M13/4/SPEXS/SP2/ENG/TZ0/XX/M

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MARKSCHEME

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SPORTS, EXERCISE AND HEALTH SCIENCE

Standard Level

Paper 2

15 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) distance running ***[1]***

(b) the breakdown of glucose to pyruvate without the use of oxygen / is an anaerobic pathway;
pyruvate is converted into lactic acid;
two/three ATP molecules produced;
generally used for high to medium intensity activities lasting no longer than two minutes; ***[2 max]***

(c) *Award **[2 max]** for characteristics:*
$\text{ATP} \rightarrow \text{enzyme} \rightarrow \text{ADP} + \text{P}_\text{i} + \text{energy} \rightarrow \text{contraction};$
fuel source is creatine phosphate/phosphocreatine/CP/PC;
amount of ATP production is limited;
energy released by the breakdown of phosphocreatine rebuilds/resynthesis ATP/to couple P_i to ADP forming ATP;
no by-products;
the potential rate for power output is at its greatest;
quickly forms new ATP;
once exhausted, can be replenished after 30 seconds to two minutes rest;

*Award **[1 max]** for relative contribution:*
the ATP-CP system is the main energy source for ATP in activities of very short duration/3–15 seconds;
gymnastics involves short sharp bursts of power and strength so the relative contribution of the ATP-CP system is high/80 %; ***[3 max]***

(d) during distance running the three energy systems will be in action with different contributions / *OWTTE*;
the anaerobic systems will produce small amounts of energy during distance running when large muscle power outputs during brief intense periods are required for example at the start of the event/during an increase in pace towards the end where the runner may sprint/during an uphill stage/when over-taking another runner;
the anaerobic energy systems will be limited, however, by the amount of energy it can produce;
the build-up of lactic acid and a quick depletion of CP will bring about a reduction in power and a drop off in speed / *OWTTE*;
distance running is essentially aerobic;
the aerobic energy system is capable of producing large amounts of energy;
the aerobic energy system will contribute the greatest percentage of energy production;
the aerobic energy system will be limited by the amount of fuel/carbohydrate/fat available;
*Award **[1 max]** per energy system.*
Accept marking point if in table format for example

Distance	ATP-CP / %	Aerobic/anaerobic / %	Aerobic / %
5000 m	5	25	70
10 000 m	3	20	77
42.2 km	1	10	89

[3 max]

(e) slow rise in heart rate when exercise is performed at a constant work rate over a prolonged period;
due to dehydration and rising temperature within the muscles;
rise in core temperature causing redistribution of blood to the periphery;
characterized by decreases in mean arterial pressure and stroke volume and an increase in heart rate to promote cooling;
blood flow to skin is increased;
water loss via sweating;
fluid shift from plasma to tissues;
redistribution of blood to the periphery for body cooling;
fall in plasma volume reduces stroke volume;
compensatory heart rate increase to maintain a constant cardiac output
$\left(\mathrm{HR} = \mathrm{SV} \times \mathrm{Q}\right)$;
increased blood viscosity;
cardiovascular drift is a greater challenge in hot climates; ***[3 max]***

2. (a) X: cervical vertebrae/vertebrae/vertebral column
Y: scapula ***[1]***
Both required for ***[1]****.*

(b) *axial skeleton:* ***[1 max]***
provides protection for brain, spinal cord, heart, digestive system;
is responsible for the upright position of the body;
transmits the weight from the head, the trunk and the upper extremities down to the lower extremities at the hip joints;
is responsible for the upright position of the human body;

appendicular skeleton: ***[1 max]***
provides protection for digestive, excretive and reproductive organs;
blood cell formation in long bones;
attachment of ligaments and muscles allowing for large movements; ***[2 max]***

3. (a) X: myosin filaments/H zone
Y: Z line/actin filaments ***[1]***
Both required for ***[1]****.*

(b) an action potential arrives at the motor endplate attached to many myofibrils;
a muscle is stimulated by a nerve impulse which releases calcium ions/Ca^{2+} from the sarcoplasmic reticulum;
Ca^{2+} binds with troponin which removes tropomyosin from the active site on the actin;
the actin and myosin form cross-bridges;
cross-bridges swivel, release and reform as the actin is pulled over the myosin and muscle shortens;
the I bands and H zones become narrower;
eventually disappear during maximal contraction;
A bands remain the same length during contraction (but are pulled towards the origin of the muscle);
muscle contraction only occurs when the level of calcium ions is high enough;
muscle contraction only occurs when ATP is available; ***[3 max]***

4. (a) power/leg power / lower limb explosive strength ***[1]***

(b) conduct the test under the same conditions/standardized warm up/familiarization/pre test briefing;
allow an acclimatization/practice period;
consistent instructions to subjects;
use the same person as the recorder;
test retest to ensure reliability;
repeat testing at the same time of day;
controlled environment (landing pit/hard surface);
use the same equipment;
use identical protocol (a two foot take-off and landing is used, with swinging of the arms); ***[3 max]***

(c) *field testing:*
can be cost effective;
can be performed more frequently;
can often require minimal equipment;
enables the testing of large numbers of subjects;
provides a meaningful/authentic environment for the athlete / higher ecological validity;
simulates specific conditions;
more readily available compared to laboratory testing;

laboratory testing:
provides a controlled environment;
uses specific equipment that cannot be transferred to the field (VO_2 max test);
frequently requires a higher level of technical support compared to field testing; ***[3 max]***
*Award **[2 max]** if only one type of testing is discussed.*

5. (a) (i) is the rate in which a body moves from one location to another / speed in a given direction / measures the rate (speed) of the positional change of an object / $\frac{\text{displacement}}{\text{time}}$ ***[1]***

(ii) is the measure of the amount of motion possessed by a moving body / mass $\times$ velocity ***[1]***

(b) in position A/standing with arms by side the centre of mass is located at around half of the person's height/near "belly button" / the point about which the body's mass is evenly distributed;
in position B/moving arms above head the centre of mass shifts upwards;
this is due to the distribution of mass shifting upwards; ***[2 max]***

SECTION B

6. (a) immediately after take-off the momentum generated is conserved throughout the dive;
the magnitude of angular momentum remains constant throughout the dive;
angular momentum = rotational velocity × moment of inertia;
the moment of inertia is larger when the body has an increased radius;
the speed of rotation/rotational velocity may be increased by moving the body into a compact (tucked/pike) shape;
the speed of rotation/rotational velocity is reduced by opening out into a straight position;
when gravity is the only external force acting on the diver, the angular momentum generated at take-off remains constant for the duration of the flight / Newton's first law;
the torque/turning effect of a force applied over time at the point of take-off determines the quantity of angular momentum; ***[3 max]***

(b) *for example gross and fine:*
small muscle action or small margin of error versus large muscle action or large margin of error;
most sports skills are gross motor skills;
fine motor skills are rarely found in sport and generally involve high levels of hand-eye coordination for example darts/snooker/putting in golf;

for example open and closed:
changing environment versus fixed environment;
a stable environment versus a predictable one;
closed skill allows the performer to commence the skill when they are ready;
open skills performed in spatially changing setting;
open skills requires the performer to act upon the object according to the action of the object;

for example discrete – continuous – serial:
clear beginning and end – unclear beginning and end;
several discrete tasks;

for example external – internal paced skills:
the environment determines the start of the skill – the performer determines the start of the skill;
internally paced allows the performer to be in full control of the timing of the movement;
internally paced requires proaction by the performer;
externally paced skills requires reaction;

for example interaction continuum (individual – coactive – interactive):
individual skills are those performed in isolation;
coactive skills are those performed at the same time as others but without direct confrontation;
interactive skills are those performed where other performers are directly involved; ***[6 max]***
*Award **[2 max]** per classification.*
Accept an example as an alternative to definition/summary.

(c) warming of the air by the nasal cavity;
moistening of the air by the nasal cavity / these add water vapour to inspired air;
cilia filters foreign particles from the air;
trap particulate matter and fumes (for example smoke/ozone/dust/yeast/bacteria);
provide some defence against chemicals/pollution and other harmful substances (that are inhaled);
pressure difference created by lung cavity provides low resistance pathway for air flow; ***[3 max]***

(d) *for example physical maturation*: ***[2 max]***
young learners have difficulty in focusing on important cues, difficulty in processing information;
young learners make a large number of errors;
as learners mature, more motor plans are generated;

for example physical fitness: ***[2 max]***
size, shape and level of fitness may assist in learning;
one diver may have more flexibility and strength than the other;
a learner has an ability to make decisions more effectively if they are not fatigued;

for example motivation:
can be related to a person's inner drive (intrinsic) or external factors such as trophies (extrinsic);
the strength of a learner's drive to achieve is (very) individual;
motivation is also linked to a person's state of arousal;

for example individual difference of coaches:
a coach's teaching style (command/reciprocal) may appeal to one diver but not the other;

for example age:
physical maturation/experience/emotional maturity will affect the progress of a learner;

for example difficulty of task:
progress will be slowed if the task is too difficult for the learner; this may have an impact on the motivation of the diver;

for example teaching environment:
a safe teaching environment/limited distractions/small group learning/attention; ***[4 max]***

(e) when the phosphate bonds of ATP are broken, the energy released from the ATP supplies the energy necessary to form or break chemical bonds in biochemical reactions (in a cell);
in the muscle, the coupling of actomyosin/formation of myosin and actin, stimulates the breakdown of ATP;
the release of energy allows the cross-bridges to swivel towards the middle of the sarcomere;
pulling the actin over the myosin, making the muscle shorter;
when the stimulus from the nerve stops and the muscle returns to resting state, ADP is rejoined to phosphate to reform ATP; ***[4 max]***

7. (a) use of heart rate monitors;
manual measurement of heart rate;
use of heart rate measurements based upon its relationship with oxygen uptake;
target heart rate/target range zone charts;
Karvonen method;
ratings of perceived exertion (Borg/OMNI/CERT scales);
METS – a multiple of resting oxygen consumption;
a specific example *eg* blood lactate testing / percentage of peak running speed; ***[4 max]***

(b) progression – readjust overload once adaptation takes place;
frequency – increase the number of training sessions to at least three times per week;
intensity – set the training session between 70–85 % of maximum heart rate;
duration – the session should last for a minimum of 20–40 minutes to develop cardiovascular capacity;
specificity – running should be the main mode of training/consider involving change of direction tasks whilst running/the bleep test could actually be used as a training tool;
variety – Fartlek/interval/hills/continuous/circuit training/cross fit; ***[4 max]***

(c) most of the oxygen in the body is transported by chemically combining with hemoglobin / oxygen enters the red blood cells and binds to the iron within the hemoglobin molecules;
oxygen and hemoglobin are bound in an easily reversible reaction (to form oxyhemoglobin);
each molecule of hemoglobin can transport four oxygen molecules;
as blood passes through the lungs, the hemoglobin picks up oxygen because of the increased oxygen pressure in the capillaries of the lungs;
it then releases this oxygen (dissociates) to body cells where the partial pressure of oxygen in the tissues is lower; ***[3 max]***

(d)

	Gymnastics floor routine	**Soccer player**
Body involvement	gross/large muscle groups	gross/large muscle groups;
Continuity	serial/a series of discrete skills	continuous/no clear beginning or end;
Environment	closed	open;
Pacing	internal	external;
Interaction	individual	interactive;

[4 max]

Award ***[1]*** *for each correct row.*

(e) insulin is secreted by the beta cells/islets of Langerhans of the pancreas in response to high blood sugar levels;
insulin regulates the sugar level in the body;
enzymes that convert glucose to glycogen are stimulated by insulin;
storage of triglycerides/lipids in the adipose tissue is stimulated by insulin;
receptors in the pancreas are sensitive to the changes in sugar level;
thus releasing the necessary requirements of insulin depending on the needs of the body;
a diet high in sugar and fat will result in a high release of insulin;
and consequently an increase in glycogen storage and accumulation of fat occurs;
sensitivity to insulin is reduced / obese subjects have poor insulin sensitivity (even if they are relatively healthy);
high levels of body fat and insulin resistance are closely linked; ***[5 max]***

8. (a) contractility – muscle has the ability to shorten;
excitability – muscle responds to a stimulus/nerve impulse;
extensibility – muscle can lengthen beyond its resting length;
elasticity – after being stretched beyond its normal resting length, muscle can return to its original length without damage (to a certain degree);
atrophy – if a muscle is not being utilized, it will waste away;
hypertrophy – muscles can grow in size (generally by increasing the size of the muscle cell);
fed by capillaries which ensures a constant supply of oxygen-rich blood and nutrients; ***[4 max]***

(b) when movements occur, muscles work in a pair (to accommodate movement *ie* muscles pull, they do not push);
agonist is the muscle that contracts/shortens (the prime mover);
antagonist is the muscle that is relaxing/stretching to allow the movement to occur;
when the prime mover is being stimulated to contract the nerve impulse to the antagonist is inhibited;
reciprocal inhibition is a safeguard against injury; ***[3 max]***

(c) the sport/skill is completely new to the learner / the beginning/initial stage of the learning stages continuum;
characterized by a large number of errors;
performance is highly variable/shows a lack of consistency from one attempt to the next;
learners are less likely to self-correct;
during the cognitive stage of learning, the beginner focuses on cognitively-orientated problems for example how fast should I move this arm?/ where should this arm be when my right leg is here?;
the learner must engage in cognitive processing as he/she listens to instructions and receives feedback;
the learner uses verbalization to aid memory;
identification and development of the component parts of the skill;
involves formation of a mental picture of the skill;
change in the rate of improvement is faster in the cognitive phase; ***[3 max]***

(d) definition of systolic blood pressure and diastolic blood pressure;
systolic blood pressure will increase for both the flexed arm hang and the chin-up;
cardiac output increases significantly for both the flexed arm hang and the chin-up which raises systolic blood pressure;
during dynamic exercise (chin-up) there is very little change in diastolic blood pressure / during isometric exercise (flexed arm hang) diastolic blood pressure increases;
during dynamic exercise there is a vasodilation of the blood vessels in the muscles;
during isometric exercise there is a resistance to blood flow caused by the contracting muscle/constriction of blood vessels/inactive muscle pump;
Accept marking points as a table for example

State	Systolic	Diastolic
Rest	120	80;
Static exercise/arm hang	increased	increased;
Dynamic exercise / chin-up	increased	unchanged (possible small decrease);

[4 max]

(e) gas exchange occurs between the alveoli and the capillaries by (passive) diffusion;
the alveoli are small hollow sacs connecting to the larger terminal bronchioles of the airways;
the alveolar walls are lined by a single cell layer of (flat epithelial) cells allowing for gas exchange;
oxygen passes from the alveoli to the capillaries;
carbon dioxide passes from the capillaries to the alveoli;
during inspiration, the partial pressure of oxygen (PO_2) in the lung is higher than that in the arteries of the alveoli;
the partial pressure of alveolar oxygen is high (13.7 kPa/103 mmHg) / the partial pressure of the oxygen capillary blood is low (5.3 kPa/40 mmHg);
this pressure difference allows O_2 to transfer into the capillary;
the partial pressure of carbon dioxide (PCO_2) in the lung is less than the arterial partial pressure of the alveoli;
the partial pressure of alveolar carbon dioxide is 5.3 kPa/40 mmHg / in the capillary blood returning to the lungs the partial pressure of the carbon dioxide present is 6.12 kPa/46 mmHg;
this pressure difference allows carbon dioxide to diffuse into the lung and eventually into the atmosphere;
appropriate diagram/schematic representation; ***[6 max]***