MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which body fluid compartment contains high levels of K\(^+\), large anions, and proteins?  
   A) plasma  
   B) interstitial fluid  
   C) intracellular fluid  
   D) A and C  
   E) A and B

2) What are the two extracellular fluid compartments in the body?  
   A) interstitial and intracellular  
   B) plasma and interstitial  
   C) intracellular and plasma  
   D) plasma and the fluid portion of the blood  
   E) none of the above

3) Which of the following statements about the resting membrane potential is TRUE?  
   A) It is normally equal to zero volts.  
   B) It results, in part, from the concentration gradients for Na\(^+\) and K\(^+\).  
   C) The inside of the membrane is positively charged compared to the outside.  
   D) It is due in part to the presence of extracellular proteins.

4) Voltage-gated (voltage-dependent) channels and antiport carriers are both types of  
   A) receptors.  
   B) structural proteins.  
   C) transporters.  
   D) enzymes.

5) The resting membrane potential in a typical nerve cell is approximately  
   A) \(-35\) mV.  
   B) \(+70\) mV.  
   C) \(-70\) mV.  
   D) \(+35\) mV.  
   E) \(0\) mV.

6) Caveolae and clathrin-coated pits are both used in  
   A) endocytosis.  
   B) phagocytosis.  
   C) exocytosis.  
   D) action potentials  
   E) neurotransmitters

7) The ion that plays a key role in initiating electrical signals in neurons is  
   A) Ca\(^{2+}\).  
   B) Na\(^+\).  
   C) K\(^+\).  
   D) Cl\(^-\).
8) Passive transport refers to a process that requires
   A) no electrical gradient.  
   B) no energy at all. 
   C) no cellular energy.  
   D) no concentration gradient. 
   E) no pressure gradient.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Match the transport process to its description.

A. active transport  
B. passive transport

9) the movement of molecules from an area of high concentration to an area of low concentration

10) the movement of molecules via proteins embedded in the cell membrane; requires ATP

11) the movement of molecules against the concentration gradient

12) tends to create an equilibrium state

Match the potential or potential change with the causative circumstances. Assume ion movements are net movements. Answers may be used more than once or not at all.

A. resting membrane potential
B. hyperpolarization
C. depolarization
D. repolarization
E. more than one of the above

13) Na⁺ enters the cell

14) K⁺ leaves the cell

15) The Na⁺-K⁺-ATPase pumps _________ Na⁺ ions into/out of the cell and _________ K⁺ into/out of the cell.

16) The ability of a carrier molecule to transport only one specific molecule or a group of closely related molecules is called _________.

A-2
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

17) Fick’s law of diffusion states that the rate of diffusion across a membrane is
   A) proportional to surface area and membrane thickness, but inversely proportional to concentration gradient.
   B) proportional to membrane permeability, but inversely proportional to concentration gradient and surface area.
   C) proportional to concentration gradient, surface area, and membrane permeability.
   D) proportional to membrane thickness and surface area.

18) Sodium ions are more concentrated in the extracellular fluid than in the intracellular fluid. This is an example of
   A) failed homeostasis.
   B) electrical disequilibrium.
   C) chemical disequilibrium.
   D) osmotic equilibrium.

19) Water will always move from ________ areas to ________ areas, if there are no impermeable barriers.
   A) hyposmotic, isosmotic
   B) hyperosmotic, hyposmotic
   C) hyperosmotic, isosmotic
   D) hyposmotic, hyperosmotic

20) Substances that readily dissolve in water and do not readily dissolve in lipids are
   A) hydrophilic and lipophobic.
   B) hydrophilic and lipophilic.
   C) hydrophobic and lipophilic.
   D) hydrophobic and lipophobic.

21) Cells that respond to signals are usually called
   A) responders.
   B) receivers.
   C) junctions.
   D) targets.
   E) contacts.

22) Which is NOT a basic method of cell-to-cell communication?
   A) diffused chemical signals
   B) cytoplasmic transfer of signals
   C) mechanical signals
   D) nerve and blood-transported signals
   E) contact-dependent signals

23) The most significant difference between a paracrine and an autocrine is
   A) the cell that releases it.
   B) the method of transport.
   C) the route of transport.
   D) the cell that responds to it.
   E) There are no differences—they are the same.
24) Receptor molecules are located
   A) in the outer cell membrane.
   B) in the cytosol.
   C) in the nucleus.
   D) B and C
   E) all of the above

25) Lipophilic hormones
   A) bind to receptors on the surface of the cell.
   B) function by activating cAMP.
   C) function by way of a second messenger system.
   D) cannot diffuse through the cell membrane.
   E) bind to receptors inside the cytoplasm or nucleus.

26) The increasingly forceful uterine contractions that lead to childbirth are an example of
   A) negative feedback.
   B) positive feedback.
   C) effector shutdown.
   D) receptor activation.
   E) none of the above

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Match each term with its description:

A. threshold
B. effector
C. oscillate
D. setpoint
E. sensitivity

27) the minimum stimulus to trigger a response
   27) ____________

28) A chemical that is secreted by a cell to act on cells in its immediate vicinity is called
   a(n) ____________.
   28) ____________

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

29) Which type of feedback promotes homeostasis?
   A) apoptosis
   B) negative
   C) positive
   D) equilibrium
   29) ____________

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

30) The sight and smell of food causes salivation. This is an example of ____________.
   30) ____________

31) Insulin increases glucose transport across the cell membrane of an adipocyte but not across the membrane of a liver cell. How can one hormone have two different effects?
ESSAY. Write your answer in the space provided or on a separate sheet of paper.

32) Describe the four classes of membrane receptor molecules.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

33) Describe the signal molecule derivatives of arachidonic acid.  

34) Which of the following is NOT a method of hormone action?  
A) control of gene expression and protein synthesis  
B) control of ion or molecule transport across cell membranes  
C) control of electrical signaling pathways  
D) control of enzymatic reaction rates  
E) All of the above are methods of hormone action.

35) When steroid hormones bind to their receptors,  
A) adenyl cyclase is activated.  
B) G proteins are inhibited.  
C) cyclic nucleotides are formed.  
D) protein kinases are activated.  
E) gene transcription may start or stop.

36) Steroid hormones are synthesized in the _________ of the cell.  
A) Golgi apparatus  
B) smooth endoplasmic reticulum  
C) nucleus  
D) mitochondria  
E) rough endoplasmic reticulum

37) Each of the following hormones is an amino acid derivative except one. Identify the exception.  
A) thyroid-stimulating hormone  
B) epinephrine  
C) thyroid hormone  
D) melatonin  
E) norepinephrine

38) The posterior pituitary gland secretes  
A) ADH.  
B) ACTH.  
C) TSH.  
D) FSH.  
E) MSH.

39) The pituitary hormone that controls the release of glucocorticoids from the adrenal cortex is  
A) ACTH.  
B) STH.  
C) LH.  
D) TSH.  
E) FSH.

40) The pituitary hormone that controls hormone synthesis and release from the thyroid gland is  
A) STH.  
B) TSH.  
C) ACTH.  
D) LH.  
E) FSH.
41) The pituitary hormone that stimulates milk production by the mammary glands is
A) FSH.
B) ACTH.
C) prolactin.
D) TSH.
E) growth hormone.

42) The pituitary hormone that stimulates cell growth and metabolism in many tissues is
A) MSH.
B) somatotropin.
C) prolactin.
D) insulin.
E) ACTH.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Match each hormone with its primary source.

A. prolactin
B. insulin
C. aldosterone
D. melatonin
E. calcitonin
F. epinephrine

43) adrenal medulla
44) pancreas
45) thyroid
46) anterior pituitary
47) adrenal cortex
48) pineal

49) The study of hormones is known as the field of__________.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

50) Synergism occurs when
A) one hormone inhibits the release of a second hormone.
B) hormones working together produce a larger effect than predicted.
C) one hormone triggers the secretion of a second hormone.
D) a hormone can exert its full effects only in the presence of another hormone.
E) hormones working together produce a smaller effect than predicted.
51) The brain and spinal cord together compose the 
   A) autonomic division system. 
   B) visceral nervous system. 
   C) somatic motor division of the nervous system. 
   D) central nervous system. 
   E) peripheral nervous system.

52) Exocrine glands, smooth muscles, and cardiac muscles are controlled by the 
   A) central nervous system. 
   B) autonomic nervous system. 
   C) enteric nervous system. 
   D) peripheral nervous system. 
   E) somatic motor division.

53) Autonomic motor neurons are subdivided into the 
   A) central and peripheral divisions. 
   B) visceral and enteric divisions. 
   C) sympathetic and parasympathetic divisions. 
   D) somatic and enteric divisions. 
   E) visceral and somatic divisions.

54) The multiple thin, branched structures on a neuron whose main function is to receive incoming signals are the 
   A) axons. 
   B) cell bodies. 
   C) dendrites. 
   D) somata. 
   E) none of the above

55) The structure on the neuron that transmits electrical signals to trigger the release of neurotransmitter is the 
   A) varicosity. 
   B) axon hillock. 
   C) axon. 
   D) nerve. 
   E) dendrite.

56) The axon is connected to the cell body by the 
   A) axon terminal. 
   B) myelin sheath. 
   C) collaterals. 
   D) synapse. 
   E) axon hillock.
57) Neurotransmitters are released from the
   A) collaterals.
   B) dendrites.
   C) synapse.
   D) axon terminals.
   E) axon hillock.

58) Clusters of nerve cell bodies in the peripheral nervous system are called
   A) neuroglia
   B) glia
   C) nodes
   D) microglia
   E) ganglia

59) Glial cells
   A) provide structural and metabolic support.
   B) guide neurons during growth and repair.
   C) help maintain homeostasis of the brain's extracellular fluid.
   D) A and C
   E) all of the above

60) Myelin is formed by
   A) axons.
   B) ependymal cells.
   C) Schwann cells.
   D) oligodendrocytes.
   E) C and D

61) These glial cells act as scavengers.
   A) microglia
   B) oligodendrocytes
   C) astrocytes
   D) Schwann cells
   E) ependymal cells

62) These glial cells may contribute to Lou Gehrig's disease.
   A) microglia
   B) ependymal cells
   C) oligodendrocytes
   D) astrocytes
   E) Schwann cells

63) Which ion(s) is/are higher in concentration inside the cell compared to outside?
   A) sodium
   B) chloride
   C) more than one of the above
   D) calcium
   E) potassium
64) The total amount of neurotransmitter released at the axon terminal is directly related to
   A) the amplitude of the graded potential.   B) the amplitude of the action potential.  
   C) the length of the axon.   D) the total number of action potentials.

65) The rising phase of the action potential is due to
   A) Na$^+$ flow into the cell. 
   B) K$^+$ flow out of the cell. 
   C) K$^+$ flow into the cell. 
   D) Na$^+$ flow out of the cell. 
   E) B and D

66) The falling phase of the action potential is due primarily to
   A) K$^+$ flow out of the cell. 
   B) K$^+$ flow into the cell. 
   C) Na$^+$ flow out of the cell. 
   D) Na$^+$ flow in the cell. 
   E) B and D

67) The point during an action potential when the inside of the cell has become more positive than the outside is known as the
   A) depolarization. 
   B) overshoot. 
   C) rising phase. 
   D) peak. 
   E) falling phase.

68) The sodium–potassium exchange pump
   A) requires ATP to function. 
   B) must re-establish ion concentrations after each action potential. 
   C) transports sodium ions into the cell during depolarization. 
   D) transports potassium ions out of the cell during repolarization. 
   E) moves sodium and potassium in the direction of their chemical gradients.

69) The all-or-none principle states that
   A) only sensory stimuli can activate action potentials. 
   B) the greater the magnitude of the stimuli, the greater the intensity of the action potential. 
   C) all stimuli great enough to bring the membrane to threshold will produce action potentials of identical magnitude. 
   D) only motor stimuli can activate action potentials. 
   E) all stimuli will produce identical action potentials.
70) When voltage-gated Na⁺ channels of a resting neuron open,
   A) Na⁺ enters the neuron.
   B) Na⁺ leaves the neuron.
   C) the neuron depolarizes.
   D) A and C
   E) B and C

71) When voltage-gated K⁺ channels of a resting neuron open,
   A) K⁺ leaves the neuron.
   B) K⁺ enters the neuron.
   C) the neuron depolarizes.
   D) A and C
   E) B and C

72) The term hyperkalemia specifically indicates too much potassium in which fluid compartment?
   A) all of the above
   B) intracellular
   C) extracellular
   D) blood
   E) interstitial

73) The ion necessary to initiate the release of acetylcholine into the synaptic cleft is
   A) potassium.
   B) calcium.
   C) chloride.
   D) sodium.
   E) zinc.

74) To increase the amount of neurotransmitter released onto a postsynaptic cell, the presynaptic cell would have to
   A) send action potentials with longer durations.
   B) send action potentials with higher frequency.
   C) send action potentials with higher voltage (higher amplitude).
   D) do nothing; no change is possible since the all-or-none law is in effect.

75) Which is/are the most common inhibitory neurotransmitter(s) of the CNS?
   A) glycine
   B) GABA
   C) glutamate
   D) A and B
   E) all of the above
76) Calcium is important in the synapse because it
   A) binds to receptors on the postsynaptic cell, opening ion channels, and triggering graded potentials.
   B) leaves the axon terminal, hyperpolarizing the cell.
   C) is necessary for acetylcholine synthesis.
   D) signals the exocytosis of the neurotransmitter.

77) Inhibitory postsynaptic potentials (IPSPs)
   A) increase membrane permeability to sodium ions.
   B) result in local depolarizations.
   C) result in local hyperpolarizations.
   D) prevent the escape of calcium ions.
   E) prevent the escape of potassium ions.

78) Spatial summation refers to
   A) multiple graded potentials arriving at one location simultaneously.
   B) repeated graded potentials reaching the trigger zone one after the other.
   C) electrical signals reaching neurons from outer space.
   D) suprathreshold potentials triggering action potentials that are extra large.
   E) all of the above

79) If a hyperpolarizing graded potential and a depolarizing graded potential of similar magnitudes arrive at the trigger zone at the same time, what happens?
   A) The cell becomes easier to excite.
   B) An action potential is fired off more quickly than usual.
   C) The cell dies.
   D) Nothing. They will cancel each other out.
   E) The cell becomes hyperpolarized.

80) Temporal summation refers to
   A) multiple graded potentials originating from different locations simultaneously.
   B) additional graded potential(s) arriving before previous ones have ceased.
   C) the temporal lobe of the brain integrating neuronal interaction.
   D) suprathreshold potentials triggering action potentials that are extra large.
   E) All of the above accurately describe temporal summation.

81) When a second EPSP arrives at a single synapse before the effects of the first have disappeared, what occurs?
   A) temporal summation
   B) hyperpolarization
   C) spatial summation
   D) decrease in speed of impulse transmission
   E) inhibition of the impulse
82) The pattern of synaptic connectivity where a large number of presynaptic neurons provide input to a single postsynaptic neuron, is known as
   A) potentiation.
   B) convergence.
   C) divergence.
   D) integration.
   E) saltatory conduction.

83) A damaged neuron has a better chance of survival and repair if the ________ is/are undamaged.
   A) Schwann cells
   B) axon
   C) cell body
   D) dendrites
   E) B and C

84) Repair of damaged neurons can be assisted by certain neurotrophic factors secreted by the
   A) Schwann cells.
   B) axon.
   C) cell body.
   D) dendrites.
   E) B and C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Match the glial cell to the nervous system division in which it is found.

   A. central nervous system
   B. peripheral nervous system

85) Schwann cells

86) oligodendrocytes

87) microglia

88) satellite cells

89) ependymal cells

90) astrocytes
Match the term with its description (answers may be used more than once).

A. ependymal cells
B. astrocytes
C. satellite cells
D. Schwann cells
E. oligodendrocytes
F. microglia

91) highly branched cells that transfer nutrients between blood vessels and neurons  
92) specialized immune cells that are confined to the CNS  
93) cells that form supportive capsules around cell bodies  
94) cells in the CNS that form myelin  
95) cells in the PNS that form myelin

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

96) The following are the main steps in the generation of an action potential.
1. sodium channels are inactivated
2. voltage-regulated potassium channels open and potassium moves out of the cell, initiating repolarization
3. sodium channels regain their normal properties
4. a graded depolarization brings an area of an excitable membrane to threshold
5. a temporary hyperpolarization occurs
6. sodium channel activation occurs
7. sodium ions enter the cell and further depolarization occurs

The proper sequence of these events is
A) 4, 6, 7, 3, 2, 5, 1.  
B) 4, 6, 7, 1, 2, 5, 3.  
C) 2, 4, 6, 7, 1, 3, 5.  
D) 4, 2, 5, 6, 7, 3, 1.  
E) 6, 7, 4, 1, 2, 3, 5.

97) Conduction occurs along an axon because
A) once Na+ enters the cell, the entire membrane depolarizes simultaneously.  
B) axonal transport “walks” voltage changes along the membrane.  
C) outflow of K+ triggers the adjacent channels to open.  
D) inflow of Na+ triggers the adjacent channels to open.
98) Conduction speed is (or can be) enhanced by
   A) myelin.
   B) altering extracellular sodium concentration.
   C) increasing the diameter.
   D) altering extracellular potassium concentration.
   E) both A and C

99) Tetrodotoxin is a toxin that blocks voltage-gated sodium channels. What effect does this substance have on the function of neurons?
   A) The neuron is not able to propagate action potentials.
   B) The absolute refractory period is shorter than normal.
   C) Action potentials lack a repolarization phase.
   D) The toxin does not interfere with neuron function because the voltage-regulated sodium channels would still function.
   E) Neurons depolarize more rapidly.

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

100) Briefly explain the organization of the nervous system in either paragraph form or using a concept map. Be sure to discuss the central, peripheral, and enteric nervous system and the divisions and branches discussed in the text.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

101) Draw a motor neuron, being sure to include and label the following parts: axon(s), dendrite(s), cell body, axon collateral(s), axon terminal(s), myelin sheath, and other components as applicable.