

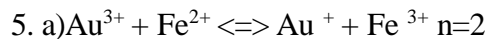
Chem 223-Exam 2 answers

1a) at lower temperatures b) always spontaneous

$$2. \Delta G = -RT \ln K = 0.008314 \text{ J/K} \cdot (359) \cdot \ln(5.3 \cdot 10^3) = -25.6 \text{ KJ}$$

$$3. K = e^{-(\Delta G/RT)} = e^{-(23.1 / (0.008314 \cdot 298))} = 8.9 \cdot 10^{-5}$$

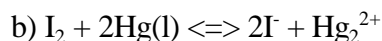
$$4. \Delta S = \Delta H/T = 16.1 \text{ KJ} / 213 \text{ K} = 0.075 \text{ KJ/K} = 75 \text{ J/K}$$



$$E^\circ = 1.40 - 0.77 = 0.63 \text{ V}$$

$$\Delta G^\circ = -nFE^\circ = -2(95.5)(0.63) = -122 \text{ KJ}$$

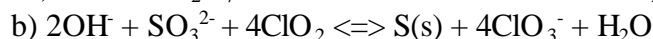
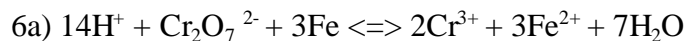
$$K = e^{(nE^\circ/0.0257)} = e^{(2 \cdot 0.63/0.0257)} = 1.96 \cdot 10^{21}$$



$$E^\circ = 0.54 - 0.80 = -0.26 \text{ V}$$

$$\Delta G^\circ = -nFE^\circ = -2(95.5)(-0.26) = 50.2 \text{ KJ}$$

$$K = e^{(nE^\circ/0.0257)} = e^{(2 \cdot -0.26/0.0257)} = 1.63 \cdot 10^{-9}$$

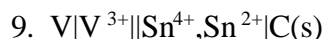
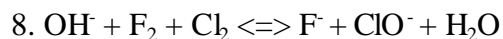


7. As written the reaction is nonspontaneous since nitrate is below Mn^{2+} in the EC series. Thus the reaction will be driven left to right. The cathode is the site of reduction. Left to right the reduction is $\text{NO}_3^- \Rightarrow \text{NO}$ for which $n=3$ and the product is NO (gfw=30).

$$\text{Coulombs} = \text{amps} \cdot \text{t(sec)} = 3.2 \cdot 2.90 \cdot 3600 = 3.34 \cdot 10^4$$

$$\text{Faradays} = \text{couls} / 96500 = 3.34 \cdot 10^4 / 96500 = 0.346$$

$$\text{moles NO} = 0.346 / 3 = 0.115 \quad \text{Mass} = 0.115 \cdot 30 = 3.45 \text{ g}$$



$$10. Q = 1 / ([\text{H}^+]^6 [\text{MnO}_4^-]^2) = 1 / (.5^5 \cdot .2^2) = 1600 \quad n=6 \quad (2 \cdot 3 \text{ (for the } \text{MnO}_4^-))$$

$$E = 1.68 - 0.0257/6 \cdot \ln(1600) = 1.65 \text{ V}$$

11. a) $\text{F}_2 + \text{Fe} \rightleftharpoons \text{F}^- + \text{Fe}^{2+}$; **yes**- F_2 is at the top of the EC series and will oxidize everything

b) $\text{Co}^{2+} + \text{Br}^- \rightleftharpoons \text{Co(s)} + \text{Br}_2$, **no** Co^{2+} (OA) is below Br^-

c) $\text{Fe}^{2+} + \text{Ni(s)} \rightleftharpoons \text{Fe(s)} + \text{Ni}^{2+}$, **no** Fe^{2+} (OA) is below Ni(s)

d) $\text{S(s)} + \text{Cd(s)} \rightleftharpoons \text{H}_2\text{S} + \text{Cd}^{2+}$, **yes** S(s) (OA) is above Cd(s)

e) numerous possibilities-any oxidizing agent between Sn(s) (-0.14V) and Fe^{2+} (0.77V)

12.a) Faraday's calculations deal with each $\frac{1}{2}$ reaction independently so the balanced equation is not needed

b) chrome plating is a physical barrier to water and oxygen so it must remain intact. Galvanization provides a sacrificial anode which makes the iron cathodic

c) permanganate reactions require high concentrations of H^+ ($4\text{H}^+ + \text{MnO}_4^- \Rightarrow \text{MnO}_2 + 2\text{H}_2\text{O}$) to go to any real degree. This corresponds to low pH.

d) ΔH and ΔS have the same sign (both positive or both negative)