

Markscheme

November 2024

Sports, exercise and health science

Higher level

Paper 3

© International Baccalaureate Organization 2024

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 2024

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, 2024

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 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

- Each row in the “Question” column relates to the smallest subpart of the question.
- The maximum mark for each question subpart is indicated in the “Total” column.
- Each marking point in the “Answers” column is shown by means of a tick (✓) at the end of the marking point.
- 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.
- An alternative word is indicated in the “Answers” column by a slash (/). Either word can be accepted.
- 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		80% 1RM ✓	<i>Accept answer without units.</i>	1 max
1.	b		25.0–11.4 = 13.6 «%» ✓	<i>Accept calculations in the converse.</i> <i>Both calculation & answer must be present for mark.</i> <i>Accept answer range 13-15.</i>	1 max
1.	c		The data shows that lifting at 80% of 1RM resulted in a 25% increase in muscle CSA/ lifting heavy weights (80% of 1RM) can increase muscle CSA, it is not the only intensity at which muscle hypertrophy can occur/ lifting at lower intensities such as 60% and 40% of 1RM also resulted in substantial increases in muscle CSA «(25.1% and 25.3% respectively)» ✓ 40% of 1RM led to a slightly higher increase in muscle CSA than 80% of 1RM (25.3% vs. 25%), indicating that even moderate weights can be effective for muscle growth ✓ The lowest intensity (20% of 1RM) also resulted in an increase in muscle CSA «(11.4%),» although this was less than the increases seen at higher intensities ✓ Therefore, the hypothesis that lifting heavy weights (80% of 1RM) is necessary to increase muscle CSA is not fully supported by the data ✓ A statistical analysis (e.g., p-value) would be essential to determine if the observed differences in muscle hypertrophy across different intensities are statistically significant ✓	<i>Max 1 with no reference to data.</i> <i>Accept any answer relating to trend of specific data.</i>	3 max

2.	a	Preparation phase (off-season): Focuses on building general and specific strength with high volume and low to moderate intensity ✓ Competition phase (pre-/ in-season): Focuses on translating strength gains into competition-specific strength and skills with high intensity and reduced volume ✓ Transition phase (post-season): Focuses on recovery and maintaining a basic level of conditioning with low intensity and volume ✓ Main goals of periodization in strength training are to optimise muscle strength gains, reduce the potential for overtraining, and peak at an appropriate time for competition ✓ Goals are met by varying the volume, intensity, and exercise selection across the macrocycle (annual plan), mesocycle (2 to 8 weeks), and microcycle (weekly plan) ✓ The coach can direct the adaptation process toward specific strength goals by varying the load or exercise selection of training (or both) across different levels of variation ✓	<i>Max 3 if not all phases have been discussed.</i> <i>Phases don't need to be named, accept alternative reference to phase.</i> <i>Award 1 max for list.</i>	4 max
2.	b	Cardiovascular problems e.g. hypertension/ atherosclerosis/ heart attack/ stroke ✓ Anabolic steroids can disrupt the normal production of hormones e.g. leading to issues like gynecomastia in men/ menstrual irregularities in women /infertility in both sexes ✓ Can lead to negative psychological effects e.g. mood swings/ aggression/ depression/ dependence ✓ Can lead to liver damage e.g. diseases like jaundice/ liver cancer ✓	<i>Award 1 max per health risk.</i> <i>Award 1 max for list.</i> <i>Do not accept a list of examples.</i>	3 max

			Unwanted physical changes e.g. as acne/ baldness, and in women, deepening of the voice/ growth of body hair ✓		
3.	a		36–38 degrees Celsius/ 97–99 Fahrenheit ✓		1 max
3.	b		Caused by exposure to high temperatures/ physical activity/ dehydration in high temperatures for too long ✓ Heat stroke is life-threatening/ the most severe stage ✓ Core temperature is 40°C or higher ✓ Causes reduced blood flow and damage to vital organs ✓ Proteins begin to denature ✓ Symptoms include frequent vomiting/ diarrhoea/ coma/ convulsions/ delusions/ lack of sweating/ Headache, rapid breathing, racing heart rate, slurred speech, blurred vision, skin changes/ skin dry ✓ Children and young adolescents are more susceptible to heat stroke due to their higher surface area to volume ratio ✓		3 max
3.	c		Altitude training involves endurance athletes training at elevations above 2,000 m for several weeks/ months ✓ The purpose is to gain a competitive advantage in endurance events in low-altitude competitions ✓ Training at such altitudes, where oxygen partial pressure is low, stimulates the release of erythropoietin (EPO) ✓ EPO promotes the production of red blood cells ✓		2 max
3.	d		Screen athletes for any pre-existing medical conditions before ascent ✓ Ensure athletes stay well-hydrated ✓ Recommend a gradual ascent to allow the body to adjust to changing oxygen levels ✓ Begin exercise regimens slowly and increase intensity over time ✓		3 max

[illegible]

Option B — Psychology of sports

Question			Answers	Notes	Total
5.	a		Experienced ✓		1 max
5.	b		70–50=20 «% increase» ✓	Accept +/- 1 Both calculation & answer must be present for a mark.	1 max
5.	c		The shooting percentages in both untimed and goal-oriented conditions were similar «for all skill levels» OR No significant difference between untimed and goal-orientated conditions «for all skill levels» ✓ There was a significant difference in shooting performance between the timed and goal-oriented conditions ✓ This suggests a goal-oriented focus can counteract the negative effects of time constraints on shooting performance OR The consistency in shooting percentages between untimed and goal-oriented conditions suggests that setting goals can help athletes maintain performance even when faced with time pressures/ anxiety ✓	Accept p-value, candidates must refer to significance or non-significance.	3 max

6.	a	Specific/ S, detail exactly what the athlete aims to achieve ✓ Measurable/ M, have quantifiable measures to track and assess progress over time ✓ Achievable/ A, within the athlete's reach, challenging but attainable ✓ Realistic/ R, set within the athlete's abilities and resources ✓ Time-bound/ T, have a defined timeline, with a start and end date ✓ Evaluation/ E, regularly assess progress and make adjustments as necessary ✓ Review/ R, assess the outcome to identify successes, challenges, and areas for future improvement ✓	<i>Award 1 mark for each principle [5 max]</i> <i>No mark is awarded for mentioning the different types of goals (process/ outcome/ etc).</i>	5 max
6.	b	SRL helps athletes manage thoughts/ behaviors/ emotions to control learning ✓ Goal-setting is vital in the forethought phase, defining desired achievements ✓ Goals steer athletes' actions/ decisions/ monitoring of progress ✓ reflection phase, athletes evaluate performance against goals/ assess strategy effectiveness and restarts the SRL cycle ✓ Goal-setting in SRL improves learning by making athletes more independent and proactive ✓		3 max
7.	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 ✓ Traits constant in a person's behaviour ✓ Innate characteristics of behaviour ✓	<i>Accept other appropriate definitions.</i>	1 max

8.	b	Opportunities: «During the development stage», athletes have the opportunity to train with specialist coaches, enhancing skill development ✓ «As athletes transition from the Initiation to mastery stage» there's a marked increase in deliberate practice hours, refining their skills for elite competition ✓ Behaviours: «In the Initiation stage» athletes largely rely on coach- or parent-led directives to shape their training ✓ «By the mastery and maintenance stages» athletes exhibit a shift towards taking charge of their development ✓ «As athletes transition between stages» athletes deploy psychological behaviours to manage unstable periods, ensuring continued development ✓ Obstacles: Injuries can act as significant roadblocks especially during the development and mastery stages when training intensity and volume are high ✓ Progressing from one stage to another «like from development to mastery» can bring about instability in performance, requiring strategies to overcome ✓	Award 1 mark for each row.	6 max
----	---	---	----------------------------	-------

Option C — Physical activity and health

Question			Answers	Notes	Total
9.	a		31«%» ✓	Accept range 30.5 - 31.5.	1 max
9.	b		38–8=30«%» ✓	Both calculation & answer must be present for mark.	1 max
9.	c		Error bars for medication only and medication and exercise groups overlap, suggesting similar results ✓ These groups have higher variance «SD», indicating more variability than the exercise only group ✓ Exercise only group's results were more consistent/ smaller SD ✓ Data supports the hypothesis as exercise had the lowest % of participants' reporting depression post-treatment «8%» ✓ Conducting an appropriate statistical test «e.g. t-test» would allow more confidence in accepting the hypothesis ✓	Award max 2 for data/ theory.	3 max
10.	a		A disease associated with physical inactivity ✓		1 max
10.	b		Energy balance is the match between energy input and energy output ✓ Stable body weight occurs when there is an energy balance ✓ Eating more and moving less can cause weight gain and related diseases ✓ Inactivity can lead to diseases e.g. coronary heart disease, stroke, hypertension, obesity, type 2 diabetes, and osteoporosis ✓ A balanced diet and active lifestyle can prevent hypokinetic diseases ✓		3 max

10.	c	Maximise functional capacities e.g. osteoporosis ✓ Reduce or alleviate or provide relief from symptoms ✓ Reduce the need for medication ✓ Reduce the risk of disease recurrence (secondary prevention) e.g. coronary heart disease, stroke, hypertension, obesity, type 2 diabetes and osteoporosis ✓ Overcome social problems and psychological distress improving psychological wellbeing ✓ Maintain or improve physical fitness ✓ Improve overall quality of life ✓	<i>Award 1 max for list.</i> <i>Award 1 mark max for each example associated with an aim.</i>	3 max
10.	d	Indicates the proportion of deaths or illnesses that would not occur if the risk factor was removed OR Measures how much a specific risk factor contributes to health problems ✓		1 max

10.	e	Motor vehicle proliferation: The increase in use of motor vehicles/ food and shopping deliveries reduces physical activity e.g. walking/ biking ✓ Employment and working patterns: Shift towards sedentary jobs or long working hours leads to less time/ opportunity for physical activity ✓ Changes in diet: Increase in fast food consumption, «which is often high in fat and sugar and low in essential nutrients» can contribute to obesity ✓ Technological advances: Increased use of technology in daily life leads to more sedentary behaviour/ less physical activity ✓ Urbanisation: Lack of safe or accessible spaces for physical activity in urban environments can hinder physical activity ✓ Socioeconomic factors: Lower socioeconomic status can limit access to resources for physical activity and healthy food ✓ Education and awareness: Lower levels of education/ lack of awareness about the importance of physical activity and healthy diet can contribute to a sedentary lifestyle ✓ Cultural norms: In some cultures, physical activity might not be promoted/ may be discouraged in certain groups (e.g. women, elderly) ✓ Mental health: Increased stress levels or mental health issues, «which have become more prevalent in modern societies» can lead to sedentary behaviours/ poor dietary habits ✓ Availability and marketing of unhealthy foods: Increased production and promotion of processed, high-calorie foods can contribute to poor dietary habits and obesity ✓ Health policies: Lack of policies promoting physical activity and healthy diet ✓		6 max
-----	---	--	--	-------

11.	a	Overuse and repetition: Injuries can be caused by overuse and repetition of running, e.g. constantly sprinting/ changing direction/long-distance running in a match/ training ✓ Rapid increase in training intensity: A rapid increase in running intensity/ duration can lead to injuries due to the body not having adequate time to adapt ✓ Playing surface: Running on a hard/ uneven field can contribute to injuries like sprains and strains ✓ Footwear: Wearing inappropriate/ ill-fitting footwear can lead to running-related injuries «e.g. blisters, plantar fasciitis, or stress fractures» ✓ Previous injuries: Previous running-related injuries, if not adequately rehabilitated, can increase the risk of re-injury when running ✓ Biomechanical imbalance: Biomechanical imbalances/ poor running technique can cause injuries «this can include improper foot placement/ running posture/ leg alignment» ✓ Running under fatigue: Fatigue can result in a decline in running form, increasing the risk of injury ✓ Lack of conditioning: Lack of strength/ flexibility in the muscles used for running can lead to injuries ✓	<i>Award 1 mark for each.</i> OWTTE	4 max
-----	---	--	--	---------------------

11.	b		Use of performance-enhancing drugs / severe dehydration/ electrolyte imbalance ✓ Underlying medical history/ genetic disorders ✓ problem when accompanied with high intensity exercise ✓ problem when accompanied with habitual weekly exercise ✓		2 max
-----	---	--	--	--	-------

Option D — Nutrition for sports, exercise and health

Question			Answers	Notes	Total
12.	a		Bar ✓		1 max
12.	b		$1.15 - 1.0 = 0.15 \text{ «g min}^{-1}\text{ »}$ ✓	Accept in the converse. Accept +/- 0.04. Both calculation & answer must be present for mark.	1 max
12.	c		Drink showed a significantly higher carbohydrate oxidation rate from 120 -150 minutes ✓ Suggesting liquid form might be more efficient utilized than solid form in events 120-150 minutes ✓ Overall peak values for carbohydrate oxidation were higher for the drink compared to the bar ✓ Significant difference only at 3 time periods (120, 135, 150 minutes) so hypothesis not supported OR No significant difference between conditions under 120 mins of exercise ✓	Accept in the converse. Accept p-value, candidates must refer to significance or non-significance.	3 max

13.	a		Caffeine can increase alertness and reduce perceived exertion during exercise ✓ Caffeine can potentially enhance muscle contraction and delay muscle fatigue ✓ Caffeine can increase fat oxidation, sparing muscle glycogen and prolonging exercise duration ✓ Caffeine can stimulate the central nervous system, improving focus during training ✓ Caffeine can increase adrenaline secretion, enhancing physical performance ✓		2 max
14.	a		Regulates body temperature ✓ Maintains blood pressure ✓ Enables transport of substances ✓ Enables the exchange of nutrients/ metabolic end products ✓ Required for all metabolic processes ✓		2 max

14.	b	Hypothalamus controls water potential/ balance through a negative feedback mechanism OR Water balance is maintained by the hypothalamus ✓ Dehydration would cause a low water content in blood OR Due to excessive sweating/ high salt consumption/ low water consumption ✓ Hypothalamus «osmo»receptors detect low water levels ✓ Hypothalamus stimulates the pituitary gland to release high volumes of ADH ✓ ADH stimulates the kidneys to reabsorb water/ reduced urine volume in bladder ✓ High volumes of water returns to blood OR Dehydration triggers thirst, leading to water intake ✓	Award 1 max for list.	4 max
-----	---	---	-----------------------	-------

14.	c	Cardiovascular System: Ingesting alcohol decreases myocardial contractility ✓ Raised blood pressure ✓ Effects on kidney function ✓ Decreased blood viscosity ✓ Dehydration caused by the effect of alcohol on the release of ADH ✓ Thermoregulation: Alcohol acts as a peripheral vasodilator, affecting thermoregulation in cold environments/ slowed/ impaired adaptation to heat and cold ✓ Neurologic Systems: Causes impaired memory/ vision impairment/ slurred speech/ motor coordination/ reduced ability to concentrate ✓ reduced inhibitions «become more aggressive» ✓	<i>Max 1 mark for each category.</i>	2 max
15.		Enzymes are catalysts in digestion ✓ Enzymes break down macronutrients into their smaller components for absorption ✓ Each enzyme is specific to a particular macronutrient e.g. amylase breaks down starch/ protease breaks down proteins/ lipase breaks down lipids ✓ Enzymes are sensitive to changes in pH and temperature therefore are specialised for their location e.g. protease of the stomach ✓		2 max

16.		Training increases the amount of GLUT4 in muscle cells ✓ Higher GLUT4 leads to higher amount of glucose uptake by the muscle cell during exercise ✓ GLUT4 move to the cell membrane in response to training increasing rate of glucose uptake ✓ Training makes muscle cells more efficient in utilizing GLUT4 transporters independent of insulin ✓ Training promotes conversion of intracellular glucose to glucose-6-phosphate OR Maintains concentration needed for continuous movement of glucose into the cell ✓		3 max
17.	a	During exercise, the increased oxygen consumption leads to an increase in free radical production ✓ Exhaustive exercise generates high levels of free radicals that cannot be controlled by natural antioxidants, potentially leading to oxidative stress ✓ Cells produce natural antioxidants to counteract free radicals, but during intense exercise, the production of free radicals may exceed the body's natural antioxidant defense ✓ The effects of free radicals are less significant in trained athletes due to adaptations, increasing the body's antioxidant defense mechanisms ✓		2 max

17.	b	A well-balanced diet would provide sufficient antioxidants from natural sources (therefore supplementation would be irrelevant) ✓ Can support health when a person has been identified as being deficient in antioxidants OR Taking supplements without a diagnosed deficiency might not offer additional benefits ✓ No consistent evidence suggests that antioxidant supplements reduce oxidative stress ✓ Consuming antioxidants in amounts exceeding the RDA might have detrimental effects on the body ✓ The supplement industry lacks strict regulation, leading to potential issues with product quality OR May contain banned substances ✓		3 max
-----	---	--	--	-------