HW ASSIGNMENT #1 - -   Physics 171/271
due Tuesday Oct 9

From textbook:
Chapter 2: 3,4,5,8
Chapter 3: 2,3

Prob 1: It should be clear that if there are no active pumps, a cell cannot simultaneously indefinitely maintain constant concentration differences for several different ions. Assume that a cylindrical shaped neuron of radius 200 microns has a resting potential of -60mV has a specific sodium conductance of 1×10^{-5} S/cm^2 and sodium ion concentrations of 50 mM (inside), 440 mM (outside). Estimate how long it would take for there to be a 10% change in the inside concentration (you can use the linearized of the I-V relationship for this problem).

Prob 2 (271 only) Instead of assuming a constant electric field across the cell membrane, imagine we have a more complex model in which

$|E| = E_0$ for $0 < z < d$

$|E| = 0$ for $d < z < l$

where z is measured from the interior side of the membrane of total thickness l. Derive the relationship between current, voltage and ion concentrations for a single permeant ion.