Chapter 4--Principles of Neural and Hormonal Communication

1. A change in a membrane potential from +30 mV to -70 mV is an example of
A. depolarization
B. hyperpolarization
C. polarization
D. repolarization
E. zero potential

2. The negative charge established along a nerve cell membrane is due to
A. movement of Na^+ into the cell
B. movement of proteins out of the cell
C. higher permeability of K^+ relative to Na^+
D. intracellular protein anions
E. higher permeability of K^+ relative to Na^+ and intracellular protein anions

3. The cells of excitable and nonexcitable tissues share
A. a threshold potential
B. a resting membrane potential
C. an ability to open the Na^+ gates
D. all of these
E. none of these

4. Which term best describes an excitable cell when a resting membrane potential is present?
A. polarized
B. depolarized
C. hyperpolarized
D. repolarized
E. nonpolarized

5. A threshold potential is
A. the potential achieved when two opposing forces acting upon an ion (concentration and electrical gradients) achieve a state of equilibrium
B. the peak potential achieved during an action potential
C. the point at which there is an explosive increase in Na^+ or Ca^{2+} permeability
D. the potential at which K^+ permeability increases
E. always a positive potential

6. A change in a membrane potential from -70 mV to -60mV is an example of
A. depolarization
B. hyperpolarization
C. polarization
D. repolarization
E. zero potential

7. Graded potentials
A. are local changes in membrane potential that occur in varying degrees of magnitude
B. serve as short-distance signals
C. serve as long-distance signals
D. are local changes in membrane potential that occur in varying degrees of magnitude, and serve as short-distance signals
E. are local changes in membrane potential that occur in varying degrees of magnitude, and serve as long-distance signals

8. During the rising phase of the action potential:
A. P_{K+} is much greater than P_{Na+}.
B. P_{Na+} is much greater than P_{K+}.
C. P_{K+} is the same as P Na^+.
D. Na^+ efflux occurs.
E. P_{Na+} is much greater than P_{K+}, and Na^+ efflux occurs.

9. Which of the following is not a graded potential?
A. end-plate potential
B. action potential
C. slow-wave potential
D. receptor potential
E. postsynaptic potential

10. Which of the following is responsible for the falling phase of an action potential?
A. opening of Na^+ gates
B. Na^+-K^+ pump restoring the ions to their original locations
C. greatly increased permeability to Na^+
D. ATP-ase destroying the energy supply that was maintaining the action potential at its peak
E. none of these

11. The rising phase of the action potential is due to
A. calcium equilibrium
B. potassium efflux
C. potassium influx
D. sodium efflux
E. sodium influx

12. The falling phase of the action potential is due to
A. calcium equilibrium
B. potassium efflux
C. potassium influx
D. sodium efflux
E. sodium influx

13. When an excitatory neurotransmitter binds to a postsynaptic neuron
A. Voltage-gated Na^+ channels open.
B. Voltage-gated K^+ channels open.
C. Chemically-gated Na^+ channels open.
D. Voltage-gated Cl^- channels open.
E. Chemically-gated Cl^- channels open.

14. When chemically-gated Na^+ channels open, the membrane
A. hyperpolarizes
B. repolarizes
C. depolarizes
D. becomes more negative
E. is inhibited

15. When a membrane is stimulated due to opening of either chemically-gated Na^+ or Cl^- channels:
A. An impulse is propagated.
B. A graded potential is established.
C. An action potential is established.
D. The voltage becomes more negative.
E. Threshold is reached.

16. An action potential on a neuron develops when
A. threshold voltage is reached on an axon
B. voltage-gated Na^+ channels open
C. spatial and/or temporal summation of graded potentials occurs to a great enough degree
D. the axon hillock reaches threshold
E. all of these

17. Myelinated axons conduct impulses much faster because
A. The myelin insulates the axon.
B. Channels only have to open at the nodes.
C. Voltage is not lost along myelinated areas.
D. Saltatory conduction occurs.
E. All of these.

18. At the peak of an action potential:
A. The electrical gradient for Na^+ causes a net movement of this ion out of the cell.
B. The concentration gradient for K^+ tends to move this ion out of the cell.
C. K^+ permeability greatly increases.
D. All of these.
E. The concentration gradient for K^+ tends to move this ion out of the cell, and K^+ permeability greatly increases.

19. Which statement is not accurate about the absolute refractory period?
A. Another stimulus, regardless of its strength, cannot initiate another action potential during this period.
B. During this period, voltage-gated Na^+ channels open, then close but are inactivated.
C. Immediately following this period, the membrane can experience another action potential if the stimulus is strong enough.
D. This period occurs during the after hyperpolarization phase of the action potential.
E. This period ensures a unidirectional spread of the action potential down a nerve fiber.

20. Because of the presence of both activation and inactivation gates, voltage-gated Na^+ channels can
A. be closed but capable of opening
B. be activated
C. be closed and not capable of opening
D. all of these
E. none of these

21. What is responsible for development of the resting membrane potential?
A. leak channels
B. gated channels
C. ion pumps
D. leak channels and gated channels
E. leak channels and ion pumps

22. The membrane is more permeable to K^+ than to Na^+
A. at resting potential
B. during the rising phase of an action potential
C. during the rising phase of a graded potential
D. at resting potential and during the rising phase of an action potential
E. at resting potential and during the rising phase of a graded potential

23. When the membrane potential is +15 mV, that portion of the membrane
A. is in the normal resting state
B. has a more positive outside border
C. is more permeable to Ca^{2+} than normal
D. is in the after hyperpolarization phase of an action potential
E. has a more positive outside border and is more permeable to Ca^{2+} than normal

24. Conduction by local current flow
A. occurs in unmyelinated fibers
B. is faster than propagation of an action potential in myelinated fibers because myelin acts as an insulator to slow down the impulse
C. involves current flowing between active and adjacent inactive areas, thereby bringing the inactive areas to threshold
D. all of these
E. occurs in unmyelinated fibers and involves current flowing between active and adjacent inactive areas, thereby bringing the inactive areas to threshold

25. Saltatory conduction
A. occurs in unmyelinated nerve fibers
B. is slower than conduction by local current flow because the myelin acts as an insulator to slow the impulse down
C. involves the impulse jumping from one node of Ranvier to the adjacent node
D. refers to the action potential spreading from one Schwann cell to the adjacent Schwann cell
E. more than one of these

26. Which statement is incorrect?
A. A local current can occur in myelinated nerve fibers.
B. A local current flow from an active to an adjacent inactive area decreases the potential in the inactive area to threshold.
C. Contiguous conduction occurs along Schwann cells that surround myelinated nerve fibers.
D. Saltatory conduction is faster than contiguous conduction.
E. Conduction by local current flow is the method of propagation in unmyelinated fibers.

27. Select the incorrect statement about the action potential.
A. It has an all-or-none characteristic.
B. It has a refractory period.
C. It is triggered by depolarization to threshold.
D. It occurs along a plasma membrane.
E. It speeds up transmission by summation.

28. Permeability of which ion is affected by a positive feedback mechanism once threshold is reached?
A. sodium
B. potassium
C. calcium
D. chloride
E. protein

29. During the peak of the action potential, the membrane becomes most permeable to
A. sodium
B. potassium
C. calcium
D. chloride
E. protein

30. If a neuron were experimentally stimulated at both ends simultaneously:
A. The action potentials would pass in the middle and travel to the opposite ends.
B. The action potentials would meet in the middle and then be propagated back to their starting positions.
C. The action potentials would stop as they met in the middle.
D. The strongest action potential would override the weaker action potential.
E. Summation would occur when the action potentials met in the middle, resulting in a larger action potential.

31. Which statement about graded potentials is false?
A. They are decremental.
B. They travel only short distances.
C. They are self-propagating.
D. They may contribute to the development of an action potential.
E. They travel in both directions along the membrane.

32. The absolute refractory period
A. prevents action potentials from spreading forward and backward
B. refers to a period when the membrane cannot undergo another action potential
C. is the time when channels opened during the action potential have not been restored to their "closed but capable of opening" conformation
D. places an upper limit on the frequency with which a neuron can conduct action potentials
E. refers to a period when the membrane cannot undergo another action potential and places an upper limit on the frequency with which a neuron can conduct action potentials

33. The period following an action potential during which a membrane cannot experience another action potential
A. is the absolute refractory period
B. occurs during the time after the Na^+ gates have opened until they are restored to their "closed but capable of opening" conformation
C. prevents the action potential from spreading back over the part of the membrane where the impulse has just passed
D. is the absolute refractory period and occurs during the time after the Na^+ gates have opened until they are restored to their "closed but capable of opening" conformation
E. all of these

34. The relative refractory period occurs after the action potential is complete because of the
A. lingering inactivation of the voltage-gated Na^+ channels
B. slowness of the voltage-gated K^+ channels
C. action of the sodium-potassium pumps
D. lingering inactivation of the voltage-gated Na^+ channels and slowness of the voltage-gated K^+ channels
E. slowness of the voltage-gated K^+ channels and action of the sodium-potassium pumps

35. The trigger zone of a neuron
A. is located where the axon connects to the neuron's cell body
B. is located in the axon terminal
C. contains only chemically gated channels
D. conducts graded potentials to the axon
E. contains only chemically gated channels and conducts graded potentials to the axon

36. If neuron Z is repeatedly stimulated very rapidly, what change would you expect in the postsynaptic neuron?
A. several simultaneous action potentials
B. movement farther away from threshold
C. spatial summation of EPSPs
D. movement farther away from threshold and spatial summation of EPSPs
E. none of these

37. Temporal summation on a postsynaptic neuron takes place when
A. a single presynaptic input causes two EPSPs to develop in rapid succession
B. an EPSP and an IPSP occur simultaneously and cancel each other out
C. two EPSPs develop simultaneously from different presynaptic inputs
D. two action potentials from two presynaptic inputs causes two action potentials to develop
E. none of these

38. Spatial summation occurs in a postsynaptic neuron
A. when several EPSPs from a single presynaptic input sum to reach threshold
B. when EPSPs from several presynaptic inputs sum to reach threshold
C. upon simultaneous interaction of an EPSP and an IPSP
D. when several IPSPs from a single presynaptic input sum to hyperpolarize the membrane
E. none of these

39. At an excitatory synapse, an action potential in the presynaptic neuron increases the
A. membrane potential of the postsynaptic cell membrane
B. permeability of the postsynaptic cell to both Na^+
C. permeability of the postsynaptic cell to Cl^-
D. all of these
E. membrane potential of the postsynaptic cell membrane and permeability of the postsynaptic cell to both Na^+

40. At an inhibitory synapse, the postsynaptic membrane experiences
A. an increase in permeability to both Na^+ and K^+
B. an increase in membrane potential
C. hyperpolarization
D. an increase in membrane potential and hyperpolarization
E. all of these

41. An IPSP is
A. produced by increased Na^+ permeability and K^+ permeability
B. produced by increased K^+ permeability or increased Cl^- permeability
C. a hyperpolarization of the presynaptic cell
D. produced by increased Na^+ permeability and K^+ permeability and a hyperpolarization of the presynaptic cell
E. produced by increased K^+ permeability or increased Cl^- permeability and a hyperpolarization of the presynaptic cell.

42. Which channel type is sensitive to serotonin?
A. voltage-gated
B. chemically-gated
C. mechanically-gated
D. acoustically-gated
E. none of these

43. Sequence the following events correctly.

Neurotransmitter diffuses across cleft.	1.
Calcium induces exocytosis of neurotransmitter.	2.
Permeability of postsynaptic membrane altered.	3.
Ion channels open.	4.
Neurotransmitter binds to receptor.	5.

A. 1, 2, 3, 5, 4
B. 1, 4, 3, 2, 5
C. 2, 1, 5, 4, 3
D. 3, 1, 4, 5, 2
E. 5, 4, 3, 1, 2

44. Which statement is incorrect?
A. Inhibitory synapses cause postsynaptic hyperpolarization.
B. An inhibitory synapse may result in postsynaptic sodium channel opening.
C. Inhibitory synapse may result in increased postsynaptic potassium efflux.
D. An excitatory synapse causes depolarization of postsynaptic membranes.
E. An excitatory synapse increases sodium permeability.

45. Which statement is correct?
A. In presynaptic inhibition, another neuron inhibits an excitatory presynaptic input.
B. An IPSP depresses information fed into the cell from an inhibitory presynaptic input.
C. Not all axon terminals of an inhibitory neuron release inhibitory neurotransmitter.
D. When presynaptic inhibition takes place, there is no change in presynaptic membrane potential.
E. An IPSP decreases the potential of the postsynaptic neuron.

46. Neuron A and neuron B release a minimal amount of neurotransmitter simultaneously onto neuron C, causing neuron C to experience an action potential. This is an example of
A. temporal summation
B. spatial summation
C. convergence
D. temporal summation and convergence
E. spatial summation and convergence

47. The nucleus of a neuron is housed in the
A. axon
B. axon hillock
C. cell body
D. collaterals
E. dendrites

48. Select the normal direction for the movement of an action potential along part of a neuron.
A. axon hillock to cell body
B. axon terminal to collateral axon
C. axon to dendrite
D. cell body to receptor
E. dendrite to cell body

49. With presynaptic inhibition:
A. An IPSP occurs on the postsynaptic cell.
B. All excitatory information being fed into the cell is prevented.
C. The release of excitatory transmitter from a specific presynaptic excitatory input is depressed.
D. More than one of these.
E. None of these.

50. A hypothetical postsynaptic neuron has three presynaptic inputs¾X, Y, and Z. When X and Y are stimulated simultaneously, the postsynaptic neuron undergoes an action potential, yet when X and Z are stimulated simultaneously, there is no change in the postsynaptic neuron's potential. What can you tell about neurons Y and Z?
A. Y and Z are both excitatory.
B. Y and Z are both inhibitory.
C. Y is excitatory and Z is inhibitory.
D. Y is inhibitory and Z is excitatory.
E. Not enough information to answer.

51. The nodes of Ranvier are
A. action potential recordings
B. breaks in the myelin covering
C. spaces between neurons
D. specialized cells around axons
E. all of these, except action potential recordings

52. In divergence:
A. Many presynaptic neurons synapse with one postsynaptic cell.
B. Dendrites diverge from the cell body to contact many presynaptic neurons.
C. The action potential initiated in the axon diminishes as it spreads into the axon terminals.
D. An axon branches to synapse with many cells so that activity in one neuron influences the excitability of many other cells.
E. Many axons spread out from one cell body.

53. Which statement about a graded potential is false?
A. It can be a depolarization.
B. It can be a hyperpolarization.
C. It can be summated.
D. It has a refractory period.
E. It occurs in a specialized area of the membrane.

54. In convergence:
A. Many presynaptic cells can synapse with a single postsynaptic cell.
B. An axon branches so that the activity in one neuron influences many other cells.
C. Many dendrites converge on the cell body.
D. All of these.
E. None of these.

55. Neuromodulators
A. bind to receptors at nonsynaptic sites
B. do not contribute directly to EPSPs
C. do not contribute directly to IPSPs
D. may influence neurotransmitter production
E. all of these

56. Presynaptic facilitation results from
A. alteration of calcium permeability
B. continued generation of EPSPs
C. neuromodulator effects
D. increased neurotransmitter production
E. none of these

57. Drugs may influence synaptic transmission by
A. altering the formation of neurotransmitters
B. blocking neurotransmitter reuptake
C. blocking receptors
D. blocking channels
E. all of these

58. Select the last step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron.
A. A neurotransmitter is released by exocytosis.
B. Calcium flows in the synaptic knob.
C. The neurotransmitter combines with protein receptor sites on the subsynaptic membrane.
D. The permeability is altered in a postsynaptic neuron.
E. None of these.

59. Select the first step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron.
A. A neurotransmitter is released by exocytosis.
B. Calcium flows into the synaptic knob.
C. The neurotransmitter combines with protein receptor sites on the subsynaptic membrane.
D. The permeability is altered in a postsynaptic neuron.
E. The neurotransmitter is synthesized.

60. Select the neuropeptide.
A. acetylcholine
B. dopamine
C. epinephrine
D. cholecystokinin
E. glycine

61. Neuropeptides
A. are sometimes co-secreted along with classical neurotransmitters
B. are synthesized in the cytosol of the axon terminal
C. act at the subsynaptic membrane of the postsynaptic neuron
D. all of these
E. are sometimes co-secreted along with classical neurotransmitters and are synthesized in the cytosol of the axon terminal

62. Tetanus toxin
A. combines with glycine receptors, thus blocking the action of this inhibitory neurotransmitter
B. destroys dopamine in the region of the brain involved in controlling complex movements
C. prevents the release of GABA onto inputs terminating on neurons that supply skeletal muscles
D. promotes presynaptic facilitation
E. causes retrograde flow in axon

63. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurotransmitter from X causes a slight hyperpolarization of the postsynaptic cell, then the
A. synapse is excitatory
B. synapse is inhibitory
C. synapse could be excitatory or inhibitory
D. postsynaptic cell's membrane potential has decreased
E. synapse is excitatory and the postsynaptic cell's membrane potential has decreased

64. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

What changes would you expect at the postsynaptic neuron when neuron X is stimulated? (Remember that the postsynaptic neuron becomes hyperpolarized by neuron X.)
A. increased P_{Na+} and P_{K+}
B. increased P_{K+} or P_{Cl-}
C. increased P_{A-}
D. increased P_{Ca2+}
E. none of these

65. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurotransmitter from Y causes the membrane potential of the postsynaptic cell to decrease slightly, then the
A. synapse is excitatory
B. postsynaptic membrane's potential will be farther away from threshold
C. postsynaptic membrane could be excitatory or inhibitory
D. neurotransmitter from Y causes an IPSP on the presynaptic membrane
E. postsynaptic membrane's potential will be farther away from threshold, and the neurotransmitter from Y causes an IPSP on the presynaptic membrane

66. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

What would you expect at the postsynaptic neuron when neuron Y is stimulated? (Remember that the postsynaptic neuron's membrane potential is decreased by neuron Y.)
A. increased P_{Na+} and P_{K+}
B. increased P_{K+} or P_{Cl-}
C. increased P_{A-}
D. increased P_{Ca2+}
E. none of these

67. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurons Y and Z receive simultaneous stimulation, what change would you expect in the postsynaptic neuron?
A. a single EPSP
B. a single IPSP
C. temporal summation of EPSPs
D. spatial summation of EPSPs
E. an IPSP and EPSP would cancel each other out, so there would be essentially no change in potential in the postsynaptic neuron

68. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurons X and Z receive simultaneous stimulation, what change would you expect in the postsynaptic neuron?
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D. spatial summation of EPSPs
E. an IPSP and EPSP would cancel each other out, so there would be essentially no change in potential in the postsynaptic neuron

69. Nerve and muscle cells establish resting membrane potentials.
True False

70. In a graded potential, the direction of current flow is designated by the movement of positive charges.
True False

71. The passive current flow of a graded potential fades quickly.
True False

72. The Na^+ and K^+ channels that open and close during an action potential are voltage-gated channels.
True False

73. A spike is another name for the axon of a neuron.
True False

74. Threshold potential is the peak potential achieved during an action potential.
True False

75. After an action potential has occurred, there is more Na^+ inside the cell than outside the cell (before any Na^+-K^+ pump activity has taken place).
True False

76. During the resting potential, the membrane is more permeable to potassium ions than to sodium ions.
True False

77. Action potentials can be summed.
True False

78. Action potentials may result from hyperpolarization or depolarization.
True False

79. For graded potentials, the magnitude of triggering is coded for in frequency rather than amplitude of depolarizations.
True False

80. Schwann cells promote axonal growth, while oligodendrocytes inhibit it.
True False

81. The refractory period limits the frequency of action potentials.
True False

82. The diffusion of potassium ions reestablishes the resting membrane potential in a neuron immediately after it develops an action potential.
True False

83. Local current flows locally between active and adjacent inactive areas of the cell membrane, thereby decreasing the potential in the inactive area to threshold.
True False

84. Along a neuron, an action potential normally travels from the dendrites to the cell body to the axon.
True False

85. Nerve fiber is another name for a dendrite on a neuron.
True False

86. The nodes of Ranvier are Schwann cells or oligodendrocytes that wrap themselves "jelly roll fashion" around the axon.
True False

87. The myelin on a myelinated fiber in the peripheral nervous system is part of Schwann cells wrapped around the axon.
True False

88. The myelin covering the axon promotes the leakage of ions from an axon, but it promotes conservation of ATP in the neuron.
True False

89. The conduction velocity of a nerve impulse is slower in myelinated fibers than in unmyelinated fibers because myelin acts as an insulator that slows down the flow of current.
True False

90. An unmyelinated fiber with a large diameter can conduct action potentials more rapidly than an unmyelinated fiber with a smaller diameter.
True False

91. Myelinated fibers throughout the nervous system can regenerate when cut, but unmyelinated fibers cannot regenerate.
True False

92. Oligodendrocytes form a regeneration tube to guide a regenerating nerve fiber to its proper destination.
True False

93. Multiple sclerosis is an autoimmune disease in which the body's defense system erroneously attacks the myelin sheath surrounding myelinated nerve fibers.
True False

94. One "strong" stimulus can cause more than one action potential, but a "weak" stimulus may or may not generate an action potential.
True False

95. Multiple sclerosis develops from a buildup of myelin of a neuron.
True False

96. Cocaine blocks the binding of dopamine at postsynaptic membranes.
True False

97. Oligodendrocytes are specialized to conduct electrical impulses to neurons.
True False

98. Action potentials are initiated at the axon hillock region because it has the lowest threshold voltage.
True False

99. The time following an action potential during which a membrane cannot respond to another stimulus, regardless of its strength, is called the relative refractory period.
True False

100. The refractory period prevents action potentials from spreading back over the part of the membrane where the impulse has just passed.
True False

101. During the relative refractory period, a neuron can experience hyperpolarization but not depolarization.
True False

102. During the absolute refractory period, the voltage-gated Na^+ channels are not capable of opening again in response to another triggering event.
True False

103. A stimulus that is too weak to depolarize the membrane to threshold produces an action potential that is weaker than normal.
True False

104. G proteins in the plasma membrane of certain cells may become activated in response to the binding of water-soluble hormones, whereas protein phosphatases are continuously active in these cells.
True False

105. Hormones derived from cholesterol are bound to proteins in the blood and primarily alter preexisting proteins via second-messenger systems.
True False

106. A postsynaptic neuron can either excite or inhibit a presynaptic neuron.
True False

107. Presynaptic inhibition is brought about when dendrites of a postsynaptic neuron alter the signals sent from an axon terminal of a presynaptic neuron.
True False

108. A single neuron may be presynaptic to one group of neurons and postsynaptic to another group of neurons.
True False

109. The tyrosine-kinase pathway is activated in response to certain lipophilic hormones, whereas the second messenger pathway is activated in response to certain hydrophilic hormones.
True False

110. Increased permeability of the postsynaptic cell to Cl^- lessens the likelihood that the postsynaptic cell will undergo an action potential.
True False

111. Amplification is a phenomenon associated with hormones derived from cholesterol.
True False

112. A given synapse may produce EPSPs at one time and IPSPs at another time.
True False

113. A lipophilic chemical messenger uses a second messenger system to alter the activity of a target cell.
True False

114. A balance of IPSPs and EPSPs will negate each other so that the grand postsynaptic potential is essentially unaltered.
True False

115. Common second messengers include cAMP, acetylcholine, and calcium ions.
True False

116. Apoptosis refers to the uncontrolled, accidental death of useful cells that have been severely injured.
True False

117. Lipophilic hormones bind to hormone response elements on DNA, which then initiates steps in the formation of new protein molecules.
True False

118. Most endocrine glands secrete paracrine substances that function as neurohormones.
True False

119. Neuropeptides are mainly neuromodulators that function as second messengers in cells that respond to hydrophilic hormones.
True False

120. The grand postsynaptic potential depends on the sum of activity of the presynaptic inputs.
True False

121. Adenylyl cyclase and diacylglycerol are more associated with hydrophilic hormones than with lipophilic hormones.
True False

122. Divergence refers to the neuronal arrangement wherein the dendrites diverge to synapse with as many presynaptic inputs as possible.
True False

123. Classical neurotransmitters and neuropeptides are sometimes co-secreted from the same axon terminal.
True False

124. **Complete each of the following statments.**

The resting membrane potential of a typical nerve cell is about _____ millivolts.
_____

125. **Complete each of the following statments.**

A plasma membrane is polarized if it separates particles with an opposite _____.
_____

126. **Complete each of the following statments.**

At _____ potential, typically around -55 mv, rapid depolarization occurs.
_____

127. **Complete each of the following statments.**

Opening channels that allow _____ ions or _____ ions result in depolarization of the plasma membrane.
_____

128. **Complete each of the following statments.**

_____ is the hindrance to electrical charge movement.
_____

129. **Complete each of the following statments.**

The chemical called _____ along axons reduces resistance and, hence, increases impulse velocity.
_____

130. **Complete each of the following statments.**

At the end of repolarization, the newly opened channels for _____ ions close.
_____

131. **Complete each of the following statments.**

When a neuron starts to depolarize, _____ ions move into the cell.
_____

132. **Complete each of the following statments.**

A single nerve cell or _____ typically consists of the following three basic parts: _____, _____, and _____.
_____

133. **Complete each of the following statments.**

The _____ or _____ of a neuron is a single, elongated tubular process that conducts action potentials away from the cell body and eventually terminates at other cells.
_____

134. **Complete each of the following statments.**

Axons can range in length from less than a millimeter to over one _____.
_____

135. **Complete each of the following statments.**

During the resting membrane potential, the inside of a neuron has a net _____ charge.

_____

136. **Complete each of the following statments.**

An increase in the size of the _____ of a nerve fiber, along with the amount of _____ around the fiber both increase its rate of conduction.

_____

137. **Complete each of the following statments.**

An action potential in a presynaptic neuron induces opening of voltage-gated _____ channels in the synaptic knob, which triggers exocytosis of synaptic vesicles.

_____

138. **Complete each of the following statments.**

_____ cells form myelin around neurons in the PNS, whereas _____ form myelin around neurons in the CNS.

_____

139. **Complete each of the following statments.**

Myelinated fibers conduct impulses about _____ times faster than unmyelinated fibers of the same diameter.

_____

140. **Complete each of the following statments.**

_____-soluble hormones must use _____ systems to exert their effects on target cells.

_____

141. **Complete each of the following statments.**

_____ are chemical messengers that bind to neuronal receptors at nonsynaptic sites and alter the effectiveness of ongoing synaptic activity.
_____

142. **Complete each of the following statments.**

When EPSPs occurring simultaneously from two different presynaptic inputs add together or sum to bring the postsynaptic cell to threshold, it is called _____.
_____

143. **Complete each of the following statments.**

Schwann cells stimulate the formation of a(n) _____ tube to rebuild damaged neurons.
_____

144. **Complete each of the following statments.**

When EPSPs originating from a single presynaptic input occur so close together in time that they add together or sum, thereby bringing the postsynaptic cell to threshold, it is called _____.
_____

145. **Complete each of the following statments.**

The neuronal relationship where a single presynaptic cell branches to terminate on many other cells is called _____.
_____

146. **Complete each of the following statments.**

The neuronal relationship where many presynaptic cells terminate on a single postsynaptic cell is called _____.
_____

147. **Complete each of the following statments.**

Opening a chemically-gated _____ channel or _____ channel will increase the membrane potential of a plasma membrane.

_____

148. **Complete each of the following statments.**

_____ are local chemical messengers that exert an effect only on neighboring cells in the immediate environment.

_____

149. **Complete each of the following statments.**

_____ are chemical messengers that do not cause the formation of EPSPs or IPSPs but rather bring about long-term changes that depress or enhance the action of the synapse.

_____

150. **Complete each of the following statments.**

One presynaptic neuron can only produce _____ summation on a postsynaptic neuron.

_____

151. **Complete each of the following statments.**

_____ move through the axon before being released from the synaptic knob and then bind to nonsynaptic receptors; whereas, _____ are made in the cytosol of the synaptic knob and after their release bind to subsynaptic receptors.

_____

152. **Complete each of the following statments.**

Axon terminals possess _____ voltage-gated channels that when operational induce neurotransmitter release.

_____

153. **Complete each of the following statments.**

_____ are released into the blood by neurosecretory neurons.

_____

154. **Complete each of the following statments.**

Intentional, programmed cell death is called _____.

_____

155. **Complete each of the following statments.**

_____ is a second messenger formed when a membrane enzyme called a cyclase becomes activated by a G protein.

_____

156. Choose the match for each substance listed.

____	neurotransmitter 1. Dendrite
____	impulse-conducting region 2. Synapse
____	branching process from a cell body 3. Axon
____	covering on the axon 4. Acetylcholine
____	junction between neurons 5. Myelin

157. Use the answer code below to answer this section.

	1. Ion movement responsible for the rising
____	increased P_{Na+} phase of the action potential
	decreased P_{Na+} and
____	increased P_{K+} 2. Permeability change that occurs at threshold
	3. Two permeability changes that occur at the
____	Na influx peak of an action potential
	4. Ion movement responsible for the falling
____	K^+ efflux phase of the action potential

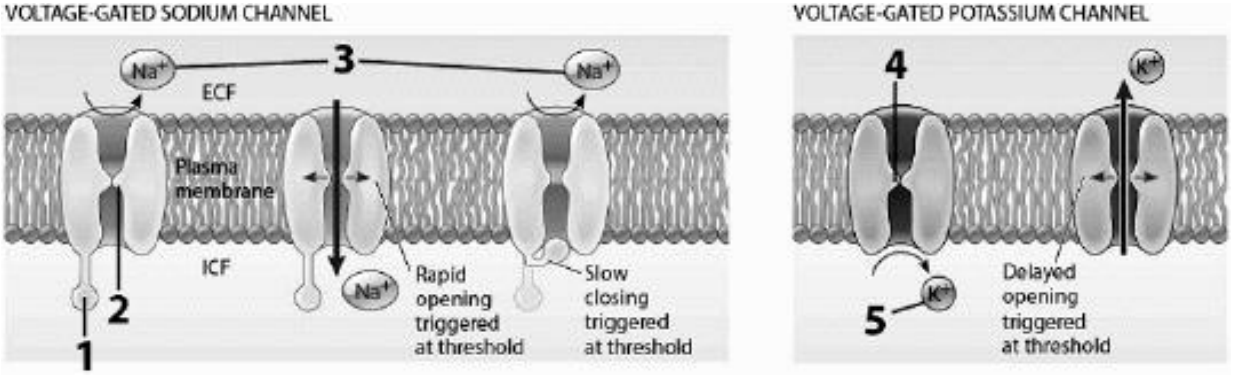
158. Assume that a hypothetical neuron has three presynaptic inputs: A and B are excitatory, and C is inhibitory. Indicate which of the following changes will take place.

1. What would occur if both presynaptic
____ temporal summation neurons A and B were fired simultaneously?
2. What would occur if presynaptic neuron B
____ spatial summation were fired rapidly?
no change in potential of3. What would occur if both presynaptic
____ the postsynaptic cell neurons A and C were fired simultaneously?

159. Match neural disease/influence with correct characteristic.

____ roseola 1. Destroys myelin
____ tetanus 2. May predispose a person to multiple sclerosis
____ multiple sclerosis 3. Competes with glycine for receptors
____ Parkinson's disease 4. Prevents release of GABA
____ strychnine 5. Due to insufficient dopamine

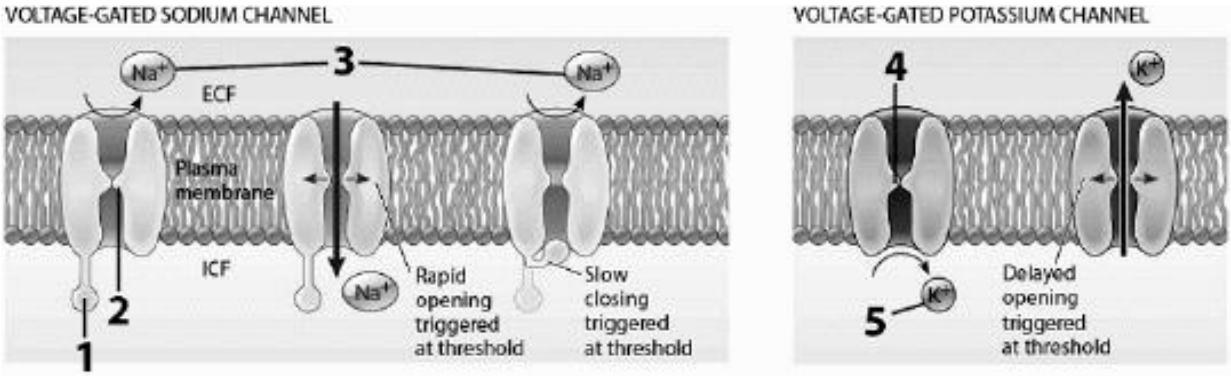
160.



Use these figures to answer the corresponding questions.

The structure labeled "1" is

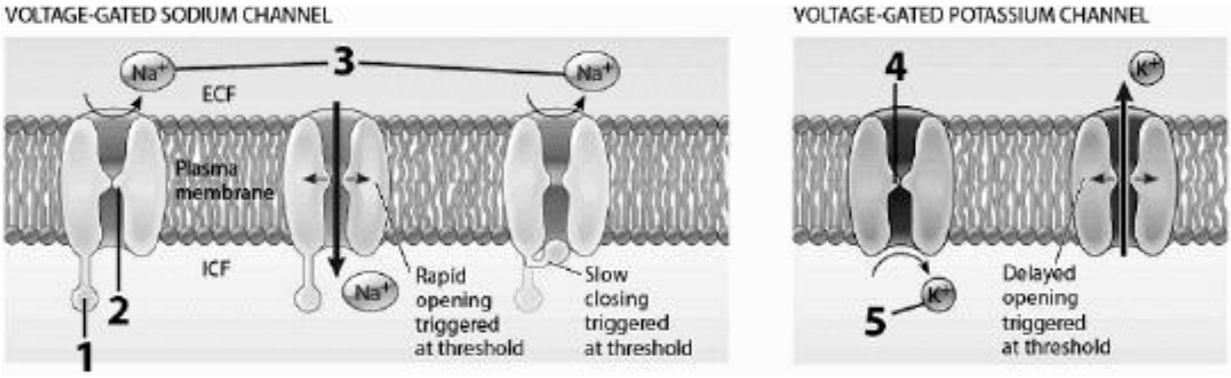
part of a chemically-gated channel a.
part of a mechanically-gated channel b.
the activation gate of a Na^+ channel c.
part of a chemically-gated channel and the activation gate of a Na^+ channel d.
none of these e.

161. 

Use these figures to answer the corresponding questions.

Which number identifies the structure that is primarily responsible for the absolute refractory period during an action potential?

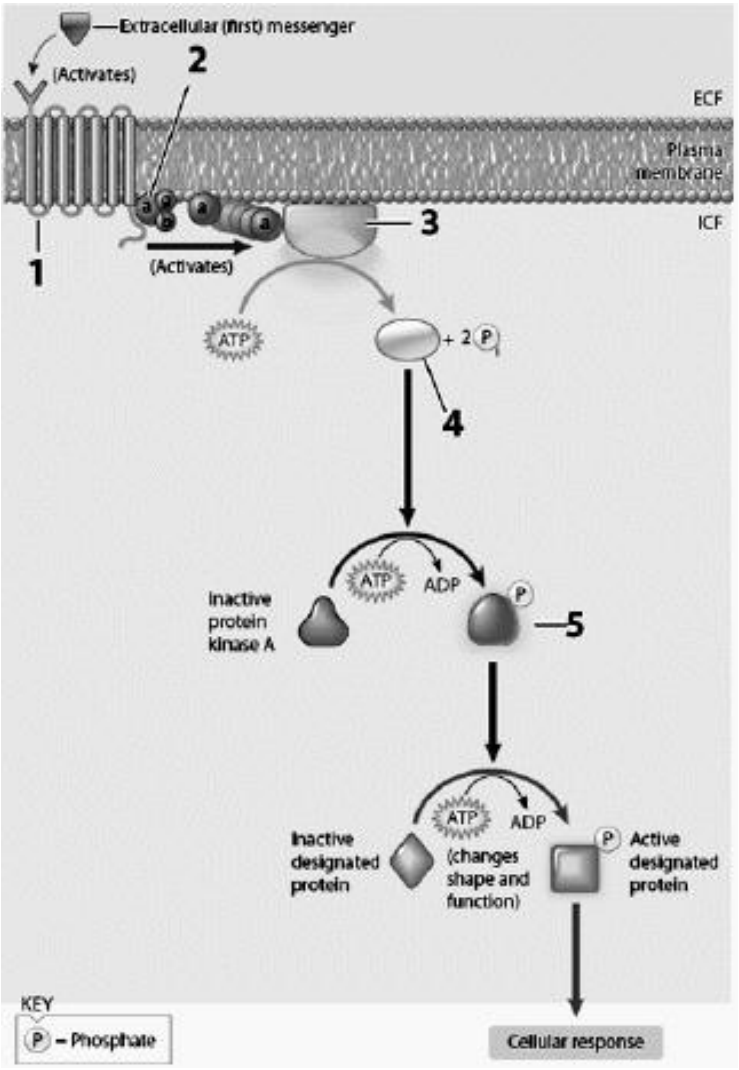
1	a.
2	b.
3-5	c.
4	d.
No number identifies this structure.	e.

162. 

Use these figures to answer the corresponding questions.

The structure labeled "4" is

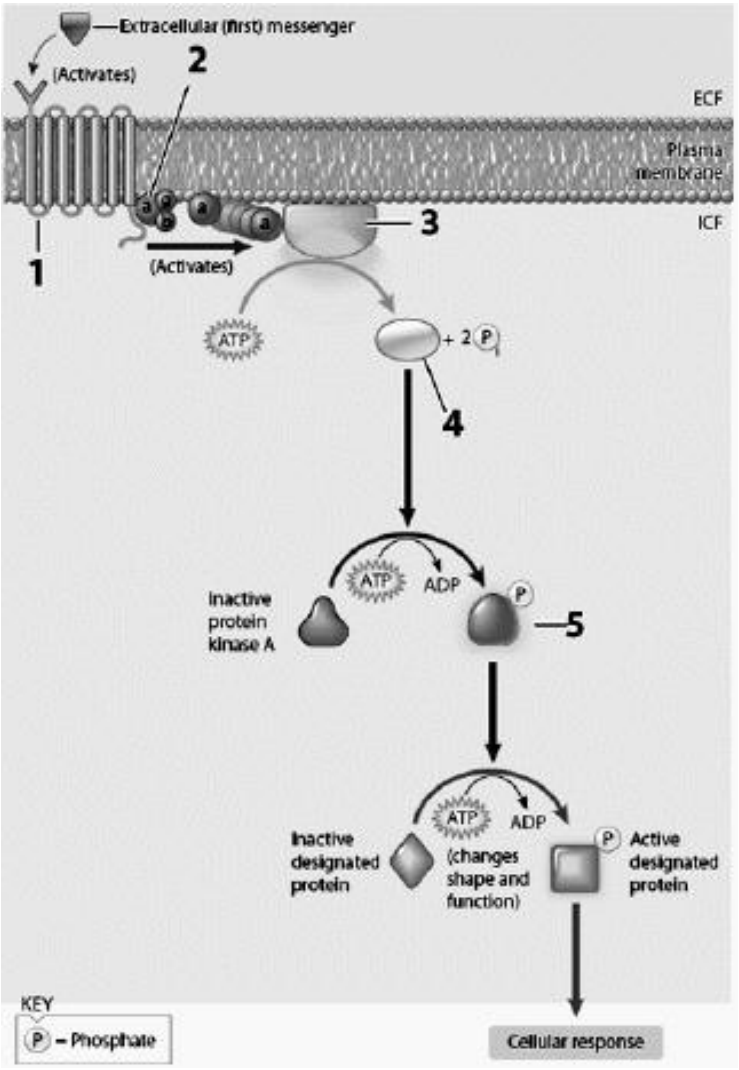
part of a channel that allows Na^+ ions to diffuse into the ECF	a.
the activation gate for a gated K^+ channel	b.
the inactivation gate for a gated Na^+ channel	c.
part of a second messenger system	d.
the activation gate for a gated K^+ channel and part of a second messenger system	e.

163. 

Use this figure to answer the corresponding questions.

This figure shows

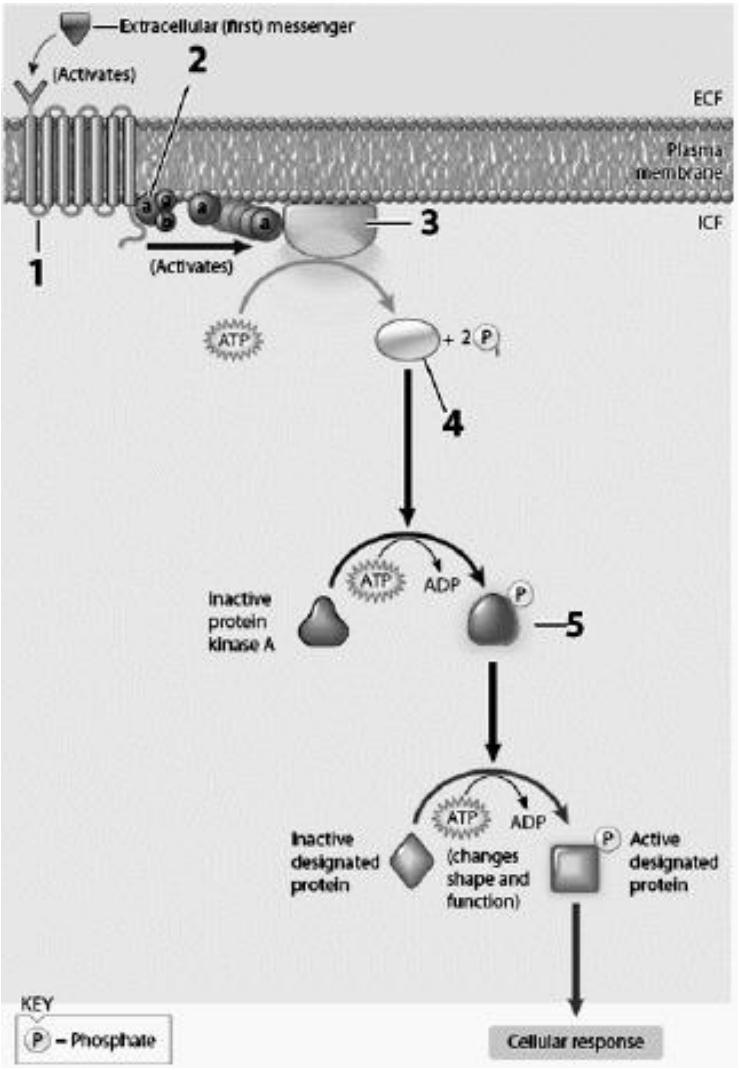
the mechanism by which some lipid-soluble hormones affect their target cells	a.
the way insulin affects certain cells	b.
the method in which IP_3 forms	c.
a common second messenger system for hormone that is derived from cholesterol	d.
none of these	e.

164. 

Use this figure to answer the corresponding questions.

Label "3" is

a second messenger	a.
an active kinase protein	b.
a G protein	c.
a G protein coupled receptor	d.
an inactive kinase protein	e.

165. 

Use this figure to answer the corresponding questions.

A second messenger is labeled

1	a.
2	b.
3	c.
4	d.
5	e.

166. Describe an action potential and explain why a region of the membrane that is in the absolute refractory period cannot experience another action potential until repolarization is complete. Include the following in your answer: voltage-gated Na^+ channels, voltage-gated K^+ channels, activation gate, inactivation gate, threshold voltage, increasing membrane potential, and decreasing membrane potential.

167. How does a depolarizing graded potential lead to the propagation of action potentials?

168. What might happen on a postsynaptic neuron if, at the same time, it receives one stimulus at an excitatory synapse located close to the axon hillock but receives two stimuli at two different inhibitory synapses, both of which are far away from the axon hillock?

169. Neuron A is excitatory to neuron B. Describe three ways that the nervous system might prevent neuron B from experiencing an action potential.

170. What are four ways in which drugs might influence the nervous system at the neuronal level?

Chapter 4--Principles of Neural and Hormonal Communication Key

1. A change in a membrane potential from +30 mV to -70 mV is an example of
A. depolarization
B. hyperpolarization
C. polarization
D. repolarization
E. zero potential

2. The negative charge established along a nerve cell membrane is due to
A. movement of Na^+ into the cell
B. movement of proteins out of the cell
C. higher permeability of K^+ relative to Na^+
D. intracellular protein anions
E. higher permeability of K^+ relative to Na^+ and intracellular protein anions

3. The cells of excitable and nonexcitable tissues share
A. a threshold potential
B. a resting membrane potential
C. an ability to open the Na^+ gates
D. all of these
E. none of these

4. Which term best describes an excitable cell when a resting membrane potential is present?
A. polarized
B. depolarized
C. hyperpolarized
D. repolarized
E. nonpolarized

5. A threshold potential is
A. the potential achieved when two opposing forces acting upon an ion (concentration and electrical gradients) achieve a state of equilibrium
B. the peak potential achieved during an action potential
C. the point at which there is an explosive increase in Na^+ or Ca^{2+} permeability
D. the potential at which K^+ permeability increases
E. always a positive potential

6. A change in a membrane potential from -70 mV to -60mV is an example of
A. depolarization
B. hyperpolarization
C. polarization
D. repolarization
E. zero potential

7. Graded potentials
A. are local changes in membrane potential that occur in varying degrees of magnitude
B. serve as short-distance signals
C. serve as long-distance signals
D. are local changes in membrane potential that occur in varying degrees of magnitude, and serve as short-distance signals
E. are local changes in membrane potential that occur in varying degrees of magnitude, and serve as long-distance signals

8. During the rising phase of the action potential:
A. P_{K+} is much greater than P_{Na+}.
B. P_{Na+} is much greater than P_{K+}.
C. P_{K+} is the same as P Na^+.
D. Na^+ efflux occurs.
E. P_{Na+} is much greater than P_{K+}, and Na^+ efflux occurs.

9. Which of the following is not a graded potential?
A. end-plate potential
B. action potential
C. slow-wave potential
D. receptor potential
E. postsynaptic potential

10. Which of the following is responsible for the falling phase of an action potential?
A. opening of Na^+ gates
B. Na^+-K^+ pump restoring the ions to their original locations
C. greatly increased permeability to Na^+
D. ATP-ase destroying the energy supply that was maintaining the action potential at its peak
E. none of these

11. The rising phase of the action potential is due to
A. calcium equilibrium
B. potassium efflux
C. potassium influx
D. sodium efflux
E. sodium influx

12. The falling phase of the action potential is due to
A. calcium equilibrium
B. potassium efflux
C. potassium influx
D. sodium efflux
E. sodium influx

13. When an excitatory neurotransmitter binds to a postsynaptic neuron
A. Voltage-gated Na^+ channels open.
B. Voltage-gated K^+ channels open.
C. Chemically-gated Na^+ channels open.
D. Voltage-gated Cl^- channels open.
E. Chemically-gated Cl^- channels open.

14. When chemically-gated Na^+ channels open, the membrane
A. hyperpolarizes
B. repolarizes
C. depolarizes
D. becomes more negative
E. is inhibited

15. When a membrane is stimulated due to opening of either chemically-gated Na^+ or Cl^- channels:
A. An impulse is propagated.
B. A graded potential is established.
C. An action potential is established.
D. The voltage becomes more negative.
E. Threshold is reached.

16. An action potential on a neuron develops when
A. threshold voltage is reached on an axon
B. voltage-gated Na^+ channels open
C. spatial and/or temporal summation of graded potentials occurs to a great enough degree
D. the axon hillock reaches threshold
E. all of these

17. Myelinated axons conduct impulses much faster because
A. The myelin insulates the axon.
B. Channels only have to open at the nodes.
C. Voltage is not lost along myelinated areas.
D. Saltatory conduction occurs.
E. All of these.

18. At the peak of an action potential:
A. The electrical gradient for Na^+ causes a net movement of this ion out of the cell.
B. The concentration gradient for K^+ tends to move this ion out of the cell.
C. K^+ permeability greatly increases.
D. All of these.
E. The concentration gradient for K^+ tends to move this ion out of the cell, and K^+ permeability greatly increases.

19. Which statement is not accurate about the absolute refractory period?
A. Another stimulus, regardless of its strength, cannot initiate another action potential during this period.
B. During this period, voltage-gated Na^+ channels open, then close but are inactivated.
C. Immediately following this period, the membrane can experience another action potential if the stimulus is strong enough.
D. This period occurs during the after hyperpolarization phase of the action potential.
E. This period ensures a unidirectional spread of the action potential down a nerve fiber.

20. Because of the presence of both activation and inactivation gates, voltage-gated Na^+ channels can
A. be closed but capable of opening
B. be activated
C. be closed and not capable of opening
D. all of these
E. none of these

21. What is responsible for development of the resting membrane potential?
A. leak channels
B. gated channels
C. ion pumps
D. leak channels and gated channels
E. leak channels and ion pumps

22. The membrane is more permeable to K^+ than to Na^+
A. at resting potential
B. during the rising phase of an action potential
C. during the rising phase of a graded potential
D. at resting potential and during the rising phase of an action potential
E. at resting potential and during the rising phase of a graded potential

23. When the membrane potential is +15 mV, that portion of the membrane
A. is in the normal resting state
B. has a more positive outside border
C. is more permeable to Ca^{2+} than normal
D. is in the after hyperpolarization phase of an action potential
E. has a more positive outside border and is more permeable to Ca^{2+} than normal

24. Conduction by local current flow
A. occurs in unmyelinated fibers
B. is faster than propagation of an action potential in myelinated fibers because myelin acts as an insulator to slow down the impulse
C. involves current flowing between active and adjacent inactive areas, thereby bringing the inactive areas to threshold
D. all of these
E. occurs in unmyelinated fibers and involves current flowing between active and adjacent inactive areas, thereby bringing the inactive areas to threshold

25. Saltatory conduction
A. occurs in unmyelinated nerve fibers
B. is slower than conduction by local current flow because the myelin acts as an insulator to slow the impulse down
C. involves the impulse jumping from one node of Ranvier to the adjacent node
D. refers to the action potential spreading from one Schwann cell to the adjacent Schwann cell
E. more than one of these

26. Which statement is incorrect?
A. A local current can occur in myelinated nerve fibers.
B. A local current flow from an active to an adjacent inactive area decreases the potential in the inactive area to threshold.
C. Contiguous conduction occurs along Schwann cells that surround myelinated nerve fibers.
D. Saltatory conduction is faster than contiguous conduction.
E. Conduction by local current flow is the method of propagation in unmyelinated fibers.

27. Select the incorrect statement about the action potential.
A. It has an all-or-none characteristic.
B. It has a refractory period.
C. It is triggered by depolarization to threshold.
D. It occurs along a plasma membrane.
E. It speeds up transmission by summation.

28. Permeability of which ion is affected by a positive feedback mechanism once threshold is reached?
A. sodium
B. potassium
C. calcium
D. chloride
E. protein

29. During the peak of the action potential, the membrane becomes most permeable to
A. sodium
B. potassium
C. calcium
D. chloride
E. protein

30. If a neuron were experimentally stimulated at both ends simultaneously:
A. The action potentials would pass in the middle and travel to the opposite ends.
B. The action potentials would meet in the middle and then be propagated back to their starting positions.
C. The action potentials would stop as they met in the middle.
D. The strongest action potential would override the weaker action potential.
E. Summation would occur when the action potentials met in the middle, resulting in a larger action potential.

31. Which statement about graded potentials is false?
A. They are decremental.
B. They travel only short distances.
C. They are self-propagating.
D. They may contribute to the development of an action potential.
E. They travel in both directions along the membrane.

32. The absolute refractory period
A. prevents action potentials from spreading forward and backward
B. refers to a period when the membrane cannot undergo another action potential
C. is the time when channels opened during the action potential have not been restored to their "closed but capable of opening" conformation
D. places an upper limit on the frequency with which a neuron can conduct action potentials
E. refers to a period when the membrane cannot undergo another action potential and places an upper limit on the frequency with which a neuron can conduct action potentials

33. The period following an action potential during which a membrane cannot experience another action potential
A. is the absolute refractory period
B. occurs during the time after the Na^+ gates have opened until they are restored to their "closed but capable of opening" conformation
C. prevents the action potential from spreading back over the part of the membrane where the impulse has just passed
D. is the absolute refractory period and occurs during the time after the Na^+ gates have opened until they are restored to their "closed but capable of opening" conformation
E. all of these

34. The relative refractory period occurs after the action potential is complete because of the
A. lingering inactivation of the voltage-gated Na^+ channels
B. slowness of the voltage-gated K^+ channels
C. action of the sodium-potassium pumps
D. lingering inactivation of the voltage-gated Na^+ channels and slowness of the voltage-gated K^+ channels
E. slowness of the voltage-gated K^+ channels and action of the sodium-potassium pumps

35. The trigger zone of a neuron
A. is located where the axon connects to the neuron's cell body
B. is located in the axon terminal
C. contains only chemically gated channels
D. conducts graded potentials to the axon
E. contains only chemically gated channels and conducts graded potentials to the axon

36. If neuron Z is repeatedly stimulated very rapidly, what change would you expect in the postsynaptic neuron?
A. several simultaneous action potentials
B. movement farther away from threshold
C. spatial summation of EPSPs
D. movement farther away from threshold and spatial summation of EPSPs
E. none of these

37. Temporal summation on a postsynaptic neuron takes place when
A. a single presynaptic input causes two EPSPs to develop in rapid succession
B. an EPSP and an IPSP occur simultaneously and cancel each other out
C. two EPSPs develop simultaneously from different presynaptic inputs
D. two action potentials from two presynaptic inputs causes two action potentials to develop
E. none of these

38. Spatial summation occurs in a postsynaptic neuron
A. when several EPSPs from a single presynaptic input sum to reach threshold
B. when EPSPs from several presynaptic inputs sum to reach threshold
C. upon simultaneous interaction of an EPSP and an IPSP
D. when several IPSPs from a single presynaptic input sum to hyperpolarize the membrane
E. none of these

39. At an excitatory synapse, an action potential in the presynaptic neuron increases the
A. membrane potential of the postsynaptic cell membrane
B. permeability of the postsynaptic cell to both Na^+
C. permeability of the postsynaptic cell to Cl^-
D. all of these
E. membrane potential of the postsynaptic cell membrane and permeability of the postsynaptic cell to both Na^+

40. At an inhibitory synapse, the postsynaptic membrane experiences
A. an increase in permeability to both Na^+ and K^+
B. an increase in membrane potential
C. hyperpolarization
D. an increase in membrane potential and hyperpolarization
E. all of these

41. An IPSP is
A. produced by increased Na^+ permeability and K^+ permeability
B. produced by increased K^+ permeability or increased Cl^- permeability
C. a hyperpolarization of the presynaptic cell
D. produced by increased Na^+ permeability and K^+ permeability and a hyperpolarization of the presynaptic cell
E. produced by increased K^+ permeability or increased Cl^- permeability and a hyperpolarization of the presynaptic cell.

42. Which channel type is sensitive to serotonin?
A. voltage-gated
B. chemically-gated
C. mechanically-gated
D. acoustically-gated
E. none of these

43. Sequence the following events correctly.

Neurotransmitter diffuses across cleft.	1.
Calcium induces exocytosis of neurotransmitter.	2.
Permeability of postsynaptic membrane altered.	3.
Ion channels open.	4.
Neurotransmitter binds to receptor.	5.

A. 1, 2, 3, 5, 4
B. 1, 4, 3, 2, 5
C. 2, 1, 5, 4, 3
D. 3, 1, 4, 5, 2
E. 5, 4, 3, 1, 2

44. Which statement is incorrect?
A. Inhibitory synapses cause postsynaptic hyperpolarization.
B. An inhibitory synapse may result in postsynaptic sodium channel opening.
C. Inhibitory synapse may result in increased postsynaptic potassium efflux.
D. An excitatory synapse causes depolarization of postsynaptic membranes.
E. An excitatory synapse increases sodium permeability.

45. Which statement is correct?
A. In presynaptic inhibition, another neuron inhibits an excitatory presynaptic input.
B. An IPSP depresses information fed into the cell from an inhibitory presynaptic input.
C. Not all axon terminals of an inhibitory neuron release inhibitory neurotransmitter.
D. When presynaptic inhibition takes place, there is no change in presynaptic membrane potential.
E. An IPSP decreases the potential of the postsynaptic neuron.

46. Neuron A and neuron B release a minimal amount of neurotransmitter simultaneously onto neuron C, causing neuron C to experience an action potential. This is an example of
A. temporal summation
B. spatial summation
C. convergence
D. temporal summation and convergence
E. spatial summation and convergence

47. The nucleus of a neuron is housed in the
A. axon
B. axon hillock
C. cell body
D. collaterals
E. dendrites

48. Select the normal direction for the movement of an action potential along part of a neuron.
A. axon hillock to cell body
B. axon terminal to collateral axon
C. axon to dendrite
D. cell body to receptor
E. dendrite to cell body

49. With presynaptic inhibition:
A. An IPSP occurs on the postsynaptic cell.
B. All excitatory information being fed into the cell is prevented.
C. The release of excitatory transmitter from a specific presynaptic excitatory input is depressed.
D. More than one of these.
E. None of these.

50. A hypothetical postsynaptic neuron has three presynaptic inputs¾X, Y, and Z. When X and Y are stimulated simultaneously, the postsynaptic neuron undergoes an action potential, yet when X and Z are stimulated simultaneously, there is no change in the postsynaptic neuron's potential. What can you tell about neurons Y and Z?
A. Y and Z are both excitatory.
B. Y and Z are both inhibitory.
C. Y is excitatory and Z is inhibitory.
D. Y is inhibitory and Z is excitatory.
E. Not enough information to answer.

51. The nodes of Ranvier are
A. action potential recordings
B. breaks in the myelin covering
C. spaces between neurons
D. specialized cells around axons
E. all of these, except action potential recordings

52. In divergence:
A. Many presynaptic neurons synapse with one postsynaptic cell.
B. Dendrites diverge from the cell body to contact many presynaptic neurons.
C. The action potential initiated in the axon diminishes as it spreads into the axon terminals.
D. An axon branches to synapse with many cells so that activity in one neuron influences the excitability of many other cells.
E. Many axons spread out from one cell body.

53. Which statement about a graded potential is false?
A. It can be a depolarization.
B. It can be a hyperpolarization.
C. It can be summated.
D. It has a refractory period.
E. It occurs in a specialized area of the membrane.

54. In convergence:
A. Many presynaptic cells can synapse with a single postsynaptic cell.
B. An axon branches so that the activity in one neuron influences many other cells.
C. Many dendrites converge on the cell body.
D. All of these.
E. None of these.

55. Neuromodulators
A. bind to receptors at nonsynaptic sites
B. do not contribute directly to EPSPs
C. do not contribute directly to IPSPs
D. may influence neurotransmitter production
E. all of these

56. Presynaptic facilitation results from
A. alteration of calcium permeability
B. continued generation of EPSPs
C. neuromodulator effects
D. increased neurotransmitter production
E. none of these

57. Drugs may influence synaptic transmission by
A. altering the formation of neurotransmitters
B. blocking neurotransmitter reuptake
C. blocking receptors
D. blocking channels
E. all of these

58. Select the last step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron.
A. A neurotransmitter is released by exocytosis.
B. Calcium flows in the synaptic knob.
C. The neurotransmitter combines with protein receptor sites on the subsynaptic membrane.
D. The permeability is altered in a postsynaptic neuron.
E. None of these.

59. Select the first step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron.
A. A neurotransmitter is released by exocytosis.
B. Calcium flows into the synaptic knob.
C. The neurotransmitter combines with protein receptor sites on the subsynaptic membrane.
D. The permeability is altered in a postsynaptic neuron.
E. The neurotransmitter is synthesized.

60. Select the neuropeptide.
A. acetylcholine
B. dopamine
C. epinephrine
D. cholecystokinin
E. glycine

61. Neuropeptides
A. are sometimes co-secreted along with classical neurotransmitters
B. are synthesized in the cytosol of the axon terminal
C. act at the subsynaptic membrane of the postsynaptic neuron
D. all of these
E. are sometimes co-secreted along with classical neurotransmitters and are synthesized in the cytosol of the axon terminal

62. Tetanus toxin
A. combines with glycine receptors, thus blocking the action of this inhibitory neurotransmitter
B. destroys dopamine in the region of the brain involved in controlling complex movements
C. prevents the release of GABA onto inputs terminating on neurons that supply skeletal muscles
D. promotes presynaptic facilitation
E. causes retrograde flow in axon

63. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurotransmitter from X causes a slight hyperpolarization of the postsynaptic cell, then the
A. synapse is excitatory
B. synapse is inhibitory
C. synapse could be excitatory or inhibitory
D. postsynaptic cell's membrane potential has decreased
E. synapse is excitatory and the postsynaptic cell's membrane potential has decreased

64. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

What changes would you expect at the postsynaptic neuron when neuron X is stimulated? (Remember that the postsynaptic neuron becomes hyperpolarized by neuron X.)
A. increased P_{Na+} and P_{K+}
B. increased P_{K+} or P_{Cl-}
C. increased P_{A-}
D. increased P_{Ca2+}
E. none of these

65. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurotransmitter from Y causes the membrane potential of the postsynaptic cell to decrease slightly, then the

A. synapse is excitatory
B. postsynaptic membrane's potential will be farther away from threshold
C. postsynaptic membrane could be excitatory or inhibitory
D. neurotransmitter from Y causes an IPSP on the presynaptic membrane
E. postsynaptic membrane's potential will be farther away from threshold, and the neurotransmitter from Y causes an IPSP on the presynaptic membrane

66. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

What would you expect at the postsynaptic neuron when neuron Y is stimulated? (Remember that the postsynaptic neuron's membrane potential is decreased by neuron Y.)

A. increased P_{Na+} and P_{K+}
B. increased P_{K+} or P_{Cl-}
C. increased P_{A-}
D. increased P_{Ca2+}
E. none of these

67. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurons Y and Z receive simultaneous stimulation, what change would you expect in the postsynaptic neuron?

A. a single EPSP
B. a single IPSP
C. temporal summation of EPSPs
D. spatial summation of EPSPs
E. an IPSP and EPSP would cancel each other out, so there would be essentially no change in potential in the postsynaptic neuron

68. **For the following questions, assume a hypothetical postsynaptic neuron has three presynaptic inputs: neurons X, Y, and Z. Also, assume neuron Z is excitatory.**

If neurons X and Z receive simultaneous stimulation, what change would you expect in the postsynaptic neuron?
A. a single EPSP
B. a single IPSP
C. temporal summation of EPSPs
D. spatial summation of EPSPs
E. an IPSP and EPSP would cancel each other out, so there would be essentially no change in potential in the postsynaptic neuron

69. Nerve and muscle cells establish resting membrane potentials.
TRUE

70. In a graded potential, the direction of current flow is designated by the movement of positive charges.
TRUE

71. The passive current flow of a graded potential fades quickly.
TRUE

72. The Na^+ and K^+ channels that open and close during an action potential are voltage-gated channels.
TRUE

73. A spike is another name for the axon of a neuron.
FALSE

74. Threshold potential is the peak potential achieved during an action potential.
FALSE

75. After an action potential has occurred, there is more Na^+ inside the cell than outside the cell (before any Na^+-K^+ pump activity has taken place).
FALSE

76. During the resting potential, the membrane is more permeable to potassium ions than to sodium ions.
TRUE

77. Action potentials can be summed.
FALSE

78. Action potentials may result from hyperpolarization or depolarization.
FALSE

79. For graded potentials, the magnitude of triggering is coded for in frequency rather than amplitude of depolarizations.
FALSE

80. Schwann cells promote axonal growth, while oligodendrocytes inhibit it.
TRUE

81. The refractory period limits the frequency of action potentials.
TRUE

82. The diffusion of potassium ions reestablishes the resting membrane potential in a neuron immediately after it develops an action potential.
TRUE

83. Local current flows locally between active and adjacent inactive areas of the cell membrane, thereby decreasing the potential in the inactive area to threshold.
TRUE

84. Along a neuron, an action potential normally travels from the dendrites to the cell body to the axon.
TRUE

85. Nerve fiber is another name for a dendrite on a neuron.
FALSE

86. The nodes of Ranvier are Schwann cells or oligodendrocytes that wrap themselves "jelly roll fashion" around the axon.
FALSE

87. The myelin on a myelinated fiber in the peripheral nervous system is part of Schwann cells wrapped around the axon.
TRUE

88. The myelin covering the axon promotes the leakage of ions from an axon, but it promotes conservation of ATP in the neuron.
FALSE

89. The conduction velocity of a nerve impulse is slower in myelinated fibers than in unmyelinated fibers because myelin acts as an insulator that slows down the flow of current.
FALSE

90. An unmyelinated fiber with a large diameter can conduct action potentials more rapidly than an unmyelinated fiber with a smaller diameter.
TRUE

91. Myelinated fibers throughout the nervous system can regenerate when cut, but unmyelinated fibers cannot regenerate.
FALSE

92. Oligodendrocytes form a regeneration tube to guide a regenerating nerve fiber to its proper destination.
FALSE

93. Multiple sclerosis is an autoimmune disease in which the body's defense system erroneously attacks the myelin sheath surrounding myelinated nerve fibers.
TRUE

94. One "strong" stimulus can cause more than one action potential, but a "weak" stimulus may or may not generate an action potential.
FALSE

95. Multiple sclerosis develops from a buildup of myelin of a neuron.
FALSE

96. Cocaine blocks the binding of dopamine at postsynaptic membranes.
FALSE

97. Oligodendrocytes are specialized to conduct electrical impulses to neurons.
FALSE

98. Action potentials are initiated at the axon hillock region because it has the lowest threshold voltage.
TRUE

99. The time following an action potential during which a membrane cannot respond to another stimulus, regardless of its strength, is called the relative refractory period.
TRUE

100. The refractory period prevents action potentials from spreading back over the part of the membrane where the impulse has just passed.
TRUE

101. During the relative refractory period, a neuron can experience hyperpolarization but not depolarization.
FALSE

102. During the absolute refractory period, the voltage-gated Na^+ channels are not capable of opening again in response to another triggering event.
TRUE

103. A stimulus that is too weak to depolarize the membrane to threshold produces an action potential that is weaker than normal.
FALSE

104. G proteins in the plasma membrane of certain cells may become activated in response to the binding of water-soluble hormones, whereas protein phosphatases are continuously active in these cells.
TRUE

105. Hormones derived from cholesterol are bound to proteins in the blood and primarily alter preexisting proteins via second-messenger systems.
FALSE

106. A postsynaptic neuron can either excite or inhibit a presynaptic neuron.
FALSE

107. Presynaptic inhibition is brought about when dendrites of a postsynaptic neuron alter the signals sent from an axon terminal of a presynaptic neuron.
FALSE

108. A single neuron may be presynaptic to one group of neurons and postsynaptic to another group of neurons.
TRUE

109. The tyrosine-kinase pathway is activated in response to certain lipophilic hormones, whereas the second messenger pathway is activated in response to certain hydrophilic hormones.
FALSE

110. Increased permeability of the postsynaptic cell to Cl^- lessens the likelihood that the postsynaptic cell will undergo an action potential.
TRUE

111. Amplification is a phenomenon associated with hormones derived from cholesterol.
FALSE

112. A given synapse may produce EPSPs at one time and IPSPs at another time.
FALSE

113. A lipophilic chemical messenger uses a second messenger system to alter the activity of a target cell.
FALSE

114. A balance of IPSPs and EPSPs will negate each other so that the grand postsynaptic potential is essentially unaltered.
TRUE

115. Common second messengers include cAMP, acetylcholine, and calcium ions.
FALSE

116. Apoptosis refers to the uncontrolled, accidental death of useful cells that have been severely injured.
FALSE

117. Lipophilic hormones bind to hormone response elements on DNA, which then initiates steps in the formation of new protein molecules.
TRUE

118. Most endocrine glands secrete paracrine substances that function as neurohormones.
FALSE

119. Neuropeptides are mainly neuromodulators that function as second messengers in cells that respond to hydrophilic hormones.
FALSE

120. The grand postsynaptic potential depends on the sum of activity of the presynaptic inputs.
TRUE

121. Adenylyl cyclase and diacylglycerol are more associated with hydrophilic hormones than with lipophilic hormones.
TRUE

122. Divergence refers to the neuronal arrangement wherein the dendrites diverge to synapse with as many presynaptic inputs as possible.
FALSE

123. Classical neurotransmitters and neuropeptides are sometimes co-secreted from the same axon terminal.
TRUE

124. **Complete each of the following statments.**

The resting membrane potential of a typical nerve cell is about _____ millivolts.
-70

125. **Complete each of the following statments.**

A plasma membrane is polarized if it separates particles with an opposite _____.
charge

126. **Complete each of the following statments.**

At _____ potential, typically around -55 mv, rapid depolarization occurs.
threshold

127. **Complete each of the following statments.**

Opening channels that allow _____ ions or _____ ions result in depolarization of the plasma membrane.
Na+, Ca2+

128. **Complete each of the following statments.**

_____ is the hindrance to electrical charge movement.
Resistance

129. **Complete each of the following statments.**

The chemical called _____ along axons reduces resistance and, hence, increases impulse velocity.
myelin

130. **Complete each of the following statments.**

At the end of repolarization, the newly opened channels for _____ ions close.
K+

131. **Complete each of the following statments.**

When a neuron starts to depolarize, _____ ions move into the cell.
sodium

132. **Complete each of the following statments.**

A single nerve cell or _____ typically consists of the following three basic parts: _____, _____, and _____.
neuron, cell body, dendrites, axon

133. **Complete each of the following statments.**

The _____ or _____ of a neuron is a single, elongated tubular process that conducts action potentials away from the cell body and eventually terminates at other cells.
axon, nerve fiber

134. **Complete each of the following statments.**

Axons can range in length from less than a millimeter to over one _____.
meter

135. **Complete each of the following statments.**

During the resting membrane potential, the inside of a neuron has a net _____ charge.
negative

136. **Complete each of the following statments.**

An increase in the size of the _____ of a nerve fiber, along with the amount of _____ around the fiber both increase its rate of conduction.
diameter, myelin

137. **Complete each of the following statments.**

An action potential in a presynaptic neuron induces opening of voltage-gated _____ channels in the synaptic knob, which triggers exocytosis of synaptic vesicles.
Na+

138. **Complete each of the following statments.**

_____ cells form myelin around neurons in the PNS, whereas _____ form myelin around neurons in the CNS.
Schwann, oligodendrocytes

139. **Complete each of the following statments.**

Myelinated fibers conduct impulses about _____ times faster than unmyelinated fibers of the same diameter.
50

140. **Complete each of the following statments.**

_____-soluble hormones must use _____ systems to exert their effects on target cells.
Water, second-messenger

141. **Complete each of the following statments.**

_____ are chemical messengers that bind to neuronal receptors at nonsynaptic sites and alter the effectiveness of ongoing synaptic activity.
Neuromodulators

142. **Complete each of the following statments.**

When EPSPs occurring simultaneously from two different presynaptic inputs add together or sum to bring the postsynaptic cell to threshold, it is called _____.
spatial summation

143. **Complete each of the following statments.**

Schwann cells stimulate the formation of a(n) _____ tube to rebuild damaged neurons.
regeneration

144. **Complete each of the following statments.**

When EPSPs originating from a single presynaptic input occur so close together in time that they add together or sum, thereby bringing the postsynaptic cell to threshold, it is called _____.
temporal summation

145. **Complete each of the following statments.**

The neuronal relationship where a single presynaptic cell branches to terminate on many other cells is called _____.
divergence

146. **Complete each of the following statments.**

The neuronal relationship where many presynaptic cells terminate on a single postsynaptic cell is called _____.
convergence

147. **Complete each of the following statments.**

Opening a chemically-gated _____ channel or _____ channel will increase the membrane potential of a plasma membrane.
K+, Cl-

148. **Complete each of the following statments.**

_____ are local chemical messengers that exert an effect only on neighboring cells in the immediate environment.
Paracrines

149. **Complete each of the following statments.**

_____ are chemical messengers that do not cause the formation of EPSPs or IPSPs but rather bring about long-term changes that depress or enhance the action of the synapse.
Neuromodulators

150. **Complete each of the following statments.**

One presynaptic neuron can only produce _____ summation on a postsynaptic neuron.
temporal

151. **Complete each of the following statments.**

_____ move through the axon before being released from the synaptic knob and then bind to nonsynaptic receptors; whereas, _____ are made in the cytosol of the synaptic knob and after their release bind to subsynaptic receptors.
Neuromodulators, neurotransmitters

152. **Complete each of the following statments.**

Axon terminals possess _____ voltage-gated channels that when operational induce neurotransmitter release.
calcium

153. **Complete each of the following statments.**

_____ are released into the blood by neurosecretory neurons.
Neurohormones

154. **Complete each of the following statments.**

Intentional, programmed cell death is called _____.
apoptosis

155. **Complete each of the following statments.**

_____ is a second messenger formed when a membrane enzyme called a cyclase becomes activated by a G protein.
cAMP

156. Choose the match for each substance listed.

4	neurotransmitter 1. Dendrite
3	impulse-conducting region 2. Synapse
1	branching process from a cell body 3. Axon
5	covering on the axon 4. Acetylcholine
2	junction between neurons 5. Myelin

157. Use the answer code below to answer this section.

	1. Ion movement responsible for the rising phase
2	increased P_{Na+} of the action potential
	decreased P_{Na+} and
3	increased P_{K+} 2. Permeability change that occurs at threshold
	3. Two permeability changes that occur at the
1	Na influx peak of an action potential
	4. Ion movement responsible for the falling phase
4	K^+ efflux of the action potential

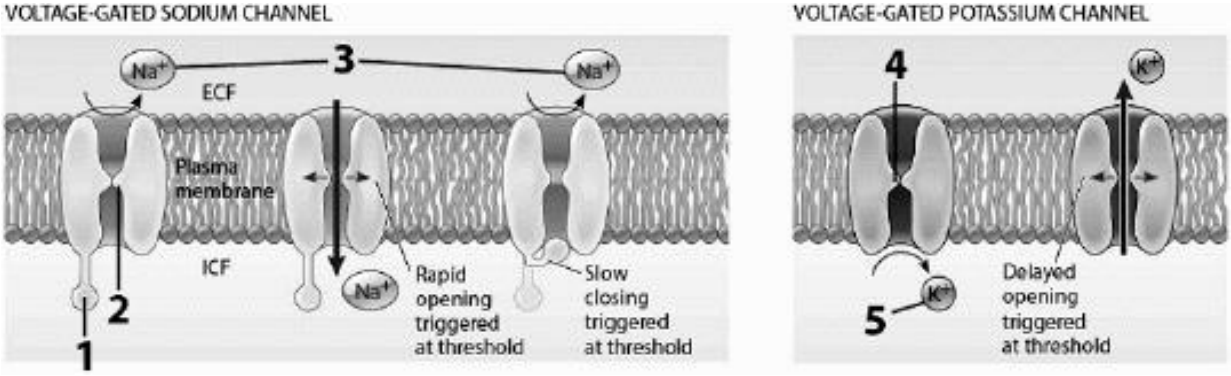
158. Assume that a hypothetical neuron has three presynaptic inputs: A and B are excitatory, and C is inhibitory. Indicate which of the following changes will take place.

	1. What would occur if both presynaptic neurons
2	temporal summation A and B were fired simultaneously?
	2. What would occur if presynaptic neuron B
1	spatial summation were fired rapidly?
	no change in potential of3. What would occur if both presynaptic neurons
3	the postsynaptic cell A and C were fired simultaneously?

159. Match neural disease/influence with correct characteristic.

2	roseola 1. Destroys myelin
4	tetanus 2. May predispose a person to multiple sclerosis
1	multiple sclerosis 3. Competes with glycine for receptors
5	Parkinson's disease 4. Prevents release of GABA
3	strychnine 5. Due to insufficient dopamine

160.

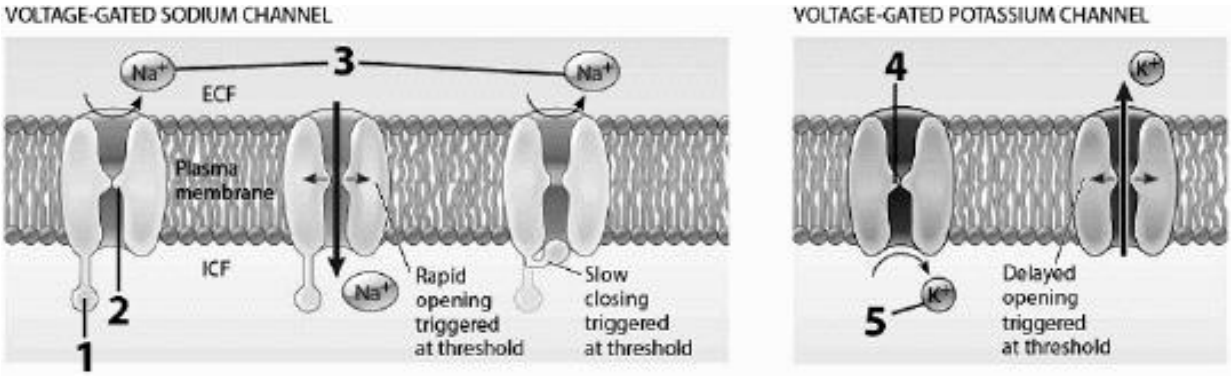


Use these figures to answer the corresponding questions.

The structure labeled "1" is

part of a chemically-gated channel	a.
part of a mechanically-gated channel	b.
the activation gate of a Na^+ channel	c.
part of a chemically-gated channel and the activation gate of a Na^+ channel	d.
none of these	e.

b

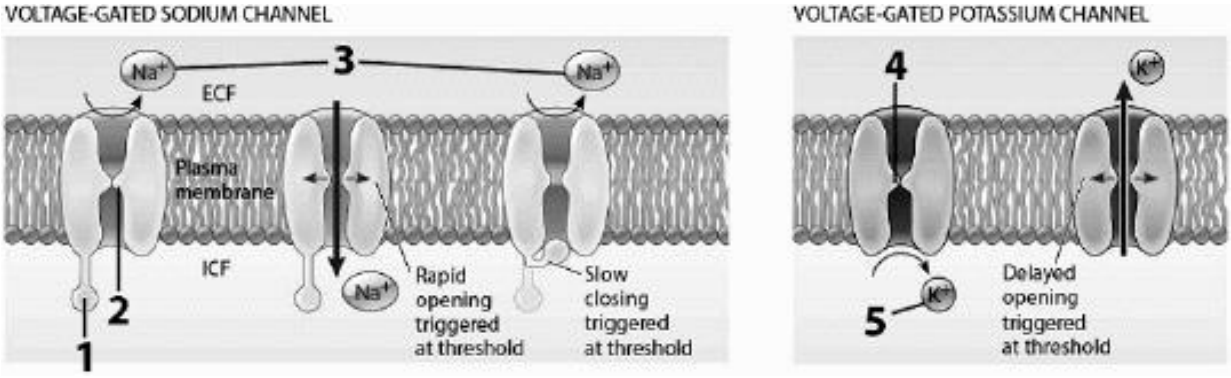
161. 

Use these figures to answer the corresponding questions.

Which number identifies the structure that is primarily responsible for the absolute refractory period during an action potential?

1	a.
2	b.
3-5	c.
4	d.
No number identifies this structure.	e.

a

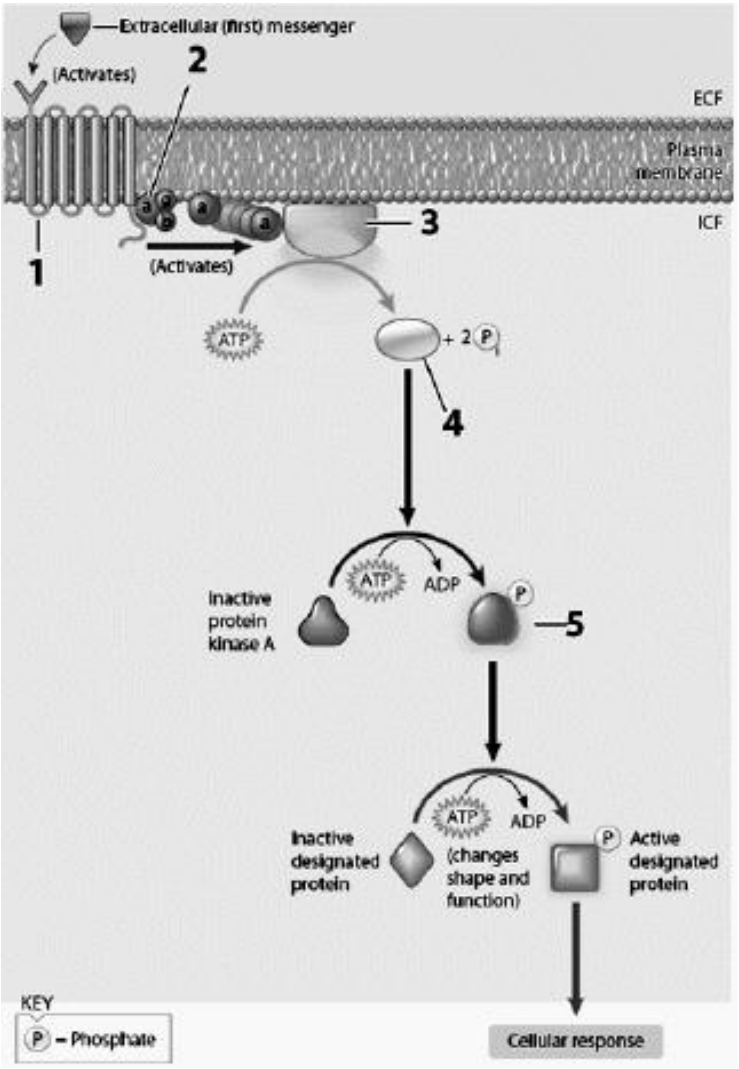
162. 

Use these figures to answer the corresponding questions.

The structure labeled "4" is

part of a channel that allows Na^+ ions to diffuse into the ECF	a.
the activation gate for a gated K^+ channel	b.
the inactivation gate for a gated Na^+ channel	c.
part of a second messenger system	d.
the activation gate for a gated K^+ channel and part of a second messenger system	e.

b

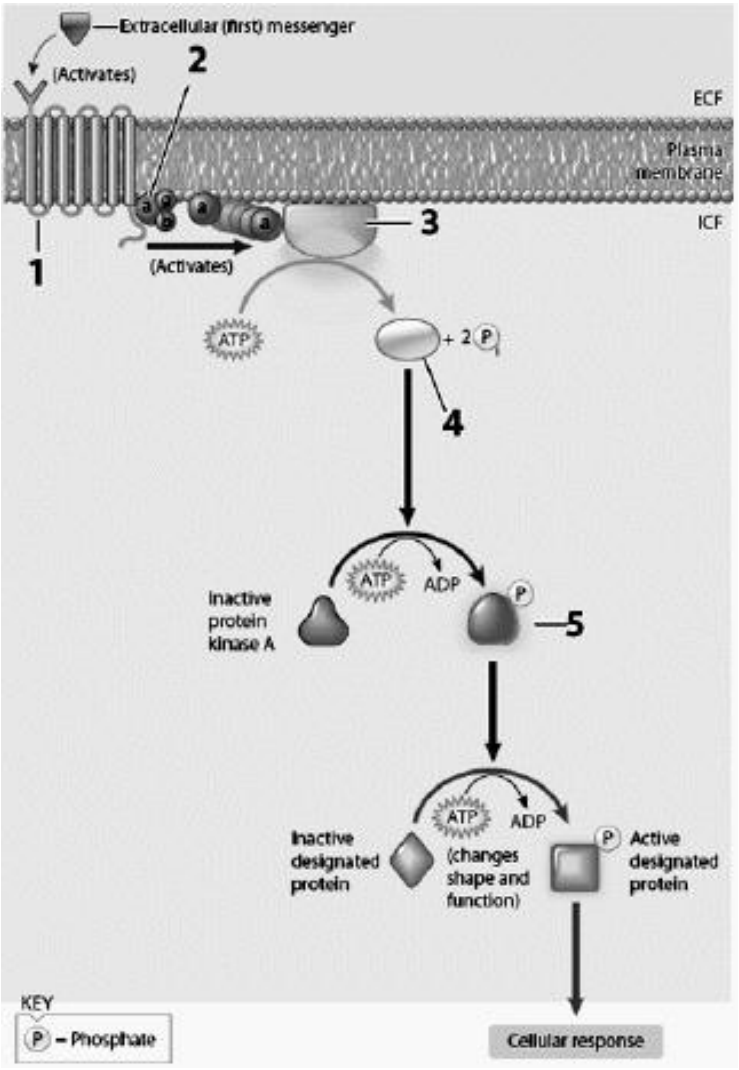
163. 

Use this figure to answer the corresponding questions.

This figure shows

the mechanism by which some lipid-soluble hormones affect their target cells	a.
the way insulin affects certain cells	b.
the method in which IP_3 forms	c.
a common second messenger system for hormone that is derived from cholesterol	d.
none of these	e.

b

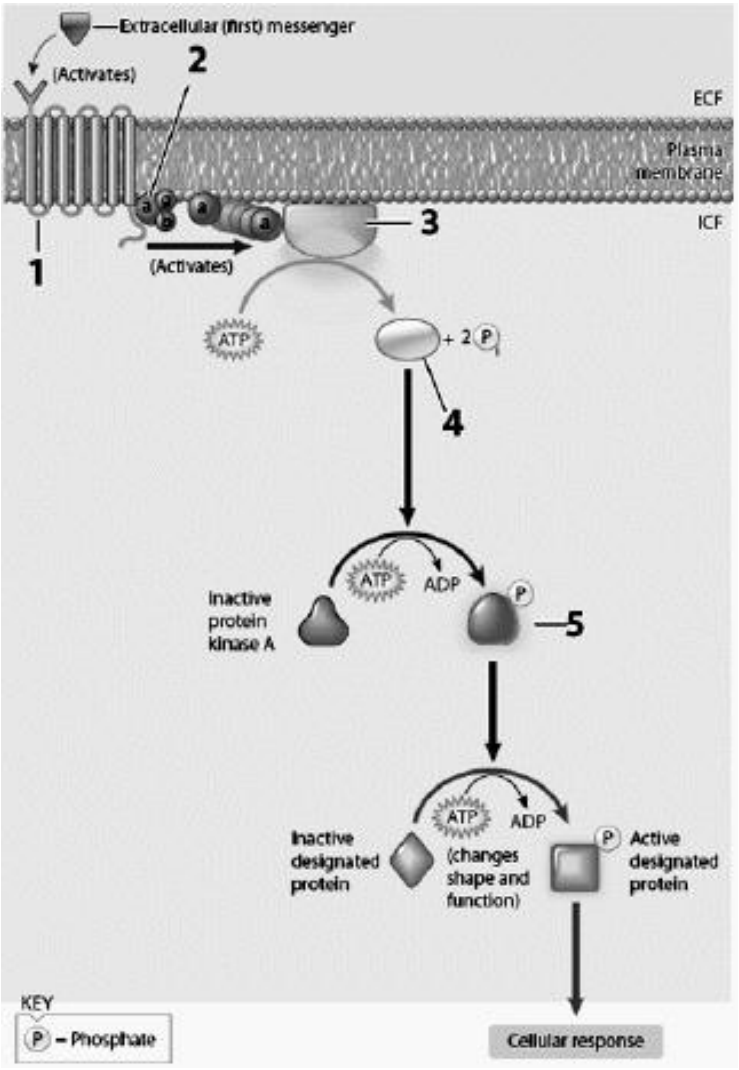
164. 

Use this figure to answer the corresponding questions.

Label "3" is

a second messenger	a.
an active kinase protein	b.
a G protein	c.
a G protein coupled receptor	d.
an inactive kinase protein	e.

c

165. 

Use this figure to answer the corresponding questions.

A second messenger is labeled

1	a.
2	b.
3	c.
4	d.
5	e.

d

166. Describe an action potential and explain why a region of the membrane that is in the absolute refractory period cannot experience another action potential until repolarization is complete. Include the following in your answer: voltage-gated Na^+ channels, voltage-gated K^+ channels, activation gate, inactivation gate, threshold voltage, increasing membrane potential, and decreasing membrane potential.

When a voltage-gated Na+ channel is at rest, its inactivation gate is open and its activation gate is closed. When threshold voltage is reached, the activation gate opens and allows Na^+ ions to diffuse into the cell; this action decreases the membrane potential to the point that the potential becomes positive. At the peak of the depolarization event, the activation and inactivation gates in the Na^+ channels close, but the voltage-gated K+ channels open. As K^+ ions diffuse out of the cell, the membrane potential increases; i.e., the membrane repolarizes. The inactivation gate in the Na+ channels will remain shut until the membrane potential has been completely repolarized. After repolarization, the inactivation gate will reopen. Now the membrane can respond to another stimulus.

167. How does a depolarizing graded potential lead to the propagation of action potentials?

A depolarizing graded potential does not reverse the polarity of the cell membrane, but it moves the potential closer to threshold voltage. If threshold voltage is reached, voltage-gated Na^+ channels in that region will open, causing an action potential in which the inside border of the membrane becomes positive. This reversal in polarity causes the membrane potential in the adjacent region to reach threshold, which causes voltage-gated Na^+ channels in that region to open. Thus, an action potential in one region will change the voltage in an adjacent region significantly enough to generate an action potential there. This process continues and allows the action potentials to be propagated along the plasma membrane.

168. What might happen on a postsynaptic neuron if, at the same time, it receives one stimulus at an excitatory synapse located close to the axon hillock but receives two stimuli at two different inhibitory synapses, both of which are far away from the axon hillock?

Since graded potentials diminish in intensity as they travel across a membrane, the closer to the axon hillock the stimulus is applied, the greater its effect. Therefore, one excitatory stimulus generating an EPSP near the axon hillock may be intense enough to reach threshold and initiate an action potential on the postsynaptic neuron, because the two IPSPs generated by the inhibitory neurons diminish as they move toward the axon hillock and may not be able to counteract the one EPSP generated near the hillock.

169. Neuron A is excitatory to neuron B. Describe three ways that the nervous system might prevent neuron B from experiencing an action potential.

Neuron A is not stimulated; therefore, it will not generate EPSPs on neuron B. *(1)*
Neuron A is actively inhibited by the formation of IPSPs on its dendrites and cell body; therefore, action potentials are not generated at A's axon hillock. *(2)*
Neuron A sends an impulse along its axon, but another neuron inhibits the release of neurotransmitter from A's axon terminal; this is presynaptic inhibition and no EPSPs are generated on B. *(3)*

170. What are four ways in which drugs might influence the nervous system at the neuronal level?

A drug or disease agent might:(1) alter the synthesis, transport, storage, or release of a neurotransmitter; (2) modify the way in which the neurotransmitter interacts with the postsynaptic receptor; (3) influence the neurotransmitters' reuptake or destruction; and (4) replace or substitute for a deficient neurotransmitter.