

Markscheme

May 2024

Sports, exercise and health science

Standard level

Paper 3

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

Mark Allocation

Candidates are required to answer **ALL** questions from two of the options [**2×20 marks**].
Maximum total = [**40 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 | 280 <W>; | <i>Accept +/- 2</i> | 1 max |
| 1. | b | <p>there was no <significant> effect of condition during the first 20% of the time-trials; as days spent training in the heat increased, power output during the time trial increased/ decreased less/ power TTH1<TTH2<TTH3; power output during TTH-1/2/3 remained lower than TTC</p> <p>OR</p> <p>power output during TTC remained higher than all other time-trials; TTC power remained relatively constant over the trial</p> <p>OR</p> <p>TTH -1/2/3 showed more variability in power throughout the trial; between 30-40%, power output in TTC decreases, whereas TTH-1/2/3 are relatively stable/ decrease very slightly; from 30% of the distance covered onward TTH-1 remained significantly <math>p<0.01</math> lower than TTC; power output during TTH-2 became significantly <math>p<0.05</math> lower than TTC from 50% of the distance covered onward;</p> | <p><i>Max [1] with no reference to data</i></p> <p><i>Accept any answer relating to trend of specific data</i></p> | 3 max |
| 1. | c | cyclists acclimatised to the heat <after 14 days>; | <p><i>Candidates should look at the difference through TTH3-2-1</i></p> <p><i>Must relate to ‘acclimatisation’</i></p> <p><i>answers relating to power output/ responses should not be credited</i></p> | 1 max |
| 2. | a | at least part of their training should take place in the <midday> sun to fully prepare; | <i>Don’t award marks for reference to timing of arrival in city</i> | 2 max |

| | | | | |
|----|---|---|---|---------------------|
| | | <p>training should be reduced to <60–70% of maximum> in the initial days of heat training <to reduce the risk of excessive heat stress/ heat disorders> and gradually increase the duration and intensity of rides over the two-week period;</p> <p>wear appropriate clothing to allow effective evaporation/ reduce conduction/ radiation e.g. light breathable clothing</p> <p>OR</p> <p>wear cooling vest;</p> <p>monitoring physiological markers, e.g. skin temperature, dizziness, nausea;</p> <p>monitor hydration status/ drinking more water/ electrolyte replacement;</p> | | |
| 2. | b | <p>sweat <produced within the sweat glands> is converted from liquid to vapour/ by heat from the skin and is transported away/ sweat evaporates, cooling the skin;</p> | <p><i>Must give an explanation along with sweat</i></p> | <p>1 max</p> |
| 2. | c | <p>typically accompanied by symptoms of extreme fatigue/ breathlessness/ dizziness/ vomiting/ muscle cramps/ fainting/ hypotension;</p> <p>if heat exhaustion is not treated, an individual may suffer from heat stroke which is a life-threatening heat disorder;</p> <p>individuals who are poorly conditioned or not acclimatised are more susceptible to heat exhaustion;</p> <p>heat exhaustion often occurs when blood plasma volume decreases by either excessive fluid loss/ mineral loss through sweating;</p> <p>blood often pools in the peripheral vessels reducing central blood volume required to maintain cardiac output;</p> <p>during heat exhaustion thermoregulatory mechanisms are unable to remove heat quickly enough due to low blood volume;</p> <p>reduction in sweating capabilities;</p> <p>typically, an increase in muscle sympathetic nerve activation increases core body temperature/ skin blood flow/ perfusion reducing blood flow to muscles causing a decline in muscle force production/ fatigue/ reduction in performance;</p> | | <p>3 max</p> |

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| 3. | a | | <p><i>Overtraining</i></p> <p>over a sustained period without adequate rest/ recovery, an athlete attempts more training than they can mentally/ physically tolerate</p> | <p>Overreaching</p> <p>over a sustained period with adequate rest / recovery, an athlete attempts more training than they can mentally/physically tolerate</p> <p>OR</p> <p>transient overtraining</p> | ; | | | 1 max |
| 3. | b | | <p>ask athletes to complete a sleep diary;</p> <p>ask athletes complete a food journal/ diary;</p> <p>record the muscle soreness/ fatigue/ muscle loss/ minor injuries between training sessions;</p> <p>record the mood/ motivation between training sessions;</p> <p>record the occurrence of upper respiratory tract infections;</p> <p>monitor resting heart rate/ blood pressure and assess patterns where it increases;</p> | | | <p><i>Don't credit training volume, change in performance because it is in the question</i></p> <p><i>Max [1] for list</i></p> | 3 max | |
| 4. | a | | <p>a substance/ device/ phenomenon that can improve an athlete's performance;</p> | | | | 1 max | |
| 4. | b | | <p>Proposed benefits:</p> <p>improves alertness/ concentration</p> <p>can increase performance at various intensities</p> <p>facilitates nerve transmission/ion transport within the muscle</p> <p>OR</p> <p>perceived improvement in reaction time;</p> <p>enhance motoneuronal excitability/ recruitment of motor units;</p> <p>effective placebo;</p> <p>benefit electrolyte balance/ glucose availability;</p> | | | <p><i>Max [2] for benefits</i></p> | 4 max | |

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| | | <p>extend endurance in moderately strenuous aerobic exercise; reduced fatigue; increased energy; consumed before exercise it can increase fat catabolism and reduce carbohydrate oxidation; caffeine can cross the blood–brain barrier and produce analgesic effects on the central nervous system; Possible harmful effects: caffeine consumption blunts the ergogenic effects of creatine supplementation on muscular power; can cause caffeine addiction, characterised by cravings and withdrawal symptoms if intake is reduced or ceased; can produce restlessness/ headaches/ arousal/ overstimulation/ insomnia/ nervous irritability/ muscle twitching; a potent diuretic reducing thermoregulation mechanisms such as evaporation OR dehydration reducing performance; excessive caffeine intake can cause gastrointestinal issues such as stomach discomfort, acid reflux, diarrhea, and dehydration; increase of blood pressure; potential death if the dose is significant enough; TOK insufficient data to link caffeine use to performance/ difficult to measure caffeine in blood;</p> | <p><i>Max [2] for harmful effects</i></p> | |
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Option B — Psychology of sports

| Question | | | Answers | | | Notes | Total | | | | | | | |
|---|---|-----|--|---------|----------|---|---|---|---|--|--|--|--|-------|
| 5. | a | i | 18; | | | Accept +/- 0.5 | 1 max | | | | | | | |
| 5. | a | ii | 15–18; =<->3; | | | Accept in the converse Accept +/- 0.5 i.e. 14.5 to 15.5 and 17.5 to 18.5 | 2 max | | | | | | | |
| 5. | a | iii | <table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">Compare</td> <td style="width: 50%;">Contrast</td> <td></td> </tr> <tr> <td>use of self-talk, goal setting and imagery all increase from low stress to high stress.</td> <td>use of relaxation decreased from low stress to high stress.</td> <td>;</td> </tr> </table> | Compare | Contrast | | use of self-talk, goal setting and imagery all increase from low stress to high stress. | use of relaxation decreased from low stress to high stress. | ; | | | | A list of individual observations from each graph alone is not sufficient Must refer to all four skills | 1 max |
| Compare | Contrast | | | | | | | | | | | | | |
| use of self-talk, goal setting and imagery all increase from low stress to high stress. | use of relaxation decreased from low stress to high stress. | ; | | | | | | | | | | | | |
| 5. | a | iv | thought-stopping; thought blocking; relaxation techniques/ meditation/ PMR/ breathing techniques/ biofeedback; mental imagery; selective attention/ processing; | | | | 1 max | | | | | | | |
| 5. | b | | subjective evaluation of a situation, and concept of jeopardy to one’s self esteem during performance or social situations, physical danger, or insecurity and uncertainty; | | | | 1 max | | | | | | | |
| 5. | c | | a process whereby muscle groups in sequence from head to toe are tensed for several seconds before being relaxed; tensing muscles appears to enable the muscle to relax more fully when released; | | | | 1 max | | | | | | | |
| 5. | d | | Education: the athlete learns about the importance of psychological skills and how they can affect performance OR | | | Must refer to, but not necessarily name the 3 stages Sub max [1] | 3 max | | | | | | | |

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| | | <p>the athlete ascertains the potential usefulness of PST; clarification of the role/level of commitment of the psychologist/ coach/ athlete;</p> <p>Acquisition: the athlete learns about the strategies and techniques to improve the specific psychological skills that they require; a needs analysis of the athlete would be carried out to ensure that any potential PST is centred around the needs of the athlete;</p> <p>Practice: to automate skills through over-learning or repeated practice; to teach athletes to systematically integrate psychological skills into their performance situations;</p> | <p><i>Sub max [1]</i></p> <p><i>Sub max [1]</i></p> | |
| 6. | a | <p>money/ extrinsic reward can have a controlling influence; money/ extrinsic/ controlling rewards reduce intrinsic motivation; extrinsic rewards can decrease satisfaction/ intrinsic motivation leads to greater satisfaction with performance; giving more rewards for something they love won't help them to try harder, as they are already trying as hard as they can/ over-justification effect; as extrinsic rewards increase they have a diminishing return; might become more motivated by status than by performance, thus negatively affecting performance;</p> | <p><i>No marks awarded for discussion of aspects that may enhance performance</i></p> | <p>3 max</p> |
| 6. | b | <p>Stability: a tennis player should attribute the defeat to unstable factors by framing the defeat as a temporary setback rather than a reflection of their abilities, the player can maintain confidence in their skills and resilience;</p> <p>Causality: a tennis player should attribute the defeat to external factors; unstable-external factors: e.g. bad officials/ weather/ luck/ crowd; unstable-internal factors: e.g. bad form/ ill/ injured/ personal/ emotional problems;</p> | | <p>3 max</p> |

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| | | <p>stable-external factors: e.g. bad on a particular surface/ don't like opponent's style of play/ previous history with official;</p> <p>by framing the defeat as a temporary setback rather than a reflection of their abilities, the player can maintain confidence in their skills and resilience;</p> | | |
| 7. | | <p>difficulty to define the term athlete;</p> <p>personality is complex and multifaceted/ some researchers believe that personality is closely related to athletic performance, others argue that personality is not related to athletic success;</p> <p>difficulties comparing data between different questionnaires;</p> <p>controversy between the value of personalities impact on performance/ personality alone does not account for behaviour in sport and exercise;</p> <p>no single personality trait exists that determines successful sports performance/ distinguishes athletes from non-athletes;</p> <p>no single personality profile has been found that sports performers are all people and sport is only one facet of their life;</p> <p>dominance of certain personality types in some sports, e.g. boxer, will skew a sample</p> <p>OR</p> <p>biasing effects of culture/ gender/ socio-economic group;</p> | <p><i>Answers about ethics are not relevant to personality research, do not credit</i></p> <p><i>Personality questionnaires can be valid and reliable, therefore do not credit statements of invalid/ unreliable</i></p> | <p>4 max</p> |

Option C — Physical activity and health

| Question | | Answers | Notes | Total | | | | | | | | | | | | | | | |
|---------------------------------------|--------------------------------------|---|---|----------------------------|--|--------------------------------|---------------------------------|---|-------------------------------|-------------------------------------|---|---------------------------------------|--------------------------------------|---|---------------------------------------|--------------------|---|---|-------|
| 8. | a | 2.11/4.48 x 100; = 47.10% / 47.09%; | Full equation is required for mark Accept +/- 1.0 | 2 max | | | | | | | | | | | | | | | |
| 8. | b | anaerobic exercise leads to <statistically significant> decrease in waist-to-hip ratio compared with aerobic; no <statistically significant> effect on triglyceride levels; anaerobic exercise leads to <statistically significant> higher HDL levels compared with aerobic; no <statistically significant> effect on LDL levels; no <statistically significant> effect on total cholesterol levels; not possible to make a clear conclusion about the link between the type of exercise and health; | Award [2] for p values; [1] for a conclusion Accept any answer relating to trend of specific data | 3 max | | | | | | | | | | | | | | | |
| 8. | c | <table border="1"> <tr> <td><i>BMI</i></td> <td><i>waist circumference</i></td> <td></td> </tr> <tr> <td>not valid for trained athletes</td> <td>more valid for trained athletes</td> <td>;</td> </tr> <tr> <td>artefact of weight and height</td> <td>artefact of waist measurement alone</td> <td>;</td> </tr> <tr> <td>two measurements / double uncertainty</td> <td>one measurement / single uncertainty</td> <td>;</td> </tr> <tr> <td>relatively common / lots of norm data</td> <td>relatively unknown</td> <td>;</td> </tr> </table> | <i>BMI</i> | <i>waist circumference</i> | | not valid for trained athletes | more valid for trained athletes | ; | artefact of weight and height | artefact of waist measurement alone | ; | two measurements / double uncertainty | one measurement / single uncertainty | ; | relatively common / lots of norm data | relatively unknown | ; | Two versus one measures could be either positive or negative MP | 2 max |
| <i>BMI</i> | <i>waist circumference</i> | | | | | | | | | | | | | | | | | | |
| not valid for trained athletes | more valid for trained athletes | ; | | | | | | | | | | | | | | | | | |
| artefact of weight and height | artefact of waist measurement alone | ; | | | | | | | | | | | | | | | | | |
| two measurements / double uncertainty | one measurement / single uncertainty | ; | | | | | | | | | | | | | | | | | |
| relatively common / lots of norm data | relatively unknown | ; | | | | | | | | | | | | | | | | | |
| 8. | d | Environmental: target classes for beginners, intermediate, advanced/ inclusive; Reinforcement: | Award [1] max for list | 2 max | | | | | | | | | | | | | | | |

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|----|---|--|-------------------------------|--------------|
| | | <p>provide rewards for continued attendance; provide feedback on fitness records for regular attendees/ educational seminars; Goal setting: create specialized classes/ fitness routines; offer new routines monthly/ open day to try new routines/ classes; set-up fitness challenges/ leader board; using technology to enhance goal setting/ enhance experience to provide additional support; Social: friends and family membership plan; provide free parking/ transport to club; maintain fitness records of participants; providing specialized training/ specialized equipment; match gym times to working times; creating social gym classes to encourage regular participation;</p> | | |
| 8. | e | <p>low levels of HDL lead to lower longevity; low levels of HDL cholesterol can weaken protective mechanisms of the blood vessels/ blood vessel function/ high blood pressure/ makes blood clots more likely to form; low HDL commonly means that one has higher LDL, increasing the risk of CVD; low levels of HDL increase the risk of atherosclerosis/ linked to increased inflammation and oxidative stress; low levels of HDL cholesterol can disrupt lipid metabolism, leading to an imbalance in cholesterol levels in the bloodstream; atherosclerosis increases chances of angina and heart attack;</p> | <i>Accept in the converse</i> | 3 max |
| 9. | | fewer symptoms of depression or anxiety | | 2 max |

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| | | <p>OR</p> <p>elevated endorphins/ serotonin/ dopamine and feelings of happiness; reduced feelings of anger; clearer thinking/ boost self-esteem; more alert and responsive; the positive effects are highly individual/ cannot be generalized;</p> | |
| 10. | a | during puberty/ teenage years; | 1 max |
| 10. | b | <p>ectomorphy leads to proportionally less bone deposition because the bones are longer</p> <p>OR</p> <p>same input of calcium, longer thinner bones, therefore lower density; weight-bearing activity is beneficial, if total body weight is less, there will be less impact/ bone remodeling/ deposition/ lower bone density;</p> | 1 max |
| 10. | c | <p>weight-bearing activities promote bone development; movement/ mobility/ physical activity leads to an enhanced bone mass; changes in bone density are site-specific and resistance training results in greater changes than endurance training</p> <p>OR</p> <p>non-weight-bearing activities such as swimming and running can also promote healthy bone growth; female bone development and growth most important in the teenage years, so moderate physical activity is particularly important</p> <p>OR</p> <p>physical activity affects hormone/ estrogen/ testosterone levels and therefore bone health; adolescents returning to sport/ physical activity from long-term injury can see improvements in bone health;</p> | 4 max |

Option D — Nutrition for sports, exercise and health

| Question | | | Answers | Notes | Total |
|----------|---|-----|--|--|-------|
| 11. | a | i | condition 1; drinking as much water as they want; | | 1 max |
| 11. | a | ii | 1.6–1.0; =<->0.6%; | Accept +/- 0.5 <i>Accept in the converse</i> | 2 max |
| 11. | a | iii | males drank significantly lower amounts of water in condition 1 compared to condition 2; whereas females drank similar amounts of water in the two sessions; body mass change in females did not vary comparing condition 1 versus condition 2; end of training session males are more dehydrated compared to females; sweat loss was consistent across all groups regardless of amount of liquid consumed; | <i>Max [1] for no reference to data</i> <i>Accept any answer relating to trend of specific data</i> | 2 max |
| 11. | a | iv | urine color/ osmolarity/ concentration; frequency of urination; | | 1 max |
| 11. | b | | the more energy an athlete expends, the greater their needs for hydration are; water is required to reduce cardiovascular drift; dehydration causes the blood to become more viscous drinking adequate fluids helps cool the body through sweating and supports thermoregulation, reducing the risk of overheating and heat-related complications; excess heat in the body is mainly managed by the evaporation of sweat, meaning that more water needs to be taken in OR fluids lost during breathing; | | 3 max |

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|-----|---|---|---------------------------------------|-------|
| | | <p>water is a medium for cellular processes in the body which keep the athlete moving/ dehydration can impair these metabolic processes, leading to decreased energy production and reduced physical performance;</p> <p>water is essential for the movement of sugars and waste in the blood stream;</p> <p>environment can change the water loss;</p> | | |
| 11. | c | <p>The benefit of consuming a drink with high sodium content:</p> <p>at the end of a match, body will have low blood electrolyte balance from sweat loss, and a sodium rich sports drink will elevate that electrolyte balance/ sodium in sports drink stimulates water and sodium absorption;</p> <p>drink would return blood plasma viscosity to normal;</p> <p>sodium increases thirst (i.e. stimulates the soccer player to ingest more);</p> <p>sodium assists in the absorption of water and carbohydrates from the digestive tract into the bloodstream, which speeds up rehydration and restores fluid stores that were depleted during exercise. Loop de Henle;</p> <p>helps promote recovery and replenishment of energy stores;</p> | | 2 max |
| 12. | a | <p>thermic effect of feeding (PAL);</p> | | 1 max |
| 12. | b | <p>Compare:</p> <p>both should have limited fat;</p> <p>Contrast:</p> <p>more fat-free mass in the sprinter;</p> <p>lower total mass in the endurance athlete;</p> | <p>Sub max [1]</p> <p>Sub max [1]</p> | 2 max |
| 13. | a | <p>small intestine—villi and microvilli increase area for absorption;</p> <p>large intestine—water balance, vitamin absorption;</p> <p>pancreas—production of enzymes;</p> <p>liver—production of bile;</p> <p>gall bladder—storage of bile;</p> | <p>Max [1] for list</p> | 4 max |

| | | | | |
|-----|---|---|---|---------------------|
| 13. | b | <p>enzymes allow for large macromolecules to be broken down for absorption</p> <p>OR</p> <p>enzymes increase rate of digestion/ acts as a catalyst;</p> <p>Choice of enzymes:</p> <p>pancreatic lipase – fats;</p> <p>pancreatic amylase – sugars;</p> <p>trypsin – protease;</p> | <p><i>Award [1] max for explanation, [1] max for enzyme and correct substrate</i></p> | <p>2 max</p> |
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