

Markscheme

November 2024

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 = [**90 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.

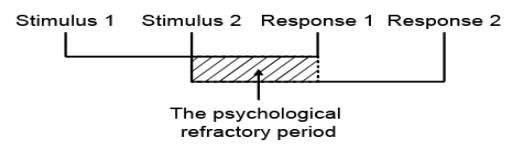
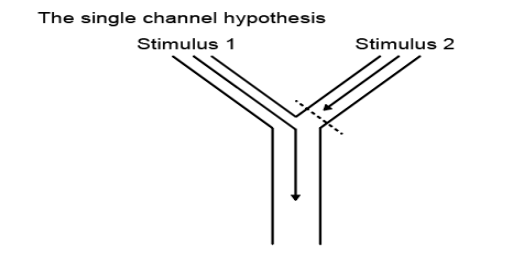
8. Words inside chevrons « » in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. If the candidate’s answer 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		Mid-competitive season ✓		1 max
1.	b		$13.3 - 12.1 = 1.2$ «% decrease» ✓		1 max
1.	c		Vertical jump assesses power ✓ Power is required to jump in basketball ✓ Vertical jump is specific to the muscles used/ movement pattern of basketball OR Basketballers with greater vertical jump height are likely to be more successful at e.g. rebounding/ blocking in competition ✓	<i>MP3 Accept any suitable example where jumping would be required in basketball.</i>	3 max
1.	d		Coordination ✓ Balance ✓ Reaction/ response time ✓ Agility ✓ Speed ✓	<i>Do not accept power or health related components (CV endurance, muscular endurance, flexibility, strength, body composition).</i>	2 max
1.	e		High-intensity exercise predominantly produces energy without oxygen/ anaerobic and endurance activities predominantly require oxygen/ aerobic for energy production ✓	<i>Must refer to both high-intensity and endurance activities to receive credit.</i>	1 max

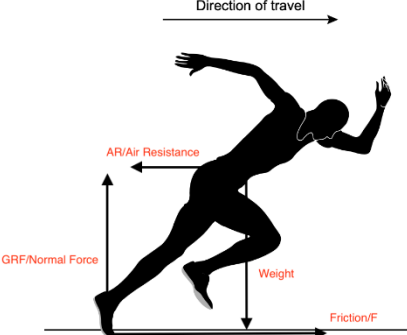
1.	f		Depletion of glycogen/ ATP/ PC «stores» ✓ Build-up of lactic acid/lactate/ hydrogen ions ✓ Depletion of calcium ions ✓	<i>Do not accept overheating/ dehydration/ depletion of acetylcholine/ depletion of glucose/ energy stores.</i>	2 max
2.	a		Half court, post-intervention ✓		1 max
2.	b		«Graphical representation of the» variability of data/ standard deviation OR «Graphical representation of the» spread of data around the mean ✓		1 max
2.	c		Graph A the error bars are large and the Graph B the error bars are small ✓	<i>Accept reference to larger or smaller as comparison.</i>	1 max
2.	d		Diastolic blood pressure decreased significantly for both half court and full court groups ✓ Systolic blood pressure decreased significantly for the full court group ✓ Half court group had no effect/ no significant increase on systolic blood pressure ✓ It could be concluded that full court practice significantly reduces blood pressure ✓ Large variability in data for the systolic blood pressure group reduces confidence in drawing a conclusion ✓	<i>Must refer to significance for MP1, MP2, MP3, MP4.</i>	3 max
2.	e		Systolic blood pressure would increase ✓ Diastolic blood pressure would increase ✓		2 max

2.	f	Goals of the specific task: E.g. Setting a challenge to score using only the left foot in soccer ✓ Rules/ conditions: E.g. Only allowed to pass forward in a game of netball ✓ Rules on equipment: E.g. Use a lighter basketball so that it is easier to pass for younger performers ✓	Accept any other <u>suitable</u> examples. No credit for no examples. Only credit each task constraint once.	2 max
2.	g	Parts of a skill are learned and then combined sequentially ✓ Allows the breakdown of a complex skill into manageable chunks ✓ Allows focus/ rehearsal of challenging aspects of the skill ✓ Allows a coach to add aspects of the skill as the performer develops competence ✓ Often used by skills that require a routine or a complex e.g. gymnastics routine/ lay-up ✓	MP1 accept WTTE there needs to be reference to learning of each part one after the other, adding each new part to the skill in order.	2 max
3.	a	Scattergrams, a method of recording the frequency and location of actions ✓ E.g. Record position/ location of shots taken during a game ✓ Frequency tables, used to record the frequency of actions by a team/ individual ✓ E.g. Frequency of three-point attempts ✓ Sequential systems, used to break down a skill/ phase of play ✓ E.g. Analysis of shooting action of shooting player ✓	Max 2 per notation system. Only credit two notation systems.	4 max

3.	b	E.g. a basketball player fakes/ dummies/ pretends that they will pass in one direction OR Stimulus one/ S1 is presented which an opponent first attends to ✓ E.g. at the last moment the basketball player dribbles in the opposite direction OR Stimulus 2/ S2 is presented shortly after Stimulus 1/ S1 ✓ The opponent must attend the first stimulus/ response 1 fully before they can process/ respond to stimulus 2 OR Due to the single channel hypothesis the opponent cannot immediately switch their attention to the second stimulus ✓ This causes a delay to the opponent's reaction to Stimulus 2/ S2 which is PRP ✓ Therefore, the basketball player can gain an advantage/ beat their opponent ✓ If fake/ dummy becomes predictable the PRP is reduced OR PRP can be affected by the experience of the performer/ opponent OR If there is a large time gap between S1 and S2 the advantage is reduced ✓	<i>Award 3 max if no example is given.</i> <i>Accept any suitable example.</i> <i>Accept a clearly annotated diagram for Max 3.</i> The psychological refractory period  The single channel hypothesis 	4 max
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3.	c	Leucocytes: Leucocytes flood to site of injury to kill bacteria/ fungi/ foreign debris ✓ Leucocytes defend against infection by cleaning up damaged cells ✓ Inflammation: Increase in blood flow to deliver leucocytes/platelets to the injury ✓ Increased blood flow to graze will lead to bleeding which helps to remove debris and toxins ✓ Clotting: Platelets rapidly form a clot to reduce bleeding ✓ Clots provide a scaffold for cells involved in tissue regeneration ✓ Lymphocyte and antibody: Lymphocytes attack viral infections that may enter the graze ✓ Antibodies are produced to fight infections entering the broken skin barrier ✓	<i>Max 1 per mechanism.</i>	3 max
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3.	d	Articular cartilage: Cartilage that absorbs shock ✓ «Covers the end of bones and» reduces friction between bones ✓ Meniscus: «Fibro» cartilage which helps «uneven» bones fit at a joint ✓ Maintain stability of joint ✓ Direct synovial fluid to area of most friction ✓ Ligaments: Prevent unwanted movement at the joint ✓ Joint/ articular capsule: Helps prevent dislocation/ maintains stability ✓ Keep synovial fluid within the joint ✓ Synovial membrane: Secretes synovial fluid «to aid lubrication» ✓	<i>Do not accept synovial fluid and bursae.</i> <i>Max 1 per feature.</i> <i>For MP2 between the bones is required to award the MP and do not accept prevent.</i>	3 max
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4.	a	F/ Friction going with direction of travel from back foot in contact with floor ✓ AR/ Air resistance going from COM in opposite direction to travel ✓ W/ Weight going from COM to floor ✓ GRF/ Normal force from points of contact ✓	 <i>Lines need to be accurately labelled, originate from the correct place and point in the right direction.</i>	4 max
4.	b	The smoother the surface of the sprinter the lower the drag ✓ The smaller the front cross-sectional area the lower the drag ✓ The more aerodynamic the shape of the sprinter the lower the drag ✓ If the sprinter is running into a head wind, the drag will be greater ✓ The lower the atmospheric pressure the lower the drag ✓ As speed of the sprinter increases the air resistance/ drag increases «exponentially» ✓	<i>Accept in the converse for all answers.</i> <i>Must be a clarification on the effect on drag.</i>	3 max

4.	c	ATP-PC system «is operating as the predominant energy system» ✓ PC/ CP is the fuel «to replenish ATP» ✓ 1PC/ CP gives 1ATP OR ADP gain/ replenish a phosphate for around 10-15 secs ✓ Process is anaerobic✓ Creatine kinase is controlling enzyme «to break down PC/ CP» ✓ OR Reaction occurs in the cytoplasm ✓	<i>No credit for lactic acid system or aerobic system.</i>	3 max
4.	d	Compare, both runners will: Demonstrate EPOC/ oxygen debt/ elevated heart/ breathing rate after exercise ✓ Need to replenish muscle phosphagen stores OR Need to replenish oxygen in myoglobin stores ✓ Contrast: 10Km runner will have a larger EPOC/ oxygen debt ✓ OR 10km take longer to recover/ return to pre-exercise levels ✓ 10km runner will need to replenish glycogen stores ✓ 10km may have higher lactate levels to remove ✓ 10km may have greater microscopic tears within the muscle ✓	<i>Contrast needs to be a clear reference to difference e.g. larger/ longer/ greater/ higher.</i>	4 max

Section B

Question			Answers	Notes	Total																												
5.	a		Blood leaves the lungs via veins ✓ Blood enters the left atrium ✓ Via the pulmonary vein✓ Blood travels to the ventricles from the atria via bicuspid valve ✓ Blood is pumped out of the left ventricle ✓ Through the aorta OR Via aortic valve ✓ Aorta transports blood to the arterial system ✓ Capillaries of skeletal muscles receive blood from arteries/ arterioles ✓	MP6 Only credit aorta if there is some reference to the blood leaving the heart after arriving from the lungs.	5 max																												
5.	b		<table><tr><td></td><td>Top spin</td><td>Back spin</td><td></td></tr><tr><td>(local) airflow velocity above the ball</td><td>lower</td><td>higher</td><td>✓</td></tr><tr><td>(local) airflow velocity below the ball</td><td>higher</td><td>lower</td><td>✓</td></tr><tr><td>(local) airflow pressure above the ball</td><td>higher</td><td>lower</td><td>✓</td></tr><tr><td>(local) airflow pressure below ball</td><td>lower</td><td>higher</td><td>✓</td></tr></table> <table><tr><td>Flight path</td><td>dip/ flatten</td><td>lift/ higher</td><td>✓</td></tr><tr><td>Bounce</td><td>lower/ flatter</td><td>higher/ bounce up</td><td>✓</td></tr></table>		Top spin	Back spin		(local) airflow velocity above the ball	lower	higher	✓	(local) airflow velocity below the ball	higher	lower	✓	(local) airflow pressure above the ball	higher	lower	✓	(local) airflow pressure below ball	lower	higher	✓	Flight path	dip/ flatten	lift/ higher	✓	Bounce	lower/ flatter	higher/ bounce up	✓	Accept correctly annotated diagrams for any MPs, ensuring candidates have made a comparison between back spin and top spin. Accept increased or decreased as alternatives to higher or lower.	4 max
	Top spin	Back spin																															
(local) airflow velocity above the ball	lower	higher	✓																														
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Bounce	lower/ flatter	higher/ bounce up	✓																														

5.	c	Rehearsal: (Conscious) repetition of information required for memory ✓ Rehearsal can be used to lengthen the time information remains in the STM ✓ Rehearsal strengthens the memory trace ✓ Increasing likelihood of information encoded/ transferred to the LTM ✓ Chunking: Grouping larger pieces of information into smaller chunks of information ✓ Smaller chunks of information are easier to store ✓ Increasing the amount of information that can be stored «as it is chunked/ grouped e.g. remembering similar routines as a group» ✓	Max 2 per method.	4 max
5.	d	Receive neural information from visual/ auditory/ smell/ somatic sensors ✓ The cerebrum interprets information received from the sensory organs ✓ E.g. A soccer player sees an opponent dribbling with the ball towards goal ✓ Interpreting and storing input ✓ Allows recognition/ evaluation of information ✓ E.g. A goalkeeper observing and association flight path of soccer as it is struck at goal ✓ Controls voluntary contractions of muscles by transmitting impulses to effectors ✓ Coordinates the movements of multiple joints/ muscles to produce smooth actions ✓ E.g. Signal to leg muscles to move to control ball passed by teammate ✓	Max 2 without reference to an example.	3 max

5.	e	Strengths: Identify susceptibility to injuries ✓ Identify potential genetic conditions that could affect health e.g. cancer ✓ Potential to identify talent based on genetic predisposition ✓ To select sport based on genetic profile ✓ Limitations: Discrimination from work/ reduce employment opportunities ✓ Discrimination from sports due to unfavourable genetic makeup ✓ Potential to encourage gene doping ✓	<i>Max 3 for strengths or limitations.</i>	4 max
6.	a	Has a negative effect on the immune system therefore increase susceptibility to infection ✓ Increased depth of breathing through regular «aerobic training» could lead to pathogens entering the respiratory system ✓ Immune system is suppressed: Due to increased secretion of stress hormones «cortisol/ adrenaline» ✓ Reduction in leucocytes ✓ Anti-inflammatory response over an extended period due to hyperinflammation «due to stress of exercise» ✓		3 max

6.	b	Similarities: Carbohydrate would be highest percentage of macronutrient ✓ Consume carbohydrate, lipids, protein and water as part of their diet ✓ Lipid intake will equal to/ higher than protein intake ✓ Differences Marathon runners have a larger percentage of macronutrient from carbohydrate than a sedentary individual ✓ Marathon runner will have a greater total volume of macronutrients than sedentary individual ✓ Marathon runners consume greater volumes of water ✓	<i>Accept implied reference to similarities and differences.</i> <i>E.g. CHO intake for sedentary is 60% and CHO intake for runner is 65%.</i>	5 max
6.	c	When the diaphragm contracts/ flattens ✓ When the external intercostal muscles contract they pull the ribcage up and out ✓ External intercostal/ diaphragm muscles contract with greater force/ more frequently ✓ External intercostal muscles aid further expansion of the rib cage during exercise ✓ Causing greater/ deeper inhalation/ increased TV during exercise OR More air rushes into the lungs ✓ Muscles cause a greater pressure gradient «with the external atmosphere» ✓	<i>MP3-6 must reference the difference between exercise and rest.</i>	5 max
6.	d	Pituitary gland is directly stimulated through «neuro» hormones sent by the hypothalamus ✓ E.g. GHRH stimulate the release of GH from pituitary gland ✓ Pituitary gland is stimulated by neural stimulus ✓ E.g. Neural stimulation to release ADH/ Vasopressin ✓	<i>Accept any suitable examples of hormones.</i> <i>Credit appropriate points when they combine MP1&2 and MP3&4.</i>	4 max

6.	e	Cognitive stage of learning is the initial stage of learning ✓ Performers do not have any previous experience OR making new connections to form a new motor programme ✓ Performers will be inconsistent/ make lots of mistakes ✓ Performers needs lots of external feedback to develop skill ✓ Performers will be inefficient and lack coordination in their movements ✓ e.g. learning to lay-up the performer may miss the basket/ jump off the wrong leg ✓ Learning is likely to be rapid during this phase ✓	<i>Max 2 without an example.</i>	3 max
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7.	a	Oxygen levels entering the lungs/ alveoli are higher than «pulmonary» capillaries OR Oxygen levels in the blood returning to «pulmonary» capillaries is lower than the alveoli/ lungs ✓ «Net» movement of gases from an area of high concentration to an area of low concentration/ Ficks Law OR «net» movement of gases down a concentration gradient ✓ Oxygen has a short diffusion pathway OR Oxygen diffuses across the thin alveoli wall into the «pulmonary» capillary ✓ Oxygen combines with haemoglobin in the blood ✓ Oxygen dissolves in the blood plasma ✓ Oxygen diffusion is enhanced by a moist layer surrounding the alveoli ✓ Oxygen diffusion is enhanced by the large surface area of the alveoli/ capillary network ✓		4 max
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7.	b	Angular momentum is generated when force is applied outside the centre of mass/ using eccentric force ✓ The greater the force applied the greater the momentum ✓ Angular momentum is conserved during a skill by the inverse relationship of angular velocity and moment of inertia ✓ E.g. a diver: To complete several rotations a diver will need to reduce their moment of inertia ✓ This is achieved by tucking limbs closer «to their COM/axis of rotation e.g., a tuck position» ✓ This increases their angular velocity «and allows greater rotation» ✓ If the performer wishes to reduce their rotations «e.g., to enter the water safely» they will need to increase their moment of inertia ✓ This is achieved by extending their limbs «further away from their COM/ axis of rotation» ✓ This reduces their angular velocity ✓	<i>Do not accept equation in isolation.</i> <i>Max 5 without reference to an example from sport.</i>	6 max
7.	c	Lowering body position to lower their COM ✓ Position the line of gravity to fall within their base of support ✓ Widen the base of support so the line of gravity is more likely to remain within the base of support ✓ In contact sports, place line of gravity at the edge of the base of support where contact will be made to increase the distance the line of gravity has to move OR Aim to maintain body position where the COM remains inside the body ✓	<i>Accept appropriately annotated diagram.</i> <i>Do not accept just widen the base of support without link to effect on line of gravity.</i>	3 max

7.	d	The brain's principal source of energy is glucose «and oxygen» ✓ The brain has limited capacity for CHO storage ✓ Potential consequences of low glucose levels are dizziness/ mental confusion/ convulsions/ loss of consciousness ✓ Therefore fat/ protein may have to be synthesised into glucose via gluconeogenesis to provide energy for brain function ✓		3 max
7.	e	Genes produce proteins responsible for the development of an individual e.g. muscle fibre type ✓ Characteristics can also be influenced by the environment e.g. lung capacity, height ✓ Genes can be switched on or switched off depending on internal or external factors, so that characteristics can change during a person's lifetime ✓ Multiple genes determine the measurable characteristics for everyone, therefore unlikely a single/ few genes are associated with athletic performance ✓		4 max
8.	a	Contractility, the ability to contract forcefully when stimulated by an action potential ✓ Extensibility, the ability to be stretched without being damaged ✓ Elasticity, the ability of the muscle tissue to return to its original length after contraction/ extension ✓ Atrophy, the ability of the muscle tissue to decrease in size «through lack of use» ✓ Hypertrophy, the ability of the muscle tissue to increase «due to being stressed from exercise» ✓	<i>Max 1 for list of 3 correct characteristics. (Candidates who accurately meet a MP max 2 with MP and list of 3 other characteristics).</i>	4 max

8.	b	Hormones are regulated by «complex» feedback loops ✓ Regulated by chemical changes within extracellular fluids e.g. blood ✓ E.g. Insulin: increase in blood glucose level stimulates release of insulin «from pancreas» ✓ E.g. Glucagon: decrease in blood glucose levels stimulates release of glucagon ✓ Signals from the nervous system/ once the substance reaches a certain level, it sends a signal that stops further release of the substance ✓ E.g. Adrenaline: released due to fight or flight response through autonomic nervous system/ sympathetic nerve ✓ Endocrine glands release hormones when stimulated by hormones released by other endocrine glands ✓ E.g. Growth hormone: stressors stimulate GHRH release from hypothalamus, which in turn stimulates pituitary to release GH ✓	<i>Award 1 max per example.</i> <i>Examples must be explained, not merely listed.</i> <i>Accept an appropriately annotated diagram.</i>	4 max
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8.	c	All energy systems will contribute to the resynthesis of ATP «during a team sport», contribution is determined by fuel availability/ oxygen availability/ intensity of activity/ duration of activity ✓ Short intense movements lasting <15 seconds utilise the ATP-PC system ✓ E.g. Sprinting down across the box in soccer to score a goal ✓ Initial seconds of match/ after break in play the ATP-PC system will predominantly resynthesize ATP ✓ Periods of high intense activity >15 seconds will utilise the Lactic acid system/ anaerobic glycolysis ✓ E.g. Channeling an attacker down the wing in soccer ✓ Aerobic energy system will be the predominant energy system for continuous movement >90 seconds ✓ E.g. Running from box to box as a midfielder during a continual transition of possession ✓ Aerobic energy system provides recovery of anaerobic processes OR Periods of rest between intense bouts of exercise will utilise the aerobic energy system ✓ E.g. Break in play during a set piece such as a ball out of play in basketball ✓	<i>Candidates need to refer to specific energy systems and examples need to link to the appropriate energy system.</i> <i>Max 5 if no example applied to a team sport.</i> <i>Max 5 without reference to all three energy systems.</i> <i>Accept any other suitable example applied to a team sport.</i>	6 max
8.	d	A sprinter will remain on the blocks/ stationary until sufficient force applied to overcome inertia ✓ As the sprinter applies a force down and back on the blocks, the blocks will provide an equal and opposite reaction force ✓ The greater the force applied by the sprinter the greater their acceleration «out of the blocks» ✓	<i>Only credit reference to newton's laws in the blocks.</i> <i>Do not penalize incorrect Newton Law label. E.g. MP1 calling it N3</i>	3 max

8.	e	Is used to capture movement of players/ ball to provide live/ post-game analysis to inform officiating decisions «e.g. technology in tennis to call the ball in or out/ Hawkeye» ✓ Is used to capture movement of players/ ball to provide live/ post-game/ practice analysis to inform future training needs «e.g. data collected for a football match on possession stats/ Hudl» ✓ Review/ replay recordings of games to analyse effectiveness of team/ opposition tactics «e.g. field hockey footage of penalty corner routines of an opposition/ Veo» ✓ Used to track nutritional/ physiological markers/ effects of training/ monitor overtraining «e.g. tracking diet and sleep on an app/ bodybyte» ✓	<i>Do not just credit example names of digital technologies, candidates must give outline of how and why the technology is used.</i> <i>Max 2 if no application to a sporting/ activity example.</i>	3 max
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