Homework 2 – DUE MONDAY 4/20

1. The equilibrium equation (2.53) states

$$J = C_0 K_1 K_2 \frac{[Na_i^+][K_e^+]}{\left([K_e^+]K_2 + [K_i^+]K_{-2}\right)K_n + [Na_i^+]K_1 K_k}$$

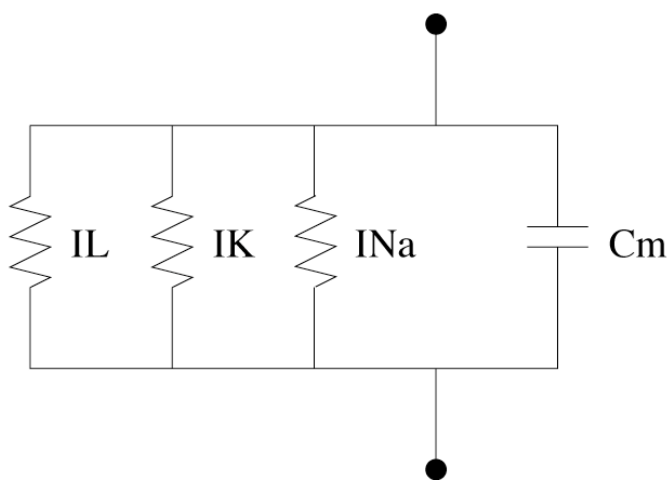
is independent of $[Na^+_e]$ and nearly linear for small concentrations of $[Na^+_i]$. Furthermore it saturates for large concentrations of $[Na^+_i]$.
Find the saturation level.

2. The Nernst equilibrium potential difference Vs across the membrane is given by

$$Vs = \frac{RT}{zF}\ln\left(\frac{[s]e}{[s]i}\right) = \frac{kT}{zq}\ln\left(\frac{[s]e}{[s]i}\right), \qquad \text{where } k = \frac{R}{N_A}$$

The constants involve include R, T, z, F, N_A.
Describe what each of these physical constants (i.e., give their name), provide an explanation for their meaning, and give their units.

3. A: Derive a current equation equivalent to (2.75) for the network below.
B: Determine the total resistance for the network.



4. Show that for time approaching infinity

$$C_m \frac{dV}{dt} = -g_{eff}(V - V_{eq}) + I_{appl}$$

gives

$$V = V_{eq} + R_m I_{appl}, \quad R_m = \frac{1}{g_{eff}}$$