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# Sports, exercise and health science

## Higher level

### Paper 3

2 May 2023

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

Candidate session number

1 hour 15 minutes

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#### Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the options.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

Option	Questions
Option A — Optimizing physiological performance	1 – 6
Option B — Psychology of sports	7 – 11
Option C — Physical activity and health	12 – 17
Option D — Nutrition for sports, exercise and health	18 – 23



### Option A — Optimizing physiological performance

1. Cold-water immersion (CWI) is commonly used for post-exercise recovery. A study looked at the effects of CWI on athletes' muscle damage indicators following completion of a triathlon (3.86 km swim, 180.25 km cycle and 42.2 km run).

The measured variables were:

- creatine kinase
- myoglobin
- cortisol
- perceived delayed onset muscle soreness (DOMS).

Measurements were taken:

- pre-event
- immediately post-event
- 16 hours post-event
- 40 hours post-event.

**Figure 1: Data for the cold-water immersion and control groups before and after the triathlon event**

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(Option A, question 1 continued)

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Group comparisons revealed the following t-test results at 16 hours post-event:

creatine kinase:  $p > 0.05$

myoglobin:  $p > 0.05$

cortisol:  $p > 0.05$

DOMS:  $p < 0.05$

(This question continues on the following page)



28EP03

Turn over

**(Option A, question 1 continued)**

- (a) Identify the group that had the lowest levels of creatine kinase after the triathlon event. [1]

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- (b) Calculate the difference in perceived DOMS score at 16 hours post-event between the cold-water immersion group and the control group. [2]

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- (c) Using the data from this study, discuss whether there is any real or perceived benefit for an athlete who completes cold-water immersion as part of exercise recovery. [3]

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**(Option A continues on the following page)**



(Option A continued)

2. (a) State the normal physiological core body temperature. [1]

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- (b) The Kona iron man event takes place in a hot climate. Athletes typically undergo heat acclimatization as part of their training to aid their performance.

Discuss the physiological adaptations that will occur for an athlete as a result of undergoing heat acclimatization. [3]

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3. (a) Distinguish overreaching and overtraining. [1]

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- (b) Discuss **two** psychological symptoms that indicate an athlete has overtrained. [2]

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(Option A continues on the following page)



(Option A continued)

4. An athlete may take anabolic steroids to help them recover more quickly from their training.

Describe the potential harmful health consequences of taking anabolic steroids.

[2]

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5. (a) Cold-water immersion is a form of cryotherapy. Outline **two** other methods of cryotherapy used in sports recovery by athletes.

[2]

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- (b) Discuss the benefits that athletes hope to gain by using cryotherapy.

[3]

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(Option A continues on the following page)



(Option A continued)

6. (a) Define the term *hypoxia*. [1]

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- (b) Outline **two** methods that an elite athlete can use to help them prevent high-altitude sickness. [2]

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- (c) Discuss **two** cardiovascular adaptations in an athlete who has trained at moderate altitude for four weeks. [2]

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**End of Option A**





**Option B — Psychology of sports**

7. A study investigated the role of trait emotional intelligence (trait EI) on mood states and serum cortisol responses during an 80.5 km treadmill ultramarathon. Participants with low trait EI were compared to those with high trait EI. All participants were matched for aerobic capacity and running ability.

Results were recorded at:

- baseline (2 weeks prior to the treadmill run)
- pre-run (30 minutes prior to the treadmill run)
- halfway (through the treadmill run)
- post-run (immediately on completion of the treadmill run).

**Table 1: Measured variables (mean  $\pm$  SD) for low and high trait EI groups**

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- (a) Identify the time period and variable that showed the greatest significant difference.

[1]

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**(Option B continues on the following page)**



**(Option B, question 7 continued)**

- (b) Calculate the difference in mean mood state between low and high trait EI for the post-run time period.

[2]

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- (c) Analyse the measured differences in cortisol and mood state between the low and high trait EI groups during the study.

[3]

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**(Option B continues on the following page)**



(Option B continued)

8. (a) Define the term *personality*. [1]

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- (b) State **one** method for measuring personality. [1]

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- (c) Discuss the interactionist approach to personality. [2]

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(Option B continues on the following page)



(Option B continued)

9. (a) Outline the term *talent*.

[1]

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(b) Discuss factors that enable an athlete to develop their talent in sport successfully.

[4]

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(Option B continues on the following page)



28EP11

Turn over

**(Option B continued)**

- 10.** (a) Athletes need to be able to deal with anxiety during sporting performances.

Describe cognitive and somatic anxiety.

[2]

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- (b) Using an example, discuss the use of mental imagery in the management of performance anxiety.

[3]

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**(Option B continues on the following page)**



**(Option B continued)**

11. (a) Outline **two** elements of self-determination theory.

[2]

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- (b) Discuss self-regulated learning strategies that a coach can employ to maximize the motivation of their team members.

[3]

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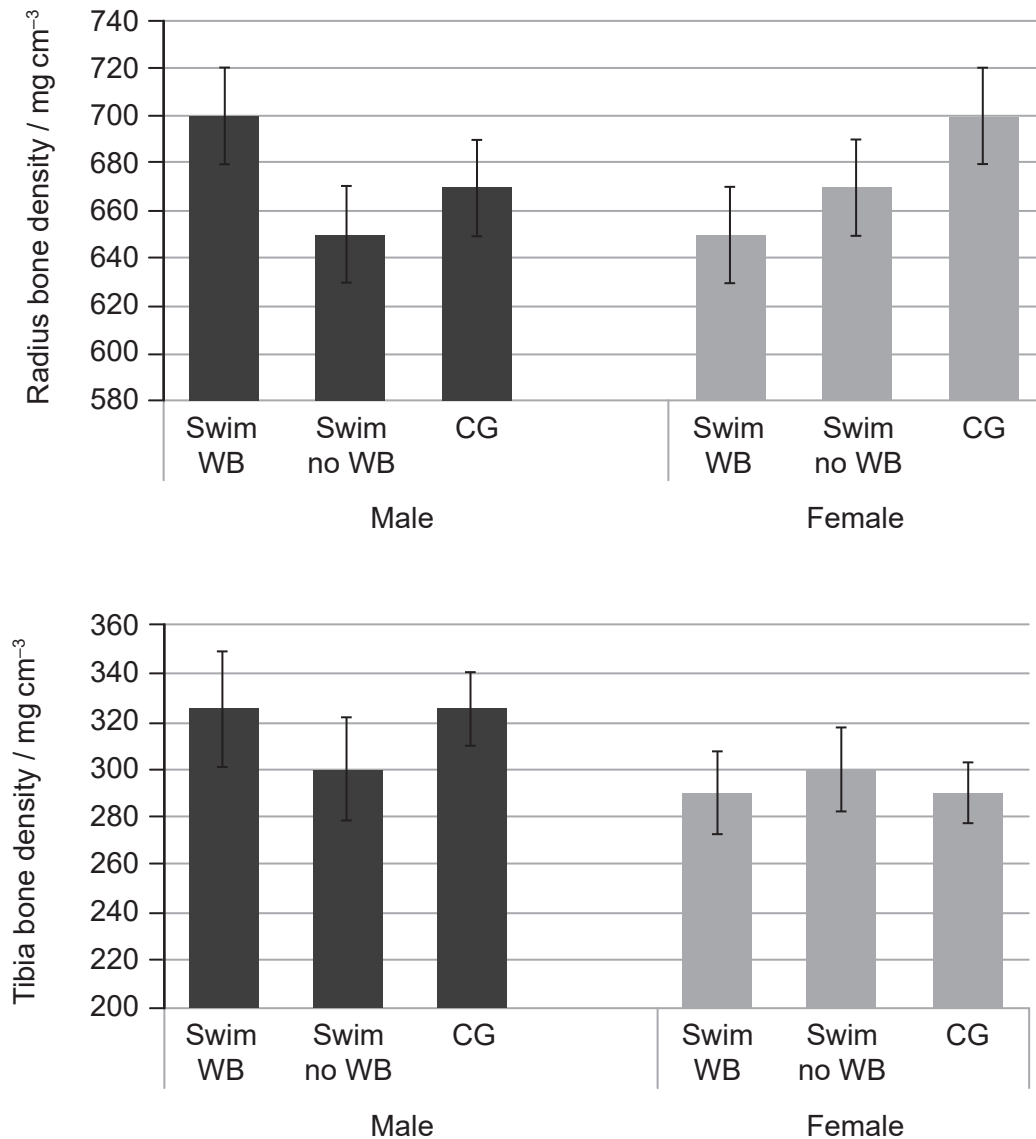
**End of Option B**



**Option C — Physical activity and health**

12. A study investigated how mode of exercise can influence the bone density of adolescents. Three groups were identified and had their bone density measured for comparison:
- Swim WB (swimmers who also take part in weight-bearing sports).
  - Swim no WB (swimmers who do not take part in weight-bearing sports).
  - CG (control group – non-swimmers who take part in weight-bearing sports).

**Figure 2: Bone density of the radius and tibia for males and females in each group**



(a) Identify the male group that had the highest bone density for both bones.

[1]

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(Option C continues on the following page)



**(Option C, question 12 continued)**

- (b) Calculate the difference in tibia bone density between the female swim no WB group and the female CG group.

[2]

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- (c) Discuss the hypothesis that weight-bearing exercises are more beneficial for developing a person's bone density than non-weight-bearing exercises.

[3]

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- 13.** (a) Outline osteoporosis.

[1]

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- (b) Discuss the risk factors for osteoporosis.

[3]

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**(Option C continues on the following page)**





**(Option C continued)**

- 14.** (a) Using examples, outline acute injuries and chronic injuries in sport. [2]

Acute injuries:

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Chronic injuries:

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- (b) Evaluate the benefits and hazards that a person must consider when they engage in an exercise programme at a local gym for the first time. [3]

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- 15.** Distinguish between exercise and physical activity. [1]

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**(Option C continues on the following page)**



(Option C continued)

16. (a) Using an example, outline what is meant by the term *population attributable risk (PAR)*. [2]

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- (b) Moderate exercise offers several health benefits.

Discuss the physiological health benefits that a person can achieve through moderate exercise.

[3]

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(Option C continues on page 19)



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**(Option C continued)**

17. (a) Type 2 diabetes is a significant health issue associated with obesity.

Outline **two other** significant health consequences of obesity.

[2]

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- (b) Discuss type 2 diabetes.

[2]

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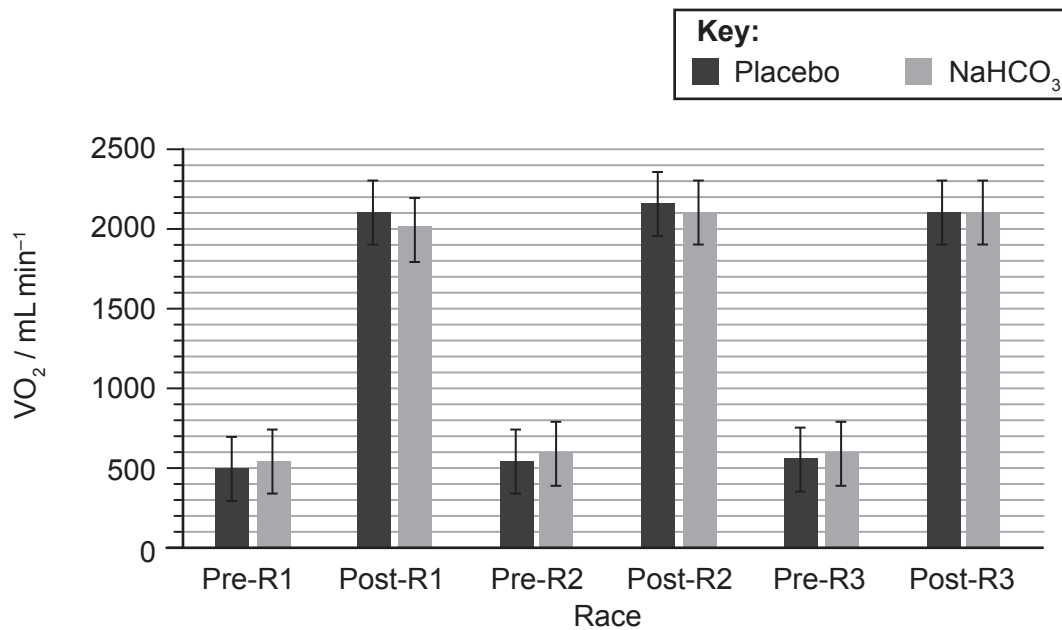
**End of Option C**



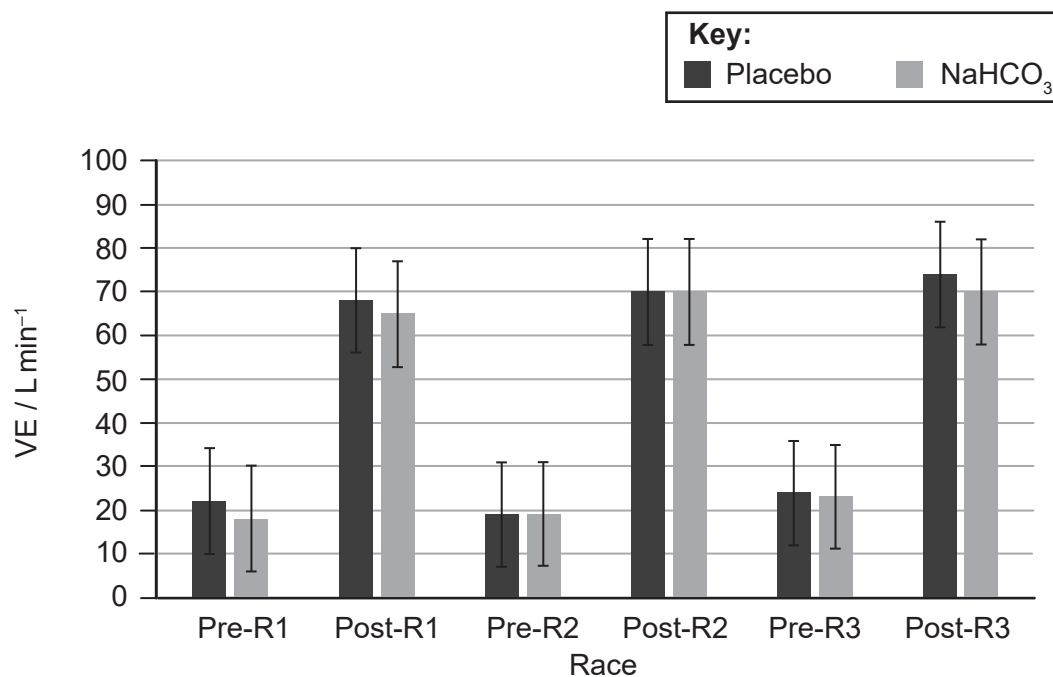
**Option D — Nutrition for sports, exercise and health**

18. A study investigated the effect of sodium bicarbonate ( $\text{NaHCO}_3$ ) ingestion on the performance of elite BMX cyclists during simulated competition. Participants ingested either  $\text{NaHCO}_3$  or a placebo 90 minutes before exercise. They completed three races (R1, R2 and R3). Oxygen uptake ( $\text{VO}_2$ ) and pulmonary ventilation ( $\text{VE}$ ) were measured before (pre-) and after (post-) each race. Race time, peak velocity and peak heart rate were also recorded.

**Figure 3(a): Mean oxygen uptake**



**Figure 3(b): Mean pulmonary ventilation**



(This question continues on the following page)



(Option D, question 18 continued)

**Table 2: Mean results for race time, peak velocity  
and peak heart rate for the three races**

Measurement	Condition	Race 1	Race 2	Race 3
Race time / s	NaHCO <sub>3</sub>	31.42	31.31	31.39
	Placebo	31.46	31.18	31.33
Peak velocity / m s <sup>-1</sup>	NaHCO <sub>3</sub>	12.95	12.86	12.90
	Placebo	13.05	12.80	13.13
Peak heart rate / bpm <sup>-1</sup>	NaHCO <sub>3</sub>	194	194	191
	Placebo	194	193	190

$p = >0.05$  for each comparison

- (a) Describe the trend for mean pulmonary ventilation before (pre) and after (post) each race. [1]

- (b) Calculate the difference in oxygen uptake (VO<sub>2</sub>) between the placebo and the sodium bicarbonate (NaHCO<sub>3</sub>) conditions after Race 1 (post-R1). [2]

(This question continues on the following page)



(Option D, question 18 continued)

- (c) Using the data in **Table 2**, discuss the hypothesis that the consumption of a buffer such as sodium bicarbonate ( $\text{NaHCO}_3$ ) can enhance human exercise performance. [3]

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19. (a) State the typical pH values found in an athlete's stomach. [1]

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- (b) Athletes consume various nutritional ergogenic aids, such as sodium bicarbonate, in the belief that they will enhance their performance.

Evaluate **one other** nutritional ergogenic aid that is commonly used by athletes. [3]

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(Option D continues on the following page)



(Option D continued)

20. (a) Define the term *basal metabolic rate*.

[1]

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(b) Glucose is a key fuel for cellular metabolism.

Discuss the transport of glucose across the cell membrane during physical activity.

[3]

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21. Evaluate the effects of alcohol consumption on athletic performance.

[3]

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(Option D continues on the following page)





**(Option D continued)**

- 22.** (a) Outline the term *antioxidant*, giving an example of a food that contains antioxidants. [2]

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- (b) Describe the production of free radicals in the body during rest and during exhaustive exercise. [2]

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- 23.** (a) State where extracellular fluid can occur throughout the body. [2]

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- (b) Water is vital for effective cellular functioning.

Discuss the role of antidiuretic hormone (ADH) in maintaining water balance in the body. [2]

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**End of Option D**



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