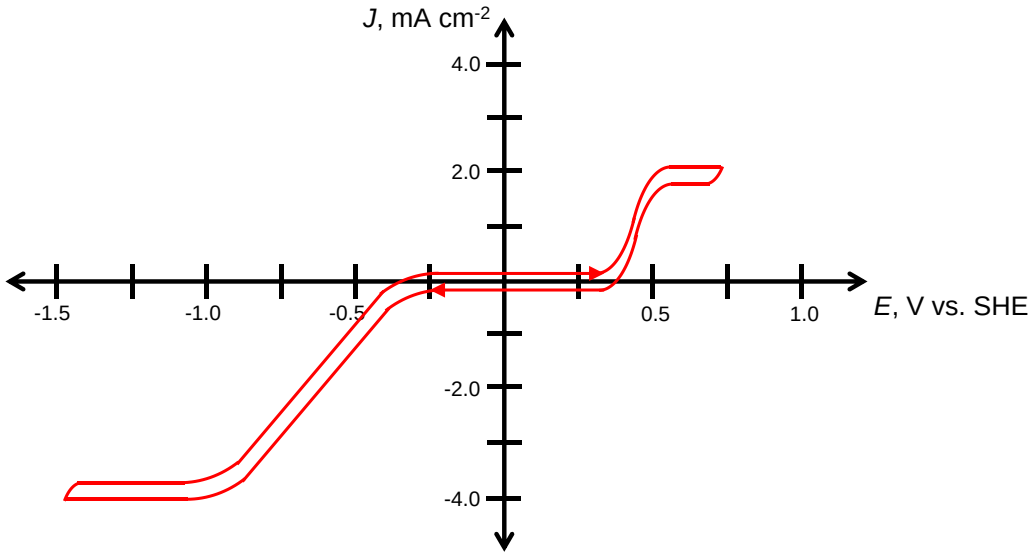
Read Chapter 5 (at least Sections 5.1, 5.2, 5.3, and 5.8), answer the following problems, fill out the mid-quarter course evaluations, and indicate with whom you worked: _____.

(1) Do problems 1.4, 2.4 (practice for the first exam), 2.11, 4.3, and 4.4 in Bard and Faulkner (B&F).

(2) Answer the following based on the *J*–*E* curve below, which was measured using a 3-electrode setup at a scan rate of 100 mV s^{-1} and using an aqueous electrolyte at room temperature.

a. Over approximately what potential range do Faradaic reactions occur?
b. Over approximately what potential range do non-Faradaic reactions occur?
c. What is the approximate double-layer capacitance and what does that tell you about the roughness factor of the electrode?
d. If I told you that the cathodic reaction was a one-electron-transfer process, approximately how many electrons were transferred during the anodic reaction?
e. If I told you that the initial concentration of both species (reduced form of one molecule and oxidized form of other molecule) was the same, what can you tell me about the diffusion coefficient of the molecule being reduced in relation to the diffusion coefficient of the molecule being oxidized?
f. If I told you there was 1 M H^+ present in the electrolyte, what can you tell me about the rate of catalysis for evolving H_2 versus the rate of catalysis for the cathodic reaction?
g. If I told you that the diffusion coefficient for the oxidized and reduced versions of the molecule that were participating in the cathodic reaction was the same, what does its $E_{1/2}$ stand for?
h. If I told you that the cathodic current was perfectly linear on this plot, and not sigmoidal, what is likely the cause of this slope and how would the slope change if I added more supporting electrolyte?
i. On the same y-axis scale, what would the *J*–*E* curve look like if I removed all the supporting electrolyte and just used deionized water? (Assume the solution resistance is 18.2 MOhm and that the electrode area is 10 mm^2.)



(3) Answer the following for a 3-electrode measurement of a cell that originally contains both the oxidized (O) and reduced (R) versions of a molecule, and where $D_O = D_R$.
   a. What equation does equation 1.4.20 reduce to when $I = 0$, and what is its name?
   b. What is the expression for the current that flows in the cell when the applied potential equals the formal potential?

(4) In Hernandez-Pagan, Vargas-Barbosa, Wang, Zhao, Smotkin, and Mallouk, *Energy & Environmental Science*, 2012, *5*, 7582 (see class website), the authors show balance sheets for several scenarios that incorporate ion-selective membranes (i.e. Figure 5 and Figure 7). With this in mind, answer the following.
   a. Based on the balance sheets shown in Figure 5, explain why there is no diffusive component.
   b. All four of the balance sheets are missing counter-ions, which should have resulted in migration opposite of the direction shown. Why were counter-ions not included in the balance sheets?
   c. Quantitatively, how would the balance sheet in Figure 5a change if the electrolyte was at pH = 3 (with HCl) and 1 M KCl was present? *Either draw a new balance sheet or explain this in words and numbers.*
      i. What would the value of t_{H^+} be if the pH = 7 (e.g. deionized water), but still with 1 M KCl?