AQA

AS LEVEL
BIOLOGY

7401/1 Paper 1
Report on the Examination

7401/1
June 2023

Version: 1.0

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General comments

Students accessed all of the questions and completed the paper in sufficient time. Only a few students required extra space. There was a wide range of responses to questions testing AO1, AO2 and AO3 skills. Similarly, there were some excellent responses to questions that tested practical and mathematical skills.

Key definitions and concepts were clearly understood by the strongest students, but weaker students struggled to state terminology to AS level standard even with straightforward definitions that appear in the specification.

Questions contain information which needs to be carefully considered and incorporated into an answer. Where images, diagrams, tables and graphs appear these must be studied carefully. Students are reminded to develop answers and take note of the command words and instructions in the question.

Question 1

01.1 This question asked for a straightforward definition of primary structure. Students are reminded to give a full answer and use concise terminology, even for a straightforward AO1 question. Some students described a chain of amino acids rather than an order or sequence. Occasionally, students confused the idea with a DNA base sequence and so described an amino acid base sequence.

01.2 This question asked for three definitions of specification terms.
Some students could correctly relate either codons or triplets to the terms ‘universal’, ‘non-overlapping’ and ‘degenerate’. Weaker students discussed base sequences or individual bases rather than the codons or triplets.
To define ‘universal’, some students wrote that the genetic code was the same in all organisms, rather than the same codon/triplet codes for the same amino acid in all organisms. Once again, students are reminded to give full answers in order to clearly explain their meaning.

Question 2

02.1 It was pleasing that many students could correctly determine that a eukaryotic cell would contain its DNA in a membrane-bound nucleus, unlike the diagram in Figure 1 in which the DNA was free. Marking point 1 was commonly seen, marking point 2 was also seen although marking point 3 was very rarely seen. Some students did not read the question properly and went on to describe differences between prokaryotic and eukaryotic DNA or to describe general organelles that would be present in a eukaryotic cell.

02.2 This was a well answered question. Students gave the full range of correct answers of the structural differences between DNA in a prokaryotic and a eukaryotic cell. A misconception is that DNA is single-stranded in a prokaryote and double-stranded in a eukaryote.

02.3 This question was an excellent discriminator. There were some excellent responses in which students described inspiration in detail, referring to how movements of the external intercostal muscles and diaphragm affect the volume and pressure in the thoracic cavity. Some students failed to gain marks because they did not fully describe the mechanism. For example, they would write that the diaphragm contracted but then did not state this made it flat/pulled it down. Weaker answers described the pathway that air would take, rather than describing what caused the air to move in.

02.4 This question proved more challenging and marking point 2 was rarely seen. It was encouraging that students could correctly infer that a thicker capsule would decrease the binding of the phagocytes to the murein in the cell wall, correctly using the material in the stem of the question. However, few went on to write that this would reduce phagocytosis and so the bacteria would continue to divide.

Question 3

03.1 No doubt students are not very familiar with the structure of a fatty acid. It proved very difficult for most students to identify the R group from the diagram. There were lots of different parts of the diagram that were identified as the R group across the range of student responses. Many students had no idea about the R group of the fatty acid. Surprisingly, few were able to gain the mark.

03.2 This was a well answered question. Students were able to correctly use Figure 3 and state two clear differences between the triglyceride shown and a phospholipid. Here is an example of using the information in the figure that named and showed the position of the ester bonds and fatty acids in the triglyceride. Students are reminded to use comparative answers to explain differences, and many did so. A common misconception here was that phospholipids contain phosphodiester bonds. Some students referred to the phosphate group as a phosphorus group.

03.3 Many students can appreciate that a phospholipid has a hydrophobic and a hydrophilic region, but fewer could then appreciate that a triglyceride only has a hydrophobic region. Some students incorrectly identified the phosphate group as hydrophobic or did not relate the hydrophilic or phosphate group attracting to water and so did not access full marks for the question.

03.4 It was pleasing that about 25% of students were able to score full marks on this question, correctly relating the structure of the two fatty acids to changes in membrane fluidity using the data from Table 1. Some students did misidentify which fatty acid was saturated or unsaturated. Others gave lengthy descriptions of how cholesterol affects membrane fluidity, rather than using the information in the question. This illustrated the importance of using all of the information in the question to explain why the fluidity of the membrane was higher after 4 months.

Question 4

04.1 The problems encountered in this question included realising that the radius is half the diameter and converting millimetres into micrometres. Also, the ‘times greater’ part of the question was occasionally given as a fraction or a ratio, or occasionally not written on the answer line. However, although about half of the students did manage to score at least 2 marks out of 3, even straightforward mathematics proved a challenge for some.

04.2 Students are familiar with seeing electron micrographs in examination questions. This question asked students to focus on one feature in the image; many failed to do this. Where students did identify a feature from the image, a nucleus or mitochondrion was mentioned, which negated marking point 1 as a nucleus or mitochondrion would be visible with an optical microscope too. Marking point 2 was seen more frequently; nevertheless many answers were not relevant to the question. These included that the image lacked colour or was in black and white, electron beams have shorter wavelengths than light or that the magnification was higher using an electron microscope.

04.3 Over half of students could identify a correct role of a helper T cell. The full range of the different marking points was seen.

04.4 This question proved very challenging as students did not give full answers. Marking point 1 was successfully awarded to responses that included the principle of the anticodon on the tRNA binding to the codon on the mRNA. This is a fundamental idea behind translation. There were general descriptions of complementary base pairing but the binding idea was important. Marking point 2 was seen much less frequently as it was necessary to appreciate that tRNA carries a specific amino acid rather than just carrying 'an amino acid'. This level of detail is required at AS level. Overall, lots of descriptions were essentially correct. However, students failed to include *binding* between anticodon and codon and the *specificity* of the amino acid in order to score both marks.

Question 5

05.1 Many students were able to calculate the surface area and volume of the two blocks. Some found shape D more difficult than shape C and so incurred an error. Many were able to correctly express a surface area to volume ratio in the format *x*:1 as presented in the table. One source of error was when students divided volume by surface area rather than the other way round.

05.2 The most common incorrect answer was 2940, as students included 1200 when calculating a mean from all four values in the table. Others realised the value for block 2 should be omitted and re-calculated a mean using only the other three values, giving the correct answer of 3520. The Practical Handbook (filestore.aqa.org.uk/resources/biology/AQA-7401-7402-PHBK.PDF) gives information about dealing with anomalous results. Anomalous results should be ignored where results are expected to be the same (for example, when repeat readings are taken).

05.3 Following on from 05.2, it was pleasing to see that some students fully appreciated that it is best practice whenever an anomalous result is identified for the experiment to be repeated. To gain credit for this question it was necessary for students not just to state 'repeat', but to state 'repeat with an undamaged block' or 'repeat with a new block that was shape C'. Too often students just give the lowest possible answer ('repeat') which fails to score a mark.

05.4 Stating the variables that should be controlled in an investigation is a fundamental test of practical skills. The best students gave full answers that were clear, such as 'same concentration of acid' rather than just 'same acid' or 'same type of agar' rather than just 'same agar'. Others just stated 'same pH' without stipulating whether they meant the pH of the acid solution or pH of the block. Many could correctly identify the temperature as one control variable but could only score the available mark if they correctly identified another variable. As shape was the independent variable, it was surprising how many students stated shape, mass or volume of blocks as a control variable, which were all ignored. 'Volume of acid' was also seen which was also ignored as the blocks just had to be submerged.

05.5 In order to gain full marks, students had to relate their answer to the context of larger organisms as stated in the question. It was also important that students appreciated that gas exchange involves diffusion. Some erroneously included active transport. It was disappointing that some students do not appreciate what a single-celled organism is. Very worryingly, a number of students stated that an insect is a single-celled organism and gave detailed accounts of gas exchange in the insect tracheal system and then went on to compare this to a mammal. Other errors included confusing whether large or small organisms had a large or small surface area to volume ratio. Nevertheless, about a quarter of students scored full marks on this question.

Question 6

06.1 Nearly half of students correctly identified that a human papilloma virus contains a capsid and attachment protein. Students should appreciate that only retroviruses contain reverse transcriptase, that bacteria rather than viruses contain a capsule, and that human papilloma viruses do not have a cell-surface membrane.

06.2 Students had to choose two enzymes involved in DNA replication and then to describe them. Many enzymes were suggested other than those on the mark scheme, RNA polymerase and reverse transcriptase being the most common. When DNA helicase was correctly stated, students discussed that it unwinds or unzips the DNA strands but did not go on to include the breaking of hydrogen bonds. The role of DNA polymerase was less well understood than DNA helicase. Some students think that DNA polymerase forms ester bonds rather than phosphodiester bonds. Others thought DNA polymerase is involved in complementary base pairing or even joining DNA strands together rather than joining adjacent DNA nucleotides together.

06.3 Over half of the students gained the mark for uncontrolled cell cycle/division/mitosis. One error was that cell division in cancer was faster rather than uncontrolled.

06.4 The full mark range was seen to this question. Students demonstrated many misconceptions and errors. These included the following: “boys should not be given the HPV vaccine, just girls, as it doesn’t affect boys”; “boys (and girls) should not be given the vaccine at age 10 to 12 years as they are not sexually active but should be given it when they are older”; “herd immunity could be achieved without vaccinating any boys”; “the vaccine was not 100% effective and so should not be used”.
In order to gain full marks, students had to provide arguments for and against as this was an evaluation question. Many students were totally against the vaccine and struggled to articulate a balanced approach that used the information they were given in the question stem.

Question 7

07.1 Definitions for species richness were better articulated than those for index of diversity. Where the index of diversity equation was stated it was not fully explained. Students need to have more practice in expressing index of diversity. Errors included ‘species richness is the number of species in a population’ or ‘the variety of alleles in a community’.
Standard deviations and their overlap is a common concept in AS examinations. Students have to really express their ideas clearly in order to gain marks. Some students still get confused if the standard deviations overlap as to whether the difference is significant or not. Students still state that if standard deviations overlap the *results* are not significant or are due to chance.

07.2 This question was very poorly answered. Most students indicated that better technology was responsible without indicating what this involved. Many suggested that improved electron microscopy was responsible or an improved ability to replicate more appropriate conditions in the laboratory. Closer suggestions included that genetic/DNA technology/hybridisation were involved. Investigating the frequency of alleles was also seen. Only the discerning few demonstrated any knowledge of DNA/genome/RNA/amino acid sequencing. Of these students, very few expressed the idea that this had led to the discovery/identification/study of more prokaryotic species. It was as if students considered this almost a ‘given’ statement in their response without the need to state it explicitly.

07.3 Students struggled with this question. The command word ‘evaluate’ required students to make a judgement from the available evidence. Students were able to extract relevant data from Table 4, but they were unable to reach a judgement (explain the significance) of the difference

noted between the two farming methods. For example, many identified that farming method 2 provided a reduced yield, suggesting that this provided evidence of greater emphasis on conservation than farming. These students failed to make the link that this would generate less food or less profit, demonstrating a lack of understanding of the primary purpose of farming. Only a small number of students established this link.

Many identified that method 2 had more carbon stored. These students suggested that this was a positive feature for conservation. Some further indicated that this would reduce the 'greenhouse effect', but they failed to develop the response to indicate that this would lead to a reduction in CO_2 in the atmosphere, the result of more carbon being stored.
When and if they recognised that species richness was higher in method 2, their response wasn't developed any further. This was also true if they recognised that the prokaryotic biomass was greater.

Students were able to appreciate that species richness, prokaryotic biomass and carbon storage were all important indicators of conservation. However, many students failed to include all three sets of data when establishing that method 2 was more focussed on conservation than farming. All too often students were distracted by the values for wheat yield.

Question 8

08.1 This question proved a challenge. Unfortunately, many students thought the root tips were placed in acid to increase the rate of mitosis/division, neutralise the root (pH), kill bacteria/pathogens or generally sterilise the tissue/root, denature enzymes or break down the cell membrane. Only about a third of students gained the mark, most of these writing either to break down cell walls or to stop mitosis.

08.2 Most students gained two marks for writing 'wear goggles' and 'wear gloves'. Marking point 3 was poorly expressed. Students would write 'clear up the spill' or 'use more dilute acid' rather than add water to the spill. Marking point 4 was hardly ever seen.

08.3 Students need to practise writing a null hypothesis. Students should have learnt that a null hypothesis usually takes the format of 'there is no difference between the samples being studied', in this case using the information in the stem of the question.
It is pleasing that many students appreciate that when comparing means the t-test is the most appropriate statistical test to choose. However, the correlation coefficient and chi-squared test were also suggested. Students are reminded that standard deviation is not a statistical test.

08.4 Less than a quarter of students scored both marks for this question. The main problems included not converting between mm and μm, not rounding correctly and not dividing correctly. These are fundamental maths skills that students need to practise.

Question 9

09.1 This question was a good discriminator. Students who performed well successfully realised the key processes behind how a pressure gradient is formed in a leaf. Many students realised the importance of sucrose moving into the phloem but they needed to state it was by co-transport or active transport. There were some excellent answers that went on to explain the reduction in water potential and subsequent entering of water by osmosis. However, general responses such as 'sucrose affecting the water potential' or 'water just entering' caused students to miss gaining marks. Poor responses often included a re-wording of the question, such as "sucrose enters the leaf, causing a pressure gradient forcing sucrose down to the root".

09.2 This question was poorly answered. Students needed to appreciate the effect of a reduced number of sucrose transporter proteins on sucrose loading at the source and the effect of this at the sink. Precise locations were needed. Furthermore, students often failed to state how sugars are produced by photosynthesis.

09.3 Many students were able to make the link between glucose uptake and respiration, indicating more respiration happening or the rate being faster. Most responses ended at this point. Students who developed their response further linked respiration to the idea of energy release, but failed to specify ATP. When ATP was involved, it was not always immediately evident that more ATP was used. ATP was regularly linked to exercise, work, movement, or use by muscles. Only a limited number of students were sufficiently precise in relating ATP to muscle contraction. Some did, however, link ATP to active transport.

It was only the discerning few who could extract relevant material from the passage, discussing the formation of a concentration gradient or the increased number of transporter proteins and, hence, the facilitated diffusion. A good proportion only discussed movement of the transporter proteins, not their increasing number.

09.4 About 36% of students identified the correct response.

Mark Ranges and Award of Grades

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