# S6 Physical Education Practice Paper

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

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## Part 1: Energy Systems and ATP Supply

**Study the data below and answer the questions, showing all steps.**

**1. A sprinter produces 21 kJ of mechanical work in a 30 s maximal sprint with a peak power of 1200 W; his sustainable aerobic power is 250 W. Find average power, peak-to-average ratio, how many times the aerobic power the average is, and name the dominant energy system.**

**Answer:** Average power = 21000 / 30 = 700 W; peak-to-average = 1.71; the average is 2.8 times the aerobic sustainable power. A 30 s all-out effort is lactic-system dominant (the ATP-PCr store lasts only about 10 s), and the wide peak-to-average gap shows power decaying over time, so sprint training should target sustaining power rather than a single peak.

**2. Per glucose molecule the aerobic system yields 30 ATP net and anaerobic glycolysis yields 2 ATP net; complete oxidation releases 2,870 kJ/mol and each mole of ATP hydrolysis delivers 30.5 kJ. Find the ATP yield ratio and the aerobic energy efficiency.**

**Answer:** Yield ratio = 30 / 2 = 15.0 times. Usable energy = 915.0 kJ/mol; efficiency = 915.0 / 2,870 x 100% = 31.88%. The remaining ~68% is lost as heat, which is why the aerobic system yields much energy but at low power, while the anaerobic systems yield little ATP very quickly.

**3. A 400 m runner expends 260 kJ in total, 25% of it aerobically. Find the aerobic and anaerobic contributions in kJ and the oxygen volume needed for the aerobic part (20.9 kJ per litre O2).**

**Answer:** Aerobic = 65 kJ, anaerobic = 195 kJ. Oxygen needed = 65 / 20.9 = 3.11 L. The anaerobic share relies on glycolysis with lactate accumulation, which limits late-race speed, so 400 m pacing must avoid exhausting the anaerobic reserve too early.

**4. The same runner shows 4.5 L of excess post-exercise oxygen consumption (EPOC). At 20.9 kJ per litre, find the extra energy cost and its share of the total race energy expenditure.**

**Answer:** EPOC energy = 94.05 kJ, or 36.17% of the race total. EPOC pays for restoring phosphocreatine, clearing lactate, and returning temperature and heart rate to rest; it is a real post-training cost and the basis of the afterburn effect, but it is not a major fat-loss tool in itself.

## Part 2: Fitness Testing and VO2max

**Study the test results below and answer the questions, showing all steps.**

**5. A student weighs 68 kg and is 1.72 m tall. Find the BMI, state the class, and give one limitation of using BMI for athletes.**

**Answer:** BMI = 68 / 1.72^2 = 22.99, within the normal band (18.5-22.9 for Asian adults). Limitation: BMI uses only mass and height and cannot separate muscle from fat, so a muscular athlete can be misclassified as overweight; body-fat percentage and waist girth are needed alongside it.

**6. A student covers 2800 m in the Cooper 12-minute run. Using VO2max = (distance - 504.9) / 44.73, estimate his maximal oxygen uptake and convert it to METs (1 MET = 3.5 ml/kg/min).**

**Answer:** VO2max = (2800 - 504.9) / 44.73 = 51.31 ml/kg/min; METs = 51.31 / 3.5 = 14.66. This is an above-average value for his age (about 45-55), and the field test carries roughly +/-10% error; a graded treadmill test is needed for precision.

**7. A student aged 18 has a resting heart rate of 58 bpm. Use the Karvonen formula to find the target heart rates at 70% and 85% intensity.**

**Answer:** HRmax = 220 - 18 = 202 bpm; heart-rate reserve = 144. At 70%: 58 + 0.70 x 144 = 158.8 bpm; at 85%: 180.4 bpm. Karvonen uses the reserve rather than a flat percentage of HRmax, so it better reflects individual resting rates; 70% is the aerobic base zone and 85% sits near the lactate threshold.

**8. The student has 17.65% body fat at 68 kg. If the target is 15% body fat with lean mass unchanged, find the target body mass and the fat to lose.**

**Answer:** Fat mass = 12 kg; lean mass = 56 kg. Target mass = 56 / (1 - 0.15) = 65.88 kg, so 2.12 kg of fat must be lost. Loss should be capped at 0.5-1% of body mass per week with adequate protein and resistance training to protect lean mass.

## Part 3: Training Principles and Progressive Overload

**Study the training programme below and answer the questions, showing all steps.**

**9. An athlete has a 80 kg squat 1RM. The coach prescribes 75% 1RM for 5 sets of 8. Find the load used and the total volume load.**

**Answer:** Load = 60 kg; reps = 40; volume load = 2,400 kg. At 75% 1RM about 10 reps are possible, so 8 reps sits in the strength-hypertrophy zone; tracking volume load captures the real stimulus better than load alone, which matters when planning progression.

**10. If 1RM rises 5% per week for 6 consecutive weeks from 80 kg, find the week-6 1RM and the total gain.**

**Answer:** 1RM = 80 x (1 + 0.05)^6 = 107.21 kg, a gain of 27.21 kg. Compounding the increase instead of adding a flat 5 kg each week avoids oversized jumps later; linear progression suits novices, while advanced lifters need periodisation and deload weeks.

**11. A runner covers 30 km in week 1 and follows the 10%-per-week rule. Find the week-4 weekly distance and the increase over week 1.**

**Answer:** Week 4 = 30 x 1.1^3 = 39.93 km, an increase of 9.93 km (33.1%). The 10% rule is a heuristic, not a hard cap: if intensity also rises the volume increase should be smaller, with a deload every 3-4 weeks.

**12. The runner trains 75 minutes per session at RPE 7 (out of 10), 4 sessions per week. Find session and weekly load in arbitrary units (AU), and the mileage when weekly distance is halved for a taper (39.93 km).**

**Answer:** Session load = 7 x 75 = 525 AU; weekly = 2,100 AU; tapered distance = 39.93 x 0.5 = 19.97 km. sRPE merges duration and intensity into one number that is easy to monitor, and a taper should cut volume while keeping intensity to preserve race feel.

## Part 4: Skill Learning and Sport Psychology

**Study the experiment data below and answer the questions, showing all steps.**

**13. A student has a simple reaction time of 0.22 s. With 4 choice stimuli the reaction time follows RT = 0.15 + 0.09 x log2(n+1). Find the choice reaction time and the difference.**

**Answer:** log2(4+1) = 2.3219; RT = 0.359 s, a difference of 0.139 s. This is Hick law: decision time rises logarithmically with the number of choices. Training shortens but cannot remove it, so tactics should reduce simultaneous options.

**14. A student completes 20 sessions of 45 minutes. Find the total practice hours; if the massed-practice group retains 80% after a week and the distributed group 65%, find the gap.**

**Answer:** Total = 900 minutes = 15 hours; the gap is 15 percentage points in favour of massed practice in this data set. Note that equal practice time usually favours distributed practice (spacing effect), so short frequent sessions with sleep between them are preferred for skill retention.

**15. A student scores 40 of 50 free throws. Find the success rate; the coach gives delayed (5 s) knowledge of results after each attempt. Explain the difference between KR and knowledge of performance and give one guideline for using feedback.**

**Answer:** Success rate = 80%. KR states the outcome (in or out) while KP describes the movement pattern (release angle, elbow position). Guideline: give frequent, specific KP early in learning, then fade feedback frequency to avoid dependency (guidance hypothesis), keeping the delay so learners self-detect errors.

**16. Two groups train 24 sessions: the blocked group does 8 blocked then 16 random sessions, the random group all random. After a week the random group retains 72% and the blocked group 58%. Find the gap and explain the difference between performance during practice and learning.**

**Answer:** Gap = 14 percentage points. Performance is what is visible during practice; learning is a durable change in capability. Random practice looks worse in practice yet retains better (contextual interference), so training methods must be judged on delayed retention tests, not immediate performance.

## Part 5: Injury Prevention, Heat and Hydration

**Study the monitoring data below and answer the questions, showing all steps.**

**17. A player loses 2.1 kg over a 90-minute session (no fluid intake). Find the sweat rate per hour and the rehydration target at 150% of the loss.**

**Answer:** Sweat rate = 1400 mL/h; rehydration target = 3.15 L. Fluid should be spread over 2-4 hours after exercise with electrolytes included, since a single large drink raises urine output and delays rehydration.

**18. On match day WBGT reaches 32 C with 85% relative humidity. Using common heat guidelines (cancel or postpone above 32 C WBGT), decide whether play should proceed and give two risk-reduction measures.**

**Answer:** WBGT of 32 C exceeds the 32 C cancel threshold, so play should not proceed. Measures: shift to early morning or evening with extra breaks and fluid access, and set up cooling stations (ice-water hand immersion, cold towels) with 10-14 days of heat acclimatisation. WBGT combines temperature, humidity and radiant heat, so it beats air temperature alone.

**19. A player is diagnosed with concussion and must follow a 6-stage return-to-play protocol with at least 24 hours per stage. Find the minimum days to return to match play and state what to do if symptoms appear.**

**Answer:** Minimum = 6 days (excluding the initial rest period). Any symptom recurrence means stepping back a stage and extending observation; stages must never be combined in one day, and youth cases should be managed more conservatively. Clearance is a medical decision, not a coach call.

**20. A footballer has 42 Nm hamstring and 75 Nm quadriceps eccentric strength. Find the H:Q ratio; if the target is 0.60, find the hamstring strength needed and the injury-risk implication.**

**Answer:** H:Q = 0.56; target hamstring strength = 45 Nm, so 3 Nm must be added. A low ratio means the hamstrings are relatively weak, leaving them exposed to high eccentric loads in sprinting and deceleration, a known risk factor for hamstring strain; Nordic hamstring curls and periodic retesting are indicated.

## Part 6: Sport Policy and Resource Efficiency

**Study the policy data below and answer the questions, showing all steps.**

**21. A district of 300 thousand residents has 45 thousand who exercise at least once a week. Find the participation rate and name one structural barrier to raising it.**

**Answer:** Participation rate = 15%. A structural barrier is facility supply mismatched to available hours (working adults can only use evenings) plus cross-district travel cost; promotion alone cannot move the number without more community facilities and flexible opening hours.

**22. A grant of HK$120 million is split 50/30/20 among elite training, community sport and school sport. Find each amount.**

**Answer:** Elite = HK$60 million; community = HK$36 million; school = HK$24 million; total HK$120 million. Allocation trades equity against measurable success: elite funding concentrates returns with visible medals, while community and school sport reach more people with health benefits that are harder to quantify.

**23. An event draws 25,000 spectators at HK$450, with HK$380 extra local spending per head and a multiplier of 1.9; hosting costs HK$8 million. Find direct revenue, total economic impact, net benefit and the benefit-cost ratio.**

**Answer:** Gate = HK$11.25 million; extra spend = HK$9.50 million; total impact = HK$39.42 million; net = HK$31.43 million; BCR = 4.93. Multipliers only count new spending, so a mainly local crowd whose spending would have happened anyway makes the real net benefit smaller than the headline figure.

**24. A sports centre has 12 courts open 14 hours a week at 85% utilisation, with annual running costs of HK$3.12 million. Find the available court-hours per week, per year, and the cost per used hour.**

**Answer:** Per week = 142.8 court-hours; per year = 7,425.6; cost per used hour = HK$420.17. Each 1 percentage point gain in utilisation lowers the cost per hour, so filling off-peak slots is more cost-effective than building new facilities.

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