



## **General Certificate of Education**

# **Biology 2411**

**BIOL4      Populations and Environment**

# **Report on the Examination**

*2010 examination - January series*

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## General Comments

The subject criteria for Biology require a change in the emphasis of the assessment objectives at A2. A significantly greater proportion of marks must now be awarded for demonstration of the skills of application and analysis (AO2) and of those underpinning *How Science Works* (AO3). There is only limited opportunity for candidates to demonstrate basic recall (AO1). Despite the misgivings expressed at the time of the Unit Test, many candidates responded well to the required changes. The best candidates rose to the challenge and demonstrated competence in the required skills. Those who were less able still showed a willingness to attempt questions, and demonstrated some ability to apply their knowledge to novel situations. Unfortunately, this group of candidates was frequently let down by limited knowledge and understanding of basic biological principles. Thus there was considerable confusion between respiration and photosynthesis, and a disappointing lack of knowledge of the carbon cycle and the quantitative aspects of energy transfer in ecosystems. Also, apparent from the start of many scripts, was a widespread failure to apply basic examination technique. Many candidates took little or no notice of such commands as “Use this information” or “Use the graph” and produced what appeared to have been prepared answers, correct in detail but irrelevant in context. Quality of written communication proved a problem for some and it was not uncommon to encounter technical language used inappropriately or to read arguments that lacked all coherence.

### Question 1

Question 1 was targeted at candidates of more modest ability and tested section 3.4.8 of the specification. It built unavoidably on foundations laid in Unit Biol 2.

- (a) The many candidates who focused correctly on heat loss were generally able to gain full credit. Some confusion was demonstrated over the relationship between size and surface area to volume ratio. This concept is specifically mentioned in the list of biological principles given at the end of Unit 2.
- (b) Part (i) was answered well although a few candidates clearly did not recognise that a percentage is not the same as an actual number. Answers relating to more geese being found further north did not gain credit. In part (ii) most candidates appreciated that this question related to selection and responded in terms of camouflage and predation. However, a significant number of responses failed to offer an explanation of the specific situation described. These answers were frequently worded in general terms or were, in some cases, related to the size of the geese or to other organisms entirely.
- (c) Although there were many excellent answers to this part of the question, there were also responses phrased in unacceptable anthropomorphic language relating to geese “not liking warm conditions” and “feeling happier further north”. Other candidates incorporated material outside the requirements of the question and gave lengthy accounts of the perceived causes of climate change.
- (d) Many candidates correctly identified the graph as illustrating stabilising selection but relatively few were able to explain the evidence with sufficient clarity to gain the mark in part (ii).

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**Question 2**

The carbon cycle and the effect of global warming on the life-cycle and numbers of insect pests provided the theme for this question.

- (a) Despite the number of marking points available, relatively few candidates were able to gain credit for recalling the principles underpinning the cycling of carbon. There was a widespread failure to appreciate that carbon is taken up by plants as carbon dioxide in the process of photosynthesis. This was apparent in the many answers which stated that carbon or specific carbon-containing compounds were absorbed by roots.
- (b) In order to demonstrate the understanding and skills required by the specification, candidates need to have acquired the mathematical skills defined on page 45. A significant number of candidates were unable to calculate a rate from a graph, and it was only the best who identified the part of the curve from which they should have worked. The most frequent incorrect response was the value of 16 obtained by dividing 400 by 25 – a figure which represented the rate of growth over the full time period.
- (c) Although most candidates successfully explained the link between nitrogen and protein, fewer understood the concept of a ratio. It was not uncommon to read that an increase in carbon dioxide concentration would lead to a lower carbon:nitrogen ratio, or that a high carbon:nitrogen ratio would result in the synthesis of more protein.
- (d) Those candidates who gained credit here had obviously read the question carefully and established that it was referring to crop loss due to caterpillars. They often responded in terms of relevant limitations of the experimental procedure or offered other valid answers relating to how an increase in carbon dioxide concentration might increase caterpillar damage. Those who failed to provide appropriate responses tended to concentrate on the effect of carbon dioxide concentration on the rate of photosynthesis

**Question 3**

This question tested the section on human populations and reflected the specification requirement that candidates should be able to interpret survival curves.

- (a) Although there was the inevitable confusion with community, many candidates gave appropriate explanations of the term, population, and expressed their answers with sufficient clarity to gain the mark.
- (b) Part (i) discriminated very effectively across the whole ability range. Most candidates were able to identify Curve **C** as the one from which to work although some hedged their bets by using all three. Those who had a clearer understanding of survival curves elected to determine the point at which half the initial cohort survived. The best candidates were able to progress from this point to express the percentage that they read off the x-axis as an absolute age. Part (ii) was answered well with many candidates successfully linking poor health care to a high infant mortality rate. There were a significant number, however, who completely misread the question. They either wrote about Curve **C** or gave a general account of what they considered to be the living conditions in 1750 without ever attempting to link this information to the shape of the curve.

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**Question 4**

The first part of Question 4 was based the requirement for candidates to carry out fieldwork as detailed in the section titled Investigative and practical skills. The question progressed to consider the application of elementary statistical analysis to the results obtained from such an investigation.

- (a) Part (i) was targeted at grade E candidates and there were many correct answers involving some method of creating a grid and the use of a random number generator. Those who did not gain full credit usually failed to indicate how they might turn the random points that they had obtained into areas that would be sampled. Two approaches to part (ii) were acceptable. Some of the best candidates had clearly encountered the use of a running mean and were able to describe the underlying principles with sufficient clarity to gain both of the available marks. The other approach was to discuss the compromise between reliability and time available. Many answers, however, ignored the question requirements and simply suggested what they considered would be a suitable number of quadrats to “collect representative data”.
- (b) Many of the less able candidates demonstrated either an inability to make use of information provided or a failure to apply common sense. Thus there were significant references both to coppicing the daffodils and to felling the whole wood at improbably frequent intervals. Those who understood the concept did not always read the graph with sufficient accuracy and described daffodil numbers rising to a peak at 3 years or there being more plants between 3 and 6 years.
- (c) The requirement for candidates to be able to apply elementary statistical analysis to the results of ecological investigations should have ensured a degree of familiarity with the concepts of a correlation coefficient and statistical significance. All that was really required here was to identify the positive correlation between the number of daffodils in flower and total rainfall, and the negative correlation with monthly mean temperature. Some candidates foundered because they misinterpreted the correlation coefficients as mean values. Others failed to link the climatic factors with the flowering of daffodils with the result that many of the statements made were vague and imprecise.

**Question 5**

The weighting of the assessment objectives limits the number of marks that can be awarded for recall of basic factual information and this question sought to test understanding of the principles underpinning respiration. It became clear in marking the scripts that although many candidates had considerable knowledge of the appropriate technical language, they lacked fundamental understanding.

- (a) Although there were occasional references to glycolysis, most candidates correctly named either the Krebs cycle or the link reaction.
- (b) Although most candidates recognised the role of enzymes, the examiners were left with the impression that many of those who made the basic error of linking decreasing temperature to enzyme denaturation were responding with prepared answers. A disturbing number of candidates revealed here, and elsewhere in the question, confusion between respiration and photosynthesis.
- (c) Apart from predictable and confusion between oxidation and reduction, and between NAD and NADP this question was answered well.

- (d) Although this part of the question was targeted at those candidates likely to be awarded higher grades, it was disappointing to note that relatively few were able to make use of the information provided, that the apple slices were transferred to anaerobic conditions in pure nitrogen gas. Many wrote about nitrogen fixation, bacterial decomposition or the need for nitrogen in photosynthesis. Better candidates generally identified respiration as anaerobic even if they failed to discuss the relative inefficiency of the process.

### Question 6

This question was directly related to the section on succession and required candidates to interpret data relating to a specific situation. Many responses reflected poor examination technique with candidates persistently failing to follow the instructions given and make use of the graph.

- (a) Candidates should be encouraged to take time to understand data given in the form of graphs or tables before attempting the questions. It appeared to the examiners that many considered the figure to represent data that they had previously encountered, and interpreted it as representing changes in population with time. Better candidates were, however, able to recognise that Species **X** had a higher rate of photosynthesis at higher light intensities and some were able to link this to competition and establishment at an early stage in succession.
- (b) Those candidates who had interpreted the graph successfully were usually able to point out that species **X** would produce shade and under these conditions species **Z**, with its higher rate of photosynthesis at lower light intensities, would be able to grow. There were many answers, however, based on Species **X** growing, dying and adding nutrients to the soil. Such an answer may have been partly correct but it made no use of the data provided, an essential prerequisite to gaining credit.

### Question 7

Unit 4 will test the principles underlying *How Science Works* with a question that will be similar in format to this. In order to provide a genuine test of the objectives involved and the appropriate degree of stretch and challenge, candidates must expect to encounter investigations with which they are unfamiliar. While it was encouraging to note that most candidates responded well to the unfamiliar, many failed to gain credit for those parts of the question that depended rather more heavily on basic factual knowledge.

- (a) Many candidates appreciated the way in which the hair traps worked and offered sensible suggestions to both parts of this question.
- (b) The importance of random selection in avoiding bias was appreciated by many.
- (c) Most candidates clearly had some appreciation of the importance of checking the repeatability of the measurements. There were frequent, and acceptable, references in part (i) to reliability. Better candidates also wrote of avoiding measurement and personal errors. Part (ii) created more in the way of difficulties, partly because it was unclear in many instances as to precisely what had been plotted. Very few candidates appeared to have encountered scatter diagrams with many responses being based on plotting the two sets of measurements and then comparing the positions of the pairs of points that resulted. An alternative approach, suggested by many, was to construct histograms and compare these. As the question specifically called for using a scatter diagram, this approach could not be given credit.

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- (d) The many candidates who answered part (i) in terms of the difficulty of establishing the relationship between the number of hairs and the number of visits by a shrew were able to gain credit. Part (ii) proved more challenging and a considerable number of candidates misinterpreted the question. They considered “setting traps immediately after using the hair tubes” in a geographical rather than a temporal sense. Others embarked on lengthy discussions of the advantages of using the mark-release-recapture technique and produced responses which had little if any relevance to the question asked. The very best candidates, however, linked time to population change and produced appropriate answers.
- (e) Although many candidates discussed specific statistical tests in their answers to this question, it was clear that they had little understanding of the role of such tests in determining the probability of an event being due to chance. There were frequent references to greater accuracy and reliability and even to the use of statistical tests being “more scientific. It was also disappointing to note the many responses that referred to neither or only a single one of the terms specifically required in the response.
- (f) It was clear from the many correct answers to part (i) that candidates had clearly understood the bubble plots despite their unfamiliarity. A significant number, however, introduced the term “correlation” without making it clear that in this case a positive correlation existed between the hair tube index and the number of shrews trapped. The absence of correlation in the case of the pygmy shrews was usually indicated, and better candidates pointed out that the hair tube index indicated that hairs were present even when shrews had not been caught in the traps.

### **Question 8**

Question 8 allowed for continuous prose and accounted for a considerable number of the marks available for knowledge and understanding.

- (a) This part of the question was generally answered well with most candidates able to comment sensibly on the raised energy level of electrons and their subsequent passage down an electron transfer chain. There were also frequent references to the release of energy allowing the generation of ATP from ADP and phosphate. Better candidates often made an appropriate reference to oxidation and reduction or to the association of the electron transfer chain with the chloroplast membranes. There was, perhaps, the inevitable confusion between photosynthesis and respiration but most problems arose where candidates had gone far beyond the requirements of the specification. In such cases detail was often confused and led to a range of contradictory and inaccurate statements.
- (b) The specification requires candidates to consider the efficiency of energy transfer between trophic levels from a quantitative viewpoint. Answers to this part of the question were frequently extremely superficial and involved little more than a catalogue of feeding habits with an often repeated statement about energy losses. Most candidates were able to point out that not all of the energy in sunlight was used in photosynthesis. The introduction of a quantitative statement about the efficiency of this initial stage was relatively rare. Where such statements were introduced, they frequently revealed confusion between the proportion of energy reflected or failing to strike chloroplasts and the efficiency of transfer to chemical potential energy in the plant. There was much discussion of energy loss with progression through a food chain. Respiration and heat loss were frequently mentioned but responses were often marred by references to

energy loss through growth and reproduction. Another common misconception was that the efficiency of energy transfer decreased with increasing trophic level.

- (c) Most candidates produced answers relevant to the question, although there was some misinterpretation of the specification term *domestic livestock* as referring to plants, and some lengthy and irrelevant discussion of economic and ethical issues. Most candidates, however, appreciated the need to reduce respiratory loss and considered heating and restriction of movement. References to controlling feed intake were not always phrased with sufficient precision to gain credit, and there was much inaccurate reference to animals turning energy into fat or meat.