

# Markscheme

November 2023

**Sports, exercise and health science**

**Higher level**

**Paper 3**

© International Baccalaureate Organization 2023

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2023

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2023

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

**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 <b>OR</b> 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**

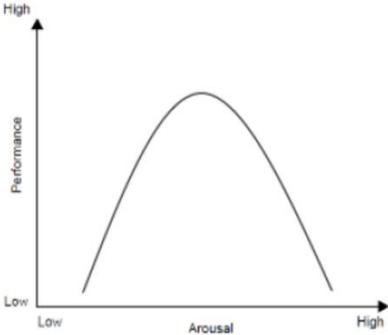
Question			Answers	Notes	Total
1	a	i	group 1/ overtrained athletes ✓		1
1	a	ii	14 – 4 ✓ = 10 ✓	<i>Accept calculation in different order</i>	2
1	a	iii	overtraining reduces growth hormone production compared to healthy athletes <b>OR</b> healthy athletes have a higher growth hormone production compared to athletes with overtraining syndrome ✓ overtrained athletes produce a similar amount of growth hormone to sedentary individuals ✓	<i>Accept the inverse statement related to healthy athletes and sedentary individuals but mention overtraining and group 1</i>	2
1	b		increase to resting heart rate/ higher blood pressure ✓ chronic muscle soreness/ bone tenderness ✓ reduced immune function /increased susceptibility to infections ✓ sleep disturbance ✓ chronic fatigue ✓ hormonal system overload/ menstrual dysfunction decreased appetite/ weight loss ✓ sudden and unexplained decrease in performance/ motivation ✓		2
1	c		an athlete should break their training year/ macrocycle to focus on different types of fitness ✓ within a macrocycle there are smaller mesocycles/ microcycles/ phases such as transition, preparation, competition/ post-season, pre-season, in-season ✓ an athlete can gradually build up their training load <b>OR</b> overload by ensuring their frequency, intensity, duration are appropriate <b>OR</b> to promote adequate recovery during each period ✓ training load may peak before an event (competition phase) then gradually drop away/ taper away as the day of the event arrives ✓		3

Question		Answers	Notes	Total
2	a	the principal barrier is clothing <b>OR</b> clothing must be well insulated/ layered/ wind or waterproof ✓ clothing insulation is measured in CLO, as insulation increases so does the CLO value ✓ extremities/ skin/ head/ hands/ feet/ face/ neck must be covered/ insulated ✓ beware of overdressing/ allow for sweat evaporation ✓		2
2	b	provide a means of applying mechanical pressure at the body surface/ compressing and supporting underlying tissue ✓ <b>Benefits include:</b> improve joint awareness <b>OR</b> increased local blood flow <b>OR</b> lactate waste product removal <b>OR</b> reduce swelling/ inflammation <b>OR</b> reduce muscle oscillations <b>OR</b> decrease post- exercise muscle soreness <b>OR</b> there is a perception of enhanced recovery time ✓ widely used as low cost/ easy to use/ non-invasive ✓ evidence of any enhancement of recovery is inconclusive/ placebo/ comfort effect ✓		2

2	c	<p>evidence of effectiveness is largely anecdotal rather than scientific research ✓  many athletes use cryotherapy techniques despite lack of evidence of their effectiveness ✓  there is a perception of enhanced recovery rates and improved performance ✓  it is claimed that there are analgesic and anti-inflammatory effects/ delayed onset muscle soreness ✓  risks associated with exposure to prolonged or extreme cold should be considered ✓  the value in the cost of therapies should be considered ✓  there is a perception of enhanced recovery and performance by increasing blood flow/ circulation  <b>OR</b>  boosted immune system  <b>OR</b>  increased energy and strength  <b>OR</b>  effective pain management ✓</p>	<p><i>Accept examples [1 max] mark for cryotherapy techniques WBC, CWI, CWT</i></p>	4
---	---	--	---	---

Question		Answers	Notes	Total
3	a	3000–5500 <metres> ✓	Accept any height range from 3000m and between 3000m-5500m e.g., 3000+/above 3000	1
3	b	hyperventilation (dizziness, confusion, lightheadedness, shortness of breath) ✓ elevated <submaximal> heart rate ✓ limited glycolysis functioning ✓ reduced saturation of hemoglobin ✓ blood/ stroke volume reduction ✓ there is an increase in urine production at altitude/ diuresis ✓		2
3	c	altitude training benefits athletes differently (some don't respond) ✓ lots of ongoing research into different approaches (live high, train high/ live high, train low/ live low, train high) ✓ research typically supports the live high, train low approach ✓ altitude training enables to maintain high intensity levels/ physiological benefits/ increase red blood cells/ capillarization/ increase in VO <sub>2</sub> max ✓ new research suggests this is no more effective than live low, train high ✓ live high, train high receives maximal exposure to altitude ✓ altitude training should typically be at moderate altitudes (2000–3000 m) ✓ accessibility of travel/ altitude chambers ✓	Award [1 max] for a list of types of training Award [1 max] per type & discussion (LHTH, LHTL, LLTH)	4

Option B — Psychology of sports

Question			Answers	Notes	Total
4	a	i	group 2/ high mental toughness ✓		1
4	a	ii	3.4 – 2.7 ✓ = 0.7 ✓	Accept calculation in different order	2
4	a	iii	no difference between high and low mental toughness groups in times of low stress ✓ meaningful difference between high and low mental toughness groups at times of high stress ✓ low mental toughness individuals experience similar/minimal burnout in high or low stress ✓ high mental toughness individuals experience less burnout in times of high stress ✓		2
4	b		performance is increased with increased arousal until a certain point ✓ there is an optimal arousal level for performance ✓ performance decreases with increased arousal beyond the optimal point ✓ the arousal–performance relationship is curvilinear ✓ there will be individual differences in optimal arousal depending on skill & sport level ✓	[1 max] for appropriate example Accept a suitably annotated diagram [1 max] 	2

4	c	<p>emotions significantly influence performance ✓                      positive emotions (e.g., excitement, pride) positively impact and increase our confidence/ motivation to perform ✓                      negative emotions (e.g., fear, anger) negatively impact and reduce our feelings of confidence/ motivation to perform ✓                      therefore, if an athlete experiences regular changes in emotion, their performance will also change regularly ✓                      individuals with high trait anxiety are more likely to be highly emotional ✓</p>	<p><i>Accept appropriate sporting examples [1 max]</i></p>	3
---	---	--	--	---

Question		Answers	Notes	Total
5	a	<p>intrinsic motivation from within is its own reward, connected to engaging in an activity for its inherent satisfaction, whereas extrinsic motivation serves as a means to achieving a specific goal/ external stimulus ✓                      extrinsic motivation is contingent upon a reward whereas intrinsic motivation is not ✓  <b>Appropriate example of each:</b>                      intrinsic: stimulation/ accomplishment/ knowledge/ enjoyment/ fun ✓                      extrinsic: money/ trophies/ fame/ praise from others/ awards/ return from injury ✓</p>	<p><i>Award [1 max] if no example given                      Award [1 max] for examples</i></p>	2
5	b	<p><b>Autonomy:</b>                      they are able to do something they find personally satisfying/ making one's own decisions/ having control over one's life/behaviours ✓  <b>Competence /mastery:</b>                      a feeling of being able to accomplish tasks/ enables them to perceive benefits of training/ self-worth ✓  <b>Relatedness:</b>                      a feeling of shared experience with others/ they enjoy engaging with their social circle/ connection to a social world/ group/ team ✓</p>		3

<b>5</b>	<b>c</b>	<p><b><i>Intrinsically-motivated athletes:</i></b> view increased knowledge as a reward and therefore strive to continue to learn ✓ enjoy taking control of their own learning ✓ more likely to invest the time/ effort/ energy ✓ success with the process/ reflection can add to the motivation of the athlete and encourage further improvement ✓ set more personal goals/ plan better/ engage in more planning ✓ are more persistent/ adaptive when something is proving difficult &lt;as they do not need rewards to continue to assert effort&gt; ✓ use more internal attributions &lt;and therefore reflect better&gt; ✓</p>		<b>3</b>
----------	----------	--	--	----------

Question		Answers	Notes	Total
6	a	<p>athletes can also achieve elite status through early specialisation/ development and mastery are combined ✓</p> <p><b>Initiation stage/ sampling years:</b> deliberate play/positive family support/ fundamental skill development ✓</p> <p><b>Development stage/ specializing years:</b> technical coaching/ recognition of talent and achievements/ deliberate practice ✓ a balance now between deliberate play and deliberate practice ✓</p> <p><b>Mastery stage/ investment years:</b> high quality training/ additional financial support ✓</p> <p><b>Perfection/ maintenance stage:</b> the athlete is maintaining their high level of proficiency/ consistent levels of practice <b>OR</b> maintains best performances focus/ ability to deal with increased demands ✓</p>	<i>[1 Max] mark per phase with relevant examples</i>	4
6	b	<p>they already have experience of responding effectively to challenges ✓</p> <p>they already have high physiological adaptations/ technical knowledge/ fitness levels ✓</p> <p>they already have many necessary psychological skills or useful personality traits ✓</p> <p>they have proven motivation to succeed in sport/ athlete has been motivated to change sport/ high levels of motivation to succeed in the new sport ✓</p> <p>they already have developed physiological traits/ motor skills/ anthropometric advantages ✓</p>		3

**Option C — Physical activity and health**

Question			Answers	Notes	Total
7	a	i	group 1/ exercise ✓		1
7	a	ii	9.4 – 7.8 ✓ = 1.6 ✓	<i>Accept calculation in different order</i>	2
7	a	iii	group 1/ exercise significantly reduced depression/ had a significant effect <relative to a placebo/ group 3> ✓ group 2/ medication significantly reduced depression/ had significant effect <relative to a placebo/ group 3> ✓ exercise and medication both similarly effective in reducing depression ✓ Placebo effect was minimal ✓		2
7	b		increase in <u>cerebral</u> blood flow/ increased delivery of oxygen to the <u>brain</u> ✓ exercising regularly can manage stress/ which lower cortisol levels ✓ weight loss/ increase in energy expenditure/ metabolic leads to increases in self-esteem/ positive body image ✓ increase in neurotransmitter activity/ norepinephrine/ dopamine/ endorphins/ serotonin ✓ reduction in muscular tension ✓ increase the size of the hippocampus and connection between neurons ✓	<i>Cerebral or brain should be mentioned for the 1<sup>st</sup> mark point</i>	2
7	c		exercise can be enjoyable/ releases endorphins/ dopamine/ serotonin/ reduce cortisol ✓ recreational exercise/ lack of interpersonal competition to reduce stress ✓ 20 minutes plus/ moderate intensity several times per week ✓ aerobic/ rhythmic exercises are preferable ✓ closed, predictable environment ✓ social interaction and promote social support ✓ environmental connection with nature ✓ exercise groups convey a sense of mastery and increased self-esteem ✓		3

Question		Answers	Notes	Total
8	a	obesity ✓ physical inactivity ✓ a diet high in <saturated> fat ✓		2
8	b	pneumonia, measles, malaria, influenza are passed from person/ carrier/ animal to person/ carrier/ animal whereas non-communicable diseases are not ✓  cardiovascular disease/ skin cancer/ chronic respiratory diseases tend to be long in duration and progress slowly whereas communicable diseases normally pass more quickly ✓	<i>Award [1 max] for distinguishing two points without examples</i>  <i>Award [1 max] for mentioning passed on/ not passed on with examples</i>  <i>Award [1 max] for mentioning long/ short duration with examples</i>	2
8	c	PAR is the calculation of the percentage or proportion of public health burden caused by the particular risk factor/ smoking ✓ indicates the proportion of deaths or illnesses that would not occur if the risk factor/ smoking was removed ✓ assumes a causal link between risk factor/ smoking and health problem ✓ use PAR to influence policy/ law, e.g., banning of smoking in public places ✓ use PAR to set up initiatives, e.g., quit smoking lines, educational programmes ✓		3

Question		Answers	Notes	Total
9	a	impact/ repetition/ overuse ✓ rapid increase in training distance or intensity ✓ running surface ✓ footwear ✓ previous injuries ✓ running experience ✓ improper running technique/ biomechanical imbalance ✓ twists and turns ✓		2
9	b	differentiate/ condition/ plan training for all levels of skill/ capability/ physical fitness ✓ avoiding overtraining/ manage/ monitor workloads ✓ ensure appropriate protective equipment/ shin pads are used ✓ correct preparation/ warm-up and recovery/ cool-down routines ✓ Be trained in first aid/ respond appropriately to injury e.g., checking for concussion ✓		3
9	c	habitual moderate to vigorous exercise protects against CHD/ obesity/ diabetes 2 ✓ can enhance psychological wellbeing/ releases endorphins/ dopamine/ serotonin/ reduce cortisol ✓ protects against osteoporosis/ improves bone density ✓ moderate exercise improves immunity <b>OR</b> improved metabolic rates and VO2max <b>OR</b> increased energy expenditure <b>OR</b> improved plasma lipid profiles <b>OR</b> decreased adiposity <b>OR</b> decreased blood pressure ✓		3

**Option D — Nutrition for sports, exercise and health**

Question			Answers	Notes	Total
10	a	i	12:00/ lunch ✓	Accept 11.30– 12.30	1
10	a	ii	2.2 – 1.0 ✓ = 1.2 ✓	Accept calculation in different order. Allow ± 0.1 on reading	2
10	a	iii	blood glucose is significantly raised in high GI diet at mealtime ✓ low GI diet leads to more stable/ high GI leads to less stable blood glucose over the 24-hour period ✓ both diets lead to similar blood glucose between meals ✓ a high GI diet leads to a negative blood glucose value at night ✓	Accept specific readings/ examples from the graph	2
10	b		<b>High:</b> glucose/ sweets/ candies/ mashed potatoes/ white bread/ white rice/ watermelon ✓ <b>Low:</b> green vegetables/ beans/ soy products/ lentils/ pasta ✓	Accept other valid examples	2
10	c		<b>Before:</b> low GI foods might be beneficial prior to exercise/ competition due to slow release of energy during performance/ avoid premature fatigue ✓ <b>During:</b> high GI foods are beneficial during exercise/ competition to boost glucose availability ✓ <b>After:</b> high GI foods are beneficial post exercise/ competition to replenish glycogen stores <more rapidly> ✓ research is unclear on some strategies/ there appears to be significant individual difference in this area ✓	Award [1 Max] for each time period  Justification must be provided in each time period for a mark	3

Question		Answers	Notes	Total
11	a	glucose crosses the brush-border membrane «using a specific transporter» ✓ passes through the «cytosol of the» absorptive cell ✓ crosses the basolateral membrane ✓ enters the capillary network ✓		2
11	b	insufficient food intake ✓ excessive exercise ✓ illness ✓ postponing or skipping a meal or snack ✓ drinking alcohol ✓		2
11	c	glucose uptake into a cell is facilitated by GLUT4, GLUT1 ✓ exercise increases muscle, therefore the amount of GLUT4 transport protein in cells ✓ exercise stimulates GLUT4 transporters ✓ this enables a higher rate of glucose uptake into the cell for use as fuel ✓ glucose taken into muscle cells is quickly converted to glucose-6-phosphate to maintain glucose movement ✓		3

Question		Answers	Notes	Total
12	a	berries ✓ red grapes ✓ kale ✓ broccoli ✓ artichokes ✓ dark chocolate ✓ pecans ✓ red cabbage ✓ beans ✓ spinach ✓ bananas ✓		1

12	b	<p>free radicals cause oxidative stress ✓                      this causes DNA damage, potentially leading to many negative health effects ✓                      free radicals can damage parts of the cell by removing electrons to create paired electrons in their structures ✓                      removing electrons from cell and mitochondrial membranes, so affecting their permeability ✓                      removing electrons from molecules such as enzymes and DNA and so impairing their function ✓</p>		3
12	c	<p><b>Strengths:</b>                      antioxidants will combat/ limit the effects of free radicals &lt;usually&gt; by removing their unpaired electron ✓                      if pre-existing dietary deficiencies exist it may help an athlete ✓                      possibly reduce the extent of exercise-induced muscle damage ✓                      antioxidants are found in foods that have other health benefits, e.g., vitamins, minerals ✓  <b>Limitations:</b>                      evidence for benefits is not strong/ convincing/ consistent ✓                      high levels of antioxidant intake has been shown to be harmful ✓                      a lack of adequate regulation of the industry means some products may be poorly formulated and contain banned substances ✓</p>	Award [3 max] for strengths or limitations	4