AQA
Questions matter

AS
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Report on the Examination

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General points

This paper produced a wide range of marks, with students displaying good AO1 knowledge of a variety of the specification content. As always, students struggled with the more applied aspects of questions and evaluation questions. Question 1 was about water and revealed some confusion between the terms specific heat capacity and latent heat of vaporisation. Question 2 required students to apply their knowledge of osmosis and antigens. Question 3 asked about cell fractionation and ultracentrifugation and the initial AO1 part was generally well answered. The second part of the question required students to evaluate an investigation. This created some issues with students clearly not reading the provided information carefully enough. Question 4 was about transcription, but in a new scenario. Well-prepared students understood the investigation and scored well, however there was the usual confusion about prokaryotes only having single-stranded DNA or only having plasmids. Question 5 was about plants and a microscope-based practical. Although this question was generally well answered, students should be encouraged to think about avoiding repetition in their answers. Question 6 was about disinfectants and bacterial growth and students struggled with the calculation of uncertainty. The second part of the question involved the evaluation of an investigation into the effectiveness of a disinfectant using a colorimeter. This question was poorly answered, and students should be encouraged to organise their answers to longer questions in separate sentences or bullet points. Question 7 was about mutations and was generally well answered. Question 8 was about the ELISA test. The first part involved application of knowledge to a new scenario and better-prepared students scored well. The second part of the question involved evaluating an investigation and this was particularly poorly answered. Marks were again missed because students failed to read the information provided carefully enough. Question 9 proved to be an excellent discriminator. Well-prepared students displayed excellent AO1 knowledge of the role of haemoglobin and the process of translation.

Question 1

01.1

Some confusion between the terms was evident and some students simply gave the physics definitions without linking the importance to living organisms. However, almost half the entry did manage to score both marks.

01.2

Students struggled with this question, with only a small minority able to clearly articulate the idea of negative pressure or tension being created due to the evaporation of water. Some students simply described what happens in a plant.

01.3

This simple calculation caused few problems to numerate students.

Question 2

02.1

This was a very straightforward magnification calculation, and most students were able to gain at least one of the two marks.

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02.2
This calculation proved more demanding with far fewer students scoring the full two marks. The most common errors were in the scaling up from mm^3 to dm^3.

02.3
The idea of the same water potential was well understood by most students, who were able to state that osmosis would cause blood cells to burst or shrink.

02.4
This question was not well answered, with too many students writing about the anti-B antibodies in the donor blood, rather than the anti-A antibodies in the recipient. There were also vague references to the immune response and antibodies 'attacking foreign antigens'. A significant number of students simply re-stated that agglutination would occur, without understanding what that meant.

02.5
A surprising number of students failed to identify blood group O as the 'universal donor' and wrote a random selection of blood groups on the answer line.

Question 3

03.1
The inclusion of more detail would allow students to increase their marks by a useful amount. Often part of but not the whole of a marking point was seen, so credit could not be given.
MP1 - students tended to give all three parts of the answer (cold, buffer, same water potential) or none.
MP2 - homogenise was well-known, filter less so.
MP3 - students often omitted reference to low speed for the initial centrifugation.
MP4 - the use of the word 'it' is unhelpful in producing a clear response. 'Centrifuge it again at higher speed' was unlikely to gain credit unless the student had made clear reference to the supernatant elsewhere in their answer. Almost two-thirds of students managed to score at least 2 marks.

03.2
Students should expect to comment on SD, if presented with a graph showing error bars. In this case, full marks could be obtained only by including a correct comment about the non-overlap of standard deviations.
MP1 was credited relatively infrequently. Students continue to lose marks when they do not state that it is the *difference in means* which is significant, instead commenting on just 'the results.' There is some misunderstanding of means: several students stated that the 'all participants showed an increase'.
MP 3, 4 and 6 were seen correctly stated on many scripts, providing three of the maximum five marks.
MP 2, 5 and 7 were less frequently awarded.
There was confusion over the term 'mitochondrial respiratory capacity' with too many students writing about 'improved oxygen uptake' and 'less anaerobic respiration'. There were also too many references to 'improved ATP production needed FOR respiration'. Better answers referred to the idea that increased ATP production may not necessarily improve athletic performance. This question scored reasonably well, however, with almost a third of students achieving four out of the five marks.

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Question 4

04.1
Most students were able to correctly identify the nucleus as the site of transcription, although confusion with translation did provide some 'ribosomes' and 'rough endoplasmic reticulum' answers.

04.2
Generally, students struggled with this question. Many students left the answer space blank and many wrote anything and everything they knew about DNA, RNA and splicing without putting it in any context. Mark point 1 was seen, but rarely; many students seemed to think the DNA was pre-mRNA and answered the question from that standpoint. Although, unless they wrote that the DNA was spliced, many could access MP1. MP2 was rarely seen. MP3 was attempted by many students, although many failed to gain the mark because they wrote that DNA and RNA are complementary without referring to the base pairs or hydrogen bonding. MP4 was achieved by most students, despite showing no understanding of what was happening. MP5 was attempted by many but referred to the mRNA being shorter than the pre-mRNA or to the DNA being shorter; and didn't mention splicing at all.

04.3
This was answered surprisingly badly, with almost half the entry scoring zero marks. Many students failed to attempt it at all and those who did often wrote about how DNA in prokaryotes is single-stranded so no hybridisation would occur. Of the two marks available, more achieved MP2, no introns in prokaryotes, rather than no loops. Unfortunately, many students misinterpret the fact that in bacteria DNA is a single loop to mean the DNA is single-stranded.

04.4
The most common response covered the third marking point – deletion of exons, though many stated the converse and referred to introns NOT being spliced out. Marks were not awarded for vague references to changes in the 'code,' rather than to base sequence or to nucleotide sequence.

Question 5

05.1
Too many students failed to achieve MP1 due to vague references to 'comparing the DNA' or the 'genetic code', rather than **DNA base sequences**. Although many students understood the idea, they often failed to achieve MP2 because they just wrote about comparing the DNA.

05.2
A surprising number of students failed to identify that all cellular organisms have ribosomes.

05.3
Most students were able to achieve both marks on this very straightforward question. Marks were occasionally missed for failing to link the increased light availability with increased rate of photosynthesis.

05.4
Most students were able to state that the tissue needed to be thin to allow light through, but fewer achieved MP1. Some answers referred to reducing diffusion pathways in the leaf for better gas exchange – a clear indication that questions need to be read more carefully

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05.5
Many students achieved MP1 and MP2. Fewer students stated MP3 or MP4. MP5 and MP6 appeared quite frequently. A number of answers supplied all three options for MP1, and students need to be aware of repetition like this. Quite a few students referred to 'only draw what you can see' or 'make the diagram at least half the page size.' Some referred to drawing from a photo, which is presumably what students at some centres do. Labels only on the left/right, with/without arrow heads are all directions which some students gave; these were not creditworthy.

Question 6

06.1
Most students were able to correctly state the volumes required for a 60% concentration, although some failed to gain marks for only describing the ratio required, rather than the volumes.

06.2
Uncertainty does not appear to be well understood, with many students showing no idea. Almost as much of a concern was the inability to calculate a percentage value from their stated value of uncertainty.

06.3
There were many long, rambling answers to this question, with some students simply re-stating the results from the table. MP3 and MP6 were very rarely seen and MP4 was often poorly expressed. Students would be well advised to consider the structure of their response to evaluation questions. A series of separate sentences or bullet points would help to organise their response and avoid repetition. Careful reading of the rubric is also essential in questions like these.

Question 7

07.1
Some very good answers were seen to this question, with students describing the failure of chromatids to separate properly and identifying the mutation as a non-disjunction. Marks were missed for references to homologous chromosomes separating, despite being told that the mutation occurs in the second meiotic division. Overall, almost half the entry scored zero for this question.

07.2
Again, there were some good answers to this question, with students understanding that the mutation has occurred in the gamete and will, therefore, be present in all body cells due to subsequent mitosis of the zygote. There was a small number of references to body cells being produced by meiosis, which is disappointing at this level. As with 07.1, almost half the entry scored zero for this relatively straightforward question.

07.3
Students struggled with this question, with a surprising number leaving the question blank. Incorrect answers often referred to the mutation occurring in gametes and during fertilisation despite being told that the mutation happens after fertilisation.

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07.4
Most students correctly identified the correlation coefficient.

07.5
A large number of students seemed fixated by the idea of oxygenated and deoxygenated blood mixing, which was completely irrelevant to the question. Most of the students achieving MP2 did so for identifying the pulmonary artery, rather than for understanding the increased volume of blood and, therefore, pressure in the lungs. A minority of students are still mixing up the left and right sides of the heart and the pulmonary artery and aorta.

Question 8

08.1
Some very good answers were seen, showing a clear understanding of the ELISA process. There were also answers that rambled on about antigen-antibody complexes and enzyme-substrate complexes, without any clear indication of what was happening. A minority of students focused on the idea of contamination with other bacteria, presumably because they had seen the word 'wash.'

08.2
Some students gained a mark for simply stating that there were similar antibodies or antigens involved. Better answers understood that the antibodies produced against syphilis antigens would be complementary to the *B. burgdorferi* antigens in the test.

08.3
This proved surprisingly difficult for a lot of students. There were many references to 'not enough bacteria in the body,' or 'not enough bacteria to bind to the antigens.' Students who did score a mark often did so for MP1, with only the better students linking this to the primary response and plasma cells for two marks.

08.4
This question was very poorly answered, with many students misunderstanding the data in the table. There were lots of references to the differences in percentages being significant due to the P values, or to there being 'no data on the intensity of symptoms,' despite this being clearly labelled in the table. There was much re-writing of the data in the table, which gained no credit, and the understanding of P values and significance was often very confused. MP1 was often missed just because students expressed themselves so poorly and simply wrote about 'more people having symptoms.'

Question 9

09.1
Many students demonstrated an excellent knowledge and sound understanding of this topic, achieving four or five marks. They gave well organised accounts that addressed, in sequence, the loading, transport and unloading of O_2. Most students gained at least one or two marks, so this was a generally accessible question, with MP1 and MP5 awarded most often.
It was pleasing to see that the topic of cooperative binding of O_2 to haemoglobin was well understood. However, many students gave far too much detail here and insufficient in other areas – given the breadth of the question. No detail beyond the description in the specification was required.

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It is worth highlighting that the question command word is 'Describe' and so detailed explanations gained no extra credit. For example, there were some accurate and detailed explanations of the role of pH in O_2 binding - often at the expense of some simple details elsewhere and so marks were missed.
The most common omission was failing to state where each process was occurring: in the lungs for MP1, in the cells and tissues for MP5.
In better responses it was clear that students appreciated that all cells/tissues receive O_2 from oxyhaemoglobin whereas weaker answers tended to refer only to muscles. Frequently red blood cells were not mentioned at all in the entire answer and so students failed to gain MP4 (the lowest scoring MP) because of it. Weaker answers also focused on haemoglobin's affinity for O_2 changing and failed to gain marks by not describing loading and unloading. There were also incorrect references to haemoglobin having 'no nucleus' and 'a large surface area for gas exchange'. It was pleasing to see that the vast majority of students correctly referred to partial pressures of O_2 or CO_2, as opposed to simply referring to concentrations of these, which gained no credit.

09.2
The majority of students attempted this question, although a minority did not write anything.
Most students successfully scored some marks, with few scoring zero marks. The process of translation was generally well understood, and it was pleasing to see many well-written responses describing translation in full, scoring the full five marks.
The best answers described translation in a series of logical steps, often numbered or in bullet points, and clearly communicated the role of mRNA, tRNA and amino acids in forming a polypeptide.
The weakest answers used vague terminology, such as 'other strands' or referred to incorrect or irrelevant processes or enzymes such as 'splicing' and 'RNA polymerase' respectively. The majority of answers correctly stated that mRNA attaches to ribosomes (MP1). There were very few references to 'rough endoplasmic reticulum.' Many did not score MP2 as they did not convey the idea that codons and anti-codons are complementary. Many students were not awarded MP3 as they referred to tRNA molecules 'bringing amino acids,' rather than specific amino acids. It was rare to read answers that included the role of ATP in joining amino acids to tRNA (alternative point for MP3). Joining of amino acids by a peptide bond (MP4) was very commonly seen, although some students confused their answers with reference to other types of bond (hydrogen, ionic, etc.). Surprisingly, few answers mentioned the role of ATP in forming peptide bonds (MP5). Only a small number of answers clearly conveyed the idea that tRNA molecules were released after amino acids were joined to the growing polypeptide chain (MP6). Many students correctly described the ribosome moving along the mRNA to form the polypeptide chain (MP7).
A small number of students described transcription and scored zero marks. It was unexpected to read references to 'splicing', 'introns/exons', 'bases', and 'DNA'. Also, a small number of students wrote about post-translational modification and polypeptide folding in the Golgi apparatus.

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Mark Ranges and Award of Grades

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