Basic Principles of Electricity and Electrical Stimulating Currents Practice Test (Sample)

Study Guide

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Questions

1. During which phase does no relaxation of the tissue occur?

- **A. During continuous current**
- **B. During interpulsed intervals**
- **C. During direct current application**
- **D. During alternating current application**

2. What does Ohm's Law state?

- **A. Current equals voltage times resistance**
- **B. Voltage equals current times resistance**
- **C. Power equals voltage divided by resistance**
- **D. Resistance equals voltage divided by current**

3. What does long duration depolarization primarily result in?

- **A. Quick muscle twitch**
- **B. Fatigue in muscle response**
- **C. Prolonged pain sensation**
- **D. Muscle relaxation**

4. Which type of waveform is typically used for muscle stimulation?

- **A. Sine wave**
- **B. Square wave**
- **C. Rectangular wave**
- **D. Triangular wave**

5. What is the primary characteristic of interpulsed intervals?

- **A. Patient can feel the current**
- **B. Current interruption that is imperceptible**
- **C. High voltage application**
- **D. Continuous electrical stimulation**

6. What is the characteristic of PC current?

- **A. It flows continuously in one direction**
- **B. It is always of the same phase**
- **C. It is monphasic or biphasic, interrupted at regular intervals**
- **D. It only affects motor nerves**

7. In a parallel circuit, what happens to the total resistance as more resistors are added?

A. The total resistance increases

B. The total resistance remains the same

C. The total resistance decreases

D. The total resistance fluctuates

8. What sensation is typically associated with the depolarization of A-Delta and C fibers?

A. Pain

B. Tingling

C. Muscle contraction

D. Relaxation

9. Which nerves are depolarized second and are responsible for contracting muscles?

A. A-Delta fibers

B. B fibers

C. Motor fibers

D. C fibers

10. What is the effect of increasing the frequency of electrical stimulation on muscle contraction?

A. Causes the contraction to weaken

B. Causes the contraction to become stronger

C. Has no effect

D. Causes relaxation of the muscle

Answers

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

Explanations

1. During which phase does no relaxation of the tissue occur?

A. During continuous current

B. During interpulsed intervals

C. During direct current application

D. During alternating current application

The phase during which no relaxation of the tissue occurs is during the interpulsed intervals. In this context, the interpulsed interval refers to the time period between the pulses of electrical stimulation. During this interval, the electrical current is not applied, allowing the tissue to start relaxing from the previous stimulation. However, since relaxation does not occur continuously through this duration and instead requires distinct periods of rest, it is important to denote that the stimulation process actively influences the tissue's activity. In contrast, during continuous current or direct current application, the current flows consistently without interruption, leading to prolonged activation of the tissue. This constant stimulation can result in fatigue and may not allow for adequate relaxation between stimulation events. Alternating current also creates periods of stimulation, but since it alternates in direction, it typically allows for some physiological response that may facilitate relaxation at certain cycles, even if only briefly. Therefore, the absence of relaxation is effectively illustrated during the distinct phases of stimulation and rest, particularly during the interpulsed intervals where no electrical current is applied, indicating that tissue recovery processes may begin but do not fully manifest until subsequent stimulations are halted.

2. What does Ohm's Law state?

A. Current equals voltage times resistance

B. Voltage equals current times resistance

C. Power equals voltage divided by resistance

D. Resistance equals voltage divided by current

Ohm's Law is a fundamental principle in electrical circuits that defines the relationship between voltage, current, and resistance. The law specifically states that the voltage (V) across a conductor is directly proportional to the current (I) flowing through it, given that the temperature and material properties remain constant. This relationship can be mathematically expressed as $V = I \times R$, where R represents resistance. Thus, the correct interpretation aligns with the understanding that voltage equals current multiplied by resistance. This is crucial in circuit analysis, as it allows for the calculation of one parameter if the other two are known. Understanding this relationship helps in various applications, such as designing circuits and troubleshooting electrical systems. In practice, Ohm's Law is widely used to ensure that electrical systems are operating correctly and safely.

3. What does long duration depolarization primarily result in?

A. Quick muscle twitch

B. Fatigue in muscle response

C. Prolonged pain sensation

D. Muscle relaxation

Long duration depolarization primarily results in fatigue in muscle response because it leads to a sustained activation of muscle fibers. When a muscle is stimulated for an extended period, it often cannot maintain its force due to a depletion of energy sources and the accumulation of metabolic byproducts, such as lactic acid. This prolonged activation causes the muscle to become less responsive and can lead to a decrease in the efficiency of muscle contractions, resulting in fatigue. The other options do not accurately describe the primary outcome of long-duration depolarization. Quick muscle twitch refers to short, rapid contractions, which are not the result of prolonged stimulation. Prolonged pain sensation may occur in different contexts but is not directly linked to the effects of long-duration depolarization. Muscle relaxation typically results from cessation of stimulation, rather than from prolonged depolarization, making fatigue the most fitting outcome.

4. Which type of waveform is typically used for muscle stimulation?

A. Sine wave

B. Square wave

C. Rectangular wave

D. Triangular wave

The square wave is commonly used for muscle stimulation due to its ability to deliver a consistent and defined pulse duration which can effectively activate muscle fibers. This waveform has a sharp transition from low to high voltage, providing a rapid rise and fall that can encourage more effective muscle contractions. The characteristics of a square wave, including its consistent frequency and amplitude, make it ideal for generating the repetitive electrical stimuli needed for therapeutic muscle engagement and strengthening. Other waveform types, such as sine waves or triangular waves, typically have more gradual changes in voltage, which may not produce the rapid and efficient muscle contractions that a square wave can achieve. Rectangular waves, while similar to square waves, often differ in their duty cycles and rise/fall times which can influence the muscle response differently. Thus, the square wave remains the preferred choice for direct muscle stimulation in therapeutic and rehabilitative contexts.

5. What is the primary characteristic of interpulsed intervals?

A. Patient can feel the current

B. Current interruption that is imperceptible

C. High voltage application

D. Continuous electrical stimulation

The primary characteristic of interpulsed intervals is that they represent current interruption that is imperceptible. In the context of electrical stimulation, interpulsed intervals allow the current to have brief pauses between pulses, which can result in a more physiological response while still maintaining the perception of continuous stimulation. These intervals are designed so that the patient does not feel the interruption of current; instead, the overall sensation remains smooth and continuous. This characteristic is crucial in therapeutic applications, as it helps to minimize discomfort and allows for a more effective treatment without overwhelming the sensory nerves, thereby promoting comfort and compliance during electrical stimulation procedures. In comparison, the other options, such as feeling the current, high voltage applications, or continuous electrical stimulation, do not accurately describe the nature of interpulsed intervals, as they either involve different types of sensations or methodologies that are outside the purview of this specific characteristic.

6. What is the characteristic of PC current?

A. It flows continuously in one direction

B. It is always of the same phase

C. It is monphasic or biphasic, interrupted at regular intervals

D. It only affects motor nerves

The characteristic of PC current being monophase or biphasic and interrupted at regular intervals is correct because it describes the nature of pulsatile currents used in various therapeutic applications. PC, or pulsed current, is known for delivering current in discrete pulses rather than a continuous stream, allowing for better control over the effects of electrical stimulation on tissues. This interruption of current is essential in clinical settings, as it can prevent tissue fatigue and enhance patient comfort while still providing effective stimulation for muscle contraction or pain relief. Understanding that PC current can be either monophase, where the pulses only flow in one direction, or biphasic, where pulses alternate directions, is crucial for practitioners when selecting the appropriate stimulation method based on the desired therapeutic outcome. The regular intervals of interruption also play a vital role in the physiological response elicited by the current, making this characteristic central to its effective application in treatments.

7. In a parallel circuit, what happens to the total resistance as more resistors are added?

A. The total resistance increases

B. The total resistance remains the same

C. The total resistance decreases

D. The total resistance fluctuates

In a parallel circuit, the total resistance decreases as more resistors are added. This occurs because each additional resistor provides an alternative pathway for the current to flow. When resistors are connected in parallel, the overall conductivity of the circuit increases, allowing more current to pass through. The formula for calculating total resistance (R_total) in a parallel circuit is given by: 1/R_total = 1/R1 + 1/R2 + 1/R3 + ... As you add more resistors (R2, R3, etc.), the sum of the reciprocals of their resistances increases. Consequently, this leads to a decrease in the total resistance. In fact, the total resistance will always be less than the smallest individual resistor in the parallel network. Thus, as resistors are added in parallel, the ability of the circuit to conduct electricity improves, supporting the idea that total resistance decreases with the addition of resistors.

8. What sensation is typically associated with the depolarization of A-Delta and C fibers?

A. Pain

B. Tingling

C. Muscle contraction

D. Relaxation

The sensation typically associated with the depolarization of A-Delta and C fibers is pain. A-Delta fibers are responsible for transmitting sharp, acute pain sensations and also convey information about temperature and touch, while C fibers transmit dull, throbbing, or chronic pain sensations. Tingling sensations are more often related to other types of nerve activity or stimulation, often associated with sensory nerve fibers that might not directly relate to the pain pathways. Muscle contractions and relaxation pertain more to motor fibers and do not specifically connect to the sensory experiences conveyed by A-Delta and C fibers. Thus, the identification of pain as the sensation is essential, as it directly correlates with the function of these fibers in transmitting pain signals to the brain.

9. Which nerves are depolarized second and are responsible for contracting muscles?

A. A-Delta fibers

B. B fibers

C. Motor fibers

D. C fibers

Motor fibers are essential for initiating muscle contraction, as they are specifically designed to carry signals from the central nervous system (CNS) directly to muscle tissues. When these fibers become depolarized, they trigger action potentials that lead to the release of neurotransmitters at the neuromuscular junction. This process ultimately results in muscle contraction. Motor fibers, also known as alpha motor neurons, are highly specialized neurons enabling voluntary movement by connecting with skeletal muscles. Their primary role is to ensure that the correct muscles contract at the right time, enabling coordinated movement. This differentiates them from sensory fibers and autonomic fibers, which have different functions in the body's nervous system. The other types of fibers mentioned serve different purposes. For example, A-Delta fibers are involved in transmitting sharp pain signals, B fibers typically conduct autonomic functions, and C fibers convey dull, aching pain sensations. These functionalities do not relate directly to muscle contraction, reinforcing the significance of motor fibers in this context.

10. What is the effect of increasing the frequency of electrical stimulation on muscle contraction?

A. Causes the contraction to weaken

B. Causes the contraction to become stronger

C. Has no effect

D. Causes relaxation of the muscle

Increasing the frequency of electrical stimulation typically leads to a stronger muscle contraction, a phenomenon often referred to as summation or tetanization. When stimulation occurs at a low frequency, individual muscle twitches are observed, and there is time for the muscle to relax between contractions. However, as the frequency increases, the muscle does not have adequate time to fully relax, resulting in a more sustained and forceful contraction. This build-up of tension occurs because the successive stimuli lead to increased calcium ion concentration in the muscle fibers, which engages more of the contractile elements within the muscle. This effect is utilized in various therapeutic and training applications, where higher frequencies can be employed to maximize muscle engagement and strength. The physiological basis for this response lies in the mechanics of muscle fiber activation, where more frequent signals reinforce the contractile activity, fostering improved muscle performance.