



GCE MARKING SCHEME

PHYSICAL EDUCATION AS/Advanced

SUMMER 2011

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2011 examination in GCE PHYSICAL EDUCATION. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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PE2 Mark Scheme - Summer 2011

The letters on the left of the answers denote what the marks have been awarded for on the candidate's paper. (**ext** - denotes marks given for a valid answer that did not appear on the initial mark scheme)

Q.1 (a) (i) Explain how extrinsic rewards could influence sporting behaviour/performance. (3)

Max. 1 mark for explanation of extrinsic rewards

Extrinsic rewards:

Tangible - trophies, medals, badges, money.

Intangible - Praise from teacher, social reinforces, smile, winning, approval.)

- Motivate through tangible/intangible rewards/improved performance.
- Strengthen S-R bond.
- Change to preferred behaviour.
- Need for caution in use of rewards - dependency can have negative affect when withdrawn.
- Reinforces/encourages positive behaviour - especially in beginners.
- Rewards for contingent behaviour.

Max of 2 mark for theory only

+ 1 for amplification and use of sporting example

(ii) Apart from using extrinsic rewards, explain another strategy you could use to support the learning process in a specific sporting activity. (3)

- Set targets.
- Provide/receive feedback.
- Give appropriate guidance.
- Appropriate presentation of skill whole/part.
- Types of practise fixed/variable; massed/distributed.
- Teaching styles.
- Knowledge and use of transfer.
- Observation.

1 mark strategy with brief simplistic explanation

1 mark for amplification of strategy with limited application to sporting activity

1 mark for full explanation of strategy with application to sporting activity

- (b) **Using examples from sport, explain how knowledge of task variables shown in the diagram above can influence the type of practice chosen by a coach/teacher.**

Whole and whole/part/whole;

- Whole method should be linked to high organisation and simple tasks
- Whole/part linked with low organisation and more complex tasks

Fixed - variable

- Fixed - possibly simple/high organisation tasks (depending on example)
- Variable - linked with more complex/low organisation tasks skills (depending on example).

Massed/Distributed

- Massed - can be associated to simple or high organisation e.g. cycling (must be relevant example)
- Distributed - can be associated to more complex tasks where a break for feedback/guidance is necessary)

Max 2 marks for appropriate practice relevant to task

Max 2 marks for amp and/or appropriate sporting example

- Q.2 (a) (i) **Complete the table below describing two personality theories and explain how each can influence behaviour in sport. (4)**

Trait theory - Eysenck

Our personality is made up on many different traits, which gives an underlying pre-disposition to act in a particular way each time a given situation occurs (or similar) E.g. If you are nervous in one sporting situation you will be nervous in all situations.

Type A - highly strung, characterised by impatience, intolerance, and stress

Type B - relaxed, tolerant approach, lower stress.

Sporting examples traits can be used to predict behaviour

Extroverts - games,

Introverts - individual

Neurotic - tendency to worry, associated with anxiety, unstable behaviour, rash and impulsive.

Social learning theory - Bandura

Personality changes with the situation and that the environment (including the behaviour of others) influences behaviour.

Sporting examples include - increased aggression learned from others
- Any relevant example.

(c) Interactionist theory

People are born with certain personality characteristics but behaviour can change depending on situation, personality not constant unless in learned situations. (Combination of trait and social learning theory) - with any previous examples

Sheldon's somatyping – mesomorphs display leadership qualities.

Endomorphs – more reserved, less likely to show leadership qualities.

1 x 1 mark for each personality theories +1 for link to sport.

(ii) Explain the advantages and disadvantages of using personality profiling in sport (3)

Advantages

- Monitor progress
- Time efficient and effective.
- Understanding of each individual
- Most effective ways to communicate with each individual.
- Provides personality strengths and weaknesses.
- Valuable discussion tool
- Put in place strategies to help athlete potential e.g. anxiety control
- Type of coaching/leading/training the athlete best responds to.

Disadvantages

- Questionnaires, observations and self-reports are not reliable as people can fix answers.
- Evidence is too general - personality alone cannot predict behaviour. (Eysenck's theory over simplistic)
- Although there is a link between personality research and performance in sport, there is a lack of evidence to support this. (Introvert and extrovert personality types can be equally as effective in both individual and team sports)

Max of 2 x 1 for advantages/disadvantages

(b) From your own sporting experiences describe the qualities necessary to be an effective leader. (3)

- Good communication skills
- Excellent knowledge and understanding of sport
- Highly developed perception skills
- Good at making decisions empathy with team members
- Understand the needs of others e.g. ambition
- Vision
- Experience
- Highly motivated
- Organised
- Adaptable

3 x 1

Q.3 (a) Using the information in the table, explain the energy continuum during a 1500m race. (4)

The relative contribution of each energy system to ATP re-synthesis is determined by the intensity and duration of exercise.

- Start - ATP - PC High intensity sprint off line to gain position
- Limited supply/short duration of ATP-PC (approx 10 secs) means also use anaerobic glycolysis for the first 100-150m
- Limited supply of muscle glycogen/build up of lactic acid means intensity has to drop
- Pace settles using aerobic system at a lower intensity/high duration
- Working under anaerobic threshold (60-80%)
- As pace builds towards end of race as intensity increases more anaerobic energy will be used
- Final sprint more ATP-PC

Must be related to the actual race in terms of intensity and duration.

(b) (i) Explain how an improved level of fitness can influence the energy systems used in a sporting activity of your choice. (3)

Aerobic effects

- An aerobically fitter person will take longer to reach anaerobic threshold
- Help conserve PC stores
- Increased aerobic fitness allow faster recovery of CP stores
- Less lactic build up

Anaerobic effects

- Increased tolerance to lactic acid (buffering capacity) - work anaerobically for longer
- Increased glycogen stores will allow for prolonged higher intensity activity
- Increased CP stores allow very high intensity exercise for longer.

(ii) Identify a cause of muscle soreness after intense exercise and explain a strategy for how it can be reduced. [3]

Causes

- Micro trauma to muscle fibres
- Extensive eccentric/negative resistance training
- Build up of blood lactate/creates low pH/acts on pain receptors to produce soreness
- New type of training - overload/restart of training after injury/rest

Max of 1 mark

- Effective cool down
- Use of rest days for repair
- Ice baths
- Massage
- Appropriate training
- Correct period of rest
- Correct nutrition of carbohydrate and protein 30 minutes after exercise

Max 1 Mark for identifying cause

Max of 1 mark for brief exp of prevention +1 amplification of point

Q.4 (a) Why are active recreation and balanced diet key factors in combating obesity in the UK? (6)

Active recreation - Exercise

- Exercise can help burn off many of the calories that have been consumed in a meal.
- Exercise can increase the ration of High Density Lipoproteins to that of Low Density Lipoproteins
- Reducing cholesterol
- This can help achieve a negative energy balance if an individual is attempting to loose weight.
- Maintain the elasticity of arteries and arterioles therefore reducing the risk of hypertension
- Raise the basal metabolic rate
- Increasing the efficiency of the respiratory system.
- Counteracts the deterioration of bones and joints.

Max of 3 marks

Any physiological adaptations and links to preventing obesity – Max 2 marks

Balanced Diet

- Controlling calorie intake
- Energy balance
- Understanding the importance of reducing fats and the problems associated with a high fat diet.
- Can increase the ration of High Density Lipoproteins to that of Low Density Lipoproteins which reduces the overall effect of: -
- Reducing cholesterol
- Short term problems - Weight control and energy balance
- Long Term problems - Obesity, atherosclerosis, angina. C.H.D., stroke, diabetes

Max 3 marks

(b) Explain the provision and athlete/player development pathway that is available for a competitive sport in your locality. (4)

This is going possibly to be personal to their chosen sport and area where they live

- Provision - what clubs, facilities, academies etc exist for the sport in their locality
- Player development pathway - a pathway from grass roots to elite level, including age groups, trials, scouting, other talent ID processes, academies, development squads, competitions etc

1 mark - Basic understanding of provision and pathway

2 marks - Greater understanding of pathway and provision with more specific information and examples provided

3 Marks - Good understanding of specific clubs and facilities in their locality and good knowledge of the various stages of the development pathway through the age groups including competition

4. All of the above and an excellent understanding of trailing systems, scouts age group competitions and how one feeds into another through to elite level

Q.5 Explain how you have developed physical performance in you chosen sporting activity. 3 pages

The answer should include the following information and must be specific to the individual and their chosen activity.

Monitoring performance (max 4 marks)

- Fitness testing
- Performance profiling
- Video/coach analysis

Training (max 6 marks)

- Developing training programme specific to the activity
- knowledge of correct warm up
- Correct methods of training related to their activity
- Application of the principles of training (linked to methods of training)
- Knowledge of training zones and the use of heart rate monitor

Recovery/nutrition/goal setting (max. 4 marks)

- correct recovery methods
- correct nutrition
- set SMART targets

Level 1	1 - 4	The candidate demonstrates some knowledge and understanding of the unit. A few relevant points are listed and there is a possible tendency to focus heavily on one discipline or treat them in a superficial way. Ideas are expressed in a simplistic but clean manner. Errors in grammar, punctuation and spelling are noticeable and intrusive.
Level 2	5 - 7	The candidate demonstrates good knowledge and understanding of the unit and is able to use some specialist vocabulary and relate testing, training etc to improving their own performance. Ideas are expressed in a clear, logical manner. Errors in grammar, punctuation and spelling occur but do not suggest weaknesses in these areas.
Level 3	8 - 10	The candidate demonstrates very good knowledge and critical understanding of all disciplines. He/she explains in detail, using specialist terms with facility, how they integrated disciplines to enhance and improve their own performance. Complex ideas are expressed with clarity. There are few, if any errors in SPG.

PE4 Mark Scheme - Summer 2011

SECTION A

Q.1 (a) Define achievement motivation and competitiveness and explain fully, using examples, the different motives that athletes may hold. [4]

- Achievement motivation can be defined as an individual's drive to strive for success. It is viewed as an aspect of personality (and therefore, stable) and also situation-specific (Atkinson, 1964).
- Athletes are fuelled by this achievement motive to seek out success and avoid failure and are prepared to defeat others in pursuit of reaching their individual goals.
- Gill (1986) defines competitiveness as a sport-specific form of achievement motivation. It is linked with an athlete's win orientation (the desire to win interpersonal competitive sporting events) and goal orientation (the desire to reach personal goals in sport).
- McClelland and Atkinson (1953) model of achievement motivation proposes that athletes hold two different motives: the motive to achieve success (NAch) and the motive to avoid failure (NaF).
- Athletes with a high motive to achieve success will seek out challenges, show high levels of persistence, value feedback (both positive and negative) from others and enjoy performing in situations where they may be evaluated by others. They will not be afraid of failure. Attacking players tend to be NAch whilst defenders tend to be NaF although this is very generalised.
- Athletes with a strong motive to avoid failure tend to worry about their performance, avoid risk and tend to avoid situations in which they may be judged. They prefer to play against opponents that they know they can beat easily (and thus guarantee success) or where defeat is inevitable (and so failure cannot be attributed to them and their ego can be protected).
- Appropriate examples of each motive will need to be offered and explained.
- Some candidates may discuss extrinsic and intrinsic motivation and ego and task orientations. Credit should be given for this providing the response is discussed in detail.

[1+1+2 for discussing motives]

"Attributions are the way people explain the causes of particular events or behaviours to themselves."

(Woods, 1998)

(b) Explain the key features of *attribution theory* and discuss how it could be used to improve an individual's sporting performance. [6]

- Attributions are the ways that athletes explain particular performances or behaviours to themselves after the event. These explanations can affect future participation and performance.
- Weiner (1972) suggests that achievement is related to the attributions that we make. He suggests that there are four types of attributions related to ability, effort, task difficulty or luck. These attributions could then be further categorised into four dimensions: internal (within our control), external (outside of our control), stable (enduring) or unstable (varying) – see table below.

	INTERNAL	EXTERNAL
STABLE	ability	task difficulty
UNSTABLE	effort	Luck

- Coaches may use the process of **attributional retraining** to help athletes improve their sporting performances.
- Coaches need to understand their athletes and observe the ways in which they approach certain situations and how they react to success or failure.
- Performers should be encouraged to view success as due to internal and stable factors, which should encourage feelings of pride and satisfaction and will help to improve levels of self confidence within athletes.
- Performers should attempt to understand failure in terms of unstable factors, both internal (such as poor levels of effort) or external (they were unlucky).
- Skilled athletes, who have tasted success previously, tend to attribute failure to unstable external factors – failure is then seen as being temporary. This approach helps to maintain both self efficacy and confidence. However, it may lead to complacency and athletes should be wary of this.
- Unskilled athletes are more likely to attribute failure to their own failing and this can impact negatively on future expectations and the possibility of dropping out of sport altogether. This is linked with a concept called learned helplessness and athletes/coaches need to be wary of this.

[2+2+2 (development)]

Q.2 (a) Explain why sedentary lifestyles can have a negative impact on health and well-being. [5]

- Health is defined as 'a complete state of physical, mental and social well being and not merely the absence of disease or infirmity'.
- Exercise is defined as 'any form of structured physical activity designed primarily to develop and maintain physical fitness. Exercise is the link between health and fitness.
- Lifestyles and levels of stress differ for individuals and so do levels of fitness.
- Health concerns affecting people of all ages centre largely on fitness, obesity and cardiac problems. The main way of preventing problems in these areas is through following an increased level of exercise.
- The rate of obesity in young people continues to rise – it is predicted that nine in 10 adults and two thirds of children will be obese by 2050.
- Hypokinetic disorders are partly a result of an increase in sedentary lifestyles. Potential health risks associated with obesity include CHD, strokes, diabetes, atherosclerosis and hypertension. Lack of mobility and excess pressure on joints may also be evident.
- Health risks associated with a high fat diet – problems of the fast food generation. Supersize me culture. Leading to short term (weight control and energy balance) and long term health problems (atherosclerosis, hypertension, angina, stroke, myocardial infarction).
- Some higher level candidates may discuss the correlation between social deprivation and low levels of physical activity. They may also consider the potential cost of such lifestyles to the NHS and ultimately, the taxpayer.

"Golf, skateboarding, mountain biking, yoga, archery, cheerleading and problem-solving challenges are being taught alongside more traditional activities".

(PE and School Sport 2005-2008, Ofsted, 2009)

(b) Justify the reasons for the inclusion of such activities within physical education and school sport and discuss their possible impact on exercise adherence. [5]

- Encouraging lifelong participation is one of the main aims of any physical education programme. Such activities have been shown to improve engagement.
- One size does not fit all – an over emphasis on traditional, competitive team games may well turn many young people off sport for life. Others flourish within them. Creating positive attitudes is vital. Research from Loughborough University suggests that healthy individual exercise is losing out as many PE teachers focus on solely team games (despite the National Curriculum requirements).
- Targets to increase participation rates for all schoolchildren to five hours of high quality physical education and sport will only be met by offering a varied menu of activities.
- Links may be made with current initiatives to help increase levels of physical activity within schools (such as 5x60 and PESS) and talent identification (improving the country's prospects in a range of sports).
- Exercise adherence research suggests that students are more likely to continue physical activity programmes if they are varied, enjoyable (social aspect of physical education), easily accessible and if they receive encouragement and good coaching. The educative value of physical activity needs to be constantly restated.

[2 + 3 or 3+2 – development of response required]

Q.3 Discuss the various strategies that might be used to help monitor, analyse and refine the physical, tactical, technical and behavioural aspects of an individual's performance. [10]

The following is indicative of the material that might be included in the answer.

The foundations for training and competing can no longer be based on simple subjective views of how well athletes perform or on traditional methods passed from one generation of coach to another (Carling, Reilly and Williams, 2009).

Performance analysis aims to help capture, analyse and evaluate key components relating to performance and provide concise feedback to inform future practice. Performance analysis may also help talent identification and there are links with elite sport (for example, the English Institute of Sport).

Qualitative and quantitative approaches to performance assessment.

Sporting activities place a different emphasis on these components.

- Technical aspects: efficiency of movement and its aesthetic qualities – a thorough understanding of the technical demands of the sport is essential to the coach and performer.
- Tactical aspects: important in many sports, especially games. Outcome significant as well as execution. Good tactical play is about decision-making.
- Behavioural aspects: Observing behaviour and assessing why performers behave in a certain way is crucial in sport.
- Physical aspects: Physical fitness is a critical factor in most sports – the physical training programmes should match the demands made of the performer while competing.

Methods of analyzing and refining performance.

- The focus of analysis depends very much on the sporting activity and the level of the performer. Candidates should make this explicit – application is key.
- Many of the methods employed at the elite level involve technology – this is evitable given the age that we live in. Sport science plays a vital role in the development of the elite performer.
- Biomechanics: Biomechanical analysis of technique is integral to the work of coaches in most sports. It can determine how coaches devise and manipulate practice sessions and what feedback they give to performers. In order to carry out a technique analysis the coach needs to know what good technique looks like and an understanding of the biomechanical principles involved in its execution. Study of the body motions in terms of force, time, distance.

Level 1 (1-4 marks)	Candidate discusses different performance analysis techniques albeit at a basic level with some examples offered. Superficial understanding of the refining aspect of the question demonstrated. Limited technical language employed.
Level 2 (5-7 marks)	Candidate shows good understanding of a variety of performance analysis techniques and links these with key performance indicators. Analysis techniques are discussed in detailed with good use of technical terminology. Clear links are established with the notion of refining/improving performance.
Level 3 (8-10 marks)	Candidate demonstrates an excellent understanding of performance analysis techniques and may also discuss their limitations. Examples are offered to amplify points. There is excellent use of technical language and the candidates makes explicit reference to using performance analysis techniques to help refine performance (link with feedback).

- Notation: Using symbols to record information about performance – statistical – patterns of play – technical errors and achievements – work/rest intervals. Match analysis only provides raw data but it can help in making more informed decisions about performance. Coaches may use this information to work out if a training intervention has been successful or identify the team's areas of strength and weaknesses (esp. relating to tactics). Many software companies have developed computerized products such as Prozone to help match analysis - speed of analysis affects depth of analysis.
- Physical Fitness (both laboratory and field) and Skill Tests: Outside competition to gain information on performance: physical conditioning, technical efficiency or tactical effectiveness. Most important use of fitness testing is to provide feedback to performers about their progress in relation to their goals. There are good for establishing a starting point for performers (baseline information) and useful for helping to plan training programmes.
- Questionnaires: Provides information from performers on issues and feelings about performance. Intervention strategies (such as relaxation techniques, imagery, mental rehearsal for example) can then be linked to results.
- Video: Provides objective information and can enhance performance analysis. Permanent, immediate, technological aids (freezing, slow motion). Use of performance analysis software such as Dartfish.

[1 + 1 + 1 + 1 + 6 for amplification of points]

SECTION B

The following levels should be applied to both questions.

LEVEL	MARK BAND	DESCRIPTOR
Level 1	1-5	<p>Candidate makes few, if any relevant points with no real application.</p> <p>There may be an attempt to draw conclusions but understanding of connections between different areas of subject content is limited or not demonstrated.</p> <p>Information is poorly organised. There is limited use of specialist terminology/vocabulary and frequent errors in spelling, punctuation and grammar.</p>
Level 2	6-10	<p>Candidate makes some valid points using relevant principles, concepts and theories. There may be some application with valid conclusions drawn. Some ability to make connections between different parts of the subject content is demonstrated.</p> <p>Information is well organised and ideas are expressed in a logical manner.</p> <p>There is good use of specialist terms/vocabulary with some errors in spelling, punctuation and grammar but these are not intrusive.</p>
Level 3	11-15	<p>Candidate shows good knowledge and understanding of relevant principles, concepts and theories. There is good application and analysis with sound logical conclusions drawn. The ability to make connections between different parts of the subject content is demonstrated on several occasions.</p> <p>Information is very well organised and argument is expressed clearly and coherently. There is good use of specialist terms/vocabulary and spelling, punctuation and grammar are generally accurate.</p>
Level 4	16-20	<p>Candidate demonstrates excellent knowledge, understanding, analysis, and evaluation using relevant principles, concepts and theories. The ability to synthesise and make connections between different parts of the subject content is fully demonstrated throughout the answer.</p> <p>Information is very well organised and the form and style of communication is highly appropriate. There is very good use of specialist terms/vocabulary with few, if any, errors in spelling, punctuation and grammar.</p>

SECTION B

Answer **one** question.

- Q.4 Discuss the structures and talent identification schemes that exist to help the United Kingdom achieve international sporting success and explain any potential barriers faced. [20]**

Hosting the Olympic and Paralympics Games in 2012 will provide this country with the greatest opportunity it has had for many years to transfer the sporting structures, facilities and systems and to leave behind a lasting legacy for years to come.

Structures and organisations:

UK Sport: has a primary responsibility to support sports in their effort to build a truly world class high-performance sporting system. This means surrounding the best athletes with the support they require to perform to their potential (UK Sport website). UK Sport is a non-governmental body based in London. It receives money from the National Lottery and passes most of this money (around 75%) onto the National Governing Bodies. It has adopted a 'no compromise' approach with money targeted at sports that consistently win medals (e.g. swimming, cycling and rowing).

United Kingdom Sports Institutes (UKSIs): provides elite athletes with a range of services including sports medicine, sports science, performance lifestyle, performance analysis and psychology.

National Governing Bodies (NGBs).

Talent identification:

- Talent identification is both an art and science and involves integrating scientific knowledge and assessment produces alongside more traditional coaching. First employed extensively by East Germany in the seventies, talent identification programmes aim to proactively seek out those that possess the raw material for international success.
- The scientific approach of identifying talent involves a series of rigorous assessments and filters to detect individuals that have 'higher probability' for podium success (UK Sport, 2009). This works best for sports that are repetitive (or perhaps 'closed') in nature rather than being 'open' and relying on individual flair
- **World Class Performance Programme:** it takes six to eight years for a promising sportsman or woman to get to the point where they can deliver medals on the world's senior stage. The pathway involves three distinct phases: Talent, Development and Podium. High level of investment (over £100 million annually) from the National Lottery and the Exchequer funds).
- **National Governing Bodies:** Each sport will have its own programme and candidates may draw on a number of specific examples. Credit should be given for this.
- **Athlete/Coach frameworks:** Coaching frameworks like the UKCC and structures that work outside that framework (for example, athletics) have a role to play in the identification and development of talent.
- **Olympic-specific talent identification schemes** may be mentioned including: Sporting Giants, Pitch2Podium, Girls4Gold, Project Swap Shop and Talent 2012: Fighting Chance.
- **Other initiatives include:** Talented Identification Scholarship Scheme (TASS), UK School Olympics, the Junior Athletic Education (JAE) programme

Potential barriers to success:

- **Funding:** Standing at about £63 million per annum for elite sport this is still below some of our European competitors (Italy £100million, France £136million). Amount of money allocated to various Sports Councils has been reduced. This obviously impact on the NGBs as the Sports Councils have had to make some tough decisions and some sports have, inevitably, missed out.
- **Structures** – problems with a decentralised (some might say fragmented) system.
- **Size of country** – the width of the base of the participation pyramid dictates how wide the base at each of the other internal levels of involvement. Links with schemes to improve mass participation.
- **Social differentiation:** issues relating to opportunity, provision and esteem (gender – female boxing for example, race, class – many medal winners are educated within public schools and disability – direct link with the Paralympics movement). Certain groups find it difficult to play a full part in sport. Society is ranked according to status - maybe because these groups are restricted by the dominant group or there maybe a lack of confidence or affluence among the members of the minority group
- **Others may be discussed and credit should be given.**

Q.5 "Scientific and technological advances have had a significant effect on the development of sport for the performer, coach, official and the spectator in recent years." Discuss this statement. [20]

- The world of sport is continually changing and evolving. Sport is a reflection of society and so advances in the scientific and technological world will inevitably manifest themselves within the avenue of sport. Is it naïve to assume that sport can exist in a vacuum?
- Debates often surround the concept of fairness – the idea of a level playing field.
- Ethical issues – can all countries afford to compete? Should they?
- Enhancement of performance and improved health and safety as a result of technological advancement (e.g. helmets in cricket, flame-retardant suits in F1, landing areas in athletics).

Developments for the performer include (not exhaustive):

- Advances in sport science: nutrition (carboloading and glycaemic index) and supplementation; recovery methods (ice baths, compression clothing, hypoxia tents); training advancements.
- Sports shoe technology: spikes, innovations in designs of shoes (Nike Air Bubble trainers and Adidas Predator football boots, for example).
- Speedo LZR Racer swimsuit, which has caused much controversy in the world of swimming. Engineered with the assistance of NASA, the bodysuit increases a swimmer's streamline qualities and thus reduces fluid friction (drag). World records have tumbled. Fina (the world governing body for swimming) has banned the use of these bodysuits (from January 2010) as they were deemed to provide athletes with an unfair advantage – not all athletes are able to wear the Speedo LZR Racer swimsuit due to contractual regulations.
- Cheetah Flex Foot, as used by Paralympian Oscar Pistorius, has also courted its fair share of controversy over the years. The prosthetic, it is argued, allows amputee athletes to run at the same speed as able bodied athletes with 25% less energy expenditure.
- Goal line technology – debates have long surrounded the introduction of such technology into football. An innovation known as the "Smartball" (a football loaded with a computer chip, which uses a network of receivers around the field to track the ball's precise position in real time) has been trialled. Relevant information could be relayed in less than a second to a watch-like device worn by the referee. However, this system has had its setbacks, and another system using, HawkEye (see below) is being investigated.

- Television replays – video replay systems for the 'third empire' have been used rugby and cricket (for run outs and disputed catches and boundaries).
- Hawkeye – used in tennis to allow players to 'challenge' official decisions and to have incorrect judgments overturned. Hawkeye works by use a series of sensors to detect the flight path of a ball and then accurately trace its path. Its use has also been used in cricket.
- Radiowave helmets have been used for a number of years in cycling and American football. In the later sport, helmets have been designed to allow quarterbacks to receive information from their coaches about forthcoming plays and are an established part of the game. In the 2009 Tour de France, the ... banned the use of such communication devices between cyclists and their teams in an attempt to regain some of the old essence of the sport.
- Performance analysis software, for example Prozone which has been used extensively in football, allows managers to get detailed statistics on individual player's performances - from how far they have run, to how many complete passes they made - for each game.

Development for the coach may include (not exhaustive):

- Many of these developments have an obvious link with the performer.
- Performance analysis – motion analysis linked to biomechanics.
- Performance analysis software (e.g. ProZone) to track distances travelled by players and positional breakdowns.
- Use of digital video recording to analysis performance – split-screen analysis may be particularly helpful. Dartfish and framework analysis.
- Use of advanced laboratory testing to monitor the progress of athletes outside of the competitive season.
- Problems of coaches pushing athletes too far – performance enhancing drugs.

Development for the official include (not exhaustive):

- Use of hawkeye and other referrals methods in cricket (success?) and tennis.
- Third man (umpire and referee) in cricket and rugby – video referral method. Instant digital review. Why can this be incorporated into football?
- Time keeping – increased accuracy of stopwatches and electronic timing (linked to the starter's pistol and blocks in athletics – pressure pads and transponders for example).
- Possible introduction of goal-line technology in football. Use of electronic flags for assistant referees.
- Are these all taking away from the role of the official? Do these referral systems undermine the authority of the official on the field?

Development for the spectator include (not exhaustive):

- Media has made it possible to watch sport in 'real-time' anywhere around the world including on mobile phones and on the Internet (England v Ukraine game).
- Big screens in the stadium and action replays have added drama and excitement to the live experience.
- Television replays – action replays, slow motion, multiple angle, zoom lenses for example have all allowed the viewer to get 'closer to the action'.
- Interactive features (the 'red' button) have enhanced the overall viewing experience.



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