Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2022

Sports, exercise and health science

Higher level

Paper 2

26 pages

Subject details: Sports, exercise and health science HL paper 2 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[50 marks]** and **TWO** question in Section B **[40 marks]**.
Maximum total = **[50 marks]**.

Markscheme format example:

Question			Answers	Notes	Total
5	**c**	**ii**	this refers to the timing of the movements ***OR*** the extent to which the performer has control over the timing of the movement; external paced skills are sailing/windsurfing/receiving a serve; internal paced skills are javelin throw/gymnastics routine;		**2 max**

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a semi colon (;) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative word is indicated in the "Answers" column by a slash (/). Either word can be accepted.

6. An alternative answer is indicated in the “Answers” column by “***OR***”. Either answer can be accepted.

7. An alternative markscheme is indicated in the “Answers” column under heading **ALTERNATIVE 1** *etc*. Either alternative can be accepted.

8. Words inside chevrons **< >** in the “Answers” column are not necessary to gain the mark.

9. Words that are underlined are essential for the mark.

10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.

Section A

Question			Answers	Notes	Total
1.	a	i	heavy and protein;		1
1.	a	ii	90 – 80; = 10 <g day^{-1}>;	*Accept 80–89* *9 <g day^{-1}>;* *No ECF*	2
1.	a	iii	for moderate exercise, carbohydrate intake is the same / does not change for both pre- and post-training <may be on 300 g day^{-1} both pre- and post->; for heavy training, carbohydrate intake increases / increases from 300 g day^{-1} <pre> to 340–350 g day^{-1} <post>;		2
1.	a	iv	mean values are similar / not substantively different; standard deviations large/greater than the difference in the mean/overlapping error bars, identifying a large spread of data about the mean, indicating unreliable results; coefficient of variation would be large/greater;		2 max
1.	a	v	heavy workload causes greater muscle tissue damage, greater protein intake is used for repair; heavier workload causes greater hypertrophy, protein required to build new muscle;	*Accept in the converse.* *Do not accept 'more calories required' or discussion of timings.* *There needs to be a specific function for protein.*	2
1.	b		glycerol and three fatty acids;		1

1.	**c**	**i**	power; strength; muscular endurance;		**1 max**
1.	**c**	**ii**	easier to achieve high ecological validity due to familiarity of environment ***OR*** results are valid due to contextual/comfortable environment; relatively inexpensive compared to laboratory tests ***OR*** often accessible to coaches/athletes to use in their performance environments; therefore limited expertise required to deliver tests; able to test multiple participants/test participants simultaneously ***OR*** collection of data can be quicker/larger/more accessible compared to laboratory methods; typically, non-invasive therefore more engagement from coaches/athletes; improvements in technology have improved accuracy of field tests;		**4 max**

2.	**a**		10 cm ***OR*** Bench A;		**1**
2.	**b**		60–40; = 20;	*Calculation required for both marks.*	**2**

3.	**a**		a reversible, exercise-induced decline in performance;		**1**
3.	**b**		depletion of CP energy sources which are vital for synthesis during this test <creatine phosphate and ATP>; intensity of test will produce high levels of fatiguing by-products such as lactic acid / hydrogen ions; reduction in calcium ion release due to repeated contractions;	*Do not accept dehydration, electrolyte loss, overheating, and other factors related to endurance activities.* ***Max [1]*** *for list of two correct factors e.g. increased lactic acid levels / reduction in calcium ions / depletion of CP stores.*	**2 max**
3.	**c**		improved oxygen transport <from the lungs> to the muscles; increased oxygen levels allow the body to utilize aerobic system to a greater degree; wider availability / variety of fuel sources as aerobic system can use carbohydrates, fats and protein as fuels; reduced reliance of lactic acid system which produces fatiguing byproducts; able to work at a higher intensity for a longer period without fatigue; improved A-VO_2 difference / efficiency of oxygen exchange;		**4 max**

4.	**a**		flat;		**1**
4.	**b**		<isometric> contraction of muscles compresses blood vessels leading to increased blood pressure; diastolic blood pressure increases; systolic blood pressure increases;		**3**

5.	**a**		the point around which the mass of a body is evenly distributed ***OR*** the point which the body is balanced in all directions/ OWTTE;		**1**
5.	**b**		the manipulation of moment of inertia directly affects the gymnast's angular velocity in order to conserve angular momentum throughout the skill ***OR*** rotating objects have angular motion, moment of inertia and angular velocity work inversely to conserve angular momentum once an object is in motion; the moment of inertia of a rotating object can be changed by redistributing the mass of the object about the axis of rotation <enabling the gymnast to perform a somersault>; at the start of the flight phase, the gymnast begins flexes their hips to reduce their moment of inertia; the reduction in moment of inertia increases angular velocity, this allows the somersault to be executed; prior to landing they extend their hips to increase moment of inertia; increasing moment of inertia reduces rotation / slows the gymnast for landing;		**4 max**
5.	**c**		when a force is applied by the skater to attempt to move from stationary to skating / overcome inertia, this is considered the coefficient of static friction; at some point, the force applied is sufficient to overcome the inertia / static friction and the skater will begin to move; once the skater is in motion, sufficient force is applied to overcome static friction, this is considered the coefficient of dynamic friction; more force is required to overcome static friction than dynamic friction;		**2 max**

6.	**a**		A: myofibril; B: actin;		**2**
6.	**b**		electrical impulse is generated by the sinoatrial (SA) node; impulse travels across atria <exciting the tissue> and arrives at the AV/VA/atrioventricular node; AV/VA node delays impulse <0.1 sec> to allow time for atria to contract and force blood into ventricles; impulse passes from the AV/VA node to the AV/VA bundle / bundle of His <into the bundle branches>; impulse conducted rapidly through Purkinje fibres that spread along ventricle walls; once stimulated the ventricles contract / pressure in ventricles forces blood out through main arteries leaving heart;	*MPs can only be awarded in correct sequence order.*	**3 max**

7.	**a**		positive <acceleration>;		**1**
7.	**b**		less area to cover during the activity therefore reduce fatigue; players are closer together therefore this will improve involvement/participation <which leads to increased motivation>; distance players have to pass/carry will be reduced therefore encourages appropriate technique / reduce power element; the number of interactions between players better replicates the adult game therefore improves / develops appropriate use of technical/tactical skills / decision making;		**2 max**
7.	**c**		modify equipment to make performing the skill easier/increase success <e.g. using smaller/lighter hockey sticks/ using large lighter balls>; modify goal/objective of task to add challenge/competition, <*e.g.* objective is to make five successful passes / certain number of passes = points>; modify the rules to increase challenge/reduce risk, <*e.g.* can score from anywhere/no hitting>; modify the rules to reduce playing numbers to increase time/success/touches;	*Accept any suitable example.* ***Max [1]*** *for modifying equipment.* ***Max [1]*** *for modifying goal of task.*	**2 max**

8.	**a**		glucose;		**1**
8.	**b**		individuals inherit 50% of their genes from each parent which will determine their athletic potential; genetic factors can provide an advantage, but are not the sole determinant of success ***OR*** to achieve the full potential of genetic factors, appropriate nutrition and training are required; *genetic factors:* height/limb length: related to basketball, volleyball, gymnast, etc.; muscle fibre type: linked to either aerobic/slow or anaerobic/fast; anaerobic threshold: endurance event such as marathon, long distance cycling etc.; lung capacity: endurance event such as marathon, long distance cycling etc.; flexibility: linked to gymnastic or similar event;	*Award **[1]** mark for each genetic factor with details as to how each genetic factor can lead to athletic success.* ***Max [1]** for list of 2 or more genetic factors.* *Need to identify which fibre type is responsible e.g. fast or slow.*	**3 max**

Section B

Question			Answers	Notes	Total
9.	a		*nervous system:* breathing is manipulated by the autonomic nervous system to increase rate <expiratory centre> & increase depth <inspiratory centre> of breathing in response to exercise; respiratory centre is found in the brain stem/medulla oblongata & pons in the brain; chemoreceptors relay information to the respiratory centre regarding lower pH or O_2 / higher CO_2 levels ***OR*** proprioceptors relay information to the respiratory centre regarding action of muscles / spindles / joint receptors; <inspiratory> respiratory centre increases stimulation <via phrenic nerve and intercostal nerves> to the inspiratory muscles <external intercostals and diaphragm>; during exercise inspiratory muscles are stimulated to contract more forcefully; <inspiratory> respiratory centre stimulates additional accessory muscles <sternocleidomastoid, pectoralis minor, scalenes> to contract <to increase depth of breathing>; during forceful ventilation nerve impulses from the inspiratory area activate the expiratory area; stretch/mechano receptors in the lungs <and bronchioles> relay information to the respiratory centre to prevent over inflation of the lungs; in response to stretch receptors, <expiratory> respiratory centre shortens the duration of inspiration / Hering-Bruer reflex; <expiratory> respiratory centre stimulates expiratory muscles <internal intercostals / obliques / rectus abdominus> to contract; expiration moves from passive to active control during exercise;	***Max [2]*** *if no reference to exercise.*	**3 max**

9.	**b**		some characteristics are expressed developmentally by genes <these are determined at birth / genetic predisposition>; *e.g.* eye colour; other characteristics are expressed environmentally; *e.g.* height influenced by nutrition;	*Award **[1]** if only an example is given.*	**3 max**
9.	**c**		*Cognitive (beginner)* learning through trial and error, child will continuously try to master the skill; many large errors are made, basic mistakes of balance and coordination/lacks fluency; *Associative (practice stage)* number and size of errors reduce, child falls over less; child begins to feel how walking / the skill should be executed, confidence develops however difficulty still with multi-tasking; *Autonomous (final stage)* motor programs are automatic; this allows performer to concentrate on other stimuli; changes can be made without external feedback; skill is biomechanically efficient;	*All three phases must be addressed for **[4].*** ***Max [2]** per stage.* *No marks for identification of phases alone.*	**4 max**

9.	**d**		hypothalamus receives information from elsewhere in the body; the hypothalamus is the part of the brain that controls/sends messages to the pituitary gland; creating feedback loop which helps to maintain homeostasis; nerve impulses from the hypothalamus stimulate the pituitary gland; GHRH/growth hormone releasing hormone is a neurohormone released from the hypothalamus which directly influences the pituitary gland to release GH/growth hormone to regulate growth; somatostatin is a neurohormone released from the hypothalamus to inhibit the pituitary gland from releasing GH; pituitary gland stimulates the release of antidiuretic hormone/ADH for water regulation;		**4 max**

9.	**e**			*Require an explanation for mark, candidates cannot just list structural and functional characteristics.* *Max [4] for either athlete.*	**6 max**

marathon runner	***OR***	*long jumper*	
higher proportion of slow twitch / lower fast twitch		higher proportion of fast twitch / lower slow twitch	;
high capillary density to increase delivery of nutrients and oxygen to muscle	*;*		
high myoglobin content to transport oxygen to mitochondria	*;*		
high mitochondrial density where aerobic respiration occurs	*;*		
high triglyceride stores are dominant energy fuel at rest	*;*		
high oxidative enzyme activity assists in use of oxygen for aerobic respiration	*;*		
low **peak** force produced		high **peak** force produced	;
low fatigability due to no fatiguing byproducts <such as lactate, hydrogen ions>		high fatigability due to no fatiguing byproducts <such as lactate, hydrogen ions>	;
aerobic – predominant energy system due to structural characteristics of fibres	;		
		high PC stores for rapid restoration of ATP	;
		high carbohydrate stores as only food fuel to be broken down without oxygen	;

<table>
<tr><td>10.</td><td>a</td><td></td><td>identification of life-threatening conditions, such as risk of sudden cardiac death, connective tissue disorder;
potential to predict susceptibility to injury and so reduce risk / improve safety for an individual athlete;
potential talent identification;
detection of gene doping;</td><td></td><td>2 max</td></tr>
<tr><td>10.</td><td>b</td><td></td><td><table>
<tr><td></td><td>high intensity</td><td>endurance</td><td></td></tr>
<tr><td>Appropriate sporting example</td><td>e.g. shot put/100m sprint</td><td>e.g. marathon/1500m swim</td><td>;</td></tr>
<tr><td>energy</td><td>anaerobic</td><td>aerobic</td><td>;</td></tr>
<tr><td>heart rate</td><td>85%+ max HR</td><td>below 85% max HR</td><td>;</td></tr>
<tr><td>fuels</td><td>PC/carbohydrates</td><td>fats/carbohydrates</td><td>;</td></tr>
</table></td><td>Accept any appropriate sporting example.</td><td>4 max</td></tr>
<tr><td>10.</td><td>c</td><td></td><td>Oxygen deficit:
when exercise begins, the aerobic system cannot supply the required energy;
anaerobic systems <ATP–PC, lactic acid> meet the shortfall;
oxygen demand is greater than oxygen supply;
deficit increases during final sprint;

Oxygen debt (EPOC):
oxygen consumption is elevated / EPOC after the event <to replenish oxygen deficit>;
will remain high until carbon dioxide and lactic acid levels return to normal;
restoration of PC;
EPOC can be divided into the fast/alactacid component where PC is restored and the slow/lactacid component where metabolic by-products are removed;</td><td>Max [2] each for oxygen deficit and debt.
Max [2] for annotated diagram to represent MP1 and MP5.</td><td>4 max</td></tr>
</table>

10.	**d**		*elite athlete:* detection: able to filter actual signals from the distraction of “noise”; can correctly interpret signals more than novice athlete due to experience; selective attention to correct stimulus / ability to detect signals sooner than novice; comparison: has a more extensive long-term memory bank to draw on to compare the stimuli to; recognition: the process of finding a corresponding stimulus in memory is more developed; able to spend little/no attention focused on executing movement / they are in autonomous phase of learning therefore full focus on signals received;	*Accept appropriate explanation in the converse.*	**4 max**

10.	**e**		*Surface drag:* as a body moves through a fluid, its outer surface catches a layer of the fluid nearby, slowing it down compared to the fluid further away; this can be minimized by changing the surface to reduce the interaction between surface and fluid; example: the use of shark-skin suits in swimming or shaving the swimmer's body to make it smooth; *Form drag:* as a body pushes against a fluid, the fluid pushes back; by streamlining the body and minimizing the surface area facing the direction of the motion; example: adopting a low-profile position during diving into the water, during the strokes and tumble turns; *Wave drag:* when a body moves along the surface of a fluid some fluid is displaced to form a wave; these waves cause additional forces that oppose motion; wave drag can be reduced by avoiding motion at the interface between air and water; example: swimming underwater for as long as is allowed at the start of a race, use of waveless swimming pools;	*Answers must give examples from swimming.* ***Max [2]*** *for each type of drag.*	**6 max**

11.	**a**		greater exposure to airborne bacteria and viruses because of an increased rate and depth of breathing; regular heavy training loads performed by elite athletes can lead to a rise in cortisol levels / reduction in adrenaline levels; high levels of stress hormones reduce leucocyte numbers therefore reducing the ability to fight infection when exposed; inflammatory response to muscle damage can become overactive due to stress hormones / levels of training; high levels of stress hormones can cause an overactive or <severely> suppress inflammation in response to infection;	*Do not accept 'low leucocytes' or 'inflammation' alone.*	**2 max**
11.	**b**		a <negative> feedback loop counteracts a change to return blood glucose levels to an acceptable level for the body; receptors in the pancreas detect changes in blood glucose; elevated blood glucose levels stimulate the release of insulin <by the pancreas> ***OR*** lower blood glucose levels inhibit release of insulin <by the pancreas>; insulin stimulates glucose uptake/promotes glycogenesis to lower blood sugar levels; lower blood glucose levels stimulate the release of glucagon <by the pancreas> ***OR*** elevated blood glucose levels inhibit release of glucagon; glucagon stimulates glycogenolysis to increase blood sugar levels;	***Max [2]*** *if no reference to high or low blood sugar levels only.*	**3 max**

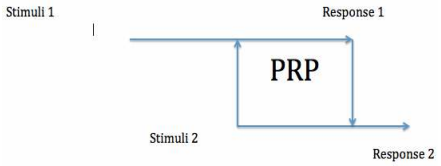
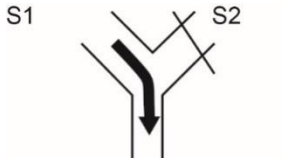
11.	**c**		*Phenomenon* occurs during prolonged submaximal exercise; reduction in blood volume due to sweating ***OR*** reduction in blood volume leads to increase blood viscosity; reduced blood volume results in decrease in stroke volume; heart rate increases to maintain cardiac output; vasodilation causes a reduction of blood flow to working muscles; *Prevention* maintain hydration to maintain blood viscosity; decrease exercise intensity; exercise during cooler part of day; wear clothing which allows air flow;	***Max [4]*** *for phenomenon.* ***Max [1]*** *for prevention.*	**5 max**
11.	**d**		action of rotation causes the air to be dragged around the rotation of the ball; this causes increased air velocity underneath the ball and a decreased air velocity on the top; there is an inverse relationship between air flow velocity and air pressure which is expressed in the Bernoulli principle; resulting in a high pressure area on the top and a low pressure on the bottom of the ball; the ball will move towards the low pressure area / downwards; the ball will drop on to the table sooner <than with either no spin or backspin> / reduce the distance the ball travels before hitting the table;	*Accept marking points as annotations on a diagram.*	**4 max**

11.	**e**		*Phase analysis model*: the coach can use this model to divide up the serve <sequentially> so that attention can be focused on the performance of each part; coaches can use video analysis to isolate phases of the serve and identify specific areas for improvement; the coach can break down the skill into preparation, retraction, action and follow through; *e.g.* preparation: positioning body/stance; *e.g.* retraction: backswing and ball toss; *e.g.* action: execution of hitting the ball; *e.g.* follow-through: continuation of action after contact; *Performance outcome model*: the <hierarchical> model can be used to identify mechanical factors that contribute to the execution of the serve, these are speed, force, coordination and <specific performance> principles; coaches can focus on mechanical factors in isolation to assist the overall performance of the serve; *e.g.* speed principles: whole body speed vs body part/racket speed, *e.g.* flexing the racket head to generate racket head speed; *e.g.* force principles: summation of forces, e.*g.* good knee bend to generate force; *e.g.* coordination principles: biomechanically efficient timing of each action; *e.g.* specific performance principles: *e.g.* poor position of ball toss affecting accuracy/placement	***Max [4]*** *for each of the models.* *Accept appropriate examples for performance improvement.* *Accept appropriate annotated diagram.*	**6 max**

<table>
<tr>
<td>12.</td>
<td>a</td>
<td></td>
<td>
<table>
<tr><td></td><td>Smooth</td><td>Cardiac</td><td></td></tr>
<tr><td>striated</td><td>no</td><td>yes</td><td>;</td></tr>
<tr><td>location</td><td>hollow organs e.g. intestine, stomach
OR
wall of blood vessels
OR
lining of tracts e.g. respiratory tract</td><td>heart</td><td>;</td></tr>
<tr><td>stimulation external to organ</td><td>only external</td><td>internal and external</td><td>;</td></tr>
<tr><td>shape</td><td>single tapering cells</td><td>branching cells</td><td>;</td></tr>
<tr><td>intercalated discs</td><td>no</td><td>yes</td><td>;</td></tr>
</table>
</td>
<td>Candidates must distinguish muscle characteristics to be awarded a mark.

Accept any suitable example location of smooth muscle.

Accept any accurate additional structural difference.</td>
<td>2 max</td>
</tr>
<tr>
<td>12.</td>
<td>b</td>
<td></td>
<td>system can only use glycogen/glucose as a fuel source;
glucose is converted into pyruvate;
system produces a low yield / 1 glucose produces 2ATP <net>;
in the absence of oxygen pyruvate is converted to lactate/lactic acid;
byproducts of lactic acid system are lactic acid, <hydrogen ions, lactate>;
system resynthesizes ATP at a rapid rate;</td>
<td></td>
<td>4 max</td>
</tr>
<tr>
<td>12.</td>
<td>c</td>
<td></td>
<td>physical barriers: e.g. increase of epithelial linings, mucous secretions;
chemical: change pH of body fluids e.g. increasing adrenalin / cortisol;
leucocyte/white blood cells fight pathogens;
antibodies are produced to fight the antigen/pathogen;
inflammation to protect area / heat;
clotting <by platelets> reduces blood loss / repair physical barrier;</td>
<td>Max [2] if mechanisms listed without examples.</td>
<td>4 max</td>
</tr>
</table>

12.	**d**		psychological refractory period; is the increase in response time(RT) to a second stimulus caused when the second stimulus has been delivered while the performer is responding to the first stimulus ***OR*** time delay in RT caused by the arrival of a second stimulus before the first is processed ***OR*** when a second stimulus arrives before the first response is completed; reaction to the second stimulus is longer as the first response is still being processed ***OR*** player has to sort out new and correct stimulus, but first they have to disregard the old and now useless stimulus and this causes the delay; hoping the defender has been distracted by the fake move as they cannot respond until the full reaction/response 1 has been processed by the brain; brain processes one action at a time causing a time delay in responding to the second stimulus ***OR*** the single channel hypothesis states that each stimulus can only be processed one at a time ***OR*** a second stimulus must wait until the first has been processed ***OR*** each stimulus we process has to progress through a single track ***OR*** any subsequent stimulus must wait for the one before it to be processed before it can be dealt with;	*Award **[1]** stating for the concept.* *Accept diagram to assist with explanation.*  	**4 max**

12.	**e**		thalamus **AND** hypothalamus form <part of> the diencephalon; *thalamus functions:* sensory input <except smell> received from receptors is relayed through the thalamus to the cerebral cortex; regulation of sensory input that reaches the conscious brain which is important for motor control ***OR*** thalamus plays a role in awareness/consciousness; regulation of sleeping/wakefulness by suppressing sensory information which may wake an individual; connection to the amygdala demonstrates a role in emotions and awareness of danger; *hypothalamus functions:* hypothalamus maintains homeostasis by controlling the internal environment through neuroendocrine control; *e.g.* fluid balance/food intake/thirst/body temperature; circadian rhythms are controlled by the release of melatonin from the pineal gland; autonomic nervous system/ANS *e.g.* heart rate/respiration/digestion/ fight or flight response; neuroendocrine control of growth;	***Max [2]*** *for a list of functions.* ***Max [2]*** *per function if detailed explanation given.* *Only credit sleep–wake cycle once, unless correctly explained for each part.*	**6 max**