

Markscheme

May 2019

Sports, exercise and health science

Higher level

Paper 2

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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 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. 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 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
1	e	<p>the plyometric condition was statistically significantly different ($p < 0.05$) / null hypothesis should be rejected ✓</p> <p>the control condition was not statistically significantly different ($p > 0.05$) / null hypothesis should be accepted ✓</p>		2
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 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 of the bone.</i>	1
3	c		in an isotonic contraction, the joint angle / muscle length are changed whereas in an isometric contraction, the joint angle and muscle length remain stable ✓ example of isotonic contraction: eg dumbbell curl ✓ example of isometric contraction: eg handstand ✓		3
3	d	i	inferior OR distal ✓		1
3	d	ii	posterior OR lateral ✓		1
3	d	iii	anterior OR proximal OR superior ✓		1

Question		Answers	Notes	Total
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
4	c	(vaso)dilation of blood vessels/arterioles to «working» muscle/(vaso)constriction of blood vessels/arterioles to non-working muscles OR shunting of blood to working muscles/away from non-essential tissues ✓ increased blood flow to the working muscles «by 25 times» OR approximately 80–85% of cardiac output is directed to «working» muscles / 15–20% blood flow to non-working muscles ✓ brain receives approximately the same volume of blood during rest and exercise ✓ increased blood in working muscles improves transport/delivery of oxygen ✓ increased blood in working muscles aids waste product removal ✓		3 max

Question		Answers	Notes	Total
5.	a	body composition ✓ cardio-respiratory fitness (aerobic capacity) ✓ flexibility ✓ muscular endurance ✓ strength ✓		2 max
5	b	<i>Strengths:</i> quick / easy to do / no training required ✓ cheap / requires little equipment ✓ good for population-level analysis ✓ useful initial indicator of potential health risks ✓ <i>Limitations:</i> does not differentiate between lean tissue or fat ✓ does not differentiate between type of fat (subcutaneous or visceral) ✓ does not account for differences in population body composition / maturity ✓	Award [2 max] for strengths and [2 max] for limitations.	3 max
5	c	identification of life-threatening conditions to allow early treatment ✓ potential to predict susceptibility to injury and therefore take steps to minimise risk ✓ potential to aid talent identification through genetic screening ✓		3

Question		Answers	Notes	Total
6.	a	the force(s) acting to oppose the motion of an object through a fluid medium/air/water ✓		1
6	b	A: friction ✓ B: «body» weight / gravity ✓		2
7.		maximum heart rate decreases with age ✓ therefore, upon exercise, older swimmers are closer to their maximal heart rate ✓ depresses the spontaneous electrical activity of the sinoatrial node ✓ the heart becomes less sensitive to adrenaline/epinephrine with age ✓		3 max

Question		Answers	Notes	Total
8.	a	A: hypothalamus ✓ B: pituitary gland ✓		2
8	b	decision making/logical analysis/reasoning ✓ planning/problem-solving ✓ motivation ✓ speech ✓ motor movements ✓ emotional expression ✓		2 max
8	c	auditory/sound/hearing eg teammate calls, official's whistle, verbal feedback from coach ✓ visual/sight/seeing eg teammate movement, opposition position, official's gesture, coach signal ✓ tactile/touch/feeling eg contact with opponent, contact with ball, contact with ground/landing ✓ olfactory/smell/smelling eg pitch, sweat ✓ thermoreceptors eg ability to detect temperature of air and gear ✓	<i>Accept description of organ enabling sensory input or any other outline for the exteroceptor sensory inputs. Award [1 max] for list.</i>	3 max

Section B

Question		Answers	Notes	Total
9.	a	<p>during exercise insulin is inhibited</p> <p>OR</p> <p>during exercise increased levels of sympathetic nervous system hormones «catecholamines» inhibits the release of insulin ✓</p> <p>insulin's 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

Question		Answers	Notes	Total
9	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>selective attention operates in the short-term sensory store ✓</p> <p>only relevant information is passed to the short-term memory ✓</p> <p>more long-term memories provide a greater source to draw from for selective attention ✓</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
9	c	<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>(continued...)</p>	<p><i>Award [2 max] for each phase.</i></p> <p><i>Award [5 max] if no example used</i></p> <p><i>Award [1 max] for an example for a phase.</i></p>	6 max

Question		Answers	Notes	Total
		<p>(Question 9c continued)</p> <p>a performer begins to “feel” what a good performance is like kinaesthetically</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>		
9	d	<p><i>For example, golf swing:</i></p> <p>preparation phase contains all of the movements to prepare the athlete for the skill (eg grip, stance, ball position) ✓</p> <p>retraction phase is the wind up to the main action (eg backswing) ✓</p> <p>action phase is the aspect of the model that most contributes to the technique (eg downswing) ✓</p> <p>follow-through is the final part of the sequence, following the main action (eg follow-through of club after contact) ✓</p>	<p><i>Award [1 max] per phase.</i></p> <p><i>Award [1 max] for list.</i></p> <p><i>Same example must be applied to each part of the model.</i></p>	4

Question	Answers	Notes	Total
<p>10. a</p>	<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 boxing</i></p>	<p>6 max</p>

Question		Answers	Notes	Total
10	b	<p>increased capillarization 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>	
10	c	<p>glucose is the main fuel source «for energy production in the brain» ✓</p> <p>glucose «and oxygen» cross the blood–brain barrier / are passed from the blood cells to the brain ✓</p> <p>the process is aerobic respiration / using oxygen ✓</p> <p>carbohydrate storage in the brain is limited ✓</p> <p>«however» supply of glucose is continuous ✓</p> <p>brain uses about half of all the sugar energy in the body ✓</p>		4 max

Question		Answers	Notes	Total
10	d	modifying equipment available eg lighter, shorter-handle rackets ✓ setting relevant task goals eg must make three passes before scoring ✓ changing the time of game eg shortening time of half/quarter ✓ modifying the size of the playing area eg smaller to encourage tighter control / adapt for young children ✓ adapting playing area design eg attacking/defending zones/no go zones ✓ modifying the balance of the teams eg create overload to practice attacking or defending ✓ modifying team's personnel eg moving better quality players to different team ✓	Award [1] max for a list of 3 or more task constraints with no examples.	6 max

Question		Answers	Notes	Total
11.	a	<p>children inherit genes from their parents via sex cells «gametes» ✓</p> <p>half of inherited genes are from each parent ✓</p> <p>many millions of different genetic combinations from the same parents are possible ✓</p> <p>human characteristics «phenotype» are determined by their genes «genotype» ✓</p> <p>some characteristics are expressed developmentally by genes</p> <p>OR</p> <p>genes can be expressed as height / eye colour / hair colour etc ✓</p> <p>some characteristics require an environmental switch ✓</p>		5 max
11	b	<p>athletes must have both physical fitness and an effective immune system to withstand infection ✓</p> <p>high training volume is associated with increased susceptibility to infection ✓</p> <p>sedentary lifestyle is associated with increased susceptibility to infection ✓</p> <p>moderate exercise is associated with reduced susceptibility to infection ✓</p> <p>moderate exercise improves the lymphatic system ✓</p> <p>moderate exercise decreases glucocorticoid levels «inverse relationship with immunity» ✓</p> <p><i>Athletes who overtrain may be more susceptible because of:</i></p> <p>lower leucocyte numbers caused by the stress of exercise ✓</p> <p>inflammation caused by muscle damage ✓</p> <p>greater exposure to airborne bacteria and viruses because of an increased rate and depth of breathing ✓</p>	<p><i>Susceptibility to infection, award [2 max] for description of J curve.</i></p> <p><i>Accept annotated diagram of J curve</i></p>	5 max

Question		Answers	Notes	Total
11	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>
11	d	<p>regulated by complex feedback loops ✓</p> <p><i>Adrenaline:</i></p> <p>can be managed by activity level ✓</p> <p>can be managed by relaxation techniques (eg meditation) ✓</p> <p>regulated by «nervous stimulation» of the adrenal gland ✓</p> <p>stress/anxiety/fear anger can promote adrenaline release ✓</p> <p><i>Insulin:</i></p> <p>regulated by chemical stimulation of the pancreas ✓</p> <p>receptors respond to increase in blood glucose / high carbohydrate intake ✓</p> <p>can be managed by injection / inhalation / infusion ✓</p> <p>stress can reduce insulin levels ✓</p>		<p>6 max</p>

Question		Answers	Notes	Total
12.	a	<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>
12	b	<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 ✓ (continued...)</p>	<p><i>Accept annotated diagram to outline the principles.</i></p>	<p>5 max</p>

Question		Answers	Notes	Total
		<p>(Question 12b continued)</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>		
12	c	<p><i>Surface drag:</i></p> <p>outer surface of body catches a layer of neighbouring fluid as it moves ✓</p> <p>reduced by creating smooth surface / shaving / shark suit ✓</p> <p><i>Form drag:</i></p> <p>reaction of fluid when a body pushes against it ✓</p> <p>proficient / streamlined swimming technique reducing turbulence ✓</p> <p><i>Wave drag:</i></p> <p>caused by the displacement of fluid (usually water), as the body moves along the surface ✓</p> <p>swimming underwater for as long as possible ✓</p> <p>wave-less pools designed to reduce wave drag ✓</p>	<p><i>Award [1 max] for list of types of drag, still awarding more marks for methods.</i></p> <p><i>Award [2 max] per type of drag.</i></p>	6 max

Question		Answers	Notes	Total
12	d	<p>recovery is vital to achieve physiological adaptations ✓</p> <p>purpose is to return the body to pre-game state as quickly as possible</p> <p>OR</p> <p>purpose is to refuel / rehydrate / lower body temperature / lower heart rater to resting heart rate ✓</p> <p>recovery rate depends on activity type (intensity and duration – dependent on position) ✓</p> <p>recovery rate affected by athlete condition ✓</p> <p><i>Excess post-exercise oxygen consumption (EPOC) for:</i></p> <p>restoration of muscle creatine phosphate stores ✓</p> <p>removal of lactic acid ☒</p> <p>replenishing myoglobin stores with oxygen ✓</p> <p>replacement of muscle / liver glycogen stores ✓</p>		5 max