

Review questions for Nervous system lecture

Multiple choice review questions:

- 1) The entire nervous system is divided into two main regions: The _____
 - A) Brain and the spinal chord
 - B) CNS and the PNS
 - C) Neurons and the glial cells
 - D) Motor neurons and the sensory neurons

- 2) The brain and the spinal chord are the _____ nervous system.
 - A) Peripheral
 - B) Autonomic
 - C) Entire
 - D) Central

- 3) All the nervous tissue outside the brain and spinal chord is the _____ nervous system.
 - A) Peripheral
 - B) Autonomic
 - C) Somatic
 - D) Central

- 4) Which of the following is **not** one of the basic functions of the nervous system?
 - A) Formulate responses to sensory stimulation
 - B) Send signals rapidly between body parts
 - C) Produce major body fluids such as plasma and interstitial tissue fluid
 - D) Detect sense stimuli

- 5) A neuron generally has all of the following principle areas except
 - A) microvilli.
 - B) a cell body.
 - C) dendrites.
 - D) an axon.

- 6) The velocity of an nerve signal along an axon will be greatest in which type of axon?
 - A) myelinated
 - B) Unmyelinated

- 7) The numerous, small extensions from the neuron's cell body are known as the
 - A) axons.
 - B) nucleus.
 - C) axon collaterals.
 - D) dendrites.

- 8) Myelin sheaths around axons located within the CNS are formed by
- A) Schwann cells.
 - B) microglia.
 - C) astrocytes.
 - D) oligodendrocytes.
- 9) Which of the following cell types is not a supporting cell or neuroglial cell of the nervous system?
- A) Schwann cell
 - B) oligodendrocyte
 - C) astrocyte
 - D) association neuron
- 10) The specialized cells of the PNS that add myelin to axons
- A) Schwann cells.
 - B) oligodendrocytes.
 - C) microglia.
 - D) astrocytes.
- 11) Nutrients are provided to neurons of the CNS by....
- A) microglia.
 - B) astrocytes.
 - C) oligodendrocytes.
 - D) satellite cells.
- 12) Which neuroglial cells are responsible for myelination of axons in the CNS?
- A) astrocytes
 - B) microglia
 - C) oligodendrites
 - D) Schwann cells
- 13) A(n) ____ neuron transmits signals from the PNS to the central nervous system.
- A) interneuron
 - B) sensory
 - C) motor
 - D) ganglion
- 14) A grouping of cell bodies located within the central nervous system is known as a
- A) tract.
 - B) nerve.
 - C) nucleus.
 - D) ganglion.
- 15) The small membrane-enclosed compartments that hold and release the neurotransmitter molecules from within the presynaptic neuron, are called
- A) synaptic vesicles.

- B) synaptic clefts.
- C) terminal boutons.
- D) gap junctions.

16) Which of the following is not a function of neurons?

- A) Respond to sense stimuli.
- B) Conduct electrical impulses.
- C) Release neurotransmitters
- D) All of these are neuron functions.

17) The term "voltage gated" means that...

- A) ion channels open and close because of changes in the neuron's voltage
- B) neuron voltage is controlled by the Na^+/K^+ pumps.
- C) ion gates will not respond unless the voltage is "regular."
- D) voltage can only be controlled by a voltmeter.

18) Both the depolarization and repolarization changes that occur during the action potential are produced by

- A) simple diffusion of ions down their concentration gradients.
- B) active transport pumps along the neuron membrane.
- C) negative feedback loops.
- D) enzymes creating new ions

19) The first voltage-gated ion channels are located at this region of the neuron:

- A) the dendrite.
- B) the cell body.
- C) the start of the axon
- D) the end of the axon (axons terminal)

20) The diffusion of K^+ out of the cell makes the inside of the cell less positive/more negative, and acts to restore the original resting membrane potential -a process called

- A) depolarization.
- B) hyperpolarization.
- C) repolarization.
- D) overshoot.

21) Arrange these action potential events in their proper sequence:

- (1) threshold voltage is reached
- (2) K^+ gates begin to open
- (3) K^+ gates close
- (4) Na^+ gates begin to open
- (5) Na^+ gates begin to close
- (6) membrane repolarization begins

- A) 1, 2, 4, 3, 5, 6
- B) 4, 6, 3, 2, 1, 5

- C) 4, 6, 2, 1, 5, 3
- D) 1, 4, 2, 6, 5, 3

22) What is the name of the time period during the course of an action potential when no degree of stimulation of the neuron can initiate another action potential?

- A) relaxation period
- B) refractory period
- C) overshoot
- D) threshold

24) Local anesthetics

- A) block the closure of voltage regulated potassium ion channels.
- B) stimulate the opening of voltage regulated potassium ion channels.
- C) block the opening of voltage regulated sodium ion channels.
- D) stimulate the opening of voltage regulated sodium ion channels.

25) If a resting neuron is stimulated and there is an inward flow of negative charges into the cell, the membrane potential will

- A) move upward away from the resting potential and closer to zero.
- B) move downward away from the resting potential, farther away from zero.
- C) stay constant at the resting potential.
- D) oscillate up and down in a wave-like fashion.

26) When the neurotransmitter molecules released from the presynaptic axon terminals have diffused across the synaptic cleft and have reached the postsynaptic membrane, they

- A) activate electrical synapses or gap junctions.
- B) open voltage-regulated Ca^{2+} channels promoting the influx of calcium ions.
- C) bind to specific receptor proteins which stimulates the opening of chemically-gated ion channels.
- D) are absorbed by endocytosis into the postsynaptic membrane and reused

27) If a neurotransmitter binds to a receptor on the target cell and produces depolarization, the neurotransmitter

- A) was probably stimulating the flow of K^+ ions out of the cell.
- B) produced an excitatory postsynaptic potential.
- C) produced an inhibitory postsynaptic potential.
- D) was probably stimulating the flow of Cl^- ions into the cell.

28) Which of the following is **not** a property of the neuron's chemically-gated channels?

- A) They respond best to membrane potential changes, such as depolarization.
- B) They are located on the dendrites, not the axon
- C) They allow ions to diffuse through ion into the neuron
- D) They are activated by neurotransmitters binding to specific receptor molecules.

29) _____ always cause an increased chance that the postsynaptic neuron will have an action potential

- A) Chemical-gated ion channels

- B) Voltage-gated ion channels
- C) IPSPs
- D) EPSPs

30) The gray matter of the brain constitutes primarily the ____ portion of the brain.

- A) cortex (outer portion)
- B) medulla (inner portion)

31) The white matter of the central nervous system gets its white color from the

- A) scarcity of blood vessels.
- B) scarcity of pigment.
- C) nerve cell bodies.
- D) presence of myelin sheaths.

32) Parkinson's disease is caused by loss of neurons that secrete the neurotransmitter

- A) acetylcholine.
- B) norepinephrine.
- C) serotonin.
- D) dopamine.

33) The right and left cerebral hemispheres are connected to each other mainly by a bundle of nerve fibers called the

- A) thalamus.
- B) insula.
- C) corpus cavernosum.
- D) corpus callosum.

34) The cerebrum is divided into lobes, including all of the following except the

- A) frontal.
- B) sagittal.
- C) temporal.
- D) occipital.

35) Sensations from the skin are converted to perceptions in which part of the brain?

- A) the primary motor area
- B) the primary sensory area
- C) Wernicke's area
- D) the amygdala

36) Sense signals from the ear are ultimately transmitted to what part of the brain?

- A) the cerebellum
- B) the cerebrum
- C) the brainstem
- D) the diencephalon

- 37) Blindness is usually caused by damage to the eyes, but could also result from trauma to the brain that destroys the
- A) the cerebellum
 - B) the cerebrum
 - C) the brainstem
 - D) the spinal cord
- 38) The structures in the brain that comprise the limbic system are involved in
- A) voluntary movement of the limbs.
 - B) emotions
 - C) speech.
 - D) bending down to cross under a pole
- 39) Fear appears to be processed by what part of the brain?
- A) the frontal lobes
 - B) the angular gyrus
 - C) the thalamus
 - D) the amygdala
- 40) The ____ seems to be involved in converting short-term memories into long-term memory.
- A) basal nuclei
 - B) Wernicke's area
 - C) hippocampus
 - D) cerebellum
- 41) The structure of the brain responsible for conscious thought, intellect, memory storage and processing, controlling the movement of skeletal muscles, and sensation is the
- A) thalamus.
 - B) cerebellum.
 - C) medulla oblongata.
 - D) cerebrum.
- 42) Emotions, regulation of sleep, wakefulness, sexual arousal, thirst, hunger, body temperature, and production of certain hormones are all functions of what structure of the brain?
- A) hypothalamus
 - B) thalamus
 - C) cerebrum
 - D) cerebellum
- 43) This brain area allows us to consciously have motivation and reward.
- A) frontal lobe
 - B) temporal lobe
 - C) amygdala
 - D) cerebellum

- 44) Damage to _____ causes a person to speak very slowly and with poor articulation, but the person still understands the meaning of words.
- A) Broca's area
 - B) Wernicke's area
 - C) the frontal lobe
 - D) the corpus callosum
- 45) The hypothalamus does *not* contain a control center for the homeostatic regulation of
- A) body temperature.
 - B) various emotional states.
 - C) urination.
 - D) eating.
- 46) The region of the CNS that contains the vital centers for regulating control of respiration rate, heart rate, and blood vessel tone is the
- A) thalamus.
 - B) cerebrum.
 - C) medulla oblongata.
 - D) cerebellum.
- 47) Alcohol depresses the activity of neurons associated with the maintenance of balance, which are located in what part of the CNS?
- A) thalamus
 - B) cerebrum
 - C) cerebellum
 - D) medulla oblongata
- 48) Damage to the cerebellum causes
- A) uncontrollable hunger
 - B) coma
 - C) loss of speech
 - D) loss of balance
- 49) The central cavities in the brain that are filled with cerebrospinal fluid are known as
- A) chambers.
 - B) vesicles.
 - C) ventricles.
 - D) atria.
- 50) The cell bodies of sensory neurons that synapse with the spinal chord are located in the
- A) dorsal root.
 - B) dorsal root ganglion.
 - C) ventral root.
 - D) ventral root gray matter.
- 51) Targets of the autonomic nervous system include all of the following except

- A) cardiac muscle.
- B) exocrine glands.
- C) skeletal muscle.
- D) endocrine glands.

52) Somatic motor neurons have axons only to ____; and are usually under ____ control.

- A) skeletal muscle; involuntary
- B) hollow organs; voluntary
- C) hollow organs; involuntary
- D) skeletal muscle; voluntary

53) Involuntary effectors (glands, smooth or cardiac muscle) are innervated (stimulated by) neurons of the _____ nervous system

- A) autonomic
- B) somatic
- C) sensory
- D) central

54) Which of the following target tissues is innervated by only neurons from the sympathetic nervous system?

- A) heart
- B) blood vessels
- C) bronchioles
- D) stomach

55) Which of the following secretes norepinephrine as a neurotransmitter?

- A) preganglionic sympathetic neurons
- B) postganglionic sympathetic neurons
- C) preganglionic parasympathetic neurons
- D) postganglionic parasympathetic neurons

56) The effects of sympathetic and parasympathetic neurons on the heart can best be described as

- A) antagonistic.
- B) identical.
- C) cooperative.
- D) adrenergic.

57) All of these neurons release acetylcholine as a neurotransmitter except

- A) postganglionic sympathetic neurons
- B) somatic motor neurons
- C) postganglionic parasympathetic neurons
- D) specific cardiac and smooth muscle fibers.

58) In general, parasympathetic activation will produce effects that are _____ to those produced by activation of sympathetic neurons.

- A) similar
- B) antagonistic
- C) complimentary
- D) identical

59) When the parasympathetic system is stimulated, what neurotransmitter is released at the target organ?

- A) acetylcholine
- B) norepinephrine
- C) epinephrine
- D) dopamine

60) Which of the following statements is true for preganglionic sympathetic neurons of the ANS?

- A) They are relatively long.
- B) Their cell bodies are in the CNS.
- C) They release norepinephrine.
- D) They synapse at the effector organ.

61) The "fight or flight" response is the term used to describe activation of the _____.

- A) parasympathetic division
- B) sympathetic division
- C) somatic nervous system
- D) CNS

62) Drugs known as amphetamines stimulate neural pathways causing mental arousal and peripheral nervous system effects that duplicate sympathetic nerve activation. The neurotransmitter that amphetamines mimic in this way, is

- A) acetylcholine.
- B) norepinephrine.
- C) serotonin.
- D) dopamine.

63) Drugs that help people with asthma breathe better by opening (dilating) airways would be classified as...

- A) beta 2 agonists.
- B) beta 1 agonists.
- C) alpha 1 agonists.
- D) alpha 2 agonists.

64) Stimulation of which of the following adrenergic receptors would cause an increase in heart rate and stronger heart contractions?

- A) alpha 1 receptors
- B) alpha 2 receptors
- C) beta 1 receptors
- D) beta 2 receptors

Answers to multiple choice questions:

1 = B	22 = B	44 = A
2 = D	24 = C	45 = C
3 = A	25 = B	46 = C
4 = C	26 = C	47 = C
5 = A	27 = B	48 = D
6 = A	28 = A	49 = C
7 = D	29 = D	50 = B
8 = D	30 = A	51 = C
9 = D	31 = D	52 = D
10 = A	32 = D	53 = A
11 = B	33 = D	54 = B
12 = C	34 = B	55 = B
13 = B	35 = B	56 = A
14 = C	36 = B	57 = A
15 = A	37 = B	58 = B
16 = D	38 = B	59 = A
17 = A	39 = D	60 = B
18 = A	40 = C	61 = B
19 = A	41 = D	62 = B
20 = C	42 = A	63 = A
21 = D	43 = A	64 = C

Fill-in-the-blank review questions:

- 1) The nervous tissue of the brain and spinal cord make up the _____ nervous system. All nervous tissue outside the brain and the spinal chord are part of the _____ nervous system.
- 2) The major organelles (such as the nucleus and ER) in neurons are located in the _____.
- 3) _____ are the short, branching processes from the cell body which detect stimuli.
- 4) The _____ is the long process of a neuron that conducts the signal to the target cell.
- 5) _____ is a white fatty coating wrapped around neuronal axons which speeds the signals passing through them and insulates and protects them.
- 7) The two principle cell types of the nervous system are _____ (which detect stimuli and carry electrical signals) and supporting cells called _____ that assist neurons but that do not detect stimuli or conduct signals.
- 8) _____ are cells which produce the myelin sheath in the peripheral nervous system, but not in the central nervous system.

- 9) _____ are cells which produce the myelin sheath in the central nervous system, but not in the peripheral nervous system.
- 10) A single Schwann cell attaches to (and adds myelin to) one/many (circle one) neuron(s).
- 11) A single oligodendrocyte cell attaches to (and adds myelin to) one/many (circle one) neuron(s).
- 12) In the CNS, _____ are supporting cells that pass nutrients to neurons and help form the blood-brain barrier.
- 13) Capillaries in the brain are much less _____ than capillaries elsewhere in the body.
- 14) In terms of their functions, there are three types of neurons: _____, _____ and _____.
- 15) Name each neuron type described: The neuron type found only in the brain and spinal cord: _____.
The neuron type that directly stimulates muscles to contract: _____. The neuron type that detects sensory stimuli: _____.
- 16) The nervous system has sensory neurons to convey signals toward the brain and spinal cord, motor neurons to send messages to muscles, and _____ neurons to connect the two.
- 17) Most sensory neurons synapse with _____ neurons. Most motor neurons synapse with _____ cells. Interneurons may synapse with _____ neurons or _____ neurons.
- 18) The two types of neurons that are found in the PNS are _____ and _____. The type of neuron found entirely inside the CNS is _____.
- 19) Sensory neurons are also called _____ neurons (a word that means “towards” because they conduct signals toward the CNS); whereas motor neurons are also called _____ neurons (a word that means “away” because they conduct signals away from the CNS)
- 20) The neuron cell bodies within the peripheral nervous system are often clustered into groups called _____
- 21) A _____ is a bundle of neurons (wrapped in connective tissues) in the PNS.
- 22) A _____ is a collection of neuron cell bodies located inside of the CNS.
- 23) Bundles of neurons that provide connections between regions of the central nervous system are called _____
- 24) The _____ neuron conducts the signal to a synapse. The cell that receives the signal at the synapse can be called the _____ cell or the _____ cell.
- 25) At a synapse, the _____ is the fluid-filled space separating the pre- and postsynaptic cells.

- 26) (True/False) The presynaptic neuron in a synapse releases neurotransmitters into the synaptic cleft.
- 27) (True/False) The postsynaptic cell in a synapse releases neurotransmitters into the synaptic cleft.
- 28) When the nerve signal in a presynaptic neuron reaches the axon terminals, neurotransmitters are released by a process called _____ (hint: It involves vesicles and the cell membrane).
- 29) At the distal end of each axon is an enlarged region called the _____. This region releases _____ that pass nerve signals from a neuron to a target cell.
- 30) If a drug was added to a motor neuron so that it could not destroy the neurotransmitters that bound to its receptors, the muscle that the neuron stimulates would stay relaxed/stay contracted (circle one)
- 31) Neurotransmitter molecules are packaged by the neuron into small, membrane-enclosed sacs known as _____
- 32) In _____ disease there is a loss of muscle coordination because the neurotransmitter dopamine is not being made by certain basal nuclei (called the substantia nigra) that are involved in movement.
- 33) Endorphins are brain neurotransmitters that bind to the same receptors as _____ drugs
- 34) The electrical nerve signal that runs along the axon is also referred to as the _____.
- 35) Resting membrane potential in nerve cells is _____ millivolts.
- 36) The different concentrations of sodium and potassium inside and outside of the cell are maintained by the _____ protein.
- 37) Ion channels along the axon membrane (which open and close in response to changes in the membrane potential) are said to be _____ gated.
- 38) The diffusion of _____ ion into the cell makes the inside of the cell more positive—a process called _____
- 39) A change in the voltage near a voltage gated sodium channel that is exactly sufficient to generate an action potential (-55 mV) is called the _____.
- 40) The major ions which change the membrane potential during an action potential are _____ and _____.
- 41) When a neuron is resting, there is more Na^+/K^+ (circle one) inside than outside. When a neuron is resting, there are more negative/positive (circle one) charges inside than outside.
- 42) In the resting state, before an action potential occurs, the voltage gated sodium channels are open/closed (choose one) and the voltage gated potassium channels are open/closed (choose one).

- 43) As the membrane potential near a voltage gated sodium channel increases from -70 mV to -55 mV sodium channel opens/closes (choose one).
- 44) As the membrane potential near a voltage gated _____ channel approaches +30 mV, the channel opens.
- 45) When a signal moves along the axon, _____ ions will cross the membrane **into** the neuron, and _____ ions will cross the membrane **out of** the neuron.
- 46) After a region of the axon reaches +30 mV, _____ ions begin to cross the membrane.
- 47) During the first part of an action potential, when the voltage is becoming more positive, the voltage gated sodium channels are open/closed (circle one) and the voltage gated potassium channels are open/closed (circle one).
- 48) During the second part of an action potential, when the voltage is becoming more negative, the voltage gated sodium channels are open/closed (circle one) and the voltage gated potassium channels are open/closed (circle one).
- 49) During an action potential, sodium ions enter/exit (circle one) the axon and potassium ions enter/exit (circle one) the axon.
- 50) The action potential changes the resting concentrations of sodium and potassium inside the neuron. The normal concentrations of these ions will eventually be restored by the _____ protein.
- 51) In an action potential the last ion to diffuse is _____
- 52) When K^+ flows out of the neuron so that the inside of the cell becomes more negative, the neuron is said to be _____ (hint: a term that means getting more negative inside).
- 53) A neuron is at rest (not carrying a signal). Then it is stimulated which causes a signal to rush down the axon to the neuron's target cell. In the blanks spaces after each description below, write 1-7 to indicate the correct order of events in the neuron.
- K^+ begins to exit the neuron _____
 - The neuron becomes repolarized _____
 - Neurotransmitter is released _____
 - Na^+ begins to enter the neuron _____
 - The neuron is negative inside and positive outside _____
 - The receptors in the dendrites are activated _____
 - The neuron becomes depolarized _____
- 54) After each description of a neuron, write a P if it describes a polarized neuron, write D if it describes a neuron that is depolarizing, and write R if it describes a neuron that is repolarizing.
- Potassium is exiting the neuron _____
 - The neuron is more getting more positive outside _____
 - Sodium is entering the neuron _____

The neuron is at rest _____

An action potential is beginning in the neuron _____

- 56) During the _____ period of a neuron no new action potentials can be generated (no matter how much stimulation the neuron receives) because the sodium and potassium channels must fully complete their depolarization and repolarization sequence before they can begin another action potential.
- 57) The dendrites of a neuron contain _____, which allow the neuron to bind to and respond to neurotransmitters.
- 58) The postsynaptic neuron binds the neurotransmitters using a receptor protein in the membrane. The receptors for neurotransmitters are called _____. (Hint: The name comes from the fact that the receptors allow ions to pass through the membrane and because they open or close depending on whether they have bound a neurotransmitter molecule).
- 59) One of the main differences between an axon and a dendrite is that the axon contains _____ ion channels, while the dendrite contains _____ ion channels. (Hint: the answers relate to what opens the channels, not what ions pass through the channels).
- 60) A(n) _____ postsynaptic potential (abbreviated _____) occurs when the neurotransmitter activates channels which allow negative ions (usually Cl^- ions) to enter.
- 61) A(n) _____ postsynaptic potential (abbreviated _____) occurs when the neurotransmitter activates channels which allow positive ions (usually Na^+) to enter the cell.
- 62) An excitatory postsynaptic potential causes the neuron's electrical potential to become more/less (circle one) positive.
- 63) An inhibitory postsynaptic potential causes the neuron's electrical potential to become more/less (circle one) positive.
- 64) More than one EPSP is usually required to produce a(n) _____ in the neuron's axon.
- 66) (True/False) The strength of an action potential (how many millivolts the axon depolarizes) is controlled by the strength of the stimulus to the dendrites.
- 68) When a neuron is stimulated by another neuron, the number of ions entering the post-synaptic neuron's dendrites does/doesn't (circle one) depend on the number of neurotransmitters released by the presynaptic neuron.
- 69) Each sentence below describes one step in a signal crossing a synapse. In the blank space after each sentence, write a number between 1 and 5 to show what order the events occur in.
- A neuron releases neurotransmitters _____
 - The electrical signal reaches the end of an axon _____
 - A neuron's dendrites depolarize _____
 - A neuron destroys neurotransmitters _____

Neurotransmitters cross the synapse _____

- 70) The gray matter of the CNS is formed from these parts of the neurons: _____ and _____.
- 71) The white matter of the CNS is formed from _____ of the neurons.
- 72) White/gray (circle one) matter is found in the deeper (inner) regions of the cerebrum.
- 73) White/gray (circle one) matter is found in the superficial (outer) regions of the cerebrum.
- 74) _____ are fluid-filled chambers within the brain.
- 75) _____ is the fluid which surrounds, and fills the hollow areas in the CNS.
- 76) The four major brain regions are the _____, _____, _____, and the _____.
- 77) Of the four major brain regions, the largest is the _____
- 78) Areas of gray matter found deep within the cerebral white matter are called _____.
- 79) _____ is a tract (an bundle of white mylenated axons) which connects the left and right cerebral hemispheres.
- 80) Touch sensations arising from skin are conveyed to the _____ of the cerebrum for interpretation.
- 81) True or false: Each small region of the primary sensory area has been mapped to touch signals from a particular body region.
- 82) The visual sense area is responsible for receiving and interpreting sight sense signals. It is located in the _____ lobe of the cerebrum.
- 83) The _____ area of the cerebrum is responsible for receiving and interpreting taste sensory signals.
- 84) The _____ area of the cerebrum is responsible for receiving and interpreting smell sensory signals.
- 85) The _____ area of the cerebrum is where voluntary movement signals are generated.
- 86) True or false: Each small region of the primary motor area has been mapped to control of a particular body region.
- 87) The amygdala and the hippocampus are important structures that make up part of the _____.
- 88) The limbic system is where _____ are generated.

- 89) The amygdala specializes in the emotion of _____.
- 90) Recalling an experience that you had a few years ago would be an example of recalling _____ memory.
- 91) From surgical experience and clinical studies it appears that the _____ is a critical area for making long-term memories
- 92) The region of the brain that allows us to control our impulses and act socially is located in the _____ lobe of the cerebrum.
- 93) A patient able to speak but who chooses words at random and is unable to connect meaning to the words is likely to have damage to _____ area, in the _____ hemisphere.
- 94) Individuals whose speech is described as a "word salad" of rapid, fluid words with no meaning, probably are suffering from damage to _____ area.
- 95) A patient unable to speak despite having a clear concept of what is conceived (e.g. wanting coffee but unable to articulate of the word "coffee") has most likely incurred damage to _____ area in the _____ hemisphere.
- 96) _____ area is where control of the muscles of speech to vocalize the words is located.
- 97) The fact that each hemisphere of the cerebrum has some abilities not shared with its partner is referred to as _____.
- 98) The _____ hemisphere usually controls math and logic.
- 99) The _____ hemisphere usually controls visual and spatial skills, emotion, and artistic skills.
- 100) The _____ is a part of the brain that contains such important structures as the thalamus and the hypothalamus
- 101) Sensory nerve signals converge in the _____, where they are sorted and relayed to the proper sensory areas of the cerebrum for interpretation.
- 102) The hypothalamus controls the _____ gland, which makes many hormones.
- 103) Body temperature regulation is controlled in the _____ region of the brain.
- 104) The _____ region of the brain contains the neural centers for hunger and thirst.
- 105) The _____ is the brain region that sits directly at the top of the spinal cord.
- 106) The brainstem is divided into three major regions: The _____, the _____, and the _____.

- 107) The superior-most of the three brainstem regions is called the _____.
- 108) The midbrain houses the _____, which adds smoothness to voluntary movements.
- 109) The middle of the three brainstem regions is called the _____.
- 110) The pons contains centers that control _____.
- 111) The inferior-most of the three brainstem regions is called the _____.
- 112) The medulla oblongata contains centers that control _____ and _____. It and the pons together contain centers that control _____.
- 113) The _____ is the brain region directly above the brain stem, and the _____ is the brain region posterior to the brain stem (hint: The answers are two of the four major brain regions).
- 114) The _____ brain region is involved in standing with balance, smoothness of movement, and memorized movements.
- 115) After each description below, write CR if it is located in the cerebrum of the brain, D if it is located in the diencephalon, BS if it is located in the brain stem, and CB if it is located in the cerebellum. Some blanks may require more than one answer.
- a) The routing center for incoming sensory signals: _____
 - b) Language areas: _____
 - c) Balance: _____
 - d) Emotion: _____
 - e) Hunger: _____
 - f) Heart rate control: _____
 - g) Breathing control: _____
 - h) Generates voluntary movements: _____
 - i) Adds smoothness to voluntary movements: _____
 - j) Impulse control and social behavior: _____
- 116) The spinal cord has a butterfly-shaped central core of gray matter. The anterior “wings” of the butterfly (the “anterior horns”) contain the cell bodies of which type of PNS neurons? _____
- 117) The spinal cord has a butterfly-shaped central core of gray matter. The posterior “wings” of the butterfly (the “lateral horns”) contain the axon terminals of which type of PNS neurons? _____
- 118) The _____ are formed from the cell bodies of sensory neurons whose axons extend inward to the spinal cord.
- 119) The white-matter of the spinal cord (the area outside the gray matter “butterfly”) consists of the myelinated axons of interneurons. The interneurons carrying signals up to the brain are called _____, and the interneurons carrying signals downward away from the brain are called _____.

- 121) The two types of nerves are cranial nerves and _____ nerves.
- 122) In humans, there are _____ pairs of spinal nerves.
- 123) Each spinal nerve has two "roots" – one _____ root composed of sensory neurons, and one _____ root composed of motor neurons.
- 124) Damage to the spinal chord in the cervical region will lead to paralysis of which limbs? _____. A person with this type of paralysis is called a _____.
- 125) Damage to the spinal chord in the lumbar region will lead to paralysis of which limbs? _____. A person with this type of paralysis is called a _____.
- 126) A _____ in an involuntary response to a stimulus.
- 127) In addition to being involuntary, a reflex is usually also _____ and _____.
- 128) The pathway of neurons that a reflex signal travels through is called its _____.
- 129) All reflex arcs include _____ neurons and _____ neurons. Some (but not all) reflex arcs have a _____ neuron between the two. (Hint: All answers are types of neurons).
- 130) All the neurons in the PNS are either _____ neurons or _____ neurons.
- 131) There are two classes of motor neurons: _____ nervous system neurons, which control involuntary organs and _____ nervous system neurons, which control voluntary muscles.
- 132) In the somatic nervous system, the target organs are all _____ muscles.
- 133) The autonomic nervous system is part of the PNS/CNS (circle one).
- 134) ANS motor neurons control two types of muscle: _____ muscle and _____ muscle. Both of these are voluntary/involuntary (circle one) muscle. The ANS motor neurons also control _____ (a type of non-muscle structure found throughout the body).
- 135) The motor neurons that control the bicep muscle are part of the _____ nervous system.
- 136) The motor neurons that control your small intestine are part of the _____ nervous system.
- 137) The motor neurons that control heart rate are part of the _____ nervous system.
- 138) The motor neurons that allow you to walk are part of the _____ nervous system.
- 139) The motor neurons that control blood pressure and pupil size are part of the _____ nervous system.

- 140) In the somatic nervous system, each motor signal that travels from the CNS to the target organ passes through _____ (how many?) motor neurons.
- 141) In the autonomic nervous system, each motor signal that travels from the CNS to the target organ passes through _____ (how many?) motor neurons.
- 142) In the autonomic nervous system, each motor signal that emerges from the CNS moves sequentially through two motor neurons as it travels to the target organ. The first motor neuron is called the _____ neuron. The second motor neuron is called the _____ neuron.
- 143) One action of acetylcholine released from parasympathetic neurons is to _____ the heart rate.
- 144) Heart rate is increased by the _____ division of the ANS.
- 145) Heart rate is decreased by the _____ division of the ANS.
- 146) The airways in the lungs are constricted by the _____ division of the ANS.
- 147) The airways in the lungs are dilated by the _____ division of the ANS.
- 148) Digestive tract activity, including motility and secretion of digestive juices, is increased by the _____ division of the ANS.
- 149) Digestive tract activity, including motility and secretion of digestive juices, is decreased by the _____ division of the ANS.
- 150) When a blood vessel constricts, this is controlled by the _____ division of the ANS.
- 151) When a blood vessel dilates, this is controlled by the _____ division of the ANS.
- 152) The sympathetic division causes blood vessels in the digestive organs to dilate/contract (circle one).
- 153) The sympathetic division causes blood vessels in the skeletal muscles to dilate/contract (circle one).
- 154) The sympathetic division causes blood vessels in the skin to dilate/contract (circle one).
- 155) The opposing effects of sympathetic and parasympathetic stimulation on most organs represent an example of _____ (opposite) effects.
- 156) After each description below, write S if it applies to the somatic nervous system. Write A if it applies to the autonomic nervous system. Some blanks may require both answers.
- a) Controls involuntary muscles: _____
 - b) Part of the PNS: _____
 - c) Made of motor neurons: _____

- d) Controls voluntary muscles: _____
- e) Controls the quadriceps muscles: _____
- f) Controls the smooth muscles of the stomach: _____
- g) Controls the speed of the heart beat: _____

157) The _____ division of the autonomic nervous system controls processes that are active when all is peaceful and going well.

158) The _____ division of the autonomic nervous system controls processes that are active when we are angry, frightened, or stressed.

159) The parasympathetic nervous system influences heart rate by releasing the neurotransmitter _____ which increases/decreases (circle one) heart rate.

160) The _____ division of the ANS has long preganglionic neurons and short postganglionic neurons because the ganglia are located close to or within the target cells.

161) "Fight or flight" responses in the body result from the release of _____ as the neurotransmitter from postganglionic sympathetic neurons and the hormone _____ from the adrenal gland.

162) The only neurotransmitter released by neurons of the parasympathetic nervous system is _____.

163) The only two neurotransmitters released by neurons of the autonomic nervous system are _____ and _____.

164) The only neurotransmitter released by neurons of the somatic nervous system is _____.

165) _____ is the neurotransmitter released from postganglionic neurons of the sympathetic division, but _____ is released from preganglionic neurons of the sympathetic division.

166) Amphetamines mimic sympathetic nervous system activity by stimulating the release of the neurotransmitter _____.

167) In the ANS, the synapse between the preganglionic neuron and the postganglionic neuron is located inside a ganglion. In the sympathetic division of the ANS, this ganglion is located near/far (circle one) from the spinal cord and near/far (circle one) from the target organ.

168) In the ANS, the synapse between the preganglionic neuron and the postganglionic neuron is located inside a ganglion. In the parasympathetic division of the ANS, this ganglion is located near/far (circle one) from the spinal cord and near/far (circle one) from the target organ.

169) _____ is an adjective that refers to norepinephrine and epinephrine and is used as the name of receptors that bind norepinephrine and epinephrine.

170) There are two major classes of adrenergic receptors, _____ and _____, each of which has several sub-classes.

- 171) The stimulation of _____ adrenergic receptors on smooth muscle causes the smooth muscle to contract.
- 172) The stimulation of _____ adrenergic receptors on smooth muscle causes the smooth muscle to relax.
- 173) Beta-1 adrenergic receptors are found in the _____.
- 174) Binding of norepinephrine to beta-1 adrenergic receptors causes the heart rate to _____.
- 175) Drugs that stop norepinephrine and epinephrine from stimulating the heart are called _____.
- 177) Blood vessel smooth muscle can have two types of _____ receptor, the receptor that binds norepinephrine. The two receptor types allow norepinephrine have two opposite effects (contracting or relaxing the vessel) depending which receptor a blood vessel is expressing. The two receptor types are called _____ and _____ adrenergic receptor.
- 178) Impaired blood circulation to the brain due to a blocked or broken vessel is known as a _____ or _____.
- 179) An abnormal build up of proteins surrounding neurons is the cause of neuron death in _____ disease.
- 180) Drugs, radiation, infections, and malnutrition are particularly dangerous while a woman is pregnant because they can damage _____.
- 181) In some elderly people, occasional forgetfulness is common. This are called mild _____.

Answers to fill-in-the-blank review questions:

- | | |
|-----------------------------------|---------------------|
| 1) Central | Interneurons |
| Peripheral | Motor neurons |
| 2) Cell body | 15) Interneurons |
| 3) Dendrites | Motor neuron |
| 4) Axon | Sensory neuron |
| 5) Myelin | 16) Interneuron's |
| 7) Neurons | 17) Interneurons |
| Neuroglial cells (or glial cells) | Muscle |
| 8) Schwann cells | Other interneuron's |
| 9) Oligodendrocytes | Motor |
| 10) One | 18) Sensory neurons |
| 11) Many | Motor neurons |
| 12) Astrocytes | Interneurons |
| 13) Leaky (or permeable) | 19) Afferent |
| 14) Sensory neurons | Efferent |

20) Ganglia	6
21) Nerve	7
22) Nucleus	3
23) Tracts	1
24) Presynaptic	2
Postsynaptic cell	4
Target cell	55) R
25) Synaptic cleft	R
26) True	D
27) False	P
28) Exocytosis	D
29) Axon terminal	56) Refractory period
Nuerotransmitters	57) Neurotransmitter receptors
30) Stay contracted	58) Chemical gated ion channels
31) Vesicles	59) Chemical gated
32) Parkinson's disease	Voltage gated
33) Opiate	60) Inhibitory
34) Action potential	IPSP
35) -70 mV	61) Excitatory
36) Sodium-potassium pump	EPSP
37) Voltage-gated	62) More
38) Sodium	63) Less
Depolarization	64) Action potential
39) Threshold	66) False
40) Sodium	68) Does
Potassium	69) 2
41) K ⁺	1
Negative	4
42) Closed	5
Closed	3
43) Opens	70) Dendrites
45) Potassium	Cell bodies
46) Na ⁺	71) Myelinated axons
K ⁺	72) White
47) K ⁺	73) Gray
48) Open	74) Ventricles
Closed	75) Cerebrospinal fluid
49) Closed	76) Cerebrum
Open	Diencephalon
50) Enter	Brain stem
Exit	Cerebellum
51) Sodium/Potassium pump	77) Cerebrum
52) K ⁺	78) Basal nuclei
53) Repolarizing	79) Corpus callosum
54) 5	80) Primary sensory area

- 81) True
- 82) Occipital
- 83) Gustatory
- 84) Olfactory
- 85) Primary motor area
- 86) True
- 87) Limbic system
- 88) Emotions
- 89) Fear
- 90) Long term
- 91) Hippocampus
- 92) Frontal
- 93) Wernicke's area
 - Left
- 94) Wernicke's area
- 95) Broca's
 - Left
- 96) Broca's area
- 97) Cerebral lateralization
- 98) Left
- 99) Right
- 100) Diencephalon
- 101) Thalamus
- 102) Pituitary
- 103) Hypothalamus
- 104) Hypothalamus
- 105) Brainstem
- 106) Midbrain
 - Pons
 - Medulla oblongata
- 107) Midbrain
- 108) Substantia nigra
- 109) Pons
- 110) Breathing
- 111) Medulla oblongata
- 112) Heart rate
 - Blood pressure
 - Breathing
- 113) Diencephalon
 - Cerebellum
- 114) Cerebellum
- 115)
 - a) D
 - b) CR
 - c) CB
 - d) CR and D
 - e) D
- f) BS and D
- g) BS
- h) CR
- i) BS and CB
- j) CR
- 116) Motor neurons
- 117) Sensory neurons
- 118) Doral root ganglia
- 119) Ascending tracts
 - Descending tracts
- 121) Spinal
- 122) 31
- 123) Dorsal
 - Ventral
- 124) Arms and legs
 - Quadriplegic
- 125) Legs
 - Paraplegic
- 126) Reflex
- 127) Rapid
 - Predictable
- 128) Reflex arc
- 129) Sensory
 - Motor
 - Interneuron
- 130) Sensory
 - Motor
- 131) Autonomic
 - Somatic
- 132) Skeletal (or voluntary)
- 133) PNS
- 134) Smooth
 - Cardiac
 - Involuntary
 - Glands
- 135) Somatic nervous system
- 136) Autonomic nervous system
- 137) Autonomic nervous system
- 138) Somatic nervous system
- 139) Autonomic nervous system
- 140) One
- 141) Two
- 142) Preganglionic
 - Postganglionic
- 143) Decrease
- 144) Sympathetic

- | | |
|----------------------|----------------------------|
| 145) Parasympathetic | 163) Acetylcholine |
| 146) Parasympathetic | Norepinephrine |
| 147) Sympathetic | 164) Acetylcholine |
| 148) Parasympathetic | 165) Norepinephrine |
| 149) Sympathetic | Acetylcholine |
| 150) Sympathetic | 166) Norepinephrine |
| 151) Sympathetic | 167) Near |
| 152) Contract | Far |
| 153) Dilate | 168) Far |
| 154) Contract | Near |
| 155) Antagonistic | 169) Adrenergic |
| 156) a) A | 170) Alpha |
| b) A and S | Beta |
| c) A and S | 171) Alpha 1 and Alpha 2 |
| d) S | 172) Beta 2 |
| e) S | 173) Heart |
| f) A | 174) Increase |
| g) A | 175) Beta blockers |
| 157) Parasympathetic | 177) Adrenergic |
| 158) Sympathetic | Alpha (1 and 2) |
| 159) Acetylcholine | Beta-2 |
| Decreases | 178) Stroke |
| 160) Parasympathetic | Cerebrovascular accident |
| 161) Norepinephrine | 179) Alzheimers |
| Epinephrine | 180) Nervous system damage |
| 162) Acetylcholine | 181) Senility |

Short answer review questions:

- 1) What are the 3 main functions of the nervous system?
- 2) What is the function of the myelin sheath that surrounds most axons?
- 4) Explain why is it important for neurons to have enzymes that destroy neurotransmitters?
- 5) Signaling from a neurotransmitter in the synaptic cleft is ended by removing the neurotransmitter from the synaptic cleft. This can occur in several ways. Describe two of them.
- 6) Draw a neuron and label the axon, cell body, and dendrites. Circle the region where there are receptors for neurotransmitters. Draw a triangle around the region where the neuron releases neurotransmitters.

7) The hippocampus is involved in emotions, but it also has another role that relates to memories. What exactly is that role?

8) List the functions of the hypothalamus.

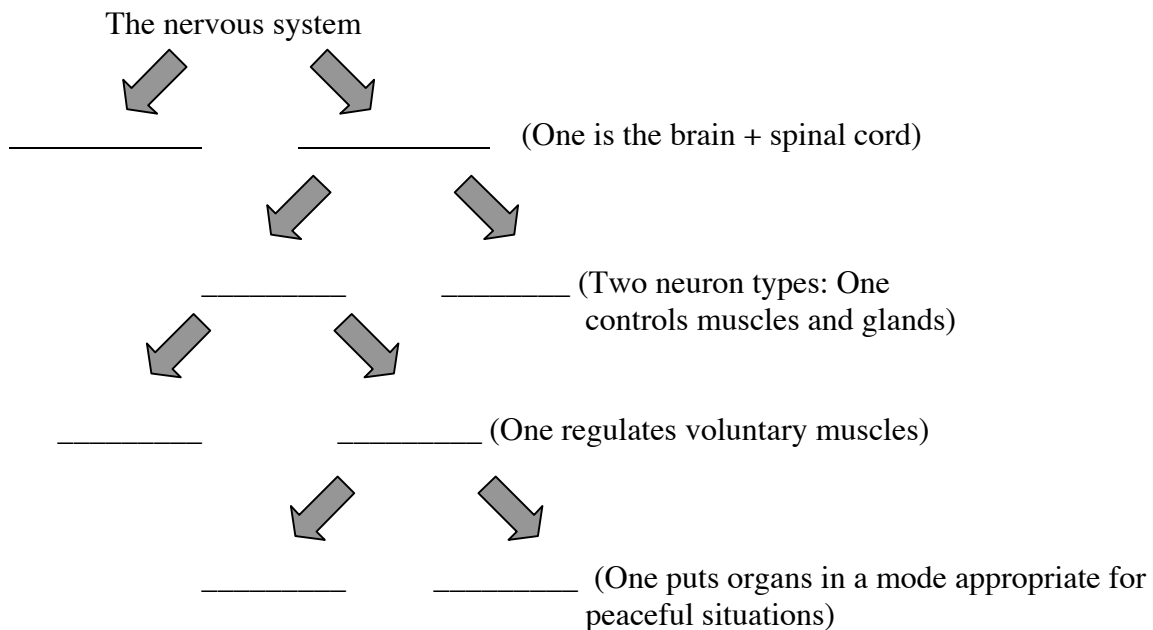
9) If the synapses in your thalamus somehow became randomly changed (in other words, your thalamus became “miswired”) speculate how your perceptions of the world might change.

10) Explain the difference between a paraplegic and a quadraplegic, in terms of where the spine is damaged and what limbs are paralyzed.

11) Name the two divisions of the ANS in the blanks below. Under each one, briefly generalize about what situations it is used in. Also, choose an organ and state what effect(s) each division has on that organ.

_____ and _____

12) Fill in the blanks in the following chart of the nervous system sub-divisions. Hints are given at the left of each level.



13) Circle all the descriptions below that are true for neurons of the somatic nervous system:

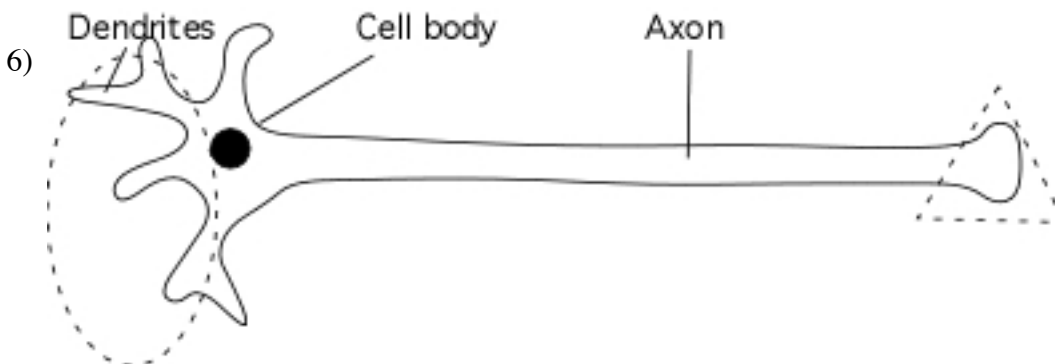
- | | | | |
|---------------------------|--------------------------|--------------------------------|-------------|
| Motor neurons | Sensory neurons | Interneurons | |
| Controls digestive organs | Controls skeletal muscle | | |
| Voluntary | Involuntary | Related to peaceful situations | |
| Part of CNS | Part of PNS | Part of ANS | Part of MTV |

14) What is a stroke and what causes it?

15) A patient who has suffered brain damage (such as by a stroke or trauma to the head) and that is exhibiting difficulty initiating voluntary movement may well have damage to the _____ region of the cerebrum.

Answers to short answer review questions:

- 1) The three main functions are (1) Sensing sense stimuli, (2) Formulating a response to the stimuli, and (3) Rapid communication between body parts.
- 2) The myelin sheath increases the speed of signals traveling through the neuron. It also protects and insulates the neuron.
- 4) Most neurons are stimulated to have an action potential by neurotransmitters. After the neurotransmitters have stimulated the neuron, the neuron must destroy them otherwise the neuron would constantly be having an action potential (in other words, it would become stuck, forever signaling its target cell).
- 5) The presynaptic neuron and the postsynaptic neuron both have enzymes that destroy the neurotransmitters. Also, the presynaptic neuron can reabsorb neurotransmitters for future use.



7) The hippocampus converts short-term memories into long-term memories. Usually, events that are emotional are the ones that the hippocampus converts into long-term memories.

8) The hypothalamus regulates the pituitary gland. It also regulates thirst, hunger, temperature, the sleep/wakefulness cycle, emotions, sex drive, blood pressure and heart beat. Note that some of these functions are also controlled by other brain regions.

9) Incoming sensory signals would be sent to the incorrect sensory areas of the cerebrum. You might taste color, for example, or feel smells, or see sounds.

10) A paraplegic has full feeling and movement of the upper limbs but no feeling or movement of the lower limbs. This occurs when the spinal chord is severed below the spinal nerves that control the arms but above the spinal nerves that control the legs. A quadriplegic has no feeling or movement of any limbs. This occurs when the spinal chord is severed above the spinal nerves that control the arms and legs (such as in the cervical region).

11)	<u>Sympathetic</u>		<u>Parasympathetic</u>
	Fearful or angry situations		Calm, peaceful, relaxed situations
	Makes digestive organs less active		Makes digestive organs more active
	Makes heart beat faster		Makes heart beat slower
	Makes bronchioles in lungs dilate		Makes bronchioles in lungs constrict

12)	CNS		PNS	
		Sensory		Motor
		SNS		ANS
			Sympathetic	Parasympathetic

13) Circles on: Motor neurons, Controls skeletal muscle, Voluntary, Part of PNS

14) A stroke (also called a cerebrovascular accident) is when part of the brain is damaged due to loss of blood supply to that brain region. The blood supply may be lost due to bursting of a brain blood vessel (an aneurism) or due to clogging of a brain blood vessel by fats or a blood clot.

15) Primary motor area