S6 Physical Education Practice Paper

S6 - Physical Education | Time: 75 minutes | Total: 100 marks | 24 parts

Part A: Energy Systems and Lactate Clearance (18 marks)

A 70 kg athlete runs 400 m in 55 s at an average power of 520 W. Three minutes after the race blood lactate is 12.0 mmol/L against a resting value of 4.0 mmol/L, plasma volume is 3.5 L, and the half-life of lactate clearance is about 15 minutes. Answer items 1 to 4.

1. (1) Calculate the total work done in joules and kilojoules, and the work per kilogram of body mass. (4 marks)

2. (2) Using the lactate concentration and plasma volume, how many mmol more lactate is present after the race than at rest? (4 marks)

3. (3) How many net ATP does one glucose molecule yield through the aerobic system and through the lactate system, and what is the ratio? (4 marks)

4. (4) Using the half-life, estimate blood lactate 30 minutes after the race and the time needed to fall below 2.0 mmol/L. (6 marks)

Part B: Levers and Torque (16 marks)

An athlete of weight 700 N rises on the toes of one foot: the line of action of body weight is 0.12 m from the pivot and the Achilles tendon has a moment arm of 0.05 m. In a second action the athlete holds 8 kg 0.32 m from the elbow, the forearm of mass 2 kg has its centre of mass 0.15 m from the elbow, the biceps moment arm is 0.045 m, and g is 9.81. Answer items 5 to 8.

5. (5) Calculate the force required in the Achilles tendon and the mechanical advantage of this lever. (5 marks)

6. (6) Calculate the resistive torque at the elbow and the force required from the biceps. (5 marks)

7. (7) State which class of lever each action belongs to and give one further human example of each. (3 marks)

8. (8) How do torque and movement speed change when a tendon inserts closer to the joint, and what does this mean for performance? (3 marks)

Part C: Projectile Motion (18 marks)

A player releases a ball 2.0 m above the floor at 7.0 m per second at 50 degrees to the horizontal. Air resistance is negligible and g is 9.81. Answer items 9 to 12.

9. (9) Find the horizontal and vertical components of the initial velocity. (4 marks)

10. (10) Calculate the rise after release and the maximum height above the floor. (4 marks)

11. (11) Calculate the time to return to the height of release and the horizontal range at that moment. (6 marks)

12. (12) If the release angle rises to 60 degrees at the same speed, how do peak height and range change, and how should a coach trade them off? (4 marks)

Part D: Heart Rate Reserve and Cardiac Output (16 marks)

A 15-year-old athlete has a resting heart rate of 55 beats per minute. During exercise the heart rate is 180 beats per minute with a stroke volume of 120 mL, against 70 mL at rest, and the 12-minute run distance is 2 800 m. Answer items 13 to 16.

13. (13) Estimate maximum heart rate as 220 minus age, find the heart rate reserve, and use it to calculate the target heart rate at 70 per cent intensity. (5 marks)

14. (14) Calculate cardiac output at rest and during exercise, and find the ratio between them. (5 marks)

15. (15) Estimate maximum oxygen uptake from the 12-minute run formula and state its unit. (3 marks)

16. (16) If 80 per cent of cardiac output goes to the working muscles during exercise, calculate muscle blood flow at rest and during exercise. (3 marks)

Part E: Body Composition and Energy Balance (16 marks)

A 70 kg athlete of height 1.72 m has 18 per cent body fat and plans to reach 12 per cent while keeping lean mass unchanged; the coach sets a daily deficit of 500 kcal and 1 kg of fat equals about 7 700 kcal. Answer items 17 to 20.

17. (17) Calculate current fat mass, lean body mass, target body mass and the fat to be lost. (5 marks)

18. (18) At that deficit, how much fat is lost per week, and how many days are needed to reach the target? (5 marks)

19. (19) Calculate the athlete current body mass index. (3 marks)

20. (20) Why should rapid weight loss on a very low calorie diet be avoided? Give one training and one health reason. (3 marks)

Part F: Training Load and Tapering (16 marks)

An athlete performs 4 sets of 8 repetitions of the squat at 80 kg, three times a week, with a one-repetition maximum of 80 kg. Training uses 75 per cent of that maximum and the load rises 5 per cent every two weeks for four weeks. Two weeks before competition the morning pulse rises from 55 to 68 beats per minute and sleep falls from 8 to 6 hours. Answer items 21 to 24.

21. (21) Calculate the tonnage of one session and of one week in kilograms. (4 marks)

22. (22) Calculate the present training load and the load to be used after four weeks. (4 marks)

23. (23) Calculate the percentage rise in morning pulse and the fall in sleep, and judge whether these suggest overtraining. (4 marks)

24. (24) Tapering usually cuts volume by 40 to 50 per cent while keeping intensity; explain why and give one way to apply it. (4 marks)
