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Examiners' Report

Principal Examiner Feedback

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(5BI3H) Paper 01

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Overview

Unit B3 Using Biology contributes 25% towards the total GCSE in Biology and Further Additional Science. This was the fifth and final paper written and examined for the B3 unit in the Science 2011 specification. The paper is combined with two additional examination units both worth 25% and a controlled assessment task also worth 25%.

The paper consists of 60 marks assessed by a variety of questions including multiple choice, short answer and two extended answer questions worth 6 marks each. Candidates should answer all questions in a time period of 1 hour. The extended answer questions are also marked on their quality of written communication (QWC) so candidates should ensure that their answer includes good use of spelling and grammar and also that the answer is written with clarity.

The paper contained questions from all three topics from the unit. These included co-evolution, types of behaviour, sex determination and sex linked inheritance, the role of ADH in the kidney and the production of urea, photoperiodicity and the production of transgenic plants, immunisation and the production of cheese and lactose-free milk.

General Comments

Most candidates were able to access the first extended writing response and were able to interpret the information given on antibody levels in the blood of a patient after a first and second injection of antigenic material. In contrast to previous years not all candidates were able to access the second extended writing response. This was based around the core practical of producing lactose-free milk using immobilised enzymes. It was clear that some students had not done the practical work which made it very difficult for them to access the question.

Maths skills were assessed in the paper for the interpretation of a sex-linked inheritance cross using a Punnett square and for using percentages to calculate how many more volunteers contracted HIV after immunisation with a placebo than an immunisation containing antigens. Many candidates lost marks for incorrectly manipulating the percentage calculation or for failing to recognise that the 16 000 volunteers had been split into two groups because they did not read the question carefully.

It was clear from the responses that candidates had used past papers during their revision. Candidates showed a good level of knowledge where similar questions had been posed before. Particularly, there were fewer mistakes on the sex-linked Punnett square than previously with fewer candidates mistakenly adding an allele to the Y chromosome. There was also fewer mistakes recognising and describing the different types of behaviour.

Candidates of all abilities were able to interpret diagrams to explain which species of moth could feed on and pollinate an orchid. However, only higher ability candidates were able to fully explain how co-evolution of these two species would have occurred. Most candidates were able to apply their knowledge on behaviour to different contexts and explain the benefit of some behaviour strategies in caterpillars and butterflies. Most were also able to recognise different behaviour types and describe habituation. Although some candidates did not fully answer this question as they just described what it was and not how it would have been achieved.

When asked to describe how sex is determined at fertilisation most candidates knew how the X and Y chromosomes combine to determine sex but not all recognised that it was the sperm that provides the X or Y. There were many accurate Punnett squares

to show the sex-linked inheritance of haemophilia. There were some good interpretations of ADH levels in the body with many candidates being able to give its role and give a reason for an increase in ADH. Although there were some good answers on the production of urea many candidates confused urea with urine.

The questions on photoperiodicity were very applied and required candidates to read and interpret information that was given in the stem of the question. It was clear than many candidates did not fully read or understand the information given and they struggled to provide coherent responses to the question. Most candidates understood why biofuels can be described as carbon neutral but their responses were not detailed, only high ability candidates linked the carbon dioxide that plants take in whilst growing to photosynthesis. High ability candidates scored well when asked to explain how a plasmid could be used to produce transgenic plants. However, many gave detailed explanation of how the plasmid would be produced and only scored marks at the end of their explanation when they linked the plasmid to Agrobacterium being able to infect plants. Some candidates probably lost marks because they misinterpreted what the question was asking and focused on the role of restriction enzymes, sticky end and ligase in constructing a plasmid which has been assessed on previous papers.

There was some confusion over the role of a placebo injections in trials and the role of immunisation in preventing disease rather than treating it. This was possibly down to candidates not proof reading their responses carefully. Most candidates were able to describe the differences in antibody levels in the blood between primary and secondary immune response and high ability candidates were able to explain the differences by referring to lymphocytes and memory lymphocytes.

The level of detail given in the explanations of how vegetarian cheese is produced varied. Where candidates focused on explaining how the enzymes were used to produce cheese they scored highly. Many candidates gave detailed explanation of the enzyme chymosin is obtained rather than how it is used and failed to score many marks. The final extended open response showed a wide variety of understanding and unusually for this paper a number of candidates scored zero. High ability candidates were able to give some excellent detailed explanations and easily obtained maximum marks on the item.

Comments on specific items

1ai – Most candidates scored 2 marks for this question recognising that species 2 had a proboscis that was long enough to reach the nectar or they utilised the information given in the diagram to explain that species 2 proboscis was the same length as the orchid tube. Where candidates missed marks on this question it was for repeating the question phrasing of feeding on the orchid or by explaining that species 2 could reach the pollen rather than the nectar.

1aii – Most candidates correctly answered this multiple choice question recognising that both species of moth could pollinate the orchid.

1bi – This question scored a range of marks. Most commonly candidates recognised that the moth was able to feed on the orchid and survive. Many candidates then linked this feeding to the role of pollinating the orchid. High ability candidates recognised that a mutation occur in the orchid to extend the tube of the moth so that a longer proboscis is produced. Very few candidates completed the description by combining the idea that feeding and pollination allow both species to survive and reproduce.

1bii- Many candidates recognised that the relationship between the orchid and the moth provided the moth with an exclusive food source. Most candidates who scored

a mark on this question either referred to a lack of competition for food or a description of the idea that they were the only insect that could feed on the orchid.

2a – Candidates of all abilities were able to answer this question well by linking the laying of eggs on the underside of a leaf to the idea that predators would not see them so they were more likely to hatch. Some candidates linked it to the idea of protection from the weather. Where candidates lost marks it was because they did not qualify the idea of protection. A few candidates misread the question and linked it to the survival of the butterfly or caterpillar rather than the eggs.

2bi – Most candidates successfully answered this question by suggesting that the caterpillars which tasted bad were less likely to be eaten. A few weaker candidates gave the idea that the caterpillar became used to the taste of the leaves and were not awarded the mark.

2bii – The idea that chemicals extracted from plant leaves could be used to relieve the symptoms of disease was recognised by most candidates on this multiple choice question.

2c – There were some very good explanation as to why closing wings could be an advantageous behaviour for butterflies when they were approached by an animal. Frequently seen responses included the idea of camouflage, decreasing surface area as well as the idea that they were less likely to be seen. These ideas were mainly linked to the idea of increased survival and maximum marks were awarded. The idea that it could be used as a communication to other butterflies to warn them of an approaching predator was also awarded credit.

2di – Many candidates recognise that giving rewards during training is an example of operant conditioning. Incorrect responses included classical conditioning and habituation.

2dii – Many candidates were able to describe habituation as the idea of getting used to or learning to ignore a neutral stimulus and were awarded the second marking point. The description of how this habituation would occur was seen less frequently. Marking point 1 described the method needed to achieve the habituation with the idea of repeated or frequent waving of flags or the use of flags during training. Some candidates missed the first marking point by just giving the idea that they would see the flags at events and get used to them which was only given marking point 2.

3ai – This question asked how sex was determined at fertilisation. Most candidates knew that the X and Y chromosome were involved. The idea that XX is female and XY is male was frequently seen but less candidates obtained the mark for the idea that it is the sperm cell contains either an X or a Y chromosome and is what determines the sex of the child. Some candidates gave the idea that the sperm has a chromosomal combination of XY or that the egg is XX and were not awarded the mark.

3aai – A good number of candidates knew that the corpus luteum produces progesterone. The most frequent incorrect response seen was the pituitary gland.

3b – This question asked for a Punnett square to be used to calculate the probability that a child of a couple would be a male with haemophilia. The female was a carrier and the male not affected. When candidates correctly identified the genotypes of the parents they nearly all went onto achieve maximum marks for the question. The first mark was awarded for the correct gametes, it was not given if the male and female were transposed. The second mark was given for the correct offspring so was awarded for candidates who correctly completed the Punnett square from gametes

that had been transposed. The most frequent error that led to the first two marks not being awarded was the additional of an allele on the Y chromosomes. Although this was seen less frequently than in previous papers. There are four possible offspring but only one is a male with haemophilia so the probability is 25%. The marks were also given for 1 in 4, 0.25, 1:3 and $\frac{1}{4}$. This mark was awarded even if the Punnett square was incorrect as it answers the question. There were a number of 50% given but the question asks for the probability of the child being male with haemophilia and the not the probability of a male child having haemophilia.

3ci – There was a range of responses given to this multiple choice question but mainly candidates of high ability knew that ADH increases the permeability of the collecting duct to water which decreases urine production.

3cii – This question only needed a reason for the rise in ADH seen at 15:00 hours, no justification was required. The most frequent responses seen were dehydration, exercise, lack of fluid intake or low water content in the blood. Some candidates gave the idea of increased sweating which was also credited.

3d – A large number of candidates failed to answer this question correctly because they described the production of urine. High ability candidates recognised that urea is produced in the liver from amino acids, no further detail was required. Occasionally candidates only scored 1 mark for saying it was produced from amino acids in the blood.

4ai – Candidates of all abilities knew that the behavioural response of plants to different day lengths is photoperiodicity and gained the mark for this multiple question.

4aaii – This question asked why short-day plants flower when there are fewer hours of daylight. It required candidates to use the information given in the question about the light sensitive protein. Those candidates who gained both marks recognised that fewer hours of day light leads to less active protein which was sufficient for both marks. The active protein inhibits flowering was given in the stem of the question. Some candidates correctly identified that there would more inactive protein but linked it to the idea that the inactive protein stimulates flowering so were not awarded credit.

4aiii – Many candidates correctly identified that inhibiting flowering in sugar cane could be achieved by exposing the plants to light. Creditworthy answers that were frequently seen included growing them in areas with long days, constant exposure to light and exposing them to more hours of sunshine. Incorrect responses were those who incorrectly interpreted the information and suggested less light or shorter days. There were some answers that suggested that the plants should be grown in the dark or underground showing a lack of understanding.

4b – This answer required an explanation of why biofuels could be described as carbon neutral. The first marking point was given for the idea that the plants removed carbon dioxide whilst growing for photosynthesis. The second marking point was the idea that the carbon dioxide is released when the fuel is burnt. One mark was given for the idea that the amount removed during growth was equal to that released during burning as it did not refer to photosynthesis. Some incorrectly identified that the carbon dioxide is released when the fuels are made. No marks were given if the answered referred to carbon rather than carbon dioxide.

4c – This question asked candidates to explain how the Ti plasmid shown in the diagram could be used to create transgenic plants. The plasmid already contained the toxin gene. Many candidates gave detailed explanations of how the plasmid could be constructed including details about cutting DNA with restriction enzymes to create

sticky ends and the use of ligase. This was not awarded credit as it did not answer the question but probably gave candidates the sense that they had answered the question well and many did not go into the detail on the creation of the transgenic plants. A lot of candidates did recognise the involvement of *Agrobacterium* and these candidates often also gained the mark for the idea that the plasmid had to be inserted into the bacterium. The idea that the bacterium infects the plant was seen less frequently. Many missed out on the mark for the idea that the toxin gene is incorporated into the plants DNA by just describing the idea that it was incorporated into the plant. There were very few references to formation of a crown gall or tumour. It is possible that some higher ability students would have included this detail had they not misinterpreted the question.

5ai – The candidates were asked for a reason why a placebo was used in the trial. Higher ability candidates recognised that it was a control. A lot of responses were awarded the mark for suggesting it was used to determine if the immunisation was effective. Some answers which were not awarded the mark suggested that it was used to see if no antigens could protect against HIV.

5aii – The most common mistake on this question was that candidates didn't divide the number of volunteers into 2 groups and calculated the number for each group based on a sample size of 16 000. If they correctly calculated the percentages they were given an error carried forward and gained two marks, provided their workings were shown. Possibly because of the nature of the calculation there were very few responses which did not show workings which was good to see and helped candidates gain partial marks for the question. There were a number of candidates whose percentage calculations were incorrect. They did not divide the percentages by 100 to calculate the number of individuals and resulted in answers of 2400 or 4800.

5aiii – Most candidates achieved marking point one for the idea that the people with the immunisation still contracted HIV. Very few explained that this was because they were not immune. There was some misinterpretation of the information about the trial seen in answers to this question with candidates suggesting the immunisation helped to cure HIV rather than preventing infection.

5b – This question was answered well by candidates of all abilities with many gaining a level 2 and high ability candidates gaining a level 3 for explaining the primary and secondary immune response by lymphocytes producing antibodies and the role of memory lymphocytes. Most candidates were able to make comparative interpretations from the graph referring to the time taken for antibody levels to rise, the overall level of antibody production or the time they remained in the blood. Some candidates missed out on a level 3 response by not explaining the primary response although they did refer to memory lymphocytes for the secondary response. There was some confusion between antibodies and antigens although this was rare. Also some candidate lost marks for suggesting that the graph represented the level of white blood cells or lymphocytes showing candidates are still not reading graph axes.

6ai – This question required candidates to recognise that sucrose is the substrate for invertase and to know the products. Candidates of high ability did well on this multiple choice question but many candidates were unable to identify the correct answer.

6aii – Even high ability candidates struggled to name *Saccharomyces* as the yeast which produces invertase. Previously this style of question has been a multiple choice question and more candidates have been able to identify the organisms which produce enzymes or food products. This highlights the importance of learning key details listed in the specification.

6b – This four mark question required candidates to explain how chymosin is used to make vegetarian cheese. Many candidates knew that chymosin was involved but the

details about cheese production were not always given. Some candidates did not answer the question and explain how chymosin was produced in a genetically modified organism. Those candidates that answered the question were able to explain that chymosin clots or curdles milk. Only high ability candidates went on to explain how the curds are compressed to form the cheese.

6c – This extended open response was based on the core practical of making lactose-free milk using immobilised enzymes. It was very clear from the responses that some candidates had not done the practical. Those candidates who had done the practical were usually able to score at least a level 2 response. To achieve a level 3 candidates had to demonstrate a good understanding of how immobilised enzymes are produced and that lactase breaks the lactose down to glucose or galactose. Only one product was required although a number of candidates knew both. Some candidates indicated that lactose was broken down to lactic acid. Level 2 responses either required detailed information about the production of immobilised enzyme or the breakdown of lactose by lactase or a combination of both parts without full details. There were some misconceptions that immobilised enzymes are denatured or that they stick to the lactose removing it from the milk. There were a number of blank responses to this question, which is unusual on Unit B3, higher tier.

Paper Summary

Based on their performance on this paper, candidates should:

- Always show the working when doing calculations as a mark can be awarded for errors carried forward in this case.
- Ensure they read graph scales accurately when extracting information from the graph.
- Check the number of marks given for the question and ensure that they have included enough facts to match the mark awarded.
- Ensure that they can interpret family pedigrees for both the sex of the individuals and genotypes for sex-linked inheritance.
- Use scientific terminology accurately where possible in responses.
- Recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given.
- Use all the information given in the question to help them construct their answer but avoiding repeating the information which has already been given
- Think about the structure of the answer before starting to write when tackling the extended answers to ensure that the answer shows clarity of writing and flows, while remembering that accurate spelling and grammar in these questions is also important.

