

Short essay questions (7.5 points each) - there will be four of these.

Explain the features of NMDA receptors that make them effective receptors for governing synaptic plasticity.

How is it possible for a receptor that depolarizes the membrane to be inhibitory?

Explain three ways that dendrites contribute to information processing in the nervous system.

What determines whether a postsynaptic receptor is excitatory or inhibitory?

How is sound transduced into action potentials in the cochlea?

How is light transduced into action potentials in the retina?

What role do the neural properties of dynamic range and spike frequency adaptation play in the encoding of color in the visual system?

Long essay questions (15 points each) - there will be two of these.

Describe, compare, and contrast the cellular and molecular mechanisms of LONG-term memory for nonassociative sensitization in Aplysia's gill-withdrawal reflex and the LONG-term memory encoded by LATE long-term potentiation in the hippocampus.

Describe, compare, and contrast the cellular and molecular mechanisms of SHORT-term memory for nonassociative sensitization in Aplysia's gill-withdrawal reflex and the SHORT term memory encoded by EARLY long-term potentiation in the hippocampus.

You are recording membrane potential from a neuron that has a resting potential of -59 mV. When you apply a very brief dose of GABA to the cell, the membrane hyperpolarizes to -65 mV then returns to resting potential. You have the ability to inject a steady current to hyperpolarize or depolarize the cell as you deliver GABA. You also have the ability to change the concentration of any ion outside the cell. Explain three tests you could run to establish whether the receptor is a potassium channel or a chloride channel and how you would interpret the outcome of those tests. You can assume that E_K is -95 mV and E_{Cl} is -75 mV.

Explain the visual processing pathways from the photoreceptors to the primary visual cortex. What happens to visual information at each of these steps: photoreceptors, bipolar cells, retinal ganglion cells, lateral geniculate nucleus, superior colliculus, and primary visual cortex (V1).

Describe and explain two ways that the nervous system determines the location of a sound in the environment.