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Diploma Programme
Programme du diplôme
Programa del Diploma

# Sports, exercise and health science
# Standard level
# Paper 3

2 May 2023

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

Candidate session number

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

1 hour

## 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 **[40 marks]**.

| Option | Questions |
|---|---|
| Option A — Optimizing physiological performance | 1 – 4 |
| Option B — Psychology of sports | 5 – 9 |
| Option C — Physical activity and health | 10 – 13 |
| Option D — Nutrition for sports, exercise and health | 14 – 17 |

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20 pages

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

**(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)**

**(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) Outline how a triathlete could use fartlek training to improve their endurance capability. [2]

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

**(Option A, question 3 continued)**

(b) Suggest how a triathlete should approach the pre-season phase of their training to maximize performance. [3]

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**4.** (a) Using a sporting example, describe how a substance could have a placebo effect on an athlete's performance. [2]

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(b) Erythropoietin (EPO) is a substance banned by the International Olympic Committee (IOC).

State **one** other class of non-nutritional ergogenic aid that is banned by the IOC. [1]

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(c) Evaluate an athlete's physiological response to using EPO. [2]

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## End of Option A

**Option B — Psychology of sports**

**5.** 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 ± 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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**(This question continues on the following page)**

**(Option B, question 5 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)**

**6.** (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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**7.** (a) Describe the inverted-U hypothesis as it relates to sports performance. [2]

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

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

(b) Using an example, discuss the positive emotions that characterize an athlete's experience. [3]

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**8.** Describe how an athlete could use different types of goals to maximize their performance. [2]

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**9.** Using an example, discuss the issues that can arise for an athlete using extrinsic motivators. [3]

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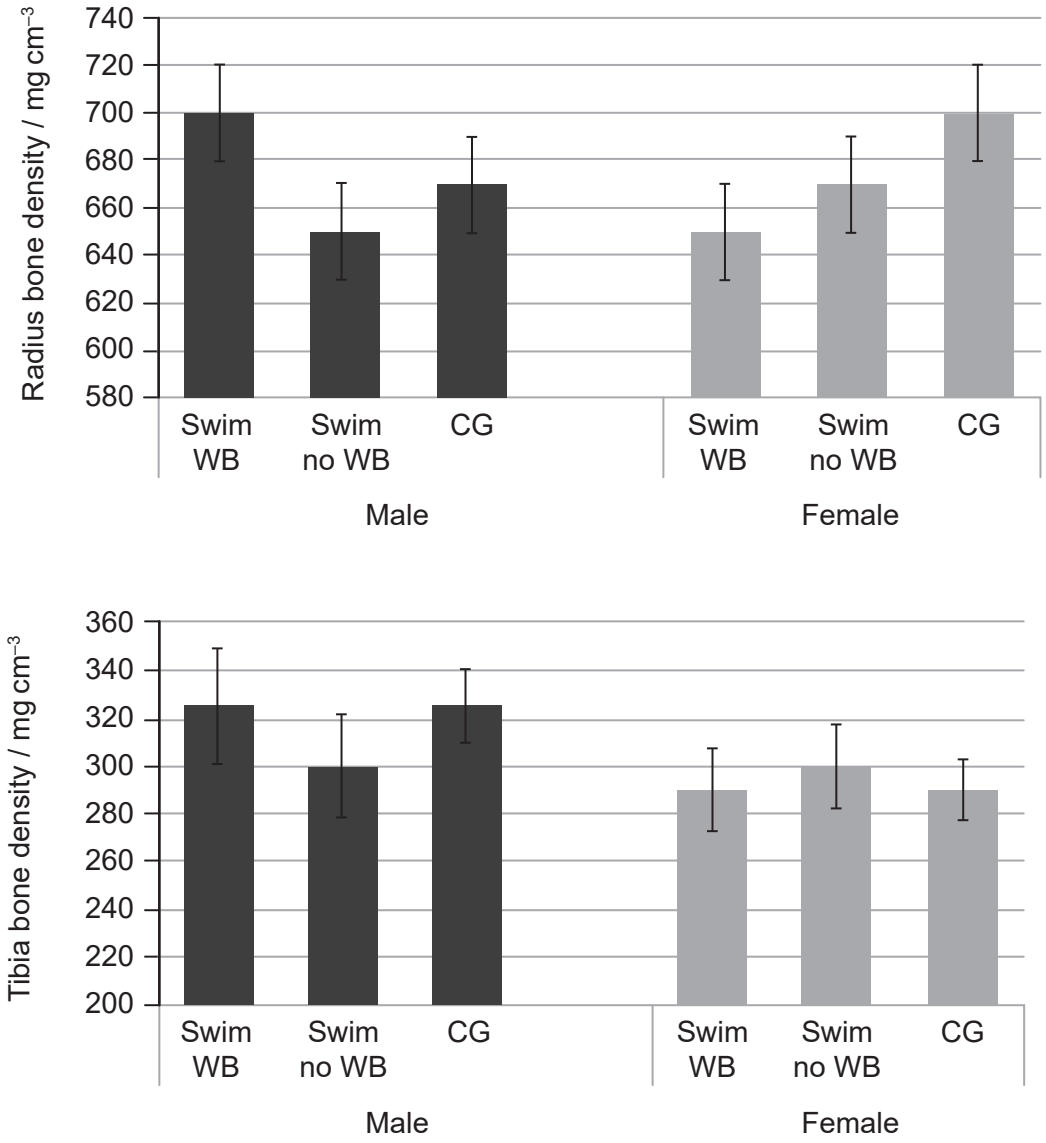
## End of Option B

**Option C — Physical activity and health**

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

**(Option C, question 10 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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**(Option C continues on the following page)**

**(Option C continued)**

**11.** (a) Outline osteoporosis. [1]

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(b) Discuss the risk factors for osteoporosis. [3]

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(c) Identify **two** health consequences of obesity. [2]

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**(Option C continues on page 15)**

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Answers written on this page
will not be marked.

**(Option C continued)**

**12.** (a) In some countries, a doctor may write a "green prescription" to encourage the patient to be physically active as part of their health management.

Outline the importance of exercise for individuals with a hypokinetic disease. [3]

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(b) Discuss potential physiological and psychological barriers encountered by individuals planning to engage in physical activity. [3]

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**13.** Outline how an appropriate amount of exercise can enhance an individual's psychological well-being. [2]

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## End of Option C

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

**14.** A study investigated the effect of sodium bicarbonate ($NaHCO_3$) ingestion on the performance of elite BMX cyclists during simulated competition. Participants ingested either $NaHCO_3$ or a placebo 90 minutes before exercise. They completed three races (R1, R2 and R3). Oxygen uptake ($VO_2$) and pulmonary ventilation (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**

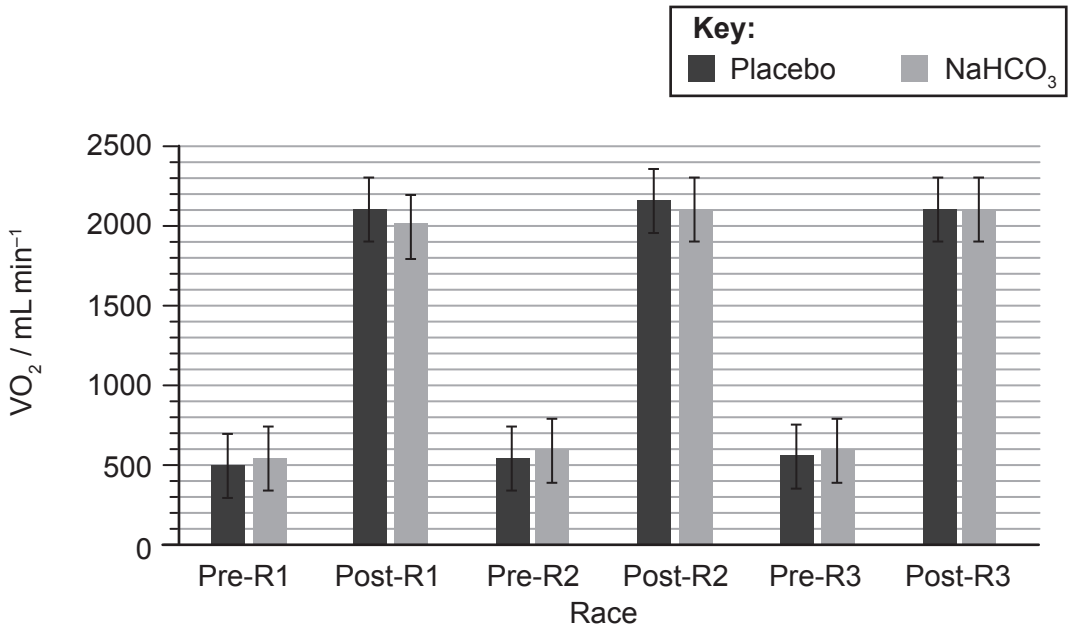
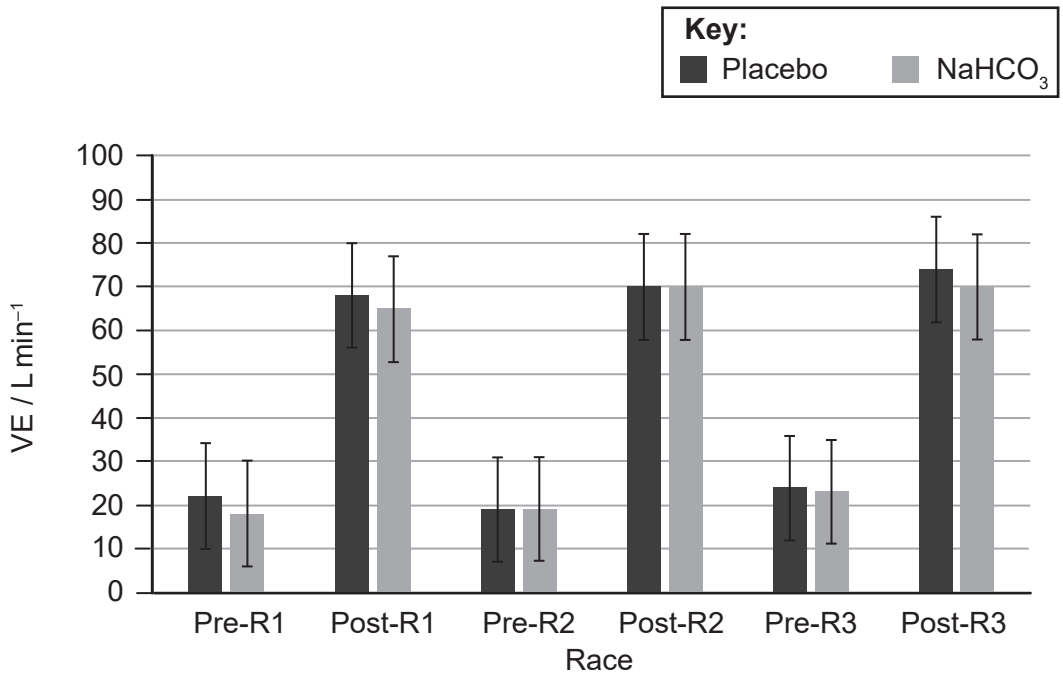



**Figure 3(b): Mean pulmonary ventilation**




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

**(Option D, question 14 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 | $NaHCO_3$ | 31.42 | 31.31 | 31.39 |
| | Placebo | 31.46 | 31.18 | 31.33 |
| Peak velocity / $m\ s^{-1}$ | $NaHCO_3$ | 12.95 | 12.86 | 12.90 |
| | Placebo | 13.05 | 12.80 | 13.13 |
| Peak heart rate / $bpm^{-1}$ | $NaHCO_3$ | 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]

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(b) Calculate the difference in oxygen uptake ($VO_2$) between the placebo and the sodium bicarbonate ($NaHCO_3$) conditions after Race 1 (post-R1). [2]

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

**(Option D, question 14 continued)**

(c) Using the data in **Table 2**, discuss the hypothesis that the consumption of a buffer such as sodium bicarbonate ($NaHCO_3$) can enhance human exercise performance. [3]

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**15.** (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)**

**16.** (a) Identify **two** reasons why water is critical for normal human functioning. [2]

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(b) Explain why a marathon runner would require a greater water intake than a shot putter during competition. [3]

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

**(Option D continued)**

**17.** (a) List **two** sources of protein for a vegetarian athlete. [2]

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(b) Outline the possible harmful effects of excessive protein in a person's diet. [3]

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## End of Option D

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**References:**

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