Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

January 2019

Pearson Edexcel International Advanced Level

In Biology (WBI05) Energy, Exercise and Coordination

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Introduction:

Students were able to demonstrate their knowledge and understanding by tackling the wide range of questions offered in this paper. It was clear that some students had studied the pre-release article and were able to relate their reading to the questions asked in a meaningful way. However, many students appear to have struggled with aspects of the paper and, in particular, with the scientific article.

Some students attempt to “set the scene” before beginning their actual response, often merely repeating the words in the actual question. This wastes valuable time and gains no credit.

Incorrect interpretation of the wording of some questions was apparent in several questions and many students appeared to struggle to apply their knowledge to the unfamiliar scenarios that were presented. In some cases, students produce detailed answers that do not address the question in the context in which it is set. Often gaining little credit.

Question (1)(b)

Most candidates found this question straightforward and many gained all three available marks. Some candidates lost marks because they confused the role of troponin and tropomyosin.

Question (1)(c)

The majority of candidates found this question straightforward and gained both marks. However, a number of candidates incorrectly suggested that tendons were elastic to allow the movement of antagonistic muscles.

Question 2(b)(i)

Candidates who read the question carefully found this question accessible and generally gained both available marks. Candidates needed to describe the effect of altitude on breathing. Some candidates only considered the effect on breathing rate and did not did not gain the first marking point.

In the response below the candidate did not consider depth of breathing so did not gain MP1. No comment was made about the difference between 0 and 4000 and 4000 and 6000 m, so did not gain MP2. Further, they did carry out an appropriate manipulation of the data provided so did not gain MP3. Simply quoting data from a table is unlikely to gain any credit.

(b) The breathing of a person is affected by altitude, the height of the location above sea level.

The table below shows the responses of a group of 12 adults to changing altitude.

Altitude / m	Available oxygen concentration (%)	Mean breathing rate / breaths min^{-1}	Mean tidal volume / dm^3
0 (sea level)	21.0	16.0	0.50
2000	16.0	16.0	0.51
4000	12.5	16.2	0.54
6000	11.0	17.8	0.70

(i) Describe the effect of altitude on breathing.

(2)

As ~~the~~ Altitude increases from 0m to 6000m, availability of oxygen decreases from 21.0% to 11.0% and the mean breathing rate / breaths min^{-1} ~~als~~ increases from 16.0 - 17.0 au.

In contrast the following response addresses all the marking points and gains the maximum of two marks.

(b) The breathing of a person is affected by altitude, the height of the location above sea level.

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(i) Describe the effect of altitude on breathing.

(2)

As altitude increases, mean breathing rate increases. and mean tidal volume increases. Hence, the ventilation rate increases as altitude increases.
Mean breathing rate increases by 1.11 times and mean tidal volume increases by 1.40 times as altitude increases

<u>Question 2(b)(ii) and 2(c)(ii)</u>

When provided with physiological data candidates can be asked to explain or interpret the data in one of two ways. First, they could be asked to explain **how** the process is regulated. Second, they could be asked explain **why** the process occurs. Candidates, who do not read the question carefully, often answer the wrong question. This pair of questions, 2bii and 2cii, demonstrate the problem students have.

2(b)(ii) This is a **'how'** question.

In the example below the candidate was given MP3 (Additional guidance). However, the candidate has provided **'why'** response and no other marking points were seen.

(ii) Explain how an increase in altitude from 4000 m to 6000 m will cause these changes in breathing.

(3)

Less concentration ~~or~~ of oxygen availability is detected by the receptor and an impulse is sent to the ventilation ~~centre~~ center in the brain which by sympathetic neurone increasing the breathing rate. More breathing rate means more oxygen intake for aerobic respiration.

In contrast the candidate producing the response below clearly recognised that it was a **'how'** question and provided a complete response gaining full marks.

(ii) Explain how an increase in altitude from 4000 m to 6000 m will cause these changes in breathing.

(3)

As the altitude increases, the availability of O_2 decreases. So ~~less~~ more CO_2 is present in the blood compared to O_2. The pH of blood decreases and this decrease in pH is detected by chemoreceptors in the carotid body. Less aerobic respiration was occuring whereas more anaerobic respiration occured - causing ~~the~~ pyruvate to be converted into lactic acid. This decrease in pH is also detected by chemoreceptors. Impulses are sent to the ventilation centre in medulla. The ventilation center then ~~increases~~ sends impulses to ~~SAN to increase to increase heart beat~~ intercostal muscles are diaphram to contract more. Thus increases breathing rate and tidal volumes.

2(c)(ii) This is a **'why'** question

To answer this question, fully, candidates need to include ideas about why heart rate needs to change (MP4).

In the example below the response is a **'how'** response and did not address the reasons for the change in heart rate. The response did gain two marks for MP1 and 3.

(ii) Explain why the resting heart rate changes as the altitude increases from 6000 m to 8000 m.

(3)

As altitude increases the amount of oxygen available decreases. The concentration of carbondioxide in the blood increases, decreasing pH. This decrease in PH is detected by the chemoreceptors in the carotid bodies in the ~~carti~~ arteries. They send nerve impulse to the brain's medulla oblongata. The medulla oblongata ~~a~~ send impulse to SAN to increase heart rate.

The response below is a 'why' response and gained all three available marks.

(ii) Explain why the resting heart rate changes as the altitude increases from 6000 m to 8000 m.

(3)

As altitude increases from 6000 to 8000m, oxygen concentration decreases in air, less oxygen in alveoli, so less oxygen in blood, so less oxygen delivered to muscles and tissues, so heart has to pump faster and be more frequently so that muscles and tissues get enough oxygen for aerobic respiration. So heart rate increases to deliver more O_2 and glucose to muscles and tissue.

Question 2(c)(i)

This was a calculation question. The questions clearly described the calculation and instructed candidates to give suitable units with their answer. Candidates following the instructions generally found the questions accessible and gained both marks.

A number of candidates did not finish the calculation i.e. they found the overall change in rate but did not divide by the change in height. A surprising number of candidates did not provide units with their answer.

Question 3(a)(i)

In this calculation candidates were asked to produce a ratio. Many candidates gained both available marks. Some leniency was allowed for reading values from the graph, marking point one. The final ratio had to be reported as a complete ratio e.g. 3.5 : 1 and not simply as 3.5.

Question 3(a)(ii)

Many candidates found this question accessible and marking points 1 and 2 were frequently observed. Some candidates also interpreted the results in terms of habituation (MP3) or provided sensible use of the data (MP4). Several candidates ignored the instruction to compare the response of the different mutants to wt C. elegans. Instead comparing them with each other. Consequently, these candidates often failed to get MP1 or 2.

Question 3(b) and 3(c)

Candidates with a good understanding of habituation and the role of synapses in nerve conduction were able to provide good responses to these questions.

Question 3(b)

Marking points 1, 2 and 4 were frequently seen. Relatively few candidates put their responses in context of the direction in which the nerve impulses were moving i.e. marking point 3 and 5.

Question 3(c)

All three marking points from the first alternative, enhanced response of stimulatory synapse, were seen. Few candidates seemed to be aware of inhibitory synapses and answers in terms of such were infrequently observed.

Question 4(b)

To understand the idea of critical window and the role of animal models in the development of visual capacities (Specification points Topic 8, 11 and 12) requires some understanding of the role of synapse formation in the brain.

This question proved difficult for many candidates. Many candidates managed to identify the visual cortex as being involved and gained MP2. Some also described the formation of additional or stronger synapses in response to increases in nerve impulses. Few candidates made reference to the loss of synapses in the absence of impulses (MP4) or that the relevant impulses originate in the retina (MP1).

Question 4(c)

Many good responses were seen to this question. Marking points 1, 3 and 5 were frequently seen. Many candidates suggested that all twins were genetically identical only gaining MP3. Very few candidates tried to explain how twin studies would need to be conducted and so MP2 or 4 were infrequently seen.

Question 5(b)

While many candidates could describe how a resting potential is maintained a significant number struggled to answer this question. Some candidates still refer to sodium or potassium rather than sodium ions or potassium ions and some describe ions moving into or out of membranes. Neither of which will gain credit. Many candidates seem unsure of the direction of movement of the ions by the sodium potassium pump.

Question 5(c)(i)

This calculation proved to be relatively straightforward for many candidates.

Question 5(c)(ii)

A pleasing number of candidates produced good responses to this challenging question. Responses were often credited for marking points 1, 2 and 3. Very few candidates finished of the response by making the link to stimulation of a large number of neurones (MP4).

Question 6(a)

This was a QWC question with the emphasis on logical sequence. Candidates appeared familiar with anaerobic respiration and produced many good responses. All marking points were observed and very few responses were penalised for lack of logical sequence.

Question 6(b)(i)

Many candidates were able to describe the data provided and gained both available marks. Some candidates struggled to distinguish the effects of ADP and reduced NAD, instead describing the combined effect.

Question 6(b)(ii)

Candidate responses to this question revealed an interesting misconception amongst some students. Candidates who appreciated that during exercise ATP and reduced NAD are used up were able to access all the available marks. However, a surprising number of students seemed to believe ADP would be phosphorylated to ATP and NAD would be converted to reduce NAD in anticipation of the need to use them in exercise. As a consequence, they suggested enzyme activity would decrease.

The response below is a typical response from a candidate that believes ATP and reduced NAD are produced in anticipation if exercise. This response gained no marks.

(ii) Using the information in the table, suggest how exercise affects the activity of isocitrate dehydrogenase in muscles.

(4)

During exercise, the amount of ATP increases. So the amount of ADP decreases. During exercise both aerobic and anaerobic respiration takes place which produced ATP from ADP and Pi. Reduced ~~NAD~~ NAD is also formed in the Krebs cycle. So the activity of the isocitrate dehydrogenase decreases due to greater number of reduced NAD and decrease in ADP during exercise.

The following example gained full marks for complete and correct response.

(ii) **Using the information in the table, suggest how exercise affects the activity of isocitrate dehydrogenase in muscles.**

(4)

During exercise, more ATP is used and hydrolysed to ADP ~~and~~ through the constant contraction of muscles and a build-up of lactate (from anaerobic respiration). Additionally, more NADH will be oxidised to NAD^+ so less NADH will be present meaning that the activity of isocitrate dehydrogenase will increase.

Question (7)

The scientific article was challenging. However, in many cases candidates responses to the questions were pleasing and many good answers were seen. It is important that candidates appreciate question 7 is not a simple comprehension exercise. Candidates need to study the article in order to prepare for this question.

Question 7(a)

The majority of candidates were able to recall that glucose was stored as starch (MP3). However, very few provided any detail on the source of glucose. Some made reference to photosynthesis but did not mention the light-independent stage (MP1) nor the production of GALP (MP2).

Question 7(b)

When answering this question many candidates simply reproduced statements from the article. In order to gain marks the candidates needed to go a little further than this and demonstrate understanding of the topic. For marking point one candidates needed to make it clear that the oscillator anticipates periods of light or dark. Anticipating sunrise or sunset was not enough. For making point 2 candidates need to exemplify why being prepared for light or darkness was an advantage. Again, simply copying the statement that 'emerging to early could prove fatal' was not sufficient. Candidates needed to suggest why this might be the case e.g. increased chance of predation. Very few candidates seemed to appreciate that light levels might change during the day and that an oscillator system would not be affected by such fluctuations (MP3).

Question 7(c)

Many candidates did not remember that regulating the body temperature is a homeostatic process (MP1) and those that did often did not recognise the role of the hypothalamus or the idea of a 'set point' about which temperature is regulated. As a consequence many candidates did not make the link between body clocks the hypothalamus (MP2) and adjustment of the set point (MP3).

Question 7(d)

Central to understanding much of the biology described in the article was the identification of different strains of fly – different mutants.

In this question candidates were asked to suggest how a strain of fruit fly differs from a species of fruit fly. The first marking point was allowed for a partial comparison. So candidates could gain the mark for a description of the biological concept of a species in terms of different strains being able to reproduce to produce viable off-spring or different species not being able to (MP1). For the second mark a complete comparison was required in terms of the genetic similarities and differences between strains and species (MP2). Very few candidates gave such a comparison.

Question 7(e)

Many candidates appeared to understand the difference between a nonsense and a missense mutation, and a number of good answers were seen. All six marking points were seen in candidate responses.

Question 7(f)

To answer this question candidates needed to describe TIM and PER acting as a transcription factor (MP1) that binds to the regulatory region or promotor region of genes to inhibit transcription (MP2). Many candidates simply suggested TIM and PER move to the nucleus to turn genes on or off gaining neither mark.

Question 7(g)

Candidates struggled to explain how apart of the hypothalamus, the SCN, could control the activity of all cells. A number of candidates made the link between the SCN and the hypothalamus (MP2). However, most went on to suggest that the SCN then sent nerve impulses to all cells in the body completely ignoring the fact that the only possible route of communication would be via a hormone (MP3 and 4). Very few candidates recognised that the change in day length, triggering a response, is detected in the retina (MP1)

Question 7(h)

Many candidates were able to suggest that depression was caused by reduced levels of neurotransmitters (MP1) such as serotonin (MP2). Fewer candidates were then able to go on and link circadian clock to control of neurotransmitter production (MP3) or disruption of the circadian clock with insufficient serotonin production (MP4).

Question 7(i)

Many candidates had a good understanding of how they could investigate the effect of the circadian rhythm on the rate of respiration. All available marking points were observed. THE QWC emphasis was on clarity of expression. IT was pleasing that few candidates were penalised for lack of clarity in their responses.

Question 7(j)

Many candidates found this question straightforward and gained both available marks. Note that when describing the release of energy from ATP candidates are expected to refer to the hydrolysis and not the breakdown of ATP (MP1).

Question 7(k)

Candidates able to transfer their understanding of how ions concentrations are regulated, in neurones, to red blood cells found this question accessible and gained two or three marks (MP1, 2 and 3). Very few candidates went on to link regulation of ion transport to membrane potential (MP4).

Paper Summary:

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 closely at the number of marks allocated to each question and equate this to the number of ideas or points presented.
- Use precise, scientific terminology of an A level standard.
- Read the stem of the question closely before committing an answer to paper.
- Understand that simply repeating the stem is unlikely to gain any credit.
- Show workings in calculation questions to avoid losing marks.
- Show how data has been manipulated where required instead of simply quoting figures from a graph or table.
- Use time management sensibly.
- Have a greater appreciation of the scientific method, in particular the design of experiments.
- Understand that the command word **explain** expects students to offer biological rationale in their response and not solely description.
- Try to provide answers that are tailored to the biological context in which the question is set.

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