



Rewarding Learning

ADVANCED
General Certificate of Education
2016

**Sports Science and the
Active Leisure Industry**

Unit A2 2
assessing

**The Application of Science
to Sports Performance**

[A2LB1]

TUESDAY 24 MAY, MORNING

**MARK
SCHEME**

MARK SCHEMES

Foreword

Introduction

Mark Schemes are published to assist teachers and students in the preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

1 (a) Define cardiac output.

Cardiac Output

- The amount of blood pumped by the heart in 1 minute, measured in l/min.
- The amount of blood pumped out by the heart/left ventricle in one minute.
- Cardiac output is the product of stroke volume and heart rate = stroke volume (SE) × beats per minute (HR).

Award [1] for a brief definition and [2] for a full definition

All other valid points will be given credit.

(AO1) [2]

(b) (i) State the expected stroke volume for an elite athlete at rest.

- Stroke volume for an elite athlete at rest averages at 90–110 ml/beat.
Award [1] for the statement.

[1]

(ii) Explain the response of an elite athlete's stroke volume when exercise levels increase from rest to maximal effort.

Some suitable points to be explained by the candidate:

- An increase in stroke volume prior to start of exercise period, due to the release of hormones (adrenaline and noradrenaline).
- More blood is pumped out of ventricles.
- Increased venous return, increased myocardial contraction during ventricular systole.
- Stroke volume increases to maximal values during submaximal work. It does not increase further as work increases towards maximal effort. This is because the heart is already expanding and contracting to its fullest possible size.
- At this increased value, stroke volume is unable to increase any further.
- Stroke volume decreases at very high exercise intensity because heart rate is so high, there is not enough time for the ventricles to fill during diastolic phase or before systolic phase.

Award [1] for key phrase, [2] for an explanation and up to [3] for a full explanation.

All other valid points will be given credit.

(AO1, AO2) [3]

(c) Outline the **two** phases of the cardiac cycle during physical activity.

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Two phases in the cycle are: relaxation – diastolic 0.5 and contraction – systolic 0.3 secs

(i) Diastolic

- Right and left atria fill with blood and the atrioventricular valves are closed (mitral and tricuspid).
- Rising atrial pressure forces open the atrioventricular valves and the ventricles begin to fill.
- The semi-lunar valves to the aorta and pulmonary arteries are closed.

(ii) Systolic

- The SA node initiates an impulse causing a wave of contraction across the atrial myocardium, forcing the remaining blood out of the atria into the ventricles.
- Semi-lunar valves remain closed, atrioventricular valves close after the passage of blood.
- Impulse then reaches the AV node which then spreads a second contraction through the ventricle walls.
- Rising ventricular pressure forces open the semi-lunar valves to the lungs and systemic arteries (pulmonary artery and aorta)
- Once blood has left the heart and the contraction ceases the semi-lunar valves shut.

Award [1] for each phase outlined and up to [2] for a detailed outline.

All other valid points will be given credit.

(2 × [2])
(AO1)

[4]

10

- 2 (a) Explain **three** physiological responses that occur when an athlete performs a warm-up.

Some examples of suitable points to be explained by the candidate:

Warm-up

- Increase in heart rate and cardiac output.
- Increase in body temperature/localised muscle temperature/joints/synovial fluid.
- Better blood flow due to lower blood viscosity due to increased temperature.
- Capillaries dilate with oxygenated blood.
- Increase in blood pressure forces blood more quickly through arteries
- Increase in ventilation rates = > rate of CO₂ removal and O₂ intake.
- Secretion of adrenaline increases the metabolic rate – speeds up local muscular metabolism.
- Nerve impulse conduction increased muscle elasticity, decreased muscle viscosity.
- Greater speed and force of contraction due to a high speed of nerve transmission.
- Enhanced glycolic enzyme action.

Award up to [1] for a brief explanation and up to [2] for a full explanation. All other valid points will be given credit.

(3 × [2])
(AO2)

[6]

- (b) Describe **two** physiological adaptations that occur as a result of regular anaerobic training.

Some examples of suitable points to be described by the candidate:

- Increased lactic acid tolerance, body more efficient at utilising lactic acid
- Increased capacity to remove lactic acid.
- Increased maximal strength, increased power, increased speed.
- Increased elasticity of tendons/cartilage.
- Increased strength of ligaments.
- Increased strength of bones/tendons.
- Increase rate of muscle fibre recruitment, hyperplasia – increase in fast twitch Type II muscle fibres.
- Increased number of muscle fibre recruited.
- Increased speed of neural transmission.
- Increase of muscle cell stores of anaerobic enzymes.

Award [1] for each key phrase, up to [2] for a full description. All other valid points will be given credit.

(2 × [2])
(AO2)

[4]

- (c) (i) Identify the difference between a response and an adaptation.

Response: are changes that occur quickly and are temporary.

Adaptation: take longer to occur and are more permanent.

Award [1] for the identification of the key phrase.

(1 × [1])

(AO1)

[1]

- (ii) Describe **two** adaptations of the respiratory system in response to regular aerobic training.

Some examples of suitable points to be described by the candidate:

- Ventilation/breathing rate – breathing rates increase with higher intensity aerobic endurance training. This enables more O₂ to move in and CO₂ to move out enhancing gaseous exchange. Gas exchange – the exchange of O₂ and CO₂ improves. Aerobic fitness training tends to improve the efficiency of the body's tissues at absorbing O₂ and remaining CO₂.
- Lung capacity/volume – at sub-maximal workloads VO₂ will be less because of greater efficiency of oxygen uptake and general improvement in lung function will occur, e.g. Increase in tidal volume (TV) and vital capacity (VC) at the expense of residual volume.
- Respiratory Muscles – the strength and endurance of the diaphragm and intercostal muscles improves. This results in an improved ability to breathe in more oxygen for longer, with less fatigue.
- Capillarisation in the lungs – more capillaries are formed in the lungs over time allowing more blood to flow in and out. This improves the uptake of oxygen as there is a greater surface area of blood to bind with haemoglobin.
- Alveoli – the number of alveoli in the lungs increase to enable more gas exchange to occur.

Award up to [1] for key phrase, award [1] for a brief description and up to [2] for a full description.

All other valid points will be given credit.

(2 × [2])

(AO2)

[4]

15

3 (a) Identify **three** muscular adaptations that are likely to occur as a result of prolonged aerobic training.

- Increase the vascularisation of the muscle.
- Increase the myoglobin within the muscle.
- Increase the size and density of the mitochondria within the muscle.
- Increase in oxidative enzymes produced within mitochondria.
- Decrease the levels of subcutaneous fat deposited within the muscle.
- Increase the stores of muscle glycogen.
- Increase the efficiency at which fat can be metabolised and muscle glycogen stores conserved.
- Cardiac muscle hypertrophy, stronger heart/increases contractile force, less beats per minute, lowering resting heart rate.
- Increased elasticity in cardiac muscle fibres, helps avoid pressure building up in the atria. The heart can fill with more blood which can then be pumped around the body.

Award [1] for key phrase and up to [3] for the identification of three muscular adaptations.

All other valid points will be given credit.

(3 × [1])
(AO1)

[3]

(b) Explain the difference between the following joint actions during a recognised sporting movement.

Some examples of suitable points to be explained by the candidate:

(i) Flexion and Extension

- Flexion, decreasing the angle between the bones of a joint. For example bending the elbow during the upward phase of a bicep curl.
- Extension, increasing the angle between the bones of a joint up to 180 degrees. For example, straightening the elbow on the throwing phase when releasing the javelin.

(ii) Plantar Flexion and Dorsiflexion

- Plantar Flexion, the action of pointing toes, increasing the angle between the tibia and tarsals. This action is brought about through contraction of the gastrocnemius muscle. For example, the punt kicking phase in Gaelic football.
- Dorsiflexion, the action of pulling toes up to the shin, caused by tibialis anterior, found in the front of the lower leg. For example, during the recovery phase when running, as the athlete recovers the foot is bent as in dorsiflexion.

Award [1] for key phrase and up to [2] for full explanation.

All other valid points will be given credit.

(2 × [2])
(AO2)

[4]

- (c) Assess **three** positive and **three** negative effects of training on the skeletal system that a coach should be aware of when training young athletes.

The quality of written communication is assessed in this question.

Indicative content:

Positive effects a coach should be aware of:

- Increased bone density, strengthening the bones to prevent injury.
- Protects against stress fractures and helps to prevent sprains and dislocations occurring in young athletes.
- Increased calcium deposits in the bones.
- Weight bearing activities improve bone density.
- Increased stability of joints, strengthens ligaments, tendons and muscle around the joints.
- Increased muscle tone, improves posture.
- Greater ability to absorb shock, reducing the risk of injury.
- Prevention of hypokinetic diseases, osteoporosis, which reduces bone density and weakens the bones. This can affect young people during adolescence.

Negative effects a coach should be aware of:

This is possible if young athletes have experienced too much or too strenuous activity.

- Getting an injury can limit or stop a young athlete from participating in physical activity.
- Increased risk of overuse or chronic injury.
- Tendonitis from continuously training from a young age.
- Young athletes could develop shin splints or Osgood Schlatter's disease, preventing them from participating in physical activity.
- Increased damage to the articular cartilage which could lead to joint problems.
- Young female athletes could experience problems with hormone levels. Low estrogen production could result in delayed onset of menstruation, leading to stress fractures and low bone mineral density.

Coaches should be fully aware of the positive and negative effects of participating in physical activity. The positive effects of participating in sport outweigh the negative effects. The coach should design appropriate training sessions, allowing rest and recovery and give young athletes appropriate advice to minimise the risks of injury or long term damage.

All coaches should be encouraged to implement active prevention measures in their training programmes, therefore decreasing the injury and re-injury rate and enhancing athletic performance.

All other valid points will be given credit.

Level 1 ([1]–[3])**Overall impression: Basic**

- Basic knowledge and understanding of the positive and negative effects of training on the skeletal system of a young athlete. The candidate may provide a few positive or negative examples, with limited explanation.
- Demonstrates a basic ability to assess the positive and negative effects of training on the skeletal system of a young athlete. The candidate may provide limited examples related to the impact on the skeletal system of young athletes.
- Quality of written communication is basic. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([4]–[6])**Overall impression: Good**

- Good knowledge and understanding of the positive and negative effects of training on the skeletal system of a young athlete. The candidate may provide some positive and negative effects, with some explanation given.
- Demonstrates a good ability to assess the positive and negative effects of training a coach should be aware of when working with young athletes. The candidate will provide some relevant examples related to the impact on the skeletal system of young athletes.
- Quality of written communication is good. The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is appropriate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning evident.

Level 3 ([7]–[8])**Overall impression: Excellent**

- Excellent knowledge and understanding of the positive and negative effects of training on the skeletal system of a young athlete. The candidate will provide fully developed explanations of the positive and negative effects on the skeletal system.
- Demonstrates an excellent ability to assess the positive and negative effects of training a coach should be aware of when working with young athletes. The candidate will provide detailed examples related to the impact on the skeletal system of young athletes to an excellent level and elaborate with thorough explanation.
- Quality of written communication is excellent. The candidate successfully selects and uses an appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is an extensive and accurate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are of a high standard and ensure that the meaning is clear.

[0] is awarded for a response not worthy of credit.
(AO3)

[8]

15

- 4 (a) Identify and explain the effects of **three** types of transfer that may occur when learning and performing movement skills.

Some examples of suitable points to be examined by the candidate:

Transfer of learning means taking skills from one sport and attempting to use them in another. Such transfer of skills can be positive when knowledge of one skill helps the learning of another or negative when the transfer becomes a hindrance.

Retroactive transfer

- When a newly learned skill influences a previously learned skill.
- This is the opposite of proactive and occurs when current learning or practice of a skill is affecting a skill that was learned in the past.

Positive transfer

- Tends to occur when the skills have a similar shape or form, e.g. using an overarm throwing technique to help learn a tennis serve, or to throw a javelin.
- There must be similarity in the structure of the skill components.
- Positive transfer can be enhanced if these similar elements are shown to learners.

Negative transfer

- This is where the effects of the previously learned or practised skill impede the learning or performance of the new skill, e.g. the difference in throwing actions between a cricket return from the boundary (round arm) and a javelin throw (through the shoulder).
- Negative transfer can occur if the practice situation does not demand the same response as the playing or competitive situation.

Zero transfer

- This is when there is no effect on current performance or learning from previous learning.
- When two skills are so different that there is no chance of any correlation, e.g. rock climbing and swimming.

Bilateral transfer

- The transfer of learning or performance from one side of the body to the other, e.g. when a basketball player who can do a lay up with the right hand learns to do it with the left hand.

Award [1] for each type of transfer identified (3 × [1])

And up to [3] for an explanation of the effects of each type of transfer (3 × [3])

All other valid points will be given credit.

(AO1, AO2)

[12]

- (b) Discuss how a coach could use **three** motivational strategies to maintain an athlete's motivation throughout the season.

The quality of written communication is assessed in this question.

Indicative content

Definition

- Motivation may be defined as the biological, emotional, cognitive or social factors that activate and direct behaviour.
- Motivation is the direction and intensity of one's effort. Motivation can be intrinsic (coming from sources within the individual) or extrinsic (coming from external sources).

Motivation is a combination of both internal and external stimuli interaction and varying in the influence they have on the performer at any particular time.

Motivation can have a positive effect on a performer, winning provides a positive motive for further participation, this may last through the post-season and help the athlete prepare for the next season.

- Coaches' knowledge of players regarding what motivates them is useful when strategies need to be developed for individual athletes.
- Coaches encourage athletes to use a range of psychological methodologies to enhance motivation. These may include imagery techniques, mental rehearsal, self talk, cue utilisation, webs and wagons, progressive muscle relaxation techniques.
- Team selection and levels of performance may vary as the season progresses which will have an impact on the athlete's motivation.
- Personality factors can influence motivation, this may have shaped the performer's choice of sport and links to achievement motivation.
- The specific situation an athlete performs in will affect their decision to accept a challenge. Two determining situational factors are probability of success versus probability of failure. Incentive value of success versus incentive value of failure.
- Athletes may develop strategies to keep motivation levels high. Athletes have access to their coaches or other mentors when they feel their motivation levels are low.
- As a coach it is important to engage the athletes in strategies that steer them towards success and to avoid a tendency to fail. Feedback is a central feature of this process, and self-esteem is enhanced through positive reinforcement. The behaviour of the coach can seriously affect the behaviour of the athlete.
- Reviewing game footage, coaches could use this strategy so that athletes would be able to see what changes are needed in order to improve. This can also give the athletes an opportunity to discuss problems.
- Motivation is an essential component of successful sports performance.
- Motivation is a combination of personal characteristics and situational aspects, motivation is highest when the performer is keen to participate, keen to learn and perform. The training programme also needs to be interesting and varied. The coach could also use pep-talks to reinforce self-esteem.
- Goal setting – engaging the athlete, setting goals which are achievable and challenging. Performance review monitoring can be used by the coach to set goals and identify areas that need further work.
- The coach could encourage the athlete to use imagery before a competition to review strategy and technique and create a sense of confidence.

- Motivation can have a negative effect on a performer, losing can be demotivating, affecting the athlete's performance. Motivation will be high as the performer nears the start of the new season.
- Athletes could develop their own "playlists", power songs. The use of music is a strategy that is commonly used.

All other valid points will be given credit.

Level 1 ([1]–[4])

Overall impression: Basic

- Basic knowledge and understanding of how a coach would use motivational strategies to maintain an athlete's motivation throughout the season. The candidate may provide basic examples.
- Demonstrates a basic ability to discuss how a coach might use motivational strategies. Candidate will give basic explanations of these strategies relating to how a coach might use them to maintain an athlete's motivation throughout the season.
- Quality of written communication is basic. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([5]–[8])

Overall impression: Good

- Good knowledge and understanding of how a coach would use motivational strategies to maintain an athlete's motivation throughout the season. The candidate may provide some examples.
- Demonstrates a good ability to discuss how a coach might use motivational strategies. Candidate will provide some examples and explanations of these strategies relating to how a coach might use them to maintain an athlete's motivation throughout the season.
- Quality of written communication is good. The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is appropriate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning evident.

Level 3 ([9]–[12])

Overall impression: Excellent

- Excellent knowledge and understanding of how a coach would use motivational strategies to maintain an athlete's motivation throughout the season. The candidate will provide fully developed examples and show excellent understanding of each one.
- Demonstrates an excellent ability to discuss how a coach might use motivational strategies. Candidate will provide thorough explanation of these strategies to an excellent level and elaborate with thorough explanation.
- Quality of written communication is excellent. The candidate successfully selects and uses an appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is an extensive and accurate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are of a high standard and ensure that the meaning is clear.

[0] is awarded for a response not worthy of credit
(AO1, AO3)

[12]

24

- 5 (a) (i) Identify and describe an **illegal** method a power athlete might use to enhance performance.

Some examples of suitable points to be described by the candidate:

- Anabolic steroids – artificially produced male hormones which help to repair the body after periods of stress.
- TGH growth hormone, ephedrine, iodine, narcotics are substances known to be used by power athletes.
- Taking anabolic steroids will help the athlete to build muscle for explosive events.
- Some athletes' fear of 'not making it' makes taking drugs more appealing.
- Rewards and recognition are worth the risk.
- Pressure from coaches, media and self to be successful.
- Drugs are easily accessible.
- The physical strength and stamina of the athlete are increased to a large extent.
- Muscular hypertrophy.
- The body growth of the athlete can be increased quickly.
- The ability of the athlete to train harder and recover quicker from high intensity sessions is greater, enabling the athlete to get most out of their training.
- The recovery rate of any injury is increased.
- The athlete can feel positive and more confident.

Award [1] for the identification of the method and up to [3] for a full description.

All other valid points will be given credit.

[4]

- (ii) Explain **two** disadvantages of using this illegal method for a power athlete.

Disadvantages

- Increased aggression, mood swings "roid rage", depression, mania
- The risk of cardiovascular disease, heart failure, valve malfunctioning.
- Male athletes who take steroids regularly can suffer testicular atrophy, reduced sperm count, infertility, baldness and breast development.
- Female athletes who use steroids can suffer from growth of facial hair, unpredictable menstruation and deepening of the voice.
- High risk of getting Hepatitis B and C and HIV from infected needles.
- Risk of kidney diseases, liver diseases and cancer is also increased.
- Anabolic steroids may lead to increased blood clot formation, even when taken only short-term

Award [1] for each key phrase and up to [2] for full explanation.

All other valid points will be given credit.

(2 × [2])

(AO2)

[4]

- (b) Identify **two** types of technological equipment used by officials to assist with the decision-making process. Evaluate the use of technology by officials in sport.

The quality of written communication is assessed in this question.

Indicative content

Two types of equipment

- Hawkeye
- Goal line technology
- Snicko referral process

Advantages

- Many sports have moved towards using technology to apply laws consistently, it ensures correct decisions are made/it is a fair competition and there is less controversy and players are more confident in the decision making process.
- It helps officials communicate with each other, it is used to support the officials who are in the field of play and may require a second opinion.
- Less pressure on official to make the final judgement/less post-match criticism.
- Timing and measurement are more accurate.
- It becomes difficult to blame referee for playing 'favouritism' or being 'paid off' for certain games.
- Type of activity, better suited to 'start-stop' sports.
- 'Citing' foul play not seen by officials.

Disadvantages

- Specific technology used must be accurate and have a high level of reliability.
- Officials using technology can still be wrong and technology cannot be used for everything, subjective judgement is still needed.
- Officials are an integral part of the sporting contest, over reliance on technology could lead to a loss of respect of officials' decisions being final.
- Technology can change the nature of the sport. It can prolong the duration of the game, when the official is checking or querying decisions to be made.
- Artificial breaks in continuous activities – football harder to use as a result. The use of technology in some sports can slow down the speed of the game.
- When and how much to use, how far back can the official go.
- Some calls cannot be verified by the replay system 'too close to call' sports officials still have to rely on their own judgement.

All other valid points will be given credit.

Level 1 ([1]–[4])

Overall impression: Basic

- Basic knowledge and understanding of the increased use of technology used by officials and basic explanation given. The candidate may provide basic examples.
- Demonstrates a basic ability to evaluate how the increased use of technology is used by officials to assist them. The candidate will provide basic examples but does not evaluate the use of technology effectively.

- Quality of written communication is basic. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([5]–[8])**Overall impression: Good**

- Good knowledge and understanding of the increased use of technology and will provide relevant explanations, using specific examples.
- Demonstrates a good ability to evaluate how the increased use of technology is used by officials to assist them. The candidate will provide some examples and evaluates the use of technology by officials.
- Quality of written communication is good. The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is appropriate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning evident.

Level 3 ([9]–[12])**Overall impression: Excellent**

- Excellent knowledge and understanding of the increased use of technology and excellent explanations given. The candidate will provide fully developed examples and shows excellent understanding of the use of technology by officials.
- Demonstrates an excellent ability to evaluate how the increased use of technology is used by officials to assist them. The candidate will provide thorough explanation and will use a variety of relevant examples.
- Quality of written communication is excellent. The candidate successfully selects and uses an appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is an extensive and accurate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are of a high standard and ensure that the meaning is clear.

[0] is awarded for a response not worthy of credit.
(AO1, AO2, AO3)

[12]

- (c) Discuss the role of technology in the preparation of elite athletes in the 21st Century.

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The quality of written communication is assessed in this question.

Indicative content

- Technology used to monitor fitness levels/use of ICT in planning training programmes and tracking the athlete's progress throughout the training cycle. Athletes have the ability to peak at the right time. Internal – Monitoring athletes, using technology, e.g. heart rates/lactate linked to training thresholds. External – force and acceleration measurements.
- Use of technology to alter training environment, e.g. hypoxic chambers, to get the altitude effects of training/live low, train high.
- Use of ergogenic aids, athletes can compliment their training by consuming and using a range of supplements and ergogenic aids to optimise their performance to gain a winning edge or to aid the recovery/injury process.
- Use of technology to develop equipment and clothing. It needs to be user friendly and include valuable properties, e.g. strength, flexibility, toughness and resistance to moisture. Footwear is generally chosen more for comfort and injury avoidance rather than performance enhancement. Clothing, e.g. full body suits used in cycling may be justified where winning or losing is measured in hundredths of a second.
- Enhances athlete's rehabilitation from injury, e.g. anti-gravity treadmill, smart shirts used to monitor sweat rate, hydration status and distance covered, ice vests and compression vests, clothing used to assist with thermoregulation.
- Use of technology to monitor, evaluate and review performance, e.g. prozone, Dartfish, Stat sports.
- Technological advances in facilities have had an impact on some team sports, e.g. 3G/4G pitches which have speeded up the game.
- Prosthetics have been made for athletes with a specific disability. Wheelchair devices used in sporting activities have become more sophisticated.
- Working on the perfect technical mode, using technologies such as smart equipment, force plates, wind tunnel vision, and GPS to improve and enhance performance. The use of motion capture analysis, which involves digitally recording on cameras, providing athletes and coaching staff information to use to analyse the performance of the athlete.
- It is not an 'even playing field'. It can be seen as an unfair advantage for those that can afford it, e.g. the trained staff, the advanced equipment. It can be very expensive, depending on the wealth of the player, sponsorship deals/developing countries, sports suffers, no investment. For some athletes, they do not have access to the high tech equipment or specialist coaching, as it is not equally available to all.
- Technology advances could lead to increased injury or violence/shorter careers, e.g. use of shoulder pads, ergogenic aids, making players bigger, fitter and more powerful.
- More emphasis is now placed on statistics in sport planning and preparation, some argue that it is losing some of the spontaneity in sport and natural talent. Some sport technology has raised questions on the validity of results, e.g. shark suits, which have been banned in swimming competitions.

All other valid points will be given credit.

Level 1 ([1]–[5])**Overall impression: Basic**

- Basic knowledge and understanding of the role that technology has on the preparation of elite athletes in the 21st Century. The candidate may provide basic examples.
- Demonstrates a basic ability to discuss the role that technology has on the preparation of elite athletes. Candidate will provide basic explanations for the use of technology.
- Quality of written communication is basic. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 ([6]–[11])**Overall impression: Good**

- Good knowledge and understanding of the role that technology has on the preparation of elite athletes in the 21st Century. The candidate will give some relevant examples.
- Demonstrates a good ability to discuss the role that technology has on the preparation of elite athletes. The candidate will provide some explanations for the use of technology.
- Quality of written communication is good. The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is appropriate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning evident.

Level 3 ([12]–[16])**Overall impression: Excellent**

- Excellent knowledge and understanding of the role that technology has on the preparation of elite athletes in the 21st Century. The candidate will provide fully developed examples and show excellent understanding of each one.
- Demonstrates an excellent ability to discuss the role that technology has on the preparation of elite athletes. The candidate will be able to discuss to an excellent level the impact of technology and elaborate with thorough explanation.
- Quality of written communication is excellent. The candidate successfully selects and uses an appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is an extensive and accurate use of specialist vocabulary. Presentation, spelling, punctuation and grammar are of a high standard and ensure that the meaning is clear.

[0] is awarded for a response not worthy of credit.
(AO3)

[16]

36

Total**100**AVAILABLE
MARKS