A-LEVEL
BIOLOGY

7402/1: Paper 1
Report on the Examination

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General Comments

An attempt was made this year to reduce the amount of reading, whilst still providing clear explanations of the novel contexts in which the questions were set. This resulted in less evidence of students running out of time.

There was also an attempt to balance the number of answer lines provided, to reduce the need for students to write on additional pages but not feel they had written less than was required. The labelling of answer lines with '[Extra space]' was used more widely to indicate to students that they were not expected to fill all the answer lines.

Question 1

1.1 It was hoped that this question would be a 'friendly' introduction to the paper and so it proved, with over half the students scoring full marks. It was pleasing to see that so many of them were able to use the correct scientific terminology to describe and explain the action of a non-competitive inhibitor. Many students used the phrase 'allosteric site', although this is not a specification term, but others were able to describe this. There was some evidence of students possibly describing their textbook diagram of a non-competitive inhibitor by suggesting that the attachment site was at the side of the active site; this was not credited. The phrasing of the responses from some students who used the word complementary or the phrase 'complementary substrate' suggested they had rote learnt this without really understanding what the word meant.

1.2 Approximately one third of students knew how to apply their knowledge of non-competitive inhibitors to this graph and did so clearly and concisely. Many students did not refer to the substrate/lipid concentration shown on the x-axis of the graph, some suggesting the graph showed changes over time.

1.3 Fewer than 10% of students achieved both marks here. The maximum length was more often successfully calculated but it was disappointing that this simple maths skill (MS 1.8) was only achieved by approximately half the students. The concept and calculation of uncertainty (MS 1.11) is new to this specification but is clearly still unfamiliar territory to many students. We recommend making use of Section L of the practical handbook as this has definitions and examples of uncertainty calculations. The practical handbook is available on the AQA website at https://filestore.aqa.org.uk/resources/biology/AQA-7401-7402-PHBK.PDF.

1.4 There was some confusion about the action of bile salts, with students describing digestion into fatty acids and glycerol, although the process of emulsification was well described by many. However, fewer students were then able to explain why the products of emulsification could not be seen with the optical microscope. Many simply stated that the products were too small but were not able to explain why they could not be seen. It was not uncommon to see that the magnification of the optical microscope was described as insufficient, rather than its resolution.

Question 2

2.1 This question was a straightforward test of recall of section 3.2.1 (Cell Structure) from the specification.

2.2 This was a difficult graph for students to interpret successfully in the context of the question. Many did not take on board the idea of increasing the fibre intake by 10 g and simply described the data. Students found it difficult to interpret the standard deviation when displayed as lines, as here, rather than error bars with which they would be more familiar.

2.3 This question was designed to test students' knowledge of experimental design (PS 2.1) and their appreciation of considerations required to obtain valid data. Many students started their answers along the lines required by the mark points but did not complete their response with an A-level explanation of the impact their idea would have on the data they obtained; for example 'collect a larger sample' or 'can't remember what they ate'.

Question 3

3.1 Approximately two-thirds of students could answer this test of AO1 skills from section 3.4.6 of the specification. Students should take care when using the word 'amount'; it is rarely acceptable at A-level, and in this case 'amount of each species' was not credited.

3.2 It was pleasing that many students showed a good understanding here, enabling most to gain at least one mark with approximately one third getting both marks. Those who did not achieve any marks on this question tended to focus on the idea of fairness, eg using the same equipment or the same area of sampling, or made references to repeating without giving an idea of magnitude. It was also common for students to suggest doing repeats at different times of day/in different seasons. The idea of sample size was somewhat variable here, with a minority of students discussing 3 repeats or several repeats.

3.3 This question asked about the use of larger fields, but many students focused solely on removal of hedges. Teachers are encouraged to reinforce with their students that in questions which refer to a figure (table/graph), the figure must be used as a basis on which to form an answer. Many students gave very detailed suggestions to explain why the biodiversity might have decreased, including explanations centred on fewer niches, monoculture or increased competition, but did not make use of Figure 4 in these answers, as was required by the question stem.

3.4 Although students are not expected to have detailed knowledge of farming, the specification requires an understanding of the balance between conservation and farming (3.4.6) and this was the focus of this question. Many students obtained one mark, which was generally for MP2 alternative one, which linked reduced area to reduced crop production/reduced income. Whilst there were some excellent answers credited with two marks, including valid suggestions beyond the mark scheme, relatively few students were able to articulate an advantage to the farmer for MP1. Most students commonly described an ecological advantage of biodiversity increasing or there being more habitats/niches, but could not follow it up with an explanation linked to the benefit to the farmer.

Question 4

4.1 As with the question about selective breeding in 2018, it was disappointing that so few students could use the principles of natural selection to explain stabilising selection here. Less than 20% of students could start to explain how alleles would be passed on and how this would affect allele frequency.

4.2 This recall (with minimal application of knowledge) question was highly discriminatory, with approximately a third of students scoring 3 marks, three-quarters scoring at least 2 and over 90% scoring at least 1. RER is not an abbreviation that is used in the specification and, as such, was not credited in place of 'rough endoplasmic reticulum'. As this passage described 'the polypeptide', quaternary was not accepted in place of tertiary structure.

4.3 Although maths skill 1.9 requires selecting an appropriate statistical test, fewer than half the students could do this correctly. Section O of the practical handbook contains a simple flowchart to aid students in understanding which statistical test should be selected.

4.4 Maths skill 1.4 requires students to understand simple probability and use the terms probability and chance appropriately. It was extremely rare to see students able to demonstrate this in answers to this question. A common phrase was 'less than 5% chance that the results were due to chance' – no appropriate use of the word probability and a misunderstanding of the statistical test that can only show the probability the *difference* is due to chance, never the probability the results are due to chance. In this question, the null hypothesis should be rejected; suggestions that it could be disproved/disregarded or was disproved/incorrect/not true were not credited.

Question 5

5.1 This proved to be a highly discriminatory question testing recall of the structure of HIV. It was well answered, with over half the students achieving 4 or 5 marks. Many concise responses were seen, often aided by a clear diagram, although the diagram was not necessary. There was some confusion between viruses and bacteria, with students describing the wrong structure. On occasions, students negated a correct mark later in their answer, often by referring to DNA as the genetic material or to the attachment proteins as antibodies.

5.2 Maths skill 0.1, requiring conversion between mm^3 and cm^3, was successfully achieved by approximately 40% of students.

5.3 Students were confident to use the data for both viral load and number of CD4 cells to explain the impact of these on the immune system. Although many students accurately described the immune response resulting from the increased number of T helper cells, very few students could make the link to the lack of AIDS symptoms, so MP5 was very rarely seen.

Question 6

6.1 It is unusual to use the command word 'describe' at A-level, but it was felt to be appropriate here with these quite challenging data. The description was expected to be of A-level

standard and, as such, required identification of the trend with stated start (with a clear appreciation that this was before birth) and end points for this investigation. The explanation for the data could be achieved by:

- application of knowledge from section 3.2.2 of the specification (option 1 and 3), or
- an appreciation that these data referred to the heart only and therefore the heart was growing and developing from before birth up until the end of this investigation, when it was fully developed (option 2).

Students who appropriately used their knowledge from section 3.8.2.1 of the specification to answer this question were given credit, although this was rarely seen. It was not uncommon for students to suggest that DNA replication was part of mitosis.

6.2 This question was mainly a test of AO1 skills, similar to one asked in 2018, with some additional application (AO2) making use of the context of the question. It was noteworthy that the standard of answers was generally good and conveyed a greater understanding of DNA replication than was the case in the 2018 examination. Mark points 1 and 2 were commonly achieved together and there was only a small minority of scripts in which students incorrectly described hydrolysing hydrogen bonds. Most students were also good at identifying phosphodiester bonds forming during polymerisation of nucleotides. MP3 and MP4 were gained by fewer students, with some students still confusing the role of DNA polymerase with complementary base pairing, or incorrectly describing the joining of bases rather than of nucleotides. It should be noted that A in place of adenine is not an abbreviation used in the specification, so was not credited.

6.3 This question proved a good discriminator, with answers representing all marks. The most successful responses were concise and made use of only the one antibody named in the question stem. Many students detailed the addition of 2 or 3 different antibodies and, although this did not prohibit them gaining all 3 marks, it often resulted in confused suggestions. It should be noted that this question specifically asked 'how the scientists identified the cells'; it therefore required a description of the procedure the scientists would undertake.

Question 7

7.1 Fewer than 10% of students achieved this mark. In order to gain credit, students needed to apply their knowledge of either leaf structure (3.3.2) or principles of development of transport systems (3.3.1).

7.2 Answers to this question showed that understanding of how to interpret life cycles was limited. Although the majority of students are capable of stating that mitosis produces two identical daughter cells whereas meiosis produces four non-identical cells with half the chromosome number, only about a quarter of students achieved both marks here, indicating that application skills are lacking. Approximately three-quarters of the students could identify the correct box for meiosis but most thought meiosis was also happening elsewhere in the life cycle.

7.3 Students struggled with applying knowledge to this unfamiliar context. Many students correctly stated that *Ulva prolifera* and *Ulva lactuca* are different species but then could not go on to explain that either their gametes could not fuse or if they did fuse would not produce fertile offspring. Few students realised that this was a type of reproductive isolation or what would happen if gametes could fuse. Many students did understand that

offspring would be infertile but did not apply this to the context of the question to gain the second mark.

Question 8

This question was based on required practical activity 3 – production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue.

8.1 Just under half the students scored one mark here, most commonly for the top row. Those who did not score any marks usually tried to use the voltage information given in Figure 8, so put voltage into the final column. It was not uncommon to see volume units of cm^{-3}/dm^{-3} which was a shame for those students who got everything else in the table correct but only achieved one mark.

8.2 Just over 10% of students made no attempt to answer this maths question but, of those who did, approximately 60% got the correct final answer and 20% got close enough to score one mark. Since all data in the table were given to 2 decimal places, the calculated answer here could not be more accurate than this (maths skill 1.1), so correct calculations with a final answer giving 3 or more decimal places only achieved one mark.

8.3 Again, over 10% of students did not attempt this question. Of those who did, approximately three-quarters of students achieved at least one mark. Many students used Figure 8 to read off the water potential for a voltage reading of −7μV but did not appreciate that, to the right of −2, the axis was becoming less negative so started with a water potential of approximately −2.1 MPa rather than −1.9 MPa. 69 cm^3 was a common 1-mark answer, giving the final size of the leaf rather than by how much it increased in area.

8.4 This was a tricky question with very few students able to achieve both marks as it required an appreciation that the x-axis in Figure 9 showed the water potential of the leaf, not of the soil in which the plants were growing. This meant responses related to the xerophyte retaining more water were not relevant to this question.

8.5 Very few students took note of the instruction to use their knowledge of gas exchange in leaves to answer this question. The majority went with the idea that less water would mean less water available for photosynthesis and so reduced photosynthesis. Several students seemed to think that 'plants grown in soil' meant that the whole plant, including the leaves, was underground. Of those who did try to use their knowledge of gas exchange, a surprising number suggested plants need carbon dioxide for respiration.

Question 9

9.1 This question required combining graph drawing skills (maths skill 3.2) with knowledge of the oxyhaemoglobin dissociation curve (section 3.3.4.1 of the specification). Approximately three-quarters of students could plot the data from the table correctly, but only those with a sound knowledge of dissociation curves appreciated that the axes needed to extend beyond the values given in the table and could draw appropriate sigmoid curves.

9.2 Approximately three-quarters of the students successfully carried out this calculation, which is very pleasing. Of those who did not score 2 marks, over half achieved one mark.

9.3 Haemoglobin affinities and dissociation are well known by many students, but using the correct vocabulary and giving full answers was necessary to gain marks. Stating 'the mouse has a lower affinity for oxygen' was quite common, missing out the word haemoglobin and so not achieving the mark. Similarly, stating 'oxygen can be released' was not enough, as 'more' was required for the marking point.

9.4 Surface area to volume ratios were well understood and many students gained a mark for realising that the mouse had a larger surface area to volume ratio. Many students could go on to say that more heat was lost. Heat/energy being 'produced' was rejected as an answer; 'energy is *released*' is the expression that must be used in A-level biology.

Question 10

10.1 Some excellent answers were seen here, but many students demonstrated some knowledge of either the property or the importance to organisms but did not give both. Very few students referred to water as a metabolite. Many students described water as a solvent (a significant number thought it is a solute), but then did not go on to describe the importance of this aspect. There was some confusion shown between heat capacity and latent heat of vaporisation and these terms were often accompanied by incomplete explanations of why they were important. Many students referred to the cohesive properties of water but did not then gain credit because they completed the statement by simply stating "aids transpiration" rather than an explanation of maintenance of the transpiration stream.

10.2 For a straightforward recall of food tests, it was a little surprising that fewer than a quarter of students achieved 4 or more marks and fewer than half scored 3 and above. Many students were able to describe the emulsion test although some are still using the word cloudy, which has not been accepted for some time. Many students were able to correctly describe a positive Benedict's test, but fewer realised that when testing for non-reducing sugar a Benedict's test must be carried out first and shown to be negative. Hardly any students referred to boiling acid and therefore very few were awarded this marking point. Many students could correctly describe the biuret test but a significant number confused amylase with amylose, underlining the need for students to read the questions slowly and carefully before answering.

10.3 This was the most successfully answered part of question 10, with nearly 40% achieving 4 or 5 marks. It was, though, surprising that a large number of students thought dimers were polymers and only gave disaccharides/dipeptides as their examples of polymers. Most students understood the role of water in hydrolysis and condensation reactions, but a smaller number appreciated that these reactions involve bond breakage or formation and therefore did not always gain credit.

Mark Ranges and Award of Grades

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