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8461/1H: Paper 1 (Higher tier)
Report on the Examination

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General

In the fifth year of the new specification for GCSE Biology, and despite the disruption caused by the COVID-19 pandemic, most students coped well with the demands of the paper and there was little evidence to suggest that students were unable to complete all questions within the allotted time.

On occasions, some students wrote excessively and should be reminded that the answer space provided has been specifically designed to fit the responses of most students.
In addition, students should be reminded that when they do use additional pages, all question parts should be numbered accurately. Several students continued their answer to one question part in the space for another, without making this clear to the examiner. In such situations, it is assumed that the writing beneath the question relates to that part and therefore, may not gain credit unless it is made explicitly clear which question part the response refers to.

In a number of cases, the use of poorly phrased sentences and imprecise language lead to a lack of clarity in some responses. Students should be encouraged to read back over longer written responses to check for errors and ensure that their meaning is clear. There were several instances of students not reading the question carefully enough or in calculations, not checking all of the instructions had been followed at the end of the answer. In multiple choice questions, particularly where two tick boxes were required, some students did not read the instructions fully and gave only one response.
The mathematical skills tested in this paper were widely understood by most students, however, a significant number were unable to draw an accurate curve of best fit and therefore, students should be exposed to a variety of graph drawing experiences that involve both curves and straight lines of best fit. Many students still struggle with the concept of converting units, incorrectly converting from millimetres to centimetres and micrometres, and schools/colleges are advised to give students as much practice at this, in different contexts, as possible.

From the Required Practical Activities covered in this paper, it is clear that some students continue to struggle with depth of understanding of the concept of osmosis, frequently confusing water concentration and solute concentration. It was clear that many students had gained experience using a microscope to prepare or view slides, as assessed in question 3.

A large proportion of students fail to acknowledge the command word in questions, particularly when the command is ‘explain’. A description here is simply not enough.
Some students also fail to adequately ‘compare’ when required to do so, instead simply quoting figures from data rather than stating whether the values are higher or lower than one another. When asked to describe differences between features, answers that refer to both of the features are required.

In the extended response question on burgers, many students failed to address the additional instruction to ‘use your own knowledge’ and therefore, despite writing lengthy responses, were unable to move out of level 1. The question on adaptations of the alveoli and villi was poorly

answered and schools/colleges are encouraged to explore this area of the specification in greater depth so that their students are able to provide linked reasons for the adaptations of each part.

Levels of Demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard demand)

01.1 Students' knowledge of sub-cellular structures was generally well evidenced in this question, with over 70% of students scoring full marks; however, the common error of referring to energy production / creation in the mitochondria was still seen. In addition, students often referred to energy being released 'for respiration', which is not creditworthy. There was also frequent confusion between cell membranes and cell walls.

01.2 Over 90% of students were able to correctly reference the function of chloroplasts. A few students simply stated that the role was to make the cell or plant green, which was insufficient.

01.3 65% of students were able to name a plant cell that was lacking in chloroplasts, however, several incorrect answers giving other types of cell (such as a bacterium), or other sub-cellular structures, were commonly seen.

01.4 Nearly 85% of students were able to correctly identify the independent variable in the investigation.

01.5 It was clear that many students had carried out the Required Practical Activity on osmosis assessed in this question. The three quarters of students who gained credit in this question were able to articulate the need to remove excess water, or that any extra water would add to the mass recorded, rather than just repeat the stem of the question.

01.6 The vast majority of students were able to use the equation provided to correctly calculate the percentage increase. Some students used an alternative method which would have led to a correct value if they had remembered to subtract 100 from their final answer. Students should therefore be reminded that, in questions where they are given an equation to use, they should use that equation to avoid missing out on vital marks.

01.7 Graph drawing skills still prove challenging for some students, and many make their lives more difficult by using unusual scales or, as often seen in this question, by shifting their *x*-axis scale. These ideas in themselves are acceptable, but only when the scales remain even and the zero is clearly identified, which often, they were not. While many students were able to plot accurately, a number incorrectly transcribed the reading of (0.3, 0.4) from the table, instead plotting the *x*-value at 4.0. Many students were unable to draw a correct curve of best fit, either drawing a straight line, or a curve that did not hit all of the points, or that was broken or 'feathered'. Curves of best fit should fall within ½ a small square of all of the points and should be a single, unbroken line. Students should also be reminded that their scale should take up at least 50% of the grid space provided.

01.8 Over a third of students understood the idea that where the curve crosses the x-axis is where there is no net loss or gain of water in osmosis, however, some students did not gain credit because of inaccurate readings. Again, readings must be within ½ a small square to be creditworthy.

01.9 As in previous years, many students continue to make the same error when describing 'concentration' in osmosis explanations and less than 45% of students gained full marks in this question. If water concentration is not specified, it is assumed that solute concentration is being described and this often results in an incorrect answer (for example, 'water moves from an area of high concentration to an area of low concentration' is **not** correct). Some students correctly articulate themselves in terms of water concentration, but then go on to contradict themselves with incorrect references to concentration gradients (again, solute is assumed unless water is specifically quoted).

Question 2 (Standard demand)

02.1 95% of students correctly identified 'vacuole' or 'cell wall' as features found in plant and fungal cells but not in animal cells. The most common error was to give 'membrane' or 'nucleus', though such answers were fairly rare.

02.2 95% of students were able to identify the fungal disease rose black spot.

02.3 While many students were able to carry out a simple calculation to find the number of times a fungal cell would divide in 24 hours, some students made errors, including stating that one and half hours is 1.3 hours or reversing the numerator and denominator in their calculation. A small but significant proportion of students went further, perhaps deciding that the sum they had completed had not been sufficient to gain the 2 marks or had simply misread the question. These students attempted to determine the total number of cells there would be in 24 hours and frequently calculated 2^{16}.

02.4 Generally, the stomach was correctly identified as the site where protein was digested in the human digestive system**,** although a significant number of students selected large intestine.

02.5 Over 90% of students correctly identified Biuret regent as able to identify the presence of protein.

02.6 The extended response question was well attempted by most students, however, some failed to acknowledge the instruction to 'use your own knowledge', and gave lengthy comparisons about the nutrient content of both burgers, without referring to why this did, or did not, contribute to a balanced diet, thus limiting these students to level 1. Some students did not make effective comparisons, using statements such as 'high in fat' rather than 'higher in fat' or simply repeated figures from the table, therefore, gaining no credit. Some students who did go on to attempt to use their own knowledge gave only vague statements about the burger being 'better for the body' and many confused the significance of each food component, stating that fat is needed for muscle growth and that excess cholesterol causes obesity, for example. Many students understood that protein is needed for muscle development but failed to go on to use the term 'growth' to gain credit. A few students wasted time by giving fairly detailed, (but irrelevant in terms of the question) accounts of enzymic digestion of carbohydrates, fats and proteins in the digestive system. A small number of students offered a valued judgement as to which type of burger might be 'better overall'.

However; as the evaluation was taken to be the comparison between the nutritional content of the two burgers, this was not required and so was ignored.

Question 3 (Standard and standard/high demand)

03.1 Over 60% of students gained the first mark point for identifying a plan to minimise the risk when using iodine solution. The second mark point for the sharp knife was less frequently awarded as students were less able to give a valid method to minimise the risk. The most common incorrect response referred to wearing goggles. Responses were often vague such as 'place it away from you'. Some students abdicated responsibility completely by recommending that the teacher or an adult cut the onion and some were more imaginative and suggested buying pre-cut onion. A few candidates transferred their knowledge from other subjects e.g. technology and talked about specific knife grips that protect the fingers.

03.2 Just over 10% of students achieved full marks in this question. Reponses for marking points 1 and 2 often lacked sufficient detail or failed to answer the question, for example describing that the layer is only one cell thick for MP1 and suggesting staining organelles that could not be seen with a light microscope for MP2. Similarly, some students concentrated on the problems of a thick slice, rarely giving an adequate converse argument. Those who scored at all on MP1 generally referred to light penetration rather than the alternative of seeing individual cells. MP2 responses often stopped at staining the whole cell, rather than its individual parts and some students described the test for starch. The purpose of the cover slip was well understood. Incorrect answers mostly referred to the angle of the coverslip having something to do with reflecting light to see the sample better.

03.3 This question was well answered, with 50% of students scoring 5 out of 6 marks, and few scoring below that. The most common error was an incorrect conversion to micrometres. Many students fail to recognise that they need to convert centimetres to millimetres before converting to micrometres and many divide by factors of 1000 rather than multiply.

03.4 In this question, some students found it difficult to articulate themselves, often contradicting themselves or tying themselves in knots by not reading their final response over for mistakes. Answers such as 'add labels', or 'label organelles / structures' that couldn't be seen with a light microscope were not creditworthy.

03.5 Despite this being a common question that students seem to be familiar with, many struggled to articulate the idea of greater magnification and resolution when faced with the idea in the context of actual cells. Just over 50% of students gained full marks. Students sometimes showed their lack of understanding of resolution, frequently giving two alternative answers for MP2, and failing to recognise that these alternatives are due to the effects of higher resolution, thus gaining only 1 mark overall.

Question 4 (Standard, standard/high and high demand)

04.1 Nearly 90% of students gained full marks in this question.

04.2 At standard/high demand, there were multiple parts needed in the response to this question, which only 19% of students achieved. Most students understood the idea that animals avoid eating the hornet moth because it looks like a hornet, but the higher level idea that the animals have 'learned' that they get stung was missed by most.

04.3 The most common score in this extended response question was 2 marks out of 6. Students were required to provide a response detailing the reasons why a tree might die if moth larvae damaged the roots, with a link(s) to the impact the reason(s) would have on the tree. Although there are clear mark points on the mark scheme, the list was not exhaustive, so non-listed appropriate indicative content was also acceptable. The impact of less absorption of water and mineral ions was more commonly cited compared to damage to xylem or phloem, with numerous students referencing support and anchorage for the tree. Many students understood the consequence of a lack of magnesium ions and nitrates and these were common responses seen. However, on occasion, some students confused the two or did not make it clear which ion linked to which consequence they were writing about. To achieve marks in both levels 2 and 3, correct linking was required, hence why many students limited themselves to level 1, as they failed to make the link between the effect of the damage and the consequence.

04.4 Only 1% of students gained full marks in this question, highlighting several misconceptions or surface levels of understanding of the events of mitosis. The majority of students who gained marks on this question did so with MPs 1 and 3, although a number of students continue to use the term 'genetic information' which is not sufficient at this level. As seen in previous years, students continue to find the idea of the separation of the chromosomes difficult and many failed to obtain MP2 because of messy written language, sometimes describing all of the chromosomes moving to one side of the cell. Many answers also clearly confused the arrangement of the chromosomes at the centre of the cell between mitosis and meiosis for this mark point. Very few students were able to access MP4, with most simply repeating the stem of the question, that two genetically identical daughter cells are produced

04.5 Over three quarters of students answered this question correctly, and on the whole, spelling was correct. Of the incorrect answers, many were erroneous biological terms. Specialisation was ignored as it was given in the question stem.

Question 5 (Standard, standard/high and high demand)

05.1 Over 90% of students were able to correctly identify the guard cells as controlling the opening and closing of the stomata.

05.2 Over 40% of students failed to gain a mark on this question, mostly due to a lack of comparative detail. The question asked for differences between the transpiration stream and translocation, however, many students just described one or the other, which was not creditworthy. A number of students failed to achieve bullet point 2 by being unsure about which molecules were transported by the phloem. A large proportion of pupils stated that glucose and mineral ions were transported, which was ignored, unless a correct reference to sugars or sucrose was given.

05.3 65% of students answered this question correctly, with the most common incorrect answer being 'warm with high humidity'. Humidity remains a concept that many students struggle to understand.

05.4 Nearly half of all students scored no marks on this question, mainly due to a failure to acknowledge the command word 'explain'. A number of students described the data from the figure but did not go on to explain how the changes described were an advantage to the plant. Some students missed out on MP1 by describing a lack of light as just 'dark' and some failed to go on to say that a lack of light meant less photosynthesis. The most commonly achieved mark point was MP2, knowing that stomata close to prevent water loss. Very few students were able to articulate that the stomata are open widest at midday because that's when light intensity is highest, with many giving vague sentences such as 'there is more light at midday' which were not detailed enough. Very few students made the explicit link between opening the stomata to let in carbon dioxide and the fact that carbon dioxide is needed for photosynthesis.

05.5 Again, nearly half of all students scored no marks on this question. Whilst some acknowledged that the stomata open wider in low atmospheric carbon dioxide, very few managed to recognise that the stomata were also open for a longer period of time; both of these ideas were needed for mark point 1. Of the marks achieved, the most common was mark point 2, as those students who had the idea of wider stomata for MP1 often went on to correctly state that more carbon dioxide could enter for photosynthesis.

Question 6 (Standard/high and high demand)

06.1 Over three quarters of students scored full marks in this question, selecting the correct numbers for surface area and volume from the table, dividing surface area by volume and then correctly rounding their answer of 73.77... to 74, the nearest whole number. Some students simply selected the correct numbers and wrote them as a ratio, but didn't progress to simplify this by dividing, so scored no marks. Another relatively common mistake that was seen was when students converted the standard form numbers to 'normal' numbers, but in doing so missed out one of the nines from 0.00996.

06.2 60% of students answered correctly, stating that as the size of the organism increased, the ratio decreased. The converse of this was also commonly seen and credited. A few noted the creditworthy relationship of inverse proportionality also. Students were asked for a relationship between two factors, but some did not refer to these factors in their response. This was the most obvious reason for students not achieving the mark. Some students got the relationship the wrong way round and others appeared to compare surface area to volume for each organism i.e. volume increasing as surface area increases, for example, stating that surface area is always bigger than volume.

06.3 Over 60% of students scored zero marks in this question. Just over 35% of students gained the first marking point, for the idea that organism **D** has a smaller surface area to volume ratio than organism **B**. Those that didn't achieve the mark failed to make their answer comparative. The converse was also credited. Very few students achieved the second mark point, which was for the idea that either the diffusion distance is **too** large or that diffusion would take **too** long. Many students just repeated the question stem and didn't mention the word diffusion.

06.4 This high demand question was not accessible to most students, with nearly 85% scoring zero marks. Most students recognised that **D** had a larger surface area to volume ratio, however failed to link this to losing heat more quickly. Some, but not many, realised that more respiration would be needed. Many students realised that metabolism is the sum of the chemical reactions in the body, but few made the link that respiration was a key part of it. Consequently, very few scored the final two marking points, with many students just stating that the rate of metabolism had increased, using information from the table in the question.

06.5 This levelled response question required students to make links between the adaptations of both villi and alveoli, which many students found difficult. The most common mark on this question was 1. Some students very competently described how the alveoli and villi are adapted to increase absorption. Some students, however, knew lots of detailed and correct information, but did not answer the question and refer to features of both alveoli and villi in their answer. Some answers lacked precision; many students lost marks referring to absorption rather than diffusion. There was also a number of references to thin membranes as opposed to thin walls. Other common mistakes were: the villi being one cell thick, reference to cell walls and the villi containing mitochondria, rather than the cells of the villi. Students who talked about both alveoli and villi and linked the adaptation to the correct consequence scored well.

Question 7 (Standard, standard/high and high demand)

07.1 Over 90% of students answered correctly, although occasional vague answers such as 'physical contact' were seen. References to sex or sexual contact / intercourse were the most commonly seen responses, but sharing needles or exchange of body fluids was also frequently seen. Some students talked about 'contraception' but did not qualify this as being a barrier method, which was not creditworthy.

07.2 Nearly 80% of students gained one mark in this question, either for referring to the number of cases increasing and then decreasing in men, or, for the fall-back mark of an overall decrease. A surprising number of students failed to read the figures correctly and suggested that cases in both men and women were decreasing or increasing until 2014. Several students identified a trend but failed to attribute it to men, women or both. Some did not attribute an overall decrease to **both** men and women or that the **total** number increased then decreased. Many compared the numbers of men and women, particularly saying that the number of cases in men was higher than in women, which was not incorrect, but not creditworthy. Several described the increase in 2014 as an anomaly. Students should be reminded to check the number of marks available for each question and to take care to consider each column of the table separately.

07.3 Just over half of students grained credit in his question. Those who fell short of the mark often gave vague answers such as 'education' or' contraception' without reference to an improvement, such as 'more', 'greater' or 'better'. Reference to vaccines was very common, which was the most common answer for zero marks, as well as several suggesting the development of herd immunity.

07.4 Over two thirds of students achieved full marks on this calculation question. Those that scored two marks often had the numerator and denominator reversed in their division or failed to round their answer to three significant figures, with the most common incorrect answer given being 0.19. The majority of students achieved 3 marks for a correct answer, sometimes given without any working shown and sometimes when the method of calculation was not clearly apparent. Some gave the figures as a ratio and did no calculation. Others gave the figures as a ratio but then produced figures which indicated that they had divided them. Many divided both numbers by 2, for no apparent reason. It was apparent that some students didn't have calculators, although some still managed a correct calculation.

07.5 Less than half of students gained this mark, with the most common incorrect answer being graphing the data to visually compare. It was also suggested frequently that the same number of men and women should be tested, considering this as a controlled investigation rather than gathered statistics. A significant number suggested presenting the results as a ratio, or presenting the total number, rather than just new cases.

07.6 A significant number of students were muddling the terms antibodies and antigens in their answer to this question about the process of vaccination. There was also some confusion around antibodies and antitoxins, and some suggesting the vaccine itself contained the antibodies. The most commonly achieved mark was mark point 1, although some students forgot to mention that the inactive virus needed to be injected into the body in some way. For MP2, some students failed to gain credit because they referred to the 'body' or 'immune system' producing the antibodies, which was not specific enough. For MP3, most students did not articulate the idea of specificity, just that antibodies were produced more quickly. There was occasionally confusion between white blood cells, lymphocytes and antibodies, with students saying that specific lymphocytes were produced, rather than specific antibodies. For this mark point, correct / specific antibodies could be inferred if it was stated that specific antibodies had been produced for MP2, and that <u>these</u> were produced on

infection. A few students talked about monoclonal antibodies suggesting they may have returned to this question after looking at questions 07.7 and 07.8. Surprisingly, MP4 was the least credited, as most students ended their account at the production of antibodies and failed to make any reference to what the antibodies do. Where there were references to the virus being destroyed / killed, this was equally likely to be in the context of the dead / inactive virus. There were also many references to preventing infection or 'fighting off', 'dealing with', 'tackling the virus' or other similar imprecise statements. There were frequent references to vaccination of a large proportion of the population providing herd immunity.

07.7 Many students were confident in describing the need for the mouse to be injected and understood that lymphocytes are combined with a tumour cell to create a hybridoma, however, many students went on to suggest that the antibodies were fused to the tumour cell, rather than the lymphocytes. The combination of ideas of extraction of lymphocytes and that these must be ones that produce specific antibodies to HIV was less well described. The most challenging part was that these hybridoma cells are then cloned to create many cells, and that it is these cells that produce the monoclonal antibodies. Vague references to 'injecting disease' were occasionally seen. The 'allowed' idea that specific lymphocytes were extracted from someone with HIV was not seen. Another common misconception highlighted by this question was the idea that the hybridoma is the monoclonal antibody. There were some very interesting attempts at spelling hybridoma in student answers.

07.8 Just over 50% of students scored marks on this question, with many not using the figure to scaffold their answer. Several answers referring to the idea of reducing the speed of spread of the virus resulting in less damage to the immune system (and therefore meaning that the patient's own immune system is better able to fight the virus for longer, reducing the chance of the viral load getting high enough to result in AIDs) were seen.

Most students missed mark point 1, and for those who did attempt it, many omitted to reference the idea that the shapes of the antibody and antigen were complementary, rather just giving the key word 'specific'.

There was further evidence of the misconception seen in question 07.7 regarding the hybridoma being given to people as the treatment (rather than isolating the antibodies), or that the hybridoma is the monoclonal antibody.

A number of students made references to the antigen or antigen binding site shape being changed which may be evidence of confusion with enzyme biology. There were also a lot of students describing the antigen being destroyed so that the HIV could not bind to the human cell. A reasonably sized group of students clearly do not understand the process of viral infection and talked about the antigen binding site allowing the human cell to take in the HIV DNA and 'learn it' so that they can produce antibodies to fight it off.

In some responses it appeared that students were identifying the human cell from the figure as a white blood cell which 'remembers' HIV, whilst others mistook the human cell for the monoclonal antibody. For the final mark point, many students thought that it was the monoclonal antibodies which engulfed / destroyed the HIV, or that the antibodies destroyed infected cells once the HIV genetic material had entered. Some thought that it was the human cell, or the antigen binding sites on it, that were doing the engulfing when invaded by HIV.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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