Markscheme

May 2021

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 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**	**i**	dominant ✓ dominant without pads ✓		**1**
1	**a**	**ii**	1697–1573 ✓ = 124 <N> ✓		**2**
1	**a**	**iii**	shoulder impact force was lower for both dominant and non-dominant with padding ***OR*** for dominant shoulder impact force was highest without padding <1719 versus 1697> ***OR*** for non-dominant shoulder also highest without padding <1648 versus 1573> ✓ there is a possible reduction in injury / hypothesis is supported✓	*Data must be interpreted; numbers don't need to be stated*	**2**
1	**b**		ground surface may have allowed for the player to apply more force / drive from their legs ✓ differences in footwear may enable better force application ✓ landing ability may have allowed more force to be applied in field *eg* synthetic surface may not encourage proper technique ✓ players may have found it easier to apply themselves mentally to the task in the real environment / greater levels of arousal✓ field measurement might have systematic error / as not as accurate. ✓	*MP3, 4, 5 accept in the converse*	**2**

Question			Answers	Notes	Total
1	c		greater accuracy / reliability of measured variable / tool used *eg* O_2 extraction for maximal oxygen consumption (VO_2max) ✓ greater control of environmental factors ✓ *Field*: more specific to performance environment / greater ecological validity / motivate the performer to perform to their optimal level ✓ field tests use less specialised / technical equipment / expertise ✓ easier to test large numbers *eg* Cooper's 12 minute run ✓ cheaper ✓	*Accept in the converse* *Award [**1 max**] for each category of response* *Award [**3 max**] if only strengths or limitations* *Note: accept 'inaccurate' as meaning 'not as accurate', if this is considered an ESL issue*	**4**
1	d		helmet A ✓		**1**
1	e		for all helmets, with cap the results/impact forces are lower ***OR*** the cap has a greater effect on helmet C than the others ✓ standard deviations for all overlap / there is very little difference between the conditions, so there is no significant difference between them ✓ p value shows no significant effect ✓		**2**

Question			Answers	Notes	Total
2.	**a**		*A:* air resistance ✓ *B*: <body> weight ✓ *C:* ground reaction force ✓		**3**
2	**b**		friction occurs when two surfaces are in contact and inhibits the movement of one surface over another ✓		**1**
2	**c**		increase: increase friction on the ground, so they can change directions more easily *eg* a football player uses studs/cleats ✓ increase friction on a surfboard and this helps them to apply push forces effectively on the board and so manoeuvre the board in the surf ✓ use of gloves to increase friction between hands and equipment *eg* gloves in baseball / golf ✓ increase the temperature of tyres in F1✓ decrease: make the surface of equipment smoother to reduce friction *eg* a skier / luge runner puts wax on the bottom of the ski / luge so that it reduces the friction on the snow and speeds up movement ✓	*Award **[2 max]** for either increase or decrease.*	**3**

Question			Answers	Notes	Total
3.	**a**		physical factors such as: gravity, altitude, light, floor space, noise, surface: *eg* reduce space available to perform skill to improve decision making ***OR*** practice under floodlights when training for a night-time match ✓ social constraints such as: peer pressure, social or cultural expectations: *eg* stereo playing to get used to crowd noise ✓		**2**
3	**b**		environment: *eg* a coach may make the playing field wider but shorter to make it easier to score / encouraging regular success ✓ individual / athlete: *eg* reduce the number of players in a team to keep all involved ✓ task: *eg* they may make the ball being used in volleyball softer so that players are encouraged to pass the ball correctly ✓	*Award **[2 max]** per constraint*	**3**

3	**c**		*eg* basketball: numbers of penalties ✓ numbers of shots taken from inside the key ✓ successful shots from inside the key ✓ shots taken outside 3 point zone ✓ successful shots from 3 point zone ✓ free throw percentage success ✓ rebounds ✓ assists ✓		**3**

Question			Answers	Notes	Total
4.	**a**		pulmonary artery goes from heart to lungs ✓ pulmonary artery carries deoxygenated blood ✓ pulmonary vein goes from lungs to heart ✓ pulmonary vein carries oxygenated blood ✓	*Award **[2 max]** for each* *Award **[2 max]** if no reference to pulmonary* *Award no mark if there is no reference to the type of blood vessel.*	**3**
4	**b**		diaphragm and <external> intercostal muscles contract <more forcefully> ✓ causing the rib cage to move <further> upwards and outwards ✓ with assistance of the accessory muscles, *eg* scaleni, sternocleidomastoid, deltoids, pectoralis ✓ therefore increasing the thoracic volume ✓ therefore reducing the thoracic pressure ✓ causes air to rush in <faster due to a greater pressure difference> ✓ increase of the depth of inhalation <per breath> ✓ increase of the frequency/rate of inhalation <per minute> ✓	*Award **[3 max]** if no reference to mechanics of inhalation during exercise*	**4**

Question			Answers	Notes	Total
5.	**a**		the skin / epithelial linings ✓ mucus ✓ enzymes ✓ macrophages ✓ platelets ✓ phagocytes/leucocytes✓ pH of bodily fluids ✓ hormones ✓ soluble factors *eg* cytokines ✓ lymphocytes/antibodies ✓ inflammation ✓		**2**
5	**b**		moderate volume of exercise appears to decrease the risk of infections compared to not exercising ✓ very high volume of exercise increases the risk higher than not exercising at all ✓ high risk of infection at high volume of exercise can be caused by increased depth and rate of breathing during intense training/lowered leucocyte levels/inflammation ✓	*Award **[1 max]** for a list*	**2**

Question			Answers	Notes	Total
6.	**a**		there is no justification for the two to be related ✓ a correlation can be used to see whether there is a relationship/connection between the change in one variable and another ✓ a correlation does not necessarily indicate that the changes are causal *eg* grip strength and VO_2max may be correlated but that does not mean that the increase of one causes the other ✓ other variables may be acting on one or both of the related variables (and affecting them in the same direction) ✓	*Credit reference to internal validity only once.*	**2**
6	**b**	**i**	the control group is the group that does not receive the treatment ✓ *eg* if a study was investigating the effect of warm-up on performance the control group would not complete a warm-up ✓ control group allows comparison point for independent variable / internal validity✓		**2**
6	**b**	**ii**	a placebo is a substance / piece of equipment which in every way appears to be like the real substance / equipment being tested ✓ *eg* a study into the effect of sugar on reaction times could use a pill that looks and tastes like the sugar pill being tested but is not sugar ✓ treatment and control groups are assigned randomly ✓ groups are compared pre- and post- testing ✓		**2**

Question			Answers	Notes	Total
7.	**a**	**i**	sit and reach ✓ arm and shoulder reach ✓	*Accept any other recognized test.*	**1**
7	**a**	**ii**	maximal sit-ups ✓ maximal push-ups ✓ flexed arm hang ✓	*Accept any other recognized test.*	**1**
7	**b**		overload increases the training above that which is normally experienced ✓ an athlete could increase the frequency of training and so train more often ***OR*** increase the number of repetitions (over time) ✓ an athlete could increase the intensity of training and so train harder / increase the resistance load (over time) ✓ an athlete could increase the duration of training and so train for a longer time ✓	*Accept specific relevant examples in place of general statement.*	**2**

Section B

Question			Answers	Notes	Total
8.	a		skeletal: voluntary movement / stimulated by motor nerves ✓ striated fibres✓ cells are bundled together by outer layers of tissue / fascia ✓ multinucleated cells ✓ have tension and stretch receptors ✓ attaches to bones via tendons *eg* biceps and triceps✓ cardiac: involuntary movement / stimulated by autonomic nerves ✓ cells are connected by branching network ✓ single nucleus cells ✓ striated fibres ✓ only found in heart ✓ smooth: involuntary movement / stimulated by autonomic nerves ✓ not striated ✓ single nucleus cells ✓ found in hollow tubes *eg* digestive system / vascular system ✓	*Award **[2 max]** for each*	**6**

8	**b**		*slow-twitch*: have a high density of capillaries ✓ high myoglobin count ✓ large number of mitochondria ✓ smaller fibre diameter ✓ high triglyceride stores ✓ low levels of glycogen storage ✓ low ATP & PC store✓ underdeveloped sarcoplasmic reticulum ✓ *fast-twitch*: less density of capillaries ✓ lower myoglobin count ✓ fewer mitochondria ✓ high levels of glycogen stored ✓ large fibre diameter ✓ high ATP & PC store ✓ developed sarcoplasmic reticulum ✓	*Award **[3 max]** for each*	**6**

8	**c**		body temperature regulation: through the movement of blood to the skin region where the blood can be exposed to cooler air temperatures ✓ through evaporation of sweat ✓ hairs erect to trap air to reduce heat loss ✓ protection and immunity: acts as a protective boundary where diseases cannot enter ✓ protection from impacts ✓ reduces the effect of radiation/sunlight/UV rays ✓ sensation: skin has nerves for sensing pressure, temperature, pain and this acts as further protection and helps with carrying out everyday tasks ✓ excretion from sweat glands: eccrine which are involved in temperature control ✓ excrete waste materials such as ammonia / urea / uric acid / water ✓ sebaceous glands secrete sebum as water repellent and antibacterial / antifungal agent ✓ apocrine produce a sweat high in fatty proteins ✓ synthesis (making) of vitamin D: vitamin D is a hormone which is made in the epidermis when sunlight penetrates it ✓	*Award **[1]** for each function up to **[4 max]***	**4**

8	**d**		frontal lobe: involved with reasoning and motivation, planning, emotions and problem-solving ✓ contains the speech and movement motor areas ✓ *eg* an athlete will use this to help them plan a move and communicate it to their team members ✓ temporal lobe: auditory sensory and association area ✓ involved with many aspects of long-term and visual memory ✓ *eg* an athlete will use this area to take in the sounds that they hear for processing and further action ✓	*Award **[2 max]** for each* *Award **[1 max]** for each function* *Award **[2 max]** if no examples given*	**4**

Question			Answers	Notes	Total
9.	**a**	**i**	nose ✓ mouth ✓ pharynx ✓ larynx ✓ trachea ✓ bronchi ✓ bronchioles ✓ lungs ✓ alveoli ✓		**2**
9	**a**	**ii**	they enable the easy flow of gases easily / provide a low resistance pathway for air flow and gas exchange ✓ as the air comes into the body it is warmed by the surrounding tissues ✓ the incoming air is moistened by the cells that line the conducting airways as they excrete mucus in order to trap particles / pathogens / excrete mucus to improve gas exchange ✓ the cells lining the conducting airways have special macrophage cells for defence against foreign bodies ✓ the cells lining the air ways have cilia for removal of any foreign bodies ***OR*** hairs in the nasal cavity filter particles from the air ✓	*Award **[1 max]** for list*	**2**

9	**b**	**i**	<endurance> training can improve VO_2max ✓ <endurance> training causes physiological adaptations such as increased cardiac output✓ gains in VO_2max will be greater the less trained you are ✓	*Award **[2 max]** for each part*	**6**
9	**b**	**ii**	in general VO_2max increases with maturation <due to an active healthy lifestyle> ✓ VO_2max begins to decline after maturation ✓ the rate of decline in VO_2max is determined by an active healthy lifestyle ✓	*Award **[2 max]** for each part*	**6**
9	**b**	**iii**	relative VO_2max is lower in females compared to males <even in highly trained athletes>✓ due to: females have a larger %fat in body mass ***OR*** females have a lower hemoglobin concentration (10–14% more in males) ***OR*** females generally have smaller heart / lungs / blood volume ✓	*Award **[2 max]** for each part* *Accept in the converse*	

9	**c**		*insulin*: made by the pancreas / beta cells ✓ is released into the blood stream to affect many cells ✓ is released when blood glucose levels are high ✓ allows cells (muscle, liver, fat) to take up glucose / glycogenesis / lipogenesis✓ *glucagon*: produced by the pancreas / alpha cells ✓ released into the blood stream ✓ is released when blood glucose levels are too low ✓ promotes glycogenolysis / gluconeogenesis / lipolysis ✓	*Award **[3 max]** for each*	**6**
9	**d**		the hypothalamus and pituitary gland work together to maintain homeostasis of the body ✓ hypothalamus controls the pituitary gland ***OR*** hypothalamus sends releasing hormones to the pituitary gland to stimulate the release of the specific hormone ✓ *eg* GHRH and GH ✓ hormones for the <posterior> pituitary are sent down from the hypothalamus for release ✓ *eg* ADH is sent directly from the hypothalamus to the pituitary <for release> ✓ the release is controlled via negative feedback ✓		**4**

Question			Answers	Notes	Total
10.	a		nucleus: contains the DNA ✓ has the instructions for the functioning of the cell ✓ cytoplasm: the matrix or fluid that is inside a cell ✓ allows for chemical reactions to occur as well as transport of various substances/anaerobic glycolysis ✓ cell membrane: outer wall of the cell ✓ controls the movement of substances in and out of the cell ✓ many cells have 2 membranes ✓ mitochondrion: involved in the aerobic production of ATP ✓ ribosomes: involved in protein synthesis (production) ✓ commonly bound to a membrane forming rough endoplasmic reticulum ✓ rough endoplasmic reticulum: involved in protein synthesis ✓	*Award **[2 max]** for a list* *Award marks for a correctly annotated diagram*	**6**

			smooth endoplasmic reticulum: produces vesicles (sacs) for transporting proteins around the cell ✓ Golgi apparatus: involved in the processing and packaging of proteins and fats ✓ centriole: involved in organizing the cell during cell division ✓ lysosome: involved in the digestion and breakdown of food particles, worn out organelles and bacteria✓		

10	**b**		both runners will use ATP-PC ✓ 100 m sprint will be throughout / to near the end ✓ 10 000 m race will be at the start and then at any time when a rapid change in pace occurs ✓ lactic acid will start to be used by the 100 m sprinter near the end ✓ lactic acid will be used at the start of the 10000 m race and then when pace goes above 85/90% maxHR ✓ aerobic system has a limited/insignificant contribution during the 100 m race ***OR*** anaerobic system will be the main energy provider for the 100 m race ✓ aerobic system will be the main energy provider for 10000 m race as the runner settles into a pace ✓	*Accept a suitably annotated diagram*	**6**
10	**c**		at the end of the race, the athlete's breathing rate <and heart rate> remains elevated ***OR*** excess post-exercise oxygen consumption occurs during recovery ✔ the greater the intensity of the race the greater the EPOC/oxygen debt ✔ ATP/ PC stores are replenished <in the muscles> ✔ myoglobin / hemoglobin are reoxygenated ✔ phosphagen stores and myoglobin stores can be replenished within a few minutes of recovery <alactacid/fast component> ✔ aerobically metabolize lactic acid ***OR*** resynthesize lactate to glycogen ✔ replacement of muscle / liver glycogen stores ✔	*Accept a suitably annotated diagram*	**4**

			the recycling/removal of lactate and replenishment of glycogen stores may take several hours after exercise <lactacid/slow component> ✔		
10	**d**		peripheral fatigue occurs rapidly whereas central fatigue is developed over a prolonged period of exercise ✓ *eg* 100 m sprint vs end of marathon peripheral can recover more rapidly than central ✓ peripheral is commonly linked to high-intensity activities whereas central is more linked to endurance activities ✓ peripheral can be due to a muscle/muscles contracting repeatedly without resting whereas central refers to impaired function of CNS ***OR*** peripheral can be due to a depletion in PC stores/accumulation of fatiguing by-products whereas central could be due to overheating, dehydration or lack of glucose stores ✓ peripheral can be seen in the reduced muscular force being generated whereas central may be impaired reactions and decision making ✓ peripheral can be localized whereas central affects whole body ✓	*Award **[3 max]** if no examples given*	**4**

Question			Answers	Notes	Total
11.	**a**		i. perceptual skills use a person's senses ✓ *eg* an athlete hearing the call of a team-mate to pass them the ball ✓ ii. motor skills use voluntary movement ✓ *eg* a player passing a ball to their team-mate ✓ iii. perceptual motor skill is a skill where a person uses their senses to help execute a movement ✓ *eg* when passing a football, a player is aware of how much they are swinging their leg to impart the force to the ball, which they are looking at with their eyes ✓	*Award **[2 max]** for each* *Award **[3 max]** if no examples are given*	**6**
11	**b**		consistency: the professional will be more consistent with their putts and be less variable in the ball's placement ✓ accuracy: the professional will generally get the ball closer to the hole than a novice from the same spot ✓ control: the professional will have greater control of their movements ✓ learned: the professional will have spent a significant amount to time practising the skill ✓ efficiency: the professional's movements will be efficient and only have the movements which are necessary for correct execution ✓ fluency: the professional's movements will flow and be coordinated, enabling success ✓	*Award **[3 max]** for a list* *Accept in the converse*	**6**

<table>
<tr><td>11</td><td>c</td><td></td><td>genes code for specific proteins which are involved in many characteristics such as fast-twitch muscle fibres / height / lung capacity <which are beneficial to particular types of sport> ✓
genes are expressed as phenotypes ✓
genes affect the potential to perform a certain skill ✓
however characteristics are influenced by multiple genes ✓
genes can be switched on or off depending on internal or external factors ✓
<i>eg</i> the correct or incorrect diet will influence the growth of an individual ✓
<i>eg</i> being active and doing exercises will trigger the body to respond and adapt / training enables individuals to perform to maximise their genetic potential✓
despite environmental factors <<i>eg</i> training> performance is limited by a genetic ceiling ✓</td><td></td><td>4</td></tr>
<tr><td>11</td><td>d</td><td></td><td><table><tr><th>Strengths</th><th>Limitations</th></tr><tr><td>can be used to identify life-threatening conditions such as risk of cardiac disease ✓
has the potential to predict susceptibility to injury ✓
potential for talent identification ✓</td><td>there are ethical issues to be aware of, if the information is used to discriminate in sport/talent selection✓
could lead to discrimination in the workplace ✓
screening may miss potential athletes because there are multiple genes involved with characteristics ✓
it may not pick up the more subtle types of traits which are vital, such as an athlete’s level of determination/motivation ✓
opens up the possibility of gene doping to improve athletic performance ✓
unlikely to be effective for talent identification ✓</td></tr></table></td><td>Award [3 max] for either</td><td>4</td></tr>
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