Nervous System Study Guide

Introduction:

The nervous system is the master coordinating system of the body. Every thought, action, and sensation reflects its activity. Because of its complexity, the structures of the nervous system are described in terms of two principal divisions—the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS, consisting of the brain and spinal cord, interprets incoming sensory information and issues instructions based on past experience. The PNS, consisting of cranial and spinal nerves and ganglia, provides the communication lines between the CNS and the body’s muscles, glands, and sensory receptors. The nervous system is also divided functionally in terms of motor activities into the somatic and autonomic divisions. It is important, however, to recognize that these classifications are made for the sake of convenience and that the nervous system acts in an integrated manner both structurally and functionally.

Questions:

1. List the three major functions of the nervous system.

   a. _____________ (sensory input)

   b. _____________ (integration of info)

   c. _____________ (commands responses)

2. Choose the key responses that best correspond to the descriptions provided in the following statements. Insert the appropriate letter or term in the answer blanks.

   KEY CHOICES:  
   A. Autonomic nervous system  
   B. Central nervous system  
   C. Peripheral nervous system  
   D. Somatic nervous system

   B  1. Nervous system subdivision that is composed of the brain and spinal cord.

   D  2. Subdivision of the PNS that controls voluntary activities such as the activation of skeletal muscles.

   C  3. Nervous system subdivision that is composed of the cranial and spinal nerves and ganglia.

   A  4. Subdivision of the PNS that regulates the activity of the heart and smooth muscle and of glands; it is also called the involuntary nervous system.

   B  5. A major subdivision of the nervous system that interprets incoming information and issues orders.

   C  6. A major subdivision of the nervous system that serves as communication lines, linking all parts of the body to the CNS.
3. This exercise emphasizes the difference between neurons and neuroglia. Indicate which cell type is identified by the following descriptions. Insert the appropriate letter or term in the answer blanks.

**KEY CHOICES:**

<table>
<thead>
<tr>
<th>A. Neurons</th>
<th>B. Neuroglia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supports, insulates, and protects cells.</td>
<td><strong>A</strong>. Neurons</td>
</tr>
<tr>
<td>2. Demonstrates irritability and conductivity, and thus transmit electrical messages from one area of the body to another area.</td>
<td><strong>B</strong>. Neuroglia</td>
</tr>
<tr>
<td>3. Release neurotransmitters.</td>
<td><strong>A</strong>. Neurons</td>
</tr>
<tr>
<td>4. Are amitotic.</td>
<td><strong>A</strong>. Neurons</td>
</tr>
<tr>
<td>5. Able to divide; therefore are responsible for most brain neoplasms.</td>
<td><strong>B</strong>. Neuroglia</td>
</tr>
</tbody>
</table>

4. Match the anatomic terms given in Column B with the appropriate descriptions of the function provided in Column A. Place the correct term or letter response in the answer blanks.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Releases neurotransmitters</td>
<td>A. axon</td>
</tr>
<tr>
<td>2. Conducts electrical currents toward the cell body</td>
<td>B. Axonal terminal</td>
</tr>
<tr>
<td>3. Increases the speed of impulse transmission</td>
<td>C. Dendrite</td>
</tr>
<tr>
<td>4. Location of the nucleus</td>
<td>D. Myelin sheath</td>
</tr>
<tr>
<td>5. Generally conducts impulses away from the cell body</td>
<td>E. Cell body</td>
</tr>
</tbody>
</table>

5. Certain activities or sensations are listed below. Using key choices, select the specific receptor type that would be activated by the activity or sensation described. Insert the correct term(s) or letter response(s) in the answer blanks. Note that more than one receptor type may be activated in some cases.

**KEY CHOICES:**

<table>
<thead>
<tr>
<th>A. Bare nerve endings (pain)</th>
<th>B. Golgi tendon organ</th>
<th>E. Pacinian corpuscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Meissner’s corpuscle</td>
<td>D. Muscle spindle</td>
<td>(pressure)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity or Sensation</th>
<th>Receptor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking on Hot Pavement</td>
<td>1. (Identify two) <strong>A</strong> And <strong>D</strong></td>
</tr>
<tr>
<td>Feeling a pinch</td>
<td>2. (Identify two) <strong>A</strong> And <strong>E</strong></td>
</tr>
<tr>
<td>Leaning on a shovel</td>
<td>3. <strong>E</strong> (B + D)</td>
</tr>
<tr>
<td>Muscle sensations when rowing a boat</td>
<td>4. (Identify two) <strong>B</strong> And <strong>D</strong></td>
</tr>
<tr>
<td>Feeling a caress</td>
<td>5. <strong>C</strong></td>
</tr>
</tbody>
</table>
6. List in order the minimum elements in a reflex arc from the stimulus to the activity of the effector. Place your responses in the answer blanks.

1. Stimulus 2. __________________________       3. ____________________________
4. ______________________________       5. Effector organ

7. Using key choices, select the terms indentified in the following descriptions by inserting the appropriate letter or term in the spaces provided.

KEY CHOICES:
A. Afferent neuron    F. Neuroglia    K. Proprioceptors
B. Association neuron    G. Neurotransmitters    L. Schwann cells
C. Cutaneous sense organs    H. Nerve    M. Synapse
D. Efferent neuron    I. Nodes of Ranvier    N. Stimuli
E. Ganglion    J. Nuclei    O. Tract

1. Sensory receptors found in the skin, which are specialized to detect temperature, pressure changes, and pain.
2. Specialized cells that myelinate the fibers of neurons found in the PNS
3. Junction or point of close contact between neurons.
4. Bundle of nerve processes inside the CNS.
5. Neuron, serving as part of the conduction pathway between sensory and motor neurons
6. Gaps in a myelin sheath
7. Collection of nerve cell bodies found outside the CNS
8. Neuron that conducts impulses away from the CNS to muscles and glands
9. Sensory receptors found in muscle and tendons that detect their degree of stretch.
10. Changes, occurring within or outside the body, that affect nervous system functioning.
11. Neuron that conducts impulses toward the CNS from the body periphery.
12. Chemicals released by neurons that stimulate other neurons, muscles, or glands.
8. **Figure 7-1** is a diagram of a neuron. First, label the parts indicated on the illustration by leader lines. Then choose different colors for each of the structures listed below and use them to color in the coding circles and corresponding structures in the illustration. Finally, draw arrows on the figure to indicate the direction of impulse transmission along the neuron’s membrane.

9. Using the key choices, identify the types of reflexes involved in each of the following situations.

   **KEY CHOICES:**

   **A. Somatic Reflex(es)**
   **B. Autonomic reflex(es)**

   1. Patellar (knee-jerk) response   **A**
   2. Pupillary light reflex   **B**
   3. Effectors are skeletal muscles   **A**
   4. Effectors are smooth muscle and glands   **B**
   5. Flexor reflex   **A**
   6. Regulation of blood pressure   **B**
   7. Salivary reflex   **B**
10. Refer to Figure 7-2, showing a reflex arc, as you complete this exercise. First, briefly answer the following questions by inserting your responses in the spaces provided.
   a. What is the stimulus? **pin prick**
   b. What tissue is the effector? **skeletal muscle**
   c. How many synapses occur in this reflex arc? **3**

Next, select different colors for each of the following structures and use them to color in the coding circles and corresponding structures in the diagram. Finally, draw arrows on the figure indicating the direction of the impulse transmission through this reflex pathway.

11. Using the key choices, complete the following statements by inserting your answers in the answer blanks.

   **KEY CHOICES:**
   A. ventricles
   B. cerebral hemispheres
   C. brain stem
   D. cerebrospinal fluid
   E. cerebellum

   The largest part of the human brain is the (paired) **cerebral hemispheres**.

   The other major subdivisions of the brain are the **cerebellum** and the **brain stem**. The cavities found in the brain are called **ventricles** and they contain **cerebrospinal fluid**.
12. Using the Key Choices, complete the following statements.

**KEY CHOICES:** A. myelinated fibers  B. Surface area  C. Neuron cell bodies  D. gyrus

A [**gyrus**] is an elevated ridge of cerebral cortex tissue. The convolutions seen in the cerebrum are important because they increase the [**surface area**]. Gray matter is composed of [**neuron cell bodies**]. White matter is composed of [**myelinated fibers**], which provide for communication between different parts of the brain as well as with lower CNS centers.

13. **Figure 7-3** is a diagram of the right lateral view of the human brain. First, match the letters on the diagram with the following list of terms and insert the appropriate letters in the answer blanks. Then, select different colors for each of the areas of the brain provided with a color-coding circle and use them to color in the coding circles and corresponding structures in the diagram. If an identified area is a part of a lobe, use the color you selected for the lobe but use [**stripes**] for that area.
14. Figure 7-4 is a diagram of the sagittal view of the human brain. First match the letters on the diagram with the following list of terms and insert the appropriate letter in the answer blanks. Then, color the brain-stem areas blue and the areas where cerebrospinal fluid is found yellow.

1. Cerebellum  
2. Cerebral Aqueduct  
3. Cerebral hemisphere  
4. Cerebral Peduncle  
5. Choroid plexus  
6. Corpora quadrigemina  
7. Corpus callosum  
8. Fourth ventricle  
9. Hypothalamus  
10. Medulla oblongata  
11. Optic chiasma  
12. Pineal body  
13. Pituitary body  
14. Pons  
15. Thalamus
15. If the following statements are true, insert the word “true” in the answer blanks. If any of the statements are false, correct the underlined term by inserting the correct term in the answer blank.

F 1. Cortical areas involved in audition are found in the occipital lobe.
F 2. The primary motor area in the temporal lobe is involved in the initiation of voluntary movements.
F 3. The right cerebral hemisphere receives sensory input from the right side of the body.
F 4. Damage to the thalamus impairs consciousness and the awake/sleep cycles.
True 5. A flat EEG is evidence of clinical death.
F 6. Brain imaging with an MRI involves the use of radioisotope tracers.

16. Using the following KEY choices, identify the meningeal (or associated) structures described below.

KEY CHOICES: A. Arachnoid layer  B. Pia mater  C. Dura mater  D. ventricles

C 1. Outermost covering of the brain, composed of tough fibrous connective tissue.
B 2. Innermost covering of the brain; delicate and vascular.
D 3. Structures that return cerebrospinal fluid to the venous blood in the dural sinuses.
A 4. Middle meningeal layer; like a cobweb in structure.
C 5. Its outer layer forms the periosteum of the skull.

17. Application of Knowledge. You have been given all of the information needed to identify the brain regions involved in the following situations. See how well your nervous system has integrated this information, and name the brain region (or condition) most likely to be involved in each situation. Place your responses in the answer blanks.

a. Following a train accident, a man with an obvious head injury was observed stumbling about the scene. An inability to walk properly and a loss of balance were quite obvious. What brain region was injured? Explain


cerebellum

b. An elderly woman is admitted to the hospital to have a gallbladder operation. While she is being cared for, the nurse notices that she has trouble initiating movement and has a strange “pill-rolling” tremor of her hands. What cerebral area is most likely involved? Explain

motor cortex (frontal lobe) (basal nuclei)
c. A child is brought to the hospital with a high temperature. The doctor states that the child’s meninges are inflamed. What name is given to this condition? Where are the meninges located?

meningitis
meninges surround and protect brain and spinal cord

d. A young woman is brought into the emergency room with extremely dilated pupils. Her friends state that she has overdosed on cocaine. What cranial nerve is stimulated by the drug?

oculomotor (moves eye and dilates pupil)

e. A young man has just received serious burns, resulting from standing with his back too close to a bonfire. He is muttering that he never felt the pain. Otherwise, he would have smothered the flames by rolling on the ground. What part of his CNS might be malfunctioning?

subarachnoid space

f. An elderly gentleman has just suffered a stroke. He is able to understand verbal and written language, but when he tries to respond, his words are garbled. What cortical region has been damaged by the stroke? Explain.

Broca’s area

g. A 12-year old boy suddenly falls to the ground, having an epileptic seizure. He is rushed to the emergency room of the local hospital for medication. His follow-up care includes a recording of his brain waves to try to determine the area of the lesion. What is this procedure called?

EEG (electroencephalogram)
18. Figure 7-6 is a cross-sectional view of the spinal cord. First, select different colors to identify the following structures and use them to color the coding circles and corresponding structures in the figure.

- Pia mater
- Dura mater
- Arachnoid

Then, identify the areas listed in the key choices by inserting the correct choices/letter next to the appropriate leader line on the figure.

KEY CHOICES:
A. Central canal
B. Column of white matter
C. Dorsal horn
D. Dorsal root
E. Dorsal root ganglion
F. Spinal nerve
G. Ventral Horn
H. Ventral Root

19. Using the KEY Choices, indicated what would happen if the following structures were damaged or transected. Place the correct letter in the answer blanks.

KEY CHOICES:
A. Loss of motor function
B. Loss of sensory function
C. Loss of both motor and sensory function

- B. 1. Dorsal root of a spinal nerve
- A. 2. Ventral root of a spinal nerve
- C. 3. Anterior ramus of a spinal nerve
20. The following table indicates a number of conditions. Use a check to show which division of the autonomic nervous system is involved in each condition.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sympathetic</th>
<th>Parasympathetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postganglionic neurons secrete norepinephrine; adrenergic fibers</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Postganglionic neurons secrete acetylcholine; cholinergic fibers</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Normally in control</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fight or Flight response system</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Causes a dry mouth, dilates bronchioles</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Constricts eye pupils, decreases heart rate</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Slows down digestive functions</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

21. You are alone in your home late in the evening, and you hear an unfamiliar sound in your backyard. In the spaces provided, list four physiologic events promoted by the sympathetic nervous system that would help you to cope with this frightening situation.

a. increased heart rate /blood flow
b. slowed digestion

c. adrenaline

d. increased respiratory rate

22. After surgery, patients are often temporarily unable to urinate, and bowel sounds are absent. Identify the division of the autonomic nervous system that is affected by anesthesia. Explain.

para sympathetic is affected - normal functions are slowed down
23. A brain tumor is found in a CT scan of Mr. Child’s head. The physician is assuming that it is not a secondary tumor (i.e. it did not spread from another part of the body) because an exhaustive workup has revealed no signs of cancer elsewhere in Mr. Child’s body. Is the brain tumor more likely to have developed from nerve tissue or from neuroglia? Why?

- neuroglia - these are mitotic - able to produce more cells - can become cancerous
- neurons are amitotic (don’t divide)

24. Amy, a high-strung teenager, was suddenly startled by a loud bang that sounded like a gunshot. Her heartbeat accelerated rapidly. When she realized that the noise was only a car backfiring, she felt greatly relieved but her heart kept beating heavily for several minutes more. Why does it take a long time to calm down after we are scared?

- parasympathetic needs time to reverse the sympathetic process
- time is needed for epinephrine to be broken down throughout the body

25. While working in the emergency room, you admit two patients who were in an auto collision. One is dead on arrival, having sustained a severed spinal cord at the level of C2. The other patient suffered a similar injury but at the level of C6 and is still alive. Explain briefly, in terms of the origin and function of the phrenic nerves, why one injury was fatal and the other was not.

- C1-C4 segments of spinal cord control breathing
- C2 controls diaphragm - loss of function here halts motion of diaphragm → blocks respiration → death
- below C4 breathing is not affected