Part I. Clinical Applications

1. How does a blockages of cerebrospinal fluid (CSF) exiting a ventricle cause irreversible brain damage? How is the condition treated?

2. After taking a walk you return home and immediately feel the urge to drink water because you are thirsty. What part of the brain is involved in the urge to drink because you are thirsty?

3. Ever since the mid-1980's an increasing number of young people have developed Parkinson's disease. The reason has been linked to a "street drug" that had a contaminant that destroyed neurons in the substantia nigra of the mesencephalon (midbrain). What clinical explanation substantiates the relationship between this street drug and the development of Parkinson's disease?

4. A person received a blow to the head and is unable to abduct his right eye. What cranial nerve do you suspect is damaged?

5. 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?

6. 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?
Part II

1. The three basic functions the nervous system serves are ________________, ________________, and ________________.

2. The (peripheral? central?) nervous system consists of cranial nerves and spinal nerves.

3. Nerve impulses carried from the periphery to the central nervous system (CNS) are transmitted over (afferent? efferent?) neurons.

4. The peripheral nervous system (PNS) is subdivided into the ________________ and ________________ nervous systems.

5. A motor neuron conducts impulses from the ________________ to ________________ and ________________.

6. This subdivision of the autonomic nervous system speeds up the heartbeat: ________________ nervous system.

7. The two principal cells associated with the nervous system are the ________________, which conduct nerve impulses, and ________________, which support and protect.

Check your understanding of the neuron by matching the nerve cell component with its description.

<table>
<thead>
<tr>
<th>axon collaterals</th>
<th>chromatophilic substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>axon hillock</td>
<td>dendrite</td>
</tr>
<tr>
<td>axolemma</td>
<td>lipofuscin</td>
</tr>
<tr>
<td>axoplasm</td>
<td>neurofibrils</td>
</tr>
<tr>
<td>axon terminals</td>
<td>synaptic vesicles</td>
</tr>
<tr>
<td>axon</td>
<td>synaptic end bulb</td>
</tr>
</tbody>
</table>

8. A highly specialized projection that carries impulses away from the cell body.

9. Bulb-shaped structures at the distal ends of the axon terminals.

10. Cytoplasmic materials in the axon.

11. Are the receiving or input portion of a neuron.

12. Small cone-shaped elevation at the cell body (origin of the axon).


14. Stores a chemical substance called a neurotransmitter.

15. Yellowish brown granules; is probably related to aging.

16. Composed of intermediate filaments; form the cytoskeleton, which provides support and shape for the cell.

17. Side branches of axons (branch off typically at a right angle to the axon).

18. Many fine processes at the distal end of an axon.
20. A neurolemmocyte is responsible for the myelination of axons of the (central? peripheral?) nervous system. After wrapping itself around the axon, the remaining, outer nucleated cytoplasmic layer is called the ________________.

21. The unmyelinated gaps between the cells that form the myelin sheath are called ________________ ________________.

Check your understanding of nerve coverings by matching the connective tissue coat with its description.

22. ______ endoneurium  23. ______ epineurium  24. ______ perineurium

   a. Superficial covering around the entire nerve.
   b. Individual axons are wrapped by this coat.
   c. This coat wraps around each fascicle.

25. Define the following.

   White matter

   B. Gray matter

26. The adult brain is divided into four principal parts. List the parts below.

   A. ________________
   B. ________________
   C. ________________
   D. ________________

27. The cerebrospinal fluid (CSF) circulates through the (subdural? subarachnoid?) space around the brain and spinal cord.

28. The ________________ ________________ are networks of capillaries from which cerebrospinal fluid is formed by filtration and secretion. The special mechanism that prevents the passage of certain substances from the blood into the cerebrospinal fluid is the ________________ ________________ ________________ barrier.
Part III

1. Recheck your knowledge of the neural coverings by listing the three meningeal layers, from superficial to deep.
   a. 
   b. 
   c. 

2. A condition in which cerebrospinal fluid pressure rises due to an accumulation of fluid in the ventricles is called __________.

3. The (astrocytes? ependymal cells?) are thought to pass some substances selectively from the blood into the brain but inhibit the passage of others.


5. List the four components of the diencephalon.
   a. 
   b. 
   c. 
   d. 

6. The thalamus forms part of the (walls? floor?) of the third ventricle. It consists of (2? 3?) masses that are joined by a bridge of gray matter called the __________.

   | anterior nucleus | ventral anterior |
   | lateral geniculate | ventral lateral |
   | medial geniculate  | ventral posterior |

   7. hearing
   8. vision
   9. taste, touch, pressure, vibration, temperature, and pain

10. The thalamus comprises approximately (70%? 80%? 90%?) of the diencephalon.

11. The hypothalamus is located ________________ to the thalamus and is partially protected by the ________________ of the sphenoid bone.

12. The hypothalamus produces two hormones, ________________ hormone and ________________, which are stored in the posterior pituitary.
. Answer (T) true or (F) false to the following questions.

13. ______ The hypothalamus plays a role in regulating body temperature.

14. ______ The control of hunger and satiety are not part of the hypothalamus's function.

15. ______ The hypothalamus is one of the centers that maintain the waking state and sleep patterns.

16. ______ The hypothalamus maintains normal osmotic pressure of the extracellular fluid volume by regulating the thirst center.

17. ______ Feelings of rage and aggression are associated with the hypothalamus.

Cerebrum

Test your knowledge of the cerebrum by answering the following questions.

18. The surface of the cerebrum is composed of (gray? white?) matter and is called the (cortex? medulla?).

19. Due to rapid embryonic development, the cortical region of the cerebrum rolls or folds upon itself. The folds are called _______________ or _______________. The deepest grooves between the folds are called _______________ and the shallower grooves are referred to as _______________.

20. The _______________ fissure, which is the most prominent, separates the cerebrum into (anterior and posterior? left and right?) hemispheres. An extension of the cranial dura mater called the _______________ _______________ extends into this fissure.

21. The cerebral hemispheres are connected internally by a bundle of transverse white matter fibers called the _______________ _______________.

Match the name of a disorder with its definition.

<table>
<thead>
<tr>
<th>Alzheimer's disease</th>
<th>multiple sclerosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>cerebral palsy</td>
<td>Parkinson's disease</td>
</tr>
</tbody>
</table>

22. _____ Debilitating neurological disorder of unknown origin; it afflicts about 11% of the U.S. population over age 65.

23. _____ Involves progressive degeneration of the myelin sheaths, to form hard plaques in the central nervous system.

24. _____ Degeneration of dopamine-releasing neurons in substantia nigra; results in unnecessary skeletal movement such as tremors.

25. _____ A group of motor disorders resulting in muscular incoordination and loss of muscle control.

Answer (T) True or (F) False to the following questions.

26. _____ Cerebrospinal fluid is formed by the choroid plexuses in the ventricles.

27. _____ The reabsorption of cerebrospinal fluid occurs through arachnoid villi.

28. _____ The two masses of gray matter that form the thalamus are joined by the medial lemniscus.

29. _____ The white matter of the cerebrum is often called the arbor vitae.

30. _____ After exiting the optic foramen, the optic nerves unite to form the optic tracts.
Part IV

18. The epithalamus, thalamus, and hypothalamus are anatomical structures of the:
   a. cerebellum
   b. diencephalon
   c. mesencephalon
   d. metencephalon

19. Relay and processing centers for sensory information are found in the:
   a. hypothalamus
   b. epithalamus
   c. pineal gland
   d. thalamus
Using the terms below, complete the following statements.

<table>
<thead>
<tr>
<th>term</th>
<th>term</th>
</tr>
</thead>
<tbody>
<tr>
<td>fissures</td>
<td>hypothalamus</td>
</tr>
<tr>
<td>thalamus</td>
<td>hippocampus</td>
</tr>
<tr>
<td>commissural</td>
<td>pituitary gland</td>
</tr>
<tr>
<td>sulci</td>
<td>aqueduct of Sylvius</td>
</tr>
<tr>
<td></td>
<td>fornix</td>
</tr>
<tr>
<td></td>
<td>spinal cord</td>
</tr>
<tr>
<td></td>
<td>third ventricle</td>
</tr>
</tbody>
</table>

20. The walls of the diencephalon are formed by the _____________.

21. The primary link between the nervous and endocrine system is the _____________.

22. The fibers that permit communication between the two cerebral hemispheres are called _____________.

23. The part of the limbic system that appears to be important in learning and storage of long-term memory is the _____________.

24. The tract of white matter that connects the hippocampus with the hypothalamus is the _____________.

25. Because the cerebrum has a pair of lateral ventricles, the diencephalic chamber is called the _____________.

26. Instead of a ventricle, the mesencephalon has a slender canal known as the _____________.

27. In the caudal half of the medulla the fourth ventricle narrows and becomes continuous with the central canal of the _____________.

28. The shallow depressions that separate the cortical surface of the cerebral hemispheres are called _____________.

29. Deep grooves separating the cortical surface of the cerebral hemispheres are called _____________.

30. The component of the brain that integrates with the endocrine system is the _____________.

31. The ventricles in the brain form hollow chambers that serve as passageways for the circulation of:
   
   a. blood
   b. cerebrospinal fluid
   c. interstitial fluid
   d. lymph

32. The central white matter of the cerebrum is found:
   
   a. in the superficial layer of the neural cortex
   b. beneath the neural cortex and around the cerebral nuclei
   c. in the deep cerebral nuclei and the neural cortex
   d. in the cerebral cortex and in the cerebral nuclei

33. The series of elevated ridges that increase the surface area of the cerebral hemispheres and the number of neurons in the cortical area are called:
   
   a. sulci
   b. fissures
   c. gyri
   d. a, b, and c are correct

34. Coordination and refinement of learned movement patterns at the subconscious level are performed by the:
   
   a. cerebellum
   b. hypothalamus
   c. pons
   d. association fibers
35. The hypothalamus contains centers involved with:
   a. voluntary somatic motor responses
   b. somatic and visceral motor control
   c. emotions, autonomic function, and hormone production
   d. maintenance of consciousness

36. The sea-horse-like structure in the limbic system responsible for storage and retrieval of new long-term memories is the:
   a. corpus callosum
   b. amygdaloid body
   c. hippocampus
   d. cingulate gyrus

37. The cardiovascular centers and the respiratory rhythmicity centers are located in the:
   a. spinal cord
   b. medulla oblongata
   c. pons
   d. cerebellum

38. The medulla oblongata contains sensory and motor nuclei associated with cranial nerves:
   a. I, II, III, IV, V
   b. II, IV, VI, VIII, X
   c. VIII, IX, X, XI, XII
   d. III, IV, IX, X, XII

39. The corpora quadrigemina of the mesencephalon are responsible for processing:
   a. sensations of taste and smell
   b. complex coordinated movements
   c. visual and auditory sensations
   d. balance and equilibrium

40. The slender canal that connects the third ventricle with the fourth ventricle is the:
   a. aqueduct of Sylvius
   b. foramen of Munro
   c. septum pellucidum
   d. diencephalic chamber

41. Excess cerebrospinal fluid is returned to venous circulation by:
   a. diffusion across the arachnoid villi
   b. active transport across the choroid plexus
   c. diffusion through the lateral and medial apertures
   d. passage through the subarachnoid space

42. Through a combination of active and passive transport mechanisms, ependymal cells secrete cerebrospinal fluid at a rate of approximately:
   a. 100 ml/day
   b. 500 ml/day
   c. 1200 ml/day
   d. 1500 ml/day
Part V

1. The white matter of the spinal cord contains:
   a. cell bodies of neurons and glial cells
   b. somatic and visceral sensory nuclei
   c. large numbers of myelinated and unmyelinated axons
   d. sensory and motor nuclei

2. The area of the spinal cord that surrounds the central canal and is dominated by the cell bodies of neurons and glial cells is the:
   a. white matter
   b. gray matter
   c. ascending tracts
   d. descending tracts

3. The type of cells that surround the nerve cell bodies in peripheral ganglia are:
   a. Schwann cells
   b. satellite cells
   c. microglia
   d. oligodendrocytes

4. Schwann cells are glial cells responsible for:
   a. producing a complete neurilemma around peripheral axons
   b. secretion of cerebrospinal fluid
   c. phagocytic activities in the neural tissue of the PNS
   d. surrounding nerve cell bodies in peripheral ganglia

5. The central nervous system (CNS) consist of the:
   a. neuron cell bodies located in ganglia
   b. axons bundled together in nerves
   c. spinal and cranial nerves
   d. brain and spinal cord

6. In the peripheral nervous system (PNS):
   a. neuron cell bodies are located in ganglia
   b. spinal nerves connect to the spinal cord
   c. cranial nerves connect to the brain
   d. a, b, and c are correct

7. In the central nervous system (CNS), the center and tracts that link the brain with the rest of the body are the:
   a. sensory and motor pathways
   b. tracts and columns
   c. nuclei and neural cortex
   d. none of the above

8. The spinal cord is part of the:
   a. peripheral nervous system
   b. somatic nervous system
   c. autonomic nervous system
   d. central nervous system

9. The identifiable areas of the spinal cord that are based on the regions they serve include:
   a. cervical, thoracic, lumbar, sacral
   b. pia mater, dura mater, arachnoid mater
   c. axillary, radial, median, ulnar
   d. cranial, visceral, autonomic, spinal

10. The inferior colliculi are associated with the
    A. thalamus
    B. pons
    C. medulla
    D. mesencephalon
    E. cerebral cortex

11. The nuclei for cranial nerves V, VI, VII, and part of VIII are contained within the
    A. midbrain
    B. pons
    C. diencephalon
    D. medulla
    E. cerebrum

12. Cerebrospinal fluid exits from the fourth ventricle via the
    A. interventricular foramina
    B. cerebral aqueduct
    C. lateral and median apertures
    D. arachnoid villi
    E. dural venous sinuses

13. The crossing over of motor fibers in the medulla occurs in the
    A. nucleus gracilis
    B. nucleus cuneatus
    C. decussation of pyramids
    D. inferior olive
    E. accessory olivary nuclei
14. If cerebrospinal fluid was withdrawn during a spinal tap, a needle would be inserted into the:
   a. pia mater
   b. subdural space
   c. subarachnoid space
   d. epidural space

15. The meninx that is firmly bound to neural tissue and deep to the other meninges is the:
   a. pia mater
   b. arachnoid membrane
   c. dura mater
   d. epidural space

16. ________________ fibers transmit impulses from the gyri in one cerebral hemisphere to the corresponding gyri in the opposite hemisphere.
   A. projection
   B. association
   C. commissural
   D. modulation

17. The primary visual area is located in the ________________ lobe.
   A. frontal
   B. parietal
   C. occipital

18. The feeding and satiety centers are located in the ________________.
   A. thalamus
   B. epithalamus
   C. pons

19. The reflex control centers for heart rhythm, respiration, and blood vessel diameter are located in the ________________.
   A. cerebellum
   B. cerebrum
   C. pons

20. Which cells are responsible for the myelin sheath in the central nervous system?
   A. neurolemmocytes
   B. oligodendrocytes
   C. astroglia
   D. microglia
   E. satellite cells

21. The functional contact between two neurons or between a neuron and an effector is called ________________.

22. The brain and spinal cord are part of the ________________ nervous system.
Part VI
Identify, by color coding and coloring, the following structures in Figure which depicts the major anatomical differences between the somatic and autonomic motor divisions of the PNS. Also identify by labeling all structures provided with leader lines.

- Somatic motor neuron
- ANS preganglionic neuron
- ANS ganglionic neuron
- Autonomic ganglion
- Gray matter of spinal cord (CNS)
- Effector of the somatic motor neuron
- Effector of the autonomic motor neuron
- Myelin sheath
- White matter of spinal cord (CNS)

Part VII
Match the distinguishing feature to the proper division of the autonomic nervous system.

a. Sympathetic system
b. Parasympathetic system
c. Both sympathetic and parasympathetic nervous system
d. Neither sympathetic nor parasympathetic nervous system

1. Short cholinergic preganglionic fibers.
2. Originates in the cranial and sacral regions of the CNS
3. Originates in the thoracic and lumbar regions of the CNS
4. Short cholinergic postganglionic fibers
5. Long adrenergic postganglionic fibers
6. Long cholinergic preganglionic fibers
7. Nicotinic receptors on postganglionic fibers
8. System that dominates in emergency “flight or flight” situations
9. Muscarinic receptors for neurotransmitters
10. Innervates smooth muscle, cardiac muscle, and exocrine glands
11. Innervates skeletal muscle
12. Dominates in relaxed situations
Part VIII

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>1. Postganglionic axons secrete norepinephrine; adrenergic fibers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Postganglionic axons secrete acetylcholine; cholinergic fibers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Long preganglionic axon, short postganglionic axon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Short preganglionic axon, long postganglionic axon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Arises from cranial and sacral nerves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Arises from spinal nerves T₁ to L₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Increases heart rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Fight-or-flight system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Stimulation causes an erection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Causes a dry mouth, dilates bronchioles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Constricts eye pupils, decreases heart rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. The system that coordinates cardiovascular, respiratory, digestive, urinary, and reproductive functions is the:
   a. somatic nervous system (SNS)
   b. autonomic nervous system (ANS)
   c. central nervous system (CNS)
   d. enteric nervous system (ENS)

14. Preganglionic fibers from the thoracic and lumbar segments form the:
   a. sympathetic division of the ANS
   b. parasympathetic division of the ANS
   c. processing centers of the CNS
   d. cell bodies in the CNS

15. The parasympathetic division of the ANS is formed by:
   a. preganglionic fibers from the thoracic and lumbar segments
   b. preganglionic neurons between segments T₁ and L₂
   c. ganglionic neurons in the vertebral column
   d. preganglionic fibers leaving the brain and sacral segments

16. The division of the nervous system that “kicks in” during periods of exertion, stress, or emergency is the:
   a. enteric division of the CNS
   b. sympathetic division of the ANS
   c. somatic motor division of the PNS
   d. parasympathetic division