

*Due: Wednesday Oct 31*

1. What is a cell membrane composed of? How thick is it? Why is it important to biomedical instrumentation?

lipids and proteins; ~10nm thick (7-15 in notes), forms an ion permeable membrane that enables transduction of action potentials that form the source of most biomedical measurements

2. What three ions play the largest role in setting the electrical environment of an excitable cell?

sodium (Na), potassium (K), and chlorine (Cl)

3. Why is a membrane in resting state referred to as “polarized”? What state refers to the increase in membrane potential during an action potential? What state refers to the decrease following an action potential?

- at rest, a cell has a buildup of charge that “polarizes” the membrane and establishes the resting potential
- increasing potential is depolarization
- decreasing potential is repolarization

4. Briefly describe the difference between the “absolute refractory period” and the “relative refractory period” of an action potential. What is the maximum action potential frequency and what is the typical rate (for a nerve cell)?

Refractory period describes the time at which an action potential is occurring. During the “absolute” portion, the membrane cannot respond to any other stimulus. During the “relative” portion, the membrane would respond to a strong stimulus.

Max frequency is 1000 Hz and typical is ~30Hz.

5. In biomedical measurements, what does “volume conductor” refer to and why is it important?

Refers to the fact that biomedical signals occur within a conductive medium, human tissue, that links electrical activity within a microscopic source to potential distributions across the body's surface. It is important because understanding this principle helps to correctly interpret biomedical waveforms.

6. Briefly describe (don't just list) the components of spinal nervous system reflex arc in terms that make sense to you.

1. sense organ: generate electrical response to stimuli (sensor)

2. sensory nerve: transmit signals from sense organ to central nervous system (pathway)

3. central nervous system: collects sensory information and produces action signals in response (controller)

4. motor nerve: transmit signals from central nervous system (pathway)

5. effector organ: muscles/etc. that perform actions based on the action signal (actuator)

7. Where are action potentials in the heart initiated? Action potentials in what part of the heart are responsible for the main peak in the ECG signal?

Sinoatrial node initiates the heart beat; Action potentials in the ventricles or ventricular muscles generate the strongest pulse seen on the ECG.

8. Which part of the brain controls instinctive responses? Which part initiates motor functions and holds memory and thought processes?

Instinctive: Hypothalamus and pituitary gland

Thoughts/memory: Cerebrum (or cortex)

9. Briefly describe the following biomedical measurement systems in terms that make sense to you:

- a. ECG: Monitor of potentials generated in the heart.
- b. EEG: Monitor of potentials generated in the brain.
- c. EMG: Monitor of potentials generated in muscles.
- d. ENG: Monitor of electrical activity of neurons in the nervous system. EEG is a specific type of ENG.
- e. ERG: Monitor of optical energy on the surface of retina or on the cornea.

10. Search *You Tube* for educational videos related to biomedical instrumentation. Locate a video that teaches you something interesting (and relevant to ECE445). Briefly describe what you saw that was interesting and list the URL of the video.

Answers will vary. See class notes for links to several useful You Tube videos.