Test Bank for Neuroscience 6th Edition by Purves

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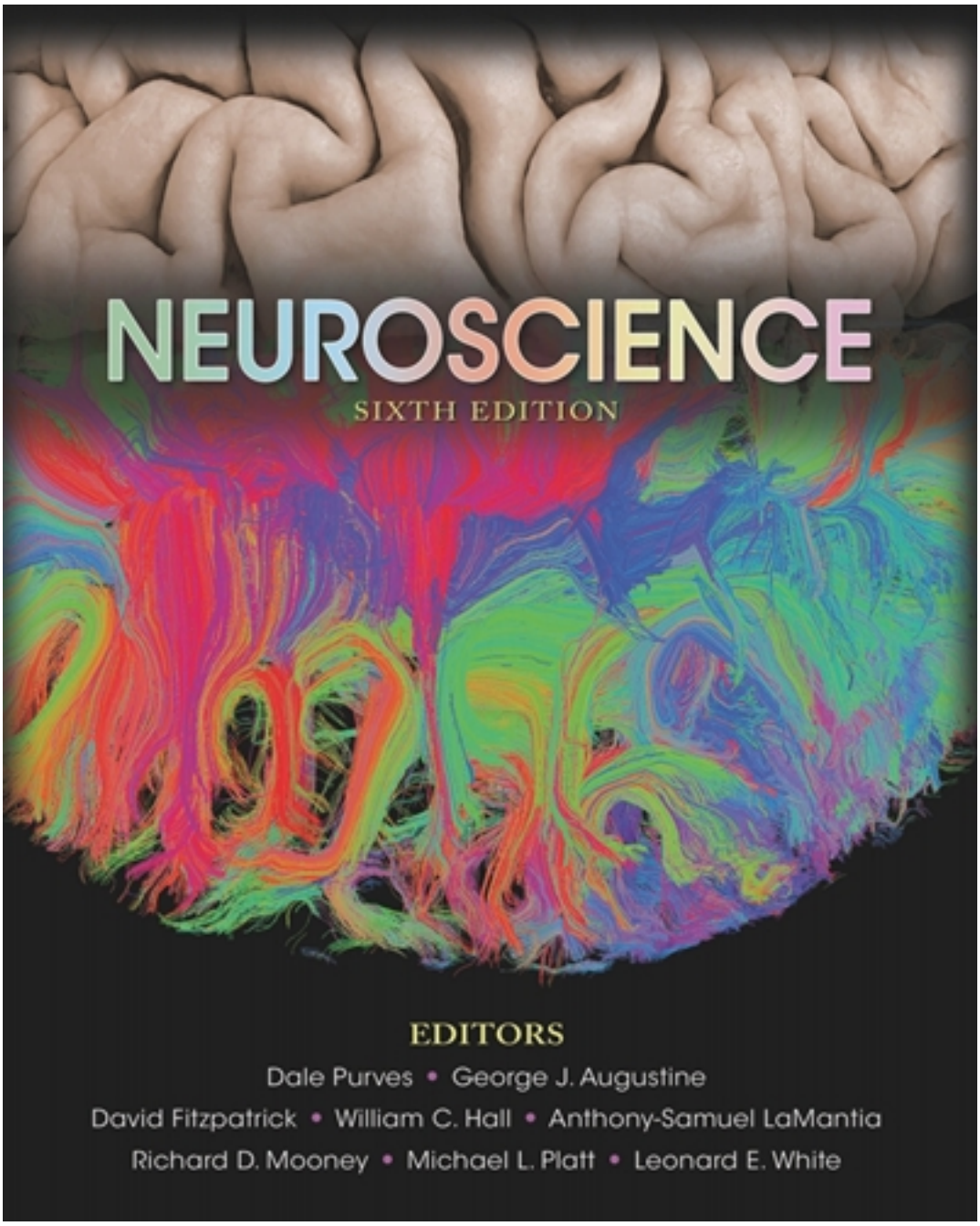


Test Bank

Test Bank

to accompany
Neuroscience, Sixth Edition
Purves • Augustine • Fitzpatrick • Hall • LaMantia • Mooney • Platt • White

Chapter 2: Electrical Signals of Nerve Cells

Multiple Choice

1. Which type(s) of electrical signals occur(s) within the neural circuit for a spinal reflex?
a. Receptor potential only
b. Action potential only
c. Synaptic potential only
d. Receptor potential and action potential only
e. Receptor potential, synaptic potential, and action potential
Answer: e
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 2. Understanding

2. The resting membrane potential typically ranges from _____ to _____.
a. –90 mV; 90 mV
b. 40 mV; 90 mV
c. 40 V; 90 V
d. –40 mV; –90 mV
e. 0 mV; 90 mV
Answer: d
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 1. Remembering

3. An action potential occurs if current injected into a neuron _____ the neuron to reach _____ potential.
a. depolarizes; synaptic
b. hyperpolarizes; synaptic
c. depolarizes; threshold
d. hyperpolarizes; threshold
e. hyperpolarizes; resting
Answer: c
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 2. Understanding

4. How will a neuron respond to an injection of negative current?
a. It will become hyperpolarized.
b. It will have a positive electrical response.
c. It will generate a single action potential.
d. It will generate multiple action potentials.

e. It will reach the threshold potential.
Answer: a
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 2. Understanding

5. The amplitude of the action potential of a given neuron is
a. larger in response to depolarizing currents of greater magnitude.
b. dependent on the magnitude of the sensory stimulus.
c. related to the number of synapses on the neuron.
d. smaller if the resting potential of the neuron is lower.
e. always the same.
Answer: e
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 2. Understanding

6. Which stimulus is most likely to evoke an action potential?
a. Small hyperpolarizing current pulse
b. Large hyperpolarizing current pulse
c. Small depolarizing current pulse
d. Large depolarizing current pulse
e. Microelectrode insertion
Answer: d
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 1. Remembering

7. Subthreshold current injected into an axon flows _____ along the axon and _____ with distance from the site of injection.
a. actively; remains constant
b. actively; decays
c. actively; grows
d. passively; remains constant
e. passively; decays
Answer: e
Textbook Reference: Long-Distance Transmission of Electrical Signals
Bloom's Level: 2. Understanding

8. What is the mechanism of action of most local anesthetics?
a. Hyperpolarize resting membrane potential of neurons
b. Block glutamate receptors in excitatory synapses
c. Enhance the activity of inhibitory synapses by acting on postsynaptic GABA receptors
d. Block Na^+ channels involved in the generation of action potentials
e. Bind opiate receptors
Answer: d
Textbook Reference: Clinical Applications: Anesthesia and Neuronal Electrical Signaling
Bloom's Level: 2. Understanding

9. Which statement about active ion transporters is true?
a. They are selectively permeable to certain ions.
b. They are functionally similar to ion channels.
c. They allow ion movement down the concentration gradient.
d. They move all ions against the concentration gradient.
e. They move certain ions against the concentration gradient.
Answer: e
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 2. Understanding

10. Which statement best describes the Nernst equation?
a. It relates the equilibrium potential of an ion to its intracellular concentration.
b. It relates the equilibrium potential of an ion to its extracellular concentration.
c. It relates the equilibrium potential of an ion to its intra- and extracellular concentrations.
d. It relates the equilibrium potentials of multiple ions to their intracellular concentrations.
e. It relates the equilibrium potentials of multiple ions to their intra- and extracellular concentrations.
Answer: c
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 1. Remembering

11. In a two-compartment model of a cell with a K^+-permeable membrane, at K^+ equilibrium potential, there is _____ flux of K^+ ions.
a. a large inward
b. a large outward
c. no net
d. a small inward
e. a small outward
Answer: c
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 2. Understanding

12. In a two-compartment model of a cell with a K^+-permeable membrane and a 10-fold excess of K^+ in the inside compartment, how would the membrane potential change if all K^+ ions were replaced by Na^+ ions?
a. It would double.
b. It would be reduced by half.
c. It would not change.
d. It would become positive.
e. No potential would be generated.
Answer: e
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

13. In a two-compartment model of a cell with a K^+- and Na^+-permeable membrane and a 10-fold excess of K^+ in the inside compartment, how would the membrane potential change if all K^+ ions were replaced by Na^+ ions?
a. It would double.
b. It would be reduced by half.
c. It would not change.
d. It would become positive.
e. No potential would be generated.
Answer: c
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

14. In a two-compartment model of a cell with a K^+- and Ca^{2+}-permeable membrane and a 10-fold excess of K^+ in the inside compartment, how would the membrane potential change if all K^+ ions were replaced by Ca^{2+} ions?
a. It would double.
b. It would be reduced by half.
c. It would not change.
d. It would become positive.
e. No potential would be generated.
Answer: b
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

15. In a two-compartment model of a cell with a K^+- and Cl^--permeable membrane and a 10-fold excess of K^+ in the inside compartment, how would the membrane potential change if all K^+ ions were replaced by Cl^- ions?
a. It would double.
b. It would be reduced by half.
c. It would not change.
d. It would become positive
e. No potential would be generated.
Answer: d
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

16. In a two-compartment model of a cell with a K^+-permeable membrane and a 10-fold excess of K^+ in the inside compartment, how would K^+ ions flow across the membrane?
a. They would flow from the inside compartment to the outside compartment.
b. They would flow from the outside compartment to the inside compartment.
c. There would be no flow of K^+ ions.
d. They would flow in both directions at the same time in equal molar quantities.
e. They would flow in both directions, but the flow would be negligible.
Answer: a
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

17. In a two-compartment model of a cell with a K^+-permeable membrane and a 10-fold excess K^+ in the inside compartment, the membrane potential is experimentally made more negative than the K^+ equilibrium potential. How would K^+ ions flow across the membrane?
a. They would flow from the inside compartment to the outside compartment.
b. They would flow from the outside compartment to the inside compartment.
c. There would be no flow of K^+ ions.
d. They would flow in both directions at the same time in equal molar quantities.
e. They would flow in both directions, but the flow would be negligible.
Answer: b
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

18. Under which circumstances is the Goldman equation equivalent to the Nernst equation?
a. When a membrane is permeable to only one ion
b. When a membrane is permeable to multiple ions
c. When the membrane is permeable to positively charged ions only
d. When the membrane is permeable to negatively charged ions only
e. When permeability of the membrane is different for different ions
Answer: a
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 4. Analyzing

19. The resting potential of a cell is negative because
a. there is an excess of K^+ outside of the cell at rest.
b. at rest there is an excess of K^+ outside of the cell, and the membrane is permeable chiefly to K^+.
c. at rest there is an excess of K^+ inside the cell, and the membrane is permeable chiefly to K^+.
d. at rest there is an excess of K^+ inside the cell, but the membrane is permeable to all ions.
e. there is an excess of Cl^- ions outside of the cell at rest.
Answer: c
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 4. Analyzing

20. How does membrane permeability to K^+ (P_K) and Na^+ (P_{Na}) change during an action potential?
a. P_{Na} always exceeds P_K; permeability does not change for either ion.
b. P_K always exceeds P_{Na}; permeability does not change for either ion.
c. P_{Na} exceeds P_K at rest; P_K temporarily increases during the action potential.
d. P_K exceeds P_{Na} at rest; P_{Na} temporarily increases during the action potential.

e. P_K exceeds P_{Na} at rest; P_{Na} increases during the action potential and remains higher than P_K until the next action potential, then it quickly drops.
Answer: d
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 4. Analyzing

21. Concentrations of which ion, inside and outside of a neuron, have the greatest effect on the resting membrane potential?
a. K^+
b. Na^+
c. Ca^{2+}
d. Cl^-
e. PO_4^{3-}
Answer: a
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 1. Remembering

22. There is an excess of _____ in the extracellular compartment, relative to the intracellular compartment.
a. Na^+ only
b. K^+ only
c. Na^+ and Ca^{2+} only
d. Na^+ and Cl^- only
e. Na^+, Cl^-, and Ca^{2+}
Answer: e
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 1. Remembering

23. Hodgkin and Katz discovered that the resting membrane potential changes by _____ mV per tenfold change in K^+ concentration.
a. +29
b. +58
c. +65
d. +90
e. +119
Answer: b
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 1. Remembering

24. Which experimental model did Hodgkin and Katz use in their studies of the resting membrane potential?
a. Living squid neuron
b. Neurons of *Aplysia* species
c. Mammalian neurons
d. Mammalian brain slices

e. Neurospheres
Answer: a
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 1. Remembering

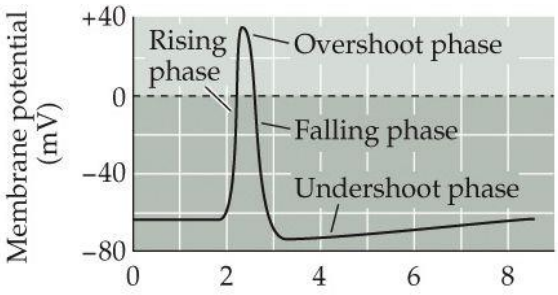
25. Which state of the plasma membrane does *not* occur during an action potential?
a. Resting phase
b. Rising phase
c. Overshoot phase
d. Falling phase
e. Undershoot phase
Answer: a
Textbook Reference: The Ionic Basis of Action Potentials
Bloom's Level: 1. Remembering

26. During which phase of an action potential does membrane permeability to Na^+ exceed membrane permeability to K^+?
a. Rising phase only
b. Rising and overshoot phases
c. Overshoot phase only
d. Overshoot and falling phases
e. All of the phases of the action potential
Answer: b
Textbook Reference: The Ionic Basis of Action Potentials
Bloom's Level: 1. Remembering

27. During the overshoot phase of an action potential, membrane potential briefly reaches a value near _____ mV.
a. –80
b. –65
c. 0
d. +50
e. +90
Answer: d
Textbook Reference: The Ionic Basis of Action Potentials
Bloom's Level: 1. Remembering

Short Answer

1. Draw a typical action potential. Label the axes and each phase of the action potential.
Answer:



Hodgkin and Huxley (1939) *Nature* 144: 710–711.

Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 3. Applying

2. Explain the difference between action potentials (all-or-none) and synaptic potentials (graded).
Answer: Action potentials have the same amplitude regardless of stimulus frequency and intensity. In contrast, the amplitude of a synaptic potential does depend on the stimulus: the number of synapses activated, strength of each synapse, and the amount of synaptic activity.
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 3. Applying

3. How is stimulus strength encoded by graded potentials? How is stimulus strength encoded by action potentials?
Answer: Stimulus strength is encoded by graded potentials by amplitude, and encoded by action potentials in frequency.
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 3. Applying

4. Explain the difference between hyperpolarization and depolarization.
Answer: The membrane potential becomes more negative during hyperpolarization, and it becomes more positive during depolarization.
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 2. Understanding

5. Suppose a water-filled aquarium is divided into two compartments by a membrane that is impermeable to all ions. If KCl is added to one compartment, what will happen to the distribution of K^+ and Cl^-? Will there be a potential difference between the two compartments? What will happen to the membrane potential if the membrane suddenly becomes selectively permeable to K^+ (but not to Cl^-)?
Answer: If KCl is added to one compartment, nothing will happen because the membrane is impermeable. There will not be a potential difference between the two compartments. If the membrane suddenly becomes selectively permeable to K^+ (but not to Cl^-), it will reach equilibrium potential for K^+.
Textbook Reference: How Ion Movements Produce Electrical Signals

Bloom's Level: 4. Analyzing

6. How would you explain the statement, "Ion channels and ion pumps have complementary functions"?
Answer: Ion pumps move ions against ion concentration gradients while ion channels allow the flow of ions in the direction of the concentration gradient.
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 3. Applying

7. What is electrochemical equilibrium?
Answer: Electrochemical equilibrium is the state of balance between the concentration and electrical gradients at which there is no net flow of charge or ions.
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 1. Remembering

8. Suppose you are recording a neuron's resting membrane potential. If you add KCl to the external medium, what will happen to the resting potential? Compare this to what will happen if you add the same amount of NaCl. What can be concluded from this comparison?
Answer: Adding KCl will cause the resting potential to become less negative. Adding NaCl to the external medium will have a small effect because membrane permeability to Na^+ is low. We can conclude that the resting membrane potential is primarily due to/attributable to the product of K^+ permeability
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

9. In what situation would you use the Goldman equation instead of the Nernst equation?
Answer: If there is more than one permeant ion in the environment you would use the Goldman equation.
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 2. Understanding

10. What is the magnitude of a typical neuron's resting membrane potential? Why do neurons and other cells have a negative resting membrane potential?
Answer: A typical neuron's resting membrane potential is approximately –65 mV. It is negative because resting membrane is permeable mainly to K^+, and there is a concentration gradient for K^+ across the plasma membrane with roughly a 13-fold excess of K^+ inside the cell.
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 2. Understanding

Multiple Choice from Dashboard Quiz

1. The synaptic potential

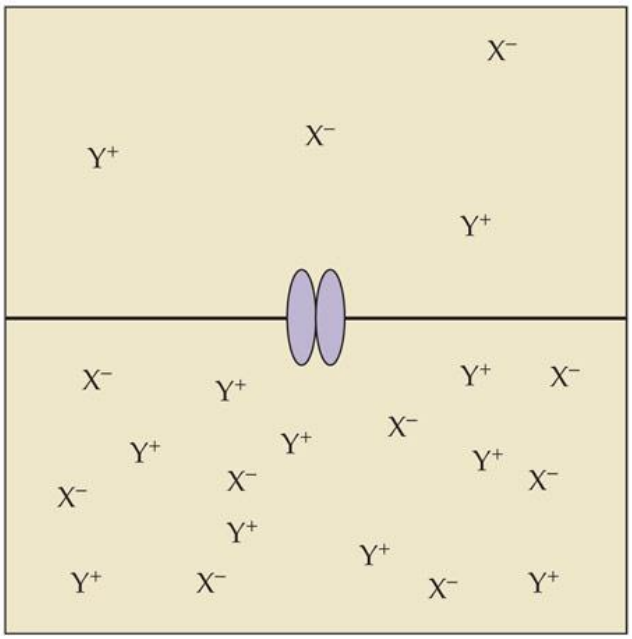
a. makes communication between nerve cells possible.
b. occurs only in response to external stimuli.
c. propagates along axons.
d. determines the cell's resting potential.
e. results in a long-term change in a cell's membrane potential.
Answer: a
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 1. Remembering

2. A dull probe stimulates a Pacinian corpuscle. An electrode is placed midway down the axon, and action potentials are recorded. After one second, the probe is pushed with greater force. What change will occur in the recording?
a. The height of action potentials will increase.
b. The frequency of action potentials will increase.
c. The frequency of action potentials will decrease.
d. The resting membrane potential will increase.
e. The threshold potential level will increase.
Answer: b
Textbook Reference: Electrical Signals of Nerve Cells
Bloom's Level: 3. Applying

3. Which statement best describes the electrical properties of nerve cells?
a. They are exceptionally good conductors of electricity (much better than copper wires).
b. They are similar in their electrical conduction properties to copper wires.
c. In comparison to copper wires, they are relatively poor conductors of electricity.
d. They are unable to conduct electricity under any circumstances.
e. They are electron sinks; they absorb many electrons, but no electricity comes out of them.
Answer: c
Textbook Reference: Long-Distance Transmission of Electrical Signals
Bloom's Level: 2. Understanding

4. Which statement best describes the action potential?
a. An action potential is specialized to transmit signals over only very short distances.
b. An action potential is a brief change in membrane potential from positive to negative.
c. An action potential is elicited by hyperpolarization.
d. An action potential occurs when the cell's membrane potential reaches threshold.
e. The level of depolarization is graded in proportion to the magnitude of the stimulus.
Answer: d
Textbook Reference: Long-Distance Transmission of Electrical Signals
Bloom's Level: 2. Understanding

5. Refer to the figure.



What would happen if the membrane became permeable to the Y^+ ions?
a. The Y^+ ions would move into the bottom chamber, down their concentration gradient.
b. The Y^+ ions would move into the bottom chamber, down their electrical gradient.
c. The Y^+ ions would move into the top chamber, down their concentration gradient.
d. The Y^+ ions would move into the top chamber, down their electrical gradient.
e. The Y^+ ions would not move.
Answer: c
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 4. Analyzing

6. Which of the following is *not* necessary for neurons to communicate electrically?
a. Consumption of metabolic energy
b. Use of active transporters to create ionic gradients
c. Separation of large amounts of electrical charge, with excess positive charges stored inside the cell
d. Selective permeability of the cell membrane via different kinds of ion channels
e. Changes in membrane potential caused by the movement of ions across the cell membrane
Answer: c
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 2. Understanding

7. What is the major determinant of the permeability of a membrane to a specific ion?
a. Size of the ion
b. Concentration of the ion inside the cell
c. Concentration of the ion outside the cell
d. Electrical charge of the ion
e. Number of open ion channels specific for that ion

Answer: e
Textbook Reference: How Ion Movements Produce Electrical Signals
Bloom's Level: 2. Understanding

8. Which statement regarding membrane potential and equilibrium potential is true?
a. Membrane potential is affected by ion concentration in- and outside of the cell; equilibrium potential is affected only by ions inside the cell.
b. Equilibrium potential is affected by the concentration and electrical gradients of one ion; membrane potential is affected by gradients of all ions.
c. Both membrane and equilibrium potentials change during an action potential.
d. Equilibrium potentials are affected by membrane permeability; membrane potentials are not.
e. Equilibrium potentials are the same for all neurons; membrane potentials can be different depending on the neuron.
Answer: b
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 2. Understanding

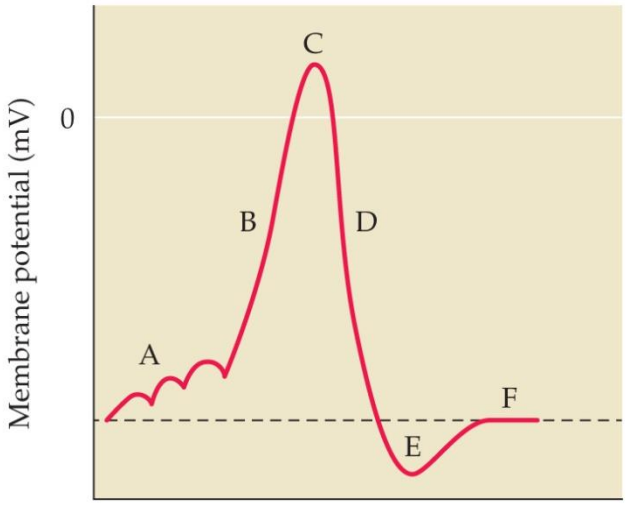
9. A friend has taken a job in a neuroscience research lab, and is studying neurons in a freshwater snail. He has been told to calculate the equilibrium potential of K^+. Which equation will he use and what other information will he need?
a. Nernst equation; concentration of K^+ inside and outside of the cell
b. Nernst equation; concentration of K^+ inside and outside of the cell and permeability of K^+
c. Goldman equation; concentration of K^+ inside and outside of the cell
d. Goldman equation; concentration of K^+ inside and outside of the cell and permeability of K^+
e. Nernst equation; concentration of K^+, Na^+, and Cl^- inside and outside of the cell
Answer: a
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 3. Applying

10. Which statement about electrochemical equilibrium is true?
a. It involves the movement of a relatively large number of ions, altering the concentrations of permeant ions.
b. It occurs when the potential across the membrane exactly offsets the concentration gradient.
c. The size of the potential is inversely proportional to the size of the ion gradient.
d. The fluxes of ion that are required to generate the membrane potential disrupt chemical electroneutrality.
e. For a given ion concentration gradient, the resulting potential is independent of the number of charges on the ion.
Answer: b
Textbook Reference: Forces That Create Membrane Potentials
Bloom's Level: 2. Understanding

11. Which factor is important in determining the membrane potential when there are multiple permeant ions?
a. The concentration gradient of the individual ionic species
b. The permeability of the membrane to the individual ionic species
c. The sum total of all of the ions on both sides of the membrane
d. Both a and b
e. All of the above
Answer: d
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 3. Applying

12. Which statement about the ionic permeability of cell membranes is true?
a. In resting nerve cells, the membrane is permeable to all ions.
b. The permeability of ions is constant over time.
c. In resting nerve cells, the membrane is quite permeable to potassium.
d. In resting nerve cells, the membrane is quite permeable to sodium.
e. In resting nerve cells, the membrane is quite permeable to calcium.
Answer: c
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 2. Understanding

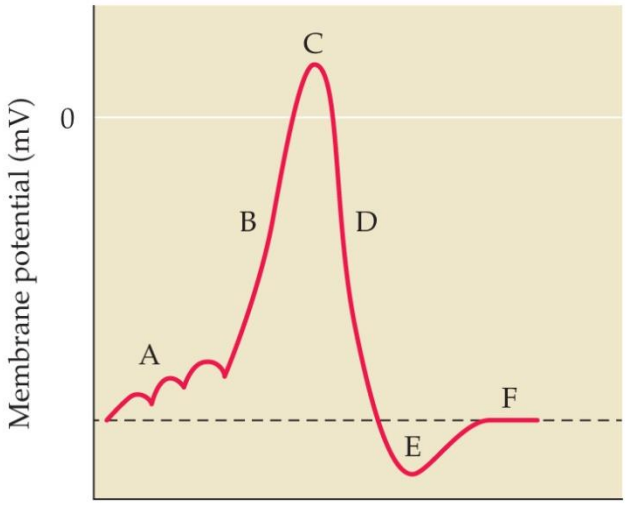
13. Refer to the figure.



In the phase labeled B, _____ ions are moving _____ the cell.
a. potassium; into
b. sodium; into
c. potassium; out of
d. sodium; out of
e. both sodium and potassium; into

Answer: b
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 4. Analyzing

14. Refer to the figure.



In the phase labeled D, _____ ions are moving _____ the cell.
a. potassium; into
b. sodium; into
c. potassium; out of
d. sodium; out of
e. both sodium and potassium; out of
Answer: c
Textbook Reference: Electrochemical Equilibrium in an Environment with More Than One Permeant Ion
Bloom's Level: 4. Analyzing

15. Which statement about ionic distributions in nerve cells is true?
a. Potassium is higher outside cells than inside cells.
b. Sodium is higher outside cells than inside cells.
c. Chloride is higher inside cells than outside cells.
d. Calcium is higher inside cells than outside cells.
e. The concentrations of all ionic species are the same for all nerve cells in all animals.
Answer: b
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 2. Understanding

16. A student new to neuroscience research is practicing recording resting membrane potentials from giant squid axons. During one of the trials, the resting membrane

potential, which is normally around –60 mV, measured –15 mV. Which statement best describes what might have occurred during the experiment?
a. The student added too much potassium to the extracellular solution.
b. The student added too much sodium to the extracellular solution.
c. The student did not add enough potassium to the extracellular solution.
d. The student did not add enough sodium to the extracellular solution.
e. The student added too little potassium and too much sodium to the extracellular solution.
Answer: a
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 3. Applying

17. How does the resting membrane potential of a typical neuron compare to the equilibrium potential (calculated by the Nernst equation) for potassium?
a. The resting membrane potential is not exactly equal to the equilibrium potential for potassium because of variation among neurons.
b. The resting membrane potential is not exactly equal to the equilibrium potential for potassium because rapid fluctuations in membrane potential prevent accurate measurements.
c. The resting membrane potential is not exactly equal to the equilibrium potential for potassium because the membrane has some resting permeability to species other than potassium.
d. The resting membrane potential is not exactly equal to the equilibrium potential for potassium because potassium does not contribute to the resting membrane potential.
e. The resting membrane potential is exactly equal to the equilibrium potential for potassium.
Answer: c
Textbook Reference: The Ionic Basis of the Resting Membrane Potential
Bloom's Level: 2. Understanding

18. The squid giant axon is useful in neuronal studies because
a. its axon is easy to penetrate with recording electrodes because it is so long.
b. the cytoplasm in the axon can be extruded, thus allowing studies of its composition.
c. multiple synapses between the nerve cells make them easy to study.
d. its giant ion channels allow insertion of recording electrodes into the channels.
e. the axon has fewer ion channels, which simplifies the analysis of observations.
Answer: b
Textbook Reference: Box 2A: The Remarkable Giant Nerve Cells of Squid
Bloom's Level: 1. Remembering

19. Studies of the ionic basis of the action potential in squid giant axon found that
a. decreasing sodium outside the cell decreases the size of the action potential.
b. decreasing sodium outside the cell increases the size of the action potential.
c. decreasing potassium outside the cell decreases the size of the action potential.
d. decreasing potassium outside the cell increases the size of the action potential.

e. manipulating sodium has large effects on both the size of the action potential and the resting membrane potential.
Answer: a
Textbook Reference: The Ionic Basis of Action Potentials
Bloom's Level: 2. Understanding

20. Hodgkin and Katz proposed that sodium was the predominant ion associated with the firing of an action potential because
a. the membrane potential approaches the Na^+ Nernst potential during the rising phase.
b. the membrane potential approaches the Na^+ Nernst potential during the falling phase.
c. sodium ions can move more quickly than other ionic species.
d. sodium ions are the only ions that can flow into the nerve cell body.
e. the sodium gradient explains the rising phase, falling phase, and overshoot of the action potential.
Answer: a
Textbook Reference: The Ionic Basis of Action Potentials
Bloom's Level: 2. Understanding