CHM 1046 - JOENS WORKSHEET #6 Due date: Monday, October 23rd

WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME ______________________________ Panther ID ____________________________

For problems involving calculations you must show your work for credit.

1) Using the thermodynamic data given below find the numerical value for the thermodynamic equilibrium constant for the following reaction. You may assume T = 25.0 °C in doing this problem.

$$Ni(OH)_2\,(s) \leftrightarrows Ni^{2+}(aq) + 2\,OH^-(aq)$$

Substance	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)	S° (J/mol·K)
$Ni^{2+}(aq)$	- 64.0	- 46.4	30.1
$Ni(OH)_2(s)$	- 538.06	- 453.1	79.5
$OH^-(aq)$	- 229.94	- 157.30	- 10.5

$$\Delta G°_{rxn} = [\ \Delta G°_f(Ni^{2+}(aq)) + 2\ \Delta G°_f(OH^-(aq))\ ] - [\ \Delta G°_f(Ni(OH)_2(s))\ ]$$

$$= [\ (-46.4) + 2\,(-157.30)\ ] - [\ (-453.1)\ ] = +92.1 \text{ kJ/mol}$$

$$\ln K = -\frac{\Delta G°_{rxn}}{RT} = -\frac{(92100.\ \text{J/mol})}{(8.314\ \text{J/mol}\cdot\text{K})\,(298.\text{K})} = -37.17$$

$$K = e^{-37.17} = 7.2 \times 10^{-17}$$

2) For the following reaction identify the Bronsted acid, the Bronsted base, the conjugate base of the Bronsted acid, and the conjugate acid of the Bronsted base.

$$NH_3(aq) + H_3O^+(aq) \rightarrow NH_4^+(aq) + H_2O(\ell)$$

Bronsted acid _____H_3O^+___________ Bronsted base _______NH_3_________

Conj base of Bronsted acid _____H_2O____________ Conj acid of Bronsted base _______NH_4^+________

3) Find the value for pH for the following solutions at T = 25.0 °C

a) A 0.044 M solution of hydrobromic acid (HBr), a strong acid

A strong acid, so

$HBr(aq) + H_2O(\ell) \rightarrow H_3O^+(aq) + Br^-(aq)$

$$[H_3O^+] = \frac{0.044 \text{ mol HBr}}{1 \text{ L}} \; \frac{1 \text{ mol } H_3O^+}{1 \text{ mol HBr}} = 0.044 \text{ M } H_3O^+$$

$pH = - \log_{10} [H_3O^+] = - \log_{10} (0.044) = 1.36$

b) A 0.128 M solution of potassium hydroxide (KOH), a strong soluble base

A strong soluble base, so

$KOH(s) \rightarrow K^+(aq) + OH^-(aq)$

$$[OH^-] = \frac{0.128 \text{ mol KOH}}{1 \text{ L}} \; \frac{1 \text{ mol } OH^-}{1 \text{ mol KOH}} = 0.128 \text{ M } OH^-$$

$pOH = - \log_{10} [OH^-] = - \log_{10} (0.128) = 0.89$

$pH = 14.00 - pOH = 14.00 - 0.89 = 13.11$