N13/4/SPEXS/SP2/ENG/TZ0/XX/M

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MARKSCHEME

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SPORTS, EXERCISE AND HEALTH SCIENCE

Standard Level

Paper 2

16 pages

Subject Details: Sports, Exercise and Health Science SL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[30 marks]** and **ONE** question in Section B **[20 marks]**. Maximum total = **[50 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.

SECTION A

1. (a) low (speed) ***[1]***

(b) distance travelled over time ***[1]***

(c) *service fault:* ***[1 max]***
increase in speed results in a higher percentage of service faults / *OWTTE*;
Accept responses in the converse.

ace: ***[1 max]***
females have more aces at low/high speeds compared to medium speeds;
females have fewer aces at medium speeds compared to low/high speeds; ***[2 max]***

(d) *opponent finds it easy to control the ball:*
(hypothesis supported) with increasing speed, males are more effective at preventing opponents from controlling the ball easily;

opponent finds it difficult to control the ball:
(hypothesis not supported) males are most effective in influencing opponents to receive the ball in a difficult position when serving at a medium speed;
(hypothesis not supported) males are least effective when serving at high speed;
(hypothesis not supported) males are more effective at influencing opponents to receive the ball at medium/low speeds than at high speed; ***[3 max]***

(e) females achieve greater ball speed than males in both the float and float jump serve;
males achieve greater ball speed than females in the jump serve;
males/females both achieve greater ball speed from float/float jump serve;
females perform with approximately the same degree of variability in all three serves whereas the males do not / *OWTTE*;
males perform with a greater degree of variability than females in the jump serve / *OWTTE*; ***[3 max]***

(f) skill is the ability and selection of an appropriate technique / skill is the ability to perform the appropriate technique on demand ***[1]***

(g) gross-fine;
is a (predominantly) gross skill, requiring the activation of large muscle groups in both the arms and legs to generate the sufficient force to propel the ball to the opponent's side of the court;

open-closed;
is a (predominantly) closed skill, there are limited environmental variables that impact on the performance of the skill;

discrete-serial-continuous; ***[1 max]***
is a (predominantly) serial skill that requires several discrete skills to be combined in order to create a more complex "whole" skill;
an underarm serve would be seen as a (predominately) discrete skill;

externally-internally paced;
is a (predominantly) internally paced skill and is mainly under the performer's control / relies upon the server to initiate the serve when they desire (although there will be a degree of external pressure that requires them to have served the ball within a prescribed time limit that will need to be adhered to);

individual-coactive-interactive;
is a (predominantly) coactive skill, performers are competing at the same time but are physically separated from one another (cannot physically inhibit the performer); ***[2 max]***
*Award **[1 max]** for stating the classification.*

2. (a) 1. adipose tissue;
2. skeletal muscle; ***[2]***
Accept responses in any order.

(b) essential amino acids cannot be synthesized by the human body and must be obtained from the individual's diet;
non-essential amino acids can be synthesized by the human body; ***[2]***

(c) insulin is secreted in response to elevated/high levels of blood glucose;
insulin secreted from pancreas;
insulin lowers the elevated blood sugar;
insulin accelerates/speeds up diffusion of glucose into cells (especially in skeletal muscle cells);
excess glucose is converted into glycogen, removed from the blood stream, and stored in the liver and muscles; ***[3 max]***

3. (a) X: sartorius;
Y: vastus lateralis; ***[2]***

(b) involuntary/smooth muscle is not (directly) under conscious control / blood vessels/airways/stomach/intestines/non-striated;
cardiac muscle is only found at the heart/unique to the heart/is a myogenic muscle (initiates its own contraction)/striated; ***[1 max]***
Do not award a mark for stating the type of muscle.

(c) *eg vertical jump/sergeant jump:* ***[3 max]***
presents greater validity as a testing method for events that require a single explosive action of the legs;
may present less validity for activities that require a series of jumps to be performed;
only focuses on power exhibited by one primary muscle group;
influenced by individual factors such as limb length when vertical jump protocol requires individuals to place a vertical marker from a standing position to the apex of their jump to determine jump height / individuals may actively underperform "baseline" measurement in order to amplify their result;

eg standing long jump: ***[3 max]***
presents greater validity as a testing method for events that require a single explosive action of the legs;
may present less validity for activities that require a series of jumps to be performed;
only focuses on power exhibited by one primary muscle group;
type of environment being used may influence results (*eg* use of a sandpit may encourage individuals to throw their body forward upon landing to land in sand, an option that may not be permissible in a sports hall/gymnasium setting);
degree of variability based upon techniques used by individual to develop momentum (squatting down/swinging arms a number of times); ***[3 max]***
Award credit for an evaluation of any other appropriate test, eg jump mats or force platform.

4. (a) warming of the air;
moistening of the air;
defence/filtering against chemicals/harmful substances that are breathed-in/inhaled; ***[1 max]***

(b) VO_2 max is the maximum volume of oxygen an individual can consume during exercise;
males tend to be physically bigger (*eg* larger lungs) than females and have a higher VO_2 max that corresponds with this / vice versa;
difference in body composition of males and females;
males tend to have a greater hemoglobin concentration than females and have a higher VO_2 max that corresponds with this / vice versa; ***[3 max]***

SECTION B

5. (a) *validity:* ***[2 max]***

is the extent to which a method/measurement of an investigation possesses the property of doing what it has been designed to do/measure;
eg testing the sprint speed of a cyclist using a running test such as a 40 m sprint would not yield valid results of the cyclist's cycling sprint speed as it employs a different mode of transport not applicable to the sport / *OWTTE*;
achieving external validity would enable your experimental results to be applicable to real situations/generalized to the population as a whole/reliant (in part) upon the adequacy of the sample;
internal validity is the extent to which the outcome/result of an investigation is a function of the variables that are measured/controlled/manipulated;

reliability: ***[2 max]***

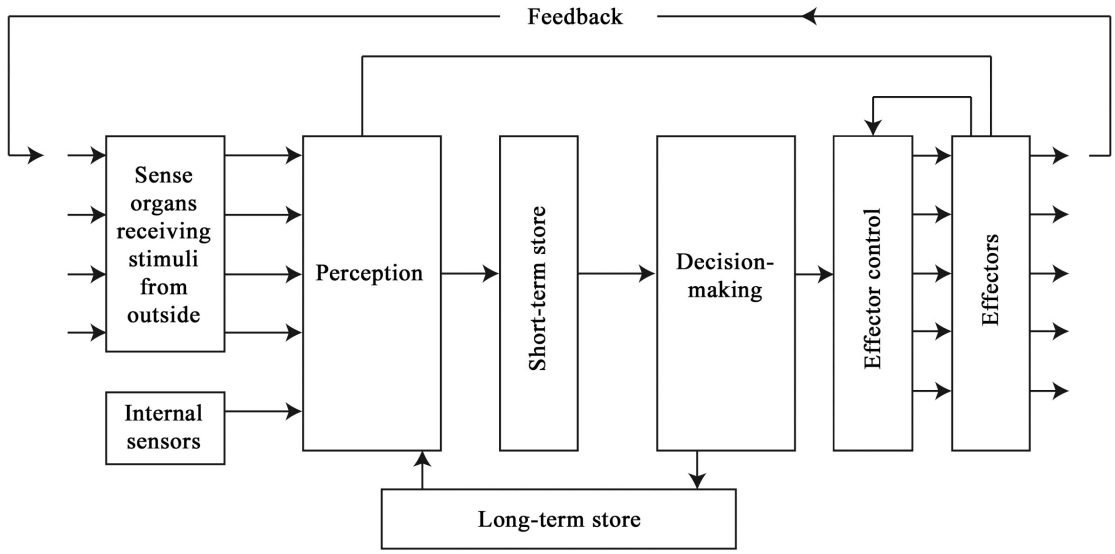
a test is reliable when you undertake a retest under the same conditions as the original and a similar result is obtained;
it is important for tests to be repeatable so that any improvements in performance can be identified and tracked/so that the effect of the manipulated variable can be clearly seen;
reliability in any kind of testing questions the accuracy of test results; ***[4 max]***

(b) a gradual increase of stress placed upon the body during exercise training / forces the body to work harder than normal;
the body and its systems are permitted time to the necessary time-frame in order to adapt to the stress being placed upon it;
if sufficient recuperation is permitted, a training effect takes place;
eg muscle hypertrophy / local muscular endurance / cardio-respiratory endurance; *Accept other relevant examples.*
as adaptation takes place, a further increase in training load is required to stimulate further increases;
intensity of training can be increased (how hard the individual trains) / increase the heart rate (within their training zone) at which the individual trains;
duration of training can be increased (how long the individual trains for) / train for a longer period of time;
frequency of training can increase (how often the individual trains / increase the number of training sessions within a given time period (day/week);
overtraining can lead to drop in performance / risk of experiencing overuse injuries;
over-reaching can occur with overload; ***[5 max]***

(c) *eg age:* ***[3 max]***
all children grow and develop (their respective systems) at different rates/speeds;
children must not be treated as "mini adults" and tasks must be adapted/differentiated to the individual needs of the young athlete;
specific catering for the child's needs can be achieved through different equipment (smaller basketballs)/smaller playing area dimensions/ adapted rules/greater timespan to learn skill;
puberty can impact on rates of learning through increases in height/weight/ strength/coordination/body composition;

eg individual differences between coaches: ***[3 max]***
level of knowledge/experience will facilitate enhanced methods of task prescription / ability to identify and acknowledge moments of ignition / foster a positive teaching environment;
use of rewards/motivational strategies may enhance the individual performance;
provide timely feedback to permit the individual to refine their performance;
utilize a range of teaching styles to enable individuals to experience a range of responsibility and opportunities to directly learn and refine skills with the assistance of the coach in addition to having the opportunity to take greater responsibility for their own training;
regular professional development/training will enable the coach to remain up to date with contemporary coaching philosophies/refine their knowledge of coaching concepts (such as motivation, skill learning) that underpin their training sessions;
if the manner which the coach adopts to convey information is consistent with the preferred learning style of the individual(s), it will enhance their rate of learning; ***[6 max]***
Accept any other valid examples (physical fitness/maturation / difficulty of task / teaching environment and motivation).

(d) *Accept a schematic representation of Welford's model of information processing, eg:*



[Source: P Beashel *et al.*, (1999), *Advanced Studies in Physical Education and Sport*, page 244]

sense organs: ***[1 max]***
receive information from our senses / there are three main ways of taking in information/three receptor systems – vision (sight), audition (hearing) and proprioceptors, which detect internal muscular tension and joint movement and help inform us of balance, touch and kinaesthesis;
eg an athlete takes in information through their eyes, ears and proprioreceptors/senses and temporarily stores all of these inputs (information about team mates, opponents, ball, pitch markings, verbal comments) prior to sorting them out;

perception: ***[1 max]***
is the process by which the brain makes sense of the stimuli received / information is perceived and filtered into relevant and irrelevant / all the information picked up by the senses is filtered by selective attention so that only relevant information, such as the flight of the ball, is retained and confusion is avoided / selective attention looks out for anticipated stimuli;
eg athletes filter numerous stimuli extracting the relevant cues, *eg* position of team mates/opposition/the ball/position on the field and they are stored in the short-term memory;

short-term memory: ***[1 max]***
stores large amounts of information for a very short time;
the inputs that are seen as relevant to the decision are then stored in the short-term memory;

decision-making: ***[1 max]***
a decision based on the relevant information or stimulus is made / an appropriate action is decided upon / a decision is made by comparing the information in the short-term memory with previous experiences stored in the long-term memory;
eg in deciding when to make a tackle, the player will compare this situation with previous situations stored in the long-term memory;

long-term memory:
selected stimuli are compared to past experiences stored in the long-term memory to select the appropriate response;

effector control:
a process that allows the decision to be put into action by sending impulses to the muscles / a network of nerves carries a message to the relevant muscles;

effectors:
action is performed with reference to movement patterns / muscular contractions take place and produce the selected response/perform the required movement;

feedback: ***[1 max]***
after the response, feedback may be either intrinsic (kinaesthesis) or extrinsic (from coach);
plays an important role in movement execution / information about the movement can be fed back into the effector mechanism allowing (if time permits) corrections to be made as the movement proceeds;
feedback also goes back in the perceptual mechanism;
since this feedback is longer (than the effector feedback loop) it takes more time to be processed, but if the movement were long enough, the information could still be used to correct latter parts for the total movement;
this feedback loop (with the perceptual system) also provides the performer (after the movement has been completed) with information regarding the success of the movement;
eg after the tackle, feedback is used to correct errors and may be either intrinsic (kinaesthesis) or extrinsic (from coach). The action and the results are stored for future reference and the whole process then begins again / *OWTTE*; ***[5 max]***
Award ***[1 max]*** *for suitable descriptions of each component related to the named example.*
Award ***[1 max]*** *if all components have been identified/identified in an appropriate diagram.*

6. (a) isokinetic; ***[2 max]***
contraction that produces movement at a constant speed/angular velocity over a joint's full range of motion;
the muscle is maximally tensed over the full range of motion;
do not normally occur during sport (where muscular contractions vary tremendously in speed and range of motion);
achieved through use of specialized (isokinetic) equipment;

isotonic; ***[2 max]***
contractions generate forces during muscle shortening at a constant rate, angle and utilizes the full range of movement;
tension remains the same / constant load is moved through the range of motion(s) possible at a joint;

eccentric;
the muscle lengthens / dynamic muscle movement;

concentric;
the muscle shortens / concentric muscle movement;

isometric;
contractions generate forces during a static contraction of the muscle where no muscle shortening or lengthening occurs; ***[4 max]***
*Award **[1]** for stating or identifying the type of contraction.*
*Award **[2 max]** per type of contraction.*

(b) reciprocal inhibition is where one muscle contracts and another relaxes;
contraction of a prime mover (agonist) with the simultaneous relaxation of the other (antagonist) muscles;
the process inhibits the stretch reflex in the antagonistic pair / when one muscle contracts an inhibitory nerve impulse is sent to the opposite muscle;
reciprocal innervations connect the antagonistic pair of muscles;
the triceps brachii are considered the agonist / triceps brachii are contracting;
the biceps brachii are considered the antagonist / biceps brachii are relaxing; ***[4 max]***

(c) depolarization of the motor end plate travels throughout the muscle via the transverse tubules/neural impulse action potential/muscle action potential;
calcium ions are released from the sarcoplasmic reticulum;
calcium binds to troponin, changing its shape/moving tropomyosin from the active site of the actin/exposes active sites on actin;
actin and myosin bind together forming a cross-bridge;
myosin head tilts toward the arm of the cross-bridge;
the breakdown of ATP releases energy;
myosin head drags actin and myosin filaments in opposite directions/performs a power stroke;
pulling of the actin filament past the myosin results in muscle shortening/sarcomere shortens (Z line shortens);
shortening of the sarcomere occurs along the entire length of every myofibril in the muscle cell;
pulling of the myosin head results in the generation of force;
immediately after the myosin head tilts, it breaks away from the active site, rotates back to its original position, and attaches to a new active site further along the actin filament;
the myosin head detaches from the actin when an ATP molecule binds to the myosin head;
the ATP is then broken down and the myosin head can again attach to an actin binding site further along the actin filament;
repeated attachments and power strokes cause the filaments to slide/contract past one another;
process continues until the ends of the myosin filaments reach the Z disks;
H zone disappears and thus shortens;
at rest troponin holds the tropomyosin in position to block the myosin-binding sites on actin filaments; ***[6 max]***

(d) at the start of the event all three systems are activated;

ATP-PC system:
the ATP-PC system produces energy quickest;
peaks around (approximately) 5 seconds and is exhausted after (approximately) 12–15 seconds;

lactic acid system:
lactic acid system peaks at around (approximately) 15 seconds and starts to decline;
there is the opportunity to oxidize metabolic by-products therefore allowing the lactic acid system to contribute additional energy for a burst of higher intensity work;

aerobic system: ***[2 max]***
at around the (approximately) 55-second point the aerobic system is the dominant producer of energy;
if steady state is achieved, energy demands are being met by the aerobic systems;
the aerobic system continues to increase until either it meets the energy demands, the event finishes or maximum oxygen consumption is reached;

at the conclusion of the event the major system utilized is the aerobic which is reflected in the excessive post-exercise consumption, it will return the body to resting conditions;
during this time anaerobic systems will be returned to resting levels;
the major energy sources for exercise are dependent on intensity/duration of the activity; ***[6 max]***
Award ***[2 max]*** *per energy system.*

7. (a) *contractility:*
the ability of muscle cells to actively generate force/to undergo shortening for movements;

elasticity:
the ability of muscle tissue to return to its original shape after contraction/extension;

extensibility:
ability of muscle to stretch without damage (within the permitted range of movement);

atrophy:
wasting away/decrease in size of muscle fibre diameter;

hypertrophy:
an enlargement of muscle tissue without cell division;

controlled by nerve stimuli:
the ability of muscle tissue to be stimulated by electrical impulses/ excitability/conductivity;

fed by capillaries:
capillaries supply muscles with oxygen and nutrients/remove waste products; ***[4 max]***

(b) the heart initiates/creates its own (myogenic) contraction / the heart does not require nerve stimulation to enable it to contract;
the heart conducts messages that allow it to generate its own contraction via a specialized group of cells that are embedded within the walls of the heart;
the sinoatrial node/SA node is located within the right atrium / the SA node acts as the pacemaker for the heart;
the actions/firing rate/stimulation of the pacemaker/SA node can be influenced by the actions of the parasympathetic (branch of the autonomic) system / slows down/reduces heart rate;
the actions of the sympathetic (branch of the autonomic) system increases/stimulates heart rate;
neurotransmitters, released by the parasympathetic systems are responsible for decreasing/increasing heart rate (respectively);
hormonal stimulation from adrenaline can also influence/increase heart rate;
the SA node sends an impulse to contract through the (left and right) atria and to the atrio-ventricular;
this causes the atria to contract/increase pressure and forces blood into the ventricles (although passive filling is also responsible);
the atrio-ventricular node/AV node is located in the bottom of the right atrium and conducts the impulse to the bundle of His;
the bundle of His/bundle branches are located within the atrial septum/central ventricle walls and spreads towards the Purkinje fibres;
Purkinje fibres are located within the ventricle walls;
stimulation of the Purkinje fibres increases pressure in the ventricles sufficiently to eject blood up and out of the (pulmonary/aortic) arteries; ***[6 max]***

(c) slow rise in heart rate when exercise is performed at a constant work rate over a prolonged period/in a hot environment;
rise in core temperature causes a redistribution of blood (through vasodilation) to the peripheral circulation;
water loss occurs via sweating;
fluid shift from plasma to tissues / reduction in blood plasma;
redistribution of blood to the periphery for body cooling;
the fall in plasma volume reduces stroke volume / Starling's law;
compensatory heart rate increase to maintain a constant cardiac output;
lower venous return;
increased blood viscosity; ***[6 max]***

(d)

Distribution of blood at rest	Redistribution of blood during exercise (long distance run)
approximately 20 % of the cardiac output goes to muscle	approximately 75 % of the cardiac output goes to muscle/most of the cardiac output;
approximately 20 % of the cardiac output goes to muscle	a shift in blood flow is accomplished partly by vasodilation in skeletal muscle / blood/vascular shunting;
approximate percentage cardiac output to kidneys is 25 %	approximate percentage cardiac output to kidneys is 3 %;
approximate percentage cardiac output to brain is 15 %	shift in blood flow is accomplished primarily by reducing blood flow / vasoconstriction to the kidneys/liver/stomach/intestines;
approximate percentage cardiac output to brain is 15 %	approximate percentage cardiac output to brain during exercise is 5 % / is consistent with volume distributed to brain at rest;
approximately 5 % of the cardiac output goes to heart	remains relatively constant (as a percentage) but in relative terms, trebles in amount it receives;
kidneys and viscera receive the largest proportion of blood / *OWTTE*	skeletal muscles receive the largest proportion of blood / *OWTTE*;

*Award **[1]** per row.*

Accept blood redistribution figures during exercise (ml min^{-1}) /tabular form.

Organ	Rest / %	Exercise / %
brain	750 (15)	750 (4.5);
heart	250 (5)	750 (4.5);
kidneys	1200 (24)	600 (3.6);
muscles	1000 (20)	12 500 (75);
skin	400 (8)	1900 (11.4);
viscera	1400 (28)	600 (3.6);
other	600 (12)	600 (3.6);
total	5600	17 500;

[4 max]

Accept proportionate values within ± 5 %.
*Accept **[1]** per row.*