11

Nervous Tissue and the Central Nervous System

Answers and Explanations

I. Organization and Functions of the Nervous System

A. Multiple Choice Questions

1. (c) – Structurally, the CNS consists of the brain and the spinal cord, and the PNS consists of the nerves and ganglia.
2. (a) – The ANS is a functional division of the nervous system, with components within the brain and spinal cord. Also, some nerves and portions of nerves are functionally included as part of the ANS.
3. (e) – Some functions of the nervous system occur at the conscious level and other functions occur autonomically, at the subconscious level.

B. True–False Questions

1. False – Neurology is study of the nervous system itself.
2. False – The nervous system functions with the endocrine system in regulating the activities of other body systems.
3. False – The functions of the ANS are influenced by the CNS, and the neurons of the sympathetic and parasympathetic divisions of the ANS are also the components of certain spinal and cranial nerves.

II. Developmental Exposition of the Brain

A. Multiple Choice Questions

1. (a) – The prosencephalon divides into the telencephalon and diencephalon, and the rhombencephalon constricts to form the metencephalon and myelencephalon. The mesencephalon does not change.
2. (b) – The telencephalon is the largest region of the brain and comprises of the cerebral hemispheres.
3. (e) – The myelencephalon consists of the medulla oblongata, which is continuous with the spinal cord.

B. True–False Questions

1. False – The neural crest, which gives rise to most of the cranial and spinal nerves, is a component of the ectodermally derived neural plate.
2. True – Both neuroglia and neurons derive from the neural plate.

C. Completion Questions

1. neural plate
2. neuroglia
3. neural crest
4. prosencephalon

III. Neurons and Neuroglia

A. Multiple Choice Questions

1. (b) – Neuroglia are five times more abundant than neurons.
2. (a) – Cell bodies within the CNS are clustered into regions called nuclei, and cell bodies within the PNS occur in clusters called ganglia.
3. (e) – A neurolemmocyte (Schwann cell) is a glial cell that forms myelin layers around axons in the PNS.
4. (c) – Neurolemmocytes form myelin in the PNS, microglia are phagocytic cells, astrocytes aid in the blood-brain-barrier, and ganglionic gliocytes support neurons.
5. (d) – There is no such structure as a mixed neuron.

B. True–False Questions
1. True – Once formed prenatally, neurons cannot mitotically divide.
2. True – The cell bodies of neurons compose the gray matter of the brain, nuclei within the white matter, and ganglia of the PNS.
3. True – Evidence indicates that some pathogens, including tetanus toxin and the herpes simplex and rabies viruses exploit axonal transport to invade neurons.
4. True – A regeneration tube, which is formed by the neurolemmocyte and is composed of myelin, attracts the growing tip of the axon.
5. False – The vascular processes of astrocytes within the brain contribute to the blood-brain-barrier.
6. False – Bipolar neurons are located in the retina of the eye. The autonomic nervous system consists of multipolar and pseudounipolar neurons.
7. True – The term *somatic* refers to innervation of a muscle or gland.

IV. Transmission of Impulses

A. Multiple Choice Questions
1. (b) – During depolarization, the inside of the cell membrane becomes more positive compared to the outside of the membrane.
2. (e) – Nerve impulses conform to all of the criteria listed in the statement choices.
3. (b) – In a given neuron, the speed of depolarization is always consistent, since it is an all-or-none response. The perceived intensity of a stimulus is determined, in part, by the number of depolarizations in a given time.
4. (d) – Neurotransmitters stimulate postsynaptic neurons to depolarize, enabling the impulse to continue on.

B. True–False Questions
1. False – Synaptic transmission is made possible by the secretion of acetylcholine (ACh). Cholinesterase breaks down ACh so that the impulse is discontinued.
2. False – Through the all-or-none response, an impulse travels the length of the nerve fiber without a loss in voltage.
3. True – The speed of a nerve impulse is determined by the diameter of the nerve fiber, the presence or absence of myelin, and the thickness of the myelin.
4. False – Aspirin and caffeine do not alter the speed of nerve impulse conduction, but they do affect the rate of synaptic transmission.

V. General Features of the Brain

A. Multiple Choice Questions
1. (d) – The cerebral arterial circle supplies blood to the pituitary gland.
2. (d) – Tracts within the central nervous system are formed by white matter.
3. (c) – The adult human brain weighs 1.5 kg and is estimated to contain 100 billion neurons, all formed prenatally.

B. True–False Questions
1. True – The brain is supported and protected by the cranium; the spinal cord is supported and protected by the vertebral column.
2. False – The entire central nervous system is covered with meninges and bathed in cerebrospinal fluid.
3. False – There are also specialized gray matter clusters of nerve cells, called nuclei, deep within the white matter.
4. True – Collectively, the aggregations of dendrites and myelinated axons and associated neuroglia within the brain compose the tracts of white matter.
5. True – Because of its high metabolic rate, the brain requires a continuous supply of oxygen and nutrients and rapid removal of metabolic wastes.
6. False – The volume of blood flow to the brain does not fluctuate according to the degree of physical or mental activity.

VI. Cerebrum

A. Multiple Choice Questions

1. (a) – The cerebrum is located in the region of the telencephalon.
2. (d) – The central sulcus separates the frontal and parietal lobes, the corpus callosum connects the two cerebral hemispheres, and there is no sagittal fissure.
3. (b) – There is no sphenoid lobe of the cerebrum.
4. (e) – The precentral gyrus is positioned immediately anterior to the central sulcus.
5. (a) – The postcentral gyrus is positioned posterior the central sulcus and responds to stimuli from cutaneous and muscular receptors throughout the body.
6. (c) – The insula of the cerebrum integrate other cerebral activity and are involved with memory. The occipital lobes of the cerebrum constitute the visual center of the brain.
7. (d) – Delta brain waves have a frequency of 1 to 5 cycles/second in awake adults; however, such a reading may indicate brain damage.
8. (a) – Projection fibers form the ascending and descending tracts from the brain to the spinal cord. Commissural fibers connect the two hemispheres. Intrinsic and spindle fibers are not found in the cerebrum.
9. (d) – The motor speech area deals with verbalization, the postcentral gyrus deals with sensory impulses, and the tentorium cerebelli partitions the cerebellum and cerebrum.

B. True–False Questions

1. False – The cerebral gyri and cerebral sulci form the convolutions of gray matter within the cerebral cortex.
2. True – These are important landmarks for delineation of cerebral structures.
3. False – The size of the precentral gyrus corresponds to the relative amount of innervation to a particular body area.
4. True – The paired insula are deep to the other four paired lobes, where they can effectively integrate cerebral activities.
5. True – Theta brain waves are most common in newborn infants.
6. False – Association fibers are confined to a given cerebral hemisphere and conduct impulses within that hemisphere.
7. False – The basal nuclei initiate involuntary muscle movement.
8. True – In most people, there is a distinction of cerebral function between the right and left cerebral hemispheres.

VII. Diencephalon

A. Multiple Choice Questions

1. (d) – The pons is located in the metencephalon.
2. (a) – The respiratory centers are located in the pons and the medulla oblongata.
3. (b) – The infundibulum is the stalklike attachment of the pituitary gland to the hypothalamus.
4. (e) – Cerebrospinal fluid is produced in the choroid plexus and ADH is produced in the hypothalamus.
5. (b) – The term *hypophysis* refers to the pituitary gland, and the removal of this gland is termed a *hypophysectomy.*
6. (b) – The cardiac accelerator hormone is released by the hypothalamus.

B. True–False Questions

1. False – The thalamus is the largest structure of the diencephalon, constituting nearly four-fifths of its area.
2. False – The hypothalamus controls the autonomic acceleration and deceleration of the heart.
3. True – The sexual center of the hypothalamus consists of specific nuclei that respond to sexual stimuli from the genitalia.
4. True – The hypothalamus consists of several specific nuclei that monitor and regulate specific body functions, including hunger, thirst, sleep, and body temperature.
5. True – The epithalamus forms a thin roof over the third ventricle, located in the superior portion of the diencephalon.

VIII. Mesencephalon

A. Matching Questions

1. (d)
2. (f)
3. (e)
4. (b)
5. (a)
6. (c)

IX. Metencephalon

A. Multiple Choice Questions

1. (e) – These are the four principal structures of the metencephalon.
2. (e) – The pneumotaxic and apneustic areas of the pons function with the rhythmicity area of the medulla oblongata in controlling respiration.
3. (a) – Arbor vitae are tracts of white matter within the cerebellum that have a distinct branching pattern.
4. (b) – A principal function of the cerebellum is coordinating skeletal muscle contraction. Nuclei within the medulla oblongata function with nuclei of the pons in controlling respiration.

B. True–False Questions

1. False – Most of the cranial nerves originate from nuclei within the pons, but not all.
2. True – These respiratory centers are called the apneustic and pneumotaxic areas.
3. False – The vermis is the central constricted area where the two cerebellar hemispheres connect.
4. True – It also maintains balance and equilibrium.

X. Myelencephalon

A. Multiple Choice Questions

1. (a) – Not all spinal cord tracts decussate within the medulla oblongata, but a number of them do.
2. (d) – The facial cranial nerve arises in the pons.
3. (d) – The medulla oblongata does not secrete hormones.
4. (a) – The reticular formation generates continuous impulses that keep the cerebrum in a state of alert consciousness.

B. True–False Questions

1. False – The nucleus ambiguus and the hypoglossal nucleus are the centers from which the vestibulocochlear nerve arises.
2. False – The nucleus gracilis and the nucleus cuneatus relay sensory information to the thalamus.
3. False – The vestibulocochlear nerve arises from the nucleus ambiguus and the hypoglossal nucleus. The inferior olivary nucleus mediates impulses.
4. True – The RAS helps in maintaining muscle tonus and in producing smooth, coordinated contractions of skeletal muscles.

XI. Meninges of the Central Nervous System

A. Multiple Choice Questions

1. (b) – From superficial to deep, the meninges are the dura mater, arachnoid, and pia mater.
2. (d) – The ligamentum denticulatum is a lateral extension of the pia mater along the spinal cord.
3. (d) – Arachnoid villi are the drainage sites for cerebrospinal fluid (CSF). Subarachnoid spaces contain CSF, and epidural spaces provide protection for the spinal cord.

B. True–False Questions

1. True – The cranial dura mater consists of the periosteal and meningeal layers; the spinal dura mater is similar to the meningeal layer.
2. False – The periosteal layer of the cranial dura mater is the periosteum of the cranium.
3. True – The dural sheath continues into the vertebral canal surrounding the spinal cord.
4. False – The pia mater is composed of loose connective tissue.

XII. Ventricles and Cerebrospinal Fluid

A. Multiple Choice Questions

1. (e) – The lateral ventricles are located in each cerebral hemisphere, but the third and fourth ventricles are centered within the diencephalon and the brain stem respectively.
2. (a) – Cerebrospinal fluid is produced by specialized capillaries called choroid plexuses.
3. (d) – Red blood cells are found only within bone marrow and the circulatory system.

B. True–False Questions

1. True – The buoyancy provided by cerebrospinal fluid enables the brain function effectively as a relatively heavy organ.
2. True – Cerebrospinal fluid also buoys the brain and maintains homeostasis of the central nervous system.
3. False – Although 800 ml of cerebrospinal fluid are produced each day, only 140–200 ml are bathing the central nervous system at a given time.
4. True – A higher pressure than this may be a symptom of hydrocephalism.
5. False – Astrocytes are an important component of the blood-brain barrier; oligodendrocytes produce myelin in the central nervous system.
6. True – The blood-brain barrier effectively maintains homeostasis within the central nervous system.
7. True – There are several sites where choroid plexuses are located.

XIII. Spinal Cord

A. Multiple Choice Questions

1. (b) – There are enlargements of the spinal cord at the cervical and lumbar vertebral segments.
2. (a) – Funiculi are ascending and descending tracts of the spinal cord within columns of white matter.
3. (a) – There are no synapses of the corticospinal tracts within the spinal cord.
4. (b) – Extrapyramidal tracts originate in the brain stem regions, serve the upper and lower extremities, and are composed of motor neurons only.

B. True–False Questions

1. False – The spinal cord ends inferiorly at the first lumbar vertebra.
2. True – These structures can be readily identified in cross sections of the spinal cord.
3. False – There are no descending tracts from the cerebellum.

XIV. Developmental Exposition of the Spinal Cord

A. Completion Questions

1. neural tube
2. alar
3. Motor

XV. Clinical Considerations

A. True–False Questions

1. True – Measurement of the pressure of cerebrospinal fluid is generally performed in the lumbar region, between L3 and L4.
2. True – These two techniques enable the visualization of cerebral vascularity.
3. False – EEG recordings are used to monitor epileptic patients to predict seizures.
4. True – A nerve block, such as that used in dentistry, desensitizes a specific area.
5. False – Cerebrovascular accident, or a stroke, is the most common clinical problem of the nervous system.

B. Matching Questions

1. (e)
2. (d)
3. (f)
4. (a)
5. (g)
6. (h)
7. (c)
8. (i)
9. (b)
10. (j)

XVI. Chapter Review

A. Completion Questions

1. perception
2. convolutions
3. motor speech area
4. electroencephalogram (EEG)
5. decussation
6. corpora quadrigemina
7. ataxic
8. falx cerebri
9. subarachnoid space
10. positron-emission tomography (PET)
11. neurotransmitter
12. Neuropeptides
13. cauda equina
14. corticospinal/extrapyramidal
15. general anesthetic/local anesthetic

B. Matching Questions

1. (g)
2. (c)
3. (b)
4. (f)
5. (a)
6. (e)
7. (i)
8. (d)
9. (h)