A-Level

Biology

7402-3

Report on the examination

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General comments

Students found this paper of comparable accessibility compared with last year's. The mean mark and standard deviation were only slightly lower. 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. Students' recall in AO1 questions was variable, with students finding 01.1 and 06.2 particularly difficult. The remaining questions tested the use of skills and knowledge in the contexts of AO2 and AO3. The percentages of non-attempts on all questions were very low and broadly in line with last year.

There were four questions that asked students to evaluate or consider the information or data provided to come to their answer. Similar to last year, rote learnt responses that did not consider the information, data, or what the question asked of the students were very much evident. Students also included comments in their responses on areas in which the question specifically asked them not to comment. Examples of these are detailed in the comments on individual questions below.

There were issues with students not reading the stem of questions correctly, not considering the context of what they were being told and not addressing commands within questions. For example, 05.3 asked students to suggest and explain, rarely did they do both. Other examples are illustrated in the comments on individual questions below.

As with last year, when answering practical-based questions, students should be reminded that if a 'scientist' has completed an experiment or investigation, they can assume that the experiment or investigation has been undertaken correctly, unless otherwise stated.

Maths skills showed variable success. Students performed well when applying numbers to an equation but struggled with the log scale on a graph. Some were unable to remember how to apply the mark-release-recapture technique to determine an estimate of population size. Students struggled to interpret statistical test results as detailed further in the comments on individual questions below.

There were some examples of students not understanding taught concepts, for example, the Hardy-Weinberg principle, mistaking the limitations of this with those of the mark-release-recapture technique.

Essays remain lengthy, with most falling in the six-to-nine-page range. Once again, this seems to suggest that students were spending more than the 45 minutes on the essay that the rubric advises. This left less time for students to complete the rest of the paper. It also demonstrates that quantity does not equal quality.

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

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indicates the extent to which an item discriminates between high-attaining and low-attaining students.

Comments on individual questions

Question 1

01.1 Approximately 40% of students obtained all three marks on what should have been an easier 3-mark AO1 question. It did discriminate well. Students generally scored mark point 3. However, for mark points 1 and 2 students combined their answer into a more generic 'genetic material replicates' and so did not score these marks. Students also mentioned organelles replicating, including those not found in a bacterium. However, these statements were ignored.

01.2 This question discriminated well and approximately a third of students obtained 2 marks. The question stated that 'the actual number of bacteria can be calculated from the $\log_{10}$ value by using the 10^x button on your calculator'. However, many students ignored this and used the log button instead. Evidence of all 1-mark responses on the mark scheme were seen in student answers. Frequently, 27 was credited, where students just read the increase of log values from the graph and did no conversion.

01.3 This question involved a drug that inhibits ATP synthase in mycobacteria by stopping hydrogen ion (proton) movement. Students did not take this on board and most discussed the movement of protons to set up a proton gradient being inhibited. If they continued the story and moved onto mark point 1, this was ignored. Student also discussed diffusion of protons in mitochondria. It is an expectation that students know bacteria do not contain mitochondria, so this meant mark point 1 was rejected. It is not expected that students know mycobacteria are not photosynthetic bacteria, so answers in the context of photosynthesis were accepted. For mark point 2, many students did not mention that no/less energy would be available to produce ATP. Some students suggested that oxidative phosphorylation is the setting up of a proton gradient rather than the production of ATP. There are still many incidences of students stating energy is produced, which negated mark point 2 or 3 once. For mark point 3, there were also many incidences of students stating that energy is required for respiration.

Question 2

All of question 2 discriminated well, and 02.1 and 02.3 had the second highest discrimination index on this paper after the essay.

02.1 Approximately 20% of students scored two marks. There wasn't really a pattern to incorrect answers, ticks were seen in all boxes in all combinations. Some students misread the question and thought they only needed to add one tick for each part of the nephron. The most common missing tick was that for the proximal convoluted tubule and the statement water can be absorbed from the filtrate.

02.2 Approximately 35% of students obtained both mark points and approximately 80% at least one mark. Mark point 2 was harder to come by. Those who did not score this just mentioned

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membrane, capillary, endothelium, or glomerulus. There was also a misconception that there are no proteins in the blood, only amino acids, as proteins are digested.

02.3 Less than 1% of students obtained all 5 marks on this question. Mark points 1 and 2 were most frequently awarded. Students struggled to correctly interpret the calculated statistic of $P<0.01$ to gain mark point 1. Some did not understand that < means less than, others used confusing and contradictory language. Some students just stated that a statistical test was done to show whether the difference was significant or not. There were many incidences of 'results are significant' not qualified. For mark point 4, students did not grasp that rats do not live as long as adults. There were suggestions that the experiment should be undertaken for at least the same length of time it takes for a human to become an adult, or suggesting that at 160 days old, humans are still babies. With mark point 5, students gave the rote learnt 'small sample size' but did not qualify this with 'so not representative'. Other rote learnt responses given, that did not consider the information provided were 'sample size not known' (it was given in the question), no control (there was) and side-effects unknown (which is what they were measuring).

Question 3

03.1 Approximately just over half of the students obtained this mark. Those who did not commonly gave an answer of 3 (the number of beetle species) or 4 (the number of all species).

03.2 Students often could give one reason why the first sample of beetles was captured during the second week of August and give one reason why the beetles had to be identified before being marked. Consequently, approximately 75% of students obtained at least 2 marks. Far fewer students could provide a second reason why the first sample of beetles was captured during the second week of August. Many students either repeated a variation of mark point 1 or simply stated that the beetles would be adults or would have food.

03.3 It was surprising how many students did not know how to work out population size using the mark-release-recapture method. Only just under a third of students scored 2 marks. Commonly an answer of 810 was given due to not calculating the correct total number in the second sample.

03.4 Approximately half of the students scored 2 marks. Students sometimes gave two alternatives of mark point 5 as their answer. Some saw mark-release-recapture and didn't consider the question, giving answers of 'no migration' and 'no births or deaths.' There was a surprising number who stated, 'to ensure the same number were counted each year', i.e., ensuring the population size is constant every year.

Question 4

04.1 This was a straightforward recall question from the specification. Two-thirds of students were able to correctly draw out the general structure of an amino acid. Common mistakes were to have hydrogen from the amino group bonded to the carbon and hydrogen from the carboxyl group bonded to the carbon. There were several incidences of glucose and ATP being drawn.

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04.2 This was well answered with approximately 80% scoring the mark.

04.3 Under half of the students obtained both marks for this question. Those who scored 1 mark either could not convert cm^3 to dm^3 or used incorrect standard form. This question did not ask for the answer in standard form, so if students are unsure of how to convert into standard form, they should have left their answer as the full number.

04.4 This question asked students to suggest three reasons for the scientists' decision using all the information provided. It stated, not to refer to statistical tests, repeats or sample size in the answer. There were many examples of students ignoring this and giving rote learnt responses of 'no stats test', 'small sample size', 'other factors involved' and 'no control'. The scientists' decision they were considering was that further investigations would be required to conclusively determine the effect of age on the immune response in healthy female mice. Again, students did not consider this decision, or the information provided. They provided answers such as 'not tested in humans' and 'need to test in males' which are not relevant to this investigation. Students often answered in the wrong context by suggesting what the scientists needed to do, rather than why they reached this decision. Students often just described the data. There were many assumptions that the scientists did not perform the investigation correctly, for example, they may have fed them different diets, or they may have used mice that were not healthy in the first place. Bearing all this in mind, approximately 10% of students scored all 3 marks, approximately a quarter scored 2 marks, and just over a third scored 1 mark.

Question 5

05.1 This question showed that some students either do not understand the Hardy–Weinberg equation or did not consider the context of this question. Mostly students stated, 'do not know if the allele for CLP is dominant or recessive' or 'do not know the allele frequency'. Other ill-considered responses included 'small population size', '$\frac{1}{700}$ is too small to estimate' and ideas that humans would choose not to mate with those with CLP. There was also confusion with mark-release-recapture with answers related to no births or deaths. Approximately 15% scored 2 marks.

05.2 This question was well answered, with 70% scoring the mark. Those who did not score gave vague responses about the gene being switched off.

05.3 This question had this highest number of non-attempts on the paper at approximately 5%. Less than 1% scored all 3 marks, and approximately half scored 0 marks. Students found this to be the hardest question on the paper. The main issue was that the command on this question was 'suggest and explain', and students either only suggested or provided an explanation. Once again, 'no stats test' was evident in many responses.

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Question 6

06.1 This was well answered, with approximately 90% scoring at least 1 mark. Common incorrect responses included make it 3D, colour it in, draw the heart, blood supply/capillaries, make it bigger, add more detail and use a ruler. Students also stated to add labels or use a sharp pencil, despite being told to not refer to these in the question.

06.2 This was not answered well, despite being little beyond GCSE; approximately a third scored 2 marks. Students mostly did not mention any contraction. Students also mentioned intercostal muscles expanding, lungs being pulled out, muscles pushing the lungs and often the opposite, i.e., decreasing the volume in the thoracic cavity.

06.3 This question involved inserting numbers into an equation and converting units. Approximately 60% were able to do this. Most commonly, students only scored 1 mark due to incorrect rounding.

06.4 Some students seemed to ignore the instruction to use the information provided. Instead, they gave two symptoms of a lung infection, such as a cough, mucus, shortness of breath. Students also stated the three conditions already given. Students also mentioned needing a sample of lung tissue to identify asbestosis, i.e., a biopsy, therefore giving the opposite of what they have been asked. This meant only around a sixth of students scored 2 marks.

06.5 This was well answered, with approximately 90% scoring at least 1 mark. Incorrect answers given would likely have offended medical professionals. There were many suggestions that scanning the lungs does not require any skill and those examining a biopsy with a microscope would likely misdiagnose asbestosis. There were also lots of suggestions that a microscope is more expensive than an MRI scanner.

06.6 Just under half scored the mark. Many students incorrectly thought a control group would be made up of health patients given the drug. The question does state there is no cure, and **Figure 6** does show that patients do die even with treatment. However, students often stated a control group would die without treatment, thereby not fully considering the question.

06.7 Although all mark points were seen across the entire cohort less than 10% scored all 4 marks. Most students obtained mark points 7 and 9. Again, students did not consider the information given and gave rote learnt responses such as no stats test and correlation does not equal causation. Students also did not work on the assumption that the scientist completed the clinical trials correctly by stating that we do not know the age, gender, ethnicity or medical history of the patients. Students also incorrectly suggested that a conclusion cannot be drawn as the number of patients in each trial is not equal.

Question 7

The essay has the highest discrimination index on this paper and produces a normal distribution. Lengthy essays were evident once again, with most being in the six-to-nine-page range. Students are reminded that the exam is designed to allow them to spend no more than 45 minutes writing the essay. Quantity is in no way increasing quality; indeed, the quality of

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written communication and the use of technical terminology was often not sufficient. Some students elected to write about many topics (6+) in little detail as opposed to choosing four as required and covering them at the correct depth.

The mean score was nearly one mark higher than last year, indicating that students are improving in selecting four topics and writing about this with a good level of AO1 A level depth.

It remains that students should be, but are not often selective with what they write, instead choosing to write absolutely everything they know about a topic. In doing so, there is a two-fold risk of wasting time and including irrelevant material. There seemed to be an increased number of attempts to address the theme in each title, i.e., the AO2 element of the essay. However, this was rarely at the correct A level depth, and often superficial. This can be seen in the modal score being 15 and less than 40% of student scoring beyond the Multistructural level.

Examiners can, and do ignore minor errors in essays, however, there were still many incidences of significant errors in essays limiting scores achieved. Students may have these misconceptions in their learning, but it would be recommended that students only write about topics within which they are confident in their knowledge.

Material beyond the specification was once again rarely seen, and if present, was somewhat anecdotal, or not at correct depth to score the highest marks. Students are also to be reminded that one piece of beyond specification material does not turn a Multistructural essay into full marks. Less than 0.1% of students scored 25, with around 0.25% scoring 24 marks. Approximately 5% of students overall scored in the 'extended abstract' level.

It remains that there are 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. Students do not need to link their selected topics to each other; they only need to be linked to the essay title. This is important to note, as in attempting to do so, some essays became somewhat tenuous, and or irrelevant. This also made it harder for some students to select topics.

This year, there was an even split of students completing each essay title, but 07.1 was not as well answered as 07.2.

With 07.1, students often gave very lengthy AO1 descriptions of topics with very little about condensation or hydrolysis reactions. For example, a page long description of synaptic transmission, and at the very end stating that acetylcholine is hydrolysed. Students should have been more selective and summarised sections of topics that are not relevant to this title. Students very much struggled to address the AO2 part of this essay, i.e., the importance of condensation and hydrolysis reactions in biological systems. These sections were often irrelevant and not the importance of the reactions they had just described. For example, students describing hydrolysis reactions involved in digestion and absorption, but outlining that this is important to provide ATP for releasing the myosin from actin in muscle contraction. With regards to muscle contraction, there were many incidences of incorrect descriptions of the use of ATP in muscle contraction. Topics generally covered with more A level detail included DNA replication, ATP, the immune system, digestion, protein synthesis, photosynthesis and control

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of blood glucose. There are several reactions in our specification that do not involve condensation or hydrolysis, but students are not expected to know this, so whilst an error, were not given as significant errors. These include:

- formation of disulfide bonds in proteins
- glucose phosphate to triose phosphate in glycolysis
- GP to triose phosphate in the Calvin cycle (but does require hydrolysis of ATP)
- regeneration of RuBP from triose phosphate in the Calvin cycle (but does require hydrolysis of ATP)
- ATP to cyclic AMP in blood glucose homeostasis
- methylation of DNA/acetylation of histones

Common significant errors included:

- hydrogen bonds being hydrolysed
- water being hydrolysed
- reduced coenzymes being formed by condensation
- myosin heads binding to actin via condensation and detaching via hydrolysis
- all stages of the nitrogen cycle involving either condensation or hydrolysis

With 07.2, students often did not outline a response to a change in the internal or external environment within their AO1, only describing a process. As much leeway was given as possible with regards to what a change in the internal or external environment could be. Topics that were well described included the immune system, photosynthesis, survival and response, receptors, control of heart rate, control of blood glucose and control of blood water potential. Students should be aware that whilst not on the A level specification, recall of temperature homeostasis from the GCSE course does not count as material beyond the specification. Students found it much easier to address the theme of this essay and there were some good examples of AO2 at A level depth. A common significant error was to state that insulin causes ATP to be converted into cyclic AMP to increase the number of glucose transporters in the membrane of liver and muscle cells.

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Mark Ranges and Award of Grades

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