Questions matter

A-level
Biology

7402/3 Paper 3

Report on the Examination

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General comments

The entry for this paper was 39 542, 2.7% higher than last summer's entry.

Students found this paper more accessible than last year's, as shown by the mean mark on this paper being nearly 10 marks higher than last year. However, the standard deviation has remained the same in comparison with 2023. The range of overall marks was from 1 to 75, the highest mark being 5 higher than last year's. 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 poor, as demonstrated with questions 03.1 and 06.1. The remaining questions test the use of skills and knowledge in the contexts of AO2 and AO3. The percentages of non-attempts on all questions were very low.

There were three questions that asked students to evaluate, in which students were asked to comment on data or consider ideas. Rote-learnt responses, such as 'there may be side-effects' and 'no stats test', were evident, with no consideration of 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 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, 'apart from' or 'use the information'. Other examples are illustrated in the comments on individual questions below.

With 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 were improved compared with last year. This paper had three 3-mark maths questions, which did allow students to access some marks. However, there was a surprising inability to correctly round numbers, and confusion as one question asked for their answer to be given to two decimal places and another asked for their answer to be to three significant figures. Students generally do not understand what a statistical test is, nor correctly use the term 'significant'. There were many incidences of students contradicting themselves within 06.7 by stating the standard deviations showed there was no significant difference, but then also stating that no statistical test had been performed.

Essays were even longer than last year, with most falling in the six-to-nine-page range. This seems to suggest that students were spending more than the 45 minutes on the essay that 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.

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Comments on individual questions

Question 1

01.1 discriminated very well, and was generally well answered, with a quarter of students scoring all three marks, half scoring two marks and only 3% failing to score a mark. The most common errors included only stating 'surface' for MP1 (the question did ask for a biological term), stating 'B cell' for MP4 and stating 'passive' for MP5.

With **01.2**, just under half of students were able to score the mark, with most stating MP1, but more commonly for stating the 'accept' comment relating to antigenic variability. There was some confusion with the action of a vaccine and that of antibiotics, with students stating that HIV has no cell wall, cell membrane or metabolism so a vaccine would be ineffective. Some students were of the belief that, as HIV replicates inside cells, healthy cells would have to be destroyed for the vaccine to work, and others stated the vaccine cannot get inside cells. This is not the case with mRNA-based vaccines.

01.3 also discriminated well and was a very simple question with a very simple mark scheme that saw just over half of students score both marks. Common mistakes included stating HIV has single-stranded DNA for MP1, or giving incorrect viral structure for MP2, thereby disqualifying them from this mark. Incorrect examples included "HIV's cell wall is made of chitin" and "there is no murein in HIV's cell membrane".

Question 2

With **02.1**, students should be used to this type of question, as it is often asked. However, only 45% of students scored the mark. The question outlined to students that, **other than those stated**, they needed to suggest two variables the student should have kept constant in this investigation. Many students ignored this command and gave variables already stated. There were also many cases of students not considering this investigation, for example stating their two variables as pH and temperature. There were also vague answers given, such as volume of air and use of 'amount' for concentration, volume or mass. Other answers given that were not creditworthy included diameter of the tubing (the diagram states this had an internal diameter of 2.5 mm) and volume of water in the water bath.

02.2 was generally well answered with 80% scoring at least 1 mark and most understanding **Figure 1** and correctly identify how to move the drop to the right. Those scoring 1 mark mostly included only MP1 or MP2 but nothing incorrect. Incorrect responses mostly included pulling the syringe up or ignored the syringe and tap completely and centred on removing soda lime or woodlice.

With **02.3**, many students did not understand what a control experiment is, and well over half of students failed to score a mark. Many thought this question was asking for another controlled variable or did not understand what would be required. Incorrect responses for MP1 were mostly 'no water bath', 'do the experiment at room temperature' 'do it at the same temperature' or 'no soda lime'. Some responses for MP1 that failed to score only stated 'no woodlice' but did not detail that all other conditions/apparatus/ equipment should be the same. Incorrect responses for MP2 mostly just stated 'to compare'.

02.4 discriminated well and a third of students scored all three marks. There were many incidences of students incorrectly rounding 0.108 to 0.12, alongside many other rounding errors. Students also ignored

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the command to give their answer to two decimal places and several students used the diameter instead of the radius in their calculation.

Question 3

03.1 asked students an AO1 specification question, but many students struggled with this; only around 15% scored all three marks, and just over a third failed to score any marks. The question stated that students needed to describe and explain the relationship between surface area to volume ratio of the **human body** and metabolic rate. However, many answered the question in the context of small and large animals, often with examples such as an elephant and a mouse. For MP1, students failed to give a relationship, instead relating surface area to volume ratio to diffusion distances and the need for humans to have specialised exchange surfaces. For MP3, there were many incidences of energy being 'produced' which, as always, were rejected.

03.2 was well answered, with a third scoring all three marks, and only 3% failing to score a mark. Other than the correct answer, the most commonly awarded mark was for evidence of 0.09 and 0.06(2) in their working. This question asked for the ratio to be given to three significant figures. Students often ignored this, and many seemingly thought an answer of 24:1 was to three significant figures.

Due to a typographical error, question **03.3** was discounted and **all** students received 1 mark.
The question is still answerable, with the correct responses being the second and third. However, the word 'not' was not supposed to be in this question and the first response was intended to be the correct answer.

03.4 was generally well answered, with two-thirds of students scoring the mark. Those who failed to score confused this question with one that would have asked them to give two structural features of the gills of a fish that increase the rate of gas exchange, giving responses such as lots of capillaries, thin or short diffusion distance.

Question 4

04.1 was well answered with just under two-thirds of students scoring the mark. Those who failed to score but were not incorrect just stated 'find the middle value'. Incorrect responses included descriptions of calculating the mean or mode, or how to measure stiffness. Students also do not seem to understand the meaning of the word 'chronological'; this was often seen in place of rank or value when describing how to order the stiffness scores. Some students stated to put all 80 scores in order and choose the middle value. However, the question asked how the scientists determined the median of the stiffness score**s**, ie those plotted and not an overall median.

04.2 discriminated well, and most students were able to access some marks, with only 3% failing to score any marks. This was the first of three questions asking students to evaluate and, as per previous papers, saw rote-learnt responses given with little consideration of the question. Most students did evaluate, giving at least one reason for and one against. Students often scored MP1, MP3 (although students are still stating 'don't know if results are due to chance'), MP7, MP8 and MP9. Students stated, 'there is no control experiment', without considering that one of the groups of mice were given 0 mg kg^{-1} of

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pralnacasan and therefore was a control group. Question **02.3** may have clued them in to consider this. Students also failed to notice that 25.0 mg kg^{-1} still reduced stiffness below the 0 mg kg^{-1} group, instead stating that this concentration increased stiffness in the mice. Some students stated there was a 'significant decrease', but then stated 'there was no stats test'. There was a number of students who only described the data for their whole answer.

Question 5

Almost all students were able to name a mutation for MP1 in answer to **05.1**, with 94% scoring at least one mark. MP2 was also well answered, with 55% scoring both marks. Those who failed to score sometimes just repeated the stem for the explanation, stating 'this will produce a shorter polypeptide'; others gave vague responses such as 'bases are affected' or 'sequences are changed'. Many also just stated that a frameshift occurs as their explanation.

05.2 was well answered by most students, with 59% scoring all three marks. A quarter of students scored two marks, mostly for an answer of 4, ie they did not factor in that only 80% of mutations are in nuclear DNA.

The idea behind **05.3** was to test students' understanding of genetic drift. However, this was rarely seen, and if it was, students did not seem to understand what it is and did not score MP2. More commonly, students scored either MP3 or MP4, but rarely both. A quarter scored two marks, and half of students scored one mark. With MP3, there were many incidences of 'genetic bottleneck' or 'founder effect'. Whilst these were acceptable, it is worth noting that these are no longer in the specification and do not need to be taught. Responses that failed to score MP3 often just repeated the stem of the question, eg there is a small population, or the islands are isolated. For MP4's last two alternatives, the term allele was required. However, most students referred to 'the mutation' instead. Lots of students also stated that the reason the frequency of LS is higher in the Faroe Islands than globally was 'if there are two carriers, the chance of inheriting LS is higher', which did not equate to MP4.

05.4 was the second evaluation question on this paper, and a fairly even split of students scored one, two or three marks. Again, some students did not evaluate, but it was generally well answered. Again, rote-learnt responses were evident, with 'no stats test' commonly stated, which in the context of this question is somewhat meaningless. Lots of students stated that a reason for screening is that, if caught early, LS could be cured, again not really considering what they have been told or what LS is. Some thought that, as LS usually causes death within the first three years, it is not worth screening as they will die anyway, or stated that due to this LS cannot be passed on. There was a number of students stating that only those who are heterozygous or carriers should be screened, without considering how illogical this statement is.

Question 6

06.1 required students to recall the specification definition of the term population, which was poorly done; 64% of students failed to score a mark, and only 5% scored two marks. Many students failed to score MP1 for either defining a community or not including time.

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06.2 saw 62% of students select the correct answer, with an even split of those who failed to score choosing each of the distractors.

06.3 discriminated well, showing a normal distribution across the marks available. This was the final evaluation question on this paper. Most students were able to evaluate, with very few only giving reasons for or against. The most common reasons 'against' seen were MP5, MP7, MP8, MP9 and MP10. Some students attempted to compare the two lines on the graph thinking they were not part of the same study, and those who failed to score any marks mostly misinterpreted the question and instead gave reasons for and against protecting bird species, or explained why protecting bird species would increase biodiversity.

06.4 saw just over a third of students correctly answer the question. Those who failed to score commonly suggested that the data were only recorded for 30 years so we don't know what happens beyond or made suggestions, such as birds may become extinct in the future.

06.5 was answered well considering application of succession is often something students find challenging. Just under 90% of students were able to score at least one mark. Students who failed to score did not take into consideration the timescale on the x-axis, suggesting that in 1949 there was only one species, hence they were all the same, and that over the next 30 years mutations led to evolution and speciation causing there to be many different species.

In contrast to 2023, there was a much lower percentage of non-attempts with the last two question parts before the essay. Last year the percentage of non-attempts was 13% on both, whereas this year the percentages of non-attempts were 5% and 2%.

06.6 discriminated well, with a fairly even split of students scoring zero, one and two marks. Many students were able to correctly suggest a climax community for MP1, although some only stated 'climax'. MP2, however, was not answered well by most students. As with **06.5**, students did not take into consideration the timescale on the x-axis, suggesting speciation will occur; others suggested that the environment causes birds to mutate and become different and others only defined succession, and did not consider what results in a climax community, and why species in a climax community might not be absolutely constant.

06.7 saw many correct interpretations of all mark points, with 85% of students able to give at least one reason, but only 11% of students were able to correctly give three reasons. There were incidences of students correctly stating MP1, but then stating 'no stats test' for their second suggested reason. As with **06.5** and **06.6**, many students focused their responses on mutations and their effect on biodiversity without considering that the LPI is a measurement of the world's biodiversity.

Question 7

As with previous years, there seems to be a trend for increasingly lengthy essays with most essays being in the six-to-nine-page range. Students should be reminded that the exam is designed to allow them to spend no more than 45 minutes writing the essay. Quantity does not lead to increased quality; indeed, the quality of written communication and the use of technical terminology was very poor.

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The essay discriminated well, and the mean score was nearly one mark higher than last year, indicating that students found this year's titles slightly more accessible. The standard deviation of the mean was, however, slightly lower than in 2023.

Students should be, but are often not, selective in what they write, instead choosing to write absolutely everything they know about a topic. In doing so, there is a risk of wasting time. For example, there were incidences of 3–4-page descriptions of protein synthesis that could have been summarised at the correct depth within half a page if students had selected the correct aspects of protein synthesis to write about. There is also a risk of losing relevance to the title; this was the case, and is outlined in each essay title below. There were very few attempts to address the AO2 element of each essay title, ie the 'importance of', and rarely were the attempts at A-level depth. This can be seen in the modal score being 15 and only 29% of student producing essays beyond the multistructural level.

Once again, material beyond the specification was rarely seen and, if present, was somewhat anecdotal or not of the correct depth to score the highest marks. Although some students included material beyond the specification that was good, if the rest of the essay was not of a sufficient standard for it to be in the 'extended abstract' level, this material could not qualify for the highest marks. 0.04% of students scored 25 (unchanged from 2023), with a further 0.19% scoring 24 marks. Overall, only 3.26% of students scored in the 'extended abstract' level. There were incidences of students who, having reached a score of 24 or 25 marks, chose to carry on writing and added paragraphs to the end that were less detailed and often irrelevant. This dropped these students into the relational level and sometimes into the multistructural level. Students who have the capability to write at the extended abstract level should know when to stop writing and have the confidence to stop after writing about four or five good topics.

There were still 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, slightly more students completed **07.2** than **07.1**.

07.1 commonly saw generally good AO1 A-level depth descriptions of DNA replication, ATP, transport across cell membrane and protein synthesis. Lesser used topics, but those that still showed good A-level depth were nerve impulses, synaptic transmission, the control of blood glucose and regulation of transcription and translation. Topics that were less well written about included digestion and absorption, photosynthesis and respiration. Additionally, these topics were mostly full recall of everything learnt about them, with little consideration of the phosphorus-containing substances within these biological systems. Some students chose to write about ATP, and then the role of ATP in several other topic areas. Theoretically, this made their essay title 'ATP and its importance in biological systems', and by only writing about one phosphorus-containing substance, very much limited their ability to discuss the importance of this in different ways. Most commonly, students outlined that, without ATP, the process they described would not happen, or would result in death. There were quite a few students who thought proteins are phosphorus-containing substances, and so wrote a paragraph about this. This not only is a significant error, but also irrelevant. Some then chose to write about enzymes as phosphorus-containing substances, again resulting in another significant error, and an irrelevant section, as this is a different part of the specification. Generally, the AO2 'importance of' aspect of each topic within this essay title was poorly answered, with little beyond GCSE depth. Students do need to understand where to stop and when they are becoming irrelevant with regard to AO2. For example, students who chose to write about the role of DNA and RNA in protein synthesis gave good AO1

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descriptions of how DNA and RNA are involved in transcription and translation. However, for their AO2, most students chose to write about protein structure instead of outlining how and why DNA and RNA are important in protein synthesis . If this was related to DNA coding for the primary structure of a protein, which determines how the secondary and tertiary structure is formed, and the need, therefore, for accurate transcription and translation, this would be fine. However, most gave page-long descriptions of protein structure with no reference to the importance of DNA and/or RNA and outlined the importance of proteins in biological systems. This now becomes irrelevant, as it is no longer the importance of phosphorus-containing substances in biological systems. Common errors included outlining how DNA polymerase forms hydrogen bonds, confusing hydrophilic and hydrophobic, stating reduced NADP provides energy in the same way as ATP, thinking that every reaction is either condensation or hydrolysis, thinking every bond is a hydrogen bond, and thinking that energy from ATP hydrolysis is used for every aspect of muscle contraction.

07.2 Whilst this title commonly saw some good AO1 A-level depth descriptions in several topics, there were many significant errors within these descriptions. Areas well covered included transport across cell membranes, photosynthesis, respiration, survival and response (IAA), receptors, control of heart rate, nerve impulses, and synaptic transmission. Of variable quality were the topics of mass transport in plants (often translocation was outlined as only the movement of glucose and not sucrose) and the contraction of skeletal muscles. Mass transport in animals was often at GCSE level, as were gas exchange, control of blood glucose concentration (very little on the second messenger model) and control of blood water potential. Almost all topics selected allowed students to write about processes within organisms. However, there were many topics that, due to how students wrote about them, were of marginal relevance. As previously mentioned, this was due to students writing a long recall section of what they had learnt, but not making any attempt to make it relevant to this essay title by referencing the mechanism or importance of transport. Something that often limited students to the unistructural level was them not understanding the specification and what constitutes a different topic. For example, some students chose to write about haemoglobin, blood circulation, the cardiac cycle and the formation and return of tissue fluid thinking this was four topics, whereas they are all part of “3.3.4.1 Mass transport in animals”. Similarly, this happened with “3.3.4.2 Mass transport in plants”, with students thinking transport in the xylem was one topic and transport in the phloem was a separate one, and with topic “3.3.2 Gas exchange”, with students thinking gas exchange in plants, insects, fish and humans were four separate topics. Similar errors appeared as those described in 07.1. In addition, there were errors stating water can move by active transport, ions move by osmosis, that sodium ions are actively transported from the epithelium of the ileum into the lumen of the ileum so they can diffuse back in, calcium ions from the pre-synaptic neurone are the calcium ions that bind to tropomyosin, and ATP is used to pump hydrogen ions in the electron transfer chain. There were also many incorrect descriptions of reabsorption throughout the nephron and incorrect descriptions of how blood flows into, through and out of the heart.

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Mark Ranges and Award of Grades

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