What is my project scope?

I would like to solve the problem of deriving the electroneutrality equation from Poisson's equation and proving Teorell's assumption.

My primary source for this problem will be the paper "Nernst-Planck Equations and the Electroneutrality and Donnan Equilibrium Assumptions" by A. D. MacGillivray. Additionally, I will use our textbook *Analysis of Transport Phenomena* as a reference to help understand and solve this problem.

To solve this problem, I will have to use methods such as: perturbation, order of magnitude analysis, and non-dimensionalization. Additionally, a good amount of the work I will do to solve this problem will be learning the concepts and governing equations involved since we have not learned them in class, and they involve new concepts such as migration.

Why this problem?

The research I am conducting is primarily focused on electrochemical analytics, meaning using electrochemical techniques to determine reaction kinetics and thermophysical properties. Thus, electrochemical cells and their governing equations are central to everything I study. One of the primary assumptions used to solve problems like this is local electroneutrality. I would really like to learn more about where this assumption comes from as well as more generally how to deal with transport of charged species as part of my study of transport phenomena. This problem is important to the wider scientific community because these governing equations build the foundation for the same electrochemical analysis theories that I am testing.

This problem is appropriate for a graduate-level transport phenomena course because there are many forces in play that affect the transport of charged ions through an electrochemical cell. This appears in the form of many different equations and principles that I will need to study. This problem expounds upon the principles we have learned in class by considering the mass transport of charged species rather than uncharged ones that we have dealt with so far. The conservation equation now includes a migration term which we have not learned about in class. To solve this problem, I will have to use some of the trickiest math techniques we have learned such as perturbation and order of magnitude analysis.

How am I going to do this?

Schedule: