AQA

AS
BIOLOGY

7401/2: Paper 2
Report on the Examination

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General Comments

Topics in which students demonstrated good knowledge included the role of ions and movement of substances across membranes, the role of haemoglobin in oxygen transport and the differences between mitosis and meiosis. The question on immunity (Q4) appeared to be more accessible to students than equivalent questions on previous papers. Knowledge was less secure on protein digestion and investigating diversity.

Many students missed opportunities to score marks by failing to take note of the detail shown in patterns of data and by omitting obvious detail in their extended answers.

Examiners commented on the poor legibility of handwriting shown in a significant number of answers and the extensive use of blue ink instead of black ink, which more than occasionally made it difficult to read these answers.

Question 01.1

This question discriminated very well, with secure understanding of protein digestion demonstrated by approximately 40% of students. Conversely, around 40% of the cohort had little, if any, knowledge of protein digestion above that expected at GCSE level. Examiners reported seeing many descriptions of digestion in general terms and many of how enzymes act, again in general terms. Students frequently mentioned lipase and carbohydrase and achieved no marks.

The action of endopeptidases and exopeptidases was known by many; however, references to dipeptidase enzymes were less common. Answers with good descriptions of all three types of protease often failed to achieve full marks because they failed to mention the hydrolysis of peptide bonds. Occasionally, students failed to gain a mark because their description gave a dipeptidase hydrolysing more than a single bond in a dipeptide. Some failed to gain marks by incorrectly naming the enzyme, eg exodipeptidase, or by giving an incorrect product of a reaction.

Question 01.2

This question tested students' understanding of how to use statistics to draw valid conclusions from data presented in the form of a bar chart and it was a good discriminator. Approximately 10% of students scored all three marks; their answers showed clarity in their understanding of how statistics supported a conclusion.

Those scoring no marks invariably ignored the error bars to describe a trend in the data and often contradicted themselves by then saying that there was no significant difference in the percentage of absorbed protein. It suggested many students have little understanding of significance testing. Those who correctly referred to the overlapping of two times the standard deviations did not always link this conclusion to differences between mean percentages of absorbed protein. They often referred, incorrectly, to differences between percentages of protein in the diet.

Question 01.3

Students found this a challenging question, with about a third achieving no marks. Many answers began with a general description of the digestion and absorption of nutrients or materials so did not address the benefit to rabbits of eating their own caecal droppings. When the explanation turned to what happens with re-ingested food, answers usually achieved a mark for the idea that more protein is digested. Students often mentioned the role of the stomach or ileum in absorption, although many kept this answer general by mentioning vaguely that absorption occurred in the digestive system. Few students identified amino acids as the product being absorbed; again, they used a general statement about absorbing proteins rather than include some obvious AS level detail. Relatively few students achieved all 3 marks, often because otherwise well written, logical suggestions included at least one of these general statements.

Question 02.1

This question discriminated well. Examiners noted some detailed and accurate explanations, which showed these students made secure links between respiration, pH changes and the oxygen supplied from haemoglobin.

Approximately two-thirds of students accurately described the effect of carbon dioxide on haemoglobin's affinity for oxygen and many went on to explain it in terms of reduced pH. Some muddled answers contained contradictions; for example, 'haemoglobin unloads more easily when its affinity for oxygen increases', or 'a shift of the curve to the left shows a reduced affinity for oxygen'. A common misconception observed in many answers had carbon dioxide bound to haemoglobin. Many students failed to gain a mark by linking the change in haemoglobin's affinity for oxygen to changes in the rate of respiration rather than to changes in pH. Some students did not confirm the direction of the pH change, or stated that increased acidity caused an increase in pH value.

Question 02.2

Many students accurately applied their understanding of oxygen dissociation curves in the context of a diving mammal. The majority of correct answers included reference to myoglobin's increased affinity for oxygen, or that it loaded/associated more readily. Some failed to gain this mark because they referred to the affinity of a seal or they used haemoglobin in the wrong context.

Fewer students went on to explain how the adaptation enabled diving. The most frequent mark gained here was for references to supplying oxygen to use in respiration during a dive, or that myoglobin acted as an oxygen store.

Question 02.3

Approximately 80% of students achieved at least one mark because they recognised and used numbers in standard form and successfully manipulated data to calculate valid figures in the context of a diving seal. Many set out their working logically and demonstrated appropriate sequential thinking. A significant number failed to gain one mark because they incorrectly rounded down the correct answer, or they calculated the time a seal of 1 kg mass could remain under water, or they calculated the oxygen used by a seal in one minute.

Question 03.1

Only about a third of students successfully named the scientists. Many of the rest either left the answer blank or referred to scientists such as Meselson and Stahl.

Question 03.2

This enzyme is well known; three quarters of the students achieved the mark.

Question 03.3

This question discriminated quite well, although it was rare for students to get all three marks. The majority understood that the DNA fragment is a template against which free nucleotides line up in complementary pairs; however, very few went further to say that the order of nucleotides in the new fragment is determined by the order on the template.

Question 04.1

This question tested knowledge of an immune response leading up to phagocytosis, and many students knew it well. It was a good discriminator. Examiners noted good descriptions of antibody-antigen complex formation leading to agglutination/clumping of pathogens. There were fewer references to these complexes attracting phagocytes. Inaccurate statements, such as 'they signal', 'identify' or 'alert' phagocytes, gained no mark. More than occasional references to antibodies with active sites or antibodies as memory cells were some of the misconceptions observed in answers. Descriptions of cell-mediated responses gained no credit.

Question 04.2

Approximately 40% of students successfully translated information between graphical and numerical forms and successfully completed the calculation. A further 10% achieved one mark for identifying the correct co-ordinates in Figure 4, but could not calculate the correct figure. A frequent error was to use 5.2 as the concentration of antibody in mouse Z, rather than the correct number of 5.1. Approximately 10% of students did not attempt to answer this question.

Question 04.3

This question discriminated quite well. Many students successfully used their graph-reading skills to take appropriate information from Figure 4 and linked it to a good understanding of the humoral immune response. Examiners noted many well explained answers contained references to primary and secondary responses and identified the long-term effectiveness of this vaccine.

Many students did not gain marks because they failed to use mean values in their explanations, or they described a pattern shown in Figure 4 without going further to link it to underlying changes in the immune response. Relatively few students included references in their explanation to either memory cell production or memory cell use, so failed to gain marks. A minority of students gave nicely worded general explanations of the immune response without linking any of these ideas to information shown in Figure 4; they also achieved no marks. Most students appreciated the significance of the protective antibody concentration and successfully used it to determine the success or otherwise of each injection.

Examiners noted that marking this question was more than occasionally hindered by poor legibility of handwriting and students' poor expression.

Question 04.4

Over half of the students achieved at least one mark on this question, but it was not a good discriminator. The marks were usually given for references to injecting the antigen or pathogen and observing faster/more rapid antibody production. Using a 'disease' or 'injecting meningitis' were common misconceptions. Occasionally, ideas on ELISA testing were used; however, these invariably tested for antigens rather than for memory cells. Many students did not make a comparative answer about the amount of antibody produced, saying 'high/fast antibody production' instead of 'higher/faster antibody production'.

Question 05.1

This question tested a practical skill of using apparatus to record quantitative measurements and it proved to be very difficult for the majority of students: only about 2% achieved both marks. Students did not appreciate that the question wanted a practical solution using the apparatus shown, so suggestions such as, 'measure volume' or 'record the drop in water level inside the beaker' were common and gained no mark. Many suggested incorrectly that the dimensions or mass of the celery would change or they used poor expressions such as 'measure changes in the mass of the beaker' rather than record the initial and final mass of the beaker and all of its contents.

A relatively small number of students successfully referred to the units given for determining the rate of water movement; consequently, few mentioned counting the xylem vessels.

Question 05.2

This question was answered correctly by around 65% of students, but did not discriminate particularly well. Examiners suspected that success in applying a good understanding of practical techniques in the novel context of using a weight potometer was centre-dependent. Some students confused the weight potometer with a bubble potometer by, for example, commenting on 'the movement of bubbles through the oil' or that 'oil prevented bubbles forming inside the xylem'. Others suggested incorrectly that the oil lubricated water movement or it prevented unwanted substances from entering the beaker.

Question 05.3

In this question, students were asked to apply their understanding of the cohesion-tension theory to a problem set in an investigation. It discriminated very well. A relatively small number of students showed an excellent understanding of the cohesion-tension theory and succinctly articulated the details of this process.

The question performed well for those who realised that water movement in the celery began with evaporation. Unfortunately, about a third of all students scored no marks and many gave explanations that skirted around the cohesion-tension theory, and confused its stages. Some of the misconceptions observed in many answers included cohesion or evaporation creating the tension in water, or descriptions of tension being a force that pulls up a water column, or evaporation reduces hydrostatic pressure. Many also suggested incorrectly that water moved along xylem vessels down an osmotic gradient. Some confused transpiration and translocation by mentioning the idea of a 'source' and 'sink'.

Question 05.4

This question tested an understanding of using dissection instruments safely and, judging from the high level of detail provided in many answers, it appears that scalpels are being used in AS practical work. Most students achieved at least one mark, usually for describing how to cut celery without causing injury. Far fewer considered a type of surface against which to make the cut and, for this reason, the question did not discriminate well between students of different ability. Those who achieved no marks tended to describe how to safely transport or store the blade, which did not address the question. Answers that suggested wearing gloves to protect fingers while cutting were common and achieved no mark.

Question 05.5

Only around 10% of students failed to score at least one mark, but the majority chose to calculate a mean which limited them to one mark and, for this reason, the question did not discriminate well. 15% of students gave the correct answer, ‘median’, and most of them recognised the relevance of the outliers. A very small number selected the mode and they invariably identified its correct value.

Question 06.1

The question discriminated quite well, with the majority of students recognising that they had to both describe and explain relevant aseptic techniques. In many responses, the depth of detail demonstrated that students had actually used these techniques in practical work.

About one third of students achieved no marks because they did not explain why their suggestions achieved aseptic conditions or they gave an inaccurate explanation: for example, an upward current of air ‘kills bacteria’. These omissions reduced the level of discrimination achieved by this question. Some students moved their description beyond the scope of the question by, for example, considering how agar is sterilised or the safe disposal of contaminated equipment. Examiners observed descriptions such as flaming the bottle neck or sterilising the lid of an agar plate; again, these gained no marks. In some otherwise detailed and nicely articulated answers, a significant number of students could not gain a mark because they failed to say how an inoculating loop or a spreading device was sterilised.

Question 06.2

This question was relatively straightforward, with more than half of students achieving full marks. The majority knew differences between mitosis and meiosis and many successfully articulated this in concise, well-structured and comparative sentences. The most frequent correct answers made references to the number of cells produced, to the number of divisions involved or to differences in genetic variation found in the daughter cells. Some failed to gain a mark because they described ‘stages’ rather than (nuclear) divisions. General statements, such as ‘mitosis is involved in asexual reproduction while meiosis is sexual’ or ‘mitosis produces diploid cells’, did not gain credit, since these are not true of all life cycles.

Question 06.3

This question provided high challenge, not least because many of those who knew that the diploid number was 14 did not answer the question, which asked them for the number of **chromatids**, not the number of chromosomes. Approximately 37% of this cohort achieved the mark.

Question 06.4

This was a difficult question, testing objective AO3, by asking students to draw a conclusion from information given in a theoretical context. Around 60% of students either did not attempt the question or achieved no marks.

Some excellent answers achieved full marks by explaining how the data supported the idea that random segregation and crossing over happened in this fungus. Those who scored no marks usually just described the numbers given in Table 2 and did not link their ideas to meiosis. Frequently, students scored one mark for recognising that homologous chromosomes separated, or that independent segregation occurred. It was not uncommon to see references to independent assortment, which is not relevant to a situation about a single locus. Many referred illogically to the random movement of chromosomes during meiosis rather than the idea that chromosomes line up in a random arrangement and many failed to gain the mark by discussing the arrangement of spores rather than the arrangement of chromosomes.

Examiners noted many students gave good descriptions of crossing over without always linking this knowledge to data given in Table 2.

Question 07.1

Students found this to be a difficult question, but it discriminated well.

Many students did not name a type of selection identified in the Specification. It suggested that topic 3.4.4, 'Genetic diversity and adaptation', is not covered well in all centres. The inaccurate types of selection students suggested included: planned, continuous, human, artificial, selective advantageous, systematic, chosen, variable, specific, differential, individual, bias and statistical. Those who did give 'directional selection' often went further to give an appropriate reason.

Examiners noted many answers gave inaccurate reasons for choosing directional selection. Some described a consequence of directional selection; for example, 'to select the best' or 'get fish of the required size' rather than 'choosing or favouring' one extreme type.

Question 07.2

A majority of students achieved at least one mark and almost half achieved both marks. The importance of a control and reasons for it were well understood. Most correct answers referred to 'control' rather than 'baseline' and many students went on to explain in detail the purpose of using this control, usually, but not exclusively, by comparing the results from tank B with the results obtained from other tanks.

Question 07.3

This multi-step mathematics problem tested students' ability to translate information from a graph into ratios and then to compare these ratios. The correct answer was achieved by a quarter of the students. Many more than this correctly calculated both ratios, but compared them using a numerical difference forgetting that the figures showed proportions. It explained why the discrimination value of the question was only quite good. Those who achieved no marks usually failed to give ratios or they had misread one or more of the co-ordinates in the graph.

Question 07.4

This question required students to look critically at information collected by scientists and use it to evaluate whether it supported a suggestion. This proved to be a difficult question, with just under half of all students concluding correctly that the evidence did not support the use of this type of fishing net. Many students gave valid reasons to support the correct conclusion without actually stating whether or not the scientists' suggestion was supported; they did not score marks. A frequently seen misconception was that the net reduced the size of the fish population rather than what was shown in Figure 8, that it reduced the mass of fish in the population. Examiners regarded this to be a consequence of students failing to take careful note of the label on the y-axis.

Many lengthy answers contained contradictory ideas and were not presented as a logical sequence. Only around 1% of students covered contrasting sides in their evaluation, so very few gained all three marks. This explained why the discrimination of the question was quite low.

Question 08.1

This question proved difficult for students even though it tested recall (AO1) of topic 3.4.7, 'Investigating diversity'. Many students gave answers which did not make a comparison, so answers such as 'amino acid sequence' did not score. Students commonly wrote about comparing amino acids without mentioning sequences, so did not score. Answers relating to immunology were seen frequently; some gained the mark with well-constructed descriptions, but many failed to refer to the idea of comparing the **amount** of antibody bound to antigen/protein. References to 'immunological differences' did not contain enough detail for a mark.

All the answers identified as 'ignore' in the comment section of the mark scheme were seen, with 'courtship' appearing most frequently. Many answers referred to comparing DNA or RNA sequences even though the question instructed students not to do this.

Question 08.2

This was a straightforward test of students' ability to calculate a percentage and give a context to theory in the question. About two-thirds of students calculated it correctly. Many, however, miscounted the base differences or calculated the percentage similarity, not the percentage difference between these sequences.

Question 08.3

Approximately 60% of students gave the correct order of histograms and a further 13% correctly identified the species histogram, but did not appreciate that the family taxon had the highest mean and widest spread of differences in base sequence.

Question 08.4

Of those who chose student's t-test as the correct statistical test, only about half stated that it is used to compare mean values, with many others writing about statistical significance without referring to comparison of means. Some excellent justifications referred to significant differences between means and included relevant comments on P values. Many failed to gain the 'justification' mark by making general comments such as, 'the difference between two histograms' or 'the difference between two results'. The last alternative in the mark scheme (data are normally distributed) was rarely seen.

Question 09.1

This question discriminated extremely well, with many answers showing that students have a secure knowledge of the role of ions in cells and can present their thinking as a logical sequence.

Most students achieved at least one mark because they knew oxygen associates with iron ions in haemoglobin, although some answers associated oxygen with red blood cells. They also gave co-transport, usually linked with glucose, as a role of sodium ions, but far fewer gave a clear description of how the sodium concentration gradient is created. Some students confused the direction taken by ions moving in the Na^{+}/K^{+} pump. Many knew phosphate ions are in nucleotides and ATP; however, a significant number of students could not be awarded this mark by going further to state that energy is 'created'. A smaller number of answers referred to phosphorylation but sometimes erroneously linked it to reducing the activation energy of reactions and substances. When answers made reference to phospholipids in the bilayer they rarely considered the water solubility of the phosphate in this molecule. Very few students considered the role of ions in osmosis.

Question 09.2

This question discriminated very well. Many students accurately described the structure of the phospholipid bilayer without always going further to describe how it affected the movement of substances. The hydrophilic and hydrophobic components of a bilayer and how they affect the movement of water-soluble and water-insoluble substances was known well. About 13% of students achieved four or five marks and gave well-structured descriptions using appropriate terminology. These students often mentioned that the number of carriers/channels affected membrane permeability.

A common misconception observed by examiners is the idea that membranes vary in width. Also, many answers referred to differences in the size of substances rather than consider differences in solubility or charge. Examiners regarded this to be obvious detail missed at AS.

Students did not always link active transport precisely to carrier proteins and frequently described in detail the process of active transport.

Cholesterol was mentioned frequently, usually in the context of affecting membrane rigidity, but general comments such as it 'affected stability/support' or 'increased membrane strength' were not credited. Numerous answers referred to the effect of temperature on membrane permeability and, again, gained no mark.

Mark Ranges and Award of Grades

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