phosphate (GP) and triose phosphate (TP) were sometimes said to be involved in the Krebs cycle, as was NADP. The movement of protons through the inner mitochondrial membrane into the intermembrane space was often only loosely described, with protons passing into the membrane, along the membrane, or out of the mitochondrion.

(c) Many students did not appear to have any real understanding of the relationship between photosynthesis and respiration. Statements such as 'plants have to respire so they can make the carbon dioxide so they can photosynthesise' were not atypical. The weakest students completely reversed the roles of the two processes. Most commonly, students gained two marks, for referring to the uses of ATP in active transport and synthesis. Marking points 1 and 4 were seen rather less often and marking points 2 and 3 were fairly rarely made. Some students demonstrated good knowledge but not the ability to be selective, giving accounts in some detail of both photosynthesis and respiration which failed to address the question fully.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website.