NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2014

SPORT AND EXERCISE SCIENCE: PAPER I

MARKING GUIDELINES

Time: 2 hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

1.1 Static/PNF stretching – stretching to limit of range and then isometrically contracting the stretched muscles. Static stretching is when you stretch to the farthest point and hold the stretch.
Dynamic/Active stretching – holding a stretched position by contraction of your own agonistic muscles contracting the antagonist. You actively hold the muscles in a stretched position. (2)

1.2 A warm muscle has a better oxygen supply, is more flexible and the athlete is better prepared physically and mentally after a warm up.
Stretching raises body temperature and heart rate. This increases blood flow to muscles, improving ROM (flexibility) and ability to contract and relax quicker. (2)

1.3 After a dynamic stretch the athlete is able to complete the task in the quickest time – 1,5 seconds compared to approximately 1,8 seconds with a static stretch and 2 seconds with no stretching. A dynamic stretch will ensure that the muscle is well supplied with oxygen and is warmer hence the quicker time – all the muscle fibres are firing. (2)
[6]

QUESTION 2

2.1 2.1.1 ATP-PC (1)

2.1.2 Aerobic (1)

2.1.3 Aerobic (1)

2.2 Glycogen (1)

2.3 80 – 95% (1)

2.4 Longer arms (longer levers); large hands and/or feet; more fast twitch fibres; greater muscle mass; more fast twitch fibres. (2)

2.5 It is thought that by performing high intensity intervals that produce lactic acid during practice, the body adapts and burns lactic acid more efficiently during exercise. This means athletes can exercise at a higher intensity for a longer period of time before fatigue or pain slows them down

Interval training leads to many physiological changes including an increase in cardiovascular efficiency (the ability to deliver oxygen to the working muscles) as well as increased tolerance to the build-up of lactic acid. These changes result in improved performance, greater speed, and endurance. (2)

2.6 The increase in cardiac output at maximal intensity is due to an increase in heart rate as stroke volume peaks at submaximal levels.
Cardiac output increases to supply the increased demand for O_2 from our working muscles.
Increased SV – the heart is stronger as a result of training and is now able to pump more blood with each beat.
The RHR decreases over time as the athlete/s heart gets stronger and able to pump more blood with each contraction resulting in the heart having to pump less often (3)

2.7 **Learners MUST make each one swimming specific.**

Duration
To get fit aerobically 20 minutes is minimum required. You need to do 20 – 60 minutes of continuous activity.

Frequency
If you want to improve, the body needs to adapt and improve physiologically. So you need regular, consistent exercise of muscles and energy systems.
Training frequency depends on the training program and the type of training.
By not exercising frequently, you won't get enough stimulation so the muscles won't adapt.
BUT training too often = injury and muscle fatigue.
When starting off → train frequently at low intensity e.g. Elite athlete → train less often but high quality focus on skills
Minimum aerobic capacity training = 3 × per week
Elite athletes = 5 – 6 × a week

Intensity
Physiological changes happen when the muscles are consistently stimulated by higher than normal amounts, i.e. muscles are overloaded.
Intensity lets you overload muscle groups and energy systems.

Elite athletes will often train in the morning at lower intensity levels in order to build up aerobic capacity. Later in the day they will do power training to build anaerobic ability.
It is very NB to choose the right intensity to stimulate positive adaptations and not cause injury or fatigue.
To monitor intensity an athlete needs to rate perceived exertion.
Hard – 80% or more of capacity
Moderate – 70%
Easy – 60%

Adaptation/Progression
The body adapts as you train. Early on in the training program, the adaptations happen easily. As time goes by, the adaptations decrease.

The 'Law of Diminishing Returns' = the higher your level of conditioning, the higher the intensity needed to make adaptations. If you train at the same levels then the improvement will not continue **but** you must also be careful not to do too much too soon. If you do, it may lead to injury or muscle damage which will then set your training program back.

Another factor to be aware of is plateauing. This happens when you get to a certain level and then seem unable to improve further. This is common and it is likely that it will happen more than once, so it is best to be prepared. When it happens you have to be prepared to stay on that level for some time. Eventually you will improve further. This is when you must be mentally strong and motivated to continue through a difficult period.

It is always difficult to decide how much overload should be applied and it has been suggested that the training intensity should not be increased by more than 10% a week.

Specificity/Type
Training is very specific/Strength training won't make you aerobically fit and endurance training won't make you strong.
One thing you must not forget is that most physical activities need a combination of exercises and perhaps even training methods. There are very few activities where it is easy to choose just one particular method and stick to that. That is why it is important to plan out and analyse exactly what is required and how those requirements can be met.

Overload
In overload a person tries to overload the body, causing a degree of stress and even a partial breakdown. Nature's reaction is to overcompensate, by giving the body enhanced powers of resistance to the stress.
E.g. strength training – an overload resistance (i.e. a heavy weight) is used to stress the muscle. This causes the protein fibres to break down. The muscles repair themselves
(adaptive process) and the fibres grow stronger. The muscles are subjected to greater stresses in progressive stages, because of the adaptation process.
Overload differs from person to person
Overload makes the body work harder in order to improve. In order to improve you must extend that capacity by increasing your workload i.e. you need to train HARDER.
This can be achieved in the following ways – frequency, intensity and duration. (12)

2.8 To ensure if the exercises/training are improving the athlete/s performance.
To check for progress.
To allow time for changes to be made to the programme to ensure further improvement.
To see if challenges are needed.
To motivate the athlete.
Is the training intense enough?
Is it specific enough?
If training is not planned properly it can lead to overtraining and burn-out.
Overtraining and burn-out are as a result of unusually high training loads/intensity with not enough rest periods or recovery time. This means that the athlete will be fatigued when training.
Planning the amount and intensity of training correctly can reduce the risk of overtraining. In planning training to help improve mental and emotional well-being, the coach needs to include relaxation techniques, varied training environments, being positive, rest days.
Physiological considerations to take into account when planning are level of recovery, lethargy and injury. If an athlete is training while lethargic they may concentrate less and lose focus. This can cause poor technique and even injury. If the athlete is prone to injury they need to have protective routines included in the planning of their training so it does not get worse.
Is the athlete meeting targets? Goals?
To ensure that gradual improvements are occurring or to prevent plateau.
To prevent injury.
To monitor for signs of fatigue and/or overtraining. When an athlete is experiencing overtraining, they will first show signs of emotions, signs such as: lack of motivation, poor concentration, becoming emotionally upset easily.
To check athlete/s psychological state. (4)
[28]

QUESTION 3

3.1 The graph shows that as the intensity of exercise increases, heart rate and respiration increase to help provide more oxygenated blood to the exercising muscles. Thus HR and VO_2 rise in a parallel fashion for most submaximal intensities. At higher intensities the body must rely on contributions from the anaerobic system to keep exercising. The contribution of the anaerobic metabolic system can be seen in the green line that depicts (LA) concentration. At low intensities, the body can break down all of the LA that is produced so the levels remain constant. At progressively higher intensities, the production of LA exceeds the removal rate or oxidation rate and the levels rise sharply. This sharp increase in LA is typically referred to as the 'anaerobic threshold' or the 'lactate threshold'. At intensities much beyond this level it is difficult to continue exercising for an extended period of time because the accumulation of LA will cause the muscles to fatigue. The 'anaerobic threshold' is an important determinant of endurance performance because it defines the level of activity a person can perform before they begin to accumulate lactic acid in the blood. Typically marathon runners will be able to sustain a pace just below this threshold for most of the race. Because of its importance for high-level performance, anaerobic training is an essential part of high-level training. One of the most common methods for building the anaerobic system is with interval training. The goal from anaerobic interval training is to shift the lactic acid curve to the right. In other words, you want to train your body so that you can exercise at a higher intensity before you begin to accumulate lactic acid in the blood. (6)

3.2 VO_{2max} is the highest rate of oxygen consumption attainable during all out, maximal exercise. A high percentage of VO_{2max} is linked to aerobic endurance.
VO_{2max} is linked to having a healthy and strong respiratory system as well as an efficient heart and circulatory system.
The higher the VO_{2max} the greater chance the cyclist has to work at a higher level and being able to exercise at a higher intensity and delaying the onset of fatigue.
The cyclist will be able to complete several days of cycling over and over again without a huge decrease in performance.

Non athlete will tire very quickly. (4)

3.3 Altitude training occurs at 2000m and higher above sea level.
It usually lasts for at least 30 days.
At this height partial pressure of oxygen is lower. There is less oxygen available.
As a result the body produces erythropoietin(EPO) to produce red blood cell production.
Those who do not have access to high altitude naturally can use other methods, e.g. hypoxic tents/oxygen tents.
Some will train low, live high.
Performance improves as a result of the extra red blood cells and increased.
haemoglobin/myoglobin/increased haematocrit.
All of this results in an increased capacity to carry oxygen.
Increased tolerance to lactic acid/buffering/delayed OBLA.
These benefits will last for up to 6 to 8 weeks.
Negative effects:-
Performance can be negatively affected by altitude sickness (lack of sleep, headaches, poor appetite, etc.)
Training at the same intensity that the athlete is used to is difficult/detraining may occur/loss of fitness.
Benefits lost within few days back at sea level. (4)

3.4 A side effect of high lactate levels is an increase in the acidity of the muscle cells, along with disruptions of other metabolites. The production of lactate during extreme exertion results in the burning sensation often felt in active muscles. This often painful sensation also gets us to stop overworking the body, thus forcing a recovery period in which the body clears the lactate and other metabolites.

Once the intensity of exercise exceeds the lactate threshold, muscles begin to use glucose inefficiently, and lactic acid can build up rapidly in the blood and muscles. When you cross the lactate threshold, the activity rapidly becomes much more difficult and unpleasant. Muscles ache, burn and become fatigued; the heart pounds; and you feel starved for air. These symptoms increase if you continue to exercise above the lactate threshold, and, in a brief time, you may be physically unable to exercise any longer at that intensity. (4)

3.5 When we stop exercising the body continues to take in higher amounts of oxygen and transports it to the muscles. The surplus energy gets used to help return the body to its pre-exercise state → this is known as the Oxygen Debt or Excess Post-Exercise Oxygen Consumption (EPOC).
During recovery, for several minutes after completing the exercise, the body takes in much more O_2 than is actually needed.
In recovery, oxygen (EPOC) is used in the processes that restore the body to a resting state and adapt it to the exercise just performed. Post-exercise oxygen consumption replenishes the phosphagen system and new ATP is synthesised (made). Post-exercise oxygen is also used to oxidise lactic acid. (Lactic acid is produced during exercise and then travels via the blood stream to the kidneys, cardiac muscle and liver.) An increased amount of oxygen is necessary to convert the lactic acid back to pyruvic acid at these locations.

After exercise stops, extra oxygen is needed to metabolise lactic acid, to replenish ATP and glycogen and to pay back any oxygen that was /borrowed/ from the haemoglobin, myoglobin, air in the lungs and from body fluids. (4)

[22]

QUESTION 4

4.1 Muscle glycogen (1)

4.2 Fatty acids and blood glucose (2)

4.3 No. Blood sugar levels have declined. (2)

4.4 Carbohydrates (1)

4.5 Carbohydrate (1)

4.6 Proteins (1)

4.7

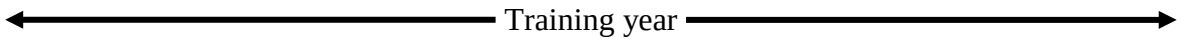
Duration of Activity	Major energy systems used	
Longer than 3 minutes	Aerobic	(1)
30 seconds – 1½ minutes	Lactic acid	(1)
Less than 10 seconds	Alactic Anaerobic	(1)

4.8

	Number of ATP produced	
Aerobic Glycolysis	2	
Electron Transport Chain	34	
Kreb's Cycle	2	(3)

[14]

QUESTION 5



Macro-cycle

Pre-season Meso 1	Competition Meso 2	Off-season Meso 3

Micro 1.1	1.2	1.3		2.1	2.2		3.1	Micro 3.2

Pupils to provide examples relating to chosen sport.

Basically, periodisation divides the training year into 3 phases:

- pre-season
- competition season
- transition or off-season

Each phase has its own aim.
There are 3 basic structures when planning a training programme:

- **Macro-cycle**
  A macro-cycle is a long plan of training aimed at achieving a long term goal.
  It consists of 1 year block training and each year's training program might be very similar to the next.
  Athletes competing at the Olympic Games may have macro-cycles lasting as long as 4 years – these are sometimes called mega-cycles.
  A macro-cycle is made up of meso-cycles.

- **Meso-cycle**
  A meso-cycle is intermediate block of training aimed at achieving medium term goals, e.g. increase strength or endurance.
  It typically lasts between 4 – 16 weeks.
  A macro-cycle can consist of 3 meso-cycles, i.e. pre-season, competition and off-season.
  Each meso-cycle can be divided into even shorter intermediate term goals.
  The length and number of meso-cycles depends on the activity and the individual.

- **Micro-cycle**
  This is a number of training sessions which form a unit.
  A micro-cycle is typically 1 week of training aimed at achieving a short term goal.
  The term 'unit' can refer to each individual training session or different parts of an individual session, e.g. athlete training 3 times a week will have a micro-cycle made up of 3 units OR 1 session of training could have 2 aims, flexibility and strength, so it will be made up of 2 units.

[9]

QUESTION 6

6.1

FACTOR	PROMOTES PARTICIPATION	INHIBITS PARTICIPATION
Socially acceptable attitudes and practices.	Sport creates a feeling of being part of a team, of belonging. This will encourage further participation. Peer pressure – can be positive. ACCEPT FEASIBLE EXAMPLES. (1)	Peer pressure – can be negative. Certain cultures frown on females playing sport. ACCEPT FEASIBLE EXAMPLES. (1)
Institutional rules and regulations.	Schools have been instructed on the amt of time that should be spent on Physical Education lessons. This exposure could encourage further participation. Govt will subsidise certain tournaments and sports – further exposure. ACCEPT FEASIBLE EXAMPLES. (1)	Govt may prevent certain people or race groups or sexes from participating in sport. ACCEPT FEASIBLE EXAMPLES. (1)
Current economic climate.	Businesses may sponsors teams, tournaments so that disadvantaged can now participate LOTTO. ACCEPT FEASIBLE EXAMPLES. (1)	Poorer regions may not have facilities, which restricts participation. Individuals with less money will only be able to take part in the expensive sports like soccer as opposed to golf. ACCEPT FEASIBLE EXAMPLES (1)
Environmental conditions	Parents and siblings who are sporty will encourage participation. Living in the countryside will encourage. ACCEPT FEASIBLE EXAMPLES. (1)	Air pollution, lack of open areas to play in, too many vehicles will all be a negative. Parents and siblings who are not keen on sport with have a negative effect. ACCEPT FEASIBLE EXAMPLES. (1)
Value-orientation, ethics and moral philosophy	An individual/s values will influence their commitment and perseverance. Knowing what is right and wrong will affect all their decisions. ACCEPT FEASIBLE EXAMPLES. (1)	An individual/s values will influence their commitment and perseverance. Knowing what is right and wrong will affect all their decisions. ACCEPT FEASIBLE EXAMPLES. (1)

Religion, customs and cultural practices	Some cultures encourage participation in particular sports, e.g. South African and New Zealand rugby. ACCEPT FEASIBLE EXAMPLES. (1)	Certain religions and cultures prevent participation in sport. Some frown on sport on certain days. Females are often not allowed to play sport in some cultures. Sport clothing can be revealing which could affect a person/s decision to play. ACCEPT FEASIBLE EXAMPLES. (1)

6.2 6.2.1 Once a person starts tertiary studies, their free time is often spent studying or researching so less time to play sport.
Once you leave school, sport becomes expensive as parents no longer provide equipment, club fees, etc. Sport facilities and coaching is not as convenient as when you are at school.
When a person starts their career, their time is limited in that they only finish work at 5 p.m. and are generally tired so do not play sport.
Married life and children limit free time.
As you get into 'old age' muscle and joint pain will interfere with sport. (4)

6.2.2 A person may be discouraged from certain sports because they don't fit traditional stereotypes e.g. a girl playing rugby may be seen as 'unfeminine' due to the strong male traditions in the sport.
Females are often considered to be the 'home makers' and are expected to look after the children and provide all meals – this will limit free time.
Females bear children and this makes them unable to play sport for several months.
Males are the breadwinners and work from 8 – 5pm and this limits time to play sport.
Men will often make business 'meetings' during golf games so this will increase participation.
In rural areas, females have to collect water for the family. (4)
[20]

QUESTION 7

7.1 Hypothermia is the condition of having an abnormally (typically dangerously) low body temperature OR a potentially fatal condition, occurs when body temperature falls below 35 °C.
The impact of hypothermia on the nervous system becomes apparent quite early.
Coordination may begin to suffer.
Cold, pale skin and intense shivering.
Speech becomes slurred.
Muscles go rigid.
Victim becomes disoriented and experiences eyesight problems.
Other harmful consequences include dehydration as well as liver and kidney failure.
Heart rate, respiratory rate and blood pressure rise during the first stages of hypothermia.
Sympathetic nervous system excitation (shivering, hypertension, tachycardia, tachypnea and vasoconstriction).
Movements are slow and laboured, accompanied by a stumbling pace and mild confusion, although the person may appear alert.
Lips, ears, fingers and toes may become blue.
Difficulty in speaking, sluggish thinking and amnesia start to appear. (3)

7.2 Mental confusion
20% to 50% of hypothermia deaths are associated with paradoxical undressing. The person becomes disoriented, confused and combative. They may begin discarding their clothing, which increases the rate of heart loss.
It can put people at risk by interfering with their ability to recognise and avoid dangers. (2)

7.3 It is very unusual for a person to be able to swim in freezing water and survive. The fact that Lewis can 'control' his core body temperature is unique and would interest a scientist.
They are unique and scientists study this. (3)

7.4
- **Curling**
  - Lack of suitable coaches.
  - No role models.
  - No equipment or very expensive.
  - Few ice rinks – none with appropriate markings.
  - No funding from SASCOC, etc.
  - ACCEPT FEASIBLE ANSWERS. (1)

- **Ice hockey**
  - Limited numbers of ice rinks in South Africa.
  - Lack of suitable coaches.
  - No role models.
  - Limited competition – no league.
  - Expensive equipment.
  - No funding from SASCOC, etc.
  - ACCEPT FEASIBLE ANSWERS. (1)

- **Skeleton**
  - Lack of suitable coaches.
  - No role models.
  - Climate in South Africa limits events requiring snow to a very short part of the year.
  - Expensive equipment.
  - No funding from SASCOC.
  - No racing tracks, etc.
  - ACCEPT FEASIBLE ANSWERS. (1)

[11]

QUESTION 8

8.1 Feel nausea; vomiting, coma
Faint, rapid pulse, low bp.
Water intoxication – sodium depletion, blood becomes diluted. Cells become waterlogged. (4)

8.2
- Thirst
- Dry mouth
- Weak
- Dizzy
- Confusion
- Fainting
- Disorientated (4)

8.3 Urine colour is a useful general indicator of hydration. When urine is a light yellow colour, it signals a proper fluid level; when urine is dark yellow, it is evidence of dehydration. It indicates when a person needs to be drinking more fluids. (2)

[10]

QUESTION 9

9.1 Involves continuous steady training mixed up with higher intensity work periods and slow recovery periods. Fartlek involves a mixture of continuous and interval training AND then adds in high intensity work. The HR needs to stay within the training zone all the time to ensure training adaptation. By keeping the HR high, it overloads the aerobic and anaerobic energy systems. (2)

9.2 Fartlek training can be adapted to suit a specific sport.
Depending on the level of the basketball – a match will either be played in 2 halves or in 4 quarters.
If playing 2 halves – Train for 45 minutes where they do a mixture of continuous running mixed up with sprinting and skill drills like lay ups, weave, dribble and pass the ball. There will then be a 15 minute drinks break (half time). Each half should involve a mixture of high intensity work with slower recovery drills.

Each player can also do different types of training depending on their position. Some players could have shorter but more frequent sprints with less rest (recovery) between each sprint. While the post players will have longer and fewer sprints with longer rests in between.

Training session must include a warm up and cool down.
Drills need to be specific to basketball. (8)
[10]

QUESTION 10

NF's, coaches and managers should notify the media when their athlete performs well.
Try and get more TV coverage and attract more sponsors.
Get more female journalists.
Promote female magazines.
Hold press conferences before events.
Encourage female role models to become more public.
Fund more coaching qualifications.
Expose coaches to international competition.
Encourage female coaches to become qualified officials.
Fund more competitions against international athletes by either bringing the athletes to South Africa for a competition or sending South African athletes overseas.
Invest in the junior athletes.
Start the athletes as young as possible.
ACCEPT FEASIBLE ANSWERS. (10)
[10]

QUESTION 11

11.1 The nature versus nurture issue of sport is very controversial.
NATURE, i.e. genes.
People are born champions.
Many people believe that genetics make up good athletes. They believe that people are born with the ability to become great athletes.
Even if you are born with 'good genes' this does not guarantee success.

NURTURE, i.e. how you are raised, what you are exposed to.
People are made into champions through hours (and years) of hard work.
A person can achieve anything in life if they want it bad enough and are willing to do everything they can to achieve it.
To argue against the 'good athlete genes are passed down through the generation' theory, exposure to sports at a young age can aid a child's athletic development. If a child is nurtured into a sport at a young age, the child will be more successful in the sport as an adult because they have been playing longer and will have more experience. (6)

11.2 **Pupils to expand and debate the topic.**
They need to draw a conclusion and state it.
Actual examples needed. (4)
[10]

Total: 150 marks