PRACTICE EXAM 14: CSCS FULL-LENGTH SIMULATION

SECTION 1 — SCIENTIFIC FOUNDATIONS

95 Questions | 1.5 Hours Recommended

EXERCISE SCIENCE (Questions 1–52)

1. A collegiate football defensive end undergoes muscle biopsy of the vastus lateralis before and after 24 months of combined heavy squat training and sprint work. The post-training biopsy will most likely show which change?

A. Complete elimination of all Type I fibers

B. Increased Type IIx from conversion of Type I

C. Decreased Type IIx with increased Type IIa

D. No measurable change in any fiber proportion

2. During the cross-bridge cycle, ATP hydrolysis on the myosin head produces ADP and inorganic phosphate. This hydrolysis provides the energy for which specific step?

A. Cocking the myosin head into the high-energy position for the next power stroke

B. Binding calcium to troponin C on the thin filament

C. Releasing calcium from the sarcoplasmic reticulum

D. Detaching the myosin head from the actin binding site

3. A novice swimmer increases her squat 1RM by 44% in 7 weeks with only 2% hypertrophy measured by ultrasound. An experienced teammate gains 5% strength with 12% hypertrophy on the same program. The novice's rapid gain relative to structural change is explained by which adaptation?

A. Sarcoplasmic fluid accumulation in the muscle fibers

B. Connective tissue thickening around the muscle belly

C. Myofibrillar protein degradation increasing fiber density

D. Neural improvements in recruitment, rate coding, and coordination

4. At sarcomere lengths longer than optimum, force production decreases because of which molecular event?

A. Actin filaments overlap and compress against the Z-lines

B. Too few cross-bridges can form due to reduced actin-myosin overlap

C. Motor neurons stop firing at stretched sarcomere lengths

D. Calcium channels close at elongated muscle lengths

5. According to the force-velocity relationship, peak power occurs at approximately which region of the curve?

A. 30-60% of maximal force with moderate-to-high velocity

B. Maximum force at zero velocity

C. Maximum velocity at zero load

D. Power is identical at every point

6. An athlete performs a 1RM back squat. According to Henneman's Size Principle, which motor unit type is recruited last during the maximal attempt?

A. Type I motor units with the lowest thresholds

B. All motor units are recruited simultaneously

C. The highest-threshold Type IIx motor units

D. Gamma motor neurons innervating muscle spindles

7. The Golgi tendon organ detects tension and produces autogenic inhibition. Chronic heavy training modifies GTO function by producing which change?

A. Increased inhibition activating at lower thresholds

B. Complete structural elimination of all GTOs

C. No measurable change under any condition

D. Reduced inhibition allowing greater voluntary force production

8. Blood lactate during a graded cycling test: 150W = 1.2, 200W = 1.8, 250W = 5.4, 275W = 9.6 mmol/L. The lactate threshold occurred at approximately which workload?

A. 150 watts

B. Between 200 and 250 watts

C. 275 watts

D. Cannot be determined from these data

9. A 40-second all-out ergometer sprint produces blood lactate of 15 mmol/L and 32% power decline. The dominant energy system is which of the following?

A. Anaerobic glycolysis

B. Oxidative phosphorylation through fat metabolism

C. The phosphagen system exclusively for 40 seconds

D. Beta-oxidation of intramuscular triglycerides

10. An athlete's RER during a 3.5-hour ride at 64% VO_2max decreases from 0.87 to 0.76. This shift reflects which metabolic change?

A. Increased anaerobic glycolysis in the final hour

B. Increased protein catabolism as the sole fuel

C. Greater fat oxidation as glycogen depletes

D. Decreased total metabolic activity

11. The Krebs cycle produces NADH and $FADH_2$. These carriers deliver electrons to which pathway for aerobic ATP production?

A. Glycolysis in the sarcoplasm

B. Beta-oxidation in the matrix

C. The phosphagen system for PCr resynthesis

D. The electron transport chain on the inner mitochondrial membrane

12. Fat cannot fuel high-intensity exercise because of which limitation?

A. Fat stores are too small for energy

B. Fat produces ATP too slowly for high-intensity demands

C. Fat cannot enter mitochondria during exercise

D. Fat generates toxic byproducts at high intensities

13. A marathon runner hits the wall at mile 21 with blood glucose at 44 mg/dL. The primary cause is which metabolic event?

A. Glycogen depletion and hypoglycemia

B. Phosphocreatine depletion from aerobic running

C. Hydrogen ion accumulation from steady-state running

D. Protein destruction of all contractile tissue

14. During a graded exercise test, VO_2 plateaus at 57 mL/kg/min. RER = 1.17, lactate = 14 mmol/L, HR within 3 bpm of max. This confirms which measure?

A. The lactate threshold

B. The ventilatory threshold

C. VO_2max at 57 mL/kg/min

D. Resting metabolic rate

15. The electron transport chain requires which final electron acceptor?

A. Carbon dioxide

B. NADH

C. Lactate

D. Oxygen

16. Stroke volume plateaus at 40-60% VO_2max. Further cardiac output increases depend on which variable?

A. Continued ventricular enlargement during the test

B. Continued heart rate increases via sympathetic activation

C. Decreased blood volume concentrating oxygen

D. Increased blood viscosity forcing faster flow

17. An athlete produces 3,400 N of vertical GRF. Body weight is 834 N (85 kg). The net force for upward acceleration is which value?

A. 2,566 N (3,400 − 834)

B. 3,400 N without subtracting body weight

C. 0 N because GRF equals body weight

D. Cannot be calculated from these data

18. During a barbell curl, the biceps must produce approximately 8× the dumbbell weight because of which lever characteristic?

A. First-class lever at the elbow joint

B. Second-class lever creating mechanical advantage

C. Third-class lever with effort arm much shorter than resistance arm

D. Force amplification from the long effort arm

19. Bicarbonate buffering of hydrogen ions from glycolysis generates CO_2 that triggers disproportionate ventilation. This defines which threshold?

A. The phosphocreatine recovery threshold

B. The fat oxidation ceiling

C. The protein deamination threshold

D. The ventilatory threshold

20. A CMJ = 66 cm and SJ = 54 cm. The 12 cm difference represents which mechanism?

A. Greater phosphocreatine during CMJ

B. The stretch-shortening cycle

C. Enhanced aerobic energy during countermovement

D. Reduced bodyweight at the transition

21. Eccentric cardiac hypertrophy from endurance training directly increases which variable?

A. Maximal stroke volume

B. Resting diastolic blood pressure

C. Blood viscosity

D. Resting sympathetic tone

22. Blood flow redistribution during maximal exercise uses which dual mechanism?

A. Permanent vessel closure to organs

B. Decreased cardiac output concentrating blood

C. Metabolic vasodilation plus sympathetic vasoconstriction

D. Increased blood viscosity forcing flow

23. A protocol of 4×10 at 70% with 60-sec rest produces greater GH than 5×2 at 93% with 5-min rest. The primary stimulus is which factor?

A. Heavier loads in the volume protocol

B. Greater training time in the strength protocol

C. Superior neural recruitment from lighter loads

D. Higher metabolic stress from incomplete recovery

24. Female athletes achieve strength gains primarily through which mechanism?

A. Greater GH compensating for lower testosterone

B. Neural adaptations including recruitment and coordination

C. Flexibility directly increasing force production

D. Bone density replacing hypertrophy

25. An athlete's T:C ratio declines 8 weeks with stagnated performance and insomnia. This indicates which condition?

A. Overtraining syndrome

B. Optimal competitive peaking

C. Normal hormonal fluctuation

D. Acute DOMS

26. Wolff's Law predicts greatest osteogenic stimulus from which exercise type?

A. Deep-water aquatic exercise

B. Recumbent cycling at low intensity

C. Ground-based resistance with compressive and impact forces

D. Seated machine exercises at light loads

27. Two athletes share a 195 kg squat. Athlete A jumps 72 cm; B jumps 55 cm. The difference is explained by which quality?

A. Superior aerobic capacity in Athlete A

B. Greater absolute strength in Athlete A

C. Greater flexibility in Athlete A

D. Superior rate of force development in Athlete A

28. During sprint acceleration, forward lean directs GRF in which direction?

A. Vertically to maximize flight time

B. Horizontally to generate forward momentum

C. Mediolaterally for balance

D. No specific direction

29. At max sprint velocity, which GRF component most distinguishes faster sprinters?

A. The vertical component

B. The anteroposterior component

C. The mediolateral component

D. All three equally

30. Connective tissue adapts more slowly than muscle because of which characteristic?

A. Identical metabolic activity to muscle

B. Higher metabolic rate than muscle

C. Lower metabolic activity and reduced blood supply

D. No capacity for structural remodeling

31. The SAID principle predicts that slow jogging for a hockey player fails to develop which demands?

A. Only aerobic fitness is needed for hockey

B. Slow jogging provides all hockey adaptations

C. Only flexibility determines hockey performance

D. Explosive skating, anaerobic recovery, and contact tolerance

32. Eccentric force exceeds concentric by 20-60%. This supports which application?

A. Identical loading for all contraction types

B. Supramaximal eccentric training exceeding concentric 1RM

C. Elimination of all eccentric training

D. Eccentric actions produce zero force

33. Detraining shows which quality declines most rapidly?

A. Aerobic capacity within 1-2 weeks

B. Maximal strength within 24 hours

C. Bone density within 5 days

D. Flexibility within 48 hours

34. Third-class levers favor which mechanical outcome?

A. Force amplification at the expense of speed

B. Equal force and speed at all angles

C. Speed and ROM at the expense of force

D. Zero mechanical advantage

35. The creatine kinase reaction's speed comes from which characteristic?

A. Complex mitochondrial processing

B. Exclusive operation within mitochondria

C. Requirement for oxygen as co-factor

D. Single-step enzymatic reaction in sarcoplasm requiring no oxygen

36. "Muscle memory" is explained by which mechanism?

A. Elevated creatine kinase persisting indefinitely

B. Retained myonuclei from prior training persisting through atrophy

C. Residual glycogen lasting years after detraining

D. Circulating testosterone remaining elevated permanently

37. PNF contract-relax increases ROM through which mechanism?

A. GTO autogenic inhibition reducing muscle tone

B. Muscle spindle facilitation increasing contraction

C. Pacinian corpuscle vibration detection

D. Ruffini ending pressure sensing

38. Diastolic BP remains stable during moderate exercise because of which mechanism?

A. Vasoconstriction in all vascular beds

B. Increased blood viscosity

C. Vasodilation in working muscles reducing peripheral resistance

D. Decreased cardiac output during diastole

39. Torque calculation: 9 kg at 90° abduction, 0.65 m from shoulder. The torque is approximately which value?

A. 9 N·m

B. 0 N·m

C. 200 N·m

D. Approximately 57.4 N·m

40. Cortisol's acute catabolic actions serve which metabolic purpose?

A. Stimulating protein synthesis via mTOR

B. Protein degradation and gluconeogenesis for blood glucose maintenance

C. Enhancing glycogen synthesis in muscle

D. Suppressing all lipolysis

41. Post-14-week blood work: stable testosterone, decreased cortisol, improved T:C ratio, continued gains. This indicates which status?

A. Successful positive adaptation

B. Overtraining syndrome

C. Medical condition

D. Meaningless data

42. Increased androgen receptor density means which of the following?

A. No effect on hormonal response

B. Eliminates need for sleep and nutrition

C. Enhanced muscle sensitivity to circulating testosterone

D. Reverses within 24 hours

43. The crossover concept describes which phenomenon?

A. Transfer of training between limbs

B. Fiber type conversion from fast to slow

C. Transition from aerobic to anaerobic threshold

D. Progressive shift from fat to carbohydrate oxidation as intensity increases

44. The Cori cycle recycles lactate through which organ?

A. The kidneys

B. The liver

C. The spleen

D. The pancreas

45. A female runner: amenorrhea 10 months, 1,100 kcal/day, 2.5 hr training, decreased BMD, stress fractures. This indicates which condition?

A. RED-S

B. Iron deficiency anemia

C. Normal adaptation

D. Vitamin D toxicity

46. RED-S in males produces which consequences?

A. Enhanced performance from efficiency

B. Increased testosterone from restriction

C. Suppressed testosterone, decreased BMD, impaired immunity, declining performance

D. No consequences in males

47. The stretch reflex is classified as which pathway type?

A. Polysynaptic through cerebral cortex

B. Voluntary cortical contraction

C. Inhibitory reflex reducing force

D. Monosynaptic — fastest reflexive contraction

48. Depth jump contact time increases from 160 ms to 350 ms by rep 6. The response is which of the following?

A. Increase box height

B. Terminate — SSC benefit is lost

C. Add ankle weights

D. Continue to 15 reps

49. Two athletes at 87 kg produce 3,050 N peak GRF. A peaks at 130 ms; B at 275 ms. A jumps higher because of which quality?

A. Superior rate of force development

B. Greater absolute strength

C. Superior aerobic capacity

D. Greater flexibility

50. If amortization exceeds 250 ms during a depth jump, which occurs?

A. Stretch reflex amplified

B. Concentric force enhanced

C. Elastic energy dissipates and stretch reflex diminishes

D. Stiffness increases improving return

51. The calf raise lever favors which outcome?

A. Speed and ROM at expense of force

B. Equal force and speed

C. Zero mechanical advantage

D. Force production because effort arm exceeds resistance arm

52. Accommodation plateau after 22 weeks is best addressed by which intervention?

A. Continue identical program indefinitely

B. Introduce variation in exercises, loads, or periodization

C. Complete cessation for 6 months

D. Reduce all loads to 25% permanently

SPORT PSYCHOLOGY (Questions 53–75)

53. Pre-competition muscle tension, elevated HR, and sweaty palms classify as which anxiety type?

A. Somatic anxiety

B. Cognitive anxiety from negative thoughts

C. Trait anxiety that cannot be modified

D. Facilitative arousal

54. The inverted-U predicts a precision archery shot requires which arousal?

A. Very high arousal for maximum activation

B. High arousal identical to a maximal tackle

C. Low-to-moderate arousal for fine motor control

D. Arousal is irrelevant to accuracy

55. Effective goal-setting combines which three types?

A. Only outcome goals

B. Only process goals

C. No goals at all

D. Outcome, performance, and process hierarchically

56. A coach says: "Your knees caved during the squat ascent." This is which feedback type?

A. Knowledge of results about the outcome

B. Knowledge of performance about technique quality

C. Intrinsic feedback from proprioception

D. Motivational feedback to increase effort

57. Random practice produces which long-term outcome compared to blocked?

A. Slower initial improvement but better long-term retention

B. Faster improvement and better retention

C. Identical outcomes

D. Faster improvement with identical retention

58. Feedback after every rep produces which long-term consequence?

A. Optimal permanent learning

B. Accelerated mastery persisting indefinitely

C. Impaired learning from dependency on external correction

D. No measurable effect

59. Distributed practice produces better learning through which mechanism?

A. Elimination of all errors

B. Glycogen resynthesis improving cortex function

C. Massed practice produces zero learning

D. Memory consolidation during rest intervals

60. An athlete in the autonomous stage demonstrates which characteristics?

A. Large errors with heavy reliance on instruction

B. Automatic execution with attention free for strategy

C. Inability to perform the skill

D. Conscious attention for every repetition

61. Burnout is characterized by which three dimensions?

A. Emotional exhaustion, depersonalization, and reduced accomplishment

B. Increased motivation and energy

C. Normal fluctuation resolving within hours

D. Acute anxiety resolving after competition

62. A 16-year-old shows isolation, worthlessness, lost interest, hopelessness. The specialist should do which of the following?

A. Design more intense training

B. Increase competitive schedule

C. Recommend parents seek mental health evaluation

D. Ignore as normal development

63. Self-determination theory identifies which three needs?

A. Strength, power, endurance

B. Visual, kinesthetic, auditory

C. Outcome, performance, process

D. Autonomy, competence, relatedness

64. A wrestler shows extreme weight manipulation, meal avoidance, and excessive exercise. The CSCS should do which of the following?

A. Prescribe a corrective meal plan

B. Refer to a qualified healthcare professional

C. Increase body comp testing

D. Ignore as normal culture

65. A teammate of similar ability completes a challenging lift, increasing the observer's confidence. Which self-efficacy source?

A. Past performance accomplishment

B. Verbal persuasion

C. Physiological state interpretation

D. Not determinable

66. An athlete excels in practice but underperforms in competition with worry. This indicates which phenomenon?

A. Social facilitation

B. Optimal arousal

C. Choking under pressure

D. Permanent disorder

67. An ACL patient fears re-injury during cutting despite full clearance. The best response is which of the following?

A. Immediate full-contact return

B. Permanent elimination of cutting

C. Dismissal of psychological concerns

D. Gradual reintroduction with sport psychology referral

68. A pitcher's fastball-to-changeup change involves which GMP adjustment?

A. Relative timing restructured completely

B. Overall speed and absolute force adjusted

C. Spatial pattern changes entirely

D. Nothing — GMP is fixed

69. A point guard scanning the court uses which attentional focus?

A. Broad-external

B. Narrow-internal

C. Narrow-external

D. Broad-internal

70. An athlete squats 200 kg for the first time. Confidence for 205 kg comes primarily from which source?

A. Vicarious experience

B. Verbal persuasion

C. Past performance accomplishment

D. Physiological state interpretation

71. Reducing feedback to ~50% produces which effect?

A. Slower acquisition during practice

B. Identical outcomes regardless

C. Permanent impairment

D. Better long-term retention through internal error detection

72. Somatic anxiety is best addressed by which intervention?

A. Thought stopping

B. Physical relaxation (PMR, diaphragmatic breathing)

C. Goal-setting worksheets

D. Failure imagery

73. Front squat transferring to clean catch is which transfer type?

A. Positive transfer

B. Negative transfer

C. Zero transfer

D. Random transfer

74. Mental imagery is most effective engaging which modalities?

A. Only visual

B. Only kinesthetic

C. Visual, kinesthetic, auditory, and emotional simultaneously

D. Only auditory

75. Self-efficacy is distinguished by which feature?

A. Global personality trait

B. Determined by genetics

C. Identical to general confidence

D. Task-specific and situation-specific

NUTRITION (Questions 76–95)

76. A 108 kg athlete at 2.2 g/kg/day requires which protein target?

A. 86 grams

B. 238 grams

C. 540 grams

D. 43 grams

77. The primary mTOR trigger amino acid is which of the following?

A. Leucine

B. Glutamine

C. Glycine

D. Alanine

78. An athlete on <15% fat for 6 months has suppressed testosterone. The cause is which of the following?

A. Excessive protein causing renal stress

B. Excessive carbohydrate causing insulin resistance

C. Inadequate fat impairing steroid hormone production

D. Chronic dehydration

79. An athlete drinks 3 L/hr plain water for 4 hours without sodium. The resulting confusion is caused by which condition?

A. Hypernatremia

B. Metabolic alkalosis

C. Rhabdomyolysis

D. Exercise-associated hyponatremia

80. Creatine maintenance (3-5 g/day) achieves saturation in approximately how long?

A. 24-48 hours

B. Approximately 28 days

C. Impossible without loading

D. 6-12 months

81. Caffeine's primary ergogenic mechanism is which of the following?

A. Blocking adenosine receptors reducing fatigue perception

B. Increasing phosphocreatine stores directly

C. Stimulating muscle protein synthesis

D. Permanently increasing metabolic rate

82. Beta-alanine is most beneficial for activities lasting which duration?

A. Less than 5 seconds

B. Longer than 60 minutes

C. 1-4 minutes

D. During complete rest

83. Which certification minimizes WADA doping risk?

A. USDA Organic

B. FDA pharmaceutical approval

C. ISO 9001 manufacturing

D. NSF Certified for Sport or Informed Sport

84. Protein during caloric deficit should be at which level?

A. 0.8 g/kg general RDA

B. 2.0-2.4 g/kg to preserve lean mass

C. Less than 0.5 g/kg

D. No protein during restriction

85. Sodium bicarbonate's most common side effect is which of the following?

A. GI distress including nausea, bloating, and diarrhea

B. Permanent liver damage

C. Cardiac arrhythmias

D. Complete energy system suppression

86. A 74 kg endurance athlete at 10 g/kg/day requires which carbohydrate target?

A. 74 grams

B. 370 grams

C. 740 grams

D. 1,480 grams

87. Vitamin D deficiency consequences include which of the following?

A. Excessive hypertrophy

B. Enhanced performance

C. No consequences

D. Impaired muscle function, compromised immunity, stress fracture risk

88. Vitamin C enhances non-heme iron absorption through which mechanism?

A. Inhibiting all iron absorption

B. Converting Fe^{3+} to bioavailable Fe^{2+}

C. No interaction with iron

D. Enhancing heme while blocking non-heme

89. Post-exercise carbohydrate within 30 min (two sessions in 8 hours) should be which amount?

A. 1.0-1.5 g/kg to maximize glycogen synthase activity

B. No carbohydrate for 12 hours

C. Only protein with zero carbohydrate

D. 0.1 g/kg to minimize insulin

90. Plant-based athletes achieve adequate amino acids through which strategy?

A. Plant diets cannot provide adequate protein

B. Only soy protein at every meal

C. Complementary plant sources throughout the day

D. 100 grams isolated BCAAs daily

91. Casein before sleep supports recovery through which mechanism?

A. Immediate emptying identical to whey

B. Complete catabolic suppression for 48 hours

C. No benefit — pre-sleep protein wasted

D. Slow gel-forming digestion providing sustained amino acid delivery

92. High-GI foods are most appropriate at which time?

A. Only at breakfast

B. During and immediately after exercise

C. Exclusively before sleep

D. Never by any athlete

93. Glutamine evidence for muscle growth in well-nourished athletes is which of the following?

A. Limited — not among robust ergogenic aids

B. Strongest evidence of any supplement

C. Permanently elevates testosterone

D. Only supplement approved by all agencies

94. Adequate dietary fat (20-35% calories) serves which functions?

A. No physiological function

B. Exclusive phosphagen fuel

C. Hormone production, vitamin absorption, membrane integrity, essential fatty acids

D. Direct Type IIx hyperplasia

95. Fluid intake during 90-min team sport should follow which guideline?

A. No fluid because drinking impairs performance

B. 4 liters at halftime

C. Only caffeinated beverages

D. 200-300 mL every 15-20 min adjusted for sweat rate

SECTION 2 — PRACTICAL/APPLIED

125 Questions | 2.5 Hours Recommended

EXERCISE TECHNIQUE (Questions 96–140)

96. An athlete performing back squats consistently shifts weight to one side during the ascent. This compensation most commonly indicates which issue?

A. Normal squat mechanics requiring no correction

B. Unilateral hip mobility restriction or strength asymmetry

C. Bilateral hip hypermobility

D. Superior quadriceps strength

97. During a deadlift, the athlete's hips rise faster than the chest ("stripper pull"). This shifts loading to which structure?

A. The lumbar spine and erector spinae

B. The ankle joint and calf musculature

C. The anterior deltoids and upper chest

D. The wrist flexors and forearm extensors

98. Dumbbell bench press with elbows flared to 90° at the bottom increases risk of which injury?

A. Hamstring strain

B. Biceps tendon rupture

C. Shoulder impingement and pectoral strain

D. Quadriceps strain

99. Single-leg RDLs for a soccer player address which sport-specific demands?

A. Bilateral pressing for throw-ins

B. Maximal bilateral squat for headers

C. Aerobic endurance for 90-minute matches

D. Unilateral hip hinge, hamstring resilience, and single-leg balance

100. Box jump landing with stiff legs and minimal knee flexion creates which concern?

A. Enhanced force production

B. Excessive impact forces from inadequate absorption

C. Improved ankle stiffness

D. No safety concern

101. The NSCA top-down power clean progression begins with which exercise?

A. The front squat to establish the receiving position

B. Full squat clean from the floor

C. Hang clean at challenging loads

D. Clean pull without catching

102. An athlete's pull-up begins with a shoulder shrug instead of lat engagement. This reduces activation of which muscle?

A. Upper trapezius

B. Biceps brachii

C. The latissimus dorsi

D. Anterior deltoid

103. Near-maximal compound lifts for trained athletes use which breathing technique?

A. Continuous exhaling through both phases

B. Inhaling during the concentric phase

C. No structured breathing needed

D. Valsalva maneuver for spinal stabilization

104. Tempo squats (4-sec eccentric, 2-sec pause) target which adaptation?

A. Maximum power through high velocity

B. Time under tension for hypertrophy and positional awareness

C. Aerobic endurance through extended sets

D. Flexibility through loaded stretching

105. Cable woodchops with rotation primarily through the lumbar spine creates which concern?

A. Excessive lumbar rotational stress increasing disc injury risk

B. Enhanced core activation

C. Improved rotational power

D. No concern — lumbar rotation is intended

106. Farmer's walks develop which combination of qualities?

A. Isolated rectus abdominis hypertrophy

B. Maximum rotational power

C. Grip endurance, core stability, and postural strength

D. Spinal flexion ROM

107. Landmine presses for an athlete with limited overhead mobility provide which advantage?

A. Identical demands to strict overhead press

B. Exclusive lower body loading

C. Isolated rotator cuff work

D. Angled pressing path without full overhead ROM

108. Kettlebell swing force production originates from which muscles?

A. Arms and anterior deltoids

B. Hip extensors (glutes and hamstrings)

C. Quadriceps through knee extension

D. Lumbar erectors through spinal hyperextension

109. Nordic hamstring curl with excessive low back strain indicates which error?

A. Lumbar hyperextension substituting for hip extensor work

B. Excessive ankle dorsiflexion

C. Too much knee flexion

D. Inadequate spinal flexion

110. Band-resisted sprints develop which quality?

A. Aerobic endurance

B. Hip flexor flexibility

C. Overloaded horizontal force during acceleration

D. Reduced joint impact forces

111. Eccentric-emphasized Bulgarian split squats (5-sec lowering) target which adaptations?

A. Maximum concentric power

B. Aerobic endurance

C. Flexibility exclusively

D. Eccentric strength, hypertrophy, and tendon resilience

112. Seated cable rows with rounded shoulders at end range indicates weakness in which muscles?

A. Pectoralis major and anterior deltoid

B. Scapular retractors (mid-traps and rhomboids)

C. Quadriceps and hip flexors

D. Biceps and brachioradialis

113. Turkish get-ups develop which primary qualities?

A. Shoulder stability, core strength, and total-body coordination

B. Isolated biceps hypertrophy

C. Maximum sprint speed

D. Maximum bilateral pressing

114. Barbell hip thrust with lumbar hyperextension at lockout creates which concern?

A. Enhanced glute activation

B. Improved core stability

C. Lumbar compressive forces from end-range hyperextension

D. No concern

115. Sled pushes for a football lineman develop which sport-specific quality?

A. Overhead pressing strength

B. Vertical jumping power

C. Aerobic endurance

D. Horizontal force production matching blocking demands

116. During lunges, front knee valgus indicates weakness in which muscles?

A. Hip flexors and rectus femoris

B. Hip abductors and external rotators (gluteus medius)

C. Ankle plantarflexors

D. Anterior deltoids

117. Depth drops (landing only, no rebound) in early plyometric progression serve which purpose?

A. Maximum concentric jumping power

B. Aerobic endurance

C. Maximum rotational power

D. Teaching eccentric landing mechanics before reactive jumps

118. Dumbbell spotting assistance is applied at which location?

A. Directly on the dumbbells

B. At the elbows for leverage

C. At the wrists near the athlete's hands

D. At the upper arms

119. Proper box jump landing requires which standards?

A. Stiff-legged with locked knees

B. On the heels with trunk flexed

C. Single-leg with opposite leg extended

D. Soft landing with hip/knee flexion, neutral spine, knees over toes

120. Face pulls with external rotation for a pressing-dominant athlete primarily serve which purpose?

A. Increasing bench press 1RM

B. Posterior shoulder and scapular health balancing pressing

C. Maximum pectoral hypertrophy

D. Aerobic shoulder endurance

121. An athlete's RDL knees slide forward excessively. The correction cue is which of the following?

A. "Push your hips straight back" to maintain the hinge

B. Increase knee flexion beyond 90°

C. Look straight down

D. Round the spine

122. Reverse lunges reduce anterior knee stress compared to forward lunges because of which factor?

A. Greater patellofemoral compression

B. Increased forward knee translation

C. Elimination of front-leg eccentric deceleration demand

D. Elimination of all eccentric action

123. The hex bar deadlift provides which advantage?

A. Greater lumbar moment arm

B. Identical biomechanics to conventional

C. Increased grip demand

D. Reduced lumbar moment arm from centered load

124. Banded squats provide maximum resistance at which position?

A. The bottom where the band is least stretched

B. The top where the band is fully stretched

C. Constant throughout ROM

D. The bottom where the athlete is weakest

125. A medicine ball throw qualifies as plyometric with which characteristic?

A. Maximal speed with minimal eccentric-to-concentric transition

B. 5-second pause between catch and throw

C. Slow controlled tempo

D. Maximum weight regardless of speed

126. Olympic platforms should be positioned with which consideration?

A. Against mirrors for technique

B. Adjacent to cardio equipment

C. Separated from traffic with clearance for dropped barbells

D. Center of facility for motivation

127. With 30 athletes and 10 racks, the optimal approach is which of the following?

A. All 30 doing bodyweight squats while waiting

B. All 30 watching one demonstration

C. Eliminating squats

D. Groups of 3 per rack rotating squat/spot/rest

128. Collars serve which safety purpose?

A. Increasing barbell weight

B. Preventing plates from sliding off during exercise

C. Improving grip friction

D. Decorative only

129. Program includes power cleans, squats, bench, rows, curls, planks. Which exercise first?

A. Power cleans — explosive exercise when freshest

B. Curls

C. Planks

D. Rows

130. Single-spotter bench grip should be which of the following?

A. Wide pronated matching athlete's width

B. No grip — hands on elbows

C. Alternated grip close to center for security

D. Supinated near plates

131. An athlete explosive on field but weak on heavy lifts has which deficiency?

A. Excessive explosive ability

B. Only aerobic conditioning needed

C. Only flexibility needed

D. Maximal strength deficit requiring heavy training

132. Correct RDL technique includes which standards?

A. Full knee lockout with lumbar rounding

B. Slight constant knee flexion, neutral spine, hip hinge, bar close to legs

C. Deep knee flexion in squat pattern

D. Alternating extension and flexion each rep

133. Swimmer's program: pull-ups, I/E rotation, anti-rotation core. This addresses which needs?

A. Pulling strength, rotator cuff health, and trunk stability

B. Only lower body power

C. Only flexibility

D. Only cardiovascular endurance

134. Pallof press trains the core to resist which force?

A. Sagittal extension

B. Sagittal flexion

C. Rotational force attempting to twist the torso

D. Frontal plane lateral flexion

135. Before the snatch, which mobility prerequisite must be assessed?

A. Only ankle dorsiflexion

B. Only wrist flexion

C. No prerequisites needed

D. Overhead squat mobility with locked arms in deep squat

136. Correct push-up standards include which combination?

A. Hips sagging with swayback

B. Straight line head-to-heels, chest near floor, elbows ~45°

C. Elbows flared to 90°

D. Partial ROM with 10-15° bend

137. Conditioning for an offensive lineman uses which protocol?

A. 5-10 yard sprints with 25-40 sec rest matching demands

B. 3-mile runs at moderate pace

C. 400-meter repeats with 60-sec rest

D. 60-min cycling at 50% HRmax

138. Face pulls target which muscles for which purpose?

A. Pectoralis major for pressing

B. Quadriceps for extension

C. Posterior deltoids, external rotators, mid-traps for shoulder health

D. Biceps for arm size

139. Reactive agility drills with visual cues develop which quality preplanned drills cannot?

A. Straight-line sprint speed

B. Bilateral strength

C. Only aerobic endurance

D. Perceptual-cognitive processing with direction change

140. Isometric mid-thigh pulls assess and develop which quality?

A. Maximum flexibility

B. Peak isometric force and rate of force development

C. Aerobic endurance

D. Muscular endurance

PROGRAM DESIGN (Questions 141–184)

141. A competitive 1500-meter runner (race ~3:30-4:15) relies most on which energy system combination?

A. Aerobic primary (~60-70%), glycolytic secondary (~25-35%), phosphagen for the kick

B. Exclusively phosphagen

C. Exclusively oxidative through fat only

D. No specific system dominant

142. A barbell push jerk is classified as power because it meets which criteria?

A. Single-joint isolation at slow tempo

B. Non-structural with no spinal loading

C. Structural, explosive, involving multiple large muscle groups

D. Identical to strict press

143. A novice completing 8 weeks of training should estimate 1RM using which approach?

A. Direct 1RM with experienced spotters

B. No testing for the first 2 years

C. Maximum effort testing on day one

D. Submaximal prediction with 5-8 RM equations

144. For an advanced athlete (7+ years), which split provides sufficient volume?

A. Total body 2×/week with 2 sets per exercise

B. Upper/lower or push/pull/legs split

C. One session/month at maximal loads

D. Machine-only circuit at 30% daily

145. The 8-12 rep range at 67-85% with 60-90 sec rest targets which adaptation?

A. Hypertrophy through tension and metabolic stress

B. Maximal strength through neural adaptation

C. Power through ballistic movement

D. Aerobic endurance

146. An athlete's 1RM deadlift is 210 kg. At 87% the working load is which value?

A. 210 kg

B. 105 kg

C. Approximately 183 kg

D. 260 kg

147. Triphasic training emphasizes eccentric → isometric → concentric sequentially. This is based on which principle?

A. All contractions produce identical force

B. Eccentric has no unique benefits

C. Concentric-only is always superior

D. Each contraction type produces distinct transferable adaptations

148. Cluster sets maintain bar velocity because of which mechanism?

A. Complete glycogen resynthesis between reps

B. Brief intra-set rest allowing partial PCr recovery and neural restoration

C. Full hormonal recovery between reps

D. Increased TUT identical to straight sets

149. Contrast training (heavy squat then jump squat 3-4 min later) exploits which phenomenon?

A. PAP priming the nervous system for enhanced power

B. Pre-exhaustion reducing jump requirements

C. Aerobic conditioning from rest

D. Flexibility from the stretch

150. VBT terminates sets at 20% velocity drop. This autoregulates which variable?

A. Heart rate during exercise

B. Flexibility between sets

C. Fatigue-induced velocity loss maintaining quality

D. Blood lactate concentration

151. An athlete returning from grade II ankle sprain needs which rehabilitation component?

A. No balance training

B. Only bilateral standing on stable surfaces

C. Maximal bilateral exercises only

D. Progressive single-leg balance on increasingly unstable surfaces

152. In-season basketball (26 games, 14 weeks) should follow which guideline?

A. Complete cessation of resistance training

B. 2 sessions/week reduced volume but maintained intensity

C. 6 sessions/week at full preparatory volume

D. Only stretching and bodyweight

153. Concurrent strength and endurance interference is minimized by which strategy?

A. Separate sessions by 6-8 hours; prioritize strength first same-day

B. Both in the same session with no separation

C. Never train endurance

D. Train only one quality, ignore the other

154. Wrestling conditioning (three 2-min periods) targets which energy system?

A. Only phosphagen with 5-sec efforts

B. Only oxidative with 30-min runs

C. The glycolytic system with 2-min high-intensity intervals

D. No conditioning needed

155. Complex training PAP rest between heavy and explosive sets is approximately which duration?

A. Zero rest immediately

B. 30 seconds

C. 20 minutes

D. 3-5 minutes for potentiation while fatigue dissipates

156. Evidence-based taper involves which adjustments?

A. Increasing volume 50% and decreasing intensity

B. Reducing volume 40-60% while maintaining intensity

C. Full volume with additional sessions

D. Complete cessation for 4 weeks

157. An annual plan for a fall championship positions general prep at which time?

A. Late spring/early summer for sufficient preparation

B. The week before championship

C. During the competitive season

D. 18 months after the championship

158. A "force-deficient" athlete should emphasize which training?

A. Only light-load high-velocity training

B. Only aerobic endurance

C. Heavy resistance training (85%+ 1RM)

D. Only flexibility

159. A 4-phase reconditioning progression reflects which principle?

A. Random exercise selection

B. Immediate return to sport demands

C. Permanent restriction from activity

D. Systematic rebuilding from healing through functional restoration

160. Linear periodization is characterized by which pattern?

A. Volume and intensity increase simultaneously

B. Increasing intensity with decreasing volume across phases

C. Constant throughout

D. Decreasing intensity with increasing volume

161. Block periodization's three-block sequence is which of the following?

A. Accumulation → Transmutation → Realization

B. Realization → Transmutation → Accumulation

C. Flexibility → Cardio → Endurance

D. Competition → Transition → General

162. In-season maintenance with maintained intensity produces which outcome?

A. Dramatic strength loss

B. Complete detraining within 48 hours

C. Strength and power maintenance

D. Significant additional gains

163. The transition period should last approximately how long?

A. 12 weeks of maximal training

B. 6 months of bed rest

C. Eliminated entirely

D. 2-4 weeks of low-intensity active recovery

164. Jump squat peak power occurs at which range?

A. 85-95% 1RM

B. 0-30% 1RM allowing high velocity

C. 50-70%

D. Equal at all loads

165. Hang clean peak power is at approximately which range?

A. 70-80% 1RM for optimal force-velocity

B. 0-10% with empty barbell

C. 95-100% at slow velocity

D. Equal at all loads

166. Beginner plyometric volume should be which of the following?

A. 250 contacts of depth jumps

B. 500 contacts

C. 80-100 foot contacts across varied intensity

D. 10 contacts regardless of type

167. Plyometrics should be positioned when in a session?

A. After heavy resistance for fatigue

B. Only on rest days

C. After a 5K run

D. After warmup when fresh

168. Squat at 92nd percentile, VJ at 26th. The deficiency is which of the following?

A. Insufficient maximal strength

B. RFD deficit requiring explosive training

C. No deficiency

D. Excessive flexibility

169. Soccer conditioning should include which combination?

A. Aerobic base, anaerobic intervals, and reactive agility

B. Only heavy resistance training

C. Only long-distance running

D. Only static stretching

170. Return-to-play requires which criterion?

A. Subjective readiness only

B. Walking without limp as sole criterion

C. Bilateral symmetry within 10%, movement competency, medical clearance

D. Any group exercise class

171. An ice hockey forward (45-60 sec shifts, 2-3 min rest) targets which energy system?

A. Only phosphagen

B. Only oxidative

C. No energy system training

D. Glycolytic with matching interval training

172. For an advanced athlete targeting a single competition, the best model is which of the following?

A. Fixed program with no variation

B. Block periodization targeted to peak at competition

C. Beginner program at 60% 1RM

D. Random exercise selection

173. After 22 weeks with plateau, the best intervention is which of the following?

A. Introduce variation in exercises, loads, or periodization

B. Continue identical program

C. Cease training for 6 months

D. Reduce loads to 25%

174. Hamstring reconditioning follows which progression?

A. Immediate full-intensity sprinting

B. Exclusive upper body permanently

C. Rest for 12 months

D. Progressive loading meeting symmetry criteria before return

175. A 12-week powerlifting block sequences which order?

A. Realization → Transmutation → Accumulation

B. Flexibility → Cardio → Endurance

C. Competition → Transition → General

D. Accumulation → Transmutation → Realization

176. Muscular endurance rest (<67% 1RM, 12+ reps) should be which duration?

A. 2-5 minutes full recovery

B. 30 seconds or less

C. 8-10 minutes

D. No rest for 90 minutes

177. 5×2 at 93% with 5-min rest develops which quality?

A. Maximal strength and neural adaptation

B. Muscular endurance

C. Hypertrophy

D. Cardiovascular fitness

178. Volume load: 5×4×145 kg equals which total?

A. 725 kg

B. 20 reps

C. 2,900 kg

D. 1,450 kg

179. Novice's first 4-6 weeks should use which strategy?

A. 95% 1RM singles

B. Only plyometric depth jumps

C. No resistance training for 12 months

D. Moderate loads (60-70% 1RM) with 10-15 reps

180. Plyometric frequency of 2-3/week with 48-72 hours is for which reason?

A. Arbitrary with no basis

B. Musculotendinous recovery from eccentric loading

C. Cognitive processing only

D. Cardiovascular restoration only

181. Training log: Wk1=4×8@70%, Wk3=4×6@78%, Wk5=4×5@83%, Wk7=4×3@89%. Which model?

A. Linear periodization

B. Block periodization

C. Random programming

D. DUP

182. Developing strength and speed requires which approach?

A. Only heavy loads above 90%

B. Only bodyweight at max velocity

C. Heavy training some days, explosive exercises others

D. Only sprint practice

183. A deload week (volume reduced ~40%, intensity maintained) serves which purpose?

A. 1RM testing under fatigue

B. Permanent reduction

C. Program restart

D. Managing fatigue while maintaining stimulus

184. A "velocity-deficient" athlete should emphasize which training?

A. Only heavy loads above 90%

B. Light-load, high-velocity training (plyometrics, jump squats, sprints)

C. Only aerobic endurance

D. Only flexibility

TESTING AND EVALUATION (Questions 185–206)

185. Assessing power in 60 athletes during 2 hours requires which test?

A. Vertical jump (CMJ) with Vertec

B. Lab isokinetic dynamometry

C. Force plate with 3D capture

D. Underwater weighing

186. Consistent scores across repeated administrations demonstrate which property?

A. Face validity

B. Construct validity

C. Reliability

D. Criterion validity

187. 1RM test: athlete lifts 165 kg, fails 170 kg. The 1RM is which value?

A. 170 kg

B. 167.5 kg average

C. Test must restart

D. 165 kg — last successful lift

188. CMJ = 71 cm, SJ = 58 cm. The 13 cm difference reflects which capacity?

A. Aerobic power

B. SSC utilization

C. Quad strength

D. Hamstring:quad ratio

189. Aerobic testing for 55 athletes outdoors with minimal equipment requires which test?

A. 20-meter beep test

B. Lab treadmill VO_2max

C. Wingate on ergometer

D. 1RM back squat

190. Skinfold assessment uses which calculation?

A. Skinfolds directly produce body fat %

B. Skinfolds estimate bone density

C. Skinfolds → prediction equations → body density → body fat %

D. Skinfolds × body weight = fat mass

191. BIA accuracy is most affected by which variable?

A. Room temperature

B. Shoe brand

C. Number of people

D. Hydration status

192. Electronic timing eliminates which error?

A. Wind resistance

B. Human timer reaction variability (0.1-0.3 sec)

C. Temperature on muscle

D. Lane color

193. Bilateral hop: R=48 cm, L=38 cm (~21%). This suggests which finding?

A. Clinically significant asymmetry exceeding 10-15% threshold

B. Normal variation

C. Right leg overtrained

D. Invalid test

194. Squat=89th, VJ=27th, agility=54th, run=65th. Priority is which quality?

A. Maximal strength

B. Aerobic endurance

C. Explosive power — VJ disproportionately low vs. strength

D. Agility

195. Most critical factor for valid longitudinal testing is which of the following?

A. Different tests each time

B. Athlete-selected conditions

C. Testing after heavy training

D. Identical conditions across sessions

196. ACL patient at 83% bilateral hop symmetry. Based on 90% criterion, recommendation is which of the following?

A. Return to competition

B. Continue strengthening until 90% met

C. Hop testing irrelevant

D. Permanent restriction

197. Force plate measures which variables simpler methods cannot?

A. Peak GRF, RFD, impulse, power in addition to height

B. Only height from reach difference

C. Only body weight

D. Only flight time

198. Sit-and-reach limitation is which of the following?

A. Expensive lab equipment required

B. Takes 30+ min per athlete

C. Measures only hamstring/lower back; influenced by limb proportions

D. Only shoulder flexibility

199. Goniometry advantage over sit-and-reach is which of the following?

A. Less accurate for every joint

B. Identical information

C. Limited to hip only

D. Joint-specific ROM at any joint identifying restrictions

200. Testing should occur at which intervals?

A. Daily

B. Beginning and end of each major phase and pre/post-season

C. Once at career start

D. Randomly

201. Submaximal prediction is most accurate within which rep range?

A. 10 or fewer reps

B. 25-30 reps

C. 15-20 reps

D. Exactly 1 rep

202. 1RM protocol warmup sets are which of the following?

A. None — attempt immediately

B. One set of 50 reps

C. 3-4 progressively heavier sets (~50%, 70%, 80-85%)

D. 10 sets of 10

203. The T-test pattern is which of the following?

A. Straight 40-yard sprint

B. 60-sec repeated jumps

C. Agility ladder fixed footwork

D. Forward sprint, lateral shuffles, backward run in T-shape

204. VJ not improved after 12 weeks plyometrics. Squat = 1.1× BW. Modification is which of the following?

A. Continue same program

B. Add heavy resistance training — squat below 1.5× limits effectiveness

C. Cessation for 6 months

D. Eliminate all lower body

205. Cooper 12-min and 1.5-mile share which limitation?

A. Require expensive equipment

B. Test only one athlete at a time

C. Cannot distinguish fitness levels

D. Depend on self-pacing influenced by motivation

206. Pre-season basketball battery assesses which domains?

A. Only bench press

B. Only body composition

C. Aerobic capacity, speed, agility, power, strength, body composition

D. Only flexibility

ORGANIZATION AND ADMINISTRATION (Questions 207–220)

207. Facility for 60 athletes at NSCA upper guideline (60 sq ft) requires which space?

A. 600 sq ft

B. 1,200 sq ft

C. 6,000 sq ft

D. 3,600 sq ft

208. EAP should be rehearsed at which frequency?

A. Only when facility opens

B. At least annually with all staff

C. Every 10 years

D. Only after emergency

209. CSCS must maintain certification in which skill?

A. CPR and AED use

B. Advanced cardiac life support

C. EMT-paramedic

D. Wilderness first responder

210. "Standard of care" is which concept?

A. Maximum insurance coverage

B. Minimum salary

C. Care a competent professional would exercise under similar circumstances

D. Required CE credits

211. Waiver does NOT protect against which claim?

A. Inherent risks disclosed and assumed

B. Normal soreness

C. Documented risks acknowledged

D. Gross negligence or reckless conduct

212. Athlete requests diagnosis. CSCS should do which of the following?

A. Diagnose independently

B. Refer to qualified medical professional

C. Prescribe medication

D. Perform surgical evaluation

213. Which activity is within CSCS scope?

A. Designing programs, teaching technique, administering tests

B. Diagnosing injuries

C. Prescribing meal plans

D. Psychological counseling

214. Damaged equipment protocol is which of the following?

A. Continue until failure

B. Hidden from athletes

C. Immediately removed, tagged, documented, repaired before return

D. Wait for manufacturer

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

A. Always comply

B. Resign without discussion

C. Implement but document privately

D. Decline unsafe practices and advocate for safety

216. Supervision ratios adjust based on which factors?

A. Only athlete count

B. Exercise complexity, athlete experience, and staff qualifications

C. Only time of day

D. Only facility dimensions

217. Records should include which documents?

A. Training logs, testing data, waivers, clearances, maintenance, incidents

B. Only financial records

C. Only social media posts

D. Only coach's plans

218. Colleague without credentials teaches heavy cleans to novices. Response is which of the following?

A. Ignore

B. Encourage higher loads

C. Address with colleague and/or supervisor

D. Post on social media

219. Closed-toe policy; athlete in sandals. Response is which of the following?

A. Allow training in sandals

B. Allow barefoot

C. Modify policy

D. Enforce policy — proper footwear required

220. CSCS holds which program authority?

A. No authority — coach decides

B. Ultimate authority for design, implementation, and supervision

C. Equipment purchasing only

D. Off-season only

PRACTICE EXAM 14 — ANSWER KEY WITH EXPLANATIONS

SECTION 1 — SCIENTIFIC FOUNDATIONS

EXERCISE SCIENCE (Questions 1–52)

1. C — The most consistently documented fiber type change from chronic heavy and sprint training is the conversion of Type IIx to Type IIa within the fast-twitch spectrum. Regular high-intensity contractile activity stimulates Type IIa myosin heavy chain expression while downregulating the Type IIx isoform. The converted fibers retain fast-twitch characteristics while gaining improved oxidative capacity and fatigue resistance that support repeated high-intensity efforts.

2. A — ATP hydrolysis on the myosin head (ATP → ADP + Pi) provides the energy to cock the myosin head back into its high-energy position, preparing it for the next power stroke. This is distinct from ATP binding, which causes cross-bridge detachment. Without ATP hydrolysis to re-energize the myosin head, the cross-bridge cycle cannot continue past the detachment step.

3. D — A 44% strength increase with only 2% hypertrophy in 7 weeks is the hallmark of neural adaptation — improved motor unit recruitment, enhanced rate coding, reduced antagonist co-contraction, and better intermuscular coordination. The nervous system's capacity to activate existing muscle improves dramatically in novices before measurable structural changes develop. The experienced teammate has already maximized most neural pathways and relies on slower hypertrophic mechanisms for smaller incremental gains.

4. B — At sarcomere lengths beyond optimum, the actin and myosin filaments are pulled apart, reducing the zone of overlap where cross-bridges can form. Fewer available binding sites means fewer simultaneous cross-bridges and therefore less total force production. This is the descending limb of the length-tension curve, where force declines progressively as the muscle is stretched beyond its optimal resting length.

5. A — Peak muscular power (force × velocity) occurs at approximately 30-60% of maximal force, where moderate force combines with moderate-to-high velocity to produce the greatest power product. At the maximum force end, velocity approaches zero and power drops despite high force. At the maximum velocity end, force approaches zero and power drops despite high speed. This is why power training uses moderate loads moved at maximal velocity.

6. C — Henneman's Size Principle dictates that motor units are recruited in an orderly sequence from smallest to largest as force demand increases. During a true 1RM attempt, force demands approach 100% of maximal voluntary contraction, requiring activation of every motor unit including the

highest-threshold Type IIx units recruited last. These largest motor units innervate the most powerful fast-twitch fibers but have the highest activation thresholds.

7. D — Chronic heavy resistance training reduces the GTO's inhibitory influence on alpha motor neurons, allowing trained athletes to voluntarily produce force closer to the true structural capacity of their musculotendinous units. This neural disinhibition is a significant contributor to strength gains beyond what hypertrophy alone provides. Untrained individuals have a larger "strength deficit" — the gap between voluntary force and structural capacity — that heavy training progressively closes.

8. B — The exponential rise from 1.8 mmol/L at 200 watts to 5.4 mmol/L at 250 watts identifies the lactate threshold — the intensity where production began exceeding clearance capacity. Below 200 watts, lactate production and removal were balanced and concentrations remained stable. The steep inflection between these two workloads marks the transition to metabolically unsustainable conditions where accumulation accelerates exponentially.

9. A — A 40-second all-out effort falls squarely within the glycolytic-dominant duration range of approximately 15 seconds to 2-3 minutes at near-maximal intensity. Anaerobic glycolysis rapidly breaks down muscle glycogen, producing pyruvate that is converted to lactate with accompanying hydrogen ion accumulation. The rising H^+ concentration reduces intracellular pH, impairing cross-bridge cycling and enzymatic function — producing the 15 mmol/L lactate and 32% power decline.

10. C — The progressive RER decrease from 0.87 to 0.76 over 3.5 hours reflects a gradual metabolic shift from carbohydrate toward greater fat oxidation as muscle and liver glycogen stores deplete. As carbohydrate availability declines during prolonged moderate-intensity exercise, the body relies increasingly on the slower but more abundant fat oxidation pathways. The lower RER (closer to 0.70) indicates a higher proportion of energy derived from fat metabolism.

11. D — NADH and $FADH_2$ from the Krebs cycle deliver their electrons to the electron transport chain on the inner mitochondrial membrane. As electrons pass along the chain's protein complexes, energy is released to pump hydrogen ions across the membrane, creating the electrochemical gradient that drives ATP synthase. This process — oxidative phosphorylation — produces approximately 34 of the 36-38 total ATP from complete glucose oxidation.

12. B — Despite yielding approximately 129 ATP per palmitate versus 36-38 from glucose, fat oxidation produces ATP at a rate far too slow to match the rapid energy demands of high-intensity exercise. The rate limitation — not total yield — determines which substrate dominates at any given intensity. When energy demand is high, the body must rely on carbohydrate pathways that produce ATP at a faster rate to meet the immediate requirement.

13. A — At mile 21 with blood glucose at 44 mg/dL, muscle and liver glycogen have become substantially depleted and the runner is hypoglycemic. Without adequate carbohydrate substrate, the body cannot maintain the ATP production rate required for the running pace. This is the classic

marathon "wall" — a catastrophic performance decline that can only be prevented or delayed through strategic carbohydrate intake during the race.

14. C — The VO_2 plateau at 57 mL/kg/min despite continued workload increases, combined with RER of 1.17, blood lactate of 14 mmol/L, and near-maximal heart rate, confirms VO_2max. The primary criterion (plateau in oxygen consumption despite increasing demand) is validated by multiple secondary verification criteria. This confirms the athlete has reached the absolute ceiling of the cardiovascular system's oxygen delivery and the muscles' oxygen utilization capacity.

15. D — Oxygen serves as the final electron acceptor at the end of the electron transport chain, combining with electrons and hydrogen ions to form water. Without oxygen to accept the electrons, the entire chain backs up — NADH and $FADH_2$ cannot be reoxidized, the Krebs cycle stalls because NAD^+ and FAD cannot be regenerated, and aerobic ATP production ceases entirely. This absolute requirement is why aerobic metabolism cannot function under anaerobic conditions.

16. B — After stroke volume plateaus at approximately 40-60% of VO_2max (limited by reduced ventricular filling time as heart rate increases), further cardiac output increases depend entirely on continued heart rate increases driven by sympathetic nervous system activation. Heart rate rises approximately linearly with exercise intensity until approaching the age-predicted maximum. This makes maximal heart rate a key limiter of maximal cardiac output and therefore VO_2max.

17. A — Net upward force = GRF − body weight = 3,400 − 834 = 2,566 N. Only force exceeding the athlete's body weight produces upward acceleration — the first 834 N simply supports the body mass against gravity. Using Newton's Second Law (a = F/m), acceleration = 2,566 ÷ 85 = 30.2 m/s^2, demonstrating why producing high peak GRF relative to body weight is essential for vertical jump performance.

18. C — The biceps curl exemplifies a third-class lever where the effort (biceps insertion on the radial tuberosity) is positioned between the fulcrum (elbow joint) and the resistance (dumbbell in the hand). Because the effort arm is much shorter than the resistance arm, the muscle must produce approximately 8× the external load to generate sufficient torque for movement. The tradeoff is that this arrangement favors speed and range of motion at the distal end of the lever.

19. D — Hydrogen ions from glycolytic metabolism are buffered by the bicarbonate system: $H^+ + HCO_3^- \rightarrow H_2O + CO_2$. The additional CO_2 generated by this buffering reaction stimulates chemoreceptors that trigger a disproportionate increase in ventilation for CO_2 removal. This non-linear ventilatory increase — breathing rising faster than oxygen consumption — defines the ventilatory threshold and closely corresponds to the lactate threshold intensity.

20. B — The 12 cm difference between CMJ (66 cm) and SJ (54 cm) represents the contribution of the stretch-shortening cycle to concentric force production. The three SSC mechanisms — stored elastic energy in the musculotendinous unit, the stretch reflex from muscle spindle activation, and increased time for force development during the eccentric phase — augment the concentric takeoff force beyond what concentric-only contraction can produce in the static jump.

21. A — Eccentric cardiac hypertrophy from chronic endurance training enlarges the left ventricular chamber, allowing greater blood filling during diastole. This larger end-diastolic volume directly increases the stroke volume — the amount of blood ejected per beat during systole. Increased maximal stroke volume is the primary cardiovascular mechanism by which endurance training enhances maximal cardiac output and therefore VO_2max.

22. C — Blood flow redistribution during maximal exercise is accomplished through two simultaneous complementary mechanisms: local metabolic vasodilation in working muscles (mediated by CO_2, decreased O_2, temperature, and metabolite accumulation) combined with sympathetic vasoconstriction in non-essential organs (digestive tract, kidneys, inactive muscles). This dual mechanism selectively directs 80-85% of cardiac output to the most metabolically active tissues during maximal effort.

23. D — The primary stimulus for acute growth hormone release is metabolic stress — elevated blood lactate, hydrogen ion accumulation, and reduced intracellular pH created by high-volume training with short rest periods. The 60-second rest prevents full metabolic recovery between sets, maintaining the acidic cellular environment that triggers GH secretion from the anterior pituitary. The heavy protocol with 5-minute rest allows full recovery, minimizing the metabolic stress that drives GH release.

24. B — Female athletes achieve significant strength gains primarily through neural adaptations — improved motor unit recruitment, enhanced rate coding, better intermuscular coordination, and reduced antagonist co-contraction. These neural mechanisms are not testosterone-dependent and account for a larger proportion of total strength gains in females because the lower testosterone environment (10-15× less than males) limits the magnitude of structural hypertrophy that can occur.

25. A — A progressively declining T:C ratio over 8 weeks, combined with performance stagnation and insomnia, represents the classic presentation of overtraining syndrome. The chronic imbalance between accumulated training stress and recovery capacity has produced systemic hormonal maladaptation. This requires significant reduction in training volume and intensity, a structured recovery phase with adequate sleep and nutrition, and potential medical evaluation to rule out other causes.

26. C — Wolff's Law predicts that bone remodels in response to the mechanical stresses placed upon it. Ground-based resistance exercises (squats, deadlifts, weighted lunges) combined with impact activities (walking, stair climbing, jumping) apply large compressive and impact forces directly to the axial and appendicular skeleton. These weight-bearing, high-force activities provide the greatest osteogenic stimulus for increasing bone mineral density.

27. D — With identical 1RM values (195 kg), the 17 cm vertical jump difference indicates superior rate of force development and power output in Athlete A. During the brief ground contact time of a vertical jump (approximately 200-400 ms), Athlete A produces force more rapidly, generating

greater impulse that translates to higher takeoff velocity and jump height. Equal maximal strength with different jump performance is the hallmark of an RFD difference.

28. B — The pronounced forward lean during sprint acceleration allows the athlete to direct ground reaction forces primarily horizontally backward against the ground. By Newton's Third Law, the ground pushes back with an equal forward-directed reaction force that overcomes the body's inertia and generates forward momentum from a stationary start. Running upright during acceleration would direct forces too vertically, reducing the horizontal component essential for forward propulsion.

29. A — Research on elite sprinters consistently demonstrates that the vertical ground reaction force applied during the brief 80-100 ms ground contact phase at maximum velocity is the primary factor distinguishing faster from slower runners. Faster sprinters produce greater vertical force relative to body weight during each contact, effectively "bouncing" off the ground with greater musculotendinous stiffness and force application efficiency.

30. C — Tendons and ligaments have lower metabolic activity and reduced blood supply compared to skeletal muscle tissue, resulting in slower rates of collagen synthesis, turnover, and structural remodeling. This means connective tissues require more time to adapt to increased training loads than the muscles they support. Progressive overload must be gradual enough to allow these structures to keep pace with muscular strength gains, preventing the window of increased injury risk.

31. D — Slow jogging fails to develop explosive skating power, anaerobic recovery between shifts, and the contact tolerance required for competitive hockey. The SAID principle requires that the training stimulus specifically match the sport's physical demands for adaptations to transfer to competitive performance. Hockey demands short, intense bursts with physical contact interspersed with brief recovery periods — fundamentally different from steady-state aerobic running.

32. B — Eccentric force production increases with lengthening velocity to a plateau approximately 20-60% above maximal isometric force. This means athletes can safely control and lower loads exceeding their concentric 1RM. This characteristic forms the 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.

33. A — Aerobic capacity (VO_2max) declines most rapidly during detraining, with measurable reductions occurring within 1-2 weeks of inactivity and significant losses accumulating by 4-8 weeks. Maximal strength is more resistant to detraining, typically maintaining for 2-4 weeks or longer after training cessation. This hierarchy of detraining rates is critical for prioritizing which physical qualities to maintain during injury rehabilitation or competitive season management.

34. C — Third-class levers have the effort arm (muscle insertion near the joint) shorter than the resistance arm (external load far from the joint), creating a mechanical disadvantage for force. However, this arrangement favors speed and range of motion at the distal end — a small amount

of muscle shortening produces a large, fast movement at the hand or foot. The tradeoff is that the muscle must produce force many times greater than the external load.

35. D — The creatine kinase reaction (PCr + ADP → ATP + Cr) is a simple, single-step enzymatic process occurring directly in the sarcoplasm without requiring oxygen, mitochondria, or complex multi-step metabolic pathways. This simplicity makes it the fastest ATP-regenerating system in the body, capable of producing ATP almost instantaneously. This rate advantage makes the phosphagen system dominant during the first 6-10 seconds of maximal effort.

36. B — The "muscle memory" phenomenon is explained by retained myonuclei from prior hypertrophic training. During initial hypertrophy, satellite cells fuse with existing muscle fibers and donate additional nuclei that persist even during detraining-induced atrophy. When training resumes, these additional nuclei accelerate the protein synthetic response, allowing faster recovery of muscle size and strength compared to individuals who have never trained before.

37. A — During the contract-relax PNF technique, the 6-second isometric contraction generates high tension that activates the Golgi tendon organ at the musculotendinous junction. The GTO sends inhibitory signals through an Ib inhibitory interneuron that reduce alpha motor neuron activity to the target muscle. This autogenic inhibition temporarily decreases muscle tone and resistance to passive stretch, allowing greater range of motion immediately following the contraction.

38. C — Vasodilation in working muscles during moderate aerobic exercise reduces total peripheral resistance — the resistance to blood flow through the systemic circulation. Because diastolic blood pressure reflects peripheral resistance during the cardiac relaxation phase, the reduced resistance from muscle vasodilation counterbalances the increased cardiac output. This prevents diastolic pressure from rising during steady-state moderate-intensity exercise.

39. D — Torque = force × moment arm = (9 kg × 9.81 m/s²) × 0.65 m = 88.29 N × 0.65 m ≈ 57.4 N·m. Mass must first be converted to force in Newtons by multiplying by gravitational acceleration (9.81 m/s²), then multiplied by the perpendicular distance from the joint axis to the gravitational force line. This calculation demonstrates why even moderate dumbbell weights create substantial torque demands on the shoulder during lateral raises.

40. B — Cortisol's acute catabolic actions include stimulating protein degradation (breaking down amino acids from muscle protein) and gluconeogenesis (converting those amino acids into glucose in the liver). These processes mobilize amino acid substrates to produce glucose for the brain — which is obligatorily glucose-dependent — and other tissues requiring glucose during periods of metabolic stress when glycogen stores are depleting.

41. A — Stable resting testosterone with decreased cortisol produces a favorable improvement in the testosterone-to-cortisol ratio, indicating a positive anabolic-catabolic balance. Combined with continued performance gains and adequate recovery, this hormonal profile confirms successful adaptation to the training program. This is the opposite of the declining T:C ratio, performance stagnation, and persistent fatigue characteristic of overtraining syndrome.

42. C — Enhanced androgen receptor density from chronic resistance training increases the muscle's sensitivity and responsiveness to circulating testosterone at the tissue level. Each testosterone molecule produces a stronger anabolic signal, potentially amplifying the hypertrophic and strength response to training even without changes in basal circulating hormone concentrations. This is a significant tissue-level adaptation that improves the muscle's ability to utilize the available hormonal environment.

43. D — The crossover concept describes the intensity-dependent progressive shift from predominantly fat oxidation at low exercise intensities to predominantly carbohydrate oxidation at higher intensities. As the body requires faster rates of ATP production at increasing workloads, it progressively relies more on the carbohydrate pathways that can produce ATP at a faster rate than the slower fat oxidation pathways. This crossover typically occurs at moderate intensities around 40-65% of VO_2max.

44. B — The Cori cycle recycles lactate through the liver, where hepatocytes convert it back to glucose via gluconeogenesis. This recycled glucose is released into the blood for use by working muscles and the obligatorily glucose-dependent brain. The pathway is particularly critical during sustained exercise because it helps maintain blood glucose levels as glycogen depletes, providing continued substrate for tissues that depend on glucose.

45. A — The combination of 10-month amenorrhea, grossly inadequate caloric intake (1,100 kcal with 2.5 hours daily training), decreased lumbar BMD, and repeated stress fractures represents Relative Energy Deficiency in Sport (RED-S). Low energy availability is the driving factor — insufficient calories relative to exercise expenditure disrupts the hypothalamic-pituitary-ovarian axis causing menstrual dysfunction, which impairs calcium metabolism and bone remodeling leading to decreased BMD and fractures.

46. C — RED-S in male athletes produces suppressed testosterone (from disrupted hypothalamic-pituitary-gonadal axis), decreased bone mineral density (from impaired hormonal signaling and calcium metabolism), impaired immune function (from insufficient energy for immune processes), and declining athletic performance (from cumulative energy deficit). Chronic low energy availability drives these consequences regardless of sex, expanding the condition well beyond the original female athlete triad.

47. D — The stretch reflex (myotatic reflex) is a monosynaptic reflex — involving only a single synapse between the afferent sensory neuron from the muscle spindle and the efferent alpha motor neuron. This single-synapse arrangement makes it the fastest possible reflexive contraction in the human body, occurring in milliseconds. During plyometric landing, the rapid eccentric stretch activates muscle spindles that produce this reflex to augment the subsequent concentric force production.

48. B — Contact times increasing from 160 to 350 ms with declining rebound height confirms fatigue and loss of SSC effectiveness. When the amortization phase exceeds approximately 250 ms, elastic

energy dissipates as heat rather than being returned as mechanical work, and the stretch reflex contribution diminishes. Plyometric training is quality-based — every repetition should demonstrate maximal effort with minimal contact time. Continuing trains degraded movement patterns with no power benefit.

49. A — Both athletes produce identical peak force (3,050 N) but Athlete A reaches peak in 130 ms versus 275 ms — demonstrating superior rate of force development. During the limited ground contact time of a vertical jump, faster RFD produces greater impulse (the area under the force-time curve), resulting in higher takeoff velocity and therefore greater jump height. RFD is the critical performance discriminator when peak force is equal between athletes.

50. C — When the amortization phase exceeds approximately 250 ms, the elastic energy stored in the musculotendinous unit during the eccentric landing dissipates as heat rather than being returned as mechanical work during the concentric takeoff. Additionally, the stretch reflex contribution from muscle spindle activation diminishes because the rapid eccentric-to-concentric transition that maximally stimulates the spindle has been disrupted by the prolonged transition delay.

51. D — In the second-class lever of the standing calf raise, the effort arm (distance from the calcaneus to the ball of the foot) is longer than the resistance arm (distance from the ankle joint to the ball of the foot). This creates a mechanical advantage greater than one, meaning the gastrocnemius and soleus can produce movement against a resistance greater than in a third-class arrangement. This is why the calf muscles can support and lift the entire body weight during plantar flexion.

52. B — The principle of accommodation predicts that the response to a constant, unchanging stimulus diminishes over time as the body fully adapts to that specific stress. After 22 weeks of identical programming, introducing variation in exercises, loads, volumes, or the periodization model provides novel stimuli that the body has not yet adapted to. This overcomes the plateau and restarts the progressive adaptation process that had stalled.

SPORT PSYCHOLOGY (Questions 53–75)

53. A — Muscle tension, elevated heart rate, and sweaty palms are somatic anxiety symptoms — the physiological activation component of competitive anxiety. Somatic anxiety represents the body's physical stress response and is distinct from cognitive anxiety (negative thoughts, worry about failure). Distinguishing between the two is essential because each requires different interventions: physical relaxation techniques for somatic symptoms, cognitive restructuring for cognitive symptoms.

54. C — A precision archery shot requires steady hands, controlled breathing, and fine motor coordination — all degraded by excessive arousal. The inverted-U hypothesis predicts that fine motor precision tasks have a lower optimal arousal point than gross motor strength tasks. Low-to-moderate arousal preserves the steady muscular control, focused attention, and fine coordination required for consistent accuracy under competitive pressure.

55. D — The most effective goal-setting approach combines outcome goals (long-term competitive targets providing direction), performance goals (specific measurable benchmarks for tracking progress), and process goals (daily controllable training behaviors directing immediate effort). This hierarchical structure connects daily actions to long-term aspirations, providing both sustained motivation and daily accountability at every level from individual training sessions to championship competitions.

56. B — "Your knees caved during the squat ascent" describes the quality of the movement pattern — how the technique was executed rather than the outcome of the lift. This is knowledge of performance (KP), providing actionable information the athlete can use to correct technique on subsequent repetitions. Knowledge of results (KR) would describe the outcome, such as "that was a successful lift" or "you squatted 150 kg."

57. A — The contextual interference effect demonstrates that random practice (intermixing exercises) produces slower initial performance compared to blocked practice but significantly better long-term retention and transfer to novel contexts. The constant task-switching forces deeper cognitive processing during each trial, building more robust motor program representations. These representations persist over time and transfer more effectively to new competitive situations.

58. C — The guidance hypothesis states that providing extrinsic feedback after every single repetition creates dependency on external correction rather than developing internal error-detection capabilities. The athlete learns to wait for the coach's input rather than attending to their own proprioceptive and kinesthetic information. Reducing feedback frequency forces the athlete to develop self-monitoring skills that produce more durable, self-sustaining motor learning.

59. D — Memory consolidation during rest intervals is the neurological process of stabilizing and transferring motor memories from short-term to long-term storage. Distributed practice (shorter sessions with rest between) allows this consolidation process to occur between practice bouts, producing more durable motor program representations that resist forgetting. Massed practice does not provide sufficient inter-trial time for this critical neural consolidation to occur effectively.

60. B — The autonomous stage is characterized by automatic, consistent skill execution with minimal conscious attention needed for technique. Cognitive resources are freed for higher-order strategic processing — monitoring the competitive environment, making tactical decisions, and adjusting performance in real time. This is the stage where an experienced athlete focuses on game strategy and bar speed rather than individual body positions during each repetition.

61. A — Athletic burnout is characterized by three interrelated dimensions: emotional exhaustion (feeling physically and psychologically drained by the sport), depersonalization (cynicism and emotional detachment from the sport and teammates), and reduced sense of personal accomplishment (feeling that continued effort produces no meaningful results). Burnout develops over weeks to months and requires professional intervention, distinguishing it from acute anxiety or normal mood fluctuation.

62. C — Increasing isolation, persistent feelings of worthlessness, lost interest in previously enjoyed activities, and expressed hopelessness about the future are potential warning signs of clinical depression in an adolescent. The strength and conditioning specialist must recognize these as beyond normal mood fluctuation and recommend that parents seek evaluation from a qualified mental health professional. Attempting to address through training modifications or increased competition is inappropriate.

63. D — Self-determination theory identifies autonomy (sense of choice and control over actions), competence (feelings of mastery and progressive improvement), and relatedness (meaningful connection to others and sense of belonging) as three basic psychological needs supporting intrinsic motivation. When all three needs are satisfied through the training environment, athletes develop the most sustainable and resilient form of internal motivation that persists without external rewards or punishments.

64. B — Extreme weight manipulation, meal avoidance, excessive exercise beyond the training plan, and preoccupation with body weight are recognized warning signs of disordered eating requiring professional evaluation. Diagnosing and treating eating disorders is entirely outside the CSCS scope of practice. The specialist must refer the athlete to a qualified healthcare professional for appropriate clinical assessment and intervention.

65. A — Observing a teammate of similar ability and experience successfully complete a challenging lift provides vicarious experience — one of Bandura's four sources of self-efficacy. Seeing someone of comparable capability succeed provides compelling evidence that the task is achievable, strengthening the observer's belief in their own capacity to perform the same lift. Vicarious experience is most powerful when the model closely matches the observer in relevant characteristics such as body type, training age, and competitive level, because the observer can most readily identify with the model's success as personally relevant.

66. A — Observing a teammate of similar ability succeed provides vicarious experience — one of Bandura's four self-efficacy sources. Seeing someone of comparable capability complete a challenging task provides evidence that success is achievable, strengthening the observer's belief in their own capacity. Vicarious experience is most powerful when the model closely matches the observer in relevant characteristics like body type and training experience.

67. C — Consistent practice excellence with systematic competitive underperformance, combined with worry and negative self-talk, indicates choking under pressure. Excessive cognitive anxiety in high-stakes competitive situations disrupts the automatic motor execution that the athlete reliably demonstrates in the low-pressure practice environment. The well-learned skill reverts to conscious, effortful processing that degrades the quality and fluency of performance.

68. D — Fear of re-injury after ACL reconstruction is a recognized psychological barrier to successful return to sport requiring comprehensive management. Gradually reintroducing sport-specific movements at progressive intensities builds physical confidence through direct mastery

experiences, while referral to a sport psychologist addresses the cognitive and emotional components through evidence-based interventions such as graded exposure and cognitive restructuring.

69. B — When a pitcher throws a fastball and then a changeup, the overall speed and absolute force of execution change (variable parameters), while the invariant features — relative timing of muscle activations, relative force proportions between muscle groups, and fundamental spatial pattern of the throwing motion — remain constant. This variable parameter adjustment is the functional advantage of generalized motor programs, allowing one base movement pattern to serve different tactical purposes.

70. A — Scanning the entire court to identify open teammates, defender positions, and spatial relationships requires broad-external attentional focus — perceiving multiple external stimuli across a wide visual field simultaneously for tactical decision-making. This broad scanning allows the point guard to process the full defensive scheme before narrowing focus to execute a specific pass or drive as the play develops.

71. C — Past performance accomplishment is the most powerful of Bandura's four self-efficacy sources. Successfully completing 200 kg provides direct, personal, undeniable evidence of capability at this load level, creating the strongest possible confidence that 205 kg is achievable. Mastery experiences generate stronger and more resilient efficacy beliefs than vicarious observation, verbal encouragement, or physiological state management.

72. D — Research demonstrates that reducing feedback frequency from 100% to approximately 50% of trials produces better long-term retention despite potentially slower initial acquisition during practice. The reduced frequency forces athletes to attend to their own proprioceptive and kinesthetic information, developing internal error-detection capabilities. This self-monitoring skill produces more durable, self-sustaining motor learning that persists in the absence of external coaching.

73. B — Muscle tension, elevated heart rate, and rapid breathing are somatic anxiety symptoms — the physiological activation component of competitive anxiety. Physical relaxation techniques such as progressive muscle relaxation and diaphragmatic breathing directly target these symptoms by teaching systematic tension release and engaging the parasympathetic nervous system to reduce cardiovascular and respiratory activation. Cognitive interventions target thoughts and worry, not physical symptoms.

74. A — The front squat develops the upright torso position, high-elbow rack posture, and deep receiving stance that directly transfer to the power clean catch position. The shared movement features between these two exercises create positive transfer — practice and strength gained on the front squat directly improve the quality and confidence of the power clean receiving position. This is a deliberate exercise selection strategy based on movement pattern similarity.

75. C — Effective mental imagery engages visual (seeing the performance), kinesthetic (feeling the muscular sensations and body positions), auditory (hearing the environmental sounds), and emotional (experiencing the confidence and composure of success) components simultaneously. Multi-sensory engagement creates the richest, most vivid mental rehearsal that transfers most effectively to actual competitive performance situations.

76. D — Self-efficacy, as defined by Bandura, is task-specific and situation-specific — an athlete can have high self-efficacy for squatting but low self-efficacy for Olympic lifting within the same training session. This distinguishes it from general self-confidence, which is a broad personality disposition applying across many different situations and tasks. Self-efficacy changes based on mastery experience, observation, encouragement, and physiological state within specific performance contexts.

NUTRITION (Questions 76–95)

76. B — A 108 kg athlete at 2.2 g/kg/day requires 238 grams of protein daily (108 × 2.2 = 237.6, rounded to 238). This upper-end recommendation supports the elevated rates of muscle protein synthesis, tissue repair from training-induced micro-damage, and anti-catabolic demands of heavy resistance training. The general population RDA of 0.8 g/kg (86 grams) is insufficient for athletes under intense training loads.

77. A — Leucine is the branched-chain amino acid identified as the primary trigger for activating the mTOR signaling pathway that initiates muscle protein synthesis. A threshold of approximately 2-3 grams of leucine per protein-containing meal ensures optimal stimulation of the protein synthetic machinery. This leucine threshold is a key consideration when evaluating protein source quality for post-exercise recovery and daily protein distribution.

78. C — Chronically inadequate dietary fat intake (below 15-20% of total calories) impairs steroid hormone production because cholesterol — a lipid molecule obtained from dietary fat — is the essential precursor for testosterone synthesis in the Leydig cells. Additionally, fat-soluble vitamins (A, D, E, K) require dietary fat for intestinal absorption. Both consequences — hormonal disruption and vitamin malabsorption — compromise health, recovery, and training adaptation.

79. D — Exercise-associated hyponatremia occurs when excessive plain water intake during prolonged exercise dilutes blood sodium concentration below safe levels (below 135 mmol/L). Consuming 3 liters per hour for 4 hours without sodium replacement dramatically reduces serum sodium relative to the sodium lost through sweat. Symptoms range from confusion and disorientation to seizures, coma, and potentially fatal cerebral edema in severe cases.

80. B — The maintenance-only approach (3-5 grams per day without the loading phase) achieves full intramuscular creatine saturation in approximately 28 days of consistent daily supplementation. This is equally effective as the loading protocol (20 g/day for 5-7 days) for reaching the same saturated endpoint — the only difference is that gradual daily accumulation takes 4 weeks instead of 1 week to reach maximum stores.

81. A — Caffeine's primary ergogenic mechanism is blocking adenosine receptors in the central nervous system. Adenosine is a neuromodulator that promotes drowsiness, reduces neural activity, and increases the perception of fatigue. By blocking these receptors, caffeine reduces fatigue perception, increases alertness and cognitive focus, and enhances pain tolerance during high-intensity effort — improving both endurance and high-intensity exercise performance.

82. C — Beta-alanine increases intramuscular carnosine, which functions as an intracellular hydrogen ion buffer during high-intensity exercise. This buffering capacity is most beneficial for activities lasting 1-4 minutes where glycolytic H^+ accumulation is the primary performance limiter. Activities shorter than this are phosphagen-dependent, and activities longer are primarily aerobic — neither benefits substantially from enhanced intracellular buffering capacity.

83. D — NSF Certified for Sport and Informed Sport are third-party certification programs that independently test supplement products for banned substances, verify label accuracy against actual contents, and screen for undeclared contaminants. Athletes subject to WADA anti-doping regulations should use only products carrying these certifications to minimize the risk of inadvertent positive drug tests from contaminated or mislabeled supplements.

84. B — During caloric deficit, protein needs increase to 2.0-2.4 g/kg/day to maximize preservation of lean muscle mass. The elevated intake provides additional amino acid substrate to counteract the accelerated protein degradation that occurs during energy restriction. Combined with maintained resistance training (providing the mechanical stimulus to retain muscle), this represents the strongest evidence-based defense against lean mass loss during intentional weight reduction.

85. A — Gastrointestinal distress — including nausea, bloating, abdominal cramping, and diarrhea — is the most common side effect limiting the practical use of sodium bicarbonate as an ergogenic aid. The alkaline nature of the compound and the large dose required (0.2-0.3 g/kg) can significantly irritate the gastrointestinal tract. Some athletes use enteric-coated capsules or serial loading protocols spread across multiple days to improve tolerability.

86. C — A 74 kg athlete at 10 g/kg/day requires 740 grams of carbohydrate daily ($74 \times 10 = 740$). This upper-end recommendation supports the extreme glycogen demands of high-volume endurance training, where daily glycogen depletion and replenishment cycles are substantial. Meeting this target requires strategic planning of carbohydrate-dense meals and snacks distributed throughout the day around training sessions.

87. D — Documented consequences of vitamin D deficiency in athletes include impaired muscle function (reduced strength, power, and neuromuscular performance), compromised immune competence (increased susceptibility to upper respiratory infections), and elevated risk of stress fractures with decreased bone mineral density. Athletes who train primarily indoors or live at northern latitudes with limited UV exposure are at the greatest risk for vitamin D insufficiency.

88. B — Vitamin C enhances non-heme iron absorption by converting ferric iron (Fe^{3+}) to the more bioavailable ferrous form (Fe^{2+}) in the intestinal lumen. This conversion is particularly important

for athletes depending on plant-based iron sources, which contain only non-heme iron with inherently lower bioavailability than the heme iron found in animal products. Consuming vitamin C-rich foods alongside non-heme iron sources at the same meal maximizes absorption.

89. A — When rapid glycogen recovery is essential (two training sessions within 8 hours), consuming 1.0-1.5 g/kg of carbohydrate within 30 minutes of the first session capitalizes on the period of maximal glycogen synthase activity. This enzyme, which catalyzes glycogen storage in the muscle, is most active immediately post-exercise and decreases progressively over the following hours. Early carbohydrate intake maximizes the resynthesis rate before the second session.

90. C — Plant-based athletes achieve adequate essential amino acid intake by consuming a variety of complementary protein sources throughout the day. Different plant proteins have different amino acid limitations — grains tend to be low in lysine but adequate in methionine, while legumes have the opposite profile. Combining multiple sources across meals ensures all essential amino acids are provided in adequate quantities without requiring animal products.

91. D — Casein protein forms a gel-like structure in the acidic stomach environment that dramatically slows gastric emptying and digestion. This slow, sustained release provides a continuous supply of amino acids into the bloodstream throughout the 7-9 hour overnight fasting period when no other protein is consumed. Research demonstrates that 30-40 grams of casein before sleep supports overnight muscle protein synthesis and recovery.

92. B — High-glycemic index foods produce rapid blood glucose and insulin responses after ingestion, making them most appropriate during and immediately after exercise. During exercise, rapid glucose delivery supports ongoing energy needs. After exercise, the fast absorption rate and insulin response maximize glycogen synthase activity and amino acid uptake into muscle cells during the critical recovery window when enzyme sensitivity is highest.

93. A — Glutamine supplementation has limited evidence for promoting muscle growth in healthy, well-nourished athletes who already consume adequate protein from whole food sources. While glutamine plays important roles in immune function and gut health, it is not currently classified among the supplements with strong ergogenic evidence for hypertrophy or performance. Supplements with robust evidence include creatine, caffeine, beta-alanine, and sodium bicarbonate.

94. C — Dietary fat serves multiple essential physiological functions: steroid hormone production (testosterone and other hormones require cholesterol as a precursor), absorption of fat-soluble vitamins (A, D, E, K require dietary fat for intestinal transport), cell membrane integrity (phospholipid bilayers depend on fatty acid composition), and provision of essential fatty acids (linoleic and alpha-linolenic acid) that the body cannot synthesize.

95. D — The general fluid intake guideline of approximately 200-300 mL every 15-20 minutes during competition helps prevent body weight loss from exceeding 2%, the threshold where measurable performance impairments begin. Individual sweat rates vary significantly based on body size,

exercise intensity, and environmental conditions. The guideline should be personalized using pre- and post-exercise body weight measurements during training.

SECTION 2 — PRACTICAL/APPLIED

EXERCISE TECHNIQUE (Questions 96–140)

96. B — A lateral weight shift during the squat ascent, consistently favoring one side, typically indicates unilateral hip mobility restriction or strength asymmetry between the two legs. The athlete compensates by shifting weight toward the more mobile or stronger side. Targeted unilateral mobility work and strengthening of the weaker or restricted side addresses the underlying cause of the compensation pattern.

97. A — When hips rise faster than the chest ("stripper pull") during the deadlift, the initial leg drive is lost and loading transfers disproportionately to the lumbar spine and erector spinae. This compensation increases lumbar flexion torque and injury risk significantly. Cueing "chest and hips rise together" or reducing the load until proper mechanics can be maintained corrects this dangerous fault.

98. C — When the dumbbells drift wide at the bottom of the press with elbows flared to 90° from the torso, the shoulder is placed in a position of extreme horizontal abduction under load. This compresses the supraspinatus tendon and pectoralis insertion against the acromion, significantly increasing the risk of shoulder impingement syndrome and pectoral tendon strain. Cueing elbows at approximately 45° reduces these risks.

99. D — Single-leg RDLs develop unilateral hip hinge strength, hamstring resilience under eccentric loading, and single-leg balance and proprioceptive control. These qualities directly address the sport-specific demands of soccer, where athletes frequently decelerate, change direction, and kick from a single-leg base. The exercise also provides targeted hamstring strengthening that reduces sprint-related hamstring injury risk.

100. B — A stiff-legged landing with minimal knee flexion on the box transmits excessive impact forces directly through the ankle, knee, and hip joints without adequate force absorption through progressive joint flexion. This increases the risk of both acute joint injury and chronic overuse damage. Proper landing requires soft contact with progressive hip and knee flexion and neutral spinal alignment to distribute forces safely.

101. A — The NSCA's top-down teaching progression for the power clean begins with the front squat to establish the receiving position — developing comfort with the bar on the anterior deltoids, the high-elbow rack posture, and the upright receiving stance. This ensures the athlete can safely and confidently catch the bar before any explosive pulling mechanics are introduced. Teaching the catch before the pull prevents dangerous receiving errors.

102. C — Initiating the pull-up with a shoulder shrug rather than scapular depression and retraction activates the upper trapezius instead of the latissimus dorsi. This compensation reduces the training

stimulus to the lats — the primary target muscle of the exercise. Cueing "pull your shoulder blades down and back before bending your elbows" corrects this common initiation error.

103. D — During maximal or near-maximal compound lifts, the Valsalva maneuver (forceful exhalation against a closed glottis) creates extreme intra-abdominal pressure that provides essential spinal stabilization for trained athletes. This technique is appropriate only for healthy individuals performing heavy loads where the spinal stabilization benefit outweighs the acute blood pressure response. It is contraindicated for individuals with cardiovascular risk factors.

104. B — Tempo prescriptions (4-second eccentric, 2-second pause) increase the total time under tension per set, which is a primary stimulus for muscle hypertrophy. The pause at the bottom eliminates the stretch-shortening cycle, developing positional strength and kinesthetic awareness at the most challenging range of motion. For novice and intermediate athletes, tempo work reinforces proper body positions and movement control throughout the squat.

105. A — Rotation should occur primarily through the thoracic spine and hips, which are anatomically designed for rotational movement. The lumbar spine has limited rotational ROM (approximately 5° per segment), and forcing rotation through this region under load creates excessive stress on the intervertebral discs and facet joints. Cueing hip and thoracic rotation while stabilizing the lumbar spine corrects this dangerous pattern.

106. C — Farmer's walks develop grip endurance (sustained heavy holds throughout the carry), core stability (resisting trunk flexion, lateral deviation, and rotation under load), and postural strength (maintaining upright spinal alignment while walking with heavy loads). These qualities transfer directly to athletic performance and represent a functional core training approach superior to isolated trunk flexion exercises.

107. D — The landmine press provides an angled pressing path (approximately 45-75° depending on body position) that trains the pressing pattern without requiring the full overhead range of motion that a strict barbell press demands. For athletes with limited overhead mobility, this modification allows continued pressing development while mobility is improved through targeted corrective work over time.

108. B — The kettlebell swing is a hip hinge movement where all force production originates from the hip extensors — primarily the gluteus maximus and hamstrings — through explosive hip extension. The arms serve only to connect the body to the kettlebell; they do not actively lift the weight. The swing should be powered by a forceful hip snap, not shoulder flexion, arm pulling, or lumbar hyperextension.

109. A — Excessive low back strain during Nordic hamstring curls indicates lumbar hyperextension substituting for the hip extensor and hamstring eccentric control that should dominate the movement. The athlete arches the lower back rather than maintaining a neutral spine while the hamstrings control the eccentric descent. Cueing "squeeze your glutes, brace your core, and maintain a straight line from knee to shoulder" corrects this compensation.

110. C — Band-resisted sprints apply horizontal resistance that specifically overloads the horizontal force production component of the acceleration phase. The athlete must generate greater horizontal ground reaction force to overcome the band resistance, developing the specific force application pattern needed for rapid forward acceleration from a standing or three-point starting position.

111. D — Eccentric-emphasized Bulgarian split squats with a prolonged 5-second lowering phase develop eccentric strength (force production during muscle lengthening), stimulate hypertrophy through extended time under tension, and build tendon resilience through progressive eccentric loading. These adaptations are particularly valuable for athletes performing high-velocity deceleration, landing, and change-of-direction movements.

112. B — Rounded shoulders and forward head posture at end range of the cable row indicate insufficient activation of the scapular retractors — middle trapezius and rhomboids — that should fully retract the scapulae at the end of each pulling repetition. Cueing "chest up, chin tucked, squeeze your shoulder blades together at the end of every pull" promotes proper scapular retraction and cervical alignment through the full ROM.

113. A — The Turkish get-up requires the athlete to transition from lying to standing while maintaining a weight locked out overhead through multiple movement planes. This exercise develops shoulder stability under varying load angles, core strength in multiple directions simultaneously, and total-body coordination and proprioceptive control. Its multi-planar demand makes it uniquely valuable for functional stability that transfers to diverse athletic movements.

114. C — Lumbar hyperextension beyond neutral at the top of the barbell hip thrust creates compressive forces on the posterior spinal structures (facet joints, spinous processes) and potential disc stress from end-range loading under resistance. The correct top position involves a neutral spine with the hips fully extended but not hyperextended. Cueing "squeeze your glutes and tuck your ribs" at lockout maintains protective alignment.

115. D — Sled pushes develop horizontal force production and acceleration mechanics that directly replicate the blocking demands of offensive linemen. The low body position, forward lean, and horizontal driving action against resistance mirror the force application pattern of both pass and run blocking. This exercise specificity makes sled pushes one of the most sport-relevant conditioning tools for this position.

116. B — Medial knee collapse (valgus) during lunges indicates weakness in the hip abductors and external rotators, primarily the gluteus medius. When these muscles cannot adequately control femoral adduction and internal rotation under load, the knee collapses inward. Cueing "drive your knee out over your toes" provides immediate correction while targeted strengthening exercises address the underlying muscular weakness.

117. D — Depth drops (landing only, no rebound) are an early-phase plyometric regression designed to teach proper eccentric landing mechanics and force absorption before introducing the reactive jumping component. The athlete learns to decelerate effectively through progressive joint flexion

and maintain neutral alignment during landing. These mechanics must be mastered before adding the concentric rebound that defines reactive depth jumps.

118. C — When spotting dumbbell pressing exercises, the spotter should apply assistance at the wrists near the athlete's hands. Spotting at the elbows creates a dangerous fulcrum effect that could cause the athlete to lose control of the independent dumbbells. Wrist contact allows the spotter to guide the load effectively in the intended pressing direction while the athlete maintains control of each dumbbell independently.

119. D — Proper box jump landing requires soft contact with hip and knee flexion to absorb impact forces progressively, a neutral spine to protect the lumbar structures, and knees tracking over the toes to protect the knee joint from valgus stress. This athletic landing position distributes impact forces across multiple joints rather than concentrating them at a single point. Stiff-legged or heel-first landings dramatically increase injury risk.

120. B — Face pulls with external rotation are specifically programmed to maintain posterior shoulder and scapular health in athletes who perform heavy pressing 3+ times per week. The high pressing volume develops the anterior deltoids and pectorals, creating a potential muscle imbalance that predisposes the shoulder to impingement. Face pulls strengthen the posterior deltoids, external rotators, and mid-trapezius to balance this anterior dominance.

121. A — "Push your hips straight back" redirects the movement from a knee-dominant squat pattern to the hip-dominant hinge pattern that defines the RDL. This cue encourages posterior hip displacement while maintaining minimal forward knee travel, preserving the slight constant knee flexion that characterizes correct RDL technique. The result reestablishes the hip hinge as the primary movement with hamstrings and glutes as prime movers.

122. C — The reverse lunge reduces anterior knee stress because stepping backward eliminates the eccentric deceleration demand that occurs when the front foot strikes the ground during a forward lunge. In the reverse lunge, the front leg remains relatively stationary with a more vertical shin, reducing the anterior-directed shear forces transmitted through the patellofemoral joint and quadriceps tendon.

123. D — The hex bar positions the load at the athlete's sides rather than in front of the body, centering the resistance closer to the body's center of mass. This shorter horizontal distance between the load and the lumbar spine reduces the moment arm and therefore the flexion torque on the lumbar spine. The result is decreased spinal loading compared to the conventional barbell deadlift.

124. B — Resistance bands provide minimum resistance at the bottom of the squat (where the band is least stretched) and maximum resistance at the top (where the band is fully stretched). This accommodating resistance profile challenges the athlete most in the mechanically strongest lockout position where free weights alone become relatively easy, training the athlete to produce force aggressively through the complete range of motion.

125. A — For a medicine ball rotational throw to qualify as a plyometric exercise, it must be performed with maximal speed and minimal transition time between the eccentric catch and the concentric throw. This rapid stretch-shortening cycle execution stores and returns elastic energy and activates the stretch reflex — the defining mechanisms of plyometric exercise. Paused, slow, or maximally heavy throws eliminate these mechanisms.

126. C — Olympic lifting platforms must be separated from general traffic areas with adequate clearance on all sides for dropped barbells and failed lift attempts. Athletes and staff should never walk behind or beside someone performing Olympic lifts because dropped bars can bounce unpredictably. This safety clearance is the primary consideration when positioning platforms within any facility layout.

127. D — Organizing athletes into groups of 3 per squat rack creates an efficient rotation where one athlete squats, one spots, and one rests between sets. This structure maximizes training density by keeping all 30 athletes productively engaged, ensures every working athlete has a dedicated spotter for safety, and maintains appropriate supervision ratios throughout the entire session.

128. B — Barbell collars prevent weight plates from sliding off the ends of the barbell during exercise. Without collars, plates can shift due to uneven pressing, asymmetric loading during racking, or momentary balance loss, causing sudden weight redistribution that may result in loss of control and potential injury. Collars are a non-negotiable safety requirement for all loaded barbell exercises.

129. A — Power cleans are the explosive exercise in this program requiring the highest neuromuscular coordination, rate of force development, and technical precision. These qualities degrade rapidly with fatigue, so power exercises must be performed first in the session when the athlete is freshest. The remaining exercises follow in descending order of technical demand: core multi-joint → assistance → core stability.

130. C — A single bench press spotter uses an alternated grip (one hand pronated, one supinated) close to the center of the bar for maximum grip security and symmetric upward force application. The alternated grip prevents the bar from rolling in either direction, and the central positioning allows smooth bilateral assistance without interfering with the athlete's pressing mechanics.

131. D — An athlete who demonstrates explosive performance on the field but struggles with heavy barbell exercises has a maximal strength deficit — their explosive ability and power expression outpace their force production capacity. Heavy resistance training at 85%+ 1RM develops the larger force foundation upon which explosive movements draw, allowing even greater power output when the strength base is combined with existing explosiveness.

132. B — Correct Romanian deadlift technique includes slight constant knee flexion maintained throughout the movement, a flat neutral spine, a hip hinge pattern (not a squat), and the barbell tracking close to the legs during both descent and ascent. The RDL targets the hamstrings and

glutes through controlled eccentric hip flexion with the primary movement occurring at the hip joint rather than the knees.

133. A — Pull-ups develop the upper body pulling strength essential for generating propulsive force during the swim stroke. Internal and external rotation exercises protect the rotator cuff from the repetitive overuse injury common in competitive swimmers. Core anti-rotation work develops the trunk stability needed for efficient force transfer between the upper and lower body during swimming.

134. C — The Pallof press trains the core musculature to resist rotational force — an external cable or band load attempts to twist the torso while the athlete actively maintains neutral trunk alignment. This anti-rotation function develops the spinal stability critical for protecting the lumbar spine during athletic movements involving rotational forces such as throwing, hitting, and change of direction.

135. D — The snatch requires receiving the barbell overhead with fully locked arms while in a deep squat position with an upright torso. Overhead squat mobility assessment verifies that the athlete can maintain a stable, locked-arm overhead position while squatting to full depth with adequate thoracic extension. Without this prerequisite mobility, attempting the snatch creates significant shoulder, wrist, and spinal injury risk.

136. B — Correct push-up execution maintains a straight line from head to heels with core braced throughout, chest touches or nearly touches the floor for full range of motion, and elbows track at approximately 45 degrees from the torso. This elbow position maximizes the training stimulus to the pressing musculature while protecting the shoulder from the impingement that occurs at extreme 90-degree flare angles.

137. A — Sprint intervals of 5-10 yards with 25-40 seconds rest precisely replicate the offensive lineman's competitive demands — short maximal-effort plays (4-7 seconds) followed by brief huddle recovery periods. This protocol targets the phosphagen system at the position's actual work-to-rest ratio, ensuring that conditioning adaptations transfer directly to the repeated short-burst pattern of competitive game play.

138. C — Face pulls with external rotation target the posterior deltoids, infraspinatus, teres minor, and middle trapezius — muscles critical for shoulder health, postural balance, and injury prevention in athletes performing heavy pressing movements. Strengthening these posterior structures counterbalances the anterior dominance from heavy bench pressing and protects against shoulder impingement.

139. D — Reactive agility drills requiring responses to visual cues while sprinting develop perceptual-cognitive processing combined with physical direction change — true agility that preplanned drills cannot address. Preplanned change-of-direction drills develop only the physical component without the decision-making under uncertainty that distinguishes game-speed agility from choreographed movement patterns.

140. B — The isometric mid-thigh pull is a standardized assessment and training tool for measuring and developing peak isometric force and rate of force development. The fixed barbell position eliminates technique variables, isolating the athlete's maximal force output capability. RFD measured from the force-time curve is a critical performance variable for athletes in explosive, power-dependent sports.

PROGRAM DESIGN (Questions 141–184)

141. A — The 1500-meter race (approximately 3:30-4:15 at near-maximal effort) relies primarily on the aerobic system as the dominant contributor (approximately 60-70% of total energy), supplemented by the glycolytic system (approximately 25-35%) which provides critical energy during the sustained high-intensity middle portion. The phosphagen system contributes to the explosive start and the final kick sprint, making all three systems relevant at different race phases.

142. C — The push jerk meets all criteria for power exercise classification: it is structural (directly loading the axial skeleton with the bar on the shoulders), performed explosively (rapid dip-and-drive with overhead receiving), and involves multiple large muscle groups (quadriceps, glutes, deltoids, triceps, core) in a coordinated explosive movement pattern requiring high neuromuscular demand.

143. D — For novice athletes with only 8 weeks of training experience, submaximal prediction using a 5-8 RM test with validated equations provides a safe, practical method for estimating maximal strength. Direct 1RM testing carries higher risk for inexperienced athletes whose technique may break down under truly maximal loads. Prediction equations from submaximal repetitions provide a reasonable 1RM estimate while maintaining a safety margin.

144. B — Advanced athletes with 7+ years of training require greater volume per muscle group to continue stimulating adaptation beyond what moderate volumes can provide. An upper/lower or push/pull/legs split allows greater exercise volume and variety per session while providing 48-72+ hours of recovery between sessions targeting the same muscle groups, supporting the higher per-muscle-group stimulus advanced athletes need.

145. A — The 8-12 repetition range at 67-85% 1RM with 60-90 second rest targets muscle hypertrophy through the combined stimuli of mechanical tension (moderate-to-heavy loading) and metabolic stress (lactate accumulation, H^+ concentration from short rest). This combination activates the cellular signaling cascades — including mTOR, satellite cell activation, and hormonal responses — that drive the protein synthesis and structural changes underlying muscle growth.

146. C — 87% of 210 kg = 182.7, rounded to approximately 183 kg per working set. This load with sets of 3 and appropriate rest (3-5 minutes) represents a heavy strength protocol targeting near-maximal motor unit recruitment and neural adaptation within the established parameters for maximal strength development in advanced athletes.

147. D — Triphasic training recognizes that eccentric, isometric, and concentric muscle actions each produce distinct neural and structural adaptations. Eccentric training develops force absorption and lengthening strength, isometric training develops force production at specific joint angles and rate of force development, and concentric training develops movement speed and force production. Sequential emphasis optimizes the transfer to explosive athletic performance.

148. B — The brief 15-20 second intra-set rest between individual repetitions in cluster sets allows partial phosphocreatine recovery and neural restoration. This prevents the progressive velocity decline that occurs during traditional straight sets as fatigue accumulates across repetitions. By maintaining bar velocity and movement quality across all reps, cluster sets provide a superior stimulus for power and rate of force development.

149. A — Post-activation potentiation (PAP) describes the enhancement of explosive performance following a heavy conditioning stimulus. The heavy squat at 85% 1RM maximally activates high-threshold motor units and increases neural drive. After 3-4 minutes of rest (allowing fatigue to dissipate while the potentiation effect persists), the subsequent jump squats benefit from enhanced neural activation, producing greater power output.

150. C — Velocity-based training uses real-time bar velocity feedback to autoregulate training load and volume by controlling fatigue-induced velocity loss. Terminating sets when velocity drops 20% below the fastest repetition ensures every rep maintains movement quality and maximal intent. This prevents athletes from grinding through slow, degraded repetitions that provide suboptimal power and RFD stimulus.

151. D — Progressive single-leg balance challenges on increasingly unstable surfaces restore the proprioceptive function and neuromuscular control that are disrupted by ankle ligament injury. Beginning on stable surfaces and progressing to foam pads, balance boards, and sport-specific perturbation tasks systematically rebuilds the joint's ability to detect and respond to positional changes, reducing the risk of recurrent ankle sprains.

152. B — In-season programming for a 14-week competitive basketball season should include 2 sessions per week with reduced volume (2-3 sets per exercise rather than 4-5) but maintained intensity on key compound lifts (80-85%+ 1RM). Research consistently demonstrates that intensity is the most critical variable for preventing in-season strength detraining when volume and frequency must be reduced for competition management.

153. A — The interference effect occurs when concurrent endurance and strength training produces suboptimal adaptations for one or both qualities compared to training each independently. Research suggests separating strength and endurance sessions by at least 6-8 hours minimizes this interference. When both must occur on the same day, performing strength before endurance preserves the quality of the strength training stimulus.

154. C — Wrestling matches consisting of three 2-minute periods of sustained high-intensity grappling represent glycolytic-dominant energy demands. Conditioning should use 2-minute high-intensity

intervals at wrestling-specific intensity with appropriate rest periods, developing the specific glycolytic capacity needed to sustain aggressive grappling across three competitive periods.

155. D — The optimal rest between the heavy conditioning stimulus and the subsequent explosive exercise for post-activation potentiation is approximately 3-5 minutes. Shorter rest intervals risk residual fatigue masking the potentiation effect and impairing explosive performance. Longer rest intervals risk the potentiation dissipating before the explosive exercise begins. The 3-5 minute window balances fatigue dissipation with maintained neural potentiation.

156. B — Evidence-based tapering for competition involves reducing training volume by 40-60% while maintaining or slightly increasing intensity over 1-3 weeks. This approach allows accumulated fatigue to dissipate (from the volume reduction) while preserving the neural and muscular adaptations that underpin performance (from the maintained intensity). Complete training cessation leads to detraining without the controlled fatigue management benefit.

157. A — For a fall championship, the general preparation phase should begin in late spring/early summer (approximately May-June) to allow sufficient time for building the broad fitness foundation. Starting earlier provides the 3-5 months needed for the systematic general-to-specific progression through preparatory phases that produces peak performance at the championship date.

158. C — A "force-deficient" athlete (strong velocity, weak force on the force-velocity profile) needs heavy resistance training at 85%+ 1RM to develop the force production capacity that is limiting their performance. The athlete already produces high velocity with light loads but lacks the maximal force foundation needed for optimal power expression. Correcting the force deficit shifts the entire force-velocity curve upward.

159. D — The 4-phase reconditioning progression (ROM/activation → strength/hypertrophy → power/speed → sport-specific integration) reflects systematic rebuilding from the tissue healing phase through progressive functional restoration to full sport-specific readiness. Each phase builds upon the adaptations and competencies established in the preceding phase, ensuring the athlete is never exposed to demands exceeding their current structural and functional capacity.

160. B — Linear periodization is characterized by progressive increases in intensity with corresponding decreases in volume across sequential mesocycles. The typical progression moves from high-volume, moderate-intensity phases (hypertrophy/endurance) through moderate-volume, high-intensity phases (strength) to low-volume, very-high-intensity phases (power/peaking). Each phase builds systematically upon the adaptations established in the preceding phase.

161. A — Block periodization sequences three concentrated training blocks: accumulation (high volume at moderate intensity for work capacity and structural foundation), transmutation (higher intensity converting structural gains into sport-specific strength and power), and realization (low volume at very high intensity for peaking performance at the target competition date). Each block builds on the adaptations of the preceding block.

162. C — Maintaining training intensity at preparatory-period levels (80-85%+ 1RM) while reducing volume and frequency preserves the neural and muscular stimulus needed to maintain strength and power during the competitive season. Research consistently demonstrates that intensity is the single most critical variable for preventing in-season detraining — volume and frequency can be substantially reduced without significant strength loss.

163. D — The transition period following the competitive season should last approximately 2-4 weeks and focus on unstructured, low-intensity active recovery providing physical restoration from accumulated competition fatigue, psychological renewal of motivation and enthusiasm, opportunity to address minor nagging injuries, and mental preparation for the next annual training cycle.

164. B — Peak power output in the jump squat occurs at approximately 0-30% of back squat 1RM because the lighter loading allows the high contraction velocities needed to maximize the velocity component of the power equation (Power = Force × Velocity). Heavier loads increase force production but reduce velocity below the threshold where peak power is achieved, resulting in lower overall power output.

165. A — The hang clean achieves peak power output at approximately 70-80% of 1RM because sufficient mass is needed to generate meaningful force production while the explosive, ballistic nature of the exercise maintains velocity high enough for peak power expression. The optimal balance between adequate mass and maintained velocity at this loading range produces the greatest power output.

166. C — Beginner athletes should start plyometric training with 80-100 foot contacts per session distributed across exercises of varying intensity (squat jumps, countermovement jumps, box jumps stepping down). This modest volume provides sufficient initial neuromuscular stimulus while limiting the eccentric loading on musculotendinous structures that have not yet been conditioned for the high-impact demands of plyometric training.

167. D — Plyometric sessions should be performed at the beginning of the training session after a thorough warmup, when the athlete is fresh for maximal effort and proper technique on every repetition. Plyometric training is quality-based — fatigue from prior heavy resistance training or conditioning degrades explosive output, impairs landing mechanics, increases ground contact times, and raises injury risk.

168. B — A squat at the 92nd percentile with a vertical jump at the 26th percentile indicates a rate of force development deficit — the athlete has excellent maximal strength but cannot express it rapidly enough during the brief ground contact time of a jump. Programming should prioritize explosive training modalities (plyometrics, Olympic lifts, jump squats) that develop the neuromuscular system's ability to produce force quickly.

169. A — Soccer matches lasting 90 minutes with mixed aerobic and anaerobic demands require a comprehensive conditioning approach: aerobic base training (tempo runs, fartlek) for sustained

play across two halves, anaerobic interval training (repeated sprints with sport-specific rest periods) for repeated sprint ability, and reactive agility conditioning (direction changes responding to unpredictable opponents and ball movement).

170. C — Return-to-play protocols require objective performance criteria: bilateral strength and functional symmetry within 10% on relevant tests, demonstrated competency in sport-specific movements (cutting, pivoting, sprinting), and formal medical clearance from the treating physician. Subjective reports alone are insufficient because persistent asymmetries exceeding 10% are associated with elevated re-injury risk.

171. D — Ice hockey shifts of 45-60 seconds with 2-3 minutes of bench rest represent glycolytic-dominant energy demands. Conditioning should use high-intensity intervals of matching duration (45-60 seconds) with corresponding rest periods (2-3 minutes) to develop the specific glycolytic capacity needed for sustained high-intensity skating during each competitive shift.

172. B — An advanced athlete with extensive training experience preparing for a single major competition requires block periodization's concentrated, precisely targeted training stimuli. The accumulation → transmutation → realization sequence allows precise control of the training emphasis in each block, timing the final peaking phase to produce optimal performance at the specific competition date.

173. A — The principle of accommodation predicts that the response to a constant, unchanging stimulus diminishes over time as the body fully adapts. After 22 weeks of identical programming, introducing variation in exercises, loads, volumes, or the periodization model provides novel stimuli that the body has not yet adapted to, overcoming the plateau and restarting the progressive adaptation process.

174. D — Reconditioning after hamstring surgery follows a systematic progression: low-intensity ROM restoration → progressive resistance training at gradually increasing loads → sport-specific movement integration (sprinting, cutting, acceleration) → unrestricted return to competition upon meeting objective bilateral symmetry criteria (within 10%) with formal medical clearance.

175. D — Block periodization for powerlifting sequences: accumulation (high volume at moderate intensity for structural development and work capacity), transmutation (higher intensity converting structural gains into sport-specific maximal strength), and realization (low volume at very high intensity for peaking the squat, bench press, and deadlift at competition). Each block builds upon prior adaptations.

176. B — Muscular endurance training uses rest periods of 30 seconds or less to maintain elevated metabolic demand and cardiovascular stress throughout the training session. Short rest prevents full metabolic recovery between sets, forcing the muscles to sustain work under progressive fatigue — training the specific adaptation of fatigue resistance that defines muscular endurance.

177. A — Five sets of 2 repetitions at 93% of 1RM with 5-minute rest is a maximal strength and neural adaptation protocol. The near-maximal loading ensures recruitment of the highest-threshold motor units, and the complete rest between sets allows full phosphocreatine recovery and neural restoration for maximal force production on every repetition.

178. C — Volume load = sets × repetitions × load = 5 × 4 × 145 = 2,900 kg. This standard calculation quantifies the total mechanical work performed, providing the objective metric needed for tracking progressive overload across training phases, comparing relative training stress between sessions, and managing accumulated fatigue within a periodized program.

179. D — Novice athletes benefit most from moderate loads (60-70% of estimated 1RM) with higher repetitions (10-15 per set) during the initial 4-6 weeks of training. This approach develops movement proficiency through multiple repetitions, builds initial work capacity, allows connective tissue time to adapt to new loading, and establishes the neural and structural foundation needed for heavier loading in subsequent phases.

180. B — The 48-72 hour recovery requirement between plyometric sessions allows adequate recovery of the musculotendinous structures that experience significant eccentric loading during plyometric exercises. Tendons and connective tissues have lower metabolic activity and blood supply than muscle tissue, requiring more time for the collagen synthesis and structural remodeling needed to adapt to high-impact training.

181. A — Progressive increases in intensity (70% → 78% → 83% → 89%) with corresponding decreases in volume (4×8 → 4×6 → 4×5 → 4×3) across sequential phases is the defining characteristic of linear periodization. Each phase builds on the preceding one, systematically moving from higher-volume, moderate-intensity training toward lower-volume, higher-intensity training in preparation for peak performance.

182. 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 addresses both ends of the force-velocity continuum. Heavy loads develop the high-force end (maximal strength), while explosive exercises develop the high-velocity end (speed-strength and power). Both qualities are essential for sprint and power sport performance.

183. D — The deload week manages accumulated fatigue from the preceding loading weeks while maintaining the neuromuscular stimulus through preserved training intensity. The approximately 40% volume reduction allows recovery and supercompensation — the body's adaptive overshoot above the previous fitness level — setting up the athlete for productive training during the subsequent loading cycle.

184. B — A "velocity-deficient" athlete (strong force, weak velocity on the force-velocity profile) needs light-load, high-velocity training to develop the velocity component limiting their performance. Plyometrics, jump squats at 30-40% 1RM, and sprint work train the neuromuscular system to

produce force rapidly — directly addressing the speed deficit while the existing force capacity provides the supporting foundation.

TESTING AND EVALUATION (Questions 185–206)

185. A — The vertical jump (CMJ) using a Vertec device is the most practical and valid field assessment of lower body explosive power for this scenario. It is valid (directly measures the power quality being assessed), reliable (produces consistent results), practical for large-group testing (60 athletes in 2 hours), and requires minimal equipment and setup time.

186. C — Reliability is the psychometric property defined by consistent, reproducible scores across repeated administrations under identical conditions. A reliable test produces similar results when the same athlete is tested multiple times without a true change in fitness level. High reliability ensures that observed score changes between testing sessions can be attributed to actual performance improvement rather than measurement variability.

187. D — The 1RM is defined as the last weight successfully lifted with acceptable technique through the full range of motion. The athlete completed 165 kg with proper form but failed at 170 kg, so 165 kg is recorded as the 1RM. Failed attempts are never counted as the 1RM regardless of how close to completion, because the technical and safety standards were not met.

188. B — The 13 cm difference between the CMJ (71 cm) and the SJ (58 cm) reflects stretch-shortening cycle utilization — the contribution of stored elastic energy in the musculotendinous unit and the stretch reflex from muscle spindle activation during the rapid countermovement. These SSC mechanisms augment concentric force production during the CMJ takeoff beyond what concentric-only contraction can produce.

189. A — The 20-meter multistage shuttle run (beep test) requires only cones and a sound system, can be administered to large groups simultaneously, and provides a valid estimate of aerobic capacity through an externally paced, progressive-intensity protocol. Its practical advantages — minimal equipment, group administration, and standardized pacing — make it optimal for the described large-group outdoor scenario.

190. C — The skinfold body composition calculation involves two sequential steps: first, skinfold thicknesses are entered into population-specific prediction equations to estimate body density; then, body density is converted to body fat percentage using conversion equations such as the Siri formula. Both steps are required — skinfold measurements alone do not directly produce a body fat percentage estimate.

191. D — Bioelectrical impedance analysis estimates body composition by passing a low-level electrical current through the body and measuring impedance. Hydration status significantly affects this measurement because water is the primary conductor of electrical current in the body. Dehydration increases impedance and overestimates body fat, while hyperhydration decreases impedance and underestimates it — potentially by several percentage points.

192. B — Electronic timing gates eliminate the human timer's reaction time variability, which introduces approximately 0.1-0.3 seconds of error per measurement. In short sprints (10-40 yards), this error can represent a substantial proportion of total sprint time and may obscure real performance differences between athletes. Electronic systems provide consistent, accurate timing free from human reaction delay and bias.

193. A — A 21% bilateral asymmetry substantially exceeds the commonly cited 10-15% clinical threshold for acceptable bilateral difference. This magnitude of asymmetry warrants targeted corrective programming with unilateral exercises emphasizing the weaker limb and possible medical evaluation to identify underlying pathology or incomplete rehabilitation contributing to the persistent deficit.

194. C — The vertical jump at the 27th percentile is disproportionately low relative to the 89th percentile squat strength, indicating a rate of force development deficit. The athlete has adequate maximal force production capacity but cannot express it rapidly enough for explosive performance. Programming should prioritize explosive training modalities to develop rapid force production.

195. D — Using identical testing conditions across both pre- and post-testing sessions — same warmup protocol, equipment, test order, time of day, environmental conditions, and verbal instructions — is the most critical standardization factor for valid longitudinal comparisons. Any variation between sessions introduces confounding variables that may be incorrectly interpreted as performance changes rather than procedural inconsistencies.

196. B — At 83% bilateral symmetry, the surgical leg has not yet met the commonly cited 90% threshold required for return-to-play consideration following ACL reconstruction. The athlete should continue progressive strengthening of the involved quadriceps and hamstrings until the symmetry criterion is achieved, because persistent asymmetries below 90% are associated with elevated re-injury risk during competitive sport.

197. A — Force plates measure peak ground reaction force, rate of force development (the slope of the force-time curve), impulse (the area under the force-time curve representing total mechanical impulse), and power output in addition to jump height. This comprehensive biomechanical data set enables detailed performance analysis that is impossible with simpler methods.

198. C — The sit-and-reach test primarily measures hamstring and lower back flexibility, does not assess range of motion at other joints (shoulder, hip, ankle, thoracic spine), and is influenced by the athlete's limb proportions (arm-to-leg-to-trunk ratio). For comprehensive flexibility evaluation or identification of specific joint restrictions, goniometric assessment provides superior diagnostic specificity.

199. D — Goniometry provides joint-specific range of motion measurements at any individual joint in the body, allowing precise identification of specific restrictions that the sit-and-reach test cannot detect. This specificity enables targeted intervention — if goniometry reveals a specific hip flexion

limitation, exercises can be prescribed to address that exact restriction rather than using generic stretching.

200. B — Testing at the beginning and end of each major training phase and at pre/post-season time points provides sufficient data for tracking longitudinal progress, evaluating program effectiveness, and identifying persistent deficiencies requiring programming modification — all without excessive disruption to the training schedule from overly frequent testing sessions.

201. A — Submaximal 1RM prediction equations are most accurate when the repetitions completed fall within 10 or fewer, because the relationship between submaximal repetitions and true 1RM becomes increasingly non-linear at higher repetition counts. At ranges above 10, muscular endurance, pain tolerance, and psychological motivation introduce variability that the prediction equations cannot account for, increasing estimation error.

202. C — The standardized 1RM testing protocol includes approximately 3-4 progressively heavier warmup sets at approximately 50%, 70%, and 80-85% of estimated 1RM before beginning single-repetition maximal attempts. This progressive loading systematically prepares the neuromuscular system, increases tissue temperature, and rehearses the movement pattern at incrementally higher intensities before the athlete encounters near-maximal loads.

203. D — The T-test involves a forward sprint, lateral shuffle in both directions, and backward run arranged in a T-shaped pattern covering approximately 40 total yards. It assesses multidirectional movement ability including forward acceleration, lateral movement speed, and backward running capability — making it a practical field test for team sport athletes who must move in multiple directions.

204. B — If plyometric training alone has not improved vertical jump after 12 weeks, the athlete's squat at only 1.1× body weight falls below the commonly recommended 1.5× body weight threshold for plyometric effectiveness. Heavy resistance training should be added to develop the strength foundation that enables plyometrics to produce further power gains. Without adequate strength, the SSC cannot be effectively loaded.

205. D — Both the Cooper 12-minute run and the 1.5-mile run require the athlete to self-pace at maximal effort for the entire test duration. Performance depends heavily on the athlete's motivation, pacing experience, and willingness to tolerate sustained high-intensity discomfort. Athletes unfamiliar with self-pacing strategies or lacking competitive motivation may produce results that significantly underestimate their true aerobic capacity.

206. C — A comprehensive pre-season basketball testing battery should assess aerobic capacity (shuttle run or 1.5-mile), sprint speed (lane sprints or 20-yard dash), agility/change of direction (T-test or pro agility), lower body power (vertical jump), upper body strength (bench press), and body composition (skinfolds or BIA). These domains align with basketball's diverse physical demands.

ORGANIZATION AND ADMINISTRATION (Questions 207–220)

207. D — Using the NSCA upper guideline of 60 square feet per athlete: 60 athletes × 60 sq ft = 3,600 square feet of recommended training area. This ensures adequate space for safe movement, equipment clearance zones, emergency access pathways, and supervision visibility during peak training periods when the maximum number of athletes are present.

208. B — Emergency action plans should be rehearsed at least annually with all staff members participating, and ideally more frequently (quarterly or semi-annually). Unrehearsed plans fail under the stress of actual emergencies because staff may not know their assigned roles, equipment locations, communication procedures, or the fastest routes for directing EMS personnel to the training area.

209. A — CPR and AED certification from a recognized provider (American Heart Association, American Red Cross, or equivalent) ensures that every CSCS-credentialed professional can provide immediate life-saving intervention for cardiac emergencies occurring in the training environment. Cardiac arrest survival rates decline approximately 7-10% for every minute without CPR and defibrillation.

210. C — The standard of care is the degree of care, skill, and diligence that a reasonably competent professional with similar training, education, and experience would exercise under similar circumstances. It represents the minimum expected level of professional competence — not perfection, but the baseline that the profession considers acceptable for safe and effective practice.

211. D — A signed waiver generally does not protect the facility against claims of gross negligence or reckless conduct — willful disregard for participant safety that goes substantially beyond ordinary carelessness. While a waiver documents that inherent risks were disclosed and voluntarily assumed by the participant, it cannot absolve a professional who demonstrates conduct so far below the standard of care as to constitute recklessness.

212. B — Diagnosing musculoskeletal conditions and prescribing rehabilitation exercises are functions that fall entirely outside the CSCS scope of practice, requiring the training and licensure of medical professionals — physicians, athletic trainers, or physical therapists. The specialist must refer the athlete to the appropriate qualified provider while continuing to manage the non-rehabilitative aspects of the training program.

213. A — The CSCS scope of practice encompasses designing periodized annual training programs based on needs analyses, teaching proper exercise technique, administering standardized performance assessments, and managing the strength and conditioning facility. Diagnosing injuries, prescribing rehabilitation, creating individualized meal plans, and providing psychological counseling all require separate professional credentials and licensure.

214. C — Equipment showing visible signs of damage, excessive wear, or mechanical malfunction must be immediately removed from service, tagged as out of order to prevent inadvertent use,

documented in the maintenance log with a description of the issue, and repaired or replaced by qualified personnel before being returned to use. Continued use of damaged equipment creates unacceptable safety and liability risk.

215. D — The NSCA's professional standards require the CSCS-credentialed professional to decline implementing practices that conflict with evidence-based safety principles, explain the scientific rationale to the sport coach, and advocate for the athletes' safety and wellbeing. The certified professional holds ultimate responsibility for the strength and conditioning program and cannot defer that responsibility to coaches lacking specialized training.

216. B — Supervision ratios should be adjusted based on three primary factors: the complexity and risk level of exercises being performed (Olympic lifts require closer supervision than machines), the experience level of the athletes (novices require more guidance), and the qualifications of available staff (more experienced staff can safely manage larger groups).

217. A — Comprehensive record keeping should include athlete training logs, performance testing data, signed liability waivers, medical clearance forms, equipment inspection and maintenance records, and incident/injury reports. These documents serve dual purposes: supporting effective evidence-based programming decisions and providing legal documentation of standard of care compliance.

218. C — An unqualified colleague independently teaching heavy power cleans to inexperienced athletes creates significant safety and liability risk for both the athletes and the institution. The concern must be addressed immediately through appropriate professional channels — discussing directly with the colleague and escalating to supervisory staff if necessary to ensure technically demanding exercises are taught only by qualified personnel.

219. D — Facility footwear policies requiring closed-toe athletic shoes exist to protect athletes from injury caused by dropped weights, rolling barbells, and equipment contact. Open-toed sandals provide zero foot protection against these hazards. The policy must be enforced consistently for all athletes — the individual cannot train until returning with proper closed-toe athletic footwear.

220. B — The NSCA's professional standards establish that the CSCS-credentialed professional holds ultimate professional authority and responsibility for the design, implementation, and supervision of the strength and conditioning program. While collaboration with sport coaches is essential for integrating strength training with sport practice, the certified professional makes final program decisions based on specialized expertise.