MATCHING

Match each description with the term that correctly identifies the generation and conduction of the nerve impulse stage. Terms may be used more than once.

a. Polarization
b. Slow depolarization
c. Rapid depolarization
d. Repolarization
e. Relative refractory period
f. Absolute refractory period

1. During this stage, the second action potential is inhibited but not impossible should a larger stimulus be applied.
2. The nerve is stimulated by the minimal threshold level.
3. The electrical potential of the neuron is approximately –70 mV.
4. During this stage, the electrical charge on the outside of the membrane is positive, while the electrical charge on the inside of the membrane is negative.
5. Occurs once the peak of the action potential is reached and the membrane potential begins to move back toward the resting potential.
6. The resting potential of the cell changes to become more negative, but not enough to trigger the firing threshold.
7. The interval during which a second action potential cannot be initiated, no matter how large a stimulus is applied.
8. The outside of the cell contains excess sodium ions at a ratio of 14:1; the inside of the cell contains excess potassium ions.
9. The gated Na^+ channels on the resting neuron's membrane release and open suddenly in order to allow the Na^+ in the extracellular fluid to influx into the cell.
10. The impulse moves between the uninsulated nodes of Ranvier that exist between each Schwann cell.

1. ANS: E DIF: Recall REF: 21| 23 OBJ: 8
   TOP: NBDHE, 2.0 Physiology
2. ANS: C DIF: Recall REF: 21 OBJ: 8
   TOP: NBDHE, 2.0 Physiology
3. ANS: A DIF: Recall REF: 20 OBJ: 5| 6
   TOP: NBDHE, 2.0 Physiology
4. ANS: A DIF: Recall REF: 20 OBJ: 8
   TOP: NBDHE, 2.0 Physiology
5. ANS: D DIF: Recall REF: 21 OBJ: 8
   TOP: NBDHE, 2.0 Physiology
6. ANS: B DIF: Comprehension REF: 21
   OBJ: 8 TOP: NBDHE, 2.0 Physiology
7. ANS: F DIF: Recall REF: 21| 23 OBJ: 7
   TOP: NBDHE, 2.0 Physiology
8. ANS: A DIF: Recall REF: 20 OBJ: 8
   TOP: NBDHE, 2.0 Physiology

9. ANS: C DIF: Recall REF: 21 OBJ: 8
   TOP: NBDHE, 2.0 Physiology
10. ANS: C DIF: Recall REF: 21 OBJ: 8
    TOP: NBDHE, 2.0 Physiology

MULTIPLE CHOICE

1. What are the nerves that conduct signals from sensory neurons to the spinal cord or brain called?
   a. Neurotransmitters
   b. Electrical synapses
   c. Afferent nerves
   d. Efferent nerves

   ANS: C
   The nerves that conduct signals from sensory neurons to the spinal cord or brain are called afferent nerves. Neurotransmitters are the endogenous chemicals that transmit signals from a neuron to a target cell across a synapse. Electrical synapses involve gap junctions that allow action potentials to move from cell to cell directly by allowing electrical current to flow between cells. Efferent nerves conduct signals away from the brain or spinal cord.

   DIF: Recall REF: 14 OBJ: 3 TOP: NBDHE, 2.0 Physiology

2. What are the endogenous chemicals that transmit signals from a neuron to a target cell across a synapse called?
   a. Neurotransmitters
   b. Electrical synapses
   c. Afferent nerves
   d. Efferent nerves

   ANS: A
   The endogenous chemicals that transmit signals from a neuron to a target cell across a synapse are called neurotransmitters. Electrical synapses involve gap junctions that allow action potentials to move from cell to cell directly by allowing electrical current to flow between cells. Afferent nerves conduct signals from sensory neurons to the spinal cord or brain. Efferent nerves conduct signals away from the brain or spinal cord.

   DIF: Recall REF: 21 OBJ: 7 TOP: NBDHE, 2.0 Physiology

3. What are the nerves that conduct signals away from the brain or spinal cord called?
   a. Neurotransmitters
   b. Electrical synapses
   c. Afferent nerves
   d. Efferent nerves

   ANS: D

The nerves that conduct signals away from the brain or spinal cord are called efferent nerves. The endogenous chemicals that transmit signals from a neuron to a target cell across a synapse are called neurotransmitters. Electrical synapses involve gap junctions that allow action potentials to move from cell to cell directly by allowing electrical current to flow between cells. Afferent nerves conduct signals from sensory neurons to the spinal cord or brain.

DIF: Recall REF: 14 OBJ: 3 TOP: NBDHE, 2.0 Physiology

4. Local anesthetic agents used in dentistry:
   a. Cause loss of nociception
   b. Prevent generation of a nerve impulse
   c. Prevent conduction of a nerve impulse
   d. All options listed

   ANS: D
   All options listed. A local anesthetic is a drug that causes reversible local anesthesia and a loss of nociception as a result of the depression of excitation in nerve endings or the inhibition of the conduction process in peripheral nerves. Local anesthetic agents used in dentistry prevent both generation and conduction of a nerve impulse.

   DIF: Recall REF: 11 OBJ: 9
   TOP: NBDHE, 2.0 Physiology| NBDHE, 6.0 Pharmacology| NBDHE, 3.0 Planning and Managing Dental Hygiene Care| NBDHE, 3.4 Anxiety and Pain Control

5. Tasks for neurons include receiving, processing, and sending information. They communicate with other neurons through axons and synapses.
   a. Both statements are true.
   b. Both statements are false.
   c. The first statement is true; the second statement is false.
   d. The first statement is false; the second statement is true.

   ANS: A
   Both statements are true. Tasks for neurons include receiving, processing, and sending information. They communicate with other neurons through axons and synapses.

   DIF: Recall REF: 12|13 OBJ: 5 TOP: NBDHE, 2.0 Physiology

6. What is another name for axons?
   a. Core bundles
   b. Mantle bundles
   c. Nerve fibers
   d. All options listed

   ANS: D
   All options listed. Axons are often referred to as nerve fibers. The nerve fibers that are bundled together and located near the outside of the nerve are called mantle bundles. The bundled nerve fibers located near the inside of the nerve are called core bundles.

   DIF: Comprehension REF: 13 OBJ: 4
   TOP: NBDHE, 2.0 Physiology

7. What is the most distal arborization of the nerve endings called?
   a. Dendritic zone
   b. Soma
   c. Axon hillock
   d. Output zone

   ANS: A
   The dendritic zone is the most distal section of the neuron and is an arborization (formation of a treelike shape) of nerve endings. The soma refers to the cell body (located at the input zone); the axon hillock, located at the summation zone, is the part of the axon where it emerges from the soma; and the output zone is located at the distal end of the axon, where nerve impulse triggers the release of neurotransmitters.

   DIF: Recall REF: 14 OBJ: 4 TOP: NBDHE, 2.0 Physiology

8. What is the name of the portion of the sensory neuron that is easily excited and has the most negative action potential threshold?
   a. Dendritic zone
   b. Soma
   c. Axon hillock
   d. Output zone

   ANS: C
   The axon hillock is the part of the neuron that has the greatest density of voltage-dependent sodium channels (Na^+); it easily excited and is the portion of the sensory neuron with the most negative action potential threshold. The dendritic zone is the most distal section of the neuron and is an arborization (formation of a treelike shape) of nerve endings. The soma refers to the cell body (located at the input zone); and the output zone is located at the distal end of the axon, where nerve impulse triggers the release of neurotransmitters.

   DIF: Recall REF: 15 OBJ: 4 TOP: NBDHE, 2.0 Physiology

9. The lipoprotein sheath that surrounds many neurons is called the myelin sheath. The myelin sheath is composed of Schwann cells.
   a. Both statements are true.
   b. Both statements are false.
   c. The first statement is true; the second statement is false.
   d. The first statement is false; the second statement is true.

   ANS: A
   Both statements are true. The lipoprotein sheath that surrounds many neurons is called myelin sheath and is composed of Schwann cells.

   DIF: Recall REF: 16-17 OBJ: 3 TOP: NBDHE, 2.0 Physiology

10. What is the propagation of action potentials along myelinated axons from one node of Ranvier to another called?
    a. Nonmyelinated
    b. Saltatory conduction
    c. Polarization

d. Refractory period

ANS: B
Saltatory conduction is the propagation of action potentials along myelinated axons from one node of Ranvier to another. Nonmyelinated refers to nerve fibers that have no myelin sheath and therefore rely on diffusion of electrolytes along the nerve cell membrane for impulse travel. Polarization refers to the resting state, when the electrical charge on the outside of the membrane is positive while the inside of the membrane is negative. The refractory period refers to the time when the neuron is busy returning sodium and potassium ions to their original sides of the nerve membrane.

DIF: Recall REF: 16-17| 17 OBJ: 5 TOP: NBDHE, 2.0 Physiology

11. The A alpha nerve fiber type is the smallest and the most numerous nerve fiber. The A delta nerve fiber type is primarily responsible for dull, aching pain.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second statement is false.
    d. The first statement is false; the second statement is true.

    ANS: B
    Both statements are false. Nerve fiber type C, the smallest and the most numerous nerve fiber, is responsible for dull, aching pain. The A alpha nerve fiber type is the largest and fastest and is responsible for muscle movement and light touch. The A delta nerve fiber type is large, fast, and primarily responsible for sharp pain.

    DIF: Recall REF: 18-19 OBJ: 6 TOP: NBDHE, 2.0 Physiology

12. Which nerve fiber type is responsible for pain related to temperature?
    a. A alpha
    b. A delta
    c. B
    d. C

    ANS: B
    Nerve fiber type A delta is responsible for sharp pain. The A alpha nerve fiber type is the largest and fastest and is responsible for muscle movement and light touch. B fibers are lightly myelinated motor fibers; and nerve fiber type C, the smallest and the most numerous nerve fiber, is responsible for dull, aching pain.

    DIF: Recall REF: 18-19 OBJ: 6 TOP: NBDHE, 2.0 Physiology

13. As the action potential moves down the line, its strength decreases as it moves from one neuron to the next. The action potential in myelinated axons does not propagate as waves as in unmyelinated axons.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second statement is false.
    d. The first statement is false; the second statement is true.

    ANS: D

The first statement is false; the second statement is true. Once a nerve is excited, the intensity of stimulation does not produce a stronger signal or become diminished as it propagates down the line. The action potential in myelinated axons does not propagate as waves as in unmyelinated axons.

DIF: Comprehension REF: 19 OBJ: 7
TOP: NBDHE, 2.0 Physiology

14. Which description best describes the mechanism by which local anesthetic drugs work?
    a. Anesthetic drugs bind to the sodium channels, the influx of sodium is interrupted, the action potential cannot rise, and the signal conduction is inhibited.
    b. Anesthetic drugs bind to the potassium channels, the influx of sodium is interrupted, the action potential cannot rise, and the signal conduction is inhibited.
    c. Anesthetic drugs bind to the sodium channels, the influx of potassium is interrupted, the action potential cannot rise, and the signal conduction is inhibited.
    d. Anesthetic drugs bind to the sodium channels, the influx of sodium and potassium is interrupted, the action potential cannot rise, and the signal conduction is inhibited.

ANS: A
Anesthetic drugs bind to the sodium channels, the influx of sodium is interrupted, the action potential cannot rise, and the signal conduction is inhibited. The mechanism does not include local anesthetic drugs binding to potassium channels or the influx of potassium.

DIF: Comprehension REF: 23 OBJ: 9
TOP: NBDHE, 2.0 Physiology| NBDHE, 3.0 Planning and Managing Dental Hygiene Care| NBDHE, 3.4 Anxiety and Pain Control

15. What is the layer of connective tissue that surrounds each axon within a nerve called?
    a. Epineurium
    b. Endoneurium
    c. Perineurium
    d. Fascicle

ANS: B
Within a nerve, each axon is surrounded by a layer of connective tissue called the endoneurium. The epineurium wraps the entire nerve; the perineurium wraps each fascicle (group of nerve fibers).

DIF: Recall REF: 13 OBJ: 3 TOP: NBDHE, 2.0 Physiology

16. What is the layer of connective tissue that surrounds the entire nerve called?
    a. Epineurium
    b. Endoneurium
    c. Perineurium
    d. Fascicle

ANS: A
The entire nerve is wrapped in a layer of connective tissue called the epineurium. Within a nerve, each axon is surrounded by a layer of connective tissue called the endoneurium; the perineurium wraps each fascicle (group of nerve fibers).

DIF: Recall REF: 13 OBJ: 3 TOP: NBDHE, 2.0 Physiology

17. The main difference between motor neurons and sensory neurons is the location of which body part?
    a. Axon
    b. Dendritic zone
    c. Cell body
    d. Terminal arborization

    ANS: C
    The main difference between motor neurons and sensory neurons is the location of the cell body. The cell body of the motor (efferent) neuron participates in impulse conduction, and therefore is located at the terminal arborization at the dendritic zone. The cell bodies of sensory (afferent) neurons do not participate in nerve conduction and therefore are located off the axon.

    DIF: Recall REF: 14 OBJ: 4 TOP: NBDHE, 2.0 Physiology

18. The cell body of which neuron participates in impulse conduction and therefore is located at the terminal arborization?
    a. Sensory neurons
    b. Motor neurons
    c. Somatic neurons
    d. All options listed

    ANS: B
    The cell body of the motor neuron participates in impulse conduction and therefore is located at the terminal arborization. The cell bodies of sensory (afferent) neurons do not participate in nerve conduction and therefore are located off the axon. Somatic neurons are associated with the somatic nervous system, a subdivision of the peripheral nervous system.

    DIF: Recall REF: 14 OBJ: 4 TOP: NBDHE, 2.0 Physiology

19. The difference between the electrical charge on the outside of the cell and that on the inside of the cell is called what?
    a. Firing threshold
    b. Membrane potential
    c. Polarization
    d. Action potential

    ANS: B
    The difference between the electrical charge on the outside of the cell and that on the inside of the cell is called the membrane potential. The nerve's firing threshold is reached when axoplasm has depolarized approximately 15-20mV from –70mV, attaining the threshold for impulse generation; polarization refers to the resting state, when the electrical charge on the outside of the membrane is positive while the inside of the membrane is negative; the action potential is the membrane potential of an active nerve conducting an impulse.

DIF: Recall REF: 19 OBJ: 8 TOP: NBDHE, 2.0 Physiology

20. At the synaptic knobs of neuron cells, what type of action is required to have the electrical impulse cross the synapse of one cell to another cell?
    a. The action of electrical synapses
    b. The action of chemical synapses
    c. The action of either electrical or chemical synapses
    d. Repolarization

    ANS: C
    To have the electrical impulse cross the synapse of one cell to another cell requires the action of either electrical synapses or chemical synapses. Repolarization occurs once the peak of the action potential is reached and membrane potential begins to move back toward the resting potential.

    DIF: Recall REF: 15-16 OBJ: 7 TOP: NBDHE, 2.0 Physiology

21. The nerve cell stage in which potassium returns to the inside of the cell and sodium returns to the outside of the cell is called what?
    a. All-or-none principle
    b. Polarization
    c. Depolarization
    d. Refractory period

    ANS: D
    The refractory period puts everything back to normal: Potassium returns inside, and sodium returns outside the cell membrane. The return to the resting state (polarization) is realized when the electrical charge on the outside of the membrane is positive while the inside of the membrane is negative. Depolarization occurs when action potential causes sodium channels to open, allowing an influx of sodium ions that changes the electrochemical gradient, which in turn produces a further rise in the membrane potential. The conduction of nerve impulses is an example of an all-or-none response: that is, once a neuron responds to the minimum threshold level, it must respond completely and will no longer be dependent of the stimulus to continue.

    DIF: Recall REF: 21 OBJ: 8 TOP: NBDHE, 2.0 Physiology

22. What do local anesthetic drugs inhibit in order to prevent nerve cell stimulation?
    a. Sodium influx
    b. Potassium influx
    c. Chloride excretion
    d. All options listed

    ANS: A
    Local anesthetic drugs act mainly by inhibiting sodium influx through sodium-specific ion channels in the neuronal cell membrane. Local anesthetic drugs do not act by inhibiting potassium influx or chloride excretion.

    DIF: Comprehension REF: 23 OBJ: 9
    TOP: NBDHE, 2.0 Physiology| NBDHE, 6.0 Pharmacology| NBDHE, 3.0 Planning and Managing Dental Hygiene Care| NBDHE, 3.4 Anxiety and Pain Control

23. The smaller-diameter nerve fibers associated with supraperiosteal injections are more sensitive to local anesthetics. The larger-diameter nerve fibers of the IA and PSA require a larger volume of local anesthetic for successful nerve blockage.
    a. Both statements are true.
    b. Both statements are false
    c. The first statement is true; the second statement is false.
    d. The first statement is false; the second statement is true.

    ANS: A
    Both statements are true. The smaller-diameter nerve fibers associated with supraperiosteal injections are more sensitive to local anesthetics. The larger-diameter nerve fibers of the IA and PSA require a larger volume of local anesthetic for successful nerve blockage.

    DIF: Comprehension REF: 23 OBJ: 9
    TOP: NBDHE, 2.0 Physiology| NBDHE, 3.0 Planning and Managing Dental Hygiene Care| NBDHE, 3.4 Anxiety and Pain Control

24. The function of the cell body is to transmit impulses. The cell body is responsible for protein synthesis and provides metabolic support for the neuron.
    a. Both statements are true.
    b. Both statements are false
    c. The first statement is true; the second statement is false.
    d. The first statement is false; the second statement is true.

    ANS: D
    The first statement is false; the second statement is true. The cell body is not involved in impulse transmission. The cell body is responsible for protein synthesis and provides metabolic support for the neuron.

    DIF: Recall REF: 15 OBJ: 4 TOP: NBDHE, 2.0 Physiology

25. The axon is:
    a. Made up of cytoplasm
    b. Surrounded by a multiple lipid membrane
    c. All options listed
    d. None of the options listed

    ANS: C
    All options listed. The axon is made up of cytoplasm, or axoplasm, and is surrounded by a multilayer lipid membrane.

    DIF: Recall REF: 15 OBJ: 4 TOP: NBDHE, 2.0 Physiology

26. Which of the following is true regarding the nodes of Ranvier?
    a. Found along myelinated nerve fibers between adjacent Schwann cells
    b. Occur at unevenly spaced intervals
    c. All options listed
    d. None of the options listed

    ANS: A

The nodes of Ranvier are found along myelinated nerve fibers, gaps in the sheath, and between adjacent Schwann cells, and they occur at evenly spaced intervals.

DIF: Recall REF: 16-17 OBJ: 5 TOP: NBDHE, 2.0 Physiology

27. The relationship between relative amounts of ions inside and outside the nerve membrane is known as which of the following?
    a. Relative refractory period
    b. Concentration gradient
    c. Action potential
    d. Axolemma

    ANS: B
    The concentration gradient is the relationship between the relative amounts of ions inside and outside the nerve membrane. Relative refractory period is the interval immediately following the absolute refractory period and before complete reestablishment to the resting state. Action potential is a nerve impulse. Axolemma is the plasma membrane of the axon.

    DIF: Recall REF: 19 OBJ: 8 TOP: NBDHE, 2.0 Physiology