Nervous System

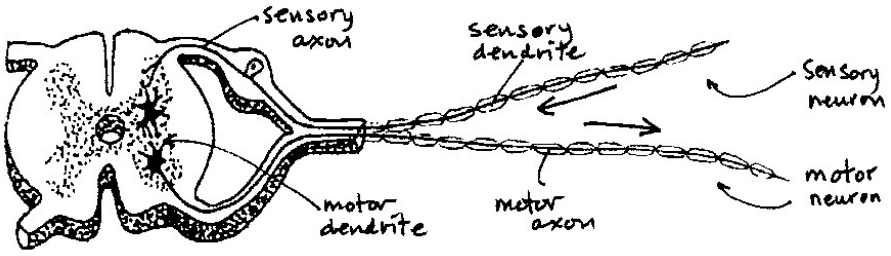
Part A. Multiple Choice

1. A
2. C
3. D
4. A
5. C
6. A
7. D
8. A
9. D
10. B
11. D
12. C
13. D
14. A
15. C
16. C
17. D
18. D
19. D
20. B
21. B
22. D
23. A
24. C
25. B
26. C
27. D
28. C
29. D
30. A
31. A
32. D
33. B
34. A
35. C
36. D
37. B
38. A
39. C
40. B
41. C
42. D
43. D
44. B
45. C

Part B. Written Answers

Note: The answers provided here are correct, but they may NOT be the only possible answers.

1. a, b, and c.



2. a. Region **X** is a synapse. For transmission to occur across a synaptic gap, neurotransmitters have to be released from the axon. The neurotransmitters are often protein-based molecules that are made in the neurons and packaged into secretory vesicles and attached to contractile proteins (cytoskeletal feature) by the Golgi bodies. When the impulse arrives at the end of the axon, affecting the presynaptic membrane, calcium ions (present in the synaptic gap) enter the axon. These ions cause the exocytosis of the neurotransmitters by the shortening of the contractile proteins. Once spilled into the gap, the neurotransmitters diffuse through the tiny space. Many of them are destroyed by enzymes, by those that reach the postsynaptic membrane are taken up by receptor sites. This reception affects the permeability of the postsynaptic membrane and diffusion of ions in to the new cell begins. This completes the transmission. The enzymatic destruction of the neurotransmitters continues and the synaptic region regains its original condition ready to be used again.

   b. Region **Y** is a section of an axon, called a node of Ranvier, where an action potential occurs. Disturbance of the membrane in this region of the axon causes a shift in its permeability. This disturbance is a result of the movement of ions as saltatory transmission affects the successive nodes. Once disturbed, the membrane suddenly becomes permeable to sodium ions, which are in abundance outside of the axon. These ions flood to the inside through specialized proteins that are known as "sodium gates". Their arrival in the axoplasm causes the axoplasm to gain a more positive charge. This depolarization shuts the sodium gates and opens the "potassium gates". These gates are also specialized proteins, but these ones allow the potassium ions to leave the axoplasm. The loss of these ions from the inside causes the repolarization of the neuron's membrane. This electrical disturbance affects the adjacent membrane region resulting in a shift in its permeability, and the process continues. In this way, the impulse moves along the neuron. The sodium and potassium ions are returned to their original positions and concentrations through the activity of Na/K pumps, which are active when the membrane is properly polarized. It is said that these pumps maintain the resting potential, keeping the membrane ready for future transmissions.

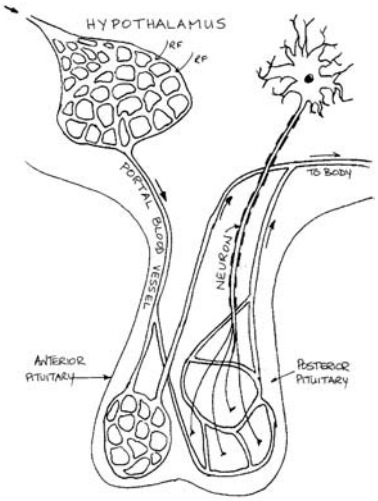
3. a. Myelin consists of fatty Schwann cells that coat the long parts of neurons in an intermittent fashion leaving spots that are not covered. These spots are called nodes of Ranvier. The effect of the myelin sheath is to prevent the depolarization and repolarization of the membrane, meaning the ions can only move at the nodes. It is described as the "jumping" of the impulse from node to node. In this manner, the impulses travel faster.

   b. Schwann cells also prevent "cross-communication" between neurons. These fatty cells hold the parallel-running neurons (as through a mixed nerve) far enough apart that ion movement in one neuron does not affect the membrane of another neuron. It is said that these cells provide insulation to the neurons.

4. These are two types of autonomic nerve fibers, the sympathetic and the parasympathetic. They each originate from two different regions of the CNS. The sympathetic fibers come from the thoracic and lumbar regions of the spinal cord, where the parasympathetic fibers come from the cranial and sacral regions.

5. The term "neuroendocrine" implies a partnering between the nervous and endocrine (hormone) systems of the body. This partnering occurs with the hypothalamus and the pituitary glands, which extend below the hypothalamus. The nerve tissue of the hypothalamus is connected to the anterior lobe of the pituitary gland by a portal system. The hypothalamus makes and releases RF's (releasing factors) which travel to the anterior pituitary through the portal system. They each cause the release of an intended hormone by the anterior pituitary.

In contrast, the hypothalamus is in communication with the posterior pituitary via a set of neurons. In this case, the hypothalamus differentially produces (according to the body's needs) hormones, which travel to the posterior pituitary for secretion into the blood.



6. Analysis of the anatomy of a synapse reveals two good reasons why only one-way transmission can occur. Firstly, the neurotransmitters are only produced in an axon (presynaptic side), and secondly, receptor sites only exits on the postsynaptic membrane.

7. a. Increased stimulation by the sympathetic nervous system results in more noradrenalin release. Noradrenalin accelerates the heart rate and diminished the activity of the smooth muscles, such as those of the digestive system. When noradrenalin level get high enough (as in massive stimulation), the body prepares itself for stressful situations such as those brought on by danger and emergency situations. This is known as the fight/flight response.
   b. There are several things that the body does in order to respond to emergency situations. These are designed to do things such as maximize blood flow (and therefore nutrient and oxygen delivery) to the skeletal muscles. The depth and rate of breathing is increased (more oxygen available), blood vessels to the skin are constricted and the blood is re-routed to the skeletal muscles, heart rate increases, and so on.