

## Chapter 16: Autonomic Nervous System

### Multiple Choice

1. Which of the following statements applies to the autonomic nervous system?
- A) The ANS innervates skeletal muscle.
  - B) ANS functions are consciously controlled.
  - C) The ANS controls unconscious movement of skeletal muscles.
  - D) The receptor molecules of the ANS may be muscarinic, nicotinic, or adrenergic.
  - E) A single neuron from the spinal cord carries action potentials to effector organs in the ANS.

Answer: d

Level: 1

2. A nerve, which causes the smooth muscle of a blood vessel wall to constrict, contains \_\_\_\_\_ neurons.

- A) sensory
- B) afferent
- C) autonomic
- D) somatic motor
- E) cranial

Answer: c

Level: 1

3. Which of the organs listed below is not directly innervated by the autonomic nervous system?

- A) the heart
- B) sweat glands
- C) smooth muscle
- D) skeletal muscle
- E) salivary glands

Answer: d

Level: 1

4. Efferent neurons of the

- A) somatic motor nerves innervate smooth muscle.
- B) ANS innervate skeletal muscle.
- C) somatic motor nerves connect skeletal muscles to the chain ganglia of the spinal cord.
- D) ANS utilize one neuron to connect the CNS to the effector organ.
- E) ANS utilize two neurons in series to connect the CNS to the effector.

Answer: e

Level: 1

5. Arrange the following in correct sequence:

1. autonomic ganglia and ganglionic synapse
2. synapse with target tissues
3. preganglionic neuron
4. postganglionic neuron

- A) 2, 3, 4, 1
- B) 1, 3, 2, 4
- C) 3, 1, 4, 2
- D) 4, 1, 3, 2
- E) 4, 3, 1, 2

Answer: c

Level: 2

6. In the sympathetic division of the ANS,
  - A) an important characteristic is convergence of neurons.
  - B) preganglionic fibers are generally longer than postganglionic fibers.
  - C) the preganglionic cell body is located in the lateral horn of the spinal cord.
  - D) a single preganglionic fiber usually synapses with a single postganglionic fiber.
  - E) preganglionic fibers emerge from the cervical portion of the spinal cord.

Answer: c

Level: 1

7. Preganglionic fibers from the thoracic and lumbar segments of the spinal cord are part of the \_\_\_\_\_ division of the ANS.

- A) central
- B) sympathetic
- C) somatic motor
- D) parasympathetic
- E) ganglionic

Answer: b

Level: 1

8. The parasympathetic nervous system is characterized by
  - A) the absence of preganglionic fibers.
  - B) the absence of postganglionic axons.
  - C) short postganglionic axons near the organs they innervate.
  - D) short preganglionic axons near the spinal cord.
  - E) long postganglionic axons.

Answer: c

Level: 1

9. The sympathetic and parasympathetic divisions of the ANS differ in the
  - A) length of the preganglionic and postganglionic axons.
  - B) location of the preganglionic cell bodies.
  - C) position of the ganglia where preganglionic and postganglionic neurons synapse.
  - D) A and B
  - E) A, B, and C

Answer: e

Level: 1

10. Sympathetic fibers leave the spinal cord in the

- A) cranial and sacral regions.
- B) lumbar and sacral regions.
- C) cranial and thoracic regions.
- D) thoracic and lumbar regions.
- E) cervical and sacral regions

Answer: d

Level: 1

11. Chain ganglia are part of the

- A) central nervous system.
- B) sympathetic branch of the ANS.
- C) somatic motor branch of the ANS.
- D) parasympathetic branch of the ANS.
- E) spinal cord.

Answer: b

Level: 1

12. The short connection between a spinal nerve and a sympathetic chain ganglion is called the

- A) white ramus communicans.
- B) gray ramus communicans.
- C) splanchnic nerve.
- D) terminal ganglia.
- E) pink ramus communicans.

Answer: a

Level: 1

13. Axons exit the sympathetic chain ganglia by all of the following except

- A) spinal nerves.
- B) cranial nerves.
- C) splanchnic nerves.
- D) sympathetic nerves.
- E) nerves that innervate the adrenal medulla.

Answer: b

14. Sympathetic preganglionic axons

- A) can synapse in terminal ganglia.
- B) must synapse in parasympathetic ganglia.
- C) can synapse with cells in the adrenal cortex.
- D) can synapse in the dorsal root ganglion.
- E) can synapse in either chain or collateral ganglia.

Answer: e

Level: 1

15. Consider the following situation: Sympathetic preganglionic axons enter a sympathetic chain ganglia. In order for these axons to reach collateral ganglia, they must now travel through

- A) a splanchnic nerve.
- B) a sympathetic nerve.
- C) a gray ramus communicans.
- D) a white ramus communicans.
- E) a dorsal root ganglion.

Answer: a

Level: 2

16. The celiac, superior mesenteric, and inferior mesenteric ganglia are \_\_\_\_\_ ganglia.

- A) chain
- B) dorsal
- C) somatic motor
- D) parasympathetic
- E) collateral

Answer: e

Level: 1

17. Sympathetic stimulation of the postganglionic cells of the adrenal medulla causes the release of

- A) acetylcholine and epinephrine.
- B) norepinephrine and acetylcholine.
- C) epinephrine and norepinephrine.
- D) cortisol.
- E) aldosterone.

Answer: c

Level: 1

18. Parasympathetic ganglia are called \_\_\_\_\_ ganglia.

- A) pelvic
- B) chain
- C) collateral
- D) terminal
- E) dorsal

Answer: d

Level: 1

19. The vagus nerve carries parasympathetic impulses to the

- A) salivary glands.
- B) lacrimal glands.
- C) smooth muscle of the eyes.
- D) thoracic and abdominal viscera.
- E) thyroid gland.

Answer: d

Level: 1

20. Approximately \_\_\_\_\_ of all parasympathetic neurons course through the vagus nerve.

- A) 10%
- B) 25%
- C) 50%
- D) 75%
- E) 90%

Answer: d

Level: 1

21. Parasympathetic preganglionic axons from the sacral region of the spinal cord course through \_\_\_\_\_ nerves that innervate the \_\_\_\_\_.

- A) splanchnic; urinary bladder and adrenal glands
- B) pelvic; lower colon and reproductive glands
- C) sacral; lower colon and urinary bladder
- D) lumbar; stomach and intestines
- E) coccygeal; anus and vagina

Answer: b

Level: 1

22. Which of the following nerves has parasympathetic axons?

- A) facial
- B) trigeminal
- C) hypoglossal
- D) spinal accessory
- E) abducens

Answer: a

Level: 1

23. Which of the following neurons is most likely to be adrenergic?

- A) preganglionic sympathetic
- B) preganglionic parasympathetic
- C) postganglionic sympathetic
- D) postganglionic parasympathetic
- E) postganglionic somatic motor

Answer: c

Level: 2

24. The membranes of all postganglionic neurons in autonomic ganglia have

- A) somatotrophic receptors.
- B) muscarinic receptors.
- C) adrenergic receptors.
- D) nicotinic receptors.
- E) macrotinic receptors.

Answer: d

Level: 1

25. Effector cells that respond to acetylcholine released from postganglionic neurons have
- A) somatotrophic receptors.
  - B) muscarinic receptors.
  - C) adrenergic receptors.
  - D) nicotinic receptors.
  - E) macrotinic receptors.

Answer: b

Level: 1

26. When acetylcholine binds with nicotinic receptors, the response is
- A) inhibitory.
  - B) excitatory.
  - C) either excitatory or inhibitory.
  - D) both excitatory and inhibitory.
  - E) neither excitatory nor inhibitory.

Answer: b

Level: 2

27. If acetylcholine binds to muscarinic receptors,
- A)  $\text{Na}^+$  channels open.
  - B)  $\text{Ca}^{++}$  channels open.
  - C) adrenaline is released.
  - D) G proteins mediate the cell's response.
  - E) the response is neither excitatory nor inhibitory.

Answer: d

Level: 2

28. The two classes of adrenergic receptors are
- A) alpha and beta.
  - B) splanchnic and terminal.
  - C) muscarinic and nicotinic.
  - D) nicotinic and cholinergic.
  - E) muscarinic and terminal.

Answer: a

Level: 1

29. Adrenergic receptors
- A) can be activated by the release of epinephrine.
  - B) have two structural forms - muscarinic and nicotinic.
  - C) when activated stimulate skeletal muscles to contract.
  - D) can be found in both the sympathetic and parasympathetic divisions.
  - E) are activated by the release of acetylcholine.

Answer: a

Level: 1

30. When norepinephrine binds to adrenergic receptors,
- A) Na<sup>+</sup> channels open.
  - B) Ca<sup>++</sup> channels open.
  - C) adrenaline is released.
  - D) G proteins mediate the cell's response.
  - E) Na<sup>+</sup> channels are closed.

Answer: d

Level: 1

31. When acetylcholine binds to autonomic muscarinic receptors,
- A) heart rate increases.
  - B) voluntary movements occur.
  - C) intestinal motility increases.
  - D) intestinal motility decreases.
  - E) intestinal motility stops.

Answer: c

Level: 2

32. Sympathomimetic agents activate
- A) nicotinic receptors.
  - B) muscarinic receptors.
  - C) adrenergic receptors.
  - D) somatotrophic receptors.
  - E) cholinergic receptors.

Answer: c

Level: 1

33. Atropine causes the pupil of the eye to dilate by blocking the effect of muscarinic receptors. This means atropine is a(n)
- A) ganglionic blocking agent.
  - B) beta-adrenergic blocking agent.
  - C) alpha-adrenergic blocking agent.
  - D) parasympathetic blocking agent.
  - E) parasympathomimetic agents.

Answer: d

Level: 2

34. Which of the following drugs would be the best choice to use in chronic asthma to dilate the bronchioles?
- A) a nicotinic agent
  - B) a muscarinic agent
  - C) alpha-adrenergic blocking agents
  - D) beta-adrenergic stimulating agents
  - E) ganglionic blocking agents.

Answer: d

Level: 3

35. Beta-blockers (beta-adrenergic blocking agents) are frequently used to
- A) cause vasoconstriction.
  - B) block muscarinic receptors.
  - C) dilate the pupils of the eye.
  - D) prevent increases in heart rate.
  - E) prevent decreases in heart rate.

Answer: d

Level: 2

36. Autonomic reflexes
- A) are impossible.
  - B) are integrated somewhere in the CNS.
  - C) have efferent input and afferent output.
  - D) are an example of positive feedback.
  - E) are harmful.

Answer: b

Level: 1

37. Autonomic reflexes might be integrated in the
- A) medulla oblongata.
  - B) spinal cord.
  - C) hypothalamus.
  - D) thalamus
  - E) A, B, C

Answer: e

Level: 1

38. Which of the following occurs when the parasympathetic system is stimulated?
- A) increased blood pressure
  - B) increased motility of the digestive tract
  - C) increased metabolism
  - D) increased heart rate
  - E) decreased motility of the digestive tract

Answer: b

Level: 2

39. Which of the following statements is false?
- A) Both divisions of the ANS can produce stimulatory effects.
  - B) Both divisions cooperate to achieve normal reproductive function.
  - C) Structures receiving dual innervation by the ANS are regulated equally by both divisions.
  - D) The sympathetic division has more influence under conditions of physical activity than does the parasympathetic division.
  - E) Dual innervation of organs by both divisions of the ANS is not universal.



Answer: c

Level: 2

40. Which of the following statements is true?
- A) The sympathetic division diverges more than the parasympathetic division.
  - B) Increased parasympathetic activity is consistent with increased physical activity.
  - C) One division of the ANS is always stimulatory and the other is always inhibitory.
  - D) Structures receiving both dual autonomic innervation are regulated equally by both divisions.
  - E) There is dual innervation of all organs.

Answer: a

Level: 2

41. John sees Martha; the pupils of his eyes dilate. It is "love at first sight." What division of the ANS is involved?
- A) sympathetic division
  - B) parasympathetic division
  - C) somatic motor division.
  - D) neither A or B
  - E) both A and B

Answer: a

Level: 3

42. Stimulation by the autonomic nervous system results in increase insulin secretion from the pancreas during and after a meal. The following are most likely to be true.
- A) increased insulin secretion is due to parasympathetic stimulation
  - B) acetylcholine agonists will stimulate insulin secretion
  - C) increased insulin secretion is due to sympathetic stimulation
  - D) increased insulin secretion is due to adrenergic agonists
  - E) A and B

Answer: e

Level: 3

43. When a person consumes a substantial amount of nicotine, the response is
- A) increased parasympathetic responses
  - B) increased sympathetic responses
  - C) decreased parasympathetic responses
  - D) decreased sympathetic responses
  - E) A and B

Answer: e

Level: 2

44. Acetylcholine will cause the pupil of the eye to constrict. A drug acts on receptors for acetylcholine to cause the pupils of the eye to dilate. Nicotine does not bind to receptors in smooth muscle cells of the iris. Therefore, the drug which causes the pupils to dilate is a
- A) nicotinic blocking agent

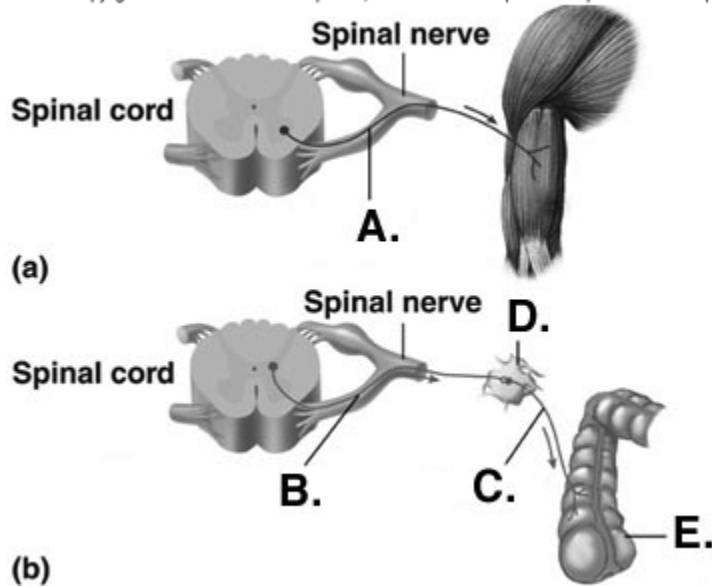
- B) muscarinic blocking agent
- C) a nicotinic agent
- D) a muscarinic agent
- E) an adrenergic agent

Answer: b

Level: 3

Refer to the following figure for questions 45-49.

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45. Identify structure “A” on the top diagram.

- A) autonomic ganglion
- B) somatic motor neuron
- C) effector organ (smooth muscle of GI tract)
- D) postganglionic neuron
- E) preganglionic neuron

Answer: b

Level: 1

46. Identify structure “B” on the bottom diagram.

- A) autonomic ganglion
- B) somatic motor neuron
- C) effector organ (smooth muscle of GI tract)
- D) postganglionic neuron
- E) preganglionic neuron

Answer: e

Level: 1

47. Identify structure “C” on the bottom diagram.

- A) autonomic ganglion
- B) somatic motor neuron

- C) effector organ (smooth muscle of GI tract)
- D) postganglionic neuron
- E) preganglionic neuron

Answer: d

Level: 1

48. Identify structure "D" on the bottom diagram.

- A) autonomic ganglion
- B) somatic motor neuron
- C) effector organ (smooth muscle of GI tract)
- D) postganglionic neuron
- E) preganglionic neuron

Answer: a

Level: 1

49. Identify structure "E" on the bottom diagram.

- A) autonomic ganglion
- B) somatic motor neuron
- C) effector organ (smooth muscle of GI tract)
- D) postganglionic neuron
- E) preganglionic neuron

Answer: c

Level: 1

For questions 50 to 53 consider the two statements and use the following key to choose your answer.

- A) Choose this if the first item is greater than the second item.
- B) Choose this if the first item is less than the second item.
- C) Choose this if both items are equal or nearly equal.

50. (1) Rate of muscle contraction when beta adrenergic receptors of the heart are stimulated.  
(2) Rate of muscle contraction when beta adrenergic receptors of intestinal muscle are stimulated.

Answer: a

Level: 3

51. (1) The frequency of sympathetic impulses to the heart when blood pressure increases.  
(2) The frequency of sympathetic impulses to the heart when blood pressure decreases.

Answer: b

Level: 3

52. (1) The number of sympathetic impulses produced when a person is angry. (2) The number of sympathetic impulses produced when a person is relaxed.

Answer: a

Level: 3

53. (1) The number of sympathetic neurons that innervate sweat glands. (2) The number of parasympathetic neurons that innervate sweat glands.

Answer: a

Level: 3

For questions 54 to 59 match the following characteristics with the correct nervous system.

- A) somatic motor nervous system
- B) autonomic nervous system
- C) both somatic and autonomic nervous systems
- D) neither somatic nor autonomic nervous system

54. acetylcholine is a neurotransmitter substance

Answer: c

Level: 2

55. target tissues may be stimulated or inhibited

Answer: b

Level: 2

56. receptor molecules may be muscarinic or adrenergic

Answer: b

Level: 2

57. all axons are myelinated

Answer: a

Level: 2

58. controls conscious movement

Answer: a

Level: 2

59. neuron cell bodies are in the cerebral cortex

Answer: a

Level: 2

For questions 60 to 68 match each of the following phrases to either the sympathetic or parasympathetic division of the autonomic nervous system.

- A) sympathetic
- B) parasympathetic

60. effects more localized

Answer: b

Level: 2

61. effects are more general

Answer: a

Level: 2

62. increases activity of GI tract

Answer: b

Level: 2

63. can produce widespread sweating

Answer: a

Level: 2

64. has greater influence during physical activity

Answer: a

Level: 2

65. effects are short-lived

Answer: b

Level: 2

66. inhibits heart rate but stimulates contraction of urinary bladder

Answer: b

Level: 2

67. provides more extensive innervation of G.I. Tract

Answer: b

Level: 2

68. stimulation of this system often activates many effectors at the same time

Answer: a

Level: 2

### Fill in the Blank

69. The thoracolumbar division is another name for the \_\_\_\_\_ division of the ANS.

Answer: sympathetic

Level: 1

70. The parasympathetic division of the ANS is also called the \_\_\_\_\_ division.

Answer: craniosacral

Level: 1

71. Cholinergic neurons secrete \_\_\_\_\_.

Answer: acetylcholine

Level: 1

72. A neuron that secretes norepinephrine would be a(n) \_\_\_\_\_ neuron.

Answer: adrenergic  
Level: 1

73. The celiac ganglion is one of the three main \_\_\_\_\_ ganglia.

Answer: collateral  
Level: 1

74. Axons from preganglionic neurons of the parasympathetic division synapse with \_\_\_\_\_ ganglia.

Answer: terminal  
Level: 1

## Essay Questions

75. Trace the path of an impulse that begins with the stimulation of temperature receptors on the back and terminates at sweat glands on the back.

Answer: Sensations of temperature travel on the lateral spinothalamic tract, from the cutaneous receptors on the back to the somesthetic area of the cerebral cortex. The somesthetic area perceives the sensation and projects the sensation to the surface of the back. The somesthetic area also sends the sensation to the somesthetic association area, where it is recognized and evaluated. This would provide conscious awareness of skin temperature. Action potentials from the sensation would also travel from the lateral spinothalamic tract to the sympathetic nervous system and its nuclei in the lateral horns of the gray matter of the spinal cord. (Descending autonomic pathways from the hypothalamus to the brainstem and brainstem to the lateral horn also carry action potentials.) Myelinated nerve fibers emerge from the spinal cord in the ventral nerve roots of the twelve thoracic and first two or three lumbar spinal nerves. The preganglionic fibers form the white rami communicans. The fibers then pass to the sympathetic chain ganglia, where they synapse with a postganglionic fiber. The postganglionic nerve fiber then joins the spinal nerve via the gray rami communicans, and is then distributed to the sweat glands.

Level: 3

76. Discuss how conscious thoughts and emotions affect the functioning of the autonomic nervous system.

Answer: The hypothalamus is regarded as the coordinating center of the autonomic nervous system. The cerebral cortex can utilize the limbic system and the hypothalamus, through its connections with the autonomic nervous system, to express some emotions. When a person experiences anxiety, pleasure, or some other emotion, the cerebral cortex and limbic system can relay action potentials to the hypothalamus. The hypothalamus responds by relaying neural influences via the descending autonomic pathways to the cardiovascular centers in the brainstem. From here, these action potentials can be projected to preganglionic neurons of the cranial nerves and the spinal cord. The portion of the hypothalamus that is stimulated will determine whether the sympathetic or parasympathetic system will be involved.

Level: 3

77. Nicotine contained in a cigarette may either increase or decrease heart rate and produce a

less regular rhythm. How is nicotine able to produce these variable responses?

Answer: Nicotine is able to produce these variable responses because nicotinic receptors are found on postganglionic neurons of both the sympathetic and parasympathetic nervous systems. Therefore, nicotine can stimulate postganglionic neurons of both systems. Nicotine can stimulate heart rate via action of the sympathetic division, or it can slow heart rate via action of the parasympathetic division.

Level: 3

78. It is final exam time. You need an A to keep your A in the class. What symptoms, mediated by the autonomic nervous system, might you be exhibiting as you take the final exam?

Answer: You would probably have an increase in sympathetic activity resulting in increased heart rate, increased blood pressure, sweating, vasoconstriction of peripheral blood vessels causing the skin to be cold, increased metabolism, dilated bronchi, more glucose released into the blood, and a decrease in gastrointestinal activity. You would probably be one very anxious person.

Level: 3