**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 Ca2+ 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 diffusion 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 amydala

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

2 = D

3 = A

4 = C

5 = A

6 = A

7 = D

8 = D

9 = D

10 = A

11 = B

12 = C

13 = B

14 = C

15 = A

16 = D

17 = A

18 = A

19 = A

20 = C

21 = D

22 = B

24 = C

25 = B

26 = C

27 = B

28 = A

29 = D

30 = A

31 = D

32 = D

33 = D

34 = B

35 = B

36 = B

37 = B

38 = B

39 = D

40 = C

41 = D

42 = A

43 = A

44 = A

45 = C

46 = C

47 = C

48 = D

49 = C

50 = B

51 = C

52 = D

53 = A

54 = B

55 = B

56 = A

57 = A

58 = B

59 = A

60 = B

61 = B

62 = B

63 = 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).

45) As the membrane potential near a voltage gated \_\_\_\_\_ channel approaches +30 mV,

 the channel opens.

46) 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.

47) After a region of the axon reaches +30 mV, \_\_\_\_\_\_ ions begin to cross the membrane.

48) 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).

49) 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).

50) During an action potential, sodium ions enter/exit (circle one) the axon and potassium ions enter/exit (circle one) the axon.

51) 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.

52) In an action potential the last ion to diffuse is \_\_\_\_\_\_\_\_

53) 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).

54) 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 \_\_\_\_\_\_

55) 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

 Peripheral

2) Cell body

3) Dendrites

4) Axon

5) Myelin

7) Neurons

 Neuroglial cells (or glial cells)

8) Schwann cells

9) Oligodendrocytes

10) One

11) Many

12) Astrocytes

13) Leaky (or permeable)

14) Sensory neurons

 Interneurons

 Motor neurons

15) Interneurons

 Motor neuron

 Sensory neuron

16) Interneuron’s

17) Interneurons

 Muscle

 Other interneuron’s

 Motor

18) Sensory neurons

 Motor neurons

 Interneurons

19) Afferent

 Efferent

20) Ganglia

21) Nerve

22) Nucleus

23) Tracts

24) Presynaptic

 Postsynaptic cell

 Target cell

25) Synaptic cleft

26) True

27) False

28) Exocytosis

29) Axon terminal

 Nuerotransmitters

30) Stay contracted

31) Vesicles

32) Parkinson’s disease

33) Opiate

34) Action potential

35) -70 mV

36) Sodium-potassium pump

37) Voltage-gated

38) Sodium

 Depolarization

39) Threshold

40) Sodium

 Potassium

41) K+

 Negative

42) Closed

 Closed

43) Opens

45) Potassium

46) Na+

 K+

47) K+

48) Open

 Closed

49) Closed

 Open

50) Enter

 Exit

51) Sodium/Potassium pump

52) K+

53) Repolarizing

54) 5

 6

 7

 3

 1

 2

 4

55) R

 R

 D

 P

 D

56) Refractory period

57) Neurotransmitter receptors

58) Chemical gated ion channels

59) Chemical gated

 Voltage gated

60) Inhibitory

 IPSP

61) Excitatory

 EPSP

62) More

63) Less

64) Action potential

66) False

68) Does

69) 2

 1

 4

 5

 3

70) Dendrites

 Cell bodies

71) Myelinated axons

72) White

73) Gray

74) Ventricles

75) Cerebrospinal fluid

76) Cerebrum

 Diencephalon

 Brain stem

 Cerebellum

77) Cerebrum

78) Basal nuclei

79) Corpus callosum

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) Substancia 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

146) Parasympathetic

147) Sympathetic

148) Parasympathetic

149) Sympathetic

150) Sympathetic

151) Sympathetic

152) Contract

153) Dilate

154) Contract

155) Antagonistic

156) a) A

 b) A and S

 c) A and S

 d) S

 e) S

 f) A

 g) A

157) Parasympathetic

158) Sympathetic

159) Acetylcholine

 Decreases

160) Parasympathetic

161) Norepinephrine

 Epinephrine

162) Acetylcholine

163) Acetylcholine

 Norepinephrine

164) Acetylcholine

165) Norepinephrine

 Acetylcholine

166) Norepinephrine

167) Near

 Far

168) Far

 Near

169) Adrenergic

170) Alpha

 Beta

171) Alpha 1 and Alpha 2

172) Beta 2

173) Heart

174) Increase

175) Beta blockers

177) Adrenergic

 Alpha (1 and 2)

 Beta-2

178) Stroke

 Cerebrovascular accident

179) Alzheimers

180) Nervous system damage

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.

 The nervous system

 (One is the brain + spinal cord)

 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ (Two neuron types: One

 controls muscles and glands)

 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ (One regulates voluntary muscles)

 \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ (One puts organs in a mode appropriate for

 peaceful situations)

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.



6)

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) Sympathetic Parasympathetic

 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