A LEVEL
BIOLOGY

7402/1
Report on the Examination

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General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

Although a much smaller cohort than normal, there was still a substantial entry that resulted in a similar overall spread of marks as in previous years. The mean mark was slightly lower than last year and there was a greater percentage of marks in the lower range. It was felt that this year's paper had some slightly more straightforward aspects than in 2019 but overall was of similar difficulty.

Comments on Individual Questions

Question 1

Although this was based on fundamental aspects from topics 1, 2 and 3, it was based on novel figures and required linking of knowledge to the context of the question. This often resulted in less than full marks for 01.1 and 01.2. Descriptions of how Na^+ moving out of the cell would generate a concentration gradient for the diffusion of Na^+ in from the lumen of the ileum were often confused and incomplete.

01.3 required students to describe a feature and then explain it, so simple answers of 'it would have a large surface area' or 'it would have protein carriers in the membrane' were insufficient to score. There was much evidence of confusion of villi and microvilli. 'Thin membranes/walls' were often stated, but are misconceptions that should not appear at A-level.

01.4 If given a blank answer space, many students would be able to draw the fluid-mosaic model of membrane structure. The requirement here to draw the phospholipids around a given membrane protein confused many students, with only 32% achieving 2 marks. Students were only required to draw phospholipids on one side of the protein to gain the 2nd mark but they had to be positioned as a bilayer with some of each hydrophilic head within the hydrophilic area of the protein and some of each hydrophobic tail within the hydrophobic area.

01.5 The best way for students to score highly here was to draw a diagram showing how two amino acids join together to form a peptide bond, showing a free amine group at one end and a free carboxyl group at the other end. Inaccurate knowledge of the structure of amino acids and of the peptide link were often seen, sometimes leading to marks being negated as the written answer and the diagram were self-contradictory.

Question 2

02.1 Many GCSE-level answers were seen here (including incorrect references to fat digestion occurring in the stomach), simply stating that the triglycerides were being digested into fatty acids. The question asked students to explain the *differences* between samples **A** and **B**. Many started their answers with long explanations of what they thought was happening in **A**, which was not part of the required answer. Only 10% of students could give a true A-level answer of triglyceride digestion to score 3 marks.

02.2 53% scored 2 marks here, with 73% scoring at least 1. Those who gave partial answers often simply stated 'so no further reactions occurred' rather than directly relating to this investigation. Thankfully, there were few references to 'killed enzymes'. Answers that scored zero included suggestions that this was the optimum temperature to speed up the reaction or that this was to kill pathogens.

02.3 This was a poorly answered question, with only 5% scoring 3 marks. We are aware that the detail with which this topic is covered in textbooks is variable and this was clear in students' answers. The specification clearly states, though, that students need to know 'the role of micelles in the absorption of lipids'. There was much confusion with the multiple roles of bile, and micelles being formed by emulsification rather than after digestion and prior to absorption. I suspect, as students lacked confidence in answering this question, they went on to give details they did feel more confident with and included chylomicrons and the absorption of fats out of the cells lining the ileum and into the blood/lymph (not creditworthy in this question).

Question 3

03.1 Much misunderstanding of the flow of blood along a pressure gradient in the heart was demonstrated here, with only 35% scoring at least 1 and 16% scoring 2 marks. Far too many students seemed unsure of the distinction between the atria and the aorta. Those who demonstrated some understanding often struggled to describe correctly the aortic/semi-lunar valve. The stem of this question required students to 'Use evidence from **Figure 3**', so mark point 2 required reference to the pressure information from the graph.

03.2 An extremely poorly answered question, with only 11% gaining any marks. The principle of the elastic recoil in the artery smoothing the blood flow was rarely seen. Many suggestions of the aorta acting as a secondary pump were seen.

03.3 This question asked students to consider only the left ventricle pressure part of **Figure 3** but many students confused themselves by trying to refer to other parts of **Figure 3**. Students who gave the correct answer (same pattern) for similarity but then suggested that the pressure in the right ventricle would be highest when the pressure in the left ventricle was lowest did not score any marks.

03.4 Surprisingly, only 34% of students could correctly calculate the heart rate of this dog. Incorrect answers ranged from a small fraction of one beat per minute to many thousands of beats per minute. Perhaps taking a moment to consider whether their answer was reasonable would have led some students to double check their calculation.

Question 4

This question was based on the required practical 4 on the effect of a variable on the permeability of cell membranes. Although we tried to make this very clear in the opening sentences of the stem of the question, there was a surprising number of students who thought this was an investigation about osmosis.

Students who kept their answer specific to this investigation scored well on 04.2, but many standard answers relating to pH or concentration of 'solutions' were seen and were not creditworthy.

04.3 and 04.4 were very revealing about the confidence students had in their own practical experience; many were found lacking. Perhaps understandably, being able to explain why ethanol disrupted the membrane was uncommon but it was disappointing how many students could not describe how acid would damage membrane proteins. Mark points 1 and 2 were for explaining what the graph shows, linking the data with the objectives of the investigation.
Students found 04.4 difficult, with the requirement to apply their practical experience to designing a method for an investigation using standard college or school laboratory equipment; 11% did not even attempt to answer this question. Many suggested obtaining colorimeter values 'from a book' or drawing a calibration curve (never going to be of any use when there is no measuring equipment available for the test results).

Question 5

05.1 was a very similar question to that asked in previous years, but many students still failed to gain marking points 1 or 3 by confusing bases with nucleotides and by suggesting that DNA polymerase catalyses formation of hydrogen bonds, forms complementary base pairs or forms phosphodiester bonds between *bases*.

05.2 As with other 2-mark maths questions, there were many possible ways to be awarded 1 mark. Students should be reminded of the need to show all their working to allow scoring for intermediate steps even if their final answer is incorrect.

05.3 Students should be careful to expand on words from the stem as part of their description. In this question, answers of 'phosphate is used to phosphorylate the enzyme' did not describe clearly enough that the phosphate attaches/associates with the enzyme for marking point 1.

05.4 **Figure 5** did not show that *more* cells were undergoing DNA replication with cyclin D but that DNA replication started earlier. This distinction was necessary for students to achieve marking point 1, awarded for their use of **Figure 5**.

Question 6

06.1 Students found it difficult to express themselves when the question asked how the gas exchange would change rather than simply what the adaptations of alveoli are. The idea of slower gas exchange (but not less gas exchange) was awarded for marking point 3. At A-level, students should be able to discuss changes in the *rate* of diffusion.

06.2 Many students did not know how to approach this question and thought that if the relationship was linear it also must be directly proportional. There were many different ways to approach this

question, using either maths skill 3.3 or 3.5, and all these approaches were covered by the mark scheme.

Question 7

07.1 Nearly all students could describe how two monosaccharides would join by a condensation reaction to form a glycosidic bond, but only 49% could combine this with correctly determining the chemical formula. Even though many stated that water would be lost in the reaction, they could not show this when giving their chemical formula.

07.2 Most students could draw a basic Y shape for an antibody, but more detail of the heavy and light chain configuration was less common. Some negated correct answers for marking point 3 by incorrectly labelling disulfide bridges/bonds as hydrogen bonds or peptide bonds.

07.3 Many students got in a muddle by referring to active sites and enzyme-substrate or antibody-substrate complexes. Many also forgot that alpha-gal is a carbohydrate (as answered in 07.1) and referred to its tertiary structure. Several students suggested that the two arms of the antibody could be complementary to different antigens. This has not been shown in naturally produced antibodies, but it was felt that this was beyond expected A-level knowledge and so would be credited in this 'suggest' question.

07.4 The 'consider' command word requires students to review and respond to the given information in this context. The mark scheme for this question was generous, with several mark points being awarded for little more than descriptions of the graph. I think students were thrown by this being related to an allergic reaction rather than a simpler primary and secondary immune response to a pathogen. As a result, answers often lacked the detail of the formation of memory cells and, therefore, faster and larger production of antibodies at repeated exposure. Several students seemed to think that the immune response was caused by a lack of relevant antibodies. Many students were not clear in their answers whether they were referring to total antibody or antibody specific to alpha-gal and did not make a distinction between them.

Question 8

08.1 Only 26% of students achieved 3 marks here. Many students referred to the nucleus/cell as a whole rather than the DNA within these cells. Common misconceptions included the idea that the only DNA present in prokaryotic cells is in the form of plasmids, that prokaryotic DNA is single stranded and that it does not form a double helix.

08.2 This question was very poorly answered. The majority of students thought the only non-coding DNA in the genome is in introns, so very few scored marking point 2. Imprecise answers without reference to DNA were common. Again, not expanding on the words used in the stem limited the award of marking point 1. Consequently, defining 'non-coding base sequences' as 'base sequences that do not code for anything' is insufficient.

08.3 and 08.4 showed students find interpretation of phylogenetic data/diagrams difficult and struggle with the concept of evolution from an extinct common ancestor rather than from one current species to another. Many students failed to understand that question 08.4 was about variation within species T; many thought this was about the introduction of another species and tried to answer how this 'new' species would fit on the phylogenetic tree. Students find it very difficult to express how information about collection of data affects validity of conclusions – this is a higher level skill expected to be tested at A-level.

Question 9

09.1 and 09.3 Again, many intermediate marks were available so students should be encouraged to show each stage of their working. Answers showing 170.6 (or 2.6/2.7) recurring were given full marks but it would be better if students rounded (correctly) to an appropriate number of significant figures or decimal places (here to the nearest whole stoma). Any convention of displaying recurring numbers was allowed although convention in the UK is to put a dot above the recurring number.

09.2 Only 22% of students scored 2 marks here. Many did not understand the principle of the null hypothesis and gave an alternative hypothesis. Many have learnt a standard format of a null hypothesis that there is no difference between the two variables – clearly not appropriate here. There are only three statistical tests required for this course and students should be encouraged to learn the simple flow chart (found in Section O of the practical handbook) that determines which is appropriate for the given data.

09.4 Mark points 1 and 2 were commonly awarded but demonstrating further evaluation skills was rare, with only 13% of students scoring more than 2 marks. Many students suggested that no statistical test had been carried out even though the legend on **Figure 10** stated that the line drawn was a line of best fit showing a statistically significant change.

Question 10

10.1 Students should be careful to refer to *RNA* nucleotides/polymerase when describing transcription. As with question 05.1 about DNA polymerase, there were students who could not be awarded marking point 5 and/or 6 for suggesting that RNA polymerase catalyses formation of hydrogen bonds, forms complementary base pairs or forms phosphodiester bonds between *bases*.

10.2 Some confusion was demonstrated between tRNA and amino acids, about what joins with the mRNA and about what is joined together to form the polypeptide. The use of ATP in the formation of the peptide bonds was rarely seen.

10.3 Definition of a gene mutation was generally well done, although some stated that it always resulted in a change in amino acid sequence. Most who scored marking point 2 did so when discussing the positive effect and the formation of a new allele that would then be passed on as a result of that individual's increased reproductive success. Few students demonstrated the understanding that any mutation would result in a new allele being formed. The mark for the mutation having no effect was most commonly awarded for the idea of the genetic code being degenerate, although this was often very poorly expressed. Many students gave low-level answers for the positive effect, with generalised suggestions of how it would change an animal's/human's appearance or ability to find food/avoid predators, without expanding to the idea of increased survival chances or reproductive success. The idea of a mutation leading to the individual having a selective or competitive advantage was awarded marking point 7 as an equivalent/better expression of the individual having increased survival chances.

Concluding Remarks

The additional pages within the answer booklet were often used and were generally clearly labelled as to which question the answer referred.

Mark Ranges and Award of Grades

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