

© International Baccalaureate Organization 2025

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 2025

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, 2025

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/>.

**Sports, exercise and health science**  
**Higher level**  
**Paper 2**

30 April 2025

**Zone A** morning | **Zone B** morning | **Zone C** morning

Candidate session number

--	--	--	--	--	--	--	--	--	--

2 hours 15 minutes

**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.



### Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. A study investigated the relationship between psychological readiness for return to sport and predicted motor unit force (MUF) after anterior cruciate ligament (ACL) injury. Psychological readiness for return to sport was measured using a return to sport after injury (RSI) questionnaire.

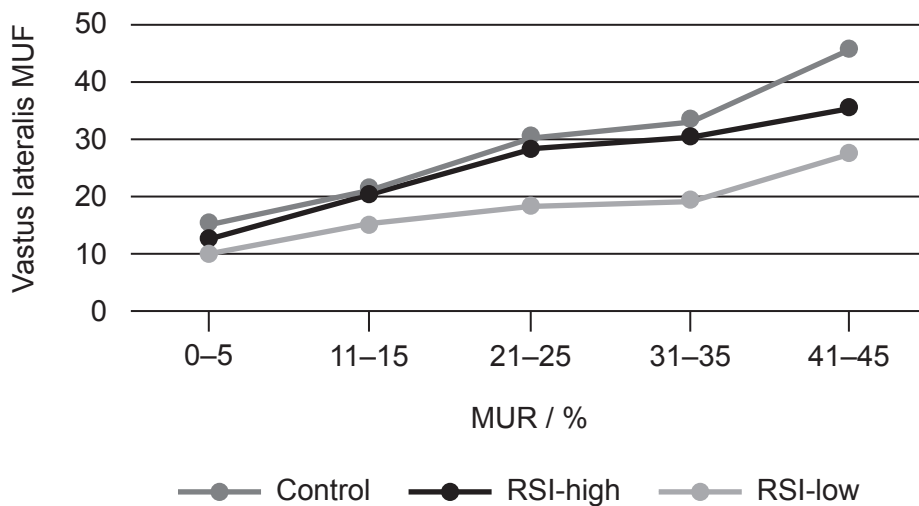
Participants were placed into three groups:

- RSI-low – low psychological readiness for return to sport
- RSI-high – high psychological readiness for return to sport
- Control – individuals without ACL injuries.

MUF was calculated using data from isometric muscle contractions of the vastus lateralis muscles. **Figure 1** shows the MUF generated at five different motor unit recruitment (MUR) percentages.

MUF = average firing rate (pulses per second) × motor unit action potential (peak-to-peak amplitude per mass).

**Figure 1**



\* Control MUF > RSI-high MUF p < 0.001  
\*\* Control MUF > RSI-low p < 0.001  
\*\*\* RSI-low MUF < RSI-high p < 0.001

- (a) Identify the group that showed the lowest vastus lateralis MUF.

[1]

.....

.....

(This question continues on the following page)



**(Question 1 continued)**

- (b) Calculate the difference in MUF of the vastus lateralis between the RSI-high and RSI-low groups at 21–25% MUR.

[1]

.....  
.....

- (c) Based on the data presented in **Figure 1**, discuss the hypothesis that psychological readiness for return to sport is related to MUF.

[3]

.....  
.....  
.....  
.....  
.....  
.....

- (d) Explain why it was important to include a control group in this study.

[2]

.....  
.....  
.....  
.....

- (e) The study also assessed the biceps femoris MUF at different MUR percentages, which generated an  $R^2$  value of 0.27. Comment on the meaning of the value.

[1]

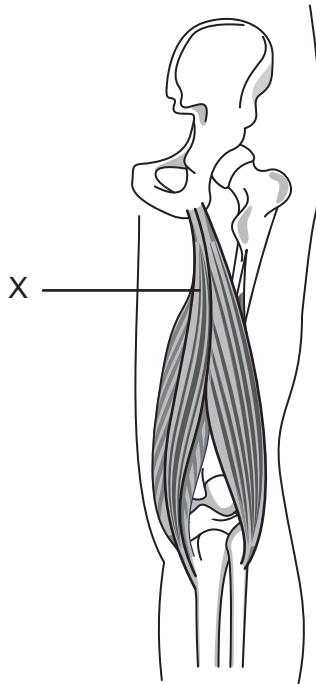
.....  
.....  
.....  
.....

**(This question continues on the following page)**



(Question 1 continued)

The diagram shows the muscles of the hamstring group.



(f) Identify the hamstring muscle X. [1]

.....

(g) Muscle tissue can contract under neural control. Outline **one** other characteristic that is common to muscle tissue. [1]

.....  
.....

(h) Define *strength* as a major component of fitness. [1]

.....  
.....

(This question continues on the following page)



**(Question 1 continued)**

- (i) Evaluate the use of a hand grip dynamometer to measure strength. [3]

.....

.....

.....

.....

.....

.....

- (j) Data collected from information technologies are not typically available through traditional techniques. Discuss **two** benefits of these technologies for an injured athlete returning to sport. [2]

.....

.....

.....

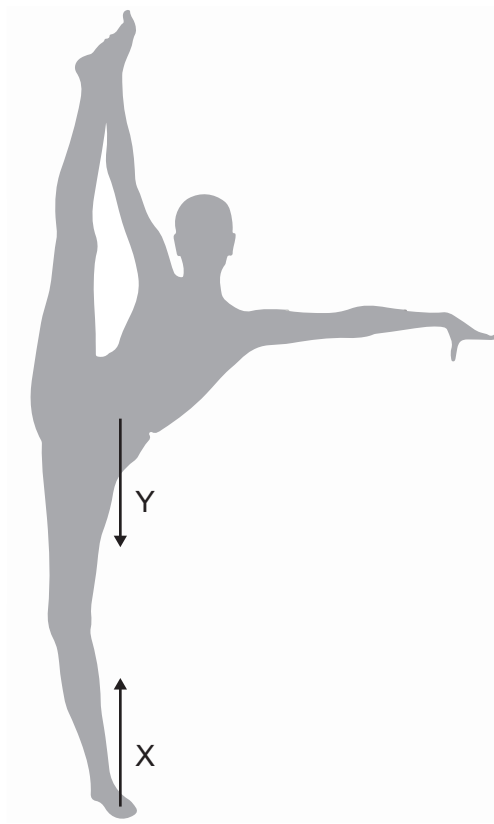
.....



2. The image shows a gymnast performing a floor routine.

(a) Identify the forces labelled X and Y acting on the gymnast.

[2]



X: .....  
Y: .....

(b) A study reported that 88% of the injuries sustained by gymnasts required them to modify their training. Suggest how **two** key principles of training programme design could be modified to reduce the recurrence of injuries.

[4]

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(This question continues on the following page)



**(Question 2 continued)**

(c) Discuss **three** differences in skill execution between a skilled and a novice gymnast. [3]

.....

.....

.....

.....

.....

.....

(d) Suggest **two** ways a coach can modify task constraints to teach motor skills in a sport of your choice. [2]

.....

.....

.....

.....

(e) Explain how the pituitary gland affects growth. [2]

.....

.....

.....

.....



3. An Ironman Triathlon consists of a 3.9 km swim, a 180.2 km bicycle ride and a 42.2 km run, 226.3 km in total. It is widely considered to be one of the most difficult one-day sporting events in the world.

(a) Describe how the long-term training for the Ironman Triathlon may suppress the triathlete's immune system. [2]

.....

.....

.....

.....

(b) The skin provides protection and immunity to the triathlete. Outline **two** other functions of the skin. [2]

.....

.....

.....

.....

(c) Predict how stroke volume and heart rate differ during submaximal exercise for trained triathletes and untrained spectators. [2]

.....

.....

.....

.....

(This question continues on the following page)



**(Question 3 continued)**

(d) Define *central fatigue*.

[1]

.....  
.....

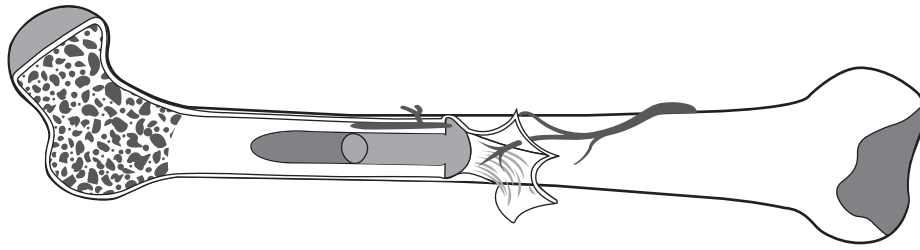
(e) Analyse **three** reasons for excess post-exercise oxygen consumption (EPOC) after a triathlon.

[3]

.....  
.....  
.....  
.....  
.....  
.....



4. The diagram shows a long bone.



(a) Outline the structure of **both** the periosteum and spongy bone.

[2]

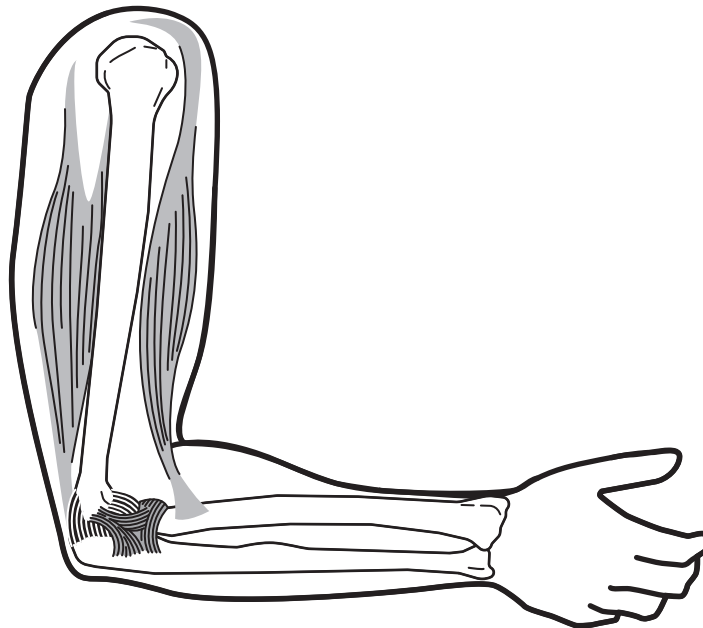
.....

.....

.....

.....

The diagram shows the elbow joint.



(b) State the location of the humerus in relation to the radius using anatomical terminology.

[1]

.....

.....

(This question continues on the following page)



**(Question 4 continued)**

(c) Distinguish between first class levers and third class levers. [2]

.....

.....

.....

.....

(d) Outline **two** types of feedback an umpire provides players during a game. [2]

.....

.....

.....

.....

(e) Explain how the short-term stress caused by competing in sport influences how the nervous system regulates adrenaline. [2]

.....

.....

.....

.....

(f) Outline **two** possible benefits of genetic screening for the health of athletes. [2]

.....

.....

.....

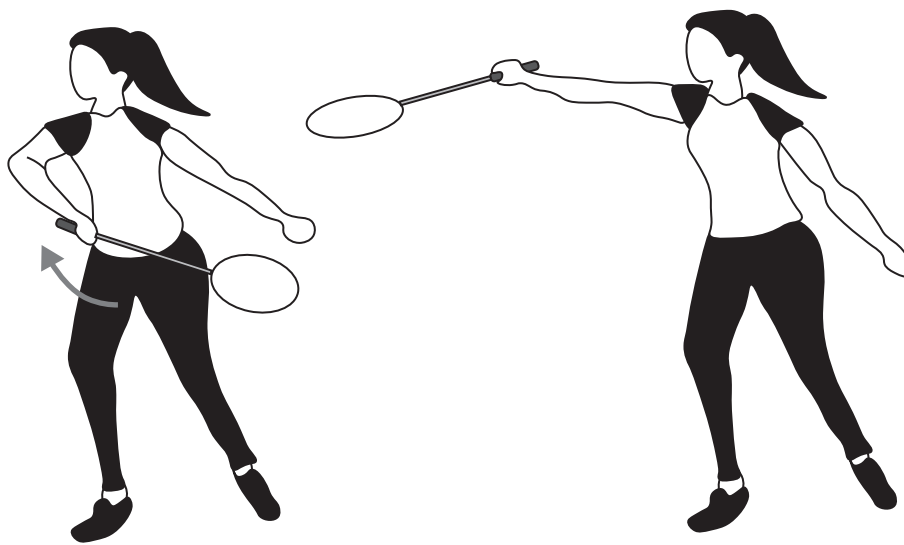
.....



### Section B

Answer **two** questions. Answers must be written within the answer boxes provided.

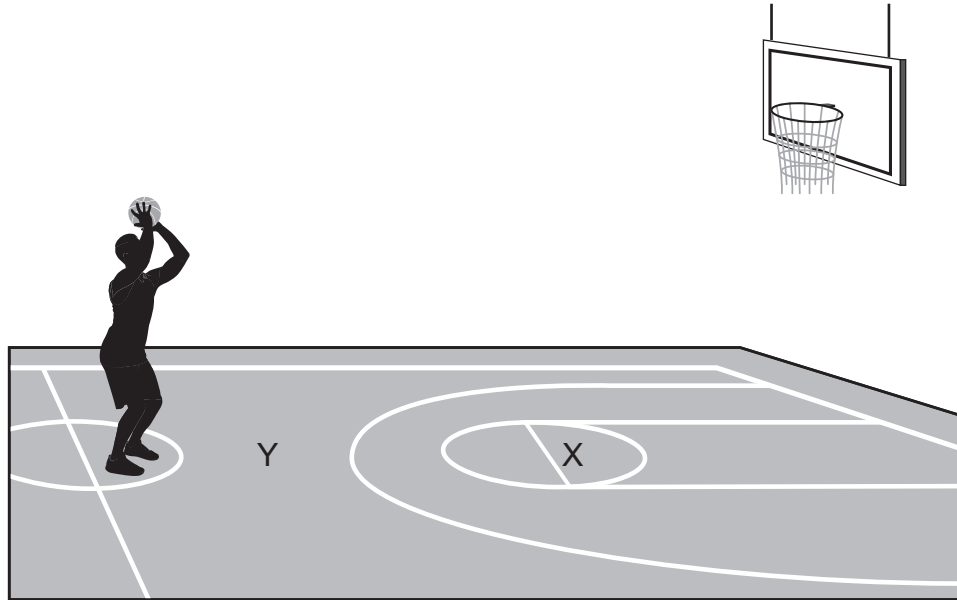
- 5. (a) Compare and contrast the process of gaseous exchange of oxygen and carbon dioxide at the alveoli during exercise. [4]
- (b) Distinguish between vigorous high-intensity and submaximal endurance activities. [2]
- (c) Identify the fuel sources and net ATP produced per molecule of fuel by the ATP-CP and the lactic acid systems. [4]
- (d) Analyse how the muscles work in pairs to extend the elbow during a backhand in badminton. [4]



- (e) Texture, fluid viscosity and shape influence the amount of drag in sports. Using examples, explain these factors and how they are adapted to improve performance in sports. [6]



- 6. (a) Describe the role of hormones. [3]
- (b) Insulin is inhibited by muscle contraction. Explain the role of insulin on glucose uptake at rest. [3]
- (c) The projectile motion of a basketball is influenced when three factors interact as the ball is released. Discuss these **three** factors and how a basketball player optimises their performance as they release a ball from points X and Y. [6]



- (d) Using sporting examples, outline a discrete, a serial and a continuous skill. [3]
- (e) Using examples, suggest ways to develop a simple notation system for basketball. [5]



- 7. (a) Outline the functions of the brain stem and the diencephalon. [4]
- (b) Analyse how acetylcholine causes calcium ions to be released into a muscle cell to stimulate contraction. [3]
- (c) Chunking, association and practice are three methods of improving memory. Describe how an athlete uses these three methods in sporting contexts. [3]
- (d) The images show a person holding a yoga headstand and a person riding a stationary bicycle.



- Explain how diastolic blood pressure responds to these exercises. [6]
  - (e) Discuss how genetic and environmental factors may affect the performance of an elite 100 m hurdler. [4]
- 8.
- (a) Discuss how the difficulty of a task affects the rate of learning. [3]
  - (b) Describe how vasodilation impacts blood redistribution during a 400 m freestyle swimming race. [4]
  - (c) Using named examples of molecules, analyse how polysaccharides are formed. [6]
  - (d) Explain why elite athletes are generally more susceptible to infection than sedentary individuals. [5]
  - (e) Outline how genes can influence human characteristics. [2]







A large rectangular area containing horizontal dotted lines for writing.



20EP17

Turn over



Large rectangular area with horizontal dotted lines for writing.



#### Disclaimer:

Content used in IB assessments is taken from authentic, third-party sources. The views expressed within them belong to their individual authors and/or publishers and do not necessarily reflect the views of the IB.

#### References:

1. Schilaty, N.D., McPherson, A.L., Nagai, T. and Bates, N.A., 2023. Differences in psychological readiness for return to sport after anterior cruciate ligament injury is evident in thigh musculature motor unit characteristics. *BMJ Open Sport & Exercise Medicine*. [pdf] Available at: <https://bmjopensem.bmj.com/content/bmjosem/9/3/e001609.full.pdf> [Accessed 5 July 2024]. Source adapted.
- 1.(f) VectorMine, 2022. *Hamstring posterior muscle anatomy with bones and ligaments outline diagram - stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/hamstring-posterior-muscle-anatomy-with-royalty-free-illustration/1367951924?phrase=hamstring&adppopup=true> [Accessed 5 July 2024]. Source adapted.
- 4.(b) VectorMine, 2018. *Elbow joint vector illustrated diagram, medical scheme. - stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/elbow-joint-vector-illustrated-diagram-royalty-free-illustration/912872238?phrase=elbow+joint&adppopup=true> [Accessed 5 July 2024]. Source adapted.
- 6.(c) Nataliia Nesterenko, 2022. *School gym flat color vector illustration - stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/school-gym-flat-color-vector-illustration-royalty-free-illustration/1366015703?phrase=basketball+court+and+hoop&adppopup=true> [Accessed 5 July 2024]. Source adapted.  
Svitlana Varfolomieieva, 2021. *Basketball players, vector illustration. Crossover dribbling, bouncing, passing, shooting ball, free throw, slam dunk. - stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/basketball-players-vector-illustration-royalty-free-illustration/1303917914?phrase=basketball+players+shooting&adppopup=true> [Accessed 5 July 2024]. Source adapted.
- 7.(d) CSA-Archive, 2018. *Yoga Pose – stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/yoga-pose-royalty-free-illustration/1003207210?phrase=yoga+headstand&adppopup=true> [Accessed 5 July 2024]. Source adapted.  
Ekaterina Pushina, 2019. *Girl doing stationary exercise bike workout. Black silhouette on white background. Vector background of gym with girls doing fitness. Women on training bike. Healthy concept and wellness lifestyle. - stock illustration*. [image online] Available at: <https://www.gettyimages.co.uk/detail/illustration/girl-doing-stationary-exercise-bike-workout-royalty-free-illustration/1173176909> [Accessed 5 July 2024]. Source adapted.

All other texts, graphics and illustrations © International Baccalaureate Organization 2025



20EP20