Questions matter

GCSE

Biology

8461/1F

Report on the examination

Version: 1.0
June 2025

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Overall Comment

Throughout the paper, students were able to showcase their AO1 knowledge well, particularly in closed style questions. Strained articulation of language in open questions often saw students unable to be awarded credit, alongside incorrectly following the instructions given, such as 'write one tick per row' or 'tick two boxes'. Many students also did not gain credit in question 04.4, which did not have any answer lines, but required students to draw their answer on the figure.
Students should be encouraged to check that they have answered all questions. A large number of students continue to use the word 'it' in their descriptive answers when it is not always clear to what 'it' refers. Students are encouraged to ensure that they are clear about what they are referring to in such instances, despite this taking more time. Students should also be reminded to use comparative language when requested – describing a value as being 'low' is not the same as it being 'lower' or 'the lowest' and quoting raw data values from graphs or tables to support a conclusion are unlikely to be comparative unless the word 'only' is used to show which value is lower.

As in previous years, common errors / misconceptions seen throughout the paper included reference to energy production (rather than release), carbon dioxide written incorrectly using symbols (for example, CO2 or CO^2) and the statement that in osmosis, water moves down the concentration gradient, from a high concentration to a low concentration.

The mathematical skills tested in this paper were widely understood by most students, and the majority excelled when provided with scaffolding or an equation needed to answer the question. However, a significant number of students neglected to use the equation provided to calculate the rate of photosynthesis or struggled to use the scaffolding provided correctly in the magnification question. Most students could accurately round to the nearest whole number but the determination of how many times greater one number is than another was less well understood. Graph drawing skills were generally strong, with students accurately plotting some difficult points. Lines of best fit remain a source of difficulty for some students, with many joining all of the points, either with a straight line or a wavy curve, or drawing their line through the origin. When asked to complete a calculation using a graph, students should take care to ensure that they have read what is being asked of them carefully, and that they have checked any values read from graphs are free from errors. Surprisingly, a number of students were unable to identify a scatter graph. As in previous series, the conversion of units, for example from millimetres to micrometres, is a skill that many students find difficult at this level, despite the conversion factor being provided.

From the required practical activities covered in this paper, it was clear that most students had gained working knowledge of the osmosis, amylase and pondweed experiments. At this level, however, a number of students found it difficult to apply this knowledge to new contexts, for example, when analysing the colour changes of iodine solution or when looking

at the time taken for pondweed to produce a set number of bubbles (likely the opposite to what they are used to). In these cases, many students disregarded their own knowledge about rates of reactions and stated erroneously that enzymes were denaturing at low temperatures or that rates were low at the optimum temperature. Many students were able to give accurate and detailed descriptions of how the osmosis method could have been improved, however, the majority neglected the command word 'evaluate' and thus could not achieve credit in Level 3. The method for creating a sterile agar plate was less well known and students struggled particularly to achieve the highest level as they had neglected to consider the correct aseptic techniques.

Generally, most students found the answer space provided to be sufficient to structure their answers. However, students should be reminded that if they do use additional pages, all question parts should be numbered accurately. Students who use a word processor for all or part of their answers should also check that each item has been numbered correctly as there were a number of errors noted this year.

Levels of Demand

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

- **Low demand** questions are designed to broadly target grades 1–3.
- **Standard demand** questions are designed to broadly target grades 4–5.

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 (low demand)

01.1 84% of students were able to identify the cytoplasm of the animal cell.

01.2 Just over two thirds of students were able to identify one structure found in the nucleus, with the most common answer seen being DNA. Students should be reminded that at all levels of demand, reference to 'genetic information' is not creditworthy. A small number of students did not read the question properly, giving the function of the nucleus instead.

01.3 Nearly 80% of students answered correctly with the most common incorrect responses being nucleus, cytoplasm or cell membrane, indicating that students had misread the question.

01.4 Nearly 80% of students answered correctly.

01.5 75% of students answered this question correctly, but this question was an example of where ineffective articulation of language was seen, such as 'to impregnate the egg' or

'to ferment the egg by swimming'. Most students who did not gain credit here gave answers that were incomplete or too vague. The function of a sperm cell is more than the function of its flagellum, and so 'to swim' was insufficient. Other answers which were unable to gain credit included 'for reproduction' or 'to make a baby'. Similarly, reference to DNA / genetic material required the additional qualification of provision 'for the egg' or 'from the male' and, without this, the mark could not be awarded. Some responses referred only to the adaptations of the sperm cell. Although correct, adaptations alone were insufficient. Occasionally, students misread the question and answered in terms of 'stem cells', and confusion between 'egg cell' and 'embryo' was sometimes seen.

01.6 70% of students scored full marks in this question, however, a small number drew more than one line from a box on the left. The most common incorrect answer was a line connecting xylem to fungi. Students should be advised to make very clear any changes they may decide to make in their answers - ambiguous responses gain no credit.

01.7 50% of students scored full marks in this question, with a further 40% scoring one mark.

01.8 Students found this question quite challenging with only 35% scoring full marks, and around a third scoring one mark. Students were required to apply their knowledge in a slightly different context than usual. Gas exchange is, perhaps, most frequently considered in the lungs and this may have led some students to answer in terms of carbon dioxide going out from the blood and oxygen going into it. The idea that water might move anywhere other than from the soil into root hair cells added to the general level of uncertainty. Students were specifically asked to tick the selected boxes, but they occasionally wrote words instead, and these were usually impossible to interpret.

Question 2 (low demand)

02.1 Two thirds of students were able to correctly identify the independent variable.

02.2 77% of students scored full marks in this question. The most frequently seen errors were nitrogen for MP1 and cellulose for MP2.

02.3 A third of students scored 2 marks, a third 1 mark and a third zero marks in this question. Many students did not realise that the data recorded was the time taken to release 10 bubbles, rather than the number of bubbles released in a set time. A significant proportion of students, therefore, struggled to articulate their ideas, with a lot of confusion over time and speed seen. Answers given, therefore, incorrectly described an increase followed by a decrease. Many gained MP1 but fewer went on to match MP2. They referred, instead, to the overall decrease up to 60 °C rather than giving consideration to the 'describe' command word which encompassed the whole span of the investigation. Credit was given for correct references to rate, rather than directly to time itself, but answers such as 'it gets quicker or slower' were too vague. Mention of an optimum temperature without any other information about time taken

before or after this value was insufficient. Explanations were not asked for in this question.

02.4 Nearly 60% of students scored full marks in this question, but of the 20% awarded zero marks, the most common incorrect response seen was to use 50 as the numerator, despite the equation being given in the question. Common errors included:

- giving a final answer of 0.30 or 0.3 with a dot to indicate a recurring number, in which case a maximum of 2 marks was considered.
- use of a time from a temperature other than 50 °C, in which case a maximum of 1 mark was given if the correctly calculated value was rounded to 1dp.
- incorrect calculation of a correct substitution (10÷33) giving an answer of 3.3, in which case a maximum of 1 mark was given for MP1.
- use of the figure for temperature, 50 °C, instead of 33 in the equation, in which case no marks were awarded.

02.5 74% of students achieved the mark in this question.

02.6 Three quarters of students achieved the mark in this question.

02.7 Nearly 70% of students scored full marks in this question, with a further 26% scoring one mark.

Question 3 (low demand)

03.1 85% of students scored both marks in this question. The most commonly seen error was confusion between antitoxins and antibiotics.

03.2 Over half of all students scored full marks in this question, with the next most common mark being 3, indicating that the majority of students found this question easy to access. Guidance was provided through the use of scaffolding for each of the steps involved and this allowed many students to access at least 3 marks. A mistake made in one step did not necessarily preclude credit being awarded elsewhere. Common errors included:

- incorrect measurements of the white blood cell, giving answers in cm or inches, or referring to the vertical line rather than to the horizontal line for width.
- incorrectly carrying out the conversion by dividing, rather than multiplying, by 1000
- incorrectly transferring numbers from one step to another by omitting or adding zeros
- using the original pre-conversion width, rather than the calculated one in micrometres, in the final substitution.

03.3 Just under half of all students were able to identify the capillary shown in the figure.

03.4 Although some students had a clear appreciation of why arteries needed to have thick walls, many (40%) were unable to gain even one mark here. The reasons behind this reflected both a lack of understanding and ineffective expression. MP1 required reference to high pressure, i.e. the conditions that made thick walls essential, and not just to 'pressure' without qualification that the pressure was 'high'. References to volume, rate of flow, direction of flow or the concentration of blood were also not creditworthy. To achieve MP2, responses then had to go on further, with an explanation of what the thick walls allowed or prevented. Responses that did not gain credit here were either:

- too vague, such as 'to stop damage', 'to prevent bleeding' or 'to keep the blood inside'.
- incorrect, such as 'to pump blood around', 'stop backflow' or 'protect from pathogens'.

03.5 10% of students did not attempt this question and a further 60% did not score credit. Many misinterpreted what was being asked for and answered in terms of risk factors, such as 'smoking', outcomes such as 'reduced blood flow' or treatments such as 'stents'. In some cases, responses were too vague to be creditworthy, such as 'blockages occur'. Incorrect answers included 'muscles in the walls contract', 'they shrink' or 'fatty acids build up'.

03.6 Many students gave answers which matched MP1 but fewer gained MP2 and as such, 50% of students scored one mark, with a further 15% scoring two marks. Responses such as 'it will create a blockage', 'it can lead to a reduction (or increase) in blood pressure', 'it causes blood to clot', 'it leads to blood flowing backwards' or 'the vessels are more likely to burst' were either insufficient or incorrect and gained no credit.
A significant number of students gained the fall-back mark by referring to the idea of the narrowed arteries leading to a heart attack.

03.7 Nearly half of all students scored full marks in this question, with the most common being a link between 'high blood cholesterol' and 'antibiotics'. The majority of students correctly associated 'heart failure' with 'heart transplant'.

03.8 Nearly three quarters of students gained credit in this question. Responses which were unable to gain credit included 'it cannot be treated', 'it is caused by the build-up of plaque', 'it has symptoms which are not easy to see' and 'it happens inside the body'.

Question 4 (low and standard demand)

04.1 This was a levelled, extended response question based on a required practical. Students were asked to describe a method to grow bacteria on a sterile agar plate. Around 20% of responses were awarded a mark within Level 3, 50% in Level 2 and 15% in Level 1. Students achieving Level 1 gave one or more appropriate points from the indicative content, but these were insufficient to allow a valid outcome to their method.

To enter Level 2, students had to make clear how an agar plate could be prepared to grow a sample of bacteria. This was the minimum requirement to match the Level 2 descriptor of 'identifying most steps in the method'.
To enter Level 3, students had to go further and give examples of aseptic techniques; by doing this, they were able to fulfil the other requirements of the question, including preparing a plate that was 'sterile' and growing a sample of 'uncontaminated' bacteria. Those students who matched the Level 3 criteria generally showed excellent knowledge and understanding of the steps involved. Their descriptions were detailed and appropriately sequenced. The responses of many students, however, remained in Level 2. They appreciated the fundamental steps of preparing and inoculating a plate but struggled to give clear mention of the aseptic techniques that should be followed. Reference to heating the inoculating loop (or some other, identifiable, description) was frequently seen but, without further points, Level 3 was not achievable. Other indicative content was often hinted at but was too vague to be considered. So, answers such as 'other bacteria from the air should be prevented from entering the plate', 'the rod should be sterilised' or 'the bench should be cleaned' were all insufficient as they did not describe how these steps should actually be carried out.

Fewer answers remained in Level 1 and those that did were either very limited in content or made confused comments such as using the Bunsen burner to heat the plate after bacteria had been added. The statements students make in these extended response questions do not need to be long or complex and it is never necessary to include all the points listed in the indicative content on the mark scheme to achieve the highest level. Neither do responses have to be written in complete sentences - succinct bullet points often suffice and may even help students to organise their ideas more effectively. As is always the case with extended response questions, however, answers are considered holistically and always in a positive framework. It was pleasing here to see some students entering Level 3 and achieving high marks.

04.2 Few students (just under 10%) gave a correct answer to this question. The reference to temperature triggered lines of thought which were inappropriate and gained no credit such as:

- a higher temperature could lead to faster growth of bacteria and this could be dangerous.
- a higher temperature might be too high and cause the bacteria to be killed / enzymes to be denatured / the antibiotics not to work.
- a higher temperature might cause the agar to melt.

Answers which suggested that the higher temperature might cause the bacteria to 'become' dangerous were also not creditworthy.

04.3 65% of students were able to identify the purpose of the control disc in the investigation.

04.4 Some students struggled to appreciate that the *difference* in the effectiveness of each antibiotic had to be reflected in their answers and simply drew rings, as requested, around A and C but without any distinctions at all. Others gave a smaller ring around A

but a larger one around C. Many, however, clearly understood this RPA and gave clear and correct answers. Students should be encouraged to use a pencil, at least in the first instance, when answering questions involving drawing. Answers often showed that students had changed their minds but were unable to erase and correct a first attempt. It was, therefore, difficult for examiners to appreciate their final intentions. Over 11% of students did not attempt this question and students are encouraged to check that all questions have been answered, particularly where no answer lines are provided.

Question 5 (low and standard demand)

05.1 77% of students achieved 2 marks in this question.

05.2 71% of students were able to identify the lungs as the site of gas exchange in humans. A wide range of other suggested organs was also seen, for which credit was not awarded. Students should be reminded of the list rule as stated in section 3.1 at the start of the mark scheme; an answer of 'lungs and heart' would score no credit in this question.

05.3 65% of students scored full marks in this question, with a further 30% achieving one mark.

05.4 Just over half of all students gained full credit in this question, with a minority achieving 2 marks as they neglected to give the final rounded figure. One mark was awarded for a division where the numerator and denominator were reversed but where correct rounding, in this case to 1, was evident. The most frequent error was to subtract 484 from 944 with a final response of 460. Students occasionally made simple mistakes when copying down the figures from the question. 33% of students scored no credit at all.

05.5 Nearly 60% of students scored full marks in this question, with over a third scoring zero. Of the incorrect answers seen, the majority had the correct words, but in the wrong position in the equation.

05.6 The most common mark awarded in this question was 1 (with over 40% of students scoring this mark), with less than 3% scoring full marks and 30% scoring zero. In the majority of responses, a lack of understanding of respiration was noted, and confusion between breathing and respiration was common. Common incorrect ideas were that 'more oxygen will be needed so the fish respires more', 'more respiration happens because the oxygen debt has to be repaid' or 'during swimming, more water moves over the gills, so more oxygen gets in as the fish respires'. Other answers suggested an increased rate of respiration was due to the 'heart beating faster'. Reference to 'swimming' (as given in the question) gained no additional credit unless there was reference to 'movement' or 'muscle' involvement. Students continue to write about energy in incorrect contexts and credit was not awarded for responses suggesting that energy was being 'produced' or being 'used for respiration'.

Question 6 (standard demand)

06.1 Over 40% of students gained credit for the answer of 'virus' here but there were, equally, many incorrect responses of 'bacteria' (around 45%). Other incorrect suggestions included 'vector', 'antitoxin', 'airborne', 'infectious', and 'fungi' and 'protists'. A surprisingly large number of students (15%) did not give any answer at all.

06.2 Nearly 40% of students correctly stated how measles could be spread, but a higher number (nearly 60%) referred, more vaguely, to 'direct contact' or 'through the air', neither of which gained credit. A few incorrectly believed that measles is a sexually transmitted disease.

06.3 Although 'willow' appeared in answers with reasonable frequency (35%), many students (45%) did not achieve this quite straightforward mark. A wide range of suggestions was evident with 'foxglove' perhaps being the most common incorrect example. A high proportion (over 17%) of students, sadly, did not attempt the question.

06.4 Nearly 70% of students achieved the mark in this question owing to the wide range of symptoms listed in the mark scheme. Occasional incorrect suggestions (25%) were made such as 'vomiting' or 'black spots'. Vague, unqualified responses such as 'temperature', 'feeling unwell' and 'changed skin colour' could not be credited.

06.5 Although students found this question accessible, very few (2%) managed to gain both marks, with 20% gaining 1 mark. Many simply answered in terms of what happens in the body as a result of vaccination. Others focused on 'children' in particular being vaccinated, referring to the ease of pathogen transfer from one child to another due to frequent close contact or to limited appreciation of hygiene. A number of answers included incorrect suggestions such as 'when the vaccinated children become adults they will have gained progressively increased immunity', 'they will be able to pass on their own immunity to their children' or 'they will then be unable to genetically pass measles on to the next generation'. MP1 was gained by a significant number through correctly referring to 'herd immunity' but many could not be awarded the mark by saying that 'fewer people would catch the disease', rather than 'have' it at any one particular time. MP2 required the idea of reduced likelihood, chance or probability of measles being spread and not a simple rewrite of the question in terms of 'therefore spread would be reduced'.

06.6 Several steps were involved in this question. Students were required to select data for unvaccinated children with severe measles and then use this percentage to calculate how many children this represented out of the total of 240. Although 55% of responses gained all 3 marks, common errors were seen. These included:

- calculations which used data for all bars
- incorrect choices from Figure 9
- mistakes in reading from the graph, for example, 55 instead of 45.

In all these instances, no credit could be awarded. Answers which showed errors in converting 45% to the actual number of children, such as 45÷240 or 240÷45, could only achieve MP1.

06.7 It was pleasing to see that students were not daunted by this question and that many made good attempts at answering. To do so, they had to appreciate exactly what the data in Figure 9 showed; the percentages of vaccinated and unvaccinated children who all had measles, and the degree of severity of these cases. The data did not show information about the likelihood of the children catching measles in the first place. Based on this information, students were required to say why the data supported all children being given a vaccination and to back up their statement with numerical evidence from Figure 9. This evidence did not need to be processed in any way to gain credit. Answers which matched both marks (17%) had to be clearly comparative, had to consider the severity of infection and had to give appropriate and accurate figures in support. Responses such as 'fewer vaccinated children had severe measles shown by there being 7 compared to 108 who had not been vaccinated', or, even more succinctly, '45% of unvaccinated children had a severe infection but only 3% of those who were vaccinated did', both gained full credit. Answers awarded only 1 mark (22%) often did not give comparative data or any data at all, despite the question asking for it. When student responses matched neither marking point (54%), it was usually because they referred to the value of vaccination only as a means of reducing the chance of getting measles in the first place.

Question 7 (standard demand)

07.1 Half of all students gave a creditworthy answer to this question, very often by referring to heart disease. Heart failure or heart problems were considered too vague and were unable to gain credit. The most frequently seen error was one of omission when students simply suggested diabetes without the qualification of 'Type 2'.

07.2 Over 50% of students gained at least 3 marks in this question. MP1 was occasionally missed due to labelling the axis with 'y' only, omitting to include 'arbitrary units' or the use of an incorrect scale. Gaining credit for correct plots was a little more challenging but, with the allowed tolerance, the majority of students were awarded at least 1 mark. It was occasionally difficult to see which points were chosen because they were either far too small or concealed by a very thick line of best fit. Students should ideally be advised to give clear crosses for plotted points and to draw graphs in pencil so that alterations can be made without ambiguity. MP4 was usually awarded for a straight line which went through/between the majority of plotted points, regardless of whether some of these had been incorrect. The most common error was to draw the straight line of best fit through the origin. It was rare to see students drawing straight lines between individual points but, where this alone was given, they were unable to achieve MP4.

07.3 Just over 50% of students answered this question correctly. Responses which could not gain credit included 'dot', 'line' or 'relationship graph', or references to conclusions in respect of correlations shown.

07.4 80% of students gained credit in this question.

07.5 Nearly 60% of students found this question difficult and did not pick up any marks. A lack of acknowledgement of the command word (explain) meant that a large number of answers were seen that simply restated the results in terms of the colour of the iodine solution without any attempt at an explanation. Many students confused the results they were seeing when attempting to explain why the colour changes had happened - a significant number read that the starting colour of iodine solution was yellow-brown and then, noting that the only result showing this same colour was at 30 °C, went on to suggest that at this temperature, there had either been no reaction at all or that the result was anomalous. Other errors included:

- the iodine test showing the presence or absence of both starch and sugars.
- amylase, rather than starch, being broken down.
- denaturation occurring at 30 °C
- iodine solution being responsible for any breakdown that occurred.

Vague suggestions that 'temperature affected amylase' or that at 90 °C 'amylase did not work', with no reference to starch or to denaturation, gained no credit.

07.6 Just over 30% of students gained credit in this question.

07.7 Nearly 10% of students scored full marks in this question, with nearly 30% scoring one mark, most commonly MP1. A wide range of answers was seen, covering organs outside the digestive system as well as within it. A substantial number of students gave the answers the wrong way around and the 'pancreas' was often chosen mistakenly in the context of being a site of production, rather than activity of, protease enzymes. Unqualified references to 'intestine' were frequently seen but were not credited.

Question 8 (standard demand)

08.1 This was a levelled, extended response question based on a required practical. Students were asked to evaluate a given method to investigate osmosis in pieces of potato.
Students achieving Level 1 (35%) made very few relevant points. Students achieving Level 2 (33%) suggested further improvements to the method and often gave reasons as to why these might be required, but judgements were always incomplete.
Students achieving Level 3 (1%) made full use of the command word 'evaluate' and considered both strengths and weaknesses of the method in addition to indicating the ways it could be improved.
Few students gave responses which allowed them to match the Level 3 requirements. Most omitted any consideration of strengths, so their judgements were incomplete. Many, nevertheless, seemed confident in their attempts at answers and this was pleasing to see.
The question asked for ways to improve the validity of results, and these needed to be clear. Discussion of controlled variables such as size, time and volume required quantification, or clarification that they needed to be the same or specific on each

occasion, rather than just 'similar', 'recorded' or 'precise'. A large number of students suggested that the mass of the cubes should be kept the same, but this was neither plausible, nor required.
The use of specific pieces of equipment only gained credit if they were linked to clear improvements to validity. Several responses referred to the use of a cork borer to obtain cylinders of potato but then neglected to add anything about the control of size; others suggested the use of stop watches but with no link to control of time.
Points which were frequently seen from the indicative content included drying the cubes before measuring mass, repeats and calculation of mean values and the use of more, different concentrations. Some students focused on aspects such as safety considerations, tables of results, graphs or explanations of osmosis. These were not appropriate additions to an evaluation, which asked for ways to improve the validity of results. Discussion of a 'wider range' of concentrations was only relevant if mention was made of 'more than 3' values within it.

08.2 23% of students scored the mark in this question.

08.3 This question asked for one way in which active transport differs from osmosis. It was most easily answered by one clear, distinctive point about active transport being given, without any further mention of osmosis. 33% of students achieved the mark in this question.

The most common correct answer seen was BP1, relating to energy. BP2 was more problematic, as answers often showed confusion in understanding. Some students gave the correct description of active transport being movement from low to high concentration but then continued to make an incorrect statement about osmosis; others gave incorrect descriptions of active transport in the first place. The following examples did not gain credit:

- 'active transport goes from low to high concentration, but osmosis goes from high to low'.
- 'active transport goes down a concentration gradient'.
- 'active transport goes from a high concentration gradient to a low concentration gradient'.

Other answers were not necessarily incorrect but lacked the further detail or qualification required to warrant the mark. These included 'active transport goes along (or across) the concentration gradient' or 'active transport goes from low to high'.
Fewer students referred to the ideas in BP3 and answers which could not gain credit were either incomplete or incorrect. They included those which:

- discussed the vague 'involvement' of minerals rather than their 'transport' or 'movement'.
- stated that 'molecules' or 'substances' were transported rather than, or as well as, water.
- suggested that 'water' was 'actively', rather than passively, transported.

Some students mistakenly thought that active transport happened in both directions whereas osmosis was only one-way. References to partially permeable membranes and to the speed of movement were not, on their own, creditworthy.

Mark Ranges and Award of Grades

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