Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2022

Sports, exercise and health science

Higher level

Paper 2

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

8. Words that are <u>underlined</u> are essential for the mark.

9. 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		52 <ml kg^{-1} min^{-1}>		1
1.	b		61–55 = 6 <ml kg^{-1} min^{-1}>;		1
1.	c		VO_{2max} (ml kg^{-1} min^{-1}) improves post-cycling for cyclist; pre training VO_{2max} during low oxygen is <significantly> lower than post training for both IMT & CG; there was a significant difference between pre-cycling and post-cycling VO_{2max} (ml kg^{-1} min^{-1}) under normal oxygen conditions for CG; training with IMT improves VO_{2max} more 6 vs 3 ml $kg^{-1}min^{-1}$ than training (without IMT) ***OR*** training with IMT improves VO_{2max} more than training (without IMT) in low oxygen conditions; training with IMT improves VO_{2max} more 6 vs 5 ml $kg^{-1}min^{-1}$ than training (without IMT) ***OR*** training with IMT improves VO_{2max} more than training (without IMT) in normal oxygen conditions;	*Accept in the converse* *Award [1] max for* 'Similar trend in results seen with IMT and CG' *Accept in the converse* *Accept in the converse*	4 max

1.	**d**		the maximal volume of oxygen which can be consumed and utilized <by the body> in one minute; <ml^{-1} min^{-1}> ***OR*** the functional capacity of the oxygen transport system ***OR*** maximal aerobic power/aerobic capacity;		**1**
1.	**e**		maximal oxygen consumption/VO_{2max} increases as muscle mass exercising increases; cycling uses large muscles groups <in the legs> ***OR*** arm ergometry uses smaller muscle groups <in the arms>; therefore, cycling would have a larger maximal oxygen consumption/VO_{2max} compared to arm ergometry; training in a discipline can influence the maximal oxygen consumption ***OR*** someone trained to use an arm ergometer may perform higher than if they completed a cycle where they are untrained;	*Accept in the converse*	**3 max**

2.	**a**	**i**	Standard deviation		**1**
2.	**a**	**ii**	graph (b) shows low variability in the testosterone levels whereas graph (a) shows high variability in the cortisol levels;	*Accept in the converse*	**1**
2.	**b**		yoga reduces the rate of salivary cortisol produced as time post exercise increases; yoga maintains/slightly elevates testosterone levels post trial; 120 minutes post yoga significantly reduces cortisol levels; 120 minutes post yoga sees the largest increase in testosterone levels;	*Do not accept stress hormones, specific reference to cortisol or testosterone are required.*	**3 max**
2.	**c**		at the end of intensive training, cortisol levels will be raised/elevated; sustained increases in cortisol levels suppress the immune system; therefore increase their risk of infection;		**2 max**

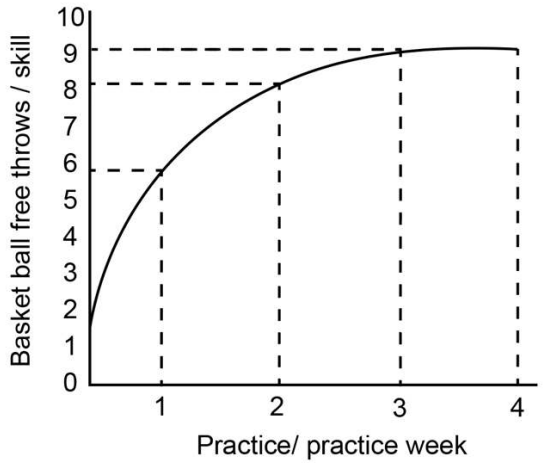
3	**a**		to regulate and coordinate a range of bodily functions; to act on specific target cells;		**1 max**
3.	**b**		adrenal gland;		**1**
3.	**c**		the sympathetic nervous system is stimulated by stress/exercise; sympathetic nervous system stimulates the release of adrenaline from the adrenal glands; adrenaline <acts directly on the SA node and > stimulates an increase in heart rate;		**2 max**
3.	**d**		*Muscle contraction:* increases glucose uptake <once glycogen stores are depleted> ***OR*** a decrease in muscle glycogen increases glucose uptake; cardiac output is redistributed to the contracting muscles; causes an increase in perfusion/blood supply to muscle capillaries ***OR*** causes an increase in muscle capillary recruitment; promotes translocation of glucose transporters (GLUT 4) which increases the permeability of the muscle <plasma> membrane; muscle contraction inhibits insulin/glycogenesis; insulin sensitivity increases as the acute effect of muscle contraction on glucose transport wears off;		**3 max**

3.	**e**		*ATP-CP system:* breakdown of PCr frees Pi; creatine kinase is the controlling enzyme; Pi combines with ADP to form ATP; 1ATP is produced <per PCr>; lasts for 10-15 seconds; *Anaerobic glycolysis/Lactic acid system:* glucose breakdown during high intensity exercise is through anaerobic glycolysis; glucose is broken down into <2> pyruvate; due to insufficient supply of oxygen during high intensity activities pyruvic acid is converted into lactic acid; <net> 2ATP are produced; lasts for 2-3 minutes/is the predominant system;	*Candidates must identify the appropriate energy system to receive credit.* *Max* [2] *ATP-PC system* *Max* [2] *anaerobic glycolysis*	**3 max**

4	**a**		reaction time + movement time ***OR*** it is the time from the introduction of a stimulus to the completion of a movement <in response to the initial stimulus>;	*Accept in the converse*	**1**
4	**b**		*Population impact on physiology:* response time is individually variable *e.g.* affected by gender/age/height; *Structural impact on physiology:* the length/ effectiveness of nerve transmission; the percentage of fast twitch / type IIb fibres; *Training impact on physiology:* muscular power due to their training; *Stress and fatigue levels:* fatigued/ high levels of stress hormones;		**2 max**
4	**c**		selective attention involves focusing on relevant information <listening for the gun>; selective attention involves ignoring/filtering out irrelevant information <crowd noise>; a sprinter who is focused on the relevant information/sound of the gun is likely to have a faster response time ***OR*** a sprinter who ignores the irrelevant information, *e.g.*, crowd noise, is likely to have a faster response time; racing on a day without additional environmental factors *e.g.*, poor weather/noisy crowd is likely to have a faster response time; selective attention improves with experience/training therefore a more experienced sprinter may improve their response time;		**3 max**

4	**d**		friction is the force that occurs when two surfaces are in contact and opposes the relative motion ***OR*** during sprinting, friction occurs between the track and footwear of the sprinter; friction prevents a sprinter from slipping on the track; friction maximizes their acceleration/motion forward therefore provide the sprinter with a faster time; sprinters maximize their friction by wearing spikes; spikes increase the surface area in contact with the ground; tartan tracks have greater friction than grass/gravel/sand;		**3 max**

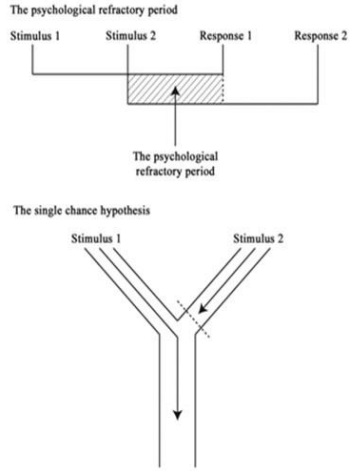
<table>
<tr><td>5</td><td>a</td><td></td><td><table><tr><th>Joint</th><th>Joint action</th><th>Muscle contraction</th></tr><tr><td>Hips</td><td>abduction;</td><td><isotonic> concentric;</td></tr><tr><td>Knees</td><td>extension;</td><td><isotonic> concentric;</td></tr></table></td><td></td><td>4</td></tr>
<tr><td>5</td><td>b</td><td></td><td>HIIT will require <predominantly> anaerobic energy systems whereas 10km will require <predominantly> aerobic energy systems;</td><td>Accept specific reference to the anaerobic energy systems.</td><td>1</td></tr>
<tr><td>5</td><td>c</td><td></td><td>at fibrous joints, bones are joined together by dense connective tissue <mainly collagen> whereas cartilaginous joints are joined by cartilage;</td><td></td><td>1</td></tr>
<tr><td>5</td><td>d</td><td></td><td>synovial fluid: acts as a lubricant, allows bones to smoothly move past each other;
articular cartilage: a <glassy> smooth layer surrounding the ends of the bones to reduce friction;
bursae: synovial fluid filled sac, sits between the tendon and bone to reduce friction;
synovial membrane: produces the synovial fluid which aids lubrication;</td><td></td><td>2 max</td></tr>
</table>

6	**a**		non-linear pedagogy;		**1**
6	**b**		whole–part–whole is when a skill is presented in full *e.g.,* the long jump; the coach would then break down the skill into discrete part *e.g.,* the run up/take off ***OR*** coach breaks the skill down into discrete parts allowing the performer to focus their attention on that element and receive <specific> feedback; then the discrete part is combined with the whole skill ***OR*** coach presents the whole skill allowing performers to experience the skill as a whole;		**3 max**
6	**c**		 *Axes labelled and scale provided:* Y axis: basketball free throws/skill, scale 0-9/10, X axis: practice/week, scale 1-4; *shape of graph and data points:* shape of graph and data points;		**2**

Section B

Question			Answers	Notes	Total
7	a		To increase success: modify environmental conditions: a coach can *e.g.*, change from outdoors to indoors/control spectators/change surface; modify the equipment: a coach can change the equipment in a particular skill/game *e.g.,* lighter/smaller ball to help; modify playing area: a coach can change the shape/size of the playing area or provide greater time for a novice player *e.g.,* making the area larger for 4 v 4 game to allow performers more space to eliminate defenders; suggesting imagery: coaches can provide some images whilst coaching or make connections for an athlete to help them visualize *e.g.,* a soccer coach may use an example of Cristiano Ronaldo during a heading practice; enforcing specific rules/conditions for performance: a coach can manipulate the rules for a novice performer *e.g.,* no tackling allowed; setting tasks/goals: coaches can provide individual or team goals to aid motivation/increase repetition of skills *e.g.,* a coach provide a specific goal to an individual or group of novice individuals where they receive points for success of a particular skill within a game;	*Award [1] max per category*	**5 max**

7.	**b**		***40m sprint test*** this is a relevant/ valid/ reliable test for measuring speed <and a basketball player requires speed to *e.g.,* attack at pace>; however, a basketball player usually sprints for less than 40m, therefore it is not specific to the needs; ***Drop test*** a drop test is a relevant/ valid/ reliable test for measuring reaction time <and basketball players require reaction time to rebound the ball/ defend/eliminate players>; however, the test only measure's reaction in the hand so not useful to basketball ***OR*** it doesn't assess whole body movements which would be specific to basketball; ***Standing broad jump test*** this is a relevant/ valid/ reliable test for assessing power <which a basketball player requires to jump for rebounds>; however, the test is not specific to the use of power in basketball;	*Award [2] max per test* *Max [1] per test if no evaluation <if only strengths OR limitations of a test are provided>* *Credit an overarching limitation [Max 1] that all three tests do not provide a complete picture of a basketballer's performance due to only focusing on three components of fitness*	**6 max**

7.	**c**		faking to shoot means that the soccer player will pretend to shoot with the intention of deceiving the opponent <in order to gain an advantage> ***OR*** a soccer player may fake/dummy a shot to send an initial cue/stimulus to the opponent; due to the single channel mechanism the opponent will begin to respond to this initial stimulus/fake shot; whilst the opponent is responding to the initial stimulus the soccer player will perform a second stimulus <*e.g.,* begin to dribble around the opponent>; due to the opponent having to respond to stimulus 1 first <single channel hypothesis> there is an increase in the opponent's reaction time to the second stimulus; this time delay is called the psychological refractory period/ PRP; <PRP> can be used to help a performer have a greater chance of success *e.g.,* pretending to shoot/run the other way; <PRP> provides a player with a greater range of options in their play/reduces their predictability;	 *Accept an annotated diagram*	**4 max**

7.	**d**		genes code for specific proteins which are involved in characteristics such as fast-twitch muscle fibres / height <which are beneficial to a basketball player>; genes are expressed as phenotypes <such as the basketballer's height>; characteristics are influenced by multiple genes; genes can be switched on or off depending on internal/external factors; *e.g.,* diet will influence the growth/height of the basketball player; *e.g.,* training enables individuals to enhance their characteristics to maximize their genetic potential;		**5 max**

8.	**a**	**i**	drag is the force or forces acting to oppose the motion of an object through a fluid medium such as air or water;		**1**
8	**a**	**ii**	as the cyclist moves through the air, the outer surface layer of their skin/helmet/clothing catches a layer of air; the more air layers that are caught on the surface of the cyclist, the greater the drag; the greater the drag, the slower they will cycle; to minimize surface drag, a cyclist could *e.g.,* wear a full body tight-fitting lycra suit/ shave down/aerodynamic equipment; surface drag is reduced in higher altitudes; surface drag could be reduced with lower cycle velocity/lower head wind speeds; to minimize surface drag, a cyclist could cycle behind a teammate/competitor <drafting>;	*Accept in the converse*	**4 max**

8	**b**		moderate exercise is associated with reduced susceptibility to infection; athletes who have high training loads may be more susceptible to infection; high training loads lead to greater exposure to airborne bacteria and viruses because of an increased rate and depth of breathing; high training loads can result in more inflammation <in respiratory tract>; inflammation <in respiratory tract> makes body more susceptible to respiratory tract infections; high training loads can lead to high levels of cortisol/adrenaline fatigue which can lead to the suppression of the immune system; high training loads can lower leucocyte numbers; leucocytes are required to help fight infection; overtraining can lead to the same susceptibility to infection as someone who is sedentary;		**5 max**

8	**c**		cardiac output is redirected to working muscles; sympathetic stimulation of blood vessels <areas of blood flow reduction *e.g.,* kidneys>; increases in acidity/temperature/CO_2 causes vasodilation in skeletal muscles; enhanced venous return in large muscle groups due to muscular & respiratory pumps; vasodilation of arterioles to working muscle; vasoconstriction of arterioles to non-active tissue; pre-capillary sphincters within non-active tissue vasoconstrict; pre-capillary sphincters within working muscles vasodilate; vasodilation to skin for cooling purposes;		**5 max**

8	**d**		circumduction: the circling of a body segment at a joint ***OR*** circumduction: *e.g.,* the arm action at the shoulder during butterfly; plantar flexion: the extension of the ankle joint ***OR*** plantar flexion: *e.g.,* the ankles during backstroke/freestyle; dorsi flexion: flexion of the ankle joint ***OR*** dorsi flexion: *e.g.,* the ankles during recovery/action phase of breaststroke; supination: lateral rotation of the radioulnar joint ***OR*** supination: *e.g.,* sculling/pulling phase of arms in breaststroke supinates the hand at the wrist; pronation: medial rotation of the radioulnar joint ***OR*** pronation: *e.g.,* arm entry into the water during freestyle pronates the hand at the wrist; flexion: closing of the joint angle ***OR*** flexion: *e.g.,* the arm at the elbow during recovery over the water in freestyle; extension: opening of the joint angle ***OR*** Extension: *e.g.,* the arms at the elbow/legs at the knee in the streamlined position during a dive; abduction: movement of a limb away from the midline ***OR*** abduction: *e.g.,* the movement of the legs at the hip kicking out in breaststroke; adduction: movement of a limb towards the midline	*Not limited to examples given* *Award [1] max for each type of movement*	**5 max**

			OR adduction: *e.g.,* the movement of the legs at the hip during the glide phase of breaststroke; rotation: movement of a bone around a central axis **OR** rotation: head turns to breath in freestyle;		

9	**a**		as the metabolic effect of the race raises body temperature, the blood vessels within the skin vasodilate to release heat; contains nerves that relay information about the sensation of the soles of feet sensing the pressure of contact with the floor; sweat excreted aids heat loss through evaporation from the skin; the epidermis synthesizes vitamin D while the skin is exposed to UVB light during the race; provides a protective barrier to microorganisms from the air/rain during a race; provides a protective barrier to physical trauma injury if the runner falls; provides a barrier that reduces harmful effects of the sun's radiation;	*Accept any suitable reference to information about sensations related to the environment whilst running.*	**5 max**
9	**b**	**i**	the pulmonary circulation transports deoxygenated blood to the lungs to be oxygenated and back to the heart to be pumped around the body;		**1**
9	**b**	**ii**	<deoxygenated> blood returns to the heart via <venules> and veins; <deoxygenated> blood enters the right atrium via the vena cava; <deoxygenated> blood travels into the right ventricle via the tricuspid valve; <deoxygenated> blood is ejected from the ventricle via the pulmonary valve; <deoxygenated> blood travels to the lungs via the pulmonary artery; blood passes through the capillary bed of the lungs<to be oxygenated>;	*Accept suitably annotated diagram*	**5 max**

9	**c**		the 10km race is a long duration <that lasts more than 26 minutes> endurance event, therefore the aerobic system is the predominant energy system ***OR*** over 50% of energy is supplied through the aerobic system; the predominant contribution of the aerobic energy system will begin around 3 minutes into the race; contribution of the aerobic system may be less if the intensity of the exercise exceeds the ability of the body to supply sufficient oxygen; contribution of aerobic system will be greater in athletes who are regularly engaged in endurance training; energy is <predominantly> supplied through the breakdown of glycogen and fatty acids; a trained athlete will utilize fatty acids more readily as they produce a higher ATP yield;	*26 mins is the current world record. Accept any duration greater than ~26 mins.*	**4 max**
9	**d**	**i**	age: from maturation an individual's tolerance to fatigue declines; level of fitness: an individual with lower fitness levels/experience of the type of training is likely to suffer greater fatigue than a trained individual; type of exercise: high-intensity exercise is likely to elicit a greater acute sensation of fatigue;		**1 max**

9	**d**	**ii**	depletion of muscle <and liver> glycogen reserves reduces energy from ATP production; low glycogen can suppress Ca^{2+} release; reduction in Ca^{2+} actin-myosin cross-bridge formation; depletion of Ach reduces transmission of nervous impulses across the synapse, reducing the speed of contraction; electrolyte loss causes decreased nerve function; dehydration can also impair actin-myosin cross-bridge formation ***OR*** overheating causes decreased muscle enzyme function; dehydration can lead to reduction in blood flow to active muscles due to low blood pressure;		**4 max**

10	**a**		contractility: ability to generate force / create tension; extensibility: ability to be stretched beyond its normal resting length; elasticity: ability to return to resting length after it has been stretched; atrophy: a decrease in myofibrils / fibre diameter/ muscle size <due to a lack of physical activity>; hypertrophy: an increase in myofibrils / fibre diameter/ muscle size <due to an increase in activity/training>;		**4 max**
10.	**b**		tropomyosin/troponin complex exposes the binding site <on actin>; myosin heads hydrolyse ATP and become energized; myosin <head> creates a cross-bridge with the actin; power stroke takes place; myosin heads slides the actin <thin filament> towards the m line; ADP is released by the myosin head; myosin releases actin if new ATP appears; myosin head reattaches further down the actin filament repeating the contraction cycle <called the ratchet mechanism>; process continues as long as calcium channels remain open;		**6 max**

10	**c**		athletes inherit 50% of their genes from each birth parent;		**1**
10	**d**		*Strengths* the identification of life-threatening conditions such as risk of sudden cardiac death, connective tissue disorder; the potential to predict susceptibility to injury and so reduce risk/improve safety for an individual athlete; *Limitations* ethical implications of involuntary exclusion from, or discrimination in, one or more sports; ethical implications of discrimination beyond sport, for example, in employment; the possibility of gene doping in the future to improve athletic performance; doesn't take into consideration motivation and environmental switch;	*Max 3 for limitations*	**4 max**
10	**e**		the hypothalamus and the pituitary gland are together responsible for homeostasis; the hypothalamus is the part of the brain that controls the pituitary gland; the proximity of the pituitary gland suspended from the hypothalamus improves the efficiency of the relationship; nerve impulses from the hypothalamus to the <posterior> pituitary gland; stimulate the <posterior> pituitary gland to secrete antidiuretic hormone (ADH) <from axon terminals>; ADH is released into the blood <which circulates to the kidney>; antidiuretic hormone causes the return of water to the blood from the kidneys/decreases water loss through sweat glands;	*Award [2] max for the relationship between pituitary gland and hypothalamus*	**5 max**