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Autonomic Nervous System

Answers and Explanations

I. Introduction to Autonomic Nervous System

A. Multiple Choice Questions

1. (a) – The skeletal muscles are voluntary and have somatic motor innervation.
2. (b) – Sympathetic innervation is excitatory, and parasympathetic innervation is generally inhibitory.
3. (b) – Autonomic ganglia are located within structures along the axis of the body, including the head, neck, and abdomen, and paralleling the spinal cord.
4. (c) – Damage to an autonomic nerve makes its target muscle more sensitive than normal to stimulating agents.
5. (d) – Because cardiac muscle is able to produce action potentials automatically, innervation is not necessary for muscle contraction.
6. (c) – In order to contract, the individual cells of multiunit smooth muscles must be stimulated separately by nerve impulses.

B. True–False Questions

1. False – A sensory neuron extends directly from a receptor organ to the CNS without synapsing with a preganglionic neuron.
2. True – Other distinctions include locations of nuclei, sites of innervation, and the effects of stimulation.
3. False – Damage to an autonomic nerve makes its target muscle more sensitive than normal to stimulating agents.
4. False – Cardiac muscle does not require innervation in order to be functional.
5. False – Neurotransmitter chemicals may be either excitatory or inhibitory.
6. False – Smooth muscle fibers do contain a great deal of actin and myosin; at the same time, they lack the sarcomeres that account for the striated appearance of skeletal and cardiac muscle fibers.

II. Structure of the Autonomic Nervous System

A. Multiple Choice Questions

1. (e) – Because the preganglionic neurons of the sympathetic division of the autonomic nervous system exit the vertebral column from the first thoracic to the second lumbar levels, the sympathetic division is also called the thoracolumbar division.
2. (b) – Because the preganglionic sympathetic neurons are myelinated and thus appear white, they are called white rami communicantes.
3. (b) – Because the preganglionic neurons of the parasympathetic division of the autonomic nervous system originate in the brain and at the second through the fourth sacral levels in the spinal cord, the parasympathetic division is also known as the craniosacral division.
4. (a) – Sympathetic stimulation of the arrector pili muscles causes erection of hair and goosebumps.
5. (c) – Parasympathetic neurons of the oculomotor, facial, and glossopharyngeal nerves synapse in ganglia located in the head; neurons in the vagus nerve synapse in terminal ganglia located in the head, neck, and throughout the trunk.
6. (d) – Constriction of visceral blood vessels is due to sympathetic stimulation.

B. True–False Questions

1. False – The sympathetic division of the autonomic nervous system is also known as the thoracolumbar division.
2. True – Postganglionic axons in the gray rami communicantes extend directly back to the anterior roots of the spinal nerves and travel distally within the spinal nerves to innervate their effector organs.
3. False – The celiac, superior mesenteric, and inferior mesenteric ganglia are collateral ganglia.
4. True – As a modified sympathetic ganglion, the adrenal medulla secretes the hormones epinephrine and norepinephrine.
5. False – The vagus nerves provide only parasympathetic innervation.
6. False – The vagus nerves within the abdominal cavity also contribute to the celiac plexus and plexuses of the abdominal aorta.

III. Functions of the Autonomic Nervous System

A. Multiple Choice Questions

1. (d) – Parasympathetic stimulation of the GI tract stimulates movement and also inhibits closing of the sphincters.
2. (a) – Acetylcholine is the most common neurotransmitter.
3. (d) – Because the muscarinic effects are inhibited by atropine, it is used clinically to dilate pupils during eye examinations, to dry mucous membranes, and to inhibit spasmodic contractions of the lower GI tract. Atropine also increases the heart rate.
4. (b) – Stimulation of sympathetic nerves enlarges the pupils; stimulation of the parasympathetic nerves constricts the pupils.
5. (a) – Parasympathetic action on the urinary bladder promotes micturition, and the reflex is enhanced by sympathetic activity.
6. (d) – Sweat glands are innervated only by the sympathetic division of the autonomic nervous system; therefore, they do not experience cooperative, antagonistic, or complementary effects.

B. True–False Questions

1. False – The parasympathetic division of the ANS is not normally activated as a whole.
2. False – The neurotransmitter released by most postganglionic sympathetic neurons is norepinephrine.
3. True – The heart rate is slowed by stimulation through the parasympathetic fibers of the vagus nerves.
4. True – The heart, with its dual innervation, is an example of an organ that experiences the antagonistic effects of sympathetic and parasympathetic stimulation.
5. False – The effects of sympathetic and parasympathetic stimulation on salivary gland secretion are complementary.
6. False – Erection of the penis is a parasympathetic response, but ejaculation is a sympathetic response.
7. False – Sympathetic stimulation of sweat glands in response to heat causes increased perspiration.
8. True – Dilatation of the surface blood vessels in response to the release of bradykinin is important in radiant heat loss.

IV. Control of the Autonomic Nervous System by Higher Brain Centers

A. Multiple Choice Questions

1. (e) – The medulla oblongata regulates respiration, along with the pons. The medulla oblongata is also a vasomotor center that affects erection of the male and female genitalia. The sexual center is located within the hypothalamus, but the hypothalamus does not control respiration.
2. (c) – Baroreceptors are located in the aortic arch and carotid sinuses, not within the heart.

3. (b) – The hypothalamus has a regulatory role over the posterior pituitary, which is not a visceral organ.
4. (b) – The limbic system consists of a group of fiber tracts and nuclei that are important in emotional drives, such as anger, fear, sex, and hunger.

B. True–False Questions

1. True – There are also stretch receptors within the ventricles that produce a reflex decrease in heart rate and vasodilation.
2. False – Stimulation of the aortic baroreceptors causes a reflex decrease in heart rate.
3. True – Because they are regulatory and necessary for homeostasis and even survival, the autonomic activities of the hypothalamus are not dependent upon higher brain centers.
4. True – Motor impulses from the cerebellum to the medulla oblongata influence activity of the ANS, including the responses of motion sickness, nausea, and sweating.

V. Chapter Review

A. Completion Questions

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| 1. visceral | 9. celiac |
| 2. glands | 10. glossopharyngeal |
| 3. ganglia | 11. vagus/parasympathetic |
| 4. intercalated discs | 12. fight/flight |
| 5. syncytium | 13. Acetylcholine |
| 6. peristaltic waves | 14. Bradykinin |
| 7. myogenic | 15. hypothalamus |
| 8. thoracolumbar | |

B. Matching Questions

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| 1. (a), (b) | 4. (b) |
| 2. (a), (b), (c) | 5. (a) |
| 3. (c) | 6. (b), (c) |