COGS 17 A03 Midterm 2 Review Answer keys

1) (Audition) What is place coding and what structure is involved in place coding?

Place coding in the auditory system refers to how different parts of the basilar membrane are mechanically tuned to resonate with different sound frequencies. The base of the basilar membrane responds to high frequencies, while the apex responds to low frequencies. This coding occurs within the cochlea, specifically on the basilar membrane

2) (Audition) The BASE of basilar membrane is _____; resonates with/is most displaced by _____(high/low) frequencies; while the APEX of of basilar membrane is _____; resonates with/is most displaced by _____(high/low) frequencies; The greater the displacement of the Basilar Membrane, the _____ the Cilia located at that place will be bent, _____ (more/less) NT the Hair Cells will release. As a result, the _____(more/less) likely _____(structure) will reach threshold for _____ Potentials.

The base of the basilar membrane is narrow and stiff, resonating with high frequencies, whereas the apex is wider and floppier, resonating with low frequencies. The greater the displacement of the basilar membrane at any point, the more the cilia there are bent, resulting in more neurotransmitter release by the hair cells, and hence, the auditory nerve fibers (spiral ganglions) at that location are more likely to reach the threshold for firing action potentials

3) (Audition) Spiral Ganglions are limited to firing at most 1000 times/second because of their _____ (what period?), so how do our auditory system code for higher frequencies?

Although spiral ganglions are limited to firing at most 1000 times per second due to their refractory periods, the auditory system can code for higher frequencies through the Volley Principle. This principle involves multiple neurons firing in succession, allowing the auditory system to perceive frequencies higher than any single neuron can encode by itself

4) (Audition) Briefly explain Volley Principle.

The Volley Principle is a method used by the auditory system to encode frequencies that are higher than the firing capabilities of individual auditory neurons. It involves groups of neurons firing in rapid succession, each taking turns to fire at a fraction of the frequency of the sound, thus collectively encoding frequencies higher than the maximum firing rate of any single neuron

5) (Audition) Localization can use intensity differences, which best works for high (high/low) frequencies; also, the auditory system can use phase differences, which best works for low (high/low) frequencies.

For localization, the auditory system uses intensity differences, which work best for high frequencies. Phase differences are utilized for low frequencies, helping the auditory system determine the direction from which a sound originates based on the timing and phase of the sound waves reaching each ear

6) (Vision) Fill out the table below:

	Receptor Cells	Bipolar Cells	Ganglion Cells	Interneurons
Which kind of potential?				
Excitatory or inhibitory NT?				
Spontaneous Firing?				N/A

Receptor Cells: Use graded potentials, release inhibitory neurotransmitters, and have spontaneous firing in darkness.
Bipolar Cells: Use graded potentials, release excitatory neurotransmitters, and also exhibit spontaneous firing.
Ganglion Cells: Use action potentials and do not show spontaneous firing since they are directly involved in transmitting information to the brain.
Interneurons (Horizontal and Amacrine cells): Use graded potentials, mostly release inhibitory neurotransmitters, and modify the interactions between other types of cells

7) (Vision) Receptor cells are turned off (on/off) by light.

Receptor cells in the retina are turned off by light, meaning that light exposure reduces their neurotransmitter release, thereby decreasing their inhibition of bipolar cells and allowing the visual signal to be processed further

8) (Vision) What are the differences between rods and cones?

	Rods	Cones
Size		

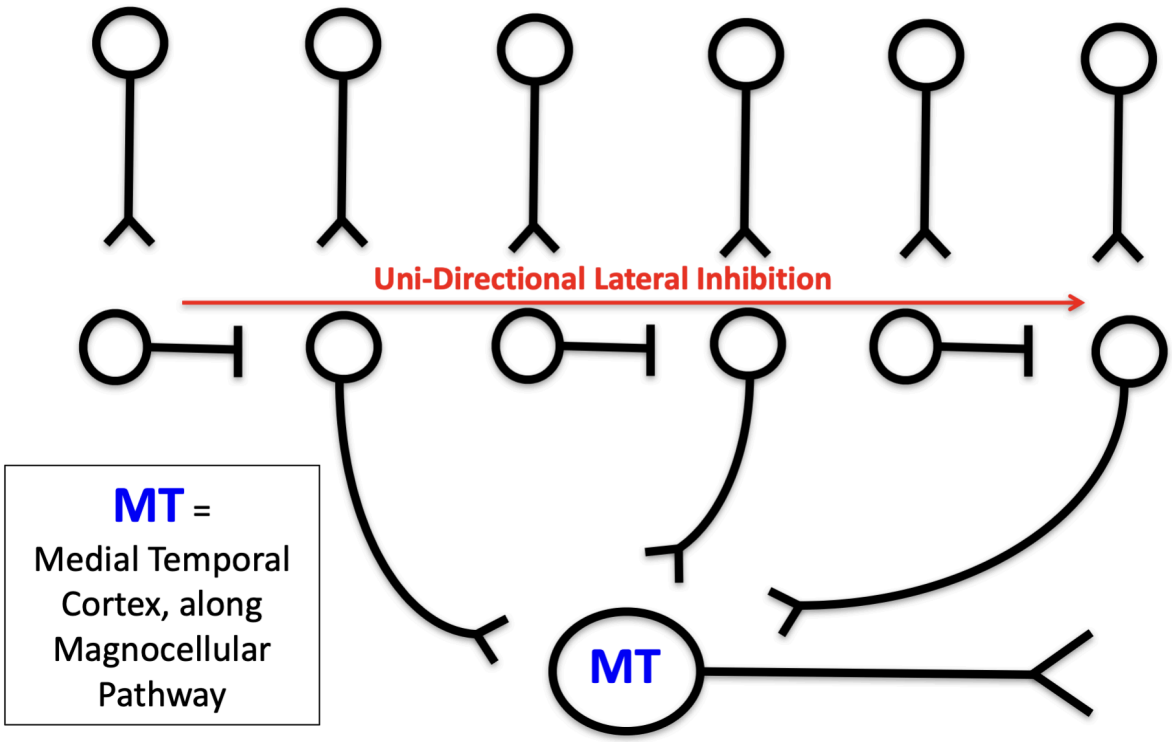
Amount of Photopigment		
Connectivity Pattern		
Sensitivity		
Acuity		
Motion Detection		
Code color?		

Size: Rods are larger; cones are smaller.
Amount of Photopigment: Rods contain more photopigment; cones contain less but have specific types that vary by wavelength.
Connectivity Pattern: Rods show high convergence (many rods to one ganglion cell); cones show low convergence (especially in the fovea, where it can be one-to-one).
Sensitivity: Rods are more sensitive to light (useful in low light conditions); cones are less sensitive but essential for color vision.
Acuity: Rods have lower acuity; cones have higher acuity, particularly in the fovea.
Motion Detection: Rods are better at detecting motion due to their high sensitivity.
Code Color: Rods do not code color; cones do and are responsible for color vision with different cones sensitive to different parts of the spectrum

9) (Vision) What are the two visual pathways and what are the differences between them?

Dorsal Stream (Where/How Pathway): Processes information related to movement and spatial location, integrating visual information with motor responses. It is involved with motion detection and the spatial aspects of vision.
Ventral Stream (What Pathway): Involved in object recognition and is crucial for identifying and processing the form and color of visual stimuli. This pathway connects to areas involved in memory and language to help recognize and label objects

10) (Vision) Will this motion detector respond to motion from left to right? Why or why not? If possible, draw a graph to demonstrate the process!



11) (Somatosensory) Which organ detects changes in head tilts? Which structure detects rotations?

Changes in Head Tilts: Detected by the otolith organs, which contain hair cells that respond to shifts in head angle due to gravity affecting the position of tiny calcium carbonate crystals.
Rotations: Detected by the semicircular canals, which are filled with fluid and contain hair cells that respond to rotational movements of the head

12) (Somatosensory) Deforming Hair Cells results in _____ (action/graded) responses to subtle, 3D changes. Bend cilia toward tallest cilia, _____ (open/close) K+ gates, K+ _____ (enters/leaves), _____ (increase/decrease) spontaneous firing rate;
bend cilia toward shortest cilia, _____ (open/close) K+ gates, K+ _____ (enters/leaves), _____ (increase/decrease) spontaneous firing rate.

Towards Tallest Cilia: Open K+ gates, K+ enters, increases the spontaneous firing rate.
Towards Shortest Cilia: Close K+ gates, K+ leaves, decreases the spontaneous firing rate

13) (Somatosensory) What causes motion sickness?

Motion sickness occurs when there is a discrepancy between the visual and vestibular inputs. For example, when visually perceiving movement while the vestibular system senses no corresponding changes in movement, leading to symptoms like nausea

14) (Somatosensory) What are the differences between the four encapsulated nerve endings?

	Meissner's	Merkel's	Pacinian's	Ruffinni's
Receptive Field				
Adapting Speed				
What is it best for?				

Meissner's Corpuscles: Small receptive field, fast adapting, best for detecting slip or light touch.
Merkel's Disks: Small receptive field, slow adapting, best for fine detail and texture.
Pacinian Corpuscles: Large receptive field, fast adapting, best for detecting vibration and deep pressure.
Ruffini's Endings: Large receptive field, slow adapting, best for detecting stretch and sustained pressure

15) (Somatosensory) If you put your hand in cold water (e.g. 70℉) for a couple minutes, and then you put your hand in 89℉ water, will you now feel the water warmer? Why?

If you initially expose your hand to cold water (70°F) and then to warmer water (89°F), the warmer water will feel even warmer than usual. This effect is due to the adaptation of the temperature receptors in your skin; cold receptors become less sensitive, making the warm receptors more dominant, hence the sensation of increased warmth

17) (Somatosensory) What are the two main pathways for somatosensory Information? What are the differences between them (where the information crosses over & what kind of information that it passes)?

Spinal-Thalamic Pathway: Carries pain and temperature information. Signals cross over to the opposite side in the spinal cord before ascending to the brain.
Medial Lemniscal Pathway: Carries touch and proprioceptive information. Signals ascend ipsilaterally in the spinal cord and cross over in the medulla

18) (Somatosensory) What is Gate Theory?

Gate Theory suggests that pain signals entering the spinal cord can be modulated (or "gated") by signals coming from the brain or other sensory inputs. Non-painful input closes the gates to painful input, which prevents pain sensation from traveling to the central nervous system. Thus, stimulation by non-painful inputs suppresses pain

19) (Motor) What are the two main motor pathways and what are the differences?

Corticospinal (Pyramidal) Pathway: Direct pathway from the motor cortex to the spinal cord, mainly involved in the voluntary control of the muscles of the body and limbs.
Extrapyramidal Pathways: Includes several tracts originating in the brainstem that govern involuntary reflexes and maintain posture and muscle tone

20) (Motor) What are the main functions of the cerebellum? How does it code for time?

The cerebellum is essential for coordinating voluntary movements, maintaining balance and posture, and learning motor skills. It adjusts the force and timing of muscle activity to make movements smooth and accurate

21) (Motor) What are the main functions of the basal ganglia?

The basal ganglia are involved in regulating voluntary motor movements, procedural learning, routine behaviors, and emotions. They help start and stop movements, regulate the intensity of movements, and block unwanted movements