S4 Physical Education Practice Paper

S4 | Physical Education | Time: 75 minutes | Total: 100 marks | 24 questions

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Part 1: Fitness Testing and Data (16 marks)

Show the formula used and give answers to two decimal places.

1. A S4 boy is 1.70 m tall and weighs 65 kg. (a) Calculate his body mass index (BMI). (b) Classify the result against the Asian adult range (normal 18.5 to 22.9).

Answer: (a) BMI = 65 / 1.70^2 = 65 / 2.89 = 22.49. (b) 22.49 lies between 18.5 and 22.9, so the result is in the normal range.

2. Waist circumference is 78 cm and hip circumference is 96 cm. (a) Find the waist to hip ratio. (b) The risk cut-off for men is 0.90; comment on the risk.

Answer: (a) Waist to hip ratio = 78 / 96 = 0.81. (b) 0.81 is below 0.90, so central obesity risk is low.

3. A 12-minute run covers 2,400 m. Using the Cooper formula VO2max = (distance - 504.9) / 44.73, estimate the maximal oxygen uptake.

Answer: VO2max = (2400 - 504.9) / 44.73 = 1895.1 / 44.73 = 42.37 ml/kg/min.

4. A class has 40 students and one student ranks 6th from the top. Percentile rank = number below the student / total x 100. Find the percentile rank.

Answer: 40 - 6 = 34 students rank below, so percentile rank = 34 / 40 x 100 = 85.

Part 2: Energy Systems and Exercise Metabolism (16 marks)

Show all working and state the units of energy.

5. A 70 kg athlete performs a 6-second sprint with an average power of 1,200 W. (a) Find the total work in joules. (b) Find the work per kilogram of body mass.

Answer: (a) Work = 1200 x 6 = 7200 J. (b) Per kilogram = 7200 / 70 = 102.86 J/kg.

6. A 30-minute run is performed at a steady oxygen uptake of 3.0 L/min. Each litre of oxygen releases about 21 kJ. (a) Find the total oxygen consumed. (b) Find the total energy in kJ and kcal (1 kcal = 4.184 kJ).

Answer: (a) Oxygen used = 3.0 x 30 = 90 L. (b) Energy = 90 x 21 = 1890 kJ = 451.7 kcal.

7. A 400 m run needs 600 kJ of energy: the ATP-PC system supplies 25%, the lactic system 45% and the aerobic system 30%. (a) Find the energy from each system. (b) Explain why speed falls in the later part of the run.

Answer: (a) ATP-PC 150 kJ, lactic 270 kJ, aerobic 180 kJ. (b) ATP-PC stores last only about 10 seconds; glycolysis then dominates and the build-up of hydrogen ions and lactate causes fatigue and a drop in power.

8. Maximal heart rate is 200 bpm, resting heart rate 60 bpm and exercise heart rate 160 bpm. Use the Karvonen formula to find the percentage of heart rate reserve.

Answer: Percentage of reserve = (160 - 60) / (200 - 60) x 100 = 100 / 140 x 100 = 71.4%.

Part 3: Biomechanics and Levers (16 marks)

Name the class of lever and show your calculation.

9. A force of 200 N acts at a moment arm of 0.35 m. Find the torque.

Answer: Torque = 200 x 0.35 = 70.0 N m.

10. A heel raise is a second-class lever with an effort arm of 0.12 m and a resistance arm of 0.04 m; body weight gives a 300 N resistance. (a) Find the mechanical advantage. (b) Find the muscle force required.

Answer: (a) Mechanical advantage = 0.12 / 0.04 = 3.0. (b) Muscle force = 300 / 3.0 = 100 N, so the lever favours force.

11. Elbow flexion is a third-class lever: the effort arm is 0.04 m, the resistance arm is 0.32 m and a 120 N load is held. (a) Find the mechanical advantage. (b) Find the muscle force required.

Answer: (a) Mechanical advantage = 0.04 / 0.32 = 0.125. (b) Muscle force = 120 / 0.125 = 960 N; the lever trades force for speed of movement.

12. The base of support has a half-width of 0.15 m and the centre of gravity is 1.05 m high. The angle of stability is theta = arctan(0.15 / 1.05). Find theta.

Answer: theta = arctan(0.1429) = 8.13 degrees; a larger angle of stability resists toppling better.

Part 4: Training Principles and Load (18 marks)

Show your working and state the units.

13. A student has a 1RM bench press of 80 kg and trains at 75% 1RM for 3 sets of 10 repetitions. (a) Find the training load. (b) Find the total number of repetitions. (c) Find the training volume in kilograms.

Answer: (a) 80 x 75% = 60 kg. (b) 3 x 10 = 30 repetitions. (c) Volume = 60 x 30 = 1800 kg.

14. For a 16-year-old athlete, maximal heart rate is estimated as 220 - age and resting heart rate is 56 bpm. Use the Karvonen formula to find the target heart rates at 60% and 80% of heart rate reserve.

Answer: Maximal heart rate = 220 - 16 = 204; reserve = 204 - 56 = 148. 60% target = 56 + 0.6 x 148 = 144.8 bpm; 80% target = 56 + 0.8 x 148 = 174.4 bpm.

15. Weekly training volume rises by 10% in each of three consecutive weeks, starting from 1,000 units. (a) Find the cumulative percentage increase after three weeks. (b) Find the volume after three weeks.

Answer: (a) 1.1^3 = 1.331, a cumulative increase of 33.1%. (b) 1000 x 1.331 = 1331 units.

16. A programme of 5 sessions of 90 minutes per week is reduced to 4 sessions per week. (a) Find the weekly training hours before and after. (b) Find the percentage reduction.

Answer: (a) From 5 x 1.5 = 7.5 hours to 4 x 1.5 = 6.0 hours. (b) Reduction = 20.0%, typical of a taper.

Part 5: Sports Psychology and Skill Learning (16 marks)

Refer to the data and justify your judgement briefly.

17. Five reaction time trials give 0.28, 0.31, 0.30, 0.29 and 0.32 seconds. (a) Find the mean. (b) Find the range.

Answer: (a) Mean = 0.30 s. (b) Range = 0.32 - 0.28 = 0.04 s.

18. A player scores 38 out of 50 shots. (a) Find the success rate. (b) State whether shooting is open-loop or closed-loop control.

Answer: (a) Success rate = 38 / 50 x 100 = 76%. (b) Shooting relies on visual feedback to correct force and angle, so it is closed-loop control.

19. Free-throw success rises from 60% to 75%. (a) Find the increase in percentage points. (b) Find the relative increase.

Answer: (a) An increase of 15 percentage points. (b) Relative increase = 15 / 60 x 100 = 25.0%.

20. Twenty practice trials are performed in 4 blocks. (a) Find the trials per block. (b) If only 2 blocks are used, find the trials per block and explain one benefit of distributed practice.

Answer: (a) 20 / 4 = 5 trials. (b) 20 / 2 = 10 trials; rest intervals in distributed practice allow memory consolidation, giving better long-term retention.

Part 6: Sports Nutrition and Hydration (18 marks)

Show your working and round sensibly.

21. A 16-year-old male weighs 65 kg and is 170 cm tall. Basal metabolic rate BMR = 10m + 6.25h - 5a + 5 (m in kg, h in cm, a in years). (a) Find the BMR. (b) With an activity factor of 1.7, find the total daily energy expenditure.

Answer: (a) BMR = 650 + 1062.5 - 80 + 5 = 1637.5 kcal. (b) Total energy = 1637.5 x 1.7 = 2783.8 kcal.

22. Carbohydrate supplies 60% of the total daily energy and provides 4 kcal per gram. Find the daily carbohydrate intake in grams.

Answer: Energy from carbohydrate = 2783.8 x 0.6 = 1670.2 kcal; intake = 1670.2 / 4 = 417.6 g.

23. Body mass is 68.0 kg before exercise and 66.4 kg after. (a) Find the mass lost in kg and as a percentage of body mass. (b) Replacing 1.5 L per kg lost, find the recommended fluid intake.

Answer: (a) Loss = 68.0 - 66.4 = 1.6 kg, that is 2.35% of body mass. (b) Fluid = 1.6 x 1.5 = 2.4 L.

24. A sports drink contains 6% carbohydrate and 40 mmol/L sodium. A 500 mL bottle is drunk. (a) Find the carbohydrate taken in grams. (b) Find the sodium taken in mmol.

Answer: (a) 500 x 6% = 30 g. (b) 40 x 0.5 = 20 mmol.