

Question 1: State the neuron doctrine in a single sentence. To whom is this insight credited?

Answer: The neuron doctrine is the idea that the neurons are not continuous with one another but are discrete cells that communicate by contact and not by continuity. This insight is credited to Santiago Ramón y Cajal.

Question 2: Which parts of a neuron are shown by a Golgi stain and are not shown by a Nissl stain?

Answer: The Golgi stain shows the neuronal cell body with the dendrites and the axon. The Nissl stain shows only the cell body.

Question 3: What are the three physical characteristics that distinguish axons from dendrites?

Answer: The three physical characteristics that distinguish axons from dendrites are:

- i) The cell body usually gives rise to a single axon while many dendrites extend from the cell body.
- ii) The axon is of uniform diameter throughout its length while dendrites rarely extend more than 2 mm in length.
- iii) The branches of an axon generally extend at right angles while dendrites generally taper to a fine point.

Question 4: Among the following structures, state those which are unique to neurons and the ones that are not: nucleus, mitochondria, rough ER, synaptic vesicle, and Golgi apparatus.

Answer: The synaptic vesicle is unique to neurons whereas the nucleus, the mitochondria, the rough ER, and Golgi apparatus are not unique to neurons.

Question 5: What are the steps by which the information in the DNA of the nucleus directs the synthesis of a membrane-associated protein molecule?

Answer: Protein synthesis, the assembly of protein molecules, occurs in the cytoplasm. The DNA never leaves the nucleus. The intermediary that carries the genetic message to the sites of protein synthesis in the cytoplasm is a long molecule called messenger ribonucleic acid, mRNA. The process of assembling a piece of mRNA that contains the information of a gene is called transcription and the resulting mRNA is called the transcript. Messenger RNA transcripts emerge from the nucleus through pores in the nuclear envelope and travel to ribosomes, the sites of protein synthesis in the cytoplasm. At these sites, protein molecules are assembled by linking individual amino acids into a chain. Amino acids of 20 different kinds are the building blocks for protein. Amino acids are brought to the ribosome by transfer RNA (tRNA). The assembling of proteins from amino acids under the direction of the mRNA is called translation.

Question 6: Colchicine is a drug that causes microtubules to break apart or depolymerize. What effect would this drug have on anterograde transport? What would happen in the axon terminal?

Answer: Vesicles containing molecules needed at the axon terminal "walk down" the microtubules within the axon on "legs" provided by a protein called kinesin. The process is fueled by ATP. Kinesin moves material only from the soma to the terminal. Movement in this direction is called anterograde transport. The application of colchicines causes microtubules to disintegrate and when applied to the axon disrupts the path for anterograde transport. As a result, all movement of material from the soma to the terminal (anterograde transport) ceases. If the colchicines application does not

kill the whole cell, then the material to be transported will accumulate on the side of the axon closest to the soma.

Question 7: Classify the cortical pyramidal cell based on (a) the number of neurites, (b) the presence or absence of dendritic spines, (c) connections, and (d) axon length.

Answer: Classification of the cortical pyramidal cell is as follows:

- (a) Cortical pyramidal cells have three or more neurites and are multipolar.
- (b) Cortical pyramidal cells have dendritic spines.
- (c) Axons of cortical pyramidal cells project to other cortical areas and also to several subcortical areas as well.
- (d) In the cerebral cortex, pyramidal cells usually have long axons that extend to other parts of the brain and are therefore Golgi type I neurons.

Question 8: What is myelin and what does it do? Which cells provide myelin to the central nervous system?

Answer: Myelin refers to layers of glial membrane that insulate axons. Myelin speeds the propagation of nerve impulses down the axon. The oligodendroglial cells provide myelin in the central nervous system.