

# PRACTICE EXAM 8: CSCS FULL-LENGTH SIMULATION

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## SECTION 1 — SCIENTIFIC FOUNDATIONS

95 Questions | 1.5 Hours Recommended

### EXERCISE SCIENCE (Questions 1–52)

1. A strength and conditioning specialist is reviewing research on fiber type transitions in response to chronic training. An untrained individual has a muscle biopsy showing 25% Type IIx fibers. After 20 weeks of combined heavy resistance training and sprint intervals, the repeat biopsy shows only 6% Type IIx with a proportional increase in Type IIa. This transition occurred because of which well-documented adaptive mechanism?

- A. Direct conversion of Type IIx to Type I through a single-step phenotypic transformation
- B. The loss of Type IIx fibers through apoptosis and replacement by entirely new Type IIa fibers
- C. Chronic training promotes the conversion of the most fatigable Type IIx fibers to the more oxidative, fatigue-resistant Type IIa phenotype within the Type II fiber spectrum
- D. Type IIx fibers migrated from the trained muscle to untrained muscles through the bloodstream

2. During excitation-contraction coupling, an action potential traveling along the sarcolemma must reach the sarcoplasmic reticulum deep within the muscle fiber to trigger calcium release. The specialized membrane structures that conduct this signal from the surface to the interior of the fiber are called which of the following?

- A. Transverse tubules (T-tubules) — invaginations of the sarcolemma that carry the action potential inward to the triads where they communicate with the sarcoplasmic reticulum
- B. Mitochondrial cristae that fold inward from the outer mitochondrial membrane
- C. Myosin heads that transmit electrical signals along the thick filament

D. Z-lines that conduct voltage from one sarcomere to the next in series

3. A 22-year-old male athlete performs a maximal voluntary contraction (MVC) on an isokinetic dynamometer. EMG analysis reveals that the athlete can voluntarily activate approximately 70% of the available motor unit pool. After 16 weeks of heavy resistance training (85-95% 1RM), repeat testing shows voluntary activation has increased to 90%. This 20% improvement is primarily explained by which neural adaptation?

A. Complete structural regeneration of all motor neurons innervating the trained muscle group

B. Reduced neural inhibition from the Golgi tendon organ and improved central drive allowing greater motor unit recruitment and firing frequency

C. Elimination of all Type I fibers leaving only Type IIx fibers that activate more easily

D. A measurement artifact from the EMG equipment requiring recalibration after 16 weeks

4. The force-velocity relationship for concentric muscle actions demonstrates that as contraction velocity increases, the maximum force a muscle can produce decreases. An athlete performing a jump squat at 30% of 1RM operates at the high-velocity end of this curve, while a heavy back squat at 90% 1RM operates at the high-force end. Which training variable — load — determines where on the force-velocity curve the athlete is training?

A. The percentage of maximal heart rate achieved during the exercise set

B. The ambient temperature in the training facility during the exercise session

C. The number of hours since the athlete's last meal before training

D. The external load as a percentage of 1RM — lighter loads allow higher velocities (speed end), heavier loads produce greater force at slower velocities (strength end), and moderate loads at moderate velocities target the power zone

5. Henneman's Size Principle predicts orderly motor unit recruitment from smallest to largest as force demand increases. A strength and conditioning specialist prescribes heavy back squats at 90% of 1RM specifically because this load ensures activation of which motor units that would not be recruited at lighter loads?

- A. Only the smallest, lowest-threshold motor units innervating Type I fibers
- B. Motor units are recruited randomly regardless of load, so all loads activate the same units
- C. The highest-threshold motor units innervating Type IIa and IIx fibers, which are only activated when force demands approach 80-85% or more of maximal voluntary contraction
- D. Only gamma motor neurons that innervate intrafusal fibers within the muscle spindle

6. An exercise physiologist measures an athlete's blood lactate during a graded cycling test. At 175 watts, lactate is 1.4 mmol/L. At 225 watts, 2.1 mmol/L. At 250 watts, 5.3 mmol/L. At 275 watts, 9.1 mmol/L. The exponential rise between 225 and 250 watts identifies which physiological marker?

- A. The lactate threshold — the intensity where lactate production begins exceeding the body's capacity to clear it, marking the transition from sustainable to unsustainable metabolic conditions
- B. The absolute  $\text{VO}_2\text{max}$  ceiling beyond which no further oxygen consumption is possible
- C. The phosphocreatine recovery threshold below which PCr cannot regenerate during exercise
- D. The complete depletion of all intramuscular glycogen stores at this specific workload

7. A strength and conditioning specialist is programming interval training for a group of 400-meter sprinters whose races last approximately 45-55 seconds at near-maximal intensity. The dominant energy system for this event duration and intensity is which of the following?

- A. Exclusively the phosphagen system for the entire 45-55 second duration
- B. The glycolytic system, which provides the dominant ATP contribution during sustained near-maximal efforts lasting 30 seconds to approximately 2-3 minutes
- C. Exclusively the oxidative system through aerobic fat metabolism at this race intensity
- D. Beta-oxidation of intramuscular triglycerides as the sole energy pathway for the 400 meters

8. A trained endurance runner with a  $\text{VO}_2\text{max}$  of 65 mL/kg/min has a lactate threshold at 78% of  $\text{VO}_2\text{max}$ . An untrained recreational jogger with a  $\text{VO}_2\text{max}$  of 40 mL/kg/min has a lactate threshold at 52% of  $\text{VO}_2\text{max}$ . The trained runner's higher lactate threshold percentage reflects which combination of physiological adaptations?

- A. Decreased mitochondrial density and reduced oxidative enzyme activity in the trained runner
- B. Complete elimination of all fast-twitch fibers through endurance training
- C. Reduced capillary density and impaired oxygen delivery to the working muscles
- D. Increased mitochondrial density, enhanced oxidative enzyme activity, greater capillary networks, and improved fat oxidation — all reducing the muscle's reliance on glycolysis at any given workload

9. During a graded exercise test, an athlete's  $\text{VO}_2$  increases linearly with each stage from rest through 8 stages. At stage 9,  $\text{VO}_2$  reaches 58 mL/kg/min and does not increase at stage 10 or 11 despite continued workload increases. RER is 1.20, blood lactate is 14 mmol/L, and heart rate is within 3 bpm of age-predicted maximum. These findings confirm which physiological measure?

- A. The lactate threshold at 58 mL/kg/min marking the onset of blood lactate accumulation
- B. The ventilatory threshold at 58 mL/kg/min indicating the onset of hyperventilation
- C.  $\text{VO}_2\text{max}$  — the absolute ceiling of aerobic energy production, confirmed by the  $\text{VO}_2$  plateau despite increasing workload with supporting secondary criteria (elevated RER, high lactate, near-maximal HR)
- D. Resting metabolic rate measured under graded exercise conditions on the treadmill

10. The electron transport chain (ETC) on the inner mitochondrial membrane is responsible for producing approximately 34 of the 36-38 total ATP molecules generated per glucose molecule during complete aerobic oxidation. The ETC requires which molecule as the final electron acceptor to function?

- A. Oxygen — which combines with electrons and hydrogen ions to form water; without it, the chain halts and aerobic ATP production ceases entirely
- B. Carbon dioxide produced by the Krebs cycle and recycled back into the ETC
- C. NADH, which is the final product of the chain rather than an input substrate
- D. Lactate, which provides electrons directly to Complex I of the electron transport chain

11. Fat oxidation through beta-oxidation produces approximately 129 ATP per molecule of palmitate compared to 36-38 from glucose. Despite this enormous yield advantage, fat cannot serve as the primary fuel during high-intensity exercise because of which physiological constraint?

- A. Fat stores are physically too small to contribute any meaningful energy during exercise
- B. The rate of ATP production from fat oxidation is too slow to match the rapid energy demand of high-intensity exercise — carbohydrate pathways produce ATP at a faster rate despite lower total yield
- C. Fat molecules cannot enter mitochondria under any metabolic condition during exercise
- D. Fat oxidation produces toxic metabolic waste that directly damages the contractile proteins

12. An athlete performs a 3-hour training ride at 65% of  $\text{VO}_2\text{max}$ . During the final 45 minutes, performance declines significantly and the athlete reports difficulty maintaining pedal cadence. Blood glucose measured at this point is 50 mg/dL. This late-ride performance decline is most directly caused by which metabolic event?

- A. Complete depletion of phosphocreatine stores from the sustained moderate-intensity cycling effort
- B. Excessive protein catabolism destroying half of the cyclist's muscle mass during the ride
- C. Hydrogen ion accumulation from anaerobic glycolysis during the steady-state moderate-intensity effort
- D. Progressive glycogen depletion in the muscles and liver combined with hypoglycemia, leaving insufficient carbohydrate substrate to maintain the exercise intensity

13. The Krebs cycle occurs in the mitochondrial matrix and produces NADH,  $\text{FADH}_2$ , a small amount of ATP/GTP, and  $\text{CO}_2$ . The NADH and  $\text{FADH}_2$  produced by the Krebs cycle are functionally important because they serve which role in aerobic energy production?

- A. They are excreted as metabolic waste products with no further energy contribution
- B. They directly produce muscular force by binding to the myosin heads during contraction
- C. They deliver electrons to the electron transport chain, which uses the electron energy to pump protons and drive ATP synthase for the production of the majority of aerobic ATP
- D. They are converted directly into phosphocreatine for the phosphagen energy system

14. A strength and conditioning specialist prescribes 6-second maximal sprints with 4-minute passive rest between efforts for a team of 100-meter sprinters. The extended rest interval is prescribed specifically to allow which metabolic process to occur?

- A. Near-complete phosphocreatine resynthesis — PCr requires 3-5 minutes for full recovery, and adequate PCr ensures maximal ATP-PC energy for each subsequent sprint to maintain training quality and specificity
- B. Complete glycogen resynthesis in all working muscles between 6-second sprint efforts
- C. Blood lactate reduction to exactly zero mmol/L before the next sprint can begin
- D. Conversion of the oxidative system to the dominant energy pathway for subsequent sprints

15. Newton's Second Law ( $F = ma$ ) states that acceleration is proportional to net force and inversely proportional to mass. A 95 kg athlete produces a peak vertical ground reaction force of 2,800 N during a vertical jump. The gravitational force on the athlete is approximately 932 N ( $95 \times 9.81$ ). The net upward force and resulting acceleration are which of the following?

- A. Net force = 2,800 N because gravitational force does not need to be subtracted from the GRF
- B. Net force = 1,868 N upward ( $2,800 - 932$ ); acceleration  $\approx 19.7 \text{ m/s}^2$  ( $1,868 \div 95$ ) — only force exceeding body weight produces upward acceleration
- C. Net force = 0 N because the GRF exactly matches gravitational force throughout the jump
- D. Acceleration cannot be calculated from force and mass measurements

16. A biomechanical analysis of a barbell deadlift reveals that the moment arm of the external load relative to the lumbar spine is greatest at approximately knee height when the torso is inclined forward. At this position, the horizontal distance between the barbell and the L4-L5 vertebral segment reaches its maximum. This creates the sticking point because of which biomechanical principle?

- A. The quadriceps reach their shortest length at knee height and can no longer produce force
- B. The athlete's grip always fails at exactly the knee-height position regardless of grip training
- C. Heart rate peaks at the knee-height position causing cardiovascular failure during the deadlift

D. Torque = force  $\times$  moment arm — the maximum moment arm at this position creates the greatest flexion torque demand on the hip and back extensors

17. During a standing biceps curl, the muscle must produce force many times greater than the external load due to the third-class lever arrangement at the elbow joint. The biceps inserts on the radial tuberosity close to the elbow joint (short effort arm), while the dumbbell is held far from the joint (long resistance arm). This lever arrangement favors which mechanical outcome?

- A. Force amplification because the effort arm is always longer than the resistance arm
- B. Equal force and speed because the effort and resistance arms are always identical lengths
- C. Speed and range of motion at the distal end of the lever at the expense of force — a small amount of muscle shortening produces a large movement at the hand
- D. Neither force nor speed because third-class levers have zero mechanical advantage

18. A strength and conditioning specialist evaluates two athletes of identical body weight (80 kg) during vertical jump testing on a force plate. Both produce 2,800 N of peak ground reaction force. Athlete A reaches peak force in 130 milliseconds while Athlete B reaches peak force in 260 milliseconds. Despite identical peak force, Athlete A achieves a significantly higher vertical jump. This performance difference is explained by which physical quality?

- A. Superior rate of force development in Athlete A — reaching the same peak force in half the time produces a greater impulse during the limited ground contact, resulting in higher takeoff velocity and jump height
- B. Greater absolute maximal strength in Athlete A despite the identical peak force values
- C. Superior aerobic capacity in Athlete A providing more oxidative energy during the jump
- D. Greater flexibility in Athlete A allowing a deeper countermovement that increased contact time

19. The stretch-shortening cycle (SSC) enhances concentric force production during a countermovement jump through three recognized mechanisms. An athlete performs a CMJ achieving 64 cm and a static squat jump achieving 53 cm — an 11 cm difference. This 11 cm represents the combined contribution of which three mechanisms?

- A. Increased aerobic energy production, enhanced blood flow, and improved thermoregulation
- B. Stored elastic energy in the musculotendinous unit, the stretch reflex from muscle spindle activation, and increased time for force development during the eccentric phase
- C. Phosphocreatine super-compensation, glycogen loading, and enhanced beta-oxidation
- D. Cardiac output increase, blood pressure elevation, and vasodilation during the countermovement

20. The Golgi tendon organ (GTO) located at the musculotendinous junction detects changes in muscle tension. When tension reaches a threshold, the GTO produces autogenic inhibition through an inhibitory interneuron, reducing alpha motor neuron activity to the same muscle. In PNF stretching, the contract-relax technique exploits this mechanism by first isometrically contracting the target muscle for 6 seconds before stretching it. The greater subsequent stretch occurs because of which neurological event?

- A. The stretch reflex is amplified producing maximal contraction rather than relaxation
- B. Permanent structural elongation of the muscle fibers from the isometric contraction
- C. Reciprocal inhibition from the antagonist muscle rather than autogenic inhibition from the GTO
- D. The GTO's inhibitory signal reduces alpha motor neuron activity to the target muscle, temporarily decreasing its tone and resistance to stretch

21. During a plyometric depth jump, the amortization phase — the transition between eccentric landing and concentric takeoff — must be minimized. If this phase exceeds approximately 250 milliseconds, stored elastic energy dissipates as heat and the stretch reflex contribution diminishes. An athlete performing depth jumps demonstrates ground contact times increasing from 160 ms to 340 ms by the sixth repetition. The strength and conditioning specialist should respond by doing which of the following?

- A. Terminating the exercise immediately because the athlete is fatiguing, contact time has doubled, and the SSC benefit is lost — continuing trains degraded movement patterns with no power development benefit
- B. Increasing the box height to 100 cm to force faster transitions under greater eccentric load
- C. Adding ankle weights to increase the eccentric stimulus on subsequent repetitions
- D. Continuing to 15 repetitions because plyometric adaptations require accumulated fatigue

22. Research on elite sprinters demonstrates that at maximum velocity (typically 30-60 meters), ground contact times are approximately 80-100 milliseconds. The ground reaction force component that most consistently distinguishes faster sprinters from slower sprinters at top speed is which of the following?

- A. The anteroposterior component that pushes the sprinter backward to increase stride length
- B. The mediolateral component that provides side-to-side stability during single-leg support
- C. The vertical component — faster sprinters apply greater vertical force relative to body weight during the brief ground contact phase
- D. All three components contribute equally with no single component more distinguishing than the others

23. During the acceleration phase of a sprint (first 10-30 meters), the athlete's body should be in a pronounced forward lean. This body position allows the athlete to direct ground reaction forces in which manner?

- A. Vertically upward to maximize flight time between each stride during early acceleration
- B. Primarily horizontally backward against the ground, producing the forward-directed reaction force needed to overcome inertia and generate forward momentum from the stationary start
- C. Mediolaterally to establish side-to-side balance before reaching maximum velocity
- D. In a random direction because body lean has no effect on GRF direction during sprinting

24. Chronic endurance training produces eccentric cardiac hypertrophy (enlarged left ventricular chamber), while chronic resistance training produces concentric cardiac hypertrophy (thickened ventricular wall). A strength and conditioning specialist should understand that eccentric hypertrophy enhances endurance performance primarily through which mechanism?

- A. Decreased maximal stroke volume requiring higher heart rates to maintain cardiac output
- B. Increased resting blood pressure that enhances oxygen delivery at submaximal intensities
- C. Reduced blood volume that decreases the workload on the heart during maximal exercise
- D. Increased maximal stroke volume because the larger chamber fills with more blood during diastole and ejects more per beat during systole — the primary mechanism for increasing maximal cardiac output

25. During moderate-intensity aerobic exercise, blood flow to working muscles increases from approximately 15-20% of cardiac output at rest to 80-85% during maximal effort. In the working muscles specifically, this local vasodilation is triggered by which combination of metabolic signals?

- A. Increased local concentrations of CO<sub>2</sub>, decreased O<sub>2</sub>, elevated temperature, and accumulation of metabolic byproducts (adenosine, potassium, hydrogen ions) that directly relax vascular smooth muscle
- B. Increased sympathetic nervous system activity causing vasoconstriction in the working muscles
- C. Decreased cardiac output that concentrates the reduced blood volume in active tissue
- D. Increased blood viscosity that forces blood into the contracting skeletal muscle tissue

26. An athlete's training protocol consists of 5 exercises, 4 sets of 10 at 70% 1RM with 60-second rest. Compared to a protocol of 5 sets of 2 at 93% 1RM with 5-minute rest, the high-volume, short-rest protocol produces which different acute hormonal response?

- A. Both protocols produce identical hormonal profiles because all resistance training affects hormones equally
- B. The heavy protocol produces greater GH because heavier loads are the primary GH stimulus
- C. Significantly greater acute growth hormone elevation from the high-volume protocol because the short rest periods maximize metabolic stress — elevated lactate, hydrogen ions, and reduced pH — which is the primary stimulus for GH release
- D. Complete suppression of all hormonal responses from both protocols

27. Testosterone levels in males are approximately 10-15 times higher than in females. Despite this substantial hormonal difference, female athletes still achieve meaningful strength gains from resistance training. The primary mechanism by which females improve strength without proportional testosterone-driven hypertrophy is which of the following?

- A. Female athletes compensate by producing 20 times more growth hormone than males
- B. Neural adaptations — improved motor unit recruitment, rate coding, intermuscular coordination, and reduced antagonist co-contraction — account for a larger proportion of strength gains in females
- C. Strength gains in females are entirely attributable to increased flexibility rather than force production

D. Female athletes achieve strength exclusively through increased bone mineral density

28. An athlete's longitudinal blood work over 10 weeks shows progressively declining testosterone, rising cortisol, deteriorating T:C ratio, declining performance, disrupted sleep, elevated resting heart rate, and persistent fatigue. This pattern most strongly indicates which condition?

A. Optimal adaptation indicating the athlete is peaking for their most important competition

B. Normal hormonal fluctuation that occurs during every training cycle and requires no action

C. Excessive carbohydrate consumption causing permanent metabolic dysfunction

D. Overtraining syndrome — chronic imbalance between cumulative training stress and recovery capacity producing systemic hormonal disruption, performance decline, and maladaptive symptoms

29. Insulin-like growth factor-1 (IGF-1) produced locally within skeletal muscle in response to mechanical loading activates satellite cells and stimulates muscle protein synthesis through the mTOR signaling pathway. The locally produced variant is called mechano-growth factor (MGF). The mTOR pathway is functionally significant because it integrates signals from which combination of inputs to regulate protein synthesis?

A. Mechanical loading (via IGF-1/MGF), amino acid availability (particularly leucine), and hormonal stimulation (insulin, IGF-1) — the central intracellular regulator determining the rate of new protein production

B. Only oxygen delivery to the mitochondria during aerobic exercise at moderate intensity

C. Only blood lactate concentration during high-intensity glycolytic exercise

D. Only bone mineral density changes in response to impact loading on the skeleton

30. According to Wolff's Law, bone remodels in response to the mechanical stresses placed upon it. A physician recommends exercise for a 62-year-old woman diagnosed with osteopenia. Based on Wolff's Law, which exercise prescription provides the greatest osteogenic stimulus for increasing bone mineral density?

A. Aquatic exercise in chest-deep water with buoyancy eliminating all gravitational loading

- B. Recumbent cycling at very low intensity for 45 minutes three times per week
- C. Ground-based, weight-bearing resistance exercises (squats, deadlifts, weighted lunges) with impact activities (walking, stair climbing), applying compressive and impact forces directly to the weight-bearing skeleton
- D. Seated upper body machine exercises with very light resistance and 30 repetitions per set

31. A strength and conditioning specialist compares two athletes with identical 1RM back squat values of 190 kg. In vertical jump testing, Athlete A achieves 70 cm while Athlete B achieves 54 cm — a 16 cm difference despite identical maximal strength. This performance gap is most likely explained by which physical quality?

- A. Greater absolute strength in Athlete A despite the identical stated 1RM values
- B. Superior rate of force development and power output in Athlete A — the ability to produce force rapidly during the brief ground contact time of a jump, translating equal maximal strength into superior explosive performance
- C. Greater aerobic capacity in Athlete A providing oxidative energy during the 0.3-second jump
- D. Superior flexibility in Athlete A allowing excessive countermovement depth that extends contact time

32. A 16-week training study tracks a novice and an experienced lifter on the same resistance program. The novice improves bench press 1RM by 42% with minimal hypertrophy. The experienced lifter improves only 4% but shows measurable pectoral hypertrophy. This two-phase adaptation pattern demonstrates which training principle?

- A. The novice is using performance-enhancing substances unavailable to the experienced lifter
- B. Both athletes should produce identical adaptation rates regardless of training experience
- C. The experienced lifter has a medical condition that prevents all neural adaptation
- D. The law of diminishing returns combined with the shift from neural to structural adaptation — novice gains are rapid and neural, while experienced lifters must rely on slower hypertrophic mechanisms for smaller incremental gains

33. Connective tissue structures (tendons, ligaments) adapt to resistance training more slowly than muscle tissue due to lower metabolic activity and blood supply. This differential adaptation rate creates which practical concern for program design?

- A. Rapid muscular strength gains can outpace connective tissue strengthening, creating a window of increased injury risk that requires gradual progressive overload and appropriate recovery
- B. Connective tissue never adapts to training and remains unchanged regardless of loading
- C. Muscle always adapts more slowly than tendons requiring longer recovery for muscle tissue
- D. Connective tissue adaptation is irrelevant to injury risk under any training circumstances

34. The SAID principle (Specific Adaptations to Imposed Demands) predicts that training adaptations are specific to the type of stress applied. A strength and conditioning specialist programs exclusively slow, steady-state jogging at 60% of maximum heart rate for a volleyball player whose sport demands include explosive jumping, rapid lateral movements, overhead hitting power, and repeated anaerobic sprints. This program violates SAID because of which fundamental mismatch?

- A. Slow aerobic training provides all the specificity needed for volleyball at every competitive level
- B. The SAID principle applies only to endurance sports and has no relevance to court sports
- C. The adaptations from slow aerobic training (enhanced oxidative capacity, slow-twitch fiber enhancement) do not provide the specific stimulus needed for the explosive, anaerobic, and multidirectional demands of volleyball
- D. Only flexibility training is relevant to volleyball because it is exclusively a technique-based sport

35. The force-velocity relationship during eccentric muscle actions differs from the concentric relationship. During eccentric actions, force production increases slightly with increasing velocity of lengthening up to a plateau approximately 20-60% above maximal isometric force. This eccentric force advantage has which practical training implication?

- A. Athletes should never perform eccentric training under any circumstances because it always causes injury
- B. Athletes can safely lower loads heavier than their concentric 1RM, forming the basis for supramaximal eccentric training that provides a novel overload stimulus for strength and connective tissue adaptation

- C. Eccentric and concentric force are always identical at every contraction velocity
- D. Eccentric actions produce zero force at all velocities because the muscle is passively stretched

36. Detraining research has established that different physiological qualities decline at different rates when training ceases. The hierarchy from most rapid decline to most resistant is which of the following?

- A. Maximal strength declines first within 24 hours, followed by flexibility within 48 hours
- B. All qualities decline at identical rates regardless of the fitness component involved
- C. Bone mineral density is lost most rapidly within the first week of any detraining period
- D. Aerobic capacity ( $VO_{2max}$ ) declines most rapidly (measurable within 1-2 weeks), followed by muscular endurance, then maximal strength (maintained approximately 2-4 weeks or longer)

37. A strength and conditioning specialist calculates the torque created by a 6 kg dumbbell during a lateral raise. The arm is fully extended at 90 degrees of shoulder abduction, and the distance from the shoulder joint to the dumbbell's center of mass is 0.55 meters. The torque about the shoulder joint is which of the following?

- A. Approximately  $32.4 \text{ N}\cdot\text{m}$ , calculated as  $6 \text{ kg} \times 9.81 \text{ m/s}^2 \times 0.55 \text{ m} = 32.4 \text{ N}\cdot\text{m}$  (mass converted to force, then multiplied by moment arm)
- B. Approximately  $6 \text{ N}\cdot\text{m}$  using only mass without converting to Newtons or applying the moment arm
- C. Exactly  $0 \text{ N}\cdot\text{m}$  because no torque is generated when the arm is at 90 degrees of abduction
- D. Approximately  $150 \text{ N}\cdot\text{m}$  regardless of the dumbbell weight, distance, or joint angle

38. During moderate-intensity aerobic exercise, systolic blood pressure progressively increases while diastolic blood pressure remains relatively stable or slightly decreases. The stable or slightly declining diastolic pressure results from which cardiovascular mechanism?

- A. Increased blood viscosity that maintains constant pressure throughout the cardiac cycle
- B. Decreased cardiac output during the diastolic relaxation phase of each heartbeat

C. Vasodilation in the working muscles reducing total peripheral resistance, which counterbalances the increased cardiac output and prevents diastolic pressure from rising

D. Vasoconstriction in all vascular beds simultaneously increasing peripheral resistance

39. A female collegiate distance runner has been amenorrheic for 7 months, trains 2.5 hours daily, estimates caloric intake at 1,200 calories per day, and has a DEXA scan showing decreased lumbar bone mineral density. She recently suffered a third metatarsal stress fracture. This clinical presentation is most consistent with which condition?

A. Iron deficiency anemia from inadequate dietary heme iron during high-volume training

B. Relative Energy Deficiency in Sport (RED-S) — the interrelationship between chronic low energy availability, menstrual dysfunction, and decreased bone mineral density

C. Normal physiological adaptation to endurance training requiring no medical evaluation

D. Vitamin D toxicity from excessive supplementation causing paradoxical bone demineralization

40. Cortisol is a glucocorticoid released from the adrenal cortex during physical and psychological stress. Its acute metabolic actions during exercise include stimulating protein degradation and gluconeogenesis. These catabolic processes provide which metabolic function during sustained exercise?

A. Directly stimulating muscle protein synthesis through the mTOR signaling pathway

B. Enhancing glycogen synthesis by activating glycogen synthase in skeletal muscle tissue

C. Suppressing all lipolysis to prevent any fat mobilization regardless of exercise intensity

D. Breaking down amino acids from muscle protein to provide substrates for glucose production in the liver, supplying glucose to the brain and other glucose-dependent tissues during stress

41. An athlete's hormonal profile after 12 weeks of well-designed training shows stable resting testosterone, decreased resting cortisol, improved T:C ratio, continued performance gains, and subjective reports of adequate recovery with 8+ hours of nightly sleep. This combined profile indicates which training status?

- A. Successful positive adaptation — stable testosterone with decreased cortisol produces a favorable anabolic-catabolic balance consistent with the positive performance trend and recovery reports
- B. Advanced overtraining syndrome requiring immediate cessation of all training and medical referral
- C. Hormonal disruption from an underlying medical condition unrelated to the training program
- D. The hormonal data provides no meaningful information about the athlete's adaptation status

42. Chronic heavy resistance training increases androgen receptor density in skeletal muscle tissue. The functional significance of this adaptation is which of the following?

- A. Androgen receptor changes have zero effect on the muscle's response to circulating hormones
- B. Increased receptor density completely eliminates the need for adequate sleep and nutrition
- C. Enhanced receptor density increases the muscle's sensitivity to circulating testosterone, potentially amplifying the anabolic signal at the tissue level even without changes in basal circulating hormone concentrations
- D. The adaptation occurs only in untrained individuals and reverses completely after 48 hours

43. An exercise physiologist monitors substrate utilization during a progressive cycling test using respiratory exchange ratio (RER). At 35%  $\text{VO}_2\text{max}$ , RER is 0.76. At 65%  $\text{VO}_2\text{max}$ , RER rises to 0.88. At 90%  $\text{VO}_2\text{max}$ , RER reaches 1.05. The progressive RER increase reflects which metabolic shift?

- A. A constant metabolic rate with zero change in fuel utilization regardless of exercise intensity
- B. A progressive shift from predominantly fat oxidation (RER closer to 0.70) to predominantly carbohydrate oxidation (RER closer to 1.00) as exercise intensity increases — described by the crossover concept
- C. An increase in protein oxidation that raises the  $\text{CO}_2\text{-to-O}_2$  ratio at all exercise intensities
- D. A decrease in all metabolic activity as exercise intensity increases above 50% of  $\text{VO}_2\text{max}$

44. The Cori cycle is a metabolic pathway that recycles lactate produced by working muscles. Lactate travels through the blood to the liver, where it is converted to glucose through gluconeogenesis. This recycled glucose is released back into the blood for use by working muscles and the brain. The Cori cycle is particularly important during sustained exercise because it accomplishes which metabolic function?

- A. Permanently removing lactate as toxic waste that has no further metabolic purpose
- B. Converting lactate directly into fatty acids for long-term storage in adipose tissue
- C. Converting lactate into essential amino acids for immediate muscle protein synthesis
- D. Helping maintain blood glucose levels by recycling lactate into usable glucose, providing continued substrate for the brain (obligatorily glucose-dependent) and working muscles

45. A strength and conditioning specialist explains that the phosphagen system's functional advantage for maximal-effort, short-duration activities is its extremely fast rate of ATP production. This speed exists because the creatine kinase reaction ( $\text{PCr} + \text{ADP} \rightarrow \text{ATP} + \text{Cr}$ ) has which characteristics?

- A. It is a simple, single-step enzymatic reaction occurring directly in the sarcoplasm without requiring oxygen, complex metabolic pathways, or mitochondrial processing — making it the fastest ATP-regenerating system
- B. It requires the most complex series of enzymatic steps of any metabolic pathway
- C. It produces ATP exclusively within the mitochondrial matrix at a rate identical to oxidative phosphorylation
- D. It requires oxygen as an essential co-factor and cannot function under anaerobic conditions

46. A strength and conditioning specialist is analyzing the second-class lever system of the human body. During a standing calf raise, the fulcrum is at the metatarsophalangeal joint (ball of the foot), the resistance (body weight) acts through the ankle joint, and the effort (gastrocnemius/soleus) acts at the calcaneus through the Achilles tendon. This second-class lever arrangement favors which mechanical outcome?

- A. Speed and range of motion at the expense of force production capability
- B. Equal emphasis on force and speed because the effort and resistance arms are always identical

C. Force production — the effort arm is longer than the resistance arm, creating a mechanical advantage greater than one, meaning the muscle can produce movement against greater resistance than in a third-class arrangement

D. Neither force nor speed because second-class levers have zero mechanical advantage

47. An athlete's passive hip flexion is 135 degrees (measured with external force), while active hip flexion is 115 degrees using their own muscular effort. The 20-degree difference between passive and active ROM reflects which principle?

A. A structural bone abnormality at the acetabulum blocking all movement beyond 115 degrees

B. The voluntary muscular effort of the hip flexors cannot move the joint as far as an external force can — the difference reflects the neuromuscular limits of active motion versus the structural limits of passive joint mobility

C. A complete tear of all hip flexor muscles preventing active motion beyond 115 degrees

D. An error in the goniometer used for the passive ROM measurement

48. The muscle spindle is a proprioceptor arranged in parallel with extrafusal fibers within the muscle belly. It detects changes in both muscle length and the rate of length change. During plyometric training, the rapid eccentric stretch upon landing activates the spindle, producing a reflexive contraction through the stretch reflex (myotatic reflex). This reflex has which neural characteristic that makes it the fastest reflex in the body?

A. The stretch reflex requires processing through the cerebral cortex, thalamus, and basal ganglia

B. The stretch reflex involves a complex polysynaptic pathway through multiple spinal cord interneurons

C. The stretch reflex arc is permanently disabled during all types of explosive exercise

D. It is monosynaptic — involving only a single synapse between the afferent sensory neuron and the efferent motor neuron, producing the fastest possible reflexive contraction

49. Chronic heavy resistance training can reduce the GTO's inhibitory influence on maximal voluntary contraction. This neural disinhibition allows trained athletes to do which of the following compared to untrained individuals with similar muscle cross-sectional area?

- A. Voluntarily recruit a greater percentage of their motor unit pool and produce force closer to the true structural capacity of their musculotendinous units — a significant neural contribution to strength gains
- B. Produce greater aerobic power through enhanced mitochondrial density in cardiac muscle
- C. Exhibit slower reaction times due to decreased proprioceptive sensitivity from GTO desensitization
- D. Generate less voluntary force because reduced GTO inhibition paradoxically impairs motor control

50. The "muscle memory" phenomenon — where previously trained individuals regain fitness faster than individuals who have never trained — is explained by which cellular mechanism?

- A. Permanently elevated blood lactate levels that accelerate glycolytic enzyme activity during retraining
- B. Increased circulating testosterone that persists indefinitely after any previous training exposure
- C. Retained myonuclei from prior hypertrophic training that persist even during detraining and accelerate the protein synthetic response when training resumes
- D. Residual muscle glycogen stores that remain in the fibers for years after all training has ceased

51. A strength and conditioning specialist evaluates a training program for a competitive high jumper. The program consists exclusively of heavy bilateral back squats performed at slow, controlled tempos with no plyometrics, no Olympic lifts, no single-leg work, and no sprint training. This program violates the SAID principle because the high jump requires which combination of sport-specific qualities not addressed?

- A. Only heavy bilateral squat strength is needed for high jump at all competitive levels
- B. Unilateral takeoff power from a single-leg base, rapid rate of force development during the brief takeoff contact, vertical power through the SSC, and explosive approach run speed
- C. Only flexibility training is relevant to high jump performance regardless of the takeoff mechanics
- D. Only cardiovascular endurance determines jumping height in the high jump

52. An exercise physiologist conducts a substrate utilization study during a 4-hour cycling ride at 60%  $\text{VO}_2\text{max}$ . RER begins at 0.85 during the first hour and progressively decreases to 0.76 by the fourth hour. This RER decrease reflects which metabolic shift?

- A. A progressive shift toward greater anaerobic metabolism during the final hours of the ride
- B. An increase in protein oxidation as the sole fuel source during the fourth hour
- C. No meaningful change in substrate utilization because RER does not reflect fuel source
- D. A progressive shift from carbohydrate toward greater fat oxidation as muscle glycogen depletes — as carbohydrate becomes less available, the body relies increasingly on the slower but more abundant fat pathways

### **SPORT PSYCHOLOGY (Questions 53–75)**

53. An Olympic swimmer reports two categories of pre-race symptoms: (1) excessive worry about split times, fear of disappointing sponsors, and intrusive negative thoughts, and (2) elevated resting heart rate, shallow breathing, and trembling hands behind the blocks. The first group represents cognitive anxiety. Which intervention most directly addresses these cognitive symptoms?

- A. Thought stopping with instructional self-talk replacement — interrupting negative thoughts with a cue word and substituting task-relevant focus cues such as "fast turns" and "strong finish"
- B. Progressive muscle relaxation targeting the physical tension in the shoulders and back
- C. Biofeedback using heart rate monitors to reduce the cardiovascular activation
- D. Ice bath immersion before the race to reduce core temperature and physical arousal symptoms

54. The inverted-U hypothesis predicts that optimal arousal varies with task complexity. A figure skater preparing to execute a complex triple axel requiring precise timing, aerial body control, and landing balance should aim for which arousal level?

- A. Very high arousal to maximize all available muscle activation for the rotational component
- B. High arousal identical to the optimal level for a maximal football blocking attempt

C. Relatively low-to-moderate arousal because the complex fine motor and spatial demands are degraded by excessive activation, which causes tremor and attentional narrowing

D. Arousal is irrelevant because it has no measurable effect on any athletic skill execution

55. A strength and conditioning specialist designs a 24-week training program for an Olympic weightlifter. According to goal-setting research, which combination of goal types provides the most effective structure for sustained motivation and daily adherence?

A. Only the outcome goal "Win the Olympic trials" with no intermediate or daily targets

B. A hierarchical combination of outcome goals (competitive placement targets), performance goals (specific measurable lift benchmarks), and process goals (daily controllable training behaviors)

C. No goals of any kind because goal-setting has been proven to decrease motivation in athletes

D. Only process goals with no long-term direction or measurable performance benchmarks

56. Self-efficacy, as defined by Albert Bandura, is task-specific and situation-specific. The four sources of self-efficacy are past performance accomplishment, vicarious experience, verbal persuasion, and physiological state interpretation. An athlete who successfully completes a 180 kg squat for the first time experiences an increase in self-efficacy primarily through which source?

A. Vicarious experience from watching a teammate complete the same weight before them

B. Verbal persuasion from the coach predicting success at 180 kg before the attempt

C. Physiological state interpretation based on reduced pre-lift heart rate and anxiety

D. Past performance accomplishment — the direct mastery experience of personal success, which is the most powerful of the four sources

57. An athlete who performs consistently well in practice but systematically underperforms in high-stakes competitions reports intense pre-competition worry, fear of failure, and disruptive negative self-talk that interferes with automatic skill execution. This pattern is most consistent with which psychological phenomenon?

A. Social facilitation where the presence of spectators and judges enhances all performance

- B. Optimal arousal producing the athlete's best possible competitive performance output
- C. A permanent personality disorder that prevents competitive success regardless of intervention
- D. Choking under pressure — excessive cognitive anxiety disrupts the automatic motor execution of well-learned skills in high-stakes environments

58. A sport psychologist recommends progressive muscle relaxation (PMR) and diaphragmatic breathing for an athlete who reports pre-competition muscle tension, elevated heart rate, and rapid shallow breathing. These physical relaxation techniques specifically target which anxiety component?

- A. Cognitive anxiety characterized by negative thought patterns and worry about performance
- B. Trait anxiety that is a permanent personality disposition unresponsive to any intervention
- C. Somatic anxiety — the physiological symptoms including muscle tension, cardiovascular activation, and respiratory changes that are directly targeted by physical relaxation techniques
- D. Social anxiety involving exclusive fear of judgment from media and spectators

59. Mental imagery is most effective when it engages multiple sensory modalities simultaneously. A tennis player preparing for a crucial service game should imagine which combination of sensory components for maximum effectiveness?

- A. Only the visual image of the ball landing in the service box with no other sensory engagement
- B. Visual (seeing the ball trajectory and placement), kinesthetic (feeling the serve motion through the arm and shoulder), auditory (hearing the ball contact the racket strings), and emotional (experiencing the confidence and composure of a successful serve) components simultaneously
- C. Only the auditory sound of the crowd without any visual or kinesthetic imagery
- D. Only the emotional fear of double-faulting to prepare for worst-case competitive scenarios

60. In Fitts and Posner's three-stage model, an athlete who can perform the hang clean with automatic, efficient technique while simultaneously monitoring bar speed, planning the next set, and adjusting session strategy without any conscious thought about body positions is in which learning stage?

- A. The cognitive stage characterized by large errors and heavy reliance on verbal instruction
- B. The associative stage where errors are still frequent and conscious attention is required for technique
- C. The preparatory stage where no physical practice has occurred
- D. The autonomous stage — the skill is largely automated, freeing cognitive resources for higher-order strategic processing and real-time performance monitoring

61. The contextual interference effect predicts that random practice (intermixing multiple exercises throughout a session) compared to blocked practice (completing all sets of one exercise before moving to the next) produces which specific motor learning outcome?

- A. Slower initial improvement but significantly better long-term retention and transfer to novel contexts — the deeper cognitive processing from constant task-switching builds more robust motor representations
- B. Faster initial improvement and superior long-term retention simultaneously in all cases
- C. Identical outcomes because practice structure has no measurable effect on motor learning
- D. Faster initial improvement with inferior long-term retention identical to blocked practice

62. The guidance hypothesis regarding feedback frequency states that providing extrinsic feedback after every single repetition during skill acquisition produces which long-term learning consequence?

- A. Optimal permanent learning because maximum feedback always produces maximum retention
- B. Accelerated mastery that persists indefinitely without negative consequence
- C. Impaired long-term learning because the athlete develops dependency on external correction rather than developing independent error-detection capabilities
- D. No measurable effect because feedback frequency is irrelevant to motor skill acquisition

63. A coach tells an athlete: "You jumped 31 inches on that vertical jump." This feedback provides information about the outcome of the performance. This type of feedback is classified as which of the following?

- A. Knowledge of performance (KP) describing the quality of the movement technique

- B. Intrinsic feedback based on the athlete's own proprioceptive sensory perception
- C. Motivational feedback designed exclusively to increase the athlete's effort level
- D. Knowledge of results (KR) — information about the outcome of the performance rather than the movement pattern that produced it

64. Distributed practice — shorter practice sessions separated by rest intervals — produces better long-term motor learning than massed practice. The primary mechanism explaining this advantage is which of the following?

- A. Distributed practice eliminates all performance errors during acquisition
- B. Memory consolidation during rest intervals — the neurological process of stabilizing and transferring motor memories from short-term to long-term storage
- C. Massed practice produces absolutely zero learning under any conditions
- D. The rest intervals allow complete glycogen resynthesis that improves motor cortex function

65. An athlete who has been progressively withdrawn, reports persistent loss of motivation, expresses feeling trapped in their sport, and demonstrates emotional exhaustion over several consecutive weeks is most likely experiencing which psychological condition?

- A. Athletic burnout — characterized by emotional exhaustion, depersonalization (cynicism toward the sport), and reduced sense of personal accomplishment
- B. Optimal psychological readiness indicating peak competitive performance capacity
- C. Normal day-to-day mood fluctuation that resolves spontaneously within 24 hours
- D. Acute pre-competition anxiety that disappears immediately after the competitive event

66. A 16-year-old high school athlete has become increasingly isolated, reports persistent feelings of worthlessness, has lost interest in activities they previously enjoyed, and expresses hopelessness about the future. The strength and conditioning specialist should respond by doing which of the following?

- A. Designing a more challenging training program to rebuild confidence through physical accomplishment

- B. Increasing the competitive schedule to provide more opportunities for success
- C. Recognizing these as potential warning signs of clinical depression and recommending that parents seek evaluation from a qualified mental health professional
- D. Ignoring the behavior because mood changes in adolescents always resolve naturally

67. A collegiate wrestler displays extreme pre-weigh-in weight manipulation, meal avoidance, excessive exercise beyond the prescribed training plan, and preoccupation with body weight and body composition. The CSCS-credentialed professional should respond by doing which of the following?

- A. Prescribing a detailed meal plan to correct the wrestler's nutritional deficiencies
- B. Conducting more frequent body composition testing to monitor weight more closely
- C. Ignoring the signs because weight manipulation is an accepted part of wrestling culture
- D. Referring the athlete to a qualified healthcare professional for evaluation — diagnosing and treating eating disorders is outside the CSCS scope of practice

68. Self-determination theory identifies autonomy, competence, and relatedness as three basic psychological needs supporting intrinsic motivation. A training environment that provides athletes choice in exercise selection, progressive challenges building mastery, and strong team cohesion supports which motivational outcome?

- A. Exclusively extrinsic motivation through external punishment and reward systems
- B. Enhanced intrinsic motivation by satisfying all three basic psychological needs
- C. Learned helplessness through systematic removal of all athlete control and competence
- D. Decreased motivation because providing choices overwhelms athletes with decision fatigue

69. RED-S (Relative Energy Deficiency in Sport) has been recognized as affecting both male and female athletes. In male athletes, chronic low energy availability can produce which combination of health consequences?

- A. Suppressed testosterone, decreased bone mineral density, impaired immune function, and declining athletic performance
- B. Enhanced performance through metabolic efficiency from chronic caloric restriction
- C. Increased testosterone production as an adaptive stress response to energy deficit
- D. No consequences because RED-S exclusively affects female athletes

70. An athlete returning from ACL reconstruction reports significant fear of re-injury during cutting and pivoting drills despite full medical clearance. The strength and conditioning specialist's most appropriate response includes which of the following?

- A. Immediately returning the athlete to full-contact competition to force them past the fear
- B. Permanently eliminating all cutting and pivoting from the athlete's training program
- C. Gradually reintroducing sport-specific movements at progressive intensities while facilitating referral to a sport psychologist for evidence-based treatment of the re-injury fear
- D. Telling the athlete that psychological concerns are irrelevant and they should focus only on physical metrics

71. Research on the psychological impact of athletic injury consistently demonstrates which finding regarding psychological factors and rehabilitation outcomes?

- A. Psychological state has no measurable effect on rehabilitation timelines or re-injury rates
- B. All athletes respond identically to injury with no individual variation in psychological response
- C. Injury always improves psychological resilience and mental toughness without any exception
- D. Athletes experiencing significant psychological distress during rehabilitation (fear, frustration, depression, isolation) have longer recovery times and higher re-injury rates

72. Motor program theory distinguishes between invariant features (relative timing, relative force proportions, spatial pattern) and variable parameters (absolute speed, absolute force, specific muscles) of a generalized motor program. When a pitcher throws a fastball then a changeup using the same arm action pattern, the variable parameter being adjusted is which of the following?

- A. The relative timing and sequencing of all muscle activations, which are completely restructured
- B. The overall speed and absolute force of the execution, while the invariant features remain constant
- C. The fundamental spatial pattern of the throwing trajectory, which changes completely for each pitch
- D. Nothing changes because the GMP is permanently fixed and cannot be modified

73. An athlete who has successfully completed a 185 kg back squat for the first time reports significantly increased confidence about attempting 190 kg. According to Bandura's self-efficacy theory, this confidence is primarily driven by which source?

- A. Past performance accomplishment — the direct mastery experience of the 185 kg squat, which is the most powerful source of self-efficacy
- B. Vicarious experience from watching a training partner squat a heavier load
- C. Verbal persuasion from the coach predicting success at 190 kg
- D. Physiological state interpretation based on reduced pre-lift anxiety symptoms

74. In Nideffer's attentional focus model, a soccer goalkeeper scanning the penalty kicker's body posture, foot angle, and run-up direction to anticipate the shot direction is primarily using which attentional focus?

- A. Narrow-internal focus directed at personal body sensations during the ready position
- B. Broad-internal focus analyzing personal tactical strategy without environmental awareness
- C. Broad-external focus — scanning multiple external stimuli simultaneously to gather perceptual information for an anticipatory decision
- D. Narrow-external focus locked exclusively on the ball placement on the penalty spot

75. Transfer of training is highest when the practiced skill and the target skill share common features. A strength and conditioning specialist prescribes front squats to improve the power clean receiving position. This exercise selection exploits which type of transfer?

- A. Negative transfer because the front squat disrupts and impairs the power clean rack position
- B. Zero transfer because no exercise affects the learning of any other exercise
- C. Random transfer that is entirely unpredictable regardless of movement similarity
- D. Positive transfer — the front squat develops the upright torso, high-elbow rack position, and receiving posture that directly transfer to the power clean catch

### **NUTRITION (Questions 76–95)**

76. A 90 kg strength athlete requires protein at the upper end of evidence-based recommendations during a heavy training phase. At 2.2 g/kg/day, the daily protein target is which of the following?

- A. 72 grams per day based on the general population RDA of 0.8 g/kg/day
- B. 198 grams per day calculated as  $90 \text{ kg} \times 2.2 \text{ g/kg/day}$
- C. 450 grams per day based on an exaggerated 5.0 g/kg/day recommendation
- D. 36 grams per day consumed exclusively in a single bedtime meal

77. Post-exercise protein intake of 20-40 grams of high-quality protein maximizes the muscle protein synthetic response. The amino acid identified as the primary trigger for mTOR pathway activation is which of the following?

- A. Leucine — the branched-chain amino acid that serves as the key trigger for mTOR activation, with a threshold of approximately 2-3 grams per meal for optimal protein synthesis stimulation
- B. Glutamine, which is the most abundant amino acid in the body
- C. Glycine, the smallest amino acid with the fastest intestinal absorption rate
- D. Alanine, the primary gluconeogenic amino acid used for hepatic glucose production

78. An athlete consumes a post-exercise meal containing 30 grams of whey protein and 80 grams of high-glycemic carbohydrate within 30 minutes of completing a high-intensity session. The physiological rationale for this specific combination and timing is which of the following?

- A. The whey protein suppresses all cortisol for 48 hours while the carbohydrate eliminates all future soreness
- B. This meal is excessively caloric and will be stored exclusively as body fat regardless of training status
- C. Whey protein stimulates muscle protein synthesis through leucine-triggered mTOR activation, the high-GI carbohydrate rapidly replenishes glycogen through maximal glycogen synthase activity, and the insulin response enhances amino acid uptake into muscle
- D. Post-exercise nutrition has no effect on recovery or adaptation under any nutritional circumstance

79. An athlete following a very low-fat diet (less than 15% of total calories) for several months reports declining energy, poor recovery, and blood work revealing suppressed testosterone. The most likely nutritional cause is which of the following?

- A. Excessive protein intake causing renal overload and secondary hormonal disruption
- B. Excessive carbohydrate consumption causing permanent insulin resistance
- C. Inadequate water intake causing chronic dehydration that mimics all hormonal suppression
- D. Inadequate dietary fat impairing steroid hormone production (cholesterol is the testosterone precursor) and reducing fat-soluble vitamin absorption (A, D, E, K)

80. During a marathon on a warm, humid day, an athlete consumes 3 liters of plain water per hour for 4 hours without sodium replacement. The athlete becomes confused and disoriented. Emergency medical personnel diagnose exercise-associated hyponatremia. This condition resulted from which mechanism?

- A. Excessive blood sodium from sodium retention during the prolonged running effort
- B. Dilution of blood sodium concentration by massive plain water intake relative to the sodium lost through sweat, reducing serum sodium below safe levels
- C. Metabolic alkalosis from the elevated pH of the consumed plain water during the race
- D. Rhabdomyolysis from mechanical muscle damage during 4 hours of continuous running

81. Creatine monohydrate supplementation enhances performance during short-duration, high-intensity activities. An athlete who uses only the maintenance dose (3-5 g/day without loading) achieves full intramuscular creatine saturation in approximately how long?

- A. Approximately 28 days of consistent daily supplementation — equally effective as the loading protocol but taking longer to reach the same saturated endpoint
- B. 24-48 hours of supplementation at the maintenance dose
- C. Full saturation can never be achieved without completing the loading phase first
- D. 6-12 months regardless of daily dose consumed

82. Caffeine enhances performance at ergogenic doses of 3-6 mg/kg consumed 30-60 minutes before exercise. The primary mechanism of caffeine's ergogenic effect is which of the following?

- A. Directly doubling intramuscular phosphocreatine stores above normal baseline levels
- B. Stimulating muscle protein synthesis equivalent to 40 grams of whey protein isolate
- C. Blocking adenosine receptors in the CNS, reducing fatigue perception, increasing alertness and focus, and enhancing pain tolerance during high-intensity effort
- D. Permanently increasing resting metabolic rate by 50% for 48 hours after a single dose

83. Beta-alanine supplementation increases intramuscular carnosine, which buffers hydrogen ions during high-intensity exercise. This buffering is most beneficial for activities lasting which duration?

- A. Less than 5 seconds where phosphocreatine is the exclusive ATP source
- B. Longer than 60 minutes where fat oxidation is the predominant energy pathway
- C. During complete rest when no metabolic byproducts are being produced
- D. 1-4 minutes where glycolytic hydrogen ion accumulation is the primary performance limiter

84. An athlete subject to WADA anti-doping regulations wants to minimize inadvertent positive drug test risk from supplement contamination. The recommended third-party certification is which of the following?

- A. USDA Organic, which guarantees complete absence of all banned performance-enhancing substances
- B. NSF Certified for Sport or Informed Sport, which independently test for banned substances, verify label accuracy, and screen for undeclared contaminants
- C. FDA pharmaceutical approval, which is mandatory for all dietary supplements before sale
- D. ISO 9001 manufacturing certification, which verifies complete banned substance testing

85. For an athlete in caloric deficit seeking to preserve lean mass, evidence supports protein intake at which level?

- A. 2.0-2.4 g/kg/day — at the upper end of recommendations to maximize lean mass preservation during energy restriction, combined with maintained resistance training
- B. The general population RDA of 0.8 g/kg/day, adequate for all populations during restriction
- C. Less than 0.5 g/kg/day to aggressively minimize total caloric intake
- D. No protein because eliminating it accelerates fat loss without affecting lean tissue

86. Sodium bicarbonate is an extracellular buffer that enhances performance during glycolytic exercise at doses of 0.2-0.3 g/kg consumed 60-90 minutes before exercise. The most common side effect limiting tolerability is which of the following?

- A. Permanent hepatic damage from any dose of sodium bicarbonate at any concentration
- B. Dangerous cardiac arrhythmias requiring immediate medical intervention after ingestion
- C. Gastrointestinal distress — nausea, bloating, cramping, and diarrhea from the alkaline compound and large dose
- D. Complete suppression of all three energy systems for 24 hours following consumption

87. An endurance athlete at high training volume requires carbohydrate at the upper range. For a 70 kg athlete at 10 g/kg/day, the daily carbohydrate target is which of the following?

- A. 70 grams based on a very low carbohydrate approach of 1 g/kg/day
- B. 350 grams based on a moderate 5 g/kg/day recommendation
- C. 1,400 grams calculated by doubling the upper recommendation range
- D. 700 grams calculated as  $70 \text{ kg} \times 10 \text{ g/kg/day}$

88. Iron deficiency is the most common nutritional deficiency worldwide. Consuming vitamin C alongside non-heme iron sources enhances absorption through which mechanism?

- A. Vitamin C inhibits all iron absorption as a protective mechanism against iron overload
- B. Vitamin C converts ferric iron ( $\text{Fe}^{3+}$ ) to the more bioavailable ferrous form ( $\text{Fe}^{2+}$ ), enhancing intestinal absorption of non-heme iron from plant-based and fortified sources
- C. Vitamin C has no interaction with iron metabolism under any dietary circumstance
- D. Vitamin C enhances heme iron absorption exclusively while blocking all non-heme iron uptake

89. When two training sessions are scheduled within 8 hours, post-exercise carbohydrate intake within 30 minutes of the first session is critical. The recommended intake is which of the following?

- A. 1.0-1.5 g/kg of carbohydrate to maximize glycogen synthase activity during the period of highest enzyme sensitivity
- B. No carbohydrate for 12 hours to promote metabolic fat adaptation before the second session
- C. 0.1 g/kg — a minimal amount to prevent any insulin response following the training session
- D. Only protein with zero carbohydrate because glycogen replenishment occurs independently

90. A plant-based athlete asks how to ensure adequate essential amino acid intake. The strength and conditioning specialist should advise which strategy?

- A. Plant-based diets cannot provide adequate amino acids under any dietary strategy or combination
- B. Only soy protein is acceptable because all other plant proteins contain zero essential amino acids
- C. Consuming a variety of complementary plant protein sources throughout the day — grains compensate for legumes' limitations and vice versa — ensures all essential amino acids are provided
- D. Daily supplementation with 100 grams of isolated BCAAs is required for all plant-based athletes

91. Consuming 30-40 grams of casein protein before sleep supports overnight recovery through which specific mechanism?

- A. Immediate gastric emptying identical to whey protein with zero difference in absorption kinetics
- B. Casein is entirely wasted because all protein consumed before sleep is excreted unabsorbed
- C. Complete suppression of all catabolic hormones for 48 hours following bedtime consumption
- D. Casein forms a gel in the stomach slowing digestion, providing sustained amino acid delivery throughout the overnight fasting period to support muscle protein synthesis during sleep

92. High-glycemic index (GI) foods are most appropriately consumed at which time relative to exercise?

- A. Only at breakfast regardless of training schedule or competition timing
- B. During and immediately after exercise when rapid glucose delivery and glycogen replenishment are the priorities
- C. Exclusively before sleep to promote overnight insulin secretion and growth hormone suppression
- D. High-GI foods should never be consumed by any athlete under any circumstances

93. The evidence for glutamine supplementation to promote muscle growth in healthy, well-nourished athletes is best described as which of the following?

- A. Limited — glutamine has not demonstrated strong evidence for muscle growth in athletes with adequate protein intake and is not classified among supplements with robust ergogenic evidence
- B. Glutamine has the strongest evidence of any supplement for muscle hypertrophy, surpassing creatine
- C. Glutamine permanently elevates testosterone at all doses in every athletic population
- D. Glutamine is the only supplement universally approved by all international anti-doping agencies

94. Adequate dietary fat (20-35% of total calories) is essential for athletes because fat serves which combination of functions?

- A. Fat has no physiological function and can be completely eliminated without any consequence
- B. Fat is the exclusive fuel for the phosphagen system during all maximal-effort sprinting activities
- C. Steroid hormone production (requiring cholesterol as a precursor), fat-soluble vitamin absorption (A, D, E, K), cell membrane integrity, and provision of essential fatty acids the body cannot synthesize
- D. Fat directly stimulates Type IIx fiber hyperplasia independent of any training stimulus

95. Vitamin D deficiency is prevalent among athletes who train indoors or live at northern latitudes. Documented consequences include which of the following?

- A. Excessive muscle hypertrophy exceeding all desired training goals and adaptations
- B. Enhanced athletic performance from the metabolic efficiency of vitamin D-depleted tissues
- C. No consequences because vitamin D has no role in muscle, bone, or immune function
- D. Impaired muscle function, compromised immune competence, and elevated risk of stress fractures with decreased bone mineral density

## SECTION 2 — PRACTICAL/APPLIED

125 Questions | 2.5 Hours Recommended

### EXERCISE TECHNIQUE (Questions 96–140)

96. Before beginning a resistance training program, a strength and conditioning specialist should assess each novice athlete's movement competency by having them perform which unloaded assessment?

- A. A 1RM back squat at the heaviest possible load to establish baseline maximal strength
- B. A bodyweight squat to evaluate ankle dorsiflexion, hip flexion, thoracic extension, knee tracking, and spinal neutrality before adding external load
- C. A barbell overhead press at 80% of estimated 1RM to assess shoulder stability under load
- D. A weighted depth jump from a 42-inch box to evaluate landing mechanics and reactive strength

97. During a barbell back squat, an athlete's heels consistently rise off the floor during the descent, shifting weight to the toes. This compensatory pattern most commonly indicates which underlying limitation?

- A. Insufficient ankle dorsiflexion mobility preventing the tibia from translating forward adequately to maintain balance with heels grounded
- B. Excessive hip flexion mobility causing the athlete to descend too deeply into the squat
- C. Superior quadriceps strength causing the anterior thigh muscles to overpower the posterior chain
- D. Excessive thoracic extension pushing the torso too far backward during the descent

98. An athlete performing the conventional deadlift is observed with the bar drifting forward of the shins. This forward bar drift produces which biomechanical consequence?

- A. Decreased torque demand on the lumbar spine because the bar is further from the body
- B. Improved leverage for the quadriceps during the initial knee extension phase of the pull
- C. Increased moment arm on the lumbar spine, dramatically increasing flexion torque and injury risk
- D. No biomechanical consequence because bar path does not affect spinal loading

99. A strength and conditioning specialist requires all athletes to use a closed grip with thumbs wrapped around the barbell during the bench press. The safety rationale for this requirement is which of the following?

- A. A closed grip activates the pectoralis major more effectively than any alternative grip
- B. A closed grip is a personal preference with no safety implications whatsoever
- C. A closed grip increases the total range of motion by approximately 4 inches
- D. A closed grip prevents the bar from rolling out of the hands onto the chest, neck, or face — a potentially catastrophic event possible with an open (false) grip

100. During a standing overhead press, an athlete arches the lower back into extreme hyperextension to compensate for excessive load. This technique error produces which safety consequence?

- A. Enhanced deltoid activation because the arch creates a more favorable pressing angle
- B. Compressive and shear forces on the lumbar spine increasing injury risk, while shifting the exercise toward an incline press and reducing the overhead range of motion
- C. Improved spinal stability because lumbar extension under load is the preferred position
- D. No consequence because lumbar position has no effect on injury risk during pressing

101. The NSCA recommends a top-down teaching progression for the power clean. The first exercise establishes the receiving position before pulling mechanics are introduced. Which exercise is taught first?

- A. The front squat — establishing the front rack position, comfort with the bar on the anterior deltoids, and the upright receiving posture before any explosive pulling phases
- B. The full squat clean from the floor at near-maximal loads
- C. The clean pull from the floor without any catch to develop pulling mechanics
- D. The hang power clean from above the knee at a challenging load

102. During the second pull of the power clean, an athlete prematurely bends the elbows. This technique error reduces the contribution of which muscle groups?

- A. The biceps brachii, which should be the primary movers during the second pull
- B. The forearm flexors, which generate all upward bar velocity during Olympic lifts
- C. The powerful hip extensors — premature arm bending substitutes arm strength for triple extension, limiting bar velocity and the weight that can be cleaned
- D. The rotator cuff muscles, which are the exclusive force generators during the power clean

103. An athlete performing depth jumps shows ground contact increasing from 165 ms to 345 ms by the sixth repetition with declining rebound height. The specialist should do which of the following?

- A. Increase box height to force faster transitions
- B. Add ankle weights for greater eccentric stimulus
- C. Continue to 15 reps because fatigue drives plyometric adaptation
- D. Terminate the exercise immediately — the athlete is fatiguing, contact time has doubled, SSC benefit is lost, and continuing trains degraded patterns with no power benefit

104. A strength and conditioning specialist programs the first plyometric session for collegiate athletes who have completed 12 weeks of resistance training but have no plyometric experience. The appropriate exercise selection and volume is which of the following?

- A. High-intensity depth jumps from 42-inch boxes at 250 foot contacts
- B. Low-to-moderate intensity exercises (squat jumps, CMJ, box jumps stepping down) at 80-100 foot contacts
- C. Single-leg depth jumps with weighted vests at 200 foot contacts
- D. Weighted jump squats at 60% 1RM for 300 foot contacts

105. When spotting a barbell back squat with a single spotter, the spotter positions behind the athlete and provides assistance at which location?

- A. Near the athlete's torso with arms under the armpits — assisting upward without gripping the bar directly
- B. On the barbell at each end to lift the weight off the athlete's back
- C. On the athlete's hips to push them straight upward during the ascent
- D. On the athlete's shoulders to stabilize the upper body throughout all repetitions

106. The Valsalva maneuver is appropriate for which specific population and exercise context?

- A. All populations regardless of cardiovascular status during every exercise at all intensities
- B. Only during very light isolation exercises at 20% of 1RM
- C. Healthy, trained athletes performing heavy compound lifts where maximal intra-abdominal pressure provides essential spinal stabilization
- D. Individuals with uncontrolled hypertension performing any type of resistance exercise

107. An athlete performing bent-over rows rounds the spine and jerks the weight with momentum. The specialist should respond by doing which of the following?

- A. Encouraging momentum because it enables heavier loads for greater overload stimulus
- B. Adding more weight because the athlete clearly has untapped strength capacity
- C. Switching permanently to a different exercise because rows cannot be performed safely
- D. Terminating the set, reducing the load, cueing rigid spinal neutrality with the pull initiated by scapular retraction

108. A baseball pitcher needs rotational power for throwing and anti-rotation stability for deceleration. Which exercise combination addresses both demands?

- A. Only weighted decline sit-ups because trunk flexion is the exclusive core demand for pitchers
- B. Medicine ball rotational throws for explosive power and Pallof press for anti-rotation stability
- C. Only isometric front plank holds for 5 minutes targeting endurance exclusively
- D. Heavy Russian twists at maximum velocity as the sole core training exercise

109. Anti-extension core exercises (ab wheel rollout, front plank) train the core to resist which specific spinal movement?

- A. Lumbar hyperextension — resisting the tendency for the lumbar spine to arch as gravity or external load pulls it into extension
- B. Trunk rotation in the transverse plane during throwing and striking activities
- C. Lateral trunk flexion in the frontal plane during side-stepping movements
- D. Trunk flexion in the sagittal plane as during crunches and sit-up exercises

110. During sprint acceleration (first 10-30 meters), the athlete should maintain a pronounced forward lean. Running upright from the first step produces which consequence?

- A. Enhanced acceleration because upright posture maximizes stride frequency from step one
- B. No consequence because body position has no relationship to acceleration mechanics
- C. Reduced horizontal GRF production, impairing acceleration because forces are directed too vertically
- D. Improved top-end speed that compensates for all acceleration losses

111. The pro agility shuttle (5-10-5) assesses change-of-direction speed rather than true agility because it lacks which component?

- A. A physical deceleration and reacceleration component at each direction change

- B. A timing mechanism to measure each individual direction change independently
- C. Multiple direction changes exceeding two within a single test trial
- D. A reactive perceptual-cognitive decision-making component requiring response to unpredictable stimuli

112. Dynamic stretching before explosive exercise is preferred over static stretching because research demonstrates which finding?

- A. Static stretching permanently destroys muscle fibers preventing future force production
- B. Dynamic stretching increases ROM while activating the neuromuscular system, whereas static stretching before explosive activity acutely reduces force production and power
- C. Dynamic and static stretching produce identical effects on all subsequent performance variables
- D. Dynamic stretching provides no flexibility benefit and serves exclusively as cardiovascular warmup

113. Foam rolling before training provides which advantage over static stretching?

- A. Increased ROM without the acute decrements in force production and power associated with static stretching
- B. Foam rolling permanently restructures fascial tissue after a single 30-second application
- C. Foam rolling produces identical performance decrements to 60-second static stretching holds
- D. Foam rolling reduces ROM compared to performing no pre-training mobility work

114. A complete warmup before resistance training should progress in which sequence?

- A. Heavy working sets → static stretching → cooldown jog → foam rolling
- B. Static stretching → maximal lifts → dynamic stretching → isolation exercises
- C. General warmup → dynamic stretching → movement preparation → specific warmup with progressive loading
- D. No warmup is necessary because resistance training itself serves as adequate preparation

115. Chronic cold water immersion after every resistance training session may produce which unintended consequence?

- A. Accelerated hypertrophy beyond what any other recovery strategy can achieve
- B. Enhanced neural adaptation and increased maximal voluntary contraction strength
- C. Improved tendon remodeling and connective tissue strengthening above normal rates
- D. Blunted inflammatory signaling necessary for hypertrophy and strength adaptation — acute post-training inflammation is part of the adaptive cascade

116. The foundational recovery practices — more important than any external modality — are which of the following?

- A. Pneumatic compression boots worn for 60 minutes after every training session
- B. Adequate sleep of 7-10 hours nightly combined with appropriate post-exercise nutrition
- C. Cryotherapy chamber sessions at  $-110^{\circ}\text{C}$  performed twice daily regardless of training content
- D. Electrical muscle stimulation applied to all major muscle groups for 90 minutes nightly

117. A conditioning program for a basketball team (48-minute games with sprints, jumps, and direction changes) should include which comprehensive approach?

- A. A combination of aerobic base training, anaerobic interval training with sport-specific rest, and reactive agility conditioning
- B. Exclusively long-distance running at 60% HRmax five days per week
- C. Only heavy resistance training with no conditioning component
- D. Only static stretching for 60 minutes per session

118. The aerobic system's most important contribution to team sport athletes performing repeated sprints is which of the following?

- A. Directly powering each maximal sprint through aerobic ATP production
- B. Eliminating all glycolytic energy production during team sport activities
- C. Recovery capacity — replenishing PCr, clearing metabolic byproducts, and restoring homeostasis between high-intensity bouts
- D. No relevance because team sports are entirely anaerobic

119. Interval training for a football DB performing 4-6 second sprints with 25-40 second huddle rest should use which work-to-rest ratio?

- A. 1:1 targeting the oxidative system with equal work and rest durations
- B. 1:3 targeting the glycolytic system with moderate recovery between efforts
- C. 1:20 with complete 2-3 minute recovery between each sprint effort
- D. 1:5 to 1:8 targeting the phosphagen system with near-complete PCr recovery

120. Active recovery — low-intensity exercise below 50% HRmax the day after intense training — provides which primary benefit?

- A. Completely eliminates all muscle soreness within 10 minutes of initiation
- B. Promotes blood flow to recovering tissues and facilitates metabolic waste removal
- C. Produces the same adaptive stimulus as a high-intensity training session
- D. Replaces the need for sleep by providing identical recovery benefits in less time

121. During a front squat, if the elbows drop during the descent, the immediate consequence is which of the following?

- A. The bar rolls forward off the anterior deltoids, creating dangerous loss of control and excessive wrist and elbow stress
- B. Enhanced quadriceps activation from the altered torso angle
- C. Improved thoracic extension and reduced demand on upper back musculature
- D. Increased biceps activation that supports the bar in the rack position

122. A reverse lunge is preferred over a forward lunge for athletes with anterior knee sensitivity because it provides which biomechanical advantage?

- A. Greater compressive force on the patellofemoral joint for cartilage strengthening
- B. Increased forward knee translation that loads the quadriceps tendon more aggressively
- C. Reduced shear force on the front knee because stepping backward eliminates the eccentric deceleration demand on the front leg
- D. Eliminated eccentric muscle action throughout the entire lowering phase

123. An athlete performing a Bulgarian split squat reports excessive anterior knee strain. Which modification reduces this stress?

- A. Moving the front foot closer to the bench to increase forward knee translation
- B. Raising the rear foot higher to increase the ROM at the front knee
- C. Adding forward lean to shift center of gravity over the front knee joint
- D. Moving the front foot further from the bench for a more vertical shin angle, shifting emphasis to hip extensors

124. A hex bar deadlift provides which biomechanical advantage over the conventional barbell deadlift?

- A. Greater moment arm on the lumbar spine increasing the training stimulus
- B. Reduced moment arm on the lumbar spine because the load is centered closer to the body's center of mass
- C. Identical biomechanics with no practical difference
- D. Increased grip demand from thicker handles

125. When spotting dumbbell pressing exercises, the spotter should apply assistance at which location?

- A. At the wrists near the athlete's hands — not at the elbows or the dumbbells
- B. Directly on the dumbbells to guide their trajectory
- C. At the elbows for additional pressing leverage
- D. At the upper arms near the shoulder to stabilize the glenohumeral joint

126. Resistance bands combined with barbells create accommodating resistance. During a banded squat, this profile provides which training benefit?

- A. Elimination of all resistance at the bottom so the athlete rests in the most difficult position
- B. Constant resistance identical to free weights throughout the ROM
- C. Maximum resistance at the top (mechanically strongest position) where free weights alone become relatively easy, training force production through the full range
- D. Maximum resistance at the bottom where the athlete is in the weakest position

127. A medicine ball rotational throw qualifies as plyometric only when performed with which characteristic?

- A. A 5-second isometric pause between catching and throwing phases

- B. Slow controlled tempo for maximum time under tension during both phases
- C. Maximum weight for developing absolute strength regardless of execution speed
- D. Maximal speed with minimal transition between eccentric catch and concentric throw to exploit the SSC

128. An Olympic lifting platform should be positioned with which primary safety consideration?

- A. Directly adjacent to cardio equipment for convenient circuit transitions
- B. Separated from general traffic areas with adequate clearance on all sides for dropped barbells
- C. Against mirrors for technique monitoring during heavy Olympic lifting attempts
- D. Center of the facility surrounded by other stations for motivational atmosphere

129. A specialist trains 30 athletes with 10 squat racks. The optimal organizational approach is which of the following?

- A. Groups of 3 per rack rotating between squatting, spotting, and resting for continuous workflow with appropriate supervision
- B. All 30 performing bodyweight squats while waiting for available racks
- C. All 30 observing one demonstration at a single rack for the entire session
- D. Eliminating all squat exercises because the facility lacks equipment for the group

130. Collars are required on all barbell exercises. The safety purpose is which of the following?

- A. Increasing the total barbell weight for additional training resistance
- B. Improving the athlete's grip by adding friction to the bar surface
- C. Preventing plates from sliding off the bar during exercise, which could cause asymmetric loading, loss of control, and injury
- D. Collars are decorative only with no functional safety purpose

131. An athlete's program includes power snatches, front squats, dumbbell bench press, single-arm rows, dumbbell lateral raises, and dead bugs. Correct exercise order places which exercise first?

- A. Dead bugs to pre-activate the core before compound movements
- B. Dumbbell lateral raises because isolation exercises precede compounds
- C. Single-arm rows because pulling exercises are always prioritized first
- D. Power snatches — the explosive exercise requiring highest neuromuscular coordination, performed when fresh

132. When spotting a bench press with a single spotter behind the head, the recommended grip is which of the following?

- A. A wide pronated grip matching the athlete's grip width
- B. An alternated grip (one pronated, one supinated) close to center for maximum security and symmetric force application
- C. No grip — hands on the athlete's elbows for leverage
- D. A supinated grip at the extreme ends near the plates

133. An athlete explosive on the field but struggling with heavy barbell lifts has which training deficiency?

- A. A maximal strength deficit — explosive ability outpaces force capacity; heavy resistance training (85%+ 1RM) develops the force foundation supporting greater explosive output
- B. Excessive explosive ability that cannot be developed further
- C. Only long-distance running is needed because aerobic fitness determines all explosive performance
- D. Only flexibility training is needed because ROM determines barbell strength

134. Correct Romanian deadlift execution includes which combination of technical standards?

- A. Full knee lockout with deliberate lumbar rounding to maximize hamstring stretch

- B. Deep knee flexion to 90 degrees with the hips dropping below the knees as in a squat
- C. Slight constant knee flexion, flat neutral spine, hip hinge, and bar tracking close to the legs
- D. Alternating between knee extension and deep flexion during each repetition of the descent

135. A training program for a swimmer includes pull-ups, internal/external rotation exercises, and core anti-rotation work. This selection addresses which sport-specific needs?

- A. Only lower body power because kicking determines swimming speed exclusively
- B. Only flexibility because ROM is the sole quality relevant to swimming performance
- C. Only cardiovascular endurance because swimming requires no upper body strength
- D. Upper body pulling strength for the stroke, rotator cuff injury prevention, and trunk stability for force transfer

136. The Pallof press trains the core to resist which specific force?

- A. Spinal extension in the sagittal plane during overhead movements
- B. Rotational force — an external load attempts to twist the torso while the athlete maintains neutral alignment
- C. Spinal flexion in the sagittal plane during crunch exercises
- D. Lateral flexion in the frontal plane during side-stepping activities

137. Before attempting the full snatch, which mobility prerequisite must be assessed?

- A. Overhead squat mobility — stable locked-arm overhead position while squatting to full depth with upright torso
- B. Only ankle dorsiflexion because the snatch is exclusively a lower body exercise
- C. Only wrist flexion because the wide grip demands minimal shoulder mobility
- D. No prerequisites because all athletes can safely perform the snatch immediately

138. Correct push-up execution includes which combination of standards?

- A. Hips sagging toward the floor with a visible swayback position throughout
- B. Elbows flared to 90 degrees regardless of shoulder comfort or safety
- C. Straight line head to heels with core braced, chest touches or nearly touches floor, elbows at approximately 45 degrees from torso
- D. Partial ROM with elbows bending only 10-15 degrees per repetition

139. Conditioning for an offensive lineman (4-7 second plays with 25-40 second rest) should use which protocol?

- A. Continuous 3-mile runs at moderate pace three times per week
- B. 400-meter repeats with 60-second rest targeting the glycolytic system
- C. 60-minute cycling at 50% HRmax for aerobic base development
- D. Sprint intervals of 5-10 yards with 25-40 seconds rest replicating phosphagen-dominant demands

140. Cable face pulls target the posterior deltoids and external rotators. The cable should be set at which height and the athlete should pull toward which target?

- A. Cable at floor level pulling toward the knees with internal rotation
- B. Cable at face height pulling toward the face while externally rotating and retracting scapulae
- C. Cable above head pulling downward in a lat pulldown motion
- D. Cable at knee height pulling diagonally in a woodchop pattern

## **PROGRAM DESIGN (Questions 141–184)**

141. A needs analysis for a competitive 800-meter runner (race lasting approximately 1:45-2:10) identifies which energy system combination as most critical?

- A. Both the glycolytic system (primary during sustained near-maximal effort) and the aerobic system (increasingly significant during the second half), with the phosphagen system contributing to the initial sprint
- B. Exclusively the phosphagen system for the entire 800-meter duration
- C. Only the oxidative system through aerobic fat metabolism at race intensity
- D. No specific energy system is dominant during the 800-meter event

142. A barbell push press is classified as a power exercise because it meets which criteria?

- A. It is performed on a machine at slow controlled tempo for muscle isolation
- B. It targets only a single joint with a very small muscle group at light resistance
- C. It is structural (loads the spine), performed explosively (rapid leg drive initiating bar elevation), and involves multiple large muscle groups
- D. It is identical to a strict overhead press with no explosive component

143. In a session containing the power clean, back squat, incline bench, lat pulldown, biceps curl, and front plank, correct exercise order places which exercise first?

- A. Biceps curl because isolation exercises precede all compound movements
- B. Front plank because core stability precedes all loaded exercises
- C. Lat pulldown because pulling exercises are always prioritized first
- D. Power clean — the explosive exercise requiring highest neuromuscular coordination

144. For a novice athlete with 3 months of experience, the most appropriate training frequency and format is which of the following?

- A. 6 sessions per week using an advanced body-part split with maximal loads
- B. 2-3 sessions per week using total-body training with moderate loads (60-70% 1RM), higher repetitions (10-15), and technique emphasis
- C. 1 session per month at maximal loads to failure on every exercise
- D. Daily sessions using only machine isolation exercises at maximum intensity

145. Training at loads  $>85\%$  1RM for  $\leq 6$  reps with 2-5 minutes rest primarily develops which quality?

- A. Maximal strength through neural adaptations — increased motor unit recruitment, improved rate coding, and enhanced intermuscular coordination
- B. Muscle hypertrophy through moderate loading with metabolic stress
- C. Muscular endurance through sustained low-force, high-repetition work
- D. Cardiovascular fitness through elevated heart rate during the session

146. An athlete's 1RM back squat is 175 kg. A hypertrophy protocol prescribes  $4 \times 10$  at 72% 1RM with 75-second rest. The training load and volume load are which of the following?

- A. Load = 175 kg; Volume = 7,000 kg
- B. Load = 90 kg; Volume = 3,600 kg
- C. Load  $\approx 126$  kg ( $175 \times 0.72 = 126$ ); Volume =  $126 \times 10 \times 4 = 5,040$  kg
- D. Load = 50 kg; Volume = 2,000 kg

147. Rest periods of 30-90 seconds are prescribed for which training goal?

- A. Maximal strength requiring complete PCr and neural recovery

- B. Explosive power requiring full recovery for ballistic quality
- C. Aerobic endurance requiring sustained elevated heart rate
- D. Muscle hypertrophy, where maintaining elevated metabolic stress and hormonal environment supports the growth stimulus

148. DUP varies training within each week (e.g., Monday hypertrophy, Wednesday strength, Friday power). The primary advantage over linear periodization is which of the following?

- A. DUP eliminates planning because variation is random
- B. More frequent exposure to different stimuli within each week, preventing accommodation and enabling simultaneous multi-quality development
- C. DUP never uses heavy loads making it inherently safer than all other models
- D. Identical outcomes to performing the same workout every session

149. Linear periodization progresses through sequential phases with which pattern?

- A. Intensity gradually increases while volume gradually decreases across sequential mesocycles
- B. Volume and intensity both increase simultaneously throughout the macrocycle
- C. Volume and intensity remain constant with no variation across any phase
- D. Intensity decreases while volume increases across sequential mesocycles

150. Block periodization concentrates training on targeted qualities. The typical three-block sequence is which of the following?

- A. Realization → Transmutation → Accumulation in reverse order
- B. Competition → Transition → General preparation with no structure
- C. Accumulation (high volume, moderate intensity) → Transmutation (higher intensity, sport-specific) → Realization (low volume, peaking)
- D. Muscular endurance → Flexibility → Cardiovascular conditioning exclusively

151. During in-season competition, reducing frequency and volume while maintaining intensity produces which outcome?

- A. Dramatic strength loss because any volume reduction causes detraining
- B. Significant additional gains from the reduced training load
- C. Complete detraining within 48 hours regardless of maintained intensity
- D. Strength and power maintenance because intensity — the most critical detraining-prevention variable — has been preserved

152. The transition period should last approximately how long and focus on which objectives?

- A. 12 weeks of maximal training to immediately prepare for next season
- B. 2-4 weeks of unstructured, low-intensity active recovery for physical/psychological restoration, injury treatment, and motivation renewal
- C. 6 months of complete bed rest with zero physical activity
- D. The period should be eliminated because continuous maximal training is optimal

153. For jump squat power development, peak power occurs at which loading range?

- A. 0-30% of back squat 1RM where lighter loading allows high velocity to maximize the velocity component
- B. 85-95% of 1RM using near-maximal loads at very slow velocity
- C. 50-70% providing balanced but suboptimal force and velocity contributions
- D. Equal power at all loads because loading does not affect power output

154. For the hang clean, peak power output occurs at approximately which loading range?

- A. 0-10% of 1RM using only the empty barbell for maximum velocity

- B. 30-40% using very light loads moved at high velocity
- C. 95-100% using near-maximal loads at very slow velocity
- D. Equal power at all loads regardless of the percentage of 1RM used

155. Plyometric volume for beginner athletes should be which of the following?

- A. 250 foot contacts exclusively high-intensity depth jumps
- B. 500 foot contacts to maximize first-session stimulus
- C. 10 foot contacts regardless of exercise type or training level
- D. 80-100 foot contacts distributed across exercises of varying intensity

156. Plyometric sessions should be positioned when within a training day?

- A. At the end after heavy resistance training and conditioning for maximum fatigue
- B. At the beginning after warmup, when fresh for maximal effort and proper technique
- C. Only during rest days with no activity within 72 hours before or after
- D. Immediately after a 5K run to simulate game-day fatigue conditions

157. An athlete with squat at the 88th percentile but vertical jump at the 30th percentile has which deficiency?

- A. Insufficient maximal strength requiring heavier squat loading despite the high ranking
- B. No deficiency because strength alone determines jump height
- C. Excessive flexibility impairing force transfer through the kinetic chain
- D. A rate of force development deficit — adequate strength but poor ability to express it rapidly, requiring explosive training

158. A soccer conditioning program (90-minute matches with mixed demands) should include which combination?

- A. Exclusively heavy resistance training with no conditioning
- B. Only long-distance running at low intensity five days per week
- C. Aerobic base training, anaerobic interval training with sport-specific rest, and reactive agility conditioning
- D. Only static stretching for 60 minutes per session

159. The transition period following the competitive season should focus on which objectives?

- A. Maximizing volume and intensity for immediate next-season preparation
- B. Complete cessation of all activity for 6 months minimum
- C. Introducing entirely new sports the athlete has never practiced before
- D. Physical and psychological recovery, injury treatment, and motivation restoration for 2-4 weeks

160. A return-to-play protocol requires which objective criterion before unrestricted competition?

- A. Subjective report of feeling ready with no testing required
- B. Bilateral symmetry within 10%, sport-specific movement competency, and medical clearance
- C. Ability to walk without a limp as the sole criterion
- D. Completion of any group exercise class regardless of content or intensity

161. A needs analysis for a competitive ice hockey forward (45-60 second shifts with 2-3 minute bench rest) identifies which energy system as the primary conditioning target?

- A. The glycolytic system using 45-60 second high-intensity intervals with 2-3 minute rest replicating shift demands

- B. Only the phosphagen system because individual strides last less than 1 second
- C. Only the oxidative system because total game duration exceeds 60 minutes
- D. No energy system training because skating technique alone determines performance

162. For an advanced athlete (7+ years) preparing for a single competition, which periodization model is most appropriate?

- A. A fixed program with zero variation for the entire preparatory period
- B. A beginner program at 60% 1RM with no progressive overload
- C. Block periodization with accumulation → transmutation → realization targeted to peak at competition
- D. Random exercise selection with no structure or peaking strategy

163. An athlete's strength has plateaued after 20 weeks of the same program. The principle of accommodation predicts which intervention is most appropriate?

- A. Continuing the identical program because all plateaus resolve spontaneously
- B. Complete training cessation for 6 months before any reassessment
- C. Permanently reducing all loads to 30% of 1RM without any other change
- D. Introducing variation in exercises, loads, volumes, or periodization model to provide novel stimuli

164. A reconditioning program after hamstring surgery should follow which progression?

- A. Immediate full-intensity sprinting on the first day of medical clearance
- B. Progressive loading from low-intensity through sport-specific movements, meeting bilateral symmetry criteria (within 10%) before unrestricted return
- C. Exclusive upper body training for the remainder of the athlete's career
- D. Continued complete rest for 12 months regardless of medical clearance

165. A 12-week block periodization program for an advanced powerlifter sequences the blocks in which order?

- A. Accumulation (high volume/moderate intensity) → Transmutation (higher intensity/sport-specific) → Realization (low volume/peaking)
- B. Realization → Transmutation → Accumulation in reverse
- C. Competition → Transition → General preparation only
- D. Flexibility → Cardiovascular → Muscular endurance exclusively

166. Rest periods for muscular endurance training (less than 67% 1RM, 12+ reps) should be which duration?

- A. 2-5 minutes for complete PCr and neural recovery
- B. 8-10 minutes for full systemic recovery before each set
- C. 30 seconds or less to maintain elevated metabolic demand throughout the session
- D. No rest — continuous exercise for 90 minutes without stopping

167. A protocol of 5×2 at 93% 1RM with 5-minute rest develops which quality?

- A. Muscular endurance through high-repetition sustained work
- B. Muscle hypertrophy through moderate loading with metabolic stress
- C. Cardiovascular fitness through sustained elevated heart rate
- D. Maximal strength and neural adaptation through near-maximal loading with complete recovery

168. Volume load calculation: 4×6×120 kg on the back squat equals which total?

- A. 480 kg (sets × load)
- B. 2,880 kg (4 × 6 × 120) using the standard formula

- C. 720 kg (reps × load)
- D. 24 repetitions (sets × reps)

169. For a novice athlete's first 4-6 weeks, the loading strategy should be which of the following?

- A. Moderate loads (60-70% estimated 1RM) with higher reps (10-15) emphasizing technique, work capacity, and connective tissue adaptation
- B. Maximal loads at 95% 1RM with singles from the first session
- C. Only plyometric depth jumps with no strength foundation
- D. No resistance training for 12 months while doing only flexibility

170. Plyometric training frequency should be 2-3 sessions per week with 48-72 hours between sessions primarily because of which requirement?

- A. The recovery time is arbitrary with no physiological basis
- B. The interval is needed only for cognitive processing of movement patterns
- C. Adequate recovery of musculotendinous structures experiencing significant eccentric loading
- D. Recovery is needed exclusively for cardiovascular restoration

171. An athlete's training log: Week 1 = 4×8 at 70%, Week 3 = 4×6 at 78%, Week 5 = 4×5 at 83%, Week 7 = 4×3 at 89%. This pattern characterizes which periodization model?

- A. Daily undulating periodization with within-week variation
- B. Linear periodization with progressive intensity increases and volume decreases across phases
- C. Random programming with no planned structure
- D. Block periodization with single-quality concentration per block

172. Developing both maximal strength and explosive speed in a sprinter's weekly plan requires which approach?

- A. Training exclusively with heavy loads above 90% 1RM for every exercise
- B. Combining heavy strength training (85%+ 1RM) on some days with explosive exercises (Olympic lifts, plyometrics, jump squats at 30-50% 1RM) on others
- C. Training exclusively with bodyweight exercises at maximum velocity
- D. Eliminating all resistance training and relying solely on sprint practice

173. A deload week after three loading weeks (volume reduced 40%, intensity maintained) serves which purpose?

- A. Managing accumulated fatigue while maintaining neuromuscular stimulus, allowing recovery and supercompensation before the next loading cycle
- B. Testing 1RM on all exercises under maximally fatigued conditions
- C. Permanently reducing load because the athlete has reached their ceiling
- D. Eliminating all stimulus so the athlete restarts from the beginning

174. A rower's needs analysis identifies aerobic endurance, pulling strength, core stability, and lower body drive. Which exercise combination addresses all needs?

- A. Exclusively distance running and cycling with no resistance training
- B. Only biceps curls because rowing is exclusively arm-driven
- C. Only depth jumps because explosive power is the sole relevant quality
- D. Rowing-specific conditioning, rows/pull-ups for pulling, anti-extension/anti-rotation core, and front squats/RDLs for lower body

175. A martial artist competing in 3-minute rounds with 1-minute rest should primarily target which energy system?

- A. Only the phosphagen system because individual strikes last less than 0.5 seconds
- B. Only the oxidative system because total fight duration exceeds 5 minutes
- C. No energy system training because technique alone determines success
- D. The glycolytic system (3-minute sustained high-intensity fighting), supplemented by phosphagen for explosive techniques and aerobic for between-round recovery

176. In-season maintenance requires which variable to be preserved to prevent detraining?

- A. Training volume at preparatory-period levels throughout the entire competitive season
- B. Training intensity (% 1RM), which research identifies as the most critical detraining-prevention variable
- C. Frequency at 5 sessions per week regardless of competition schedule
- D. Exercise variety with completely new exercises at every session

177. The annual training plan should organize the year in which sequence?

- A. General preparation → Specific preparation → Competition → Transition
- B. Competition → Transition → General preparation → Specific preparation
- C. Transition → Competition → General preparation → Specific preparation
- D. Specific preparation → General preparation → Transition → Competition

178. A protocol of 4×12 at 70% 1RM with 60-second rest targets which adaptation?

- A. Maximal strength through heavy loading with complete neural recovery
- B. Explosive power through ballistic high-velocity movement

C. Muscle hypertrophy through moderate loading with mechanical tension and metabolic stress from short rest

D. Phosphagen system development through brief maximal-intensity efforts

179. A decathlete needs sprint speed, endurance, jumping power, throwing power, and skills simultaneously. Which periodization approach is best?

A. Block periodization focusing on one event for 4 weeks before switching

B. Linear periodization training only sprinting for 6 months then throwing for 6 months

C. No structured training because event variety makes periodization impossible

D. Concurrent training with undulating periodization addressing multiple qualities simultaneously

180. An athlete with a wrist injury preventing barbell grip should train which lower body exercises?

A. No training of any kind until the wrist is fully healed

B. Belt squats, leg press, goblet squats with modified grip — exercises not requiring conventional barbell grip

C. Only upper body machine exercises to maintain uninjured areas

D. Heavy barbell back squats with standard grip because the wrist will adapt

181. A goalkeeper's demands include explosive saves and 2-5 second sprints with variable rest. The conditioning work-to-rest ratio should be which of the following?

A. 1:8 to 1:12 targeting the phosphagen system with near-complete PCr recovery between explosive efforts

B. 1:1 targeting the oxidative system with equal work and rest

C. 1:3 targeting the glycolytic system with moderate recovery

D. No structured rest — continuous 90-minute training without breaks

182. The general preparation phase emphasizes which foundational qualities?

- A. Sport-specific power and speed for immediate competitive readiness
- B. Complete rest with no training for the entire phase
- C. A broad base of hypertrophy, general strength, work capacity, and aerobic fitness
- D. Exclusively technical sport skill practice with no physical training

183. The specific preparation phase shifts to which training focus?

- A. Sport-specific qualities including power, speed, agility, and sport-specific conditioning
- B. Maximum aerobic endurance through exclusive long-distance running
- C. Complete rest to conserve energy for competition
- D. Only flexibility training because other qualities maintain automatically

184. A DUP week (Monday hypertrophy, Wednesday strength, Friday power) provides which primary advantage?

- A. DUP eliminates all planning because variation is random
- B. More frequent exposure to different stimuli within each week, preventing accommodation and enabling simultaneous multi-quality development
- C. DUP never uses heavy loads reducing all injury risk
- D. Identical outcomes to performing the same workout every session

## TESTING AND EVALUATION (Questions 185–206)

185. Assessing lower body explosive power in 45 athletes during a 90-minute session requires which test?

- A. The vertical jump (CMJ) using a Vertec — valid, reliable, practical for large groups, and efficiently administered
- B. Laboratory isokinetic dynamometry requiring 25 minutes per individual
- C. Force plate analysis with 3D motion capture requiring specialized personnel
- D. Underwater weighing to assess body composition as a power proxy

186. A test producing consistent scores across repeated administrations under identical conditions demonstrates which property?

- A. Face validity based on apparent relevance to the sport
- B. Construct validity measuring an underlying physiological quality
- C. Reliability — consistency ensuring observed changes reflect true performance improvement
- D. Criterion validity through gold-standard comparison

187. During 1RM testing, an athlete lifts 135 kg successfully then fails at 140 kg. The recorded 1RM is which value?

- A. 140 kg because the athlete attempted this weight
- B. 137.5 kg as the average of successful and failed attempts
- C. The test must restart because any failure invalidates prior results
- D. 135 kg — the last weight successfully lifted with acceptable technique through full ROM

188. An athlete's CMJ is 66 cm and SJ is 55 cm. The 11 cm difference reflects which capacity?

- A. Maximum aerobic power during the jump session
- B. Stretch-shortening cycle utilization — stored elastic energy and stretch reflex from the countermovement enhancing concentric force production
- C. Hamstring-to-quadriceps ratio for ACL injury prediction
- D. Absolute maximal quadriceps strength independent of contraction velocity

189. Assessing aerobic capacity in 50 soccer players outdoors with minimal equipment requires which test?

- A. The 20-meter beep test — requires only cones and a sound system, administered to groups, providing valid aerobic capacity estimates
- B. Direct  $\text{VO}_2\text{max}$  on a laboratory treadmill with metabolic cart
- C. Wingate anaerobic power test on a specialized cycle ergometer
- D. 1RM back squat as a lower body strength proxy for aerobic fitness

190. Skinfold body composition involves which two-step calculation?

- A. Skinfolds directly produce body fat percentage without intermediate calculation
- B. Skinfolds estimate bone mineral density only
- C. Skinfolds entered into prediction equations to estimate body density, then converted to body fat percentage using equations such as the Siri formula
- D. Skinfolds multiplied by body weight to produce fat mass in kilograms

191. BIA body composition accuracy is most affected by which variable?

- A. Ambient room temperature during measurement

- B. The brand of athletic shoes worn during assessment
- C. Number of people present in the testing room
- D. The athlete's hydration status, affecting electrical conductivity and potentially altering estimates by several percentage points

192. Electronic sprint timing is more accurate than hand timing because it eliminates which error?

- A. Wind resistance affecting running velocity
- B. The human timer's reaction time variability (approximately 0.1-0.3 seconds per measurement)
- C. Temperature effects on muscle contraction speed
- D. Lane marking color affecting athlete motivation

193. A bilateral single-leg hop comparison: right = 44 cm, left = 35 cm (approximately 20% asymmetry). Clinical thresholds suggest which of the following?

- A. Normal variation requiring no intervention
- B. The right leg is overtrained requiring detraining
- C. The test was administered incorrectly invalidating all results
- D. Clinically significant asymmetry exceeding 10-15% threshold warranting corrective programming and possible medical evaluation

194. An athlete's test results: squat = 84th, vertical jump = 31st, pro agility = 57th, 1.5-mile run = 61st. The highest programming priority is which quality?

- A. Maximal strength already at the 84th percentile
- B. Aerobic endurance at the 61st percentile
- C. Explosive power (31st percentile vertical jump) — disproportionately low relative to high strength, indicating a rate of force development deficit
- D. Agility at the 57th percentile

195. The most critical factor for valid longitudinal testing comparisons is which of the following?

- A. Using different tests at each time point to prevent adaptation
- B. Allowing athletes to choose conditions at each session
- C. Testing immediately after heavy training for fatigued performance evaluation
- D. Identical conditions across sessions — same warmup, equipment, test order, time of day, and environment

196. An athlete returning from ACL reconstruction achieves 88% bilateral hop symmetry. Based on the 90% criterion, the recommendation is which of the following?

- A. Return to unrestricted competition because 88% is close enough
- B. Continue progressive strengthening because the surgical leg has not met the 90% threshold
- C. Bilateral hop testing has no relevance to ACL return-to-play
- D. The athlete should be permanently restricted from competition

197. A force plate during vertical jump testing measures which variables that simpler methods cannot?

- A. Peak GRF, rate of force development, impulse, and power output in addition to jump height
- B. Only jump height from standing reach minus jumping reach
- C. Only body weight before the test
- D. Only flight time from takeoff to landing

198. The sit-and-reach test has which primary limitation?

- A. Requires expensive laboratory equipment unavailable in field settings
- B. Takes more than 30 minutes per athlete to administer

- C. Primarily measures hamstring and lower back flexibility, does not assess other joints, and is influenced by limb proportions
- D. Measures only shoulder flexibility with no lower body relevance

199. Goniometric assessment provides which advantage over the sit-and-reach?

- A. Goniometry is less accurate than the sit-and-reach for all joints
- B. Identical information with no additional value
- C. Measurement limited to the hip joint only
- D. Joint-specific ROM measurements at any individual joint, identifying specific restrictions the sit-and-reach cannot detect

200. Performance testing should be conducted at which intervals?

- A. Daily for maximum data granularity
- B. At the beginning and end of each major training phase and at pre/post-season time points
- C. Once at career start with no subsequent testing
- D. Randomly with no schedule to prevent athlete preparation

201. Submaximal 1RM prediction equations are most accurate with repetitions within which range?

- A. 10 or fewer, because the rep-to-1RM relationship becomes less linear at higher counts introducing greater error
- B. 25-30 repetitions for maximum statistical data points
- C. 15-20 repetitions to demonstrate full endurance capacity
- D. Exactly 1 repetition eliminating the need for prediction

202. The standardized 1RM protocol includes how many warmup sets before maximal attempts?

- A. No warmup — attempt estimated 1RM immediately
- B. One set of 50 light repetitions for blood flow
- C. 3-4 progressively heavier sets (approximately 50%, 70%, 80-85% of estimated 1RM) before maximal singles
- D. 10 sets of 10 at increasing loads for complete preparation

203. The T-test assesses multidirectional movement through which pattern?

- A. Straight-line 40-yard sprint with no direction changes
- B. Repeated vertical jumps for 60 seconds
- C. Agility ladder drill with predetermined footwork patterns
- D. Forward sprint, lateral shuffle in both directions, and backward run in a T-shaped pattern

204. An athlete's vertical jump hasn't improved after 12 weeks of plyometrics. Their squat is  $1.1 \times$  body weight. The modification is which of the following?

- A. Continue identical plyometric program for 12 more weeks
- B. Add heavy resistance training to develop the strength base — squat below  $1.5 \times$  body weight limits SSC effectiveness
- C. Eliminate all lower body training
- D. Complete training cessation for 6 months

205. The Cooper 12-minute run and 1.5-mile run share which limitation?

- A. Both require expensive metabolic equipment
- B. Both can only test one athlete at a time

- C. They depend on self-pacing at maximal effort, influenced by motivation and pacing experience
- D. Neither distinguishes between athletes of different fitness levels

206. A pre-season battery for a collegiate basketball team should assess which domains?

- A. Only bench press because upper body strength is the sole determinant
- B. Only body composition because lean athletes always outperform
- C. Aerobic capacity, sprint speed, agility, lower body power, upper body strength, and body composition
- D. Only flexibility because basketball requires no other physical qualities

### **ORGANIZATION AND ADMINISTRATION (Questions 207–220)**

207. A facility accommodating 55 athletes needs minimum floor space (NSCA minimum 40 sq ft/athlete) of which of the following?

- A. 550 sq ft (10 sq ft per athlete)
- B. 1,100 sq ft (20 sq ft per athlete)
- C. 5,500 sq ft (100 sq ft per athlete)
- D. 2,200 sq ft ( $55 \times 40$ ), with the upper guideline of 60 sq ft producing 3,300 sq ft

208. An EAP should be rehearsed at which minimum frequency?

- A. Only once when the facility opens
- B. At least annually with all staff, ideally more frequently
- C. Every 10 years with facility renovation
- D. Only after an emergency to evaluate the response

209. CSCS professionals must maintain certification in which emergency skill?

- A. CPR and AED use from a recognized provider
- B. Advanced cardiac life support at physician level
- C. EMT certification at paramedic level
- D. Wilderness first responder certification

210. The "standard of care" in negligence law refers to which concept?

- A. Maximum insurance coverage required by state law
- B. Minimum professional salary demonstrating competence
- C. The degree of care a reasonably competent professional with similar training would exercise under similar circumstances
- D. Continuing education credits required for recertification

211. A waiver generally does NOT protect against which claim type?

- A. Inherent risks clearly disclosed and voluntarily assumed
- B. Normal soreness from appropriately designed training
- C. Risks explicitly acknowledged by the participant
- D. Gross negligence or reckless conduct — willful safety disregard beyond ordinary carelessness

212. An athlete asks for chronic shoulder pain diagnosis and rehabilitation prescription. The CSCS should do which of the following?

- A. Diagnose the condition and prescribe rehabilitation independently
- B. Refer to a qualified medical professional — diagnosis and rehabilitation are outside the CSCS scope
- C. Prescribe anti-inflammatory medication based on body weight

D. Perform a surgical evaluation of the shoulder

213. Which activity falls within the CSCS scope of practice?

- A. Designing periodized programs, teaching technique, administering tests, and managing the facility
- B. Diagnosing musculoskeletal injuries through physical examination
- C. Prescribing individualized meal plans with caloric and macronutrient targets
- D. Providing psychological counseling for clinical depression

214. Damaged equipment should be handled by which protocol?

- A. Continued use until complete failure because replacement is expensive
- B. Hidden from athletes to prevent concern
- C. Immediately removed, tagged out of order, documented in maintenance logs, and repaired/replaced before return
- D. Only the manufacturer can evaluate damage

215. When a coach's demands conflict with safety, the CSCS should do which of the following?

- A. Always comply because the coach has final authority
- B. Resign immediately without discussion
- C. Implement demands but document objections privately
- D. Decline unsafe practices, explain the evidence-based rationale, and advocate for athlete safety

216. Supervision ratios should adjust based on which factors?

- A. Only total athlete count regardless of exercises performed

- B. Exercise complexity, athlete experience level, and staff qualifications
- C. Only time of day
- D. Only facility dimensions

217. Record keeping should include which documents?

- A. Athlete training logs, testing data, waivers, medical clearances, equipment maintenance records, and incident reports
- B. Only financial statements and tax returns
- C. Only social media posts from training sessions
- D. Only the head coach's practice plans

218. A colleague without credentials independently teaches heavy power cleans to inexperienced athletes. The response should be which of the following?

- A. Ignore it because it doesn't involve the specialist's athletes
- B. Encourage higher loads to accelerate development
- C. Addressing the concern with the colleague and/or supervisor — unqualified instruction creates significant safety and liability risk
- D. Post about it on social media

219. A facility requires closed-toe shoes. An athlete arrives in sandals. The response should be which of the following?

- A. Allow training because footwear enforcement is unnecessarily strict
- B. Allow barefoot training as an alternative
- C. Permanently modify the policy for this athlete
- D. Enforce the policy — the athlete cannot train until returning with proper closed-toe athletic footwear

220. The NSCA establishes that the CSCS holds which authority regarding the program?

- A. No authority because the sport coach makes all decisions
- B. Ultimate professional authority and responsibility for the design, implementation, and supervision of the strength and conditioning program
- C. Authority limited to equipment purchasing only
- D. Authority only during the off-season with in-season deferred to coaches

# PRACTICE EXAM 8 — ANSWER KEY

## WITH EXPLANATIONS

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### SECTION 1 — SCIENTIFIC FOUNDATIONS

#### EXERCISE SCIENCE (Questions 1–52)

1. C — Chronic training promotes conversion of Type Ix fibers to the more oxidative, fatigue-resistant Type IIa phenotype within the Type II spectrum. This is the most well-documented fiber type transition in exercise science. The Type IIa fibers retain fast-twitch contractile properties while gaining greater oxidative capacity and fatigue resistance.
2. A — Transverse tubules (T-tubules) are invaginations of the sarcolemma that carry the action potential from the fiber surface deep into the interior, where they communicate with the sarcoplasmic reticulum at the triads. Without T-tubules, only the outermost myofibrils would receive the contraction signal, producing uncoordinated force generation.
3. B — The improvement from 70% to 90% voluntary activation reflects reduced neural inhibition from the Golgi tendon organ and improved central drive to the motor neuron pool. Chronic heavy loading desensitizes the GTO's protective inhibition and enhances the brain's ability to maximally recruit available motor units during voluntary effort.
4. D — The external load as a percentage of 1RM determines where on the force-velocity curve the athlete trains. Lighter loads allow higher velocities (speed-strength end), heavier loads produce greater force at slower velocities (maximal strength end), and moderate loads at moderate velocities target the power zone in the middle of the curve.
5. C — According to Henneman's Size Principle, the highest-threshold motor units innervating Type IIa and Ix fibers are recruited only when force demands approach 80-85% or more of maximal voluntary contraction. Heavy loads above this threshold ensure complete motor unit pool activation, providing the neural stimulus for maximal strength development.
6. A — The exponential rise from 2.1 mmol/L at 225 watts to 5.3 mmol/L at 250 watts identifies the lactate threshold — the intensity where production began exceeding clearance capacity. Below this point, lactate production and removal were balanced; above it, accumulation accelerates exponentially.
7. B — A 45-55 second near-maximal effort falls within the glycolytic-dominant duration range. The glycolytic system provides the primary ATP contribution through rapid breakdown of muscle

glycogen, producing the energy needed for sustained high-intensity effort while generating the hydrogen ions that cause progressive fatigue.

8. D — The trained runner's higher lactate threshold (78% vs. 52% of  $\text{VO}_2\text{max}$ ) reflects increased mitochondrial density, enhanced oxidative enzyme activity, greater capillary networks, and improved fat oxidation. These adaptations reduce muscle reliance on glycolysis at any given workload, delaying the onset of lactate accumulation.
9. C — The  $\text{VO}_2$  plateau at 58 mL/kg/min despite two additional workload increases, combined with RER of 1.20, lactate of 14 mmol/L, and near-maximal heart rate, confirms  $\text{VO}_2\text{max}$ . The primary criterion (plateau) is validated by multiple secondary criteria confirming the athlete reached their absolute aerobic ceiling.
10. A — Oxygen serves as the final electron acceptor at the end of the ETC, combining with electrons and hydrogen ions to form water. Without oxygen, electrons cannot exit the chain, NADH and  $\text{FADH}_2$  accumulate in reduced form, and aerobic ATP production ceases entirely.
11. B — Fat oxidation produces ATP at a rate too slow to match the rapid energy demand of high-intensity exercise, despite its greater total yield per molecule. The carbohydrate pathways (glycolysis and oxidative phosphorylation) produce ATP at a faster rate, making them dominant when energy demand is high.
12. D — After 3 hours at 65%  $\text{VO}_2\text{max}$ , muscle and liver glycogen become substantially depleted and blood glucose drops to 50 mg/dL. Without adequate carbohydrate substrate, the body cannot maintain the ATP production rate needed for the exercise intensity — the classic endurance "bonk."
13. C — NADH and  $\text{FADH}_2$  deliver their electrons to the electron transport chain, which uses the electron energy to pump protons across the inner mitochondrial membrane. This proton gradient drives ATP synthase, producing approximately 34 of the 36-38 total ATP from complete glucose oxidation.
14. A — Full PCr replenishment requires 3-5 minutes of rest. The 4-minute interval ensures near-complete phosphocreatine availability for each subsequent sprint, maintaining the phosphagen system as the dominant energy contributor and preserving the quality and specificity of maximal-effort training.
15. B — Net upward force =  $2,800 - 932 = 1,868$  N. Acceleration =  $1,868 \div 95 \approx 19.7$  m/s<sup>2</sup>. Only the force exceeding the athlete's body weight (gravitational force) produces upward acceleration — the first 932 N simply supports the athlete's mass against gravity.
16. D — Torque equals force multiplied by moment arm. At knee height with the torso inclined forward, the horizontal distance between the barbell and the lumbar spine is at maximum. This creates the greatest flexion torque demand on the hip and back extensors, making this the mechanical sticking point.

17. C — Third-class levers have a short effort arm (biceps insertion near the elbow) and long resistance arm (dumbbell far from the joint). This arrangement favors speed and range of motion — a small amount of muscle shortening produces a large, fast movement at the hand — but the muscle must produce force many times greater than the external load.
18. A — Both athletes produce identical peak force (2,800 N), but Athlete A reaches it in 130 ms versus 260 ms. This superior rate of force development produces greater impulse during the limited ground contact time, resulting in higher takeoff velocity and jump height despite equal peak force.
19. B — The three SSC mechanisms are: stored elastic energy in the musculotendinous unit returned as mechanical work during the concentric phase, the stretch reflex from muscle spindle activation augmenting concentric force, and increased time for force development because tension builds during the eccentric phase before concentric begins.
20. D — The 6-second isometric contraction generates high tension that activates the GTO. The GTO sends inhibitory signals through an Ib interneuron that reduce alpha motor neuron activity to the target muscle, temporarily decreasing its tone and resistance to stretch — allowing a greater subsequent ROM.
21. A — Ground contact times doubling from 160 to 340 ms with declining jump height confirms fatigue and loss of SSC effectiveness. Plyometric training is quality-based — every repetition should demonstrate maximal effort with minimal contact time. Continuing trains degraded patterns with no power benefit.
22. C — Research on elite sprinters consistently demonstrates that vertical GRF during the brief ground contact phase (80-100 ms) at maximum velocity is the primary factor distinguishing faster from slower runners. Faster sprinters produce greater vertical force relative to body weight.
23. B — The forward lean during acceleration allows the athlete to direct ground reaction forces primarily horizontally backward against the ground. Newton's Third Law produces an equal forward-directed reaction force that overcomes inertia and generates forward momentum from the stationary start.
24. D — Eccentric hypertrophy increases left ventricular chamber volume, allowing greater filling during diastole and ejection of more blood per beat during systole. This increased maximal stroke volume is the primary mechanism for enhancing maximal cardiac output and endurance performance.
25. A — Local vasodilation in working muscles is triggered by metabolic signals: increased CO<sub>2</sub>, decreased O<sub>2</sub>, elevated temperature, and metabolite accumulation (adenosine, potassium, hydrogen ions). These directly relax vascular smooth muscle, increasing local blood flow to the most metabolically active tissues.
26. C — The high-volume, short-rest protocol maximizes metabolic stress — elevated lactate, hydrogen ions, and reduced pH — which is the primary stimulus for acute GH release from the

anterior pituitary. The heavy protocol minimizes metabolic stress but drives superior neural adaptation through maximal motor unit recruitment.

27. B — Female athletes achieve strength gains primarily through neural adaptations — improved motor unit recruitment, rate coding, intermuscular coordination, and reduced antagonist co-contraction. These neural mechanisms account for a larger proportion of total gains in females because lower testosterone limits the magnitude of structural hypertrophy.
28. D — Progressive testosterone decline, rising cortisol, deteriorating T:C ratio, performance decline, disrupted sleep, elevated resting HR, and persistent fatigue over 10 weeks represent classic overtraining syndrome. Chronic imbalance between accumulated training stress and recovery capacity has produced systemic maladaptation.
29. A — The mTOR pathway integrates signals from mechanical loading (IGF-1/MGF), amino acid availability (particularly leucine), and hormonal stimulation (insulin, IGF-1). It is the central intracellular regulator determining the rate of new contractile and structural protein production within the muscle fiber.
30. C — Wolff's Law predicts bone remodeling in response to mechanical stress. Ground-based resistance exercises with impact activities apply compressive and impact forces directly to the weight-bearing skeleton, providing the greatest osteogenic stimulus. Non-weight-bearing activities provide minimal bone loading.
31. B — With identical 1RM values (190 kg), the 16 cm jump difference indicates superior rate of force development and power in Athlete A. During the brief ground contact of a jump, Athlete A produces force more rapidly, generating greater impulse that translates to higher takeoff velocity and jump height.
32. D — The law of diminishing returns combined with the neural-to-structural adaptation shift explains the different rates. The novice captures rapid neural gains (42% with minimal hypertrophy), while the experienced lifter must rely on slower hypertrophic mechanisms for smaller incremental improvement (4% with measurable hypertrophy).
33. A — Rapid muscular strength gains can outpace connective tissue strengthening because tendons and ligaments have lower metabolic activity and blood supply. This differential rate creates a window where muscular forces may exceed connective tissue capacity, requiring gradual progressive overload and adequate recovery.
34. C — Slow aerobic training develops oxidative capacity and slow-twitch enhancement but does not provide stimulus for explosive jumping, rapid lateral movement, overhead hitting power, or anaerobic sprint ability — the specific demands of volleyball. The SAID principle requires training specificity matching sport demands.
35. B — Eccentric force increases slightly with lengthening velocity up to a plateau 20-60% above isometric maximum. Athletes can safely lower loads exceeding their concentric 1RM, forming the

basis for supramaximal eccentric training that provides a novel overload stimulus for strength and connective tissue adaptation.

36. D — Aerobic capacity declines most rapidly (measurable within 1-2 weeks), followed by muscular endurance, then maximal strength (maintained 2-4 weeks or longer). This hierarchy guides rehabilitation programming — aerobic fitness requires earlier attention while strength can be temporarily deprioritized.
37. A — Torque = force  $\times$  moment arm =  $(6 \text{ kg} \times 9.81 \text{ m/s}^2) \times 0.55 \text{ m} = 58.86 \text{ N} \times 0.55 \text{ m} \approx 32.4 \text{ N}\cdot\text{m}$ . Mass must be converted to force (Newtons) then multiplied by the perpendicular distance from the joint axis to the gravitational force line.
38. C — Vasodilation in working muscles reduces total peripheral resistance. Because diastolic pressure reflects peripheral resistance during cardiac relaxation, the reduced resistance counterbalances the increased cardiac output and prevents diastolic pressure from rising during moderate exercise.
39. B — Amenorrhea for 7 months, grossly inadequate caloric intake (1,200 kcal with 2.5 hours daily training), decreased lumbar BMD, and recurrent stress fractures represent RED-S. Low energy availability drives menstrual dysfunction and compromised bone health through hormonal disruption.
40. D — Cortisol's catabolic actions break down amino acids from muscle protein to provide substrates for hepatic gluconeogenesis. This produces glucose for the brain (obligatorily glucose-dependent) and other tissues during stress when glycogen stores are being depleted.
41. A — Stable testosterone with decreased cortisol produces a favorable T:C ratio indicating positive anabolic-catabolic balance. Combined with performance gains, good sleep, and subjective recovery, this confirms successful adaptation without overreaching or overtraining.
42. C — Enhanced androgen receptor density increases the muscle's sensitivity to circulating testosterone at the tissue level. Each testosterone molecule produces a stronger anabolic signal, potentially amplifying the hypertrophic and strength response even without changes in basal hormone concentrations.
43. B — The progressive RER increase from 0.76 to 1.05 reflects the crossover concept — a shift from predominantly fat oxidation at low intensities to predominantly carbohydrate oxidation at high intensities. The body requires the faster ATP production rate that only carbohydrate pathways can provide as intensity escalates.
44. D — The Cori cycle recycles lactate into glucose in the liver, maintaining blood glucose levels during sustained exercise. This is critical because the brain is obligatorily glucose-dependent and the working muscles benefit from continued glucose availability as local glycogen depletes.

45. A — The creatine kinase reaction is a simple, single-step enzymatic process occurring directly in the sarcoplasm. It requires no oxygen, no mitochondria, and no complex multi-step pathways — making it the fastest ATP-regenerating system, dominant during the first 6-10 seconds of maximal effort.
46. C — In the second-class lever of the calf raise, the effort arm (calcaneus to ball of foot) is longer than the resistance arm (ankle to ball of foot). This creates a mechanical advantage greater than one, meaning the muscle can produce movement against resistance greater than in a third-class arrangement.
47. B — Passive ROM exceeds active ROM because external force can move the joint beyond the limit of voluntary muscular effort. The 20-degree difference reflects the neuromuscular limits of active motion — the hip flexors cannot generate sufficient force to move the joint through the full passive range.
48. D — The stretch reflex is monosynaptic — involving only a single synapse between the afferent sensory neuron from the muscle spindle and the efferent alpha motor neuron. This single-synapse arrangement produces the fastest possible reflexive contraction, occurring in milliseconds.
49. A — Reduced GTO inhibition allows trained athletes to voluntarily recruit a greater percentage of their motor unit pool, producing force closer to the structural capacity of the musculotendinous unit. This neural disinhibition is a significant contributor to strength gains beyond hypertrophy alone.
50. C — Retained myonuclei from prior training persist even during detraining-induced atrophy. When training resumes, these additional nuclei accelerate the protein synthetic response, allowing faster recovery of muscle size and strength — explaining the "muscle memory" phenomenon.
51. B — The high jump demands unilateral takeoff power, rapid RFD during the brief contact, vertical power through the SSC, and explosive approach speed. Slow bilateral squats alone fail to develop these sport-specific demands — violating the SAID principle's requirement for training specificity.
52. D — The progressive RER decrease from 0.85 to 0.76 over 4 hours reflects increasing reliance on fat oxidation as glycogen depletes. As carbohydrate availability declines, the body shifts toward the slower but more abundant fat pathways, producing the lower CO<sub>2</sub>-to-O<sub>2</sub> ratio characteristic of fat metabolism.

### **SPORT PSYCHOLOGY (Questions 53–75)**

53. A — Excessive worry, fear of disappointment, and negative thoughts are cognitive anxiety symptoms requiring cognitive interventions. Thought stopping interrupts the negative pattern with a cue word, and instructional self-talk replacement redirects cognitive resources to task-relevant performance cues.

54. C — A triple axel requires precise timing, aerial control, and landing balance — complex fine motor and spatial demands degraded by excessive arousal. Low-to-moderate arousal preserves the fine coordination and focused attention needed for this technically demanding element.
55. B — The hierarchical combination is most effective: outcome goals provide long-term direction, performance goals provide measurable benchmarks for tracking progress, and process goals direct daily attention to controllable training behaviors that drive improvement.
56. D — Past performance accomplishment is the most powerful of Bandura's four self-efficacy sources. Successfully completing 180 kg provides direct personal evidence of capability — stronger efficacy beliefs than vicarious experience, verbal persuasion, or physiological state interpretation.
57. D — Excellent practice with systematic competitive underperformance, combined with worry, fear of failure, and disruptive negative self-talk, indicates choking under pressure. Excessive cognitive anxiety disrupts the automatic motor execution demonstrated in low-pressure practice.
58. C — Muscle tension, elevated heart rate, and rapid breathing are somatic anxiety symptoms requiring physical relaxation techniques. PMR teaches systematic tension release and diaphragmatic breathing activates the parasympathetic nervous system to reduce cardiovascular and respiratory activation.
59. B — Effective imagery engages visual (ball trajectory), kinesthetic (serve motion feel), auditory (racket contact), and emotional (confidence of success) components simultaneously. Multi-sensory engagement creates the richest mental rehearsal that transfers most effectively to actual performance.
60. D — Automatic technique with simultaneous monitoring, planning, and strategy adjustment without conscious thought about body positions defines the autonomous stage. The skill is automated, freeing cognitive resources for higher-order processing and real-time performance optimization.
61. A — Random practice produces slower initial improvement but significantly better long-term retention and transfer. The constant task-switching forces deeper cognitive processing that builds more robust motor representations persisting over time and transferring to novel contexts.
62. C — The guidance hypothesis states constant feedback creates dependency on external correction. Athletes wait for the coach rather than developing internal error-detection capabilities. Reducing frequency forces attention to proprioceptive information, building self-monitoring skills.
63. D — "You jumped 31 inches" is knowledge of results (KR) — information about the outcome of the performance. KR tells what happened (the result) but not how the movement was executed. KP would describe the technique itself.

64. B — Memory consolidation during rest intervals stabilizes and transfers motor memories from short-term to long-term storage. Distributed practice allows this neurological process between bouts, producing more durable representations that resist forgetting and transfer to new situations.
65. A — Progressive withdrawal, persistent motivation loss, feeling trapped, and emotional exhaustion over weeks are hallmark symptoms of athletic burnout — characterized by emotional exhaustion, depersonalization, and reduced sense of accomplishment.
66. C — Increasing isolation, persistent worthlessness, lost interest, and expressed hopelessness are potential warning signs of clinical depression in an adolescent. The specialist must recognize these signs and recommend professional mental health evaluation by qualified providers.
67. D — Extreme weight manipulation, meal avoidance, excessive exercise, and weight preoccupation are disordered eating warning signs requiring professional evaluation. Diagnosing and treating eating disorders is outside the CSCS scope — referral to a qualified healthcare professional is mandatory.
68. B — Providing autonomy (choice), competence (progressive challenges), and relatedness (team cohesion) satisfies all three basic psychological needs identified by self-determination theory. Meeting these needs fosters intrinsic motivation — the most sustainable form supporting adherence, effort, and resilience.
69. A — RED-S in male athletes produces suppressed testosterone, decreased bone mineral density, impaired immune function, and declining performance. Chronic low energy availability drives these consequences regardless of sex, expanding beyond the original female athlete triad.
70. C — Fear of re-injury is a recognized psychological barrier to return from ACL surgery. Gradual reintroduction at progressive intensities builds confidence, while sport psychology referral addresses cognitive and emotional components through evidence-based interventions.
71. D — Research consistently demonstrates that athletes experiencing significant psychological distress during rehabilitation (fear, frustration, depression, isolation) have longer recovery times and higher re-injury rates. Psychological factors significantly influence rehabilitation outcomes.
72. B — The absolute speed and force change between the fastball and changeup, but the invariant features (relative timing, relative force proportions, spatial pattern) remain constant. This variable parameter adjustment is the functional advantage of generalized motor programs.
73. A — Past performance accomplishment is the most powerful self-efficacy source. Successfully completing 185 kg provides direct personal evidence of capability, creating the strongest confidence that 190 kg is achievable. Mastery experience surpasses all other sources.
74. C — Scanning the kicker's body posture, foot angle, and run-up requires broad-external focus — perceiving multiple external stimuli simultaneously to gather perceptual information for an anticipatory decision about dive direction.

75. D — The front squat develops the upright torso, high-elbow rack position, and receiving posture that directly transfer to the power clean catch. Shared movement features create positive transfer — practice on the front squat directly improves the clean receiving position.

### **NUTRITION (Questions 76–95)**

76. B — A 90 kg athlete at 2.2 g/kg/day requires 198 grams of protein daily ( $90 \times 2.2 = 198$ ). This upper-end recommendation supports the elevated protein synthesis, tissue repair, and anti-catabolic demands of heavy resistance training.
77. A — Leucine is the branched-chain amino acid identified as the primary trigger for mTOR activation and protein synthesis initiation. A threshold of approximately 2-3 grams per meal ensures optimal stimulation of the protein synthetic machinery.
78. C — Whey protein stimulates MPS through leucine-triggered mTOR activation. High-GI carbohydrate rapidly replenishes glycogen through maximal glycogen synthase activity. The insulin response from carbohydrate enhances amino acid uptake into muscle, creating a synergistic recovery effect.
79. D — Chronically inadequate dietary fat (below 15-20% of calories) impairs steroid hormone production because cholesterol is the testosterone precursor. Fat-soluble vitamins (A, D, E, K) also require dietary fat for absorption. Both consequences compromise health and adaptation.
80. B — Consuming 3 liters per hour of plain water for 4 hours without sodium replacement dramatically dilutes blood sodium concentration below safe levels. The massive fluid intake relative to sodium losses through sweat causes exercise-associated hyponatremia.
81. A — The maintenance-only approach (3-5 g/day) achieves full creatine saturation in approximately 28 days — equally effective as the loading protocol but taking longer through gradual daily accumulation to reach the same saturated endpoint.
82. C — Caffeine blocks adenosine receptors in the CNS. Adenosine promotes drowsiness and reduces neural activity; blocking these receptors reduces fatigue perception, increases alertness and focus, and enhances pain tolerance during high-intensity effort.
83. D — Carnosine buffers hydrogen ions during high-intensity exercise. This is most beneficial for activities lasting 1-4 minutes where glycolytic hydrogen ion accumulation is the primary performance limiter. Shorter activities are phosphagen-dependent; longer ones primarily aerobic.
84. B — NSF Certified for Sport and Informed Sport independently test for banned substances, verify label accuracy, and screen for undeclared contaminants. These certifications provide the most reliable protection against inadvertent positive drug tests under WADA regulations.
85. A — During caloric deficit, protein needs increase to 2.0-2.4 g/kg/day to maximize lean mass preservation. Elevated protein combined with maintained resistance training provides the strongest defense against the accelerated muscle catabolism of energy restriction.

86. C — GI distress — nausea, bloating, cramping, diarrhea — is the most common side effect limiting sodium bicarbonate use. The alkaline compound and large dose (0.2-0.3 g/kg) irritate the GI tract, sometimes impairing rather than enhancing performance.
87. D — A 70 kg athlete at 10 g/kg/day requires 700 grams of carbohydrate daily ( $70 \times 10 = 700$ ). This upper-end recommendation supports the extreme glycogen demands of high-volume endurance training with daily depletion-replenishment cycles.
88. B — Vitamin C converts ferric iron ( $\text{Fe}^{3+}$ ) to the more bioavailable ferrous form ( $\text{Fe}^{2+}$ ), enhancing intestinal absorption of non-heme iron from plant-based sources. This is particularly important for athletes with low ferritin depending on plant-based iron.
89. A — When rapid glycogen recovery is needed (two sessions within 8 hours), consuming 1.0-1.5 g/kg within 30 minutes capitalizes on maximal glycogen synthase activity. This enzyme is most active immediately post-exercise, maximizing the resynthesis rate.
90. C — Plant-based athletes achieve adequate amino acids by consuming complementary sources throughout the day. Grains are low in lysine but high in methionine; legumes have the opposite profile. Combining multiple sources across meals provides all essential amino acids.
91. D — Casein forms a gel in the stomach slowing digestion, providing sustained amino acid delivery throughout the 7-9 hour overnight fasting period. This sustained release supports muscle protein synthesis during sleep when no other protein is consumed.
92. B — High-GI foods produce rapid blood glucose spikes and are most appropriately consumed during and immediately after exercise when rapid glucose delivery and glycogen replenishment are the priorities. The fast absorption matches acute peri-exercise metabolic needs.
93. A — Glutamine has limited evidence for muscle growth in healthy, well-nourished athletes with adequate protein. It is not classified among supplements with robust ergogenic evidence (creatine, caffeine, beta-alanine, sodium bicarbonate) for hypertrophy or performance.
94. C — Fat is essential for steroid hormone production (cholesterol is the testosterone precursor), fat-soluble vitamin absorption (A, D, E, K), cell membrane integrity (phospholipid bilayer), and essential fatty acids (linoleic, alpha-linolenic) the body cannot synthesize.
95. D — Vitamin D deficiency produces impaired muscle function, compromised immune competence, and elevated stress fracture risk with decreased bone mineral density. Athletes training indoors or at northern latitudes with limited UV exposure are at greatest risk.

## **SECTION 2 — PRACTICAL/APPLIED**

### **EXERCISE TECHNIQUE (Questions 96–140)**

96. B — Before loading any exercise, each novice athlete should demonstrate a bodyweight squat to assess mobility (ankle, hip, thoracic), motor control (knee tracking, spinal neutrality), and basic

movement competency. This screening identifies restrictions requiring correction before external load is added.

97. A — Heels rising indicates insufficient ankle dorsiflexion — the tibia cannot translate forward adequately to maintain balance with heels grounded. The body compensates by shifting weight forward onto the toes. Ankle mobility work or elevated heels address this limitation.
98. C — Forward bar drift increases the horizontal distance from bar to lumbar spine, creating a larger moment arm. Because  $\text{torque} = \text{force} \times \text{moment arm}$ , this dramatically amplifies flexion torque and lumbar injury risk.
99. D — An open (false) grip allows the bar to roll out of the hands onto the chest, neck, or face — a potentially catastrophic event. A closed grip with wrapped thumbs creates a mechanical lock preventing uncontrolled bar displacement. This is a non-negotiable safety standard.
100. B — Excessive lumbar hyperextension under load creates compressive and shear forces on vertebrae, discs, and facet joints while shifting the exercise toward an incline press pattern. This compensation indicates the load exceeds the athlete's strict pressing capacity.
101. A — The NSCA top-down progression begins with the front squat to establish the rack position — comfort with the bar on deltoids, high elbows, and upright torso — before any pulling mechanics are introduced. Safe reception must be established before explosive pulling.
102. C — Premature arm bending substitutes arm strength for the more powerful hip extensors. Arms should remain straight during the second pull, transmitting force from explosive triple extension. Pulling with arms limits bar velocity and the weight that can be cleaned.
103. D — Contact times doubling from 165 to 345 ms with declining height confirms fatigue and SSC loss. Plyometrics are quality-based — continuing degraded repetitions trains poor patterns with zero power benefit. Terminate immediately.
104. B — Novice athletes begin with low-to-moderate intensity (squat jumps, CMJ, box jumps stepping down) at 80-100 foot contacts. High-intensity exercises and excessive volumes require connective tissue conditioning and movement competency from progressive plyometric experience.
105. A — A single spotter positions behind the athlete with arms under the armpits to assist upward at the torso. Never grip the bar directly — this creates asymmetric loading. Torso support safely assists the athlete without interfering with the barbell.
106. C — The Valsalva is appropriate for healthy, trained athletes performing heavy compound lifts where maximal intra-abdominal pressure provides essential spinal stabilization. Contraindicated for individuals with cardiovascular risk factors where extreme blood pressure spikes pose danger.
107. D — Spinal rounding with momentum indicates excessive load and dangerous technique. Terminate the set, reduce load, and cue rigid spinal neutrality with pulling initiated by deliberate scapular retraction before elbow flexion.

108. B — A pitcher needs rotational power (medicine ball throws) for throwing and anti-rotation stability (Pallof press) for deceleration and spinal protection. This combination addresses both the force-producing and force-resisting demands of pitching.
109. A — Anti-extension exercises resist lumbar hyperextension as gravity or external load pulls the spine into an arched position. The rectus abdominis and deep stabilizers maintain spinal neutrality against this extending force.
110. C — Running upright directs forces too vertically, reducing the horizontal component needed to overcome inertia. The forward lean allows horizontal force application, generating the forward-directed reaction forces essential for rapid acceleration.
111. D — The pro agility shuttle uses a preplanned pattern. True agility requires a reactive perceptual-cognitive component — perceiving, processing, and responding to unpredictable stimuli while executing direction changes.
112. B — Dynamic stretching increases ROM while activating the neuromuscular system. Static stretching before explosive activity acutely reduces force production and power by decreasing musculotendinous stiffness and neural activation.
113. A — Foam rolling provides ROM improvements without the acute decrements in force and power associated with static stretching. This preserves neuromuscular readiness for explosive performance while enhancing flexibility.
114. C — The correct sequence: general warmup → dynamic stretching → movement preparation → specific warmup with progressive loading. This general-to-specific progression optimizes tissue temperature, neuromuscular activation, and movement readiness.
115. D — Chronic CWI may blunt inflammatory signaling (prostaglandins, cytokines, satellite cell activation) necessary for muscle protein synthesis and tissue remodeling. Acute post-training inflammation is part of the adaptive cascade — chronically suppressing it impairs hypertrophy.
116. B — Sleep (7-10 hours) and post-exercise nutrition (protein for repair, carbohydrate for glycogen) are foundational recovery practices with the strongest evidence. No external modality can compensate for deficits in these biological requirements.
117. A — Basketball's diverse demands require aerobic base (sustained 48-minute play), anaerobic intervals (court-length sprints with sport-specific rest), and reactive agility (direction changes responding to unpredictable game situations).
118. C — The aerobic system's primary team sport contribution is recovery capacity. Between sprints, it replenishes PCr, clears lactate and hydrogen ions, and restores homeostasis. Superior aerobic fitness enables faster recovery and sustained repeated-effort performance.

119. D — A DB performing 4-6 second sprints with 25-40 second rest operates at approximately 1:5 to 1:8, targeting the phosphagen system with near-complete PCr recovery. This matches the sport-specific energy demand pattern.
120. B — Active recovery at low intensity promotes blood flow to recovering tissues, facilitating nutrient and oxygen delivery while assisting metabolic waste removal. This circulatory benefit is the primary mechanism for improved subjective recovery.
121. A — Dropped elbows cause the bar to lose its shelf on the anterior deltoids and roll forward. This creates dangerous loss of control, excessive wrist and elbow stress, and forward center of gravity shift.
122. C — Stepping backward eliminates the eccentric deceleration demand on the front leg that occurs during forward lunging. The front leg remains stationary with a more vertical shin, reducing shear forces on anterior knee structures.
123. D — Moving the front foot further from the bench creates a more vertical shin angle, reducing forward knee translation. This shifts loading from knee extensors to hip extensors, decreasing shear forces on anterior knee structures.
124. B — The hex bar centers the load at the athlete's sides, reducing horizontal distance between load and lumbar spine. This shorter moment arm decreases flexion torque and spinal loading compared to the conventional deadlift.
125. A — Dumbbell spotting occurs at the wrists near the athlete's hands. Elbows create a dangerous fulcrum; dumbbells may move independently. Wrist contact allows effective directional guidance of the load.
126. C — Bands provide maximum resistance at the top (fully stretched) where free weights become relatively easy. This accommodating profile trains force production through lockout in the mechanically strongest position.
127. D — Plyometric classification requires maximal speed with minimal transition between eccentric catch and concentric throw to exploit the SSC. Rapid execution stores and returns elastic energy and activates the stretch reflex.
128. B — Olympic platforms must be separated from traffic areas with adequate clearance for dropped barbells and failed lifts. Safety clearance is the primary positioning consideration.
129. A — Groups of 3 per rack create efficient rotation: squat, spot, rest. This maintains continuous workflow, ensures dedicated spotters, and keeps all athletes productively engaged with supervision.
130. C — Collars prevent plates from sliding off barbell ends. Without collars, plates can shift causing sudden asymmetric loading, loss of control, and potential injury.

131. D — Power snatches are the explosive exercise requiring highest neuromuscular coordination and must be performed first when fresh. Remaining exercises follow: core multi-joint → assistance → core stability.
132. B — A single bench spotter uses an alternated grip (one pronated, one supinated) close to center for maximum security and symmetric force application. This positioning allows smooth assistance without interfering with pressing.
133. A — An athlete explosive on field but struggling with heavy lifts has a strength deficit. Heavy training (85%+ 1RM) develops the larger force foundation supporting greater explosive output.
134. C — Slight constant knee flexion, neutral spine, hip hinge, and bar close to legs represent correct RDL technique. The RDL targets hamstrings and glutes through controlled eccentric hip flexion.
135. D — Pull-ups develop pulling strength for the stroke. Internal/external rotation exercises protect the rotator cuff from overuse. Core anti-rotation work develops trunk stability for force transfer during swimming.
136. B — The Pallof press trains the core to resist rotational force — an external load attempts to twist the torso while the athlete maintains neutral alignment. This anti-rotation function protects the spine.
137. A — The snatch requires overhead reception in a deep squat. Overhead squat mobility assessment verifies stable locked-arm overhead position while squatting to full depth with upright torso.
138. C — Correct push-up: straight line head to heels, core braced, chest touches floor, elbows at approximately 45 degrees. This maximizes stimulus while protecting the shoulder from impingement.
139. D — Sprint intervals of 5-10 yards with 25-40 seconds rest replicate the lineman's phosphagen-dominant demands at the sport-specific work-to-rest ratio for maximum training transfer.
140. B — Face pulls at face height with external rotation and scapular retraction target posterior deltoids, infraspinatus, teres minor, and middle trapezius — muscles critical for shoulder health and postural balance.

#### **PROGRAM DESIGN (Questions 141–184)**

141. A — The 800 meters (1:45-2:10) relies primarily on the glycolytic system for sustained near-maximal effort, with the aerobic system increasingly significant during the second half. The phosphagen system powers the explosive start and initial acceleration.
142. C — A push press is structural (loads the spine), performed explosively (rapid leg drive), and involves multiple large muscle groups. It meets all criteria for power exercise classification.
143. D — The power clean is the explosive exercise requiring highest neuromuscular coordination and must be performed first when fresh. Subsequent exercises follow the standard hierarchy.

144. B — Novice athletes benefit from 2-3 total-body sessions per week with moderate loads (60-70% 1RM), higher repetitions (10-15), and technique emphasis. This provides adequate stimulus with sufficient recovery.
145. A — Loads >85% 1RM for ≤6 reps with 2-5 minutes rest develop maximal strength through neural adaptations: increased motor unit recruitment, improved rate coding, and enhanced intermuscular coordination.
146. C — 72% of 175 kg = 126 kg. Volume load =  $126 \times 10 \times 4 = 5,040$  kg. This moderate load with higher repetitions and short rest falls within the hypertrophy training zone.
147. D — Rest of 30-90 seconds maintains elevated metabolic stress (lactate, H<sup>+</sup>) and the hormonal environment (GH, testosterone) supporting the growth stimulus. Incomplete recovery sustains the hypertrophic signaling cascade.
148. B — DUP's advantage is more frequent exposure to different stimuli within each week. Cycling through hypertrophy, strength, and power prevents accommodation and enables simultaneous multi-quality development.
149. A — Linear periodization progressively increases intensity while decreasing volume across mesocycles: high-volume/moderate-intensity → moderate-volume/high-intensity → low-volume/very-high-intensity peaking.
150. C — Block periodization: accumulation (high volume, moderate intensity) → transmutation (higher intensity, sport-specific) → realization (low volume, peaking). Each block concentrates on targeted qualities building upon prior adaptations.
151. D — Maintaining intensity while reducing volume and frequency preserves the neural and muscular stimulus for strength maintenance. Intensity is the most critical detraining-prevention variable.
152. B — The transition period lasts 2-4 weeks of unstructured, low-intensity active recovery for physical/psychological restoration, injury treatment, and motivation renewal before the next cycle.
153. A — Jump squat peak power occurs at 0-30% of 1RM where lighter loading allows high velocity to maximize the velocity component of the power equation.
154. C — Peak power in the hang clean is achieved at moderate-to-heavy loads (approximately 70-80% of 1RM) because the ballistic nature of the exercise requires sufficient mass for meaningful force production while allowing adequate bar velocity for peak power expression. Very light loads produce high velocity but insufficient force, while near-maximal loads reduce velocity below the optimum.
155. D — Beginners start with 80-100 foot contacts per session across exercises of varying intensity. This provides initial stimulus while protecting musculotendinous structures not yet conditioned for high-impact plyometric loading.

156. B — Plyometrics follow warmup when fresh for maximal effort and proper technique. Fatigue from prior exercise degrades explosive output and landing mechanics, reducing training quality and increasing injury risk.
157. D — High squat (88th percentile) with low vertical jump (30th percentile) indicates a rate of force development deficit — adequate strength but poor rapid expression. Explosive training (plyometrics, Olympic lifts, jump squats) develops this quality.
158. C — Soccer's 90-minute mixed demands require aerobic base (sustained play), anaerobic intervals (repeated sprints), and reactive agility (direction changes responding to opponents).
159. D — The transition period provides 2-4 weeks of physical and psychological recovery, injury treatment, and motivation restoration through unstructured low-intensity activity.
160. B — Return to play requires bilateral symmetry within 10%, sport-specific movement competency, and medical clearance. Objective criteria reduce reinjury risk from persistent asymmetries.
161. A — Hockey shifts of 45-60 seconds with 2-3 minutes rest represent glycolytic-dominant demands. Training with matching intervals and rest targets the glycolytic system for maximum transfer.
162. C — An advanced athlete preparing for a single competition requires block periodization's concentrated stimuli. Accumulation → transmutation → realization provides precise control targeted for peak performance at the competition date.
163. D — The principle of accommodation predicts diminished response to constant stimulus. Variation in exercises, loads, volumes, or periodization provides novel stimuli overcoming the plateau.
164. B — Hamstring reconditioning progresses from low-intensity through sport-specific movements, meeting bilateral symmetry (within 10%) before unrestricted return. Each stage builds upon the previous.
165. A — Block periodization: accumulation (high volume/moderate intensity) → transmutation (higher intensity/sport-specific) → realization (low volume/peaking). Each block builds on prior adaptations.
166. C — Muscular endurance uses 30 seconds or less rest to maintain elevated metabolic demand. Short rest prevents full recovery, forcing sustained work under fatigue.
167. D — Five sets of 2 at 93% 1RM with 5-minute rest develops maximal strength through neural adaptation. Near-maximal loading with complete recovery ensures maximal force on every repetition.
168. B — Volume load =  $4 \times 6 \times 120 = 2,880$  kg. Standard calculation for quantifying training work, used for tracking overload and comparing phases.

169. A — Novice athletes use moderate loads (60-70% 1RM) with higher reps (10-15) for the first 4-6 weeks. This develops technique, work capacity, connective tissue adaptation, and foundational neural patterns.
170. C — The 48-72 hour requirement allows adequate recovery of musculotendinous structures experiencing significant eccentric loading. Tendons adapt slower than muscle and require longer recovery.
171. B — Progressive intensity increases (70% → 78% → 83% → 89%) with volume decreases (4×8 → 4×6 → 4×5 → 4×3) across phases is the defining characteristic of linear periodization.
172. B — Combining heavy training (85%+ 1RM) with explosive exercises (Olympic lifts, plyometrics, jump squats at 30-50%) addresses both force-velocity ends. Heavy loads develop maximal force; explosive exercises develop high-velocity power.
173. A — The deload manages accumulated fatigue while maintaining neuromuscular stimulus through preserved intensity. Volume reduction allows recovery and supercompensation before the next loading cycle.
174. D — Rowing-specific conditioning for endurance, rows/pull-ups for pulling strength, anti-extension/anti-rotation core for stability, and front squats/RDLs for lower body drive address all identified needs.
175. D — Three-minute rounds fall within the glycolytic-dominant range. Glycolysis provides primary ATP during each round, supplemented by phosphagen for explosive techniques and aerobic for between-round recovery.
176. B — Training intensity (% 1RM) is the most critical detraining-prevention variable. Volume and frequency can be substantially reduced while maintained intensity preserves neural and muscular adaptations.
177. A — The correct annual sequence: general preparation → specific preparation → competition → transition. Each period builds upon the preceding one from broad fitness through sport-specific readiness.
178. C — Four sets of 12 at 70% with 60-second rest is a hypertrophy protocol. Moderate load provides mechanical tension, higher reps and short rest create metabolic stress, and the combined stimulus drives muscle growth.
179. D — A decathlete's diverse events require simultaneous multi-quality development. Concurrent training with undulating periodization addresses sprint speed, endurance, jumping power, throwing power, and skills in parallel.
180. B — Belt squats, leg press, goblet squats with modified grip, and other exercises bypassing barbell grip maintain lower body training. Eliminating all training causes unnecessary detraining of uninjured regions.

181. A — A goalkeeper's explosive saves (2-5 seconds) are phosphagen-dominant. Work-to-rest ratios of 1:8 to 1:12 allow near-complete PCr recovery between explosive efforts.
182. C — General preparation builds a broad base of hypertrophy, strength, work capacity, and aerobic fitness. This foundation supports the more specific, intense training of subsequent phases.
183. A — Specific preparation shifts to sport-specific power, speed, agility, and conditioning. Exercise selection becomes targeted and methods replicate competitive demands.
184. B — DUP provides frequent exposure to different stimuli within each week, preventing accommodation and enabling simultaneous multi-quality development — the primary advantage over single-emphasis models.

### **TESTING AND EVALUATION (Questions 185–206)**

185. A — The vertical jump (CMJ) using a Vertec is valid, reliable, practical for 45 athletes in 90 minutes, and directly measures lower body explosive power in a sport-relevant movement.
186. C — Reliability is consistency and reproducibility across repeated administrations. High reliability ensures observed changes reflect true performance improvement rather than measurement variability.
187. D — The 1RM is the last weight successfully lifted with acceptable technique through full ROM. The athlete completed 135 kg but failed at 140 kg, so 135 kg is recorded.
188. B — The 11 cm CMJ-SJ difference reflects stretch-shortening cycle utilization. The countermovement stores elastic energy and activates the stretch reflex, enhancing concentric force production unavailable in the static jump.
189. A — The beep test requires only cones and a sound system, is administered to groups, and provides valid aerobic capacity estimates. Its externally paced progressive protocol suits team sport athletes.
190. C — The two-step calculation: skinfolds enter prediction equations to estimate body density, then body density converts to body fat percentage via equations such as the Siri formula.
191. D — BIA accuracy is most affected by hydration status, which alters electrical conductivity. Dehydration overestimates body fat; hyperhydration underestimates it. Consistent hydration is essential.
192. B — Electronic timing eliminates the human timer's reaction time variability (0.1-0.3 seconds). In short sprints, this error is a substantial proportion of total time, obscuring real performance differences.
193. D — A 20% asymmetry exceeds the 10-15% clinical threshold, warranting corrective programming emphasizing the weaker leg and possible medical evaluation for underlying pathology.

194. C — The vertical jump (31st percentile) is disproportionately low relative to the 84th percentile squat, indicating a rate of force development deficit. Explosive training should be the highest priority.
195. D — Identical conditions across sessions — same warmup, equipment, test order, time, environment — is the most critical factor ensuring changes reflect true performance rather than procedural variability.
196. B — At 88%, the surgical leg hasn't met the 90% threshold. Continued progressive strengthening is needed because the persistent asymmetry is associated with elevated reinjury risk.
197. A — Force plates measure peak GRF, rate of force development, impulse, and power output in addition to jump height. This comprehensive data is impossible with simpler methods.
198. C — The sit-and-reach primarily measures hamstring and lower back flexibility, doesn't assess other joints, and is influenced by limb proportions. Goniometry provides more specific assessment.
199. D — Goniometry provides joint-specific ROM measurements at any individual joint, identifying specific restrictions the sit-and-reach cannot detect. This allows targeted intervention.
200. B — Testing at the beginning and end of each major phase and at pre/post-season provides sufficient data for tracking progress and evaluating programs without excessive disruption.
201. A — Prediction equations are most accurate with 10 or fewer repetitions because the rep-to-1RM relationship becomes less linear at higher counts. Endurance, motivation, and pain tolerance introduce error at higher reps.
202. C — The protocol includes 3-4 progressively heavier warmup sets (approximately 50%, 70%, 80-85% of estimated 1RM) before maximal attempts. This progressive loading prepares the neuromuscular system.
203. D — The T-test includes forward sprint, lateral shuffle in both directions, and backward run in a T-shaped pattern assessing multidirectional movement ability.
204. B — A squat at  $1.1\times$  body weight falls below the  $1.5\times$  threshold for plyometric effectiveness. Heavy resistance training develops the strength foundation needed for plyometrics to produce power gains.
205. C — Both tests depend on self-pacing at maximal effort, influenced by motivation, experience, and discomfort tolerance. Athletes unfamiliar with self-pacing may underestimate true aerobic capacity.
206. C — A comprehensive basketball battery assesses aerobic capacity, sprint speed, agility, lower body power, upper body strength, and body composition — aligning with basketball's diverse physical demands.

## ORGANIZATION AND ADMINISTRATION (Questions 207–220)

207. D — Using the NSCA minimum:  $55 \times 40 = 2,200$  sq ft. Upper guideline:  $55 \times 60 = 3,300$  sq ft. The minimum is 2,200 square feet.
208. B — EAPs should be rehearsed at least annually with all staff, ideally more frequently. Unrehearsed plans fail under emergency stress because staff may not know roles or procedures.
209. A — CPR and AED certification ensures every CSCS professional can provide immediate life-saving intervention for cardiac emergencies. Survival rates decline approximately 10% per minute without intervention.
210. C — The standard of care is the degree of care, skill, and diligence a reasonably competent professional with similar training would exercise under similar circumstances — the minimum expected competence.
211. D — Waivers do not protect against gross negligence or reckless conduct — willful disregard for safety beyond ordinary carelessness. Waivers document inherent risk disclosure but cannot absolve reckless behavior.
212. B — Diagnosis and rehabilitation prescription are outside the CSCS scope. These require medical training and licensure. Refer to a physician, athletic trainer, or physical therapist.
213. A — The CSCS scope encompasses designing periodized programs, teaching technique, administering tests, and managing the facility. Diagnosis, rehabilitation, meal planning, and counseling require separate credentials.
214. C — Damaged equipment must be immediately removed, tagged out of order, documented in maintenance logs, and repaired or replaced before return. Continued use violates the duty to maintain safety.
215. D — The CSCS must decline unsafe practices, explain the evidence-based rationale, and advocate for athlete safety. The certified professional holds ultimate responsibility for the program.
216. B — Ratios adjust based on exercise complexity (Olympic lifts need closer supervision), athlete experience (novices need more guidance), and staff qualifications (more qualified staff manage larger groups).
217. A — Records include training logs, testing data, waivers, medical clearances, equipment maintenance logs, and incident reports. These support programming and provide legal documentation.
218. C — Unqualified instruction of technically demanding Olympic lifts to inexperienced athletes creates significant safety and liability risk. The concern must be addressed immediately through professional channels.

219. D — Footwear policies protect athletes from dropped weights. Open-toed sandals provide zero protection. The policy must be enforced — proper closed-toe shoes required before training.
220. B — The NSCA establishes that the CSCS holds ultimate professional authority and responsibility for the design, implementation, and supervision of the strength and conditioning program.