

Problem Set 8. Redox Titrations.
Chem 2222, Summer 2008 Key

All cell notations and potentials conform to the thermodynamic convention (written as anode||cathode). Express electrode potentials relative to SHE.

1. Consider the following cell
 $\text{Zn}|\text{Zn}^{2+}(0.100\text{ M})||\text{Ti}^{3+}(0.0100\text{ M}), \text{Ti}^{+}(0.100\text{ M})|\text{Pt}$
 - a) Write the overall balanced cell reaction.
 - b) Calculate E_{anode} , E_{cathode} , and E_{cell} .
2. Consider following cell. SCE stands for the saturated calomel reference electrode, which has a fixed potential of 0.244 volt.
 $\text{Pt}|\text{VOSO}_4(0.0100\text{ M}), \text{V}_2(\text{SO}_4)_3(0.200\text{ M}), \text{HClO}_4(0.0100\text{ M})||\text{SCE}$
 - a) Write the half reaction (as a reduction) and the Nernst equation for the half-reaction at the Pt electrode.
 - b) Calculate E_{anode} and E_{cell} .
 - c) Write the half reaction that actually occurs (oxidation or reduction?) at the Pt electrode if current is allowed to flow.
3. Calculate the potential for a Ag electrode immersed in saturated AgI with 0.0800 M KI.
4. Calculate the potential for a Zn electrode in 0.00200 F ZnSO_4 and 4.0 F NH_3 .
5. Calculate the equilibrium constant for the reaction
$$\text{Ti}^{3+} + 2\text{Fe}^{2+} \rightleftharpoons \text{Ti}^{+} + 2\text{Fe}^{3+}$$

Answers

1. b) $E_{\text{anode}} = -0.79\text{ V}$
 $E_{\text{cathode}} = 1.22\text{ V}$
 $E_{\text{cell}} = 2.01\text{ V}$
2.
 - a. $\text{VO}^{2+} + 2\text{H}^{+} + \text{e}^{-} \rightarrow \text{V}^{3+} + \text{H}_2\text{O}$
 - b. $E_{\text{anode}} = 0.028\text{ V}$; $E_{\text{cell}} = 0.216\text{ V}$
 - c. $\text{V}^{3+} + \text{H}_2\text{O} \rightarrow \text{VO}^{2+} + 2\text{H}^{+} + \text{e}^{-}$
3. $E = -0.087\text{ V}$
4. $E = -1.18\text{ V}$ (exact value = -1.177; approx value = -1.177 if no correction for change in $[\text{NH}_3]$)
5. $K_{\text{eq}} = 1.6 \times 10^{16}$