General Comments

The paper produced a relatively good spread of marks and, overall, students seemed to find the paper accessible. A number of questions proved to be very effective discriminators and gave students the opportunity to show their understanding of a topic or to demonstrate their analytical skills. 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. However, weaker responses often failed to gain credit due to the use of imprecise or inappropriate scientific terminology. One area of concern was the poor responses in parts of question 3 relating to the understanding of genetically-based family trees. Question 7, which tested AO3 skills, was generally answered well, apart from the questions involving evaluation of data. There was also considerable variation in the ability of students to express their ideas clearly and logically.

Question 1

(a) Over eighty percent of students had little difficulty obtaining both marks for this question usually by referring to birth rate and death rate. References to immigration and emigration were ignored except where the context was incorrect. Students scoring one mark often referred to a change in population but did not mention a time period.

(b) Again, most students obtained both marks in this question. Common correct responses included high birth rate, high death rate and low life expectancy. A significant number of students referred to the ‘wide base’ and ‘narrow top’ as evidence that the country is at an early stage of demographic transition. Students obtaining one mark often incorrectly suggested that there was evidence of a low death rate. As with part (a), very few students scored zero.

Question 2

(a) The vast majority of students correctly named the pioneer species as *Ulva lactuca*.

(b) (i) Fewer than half the students obtained this mark. Those who did frequently referred to the difficulty in counting or identifying individual organisms because of their small size. Many students simply stated it would be ‘easier’ or ‘more accurate’ without providing any explanation.

(b) (ii) Most students did not obtain this mark, as they simply stated that the concrete blocks were ‘not natural’ or were ‘man-made’. Correct responses usually referred to factors such as nutrients, minerals or texture being different and affecting the growth of algae.

(c) Most students obtained at least one mark, usually for the principle of a species making the conditions less hostile. However only ten percent of students gained all four marks by using the results provided to describe and explain the process of succession. These students referred directly to the species involved and related the changes in percentage cover to interspecific competition as the environment changed. Many students simply provided a generic description of succession, often only referring to the pioneer species. This rote learning was clearly demonstrated by the number of students who included mosses, shrubs and trees in their responses.

Question 3

(a) The phenotype as the expression of the genotype was well known, with the vast majority of students gaining the first marking point. Less than a quarter of students mentioned the effect of the environment on the phenotype. Answers that failed to gain a mark just described the phenotype as the visible characteristics or appearance of an organism.
(b) (i) Over a third of students scored zero on this question. Most of these students suggested that the phenotypes of 1, 2, and 4/5 proved that the allele for Tay-Sachs disease is recessive. There was also a common misconception that individual 3 was the son of 1 and 2. Approximately half the students who correctly referred to individuals 3, 4 and 9/11, provided a suitable explanation to gain a second mark. Unfortunately, the use of poor terminology prevented more students from gaining both marks; for example, ‘do not carry the gene’.

(b) (ii) This proved to be very problematic with less than twenty percent of students scoring above zero. Many students had no idea how to prove that the allele for Tay-Sachs was not on the X-chromosome, often identifying the wrong individuals or suggesting that only males should be affected. Some students gained the first mark for correctly selecting individuals 11 and 3, but only a minority of students were able to explain how this proved that the allele was not on the X-chromosome. The allele was often thought to be on the Y-chromosome. The fathers were also thought to pass their X-chromosome to their sons. Some answers were very general and failed to mention any numbered individuals.

(c) (i) This proved to be quite an effective discriminator despite fifty percent of students obtaining all three marks. Students obtaining a single mark often did so by attempting to calculate $2pq$. Although many students gained credit for showing that $q^2 = 0.001$, a significant number incorrectly indicated that $q = 0.001$. It was disappointing to find incorrect answers which showed no ‘working’ as some of the calculation might have been along the right lines. The required use of decimals certainly proved troublesome for some students. A small minority of students simply provided the Hardy-Weinberg equation but made no attempt to use it.

(c) (ii) It was surprising to find that almost fifty percent of students did not gain this mark. Most correct responses noted the information provided in the stem of part (b), ie ‘sufferers of this disease often die during childhood’. Incorrect responses related to more general reasons why the Hardy-Weinberg equation might not apply, such as emigration, immigration, lack of random mating etc. Random fertilisation and mutation were often seen as incorrect responses. Natural selection, selection against individuals with Tay-Sachs, stabilising selection and directional selection were also suggested.

**Question 4**

(a) Over ninety percent of students obtained at least one mark, usually by identifying which reactions occur in mitochondria. The majority also knew the stages of respiration during which NAD is reduced. However, the stages of respiration during which carbon dioxide is produced were less well known.

(b) (i) Most students obtained a mark for stating that glucose is used in glycolysis or that it is broken down in the cytoplasm. Very few students gained the second mark, as they failed to explain that glucose could not pass through mitochondrial membranes.

(b) (ii) The vast majority of students obtained a mark for suggesting that malonate attaches to the active site of an enzyme, or that it is a competitive inhibitor. Most of these students then gained credit for explaining that this would reduce the formation of enzyme-substrate complexes. However, weaker responses were very confused, with malonate, fumarate or succinate having an active site. Some students referred to non-competitive inhibition.

(b) (iii) Almost forty percent of students gained both marks in this question, which produced some excellent answers. These students referred to the inhibition of the Krebs cycle, reduced production of reduced co-enzymes and the role of oxygen as the terminal electron acceptor. Students
obtaining a single mark often referred to the Krebs cycle being inhibited. A common misconception in weaker responses was that oxygen is used directly in the Krebs cycle.

**Question 5**

(a) (i) Three out of four students gained this mark by stating that carbon dioxide is a limiting factor on photosynthesis. Inadequate responses often simply stated that carbon dioxide was needed for photosynthesis.

(a) (ii) Twenty percent of students gained this mark by indicating that any difference in growth during the experiment would be due to iron deficiency. There was a large variety of incorrect responses but the majority referred to a ‘fair test’, ‘similar growth’ or ‘same level of TP’.

(a) (iii) Only the better responses included the realisation that the period in the dark was to ensure that the levels of triose phosphate were similar/low in both groups of plants at the start of the experiment. Many who did mention triose phosphate thought that it would all have been used up or converted to glucose/RuBP, ignoring the evidence from the graph. Weaker responses only referred to preventing the light-dependent reaction, or just preventing photosynthesis.

(b) This question proved to be a very effective discriminator and produced a good range of marks. Most students gained a mark for ATP being produced during electron transport. Although many students then gained a mark for the production of reduced NADP, a significant minority incorrectly referred to NAD. The decrease in production of triose phosphate was not always linked to a decrease in glycerate-3-phosphate. Only better responses referred to ATP and reduced NADP being produced during the light-dependent reaction. Despite the stem of the question stating ‘knowledge of photosynthesis’ a number of students described electron transport during respiration.

(c) This question caused some difficulty for students, with almost forty percent gaining no marks. It was surprising to find a number of students referring to respiration in their answers and confusing the Calvin cycle with the Krebs cycle. Some students with a better understanding failed to gain credit as they limited their explanation to the Calvin cycle being reduced. Students gaining one mark often referred to the role of RuBP in combining with carbon dioxide. Only the best responses linked iron deficiency to a reduction in the amount of triose phosphate and therefore less RuBP.

**Question 6**

(a) This question was the most effective discriminator on the entire paper. The best answers used all the information provided to describe how geographic isolation could cause a very high diversity of bird species. At the other extreme, speciation was ignored and a description of succession was given. Most answers did attempt to explain speciation but often did not make sufficient use of the information provided to gain high marks. Usually these accounts only gained the marks for geographic isolation and for describing differential reproductive success. Poor use of terminology was also clearly evident in these weaker responses. References to different selection pressures and changes in allele frequency were often only mentioned in better responses.

(b) Surprisingly, almost fifty percent of students failed to gain this mark. Common incorrect response referred to a climax community being formed, or mutations not occurring. Students gaining this mark often mentioned no ‘isolation or ‘a similar environment’.
Question 7

(a) (i) Almost eighty percent of students obtained this mark, usually by stating that this method helps to make the samples ‘representative’ or ‘reliable’.

(a) (ii) The vast majority of students gained at least one mark for referring to using coordinates or dividing an area into squares. Most of these students gained a second mark for describing a method of generating random numbers. Some students incorrectly referred to the mark, release and recapture method.

(a) (iii) Almost fifty percent of students gained two marks for providing two valid reasons for changes in the population of lizards at different times of the year. Breeding, predators, prey and temperature changes were common correct responses. Responses such as ‘weather’ or ‘climate’ were not credited and limited most of the other students to one mark.

(b) This was generally answered well, with many students gaining both marks. The most common scoring point was the idea of allowing a valid comparison. Some students failed to note that the numbers in the samples vary and obtained one mark. Incorrect responses often referred to reliability.

(c) Considering the data provided were not particularly complex, it was disappointing to note that forty percent of students scored zero for this question. The most common scoring mark point was for referring to the results at site 5 for A. gingivinus. Relatively few students gained a second mark by referring to a positive correlation or to the limited results for A. wattsi.

(d) (i) The vast majority of students gained one mark for stating that more A. gingivinus than A. wattsi are infected. Many students then tried to explain why this might be the case (more die so less competition for food etc), rather than trying to give further explanations of how they reached the conclusion. As a result, very few students obtained two marks.

(d) (ii) A significant minority of students did not use the information provided on the destruction of blood cells and gained zero marks. Students who did use this information often referred to the increased susceptibility to disease due to destruction of white blood cells. There were slightly fewer marks gained for the effects caused by a reduction in red blood cells.

(d) (iii) Less than fifty percent of students obtained both marks. Although students understood that the P value represented probability, the less than symbol < was often interpreted as ‘is’ or ‘equal to’. Other errors included referring to 0.01% rather than 1% probability or the correlation not being due to chance (with 0.01/1%). Some students correctly used a probability of more than 99%/0.99 that the correlation is not due to chance.

Question 8

(a) Only ten percent of students obtained more than four out of the six marks available. Answers often gave the disadvantages of chemical pesticides and biological agents without making the advantages of using an integrated system clear. All marking points were seen in responses, but usually only 2 or 3 of them in any one response. The most common marking points referred to the specificity of biological agents, its single application and the reduced need to apply chemical pesticides. The fact that chemical pesticides act quickly was also appreciated by many students. A common error in weaker responses was to confuse pesticides with fertilisers and then to provide a detailed account of eutrophication. On a positive note, the common confusion between resistance and immunity was less apparent than on previous papers. A larger than expected number of students gained no marks for this question.
(b) Not surprisingly this question produced a lot of good answers but still discriminated well despite forty percent of students scoring four or more marks out of the five available. Weaker responses lacked the appropriate level of scientific terminology, omitted essential details or confused ideas. Most students referred to an algal bloom and its effect on penetration of light. However, some students omitted any reference to photosynthesis, or related a reduced oxygen concentration solely to the activity of plants. Some students referred to fish dying due to lack of food with no reference to oxygen or respiration. The best responses were often clear and concise and read as the mark scheme. These answers referred to saprobic microorganisms rather than simply ‘decomposers’ and clearly related the death of fish to a decrease in oxygen for respiration.

(c) Almost eighty percent of students obtained at least half the marks on this question. However, relatively few obtained maximum marks despite all the marking points regularly occurring on different scripts. The two most commonly seen marking points were those related to less respiratory losses due to animals being kept inside/warm and having restricted movement. References to selective breeding were also fairly frequent. Students often referred to animals being fed controlled diets but did not always explain clearly how this increased net productivity. A common explanation, which was not credited, was to state that it increased ‘growth’. Similarly, when students referred to animals being slaughtered when still growing, explanations were often inadequate. Better students had no such problems and provided verbatim the mark scheme answers.

**Mark Ranges and Award of Grades**

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Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

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