AS LEVEL
BIOLOGY

7401/2

Report on the Examination

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General Comments

The overall standard of responses to this paper was a little disappointing given that this is the second paper for this new specification. The mean mark was lower than in 2016. Examiners noted that some responses were difficult to read; students should ensure that their work is legible so that examiners can mark it. Students scored best on questions testing Assessment Objective 1, recall with understanding, and simple calculations, but many seemed unprepared for questions involving the more demanding mathematical requirements of the new specification. There is a higher proportion of marks on this paper for application (AO2), analysis and evaluation (AO3) than there is on paper 1, and some students did not seem to be prepared for this.

Some students have clearly been trained to analyse the question before attempting an answer. This is evident from the highlighting and underlining of key words and phrases in the question. This is a strategy that weaker students could usefully employ as their answers often fail to use the key information provided in the question to help them to apply their knowledge to the question asked.

Many answers were seen in which students seemed to have the right idea but failed to express themselves clearly or use appropriate scientific terminology.

Question 1

More than 40% of the students gained both marks on question 01.1, usually for correctly contrasting the types of glucose (α or β), or by referring to the branched or straight chain of the molecule. Those who failed to score often did not give differences, referring only to one of the molecules.

Question 01.2 discriminated well. Many students wrote about starch being insoluble and therefore not affecting the water potential, and the branched nature of the molecule making it compact. However, a large number of students did not follow the instruction to both describe **and** explain features of starch that make it a good storage molecule.

In answering question 01.3, 87% of students correctly identified the correct test.

In answering question 01.4 most students were able to attempt the calculation but many were unable to convert millimetres to micrometres and therefore gained only 1 mark.

Whilst half of the students scored both marks for question 01.5, there were many who were unable to identify the correct type of microscope and often their evidence was that the photograph was black and white rather than in 3-D.

Question 2

Practical question 02.1 was poorly answered by students with only 3% gaining both marks. It was not uncommon for students to write about water potential and those who did refer to the concentration of the pigment rarely linked too much water with a less concentrated solution, or the converse. General answers relating to controlling variables were also frequent. Surprisingly few

students realised that using the same volume of water was necessary to make the results comparable.

In answering question 02.2, only 17% of the students stated correctly that to monitor the temperature, several readings of the temperature must be taken. Most thought that placing a thermometer in the tube or using a water bath would monitor the temperature.

Almost half of the students could draw a suitable curve between the points in question 02.3. Both a smooth S-shaped curve and ruled point-to-point lines were accepted. Those who did not gain this mark often extrapolated the line beyond the points given, or drew an inappropriate curve.

In answering question 02.4, a quarter of the students gained at least 1 mark. These students usually wrote about damage to the cell-surface membrane whilst a few students enhanced their answer with a more detailed explanation of membrane proteins denaturing or increased fluidity of the phospholipid bilayer. Reponses failing to gain credit often referred to enzymes or kinetic theory and it was not uncommon to see references to the cell wall bursting.

Question 3

Students clearly have difficulty in describing data with almost a quarter gaining no marks at all for question 03.1, and many of these confusing data for low-starch and high-starch diets. However, most could state that a low-starch diet was linked to fewer copies of the gene and many correctly identified the modal values. There were few references to the overlapping ranges and the higher range in populations with a high-starch diet. Students would benefit from learning to use terms such as mode and range in their answers to similar questions.

In answers to question 03.2, students seemed less confident in their knowledge of protein synthesis than in their knowledge of enzyme action. Consequently, very few students could explain that, with more copies of the gene, there would be more transcription or more mRNA formed. However, most realised that there would be more enzyme present and then went on to explain the advantage in terms of faster starch digestion.

Often students failed to use the information given to them in question 03.3 and wrote generic answers about natural selection which failed to gain any marks. Examiners were looking to award marks for points made in the context of multiple copies of the *AMY1* gene. Those students who did this often gave excellent answers referring to mutation resulting in extra copies; they then went on to explain that this mutation resulted in a higher chance of survival and reproduction in populations with a high-starch diet, with the beneficial mutation being passed on to their offspring.

Question 4

Two-thirds of the students gave the correct answer of 6 g dm^{-3} for question 04.1.

Approximately 40% of the students were able to gain 2 marks for question 04.2. A significant number did not read the key on the graph correctly and so gave figures for females instead of males. Some students left the calculation as a fraction, perhaps through not bringing a scientific calculator to the examination – these students scored 1 mark.

In question 04.3, many students realised that the protein concentration decreased more in females than males, but very few used the given information about the standard deviation to comment on

the significance of this difference. Students should take more care in interpreting graphical information since, again, many confused the male and female data.

Question 04.4 was answered poorly, with 10% of students giving no response and over half scoring no marks. This was disappointing as the idea of preparing a dilution series to produce a calibration curve is in Required Practical 3. There were some good answers in which students wrote about measuring the absorbance of known concentrations of protein, but many suggested producing different concentrations of blood plasma rather than protein. These students were still able to gain some marks. Very few went on to describe how to draw the calibration curve in sufficient detail to gain a mark. Many students suggested plotting age as part of their calibration curve, and few were able to give both axes. Those who did were usually able to continue their answer to gain one mark for the use of the curve to find the protein concentration from the absorbance value.

In question 04.5, almost 40% of students gained 1 mark for suggesting a decrease in protein content could be linked to fewer antibodies. Examiners were surprised by how many students thought that cells were proteins.

Question 5

Some very good answers were seen to question 05.1, with almost 30% of students gaining both marks for giving a detailed account of cooperative binding of oxygen to haemoglobin. Others failed to take account of the question stem and went on to compare HbA with HbF.

In answering question 05.2 only 2% of students gained both marks, with 64% scoring no marks. Often students described the advantage to the fetus in having HbF rather than the advantage to the baby of having HbA, as asked. Those who did state that HbA would have a higher affinity for oxygen rarely recognised that this would be important at low partial pressures of oxygen; those who realised that this would allow more oxygen to unload in the tissues often did not explain that this would be advantageous as it would allow more aerobic respiration.

In answering question 05.3, students followed the instruction to use information from the figure and the table in their answer but often referred to just one of these. Many students were able to state that more oxygen would be carried after treatment, but not many used the data in the table to comment on the size of the increase as being large or significant. Only a few students related the increased transport of oxygen correctly to the higher affinity of HbF for oxygen.

Question 6

There were some excellent answers to question 06.1 from students who had clearly used this method in their practical activities, but there were some answers which suggested other students had no recollection of this apparatus. Many correctly suggested that they would use the eyepiece graticule to measure the diameter of a large number of stomata to calculate a mean: these students gained 2 marks. Less well known, however, was the idea that the eyepiece graticule must be calibrated against a measuring device such as a stage micrometer or a plastic ruler. However, there were also some lengthy answers that described in great detail how the eyepiece graticule would be calibrated but then failed to give any further information.

Students found the calculation in question 06.2 difficult, with only about a quarter gaining 2 marks. The main problem was misreading the y axis of the graph as if it was the mean diameter of the stomata rather than the reduction in diameter compared with the control. Consequently, few students were able to gain the one mark available for calculating the reduction in mean diameter compared with the control for PS3 and ABA.

In question 06.3, more than half of the students gained at least 1 mark for stating that ABA would reduce transpiration, but relatively few went on to explain how this would aid survival in dry conditions. Answers that failed to score were sometimes superficial – "less water lost so more retained" – or suggested that ABA would provide water for the plant.

Many students realised, in question 06.4, that if the stomatal openings were smaller then fewer spores could enter the leaf. However, others failed to use the information given in the question and did not state that it would be the air-borne spores that would pass through the stomatal pore.

Question 7

Many students had difficulty assimilating the information given in question 07.1 and assumed that NMO was a pathogen. This led them to give an extended answer involving the immune response, plasma cells and antibody production. There was also confusion between enzymes and antibodies with many references to active sites and enzyme-substrate complexes. However, almost 40% of the students scored at least 2 marks with some using scientific terminology accurately and writing concise answers which clearly explained how the specific tertiary structure of the variable region of the antibody would be complementary to only one antigen, in this case the antigen on the nerve cell.

Few students gained the 3 marks available for question 07.2. Most seemed to give just one point and re-state this in several ways; typically this would be relating to the varying number of vertebrae surrounding damaged nerve cells at a particular concentration of antibody. It was not uncommon for students to recognise that the correlation was weak but surprisingly few commented on the small number in the study.

In question 07.3, as in 07.1, many students wrote about NMO as a pathogen, or active sites on the antibodies, preventing them from gaining marks. This was a demanding question but there were some excellent answers seen recognising that when the monoclonal antibody binds to the nerve cell antigen it would not cause any damage and it would also prevent anti-AQP4 binding and causing damage. Weaker answers often stated incorrectly that as the variable regions of the two antibodies were the same they would bind together.

Question 8

Almost 60% of the students correctly identified the trisomy of chromosome 13 in question 08.1. Most of the incorrect answers referred to there being no Y chromosome.

In answers to question 08.2, there was evidence that students are less confident in their knowledge of mutation involving a change in chromosome number. There was an assumption made by some that, as this was a mutation, it must involve a change in the base sequence – answers of this type gained no marks. At the other end of the spectrum, some excellent answers were seen in which students wrote about non-disjunction during meiosis.

Most students knew, in question 08.3, that body cells are produced by mitosis and often gained a mark for explaining that all cells are derived from a single cell, the zygote. Relatively few (17%) gained a further mark either for pointing out that the mutation would have been present in one of the gametes used in the formation of the zygote, or that mitosis produces genetically identical cells.

In answers to question 08.4, it was again evident that some students did not use the information given in the diagram, which clearly showed the direction of the blood flow. Some students wasted a lot of time writing about the functions of the aorta and pulmonary artery. The vast majority gained at least one mark for stating that there would be less oxygen delivered to the tissues, but fewer went on to explain that there would be less oxygen available for aerobic respiration, which would reduce growth or development of the tissue or organ.

Question 9

There was a wide range in the quality of the responses to question 09.1, with 16% gaining 4 or 5 marks and approximately the same percentage gaining zero marks. Many students did not seem to understand what is meant by the cohesion-tension hypothesis and complicated their answer with unnecessary and lengthy accounts of the movement of water across a root, root pressure and even translocation. Those who understood the scope of the question were frequently able to access the mark scheme, with most writing about hydrogen bonding between water molecules resulting in cohesion and water being pulled up the xylem as a continuous column. Many wrote about transpiration from the leaves though few explained how this would result in a lower water potential in the leaf cells. Only a small number of students referred to adhesion of water molecules to the walls of the xylem vessels.

Question 09.2 discriminated well, with approximately 20% of students gaining 4 or 5 marks and 28% gaining no marks (although quite a few of these may well have been as a result of students running out of time). Some excellent answers were seen in which students wrote logically and clearly using accurate scientific terminology, though even these students rarely gave the full information for complementary base pairing. A high percentage of students gained the 2 marks available for describing how the pre-mRNA formed is cut and spliced to form mature mRNA. The role of RNA polymerase was often incorrectly stated and students frequently stated that plant DNA does not contain introns.

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.