Markscheme

May 2023

Sports, exercise and health science

Higher level

Paper 3

24 pages

Subject details: Sports, exercise and health science HL paper 3 markscheme

Mark Allocation

Candidates are required to answer **ALL** questions from two of the options **[2×25 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.

Option A — Optimizing physiological performance

Question			Answers	Notes	Total
1.	**a**		Cold-water immersion; ✓		**1**
1.	**b**		60–70; ✓ = 10; ✓	*Accept in the converse.*	**2**
1.	**c**		***Perceived*:** DOMS levels are slightly lower in the CWI group; ✓ The *p* value for DOMS between groups is <statistically> significant/$p < 0.05$/there is a perceived difference <at 16 hours post-event>; ✓ ***Real*:** There is no significant difference in creatine kinase between the two groups/levels of creatine kinase are not significantly different/$p > 0.05$/ error bars/closeness of means/there was no difference; ✓ There is no significant difference in myoglobin between the two groups/myoglobin are not significantly different/$p > 0.05$/ error bars/ closeness of means/there was no difference; ✓ There is no difference in cortisol between the two groups/cortisol levels are not significantly different/$p > 0.05$/error bars/closeness of means/there was no difference; ✓	*Award **[2] max** for no data* *Award 1 min for perceived and 1 min for real*	**3**

Question			Answers	Notes	Total
2.	**a**		36 – 38 degrees Celsius / 97 – 99 Fahrenheit; ✓	*Units not required to achieve 1 mark* *Accept temperatures within the range as stand-alone e.g., 37*	
2.	**b**		Increased plasma volume <which supports stroke volume and enables cardiac output to be maintained>; ✓ Increased sweat response; ✓ Quicker sweat response/sweating starts earlier; ✓ Decreased glycogen use; ✓ More dilute sweat concentration which conserves sodium; ✓ Improved blood flow to skin; ✓ HR will increase at a slower rate; ✓		**3**

Question			Answers	Notes	Total
3.	a		Overreaching is known as transient overtraining/short term overtraining; ✓ ***OR*** Overreaching is a systematic attempt to intentionally overstress the body beyond its current level of tolerance; ✓ ***OR*** Overreaching may result in a short-term reduction in performance (days or weeks) but with recovery, performance will increase; ✓ ***AND*** Overtraining is when an athlete attempts to do more training than they are able to physically and/or mentally tolerate; ✓		1
3.	b		Heightened arousal, *e.g.,* irritability/restlessness/excitability/anxiousness; ✓ Loss of motivation/ vigour; ✓ Lack of mental concentration; mental fatigue, sleep disturbances; ✓ Feelings of depression/burn out/ impaired mood, low self-esteem and loss of confidence/prone to eating disorders, lack of appreciation for things that are normally enjoyable; ✓		2

Question			Answers	Notes	Total
4.			Early closure of epiphysis of long bones reducing final stature/height; ✓ **Cardiovascular system** High blood pressure/blood clots/heart attacks/ hypertension/ heart disease/ stroke/ artery damage; ✓ **Liver** Peliosis hepatis/ tumours damage/cancer; ✓ **Musculoskeletal system** Short stature (if taken by adolescents)/ tendon injury; ✓ Psychiatric effects Aggression/ mania/ delusions/ psychological dependence/ addiction on the physical result; ✓ **Skin** Severe acne and cysts/ oily scalp and skin/ abscess at injection site/ jaundice; ✓ **Hormonal system** ***Men***- decreased sperm production/ enlarged breasts/ shrinking of the testicles/ male-pattern baldness/ testicular cancer/ prostate enlargement/cancer; ✓ ***Women***- / voice deepening/decreased breast size/ coarse skin/ excessive body hair growth/ male-pattern baldness; ✓		**2**

Question			Answers	Notes	Total
5.	a		**Whole body cooling (WBC):** When the whole person is exposed to dry air at very low temperatures *e.g.*: – 110°C for a brief period of time; ✓ **contrast water therapy (CWT):** This involves alternating the body or parts of the body in hot- and cold-water treatments; ✓ **Ice packs:** Application of an ice pack to a specific area which may be injured; ✓	*Award **[1] max** for method and outline of the method*	**2**
5.	b		Reduce inflammation to damaged muscle fibres; ✓ Flush out waste products like lactate/rapid constriction and dilation of blood vessels; ✓ Analgesic (pain killing) effect; ✓ There could be a placebo effect; ✓ Increased circulation improves/ accelerates recovery time ✓ Boosted immune system; ✓ Increased energy levels due to hormone release *e.g.,* endorphins and adrenaline are released to help your body cope with the extreme cold temperatures; ✓	*Award **[2] max** for a list* *List would need to include min 3 aspects*	**3**

Question			Answers	Notes	Total
6.	a		This is the condition in which the <u>oxygen supply to cells is insufficient;</u> ✓	*Do not accept to brain*	1
6.	b		Upon arrival at altitude spend a day or so resting; ✓ Screen for pre-existing medical conditions *e.g.,* respiratory or cardiac issues; ✓ Promote hydration by having a person drink a little but often/avoid alcohol; ✓ Ascend gradually *e.g.,* no more than 1000 m per day but depends on whether you are sleeping high/walk high-sleep low protocol; ✓ Steadily build up exercise volume/intensity at altitude; ✓ Use medication for example, acetazolamide <a respiratory stimulant>/diamox; ✓		2
6.	c		Increase in number of red blood cells / Hb content which helps to transport a larger volume of O_2; ✓ Increased hematocrit / increased hemoglobin concentration, associated with more EPO There is also an increase in plasma volume <but not to sea-level values>; ✓ There is an increased capillary density in the muscles which helps to transport a larger volume of O_2; ✓ Lower resting heart rate relative to the initial resting heart rate experienced by the athlete at altitude; ✓		2

Option B — Psychology of sports

Question			Answers	Notes	Total
7.	a		Cortisol, post-run; ✓	*Award [1] for period and variable*	1
7.	b		218.3–202.8; ✓ = 15.5; ✓	*Accept answer in the converse.*	2
7.	c		Cortisol levels were higher for high trait EI for all time periods; ✓ Mood disturbance was higher for low EI for all time periods; ✓ For post-run time period the differences in both measures were statistically significant; ✓ No significant difference in both measures between high & low trait EI at baseline, pre-run and halfway; ✓1	*Award marks for correct interpretation/ analysis of data*	3

Question			Answers	Notes	Total
8.	a		Those relatively stable and enduring aspects of individuals which distinguish them from other people, making them unique but at the same time permit a comparison between individuals; ✓		1
8.	b		Questionnaire/ interview/ observation; ✓		1
8.	c		Behaviour is due to interaction between personality and environment / behaviour = personality x environment; ✓ Behaviour can be modified as the person responds to environmental cues; ✓ Genetic and environmental influences are intertwined; ✓ The expression of personality can be enhanced or suppressed by the environment; ✓ Personality traits can be used to predict behaviour in different situations; ✓	*Accept a relevant diagram for max 1 mark*	2

Question			Answers	Notes	Total
9.	a		A multidimensional concept identified by characteristics that are only partially genetically determined/ talent involves psychological as well as physiological, motor, sociological and environmental factors; ✓		1
9.	b		Having a stimulating environment/ opportunities/ challenges which keeps developing the athlete; ✓ Positive support from significant others/family/ friends; ✓ Having the intrinsic motivation to continue to be involved in the sport during good and bad times; ✓ Psychological skill <*e.g.,* resilience> must develop to continue progression, *e.g.,* coach-led versus self-determined motivation/ self-regulation theory; ✓ Obstacles *e.g.*, injury, deselection> must be overcome; ✓ **Initiation stage:** Existence of opportunities/initial goal setting; ✓ **Development and mastery stages:** Developing physical skills through practice with others and top coaches/ Developing characteristics such as perseverance, mental toughness through good coaching and support; ✓ **Maintenance stage:** Setting and reviewing realistic goals for development; ✓	*Award marks for factors, not naming or linking to stages*	4

Question			Answers	Notes	Total
10.	a		**Cognitive:** Negative thoughts which can affect performance/confidence; ✓ **Somatic:** Physiological changes which indicate that a person is anxious <such as trembling, nausea>; ✓		2
10.	b		Mental imagery is using all of the senses to recreate an experience in the mind/can be used for general or specific situations / PETTLEP technique (physical, environment, task, time, learning, emotion, perspective); ✓ The greatest benefits for reducing anxiety will come when conditions mirror as much as possible the real situation *e.g.,* going to the stadium and picturing yourself performing the task while standing in the right spot; ✓ Can be used to motivate an athlete/ boost confidence through regular rehearsal; ✓ Performer can use imagery before or during an event *e.g.,* a golfer can use imagery before the start of the game by being in the spot and picturing themself successfully hitting a ball to the target or just before the shot they can step back and focus on the actual spot and picture the shot shape, direction and feeling; ✓		3

Question			Answers	Notes	Total
11.	a		Autonomy: having sufficient choice to make one's own choice about activities; ✓ Competence: having a sense of personal accomplishment and worth; ✓ Relatedness: A feeling of belonging to a group or social world; ✓	***Max [1]*** *for a list*	**2**
11.	b		**forethought phase:** Coach should outline purpose of training; ✓ Players involved in setting goals and planning; ✓ **monitoring phase:** Monitor /adapt goals regularly / plan training to engage the athletes / variety of tasks; ✓ Use technology to help show performance development; ✓ Coach encourages team members to provide peer feedback; ✓ **reflection phase:** Review goals/recognise success <to promote self-efficacy>; ✓ Self-reflections influence athletes' future planning/ goals, prompting the cycle to begin again; ✓	*Acceptable explanations may not fit under phase heading*	**3**

Option C — Physical activity and health

Question			Answers	Notes	Total
12.	**a**		Swim WB; ✓		**1**
12	**b**		300–290; ✓ =10; ✓	*Accept answer in the converse*	**2**
12.	**c**		For males who swam and performed weight-bearing exercises their bone density was the highest which supports the hypothesis; ✓ Male swimmers who did not do any other weight-bearing exercise had the lowest bone density which supports the hypothesis; ✓ For females who swam and performed weight-bearing exercises their bone density was the lowest which does not support the hypothesis; ✓ Females who were only doing land-based weight-bearing exercising had the highest bone density for radius which does support the hypothesis; ✓ There was very little difference for bone density in the tibia indicating no effect from weight-bearing exercises; ✓	*Accept equivalent data* *Award **[2] max** for no data*	**3**

Question			Answers	Notes	Total
13.	**a**		A condition where a person's bone density decreases/gets low and bones tend to become brittle and prone to breaking; ✓		**1**
13.	**b**		A lack of dietary calcium especially in youth and adolescents can reduce bone density; ✓ Toxins and free radicals produced by cigarette smoking affect the balance of estrogen; ✓ Cigarette smoking can damage osteoblasts; ✓		**3**

			Having lower bone density compared to other build types makes ectomorphs more susceptible to osteoporosis ***OR*** A low BMI increases the risk of osteoporosis; ✓ Early menopause in older women which leads to reduced estrogen levels can reduce bone density; ✓ The female triad ***OR*** Females who exercise intensely suffer from a pause in their menstruation similar to early menopause ***OR*** Athletic amenorrhea regular weight bearing dynamic exercise helps to build and maintain bone mass, therefore bone density decreases with physical inactivity; ✓ Hormone-related disorders/ overactive thyroid gland/ disorders of pituitary gland/ overactivity of parathyroid glands; ✓ Genetics a family history of osteoporosis; ✓ Individuals who have suffered with eating disorders are more susceptible; ✓ As individuals get older they are more susceptible to osteoporosis; ✓		

Question			Answers	Notes	Total
14.	a		**Acute injuries:** occur suddenly *e.g.,* bone fracture, tendon or ligament tear from impact; ✓ **Chronic injuries:** are developed over a long period of time *e.g.*, meniscus wear, tendonitis; ✓		2
14.	b		**Strengths/benefits:** The training will stimulate improvements in fitness in individuals; Reduce periods of sedentary activities; ✓ Fitness benefits will help to lessen the risks for coronary heart disease/ hypertension/ balance body composition; ✓ Release of appropriate hormones improving mental health- Changes in brain neurotransmitters- endorphins, serotonin etc.- Structural changes in the brain; ✓ Promote social interactions that will increase motivation to continue going back; ✓ **Limitations/hazards:** Working at high intensity/pushing yourself too hard / having poor technique can cause sudden acute injuries; ✓ Older or less fit individuals may be prone to injury through lack of body conditioning; ✓ Can exacerbate the risk for CHD due to the high intensity/physical stress; ✓ Lack of knowledge in using equipment appropriately causing injury; ✓	*Award **2[max]** for strength or limitation*	3

Question			Answers	Notes	Total
15.			Physical activity is any body movement produced by muscle action that increases energy expenditure whereas exercise is planned, structured, repetitive and purposeful physical activity; ✓ For example, gardening is physical activity but not classes as exercise whereas going for a jog as part of a training run is both exercise and physical activity; ✓	*Accept for 1 mark for both physical activity and exercise*	**1**
16.	**a**		A calculation of the <u>percentage</u> or proportion of public health burden that is caused by a particular risk factor; ✓ For example, PAR for lung cancer deaths associated with moderate smoking calculated is 52%- 58% which means that 52%- 58% of lung cancer deaths would **not** occur if people in the population did not smoke; ✓	*Accept answers of similar range percentages and examples of PAR*	**2**
16.	**b**		Improved metabolic rates and VO_2max enabling people to be more active in their lives for longer periods / increased productivity; ✓ Increased energy expenditure/metabolic rate and so improves their body composition; ✓ Improved plasma lipid profiles which reduces the chances of getting or aggravating coronary heart disease issues; ✓ Decreased blood pressure and this reduces coronary heart disease risks; ✓ Improved body composition lowers strain on skeletal system / heart / joints / blood vessels / increases bone density and less chances of osteoporosis; ✓		**3**
17.	**a**		Osteoarthritis; ✓ Long term stress on the cardiovascular system can lead to coronary heart disease such as angina/heart attack / atherosclerosis; ✓		**2**

			Increased risk of hypertension due to increased plaque/fatty deposits within the arteries; ✓ Increased risk of developing cancer *e.g.,* bowel cancer; ✓ Increased risk of developing type 2 diabetes due to insulin resistance from poor diet; ✓ Respiratory conditions *e.g.,* obesity reduces lung volumes and can lead to diseases such as asthma/hyperventilation syndrome; ✓		
17.	**b**		It is a disease of insulin resistance; ✓ Cells do not respond to the insulin being produced in the body; ✓ It tends to occur in old age or if someone has obesity; ✓ It is treated with exercise and diet changes; ✓ Improved body composition lowers strain on skeletal system/ heart/joints/blood vessels; ✓ Can be caused by a combination of genetic and environmental factors; ✓		**2**

Option D — Nutrition for sports, exercise and health

Question			Answers	Notes	Total
18.	**a**		In every case the ventilation rate after/ post the race is higher than before/pre; ✓		**1**
18.	**b**		2000–2100; ✓ 100 <mL min^{-1}>; ✓	*Accept in the converse*	**2**
18.	**c**		Race time for both conditions are very similar which does not support the hypothesis; ✓ Peak velocity is very similar across all races and shows no significant difference which does not support the hypothesis; ✓ Heart rate data is extremely similar which does not support the hypothesis; ✓ Oxygen consumption/VE are all similar indicating no physiological benefit for these variables from consumption of $NaHCO_3$ which does not support the hypothesis; ✓	*Award **[2] max** for no data*	**3**

Question			Answers	Notes	Total
19.	a		1.0 to < 4.0; ✓	*Do not accept "4"*	1
19.	b		**Sports drinks / bars / gels:** *Strengths* can help replace lost water from sweat; ✓ replaces electrolytes; ✓ replaces glucose in an easy to consume form while exercising; ✓ *Limitations* can be hard to digest while exercising; ✓ **Caffeine:** *Strengths* can increase performance at various intensities; ✓ improve alertness; ✓ *Limitations* induce anxiety; ✓ mild diuretic; ✓ cause insomnia; ✓ **Creatine:** *Strengths* high safety record for athletes; ✓ Thought to assist recovery of muscles; ✓	*Award **2 [max]** for strength or limitation*	3

			Increases brain health; ✓ Reduces inflammation; ✓ *Limitations* creatine thought to cause water retention increasing body mass, kidney damage, hair loss, and dehydration but this has not been proven; ✓		

Question			Answers	Notes	Total
20.	**a**		The minimum amount of energy expended by the body to maintain vital processes such as respiration, digestion, circulation; ✓		**1**
20.	**b**		Active transport via GLUT4 and GLUT1 transporters moves glucose into cells; ✓ GLUT4 transporters are stimulated as a result of stimuli such as calcium ions / muscle contraction; ✓ GLUT4 transporters are stored inside intracellular vesicles that are translocated to the cell membrane, when needed, to allow for greater glucose movement into the cell; ✓ Glucose taken into the muscle cells is quickly converted to glucose-6-phosphate which ensures that the concentration gradient for glucose movement is maintained; ✓ A trained person will have more GLUT4 transporters in their cells than an untrained person; ✓		**3**
21.			**Strengths** Small amounts can reduce tremor; ✓ Small amounts can suppress stress hormones/relaxant; ✓	***2 [max]*** *for strength or limitation* ***1 [max]*** *for lists over 3*	**3**

			Limitations *Negatively affects*: Reaction time, balance and coordination; ✓ Strength and power; ✓ Speed is impaired; ✓ Impairs gluconeogenesis; ✓ Reduce performance; ✓ Decreased cognitive function; ✓ Causes fatigue; ✓		

Question			Answers	Notes	Total
22.	**a**		Antioxidants are molecules that can prevent or limit the damaging effects of free radicals by turning them into substances that are far less reactive / They stop the Chain reactions which free radicals cause; ✓ Antioxidants occur in broccoli, kale, berries, tea, and nutrients containing vitamins A, C, and E; ✓	*[1] for outline; [1] for example*	**2**
22.	**b**		Free radicals are produced in the body as a by-product of normal cellular function; ✓ Exhaustive exercise generates high levels of free radicals that can't be controlled by natural antioxidants in body/oxidative stress; ✓ Training partially reduces the build-up of free radicals as a result of exhaustive exercise; ✓		**2**

Question			Answers	Notes	Total
23.	a		Blood <plasma>; ✓ Lymph fluid; ✓ Saliva and digestive juices; ✓ Fluid in the eyes; ✓ Fluid around nerves, spine, brain; ✓ Fluid secreted by the kidneys; ✓		2
23.	b		ADH can affect the permeability of the distal tubule and collecting duct; ✓ When ADH is present then distal tubule and collecting duct allow water to be reabsorbed into the body; ✓ When water levels in the body are low, receptors in the hypothalamus are stimulated to transmit an impulse to the pituitary gland to release ADH; ✓ ADH is transported to the kidneys by the blood; ✓		2