CHAPTER 11

Sample Answers for Chapter Discussion Questions

Question #1
Another name for a nerve cell is a neuron. The major components of a neuron are the cell body (houses the nucleus), the dendrites (receive impulses from adjacent neurons), the axon (conducts impulses through the neuron), and terminal endings (transmit impulses to adjacent neurons).

Question #2
Afferent information includes the neural impulses carried from the environment to the brain or spinal cord. Efferent information includes the neural impulses carried from the brain and the spinal cord to the target tissue (e.g., muscles).

Question #3
Receptive segment (cell body and dendrites): receives synaptic input from adjacent neurons

Conductive segment (axon): spreads neural information through the neuron in the form of a nerve impulse

Transmissive segment (axon terminals): converts the nerve impulse into a chemical message (in the form of neurotransmitters) that travels through the synapse to another neuron

Question #4
Resting membrane potential is negative (–70 mV) because the inside of the nerve cell is negative relative to the outside. When a stimulus reaches the nerve fiber, positive ions rush into a particular region of the membrane and are then quickly pumped back out to return the neuron to its resting state. This is called an action potential, or state of depolarization, which reaches its peak at about 40 mV. In a domino effect, the action potential is repeated in adjacent areas of the neural membrane.

The distribution of ions is the driving force behind the change in the membrane potential. During rest or polarization, a greater number of negative ions are located on the inside of the membrane. During depolarization, negative ions quickly rush out and positive ions rush in, creating a positive action potential. To return the neural membrane to its resting potential, negative ions are pumped back in and the positive ions back out.

Question #5
A synaptic transmission will cause an action potential in the postsynaptic cell as long as its strength is above the minimum threshold level. This is called the all-or-none law. The intensity of the action potential remains constant along the nerve fiber’s length regardless of the strength of the stimulus. A stronger stimulus above the minimum threshold will not give rise to a stronger action potential.

Question #6
1. Stimulus identification stage: involves sensing environmental information and determining what it is (perception)

2. Response selection stage: involves translation from perception to movement or response in the form of a motor program (i.e., a motor program is selected)

3. Response programming stage: involves organizing the selected movement (i.e., retrieving the motor program) and commanding the correct muscles appropriately (force, sequence, etc.)

**Question #7**
Closed-loop control follows the idea that movements may be planned and adjusted by feedback during the movement. Open-loop control involves structuring movements in advance (and therefore does not involve feedback), enabling them to be run off automatically when initiated.

Advantages of the closed-loop control system:
* good for new skills
* allows for adjustments according to the situation (i.e., open skills)
* adds versatility to our movement
* good for activities requiring precision and accuracy

Advantages of the open-loop control system:
* good for fast and forceful movements produced without extensive conscious control
* allows attention to be diverted to other responses
* does not demand much time because there is no feedback

**Question #8**
Sensory mechanisms:
Limitation: poor visual skills; strategy: detect visual problems early and correct if possible
Limitation: learner does not hear instructor; strategy: limit the noise in the gym

Perceptual mechanisms:
Limitation: limited attention span; strategy: provide only one critical component of a skill at a time
Limitation: limited capacity of short-term memory; strategy: provide only limited amount of information
(Refer to Table 10.1 for more possible answers.)
Question Bank for Written Student Assessment and Evaluation

Quiz: How Much Do You Know About Information Processing?

1. Outline one structural and one functional difference between the central and peripheral nervous systems.
   **Answer:** Central nervous system is located in the brain and the spinal cord and it acts as the control center. In contrast, peripheral nervous system is located outside of the brain and the spinal cord and it connects the rest of the body with the central nervous system.

2. Describe three general categories of neurons and their function.
   **Answer:**
   - **Afferent neurons:** carry signals to the brain or spinal cord
   - **Efferent neurons:** carry signals from the brain or spinal cord
   - **Interneurons:** carry signals within the spinal cord or brain

3. List at least three parts that make up every neuron.
   **Answer:** Dendrites, cell body, axon, terminal endings

4. What is the function of a myelin sheath (i.e., fatty tissue wrapped around an axon) and by what means is this function accomplished?
   **Answer:** The function of the myelin sheath is to allow a faster travel of neural messages through an axon. The myelin sheath acts as an insulator to prevent leakage of current and the gaps between the myelin sheath allow the impulses to skip from one gap to another, thereby speeding up impulse travel.

5. Describe the three functional regions of a neuron and their function.
   **Answer:**
   - **Receptive segment:** receives synaptic input from other neurons and sends it to the axon.
   - **Conductive segment:** Allows neural information to travel through the neuron in the form of neural impulse.
   - **Transmissive segment:** converts the neural impulse into chemical stimulus which is received by another neuron or muscle cell.

6. What does the “all-or-none” law of neural stimulation state?
   **Answer:** The all-or-none law states that a synaptic transmission will cause an action potential in the post-synaptic cell as long as its strength is above a minimum threshold level.

7. Name and describe the three information processing stages.
**Answer:**

**Stimulus identification** stage focuses on sensing environmental information and determining what it is.

**Response selection** stage generates a response to one's perception of the stimulus.

**Response programming and execution** stage organizes the selected movement from the response selection stage.

8. What is proprioception?
   **Answer:** *The sense of joint movement, muscle tension, orientation, touch, and balance.*

9. Name five exteroceptors.
   **Answer:** *Vision, audition, smell, touch, and taste.*

10. Fill in a specific example beside each component of the information processing of a basketball drilling action.

   - **Coaching instruction:** ________________ (e.g., feel the ball)
   - **Sensory receptors:** ________________ (e.g., proprioception)
   - **Central processing system functions:** ________________ (e.g., perception)
   - **Effector system:** ________________ (e.g., hand muscles)
   - **Output:** ________________ (e.g., dribble)
   - **Exteroceptive feedback:** ________________ (e.g., motivation)

11. Describe one advantage and one disadvantage of the closed-loop control system.
   **Answer:**
   - **Advantages:** (1) allows performance of unpracticed actions; (2) offers flexibility and adaptability to movement; (3) come in handy in activities requiring precision and accuracy.
   - **Disadvantage:** does not effectively explain the control of rapid, discrete actions.

12. Describe one advantage and one disadvantage of the open-loop control system.
   **Answer:**
   - **Advantages:** (1) allows performance of fast forceful movements without extensive conscious control; (2) allows diversion of attention to other processes.
   - **Disadvantage:** is ineffective in situations that are unstable and less predictable.

   **Answer:**
   (1) Quality of sensory input information
   (2) Quality and effectiveness of sensory receptors relaying information to the CNS
   (3) Speed of processing stimulus information (reaction time)
   (4) Ability to anticipate
   (5) Capacity to concentrate
   (6) Level of physiological readiness
Multiple Choice Questions

1. Which of the following statements about the central nervous system is true:
   A) It includes the spinal cord.
   B) It includes the brain.
   C) It acts as a control center of our abilities.
   D) All of the above.
   E) Two of the above.
   Answer: D

2. What is the fundamental functional and structural unit of the nervous system?
   A) brain
   B) spinal cord
   C) neuron
   D) motor endplate
   E) nerve
   Answer: C

3. Which of the following carry signals to the brain or spinal cord:
   A) motor neurons
   B) afferent neurons
   C) efferent neurons
   D) interneurons
   E) both A and C
   Answer: B

4. Which of the following carry signals from the brain or spinal cord:
   A) motor neurons
   B) afferent neurons
   C) efferent neurons
   D) interneurons
   E) both A and C
   Answer: E

5. An axon:
   A) receives stimuli from a neighboring neuron
   B) is sometimes wrapped in a fatty covering
   C) houses the cell nucleus
   D) none of the above
   E) two of the above
   Answer: B

6. The myelin sheath:
   A) is smooth and continuous
   B) acts as an insulator
   C) slows the transmission of messages
D) is found in all neurons
E) all of the above
Answer: B

7. The nodes of Ranvier are part of the _________ segment of a neuron:
A) transmissive
B) interneural
C) terminal
D) receptive
E) conductive
Answer: E

8. Which of the following statements about the nodes of Ranvier is false:
A) They are specialized structures found in all neurons.  
B) They are gaps in the fatty covering of the axon.  
C) They allow neural messages to travel much faster.  
D) Neural impulses skip from one node to the next.  
E) None of the above.
Answer: A

9. Resting membrane potential at -70 mv is also known as:
A) depolarization  
B) repolarization  
C) polarization  
D) action potential  
E) two of the above  
Answer: C

10. The neural synapse is a junction between:
A) a terminal ending of one neuron and a dendrite of another neuron  
B) the terminal endings of two neurons  
C) the axons of two neurons  
D) the cell body of one neuron and a dendrite of another neuron  
E) the axon of one neuron and a terminal ending of another neuron  
Answer: A

11. The relative refractory period:
A) lasts for about a millisecond  
B) is the period in which a second action potential is not possible  
C) is the period during which a stronger action potential can be reached  
D) is the period in which a neuron can be fired only by a very strong synaptic transmission  
E) two of the above  
Answer: D

12. The transmitter acetylcholine:
A) has a strong excitatory effect
B) has a weak excitatory effect  
C) has a strong inhibitory effect  
D) has a weak inhibitory effect  
E) has either a strong or weak inhibitory effect depending on the rate of transmission  
**Answer: A**

13. The five classic senses are known as:  
A) interoceptors  
B) exteroceptors  
C) proprioceptors  
D) preceptors  
E) none of the above  
**Answer: B**

14. Which of the following is **not** a stage of information processing:  
A) stimulus identification  
B) response selection  
C) response programming and execution  
D) feedback  
E) none of the above  
**Answer: D**

15. A continuous reception of information that is related to our movements during a motor skills practice is known as:  
A) response programming  
B) neural stimulus  
C) feedback  
D) open-loop control system  
E) two of the above  
**Answer: C**

16. Which of the following is **not** an advantage of a closed-loop control system:  
A) offers flexibility and adaptability to movement  
B) allows attention to be directed to processes such as strategy and creativity  
C) guides activities requiring precision and accuracy  
D) allows us to perform unpracticed actions  
E) none of the above  
**Answer: B**

17. The open-loop control system is made up of the following parts:  
A) feedback and comparator  
B) feedback and executive  
C) comparator and effector  
D) executive and effector  
E) comparator and executive  
**Answer: D**
18. Which of the following statements about open-loop control is **false**:
A) It is based on the motor program concept.
B) It allows for fast and forceful movements without the need for extensive conscious control.
C) It is a constant, self-regulated process.
D) It allows athletes to execute skills automatically.
E) None of the above.
**Answer: C**

19. The effectiveness of information processing depends most on:
A) the quality of sensory input information
B) the speed of processing the information
C) the ability to anticipate
D) the level of arousal and psychological readiness
E) all of the above
**Answer: E**

20. An effective instruction strategy to improve long-term memory is:
A) providing continuing rehearsal of a skill until it is learned
B) providing only a limited amount of information at a time
C) minimizing time between the demonstration and the rehearsal
D) avoiding unrelated activities in the gym
E) all of the above
**Answer: A**

**Fill in the Blank Questions**

1. The ________ nervous system connects the ________ nervous system with the rest of the body. **Answer: peripheral; central**

2. Afferent neurons are also referred to as ________ neurons. **Answer: sensory**

3. A third category of neurons, the ________, originate or terminate in the brain or spinal cord. **Answer: interneurons**

4. Branch-like fibers that extend from the cell body and receive messages are called ________.
   **Answer: dendrites**

5. An axon transmits messages to its ________ endings. **Answer: terminal**

6. An electrical difference across a cell membrane is called a membrane _________. **Answer: potential**

7. An action potential, or state of ________, reaches its peak at about 40 mv. **Answer: depolarization**
8. A synaptic transmission will cause an action potential in the postsynaptic cell as long as its strength is above a minimum threshold level. This is called the ________ law. **Answer:** all-or-none

9. The sense of movement of joints, muscular tensions, orientation in space, touch, and balance is known as ________. **Answer:** proprioception

10. A player’s ________ serves to filter out most of the available information presented. **Answer:** selective attention

11. Several key elements form the basis for closed-loop control: error detection, error correction, and feedback. There is also a reference of ________ that specifies the desired value for the system. **Answer:** correctness

12. Arousal, fatigue, and boredom are all measures of a person’s ________ state. **Answer:** psychological

13. ________ allows us to store, retrieve, and utilize information from past experiences as we need it. **Answer:** Memory

**True or False Questions**

1. The brain and the spinal cord make up the peripheral nervous system. **Answer:** false (Correct: central nervous system)

2. A human chess player cannot beat the most advanced supercomputer chess program, which can consider 200 million moves in one second. **Answer:** false (Correct: can beat)

3. Nervous activity is solely achieved by the brain. **Answer:** false (Correct: is not solely)

4. Sensory neurons carry signals to the brain or spinal cord. **Answer:** true

5. Afferent neurons are also called motor neurons. **Answer:** false (Correct: Efferent neurons)

6. Nodes of Ranvier are gaps that separate a myelin sheath. **Answer:** true

7. The axon serves as the conductive segment of the neuron. **Answer:** true

8. The transmissive segment receives a continuous bombardment of synaptic input from numerous other neurons on the receptor site. **Answer:** false (Correct: receptive)

9. The inside of a neuron tends to be positive relative to the outside. **Answer:** false (Correct: negative)
10. Each axon branches into terminals and at its end forms a junction with another neuron called a synapse. **Answer:** true

11. A stronger stimulus will make the neurons fire at a faster rate. **Answer:** true

12. The period in which a second action potential is not possible is known as the relative refractory period. **Answer:** false (Correct: absolute refractory period)

13. The response selection stage can be described as a translation mechanism between what is sensed and what movement is desired. **Answer:** true

14. Body position is an example of exteroceptive feedback. **Answer:** false (Correct: proprioceptive)

15. In an open-loop control system, a specific reading is continuously compared with a standard value. **Answer:** false (Correct: a closed-loop)

16. A thermostat operates like a closed-loop control system. **Answer:** true

17. A gymnast on a balance beam uses the closed-loop control system to maintain her balance. **Answer:** true

18. Bobsled riders depend mainly on extrinsic feedback. **Answer:** false (Correct: intrinsic feedback)

19. Open-loop control is not as effective in situations that are unstable and less predictable. **Answer:** true

20. Exteroceptors and proprioceptors are both sensory mechanisms. **Answer:** true

**Other Types of Questions**

1. Label the following diagram:
2. Match the following terms with their corresponding definition.

<table>
<thead>
<tr>
<th>Term</th>
<th>Answer</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Receptive segment</td>
<td>D</td>
<td>A) A period of several milliseconds during which a neuron can only be fired by a very strong synaptic transmission</td>
</tr>
<tr>
<td>2. Conductive segment</td>
<td>E</td>
<td>B) Converts the nerve impulse into a chemical message</td>
</tr>
<tr>
<td>3. Transmissive segment</td>
<td>B</td>
<td>C) A period of about a millisecond during which a second action potential is not possible</td>
</tr>
<tr>
<td>4. Absolute refractory period</td>
<td>C</td>
<td>D) Processes synaptic input from other neurons</td>
</tr>
</tbody>
</table>
3. Explain the first stage of information processing.

**Answer:**
The first stage of information processing is stimulus identification. This stage focuses on sensing environmental information and determining what it is. These sensations come from diverse sources including the five classic senses (known as exteroceptors) of vision, audition, smell, touch, and taste, as well as a few others such as proprioception (the sense of joint movement, muscle tension, orientation, touch, and balance). This first stage is important for providing information about the nature of the environmental stimuli, including patterns of movement, direction, and speed of movement.

4. What is closed-loop control? Identify its key elements.

**Answer:**
Closed-loop control is a process in which a specific reading is continuously compared with a standard value. The system is based on the idea that movements may be planned and adjusted by feedback even during the movement. The key elements of closed-loop control are error detection, error correction, and feedback.

5. What are the disadvantages of open-loop control?

**Answer:**
Open-loop control is not as effective in situations that are unstable and less predictable. In these situations, movements may not be determined effectively in advance, so many movements would suffer without feedback. It follows that more precise and complex actions would be in need of more extensive well-developed motor programs. Although practice can help develop motor programs so that they do become more elaborate, an open-loop control system is generally more accurate for describing rapid, discrete skills that occur in relatively predictable environments.

6. Identify six factors that influence the effectiveness of a learner’s information processing.

**Answer:**
The quality of sensory input information reaching the performer’s senses
The quality and effectiveness of sensory receptors in relaying information to the CNS
The speed of processing stimulus information, known as reaction time
The ability to anticipate
The capacity to concentrate and attend to stimuli
The level of arousal and psychological readiness