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# ELEC436 HW#7

**Q1). Where is sinoatrial node located in the heart?**

According to the diagram below, representing a mammalian heart, the location of the sinoatrial node is at the wall of the right atrium.

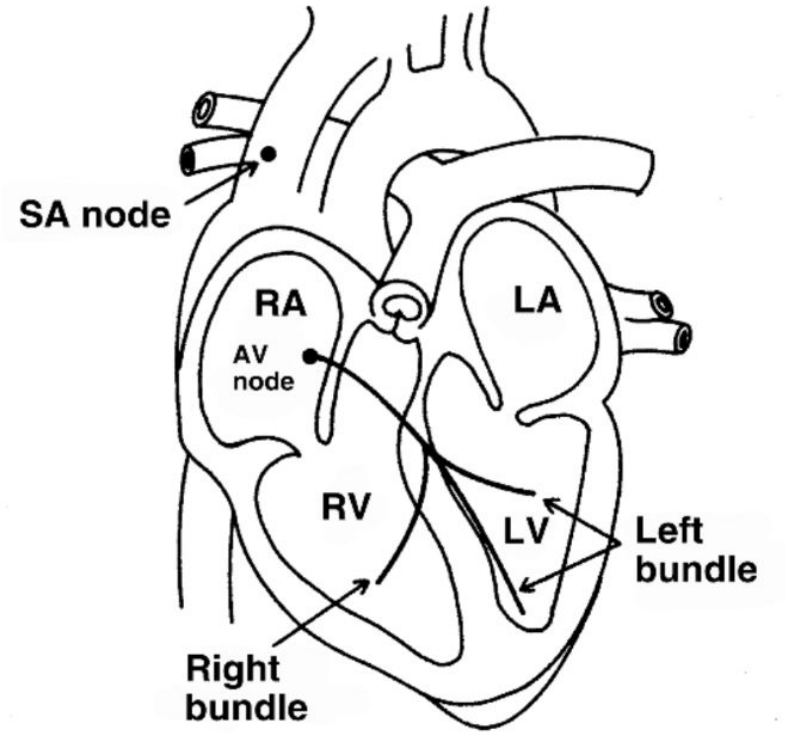



**Figure 9.1.** Pacemaker (SA node) and Specialized Conducting Regions (AV node, right and left bundles) of the Mammalian Heart.

**Q2) List 10 electrodes for ECG measurement on the surface of the body.**

The surface of the body contains ECG measurement that comprises ten electrodes distributes as follows: the first electrode is on the left arm. The second electrode is on the right arm, the third on the left leg, the fourth electrode is on the right leg of the body. Moreover, the placement of the other six electrodes remaining is next to the heart distributed as follows; two are on the fourth ICS appearing to the right side of the sternum. The two appear mainly

opposite to the body (V1 and V2). The distribution of the other four is one electrode to the second ICS (V4), the other electrode placed halfway between V2 and V4 (V3), the other electrode placed between V4 and V6, and the last one placed on the fifth ICS mainly at the mid-axillary line.

**Q3) What is PR and QT interval in ECG signal?**

The ECG signal has two intervals, namely the PR interval and the QT interval. The PR interval acts as an atrial depolarization. Specifically, the PR interval action potential propagation becomes slower at the atrioventricular node. More so, the PR interval in the Calcium based activation is always smaller than the Sodium based activation. Mostly, the PR interval comprises of both the P wave and the PR segment. Clearly, the interval provides information concerning the contraction and relaxation of the atria, ensuring the filling of blood into the ventricles. However, the interval ends before the depolarization of the ventricular. On the other hand, the QT interval illustrates both the depolarization and the subsequent repolarization of the ventricular. Specifically, the QT interval comprises of the QRS complex, the ST segment, and the T wave. Mostly, observation in the QRS complex involves the AP propagation arising from the AV node to the HIS bundle. The propagation is then continuous from the HIS bundle to the Purkinje fibers that hast fast propagations. Then the polarization shifts from the left ventricles to the right ventricles. Moreover, repolarization of the atrial and the depolarization of the ventricle happen simultaneously to ensure the domination of the QRS signal. Clearly, in the ST segment, the net current is zero and only has the ventricular contracts with the T wave indicating the ventricular repolarization.

**Q4) Explain the operational principle of neuromuscular junction.**

Indeed, the neuromuscular junction's operational principle involves the potential propagation occurring through the motor neuron towards the skeletal muscle. The junction whereby the motor neuron excites the skeletal muscle is the neuromuscular junction. The intersection consists of a chemical synapse with various points of interaction ranging from the axon terminals in the motor neurons and the motor endplate mainly from the fiber in the skeletal muscle. Mainly, the operational principle has the following steps; first, the AP moves from the motor neuron towards an axon terminal. The terminal facilitates the opening of the voltage-gated Ca channels and the diffusion of the Calcium ions. The distribution of the ions into the terminal causes the release of the acetylcholine through the exocytosis from the

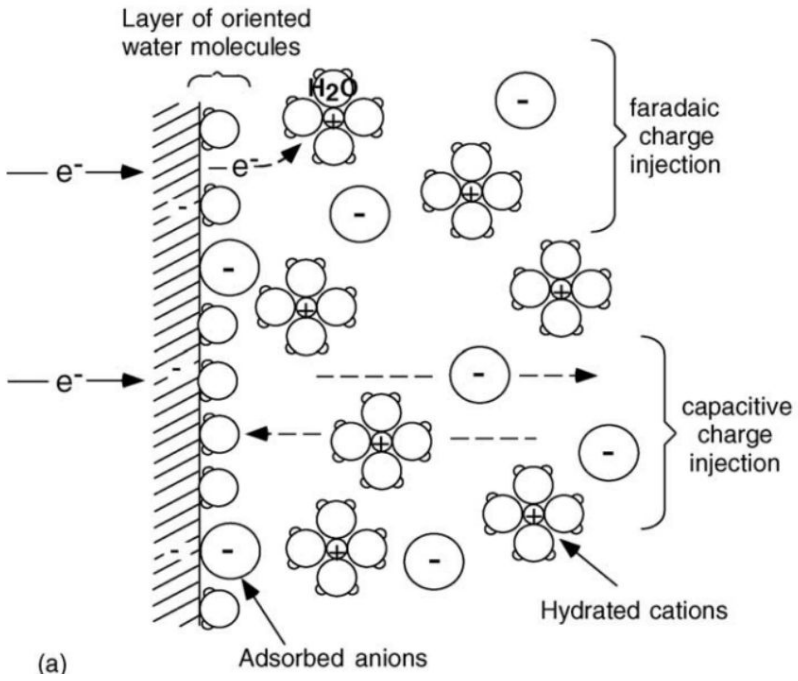
synaptic vesicles. Moreover, the acetylcholine released diffuses on the synaptic cleft binding with the acetylcholine receptors hence causing the opening of the ligand-gated cation channels on the specific receptors. Therefore, this facilitates the entrance of the sodium ions into the muscle fiber. Moreover, the potassium ions leave the fiber leading to the negativity of the membrane potential after depolarization. Despite the depolarization, there is the propagation of the action potential along the sarcolemma following the achievement of the threshold value for the potential. Hence, the action indicates that the muscle begins to contract, providing a response to the action potential that is incoming.

**Q5) What parameters of stimulation electrode is required to consider?**

The main parameters involving the stimulation electrode in consideration comprises the specific size, shape, and the location of the electrode. More so, the consideration consists of the strength and the waveform of the stimulating current, the compatibility of the material, and the extent of the reversible behavior.

**Q6) At the electrode electrolyte interface what kind of charge transfer mechanisms occur?**

Mainly, the charge transfers occurring at the electrode interface are the capacitive and faradaic charge transfers. The capacitive charge transfer arises mostly following the Helmholtz double-layer involving the adsorbed water layer absorbed on the metal. More so, the interface provides a possibility for the faradaic transfers. The transfer illustrates the direct transfer from the electrode to the electrolyte. The faradaic transfer is mostly irreversible and harmful to the cells hence unwanted, resulting in electrons moving to the electrolyte.




**Q7) List at least 2 types of pulse types used for stimulation electrodes and explain.**

Specifically, the main types of pulses used in the stimulation of the electrodes include the monophasic and the biphasic currents. Mostly, the monophasic pulse is the current traveling in one direction allowing the accumulation of the charges in the biological tissue. However, the accumulation is not desirable as it may cause irreversible harm to the biological medium. Moreover, there is a need to avoid the accumulation of the monophasic charges by the use of the biphasic pulse. Mostly, on many occasions, the entire process becomes reversible and repetitive following the introduction of the charge density on the medium in each phase being lower than the limit reversible in the biphasic case. Therefore, following the above reasons, there is no use of the monophasic stimulation on its own warranting their mixer.

**Q8) List at least 2 types of stimulation electrodes.**

The two main satisfactory types of stimulation electrodes are made of the platinum, platinum-iridium, and the 316 stainless steel. Moreover, some of the electrodes used in the field include the surface electrodes, the cuff electrodes, and the coiled wire electrodes.