

Markscheme

November 2025

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** questions 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	HIIT/ high-intensity interval training✓		1 max
1.	b	48-45=3 «mLO ₂ kg ⁻¹ min ⁻¹ »✓	Accept +/- 1 from 48 and +/- 0 from 45 (e.g. 49-45 =4 or 47-45=2).	1 max
1.	c	<p>VO₂ max improves for both HITT and MICT «however there is no evidence of significance»✓</p> <p>VO₂ max dropped for both HIIT and MICT groups' for Post- to 4-weeks after training/ TE</p> <p>OR</p> <p>VO₂ max remained higher than pre-training for both HIIT and MICT groups' for Post- to 4-weeks after training/ TE ✓</p> <p>VO₂ max significantly higher post-training for the HIIT group «compared to MICT group»✓</p> <p>VO₂ max significantly higher 4-weeks after training/ TE for the HIIT group «compared to MICT group»✓</p> <p>There was no significant difference between groups in VO₂ max pre-training✓</p>	<p>MP2.1 must refer to remain/ maintained or relative to pre-training.</p> <p>MP 3/4 must refer to the significance for credit.</p>	3 max
1.	d	<p>SD shows the variability of the data around the mean✓</p> <p>A small standard deviation indicates that the data is clustered closely around the mean value✓</p> <p>A large standard deviation indicates a wider spread of the data around the mean✓</p>		1 max
1.	e	<p>Peripheral fatigue</p> <p>Develops during shorter intense exercise and is caused by reduced muscle force✓</p> <p>Central/ mental fatigue</p> <p>Develops during prolonged exercise and is caused by impaired function of the central nervous system✓</p>	<p>Reference to how fatigue develops and what occurs for credit.</p> <p>Do not need to specifically use the term exercise.</p>	2 max

Question		Answers	Notes	Total
1.	f	<p>Depletion of muscle/ liver glycogen reserves reduces energy source for ATP production✓</p> <p>Reduction in Ca⁺⁺ release reduces muscle ability to perform muscle contraction✓</p> <p>Depletion of acetylcholine decreases effectiveness of muscle contraction✓</p> <p>Dehydration decreases effectiveness of waste product removal/ nutrient delivery✓</p> <p>Electrolyte loss causes decreased nerve function/ cramping✓</p> <p>Overheating impairs enzymes and causes decreased muscle function✓</p>	<p><i>Accept hydrogen ion accumulation/ acidification of muscles which reduces contractile function but do not accept lactic acid.</i></p>	4 max

2.	a	111 «s»✓	Accept +/-3.	1 max
2.	b	25 - 20 = 5 «kJ»✓	<p><i>Accept 24.5-25.5 and 19.6-20 as ranges.</i></p> <p><i>Reminder full workings and accurate answer required for the mark.</i></p> <p><i>E.g. 24.5-19.8 = 4.7«kJ».</i></p>	1 max
2.	c	<p>TTE and TWC improves for the BA group «after 28 days» ✓</p> <p>TTE shows a lower value for the BA group compared to PLA as the error bars are not overlapping at pre to day 7✓</p> <p>TWC shows similar values in BA the PLA groups between pre and day 7 as the error bars overlap ✓</p> <p>TTE and TWC show no difference in the data between the BA and PLA group until 28 days of supplementation/ or between days 0 and 21 as error bars overlap✓</p>		3 max

2.	d	<p>Essential amino acids Cannot be synthesized by the human body OR Must be obtained from the diet✓</p> <p>Non-essential Amino acids can be synthesized by the human body OR Do not need to be obtained from the diet✓</p>		2 max
2.	e	<p>Use measuring tools/ IV and DV that permit the demonstration of causality✓ Control group allows a comparison between experimental group/ provides a baseline✓ Placebo prevents bias/ avoid the psychological effects✓ Use of blind/ double blind allocation prevents bias✓ Use of «inferential» statistics shows the significance of the findings✓ Randomization guards against bias/ ordering/ learned/ fatigue effects✓</p>		3 max

Question		Answers	Notes	Total
3.	a	<p>Describing a structure farther from the site of attachment/ axial skeleton/ centre of body/ trunk✓</p> <p>E.g. Radius is distal end of the humerus</p> <p>OR</p> <p>E.g. Patella is the distal end of the femur✓</p>	<p><i>Do not accept midline.</i></p> <p><i>Limit examples to the appendicular skeleton and must be within same limb.</i></p> <p><i>Scapula/ clavicle > humerus > radius/ ulna > carpals > metacarpals > phalanges.</i></p> <p><i>Pelvis/ pelvic girdle/ ilium > Femur > patella > tibia > tarsals > metatarsals > phalanges.</i></p>	2 max
3.	b	<p>An enzyme that breaks down acetylcholine (to reduce the amount in the synapse)✓</p> <p>More cholinesterase reduces the stimulation of the motor end plate✓</p> <p>Cholinesterase inhibits muscular contraction✓</p>		2 max

3.	c	<p>Velocity/ speed of throw Increasing acceleration/ momentum/ force/ power applied during run up/ throw/ release «increase speed of release»✓</p> <p>Angle of throw Adjust angle of the throw to an optimal of 30-45 degrees✓</p> <p>Height of javelin during throw The height of the thrower cannot be altered✓ Maximise the individual's height potential «extend body» at the point of release✓</p>		3 max
3.	d	<p>Clarity Information is clear/ simple/ visual/ concise to prevent confusion/ overload/ make it easier to understand✓ Avoiding teaching/ learning similar but distinct items in the same session «to avoid interference with the memory of the other»✓ E.g. A coach uses language/ concepts appropriate for the age group ✓</p> <p>Chunking Learners chunk/ group items together to retain more of the information «than individual items»✓ E.g. A swim coach may break down instruction of a swimming stroke into parts such as the catch, power phase, and finish✓</p>	Only credit sporting/ exercise examples.	4 max
3.	e	<p>E.g. Maximum sit-up/ squat/ pushup/ pull-up «test»✓ Quantified by counting the total number of repetitions an athlete can perform✓ In a given time frame (e.g. 1 minute/ to fatigue)✓</p> <p>ALTERNATIVE E.g. Flexed arm hang/ plank/ static squat/ wall sit✓ Quantified by maintaining position✓ Measured by the total length of time to fatigue✓</p>	<p>Only award marks for ONE type of test.</p> <p>Accept appropriate example e.g. sit-up bleep test.</p> <p>Do not accept cardiovascular endurance tests e.g. 12 minute cooper run or MSFT.</p>	3 max

Question		Answers	Notes	Total
4.	a	Brachiocephalic✓ «R/ L» subclavian✓ «R/ L» <u>common</u> carotid✓	<i>Specific order is not required.</i> <i>Accept incorrect spelling.</i>	2 max
4.	b	Regulated through a «complex» feedback loop mechanism✓ Regulated by signalling from the nervous system✓ E.g. Adrenalin is regulated by the nervous system/ sympathetic response✓ Regulated by the chemical changes in the blood✓ E.g. Insulin and glucagon are regulated by serum glucose levels✓ Regulated by other hormones/ endocrine glands/ system✓ E.g. Thyroid regulated by the hypothalamus/ anterior pituitary hormones✓	<i>Max [2] with no example provided.</i> <i>Max [1] for example.</i> <i>Accept any other suitable example.</i>	3 max
4.	c	A force that acts parallel to the interface of two surfaces that are in contact and opposes relative motion.✓		1 max

Question		Answers	Notes	Total
4.	d	<p>Surface area/ Contact Road/ thin/ smooth tires will allow less surface area/ contact with the road</p> <p>OR Mountain/ thick/ rough tires will increase the surface area/ contact with the ground ✓</p> <p>Friction impact Road/ thin/ smooth tires will reduce friction with the ground</p> <p>OR Mountain/ thick/ rough tires will increase friction with the ground ✓</p> <p>Traction/ Speed Lower friction will increase forward speed/ optimal for road bikes</p> <p>OR Greater friction will increase traction/ reduce slipping/ optimal for mountain bikes ✓</p>		3 max
4.	e	<p>Adjust the goal/ difficulty of the specific task ✓</p> <p>Adjust rules of the task/ dimensions/ timings ✓</p> <p>Adjust the equipment to allow success ✓</p>	<p><i>Accept a suitable example as an alternative outline (up to Max [1] mark per factor).</i></p> <p><i>Goals – accept e.g. speed/ accuracy</i></p> <p><i>Rules – accept e.g. playing area, net height, shot clock, player numbers</i></p> <p><i>Equipment – e.g. ball size, weight, material.</i></p>	2 max

4.	f	<p>Identification of life-threatening/ genetic conditions - to allow early treatment/ intervention✓</p> <p>Potential to predict susceptibility to injury - and therefore take steps to minimize risk✓</p> <p>Potential to aid talent identification - by providing more objective data on traits «such as endurance» than based on age/ maturity/ previous experience✓</p> <p>Potential to personalise training - to focus on strengths/ or improve limitations✓</p>	<p><i>Credit can only be given if the potential benefit is identified and a suitable expanded point.</i></p>	<p>3 max</p>
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Section B

Question		Answers	Notes	Total
5.	a	<p>Contractility: The ability of muscle to shorten/ generate force✓</p> <p>Extensibility: The ability of muscle to stretch beyond normal/ resting length «without damage»✓</p> <p>Elasticity: The ability of muscle to return to its normal/ resting length after being stretched/ lengthened/ contracted✓</p>	<i>Contractility: Do not accept contract.</i>	3 max
5.	b	<p>Gases/ CO₂/ O₂ diffuse across the alveoli membrane✓</p> <p>Gases/ CO₂/ O₂ move from a high to low partial pressure/ down a concentration gradient✓</p> <p>PPO₂ is higher in the lungs than in the «pulmonary» capillary✓</p> <p>«Net» movement of O₂ from the lungs/ alveoli to the «pulmonary» capillaries;</p> <p>Alveoli/ capillary walls are 1 cell thick/ thin therefore provide a short diffusion pathway which aids diffusion✓</p> <p>Dense alveoli/ capillary network provides a large surface area which aids diffusion ✓</p> <p><i>Exercise</i></p> <p>PPO₂ lower in «pulmonary» capillaries «compared to rest» due to increased respiration within muscles✓</p> <p>Therefore «rate of» diffusion will be greater/ faster due to a steeper concentration gradient✓</p>	<p><i>Max [4] if no reference to exercise.</i></p> <p><i>MP3, 4 & 8 Accept in the converse for PPCO₂.</i></p>	5 max

Question		Answers	Notes	Total
5.	c	<p>Motivation A highly motivated player will persevere during difficult tasks/ times until they have mastered the task✓ Highly motivated learners tend to be more engaged/ on-task/ intrinsically focused on learning✓</p> <p>Physical fitness Unfit players will not be able to complete drills and practice tasks to improve✓ E.g. an unfit player will not be able to focus on the set task such as one touch ball retention drill✓</p> <p>Coach Positive coaching qualities will meet the needs of their performers enhancing their rate of learning✓ E.g. a dictatorial coach may hinder the players’ ability to apply skills when they play the game as the players have to make decisions by themselves in a fluid/ game situation✓ E.g. a coach who only provides negative feedback may turn players off from being involved✓</p>	<p><i>Award [2] max per factor. Accept in the converse. Accept in the converse for examples.</i></p> <p><i>Accept any reasonable coach quality Mp5.</i></p>	<p>5 max</p>

Question		Answers	Notes	Total
5.	d	<p>The hypothalamus and the pituitary gland are together responsible for homeostasis OR The hypothalamus maintains homeostasis by controlling the pituitary gland✓ The proximity of the pituitary gland to the hypothalamus improves the efficiency of the relationship✓ GHRH released from the hypothalamus to the «anterior» pituitary gland✓ GHRH released through portal blood vessel✓ The «anterior» pituitary gland is then stimulated to secrete growth hormone (GH) «from the somatotroph cells into the blood»✓</p>		4 max
5.	e	<p>Sustained increases in the level of adrenalin/ cortisol «over time to suppress the immune system»✓ Lower leucocyte numbers which increase the risk of infection/ susceptible to pathogens✓ Overactive «pro» inflammatory response to tissue repair/ oxidative stress✓ Greater exposure to airborne bacteria/ viruses in the respiratory tract due to regular intense breathing✓</p>	<p><i>Do not accept reference to an increase in susceptibility to infection without the mechanisms outlined in the MP.</i> <i>Do not accept J curve or annotated diagram as it does not show WHY.</i></p>	3 max
6.	a	<p>Regulated by a negative feedback loop✓ Hypoglycemia stimulates the release of glucagon from the pancreas/ alpha cells✓ Exercise will reduce the amount of muscle glycogen, further stimulating glucagon✓ Increased glucagon promote glycogenolysis «breakdown of glycogen in liver and active tissue»✓ Increased gluconeogenesis «using amino acids, lactate, to make glucose» Increased lipolysis «increased levels of fatty acids in the blood»✓</p>	<p><i>Accept low blood sugar.</i></p>	4 max

<p>6.</p>	<p>b</p>	<p>Newton’s first law/ law of inertia A skater must apply sufficient force to move/ overcome inertia at the start of the race✓ Once in motion during the race, the skater will continue to remain in motion unless acted upon by an external force✓</p> <p>Newton’s second law/ law of acceleration The greater the force they apply as they push off the ice, the faster they accelerate✓ The skater’s movement is made in the direction of the force applied✓ Acceleration is dependent on the skater’s mass✓</p> <p>Newton’s third law/ law of reaction The skater applies an action force down AND back on the ice «to propel forward»✓ The ice applies an equal upward AND forward reaction force✓</p>	<p><i>Award max [2] per law.</i> <i>Accept reference to impulse-momentum relationship.</i></p>	<p>5 max</p>
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Question		Answers	Notes	Total
6.	c	<p>Overload Each training session is trying to put strain on the body greater than previously done✓</p> <p>Frequency Build up the frequency of rides i.e. so that you may be riding every other day✓</p> <p>Duration Gradually build up the duration/ time cycling so that the body is used to the distance needed✓ Push the training time beyond what you are normally training/ beyond the event time so that you will cope on the day✓</p> <p>Intensity Gradually build up the riding speed over the distances so that you are maximizing this aspect✓ Train on hills/ have periods of high intensity effort and periods of recovery on a training ride✓</p> <p>Variety Train/ cycle in a variety of different environments e.g. hills, flat, spinning (gym)✓</p> <p>Periodization Plan the programme to develop endurance for the first few weeks followed by speed endurance✓ Ensure that there is a good balance between training days and rest days to allow recovery✓</p> <p>Specificity Training should mimic performance/ movement/ muscle groups/ energy systems.✓</p> <p>Reversibility Be conscious that if no training occurs for whatever reason then training effects will slowly diminish✓</p>	<p><i>Award max [1] for each principle.</i></p> <p><i>Note: the principle doesn't need to be named; a description of the principle is sufficient.</i></p>	4 max

Question		Answers	Notes	Total
6.	d	<p>Surface drag Outer surface of body catches a layer of neighbouring fluid as it moves, opposing motion✓ Reduced by wearing smooth clothing/ helmet✓</p> <p>Form drag Reaction force of air when the skier pushes against it, opposing motion✓ Proficient/ streamlined ski tuck technique✓</p>	<p><i>Award max [1] for list of types of drag, still awarding more marks for methods.</i></p> <p><i>Award max [1] per type of drag.</i></p>	4 max
6.	e	<p>Leucocyte/ white blood cells «B cells/ T cells/ natural killer cells» fight pathogens✓ Antibodies are produced to fight the antigen/ pathogen✓ Inflammation to protect area/ heat✓ Clotting «by platelets» reduces blood loss/ repair physical barrier✓ Skin/ epithelial linings/ mucosal secretions act as a physical barrier to infections/ pathogens✓ Lower pH of bodily fluids/ hormones and other soluble factors make inhabitable for pathogens✓</p>	<p><i>Max [1] if mechanisms listed without examples.</i></p>	3 max

Question		Answers	Notes	Total
7.	a	<p>Articular cartilage Smooth tissue which covers the surface of articulating bone✓ Absorbs shock/ allows friction free movement✓</p> <p>Synovial fluid Lubricates/ reduces friction within the joint «capsule»/ between cartilage; Nourishes the «articular» cartilage✓</p> <p>Ligaments Tough bands of fibrous «slightly elastic» connective tissue✓ Connects bone to bone «stabilizing the joint during movement»✓</p> <p>Synovial membrane Location just inside the articular capsule✓ Secretes synovial fluid into the joint✓</p> <p>Articular capsule A fibrous sac that surrounds/ encloses the joint✓ Provides strength to the joint✓</p> <p>Bursae Fluid filled sacs located where a tendon moves over a bone✓ Reduces the friction between tendons and bones✓</p> <p>Meniscus Fibro-cartilage located at the knee joint✓ Shock absorption «and load bearing» at the knee✓</p>	<p><i>Award max [1] per feature.</i></p> <p><i>Do not accept prevents friction (synovial fluid).</i></p>	<p>3 max</p>

Question		Answers	Notes	Total
7.	b	<p>Occurs during prolonged submaximal exercise✓ Reduction in blood plasma due to sweating✓ Reduction in blood volume leads to increase blood viscosity✓ Reduced blood volume results in decreases in stroke volume✓ Cardiac output = stroke volume x heart rate✓ Heart rate increases to maintain cardiac output</p> <p>OR</p> <p>A progressive increase in heart rate due to a decline in stroke volume✓ Vasodilation to skin causes a reduction of blood flow to working muscles✓</p>		6 max
7.	c	<p>Physical proficiency: consists of gross movements/ use of large muscle groups✓ Examples: dynamic flexibility/ static flexibility/ explosive strength/ trunk strength/ stamina/ gross body equilibrium✓</p> <p>Perceptual motor abilities: a combination of how we make sense of our environment/ perception and how we act/ motor control✓</p> <p>Examples: multi-limb coordination/ manual dexterity/ reaction time/ aiming/ postural discrimination/ speed of arm movement✓</p>	<p><i>Max [2] per category. Max [2] without a sporting example.</i></p> <p><i>Specific mention of individual abilities is not required as long as the example fits a category.</i></p>	3 max

Question		Answers	Notes	Total
7.	d	<p>As the body temperature raises, the blood vessels within the skin vasodilate to release heat</p> <p>OR</p> <p>As temperature falls the blood vessels constrict/ hairs erect to trap air reducing heat loss✓</p> <p>Relay information about the sensation of the touch from the external environment✓</p> <p>Sweat excreted aids heat loss through <u>evaporation</u> from the skin✓</p> <p>«The epidermis» synthesizes vitamin D while the skin is exposed to <u>UV/ sun light</u>✓</p> <p>Provides a protective barrier to infection/ pathogens/ microorganisms✓</p> <p>Provides a protective barrier to physical trauma/ injury✓</p> <p>Provides a barrier that reduces harmful effects of «radiation from» the sun✓</p>	<p><i>Must refer to trapping of the air for heat.</i></p> <p><i>Do not accept excretion of waste.</i></p>	5 max
7.	e	<p>Scatter diagrams can represent the playing area and allow for the location of events✓</p> <p>E.g. location of shots made in a soccer match✓</p> <p>Additional data such as the time of the event, players involved, or actions taken can be recorded✓</p> <p>The use of colours can enhance visual impact✓</p> <p>Can be used to analyse patterns in the data/ clusters in events/ strategic analysis✓</p> <p>Data analysis can lead to making strategic decisions for future games✓</p>	<p><i>Accept a suitably annotated diagram for Mp1 & 2.</i></p> <p><i>Accept any suitable example Max [1].</i></p>	3 max

Question		Answers			Notes	Total	
8.	a		Phosphagen/ ATP-PCr	Anaerobic glycolysis/ lactic acid system	Aerobic	<p><i>Max [2] per system.</i></p> <p><i>Accept any duration within the range provided.</i></p> <p><i>Aerobic system must reference carbohydrate AND fat for credit.</i></p>	6 max
		Duration	Up to 20 sec✓	10 sec to 3 min✓	Greater than 2 minutes✓		
		Fuel sources	ATP stores/ creatine phosphate✓	Glucose/ glycogen✓	Glucose/ glycogen AND fat✓		
8.	b	<p>Causes</p> <p>Muscle tissue damage resulting in inflammation✓</p> <p>Inflammation will compress nerves leading to pain✓</p> <p>The more unfamiliar/ intense the training is the greater the microdamage/ inflammation/ DOMS✓</p> <p>The more eccentric training the greater the microdamage/ inflammation/ DOMS✓</p> <p>Prevention</p> <p>Reducing eccentric component of muscle actions during early training✓</p> <p>Starting training at a low intensity/ warm up appropriately AND gradually increase the intensity✓</p>				4 max	

Question		Answers	Notes	Total
8.	c	<p>Exteroceptors Exteroceptors provide information about the external environment✓ Cutaneous/ tactical exteroceptors are present in the skin✓ Special exteroceptors are present in the head✓</p> <p>Proprioceptors Proprioceptors provide information about position and posture of the body✓ General proprioceptors are present in the locomotor system✓ Special proprioceptors are present in the head✓</p> <p>Interoceptors Interoceptors provide information about events in the viscera/ organs/ internal environment✓</p>	<p><i>Max [2] per system.</i></p>	<p>3 max</p>
8.	d	<p>Provides objective «quantifiable» data on performance ✓ Facilitates feedback to aid learning/ motivation/ training✓ A way of recording athlete progress/ the effectiveness of the coaching process✓ Information aids the coach design a practice environment to bring about desired behaviour of the athlete✓ A way of recording markers to manage overtraining✓</p>		<p>3 max</p>

Question		Answers	Notes	Total
8.	e	<p>Genes code for specific proteins involved in athletic characteristics «e.g. fast-twitch muscle fibres/ height/ lung capacity»✓</p> <p>Genes are expressed as phenotypes✓</p> <p>Genes affect the potential to perform a certain skill</p> <p>OR</p> <p>E.g. An athlete who is tall maybe better at blocking at a volleyball net✓</p> <p>However athletic characteristics are influenced by multiple genes✓</p> <p>Genes can be switched on or off depending on internal or external factors «e.g. diet/ training»✓</p> <p>Despite environmental factors «e.g. training» performance is limited by a genetic ceiling✓</p>	<p><i>Accept any suitable example of a genetic characteristic and its positive impact on a skill.</i></p>	<p>4 max</p>