

CHAPTER 1 ORGANIZATION AND FUNCTION OF THE NERVOUS SYSTEM

1.1 Multiple Choice

1. The average human brain contains nearly _____ neurons.

- a. 10 billion
- b. 100 billion
- c. 200 billion
- d. 1 trillion

Answer: C

Diff: 1 Page Ref: 1

2. The three major classes of neurons are

- a. motor, sensory, and interneurons.
- b. efferent, afferent, and glia.
- c. motor, efferent, and afferent.
- d. glia, interneurons, and motor.

Answer: A

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3. The nucleus of a neuron resides within the

- a. terminal button.
- b. axon.
- c. cell body.
- d. dendrites.

Answer: C

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4. The axon hillock is located

- a. at a cell's terminal button.
- b. at gaps in a cell's myelin.
- c. where the axon leaves the cell body.
- d. where dendrites connect to the cell body.

Answer: C

Diff: 1

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5. Myelin serves to

- a. increase the speed of conduction along the axon.
- b. insulate a cell's axon from the electrical activity of adjacent axons.
- c. synthesize and store neurotransmitter substances.
- d. Both a and b are correct

Answer: D

Diff: 2

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6. Neurotransmitters are stored and released from a cell's

- a. terminal button.
- b. node of Ranvier.
- c. cell body.
- d. axon hillock.

Answer: A

Diff: 1

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7. The pressures acting on charged ions include _____ and _____ pressures.

- a. hydrostatic; electrostatic
- b. diffusion; hydrostatic
- c. diffusion; electrostatic
- d. diffusion; glucostatic

Answer: C

Diff: 2

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8. A neuron's resting membrane potential is caused by

- a. sodium ions.
- b. a disequilibrium of positive and negatively charged ions inside and outside the axon.
- c. a high concentration of sodium inside the cell.
- d. potassium ions.

Answer: B

Diff: 1

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9. The resting membrane potential has a charge of about _____ millivolts.

- a. 0
- b. +100
- c. -70
- d. -55

Answer: C

Diff: 1

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10. The resting membrane potential is maintained because

- a. potassium ions cannot cross through the cell membrane to the outside.
- b. sodium ions cannot cross to the inside of the cell membrane.
- c. there is no pressure acting on sodium ions.

d. there is no pressure acting on potassium ions.

Answer: B

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11. Potassium is said to be at equilibrium during a resting potential because

- a. electrostatic pressure forcing it in equals the diffusion pressure forcing it out.
- b. diffusion pressure forcing it in equals the electrostatic pressure forcing it out.
- c. hydrostatic pressure forcing it in equals the electrostatic pressure forcing it out.
- d. it is equally concentrated inside and outside the cell.

Answer: A

Diff: 2

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12. Changes in the voltage of a cell that vary depending on the strength of stimulation are referred to as

- a. action potentials.
- b. depolarization.
- c. hyperpolarization.
- d. graded potentials.

Answer: D

Diff: 2

Page Ref: 7

13. When an axon is depolarized to approximately _____ millivolts, an action potential is initiated.

- a. -55
- b. -70
- c. 0
- d. +30

Answer: A

Diff: 1 Page Ref: 7

14. Ion channels for sodium ions open when the membrane is _____ to about _____ millivolts.

- a. depolarized; -55
- b. polarized; -70
- c. charged; +30
- d. depolarized; 0

Answer: A

Diff: 1 Page Ref: 7

15. The initiation of an action potential is a consequence of an _____ of _____ ions.

- a. influx; potassium
- b. efflux; chlorine
- c. influx; sodium
- d. All of the above are correct

Answer: C

Diff: 1 Page Ref: 7

16. During an action potential, the membrane voltage changes from _____ to about _____ millivolts on the inside relative to the outside.

- a. -70; 0
- b. 0; +50
- c. -70; +30

d. -70; +55

Answer: C

Diff: 1 Page Ref: 7

17. Local anesthetics such as lidocaine work by

- a. preventing the release of neurotransmitters signaling pain messages.
- b. blocking sodium channels so an action potential cannot occur.
- c. preventing cells from receiving signals from pain-transmitting neurons.
- d. blocking receptor sites for pain-signaling neurotransmitters.

Answer: B

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18. An action potential is initiated at a cell's

- a. dendrites.
- b. axon hillock.
- c. terminal button.
- d. node of Ranvier.

Answer: B

Diff: 1 Page Ref: 8

19. Myelin is made up of _____ in the central nervous system.

- a. fat cells
- b. Schwann cells
- c. oligodendrocytes
- d. astrocytes

Answer: B

Diff: 3 Page Ref: 9

20. Myelin is made up of _____ in the peripheral nervous system.

- a. fat cells
- b. Schwann cells
- c. oligodendrocytes
- d. astrocytes

Answer: B

Diff: 3 Page Ref: 9

21. Gaps in myelin surrounding an axon are referred to as

- a. receptors.
- b. demyelination.
- c. nodes of Ranvier.
- d. synapses.

Answer: C

Diff: 1 Page Ref: 9

22. The total amount of neurotransmitter released during an action potential depends on

- a. how much sodium enters the terminal button.
- b. how much calcium is ejected from the terminal button.
- c. regulatory proteins that contain the neurotransmitter substance.

d. how much calcium enters the terminal button.

Answer: D

Diff: 2 Page Ref: 11

23. Once released into the synaptic gap, neurotransmitter substances

a. bind to receptor sites on both pre- and postsynaptic sites.

b. are degraded by a breakdown enzyme.

c. are returned to the transmitting cell via reuptake.

d. All of the above are correct

Answer: D

Diff: 2 Page Ref: 12–13

24. Receptor proteins that directly control either the opening or closing of specific ion channels are referred to as _____ receptors.

a. ionotropic

b. metabotropic

c. postsynaptic

d. presynaptic

Answer: B

Diff: 2 Page Ref: 12

25. Receptor proteins that indirectly open or close ion channels through the activation of a second messenger are referred to as _____ receptors.

- a. ionotropic
- b. metabotropic
- c. postsynaptic
- d. presynaptic

Answer: B

Diff: 2 Page Ref: 12

26. Which of the following is an example of a second messenger?

- a. Sodium
- b. A G protein
- c. Acetylcholine
- d. Cyclic adenosine monophosphate

Answer: D

Diff: 3 Page Ref: 12

27. Proteins on the presynaptic terminal that transport neurotransmitter substances back into the terminal button are referred to as

- a. G proteins.
- b. reuptake transporters.
- c. autoreceptors.
- d. metabotropic receptors.

Answer: B

Diff: 2 Page Ref: 13

28. Receptors on the presynaptic terminal that regulate neurotransmitter synthesis and storage are referred to as

- a. heteroreceptors.
- b. autoreceptors.

c. metabotropic receptors.

d. Both a and b are correct

Answer: D

Diff: 2 Page Ref: 16–17

29. The main difference between autoreceptors and heteroreceptors is that

a. heteroreceptors are activated by a different neuron and neurotransmitter, whereas autoreceptors are activated by the neuron they regulate.

b. heteroreceptors are postsynaptic, whereas autoreceptors are presynaptic.

c. heteroreceptors are metabotropic, whereas autoreceptors are ionotropic.

d. heteroreceptors are excitatory, whereas autoreceptors are inhibitory.

Answer: A

Diff: 3 Page Ref: 17

30. Which of the following is NOT a criterion for a substance to meet the definition of a neurotransmitter?

- a. It must be synthesized and stored in the presynaptic neuron.
- b. It must cause a postsynaptic effect after it interacts with a receptor.
- c. It must be taken up intact by the transmitting neuron.
- d. It must have some mechanism for its degradation or reuptake.

Answer: C

Diff: 2

Page Ref: 17

31. Otto Loewi received the Nobel Prize in 1936 for his discovery of _____.

- a. dopamine
- b. norepinephrine
- c. serotonin
- d. acetylcholine

Answer: D

Diff: 2

Page Ref: 19

32. The neurotransmitter that activates all neuromuscular synapses is called _____.

- a. norepinephrine
- b. acetylcholine
- c. dopamine
- d. muscarine

Answer: B

Diff: 2

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33. The neurotransmitter of the mesolimbic system is called _____.

- a. norepinephrine
- b. serotonin
- c. adenosine

d. dopamine

Answer: D

Diff: 2 Page Ref: 23

34. The neurotransmitter involved in emotional behavior, arousal, and sleep that is derived from the amino acid tryptophan is called _____.

a. dopamine

b. norepinephrine

c. serotonin

d. acetylcholine

Answer: C

Diff: 3 Page Ref: 25

35. The most abundant excitatory neurotransmitter is called _____.

a. GABA

b. serotonin

c. norepinephrine

d. glutamate

Answer: D

Diff: 2 Page Ref: 26

36. The glutamate receptor that has been implicated as a mechanism for long-term potentiation is called _____.

- a. NMDA
- b. metabotropic
- c. kainate
- d. AMPA

Answer: A

Diff: 2

Page Ref: 27

37. The most abundant inhibitory neurotransmitter is called _____.

- a. GABA
- b. serotonin
- c. Substance P
- d. glutamate

Answer: A

Diff: 2

Page Ref: 28

38. Alcohol binds to a specific receptor site on the _____ receptor complex.

- a. NMDA
- b. GABA
- c. dopamine
- d. norepinephrine

Answer: B

Diff: 3

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39. The neurotransmitter that transmits pain signals in the spinal cord is called _____.

- a. serotonin
- b. glycine
- c. Substance P

d. nonrepinephrine

Answer: C

Diff: 2 Page Ref: 30

40. Anatomical sections through the brain along the axis from front to back are called _____ sections.

a. coronal

b. horizontal

c. sagittal

d. oblique

Answer: C

Diff: 2 Page Ref: 34

41. The respiratory center of the brain is located in the _____.

a. medulla

b. pons

c. medbrain

d. cerebellum

Answer: A

Diff: 3 Page Ref: 35

42. Damage to the _____ might lead to jerky, uncoordinated movements.

- a. medulla
- b. pons
- c. medbrain
- d. cerebellum

Answer: D

Diff: 2

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43. A system of neurons originating deep in the brainstem which controls arousal, consciousness, and alertness is the _____ system.

- a. mesolimbic
- b. reticular activating
- c. striatal
- d. somatosensory

Answer: B

Diff: 2

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44. Which of the following structures is NOT part of the limbic system?

- a. Hippocampus
- b. Amygdala
- c. Medulla
- d. Nucleus accumbens

Answer: C

Diff: 3

Page Ref: 38

45. The mesolimbic-cortical system originates in the _____ and projects dopamine containing neurons to the _____.

- a. nucleus accumbens; frontal cortex
- b. septum; prefrontal cortex

- c. ventral tegmental area; frontal cortex
- d. ventral tegmental area; nucleus accumbens

Answer: C

Diff: 3 Page Ref: 39

46. The _____ undergoes considerable degeneration with prolonged periods of stress, schizophrenia, or post-traumatic stress disorder.

- a. hypothalamus
- b. hippocampus
- c. thalamus
- d. basal ganglia

Answer: B

Diff: 3 Page Ref: 39

47. The ventromedial nucleus, lateral nucleus, preoptic nucleus, and paraventricular nucleus are all parts of the

- a. hypothalamus.
- b. thalamus.
- c. basal ganglia.
- d. mesolimbic system.

Answer: A

Diff: 2 Page Ref: 40

48. The _____ controls most sensory input to the cortex and is involved in regulating attention and arousal.

- a. hypothalamus
- b. basal ganglia
- c. medulla
- d. thalamus

Answer: D

Diff: 2 Page Ref: 41

49. Which of the following is NOT part of the basal ganglia?

- a. Caudate nucleus
- b. Putamen
- c. Substantia nigra
- d. Nucleus accumbens

Answer: D

Diff: 2 Page Ref: 41

50. Which of the following structures of the brain is affected by Parkinson's disease?

- a. Thalamus
- b. Substantia nigra
- c. Nucleus accumbens
- d. Hippocampus

Answer: B

Diff: 2 Page Ref: 42

1.2 Discussion/Essay

1. Why does a neuron rest at –70 millivolts inside the cell membrane with respect to outside the cell membrane?

2. What are the differences between action potentials and graded potentials?
3. How does an action potential propagate along an unmyelinated axon?
4. How does myelin affect propagation? Why?
5. What happens to a neurotransmitter once it has been released?
6. What are receptors? What is their makeup?
7. What are the differences between ionotropic and metabotropic receptors?
8. What is a second messenger? Provide an example of one.
9. Describe the mechanisms for both EPSPs and IPSPs.
10. Describe the functions and differences between autoreceptors and heteroreceptors.
11. Review the following major neurotransmitters: ACh, NE, DA, SE, glutamate, GABA, and endorphins.