

# PRACTICE EXAM 7: 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 analyzing muscle biopsy data from two athletes. Athlete A has 70% Type I fibers and 30% Type II fibers. Athlete B has 25% Type I and 75% Type II fibers. Based on the known relationships between fiber type and athletic performance, which sport pairing most logically matches these profiles?

- A. Both athletes are best suited for identical sporting activities regardless of fiber type composition
- B. Athlete A is physiologically suited for endurance events requiring sustained aerobic output, while Athlete B is suited for explosive power events requiring rapid, high-force contractions
- C. Athlete B is suited for marathon running because Type II fibers have superior fatigue resistance
- D. Athlete A is suited for the 60-meter dash because Type I fibers produce the fastest contraction speeds

2. During the cross-bridge cycle, ATP must bind to the myosin head to detach it from actin before the next power stroke can occur. In the absence of ATP after death, cross-bridge detachment cannot occur. This permanent binding of myosin to actin is the molecular basis for which condition?

- A. Rigor mortis — the postmortem stiffening of skeletal muscles caused by the permanent attachment of myosin heads to actin when ATP is no longer available to break the cross-bridge bond
- B. Delayed-onset muscle soreness from eccentric exercise-induced micro-damage
- C. Muscle spasm caused by excessive calcium release from an overstimulated sarcoplasmic reticulum
- D. Muscle atrophy caused by disuse and the loss of contractile protein through protein degradation

3. A novice athlete begins a resistance training program and increases their bench press 1RM from 60 kg to 84 kg in 8 weeks — a 40% improvement. MRI shows less than 3% increase in pectoral cross-sectional area. Which type of adaptation is primarily responsible for this disproportionate strength gain relative to the modest structural change?

- A. Sarcoplasmic hypertrophy that increased fluid volume within the muscle fibers
- B. Significant hyperplasia producing new muscle fibers too small to detect on MRI
- C. Measurement error in the MRI that underestimated the true magnitude of hypertrophy
- D. Neural adaptations — improved motor unit recruitment, enhanced rate coding, reduced antagonist co-contraction, and better intermuscular coordination

4. The length-tension relationship describes how muscle force output varies with sarcomere length. At the muscle's optimal resting length, force production is maximal because the number of actin-myosin cross-bridges that can simultaneously form is at its peak. At sarcomere lengths shorter than optimum, force decreases because of which molecular event?

- A. The myosin heads lose their ability to hydrolyze ATP at shortened sarcomere lengths
- B. Calcium cannot be released from the sarcoplasmic reticulum when the muscle is shortened
- C. Actin filaments from opposite sides of the sarcomere overlap each other and may press against the Z-lines, physically interfering with cross-bridge formation
- D. The motor neurons innervating shortened fibers spontaneously cease firing action potentials

5. An athlete performs a heavy back squat with a 4-second controlled eccentric descent followed by an explosive concentric ascent. During the eccentric descent, the quadriceps are actively generating force while lengthening to control the rate of knee flexion under load. The maximum eccentric force the quadriceps can produce exceeds the maximum concentric force by approximately 20% to 60%. This eccentric force advantage has which direct training application?

- A. Athletes should never train eccentrically because the excessive forces always cause injury
- B. Athletes can safely lower loads heavier than their concentric 1RM, forming the basis for supramaximal eccentric training methods that provide a novel overload stimulus

- C. Eccentric and concentric force production are always identical at all contraction velocities
- D. Eccentric training is beneficial only for rehabilitation and has no application in performance training

6. Henneman's Size Principle states that motor units are recruited in an orderly sequence from smallest (lowest threshold) to largest (highest threshold) as force demand increases. To recruit the highest-threshold motor units innervating Type IIx fibers during resistance training, the load must be approximately what percentage of 1RM?

- A. Above 80% to 85% of 1RM, ensuring that force demands are high enough to activate the highest-threshold motor units in addition to all lower-threshold units already recruited
- B. Below 30% of 1RM because light loads preferentially activate the largest motor units first
- C. Exactly 50% of 1RM because this intensity activates all motor units simultaneously
- D. Motor unit recruitment is random and unrelated to load intensity under any condition

7. The stretch-shortening cycle (SSC) enhances concentric force production through three recognized mechanisms: elastic energy storage and return, the stretch reflex, and increased time for force development. During a countermovement jump, the rapid eccentric descent stores elastic energy in which specific structural component?

- A. The motor neurons innervating the quadriceps and gluteal muscles
- B. The bony structures of the femur and tibia that deform elastically under load
- C. The musculotendinous unit — the tendons and the elastic components (series and parallel) of the muscle-tendon complex
- D. The synovial fluid within the knee joint capsule that compresses during the descent

8. An exercise physiologist monitors a runner's oxygen consumption during a graded treadmill test. At stage 9,  $\text{VO}_2$  reaches 62 mL/kg/min and does not increase despite two additional stages of increased speed and grade. RER exceeds 1.15, blood lactate is 13 mmol/L, and heart rate is within 5 bpm of age-predicted maximum. This collection of criteria confirms that the runner has reached which physiological measure?

- A. The lactate threshold at which blood lactate begins exponential accumulation

- B. The ventilatory threshold at which ventilation increases disproportionately to  $\text{VO}_2$
- C. Resting metabolic rate measured under exercise conditions on the treadmill
- D.  $\text{VO}_2\text{max}$  — the absolute ceiling of the body's capacity to consume and utilize oxygen, confirmed by the plateau in  $\text{VO}_2$  despite increasing workload along with secondary verification criteria

9. During a 45-second all-out cycling sprint, an athlete reports severe quadriceps burning and progressive difficulty maintaining pedal cadence. Blood lactate measured immediately after the effort is 18 mmol/L. The metabolic pathway that dominated ATP production during this effort and caused the associated fatigue is which of the following?

- A. Beta-oxidation of intramuscular triglycerides through the mitochondrial fatty acid oxidation pathway
- B. Anaerobic glycolysis — the rapid breakdown of muscle glycogen producing pyruvate that is converted to lactate, with the accompanying hydrogen ion accumulation reducing intracellular pH and impairing muscle function
- C. The phosphagen system through exclusive phosphocreatine hydrolysis for the entire 45-second duration
- D. Oxidative phosphorylation through the electron transport chain using exclusively fat as substrate

10. An endurance cyclist trains at 65% of  $\text{VO}_2\text{max}$  for a 4-hour ride. During the final 30 minutes, performance declines significantly despite maintained effort. Blood glucose has dropped to 52 mg/dL. This late-ride performance decline is most directly caused by which metabolic event?

- A. Progressive glycogen depletion in the muscles and liver combined with hypoglycemia, leaving insufficient carbohydrate substrate to maintain the exercise intensity — the classic "bonk"
- B. Complete depletion of intramuscular phosphocreatine stores during the aerobic cycling effort
- C. Excessive protein catabolism that has destroyed 40% of the cyclist's skeletal muscle mass during the ride
- D. Hydrogen ion accumulation from anaerobic glycolysis during the sustained moderate-intensity effort

11. The Krebs cycle (citric acid cycle) is a central metabolic pathway of aerobic energy production. It occurs within the mitochondrial matrix and produces NADH and FADH<sub>2</sub> as its primary energy-carrying outputs. These electron carriers subsequently deliver their electrons to which metabolic pathway for the production of the majority of aerobic ATP?

- A. Glycolysis in the sarcoplasm for additional anaerobic ATP production through substrate-level phosphorylation
- B. Beta-oxidation of fatty acids in the mitochondrial matrix for further lipid metabolism
- C. The electron transport chain on the inner mitochondrial membrane, where the electrons drive proton pumping and oxidative phosphorylation
- D. The phosphagen system for direct phosphocreatine resynthesis in the sarcoplasm

12. Fat oxidation through beta-oxidation yields substantially more ATP per molecule than glucose (approximately 129 ATP from palmitate versus 36-38 from glucose). Despite this superior yield, fat cannot serve as the primary fuel during very high-intensity exercise because of which fundamental constraint?

- A. Fat stores are too small to contribute meaningful energy during any form of exercise
- B. Fat molecules are physically too large to enter mitochondria under any metabolic condition
- C. Fat oxidation produces toxic byproducts that directly damage the contractile proteins at high intensities
- D. 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

13. An exercise physiologist measures blood lactate in a well-trained female runner during a graded treadmill test. At 8 km/h, lactate is 1.0 mmol/L. At 10 km/h, it is 1.6 mmol/L. At 12 km/h, it rises to 4.8 mmol/L. At 13 km/h, it reaches 8.5 mmol/L. The lactate threshold occurred at approximately which running speed?

- A. At 8 km/h where the first lactate measurement was obtained during the test
- B. Between 10 and 12 km/h, where the exponential rise in blood lactate indicates production began exceeding the body's clearance capacity
- C. At 13 km/h where the absolute highest lactate concentration was recorded

D. The lactate threshold cannot be identified from these progressive test data points

14. A strength and conditioning specialist prescribes 6-second maximal sprints with 4-minute passive rest for a group of 100-meter sprinters. The 4-minute rest interval serves which primary physiological purpose?

A. Allowing near-complete phosphocreatine resynthesis so that maximal ATP-PC energy is available for each subsequent sprint, maintaining the quality and specificity of the training stimulus

B. Allowing complete muscle glycogen resynthesis between each 6-second sprint effort

C. Reducing blood lactate concentration to exactly zero before each subsequent sprint

D. Allowing the oxidative system to become the exclusive energy pathway for the next sprint

15. During progressive exercise, the ventilatory threshold is identified as the intensity where ventilation increases disproportionately relative to oxygen consumption. This disproportionate increase occurs because of which buffering process?

A. The phosphagen system converting PCr to creatine and releasing CO<sub>2</sub> as a direct byproduct

B. Direct conversion of lactate to CO<sub>2</sub> within the working muscle mitochondria

C. The bicarbonate buffering system converting hydrogen ions and bicarbonate into water and CO<sub>2</sub>, with the additional CO<sub>2</sub> requiring increased ventilation for expulsion

D. Complete deactivation of all chemoreceptors that normally regulate breathing rate

16. Newton's First Law (Inertia) states that a body at rest remains at rest unless acted upon by an external force. During a sprint start from the blocks, the sprinter must overcome their body's inertia to begin forward movement. This principle explains why which phase of the sprint requires the greatest force production?

A. The maximum velocity phase where the sprinter is already at top speed

B. The deceleration phase after crossing the finish line when no muscular effort is needed

C. All phases require identical force production because inertia is constant at every velocity

D. The initial acceleration phase, where the sprinter must generate the greatest force to overcome the inertia of their stationary body mass and begin forward movement

17. A biomechanical analysis reveals that during a barbell overhead press, the sticking point occurs when the elbows are at approximately 90 degrees and the forearms are horizontal. At this position, the perpendicular distance from the barbell's line of gravitational force to the shoulder joint axis is at its maximum. This biomechanical factor creates the sticking point because of which principle?

A. Torque equals force multiplied by moment arm — the maximum moment arm at this position creates the greatest torque demand on the shoulder musculature, making this angle the most mechanically challenging

B. The deltoid muscles are at their shortest length and physically cannot generate force at 90 degrees

C. Blood flow to all shoulder muscles is completely occluded when the elbows reach 90 degrees

D. Gravitational force on the barbell doubles at the 90-degree elbow position

18. An athlete performs a standing long jump. During the takeoff, the athlete pushes against the ground at an angle directing force both downward and backward. According to Newton's Third Law, the ground pushes back with an equal and opposite force. The horizontal component of this ground reaction force is primarily responsible for which aspect of jump performance?

A. The vertical height achieved during the flight phase of the standing long jump

B. The horizontal distance traveled during the flight phase, which is the primary performance measure

C. The rotational torque about the athlete's center of mass during the takeoff phase

D. The impact absorption forces experienced at the moment of ground contact during landing

19. A strength and conditioning specialist evaluates two athletes of identical body weight (85 kg) during vertical jump testing on a force plate. Athlete A produces 3,000 N of peak ground reaction force in 140 milliseconds. Athlete B produces 3,000 N of peak force in 270 milliseconds. Both athletes have the same peak force, but Athlete A achieves a significantly higher vertical jump. The physical quality that explains Athlete A's superior jump despite identical peak force is which of the following?

- A. Greater absolute maximal strength that was not detected by the identical peak force values
- B. Superior aerobic capacity that provided more oxidative energy during the ground contact phase
- C. Greater flexibility allowing a deeper countermovement that extended the total contact duration
- D. Superior rate of force development — reaching the same peak force in less time produces greater impulse during the limited ground contact, resulting in higher takeoff velocity

20. The Golgi tendon organ (GTO) is located at the musculotendinous junction and detects changes in muscle tension. When tension reaches a threshold level, the GTO produces autogenic inhibition — a reflexive reduction in muscle force production that serves as a protective mechanism. Chronic heavy resistance training has been shown to produce which specific change in the GTO's function?

- A. Complete structural elimination of all GTOs from the musculotendinous junction
- B. Increased GTO sensitivity causing activation at progressively lower tension thresholds
- C. Reduced inhibitory influence, allowing trained athletes to voluntarily produce force closer to the structural capacity of their musculotendinous units
- D. Conversion of GTOs into additional muscle spindles that amplify the stretch reflex

21. PNF stretching techniques exploit proprioceptor mechanisms to achieve greater range of motion. In the contract-relax method, the athlete first isometrically contracts the target muscle against resistance for 6 seconds, then relaxes and allows the muscle to be stretched further. The increased stretch range after the contraction is primarily due to which neurological mechanism?

- A. Autogenic inhibition from the GTO — the isometric contraction generates high tension that activates the GTO, which then reflexively inhibits the alpha motor neurons innervating the target muscle, temporarily reducing its tone
- B. Reciprocal inhibition from the muscle spindle in the antagonist muscle group
- C. Permanent structural elongation of the muscle fibers caused by the isometric contraction
- D. The withdrawal reflex triggered by pain receptors in the tendon during the contraction

22. During a depth jump from a 60 cm box, the amortization phase (the brief transition between eccentric landing and concentric takeoff) must be minimized to maximize the stretch-shortening cycle benefit. If this phase exceeds approximately 250 milliseconds, which of the following consequences occurs?

- A. The stretch reflex is amplified because the muscle spindle has additional time to generate a signal
- B. Stored elastic energy dissipates as heat and the stretch reflex contribution diminishes, reducing total power output and defeating the purpose of the plyometric exercise
- C. Concentric force production is unaffected because the amortization phase duration has no influence
- D. The musculotendinous unit becomes stiffer, enhancing elastic energy return on subsequent jumps

23. An athlete's resting cardiac output is approximately 5.0 L/min with a heart rate of 50 bpm and stroke volume of 100 mL/beat. During maximal exercise, cardiac output increases to 32 L/min. At maximal exercise, approximately 80% to 85% of this cardiac output is directed to the working skeletal muscles compared to only 15% to 20% at rest. This redistribution is accomplished through which mechanism?

- A. Permanent structural closure of blood vessels to the brain and internal organs during exercise
- B. Decreased total cardiac output that concentrates the reduced blood volume in the working muscles
- C. Increased blood viscosity that mechanically forces blood into the contracting muscle tissue
- D. Selective vasodilation in working muscles mediated by local metabolic signals combined with vasoconstriction in non-essential organs mediated by sympathetic nervous system activation

24. Chronic endurance training produces eccentric cardiac hypertrophy characterized by an enlarged left ventricular chamber. This adaptation directly increases which cardiovascular variable that enhances endurance performance?

- A. Resting diastolic blood pressure through elevated peripheral vascular resistance
- B. Blood viscosity through excessive red blood cell production beyond normal physiological limits
- C. Maximal stroke volume, because the larger chamber can fill with more blood during diastole and eject a greater volume per beat during systole
- D. Resting heart rate through enhanced sympathetic nervous system dominance at rest

25. During moderate-intensity steady-state aerobic exercise (60%  $\text{VO}_2\text{max}$ ), systolic blood pressure progressively increases while diastolic blood pressure remains relatively stable or decreases slightly. The stable diastolic pressure during exercise results from which cardiovascular mechanism?

- A. Vasodilation in the working muscles reducing total peripheral resistance, which counterbalances the increased cardiac output and prevents diastolic pressure from rising
- B. Vasoconstriction in all vascular beds simultaneously increasing resistance throughout the body
- C. Decreased cardiac output during the relaxation phase of each cardiac cycle
- D. Increased blood viscosity that maintains constant pressure throughout the cardiac cycle

26. A resistance training protocol consisting of 5 exercises, 4 sets of 10 repetitions at 70% 1RM with 60-second rest periods produces which acute hormonal response compared to a protocol of 5 sets of 2 at 93% 1RM with 5-minute rest?

- A. Both protocols produce identical hormonal responses because all resistance training affects hormones equally
- B. The high-volume, short-rest protocol produces greater acute growth hormone elevation due to higher metabolic stress, while the heavy protocol produces superior neural adaptation from maximal motor unit recruitment
- C. The heavy protocol produces greater GH because heavier loads are the primary GH stimulus
- D. Neither protocol produces any measurable hormonal response

27. An athlete's longitudinal blood work over 10 weeks of intensive training reveals progressively declining testosterone, rising cortisol, a deteriorating testosterone-to-cortisol ratio, declining performance, disrupted sleep, and persistent fatigue. This pattern is most consistent with which condition?

- A. Optimal peaking for competition indicating the athlete is in their best physical condition
- B. Normal hormonal variation that requires no intervention or programming modification
- C. Excessive carbohydrate consumption causing metabolic syndrome
- D. Overtraining syndrome — a chronic maladaptive state where accumulated training stress has exceeded recovery capacity, producing systemic hormonal disruption and performance decline

28. Growth hormone (GH) is released from the anterior pituitary gland in response to exercise. Which resistance training protocol characteristics consistently produce the greatest acute GH elevation in research?

- A. Single-joint isolation exercises targeting very small muscles with very light loads
- B. Low volume with maximal loads (95-100% 1RM) and extended rest periods (5-7 minutes)
- C. High volume, moderate intensity (70-85% 1RM), and short rest periods (60-90 seconds) that maximize metabolic stress — the primary stimulus for GH release
- D. Complete rest without exercise to maximize basal GH pulsatility during the resting state

29. Insulin-like growth factor-1 (IGF-1) produced locally within skeletal muscle in response to mechanical loading is called mechano-growth factor (MGF). This local IGF-1 variant activates satellite cells and stimulates protein synthesis through which intracellular signaling pathway?

- A. The mTOR (mammalian target of rapamycin) pathway — the central regulator of muscle protein synthesis that integrates signals from mechanical loading, hormones, and amino acid availability
- B. The beta-oxidation pathway that converts fatty acids into building blocks for new contractile protein
- C. The glycolytic pathway that produces lactate as a direct stimulus for protein synthesis
- D. The cortisol degradation pathway that removes all catabolic hormones from the muscle cell

30. Wolff's Law states that bone remodels in response to mechanical stresses placed upon it. An exercise physiologist is advising a 58-year-old postmenopausal woman with osteopenia. Based on Wolff's Law, which exercise prescription provides the greatest osteogenic stimulus?

- A. Aquatic exercise performed in chest-deep water with full buoyancy support and no impact
- B. Ground-based, weight-bearing resistance exercises (squats, deadlifts, weighted lunges) with impact activities (walking, stair climbing), which apply compressive and impact forces directly to the weight-bearing skeleton
- C. Seated upper body machine exercises with very light resistance at 25% of estimated 1RM
- D. Recumbent stationary cycling at very low intensity for 30 minutes three times per week

31. A strength and conditioning specialist compares two athletes: both have a back squat 1RM of 180 kg. In vertical jump testing, Athlete A achieves 72 cm while Athlete B achieves 55 cm. Since maximal strength is identical, the 17 cm difference in jump height is most likely explained by which physical quality?

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

32. During the acceleration phase of a sprint (first 10-30 meters), the sprinter's body should be in a pronounced forward lean. An athlete who sprints fully upright from the first step will experience which performance consequence?

- A. Enhanced acceleration because the upright position maximizes stride frequency
- B. No consequence because body lean has no relationship to acceleration mechanics
- C. Reduced horizontal ground reaction force production, impairing acceleration because the upright position directs the force vector too vertically instead of horizontally
- D. Improved top-end speed that compensates for any reduction in initial acceleration

33. At maximum velocity during sprinting (typically reached between 30 and 60 meters), research on elite sprinters has consistently identified which ground reaction force component as the primary distinguishing factor between faster and slower runners?

- A. The vertical ground reaction force applied during the brief ground contact phase — faster sprinters produce greater vertical force relative to body weight during contact times of approximately 80-100 milliseconds
- B. The anteroposterior component that pushes the sprinter backward for increased stride length
- C. The mediolateral component providing side-to-side balance during the single-leg support phase
- D. All three components contribute equally with no single component more important than the others

34. An exercise physiologist studies substrate utilization during progressive cycling. At 30% of  $\text{VO}_2\text{max}$ , fat contributes approximately 80% of energy. At 60%, fat contributes 50%. At 85%, fat contributes only 15%. This progressive shift from fat to carbohydrate dominance as intensity increases is described by which metabolic concept?

- A. The phosphagen depletion hypothesis explaining the PCr-to-glycolysis transition during sprinting
- B. The crossover concept — as exercise intensity increases, the body progressively shifts from predominantly fat oxidation to predominantly carbohydrate oxidation because carbohydrate pathways can produce ATP at the faster rate required
- C. Wolff's Law describing mechanical loading effects on bone mineral density
- D. The Valsalva mechanism describing blood pressure responses to heavy resistance exercise

35. Detraining research demonstrates that different physiological qualities decline at different rates when training ceases. An athlete who stops all training will experience which hierarchy of decline from most rapid to most resistant?

- A. Maximal strength declines most rapidly within 24 hours, followed by flexibility within 48 hours
- B. All physiological 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 inactivity period
- D. Aerobic capacity ( $\text{VO}_2\text{max}$ ) declines most rapidly (measurable within 1-2 weeks), followed by muscular endurance, then maximal strength (maintained for approximately 2-4 weeks or longer)

36. The SAID principle (Specific Adaptations to Imposed Demands) predicts that the body adapts specifically to the type of training stress applied. A strength and conditioning specialist designs a program for a high jumper consisting exclusively of heavy bilateral back squats at slow, controlled tempos. This program violates SAID because it fails to develop which sport-specific demands?

- A. Only bilateral maximal strength is needed for high jump performance regardless of the takeoff mechanics
- B. The SAID principle does not apply to jumping events because all jumps are purely technique-dependent

C. Unilateral takeoff power, rapid rate of force development, vertical force application from a single-leg base, and the stretch-shortening cycle mechanics that define the high jump approach and takeoff

D. Only flexibility is relevant to high jump performance and no strength training of any type is needed

37. The force-velocity relationship for concentric muscle actions describes an inverse relationship: as contraction velocity increases, the maximum force the muscle can produce decreases. This relationship has which fundamental implication for training program design?

A. To develop maximal strength, heavy loads at slow velocities are needed (high-force end); to develop speed, light loads at high velocities are needed (high-velocity end); to develop power, a combination targeting the middle of the curve is needed

B. All training should be performed at the same velocity regardless of the training goal

C. The force-velocity relationship has no practical application to any aspect of program design

D. Only the high-force end of the curve is relevant for all athletes in every sport

38. A strength and conditioning specialist calculates torque during a dumbbell lateral raise. An athlete holds a 7 kg dumbbell with the arm fully extended at 90 degrees of shoulder abduction. The distance from the shoulder joint axis to the dumbbell's center of mass is 0.60 meters. The torque created by the dumbbell about the shoulder joint is which of the following?

A. Approximately 7 N·m, calculated by using only the mass without converting to Newtons

B. Approximately 41.2 N·m, calculated as  $7 \text{ kg} \times 9.81 \text{ m/s}^2 \times 0.60 \text{ m} = 41.2 \text{ N}\cdot\text{m}$  (force  $\times$  moment arm)

C. Exactly 0 N·m because no torque is generated when the arm is at 90 degrees of abduction

D. Approximately 100 N·m regardless of the dumbbell weight, moment arm, or joint angle

39. The human body predominantly operates through third-class levers, where the effort (muscle insertion) is positioned between the fulcrum (joint) and the resistance (external load). This arrangement creates a mechanical disadvantage for force because the effort arm is shorter than the resistance arm. The functional advantage of this lever arrangement is which of the following?

A. Force amplification that allows the muscle to produce less force than the external load

- B. Equal emphasis on force and speed because the effort and resistance arms are always identical
- C. No advantage — third-class levers are biomechanically inferior in every performance metric
- D. Speed and range of motion at the distal end of the lever — a small amount of muscle shortening produces a large, fast movement at the far end, which is essential for throwing, kicking, and striking

40. A strength and conditioning specialist is explaining the active and passive components of flexibility to a group of athletes. An athlete's passive shoulder flexion is 175 degrees (measured with external force), while their active shoulder flexion is 155 degrees (produced by their own muscular effort). The 20-degree difference between these two measurements is explained by which factor?

- A. A structural bone abnormality that blocks all active motion beyond 155 degrees
- B. A complete rotator cuff tear preventing active shoulder flexion beyond 155 degrees
- C. The voluntary muscular effort of the shoulder 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 the joint
- D. The goniometer used for the passive measurement was calibrated incorrectly by exactly 20 degrees

41. Muscle spindles are proprioceptors arranged in parallel with extrafusal fibers within the muscle belly. They detect changes in both the length and the rate of length change of the muscle. During a plyometric depth jump, the rapid eccentric stretch of the quadriceps upon landing activates the muscle spindles, which produce a reflexive contraction through which neural pathway?

- A. The stretch reflex (myotatic reflex) — a monosynaptic reflex arc where the muscle spindle afferent synapses directly on the alpha motor neuron, producing the fastest possible reflexive contraction to augment the subsequent concentric jump
- B. The Golgi tendon organ reflex that inhibits the muscle to prevent tendon damage
- C. The withdrawal reflex that pulls the entire limb away from a painful stimulus
- D. The crossed-extensor reflex that extends the contralateral limb during the landing phase

42. A strength and conditioning specialist is advising an athlete on the difference between the acute cardiovascular response to heavy resistance exercise versus aerobic exercise. During a maximal squat with the Valsalva maneuver, blood pressure can spike to values exceeding 400/300 mmHg. The Valsalva maneuver produces this extreme response through which mechanism?

- A. Decreased heart rate through parasympathetic nervous system activation during the lift
- B. Forceful exhalation against a closed glottis creating extreme intra-thoracic and intra-abdominal pressure, which elevates both systolic and diastolic blood pressure far above normal exercise values
- C. Vasodilation in all peripheral vascular beds reducing resistance and paradoxically spiking pressure
- D. Release of epinephrine from the anterior pituitary gland stimulating excessive cardiac contractility

43. A female athlete's testosterone levels are approximately 10 to 15 times lower than a male counterpart's. Despite this significant hormonal difference, female athletes still achieve substantial strength gains from resistance training. The primary mechanism by which females improve strength is which of the following?

- A. Female athletes compensate by producing 20 times more growth hormone than males
- B. Strength gains in females are entirely attributable to improved flexibility rather than force production
- C. Female athletes achieve strength exclusively through massive bone mineral density increases
- D. 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

44. Chronic heavy resistance training has been shown to increase androgen receptor density in skeletal muscle. This adaptation has which practical significance for the strength and conditioning specialist?

- A. Androgen receptor changes have no effect on the muscle's response to circulating hormones
- B. Increased receptor density eliminates the need for adequate sleep and nutrition for recovery
- C. Enhanced androgen receptor density increases the muscle's sensitivity and responsiveness to circulating testosterone, potentially amplifying the anabolic signal even without changes in basal hormone levels
- D. The adaptation reverses upon cessation of training within 24 hours, providing no lasting benefit

45. An exercise physiologist conducts a substrate utilization study during a 3-hour cycling ride at 65%  $\text{VO}_2\text{max}$ . The respiratory exchange ratio (RER) begins at 0.86 in the first 30 minutes and gradually decreases to 0.77 by the end of the ride. This progressive RER decrease reflects which metabolic shift?

- A. A progressive shift from carbohydrate oxidation toward greater fat oxidation as glycogen stores deplete during the prolonged moderate-intensity ride
- B. A shift toward exclusive protein oxidation as the sole fuel source during the final hour
- C. An increase in anaerobic glycolytic metabolism during the final stages of the ride
- D. No meaningful change in substrate utilization because RER does not reflect fuel source usage

46. The Cori cycle recycles lactate produced by working muscles into glucose through a metabolic pathway involving the liver. In this pathway, lactate travels from the muscles through the blood to the liver, where it is converted to glucose via gluconeogenesis. The recycled glucose is then released back into the blood for use by which tissues?

- A. Exclusively by adipose tissue for storage as triglycerides during exercise
- B. By the working muscles and the brain, helping to maintain blood glucose levels and providing continued fuel substrate during sustained exercise
- C. Only by the bone marrow for erythropoiesis during the exercise session
- D. Exclusively by the kidneys for filtration and urinary excretion as metabolic waste

47. Connective tissue structures (tendons, ligaments, and cartilage) adapt to resistance training more slowly than muscle tissue due to their lower metabolic activity and blood supply. This differential adaptation rate has which practical implication for the strength and conditioning specialist?

- A. Connective tissue never adapts to training and remains permanently unchanged regardless of loading
- B. Muscle tissue adapts slower than tendons, so the risk period occurs when tendons outpace muscle
- C. Connective tissue adaptation is irrelevant to injury risk because tendons are not loaded during exercise
- D. Rapid muscular strength gains can outpace connective tissue strengthening, creating a window of increased injury risk that requires gradual progressive overload and appropriate recovery

48. An athlete's blood work after 14 weeks of well-designed progressive resistance training shows stable resting testosterone with slightly decreased resting cortisol. The testosterone-to-cortisol ratio has improved favorably. Performance testing shows continued gains. The athlete reports feeling recovered between sessions and sleeping 8 to 9 hours nightly. This combined profile most strongly indicates which training status?

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

49. An athlete performs a maximal isometric mid-thigh pull on a force plate. Peak force is 4,000 N reached in 200 milliseconds. The rate of force development (RFD) is calculated as the change in force divided by the change in time. Assuming force began at zero, the average RFD is which of the following?

- A. 20,000 N/s ( $4,000 \text{ N} \div 0.200 \text{ s}$ ), indicating the average rate at which force increased from zero to peak during the 200-millisecond contraction window
- B. 4,000 N/s calculated by dividing peak force by 1 second regardless of the actual time to peak
- C. 800 N/s calculated by dividing peak force by 5 seconds for no apparent physiological reason
- D. RFD cannot be calculated from force plate data under any measurement conditions

50. Chronic resistance training can reduce the Golgi tendon organ'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. Produce greater aerobic power through enhanced mitochondrial density in the cardiac muscle
- B. 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 contributor to strength gains
- C. Exhibit slower reaction times due to decreased proprioceptive sensitivity from GTO desensitization
- D. Generate less total voluntary force because the reduced inhibition paradoxically impairs motor control

51. An athlete who has been completely sedentary for 8 weeks following surgery begins a reconditioning program. Research on detraining and retraining indicates that the "muscle memory" phenomenon — where previously trained individuals regain fitness faster than never-trained individuals — is explained by which mechanism?

- A. Permanently elevated creatine kinase levels that allow faster PCr resynthesis during retraining
- B. Increased circulating testosterone that persists indefinitely after any prior training exposure
- C. Residual glycogen stores that remain in the muscle for years after training cessation
- D. Retained myonuclei from prior training that accelerate the protein synthetic response when training resumes, allowing faster recovery of muscle size and strength

52. A strength and conditioning specialist is evaluating a training program's specificity for a volleyball player. The program consists exclusively of heavy bilateral lower body exercises (back squat, leg press) at slow tempos, with no jumping, no upper body training, and no sport-specific conditioning. This program violates the SAID principle because volleyball performance requires which combination of qualities not addressed?

- A. Only heavy bilateral strength is relevant to volleyball performance at any competitive level
- B. Only flexibility training is needed because volleyball is exclusively a technique-based sport
- C. Explosive vertical jump power, overhead pressing and hitting strength, lateral agility, and sport-specific aerobic/anaerobic conditioning — none of which are developed by slow bilateral lower body training alone
- D. Only cardiovascular endurance is relevant to volleyball regardless of the explosive demands

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

53. A competitive swimmer reports two distinct groups of pre-race symptoms: (1) racing thoughts, worry about swim times, and fear of disappointing the coaching staff, and (2) elevated heart rate, shallow rapid breathing, and trembling hands behind the blocks. The first group of symptoms is classified as cognitive anxiety. Which intervention most directly addresses these cognitive symptoms?

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

54. According to the inverted-U hypothesis, the optimal arousal level for a given task varies with task complexity. A powerlifter preparing for a maximal deadlift attempt should aim for which arousal state?

- A. Very low arousal to minimize all muscle tension and maximize complete relaxation before lifting
- B. Relatively high arousal because gross motor, high-force tasks benefit from elevated physiological activation that supports maximal muscle recruitment and aggressive effort
- C. Moderate arousal identical to the optimal level for a precision putting stroke in golf
- D. Arousal level is irrelevant because it has no measurable effect on maximal strength performance

55. An athlete preparing for the Olympic trials sets the following goals: "Make the Olympic team" (outcome), "Achieve a personal best of 10.85 seconds by June" (performance), and "Execute a full dynamic warmup and two perfect practice starts before every session" (process). Research on goal-setting indicates that which statement about this goal hierarchy is most accurate?

- A. Only the outcome goal is necessary because it provides all the motivation needed for daily training
- B. The outcome goal should be eliminated because it creates excessive pressure and always impairs performance
- C. All three goals should be replaced with a single vague aspiration to reduce cognitive complexity
- D. The hierarchical structure is optimal — the outcome goal provides direction, the performance goal provides a measurable benchmark, and the process goal directs daily attention to controllable training behaviors

56. Self-efficacy, as defined by Bandura, is task-specific and situation-specific. An athlete who watches a teammate of similar ability and experience successfully complete a challenging lift they have been hesitant to attempt is experiencing which source of self-efficacy?

- A. Past performance accomplishment based on personal mastery of the specific task
- B. Physiological state interpretation based on the absence of pre-lift anxiety symptoms
- C. Vicarious experience — observing someone of comparable capability succeed provides evidence that the task is achievable, strengthening the observer's belief in their own capacity
- D. Verbal persuasion from the coach verbally encouraging the athlete to attempt the lift

57. A strength and conditioning specialist teaches an athlete to use mental imagery before competition. For the imagery to be most effective, the athlete should construct the mental rehearsal engaging which sensory modalities?

- A. Only the visual modality with all other sensory input deliberately suppressed
- B. Only the kinesthetic feel of the movement with no visual or emotional engagement
- C. Only the auditory sounds of the competition environment with no visual imagery
- D. Visual, kinesthetic, auditory, and emotional components simultaneously for the most vivid and transferable mental rehearsal

58. In Fitts and Posner's three-stage model of motor learning, an athlete who can perform the power clean with consistent, efficient technique while simultaneously monitoring bar speed, adjusting timing, and planning the next set without conscious thought about body positions is in which stage?

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

59. The contextual interference effect is a well-documented finding in motor learning research. A training session that intermixes three exercises in random order (ABCBCAACB) rather than practicing each in blocks (AAABBBCCC) produces which learning outcome?

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

60. The guidance hypothesis in motor learning states that providing feedback after every single repetition during skill acquisition produces which long-term learning consequence?

- A. Optimal long-term retention because maximum feedback produces maximum learning universally
- B. Accelerated mastery that persists permanently without any negative side effects
- C. Impaired long-term learning because the athlete develops dependency on external correction rather than developing independent error-detection capabilities
- D. No effect on learning because feedback frequency has no relationship to skill acquisition

61. A coach tells an athlete after a deadlift: "Your hips rose too fast and your back rounded during the initial pull." This feedback is classified as which type?

- A. Knowledge of performance (KP) — information about the quality of the movement pattern itself (how the lift was executed) rather than the outcome
- B. Knowledge of results (KR) providing information about the outcome of the lift
- C. Intrinsic feedback based on the athlete's own proprioceptive perception during the lift
- D. Motivational feedback designed exclusively to increase effort on subsequent attempts

62. Distributed practice — shorter sessions with rest intervals — has been shown to produce better long-term motor learning than massed practice. The primary mechanism explaining this learning advantage is which of the following?

- A. Distributed practice eliminates all performance errors during acquisition
- B. Massed practice produces absolutely no learning under any conditions or circumstances
- C. The rest intervals allow complete glycogen resynthesis improving motor cortex function
- D. Memory consolidation during the rest intervals — the neurological process of stabilizing and transferring motor memories from short-term to long-term storage

63. 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. Optimal psychological readiness indicating the athlete is peaking for competition performance
- B. Athletic burnout — characterized by emotional exhaustion, depersonalization (cynicism toward the sport), and reduced sense of accomplishment
- C. Normal mood variation that resolves spontaneously within hours without any intervention
- D. Acute pre-competition anxiety that disappears immediately after the competitive event concludes

64. A 17-year-old high school athlete has become increasingly isolated, reports persistent feelings of worthlessness, has lost interest in activities they previously enjoyed, and has expressed hopelessness about the future. The strength and conditioning specialist should respond by doing which of the following?

- A. Designing a more intense training program to rebuild confidence through physical accomplishment
- B. Increasing the athlete's competitive schedule to provide more success opportunities
- C. Recognizing these as potential warning signs of clinical depression and recommending that the parents seek evaluation from a qualified mental health professional
- D. Ignoring the behavior because all mood changes in adolescents resolve naturally without intervention

65. A collegiate wrestler displays extreme pre-weigh-in weight manipulation, avoidance of team meals, excessive exercise beyond the prescribed training plan, and preoccupation with body weight. According to scope of practice guidelines for the CSCS, the appropriate response is which of the following?

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

66. Self-determination theory identifies three basic psychological needs: autonomy, competence, and relatedness. A strength and conditioning specialist who removes all athlete choice from training, provides no positive feedback, and isolates athletes who underperform is most directly undermining which motivational outcome?

- A. Exclusively extrinsic motivation, which is actually enhanced by authoritarian environments
- B. Intrinsic motivation — all three basic psychological needs (autonomy through choice, competence through feedback, relatedness through inclusion) are simultaneously violated
- C. Only relatedness with no effect on autonomy or competence perceptions
- D. No motivational outcome because self-determination theory does not apply to athletic settings

67. Research on Relative Energy Deficiency in Sport (RED-S) has established that chronic low energy availability produces health and performance consequences in both male and female athletes. In male athletes specifically, chronic energy deficiency can produce which combination of consequences?

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

68. An athlete returning from ACL reconstruction demonstrates significant fear of re-injury during cutting and pivoting drills despite full physical clearance from the orthopedic surgeon and physical therapy team. The strength and conditioning specialist's most appropriate response includes which of the following?

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

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

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

70. An athlete who has successfully completed a 175 kg back squat for the first time reports significantly increased confidence about attempting 180 kg at the next session. According to Bandura's self-efficacy theory, this confidence increase is primarily driven by which source?

- A. Vicarious experience from watching another athlete complete a heavier squat
- B. Past performance accomplishment — the direct mastery experience of successfully completing the 175 kg squat, which is the most powerful source of self-efficacy
- C. Verbal persuasion from the coach predicting success at the heavier weight
- D. Physiological state interpretation based on reduced resting heart rate before the next session

71. In Nideffer's attentional focus model, a quarterback reading the defensive formation before the snap to identify coverage schemes and locate open receivers is using which type of attention?

- A. Narrow-internal focus directed at specific body sensations during the throwing motion
- B. Narrow-external focus locked exclusively on a single defender's positioning
- C. Broad-internal focus analyzing personal emotional state without environmental awareness
- D. Broad-external focus — scanning a wide field of external stimuli to perceive multiple defenders and receivers simultaneously

72. Motor program theory distinguishes between invariant features (relative timing, relative force proportions, fundamental spatial pattern) that remain constant across executions and variable parameters that can be adjusted. When a baseball pitcher throws a fastball and then a changeup using the same fundamental arm action pattern, the variable parameter being adjusted is which of the following?

- A. The relative timing and sequencing of muscle activations, which are completely restructured for each pitch
- B. The fundamental spatial pattern of the throwing motion, which is a completely different trajectory for each pitch
- C. The absolute speed and force of the movement execution, while the invariant features (relative timing, relative force proportions, spatial pattern) remain constant
- D. Nothing changes because the GMP cannot be adjusted for different conditions under any circumstance

73. An athlete performs consistently well in practice but systematically underperforms during important competitions. The athlete reports intense pre-competition worry, fear of failure, and disruptive negative self-talk during competition. This pattern is most consistent with which phenomenon?

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

74. A sport psychologist recommends progressive muscle relaxation and diaphragmatic breathing for an athlete experiencing pre-competition anxiety symptoms of muscle tension, elevated heart rate, and rapid shallow breathing. These physical relaxation techniques specifically address which component of anxiety?

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

75. Transfer of training describes how practice on one task affects performance on another. A strength and conditioning specialist prescribes front squats specifically to improve an athlete's power clean receiving position. This exercise selection exploits which type of transfer?

- A. Negative transfer where the front squat disrupts and impairs the power clean rack position
- B. Zero transfer because no exercise can influence the learning or performance of any other exercise
- C. Random transfer that is entirely unpredictable from the similarities between the two movements
- 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 85 kg strength athlete requires protein at the upper end of evidence-based recommendations to support heavy resistance training. At 2.2 g/kg/day, the daily protein target is which of the following?

- A. 68 grams per day based on the general population RDA of 0.8 g/kg
- B. 130 grams per day based on a moderate recommendation of approximately 1.5 g/kg
- C. 187 grams per day calculated as  $85 \text{ kg} \times 2.2 \text{ g/kg/day}$
- D. 425 grams per day based on an exaggerated 5.0 g/kg/day recommendation

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

- A. Leucine — the branched-chain amino acid that serves as the key trigger for mTOR activation and the initiation of muscle protein synthesis when consumed in adequate amounts (2-3 grams per meal)
- B. Glutamine, which is the most abundant amino acid in the body but has limited evidence for triggering MPS
- C. Glycine, which is the smallest amino acid with the fastest absorption rate from the intestine
- D. Alanine, which is the primary gluconeogenic amino acid used for hepatic glucose production

78. An athlete following a very low-fat diet (less than 15% of total calories) for several months presents with declining energy, poor recovery, and suppressed testosterone on blood work. The nutritional explanation for this presentation is which of the following?

- A. Excessive protein intake from the high-protein dietary approach causing renal overload
- B. Inadequate dietary fat impairing steroid hormone production (testosterone synthesis requires cholesterol as a precursor) and reducing absorption of fat-soluble vitamins (A, D, E, K)
- C. Excessive carbohydrate consumption causing permanent insulin resistance
- D. Inadequate water intake causing chronic dehydration that suppresses testosterone production

79. During a triathlon lasting 5 hours on a warm day, an athlete consumes only plain water at a rate of 2.5 liters per hour without any sodium-containing fluids or electrolyte replacement. After the race, the athlete becomes confused and disoriented. Emergency personnel diagnose exercise-associated hyponatremia. This condition resulted from which mechanism?

- A. Excessive blood sodium concentration from sodium retention during prolonged exercise
- B. Metabolic alkalosis from the elevated pH of the consumed plain water during the race
- C. Rhabdomyolysis from mechanical skeletal muscle damage during the 5-hour triathlon event
- D. Dilution of blood sodium concentration by excessive plain water intake relative to the sodium lost through sweat, reducing serum sodium below safe levels

80. Creatine monohydrate supplementation increases intramuscular phosphocreatine stores and enhances performance during short-duration, high-intensity activities. An athlete who skips the loading phase (20 g/day for 5-7 days) and uses only the maintenance dose (3-5 g/day) will achieve full muscle creatine saturation in approximately how long?

- A. 24 to 48 hours of supplementation at the maintenance dose
- B. Full saturation cannot be achieved without completing the loading phase first
- C. Approximately 28 days of consistent daily supplementation at 3-5 grams per day
- D. 6 to 12 months of supplementation regardless of the daily dose consumed

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

- A. Blocking adenosine receptors in the central nervous system, reducing the perception of fatigue, increasing alertness and focus, and enhancing pain tolerance during high-intensity effort
- B. Directly increasing intramuscular phosphocreatine stores by 100% above normal baseline values
- C. Stimulating muscle protein synthesis equivalent to consuming 40 grams of whey protein isolate
- D. Permanently increasing resting metabolic rate by 50% for 48 hours after a single dose

82. Beta-alanine supplementation increases intramuscular carnosine, which functions as an intracellular hydrogen ion buffer. This buffering capacity is most beneficial for activities lasting which duration?

- A. Less than 5 seconds where the phosphagen system exclusively provides all required ATP
- B. 1 to 4 minutes where hydrogen ion accumulation from glycolysis is the primary performance limiter
- C. Longer than 60 minutes where fat oxidation is the predominant energy pathway
- D. During complete rest when no metabolic byproducts are being produced

83. An athlete subject to WADA anti-doping regulations wants to minimize the risk of an inadvertent positive drug test from supplement contamination. The strength and conditioning specialist should recommend products carrying which third-party certification?

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

84. For an athlete in a caloric deficit seeking to lose body fat while preserving lean muscle mass, the evidence supports which protein intake strategy?

- A. The general population RDA of 0.8 g/kg/day, which is adequate for all populations during restriction
- B. Less than 0.5 g/kg/day to aggressively minimize caloric intake regardless of muscle consequences
- C. 2.0 to 2.4 g/kg/day at the upper end of recommendations to maximize lean mass preservation during energy restriction combined with maintained resistance training
- D. No protein because complete elimination accelerates fat loss without any muscle catabolism

85. Sodium bicarbonate is an extracellular buffer used to enhance performance during high-intensity glycolytic exercise. The typical effective dose is 0.2 to 0.3 g/kg consumed 60 to 90 minutes before exercise. The most common side effect that limits its practical use is which of the following?

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

86. An endurance athlete training at high volume requires carbohydrate at the upper range of recommendations. For a 65 kg athlete at 10 g/kg/day, the daily carbohydrate target is which of the following?

- A. 65 grams per day based on a very low carbohydrate approach of 1 g/kg/day
- B. 650 grams per day calculated as  $65 \text{ kg} \times 10 \text{ g/kg/day}$
- C. 325 grams per day based on a moderate recommendation of 5 g/kg/day
- D. 1,300 grams per day calculated by doubling the upper end of the recommended range

87. Vitamin D deficiency is prevalent among athletes who train indoors or live at northern latitudes with limited sun exposure. Documented consequences of vitamin D deficiency in athletes include which of the following?

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

88. Iron deficiency is the most common nutritional deficiency worldwide and is particularly prevalent among female athletes and endurance athletes. Consuming vitamin C alongside non-heme iron sources enhances absorption through which specific mechanism?

- A. Vitamin C inhibits all intestinal iron absorption as a protective mechanism against iron overload
- B. Vitamin C has no interaction with iron metabolism under any dietary circumstance
- C. 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 food sources
- D. Vitamin C enhances heme iron absorption exclusively while completely blocking non-heme iron uptake

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

- A. 1.0 to 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 fat adaptation and metabolic flexibility
- C. 0.1 g/kg of carbohydrate — a minimal amount to prevent any meaningful insulin response
- D. Only protein with zero carbohydrate because glycogen replenishment occurs independently

90. A plant-based athlete asks the strength and conditioning specialist how to ensure adequate essential amino acid intake from a diet excluding all animal products. The specialist should advise which dietary strategy?

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

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

- A. Immediate gastric emptying identical to whey protein with no difference in digestion rate
- B. Casein is completely wasted because all protein consumed before sleep is excreted without absorption
- C. Complete suppression of all catabolic hormones for 48 hours following bedtime consumption
- D. Casein forms a gel in the stomach that slows digestion, providing sustained amino acid delivery throughout the overnight fasting period to support muscle protein synthesis during sleep

92. The glycemic index (GI) ranks carbohydrate foods by their blood glucose response after ingestion. High-GI foods are most appropriately consumed at which time relative to exercise for optimal performance and recovery?

- A. Only at breakfast because morning is the only time high-GI foods are properly metabolized
- B. Exclusively before sleep to promote overnight insulin secretion and growth hormone suppression
- C. During and immediately after exercise when rapid glucose delivery and glycogen replenishment are the priorities
- D. High-GI foods should never be consumed by any athlete under any dietary circumstances

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

- A. Limited — glutamine has not demonstrated strong evidence for muscle growth in healthy athletes and is not classified among supplements with robust ergogenic evidence
- B. Glutamine has the strongest evidence of any supplement for muscle hypertrophy
- C. Glutamine permanently elevates testosterone in all athletic populations at any dose
- D. Glutamine is the only supplement universally approved by all anti-doping organizations

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

- A. Fat has no physiological function and can be completely eliminated without any consequence
- B. 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
- C. Fat is the exclusive fuel for the phosphagen energy system during maximal sprinting
- D. Fat directly stimulates Type IIx fiber hyperplasia independent of any training stimulus

95. An athlete competing in a team sport involving 90 minutes of play with repeated sprints and direction changes should maintain hydration during competition. The general guideline for fluid intake during exercise is which of the following?

- A. No fluid intake during competition because drinking impairs all athletic performance
- B. A minimum of 4 liters consumed in a single bolus at halftime regardless of thirst or sweat rate
- C. Only caffeinated beverages because caffeine enhances both hydration and performance together
- D. Approximately 200-300 mL every 15-20 minutes, adjusted for individual sweat rate and environmental conditions

## **SECTION 2 — PRACTICAL/APPLIED**

**125 Questions | 2.5 Hours Recommended**

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

96. Before loading any barbell exercise in a resistance training program, a strength and conditioning specialist should first assess each novice athlete's ability to perform which movement?

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

97. During a barbell back squat, an athlete's knees consistently collapse inward (valgus) during the ascent. This technique fault indicates weakness in which muscle group, and which coaching cue best addresses the error?

- A. The hip abductors and external rotators (gluteus medius) are weak — cue "drive your knees outward over your toes" while strengthening these muscles through targeted corrective exercises
- B. The hip flexors are too strong and require passive stretching to resolve the valgus pattern

- C. The erector spinae are too weak, requiring increased spinal flexion during the squat to compensate
- D. The ankle dorsiflexors are too strong, creating excessive forward knee travel that causes the valgus

98. An athlete performing the conventional deadlift is observed with the barbell drifting 6 inches forward of the shins during the initial pull from the floor. This forward bar drift produces which primary biomechanical consequence?

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

99. A strength and conditioning specialist requires all athletes performing the barbell bench press to use a closed grip with thumbs wrapped around the bar. 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 position
- B. A closed grip is a personal preference with no safety implications for the bench press
- C. A closed grip increases the range of motion of the bench press by approximately 4 inches
- D. A closed grip prevents the barbell from rolling out of the hands onto the chest, neck, or face — a potentially fatal event that can occur with an open (false) grip

100. During a standing barbell overhead press, an athlete compensates for excessive load by arching the lower back into extreme hyperextension. This technique error creates which primary safety consequence?

- A. Enhanced deltoid activation because the arch creates a more favorable pressing angle
- B. Improved spinal stability because lumbar extension is the preferred pressing position
- C. Compressive and shear forces on the lumbar spine that increase injury risk, while simultaneously shifting the exercise toward an incline press pattern and reducing the overhead range of motion

D. No safety 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 taught in this progression establishes the receiving position before any 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 receiving posture before learning the explosive pulling phases
- B. The full squat clean from the floor at near-maximal loads to assess the athlete's natural ability
- C. The clean pull from the floor without a catch to develop pulling strength before the catch is introduced
- D. The hang power clean from above the knee at a challenging load to develop explosive hip extension

102. During the second pull of the power clean, the athlete should drive through explosive triple extension (hips, knees, ankles) while keeping the arms straight. An athlete who prematurely bends the elbows during the second pull commits which error?

- A. The correct technique variation recommended for all loads above 60% of 1RM
- B. Pulling with the arms rather than driving through triple extension — this reduces the contribution of the powerful hip extensors and limits the weight that can be successfully cleaned
- C. The preferred arm action for maximizing bar velocity during all phases of Olympic lifting
- D. An appropriate modification for athletes with limited shoulder mobility during the pull

103. An athlete performing depth jumps from a 70 cm box demonstrates ground contact times increasing from 175 ms to 355 ms by the sixth repetition with declining rebound height. The specialist should respond by doing which of the following?

- A. Increasing the box height to 100 cm to force faster transitions under greater eccentric load
- B. Adding ankle weights to increase the training stimulus during each subsequent repetition
- C. Continuing to 15 repetitions because plyometric training benefits from accumulated fatigue

D. Terminating the exercise immediately — the athlete is fatiguing, contact time has doubled, and the SSC benefit is lost; continuing trains degraded movement patterns with no power benefit

104. A strength and conditioning specialist is programming the first plyometric session for a group of collegiate athletes who have completed 12 weeks of resistance training but have no plyometric experience. Which exercise intensity and volume is most appropriate?

A. High-intensity depth jumps from 42-inch boxes at 250 foot contacts per session

B. Single-leg depth jumps with weighted vests at 200 foot contacts per session

C. Low-to-moderate intensity exercises (squat jumps, countermovement jumps, box jumps stepping down) at 80-100 foot contacts per session

D. Exclusively weighted jump squats at 60% of 1RM for 300 foot contacts

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

A. Near the athlete's torso with arms extending under the armpits to assist the athlete upward — never gripping the barbell directly

B. Directly 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 a failed repetition

D. On the athlete's shoulders to stabilize the upper body throughout the entire working set

106. The Valsalva maneuver produces extreme blood pressure spikes during heavy lifting. This technique is appropriate for which specific population and exercise context?

A. All populations regardless of cardiovascular status during every exercise at all intensities

B. Healthy, trained athletes performing heavy compound lifts (near-maximal squats, deadlifts, presses) where maximal intra-abdominal pressure is needed for spinal stabilization

C. Only during very light isolation exercises such as biceps curls at 20% of 1RM

D. Individuals with uncontrolled hypertension performing any type of exercise

107. An athlete performing barbell bent-over rows rounds the spine significantly while jerking the weight upward with body momentum. The specialist should respond by doing which of the following?

- A. Encouraging the momentum technique because it allows the use of heavier loads
- B. Adding more weight because the athlete clearly has untapped capacity
- C. Switching permanently to a different exercise because rows cannot be safely performed by anyone
- D. Terminating the set, reducing the load, and cueing a rigid neutral spine with the pull initiated by deliberate scapular retraction before elbow flexion

108. A strength and conditioning specialist is designing core training for a baseball pitcher who needs rotational power for throwing and anti-rotation stability for deceleration. Which exercise combination best addresses both demands?

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

109. Anti-extension core exercises such as the ab wheel rollout and front plank progressions train the core musculature 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, maintaining spinal neutrality through active anterior core engagement
- B. Trunk rotation in the transverse plane during throwing and striking sports
- C. Lateral flexion of the trunk in the frontal plane during side-stepping movements
- D. Trunk flexion in the sagittal plane as occurs during crunch and sit-up exercises

110. During the acceleration phase of a sprint (first 10-30 meters), the athlete's body should be in a pronounced forward lean. Running fully upright from the first step produces which performance consequence?

- A. Enhanced acceleration because the upright position maximizes stride frequency immediately
- B. Reduced horizontal ground reaction force production, impairing acceleration because the upright position directs forces too vertically instead of horizontally
- C. No performance consequence because body position has no relationship to sprint mechanics
- D. Improved deceleration ability that fully compensates for any reduction in acceleration

111. The pro agility shuttle (5-10-5) is commonly classified as an "agility test" but technically assesses change-of-direction speed rather than true agility. True agility requires which additional component that the pro agility shuttle lacks?

- A. A physical deceleration and reacceleration component at each direction change
- B. A timing mechanism to measure the speed of each individual direction change
- C. Multiple direction changes within a single trial exceeding two total changes
- D. A reactive perceptual-cognitive decision-making component requiring the athlete to respond to unpredictable stimuli while executing direction changes

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

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

113. Foam rolling used as a pre-training preparation tool provides which specific advantage compared to static stretching?

- A. Increased range of motion without the acute decrements in force production and power associated with static stretching — preserving neuromuscular readiness for explosive performance
- 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 range of motion compared to performing no pre-training mobility work

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

- A. Heavy working sets → static stretching → general warmup → cooldown
- B. General warmup (low-intensity activity) → dynamic stretching → movement preparation → specific warmup with progressive loading in the training exercises
- C. Static stretching → maximal lifts → dynamic stretching → isolation exercises
- D. No warmup is necessary because resistance training itself constitutes adequate preparation

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

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

116. The single most important recovery practices — more important than any external modality, device, or technology — are which of the following?

- A. Pneumatic compression boots worn for 60 minutes after every training session
- B. Cryotherapy chamber sessions at minus 110°C performed twice daily regardless of training
- C. Adequate sleep of 7-10 hours nightly combined with appropriate post-exercise nutrition (protein for repair, carbohydrate for glycogen replenishment)
- D. Electrical muscle stimulation applied to all major muscle groups for 90 minutes nightly

117. The aerobic system provides which specific benefit to team sport athletes who perform repeated high-intensity sprints during competition?

- A. Recovery capacity — the aerobic system replenishes phosphocreatine, clears metabolic byproducts (lactate, hydrogen ions), and restores homeostasis between high-intensity bouts
- B. Direct ATP production for each individual maximal sprint through aerobic metabolism
- C. Complete elimination of all glycolytic energy production during team sport competition
- D. No relevance to team sports because all team sport activities are exclusively anaerobic

118. Interval training for a football wide receiver who performs repeated 3-to-5-second sprint routes with 25-to-40-second huddle rest between plays should use which work-to-rest ratio?

- A. 1:1 ratio targeting the oxidative system with equal work and rest durations
- B. 1:5 to 1:8 ratio targeting the phosphagen system with near-complete PCr recovery between sprint efforts
- C. 1:20 ratio targeting the oxidative system with complete recovery between every effort
- D. No structured rest because all conditioning should be continuous for 60 minutes

119. Tempo running at lactate threshold intensity (approximately 75-85% of maximum heart rate) for 20-30 minutes develops which specific aerobic adaptation?

- A. Maximum sprint speed through phosphagen system enhancement at very high intensity
- B. Explosive power through rapid force development during each running stride
- C. Only flexibility through prolonged eccentric loading of the lower extremity during each stride
- D. The body's capacity to sustain higher absolute intensities before lactate accumulation exceeds clearance — effectively raising the lactate threshold

120. Active recovery — low-intensity exercise below 50% of maximum heart rate the day after intense training — provides which primary proposed benefit?

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

121. When performing a front squat, maintaining high elbows throughout the movement is critical for bar stability. 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 and center of gravity shift
- C. Improved thoracic extension and reduced demand on the upper back musculature
- D. Increased biceps activation that helps support the barbell in the rack position

122. A reverse lunge is often preferred over a forward lunge for athletes with anterior knee sensitivity. The biomechanical advantage of the reverse lunge is which of the following?

- A. Greater compressive force on the patellofemoral joint for strengthening the articular cartilage
- B. Reduced shear force on the front knee because stepping backward eliminates the eccentric deceleration demand that occurs when the front foot strikes the ground during a forward lunge
- C. Increased forward knee translation that loads the quadriceps tendon more aggressively
- D. Eliminated eccentric muscle action throughout the entire lowering phase of the movement

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

- A. Moving the front foot closer to the bench to increase forward knee translation over the toes
- B. Raising the rear foot to a higher bench to increase the total range of motion at the front knee
- C. Adding a pronounced forward torso lean to shift the body's center of gravity over the front knee
- D. Moving the front foot further from the bench to create a more vertical shin angle, shifting primary loading from the knee extensors to the hip extensors

124. A hex bar (trap bar) deadlift positions the athlete inside the bar with handles at the sides. Compared to a conventional barbell deadlift, the hex bar provides which primary biomechanical advantage?

- A. Greater moment arm on the lumbar spine that increases the training stimulus for the erector spinae
- B. Identical biomechanics to the conventional deadlift with no practical difference whatsoever
- C. Reduced moment arm on the lumbar spine because the load is centered closer to the body's center of mass, decreasing spinal loading
- D. Increased grip demand because hex bar handles are always substantially thicker than standard bars

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

- A. At the wrists near the athlete's hands — not at the elbows or at the dumbbells themselves
- B. Directly on the dumbbells themselves to guide them along the intended movement trajectory
- C. At the elbows to create a fulcrum that provides additional pressing leverage
- D. At the upper arms near the shoulder to stabilize the glenohumeral joint complex

126. Resistance bands combined with barbells create accommodating resistance. During a banded back squat, bands provide minimum resistance at the bottom (least stretched) and maximum at the top (fully stretched). This loading profile provides which training benefit?

- A. Elimination of all resistance at the bottom allowing the athlete to rest during the most difficult position
- B. Maximum resistance in the mechanically strongest position (top) where free weights alone become relatively easy, training the athlete to produce force through the full range of motion
- C. Constant resistance identical to free weights throughout the entire range of motion without variation
- D. Maximum resistance at the bottom where the athlete is in the weakest mechanical position

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

- A. A deliberate 5-second isometric pause between catching and throwing phases
- B. Slow, controlled tempo during both catching and throwing for maximum time under tension
- C. Maximum weight regardless of the speed of execution for developing absolute strength
- D. Maximal speed with minimal transition time between the eccentric catch and concentric throw to exploit the stretch-shortening cycle

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

- A. Directly adjacent to cardiovascular equipment for convenient superset circuit rotations
- B. Against mirrors so athletes can monitor their technique during heavy Olympic lifting attempts
- C. Separated from general traffic areas with adequate clearance on all sides for dropped barbells and failed lifts
- D. In the center of the facility surrounded by other training stations for motivational atmosphere

129. A strength and conditioning specialist is training 30 athletes with 10 available squat racks. Which organizational strategy maximizes training efficiency while maintaining safety?

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

130. Collars are required on all barbell exercises during training sessions. The safety rationale is which of the following?

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

131. An athlete's training program includes power cleans, front squats, incline bench press, seated cable rows, dumbbell biceps curls, and dead bugs. Arranged according to NSCA exercise order guidelines, which exercise is performed first?

- A. Dead bugs to pre-activate the core before compound movements are initiated
- B. Dumbbell biceps curls because isolation exercises should always precede compound movements
- C. Seated cable rows because pulling exercises should be prioritized over pushing exercises
- D. Power cleans — the power/explosive exercise requiring the highest neuromuscular coordination, performed when the athlete is freshest

132. When spotting a barbell bench press with a single spotter behind the head of the bench, the spotter should use which grip?

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

133. An athlete who demonstrates explosive field performance (fast sprinting, high jumping) but struggles with heavy barbell exercises has which specific training deficiency?

- A. A maximal strength deficit — their explosive ability outpaces their force production capacity; heavy resistance training (85%+ 1RM) develops the larger force foundation that supports even greater explosive output
- B. Excessive explosive ability that cannot be further developed through any form of training
- C. Only long-distance running is needed because aerobic fitness determines all explosive performance
- D. Only flexibility training is needed because range of motion is the sole determinant of barbell strength

134. Correct Romanian deadlift (RDL) execution includes which specific combination of technical standards?

- A. Full knee lockout with intentional lumbar rounding to maximize hamstring stretch
- B. Slight constant knee flexion maintained throughout, flat neutral spine, hip hinge pattern, and the bar tracking close to the legs during the descent and ascent
- C. Deep knee flexion to 90 degrees with the hips dropping below the knees in a squat pattern
- D. Alternating between full knee extension and deep flexion during each repetition

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

- A. Only lower body power because kicking exclusively determines swimming performance
- B. Only flexibility because range of motion is the sole physical quality needed for swimming
- C. Only cardiovascular endurance because swimming requires no upper body strength or stability
- D. Upper body pulling strength for the swim stroke, rotator cuff injury prevention for the repetitively stressed shoulder, and trunk stability for force transfer during swimming

136. An anti-rotation exercise such as the Pallof press trains the core musculature to resist which specific force?

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

137. Before an athlete attempts the full snatch, which mobility prerequisite must be assessed?

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

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

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

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

- A. Continuous 3-mile runs at moderate pace three times per week for aerobic base development
- B. 400-meter repeats with 60-second rest periods targeting the glycolytic energy system
- C. 60-minute stationary cycling at 50% of maximum heart rate for cardiovascular conditioning
- D. Sprint intervals of 5-10 yards with 25-40 seconds rest, replicating the position's phosphagen-dominant demands and actual work-to-rest ratio

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

- A. Cable at floor level, pulling upward toward the knees while internally rotating the shoulders

- B. Cable above head height, pulling downward toward the waist in a lat pulldown motion
- C. Cable at face height, pulling toward the face while externally rotating the shoulders and retracting the scapulae
- D. Cable at knee height, pulling diagonally across the body in a woodchop rotation pattern

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

141. A needs analysis for a competitive 800-meter runner identifies that the race lasts approximately 1:45 to 2:10 of near-maximal effort. Based on this duration and intensity, which energy system combination is most critical for performance?

- A. Both the glycolytic system (primary contributor during the sustained high-intensity effort) and the aerobic system (increasingly significant during the second half and for recovery between training bouts), with the phosphagen system contributing to the initial sprint
- B. Exclusively the phosphagen system because the athlete sprints at the start
- C. Only the oxidative system because the event lasts longer than 60 seconds
- D. No specific energy system is dominant during the 800-meter distance

142. A strength and conditioning specialist is classifying exercises. A barbell push press involves a rapid dip-and-drive of the legs to initiate bar elevation, followed by pressing the bar overhead. This exercise is classified as a power exercise because it meets which specific criteria?

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

143. In a training session containing the power snatch, back squat, dumbbell shoulder press, lat pulldown, dumbbell lateral raise, and front plank, which exercise is performed first according to NSCA guidelines?

- A. Front plank to pre-activate core stabilizers before compound exercises
- B. Power snatch — it is the power/explosive exercise requiring the highest neuromuscular coordination and should be performed when the athlete is freshest
- C. Dumbbell lateral raise because isolation exercises should precede all compound movements
- D. Lat pulldown because pulling exercises should always be prioritized over all other movement patterns

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

- A. 6 sessions per week using an advanced body-part split with maximal loads from every session
- B. 1 session per month at 95% of estimated 1RM taken to failure on every exercise
- C. 2-3 sessions per week using total-body training with moderate loads (60-70% 1RM), higher repetitions (10-15), and emphasis on technique mastery
- D. Daily sessions using exclusively machine-based isolation exercises at maximum intensity

145. According to the repetition maximum continuum, training at loads greater than 85% of 1RM for 6 or fewer repetitions with 2-5 minutes of rest primarily develops which physical 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 accumulation
- C. Muscular endurance through sustained low-force, high-repetition contractions under fatigue
- D. Cardiovascular fitness through sustained elevated heart rate during the resistance training session

146. An athlete's tested 1RM on the bench press is 110 kg. A hypertrophy protocol prescribes 4 sets of 10 at 72% 1RM with 75-second rest. What is the prescribed training load and total volume load?

- A. Load = 110 kg; Volume = 4,400 kg
- B. Load = 55 kg; Volume = 2,200 kg
- C. Load = 90 kg; Volume = 3,600 kg
- D. Load = approximately 79 kg ( $110 \times 0.72 = 79.2$ , rounded to 79 kg); Volume =  $79 \times 10 \times 4 = 3,160$  kg

147. Rest periods of 30 to 90 seconds between sets are specifically prescribed for which training goal?

- A. Maximal strength requiring complete phosphocreatine and neural recovery between sets
- B. Muscle hypertrophy, where maintaining elevated metabolic stress and the associated hormonal environment supports the growth stimulus
- C. Explosive power requiring full recovery for maximal ballistic movement quality on every set
- D. Aerobic endurance requiring sustained elevated heart rate throughout the resistance session

148. Daily undulating periodization (DUP) varies training emphasis within each week. A typical DUP week includes Monday (4×10 at 70% — hypertrophy), Wednesday (5×4 at 85% — strength), and Friday (5×3 at 75% explosive tempo — power). The primary advantage of DUP over linear periodization is which of the following?

- A. DUP eliminates the need for planned structure because all daily variation is completely random
- B. DUP never uses heavy loads making it inherently safer than every other periodization model
- C. More frequent exposure to different training stimuli within each week, potentially preventing accommodation and allowing simultaneous development of multiple physical qualities
- D. DUP produces identical adaptation outcomes to performing the same workout at every session

149. Linear periodization (LP) progresses through sequential phases with which characteristic pattern of volume and intensity change?

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

150. Block periodization concentrates training on targeted qualities within each multi-week block. The typical three-block sequence for peaking at competition is which of the following?

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

151. During the competitive in-season period, a strength and conditioning specialist reduces training frequency from 4 to 2 sessions per week and volume from 4 to 2 sets per exercise, while maintaining intensity at 85% of 1RM. What outcome is expected?

- A. Dramatic strength loss because volume and frequency were both reduced
- B. Strength and power maintenance because intensity — the most critical variable for preventing detraining — has been preserved
- C. Significant additional strength gains from the reduced training load and increased recovery
- D. Complete detraining within the first 48 hours despite maintained exercise intensity

152. The transition period following the competitive season should last approximately 2-4 weeks and focus on which objectives?

- A. Maximizing training intensity immediately to prepare for the next competitive season
- B. 12 weeks of maximal training volume with no reduction in any programming variable
- C. Unstructured, low-intensity active recovery providing physical and psychological restoration, minor injury treatment, and motivation renewal before the next training cycle
- D. Complete bed rest with zero physical activity of any kind for the entire period

153. For developing explosive power in the jump squat, peak power output typically occurs at which loading range?

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

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

- A. 0-10% of 1RM using only the empty barbell for maximum velocity with minimal mass
- B. 30-40% of 1RM using very light loads moved at high velocity
- C. 95-100% of 1RM using near-maximal loads at very slow contraction velocity
- D. 70-80% of 1RM — sufficient mass for meaningful force production while velocity remains high enough for peak power expression in this ballistic movement

155. Plyometric training volume for beginner athletes is recommended at which level?

- A. 250 foot contacts per session consisting exclusively of high-intensity depth jumps

- B. 80-100 foot contacts per session distributed across exercises of varying intensity
- C. 500 foot contacts to maximize the training stimulus from the very first plyometric session
- D. 10 foot contacts per session regardless of exercise type, intensity, or the athlete's training level

156. Plyometric sessions should be positioned within the training day at which point relative to other training components?

- A. At the end of the session after heavy resistance training and conditioning for maximum fatigue
- B. Only during rest days with no other physical activity within 72 hours before or after
- C. At the beginning of the session after a thorough warmup, when the athlete is fresh for maximal effort and proper technique on every repetition
- D. Immediately after a 5-kilometer conditioning run to replicate game-day fatigue conditions

157. An athlete with a back squat at the 90th percentile but a vertical jump at the 30th percentile demonstrates which specific training deficiency?

- A. A rate of force development deficit — adequate maximal strength but poor ability to express it rapidly, requiring increased explosive training (plyometrics, Olympic lifts, jump squats)
- B. Insufficient maximal strength requiring even heavier squat loading
- C. No training deficiency because strength and jump height are completely unrelated qualities
- D. Excessive flexibility that impairs force transfer from the lower body through the kinetic chain

158. A conditioning program for a lacrosse team (60-minute games with repeated sprints interspersed with lower-intensity movement) should include which combination?

- A. Exclusively heavy resistance training with no conditioning component of any kind
- B. Only long-distance running at very low intensity performed five days per week
- C. Only static stretching for 60 minutes per session as the exclusive conditioning modality

D. Aerobic base training (tempo runs, fartlek), anaerobic interval training (repeated sprints with sport-specific rest), and change-of-direction conditioning

159. A return-to-play protocol for a unilateral lower extremity injury requires which objective criterion before unrestricted competition?

- A. Subjective report of feeling ready with no objective performance testing required
- B. Bilateral strength and functional symmetry within 10% on relevant tests, sport-specific movement competency, and medical clearance
- C. Ability to walk without a limp for 5 minutes on level ground as the sole criterion
- D. Completion of any group exercise class regardless of its content, intensity, or relevance

160. A needs analysis for a competitive volleyball team identifies explosive vertical jumping power, overhead hitting and serving strength, lateral agility, and sport-specific conditioning as priority qualities. Which comprehensive training program best addresses these needs?

- A. Exclusively long-distance running because endurance is the sole physical demand of volleyball
- B. Only flexibility training because volleyball is a technique-only sport requiring no physical training
- C. Plyometrics and Olympic lifts for jumping power, overhead pressing and pulling for hitting/serving, lateral agility drills, and anaerobic interval conditioning matching volleyball's work-to-rest patterns
- D. Exclusively heavy bilateral back squats because lower body strength alone determines all volleyball performance

161. For an advanced athlete with 7 years of training preparing for a single major competition, which periodization model is most appropriate?

- A. A fixed program with no variation performed identically for the entire preparatory period
- B. A beginner program using 2 sessions per week at 60% 1RM with no progressive overload
- C. Random exercise selection with no structure, overload, or planned peaking strategy

D. Block periodization with accumulation, transmutation, and realization phases specifically targeted to produce peak performance at the competition date

162. An athlete who has been training with the same program for 22 weeks reports that strength gains have completely stagnated. According to the principle of accommodation, the most appropriate intervention is which of the following?

- A. Continuing the identical program indefinitely because all plateaus eventually resolve without change
- B. Complete cessation of training for 6 months to allow all accumulated fatigue to dissipate
- C. Permanently reducing all loads to 30% of 1RM without increasing any other training variable
- D. Introducing variation in exercises, loads, volumes, or periodization model to provide novel stimuli that overcome the accommodation plateau

163. A reconditioning program for an athlete returning from hamstring surgery should follow which general progression?

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

164. A strength and conditioning specialist designs an annual training plan for a track and field thrower with a single championship in late June. The general preparation phase should begin approximately when?

- A. Late June immediately before the championship competition
- B. In May at the start of the outdoor competitive season
- C. In January during the off-season to allow sufficient preparation time before the championship
- D. In October of the following year, 16 months after the competition has already concluded

165. A 12-week block periodization program for an advanced athlete preparing for competition sequences the three blocks in which order?

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

166. When prescribing rest periods for a muscular endurance training protocol (less than 67% 1RM, 12+ repetitions), the recommended rest interval is which of the following?

- A. 2-5 minutes for complete phosphocreatine and full neural recovery between every set
- B. 8-10 minutes for full systemic recovery between each endurance training set
- C. No structured rest — all exercises performed continuously for 90 minutes without stopping
- D. 30 seconds or less to maintain elevated metabolic demand throughout the entire training session

167. A strength and conditioning specialist programs 5 sets of 2 at 92% 1RM with 5-minute rest. This protocol primarily develops which physical quality?

- A. Muscular endurance through high-repetition sustained work under metabolic fatigue
- B. Maximal strength and neural adaptation through near-maximal loading with complete recovery between sets
- C. Muscle hypertrophy through moderate loading with elevated metabolic stress from short rest
- D. Cardiovascular fitness through sustained elevated heart rate during the resistance session

168. A strength and conditioning specialist calculates volume load: 5 sets  $\times$  5 reps  $\times$  140 kg on the back squat. The total volume load is which of the following?

- A. 700 kg calculated as sets multiplied by the load alone
- B. 25 repetitions calculated as sets multiplied by repetitions only
- C. 3,500 kg calculated as  $5 \times 5 \times 140$  using the standard volume load formula
- D. 1,400 kg calculated as repetitions multiplied by load only

169. For a novice athlete beginning their first resistance training program, the initial 4-6 weeks should use which loading and repetition strategy?

- A. Moderate loads (60-70% estimated 1RM) with higher repetitions (10-15) emphasizing technique mastery, work capacity development, and connective tissue adaptation
- B. Maximal loads at 95% 1RM with single repetitions from the first training session
- C. Only plyometric depth jumps from maximum-height boxes with no strength foundation
- D. No resistance training for 12 months while focusing exclusively on flexibility and stretching

170. Plyometric training frequency should be limited to 2-3 sessions per week with 48-72 hours between sessions. The primary physiological rationale for this recovery requirement is which of the following?

- A. The recovery time is purely arbitrary with no physiological basis or justification
- B. The interval is needed only for cognitive processing of plyometric movement patterns
- C. The recovery is needed exclusively for the cardiovascular system to return to resting levels
- D. Adequate recovery of musculotendinous structures experiencing significant eccentric loading during plyometric exercises

171. An athlete's training log reveals: 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 progressive increase in intensity with corresponding volume decrease is characteristic of which periodization model?

- A. Daily undulating periodization with within-week variation of intensity and volume
- B. Linear periodization with progressive increases in intensity and decreases in volume across sequential phases
- C. Random programming with no systematic progression or planned structure
- D. Block periodization with concentrated focus on a single quality per multi-week block

172. A strength and conditioning specialist wants to simultaneously develop maximal strength and explosive speed in a sprinter's weekly training plan. Which approach addresses both ends of the force-velocity continuum?

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

173. A training program includes a deload week after three consecutive loading weeks. During the deload, volume is reduced by approximately 40% while intensity is maintained. The purpose of this planned reduction is which of the following?

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

174. A needs analysis for a competitive rower identifies aerobic endurance, upper body pulling strength, core stability, and lower body drive power as primary physical qualities. Which exercise combination best addresses all identified needs?

- A. Exclusively long-distance running and cycling with no resistance training component
- B. Only biceps curls and wrist curls because rowing is exclusively an arm-driven exercise
- C. Only plyometric depth jumps because explosive power is the sole quality relevant to rowing
- D. Rowing-specific aerobic conditioning, barbell rows and pull-ups for pulling strength, anti-extension/anti-rotation core exercises, and front squats/Romanian deadlifts for lower body drive

175. A training program for 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 each
- B. The glycolytic system, because 3-minute rounds of sustained high-intensity fighting fall within the glycolytic-dominant duration range, supported by the phosphagen system for explosive movements and the aerobic system for between-round recovery
- C. Only the oxidative system because total fight duration exceeds 5 minutes
- D. No energy system training is needed because technique alone determines competitive success

176. An in-season strength maintenance program prescribes 2 sessions per week at 80-85% 1RM with reduced volume. The critical variable that must be maintained to prevent detraining is which of the following?

- A. Training volume, which must remain at preparatory-period levels throughout the competitive season
- B. Training frequency, which must remain at 5 sessions per week regardless of competition schedule
- C. Training intensity (percentage of 1RM), which research identifies as the most critical variable for preventing strength detraining when volume and frequency are reduced
- D. Exercise variety, requiring a completely new exercise at every training session

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

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

178. A strength and conditioning specialist designs a protocol: 3 sets of 15 at 60% 1RM with 30-second rest periods. This protocol targets which training adaptation?

- A. Muscular endurance through high repetitions, low-to-moderate load, and minimal rest that maximizes sustained metabolic demand
- B. Maximal strength through heavy loading with complete neural recovery between sets
- C. Explosive power through high-velocity ballistic movement at submaximal loads
- D. Phosphagen system enhancement through brief maximal-intensity efforts

179. A training program for a decathlete competing in 10 events requires simultaneous development of sprint speed, endurance, jumping power, throwing power, and technical skills. Which periodization approach is most suitable?

- A. Block periodization focusing exclusively on one event for 4 weeks before switching
- B. Concurrent training with undulating periodization addressing multiple physical qualities simultaneously throughout the training year
- C. Linear periodization focusing only on sprinting for 6 months then only throwing for 6 months
- D. No structured training because the variety of events makes periodization impossible

180. An injured athlete with a wrist injury preventing barbell gripping should have their lower body training modified to include which exercises?

- A. No training of any kind until the wrist is fully healed without modification
- B. Heavy barbell back squats with standard grip because the wrist will adapt under training load
- C. Belt squats, leg press, goblet squats with modified grip, and other lower body exercises not requiring conventional barbell grip
- D. Only upper body machine exercises to maintain strength in the uninjured regions

181. A strength and conditioning specialist programs conditioning for a soccer goalkeeper who performs explosive saves and 2-5 second sprints with variable rest. Which work-to-rest ratio replicates these demands?

- A. 1:1 ratio targeting the oxidative system with equal work and rest durations
- B. 1:3 ratio targeting the glycolytic system with moderate recovery between efforts
- C. No structured rest because goalkeepers should train continuously for 90 minutes
- D. 1:8 to 1:12 ratio targeting the phosphagen system with near-complete PCr recovery between explosive efforts

182. During the general preparation phase, training emphasis should focus on which foundational qualities?

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

183. During the specific preparation phase, training emphasis shifts to which focus?

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

184. A strength and conditioning specialist designs a DUP week: Monday = 4×10 at 70% (hypertrophy), Wednesday = 5×4 at 85% (strength), Friday = 5×3 at 75% explosive (power). This structure provides which advantage?

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

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

185. A specialist needs to assess lower body explosive power in 50 athletes during a 2-hour testing session. Which test is most practical and valid?

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

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

- A. Reliability — consistency and reproducibility ensuring observed changes reflect true performance improvement rather than measurement error
- B. Face validity based on the test's apparent relevance to the sport
- C. Construct validity demonstrating accurate measurement of an underlying quality
- D. Criterion validity through comparison with a gold-standard instrument

187. During 1RM testing, an athlete lifts 140 kg successfully with proper technique, then fails at 145 kg. The recorded 1RM is which value?

- A. 145 kg because the athlete attempted this weight despite failing
- B. 140 kg — the last weight successfully lifted with acceptable technique through the full ROM
- C. 142.5 kg as the average of the successful and failed attempts
- D. The test must be restarted because any failed attempt invalidates all prior results

188. An athlete's CMJ is 63 cm and SJ is 52 cm. The 11 cm difference reflects which neuromuscular capacity?

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

189. A specialist assesses aerobic capacity in 45 soccer players outdoors with minimal equipment (cones, sound system). Which test is most appropriate?

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

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

- A. Skinfold thicknesses entered into prediction equations to estimate body density, then converted to body fat percentage using equations such as the Siri formula
- B. Skinfolds directly produce body fat percentage without any intermediate calculation
- C. Skinfolds estimate bone mineral density with no relationship to body fat percentage
- D. Skinfolds multiplied by body weight to produce fat mass in kilograms

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

- A. The ambient room temperature in the testing facility
- B. The athlete's hydration status, which affects electrical conductivity and can alter estimates by several percentage points
- C. The brand of athletic shoes worn during the measurement session
- D. The number of people present in the room during testing

192. Sprint testing with electronic timing gates is more accurate than hand timing because electronic systems eliminate which error source?

- A. Wind resistance affecting the athlete's running velocity during the sprint

- B. Temperature effects on muscle contraction speed during testing
- C. The color of lane markings on the testing surface
- D. The human timer's reaction time variability, introducing approximately 0.1-0.3 seconds of error per measurement

193. A bilateral single-leg hop comparison: right = 43 cm, left = 34 cm — approximately 21% asymmetry. Based on clinical thresholds, this suggests which of the following?

- A. Normal bilateral variation requiring no intervention or assessment
- B. The right leg is overtrained and should be detrained to match the left
- C. A clinically significant asymmetry exceeding the 10-15% threshold warranting corrective programming and possible medical evaluation
- D. The test was administered incorrectly and results are completely invalid

194. An athlete's test results: back squat = 83rd percentile, vertical jump = 32nd percentile, pro agility = 55th percentile, 1.5-mile run = 60th percentile. The highest programming priority should be which quality?

- A. Explosive power (vertical jump at 32nd percentile) — disproportionately low relative to high squat strength, indicating a rate of force development deficit
- B. Maximal strength, already well-developed at the 83rd percentile
- C. Agility at the 55th percentile
- D. Aerobic endurance at the 60th percentile

195. Testing should be conducted under standardized conditions. The most critical factor for valid longitudinal comparisons is which of the following?

- A. Using different tests at each time point to prevent the athlete from adapting to testing
- B. Identical conditions across sessions — same warmup, equipment, test order, time of day, and environmental conditions

- C. Allowing athletes to choose their warmup and conditions at each session
- D. Testing immediately after heavy training to evaluate fatigued performance

196. An athlete returning from ACL reconstruction achieves 87% bilateral symmetry on single-leg hop testing. Based on the 90% criterion, the recommendation is which of the following?

- A. Return to unrestricted competition because 87% is close enough to the threshold
- B. Bilateral hop testing has no relevance to ACL return-to-play decisions
- C. The athlete should be permanently restricted from all competitive sport
- D. Continue progressive strengthening because the surgical leg has not yet met the 90% threshold

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

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

198. The sit-and-reach test primarily measures which flexibility components, and what is its main limitation?

- A. Hamstring and lower back flexibility — its limitation is that it does not assess other joints and is influenced by limb proportions, providing no whole-body flexibility assessment
- B. Only shoulder flexibility with no lower body relevance whatsoever
- C. Whole-body flexibility with equal assessment of all joints in the body
- D. Only neck range of motion without any lower extremity component

199. Goniometric assessment provides which specific advantage over the sit-and-reach test for flexibility evaluation?

- A. Goniometry is less accurate than the sit-and-reach for every joint in the body
- B. Joint-specific ROM measurements at any individual joint, identifying specific restrictions that the sit-and-reach cannot detect
- C. Identical information to the sit-and-reach with no additional diagnostic value
- D. Measurement capability limited exclusively to the hip joint with no application elsewhere

200. Performance testing should be conducted at which intervals throughout the training year?

- A. Daily to capture maximum data granularity on performance fluctuations
- B. Only once at the beginning of the athlete's career with no subsequent testing needed
- C. Randomly with no schedule to prevent athletes from preparing for testing
- D. At the beginning and end of each major training phase and at pre/post-season time points

201. Submaximal 1RM prediction equations are most accurate when the repetitions completed are within which range?

- A. 25-30 repetitions providing maximum statistical data points for prediction accuracy
- B. 15-20 repetitions to fully demonstrate muscular endurance capacity
- C. 10 or fewer repetitions, because the relationship between reps and 1RM becomes less linear at higher counts, introducing greater prediction error
- D. Exactly 1 repetition, which eliminates the need for any prediction equation

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

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

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

- A. A straight-line 40-yard sprint with no directional changes
- B. Forward sprint, lateral shuffle in both directions, and backward run arranged in a T-shaped pattern covering approximately 40 yards total
- C. Repeated vertical jumps for 60 seconds measuring total height accumulated
- D. Agility ladder drill with predetermined fixed footwork patterns

204. An athlete's vertical jump has not improved after 12 weeks of plyometric training. Reassessment reveals their squat 1RM is only  $1.2\times$  body weight. The most appropriate modification is which of the following?

- A. Continue the identical plyometric program for 12 more weeks without any modification
- B. Complete cessation of all training for 6 months before any reassessment
- C. Eliminate all lower body exercises and focus exclusively on upper body development
- D. Add heavy resistance training to develop the strength base needed for plyometrics — the squat below  $1.5\times$  body weight limits SSC effectiveness

205. The Cooper 12-minute run and the 1.5-mile run both estimate  $VO_2\max$ . The shared limitation is which of the following?

- A. Both require expensive laboratory metabolic analysis equipment
- B. Both can only be administered to one athlete at a time
- C. They depend on the athlete's self-pacing ability at maximal effort, influenced by motivation and pacing experience
- D. Neither can distinguish between athletes of different aerobic fitness levels

206. A comprehensive pre-season testing battery for a collegiate football team should assess which combination of performance domains?

- A. Only maximal bench press because upper body strength is the sole determinant of football performance
- B. Only body composition because lean athletes outperform all others regardless of other qualities
- C. Only flexibility because football requires no strength, speed, power, or endurance
- D. Aerobic capacity, sprint speed (10-40 yards), agility/change-of-direction, lower body power, upper body strength, and body composition

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

207. A university plans a facility accommodating 55 athletes simultaneously. Using the NSCA minimum of 40 sq ft per athlete, the minimum floor space is which of the following?

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

208. An emergency action plan (EAP) must be rehearsed at which minimum frequency to ensure readiness?

- A. Only once when the facility first opens with no subsequent rehearsals needed
- B. Only when a new staff member is hired for their individual orientation
- C. Every 10 years aligned with major facility renovation cycles
- D. At least annually with all staff members participating, and ideally more frequently

209. The NSCA requires CSCS-credentialed professionals to maintain current certification in which emergency response skill?

- A. Advanced cardiac life support requiring physician-level training and equipment
- B. Emergency medical technician certification at the paramedic level
- C. CPR and AED use from a recognized provider — ensuring the ability to provide immediate life-saving intervention for cardiac emergencies
- D. Wilderness first responder certification for remote outdoor training environments

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

- A. The degree of care, skill, and diligence a reasonably competent professional with similar training would exercise under similar circumstances — the minimum expected competence
- B. The maximum insurance coverage required by state law for all fitness facilities
- C. The minimum salary a professional must earn to demonstrate professional competence
- D. The number of continuing education credits required for annual CSCS recertification

211. A signed waiver generally does NOT protect the facility against which type of legal claim?

- A. Claims based on inherent risks that were clearly disclosed and voluntarily assumed by the participant

B. Gross negligence or reckless conduct — willful disregard for participant safety that goes beyond ordinary carelessness

C. Claims for normal muscle soreness following an appropriately designed training session

D. Claims from participants who explicitly acknowledged documented inherent risks of training

212. An athlete asks the specialist to diagnose chronic shoulder pain and prescribe rehabilitation exercises. According to scope of practice, the appropriate response is which of the following?

A. Diagnose the condition and prescribe a comprehensive rehabilitation protocol independently

B. Prescribe specific anti-inflammatory medication based on the athlete's body weight and symptoms

C. Perform a surgical evaluation to determine the extent of structural shoulder damage

D. Refer to a qualified medical professional (physician, athletic trainer, physical therapist) because diagnosis and rehabilitation prescription are outside the CSCS scope of practice

213. Which combination of activities falls within the CSCS scope of practice?

A. Diagnosing musculoskeletal injuries through physical examination and imaging interpretation

B. Prescribing individualized meal plans with specific caloric targets and macronutrient ratios

C. Designing periodized training programs, teaching exercise technique, administering performance assessments, and managing the strength and conditioning facility

D. Providing psychological counseling for clinical depression and anxiety disorders

214. Damaged equipment should be handled according to which protocol?

A. Immediately removed from service, tagged out of order, documented in the maintenance log, and repaired or replaced before returning to use

B. Continued use until the equipment completely fails because replacement is expensive

C. Hidden from athletes to prevent unnecessary concern about equipment quality and safety

D. Only the manufacturer can evaluate equipment, so nothing should be done until their scheduled visit

215. When a sport coach's training demands conflict with evidence-based safety practice, the CSCS should do which of the following?

- A. Always comply because the sport coach has ultimate authority over all training decisions
- B. Decline to implement unsafe practices, explain the evidence-based rationale, and advocate for athlete safety and wellbeing
- C. Resign immediately without discussing the disagreement or attempting resolution
- D. Implement the demands but document personal objections in a private personal journal

216. Supervision ratios in the facility should be adjusted based on which combination of factors?

- A. Only the total number of athletes present regardless of the exercises being performed
- B. Only the time of day when the training session takes place
- C. Only the physical dimensions of the facility without considering the activities or population
- D. The complexity of exercises being performed, the experience level of the athletes, and the qualifications of the supervisory staff

217. Comprehensive record keeping should include which documents for both programming effectiveness and legal protection?

- A. Only the facility's financial statements and annual tax returns
- B. Only social media posts and marketing photographs from training sessions
- C. Athlete training logs, testing data, signed waivers, medical clearance forms, equipment maintenance records, and incident reports
- D. Only the head coach's practice plans and game film analysis notes

218. A colleague without credentials has been independently teaching heavy power cleans to inexperienced freshman athletes with no progression or qualified supervision. The appropriate response is which of the following?

- A. Addressing the concern with the colleague and/or supervisor — unqualified instruction of technically demanding Olympic lifts to inexperienced athletes creates significant safety and liability risk
- B. Ignoring the situation because it does not directly involve the specialist's own athletes
- C. Encouraging the colleague to increase the barbell load to accelerate the athletes' development
- D. Posting about the situation on social media to publicly expose the unsafe practice

219. A facility policy requires closed-toe athletic shoes for all training. An athlete arrives wearing open-toed sandals. The specialist should respond by doing which of the following?

- A. Allowing the athlete to train because enforcing footwear policies is unnecessarily strict
- B. Enforcing the policy — the athlete cannot train until returning with proper closed-toe athletic shoes, as open-toed footwear creates unacceptable risk from dropped weights and equipment
- C. Allowing barefoot training as a suitable alternative to the prohibited sandals
- D. Permanently modifying the facility policy to accommodate this athlete's personal footwear preference

220. The NSCA professional standards establish that the CSCS holds which authority regarding the strength and conditioning program?

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

# PRACTICE EXAM 7 — ANSWER KEY

## WITH EXPLANATIONS

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### SECTION 1 — SCIENTIFIC FOUNDATIONS

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

1. B — Athlete A's 70% Type I composition supports sustained aerobic output ideal for endurance events, while Athlete B's 75% Type II composition supports explosive, high-force, short-duration power events. Fiber type distribution is largely genetic and strongly influences which athletic activities an individual is physiologically suited for.
2. A — Rigor mortis occurs because ATP is required to detach the myosin head from actin after the power stroke. When ATP is no longer available after death, the myosin heads remain permanently bound to actin, creating the characteristic postmortem muscle stiffness that persists until proteolytic enzymes begin degrading the contractile proteins.
3. D — A 40% strength gain with less than 3% structural change in 8 weeks is the hallmark of neural adaptation — improved motor unit recruitment, enhanced rate coding, reduced antagonist co-contraction, and better intermuscular coordination. In novice trainees, the nervous system's ability to activate existing muscle mass improves dramatically before measurable hypertrophy develops.
4. C — At sarcomere lengths shorter than optimum, actin filaments from opposite sides overlap each other and may press against the Z-lines, physically interfering with cross-bridge formation. This molecular crowding reduces the number of productive cross-bridges, decreasing the force the muscle can produce at shortened lengths.
5. B — Because eccentric force capacity exceeds concentric capacity by 20-60%, athletes can safely lower loads heavier than their concentric 1RM. This characteristic is the physiological basis for supramaximal eccentric training — loading the eccentric phase beyond the concentric maximum to provide a novel overload stimulus for strength and connective tissue adaptation.
6. A — According to Henneman's Size Principle, the highest-threshold motor units innervating Type IIx fibers are recruited only when force demands exceed approximately 80-85% of maximal voluntary contraction. Loads above this threshold ensure activation of the entire motor unit pool, providing the specific neural stimulus needed for maximal strength and power development.
7. C — During the countermovement, elastic energy is stored in the musculotendinous unit — specifically the tendons and the series and parallel elastic components of the muscle-tendon

complex. This stored energy is returned as mechanical work during the subsequent concentric phase, augmenting force production beyond what muscle contraction alone can achieve.

8. D — The  $\text{VO}_2$  plateau despite increasing workload, combined with RER above 1.15, blood lactate of 13 mmol/L, and heart rate near age-predicted maximum, confirms  $\text{VO}_{2\text{max}}$ . The primary criterion (plateau) is supported by multiple secondary verification criteria, confirming that the athlete has reached the absolute ceiling of aerobic energy production.
9. B — A 45-second all-out effort falls squarely within the glycolytic-dominant duration range. Anaerobic glycolysis rapidly breaks down muscle glycogen, producing pyruvate that is converted to lactate. The accompanying hydrogen ion accumulation reduces intracellular pH, impairing cross-bridge cycling and enzymatic function — causing the severe burning and cadence decline.
10. A — After 4 hours at 65%  $\text{VO}_{2\text{max}}$ , muscle and liver glycogen stores become substantially depleted, and blood glucose drops to hypoglycemic levels (52 mg/dL). Without adequate carbohydrate substrate, the body cannot maintain the ATP production rate needed to sustain the exercise intensity — the classic endurance "bonk."
11. C — NADH and  $\text{FADH}_2$  from the Krebs cycle deliver their electrons to the electron transport chain on the inner mitochondrial membrane. As electrons pass along the chain, energy is released to pump hydrogen ions across the membrane, creating the electrochemical gradient that drives ATP synthase to produce the majority of aerobic ATP.
12. D — Fat oxidation through beta-oxidation produces ATP at a rate far slower than carbohydrate metabolism through glycolysis and oxidative phosphorylation. During high-intensity exercise, the rapid ATP demand exceeds what fat oxidation can supply, forcing the body to rely on the faster carbohydrate pathways despite fat's superior per-molecule yield.
13. B — The steep rise from 1.6 mmol/L at 10 km/h to 4.8 mmol/L at 12 km/h represents the inflection point where lactate production began exceeding clearance capacity. Below 10 km/h, production and clearance were balanced; the exponential rise between 10 and 12 km/h identifies the lactate threshold.
14. A — Full PCr replenishment requires 3-5 minutes of passive rest. The 4-minute interval ensures near-complete phosphocreatine availability for each subsequent 6-second sprint, maintaining the phosphagen system as the dominant energy contributor. Shorter rest would shift the energy demand toward glycolysis, altering the training specificity.
15. C — The disproportionate ventilation increase at the ventilatory threshold occurs because the bicarbonate buffering system converts hydrogen ions (from glycolytic metabolism) and bicarbonate into water and  $\text{CO}_2$ . This additional  $\text{CO}_2$  must be expelled through increased ventilation, causing the non-linear rise in breathing rate.
16. D — The acceleration phase requires the greatest force production because the sprinter must overcome their body's inertia from a stationary position. According to Newton's First Law, a body

at rest remains at rest unless acted upon by a sufficiently large external force. The muscular forces during the start must exceed the inertial resistance of the entire body mass.

17. A — Torque equals force multiplied by moment arm. When the forearms are horizontal at 90 degrees, the perpendicular distance from the barbell's gravitational force line to the shoulder joint axis is at maximum. This creates the greatest torque demand on the shoulder musculature, making this angle the mechanical sticking point.
18. B — The horizontal component of the ground reaction force propels the athlete forward through the air during a standing long jump. While the vertical component determines flight height, the horizontal component determines forward distance — the primary performance measure in this event.
19. D — Both athletes produce identical peak force (3,000 N), but Athlete A reaches it in 140 ms versus 270 ms. This superior rate of force development produces a greater impulse during the limited ground contact time of a vertical jump. Greater impulse means higher takeoff velocity and therefore greater jump height.
20. C — Chronic heavy training reduces the GTO's inhibitory influence on alpha motor neurons, allowing trained athletes to voluntarily activate a greater percentage of their motor unit pool during maximal efforts. This neural disinhibition enables force production closer to the true structural capacity of the musculotendinous unit.
21. A — The 6-second isometric contraction generates high tension that activates the GTO at the musculotendinous junction. The GTO sends inhibitory signals through an Ib inhibitory interneuron to the alpha motor neurons innervating the target muscle, temporarily reducing its tone and allowing a greater passive stretch range.
22. B — When the amortization phase exceeds 250 ms, stored elastic energy dissipates as heat rather than being returned as mechanical work during the concentric takeoff. The stretch reflex contribution also diminishes because the rapid eccentric-to-concentric transition that maximally stimulates the muscle spindle has been disrupted.
23. D — Blood flow redistribution during maximal exercise is achieved through selective vasodilation in working muscles (mediated by local metabolic signals — CO<sub>2</sub>, decreased O<sub>2</sub>, heat, metabolites) combined with vasoconstriction in non-essential organs (mediated by the sympathetic nervous system). This dual mechanism prioritizes delivery to the most active tissues.
24. C — Eccentric cardiac hypertrophy increases the left ventricular chamber volume, allowing greater filling during diastole. This larger end-diastolic volume directly increases the stroke volume — the amount of blood ejected per beat — which is the primary mechanism enhancing maximal cardiac output and endurance performance.
25. A — Vasodilation in working muscles reduces total peripheral resistance — the resistance to blood flow through the systemic circulation. Because diastolic pressure reflects peripheral resistance

during cardiac relaxation, the reduced resistance prevents diastolic pressure from rising despite increased cardiac output.

26. B — The high-volume, short-rest protocol maximizes metabolic stress (elevated lactate, hydrogen ions, reduced pH), which is the primary stimulus for acute GH release. The heavy, long-rest protocol minimizes metabolic stress but maximizes neural adaptation through near-maximal motor unit recruitment and rate coding.
27. D — Progressive testosterone decline, rising cortisol, deteriorating T:C ratio, declining performance, disrupted sleep, and persistent fatigue over 10 weeks represent classic overtraining syndrome. The chronic imbalance between accumulated training stress and recovery capacity has produced systemic maladaptation requiring program modification and medical evaluation.
28. C — High-volume, moderate-intensity training (70-85% 1RM) with short rest (60-90 seconds) consistently produces the greatest acute GH response. The elevated metabolic stress — blood lactate accumulation, hydrogen ion concentration, and reduced pH — triggers maximal GH release from the anterior pituitary.
29. A — mTOR activates satellite cells and stimulates muscle protein synthesis through the mTOR pathway — the central intracellular regulator that integrates signals from mechanical loading, hormonal stimulation (IGF-1, insulin), and amino acid availability to determine the rate of new protein production within the muscle fiber.
30. B — Wolff's Law predicts bone remodeling in response to mechanical stress. Ground-based resistance exercises with impact activities apply large compressive forces directly to the weight-bearing skeleton, providing the greatest osteogenic stimulus. Non-weight-bearing exercises like aquatic exercise and cycling provide minimal bone-loading stimulus.
31. D — With identical 1RM values (180 kg), the 17 cm jump difference indicates superior rate of force development and power output in Athlete A. During the brief ground contact time of a jump, Athlete A produces force more rapidly, generating greater impulse that translates to higher takeoff velocity and jump height.
32. C — Running upright during acceleration directs forces too vertically, reducing the horizontal component needed to overcome inertia. The forward lean allows horizontal force application against the ground, generating the forward-directed reaction force essential for rapid acceleration from a standing or near-standing start.
33. A — Research consistently shows that vertical GRF during the brief ground contact phase (80-100 ms) at maximum velocity is the primary factor distinguishing faster from slower sprinters. Faster sprinters produce greater vertical force relative to body weight, effectively "bouncing" off the ground with greater stiffness.
34. B — The crossover concept describes the intensity-dependent shift from predominantly fat oxidation at low intensities to predominantly carbohydrate oxidation at higher intensities. As

intensity increases, the body requires the faster ATP production rate that only carbohydrate metabolism can provide.

35. D — Aerobic capacity declines most rapidly (measurable within 1-2 weeks), followed by muscular endurance, then maximal strength (maintained approximately 2-4 weeks or longer). This hierarchy guides rehabilitation programming — aerobic fitness requires earlier attention while strength can be temporarily deprioritized.
36. C — The high jump demands unilateral takeoff power from a single-leg base, rapid rate of force development during the brief ground contact, vertical power through the SSC, and explosive movement from the approach run. Slow bilateral squats alone fail to develop these sport-specific qualities.
37. A — The force-velocity curve establishes that different goals require different loading strategies: heavy loads at slow velocities for maximal strength, moderate loads at moderate-to-high velocities for power, and light loads at high velocities for speed. Program design must target the specific curve region relevant to the athlete's needs.
38. B — Torque = force  $\times$  moment arm =  $(7 \text{ kg} \times 9.81 \text{ m/s}^2) \times 0.60 \text{ m} = 68.67 \text{ N} \times 0.60 \text{ m} \approx 41.2 \text{ N}\cdot\text{m}$ . Mass must be converted to force (Newtons) by multiplying by gravitational acceleration, then multiplied by the perpendicular distance from the joint axis to the force line.
39. D — Third-class levers favor speed and range of motion at the distal end of the lever. A small muscle shortening produces a large, fast movement far from the joint — essential for throwing, kicking, and striking. The tradeoff is that the muscle must produce forces many times greater than the external load.
40. C — Passive ROM exceeds active ROM because external force can move the joint beyond the limit of the individual's voluntary muscular effort. The 20-degree difference reflects the neuromuscular limits of active motion — the muscles cannot generate sufficient force or coordination to actively move the joint through the full passive range.
41. A — The stretch reflex (myotatic reflex) is a monosynaptic arc where muscle spindle afferents synapse directly on alpha motor neurons innervating the same muscle. This single-synapse arrangement produces the fastest possible reflexive contraction, augmenting the concentric force production during the SSC.
42. B — The Valsalva maneuver involves forceful exhalation against a closed glottis, creating extreme intra-thoracic and intra-abdominal pressure. This elevated pressure mechanically compresses blood vessels and the heart, dramatically increasing both systolic and diastolic blood pressure far above normal exercise values.
43. D — 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 strength gains in

females because the lower testosterone environment limits the magnitude of structural hypertrophy.

44. C — Enhanced androgen receptor density increases the muscle's sensitivity and responsiveness to circulating testosterone at the tissue level. This means each testosterone molecule produces a stronger anabolic signal, potentially amplifying the hypertrophic and strength response even without changes in basal circulating hormone levels.
45. A — The progressive RER decrease from 0.86 to 0.77 during 3 hours of cycling reflects increasing reliance on fat oxidation as glycogen stores deplete. As carbohydrate availability declines, the body progressively shifts toward fat as the dominant substrate, producing the lower CO<sub>2</sub>-to-O<sub>2</sub> ratio characteristic of fat metabolism.
46. B — The Cori cycle recycles lactate into glucose in the liver, which is released back into the blood for use by working muscles (as exercise fuel) and the brain (which is obligatorily glucose-dependent). This recycling pathway helps maintain blood glucose during sustained exercise when hepatic glycogen is being depleted.
47. D — Rapid muscular strength gains can outpace the slower adaptation of tendons and ligaments, which have lower metabolic activity and blood supply. This differential rate creates a window of increased injury risk that requires gradual progressive overload and appropriate recovery to allow connective tissues to keep pace with muscle development.
48. C — Stable testosterone with decreased cortisol produces a favorable T:C ratio indicating positive anabolic-catabolic balance. Combined with continued performance gains, good sleep, and subjective recovery, this profile confirms successful adaptation to the training program without signs of overreaching or overtraining.
49. A — Average RFD = change in force ÷ change in time = 4,000 N ÷ 0.200 s = 20,000 N/s. This value represents the average rate at which force increased from baseline to peak during the 200-millisecond contraction window. RFD is a critical performance variable for athletes in explosive sports.
50. B — 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 their musculotendinous units. This neural disinhibition is a significant contributor to strength gains beyond what hypertrophy alone provides.
51. D — The "muscle memory" phenomenon is explained by retained myonuclei from prior training. When muscle fibers hypertrophy, satellite cells fuse with existing fibers, donating additional nuclei. These myonuclei persist even during detraining-induced atrophy, allowing faster protein synthetic responses when training resumes.
52. C — Volleyball requires explosive vertical jumping power, overhead pressing/hitting strength, lateral agility for defensive positioning, and sport-specific aerobic/anaerobic conditioning for

sustained play. Slow bilateral lower body exercises alone cannot develop these diverse performance demands.

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

53. A — Racing thoughts, worry about times, and fear of disappointing coaches are cognitive anxiety symptoms requiring cognitive interventions. Thought stopping interrupts the negative pattern, and instructional self-talk replacement redirects cognitive resources from worry to task-relevant performance cues such as "smooth entry" and "strong turns."
54. B — A maximal deadlift is a gross motor, high-force task that benefits from relatively high arousal. Elevated physiological activation supports maximal muscle recruitment, aggressive effort, and the intense focused force production needed for near-maximal lifting. Fine motor tasks require lower optimal arousal.
55. D — The hierarchical goal structure is optimal: the outcome goal (Olympic team) provides long-term direction, the performance goal (10.85 seconds) provides a measurable benchmark for tracking progress, and the process goal (dynamic warmup and perfect starts) directs daily attention to the controllable behaviors that drive improvement.
56. C — Observing a teammate of similar ability succeed provides vicarious experience — one of Bandura's four sources of self-efficacy. Seeing someone of comparable capability complete the task provides evidence that success is achievable, strengthening the observer's belief in their own capacity.
57. D — Effective imagery engages visual (seeing the performance), kinesthetic (feeling the muscular sensations), auditory (hearing the environmental sounds), and emotional (experiencing the confidence and composure) components simultaneously. Multi-sensory engagement produces the richest, most transferable mental rehearsal.
58. B — Consistent technique with simultaneous monitoring of bar speed and strategic planning 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.
59. B — Random practice produces slower initial improvement because task-switching disrupts immediate performance, but significantly better long-term retention and transfer. The deeper cognitive processing forced by constant switching builds more robust motor representations that persist over time and transfer to novel contexts.
60. C — The guidance hypothesis states that constant feedback creates dependency on external correction. The athlete waits for the coach rather than developing internal error-detection. Reduced feedback frequency forces attention to proprioceptive information, building self-monitoring capabilities that produce lasting, self-sustaining skill.

61. A — "Your hips rose too fast and your back rounded" describes the quality of the movement pattern itself — how the lift was executed. This is knowledge of performance (KP), which provides actionable information about technique rather than the outcome of the lift.
62. D — Memory consolidation during rest intervals is the neurological process of stabilizing motor memories and transferring them from short-term to long-term storage. Distributed practice allows this consolidation between bouts, producing more durable representations that resist forgetting and transfer to new situations.
63. B — Progressive withdrawal, persistent motivation loss, feeling trapped, and emotional exhaustion over several weeks are hallmark symptoms of athletic burnout — characterized by emotional exhaustion, depersonalization (cynicism toward the sport), and reduced sense of personal accomplishment.
64. C — Increasing isolation, persistent worthlessness, loss of interest in previously enjoyed activities, 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.
65. A — Extreme weight manipulation, meal avoidance, excessive exercise, and weight preoccupation are warning signs of disordered eating requiring professional evaluation. The CSCS must refer to a qualified healthcare professional — diagnosing and treating eating disorders is outside the CSCS scope of practice.
66. B — Removing choice violates autonomy, providing no feedback undermines competence, and isolating underperformers destroys relatedness. All three basic psychological needs are simultaneously violated, directly undermining intrinsic motivation — the most sustainable form supporting long-term adherence, effort, and resilience.
67. D — 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 the condition beyond the original female athlete triad.
68. C — Fear of re-injury is a recognized psychological barrier to return from ACL surgery. Gradual reintroduction of sport-specific movements at progressive intensities builds physical confidence, while sport psychology referral addresses the cognitive and emotional components through evidence-based psychological interventions.
69. A — Research consistently demonstrates that athletes experiencing significant psychological distress during rehabilitation have longer recovery timelines and higher re-injury rates. Psychological factors — fear, frustration, depression, social isolation — significantly influence rehabilitation outcomes and return-to-play success.

70. B — Past performance accomplishment is the most powerful source of self-efficacy. Successfully completing 175 kg provides direct personal evidence of capability, creating the strongest confidence that 180 kg is achievable. Mastery experience surpasses all other efficacy sources in strength and persistence.
71. D — Reading the entire defensive formation requires broad-external attentional focus — scanning a wide visual field to simultaneously perceive multiple defenders, receivers, and coverage schemes. This broad scanning precedes the narrowing to a specific target as the play develops.
72. C — The absolute speed and force change between the fastball and changeup, but the invariant features (relative timing, relative force proportions, spatial pattern) of the throwing GMP remain constant. This variable parameter adjustment is the functional advantage of generalized motor programs.
73. A — Excellent practice with systematic competitive underperformance, combined with worry, fear of failure, and negative self-talk, indicates choking under pressure. Excessive cognitive anxiety disrupts the automatic motor execution that the athlete demonstrates in the low-pressure practice environment.
74. B — Muscle tension, elevated heart rate, and rapid breathing are somatic anxiety symptoms requiring physical relaxation techniques. Progressive muscle relaxation teaches systematic tension release, and diaphragmatic breathing activates the parasympathetic nervous system to reduce cardiovascular and respiratory activation.
75. D — The front squat develops the upright torso, high-elbow rack position, and deep receiving posture that directly transfer to the power clean catch. Shared movement features create positive transfer — practice on the front squat directly improves the quality of the power clean receiving position.

### **NUTRITION (Questions 76–95)**

76. C — An 85 kg athlete at 2.2 g/kg/day requires 187 grams of protein daily ( $85 \times 2.2 = 187$ ). 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 muscle protein synthesis initiation. A threshold of approximately 2-3 grams of leucine per meal ensures optimal stimulation of the protein synthetic machinery.
78. B — Chronically inadequate dietary fat (below 15-20% of calories) impairs steroid hormone production because cholesterol is the precursor for testosterone synthesis. Fat-soluble vitamins (A, D, E, K) also require dietary fat for intestinal absorption. Both consequences compromise health and training adaptation.

79. D — Consuming 2.5 liters per hour of plain water for 5 hours without sodium replacement dramatically dilutes blood sodium concentration. The massive fluid intake relative to sodium losses reduces serum sodium below safe levels, causing the confusion and disorientation characteristic of exercise-associated hyponatremia.
80. C — The maintenance-only approach (3-5 g/day) achieves full intramuscular creatine saturation in approximately 28 days. This is equally effective as the loading protocol for reaching the same saturated endpoint — it simply takes longer through gradual daily accumulation.
81. A — Caffeine's primary ergogenic mechanism is blocking adenosine receptors in the central nervous system. 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.
82. B — Carnosine buffers hydrogen ions during high-intensity exercise. This buffering is most beneficial during activities lasting 1-4 minutes where glycolytic hydrogen ion accumulation is the primary performance limiter. Shorter activities are phosphagen-dependent; longer activities are primarily aerobic.
83. D — 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.
84. C — 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 muscle catabolism that accelerates during energy restriction.
85. A — Gastrointestinal distress — nausea, bloating, cramping, diarrhea — is the most common side effect limiting sodium bicarbonate use. The alkaline nature and large dose (0.2-0.3 g/kg) irritate the GI tract, and some athletes use enteric-coated capsules or serial loading to improve tolerability.
86. B — A 65 kg athlete at 10 g/kg/day requires 650 grams of carbohydrate daily ( $65 \times 10 = 650$ ). This upper-end recommendation supports the extreme glycogen demands of high-volume endurance training with daily depletion-replenishment cycles.
87. 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.
88. C — 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 who rely on plant-based iron.

89. A — When rapid glycogen recovery is needed (two sessions within 8 hours), consuming 1.0-1.5 g/kg of carbohydrate within 30 minutes capitalizes on maximal glycogen synthase activity. This enzyme is most active immediately post-exercise, maximizing resynthesis rate.
90. B — Plant-based athletes achieve adequate essential 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 that slows 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. C — 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 the acute metabolic needs of the peri-exercise window.
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. B — 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 — Fluid intake of 200-300 mL every 15-20 minutes prevents body weight loss exceeding 2%, where performance impairments become measurable. Individual sweat rate and environmental conditions should be used to personalize the strategy.

## **SECTION 2 — PRACTICAL/APPLIED**

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

96. C — Before loading any exercise, each athlete should demonstrate an unloaded bodyweight squat to assess mobility, motor control, and movement competency. This screening identifies ankle, hip, and thoracic restrictions and knee tracking or spinal neutrality deficiencies requiring correction before external load is added.
97. A — Knee valgus indicates weakness in the hip abductors and external rotators (gluteus medius). Cueing "drive your knees outward over your toes" provides immediate correction while targeted strengthening of these muscles addresses the root cause of the medial collapse.
98. B — 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 the flexion torque the erector spinae must resist, substantially elevating 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 thumbs wrapped creates a mechanical lock preventing uncontrolled bar displacement. This is a non-negotiable safety standard.
100. C — Excessive lumbar hyperextension under load creates compressive and shear forces on the 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's top-down progression begins with the front squat to establish the receiving position — comfort with the bar on the deltoids, high elbows, and upright torso — before any pulling mechanics are introduced. This ensures safe reception before explosive pulling is taught.
102. B — Premature arm bending substitutes arm strength for the more powerful hip extensors. The arms should remain straight during the second pull, transmitting force from explosive triple extension. Pulling with the arms limits bar velocity and the weight that can be cleaned.
103. D — Contact times doubling from 175 to 355 ms with declining rebound height confirms fatigue and loss of SSC effectiveness. Plyometrics are quality-based — continuing degraded repetitions trains poor patterns with no power benefit. The exercise must be terminated immediately.
104. C — Novice athletes begin with low-to-moderate intensity plyometrics (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 developed through progressive experience.
105. A — A single back squat spotter positions behind the athlete with arms extending under the armpits. Assistance is provided at the torso — never by gripping the bar directly, which creates asymmetric loading. Torso support safely assists the athlete upward.
106. B — The Valsalva maneuver is appropriate for healthy, trained athletes performing heavy compound lifts where maximal intra-abdominal pressure provides essential spinal stabilization. It is 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. The set must be terminated, load reduced, and the athlete cued to maintain rigid spinal neutrality with the pull initiated by deliberate scapular retraction before elbow flexion.
108. C — A pitcher needs rotational power for throwing (medicine ball rotational throws) and anti-rotation stability for deceleration and spinal protection (Pallof press variations). 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 ab wheel rollout challenges the rectus abdominis and deep stabilizers to maintain spinal neutrality against this extending force.

110. B — Running upright directs forces too vertically, reducing the horizontal component needed to overcome inertia. The forward lean allows horizontal force application against the ground, generating 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. This decision-making element is what the shuttle lacks.
112. C — 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. This evidence drives the pre-exercise preference for dynamic stretching.
113. A — Foam rolling provides range of motion improvements without the acute decrements in force and power associated with static stretching. This preserves neuromuscular readiness for explosive performance while enhancing flexibility.
114. B — 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 pattern readiness.
115. D — Chronic CWI may blunt the inflammatory signaling (prostaglandins, cytokines, satellite cell activation) necessary for muscle protein synthesis and tissue remodeling. The acute inflammation after training is part of the adaptive cascade — chronically suppressing it may impair hypertrophy and strength adaptation.
116. C — Sleep (7-10 hours) and post-exercise nutrition (protein for repair, carbohydrate for glycogen) are foundational with the strongest evidence base. No external modality — compression, cryotherapy, EMS — can compensate for deficits in these non-negotiable biological requirements.
117. A — The aerobic system's primary team sport contribution is recovery capacity. Between sprints and high-intensity efforts, the aerobic system replenishes PCr, clears lactate and hydrogen ions, and restores homeostasis. Superior aerobic fitness enables faster recovery and sustained repeated-effort performance.
118. B — A wide receiver performing 3-5 second sprints with 25-40 seconds 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 and work-to-rest pattern.
119. D — Tempo running at lactate threshold trains the body to sustain higher absolute workloads before lactate production exceeds clearance. This adaptation raises the threshold to a higher percentage of  $VO_2\text{max}$ , allowing greater aerobic intensity before fatigue-inducing acidosis develops.

120. C — Active recovery at low intensity promotes blood flow to recovering tissues, facilitating nutrient and oxygen delivery while assisting removal of metabolic waste products. This circulatory benefit is the primary proposed mechanism for improved subjective recovery.
121. A — Dropped elbows cause the bar to lose its shelf on the anterior deltoids and roll forward, creating dangerous loss of control, excessive wrist and elbow stress, and a forward center of gravity shift. High elbows are essential for safe front squat execution.
122. B — 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 the shear forces on anterior knee structures contributing to patellofemoral pain.
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 (glutes, hamstrings), decreasing the shear forces on anterior knee structures.
124. C — The hex bar centers the load at the athlete's sides, reducing the horizontal distance between load and lumbar spine. This shorter moment arm decreases flexion torque and spinal loading compared to the conventional barbell deadlift.
125. A — Dumbbell spotting occurs at the wrists near the athlete's hands. Spotting at elbows creates a dangerous fulcrum effect, and the dumbbells themselves may move independently. Wrist contact allows effective directional guidance of the load.
126. B — 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, eliminating the deloading effect at the top of the ROM.
127. D — Plyometric classification requires maximal speed with minimal transition between eccentric catch and concentric throw to exploit the SSC. This rapid execution stores and returns elastic energy and activates the stretch reflex. Paused or slow throws eliminate these mechanisms.
128. C — Olympic platforms must be separated from traffic areas with adequate clearance for dropped barbells. Athletes and staff should never be in the impact zone during lifting. This 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 30 athletes productively engaged with appropriate supervision throughout the session.
130. B — Collars prevent plates from sliding off barbell ends. Without collars, plates can shift from uneven pressing, asymmetric racking, or balance loss, causing sudden weight redistribution, loss of control, and potential injury.

131. D — Power cleans are the explosive exercise requiring highest neuromuscular coordination and must be performed first when fresh. Remaining exercises follow the hierarchy: core multi-joint → assistance → core stability.
132. C — A single bench press spotter uses an alternated grip (one pronated, one supinated) close to center for maximum grip security and symmetric upward force application. This positioning behind the head allows smooth assistance without interfering with pressing mechanics.
133. A — An athlete explosive on the field but struggling with heavy lifts has a maximal strength deficit. Their power expression outpaces force capacity. Heavy training (85%+ 1RM) builds the larger force foundation supporting greater explosive output.
134. B — Slight constant knee flexion, neutral spine, hip hinge, and bar close to legs represent textbook RDL technique. The RDL targets hamstrings and glutes through controlled eccentric hip flexion with the primary movement at the hip joint.
135. D — Pull-ups and lat pulldowns develop pulling strength for the swim stroke. Internal/external rotation exercises protect the rotator cuff from repetitive overuse. Core anti-rotation work develops trunk stability for force transfer during swimming.
136. C — 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 during athletic movements involving rotational forces.
137. A — The snatch requires receiving the bar overhead in a deep squat. Overhead squat mobility assessment verifies stable locked-arm overhead position while squatting to full depth with an upright torso — the essential prerequisite for safe snatch execution.
138. B — Correct push-up: straight line head to heels, core braced, chest touches or nearly touches floor, elbows at approximately 45 degrees. This maximizes training stimulus while protecting the shoulder from impingement at extreme elbow flare angles.
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. This ensures conditioning adaptations transfer directly to the repeated short-burst pattern of play.
140. C — Face pulls at face height with external rotation and scapular retraction target posterior deltoids, infraspinatus, teres minor, and middle trapezius. These muscles are critical for shoulder health and postural balance in pressing-dominant athletes.

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

141. A — The 800-meter race (approximately 1:45-2:10) relies primarily on the glycolytic system for sustained high-intensity ATP, with the aerobic system increasingly significant during the second half. The phosphagen system powers the explosive start and initial acceleration through the first 100 meters.

142. D — A push press involves rapid leg drive initiating bar elevation followed by pressing overhead. It is structural (loads the spine), performed explosively (rapid force from the dip-and-drive), and involves multiple large muscle groups — meeting all criteria for power exercise classification.
143. B — The power snatch is the explosive exercise requiring highest neuromuscular coordination and must be performed first when fresh. Subsequent exercises follow: core multi-joint → assistance → core stability.
144. C — Novice athletes with 3 months of experience benefit from 2-3 total-body sessions per week with moderate loads (60-70% 1RM), higher repetitions (10-15), and technique emphasis. This frequency 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, enhanced intermuscular coordination. The heavy loading activates high-threshold motor units.
146. D — 72% of 110 kg = 79.2 kg, rounded to 79 kg. Volume load =  $79 \times 10 \times 4 = 3,160$  kg. This moderate load with higher repetitions and short rest falls within the hypertrophy training zone.
147. B — Rest periods of 30-90 seconds maintain elevated metabolic stress (lactate, H<sup>+</sup> accumulation) and the hormonal environment (GH, testosterone) supporting the growth stimulus. Incomplete recovery sustains the metabolic conditions contributing to the hypertrophic signaling cascade.
148. C — DUP's primary advantage is more frequent exposure to different stimuli within each week. Cycling through hypertrophy, strength, and power prevents accommodation to any single zone while enabling simultaneous multi-quality development.
149. A — Linear periodization progressively increases intensity while decreasing volume across sequential mesocycles: high-volume/moderate-intensity → moderate-volume/high-intensity → low-volume/very-high-intensity peaking.
150. D — Block periodization: accumulation (high volume for work capacity) → transmutation (higher intensity for sport-specific adaptation) → realization (low volume for peaking). Each block concentrates on targeted qualities building upon prior adaptations.
151. B — Maintaining intensity at 85% 1RM while reducing volume and frequency preserves the neural and muscular stimulus for strength maintenance. Intensity is the most critical variable — volume and frequency can be reduced without detraining.
152. C — The transition period provides 2-4 weeks of unstructured, low-intensity active recovery for physical restoration, psychological renewal, minor injury treatment, and motivation renewal before the next training 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. Heavier loads increase force but reduce velocity below the threshold for peak power.

154. D — The hang clean achieves peak power at 70-80% of 1RM because sufficient mass is needed for meaningful force production while velocity remains high. The ballistic nature accelerates the load throughout the full ROM.
155. B — Beginners start with 80-100 foot contacts per session across varying intensity. This provides initial stimulus while protecting musculotendinous structures not yet conditioned for high-impact plyometric loading.
156. C — Plyometrics should follow warmup when the athlete is fresh for maximal effort and technique. Fatigue from prior exercise degrades explosive output and landing mechanics, reducing training quality and increasing injury risk.
157. A — High squat (90th percentile) with low vertical jump (30th percentile) indicates a rate of force development deficit. The athlete has strength but cannot express it rapidly. Explosive training (plyometrics, Olympic lifts, jump squats) develops rapid force production.
158. D — Lacrosse's mixed demands require aerobic base (60-minute sustained play), anaerobic intervals (repeated sprints with sport-specific rest), and change-of-direction conditioning. Each component addresses specific physical demands.
159. B — Return to play requires bilateral symmetry within 10%, sport-specific movement competency, and medical clearance. Objective criteria reduce reinjury risk associated with persistent asymmetries that subjective assessment alone cannot detect.
160. C — Volleyball requires plyometrics and Olympic lifts for jumping power, overhead pressing and pulling for hitting/serving, lateral agility drills for defensive positioning, and anaerobic interval conditioning matching volleyball's work-to-rest patterns.
161. D — An advanced athlete preparing for a single competition requires block periodization's concentrated stimuli. Accumulation → transmutation → realization provides precise control with the final block targeted for peak performance at the competition date.
162. D — The principle of accommodation predicts diminished response to constant stimulus. Introducing variation in exercises, loads, volumes, or periodization provides novel stimuli overcoming the plateau and resuming progress.
163. B — Hamstring reconditioning progresses: low-intensity ROM restoration → progressive resistance → sport-specific movements → unrestricted return based on objective bilateral symmetry (within 10%). Each stage builds upon the previous.
164. C — For a late June championship, general preparation should begin approximately in January to allow 5-6 months of structured preparation through general preparation, specific preparation, and peaking phases.

165. A — Block periodization: accumulation (high volume/moderate intensity) → transmutation (higher intensity/sport-specific) → realization (low volume/peaking). Each block builds upon preceding adaptations toward competition readiness.
166. D — Muscular endurance training uses 30 seconds or less of rest to maintain elevated metabolic demand. Short rest prevents full recovery, forcing muscles to sustain work under fatigue — the specific adaptation being developed.
167. B — Five sets of 2 at 92% 1RM with 5-minute rest develops maximal strength through neural adaptation. Near-maximal loading recruits the highest-threshold motor units with complete recovery ensuring maximal force on every repetition.
168. C — Volume load =  $5 \times 5 \times 140 = 3,500$  kg. This standard calculation quantifies total training work for tracking progressive overload and comparing training phases.
169. A — Novice athletes use moderate loads (60-70% 1RM) with higher repetitions (10-15) for the first 4-6 weeks. This develops technique proficiency, builds work capacity, allows connective tissue adaptation, and establishes the foundation for heavier loading.
170. D — The 48-72 hour recovery requirement allows adequate recovery of musculotendinous structures experiencing significant eccentric loading. Tendons adapt slower than muscle and require longer recovery to prevent overuse injury from frequent plyometric sessions.
171. B — Progressive intensity increases (70% → 78% → 83% → 89%) with corresponding volume decreases (4×8 → 4×6 → 4×5 → 4×3) across sequential phases is the defining characteristic of linear periodization.
172. C — Combining heavy training (85%+ 1RM) with explosive exercises (Olympic lifts, plyometrics, jump squats at 30-50% 1RM) 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 — the adaptive overshoot above previous fitness — preparing for the next loading cycle.
174. D — Rowing-specific aerobic conditioning for endurance, barbell rows and pull-ups for pulling strength, anti-extension/anti-rotation core exercises for trunk stability, and front squats/RDLs for lower body drive address all identified needs.
175. B — Three-minute fighting rounds fall within the glycolytic-dominant range. The glycolytic system provides primary ATP during each round, supplemented by phosphagen for explosive techniques and aerobic for between-round recovery.
176. C — Training intensity (percentage of 1RM) is the most critical variable for preventing detraining. Volume and frequency can be substantially reduced while maintained intensity preserves neural and muscular adaptations.

177. D — The correct annual sequence: general preparation → specific preparation → competition → transition. Each period builds upon the preceding one, progressing from broad fitness through sport-specific development to competitive peaking and recovery.
178. A — Three sets of 15 at 60% 1RM with 30-second rest is a muscular endurance protocol. Low-moderate load, high repetitions, and minimal rest maximize sustained metabolic demand — training the specific adaptation of fatigue resistance.
179. B — A decathlete's 10 diverse events require simultaneous development of multiple qualities. Concurrent training with undulating periodization addresses sprint speed, endurance, jumping power, throwing power, and skills in parallel throughout the year.
180. C — Belt squats, leg press, goblet squats with modified grip, and other exercises bypassing barbell grip maintain lower body training while accommodating the wrist injury. Eliminating all training causes unnecessary detraining.
181. D — A goalkeeper's explosive saves and short sprints (2-5 seconds) are phosphagen-dominant. Work-to-rest ratios of 1:8 to 1:12 allow near-complete PCr recovery, matching the variable explosive demands of the position.
182. A — General preparation builds a broad foundation of hypertrophy, general strength, work capacity, and aerobic fitness. This base supports the more specific, intense training during subsequent phases.
183. B — Specific preparation shifts to sport-specific qualities: power, speed, agility, and sport-specific conditioning. Exercise selection becomes targeted, and methods replicate competitive demands identified in the needs analysis.
184. C — DUP provides frequent exposure to different stimuli within each week, preventing accommodation and enabling simultaneous multi-quality development — the primary advantage over models that address one quality per extended phase.

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

185. D — The vertical jump (CMJ) using a Vertec is valid, reliable, practical for 50 athletes in 2 hours, and directly measures lower body explosive power. Multiple athletes can be tested efficiently with a single device.
186. A — Reliability is consistency and reproducibility across repeated administrations under identical conditions. High reliability ensures observed changes reflect true performance improvement rather than measurement variability.
187. B — The 1RM is the last weight successfully lifted with acceptable technique through full ROM. The athlete completed 140 kg successfully but failed at 145 kg, so 140 kg is recorded. Failed attempts are never counted.

188. C — The 11 cm difference between CMJ (63 cm) and SJ (52 cm) reflects stretch-shortening cycle utilization — stored elastic energy and stretch reflex contribution from the countermovement enhancing concentric force production unavailable in the static jump.
189. D — The beep test requires only cones and a sound system, can be administered to groups, and provides a valid aerobic capacity estimate. Its externally paced, progressive-intensity protocol is suitable for team sport athletes.
190. A — The two-step calculation: skinfolds enter prediction equations to estimate body density, then body density converts to body fat percentage using equations such as the Siri formula. Both steps are required for the final estimate.
191. B — BIA accuracy is most significantly affected by hydration status, which alters electrical conductivity. Dehydration overestimates body fat; hyperhydration underestimates it. Consistent hydration is essential for reliable results.
192. D — Electronic timing eliminates the human timer's reaction time variability (0.1-0.3 seconds per measurement). In short sprints, this error represents a substantial proportion of total time and obscures real performance differences.
193. C — A 21% asymmetry substantially exceeds the 10-15% clinical threshold, warranting targeted corrective programming emphasizing the weaker leg and possible medical evaluation to identify underlying pathology.
194. A — The vertical jump (32nd percentile) is disproportionately low relative to the 83rd percentile squat, indicating a rate of force development deficit. Explosive training should receive highest programming priority.
195. B — Identical testing conditions across sessions — same warmup, equipment, test order, time of day, environment — is the most critical standardization factor ensuring changes reflect true performance rather than procedural variability.
196. D — At 87%, the surgical leg hasn't met the 90% symmetry threshold. Continued progressive strengthening is needed because the persistent asymmetry is associated with elevated reinjury risk.
197. C — Force plates measure peak GRF, rate of force development, impulse, and power output in addition to jump height. This comprehensive biomechanical data is impossible to obtain with simpler methods.
198. A — The sit-and-reach primarily measures hamstring and lower back flexibility, doesn't assess other joints, and is influenced by limb proportions. For joint-specific assessment, goniometry provides more diagnostic information.
199. B — Goniometry provides joint-specific ROM measurements at any individual joint, identifying specific restrictions the sit-and-reach cannot detect. This specificity allows targeted identification of limiting joints or tissues.

200. D — 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 training disruption.
201. C — Prediction equations are most accurate with 10 or fewer repetitions because the rep-to-1RM relationship becomes less linear at higher counts. Muscular endurance, motivation, and pain tolerance introduce variability the equations cannot account for.
202. A — 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 at incrementally higher intensities.
203. B — The T-test includes forward sprint, lateral shuffle in both directions, and backward run arranged in a T-shaped pattern covering approximately 40 yards. It assesses multidirectional movement including forward, lateral, and backward capabilities.
204. D — A squat at  $1.2\times$  body weight falls below the recommended  $1.5\times$  threshold for plyometric effectiveness. Heavy resistance training develops the strength foundation enabling plyometrics to produce further power gains.
205. C — Both tests depend on self-pacing at maximal effort, influenced by motivation, pacing experience, and discomfort tolerance. Athletes unfamiliar with maximal self-pacing may underestimate their true aerobic capacity.
206. D — A comprehensive football battery assesses aerobic capacity, sprint speed (10-40 yards), agility, lower body power, upper body strength, and body composition — aligning with football's diverse physical demands.

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

207. B — 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 with the upper guideline providing more comfortable spacing.
208. D — 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, equipment locations, or communication procedures.
209. C — 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 CPR and defibrillation.
210. A — The standard of care is the degree of care, skill, and diligence a reasonably competent professional with similar training would exercise under similar circumstances. It represents expected minimum competence.

211. B — 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 professional behavior.
212. D — Diagnosing conditions and prescribing rehabilitation are outside the CSCS scope. These require medical training and licensure. The specialist must refer to a physician, athletic trainer, or physical therapist.
213. C — The CSCS scope encompasses designing periodized programs, teaching technique, administering performance assessments, and managing the facility. Diagnosing injuries, prescribing rehabilitation, meal planning, and psychological counseling require separate credentials.
214. A — 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 a safe training environment.
215. B — The CSCS must decline unsafe practices, explain the evidence-based rationale, and advocate for athlete safety. The certified professional holds ultimate responsibility for the strength and conditioning program.
216. D — 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 safely).
217. C — Records include training logs, testing data, waivers, medical clearances, equipment maintenance logs, and incident reports. These support programming and provide legal documentation of standard of care.
218. A — 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. B — Footwear policies protect athletes from dropped weights. Open-toed sandals provide zero protection. The policy must be enforced consistently — proper closed-toe athletic shoes are required before training.
220. D — The NSCA establishes that the CSCS holds ultimate professional authority and responsibility for the design, implementation, and supervision of the strength and conditioning program based on specialized expertise.