

A. Problems [Note: \mathcal{E}° denotes standard emf.]

- [1] For the cell: $\text{Cu} \mid \text{CuCl}_2 (m) \mid \text{AgCl} \mid \text{Ag}$
 $\mathcal{E}_{298\text{K}}$ is 0.193 V and -0.074 V for $m = 10^{-4}$ mol/Kg and $m = 0.2$ mol/Kg, respectively.

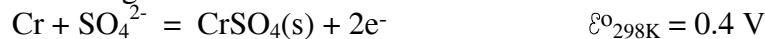
Write the electrode and net cell reactions, and calculate the mean activity coefficient for 0.2 mol/Kg CuCl_2 . [Hint: Note that when m is very small, we can assume unity mean activity coefficient.]

- [2] Given that $\mathcal{E}^\circ_{298\text{K}}$ is -0.627 V for the cell:



- Write down the cell reaction, and each electrode reaction.
- Calculate $\mathcal{E}_{298\text{K}}$ if $m = 0.1$ mol/Kg (assume the activity coefficients are unity and $\mathcal{E}^\circ_{298\text{K}} = -0.627$ V).
- Repeat the calculation in part b, but take the mean activity coefficient of H_2SO_4 (0.1 mol/Kg) to be 0.27.

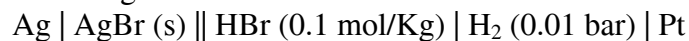
- [3] Given the following information:



K for CrSO_4 is 10^{-6} at 25°C .

- Write the cell reaction for the cell:
 $\text{Cr} \mid \text{CrSO}_4 (s) \parallel \text{H}_2\text{SO}_4 (0.001 \text{ mol/Kg}) \mid \text{H}_2 (1 \text{ bar}) \mid \text{Pt}$
- Calculate the emf for this cell at 25°C (assume the activity coefficients are unity).
- Calculate \mathcal{E}° for this cell at 50°C if ΔH° is -10kJ.
 [Hint: Think of a simple way to estimate $\partial\mathcal{E}^\circ/\partial T$.]
- Calculate the emf for this cell at 25°C , using activity coefficients from the Debye-Hückel limiting law. [Use the B constant given in the lecture notes.]

- [4] Using the following data for this electrochemical cell:



$\mathcal{E}_{298\text{K}} = -0.165$ V; $\Delta H^\circ = -50$ kJ

K for AgBr is 10^{-12} and $\mathcal{E}^\circ_{298\text{K}}$ for Ag/Ag^+ is -0.8 V.

- Write down the cell reaction.
- Calculate $\mathcal{E}^\circ_{298\text{K}}$ for the cell.
- Calculate q_{rev} [the heat absorbed per Faraday when the cell operates reversibly] at 298 K. Calculate ΔS .
- Calculate γ_{\pm} for 0.1 mol/Kg HBr.

- [5] For the cell: $\text{Ag} \mid \text{Ag}_2\text{SO}_4 (s) \parallel \text{H}_2\text{SO}_4 (0.1 \text{ mol/Kg}) \mid \text{H}_2 (1 \text{ bar}) \mid \text{Pt}$,
 \mathcal{E} and \mathcal{E}° are -0.7 V and -0.63 V at 25°C , respectively.

Calculate the difference ($\mathcal{E} - \mathcal{E}^\circ$) at 35°C .

PLEASE NOTE: You are allowed to have a calculator and ONE 8.5"×11" single-sided page of "cheat-sheet" for the Final Exam.