US 1114. Exam 3, April 29, 2009

Name_____

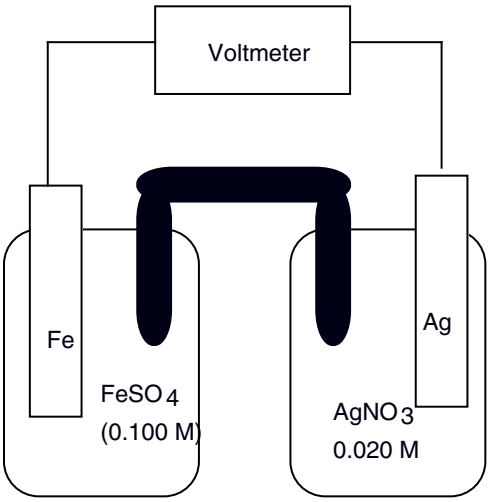
By submitting this exam, I certify that I have neither given nor received unauthorized aid.

$\Delta G^o = \Delta H^o - P\Delta V$, $\Delta G^o = \Delta H^o - T\Delta S^o$, $S = k \ln W$, k= 1.38 x 10^{-23} J/K, $\Delta G = -RT\ln K$,

R= 8.314 J/molK, $pH = \frac{pK_{a1} + pK_{a2}}{2}$, $\Delta G = \Delta G^\circ + RT \ln Q$, $E = E^\circ - \frac{0.0592}{n} \log Q$,

$\Delta G^o = -nFE^o$, F=96,500 C/mole e^-,

(1)(12 points) For the following cell at 298K , answer the following questions



(a) What is the shorthand notation for the cell above?

(b) Write the anodic half cell (equation)

(c) Write the cathodic half cell equation

(d) What is the E value for the cell?

(2)(9 points) Balance the following 1/2 reactions in base

(a) Fe ------> Fe_2O_3

(b) PbO_2 ----------> Pb

(c) Write the following reaction as a balanced redox reaction Fe + PbO_2 ---> Fe_2O_3 + Pb

(4)(4 points) If 5.00 coulombs of charge is used to reduce $PbSO_4$, how much Pb was formed (in g) ?

(5)(6 points) State the the fist, second, and third laws of thermodynamics

(6)(2 points) For the following reaction at 298 K, what is ΔG^{o}?

$CH_3CO_2H + H_2O \text{ <---> } H_3O^+ + CH_3CO_2^-$ $K_a = 1.8 \times 10^{-5}$

(7)(4 points) (a) What is the entropy of 4 cards randomly chosen from a 52 card deck (no jokers)?

(b) What is the entropy of 1 mole of random coin flips?

(8)(3 points) Circle the element in each pair that you would expect to have a higher entropy

(a) Dr. Jordan's office or Dr. York's office

(b) $2I_{(g)}$ or $I_{2(g)}$

(c) ice or steam

(9)(4 points) For the reaction below, calculate ΔH^o and ΔS^o. At what temperatures is this reaction spontaneous (be specific).

$Ba_{(s)}$ ---> $Ba_{(g)}$

ΔH_f^o	0	180 kJ/mole
ΔS^o	62.8 J/molK	170.3 J/molK

(10)(4 points) For the following reaction, $\Delta G^o = 30.0$ kJ.

$$Ca(OH)_2(s) \text{ <---> } Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$$

If there are currently 3.00 g of $Ca(OH)_2$, $[Ca^{2+}]$ is 0.010 M, and $[OH^-]$ is 1.00×10^{-4}, is the reaction spontaneous? Show work.

(11)(8 points) Attach study plan sheet

(Extra Credit)(6 points) As the temperature increases, the vapor pressure of a liquid increases at an exponential rate. Can you explain this phenomenon using the equation below and what you have studied in the last few chapters? What is the concentration of water vapor at 50 ºC?

$$H_2O_{(l)} \text{ <---> } H_2O_{(g)} \qquad \Delta H^o = 44 \text{ kJ}, \ \Delta S^o = 118 \text{ J/mol K}$$