



# **MARKSCHEME**

**May 2013**

**SPORTS, EXERCISE AND HEALTH  
SCIENCE**

**Standard Level**

**Paper 3**

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.*

## Subject Details: Sports, Exercise and Health Science SL Paper 3 Markscheme Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [**2 × 20 marks**].  
Maximum total = [**40 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

**Option A — Optimizing physiological performance**

**A1.** (a)  $\sim 37.2^{\circ}\text{C}/\sim 37.3^{\circ}\text{C}$  [1]

(b) core temperature rises (slightly) / over the 20 minutes rest period, group B core temperature rises slightly from  $37^{\circ}\text{C}$  to  $\sim 37.3^{\circ}\text{C}$  [1]

(c) at the start of exercise group A core temperature was higher than group B;  
for both groups core temperature was lower at the end of exercise than it was at the beginning of exercise and vice versa;  
during the early part of exercise group B core temperature started to increase whereas group A was decreasing;  
group B core temperature decreased less during exercise than did group A and vice versa;  
at the start of exercise group B temperature is slightly higher ( $\sim 0.3^{\circ}\text{C}$ ) than group A;  
over the first ten minutes of exercise, group B temperature continues to rise to its peak of ( $\sim 37.5^{\circ}\text{C}$ ) thereafter falling progressively over the last 30 minutes (to  $\sim 37.3^{\circ}\text{C}$ ) / at the start of exercise, group A core temperature falls sharply over the first ten minutes to  $\sim 36.7^{\circ}\text{C}$ , recovers marginally at the 40<sup>th</sup> minute, only to fall progressively to  $\sim 36.2^{\circ}\text{C}$  at the 60<sup>th</sup> minute;  
at the end of exercise the core temperature difference was greater between the groups compared to the start of exercise; [3 max]

(d) *for example frostnip: [2 max]*  
frostnip is initial freezing of superficial skin tissue;  
frostnip does not cause long-term damage;  
with frostnip it is possible for nerves to become damaged;  
frostnip can lead to frostbite;

*for example frostbite: [2 max]*  
localized hypothermia is known as frostbite;  
frostbite occurs in body parts farthest from the heart (fingers/toes/nose/ears);  
frostbite occurs in body areas with larger/more exposed areas;  
a risk of gangrene/amputation/high risk of infection/potential death;

*for example hypothermia: [2 max]*  
lowering of body temperature / below  $35^{\circ}\text{C}$  ;  
clinical categories of hypothermia for example mild (ranging from  $32^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ ) to profound ( $< 25^{\circ}\text{C}$ ) / excessive body heat loss leading to low body temperature;  
once the body temperature falls below about  $34.5^{\circ}\text{C}$  the hypothalamus begins to lose its ability to regulate body temperature;  
the sinoatrial node of the heart is affected causing heart rate to decrease which in turn reduces cardiac output;  
there is a decrease in respiratory rate and volume;  
impairment of cognitive function;  
severe hypothermia can lead to death; [2 max]

**A2. (a) *over-reaching: [1 max]***

is transient overtraining;  
generally results from excessive and protracted overload with inadequate recovery and rest;  
an increase in performance above baseline can occur, if an over-reaching phase approximately one week is followed by an immediate return to normal training / a taper following normal training can result in additional performance increases;  
this is known as functional over-reaching where the athlete comes back stronger and fitter after the recovery period;  
over-reaching can be remedied by a few days of rest/short-term rest and dietary manipulation;

***overtraining: [1 max]***

is attempting to do more work than you are physically/physiologically/psychologically capable of doing;  
leads to decreased performance capacity/decline in performance;  
the body experiences more catabolism than anabolism;  
there is a decline in muscular strength/coordination/maximal working capacity;  
results in a number of symptoms for example decreased appetite/body weight loss/muscle tenderness/prone to respiratory infections/allergic reactions/nausea/sleep disturbances/elevated resting heart rate/blood pressure/reduce motivation for training;  
overtraining takes longer to remedy than over-reaching;

**[2 max]**

- (b) resistance training is the purposeful use of resistance equipment in order to reach a desired goal/goals (including changing body shape (for example body building/increase in body size/muscle) / general fitness / athletic competition (for example weightlifting/powerlifting) / training for other sports / rehabilitation);  
resistance can be encountered from a number of sources including gravity/inertia/friction/elastic properties/fluid;  
increased duration of training and/or sets and/or repetitions and/or percent rep max during training;  
decrease rest time between training tasks;  
can be specific / target individual muscles and muscle groups;

***modes of training [1 max]:***

for example free weights allow for force production where the lifter is challenged to control, stabilize and direct the movement / produce sport specific movements;  
for example resistance machines permit movement in a guided/restricted manner that present less challenge with regard to control, stabilization and directed movement / some resistance machines restrict normal acceleration and velocity patterns;  
for example vibration is a newer concept in developing strength and power *ie* mechanical stimulus that results from an oscillatory motion (intensity, frequency and amplitude);

**[2 max]**

- (c) periodization can be defined as a (logical phasic) method of manipulating training variables in order to increase potential for achieving specific performance goals;  
periodization is non-linear training;  
discuss preparation phase (pre-season);  
discuss competition phase;  
discuss transition phase (off/post-season);  
main goals of periodization are reduction of overtraining potential/peaking at an appropriate time/providing maintenance for sports with a specific season;  
goals are met by variation of volume, intensity factors, and exercise selection;  
the coach can direct the adaptation process toward specific goals by varying the load or exercise selection of training (or both) across/between levels of variation (*ie* macro-, meso-, microcycles, daily and intratraining sessions);  
planning the training programme with periodization (macro {months to years} + meso {2 to 8 weeks} + micro {7 to 14 days});
- [3 max]

**A3.** (a) a substance/phenomenon that can improve an athlete's performance [1]

- (b) increased risk of blood viscosity;  
increased risk of blood clotting;  
increased risk of heart failure;  
potentially dangerous increases in blood pressure which may lead to strokes and heart attacks;
- [2 max]

- (c) increases mental alertness;  
increases concentration;  
elevates mood;  
decreases fatigue and delays its onset / improves endurance performance / sparing of muscle glycogen;  
decreases reaction time (*ie* faster response);  
enhances catecholamine release;  
increases FFA mobilization;  
increases use of muscle triglycerides;  
lowers perception of effort at a given rate of work;  
may facilitate calcium exchange at the sarcoplasmic reticulum/increase the activity of the sodium-potassium pump/better maintaining muscle membrane potential;
- [3 max]

**Option B — Psychology of sport**

- B1.** (a) (group) B **[1]**
- (b) (my parents) are proud of my sporting accomplishments **[1]**
- (c) intrinsically motivated people have a focus on fun;  
intrinsic motives can be associated with wanting to stay healthy/wanting to lose weight/to be or stay fit/to socialize with friends;  
intrinsically motivated people enjoy competition;  
intrinsically motivated people want to learn skills to the best of their ability/to achieve things;  
intrinsically motivated people enjoy improving/strive inwardly to be competent/are self-determined/proud;  
types of intrinsic (*ie* knowledge/accomplishment/stimulation);  
self-determination theory argues that competence, autonomy, and relatedness are the three basic human needs, and the degree to which they are satisfied will go a long way to determining an individual's intrinsic motivation; **[3 max]**

- B2.** (a) a negative emotional state in which feelings of nervousness, worry, and apprehension are associated with arousal and/or over-arousal of the body / negative aspect of mood / *OWTTE* **[1]**
- (b) mental preparation for the maximal fitness test;  
positive self-statements/self-talk can help sustain effort / positive self-talk focuses on increasing energy/effort/positive attitude;  
motivational/instructive self-talk can enhance self-esteem/motivation/attentional focus/performance;  
positive categories of self-talk include psych-up (for example for power)/confidence (for example I can make it)/instruction (for example focus on your technique) and anxiety control (for example calm down);  
metaphors are helpful for improving performance (for example quick like a cheetah/strong like a bull);  
self-talk techniques for improving performance include using short, specific phrases/first person/present tense/speaking kindly to yourself;  
use of thought stopping to cope with negative thoughts/change negative self-talk to positive self-talk;  
focusing on relevant cues (for example breathing techniques during the fitness test); **[3 max]**
- (c) improves neuro-muscular pathways;  
anecdotal/case study/experimental methods have shown that imagery can improve performance;  
effectiveness of imagery is influenced by both situational and personal factors/nature of the task/skill level of performer/imaging ability of the person;  
uses of imagery include enhancing motivation/reducing anxiety/building confidence/enhancing concentration/recovering from injury/solving problems /practising specific skills and strategies;  
requires training and development as a skill / athletes use visual/kinaesthetic /olfactory/auditory senses;  
not totally the full authentic performance experience/imagery not as useful as actually practising the skill;  
requires the involvement of a specialist in sports psychology; **[4 max]**  
*Award [3 max] if only implications or limitations are included in the response.*

- B3.** (a) data collection (interviews/questionnaires/observing behaviour);  
validity and reliability issues;  
ethical issues (informed consent, confidentiality, use of results, predicting performance);  
sport-specific measures of personality predict behaviour in sport settings better than general personality tests;  
personality can be influenced by many factors including the environment or the other people involved; *[2 max]*
- (b) the trait approach does not consider the particular situations that might also influence an individual's behaviour / situations alone are not enough to predict behaviour accurately;  
the interactionist approach considers the situation and the person as co-determinants of behaviour (*ie* variables that together determine behaviour);  
we can predict behaviour better when we have more knowledge of the specific situation and the ways individuals respond to particular types of situations; *[2 max]*
- (c) although personality traits and states can help predict sport behaviour and success, they are not precise;  
personality alone does not account for behaviour in sport and exercise;  
there is ambiguity in definitions of an athlete;  
no specific personality profile has been found that consistently distinguishes athletes from non-athletes;  
profiling results are often subjective, inaccurate and invalid;  
a non-athlete is unlikely to have experienced or had the need to respond to the sporting situations athletes find themselves in; *[3 max]*

**Option C — Physical activity and health**

- C1.** (a) (i) exercise group *[1]*
- (ii) exercise group *[1]*
- (b) the exercise group had a more positive body image score pre/post compared to the control group;  
the exercise group had a superior body image score (6.20) at the start of the programme compared to the control group (7.21);  
there was a greater change in body image score from pre to post for the exercise group compared to the control group / the post programme score for the exercise group (5.47) was a ~12 % improvement in body image;  
both groups had a similar pre variance score for body image (2.57 versus 2.59) / the variances were very similar pre-programme (2.57–25.9), but reached 50 % by the programme’s end (1.66–2.60);  
the exercise group had much less variance for body image score post exercise;  
the body image pre score for the exercise group was lower than the post score for the control group;  
for the control group the post programme score was 6.82 – a 5 % difference;  
the final difference between the two groups was 25 %;  
the body image score for both exercise groups was lower post compared to pre the ten-week exercise programme; *[2 max]*
- (c) physical activity/exercise has been shown to be associated with decreased symptoms of depression and anxiety / vice versa for physical inactivity / reductions in state anxiety and depression after exercise may be achieved with exercise intensities with sub-maximal exercise;  
the mechanisms responsible for physical activity/exercise-related improvements in depression and anxiety disorders are not all known (for example increased self-efficacy/a sense of mastery/distraction/changes of self-concept);  
nature of the exercise programme (enjoyable/rhythmic/absence of interpersonal competition/closed and predictable environment/20–30 minutes/several times a week) / exercise produces larger anti-depressant effects when the training programme is at least nine weeks long/adherence to a programme is over a longer term;  
anxiety/depression reduction after exercise occurs for all types of participants (male/female, fit/unfit, active/inactive, anxious/non-anxious, healthy/non-healthy, younger/older, with/without anxiety disorder, socio-economic status);  
both aerobic and anaerobic exercise are associated with reductions in depression;  
socialising aspect of exercising with other people; *[3 max]*

**C2.** (a) combinations of moderate and vigorous activity are complementary in the production of health benefits / moderate intensity aerobic activity for a minimum of 30 minutes on five days each week / vigorous intensity aerobic activity for a minimum of 20 minutes on three days each week;  
moderate intensity activities can be accumulated toward the 30 minute minimum by performing bouts lasting ten or more minutes;  
every adult should perform activities that maintain/increase muscular strength and muscular endurance on a minimum of two days per week;  
older adults should, in addition, undertake activities to maintain or increase flexibility and balance;  
further benefits may be gained by exceeding the minimum recommendations;  
everyday activities for example walking/cycling to work/doing housework/gardening/DIY/manual work / recreational activities for example dancing/active play amongst children/walking/cycling / sports, exercise and fitness training at a gym/exercise class/swimming / competitive sports for example football/rugby/tennis;

*[2 max]*

(b) there are socio-cultural, practical and knowledge barriers that impact on physical activity behaviours / knowledge barriers start with the correlation between higher educational achievement and higher levels of participation in physical activity;  
unsafe environments/hazards of exercise (for example cycle and swimming accidents);  
uncontrolled disease state (for example unstable angina/poorly controlled diabetes/uncontrolled hypertension);  
anxiety and lack of confidence / poor body image/self-esteem;  
musculoskeletal injuries;  
triggering of other health issues (for example heart attack/respiratory tract infections);  
practical barriers include physical, medical and economic obstacles (for example cost/safety/ access/ time pressures/health issues);

*[3 max]*

**C3.** (a) while the heart is contracting, little blood flows in the coronary arteries because they are squeezed shut / when the heart relaxes blood flows through the coronary arteries / *OWTTE*;  
right and left coronary arteries (branch from the aorta and) supply oxygenated blood to the heart / *OWTTE*;  
left coronary artery divides into the circumflex branch and left anterior descending artery / *OWTTE*;  
circumflex branch supplies oxygenated blood to the walls of the left ventricle and left atrium / *OWTTE*;  
left anterior descending artery supplies oxygenated blood to the walls of both ventricles / *OWTTE*;  
right coronary artery supplies the right atrium with oxygenated blood / *OWTTE*;  
right coronary artery divides and supplies the walls of the two ventricles with oxygenated blood / *OWTTE*;  
after blood passes through the coronary arteries, it flows into capillaries (delivering oxygen and nutrients/collects carbon dioxide and waste) and then into veins / *OWTTE*;

*[2 max]*

(b) simply getting old is a risk factor for cardiovascular disease;  
ethnicity plays a role – people with African/Asian ancestry are at higher risks of developing cardiovascular disease than other racial groups;  
cardiovascular risk factors that cannot be changed/non-modifiable (for example age/gender/heredity/family history/ethnic background);  
cardiovascular factors that can be changed/modifiable (for example high blood pressure/elevated serum cholesterol/cigarette smoking/obesity/diabetes/stress);  
cardiovascular protective factors (for example HDL cholesterol/exercise/moderate alcohol intake);  
cardiovascular risk factor modification (for example eat a diet low in saturated fats/reduce weight if overweight/moderate salt intake/take regular exercise/stop smoking);  
impact of risk factors is at least additive and possibly multiplicative / an individual's risk is determined in part by the number of risk factors present, as well as the level of each individual factor;  
compounding effect / it is not sensible to view the risk of having cardiovascular disease as great or small on the basis of a single risk factor / a treatment programme for risk factor reduction must be comprehensive;  
early detection and treatment of risk factors which initiate cardiovascular disease could arrest/greatly delay its further progression / emphasis should be on preventing the disease (instead of waiting for it to develop and then treat it) / use of imaging techniques/technologies/MRI;

*establishing causality:[1 max]*

large randomly-controlled intervention trials (for example of physical activity) with disease endpoints is problematic / epidemiological research is often observational and because of bias and confounding, a rather blunt tool;  
certain requirements must be satisfied before a causal claim is accepted (for example empirical demonstration of an association/an underlying mechanism) / criteria to assess whether a risk factor is causal (for example plausibility/consistency/strength of association/dose-response);  
validity of animal experimentation;

*[3 max]*

- (c) proliferation of the motor vehicle / *OWTTE*;  
changes in employment/working patterns / *OWTTE*;  
changes in diet / fast food / *OWTTE*;  
physical inactivity and modern lifestyles / TV watching/gaming/computer use;  
decline in walking and cycling / children driven to school by car / obesity  
epidemic / *OWTTE*;  
ageing populations / increase in the total number of older people worldwide /  
age-related diseases / rapid decline in activity level with increasing age / *OWTTE*; **[3 max]**

**Option D — Nutrition for sport, exercise and health**

- D1.** (a) group A/carbohydrate only group **[1]**
- (b) both groups had a slightly lower muscle force two days post training;  
group B had a muscle force that was slightly higher than the group A two days post training;  
the muscle force for group A lowered by more than the muscle force for group B two days post training; **[2 max]**
- (c) *an ergogenic aid:*  
is any natural substance that enhances performance;  
can act as a central/peripheral stimulant of the nervous system (for example caffeine);  
can increase storage/availability of a limiting substrate (for example creatine);  
can act as a supplemental fuel source (for example glucose);  
can reduce/neutralize performance-inhibiting metabolic by-products (for example bicarbonate);  
protein and amino acid supplementation may serve an anabolic role by optimizing body composition crucial in strength-related sports;  
dietary oxidants, for example vitamins C and E and carotenes, may prevent oxidative stress that occurs with intense exercise;  
performance during high-intensity exercise, for example sprinting, may be improved with short-term creatine loading, and high effort exercise lasting one to seven minutes may be improved through bicarbonate loading immediately prior to activity;  
caffeine dosing before exercise delays fatigue and may enhance performance of high-intensity exercise;  
can facilitate recovery (for example water);  
placebo effect; **[3 max]**

- D2.** (a) pepsin and trypsin **[1]**  
*Both required in any order to award [1].*
- (b) carbohydrates are absorbed as monosaccharides;  
glucose is transported into epithelial cells of the villi by active transport;  
glucose crosses the brush-border membrane, and passes through the cytosol of the absorptive cell / *OWTTE*;  
after absorption, glucose is transported out of the epithelial cells by diffusion into the capillaries / after absorption glucose crosses the basolateral membrane before entering the capillary network; **[2 max]**
- (c) an enzyme is a (highly specific) protein catalyst;  
enzymes accelerate the forward and reverse rates of chemical reactions;  
the human body functions at approximately 37 °C therefore increasing the need for enzymes to speed up reactions in the body;  
temperature (and hydrogen ion concentration) affects enzyme activity / increases in temperature generally accelerate enzyme reactivity;  
each digestive enzyme performs its maximum activity at a specific pH;  
digestive enzymes (are diverse and) are found in the saliva, in the stomach, in the pancreatic juice and in the intestinal (small and large) secretions/as part of the lining of the gastrointestinal tract; **[2 max]**

- D3.** (a) self-monitoring/monitoring by the hockey coach/medical staff;  
monitoring body weight stability/euhydration in a bodyweight that is relatively stable (within 0.45 kg) day to day / in sports the level of dehydration is quantified by the amount of weight lost (usually by exercise) during a diurnal cycle;  
monitoring urine volume/osmolality/specific gravity/colour;  
blood-borne indicators (for example changes in serum osmolality/serum sodium);  
monitoring of body water stores/bioelectrical impedance; *[3 max]*
- (b) homeostasis is the condition in which the body's internal environment remains relatively constant (within physiological limits) / a feedback system is a cycle of events in which the status of a body condition is continually monitored, evaluated, changed, re-monitored, re-evaluated, and so on (for example blood glucose level);  
negative feedback is a mechanism of response in which a stimulus initiates actions that reverse/reduce the stimulus;  
receptors that are part of the feedback system detect the change and send input to a control centre;  
control centre evaluates the input and, if necessary, issues output commands to an effector / *OWTTE*;  
effector produces a physiological response that is able to return the controlled condition to its normal state;  
nervous and hormonal systems work in harmony to achieve homeostasis; *[3 max]*
- (c) drinking too much fluid with too little sodium can lead to hyponatremia;  
hyponatremia is low plasma levels of sodium/deficiency of sodium ions in the blood/a blood sodium concentration below the normal range (of 136 to 143 mmol L<sup>-1</sup>);  
very low levels of blood sodium concentration (below 130 mmol L<sup>-1</sup>) trigger severe symptoms/water intoxication;  
symptoms of hyponatremia range from mild (for example headache) to severe (for example pulmonary edema) / symptoms appear in stages – weakness, disorientation, seizures, and coma;  
hyponatremia can lead to coma/death if the condition is not reversed;  
frequently ingesting large volumes of plain water draws sodium from the extra-cellular fluid compartment into the unabsorbed intestinal water, further diluting sodium concentration; *[3 max]*
-