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Biology BIOL4

(Specification 2410)

Unit 4: Populations and Environment

Report on the Examination

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General comments

A good range of responses was seen in all questions, with a significant number of candidates gaining the majority of marks available. Poor written communication, where answers were too ambiguous to gain credit or used terms such as effect instead of increase or decrease cost candidates some marks. Candidates also often failed to gain marks as a result of superficial reading; locating a key word and then writing everything they could remember rather than taking note of the mark allocation and the amount of space available for their responses. This was particularly apparent in question 7.

Question 1

(a) The column for aerobic respiration was usually correct, but the other two contained a variety of errors that suggested that these processes were less well understood.

(b) Most candidates gained this mark, but a number did not through the use of P, the symbol for the element phosphorus, rather than one of the many accepted abbreviations for phosphate.

(c) There were some good answers here where candidates showed a sound understanding of ATP releasing energy in small amounts in a single reaction. However, a large number of responses were very vague, simply stating that the production of ATP was quick or easy.

(d) Few candidates understood the significance of ATP being too unstable to be stored within cells. A larger number understood that a high turnover of ATP balances its continuous use within cells. Weaker candidates gained one of the marks by showing that they knew of specific processes that required ATP, such as active transport or muscle contraction. Marks were not given for imprecise terms such as growth.

Question 2

(a) Weaker candidates gave superficial answers that referred to optimum temperatures for photosynthesis, rather than using the data in the table to explain that, as July had the highest temperature, the enzyme-catalysed reactions would be taking place more rapidly. Some candidates explained the effect of increasing temperature on enzyme reactions very well, but then failed to gain the second mark by going on to show that this would result in faster photosynthesis and therefore increased productivity.

(b) In part (i), the equation was well known and written in conventional terms or abbreviations, although some candidates failed to gain this mark because they referred to energy loss without linking it to respiration. A significant number of candidates gained both of the marks for part (ii) by explaining that respiratory losses were lower in August, but those who tried to explain the stem by writing a comparative account of the effects of temperature on photosynthesis and respiration did not do so clearly. Very few candidates realised that increasing temperatures had a greater effect on the rate of respiration than on the rate of photosynthesis. A worrying number explained that the plants were using up energy in maintaining their body temperature in the cooler month.

(c) Most candidates gained this mark.

(d) Few candidates were able to suggest that increased respiration would replace the heat lost to the environment, but most realised that more heat would be lost in March and that the horse would use energy in maintaining its body temperature. Although temperature control is not a requirement for this unit, credit was given to those candidates who showed understanding of the energy implications of the process.

Question 3

(a) Apart from the few candidates in part (i) who discussed the recycling of 'animal', this question seemed to pose few problems. Where candidates interpreted 'open pond' as a natural pond containing wildlife and associated processing of waste with environmental damage, they were given credit. In part (ii), better candidates explained the effect of heat on enzymes and, thus, on microorganisms if it were not dissipated. Weaker candidates tended to do no more than repeat the stem of the question.

(b) In part (i), the effects of leaching of nitrates into watercourses were well known and many candidates gained full marks on this section. Part (ii) was answered less convincingly, with many candidates referring to the low cost or easy availability of animal waste, rather than identifying the high energy demands and carbon dioxide emissions associated with the production of artificial fertiliser.

Question 4

(a) A surprisingly large number of candidates did not gain this mark because they missed out the time factor, or the relative population size, or both.

(b) Part (i) was generally answered very well although a few candidates did no more than re-write the question. Part (ii) was also answered well.

Question 5

(a) Many of the explanations given in part (i) were very superficial, for example "fewer white kittens so it must be recessive". References to genotypes were required, although the term carrier was accepted as synonymous with heterozygote. In part (ii), it was evident that some candidates clearly did not understand the term ratio. An understanding of ratios is a mathematical requirement stated in section 3.9 of the specification.

(b) Most candidates gained the mark for part (i) but part (ii) proved more challenging. A common mistake, perhaps because the sex of the parent cats had been stated, was to assume that the inheritance of this fur colour was sex-linked. Another common error was to miss out the $\mathbf{Bb^i}$ genotype for the black offspring. There were many good answers to part (iii) although few candidates commented that gametes are not always produced in equal numbers, as the Mendelian ratio assumes, or that a small sample was involved. In part (iv), many candidates assumed that they were only expected to suggest a single cross that would produce all chocolate cats, rather than produce a self-sustaining population. Nevertheless, a pleasing number thought through the problem carefully with many mentioning all the marking points in their answers.

Question 6

(a) About 50% of candidates gained both of the marks available for part (i), but of the rest there was considerable evidence of confusion. Nearly all wrote out the equation $p^2 + 2pq + q^2 = 1$, when finding 0.2^2 was all that was needed in this case. Many also did not know whether the allele frequency of 0.2 was the value for q or for q^2. Most candidates responded correctly to part (ii), but a number continued to provide irrelevant detail about the conditions required for the Hardy-Weinberg principle to be valid.

(b) Few candidates gained both the marks available for part (i), as they did not show the necessary understanding of the difference between chance and probability. The

answer given by many to part (ii), stabilising selection, suggested that they had not read the stem of this part of the question carefully enough. Those candidates who missed marks in their explanations usually did so because they wrote generally about selection rather than explaining the effect of this allele on survival and reproductive success and the consequent decrease in its frequency.

Question 7

(a) Candidates frequently failed to gain credit because they wrote that the mites affected breeding (as stated in the question) rather than reduced breeding success, before they went on to explain why.

(b) The response 'to eliminate bias' gained most candidates one mark for their answer to part (i), but fewer appreciated the importance of being able to apply a statistical test to the data collected. In part (ii), many candidates showed that they understood the significance of variation in breeding success but did not look critically at the independent variable so did not comment on the lack of data between 15 and 170 mites per pair of parent birds. Weaker candidates tried to answer the whole question in a single sentence rather than breaking their answers into separate parts.

(c) In part (i), candidates seemed to find it difficult to go beyond the general answer of 'there is no difference' and relate their null hypothesis to the investigation in question. A common error was to state that, 'There is no difference between the mites and the breeding success of the birds'. Most incorrect responses to part (ii) simply restated that the correlation was negative, or that one value went up as the other went down. Marks were only gained by answers that related to the data in the question, stating clearly that breeding success went down as the number of mites went up.

(d) Many candidates made reference in part (i) to anomalous data, rather than describing the wide scatter or points. Others failed to gain marks because they did not refer to the number of mites and the size of the oil gland in their answers. In part (ii), some candidates only considered the practical details here, rather than using the information in the stem. They were required to explain that preening only took place at certain times of day and that after preening the gland was significantly smaller, causing the measurement to be lower than it would have been earlier in the day.

(e) Most candidates realised that pathogenic organisms were harmful, but few made the second step and explained that a reduction in pathogens would allow the parent birds to have greater breeding success because, for example, they had not passed disease to their offspring.

Question 8

(a) The majority of answers were correct and concise but some candidates included extensive detail about nitrogen fixation, and denitrification that were not required by the question.

(b) Some marks were missed as candidates referred to carbon rather than to carbon dioxide. Some candidates made irrelevant mention of carbon dioxide release when *fossil* fuels are burned; others did not stress the significance of loss of photosynthetic organisms and the way in which this would reduce carbon dioxide uptake.

(c) A very large number of candidates appeared to have written all they knew about photosynthesis, rather than focus on the light independent reaction as required by the question. Generalising the reactions and writing too superficially, e.g., 'GP is converted to TP using ATP', was common but gained no marks, whereas 'GP is reduced to TP' would have gained one mark and 'GP is reduced to TP

using energy from ATP and the reducing power from reduced NADP' would have gained three. Many diagrams and schemes for the light-independent reaction were included and, where these contained additional information, this was credited. However, many were inaccurate or only repeated what had already been written There were also a worrying number of these diagrams labelled as the Krebs cycle.

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