



# Examiners' Report Lead Examiner Feedback

January 2021

Pearson BTEC Nationals  
In Sport and Exercise Science (31813H)  
Unit 1: Sport and Exercise Physiology

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## Introduction

The format of this assessment remains unchanged from previous test series. As previously, the paper was split into four questions. Each question was based on a sport or exercise scenario and required learners to demonstrate knowledge and understanding of a range of specification topics and apply this knowledge to the specific question scenario. Three questions were marked out of 18 marks, and one out of 16 marks, 8 marks being awarded for the final part of each question where an extended response was required.

Each of the extended response questions were marked using a 'levels based' approach to assess where the overall quality of the response was considered rather than the specific number of facts stated, although this obviously had a bearing on the quality of the response. The remainder of the questions on the paper were assessed using a traditional point's based approach, where a mark was given for each appropriate point. More detail can be found below in the individual question section of the report.

Learner performance varied throughout the paper, with the full range of marks being accessed on each question. Whilst the extended response questions are challenging due to their nature, most learners gained some marks for these questions, centres and learners should be congratulated on their preparation for this aspect of the assessment.

The style of the assessment is challenging due to the depth and breadth of knowledge required to fully address the demands of the paper. The extended response questions account for 45% of the paper, each question demanding depth of knowledge, but across the paper this also requires breadth as each of these questions examines different areas of the specification.

The assessment is also challenging due to the need to apply knowledge not only in the extended response questions but also the 'points-based' questions, for example, Q01aii; Q01bi; Q02a and Q03d. There are limited instances within each question where only recall of knowledge is required, for example, Q01ai; Q01bii; Q03b and Q04ai therefore raising the demand on the learner.

## Individual Questions

The following section considers each question on the paper, providing examples of a range of learner responses and a brief commentary of why the responses gained the marks they did. This section should be considered with the corresponding mark scheme.

### Q 01

The context for this question is a 200m sprinter.

#### Q 01(a)

Learners were asked to state one effect of testosterone on the muscular system and then explain why increased levels of testosterone could improve sprinting performance. Many learners correctly linked testosterone to increased muscle growth, correctly focusing on the muscular system.

#### This response gained 1 mark

The learner correctly identified muscle growth in (i). However, there was no explanation or application of this knowledge to address part (ii) of the question.

Peter is a 200m sprinter.	
Sprinters need to be powerful to run fast.	
Testosterone is a hormone.	
1 (a) (i) State <b>one</b> effect of testosterone on the muscular system.	(1)
Growth	
(ii) Explain <b>one</b> reason why increased levels of testosterone could improve Peter's 200m sprinting performance.	(2)
increase in testosterone improves Peter's 200m sprint	
because with increase in testosterone level <del>we</del> <sup>he</sup> get	
more muscle growth with higher amount of	
muscle <del>it</del> leads to improved performance	

**This response gained 2 marks**

The learner correctly identified muscle growth in (i) and explained in (ii) that this allows the muscles to generate more force. To gain the third mark application to sprinting performance was also required.

Peter is a 200m sprinter.

Sprinters need to be powerful to run fast.

Testosterone is a hormone.

1 (a) (i) State **one** effect of testosterone on the muscular system.

(1)

increased growth

(ii) Explain **one** reason why increased levels of testosterone could improve Peter's 200m sprinting performance.

(2)

he could develop a larger  
mass of muscle, which will <sup>mean</sup> his muscle  
will produce more force

**This response gained 3 marks**

All required elements were present in this response. Testosterone to increase muscle strength, allowing for increased size and contractile force of the fibres resulting in pushing harder off of the blocks and sprinting faster.

Peter is a 200m sprinter.

Sprinters need to be powerful to run fast.

Testosterone is a hormone.

**1 (a) (i) State **one** effect of testosterone on the muscular system.** (1)

Increased muscle fibre sizes will be increased and become stronger.

**(ii) Explain **one** reason why increased levels of testosterone could improve Peter's 200m sprinting performance.** - aggression - heart rate (2)

~~Testosterone increases alertness so~~  
It will cause muscle fibres to increase in size so they can have a bigger contraction and create more force so Peter can sprint faster and push harder off of the blocks

**Q 01(b)**

This part of the question focused on muscle fibre types.

**Q 01(b)(i)**

When asked to explain why a particular muscle fibre type is used in an activity it is important that learners think about the characteristics of the fibre type and in particular which of its characteristics would be important to the stated activity. For this question, the fact that type IIx fibre quickly is not why this fibre type is recruited for the 200m sprint, rather why it isn't recruited for longer distance races. Relevant characteristics included fast contraction time and high force production, either of these characteristics could then be easily applied to the start of the 200m sprint.

**This response gained 1 mark**

This learner identifies a relevant characteristic but does not complete the explanation by applying the use of the characteristic to the start of the 200m sprint.

At the start of a 200m sprint, Peter's type IIx muscle fibres are recruited.

(b) (i) Explain **one** reason why type IIx muscle fibres are recruited at the start of a 200m sprint. (2)

These muscle fibres are adaptable to your training. As Peter trains for 200m events the type IIx muscle fibres are fast twitch in nature meaning they can contract rapidly for a short period of time.

**This response gained 1 mark**

This learner states why, from a performance point of view, the fibre type is used but there is no explanation to support this, ie no link to the nature of the fibre type that means it is selected rather than another fibre type.

At the start of a 200m sprint, Peter's type IIx muscle fibres are recruited.

(b) (i) Explain **one** reason why type IIx muscle fibres are recruited at the start of a 200m sprint. (2)

Type IIx muscle fibres are <sup>used in</sup> ~~very~~ short durations, for high explosive intensity exercises. 200m sprint would use type IIx to sprint quickly and sharply at the beginning to get a headstart against competitors.

**This response gained 2 marks**

The learner identifies why this fibre type is selected and how it is used, ie it produces high force used at the start to provide the required power to push off the blocks.

At the start of a 200m sprint, Peter's type IIx muscle fibres are recruited.

(b) (i) Explain **one** reason why type IIx muscle fibres are recruited at the start of a 200m sprint. (2)

Type IIx muscle fibres produce lots of force and are very fast contracting. They will be recruited at the start of the 200m sprint when Peter pushes off the blocks. This movement requires lots of power and fast actions, so Type IIx are used.

**Q 01(b)(ii)**

Designed as an accessible question, learners were asked to name one other fibre type. The muscle fibre types identified in the specification are referred to as Type 1, Type IIa, Type IIx. Whilst most learners accurately identified either Type 1 or Type IIa some learners failed to gain the available mark as they referred to Type 1a.

**This response gained 0 marks**

The learner identifies the fibre type as Type 1a rather than Type 1.

(ii) Name **one other** muscle fibre type found in the body. (1)

Type 1a muscle fibres

**This response gained 1 mark**

(ii) Name **one other** muscle fibre type found in the body. (1)

Type IIa

**Q 01(c)**

This part of the question asked learners to explain why muscle temperature changes during a sprint.

When 'a change' is referenced in a question, but the direction of that change is not given the learner should include the direction of the change in their response, in this case whether the muscle temperature increases or decreases.

To gain both marks responses needed to identify an increased muscle temperature and what caused this.

**This response gained 1 mark**

The learner correctly identifies muscle temperature increases.

Peter's muscles change temperature during a 200m sprint.

(c) Explain **one** reason why Peter's muscles change temperature during a 200m sprint. (2)

Temperature increases in the muscles due to an increase of lactic acid through fatigue.

**This response gained 2 marks**

The learner correctly identifies muscle temperature increases and why it does so during exercise.

Peter's muscles change temperature during a 200m sprint.

(c) Explain **one** reason why Peter's muscles change temperature during a 200m sprint. (2)

They will change temperature due to them working fast and the muscles contracting quickly producing heat.

### Q 01(d)

This was the first of four extended questions on the paper. The full mark range was seen in learner responses.

This question asked learners to evaluate the importance of the three energy systems during a 200m sprint.

Responses to extended answer questions are marked using levels based mark schemes; the quality of the response determining the level. There are four levels; level 0 where there is no rewardable material presented and then levels 1, 2, 3; the higher the level the greater the quality of the response.

To address this question, learners should have referenced the three energy systems stated on the specification:

- ATP-PC system
- Lactate system
- Aerobic system

Phases of a particular system, such as aerobic glycolysis or Krebs cycle could be used to show knowledge of a system but not as a system in its own right. Similarly, the immediate stores of ATP in the muscle is not an energy system listed on the specification.

To achieve level 3 in the marking bands learner responses needed to demonstrate knowledge of the energy systems, be able to apply this knowledge to the question context and ideally make reasoned judgements as to the importance of each system based on the question context.

Level 1 response

Peter takes 26 seconds to sprint 200m.  
His body uses different energy systems during a 200m sprint.

anaerobic glycolysis  
ATP-PC  
Aerobic glycolysis

(d) Evaluate the importance of the **three** energy systems during a 200m sprint.

(8)

During the start of the 200m Sprint it is important for Peter to be able to access a quick burst of energy which is provided by the ATP-PC system. As the ATP-PC system can only supply the muscles with a couple seconds of energy. This is <sup>an</sup> important stage of his race because if he gets a good start it will make the rest of the race easier.

As the ATP-PC system is used & the anaerobic glycolysis system is being prepared. This means ~~that~~ although this normally supplies energy slowly it means he will be able to maintain a constant speed through the middle of the race.

Finally the Anaerobic system is used to provide the energy needed to be able to sprint ~~at~~ towards the finish line. If this energy is accessible at the end it will give his muscles more power to finish the race with energy left over.

There is some relevant content included in the response, for example reference to the ATP-PC system and anaerobic glycolysis and the link between the ATP-PC system and quick access to energy to fuel muscle contraction. However, the bulk of the response lacks clarity, for example, linking the middle of the sprint to the aerobic energy pathway. Whilst detailed knowledge of sporting activities is not required it is expected that learners would be sufficiently familiar the demands of a sprint.

Level 2 response

Peter takes 26 seconds to sprint 200m.  
His body uses different energy systems during a 200m sprint.

(d) Evaluate the importance of the **three** energy systems during a 200m sprint.

(8)

During the 200m sprint Peter's body will need to use all three of his energy systems, starting with the ATP-PC system.

The ATP-PC system is the first system used when performing exercise this is because it is how the body uses its glycogen stores. This system offers Peter a quick burst of energy so the first 12 seconds he can run at his best to gain an advantage over the other racers.

After Peter's ATP stores have been depleted he will start to use the lactate system, this system is to aid the body during anaerobic exercise after the athlete has depleted their ATP-PC stores however as this is mainly for anaerobic exercise Peter will move straight into the aerobic energy system where his body will start to replenish his ATP-PC stores with the aid of oxygen this gives Peter the opportunity to finish the race without burning out.

This response identifies the three energy systems. There is a relevant account of the ATP-PC system, explaining why it is used first and the limitations of this system in terms of depletion of energy stores thus the need to move to the lactate system. Knowledge of the lactate system however is limited, an appreciation that the lactate system could provide energy for 2/3 minutes should mean there is no need to move to the aerobic system as suggested in the response.

Level 3 response

Peter takes 26 seconds to sprint 200m.  
His body uses different energy systems during a 200m sprint.

(d) Evaluate the importance of the **three** energy systems during a 200m sprint.

(8)

The ATP-PCr system would be the best system for the first 2 to 10 seconds of the race. This is because it supplies quick energy through ATP, creatine and phosphate release allowing him to start at a high intensity. After this the lactate system will begin to work after the first 10 seconds. This is important to keep Peter at the same intensity throughout his race. The lactate system uses carbohydrates, protein and fatty acids that breakdown to supply the energy. However, the ~~the~~ only downside to this system is that it produces lactic acid that will cause the muscles to fatigue over time. The least important energy system for Peter to use during his 200m sprint is the aerobic system. The aerobic system produces a larger amount of ATP for energy, <sup>at once</sup> but it requires a large amount of oxygen ~~for~~ <sup>to</sup> make it. Where Peter is taking part in an anaerobic event he won't have the oxygen available for this.

The energy systems are identified and key, relevant facts about each system are stated. There is also application, when each system is predominant in the race and some evaluation of the importance of the systems, eg ATP-PCr best system for the first 8 – 10 seconds because..... Providing relevant justified arguments to support points made is a clear trait within level 3.

**Q 02**

The context for this question is a runner who is training for a marathon.

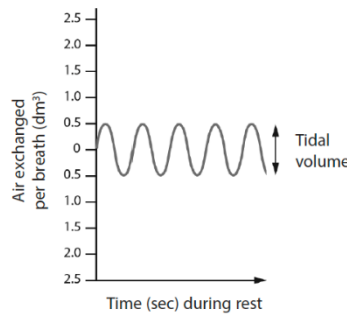
**Q 02(a)(i)**

Learners were given a graph of the runner’s tidal volume at rest and asked to explain two ways the trace or line on the graph would change when the runner started running.

Lena is training for a marathon. To complete the marathon Lena will need to run just over 26 miles.

**Figure 1** shows a graph of Lena’s tidal volume at rest.

The line on the graph is called a trace.



**Figure 1**

Those learners that knew that breathing rate and depth increase as a result of exercise then had to apply this knowledge to say how this would impact the lines on the graph. There were a variety of responses to this question, however the majority of learner’s did correctly identify the increase in the depth of breathing and the corresponding increase in height of the lines of the graph thus accessed two of the available marks.

**This response gained 2 marks**

The response clearly identifies increased depth and rate of breathing but does not then apply this knowledge.

2 (a) (i) Explain **two** ways the trace shown in **Figure 1** will change when Lena starts running.

(4)

1

The tidal volume will increase as Lena takes in more oxygen.

2

The amount of breaths Lena make will increase so provide more oxygen to working muscles.

**This response gained 4 marks**

The response clearly identifies increased depth and rate of breathing and how this would be represented on the graph.

2 (a) (i) Explain **two** ways the trace shown in **Figure 1** will change when Lena starts running.

(4)

1

Lena's tidal volume will increase meaning the trace will become longer in height with each breath.

2

~~the~~ Because Lena's breathing rate will increase when she starts to run, the up's and down's in the trace will become more frequent, signifying more breaths taken by her.

**Q 02(a)(ii)**

Learners were asked why a change in tidal volume was important when starting to run. To gain both marks learners should have linked increased tidal volume with increase oxygen and then stated the importance of this, eg for aerobic energy production. It is important when learners are asked to explain that they make a point and then develop it, eg more oxygen because....

**This response gained 1 mark**

This response provides two reasons for increasing tidal volume rather than an explanation of one reason, ie it doesn't tell us why having more oxygen (or removing more carbon dioxide) is important.

(ii) Explain **one** reason why a change in tidal volume is important when Lena starts running. (2)

*Tidal volume should increase as it means more oxygen will be <sup>inhaled</sup> in per breath and more carbon dioxide will be exhaled per breath.*

**This response gained 2 marks**

(ii) Explain **one** reason why a change in tidal volume is important when Lena starts running. (2)

*The change in tidal volume allows more oxygen to be inhaled for Lena to then use as energy in her run.*

**Q 02(b)**

Learners were asked to describe one way the cardiovascular system increased blood flow to the muscles during the run.

The expected response was a description of redistribution of blood flow, how blood vessels to the digestive system vasoconstricted whilst those to the active muscles vasodilated. Credit was also given for a description that referenced increased cardiac output therefore increasing blood expelled per minute.

**This response gained 1 mark**

In this response there is reference to how blood flow to the digestive system decreases but not how this helps increase blood flow to the working muscles.

During Lena's marathon run there will be an increase in blood flow to Lena's working muscles.

(b) Describe **one** way the cardiovascular system increases blood flow to the muscles during Lena's run.

(2)

During lenas run blood will be sent to more  
blood flow will be sent to the working muscles  
as less will be sent to her digestive system.

**This response gained 2 marks**

During Lena's marathon run there will be an increase in blood flow to Lena's working muscles.

(b) Describe **one** way the cardiovascular system increases blood flow to the muscles during Lena's run.

(2)

It increases blood flow using vasodilation  
of the vessels to the working muscles, allowing  
more blood to pass through. Vasoconstriction of the  
vessels to the digestive system to reduce blood  
going to them and redirect it to the  
working muscles.

**Q 02(c)**

Learners were told that as a result of training there was capillarisation of the muscular system. The question asked learners to explain one effect of capillarisation on diffusion rate in the working muscles. Those learner's that understood the term capillarisation recognised that this would increase diffusion rate and were able to say why, ie more capillaries/greater surface area for diffusion to occur.

**This response gained 1 mark**

This response correct identifies the resulting increase in diffusion rate but does not explain why capillarisation has this effect.

One long-term adaptation of Lena's training on her muscular system is capillarisation.

(c) Explain **one** effect of capillarisation on diffusion rate in the working muscles. (2)

Increased capillarisation will lead to an increase in gaseous exchange rate / diffusion rate so more the transfer of O<sub>2</sub> and CO<sub>2</sub> will be more efficient and faster.

**This response gained 2 marks**

The effect of capillarisation on diffusion rate is stated and explained.

One long-term adaptation of Lena's training on her muscular system is capillarisation.

(c) Explain **one** effect of capillarisation on diffusion rate in the working muscles. <sup>increase more blood (2)</sup> <sub>more surface area</sub>

capillarisation increases diffusion rate by increasing the surface area available for gaseous exchange within the muscles and increasing oxygen absorption into the muscles

**Q 02(d)**

The extended response for question 2 asked learners to analyse the effect of regular weight-bearing exercise on the skeletal system and subsequent training sessions.

Like all of the extended response questions, the quality of learner responses varied. Some learners were clearly knowledgeable about the skeletal system and could apply this knowledge to the question context. For example, that the exercise would stimulate osteoblasts/osteoclast activity which in turn would lead to greater bone density allowing the runner to increase the training load due to the reduced risk of injury.

Most learners were able to talk about the role of osteoblasts and osteoclasts in bone formation and some also made accurate references to either increased tendon strength due to increased collagen content or increased calcium absorption and the impact this had on training.

**Level 1 extract**

In this extract osteoblasts and osteoclasts are mentioned but the role of each is incorrectly stated. However, the effect of the weight-bearing exercise on remodelling and bone strength is correctly identified so some relevant content (in terms of question context) included in the response.

Lena's training programme involves long-distance continuous running.  
Continuous running is weight-bearing exercise.

(d) Analyse the effect of regular weight-bearing exercise on Lena's skeletal system and her ability to continue with her training programme.

(8)

The effects of regular weight-bearing on Lena's skeletal system is that it will increase her bone remodelling process in which osteoblasts remove old bone and osteoclasts replace that old bone. This will strengthen Lena's skeletal system and allow her to continue with her training programme. In addition to this Lena will have an increase in blood plasma, which aids her bone growth.

**Level 2 extract**

Some accurate knowledge and understanding is demonstrated in this extract, for example the role of the osteoblasts and osteoclasts and the increase in calcium. This is stated in response to the question context, ie that the exercise stimulates growth of new bone causing an increase in bone density, linking this to a reduced risk of injury.

(d) Analyse the effect of regular weight-bearing exercise on Lena's skeletal system and her ability to continue with her training programme.

(8)

weight bearing activity stimulates the growth of new bone. This results in the osteoclasts breaking down old bone and the osteoblasts rebuilding this bone. This results in the bones returning more densely compact and stronger, as the new bone allows so. regular weight-bearing exercise will also increase the amount of calcium stored within the bone marrow, this enables an increase in the bone remodelling process, this prevents injury through stress fractures, as the bones are more densely compact and stronger.

### Level 3 extract

The response demonstrates accurate knowledge and understanding, the points made are relevant to the question context, and there is a developed and logical analysis based on the content presented.

The focus in the first paragraph is on the role of bone cells and calcium and the effect of these on bone density and reduced risk of injury.

The second paragraph looks at the way exercise impacts collagen content in ligaments and the effect of this. Thus, the response demonstrates knowledge of the topic, application of this knowledge and the effect of all this on further training.

Lena's training programme involves long-distance continuous running.  
Continuous running is weight-bearing exercise.

(d) Analyse the effect of regular weight-bearing exercise on Lena's skeletal system and her ability to continue with her training programme.

(8)

The adaptation to to regular weight-bearing exercise is an increase in osteoblast and a decrease in osteoclast activity. Osteoclasts break down bone, releasing calcium into the blood stream. Osteoblasts build up bone by bringing calcium from the blood, increasing bone density. Weight-bearing exercise will reduce osteoclast activity and increase osteoblast activity. This will maintain a healthy bone density and increase the strength of her bones. This is beneficial as it will reduce the chance of injury throughout the rest of Lena's training programme, so she will be able to continue.

Another adaptation is an increase in the amount of collagen in ligaments. When she runs, small tears will appear in her ligaments. The body mends these tears by increasing the amount of collagen in them. As a result, the ligaments become stronger and more pliable. This is beneficial to Lena. As her ligaments are getting stronger, she will reduce the chance of injury at these joints. This means she will be able to complete the rest of the training programme.

**Q 03**

The context for this question is a mixed martial arts (MMA) fighter.

**Q 03(a)**

Learners were asked to state one nutritional strategy to implement before training and one supplement to take during training to ensure the MMA fighter had enough energy for training. The majority of learners gained the available marks for reference to carbohydrate intake and the use of carbohydrate supplements. The examples of carbohydrate supplements varied from generic carbohydrate drinks to specific brands. Where marks were not achieved it was often due to link to protein or hydration rather than carbohydrates.

**This response gained 1 mark**

Credit was given for the nutritional strategy.

Pedro does not always have the energy he needs to train effectively.

**3 (a) (i) State one nutritional strategy** Pedro should consider to make sure he has enough energy for training. (1)

*To have a high carbohydrate based diet.*

---

Pedro could use dietary supplements to provide additional energy for training.

(ii) Give **one** example of a dietary <sup>tablet</sup> **supplement** Pedro could take **during** a training session to provide additional energy for training. (1)

*vitamines*

**This response gained 2 marks**

Pedro does not always have the energy he needs to train effectively.

**3 (a) (i) State one nutritional strategy** Pedro should consider to make sure he has enough energy for training. (1)

*Plan his carbohydrate intake around training.*

---

Pedro could use dietary supplements to provide additional energy for training.

(ii) Give **one** example of a dietary **supplement** Pedro could take **during** a training session to provide additional energy for training. (1)

*~~Sports drink / juice~~ Glucose sports drink.*

**Q 03(b)**

Learners were asked to state two causes of overtraining. Whilst many learners stated one cause of overtraining, often linked to lack of time for recovery, relatively few correctly identified two causes.

**This response gained 0 marks**

Some learners misinterpreted the question referencing possible effects of overtraining rather than the causes.

(b) State **two** causes of overtraining. (2)

1 Muscle injury

2 Tiredness

**This response gained 1 mark**

Credit was given for the reference to limited recovery time.

Pedro trains for 2 hours every day.  
Pedro's coach tells him he is overtraining.

(b) State **two causes** of overtraining. (2)

1 need for perfectionism in the activity

2 ~~obsession with activity~~ limited rest recovery time between sessions.

**This response gained 2 marks**

Both causes as stated in the unit content.

Pedro trains for 2 hours every day.  
Pedro's coach tells him he is overtraining.

(b) State **two** causes of overtraining. (2)

1 exercise addiction

2 imbalance in training programme

**Q 03(c)**

Learners were asked to state the effect of excess adrenaline production on the MMA fighter's performance. Some learners incorrectly focused on the body's normal response to adrenaline rather than excess adrenaline associated with overtraining. Most learners appreciated that excess adrenaline would have a detrimental effect on performance and therefore gained some credit.

**This response gained 1 mark**

Credit was given here for reference to fatigue, although the impact on performance was not stated.

One effect of overtraining is excess adrenaline production.

(c) Explain the effect of excess adrenaline production on Pedro's performance. (2)

An excess of adrenaline can lead to fatigue. This is because adrenaline gives a short boost in energy and if this is not used the body can fatigue faster.

This response gained 2 marks

One effect of overtraining is excess adrenaline production.

(c) Explain the effect of excess adrenaline production on Pedro's performance.

Excess adrenaline production is not <sup>will decrease</sup> his (2)  
performance as he will feel fatigued and  
depressed, which ~~is~~

**Q 3(d)**

Learners were asked to explain why a lack of rest between training sessions will have a negative impact on the fighter's muscular system and performance.

A large number of learners correctly linked lack of rest to potential for injury or lack of adaptations. Some learners explained this through microtears forming and not having time for recovery. However relatively few learners also clearly linked to performance, stopping at the impact on the muscular system. To gain all four the explanation needed to show how the impact on the muscular system impacted performance, for example, if injured an inability to train leading to loss of fitness/performance or an inability to train as hard reducing performance.

**This response gained 2 marks**

The response identifies that lack of rest means no time to repair 'muscle tear/rip' leading to injury. Whilst this is correct it is an incomplete response. As a result of the training session the muscles would have micro tears rather than rips and the impact of this on performance also needs addressing. For example, an injury would lead to a reduction in training therefore a drop in fitness

Pedro is not giving his body enough time to rest between training sessions.

(d) Explain **one** reason why a lack of rest between training sessions will have a **negative** impact on Pedro's muscular system and his performance.

(4)

One reason ~~why~~ is that if Pedro does not give his muscles time to rest then they are going to become injured. This is because once an athlete <sup>participates in</sup> exercises exercise their muscle tears rip a little, therefore they need time to repair themselves so an athlete can perform at their best. But if they are not given time to repair then they can rip even more causing injury to the muscle.

This response gained 4 marks

Pedro is not giving his body enough time to rest between training sessions.

(d) Explain **one** reason why a lack of rest between training sessions will have a **negative** impact on Pedro's muscular system and his performance.

(4)

A lack of rest between sessions doesn't allow Pedro's body enough time to recover. In his muscular system ~~the~~ they are not allowing enough time for their body to repair the micro-tears caused during training sessions. Less recovery time will allow the tears to become worse until they suffer from a muscular injury which will put them out of training, delaying and decreasing their performance.

**Q 3(e)**

This was the third extended response question. Learners were asked to evaluate the importance of the different methods of heat loss from the body during a training session.

To fully address the question learners needed to demonstrate knowledge of the different methods of heat loss covered in the unit content: convection, conduction, radiation and evaporation and then apply this knowledge to the indoor training session, eg conduction of heat through direct contact with the training equipment. A significant number of learner's picked up on the fact the fighter was training indoors allowing them to be evaluative about the heat loss methods, eg if air conditioning or a fan in the training space this would mean convection would be much more effective due to the additional cool breeze, otherwise this method would be less effective.

**Level 1 extract**

The response demonstrates isolated elements of knowledge thus gains credit despite the lack of reference to specific heat loss methods from the unit content. Sweating allows heat loss through evaporation rather than being a specific heat loss method in its own right.

Pedro completes all his training indoors at his local leisure centre.

It is important that Pedro's body does not overheat during training.

(e) Evaluate the importance of the different methods of heat loss from the body during one of Pedro's training sessions.

(8)

The first method of heat loss will be sweating. This is used to cool the body down as water is released, however it is important the water levels are restored after. At least 1.5 times the water lost must be replenished after sweating so that he remains hydrated. This is so he can continue sweating without feeling side effects such as dizziness due to his water levels being low.

**Level 2 extract**

The response demonstrates some accurate knowledge and understanding about evaporation and the use of vasodilation to increase blood flow to the extremities, although this is not specifically attached to a method of heat loss. Some of the points made are linked to the context in the question. There is also an attempt at evaluation in terms of the importance of heat loss in general to avoid fatigue if he overheats.

Pedro completes all his training indoors at his local leisure centre.

It is important that Pedro's body does not overheat during training.

(e) Evaluate the importance of the different methods of heat loss from the body during one of Pedro's training sessions.

- sweat  
- vasoconstriction  
and vasodilation  
- hairs

(8)

Pedro's body will try to lose heat from the body in many different ways, this is important so he does not overheat and become tired ~~as~~ quick.

Pedro's body will try to lose heat through sweat, this allows the heat to evaporate with the sweat and also the sweat can become cold due to air passing onto it and cooling the body as it becomes colder on the ~~skin~~ surface of the skin.

Also the body can vasoconstrict and vasodilate the blood in certain parts of the body and bring some blood to the surface of the skin allowing it to cool and make the body lose heat through the blood, also air touches the skin and cools down the blood this way.

**Level 3 extract**

The response gives good coverage of the four methods of heat loss. For each method the learner considers how this would apply within the training session and then attempts to evaluate how effective this would be.

The highlighting on the extract shows the methods (yellow), how the method might apply to the MMA fighter (pink) and reasoned judgements about the effectiveness (green).

Pedro completes all his training indoors at his local leisure centre. Conduction  
convection  
radiation

It is important that Pedro's body does not overheat during training.

(e) Evaluate the importance of the different methods of heat loss from the body during one of Pedro's training sessions. (8)

Conduction allows for the body to lose heat ~~when~~ by transferring heat between the body and another object. When training in a mixed martial arts the Pedro will not have the opportunities to lose heat by resting contact with other objects as he is constantly on the move and will not be resting contact with a cooler ~~or~~ object for a long period of time. This therefore means that conduction will not be too important or better when losing heat as he will not be resting contact with cooler objects for long periods. Convection allows the body to lose heat by having sweat ~~evaporate~~ ~~away~~ by the air. Heat is on the skin whisked away by the air. Convection is dependent on the temperature of the leisure centre and if there is air conditioning in the centre or not. If there is air conditioning in the centre, convection will occur because the air is cooler and will whisk the sweat away from the skin. However, if it is warm in the centre, convection will not occur as there will not be a difference in temperature. Therefore prohibiting convection from happening. Radiation allows for the body to lose heat than objects, but without contact. This will allow by standing near something cool - at the same body and object take part of the other to compare the temperature. This is why in the leisure centre first there will be something cool after the a longer time to be able to stand near during training so I don't think radiation is important. Evaporation allows for the body to lose heat by sweat receiving a certain temperature and then evaporating allows the body to cool down. This will be important for Pedro because it allows him to be able to get rid of sweat quickly, allowing for him to lose body heat through more sweating, which therefore means it will be the most appropriate method for Pedro's body.

**Q 04**

The context for this question is a cross country skier at high altitude.

**Q 04(a)(i)**

Learners were asked to state the meaning of the term hypoxia. Most learners successfully linked this to a lack of oxygen

**This response gained 0 marks**

Hypoxia is an initial response of the body to high altitude.

4 (a) (i) State the meaning of the term hypoxia.

(1)

This is a symptom of high altitude causing  
high altitude sickness.

**This response gained 1 mark**

Karl's next race will be at high altitude.

Hypoxia is an initial response of the body to high altitude.

4 (a) (i) State the meaning of the term hypoxia.

(1)

When the body is deprived of oxygen

**Q 04(a)(ii)**

Learners were asked to explain why resting heart rate increases in response to being at high altitude. Many learners gained credit even though they talked about heart rate increase during exercise as the reasoning in this context is the same. Learners should avoid using terminology such as 'thin air' to describe low partial pressure of oxygen.

**This response gained 1 mark**

The heart and cardiovascular system is responsible for oxygen transport, therefore full credit could not be awarded for the incorrect explanation that resting heart rate increases to get more oxygen into the body. Oxygen intake is the responsibility of the respiratory system.

(ii) Explain why Karl's **resting** heart rate increases in response to being at high altitude. (2)

Resting heart rate will increase because at altitude partial pressure of oxygen is low. As a result Karl's heart will beat more to get more oxygen into the body to meet bodies demands.

**This response gained 2 marks**

This gains two marks as the lack of oxygen is identified and then the explanation follows that heart rate increases therefore to compensate so that the same amount of oxygen can still be delivered.

(ii) Explain why Karl's **resting** heart rate increases in response to being at high altitude. (2)

Karl's resting heart rate increases because there is a lower volume of oxygen in the air, meaning his cardiovascular system needs to work at a faster pace to get the same amount of oxygen to respiratory cells as it would at a lower altitude.

**Q 04(a)(iii)**

Learners were asked to state two possible symptoms of altitude sickness. The list of possible symptoms is quite significant therefore the majority of learners found this to be an accessible question. Most common symptoms were nausea and headaches, less popular symptoms are shown in the responses below.

**This response gained 1 mark**

Altitude sickness is another initial response of the body to high altitude.

(iii) State **two** possible symptoms of altitude sickness. (2)

1 You may feel light headed and dizzy

2 You may feel like you have lots of energy

**This response gained 2 marks**

Altitude sickness is another initial response of the body to high altitude.

(iii) State **two** possible symptoms of altitude sickness. (2)

1 Dizziness

2 Quicker fatigue/tiredness

**Q 04(b)**

This part of the question asked learners to explain why extreme cold conditions could cause frostbite. Correct responses focused on the lack of blood flow to the extremities to allow the body to maintain core body temperature.

**This response gained 1 mark**

This response provides a partial explanation, ie that a reduction in blood flow can lead to frostbite. To complete the explanation reference should have been made to the reason for this, ie that this was necessary to maintain core temperature.

The air temperature at high altitude can be extremely cold and cause frostbite.

(b) Explain why extreme cold conditions can cause frostbite. (2)

Frostbite is a result of vasoconstriction. The blood vessels constrict so tightly that no or barely any blood is flowing to that region of the body. (vasoconstriction occurs in extreme cold).

**This response gained 2 marks**

The air temperature at high altitude can be extremely cold and cause frostbite.

(b) Explain why extreme cold conditions can cause frostbite. (2)

Extreme cold conditions cause high levels of vasoconstriction. As the blood is drawn away from the extremities into the core body temperature and reserves the blood to the vital organs. In turn the supply of blood to the extremities is cut off resulting in tissue death and frostbite.

**Q 04(c)(i)**

Learners were asked to explain why shivering helps to reduce heat loss. Many learners gained at least one mark for this question, stating that this was because it generated heat. To gain both marks it needed to be clear why heat was generated, eg rapid contraction of the muscle.

**This response gained 1 mark**

Whilst the statement 'shivering generates heat' is correct, as the question asks for an explanation, we need to know why it generates heat to gain full credit.

Shivering is one method of reducing heat loss.

(c) (i) Explain why shivering can help reduce heat loss. (2)

Shivering generates heat within the muscle tissue itself, this allows for an insulated layer of warmth within the body

**This response gained 2 marks**

Shivering is one method of reducing heat loss.

(c) (i) Explain why shivering can help reduce heat loss. (2)

Rapid muscle contraction creates heat within the muscles

**Q 04(c)(ii)**

Learners were asked to state one other method of reducing heat loss. Specific methods to reduce heat loss are given in the unit content, in addition to these clear, accurate descriptions of the methods were also credited. Whilst many learners correctly identified a method to reduce heat loss, some misinterpreted the question, as in the example below or by stating a method of heat loss rather than a method to reduce heat loss.

**This response gained 0 marks**

The response indicates what should happen to blood flow if the body is cold rather than stating a method of heat loss.

(ii) State **one other** method of reducing heat loss. (1)

at directing the blood flow to the  
major organs.

**This response gained 1 marks**

(ii) State **one other** method of reducing heat loss. (1)

non-shivering thermogenesis.

**Q 04(d)**

The final extended response question asked learners to evaluate the impact of three adaptations on long-distance cross-country skiing performance at high altitude.

Learners were given the adaptations to evaluate, they are shown in the table below.

Karl trains at high altitude so his body can adapt before his cross-country race.

**Table 1** shows three adaptations to training at high altitude.

<b>Adaptation to training at high altitude</b>
Increased mitochondria
Increased red blood cell production
Increased oxidative enzymes

**Table 1**

One obvious drawback of providing the adaptations is that learners may not be as familiar with these adaptations as others, however, by giving the adaptations to be evaluated learners were far less likely to talk about incorrect adaptations for the body system in the question or to talk about responses rather than adaptations.

Of the given adaptations, the impact of increased red blood cell production appeared most accessible, increased oxidative enzymes the least. Common misconceptions re the oxidative enzymes included thinking of them as oxygen stores rather than their use to break down fat for fuel.

As with all extended response questions it is important to show development in the answer, taking a fact, e.g. increased red blood cell production and developing this by applying to the question context, e.g. meaning a corresponding increase in haemoglobin to carry oxygen so more oxygen could be carried so the performer could work aerobically for longer thus delaying fatigue.

As for the previous extended responses, the depth of knowledge and level of understanding of some learners was very impressive.

**Level 1 extract**

The response provides isolated elements of knowledge and some generic assertions are made (as not developed). For example, there is reference to more energy as there are more mitochondria and more oxygen being delivered due to increased red blood cell production. Both of these statements are relevant to the question, but neither is explained, applied or evaluated.

(d) Evaluate the impact of the adaptations in **Table 1** on Karl's long-distance cross-country skiing performance at **high altitude**.

(8)

Mitochondria are the powerhouse cell, increase in mitochondria will allow for more energy to be produced to provide energy to help body be able to climatise to the new environment.

An increase in red blood cell production allows for more oxygen to be delivered to the working muscles in one cardiac output. Allowing the body to have balance of over the increase of carbon dioxide due to the high altitude.

This means when performing it in her event her body will climatise and accustomed to the changes to the altitude, allowing her to perform as well as she would at sea level.

**Level 2 extract**

This response develops points a little more for example in the first paragraph there is reference to increased energy production due to the mitochondria and the impact of this being that the skier will feel less fatigued and therefore able to cover long distances. In the second paragraph there is reference to increased haemoglobin due to the increased red blood cell production the consequence being that more oxygen can be transported reducing risk of hypoxia and therefore fatigue.

(d) Evaluate the impact of the adaptations in **Table 1** on Karl's long-distance cross-country skiing performance at **high altitude**.

(8)

The impact of the increased mitochondria allows more energy to be produced for Karl. The mitochondria is the 'powerhouse' of the cells and helps with energy production. This will benefit Karl as he will feel less fatigued and will be capable to cover longer distances. ~~As furthermore the~~

furthermore the increase in red blood cell production allows more oxygen to be passed around the body and to the working muscles. The red blood cells will carry more oxygen around the body leading to a haemoglobin increase. As red blood cells increase, so does haemoglobin. This then prevents hypoxia which is an initial response to the body at high altitude. Karl will feel less fatigue and more focused as he will have and

**Level 3 extract**

This response demonstrates knowledge and understanding, providing relevant 'theory' about each adaptation and then application of this knowledge to the skier in the question and the impact the adaptation will have on performance. This is a well-structured response.

Paragraph 1 of the response partially evaluates the impact of more mitochondria, linking this to increased energy and therefore off-setting fatigue.

(d) Evaluate the impact of the adaptations in **Table 1** on Karl's long-distance cross-country skiing performance at **high altitude**.

(8)

The first adaptation, increased mitochondria, is very beneficial. By increasing the number of mitochondria, it increases the production of ATP as there are more cells that can carry it out. This would help boost him when he works aerobically, such as during a down hill section. By increasing the number of mitochondria, it allows there to be more ATP for Type I and Type II muscle fibres, which both have a high oxidative capacity. Due to the increased energy, it will also delay the onset of fatigue, meaning Karl can maintain his performance over for longer during his ascent.

Paragraph 2 demonstrates a good level of knowledge of the adaptation to red blood cells, identifying the role of EPO and haemoglobin as well as considering the impact of more haemoglobin, (greater oxygen carrying capacity) delaying fatigue allowing them to maintain performance. This point is well argued, justifying why it is necessary at altitude in terms of oxygen levels.

The next adaptation is increased red blood cell production. This occurs because the body responds to altitude by increasing the amount of EPO released. It is this that produces red blood cells. As there are more red blood cells, there is more haemoglobin. This increases the O<sub>2</sub> carrying capacity of the body, as there is more haemoglobin to bind to. This is very beneficial. At altitude, there is less O<sub>2</sub> due to decreased pressure. This would mean less O<sub>2</sub> would be able to be delivered to the working muscles. However, as there is more haemoglobin, the body can carry the more O<sub>2</sub> at altitude. This means the body can continue to produce ATP aerobically, delaying fatigue. This will mean that he will be able to maintain performance throughout the majority of the event.

Paragraph 3 deals with the final adaptation and the role in energy production. The link between mitochondria and oxidative enzymes is also made explaining that this will increase aerobic energy production even further and the impact this has on performance.

The final adaptation is increased oxidative enzymes. These are enzymes that will catalyse reactions when making energy aerobically. This will be very sensitive to P<sub>50</sub>. By increasing the enzymes, ~~there will~~ along with increased mitochondria, will increase the rate at which his body will aerobically produce ATP. This is good as if there is more energy being produced, there is more available to Type 1 and Type 1b muscle fibres for contraction. Again, this will allow him to maintain his performance across the event during aerobic sections, as fatigue can be delayed.



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