



Examiners' Report Lead Examiner Feedback

June 2022

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

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June 2022

Publications Code 31813H_2206_ER

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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.

Introduction

This LE Report should be considered with the live external assessment and corresponding mark scheme.

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.

Introduction to the Overall Performance of the Unit

Learner performance varied throughout the paper. Whilst the extended response questions were challenging most learners gained some marks for these questions. 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 writing questions account for almost half 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.

Whilst the extended response questions make this a potentially challenging assessment for learners, centres and learners continue to prepare well for this part of the assessment. Responses are becoming more structured; scenarios are being used to good effect to aid application of knowledge and a greater number of learners are demonstrating the skills of analysis and evaluation within their responses.

The assessment is also challenging due to the need to apply knowledge not only in the extended answer questions but also the 'points-based' questions, for example, Q1a; Q2bii; Q3b and Q4cii, therefore raising the demand on the learner.

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.

Q1

A cricketer was the context for question 1.

Q1(a)

This part of the question asked learners to explain one advantage of increased synovial fluid in the joints of a cricketer. To gain both marks learners needed to identify an advantage of synovial fluid production and then expand on this linking the identified advantage to the cricketer. Many responses correctly identified lubrication or reduction in friction as an advantage and went on to link this to a performer.

In an 'explain' question, it is important that an answer is developed to show the required understanding, rather than stating two separate, unrelated points.

This response gained 2 marks

Ed is a cricketer.

When Ed plays cricket his skeletal system responds by increasing the amount of synovial fluid in his joints.

1 (a) Explain **one** advantage of increased synovial fluid in Ed's joints for his cricket performance.

(2)

Synovial fluid increases the amount of lubrication in the joint, this allows it to move more freely. When ed wants to throw a cricket ball this will help the shoulder joint move with less friction, lowering chances of injury.

The advantage is identified, increases lubrication at the joint, and then developed by linking to the question context.

This response gained 1 mark

1 (a) Explain **one** advantage of increased synovial fluid in Ed's joints for his cricket performance.

(2)

When Ed is playing Cricket there will be high amounts of force on his joints and the synovial fluid will help to cushion the force on his joints

One mark is awarded for identification that the synovial fluid will cushion the force on the joints. To gain the second mark the learner needed to explain why this was an advantage, e.g., therefore stopping wear and tear on the cartilage so they could continue to play.

Q1(b)

This part of the question asked learners to *describe* the process of bone remodelling. Describe is often used when giving detail about the stages of a process, thus learners should try to give detail, logically going through a process from start to finish, using the marks awarded as a guide to the number of points or amount of detail required.

There were several ways the four marks could be achieved, making the question a little more accessible. Popular correct responses scoring all four marks first indicated that bone-remodelling was required due to the stress placed on the bones because of training and how this stimulated osteoblast activity to build new bone and osteoclasts to remove old bone, resulting in increased bone density/strength.

This response gained 4 marks

During a 12-week cricket training programme Ed's skeletal system adapts through the process of bone remodelling.

(b) Describe the process of bone remodelling.

(4)

Bone remodeling ~~is a~~ requires the use of osteoclasts, osteoblasts and osteocytes. Osteoclasts are recruited to break old bone that may be damaged as a result of exercise. Osteoblast activity is then stimulated to build new bone when weight bearing exercise occurs. Weight bearing exercises help to stimulate these cells and 'nudge' them into action. Osteocytes work closely with osteoclasts to control both bone reabsorption and formation. This will stimulate remodelling of the bone.

No marks are awarded for identification of the bone cells, their role also needs to be clear. In this example one mark is awarded for the role of osteoclasts, one mark for the training stimulating osteoblast activity, one mark for the role of the osteoblasts, and one mark for role of osteocytes in controlling bone resorption.

This response gained 2 marks

(b) Describe the process of bone remodelling.

↳ How it happens

osteoclast

↳ clear

(4)

The process of bone remodelling includes osteoblast and osteoclast. ~~osteoblast~~ but osteoclast clear the old bone, which osteoblast builds the new bone. using both osteoclast and osteoblast Ed's skeletal system will adapt through this. bone remodelling enables Ed to perform better as osteoclast had removed old bone and osteoblast had built the new bone.

One mark is awarded for the description of the role of osteoblasts, and one mark for the description of the role of osteoclasts.

Q1(c)

This part of the question asked learners to name two respiratory muscles involved in breathing. Whilst many learners correctly identified the diaphragm and one of the intercostal muscles to gain both marks there were also many incorrect responses. Although the question asked for respiratory muscles, marks were awarded if a skeletal muscle which supports respiration was given. Popular incorrect responses related to body organs, normally the heart and lungs.

This response gained 2 marks

Ed's breathing rate changes when he is playing cricket.

(c) Name **two** of the respiratory muscles involved in breathing. (2)

1 Diaphragm

2 Intercostal muscles

The intercostal muscles were accepted for one mark, the diaphragm for the second muscle. Two marks could also have been achieved for stating the internal intercostal muscles and the external intercostal muscles.

This response gained 0 marks

(c) Name **two** of the respiratory muscles involved in breathing. (2)

1 heart

2 lungs

Internal organs rather than respiratory muscles named.

Q1(d)

This was the first of four extended questions on the paper.

Learners were asked to evaluate the importance of the different muscle fibre types to a batter and wicketkeeper during a game of cricket. Information was given about each playing position to help learners apply their knowledge and an image of both in action was provided.

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.

For this question level 1 responses tended to rely heavily on the image and accompanying text, focusing on how the players used the fibre types, e.g., the batsman uses type 2x to hit the ball hard/far, but the characteristics of the fibre type that make it suitable for this action was often omitted. Similarly, evaluation of the importance therefore was also omitted as evaluations need to develop from previous points made.

Level 2 responses tended to demonstrate knowledge of the relevant characteristics of the fibre type, but again, often failed to evaluate the importance.

To achieve level 3 learners' responses required accurate knowledge of the fibre types, to apply this knowledge within the question context and conclude (based on arguments made) why this was important to the player. For example, evaluating that without type 2a fibres to provide moderate to high force with some resistance to fatigue it would not be possible to hit the ball far enough, or run quickly enough between the wickets to score multiple runs from one hit.

This response gained Level 3 - 8 marks

Figure 1 shows two players during a cricket match.

The batter is trying to hit the ball hard, so it goes as far as possible. The further a batsman hits the ball the more runs he can score by repeatedly sprinting between the wickets.

The wicket-keeper is stationary behind the wicket.



Source: © CHEN WS/Shutterstock

Figure 1

(d) Evaluate the importance of the different muscle fibre types to the cricket players in **Figure 1**.

(8)

Type I fibres are slow twitch fibres which are used for aerobic activity. They fatigue slowly and use oxygen as fuel. They would be useful for the players when standing or walking between positions and ~~the~~ would allow the players to continue for long periods of time and last the whole game. These fibres contain lots of mitochondria and have a good blood supply to allow them to complete low power contractions for long periods of time without fatigue.

Type IIa fibres are fast twitch fibres otherwise known as FOG fibres. They are mainly used for anaerobic activity but have slight aerobic capacity. They produce relatively high power contractions but fatigue quicker than Type I fibres. The players would use these fibres when sprinting between the wickets to score runs.

Type 1x fibres are fast twitch fibres. They produce high power explosive contractions but fatigue very quickly. They are only used for anaerobic activities due to the how fast they fatigue. Players would use these when batting to hit a powerful shot and the wicketkeeper would use it to react and catch the ball quickly. They could also be used for especially fast sprints so the batter can get to the wicket before getting out. Overall the batter would use type 1x and 1a fibres the most and the wicket-keeper would use type 1 and type 1x the most to perform the skills needed to their highest ability.

All three muscle fibre types are correctly identified, some relevant characteristics of the fibre types are identified, e.g., type 1 being slow to fatigue, type 2a having aerobic and anaerobic capacity, producing relatively high power. There is also reference to type 2x producing explosive contractions. The reference to type 2x fatiguing quickly is not considered as this is not a reason the performer would use the fibre type; therefore focus should be on the high force production. There is appropriate application of fibre types, e.g., type 1 used by the wicketkeeper when stationary in a squatted position, or type 2x when the batter needs to hit a powerful shot and the wicketkeeper needing to make a sudden catch. There is also some evaluation e.g., the type of fibres most used by each performer and why.

This response gained Level 2 – 5 marks

Figure 1

(d) Evaluate the importance of the different muscle fibre types to the cricket players in Figure 1. (8)

Type 1 occurs quite often within cricket. The wicketkeeper uses type 1 often in cricket mainly when they are not been called into action and are watching the batter strike the ball.

Type 2a also occurs in cricket and is shown best within the batter when they are repeatedly running between the wickets and changing direction. This is type 2a as the action of running between the wickets involves both anaerobic exercise as well as aerobic exercise.

The fibre type 2x also occurs between the wicketkeeper and the batsman. The wicketkeeper expresses type 2x when reaching to catch the ball either from the bowler or the batsman's misshot. The wicketkeeper requires a short burst of energy to quickly react and reach for the ball. The action is also made anaerobically. Also, batsman express type 2x when striking the ball. This action requires high levels of power and is done anaerobically.

All three muscle fibre types are correctly identified, and each fibre type is accurately applied to the question context. No characteristics of the fibre types are given, neither are any evaluative statements.

This response gained Level 1 – 1 mark

(d) Evaluate the importance of the different muscle fibre types to the cricket players in **Figure 1**.

(8)

Different muscle fibers are important because they all work at different speeds. The first muscle fibre is a ~~slow~~ slow twitch. The second is a fast twitch and the third contracts the fastest. In figure 1, the batter would need the last muscle fiber type, this is because he is trying to hit the ball as hard as he can. It is important because his muscles need to contract quickly so he can get enough power in his swing.

The learner differentiates between slow and fast twitch muscle fibres but without appropriate identification, cannot gain further credit for their applied use.

Q2

A rugby player provided the context for question 2.

Q2(a)(i)

This part of the question asked learners to state the effect of strength training on resting levels of human growth hormone (HGH). The expected response, achieved by many learners was that it would increase.

This response gained 1 mark

Shawn is a rugby player. He is training to improve his muscular strength and VO_2 max.

Strength training causes adaptations to the levels of hormones produced by the body.

2 (a) (i) State the effect of strength training on the resting levels of human growth hormone (HGH).

(1)

levels will be higher

This response gained 0 marks

Shawn is a rugby player. He is training to improve his muscular strength and VO_2 max. ^{Oxygen Volume}

Strength training causes adaptations to the levels of hormones produced by the body.

2 (a) (i) State the effect of strength training on the resting levels of human growth hormone (HGH).

(1)

~~A~~ Testosterone

Rather than stating the effect a hormone linked to strength development is stated, along with HGH levels decreasing this was a popular incorrect response.

Q2(a)(ii)

This part of the question asked learners to explain the effect of HGH on the muscular system. To gain both marks learners needed to identify that it promotes muscle growth or muscle repair and then expand on this linking this to protein synthesis or increased muscle strength.

Some responses correctly identified the promotion of muscle growth or that HGH resulted in increased strength of muscles. Many learners gained both marks.

This response gained 2 marks

(ii) Explain the effect of HGH on the muscular system.

(2)

HGH will help the muscular system grow and become stronger

The advantage is identified, increases lubrication at the joint, and then developed by linking to the question context.

This response gained 1 mark

(ii) Explain the effect of HGH on the muscular system.

(2)

HGH positively affects the muscular system as it helps to increase muscular endurance strength and tone.

One mark is awarded for understanding that HGH increased muscle strength.

Q2(a)(iii)

This part of the question asked learners to name one other hormone that had a similar effect on the muscular system as HGH.

Whilst most learners correctly identified testosterone several incorrect hormones were also offered in response, e.g., adrenaline, oestrogen. Cortisol was amongst the incorrect responses, along with some of the possible effects of HGH/testosterone, e.g., broader shoulders.

This response gained 1 mark

(iii) Name **one other** hormone that has a similar effect on the muscular system as HGH.

(1)

Testosterone

The advantage is identified, increases lubrication at the joint, and then developed by linking to the question context.

This response gained 0 marks

(iii) Name **one other** hormone that has a similar effect on the muscular system as HGH.

(1)

Adrenaline

Adrenaline was a popular incorrect response.

Q2(b)(i)

This part of the question asked learners to state the meaning of the term VO_2 max. The critical point for learners to express is this is the maximum amount of oxygen that can be taken in and used. No credit was given if the response simply stated it was the amount of oxygen intake or breathed in. An alternative correct response was aerobic capacity or a more detailed definition.

This response gained 1 mark

Shawn's aerobic training increases his VO_2 max.

(b) (i) State the meaning of the term VO_2 max.

(1)

total oxygen uptake.

One mark was awarded for total oxygen uptake, i.e., the amount of oxygen used by the body, not just breathed in.

This response gained 0 marks

(b) (i) State the meaning of the term VO_2 max.

(1)

The ~~maximum~~ maximum volume of air that can be breathed in and out. per minutes

No reference was made to oxygen being used therefore no mark awarded.

Q2(b)(ii)

This part of the question required an understanding of the term anaerobic threshold. Learners were asked to explain one effect of an increase in VO_2 max on anaerobic threshold. One mark was awarded for identification of the effect, i.e., it would be increase/delayed, this was often the mark gained by learners. To gain both marks this needed to be expanded on to explain the effect. Two creditable responses included, because they could consume more oxygen, because it allowed them to work aerobically for longer. Whilst some learners appreciated this concept many were confused by the terminology, thinking an increased VO_2 max meant they could work anaerobically for longer.

This response gained 2 marks

(ii) Explain **one** effect of an increase in VO_2 max on Shawn's **anaerobic** threshold. (2)

It would increase his anaerobic threshold because his body will be able to use more oxygen, so he would be able to last for longer during exercise

One mark was awarded for increased anaerobic threshold and one mark for the relevant expansion that they would be able to use more oxygen.

This response gained 1 mark

(ii) Explain **one** effect of an increase in VO_2 max on Shawn's **anaerobic** threshold. (2)

If his VO_2 max is higher, then his anaerobic threshold will also be higher as he will be able to take in an increased amount of oxygen.

One mark awarded for increased anaerobic threshold. No reference was made to oxygen being used therefore no second mark awarded.

Q2(c)(i)

This part of the question asked learners to state two other changes to blood composition because of aerobic training. The anticipated responses were an increased red blood cell count or increased haemoglobin.

Some learners repeated the example in the question, increased blood plasma volume, therefore did not gain a mark. Some learners referred to EPO but as a hormone, this was not accepted. Other incorrect responses included lower pH, increased viscosity, more oxygenated blood, increased mitochondria.

This response gained 2 marks

Shawn's blood composition adapts and changes as a result of his aerobic training.
One adaptation is an increase in blood plasma volume.

(c) (i) State **two other** changes to blood composition as a result of aerobic training. (2)

1. increased red blood cell production

2. increased haemoglobin concentration

This response gained 1 mark

Shawn's blood composition adapts and changes as a result of his aerobic training.
One adaptation is an increase in blood plasma volume.

(c) (i) State **two other** changes to blood composition as a result of aerobic training. (2)

1. Increase in number of capillaries

2. Increase in red blood cells.

One mark awarded for increase in red blood cells.

This response gained 0 marks

Shawn's blood composition adapts and changes as a result of his aerobic training.
One adaptation is an increase in blood plasma volume.

(c) (i) State **two other** changes to blood composition as a result of aerobic training.

(2)

1 Platelets

2 Red blood cells

It is important if asked to state changes that the change is identified, no mark is given for stating red blood cells without reference to an increase.

Q2(c)(ii)

This part of the question asked learners to state one advantage of an increase in blood plasma volume. The anticipated response was blood viscosity is reduced or that blood flows more easily. Other possible answers included delayed dehydration, control of body temperature, increased sweating.

This response gained 1 mark

(ii) State **one** advantage of an increase in blood plasma volume.

(1)

blood circulates through the body
more freely due to less thick blood.

One mark awarded for blood circulating more freely, or that the blood is 'less thick', although appropriate terminology would always be encouraged.

This response gained 0 marks

(ii) State **one** advantage of an increase in blood plasma volume. (1)

It's get blood around the body more quickly

Increased speed of blood flow was not an acceptable response, focus needed to be on the 'ease' with which the blood was flowing rather than rate.

Q2(d)

The second extended question asked learners to evaluate the impact of three given responses to a single training session: change in tidal volume, change to blood pH, change in a-vO₂ diff.

Learners were not told what the change was, just that there was a change.

Of the three responses to training, a-vO₂ diff appeared by far more challenging to evaluate.

Learner responses were well organised, dealing in the main with each type of response to exercise in turn, but also making links between the responses to exercise where appropriate, e.g., the link between increased tidal volume to combat the increased acidity in the blood.

For this question level 1 responses tended to focus on the effect of lactic acid on blood acidity, often with no reference to the impact of CO₂, or on the increased breathing depth to supply more oxygen.

Application to the question context and evaluation seemed accessible, within level 2 responses, with many discussing the need for increased oxygen or CO₂ removal so the performer could continue to work aerobically or delay fatigue. Knowledge and understanding of this specification area seemed less well known, especially a-vO₂ diff as mentioned above.

To achieve level 3 learners' responses needed to demonstrate knowledge and understanding of the responses of the body systems to a single training session, to relate this knowledge to the question context

and conclude (based on arguments made) the impact of the responses of the body systems. important to the player. For example, evaluating that, if left unchecked, a low blood pH would cause muscle fatigue therefore causing the performer to lower the intensity of the work to allow time for the increased tidal volume to remove excess CO₂.

This response gained Level 3 - 8 marks

As soon as Shawn begins a training session his body systems respond to the increase in activity level.

Table 1 shows three responses of Shawn's body systems to a single training session.

Responses to a single training session
Change in tidal volume
Change to blood pH
Change in arteriovenous oxygen difference (a-vO ₂ diff)

Table 1

(d) Evaluate the impact of each of the responses in **Table 1** on Shawn's ability to maintain the increased activity level during his training session.

(8)

As he exercises his blood will become more acidic due to there being more carbon dioxide than oxygen. This will lead to a build up of lactic acid which is poisonous if levels become too high. A build up of lactic acid will cause muscle cramps and fatigue.

His tidal volume will increase as he will start breathing more heavily and quickly during exercise so that he can inhale more oxygen to be delivered to working muscles as well as diffuse carbon dioxide into the alveoli and out of the lungs so that it doesn't build up.

The amount of oxygen in the ~~the~~ veins will be less than the amount in the arteries as they will have picked up more oxygen from the lungs to take around the body and veins will need to transport deoxygenated blood to the lungs to get rid of carbon dioxide.

Despite the brevity of the response there is sufficient evidence to place at level 3. There is some isolated knowledge about $a-vO_2$ diff, and applied knowledge in relation to the other two responses, e.g.,

- exercise increasing blood acidity due to increased CO_2 ,
- tidal volume increasing to increase the amount of oxygen inhaled and to remove CO_2

There is also evaluation of the impact of the responses e.g., the resultant muscle fatigue if tidal volume wasn't increased to increase rate CO_2 could be expelled, the reason for the change in blood pH.

This response gained Level 2 - 6 marks

(d) Evaluate the impact of each of the responses in **Table 1** on Shawn's ability to maintain the increased activity level during his training session.

(8)

Tidal volume is the size of each breath. Tidal volume will increase when Shawn exercises as his breathes will be bigger as more oxygen is needed for his muscles. The reason tidal volume increases is so Shawn can maintain his activity levels during his training. More oxygen will be needed so Shawn's muscles can work efficiently so tidal volume increases to allow Shawn to inhale more oxygen.

Blood pH will change due to exercise as ~~more~~ more carbon dioxide will ~~enter~~ enter the body.

And lactic acid will build, in muscles. The lactic acid will denature enzymes in muscles causing them to miss fire. This will impact Shawn's activity levels as he will start to slow down because ~~of his muscles feeling the~~ effect of lactic acid will have started.

arteriovenous difference is the difference in oxygenated blood in veins and in arteries. This will change because the amount of oxygenated blood will increase as Shawn works, muscles need oxygen to maintain muscular contractions.

This response demonstrates all required skills to achieve level 2. There is some accurate knowledge and understanding about all three responses, e.g., a statement about a-vO₂ diff. Application, e.g., that tidal volume increases due to increased demand for oxygen due to exercise and there is evidence of a partially developed evaluation, e.g., that the increase in oxygen allows the performer to maintain his activity levels. Reference is made to changes in blood pH and whilst the cause for a decrease in pH is clearly stated it is also important to be clear about what the change will be. I.e., an increase in CO₂ would not increase blood pH.

This response gained Level 1 - 2 marks

TABLE 1

(d) Evaluate the impact of each of the responses in **Table 1** on Shawn's ability to maintain the increased activity level during his training session. (8)

Change in tidal volume will allow Shawn to bring more oxygen to ~~working~~ the working muscles which will allow him to perform longer without fatiguing.

Changes to blood pH level will allow Shawn body to realise earlier when he needs heat or to lose heat.

This response demonstrates isolated elements of knowledge and limited evaluation and so is placed at level 1.

Q3

A generic exercise session provided the context for question 3.

Q3(a)

Learners were given an image depicting two energy systems and asked to name the energy systems in the image.

Many learners were able to apply their knowledge of energy systems and use the information in the image to correctly identify both systems. Where only one mark was gained this was often for misidentification of the first system, the ATP-PC system, although B was also misidentified, e.g., ATP system or lactate system.

This response gained 2 marks

Ariana exercises regularly.

The energy required for exercise is produced using the body's energy systems.

Figure 2 shows a simplified summary of energy production through two different energy systems.

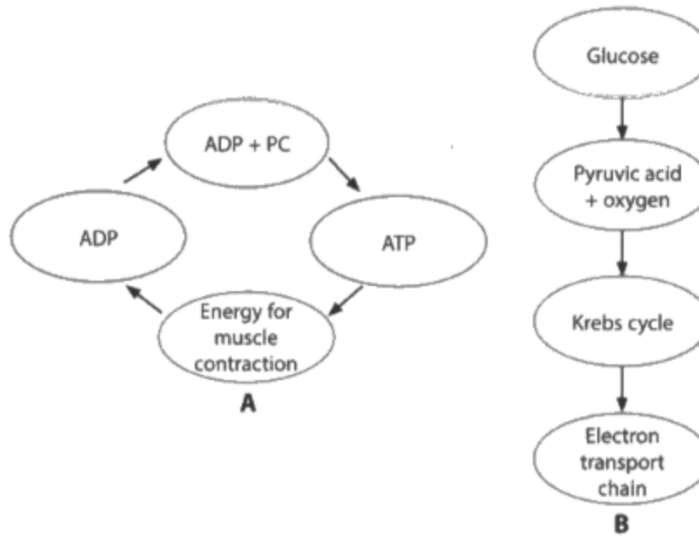


Figure 2

3 (a) Name the energy systems labelled **A** and **B** in **Figure 2**.

(2)

A ATP-PC system

B aerobic system

This response gained 1 mark

3 (a) Name the energy systems labelled **A** and **B** in **Figure 2**.

(2)

A ATP-PC

B lactate

One mark was awarded for correct identification of the ATP-PC system, unusually, the second system was incorrectly stated.

Q3(b)

This part of the question asked learners to explain which one of the energy systems in the image would be used for long periods of low-intensity work. Many learners gained two marks for this question, correctly identifying energy system B and linking this to the use of oxygen. To gain the third mark reference was also needed to its use due to the size of the energy yield.

This response gained 3 marks

Ariana's exercise session has long periods of low-intensity work and short periods of high-intensity work.

(b) Explain which **one** of the energy systems, **A** or **B** in **Figure 2**, is used for the long periods of low-intensity work.

(3)

The aerobic system is used for long periods of low intensity work. It can provide energy for hours with the availability of oxygen. It has an ATP yield of 34 and takes 24-72 hours to recover.

One mark is awarded for the correct energy system, and two further marks for the explanation, that it uses oxygen and has an energy yield of 34 ATP.

This response gained 1 mark

(b) Explain which **one** of the energy systems, **A** or **B** in **Figure 2**, is used for the long periods of low-intensity work.

(3)

B is used. This is because the Lactic acid System works on average for exercise around 2-3 minutes. Whereas, A (ATP-PC) works for short periods of high intensity workouts.

One mark is awarded for correct identification of system B. No further marks awarded as there is no explanation why that system is used, just some information about the other two energy systems.

Q3(c)

Learners were asked to describe two phases of the cardiac cycle. Marks were awarded for identifying each phase, systole, and diastole and then a brief description, for example, systole is the contraction phase of the cardiac cycle.

Incorrect responses often focused on vasodilation and vasoconstriction of blood vessels as the phases or were more general in terms of oxygen transport or descriptions of heart rate and stroke volume.

This response gained 4 marks

The cardiac cycle maintains blood flow so that nutrients can be transported to the muscles for energy production.

(c) Describe the **two** phases of the cardiac cycle.

(4)

1 Systole, which is the active phase. This involves the atria contracting and sending blood into the ventricles.

2 ~~Diastole~~ Diastole, which is the resting phase. This involves the ~~ventricles~~ heart relaxing, as well as the ventricles filling up with blood.

Both phases are correctly identified and described.

This response gained 2 marks

(c) Describe the **two** phases of the cardiac cycle.

(4)

1. Systolic Phase of ~~the~~ within the cardiac cycle the heart relaxes and fills up with blood. This blood enters the ~~at~~ heart and goes from de oxygenated to oxygenated.
2. Diastolic phase within the cardiac cycle the heart contracts pushing forward blood around the body and returning back to the lungs.

Two marks are awarded for identification of the phases, but no more marks awarded as the descriptions do not match the stated phases.

This response gained 0 marks

(c) Describe the **two** phases of the cardiac cycle.

(4)

1. ~~The~~ ~~words~~ ~~the~~ there will be an increase of stroke volume ~~when~~ as the blood will flow.
2. Also will be an increase in heart rate

Phases not identified or described.

Q3(d)

Learners were told that a lack of energy sources would cause muscle fatigue and then asked to state another cause. Most learners offered an alternate reason for muscle fatigue, correct responses covering all those listed in the unit specification. Depletion of acetylcholine, accumulation of CO₂ and accumulation of lactate were all popular correct answers. Incorrect responses referenced DOMs or lack of oxygen, rather than making the link between the lack of oxygen and the fatiguing by-product this resulted in.

This response gained 1 mark

Without sufficient energy sources muscle fatigue will occur.

(d) State **one other** cause of muscle fatigue during exercise.

(1)

Build up in waste products

One mark was awarded for identification that a build up of waste products will cause muscle fatigue.

This response gained 0 marks

Without sufficient energy sources muscle fatigue will occur.

(d) State **one other** cause of muscle fatigue during exercise.

(1)

~~(DOMS)~~ DOMS

No mark awarded.

Q3(e)

The third extended question asked learners to analyse the role of the cardiovascular system and the thermoreceptors in maintaining body temperature during exercise. This question asked learners to draw together their knowledge and understanding of two different body systems, i.e., the CV system and the thermoreceptors within the nervous system.

Many learners gained credit for their knowledge and understanding of either the thermoreceptors or the role of the CV system, relatively few learners were able to clearly make the required link between the monitoring function of the thermoreceptors and the impact of this on the CV system and therefore temperature regulation.

For this question level 1 responses tended to focus on general heat loss methods, e.g., sweating, or increased blood flow to the skin.

Within level 2 responses, knowledge was appropriately expanded on, with many discussing the need for the CV system to redirect blood flow through vasodilation so there was increased blood flow to the skin allowing heat loss through evaporation of sweat or radiation of heat from the body. Some also made the link between the CV system being told to do so by the nervous system, appreciating that some other mechanism was controlling the CV system to act in this way.

At level 3 learners' responses tended to demonstrate knowledge and understanding of the role of both in regulating temperature making relevant links between the thermoreceptors, the CV system and heat loss.

This response gained Level 3 - 8 marks

The cardiovascular system and the thermoreceptors in the nervous system work together to maintain Ariana's body temperature during exercise.

(e) Analyse the role of the cardiovascular system and the thermoreceptors in maintaining Ariana's body temperature during exercise.

(8)

When the thermoreceptors detect that the body is over 37°C a signal is sent to the hypothalamus (the body's thermostat) ~~because the body wants~~ the cardiovascular system has multiple responses to help prevent hyperthermia such as redirected blood from its core outward towards the skin this is known as vasodilation and the blood heats up the sweat on the skin which evaporates and the body loses heat.

Thermoreceptors first send a signal the SNS to the hypothalamus in the brain in order to kickstart other systems the medulla which will control the increase in HR and vasodilation.

blood is also redirected outwards of the towards the skin so ~~at least one of~~ the four heat loss measures come into affect for example sweating doesn't work in the ocean so conduction occurs taking heat from the skin instead. ~~as~~ as the body

wants to maintain homeostasis (balanced body temperature).

There is lots of relevant knowledge within the response, e.g., that body temperature should be at 37°C or that heat can be lost through sweating. Most of these points are expanded on and links made between the thermoreceptors and the CV system, or the CV system and heat loss. For example, information is given about the role of the thermoreceptors to detect increases in heat and their role to inform the CNS, which is expanded on and developed making the link to the CV system and its control to cause vasodilation.

This response gained Level 2 - 5 marks

(e) Analyse the role of the **cardiovascular system and the thermoreceptors** in maintaining Ariana's body temperature during exercise.

(8)

Thermoreceptors ~~allow for~~ are receptor cells that detect a change in body temperature. In exercise, due to the friction cause by the movement of limbs and the constant contraction and relaxation of the working muscles, this produces heat energy which will increase body temperature. Thermoreceptors will detect this change and send signals to the brain to initiate cooling technique, some of these include vasodilation, increases respiration and perspiration. Perspiration or sweating cools the body down by excreting liquid contain electrolytes through the pores, ~~to act with~~ which acts especially well with outside climate like wind, to cool body temperature down. The cardiovascular system works with thermoreceptors by allowing thermoreceptors to signal to the brain that ~~AA~~ Ariana's body temperature is ~~too~~ high and for vasodilation to ~~take~~ place. Vasodilation is when the blood vessels dilate and rise to the skin's surface in order to decrease core body temperature.

This response demonstrates all required skills to achieve level 2. There is some accurate knowledge and understanding about the role of thermoreceptors which is expanded on, explaining why temperature will increase during exercise, calling the thermoreceptors into play. A link

between the CV system and the nervous system is made, more detail could have been added but there is a clear indication of the interaction between the thermoreceptors, their signals to the brain and then action of the CV system.

This response gained Level 1 - 2 marks

(e) Analyse the role of the **cardiovascular system and the thermoreceptors** in maintaining Ariana's body temperature during exercise. (8)

thermoreceptors help the body to find out temperatures, if a person is over-heating the body will find out and the cardiovascular system will start attempting to bring the temperature back down to its resting state. The body will do this by making you sweat and breathe heavily.

This response demonstrates isolated elements of knowledge, e.g., thermoreceptors 'find out temperature' and 'sweating helps heat loss', and so is placed at level 1.

Q4

An ultra-distance bike race provided the context for question 4.

Q4(a)

This part of the question asked learners to explain one nutritional strategy the cyclist could use to complete the endurance event. To address the question learners needed to know and understand that there would be insufficient energy stores in the body to complete such a long distance race. Those that made that connection were able to explain how taking supplements during the event would help to maintain the energy stores. Marks were also awarded to those who focused on before event preparation, i.e., carbohydrate loading to ensure glycogen stores were fully maximised before the event.

This response gained 2 marks

Ava competes in ultra-distance bike races. The races are at least 700km long.

To cycle this distance Ava must have an appropriate nutritional strategy to maintain her energy levels.

4 (a) Explain **one** nutritional strategy Ava should use to complete this endurance event.

(2)

One nutritional strategy is to eat energy bars during the race. This ~~is~~ is because they contain glucose in them. This will help maintain and regenerate Avas energy production.

One mark was awarded for identification of the strategy of eating energy bars during the event and one mark for expanding on this point that this will help maintain energy production.

This response gained 1 mark

4 (a) Explain **one** nutritional strategy Ava should use to complete this endurance event.

(2)

She should use carb loading out continuously increase her carb intake coming up to the race, this with supply her energy systems with the energy they need to be used and will therefore help her during the event.

One mark is awarded for carbohydrate loading/increasing carbohydrate intake before the event. To gain the second mark this point needed expanding to explain why, i.e., that the body had insufficient energy stores, rather than just using the carbohydrates for energy.

Q4(b)

This part of the question asked learners to explain why it is important to rehydrate during the long race. Many responses correctly identified the need to replace lost fluids or prevent dehydration and explained otherwise the performer could overheat or fatigue sooner. A limited number of responses made the link between these two statements, i.e.,

that they would overheat as they would be unable to continue to sweat or they would be unable to continue to regulate body heat without topping up their fluid levels.

Marks were also awarded for responses that focused on the loss of electrolytes due to sweating, reducing muscle contraction, leading to muscle fatigue.

This response gained 3 marks

Ava drinks plenty of fluids during her race to rehydrate.

(b) Explain **one** reason why it is important that Ava rehydrates during her race.

(3)

To prevent dehydration which is the body's reaction to ~~the~~ hypertrophy ~~to~~ exertion and can lead to overheating and less sweat production which could be fatal as the body can't regulate body temperature or evaporate heat through sweat.

One mark is awarded for preventing dehydration, and one mark for impact of this, i.e., overheating, and one mark for the link between the two, that there will be less sweat production so the body will be unable to regulate temperature.

This response gained 2 marks

(b) Explain **one** reason why it is important that Ava rehydrates during her race.

(3)

She needs to rehydrate as water will be lost through sweat and respiration which will reduce the amount of electrolytes in her body which are needed for muscle contractions and therefore need to be replaced.

One mark is awarded for loss of electrolytes through sweating and one mark for link to muscle contractions.

Q4(c)(i)

Learners were given the definition of minute volume and then asked to state how to calculate minute volume. The definition appeared to assist many learners in gaining at least one mark for this question. Incorrect responses tended to link to stroke volume or cardiac output and heart rate or a lack of appreciation that the values should be multiplied.

This response gained 2 marks

Minute volume is the amount of air breathed in and out every minute.

(c) (i) State the calculation for minute volume. (2)

~~Stroke volume x heart rate~~

Tidal volume x breathing rate

~~Stroke volume~~ TV x BR

One mark is awarded for identification of tidal volume and one mark for this being multiplied by breathing rate. Recognised abbreviations for the calculation were accepted.

This response gained 1 mark

Minute volume is the amount of air breathed in and out every minute.

(c) (i) State the calculation for minute volume. (2)

Cardiac output x tidal volume.

One mark is awarded for tidal volume. No mark for incorrect reference to cardiac output.

Q4(c)(ii)

This part of the question asked learners to explain why an increase in minute volume would be an advantage during an ultra-distance race.

Marks were awarded for knowing this would mean an increase in oxygen taken into the body that would then result in more oxygen for the working muscles meaning that fatigue would be delayed or that they would be able to continue to work aerobically.

Alternatively, the response could focus on increased carbon dioxide being breathed out, decreasing CO₂ levels in the blood, thus delaying muscle fatigue.

This response gained 3 marks

(ii) Explain **one** reason why an increase in minute volume would be an advantage to Ava during an ultra-distance bike race. (3)

This will mean that Ava is bringing in more oxygen to the body that is going to the working muscles. So therefore the muscles won't be tiring and they will keep working efficiently without lactic acid building up that will cause her to fatigue.

One mark was awarded for more oxygen being breathed in, one mark for the expansion that this means more oxygen to the working muscles and one mark for the impact of this, i.e., that lactic acid would not build up thus she would not fatigue.

This response gained 2 marks

(ii) Explain **one** reason why an increase in minute volume would be an advantage to Ava during an ultra-distance bike race.

(3)

This would be an advantage as the greater the minute volume, the greater the amount of oxygen delivered to the working muscles. This will reduce Ava's fatigue as it prevents her muscles from producing lactic acid which would result in muscular fatigue. The less fatigue, the greater distance Ava can travel without slowing down or stopping. This advantage would result in Ava completing her race quicker.

One part of the process was omitted from this response, the fact that in order to get more oxygen to the working muscles the increased minute volume meant that more oxygen could be breathed in.

(ii) Explain **one** reason why an increase in minute volume would be an advantage to Ava during an ultra-distance bike race.

(3)

This allows Ava to be able to breathe more air in and out quicker every minute and therefore the blood will pump faster to the working muscles allowing for more oxygen in the muscles to meet the demands of the exercise.

One mark is awarded for more oxygen to the muscles. There is no impact of this, e.g., slower to fatigue so no further expansion mark. No marks were awarded for increased air breathed in, this needed to relate to oxygen, or carbon dioxide if being breathed out.

Q4(d)

The final extended question asked candidates to analyse why strength and muscular endurance training improve the cyclists race times.

To fully address the question candidates should have analysed both types of training., considering the adaptations that each type of training brings and analysing why this would result in an improvement in race time. The relevant adaptations were not always well-known, however some candidates still accurately linked strength training to increased power or force being exerted on the peddles allowing increased speed particularly during the hill climbs, similarly that the muscular endurance training should delay muscle fatigue so that pace could be maintained for longer improving overall race time. Therefore, some marks were still achieved even without specific knowledge of the relevant adaptations, but for the ability to apply understanding of the types of training to the question scenario.

This response gained Level 3 - 8 marks

Ava's next competition is 800 km long and includes a lot of steep hill climbs.

Ava uses strength **and** muscular endurance training to cause adaptations to her **muscular** system.

(d) Analyse why Ava's cycling race times will improve as a result of strength **and** muscular endurance training.

(8)

Long term strength training will increase the size of the muscles and the power output of them via hypertrophy and hyperplasia. This means that each of her contractions will be more powerful which will mean that she will be able to cycle faster and further with less pedals and can powerfully get up the hill climbs quicker

The long term muscular endurance training will increase the glycogen and haemoglobin and myoglobin stores as well as increasing mitochondria production. This will increase the energy that she will have meaning that she will fatigue less as the mitochondria will create ATP faster and the glycogen stores will allow for more energy to be produced. A reduction in fatigue will mean she will be able to cycle faster for longer which will improve her cycling times.

Strength training also encourages ~~her~~ stronger tendons and ligaments and strengthens bones due to them becoming more dense under weight bearing exercises. This reduces her chances of injury which allows her to train more. More training means that she can continue to strengthen her muscles to become even more powerful.

Responses do not need to be long to achieve maximum marks, as is the case here. This response is very well structured. The paragraphs contain adaptations, the application of the given adaptations to the question scenario and the analysis making it clear why race times are reduced. links to reduced race times. The final paragraph provides additional information.

This response gained Level 2 - 5 marks

(d) Analyse why Ava's cycling race times will improve as a result of strength and muscular endurance training.

(8)

There are 3 main adaptations to Ava's muscular system that can occur. These are hypertrophy, hyperplasia and capillarisation.

The first adaptation to Ava's muscular system is hypertrophy. Hypertrophy is when your muscles get bigger and stronger due to the muscle fibres building up and enlarging which ultimately enlarges your muscles. Ava's cycling race times will improve due to hypertrophy because with stronger and more dense muscles it will enable her to pedal with more force which will enable her to go faster and also enable her muscles to contract for longer meaning that it will take longer for her muscles to fatigue.

The second adaptation to Ava's muscular system is hyperplasia. Hyperplasia is when the muscle fibres in your muscles tear to enable the muscles to grow back stronger and more dense. This is similar to hypertrophy but this is the ~~muscles~~ muscle fibres tearing instead of building on each other.

Ava's cycling times will improve due to hyperplasia because it will enable her to do more frequent peddals without fatiguing and will enable her to put more force into peddling when going up steep hills.

The third adaptation to Ava's muscular system is capillarisation. Capillarisation is when there is an increase in capillaries which means more oxygen will go to the muscles after gaseous exchange. Ava's cycling times will improve due to capillarisation because it will enable her to pedal more frequently due to the fact that she has more oxygen and won't fatigue quickly. Also with an increase in oxygen it also means an increase in energy so she will be able to put in more power into her pedals to gain distance to make the times better.

This response demonstrates all required skills to achieve level 2. There is some accurate knowledge and understanding of the adaptations that each type of training can cause. Whilst it is fairly clear the candidate has linked the adaptations to the correct form of training it would be better to have a specific statement, maybe at the start of the paragraph to ensure there is no doubt. There is analysis of how the adaptation hypertrophy, would be beneficial to the cyclist, 'apply more force'. No credit for link to fatigue, this would be credited if linked to muscular endurance training. The following paragraph about hyperplasia has some inaccuracies and repetitive points so does not contribute further to the response.

The next part of the response of note is the adaptation capillarisation and this is appropriately explained and linked to delayed fatigue.

This response gained Level 1 - 2 marks

(d) Analyse why Ava's cycling race times will improve as a result of strength and muscular endurance training.

(8)

As Ava is training for strength and muscular endurance micro tears are being made in Ava's muscles. As Ava consume a large amount of protein those muscle micro tears will be filled in with bigger and stronger muscle this is called hypertrophy. When Ava continuously trains for muscle endurance and strength muscular hypertrophy will be occurring so strength will increase and so will muscular endurance.

When its time for Ava's 800km race with steep hills to climb Ava will be able to climb the steep hills at a faster rate due to Ava training for strength and muscular endurance. her muscular endurance training will help her ~~endure~~ get through the steep hill quicker for the steep hills. Endurance training will also increase the amount of muscle fibers this is called hypertrophy. This means Ava will have more muscle fiber type 2As which will help her get through steep hills at a quicker rate. This in total will improve Ava's cycling race times.

This response demonstrates isolated elements of knowledge and limited analysis and so is placed at level 1. I.e., strength training causes hypertrophy which means they will be able to climb steep hills at a quicker rate to improve race times.

Summary

Based on their performance on this paper, learners should:

- Use appropriate technical language throughout your responses, ie do not abbreviate terms, e.g., state osteoblasts in full rather than simply stating 'blasts'
- Tailor your response based on the command word in the question, eg, state does not require any expansion of a point but explain will.
- Use the number of marks gained and the space available as a guide to the depth of response required.
- Be clear about terminology used in the specification as these words will be repeated in the exam paper, e.g., responses and adaptations.
- Know the different body systems so you can focus on the correct one within a question.
- Use the question scenario to demonstrate your ability to apply your knowledge.



Llywodraeth Cynulliad Cymru
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