A-LEVEL
BIOLOGY

7402/3 Paper 3
Report on the Examination

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General comments

The entry for this paper was 38 494, 5.6% higher than last summer's entry.

The mean mark and standard deviation were slightly lower than in 2022. The range of overall marks was from 0 to 70, the highest mark being 2 less than last year. Correct responses were seen in all parts of all questions, and all mark points were seen in students' responses.

Most of the marks for AO1 factual recall in this paper are in the essay. The remaining questions test the use of skills and knowledge in the contexts of AO2 and AO3. These proved challenging for many students, more so in questions testing AO2 this year, with students seemingly not using the information in the stem of questions. In questions testing AO3 in which students were asked to comment on data, rote-learned responses, such as 'long term effects unknown' and 'no stats test', were evident, with no consideration whether these would apply to the question. Examples of these are detailed in the comments on individual questions section below.

There were issues with students addressing command words correctly; for example, 'suggest and explain' only yielding suggestions or explanations, not both, and in several cases, only descriptions. Some commands were ignored; for example, with **01.2** and 'Use **Figure 1** to describe what is meant by the all-or-nothing principle'. Students failed to use **Figure 1**. Other examples are illustrated in the comments on individual questions below.

Maths skills seemed to be lacking, with a lack of correct rounding and an inability to use standard form causing many students to fail to gain marks. An understanding of how to correctly use the terms 'probability', 'chance' and 'significant' was generally not seen with question **06.4**. The maths questions generally had a higher rate of non-attempts than non-maths questions.

Essays were lengthier than usual, with most falling in the five-to-eight-page range. This, twinned with poor performance on questions **01** to **06**, and a high rate of non-attempts of the last two questions, **06.5** and **06.6**, seems to suggest that students were spending more time on the essay than the rubric advises, leaving less time for the rest of the paper.

Several questions discriminated well. In this report, references to how well a given question discriminated are based on numerical discrimination indices calculated from marking data, not on the opinions of the examiners. The discrimination index is a measure of correlation and indicates the extent to which an item discriminates between high-attaining and low-attaining students.

Comments on individual questions

Question 1

01.1 discriminated very well, and saw nearly half of students scoring all three marks. Several students referred to a 'stretch-mediated membrane' or a 'stretch-mediated response', rather than to stretch-mediated sodium ion channels. Students were often restricted to 2 marks out of 3 on this question by only referring to sodium, and not sodium ions, in their response. Students rarely referred to sodium ions diffusing in for MP4, instead referring to an 'influx'.

With **01.2**, as mentioned in the general comments, students were asked to 'Use **Figure 1** to describe what is meant by the all-or-nothing principle'. A quarter of students did this successfully and scored both marks. However, many failed to use **Figure 1**, and just described the principle in general terms, with 41% scoring 1 mark. Quoted values for the threshold ranged from –70 mV to +40 mV. It should be noted that there is no expectation for students to know any numerical threshold value/s.

With **01.3**, 66% of students correctly stated the 'refractory period'. Students who failed to score gave answers including 'rest period,' 'lag time,' 'action potential' and 'hyperpolarisation'. This last response shows that students were not reading the time quoted in the question, from 0.6 ms to 4.0 ms, as they should have spotted on the graph that hyperpolarisation happened after this timeframe.

Question 2

With **02.1**, just under 60% of students scored the mark. Students were asked: 'Other than those stated, suggest two variables the student needed to keep constant in her investigation'. Many students seemed to ignore 'Other than those stated' or failed to check **Figure 2** to determine what variables were stated as being constant, as there were many incidences of 'temperature (of the water bath)', and 'time in the water bath' being given. Several students seemed to confuse yeast cells for being plant cells, and stated the controlled variables as light and carbon dioxide. Students often stated 'amount' instead of concentration, volume or mass.

With **02.2**, roughly an equal proportion of students scored 0, 1 and 2 marks. Those who failed to score 2 marks, often scored 1 mark as a result of reading the scale as 3.7 mm and not 3.7 cm, reading the scale as 3.65 cm, or giving their response not in standard form and/or not to 2 significant figures, as the question demanded.

02.3, as with **02.2**, saw roughly an equal proportion of students scoring 0, 1 and 2 marks. The most common reason for students not scoring 2 marks, was writing 'broken down' instead of hydrolysed. A smaller number of students referred to maltose as a polysaccharide, or stated that maltose is a monosaccharide and glucose a disaccharide.

With **02.4**, MP1 was generally well answered, with half of students scoring this mark. A lack of understanding of this experiment's method saw students incorrectly state that this experiment only produces qualitative results. Students struggled to suggest how the accuracy of this method could be improved for MP2, with only 13% of students scoring 2 marks. There were students who only wrote 'use a colorimeter' and some misunderstood the idea of finding an end point to the reaction, so rather than stating to use a colorimeter to time how long it takes to reach a certain absorbance, stated to measure absorbance after a set time. Others confused this experiment with one to determine the concentration of reducing sugar in a solution; for example, by stating to produce a dilution series and compare colours, or to produce a calibration curve, measure absorbance and read glucose concentration from the graph. Those who lacked any understanding of the experiment at all often stated to repeat the experiment and calculate a mean.

02.5 discriminated well and nearly three-quarters of students scored 2 marks. Those who failed to score confused the link reaction with glycolysis and, therefore, put glucose in the top box, pyruvate in the bottom box, and ATP in the right-hand box.

Question 3

With **03.1**, 80% of students correctly identified the answer as **B**. Students were asked to tick (✓) **one** box; there were incidences of more than one box being ticked.

With **03.2**, students struggled to correctly calculate the mean number of bacteria in the undiluted bottle of liquid culture. Only 15% scored 2 marks, and 77% scored 0 marks. The most common answers given were just the mean, or 2.54×10^7, resulting from students only multiplying the mean by 100 000.

17% of students did not attempt **03.3**. Any error from **03.2** was carried forward to this question, and this did allow more students (25%) to access the mark. Whilst the question stated that students could use the ln or log button on their calculator to calculate their answer, this was not essential.

With **03.4**, many students gave one of the expected responses on the mark scheme, with 45% scoring 1 mark, but only 14% scoring 2 marks. Those who failed to score often did not carefully read and understand the practical procedure followed, and stated that the chloramphenicol ran out, or there was not enough chloramphenicol, or that chloramphenicol was not evenly spread on the plate. For MP3, students sometimes stated that bacterial had become 'immune' to chloramphenicol.

Question 4

04.1 discriminated well, although roughly a third failed to score a mark. This seemed to stem from students having not read or understood **Figure 5**. As a result, the context of most responses was incorrect. Many responses referred to the stem cell growth factor receptor protein (SCFR) as a cell 'detected by its antigens' which is 'engulfed' and 'put in a phagosome' and 'destroyed by osmotic lysis'. There were also suggestions that a lysosome is a macrophage, with responses outlining that a lysosome engulfs SCFR. There were also incidences of lysosome and lysozyme being used interchangeably.

04.2 saw many students simply repeating the stem of the question in their responses. For example, the control group did not get a transplant of bone marrow stem cells. Others provided descriptions of the results for the control group and the c-KIT– group, rather than providing explanations. Many also described dead rats for the control group, ie., by stating 'the control group did not receive a transplant, and therefore cardiomyocytes cannot contract', despite **Figure 6** showing that the control group still produced ventricular blood pressure. This meant that a third of students did not score any marks.

04.3 was generally well attempted, with just over half of students scoring 1 or 2 marks.

With **04.4**, again, students did not appear to understand the context of the question or comprehend what is shown in **Figure 6**, causing 63% to score 0 marks and only 5% to score 2 marks. For connexin-43, the majority of students stated that it allows impulses to pass from the SAN (to the AVN), or pass across atria, therefore not noticing that **Figure 6** shows ventricular pressure. For GATA-4, most students only stated that actin and myosin can be produced, therefore allowing the heart to contract, and so not suggesting how GATA-4 would result in the increased ventricular blood pressure seen for the c-KIT+ group in **Figure 6**.

Question 5

With **05.1**, 40% of students were able to determine the two correct years. The most common error was stating more than the two years on the mark scheme and attempting to give the year wherever the line crossed y = 6, thereby not reading the scale on the x-axis correctly.

With **05.2**, MP1 was commonly seen with nearly half of students scoring this mark, but students failed to understand the index of diversity by stating that each or all species were present in small numbers for MP2. As a result, only 7% of students scored 2 marks. There were also several answers that ignored the data and gave responses detailing how competition and predation affect diversity.

05.3 proved accessible for most students, allowing some marks to be scored; however, only 1% of students scored all 4 marks. There were many rote-learned responses given, such as 'we don't know the sample size' and 'no stats tests'. There were also many responses that stated that the investigation was 'only 29 years', '29 years is not long enough to spot a trend' or 'long-term effects unknown'.

Question 6

With **06.1**, many students read this as 'Give **two** types of cell that are involved in an immune response' and so stated B cells and T cells as their responses. As a result, just over half of students scored 0 marks.

06.2 asked students to suggest and explain; however, just over half of students either suggested or explained, not both. For example, they stated just 'as a control' or 'to compare'. There was also a large number of responses stating 'as a control variable'.

06.3 showed that the majority of students are unable to correctly draw a graph, with only 30% scoring all 3 marks and 6% of students not attempting to draw a graph at all. Students did not make drawing the graph easy due to selecting difficult scales; for example, 15 cm × 10^{-3} for every 10 small squares on the grid. Also seen were non-linear scales, all bars touching, mismatched standard deviation bars, and not plotting what was asked, ie. including mean concentration of anti-OXA antibody, or plotting mean increase in ear thickness against mean concentration of anti-OXA antibody.

06.4 discriminated well. It asked students to use the data to justify their conclusions, but this was generally not done, or not done correctly, with only 8% scoring all three marks and half of students scoring 0 marks. There remains poor understanding of statistics and significance. There was a large number of students who did attempt to describe the statistics, and then followed this with 'however, no stats tests have been performed so we cannot be sure'. The 'principle mark' applied to this mark scheme did allow more students to score 1 mark.

06.5 was not answered by 13% of students. This might be because students ran out of time due to spending too long on their essay. Those who did attempt this question were able to access marks, although 23% scored 0 marks. Scoring all 4 marks proved difficult, with only 4% achieving this. Some students did confuse MP1 and MP3; for example, stating that an increase in antibody causes the humoral response, and an increase in T_c cells causes the cellular response. Again, rote-learned responses appeared in student responses; for example, 'no stats test' and 'no sample size stated'. Students need to remember that on exam papers, if scientists have performed the investigations, it can be assumed they did it correctly unless otherwise stated, ie. the sample size will be sufficient. There was evidence of students having read the first line incorrectly and understood it to read 'oestrogen has the opposite effect on humans and mice', rather than the opposite effect on two different autoimmune diseases. As a result, the context of their answers was incorrect, but they still were able to score MP8.

As with **06.5**, **06.6** was not answered by 13% of students. This may also be because students ran out of time due to spending too long on their essay. Students failed to grasp what the Hardy-Weinberg principle is and scored 0 marks. There was also confusion with the conditions required for the Hardy-Weinberg principle and the mark-release-recapture technique. For example, many students stated the principle would not hold true as there cannot be any births or deaths. Those who did understand the principle, often did not make the correct selection of the aspect of it they needed to consider; for example, stating that there cannot be any migration, the population must

be large or no mutations can occur. There were also several students stating that as the allele is dominant, it will increase in frequency. As a result, 69% of students scored 0 marks and only 6% scored 2 marks.

Question 7

As mentioned in the general comments, this year the essays were very lengthy. This suggests that students are spending longer than the advised 45 minutes on this question, possibly to the detriment of the rest of the exam paper.

The essay discriminated well. The mean score on the essay was down slightly from the 2022 series. Good AO1 content was frequently seen, however this was often interspersed with several significant errors. AO2 remained largely fairly superficial, as seen by the modal score remaining at 15 marks and 63% of students failing to score higher than this. Material beyond the specification was rarely seen, or at correct depth to score the highest marks. Some students included material beyond the specification that was good; however, if the rest of the essay was not of a sufficient standard for it to be in the 'extended abstract' level, it could not qualify for the highest marks. 0.05% of students scored 25 (unchanged from 2022), with a further 0.20% scoring 24 marks. Only 3% of students overall scored in the 'extended abstract' level. There were many cases where introductions and conclusions had been added; these did not score any marks, are not necessary, and could potentially take up time that students could be using to score marks. This year, the vast majority of students completed **07.2** rather than **07.1**.

07.1 was generally answered poorly, with little A-level depth. Areas that students did cover at the appropriate depth included mass transport in plants, the nutrient cycles, survival and response, and populations in ecosystems (succession). With nutrient cycles, students did discuss why farmers plough fields in order to aerate the soil, thereby discouraging anaerobic denitrifying bacteria. Students would be advised to consider that many farmers now no longer plough fields as it can leave soil vulnerable to erosion and promote agricultural run-off. Avoiding ploughing creates better soil structure, does not disturb mycorrhizal networks or damage other soil wildlife as much. The title asked about the importance of interactions between organisms and their environment. However, students often failed to give any interaction, instead just describing processes, such as the light-dependent and light-independent reactions of photosynthesis, what happens in cells in response to insulin or glucagon, or the immune response. Students are advised to know the specification structure. For example, there were students who clearly thought plant tropisms, taxes and kineses and the simple reflex were three separate topics. However, these all fall under survival and response, section 3.6.1.1 of the specification. Descriptions of courtship from species and taxonomy (section 3.4.5 of the specification) rarely moved beyond GCSE level, with descriptions of a peacock using its feathers to attract a mate. Other GCSE-level topics commonly used were food chains/webs, the carbon cycle, adaptations of camels and polar bears, and temperature homeostasis. It is assumed with the latter that students are trying to bring this in as beyond the specification material. However, GCSE-level descriptions do not constitute beyond A- level specification material.

07.2 saw most students write about the structure of, and transport across, membranes, the immune system, digestion and absorption, photosynthesis, respiration, nerve impulses, synapses, the control of blood glucose and the control of blood water potential at the right level. Attempts at gas exchange were generally at GCSE level, and often mentioned 'thin membranes'. This title asked students to write about the importance of membranes in the functioning of cells. Students were generally good at writing about the role of the membrane in the functioning of cells; however, for the importance, they often picked a loosely linked topic and gave more AO1 knowledge of that topic. For example, many gave a clear description of the role of membranes in synapses, but for the importance aspect described the roles of actin, myosin, calcium ions and ATP in myofibril

contraction. Another example is that of a good description of the role of the membrane in the co-transport of sodium ions and glucose, but then for the importance aspect describing glycolysis. This was classed as irrelevant material. There were occasions when the descriptions students gave were more about the importance in the functioning of an organism, rather than the functioning of a cell; for example, being able to run away from predators. Within transport across cells, students often incorrectly stated that the membrane prevents water movement by osmosis, prevents water moving into cells and prevents them from bursting. Within cell recognition and the immune system, there were several students who incorrectly described viruses as cells with a membrane, giving examples of Covid-19 and HIV. Within photosynthesis, students sometimes incorrectly stated that the ATP produced in the light-dependent reaction was used for active transport in the roots, and others even discussed its use in the sodium-potassium pump and the nervous system, and muscle contraction. Within both photosynthesis and respiration, the majority of students stated that the electron transfer chain 'actively transports protons from the matrix to the intermembrane space'. Students should be aware that this is not active transport, but that this was not given as a significant error on the essay. Students commonly tried to bring in the effect of cholera as beyond specification material, but the vast majority who tried to do so ended up with a significant error, as most responses stated 'cholera produces a toxin that binds to a chloride ion channel protein permanently opening it'. This is incorrect. The toxin binds to a receptor, is taken into a cell via endocytosis, and works via a second messenger model to cause ATP-mediated release of chloride ions via the CFTR channel proteins.

Mark Ranges and Award of Grades

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