GCSE

BIOLOGY

8461/2H Paper 2

Report on the Examination

8461

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General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

This was a very small and atypical cohort and the evidence from the standard of responses suggests that the cohort was a little weaker than in previous years. Most students completed the paper and there were very few gaps or omissions; however, the quality of response was often superficial and lacking in detail.

Comments on Individual Questions

Questions 1 and 2 were common with Biology Paper 2 Foundation Tier.

Question 1 (standard demand)

The topic was the decay of milk. **01.2** was not answered well, with just over one-third of the entire entry able to give ‘fatty acids’ as the product of lipid breakdown. Common errors were ‘lipase’ and ‘amino acids’. ‘Glycerol’ was sometime stated in addition to fatty acids but inclusion of this forfeited the mark as it was not clear the student knew which one caused the pH to decrease.

In **01.4**, the need to control the volume of milk was frequently recognised, although some students forgot the aim of the investigation and qualified their answer unsuitably as cows’ milk. Very few other correct answers were offered, the most common being the time of day when the pH should have been measured. A significant number of students repeated information already provided, including the duration of the investigation, or incorrectly suggested ‘temperature’ (which was the independent variable).

A large majority of students in **01.6** either misinterpreted the graph itself or the aim of the investigation. Thus, there were many descriptions of temperature and pH falling as time progressed. It was particularly common for students to interpret the y-axis as showing pH, despite it being clearly labelled as the time taken. Thus, fewer than one-third of students gained both marks here and many omitted any reference to data, as required by the question.

In **01.7** some students contradicted the information and described the reverse relationship, while others compared pH10 with pH5 rather than the time taken for reaction at 10 °C compared with that at 5 °C. Those who did gain the mark usually referred to enzyme activity, although some thought the enzyme would have denatured at 10 °C. Hardly any referred to a higher rate of division of microorganisms at the higher temperature.

In **01.8** some students recognised that one possible cause was due to differences in composition between the different types of milk, often suggesting different amounts of lipid. Higher-attaining students also suggested different amounts of bacteria present or differences in the starting pH; however very few were able to offer two acceptable ideas.

Question 2 (standard demand)

The question was about human population increase and the problem of provision of sufficient food. For the calculation in **09.2**, both of the values required were given in the information, so it was not necessary to determine figures from the graph. Despite this, many students did attempt to, often incorrectly. For those who did show the correct numbers in their calculations, a large proportion used them incorrectly, often adding them and very few did the necessary calculation of dividing the difference by 50. Some just left the value at '0.9'. Others calculated the mean of the two given values rather than the mean annual increase. Fewer than half of the students were completely successful.

In **02.3** most students attempted to draw some sort of extrapolation on the graph; however, this was sometimes not linked to the trend shown by the line, rising a little, then plateauing or even taking a downturn. Students could still gain the second mark for reading the correct value from their own line. This was often not done accurately, particularly by students who continued their extrapolation beyond 2050 and read off the final population value. It was clear that students who simply read the scale, and gave answers such as '10' had not considered the implication that their answer of a human population of only 10, rather than 10 billion, is unlikely.

In **02.4** students showed some understanding of the term 'quota' and described limiting fishing in one way or another. However, this was as far as some got as they omitted the idea that the remaining fish would be able to reproduce, in order to maintain stocks. Lower-attaining students often suggested that a quota referred to the amount of fish that people could buy or eat. In **02.5** most students successfully linked the need for more farmland to an increasing population needing more food. References to the use of chemicals to enhance growth were only given very occasionally. In terms of reduced biodiversity, few students went beyond deforestation and habitat loss, although some suggested that the latter might result in migration of animals to find new habitats. There were only occasional references to methane and carbon dioxide production and an association of these with global warming. The question differentiated between students well.

Question 3 (standard & standard/high demand)

This question was about plant hormones and in **03.2** most students understood that the given investigation was inadequate due to the presence of the radiator nearer to some of the seedlings than to others. Many also suggested that the same number of seedlings should have been used in each dish. A few suggested that equal amounts of water should have been provided in each dish or that the light intensity could actually have been measured. A common incorrect answer was that the seedlings should have been subjected to the same light intensity (this being the independent variable).

In **03.3** suggestions for how the length of the curved seedling might be measured were often inadequate – eg 'with a ruler'. Successful students realised that the seedling would either need to be straightened before measuring or that a flexible device such as a tape measure or a piece of thread would need to be employed. And in **03.4** students were very confused about differential growth rates on the two sides of a seedling for bringing about the phototropic response. A substantial proportion thought that the seedling grew more on the side facing the light, sometimes citing an increased rate of photosynthesis on that side to fuel extra growth.

Question 4 (standard, standard/high & high demand)

This question was about DNA. **04.3** is a five-step calculation, which differentiated very well between students. Most were able to multiply the number of nucleotides in the cell (given as 1.2×10^{10}) by the length of one pair of nucleotides (given as 0.34 nm) – although some divided these. The main errors came from attempts to convert nanometres to metres (as required by the question) and in not realising that the answer had to be divided by 2 as the nucleotides came in pairs. Many students wrote out long strings of zeros in their calculations and consequently made transfer errors from one line to the next in their calculation; others did not know how many nanometres there are in a metre and used factors of a thousand or a million to interconvert the units (this being covered by the 'Working Scientifically' section of the Specification, part 4, WS4.4 and 4.5). An eighth of students scored all 5 marks, although nearly 60% scored 3 marks and above. It was also evident that some students had little concept of the sizes of molecules and cells and, although the correct answer was 2.04 m of DNA per cell, the most extreme was 1.76×10^{17} m.

Question 5 (standard/high & high demand)

This question was about cell division and genetics. In **05.1** many students confused the two types of cell division, mitosis and meiosis: 1 in 10 students were able to give 3 correct differences between the two. Some described only one type of division rather than giving the comparison demanded by the question; others fell short of giving sufficient detail – eg describing the daughter cells as 'identical / non-identical' rather than being *genetically* identical / non-identical'; many included irrelevant points about where in the body the cell division occurred (the question asked for differences in the 'processes'). Two common misunderstandings were that meiosis occurred 'in gametes' and that meiosis required two parents whereas mitosis required only one.

For **05.3** explanations of how students derived the genotype of person1 were frequently insufficient. Since this person had the condition Dupuytren's, he must have had either one or two of the dominant alleles. The fact that he had an unaffected child (person 6), showed he must also have had the recessive allele – hence his genotype was Dd or heterozygous. Most students mentioned only the children as evidence and did not relate person 1's genotype to his phenotype.

Students had to draw a Punnett square diagram in **05.4** to find the probability that persons 7 and 8 in could produce another child with Dupuytren's. Since persons 7 and 8 had *different* phenotypes, it was surprising how many students assigned the *same* genotype to each of them (usually both being Dd). Other common errors were not identifying which parent was which (ie gametes D and d from person 7, and only d gametes from person 8) and not assigning phenotypes to the offspring genotypes.

In **05.5** explanations of the evidence in the pedigree diagram that the D allele is *not* on the Y chromosome, it was evident that many students did not know that males are XY and females XX as many thought the female had a Y chromosome. Those that did know this were able to point out that some females had Dupuytren's despite not having a Y chromosome, or that the condition can be passed from fathers to their daughters, or that an affected mother and unaffected father can have an affected son. Many students insisted, erroneously, that the allele must have been on the X chromosome.

Question 6 (standard, standard/high & high demand)

This question was about the brain and vision, and applications to the use of MRI scanners and to the evolution of a sight adaptation in birds. Many students lacked precision in their explanations for **06.3**. In order to explain the advantage of the functional MRI (fMRI) scanner, using the given information, the majority of successful students stated that it would enable doctors to see which part of the brain was active / inactive in a certain situation in order to ascertain the location of any brain damage. Some were more explicit and explained that the context for this would be having the patient perform a particular task. Some suggested, correctly, that the scan could be compared with one from a person without brain damage, or that the fMRI scanner could be used on a person who had difficulty staying still such as a young child or a person with Parkinson's.

06.4 was not answered at all well by many students. The question asked for how the brain received information from the eye, *not* how the eye produced an image or made adjustments for different light intensities, *nor* for the coordination of any response, some or all of which were included in the answers of many. Several important details were also omitted in many answers – eg light is not just focused on 'the back of the eye' but on the *retina*, and the latter is actually *sensitive* to the light or contains *receptors* rather than just being the passive recipient of an image; *impulses* are then sent along *neurones* (not just 'messages' or 'signals' in 'nerves') in the *optic nerve*.

Given that some birds had an adaptation allowing them to detect UV light, and that some fruits and the urine of small mammals reflected UV light, students had to explain how this feature in the birds might have evolved in **06.5**. Many students suggested correctly that a mutation might have occurred in an ancestral bird, although very few went on to state that this would have been a random occurrence. Very few students related this to a possible structural change in the cells of the retina. However, many did realise that the mutation, or ability to detect UV, would enable the birds to see fruits and thus obtain more food than non-mutant birds and/or see where small mammals had been and hence either avoid predation or manage to catch these mammals as food. Many students then went on to explain that the birds with UV vision would be more likely to survive and reproduce, passing on their favourable allele (or 'the mutation') to their offspring, perhaps over many generations, and that this was an example of natural selection. Some students interpreted this as a 'speciation' question and hence gave an answer they had prepared previously. Students need to read the question carefully in order to assess what aspects of their knowledge may be applied *appropriately* in answering it. The question differentiated very well across the entire ability range of the students.

Question 7 (standard, standard/high & high demand)

This question presented students with a novel situation: the development of a new type of food for dogs from insects. This was set in the context of a food chain, the transfer of biomass and, ultimately, in the provision of food security for humans. **07.1** was a relatively straightforward question for students. Problems mainly arose in the labelling with the use of terms such as 'secondary' and 'tertiary' consumers (the latter being entirely inappropriate), or by adding multiple labels that included the names of the organisms, the types of producer and consumer and the numbered trophic levels, but with an error in one of these, and thus this mark could not be awarded. In 07.2 reasons given by students for the incomplete transfer of biomass from the insects to the dogs were largely incorrect, with 1% of students being able to describe two. Some students made inappropriate references to some of these processes occurring in the insects rather than in the dogs.

07.3 related the scenario of insect-based dog food to human food security. Students found this difficult and, although nearly three-quarters scored one mark (usually for stating that more meat would be available for human consumption if dogs were fed on insects), 7% gained further credit. Few realised that if less meat were consumed by dogs, then less land would be required for animal grazing and hence it could be utilised for growing crops. Hardly any suggested that a reduction in farm animals would perhaps reduce methane output and the negative effects of methane on the climate and hence on the growth of crops.

Question 8 (standard, standard/high & high demand)

This question was about extinct mammals and the causes of their extinction. In **08.1** many students had difficulty reading the scale on the graph as the numbers increased from right to left on a time scale showing millions of years ago. The overlap in existence between the two species could be determined either by subtracting the end of the overlap from its beginning (38.5 - 36 million years = 2.5 million years) or by ascertaining that each small square represented 0.5 million years, hence 5 small squares represented 2.5 million years. Many did not gain a mark due to omitting the word 'million' in front of years on the answer line.

In **08.2** students found it conceptually difficult that the extinction of a carnivore should lead to the subsequent extinction of a herbivore, so much so that many of them imagined that the carnivore had been eaten by the herbivore, the latter thus running out of food. Higher-attaining students followed one of three possible routes to develop a hypothesis to explain the situation:

1. The extinction of the carnivore led to an increase in numbers of another carnivore which ate the herbivore.
2. The extinction of the carnivore led to an increase in numbers of a different herbivore which outcompeted (for food) the herbivore given in the question.
3. The extinction of the carnivore led to an increase in numbers of the herbivore which competed with other members of its own species so that their food ran out.

The concept of the fossil record being unclear for older species was difficult for the majority of students in **08.3**: 40% scored any marks in this question with a minority achieving the full 3 marks. Higher-attaining students stated that older fossils were more likely to have been destroyed by geological events such as earthquakes. Some alluded to the fact that older fossils were more likely to be buried deeper underground or were in inaccessible places such as the ocean bed, or that they were smaller, and so were more difficult to find.

In **08.4** students had to evaluate data in the form of four simple graphs showing the percentage survival of large mammal species in four different areas of the world over millions of years in relation to the time when humans first appeared in each area in order to decide whether the hypothesis that humans caused mass extinctions was correct or not. Most students noticed that large decreases in the percentage survival of the large mammals occurred when humans entered three of the areas, which supported the hypothesis. Many pointed out that, to the contrary, the decrease in survival was much less in one of the areas (Africa) and that it might have been due to some other factor, that only large mammals were considered rather than all animal species, that there was no information given about, for example, predators, pathogens, food sources, any abiotic factors, and that these four areas of the world were not necessarily representative of the effects of humans elsewhere. To obtain the highest marks, students had to have considered both sides of the argument and made a judgement based upon the evidence (or lack of it) which they had cited. 4% of students attained the highest level in their answers in order to be awarded 5 or 6 marks, the majority of the rest scoring either 2 or 3 marks.

Concluding Remarks

Particular problems which occurred quite frequently included:

- confusion of certain terms, eg mitosis / meiosis, reabsorption / filtration / excretion
- paying insufficient attention to information provided in the stem of a question in order to guide a reasoned response, avoid misconceptions and the inclusion of irrelevant information
- repeating, rather than using, information given in the question, for which no marks are available
- careless reading of the question resulting in an inappropriate answer, or not following instructions in multiple-choice items, such as to tick the correct number of boxes
- careless reading of data from a graph
- omitting numbers when a question asks for the use of data
- missing a question when no answer lines were provided and the answer needed to be in a table or a Punnett square
- poor handwriting, for example with numerals – especially the distinction between the numbers 1 and 2
- not checking whether the answer to a calculation is sensible – for example, in converting units over an appropriate order of magnitude, such as the conversion of nanometres to metres.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.