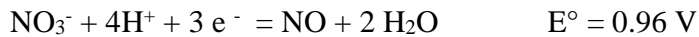


**Note: Here are some typical problems from a previous longer final. The Colby portion of the 2014 final will be one hour.**

**Part 1:** 8 points each.

1. . The change in entropy for the phase transition  $\text{PCl}_5(\text{s}) \rightarrow \text{PCl}_5(\text{g})$  is  
(a) positive (b) negative (c) about zero

6. Will  $\text{NO}_3^-$  oxidize Cu to  $\text{Cu}^{2+}$  under standard conditions? Show your work for credit. Note:



7. Name the following compounds or supply the formula:

a.  $\text{KNO}_2$  \_\_\_\_\_

b.  $\text{NaClO}_3$  \_\_\_\_\_

c. phosphorous acid \_\_\_\_\_

8. The reaction  $3\text{Cd}(\text{s}) + 2\text{Al}^{3+} = 3\text{Cd}^{2+} + 2\text{Al}(\text{s})$  has a negative standard cell voltage. Is the equilibrium constant

(a) greater than 1 (b) less than 1 (c) can't tell from the information given

10. For the reaction  $\text{Cd}(\text{s}) + 2\text{Fe}^{3+} = \text{Cd}^{2+} + 2\text{Fe}^{2+}$  the standard cell potential is  $E^\circ = 0.371\text{ V}$ . Calculate the cell potential if  $[\text{Fe}^{3+}] = 0.100\text{M}$  and  $[\text{Cd}^{2+}] = [\text{Fe}^{2+}] = 0.010\text{ M}$ .

15. In the electrolysis of a solution containing  $\text{Cd}^{2+}$  ions, 0.500 g of Cd are plated out using a current of 0.500 amp. How much time does this take?.

23. Calculate  $\Delta G$  for the reaction  $\text{NO}(\text{g}) + \text{O}_3(\text{g}) \rightarrow \text{NO}_2(\text{g}) + \text{O}_2(\text{g})$  at 298.2K when the pressures are as follows:  $P_{\text{NO}} = 1.00 \times 10^{-6}$ ,  $P_{\text{O}_3} = 1.00 \times 10^{-6}$ ,  $P_{\text{NO}_2} = 1.00 \times 10^{-7}$ , and  $P_{\text{O}_2} = 1.00 \times 10^{-4}$ .  $\Delta G^\circ = -198 \text{ kJ}$  for this reaction.

### Helpful Formulas and Constants

$$h = 6.63 \times 10^{-34} \text{ J sec}$$

$$c = 3.0 \times 10^8 \text{ m sec}^{-1}$$

$$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$$

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$T(0^\circ\text{C}) = 273.15 \text{ K}$$

$$F = 96485 \text{ C mol}^{-1}$$

$$1 \text{ L atm} = 101.3 \text{ J}$$

$$\pi = MRT$$

$$q = mC_s\Delta T$$

$$w = -P\Delta V$$

$$\Delta H = \Delta E + \Delta(PV)$$

$$\ln\left(\frac{P_2}{P_1}\right) = -\frac{\Delta H_{\text{vap}}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln\left(\frac{k_2}{k_1}\right) = -\frac{\Delta E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln\left(\frac{[A]}{[A]_0}\right) = -kt \quad \frac{1}{[A]} - \frac{1}{[A]_0} = kt$$

$$t_{1/2} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{1}{k[A]_0}$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

$$E = E^\circ - \frac{RT}{nF} \ln Q$$

$$E = E^\circ - \frac{0.0257 \text{ V}}{n} \ln Q$$

$$E = E^\circ - \frac{0.0592 \text{ V}}{n} \log Q$$