edexcel

Exemplar: Component one 9PE01/01

AS and A Level Physical Education

Pearson Edexcel Level 3 Advanced GCE in Physical Education (9PE0)

Pearson Edexcel Level 3 Advanced Subsidiary GCE in Physical Education (9PE0)

ALWAYS LEARNING

PEARSON

Contents

About this exemplar pack

This pack has been produced to support Physical Education teachers delivering the new AS/GCE Physical Education specification (first assessment summer 2018).

The pack contains exemplar student responses to GCE A level Physical Education **component one: Scientific Principles of Physical Education 9PE0/01**.

It shows real student responses to the questions taken from the sample assessment materials.

The AS and A level questions address four Assessment Objectives: AO1, AO2, AO3 and AO4.

Students must:		% in GCE A Level
AO1	Demonstrate knowledge and understanding of the factors that underpin performance and involvement in physical activity and sport.	23
AO2	Apply knowledge and understanding of the factors that underpin performance and involvement in physical activity and sport.	23
AO3	Analyse and evaluate the factors that underpin performance and involvement in physical activity and sport.	24
AO4	• Demonstrate and apply relevant skills and techniques in physical activity and sport. • Analyse and evaluate performance.	30
	Total	**100%**

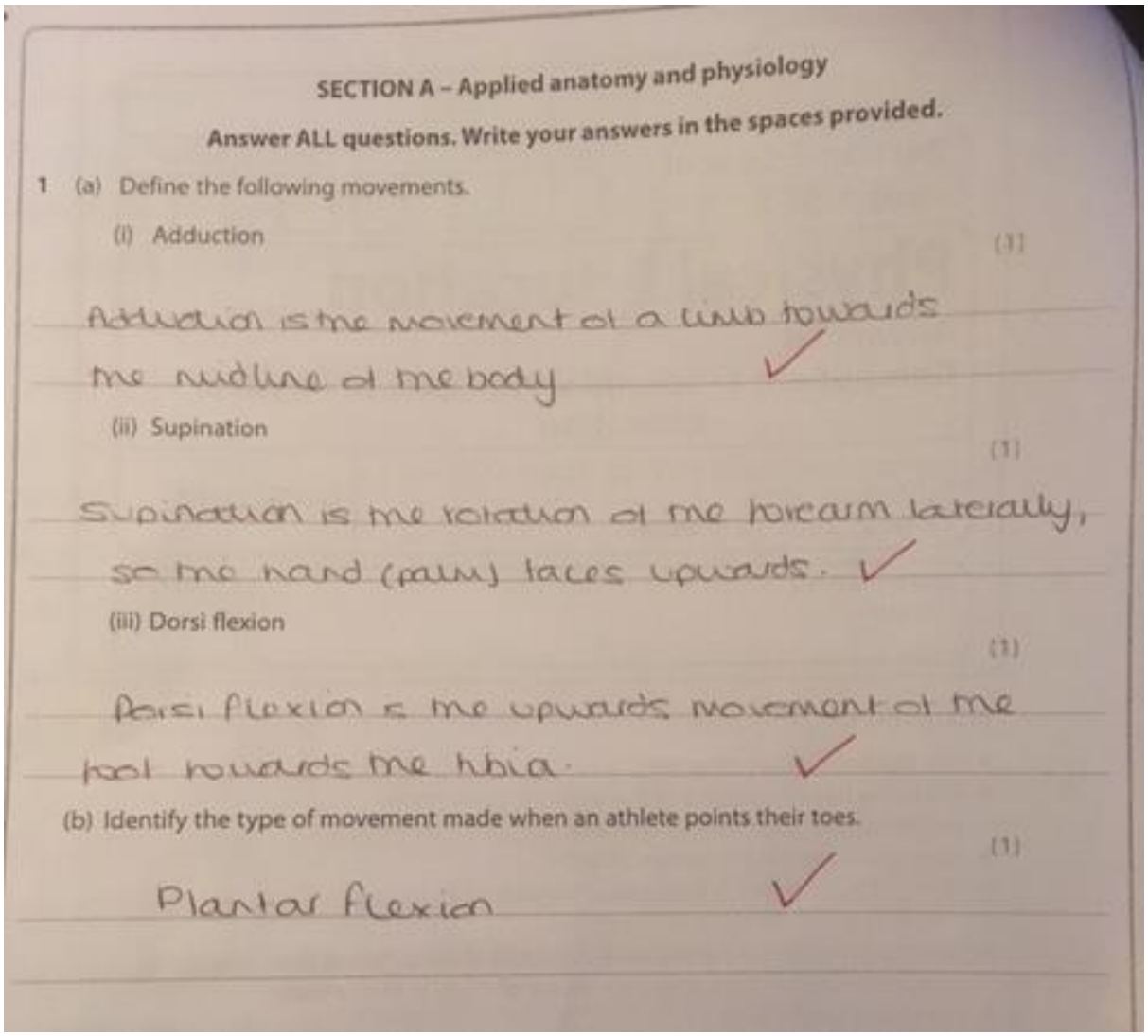
The following exemplar material is structured to show the commentary for each question in **9PE0/01** followed by a student response. Some responses have been typed out for clarity. The commentary will include, where appropriate, ways of improving the response.

Sample assessment material 9PE0/01

Question 1a and 1b

Learners should be encouraged to learn definitions from the specification where they are listed and then the topic guides (where these are not in either, other sources can be used). Learners were able to define Adduction, Dorsi Flexion, and the movement produced when pointing toes. They were less often able to define supination. Learners will need to accurately learn all definitions in the specification.

EXEMPLAR RESPONSE



SECTION A – Applied anatomy and physiology

Answer ALL questions. Write your answers in the spaces provided.

1 (a) Define the following movements.

(i) Adduction (1)

Adduction is the movement of a limb towards the midline of the body ✓

(ii) Supination (1)

Supination is the rotation of the forearm laterally, so the hand (palm) faces upwards. ✓

(iii) Dorsi flexion (1)

Dorsi flexion is the upwards movement of the foot towards the tibia. ✓

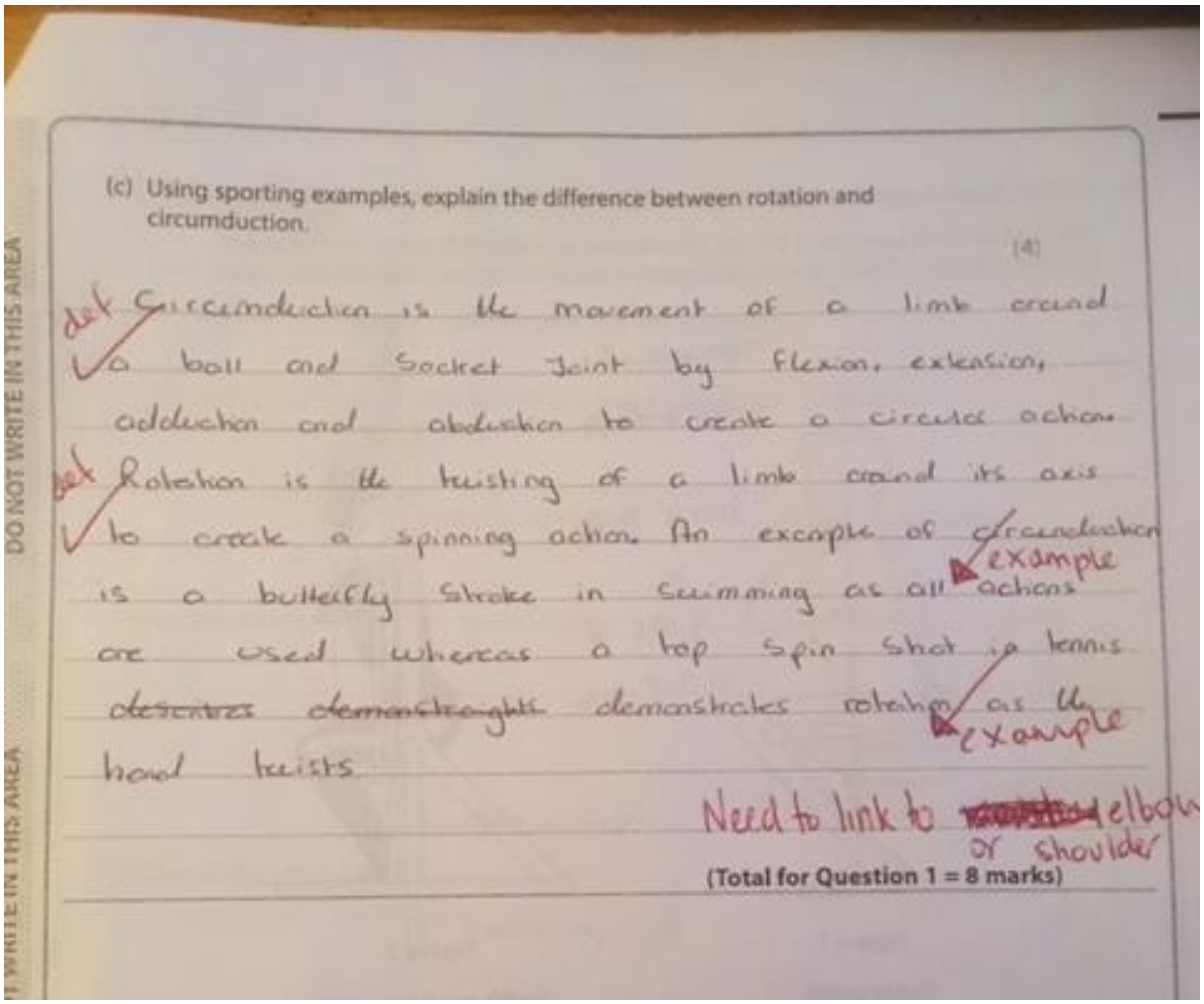
(b) Identify the type of movement made when an athlete points their toes. (1)

Plantar flexion ✓

Question 1c

In this question learners needed to understand both definitions and then go on to apply it to appropriate examples. There are many examples that could be used and the mark scheme would allow for any appropriate examples to be rewarded. This question was more difficult, and less well answered than parts a and b. In the example work you will see that this candidate knows the definitions and has also used accurate examples – however the examples do not link to the specific joint in the body and are therefore less clear. An example of a movement would need to link to a specific joint to ensure that it is fully accurate.

EXEMPLAR RESPONSE



(c) Using sporting examples, explain the difference between rotation and circumduction.

(4)

det ✓ Circumduction is the movement of a limb around a ball and Socket Joint by flexion, extension, adduction and abduction to create a circular action

det ✓ Rotation is the twisting of a limb around its axis to create a spinning action. An example of circumduction is a butterfly stroke in swimming as all actions are used whereas a top spin shot in tennis ~~describes demonstrates~~ demonstrates rotation as the hand twists.

example

example

Need to link to ~~wrist~~ elbow or shoulder

(Total for Question 1 = 8 marks)

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Question 2a

Learners will need to be taught how to perform calculation style questions. Calculators are permitted in the exam and should be encouraged. It is important to show working out in calculation questions to ensure that if an incorrect answer is obtained some marks may still be gained for the methodology. Correct units are also important in the answer. This learner has shown very clear working out and applied correct units to the answer.

EXEMPLAR RESPONSE

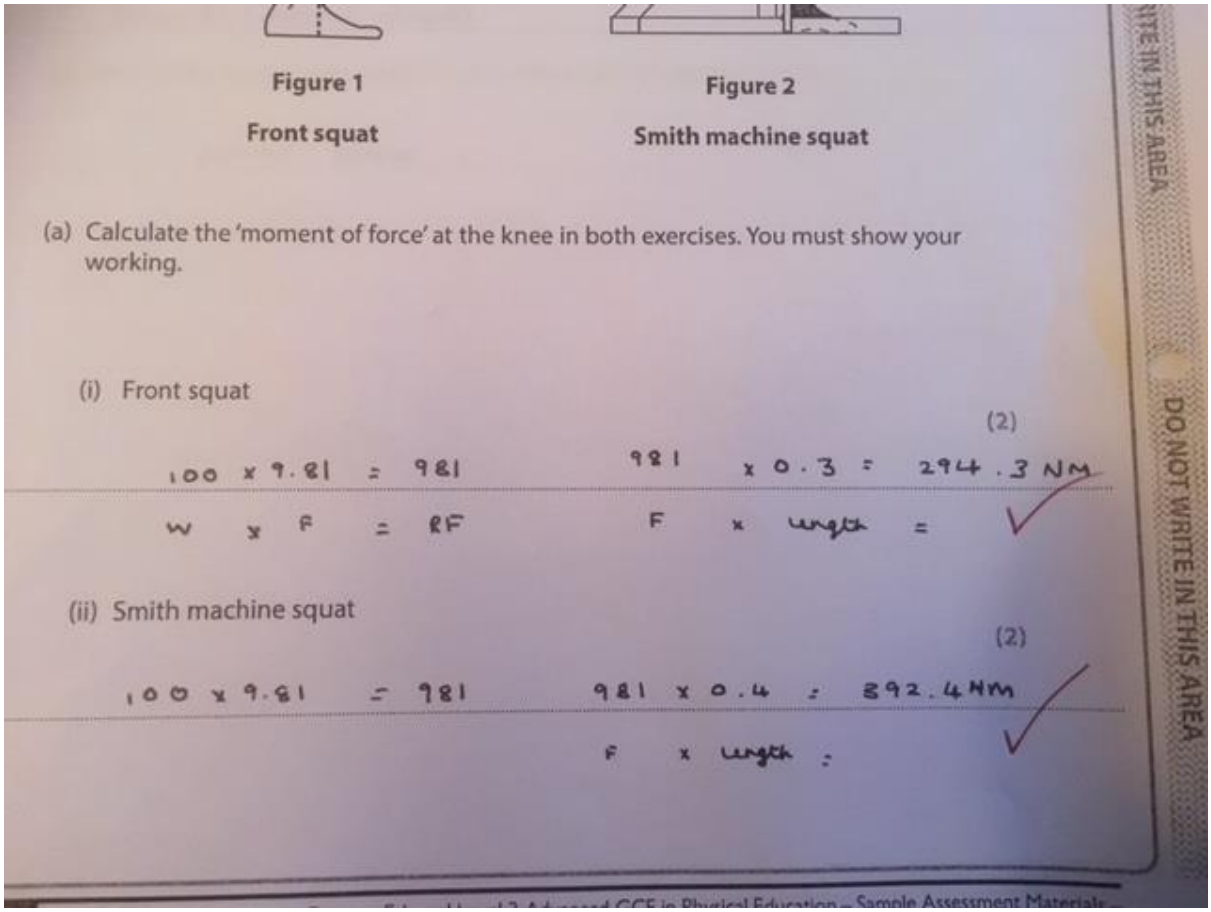

Figure 1
Front squat

Figure 2
Smith machine squat

(a) Calculate the 'moment of force' at the knee in both exercises. You must show your working.

(i) Front squat

(2)

100 x 9.81 = 981 W x F = RF

981 x 0.3 = 294.3 NM F x length =

(ii) Smith machine squat

(2)

100 x 9.81 = 981

981 x 0.4 = 392.4 NM

F x length =

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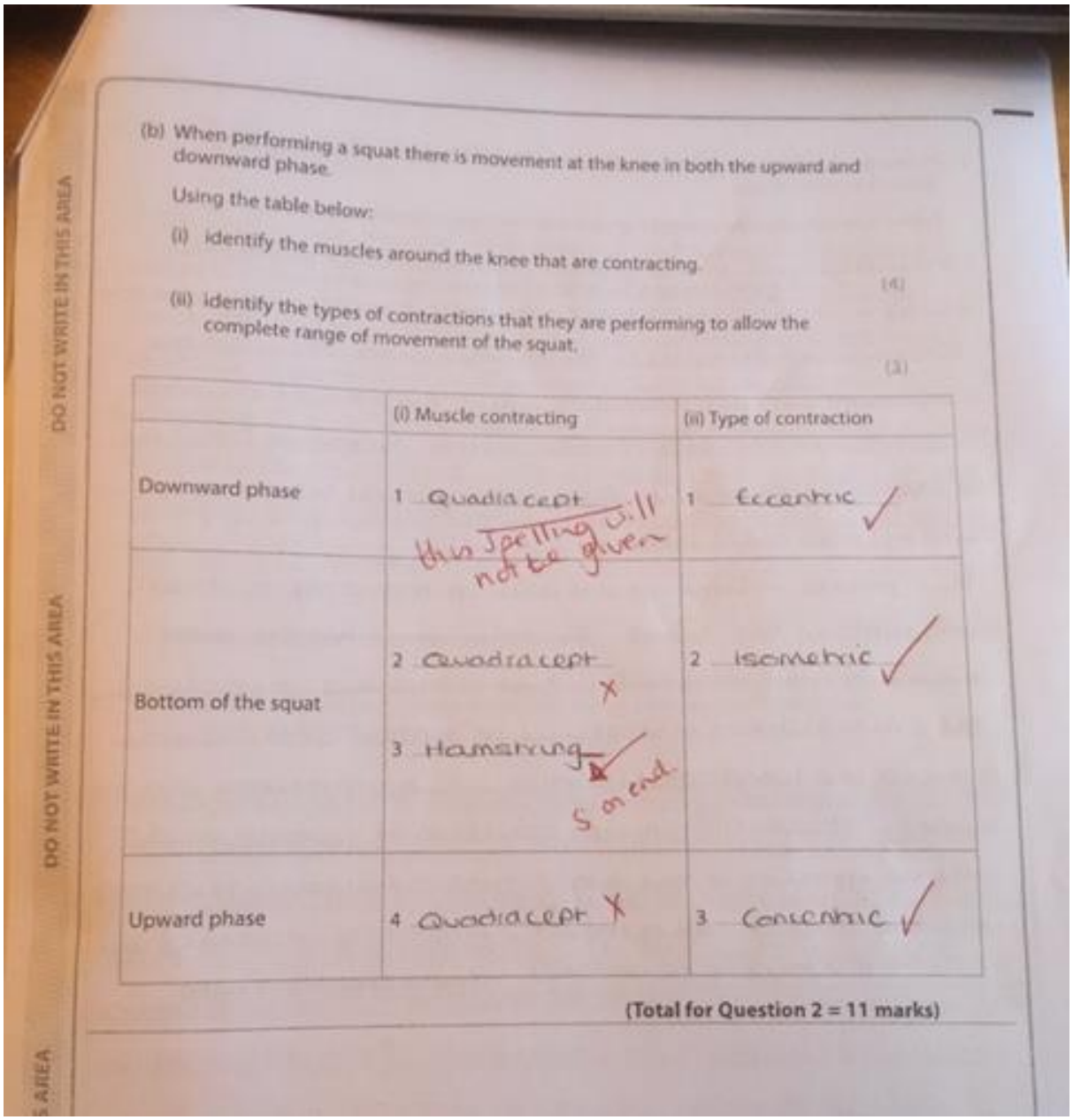
Question 2b

Muscle names and movements will also need to be taught in line with the specification. In this example the learner has not spelt the muscle name correctly in line with the specification. This will therefore restrict the marks available.

EXEMPLAR RESPONSE



(b) When performing a squat there is movement at the knee in both the upward and downward phase.

Using the table below:

(i) identify the muscles around the knee that are contracting.

(4)

(ii) identify the types of contractions that they are performing to allow the complete range of movement of the squat.

(3)

	(i) Muscle contracting	(ii) Type of contraction
Downward phase	1 Quadiacept this spelling will not be given	1 Eccentric ✓
Bottom of the squat	2 Quadriacept X 3 Hamstrung ✓ S on end	2 Isometric ✓
Upward phase	4 Quadiacept X	3 Concentric ✓

(Total for Question 2 = 11 marks)

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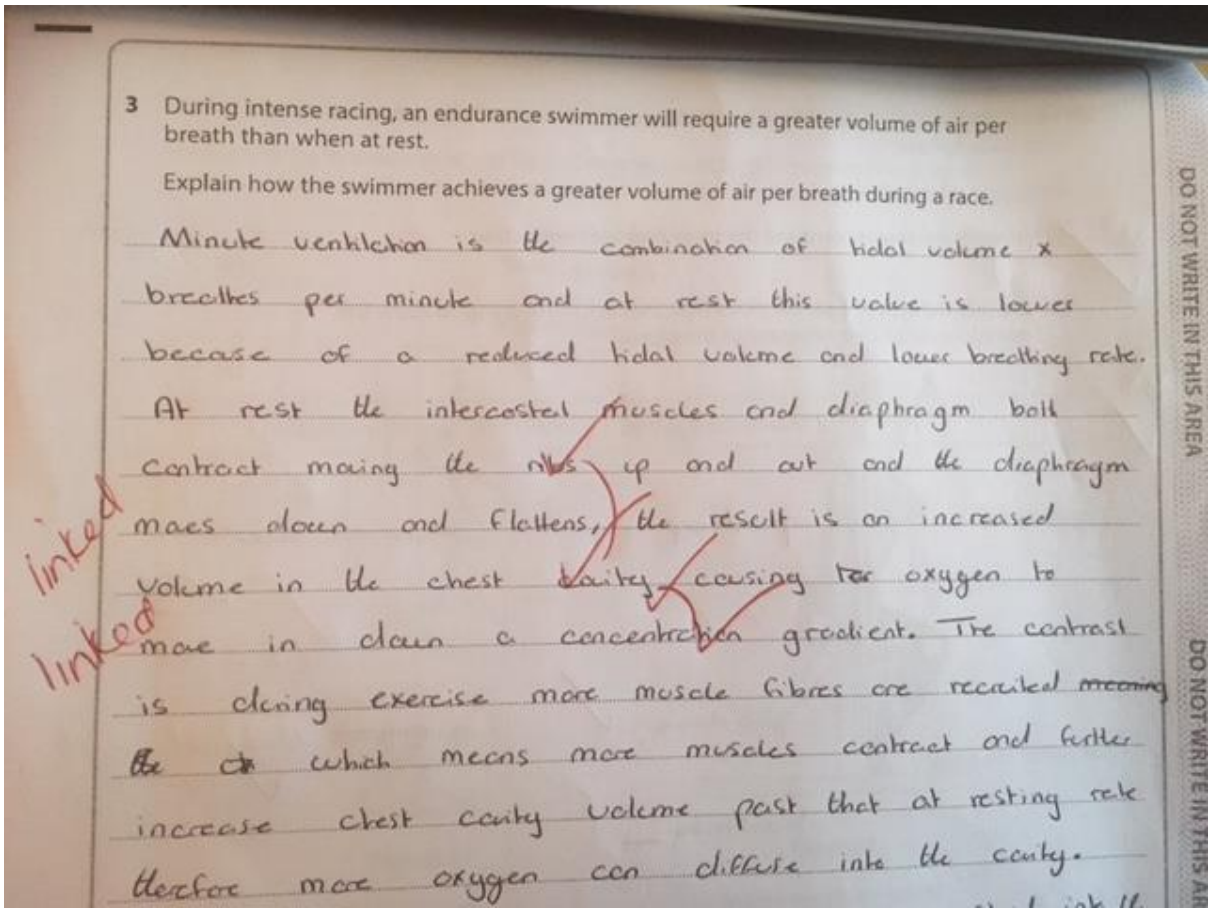
Question 3

Explain questions require linked answers. This example shows how the learner is able to make links. For example, the movement of the ribs and diaphragm causes an increase in volume, and the increased volume allows the movement along the concentration gradient. These are examples of linked points. Linked points are essential in explain questions.

EXEMPLAR RESPONSE



3 During intense racing, an endurance swimmer will require a greater volume of air per breath than when at rest.

Explain how the swimmer achieves a greater volume of air per breath during a race.

Minute ventilation is the combination of tidal volume x breathes per minute and at rest this value is lower because of a reduced tidal volume and lower breathing rate. At rest the intercostal muscles and diaphragm both contract moving the ribs up and out and the diaphragm moves down and flattens, the result is an increased volume in the chest cavity causing for oxygen to move in down a concentration gradient. The contrast is during exercise more muscle fibres are recruited meaning the ~~ch~~ which means more muscles contract and further increase chest cavity volume past that at resting rate therfore more oxygen can diffuse into the cavity.

linked

linked

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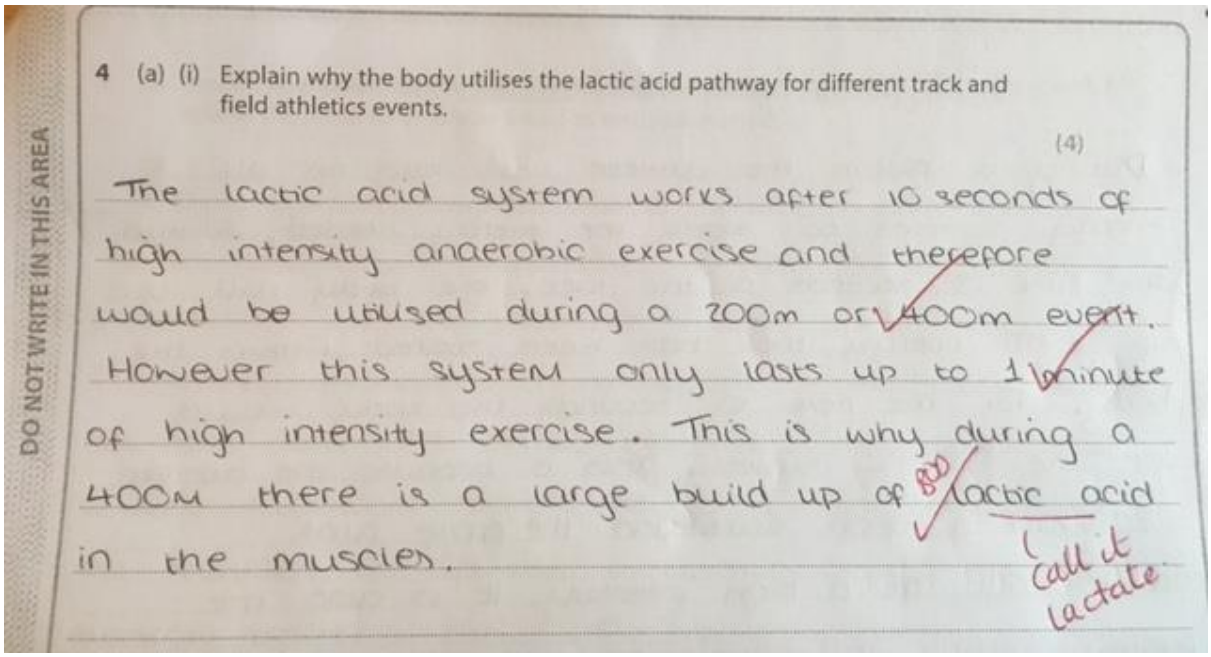
Question 4a(i)

Learners found this difficult. They will need a detailed understanding of the energy systems and the energy continuum (updated in the topic guide). The application of the question will require linked explanations. The critical thing here is not to repeat everything known about this system but to explain WHY this system is used. Lactic acid should be referred to as lactate.

EXEMPLAR RESPONSE



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4 (a) (i) Explain why the body utilises the lactic acid pathway for different track and field athletics events.

(4)

The lactic acid system works after 10 seconds of high intensity anaerobic exercise and therefore would be utilised during a 200m or 400m event. However this system only lasts up to 1 minute of high intensity exercise. This is why during a 400M there is a large build up of lactic acid in the muscles.

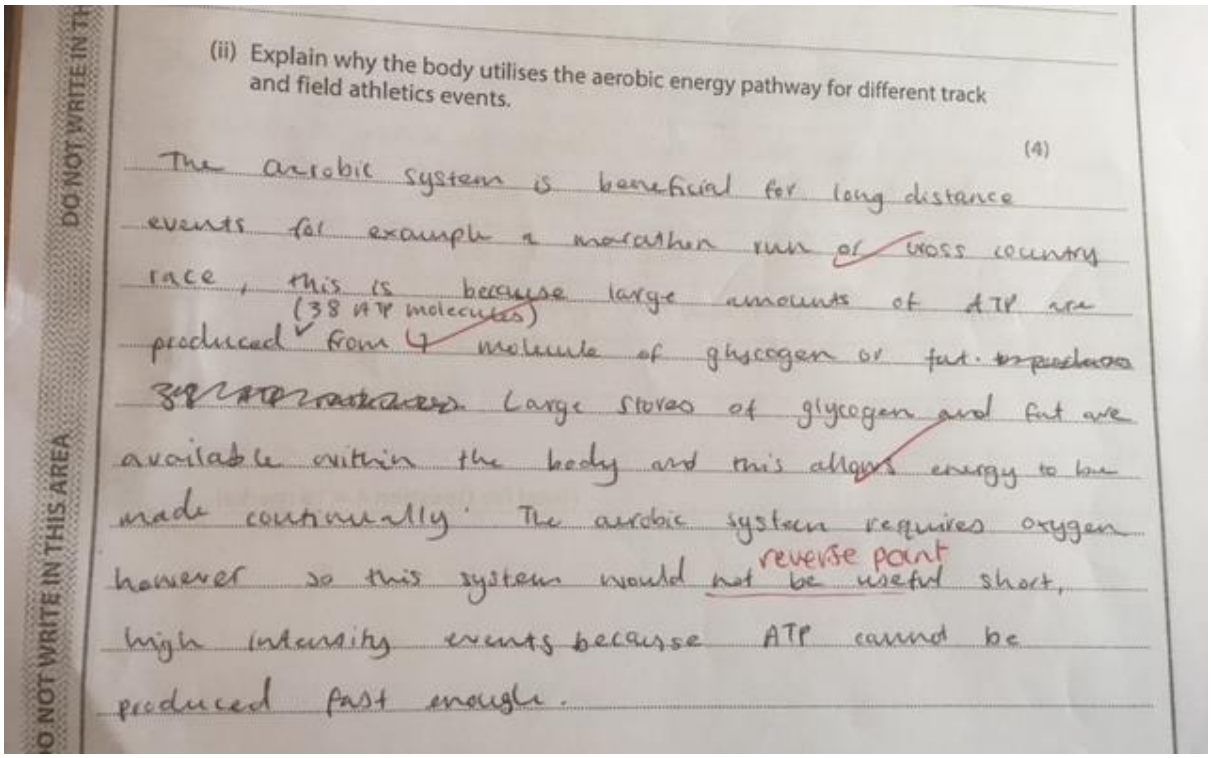
800

call it lactate

Question 4a(ii)

In the example for 4aii you can see the learner has made reverse points about why the system should not be used. Learners do not get credit for reverse points and will need to link all their points to the aerobic pathway and why it would be useful, not why it would not be useful for anaerobic events. This is another example of an explain question and therefore linked points are important.

EXEMPLAR RESPONSE



(ii) Explain why the body utilises the aerobic energy pathway for different track and field athletics events.

(4)

The aerobic system is beneficial for long distance events for example a marathon run or cross country race, this is because large amounts of ATP are produced (38 ATP molecules) from 1 molecule of glycogen or fat. Large stores of glycogen and fat are available within the body and this allows energy to be made continually. The aerobic system requires oxygen however so this system would not be useful short, high intensity events because ATP cannot be produced fast enough.

reverse point

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Question 4b

Whilst this learner understands the elements of the race and why certain systems would be used at certain times they do not assess where the race would be on the energy continuum. A good answer here will explain where it lies on the continuum and then go on to support the answer with the elements of the race and support their points made.

EXEMPLAR RESPONSE

Q04 (b) Assess where the 1500 m track race would be placed on the energy continuum.

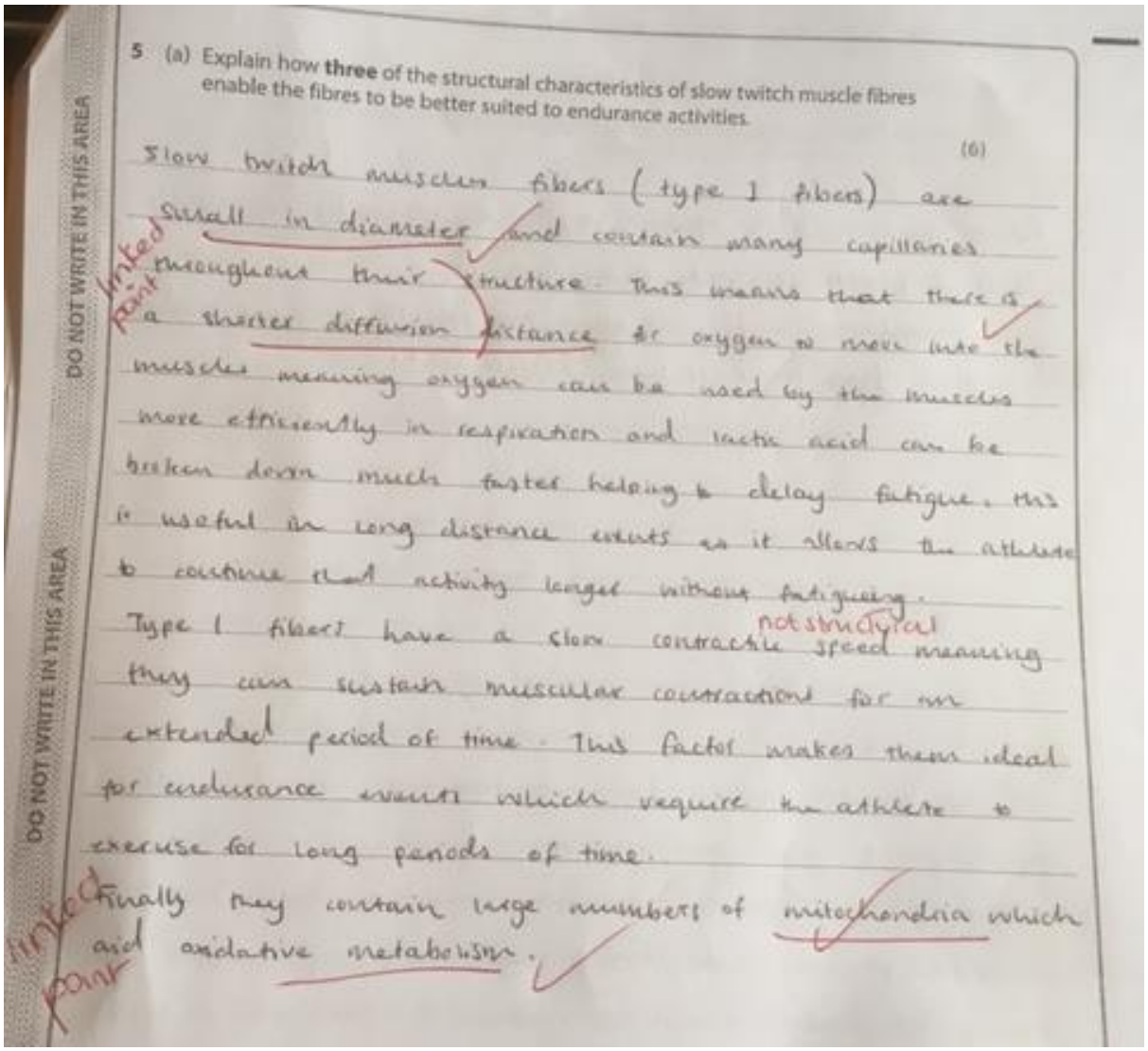
During a 1500m the athlete will rely on all 3 energy systems to supply the energy needed. Within the first 3 seconds of the race, the body will use up ATP energy that has been stored within the body. For the next 10 seconds the body would use the ATP-PC system. This is because the athlete will want a good start and therefore runs anaerobically at a high intensity. It is also the fastest source of energy as the ATP-PC system works within the muscle cells. The body would then utilise the aerobic system because the race lasts longer than a minute and will therefore be performed at a low intensity with the use of oxygen as this system is the most efficient in supplying ATP energy. For the last lap of the race the intensity would increase and would therefore be working anaerobically, however the athlete will begin to fatigue from a build-up of lactic acid in muscles.

Question 5a

As this is an explain question the linked points will need to explain how they are suited to endurance activities. The two examples show linked points being made. Learners must be careful to ensure they understand the differences between structural and functional answers. This question demands structural answers. You can see one learner talks about speed of contraction which is functional and therefore does not gain credit. This is a common error in this type of question.

Each linked pair scores one mark in an explain question.

EXEMPLAR RESPONSE 1



5 (a) Explain how **three** of the structural characteristics of slow twitch muscle fibres enable the fibres to be better suited to endurance activities.

(6)

Slow twitch muscles fibers (type 1 fibers) are small in diameter and contain many capillaries throughout their structure. This means that there is a shorter diffusion distance for oxygen to move into the muscles meaning oxygen can be used by the muscles more efficiently in respiration and lactic acid can be broken down much faster helping to delay fatigue. This is useful in long distance events as it allows the athlete to continue their activity longer without fatiguing.

Type 1 fibers have a slow contractile speed meaning they can sustain muscular contractions for an extended period of time. This factor makes them ideal for endurance events which require the athlete to exercise for long periods of time.

Finally they contain large numbers of mitochondria which aid oxidative metabolism.

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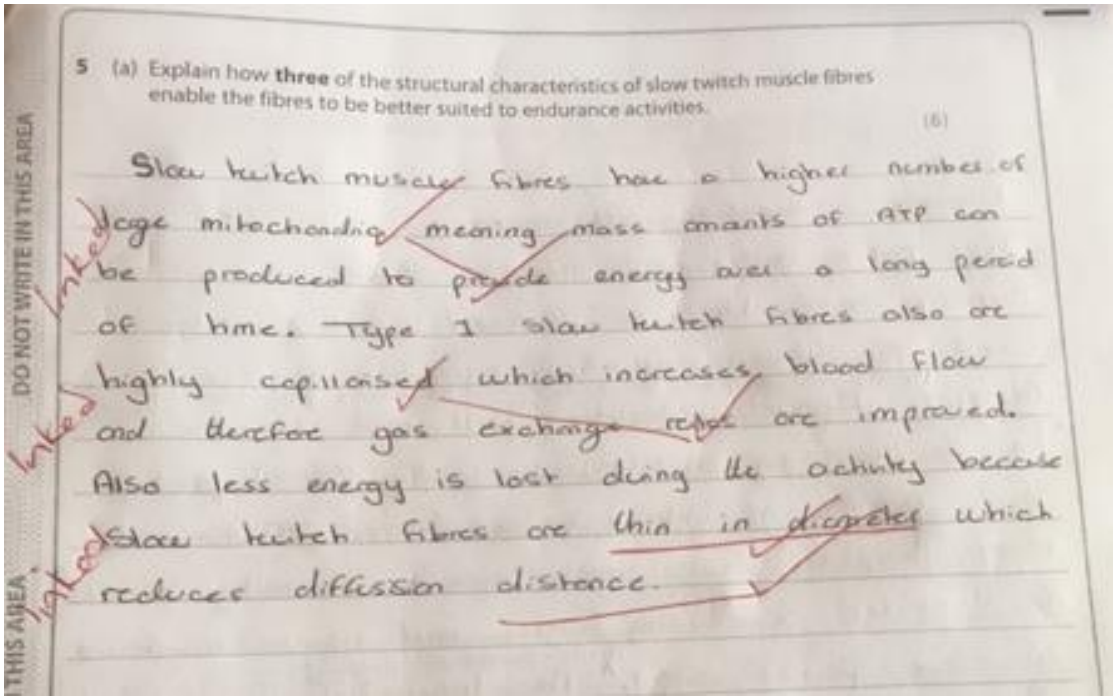
linked point

linked point

not structural

EXEMPLAR RESPONSE 2



5 (a) Explain how **three** of the structural characteristics of slow twitch muscle fibres enable the fibres to be better suited to endurance activities.

(6)

Slow twitch muscle fibres have a higher number of large mitochondria meaning mass amounts of ATP can be produced to provide energy over a long period of time. Type 1 slow twitch fibres also are highly capillarised which increases blood flow and therefore gas exchange rates are improved. Also less energy is lost during the activity because slow twitch fibres are thin in diameter which reduces diffusion distance.

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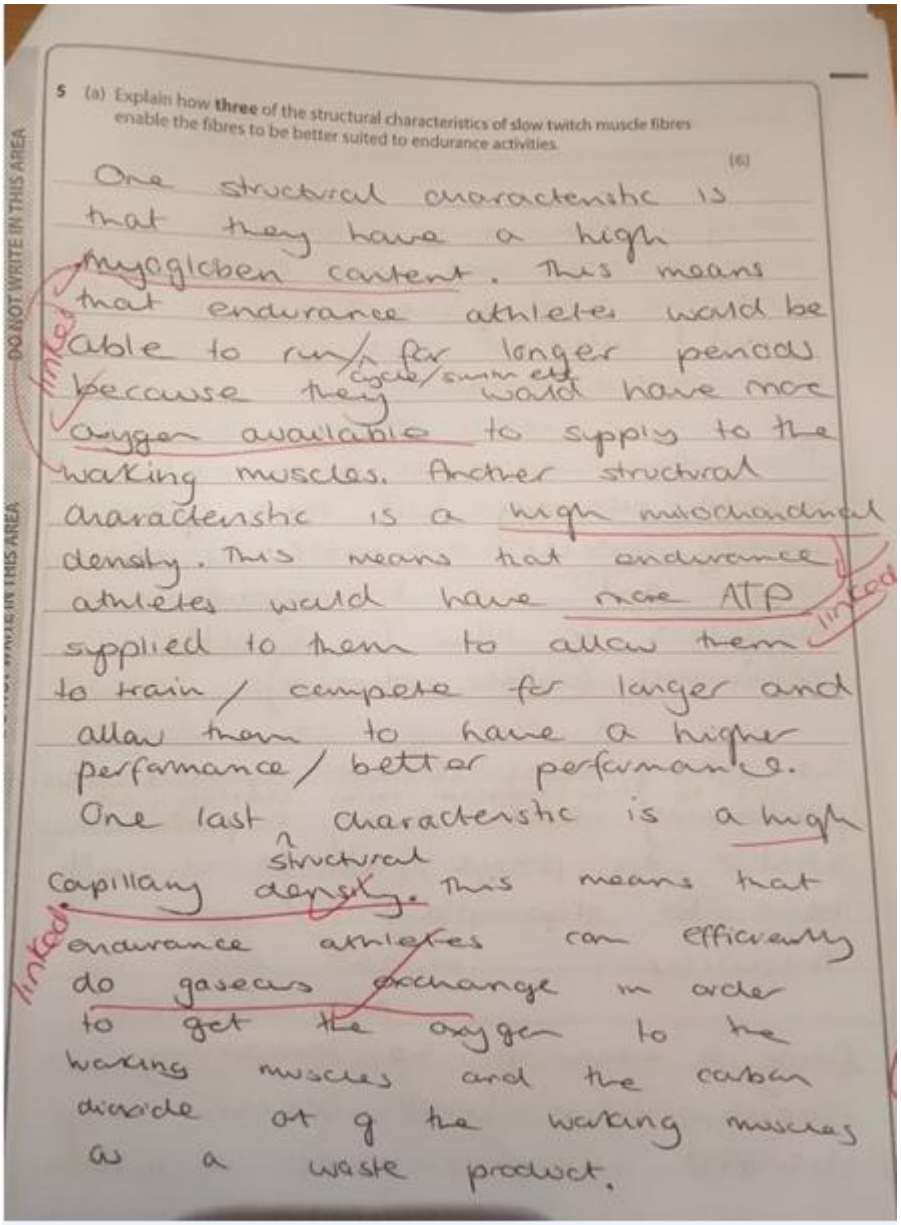
EXEMPLAR RESPONSE 3



5 (a) Explain how **three** of the structural characteristics of slow twitch muscle fibres enable the fibres to be better suited to endurance activities.

(6)

One structural characteristic is that they have a high myoglobin content. This means that endurance athletes would be able to run/cycle/swim for longer periods because they would have more oxygen available to supply to the working muscles. Another structural characteristic is a high mitochondrial density. This means that endurance athletes would have more ATP supplied to them to allow them to train/compete for longer and allow them to have a higher performance/better performances. One last structural characteristic is a high capillary density. This means that endurance athletes can efficiently do gaseous exchange in order to get the oxygen to the working muscles and the carbon dioxide of the working muscles as a waste product.

linked

linked

linked

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Question 5b

In this question structural answers must be linked to functional responses. One error learners make is to confuse functional and structural and therefore are not able to accurately link them together.

EXEMPLAR RESPONSE

Q05 (b) Structural responses provide functional benefits.

Explain how four structural responses experienced during a warm up would lead to functional improvements in a performance.

Elasticity of the muscles will increase so that the muscles have a wider range of movement. (linked response)

Vaso-constriction in areas of the body that are not as important so that more oxygenated blood can be transported to the working muscles. (linked response)

Vasodilation of capillaries in the working muscles to maximise the amount of oxygen available. (linked response)

An increase in synovial fluid lubricates the joints to decrease the chance of injury. (linked response)

Question 6

Learners will need to be able to use knowledge from across the course to be able to write a coherent extended response. An unhealthy lifestyle and it's factors will need to be linked to the body systems to score well in this question.

The example shows excellent scientific detail and links each of the factors to physiological detail and the effects it will have on the body.

EXEMPLAR RESPONSE

Q06 Discuss the likely effects of an unhealthy lifestyle on the body.

Use your knowledge and understand from across the course of study to answer this question.

Health is a complete state of social, mental and physical well-being; not merely the absence of illness or infirmity. An unhealthy lifestyle can be made of many contributing factors such as poor diet, smoking, stress, sleep deprivation and the use of performance enhancing drugs. All these factors can have a wide range of effects on the health of the body.

One factor of an unhealthy lifestyle is having a poor diet, which consists of a high proportion of fat and calcium. This has a negative effect on the body because a poor diet will lead to the accumulation of fatty deposits, low density lipoproteins (LDLs) or plaque on the walls of arteries (such as the coronary artery). This will lead to the narrowing or blockage of lumen in the blood vessels. Consequently, will reduce oxygen supply at the heart and may result in a hear attack, stroke or myocardial infection. In addition, a lack of calcium will prevent bones and the skeletal system developing and improving strength. This means diseases such as osteoporosis are more likely to occur and increase chance of injury. Overall, a poor diet has negative effects on the body and will inhibit an individual's sporting performance.

Another factor is the use of smoking in an individual's lifestyle. This has a damaging impact on the body in many ways. Firstly, because the carbon monoxide within the cigarettes increases the heart rate and causes blood pressure to rise to unhealthy levels. Therefore, will put a large amount of strain on the heart and cardiovascular system. In addition, when smoking chemicals enters the mouth and trachea, it irritates them, leaving burns to the cilia and alveoli. This means the alveoli lose the ability to take in air and diffuse gases into the bloodstream as effectively. Consequently, smoking has many inhibiting effects on the cardiovascular and respiratory systems, causing the body to be unhealthy.

An additional factor is high levels of stress or anxiety. This is part of an unhealthy lifestyle on the body because stress can result in a high blood pressure. This can lead to many coronary issues such as heart disease. It can also cause hypertension within the muscles, making the body uncomfortable and can result in damaging body tissue. As a result, stress has a lot of bad effects on the body's muscular and nervous system. These

effects of stress may also result in an individual choosing not to participate in sport, due to their inhibiting unhealthy body.

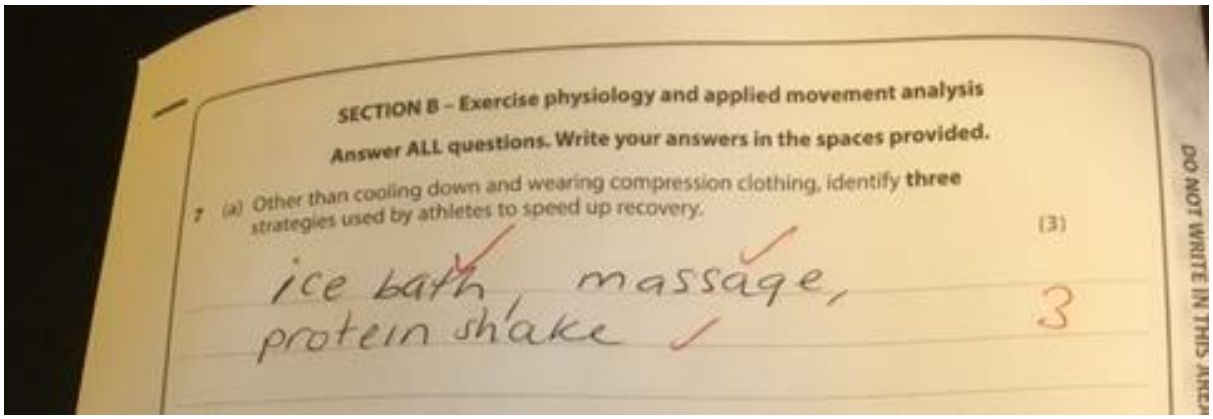
However, one last factor of an unhealthy lifestyle is the use of performance enhancing drugs, which can result in more positive effects. This is because PEDs such as anabolic steroids, peptide hormones and stimulants all have boosting effects upon the body. They can increase strength and recovery, increase red blood cell count to enhance the body's endurance and stimulate the body's nervous system. But on the other hand, even though these factors may have short-term enhancement on the body, they gradually can become negative effects. They can result in nausea, insomnia, heart attacks, strokes and hypertension. Consequently, all these side effects of PEDs lead to largely unhealthy impacts on the body and highlights deviance which could occur.

Overall, in conclusion, even though there is an element that PEDs may have a positive short term effect on the body, all the other factors including poor diet, smoking and stress, all have significantly negative impacts on the body's health. They can contribute to unhealthy damage in the body's systems such as cardiovascular system, respiratory system and nervous system. Consequently, leading to an unhealthy body.

Question 7a

Learners will need to be careful about repeating points when asked to identify a list of things. Many learners repeat points and would therefore not have scored maximum marks. This is a good example.

EXEMPLAR RESPONSE


SECTION B – Exercise physiology and applied movement analysis

Answer ALL questions. Write your answers in the spaces provided.

7 (a) Other than cooling down and wearing compression clothing, identify **three** strategies used by athletes to speed up recovery. (3)

ice bath, massage, protein shake

3

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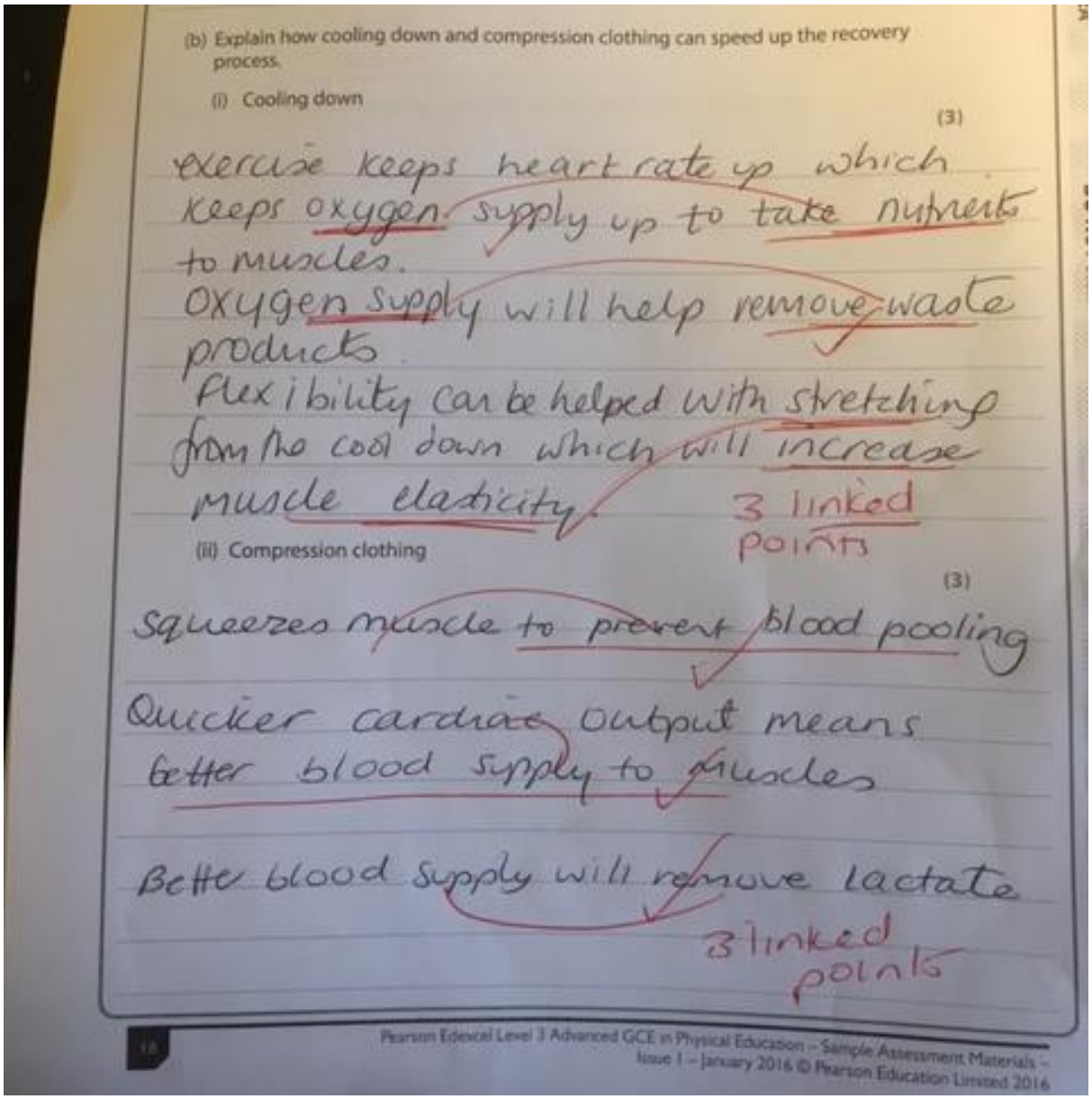
Question 7b

Learners had knowledge in isolation but were not able to support with linked statements to explain the reasoning. In this question they had to link points together to explain how the item can speed up the recovery. This is a good example demonstrating linked points

EXEMPLAR RESPONSE



(b) Explain how cooling down and compression clothing can speed up the recovery process.

(i) Cooling down

(3)

exercise keeps heart rate up which keeps oxygen supply up to take nutrients to muscles.
Oxygen supply will help remove waste products.
Flexibility can be helped with stretching from the cool down which will increase muscle elasticity.

3 linked points

(ii) Compression clothing

(3)

Squeezes muscle to prevent blood pooling

Quicker cardiac output means better blood supply to muscles

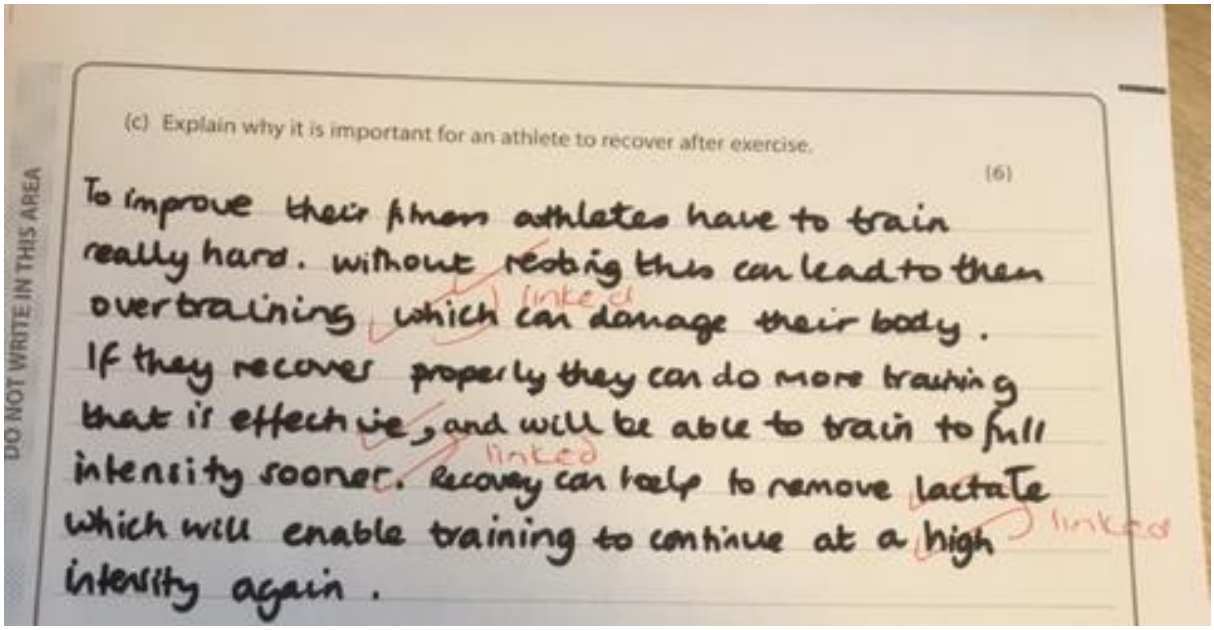
Better blood supply will remove lactate

3 linked points

Question 7c

Learners were only familiar with reducing the risk of injury as a reason for recovery after exercise. There are many reasons that will need to be expanded upon using both the specification and topic guides to support knowledge. As an explain question, this requires linked points.

EXEMPLAR RESPONSE



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(c) Explain why it is important for an athlete to recover after exercise.

(6)

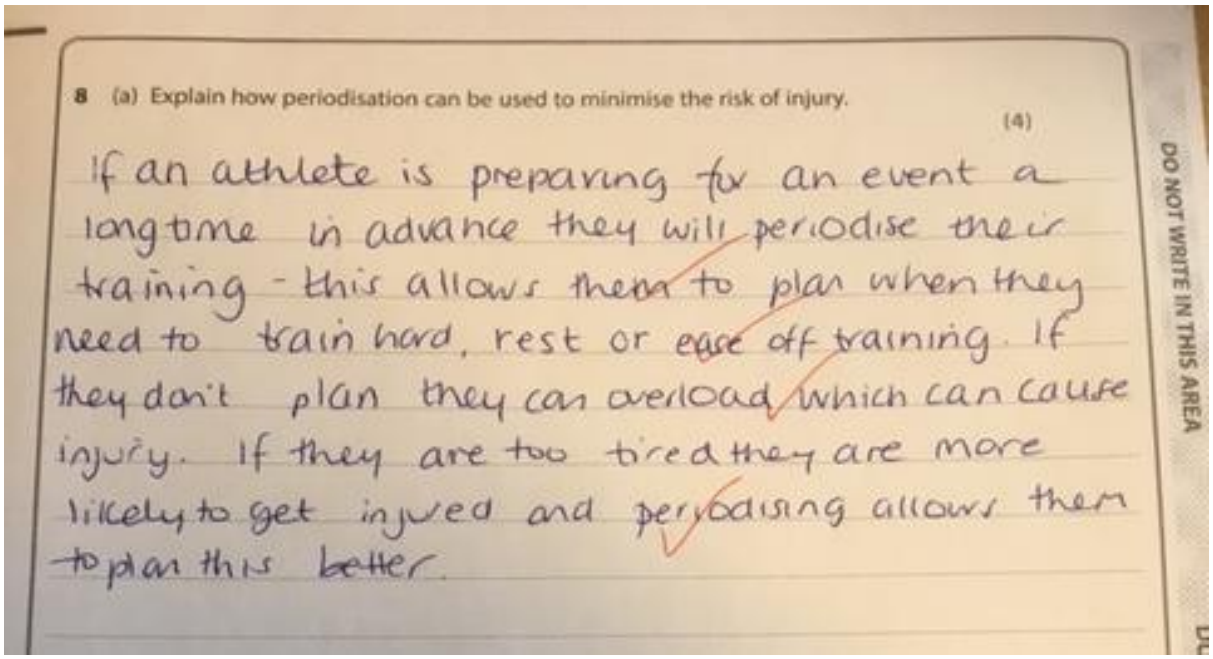
To improve their fitness athletes have to train really hard. without resting this can lead to them overtraining which can damage their body. linked

If they recover properly they can do more training that is effective, and will be able to train to full intensity sooner. linked recovery can help to remove lactate which will enable training to continue at a high intensity again. linked

Question 8a

Learners have some knowledge in isolation but are not always linking points together to provide linked reasoning which will be crucial for achieving higher marks in explain questions.

EXEMPLAR RESPONSE



8 (a) Explain how periodisation can be used to minimise the risk of injury.

(4)

If an athlete is preparing for an event a long time in advance they will periodise their training - this allows them to plan when they need to train hard, rest or ease off training. If they don't plan they can overload which can cause injury. If they are too tired they are more likely to get injured and periodising allows them to plan this better.

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Question 8b

The element that was difficult for learners in this question was the linking of the two elements together, linking periodisation to exercise intensity. It is important that learners read every element of the question and try to apply their understanding to the specific question that they have been asked. The response has a high level of accurate knowledge, covers a wide range of issues, and uses evaluation /analysis.

EXEMPLAR RESPONSE

Q08 (b) An athlete uses periodisation to plan their training programme.

Examine how technology used to measure exercise intensity can contribute to successful periodisation for the athlete.

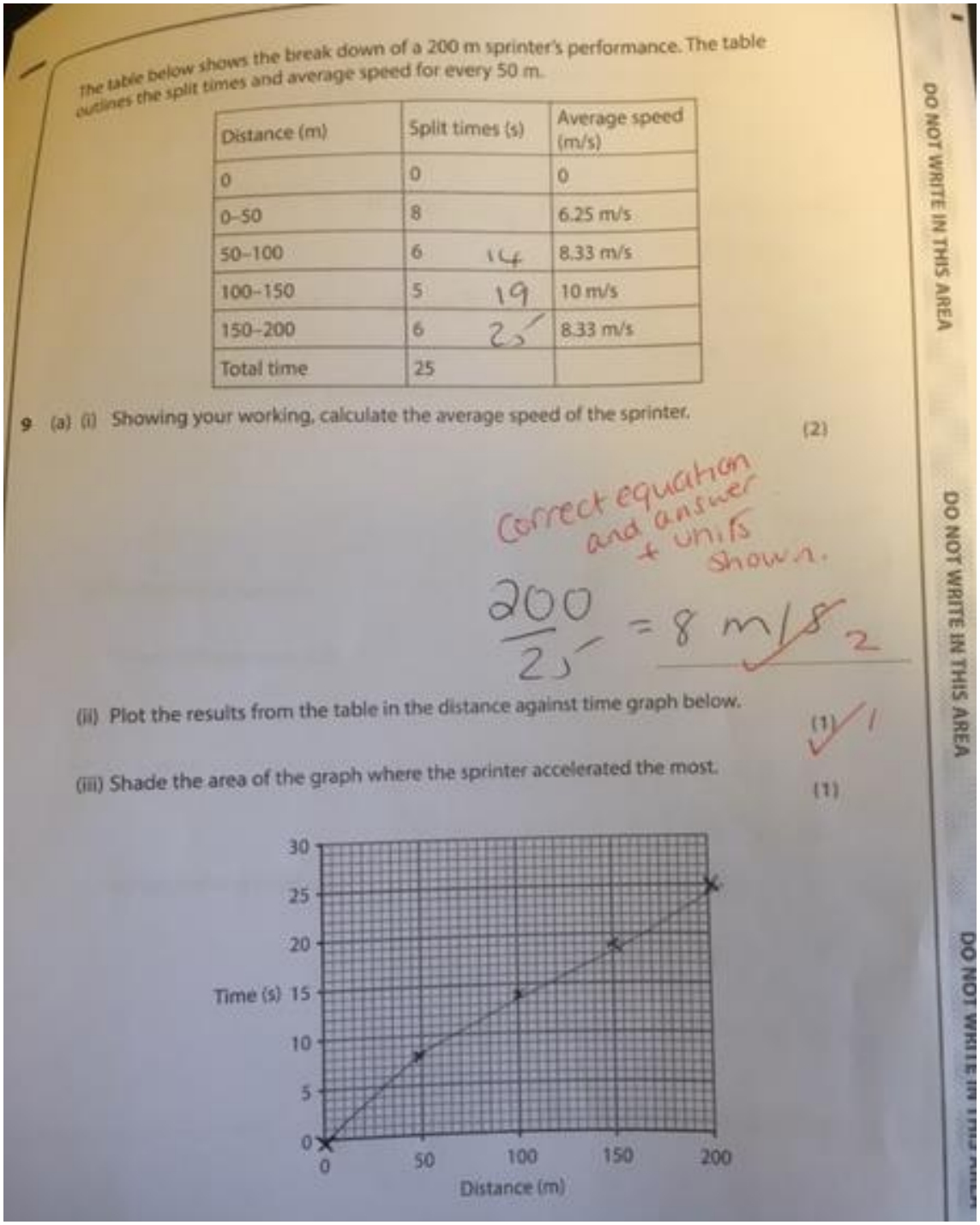
Periodisation means planning training over a period of time. Technology can be used to monitor exercise intensity which can help plan the periodisation. In different macrocycles different intensities of training will be needed. E.g. pre-season aerobic training focussing on VO2 max is needed. Heart rate monitors can help get this to the right intensity. However, there are problems with the functionality of this equipment – it can be unreliable at high intensity work. At later stages in the cycle an athlete may focus on power or speed in the run up to the competition phase. Power meters can be an example of technology used for this. However, they can be expensive or more suited to some sports. Apps and devices can also help with technology to guide intensity as they can show how hard you are training, what training has been done and can be loaded with an athlete's personal data.

Question 9a & 9b

Calculators will be needed in the exam and quantitative skills are an essential element of the paper. All learners knew the max HR-resting HR=HR reserve but not target heart rate. All learners could calculate heart rate reserve but not the lowest and highest training heart rate. In these questions showing full working out and correct units are important.

Shade is not a command word that will be utilised in the examination.

EXEMPLAR RESPONSE



The table below shows the break down of a 200 m sprinter's performance. The table outlines the split times and average speed for every 50 m.

Distance (m)	Split times (s)	Average speed (m/s)
0	0	0
0–50	8	6.25 m/s
50–100	6 (14)	8.33 m/s
100–150	5 (19)	10 m/s
150–200	6 (25)	8.33 m/s
Total time	25	

9 (a) (i) Showing your working, calculate the average speed of the sprinter. (2)

Correct equation and answer + units shown.

$\frac{200}{25} = 8\ m/s$ 2

(ii) Plot the results from the table in the distance against time graph below. (1) 1

(iii) Shade the area of the graph where the sprinter accelerated the most. (1)

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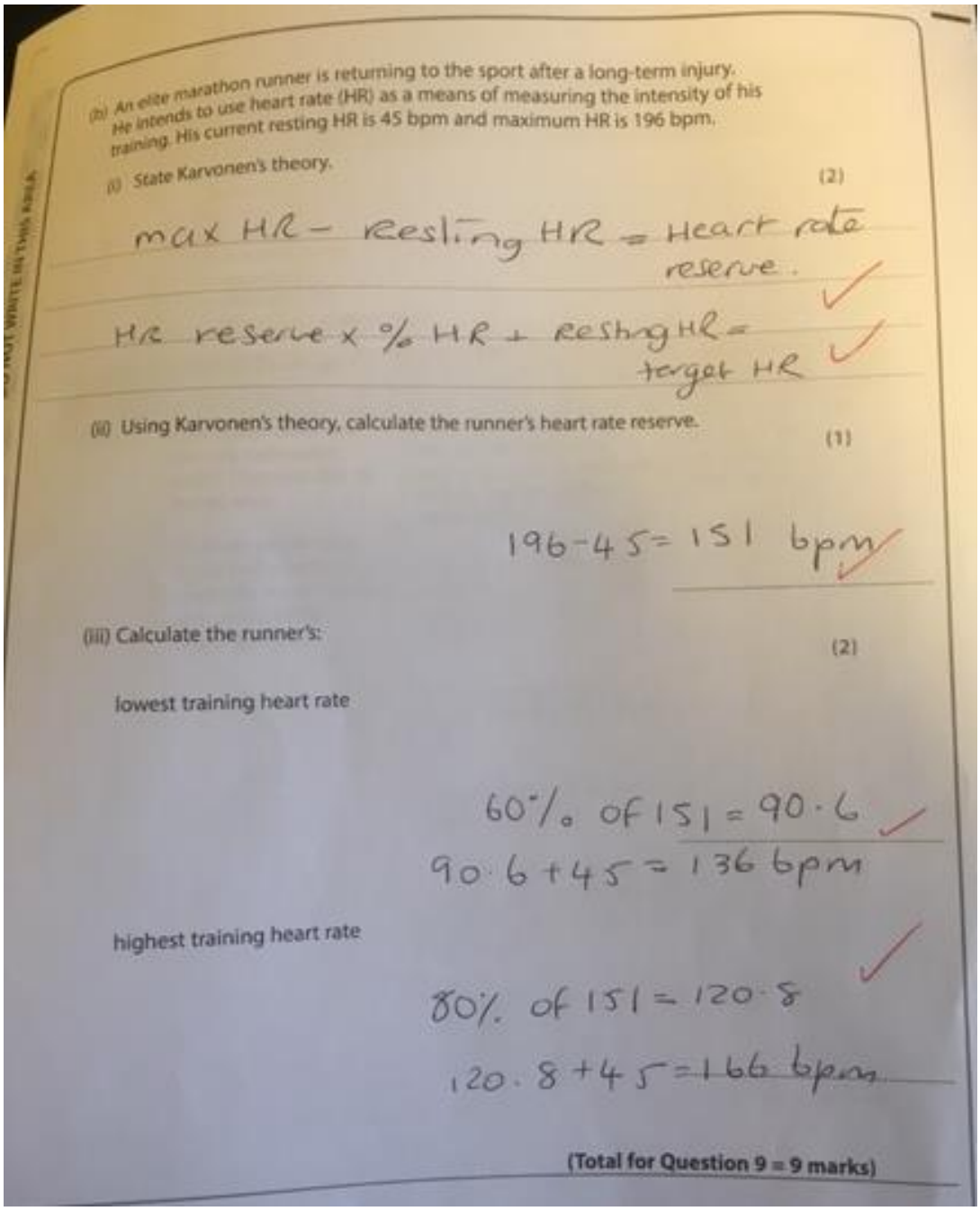


(b) An elite marathon runner is returning to the sport after a long-term injury. He intends to use heart rate (HR) as a means of measuring the intensity of his training. His current resting HR is 45 bpm and maximum HR is 196 bpm.

(i) State Karvonen's theory. (2)

max HR − Resting HR = Heart rate reserve. ✓

HR reserve × % HR + Resting HR = target HR ✓

(ii) Using Karvonen's theory, calculate the runner's heart rate reserve. (1)

196 − 45 = 151 bpm ✓

(iii) Calculate the runner's: (2)

lowest training heart rate

60% of 151 = 90.6 ✓

90.6 + 45 = 136 bpm

highest training heart rate

80% of 151 = 120.8 ✓

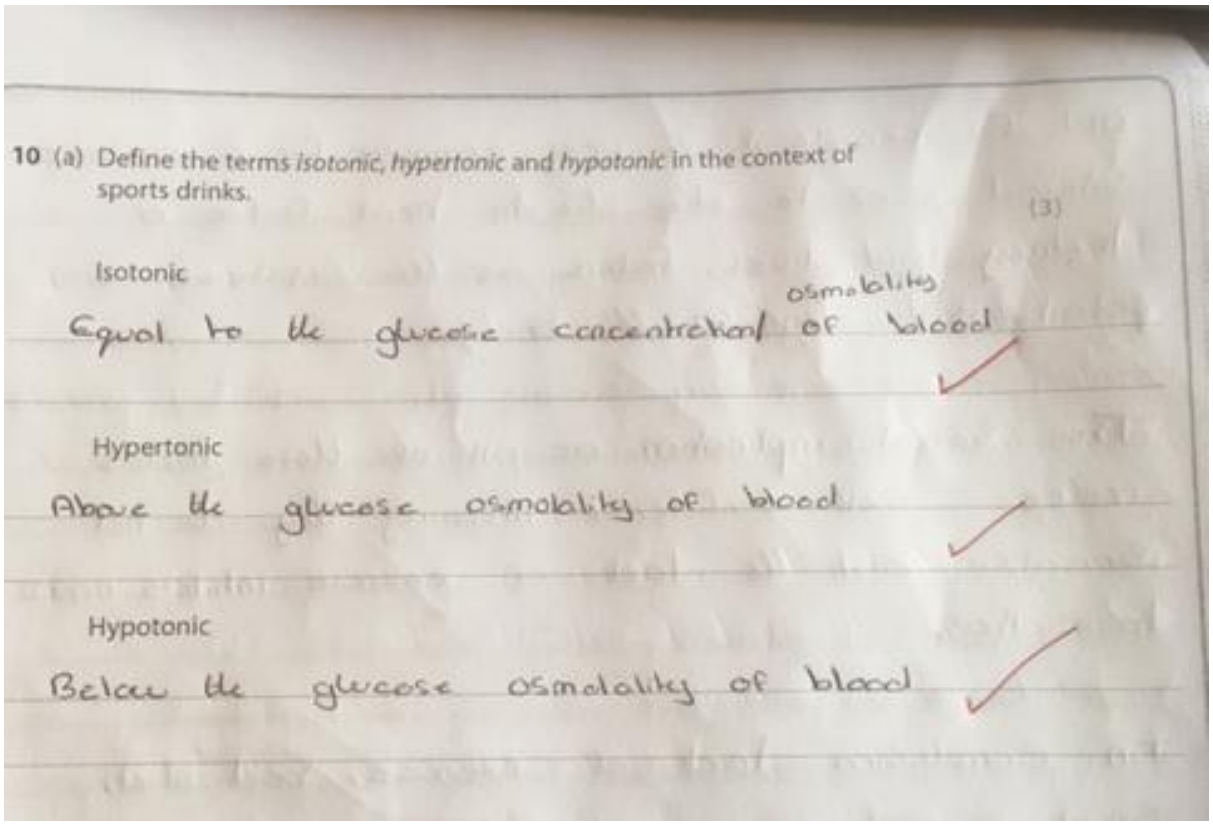
120.8 + 45 = 166 bpm

(Total for Question 9 = 9 marks)

Question 10a

These definitions are in the specification and therefore will need to be learnt as per the specification. This example shows that the wording is very similar and would be given credit.

EXEMPLAR RESPONSE



10 (a) Define the terms *isotonic*, *hypertonic* and *hypotonic* in the context of sports drinks.

(3)

Isotonic

Equal to the glucose concentration/ osmolality of blood ✓

Hypertonic

Above the glucose osmolality of blood ✓

Hypotonic

Below the glucose osmolality of blood ✓

Question 10b

Learners would need to apply their understanding of hypotonic drinks and then apply to practical examples. The example here shows that this candidate understands the theory and the effect on performance and would therefore score in the highest band.

EXEMPLAR RESPONSE

Q10 (b) Assess the merits of hypotonic drinks for a marathon runner.

Hypotonic drinks can be beneficial for a marathon runner. Firstly they are good for marathon runners because they contain low levels of glucose within them, so they can be absorbed into the bloodstream the fastest. Therefore, helping them to rehydrate easily before and during a race. They are also good as they rapidly replace fluids (and electrolytes) lost in their sweat which occurs during endurance activities. Therefore, preventing a decrease in performance. In addition, they are also good for lower intensity exercise as they can be easily absorbed into the bloodstream whilst being active. The increase in fluid in the bloodstream will increase distribution and diffusion at the blood to muscles around the runner's body, especially, leg muscles which are continuously contracting over a long period of time. However, hypotonic drinks contain lower levels of glycose, therefore they can't help the runner recover their glycogen stores after a race, in addition, they provide very little energy due to the low glycose levels.

Question 11

Learners need to be aware of POLICE and RICE but only the best learners have been able to distinguish between them in detail. This answer requires significant knowledge of links between theory and practise.

EXEMPLAR RESPONSE

Q11 Assess the use of POLICE rather than RICE as a rehabilitation strategy for sporting injuries sustained in a team game.

POLICE means Protection, Optimal loading, Compression and Elevation, whereas RICE means Rest, ICE, Compression and Elevation. The similar elements of ICE to help speed up healing, compression helps to reduce swelling and elevation helps to drain fluid out of the injury. POLICE includes extra elements of Protection and optimal loading. Optimal loading helps recovery by increasing the right amount of stress to help blood return to the injured body part. RICE may mean you lose fitness or get muscle atrophy which would possibly be of concern to athletes if they are totally resting. But POLICE could cause further damage if the optimal loading is not done carefully or if a muscle is torn and needs complete rest.

Question 12

The best learners could see that interval training could be valid for a marathon runner. Those scoring lower marks were not able to explain why it might be useful.

The example here shows excellent knowledge and shows sophisticated analysis supported with examples. It talks about why this type of training might be beneficial supported with examples from the race.

EXEMPLAR RESPONSE

Q12 Analyse whether interval training is a valid method of training for an elite marathon runner.

Internal training is a type of training characterised by period of alternating exercise and rest. This provides a versatile training method that enables a performer to alter it to their requirements. Interval training can have a variety of effects for a marathon runner but the validity could be questioned.

Interval training is a valid method for marathon runners. This is because the runner could use aerobic intervals which are characterised by a lower intensity effort (below 50% of maximum), with shorter recovery periods, for example a runner completing a one kilometre interval. As a result, this will facilitate an increase in the runner's aerobic capacity and VO2max indicating that interval training is a valid method for marathon runners.

It is also valid because the runner could use lactic acid intervals which are characterised by medium to high intensity effort (60 – 80% maximum effort), with varying recovery periods. Therefore, this will increase the runner's blood buffering capacity and lactate tolerance. This will help the runner work higher into their aerobic threshold and step into their anaerobic threshold at key points in a marathon such as taking over a competitor or pushing for the finish line. As a result, also highlighting that interval training is a valid method for a marathon runner.

It is additionally valid because the use of interval training and the higher intensity associated with it can help develop a marathon runner's cadence. This will result in an optimal cadence developing and help improve technical performance and power output over the course of a marathon .This consequently indicates it is a valid method.

However, on the other hand, the validity of this method for a marathon runner can be questioned. This is because when a runner is completing an interval session they may be working at an intensity which is too high (ATP-PC intervals). Therefore, they will be working in their anaerobic threshold which is not beneficial over the course of a marathon and will result in the build-up of lactic acid and OBLA. Consequently, this will inhibit the marathon runner's performance, showing that it is not a valid method training.

In addition, if a marathon runner is completing interval training at an intensity too high, they will be working other components of fitness. For example speed and agility, which are not beneficial to a marathon race. Unlike the components of cardiovascular and muscular endurance which they need to develop to enhance performance. As a result,

showing that interval training is not as valid to marathon runners as it develops unbeneficial components not required in a marathon race.

In conclusion, even though the validity of interval training may be questionable due to its results of working in an anaerobic threshold and developing undesirable component in ATP-PC system. It is mainly a valid method of training for marathon runners. This is because aerobic intervals can develop aerobic capacity, lactic acid intervals can increase lactate threshold and finally it can increase cadence. Consequently all these factors can contribute to an enhanced performance of a marathon runner, making interval training valid.

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