Chapter 2
The Neural Bases of Learning and Memory

TRUE/FALSE

1. Motor neurons have long axons that send signals specifically to muscles.

   ANS: T PTS: 1 DIF: low REF: page 44

2. Action potentials can vary from creating a large effect to a small effect.

   ANS: F PTS: 1 DIF: low REF: page 46

3. Following an action potential, the exchange of sodium ions for potassium ions restores the balance in a neuron.

   ANS: T PTS: 1 DIF: medium REF: page 48

4. An EEG measures the single firing of a neuron, one at a time.

   ANS: T PTS: 1 DIF: low REF: page 49

5. When the charge of a neuron changes from negative to positive the result is an inhibitory postsynaptic potential.

   ANS: F PTS: 1 DIF: low REF: page 51

6. Donald Hebb proposed the theory that when neurons are activated they have the potential to form a cell assembly.

   ANS: T PTS: 1 DIF: low REF: page 55

7. Normally, long-term depression (LTD) occurs when either presynaptic activity or postsynaptic activity occurs alone.

   ANS: T PTS: 1 DIF: low REF: page 59

8. The brain and the spinal cord are the two main parts of the autonomic nervous system.

   ANS: F PTS: 1 DIF: low REF: page 66

9. The role of the sympathetic nervous system is to calm our bodies down after something stressful.

   ANS: F PTS: 1 DIF: low REF: page 67

10. The cerebellum is essential for conditioned behaviors like blinking in response to a puff of air directed at the eye.

    ANS: T PTS: 1 DIF: medium REF: page 68

MULTIPLE CHOICE

1. _____ are groups of interconnected neurons that work together to represent stimuli, actions, and thought.
   a. Cells
   b. Circuits
   c. Systems
   d. Neuronal sets

   ANS: B PTS: 1 DIF: low REF: page 41

2. Early anatomists compared neural networks to an interconnected spider web. This idea led to the idea of the _____.
   a. reticular theory of the brain
   b. reticular activating system
   c. neuron doctrine
   d. neuronal doctrine theory of the brain

   ANS: A PTS: 1 DIF: medium REF: page 41

3. Which of the following was NOT a type of neuron described by Spanish anatomist Santiago Ramón y Cajal?
   a. principal
   b. motor
   c. sensory
   d. interconnecting

   ANS: D PTS: 1 DIF: low REF: page 44

4. Which of the following was NOT a reason given for why our memory may decline as we age?
   a. Brain cells linked with memory decline in size.
   b. Blood flow to the brain is restricted as we age.
   c. The number of connections between the neurons degrade .
   d. Brain cells linked with memory decline in number.

   ANS: C PTS: 1 DIF: medium REF: page 45

5. The synapse consists of all of the following EXCEPT:
   a. presynaptic material.
   b. postsynaptic material.
   c. synaptic cleft.
   d. synaptic connector.

   ANS: D PTS: 1 DIF: low REF: page 46

6. Which of the following is true of a neuron during resting potential?
   a. The charge of the cell is slightly positive.
   b. Sodium ions flow in and out of the cell.
   c. Potassium ions flow in and out of the cell.
   d. Most channels in the membrane close.

   ANS: C PTS: 1 DIF: high REF: page 47

7. A change of about _____ mV in potential is enough to fire a neuron and generate an action potential.
   a. 5-10
   b. 10-15
   c. 15-20
   d. 20-25

   ANS: C PTS: 1 DIF: low REF: page 47

8. The synaptic potential created in a distant dendritic branch would most likely be _____ when it arrived at the cell body.
   a. small
   b. large
   c. average
   d. it depends on where it occurred

   ANS: A PTS: 1 DIF: low REF: page 47

9. Findings by Otto Loewi in neuronal transmission supported his theory that _____.

a. electrical impulses could stimulate nervous system activities
b. chemical agents could stimulate nervous system activities
c. action potentials were larger than synaptic potential
d. action potentials are based on an all-or-none principle

ANS: B PTS: 1 DIF: high REF: page 49

10. An inhibitory postsynaptic potential is caused by a flow of _____ ions, while an excitatory postsynaptic potential is due to an increase of _____ ions.
a. sodium; potassium
b. chloride; sodium
c. potassium; chloride
d. sodium; chloride

ANS: D PTS: 1 DIF: high REF: page 50

11. Cocaine enhances the synaptic potential for which of the following neurotransmitters?
a. norepinephrine
b. acetylcholine
c. serotonin
d. GABA

ANS: A PTS: 1 DIF: low REF: page 52

12. Charles Sherrington discovered the simplest brain circuit called the _____.
a. cell assembly
b. reciprocal arc
c. reflex arc
d. reciprocal reflex

ANS: C PTS: 1 DIF: low REF: page 53

13. Which of the following is NOT true about long-term potentiation?
a. Changes in the cellular responses last for several hours.
b. Rapid increases occurred in the excitatory action potential after one stimulation.
c. More cells within the assembly reached action potential.
d. It requires a decrease in the potential of the postsynaptic cell followed by an increase.

ANS: D PTS: 1 DIF: high REF: page 58

14. The most frequent excitatory neurotransmitter in the hippocampus is _____.
a. GABA
b. glutamate
c. norepinephrine
d. dopamine

ANS: B PTS: 1 DIF: low REF: page 58

15. Calcium ions in the postsynaptic neuron aid in the process of long-term potentiation by synthesizing neurotrophins, which _____.
a. increase the magnesium ion levels
b. decrease the size of the synapses
c. permanently sensitize the synapses
d. activate the release of more calcium ions

ANS: C PTS: 1 DIF: medium REF: page 58

16. In a study by Richard Morris, injecting rats with the drug AP5 resulted in the rats _____.
a. quickly finding the platform
b. swimming in the vicinity of the platform
c. eventually finding the maze after circling the area
d. failing to swim in the vicinity of the maze

ANS: D PTS: 1 DIF: medium REF: page 62

17. How was long-term potentiation (LTP) affected in genetically modified mice with extra NMDA receptors?
    a. LTP was delayed.
    b. LTP was induced more readily.
    c. LTP did not occur.
    d. The rate of LTP was normal at first but then it decreased.

    ANS: B PTS: 1 DIF: medium REF: page 62

18. The practice of *phrenology* was originally called _____ by Francis Gall.
    a. *typology*
    b. *somatology*
    c. *organology*
    d. *somatotyping*

    ANS: C PTS: 1 DIF: low REF: page 64

19. Which of the following was not a flaw of Francis Gall's research?
    a. He used only males.
    b. He used small samples.
    c. His research was subjective.
    d. He examined the skull, not the brain directly.

    ANS: A PTS: 1 DIF: low REF: page 64

20. Correct examples of localization of function in the brain include all but which of the following?
    a. Left frontal lobe for speech comprehension.
    b. Right frontal lobe for speech production.
    c. Left frontal lobe for spatial reasoning.
    d. Right frontal lobe for verbal gestures.

    ANS: B PTS: 1 DIF: low REF: page 65

21. The spinal nerves carry information in and out of the brain via the _____.
    a. central nervous system
    b. central peripheral nervous system
    c. peripheral nervous system
    d. perinatal nervous system

    ANS: C PTS: 1 DIF: low REF: page 66

22. Key cranial nerves responsible for the heart, circulatory system, and the diaphragm are located in the _____.
    a. forebrain
    b. midbrain
    c. hindbrain
    d. prefrontal

    ANS: C PTS: 1 DIF: low REF: page 68

23. After the car accident, Dan was not able to regulate when he was hungry, thirsty, or sleepy. Damage most likely occurred to the _____, located in the _____.
    a. hypothalamus; midbrain
    b. hypothalamus; forebrain
    c. thalamus; midbrain
    d. thalamus; forebrain

    ANS: B PTS: 1 DIF: high REF: page 68

24. According to evolutionary principles, one of the first cortical areas to develop was the _____.
    a. striatum
    b. thalamus
    c. hypothalamus
    d. hippocampus

    ANS: D PTS: 1 DIF: medium REF: page 68

25. Which of the following is not true of the cerebral cortex?
    a. It contains 4 lobes.
    c. Its neurons are arranged in layers.

b. It is the second largest part of the cerebral hemispheres.
d. It is divided into symmetrical halves.

ANS: B PTS: 1 DIF: low REF: page 69

26. If your dog rubs up against your left arm which specific brain area would process this information?
a. The left parietal lobe.
b. The left temporal lobe.
c. The right parietal lobe.
d. The right temporal lobe.

ANS: C PTS: 1 DIF: high REF: page 70

27. The _____ somatosensory area is the specific cortical area responsible for processing information about the distance that an oncoming car is from your car.
a. primary
b. secondary
c. association
d. quadratic

ANS: B PTS: 1 DIF: low REF: page 72

28. After the accident, Jim was not able to recognize his wife's face. Specific damage would most likely be to the _____ cortex.
a. auditory
b. cerebral
c. motor
d. inferotemporal

ANS: D PTS: 1 DIF: medium REF: page 73

29. Which of the following is NOT one of the four major functional systems of the brain?
a. sensory
b. rational
c. motor
d. emotional

ANS: B PTS: 1 DIF: low REF: page 74

30. The second cranial nerve is the _____ nerve.
a. optic
b. trigeminal
c. olfactory
d. vagus

ANS: A PTS: 1 DIF: medium REF: page 74

31. The role of the premotor cortex is to _____.
a. initiate motor movements with incoming sensory information
b. send motor information on to the parietal lobe
c. coordinate motor movements
d. integrate reflexive actions

ANS: C PTS: 1 DIF: high REF: page 74

32. What type of behaviors would be affected if the striatal subsystem was damaged?
a. simple motor tasks
b. simple sensory tasks
c. complex motor tasks
d. complex sensory tasks

ANS: C PTS: 1 DIF: medium REF: page 75

33. The amygdala would be closely linked with which type of learning?
a. complex motor
b. emotional
c. fine motor
d. familiar objects

ANS: B PTS: 1 DIF: low REF: page 80

34. The large prefrontal association cortex is well developed in primates, especially humans and is correlated with:
    a. short term memory.
    b. long term memory.
    c. emotions.
    d. intelligence.

    ANS: D PTS: 1 DIF: low REF: page 78

35. Which of the following would not be a function of the autonomic nervous system?
    a. salivation
    b. sweating
    c. crying
    d. respiration

    ANS: C PTS: 1 DIF: low REF: page 77

ESSAY

1. Describe the biological and electrical changes in the neuron during an action potential.

   ANS:
   Since an action potential is based on an all-or-none principle, when the synaptic transmission rises above the threshold, the cell fires. When this occurs, sodium molecules flow inside the cell through channels, resulting in a +40mV potential (from the -70mV at resting state). Then additional potassium flows outside of the cell, trying to restore the charge of the cell at -70mV. A cellular pump exchanges sodium for potassium to restore balance of the molecular concentrations.

   PTS: 1 REF: page 48

2. Discuss how Otto Loewi's study supported his theory that chemical signals also control neuron activity.

   ANS:
   Otto Loewi took a live frog heart and bathed it in a neutral solution where it continued to beat for a period of time. Next, he electrically stimulated the heart to make it slow down and removed some of the solution surrounding this heart. Loewi placed the solution from the first heart and placed it into a chamber holding another beating heart. After a few seconds the second heart slowed down with no stimulation by the scientist.

   PTS: 1 REF: page 49

3. Explain why functional brain imaging is called modern phrenology. Also describe how an fMRI works.

   ANS:
   Francis Gall tried to map out faculties that were localized in specific brain areas. Clinical and experimental work, however, did not support his map of faculties. Functional magnetic resonance imaging (fMRI) technology has allowed a deeper look into the activity of specific brain areas while individuals are completing tasks. The fMRI sends out magnetic impulses which cause the iron molecules in the hemoglobin (a primary component of blood) to twist. The degree in which the hemoglobin twists is dependent upon the amount of oxygen in the blood. Brain areas that are more active have more oxygen in them, so these areas can be determined easily from brain areas that are not being activated. Computers pick up these sensor readings from the brain and map out the brain's activities.

   PTS: 1 REF: page 65

4. Give a general overview of the types of abilities that are regulated by the three main regions of the brain. Start with the most primitive area.

   ANS:
   The hindbrain is the most primitive brain region. It controls many of the cranial nerves and nuclei that send impulses to and from the spinal cord and cranial nerves. Some of the most basic behaviors, like respiration, sleep and wakefulness, circulation, heart activity, and fine coordination of movement are controlled by this region. There may also be areas responsible for some aspects of language and other cognitive functions housed here. The midbrain has centers for coordinating vision and hearing with movement as well as orienting actions, like following a moving target, and reflexive movements, like freezing and escaping.

   The forebrain is at the front of the brain and has two subdivisions with different functions. The lower subarea connects the cerebral cortex and the lower brain area. The thalamus regulates basic survival behaviors, like eating, sex, and sleeping. The pituitary gland is found in the forebrain, and it is the master gland that controls the other glands. Near the surface of the brain is the cerebral cortex, which houses the hippocampus for long term memory and spatial orientation and the amygdala for emotional learning.

   PTS: 1 REF: pages 70 and 71

5. Describe the general actions of each of the four functional systems in the brain.

   ANS:
   The sensory system sends information from the sensory organs to the thalamus for processing. This information initially goes to the primary sensory systems, then to the secondary sensory systems for further processing, and finally on to sensory association areas. In the motor systems, information is organized so that it allows for control and coordination of voluntary movements. The emotional systems mediate emotions and automatic behaviors associated with these emotions. The amygdala is key to the emotional pathways throughout the brain. Last is the cognitive system, which involves the association areas of the cortex and performs the highest level of cognitive processing. One cognitive system connects almost all higher cortical areas and the hippocampus (memory); another focuses on the prefrontal cortex or the area in front of the motor cortex.

   PTS: 1 REF: page 77