GCSE

BIOLOGY

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

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General

Nearly all questions were attempted by all students and there were some very good answers.

Particular problems which occurred quite frequently included:

- Paying insufficient attention to information provided in the stem of a question in order to guide a reasoned response and avoid misconceptions and the inclusion of irrelevant information.
- Repeating (rather than using) information given in the question, for which no marks are available and which wastes both time and space (there being adequate space provided for relevant material without recourse to additional answer pages).
- Careless reading of the question resulting in an inappropriate answer, for example failure to give a comparative answer to a comparative question, or failure to use specific data from a graph.
- Careless reading of data from a graph or imprecise plotting of points on a graph.
- Poor handwriting, for example with numerals – especially the distinction between the numbers 1 and 2, or the numbers 4, 7 and 9.
- Striking an incorrect balance between depth and breadth of coverage in an extended prose answer.
- Understanding of kidney functioning, meiosis and the concept that plants respire 24 hours a day rather than just at night.
- Being insufficiently precise in an answer and thus not conveying appropriate meaning.

Question 1

This was the first of three questions common to both the Foundation and Higher Tier papers. It was about different species of bird living in the same habitat

01.1 Just under half of the students selected the term community for describing all of the organisms living in the same habitat. Ecosystem was a strong distracter.

01.2 Nearly all students selected the pair of birds with a common generic name, the brambling and the chaffinch, as those being most closely related.

01.3 Similarly, the fact that the two species named in the question could not breed together to give fertile offspring was recognised by the vast majority as the criterion for them being different species.

01.4 In this question, students had to describe one of the patterns from the graph showing how the number of birds of four species varied throughout one year. Students were expected to make reference to the months given on the horizontal axis. A suitable answer included the number being constant from January to April, then increasing during April and May and finally decreasing over the remainder of the year. Many answers were less precise and fewer than half gained all 3 marks, although three-quarters of the students gave at least two valid points.

01.5 A high proportion of students were able to select species B as the one with the lowest resistance to the disease as its numbers fell the most during the given months of June and July.

01.6 In this question, students had to decide which species migrated between the UK and other countries, giving the reason for their choice. Around three-quarters correctly selected species D, giving its presence on the graph only between May and September (or being present only in the summer, or absent the rest of theyear) as their reason.

Question 2

This was the second of three questions common to both the Foundation and Higher Tier papers. It was about the functioning of the eye and included a description of an investigation of reaction time.

02.1 Three-quarters of students correctly selected accommodation as the term relating to adjustment of focus.

02.2 An even higher proportion knew that the image would be focused on structure B in Figure 3 (the retina).

02.3 Almost all knew that structure E (the ciliary muscle) would contract to focus on a near object.

02.4 Students experienced some difficulty in describing what happened to the shape of the lens when focusing on a near object. Acceptable terms included becoming fatter / thicker / rounder or more convex or more curved. Terms such as ‘larger’ were considered ambiguous and ‘more concave’ (used by many) was simply incorrect. Around half the students gave acceptable answers.

02.5 Given that the iris contains muscles, students had to desribe the role of these muscles for assisting in clear vision when moving into a brightly-lit area. Some evidently did not read the question carefully and described the precise opposite – moving into a dimly-lit area. Many were confused between iris muscles and ciliary muscles. Reference to radial and circular muscles were ignored as this went beyond the detail required by the Specification. Students were required to give two details from the muscles contracting, reducing the size of the pupil and a decrease in the amount of light entering the eye. Most scored at least one mark but fewer than half gained two.

02.6 This was an extended response style of question in which students had to plan an investigation to test the effect of drinking coffee on reaction time. Most opted for the ruler drop practical but the level of detail included was highly variable. The instruction in the question was ‘You should include...how to make the investigation valid’ which incorporates the concepts of control variables, repetitions and the calculation of mean values. Although many students omitted such details, around 50 percent scored full marks.

Question 3

This was the third of the three questions common to both the Foundation and Higher Tier papers. The topic was reproduction and selective breeding.

03.1 The advantage given by most for growing genetically-different tomatoes was that some might be less susceptible to disease. Almost two-thirds of students gave a suitable answer.

03.2 Deciding on an advantage for growing genetically-identical tomatoes proved more problematic and only one third could suggest a feature such as all growing at the same rate or all having the same named desirable feature such as high yield, disease resistance or flavour.

03.3 Very few students could successfully describe what is meant by tissue culture. Use of 'tissue' as the starting material was deemed inadequate and required amplification in terms of cells being grown. Fewer than 1 in 5 gave an appropriate answer.

03.4 More than two-thirds of students were able to suggest why genetically-identical tomatoes growing in a garden might not all attain the same height – for example, due to variations in light intensity, ions, water or temperature in different areas of the garden.

03.5 This question was about sex determination in dogs. Students had to use the symbols X and Y to complete a blank Punnett square. Most knew that the male dog would produce gametes containing either an X or a Y chromosome, and that all the female gametes would contain an X chromosome, and over three-quarters were successful in the completion of the Punnett square.

03.6 The explanation of why a litter of six puppies might be expected to consist of three males and three females was straightforward for most: either in terms of the expected 1:1 ratio of males and females or the inheritance of a Y chromosome by only half of the offspring (as demonstrated in a correct answer to the previous question).

03.7 This question was about the breeding of chickens for meat production and egg production. Given the results of an investigation in Figure 5 which showed that chicken variety A had high egg production while variety B grew more quickly, students had to suggest two control variables for the investigation. Many answers were rather vague – such as the same 'living conditions' / 'environment'. More specific conditions, such as temperature, lighting, amount or type of food, all being kept indoors or all outdoors, were required. The most common correct answer related to the chickens' food. While most students could suggest at least one suitable control variable, fewer than half could give two.

03.8 The data in the investigation had come from 500 chickens of each variety and students had to give a reason why such a large number had been used. Acceptable answers included the idea this would be more representative, or would give a more valid mean, or would reduce the effects of any anomalies (and not that it would 'eliminate' anomalies). Three-quarters of students were successful.

03.9 In this question, students had to describe how selective breeding of the two chicken varieties might produce a new variety of chicken that was good for both meat production and egg production. Many answers lacked precision: thus it was not often evident that only the best from varieties A and B would be mated and that the best (for both qualities) from the offspring would then be selected and mated, and that this would be continued over several generations. Often, it was impossible to tell from students' answers which generation of chickens was being used: the original parents, the first generation offspring or subsequent generations of offspring. The term 'repeat' was often used in an ambiguous context. Thus only 1 in 20 students scored all 4 marks, and only a third gained half-marks.

Question 4

This question was about decay – both in the natural environment and in a laboratory investigation.

04.1 This was an extended response style of question about the recycling of the elements carbon and nitrogen in tree leaves that fall in the autumn.
High-level answers had to include the role of microorganisms, the release of carbon dioxide, the use of carbon dioxide by trees in photosynthesis and the release and use of nitrate ions for making a named organic nitrogen-containing compound in the trees.
Further details, such as the enzyme-catalysed digestion of compounds in the leaves by the microorganisms, the production of carbon dioxide by their respiration, the use of carbon dioxide by trees to make glucose / starch / cellulose (or other organic substance), the uptake of nitrate via the roots of trees using active transport, were also rewarded. Very few students (only 1 in 20) scored all of the 6 marks available and only a quarter gained half-marks. Many just wrote about 'carbon' (rather than carbon dioxide) and about 'nitrogen' (rather than nitrates) which impeded their ability to score marks.

04.2 Given the results in Table 1 which showed daily recordings of the pH of milk samples at three different temperatures over 4 days, students were required to suggest an improvement to the method of the investigation. Appropriate answers included measuring the pH values at shorter time intervals, the use of more than the three given temperatures, doing repeats at each temperature and calculating means at each time interval. However, only half of the students gave such answers; a common inadequate answer was 'do repeats' with no mention of calculating mean values.

04.3 In this question, students had to plot the data for the pH values obtained at 25 °C on the graph in Figure 6. Just over half scored all 3 marks. There were many errors in plotting points, for example the plotting of values 4.9 and 4.8 as, respectively, 1 small square below 5 and 2 small squares below 5 (the actual scale was 2 small squares for 0.1 units). Some failed to gain marks for plotting as they may have used dots instead of crosses but the dots were then obscured by the line drawn on top of them. Some drew straight lines, point-to-point, instead of following the instruction 'draw a line of best fit', and some drew sketchy lines.

04.4 This was a 4-mark calculation to compare two rates of reaction. Students were instructed to draw a tangent to the 15 °C line at 2 days. Some did not draw a tangent; others drew one that spanned just 1 or 2 cm each way rather than extending to each axis which would, conveniently, have met the y-axis at 6.5 and the x-axis at 4.0, giving a gradient of

$$\frac{6.5-4.5}{4} = 0.5$$

This then had to be divided by the gradient for 5 °C, given as 0.3 in the question, producing a final answer of 1.67 times faster.
Some missed the value 0.3 given in the question and calculated it for themselves. Others subtracted 0.3 from their calculated gradient for 15 °C. There were also errors in reading values from the graph and in forgetting to subtract the lower y-axis value from the higher one. A little over one-third scored full marks.

04.5 An explanation was required for why the pH changed more quickly at 15 °C than at 5 °C. The graph (and data in Table 1) showed quite clearly that the pH decreased with time, but some students wrote about an increase in pH. Some thought that enzymes denatured at 15

°C, although how that would make the reaction faster was unclear. Although some understood that a decrease in pH must have been caused by acid production, very few thought that fatty acids would have been produced by the breakdown of lipids in the milk ('amino acids' being a more common answer). Only 1 in 6 students scored all 3 marks with just under a half scoring at least 2.

Question 5

This question was about homeostasis controlled by hormones.

05.1 Most students understood the simple representation of negative feedback shown in Figure 8 for the regulation of the concentration of a substance dissolved in the blood. The main omission, by one-quarter of students, was in not pointing out that the action of each hormone would return the concentration back to the ideal, or normal, concentration. Just under one-half of students gained full marks.

05.2 Understanding of the action of thyroxine, in the context of raising body temperature, was very limited. Many invoked temperature-regulation mechanisms such as vasoconstriction. Only 1 in 9 fully appreciated that thyroxine raised the metabolic rate and that one aspect of this – respiration – would release energy, or heat.

05.3 Table 2 showed the effects of different concentrations of ADH in the blood on the concentration of dissolved substances in urine and on the rate of urine production. Students had to explain the effects of a decrease in ADH between two of the values in the table. Hardly any mentioned that a lowering of ADH would decrease the permeability of the kidney tubules to water. Many understood that the change would decrease the reabsorption of water by the kidneys but the consequential effect on the urine was often poorly explained – few could relate the volume increase and the concentration decrease to more water being in the urine. Only 1 in 40 scored all 4 marks and only one-quarter scored half-marks. Some students just described the function of ADH without relating their answer to the decrease given in the question. Others used the inadequate term 'absorption' rather than reabsorption. Others thought that absorption related to water entering the kidney tubule rather than leaving it.

Question 6

This question was about the combined effects of respiration and photosynthesis on the carbon dioxide concentration in the air and the recovery of a rainforest community following deforestation.

06.1 Most students only considered the effects of photosynthesis in this question about changing carbon dioxide concentrations in the air in a tropical rainforest over a 24-hour period. For the first 6 hours shown in Figure 9 there was no light – hence only respiration took place and this produced carbon dioxide, hence the high levels of carbon dioxide shown on the graph. Many students understood that photosynthesis would not occur in the dark but then attributed respiration solely to animals in the forest. Between 8 am and 12 noon, the graph showed that carbon dioxide levels decreased. While most understood that the plants would be photosynthesising at this time, few realised that respiration also took place but the rate of photosynthesis exceeded that of respiration – hence a net uptake of carbon dioxide. Fewer than one-quarter of students reached even half-marks and only 1 percent scored all 4 marks.

06.2 Many students missed the concept of the time factor in answering this question which asked for an explanation why replacing rainforest with a maize crop would increase the carbon dioxide concentration in the air over one year. Using information from Figure 9 and Figure 10 should have indicated that maize removed less carbon dioxide from the air over the course of one day (not simply that the carbon dioxide concentration in the air decreased less at midday). Although many commented on the maize crop growing for just 6 months of the year, few stressed that this would mean the maize was only taking in carbon dioxide for half the year compared to the rainforest doing the same throughout the year. Only 1 in 40 students fully demonstrated their understanding of this situation.

06.3 Figure 11 showed an increase in the number of tree species with time following deforestation. The data were presented as percentages compared with adjacent control areas. About half of the students appreciated that presenting the data as percentages enabled comparisons to be made, but hardly any made the point that the initial numbers of species would have varied from one study area to another thus making a comparison of absolute numbers invalid. Mistakenly referring to the number of trees rather than to the number of tree species was quite common.

06.4 The stem to this question gave the information that the biodiversity of trees increased in the regenerating forest, but many restated this as their conclusion from the data in Figure 11. Further details from the data were required – such as the number of tree species exceeding the original number after about 50 years, or the fact that for any point in time there was great variability from one area to another, or a description of the changing pattern of recovery with time. Only 10 percent were successful here.

06.5 Many attributed the given increase in animal diversity in the regenerating rainforest to there being more food or more habitat available rather than to more variety of food types and more types of habitat.

Question 7

This question was about an inherited condition resulting in underproduction of the hormone FSH in one woman.

07.1 Given the graph in Figure 12 which showed changes in the concentrations of FSH and oestrogen in the woman's blood and in the number of follicles in her ovaries following 7 days of FSH injections, students had to look for evidence that the follicles were the source of oestrogen. A little over one-third appreciated the correlation between the rising follicle volume and oestrogen concentration lines on the graph. Many related the oestrogen production just to the increase in FSH.

07.2 This question was a 5-mark calculation of the number of follicles present in the woman's ovaries on the 11th day after the start of FSH injections. The question gave the mean diameter of a follicle as 22 mm and Figure 12 showed that, on the 11th day, the total volume of the follicles was 39 000 mm^3.

Despite being given the formula for the volume of a follicle, a considerable number of students squared rather than cubing the radius. Some used the diameter in the calculation instead of the radius. Either of these mistakes prevented them from being awarded the first 2 marks which were for calculating the volume of one follicle, but it was still possible to gain the remaining points. Many students used the 'π' button on their calculator rather than the

figure of 3.14 which was given to them but this was accepted within the mark scheme. Many students calculated the volume of one follicle but got no further.
Readings of the total volume of follicles from the graph were often accurate enough to be rewarded but some students read from the incorrect y-axis, from the wrong place on the volume curve or from the FSH curve.

Wrong figures for follicle volumes could be used in the final steps of the calculation as long as the answer given was correct for the figures used. Many students were able to access the last two marking points for dividing their misread total volume by their miscalculated volume of one follicle and then rounding to a whole number, as instructed in the question. Just under half the students scored full marks in this calculation.

07.3 Here students were required to explain the link between lack of FSH in the woman's blood and the lack of breast development. Some students suggested a direct link but better ones knew that FSH would normally have stimulated oestrogen secretion and that the latter was the cause of breast development.

07.4 Given that the woman had inherited a faulty gene for FSH production from each of her parents, and that each parent was able to produce FSH, most students could work out that each parent was heterozygous and were therefore able to construct an appropriate Punnett square diagram to show these parents could have a child who could not produce FSH. Despite the instruction to 'identify the phenotype of each offspring genotype', many simply omitted this or gave inadequate identifications – eg just the woman's phenotype, or describing the different genotypes as being homozygous, heterozygous or carriers, none of which is a phenotype.

07.5 The most successful answers, without any prompting in the question, included another Punnett square to show that the probability of the homozygous recessive woman and the heterozygous man producing a child able to produce FSH was 0.5. This necessitated identifying the woman's gametes as all having the recessive allele while half of the man's gametes would have the recessive and half the dominant allele, and identifying that half the potential offspring would be heterozygous and hence able to make FSH. Almost half the students made some headway with this, but only 1 in 6 gained full marks.

Question 8

This question was about meiosis and DNA structure.

08.1 Given the identity of the first and last diagrams in Figure 13, two-thirds of students were able to put the remaining four in the correct sequence to show the process of meiosis.

08.2 However, in this question, the vast majority did not follow the instruction to give the number of chromosomes per cell in Figure 13 but decided to use human chromosome numbers. Thus, the most common answer for the number of chromosomes at the start of meiosis was 46 and, at the end, 23. Various other numbers were given and, as long as the end number was half the starting number, 1 mark out of 2 was scored. Only 3 percent gave the correct values of 16 and 8 from Figure 13.

08.3 Fewer than a quarter of students were able to give a 3-mark answer explaining why it was necessary for the number of chromosomes at the end of meiosis to be different from that at the start. Many made just two points – either for meiosis producing gametes which could

fuse at fertilisation or for stating that fertilisation would restore the correct chromosome number. Some students simply described the process of meiosis, while others gave a comparison of meiosis and mitosis, both of which were not relevant to the question.

08.4 Most students found it very difficult to describe how meiosis produces cells that are genetically different and so scored no marks. Some described how random fertilisation causes genetic differences which was not relevant. Very few students could describe that one chromosome from each **pair** of chromosomes would separate **randomly** to opposite ends of the cell or into each of the gametes.

08.5 Nearly three-quarters of students knew that the four substances labelled A, C, G or T in Figure 14 were bases. Common errors included 'amino acids', 'proteins' and 'nucleotides'.

08.6 Two-thirds evidently knew the meaning of the term nucleotide and successfully counted twelve of them in the portion of DNA shown in Figure 14.

Question 9

This question was about how fossil evidence and our increasing understanding of the mechanisms of genetics have contributed to our understanding of evolution.

This was a high demand and challenging extended response question. Level 3 responses were rarely seen, but such answers were clear and well-structured, addressed several of the points of indicative content in the mark scheme and told the 'story' particularly well and eloquently. Level 2 responses were common. For the most part, students answered well when writing about fossils. They tended to do less well when writing about the genetics aspect of the question and gave some weak accounts about natural selection.

Level 1 responses were weak in general and tended to mention fossils rather than genetics. Many students produced answers that were lacking in specifics and contained little or no relevant information. The question expected students to have some knowledge of fossils and the mechanisms of genetics and how these have contributed to our knowledge of Darwinian evolution. The vast majority of students confined their answers to animals (sometimes only humans) and there was meagre reference to the evolution of plants.

In describing fossil evidence, many students gave much detail of how fossils were formed (and sometimes little else) but others were able to describe the role of fossils in enabling the understanding of how past organisms have developed through time. However, many failed to express that evolution occurred on a species-wide scale, instead referring to the change in individual organisms. Little was mentioned about extinction or how the fossil evidence is incomplete or how modern discoveries are helping to fill the gaps.

Descriptions of how the mechanisms of genetics have contributed to our knowledge of evolution were poorly expressed or not accounted for at all. Such mechanisms began with Mendel and his experiments which have led to our understanding of chromosomes, mechanisms of cell division, genes, alleles and then to the structure of DNA and its detailed function. A few students referred to Mendel's experiments with peas but considerations of genetics were limited to descriptions of speciation which did achieve some credit; however, statements were often made about advantageous characteristics or even genetics being passed on to offspring instead of alleles, or genes or mutations.

Mark Ranges and Award of Grades

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