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Principal Examiner Feedback

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Pearson Edexcel IAL in Biology (WBI05) Paper 01 - Energy, Exercise and Coordination

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General Points

Students were able to demonstrate their knowledge and understanding by tackling the wide range of questions offered in this paper. It was clear that the vast majority of students had studied the pre-release article and were able to relate their reading to the questions asked in a meaningful way. There were very few blank spaces indicating that students found the questions accessible.

Some students attempt to "set the scene" before beginning their actual response, often merely repeating the words in the actual question. Irrelevant writing wastes time and gains no credit.

Incorrect interpretation of the wording of some questions was minimal and most students were able to apply their knowledge to the unfamiliar scenarios that were presented. Overall, the level of knowledge demonstrated was very satisfying.

Question 1(a)

The multiple choice questions at the start of the paper were well answered. The most common error in (i) was to identify the apparatus as a respirometer. Most gained credit for giving the answer as $0.5dm^3$ in (ii); a few struggled to calculate the difference in breathing rate as 3 breaths min^{-1} in (iii), and most appreciated that the ventilation centre is more sensitive to carbon dioxide in (iv).

Question 1(b)

This question examined understanding of how the rate of diffusion would be affected by the narrowing of airways caused by asthma. Most students were able to appreciate that the rate of diffusion would decrease but providing an acceptable explanation posed more difficulty. The examiners rewarded answers that stated that the area of diffusion would be reduced and that the concentration gradient would also be reduced. Some students wrote expertly about Fick's law, but failed to address the question. Some also believed that asthma would increase the thickness of the alveoli.

Question 1(c)

Most students appreciated that drinking hot coffee would increase the core body temperature and many went on to state that this would be detected by the hypothalamus resulting in nerve impulses being sent to the sweat glands. Students are reminded that the examiners expect detail that mirrors understanding at this level. Many lost credit by simply stating that sweating would increase without mentioning how this would be stimulated.

Question 2(a)

This was a well answered multiple choice question.

Question 2(b)(i)

Most were able to offer an acceptable definition of the term 'active transport'. It was common to see a correct reference to movement against a concentration gradient but many omitted to mention the requirement for energy.

Question 2(b)(ii)

A surprising number of students seem unaware that hydrogen bonds occur between adjacent cellulose microfibrils. Most thought glycosidic bonds were responsible and some thought peptide bonds were involved. Those who hedged their bets by naming more than one bond lost credit.

Question 2(b)(iii)

Students are encouraged to read questions carefully. Many failed to appreciate that this question expected answers that concentrated on events taking place with 'cells' and not 'coleoptiles'. The examiners gave credit for answers that noted the osmotic uptake of water and the elongation of the cells.

Question 2(c)(i)

This question tested ability to describe the pattern shown by a graph. Most students gained at least one mark by describing no change in elongation between the IAA concentrations of 10^{-6} and 10^{-4} ppm, or by stating that the optimum for elongation was 1 ppm. The most challenging mark was describing the fact that after 10^{-2} ppm the elongation was inhibited.

Question 2(c)(ii)

This question examined student ability to explain the features of an experimental design that would allow a valid comparison to be made of the elongation of coleoptiles at each concentration. Students struggled to appreciate the importance of controlling the biotic variable by using the same species and controlling the abiotic variables of temperature and light intensity. Most were able to appreciate the need to repeat to ensure reliability. Additional ideas of leaving the coleoptiles for the same duration and using the same volume of IAA were also rewarded, though if the term 'amount' was used rather than 'volume' no credit was given.

Question 3(a)

This multiple choice question produced a variety of responses, though most appreciated that drugs affect selection of mutations in the parasites.

Question 3(b)

This simple question revealed a wide range of responses. Some diagrams were superb but many showed no understanding of the structure of a cell membrane. In the latter answers, phospholipids were drawn with one or three fatty acid tails, or not drawn at all, and the channel protein, if present, failed to span the whole membrane.

Question 3(c)(i)

Most appreciated that the hamsters should also be infected with hookworms, but many lost the second mark by stating that these hamsters should not be given GM bacteria. The second mark required students to state what they were given, that is, non GM bacteria.

Question 3(c)(ii)

This question challenged students though the examiners did see some very good answers in which, for the first mark, the idea of the difference in the original number of hookworms and the number of hookworms found in treated hamsters was evident. Many lost this mark by stating they would count the original number and the number after treatment but giving no indication of the difference between these two values. The second mark required an indication that this value would be divided by the original number of hookworms and multiplied by 100.

Question 3(d)

This question required students to suggest reasons why clinical trials are needed. The examiners rewarded the commonly seen ideas of safety and efficacy.

Question 4(a)

This multiple choice question for part posed few problems and most appreciated that most ATP molecules would be produced by oxidative phosphorylation in the mitochondria. Options A and B were seldom selected but option C was noted on several occasions.

Question 4(b)(i)

This question effectively asked students to explain why blood lactate concentration increases with increasing levels of exercise. The examiners rewarded those who appreciated that oxygen supply becomes an issue and in order to continue ATP production glycolysis continues and the pyruvate produced is converted to lactate using reduced NAD. Students need to be encouraged to include the level of detail expected at this stage of their education. Many students failed to understand the command word ‘explain’ and merely described the trend shown by the data.

Question 4(b)(ii)

This question required students to suggest why the increase in lactate with increasing exercise was lower for the athlete. Many tended to describe the trends in the data and this lost them credit. There were many unnecessary references to fast and slow muscle twitch fibres. The examiners rewarded students who appreciated that the athlete would have an improved ability to supply oxygen due to changes to their cardiovascular and ventilation systems.

Question 4(c)(i)

This question required students to name molecule X as reduced NAD. Many succeeded in this task but incorrect responses such as NAD, NAD^+ and NADP were seen.

Question 4(c)(ii)

Credit was given to students who identified molecule Y as pyruvate and appreciated it is converted to acetyl CoA. Mention of the link reaction or the Krebs cycle in context also gained credit. Many also appreciated pyruvate can be converted to glucose.

Question 5(a)

Most were able to note that the more weeks spent training correlated positively with the increase in the number of mitochondria. The second mark was awarded to those who appreciated that after 15 weeks there is a steepening of the line showing the increase.

Question 5(b)(i)

Students were awarded both marks if their answer fell within a generous range of 33.36 and 47.61. One mark was still available for incorrect answers providing the examiners could see in the working that the student had attempted to calculate the difference between the high and low value for their calculated mitochondria widths and that they had then attempted to divide by the low value.

Question 5(b)(ii)

This question challenged many students and discriminated very well. The examiners gave credit to those made reference to cristae, the electron transport chain and oxidative phosphorylation in their answer. They also credited the idea of electrons being passed along carriers, the idea of protons being moved to the intermembrane space to create an electrochemical gradient that allows ATP synthesis as a result of chemiosmosis. Some students wrote all they could recall about Krebs cycle without providing the information that the question demanded. The examiners would encourage students to read questions carefully as failure to do so often results in wasted time and little credit.

Question 6(a)(i)

This multiple choice item posed little difficulty for most students, though some thought that the cruciate ligament is attached to cartilage and that ligaments are elastic.

Question 6(a)(ii)

This was the most difficult multiple choice item in the paper for students. Many thought that ligaments are elastic or that they were made from myosin.

Question 6(b)

The calculation was well done. The correct answer of 19 500 gained two marks. The examiners awarded one mark if the answer was incorrect but it could be seen in the working that a correct calculation had been attempted.

Question 6(c)(i)

Students were credited for stating that the failure rate for allografts is higher than that of autografts. Thereafter, two more marks were available for providing acceptable reasons. The examiners gave credit for ideas of rejection due to foreign antigens and that disease transmission is more likely with allografts. Most understood the idea of rejection but many lost credit by being too general as to why. For example, stating that allografts would be rejected because the tissue is from a different person. The examiners needed to know what was different.

Question 6(c)(ii)

This question discriminated well and all the marking points were observed by the examiners.

Question 6(c)(iii)

It was pleasing to note that most were able to give at least one advantage of using keyhole surgery to repair torn ligaments. The most common acceptable responses made reference to the idea that keyhole surgery is less invasive and faster recovery time.

Question 7(a)

This question required students to appreciate that low levels of neurotransmitter contribute to depression by reducing depolarisation of the postsynaptic membrane which produces fewer impulses in the postsynaptic neurone. Some students lost credit by repeating the words in the actual question and not addressing the need to 'explain'.

Question 7(b)

There were many excellent accounts that explained the role of rhodopsin in reducing membrane permeability in a rod cell. The examiners gave marks for indicating the bleaching of rhodopsin into opsin and retinal with the consequent closing of sodium ion channels whilst the sodium ion pumps continued to function.

Question 7(c)

Some students were able to acknowledge that an action potential would be generated but only the better students explained the reason why. The answers of these students showed understanding that depolarisation of the neurone membrane would take place as a result of sodium ion channels opening with the consequent influx of sodium ions.

Question 7(d)

This seemingly simple task proved challenging for many. The examiners rewarded one mark to those who started their line at -70 mV and continued until it was above +30mV. The second mark was awarded if the examiners could see hyperpolarisation based on wherever the student had started their drawing of the action potential.

Question 7(e)

The signalling effect of peptide hormones was understood by some, though most struggled to express their answers clearly. The examiners rewarded students who made reference to the binding of epinephrine to receptors on cell membranes, the involvement of a messenger molecule, the protein kinase cascade and the role of transcription factors in switching on genes.

Question 7(f)

This question challenged understanding of how fMRI scanners are able to detect activity of neurones. The examiners rewarded those who appreciated that active neurones would respire and that this would require an increased blood flow to provide oxygen. The use of radio waves and the emission of signals were credited, as was an appreciation that the active area of the brain could be detected as it would appear brighter.

Question 7(g)

This question tested student ability to understand how optogenetics may help people with depression. The idea is that conditioning will occur when light is used to stimulate the dopamine neurones so they release the neurotransmitter that will increase feelings of reward and pleasure. This concept challenged many students but a generous mark scheme allowed credit to be given.

Question 7(h)

This question required students to communicate the idea that deep brain stimulation would promote the release of dopamine at synapses with the consequent depolarisation of the postsynaptic membrane followed by an action potential in the postsynaptic neurone. Many students struggled to express these ideas and most scored poorly.

Question 7(i)

This question discriminated very well between students. The question required students to appreciate that fast twitch muscle fibres are stimulated more than slow twitch. Thereafter, credit was given for those who explained how features of fast twitch fibres such as few mitochondria, few capillaries and little myoglobin would result in more anaerobic respiration and the production of lactate which induces muscle fatigue. This was a QWC question with the emphasis on spelling. Examiners were instructed to mark fully and delete one mark only for one or more spelling errors of biological terms.

Question 7(j)

Many students wrote accounts that gained full marks by referring to the role of restriction and ligase enzymes in producing recombinant plasmids that could be used as vectors. Many students failed to understand the demand of the question and quoted verbatim on part of the article dealing with nanoparticles.

The paper gave students the opportunity to demonstrate their knowledge and understanding; their ability to apply this knowledge to unfamiliar scenarios; and their ability to draw together links between different areas of the specification.

In order to avoid common pitfalls in future papers it would be helpful to:

- Look at the number of marks allocated to each question and try to make sure that answers at least equate in terms of the number of ideas presented
- Use precise, scientific terminology that reflects A level study
- Appreciate that repeating the stem of a question or sentences from the passage is unlikely to be rewarded
- Be relevant with longer prose answers. This will help avoid wasting time which could be of value with the more difficult analytical questions
- Read the stem of a question carefully before committing to paper
- In calculation questions, show your working, to avoid losing all the marks for a simple mathematical error
- Understand that the command word explain expects students to offer biological rationale in their response and not solely description

Grade Boundaries

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