Markscheme

November 2023

Sports, exercise and health science

Standard level

Paper 2

Subject details: Sports, exercise and health science SL paper 2 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[30 marks]** and **ONE** question in Section B **[20 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 <u>underlined</u> 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 an d 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.

Question			Answers	Notes	Total
1	**a**		850 <W>✓		**1**
1	**b**		36-33 = 3 <ml kg^{-1} min-1>✓	*Accept +/- 0.1 e.g., 2.9/ 3.1*	**1**
1	**c**		***Contrast:*** SD for avg power is smaller than peak power therefore data is more reliable✓ EM avg/ peak power SD is smaller than for CON, therefore EM data is more reliable✓ ***Compare:*** both pre and post training peak power/ average power SD for EM/ CON is similar, therefore the reliability is similar✓ both peak power/ average power show low reliability as SDs are relatively large based on scale✓	*Max 1 for compare or contrast* *Accept in the converse* *Accept referencing to the graphs e.g., fig1b* *Only award a mark if there is a clear reason why the reliability is high/ low/ similar e.g., low reliability due to large error bars/ SD/ variation <about the mean>*	**2**
1	**d**		EM appears to improve peak power✓ however, EM has no significant effect on peak power✓ EM has had no effect on VO2 Max <compared to control> ✓ EM has had no effect on average power <compared to control>✓ error bars are overlapping for peak power/ average power/ VO2 max therefore there is no significance✓	*For MP2 there must be a mention of statistical significance*	**3**
1	**e**		to minimize/ remove/ avoid bias✓ increases confidence in the conclusion/ the effect is caused by IV ***OR*** provides reliability/ validity of conclusion✓	*Do not accept to make the test fair*	**1**

Question			Answers	Notes	Total
2	**a**		external intercostal muscles contract pulling the rib cage upwards and outwards ***OR*** diaphragm contacts and moves down✓ which increases the thoracic cavity volume ***OR*** which reduces the pressure in the thoracic cavity✓		**2**
2	**b**	**i**	\<resting heart\> rate would be lower ***OR*** \<sub-maximal\> exercise heart rate would be lower✓		**1**
2	**b**	**ii**	\<SV\> would be higher/ increases/ is greater✓		**1**
2	**b**	**iii**	\<Q\> would remain unchanged/ slightly lower at rest✓ \<Q\> at maximal exercise will be higher/ increases✓		**1**

3	a										Award [1] for ECF for accurate matching annotation to an incorrect label e.g., tendon-attaches muscle to bone Award [1] for ECF for accurate annotation X(ligament) Y(cartilage) despite incorrect label Accept any accurate reference to anatomical structure/ function of the label as an annotation	4

For the 3a box, the content reads:

	Label		Annotation	
X	ligament **OR** muscle	✓	**For ligament** tough/ fibrous/ elastic tissue **OR** connects bone to bone **OR** stabilizes the joint	✓
Y	<articular> cartilage	✓	smooth/ connective tissue covering ends of bones <at joint> **OR** provides protection/ shock absorption <to bones> **OR** reduces friction <between bones>	✓

3	b	i	e.g., a gymnast requires high levels of flexibility to complete the splits during a floor routine✓	Accept any relevant application of flexibility	1
3	b	ii	e.g., a rower repeatedly pulling their oar against the water to propel the boat towards the line✓	Accept any relevant application of muscular endurance	1

3	c							2

	Skeletal	*Smooth*	
Location	found attached to bones	located in hollow organs	✓
Nuclei	multinucleated	mononucleated	✓
Fibre	striated/ unbranched	non-striated/ branched <with tapered edges>	✓
Control	voluntary	involuntary	✓

3	d		protein✓		1

| 3 | e | | muscles can only use ATP as fuel to contract✓

ATP is hydrolysed/ broken down the by products are energy, ADP & P$_i$✓

the hydrolysis of ATP is controlled by enzymes/ ATPase✓

energy released from ATP hydrolysis allows:
• to change the position of the myosin head to prepare to attach to actin
• is used to complete the power stroke
OR
• sarcomere shortens✓

the arrival of a new ATP molecule to the myosin head causes the myosin head to detach from actin✓ | | 3 |

Question			Answers	Notes	Total
4	a	i	\<the sprinter is\> accelerating✓ \<the sprinter is\> increasing speed/ velocity✓	*Accept non uniform change in speed/ velocity*	1
4	a	ii	\<the sprinter is\> moving at constant/ uniform speed/ velocity✓		1
4	b		oxygen needs differ between rest and exercise✓ oxygen deficit occurs because oxygen supply cannot meet the change in needs required as the body transitions from rest to exercise✓ therefore, energy is supplied anaerobically✓ intensity of exercise will determine the size of the deficit✓		3

	Question		Answers	Notes	Total
5	a		**Newton's first law/ law of inertia** sprinter will remain at rest in the blocks whilst there is no external force acting upon them✓ therefore, after the starting signal they apply a sufficient force to overcome their inertia to start moving✓ **Newton's second law/ law of acceleration** the acceleration of the sprinter is in the direction of the force being applied✓ the greater the force the sprinter applies as they push off from the blocks the greater their acceleration✓ acceleration is dependent on sprinter's mass✓ **Newton's third law/ law of reaction** sprinter applies an action force down and back on the blocks✓ therefore, the blocks apply an upwards and forwards reaction force✓	*Award **[2 max]** per law* *Accept reference to impulse momentum relationship Newton's 2nd law*	**5**
5	b		1. process occurs when blood glucose levels are low due to fasting or exercise✓ 2. adrenalin stimulates glycogenolysis to raise glucose levels✓ 3. glucagon acts on the liver to stimulate glycogenolysis✓ 4. carbohydrate stores in the liver are in the form of glycogen/liver stores glucose as glycogen✓ 5. glucose is released into the blood by breaking down glycogen✓ 6. which involves a hydrolysis reaction✓ 7. requires enzymes for optimal function/ phosphorylase is the main enzyme✓		**6**
5	c		**Physical maturation** physical maturity provides the gross motor skills/physique/stature required to execute tasks✓ Rate of learning increases as children approach full maturity✓	*Award **[2] max** per factor* *Only credit the highest attaining three factors*	**5**

		e.g., a smaller/ less physically mature individual may lack the height/ mechanics to jump over a high jump bar✓ *e.g.,* a toddler doesn't have the running skills to dribble a football/ basketball with control✓ **Physical fitness** players need the stamina/flexibility/coordination to practice/ learn/ execute skills✓ rate of learning will be slow if performers lack the necessary fitness component✓ *e.g.,* lack of flexibility will prevent learning/executing the pike in trampolining✓ **Age** age of players can affect their experience / mental ability to understand and apply tactics✓ Rate of learning decreases as an adult ages **OR** Rate of learning increases as child ages towards adulthood✓ *e.g.*, younger players may pick skills up quickly and be uninhibited by previously learnt poor techniques **OR** *e.g.,* older players may pick up skills more quickly as they have the ability to adapt and apply previously learnt skills✓ **Coach:** the style of coaching can determine whether the players will learn effectively✓ *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✓ **Difficulty of task** rate of learning may be slow if the task is too difficult/ unobtainable✓ *e.g.,* rolling a ball along the floor compared to kicking a ball moving towards you✓	

			Teaching environment this can determine the opportunities that there are for practice✓ rate of learning is increased if the environment limits barriers to learning✓ *e.g.,* is there enough equipment to maximise time practising✓ **Motivation** highly motivated players will persevere during difficult tasks until they have mastered the task✓ high levels of motivation increases the rate of learning✓ *e.g.,* a player practising a complex drag flick action in their own time✓		
5	d		an aerobic warm up increases CO_2 production in the muscles✓ increase in acidity/ lower pH/ CO_2 concentration is detected by <chemo>receptors✓ <proprio>receptors detect an increase in muscle movement✓ receptors inform the brain/ respiratory centre✓ the brain/ medulla oblongata stimulates/sends nervous signals to the inspiratory muscles to contract✓ nerve impulses are sent via the sympathetic nervous system <phrenic nerve✓ nerve impulses stimulate an increase in the depth of breathing✓		4

	Question		Answers	Notes	Total
6	**a**		ensure participants complete a PAR-Q/ informed consent/ appropriate warm up prior to the test✓	*Max [3] for each test*	**6**
			12-minute Cooper's run:		
			mark out regular intervals on a 400m running area✓		
			participants are required to run continually for 12 minutes✓		
			the sports scientist will begin the timer at the start of the test✓		
			at 12-minutes participants will stop and the distance covered will be recorded✓		
			distance covered will be assessed against a table which translates the distance to a VO_2 max prediction✓		
			Maximum push-up test:		
			participant lies on the ground, places their hands by the shoulders and straightens the arms✓		
			participant lowers the body until the elbows reach 90° and then extends the arms to return to the start position✓		
			participant continues this push-up action, with no rest, until they are unable to continue✓		
			the sports scientist counts and records the number of correctly completed push-ups✓		
			compares the results to a table of normative values✓		

6	b		the sarcoplasmic reticulum releases calcium ions✓ calcium ions bind to troponin✓ tropomyosin/ troponin complex exposes the binding site <on actin>✓ myosin <head> creates a cross-bridge with the actin✓ power stroke takes place✓ z lines come closer together/ H zone gets smaller/ sarcomere shorten✓ myosin releases actin if new ATP appears✓ myosin heads attached further down the actin filament repeating the cycle <ratchet mechanism>✓ myosin heads continue the cross bridge cycle until insufficient calcium is present in the muscle cell✓		6
6	c		during prolonged exercise there is an increase in body temperature/ blood flow is diverted to the skin✓ cooling/ sweating causes fluid loss/ decreases in blood plasma✓ this results in increased blood viscosity *OR* this results in decreased stroke volume✓ to maintain homeostasis/ cardiac output/ Q there is a <gradual> increase in HR (cardiac drift) *OR* reduction in venous return/ stroke volume causes the heart rate to increase to maintain cardiac output✓ hot/ humid conditions may cause ultramarathoner to experience cardiovascular drift earlier <than under normal conditions>✓		4

| 6 | d | | CP stores will be depleted during the initial stages of the race✓
 ATP is resynthesized by the lactic acid system✓
 ATP is resynthesized anaerobically✓
 glucose is broken down into pyruvate✓
 pyruvate is converted to lactic acid <without the presence of oxygen>✓
 1 glucose molecule = 2 ATP <net>✓ | *Accept 1 mark for any named enzyme e.g., lactate dehydrogenase for the conversation of pyruvate to lactic acid* | **4** |

	Question		Answers				Notes	Total
7	**a**			**Marathon runner**	**100m sprinter**			**5**
			predominant muscle fibre type	slow twitch/ type I	fast twitch/ type II	✓		
			aerobic/ oxidative capacity	high	low	✓		
			anaerobic capacity	low	high	✓		
			speed of contraction	low	high	✓		
			force of contraction/ power production	low	high	✓		
			resistance to fatigue	high	low	✓		
7	**b**		trained individuals will likely have a higher VO2 max than untrained individuals✓ ***this is due to physiological adaptations to training:*** due to an increase in stroke volume/ maximal cardiac output✓ increased oxygen carrying capacity/ hemoglobin content✓ increased capillary density in muscles✓ increased mitochondrial density/ increased arteriovenous oxygen difference✓ increased maximal minute ventilation/ increased muscular endurance of respiratory muscles✓ training leads to a greater area of muscle mass and a higher VO_2 max✓	*Award max [3] for physiological adaptations*	**4**

| 7 | c | | psychological refractory period/ PRP is the increase in reaction time to a second stimulus caused when the second stimulus has been delivered while the performer is responding to the first stimulus
OR
it is the time delay in reaction time caused by the arrival of a second stimulus before the first is processed✓
this is believed to take place due to brain processing information on a single track/ using the single channel mechanism✓
strengths:
can be used to help a performer have greater chances of success *e.g.,* pretending to pass/ run one direction then quickly changing to pass/ run the other way✓
provides a performer with a greater range of options in their play✓
external noise *e.g.,* other players calling, or crowd noise can enhance the effectiveness of the PRP✓
the more options that a player has will increase the reaction time to the stimulus <Hick's law>✓
limitations:
if a performer uses it too often, they will become predictable and this limits success✓
anxiety might make the performer get the timing wrong and thus the PRP is not effective✓
conclusion:
e.g., in sports you can use PRP as an advantage by introducing a dummy stimulus before the real movement✓ | *Award max [1] for description of PRP*
Award [1 max] for an annotated diagram of the single channel hypothesis for mark points 1 and 2
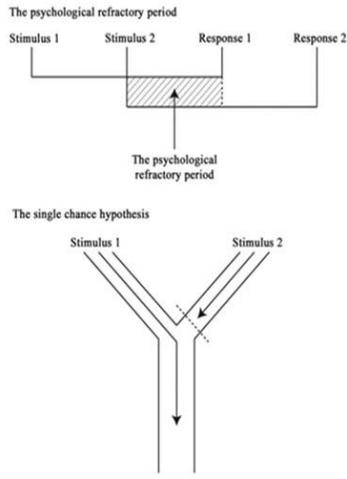
Award [5] max if only strengths or limitations provided
Award [5] max if no examples given | 6 |

7	d		gross-fine continuum	fine✓			5
			open-closed continuum	closed✓			
	5		discrete-serial-continuous continuum	discrete✓			
			pacing continuum	internally paced✓			
			interaction continuum	coactive✓			