Arizona State University (ASU) BIO201 Human Anatomy and Physiology I Exam 3 Practice (Sample)

Study Guide

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Questions

1. What is the process by which a single synapse receives many EPSPs in a short period of time called?

   A. Temporal summation

   B. Spatial summation

   C. Synaptic plasticity

   D. Neurotransmitter release

2. What is rigor mortis?

   A. A condition where muscles remain relaxed after death

   B. A temporary paralysis of the muscles

   C. A hardening of muscles beginning a few hours after death

   D. An involuntary muscle contraction during sleep

3. What is considered a motor unit?

   A. One nerve and multiple muscle fibers

   B. Multiple nerves innervating one muscle fiber

   C. All muscles of the body

   D. All nerve fibers in the spinal cord

4. What happens to muscle tension when a muscle is overly contracted before stimulation?

   A. The muscle generates maximum tension

   B. The muscle exerts no tension

   C. The muscle generates weak tension

   D. The muscle works normally

5. What neurotransmitter's deficiency is noted in Alzheimer's disease?

   A. Dopamine

   B. Serotonin

   C. Acetylcholine (ACh)

   D. Norepinephrine

6. Excitatory postsynaptic potentials (EPSP) are characterized by what change?

A. A negative voltage increase

B. A positive voltage change

C. A decrease in cell membrane permeability

D. No change in resting potential

7. What type of training is characterized by the contraction of muscles against a load that resists movement?

A. Endurance training

B. Resistance training

C. Aerobic training

D. High-intensity interval training

8. During muscle contraction, what happens after calcium is released from the terminal cisternae?

A. Calcium binds to myosin heads

B. Calcium binds to troponin

C. Calcium is pumped back into the extracellular space

D. Calcium levels remain unchanged

9. During which phase of a twitch contraction does the muscle experience a short delay after stimulation?

A. Contraction

B. Relaxation

C. Latent

D. Tetanus

10. Which of the following muscles is an example of a large motor unit?

A. Eye muscles

B. Hand muscles

C. Gastrocnemius

D. Facial muscles

Answers

1. A
2. C
3. A
4. C
5. C
6. B
7. B
8. B
9. C
10. C

Explanations

1. What is the process by which a single synapse receives many EPSPs in a short period of time called?

A. Temporal summation

B. Spatial summation

C. Synaptic plasticity

D. Neurotransmitter release

The process described, where a single synapse receives multiple excitatory postsynaptic potentials (EPSPs) within a short timeframe, is known as temporal summation. This phenomenon occurs when successive signals arriving at the same synapse contribute to a cumulative effect. If these EPSPs occur close enough together in time, their amplitudes can add together, potentially reaching the threshold needed to trigger an action potential in the postsynaptic neuron. Temporal summation highlights the importance of the timing of synaptic inputs and demonstrates how rapid successive stimulation at a synapse can enhance neuronal communication. This process is crucial for the integration of synaptic signals, allowing for dynamic responses to stimuli. It contrasts with spatial summation, which involves the simultaneous input of EPSPs from multiple synapses located on the same neuron, and the other options mentioned pertain to different aspects of synaptic function or neurotransmission rather than the specific accumulation of EPSPs over time.

2. What is rigor mortis?

A. A condition where muscles remain relaxed after death

B. A temporary paralysis of the muscles

C. A hardening of muscles beginning a few hours after death

D. An involuntary muscle contraction during sleep

Rigor mortis is a well-documented physiological process that occurs after death, characterized by the stiffening of the body's muscles. This process begins several hours post-mortem, typically around 2 to 6 hours after death, as biochemical changes occur in the muscle tissues. After the cessation of life, ATP (adenosine triphosphate) production stops, which is necessary for muscle relaxation. Without ATP, myosin heads remain bound to actin filaments, leading to a sustained contraction and stiffness in the muscles. This condition can persist for up to 24 to 48 hours before ultimately resolving as the tissues begin to decompose. Understanding rigor mortis is crucial for forensic science and medicine, as it serves as an important indicator of the time of death and can assist in determining post-mortem intervals in criminal investigations or medical examinations. The other options describe situations that do not accurately represent rigor mortis, which is specifically about the stiffening phenomenon following death.

3. What is considered a motor unit?

A. One nerve and multiple muscle fibers

B. Multiple nerves innervating one muscle fiber

C. All muscles of the body

D. All nerve fibers in the spinal cord

A motor unit is defined as a single motor neuron and all the muscle fibers it innervates. This concept is crucial for understanding how muscle contractions are initiated and controlled within the body. When a motor neuron sends an electrical impulse, it activates all the muscle fibers associated with that particular neuron, leading to contraction. This organization allows for precise control of muscle movement, as different motor units can be activated independently depending on the force needed for a specific action. While the other options describe different aspects of muscle and nerve interactions, they do not accurately capture the definition of a motor unit. The relationship between a single nerve and the multiple muscle fibers it controls is essential for coordinated movement and force generation in muscles.

4. What happens to muscle tension when a muscle is overly contracted before stimulation?

A. The muscle generates maximum tension

B. The muscle exerts no tension

C. The muscle generates weak tension

D. The muscle works normally

When a muscle is overly contracted before stimulation, it is in a position where the actin and myosin filaments overlap excessively, leading to less effective cross-bridge formation. This structural arrangement decreases the muscle's ability to generate force effectively. In this overly contracted state, the sarcomeres are compressed, which limits the sliding motion that is essential for muscle contraction. As a result, when stimulation occurs, the muscle is unable to exert the maximum tension that would be possible if it were at a more optimal length. Consequently, this results in relatively weak tension being produced during contraction. This phenomenon is explained by the length-tension relationship in muscle physiology, where there is an optimal length for generating maximal force, and both overly stretched and overly contracted states lead to diminished tension production.

5. What neurotransmitter's deficiency is noted in Alzheimer's disease?

A. Dopamine

B. Serotonin

C. Acetylcholine (ACh)

D. Norepinephrine

In Alzheimer's disease, the deficiency of acetylcholine (ACh) plays a significant role in the cognitive decline and memory loss associated with this condition. Acetylcholine is a crucial neurotransmitter involved in various brain functions, particularly in the areas related to attention, memory, and learning. Research has shown that the levels of acetylcholine are notably reduced in the brains of individuals suffering from Alzheimer's disease. This decline in ACh is linked to the degeneration of cholinergic neurons, which are responsible for producing and releasing acetylcholine. The impact of ACh deficiency is evident as patients experience difficulties in forming new memories and retrieving existing ones, which are hallmark symptoms of Alzheimer's. In understanding the importance of neurotransmitters, it's also valuable to recognize that other neurotransmitters like dopamine, serotonin, and norepinephrine, while they have their own significant roles in mood, arousal, and other functions, are not the primary contributors to the cognitive symptoms observed in Alzheimer's disease. Instead, the stark decrease in acetylcholine correlates heavily with the pathological features and symptoms of this neurodegenerative disorder.

6. Excitatory postsynaptic potentials (EPSP) are characterized by what change?

A. A negative voltage increase

B. A positive voltage change

C. A decrease in cell membrane permeability

D. No change in resting potential

Excitatory postsynaptic potentials (EPSPs) are characterized by a positive voltage change in the postsynaptic neuron. This occurs when neurotransmitters bind to receptors on the postsynaptic membrane and lead to the opening of sodium ion channels. As sodium ions (Na+) flow into the neuron, the inside of the neuron becomes less negative (or more positive) relative to the outside. This depolarization moves the membrane potential closer to the threshold for generating an action potential, increasing the likelihood that the neuron will fire an action potential. This positive voltage change is crucial for the processes of synaptic transmission and neuronal communication. By facilitating depolarization, EPSPs play a key role in the integration of synaptic signals, helping to determine whether a neuron will respond to incoming stimuli. Thus, the characteristic of a positive voltage change is fundamental to understanding how excitatory signals influence neuronal activity.

7. What type of training is characterized by the contraction of muscles against a load that resists movement?

A. Endurance training

B. Resistance training

C. Aerobic training

D. High-intensity interval training

Resistance training is characterized by the contraction of muscles against a load that resists movement. This type of training aims to improve muscular strength, power, and endurance by using weights, resistance bands, or body weight to create resistance during exercises. When muscles contract against this load, it leads to micro-tears in the muscle fibers, which then repair and grow stronger during recovery. This process not only enhances muscle size and strength but also increases bone density and metabolic rate. Endurance training primarily focuses on improving cardiovascular fitness and stamina over extended periods, typically involving activities like running or cycling at a moderate intensity without significant resistance. Aerobic training is similar, emphasizing sustained and rhythmic activities that rely on oxygen for energy. High-intensity interval training involves short bursts of intense exercise followed by rest or lower intensity, but it does not specifically emphasize the load-bearing aspect of muscle contraction like resistance training does.

8. During muscle contraction, what happens after calcium is released from the terminal cisternae?

A. Calcium binds to myosin heads

B. Calcium binds to troponin

C. Calcium is pumped back into the extracellular space

D. Calcium levels remain unchanged

During muscle contraction, once calcium is released from the terminal cisternae of the sarcoplasmic reticulum, it plays a crucial role by binding to troponin. This binding of calcium to troponin induces a conformational change in the troponin complex, which is part of the thin filament of the muscle fiber. As a result, this change alters the position of tropomyosin, another regulatory protein, allowing the myosin heads on the thick filaments to interact with actin, which is essential for muscle contraction to occur. This process is key in enabling the cross-bridge cycle, leading to muscle shortening and contraction. In understanding this process, it's important to note that myosin heads do not directly bind calcium; rather, their action is mediated through the changes initiated by calcium binding to troponin. Additionally, once contraction is complete and calcium levels need to return to baseline, calcium is actively pumped back into the sarcoplasmic reticulum or out of the cell, rather than remaining unchanged or moving into the extracellular space immediately after its release.

9. During which phase of a twitch contraction does the muscle experience a short delay after stimulation?

A. Contraction

B. Relaxation

C. Latent

D. Tetanus

The phase during which the muscle experiences a short delay after stimulation is known as the latent period. This period occurs right after the muscle fibers have been stimulated but before any visible contraction takes place. During the latent phase, the action potential travels along the sarcolemma and into the muscle fibers via T-tubules, leading to the release of calcium ions from the sarcoplasmic reticulum. It is this release of calcium that triggers the contraction process. This initial delay is crucial because it allows the necessary biochemical processes to occur before the muscle begins to contract. Understanding this phase is important in the study of muscle physiology, as it highlights the time required for the excitation-contraction coupling process to begin.

10. Which of the following muscles is an example of a large motor unit?

A. Eye muscles

B. Hand muscles

C. Gastrocnemius

D. Facial muscles

The gastrocnemius muscle serves as an example of a large motor unit due to its role in producing powerful movements, specifically during activities like running and jumping. Large motor units are characterized by a higher number of muscle fibers innervated by a single motor neuron, which enables the generation of greater force. The gastrocnemius, being one of the primary muscles in the calf, is associated with activities that require significant force and strength, thus it comprises larger motor units to effectively support these demanding movements. In contrast, muscles such as the eye muscles and hand muscles consist of small motor units. These small motor units allow for fine motor control and precision movements, which are essential for tasks like tracking visual stimuli and manipulating small objects. Facial muscles also typically contain smaller motor units, enabling subtle and intricate facial expressions. The distinction between large and small motor units is critical in understanding how different muscles perform their respective functions based on the demands of the activity.