NSCA TSAC-F® - Quiz Questions with Answers

1. Exercise Sciences

1.

Which of the following is **not** true about cartilage?

It has its own blood vessels

It covers the ends of long bones

It forms a connection between the ends of the ribs and the sternum

It makes up a large portion of the larynx

Correct answer: It has its own blood vessels

Cartilage is considered a connective tissue and is mostly made up of chondrocytes and a water-carbohydrate matrix. Unlike bone, cartilage does not have nerves or blood vessels, which can result in a delay in the healing of injuries to this tissue. Cartilage is found in many places in the body, including the ends of bones, and it forms the connection between the sternum and the ribs. Some structures are primarily composed of cartilage, including the discs found between the vertebrae, as well as the larynx, nose, and outer ear.

2.

Which of the following is **not** considered anatomical dead space?

Alveoli

Bronchioles

Trachea

Correct answer: Alveoli

When we breathe in, oxygen passes through many areas of anatomical dead space, which refers to areas that cannot provide gas exchange. These areas include the nose, trachea, bronchi, and bronchioles. The alveoli (small air-containing compartments in the lungs) make up the functional unit of the pulmonary system where gas exchange occurs.

3.

What is the maximum recommended exposure time for firefighters working in an environment over 100 degrees Celsius (212 degrees F)?

25 minutes

15 minutes

60 minutes

At this temperature, there is no recommended time limit

Correct answer: 25 minutes

Thermal stress is a significant concern for firefighters, especially when working in a hot environment—which can be a result of fire or weather or both. When the ambient temperature is above 100 degrees celsius, the maximum recommended exposure time is 25 minutes. The hazards of a high ambient temperature are amplified by an increase in body temperature due to personal protective equipment (PPE) as well as the heat produced by the working muscles.

Thermal stress can affect performance due to the increase in heat storage and decreased ability to maintain heat balance. Dehydration also amplifies the risk for heat related illnesses. It's important to note that firefighters who have better aerobic capacity may have an increased tolerance to thermal stress.

4.

What type of training device uses variable resistance to ensure that the rate of movement remains constant throughout a range of motion?

Isokinetic

Isometric

Isotonic

Eccentric

Correct answer: Isokinetic

Isotonic muscle contractions are those used with general resistance training and daily movements. These include both concentric (shortening) and eccentric (lengthening) muscle actions and occur when lifting and lowering objects. These involve movement against an unchanging resistance through a range of motion (ROM). Isotonic means "same tension".

Isometric muscle actions involve creating tension and generating force in a muscle without any change to joint angle or the length of the muscle. Isometric means "same tension". Holding equipment, such as a firehose, for any length of time is an example of an isometric contraction that would be used on the job for a tactical athlete.

Isokinetic (same speed) exercise devices automatically adjust the resistance up or down during movement in order to keep the rate of movement constant throughout the entire range of motion. If you try to speed up the movement, the resistance will increase and if your movement slows down, the resistance will decrease.

5.

Which of the following physiological adjustments might we experience when first entering an area of high altitude?

Increase in pulmonary ventilation at rest

Decrease in pulmonary ventilation with exercise

Decrease in heart rate at rest

Correct answer: Increase in pulmonary ventilation at rest

When we enter an area of high altitude, the following things happen in our bodies:

- *Pulmonary ventilation increases at rest and during exercise (hyperventilation).*
- *Heart rate increases at rest and during submaximal exercise.*

After about two weeks' time, these measures begin to drop to normal values as the body adjusts.

6.

Performing a biceps curl exercise is an illustration of what type of lever?

Third-class lever

Second-class lever

First-class lever

Correct answer: Third-class lever

There are three classes of levers in the body's biomechanics.

A third-class lever is one in which the muscle force and the resistive force act on the same side of the fulcrum (joint), with the muscle force closer to the fulcrum than the resistive force.

In the biceps curl, it may seem as though the muscle force is on the opposite side of the fulcrum (which is the elbow) from the resistive force; however, it's actually on the same side. The resistive force lies in the hand holding the weight (the resistive force is the dumbbell pushing through the hand). The muscular force in the biceps lies in on the same side of the fulcrum because the biceps muscle attaches to the forearm, below the elbow joint, and this is where the muscle force is applied to create the elbow flexion movement involved in a biceps curl.

Because both forces are on the same side of the fulcrum, and the muscle force lies closer to the fulcrum than the resistive force, this makes it a third-class lever system.

7.

When a change in tension is sensed at the musculotendinous junction, what activates in the tendon?

Golgi tendon organs

Action potential

Muscle spindles

Correct answer: Golgi tendon organs

Golgi tendon organs (GTOs) are proprioceptors located in the tendons near the myotendinous junction and are in a series, with muscle fibers. GTOs are activated when they sense a change of tension at the musculotendinous junction. They help prevent injury by triggering relaxation of the muscle in order to avoid too much force production.

Muscle spindles are also proprioceptors that sense changes in the muscle. They are located within muscle fibers, enclosed in a sheath of connective tissue. Muscle spindles provide information concerning muscle length and the rate of change in length. When a muscle is stretched, spindles are activated and send a message to the central nervous system to produce tension in the muscle in order to prevent damage to the tissue from an excessive stretch.

8.

An athlete recently sustained an injury to their shoulder after a fall. They were diagnosed with a complete tear to the teres major muscle. Which of the following actions would you expect the athlete to have difficulty performing?

Shoulder extension

Shoulder flexion

Shoulder abduction

Correct answer: Shoulder extension

The primary muscles for shoulder extension are the latissimus dorsi, posterior deltoid, and teres major.

For shoulder flexion, the muscles responsible are the pectoralis major, anterior deltoid, and biceps brachii. Shoulder abduction is performed by the deltoid and supraspinatus.

9.

Which of the following is an agonist in leg extension?

Quadriceps

Hamstrings

Gluteals

Correct answer: Quadriceps

The agonist is defined as the muscle or muscle group actively causing the movement.

During leg extension, the quadriceps contract to straighten the knee from a flexed (bent) leg position to an extended (straight) leg position. Therefore, the quadriceps are the agonist in this movement.

10.

When analyzing the sarcomere, there are plenty of areas of overlap between myosin and actin. Which area of the sarcomere has no actin during the relaxation phase of muscle contraction?

H-zone

A-band

I-band

Correct answer: H-zone

The sarcomere consists of overlapping actin and myosin filaments. The following terms describe the different areas of the sarcomere:

I-band: Made up of solely actin filaments, the I-band corresponds with the areas in two different adjacent sarcomeres.

A-band: The A-band is the length of the myosin filaments within the sarcomere. Actin filaments partially overlap the myosin in this area during relaxation, and the overlap of the two increases as the muscle shortens during contraction.

H-zone: Containing only myosin filaments, it becomes smaller as the overlap between actin and myosin increases during muscle contraction.

Z-line: This is the anchor point for the actin filaments and lies in the middle of the I-band. The Z-lines indicate the ends of the sarcomere and appears as a thin, dark line running longitudinally through the I-band.

11.

The lowering phase of a bench press would cause what kind of muscle action?

Eccentric

Concentric

Isometric

Correct answer: Eccentric

Eccentric muscle actions occur when the muscles lengthen under load because the contractile force is less than the resistive force. The forces generated within the muscle are less than the external forces. This occurs during the lowering phase of resistance exercise. Eccentric muscle actions help to prevent the weight from accelerating downward and causing injury.

Concentric muscle actions occur when the contractile force is greater than the resistive force and the muscle shortens. Isometric muscle actions occur when the contractile force is equal to the resistive force and the muscle stays the same length.

12.

An athlete is instructed to imagine a past achievement as a method to increase motivation. Which of the following would best describe this type of motivation?

Visualization motivation

Intrinsic motivation

Reward-based motivation

Correct answer: Visualization

Visualization involves using the ability of the brain to "draw" and "recall" mental images that can help create positive emotional responses and improve motivation. This can be done through reliving a past success, imagining a success yet to be achieved, and understanding the value of what they do.

13.

The debatable concept that muscle fibers can actually split longitudinally, resulting in additional muscle fibers, is known as what?

Hyperplasia

Hypertrophy

Protein synthesis

Correct answer: Hyperplasia

Hyperplasia is the mechanism of increasing muscle size by longitudinally splitting muscle fibers, resulting in an increase in total muscle fibers. This results from high-intensity resistance training, but has only been shown to work in animals; human studies on this topic are controversial.

14.

Which of the following is **not** an adaptation to resistance training?

Increase in mitochondrial density

Increased rate of force production

Increased glycogen stores

Correct answer: Increase in mitochondrial density

There are some very specific adaptations that occur as a result of consistent resistance training:

- *Increased muscle and fiber size*
- *Decreased capillary and mitochondrial density*
- *Increased short-term endurance*
- *Increased strength and power as well as increased rate of force production*
- *Increased glycogen stores*

Mitochondrial density does not increase with consistent resistance training, but does increase with consistent aerobic training.

15.

The rectus femoris and sartorius are part of which muscle group?

Hip flexors

Knee extensors

Hip extensors

Hip adductors

Correct answer: Hip flexors

Both the sartorius and rectus femoris contribute to bringing the knee toward the chest to create hip flexion, along with other muscles such as the psoas major and the iliacus. The rectus femoris also contributes to knee extension, but the sartorius does not.

The knee flexors include the hamstring group—the semitendinosus, semimembranosus, and biceps femoris. These muscles are also part of the hip extensors, along with the gluteus maximus.

16.

Every muscle has an origin and an insertion. What is a way of discerning between the two?

The origin is the more stationary structure and the insertion is the more mobile structure

The origin is the distal attachment and the insertion is the more proximal attachment

The origin is farther away from the body and the insertion is more toward the center of the body

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Correct answer: The origin is the more stationary structure and the insertion is the more mobile structure

Each muscle in the body has both an origin and insertion—places on either end of the muscle where the muscle is attached to the supporting structures, usually connecting tendon to bone. The origin is a muscle's most proximal (toward the center of the body) attachment, and its insertion is its distal (away from the center of the body) attachment.

Sometimes an origin can be referred to as more of a stationary structure, while the insertion is more mobile as an attachment. This is because the insertion of the muscle is where movement occurs when the muscle contracts. For example, when the biceps brachii contract, the insertion of the muscle pulls on the forearm, which results in elbow flexion as the muscle shortens, while the origin of the muscle stayed anchored.

17.

Which of the following would **decrease** as a physiological adaptation to resistance training?

Mitochondrial density

Anaerobic power

Muscle fiber size

Correct answer: Mitochondrial density

There are several physiological variables that increase or decrease as a result of resistance training. Mitochondrial density is an example of something that decreases.

Muscular strength, muscle fiber size, anaerobic power, rate of force development, and cytoplasmic density are examples of variables that increase after resistance training.

18.

Gary is a 35-year-old looking to begin an aerobic exercise program, and his doctor tells him to begin his program at a lower intensity—around 55% of his maximal heart rate. His resting heart rate is 65 bpm.

Using the Karvonen method, how can Gary estimate his age-predicted maximal heart rate (APMHR) and his target heart rate (THR)?

220 minus his age

220 minus resting heart rate

220 x 0.55 + 65

Correct answer: 220 minus his age

The Karvonen method provides equations that can be used to estimate one's age-predicted maximal heart rate (MHR) and target heart rates (THR).

1. To estimate one's age-predicted maximal heart rate (APMHR) using this formula, subtract their age from 220.

For Gary: APMHR = 220 - 35 = 185 bpm (estimated max heart rate)

2. Determine heart rate reserve (HRR): HRR = APMHR - resting heart rate (RHR)

HRR = 185 bpm - 65 bpm = 120 bpm

3. Determine target heart rate (THR): THR = HRR x exercise intensity + RHR

THR = 120 x 0.55 + 65 = 66 + 65 = 131 bpm (target heart rate)

Note that a true maximal heart rate would have to be determined via lab testing, and the age-predicted equations for estimating MHR can be unreliable. Therefore, it's also important to monitor the rate of perceived exertion (RPE) at varying intensities. Beginners should also start at lower intensities and progress with consistent training.

19.

Which of the following formulas represents how to calculate the MAP of an athlete?

(SBP - DBP) / 3 + DBP

(SBP - DBP) / 2 + SBP

(SBP - DBP) / 2 - DBP

(SBP - DBP) / 5 x DBP

Correct answer: (SBP - DBP) / 3 + DBP

The Mean Arterial Pressure (MAP) of an athlete is calculated using the following formula: MAP = (SBP - DBP) / 3 + DBP. This equation takes into account both the Systolic Blood Pressure (SBP), which is the maximum pressure in the arteries during heart contraction, and the Diastolic Blood Pressure (DBP), which is the pressure when the heart is at rest between beats. The formula essentially estimates the average arterial pressure over a single cardiac cycle with a weighting that reflects the fact that the heart spends more time in diastole (rest) than in systole (contraction).

The incorrect formulas provided deviate from the established method for calculating MAP and would not accurately reflect the average arterial pressure:

- ***(SBP - DBP) / 2 + SBP**: This formula inaccurately overemphasizes systolic pressure and does not correctly calculate the mean arterial pressure.*
- ***(SBP - DBP) / 2 - DBP**: Subtracting the diastolic pressure in this manner does not make physiological sense in the context of calculating average arterial pressure and would result in an inaccurate value.*
- ***(SBP - DBP) / 5 x DBP**: This formula not only uses an incorrect divisor (5 instead of 3) but also improperly applies the relationship between SBP, DBP, and MAP, leading to an incorrect calculation of mean arterial pressure.*

Correctly calculating MAP is crucial for understanding an athlete's cardiovascular health, especially during physical exertion. MAP provides a more comprehensive picture of blood flow, oxygen delivery to tissues, and overall cardiovascular stress than either SBP or DBP alone, making it a valuable measure for athletes and their coaches to monitor.

20.

Funneling lactate into the blood to be transported to the liver, where it is converted to glucose, is know as what?

Cori cycle

Glycolysis

Krebs cycle

Correct answer: Cori cycle

Lactate can be cleared by oxidation during exercise, or it can also be transported in the blood to the liver, where it is converted to glucose. This process is known as the Cori cycle. This glucose is used for energy when needed during exercise, or may instead be converted to glycogen and stored.

21.

When a joint is located near one end of the body segment (e.g., the arm), with the muscle force exerted farther away from the joint than the weight or resistance, this is referred to as which of the following?

Second class lever

First class lever

Third class lever

Fourth class lever

Correct answer: Second class lever

When discussing biomechanics and how forces act on the human body, particularly in relation to exercise and movement, the concept of lever systems becomes crucial. A lever is a simple machine consisting of a rigid bar (the body segment in this case) that rotates around a fixed point called the fulcrum (the joint). Lever systems are categorized according to the arrangement of three key components: the fulcrum (the pivot point), the effort (the force exerted, often by a muscle), and the load (the resistance that needs to be overcome or moved).

A second class lever system is characterized by the load being located between the fulcrum and the point where the force is applied. An everyday example is a wheelbarrow, where the wheel acts as the fulcrum, the load is in the middle, and the effort is applied at the handles. In the human body, an example could be standing on your toes, where the balls of your feet are the fulcrum, the body weight acts as the load on the ankle joint, and the effort is applied by the calf muscles behind the ankle joint. This arrangement provides a mechanical advantage, allowing the applied force to move a larger load.

The other lever types have different configurations:

- ***First class lever**: The fulcrum is positioned between the effort and the load, such as in the case of a seesaw. An example in the human body is the action of the neck muscles when nodding the head, with the skull as the load, the neck joint as the fulcrum, and the neck muscles providing the effort.*
- ***Third class lever**: Here, the effort is applied between the fulcrum and the load. This is the most common type of lever in the human body, providing a speed and range of motion advantage at the expense of force. An example is the biceps curl, where the elbow acts as the fulcrum, the effort is applied by the biceps muscle, and the load is in the hand (the weight being lifted).*

- ***Fourth class lever**: This is not a standard classification in the study of biomechanics and lever systems. The traditional models include only the first, second, and third class levers.*

Therefore, when the muscle force is exerted farther away from the joint than the weight or resistance, especially when the joint is located near one end of the body segment like the arm, it represents a second class lever system. This arrangement is less common in the human body but is effective for specific movements where the mechanical advantage allows for the lifting or moving of heavy loads with comparatively less effort.

22.

The nerves that innervate skeletal muscle are called which of the following?

Motor neurons

Golgi tendon organs

Motor units

Muscle fibers

Correct answer: Motor neurons

The nerves responsible for innervating skeletal muscle, prompting it to contract and produce movement, are known as motor neurons. These specialized neurons transmit signals from the central nervous system to the skeletal muscles, effectively converting neurological messages into mechanical actions.

- ***Golgi tendon organs**: These are sensory receptors located within the tendons near the muscle-tendon junction. They monitor tension developed in muscles and provide feedback to the central nervous system to prevent muscle damage from excessive force. While they are involved in the feedback loop that regulates muscle contraction, they do not directly innervate muscles.*
- ***Motor units**: A motor unit is comprised of one motor neuron and the muscle fibers it stimulates. This unit is the essential component of muscle contraction, where a solitary impulse from the motor neuron triggers a synchronized contraction of all connected muscle fibers. While it is intimately linked to the function of motor neurons, a motor unit encompasses the neuron along with the muscle fibers it governs rather than the nerve alone.*
- ***Muscle fibers**: These are the individual cells that make up skeletal muscles. Muscle fibers are the contractile units that shorten and generate force when stimulated by motor neurons. While they are the target of innervation by motor neurons, they are not the nerves themselves.*

Motor neurons are the specific type of nerves that innervate skeletal muscle, enabling the control of voluntary movements through the transmission of signals from the central nervous system to the muscles. This distinguishes them from the other options, which are related components of the neuromuscular system but do not serve the same direct innervating function as motor neurons.

23.

When a person intends to increase their physical activity and thinks about it now and then, but still does not feel ready to become physically active, what process of the transtheoretical model is this describing?

Contemplation

Precontemplation

Preparation

Correct answer: Contemplation

There are five steps to behavior change, according to the transtheoretical model. The following is an example of the process of a person who wants to become physically active:

1. Precontemplation - The person does not intend to increase physical activity and is not thinking about becoming physically active.

2. Contemplation - The person intends to increase physical activity and is giving it thought now and then, but is not yet physically active.

3. Preparation - The person is engaging in some activity, accumulating at least 30 minutes of moderate-intensity physical activity at least one day per week, but not on most days of the week.

4. Action - The person is accumulating at least 30 minutes of moderate-intensity physical activity on five or more days a week, but has done so for less than six months.

5. Maintenance - The person is accumulating at least 30 minutes of moderate-intensity physical activity on five or more days a week and has been doing so for six months or more.

24.

Hormones are released during and after heavy resistance training sessions. How would aerobic training affect hormone sensitivity?

Sensitivity would increase

Sensitivity would decrease

Sensitivity would stay the same

Correct answer: Sensitivity would increase

Aerobic training results in an increased sensitivity to hormones such that a lower concentration of hormones will have the same effect after training. They will experience less stress overall on their bodily systems as a result than an untrained person.

25.

When you multiply the muscle force times the torque arm, this distance is referred to as which of the following?

Muscle torque

First class lever

Second class lever

Resistive torque

Correct answer: Muscle torque

When calculating the mechanical aspects of muscle activity, particularly in the context of biomechanics and exercise physiology, the term muscle torque is used to describe the rotational force produced by a muscle. Torque, in general, is a measure of the force that can cause an object to rotate about an axis. It is calculated by multiplying the muscle force (the magnitude of the force exerted by the muscle) by the torque arm (the perpendicular distance from the axis of rotation to the line of action of the force).

Muscle torque is the product of the muscle force and the length of the torque arm. It represents the rotational force the muscle generates around a joint. For example, in the knee joint during a leg extension, the muscle force exerted by the quadriceps is multiplied by the distance from the knee joint to where the force is applied (the torque arm) to calculate the muscle torque.

The other terms mentioned relate to different aspects of biomechanics but do not directly describe the product of muscle force and torque arm distance:

- ***First class lever**: A type of lever where the fulcrum is located between the effort (force applied) and the load (resistance to be moved). An example would be the seesaw.*
- ***Second class lever**: In this lever system, the load is located between the fulcrum and the effort. An example is the wheelbarrow.*
- ***Resistive torque**: This refers to the torque that opposes the movement of a joint, often created by the weight of a body part or an external weight. It contrasts with muscle torque, which aims to create movement.*

Thus, muscle torque specifically refers to the rotational force produced by the muscle's action, critical for understanding how movements are generated and controlled within the human body.

26.

Which of the following describes systolic blood pressure?

The pressure on the arterial walls following ventricular contraction

The pressure in the heart as blood is being forcefully ejected during contraction

The pressure on the arterial walls during relaxation of the heart

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Correct answer: The pressure on the arterial walls following ventricular contraction

Blood pressure is a common measuring tool that includes two readings—a systolic number (the first one) and a diastolic number (the second one).

Systolic blood pressure refers to the pressure on the vessels after the heart contracts, sending blood into the arteries.

Diastolic blood pressure refers to the pressure in the vessels following the relaxation of the heart.

27.

What type of cartilage can be found between the intervertebral disks?

Fibrocartilage

Elastic cartilage

Hyaline cartilage

Correct answer: Fibrocartilage

Fibrocartilage is a very tough form of cartilage found in the intervertebral disks of the spine and in the menisci in the knee. It is designed to protect the joints from heavy downward pressure, such as that experienced during daily weight-bearing activities.

Hyaline cartilage is an articular cartilage that is found on the articulating surface of bone. It allows both flexibility and support for the joints. Elastic cartilage, which is the type of cartilage found in the ear, can tolerate being distorted and and still returns to its normal shape.

28.

Which of the following types of muscle fibers has a high oxidative capacity, low contractile force, and small size?

Type I

Type II

Type IIa

Type IIx

Correct answer: Type I

Muscle fibers can be classified based on their contraction speed, force production, size, and metabolic capabilities. Among the types mentioned, Type I fibers, also known as slow-twitch fibers, are characterized by their high oxidative capacity, low contractile force, and small size. These fibers are designed for endurance and can sustain activity for long periods without fatigue, thanks to their efficient use of oxygen to generate energy.

The correct answer and the other answer options are described as follows:

- ***Type I (Slow-Twitch) Fibers**: These fibers have a high density of mitochondria, rich capillary networks, and abundant myoglobin, contributing to their high oxidative capacity and endurance. They are smaller in diameter and generate less force, making them ideal for activities like long-distance running or cycling.*
- ***Type II (Fast-Twitch) Fibers**: These fibers are further categorized into Type IIa and Type IIx (or IIb, depending on the classification system), with differences in their oxidative and glycolytic capacities.*
- ***Type IIa (Fast Oxidative Glycolytic) Fibers**: These are somewhat of a middle ground between Type I and Type IIx fibers, possessing both high oxidative capacity and the ability to generate more force than Type I fibers, but less than Type IIx. They are larger than Type I fibers and can sustain activity for a moderate duration.*
- ***Type IIx (or IIb) Fibers**: These have the highest contractile force and size among the fiber types but have a low oxidative capacity. They rely more on anaerobic metabolism, making them suited for short, explosive activities like sprinting or lifting heavy weights. They fatigue quickly due to their limited use of oxygen.*

Type I fibers are uniquely adapted for endurance thanks to their energy efficiency and ability to resist fatigue, contrasting with Type II fibers, which are tailored for strength, speed, and power but fatigue more rapidly.

29.

How can we measure cardiac output?

Stroke volume x heart rate

Heart rate x systolic blood pressure

Heart rate x diastolic blood pressure

Correct answer: Stroke volume x heart rate

Cardiac output is the amount of blood pumped by the heart in liters per minute and is determined by the quantity of blood ejected with each beat (stroke volume) and the heart's rate of pumping (heart rate):

Q = stroke volume x heart rate

Q = cardiac output

30.

Surface drag provides what type of resistive force?

Fluid resistance

Friction

Inertia

Correct answer: Fluid resistance

Many things can provide resistive force to muscles, including gravity, inertia, friction, fluid resistance, elasticity, and negative work and power.

Surface drag is a type of fluid resistance that results from friction of a fluid passing along the surface of an object.

There are machines that provide fluid resistance using fluid cylinders, and these types of machines do not provide eccentric muscle movements. They involve alternating concentric muscle actions of antagonistic muscle groups; each muscle rests while its antagonist works.

31.

When the intensification of a training stimulus continues without adequate recovery and regeneration, this is known as which of the following?

Nonfunctional overreaching

Overreaching

Overtraining syndrome

Functional overtraining

Correct answer: Nonfunctional overreaching

Nonfunctional overreaching describes a scenario where the balance between training and recovery is disrupted due to excessive training load without adequate rest, leading to a temporary decline in performance that lasts longer than would be seen with functional overreaching. Unlike functional overreaching, which can ultimately lead to performance improvements once adequate recovery occurs, nonfunctional overreaching can result in more serious and prolonged negative outcomes.

Here's a breakdown of the other terms provided:

- ***Overreaching**: This term encompasses both functional and nonfunctional overreaching and refers to the state of excessive training load that surpasses an athlete's recovery capacity. While it can be a strategy used intentionally to induce specific adaptations (functional overreaching), when mismanaged, it can lead to nonfunctional overreaching.*
- ***Overtraining syndrome**: This is a more severe and chronic condition that results from prolonged overreaching without adequate recovery, leading to long-term decrements in performance and potentially serious health problems. Overtraining syndrome requires significantly longer recovery periods than overreaching and is characterized by a wide range of physiological, biochemical, and psychological symptoms.*
- ***Functional overtraining**: The term functional overtraining is not recognized or used correctly in the context of sports science. The correct term is functional overreaching, which refers to a deliberate, short-term increase in training load that, with proper recovery, leads to performance improvements. It's a strategy used by athletes and coaches to push the limits of training adaptations without crossing into the territory of nonfunctional overreaching or overtraining syndrome.*

Nonfunctional overreaching is a state resulting from an imbalance between training load and recovery, leading to a temporary but more prolonged decline in athletic

performance than functional overreaching, and if not addressed, can progress to the more serious condition of overtraining syndrome.

32.

An athlete is performing an upper body workout in order to improve overall strength. During a biceps curl, when would the biceps be performing a concentric muscle action?

When the dumbbell is on its way up

When the dumbbell is on its way down

When the dumbbell is halfway through the movement

Correct answer: When the dumbbell is on its way up

A concentric muscle action is when the muscle shortens because the contractile force is greater than the resistive force.

In the case of a biceps curl, the biceps muscle shortens as the dumbbell is on its way upward, thereby creating a concentric muscle action.

33.

When the blood glucose level is too low, the body releases what hormone to increase blood glucose levels?

Glucagon

Insulin

Oxytocin

Correct answer: Glucagon

The pancreas is an endocrine gland that releases two different hormones that, together, regulate blood glucose levels. Those hormones are insulin and glucagon.

Glucagon acts to increase blood glucose levels, while insulin does just the opposite: it promotes the entry of blood glucose into cells.

34.

Which of the following is **not** a mechanism that contributes to varying degrees of peripheral blood concentrations of hormones?

The blood sample retrieval site

Tissue clearance rate

Fluid volume shifts

Correct answer: The blood sample retrieval site

There are a number of mechanisms that affect the peripheral blood concentrations of hormones:

- Fluid volume shifts: Body fluid moves to intercellular areas and causes more concentrated blood.
- Tissue clearance rates: The time it takes a hormone to circulate through the tissue. Hormones travel at different rates.
- Hormonal degradation: The hormone itself can break down.
- Venous pooling of blood: Blood traveling back to the heart is slowed by venous pooling.
- Interactions with binding proteins in the blood: Hormones bind with specialized proteins in the blood that make it easier for the blood to transport the hormone.

35.

Which of the following hormones is considered a catabolic hormone?

Cortisol

Testosterone

Insulin-like growth factor

Correct answer: Cortisol

Hormones are either anabolic or catabolic in nature. Anabolic hormones are those that promote tissue building while anabolic hormones promote degrading of cells.

Some examples of anabolic hormones are testosterone, insulin-like growth factor, insulin, and growth hormone. Examples of catabolic hormones are cortisol and progesterone.

36.

Which of the following is the pressure in the arteries following contraction of the heart?

Systolic blood pressure

Diastolic blood pressure

Mean arterial pressure

Total peripheral resistance

Correct answer: Systolic blood pressure

Systolic blood pressure represents the pressure within the arteries immediately after the heart contracts. It reflects the highest level of blood pressure in the arteries and is the first number recorded in blood pressure readings (for example, in a reading of 120/80 mmHg, 120 is the systolic pressure). This measurement is crucial for assessing cardiovascular health, as elevated systolic pressure can indicate a higher risk of heart disease and stroke.

The other terms provided relate to different aspects of blood pressure and cardiovascular function:

- ***Diastolic Blood Pressure**: This refers to the arterial pressure measured during the period when the heart is in a state of relaxation between contractions. It represents the lowest level of blood pressure and is the second number in blood pressure readings (in the example of 120/80 mmHg, 80 is the diastolic pressure). Diastolic pressure is important for understanding the overall health of the arteries and how effectively the heart relaxes.*
- ***Mean Arterial Pressure (MAP)**: This is an average blood pressure within the arteries throughout one cardiac cycle, weighted toward diastolic pressure because the heart spends more time in diastole. MAP is considered a better indicator of perfusion to vital organs than systolic pressure alone and can be approximated using the following formula: MAP ≈ diastolic BP + 1/3(systolic BP - diastolic BP).*
- ***Total Peripheral Resistance (TPR)**: Total Peripheral Resistance (TPR) represents the opposition to blood flow through the body's entire network of blood vessels, except for those in the lungs. Factors such as the width of blood vessels, the thickness of the blood, and the total distance the blood travels through the circulatory system all play a role in determining TPR. In conjunction with the heart's output, TPR plays a crucial role in setting the level of blood pressure within the arteries.*

In summary, systolic blood pressure is a key measure of the force exerted on artery walls immediately after the heart contracts, providing essential information about cardiovascular health and the risk of hypertension-related conditions.

37.

What is another name for spongy bone tissue found at the ends of long bones?

Cancellous

Lamellae

Cortical

Epiphyses

Correct answer: Cancellous

The bone tissue found in the shaft of long bones is cortical bone, which is very compact. This section of these bones is known as the diaphysis. The ends of the bones, known as the epiphyses, are composed of bone that has a spongy appearance and is known as spongy, or cancellous, bone.

The lamellae are rings of bone tissue that, along with the osteocytes, form the osteon of the compact (cortical) bone and surround the Haversian canal. This is where the blood vessels are found that bring necessary nutrients and minerals to the bone tissue.

38.

The ability of experienced lifters to recruit high-threshold motor units before low-threshold motor units is known as what type of recruitment?

Selective recruitment

Size principle recruitment

Rate coding

Correct answer: Selective recruitment

The size principle tells us that motor units are recruited in order according to motor neuron size. Smaller motor neurons have a lower recruitment threshold and are recruited first. If more force is required, intermediate and then larger motor neurons are then recruited to provide sufficient force production. Maximal force production requires the recruitment of a maximal percentage of available motor units, and at a very high rate.

There are a few exceptions to the size principle, including the ability to recruit high-threshold motor units first, which is optimal for speed and power performance. This is referred to as selective recruitment, and involves recruiting the high threshold, fast-twitch, large motor neurons units without first recruiting the slow-twitch, smaller motor units. This can occur in activities that require maximal contraction with high force production at a maximal rate of speed, such as the olympic-style lifts.

39.

Which of the following concepts is a popular method of understanding hormone receptors?

Lock and key method

Engine relationship

Accept and react relationship

Correct answer: Lock and key method

The signal from a hormone is relayed to cells that match with the correct receptor for that specific hormone. The receptor is the lock and the hormone is the key. Hormones need to fit with the exact receptor in order for a reaction to occur, just as when only a certain key will open a certain lock.

40.

Various exercise training modalities can increase serum testosterone concentrations in boys and younger men. Which of the following training modalities does **not** do so?

Long rest intervals

Large muscle group exercises

Two or more years of resistance training experience

Correct answer: Long rest intervals

There are five noted exercise modalities that can increase testosterone concentrations in boys and young men:

- Large muscle group exercises (deadlift, power clean, etc.)
- Heavy resistance (85-95% 1RM)
- Moderate to high volume of exercise
- Short rest intervals (30 seconds to 1 minute)
- Two or more years of resistance training experience

41.

A strength coach notices that an athlete is exhibiting unusual fatigue, mood changes, and an increase in illnesses. The coach assesses the athlete's exercise frequency, volume, or intensity of training, in order to screen for what condition?

Overtraining syndrome

Bone stress injury

Overuse injury

Correct answer: Overtraining syndrome

Overtraining can be a serious issue for tactical athletes, especially due to the physical nature of their work. Excessive frequency, volume, and/or intensity of training can lead to excessive fatigue and decreases in performance. Over time, this can lead to overtraining syndrome, which can be detrimental to the body and can take an athlete out for months, or even permanently.

Warning signs include:

- *Unusual fatigue*
- *Mood changes*
- *Elevated heart rate and blood pressure*
- *Diminished quality of sleep*
- *Occurrence of illness or injury*
- *Menstrual changes*

It's important to ensure adequate recovery is provided and to account for all physical work, both on the job and in training, to help prevent overtraining syndrome.

Both bone stress injuries and overuse injuries would present with a gradual onset of pain with activity.

42.

During what type of muscle action is strength **greatest**?

- **Eccentric**
- Concentric
- Isometric
- Isotonic

Correct answer: Eccentric

When measuring strength outputs, strength is greatest during the eccentric (which is typically the lowering) portion of a movement. Isometric muscle actions generally produce less force than eccentric muscle actions, but more force than concentric muscle actions, depending on joint position.

Eccentric strength can be important for individuals in tactical professions. On-the-job movements that require eccentric strength include movements such as landing from jumps. It's important to note, however, that focused eccentric training is advanced and more taxing than traditional concentric-eccentric training.

43.

Pushing your hands together in front of your chest with no external movement is an example of which type of exercise?

Isometric

Isotonic

Isokinetic

Hypertrophic

Correct Answer: Isometric

Pushing your hands together in front of your chest without any external movement exemplifies an isometric exercise. Isometric exercises involve muscle contractions where the muscle length does not change, and there is no visible movement at the joint. These exercises are effective for building strength and stability by maintaining a constant position for a period of time.

Here's a breakdown of the options provided and why isometric is the correct answer:

- ***Isometric**: In isometric exercises, muscles exert force without changing length, and there's no visible movement. Holding a position steadily, such as pushing hands together, planking, or wall sitting, are all examples of isometric exercise.*
- ***Isotonic**: Isotonic exercises involve movements where the muscle length changes while the muscle contracts, moving a constant weight through the range of motion of a joint. Examples include squats, bicep curls, and bench presses. Unlike isometric exercises, isotonic movements are dynamic with visible movement and muscle length change.*
- ***Isokinetic**: Isokinetic exercises require specialized equipment to maintain a constant speed of movement while the muscle contracts. The resistance provided by the equipment adjusts throughout the range of motion to match the user's force output, ensuring the speed of movement remains constant. This type of exercise is often used in rehabilitation settings.*
- ***Hypertrophic**: This term refers not to a type of exercise but to hypertrophy, a process where muscles increase in size typically as a result of strength training, including both isotonic and isometric exercises. Hypertrophy is a goal or outcome rather than a method of exercise.*

Pushing hands together in front of the chest with no external movement is an example of an isometric exercise, where muscles generate force without changing

length or moving a joint, focusing on strength and stability without dynamic movement.

44.

Metabolism is the total of what two reactions?

Exergonic and endergonic

Fast glycolysis and slow glycolysis

Calcium release and potassium release

Correct answer: Exergonic and endergonic

Metabolism is a process of adjustments. It's a total amount of catabolic and anabolic reactions, also referred as exergonic and endergonic, respectively.

Exergonic reactions (catabolism) are energy-releasing reactions that break down molecules into smaller molecules. Endergonic reactions (anabolism) is the synthesis of larger molecules into bigger molecules, using the energy released from exergonic reactions.

45.

An untrained person would typically reach the lactate threshold at what percentage of their VO2max?

50-60%

70-80%

30-40%

Correct answer: 50-60%

The exercise intensity or relative intensity at which blood lactate begins to accumulate has been termed the lactate threshold (LT). This occurs when lactate is produced faster than it is cleared. The LT represents an increasing reliance on anaerobic mechanisms; therefore, it corresponds well with the ventilatory threshold and is often used as a marker for anaerobic threshold.

The lactate threshold typically begins at 50-60% of maximal oxygen uptake (VO2max) in untrained individuals and 70-80% in trained athletes.

46.

An athlete performs a barbell bench press with a spotter during an upper-body strength workout. During what phase of a barbell bench press is negative work being performed?

As the bar is lowering

As the bar is moving up

When the bar is at the halfway mark

Correct answer: As the bar is lowering

Negative work occurs when a force exerted on a weight is in the direction opposite to the one in which the weight is moving. As the lifter lowers the barbell, force is applied to the bar in an upward direction while the barbell is moving in a downward direction.

Positive work describes the work performed when force is applied in the same direction of the movement. As the lifter pushes the barbell up from the chest to extend the arms, the force is applied to the bar in an upward direction, and the bar is also moving in an upward direction.

47.

Your skeletal muscle tissue has the characteristic of being able to stretch beyond its normal resting length. What is this referred to?

Extensibility

Contractibility

Excitability

Elasticity

Correct answer: Extensibility

Extensibility refers to the unique ability of skeletal muscle tissue to stretch or extend beyond its normal resting length. This characteristic is crucial for a wide range of bodily movements and activities, enabling muscles to adapt to the demands placed upon them, from everyday tasks to athletic performance. Extensibility ensures that muscles can accommodate movements that require a greater range of motion, contributing to overall flexibility and mobility.

Here's a closer look at the provided options and their relevance to muscle tissue properties:

- ***Extensibility**: Extensibility allows muscle tissue to stretch in response to a force, which is essential for movement and flexibility. This property is vital for the functionality of muscles, as it permits them to adapt and elongate as needed during physical activities.*
- ***Contractility**: This property of muscle tissue describes its ability to contract or shorten forcefully when stimulated by the nervous system. Contractility is the fundamental action that enables muscle to produce movement by generating force, pulling on bones, or causing internal movements within the body.*
- ***Excitability**: Also known as irritability, this characteristic refers to muscle tissue's ability to respond to a stimulus, typically from the nervous system. Excitability enables muscle fibers to react to signals and initiate the processes leading to contraction, making it a critical aspect of muscle function.*
- ***Elasticity**: After being stretched or contracted, muscle tissue has the ability to return to its original resting length thanks to its elasticity. This property ensures that muscles can recover from extensions and contractions, maintaining their integrity and readiness for subsequent actions.*

While contractility, excitability, and elasticity are all vital properties of muscle tissue that enable its functionality and responsiveness, extensibility specifically describes

the muscle's capacity to stretch beyond its normal length, contributing to the body's flexibility and the range of motion of joints.

48.

What percentage of VO2max will cause a shift in fatty acid oxidation to carbohydrate?

70-80%

50-60%

25-30%

Correct answer: 70-80%

Intramuscular and circulating fatty acids are potential energy sources during exercise. Fat stores are large and represent a vast source of fuel. During low-intensity exercise, a high percentage of the energy produced is derived from fatty acid oxidation. However, when the intensity of exercise rises (70-80% VO2max), there is a shift from fat to carbohydrate as the primary source of fuel.

49.

What is the name for the synapse between a motor neuron and the muscle fibers it innervates?

Neuromuscular junction

Neuromuscular fibers

Sarcolemma

Correct answer: Neuromuscular junction

A single motor neuron innervates many muscle fibers. This is known as a motor unit. The synapse between a motor neuron and the muscle fibers it innervates is called the neuromuscular junction. This is where communication occurs. Acetylcholine is released from the nerve endings, travels across the neuromuscular junction and binds to receptor sites on the end plate of the sarcolemma, initiating a muscular contraction.

50.

The conversion of ADP + Pi to ATP is known as what?

Phosphorylation

Glycolysis

Cori cycle

Correct answer: Phosphorylation

Phosphorylation is the process of adding an inorganic phosphate (P) to another molecule. So the addition of Pi to ADP, resulting in ATP, is the phosphorylation of ADP to ATP.

51.

Where does internal respiration occur?

Internal respiration occurs between the systemic capillaries and the cells of the body (such as muscle cells)

Internal respiration occurs in the lower respiratory system

Internal respiration occurs in the upper respiratory system

Internal respiration occurs between the alveoli in the lungs and the pulmonary capillaries

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Correct answer: Internal respiration occurs between the systemic capillaries and the cells of the body (such as muscle cells)

Oxygen and carbon dioxide are exchanged in the body through both external and internal respiration. When we breathe in oxygen, the oxygen is first warmed and moistened as it travels through the upper respiratory system, which includes the nasal cavity and the pharynx. It then travels to the lower respiratory system, which includes the larynx, trachea, bronchioles, bronchi, lungs and the alveoli.

Because the partial pressure of oxygen is greater in the alveoli than it is in the pulmonary capillaries, oxygen diffuses into the blood. This is where external respiration occurs. Once the oxygenated blood travels to the heart, it is then pumped out to the rest of the body, where oxygen is diffused out of the capillaries and into the cells. This is where internal respiration occurs.

The same thing happens in reverse with carbon dioxide (CO_2). The cells use the oxygen in cellular respiration, producing CO_2, which then needs to be removed from the body. The CO_2 is diffused into the bloodstream and brought back to the heart and then back to the lungs, where it can be diffused into the lower respiratory system through external respiration and then breathed out when we exhale.

52.

Which of the following athlete types would have the **greatest** amount of Type II muscle fibers?

Weightlifter

Marathon runner

Cross-country skier

Correct answer: Weightlifter

Muscle fibers are categorized as Type I or Type II. Type I fibers are considered slow-twitch, meaning these motor units develop force slowly and relax slowly, and have a long twitch time. Type II fibers develop force and relax quickly, and have a short twitch time.

Athletes in different sports typically have a fiber type that matches the performance needs of the sport. Type I fibers are generally efficient and fatigue resistant and have a high capacity for aerobic energy supply. They also have limited potential for rapid force development. Type II are essentially the opposite; they are inefficient and fatigue more quickly while having low aerobic power, rapid force development, and high anaerobic power.

Cross-country skiers and marathon runners would have high amounts of Type I fibers, and weightlifters would typically have more Type II fibers.

53.

Where are platelets, red blood cells, and most white blood cells made?

In the bone marrow

In the blood

In the endocrine glands

In the liver

Correct answer: In the bone marrow

Bones have many functions in the body, aside from providing a structural framework that enables movement. Many minerals are stored in bone tissue, and our skeletal system provides protection for the soft tissues in our bodies, including our organs, which includes the brain. They also play an important role in the production of blood cells. In fact, red and (most) white blood cells and platelets are all produced in bone marrow before entering the bloodstream.

54.

Which of the following terms refers to the rate of movement through a ROM that is controlled and not the resistance on the barbell or standard weight training machine?

Isokinetic

Variable resistance

Isometric

Isotonic

Correct answer: Isokinetic

Isokinetic exercise refers to a type of strength training where the speed of the muscle contraction is kept constant throughout the Range Of Motion (ROM) irrespective of the force applied. This is achieved using specialized equipment that adjusts the resistance to match the exertion of the user, ensuring that the movement speed remains constant. This characteristic makes isokinetic exercise unique and particularly useful for rehabilitation and precise muscle strengthening because it allows for controlled muscle loading at a constant rate.

Here's why the other terms do not fit the description:

- ***Variable resistance**: This type of exercise involves changes in resistance at different points in the ROM. Common in weight training with equipment like resistance bands or machines that alter the resistance curve, variable resistance does not specifically control the rate of movement but rather the force required throughout the exercise.*
- ***Isometric**: In isometric exercises, the muscle length does not change, and there is no movement through a ROM. Instead, the muscle generates force while staying in a constant position, such as holding a plank or a wall sit. This type of exercise contrasts with isokinetic exercises, which involve movement at a constant speed.*
- ***Isotonic**: Isotonic exercises involve moving a constant weight through a ROM with the muscle changing length and going through concentric (shortening) and eccentric (lengthening) contractions. While the resistance remains the same throughout the exercise, the speed of movement can vary, differing from the controlled speed characteristic of isokinetic exercise.*

Isokinetic exercises are distinguished by their controlled rate of movement through a ROM, facilitated by specialized equipment that adjusts resistance to maintain a constant speed, regardless of the force applied by the user. This makes it

fundamentally different from variable resistance, isometric, and isotonic exercises, which do not inherently control the speed of movement.

55.

What is **not** a benefit of BCAA supplementation for a tactical athlete?

Decreased protein oxidation

Improved recovery time

Decreased muscle breakdown

Increased muscle building

Correct answer: Decreased protein oxidation

There are three branched chain amino acids (BCAAs): leucine, isoleucine and valine. Supplementation can be beneficial for the tactical athlete and is not associated with any significant side effects.

In addition to improved recovery time, decreased muscle breakdown, and increases in muscle building, BCAAs may also help a tactical athlete maintain focus while training at a higher intensity and may also lead to decreased muscle soreness post-activity.

56.

When determining a client's goals in the initial meet and greet, you start using the SMART acronym. What does the "A" in SMART stand for?

Action-oriented

Attention

Acquired mindset

Correct answer: Action-oriented

Personal trainers sometimes use the SMART acronym to help determine goals the client may have.

***S**pecific*
***M**easurable*
***A**ction-oriented*
***R**ealistic*
***T**ime-bound*

Using this acronym can help you prepare the most helpful workout routines for your clients.

57.

Which structure is **not** considered a component instrumental in keeping the ball of the humerus in place in the shoulder joint?

Deltoids

Rotator cuff muscles

Pectoralis minor

Correct answer: Deltoids

The stability of the shoulder depends on the glenoid labrum, the joint synovium, and the capsules, ligaments, muscles, tendons, and bursae.

Muscular components keeping the ball of the humerus in place are the rotator cuff muscles (supraspinatus, infraspinatus, subscapularis, and teres minor) and the pectoralis minor.

The three heads of the deltoids help create shoulder abduction, flexion and extension and do not really contribute to shoulder joint stability.

58.

When a person is stretching, what do muscle spindles trigger in an attempt to stop further stretching?

Stretch reflex

Reciprocal inhibition

Mechanoreceptor reflex

Correct answer: Stretch reflex

Muscle spindles are proprioceptors located within muscle fibers that send a signal to the brain when a muscle is being stretched quickly. This signal triggers the stretch reflex, where the muscle contracts in an attempt to stop further stretching of the muscle.

When stretching, the aim is to avoid triggering of the stretch reflex because motion will then be limited and damage can occur if the stretch continues. The slower the stretch, the less likely the muscle spindles will be activated.

59.

Richard is performing heavy back squats, and on his third and final repetition he leans forward more than on his other two reps. Where would there lie the greatest amount of torque while in a leaning-forward position?

Lumbar spine

Cervical spine

Thoracic spine

Correct answer: Lumbar spine

Torque while performing a back squat has to do with the position of the torso. We are observing the moment arm length; the farther the weight from the fulcrum, the larger the moment arm and the larger the torque value.

If the torso is in a more upright position, that means the horizontal distance from the weight to the lumbar spine is short, resulting in low torque for the lower back. If the torso is leaned forward, the horizontal distance between the lower back and the weight is large, larger than that of the thoracic spine and cervical spine. This large horizontal distance between the weight and the lumbar spine (the moment arm) results in a high torque value and puts the athlete at risk for injury to that area.

60.

Which of the following is **not** one of the three major categories of muscle fiber types?

Slow glycolytic

Slow oxidative

Fast oxidative glycolytic

Fast glycolytic

Correct answer: Slow glycolytic

Slow glycolytic fibers do not exist as a category; this is a misnomer since glycolysis is a process that generates energy without oxygen and is typically associated with fast-twitch muscle fibers (fast glycolytic).

Muscle fibers can be categorized based on their contraction speed and metabolic capabilities, which are crucial for different types of physical activities. The three primary types of muscle fibers recognized are slow oxidative, fast oxidative glycolytic, and fast glycolytic. These fibers vary in their speed of contraction and how they produce energy:

- *Slow Oxidative (Type I) fibers are known for their endurance. They contract slowly, allowing you to perform activities like long-distance running without tiring quickly. These fibers are highly efficient at using oxygen to generate energy for sustained activity.*
- *Fast Oxidative Glycolytic (Type IIa) fibers are a hybrid of sorts. They can contract more quickly than slow oxidative fibers and can use both aerobic (with oxygen) and anaerobic (without oxygen) metabolism to create energy, making them versatile for activities that require both endurance and power, such as middle-distance running.*
- *Fast Glycolytic (Type IIb) fibers are your sprinters. They contract quickly, providing short bursts of power and speed but tire out quickly. They primarily use anaerobic metabolism to produce energy, making them less efficient at using oxygen.*

The above categorization reflects the fibers' metabolic pathways (oxidative for endurance and glycolytic for quick, powerful movements) and contraction speed.

61.

Activities such as resistance training that are high-intensity, and thus have a high power output, require a rapid rate of supplied energy and rely almost entirely on which energy system?

Phosphagen system

Glycolytic system

Oxidative system

Correct answer: Phosphagen system

The phosphagen, glycolytic, and oxidative energy systems differ in their ability to supply energy for activities of various intensities and durations. Exercise intensity is defined as a level of muscular activity that can be quantified in terms of power.

Activities such as resistance training that are high-intensity and thus have a high power output require a rapid rate of supplied energy and rely almost entirely on the energy supplied by the phosphagen system. Activities low in intensity, such as marathon running, rely on the oxidative system.

62.

What does the term *oxygen uptake* refer to?

The amount of oxygen consumed by the body's tissues

The amount of oxygen required during exercise

The amount of oxygen returned from the body's tissues to the heart

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Correct answer: The amount of oxygen consumed by the body's tissues

Oxygen uptake refers to the amount of oxygen consumed by the body's tissues. As exercise begins and increases in intensity, the tissues need more oxygen for energy. The higher the intensity of training, the higher the oxygen uptake within our cells.

Maximal oxygen uptake (maximal oxygen consumption) is the greatest amount of oxygen that can be used at the cellular level for the entire body. This is commonly referred to as VO_2 max and is widely used as measure of an individual's cardiorespiratory fitness level.

63.

When training special populations, increasing their maximal aerobic power is essential. How do we normally refer to maximal aerobic power?

VO2 max

Lactate threshold

Peak VO2

Correct answer: VO2 max

VO2 max is a measure of the maximum amount of oxygen taken in, transported to and used by the cells. It is often used as a measure of an individual's aerobic fitness level. The greater their VO2 max, the greater their fitness capability. The ability to take in and use more oxygen increases the amount of energy produced, enabling the individual to perform more work. VO2 max increases over time with consistent aerobic training.

VO2 peak is the highest amount of oxygen consumed during peak exercise.

64.

During the eccentric movement of the biceps curl exercise, the triceps brachii acts as which type of mover?

Antagonist

Agonist

Synergist

Stabilizer

Correct answer: Antagonist

During the eccentric phase of the biceps curl exercise, when the arm is extending and the biceps are lengthening under tension to control the descent of the weight, the triceps brachii acts as the antagonist. In muscle actions, the antagonist muscle is the one that opposes the primary mover (agonist) to provide balance, control, and precision to movements.

Here's a breakdown of the terms provided:

- ***Antagonist**: As the biceps muscle (the agonist) is actively lengthening to lower the weight, the triceps brachii opposes the biceps' action to control the speed of the movement and ensure joint stability.*
- ***Agonist**: The agonist is the primary muscle responsible for executing a specific movement. In the case of the biceps curl, the biceps brachii serves as the agonist during both the concentric (lifting) and eccentric (lowering) phases by contracting to lift the weight and controlling its descent, respectively.*
- ***Synergist**: Synergist muscles assist the agonist in performing a movement by adding extra force or by minimizing unwanted movement. During the biceps curl, muscles like the brachialis and brachioradialis act as synergists to aid in the flexion of the elbow.*
- ***Stabilizer**: Stabilizer muscles support the body or limbs to allow the agonist muscles to function effectively. In the biceps curl, muscles such as the rotator cuff group help stabilize the shoulder joint, while the core muscles may stabilize the torso during the exercise.*

During the eccentric movement of the biceps curl, where the arm is being straightened and the load is being lowered, the triceps brachii acts as the antagonist. It opposes the biceps brachii to help control the motion and maintain joint integrity,

highlighting the importance of balanced muscle actions in executing exercises safely and effectively.

65.

According to anatomical structure differences, who should be able to lift more weight in a bicep curl?

One whose tendons are inserted on the bone farther away from the joint center

One whose tendons are inserted on the bone closer to the joint center

One whose moment arm is shorter

Correct answer: One whose tendons are inserted on the bone farther away from the joint center

A person whose tendons are inserted on the bone farther away from the joint center has a longer moment arm. Because muscle force acts through a longer moment arm, this person should be able to lift more weight.

66.

Which anatomical plane figuratively divides the body into right and left halves?

Sagittal

Frontal

Transverse

Correct answer: Sagittal

There are three planes, the sagittal, frontal, and transverse planes, which divide the body into right-left, front-back, and upper-lower sections, respectively.

They can be very useful for strength coaches in describing body movements and making the work of anatomical structures understandable.

67.

Which type of athlete would most likely have the highest mitochondrial density?

Marathon runner

Sprinter

Baseball player

Correct answer: Marathon runner

Mitochondria are organelles within muscle cells that create energy aerobically. The more aerobically trained you are, the more mitochondria you have.

Anaerobic athletes possess lower numbers of mitochondria because they rely on anaerobic metabolism, so fewer mitochondria are in their working muscles.

Comparing the marathon runner, the sprinter and the baseball player, the marathon runner will have higher aerobic fitness and therefore have higher mitochondrial density.

68.

The biceps brachii, an elbow flexor, also contributes to what movement at the shoulder joint?

Flexion

Extension

Abduction

Adduction

Correct answer: Flexion

The biceps brachii works with the brachialis and the brachioradialis to create elbow flexion (bending the elbow). In addition, the biceps brachii also contributes to shoulder flexion—bringing the arm up and forward. The other muscles that create shoulder flexion are the pectoralis major in the chest and the anterior deltoid in the front of the shoulder.

69.

What must pyruvate be converted to when entering the mitochondria and heading to the Krebs cycle?

Acetyl-CoA

Lactate

H+

Correct answer: Acetyl-CoA

At lower intensities of exercise, the mitochondria become involved in the production of ATP for energy. The process of aerobic metabolism begins with glycolysis and continues with what is known as the Krebs cycle. The end of glycolysis results in pyruvate, and in order to be shuttled into the mitochondria and used in the Krebs cycle, pyruvate must first be converted to Acetyl-CoA. This process is done by the pyruvate dehydrogenase complex. After pyruvate converts to Acetyl-CoA, it can enter the Krebs cycle.

70.

Which structural firefighter task primarily uses the ATP/CP system?

Ladder raise

Victim drag

Stair climb

Hose operation

Correct answer: Ladder raise

Structural firefighting tasks are classified into three different categories, depending on which energy system is primarily used for each task. The ladder raise and other high intensity tasks that last 10 seconds or less primarily rely on the ATP/CP system.

A victim drag relies on the glycolytic system and the stair climb and hose operation most often rely on the oxidative system for energy.

71.

What physiological adaptation might we see after consistent blood doping?

Increased red blood cell production

Increased blood lactate in submaximal exercise

Decrease in oxygen carried to working muscles during submaximal exercise

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Correct answer: Increased red blood cell production

Blood doping is performed illegally by athletes who hope to deliver more oxygen to working muscles during competition. Doping can be done by infusion of an individual's own red blood cells, or another person's, or erythropoietin (EPO).

As a result of doping, the belief is that more oxygen can be delivered to working muscles due to the increase in red blood cells and hemoglobin, which can potentially lead to higher levels of performance. However, this result has not been proven definitively, and doping carries greater risks for thrombosis and hypertension.

72.

Daniel is performing a barbell deadlift for ten repetitions. What type of muscle action are his abdominals performing?

Isometric

Eccentric

Concentric

Correct answer: Isometric

There are three basic types of muscle actions: concentric, eccentric, and isometric.

Isometric muscle actions occur when the muscle length does not change because the contractile force is equal to the resistive force.

During a deadlift, the hamstrings are eccentrically lengthening while the abdominals are staying still and keeping the torso rigid throughout the entire exercise. This indicates the abdominals are performing an isometric muscle action.

73.

Which of the following provides sensory feedback to the CNS so that it can elicit the proper amount of muscle contractile force to overcome the resistance placed upon the muscle?

Golgi Tendon Organ

Sarcomere

Neuromuscular filament

Second class lever

Correct answer: Golgi Tendon Organ

The Golgi Tendon Organ (GTO) plays a crucial role in providing sensory feedback to the Central Nervous System (CNS) regarding the tension developed in muscles. This feedback mechanism is essential for the CNS to regulate and adjust the contractile force of muscles, ensuring that the force produced is appropriate for overcoming any resistance encountered. The GTOs are proprioceptive sensory receptors located at the junction of muscle and tendon, and they sense changes in muscle tension rather than length, helping to prevent muscle damage from excessive force.

Here's a brief overview of the provided options and why the golgi tendon organ is the correct answer:

- ***Golgi Tendon Organ**: This is the correct answer because it specifically senses and responds to changes in muscle tension. When the tension reaches a high level, GTOs send inhibitory signals to the CNS to reduce muscle contraction, thereby preventing potential damage. This feedback loop allows for the fine-tuning of muscle force output.*
- ***Sarcomere**: This is the smallest functional unit within a muscle fiber responsible for muscle contraction. Sarcomeres do not directly provide sensory feedback to the CNS but are involved in the mechanical action of muscle contraction through the sliding filament theory.*
- ***Neuromuscular filament**: This term is not standard in physiology. Neuromuscular refers to the interaction between nerves and muscles, often in the context of the neuromuscular junction where nerve impulses trigger muscle contractions. Filaments (actin and myosin) are part of the sarcomere structure involved in contraction, not sensory feedback.*
- ***Second class lever**: This term describes a type of lever system in biomechanics, where the load lies between the effort and the fulcrum. Lever systems explain how forces are applied and movements are generated in the*

body, but they do not provide sensory feedback to the CNS about muscle contractile force.

The golgi tendon organ is uniquely responsible for monitoring and providing feedback on muscle tension to the CNS, enabling the adjustment of muscle contractile force to safely and effectively manage and overcome resistance.

74.

An action potential signals the release of which of the following in order to stimulate a muscle contraction?

Calcium

Actin

Magnesium

Correct answer: Calcium

An action potential is a nerve impulse that stimulates muscle contraction. The discharge of an action potential through a motor nerve to the neuromuscular junction signals the release of calcium from the sarcoplasmic reticulum into the myofibril. This leads to tension development in muscle, and results in muscle contraction.

75.

What are the regulatory proteins in myofilaments that play a role in the sliding filament mechanism?

Troponin and tropomyosin

Actin and myosin

Myosin and troponin

Actin and tropomyosin

Correct answer: Troponin and tropomyosin

The sliding filament mechanism, which underlies muscle contraction, involves several key proteins within the muscle fibers. Among these, troponin and tropomyosin are the regulatory proteins that play a crucial role in this process. Tropomyosin blocks the myosin-binding sites on actin molecules, preventing muscle contraction in a relaxed state. Troponin binds to calcium ions, which causes a conformational change in tropomyosin, exposing the myosin-binding sites on actin and allowing muscle contraction to occur.

The other pairs of proteins mentioned have different roles in the muscle contraction process:

- ***Actin and myosin**: These are the main contractile proteins involved in muscle contraction. Actin forms the thin filaments, and myosin forms the thick filaments. The interaction between actin and myosin, facilitated by the regulatory proteins troponin and tropomyosin, is what drives the muscle contraction process.*
- ***Myosin and troponin**: While myosin is a contractile protein and troponin is a regulatory protein, they do not form a pair in the context of regulatory roles in the sliding filament mechanism. Myosin interacts with actin to generate force, while troponin regulates this interaction by responding to calcium levels.*
- ***Actin and tropomyosin**: Although both actin and tropomyosin are found on the thin filament, actin is a contractile protein, and tropomyosin is a regulatory protein. This option does not correctly pair the two regulatory proteins involved in the sliding filament mechanism.*

Troponin and tropomyosin are the regulatory proteins that directly control the sliding filament mechanism by regulating the interaction between the contractile proteins actin and myosin, thus enabling or inhibiting muscle contraction.

76.

What is a potential hormone adaptation as a result of aerobic training?

Increased sensitivity to hormones

Decreased sensitivity to hormones

Decreased ability to meet metabolic demands of exercise

Correct answer: Increased sensitivity to hormones

Several potential adaptations are possible with aerobic and resistance training, including:

- *increased hormone sensitivity*
- *lowered increase of catecholamines and cortisol following exercise*
- *decrease in training stress when compared to an untrained individual*
- *increased ability to meet metabolic demands of exercise*

77.

What is the cause of peripheral fatigue that occurs during exercise?

Metabolic acidosis

Lactic acid

Pyruvate

Correct answer: Metabolic acidosis

The process of exercise-induced peripheral fatigue is caused by metabolic acidosis, which is the process of lowering the pH, which inhibits energy system turnover rate.

Although muscle fatigue experienced during exercise often correlates with high tissue concentrations of lactate, lactate is not the cause of fatigue. Lactate formation accumulates H+ ions, which in turn lowers the pH.

78.

During a rotational medicine ball throw, what plane is the torso moving through?

Transverse

Sagittal

Frontal

Correct answer: Transverse

There are three anatomical planes that can be used to describe movement patterns:

Sagittal: This plane divides the body into right and left halves. Movements along this plane are forward and backward, such as walking lunges.
Frontal: This plane divides the body into front and back halves. Movements in this plane are side to side, such as a side lunge and a lateral jump.
Transverse: This plane divides the body into top and bottom halves. Movements in this plane are rotational, such as a rotational medicine ball throw. Some movements occur in the transverse plane that don't involve torso rotation, such as the DB fly.

79.

An athlete continues to train despite feeling tired and not fueling his body properly. The trainer attempts to educate the athlete on the potential negative effects his actions may have on his body.

Which of the following is most likely to occur?

Catabolic effects may exceed anabolic effects

Anabolic effects may exceed catabolic effects

Muscle cell death

Correct answer: Catabolic effects may exceed anabolic effects

Remodeling of muscle tissue is predominantly done following an exercise session. Increases in actin and myosin along with decreases in protein degradation occur; however, if the stress is too high and the body is unable to adapt to the stress, it can have negative effects on the body. The anabolic effects post-exercise can be overshadowed by the catabolic effects if the stress reaches too high a level, and the testosterone to cortisol ratio decreases. Increased rest and recovery is necessary in this situation, along with possible referral to a medical professional.

80.

Which of the following is a kinesiological factor that influences an individual's mobility and flexibility?

Muscle origin and insertion

Age

Physical activity level

Body composition

Correct answer: Muscle origin and insertion

Kinesiological factors that affect an individual's mobility and flexibility are rooted in the structural and functional aspects of the musculoskeletal system. Among these factors, muscle origin and insertion play a crucial role.

The points at which muscles are attached to the bones, known as the origin (where the muscle begins) and insertion (where it ends), significantly influence how a muscle moves a joint and, consequently, an individual's range of motion and flexibility. The specific locations of these attachments determine the muscle's leverage and the movement's amplitude, directly impacting mobility and flexibility.

The other options, while important, are not kinesiological factors per se but rather external factors that can affect mobility and flexibility:

- ***Age**: Aging can affect mobility and flexibility due to changes in muscle elasticity, joint health, and the overall decrease in physical activity. However, it is more of a biological factor than a kinesiological one.*
- ***Physical activity level**: Regular physical activity can improve flexibility and mobility by keeping the muscles and joints conditioned. While highly influential, it's an environmental or lifestyle factor rather than a kinesiological one.*
- ***Body composition**: The ratio of fat mass to lean muscle mass can impact an individual's mobility and flexibility with excessive body fat potentially restricting movement. Like age and physical activity level, body composition is more of a physiological and lifestyle factor affecting mobility and flexibility.*

The origins and insertions of muscles are kinesiological factors directly influencing mobility and flexibility by determining how muscles can move the joints they are attached to. This structural aspect of the musculoskeletal system plays a foundational

role in an individual's ability to perform a wide range of movements with varying degrees of flexibility.

81.

If Josh is trying to improve his vertical jump, what resistance exercise should be implemented to enhance his ability?

Back squats

Box jumps

Power cleans

Correct answer: Back squats

When trying to improve one's ability in certain physical areas, specificity of training matters. Specificity holds that training is most effective when resistance exercises are similar to the activity in which improvement is sought. Performing a well-rounded group of exercises is great, but incorporating specific exercises to enhance one's ability in certain parameters is needed; joint range of motion in the training exercises should be at least as great as those in the target activity.

When examining the vertical jump, we notice flexion and extension of the hips, knees, and ankles. We want to pick an exercise that mimics those joint movements and attempt to strengthen the relevant muscles as best we can in order to see specific gains in our vertical jump. The back squat accomplishes that, taking our bodies through hip, knee, and ankle flexion and extension.

While power cleans and box jumps are appropriate exercises for power development, the question is asking for a resistance exercise, not a plyometric or power-specific option.

82.

Which of the following is **not** a symptom of overtraining?

Decreased blood pressure

Sleep disturbances

Moodiness

Correct answer: Decreased blood pressure

With overtraining, blood pressure will actually increase, potentially due to altered hormonal concentrations and releasing of cortisol throughout the body. In addition to these things, fatigue, menstrual changes, decreased motor control, decrease in force production, and sickness/infection are all possible symptoms of overtraining.

83.

Which of the following is an example of a flat bone?

The bones of the skull

The patella

The fibula

Correct answer: The bones of the skull

There are about 206 bones in the body, all connecting in some fashion to create various joints.

There are four categories of bones: long, short, flat and irregular.

The bones of the vertebrae and the pelvis are classified as irregular bones, while the arm and leg bones are long bones. The patella and the bones of the wrists and ankles are short bones.

Flat bones are thin and curved in addition to being flat. The bones of the skull are flat bones.

84.

During a biceps curl, what point throughout the range of motion would have the largest torque value?

When the forearm is parallel to the ground

When the weight is at its lowest position

When the weight is at its highest position

Correct answer: When the forearm is parallel to the ground

Torque is the degree to which a force tends to rotate an object about a specified fulcrum. Moment arm is the perpendicular distance from the line of action of the force to the fulcrum.

Torque is defined as the magnitude of a force times the length of its moment arm. Since the weight of the barbell stays the same throughout the motion, determining what position has the longest moment arm will give you the highest torque measurement. In a biceps curl, this position is when the forearm is parallel with the ground.

85.

The myocardium is part of what structure?

Heart muscle

Skeletal muscle

Shoulder muscle

Correct answer: Heart muscle

The myocardium is the muscular tissue of the heart that makes up the heart walls. These walls relax and contract to push blood through the heart to the rest of the body. These repetitive contractions of the heart are heartbeats and are regulated and stimulated by the heart's conduction system using electrical signals.

86.

A tactical athlete has been overtraining and is being evaluated by a medical professional. Which of the following hormones might you see an increase of as a result of overtraining?

Cortisol

Testosterone

Maximal exercise capacity

Correct answer: Cortisol

Many hormonal shifts and imbalances can occur due to overtraining. Decreases in testosterone and insulin growth factor-1 have been seen, as well as increases in cortisol levels. These changes can indicate a stress response.

Other physiological markers include a decreased maximal or submaximal exercise capacity.

87.

An athlete eats a small snack prior to an intense workout with his strength and conditioning coach. Which type of glycogen is most important for high-intensity activity?

Muscle glycogen

Liver glycogen

Dietary glycogen

Correct answer: Muscle glycogen

Glycogen is stored in muscle tissue as well as in the liver. The intensity and duration of activity dictates which will provide the fuel for the body.

Muscle glycogen is a more important energy source than liver glycogen during short-term, high-intensity exercise. Liver glycogen is utilized during low-intensity and longer-duration exercise.

88.

Which of the following is responsible for building bone tissue?

Osteoblasts

Osteoclasts

Osteocytes

Osteons

Correct answer: Osteoblasts

Although bones make up the structure and framework of the human body, bone tissue is living tissue and is constantly breaking down old bone tissue and rebuilding new bone tissue. Osteoclasts are responsible for breaking down (resorbing) bone tissue, while osteoclasts deposit mineral and create new bone tissue.

Osteocytes are mature bone cells that exist in bone tissue, while the osteon is a cylinder that is made up of osteocytes and a bone mineral matrix.

89.

During aerobic exercise, what measure is increasing as intensity increases?

Minute ventilation

Vasoconstriction

Diastolic blood pressure

Correct answer: Minute ventilation

Minute ventilation, the volume of air breathed per minute, increases as aerobic intensity increases. With increased intensity, there are significant increases in oxygen delivered to working tissues, in carbon dioxide returned to lungs, and in minute ventilation.

Minute ventilation increases during higher frequencies of breathing, depth of breathing, or both.

Diastolic blood pressure is generally unchanged in healthy adults during aerobic exercise. Also, during aerobic exercise, the body experiences vasodilation, not vasoconstriction, in the working muscles.