

Read Section 5.9 and Chapter 13, answer the following problems, and indicate with whom you worked:

- (1) Do problems 5.2, 5.16, 2.12, and 2.14 in Bard and Faulkner (B&F).
- (2) What is the iR_u drop for a disk UME immersed in *deionized water* when it reaches steady-state mass-transport-limited current? (Assume that the resistivity of deionized water is ~ 18.3 M Ω cm – which it is for laboratory deionized water – and that the redox species are not charged, participate in one-electron-transfer reactions, have a diffusion coefficient of 10^{-5} cm² s⁻¹, and are present at 1 μ M.)
- (3) A Cottrell plot (i versus $t^{1/2}$) for data measured at a disk UME ($r_0 = 1$ μ m) exhibits a slope of $0.022944 \text{ nC} / \sqrt{\text{s}}$ and a y-intercept of 2.31564 nA.
 - a. Determine the value of the diffusion coefficient.
 - b. If the concentration of redox-active species is 1 mM, how many electrons are transferred per redox event?
 - c. What would the value of the slope be for the corresponding Anson plot (q versus $t^{1/2}$) at early, non-steady-state times?
- (4) A dialysis bag is filled with 100 mM dianionic protein with sodium counterions and immersed in an aqueous electrolyte containing 1 mM NaCl. Assuming the concentration of NaCl in the electrolyte remains the same and the protein is too large to diffuse out of the bag, answer the following questions when the system is at equilibrium.
 - a. What is the concentration of Cl⁻ in the bag?
 - b. What is the Donnan potential? Calculate this using the [Na⁺], and verify your answer by then calculating the Donnan potential using the [Cl⁻].
- (5) A three-electrode measurement is performed using a Pt disk WE, SCE (containing saturated MCl) RE, and a Pt mesh CE, all immersed in an aqueous electrolyte consisting of x mM MCl, 10 μ M ferrocene (Fc), and 10 μ M ferrocenium (Fc⁺). You measure the reduction potential of Fc⁺ and notice that the value is not that expected based on the E^0 from the CRC. Given the following information, what is likely the cause of this discrepancy, and is the discrepancy a more accurate value for the Fc⁺ reduction potential?
 - a. Measured with a voltmeter; the discrepancy is larger when $x = 100$ mM, versus when $x = 1$ mM.
 - b. Measured with a voltmeter; the discrepancy is larger when $M = \text{Na}^+$, versus when $M = \text{K}^+$.
 - c. Measured by performing a CV; the discrepancy is larger when $x = 1$ mM, versus when $x = 100$ mM.
 - d. Measured by performing a CV; the discrepancy is larger when the WE is not a UME, versus when the WE is a UME.