CHAPTER 2: STRUCTURE AND FUNCTIONS OF CELLS OF THE NERVOUS SYSTEM

Topic	Question Type	Factual	Conceptual	Application
Cells of the Nervous System	Multiple Choice	2,3,4,6,7,9,11,12,15 18-20,23,26-28,31-36,41	5,8,10,13,14,16,21-25,29,30,37.38,40	1,7,39
	True-False	1-5		
	Short-Answer Essay	1-3		
	Essay	1		
Communication Within a Neuron	Multiple Choice	42,45,47,50,51-55,57,61,64,67,75	43,44,46,48,49,56,62,63 65,66,68,69-74	
	True-False	6-13		
	Short-Answer Essay	4-6		
	Essay	2-3		
Communication Between Neurons	Multiple Choice	76,78,82,83,87,89,92,93,94	77,79,80,81,84,85,86,90	88
	True-False	14-19		
	Short-Answer Essay	7-9		
	Essay	4,5		

CHAPTER 2: STRUCTURE AND FUNCTIONS OF CELLS OF THE NERVOUS SYSTEM

2.1 Multiple Choice

1) The major symptom experienced by Katharyn D. in the chapter prologue was
A) manic symptoms while at her job.
B) taking a long time to get to sleep at night.
C) excessive tiredness.
D) seizure-like activity just prior to a meal.
E) the recurrence of thoughts of dread and doom.
Answer: C
Rationale: The major symptom experienced by Katharyn D. in the chapter prologue was excessive

tiredness.
Diff: 1 Page Ref: 20 Objective: Applied
LO: 2.1 APA: 1.1

2) _____ neurons gather information from the environment related to light, odors, and bodily contact with objects.
A) Sensory
B) Motor
C) Golgi
D) Relay inter-
E) Efferent
Answer: A
Diff: 1 Page Ref: 20 Objective: Factual
LO: 2.1 APA:1.1

3) _____ neurons function to contract muscles.
A) Sensory
B) Motor
C) Golgi
D) Afferent
E) Local inter-
Answer: B
Diff: 1 Page Ref: 20 Objective: Factual
LO: 2.1 APA: 1.1

4) Which of the following is correct regarding neurons?
A) Interneurons are located outside the brain and spinal cord.
B) Motor neurons gather information from the environment.
C) The number of neurons in the human nervous system is estimated at more than 100 billion.
D) Neurons are found only inside the brain and spinal cord.
E) The number of neurons in the human nervous system is estimated at less than 10 billion.
Answer: C
Diff: 3 Page Ref: 20-21 Objective: Factual
LO: 2.1 APA: 1.2

5) The _____ is comprised of the brain and spinal cord.
A) peripheral nervous system
B) central nervous system
C) enteric nervous system
D) brainstem
E) antebrain
Answer: B
Rationale: The central nervous system is comprise of the brain and spinal cord.
Diff: 2 Page Ref: 21 Objective: Conceptual
LO: 2.1 APA: 1.1

6) _____ are located entirely within the central nervous system.
A) Sensory neurons
B) Motor neurons
C) Relay interneurons
D) Efferent interneurons
E) Multipolar neurons.
Answer: C
Diff: 2 Page Ref: 20 Objective: Factual
LO: 2.1 APA:1.1

7) The _____ system is comprised of the nervous system outside of the brain and spinal cord.
A) peripheral nervous
B) central nervous
C) enteric nervous
D) corticospinal
E) corticospinal nervous
Answer: A
Diff: 2 Page Ref: 21 Objective: Factual
LO: 2.1 APA:1.1

8) The neuron region that resembles a tree is the
A) soma.
B) axon.
C) dendrites.
D) terminal buttons.
E) cell body.
Answer: C
Rationale: The neuron region that resembles a tree is the dendrites.
Diff: 2 Page Ref: 21 Objective: Conceptual
LO: 2.1 APA:1.1

9) The _____ contain(s) the nerve cell nucleus and functions to _____.
A) soma; provide for the life processes of the cell
B) axon; conduct action potentials
C) axon terminals; form the membrane of the nerve cell
D) dendrites; provide for the life processes of the cell
E) mitochondria; conduct action potentials
Answer: A
Diff: 1 Page Ref: 26 Objective: Factual
LO: 2.4 APA:1.1

10) The _____ carries information from the cell body out to the terminal buttons.
A) soma.
B) axon.
C) dendrites.
D) terminal buttons.
E) glia
Answer: B
Rationale: The axon carries information from the cell body out to the terminal buttons.
Diff: 2 Page Ref: 21 Objective: Conceptual
LO: 2.1 APA:1.1

11) The portion of a neuron that carries a signal toward the cell body is the
A) soma.
B) axon terminal.
C) presynaptic membrane.
D) dendrite.
E) glial membrane.
Answer: D
Diff: 1 Page Ref: 21-22 Objective: Factual
LO: 2.1 APA:1.1

12) The physical gap between two nerve cells across which messages are transmitted is the
A) glial junction.
B) axonal contact.
C) synapse.
D) dendritic apposition.
E) neural gap.
Answer: C
Diff: 1 Page Ref: 21 Objective: Factual
LO: 2.1 APA:1.1

13) The membranes that most commonly form synapses are the _____ and the _____.
A) axon terminals; dendrites
B) dendrites; soma
C) soma; glial
D) axon terminals; soma
E) glial cells; soma
Answer: A
Rationale: The membranes that most commonly form synapses are the axon terminals and the dendrites.
Diff: 3 Page Ref: 21 Objective: Conceptual
LO: 2.1 APA:1.2

14) Which of the following is true regarding the action potential (AP)?
A) The AP is carried along the glial membrane.
B) The AP is always of the same amplitude and duration in a given cell.
C) The AP is a graded signal.
D) The AP is a long-lasting electrical signal.
E) The AP is due to chloride currents.

Answer: B
Rationale: The action potential is always of the same amplitude and duration in a given cell.
Diff: 2 Page Ref: 22 Objective: Conceptual
LO: 2.1 APA: 1.2

15) The _____ neuron is the most common nerve cell type in the central nervous system.
A) apolar
B) multiglial
C) unipolar
D) bipolar
E) multipolar
Answer: E
Diff: 1 Page Ref: 22 Objective: Factual

LO: 2.2 APA:1.1

16) The _____ neuron has dendrite-like branches and transmits sensory information to the brain.
A) bipolar
B) multipolar
C) unipolar
D) apolar
E) tripolar
Answer: C
Rationale: The unipolar neuron has dendrite-like branches and transmits sensory information to the brain.
Diff: 2 Page Ref: 22 Objective: Conceptual
LO: 2.2 APA:1.2

17) An impaired ability to sense temperature and touch might be expected after damage to which type of nerve cell?
A) glial cells
B) multipolar neurons
C) unipolar neurons
D) Schwann cells
E) microglial cells
Answer: C
Rationale: An impaired ability to sense temperature and touch might be expected after damage to unipolar neurons.
Diff: 3 Page Ref: 22 Objective: Applied
LO: 2.2 APA:1.1

18) Neurotransmitter molecules are secreted from a(n) _____ in response to the arrival of an action potential.
A) glial cell
B) dendrite
C) axon terminal
D) mitochondrion
E) soma
Answer: C
Diff: 1 Page Ref: 22 Objective: Factual
LO: 2.2 APA:1.1

19) The membrane of a nerve cell is comprised of
A) protein molecules.
B) vesicle remnants.
C) a double layer of lipid molecules.
D) cytoplasm.
E) a double layer of protein molecules.
Answer: C
Diff: 1 Page Ref: 23 Objective: Factual
LO: 2.2 APA:1.1

20) A key function of specialized lipid molecules located in a nerve cell is to
A) detect the presence of chemicals inside the cell.
B) form the matrix that gives a neuron its shape..
C) form channels to carry ions into and out of the cell.

D) transport hormones into blood stream. E) induce DNA synthesis.
Answer: C
Diff: 1 Page Ref: 23 Objective: Factual
LO: 2.2 APA:1.1

21) Match up the correct pairing of each cell structure with its function.
A) mitochondria; production of cytoplasm
B) cytoskeleton; production of DNA
C) lipid bi-layer; formation of the cell membrane
D) synapse; production of ribosomes
E) microtubules; production of cytoplasm
Answer: C
Rationale: The lipid bi-layer of a cell forms the cell membrane.
Diff: 2 Page Ref: 23-24 Objective: Conceptual
LO: 2.2 APA:1.2

22) The recipes for generating individual proteins are contained within the
A) mitochondria.
B) cytoskeleton.
C) genes.
D) terminal buttons.
E) dendrites.
Answer: C
Rationale: The recipes for generating individual proteins are contained within the genes.
Diff: 2 Page Ref: 24 Objective: Conceptual
LO: 2.2 APA: 1.1

23) Enzymes
A) are formed from lipids.
B) are molecules that control chemical reactions.
C) control the aborption of glucose into cells..
D) provide energy to the cell.
E) form the boundary of a nerve cell..
Answer: B
Diff: 1 Page Ref: 24 Objective: Factual
LO: 2.2 APA:1.1

24) Match the correct function with the appropriate neuronal organelle.
A) mitochondria; extraction of energy from nutrients
B) mitochondria; formation of vesicles
C) microtubules; breakdown of proteins
D) microtubules; transport of chemicals across the synapse
E) cytoskeleton; extraction of energy from nutrients
Answer: A
Rationale: Mitochondria act to extract energy from nutrients.
Diff: 2 Page Ref: 23-24 Objective: Conceptual
LO: 2.2 APA:1.2

25) Which of the following is correct regarding axoplasmic transport?
A) Anterograde transport involves moving substances from the dendrites to the soma.
B) Retrograde transport involves moving substances from the soma to the axon terminals.

C) Vesicles are the major factor involved in retrograde transport.
D) Retrograde transport is half as fast as anterograde transport.
E) Vesicles are the major factor involved in anterograde transport.
Answer: D
Rationale: Retrograde transport is half as fast as anterograde transport.
Diff: 3 Page Ref: 24 Objective: Conceptual
LO: 2.2 APA: 1.1

26) _____ is made up of thirteen filaments arranged around a hollow core and is involved in axoplasmic transport.
A) The myelin sheath
B) The terminal button
C) A neurofilament
D) A nanotubule
E) A microtubule
Answer: E
Diff: 1 Page Ref: 24 Objective: Factual
LO: 2.2 APA:1.1

27) Match the correct function with the appropriate neuronal organelle.
A) cell membrane; production of fat-like molecules
B) mitochondria; formation of vesicles
C) DNA; breakdown of proteins
D) microtubules; transport of molecules between the soma and the axon terminals
E) cytoskeleton; extraction of energy for cell use
Answer: D
Diff: 1 Page Ref: 29 Objective: Factual
LO: 23-24 APA: 1.2

28) The _____ cells are the most important support cells of the central nervous system.
A) Schwann
B) glial
C) Golgi
D) platelet
E) microtubule
Answer: B
Diff: 1 Page Ref: 24 Objective: Factual
LO: 2.2 APA: 1.1

29) A key function of glial cells is to
A) provide nutrition to the brain.
B) remove physical debris from the blood.
C)secrete cerebrospinal fluid..
D) insulate a nerve cell from other nerve cells.
E) slow down conduction of action potentials.
Answer: D
Rationale: A key function of glial cells is to insulate a nerve cell from other nerve cells.
Diff: 3 Page Ref: 24-25 Objective: Conceptual
LO: 2.2 APA: 1.2

30) Which of the following is true of neurons?
A) Neurons have a high metabolic rate and require a continuous source of fuel.
B) The dendrites store nutrients and oxygen for later use by the soma of the neuron.
C) Dead neurons are consumed by other neurons.
D) Neurons make up 89 percent of the volume of the brain.
E) Dead glial cells are replaced by newly formed neurons.
Answer: A
Rationale: Neurons have a high metabolic rate and require a continuous source of fuel.
Diff: 2 Page Ref: 25 Objective: Conceptual
LO: 2.2 APA: 1.1

31) Oligodendrocytes perform which of the following functions?
A) physical support of nerve cells
B) provision of nourishment to neurons
C) clean up debris within the brain
D) regulation of the chemical environment in the fluid surrounding neurons
E) enhance conduction velocity along an axon.
Answer: E
Diff: 2 Page Ref: 25 Objective: Factual
LO: 2.2 APA:1.2

32) Which of the following glial cells are important for the supply of energy for neurons?
A) Schwann cells.
B) phagocytes
C) dendrocytes
D) astrocytes
E) nanotubules
Answer: D
Diff: 1 Page Ref: 25 Objective: Factual
LO: 2.2 APA:1.1

33) The process of phagocytosis involves
A) the removal of neuronal debris.
B) the transfer of lactate from a glial cell to a neuron.
C) the wrapping of layers of fatty material around an axon membrane.
D) structural support of a nerve cell.
E) the conversion of glycogen to glucose.
Answer: A
Diff: 1 Page Ref: 25 Objective: Factual
LO: 2.2 APA:1.1

34) Which of the following cells are important for the removal of nerve cell debris?
A) Schwann cells
B) phagocytes
C) dendrocytes
D) microglia
E) nanotubules
Answer: D
Diff: 1 Page Ref: 27 Objective: Factual
LO: 2.2 APA:1.1

35) Which of the following cells are important for the immune system reaction to brain damage?
A) Schwann cells
B) phagocytes
C) dendrocytes
D) astrocytes
E) microglia
Answer: E
Diff: 1 Page Ref: 27 Objective: Factual
LO: 2.2 APA: 1.2

36) The _____ are important for the process of myelination of nerve axon membranes in brain.
A) oligodendrocytes
B) microglia
C) astrocytes
D) neurocytes
E) Schwann cells
Answer: A
Diff: 1 Page Ref: 27 Objective: Factual
LO: 2.2 APA:1.1

37) Which of the following is true of Schwann cells?
A) Schwann cells are found within the brain.
B) Schwann cells provide myelin for central nerve cells.
C) A single Schwann cell wraps a single segment of a peripheral nerve cell.
D) A single Schwann cell myelinates up to 3 segments of axon membrane.
E) Schwann cells slow down conduction of action potentials along the axon.
Answer: C
Rationale: A single Schwann cell wraps a single segment of a peripheral nerve cell.
Diff: 3 Page Ref: 27 Objective: Conceptual
LO: 2.2 APA:1.1

38) The presence of a barrier between the blood stream and the brain is suggested by the observation that
A) all cells of the body are stained by a dye injected into the bloodstream.
B) injection of dye into the bloodstream stains all cells but those of the brain and spinal cord.
C) the gut is stained by a dye injected into the brain ventricles.
D) injection of dye into the ventricles stains all cells of the body.
E) most chemicals rapidly reach the brain after oral ingestion..
Answer: B
Rationale: The presence of a barrier between the blood stream and the brain is suggested by the observation that injection of dye into the bloodstream stains all cells but those of the brain and spinal cord.

Diff: 3 Page Ref: 27 Objective: Conceptual
LO: 2.2 APA:3.1

39) Activation of cells within the area postrema would be predicted to produce
A) stimulation of locomotion.
B) the experience of a visual hallucination.
C) consumption of a palatable food.
D) feelings of nausea and vomiting.
E) auditory hallucinations.

Answer: D
Rationale: Activation of cells within the area postrema would be predicted to produce feelings of nausea and vomiting.
Diff: 2 Page Ref: 28 Objective: Applied
LO: 2.2 APA:3.1

40) Which of the following is true of the blood-brain barrier?
A) The barrier is uniform throughout the brain.
B) The barrier is selectively permeable.
C) The barrier functions to regulate the chemical composition of the cerebrospinal fluid.D) The barrier is formed by Schwann cells that line the capillaries of the brain.
E)The barrier is formed by astrocytes.
Answer: B
Rationale: The blood-brain barrier is selectively permeable.Diff: 2 Page Ref: 27 Objective: Conceptual
LO: 2.2 APA:1.1

41) Toxic substances in the blood are detected at the _____ which in turn triggers vomiting.
A) cerebellum
B) blood-brain barrier
C) hypothamus
D) amygdala
E) area postrema
Answer: E
Diff: 2 Page Ref: 28 Objective: Factual
LO: 2.2 APA:1.2

42) Which of the following represents the normal order of activation in neuronal transmission?
A) axon -> dendrite -> cell body -> axon terminals
B) axon terminals -> cell body -> axon -> dendrite
C) dendrite -> cell body -> axon -> terminal button
D) cell body -> axon -> dendrite -> axon terminal
E) dendrite -> axon terminal -> cell body -> axon
Answer: C
Diff: 2 Page Ref: 29 Objective: Factual
LO: 2.3 APA:1.2

43) The simplest version of a withdrawal reflex involves a
A) pain receptor synapsing onto a motor neuron in the spinal cord.
B) pain receptor that projects to the thalamus, which then projects to motor cortex and then down to the spinal cord.
C) motor neuron within the spinal cord that is spontaneously active.
D) sensory neuron in visual cortex that synapses onto a motor neuron in the spinal cord.
E) muscle fiber connecting onto an interneuron.
Answer: A
Rationale: The simplest version of a withdrawal reflex involves a pain receptor synapsing onto a motor neuron in the spinal cord.
Diff: 1 Page Ref: 29 Objective: Conceptual
LO: 2.3 APA:1.1

44) The giant squid axon is specialized for which of the following?
A) integration of sensory messages regarding the environment
B) planning of feeding-related movements
C) rapid contraction of the squid mantle which propels the squid away from danger
D) coordination of general sensory-motor function
E) contraction of the mouth of the squid to produce chewing movements
Answer: C
Rationale: The giant squid axon is specialized for rapid contraction of the squid mantle which propels the squid away from danger.
Diff: 2 Page Ref: 30 Objective: Conceptual
LO: 2.4 APA: 1.1

45) Which of the following is inserted into an axon to record electrical potentials?
A) a single reference wire.
B) a microelectrode inserted into the axon interior
C) an oscilloscope
D) a voltmeter terminal
E) A thin metal cannula
Answer: B
Diff: 3 Page Ref: 30 Objective: Factual
LO: 2.4 APA:2.1

46) The interior of a neuron at rest
A) is positively charged relative to the outside.
B) is at the same voltage potential as the outside.
C) has the same ionic concentrations as the outside.
D) is negatively charged relative to the outside.
E) contains high levels of sodium ions..
Answer: D
Rationale: The interior of a neuron at rest is negatively charged relative to the outside.
Diff: 2 Page Ref: 30 Objective: Conceptual
LO: 2.4 APA: 1.1

47) The _____ is defined as the difference in electrical charge between the inside and the outside of the axon membrane.
A) membrane
B) local
C) glial
D) action
E) axon
Answer: A
Diff: 2 Page Ref: 30 Objective: Factual
LO: 2.4 APA:1.2

48) Movement of the axon membrane potential from -70 mV to -90 mV would be termed a(n)
A) action potential.
B) threshold potential.
C) depolarization.
D) hyperpolarization.
E) excitatory local potential.
Answer: D

Rationale: Movement of the axon membrane potential from -70 mV to -90 mV would be termed a(n) hyperpolarization.
Diff: 1 Page Ref: 31 Objective: Conceptual
LO: 2.5 APA: 1.1

49) Movement of the axon membrane potential from -90 mV to -80 mV would be termed a(n)
A) depolarization.
B) threshold potential.
C) action potential.
D) hyperpolarization.
E) inhibitory local potential.
Answer: A
Rationale: Movement of the axon membrane potential from -90 mV to -80 mV would be termed a(n) depolarization.
Diff: 1 Page Ref: 31 Objective: Conceptual
LO: 2.5 APA:1.1

50) An electrical charge applied to an axon that moves the membrane potential from -70 mV to -45 mV will result in a(n)
A) action potential.
B) local potential.
C) downward shift of the threshold of excitation.
D) upward shift of the membrane threshold.
E) long-term change in the membrane potential.
Answer: A
Diff: 1 Page Ref: 31 Objective: Factual
LO: 2.4 APA:1.2

51) The membrane voltage level at which an action potential is triggered is termed the
A) refractory period.
B) hyperpolarization event.
C) threshold of excitation.
D) rate level.
E) equilibrium point.
Answer: C
Diff: 1 Page Ref: 31 Objective: Factual
LO: 2.4 APA:1.1

52) The process by which molecules are evenly distributed throughout a medium is
A) retrograde transport.
B) diffusion.
C) anterograde transport.
D) electrostatic pressure.
E) carrier-mediated transport.
Answer: B
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

53) _____ are substances that form charged particles when dissolved in water.
A) Ions
B) Molecules
C) Electrolytes
D) Cations
E) Anions
Answer: C
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

54) _____ are charged particles formed when certain molecules dissolves in water.
A) Ions
B) Solvents
C) Electrolytes
D) Electrons
E) Proteins
Answer: A
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

55) _____ are positively charged particles.
A) Transmitters
B) Solvents
C) Electrolytes
D) Cations
E) Anions
Answer: D
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

56) Cation is to anion as
A) transport is to diffusion.
B) positive is to negative.
C) diffusion is to transport.
D) negative is to positive.
E) intracellular is to extracellular.
Answer: B
Rationale: Cation is to anion as positive is to negative.
Diff: 3 Page Ref: 32 Objective: Conceptual
LO: 2.4 APA:1.1

57) _____ are negatively charged particles.
A) Transmitters
B) Solvents
C) Electrolytes
D) Cations
E) Anions
Answer: E
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

58) The process by which similarly charged particles repel each other and are thus distributed throughout a medium is termed
A) diffusion.
B) carrier-mediated transport.
C) refraction.
D) electrostatic pressure.
E) diffraction.
Answer: D
Diff: 2 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

59) Which of the following is true of ion distribution across the axon membrane?
A) Sodium ions are concentrated outside the axon membrane.
B) Potassium ions are concentrated outside the axon membrane.
C) The action potential is the balance point between diffusion and electrostatic pressure.
D) Chloride ions are concentrated inside the axon membrane.
E) Sodium ions are concentrated inside the axon membrane.
Answer: A
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

60) The force of diffusion would tend to move _____ ions _____ the axon.
A) chloride; out of
B) sodium; into
C) potassium; into
D) organic; into
E) sodium; out of
Answer: B
Diff: 1 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.2

61) The force of _____ moves sodium ions _____ the axon
A) diffusion; into
B) retrograde transport; out of
C) diffusion; out of
D) electrostatic pressure; out of
E) sodium-potassium pump; into
Answer: A
Diff: 2 Page Ref: 32 Objective: Factual
LO: 2.4 APA:1.1

62) Which of the following is a consequence of the activity of the sodium-potassium transporters?
A) Extracellular sodium concentrations are kept low.
B) Intracellular sodium concentrations are kept very high.
C) Extracellular potassium concentrations are kept very high.
D) Intracellular sodium concentrations are kept low.
E) Little energy is required to maintain ionic differences across the membrane.
Answer: D
Rationale: As a consequence of the activity of the sodium-potassium transporters, intracellular sodium concentrations are kept low.
Diff: 2 Page Ref: 32 Objective: Conceptual

LO: 2.4 APA:1.1

63) In a resting nerve cell, which of the forces listed below will act to push sodium ions into the cell?
A) diffusion
B) osmotic pressure
C) sodium-potassium pump
D) ion channel inactivation
E) electrostatic pressure resulting from positive charge inside the axon
Answer: A
Rationale: In a resting nerve cell, diffusion acts to push sodium ions into the cell.
Diff: 2 Page Ref: 32-33 Objective: Conceptual
LO: 2.4 APA:1.2

64) The specialized pores located in the axon membrane that open or close are termed
A) receptors.
B) voltage transporters.
C) autoreceptors.
D) ion channels.
E) sodium-potassium transporters.
Answer: D
Diff: 2 Page Ref: 34 Objective: Factual
LO: 2.4 APA:1.1

65) Which of the following is true of an action potential?
A) The sodium channels are opened at a lower voltage than are potassium channels.
B) An action potential requires 5 msec for completion.
C) During an action potential, the interior becomes even more negative.
D) The potassium channels are opened at a lower voltage than are sodium channels.
E) The overshoot is due to a prolonged change in sodium conductance.
Answer: A
Rationale: During an action potential, the sodium channels are opened at a lower voltage than are potassium channels.
Diff: 2 Page Ref: 34-35 Objective: Conceptual
LO: 2.5 APA:1.1

66) Which of the following events restores the membrane potential from the peak of the action potential back to the resting level?
A) Sodium ions move into the cell.
B) Potassium ions move out of the cell.
C) Potassium ions move into the cell.
D) Chloride ions move into the cell.
E) Chloride ions are extruded from the cell.
Answer: B
Rationale: Movement of potassium ions out of the cell restores the membrane potential to baseline from the peak of the action potential.
Diff: 2 Page Ref: 35 Objective: Conceptual
LO: 2.5 APA:

67) The "all-or-none law" refers to the observation that an action potential
A) will diminish to near zero when transmitted down a long axon.
B) fires at the same rate regardless of the inputs to the neuron.

C) is conducted more rapidly down the axon as it reaches the axon terminal.
D) is produced whenever the membrane potential reaches threshold.
E) travels only in one direction.
Answer: D
Diff: 2 Page Ref: 36 Objective: Factual
LO: 2.5 APA:

68) Sensory stimuli that vary in intensity are coded by variations in the _____ of a neuron.
A) firing rate
B) resting membrane potential
C) speed of conduction of action potentials
D) total amplitude of the action potential
E) repolarization rate
Answer: A
Rationale: Sensory stimuli that vary in intensity are coded by variations in the firing rate of a neuron.
Diff: 2 Page Ref: 36 Objective: Conceptual
LO: 2.5 APA:1.2

69) Subthreshold depolarizations of the axon membrane
A) are not conducted along the membrane.
B) remain the same size at each point along the membrane.
C) are just smaller versions of the action potential.
D) decrease in amplitude as they sweep along the membrane.
E) involve the closing of ion channels.
Answer: D
Rationale: Subthreshold depolarizations of the axon membrane decrease in amplitude as they sweep along the membrane.
Diff: 2 Page Ref: 36 Objective: Conceptual
LO: 2.5 APA:1.1

70) Ions enter and leave the membrane of a myelinated axon at the
A) terminal buttons.
B) axon hillock.
C) nodes of Ranvier.
D) segment of membrane under the Schwann cell wrapping.
E) release zone.
Answer: C
Rationale: Ions enter and leave the membrane of a myelinated axon at the nodes of Ranvier.
Diff: 2 Page Ref: 36 Objective: Conceptual
LO: 2.5 APA:1.1

71) A key advantage of saltatory conduction is that
A) more sodium ions have to be pumped out of the cell after an action potential.
B) myelin allows the nerve cell to recycle neurotransmitter molecules.
C) less transmitter is required to send a message across the next synapse.
D) myelin speeds up the velocity at which an axon can conduct an action potential.
E) myelin requires that nerve cell axons be larger in order to rapidly conduct a signal.
Answer: D
Rationale: A key advantage of saltatory conduction is that myelin speeds up the velocity at which an axon can conduct an action potential.
Diff: 3 Page Ref: 36 Objective: Conceptual

LO: 2.5 APA:3.1

72) Saltatory conduction is rapid because
A) the action potential does not have to depolarize every segment of the axon membrane.
B) myelinated cells have more leakage through the membrane.
C) myelinated axons are larger in diameter.
D) myelinated cells have more ion channels per unit area than do non-myelinated cells.
E) myelinated fibers have a lower threshold of activation.
Answer: A
Rationale: Saltatory conduction is rapid because the action potential does not have to depolarize every segment of the axon membrane.
Diff: 3 Page Ref: 37 Objective: Conceptual
LO: 2.5 APA:3.1

73) Neuronal signals are carried across the synapse by
A) direct electrical connections between the two cells.
B) the secretion of transmitter molecules into the synapse.
C) the transfer of ions from one cell to another.
D) an inhibitory effect of a transmitter molecule on the postsynaptic membrane.
E) an influx of potassium ions into the axon terminal.
Answer: B
Rationale: Neuronal signals are carried across the synapse by the secretion of transmitter molecules into the synapse.
Diff: 2 Page Ref: 37-38 Objective: Conceptual
LO: 2.6 APA:1.1

74),Which of the following is true of synapses?
A) Action potentials open chloride channels to release neurotransmitters.
B) Presynaptic voltage changes past threshold triggers the release of neurotransmitters.
C) The interior of the nerve cell becomes more negative during the action potential.
D) The exterior of the nerve cell becomes more positive during the action potential.
E) Glia are shown to slow down the release of transmitter substances from the axon.
Answer: B
Rationale: Presynaptic voltage changes past threshold triggers the release of neurotransmitters into the synapse.
Diff: 2 Page Ref: 37 Objective: Conceptual
LO: 2.6 APA:1.2

75) A common form of a synapse can involve a junction between an axon terminal and a(n) _____.
A) dendrite
B) blood vessel
C) axon hillock
D) glial cell
E) Node of Ranvier.
Answer: A
Diff: 1 Page Ref: 37 Objective: Factual
LO: 2.6 APA:1.2

76) The term _____ means "little bladder."
A) vesicle
B) neurite

C) cisternae
D) mitochondria
E) storage pool
Answer: A
Diff: 1 Page Ref: 38 Objective: Factual
LO: 2.6 APA: 1.1

77) In which portion of a neuron would you expect to find the largest number of vesicles?
A) the dendritic spines
B) the soma
C) near the nuclear membrane
D) the release zone
E) the axon hillock
Answer: D
Rationale: You would expect to find the largest number of vesicles in the release zone.
Diff: 1 Page Ref: 39 Objective: Conceptual
LO: 2.6 APA:1.2

78) A key event for the release of neurotransmitter from the presynaptic membrane is the
A) hyperpolarization of the axon membrane.
B) arrival of an action potential at the axon terminal.
C) influx of potassium ions into the axon terminal.
D) activation of the sodium-potassium pumps.
E) opening of ion channels within the microtubules.
Answer: B
Diff: 2 Page Ref: 38 Objective: Factual
LO: 2.6 APA:3.1

79) Which of the following is true of neurotransmitter function?
A) Neurotransmitters diffuse widely across the brain to exert changes in metabolism.
B) Neurotransmitters directly alter ion channels using a second-messenger chemical.
C) Neurotransmitters are released into the synapse from the cistaerna.
D) Neurotransmitters open ion channels in the postsynaptic membrane.
E) Neurotransmitters alter ion channel activity for minutes.
Answer: D
Rationale: Neurotransmitters open ion channels in the postsynaptic membrane.
Diff: 3 Page Ref: 39-40 Objective: Conceptual
LO: 2.6 APA:1.1

80) Match up the receptor type with its action.
A) metabotropic; direct opening of an ion channel
B) ionotropic; more time required to open an ion channel
C) metabotropic; G-protein activation leads to activation of a second messenger
D) metabotropic; second messenger effects are specific to opening ion channels
E) metabotropic; rapid and short-lived effects on ion channels
Answer: C
Rationale: In metabotropic receptors, G-protein activation leads to activation of a second messenger.
Diff: 3 Page Ref: 40-41 Objective: Conceptual
LO: 2.6 APA:3.1

81) Match up the correct pairing of a receptor type with its action.
A) ionotropic; direct opening of an ion channel
B) ionotropic; more time required to open an ion channel
C) ionotropic; G-protein activation leads to activation of a second messenger
D) metabotropic; second messenger effects that are specific to neuronal communication
E) metabotropic; rapid and short-lived effects on ion channels
Answer: A
Rationale: Activation of ionotropic receptor results in the direct opening of an ion channel.
Diff: 3 Page Ref: 40 Objective: Conceptual
LO: 2.6 APA:3.1

82) Match the correct PSP effect with each ion channel action.
A) entry of a negative ion; hyperpolarization
B) entry of a positive ion; hyperpolarization
C) exit of a positive ion; depolarization
D) exit of a negative ion; hyperpolarization
E) B and D are correct.
Answer: A
Diff: 2 Page Ref: 40 Objective: Factual
LO: 2.7 APA:1.1

83) Which of the following ion channel events will produce an EPSP?
A) opening a sodium channel
B) closing a sodium channel
C) opening a potassium channel
D) opening a manganese channel
E) closing a calcium channel
Answer: A
Diff: 2 Page Ref: 40 Objective: Factual
LO: 2.7 APA:1.1

84) Which of the following will "neutralize" the effect of an EPSP?
A) further opening a sodium channel
B) allowing intracellular anions to leave the cell
C) closing a potassium channel
D) opening a chloride channel
E) B and D are correct.
Answer: D
Rationale: The opening of a chloride channel will “neutralize” the effect of the EPSP.
Diff: 3 Page Ref: 41 Objective: Conceptual
LO: 2.7 APA:1.2

85) Which of the following ion channel events will reliably produce an IPSP regardless of the current level of the membrane potential?
A) opening a sodium channel
B) losing a potassium channel
C) opening a potassium channel
D) opening a chloride channel
E) opening a channel to admit calcium ions into the axon
Answer: C
Rationale: The opening of a potassium channel will reliably produce an IPSP regardless of the current

level of the membrane potential.
Diff: 3 Page Ref: 41 Objective: Conceptual
LO: 2.7 APA:1.1

86) The process which terminates the postsynaptic potentials induced by most neurotransmitters is
A) disruption of the postsynaptic receptor.
B) enzymatic degradation of the transmitter molecule.
C) inhibition of transmitter synthesis.
D) facilitation of transmitter release.
E) reuptake of the molecule into the axon terminal.
Answer: E
Rationale: The process which terminates the postsynaptic potentials induced by most neurotransmitters reuptake of the molecule into the axon terminal.
Diff: 2 Page Ref: 42 Objective: Conceptual
LO: 2.7 APA:1.2

87) The process which terminates the postsynaptic potentials induced by acetylcholine is
A) disruption of the postsynaptic receptor.
B) enzymatic degradation via AChE.
C) inhibition of ACh synthesis.
D) facilitation of ACh release.
E) reuptake.
Answer: B
Diff: 2 Page Ref: 43 Objective: Factual
LO: 2.7 APA: 1.1

88) A drug that inactivates AChE would be expected to
A) prolong the effects of ACh in the synapse.
B) terminate the effects of ACh in the synapse.
C) speed up the synthesis of ACh.
D) impair the synthesis of ACh.
E) activate the presynaptic autoreceptor for ACh.
Answer: A
Rationale: A drug that inactivates AChE would be expected to prolong the effects of Ach in the synapse.
Diff: 3 Page Ref: 43 Objective: Applied
LO: 2.7 APA:3.1

89) An autoreceptor is located on the _____ and is sensitive to _____.
A) presynaptic membrane; the transmitter released by that neuron
B) presynaptic membrane; a different transmitter released by another neuron
C) presynaptic membrane; calcium ions located in the synapse
D) postsynaptic membrane; calcium ions located in the synapse
E) presynaptic membrane; the amount of second messenger activity in the postsynaptic cell
Answer: A
Rationale: Autoreceptors are metabotropic in nature.
Diff: 1 Page Ref: 44 Objective: Factual
LO: 2.7 APA: 1.1

90) Autoreceptors
A) are sensitive to the presence of neuropeptides in the synapse.
B) control the release of calcium ions from the axon terminal.
C) mostly facilitate neuron function.
D) are metabotropic in nature.
E) control the formation of new dendritic spines.
Answer: D
Diff: 2 Page Ref: 44 Objective: Conceptual
LO: 2.8 APA:1.1

91) Neuromodulators
A) have a lipid structure.
B) directly elicit postsynaptic potentials.
C) are usually found in small dense-core vesicles in terminal buttons.
D) diffuse widely to effect many neurons.
E) have only a local action at a few synapses.
Answer: D
Diff: 2 Page Ref: 45 Objective: Factual
LO: 2.8 APA:1.1

92) Neuromodulators
A) are rarely of a peptide form.
B) are secreted from a neuron and only affect an adjacent neuron.
C) are inevitably inhibitory.
D) are secreted from neurons, but dispersed widely in brain.
E) are typically secreted in very small amounts compared to neurotransmitters.
Answer: D
Diff: 3 Page Ref: 45 Objective: Factual
LO: 2.8 APA:1.1

93) Most _____ are secreted into the extracellular fluid from endocrine glands or tissues.
A) neurotransmitters
B) neuropeptides
C) modulators
D) hormones
E) pheromones
Answer: D
Diff: 1 Page Ref: 45 Objective: Factual
LO: 2.8 APA:1.1

94) The key symptom of myasthenia gravis is
A) fatigability.
B) mania and excitation.
C) depression and sleep disturbance.
D) inability to make coordinated movements.
E) impaired autoreceptor function.
Answer: A
Diff: 2 Page Ref: 46 Objective: Factual
LO: 2.8 APA:1.1

2.2 True-False

1) Motor neurons gather information from the environment.
Answer: FALSE
Diff: 1 Page Ref: 20

2) The cell membrane is formed by a single layer of lipid molecules.
Answer: FALSE
Diff: 1 Page Ref: 20

3) The myelin sheath around an axon in the brain is formed by oligodendrocytes.
Answer: TRUE
Diff: 2 Page Ref: 23

4) The blood-brain barrier is formed by astrocytes.
Answer: FALSE
Diff: 1 Page Ref: 25

5) In a neuron at rest, the inside of the cell is more negative than the cell exterior.
Answer: TRUE
Diff: 1 Page Ref: 27

6) A hyperpolarizing stimulus makes the interior of the neuron even more negatively charged.
Answer: TRUE
Diff: 2 Page Ref: 31

7) Both electrostatic and diffusion forces affect the concentration of ions in the extracellular and intracellular fluids.
Answer: TRUE
Diff: 1 Page Ref: 32

8) An anion is positively charged ion.
Answer: FALSE
Diff: 1 Page Ref: 32

9) The sodium-potassium transporter keeps the intracellular concentration of sodium ions low by pushing them out of the axon.
Answer: TRUE
Diff: 1 Page Ref:33

10) Chloride ions are found in high concentration outside neurons.
Answer: FALSE
Diff: 1 Page Ref: 33

11 An action potential decreases in size as it moves along the axon toward the terminal buttons.
Answer: FALSE
Diff: 1 Page Ref: 36

12) A thick myelinated axon fiber will conduct an action potential more rapidly than will a thin unmyelinated fiber.
Answer: TRUE

Diff: 3 Page Ref: 36

13) Saltatory conduction speeds up conduction velocity in non-myelinated neurons.
Answer: FALSE
Diff: 1 Page Ref: 36

14) Transmitter substances are secreted from the terminal buttons of a neuron.
Answer: TRUE
Diff: 1 Page Ref: 38

15) The most important source of EPSPs is the neurotransmitter-dependent sodium channel.

Answer: TRUE
Diff: 1 Page Ref: 41

16) Opening a chloride channel will neutralize an EPSP.
Answer: TRUE
Diff: 2 Page Ref: 41

17) Enzymatic inactivation allows for the rapid reuse of a transmitter molecule.
Answer: FALSE
Diff: 1 Page Ref: 42

18) The transmitter acetylcholine is primarily inactivated by reuptake of the molecule into the axon terminal.
Answer: FALSE
Diff: 2 Page Ref: 43

19) Autoreceptors are metabotropic receptors.
Answer: TRUE
Diff: 2 Page Ref: 44

2.3 Short-Answer Essay

1) Contrast the various forms of neurons in brain by their connections and functions.
Answer: Sensory neurons carry information toward the brain while motor neurons carry signals to the muscles and glands of the periphery.
Diff: 1 Page Ref: 20

2) Name and discuss the general functions of the three glial cell types in the brain.
Answer: Oligodendrocytes form CNS myelin. Astroglia provide support and nutrition for neurons. Microglia are involved in brain immune function.
Diff: 3 Page Ref: 24-26

3) Explain how the area postrema may play a role in minimizing poison toxicity.
Answer: Because the blood-brain barrier is weak near this structure, toxins in blood can stimulate this brain region to cause emesis, which would void the stomach and in turn may reduce the total amount of toxicity to the organism.
Diff: 2 Page Ref: 27-28

4) What would be the effect of opening potassium channels in the axon membrane?
Answer: Potassium ions would leave the cell, making the interior even more negative. This in turn would limit the excitability of the nerve cell.
Diff: 2 Page Ref: 32-33

5) What would you expect the impact to be on an organism treated with a drug that blocks neuronal sodium channels?
Answer: Rapid death owing to the cessation of action potentials.
Diff: 1 Page Ref: 33

6).Contrast local potentials versus action potentials.
Answer: Local potentials are graded in size, degrade with distance and can summate to produce an action potential. Action potentials are fixed in size, do not degrade and cannot summate.
Diff: 1 Page Ref: 33-36

7) Explain why saltatory conduction speeds up the velocity of action potentials.
Answer: In saltatory conduction, the action potential does not have to depolarize every segment of membrane, only those at the widely separated nodes of Ranvier.
Diff: 3 Page Ref: 44

8) What would you expect to happen if the enzyme AChE were to be disabled in your body?
Answer: My ACh activity would greatly increase, because AChE normally serves to degrade ACh. Later, this would lead to overstimulation of cholinergic receptors.
Diff: 3 Page Ref: 42-43

9) What is the general function of autoreceptors?
Answer: To modulate the internal biochemical activity of the presynaptic cell.
Diff: 1 Page Ref: 44

2.4 Essay

1) Discuss the general support functions of glial cells for the nervous system.
Answer: Glial cells: provide physical or structural support for individual neurons; provide energy to neurons; take away waste products; buffer the environment of a nerve cell; provide insulation in the form of myelin; digest dead or dying nerve cells; are involved in immune function.
Diff: 2 Page Ref: 24-27

2) Explain how ion channels alter the electrical properties of a nerve cell membrane.
Answer: Ions are charged particles that are unequally distributed across the cell membrane. When ion channels open, diffusion and electrostatic pressure push sodium ions into the cell or potassium ions out of the cell. These movements result in changes in voltage across the membrane.
Diff: 2 Page Ref: 32-33

3). Provide an overview of the ionic events that produce the action potential. Answer: Movements of the membrane potential past threshold, open sodium channels, which moves the membrane potential from -60 to roughly +40 mV. The sodium channels then close, and the potential is restored to resting by an opening of the potassium channels.
Diff: 3 Page Ref: 34-35

4) Explain why the reuptake process has become a critical target for therapeutic drugs.
Answer: The postsynaptic action of many neurotransmitters is terminated via reuptake of the molecule through the membrane transporter. A drug that blocks such a transporter would be expected to raise the synaptic levels of that neurotransmitter. For a disease or disorder that is thought to result from a low synaptic activity of that transmitter, blockade of the reuptake process would generate a beneficial effect.
Diff: 3 Page Ref: 42-43

5) Explain how the nerve cell membrane acts as an integrator of incoming inputs.
Answer: Neurotransmitter-gated receptors can open separate ion channels. Opening a sodium channel would result in an EPSP, while opening a potassium channel would result in an IPSP. The critical event which produces an action potential is reaching the threshold value for the membrane. EPSPs move the potential closer to that value; IPSPs move it further away. The PSPs can add together spatially and temporally, because of the residual nature of these potentials.
Diff: 2 Page Ref: 43-44