GCSE

BIOLOGY

8461/2H – Paper 2 Higher
Report on the Examination

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General Introduction to the Autumn Series

This has been another 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

The number of entries for the Higher Tier was only 240 compared to an entry of 723 last year, and 107 657 in 2019. The profile of students taking the exam was, as expected for this unusual series, different from a typical summer series. In particular, there was a higher proportion (~36%) of private students.

The mean mark awarded this year was 7% lower than the previous series. Generally, factual knowledge and the standard of written communication were weaker in this year's cohort compared with last year.

Comments on Individual Questions

Questions 1, 2, 3 and 4 were common with Biology Paper 2 Foundation Tier.

Question 1 (standard demand)

This question was about DNA and its replication. Answers to most parts of this question were satisfactory, with most students knowing that DNA was found in chromosomes, recognising the term replication with respect to a diagram showing this process, being able to assign symbols for bases on the same diagram, and knowing that meiosis was the type of cell division used in sperm production.

The names of specific parts of the DNA molecule (sugar and base) and the substance coded for by a gene (protein) were less well known – but success here might have been limited by the fact that the questions were open rather than being multiple choice.

More than half of the students were able to deal with numbers in standard form, showing understanding that a sperm cell has half the usual amount of DNA and that half of 6×10^{-12} is 3×10^{-12}.

One-fifth of the students did not attempt **01.4**. This was probably due to there being no answer lines, and the answer having to be written on the diagram (Figure 2).

Question 2 (standard demand)

This question was about the effect of temperature on the decay of milk, as followed by monitoring changes in pH. It related to Required Practical Activity 10.

Success was very mixed in the different parts of this question. Fewer than half were able to suggest that a water bath (or an incubator) could be used for keeping the milk at a constant temperature of 20 °C and, despite pH being the dependent variable, many suggested that it might be a variable that should have been kept constant.

A quarter of the students scored full marks for plotting the graph of the results. The major error was to draw a straight line instead of a curve through the plotted points. Some students also forgot to label the *x*-axis. The sketched line showing expected results at the higher temperature of 25 °C proved difficult for most students: most did not draw a line starting at the same pH as that for 20 °C and many did not indicate a faster fall in pH with time. In addition, approximately one-fifth of students made no attempt at sketching the line on the graph.

Question 3 (standard demand)

This question was about the maintenance of human body temperature. Although most students understood that the person whose temperature and rate of sweating were being monitored in the investigation should remain still to avoid an increase in these quantities, many gave the vague and inadequate answer that movement would have 'affected' them.

The vast majority of students were able to read the required body temperature (37.4°C) from the graph but approximately one-fifth presumably did not refer to the graph and chose one of the other options (36.8°C or 37°C) from their general knowledge.

03.3 revealed a lack of understanding in the vast majority of students (1 in 9 scored any marks). Very few appreciated that, upon drinking some ice-cold water, the *blood* would be cooled at the mouth or stomach and that this cooled *blood* would lead to a decrease in temperature near the brain. Most assumed it was the proximity of the mouth to the brain that caused the temperature decrease in the latter.

Around half of the students knew that the thermoregulatory centre in the brain communicated with the sweat glands via the nervous system, although the use of hormones was a common misconception.

In **03.5**, students were given a specific time period to consider in Figures 5 and 6 (graphs showing changes in body temperature and in the rate of sweating, respectively) but very few were able to explain that there was *less* sweating (as opposed to 'no sweating') and that consequently *less* heat would have been lost. Many students did not give an answer that related to the data in the graphs or did not refer to the time period specified in the question. Many also included irrelevant information about vasodilation, vasoconstriction or shivering.

In **03.6**, a common misconception was revealed: although half the students correctly selected dilation of blood vessels in the skin as the reason for reddening of the skin, almost as many, thought that the blood vessels would have moved closer to the skin surface.

Question 4 (standard demand)

This was a 6-mark extended response question about decay in a compost heap and the recycling of chemicals in the dead plant remains for re-use by living plants. Answers frequently lacked details of named substances and processes. The vast majority of students gave answers sufficient for Level 1, with 1 in 25 attaining Level 2 and none scoring full marks.

The most commonly given correct points related to the release of mineral ions from the dead plant matter, the production of carbon dioxide and the use of carbon dioxide in photosynthesis by the living plants, possibly to make a named organic substance such as glucose. Digestion by enzymes and respiration in microorganisms were referred to less often. Details of how living plants took in carbon dioxide (diffusion through stomata into leaves) or mineral ions (active transport via the root hairs) were rarely mentioned. Similarly, hardly any answers explained that living plants might use ions such as nitrate for making compounds like amino acids, proteins or DNA; or that phosphate could be used to make DNA.

Common errors included the microorganisms 'eating' the dead plant material, considering that worms and insects were microorganisms and that microorganisms released waste products as faeces. Often 'carbon' was release by the microorganisms rather than carbon dioxide, and 'nutrients' rather than mineral ions.

Question 5 (standard, standard/high & high demand)

This question related to Required Practical Activity 9 and was about determination of the size of a daisy population on a lawn. There was much confusion about biotic and abiotic factors that might affect the growth of daisy plants on the lawn and, although three-quarters assigned at least two of the given factors correctly, fewer than half got all six correct.

In **05.2**, around half the students knew that sampling of the daisies should be at random but very few were able to describe adequately how this might be achieved, ie the use of random coordinates. References to 'throwing' the quadrat were not rewarded.

05.3 was a 6-mark extended calculation of the daisy population on a triangular shaped lawn with a rectangular paved area cut into it. This examined mathematics skill 5c and students were therefore expected to know how to calculate the area of a triangle and a rectangle. However, some thought that the Pythagoras theorem was appropriate for calculating the area of a triangle. Some calculations were very difficult to follow and students should be encouraged to make their reasoning clear; others gave highly improbable answers, eg a total population on the lawn being less than the mean for one quadrat. There was the anticipated error in calculating the area of a 50 cm $\times$ 50 cm quadrat, with incorrect answers including 25 m^2. Many students attempted to convert all measurements to centimetres rather than metres and the excessive number of zeros often caused transfer errors from one line of working to the next; or they thought there were 100 cm^2 in 1 m^2 rather than 10 000. Some calculations did not include the given mean of 6 plants per quadrat. Thus, around an eighth of students were completely successful, scoring all 6 marks, and almost two-thirds scored less than half-marks.

Most students scored one of the two marks available in **05.4**, for pointing out that the use of just 10 quadrats may not have been sufficient. Hardly any students could go on to elaborate on this to state, for example, that this may not have been a representative sample or that it would not have allowed for an uneven distribution of the daisies, or that the 10 quadrat positions may not have been sufficiently random.

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

This question was about coordination by the nervous and endocrine systems. Most students were able to state that a reflex action was either a response (reaction) or that it was automatic with around one-third providing both points.

06.2 was worth 6 marks for describing how a person's nervous system would coordinate the withdrawal of a hand from a hot object by reflex action. A few students scored full marks and just under a half scored half-marks or more. Common errors included misnaming the neurones involved, using the term 'messages' instead of impulses, thinking that this reflex involved the brain, and referring to the spinal cord as the 'spine'. Omissions included the mechanism of synaptic transmission via a chemical crossing the gap and the location of the synapses in the spinal cord.

In **06.3**, very few students were able to give three differences between coordination by the endocrine and nervous systems, although just under half could give at least one. The most common correct answers were that endocrine coordination was generally slower and longer-lasting than nervous coordination. While many students alluded to a chemical, or hormone being involved in endocrine action, few explained that this was transmitted via the blood rather than along neurones. Some answers were inadequate as they were not comparative, eg hormonal coordination is not just 'slow' but slower than nervous coordination.

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

This question was about a marine food web and legislation to ensure sustainable fishing of herring in the North Sea. In **07.1**, almost two-thirds of students scored 1 mark for stating either that light was the source of energy for the algae or that the algae used photosynthesis. Many stated that the energy came 'from the Sun' which did not distinguish between light and other forms of solar energy. Incorrect answers included carbon dioxide, water, mineral ions and even from eating other organisms. 1% of answers mentioned that chlorophyll or chloroplasts absorbed the light energy.

Most students were able to identify a primary consumer and the producer in the food web in **07.2** and **07.3**, respectively. A common incorrect answer for the primary consumer was the 'human', presumably confusing primary with top. Similarly, around three-quarters of students were able to assign 5 organisms from the food web to a food chain ending in the human.

In **07.5**, although one reason for the lower biomass of the mackerel than that of the combined biomass of the krill and squid was given as non-digestibility of parts of these animals, many students suggested 'lost in faeces' as an additional reason. Around one-third of students gained some credit for their answers by suggesting losses due to respiration or excretion or, alternatively, that some parts of the krill and squid were not even eaten or they were eaten by other animals.

07.6 was a 4-mark calculation of percentage decrease using figures read from a graph. Fewer than half of students were completely successful. Errors included the use of an incorrect starting point – the first and highest value on the graph for the year 1950 was quite a common error, or reading the value for 1977 as '0.2' or '0.05' instead of 0.1. Many students did not get credit for not rounding their answer to the nearest whole number as instructed in the question. Some calculated a percentage reduction in excess of 100%, the highest such value being '2300%'. Around one-sixth of students scored no marks.

07.7 was a 6-mark extended response question requiring the evaluation of the data from the graph in relation to various acts of legislation introduced at different times. Many students found this very difficult with more than two-thirds attaining no higher than Level 1. The question instructed students to use data from the graph and information from the diagram showing the relationship between mesh size of fishing nets and the sizes of herring of different ages. Many students did not cite any data, or did not consider all four pieces of legislation and their subsequent effects on herring biomass. It was rare to read any negative points – the most common being the decrease in biomass at certain times despite the legislation that had been introduced – and hardly any students thinking that causes in addition to the given legislation might have been responsible for the changes in biomass or that, since the acts of legislation overlapped in their application, it was hard to ascertain the effect of each. Very few students attempted to make a judgement on the basis of the points they had made and no-one scored all 6 marks.

Question 8 (standard/high & high demand)

This question was about the inheritance of sickle cell anaemia and its effects. Answers to **08.1** were generally insufficient. Many students knew that a mutation in the haemoglobin gene could result in less oxygen being transported around the body (although some stated this would 'affect' the amount of oxygen), but hardly any went on to explain that this would mean a lower level of respiration.

Calculations in **08.2** were weak. Some students did not count the number of normal and sickled cells in Figure 13. Many did not understand the difference between the ratio 4:13 and the fraction $\frac{4}{13}$. Many did not go on to convert the correct fraction $\frac{4}{17}$ to a decimal (0.24) or to a percentage (24%). Some students, having worked out a percentage, did not include the % symbol in their answer, thus giving an incorrect proportion of '24'. Thus few students scored both marks.

08.3 was a construction of a Punnett square to determine the probability that certain parents from the family pedigree diagram would produce a child with sickle cell trait, followed by multiplication by ½ to find the probability that this child would be female. A very small proportion of students was completely successful. Errors included assigning the same genotype to parents who had different phenotypes, not stating which gametes came from which parent, not identifying the phenotypes of the offspring genotypes and not dividing the probability from the Punnett square by 2 to allow for the biological sex specified in the question. A few students showed the offspring as being haploid even though each was derived from two haploid gametes.

In **08.4**, students had difficulty in applying information from various other parts of question 8 to evaluate the scientist's statement about the advantage of having the H^S allele in countries where malaria occurs. Around 96% of studebts did not discuss the effects of sickle cell anaemia and malaria on people of different stated genotype and thus scored no marks.

Question 9 (standard, standard/high & high demand)

This question was about Galapagos Island finches. In **09.1**, one-quarter of students were able to give the names of all four of the taxa missing from the table. Once again, probably because there were no answer lines and answers had to be written in the table, a quarter of students did not attempt this question.

In **09.2**, fewer than one-third of students were able to select *Geospiza fortis* from the table as the binomial name of the medium ground finch. It was evident that many did not know that the binomial name consisted of genus + species, while some did not appreciate that binomial indicated a two-word answer: 'fortis' being a common response.

Very few students scored the mark in **09.3**. Most described a 'positive correlation' in the results or stated that the beak depths of the offspring were 'proportional to' those of the parents but did not mention that the offspring beak sizes were approximately the same as those of the corresponding parents. Around one in seven students scored a mark.

Just over 1% of students gave a creditworthy answer to **09.4**. Common incorrect answers were that there was 'a range' of beak depths in the offspring, not stating that this was so for each parental value. There were also vague references to 'anomalies' and 'outliers' and some gave numerical values that were beyond the scales on the graph.

09.5 also proved to be very difficult and it was evident that many students did not understand the question, assuming that it was about speciation which it was not. Better answers attempted to relate beak size to the sizes of seeds produced by plants on the two islands and whether or not there was competition from the second species. Mutations were correctly mentioned quite often as a cause of variation in beak size but this concept then had to be applied to selection on the basis of availability of suitable foods (seeds). The highest mark scored was 4 out of 6, with few gaining half-marks. More than half the students scored no marks at all.

A third of students scored any marks in **09.6**, mainly for stating that competition for food might be reduced on the larger island. However, most did not relate this to the potentially greater abundance or greater variety of plants and seeds on the larger island and many did not qualify the concept of competition with it being for food, despite the relationship between beak size and seed size having been given in the stem before **09.5**.

Concluding Remarks

Overall, this November's paper was broadly comparable in demand to last year's, but this year's students appeared to be weaker on average and so found a number of questions more difficult.

Areas of the Specification about which knowledge was acceptable were:

- 4.6.1.5 DNA structure
- 4.7.4.1 Trophic levels.

Particular areas of the Specification about which knowledge seemed limited were:

- 4.5.2.4 Control of body temperature
- 4.5.3.4 Hormones in human reproduction
- 4.6.1.6 Genetic inheritance
- 4.6.4 Classification of living organisms
- 4.7.1.2 and 4.7.1.3 Abiotic factors and biotic factors
- 4.7.2.2 and 4.7.2.3 How materials are cycled and decomposition .

Students struggled to apply knowledge and understanding of Specification sections:

- 4.6.1.6, 4.6.2.1 and 4.6.3.1 Genetic inheritance, variation and evolution
- 4.7.5.3 Sustainable fisheries.

This year, as in previous years, certain general problems have been perpetuated, such as:

- not paying sufficient attention to information given in the introductory stem to a question
- needless repetition of information given in the stem of the question
- imprecise use of technical vocabulary
- not giving a comparative answer to a comparative question
- not necessarily paying attention to both sides of an argument in an evaluation question
- poor layout of working in mathematical problems, struggling with the interconversion of units and lack of consideration regarding whether the answer obtained is reasonable
- failing to answer a question where there were no answer lines, but where the answer needing to be inserted into a table or diagram.

Mark Ranges and Award of Grades

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