

Markscheme

May 2019

Sports, exercise and health science

Standard level

Paper 2

21 pages

No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without written permission from the IB.

Additionally, the license tied with this product prohibits commercial use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, is not permitted and is subject to the IB's prior written consent via a license. More information on how to request a license can be obtained from <http://www.ibo.org/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite de l'IB.

De plus, la licence associée à ce produit interdit toute utilisation commerciale de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, n'est pas autorisée et est soumise au consentement écrit préalable de l'IB par l'intermédiaire d'une licence. Pour plus d'informations sur la procédure à suivre pour demander une licence, rendez-vous à l'adresse <http://www.ibo.org/fr/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin que medie la autorización escrita del IB.

Además, la licencia vinculada a este producto prohíbe el uso con fines comerciales de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales— no está permitido y estará sujeto al otorgamiento previo de una licencia escrita por parte del IB. En este enlace encontrará más información sobre cómo solicitar una licencia: <http://www.ibo.org/es/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

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**].

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 tick (✓) 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.
11. 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 “Answers” column 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) in the “Notes” column.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. 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. “ECF acceptable” will be displayed in the “Notes” column.
14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.

Section A

Question		Answers	Notes	Total
1.	a	8 minutes AND plyometric ✓		1
1	b	6.75 – 6.55 ✓ = 0.20 «m s ⁻¹ » ✓	Accept calculations in the reverse. Consider ECF	2
1	c	plyometric exercise improved performance / hypothesis is supported ✓ The t-test supports the hypothesis that plyometric exercise improves performance with $p < 0.05$ «at 4 minutes» ✓ plyometric exercise did not improve performance prior to 4 minutes ✓ plyometric exercise was less effective after 8 minutes / plyometric condition speed increased/was better than the control up to the 12-minute test period ✓	For mark point 1, accept the use of the actual data for discussion. Also the reason for the judgement needs to relate to the data.	2 max
1	d	the control condition allows for a comparison point for the experimenter to compare the subjects speed with OR shows if there is an effect of the plyometric condition compared to walking only ✓ a control allows one factor to be investigated while all others are kept constant OR there are confounding variables in comparing outcomes with baseline data ✓ the control condition allows the researcher to determine warm-up / fatigue effects ✓ control condition increases «internal» validity ✓		2 max

Question		Answers	Notes	Total
2.	a	<p>Cells (erythrocytes / leucocytes / platelets) ✓</p> <p>plasma ✓</p> <p>electrolytes ✓</p> <p>proteins ✓</p> <p>gases ✓</p> <p>nutrients ✓</p> <p>waste products ✓</p> <p>hormones ✓</p>	<p><i>Accept suitable examples of any component eg oxygen would be awarded the mark for gases</i></p>	1 max
2	b	<p>HR and/or SV need to increase to maintain/increase Q during prolonged exercise ✓</p> <p>sweating/fluid loss/decrease in blood plasma/increased viscosity/decrease in SV can be compensated for by a «gradual» increase in HR / cardiovascular drift ✓</p> <p>rise in body temperature / diversion of blood flow to the skin / reduced blood volume to working muscles can be compensated for by an increase in HR / cardiovascular drift ✓</p> <p>to maintain blood volume / to maintain Q an athlete can ingest electrolyte drink or water and foods during prolonged exercise «to avoid cardiovascular drift» ✓</p>	<p><i>Simply stating the equation for cardiac output is not enough for a mark</i></p>	3 max

Question			Answers	Notes	Total
3.	a		A: epimysium ✓ B: muscle fibre/muscle cell/endomysium ✓ C: perimysium/ «muscle» fascicle ✓		3
3	b		«often proximal» attachment of a muscle tendon to a stationary bone ✓	<i>Must refer to stationary/non-moving/fixed end.</i>	1
3	c		myosin heads use the breakdown of ATP to trigger the contraction process ✓ the breakdown of ATP to ADP releases phosphate molecule ✓ the release of a phosphate molecule provides the energy for muscle contraction ✓ ATP reattaches to the myosin head and this causes the detachment of the cross bridge ready for the next phase if necessary ✓ during sprinting the ATP will come from stores (2 seconds approximately) / from the ATP-PC system ✓ depending on the length of the sprint the lactic acid process will provide sources of ATP ✓		3
3	d		reciprocal inhibition is a neuromuscular reflex that inhibits opposing muscles «to enable voluntary movements» ✓ the quadriceps act as the agonist / concentrically contracting ✓ the hamstrings act as the antagonist / relaxing to enable knee extension ✓		3
3	e		A: effort/muscular force ✓ B: load/resistance force ✓ C: fulcrum/pivot ✓		3
3	f	i	Inferior OR distal ✓		1

Question			Answers	Notes	Total
3.	f	ii	posterior OR lateral ✓		1
3	f	iii	anterior OR proximal OR superior ✓		1
4.	a		the force exerted by blood on arterial walls during ventricular contraction ✓		1
4	b		increase in systolic blood pressure ✓ no change/slight decrease in diastolic blood pressure ✓		2

Question		Answers	Notes	Total
5.	a	<p><i>Inhalation:</i></p> <p>diaphragm contracts and flattens ✓</p> <p><u>internal</u> intercostal muscles relax ✓</p> <p>external intercostal muscles contract ✓</p> <p>raising the rib cage upwards <u>and</u> outwards ✓</p> <p>this increases the thoracic volume ✓</p> <p>this decreases the thoracic pressure ✓</p> <p>the result of this is that air moves into the lungs ✓</p> <p>accessory muscles contract such as trapezius / sternocleidomastoids / scaleni ✓</p> <p><i>Exhalation:</i></p> <p>diaphragm relaxes and moves upwards ✓</p> <p><u>internal</u> intercostal muscles contract ✓</p> <p>external intercostal muscles relax ✓</p> <p>lowering the rib cage downwards <u>and</u> inwards ✓</p> <p>this decreases the thoracic volume ✓</p> <p>this increases the thoracic pressure ✓</p> <p>the result of this is that air moves out of the lungs ✓</p> <p>accessory muscles contract such as the abdominal muscles ✓</p>	<p><i>Mark points must clearly be linked to the relevant process of inhalation or exhalation.</i></p> <p><i>Award [4 max] from inhalation/exhalation.</i></p> <p><i>Award [5 max] if no mention of accessory muscles</i></p> <p><i>The movement of air needs to be clearly linked to the factors of changing volume or pressure or some other relevant variable</i></p>	6 max

Question		Answers	Notes	Total
5.	b	<p><i>Whole</i></p> <p>the skill is demonstrated and practised as a whole, from start to finish ✓</p> <p>commonly used for skills that cannot be easily broken into parts because they are quick and fluent / discrete in nature or simple serial skill ✓</p> <p>an example would be completing a dig in volleyball / long jump ✓</p> <p><i>Whole-part-whole</i></p> <p>the whole skill is demonstrated and practised first, before being broken down into its constituent parts and then progressed back to the whole skill ✓</p> <p>commonly used for complex skills that contain specific parts / serial in nature ✓</p> <p>an example could be tennis serve by doing the whole action followed by practising the parts «ball toss, arm phases, grip, contact» then putting them together again ✓</p> <p><i>Progressive part</i></p> <p>parts of the skill are practised individually before being linked together ✓</p> <p>commonly used for skills that contain discrete parts that form a sequence ✓</p> <p>an example could be in basketball practising the dribble, then the 2 steps then the jump off one foot before combining ✓</p> <p><i>Part</i></p> <p>parts of the skill are demonstrated and practised individually ✓</p> <p>commonly used for complicated or serial skills, where the coach may wish to isolate a particular component to practise ✓</p> <p>an example could be learning how to do the arm action of a swim stroke using a pull buoy and then the legs using a kick board before putting them together ✓</p>	<p><i>Explanation must correctly match method for mark.</i></p> <p><i>Award [2 max] for presentation method.</i></p>	4 max

Question		Answers	Notes	Total
5.	c	<p>increased capillarisation in lungs/ trained muscles ✓</p> <p>blood plasma increases ✓</p> <p>red blood cell count / hemoglobin increases ✓</p> <p>more effective blood redistribution ✓</p> <p>these factors result in increased arterio-venous oxygen difference (a-VO₂ difference) ✓</p> <p>decreased resting blood pressure ✓</p> <p>improved elasticity of blood vessels ✓</p> <p>decreased <u>resting</u> heart rate ✓</p> <p>increased stroke volume ✓</p> <p>lower working heart rate when working at the same intensity as to prior to the training occurred ✓</p>	<p><i>Lower working HR needs to be clearly linked to when working at the same intensity as prior to training</i></p>	4 max

Question		Answers	Notes	Total
5.	d	<p>all systems work concurrently / at all times ✓</p> <p>dominant system is determined by intensity and duration / the anaerobic system will dominate due to the short duration «3 minutes» and high intensity of many of the actions «punching is explosive» ✓</p> <p><i>ATP-CP:</i></p> <p>dominant for the first 7–10 seconds ✓</p> <p>system replenishes initially used ATP ✓</p> <p>one ATP produced from one CP ✓</p> <p>has a high rate but low yield ✓</p> <p>during quieter phases in the round the system may be replenished to assist the seamless flow of ATP ✓</p> <p><i>Lactic acid / anaerobic glycolysis:</i></p> <p>dominant from five seconds to 1–2 minutes ✓</p> <p>source of ATP is glucose molecule ✓</p> <p>2–4 ATP produced from one glucose molecule ✓</p> <p>bi-product of «hydrogen ions» / lactic acid inhibits effectiveness of ATP production ✓</p>	<p><i>Award [3 max] per energy system.</i></p> <p><i>Award [5 max] if the explanation does not refer to the energy systems during boxing</i></p>	6 max

Question		Answers	Notes	Total
6.	a	<p>carbohydrates are primary energy source «40–70%» ✓</p> <p>carbohydrates provide 4 calories per gram / 1760 kJ per 100 grams ✓</p> <p>proteins contribute a smaller amount «10–30%» ✓</p> <p>proteins provide 4 calories per gram / 1720 kJ per 100 grams ✓</p> <p>lipids make up a relatively small amount of intake «10–30%» ✓</p> <p>fats provide 9 calories per gram / 4000kJ per 100 grams ✓</p> <p>recommendations vary by country / age / gender / height / weight / RMR / activity level ✓</p> <p>calorie intake should be 2000–3000 for males and 1600–2400 females ✓</p> <p>there is much contention about recommended ranges ✓</p>	<p><i>Accept other reasonable recommendations.</i></p>	<p>5 max</p>

Question		Answers	Notes	Total
6.	b	<p><i>Experience:</i></p> <p>more experienced athletes can better use their long-term memory to improve their selective attention ✓</p> <p>experienced athletes selectively attend to stimuli quicker than less experienced athletes ✓</p> <p>selective attention can be improved through over-learning ✓</p> <p>more experienced athletes better filter stimuli into relevant and irrelevant «noise» ✓</p> <p><i>Memory:</i></p> <p>the apparent limited capacity of the short-term memory indicates that there is some form of selective attention to prioritise stimuli ✓</p> <p>more long-term memories provide a greater source to draw from for selective attention ✓</p> <p>selective attention operates in the short-term sensory store ✓</p> <p>only relevant information is passed to the short-term memory ✓</p> <p>Long-term memory will enable a person to attend quickly to the correct stimuli in future situations ✓</p>	<p><i>Award [4 max] for experience or memory</i></p> <p><i>Award [5 max] if there is no link to a sporting example</i></p>	6 max

Question		Answers	Notes	Total
6.	c	<p>the Bernoulli principle explains how relative air pressure «from backspin» around a golf ball means that it experiences a lift force and travels further through the air ✓</p> <p>as a golf ball travels with backspin, it experiences higher air pressure on the bottom of the ball and lower air pressure on the top of the ball ✓</p> <p>the ball/object is attracted to the area of lower air pressure, which is above the ball and therefore experiences lift ✓</p> <p>the lift force is perpendicular to the direction of the airflow ✓</p> <p>the faster the ball travels / spins, the greater the differences in relative air pressure and therefore the greater the lift force ✓</p> <p>the dimples on the golf ball encourage small turbulent air, which protects the ball against drag force ✓</p> <p>a ball struck off «laterally» centre will spin in the air, therefore creating lower relative air pressure on one side and generating curve ✓</p>	<p><i>Accept annotated diagram to outline the principles.</i></p>	<p>5 max</p>

Question		Answers	Notes	Total
6.	d	<p>the acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, and inversely proportional to the mass of the object</p> <p>OR</p> <p>$F = ma$ ✓</p> <p>the ball will travel in the same direction as the direction of the net force applied to the ball ✓</p> <p>when the club contacts the ball, the change in momentum of the club is transferred to the ball/conservation of momentum ✓</p> <p>the greater the change in momentum of the ball, the longer distance the ball will travel</p> <p>OR</p> <p>the greater the impulse applied to the ball, the longer distance the ball will travel ✓</p> <p>larger clubs /club with greater mass will generate a greater force and therefore propel the ball further</p> <p>OR</p> <p>a lighter golf ball will accelerate faster when struck by the golf club ✓</p>	<p><i>Accept annotated diagrams for suitable mark points.</i></p>	<p>4 max</p>

Question		Answers	Notes	Total
7.	a	<p><i>Phases:</i></p> <p>cognitive/verbal phase, associative/motor phase, autonomous phase ✓</p> <p>Cognitive/verbal phase:</p> <p>the activity is completely new to the learner/they are in the beginning/initial stage of the learning continuum ✓</p> <p>performance is highly variable/shows a lack of consistency from one attempt to the next ✓</p> <p>learners are less likely to self-correct/ require an external coach to provide feedback ✓</p> <p>during the cognitive stage of learning, the beginner focuses on cognitively-orientated problems, for example, body position for skill execution/ how fast should I move this arm / rules of the game ✓</p> <p>the change in the rate of improvement is faster in the cognitive phase ✓</p> <p>Associative/motor phase:</p> <p>a performer practices the task and can associate their movements with the mental image of the skill ✓</p> <p>a performer begins to “feel” what a good performance is like kinaesthetically (continued...)</p>	<p>Award [2 max] for each phase.</p> <p>Award [5 max] if no example used.</p> <p>Award [1 max] for an example for a phase.</p>	<p>6 max</p>

		<p>(Question 7a continued)</p> <p>OR</p> <p>a performer begins to detect and correct errors in their performance/ begins to develop consistent movements ✓</p> <p>Autonomous phase:</p> <p>reaction time is shorter as motor programmes are well learnt «stored in long-term memory» ✓</p> <p>skills appear automatic/instinctive as attention is focused elsewhere (for example on tactics, the move or pass or shot and on using fakes) ✓</p> <p>a performer judges their own performance and is able to make changes without external feedback from a coach ✓</p> <p>a performer will perform with a greater level of skill/consistency/accuracy/fluency / as they get closer to the autonomous phase ✓</p>		
--	--	--	--	--

Question		Answers	Notes	Total
7.	b	<p><i>apply to all:</i></p> <p><i>strengths:</i></p> <p>can administer to many at once ✓</p> <p>inexpensive ✓</p> <p>minimal equipment ✓</p> <p>no training required to administer ✓</p> <p><i>limitations:</i></p> <p>are indirect measures of VO₂max ✓</p> <p>ALTERNATIVE TEST 1: Multistage fitness test/bleep test/Leger test</p> <p><i>strengths:</i></p> <p>large normative data available ✓</p> <p>correlation with VO₂max is good ✓</p> <p><i>limitations:</i></p> <p>as a maximal test, it relies heavily on psychological attributes ✓</p> <p>requires lots of turning, which can be a confounding factor ✓</p> <p>ALTERNATIVE TEST 2: Cooper's 12-minute run</p> <p><i>strengths:</i></p> <p>limited turning involved</p> <p>easier for athletes to motivate themselves ✓</p> <p><i>limitations:</i></p> <p>relies on athlete pacing themselves correctly ✓</p> <p>submaximal, meaning less accurate VO₂max estimation ✓ (continued...)</p>	<p>Award [1 max] for listing 2 valid aerobic tests</p> <p>Award [4 max] for each aerobic test.</p> <p>Award [2 max] for strength or limitation for each test</p>	6 max

Question		Answers	Notes	Total
7.	b	<p>(Question 7b continued)</p> <p>ALTERNATIVE TEST 3: Harvard step test</p> <p><i>strengths:</i></p> <p>clearly paced by metronome ✓</p> <p>submaximal nature makes it effective for people with health issues ✓</p> <p><i>limitations:</i></p> <p>significantly affected by lower body muscular endurance ✓</p> <p>submaximal, meaning less accurate VO₂max estimation ✓</p>		
7	c	<p>gases diffuse across the alveoli membrane ✓</p> <p>movement is from high to low partial pressure/concentration gradient ✓</p> <p>oxygen partial pressure is higher in air breathed in compared to blood ✓</p> <p>carbon dioxide has a higher partial pressure in blood compared to lungs ✓</p> <p>the concentration gradient is maintained due to ventilation / blood flow ✓</p> <p>diffusion is facilitated by the thin / moist barrier/ large alveoli surface area between blood and alveoli ✓</p> <p>greater volumes of gases diffusing across alveoli membrane when exercising ✓</p>	<p><i>Accept answers in the converse where appropriate.</i></p>	<p>4 max</p>

Question		Answers	Notes	Total
7.	d	<p>during exercise insulin is inhibited</p> <p><i>OR</i></p> <p>during exercise increased levels of sympathetic nervous system hormones «catecholamines» inhibits the release of insulin ✓</p> <p>insulins role is to increase glucose uptake by muscle for glucose storage/ glycogenesis ✓</p> <p>during exercise adrenaline is released ✓</p> <p>adrenaline stimulates glucose uptake «for glucose to be used» ✓</p> <p>adrenaline promotes the conversion of glycogen to glucose/ glycogenolysis ✓</p> <p>adrenaline promotes lipolysis/ catabolism of fatty acids ✓</p> <p>when glucose levels in blood drop during exercise glucagon is released</p> <p>glucagon stimulates the conversion of glycogen to glucose/ glycogenolysis ✓</p> <p>during exercise glucose uses transporters (GLUT4) ✓</p> <p>vesicles containing GLUT4 are mobilised to the plasma membrane by exercise ✓</p>		4 max