



General Certificate of Education

Biology 2410

BIOL4 Populations and environment

Report on the Examination

2010 examination - June series

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General Comments

Many questions allowed all candidates to demonstrate some level of knowledge or understanding. This was especially true in question 8 where the whole range of ability was evident. Basic ideas were not always dealt with confidently. Explaining the placing of a suspension of mitochondria in an isotonic solution was one example where candidates were less than successful. Major issues identified by examiners were the apparent lack of consideration of what a question was about, a lack of adequate interpretation of given data, and a failure to recognise what should be familiar ideas but in a different context. Mathematical skills are required and detailed in the specification. This examination has revealed that improving the ability candidates to calculate or use ratios should be a priority for many centres.

Question 1

- (a) Most candidates correctly identified ammonia as the product of nitrogen fixation.
- (b) Candidates appreciated the idea of substances with a similar shape fitting the active site of an enzyme. Some, however, incorrectly identified the active site as part of a substrate structure.
- (c)(i) Better candidates identified ATP as the product of aerobic respiration and went on to suggest, appropriately, that as *Azotobacter* removes oxygen during aerobic respiration, nitrogenase would have the required anaerobic conditions and catalyse the fixation of nitrogen. Less able candidates did not make full use of information provided in the question introduction and had limited success.
- (c)(ii) Processes involved in growth, such as protein synthesis or the production of new cells, require energy. If this energy is used in nitrogen fixation, less will be available for growth. Consequently, growth will be slower. Better candidates expressed this idea clearly.

Question 2

- (a) The majority of candidates completed the calculation successfully. A few failed to recognise that 18 marked and 20 unmarked birds produced a total of 38 birds trapped in the second sample. Collectively, there were various permutations of the three numbers with some candidates arriving at a population size that, on careful thought, could not have been right.
- (b) In the remaining parts of the question, better responses were seen from candidates who could apply their understanding of the limitations of mark-release-recapture with specific information.
 - (b)(i) In June, there is an increase in population size when young birds leave their nests to join the adult population. It was not appropriate to describe this as migration.
 - (b)(ii) In March, birds in territories would not mix within the population and sampling would result in capturing the same birds.

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- (c) Recording the DNA base sequence of whales would be similar to marking the animals. If the base sequence were identified again, then it would be known that the same 'marked' animal had been recaptured.

Although many candidates clearly understood the technique of mark-release-recapture, a large number could not apply what they knew when presented with an unfamiliar context.

Question 3

- (a) Although most candidates knew that the Hardy-Weinberg principle relates to the frequency of alleles, few explained that the frequency should remain constant from one generation to the next.
- (b) As in question 2, candidates who performed better could apply their knowledge and demonstrate genuine understanding. Thus, they were able to explain that as white cats were deaf they would be at a selective disadvantage. As such, they would be unlikely to survive and pass on their alleles to the next generation.
- (c) Although many candidates were aware that $p + q = 1$, they could not explain that a combined frequency of greater than 1 would indicate that the alleles were not of the same gene.
- (d) Many candidates failed to complete the calculation successfully, either because they assumed the information in the table referred to genotype rather than allele frequency or neglected to produce the answer as a percentage, as required.

Question 4

A weakness with interpreting information denied some candidates the opportunity to gain high marks in this question.

- (a) A large proportion did not complete the equation successfully, mainly as a result of including absorption (A).
- (b)(i) The use of concentrates or providing food with a high nutritive value would increase the value for A, since it would be more readily digestible, or would produce less waste. Less able candidates associated this part of the question with reducing respiration.
- (b)(ii) During intensive rearing, animals respire less because their movement is restricted.
- (c)(i) The majority of candidates appreciated this but were unable to calculate the required ratio. Many gave an answer that was the reverse of the correct value. Others did not give a ratio, or did not simplify it.
- (c)(ii) Applying an understanding of this ratio also proved difficult for some, although all that was expected was recognition that mammals maintain a high body temperature or have a higher body temperature than insects.
- (d) The last part of this question differentiated candidates on their ability to evaluate evidence in a graph. Many recognised that a positive correlation was shown but fewer
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commented on the agreement between predicted and actual values, or referred to the predicted values being generally higher than actual values. Weaker candidates discussed a perceived line of best fit and discussed proportional changes as opposed to looking for a correlation between values.

Question 5

- (a) A large number of candidates did not associate an increase in soil nitrate concentration with the process of nitrification or with the activity of nitrifying bacteria. This was despite identification of dead organisms and the process of decomposition as the starting point for formation of nitrates.
- (b)(i) The graph showed that when pioneer plants first colonised abandoned crop fields there was a high percentage cover of bare soil. Few made use of the data and used the graph to help answer this question. Discussions of fluctuations in air temperature gained little credit.
- (b)(ii) Similarly candidates also failed to recognise from the graph that, after 50 years, there was greater cover of woody plants. Those that appreciated this were able to explain the advantage for new colonisers of an ability to survive in the shade of taller woody plants.
- (c) In the final part of the question, candidates were reminded to use the graph and many did appropriately. They were able to explain that small annual plants would be outcompeted by woody plants unless these were removed or had their growth managed.

Question 6

- (a) This question separated candidates into those who had a general idea about electron transfer and those who appreciated the role of membranes in this process. A common error was to describe protons as moving into or out of the membrane, rather than across it. Although this question was largely based on factual recall, a significant proportion showed a lack of adequate preparation or clearly did not appreciate the level of detail expected.
- (b)(i) A large proportion of candidates appeared not to understand what was meant by 'isotonic'. Many believed the term to be associated with control of pH. Where answers were related to the control of water movement, many erroneously related osmotic damage to the cell rather than the organelles in question.
- (b)(ii) Mitochondria were under investigation so glucose was not used as the respiratory substrate since it does not enter mitochondria. Glycolysis occurs in the cytoplasm. Surprisingly few candidates were able to explain this adequately.
- (b)(iii) It was to be expected that rather more candidates would appreciate the role of oxygen as the terminal acceptor in the electron transfer chain than was the case. Many failed to make the necessary link suggesting that it was required for ATP production in some way.

Question 7

- (a)(i) It could be concluded from the evidence in Figure 1 that fewer people visited site R because the *mean* value was lower than that for the other two sites. Although most candidates made reference to this, relatively few commented on the values of the standard deviations. All that was expected from the question about probability values was recognition that there was a probability of less than 5% that the difference was due to chance. It was clear in the answers to this part of the question that many candidates lack an understanding of the principles underlying statistical tests.
- (b)(i) Candidates were more successful with part (b). Most appreciated that using only 10 quadrats was inappropriate because the number of species was still increasing.
- (b)(ii) Similarly, using 25 was inappropriate since the curve on the graph had levelled out and the same result could be obtained using fewer quadrats.
- (c) Incubation at a high temperature would result in combustion and the loss of dry mass. Weaker candidates responded inappropriately to the reference to temperature and offered explanations based on enzyme denaturation.
- (d) Candidates who were successful with subsequent questions appeared to have spent some time interpreting the data first. Weaker candidates tended to plunge straight into questions, a strategy that resulted in limited credit. The ratio of dry biomass of animals to dry biomass of seaweeds is less than one because the animals feed on seaweeds. It is the loss of energy between trophic levels, due to respiration or as heat for example, that results in a ratio of less than one. Relatively few candidates were able to explain this.
- (e) The better candidates could show how the data in Figure 3 supported the view that a smaller number of larger seaweeds were found on frequently visited beaches. They appreciated that the site with most people (U) had the largest ratio for dry biomass of seaweeds to abundance of seaweeds, although they could not always justify this. The difficulty for many continued into the final part of this question, but better candidates could draw some conclusions. Rows one and four revealed that fewer larger animals were found where there was more human disturbance and credit was given where the data were used to support this idea. Row two showed that the number of plant species also fell where there was more disturbance.

Question 8

This question allowed candidates to demonstrate their knowledge but this did not mean that all were successful. All parts discriminated across the ability range.

- (a) A significant proportion of candidates still gave the impression that they believed that respiration in plants only occurs at night. Others suggested that photosynthesis continues at night, but at a reduced rate. There were contradictions relating to the concentration of carbon dioxide in the canopy and at ground level. Few candidates considered the idea of the relative rates of photosynthesis and respiration in the light and the effect on the net uptake of carbon dioxide. There were, however, many complete and high scoring responses.

- (b) Weaker candidates confused substances featuring in the light-independent reaction with those featuring in the Krebs cycle, and confused reduced NADP and reduced NAD. There were many good answers which identified that two molecules of glycerate-3-phosphate are formed and that this is reduced to triose phosphate using reduced NADP and energy from ATP.
- (c) There were many complete responses but weaker answers suggested that the products of decomposed worms would be absorbed through the roots of plants and then transported to the leaves. Better candidates described the role of saprobionts, extracellular digestion and the absorption of the products of digestion by these organisms. They continued to describe the release of carbon dioxide by the respiration of such organisms, and the uptake of carbon dioxide into leaves through stomata. There was some confusion between the terms stroma and stomata.