



Rewarding Learning

**ADVANCED
General Certificate of Education**

**Sports Science and the
Active Leisure Industry**

Unit A2 2

The Application of Science
to Sports Performance

[AAL21]

Assessment

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are intended to ensure that the GCE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives

Below are the assessment objectives for GCE Sports Science and the Active Leisure Industry.

Candidates must:

demonstrate knowledge and understanding of sports science and the active leisure industry (AO1);
apply knowledge, understanding and skills through different contexts appropriate to the sports science and the active leisure industry (AO2); and
analyse and evaluate evidence to make reasoned and valid judgements about sports science and the active leisure industry (AO3).

Quality of candidates' responses

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17-year-old or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

Flexibility in marking

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 17-year-old or 18-year-old GCE candidate.

Awarding zero marks

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark schemes

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response

Tasks and questions requiring candidates to respond in extended writing are marked in terms of levels of response. In deciding which level of response to award, examiners should look for 'best fit' bearing in mind that weakness in one area may be compensated by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response. An example follows:

Level 1: Quality of written communication is basic.

Level 2: Quality of written communication is good.

Level 3: Quality of written communication is excellent.

In interpreting these level descriptions, an example is provided below. Examiners should refer to the specific guidance given within the mark scheme for each question:

Band 1 (Basic): The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material will lack clarity and coherence. There is little use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Band 2 (Good): The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Band 3 (Excellent): The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.

- 1 (a) (i) Some examples of suitable points to be explained by the candidate:
- The automatic opening up of blood vessels (arterioles) to active muscle tissue and the constriction of blood vessels to non-active tissue as a response to an increase in exercise.
 - Vascular shunting refers to the distribution of blood around the body.
 - During exercise the blood is redistributed to the muscles – away from the organs (stomach, kidneys, liver) where the majority of the blood is at rest.

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

All other valid points will be given credit.

(AO1)

[2]

- (ii) Some examples of suitable points to be identified by the candidate:
- Vasomotor control diverts blood to the skeletal muscle tissue where it is needed.
 - Vasomotor centre stimulates nerves in the muscle walls of arteries/arterioles resulting in:
 - Vasoconstriction of blood vessels; reduces blood flow to non-active tissue.
 - Vasodilation of blood vessels; increases blood flow to active skeletal muscle.
 - Vascular shunting aids performance by increasing blood flow to working muscles. Oxygen facilitates energy production and the performer can work for longer.

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

All other valid points will be given credit.

(AO2)

[2]

- (b) Some examples of suitable points to be identified by the candidate:
- Systolic blood pressure increases as exercise intensity increases from 120 mmHg (at rest) up to 240 mmHg (at maximal levels). Large increase in activities involving isometric muscular contractions or maximal intensity.
 - Systolic blood pressure can decrease (slightly) during prolonged exercise.
 - Diastolic blood pressure has little or no change during submaximal exercise. May decrease during gross muscle activities (e.g. rowing).
 - Diastolic blood pressure decreases in trained performers.
 - Diastolic blood pressure increases during maximal intensity exercise or in activities involving isometric muscular contractions.
 - Age, anxiety/stress, caffeine consumption, medical conditions (obesity, CHD) and environmental factors (heat, humidity) may affect systolic blood pressure.

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

All other valid points will be given credit.

(2 × [2])

(AO2)

[4]

- (c) Some examples of suitable points to be identified by the candidate:
- Breathing rate increases, 12–16 at rest to 60–70 during high intensity training session.
 - Depth of breathing, and tidal volume, increases.

- Minute ventilation increases as a result of tidal volume and respiratory rate increases due to exercise. $VE = TV \times f$.
- Respiratory muscles controlling inspiration and expiration work harder, (diaphragm, intercostal, scalenes, sternocleidomastoid).
- Increase in CO_2 production, hydrogen ions (H^+) and body and blood temperatures stimulate further increases in pulmonary ventilation.
- Pulmonary ventilation (V.E.) may increase from around 10 litres per minute to over 100 litres per minute.
- Rapid rise of V.E. on exercise beginning. This is due to proprioceptor sensory stimulation, and also due to continued release of hormones.
- During high intensity workloads there is a continued slower increase in V.E. as anaerobic systems are stressed. This produces lactic acid + $CO_2 + K^+$, which stimulate chemoreceptors at maximal level. The main stimulant for increased rates of ventilation is the presence of carbon dioxide in the blood flowing past chemoreceptors.
- As exercise ends, there is a rapid decline in V.E. due to cessation of proprioceptive stimuli and the withdrawal of hormones, then a levelling out to pre-exercise values.
- Gaseous exchange rates increase to deliver oxygen to the working muscle and remove CO_2 and lactic acid.

Award [1] for each response outlined.
All other valid points will be given credit.
(4 × [1])
(AO1)

[4]

12

2 (a) Some examples of suitable points to be identified by the candidate:

A learning plateau is when improvement in performance seems to have stopped. Causes include:

- Psychological factors – stress, motivation, boredom, emotional.
- Physical factors – inadequate/inappropriate training methods, overtraining.
- Technique factors – changes in technique, coaching, equipment.

Methods to overcome learning plateaus:

- A coach could provide positive feedback and visual guidance.
- The use of extrinsic rewards and plenty of encouragement to keep the athlete engaged.
- Using different methods of training or teaching skills, breaking the skill down, use of whole–part–whole method.
- Use of visualisation/mental imagery to keep the athlete focused and on task.
- Vary sessions, training programme to avoid boredom and incorporate appropriate rest and recovery – avoid mental/physical fatigue.
- Explain to the performer that the learning plateau is a normal part of the learning process.
- The coach makes sure to plan appropriate goals to ensure continued progress.
- Ensure the learner is physically ready for the next step.
- Selection of appropriate input/cues – selective attention.

Award [1] for each cause identified and up to [2] for the full explanation of methods.

All other valid points will be given credit.
(2 × [3])
(AO1, AO2)

[6]

(b) Some examples of suitable points to be identified by the candidate:

(i) Cognitive Stage

- Command and practice style allows control and safety;
- Demonstrations/highlight important cues, visual and manual guidance;
- Use of motivation/rewards/reinforcement to encourage the learner;
- Simple feedback, performers must be able to understand terminology used;
- Avoid overload, physically and mentally, performer must have the ability, skill and fitness to perform effectively;
- Knowledge of results important, learner focuses on the skill not external factors.

(ii) Associative Stage

- Practice, reciprocal, discovery methods allow learner to take some responsibility for their own performance;
- Feedback more specific as the learner's knowledge, understanding and ability develop;
- Kinaesthetic 'feel' for successful outcomes, knowledge of performance to achieve successful outcomes/knowledge of result;
- Visual and verbal guidance to highlight strengths and weaknesses;
- Feedback more detailed, performers understand the activity/terminology better;
- Learner starts to focus on external factors not just the 'closed' skill.

(iii) Autonomous Stage

- Concentration on external demands rather than the skill itself;
- Self analysis and ability to interpret internal and external feedback developed/detailed discussion on finer points;
- Goal setting;
- Detailed verbal guidance/feedback can be given as performer has high degree of knowledge and understanding of performance;
- Problem solving approach can be used due to ability of the performer.

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

(3 × [2])
(AO2)

[6]

12

3 (a) Some examples of suitable points to be identified by the candidate:

Sports Clothing:

- Improvement in design and manufacturing of clothing for sport. Availability and variety of sports clothing offering a wide range to suit various sports.
- Developments enhance the athlete's performance as a result of specific features, e.g. Smart shirts, skins, speed suits. Clothing is more streamlined, comfortable, breathable, waterproof and prevents/aids heat loss.
- Footwear is constantly being improved (lighter, cushioned impact, support, sport specific).

Equipment and Design:

- New materials have contributed to advances in sport, e.g. super light strong metals in bikes and tennis racquets, the use of fibreglass in cricket bats.

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- Improvements make it safer in some sports, e.g. better landing mats used in pole vaulting, high jump and gymnastics. Helmets in cycling, lighter but designed to higher safety specification.
- CAD technology has led to improvements in design (aerodynamics) and electronic advances to finer and easier controls.
- Video, GPS, HRM, Power meters allow detailed analysis of individual and team performance (fitness, quality of movement, tactical).

Physiological Aids:

- Nutrition/hydration/supplements, allow athletes to perform at higher intensities for longer periods of time. Creatine aids recovery/increases in strength. Caffeine may improve performance in endurance events. Isotonic/energy drinks.

Award [1] for each ergogenic aid identified and up to [2] for the full explanation.

All other valid points will be given credit.

(2 × [2])

(AO1, AO2)

[4]

(b) Some examples of suitable points to be identified by the candidate:

The consequences of being found guilty could end sporting careers, damage reputations and affect future prospects both in and out of sport.

The sanctions for an anti-doping violation can include:

- Disqualification of results at an event, including forfeiture of medals/ prize money (this can be retrospective so medals/titles won previously can be taken away).
- A ban from all sport (competing, training or coaching) for up to four years or even life in repeat or the most serious cases.
- Financial penalties (loss of sponsorship, wages).
- Media attention that can result in permanent damage to reputations.
- May affect the athlete's emotional and psychological well-being (guilt, depression).
- Violations can place pressure not just on the athlete but others close to him/her, friends, partners and family, these consequences are often the most difficult for athlete to deal with.
- May reflect on the 'honesty' of the rest of the team or sport and have a monetary effect.

Award [1] for a key phrase and up to [2] for the full description.

All other valid points will be given credit.

(2 × [2])

(AO2)

[4]

(c) The quality of written communication is assessed in this question.

Indicative content:

Disadvantages

- Cost and availability, not all sports or teams can afford the required technology.
- The technology used must be accurate and have a high level of reliability.
- Officials using technology can still be wrong and technology is not/ cannot be used for every sport.
- Subjective judgement is still needed, 'soft' signals or 'on-field' decisions can affect outcomes (umpire's call in lbw review).

- Some decisions can be ‘too close to call’ and cannot be verified by the replay system.
- Sports officials still have to rely on their own judgement. Officials are an integral part of the sporting contest, over reliance on technology could lead to a loss of respect of officials’ decisions.
- Replays of an ‘incorrect’ decision may affect the mental state of the officials, players or spectators.
- Replays can be seen by players/spectators, increasing the pressure on officials and allowing decisions to be questioned.
- Officials are required to carry or wear extra equipment.
- 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 view 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.

Advances associated with technology

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 the 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.

Level 1 ([1]–[3])

Overall impression: Basic

- Basic knowledge and understanding of the disadvantages of the use of technology in officiating sporting events. The candidate may simply list basic examples.
- Demonstrates a basic ability to analyse the disadvantages of the use of technology in officiating sporting events. Candidates will give some explanation, with limited evaluation.
- 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 the intended meaning is not clear.

Level 2 ([4]–[6])

Overall impression: Good

- Good knowledge and understanding of the disadvantages of the use of technology in officiating sporting events. The candidate may simply list relevant examples.
- Demonstrates a good ability to analyse the disadvantages of the use of technology in officiating sporting events. Candidates will give relevant explanations.
- 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 the meaning evident.

Level 3 ([7]–[8])

Overall impression: Excellent

- Excellent knowledge and understanding of the disadvantages of the use of technology in officiating sporting events. The candidate will include fully developed examples and show excellent understanding of each one.
- Demonstrates an excellent ability to analyse the disadvantages of the use of technology in officiating sporting events. The candidate will be able to discuss the adaptations to an excellent level and elaborated using 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)

[8]

16

4 (a) Muscular system

Structural adaptations:

- Increased vascularisation of muscle tissue.
- Increased myoglobin, mitochondria and glycogen content in the muscle.
- Muscle hypertrophy of type IIa and IIb fibres.

Functional benefits:

- Increased endurance of specific muscle groups and greater efficiency utilising oxygen.
- Increased maximal and dynamic strength and lean muscle mass.
- Ability to work faster/harder in explosive events or longer in endurance events.

Skeletal system

Structural adaptations:

- Increased thickness of ligaments and tendons
- Development of new stress layers in the supporting bones.

Functional benefits:

- Increased strength of bones and ligaments.
- Increased elasticity of tendons.
- More resistant to injury.

Cardiovascular system

Structural adaptations:

- Increased vascularisation (capillaries, alveoli) and red blood cell count.
- Cardiac hypertrophy, increased thickness of ventricular myocardium.
- Increased blood volume and haemoglobin levels.

Functional benefits:

- Bradycardia, increased stroke volume, maximal cardiac output and end diastolic volume; decreased end systolic volume.
- Increased VO_2 max, efficiency of cardiac and respiratory muscles.
- Increased capacity to tolerate and remove lactic acid.
- Ability to work faster/harder for longer.

Award [1] for the identification of each structural adaptation and up to [3] for the full explanation.

All other valid points will be given credit.

(3 × [4])

(AO1, AO2)

[12]

- (b) (i) Some examples of suitable points to be identified by the candidate:
- White colour with a large fibre diameter
 - Fast forceful contractions (fast twitch), suitable for high intensity explosive activities. 300–800 fibres per motor unit.
 - Low density levels of mitochondria, myoglobin and capillaries.
 - Rely on anaerobic respiration and fatigue rapidly, alactic nature.
 - High level of glycogen storage.
 - Low oxidative enzyme activity and ability to generate ATP.

Award [1] for each characteristic identified.

All other valid points will be given credit.

(AO1)

[2]

(ii) **The quality of written communication is assessed in this question.**

Indicative content:

- Altitude is the measurement of elevation, altitude training takes place around 2000m/8000 feet above sea level.
- Atmospheric pressure decreases as altitude increases. This has significant implications for athletes because a fall in partial pressure can lead to a shortage of oxygen (hypoxia).
- Spending time at altitude (or hypoxic environments) results in physiological adaptations that may enhance the performance of endurance athletes.
- LHTL
- Use of hypoxic tents/chambers.
- Increased production of erythropoietin/EPO/hEPO naturally.
- Increased number and concentration of red blood cells (haematocrit). Illegal use of blood doping has similar effect.
- Increased concentration of haemoglobin and myoglobin.
- Increased mitochondria and capillarisation.
- Enhanced oxygen transport to overcome oxygen debt.
- Increased tolerance to lactic acid/delayed OBLA.
- Breathing rates increase.

All other valid points will be given credit.

Level 1 ([1]–[3])

Overall impression: Basic

- Basic knowledge and understanding of the use of altitude training as a method to improve performance in sporting events. The candidate may simply list basic examples.
- Demonstrates a basic ability to analyse how adaptations due to a period of altitude training may enhance sporting performance. Candidates will give some explanation, with limited evaluation.
- 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 the intended meaning is not clear.

Level 2 ([4]–[7])

Overall impression: Good

- Good knowledge and understanding of the use of altitude training as a method to improve performance in sporting events. The candidate may simply list relevant examples.
- Demonstrates a good ability to analyse how adaptations due to a period of altitude training may enhance sporting performance. The candidate will give relevant explanations.
- 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 the meaning evident.

Level 3 ([8]–[10])

Overall impression: Excellent

- Excellent knowledge and understanding of altitude training as a method to improve performance in sporting events. The candidate will include fully developed examples and show excellent understanding of each one.
- Demonstrates an excellent ability to analyse how the adaptations due to a period of altitude training may enhance sporting performance. The candidate will be able to discuss the adaptations to an excellent level and elaborated using 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)

[10]

24

5 (a) Some examples of suitable points to be identified by the candidate:

Hinge Joint:

- Elbow, knee and ankle.
- Allow movement in one direction through flexion and extension.
- Ankle plantar flexion (toes pointed) or dorsiflexion (toes point upwards).
- Sporting applications:
 - Bicep curl:
 - flexion on the upward phase controlled by the contraction of the biceps
 - extension on the downward phase contraction of the triceps.
 - Kicking a football:
 - flexion on withdrawal controlled by the contraction of the hamstring
 - extension on kicking phase controlled by the quadriceps.

Pivot Joint:

- Neck, between the axis and atlas or radio-ulnar joint in the upper forearm.
- Allows rotational movement.
- Sporting applications:
 - Swimming:
 - turning the head when breathing in front crawl.

Condyloid:

- Wrist, allows flexion and extension along two axes.
- Sporting applications:
 - Flick serve in badminton or top spin backhand in table tennis.
 - Wrist spin in cricket.

Award [1] for the identification of joint and up to [3] for the full description.
All other valid points will be given credit.

(2 × [4])

(AO1, AO2)

[8]

(b) The quality of written communication is assessed in this question.

Indicative content:

Coaches need to be fully aware of the positive and negative effects of exercise on the skeletal system. The positives outweigh the negatives.

Positive effects the coach should be aware of:

- Increased bone density, strengthens bones to prevent injury.
- Increased stability of joints to prevent dislocations through strengthened ligaments, tendons and muscle.
- Greater ability to absorb shocks when landing or falling.
- Increased bone density and calcium deposits in the bones help to prevent stress fractures.
- Increased muscle tone improves posture.
- Prevention of hypokinetic diseases, e.g. osteoporosis.

Negative effects the coach should be aware of:

- Young athletes may suffer from overuse injuries due to too much activity of the wrong type, e.g. Osgood Schlatter's disease or shin splints.
- Increased chance of damage to the articular cartilage.
- Young female athletes may experience problems with hormonal levels. Low estrogen production decreases bone density and could delay the onset of menstruation.

Coaches must design training programmes which:

- Minimise the risk of injury or long term damage to the young athlete.
- Allow appropriate time for rest and recovery.
- Apply appropriate progression and overload.
- Concentrate on teaching technique first before adding resistance.
- Insist on proper warm-ups and cool-downs.
- Ensure all equipment used is appropriate to the age and ability of the young athlete.

All other points will be given credit.

Level 1 ([1]–[4])

Overall impression: Basic

- Basic knowledge and understanding of the effects on the skeletal system a coach should be aware of when working with young athletes. The candidate may simply list basic examples.
- Demonstrates a basic ability to analyse the effects on the skeletal system a coach should be aware of when working with young athletes. Candidates will give some explanation with limited evaluation.
- 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 the intended meaning is not clear.

Level 2 ([5]–[8])

Overall impression: Good

- Good knowledge and understanding of the effects on the skeletal system a coach should be aware of when working with young athletes. The candidate may simply list relevant examples.
- Demonstrates a good ability to analyse the effects on the skeletal system a coach should be aware of when working with young athletes. The candidate will give relevant explanations.
- 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 the meaning evident.

Level 3 ([9]–[12])

Overall impression: Excellent

- Excellent knowledge and understanding of the effects on the skeletal system a coach should be aware of when working with young athletes. The candidate will include fully developed examples and show excellent understanding.
- Demonstrates an excellent ability to analyse the effects on the skeletal system a coach should be aware of when working with young athletes. The candidate will be able to discuss the effects on the skeletal system of the young athlete to an excellent level and elaborated using 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)

[12]

(c) The quality of written communication is assessed in this question.

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Indicative content:

Three areas: Physiology, Psychology and Technology.

Physiology:

- Physiologists, podiatrists, fitness coaches, strength and conditioning coaches analyse activities and the fitness/energy demands involved.
- Heart rate monitoring, VO₂ max measurement, GPS, Pro Zone, Dartfish, gait analysis are all used to analyse performance and develop training programmes.
- Physiotherapists, sports massage, sports therapists look after the preparation and rehabilitation of athletes.
- Nutrition specialists design athlete specific nutrition/hydration strategies to allow maximum performance, especially important for endurance athletes.

Psychology:

- Sports psychologists work to improve visualisation, confidence, motivation.
- Goal setting for training phases and competition.
- Individual and team performance profiling, team dynamics and team bonding strategies.

Technology:

- Biomechanics and movement analysis.
- Developments in clothing and equipment to improve performance (aerodynamics, compression clothing, materials such as carbon fibre, titanium).
- Performance analysis methods (heart rate monitoring, VO₂ max measurement, GPS, Pro Zone, Dartfish, gait analysis are all used to analyse performance and develop training programmes).

Sport is not a level playing field, many of these scientific developments are only available to 'rich' nations.

'Nature or nurture' argument, is it the ability of the athlete or the ability/availability of sports science that determines the result?

How to use the scientific developments is vital to maximise performance and avoid injuries or other sanctions (accidental use of banned substances).

Application through the use of relevant sporting examples of how scientific developments will improve an athlete's performance.

All other valid points will be given credit.

Level 1 ([1]–[5])

Overall impression: Basic

- Basic knowledge and understanding of the different scientific developments a coach could use to improve an athlete's performance. The candidate may simply list basic examples.
- Demonstrates a basic ability to analyse the different scientific developments a coach could use to improve an athlete's performance. Candidates will give some explanation, with limited evaluation.
- 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 the intended meaning is not clear.

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

- Good knowledge and understanding of the different scientific developments a coach could use to improve an athlete’s performance. The candidate may simply list relevant examples.
- Demonstrates a good ability to analyse the different scientific developments a coach could use to improve an athlete’s performance. The candidate will give relevant explanations.
- 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 the meaning evident.

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

- Excellent knowledge and understanding of the different scientific developments a coach could use to improve an athlete’s performance. The candidate will include fully developed examples and show excellent understanding.
- Demonstrates an excellent ability to analyse the different scientific developments a coach could use to improve an athlete’s performance. The candidate will be able to discuss the different scientific developments a coach could use to an excellent level and elaborate using 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)

[16]

36

Total

100

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