A-LEVEL

BIOLOGY

7402/1

Report on the Examination

7402

June 2017

Version: 1.0

General Comments

This assessment covers topics 1-4 from the specification and their corresponding practical skills. Although these are the topics that are in common with the AS assessments, the questions within this examination are designed to be at A-level standard and a step up from those that would be asked at AS. Questions testing Assessment Objective 1 will be similar in style to those in AS papers, since no greater depth of knowledge is expected here, although a slightly wider range of knowledge may be tested within one question. The A-level weightings for AO2 and AO3 are higher than at AS; students are expected to apply their knowledge within unfamiliar contexts.

Across all Ofqual-accredited science A-level subjects, there has been an increase in the difficulty and weighting of the mathematical skills assessed. Examiners noted that many teachers appeared to have dedicated time to coaching their pupils in these skills and there were fewer blank answer spaces for these questions than in previous series. Consequently, as well as many full mark awards, there were more students receiving intermediate marks for successfully completing some aspects of the calculation.

Statistical analysis and understanding of P values presented in the paper caused difficulties for many students. Responses often revealed fundamental misunderstandings about statistical analysis: for example, suggesting the ‘results’ are significant, that if ‘results’ are insignificant this means that there is a problem with the investigation and that it should be repeated to try to get a ‘better’ result, or that a P value of 0.05 indicates that 5% of the results were due to chance.

There was some evidence that a minority of students only just had sufficient time to complete this paper (and that a few ran out of time). There is much to read and interpret in this style of paper, but 91 marks should still be accessible in two hours. There were many very lengthy answers with much material that was not creditworthy. Students should be encouraged to take careful note of the command word used in each question and referred to the list of command words found in the Teaching Resources section of the AS and A-level Biology section of the AQA website. This should help students to focus their answer on the question being asked, so that they have the best chance to fulfil the requirements, without writing excessively and wasting time.

The ‘list rule’ came into effect when marking any question that required a set number of responses. This means that, if students give more than the required number of responses, each incorrect response negates one correct response (please refer to the information on the first page of the mark scheme available on the AQA website for more details of this rule). Students should take care if they add extra answers as an afterthought. It was evident that some students had added extra answers, beyond the number required, that had then negated an earlier correct point.

Question 1

It was hoped that this would provide a reasonably straightforward start to the paper, assessing AO1 on topics 3.1.5.1 and 3.4.2.

01.1 Only 22% of students could correctly name the types of molecule that make up a ribosome.

01.2 This question was answered much more successfully than 01.1, with 48% of students gaining all three marks.

01.3 This question proved to be very accessible, with 96.3% of students gaining the mark.

01.4 Although 83% of students scored 2 marks for this question, there were some incorrect answers, e.g., indicating that the introns removed from the pre-mRNA were made of DNA.

Question 2

This question tested topics 3.1.2 and 3.2.3 with a combination of AO1 and AO2.

02.1 The majority of students scored mark point 2 for the idea that glycogen is a branched molecule or that it contains glycosidic bonds. Although many students knew that glycogen is a 'chain' of alpha glucose, fewer could use the correct terminology to state that it is a polysaccharide or a polymer. Students must take care to specify alpha glucose or α-glucose rather than a-glucose. It was not uncommon for students to describe glycogen as if it were identical to starch and to include references to amylose and amylopectin in their answers.

02.2 This question required a little application of biological principles, with students' knowledge of glycogen. Many students started their answers with reference to branching molecules providing many 'ends' for enzymes – this was not relevant and is indicative of students rushing to write all they know, rather than considering what is relevant to answer the specific question asked. As with question 02.1, students often knew the basic principle of breaking down glycogen to release the glucose, but did not use the appropriate term of 'hydrolysis' to gain the first mark point. Many students suggested that this hydrolysis of glycosidic bonds releases energy, rather than thinking about glucose as the substrate for respiration in all human cells.

02.3 Although this question gave the context of the adaptation of the cell-surface membranes of cells lining the uterus, making it an AO2 question, this should have been fairly straightforward application of knowledge from 3.2.3. Many students did not gain full marks because they seemed not to read the question sufficiently carefully. It required reference to the cell-surface membranes only, so answers relating to "one cell thick", "many mitochondria", or "a good blood supply" were not relevant. The question also required a suggestion **and** an explanation to gain each mark. It was not uncommon to see reference to "thin membranes", indicating a clear confusion between the phospholipid bilayer structure of a cell-surface membrane and the epithelial layer of an exchange surface. Reference to 'villi' also demonstrated similar confusion and prevented a student from obtaining mark point 1. It is important to note that, when referring to protein carriers/channels, only carriers can be used for active transport; either can be involved in facilitated diffusion. Also, for a membrane to be adapted for rapid transport, it must have **more** of these proteins, rather than them just being present.

02.4 As with all calculations that meet the national requirement to be at the standard of higher tier GCSE Mathematics, this required a multi-step process. Firstly, students needed to work out that there would be 128 cells after 3 days: 2 cells after the first day, then another 6 divisions. This was where many students struggled. It was pleasing to see how many students could correctly use standard form to express their final answer. It should be noted that the convention for standard form to be correct is to have a number greater than 1 and less than 10, multiplied by 10 to a power, i.e. the decimal point should be after the **first** digit.

Question 3

03.1 There were some excellent answers here, but many students did not gain marks because their answers failed to focus on the NHE3 carrier protein. Many tried to explain why the ions would move, often describing how movement of one ion would generate an electrochemical gradient allowing the other to move (by facilitated diffusion), rather than sticking with the question of **how** the active transport (as stated in the stem of the question) of these two ions could work.

03.2 This question was the first test of AO3 skills in this paper and gave students their first opportunity to interpret and evaluate scientific information. There were two parts to the mark scheme. The first required students to explain why an increase in mean mass of contents in the gut would allow scientists to reach the conclusion that salt absorption had been reduced. Many students successfully achieved these two marks, although some showed confusion between the contents in the lumen of the gut and in the cells lining the gut wall. The second required students to interpret the statistical test; this was often not attempted by students and those who did were rarely completely successful. Even though the stem contained a statement to help students (The scientists carried out a statistical test to see whether the difference in the means was significant), many referred to significant ‘results’, and very few could correctly describe what the P value showed with appropriate use of the words ‘probability’ and ‘chance’.

03.3 This question required students to apply their knowledge of topic 3.3.4.1 and only 15% could do this with sufficient detail to score both marks. The question was carefully worded to lead students to the high salt concentration in the blood entering the capillaries, with the hope that an explanation linked to decrease in water potential of the tissue fluid would be given. Those who went down this route often scored this mark, but then referred to less ‘tissue fluid’ being reabsorbed at the venule end, rather than less water reabsorbed by osmosis. Students are not expected to have knowledge of how salt affects the blood, but may have some knowledge of the fact that a high salt diet can lead to an increase in blood pressure. Any explanation of how a high salt concentration increased blood pressure was ignored, and only the part of the answer focusing on what happens at the capillary bed to cause a build-up of tissue fluid was marked. Consequently, many students scored one mark for salt increasing the blood pressure (although it had to be clearly high**er** than normal; statements referring to ‘high’ pressure at the arteriole end were insufficient to gain credit). Only a few could go on to suggest that, as a result, **more** fluid would move out at the arteriole end of the capillary.

Question 4

04.1 There were many excellent answers to this question, with over 50% of students achieving both marks. The majority of students knew that bacteria divide by binary fission, but often did not include sufficient, or specific enough, detail in their description of what happens during this process to score the second mark. There were several statements about mitosis and some descriptions of viral replication.

04.2 This question required an **explanation** and so there were no marks for a description of the graph. Many students gave lengthy descriptions and, even if they went on to write creditworthy statements after this, they had wasted much time and energy. The first requirement was for students to realise that, since the 30 ºC line stays at 100%, both lines at 50 ºC and 60 ºC show denaturation of the enzymes. Many students got this far, but their explanations of what happens to the protein during denaturation were often incomplete or imprecise. For example, some stated that ‘bonds’ would be broken or that ‘hydrogen, ionic, disulfide and peptide bonds’ would be broken, so not achieving mark point 3. The mark least often awarded was for the explanation that a temperature of 60 ºC would denature the enzyme more quickly because of the increased (kinetic) energy at this temperature.

04.3 / 04.4 Both of these questions required careful reading of the question stems to access the mark points; many students got half-way through their answers, but gave insufficient detail to score full marks. For question 04.3, many students appreciated that the extracellular proteases would digest protein and this might protect the bacteria in some way, but their answers were not specific enough to gain credit for this idea. Similarly, many appreciated that extracellular protein digestion would provide useful products for the bacteria but did not go on to state that these products would be amino acids that could be used for growth/protein synthesis within the bacteria. For question 04.4, it was pleasing to see how many students could state that the dipeptidases would hydrolyse bonds in dipeptides, but many were not confident what these bonds were, or what the products of this hydrolysis would be. Many did not continue their answer to state the importance of this hydrolysis with reference to the passage of amino acids across the cell-surface membrane into the cells for absorption.

Question 5

This question revealed some confusion between antibiotics and vaccines, with many answers discussing immune responses as a result of taking antibiotics.

05.1 72.5% of students gained this mark.

05.2 Some good understanding was demonstrated of how this universal enzyme could be different in different species. Some students demonstrated understanding but their responses were insufficiently precise to fulfil the marking criteria; they failed to reference the ‘tertiary’ structure or the ‘shape’ of the active site. Some students successfully suggested that the human enzyme would be found in the mitochondria and so be inaccessible to the antibiotic.

05.3 67% of students scored 2 marks. Those who did not, usually could not convert 30g to 0.03kg.

05.4 There were two ranges of correct answer here, crediting a percentage difference compared with either group A or group R. Ranges were calculated to allow for a tolerance of half a 2x2 mm square when reading from the graph, and for rounding at different stages. It was pleasing to note that 46% of students could correctly complete this calculation. Some clearly were unfamiliar with using the 10^x function on their scientific calculators. 14% of students could correctly read from the graph and convert these values into actual numbers of bacteria, but then could not calculate the percentage difference.

05.5 Only 6% of students achieved all 3 marks here. Those who did were those who fully understood that the significant aspect of the data was that **neither** antibiotic killed all the bacteria and then went on to **explain** the consequences of this. As with question 04.2, some students wrote extensive descriptions of the data; this is not creditworthy in this ‘explain’ question. Those who wrote extensive descriptions often then forgot the instruction to use their knowledge of the evolution of antibiotic resistance. Mark point 3 was commonly achieved for the idea that bacteria resistant to one antibiotic would be killed by the other antibiotic. There was a disappointing number of references to 'immune' bacteria. Some students tried to evaluate the information (not requested here), with statements relating to this investigation being in mice rather than humans.

Question 6

This question was based on required practical activity 4 – an investigation into the effect of a named variable on the permeability of cell-surface membranes. The practical skills assessed here are found in section 8.3 of the specification.

06.1 Some good understanding was demonstrated here, but students often failed to gain credit due to poor use of language. "Amount" and "level" are not accepted units; pH and light must be qualified, e.g. 'soil pH' and 'light intensity', and 'nutrients' is not an acceptable alternative to mineral ion concentration at this level.

06.2 A very small number of students achieved 4 marks here. The most commonly awarded mark was for identifying that 2,4-D increased the release of ions from wild oats but had very little effect on wheat (mark point 1). There was quite a lot to read and understand in the stem of the question, and some students did not appreciate that disruption of the cell-surface membranes was linked to loss of ions, and so damage to the plant itself. Some students confused these ions from leaves with ions in the soil and consequently suggested greater ion concentration in the water would allow more ion uptake, to be used for growth. The lowest significant difference (LSD) was a novel context, and many students did not read/understand the explanation, and assumed the LSD was a form of standard deviation.

06.3 Unfortunately, many students did not fully link the context of this question to the practical they had carried out, and so were not confident in their suggestions here. Many mistakenly thought that the 2,4-D was in the water at this point. Those who did appreciate that the temperature must remain constant, to avoid further changes in membrane permeability (rather than enzyme activity), were often too vague in their responses to gain credit. Better students often appreciated that temperature would affect the rate of diffusion of ions out of the leaf discs. Why the leaf discs were shaken was generally better answered, although those who showed some idea of maintaining the diffusion gradient for ions often gave vague, imprecise answers that could not be given credit.

Question 7

Both questions 07.1 and 07.2 were about specific events within the immune response; many students gave lengthy answers, only small parts of which were relevant to the specific question asked. Some forgot that these two questions were about viruses and started to write about bacteria. Having said this, there were some extremely good answers to both questions, with over half of students achieving at least 2 marks for each.

07.1 Many students did not refer to the antigen being presented on the surface membrane of the phagocyte, so could not be awarded mark point 3.

07.2 Some students described, once again, how the virus would be presented. Mark points 3 and 4 were more often awarded than mark points 1 and 2, suggesting better understanding of the actions of B cells in the immune response than T cell involvement. Mark point 1 could be awarded if the student stated that a T cell binds to the antigen and then differentiates into a T helper cell.

07.3 The responses to this question revealed much misunderstanding of the immune response as a whole, with many references to 'thinking' immune systems. Many students simply repeated phrases from the question stem; for example, "since the virus protein and the human collagen have a similar shape, the immune system will attack the human collagen". Students needed to identify that the part of the immune response which would 'attack' the collagen would be the binding of specific antibodies, and then to use their knowledge of how an antigen-antibody complex leads to the destruction of the antigen (section 3.2.4 of the specification), i.e., human collagen in this case. Credit could be gained for reference to agglutination or phagocytosis as methods of 'attacking' the human collagen, since these are the methods of antigen destruction named in the specification.

Question 8

This question is based on sections 3.4.5 and 3.4.7 of the specification. For question 08.4, only 14% of students could name the three comparisons that are stated in the specification for investigating genetic diversity (other than the observable characteristics that had been used to generate Classification **X**). Although this method is no longer in the specification, DNA hybridisation was accepted as a method of comparing DNA base sequences.

Question 9

09.1 Even though the majority of students had some knowledge of the structure of the insect tracheal system, it was surprising how few could explain how it is adapted for efficient gas exchange. It should be noted that this is the context of section 3.3.2 of the specification – adaptations of gas exchange surfaces…for efficient gas exchange and the limitation of water loss. In order to **explain** successfully here, students needed to identify the feature of the tracheal system, and go on to explain how this chosen feature allows for efficient gas exchange. Many students stated that a short diffusion pathway is required, but could not give the feature of the tracheal system that allowed this. Many students referred to "thin tracheoles", which was insufficient, or referred to "thin membranes of tracheoles" (demonstrating a similar lack of clarity of understanding of the difference between a cell-surface membrane and epithelial cell layer of an exchange surface to that seen in question 02.3). Similarly, many students appreciated that a large surface area is required, but could not sufficiently explain how this is achieved in an insect with highly branched/numerous tracheoles. There were some very good descriptions of lactate formation, causing water to be drawn out of the ends of the tracheoles, but few students could relate this to faster gas exchange as a result of diffusion through air, or a larger surface area. It was common to see those students, who identified ventilation as being important, then being unable to explain how this maintained a diffusion gradient. Explanations such as "moving carbon dioxide out and oxygen in" were not uncommon, and were not creditworthy. References to spiracles were not given credit as these are essential for limiting water loss but are not essential for efficient gas exchange.

09.2 This was designed to test understanding of the statement in section 3.3.1: 'Students should be able to appreciate the relationship between surface area and volume ratio, and metabolic rate'. Most students saw this question as an opportunity to write about their knowledge of gills as a gas exchange system, rather than focusing on the way of life of the damselfly larvae. Although this led some students to describe how more oxygen could be absorbed, the key to the question was about the increased activity of the damselfly and, therefore, its increased use of oxygen.

09.3 Only 7% of students gained all three marks here. Dealing with uncertainties is new to this specification, as is using an appropriate number of significant figures (specification section 6.2, MS 1.1 and MS 1.11). There are clear explanations of using uncertainties and choosing an appropriate number of significant figures in the online Practical Handbook, Sections K and L.

09.4 This question tests PS 4.1 from section 8.3 of the specification, linked to required practical activity 5 and apparatus and techniques skill AT e. The most common answers that did not gain credit were suggestions that the drawing should contain more detail, or an electron microscope should be used to enable more detail to be drawn. References to adding more labels were given credit even if the extra parts to be labelled were named incorrectly.

Question 10

10.1 The command word here was **contrast** and so statements showing clear differences between the use of the two microscopes were required to gain credit. Most students demonstrated sound knowledge of the optical and electron microscopes, but few managed to gain all six marks for relevant contrasting statements. Many suggested that no organelles could be seen with an optical microscope, rather than only larger organelles being visible. Some referred to SEMs and 3D images; neither was relevant here.

10.2 There were many good answers here, with over 70% of students scoring 2 marks and over 40% gaining 3 marks. Mark point 4 was the least often awarded. Students often failed to gain mark point 3 because they stated that **W** contained half the genetic material of **Z**, rather than specifying half the DNA. Several students discussed these cells as if they were human cells rather than plant cells, mentioning 23 pairs of chromosomes originally, or 23 chromosomes in cells in **W**. Some students named stages of meiosis in their answer. These were ignored as this is not expected knowledge; we were only looking for the outcomes of 1^{st} and 2^{nd} meiotic divisions.

10.3 The full range of 0 – 5 marks was seen in similar proportions here (although slightly fewer with full marks). The main reason for the discrimination was how fully each student used the information from the question stem. The two groups of seeds to be investigated had been collected already, and the investigation that was needed was simply to find out if there was a difference in size of these seeds. Many students gave extensive answers relating to how to collect the seeds from the environment, and how to measure the pollution – neither of which was relevant to the question. Many students selected an inappropriate statistical test or listed several options, which could not be given credit, even if t-test was amongst the list of possibilities (see note about the ‘list rule’ in the final paragraph of “General Comments” above).

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.