1. If a significant amount of Cl\(^-\) entered the body of a motor neuron, which of the following would occur?
   a. The neuron would contract
   b. The \(V_M\) would move towards threshold
   c. An action potential would occur
   d. The neuron would be less likely to fire an action potential
   e. The \(V_M\) would become more positive

2. The venom of a puffer fish (tetrodotoxin) stops voltage-gated sodium channels from functioning. Thus, you would expect a cell treated with tetrodotoxin to:
   a. Produce stronger than normal action potentials
   b. Produce action potentials quicker
   c. To be unable to produce action potentials
   d. To be able to depolarize but not repolarize
   e. Both A and B are correct

3. Chemical messengers released by endocrine glands into the blood are known as hormones.
   a. True
   b. False

4. Which of the following is an example of an effector?
   a. Skeletal muscle
   b. Smooth muscle
   c. Cardiac muscle
   d. Glands
   e. All of the above

5. The 2 divisions of the somatic nervous system are the sympathetic division and the parasympathetic division.
   a. True
   b. False

6. The cell body of neuron in the brain will contain a nucleus. A collection of neuron cell bodies in the brain is a nucleus.
   a. True
   b. False

7. Which of the following is NOT a function of glial cells?
   a. Maintaining a neuron’s chemical environment.
   b. Sending action potentials to effector tissues
   c. Insulating axons
   d. Devouring microorganisms
   e. Transferring nutrients to neurons
8. Which of the following is FARTHEST from the nucleus of a neuron?
   a. Nissl body
   b. Axon collateral
   c. Telodendrion
   d. Axon hillock
   e. Dendrite

9. Which of the following is NOT TRUE?
   a. The plasma membrane of the axon is the axolemma
   b. A gap between 2 Schwann cells is a neurilemma
   c. The neuron contains protein filaments called neurofibrils
   d. Each telodendrion ends at an axon terminal
   e. Axon terminals contain synaptic vesicles

10. Which of the following is the LEAST abundant in the body?
    a. Motor neurons
    b. Interneurons
    c. Bipolar neurons
    d. Multipolar neurons
    e. Unipolar neurons

11. The number of axons in a multipolar neuron is _________________ the number of axons in a bipolar neuron.
    a. Greater than
    b. Fewer than
    c. The same as

12. Sensory neurons are considered to be efferent neurons because they take information from organs to the brain and the spinal cord.
    a. True
    b. False

13. Which of the following is NOT TRUE?
    a. Positively charged ions are known as anions
    b. The flow of ions into a cell is an example of an electrical current.
    c. The plasma membrane is a source of electrical resistance
    d. A separation of negative and positive charges is a source of potential energy.
    e. A typical neuron has a membrane potential of -70 mV

14. Suppose you had a neuron that had more potassium leakage channels than normal. Which of the following would be the most likely value of its membrane potential?
    a. +30 mV
    b. 0 mV
    c. -55 mV
    d. -70 mV
    e. -85 mV
15. When the sodium potassium pump breaks down a molecule of ATP, _____ K+ ions are moved into the cell and _____ Na+ are moved out of the cell.
   a. 2-3
   b. 3-2
   c. 3-4
   d. 4-3
   e. None of the above

16. The influx of sodium will cause the membrane potential of a neuron to:
   a. Increase
   b. Decrease
   c. Stay the same

17. Extracellular potassium levels are ____________________ intracellular potassium levels.
   a. Greater than
   b. Less than
   c. The same as

18. The influx of chloride ions (Cl-) will cause the membrane potential of a neuron to:
   a. Increase
   b. Decrease
   c. Stay the same

19. As a graded potential moves away from its site of origin, its amplitude will:
   a. Increase
   b. Decrease
   c. Stay the same

20. As an action potential moves away from its site of origin, its amplitude will:
   a. Increase
   b. Decrease
   c. Stay the same

21. Voltage-gated channels are primarily found on the:
   a. Axon
   b. Dendrites
   c. Soma
Refer to the above graph for the next 5 questions. The x-axis is time in milliseconds. The y-axis is voltage (membrane potential) in millivolts. The red arrow indicates when a stimulus was applied to the neuron.

22. At time=0.5 ms, sodium channels are __________ and membrane is ______________.
   a. Open – depolarizing
   b. Closed – depolarizing
   c. Open – repolarizing
   d. Closed – repolarizing

23. At time=2 ms, the membrane is hyperpolarized.
   a. True
   b. False

24. At time=1 ms, ________ channels are inactivated and the membrane is ________________.
   a. Sodium – depolarizing
   b. Potassium – depolarizing
   c. Sodium – repolarizing
   d. Potassium – repolarizing

25. At which of the following times is the neuron at its resting membrane potential?
   a. 1 ms
   b. 2 ms
   c. 3 ms
   d. 4 ms

26. There are 2 points of the graph where there is NO potential difference across the neuron membrane.
   a. True
   b. False
27. A rise in calcium levels inside the axon terminal of a neuron will cause the number of phospholipids in the plasma membrane of that axon terminal to:
   a. Increase
   b. Decrease
   c. Stay the same

28. The velocity of an action potential in a myelinated axon is _______________ the velocity of an action potential in an unmyelinated axon.
   a. Greater than
   b. Less than
   c. The same as

29. The velocity of an action potential in a large diameter axon is _______________ the velocity of an action potential in a small diameter axon.
   a. Greater than
   b. Less than
   c. The same as

30. A sensory nerve in the foot is part of the PNS while a motor nerve in the foot is part of the CNS.
   a. True
   b. False

31. In the above picture we have 2 separate telodendria synapsing on 2 different dendrites of a neuron. Suppose the 2 telodendria stimulate their dendrite one right after another. 2 graded potentials would be created. These 2 graded potentials would then combine at the axon hillock and possibly exceed threshold and generate an action potential. This is an example of:
   a. Spatial summation
   b. Temporal summation
   c. Both spatial summation and temporal summation
   d. Neither spatial summation nor temporal summation

32. The arrival of an action potential at an axon terminal will cause calcium levels inside the axon terminal to:
   a. Increase
   b. Decrease
   c. Stay the same
33. Suppose the binding of neurotransmitter to receptors on a dendrite caused the opening of chemically-gated potassium channels. This would result in:
   a. The production of a postsynaptic potential
   b. The production of an inhibitory postsynaptic potential
   c. The efflux of potassium ions
   d. The membrane potential becoming more negative
   e. All of the above

34. 2-(diethylamino)ethyl 4-aminobenzoate is a chemical that prevents voltage-gated sodium channels from opening. Which of the following is the most likely outcome of an injection of this chemical?
   a. Motor neurons would be more likely to generate action potentials
   b. Sensory neurons would be unable to generate action potentials
   c. Interneurons would be more likely to depolarize
   d. All of the above

35. Lead can damage the myelin sheath of neurons.
   a. True
   b. False

36. \([K^+]\) inside a neuron is normally __________________________ \([K^+]\) outside a neuron.
   a. Greater than
   b. Less than
   c. The same as

37. \([Na^+]\) inside a neuron is normally __________________________ \([Na^+]\) outside a neuron.
   a. Greater than
   b. Less than
   c. The same as

38. If a sodium channel in the plasma membrane of the axon hillock of a neuron opened, the \([Na^+]\) inside the cell would:
   a. Increase
   b. Decrease
   c. Stay the same

39. If a potassium channel in the plasma membrane of the axon hillock of a neuron opened, the \([K^+]\) inside the cell would:
   a. Increase
   b. Decrease
   c. Stay the same

40. If a sodium channel in the plasma membrane of the axon hillock of a neuron opened, the potential difference between the inside the cell and the outside of the cell would:
   a. Increase
   b. Decrease
   c. Stay the same
41. If a potassium channel in the plasma membrane of the axon hillock of a neuron opened, the potential difference between the inside the cell and the outside of the cell would:
   a. Increase
   b. Decrease
   c. Stay the same

42. The arrival of an electrical signal at an axon terminal would cause the number of synaptic vesicles in the axon terminal to:
   a. Increase
   b. Decrease
   c. Stay the same

43. The entry of chloride ions into a resting neuron would cause the membrane potential to:
   a. Increase
   b. Decrease
   c. Stay the same

44. The number of dendrites on a neuron is typically ______________________ the number of axons on a neuron.
   a. Greater than
   b. Less than
   c. The same as

45. The number of multipolar neurons in the body is ______________ the sum of the number of bipolar neurons and the number of unipolar neurons.
   a. Greater than
   b. Less than
   c. The same as

46. The number of bipolar neurons found above the diaphragm is ____________ the number of bipolar neurons found below the diaphragm.
   a. Greater than
   b. Less than
   c. The same as

47. A group of somata in the brain is referred to as a ________________.

48. The cell responsible for forming the insulating cover of an axon is the _____________.

49. Neutrotransmitters travel from a presynaptic cell to a postsynaptic cell by means of ________________.
   (One word answer please.  9 letters.)

50. Name an integral protein that breaks down ATP in order to contribute to the inequality of cations between the inside of the cell and the outside of the cell.
51. Draw a graph of the changes in the membrane potential that occur during an action potential. Use the axes provided below.

![Graph](https://example.com/graph.png)

Use the following letters and instructions to label your graph.

- a. Label the resting membrane potential twice.
- b. Label the depolarization phase of the action potential
- c. Label the repolarization phase of the action potential
- d. Label the hyperpolarization phase of the action potential
- e. Label the phase when the membrane is most permeable to sodium
- f. Label the phase when the membrane is most permeable to potassium
- g. Label the phase when the v-gated sodium channels are inactivated
- h. Label the point at which the membrane potential is the smallest (really think about this)

52. Explain why action potential propagation is said to be unidirectional!

**In each of the next 10 items, 2 quantities are given and are being compared.**

Choose A if quantity A is the larger of the 2.
Choose B if quantity B is the larger of the 2.
Choose C if the 2 quantities are equal in size.

53. A. The percentage of spinal cord gray matter composed of myelinated axons
    B. The percentage of spinal cord white matter composed of myelinated axons

54. A. The number of motor neuron axons in the dorsal root
    B. The number of sensory neuron axons in the dorsal root

55. A. The number of sensory neuron cell bodies found in spinal cord gray matter
    B. The number of motor neuron cell bodies found in spinal cord gray matter

56. A. The number of meninges surrounding the spinal cord
    B. The number of processes extending from the soma of a sensory neuron
57. A. The amount of CSF found in the subarachnoid space  
   B. The amount of CSF found in the epidural space

58. A. The number of fibrous proteins in the dura mater  
   B. The number of fibrous proteins in the pia mater

59. A. The distance from the skin to the dura mater  
   B. The distance from the skin to the arachnoid mater.

60. A. The length of the spinal cord  
   B. The length of the spinal column

61. A. The number of pairs of cervical spinal nerves  
   B. The number of cervical vertebrae

62. A. The number of pairs of thoracic spinal nerves  
   B. The number of thoracic vertebrae

Use the above diagram for the next 5 questions.

63. Contains the CSF

64. Contains sensory neuron somata

65. Contains motor neuron cell bodies

66. Ventral horn

67. Posterior horn
The next 5 Questions are TRUE/FALSE

68. Roughly 75% of spinal nerves carry only sensory information.

69. The spinal cord is directly connected to the cerebrum.

70. Cutting the ventral roots would affect sensation but not motor control.

71. The spinal cord ends at the level of the S2 vertebra.

72. The spinal cord is primarily composed of epithelial tissue.

Use the following diagram to answer the remaining questions.

73. Point at which voltage-gated sodium and potassium channels are both closed.

74. Point at which potassium efflux exceeds sodium influx.

75. Point at which the membrane potential is at its largest.

76. Point when the neuron is in the relative refractory period.