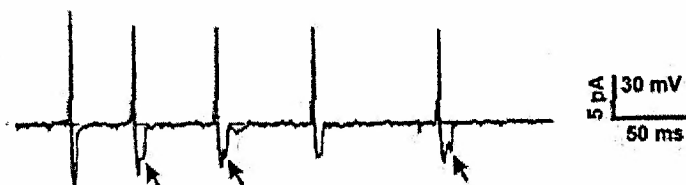


1. State True/False with reasons [5]
 - a. Diffusion of a solute molecule starts when its concentration gradient is established.
 - b. Strength of coulombic interaction between any two charges separated by a distance – is reduced in the presence of mobile ions.
 - c. The radius of the pore of the voltage-gated Na^+ ion channel linearly increases as a function of membrane potential.
 - d. Energy cost of immersing an apolar object in a polar media depends on its volume.
 - e. In equilibrium, every ion species exists at internal concentrations such that their Nernst potentials match the membrane potential of the vesicle/cell.

-----DO ANY 5 of Qns. 2-7-----

2. Stoke-Einstein equation ($\zeta D = k_B T$; where, D: diffusion coefficient; ζ : viscous drag) relates temperature with the diffusion coefficient and viscous drag. Design an experiment which can measure Boltzmann constant experimentally. List the various steps clearly. [3]
3. When fluorescent molecules come too close to each other there is a possibility of resonance energy transfer (RET) or even quenching. The Forster's distance is a lengthscale at which RET is highly probable. If this distance is ~ 5 nm, at what concentrations will it start occurring in the sample? [3]
4. How are ion pumps different from ion channels? What role does each have to the generation and propagation of action potential? [3]
5. Consider a $-ve$ plate dipped in a solution of monovalent ions. Express number density of $+ve$ and $-ve$ ions [$c_+(x)$ and $c_-(x)$] in terms of $V(x)$ invoking Boltzmann distribution. c_∞ is the number density before the $-ve$ plate was dipped. Hence, write the expression for the net the charge density $\rho(x)$. Note: Electric energy = $zeV(x)$ where $V(x)$ is the potential, z : valency, e : charge of an electron. [3]
6. You have been given a dye whose fluorescence increases by 25% for every 100mV of depolarization. This is used to label an axon of length 100 μm . [3]
 - a. Draw the fluorescent profile in 3 snapshots (assume 10 μs apart) of the axon on being excited at the centre by a stimulus above the threshold. Shade with pencil – darker: more fluorescent. Use vel. of prop = 1m/s. Put an approximate scale bar.
 - b. Plot the fluorescence at particular pixel changing with time when the stimulus is greater than the threshold.
7. What does the figure represent? Which molecules are responsible for the post-dip sections with arrows? What could have happened to the molecules at the times exactly pointed out by the arrows? [3]



Butter