AQA

AS LEVEL
BIOLOGY

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Report on the Examination

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General Comments

Students demonstrated good knowledge of protein structure, surface area to volume ratio, substance movement across membranes, mitosis and the mass flow hypothesis. Their knowledge was more limited on the principle of digestion, the structure of prokaryotic DNA and when describing the basis of evolutionary relationships. Examiners found examples in which students' weak examination skills led to some giving descriptions when asked to evaluate or to compare and contrast and in making poor use of the information given in headings, both in graphical and tabulated form. Changing the subject of an equation (Maths requirement MS 2.2) is well understood; so too, for many, is how to round numbers appropriately. Most questions testing an understanding of mathematics principles proved to be good discriminators. Most students demonstrated good knowledge and understanding of the technique for preparing a stained squash of cells (required practical activity 2), but far fewer were able to calculate the mitotic index. Few students were able to apply successfully an understanding of how to prepare a dilution series (required practical activity 3) to a new context. Students generally demonstrated a good ability to make conclusions, but often without including all of the details within the data, which led many to give a long explanation of a single point.

Question 1

In 01.1, statements describing the Golgi apparatus and cell wall were selected correctly by many students. The description of the chloroplast was incorrectly identified most often as a nucleus, and frequently as a mitochondrion. 24.5% of students scored all three marks.

In 01.2, most students knew mitochondria released energy, but they were often unable to apply their knowledge in the context of this question to explain what use gland cells made of this energy. Statements such as "ATP supplies energy for milk production" (rather than protein production), were frequently given and achieved no mark. Answers involving mitochondria "producing energy" (a misconception reported in previous Examiners' Reports), and "energy being released for respiration" were examples of students' poor expression. The function of Golgi vesicles was less well known and their correct function of transporting glycoprotein/milk out of cells was expressed in relatively few answers. Many explanations lacked precision, for example "Golgi vesicles transport milk to its destination". Exocytosis was accepted as an alternative and was often mentioned in well explained answers, but some students confused it with endocytosis and failed to gain the mark. The idea of breast feeding confused many and caused some to apply their knowledge illogically: "mitochondria provide ATP for the baby" was one, fairly common, inaccurate application of AS level understanding. Nearly 60% of students failed to score on this question.

Question 2

Generally, students demonstrated their good knowledge of protein structure in 02.1. Most students achieved a mark for naming condensation and many went further to describe the groups involved in joining together amino acids. Diagrams used to support descriptions were almost invariably accurate and labelled fully. Those who scored no marks (17%) named the reaction as hydrolysis, gave lengthy accounts of translation, referred to a reaction between H and OH, or confused the amine group with nitrate/nitrile.

In 02.2, 35.4% of students gained two marks, usually by referring to the involvement of hydrogen bonds in forming an alpha helix or beta-pleated sheet. The first alternative in mark point 2 was less often seen and students were often muddled about what bonded to what. Precise and well explained descriptions of hydrogen bonding were present in a few answers. Some students confused protein structure with nucleic acid structure. It was not unusual for students to have no idea about how secondary structure is produced.

In many answers to 02.3, students applied their understanding well and gave clear and often succinct explanations of why tertiary structures differed, using appropriate AS biology knowledge. Those who scored one mark often did not name the bonds or mention the 'different location' of bonds, and they could not explain the idea of 'different sequences'. Some answers missed the point of the question by describing how tertiary structures formed, or confused DNA structure with protein structure. Some students incorrectly used the degenerate nature of the DNA code as the reason why primary structure varied. The alternative interpretation relating to changes being caused by variation in pH or temperature was seen a number of times and gained a mark.

Question 3

In 03.1, most students (70.3%) knew the relationship and described it correctly. Some misinterpreted the question and wrote about the advantage of having a large or small surface area to volume ratio; for example by discussing diffusion or gas exchange. Some missed the idea of describing a relationship and gave specific examples, for example "large organisms have small ratios".

Question 03.2 discriminated pretty well. Most students successfully changed the subject of the equation to find the radius and converted this figure into a diameter. Some failed to gain a mark because they left the subject of the equation as r^2, or they did not double the radius to give the diameter. Many answers showed that students understood the mathematics skill associated with rounding numbers.

Students found question 03.3 difficult (60.5% scored zero) because it asked them to apply an understanding of practical procedures to a novel context. Many failed to focus on the idea of small quantities and wrote instead about "the small organism" or "this is a small unit of measurement". Others gave standard answers such as "easier to compare" or "more accurate/precise", again insufficient. Those who gained the mark usually did so for writing about the small or low uptake of oxygen. A few students demonstrated good understanding of mathematics principles by realising that using µmol would avoid the use of standard form or the use of many decimal places, and often gave a detailed explanation to reinforce their clear understanding.

Many answers to question 03.4 did not go further than "it is easier or quicker to measure mass". However, 38.1% of students gained the mark and all the alternatives on the mark scheme were seen multiple times. Some students gave illogical suggestions, like "masses of a development stage would be different whereas volumes are the same", and others "that these were too small to measure".

For 03.5, there were a lot of seemingly good answers that avoided reference to respiration and so did not gain credit. Others went no further than oxygen is used in respiration, so is a measure of metabolic rate; again, this was insufficient. Some students implied incorrectly that oxygen is a reactant in all metabolic processes; others gave the usual misconception of energy 'production', and breathing was confused with respiration in more than a few answers. Those who achieved the mark (25.1%) demonstrated, often in an accurate and concise passage, a good ability to apply their understanding. Both alternatives on the mark scheme were often seen.

In question 03.6, most students demonstrated their ability to use results to make a conclusion by identifying there was no information about the egg, so one mark was very accessible. Some incorrectly suggested the dash in the table meant eggs did not respire or were dead. Many did not comprehend the reference in the table to 'mean', so suggested incorrectly that only a single tadpole or frog was studied. Others gave tadpole as the stage where no information was presented, which is not shown in the table. Few students explained precisely why a relationship is not concluded from only two data points. Very few made reference to there being a lack of statistics. Some students misunderstood this question and gave their own conclusion for these results.

Question 4

Most answers to 04.1 achieved one mark for describing the movement of substances down a gradient. Some went further to identify the concentration gradient in diffusion and the water potential gradient in osmosis. No marks were awarded when movement was described inaccurately as being along or across a gradient, or from one gradient to another gradient. A commonly held misconception about passive processes was found in a large number of answers which described these processes as 'requiring no energy'.

Many students answered question 04.2 well by applying an understanding of facilitated diffusion to explain the shape of the curve and 9.3% of them achieved all three marks. Often these explanations demonstrated logical progression of thought, by describing a trend in the data and explaining how the action of carrier proteins accounted for it. The principles of diffusion were well understood. The most common errors were to suggest that the loss of a concentration gradient accounted for levelling off in the curve or to write about no uptake between C and D: they suggested these students had not taken sufficient notice of the y-axis label. The description of a correlation, to achieve the second marking point, was often little more than a ramble of tortuously unclear comparisons. A significant minority referred incorrectly to enzyme active sites in the context of carrier proteins.

In question 04.3, on the whole, students demonstrated good ability to apply their understanding of facilitated diffusion and membrane structure to the graph and scored marks. Their ability to describe the relationship shown by the monoglyceride curve, however, was weaker. Many described the change in rate as 'constant', when what they really meant was 'constant increase', or they did not include both variables in the description of the relationship. Some stated incorrectly that concentration had no effect on the rate of uptake. Most students understood that the graph indicated the absence of active transport and carrier proteins. Students often went on to discuss the phospholipid bilayer, but occasionally failed to mention diffusion or the solubility of monoglycerides in the bilayer.

Question 5

It was evident that many students had practical experience of the procedure in question 05.1 as answers tended to be well-explained. Most students achieved at least one mark, usually for stating mitosis occurred at the root tip. A significant number described mitosis as being the cell cycle, or "most stages of the cell cycle occur at the tip" when, in fact, all stages occur there. Another misconception was observed in answers where meiosis happened in root cells. The reason for pressing down firmly was not well known and explanations were left short by not mentioning cells/tissue or that light passed through. To remove air bubbles or to distribute stain were frequent alternatives, but ignored by examiners.

Question 05.2 discriminated well. Many students successfully calculated the time spent by cells in anaphase and a significant proportion took this one step further and calculated the correct percentage difference. Their workings were usually well presented and demonstrated logical thinking. Quite a few students did not know how to calculate the mitotic index, even though it is part of required practical activity 2 (section 7.2 of the specification). Many (8%) made no attempt at all to answer the question.

The vast majority of students (93.9%) correctly identified cytokinesis in 05.3.

For 05.4, most students gave a description of a relevant technique to check the accuracy of a cell count and often followed this with an appropriate explanation. Examiners sensed that the explanations were based on students' first-hand experience – gained by doing the required practical. Some students misinterpreted the question and gave, often in long accounts, a step by step procedure to calculate the mitotic index. Others went off track by describing the calculation of mean values, which would improve accuracy of mitotic index scores, but not the accuracy of cell counts. Some students mistakenly believed that the root cells would continue to go through mitosis after staining and squashing. A few failed to notice that the stem of the question referred to 'this root tip' and wrote about using other root tips to check their count.

In 05.5, many students demonstrated sound knowledge of mitosis and applied it well to give a sensible suggestion of how the chemical affected root growth. Most suggested the chemical affected spindle fibres, and went on to identify correctly the stage of mitosis inhibited by it, and developed a line of reasoning to its logical conclusion, in which new cells did not form. Almost as many students referred to chromosome separation as to chromatid separation. Some confused meiosis with mitosis by referring to homologous chromosome pairs and crossing over.

Question 6

In 06.1, most students (60.4%) were able to obtain at least one mark, either for explaining that treatment D was used to compare the effects of other treatments, or that it enabled the scientists to see the effect of substance X. A much smaller number of students included both of these ideas in their answer. A small number of students showed excellent awareness of how best to use a control when they subtracted the figure given for roots growing in D from figures obtained in other treatments. There were good discussions related to comparing treatments, and 'active substance versus agar alone'. Several made good use of terms such as `independent variable'.

Most students achieved a mark on question 06.2 for recognising that the presence of substance X increased root growth, so had successfully made a conclusion by analysing data. Many went as far as subtracting the figure for the 'control' from the result for treatment E. The limitation in many answers, however, and the reason why relatively few candidates achieved two marks was their inability to explain what was shown by the 'control'. Most tried to do this by describing the data (for example, '…while D only had 5 roots'), rather than make a conclusion along the lines of, 'D shows roots are still produced without the substance'. Fewer still achieved the mark for substance transport in the stem because substance movement was implied rather than stated explicitly.

The best answers to 06.3 provided a clear description of the evidence and linked it precisely and immediately to a context, either in support of, or against the mass flow hypothesis. However, only 0.6% of students scored all four marks. Many students gave detailed and accurate descriptions of the hypothesis, without linking their knowledge to the outcomes of the investigation and without applying what they knew of mass flow in the evaluation. The answers tended to be lengthy, but usually only made a single valid point, and in the majority of cases this was: "F shows phloem is required, so this supports the hypothesis". Very few students considered aspects of the mass flow hypothesis other than the requirement for intact phloem. Many correctly said bulging occurred above the ringed section according to the hypothesis, but bulging was not present in Figure 4, so students had not considered either the information given or applied their understanding with sufficient care. Many mentioned the idea of a source and sink, but rarely applied it to this investigation, so very few stated the agar was the source (to support the hypothesis) and roots were the sink. Some referred to leaves as the source of the assimilate, even though leaves were not shown in the figure. The small number of students who did refer to Treatment G chose to link vaguely their ideas of enzymes to explain these results, but they rarely referred to processes, like respiration or active transport which they should know are involved in mass flow.

Question 7

In 07.1, many of the definitions given for digestion were general statements well below the standard expected at AS level. They were often incorrect, such as “food is broken down ready for absorption”, or “it is a process taking food between mouth and rectum”, or “when food is eaten”. Also, many students seem to think that absorption is part of digestion. Irrelevant, but correct, details about enzyme action were given in more than a few answers and it suggested that students’ knowledge of section 3.1.4.2 of the specification is more detailed than it is of section 3.3.3.

Many students regarded this question as a test of why digestion is faster with two enzymes, and so duplicated the answer to 07.4, rather than suggest why they acted at different places. Many described the specific nature of an active site or stated active sites are different, without a precise focus on the idea of different shapes. The complementary relationship between enzymes and the location on cellulose where complexes form is well understood. Some students had the misconception that cellulose was a protein or acted as an enzyme.

Question 07.3 discriminated well. Almost every permutation of the numbers shown in Table 4 was used in calculations, so many students (33.1%) achieved no marks and a fair proportion (30%) scored only one mark. Many did not extract the correct information from the results table, and performed a calculation on the quantity of cellulose remaining, not on the amount digested. An equal proportion of students expressed rate as digestion per hour, not noticing the question required it to be per minute. The majority of students who derived a figure with decimals converted this correctly into standard form, although some failed to gain marks because they used 10^3 rather than 10^{-3}. Many answers were supported with clear working and demonstrated logical progression in mathematical steps.

A reasonable number of students (22%) achieved both marks in question 07.4, although some made it more difficult to convey their understanding by beginning the answer with the action of exocellulase rather than from how the ‘ends’ were created. A large number of students correctly described the role of each enzyme, but then failed to explain how this would give the greatest rate of reaction, or they gave a general account without identifying the enzymes. Many added together the quantity of enzymes in the mixture and suggested incorrectly that ‘double the enzyme’ or ‘twice as many active sites’ was the reason for the increased rate of digestion.

In 07.5, the correct formula for calculating percentage loss was presented in a variety of ways and demonstrated that many students are aware of this mathematics skill. Their use of terms such as ‘total’ for ‘original’, or ‘new/old’ for ‘final/initial’ occasionally made it difficult for examiners to determine precisely what students meant. Omitting to multiply by 100, and subtracting mass lost from the original mass, instead of subtracting final mass, were common errors. Many students failed to gain the mark by calculating the percentage of cellulose remaining. Surprisingly, 10.7% of students made no attempt at this question.

Question 8

Question 08.1 was designed to test the ability of students to apply their understanding of how to produce a dilution series in a new context, so building on the demand of required practical 3. Not many students (3.2%) achieved all three marks, mainly because most failed to 'mix' the diluted suspension, which is a key part of a dilution series technique. The correct procedure to prepare 1 in 10 dilutions was given by the majority of students although a significant number failed to score this mark by adding 10 units of liquid to 1 unit of original culture. Quite a few students did not use the suspensions in their correct proportions to produce 1 in 1000 dilutions: adding 1 unit of the 1 in 10 dilution to 999 units of water was a common error. Some students expressed the dilution series as a set of equations, and rarely gave enough information about the volumes to use in these equations for examiners to award marks. Quite a lot of students (14.5%) made no attempt to answer this question which suggested to examiners that some schools/colleges had not carried out this kind of practical work.

Relatively few students in 08.2 demonstrated the ability to perform this multi-step mathematical problem set in a microbiology context to gain both marks. Many missed a single step and achieved one mark. They often gave 375 in the answer, but the number of zeros associated with it varied enormously. Examiners noted some examples where mathematical working was signposted clearly. In poorly presented answers, however, students failed to gain marks because they hid their solution in a jumble of figures. A significant number of students (10.6%) did not attempt to answer this question.

In question 08.3, students were asked to apply an understanding of the dilution series technique to a context of counting cells in different suspensions. Many did not appreciate the 1 in 10 dilution was a low dilution and so suggested the number of cells in this suspension would be too low. Of those who scored one mark, some suggested there would be too many cells without reference to counting and, if they did count the cells, mention was infrequently made to the idea of accuracy. 'Time consuming' or 'too difficult' to calculate were often the main reasons for not using the dilution, for which no mark was awarded. Again, a high proportion of students (16.2%) failed to attempt this question.

Most answers to 08.4 achieved one mark, usually for suggesting animals were given more tetracycline or that it was used over a longer time period. Few students went on successfully to explain a reason. Those who were successful addressed the context of why more tetracycline-resistant bacteria than streptomycin-resistant bacteria occurred, occasionally by referring correctly to differences in selection pressure or differences in directional selection. Most students, however, did not make this comparison so failed to get a mark. In explanations of natural selection, reference to gene or allele transfer during reproduction was often omitted. Examiners noted misconceptions in many answers, such as "antibiotics mutate", "antibiotics cause mutations", "tetracycline reproduced" and "bacteria develop immunity".

In 08.5, only 16.7% of students accurately applied what they knew about selection to make a logical suggestion for explaining the scientists' results. The most frequent correct answer described bacteria passing on the resistance gene in their reproduction, and occasionally a clear explanation of stabilising selection was provided, which also gained the mark. Examiners reported many instances where the animals' immune response was incorrectly suggested as being a contributing factor.

Question 9

In question 09.1, it was clear that some students had been taught how to respond to the command 'compare and contrast'. They produced well-organised answers, although these largely concentrated on the differences between the two types of DNA and seldom referred to similarities. Students who wrote lists about each type of DNA and did not make clear comparisons and contrasts, did not gain marks. A significant number of students compared prokaryotic cells with eukaryotic cells (such as "DNA floats in the cytoplasm, but in eukaryotes it is contained in a nucleus") or they compared DNA with RNA. Misconceptions were common; for example, "prokaryotic DNA is single stranded", "it contains uracil", "it is not replicated semi-conservatively", "it contains ribose", "viruses are prokaryotes", "DNA is an alpha helix", "all prokaryotes have plasmids". Very few students (0.3%) achieved five marks and not many (1.9%) got four marks. Many answers showed little evidence of knowledge beyond GCSE level; for example, "DNA consists of four named bases", "DNA is made of a sugar, a phosphate and four bases". Knowledge about nucleotides was given in very few answers. The low quality of answers (the mean mark on this question was only 0.79 out of 5), along with evidence of frequent misconceptions, gave examiners a sense that section 3.4.1 of the specification about DNA structure is not well understood.

In 09.2, it was evident that students had difficulty with this topic and many answers (56.4%) gained no credit. Some students were diverted because the question referred to haemoglobin, and went into long detail on levels of protein structure and physiological adaptations to different oxygen environments; for example, mammals at different altitudes. Those who discussed evolutionary relationships often gave vague answers that referred to sharing a common ancestor or being related, rather than use ideas like more differences would indicate a more distant relationship and an earlier common ancestor. Very few students considered what caused the differences in the primary structure of haemoglobin, consequently little mention was made of mutation, which is the process underpinning species change in evolution. Few considered why these differences accumulated over time. Many answers achieved two marks, and rarely more than three marks. The mean mark on this question was only 0.46 out of 5.

Mark Ranges and Award of Grades

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