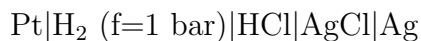


Chemistry 431
Problem Set 13
Fall 2023

1. For the cell



the measured *standard* EMF at 25.°C is $E^\ominus = 0.222$ volts. If the measured EMF of the cell at 25.°C is 0.385 volts, what is the pH of the HCl solution? Using molalities, assume $\text{pH} = -\log_{10}(m_{\text{H}^+}/m_0)$.

2. Consider the cell



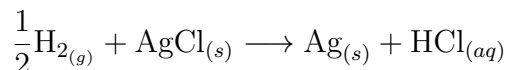
- (a) Use Table 11.1 to find the standard EMF for the cell at 25.°C.
(b) Calculate ΔG at 25.°C when 1 Faraday of current passes through the cell.
(c) Show that the total reversible work attending the passage of 1 Faraday of current through the cell is

$$w_{rev} = -E^\ominus F + \frac{1}{2}RT.$$

3. Show that

$$\left(\frac{\partial \frac{E^\ominus}{T}}{\partial T} \right)_p = \frac{\Delta_m H^\ominus}{nFT^2}$$

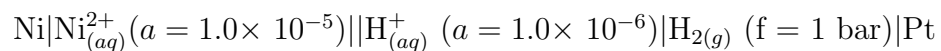
4. When the reaction



takes place at 25.°C in a cell, the reversible electrical work done by the reaction on the surroundings is 34476 Joules. When the same reaction takes place in a calorimeter doing only *PV*-work at a constant pressure of 1 bar at 25.°C, the heat transferred to the surroundings is 39292 Joules (the reaction is exothermic).

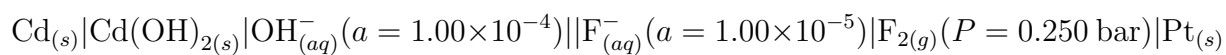
- (a) What is the heat liberated by the reversible reaction to the surroundings in the electrochemical cell?
(b) Calculate $\Delta_m S^\ominus$, $\Delta_m H^\ominus$ and $\Delta_m U$ for the reaction. Assume ΔV for the reaction is just that associated with the disappearance of 1/2 mole of an ideal gas.

5. Use Table 11.1 to calculate the EMF of the cell



at 25.°C.

6. At 298 K, the EMF of the electrochemical cell



is 3.716 V. Given the standard half-cell reduction potentials $E_{\text{Cd}^{2+}/\text{Cd}(\text{OH})_2/\text{Cd}}^{\ominus} = -0.809$ V and $E_{\text{F}^-/\text{F}_2}^{\ominus} = 2.866$ V, calculate the fugacity coefficient for the fluorine gas in the cell.