Examiners' Report
Lead Examiner Feedback

January 2022

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

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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade, at Distinction, Merit and Pass.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the external assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark is for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each external assessment we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each assessment, because then it would not take accessibility into account.

Grade boundaries for this, and all other papers, are on the website via this link:
http://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

Awarding BTEC qualifications in 2022

Ofqual has set out their plans for awarding qualifications in 2022 and intend to return to a normal, pre-pandemic, approach to grading standards over by 2023. They have confirmed that 2022 will be a transition year, to reflect that we are in a pandemic recovery period and students' education has been disrupted.

Our guiding principle and approach to awarding BTEC qualification results in 2022 will be to ensure parity in relation to the approach being taken for GCSE and A level learners. BTEC courses have a different structure and design to academic qualifications - BTECs are modular qualifications (with assessments taking place throughout the course) compared to GCSEs and A levels which are linear (assessed and awarded at the same time at the end of the year), and therefore our approach needs to be different.

In 2022 we will return to the usual method of calculating BTEC qualification results, however adaptations including, U-TAGs and reduced internal assessment, are in place to provide a comprehensive package of support for students.

The basis of our awarding approach to BTECs this year is to ensure it is as fair as possible for all learners. We will use a range of evidence to set grade boundaries for the external units. Part of this evidence will be to closely monitor learner performance in all assessments that contribute to learners' final qualification grade, to ensure parity with A level and GCSEs.

Further information can be found on our website and via our Social Media channels.

Unit 1: Sport and Exercise Physiology 31813H

Grade	Unclassified	Level 3			
		N	P	M	D
Boundary Mark	**0**	**12**	**23**	**34**	**45**

Introduction

The format of this assessment followed that of 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.

Four extended response questions make this a potentially challenging assessment for learners, but centres and learners should be congratulated, this series maybe more than most, on their preparation for this assessment. Overall learners appeared well prepared and well versed on many of the specification topics covered in this assessment.

Individual Questions

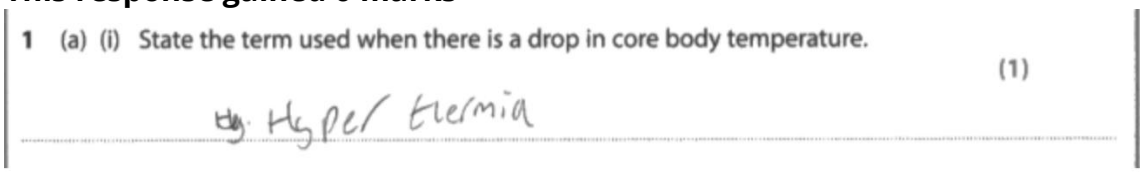
The following section considers each question on the paper, providing examples of popular learner responses and a brief commentary of why the responses gained the marks they did. This section should be considered with the live external assessment and corresponding mark scheme.

Q01(a)

The context for question 1 was rowing. Learners were presented with an image of a team rowing on a cold, wet day. They were told one effect of cold on the body is a drop in core temperature.

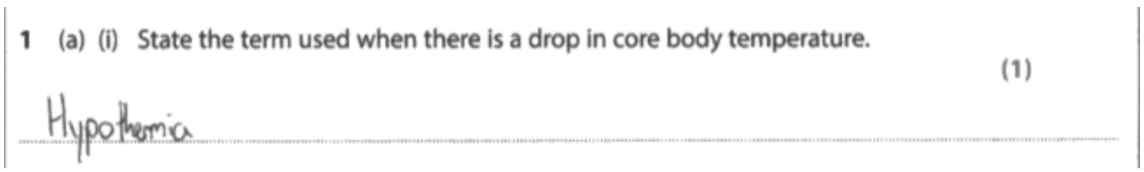
In part (a)(i) learners were asked to state the term used when there is a drop in body temperature. Some learners were clearly unsure, but many gave the correct response hypothermia. A popular incorrect response was hyperthermia. It is worth noting that due to the similarity in spelling it is essential that learners write technical terms clearly. Other incorrect responses were thermoregulation and thermogenesis.

This response gained 0 marks


1 (a) (i) State the term used when there is a drop in core body temperature. (1)

Hyper Thermia

This response gained 1 mark


1 (a) (i) State the term used when there is a drop in core body temperature. (1)

Hypothermia

In part (a)(ii) learners were asked to state one other effect of extreme cold on the body. A wide range of answers were accepted for this question from numbness/pins and needles to slurred speech, although the expected response was frostbite as this is the only other effect of extreme cold given in the specification for this unit. Incorrect responses tended to focus on shivering or non-shivering thermogenesis.

This response gained 0 marks

(ii) State **one other** effect of extreme cold on the body. (1)

Causes shivering

This response gained 1 mark

(ii) State **one other** effect of extreme cold on the body. (1)

frostbite

Q01(b)

This part of the question asked learners to explain how non-shivering thermogenesis reduced heat loss from the body. The required response focused on increasing metabolism or metabolic heat production through the release of adrenaline or increasing the metabolism of brown fat within the body. Those familiar with the term gained the two available marks. Incorrect responses tended to focus on the shivering aspect of the term.

This response gained 0 marks

(b) Explain how non-shivering thermogenesis reduces heat loss from the body. (2)

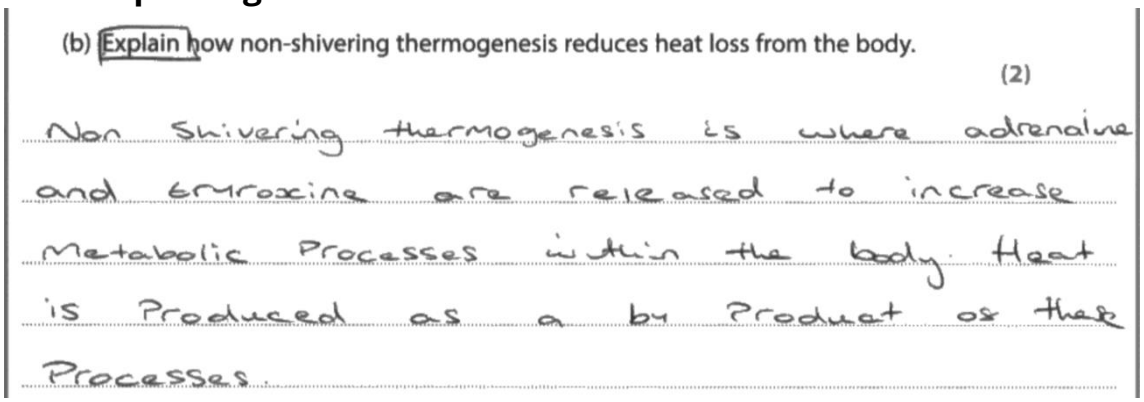
Non-shivering thermogenesis is when the ~~never~~ hairs on the body stand up trying to trap the warm air under them. By it doing ~~the~~ this helps the body feel warmer.

This response gained 1 mark

(b) Explain how non-shivering thermogenesis reduces heat loss from the body. (2)

non-shiverig thermogenesis reduces heat loss by ~~stren~~ secreting adrenaline / cortisol into the body to increase the body's working rate to help reduce heat loss from the body.

This response gained 2 marks



(b) Explain how non-shivering thermogenesis reduces heat loss from the body.

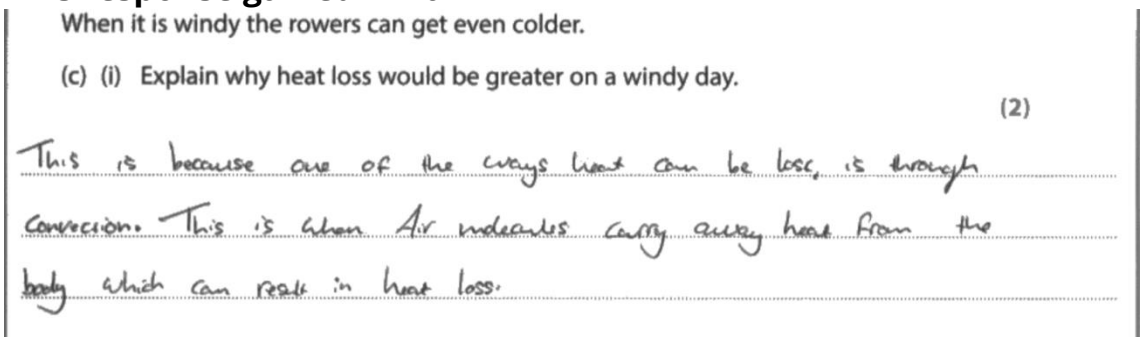
(2)

Non Shivering thermogenesis is where adrenaline and thyroxine are released to increase Metabolic Processes within the body. Heat is Produced as a by Product of these Processes

Q01(c)

This part of the question asked learners about heat loss methods. Part (c)(i) asks learners to explain why heat loss is greater on a windy day. Correct responses identified convection as the relevant method of heat loss, explaining that this was because of air flow over the skin resulting in heat loss from the warm body to the colder air. Incorrect responses tended to describe other methods of heat loss. It was important for learners to reference where heat loss occurred, i.e., from the skin, rather than a general statement re the body.

This response gained 1 mark



When it is windy the rowers can get even colder.

(c) (i) Explain why heat loss would be greater on a windy day.

(2)

This is because one of the ways heat can be lost, is through convection. This is when Air molecules carry away heat from the body which can result in heat loss.

This response gained 2 marks

When it is windy the rowers can get even colder.

(c) (i) Explain why heat loss would be greater on a windy day.

(2)

Heat loss would be greater on a windy day because there is an increase of convection, this is where the cold wind blows away the warm air trapped near the skin and replaces it with cold air

Part (c)(ii) asks learners to describe one method of heat loss if the rower falls into the water. Correct responses identified conduction as the relevant method of heat loss, describing heat was lost through direct contact with the water. It was important for learners to be very clear about direct contact and not simply repeat that this was due to falling in the water, as this was given in the question. Incorrect responses tended to describe other methods of heat loss or failed to describe the direct contact needed. In the example below an incorrect method is stated but reference is made to direct contact which is credited.

This response gained 1 mark

The water temperature of the river Ronald rows on is much colder than the air temperature.

(ii) Describe **one** method of heat loss from Ronald's body if he falls into the cold water.

(2)

Convection is the way in which heat is lost from one object to another through physical contact with the object.

This response gained 2 marks

The water temperature of the river Ronald rows on is much colder than the air temperature.

(ii) Describe **one** method of heat loss from Ronald's body if he falls into the cold water.

(2)

one heat loss method would be conduction. Conduction is a transfer of heat through touch. as the cold water surrounds him it conducts his heat.

Q1d – This is the first of four extended response questions on the paper. The theme for this question was the impact of training adaptations on the muscular system because of strength training compared to aerobic training for a long-distance rower.

Strength training adaptations appeared to be more familiar content for learners, especially the link between strength training and hypertrophy and its application to the question context, i.e., that the rower would be able to 'row harder or get a better pull through the water'. Very few learners referred to the increase in motor unit recruitment, or the impact of this.

Aerobic adaptations were also well known by some, whilst others gave generic aerobic adaptations, focusing on the CV and respiratory systems, talking about aerobic fitness rather than the muscular system as required. E.g., discussing the impact of cardiac hypertrophy or increased haemoglobin rather than increased myoglobin stores or mitochondria in the muscle.
Other common errors when answering this question occurred where the link between named adaptations and type of training was not made. For example, some learners mentioned an increase in myoglobin but did not link this to aerobic training.

Those able to identify relevant adaptations to the muscular system and develop this knowledge through application to the question context scored highly on this question. Responses in level 1 tended to omit the adaptations or only briefly investigate one adaptation.

Level 1 response (1 – 3 marks)

Ronald uses strength training **and** aerobic training to cause **adaptations** to his muscular system.

(d) Evaluate which of these training methods will provide the most beneficial adaptations to Ronald's **muscular system**, so he can perform well in a long-distance rowing race.

(8)

Stronger cont
Tetanus
wave summ
hypertrophy.

In my opinion, Ronald should use more strength training to gain more beneficial adaptations to his muscular system, this is because of the following factors;

One adaptation that occurs to the muscular system due to exercise is hypertrophy. This is when muscle becomes larger and stronger. This happens due to tears in muscle fibres repairing and thickening to become larger and stronger due to being able to exert more force as more sarcomeres are present. This would come more from strength training than it would aerobic training due to the intensity and nature of strength training. Hypertrophy will be beneficial to Ronald as he will be able to adapt better technique and more forceful strokes within his long distance rowing race.

Level 2 extract (4 – 6 marks)

Ronald uses strength training **and** aerobic training to cause **adaptations** to his muscular system.

(d) Evaluate which of these training methods will provide the most beneficial adaptations to Ronald's **muscular system**, so he can perform well in a long-distance rowing race.

(8)

The adaptations to Ronalds muscular system through strength training would be based around power. Ronalds muscles would gain more motor units which would create a stronger contraction. His muscles would increase in size due to hypertrophy and hyperplasia. These adaptations would all benefit Ronalds performance more in a short-distance rowing race rather than a long-distance race.

The adaptations to Ronalds muscular system through aerobic training would be based around endurance. Ronalds muscle cells would gain more mitochondria, mitochondria carry out respiration and produce energy. Having more mitochondria would mean that Ronald would be able to row for longer time in the race without feeling fatigue.

Level 3 extract (7 – 8 marks)

Ronald uses strength training **and** aerobic training to cause **adaptations** to his muscular system.

(d) Evaluate which of these training methods will provide the most beneficial adaptations to Ronald's **muscular system**, so he can perform well in a long-distance rowing race.

(8)

1). facts
2. Relate to Q
3. Evaluate.

the race. Strength training also induces micro-tears within the muscles. With sufficient rest & recovery, the tears are repaired and overtime are build back bigger and stronger. This is called muscular hypertrophy. By undergoing repair and hypertrophy, Ronald will be able to exert more force when he is rowing, meaning he will travel further with each stroke, using the same effort. Similarly, hyperplasia is the increase in the number of muscle fibres a person has. By having more muscle fibres than before, overtime, Ronald will be able to recruit more of these as the fibre types he requires for the event. For example, he will recruite more type 1 fibres as they can contract for long periods of time with minimal fatigue. Additionally, more muscle fibres mean that he can exert more power into each stroke.

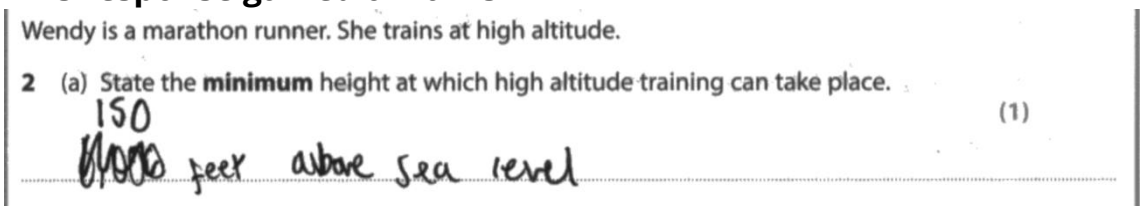
time. By aerobic training, Ronalds myoglobin stores increase. This is the site at which oxygen is stored within the muscles. By having a greater oxygen supply, the muscles are able to contract repeatedly for the duration of the race with less fatigue, as there is enough O_2 to break down lactic acid faster than it's produced.

Q02

The context for question 2 was a marathon runner training at high altitude.

Q02(a) Learners were asked to state the minimum height required to be considered high altitude. The specification states this figure is 2400m above sea level. However, a range around this figure was accepted. There was a vast range of responses from 6 inches about sea level to 10,000km.

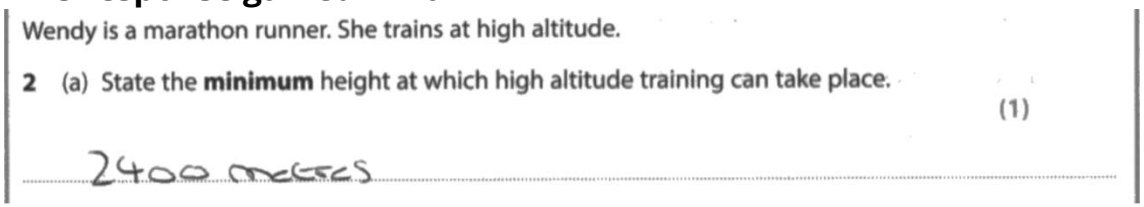
This response gained 0 marks


Wendy is a marathon runner. She trains at high altitude.

2 (a) State the **minimum** height at which high altitude training can take place. (1)

150 feet above sea level

This response gained 1 mark

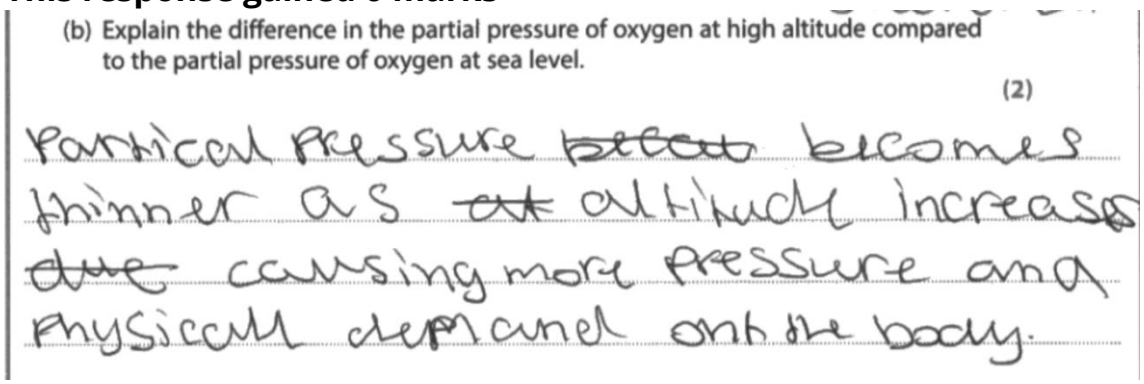

Wendy is a marathon runner. She trains at high altitude.

2 (a) State the **minimum** height at which high altitude training can take place. (1)

2400 meters

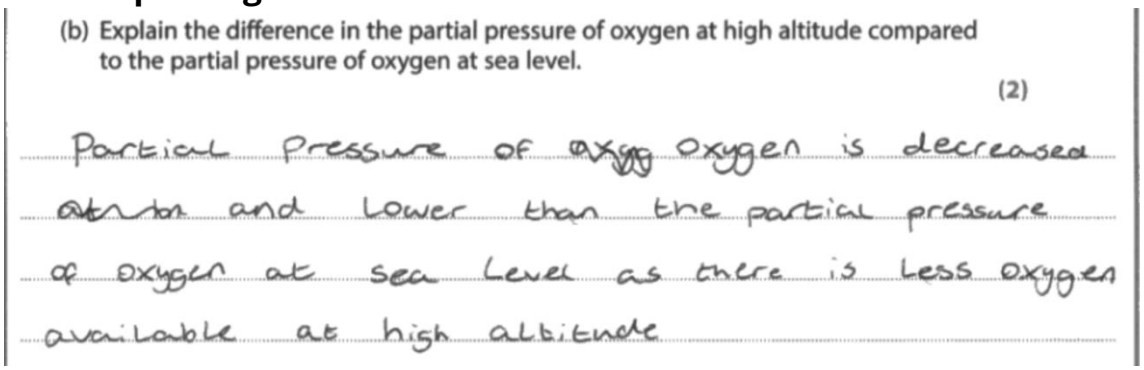
Q02(b) This question asked learners to explain the difference between the partial pressure of oxygen at high altitude compared to sea level. Whilst many learners clearly understood why there was a lower partial pressure of oxygen at high altitude many did not. Whilst some leeway was given for the justification why ppO_2 was less at high altitude, 'thick' or 'dense' air/oxygen was not credited.

This response gained 0 marks


(b) Explain the difference in the partial pressure of oxygen at high altitude compared to the partial pressure of oxygen at sea level. (2)

Partical Pressure becomes thinner as altitude increase due causing more pressure and physicall depraved on the body.

This response gained 2 marks



(b) Explain the difference in the partial pressure of oxygen at high altitude compared to the partial pressure of oxygen at sea level.

(2)

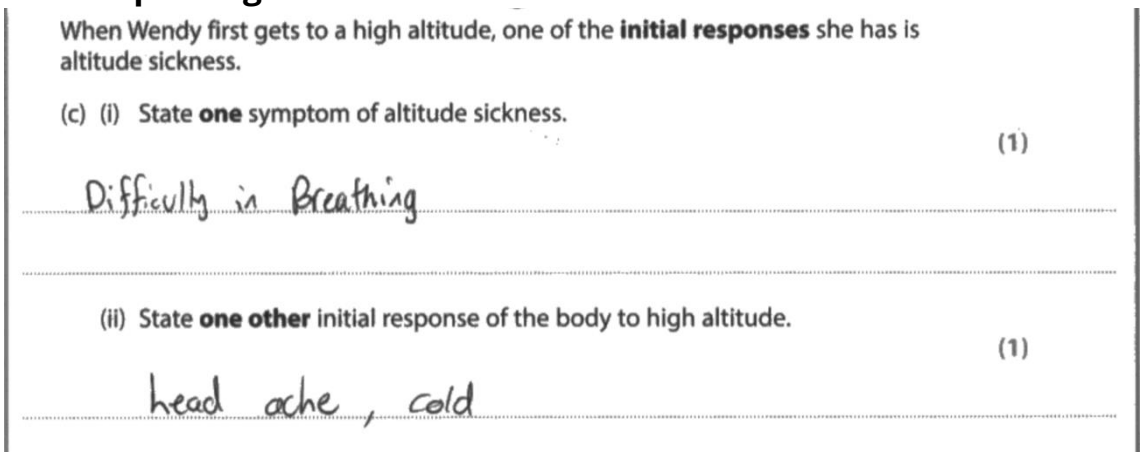
Partial Pressure of ~~oxyg~~ oxygen is decreased at high and lower than the partial pressure of oxygen at sea Level as there is less oxygen available at high altitude

Q02(c)(i-ii)

(i) learners were asked to state one symptom of altitude sickness. Whilst many learners correctly stated nausea or its equivalent there were a variety of other correct responses as well, including headaches, dizziness, and shortness of breath. The key word in the question is 'symptom', learners needed to think about how altitude sickness would make someone feel.

(ii) This part of the question asked learners to state one other initial response of the body to high altitude. Incorrect answers often gave further examples of symptoms of altitude sickness rather than a response to high altitude. Increased breathing rate was a popular correct answer, as was hypoxia and increased heart rate.

This response gained 1 mark



When Wendy first gets to a high altitude, one of the **initial responses** she has is altitude sickness.

(c) (i) State **one** symptom of altitude sickness.

(1)

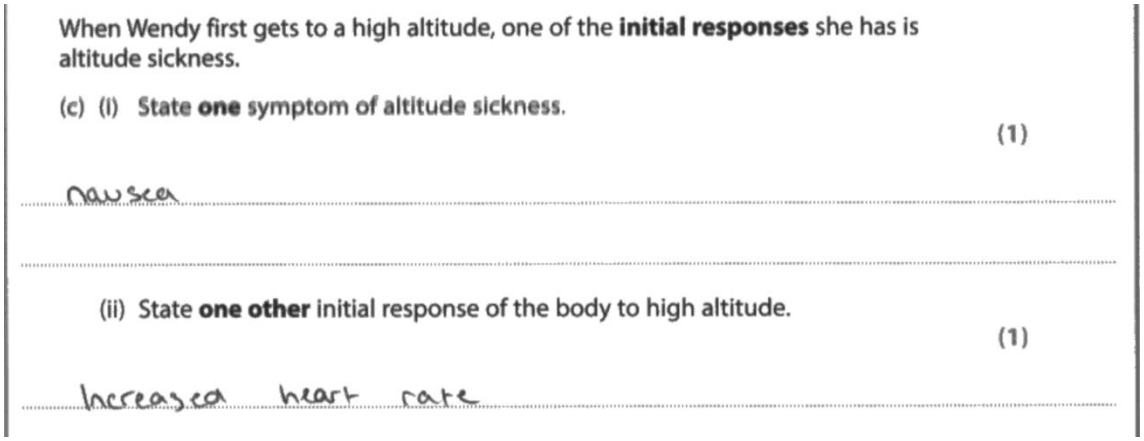
Difficulty in Breathing

(ii) State **one other** initial response of the body to high altitude.

(1)

head ache, cold

This response gained 2 marks



When Wendy first gets to a high altitude, one of the **initial responses** she has is altitude sickness.

(c) (i) State **one** symptom of altitude sickness.

(1)

nausea

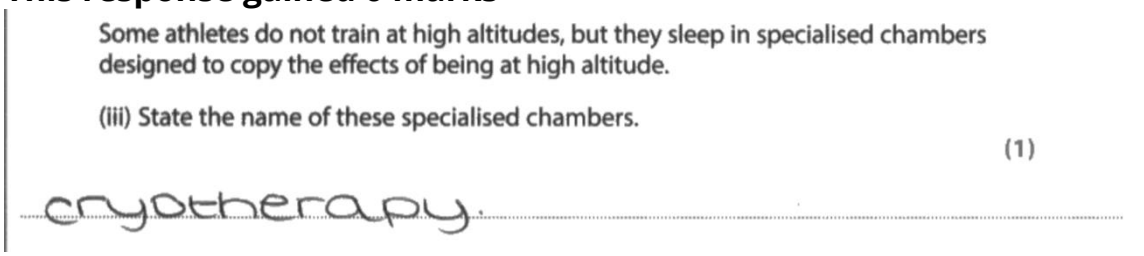
(ii) State **one other** initial response of the body to high altitude.

(1)

increased heart rate

Q2(c)(iii) Learners were asked to name the specialised chambers some athletes use to mimic being at high altitude. Many learners gave correct responses, the most common correct responses being hypoxic chambers and altitude tents. Incorrect responses tended to be examples of specialised chambers that increase oxygen content rather than decrease it, e.g., hyperbaric chambers or oxygen tents. Some learners incorrectly stated ice therapy.

This response gained 0 marks



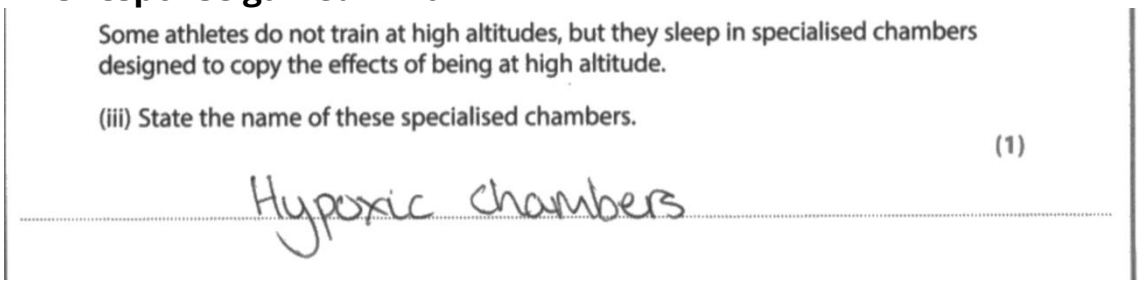
Some athletes do not train at high altitudes, but they sleep in specialised chambers designed to copy the effects of being at high altitude.

(iii) State the name of these specialised chambers.

(1)

cryotherapy.

This response gained 1 mark



Some athletes do not train at high altitudes, but they sleep in specialised chambers designed to copy the effects of being at high altitude.

(iii) State the name of these specialised chambers.

(1)

Hypoxic chambers

Q02(d) Learners were provided with 2 adaptations to training at high altitude and asked to explain why each would improve marathon performance. The adaptations were: increased red blood cell production and increased number of mitochondria. Learners found the red blood cell explanation much more straight-forward, with many correctly stating that more red blood cells meant there was more haemoglobin therefore more oxygen could be carried, or that the increase in red blood cells meant more oxygen was available to delay fatigue. If two marks were not achieved for this part of the question this was often because the response was not developed, e.g., a statement about more oxygen but not the link to performance.

The main issue for many learners was an apparent unfamiliarity with the role of mitochondria and although several called them the 'powerhouse' they then linked this to oxygen rather than energy production. Correct responses linked mitochondria to increased sites for aerobic respiration to take place, increasing energy available for the run.

This response gained 1 mark

Two **adaptations** to training at high altitude are:

- increased red blood cell production
- increased number of mitochondria.

(d) Explain why each of these adaptations will improve Wendy's marathon performance.

(i) Increased red blood cell production

(2)

More red blood cells will be able to carry oxygen to the working muscles. With more oxygen being carried the better and faster Wendy can perform.

(ii) Increased number of mitochondria

(2)

More cell production meaning that Wendy will perform better.

This response gained 4 marks

(d) Explain why each of these adaptations will improve Wendy's marathon performance.

(i) Increased red blood cell production

(2)

The more red blood cells means the more blood can be delivered to the working muscles. The red blood cells are full of haemoglobin meaning more oxygen can be delivered to the working muscles meaning the muscle can work for longer without becoming fatigued.

(ii) Increased number of mitochondria

(2)

Increased mitrochondria will allow more energy to be produced. This is where aerobic respiration takes place. The more energy produced means the more energy the muscles have meaning the can work for longer without becoming fatigued.

Q2(e) This extended response question asked learners about the importance of the responses of the CV system at the start of exercise.

Many learners were able to accurately identify increases in heart rate/stroke volume or cardiac output as a response to exercise and expand on the importance of these, for example, resulting in more oxygen being available for exercise so the runner could work for longer before fatiguing. Vascular shunting was also well known and applied to the question context. Less common was reference to the responses: Starlings Law or an increased diffusion rate. Very few learners discussed VO_2 diff or changes in blood pH.

Popular incorrect responses focused on other body systems, e.g., the response of the respiratory system to beginning exercise.

Level 1 response (1 – 3 marks)

Wendy is taking part in the London Marathon.

As Wendy starts the race one of the **initial responses** of her cardiovascular system is an increase in her heart rate.

(e) Assess the importance of the initial responses of Wendy's **cardiovascular system** to her running performance in the first few minutes of the marathon.

(8)

Increased heart rate is important because as your muscles start to work they need more oxygen from red blood cells, this is provided by an increase in heart rate.

Increased breathing rate is important because more carbon dioxide is produced and you need more oxygen to replace it.

Level 2 response (4 – 6 marks)

Wendy is taking part in the London Marathon.

As Wendy starts the race one of the **initial responses** of her cardiovascular system is an increase in her heart rate.

(e) Assess the importance of the initial responses of Wendy's **cardiovascular system** to her running performance in the first few minutes of the marathon.

(8)

The production of adrelanine at the start of a race is very important, this is because it causes Wendy's heart rate to increase therefore her stroke volume, the amount of blood pumped out of the heart in a beat and her cardiac output the amount of blood pumpede out of the heart in a minute will both increase meaning more blood containing oxygen can be taken to the working muscles so she can start to work aerobically as soon as possible and when the Atp-pc and the laetate system have finished being used. This will have a positive impact on Wendy's performance.

Secondly adrenaline will also cause vasodilation and vasoconstriction to occur. Vasodilation will occur to all of the working muscles so that lots of aerobic respiration can occur. Vasoconstriction will occur at all of the parts of the body not being used or needed such as the stomach. This means that more aerobic respiration can occur.

Level 3 extract (7 – 8 marks)

Wendy is taking part in the London Marathon.

As Wendy starts the race one of the **initial responses** of her cardiovascular system is an increase in her heart rate.

(e) Assess the importance of the initial responses of Wendy's **cardiovascular system** to her running performance in the first few minutes of the marathon.

(8)

working with O_2 and nutrients. Overall this allows increased stroke volume and increased cardiac output so she can delay fatigue and the effects of OBLA, helping her carry on the marathon.

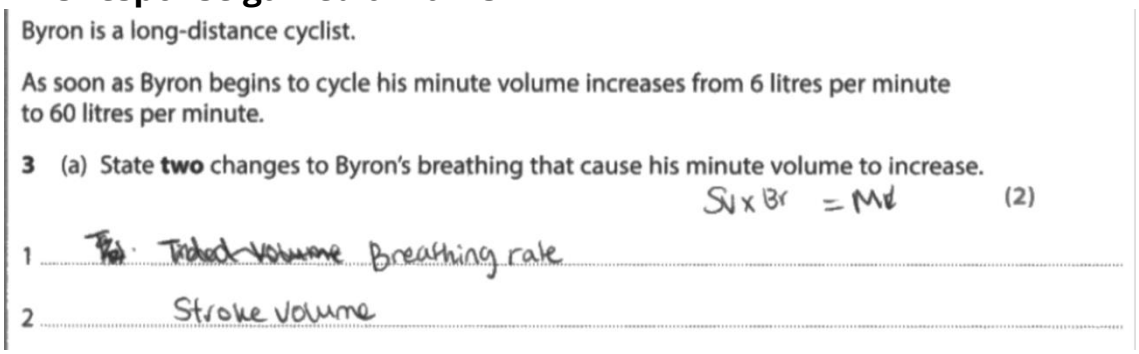
Starlings law comes in to effect as the heart increases in elasticity it will be able to contract with greater force, allowing stroke volume and cardiac output to increase, because SV x HR = Q. This means more blood will be circulated around the body to

working muscles in order to delay fatigue and OBLA so that Wendy can run the marathon.

When wendy starts running the body will start to produce CO_2 as a waste product from energy production, this increase in CO_2 decreases the Ph in blood, which is detected by chemoreceptors found in the aorta and carotod artery. The hydrogen from the CO_2 will denature enzymes that are used to split cells for energy production, meaning Wendy would have less energy to run the race. However a response of the

Q03 The context for this question was a long-distance cyclist.
Q03(a) This part of the question asks learners to state two changes to breathing that cause minute ventilation to increase. Whilst there were many correct responses citing increased breathing rate and increased breathing volume many learners gained only one of the available mark due to the following common errors. Referencing heart rate, repeating a response, e.g., increased breathing rate and increased speed of breathing or not mentioning what the change was, i.e., stating breathing rate and breathing depth without saying these increased.

This response gained 0 marks



Byron is a long-distance cyclist.

As soon as Byron begins to cycle his minute volume increases from 6 litres per minute to 60 litres per minute.

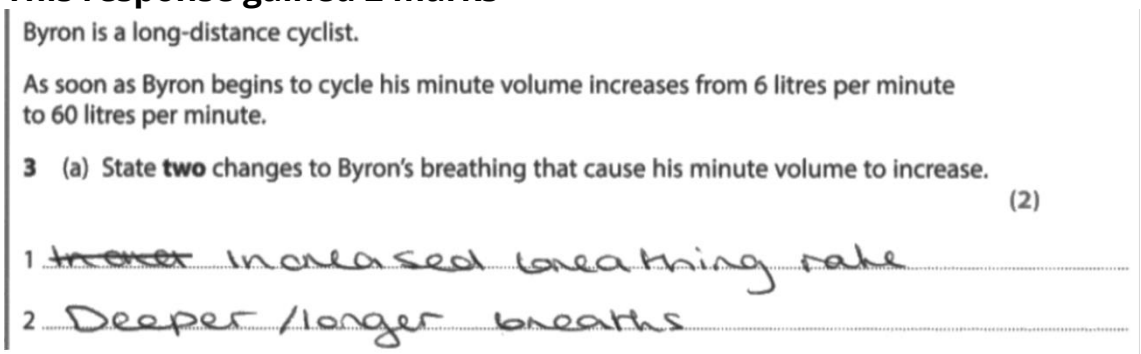
3 (a) State **two** changes to Byron's breathing that cause his minute volume to increase. (2)

SV x Br = MV

1 ~~Tidal Volume~~ Breathing rate

2 Stroke volume

This response gained 2 marks



Byron is a long-distance cyclist.

As soon as Byron begins to cycle his minute volume increases from 6 litres per minute to 60 litres per minute.

3 (a) State **two** changes to Byron's breathing that cause his minute volume to increase. (2)

1 ~~increase~~ increased breathing rate

2 Deeper / longer breaths

Q03(b) – This question asked learners to state two respiratory muscles. Whilst many identified the intercostal muscles and the diaphragm others referenced the skeletal muscles that assist with breathing, for example the sternocleidomastoid and the rectus abdominus, these were all credited. Incorrect responses linked to the CV system, e.g., the heart or other structures in the respiratory system, e.g., the lungs, trachea or mouth.

This response gained 0 marks

(b) Name **two** respiratory muscles used when breathing.

(2)

1 lungs

2 heart

This response gained 2 marks

(b) Name **two** respiratory muscles used when breathing.

(2)

1 Sternomascloid

2 Inter costal muscles

Q03(c) This question asked learners to explain why an increase in sweat production is advantageous when cycling long distances in very hot conditions.

Correct responses referred to heat loss through evaporation of sweat to prevent the cyclist overheating or to allow the cyclist to cycle at a faster pace for longer.

Incomplete responses often omitted to mention evaporation or link the response to the advantage for the athlete in terms of dealing with the hot conditions or the potential impact on their performance.

This response gained 1 mark

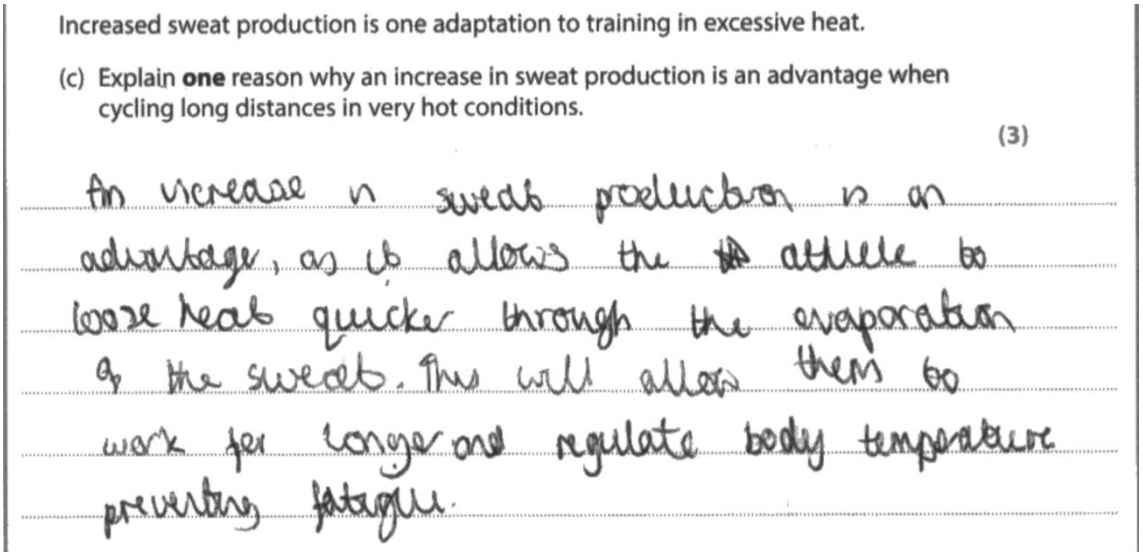
Increased sweat production is one adaptation to training in excessive heat.

(c) Explain **one** reason why an increase in sweat production is an advantage when cycling long distances in very hot conditions.

(3)

Sweat helps keeping the body's core temperature low enough to not overheat. In hot conditions an increase in sweat production will allow byron to perform well for as long as possible. And as long as Byron keeps hydrated the longer he can perform with a optimal body temperature.

This response gained 3 marks



Increased sweat production is one adaptation to training in excessive heat.

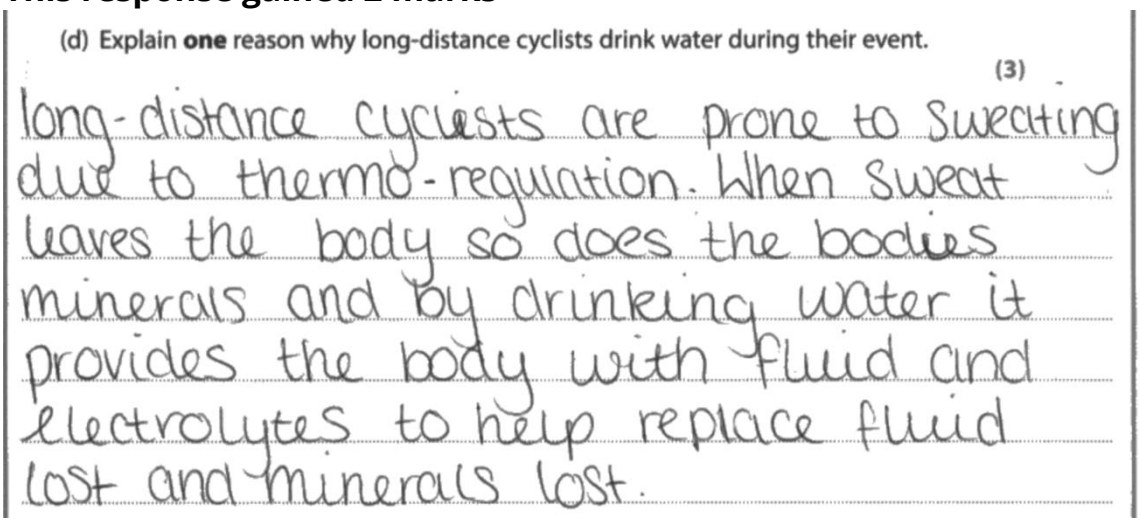
(c) Explain **one** reason why an increase in sweat production is an advantage when cycling long distances in very hot conditions.

(3)

An increase in sweat production is an advantage, as it allows the athlete to loose heat quicker through the evaporation of the sweats. This will allow them to work for longer and regulate body temperature preventing fatigue.

Q03(d)
This question asked learners to explain why long-distance athletes would drink water during a race. Correct responses referred to needing to replace water lost through sweating to avoid dehydration. Some learners correctly linked hydration to blood viscosity and oxygen transport. Where maximum marks were not achieved this tended to be due to repeating the same point, e.g., drink water to maintain hydration to stay hydrated.

This response gained 2 marks



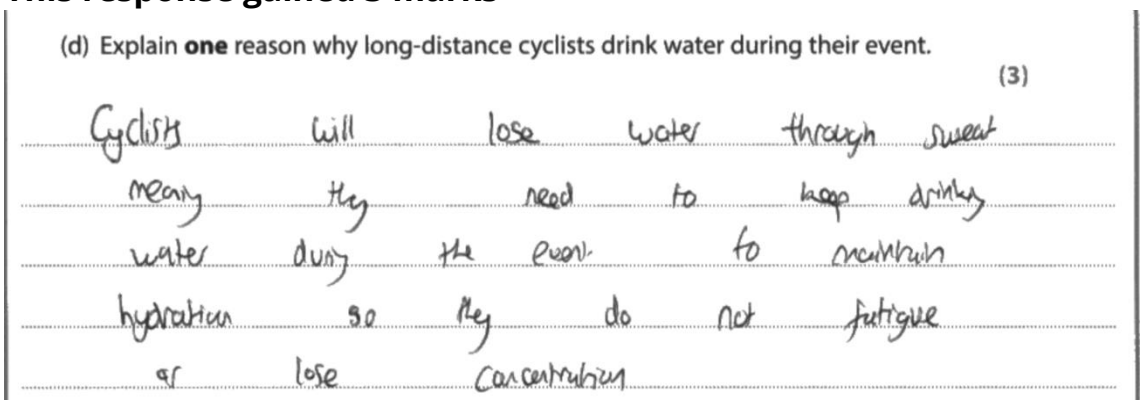
(d) Explain **one** reason why long-distance cyclists drink water during their event.

(3)

long-distance cyclists are prone to sweating due to thermo-regulation. When sweat leaves the body so does the bodies minerals and by drinking water it provides the body with fluid and electrolytes to help replace fluid lost and minerals lost.

Non-bulleted text should be written in Open Sans font size 12
Bullet points and text in tables is font size 11

This response gained 3 marks

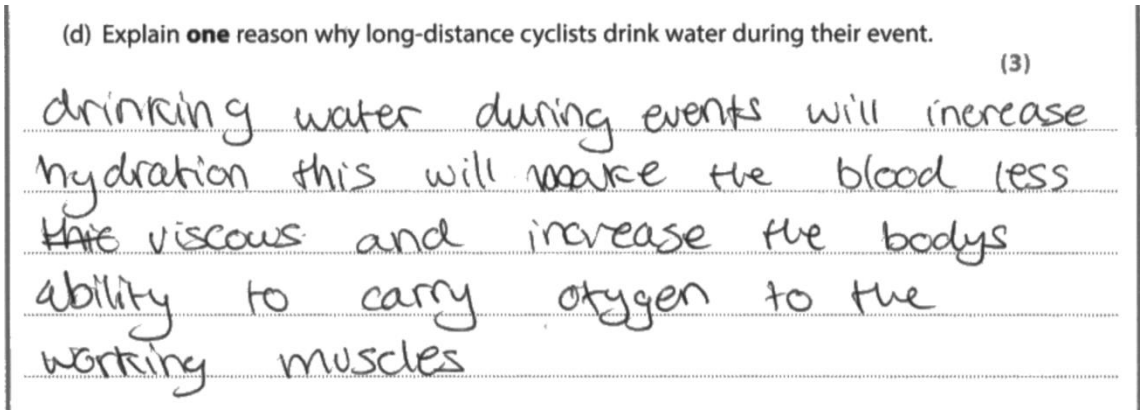


(d) Explain **one** reason why long-distance cyclists drink water during their event.

(3)

Cyclists will lose water through sweat
meany they need to keep drinky
water duny the event to maintain
hydration so they do not fatigue
or lose concentration

This response gained 3 marks



(d) Explain **one** reason why long-distance cyclists drink water during their event.

(3)

drinking water during events will increase
hydration this will make the blood less
~~that~~ viscous and increase the bodys
ability to carry otygen to the
working muscles

Q03(e) The focus of this part of the question was on recovery of the energy systems, therefore this should have been the focus for learner responses. Where it was learners gave good quality responses: correctly identifying the time required by each energy system to recover; what needed to happen during recovery, e.g., oxygen used to break down lactate during lactic energy system recovery; and how the system could be used within the race, to establish the impact of incomplete recovery on performance.

Several learners however talked about the use of each system in general terms or how energy is released, going into detail of Krebs cycle and the electron transport chain for example. This was not required for this question context and therefore could not be rewarded.

Some learners referred to ATP as a system, confusing the immediate supply of ATP with the ATP-PC system.

It is advisable for learners to use the terminology from the specification, i.e., the ATP-PC system, the lactate system and the aerobic system.

Level 1 response (1 – 3 marks)

* Byron takes part in two long-distance races with only one day's rest between each race.

Byron knows that rest is essential to allow all three of his energy systems time to recover.

(e) Evaluate whether 24 hours is long enough for all three of Byron's energy systems to fully recover so he can perform well in his second race.

(8)

Byron should take up to 48-72 hours between his races.
This will allow all 3 energy systems to fully replenish, giving him a better overall time for his second race.
as this is long distance the main energy system that byron will be using is the aerobic system.
however, because it is a race he will need to have a faster intial start to potentially gain advantage before his body starts to use his aerobic system.

Level 1 response (1 – 3 marks)

Byron takes part in two long-distance races with only one day's rest between each race.

Byron knows that rest is essential to allow all three of his energy systems time to recover.

(e) Evaluate whether 24 hours is long enough for all three of Byron's energy systems to fully recover so he can perform well in his second race.

(8)

~~There~~ The first energy which is the ATP-PC system is only a short lasting recovery time of 2-4 minutes which means that energy system will have recovered.

The second energy system the Lactate system also isn't a long lasting energy system so the recovery time is also less than 24hours meaning the first 2 energy systems will have recovered

The final energy system which is a long lasting energy system. The aerobic energy system takes a longer time to recover normally up to 24hours this means Byrons energy systems should have fully recovered ~~for~~ so he

Level 2 response (4 – 6 marks)

Byron takes part in two long-distance races with only one day's rest between each race.

Byron knows that rest is essential to allow all three of his energy systems time to recover.

(e) Evaluate whether 24 hours is long enough for all three of Byron's energy systems to fully recover so he can perform well in his second race.

(8)

24 hours should be just enough time for Byrons body systems to recover. The ATP-PC energy system takes 30 seconds to recover 50% and 3 minutes to recover fully. The lactic acid energy system takes 15 minutes to recover 50% and 60 minutes to recover fully. The aerobic energy system takes 3 hours to recover 50% and 24 hours to recover fully. The main problem Byron would have is whether the aerobic energy system will recover in time, as he will use this one the most. Providing he eats and drinks well the energy system should be fully recovered in 24 hours time.

Level 3 response (7 – 8 marks)

Byron takes part in two long-distance races with only one day's rest between each race.

Byron knows that rest is essential to allow all three of his energy systems time to recover.

(e) Evaluate whether 24 hours is long enough for all three of Byron's energy systems to fully recover so he can perform well in his second race.

(8)

The first energy systen is the ATP-PC System. 24 hours is enough time for this energy system to recoves. It takes 2-3 minuets for this energy system to secover, 50% of PC stores are resynthesised within 30 seconds of rest. ~~the Second energy system is~~ The ATP-PC System is only used for 8-10 seconds of high intensity exercise. The Second energy System is the Lactic System, it can take up to 40 minuets for this System to recover, the accumulated lactic acid will be buffered by oxygen. Lactic acid is produced in this energy System because it is ~~used for~~ an anaerobic system, ~~that~~ which causes pyruvate to turn into lactic acid as there is no oxygen available, to allow pyruvate to enter KREBS Cycle. Therefore 24 hours will be enough time for the lactic System to recoves. Finally the aerobic System will require ~~24 hours~~ up to 24 hours or more to recover. This is due to the depleted ATP-PC stores, ~~and~~ glycogen and fat stores (and myoglobin). ~~The~~ The Long component of EPOC will be in effect to replenish the

ATP-PC stores lost, around 34-36 ATP and myoglobin will be re saturated with oxygen. glycogen and fat stores will be replenished throug 3-4 meals that are nutritiosh, this could take 24+ hours to get these meals in.

Q04 The context for this question was an athlete competing in 100m and 400m races.
Q04(a)(i) – Learners were told the athletes heart rate would increase prior to the start of his race and asked to state the term used when heart rate increase just before exercise begins. The required response was anticipatory rise. Most learners accurately stated this term. Incorrect responses tended to reference fight or flight or the hormone responsible or gave a variation of the required term which was not credited.

This response gained 0 marks

Bill is a wheelchair athlete. He competes in 100m and 400m races.

Before the start of a race Bill's heart rate increases.

4 (a) (i) State the term used when heart rate increases just before exercise starts.

(1)

Adrenalin

This response gained 1 mark

Bill is a wheelchair athlete. He competes in 100m and 400m races.

Before the start of a race Bill's heart rate increases.

4 (a) (i) State the term used when heart rate increases just before exercise starts.

(1)

Anticipatory rise

Q04(a)(ii) Asked learners to state the hormone responsible for the increase in heart rate prior to the start of the event. Again, most learners correctly stated adrenaline. A popular incorrect response was testosterone.

This response gained 0 marks

(ii) State the hormone responsible for this increase in heart rate. (1)

Testosterone?

This response gained 1 mark

(ii) State the hormone responsible for this increase in heart rate. (1)

adrenaline

Q04(b)(i) Learners were asked to state the cause of micro-tears during a training session. Therefore, learners' responses should have focused on increased stress on the muscle, anything that clearly indicated the muscle was working harder than it was used to. Most learners did just this. Incorrect responses were a little too vague for credit, for example, reference to weight bearing activity or simply training. Conversely, some learners gave very detailed answers, giving a full explanation rather than being guided by the question command word 'state' and the allocation of 1 mark for this question.

This response gained 0 marks

Training can produce micro-tears in muscles.

(b) (i) State what causes micro-tears in muscles during training. (1)

weight-baring exercises

This response gained 1 mark

Training can produce micro-tears in muscles.

(b) (i) State what causes micro-tears in muscles during training. (1)

stress placed on the muscles during

Q04(b)(ii) The question asked learners to explain one advantage of producing micro-tears in the muscles. To gain both marks learners needed to appreciate that the microtears stimulated muscle growth through protein synthesis allowing the muscles to grow stronger. Incomplete responses often stated the advantage, increased strength, without the explanation.

This response gained 1 mark

(b) (ii) Explain **one** advantage of producing micro-tears in Bill's muscles.

(2)

When micro-tears occur, it allows muscles to get stronger. This is because, when muscles tear, they regrow longer allowing allows For more to be applied before they tear again. This ~~can~~ Bill to exert more Force. This ~~incr~~ results in making Bill's muscles stronger and also bigger.

This response gained 2 marks

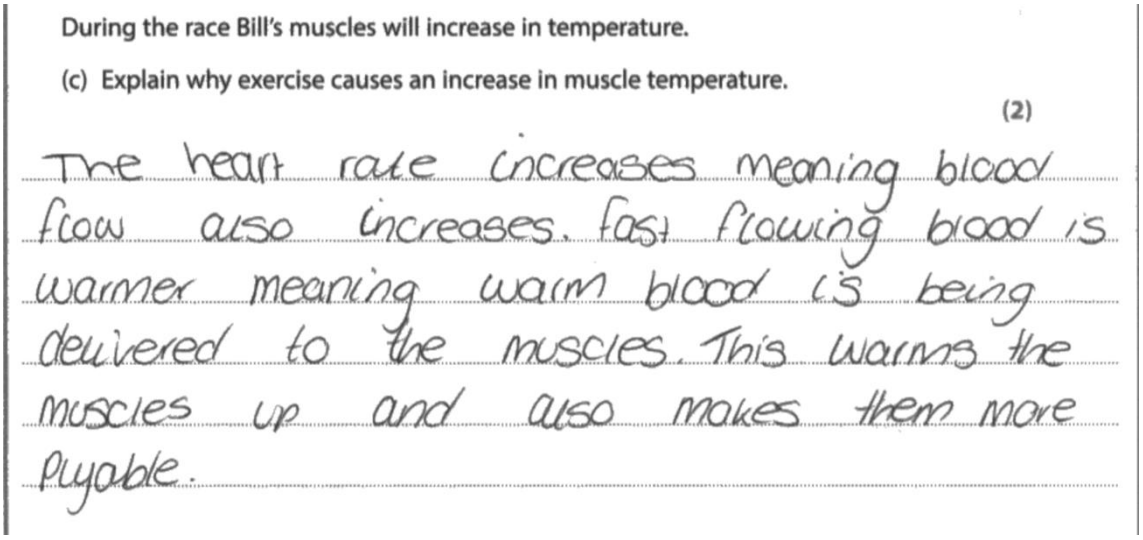
(b) (ii) Explain **one** advantage of producing micro-tears in Bill's muscles.

(2)

He will have increased protein synthesis, meaning his muscles can grow and repair from protein. Eventually leading to increased muscle strength. He will have increased

Q04(c) Learners were asked to explain why exercise causes an increase in muscle temperature. Correct responses used the question context, stating that muscle contraction generated heat from energy production and as the muscles contract more during exercise increased heat would be produced. Or that heat is produced during energy production and the muscles require energy to contract. Incomplete responses tended to omit reference to the expansion or explanation, i.e., the effect of exercise, e.g., heat produced during energy production or heat produced during muscle contraction without linking this to the increase during exercise. Incorrect responses tended to explain the effect of increased muscle temperature, linking to increased range of movement or linked to redistribution of blood flow.

This response gained 0 marks



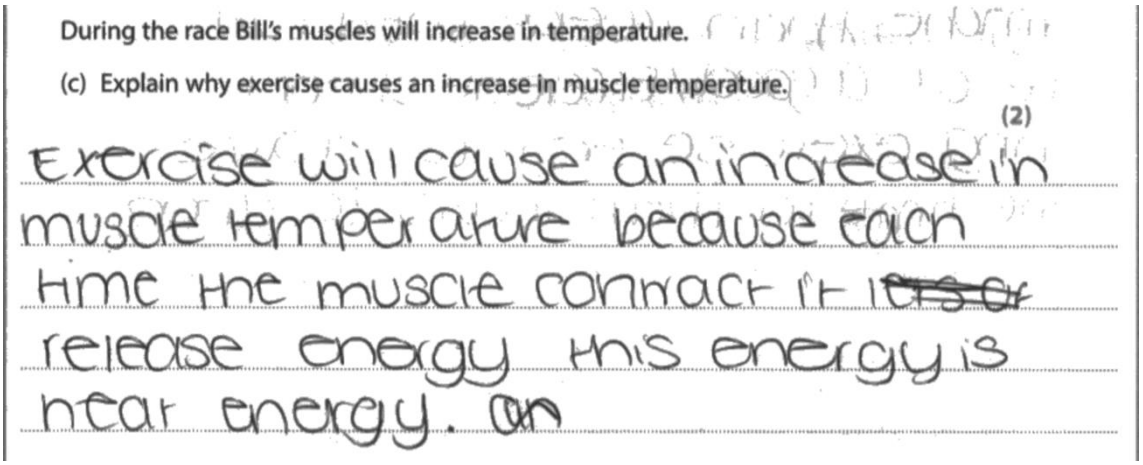
During the race Bill's muscles will increase in temperature.

(c) Explain why exercise causes an increase in muscle temperature.

(2)

The heart rate increases meaning blood flow also increases. fast flowing blood is warmer meaning warm blood is being delivered to the muscles. This warms the muscles up and also makes them more flyable.

This response gained 1 mark



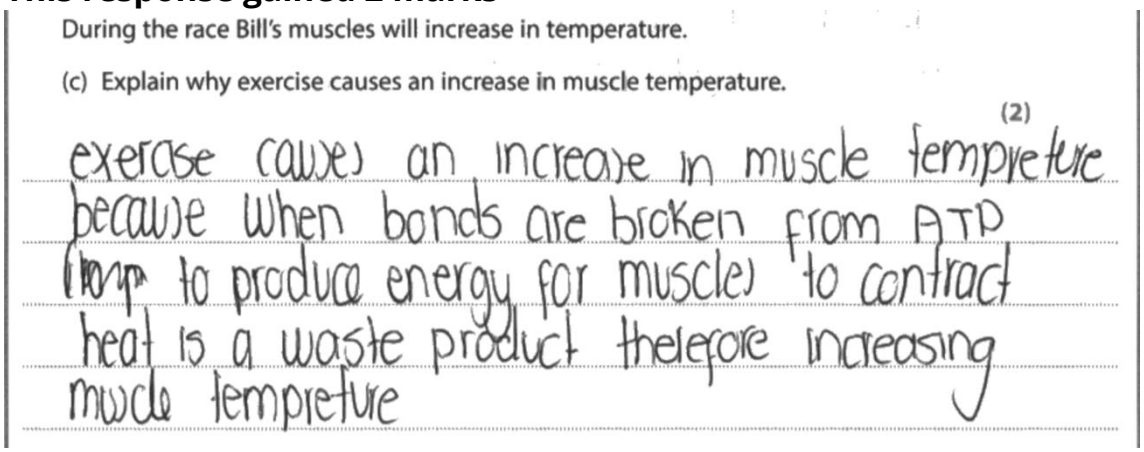
During the race Bill's muscles will increase in temperature.

(c) Explain why exercise causes an increase in muscle temperature.

(2)

Exercise will cause an increase in muscle temperature because each time the muscle contract it ~~is or~~ release energy this energy is near energy. an

This response gained 2 marks



During the race Bill's muscles will increase in temperature.

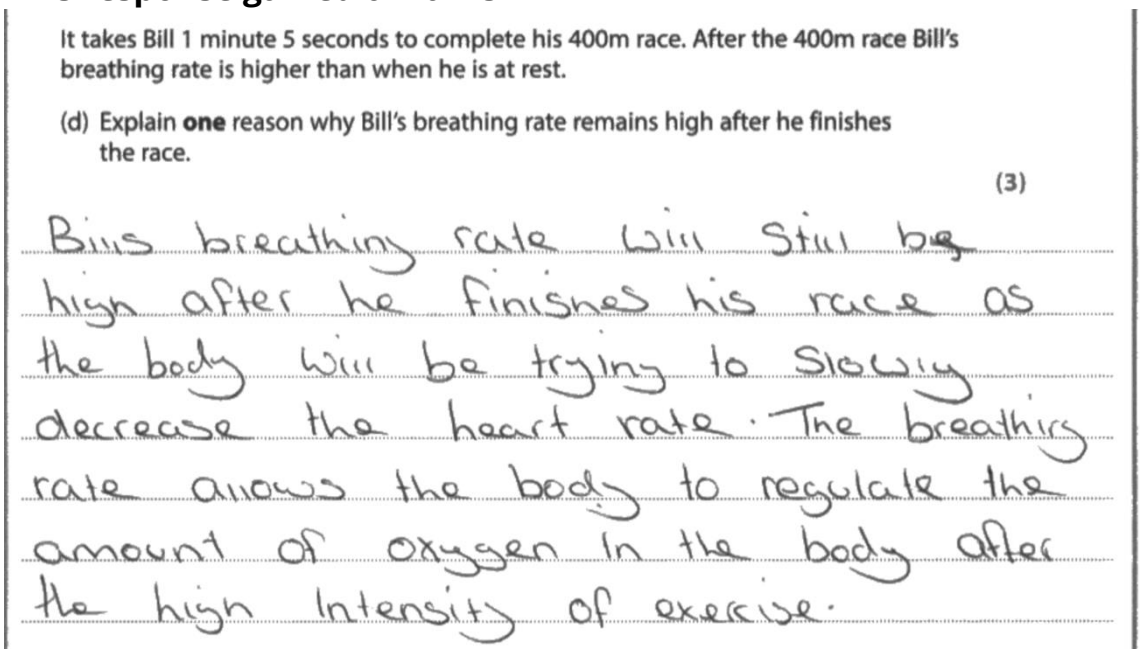
(c) Explain why exercise causes an increase in muscle temperature.

(2)

exercise cause) an increase in muscle tempreture because when bonds are broken from ATP (hemp to produce energy for muscle) to contract heat is a waste product therefore increasing muscle tempreture

Q04(d) This question asks why breathing rate remains high after finishing a 400m race.
Correct responses identified that this was so more oxygen could be brought into the body and then expanded on this explaining why this was necessary, e.g., as this was a 400m race/the race took 1m 5 seconds to complete, lactate would have been produced which requires oxygen to break it down. Alternative expansions could have focused on EPOC, oxygen debt, OBLA, or any other relevant reason given the question context.
Incomplete responses often omitted reference to needing more oxygen.
Incorrect responses tended to focus on the CV system.

This response gained 0 marks



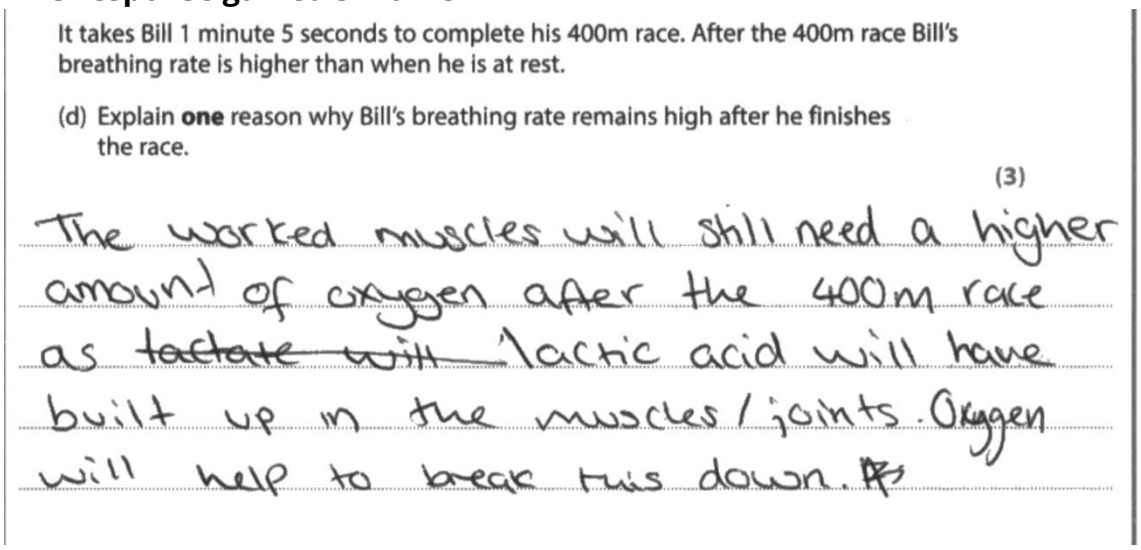
It takes Bill 1 minute 5 seconds to complete his 400m race. After the 400m race Bill's breathing rate is higher than when he is at rest.

(d) Explain **one** reason why Bill's breathing rate remains high after he finishes the race.

(3)

Bills breathing rate will still be high after he finishes his race as the body will be trying to slowly decrease the heart rate. The breathing rate allows the body to regulate the amount of oxygen in the body after the high intensity of exercise.

This response gained 3 marks



It takes Bill 1 minute 5 seconds to complete his 400m race. After the 400m race Bill's breathing rate is higher than when he is at rest.

(d) Explain **one** reason why Bill's breathing rate remains high after he finishes the race.

(3)

The worked muscles will still need a higher amount of oxygen after the 400m race as ~~lactate with~~ lactic acid will have built up in the muscles / joints. Oxygen will help to break this down.

Q04(e) This question asked learners to analyse the contribution made by muscle spindles, Golgi tendons (GTOs) and motor units in helping lift varying amount of weight and to do so safely.

Many learners were able to give a full, accurate analysis despite the complexity of these topic areas. Common key points for each structure included: Muscle spindles detecting stretch, preventing the muscle being overstretched when lifting a weight can causing the muscle to contract if overstretching to prevent injury. GTOs detect tension in the muscle and can stop the muscle creating too much tension when lifting through the reflex arc to prevent injury. Motor units vary in size and muscle fibre type, they provide the force to lift the weight and by recruiting more or fewer motor units, heavier or lighter weights can be lifted. Overall, the GTO's and muscle spindles keep the performer safe/injury free, and the motor units allow him to lift the different weights.

Common misconceptions included GTOs monitoring stretch, that the spindles and GTOs were responsible for providing the force to lift the muscles, or an analysis of the role of muscle fibre type rather than motor unit.

Prevention of injury and the link between GTOs, muscle spindles and the CNS was well known, as was the need to increase the number of motor units to increase the amount of force to lift the heavier weights.

It is important for learners to really focus on the question context in the extended responses as this should help direct their responses. For

example, some learners described the structures in detail and the process of muscle contraction, this level of detail was not required.

Level 1 response (1 – 3 marks)

Bill goes to weight training classes to increase his muscular strength. Depending on the muscles being worked Bill will use heavier or lighter weights.

The muscle spindles, Golgi tendon organs (GTOs) and motor units are all controlled by the nervous system and are used during weight training.

(e) Analyse the contribution made by muscle spindles, GTOs and motor units in helping Bill lift the different weights and lift them safely.

(8)

The GTO's help to send signals to the CNS, This allows for the body to know how many motor units it takes for the muscle to lift a given weight. If it is a light weight the GTO organs will send signals that not a lot of force will be needed in order to move that object.

The motor units are groups of muscle fibres that pair together to achieve a common goal. The heavier the weight, the more motor units will be required to lift the given weight. The lighter the weight the less motor units will be needed.

Level 2 response (4 – 6 marks)

Bill goes to weight training classes to increase his muscular strength. Depending on the muscles being worked Bill will use heavier or lighter weights.

The muscle spindles, Golgi tendon organs (GTOs) and motor units are all controlled by the nervous system and are used during weight training.

(e) Analyse the contribution made by muscle spindles, GTOs and motor units in helping Bill lift the different weights and lift them safely.

(8)

Muscle Spindles are located in the muscles and are a type of receptor. When streching or over-lifting your muscle spindles will detect it can send an impulse to the medulla oblangata telling it to stop. This will help Bill as it will prevent him from getting injured from over lifting or over-Strecthing and tearing or pulling a muscle. Golgi tendon organs have very Similar roles however they are located within tendons. If over-lifting or over-Streching your golgi tendon organ will send an impulse to the medulla oblangata which will stop Bill from injuring his tendons. Motor units are located all over the body and they receive impulses from the medulla oblangata, which travel to motor units which then cause a muscle contraction, producing

movement. This is how Bill will know how much effort needs to be put into each weight. If the weight is heavy, more impulses to more motor units will be sent and received. This is how Bill will lift the weights safely as the correct amount of motor units will be used to create a small or big enough contraction.

Level 3 extract (7 – 8 marks)

Bill goes to weight training classes to increase his muscular strength. Depending on the muscles being worked Bill will use heavier or lighter weights.

The muscle spindles, Golgi tendon organs (GTOs) and motor units are all controlled by the nervous system and are used during weight training.

(e) Analyse the contribution made by muscle spindles, GTOs and motor units in helping Bill lift the different weights and lift them safely.

(8)

Muscle spindles are organs within a muscle belly that act as proprioceptors and sense changes in muscle length. When the muscle is stretched, so is the muscle spindle. This information is sent to the central nervous system which sends signals to the motor units in the muscle to increase the strength of the contraction in order to slow down the rate at which the muscle has been stretched and avoid injury caused by overextension. This is a protective response known as stretch reflex.

Golgi tendon organs are ~~muscle tendons~~ organs that are located where the muscle and tendon attach. They act as proprioceptors and sense changes in muscle tension. This information is sent to the CNS. If the tension becomes too great, signals are sent to the musde to relax in order

to avoid injury by ~~the~~ overtension. This is a protective response called inverse ~~no~~ myotatic reflex.

Motor units have their main body in the CNS and branches (axons) that gointo the muscles. They can innervate many muscle fibres (provide with nerves). They carry signals from the CNS to the muscles in order to stimulate contraction. They are responsible for causing contraction or relaxation of the muscles by carrying motor

Summary

Based on their performance on this paper, learners should:

- Know the different body systems so you can focus on the correct one within a question.
- Be clear about terminology used in the specification as these words will be repeated in the exam paper, e.g., responses, adaptations.
- Use terminology in the specification, eg the names of the energy systems
- Read questions carefully to avoid repeating answers already given in the question, e.g., Q02c.
- Tailor your response based on the command word in the question, e.g., state does not require any expansion of a point but explain will.
- Use the number of marks awarded and the space available as a guide to the depth of response required. There should always be more space than you need.
- Be clear, e.g., if an extended question asks about different adaptations to the muscular system make sure you are clear in your response, including only the relevant adaptations.
- Use all the information provided in the question scenario to demonstrate your ability to apply your knowledge.